International Nuclear Physics Conference 2010 (INPC2010)

Sunday 04 July 2010 - Friday 09 July 2010

Vancouver, BC, Canada

Programme

Table of contents

Monday 05 July 2010 5
- Opening Plenary Session 5
- Hot and Dense QCD Plenary Session 6
- Hadrons in Nuclei Plenary Session 7
- HS1 8
- NA1 9
- NF1 10
- NI1 11
- NR1 12
- NS1 14
- NS7 16
- SM1 18
- Coffee Break 20
- HS2 20
- NA2 21
- NF2 23
- NI2 25
- NR2 26
- NS2 28
- NS8 30
- SM2 32
- Poster Session 1 34
- Student Poster Session 1 60

Tuesday 06 July 2010 72
- Nuclear Astrophysics Plenary Session 72
- Coffee Break 73
- Nuclear Reactions Plenary Session 73
- HN1 74
- NI3 75
- NN1 76
- NR3 77
- NR5 78
- NS3 80

NS9 81
SM3 83
Coffee Break 85
HD1 85
HN2 86
NA3 87
NF3 89
NN2 91
NR4 93
NS10 95
NS4 97
Poster Session 2 99
Student Poster Session 2 123
Wednesday 07 July 2010 135
New Facilities and Instrumentation Plenary Session 135
Nuclear Applications and Interdisciplinary Research Plenary Session 136
Award Session 136
Thursday 08 July 2010 137
Hadron Structure Plenary Session 137
Coffee Break 138
Nuclear Structure Plenary Session 138
HD2 139
HN3 141
HS3 142
NA4 143
NF4 145
NR6 147
NS11 149
NS5 151
Coffee Break 153
HD3 153
HN4 155
HS4 157
NA5 158
NF5 160
NR7 162
NS12 164
NS6 166
Friday 09 July 2010 168
Standard Model Tests and Fundamental Symmetries Plenary Session 168
Coffee Break 169

Neutrinos and Nuclei Plenary Session 169

Monday 05 July 2010

Opening Plenary Session - Chan Centre (08:30-09:30)

time	title
08:30	**Opening Remarks (00h15')** *Speaker: DILLING, Jens*
08:45	**Nuclear Physics - Selected Achievements and Perspectives (00h45')** *Speaker: BRAUN-MUNZINGER, Peter* We will highlight recent achievements in the field of nuclear physics and explore promising areas for future research.

Hot and Dense QCD Plenary Session - Chan Centre (09:30-11:30)

time	title
09:30	**Hot QCD Matter: Lessons Learned over the Past Decade, and New Questions for the Next Decade (00h30')** *Speaker: NAGLE, James* We review the key physics learned about hot QCD matter (the quark-gluon plasma) from experiments at the Relativistic Heavy Ion Collider (RHIC). The surprising properties and their implications are discussed. Additionally, we speculate about the next decade of new questions and hopefully new discoveries.
10:00	**The Phase Diagram of Dense QCD (00h30')** *Speaker: FUKUSHIMA, Kenji* Understanding the phase diagram of QCD under extreme conditions at finite temperature and baryon density is a longstanding problem. Theoretical and experimental efforts have been revealing the structure of the phase diagram at zero baryon density, which is being extended towards higher baryon density. In fact several facilities such as the FAIR at GSI, the NICA at JINR and future project of RHIC at BNL are planning heavy-ion collision experiments at moderate energy (collision energy per NN is around 10GeV) to explore dense-QCD physics. In this talk recent developments and remaining problems related to dense QCD, which include the QCD critical point, relation between deconfinement and chiral restoration, quarkyonic (baryon-rich) matter, hypothetical triple-point structure, will be reviewed.
10:30	Coffee Break (00h30')
11:00	**Phenomenology of the Little Bang (00h30')** *Speaker: OLLITRAULT, Jean-Yves* I discuss selected topics in heavy-ion phenomenology where significant progress has been made since the last INPC conference. Viscous relativistic hydrodynamics provides a well-defined theoretical framework for modeling the expansion of the strongly-interacting system created in a collision. These calculations are now able to put tight constraints on thermodynamical properties of QCD such as its viscosity and equation of state. Initial conditions are still a great source of uncertainty. The role of fluctuations in the wavefunctions of the incoming nuclei has been revealed by several analyses, such as the ridge structure observed in two-particle correlations. I discuss the current understanding of the ridge and of other correlation measurements. Finally, I discuss uncertainties in the description of the late, freeze-out stage where the system dissociates into hadrons.

Hadrons in Nuclei Plenary Session - Chan Centre (11:30-12:30)

time	title
11:30	**Strangeness in Nuclear Physics (00h30')** *Speaker: NAGAE, Tomofumi* Strangeness degree of freedom is not so evident in traditional low-energy nuclear physics. Some effects of sea-quark components, ssbar, in a nucleon have been looked for in several measurements. However, they are found to be not so large effects. Strangeness is, somehow, hidden in nature. Nevertheless, it always plays an important role when we discuss some exotic phenomena at high temperature, high density, etc. This is because the s quark mass (92.4±2.5 MeV/c2) is close to the typical energy scale of QCD (ΛQCD=150-250 MeV). The effect of strangeness is not trivial and essential in some cases; for example, hadronic matters inside of a neutron star. The strangeness can be explicitly implanted into a nucleus as strong bound states of strange hadrons with a nucleus. Thereby, we can extend our scope of hadron many-boody systems into the flavor SU(3), and create new types of hadronic systems. In this talk, I will review the recent topics in the field of Strangeness Nuclear Physics, and discuss future prospects in a new facility J-PARC.
12:00	**Nuclear Studies with Hard Knockout Reactions (00h30')** *Speaker: PIASETZKY, Eliezer* The combination of hard knockout reactions induced by electrons (data from JLab)and protons (data from BNL) in kinematic regimes that were not reachable before, reveals the details of short-range nucleon-nucleon correlations in nuclei. This talk will discuss the experiments involving the two-nucleon knock-out reactions 12C(e,e'pp), 12C(e,e'pn) and 12C(p,ppn). The most significant result is the demonstration of the dominance of correlated np pairs over pp pairs in the range of relative momenta 300-600 MeV/c. This can be explained in terms of short-range tensor-force dominance. These new results are essential for refining our understanding of the short-range behavior of the N-N force. Moreover, short range pp pairs are manifestation of asymmetric dense cold nuclear matter that can be studied in the laboratory, and are relevant to studying neutron stars.

HS1 - Forest Sciences Centre 1001 (14:00-15:35)

time	title
14:00	**Experimental Studies of Nucleon Spin Structure: from the Past to the Future (00h25')** *Speaker: BADELEK, Barbara* Since 1988 the nucleon spin structure is one of hottest and mostly challenging problems in the QCD. Originally formulated by the European Muon Collaboration and followed by a wide experimental and theoretical activity, it is still largely unsettled. This is a review talk where open problems, tools, experiments, their limitations and results will be presented.
14:25	**Recent DVCS Results from HERMES (00h15')** *Speaker: KAISER, Ralf* The HERMES experiment at DESY used the polarised electron/positron beam of HERA to investigate the spin structure of the nucleon. A particular focus of the ongoing physics analysis are Generalised Parton Distributions studied via Deeply Virtual Compton Scattering (DVCS). This talk will present the most recent HERMES DVCS analysis results. These include the first extraction of the longitudinal double spin asymmetry as well as DVCS beam spin and beam charge asymmetries extracted from the final two years of data taking in 2006/7.
14:40	**Present and Future Exploration of the Nucleon Spin and Structure at COMPASS (00h15')** *Speaker: MARCHAND, Claude* COMPASS is a multi-purpose fixed target experiment at CERN’s Super Proton Synchrotron, dedicated to the study of the structure of the nucleon. From 2002 to 2011, high statistics data for inclusive and semi-inclusive deep inelastic scattering will have been collected using polarized 160 GeV/c muons on polarized Li6D and NH3 targets. Measurements in longitudinal spin configuration give access to the gluon polarization, additional piece to the nucleon spin. They also allow to constrain the g1 structure function, and thus the Björken sum rule, with greater accuracy. Measurements in transverse spin configuration allow to extract Collins and Sivers asymmetries, sensitive to transverse spin distributions. From 2012 and onwards, COMPASS foresees a measurement of Deeply Virtual Compton Scattering, which gives access to some Generalized Parton Distributions which represent the ultimate theoretical description of nucleon structure. Of special importance is the GPD E, connected to the orbital momentum of the quarks in the nucleon. Also, a Drell-Yann measurement is foreseen to give access to Transverse Momentum Dependant Parton Distribution Functions, without involving Fragmentation Functions.
14:55	**Measurement of Sea Quark Polarization with W Boson Production at PHENIX (00h15')** *Speaker: KARATSU, Kenichi* The collisions of polarized protons at the Relativistic Heavy-Ion Collider (RHIC) provide us good opportunities to study proton spin structure. One of the main goals of the RHIC spin program is to measure the polarization of sea quarks using W boson production. The uncertainty of sea quark polarization still remains large, though the polarizations of valence quarks have been determined well by DIS and Semi-Inclusive DIS. Spin asymmetry of W boson production is a clean way to measure the sea quark polarization since the chirality of interacting quarks are almost fixed in the V-A coupling and the flavor identification of sea quarks is possible by separate measurement of W+/W- production. PHENIX is a detector located at one of the collision points of RHIC, and observes W bosons through the decay to leptons at mid-rapidity (|eta|<0.35) and forward rapidity (1.2< |eta| <2.4). The first sqrt(s) = 500GeV run at RHIC was held in early 2009 (RHIC Run9), and the first attempt to measure W bosons was performed at PHENIX. I would like to present the first results of cross section and single spin asymmetry of W production at PHENIX mid-rapidity region.
15:10	**Building a Picture of the Proton from Lattice QCD (00h25')** *Speaker: RICHARDS, David* Lattice QCD has an increasing role in understanding the structure of hadrons. In this talk, I will review recent lattice calculations beginning with the electromagnetic form factors, describing the distribution of charge and currents within a nucleon, and the parton distribution functions. I will then describe investigations of some new measures of hadron structure, including the Generalized Parton Distributions and Transverse-Momentum-Dependent distributions, and show how lattice calculations, together with experimental measurements, will enable the construction of a three-dimensional picture of the nucleon. I will conclude with prospects for future advances, including the calculation of isoscalar contributions to hadron structure and calculations at the physical light-quark masses.

NA1 - Forest Sciences Centre 1221 (14:00-15:35)

time	title
14:00	**Explosive Nucleosynthesis in Core-Collapse Supernovae (00h25')** *Speaker: ARCONES, Almudena* The specific mechanism and astrophysical site for the production of half of the heavy elements, the so-called r-nuclei, remains to be found. Observational data indicate that there are two components. The heavy r-process nuclei (A>130) are produced by rapid neutron capture in a yet unknown site. The other component corresponds to the "lighter heavy nuclei" or weak r-process. Our nucleosynthesis studies are based on trajectories of hydrodynamical simulations for core-collapse supernovae and their subsequent neutrino-driven winds. We show that weak r-process elements can be produced in neutrino-driven winds and we relate their abundances to the neutrino emission from the nascent neutron star. The conditions found in the latest hydrodynamical simulations are not favorable for the production of heavy r-process elements. However, by artificially increasing the wind entropy, elements up to A=195 can be made. In this way one can mimic the general behavior of an ejecta where the r-process occurs. We use this approach to study the impact of the nuclear physics input (nuclear masses, neutron capture cross sections, and beta-delayed neutron emission) on the final abundances.
14:25	**Proton vs. Neutron Captures in the Neutrino Winds of Core-Collapse (00h25')** *Speaker: WANAJO, Shinya* Recent hydrodynamic studies of core-collapse supernovae show that the bulk of the neutrino-driven ejecta is proton-rich. This indicates the severe difficulty of neutron capture nucleosynthesis (r-process), but opens a new window towards the possibility of proton capture nucleosynthesis (nup-process) in this condition. In this talk, both the possibilities of r-process and nup-process in this condition will be overviewed, based on detailed nucleosynthesis calculations with the hydrodynamic and semi-analytic models of neutrino-driven winds. In particular, the uncertainties in the supernova dynamics as well as in the relevant nuclear reaction rates are discussed in some detail.
14:50	**Nucleosynthesis in Gamma-Ray Bursts and Extremely Metal-Deficient Halo Stars (00h15')** *Speaker: KAJINO, Toshitaka* Gamma-ray bursts are the most energetic event in the Universe. Although it has been a long standing mystery what is the central engine of GRB, recent 2D simulation in collapsar (failed supernova) model has succeeded in making relativistic jet due to efficient heating by annihilation of pair-neutrinos from accretion disk surrounding the black hole (BH). In the lights of this success, we study the GRB nucleosynthesis in two ways: First, we apply 2D numerical simulation to the r-process nucleosynthesis. Second, we construct a semi-analytic model of the collapsar and apply to the nucleosynthesis in outer layers, accretion disks and the jet. We find that the light-mass-nuclei like CNO produced in outer layers are very enhanced, while the heavy FeCoNi produced in silicon burning layer close to the BH are mostly falling back onto the BH. We still find the r-process elements like Sr and Ba which can be produced in the neutron rich outflows from accretion disk. We compare theoretical prediction with the abundance pattern detected in an oldest metal-deficient star HE1327-2326 and HE0107-5240 with [Fe/H] = -5.4 and -5.3, respecively, which are in reasonable agreement with each other.
15:05	**SUSY-Catalyzed Big-Bang Nucleosynthesis as a Solution of Lithium Problems (00h15')** *Speaker: KUSAKABE, Motohiko* There has been a nagging puzzle in nuclear astrophysics which is that the 6Li abundance observed in metal poor halo stars appears to exhibit a plateau as a function of metallicity similar to that for 7Li. This suggests a big bang origin for 6Li. However, because the radiative capture of a deutron by an alpha particle during the big bang is suppressed, it is difficult to explain this observed 6Li abundance. At the same time the observed 7Li abundance is below that expected from BBN. In this talk we review our approaches to explain this observation. Among the possibilities there are the astration of lithium isotopes, galactic chemical evolution, and effects from a massive charged or neutral unstable relic SUSY particles present during BBN. We present in this talk that it is most likely to obtain a simultaneous solution to both the problems of underproduction of 6Li and overproduction of 7Li in the paradigm of SUSY-DM particle catalyzed BBN. We discuss implications of this model in constraining the mass of DM particles which are expected to be measured at LHC or CDMS II. We also discuss importance of precise theoretical model of few-body reactions including SUSY particles.
15:20	**Direct Capture Reactions and r-Process (00h15')** *Speaker: OTSUKI, Kaori* The r-process is rapid neutron capture process which proceed extremely neutron-rich unstable nuclei. Nuclear physics input for theoretical calculations, such as mass, beta-decay rates and radiative capture rates have to be obtained in theoretical model since they cannot be measured in experiments. There are two different contributions to neutron capture reactions, the direct capture process and the compound nuclear process. The rates of the latter are obtained in Hauser-Feshback calculations, that are publicly available in archives. The direct capture reaction has been neglected in previous r-process studies although its importance has been pointed out. We studied the role of direct capture in r-process nucleosynthesis. The reaction rates are calculated in semi-analytic way and adopted in dynamical full network code. We found the direct capture furthers r-process and make freeze out time earlier. This effect changes final yields drastically. The shorter beta-decay half lives also show similar effect. Our results imply that beta-decay rates and radiative capture rates are important in dynamical calculation because these reaction rates effect on the freeze out temperature.

NF1 - Life Sciences Centre 1510 (14:00-15:35)

time	title
14:00	**Proton Radiography and Its Applications at Los Alamos National Lab (00h25')** *Speaker: SAUNDERS, Alexander* Proton Radiography (PRAD) is a diagnostic tool that uses high energy proton beams to generate sequences of flash radiographs of fast moving objects. It has been used at Los Alamos National Lab to study such phenomena as detonation of high explosives and explosively-driven metal deformation, failure, and equation of state. PRAD is the only technique that can generate tens of frames of flash radiography data on time scales ranging from nanoseconds to hours. PRAD principles and techniques will be described, and examples of results from PRAD experiments will be presented, including those related to national defense, material science, and nuclear energy development.
14:25	**Moving Toward More Reliable Supplies of "Medical Isotopes" (00h25')** *Speaker: RUTH, Thomas J.* With 80% of the world's diagnostic studies using radionuclides relying on 5 aging nuclear reactors and seemingly endless shutdowns due to leaks, the medical community is desperate for new sources of radionuclides in general and 99Mo/99mTc in particular. This presentation will cover the various options from a production perspective giving examples of facilities being built, proposed and redirected with the mission of producing radionuclides for medicine. The alternatives range form the use of photons, to low energy protons to high energy protons, all at extremely high fluxes. The challenges include the removal of single point of failure in the supply chain, to the need for enriched target materials, to the elimination of high enriched uranium as target or source of neutrons. An estimation of the time lines for the various approaches will be given along with a critical view as to the stage of development and research needed to make the process viable.
14:50	**The HIE-ISOLDE Project (00h15')** *Speaker: HERLERT, Alexander* The HIE-ISOLDE project aims at several important upgrades of the present ISOLDE radioactive beam facility at CERN. The main focus lies in the energy upgrade of the post-accelerated radionuclide beams from 3 MeV/u up to 10 MeV/u through the addition of superconducting cavities. This will open the possibility of many new types of experiments including transfer reactions throughout the nuclear chart. The prototype of the Nb-sputtered cavities for the new superconducting linear accelerator has been completed and will soon be tested. The project also includes a design study of improved production targets to accommodate to the future increase of proton intensity delivered by the new LINAC4 proton driver. This improvement combined with the recently installed solid state lasers of the RILIS laser ion source and the radiofrequency quadrupole cooler and buncher ISCOOL will lead to an increase of the radioactive beam intensities of up to an order of magnitude. The project has been approved by CERN and its implementation started in January 2010. An overview of the project and the timeline will be presented.
15:05	**TACTIC: A New Detector for Low Energy Nuclear Astrophysics (00h15')** *Speaker: FOX, Simon* Directly measuring nuclear astrophysics reactions presents unique challenges. Low energy reaction products and small reaction cross sections are just two of the issues that the TACTIC detector addresses. TACTIC is the “TRIUMF Annular Chamber for Tracking and Identification of Charged-particles” detector being developed by TRIUMF and the University of York, UK. TACTIC is a cylindrical, active-target TPC providing high detection efficiency; a "shielding" cathode traps the ionization created by the beam and allows for higher intensities than typical TPCs. The 480 anode signals are collected through custom preamplifiers, digital electronics and acquisition systems. Acquisition and analysis software is also undergoing extensive development. Amplification of the small signals is accomplished using a Gas Electron Multiplier (GEM). The fill gas, He-CO2, provides both particle detection and a homogeneous, variable-thickness target for studying reactions on alphas, such as 8Li(alpha,n)11B. A preliminary study of this flagship reaction was carried out in June 2009 and the results are providing feedback into the development of the final detector and infrastructure.
15:20	**SAGE Spectrometer - The First Results (00h15')** *Speaker: PAPADAKIS, Philippos* In-beam gamma-ray and electron spectrometers have long been used as tools to probe the structure of atomic nuclei. However, if used separately they can provide only partial information of the nuclear de-excitation processes and consequently of nuclear structure. This becomes increasingly problematic in heavy nuclei, especially at low transition energies and high multipolarities, where internal conversion competes strongly with gamma-ray emission. The SAGE spectrometer allows efficient cross-coincidence measurements between gamma-rays and conversion electrons by combining the JUROGAM II germanium detector array with a highly segmented silicon detector and a solenoid electron transfer system. It employs digital front-end electronics and is coupled with the RITU gas-filled recoil separator and the GREAT focal-plane spectrometer for Recoil-Decay Tagging studies. The SAGE spectrometer has been successfully commissioned in the University of Jyväskylä earlier this year. The setup will be described and results from the first in-beam measurements showing electron-gamma coincidences will be presented.

NI1 - Forest Sciences Centre 1003 (14:00-15:40)

time	title
14:00	**Superheavy Element Chemistry at GSI Darmstadt (00h25')** *Speaker: SCHAEDEL, Matthias* Superheavy element (SHE) chemistry at the GSI was focused on element 108 and is aiming for the element 114 region. Common to this research is the quest for the influence of relativistic effects on chemical properties of SHE. In parallel, modern relativistic quantum theory has provided crucial guidance and understanding. Fast chemical separations were also applied as an excellent tool to separate element 108. The discovery of deformed doubly-magic 270Hs and adjacent 271Hs were highlights. The success of SHE chemistry at GSI was closely linked to technical improvements from target technology to transport systems, chemical separation devices, and innovative detection systems. Most recently, coupling of chemical set-ups to recoil separators, e.g. TASCA at GSI, is opening new fields of SHE chemistry and it provides great perspectives for the future. After last years synthesis of 288114 and 289114 in the 48Ca on 244Pu reaction and the measurement of their decay properties in the focal plane detector of TASCA, the subsequent chemistry experiment used the COMPACT device directly coupled to TASCA for the first successful element 114 chemistry experiment at GSI.
14:25	**Superheavy Element Chemistry at RIKEN (00h25')** *Speaker: MORITA, Kosuke* Chemistry studies of the heaviest elements (Z > 103) (SHEs) attract interests widely to nuclear- and radio-chemists because possible strong relativistic effects might appear in their chemical properties of SHEs. The small production yields and the short half-lives of the isotopes of SHEs make the precise chemical studies of them difficult very much. In RIKEN we have been developing the systems to investigate chemical properties of SHEs at RI Beam Factory (RIBF) in RIKEN Nishina Center. Two gas-filled recoil ion separators (GARIS, GARIS-II) were installed at Riken Linear Accelerator (RILAC) Facility in RIBF. The performances of the gas-jet transport system coupled to GARIS were investigated using the alpha spectrometry method on uranium and curium based fusion reactions[1]. The results showed that the system is a promising interface to explore new frontiers in superheavy chemistry. Technical developments of the automated detection system for alpha/SF spectrometry, the solvent extraction system with a flow-injection- analysis- technique, and the hydroxide coprecipitation method are in progress. [1] H. Haba et al., Chem. Lett. 38 (2009) 426-427.
14:50	**Superheavy Element Physics and Chemistry at Berkeley (00h25')** *Speaker: NITSCHE, Heino* We are studying the physics and chemistry of the heaviest elements (HE). The most fundamental goal in chemistry is the determination of the chemical properties of the elements. Isotopes of lawrencium and even heavier elements have half-lives of a few minutes or less, and can only be produced at accelerators. Production rates are low, ranging from one atom per minute down to one atom per day, so chemistry must be performed on single atoms. Therefore, relatively little is known about the chemistry of the heaviest elements. Until recently, the most important aspect of a chemical separation system used for study of the heaviest elements was the need for an extremely efficient separation of the HE atoms from interfering radioactivities concurrently produced in the nuclear reactions used. We have pioneered the use of the Berkeley Gas-filled Separator (BGS) as a pre-separator to provide high-purity heavy element samples for chemical separations. This allows development of a broad range of chemical separation systems can better elucidate the chemical properties of the heaviest elements . The production of transactinide elements and their chemical characterization will be discussed.
15:15	**Nuclear Chemistry for Nuclear Physics: Extraction of Radionuclides from Accelerator Waste at PSI (00h25')** *Speaker: SCHUMANN, Dorothea* PSI operates the most powerful proton accelerator world-wide. With 590 MeV and a beam current of 2.5 mA it serves as the proton feeder for the Swiss neutron spallation source SINQ. Components in the surrounding of this instrument are highly activated by high energetic protons and secondary particles. Since spallation reactions induce the production of isotopes with masses up to one mass unit higher then the target mass, the spectrum of produced radio elements covers nearly the entire periodic table. Therefore, some of these activated components represent valuable archives for exotic and rare isotopes, which are urgently needed for experiments in several scientific fields. One of these research areas is nuclear physics, and especially nuclear astrophysics. 60Fe, 44Ti and 26Al samples were prepared from an irradiated copper beam dump using chemical separation technique. Other radionuclides like 53Mn and 59Ni are also available from these sources. 7Be can be separated from the cooling water of the SINQ. Two successful experiments with 60Fe were already performed: 1) the re-measurement of the half-life and 2) the determination of the neutron capture cross section.

NR1 - Forest Sciences Centre 1005 (14:00-15:40)

time	title
14:00	**Polarization Observables and Spin-Aligned Fusion Rates in 2H(d,p)3H and 2H(d,n)3He Reactions (00h25')** *Speaker: FONSECA, António C.* Neutron (n) and proton (p) transfer reactions in deuteron-deuteron (dd) scattering, d+d-p+3H and d+d-n+3He, are amongst the simplest nuclear reactions where charge-symmetry breaking (CSB) in the nuclear force can be searched for. The aim of the present paper is to study the energy dependence of the d+d-p+3H and d+d-n3He observables below three-body breakup threshold using different nuclear force models such as AV18, CD Bonn, N3LO, and INOY04 together with the Coulomb force between protons which is the most important cause of CSB. In addition to the differential cross sections there are precise measurements of the deuteron analyzing powers between 1.5 and 4 MeV deuteron lab energy, as well as polarization of the outgoing nucleon and deuteron to nucleon spin transfer coefficients. It was initially believed that at very low energy the production of neutrons, resulting from d+d-n+3He, could be controlled by polarizing all deuterons in the plasma, such that only spin-aligned dd fusion would take place. In the absence of an experimental measurement our exact 4N calculations will allow to verify the assumption on the possible d+d-n3He supression with spin-aligned deuterons.
14:25	**Cross Section of the Deuteron-Proton Breakup as a Probe of Three-Nucleon System Dynamics (00h15')** *Speaker: STEPHAN, Elzbieta* Modern nucleon-nucleon (NN) interaction models can be probed quantitatively in the three-nucleon (3N) environment by comparing predictions based on rigorous solutions of the Faddeev equations with the measured observables. It has been found that a proper description of the experimental data cannot be achieved with the use of NN forces alone. This indicates a necessity of including additional dynamics: subtle effects of suppressed degrees of freedom, introduced by means of genuine 3N forces, or, for a long-time neglected, Coulomb force. A large set of high precision, exclusive cross-section data for the 1H(d,pp)n breakup reaction at 130 MeV, contributes significantly to constrain the physical assumptions underlying the theoretical interaction models. Comparison of nearly 1800 cross-section data points with the predictions using nuclear interactions generated in various ways (semi-phenomenological meson exchanges, coupled barion channels approach, chiral perturbation theory), allowed to establish for the first time a clear evidence of importance of the 3N forces in the breakup process. Moreover, the results confirmed predictions of sizable Coulomb force influences in this reaction.
14:40	**Three Nucleon Forces Effects in the Electron Scattering of 4He (00h15')** *Speaker: BACCA, Sonia* The investigation of light nuclei with ab-initio methods provides an optimal setting to probe our present knowledge of nuclear forces, since the few-nucleon problem can be accurately solved. We believe, supported by recent advances in effective field theory, that nucleons interact not only in pairs but also via many-body forces. Theoretical efforts need to be taken towards the identification of bound and continuum nuclear observables sensitive to the less known many-nucleon forces. In a recent study we found that the longitudinal electron scattering off 4He is potentially such an observable. We will present our results with traditional two and three-body potentials, with emphasis on the role of three-body forces and on the comparison with experiment. Preliminary results using effective field theory forces will be also discuss.
14:55	**Systematic Measurement of Star Anomaly in pd Breakup Reaction (00h15')** *Speaker: SAGARA, Kenshi* After Faddeev calculation of pd breakup with reliable treatment of Coulomb force was made by Deltuve et al. in 2005, we started a systematic measurement of pd breakup cross section at Star configurations around 13 MeV. When outgoing three nucleons from pd breakup form an equilateral triangle, the configuration is called Star. When the triangle is perpendicular to the beam axis, the configuration is called Space Star (SS). SS anomaly was first found in nd breakup at 13 MeV by Erlangen group in 1989. Measured nd breakup cross section at SS was found to be about 25% higher than calculation. SS anomaly is curious: (a) measured cross section is higher than calculation in nd breakup and lower than calculation in pd breakup, (b) SS anomaly is most dominant at 13 MeV. Effects of 3-nucleon forces are too small to cause SS anomaly. At present we have no idea for the origin of SS anomaly. Our systematic measurement suggests that Star anomaly appears in a wide range of configurations and SS anomaly is the largest anomaly. The suggestion is a big hint to speculate the origin of SS anomaly.

15:10	**Measurement of pd Breakup Cross Sections in the Off-Plane Star Configurations at E/A = 13 MeV (00h15')** *Speaker: MAEDA, Yukie* Recently the data of the differential cross sections for the 1H(d,pp)n breakup reactions in the off-plane star configurations at E = 19MeV are reported from Koln. This study covers the kinematical configurations in which all three nucleons in the final state scattered with equal magnitudes of momenta in the c.m. system. The comparison of the data with the Faddeev calculations based on the modern NN forces showed large discrepancies up to 25 %, which we call "off-plane star anomaly". To clarify the cause of this anomaly, we carried out the measurement of the 1H(d,pp)n at E = 26MeV at RCNP and that of the 2H(p,pp)n at E = 13 MeV at KUTL. In the experiment at RCNP, we used the rotating polyethylene (CH2) foil as the proton target. Two scattered protons in the final state were detected in coincidence by a pair of lithium-drift silicon detectors (SSD) installed in the vacuum chamber. In this work, we measured the differential cross sections for alpha = 120 – 180 degree while alpha is the angle between the scattered plane and the beam direction. In the presentation, we are going to show the data and the comparison between our data and the results of the Faddeev calculations.
15:25	**Studying Nuclear Reactions of Few-Particle Systems via Faddeev-Yakubovsky Formalism (00h15')** *Speaker: LEKALA, Mantile Leslie* We consider quantum scattering of three and particles at low energy using differential Faddeev-Yakubovsky equations. In particular we consider situations where three particles are in the incoming channel, and also cases for long-range interactions. Reactions involving four particles are technically demanding, in comparison to three particle reactions. One of the reasons for this is that large number of coupled equations are involved. Another challenge is the difficulty associated with the inclusion of Coulomb forces. Thus one will require a plethora of partial waves in order to achieve convergence. Usually, the Coulomb problem is circumvented by the use of a screened potential and renormalization. In this work we employ the Coulomb Fourier transformation approch of Alt et. al. to handle the inclusion of the Coulomb interaction in the Hamiltonian. We present an extended version of our three-dimensional three-body spectral type method to four-body and use it to handle the inhomogeneous equations resulting from the differential Faddeev-Yakubovsky equations. Reactions cross sections are obtained for three- and four-particle scattering problems of astrophysical importance.

NS1 - Life Sciences Centre 2 (14:00-15:40)

time	title
14:00	**Shell Structure and Modern Effective Interactions (00h25')** *Speaker: HJORTH-JENSEN, Morten* I will present recent advances in the derivation of effective interactions for the nuclear shell model, with applications to mass regions from A=100 to A=132. The effect of three-body correlations and forces will also be examined.
14:25	**100Sn and Neighbouring Nuclei (00h15')** *Speaker: FAESTERMANN, Thomas* We have produced 100Sn and nuclei in its neighbourhood by fragmentation of 124Xe ions from the SIS at GSI, Darmstadt. The fragments of interest were separated and identified in the FRS. In addition to 259 nuclei of 100Sn we observed for the first time the N=Z-1 nuclei 95Cd, 97In and 99Sn. Because of the reduced yield of 103Sb we conclude that proton radioactivity with a half life below 100ns is its dominant decay channel. The fragments were stopped in a stack of DSSDs for the correlation of implantation with subsequent decays. Ten Si detectors in front and behind this implantation zone served as calorimeter for betas. The implantation detector was surrounded by the 105 Ge detectors of the RISING array. A number of isomeric states was observed. In 102Sn we find a new isomeric gamma-line which we attribute to the 6+ - 4+ transition. In 98Cd we also observe an unknown transition, shedding light on core excited states. For the decay of 100Sn we deduce a precise value of the half-life and of the decay energy to the lowest 1+ state in 100In. That gives us the GT strength of the decay which is the largest ever seen. For the first time we observe the γ-cascade depopulating that 1+ state.
14:40	**Nuclear Structure Studies at the Borders of Stability (00h15')** *Speaker: FERREIRA, Lidia* We have performed theoretical calculations to describe the structure of nuclei at the extremes of stability, using the nonadiabatic quasiparticle approach. We reproduce the experimental half-life for proton radioactivity in 121Pr assuming J=7/2- as decaying state, showing for the first time clear evidence for partial rotation alignment in a proton emitting nucleus[1]. Recent findings suggest the departure from axial deformation in the region of proton emitting nuclei. Our calculation for 145Tm[2], giving the energy spectra of parent and daughter nuclei, half-life and fine structure, confirmed a large triaxiality. Similarly, we have studied decay of 141Ho[3], the only known nucleus for which fine structure in proton emission from both ground and isomeric states was observed. The interpretation of the data pointed out to the breaking of axial symmetry in this emitter. The present studies provide new theoretical tools to access nuclear structure properties far from the stability domain. 1. M.C. Lopes, E. Maglione, L.S. Ferreira, Phys. Lett.B 673(2009)15 2. P. Arumugam, L.S. Ferreira, and E. Maglione Phys. Rev. C78(2008) 041305 3. P. Arumugam, Ferreira, and Maglione PLB680, 443(2009)
14:55	**Identification of Excited States in the N = Z=46 Nucleus 92Pd: Evidence for an Isoscalar Spin-Aligned Coupling Scheme (00h15')** *Speaker: CEDERWALL, Bo* Gamma-ray transitions have been identified for the first time in the extremely neutron-deficient, N=Z nucleus 92Pd and energies of the lowest excited states have been deduced. The experiment was performed at the Grand Accelerateur National d'Ions Lourds (GANIL) using the 58Ni(36Ar, 2n)92Pd heavy-ion fusion-evaporation reaction at a beam energy of 111 MeV. Charged particles, neutrons and gamma rays emitted in the reactions were detected by the DIAMANT CsI charged particle detector system, the NEUTRON WALL liquid scintillator detector array and the EXOGAM Ge detector array. The results are in agreement with theoretical predictions of a "phase transition" from the normal seniority coupling scheme to a isoscalar spin-aligned coupling scheme at N = Z.
15:10	**Ab Initio Shell Model with a Core: Extending the No-Core Shell Model to Heavier Nuclei (00h15')** *Speaker: BARRETT, Bruce* The No-Core Shell Model (NCSM) has had considerable success in describing the binding energies and other physical properties of light nuclei, A>16. The big challenge facing future NCSM investigations is how to perform such calculations for heavier nuclei, for which the model spaces become unmanageable with existing computers. Our current studies involve the development of new many-body approaches for achieving this goal, such as successive unitary transformations, so as to include the effects of all nucleons, as proposed by Navratil, et al. [1] We construct effective one-, two- and three-body interactions for the p-shell by performing $N_{max}\hbar\Omega$ ab initio NCSM calculations for the A=5, 6 and 7 nuclei, respectively, with $N_{max} = 2,4,...,12$ and projecting the many-body Hamiltonians onto the $0\hbar\Omega$ space. Results of standard shell-model calculations using the derived Hamiltonians (both with and without the three-body terms) for p-shell nuclei with A>6 will be presented and compared with exact NCSM results. The same procedure can also be used for determining other effective operators within the p-shell. [1] P. Navratil, et al,, Phys. Rev. C 55, R573 (1997).

15:25 **Isomer and Beta-Decay Spectroscopy of Tz=1 Isotopes Below the N=Z=50 Shell Gap (00h15')**

Speaker: BOUTACHKOV, P.

The RISING setup at the GSI-FRS facility has been used to investigate the isomer and beta decays in N~Z Cd, Ag and Pd isotopes. The nuclei were produced via fragmentation of a 124Xe beam, with energy of 850 MeV/u, on a 9Be target. After separation and identification the fragments were implanted into an array of 9 Double Sided Silicon Strip Detectors. The silicon stopper was surrounded by the RISING gamma-ray spectrometer. The results give information on the p-n interaction and the shell evolution in the N~Z~50 region. They provide stringent tests of the shell model and the effective interactions. In this talk new results on the Tz=1 isotopes, 94Pd, 96Ag and 98Cd will be presented. In 94Pd a new high-spin isomer has been observed, whilst in 96Ag 3 new isomeric states have been identified, including core-excited states. In 98Cd a new high-energy isomeric gamma-ray transition is observed, thus enabling us to confirm the previous spin assignment for the core-excited 12+ isomer and estimate the E2 and E4 strengths for the decay of this state. The results will be compared with shell model calculations.

NS7 - Life Sciences Centre 3 (14:00-15:40)

time	title
14:00	**Spectroscopy In and Around the Island of Inversion (00h25')** *Speaker: SCHEIT, Heiko* The magic neutron number N=20 arises after 2 quanta of the harmonic oscillator and persists after considering a more realistic potential including the spin-orbit interaction. The N=20 shell gap can be found between the 0d3/2 and 0f7/2 orbitals. It has become clear that magic numbers can evolve as a function of Z and N due to (residual) p-n interactions, which can lead to a quenching of certain magic numbers and the appearance of others. The archetypical example of these very rapid changes in nuclear structure is the so-called 'island of inversion', comprising the very neutron-rich nuclei near N~21 and Z~11. Historically it was found that these nuclei are more bound than expected and subsequent experimental observations pointed toward an abrupt onset of collectivity with deformed ground states. These properties can best be explained by the dominance of intruder configurations, i.e. configurations outside the sd-shell. The interest in this region of the nuclear chart has grown enormously over time, due to the ever better accessibility of these nuclei at RNB facilities. I will review the current experimental understanding of these nuclei and will give an outlook on the experimental progress to be expected in the near future.
14:25	**Single- and Two-Neutron Transfer with a 30-Mg Beam (00h15')** *Speaker: KRUECKEN, R.* The island of inversion around 32-Mg continues to be of great interest in the study of the evolution of shell structure in exotic nuclei. In particulr the evolution of single-particle levels when moving from the sd-shell nucleus 30-Mg to 31-Mg is of significant interest. Also the investigation of the coexistence of spherical and deformed 0+ states in 30-Mg and 32-Mg on either side of the border of the island of inversion provides an important test for theoretical models. In this contribution we would like to report on first results of (d,p) and (t,p) reactions in inverse kinematics using a 30-Mg beam from the REX-ISOLDE accelerator at CERN. In particular the (t,p) reaction is to our knowledge the first use of a radioactive tritium target with a radioactive ion beam. Light charged particles emmitted from the target were detected by the T-REX particle detector while gamma-rays were detected by the MINIBALL gamma-ray detector array. We will report on our results from the (d,p) and (t,p) experiments, in particular the first observation of a shape coexisting 0+ state in 32-Mg.
14:40	**Charge Radii of Magnesium Isotopes: The Island of Inversion Investigated by Dedicated Laser-Spectroscopy Methods (00h15')** *Speaker: YORDANOV, D. T.* The island of inversion is commonly regarded as an island of deformation. Yet, the transition to a deformed configuration in the isotopes of magnesium is not well understood. This problem cannot be addressed by quadrupole-moment measurements due to nuclear spin 0 or 1/2 of most key isotopes. Experimental evidence from reaction studies as well as the spins and magnetic moments of 31,33Mg are consistent with considerable prolate deformation. However, in order to obtain a continuous picture of the evolution of the nuclear shape along the magnesium chain one has to measure a quantity accessible for all isotopes (odd and even) with the same experimental technique. Accordingly, a measurement of the rms charge radii of the neutron-rich magnesium isotopes will be presented for the first time. This work was undertaken with the collinear laser spectroscopy setup at ISOLDE-CERN. The measurements on 24-32Mg will be presented with emphasis on the novel methodology for extracting accurate isotope shifts from beta-detection spectra. The results will be discussed in terms of deformation in light nuclei near N=20 and in the context of evolution of the shell structure away from stability.
14:55	**Measurement of Unbound Excited States of 24O (00h15')** *Speaker: TSHOO, K.H.* The excitation energy of the first 2+ state of 24O, which is the newly proposed doubly magic nucleus, is of great concern with regards to the new N=16 magicity. Very recently, 24O was studied in nucleon removal reaction with a radioactive 26F beam at MSU, but the first 2+ state was not clearly identified due to the possible near proximity of the first 2+ and 1+ states. In the present experiment, the unbound excited states of 24O have been investigated using the 24O(p,p')24O* → 23O + n reaction. The yields of the 1+ state is expected to be suppressed by a factor ~5 as compared to that of the 2+ state in (p,p') reaction. In the experiment performed at RIKEN, a 63 MeV/nucleon secondary beam of 24O was produced by the fragmentation of a 95 MeV/nucleon 40Ar primary beam on a Be production target. The decay energy spectrum of 23O + n was constructed in the invariant mass of the neutron and the charged fragment in coincidence. In the presentation, the observed decay energy spectrum of 23O + n will be discussed along with the excitation energy of the first 2+ state comparing to those of the previous experiment and theoretical calculations.

15:10	**Changes in Mn Nuclear Charge Radii Across the N = 28 Shell Closure (00h15')** *Speaker: CHARLWOOD, Frances* The first laser spectroscopic study of Mn (over the N=28 shell closure) has been achieved by the use of in-cooler optical pumping. Mean-square charge radii and nuclear quadrupole moments for ground and isomeric states in 50-56Mn have been extracted. Mass measurements in this region have previously indicated that the nuclear binding of Mn decreases smoothly through the N=28 shell closure (unlike the behaviour at all other magic shells) and that no shell closure "kink" is seen in the neutron separation energies. The charge radii reported here show a well-defined, sharp shell closure, closely following that observed in Ca. The complete contrast in mass and charge radii measurements for Mn are strikingly different to the near identical trends seen for Z~40. Such differences critically affect our understanding of the impact of structure on binding energy. Extensions to the current measurements and the prospects for future measurements (further exploiting optical pumping) will be presented.
15:25	**Low-Lying Level Structure of Light Neutron-Rich Nuclei Beyond the Dripline: 7,9He and 10Li (00h15')** *Speaker: AL FALOU, Hicham* The continuum states of unbound light neutron-rich nuclei provide important constraints on our understanding of nuclear shell structure far from stability. Experimentally this region offers the only practical possibility for spectroscopy beyond the neutron dripline. Theoretically, state-of-the-art models, such as the continuum shell model and ab-initio type approaches, are beginning to explore such systems. In addition, the structure of nuclei such as 10Li is key to constructing three-body descriptions of two-neutron halo nuclei. One of the tools well adapted to the study of nuclei far from stability is that of knockout or breakup of an energetic radioactive beam. Following a brief description of the technique, two specific topics will be discussed: - A search for the putative low-lying 1/2- spin-orbit partner of the 7He(3/2-) ground state. - An investigation of the parity inversion in the N=7 isotones 9He and 10Li. The talk will conclude with comments on the need to investigate more fully the structure of 9He and 10Li and future low-energy experiments transfer reaction experiments that are currently being pursued at ISAC-TRIUMF.

SM1 - Life Sciences Centre 1410 (14:00-15:35)

time	title
14:00	**Final Results for the Muon Decay Parameters from TWIST (00h25')** *Speaker: MISCHKE, Richard* The TRIUMF Weak Interaction Symmetry Test (TWIST) collaboration has completed the world's most precise measurement of the energy-angle spectrum of positrons from the decay of highly polarized muons. A simultaneous measurement of the muon decay parameters rho, delta, and P mu epsilon tests the Standard Model (SM) in a purely leptonic process and provides improved limits for relevant extensions to the SM. Since the completion of data taking in 2007, the analysis has focused on reducing systematic uncertainties, estimating residual biases, and evaluating consistency checks. The analysis was blind with respect to the central values of the parameters, so the final results were unknown until the analysis was completed and the values of the hidden parameters were revealed. The statistical errors are sufficiently small that the total uncertainties for rho, delta, and P mu epsilon are dominated by systematic uncertainties. The talk will include a description of the experimental apparatus and analysis procedures, with particular attention to the reduction of leading systematic uncertainties. The final results and their uncertainties will be presented along with implications for physics beyond the SM.
14:25	**Results from the Search for an Electric Dipole Moment of 199Hg (00h25')** *Speaker: HECKEL, Blayne* Observation of a nonzero EDM would imply CP violation beyond the Standard Model. Additional sources of CP violation are expected to help explain the matter-antimatter asymmetry observed in our universe and naturally arise in extensions to the standard model such as supersymmetry. Our group has recently reported a new upper limit: |d(Hg)| < 3.1 x 10^(-29) e-cm for the EDM of 199Hg. The experiment compared the spin precession frequencies in four spin-polarized Hg vapor cells: two cells lie in parallel magnetic and anti-parallel electric fields, resulting in EDM-sensitive spin precession while the remaining two cells, at zero electric field, serve to cancel noise generated by magnetic field gradients and test for systematic errors. A frequency shift, linear in the applied electric field, due to the Stark mixing of atomic states has been identified and measured. A description of the EDM experiment and measurements that led to our recent result will be presented. This work was supported by NSF Grant PHY-0457320 and the DOE Office of Nuclear Science.
14:50	**High Precision Measurement of the pi → e nu Branching Ratio: A Sensitive Probe for New Physics (00h15')** *Speaker: MALBRUNOT, Chloe* Study of rare decays is an important approach for exploring physics beyond the Standard Model (SM). The branching ratio of the helicity suppressed pion decays, R = Gamma(pi+→e+ nu e+pi+→e+nu e gamma)/Gamma(pi+→mu+nu mu+pi+→mu+nu mu gamma) is one of the most accurately calculated decay process involving hadrons and has so far provided the most stringent test of the hypothesis of e-mu universality in weak interactions. The branching ratio has been calculated in the SM to better than 0.01% accuracy to be R_SM = 1.2353(1) x 10^4. The PIENU experiment at TRIUMF, which started taking physics data in September 2009, aims to reach an accuracy five times better than the previous experiments, so as to confront the theoretical calculation at the level of \pm0.1%. If a deviation from the R_SM is found, "new physics", at potentially very high mass scales (up to 1000 TeV), could be revealed. Alternatively, sensitive constraints on hypotheses can be obtained for interactions involving pseudoscalar or scalars. So far, 4 million pi+ → e+nu e events have been accumulated by PIENU. The presentation will outline the physics motivations, describe the apparatus and techniques designed to achieve high precision and present the latest results.
15:05	**Mu2e: A High-Sensitivity Charged Lepton Flavor-Violating Search at Fermilab (00h15')** *Speaker: LYNCH, Kevin* Mu2e will search for coherent, neutrino-less conversion of muons into electrons in the field of a nucleus, improving on existing sensitivity limits by four orders of magnitude. Such a charged lepton flavor-violating reaction probes new physics complementary to the LHC and can reach a scale unavailable to direct searches at either present or planned high energy colliders. The physics motivation for Mu2e will be presented, as well as the design of the muon beamline and spectrometer. A scheme by which the experiment can be mounted in the present Fermilab accelerator complex will be described. Prospects for increased sensitivity from the Project X linac that is being proposed by Fermilab will be discussed.

15:20 **Testing Time Dilation on Fast Ion Beams (00h15')**

Speaker: SAATHOFF, Guido

One of the early tests of Lorentz invariance, the essential ingredient of Special Relativity, was realized in the measurement of time dilation by Ives and Stilwell in 1938. They used hydrogen atoms in canal rays as moving clocks and measured the Doppler shifts of suitable spectral lines both in forward and backward direction of the atomic motion. This measurement principle, after which time dilation and the clock velocity are derived from the Doppler shifts, still delivers the best test of the effect. In a modern version of this experiment we store singly-charged lithium ions at 34% of the speed of light c in the ESR storage ring at the Helmholtzzentrum GSI in Darmstadt, Germany. The Doppler shifts of an optical dipole transition are measured to 10 ppb by laser spectroscopy. At this level of accuracy, the experiment is already on par with our previous measurements at 6% of c at the TSR storage ring in Heidelberg. Both experiments find Doppler shifts in accordance with Special Relativity and constrain deviations of time dilation to below 100 ppb. Based on a detailed investigation of systematic effects at the TSR, we expect another 10fold improvement in future ESR measurements.

Coffee Break - Forest and Life Sciences Centre Atriums (15:40-16:10)

HS2 - Forest Sciences Centre 1001 (16:10-17:45)

time	title
16:10	**Experimental Studies of Nucleon Valence Quark Structure (00h25')** *Speaker: MEZIANI, Zein-Eddine* The valence quark region is a fertile ground for probing the quark structure of the nucleon as well as the dynamics of quarks and gluons confined within. I will highlight results of nucleon quark structure studies in the valence region using the 6 GeV electron beam at Jefferson Lab and will discuss proposed experiments that will further explore quark-gluon correlations with the planned 12 GeV electron beam energy upgrade. These studies are made possible by the availability of a highly polarized electron beam combined with highly polarized targets and a choice of detectors that maximize the figure of merit for each planned experiment.
16:35	**The Generalized Polarizabilities of the Nucleon (00h15')** *Speaker: DORIA, Luca* Electric and magnetic polarizabilities are fundamental quantities characterizing strong interacting bound systems like the nucleon and they can be accessed experimentally through Compton scattering. By means Virtual Compton Scattering (VCS), the momentum dependence of the polarizabilities can be investigated. Moreover, VCS permits the mesurement of four new observables: the spin generalized polarizabilities. This challenging measurement requires a double polarization experiment, which was performed for the first time at the Institute of Nuclear Physics in Mainz, exploiting the high-current, high-polarization cw electron beam delivered by the MAMI microtron.
16:50	**Measurement of the Lamb Shift in Muonic Hydrogen: The Proton Radius Puzzle (00h15')** *Speaker: ANTOGNINI, Aldo* We have measured several 2S-2P transition frequencies in muonic hydrogen (mu-p) and deuterium (mu-d) with 20 ppm precision. From our measurements we can extract the proton rms charge radius with 0.1% relative accuracy. This new value is 10 times more precise than previously obtained. However, it disagrees by 5 standard deviations from the CODATA value. The origin of this discrepancy is not yet known. It may come from theory of the muonic hydrogen energy levels (used to deduce the new value), or from problems in H spectroscopy experiments or H energy level theory (both used to deduce the CODATA value). Similarly we have improved the deuteron rms charge radius by an order of magnitude. The new proton and deuteron radii are a benchmark for lattice QCD and few-nucleon theories, respectively. The impact of muonic atom spectroscopy on few-nucleon theories will be extended by the planned measurement of the muonic helium Lamb shift. This will improve the helion and alpha-particle radius values. Setup, measurements and results will be presented. In addition the discrepancy and the impacts of these measurements on bound-state QED tests and fundamental constants will be discussed.
17:05	**Final Results of the G0 Experiment : Strange Quark Contributions to the Nucleon Form Factors in Parity-Violating Electron Scattering (00h15')** *Speaker: VERSTEEGEN, Maud* The G0 experiment was dedicated to the measurement of the strange quark contributions to the nucleon electric and magnetic form factors. The strange quark vector contributions can be accessed by comparing the electromagnetic form factors of the proton and the neutron, relatively well known at small Q2, with the weak form factors of the proton measured by G0. The experiment uses the parity violation property of the weak interaction to measure a parity-violating asymmetry in the elastic scattering of longitudinally polarized electron onto a proton target. This asymmetry can be written as a linear combination of the strange electric and magnetic contributions. Their separation requires two measurements : at small forward and large backward scattering angles. An axial part, which is negligible at forward angles, is also present in the asymmetry and is sizable at backward angles. An additionnal measurement off a deuterium target was thus performed at backward angles. The G0 Backward Experiment and the results on the strange contributions to currents in the nucleon at Q2 equal to 0.22 and 0.63 (GeV/c)2 will be presented together with the results on the isovector axial form factor.
17:20	**Overview of the Electromagnetic Structure of Nucleons (00h25')** *Speaker: HEMMERT, Thomas* I present an overview on theoretical calculations regarding nucleon form factors, nucleon polarizabilities and the spin structure of the nucleon. Particular emphasis is put on the status of Lattice QCD calculations for these observables.

NA2 - Forest Sciences Centre 1221 (16:10-17:50)

time	title
16:10	**Activation Experiments for p-Process Nucleosynthesis (00h25')** *Speaker: SONNABEND, Kerstin* The nucleosynthesis of the proton rich p-nuclei is described in complex reaction networks including several hundred isotopes and the corresponding reaction rates. Therefore, theoretical predictions of the rates, normally in the framework of the Hauser-Feshbach theory, are necessary for the modelling. The reliability of these calculations should be tested experimentally for selected isotopes and in systematic studies. A perfect tool for the latter case are activation experiments: their high sensitivity and selectivity allows measurements with small amounts of target material which is mostly the case for the low abundant p-nuclei. Different approaches for systematic studies on the input for Hauser-Feshbach calculations - such as optical particle-nucleus potentials - will be presented with focus on activation experiments. Recent results and their influence on an improvement of the nuclear physics of p-process nucleosynthesis are discussed. supported by DFG (SFB634) and LOEWE (HIC for FAIR)
16:35	**Indirect Measurements of Stellar and Explosive Nuclear Astrophysics Reactions (00h15')** *Speaker: LIU, Weiping* To account for the short half and extremely low reaction cross section, novel in-direct approach is the effective solution. One can use direct reaction which involves same proton or neutron transfer as in radiation capture, by using the beams of low energy unstable nuclei. This technique uses DWBA analysis of experimental angular distribution to extract asymptotic normalization constants or nuclear spectroscopic factors. Then this radical contribution is inserted to capture rates calculations. This approach is tested to be reliable with the precision mainly limited by the ambiguity of optical potentials. We measured the angular distributions for some single proton or neutron transfer reactions, such as 7Be(d,n)8B, 11C(d,n)12N, 8Li(d,p) 9Li and 13N(d,n)14O and 12N(d,n)13O in inverse kinematics, and derived the astrophysical S-factors or reaction rates of 7Be(p,g)8B, 11C(p,g)12N, 8Li(n,g)9Li, 13N(p,g)14O and 13N(p,g)14O by asymptotic normalization coefficient, spectroscopic factor, and R-matrix approach at astrophysically relevant energies. This talk will summarize the nuclear astrophysical studies using the unstable ion beam facility GIRAFFE in CIAE, by indirect measurements.
16:50	**17F Breakup Reactions: A Touchstone for Indirect Measurements (00h15')** *Speaker: SFIENTI, Concettina* Dissociation has become an essential tool in several domains of nuclear physics. Coulomb breakup can be used as an indirect method to measure radiative-capture cross sections at stellar energies [1]. Though simple it may seem, this indirect technique relies on peculiar assumptions. Recent theoretical analyses of the Coulomb breakup of 8B (e.g. [2]) have shown that these assumptions are not all satisfied. Whereas many experimental investigations on such a phenomenon have been conducted on 8B, the case of 17F has been poorly addressed up to now. Yet the Coulomb dissociation of 17F is the ideal test case to study the accuracy of the indirect technique [1]. An exclusive study of 17F breakup reactions has thus been performed at the FRIBs facility of LNS (Catania,Italy) [3]. The experimental setup allowed the measurement of the momenta and angles of all outgoing decay particles with a geometrical efficiency of 72% and a resolution of approximately 300 keV. The first results and model comparison will be presented. [1] G. Baur and H. Rebel, Annu. Rev. Nucl. Part. Sci. 46 (1996) 321. [2] G. Goldstein, et al., PRC 76 (2007) 024608. [3] G. Raciti et al., NIM B 266 (2008) 4632.
17:05	**Ground-State Proton Decay of 69Br and Implications for the rp Process 68Se Waiting-Point (00h15')** *Speaker: ROGERS, Andrew* To realistically model the rp process, experimental data for nuclei along the proton dripline are required. This process plays an important role in our understanding of Type I X-ray bursts and their observed lightcurves. The waiting-point nucleus, 68Se, is of particular interest, where a long beta-decay half-life coupled with inhibited proton capture to the proton unbound nucleus 69Br restricts the reaction flow. However, the reaction rate for the 2p-capture process 68Se+p->69Br+p->70Kr depends exponentially on the 68Se capture Q-value and may significantly bypass the waiting point. This Q-value is poorly constrained. We have performed an experiment to measure Q-values of proton unbound states in exotic nuclei at the NSCL Coupled Cyclotron Facility. The experiment is designed to reconstruct the decays of proton unbound nuclei, specifically 69Br, by detecting the decay protons using the MSU High Resolution Array (HiRA) in coincidence with a heavy residue (e.g. 68Se) which is measured in the S800 spectrograph. We report on the first direct measurement of 69Br ground-state proton decay and its implications within the context of a single-zone X-ray burst model.

17:20	**Measurement of the 26Al(d,p)27Al Reaction to Constrain the 26Al(p,gamma) Reaction Rate (00h15')** *Speaker: PAIN, Steven* A landmark in observational astronomy has been the detailed galactic mapping of the 1809-keV gamma ray associated with the beta decay of 26Al, providing an insight into the ongoing galactic nucleosynthesis. A key to the interpretation of the gamma-ray map is the rate of destruction of 26Al via the 26Al(p,gamma)27Si reaction, requiring an understanding of states near the proton threshold in 27Si. Because of the difficulties inherent in measuring directly the strengths of these resonances and in measuring proton transfer reactions, an alternative is to measure mirror states in 27Al to inform the 27Si structure. The mirrors to the astrophysically relevant states have been identified previously, leaving the spectroscopic strengths of these states as the dominant contribution to the uncertainty in the 26Al(p,gamma)27Si reaction rate. The 26Al(d,p)27Al reaction has been measured in inverse kinematics at the HRIBF to obtain spectroscopic information on these mirror states. A beam of ~5 million 26Al per second impinged on a ~0.150 mg/cm2 CD2 target. Proton ejectiles were detected in the SIDAR and ORRUBA silicon detector arrays. Details of the experimental setup and data analysis will be presented
17:35	**Experimental Investigation of the Stellar Reaction 30S(p,gamma)31Cl via Coulomb Dissociation (00h15')** *Speaker: TOGANO, Yasuhiro* The stellar reaction 30S(p,gamma)31Cl was studied via Coulomb dissociation. The nucleus 30S is a candidate for the waiting point, where the reaction flow to higher masses is interrupted by long beta decay, in the rapid proton capture (rp) process. The 30S(p,gamma)31Cl reaction decreases the amount of 30S, and thus speeds the reaction flow of the rp process up. Therefore the strength of this reaction affects the resultant abundance in the rp process. The aim of the present work is to determine the resonant capture reaction rate of 30S(p,gamma)31Cl using the Coulomb dissociation of 31Cl. The experiment was performed at RIPS in RIKEN Nishina Center. The secondary beam of 31Cl at 58 MeV/nucleon was produced and separated using RIPS and bombarded a 208Pb target. The relative energy between the isotopes 30S and protons was obtained using the invariant-mass method. In this talk, we discuss the radiative width of the first excited state in 31Cl which is relevant to the resonant capture in the 30S(p,gamma)31Cl reaction and astrophysical implications obtained from the present study.

NF2 - Life Sciences Centre 1510 (16:10-17:50)

time	title
16:10	**New Detector Technologies for Charged Particle Spectrometry (00h25')** *Speaker: PAGE, Robert* The planning and construction of ambitious new accelerator facilities across the globe is stimulating the development of the advanced instrumentation needed to exploit them. Spectrometers for measuring charged particles emitted in radioactive decays or nuclear reactions are reaching high levels of complexity, incorporating novel detector technologies and involving thousands of readout channels. In many cases, the charged particle spectrometers are being designed to operate in conjunction with new generations of gamma-ray detector arrays based on segmented germanium detectors or new scintillator materials, neutron detector systems and magnetic spectrometers. This presentation will review current developments in this rapidly evolving field.
16:35	**High-Resolution SHARAQ Spectrometer at RI Beam Factory (00h15')** *Speaker: UESAKA, Tomohiro* The high-resolution SHARAQ spectrometer and the dedicated beam-line have been constructed at the RI Beam Factory for high-resolution magnetic analysis of radioactive isotope beams. The SHARAQ spectrometer is designed to achieve a momentum resolution of dp/p=1/14700 for particles with a magnetic rigidity of 1.8-6.8 Tm. It is designed also to achieve an angular resolution of 1 mrad. The beam-line is designed to be dispersion-matched to the spectrometer to accomplish the required resolutions for a secondary RI beams with large momentum spread. We have conducted commissioning runs of the spectrometer and the beam-line in March and May of 2009. It was found that beam tuning based on particle trajectories measured with low-pressure tracking detectors is quite efficient in achieving dispersion matching conditions. After the tuning, we have achieved lateral and angular dispersion matching conditions simultaneously, and obtained a momentum resolution of 1/8100. Overview of the SHARAQ spectrometer and details of the dispersion matching tuning based on measured beam trajectories will be reported.
16:50	**SAMURAI Project at RIBF (00h15')** *Speaker: SHIMIZU, Yohei* SAMURAI (Superconducting Analyzer for MUlti-particles from RAdio Isotope beam) project aims to open a new research field in nuclear physics by use a large acceptance spectrometer for kinematically complete measurements of multiple particles emitted in RI-beam induced reactions. The SAMURAI spectrometer consists of a large gap superconducting dipole magnet, heavy ion detectors, neutron detectors, and proton detectors. What is special about the SAMURAI system is that projectile-rapidity protons or neutrons are detected with large angular and momentum acceptance in coincidence with heavy projectile fragments. With an effective combination of these equipments, the SAMURAI system allows us to perform various experiments: electromagnetic dissociation, various direct reactions, polarized deuteron induced reactions, and EOS studies. SAMURAI project is currently underway at RIBF. The construction of the superconducting dipole magnet will start in autumn 2010 and finish in spring 2011. The detectors are also constructed in parallel. The first commissioning run is scheduled in autumn 2011.
17:05	**India's Superconducting Cyclotron, India-FAIR (GSI) Collaboration and India-FAIR-TRIUMF Collaboration (00h15')** *Speaker: SINHA, BIKASH* The K=500 Superconducting Cyclotron has been commissioned recently. On 25th August around 3.30 A.M. neutrons were observed at the edge of the cyclotron in the neutron monitor, 20 Ne 3+ beam was circulating internally at a frequency of RF = 14 MHz and energy of 4.44 MeV/nucleon, clearly a land mark achievement. VECC now has embarked on a collaboration project for construction of 'e' linac, both for TRIUMF Laboratory and VECC, esseentially for the RIB programme. VECC is also an important collaborator for the FAIR facility at GSI, Darmstadt both in hardware such as Superconducting magnets for energy buncer in Super-FRS, beam stoppeds as well in building detectors such as CBM to study compressed baryonic matter. All this will be reported.
17:20	**EURISOL: A Design Study for the Next Generation European ISOL Facility (00h15')** *Speaker: BLUMENFELD, Yorick* EURISOL is a concept for an “ultimate” ISOL facility for Europe. A Design Study was carried out with 20 participating laboratories from 14 European countries partly funded by the European Commission. EURISOL will consist of a Superconducting CW LINAC capable of accelerating 5mA of H- to 1 GeV (5 MW beam power). A novel magnetic beam splitting system will create up to three 100kW beams which will impinge directly on solid targets to induce spallation reactions. The major part of the beam will be sent to a Hg loop converter where the neutrons produced will induce fission in 6 UCx targets. After selection the radioactive beams can either be used at low energies or post-accelerated with continuous energy variation up to 150A MeV for 132Sn, for example. The high intensity, high energy n-rich beams such as 132Sn can then be fragmented to produce many n-rich nuclei otherwise inaccessible, with large intensities. The presentation will give a brief overview of the physics reach of such a facility, describe the proposed layout as well some of the technical advances and hardware tests realized during the Design Study and finally discuss EURISOL within the roadmap for RIB facilities in Europe.

17:35 **Status of TIGRESS (00h15')**

Speaker: HACKMAN, Greg

The TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer (TIGRESS) is now fully operational. It is designed for in-flight gamma-ray spectroscopy measurements to study the structure of exotic short-lived nuclei following near- or above-Coulomb-barrier reactions induced by ISAC-II accelerated ion beams. It consists of up to 16 units of four highly-segmented high-purity large-volume germanium detectors, with BGO and CsI escape suppression shields. TIGRESS has accommodated silicon and scintillator charged-particle auxiliary detectors and is designed to interface with heavy ion mass analyzers such as EMMA. All primary and auxiliary detector signals are digitized by 50 MHz or 100 MHz flash ADC's as appropriate, with trigger and data collection sharing a common LVDS link. The 8-fold segmentation of the diode outer contacts (four azimuthal, two lateral) provides sensitivity to interaction positions and is used to compensate for Doppler shifts. This talk will summarize the current status of TIGRESS, such as key performance parameters (efficiency, resolution and peak-to-total), available auxiliary detectors, anticipated future developments, and highlights from experimental campaigns.

NI2 - Forest Sciences Centre 1003 (16:10-17:50)

time	title
16:10	**The Spallation Neutron Source: The World's Next Generation Neutron Beam Facility is Operating at 1 MW (00h25')** *Speaker: GAULIN, Bruce* The Spallation Neutron Source is the world's next generation neutron source. It is providing new neutron instrumentation, primarily for materials science applications, with figures-of-merit improvements of between 10 – 100 over previous best-in-class capabilities. It is based on a GeV proton linear accelerator and accumulator ring, which delivers high current, microsecond proton bunches to a Hg target with a repetition rate of 60 Hz. The neutron pulses, which result from spallation, are fed to up to 24 instrument stations which carry out forefront neutron scattering experiments in parallel. These instruments use the time-of-flight of the neutrons and pixilated, area detectors to determine the momentum and energy transfer of the neutron scattering events. I will illustrate the capabilities of this new facility showing new neutron scattering results from magnetic materials with exotic quantum and frustrated ground states.
16:35	**The Production and Application of Low Energy Muons (00h25')** *Speaker: PROKSCHA, Thomas* Low-energy muons (LE-mu+) with tunable energy between 0.5 and 30 keV provide a unique novel tool to probe magnetism, superconductivity, dimensional effects and other phenomena in thin film structures and close to surfaces on a nanometer scale. The variation of energy allows depth selective studies in the range from ~1 to ~200 nm. At PSI 100% spin polarized LE-mu+ are produced by a moderation technique where a fraction of a polarized, high intensity 4-MeV mu+ beam is slowed down in a solid Ar moderator to an energy of about 20 eV, re-accelerated electrostatically to 15 keV, and transported by a system of electrostatic lenses to the sample region where the implantation energy is adjusted by changing the potential of the sample. Information on the local environment of the implanted muon is obtained by using the muon spin rotation technique (muSR) which measures the time evolution of the muon spin polarization in external or internal magnetic fields. The recent extension of this local probe technique to low implantation energies (LE-muSR) opens a new field of fascinating depth dependent studies which we will illustrate on selected experiments.
17:00	**Accelerator Produced Positrons and a Unique Way to Store Them (00h25')** *Speaker: LYNN, Kelvin* The power of positrons is already realized with Positron Emission Tomography (PET) used for medical diagnostics, tracing chemical reactions in plants, catalytic conversion processes, and other chemical processes. Positrons also are implemented to probe defects in metals, semiconductors and insulators. They tend to trap and localize at open volume defects ranging in size from atomic-sized mono-vacancies to pores with 10s of nm in diameter. A general overview of positrons will be presented to understand the porosity which is used as filters and dielectric materials. Researchers apply positrons to atomic defects to gain the knowledge for the development of new materials for tomorrow's challenges. Positron annihilation with electrons releases more energy per weight than any other energy production method including that for power reactors or chemical fuels for use in the Space Shuttle. All of the mass of the positron and electron are converted into electromagnetic radiation, i.e. light. Positron annihilation leaves no nuclear residue for current and future generations to have any concerns. The talk will addresses issues pertaining to the use of positrons (the antimatter counterpart of electrons): •□Production of positrons (presentl
17:25	**Boron Coated Straws as a Replacement for 3He-Based Neutron Detectors (00h25')** *Speaker: LACY, Jeffrey* Efforts to equip seaports with neutron detectors to detect SNM have been undermined by a 3He shortage. Demand for 3He in US security applications alone exceeds world supply. Neutron science, safeguards, & other 3He-dependent fields have faced cutbacks. Non-He3 neutron detectors with large sensitive areas, low cost, & gamma sensitivity must be developed. We propose a technology based on close-packed arrays of long, 4mm diameter, Al or Cu straw tubes, thinly coated internally with 10B-enriched boron carbide. Straw arrays offer a neutron stopping power equal to 2.68atm of 3He gas. Boron's abundance and low enrichment costs give boron-coated straw (BCS) technology strong advantages over 3He-based systems. Faster signals, short recovery time, low weight, portability, & low production cost are added benefits. We review 3 BCS detector prototypes including: a 1m2 neutron-imaging panel, a moderator-free standoff monitor, and a portal monitor for fissile materials. The imager has 7x4x4 mm3 3D spatial resolution & sustains 200,000cps count rates per readout channel (n=22) with little resolution loss. The standoff device was tested at ORNL, and successfully operated onboard a moving boat.

NR2 - Forest Sciences Centre 1005 (16:10-17:50)

time	title
16:10	**Beyond the Driplines with Nuclear Reactions (00h25')** *Speaker: THOENNESSEN, Michael* The study of nuclear properties is not limited to bound nuclei. Nuclei beyond the neutron- and proton dripline offer the unique possibility to explore nuclear structure properties at the extremes. Only the lightest unbound nuclei are accessible by multiparticle transfer reactions with stable beams. In the recent past nucleon removal reactions in inverse kinematics have been successfully been used to study heavier unbound systems. An overview of recent results of nuclei beyond the proton and neutron dripline will be presented.
16:35	**Measurements on the Two-Proton Emission for 23Al and 22Mg Nuclei (00h15')** *Speaker: MA, Yu-Gang* For the proton-rich nuclei, the decay mechanism is complicated, especially for two-protons (2p) radioactivity. Recently, diproton emission has been observed for some nuclei. In this work, we will focus on proton-rich nuclei, namely ^{23}Al and ^{22}Mg which have attracted a lot of interest in recent years for some reasons, eg., ^{23}Al may play a crucial role in solving the depletion of the NeNa cycle in ONe novae. In our previous experiments performed at HIRFL beamline, Lanzhou and at RIKEN-RIPS beamline, "an abnormal increase" in the reaction cross section has been observed. In this work, we measured two-proton momentum and angular correlations for the ^{23}Al and ^{22}Mg excited states from the ^{23}Al and ^{22}Mg radioactive beam on a ^{12}C target at 72 A MeV at the projectile fragment separator beamline (RIPS) in the RIKEN Ring Cyclotron Facility. The three body decay channels are clean identified. The relative momentum and opening angle between two protons in the rest frame of three body decay channels demonstrate that there are some diproton emission components from ^{2}He cluster for the excited ^{23}Al and ^{22}Mg.
16:50	**Evidence of Strong Effects of the 11Be Halo Structure on Reaction Processes at Energies Around the Coulomb Barrier (00h15')** *Speaker: DI PIETRO, Alessia* In the present contribution, results of the collisions induced by the three Beryllium isotopes, 9,10,11Be on a 64Zn target at Ecm ≈ 24.5 MeV, close to the Coulomb barrier, will be presented. The 9Be+64Zn experiment was performed at Laboratori Nazionali del Sud in Catania, whereas the experiments with the radioactive beams, 10,11Be+64Zn, were performed at Rex-ISOLDE at CERN using the first post-accelerated radioactive 10,11Be beams. For the first time strong effects on elastic-scattering and reaction cross-section are experimentally observed in the collision induced 11Be. These effects are being related to 11Be halo structure. The elastic-scattering cross-section is suppressed at small angles, owing to absorption occurring at very large impact parameters. Consequently, a very large total reaction cross-section is extracted for the 11Be induced collision which is more than double than the ones measured in the collisions induced by the other two Beryllium isotopes, 9,10Be. It will be shown that such a strong enhancement of the total reaction cross-section with 11Be is due to transfer and break-up processes.
17:05	**Shell Evolution Around N=20 and N=16 Neutron-Rich Nuclei (00h15')** *Speaker: KANUNGO, Rituparna* The changes in shell structure of neutron-rich nuclei have been a subject of much attention. We will present recent investigations on the N=16 new shell closure and the breakdown of the N=20 shell closure via neutron removal reactions. The disappearance of the N=20 shell closure remains to be a region of great theoretical and experimental interest. Our presentation will report new results on momentum distribution for one-neutron removal from 33Mg. The observations require effects beyond the predictions of the Monte Carlo Shell Model with sdpfm interaction indicating the lowering of the 2p3/2 orbital. While N=20 gap disappears a new gap is suggested to appear from empirical signatures, as well as theoretical predictions. The neutron occupancy in 24O will be shown to conclusively establish 24O as a new doubly magic nucleus at the neutron drip-line with a shell gap at N=16.
17:20	**Deducing Physical Properties of Weakly Bound States from Low-Energy Scattering Data (00h15')** *Speaker: SPARENBERG, Jean-Marc* General results from scattering theory are first reviewed, showing that, for a given partial wave, phase-equivalent potentials, i.e. potentials with identical scattering phase shifts, can display arbitrary bound-state energies and asymptotic normalization constants (ANCs) [1]. However, in the case of a weakly bound state, a unique potential is shown to have a shorter range than all other potentials of the phase-equivalent family. For this unique potential, compact algebraic equations are derived [2], which connect the binding energy and the ANC of the subthreshold bound state with the effective-range expansion of the corresponding partial wave. These relations are established for positively-charged and neutral particles, using the analytic continuation of the scattering (S) matrix in the complex wave-number plane. Their accuracy is checked on simple local potential models for the 16O+n, 16O+p and 12C+alpha nuclear systems, with exotic nuclei and nuclear astrophysics applications in mind. Finally, their applicability to experimental data is explored. [1] J.-M. Sparenberg, Phys. Rev. C 69 (2004) 034601 [2] J.-M. Sparenberg, P. Capel and D. Baye, Phys. Rev. C 81 (2010) 011601(R)

17:35 **Elastic Scattering of Neutron-Rich Helium Isotopes from Polarized Protons at 71 MeV/A (00h15')**

Speaker: SAKAGUCHI, Satoshi

Spin-orbit (LS) coupling in atomic nuclei has played essential roles in the understanding of nuclear reactions, structures and interactions. The LS coupling in nucleon scattering is represented by the LS term of the optical model potential (LS potential). The LS potential is modeled by a surface-peaked shape since LS coupling is essentially a surface effect. From this surface nature, one can naturally expect that the LS potential would have a shallow and extended shape in neutron-rich nucleus as a consequence of its diffused density. In order to determine the LS potentials in 6He and 8He, we measured the analyzing powers of p+6,8He elastic scattering at 71 MeV/A at RIKEN. Newly constructed polarized proton target allowed us to measure the analyzing power for the first time in RI-beam experiments. We found that LS potentials in 6He and 8He have remarkably “diffused” shapes: 1) Depths of them are 30-50% of those in stable nuclei. 2) Peaks of them are located at radii 20% larger than the global systematics. These characteristics indicate that extended densities of n-rich He isotopes are reflected in the shape of LS potentials. Results of microscopic analyses will also be presented.

NS2 - Life Sciences Centre 2 (16:10-17:50)

time	title
16:10	**Spectroscopy Studies in the Nickel Region Around N=40 and 50 (00h25')** *Speaker: VAN DUPPEN, Piet* The structure along the nickel isotopic chain (Z=28) is characterized by a large number of closed neutron shells: N=20, 28, 40 and 50. This region is therefore an ideal testing ground for large scale shell-model calculations as well as for novel theoretical approaches like e.g. the coupled cluster approach. The development of new and post-accelerated radioactive ion beams (RIB) resulted in an active exploration of this region of the nuclear chart using beta decay studies, laser spectroscopy studies, Coulomb excitation measurements and one-neutron transfer reactions. These studies are complemented by spectroscopy studies using deep inelastic reactions. In this contribution, we will, starting from a very short overview of the current experimental achievements, focus on very recently obtained results from the ISOLDE facility using the MINIBALL germanium array (e.g. beta-decay studies of neutron-rich Mn isotopes and 66Ni(d,p)67Ni reaction). Model calculations will be tested with the new experimental findings. Finally, the new opportunities that become available with the recently approved HIE-ISOLDE facility delivering higher energy and even higher intensity RIB will be discussed.
16:35	**g(2+) Measurements and Structural Changes in Nuclei with A ~ 100 (00h15')** *Speaker: CHAMOLI, SANJAY KUMAR* In the region of A = 100 a number of g factors have been measured for the first 2+ states in neutron-rich nuclei produced as fission fragments [1]. Recently, Frauendorf et al. [2] have introduced a version of the cranking model applicable to this region, in which the yrast states are treated as quadrupole waves running over the nuclear surface like a tidal wave over the ocean's surface. To test this model requires improved experimental g factors for many of the stable isotopes. With this motivation, new transient field g-factor measurements on stable isotopes of Pd, Ru and Cd in conventional and inverse kinematics both, have been done at the ANU, Canberra. In these measurements the relative g factors are typically determined with a precision of the order of 5% or better. The new g factor data for this region tell a different story, suggesting sensitivity to the underlying shell structure, particularly the location of the proton Fermi surface between the N = 40 and N = 50 shells. This work was supported in part by the Australian Research Council Discovery Scheme Grant No. DP0773273 [1] A.G. Smith et al., Phys. Lett. B, 591, 55 (2004) [2] S. Frauendorf and Y. Gu, arXiv:0709.0254
16:50	**Fully Microscopic Shell-Model Calculations with Realistic Effective Hamiltonians (00h15')** *Speaker: CORAGGIO, Luigi* The advent of nucleon-nucleon potentials derived from the chiral perturbation theory, as well as the so-called V-low-k approach to the renormalization of the strong short-range repulsion contained in the potentials, have brought renewed interest in the realistic shell-model calculations. Here we focus on calculations where a fully microscopic approach is adopted. In fact, in these calculations no adjustable parameter is introduced, since shell-model single-particle energies, two-body matrix elements of the residual interaction, and single particle matrix elements of the electromagnetic multipole operators are derived theoretically. This has been done within the framework of the time-dependent degenerate linked-diagram perturbation theory [1]. We present results for nuclei ranging from the p-shell up to the N=82 isotones [2-4], showing the ability of realistic effective hamiltonians to provide an accurate description of nuclear structure properties. [1] L. Coraggio et al., Prog. Part. Nucl. Phys. 62, (2009) 135. [2] L. Coraggio and N. Itaco, Phys. Lett. B 616 (2005) 43. [3] L. Coraggio et al., Phys. Rev. C 75 (2007) 024311. [4] L. Coraggio et al., Phys. Rev. C 80 (2009) 044320.
17:05	**Shell Evolution in the Newly-Explored Neutron-Rich Region Around Z=82 and Far Beyond N=126 (00h15')** *Speaker: GOTTARDO, Andrea* The modification of the nuclear structure in exotic nuclei is one of the key topics in modern nuclear physics. However, little is known about the evolution of Z=82 shell closure and the region around, beyond N=126. The neutron-rich nuclei in this region are also relevant for nuclear astrophysics, and the measurement of their beta-decay half lives will improve the understanding of the r-process stellar nucleosynthesis in heavy nuclei. The nuclei of interest were populated by using a 1GeV*A 238U beam at GSI. The resulting fragments were separated and analyzed with the FRS-Rising setup. Many neutron-rich isotopes were identified for the first time. The exotic isotopes observed extended up to 218Pb for the Z=82 shell closure and up to N=138 and N=135 for shell-model proton-hole Tl and proton-particle Bi nuclei, respectively. Also the Z=80 210Hg ion was produced and studied. A significant number of new isomers were discovered in these nuclei. The spectroscopic information together with state-of-the-art shell-model calculations will allow to understand the evolution of the nuclear interaction around Z=82.
17:20	**Hyperspherical Effective Interaction for Non-Local Potentials (00h15')** *Speaker: ORLANDINI, Giuseppina* The effective interaction hyperspherical harmonics method (EIHH), formulated for local forces, is generalized to accomodate non-local interactions. Applying this method to study ground-state properties of 4He with a modern effective field theory nucleon-nucleon potential model (Idaho-N3LO) one finds a substantial acceleration in the convergence rate of the hyperspherical harmonics series. Also studied are the binding energies of the six-body nuclei 6He and 6Li with one of the inverse scattering potential models. Again an excellent convergence is observed.

17:35 **Three-Nucleon Forces for Medium-Mass Neutron-Rich Nuclei (00h15')**

Speaker: HOLT, Jason

In this talk I will discuss the first consistent and systematic applications of chiral three-nucleon (3N) forces in microscopic nuclear structure calculations for medium-mass nuclei. I will show how the additional repulsion from three-body forces provides a significant correction to the basic ingredients of configuration interaction calculations: the microscopic single particle energies and the monopole part of valence shell effective interactions. As neutrons are added, the influence of 3N forces becomes more pronounced and can have important implications in predicting fundamental properties of neutron-rich systems. This is manifested in a microscopic explanation of the oxygen anomaly, where with 3N forces, we predict the neutron dripline to be at N=16 rather than at N=20. Furthermore, within the calcium isotope chain we will show how a major failing of NN-only models, the prediction of 48Ca as a closed-shell nucleus, is remedied by the inclusion of 3N forces.

NS8 - Life Sciences Centre 3 (16:10-17:50)

time	title
16:10	**The Gamma Decay of the Pygmy Resonance and the Neutron Skin of Nuclei (00h25')** *Speaker: BRACCO, Angela* The Giant Dipole Resonance, the simplest collective nuclear vibration, has been a subject of extensive studies because of its cability to probe different interesting aspects of nuclear structure. In recent year the interest in the properties of the nuclear response of E1 character has been renewed, due to the peculiar features that it may assume in neutron-rich nuclei. In particular, dipole strength is expected to show up at low energy; this strength is mainly made up by neutron excitations and consequently, it has mixed isoscalar/isovector character. The name "Pygmy Dipole Resonance" (PDR) has been introduced to indicate any kind of strength below the GDR energy region. The experimental results on 68Ni obtained with the RISING array at GSI with beam energy of 600 MeV/nucleon is compared with data from neutron break up in Sn neutron rich isotopes and with different predictions. A discussion on the possibility to deduce information on the slope of the symmetry energy and on the neutron skin will be presented.
16:35	**Exploring the Structure of n-Rich Nuclei by One-Neutron Knockout at Relativistic Energies (00h15')** *Speaker: CORTINA-GIL, Dolores* The isospin variations present in exotic nuclei are predicted to modify the nuclear mean-field picture together with the long and short-range correlations. The role of certain residual interactions becomes enhanced with proton-neutron asymmetry and is at the origin of the observed change in traditional magic numbers, that are in turn replaced by new magic gaps. The study of nuclear structure in these areas, is a key issue for the understanding of the evolution of the shell structure with isospin. The FRS-GSI was used to measure the momentum distributions of core-fragments after knockout at relativistic energies along with the one-nucleon removal cross-sections for a wide sample of n-rich nuclei (Z=6–13). MINIBALL detector allowed in some cases a fragment final state selection. Relevant structural phenomena such as the formation of one-neutron halos in odd-mass carbon isotopes will be discussed. One-neutron knockout from 22N has been carried out for the first time showing the change from a 0d5/2 to a 1s1/2 valence neutron. The structure of 26F, with a significant 1s1/2 neutron admixture, will be also addressed. The g.s configuration of n-rich Ne(24−28) will be also discussed.
16:50	**Splitting of the Pygmy Dipole Resonance (00h15')** *Speaker: SAVRAN, Deniz* In stable and unstable nuclei in different mass regions a concentration of electric dipole (E1) strength is found around the particle separation energy which is usually denoted as Pygmy Dipole Resonance (PDR). In stable nuclei the PDR has been studied in the last years systematically using the method of high resolution real photon scattering and the PDR has been established as a common excitation mode of atomic nuclei. While some of the gross features are reproduced by different theoretical model description, its detailed structure and the degree of collectivity are a matter of ongoing discussions. In order to optain complementary experimental data we have investigated the PDR in (alpha, alpha′ gamma) coincidence experiments at the Big-Bite Spectrometer at the KVI. In comparison to results from (gamma, gamma′) experiments a structural splitting of the PDR into two separated groups could be observed in the N=82 nuclei 140-Ce and 138-Ba [1,2]. New results of additional experiments on 124-Sn und 94-Mo will be present, which establish this structural splitting as a common feature of the PDR. [1] D. Savran et al., PRL 97 (2006) 172502 [2] J. Endres et al., PRC 80 (2009) 034302
17:05	**Nuclear Many-Body Problem, Connecting Structure and Reactions (00h15')** *Speaker: VOLYA, Alexander* A sound simultaneous description of the structure and reaction features in the many-body nuclear system is at the very heart of understanding the short-lived nucleonic matter in the laboratory and in the Universe. In this presentation I will discuss techniques that explicitly make a connection between the structure and reaction properties of nuclei. I will demonstrate some realistic applications of the Time Dependent Continuum Shell Model where observation of cross section, its angular dependence, and interference between resonances allows one to make in-depth conclusions about the many-body structure. Renormalizations due to virtual excitations, behavior of the spectroscopic amplitudes, and changes in the collective dynamics due to the presence of reaction continuum will be discussed. Using the Variational Amplitude method and coupled channel approaches, I will revisit the continuum conundrum related to the questions of scattering and tunneling with composite objects.

17:20	**Evidence for Broad Unbound 0+ and 2+ States in 12C (00h15')** *Speaker: HYLDEGAARD, Solveig* The low energy triple-alpha continuum displays a fascinating mixture of mean field and cluster structure, but its decomposition poses a challenge because of the existence of several broad, interfering states. Beta decay of 12N and 12B provide a way to simplify the picture by only permitting 0+, 1+ and 2+ states to be populated. The position of the lowest 2+ state is important both for determining the triple-alpha reaction rate at high temperatures, and also for understanding the cluster structure of the Hoyle state. Several measurements have been published, reporting on 2+ states overlapping with the broad 10 MeV 0+ component, but consistency remains to be found. Two complementary beta-decay experiments have been performed at JYFL in Jyväskylä, Finland, and KVI, the Netherlands. Data from these two experiments have been analyzed within the R-matrix framework, which has been adapted to treat the sequential decay via 8Be 0+ and 2+ states. The results of the combined analysis will be presented showing evidence for a 0+ and 2+ state in the 10.5-12 MeV energy region. At higher energy other 2+ and 0+ components are needed to describe the high-energy 12N decay spectrum.
17:35	**Fine and Gross Structure of the Pygmy Dipole Resonance (00h15')** *Speaker: TONCHEV, Anton* In stable and weakly bound neutron-rich nuclei a resonance-like concentration of dipole states has been observed for excitation energies around the neutron separation energy. This clustering of strong dipole states has been named the pygmy dipole resonance (PDR) in comparison to the giant dipole resonance that dominates the E1 response. Microscopic nuclear models predict the existence of the PDR arising from the formation of a neutron skin in very neutron-rich exotic nuclei. In addition, the dipole strength distributions at the particle separation energies might affect the reaction rates in astrophysical scenarios where photo-disintegration reactions are important, i.e., in hot stars and stellar explosions. This talk is giving an overview of the high-sensitivity studies of E1 and M1 transitions in N = 82 nuclei using the nearly monoenergetic and 100% linearly polarized photon beams from the High-Intensity-Gamma-Ray Source facility. The fine and gross structure of the dipole-strength distribution of the PDR has been observed for the first time and novel information about the character of this mode of excitation has been obtained.

SM2 - Life Sciences Centre 1410 (16:10-17:50)

time	title
16:10	**Progress in Weak Scale Baryogenesis (00h25')** *Speaker: CIRIGLIANO, Vincenzo* I will discuss recent theoretical progress in understanding weak scale baryogenesis. In the first part of the talk I will summarize the phenomenology of weak scale baryogenesis in the Minimal Supersymmetric Standard Model, and the implication of successful baryogenesis for Electric Dipole Moment searches. In the second part of the talk I will discuss the quantum transport aspects of the problem, with emphasis on in-medium CP violating flavor oscillations.
16:35	**Ultra-High Precision Half-Life and Branching-Ratio Measurements for the Superallowed beta+ Emitter 26mAl (00h15')** *Speaker: FINLAY, Paul* When corrected for radiative and Coulomb effects, the ft values for superallowed 0+ to 0+ beta decays provide the most precise value of V_ud. The nuclear structure dependent correction for 26mAl is much smaller than the other twelve precision superallowed cases, making it an ideal case to reduce the experimental errors contributing to the Ft value. A branching ratio and half-life measurement for 26mAl has been made at the ISAC facility at TRIUMF. The half-life was measured via a 4 pi continuous gas flow proportional counter, and with a precision of 0.01%, represents the most precise measurement of any superallowed half-life to date. The branching ratio was measured with the 8 pi Spectrometer, an array of 20 HPGe detectors. Of the non-analog decay branches of 26mAl, only that to the first 2+ level in 26Mg could have a measureable branching ratio. Our analysis improves the upper limit on this non-superallowed beta transition. These results, combined with recent Q-value measurements, yield the most precisely determined ft and Ft value for any nucleus, providing a benchmark against which to test the other superallowed cases.
16:50	**Nuclear Degree of Freedom in Schiff Screening (00h15')** *Speaker: LIU, C.-P.* Measurements of electric dipole moments (EDMs) of neutral systems like atoms are subject to the effect of Schiff screening. Recently, there is a dispute regarding whether treating the nucleus as a dynamical degree of freedom generates additional contribution to a measured atomic EDM. We present here another approach, by a perturbation scheme based on the Born-Oppenheimer approximation, to illustrate the roles played by the nuclear ground state and excitations separately.
17:05	**Test of Time Reversal Symmetry Using Polarized 8Li at TRIUMF-ISAC (00h15')** *Speaker: MURATA, Jiro* A new experimental project of MTV is running at TRIUMF, aiming to achieve the highest precision test of time reversal symmetry in polarized nuclear beta decay by measuring a triple correlation (R-correlation), motivated to search new physics beyond the standard model, for the CKM predicts negligible effects on the u-d quark system. In this experiment, existence of transverse electron polarization is examined utilizing analyzing power of Mott scattering from a metal foil. Backward scattering electron tracks are measured using multi-wire drift chamber in event-by-event, for the first time. By utilizing the tracking device, the largest systematic effect can be cancelled out, which has been the bottle neck in the sensitivity on the previous study. The MTV experiment was commissioned at TRIUMF-ISAC in 2009 using 80% polarized 8Li beam at 10Mpps resulting order 1% precision on the R, after performing feasibility test at KEK-TRIAC in 2008 using 8% polarized beam at 100kpps yielding 40% precision. In 2010, physics production run is scheduled, aiming to reach below 0.1% precision. In this talk, preparation status for the 2010 run and results from the commissioning run will be presented.
17:20	**An Experimental Search on the Electron EDM Based on Solid-State Techniques (00h15')** *Speaker: KIM, Young Jin* A discovery of a permanent electric dipole moment of the electron (eEDM) would provide crucial information about the nature of T-violation and imply new sources of CP-violation beyond the Standard Model. We are pursuing research that would improve the present experimental limit of the eEDM using a new technique in solid-state systems at 4K. The experiment uses a Gadolinium Gallium Garnet sample with a large magnetic response, that can be measured using the Superconducting Quantum Interference Device as the magnetometer. In this presentation, I will discuss the progress to control the systematic effects, including the design and implementation of a 24-bit DAQ system with ultra-low level of channel crosstalk, the control of the high voltage drift from the supply, and the observed difference between the polycrystalline and single-crystal samples. Currently, the experiment is free of sources that could produce spurious signal at 10^-24 e-cm level. We are currently integrating of data, with the goal to push the limit of eEDM to 10^-25 e-cm level. Further enhancement of the eEDM sensitivity would require operating the experiment at sub-Kelvin temperatures.

17:35 **Fully Self-Consistent Calculations of Nuclear Schiff Moments (00h15')**

Speaker: BAN, Shufang

We calculate the Schiff moment of nuclei 199Hg and 211ra in completely self-consistent odd-nucleus mean-filed theory by modifying the Hatree-Fock-Bogoliubov code HFODD. We allow for arbitrary shape deformation, and include the effects of nucleon dipole moments alongside those of a CP-violating pion-exchange nucleon-nucleon interaction. The results for 199Hg differ significantly from those of previous calculations when the CP-violating interaction is of isovector character.

Poster Session 1 - Life Sciences Centre Atrium (19:30-21:30)

title	board
Meson Spectroscopy with COMPASS (00h00') *Speakers: AUSTREGESILO, Alex, NERLING, Frank* The COMPASS fixed-target experiment at CERN SPS is dedicated to the study of hadron structure and dynamics. For the physics programme using hadron beams, the focus is on the detection of new states, in particular the search for J^{PC} exotic states and glueballs. After a short pilot run in 2004 (190 GeV/c negative pion beam, lead target), we started our hadron spectroscopy programme in 2008 by collecting unprecedentetly statistics with a negative hadron beam (190 GeV/c) on a liquid hydrogen target. A similar amount of data with positive hadron beam (190 GeV/c) has been taken in 2009, as well as some data (negative beam)on nuclear targets. The spectrometer features not only large angular acceptance and high momentum resolution but also good coverage by electromagnetic calorimetry, crucial for the detection of final states involving π^0 or $\eta. A first interesting result of the observation of a significant J^{PC} spin exotic signal consistent with the disputed $\p_1(1600)$ in the pilot run data was recently submitted for publication. We will present an overview of the status of various ongoing analyses on the 2008/09 data.	
Structure of Lambda(1405) Revealed with Coupled-Channel Complex Scaling Method (00h00') *Speaker: DOTE, Akinobu* Lambda(1405) (Lambda(1405); an excited hyperon, Jpi=1/2-, isospin 0) has been a mysterious baryon for a long time, because a naïve quark model can't explain its small mass. Today, Lambda(1405) is considered to be a quasi-bound KbarN state rather than a 3-quark state. Recently, the importance of Lambda(1405) has increased, because it is regarded as an important building block of Kbar nuclei (nuclei involving K- mesons) and it gives critical constraint to KbarN interaction. The observed Lambda(1405) is a bound state for KbarN channel but a resonant state for pi Sigma channel. We investigate Lambda(1405), treating it as a KbarN-pi Sigma coupled system, with the complex scaling method (CSM) which has succeeded in studying resonant states in nuclear physics. The CSM gives us a wave function of the system as well as the pole position. In the Kbar nuclear physics, there has been large controversy between a phenomenological (energy-independent) KbarN potential and a chiral SU(3)-based (energy-dependent) one. These potentials give a different pole position for the I=0 KbarN resonance. Analyzing the obtained CSM wave function, we discuss how the structure and property of Lambda(1405) differ between these KbarN potentials.	
Constraining Quark Transversity through Collins Asymmetry Measurements in Mid-Rapidity Jets in p \up p Collisions at STAR (00h00') *Speaker: FERSCH, Robert* First quantitative insights into transverse quark spin degrees of freedom in the proton have been obtained from Belle measurements of Collins fragmentation in e+e− collisions along with HERMES and COMPASS measurements of the Collins asymmetry in deep-inelastic lepton-nucleon scattering. Further constraints can be added from measurements of the azimuthal asymmetry of leading charged pions in jets produced by transversely polarized proton collisions. This asymmetry can be expressed as a convolution of the quark transversity, the Collins fragmentation function and a hard-scattering spin-transfer coefficient. We present the status of the first such asymmetry measurement from \sqrt s =200 GeV transversely polarized (~58%) proton collision data (totalling ~1/pb) collected at the Solenoidal Tracker at RHIC (STAR), with full azimuthal coverage at mid-rapidity (|eta| < 1). Available data give a statistical precision of sigma ~ 0.01, for average quark momentum fraction < x > ~ 0.2, at each of four intervals of the hadron-jet momentum fraction z over 0.1 < z < 0.6.	
QCD Sum Rules in a Bayesian Approach (00h00') *Speaker: GUBLER, Philipp* QCD sum rules are analyzed using the Maximum Entropy Method (MEM), which makes it possible to have direct access to the spectral functions of two-point correlators. This means that we do not need to make any assumptions about the explicit form of the spectral function, such as the traditional "pole + continuum" ansatz, but can obtain the most probable spectral function directly by using MEM. Compared with the traditional QCD sum rule analysis, this method has many advantages: As we have direct access to the spectral function, we do not have to deal with results depending on "unphysical" parameters such as the Borel mass or the threshold parameter. Another advantage is that, by examining the behavior of the spectral function, we are able to clearly distinguish narrow resonances from scattering states. As a first test of the applicability of our method, we have analyzed the sum rules of the rho meson, a case in which the traditional sum rules are known to work well. Our calculation shows a clear peak around 800 MeV, which confirms the older sum rule results and shows that MEM can be successfully applied to QCD sum rules.	

The NJL-Jet Model for Quark Fragmentation Functions (00h00')

Speaker: ITO, Takuya

Quark distribution and fragmentation functions are the basic nonperturbative ingredients for a QCD-based analysis of hard scattering processes. We present some results of our recent calculations [1] of quark fragmentation functions to pions in the NJL model. The important point is that our fragmentation functions naturally satisfy the momentum and isospin sum rules without any new parameters into the theory. Our calculation is based on a product ansatz to describe cascade-like fragmentation processes, similar to the product ansatz used in the quark jet-model of Field and Feynman [2]. We present numerical results and compare with the empirical results [3]. We argue that this NJL-jet model provides a very useful framework to calculate the fragmentation functions in an effective chiral quark theory. [1] T. Ito, W. Bentz, I.C. Cloet, A.W. Thomas, K. Yazaki, Phys. Rev. D 80 (2009) 074008. [2] R.D. Field, R.P. Feynman, Nucl. Phys. B 136 (1978) 1. [3] M. Hirai, S.Kumano, T.H. Nagai, K. Sudoh, Phys. Rev. D 75 (2007) 094009.

Hadron Form Factors at Large Transfer Momentum (00h00')

Speaker: LIN, Huey-Wen

In this presentation, I report a recent breakthrough in lattice QCD calculations of hadron electromagnetic form factors. Conventional lattice form-factor calculations can only reach about 2.5 GeV^2, but in this work the transfer momentum is pushed as large as 6 GeV^2. Our approach can be applied to lattices with smaller lattice spacing to achieve even larger-Q^2 form factors. These measurements could give important theoretical input to experiments, such as those of JLab's 12-GeV program, and provide insight into hadronic structure.

$D\bar{D}$ Production Cross Sections and Their Interactions (00h00')

Speaker: LIU, Yan-Rui

It has become an important problem whether the heavy quark meson-meson bound states exist after the observation of the near-threshold exotic XYZ states. We have studied in detail the simple and important $D\bar{D}$ system in a meson exchange model. By solving the Schrodinger equation directly, we obtain the binding energies, the phase shifts and the cross sections for the S and P wave interactions. For the S wave case, we have found a $D\bar{D}$ bound state when the short range vector meson exchange interactions play a key role. For the P wave case, the attraction is not strong enough to form a resonance, but there is a bump in the scattering cross section. Recently, BES observed an anomalous lineshape in the $e^+e^-\to D\bar{D}$ process. Based on the calculated P wave phase shifts and the separable potential approximation, we have explored whether it is due to the elastic $D\bar{D}$ rescattering effect. Our calculation indicates that it is difficult to understand the observed structure with this effect. However, it does lead to an anomalous lineshape in an extreme case.

ϕ(1020) Photoproduction on the Proton and on the Neutron (00h00')

Speaker: MICHERDZINSKA, Anna

The mechanism of ϕ photoproduction on the nucleon is not yet well understood. In order to differentiate between the various mechanisms proposed for ϕ photoproduction, data for both differential cross sections and spin observables are needed. All existing experimental data come from ϕ photoproduction on the proton, and there is only one published result currently available using a linearly polarized photon beam. There are no experimental results at all for ϕ photoproduction on the neutron. Our high-statistics and large-kinematic-coverage g13 experiment, using the CLAS at Jefferson Lab, where both linearly and circularly polarized photons were incident on a deuterium target, can provide such data. We are analyzing these data to extract angular distributions for the $\gamma + p \rightarrow K^+ K^- + p$ and $\gamma + n \rightarrow K^+ K^- + n$ reaction channels. An update on the analysis of these data will be presented.

Pair-Symmetric Background Analysis of Spin Asymmetries of the Nucleon Experiment (Jefferson Lab E07-003) (00h00')

Speaker: NDUKUM, Luwani

The SANE experiment at the Thomas Jefferson Lab National Accelerator Facility measured inclusive double spin asymmetries by scattering longitudinally polarized electrons on a longitudinally and transversely polarized NH3 target. The measurements were done at momentum transfer of 2.5 lessthanequal Q^2 lessthanequal 6.5 GeV^2 and Bjorken x of 0.3 lessthanequal x lessthanequal 0.8. Preliminary analysis of the pair-symmetric background used to recover low x data will be discussed.

The Lamb Shift in Muonic Hydrogen: The Experiment to Measure the Proton rms Charge Radius (00h00')

Speaker: NEBEL, Tobias

The charge radius R_p of the proton has so far been known only with a surprisingly low precision of about 1\%, using mainly hydrogen spectroscopy data and bound-state QED calculations. An independent value from electron scattering is even less accurate (2\%) limiting test of bound-state QED in hydrogen. We have measured the Lamb shift in muonic hydrogen (μp, i.e. a proton orbited by a negative muon) with 20 ppm precision via laser spectroscopy of the $2S - 2P$ transition. From this, a new value for the proton charge radius can be extracted via bound-state QED in muonic hydrogen. We could determine the proton rms charge radius to 10^{-3}, the precision now being limited by the proton's polarizability - the experimental data could provide a twice better uncertainty on R_p. While our other work presented at this conference aims at the implications to nuclear physics and to theory, this work intends to focus on the experimental setup as well as the measured data. Since a suprisingly large discrepancy of our result to the widely accepted CODATA-value was discovered, a discussion of the statistical and systematic uncertainties will be given.

A Regge Approach in K* Photoproduction (00h00')

Speaker: OZAKI, Sho

Recently strangeness photoproduciton has been of interest in hadron physics. Several photon facilities have been providing rich and variety of data. There interesting phenomena are reported including the observation of the pentaquark. Also unexpected peak structures near the threshold are found in phi photoproduction and in Lambda resonance photoproduction. To understand those interesting phenomena, we have to understand a fundamental mechanism of the open strangeness photoproduction. In this talk, we will discuss K* photoproduction within Regge approach. K* is a vector meson like a phi meson. In phi photoproduction Pomeron contribution successfully reproduces experimental observables. Therefore one can expect that Reggeons play an important role also in K* photoproduction. We find that the energy dependence differs from that of the phi photoproduction due to the different trajectories which are allowed in the reactions. In spin density matrices we find that there are obvious differences between our model with Regge phenomenology and the previous work based on the Feynman amplitude of the effective Lagrangian method.

Time-Like Electromagnetic Form Factors at Panda-FAIR (00h00')

Speaker: TOMASI-GUSTAFSSON, Egle

At the accelerator complex FAIR (Darmstadt, Germany) a program of measurements of electromagnetic proton form factors is foreseen in the time-like region, with the detector PANDA. The high intensity and high energy antiproton beams will open the possibility to determine these form factors in a wide kinematical range, through the annihilation reaction $ p+\bar p\to e^++e^-$. The status of the proposed experiment as well as the expected results will be presented on the basis of realistic simulations. The impact of these measurements on the understanding of the nucleon structure and of the reaction mechanism will be discussed. At moderate values of the momentum transfer squared, q^2 the individual determination of the electric and magnetic FFs will strongly constrain the nucleon models, whereas at larger q^2 the validity of asymptotic properties predicted by QCD will be tested. These data, together with the information from the space-like region, will provide the experimental ground for a unified view of the electromagnetic structure of the proton as observed in scattering and annihilation reactions.

W+/- Production and Single-Spin Asymmetries in Polarized p+p Collisions at 500 GeV at RHIC (00h00')

Speaker: WISSINK, Scott

W boson production in longitudinally polarized p+p collisions provides a clean and novel probe of the flavor dependence of (sea) antiquark polarization distributions in the nucleon. The W+(-) are produced in leading order via u+dbar (d+ubar) fusion, and can be studied through detection of their decay leptons. The STAR Time Projection Chamber (TPC) provides excellent charged particle tracking at mid-rapidity, and allows for robust e+/e- separation for p_T up to ~50 GeV/c. Electromagnetic calorimeters (EMC's) are used to determine the precise lepton energy. The large acceptances of the TPC and EMC systems cover most of the decay lepton phase space, and allow strict isolation conditions to be imposed on the lepton, while also enabling a veto on substantial away-side energy. The latter requirement reduces the `QCD' background by several orders of magnitude, and results in very clean yield extraction. Preliminary results for the W+/- production cross sections and parity-violating single-spin asymmetries A_L, obtained from the STAR 2009 data set at sqrt(s) = 500 GeV, will be presented, along with projections for the future W program at STAR at mid- and forward rapidities.

Extracting Amplitudes from Meson Photoproduction Data (00h00')

Speaker: WORKMAN, Ron

A wealth of new photo- and electroproduction data from JLab, MAMI, and CB-ELSA are now becoming available to groups involved in baryon resonance physics. The possibility of a 'complete experiment' and amplitude reconstruction with minimal model dependence is now being discussed. Here we recall the basic principles of resonance extraction, consider their limitations, and comment on current photoproduction fits over the medium-energy region.

Strangeness Production in Heavy Ion Collisions Close to the Threshold (00h00')

Speakers: AICHELIN, joerg, HARTNACK, Christoph, OESCHLER, Helmut, LEIFELS, Yvonne

In recent years event generators made it possible to understand many details of heavy ion reactions in the energy range between 500 AMeV and 2 AGeV. One of the most challenging questions is the understanding of strangeness production and its interaction with the nuclear environment. This is a double challenge: On the one side strangeness production depends on nuclear properties like the Fermi motion and on the density at the point of creation, on the other side the nucleus can serve as a laboratory to study the interaction between strange particles and nucleons. Three physics topics are addressed 1) The K^+N interaction can be directly inferred from experimental data. This is the first time that the interaction between a meson and nuclear matter is measurable. 2) The K^+ yield is a direct measure of the hadronic equation of state The available high precision measurements allow to conclude that the compressibility modulus is around 200 MeV. 3) The large difference between K^- yield and the K^- spectra in pp(pA) and AA collision is due to the fact that in heavy ion collision the dominant channel for K^- production is lambda pi -> K^- N, which is absent in pp(pA).

Formation of $^5_{\Lambda \Lambda}$H and $^6_{\Lambda \Lambda}$He from Stopped $\Xi ^-$ on ^{6}Li (00h00')

Speaker: MIN, Aye Aye

The light double-Λ hypernuclei, $^5_{\Lambda \Lambda}$H and $^6_{\Lambda \Lambda}$He, are simultaneously populated with a ratio of 1.24 by means of stopped $\Xi ^-$ on ^{6}Li. $^6_{\Lambda \Lambda}$He, known as "Nagara", can be detected by neutron measurement. $^5_{\Lambda \Lambda}$H is identified with weak-decay spectrum, the most characteristic one of which is $^5_{\Lambda \Lambda}$H $\rightarrow \alpha + \Sigma ^- +109.1$ MeV. Comparison of $\Delta B_{\Lambda \Lambda}$'s of the two hypernuclei enables us to deduce the $\Lambda \Lambda$-ΞN coupling interaction quantitatively which plays a crucial role in the strangeness -2 sector.

The Three-Body Nonmesonic Weak Decay Process of Lambda Hypernuclei and Its Exclusive Measurement at J-PARC (E18) (00h00')

Speaker: BHANG, Hyoung

The fundamental interests of nonmesonic weak decay (NMWD) study is that it provides so far the only pratical means to explore the strangeness changing (ΔS=1) baryon-baryon weak interaction, ΛN→NN, which is the dominant mechanism of NMWD. However, the significant contribution of 3-body process, ΛNN→NNN, has been found in the recent experiments. We have measured the branching ratio of the the 3-body process in the NMWD of 12ΛC for the first time from the quenching of the nucleon yields in the KEK-PS E508 experiment [1]. However, at the moment, its uncertainty reaches ~45 percent due to the limited statistics. In the J-PARC E18 experiment, the contribution of 3-body NMWD process will be measured accurately detecting both the pair nucleon correlations and the triple coincidence events. Then we can determine all the partial decay widths of NMWD accurately taking accounts of the 3-body process for the first time. In the presentation, the signatures of the 3-body process in KEK-PS E508 data and the preparation status of J-PARC E18 such as the setup, the expected yields and other experimental issues will be discussed. [1] M. Kim et al., Phys. Rev. Lett. 103 (2009) 182502.

Nuclear Suppression of Dileptons at Forward Rapidities (00h00')

Speaker: CEPILA, Jan

Data from E772 and E866 experiments on the Drell-Yan process exhibit a significant nuclear suppression at large Feynman xF. We show that a corresponding kinematic region does not allow to interpret this as a manifestation of coherence or a Color Glass Condensate. We demonstrate, however, that this suppression mechanism can be treated alternatively as an effective energy loss proportional to initial energy. To eliminate suppression coming from coherence, we calculate nuclear suppression also at large dilepton masses. Our calculations are in a good agreement with available data. Since the forward region can be also approached in transverse momenta pT, we present corresponding predictions for expected large-pT suppression as well. The same mechanism is then applied at forward rapidities in the RHIC energy range. Since a new experiment E906 planned at FNAL will provide us with more precise data soon, we present also predictions for expected large-xF nuclear suppression in this kinematic region.

Lambda(1405) and K-pp Studied with Coupled-Channel Complex Scaling Method (00h00')

Speaker: DOTE, Akinobu

Kbar nuclei (nuclear system with anti-kaon) is expected to be exotic systems due to the strong KbarN attraction. Recently, the most essential Kbar nucleus "K-pp" has been focused in both theoretical and experimental studies. In theoretical studies, a Faddeev (AGS) calculation with a separable potential pointed out the importance of pi ΣN three-body dynamics which is not explicitly dealt with in a variational calculation with an effective KbarN potential. Here, we will investigate “K-pp” as a resonant state of coupled KbarNN-pi YN system with a coupled-channel Complex Scaling Method (CSM). Since the CSM is an extended scheme of a variational method, we can use a reliable NN and KbarN potentials used in the variational calculation, not a separable-type potential and know detailed properties of the system by analyzing the CSM wave function. We will report the Lambda(1405) (a quasi-bound state of K-p system) described in CSM scheme with a phenomenological KbarN potential (energy-independent) and a KbarN potential based on a chiral SU(3) theory (energy-dependent). As for K-pp, the energy and width calculated using a realistic NN potential, and its structure will be reported.

Investigation of the $\gamma n \rightarrow K^{0} \Lambda$ Process Near the Threshold (00h00')

Speaker: FUTATSUKAWA, Kenta

Kaon photoproduction plays important roles in the investigation of meson-baryon interaction, structures of hadrons, and in the search for missing resonances thanks to the new degree of freedom ``strangeness''. In order to explore the experimental study of the $\gamma n \rightarrow K^{0} \Lambda$ channel, a new neutral kaon spectrometer (NKS2) was installed at the Laboratory of Nuclear Science, Tohoku University (LNS-Tohoku). The particle identification was performed by the momentum and the time-of-flight information. The vertex was reconstructed by the tracing back of two tracks. In total, 700 events assigned to K^{0} and 4000 events due to Λ were identified from the measured invariant masses of $\pi^{+}\pi^{-}$ and $p\pi^{-}$. Additionally, there are 130 events assigned to the coincidence event of K^{0} and Λ. The differential cross section of $\gamma + d \rightarrow K^0 + X$ and $\gamma + d \rightarrow \Lambda + X$ were obtained and compared with the isobar-model calculations. In addition, the differential cross section of $\gamma + n \rightarrow K^0 + \Lambda$ was measured for the first time.

Pion Induced Reaction on Helium in the Delta Resonance Energy Region (00h00')

Speaker: GNESI, Ivan

The PAINUC experiment has collected new data on pion-4He interaction, at the energy of maximum Delta resonance excitation on 4He, T=106 MeV. The events are collected using a triggered Self Shunted Streamer Chamber filled with helium at atmospheric pressure of the Joint Institute for Nuclear Research (JINR) in Dubna (Russia). All the charged secondaries, down to slow (1 MeV) and highly ionizing helium fragments, are measured. The first experimental evidence for a interaction channel with a high energy gamma in the final state has been obtained, with energy spectrum in agreement with a Planck blackbody radiation at T~16 MeV. The Delta-minus resonance below the pion production energy has been observed in neutron ko reactions. The invariant mass has been measured at M=1157 MeV/c2 with a width of 38 MeV/c2, thus shifted with respect to the free nucleon Delta. The observations suggest the existence of a collective nuclear resonance involving 3-4 nucleons giving a binding energy contribution of 50 MeV/nucleon. Finally, in the pion absorption interaction, fine structures in all 3-nucleon invariant mass spectra has been observed, as expected for a collective resonance excitation.

Perspectives of the Double Strangeness Physics at FAIR (00h00')

Speaker: IAZZI, Felice

The investigation of the hypernuclear systems with S=-2 strangeness contents can answer to several important aspects of hypernuclear physics like the X- nucleon and X- nuclei interactions, the Lambda-Lambda interactions and the double hypernuclei decay mechanisms [1]. All these investigations can be performed only starting from the production of the doubly strange hyperon X-, followed by the stopping of the hyperon in matter and the formation of the doubly strange systems (doubly strange hypernuclei, double hypernuclei and doubly strange exotic atoms). Inside the PANDA Collaboration a technique to produce X- hyperons and doubly strange systems using antiprotons at 3GeV/c in a 2-target set-up has been designed. This project will use the HESR antiproton ring of the future FAIR complex. The feasibility study of the project has been completed and the production of stopped hyperons is expected at a rate of several thousands per day. The details of the double hypernuclear physics, of the experimental design and expected results will be presented. [1] K.Szymanska et al.,Acta Phys. Pol. B 41, 285 (2010)

Nonmesonic Weak Decay Spectra (00h00')

Speaker: KRMPOTIC, Francisco

The proton kinetic energy spectra obtained recently in the FINUDA experiment, and the KEK measurement of the angular correlation, kinetic energy sum, as well as the centre of mass momentum spectra of two emitted nucleons in the nonmesonic weak decays (NMWD) of several hypernuclei were analyzed theoretically. With the purpose to quantify the contributions of the final state interactions, and the three-nucleon NMWD emissions, we first compare the data with the theoretical spectra evaluated within the Independent-Particle Shell-Model (IPSM). The dynamic is described by the one-meson-exchange of pi +K mesons with standard parameterization. Later on, are calculated the momentum distributions of the primary nucleons within this model, and a Monte Carlo simulation is used to account for the FSI. The new derived spectra are again confronted with the measured spectra, and we use them to evaluate the number of neutrons (Nn) and protons (Np) per Lambda decay, and use the measurement ratio Nn/Np of these quantities to determine the ratio Gamma n/Gamma p of neutron to proton induced NMWD.

Multi-Kaonic Hypernuclei and Kaon Condensation (00h00')

Speaker: MARES, Jiri

This contribution reports on dynamical, self-consistent calculations of multi-\bar{K} hypernuclei, which were performed by adding antikaons to particle-stable nuclear configurations of nucleons, \Lambda and \Xi hyperons [1]. Our results show a robust pattern of saturation of the \bar{K} separation energy B_K as a function of the number of antikaons, with B_K bounded from above by 200 MeV. The associated baryon densities saturate at values 2-3 times nuclear-matter density. The main reason for saturation is the repulsion induced by the vector meson fields between \bar{K} mesons, similarly to what was found for multi-\bar{K} nuclei [2]. The calculations confirm that strangeness in finite strong-interaction self-bound systems is realized through hyperons, with no room for kaon condensation. I wish to acknowledge a fruitful collaboration with Eli Friedman, Avraham Gal, and Daniel Gazda. This work was supported by GACR grant 202/09/1441. [1] D. Gazda, E. Friedman, A. Gal, and J. Mares, Phys. Rev. C 80, 035205 (2009). [2] D. Gazda, E. Friedman, A. Gal, and J. Mares, Phys. Rev. C 77, 045206 (2008).

Effects of Two- and Three-Nucleon Correlations on the Scaling Behavior of Inclusive (e,e') Response Functions of Complex Nuclei (00h00')

Speaker: MEZZETTI, Chiara Benedetta

The scaling behavior shown by the CLAS inclusive cross section ratios of 4He, 12C and 56Fe to 3He [1], has been interpreted as evidence that the electron probes two- and three-nucleon correlations in complex nuclei similar to the ones occurring in 3He [2]. To provide useful information on Short Range Correlations (SRC) in nuclei, a new approach [3] to the analysis of inclusive cross sections is illustrated, based upon the introduction of proper scaling functions and variables incorporating the effects of two- and three-nucleon SRC. The new scaling functions are closely related to the two- and three-nucleon longitudinal momentum distributions, so that the plateaux exhibited by the experimental inclusive ratios can be naturally explained in terms of two- and three-nucleon momentum distributions, provided the final state interaction of the struck nucleon with the partner correlated nucleons is taken into account. [1] K. Egiyan et al, Phys. Rev. Lett. 96 (2006) 082501 [2] L. Frankfurt, M. Strikman, Phys. Rep. 76 (1981) 214; Phys. Rep. 160 (1988) 235 [3] C. Ciofi degli Atti and C.B. Mezzetti, Phys. Rev. C 79 (2009) 051302(R); C.B. Mezzetti and C. Ciofi degli Atti, arXiv:0906.5564 (2009)

Multi-Antikaonic Nuclei and In-Medium Kaon Properties in Dense Matter (00h00')

Speaker: MUTO, Takumi

Strangeness degree of freedom provides an important aspect for dense matter which may be realized in neutron stars and/or heavy ion collisions. Kaon condensation has been studied both theoretically and observationally. Recently deeply bound antikaonic nuclear states in terrestrial experiments have also been investigated extensively. Stimulated by these studies, we investigate multi-antikaonic nuclei (MKN), where several K^- mesons are bound in the nucleus, and clarify the structure of the MKN by obtaining the density profiles of the nucleons and K^- mesons, binding energy of the MKN, etc. We base our study on the relativistic mean-field theory, coupled with $¥bar K$-nucleon and $¥bar K-¥bar K$ interactions which respect chiral symmetry. The $¥Lambda$(1405) is introduced as a pole contribution to the energy together with the range effects as the second-order perturbation with respect to the relevant axial-vector current. It is shown that protons are attracted more to the K^- mesons lying around the center than neutrons and that there is a neutron skin structure in the outer part of the MKN. The relation between the MKN and kaon condensation in neutron stars is mentioned.

X-Ray Spectroscopy of Kaonic Atoms at DAFNE (00h00')

Speaker: ZMESKAL, Johann

The SIDDHARTA experiment aims at a precise measurement of K-series kaonic hydrogen x-rays and the first-ever measurement of the kaonic deuterium x-rays to determine the strong-interaction energy-level shift and width of the lowest lying atomic states. These measurements offer a unique possibility to precisely determine the isospin-dependent K-nucleon scattering lengths which are directly connected with the physics of the KN interaction, and thus were eagerly awaited while many studies of the K-nucleus interaction - both experimental and theoretical - have been reported over the past several years. The experiment has been performed at the DAFNE e+e- collider which produces the phi-resonance that decays into K+K-. The resulting low energy K-'s with small energy spread are well suited to be stopped in a gas target efficiently for producing these atoms. As x-ray detectors, we employed 144 silicon drift detectors developed especially for this experiment, having good energy resolution of 150 eV FWHM at 6keV and time resolution of sub-micro seconds. The data taking was completed in November 2009. In this talk, an overview of this experiment and recent results will be presented.

Observation of Rare Non-Mesonic Weak Decay $^4_{\Lambda}$He -> d + d (00h00')

Speaker: OUTA, Haruhiko

Results will be reported for observation of the rare two-body non-mesonic weak decay modes of four-body s-shell light lambda hypernucleus, 4_Lambda_He -> d + d. In is known that non-mesonic weak decay(NMWD) of 4_Lambda_He occurs predominantly from lambda p→np decay mode where deuteron remains as spectator. Neither d+d nor 3H + p decays had been observed so far. It is interesting to study these rare NMWD modes because those decay branching ratios might be much enhanced when two (or more) nucleons-involved NMWD occurs. In the KEK-PS 549 experiment, we accumulated about 10^5 energetic deuterons (Pd>500MeV/c; about 1% of stopped K-) from the K- absorption reaction on liquid helium. Abundant emission of energetic deuterons is hard to be explained by naive two-nucleon K- absorption picture of K-NN->YN. About 60 d+d pairs are observed in completely back-to-back direction, whose momenta agree well to those from the two-body decay of stopped 4_L_He -> d+d (Pd =572MeV/c). We obtained the decay branching ratio of 4_L_He→ d+ d is about 6*10^-4, about 0.3% of the total NMWD branching ratio. We also obtained stringent upper limit for the 4_L_He -> 3H + p decay.

Non-Mesonic Weak Decay Widths of $^5_{\Lambda}$He and $^{12}_{\Lambda}$C Hypernuclei (00h00')

Speaker: OUTA, Haruhiko

We will report the results of non-mesonic weak decay experiments of light lambda hypernuclei (5_L_He and 12_L_C) focusing on the precise determination of the non-mesonic weak decay widths. We measured lifetimes and emission probability of all the major decay products (pi-, pi0,n and p) from the light hypernuclei and obtained pi-/pi0 and the total non-mesonic decay widths with accuracy of about 5%. For the non-mesonic weak decay(NMWD) process, we found that the ratio of two major NMWD modes, Gamma(Ln->nn)/Gamma(Lp->np), is close to 1/2, which is now consistent to therecent theoretical calculation. However, calculations still have difficulty to reproduce the observed asymmetry parameter of decay proton emission from the polarized hypernuclei, suggesting the importance of scalar-isoscalar type weak interaction between two baryons. We also found that both of our inclusive nucleon & NN-coincidence spectra are well reproduced when one assumes 29+-13% of the NMWD comes from multi-nucleon induced process, LNN->NNN[1]. In this presentation, we will review our final results of the NMWD of light lambda hypernuclei. [1] M. Kim et al., Phys. Rev. Lett 103 (2009) 182502

Strangeness Production in Heavy Ion Collisions Around 2A GeV in FOPI (00h00')

Speaker: PIASECKI, Krzysztof

The region of beam energies at around 2A GeV is of particular interest for studying strangeness production in heavy ion collisions, as it is situated below or near threshold for the production of these strange particles. Properties of particles emitted at such conditions allow to investigate the in-medium effects which leave footprints in distributions of dynamic observables like flow and ratios of kinetic energies. Thanks to the recent installation of Multi-Strip Multi-Gap RPC, a new timing detector with excellent resolution of σ_{ToF}~=~88~ps (system), FOPI has extended the insight into the momentum space of charged kaons and ϕ mesons. Systematic data on K$^{0,+}$,ϕ mesons, Λ baryon and K*(892), Σ^*(1385) will be presented. Yield ratios are found to be surprisingly well described by the statistical model, as well as the dynamical calculations. Recent strange multi-baryonic bound states will be shown as well.

Precision Spectroscopy of Kaonic Helium-3 X-Rays at J-PARC (00h00')

Speaker: SATO, Masaharu

Kaonic atoms are valuable systems to probe antikaon-nucleon interaction at threshold energy. Measurements of X-ray transitions from the kaonic atoms have been intensively performed to derive the strong interaction induced shift and width of the energy levels of the kaonic atoms. On the theoretical side, a recent model which accommodates nuclear antikaon bound states predicts a possible large shift of the 2p level of kaonic helium-3 and/or helium-4 atoms, whereas most of the calculations with an optical model result in very small energy shift. Although large shift of kaonic helium-4 has been restricted by a recent KEK measurement of kaonic helium-4, the possibility for that of having a larger value for kaonic helium-3 is still remaining. Since such a large 2p shift can be realized only with strongly attractive potential, crucial information on their potential can be obtained together with the result of kaonic helium-4. Therefore we will perform a precision measurement of the 2p energy shift of kaonic helium-3 at the K1.8BR beam line in the J-PARC hadron facility. In this contribution, the overview and the current status of the experiment will be presented.

The Search for Deeply-Bound Kaonic Nuclear States at J-PARC (00h00')

Speaker: TSUKADA, Kyo

We will present the J-PARC E15 experiment, which will be performed at the K1.8BR beam line. Recently, many studies of deeply-bound kaonic nuclear states have been performed. Theoretically, some calculations predict the existence of deeply-bound kaonic nuclear states, but the calculated values of binding energy and width are not yet converged. Experimentally, although there are several reports of the kaonic nuclear states by invariant mass spectroscopy via the decay particles and/or missing mass spectroscopy using (K-,N) reactions, conclusive evidences for such bound states are not yet provided. In order to clarify this controversial issue, the J-PARC E15 experiment was proposed to search for the simplest kaonic nuclear bound states, namely K-pp, via the in-flight 3He(K-,n) reaction using 1.0 GeV/c K- beam. This experiment has the advantage that the exclusive measurement can be performed by the missing mass spectrum and invariant mass spectroscopy. The construction of spectrometers is now in progress in accordance with the aim of data-taking in 2011. The physics case of the E15 experiment and the current status of preparation will be presented.

Lambda*-Hyper-Nuclei with Chiral Dynamics (00h00')

Speaker: UCHINO, Toshitaka

Bound states of Lambda*=Lambda(1405) in nuclei, the Lambda*-hyper nuclei, are studied from the viewpoint of chiral dynamics. As the Lambda* is formed by a strong attraction between Kbar and the nucleon, the Lambda*- hyper nuclei can be a main component of the Kbar nucleon bound states. We use an extension of the Julich one-boson-exchange potential for the interaction between Lambda* and nucleon. The coupling constants concerning the Lambda* are determined by a microscopic theory based on chiral dynamics of meson-baryon systems. We discuss the level structure of the Lambda*-hyper-nuclei in the case when the Lambda* is described as a superposition of two states.

Centrality Dependence of Observables at SPS and RHIC is a Core Corona Effect (00h00')

Speakers: AICHELIN, joerg, WERNER, klaus

Because statistical models fail, the understanding of the centrality dependence of the multiplicity, of $^$ and of the elliptic flow of identified particles has been a challenge since long. A while ago it has been proposed that even in the most central collisions there remain particles (usually close to the surface of the interaction zone) which do not come to equilibrium (corona particles) whereas others come to a local equilibrium (core particles). Based in this observation we have developed a parameter free model which describes the centrality dependence of all these observables at SPS as well as at RHIC and for CuCu as well as for AuAu. This model has been validated with EPOS, one of the standard event generators. The centrality dependence of the elliptic flow has been considered as an observable which allows to fix the viscosity of a plasma. Our model shows that this dependence can be predicted assuming the same fraction of completely equilibrized core and not equilibrized corona particles which has been used to understand the centrality dependence of the multiplicity and reproduces correlations between peripheral heavy ion collisions and pp which are alien to hydro.

Shear Viscosity for a Hadron Gas (00h00')

Speaker: BANIK, Sarmistha

Recently a universal bound \$\eta/s\geq 1/4\pi$ for the ratio of shear viscosity (η) to entropy density (s) has been proposed by Kovtun, Sonand Starinets (KSS). Experimental results from ultra-relativistic heavy ion collisions at BNL-RHIC energy seems to indicate that a system of thermalised quarks and gluons has been formed in these collisions and the quantity, η/s for such a system support this bound. A small value of η/s led to the occlusion that the system formed in ultra-relativistic heavy ion collisions above the the deconfinement temperature behaves like a super-fluid. A recent lattice calculation of gluonic plasma also supports the current estimates. We calculate the shear viscosity coefficient for a hadronic gas consisting of pions, kaons and nucleons in the effective Lagrangian approach. The variation of η/s with temperature and baryonic chemical potential will be presented both for partonic and hadronic system. Implications of the results on the experimental observables will also be discussed.

The Kaon to Pion Ratio in Heavy Ion Collisions (00h00')

Speaker: BANIK, Sarmistha

A microscopic approach has been employed to study the kaon productions in heavy ion collisions. The momentum integrated Boltzmann equation has been used to study the evolution of strangeness in the system formed in the heavy ion collision at relativistic energies. The calculation has been done for different centre of mass energies ($\sqrt{s_{\mathrm NN}}$) ranging from AGS to RHIC and results have been compared to the available experimental data. We observe a horn like structure in the variation of K^+/π^+ with ($\sqrt{s_{\mathrm NN}}$) when the formation of a partonic phase is assumed beyond a certain ($\sqrt{s_{\mathrm NN}}$). We also observe that the ratio increases monotonically when a hadronic initial state is assumed for all ($\sqrt{s_{\mathrm NN}}$). Therefore, we attribute the non-monotonic variation of K^+/π^+ with ($\sqrt{s_{\mathrm NN}}$) as an indicator of the formation of partonic phase beyond a certain ($\sqrt{s_{\mathrm NN}}$). A monotonically increasing nature of the K^-/π^- ratio is obtained within the ambit of the present formalism for all ($\sqrt{s_{\mathrm NN}}$).

Chiral Magnetic Effect and Chiral Phase Transition (00h00')

Speaker: FU, Wei-jie

We study the influence of the chiral phase transition on the chiral magnetic effect. The azimuthal charge-particle correlations as functions of the temperature are calculated. It is found that there is a pronounced cusp in the correlations as the temperature reaches its critical value for the QCD phase transition. It is predicted that there will be a drastic suppression of the charge-particle correlations as the collision energy in RHIC decreases to below a critical value. We show then the azimuthal charge-particle correlations can be the signal to identify the occurrence of the QCD phase transitions in RHIC energy scan experiments.

Nuclear Suppression at Low Energy Heavy Ion Collisions (00h00')

Speaker: SINHA, BIKASH

The effects of non-zero baryonic chemical potential on the drag asnd diffusion coefficients of a heavy quarks propagating through a quark gluon plasma have been studied. The nuclear suppression factor, R AA for non-photonic single electron spectra resulting from the semileptonic decays of hadrons containing heavy flavours has been evaluated for low energy collisions. The role of non-zero baryonic chemical potential on R AA has been discussed

Going Closer to the Big Bang at LHC (00h00')

Speaker: SINHA, BIKASH

The initial temperature attained in the collision of two nuclei LHC is expected to be around 500 MeV or even more. Assuming the quark hadron phase transition is around 200 MeV, LHC, thus provides a panorama of the universe somewhat earlier times than QCD phase transition. What new phenomena are we supposed to learn from such a possibility?

Searching for the Critical Point of the Strongly Interacting Matter with the NA61 Heavy Ion Experiment at the CERN SPS (00h00')

Speaker: BRAVAR, Alessandro

The NA61 experiment at CERN proposes a new experimental program to study hadron production in hadron-nucleus and nucleus-nucleus collisions at energies accessible at the SPS. The NA61 detector is based on an extensive upgrade of the NA49 detector, which successfully took data from 1994 to 2002. The main physics goals of NA61 is to study the properties of the onset of deconfinement and to search for signatures of the critical point of strongly interacting matter. The NA49 results indicate that the energy threshold for deconfinement is reached already at the lower SPS energies, while theoretical predictions locate the critical point of strongly interacting matter at energies accessible at the SPS. A broad interval in the (T - mu_B) phase diagram will be scanned using different ion species (system scan) at various energies (energy scan). First p-p reference data at different energies have been taken in 2009. A boron beam will be produced by fragmenting a primary lead beam from the SPS, while heavier ions will be directly accelerated by the SPS. A test run with boron will be performed later in 2010. Physics with ion beams will start in 2011; it will take 3 to 4 years to complete it.

QCD Factorization at Forward Rapidities (00h00')

Speaker: SUMBERA, Michal

We analyze several reactions on nuclear targets at forward rapidities and different energies (at smallest experimentally accessible Bjorken x). Nuclear effects are usually interpreted as a result of shadowing or the Color Glass Condensate. QCD factorization of soft and hard interactions requires the nucleus to be an universal filter for different Fock components of the projectile hadron. We demonstrate, however, that this is not the case in the vicinity of the kinematic limit, x \to 1, where sharing of energy between the constituents becomes an issue. This effect can be treated alternatively as an effective energy loss proportional to initial energy leading to a nuclear suppression at any energy, and prediction of Feynman x_F scaling of the suppression. The same kinematic limit can be approached in transverse momentum when the Cronin enhancement of particle production at medium-high p_T switches to a suppression at larger p_T violating thus QCD factorization. The effect seems to be confirmed by data on pion production in d+A collisions at RHIC, and even for direct photons and also brings corrections to observed jet quenching at RHIC. [1] Nucl. Phys. A 830, 611C, Phys. Rev. C78, 025213.

Heavy Ions at LHC Energies: Predictions for Net-Baryon Distributions (00h00')

Speaker: WOLSCHIN, Georg

We investigate baryon and charge transport in relativistic heavy-ion collisions, compare with Au + Au RHIC data at sqrt (s_NN) = 0.2 TeV, and make predictions for net-proton rapidity distributions in central Pb + Pb collisions at CERN LHC energies of sqrt (s_NN) = 2.8, 3.9, and 5.5 TeV. We use the gluon saturation model and put special emphasis on the midrapidity valley |y|< 2 where ALICE data should soon be available [1]. The main physical process is here the scattering of valence quarks from the gluon condensate. The interaction of large-x valence quarks with small-x gluons is particularly relevant in the region of large rapidities y = 5 – 7 where the net-baryon fragmentation peak is expected to occur in central Pb + Pb collisions at LHC energies. Its position in rapidity space is sensitive to the gluon saturation-scale exponent lambda, and we expect to be able to determine it from net-baryon data at large y should they become available in the far future [2]. [1] Y. Mehtar-Tani and G, Wolschin, arXiv: 1001.3617, to be published in Phys. Lett. B. [2] Y. Mehtar-Tani and G, Wolschin, Phys. Rev. Lett. 102, 182301 (2009); Phys. Rev. C 80, 054905 (2009).

Shear Viscosity in Neutron Matter from Microscopic Nucleon-Nucleon Cross (00h00')

Speaker: ZHANG, Hong-Fei

We present a numerical study of shear viscosity in pure neutron matter in the framework of the Brueckner theory. The investigation covers a wide density range as requested in the applications to the neutron star collective dynamics. The calculation of in-medium cross sections and nucleon effective masses are performed with a consistent two and three body interaction, based on the meson exchange model with meson parameters taken from the Bonn B potential.

J/Psi as a Probe of Strongly Interacting Matter Created at LHC (00h00')

Speaker: ZHUANG, Pengfei

By taking two kinds of equation of state for the created QGP in high energy nuclear collisions at RHIC and LHC, namely weakly and strongly coupled QGP, we solve the transport equation for J/Psi motion together with the hydrodynamic equations for QGP evolution. While the J/Psi yield is not very much sensitive to the equation of state, the transverse momentum distribution at LHC depends significantly on the state of the matter.

Supernova Pointing by Neutrino Matter Oscillation (00h00')

Speaker: BURGMEIER, Armin

A core-collapse supernova will emit a neutrino burst which can be detected on Earth. If the neutrinos travel through the Earth before reaching the detector they do oscillate via interaction with Earth matter, yielding oscillations in the neutrino energy spectrum. The frequency of these oscillations in energy is correlated with the pathlength traveled in the Earth and therefore contains information on the supernova location. For this technique to be useful for pointing basically good energy resolution, well-known oscillation parameters and high statistics are required. It is inferior to pointing with elastic scattering in a water Cherenkov detector but could be applied for scintillator-type detectors which have better energy resolution but weak intrinsic pointing capabilities. By the time a nearby supernova happens the requirements might well be fulfilled; if no water Cherenkov detector is running at that time it might even be the only possibility to gain directional information. The pointing quality can be further improved by combination of measurements from multiple detectors and also by taking relative timing into account. I will summarize the potential of this technique.

Neutrino-Nucleus Reactions for Nucleosynthesis (00h00')

Speaker: CHEOUN, Myung-Ki

We calculated neutrino-induced reactions in the energy range below the Quasi-Elastic region for nuclei of astrophysical importance. Neutrino-induced reactions turned out to be important for nucleosynthesis in core collapsing supernovae because the expected neutrino flux is sufficiently high enough to excite many relevant nuclei in spite of the small cross section. Our calculation is carried out with the Quasi-particle Random Phase Approximation (QRPA), which has been successfully applied for the β and double β decay of relevant nuclei. Our QRPA takes neutron-proton pairing as well as neutron-neutron and proton-proton pairing correlations into account. To describe neutrino scattering, general multipole transitions by weak interactions with a finite momentum transfer are calculated for NC and CC reactions. Both reactions are described in a theoretical framework. Our results, which are compared with other theoretical calculations, are shown to well reproduce the sparce experimental data, in specific, for ^{12}C and ^{56}Fe targets. Therefore our results for ^{56}Ni, ^{138}La and ^{180}Ta targets could be valuable input data for relevant fields.

Neutrino and Antineutrino Charge-Exchange Reactions on 12C (00h00')

Speaker: KRMPOTIC, Francisco

The weak-interaction formalism was elaborated thoroughly, yielding simple expressions for transition rates, which greatly facilitates calculations of neutrino-nucleus reactions and muon capture. We found inappropriate the RPA and QRPA models for describing the nuclear structure of the A=12 triad {B,C,N} ground states; the first one because of the inability in opening the p3/2 shell, and the second one because of the non-conservation of the number of particles. Inclusive neutrino-12C cross-sections were studied within both the PQRPA, and RQRPA. At difference with exclusive ones, they: a) steadily increase when the configuration space is augmented, b) approach to the sum-rule limit at low energy, but are significantly smaller at high energies, and c) converge in magnitude for sufficiently large configuration spaces. The multipole decomposition shows that, while at low neutrino energy mainly contribute the allowed reactions, the first-forbidden ones dominate at medium and high energies, where the second- and third-forbidden contributions are also sizable. The cross-sections related with astrophysical applications are also discussed.

Recent Advances on the Neutrinoless Double Beta Decay within the Interacting Shell Model (00h00')

Speaker: MENENDEZ, Javier

The state of the art Interacting Shell Model (ISM) calculations of the Nuclear Matrix Elements (NME) for the neutrinoless double beta decay ($0\nu\beta\beta$) will be presented. In particular, the role of quadrupole correlations or deformation will be addressed, showing that the NME is very much reduced when the initial and final nuclei show different deformation. In addition, an estimation of the uncertainty on the ISM calculation of the NME will be given. The implications of the NME's obtained into the neutrino masses will be briefly mentioned, in particular the compatibility of the Heidelberg-Moscow claim of detected $0\nu\beta\beta$ decay and recent cosmological data. Finally, the dependence of the NME on the neutrino mass will be studied. This allows to distinguish the dominant contributions to the decay in different seesaw models, and leads to restrictions on their neutrino mixing matrices.

Study of 48Ca Double Beta Decay by CANDLES (00h00')

Speaker: OGAWA, Izumi

CANDLES is the project to search for double beta decay (DBD) of ^{48}Ca by using CaF$_2$ scintillators. The Q-value of ^{48}Ca, which is the highest (4.27~MeV) among potential DBD nuclei, is far above energies of γ-rays from natural radioactivities (maximum 2.615~MeV from ^{208}Tl decay), therefore we can naturally expect small backgrounds in the energy region we are interested in. We have constructed the prototype detector, CANDLES III in our laboratory (Osaka U.) at sea level and studied the basic performance of the system, including the light collection, position reconstruction and background rejection. We are now moving the detector system to new experimental room at Kamioka underground laboratory. Present status of the CANDLES III detector system at Kamioka will be presented.

The HALO Supernova Neutrino Detector and Need for Lead-Neutrino Cross Sections (00h00')

Speaker: YEN, Stanley

The HALO detector, composed of 76 tons of lead and the 3He neutron detectors from the SNO experiment, is presently under construction in SNOLAB. HALO will be primarily sensitive to electron neutrinos from a galactic supernova, in contrast to scintillators and water Cerenkovs which are sensitive to electron anti-neutrinos. A comparison of the rates in the two types will enable a flavor decomposition of the neutrinos from a supernova, and possibly reveal signatures of the novel flavor changes due to collective neutrino-neutrino interactions that have been understood only in the past few years, as well as put constraints on the mixing angle theta-13 and the neutrino mass hierarchy. There is an urgent need for both theoretical calculations and experimental measurements of the cross sections for neutrino interactions on lead, to enable such a flavor decomposition to be reliably carried out.

The QMC Model as a Description of Finite Nuclei and Hybrid Stars (00h00')

Speaker: CARROLL, Jonathan

Quantum Hadrodynamics (QHD) provides a useful framework for investigating dense matter, yet it breaks down when strangeness carrying baryons are introduced into the calculations, as the baryon effective masses can become negative at high density. The Quark-Meson Coupling (QMC) model overcomes this issue by incorporating the quark structure of the nucleon, thus allowing for a feedback to the interaction with the meson fields. With the inclusion of this feature, QMC becomes a successful description of finite nuclei and nuclear matter. We present various extensions of dense matter QMC by including hyperonic and quark-matter phases beyond the mean-field approximation, and comment on the ability to describe various phenomena and experimental data.

Studies of Neutron-Rich Nuclei Using the CPT Mass Spectrometer at CARIBU (00h00')

Speaker: CHAUDHURI, A.

The nucleosynthetic path of the astrophysical r process and the resulting elemental abundances depend on neutron-separation energies which can be determined from the masses of the nuclei along the path. Due to the current lack of experimental data, mass models are often used. The mass values provided by the mass models are often too imprecise or disagree with each other. Therefore, direct high-precision mass measurements of neutron-rich nuclei are necessary to provide input parameters to the calculations and help refine the mass models. The CARIBU facility of Argonne National Laboratory will provide experiments with beams of short-lived neutron-rich nuclei. The Canadian Penning Trap (CPT) mass spectrometer has been relocated to the CARIBU low-energy beam line to extend measurements of the neutron-rich nuclei into the mostly unexplored region along the r-process path. This will allow precise mass measurements (~10 keV/c^2) of more than a hundred very neutron-rich isotopes that have not previously been measured.

Is 244Pu Really a Primordial Nuclide? (00h00')

Speaker: FAESTERMANN, Thomas

With the current knowledge of nuclear and astrophysics, 244Pu could be both the heaviest and shortest lived nuclide present on Earth as a relic of the last Supernova(e) that occured before the formation of the Solar System. A quantitative detection of this isotope would yield its relative abundance from nucleosynthetic processes at the onset of Solar system formation. Four decades ago Hoffman et al. [Nature 239(1971)132] reported on a successful direct detection of this nuclide in the rare-earth rich mineral Bastnaesite by use of a mass spectrometer. In our search for primordial Plutonium in a sample of Bastnaesite from the same mine using a highly sensitive Accelerator Mass Spectrometry (AMS) setup not a single event of 244Pu was observed. We give an upper limit for the current abundance of 244Pu in Bastnaesite of 370 atoms per gram, which is in clear disagreement with the previously determined value. Thus the existence of 244Pu during the early history of our Solar System can up to now only be derived unambiguously with indirect methods detecting fragments originating from its spontaneous fission. Our newly determined upper limit is in agreement with those indirect observations.

Constraining Nova Observables: Direct Measurement of 33S(p,gamma)34Cl in Inverse Kinematics (00h00')

Speaker: FALLIS, J.

The 33S(p,gamma)34Cl reaction is important for understanding certain elemental abundances in oxygen-neon (ONe) novae. Nucleosynthesis calculations predict as much as 150 times the solar abundance of 33S in the ejecta of ONe novae. The overproduction factor may, however, vary by factors of 0.01 – 3 due to uncertainties in the 33S(p,gamma)34Cl reaction rate at nova temperatures. If this overproduction remains large it could be used as a diagnostic tool for classifying presolar grains. Better knowledge of this rate would also aid in interpreting nova observations over the S-Ca mass region, and contribute to the firm establishment of the endpoint of this nucleosynthetic process. Lastly, constraining the rate would help to better evaluate prospects of observing gamma-rays from the 34mCl decay in novae. Previous direct examinations of the 33S(p,gamma)34Cl reaction rate have only identified resonances down to ER = 434 keV. At nova temperatures, however, lower-lying resonances could play a dominant role. We will report on measurements made with the DRAGON recoil mass spectrometer down to at least ER = 220 keV.

Measurement of the 17O(alpha,gamma)21Ne Reaction at DRAGON (00h00')

Speaker: HAGER, U.

To understand the abundances of isotopes produced by the slow neutron capture process (s-process) in massive stars, improved knowledge of neutron sources and poisons is needed. Especially in stars with low metallicity, 16O is, due to its large abundance, a potential neutron poison, removing neutrons through the 16O(n,gamma) reaction. However, should this be followed by 17O(alpha,n) reactions, neutrons can be returned, reducing the poisonous effect of 16O. In competition with this recycling is the 17O(alpha,gamma) reaction; if this proceeds the poisonous effect of 16O becomes much stronger. Consequently, the ratio of the 17O(alpha,n) to 17O(alpha,gamma) reaction rates is crucial for reliable calculations of s-processing in low metallicity stars. In the absence of detailed experimental data, especially for the latter reaction, two theoretical estimates of this ratio have been proposed. These differ by typically a factor of 1000; new data are required to reduce this disagreement. In this talk we present new 17O(alpha,gamma) reaction data (Ecm 620-1600 keV) from the TRIUMF DRAGON facility. [1] P. Descouvement, Phys. Rev. C 48:2746-2752, 1993 [2] G. R. Caughlan and W. A. Fowler, At. Data Nucl. Data Tab. 40:283-334,1988

Direct Measurement of the 18F(p,a)15O Reaction at Novae Temperatures (00h00')

Speaker: LAIRD, Alison

Novae may well be the only class of explosive environment where all the important nuclear reactions can be measured at the relevant energies. Indeed, at the present time, there remain only a few reaction rates that have significant experimental uncertainties. One of these is the 18F(p,a)15O reaction thought to be the main destruction mechanism of 18F during the outburst. Annihilation radiation from the decay of 18F after the explosion dominates the gamma-ray emission and thus observational data of its abundance will provide unique information on the conditions during the outburst, assuming the nuclear reaction rates are sufficiently constrained. A direct measurement of this important reaction has been performed at novae temperatures. Using the ISAC radioactive beam facility at the TRIUMF laboratory, Canada, a 18F beam was incident on a CH2 target. Reaction products were detected, in coincidence, in highly segmented silicon strip arrays in the TUDA chamber. Data were taken at 250, 330, 430 and 665 keV, in the centre of mass, to study the contributions from key resonances and the interference between them. Results will be presented.

Ultra Strong Electric Fields and Charge Effects on Neutron and Quark Stars (00h00')

Speaker: MALHEIRO, Manuel

We show that compact stars can bound a large amount of charge due to the strong attractive gravitational field, open the question if these stars are local charged neutral in their interior. Recently, has been discussed the possible existence of ultra strong electric fields on the surface of strange quark stars, that can be at the order of 10^19 V/cm [1]. The energy density associated with such huge electric fields is on the same order of magnitude as the energy density of strange quark matter itself, and can alters the masses and radii of quark stars facilitating the interpretation of massive compact stars with masses around two solar masses observed recently. [1] - Rodrigo Picanco Negreiros, Fridolin Weber, Manuel Malheiro, and Vladimir Usov, Phys. Rev. D80, 083006 (2009)

Asymmetric Neutrino Reaction from Magnetized Proto-Neutron Stars in Fully Relativisitc Framework Including Hyperons (00h00')

Speaker: MARUYAMA, Tomoyuki

Various phases of the hot and dense hadronic matter are interesting topics in nuclear, particle and astro physics. The neutron star is the most possible target to realize these dense matter. Furthermore a new type of neutron stars, called as ``magnetars'', with a super strong magnetic field has been discovered. In this study the neutrino emission is the important observable information; it also gives us an interesting question as for the dense matter. In this work, then, we have calculate scattered and absorbed neutrino cross-sections in the hot and dense hadron with hyperons under strong magnetic field. We treat the magnetic field with the perturbative way, ignore the contribution from the conventional current and consider only the spin-interaction. As a result we can get a significant angular dependence of the neutrino absorption part (\nu_e -> e^-) when the strength of the magnegtic-field is several 10^{17} G; the neutrinos emissions are more in the direction parallel to the magnetic-field than that in the opposite direction. This results imply that the strong magnetic field could influences the pulser-kick and the cooling process of proto-neutron stars.

Increase of Electron-Capture Nuclear Decay Rate Under Compression (00h00')

Speaker: RAY, AMLAN

The increased electron capture rates of the nuclei under compression play an important role in the complex dynamics of supernova explosion. Although the situation similar to the supernova condition cannot be simulated in the laboratories, the effect of compression on the electron capture rate was studied by measuring the increase of the orbital electron capture rates of 109In and 110Sn in the smaller Au lattice versus larger Pb lattice. The observed increases were (1+-0.17)% and (0.48+-0.25)% for 109In and 110Sn respectively. The effective pressure experienced by the radioactive atom in the smaller spatial confinement of Au lattice is much higher than what can be achieved by mechanical means in the laboratory. Our observations can be understood by calculating the increase of the eigenstate energy of the compressed atom using TB-LMTO code and then estimating the corresponding increase of the electron density at the nucleus in the framework of Thomas-Fermi model of atom. Recent density functional calculations also support the use of Thomas-Fermi model for the compressed atoms. So the use of Thomas-Fermi model might be useful for the compressed atoms in the pre-supernova stars.

Properties of 26Mg and 26Si in the sd Shell Model and the Determination of the 26Al(p,gamma)26Si Reaction Rate (00h00')

Speaker: RICHTER, W.A.

We will present results for levels in 26Si (mirror of 26Mg). The calculated gamma-decay lifetimes and 25Al to 26Si spectroscopic factors together with experimental information on the levels of excited states are used to determine the 26Al(p,gamma)26Si reaction rates together with a theoretical error on this rate based on the use of the new USDA and USDB interactions. The production mechanism and production site for the long-lived radioactive isotope 26Al has been of interest since the first indications of 26Al enrichment in meteoritic inclusions was observed. Understanding its origin would serve as a unique signature for nucleosynthesis in novae and supernovae. The main reaction sequence leading to 26Al is 24Mg(p,gamma)24Al(beta+ nu)25Mg(p,gamma)26Al. At the high-temperature conditions expected for shell carbon burning and explosive neon burning the 25Al(p,gamma)26Si reaction becomes faster than the 25Al beta decay. Since 26Si beta decays to the short lived 0+ state of 26Al, the long-lived (5+) state becomes depleted.

Constraints on Nuclear Equation of State and Properties of Compact Stars (00h00')

Speaker: ROY CHOWDHURY, Partha

Nuclear EoS is of great interest as its features control the stability of neutron star (NS), the evolution of the universe, SN explosion, nucleosynthesis as well as central collisions of heavy nuclei. Recent astrophysical observations of massive NS and heavy-ion (HI) data are confronted with our present understanding of the EoS of dense hadronic matter. The stiffness of the high-density matter controls the maximum mass of compact stars. New measurements of the properties of pulsars point towards large masses and correspondingly to a rather stiff EoS characterized by symmetric nuclear matter incompressibility K_inf ~250-270 MeV or more. We investigate the impacts of the compression modulus and symmetry energy of nuclear matter on the maximum mass of NS in view of the recent constraints from the isospin diffusion in HI collisions at intermediate energies. We find that the large values of gravitational masses (~2.0 Msolar) for the NS are possible with the present EoS with the K_inf ~274.7 \pm 7.4 MeV, which is rather `stiff' enough at high densities to allow NS with large values of masses ~2Msolar while the corresponding symmetry energy is `super-soft' as preferred by FOPI/GSI experimental data.

The Medium Effect of Magnetic Moments of Baryons on the Neutron Star Under Strong Magnetic Fields (00h00')

Speaker: RYU, Chung-Yeol

We investigate the medium effect due to the density-dependent magnetic moments of baryons on the neutron star under strong magnetic fields. If we allow the variation of the anomalous magnetic moments (AMM) of baryons in a dense matter under strong magnetic fields, it naturally affects the chemical potentials of the baryons to be large and leads to the increase of proton fraction because the enhancement of the AMMs of nucleons is larger than that of hyperons. Consequently, it causes the suppression of hyperons, resulting in the stiffness of the equation of state (EoS). Under the presumed strong magnetic fields, we evaluate the relevant particles' population, the EoS and the maximum masses of neutron stars by including the AMM depending on density, and then compare them with those obtained from the AMM in free space. The strong magnetic fields can cause a heavy neutron star with about 2-3 M_{sun} for hyperonic phase and the effect of the density dependent AMM of baryons can give rise to the increase of maximum mass with about 0.1 M_{sun} under very high magnetic fields though it depends on the strength of magnetic fields.

Direct Measurement of 12C+4He Fusion Cross Section at Ecm = 1.5 MeV at KUTL (00h00')

Speaker: SAGARA, Kenshi

In helium burning in stars, 12C+4He fusion reaction takes place at around Ecm =0.3 MeV. The cross section of this important reaction has been tried to be measured in the past 40 years in the world, but we have no reliable data yet. Direct measurements of 4He(12C,16O)gamma reaction at Ecm from 5 MeV down to 1.9 MeV were made by Rolfs et al. at Ruhr University tandem laboratory. At Kyushu University tandem accelerator laboratory (KUTL), we directly measured 4He(12C,16O)gamma cross section first at Ecm = 2.4 MeV, using a 12C beam, a windowless 4He gas target, and an electric-magnetic analyzer for 16O. We are now making experiment at Ecm = 1.5 MeV. The 12C beam is pulsed to reject backgrounds using time of flight. Our windowless He gas target has enough thickness of 24 Torr x 4 cm. All the 16O recoils in a charge state are analyzed and focused on a Si detector. Our plan is to measure 4He(12C,16O)gamma cross section from Ecm = 2.4 MeV down to 0.7 MeV, and to extrapolate the experimental results to Ecm = 0.3 MeV.

Pasta Structures of Quark-Hadron Phase Transition in Proto-Neutron Stars (00h00')

Speaker: YASUTAKE, Nobutoshi

We study the quark-hadron (QH) phase transition w/wo neutrinos at finite temperature. For the hadron phase, we adopt a realistic equation of state (EOS) in the framework of the Brueckner-Hartree- Fock calculation including hyperons. EOS becomes then too soft to support the canonical mass of 1.4 solar mass, but QH transition may help it out of a difficulty[1]. The properties of the mixed phase are clarified by considering the finite-size effects under the Gibbs conditions at finite temperature [2]. We find that the mixed phase is limited due to thermal instability, and thereby EOS gets closer to that given by the Maxwell construction. Moreover, the number of hyperons is suppressed by the presence of quarks. In this talk, we will show the effects of neutrinos to the pasta structures as new results. These characteristic features of the hadron-quark mixed phase should be important for many astrophysical phenomena such as mergers of binary neutron stars, or supernovae. [1] T. Maruyama et al., Phys. Rev. D76(2007) 1234015; Phys. Lett. B659(2008) 192. [2] N. Yasutake et al., Phys. Rev. D80 (2009) 123009.

Low-Lying Level Structure of 9Li (00h00')

Speaker: AL FALOU, Hicham

The neutron-rich light nuclei provide a fertile testing ground for our understanding of nuclear structure. Recent advances in ab initio models enable calculations of nuclear structure of nuclei with A<12. Yet, available data for such nuclei are limited because, in many cases, the corresponding targets are unstable. With the advent of radioactive nuclear beams, however, such studies can now be carried out by using inverse kinematics. The nucleus 9Li is of interest being the core of the two-neutron halo 11Li, as well as being a candidate of N=6 sub-shell closure. 9Li is well within the scope of current state-of-the-art ab initio calculations. Little information about 9Li is known. We will report on the first study of the d(9Li,d')9Li* inelastic scattering reaction that has been performed at TRIUMF. The first two excited states were observed. The multipolarity of excitations will be determined from angular distribution of deuterons using a DWBA calculation. This determination will provide information on the possible spin assignment of these states. Such data can be used to test the predictions of ab initio model calculations of nuclear structure for nuclei away from stability.

12C, 9Be and 6Be Resonances: Structure and Three-Body Decay (00h00')

Speaker: ALVAREZ-RODRIGUEZ, Raquel

The structure of three-cluster nuclei 12C, 9Be and 6Be has been extensively studied, both theoretically and experimentally, but, suprisingly, there are still large uncertainties regarding their low-lying excited states. For example, there is no agreement regarding the existence of low-lying 2+ excited state in 12C, postulated by Morinaga in the fifties. A good understanding of these states and their decay mechanisms is needed since they are the more likely ones to be important in stellar scenarios. The decay of low-lying 12C, 9Be and 6Be resonances into alpha alpha alpha, alpha alpha n and alpha p p are studied within the complex-rotated hyperspherical adiabatic method. We consider several resonances above the break-up threshold in each case. The short-distance properties of each resonance are studied. Their properties at large distances are decisive for the momentum distributions of the three decaying fragments. The innovative results are exhibited as alpha, n or p energy distributions, energy correlations of Dalitz plots and angular distributions. The predicted momentum distributions are compared to recent experimental data, when possible, and overall agreement is found.

Kinematical Correlation in Direct Reactions Induced by Halo Nuclei in the Region of 11Be (00h00')

Speaker: AMORINI, francesca

The study of dripline nuclei is at the present time a challenging tool to understand structure of nuclear matter toward extreme conditions. In this environment, halo nuclei represent peculiar probes to investigate the passage from stability to lightly bound or unbound configurations, and to test the validity of nuclear models. A complete study of halo nuclei in the region of Be is progress at LNS in Catania, where radioactive beams at Fermi energies can be produced through in flight fragmentation by the FRIBS facility. Some experiments were already performed with the CHIMERA multidetector. 13C and 18O primary beams at 55 MeV/A impinging on 9Be target, generate exotic beams as 10,11,12Be, 12,13,14B and 16,17C with good intensity. These beams are subsequently sent on CH2 and CD2 target to induce direct reactions such as 11Be(p,d)10Be and 10Be(d,p)11Be, to study neutron transfer in order to investigate halo structure. First results of the application of kinematical correlation between reaction fragments detected in the whole solid angle coverage of the array will be shown.

TASISpec: The Next Step in Superheavy Element Spectroscopy (00h00')

Speaker: ANDERSSON, Lise-Lotte

A new nuclear spectroscopy setup called TASISpec [1] (TAsca Small Image mode Spectroscopy) has been commissioned. It exploits the unique small image mode of the TASCA Separator at GSI. The produced SHE can be focused into an area of less than 3 cm in diameter providing the possibility to place composite Ge-detectors very closely around the focal plane, resulting in an unprecedented, highly efficient detection of gamma-rays and X-rays in coincidence with implanted SHE and their decays. In April 2010 TASISpec will be used to disentangle the K-isomer decay scheme of 253No. From previous studies [2] numerous question marks remain. The K-isomers - when defined in excitation energy, spin, and parity - will provide information about the single-particle shell structure of SHE which in turn will relate to shells responsible for magic numbers at or around the anticipated 'island of stability' [3]. Results from this first main beam experiment will be presented along with properties of the set-up and planned upgrades. [1] L-L Andersson et al., submitted to Nucl. Instrum. Meth. A [2] F.P. Hessberger et al., Eur. Phys. J. A 22, 417 (2004) [3] R-D Herzberg et al. Nature 442(7105), 896 (2006)

A Novel Manifestation of Alpha Clustering Discovered in 212Po: Pure Alpha-208Pb States Revealed by Their Enhanced E1 Decays (00h00')

Speaker: ASTIER, Alain

When a nucleus clusterizes into fragments with different charge to mass ratios, its centre of mass does not coincide anymore with its centre of charge, and a sizeable static E1 moment may arise in the intrinsic frame [1], leading to large values of the B(E1) transition probabilities. New experimental results have been obtained for the 212Po isotope. Excited states in 212Po were populated by α transfer using the 208Pb(18O,14C) reaction. Several levels were found to decay by a unique E1 transition populating the yrast state of same spin value. Their lifetimes, measured in the range [0.1-1.4] ps, lead to very-enhanced E1 transitions: B(E1) = 2x10-2 – 1x10-3 W.u. (i.e. up to 1000 times more than typical B(E1) values). These states, which coexist with those expected by the shell model, are the fingerprints of the “α-208Pb” structure of 212Po. They are interpreted as being due to the oscillatory motion of the α-core distance around its equilibrium position [2]. Such a motion, observed for the first time in the whole nuclear chart, represents a novel manifestation of α clustering. [1] F. Iachello, Phys. Lett. 160B, 1 (1985) [2] A. Astier et al., Phys. Rev. Lett. 104, 042701 (2010)

The Finite Amplitude Method: How to Obtain QRPA Codes from Existing HFB Codes (00h00')

Speaker: AVOGADRO, Paolo

The finite amplitude method (FAM) is a novel technique which greatly simplifies the writing of fully self consistent QRPA codes (in particular for deformed systems). The derivation of the QRPA equations from the TDHFB in the small amplitude limit shows that the difficult part in writing the equations is in the calculation of the residual fields. Starting from an existing HFB code the FAM allows to obtain the residual fields with a numerical derivative (so that no analytic derivation is needed). The equations obtained with this technique are fully self consistent (all the terms of the single particle Hamiltonian already present in the HFB code are kept). The FAM can be be applied to non spherical systems thus leading to fully deformed QRPA codes which would be timely in the study of exotic and deformed nuclei.

Helium Halo Isotopes from Low-Momentum Interactions (00h00')

Speaker: BACCA, Sonia

The physics of the strong force gives rise to fascinating halo structures in light nuclei. A prominent example are the helium halo nuclei, He6 and He8, with a two- and a four-neutrons halo, respectively. In literature, several ab initio calculations of these nuclei are found, which are based on traditional potentials and include short-range phenomenology. Our aim is to describe properties of halo nuclei starting from forces derived within the modern approach of effective field theory, where two- and three-body forces among nucleons arise naturally and consistently with each other. Along the road to accomplish that, we present our theoretical approach to the study of He6 and He8 with low momentum interactions. Binding energies and radii will be discussed and compared to experimental data.

Status of Self-Consistent Green's Function for Medium Size Nuclei (00h00')

Speaker: BARBIERI, Carlo

I will discuss Green's function theory in view of its capability of large-scale and ab-initio studies of exotic nuclei. The state of the art method, the so-called Faddeev random phase approximation (FRPA), reproduces the ground state of 4He within 150keV or less. Analogous results come from benchmark studies of ground state and ionization energies in atomic systems. The method is size extensive and therefore errors in larger systems can be controlled. Microscopic developments of FRPA are timely since this formalism gives a theoretical ground for linking structure the reaction theory. Although technically complex, a single FRPA calculation provides simultaneous information on single-particle states and transfer reactions, collective excitations (with and without charge-exchange), two-nucleon transfer, and ground state densities. Applications in the sd and pf shells--based on realistic forces and no-core spaces--have been achieved and will be reported.

Collective States in 120,122Cd Populated via the Beta Decay of 120,122Ag (00h00')

Speaker: BATCHELDER, J. C.

The neutron-rich even-even 110-118Cd isotopes are expected to exhibit harmonically spaced multiphonon states, complicated by low-lying intruder states at the proton mid-shell. Recent studies [1,2] have shown that in these nuclei, none of the observed 0+ and 2+ states previously assigned as 3-phonon states decay in a manner consistent with a 3-phonon state. If the explanation for the discrepancy arises, at least partially, from mixing with intruder states, the effect should be smaller farther away from the mid-shell. To investigate this we have measured the beta decay of 120Ag and 122Ag. These nuclei were produced via the bombardment of protons on 238U at the HRIBF at ORNL. Fission products were then mass-separated by the UNISOR separator and moved to the counting position located at the center of the CARDS array, which consisted of 3 clover Ge detectors, and a 5mm thick Si conversion-electron spectrometer. Comparisons of the measured levels and decay patterns in 120Cd and 122Cd to calculations done in the IBM-2 framework will be presented and discussed. [1] P. E. Garrett, et al., Phys. Rev. C 78, 044307 (2008). [2] J. C. Batchelder, et al., Phys Rev C 80, 054318 (2009).

Systematics of Magnetic Rotation Bands in a Simple Perspective (00h00')

Speaker: BHATTACHARJEE, Tumpa

Following the discovery of shears mechanism in A~190 region, a significant amount of experimental and theoretical activities have been undertaken towards characterization of the Magnetic Rotation(MR) bands and to search for similar bands in other mass region. Theoretically, both phenomenological and microscopic descriptions have been attempted with a view to understand the underlying mechanism of the spontaneous symmetry breaking of nucleonic currents, involved in the development of MR bands. Notably, the semi-classical description of MR bands, proposed by R. M. Clark and A. O. Macchiavelli, has been equally successful in describing the experimental data on MR bands in A~190 region. In this work, we have studied the characteristics of the MR bands in different mass regions in the framework of the semi-classical prescription to arrive at some systematics of the interaction strength as well as rotational contribution involved. The other experimental observables, such as, moment of inertia, angular frequency and alignment have also been examined in this simple perspective with an aim to characterize the MR bands in different mass region and the results will be presented in detail.

Entrance Channel Effects in Isotopic Distribution of Fragments in 13C+12C and 12C+12C Reaction at Low Energy (00h00')

Speakers: BHATTACHARYA, Chandana, RANA, Tapan Kumar

Resonance spectroscopy is one of the important tool to study the structure of exotic unbound nucleus. Such study will not only provide the information of the different state but also can be used to extract the temperature. Recently, there is lots of interest in studying the cluster state using resonance spectroscopy. Here, we present the difference in cluster state formation in 13C + 12C and 12C + 12C reactions at 6MeV/u . It has been observed that the yield of neutron rich isotopes of different fragments is more in 13C + 12C reaction compared to other reaction.

A New Algorithm for Large Scale Shell Model Calculations and its Applicability to Medium-Heavy and Neutron Rich Nuclei (00h00')

Speaker: CORAGGIO, Luigi

An importance sampling iterative algorithm, developed few years ago [1] for diagonalizing large matrices, is upgraded so as to allow large scale nuclear shell model calculations in the uncoupled m-scheme. By exploiting the sparsity properties of the Hamiltonian matrix and projecting out effectively the good angular momentum, the new importance sampling allows to reduce drastically the sizes of the matrices while keeping full control of the accuracy of the eigensolutions. This new version can generate a large number of eigenstates for each angular momentum and, therefore, is able to provide a complete description of the low energy properties of complex nu- clei. The method has been implemented numerically for the study of the low-lying spectra in semimagic nuclei like 116 Sn, in open shell nuclei like 128,130 Xe, possible candidates for being near the U(5)-O(6) shape transition critical point, and in neutron rich nuclei like 140 Te. The calculation produces quite rich spectra together with all possible electromagnetic transition strengths, thereby offering an exhaustive and reliable description of the spectroscopic properties of the nuclei under study. [1]JPG, 29, 2319 (2003)

Level Densities and Strength Functions in Zr Isotopes (00h00')

Speaker: BüRGER, Alexander

Level densities and gamma-ray strength functions are an important input to stellar evolution models and isotope abundance calculations. The nuclear physics group at the Oslo Cyclotron Laboratory has developed the so-called "Oslo Method" to extract both the level density and the gamma-ray strength function below the particle-emission thresholds from particle-gamma coincidence data obtained in proton- or 3He-induced pickup or transfer reactions. This experimental method will be presented in the talk. The experimental setup at the Oslo Cyclotron Laboratory has recently been upgraded with a new set of 64 Si particle telescopes designed specifically for the use with the Oslo Method. The new setup has been successfully tested with an experiment on 90Zr and 92Zr. The level densities and gamma-ray strength functions measured in this experiment will be presented and discussed. The nucleus 90Zr has been studied using both the (p,p') reaction on 90Zr and the (p,t) reaction on 92Zr, and the results reconfirm the validity of the assumptions and approximations underlying the Oslo Method.

Weakly-Bound Rare Isotopes with a Coupled-Channel Approach that Includes Resonant Levels (00h00')

Speaker: CANTON, Luciano

The study of data from radioactive ion beams (RIB) implies the description of weakly-bound nuclear systems. One important aspect of these systems concerns the effect of strongly coupled low-lying excited states, which might not be stable levels, but particle emitting resonances with decay widths significantly different from zero. While current coupled-channel studies of RIB data assume excited energy levels of zero width, it is important to explore the effect of resonance-decay in the excited levels. How does this character change the compound spectra and scattering observables? This question is explored in the framework of a multi-channel algebraic scattering (MCAS) method. For a range of light-mass, particle-unstable nuclear targets (or beams), we compare calculations where the excited levels have and have not the resonant characters. We find that the resonance character markedly change the evaluated cross sections and compound spectra. A proper description of the energy-dependence of the decay widths is needed, specifically to avoid their influence on the sub-threshold bound-state regime.

Influence of the Halo on Angular Distributions for Elastic Scattering and Breakup of Halo Nuclei (00h00')

Speaker: CAPEL, Pierre

Recent elastic-scattering experiments involving halo nuclei have shown the necessity to include a breakup channel to explain the features of these differential cross sections [1,2]. In the dynamical eikonal approximation (DEA) both elastic scattering and breakup of halo nuclei can be consistently described [3]. It therefore constitutes an excellent reaction model to analyse such data. We propose an extension of the Near-Far decomposition [4] to study angular distributions obtained within the DEA for both elastic scattering and breakup. Considering 11Be as a test case, we show that the major features of these distributions at forward angles can be interpreted as a diffractive process. Accordingly, information about the extension of the halo can be extracted from such distributions. This new application of the Near-Far decomposition provides an interesting method to study exotic nuclei, that resorts to mere elastic scattering. [1] V. Lapoux et al., Phys. Lett. B 658, 198 (2008) [2] A. Di Pietro et al., Phys. Rev. C 69, 044613 (2004) [3] D. Baye, P. Capel, and G. Goldstein, Phys. Rev. Lett. 95, 082502 (2005) [4] M. S. Hussein and K. W. McVoy, Prog. Part. Nucl. Phys. 12, 103 (1984)

Benchmarking Models of Breakup Reactions (00h00')

Speaker: CAPEL, Pierre

The advent of radioactive-ion beams in the mid 80s has led to the discovery of halo nuclei. Several reaction models have been developed to extract structure information from the measurements. These models rely on different assumptions: semiclassical [1] or eikonal [2] approximations, or a discretization of the continuum [3]. Though these models are usually in fair agreement with experiment, there remain some disagreements between their predictions. In order to better understand the advantages and weaknesses of each model and to precise their range of validity, we compare them to one another. We also analyse the significance of relativistic effects at intermediate energy, that are simulated in some of the models and not in others. Our comparison provides a hint for the reason for the long-standing problem of the E2 strength in Coulomb breakup of 8B [4]. [1] H. Esbensen and G. F. Bertsch, Nucl. Phys. A 600, 37 (1996) [2] D. Baye, P. Capel, and G. Goldstein, Phys. Rev. Lett. 95, 082502 (2005) [3] J. A. Tostevin, F. M. Nunes, and I. J. Thompson, Phys. Rev. C 63,024617 (2001) [4] J. Mortimer, I. J. Thompson, and J. A. Tostevin, Phys. Rev. C 65,064619 (2002)

States of 15C via the (18O,16O) Reaction (00h00')

Speaker: CAPPUZZELLO, Francesco

A study of the 15C states was pursued at the Catania INFN-LNS laboratory by the 13C(18O,16O)15C reaction at 84 MeV incident energy. The 16O ejectiles were detected at forward angles by the MAGNEX magnetic spectrometer. Thanks to an innovative technique the ejectiles were identified without the need of time of flight measurements. Exploiting the large momentum acceptance (20%) and solid angle (50 msr) of the spectrometer, the 15C energy spectra were obtained with a relevant yield up to about 25 MeV excitation energy. The application of the powerful technique of the trajectory reconstruction did allow to get an energy resolution of about 80 keV FWHM. The spectra show several known low lying states up to about 7 MeV as well as an unknown resonant structure at about 13 MeV. The strong population of these latter together with the measured width of about 5 MeV FWHM reveals the excitation of a collective mode. In addition the measured angular distribution seems to indicate a transfer of a correlated neutron pair in L = 0 configuration, compatible with the Giant Pairing Vibration mode. The analysis is on the way and preliminary results will be presented at the Conference.

Fermi Breakup and the Statistical Multifragmentation Model (00h00')

Speaker: CARLSON, Brett

The Statistical Multifragmentation Model, an equilibrium model of multifragmentation reactions, uses the configurations of a statistical ensemble to determine the distribution of primary fragments, which are then assumed to decay by sequential compound emission or Fermi breakup. As the first step toward a more unified model of these processes, we demonstrate the equivalence of a generalized Fermi breakup model, in which densities of excited states are taken into account, to the microcanonical version of the statistical multifragmentation model. We then discuss how the unified Fermi breakup / statistical multifragmentation model might be modified to describe the well-known process of compound nucleus emission as well.

Realistic Shell-Model Calculations with a Chiral NN Potential for Neutron-Rich sd-Shell Nuclei (00h00')

Speaker: CORAGGIO, Luigi

Recent experimental studies [1-3] have provided more information about the shell evolution of sd-shell nuclei towards the neutron dripline. Here we present shell-model calculations for neutron-rich C, N, and O isotopes performed using a realistic effective Hamiltonian, that is derived from a chiral NN potential. Our approach is fully microscopic, since shell-model single-particle energies, matrix elements of the residual interaction, and single-particle matrix elements of the electromagnetic multipole operators are derived theoretically. This has been done within the framework of the time-dependent degenerate linked-diagram perturbation theory [4]. The calculated results are in very good agreement with the available experimental data, providing a sound description of these isotopic chains. More precisely, the location of the neutron dripline, as well as the disappearance of the N=14 subshell closure when going from the O to the C isotopes, are reproduced. [1] C.R. Hoffman et al., Phys.Lett. B672 (2009) 17. [2] M.J. Strongman et al., Phys.Rev. C80 (2009) 021302. [3] K. Tanaka et al., Phys.Rev.Lett. 104 (2010) 062701. [4] L. Coraggio et al., Prog.Part.Nucl.Phys. 62 (2009) 135.

Towards a Unified Description of Nucleon- and Light Nucleus-Induced Reactions in the 40 MeV-10 GeV Range (00h00')

Speaker: CUGNON, Joseph

The standard version of Liège INC model gives a good description of inclusive nucleon (N) and pion cross sections and of residue yields for N-induced reactions in the 200 MeV-2 GeV incident energy range (confirmed by the recent IAEA benchmark). Recently, several extensions of the model have been studied , which accommodate emission of light charged particles (through a dynamical coalescence model) and light nuclei as projectiles. Other aspects of nuclear dynamics, such as the role of soft collisions, the proper treatment of Pauli blocking and a realistic description of the Fermi surface (which are influential at low energy), and such as multipion channels in N-N and pion-N collisions (which are important at high energy), have been introduced. These developments allow a coherent description of nuclear reactions in the ~40 MeV to 10 GeV incident energy range, with a handful of parameters, determined once for all. Illustrative results (obtained with coupling to various de-excitation models) will be presented, as well as a tentative theoretical explanation of the validity of our INC model at low energy, where the conditions for independent N-N collisions are badly violated.

A Differential-Plunger for Lifetime Measurements of Tagged Exotic- and Unbound Nuclear States (00h00')

Speaker: CULLEN, David

This talk will discuss the development of a new Differential Plunger device at the University of Manchester. The new plunger is designed to work with recoil-, proton-, alpha- and isomer-tagging at the University of Jyvaskyla, Finland. It takes advantage of the existing GREAT and RITU infrastructure to preferentially select weak nuclear channels by detection of recoils, isomeric states or proton/alpha decays at the focal plane of the RITU gas-filled separator. The low-background environment produced by this sensitive tagging technique allows the lifetimes of the states above these isomers and alpha- or proton-unbound states to be measured for the first time. This lifetime information can provide crucial information about the deformation and underlying configuration of the isomer-, alpha-, proton-decaying state. One aim of this work is to study the effect of the triaxiality on tunnelling decay rates. The new plunger design is optimised to work in the RITU gas and will make use of the Lyrtec digital electronics from the SAGE and LISA projects. The status of the device will be discussed along with the first isomer-tagged differential measurements in the proton-unbound nucleus 144Ho.

In-Source Laser Spectroscopy with the LISOL Gas Cell (00h00')

Speaker: DARBY, Iain

The Leuven Isotope Separator On-Line (LISOL) laser ion source is used for the on-line production of short-lived radioactive isotopes. At LISOL, the nuclear reaction products recoiling out of the target are thermalised and neutralised in a noble buffer gas, then resonantly ionised by laser radiation in a two-colour two-step process, extracted from the ion source, accelerated and mass separated. In this way isobaric and isotopic selectivity can be achieved. The laser ion source made it possible to perform β-decay studies of nuclei that are produced in light/heavy ion-induced fusion evaporation reactions. Recently, following the implementation of a number of innovative techniques which improved the gas cell's performance, on-line intra-cell laser spectroscopy was performed on the neutron deficient 57,58,59Cu isotopes and their magnetic dipole moments extracted. In continuation of these developments further improvements are in progress aimed at studying the neutron deficient Ag and Sn isotopes around A~100. In this contribution we will present an overview of the implemented developments, the results from the Cu isotopes and the first on-line results from 97-101Ag.

Exotic Projectiles Fragmentation: From Absolute Cross-Section Measurements to Nuclear-Structure Phenomena (00h00')

Speaker: DE NAPOLI, Marzio

The study of the fragmentation process is relevant in different fields of the physics concerning both basic reasearch and applications as hadrontehrapy and space radiation protection. Theoretical descriptions of the process range from non-equilibrium cold-fragmentation [1] to equilibrated two stages abrasion-ablation hypothesis [2]. Moreower, signatures of nuclear structure were found in the production yields in fragmentation reactions [3]. Recently a systematic study of the projectile fragmentation process for exotic and stable nuclei has been performed at the LNS by using the FRIBs facility [4]. The use of the tagging technique has given the opportunity of measuring the reaction cross-sections by counting one-by-one the different incoming projectiles. The relevant solid angle was fully covered with high granularity, efficiency and resolution Si-CsI hodoscopes to completely characterize the fragmentation products. The results of the experiment will be presented. [1] J. Benlliure et al., Nucl. Phys. A 660 (1999) 87 [2] A. Leistenschnaider et al., Phys. rev. C65 (2002) 064604 [3] M.V. Ricciardi et al., Nucl. Phys. A 733 (2004) 299 [4] G. Raciti, et al. NIM B 266 (2008) 4632

Deformation in the Mid fp-Shell Region: Isomer Tagging in 59Cr (00h00')

Speaker: DEACON, Alick

The structure above the 96-mu s isomer in the isotope 59Cr has been investigated to shed light on the nature of the developing nuclear shapes in the neutron-rich fp shell. Within this region evidence has previously been interpreted in different cases as indicating strong prolate, mildly oblate, oblate and rather soft deformations in closely-lying isotopes. Neutron shell gaps appear at both prolate and oblate shapes near mass-60 that might help drive rapid shape changes. It has been suggested that the 59Cr isomer is associated with an oblate shape, but the experimental situation is rather uncertain, as this interpretation is not unambiguous. The 13C(48Ca,2p)59Cr reaction was used at Gammasphere to populate states above the isomer. Isomer-decay tagging was used in two different ways. Firstly, a Pb catcher placed after the target, along with beam pulsing, pro- vided high-statistics, but complex, prompt-delayed correlations. Secondly, following recoil separation through the FMA, delayed transitions detected in a clover array behind the focal plane were correlated to prompt gamma rays in Gammasphere. Presented here are results from this experiment along with discussion of the methodologies.

Degeneracies Around the Alhassid-Whelan Arc of Regularity (00h00')

Speaker: FETEA, Mirela

More than a decade ago Alhassid and Whelan identified an interior path connecting the U(5) and SU(3) vertices of the Casten symmetry triangle which unlike most of the rest of the interior does not exhibit chaos but rather preserves regularity. Recently, 12 nuclei whose parameters lie along this regularity were found and they all exhibit an almost one-to-one correspondence between the gamma band head and the K=02+ band head. Based on the SU(3) description of the wave functions, we found a couple of different degeneracies, rapidly disappearing as one goes away from the Arc suggesting possible quantum number(s) that may (approximately) be valid in the regular region.

Effects of Tensor Correlations on the Positive Parity States of Some Even-Even Nuclei in the sd Shell (00h00')

Speaker: FIASE, Joseph

Effects of tensor correlations on the positive parity states of some even-even nuclei in the sd shell are examined. Two-body nuclear matrix elements are obtained by the lowest order constrained variational technique with and without tensor correlations. The matrix elements calculated are used as input into the OXBASH shell model code to calculate energy spectra of some even-even nuclei with and without tensor correlations. We have found that the effect of tensor correlations is to open up the calculated energy spectra and provide reasonable agreement with experiment, whereas the energy spectra calculated without tensor correlations compress the energy spectra and provide significant disagreement with experimental data.

Structure of ^{9}Be Low-Lying Spectrum Within a Three-Cluster Model (00h00')

Speaker: VLAHOVIC, Branislav

We study structure of the ^{9}Be energy spectra using the cluster model $\alpha+\alpha+n$. In this model the total orbital momentum is fixed for each energy level. We classified each ^{9}Be energy level as a member of spin-flip doublet corresponding to total orbital momentum (0+, 2+,4+, 1-, 2-,3-, 4-) of the system. The local pairwise potentials are used and the Pauli blocking is simulated by repulsive core of the s-wave components of these potentials. The Ali-Bodmer potential (model E) are applied for $\alpha\alpha$ interaction and for $\alpha-n$ potential modified version of [1] is used. Configuration space Faddeev calculations are performed for energy of the bound state and resonances. A variant of the method of analytical continuation in coupling constant is applied to calculate the energies of low-lying levels. The results are compared with those of [2] and the qualitative agreement with these calculations is demonstrated. The experimental data for ^{9}Be spectrum are well reproduced by our calculations. Our calculations confirm predictions for the J=9/2- resonance to be at about 11 meV. [1] D. Fedorov at al. PRC 49 201 (1994); 2. C. Steven at al. PRC 66 044310 (2002)

Light Ion Induced Nuclear Reactions Close to the Coulomb Barrier (00h00')

Speaker: FORSTNER, Oliver

Many important astrophysical cross sections cannot be measured directly. Thus, it is necessary to understand the mechanism of these nuclear reactions to estimate the excitation functions by model calculations. The aim of our study is to determine excitation functions for the formation of different reaction products with light ions near the Coulomb barrier and to compare the results with computations according to different reaction mechanisms (compound reactions, direct reactions). In the present study results from experiments with a Beryllium beam on a thin Aluminum target below the Coulomb barrier will be presented. A beam of Be-9 ions with energies between 5 and 14 MeV was produced at the VERA tandem accelerator. The formation of several reaction products was determined by the characteristic gamma emissions from these nuclides. For this purpose a HPGe-detector (Ortec GAMMA-X, 25% rel. efficiency) was used perpendicular to the beam line, about 5 cm away from the target. The number of ions impinging on the target during the irradiation was determined by measuring the ion current on the target itself.

Phase Transitions in Phenomenological and Microscopic Cluster Models (00h00')

Speaker: FRASER, P. R.

Two algebraic cluster models of nuclear structure using the same Hamiltonian are explored: a Phenomenological Algebraic Cluster Model (PACM), and a Semi-microscopic Algebraic Cluster Model (SACM). The PACM does not incorporate the Pauli exclusion principle, while the SACM does account for this, by considering the Wildermuth condition in the coherent states and the Hamiltonian. The Hamiltonian considered is an admixture of three dynamical symmetries; the SU(3), O(4), and O(3), with weighting of each determined by parameters. The model Hilbert space of the SACM is constructed in such a way that it includes all shell model states which correspond to the cluster structure of interest. Phase transitions and their orders are investigated for each model, using coherent states, and parameter phase diagrams are presented. It is found that consideration of the Pauli principle has significant consequences.

Directional Correlation of Nuclear-Collision Probability for Aligned Beams of Deformed Nucleus (00h00')

Speaker: FUKUDA, Mitsunori

We could observe a correlation between the direction of nuclear deformation axis and the nuclear collision probability for heavy-ion collisions at intermediate energies for the first time. The collision probability was deduced from interaction cross section. The aligned deformed nuclei were produced in the projectile fragmentation by selecting the parallel momentum of projectile fragments. The experiment was carried out at the HIMAC synchrotron and fragment-separator facility. Aligned nuclear beams of 10B were produced through the projectile fragmentation of 130A MeV 11B primary beam on Be targets. By selecting the parallel momentum using the separator, negative or positive nuclear spin alignment of 10B relative to the beam axis were created. The ground state of 10B is considered to have a large prolate deformation of beta2 ~ +0.8 from its large positive Q moment. Using these aligned beams, the interaction cross sections were measured on a carbon target. For each momentum point, the incident energy at the reaction target was tuned to be the same. A clear directional correlation was observed. We will report on the details of measurements and discussions on this intriguing result.

Repulsive Optical Potential for High-Energy Heavy-Ion Scattering (00h00')

Speaker: FURUMOTO, Takenori

Recently, we have proposed new complex G-matrix interactions CEG07. The CEG07 G-matrices are derived from the free-space nucleon-nucleon interaction, the Extended Soft Core (ESC) model, including the three-body force (TBF) contributions composed of the three-body repulsive (TBR) and three-body attractive (TBA) components. The folding model studies of the nucleon-nucleus and nucleus-nucleus elastic scattering with the use of the CEG07 interactions revealed a decisive role of the TBF effects in reproducing the observed data. Another important prediction of the folding model is that the real part of the folding-model potential (FMP) for nucleus-nucleus systems becomes positive (i.e.~repulsive). We investigate the energy evolution of FMPs in more detail and discuss the possible method for giving an evidence for the repulsive nature of heavy-ion optical potentials at higher energies. We propose to measure the characteristic evolution of diffraction pattern in the differential cross section at forward angles over the energy range of E/A=100$\sim$400 MeV to pin down, for the first time, the clear evidence of repulsive optical potential for heavy-ion systems.

Bended Linear-Chain Configuration of 3alpha Clusters in 13C (00h00')

Speaker: FURUTACHI, Naoya

The realization of linear-chain configurations of alpha clusters has been discussed long time. In the past, the linear-chain configuration of 3alpha clusters was suggested in 12C, and the second 0+ state at Ex=7.65 MeV was a candidate of this structure. However, the second 0+ state is now known to have a dilute cluster-gas structure. It is interesting to investigate how the cluster structures in 12C are changed by valence neutrons, and whether the linear-chain configuration of 3alpha clusters is stabilized or not. Experimentally, Kpi=3/2+- bands that are the candidates of the linear-chain configuration have been proposed on the basis of the systematic analysis of transfer reactions, inelastic excitations one other data. To investigate the proposed linear-chain configuration in 13C, we have performed the microscopic 3alpha+n model calculation. We have found two excited rotational bands that have developed 3alpha cluster structure. The 3alpha cluster structure in the lower band is not so dilute as the second 0+ state of 12C, but has increased stability with the bended linear-chain configuration of 3alpha clusters.

Applying Kramers Formula for the Nuclear Fission Problem: How Accurate Is It? (00h00')

Speaker: GONTCHAR, Igor

The Kramers formula for the fission rate (KFR) [1] and its modifications are widely used in modeling fission and fusion of excited nuclei [2-7]. More accurate – but very time consuming – way to obtain the quasistationary fission rate (QSFR) is to model the process dynamically using stochastic equations [2, 7]. So far the difference between KFR and QSFR was shown to reach approximately 20% and the reasons of this were not identified [7]. We now manage to isolate the causes of the difference to be the distinct features of the potential energy of the fissioning nuclei and the approximations made deriving the KFR. We also report on the modifications of the KFR which reduce the difference down to 2%. [1] H.A. Kramers, Physica 7, 284 (1940) [2] P. Frobrich and I.I. Gontchar, Phys. Rep 292 (1998) 131 [3] H. Hofmann and F.A. Ivanyuk, Phys. Rev. Lett. 90, 132701 (2003) [4] G. McCalla and J.P. Lestone, Phys. Rev. Lett. 101, 032702 (2008) [5] B. Jurado et al., Phys. Rev. Lett., 93, 072501 (2004) [6] C. Schmitt et. al., Phys. Rev. Lett. 99, 042701. (2007) [7] I.I. Gontchar, P. Frobrich and N. I. Pischasov, Phys. Rev. C 47, 2228(1993)

Investigation of Elastic Scattering of ^16O Oxygen on the Nuclei ^12C at Different Energies Using Different Optical Potential Codes (00h00')

Speaker: HAMADA, Sherief

Study of elastic scattering of heavy ions on light nuclei at energies near the Coulomb barrier is of interest both in terms of establishing reliable values for the parameters of interaction potentials of heavy ions at low energies, and for studying the mechanism of cluster transfer in the scattering. For example, an important feature of these data is the substantial rise in cross section in the rear corners, ranging from 80º, at energies of 17 - 80 MeV. As expected, the experimental results of the elastic scattering of 16O on 12C at an energy E = 1.75 MeV/ nucleon shows a marked rise in cross section of elastic scattering at large angles. The process of scattering of 16O ions on the nuclei 12C core is quite satisfactorily described in the forward scattering angles using the optical model and to assess the contribution of exchange effects due to clustering phenomena Born approximation method of distorted waves and also Spival Code with l-dependent imaginary potential were used.

OLYMPUS - An Experiment to Determine the Multi-Photon Contribution to Nucleon Form Factor Data (00h00')

Speaker: HASELL, Douglas

The large discrepancy between polarized and unpolarized determinations of the proton's electric to magnetic form factor ratio, mu_p GEp / GMp, suggests a significant contribution beyond the single photon exchange usually employed to describe elastic electron scattering. This discrepancy increases rapidly with increasing momentum transfer. Since our current understanding of nucleon form factors and related quantities is based on elastic electron scattering data, it is important to know the extent of contributions beyond the single photon exchange. The OLYMPUS experiment will directly measure the contribution of multi-photon exchange by measuring the ratio of the electron-proton to the positron-proton elastic scattering cross section. Details of the experiment and current theoretical understanding will be presented.

Three-Nucleon Forces: From Neutron Matter to Neutron Stars (00h00')

Speaker: HEBELER, Kai

We study neutron and nuclear matter based on chiral nucleon-nucleon interactions. In particular, we investigate the effect of chiral three-nucleon forces, study in detail the theoretical uncertainties of the equation of state, provide constraints for the symmetry energy and its density dependence, and explore the impact on the S-wave superfluid pairing gap. Furthermore we show that our results impose well-defined constraints on the radius of neutron stars.

Time Scales in Nuclear Giant Resonances (00h00')

Speaker: HEISS, Dieter

We propose a general approach to characterise fluctuations of measured cross sections of nuclear giant resonances. Simulated cross sections are obtained from a particular, yet representative, self-energy that contains all information about fragmentations. Using a wavelet analysis, we demonstrate the extraction of time scales of cascading decays into configurations of different complexity of the resonance. We argue that the spreading widths of collective excitations in nuclei are determined by the number of fragmentations as seen in the power spectrum. An analytic treatment of the wavelet analysis using a Fourier expansion of the cross section confirms this principle. A simple rule for the relative lifetimes of states associated with hierarchies of different complexity is given.

In-Medium Similarity Renormalization Group for Nuclear Matter (00h00')

Speaker: HERGERT, Heiko

The Similarity Renormalization Group (SRG) has recently been employed to nucleon-nucleon and three-nucleon interactions with great success, making use of the flow-equation formulation originally developed by Wegner in solid state physics. The In-Medium SRG extends this approach to the A-nucleon system. Its essential feature is a continuous unitary transformation which drives the A-body Hamiltonian towards a band-diagonal structure in a normal-ordering prescription w.r.t. a given reference state. In the process of this transformation, dominant contributions from many-body forces are resummed into effective density-dependent interactions of lower rank, which allows efficient systematic truncations, e.g., by omitting residual interactions beyond the two-body level. We discuss applications of the In-Medium SRG to nuclear matter, and its relation to diagrammtic many-body expansions in this context, e.g., Bethe-Brueckner-Goldstone and parquet theory. By virtue of implicitly including higher-order many-body forces, the In-Medium SRG results are significantly less cutoff-dependent than those obtained with renormalized vacuum NN interactions in the Vlow-k and SRG approaches.

Hartree-Fock-Bogoliubov and Quasiparticle RPA with Unitarily Transformed Realistic Interactions (00h00')

Speaker: HERGERT, Heiko

The development of transformation methods like the Unitary Correlation Operator Method (UCOM) or the Similarity Renormalization Group (SRG) has opened the possibility of performing many-body calculations in the Hartree-Fock method an its extensions like the Random Phase Approximation (RPA) while maintaining a stringent link to the underlying realistic nucleon-nucleon interactions (or even 3N interactions in the case of the SRG). By using actual Hamiltonians, one can avoid conceptual issues which arise in the context of the Energy Density Functional (EDF) formalism, and maintain a clear picture of correlation effects which are obscured by the fitting procedures of phenomenological EDFs. Furthermore, such calculations can provide both guidance and benchmarks in the effort to microscopically derive a spectroscopic-quality universal EDF. We present select results obtained with transformed interactions in the framework of the Hartree-Fock-Bogoliubov approach and the Quasiparticle RPA, including ground-state properties and odd-even mass differences, as well as Giant and Pygmy modes of excitations in various isotopic and isotonic chains.

Generator Coordinate Method Analysis of Neutron-Rich Se and Ge Isotopes (00h00')

Speaker: HIGASHIYAMA, Koji

There is ongoing interest into the question of robustness for the traditional magic numbers at N, Z = 28 and 50, and how the related suggestion of new subshell closures at nucleon numbers 32 and 34 varies as a function of neutron/proton number. The study of the low-lying and high-spin states in the neutron-rich Se and Ge isotopes provides us with an ideal testing ground on robustness of magic N=50. In this work we have studied various Se and Ge isotopes in terms of the generator coordinate method (GCM). The effective Hamiltonian employed in the present calculations consists of the single particle energies and the monopole and quadrupole pairing plus quadrupole-quadrupole interactions, whose strengths are the same as those used in the shell model study [Phys. Rev. C 78, 044320 (2008)]. The model reproduces well the energy levels of high-spin states as well as the low-lying states. The structure of the high-spin and low-lying collective states is analyzed through the GCM wave functions. It is shown that the triaxial components play essential roles in describing the gamma bands.

Local QRPA Vibrational and Rotational Inertial Functions for Large-Amplitude Quadrupole Collective Dynamics (00h00')

Speaker: HINOHARA, Nobuo

On the basis of a microscopic theory of large-amplitude collective motion, called the adiabatic self-consistent collective coordinate method, we have developed a local quasiparticle RPA (QRPA) to microscopically determine the vibrational and rotational inertial functions appearing in the five-dimensional (5D) quadrupole collective Hamiltonian of the Bohr-Mottelson type. The local QRPA is a natural extension of the QRPA for small-amplitude vibrations to large-amplitude vibrations, and provides an efficient way of evaluating the inertial functions taking into account the contributions from the time-odd terms that arise in the moving mean field. These contributions are ignored in the widely used Inglis-Belyaev cranking inertial functions. We apply the newly developed microscopic approach to a wide variety of low-frequency quadrupole collective motions including anharmonic vibrations, quantum phase transitions and oblate-prolate shape coexistence/mixing phenomena. The result of our microscopic calculation intelligibly demonstrate the importance of using the deformation dependent collective masses (inertial functions) in the 5D collective Hamiltonian.

Density-Dependent Effective Nucleon-Nucleon Interaction from Chiral Three-Nucleon Forces (00h00')

Speaker: HOLT, Jeremy

We derive density-dependent corrections to the in-medium nucleon-nucleon interaction from the leading-order chiral three-nucleon force that arises at next-to-next to leading order in the chiral expansion. We first consider a medium of isospin-symmetric nuclear matter and find six distinct one-loop diagrams contributing to the in-medium nucleon-nucleon interaction. We next consider modifications that arise due to a small isospin asymmetry and finally study the case of pure neutron matter as an extreme limit of isospin asymmetry. By combining these density-dependent components with the low-momentum potential V_low-k, we obtain an effective interaction suitable for nuclear structure calculations of medium-mass and heavy nuclei, where a direct implementation of the three-nucleon force is computationally prohibitive. As an application we study the Fermi liquid parameters of symmetric nuclear matter which characterize the interaction of quasiparticles on the Fermi surface. We find that the strongly repulsive character of the three-nucleon force is responsible for stabilizing nuclear matter at leading-order in the expansion of the quasiparticle interaction.

Measurement of Internal Conversion Electrons in 161Ho (00h00')

Speaker: IBRAHEEM, Yasir Saleh

The present study of the EC/β+ decay of 161Er to the levels in 161Ho was completed at the ISOL complex of YASNAPP-2 at JINR, Dubna, in the framework of a program to study the decay of odd-nuclei. Spectra of single γ-ray and γ-γ coincidences were measured with various types of HPGe-detectors. Our results on the γ-ray and γ-γ coincidence measurements have been previously published, where a number of new levels have been suggested. In order to get information on the multipolarity of γ - transitions, the conversion electrons with energies of 10 to 500 keV have been measured for transitions in 161Ho with a β-spectrograph having a resolution of 0.03 %. The source for conversion electron measurements was obtained by electro-deposition of the Er fraction on a 0.1 mm Pt wire. The conversion results obtained for 161Ho allowed several new assignments for different transitions. Spin – parity assignments for most of the previously observed levels have been checked. Our measurements also confirmed the disagreement between the result of the relative γ-ray intensity of the 11.28 keV obtained by us (Iγ ~ 3.9 ± 0.7) and previous Ref., which has reported value (Iγ ~ 10).

Nuclear Deorientation Measurements Using the Plunger Technique in 106Pd and 108Pd Isotopes (00h00')

Speaker: ILIE, Gabriela

Nuclei recoiling into vacuum from thin targets are subject to large hyperfine fields involving the nucleus and the surrounding electron configurations. The presence of this hyperfine filed results in a loss of the initial nuclear alignment and a corresponding reduction in the anisotropy of the gamma-ray angular distribution. The attenuation of gamma-ray angular distributions has been measured for the 2^+_1 state in 106Pd and 108Pd. The states were Coulomb excited using the inverse kinematics reaction by beams of 330 MeV and 336 MeV, respectively, on a 24Mg target. The recoil distance method was used to measure the time-dependence of the attenuation during the flight time as a function of distance. Because the hyperfine interaction involves the nuclear magnetic moments, the g factors of excited states can be obtained from the deorientation measurement. The aim of the present technique which was tested for the first time at WNSL is to measure the deorientation together with the lifetime of the state in an inverse kinematics Coulex reaction. The status of the experimental analysis, results, and a discussion of the parameterization used to fit the data in this work will be presented.

Systematic Calculation of Electric Dipole Strength with Fully Self-Consistent Skyrme-HF Plus RPA (00h00')

Speaker: INAKURA, Tsunenori

We have carried out systematic calculations of the electric dipole modes of excitation up to mass $A=$100 region in the self-consistent Skyrme-Hartree-Fock (SHF) plus RPA approach. We solve the equations in the three-dimensional Cartesian-coordinate-mesh representation without any spatial symmetries. The fully self-consistent RPA are realized using an iterative method we have recently developed; the finite amplitude method (FAM). The method allows us to treat both spherical and deformed nuclei on an equal footing and simultaneously to avoid explicit evaluations of complex residual fields. We will show systematics of the mean energies, widths, and deformation splitting of the giant dipole resonances, in comparison with experiments. We also discuss variations of the low-lying dipole mode in neutron-rich and proton-rich nuclei.

Degenerating Molecule-Like States in Be Isotopes (00h00')

Speaker: ITO, Makoto

In light neutron-excess systems, various molecular structures are discussed from the view point of the clustering phenomena. In particular, much attention has been concentrated on Be isotopes, and their properties can be naturally explained by adding neutrons to the alpha+alpha structures in 8Be. The low-lying states of these isotopes can be described by the covalent structures of excess neutrons, while, in their highly excited states, recent experiments revealed the existence of the atomic or ionic structure, such as 12Be=6He+6He and 14Be=6He+8He. In this report, we discuss the exotic structure change in even Be isotopes from the bound states to the unbound ones. In particular, the structures will be discussed in connection to the chemical bonding of excess neutrons. The theoretical calculations are performed using the generalized two-center cluster model, which can handle the structural changes of the covalent, ionic and atomic configurations in two-center systems. We will show that the chemical bondings change from level to level, and they coexist in the same nucleus with a strong degenerating feature. Characteristic enhancements in reaction probabilities will also be discussed.

Spectroscopy of Exotic Nuclei and Isospin Properties of Shell Evolution (00h00')

Speaker: IWASAKI, Hironori

Exotic nuclei with very unusual proton-to-neutron ratios often show surprising phenomena, presenting important challenges to our understanding of atomic nuclei. The goal of present-day nuclear physics is thus to establish the unified understanding of nuclear structure for stable and exotic nuclei, by exploring the isospin degree-of-freedom of the shell structure and collective properties of nuclei. The present talk focuses on recent experimental studies of neutron-rich and neutron-deficient nuclei in the vicinity of the conventional magic numbers N,Z = 8 [1,2]. The universality as well as the charge independence of the shell quenching phenomena far from the beta-stability line has been demonstrated through two spectroscopic studies of exotic nuclei: a level lifetime measurement of 13B with a neutron number of N=8 [1] and missing-mass spectroscopy of 12O with a proton number of Z=8 [2]. The experimental results will be presented and discussed in terms of possible mechanisms responsible for shell evolution in exotic nuclei. [1] H.Iwasaki et al., Phys. Rev. Lett. 102 (2009) 202502. [2] D.Suzuki et al., Phys. Rev. Lett. 103 (2009) 152503.

Shape Inhibition of Closed Shell Nuclei in the Fission Process (00h00')

Speaker: JAIN, Ashok

Recently, the fission fragment mass distribution for the nucleus ${100}^{256}Fm$ has been measured [1]. The observed distribution shows fine structure dips corresponding to fragment shell closure at Z=50 and N=82. We have analyzed the effect of nuclear structure in the dynamical evolution of the fissioning nucleus by using a two step model. In the first step, the fission fragments are considered to be formed inside the nucleus and in the second step, they tunnel out of the confining nuclear interaction barrier. The fission fragment formation probability is calculated by solving the quantum mechanical Schrodinger equation, whereas the WKB penetrability is obtained analytically. In our investigation, dissipation effects are included by using the prescription of Caldeira and Leggett [2]. These results clearly reveal a new feature of shape inhibition of closed shell nuclei during the fission process. Detailed results of our calculation will be presented. References: [1] L. S. Danu et al., Physical Review C81, 014311 (2010). [2] A.O. Caldeira and A.J. Leggett, Ann. Phys. (N.Y.) 149, 374 (1983).

New Neutron-Rich Micro-Second Isomers Produced via In-Flight Fission of 345 MeV/u Uranium (00h00')

Speaker: KAMEDA, Daisuke

Over forty (sub) micro-second isomers including more than 10 new isomers have been observed during new isotope-production experiments with the BigRIPS in-flight separator in the RIKEN RI beam factory (RIBF). In-flight fission of 345 MeV/u 238U was adopted to access very neutron-rich isotopes of the atomic numbers from Z~30 to ~50. The experiment was performed with the U beam at the intensity of 0.22 pnA on a target. The Be and Pb targets were used for producing fission fragments of Z~ 30-40 and Z~50, respectively. The neutron-rich fragments were selected in the first stage of BigRIPS and were identified in the second stage using the TOF-dE-Bρ method. The achieved A/Q resolution, 0.035-0.056 %, was sufficient to distinguish charge states of the fragments. The fragments were implanted to an Al stopper. The isomeric gamma rays were detected using three clover-type HPGe detectors by the particle-gamma coincidence technique. The observed isomeric decays provide new spectroscopic information about the rare isotopes, together with the isomer-to-total production ratios.

Two-Neutron Correlation in Halo Nuclei via Coulomb Breakup Reactions (00h00')

Speaker: KIKUCHI, Yuma

Two-neutron halo nuclei have been studied with a keen interest in the structure of the ground states and their excitations, and it has pointed out the importance of the two-neutron correlations between the halo neutrons. To expose the role of the two-neutron correlations, Coulomb breakup experiments have been performed, and the low-lying enhancement in the cross section has been confirmed. Theoretically, based on the core+n+n three-body models, the breakup mechanism of the two-neutron halo nuclei has been also studied [1-3]. In this contribution, we discuss the role of the two-neutron correlation in the Coulomb breakup of 6He. Here, we present the breakup cross section and the invariant mass spectra for the binary subsystems such as of 5He and n-n. From the obtained results, it is found that the low-lying enhancement in the cross section comes from the final state interactions dominantly, and we confirmed that the 5He resonance and n-n virtual state play important roles in the Coulomb breakup reaction of 6He [3]. [1] T. Myo et al., PRC63 (2001), 054313. [2] T. Myo et al., PRC76 (2007), 024305. [3] Y. Kikuchi et al., PTP122 (2009), 499, and submitted to PRC.

Nuclear Decay Spectroscopy at the ISOLTRAP Mass Spectrometer (00h00')

Speaker: KOWALSKA, Magdalena

The Penning trap mass spectrometer ISOLTRAP[1] located at ISOLDE/CERN has pioneered the field of high-precision mass measurements of short-lived nuclides. ISOLTRAP has determined over 400 masses, many for the first time, with relative precision up to 10-8 [2]. The inherent high mass resolution of the Penning trap can be used not only for mass determination, but also for beam purification and preparation for further studies[3]. Therefore, at ISOLTRAP we recently installed a decay spectroscopy setup, which we will use for decay studies on pure samples in regions where contamination otherwise hampers such measurements[4]. The system will also assist mass studies by identification of trapped species in cases of unknown production of different isomeric states. Here, we present the setup and commissioning work using 80Rb beam, with which we optimised the efficiency of the ion transfer and of beta- and gamma- detection. We also give an outlook for future studies. [1] M. Mukherjee et al, Eur. Phys. J. A 35, 1, '08 [2] M.K., Hyp. Int. online, '10 [3] L. Weismann et al., Hyp. Int. 132, 535, '01; S. Rinta-Antila et al., Eur. Phys. J. 31, 1, '07 [4] M.K. et al, Eur. Phys. J. A 42, 351, '09

Nuclear Reactions at 25 MeV/Nucleon: Isospin Effects in Semi-Central Collisions (00h00')

Speaker: LOMBARDO, Ivano

Isospin dependence of dynamical and thermodynamical properties observed in reactions 40Ca+40,48Ca and 40Ca+46Ti at 25 MeV/nucleon have been studied. We used the CHIMERA array in order to detect the reaction products. Strong isospin effects are seen in the isotopic distributions of light nuclei. Reaction dynamics seem to be strongly influenced by the different N/Z values of the entrance channels. For the neutron rich reaction 40Ca+48Ca we observe an enhanced probability to produce heavy residues by means of incomplete fusion mechanisms. On the contrary, binary-like phenomena prevails for the isospin symmetric collision 40Ca+40Ca. By comparing experimental mass distributions with calculations performed with CoMD-II model, we can extract information about the stiffness of the symmetry potential at near saturation densities. On the thermodynamical side, we reconstruct apparent temperature and excitation energy values of hot sources formed in incomplete fusion events. The obtained thermo-dynamical parameters are weakly dependent on the N/Z content of the entrance channels. We will show also preliminary results obtained in nuclear collisions 48Ca+48Ca and 42Ca+54Fe at 25 MeV/nucleon.

Simultaneous Description of Scattering and Fusion of Loosely Bound 6,7Li with 28Si at Sub- and Near Barrier Energies (00h00')

Speaker: MAJUMDAR, Harashit

Scattering measurements involving weakly bound nuclei became important due to influence on the fusion process of couplings both to collective degrees of freedom and to breakup/transfer channels. Hence simultaneous analysis of elastic scattering, breakup and fusion cross-sections is necessary for proper description of the reaction mechanism. There are few attempts in this line with few heavy and medium mass targets. But there is no such work in the light target region.In this perspective we have measured elastic angular distributions for 6,7Li+28Si at certain energies in the interval E = 11 – 26 MeV and experimentally extracted total fusion cross-sections for the same systems in the region E=6-26 MeV. Best optical model parameters were found by fitting our elastic data and other data in literature using the code ECIS94. Energy dependence of the potentials showed some features distinctive from those observed with heavy/medium targets . This set of potential parameters were then used to analyse the experimental fusion excitation functions employing the CCFULL code. Preliminary analysis showed encouraging results.Detailed analysis with proper coupling is in progress.

Reaction Dynamics for the System 17F+58Ni at Near-Barrier Energies (00h00')

Speaker: MAZZOCCO, Marco

The scattering process of 17F ions from a 58Ni target has been measured at two colliding energies: 54.1 and 58.5 MeV (VB ~ 46 MeV). The 17F secondary beams with intensities ~ 100 kHz and energy resolutions ~ 1 MeV were produced at the facility EXOTIC at LNL (Italy) and charge reaction products were detected by means of the detector array EXODET. The results were analyzed within the framework of the optical model with the coupled channel code FRESCO. We computed possible contributions to the quasi-elastic data arising from inelastic excitations (sigma ~ 67-75 mb), p-stripping channels (Qgg = + 2.8 MeV, sigma \geq 7-15 mb), n-, 2n-, alpha- and t-pick-up channels (sigma ~ 1 mb) and from the breakup process 17F → 16O + p (Sp = 0.6 MeV, sigma ~ 130-153 mb). Possible (strong) contributions from p-stripping channels leading to resonant states above the 59Cu proton separation energy (Sp = 3.4 MeV) were also investigated. From this analysis a lower limit of 515 (566) mb was extracted for the reaction cross section at 54.1 (58.5) MeV. The comparison with the reaction cross sections measured for the system 16O + 58Ni indicates a rather moderate enhancement (~ 20%) of the 17F reaction probability.

A New Interpretation for the Quasi-Elastic Barrier Distribution (00h00')

Speaker: MONTEIRO, Davi

In this work, we verify [1] that the quasi-elastic (elastic+inelastic) backscattering barrier distributions for weakly-bound systems do not strictly correspond to fusion barrier distributions, but rather to a reaction threshold distribution, as proposed by Zagrebaev [2] in a recent paper concerning very heavy systems. Through experimental data from two recent works with one weakly bound system [3, 4], we verifiy that fusion barrier distributions can be associated with quasi-elastic barrier distributions, only when there is no relevant channels apart from fusion. References: [1] D.S.Monteiro et al., Phys. Rev. C 80, 047602 (2009) [2] Zagrebaev [Phys. Rev. C 78, 047602 (2008)] [3] D.S.Monteiro et al., Phys. Rev. C 79, 014601 (2009) [4] S. Mukherjee et al., Phys. Rev. C 80, 014607 (2009

A Neutron Halo in the Drip-Line Nucleus 22C (00h00')

Speakers: YAMAGUCHI, Takayuki, NISHIMURA, Daiki

The largest "Borromean" quantum three-body bound system has been expected for the drip-line nucleus 22C, based on a shell-model argument on the new magic number N=16 in the light neutron-rich nuclei and its small two-neutron separation energy (S2n~0.4 MeV). Precision reaction(interaction) cross sections at intermediate energies have a high sensitivity to unusual nuclear structures such as halo and skin in the density distributions. A large cross section was the first fingerprint of two-neutron halo structure observed in 11Li. We report a recent achievement along such studies to explore nuclear structures close and at the drip-line. The experiment was performed at the RIKEN projectile fragment separator (RIPS), RIKEN Nishina Center. Reaction cross sections for 19C, 20C and 22C on a liquid hydrogen target have been measured at around 40A MeV by a transmission method. An anomalously large enhancement of the cross sections for 22C compared to those for neighboring C isotopes was observed. A few-body Glauber calculation suggests that the two-valence neutrons in 22C preferentially occupy the s1/2 orbital. The present result supports the new magic number N=16.

Vector and Tensor Analyzing Powers in Deuteron-Proton Breakup (00h00') 127

Speaker: STEPHAN, Elzbieta

High precision data for vector and tensor analyzing power for the dp breakup reaction at 130 MeV deuteron beam energy have been measured in the large part of the phase space. They are compared to the theoretical predictions based on various approaches to describe the three nucleon (3N) system dynamics. Theoretical prediction describe very well vector analysing power data and no three-nucleon force effect is observed for these observables. Tensor analyzing powers can be also very well reproduced by calculations in most of the studied region, but locally certain discrepancies are observed. For A_{xy} such discrepancies usually appear or are enhanced when model 3N forces, TM99 or Urbana, are included. Problems with describing A_{xx} and A_{yy} are limited to very small kinematical regions, usually characterized with the lowest relative energies of two protons, and they are present for all theoretical approaches. These findings will be confronted with preliminary results of similar analysis performed for dp breakup reaction studied at beam energy of 100 MeV.

Student Poster Session 1 - Life Sciences Centre Atrium (19:30-21:30)

title	board
Baryon Spectroscopy at COMPASS (00h00') *Speaker: AUSTREGESILO, Alexander* COMPASS is a fixed-target experiment at CERN SPS which investigates the structure and spectroscopy of hadrons. Its experimental setup features a large acceptance and high momentum resolution spectrometer including particle identication and calorimetry and is therefore ideal to cover a brought range of different topics. During in total 9 weeks in 2008 and 2009, a 190 GeV/c proton beam impinging on a liquid hydrogen target was used primarily to study the production of exotic mesons and glueball candidates at central rapidities. As no bias on the kinematics of the forward-going particles was introduced by the trigger system, these data also yield the unique possibility to study diffractive dissociation of the beam proton while an inert target is assumed. To this end exclusive events with one proton and either a pair of oppositely charged pions or kaons in the final state have been extracted and dominant features of the light baryon spectrum became clearly visible. We will present the status of the ongoing studies and discuss the application of partial wave analysis techniques, which are being successfully employed already for diffractive dissociation reactions of pions in COMPASS.	
Delta-Isobar Production in Deuteron Photodisintegration (00h00') *Speaker: GRANADOS, Carlos* Hard photodisintegration of the deuteron in Delta-isobar production channels is proposed as a useful process in identifying the quark structure of hadrons and of hadronic interactions at large momentum and energy transfer. The reactions are modeled using the hard rescattering model (HRM) following previous works on hard breakup of a nucleon nucleon (NN) system in light nuclei. Through the HRM, it's predicted that for gamma d-->Delta Delta the scattering is largely suppressed in the backward direction resulting in very asymmetric angular distributions in comparison to gamma d--> pn. An estimate of the Delta Delta to pn production ratio is also obtained, and it indicates a dominance of the pn channel of between 5 and 10 times over the Delta Delta channel, in contrast with what is predicted assuming an onset of hidden color for which these cross sections are comparable.	
Precision Pionic Atom Spectroscopy at RIKEN-RIBF (00h00') *Speaker: ITOH, Satoshi* We are planning to perform precision pionic atom spectroscopy at the RIKEN-RIBF. The experimental objective is to achieve the world highest precision of the deeply bound pionic atom spectroscopy by using (d,3He) reaction, thereby precisely determining the in-medium isovector interaction strength between the pion and the nucleus. By applying the dispersion matching technique between the beam transfer line and the BigRIPS spectrometer, we expect to achieve the experimental resolution of 200 keV (FWHM), with which both the 1s and 2s states of the pionic-Sn atom should be simultaneously observable. In May 2009, we performed a test experiment to establish a method to accomplish the dispersion matching and to measure the resolution. In the test experiment, we realized the dispersion matching and obtained the experimental resolution of 190 keV (FWHM). In my session, I would like to introduce the precision pionic atom spectroscopy at the RIKEN-RIBF and report results of the test experiment.	
Exclusive Analysis of the gamma n to K+ Sigma- Reaction at E_gamma=0.8-2.3 GeV (00h00') *Speaker: MUNEVAR, Edwin* Strangeness channels have been shown to be important for the experimental search for missing resonances. They are uniquely suited because they allow the possibility of determining several spin observables. A recent experiment performed at Jefferson Lab (g13 run period) [1], using a liquid deuterium target with linearly and circularly polarized tagged photon beams covering energies from threshold to 2.3 GeV, and using the CLAS detector, provides high-quality data (about 52 billion triggers) with good kinematic coverage and many experimental observables available for each reaction channel. We have analyzed these data to measure strangeness photoproduction on the neutron, in particular, for the gamma, n to K+ Sigma- reaction. A preliminary exclusive measurement of the cross section and the photon beam asymmetry for this reaction will be presented. [1] P. Nadel-Turo\'nski et al., Kaon Production on the Deuteron Using Polarized Photons, PAC30 Proposal: PR-06-103, 2006.	
What Can We Learn From the Subthreshold Phi(1020) Production? (00h00') *Speaker: GASIK, Piotr* Strange particles are very sensitive probes of hot and dense nuclear matter formed in the relativistic nucleus - nucleus collisions. In our experimental studies performed at SIS18 (GSI Darmstadt) with the FOPI Spectrometer, we have measured Phi(1020) meson production in Al+Al and Ni+Ni collisions at 2A GeV. The production of Phi mesons, which decay predominantly in the K+K- channel, obviously affects the rate of kaon production. From the measured production yields we have extracted baryochemical parameters within the statistical model. Comparison of our results with the data obtained at higher energies will be presented.	

Charm Hadrons in Dense Matter and Charmed Hypernuclei (00h00')

Speaker: JIMENEZ TEJERO, clara estela

The properties of charm mesons D, Dbar, Ds and Dsbar in dense and hot nuclear matter are studied within a coupled channel approach with a t-channel vector meson exchange interaction between the pseudoscalar mesons and the ground-state baryons [1]. The in-medium scattering amplitudes are derived by solving the Lippmann-Schwinger equation, including Pauli blocking effects and medium self-energies for the D, Dbar, Ds and Dsbar mesons in a self-consistent way [2]. The spectral functions have a distinctive quasiparticle peak and other structures associated to the excitation of charmed baryon-hole modes. The properties of charmed hypernuclei will also be presented. The single-particle energies of Lambda_c and Sigma_c hyperons bound in several nuclei are obtained from their self-energies, which are obtained within a many-body approach employing Y_c-nucleon interactions constructed via a SU(4) extension of the most recent hyperon-nucleon Juelich potential. The effects of the non-locality and energy dependence of the self-energy on the bound states are investigated. C.E. Jimenez-Tejero, I. Vidana, A. Ramos, Phys.Rev.C80 (2009) 055206 C.E. Jimenez-Tejero, et al., (in preparation).

Study of Pionic and Dalitz Decays of the Delta Resonance with HADES (00h00')

Speaker: LIU, Tingting

The detailed study of the pionic decay and the first measurement of Dalitz decay of the Delta(1232) resonance have been carried out with HADES in the p+p reaction at kinetic beam energy of 1.25 GeV. This experiment belongs to the HADES elementary reaction program providing selective information on different sources of di-electron emission as a complement to the heavy-ion experiments. The energy, chosen just below the eta production threshold, is suited to study the Delta Dalitz decay, which is one of the main sources of di-electron emission in the e+e− invariant mass range 0.15 GeV/c2 < Me+e− < 0.5 GeV/c2. As a first step, the hadronic channels pp→np pi+ and pp→pp pi0 are checked to constrain the resonance production and decay mechanisms. Then, the well controlled models are used for the di-electron production analysis in inclusive pp → e+e−X and exclusive pp→ppe+e− channels. The excitation of the Delta resonance is identified through its mass and production angular distributions. For the first time, the Delta Dalitz decay branching ratio and its helicity angular distribution have been measured. The sensitivity to the time-like electromagnetic N−Delta transition form factor is studied as well.

s-n Scaling in the gamma+3He to p+d Process (00h00')

Speaker: POMERANTZ, Ishay

The constituent counting rule predicts the differential cross section at fixed large center-of-mass angle for exclusive high energy reactions to be: [\frac{d\sigma}{dt} \sim f(t/s)s^{-n}] where s and t are Mandelstam variables and n is the total number of elementary fields in the initial and final states minus 2. The validity of these counting rules was verified for several reactions and n values in the range of 7 to 11. We measured at Jefferson lab the high energy 90° c.m. photodisintegration of 3He into a proton and a deuteron. Cross-section measurements were taken for s= 14-15 GeV2. For this reaction, counting rules prediction is n= 17. We present our preliminary results compared to this prediction.

Hard Photodisintegration of a Proton Pair (00h00')

Speaker: POMERANTZ, Ishay

We present data for the energy dependence of the high energy 90° c.m. photodisintegration of proton-pairs in ^{3}He [1]: \[\frac{d\sigma}{dt}(\gamma+{\rm ^3He} \to p+p+n) \] in kinematics corresponding to the proton pair (and the spectator neutron) nearly at rest in the initial state. Cross-section measurements were taken for eight photon energies in the range of 0.8 - 4.7 GeV. Scaling of the cross section by s^{-11} was observed, in agreement with the constituent counting rule prediction, but commencing at $E_\gamma\ \approx$ 2.2 GeV, rather than 1 GeV as in the deuteron (pn pair) breakup. The magnitude of the scaled cross section $(s^{11}\frac{d\sigma}{dt})$ for pp pair breakup was found to be dramatically lower than for the breakup of pn pairs and theoretical predictions. At energies below the scaling region, the scaled cross section was found to present a strong energy-dependent structure not observed in the pn breakup. The data indicate a transition from three-nucleon hadronic photodisintegration processes at low energies to two-nucleon quark-dominated photodisintegration processes at high energies. [1] I. Pomerantz et al., Phys. Lett. B 684 (2010) 10610

Kaonic Helium X Ray Measurement in SIDDHARTA Experiment (00h00')

Speaker: SHI, HEXI

We performed a spectroscopy measurement of kaonic atom x rays in the SIDDHARTA experiment, at DAFNE e+e- collider in Frascati, Italy. While the main objective is to measure the energy of K-series x ray of the kaonic hydrogen atom, to determine the energy shift and width of its ground state induced by the kaon-nucleon strong interaction, a part of the beam time was dedicated to the kaonic helium x ray measurement to tune the experimental setup. A total number of 144 silicon drift detecters with large effective area and good energy resolution were used for x ray detection. We applied the sub-microsecond time resolution of the silicon detector to select kaon correlated x ray events to reduce a continuous background from the beam line. Since the x ray yield per incident kaon for kaonic helium 3d-2p transition is ten times higher than for kaonic hydrogen 2p-1s transition, and the energies of both are close to 6 keV, we measured kaonic helium x ray to test the time coincidence system and the performance of silicon detectors. The performance of the x ray detectors are successfully evaluated and tuned, and we obtained a precision of a few eV for the kaonic helium 3d-2p transition energy.

Study of Nuclear Matter Under Extreme Conditions (00h00')

Speaker: AJAZ, Muhammad

Nuclear transparency effect is very long and wide studied one in nuclear physics. The ratio of different characteristics of hadron-nuclear and nuclear-nuclear collisions to ones of nucleon-nucleon interaction has appeared sensitive to the states of nuclear matter. Easing and disappearing of the transparency is a signal of the changing the properties of the medium. Nowadays the new high temperature and high density states of nuclear matter – nuclear matter under extreme conditions are looked for and absolutely new properties of matter - color transparency ones are discussed widely. So we investigate nuclear transparency effect to get the signal and study the properties of nuclear matter under extreme conditions. We are using experimental data on light nuclear interactions (in pp-, pC-, dC-, HeC- and CC-reactions) at 4.2 A GeV/c. We study the behavior of the ratios of the some characteristics of hadron-nuclear and nuclear-nuclear collisions to ones of nucleon-nucleon interactions. The experimental results are compared with ones coming from the CASCADE and UrQMD codes.

Photons from Anisotropic Quark-Gluon-Plasma (00h00')

Speaker: BHATTACHARYA, Lusaka

We calculate medium photons due to Compton and annihilation processes in an anisotropic media. The effects of time-dependent momentum-space anisotropy of Quark-Gluon-Plasma (QGP) on the medium photon production are discussed. Such an anisotropy can results from the initial rapid longitudinal expansion of the matter, created in relativistic heavy ion collisions. A phenomenological model for the time-dependence of the parton hard momentum scale, $p_{hard}(\tau)$, and anisotropy parameter, $\xi(\tau)$, has been used to describe the plasma space-time evolution. We find significant dependency of photon yield on the isotropization time (τ_{iso}). It is shown that the introduction of early time momentum-space anisotropy can enhance the photon production by a factor of $10~(1.5)$ (in the central rapidity region) for free streaming (collisionally-broadened) interpolating model if we assume fixed initial condition. On the other hand, enforcing the fixed final multiplicity significantly reduces the enhancement of medium photon production.

Measuring Isotropization Time of Quark Gluon Plasma from the Direct Photon at RHIC (00h00')

Speaker: BHATTACHARYA, Lusaka

We calculate transverse momentum distribution of direct photons from various sources by taking into account the initial state momentum anisotropy of quark gluon plasma (QGP) and late stage transverse flow effects. To evaluate the photon yield from hadronic matter we include the contributions from baryon-meson reactions. The total photon yield, calculated for various combinations of initial conditions and transition temperatures, is then compared with the recent measurement of photon transverse momentum distribution by the PHENIX collaboration. It is shown that due to the initial state anisotropy the photon yield from the QGP is larger by a factor of $8-10$ than the isotropic case in the intermediate p_T regime. It is also demonstrated that the presence of such an anisotropy can describe the PHENIX photon data better than the isotropic case in the present model. We show that the isotropization time thus extracted lies within the range $1.5 \geq\tau_{\rm iso} \geq 0.5$ fm/c for the initial conditions used here.

Identified Particles Directed Flow in Au+Au Collisions at RHIC (00h00')

Speaker: CHEN, Jiayun

Directed flow (v1) is one of the key observables in characterizing properties of the dense and hot medium created in the relativistic heavy-ion collisions. Because of baryon stopping, the rapidity dependence of proton v1 is expected to have a positive slope, opposite to that of pions. The expansion of a quark-gluon plasma phase however can cancel out this effect and lead to a reduced or even negative slope for proton v1 near mid-rapidity. In this talk, Directed flow, v1 for charged hadrons and identified particles including pions, kaons (Ks), protons and antiprotons, for Au + Au collisions at 200 GeV are measured. Negative v1 slopes are found for pions, proton, antiprotons and kaon(Ks) in centrality 10%-70%, which are consistent with anti-flow phenomenon. Nevertheless, in mid-central collisions (5-30%), proton v1 slope is less than 0.1%, and a surprisingly sizable difference between v1 of protons and antiprotons is observed. The centrality and energy dependence of proton v1 is also studied. The comparison between the current results and the available models (RQMD, uRQMD, AMPT,QGSM) will be presented.

Study of the Strange Resonance Sigma (1385) in the Decay Channel Lambda-Pi: Simulation Studies and First Analysis Attempts on pp Collisions in the ALICE Experiment (00h00')

Speaker: VENARUZZO, Massimo

Due to its strange quark content and high mass, the measurement of the Sigma(1385) yields will give additional information about strangeness and resonance production at the LHC energies. The comparison between yields in pp and PbPb can help providing an estimate of the time-span between chemical and thermal freeze-out: it determines the net effect of re-scattering and regeneration on the total yield and therefore, gives interesting constrains for the expansion of the Quark Gluon Plasma formed in ultra-relativistic heavy-ion collisions. Tools for the extraction of the Sigma(1385) signal in the strongly-decaying Lambda pi channel in simulated pp collisions will be presented. The fitting procedure involves different techniques for combinatorial background evaluation. Its implementation and its use to extract the signal, the significances and the yields in different bins of transverse momentum and rapidity, will be presented together with a first analysis attempt on real pp collisions data at 7 TeV.

Beam Energy and System Size Scan on Dihadron Azimuthal Correlation (00h00')

Speaker: ZHU, Yuhui

Dihadron correlation is an essential tool to study the interaction between QGP and jet. A systematic simulation on collision system size and beam energy dependence of di-hadron correlations is studied by AMPT model. Some physical observables calculated in two versions of AMPT are compared to study the different physical processes undergoing a partonic phase or a pure hadron gas. In the AMPT version undergoing a partonic phase, with varying the beam energy or system size, the change of the structure of correlation functions from an almost single peak to an obvious double peak implies a change of responding mechanisms of the medium to the jet. The correlation functions in different versions accord with each other at very low energies or in rather small systems, indicating that maybe the most essential factor which determines the trend of physical process is some global parameter. The beam energy dependence of the initial energy density indicates that maybe it is the initial energy density which drives the physical processes to a certain direction, and the dependence trend shows that the turning point may exist between 7 GeV and 39GeV in Au+Au collisions.

In Trap bb Decay Spectroscopy at TITAN (00h00')

Speaker: BRUNNER, Thomas

In order to determine the nature of the neutrino several very sensitive experiments are presently searching for evidence of neutrinoless double beta decay. In this special lepton number violating decay, a complex nuclear matrix element connects the half life of this process with the effective neutrino mass. The measurement of electron-capture branching ratios (ECBR) of odd-odd intermediate transition nuclei in a bb-decay offers an ideal benchmark to determine nuclear matrix elements. For this, a new technique has been developed and tested at TRIUMF's TITAN facility. Intermediate transition nuclei will be stored in an open access Penning ion trap that allows their nuclear decays to be observed in-situ. The 5 T magnetic field guides the betas out of the trap. Thus, EC X-rays can be detected radially with ideally no beta background contribution. During preliminary experiments with 107In and 126Cs the performance of X-ray and b-detectors as well as the experimental setup as a whole has been tested. In both experiments it was possible to store ~1e5 ions in the Penning trap and determine their ECBR. This contribution will present results of this new method of in-trap-decay spectroscopy.

Discrimination of Muons and Hadrons in Calorimeters Using the Artificial Neural Network for Atmospheric Neutrino Experiment (00h00')

Speaker: GHOSH, Tapasi

The India-based Neutrino Observatory (INO) [1] is a proposed atmospheric neutrino experiment where a large magnetized Iron Calorimeter (ICAL) will be used as main detector. When cosmic neutrinos interact with iron nuclei, they will produce corresponding charged lepton together with hadron shower. Hence in calorimetric measurements of neutrino interactions, hits generated by muons and hadrons together in an event poses a challenge in identifying muon hits for reconstruction of tracks. An algorithm based on the Artificial Neural Network (ANN) is developed to separate out the muon events and muon hits from the hadron events and hadron hits respectively in a calorimeter. The muon identification efficiency of about 98 % with < 10 % hadron background fraction were obtained when muon and hadron events are mixed in event-level. However, for a case where hits from two types of particle are embedded in an event (i.e. generated due to charged current interaction), the efficiency obtained is 67 % with < 40 % hadron background fraction. It is seen that ANN provides a considerably better performance compared to other conventional likelihood methods. 1. INO Project Report INO/2006/01, June 2006, (http://www.imsc.res.in/~ino/)

Using the Two Species Lipkin System to Understand the Random Phase Approximation (00h00')

Speaker: MALKUS, Annelise

The two speciel Lipkin model is a simple two level system that can be solve exactly. As such it makes a usefull tool for evaluating the Random Phase Approximation (RPA). We find the exact spectrum numerically and an approximate spectrum analytically using the RPA. We examine the behavior inside the spherical region and in the deformed region.

Results for CCQE Scattering with the MINOS Near Detector (00h00')

Speaker: MAYER, Nathan

The MINOS experiment has the world's largest data set of neutrino interactions in the 1-10 GeV energy range. The data set consists primarily of neutrino-iron interactions which enables us to explore the effects of high Z on neutrino-nucleus scattering. I will present preliminary results on quasi-elastic scattering using an event sample selected to have a single prong and low hadronic energy recorded during an exposure of the MINOS Near Detector to neutrinos from the NuMI beam at Fermilab. We extract a value of the axial-vector mass from fits of the quasi-elastic Q2 distribution and I will discuss the behavior of the distribution at low Q2 where many model uncertainties are important. I will also present future improvements in the M_A measurements which will be possible by including a 2-prong sample improving coverage at high Q2 values.

A High-Precision Measurement of theta13 at Daya Bay (00h00')

Speaker: MCFARLANE, Michael

A High-Precision Measurement of theta13 at Daya Bay Michael McFarlane, University of Wisconsin - Madison On behalf of the Daya Bay Collaboration The Daya Bay Reactor Neutrino Experiment is a neutrino oscillation experiment under construction at the Daya Bay Nuclear Power Plant in China with the goal of measuring the neutrino mixing angle theta13. Daya Bay deploys eight antineutrino detectors filled with 20 tons of gadolinium-doped liquid scintillator apiece to detect antineutrinos via inverse double beta decay. Pairs of identical detectors are distributed among underground sites ranging from 0.3-2km from the reactors. By comparing the relative antineutrino fluxes between near and far detectors, Daya Bay will reach a sensitivity of sin^2 (2 theta)<0.01 at 90% C.L.

Improvements to Resolution and Efficiency of the DEAP-3600 Dark Matter Detector and their Effects on Background Studies (00h00')

Speaker: OLSEN, Kevin

The DEAP 3600 collaboration is searching for dark matter with a detector consisting of 3600 kg of pure liquid argon in a low background detector, located in the SNOLAB underground laboratory. We report on our investigations of several crucial aspects of this detector, including phototube properties, algorithms for measuring energy and rejecting backgrounds, and developed techniques to measure the surface backgrounds in a prototype detector.

ArgoNeuT and the Neutrino-Argon Charged Current, Quasi-Elastic Cross Section (00h00')

Speaker: SPITZ, Joshua Spitz

Liquid Argon Time Projection Chamber (LArTPC) technology offers exceptional resolution, calorimetry, scalability, and particle identification capabilities for neutrino detection. ArgoNeuT, a 170 liter LArTPC neutrino detector, recently completed its 160 day physics run in the NuMI beamline at Fermilab. Thousands of neutrino and anti-neutrino events (from 0.1-10 GeV) in a wide variety of channels have been collected. The ongoing charged current, quasi-elastic (anti-)neutrino-argon cross section analysis will be discussed. (Anti-)Neutrino events in ArgoNeuT and preliminary kinematic distributions will be presented along with a description of the detector design and future prospects. Special emphasis will be placed on understanding intra-nuclear interactions and their effect on neutrino-nucleus cross section measurements.

Revisit Electroweak Pion and Photon Production Off Nucleon and Nuclei up to Intermediate Energy (00h00')

Speaker: ZHANG, xilin

The whole project is, to some extent, to investigate the Electroweak response of the nuclear many-body system up to intermediate energies, where the Delta resonance becomes important. Eventually, we will apply the theory to calculate weak pion and photon production off nuclei, which are potential backgrounds in neutrino oscillation experiments, such as MiniBooNE, for example. First, we will try to build up the theoretical framework, combining both Chiral Field Theory and Quantum Hadrodynamics(QHD). Second, we will finish Electro, Neutral Current (NC) and Charged Current (CC) quasielastic scattering off nuclei, NC and CC pion production and NC photon production off NUCLEONS and NUCLEI. In these calculations, the calculation of weak pion production off the nucleon will be the benchmark. And then weak photon production off the nucleon will be something new. Concerning the many-body effects, the electroweak quasielastic scattering calculation will be the benchmark. And weak pion and photon production off nuclei will be something new.

Gravitational Wave Generated by Mass Ejection in Protoneutron Star Neutrino Burst (00h00')

Speaker: ALMEIDA, Luis Gustavo

In this work we discuss the mechanism of mass ejection in protoneutron stars induced by diffusion of neutrinos. A dynamical calculation is employed in order to determine the amount of matter ejected and the properties of the remnant compact object. The equations of state of this supra-nuclear regime is properly linked with others describing the different sub-nuclear regimes of density. For specified initial configurations of the protoneutron star, we solve numerically the set of equations of motion together with a schematic treatment of the neutrino transport through the dense stellar medium. We investigate the gravitational waves production accompanying the mass ejection induced by the neutrino burst. It is estimated the gravitational wave intensity and the detection of such wave by the existing detector or near future project for this purpose is discussed.

Mass Ejection Induced by Proto-Neutron Star Neutrino Burst (00h00')

Speakers: ALMEIDA, Luis Gustavo, RODRIGUES, Hilario

In this work we present an effective dynamical calculation to investigate the possibility of mass ejection in proto-neutron stars. The neutrino momentum transfer when neutrino flux diffuses through the core dense medium can induce the mass ejection after the collapse and bounce of the proto-neutron star structure. A simplified dynamical calculation is employed in order to determine the amount of matter ejected and the properties of the compact object left behind, as a remnant dense core. In solving the dynamical evolution of the system, the internal energy density and pressure of the medium is described by an equation of state which incorporates the quark and hadronic phases as well as the mixed coexisting phase. The equations of state of this supra-nuclear regime is properly linked with others describing the stellar matter in different sub-nuclear regimes of density. The set of equations of motion is solved numerically coupled to a schematic treatment to the neutrino transport along the dense media of the shells.

Lifetime Measurement of the 6.79 MeV State in 15O (00h00')

Speaker: GALINSKI, Naomi

The 14N(p,gamma)15O reaction rate is the principal nuclear uncertainty in estimating the ages of globular cluster stars, the oldest objects in our galaxy. R-matrix analyses of the 14N(p,gamma)15O S factor indicate that the main contributor to S(0) is the transition to the 3/2+, 6.79 MeV state in 15O, lying 506 keV below the 14N + p threshold. Therefore the reaction rate at stellar temperatures strongly depends on the width or equivalently the lifetime of the 6.79 MeV state. We measured the lifetime of the 6.79 MeV state using Doppler shift attenuation method via the 3He(16O,alpha)15O reaction. We bombarded a 3He implanted Au foil with a 50 MeV 16O beam from the ISAC-II accelerator to populate the 6.79 MeV state in 15O. The experimental setup employed the Doppler Shift Lifetimes Facility and a TIGRESS gamma ray detector. This lifetime measurement will provide an experimental constraint on the stellar rate of the 14N(p,gamma)15O reaction.

NEURAL - A Tracking Detector for Neutron-Induced Reactions of Astrophysical Importance (00h00')

Speaker: MARTIN, L.

Observations from gamma ray telescopes indicate that most of the galactic 26Al originates in massive stars. Several sites have been discussed for its production, including proton burning in the winds of very massive stars, and the later, explosive burning stages of these stars. Observations from the RHESSI and INTEGRAL missions currently seem to point to the latter scenario. In the advanced burning stages of massive stars the presence of neutrons becomes an important factor in nuclear reaction networks. In addition to the 26Al(p,gamma)27Si reaction, the neutron capture reactions 26Al(n,p)26Mg and 26Al(n,α)23Na can lead to the destruction of 26Al, and thus alter the observed 26Al abundance. NEURAL is a proposed detector design to measure the excitation functions of these reactions over a wide range of energies. 26Al targets implanted at TRIUMF will be exposed to a pulsed neutron beam at LANSCE (Los Alamos). NEURAL is designed to detect all charged reaction products, combining a TPC for the heavy ions, and Si detectors for the light particles mounted around the target. A first prototype has been built and partially tested at TRIUMF and LANSCE.

Finite Temperature Relativistic Random-Phase Approximation and its Applications in Astrophysics (00h00')

Speaker: NIU, Yifei

The fully self-consistent relativistic random-phase approximation (RRPA) framework based on effective Lagrangian with density dependent meson-nucleon couplings is extended to finite temperatures for studies of non-charge exchange and charge exchange modes. The finite temperature RRPA (FTRRPA) configuration space is built from the spectrum of single-nucleon states obtained by the temperature dependent relativistic mean field theory. In the non-charge exchange cases, illustrative calculations are performed for the isoscalar monopole and isovector dipole modes. In particular, the evolution of low-energy excitations with temperature is analyzed, including the modification of pygmy structures corresponding to the resonant oscillation of the weakly-bound neutron skin against the isospin saturated proton-neutron core. In the charge exchange channels, the evolution of GT transitions with temperature is presented for selected iron group nuclei and germanium isotopes. The charge exchange FTRRPA is applied in studies of electron capture cross sections for target nuclei at finite temperature, relevant in modeling the evolution of a massive star and in pre-supernovae stellar collapse.

Study of Astrophysically Important Excited States of 30S via the 28Si(3He,n gamma)30S (00h00')

Speaker: SETOODEHNIA, Kiana

The 29P(p,gamma)30S reaction at nova temperatures plays an important role in understanding the Si isotopic abundances in presolar SiC grains of nova origin, which provide us with information on the nature of the white dwarf progenitor's core and the peak temperatures achieved during nova outbursts. The 29P(p,gamma)30S reaction rate is uncertain due to lack of information about the properties of two low-energy proton unbound 3+ and 2+ resonances that dominate this reaction rate at nova temperatures. We performed an in-beam gamma-ray spectroscopy experiment at the University of Tsukuba Tandem Accelerator Complex laboratory in Japan to study the excited states of interest in 30S, with the aim of determining their level parameters more accurately to be able to reduce the uncertainty in the 29P(p,gamma)30S reaction rate. 30S excited states of interest were populated by the 28Si(3He,n gamma)30S reaction and the gamma-rays and neutrons were detected by two Ge-detectors as well as a liquid scintillator, respectively. The present status of data analysis will be be discussed.

New Equation of State for Supernova (00h00')

Speaker: SHEN, Gang

We calculate the equation of state (EoS) of nuclear matter for a wide range of temperatures, densities, and proton fractions for use in supernova and neutron star merger simulations. We employ a full relativistic mean field (RMF) calculation for matter at intermediate density and high density, and the Virial expansion of a nonideal gas for matter at low density. This is an improvement over the Lattimer-Swesty equation of state and the H. Shen and Toki equation of state. We use the RMF parameter set NL3, and approximate the unit cell for non-uniform nuclear matter as a spherical Wigner-Seitz cell, wherein the mean fields of nucleons are solved fully self-consistently. The Virial gas consists of neutrons, protons, alpha particles, and 8980 species of nuclei from FRDM mass tables. As the density decreases, the mean field results match smoothly to the Virial gas. At very low density, the Virial expansion reduces to nuclear statistical equilibrium. We tabulate the resulting EoS at over 180,000 grid points in temperature T = 0 - 80 MeV, density nB = 10−8 - 1.6 fm−3, and proton fraction YP = 0 - 0.56. This table will soon be available for supernova and neutron star merger simulations.

Measurement of Emission of Hydrogen- and Helium-Isotopes from Carbon, Silicon, Iron and Bismuth Induced by Intermediate Energy Neutrons (00h00')

Speaker: BEVILACQUA, Riccardo

We have measured double differential cross sections (DDX) and yields for emission of hydrogen- and helium-isotopes in the interaction of 175 MeV quasi-monoenergetic neutrons with C, Si, Fe and Bi using the Medley setup, a spectrometer system installed at the The Svedberg Laboratory (Uppsala, Sweden). Medley offers well defined particle identification with low-energy thresholds, over a wide dynamic range. Energy spectra were measured at eight laboratory angles. The time-of-flight was used to reduce the contribution from the low energy tail in the accepted incident neutron spectrum. The experimental data presented in this work will provide benchmark points for state-of-the-art theoretical models, helping to produce reliable evaluated data, to verify new phenomenological optical model potentials, to ensure a good link between low and high energy processes. We compared experimental DDX with model calculations using the TALYS code. Using the PHITS code we also compared the experimental results with the evaluated cross sections in the JENDL high-energy file, with the intra-nuclear cascade model and with quantum molecular dynamics calculations. We will present and discuss these results.

Th-U Fuel Cycle in the Spallation Neutron Environment (00h00')

Speaker: BHATIA, Chitra

Neutronics of a reactor for accelerator driven subcritical system (ADS) based on spallation neutrons is expected to be very much different compared to a thermal and a fast reactor. For the purpose of study of a fuel cycle elementary cross sections are calculated from the TALYS 1.0 and the CASCADE code and the spectrum average cross sections are calculated using the PREPRO-07 code. It is observed that values of the sp.av.cs. are high in several mb range for many non elastic channels of elements of the fuel cycle e.g. sp. av. cs. of 232Th(n,6n) =7.77 mb and 235U(n,3n) = 27.8 mb. Obviously, these reactions are not possible in thermal and the fast reactors. It is also revealed that sp.av.cs. of (n,g) reaction of fuel element of a cycle is reduced drastically in case of spallation neutron spectrum compared to a thermal spectrum e.g. in case of 232Th it reduces to 90.1 mb from 3.11 b. In the paper, detailed tables of the sp. av. cs. are given for numerous reactions pertaining to the extended Th-U fuel cycle and compared them with the corresponding available data in case of the thermal and the fast spectra. It is concluded that fuel cycles of an ADS reactor will be highly extensive.

A Study of Non-Elastic Reaction Rates for the ADS Materials in the Environment of Spallation Neutrons Produced by 1.6 GeV d-Beam (00h00')

Speaker: BHATIA, Chitra

For the design and modeling of accelerator driven sub critical system a detailed study of response of ADS materials to the spallation neutrons is required. For this purpose reaction rates of different reactions in 209Bi, natMo, 56Fe, natNi, 55Mn, natTi and natCo are determined in an experiment conducted at Nuclotron of JINR, Dubna using 1.6GeV d-beam in the “Energy + Transmutation” set up. Reaction rates of various (n,xn) and (n,xnpy) reactions are studied in these samples. Data of reaction rates of 209Bi (n,xn) reactions with x = 3 to 9, natMo (n, g), (n,3n), (n,6n), 56Fe (n,p), (n,p2n), (n, p4n), natNi (n,2n), (n,3n), (n,p), (n,d), (n,t), 55Mn (n, g), (n,2n) , (n,4n), natTi (n, p), (n, d), (n, t) and natCo (... n, xn) reactions with x = 2 to 5 along with (n, p), (n, 2p2n) , (n, 2p4n) and (n, 2p4n) are presented. These results will be compared qualitatively with our earlier GAMMA-2 experiment having moderated neutron flux using paraffin moderator. The experimental flux deduced using (n,xn) , (n,g) and (n,xnpy) reactions will also be presented.

Study of Transfer Reaction Channel Produced in the System 12C+27Al at 73 MeV (00h00')

Speaker: BISWAS, Mili

Recently, we have studied one nucleon transfer (proton transfer) in the reaction 12C+27Al which ends up with 11B+28Si as exit channel. The experiment was carried out at BARC-TIFR 14UD Pelletron Accelerator Laboratory, Mumbai, using 73 MeV 12C ion beam on 27Al target. Emitted fragments have been detected in Si-Si telescope in a wide angular range. The solid angle coverage was 2.26□10-4 sr. Here, in this paper, the different states of 11B populated in the reactions 12C+27Al will be presented. The experimental data have been analyzed with the software LAMPS. The theoretical zero range distorted wave Born-approximation calculations have been done using the code DWUCK4. The required optical model potential parameters were extracted by fitting the elastic angular distribution data for the systems 12C+27Al (entrance channel) and 11B+28Si (exit channel) respectively using the code ECIS94. Though the theoretical DWBA calculation reproduces the shape of the experimental angular distributions for the ground and first excited state very well still they vary in magnitude. DWBA calculation underpredicts the differential scattering cross sections.

Enhancement of the Two Neutron Transfer Channel in the 18O Induced Reactions at 84 MeV (00h00')

Speaker: CARBONE, Diana

A systematic study of particle-particle correlations in different nuclei has been done by transfer reactions induced by 18O Tandem beam at 84 MeV incident energy. This corresponds to about ten times the Coulomb barrier for light targets as 9Be, and is around the barrier for the heavier one, 208Pb. In addition the incident energy is safely low to reduce the influence of deep inelastic mechanism. In these conditions detailed information about nuclear structure can be accessed. The experiment has been performed this year at the INFN – LNS (Italy) using a 18O beam on different targets as 9Be, 11B, 13C, 28Si, 58Ni, 64Ni, 120Sn and 208Pb. The ejectiles have been momentum analyzed by the MAGNEX spectrometer. The achieved mass resolution (about 1/160) has allowed to identify the reaction products corresponding to different reaction channels, such as one and two neutron or proton transfer, inelastic scattering etc. The integrated cross sections show an enhanced yield for the transfer of two neutrons compared to one. This striking result demonstrates that the (18O,16O) reaction proceeds mainly by the direct transfer of the neutron pair, instead of being a second order process.

Quasi Fission Reaction in Highly Asymmetric Reactions (00h00')

Speaker: E, Prasad

Quasi fission (QF) process is a non-compound nucleus process and a major hurdle in the formation of superheavy elements and evaporation residues. Early dynamical models predicted the onset of these process when the charge product (ZPZT) of the reaction partners is greater than 1600. However recent observation of unexpected presence of QF in asymmetric reactions forming the compound system Po, Ra and Th, has evoked considerable interest in this field. In this context, we have measured the mass angle correlations and mass ratio distributions of fragments in two highly asymmetric reactions 16O + 194Pt (ZPZT = 624) and 24Mg + 186W (ZPZT = 888), forming the same compound system 210Rn. The fragments were measured in position sensitive MWPCs and the mass ratio distributions were deduced using conservation principles. It has been observed that the mass ratio widths of 24Mg + 186W reaction are larger than that of 16O + 194Pt reaction, at the same excitation energies. Calculations show a remarkable deviation of 24Mg + 186W reaction from compound nucleus behavior, confirm the onset of QF in this reaction, which could be due to the very high deformation of the reacting partners.

New Results on Central Collisions: 124,136Xe+124,112Sn at 32 and 45 MeV/u (00h00')

Speaker: GAGNON-MOISAN, Francis

Since the first results published in 2001, evidence for a spinodal decomposition in multifragmentation from charge correlation has kept a high interest in the heavy ion community. The significance of those results were however limited by the low statistics available, and a new INDRA campaign was held at GANIL; the very first results are about to be advanced. In addition to the evidence for spinodal decomposition, which should unambiguously prove the existence of a liquid-gas type transition for nuclei, the effect of isospin on the spinodal region is studied. We have a high statistics experimental data, on systems 124,136Xe+124,112Sn at 32 and 45 MeV/u, with excellent overall identification and calibration. Another isospin effect is studied with the recently developed relation between N/Z and kinetic energy (with IMF in central collisions) by M.Colonna & al. This relation, which is EOS-dependent, show interesting results in simulations. For the first time, theoretical prediction are confronted with experimental data on the Xe+Sn systems available.

Light Charged Fragments Analysis in the 36Ar+58Ni and 58Ni+58Ni Reactions (00h00')

Speaker: GAUTHIER, Jérôme

The existence of a third emission source between the target and the projectile in heavy-ion reactions has been shown some years ago. Recent studies seem to show that this zone has a N/Z ratio higher than the N/Z of the whole system. These results suggest a neutron enrichment of the mid-rapidity. The two first campaigns of the INDRA detector provide a very high amount of well-identified and calibrated data. So, this allows us to make a good selection of the mid-rapidity for 36Ar+58Ni and 58Ni+58Ni reactions from 32 to 84 AMeV. Light particles and fragments (Z=1 to 4) investigation show an interesting behavior depending upon the emission source, the system and the beam energy. However, INDRA is designed to study the most central collisions. Our own detector, HERACLES, which will receive the ISAC-II beams, has been designed to study peripheral collisions. The capacity of ISAC-II to deliver exotic beams is another very useful feature allowing us to add the isospin variable to the experiment.

Barrier Modificaton in Sub-Barrier Fusion Reaction 64Ni+100Mo Using Wong Formula with Skyrme Forces in Semiclassical Formalism (00h00')

Speaker: GUPTA, raj kumar

Recently, Wong formula is shown to have the inbuilt property of “barrier modification” via the \ell-summation, ignored in its use of \ell=0 barrier alone (Phys. Rev. C 80 (2009) 034618). This is found adequate for 48Ca based capture reactions, but require additional barrier modifications at sub-barrier energies for fusion-evaporation data in 64Ni+100Mo, etc., also supported by the Dynamical Cluster-decay Model calculations (J. Phys. G: Nucl. Part. Phys. 36 (2009) 085105). These studies are based on proximity potential. In present work, we use Semiclassical Extended Thomas Fermi method for calculating the nucleus-nucleus interaction potential under frozen density approximation, with different Skyrme forces. Interestingly, Wong formula, with explicit \ell-summation, and effects of deformations and orientations of nuclei included, still requires additional barrier modifications for force SIII, but none for force GSkI for an almost exact fit to 64Ni+100Mo data. Thus, barrier modification effects are shown accounted for in terms of a proper choice of (Skyrme) force or interaction barrier. However, a force good for one reaction may not be good for another reaction of the same type.

Fission Time Scale from Alpha Particle Multiplicity in 16O +209Bi Reaction at Elab=110 MeV (00h00')

Speaker: YOGESH KUMAR GUPTA, Yogesh

Alpha particle spectra have been measured in coincidence with fission fragments (FFs) for 16O +209Bi system at excitation energy of 55 MeV using the Linac facility, Mumbai, India. The α-particles and FFs were detected using CsI(Tl)-PD detectors and a position sensitive gas ionization chamber, respectively. Pre- and post-scission α-multiplicities (αpre and αpost) were extracted using a moving-source-fit of the α-spectra, and these values are (3.7± 0.15)x10-3 and (0.57 ± 0.19)x10-4. The temperatures, Tpre and Tpost were calculated with level density parameter A/11 for the composite system and A/7 for FFs. The Tpre was scaled down by 10% to account for multi-step evaporation. Statistical model calculations using the code JOANNE2 were carried out to reproduce the αpre. Pre-scission emission is assumed to take place from two points in the deformation space, corresponding to mean pre-saddle (Ztr=1.28) and mean saddle to scission deformation (Zssc=2.08). Mean pre-saddle time (τtr) and mean saddle to scission time (τssc) were varied and the total fission time required to explain αpre is ~45 zs (10-21 s), which is consistent with other systems in this fissility region.

Measurement of the gamma d \to pi^- pp and gamma d \to pi^+ pi^- np Reactions (00h00')

Speaker: HAN, Yun-cheng

Photoproduction reactions of the gamma d \to pi^- pp (R1) and gamma d \to pi^+ pi^- np (R2), were measured with the second generation of Neutral Kaon Spectrometer (NKS2). Photon beams were provided by the tagged photon facility in the Laboratory of Nuclear Science, Tohoku University, with energy 0.8-1.1 GeV. NKS2 is consisted of drift chambers, inner hodoscopes (IH), and outer hodoscopes (OH). A magnetic field of 0.42 T was applied. IH and OH were employed to give trigger signals and measure the Time-Of-Flight. Drift chambers were used for the charged particle tracking. The acceptance of NKS2 was estimated by a GEANT4 simulation, in which nucleons' Fermi motion was considered. The quasi-free(QF) process and non-quasi-free(NQF) contribution of R1 and R2 were obtained separately. The NQF contribution of R1, in which all three final-state particles were measured, was derived for the first time. The R2 with intermediate double delta channel was obtained. This reaction is one of the important non-quasi-free processes of R2. Total cross sections will be given in an energy bin of 6 MeV. The differential cross section of R1(R2) on the emission angle of pi^- (proton) will be presented.

Isospin Mixing Within Relativistic Mean-Field Models Including the Delta Meson (00h00')

Speaker: ABATI GRAEFF, Clebson

In this work we investigate isospin mixing effects in asymmetry (parity-violating electron scattering) for $^{4}\textrm{He}$, $^{12}\textrm{C}$, $^{16}\textrm{O}$, $^{40}\textrm{Ca}$ and $^{56}\textrm{Ni}$ nuclei. The scattering analysis is developed with distorted waves (DWBA) accounting for nucleons form factors, which are given by the Galster parametrization. For the nuclei, we use the Walecka Model (QHD), including the σ, ω, ρ and δ mesons as well as the electromagnetic interaction. The δ meson effects are specially interesting, as they should have contributions for the isospin mixing. Seeking good results for nuclear properties, we use lagrangeans including non-linear terms as well as lagrangeans including density dependent couplings. The model is solved in a Hartree approximation with spherical symmetry using a self-consistent calculation by means of an expansion of nuclear wave functions and potentials in an harmonic oscillator basis. Results using the NL3, NLδ, TW and DDHδ parametrizations are obtained and comparisons with non-relativistic models are made.

New Signature of a First Order Phase Transition at the O(6) Limit of the IBM (00h00')

Speaker: BETTERMANN, Linus

The dynamical symmetry O(6) of the interacting boson model (IBM) is a first order shape-phase transition between prolate and oblate deformed nuclei. It was shown in Ref. [1] that first order phase transitions exhibit an oscillation and a pronounced peaking of the relevant order parameter at the critical point. This signature was not yet observed for the O(6) phase transition, in contrast to the phase transition at X(5). This discrepancy was explained by the different nature of both phase transitions. We performed calculations within the framework of the IBM to determine the γ deformation of the 0^+_1 and 0^+_2 states with the model independent shape invariant K_3. The newly introduced order parameter $\Delta K_3\equiv K_3(0^+_1)-K_3(0^+_2)$ shows the signature discussed in Ref. [1] for the first time at the O(6) limit [2]. The calculations will be compared with existing data for the ground state. Prospects to measure K_3 for the 0^+_2 state will be discussed. Work supported by the US DOE (DE-FG02-91ER40609) and the German DFG (Jo391/3-2). [1] F. Iachello and N.V. Zamfir, Phys. Rev. Lett. 92, 212501, 2004 [2] L. Bettermann et al. Phys. Rev. C 81, 021303(R), 2010

Changes in Mn Nuclear Charge Radii Across the N = 28 Shell Closure (00h00')

Speaker: CHARLWOOD, Frances

The first laser spectroscopic study of Mn (over the N=28 shell closure) has been achieved by the use of in-cooler optical pumping. Mean-square charge radii and nuclear quadrupole moments for ground and isomeric states in 50-56Mn have been extracted. Mass measurements in this region have previously indicated that the nuclear binding of Mn decreases smoothly through the N=28 shell closure (unlike the behaviour at all other magic shells) and that no shell closure "kink" is seen in the neutron separation energies. The charge radii reported here show a well-defined, sharp shell closure, closely following that observed in Ca. The complete contrast in mass and charge radii measurements for Mn are strikingly different to the near identical trends seen for Z~40. Such differences critically affect our understanding of the impact of structure on binding energy. Extensions to the current measurements and the prospects for future measurements (further exploiting optical pumping) will be presented.

First Evidence of AMR in an Odd-A Nucleus 105Cd (00h00')

Speaker: CHOUDHURY, Deepika

The phenomenon of Anti-magnetic Rotation (AMR) is new compared to Magnetic Rotation giving rotational like bands in nearly spherical nuclei. Till date AMR has been confirmed only in 106Cd and 108Cd nuclei. In the present work we discuss lifetime measurements by Doppler Shift Attenuation Method (DSAM) with the aim of searching AMR in the negative parity yrast band of 105Cd built on nu(h11/2) configuration. After the band-crossing at h(bar) omega ~ 0.44 MeV, the increase in spin beyond I=23/2 is expected to be due to AMR by alignment of a pair of g9/2 proton holes. The 105Cd nucleus has been studied to high spin states by the 94Zr(16O, 5n) reaction using a 14 clover detector array. Both symmetric and anti-symmetric matrices have been made to build the level scheme and for lifetime analysis respectively. Several transition energies and intensities change from the previous measurements and new transitions have been added to the previously known level scheme. The LINESHAPE code has been used to fit the Doppler broadened line-shapes for extracting the lifetimes of the states. Our preliminary results do confirm the presence of AMR in the odd-A 105Cd. Detailed results will be presented in the paper.

The Density Dependence of Nuclear Symmetry Energies and Brown-Rho Scaling (00h00')

Speaker: DONG, Huan

We calculate nuclear symmetry energies using realistic NN potentials with density dependent modifications based on the linear Brown-Rho BR1) scaling. Using the V_{low-k} low-momentum interactions derived from such potentials, the equations of state (EOS) for symmetric and asymmetric nuclear matter, for densities ρ up to $\sim 5 \rho_0$, are derived using a RPA method where the particle-particle hole-hole ring diagrams are summed to all orders. We also calculate the EOS based on a nonlinear scaling (BR2) and that given by the interaction (V_{low-k}+TBF) where V_{low-k} is the unscaled low-momentum interaction and TBF is an empirical Skyrme-type 3-body force. For ρ below $\sim \rho_0$, these 3 EOS are nearly identical, all giving satisfatory nuclear matter saturation properties. But for ρ beyond ρ_0, the BR1 EOS is overly too stiff, while the other 2 EOSs are both in satisfactory agreement with the constraints of Danielewicz et al. The symmetry energies from the BR2 and (V_{low-k}+TBF) EOSs are respectively $E_{sym}(\rho)=33.9(\rho/\rho_0)^{0.82}$ and $30.3(\rho \rho_0)^{0.53}$, the former being in better agreement with the experimental constraint.

Coulomb Excitation and Quadrupole Moments in the A~80 Region (00h00')

Speaker: GARCIA-RUIZ, Ronald Fernando

At the Holifield Radioactive Ion Beam Facility in Oak Ridge National Laboratory, we have performed a series of experiments in the mass A~80 region using both Coulomb Excitation mechanism and Radioactive Ion Beams to measure the reduced transition probability B(E2; 0+ \to 2+). In order to go a step further we are exploring the determination of the electric quadrupole moment, Q, of the first excited state 2+ in the radioactive nucleus 78Ge. For an even-even nucleus, the static quadrupole moment of the first excited state gives a measurement of the deviation of the nuclear charge distribution from a spherical symmetry, and can be determined measuring the reorientation effect in Coulomb Excitation. The measurement of such a basic indicator of the nuclear structure has particular importance in transitional regions such as the germanium isotopic chain. We report on the use of the least squares analysis code GOSIA to determine Q for the 21+ states of the stable nuclei 78,82Se. These results are part of the cross check analysis that currently is undergoing for the determination of the quadrupole moment of the radioactive nuclei 78Ge.

Shell Evolution in the Newly-Explored Neutron-Rich Region Around Z=82 and Far Beyond N=126 (00h00')

Speaker: GOTTARDO, Andrea

The modification of the nuclear structure in exotic nuclei is one of the key topics in modern nuclear physics. However, little is known about the evolution of Z=82 shell closure and the region around, beyond N=126. The neutron-rich nuclei in this region are also relevant for nuclear astrophysics, and the measurement of their beta-decay half lives will improve the understanding of the r-process stellar nucleosynthesis in heavy nuclei. The nuclei of interest were populated by using a 1GeV*A 238U beam at GSI. The resulting fragments were separated and analyzed with the FRS-Rising setup. Many neutron-rich isotopes were identified for the first time. The exotic isotopes observed extended up to 218Pb for the Z=82 shell closure and up to N=138 and N=135 for shell-model proton-hole Tl and proton-particle Bi nuclei, respectively. Also the Z=80 210Hg ion was produced and studied. A significant number of new isomers were discovered in these nuclei. The spectroscopic information together with state-of-the-art shell-model calculations will allow to understand the evolution of the nuclear interaction around Z=82.

Fission Phenomenon in Heavy and Superheavy Nuclei- A Semiclassical View (00h00')

Speaker: GUPTA, Rajiv

The tunneling probability is calculated in a dynamical description of nuclear fission in the low energy regime within the framework of the semiclassical quantization. The interaction barrier is calculated by using asymmetric two centre shell model (ATCSM) and its appropriate polynomial fit generates analytical expression for the tunneling probability. The powerful semiclassical quantization technique reproduces the tunnel splitting. Our results clearly show that dissipation enhances the tunneling probability. It has also been seen that fission of compound nucleus from the excited state is a slow process. An appropriate condition for fission isomeric states is also pointed out. The survival probability of the superheavy elements is a remarkable outcome of our model. We have tested our model for nuclei U-236, Cf-252, Fm-254, No-252, No-256, Rf-258, Sg-260, Hs-266 and Ds-272.

Complete Electric Dipole Response in 120Sn: A Test of the Resonance Character of the Pygmy Dipole Resonance (00h00')

Speaker: HEILMANN, Anna Maria

In high-resolution (p,p') experiments under 0^\circ the complete B(E1) strength distribution can be studied in stable nuclei. At the Research Center of Nuclear Physics in Osaka, Japan, the strength distribution under 0^\circ and observables for the polarization transfer of E1 and M1 excitations in 120Sn were measured in an excitation energy range of 5−25 MeV. The systematics of the pygmy dipole resonance (PDR) in stable tin isotopes has been recently studied at the superconductiong linear accelerator S-DALINAC in Darmstadt [1]. From this study it was concluded that knowledge of the complete E1 response would be important to di□erentiate between relativistic an nonrelativistic QRPA models predicting largely di□erent properties of the pygmy dipole resonance. From the present measurement the whole B(E1) strength distribution and the branching ratios of the PDR to ground state can be extracted. First results on the E1 strength will be presented. [1] B. "Ozel, J. Enders, H. Lenske, P. von Neumann-Cosel, I. Poltoraska, V.Yu. Ponomarev, A. Richter, D. Savran, and N. Tsoneva submitted to Phys. Lett. B (2009).

Neutron Vacancies Outside N=82 Isotones (00h00')

Speaker: HOWARD, Alan

Recent work has been carried out linking shifts in single-particle energy levels across several series of isotopes and isotones with the tensor part of the nucleon-nucleon interaction [1][2]. In the present work a systematic study was carried out of the N=81 nuclei 137Ba, 139Ce, 141Nd and 143Sm, all of which exhibit states at low energies characterised by single-neutron hole excitations below the N=82 closed core. These states were populated through the single-neutron removal reactions (p,d) and (3He,alpha) at energies of 23 and 40 MeV, respectively. Light ejectiles were momentum analysed using the Yale split-pole spectrograph. The transferred angular momenta were inferred using angular distributions and ratios of cross sections between the two reactions. The energy centroids of the underlying single-particle states were reconstructed from the observed fragments using spectroscopic factors deduced from a DWBA analysis of the measured cross sections. The results will be discussed with reference to the expected effects of the tensor interaction. [1] T. Otsuka et al., Phys. Rev. Lett. 95, 232502 (2005) [2] B. P. Kay et al., Phys. Lett. B 658, 216-21 (2008)

Particle-Vibration Coupling in Superfluid Nuclei (00h00')

Speaker: IDINI, Andrea

I will present the solution of the Dyson equation (also known as Nambu-Gor'kov equation) for the case of superfluid nuclei. Starting from a mean field obtained with an effective nucleon-nucleon force, one renormalizes the single-particle states through the coupling to the collective vibrations of the system, calculating both the normal and the abnormal self energies, and obtaining a detailed description of the fragmentation of the quasiparticle strength. As a results, aside from a renormalized (Morel-Nozières like) pairing gap, one obtains spectroscopic amplitudes which can be used to calculate both one and two-nucleon transfer reaction cross sections. The formalism is applied to Sn-Isotopes and the resulting gaps, spectroscopic factors and pair transfer cross sections, are compared with the experimental findings.

Analysis of Nucleon-Nucleon Interactions Using Effective Field Theory: Extracting Residual Scattering Strengths (00h00')

Speaker: IPSON, Katie

Effective field theories (EFTs) provide a model independent description of high-energy physics at low-energy scales. Weinberg suggested in the 1960s that one can use chiral perturbation theory (the EFT of QCD) to determine long range nucleon-nucleon (NN) forces. The longest-range contributions are due to one pion exchange (OPE) and two pion exchange (TPE). Following the method outlined in [Birse and McGovern 2004] the 1P1 partial wave was examined within an EFT in which OPE is iterated to all orders. A residual scattering strength (RSS) was obtained using distorted-wave methods to remove the effects of OPE. A more refined RSS was then determined by subtracting the effects of TPE and relativistic corrections to OPE perturbatively. Unlike the more peripheral spin-singlet waves, TPE matrix elements in the 1P1 channel contain a singularity which required regularising and subsequently renormalising. By examining the RSSs rather than the phase shifts, a qualitative scale of the missing physics (~260MeV) was estimated. Such a low value indicates the presence of additional physics which has not been considered. I am currently working on the 3S1-3D1 coupled waves using the same approach.

Two-Proton Decay of 6Be (00h00')

Speaker: KURIHARA, Nozomi

The two-proton (2p) decay is one of the characteristic features in proton-rich nuclei, and has attracted much attention. In particular, 6Be has no bound state and its ground state can directly decay into three-body scattering states. On the other hand, although the 5Li+p threshold opens above the ground state energy, the 6Be nucleus can also decay via the 5Li+p channel due to the broad decay width of 5Li. Therefore, to understand the decay mechanism of the 6Be ground state, it is required to determine how the two possible decay process compete: the direct 2p decay and the sequential decay via the 5Li+p channel. In this contribution, to investigate which decay process is favored in 6Be, we present the obtained reduced width amplitudes and the penetrabilities using the 4He+N+N model [1], and discuss the decay mechanism of 6Be. From the obtained results, the reduced width amplitudes indicate that the 6Be ground state has comparable component for each channel of the direct 4He+2p and the sequential 5Li+p decays. Furthermore, the result of the penetrability shows that the direct 2p decay is favored. Reference [1] Y. Kikuchi, et al. Prog. Theor. Phys. 122 (2009), 499.

Nuclear Structure of 64Zn via Polarized Deuteron Scattering (00h00')

Speaker: LEACH, Kyle

A series of experiments have been undertaken to probe the accuracy of new nuclear structure calculations used for predicting the isospin correction factors involved in superallowed Fermi beta decay. The experiments use the single neutron pickup reaction on superallowed daughter nuclei, and compare the experimentally determined spectroscopic factors with theoretical predictions. The specific case discussed will be that of 64Zn(d,t), which probes the calculations near those of the superallowed daughter 62Zn. In order to extract experimental spectroscopic factors, both measured and DWBA calculated cross-sections are required. For the latter, correct optical-model parameters (OMPs) are essential in order to calculate accurate cross-sections. A deuteron scattering experiment was therefore performed at the Maier-Leibnitz-Laboratory (MLL) of TUM/LMU in Munich, Germany, using a 22 MeV polarized deuteron beam from the tandem Van de Graaff accelerator and the TUM/LMU Q3D magnetic spectrograph. This work presents a comparison of several global deuteron OMPs by examining deuteron scattering cross-sections and asymmetries for six states in 64Zn.

Relativistic Hartree-Fock-RPA Calculations of Charge-Exchange Excitations in Nuclei (00h00')

Speaker: LIANG, Haozhao

Charge-exchange excitations play central roles in many important issues of nuclear physics and astrophysics, such as the beta-decay of nuclei, neutrino-nucleus cross sections, neutron star and supernova evolutions. In this work, a fully self-consistent charge-exchange relativistic random phase approximation based on the relativistic Hartree-Fock approach is presented. Using effective Lagrangians which can describe at a quantitative level the ground state properties of spherical nuclei, this RPA approach is applied to investigate a number of issues: the nuclear spin-isospin resonances, isospin symmetry-breaking corrections for the superallowed beta decays, and the charged-current neutrino-nucleus cross sections. For the Gamow-Teller and spin-dipole resonances, it is found that a very satisfactory agreement with the experimental data can be obtained without readjusting the effective Lagrangian. The isoscalar mesons are found to play an essential role via the exchange terms, a feature not present in usual RMF-RPA models. For the isospin symmetry-breaking corrections, it is found that they are sensitive to the proper inclusion of the exchange contributions to the Coulomb mean field.

The Ground State Binding Energy of the Closed Shell Nuclei with the Density Dependent AV18 Effective Interaction in LOCV Method (00h00')

Speaker: MARIJI, Hodjat

We calculate the ground state binding energy of some light closed shell nuclei, i.e., 4He, 12C, 16O, 28Si, 32S, 40Ca and 56Ni. To this, we use our channel-dependent effective two-body interactions(CDEI) data through the lowest order constraint variational (LOCV) method for asymmetric nuclear matter with the charge-dependent AV18 bare NN potential up to Jmax=2 and Jmax=5. To this aim, we apply the local density approximation approach in the harmonic oscillator basis and Brody-Moshinskii coefficients to get a relative and center of mass dependent effective two-body potential. We show the ground state energies of the closed shell nuclei with AV18 (Jmax=2) are more binding than Reid68 bare NN potential. However, there is not much difference between the AV18 (Jmax=5) and Reid68Day which has been defined up to Jmax=5. Mean while, we present the CDEI contributions up to Jmax=5 through calculating that of 16O and 40Ca. We conclude that the contributions of higher partial waves (J>2) are not very important and two-body kinetic energy in J=1 channel is twice as that of J=0 against the two-body potential energy. Finally, our work results are compared with other works and experimental data.

Neutron Reactions on 76-Ge - Background in Neutrinoless Double Beta Decay Experiments (00h00')

Speaker: MEIERHOFER, Georg

The possible observation of the neutrinoless double beta decay is a proof of the Majorana nature of the neutrino. If theory provides precise matrix elements the effective neutrino mass can be derived from the measured half life time. A promising approach to observe this decay uses germanium crystals, isotopically enriched in 76-Ge, which serve as source and HPGe detector at the same time. The double beta decay of 76-Ge has a Q-value of 2039keV. The upcoming Gerda and Majorana experiments will be based on this method. Fast neutrons produced by cosmic muons are source of background due to various reactions with the Ge nuclei in the detectors. The most severe contribution is the beta-decay of 77-Ge after neutron capture on 76-Ge. High energetic beta-particles emitted by this decay may cause signals in the detectors identical to neutrinoless double beta decay events. Furthermore the (n,p)-reaction and neutron scattering have to be considered in the background analysis in the region of interest at 2039keV. Experiments performed to quantify these contributions and their results will be presented.

Tuesday 06 July 2010

Nuclear Astrophysics Plenary Session - Chan Centre (08:00-10:00)

time	title
08:00	**What Do We Understand About Explosive Nucleosynthesis? (00h30')** *Speaker: BLACKMON, Jeff* Isotopic abundances reflect both nuclear structure and environmental history. New astrophysical observations are providing evidence that is helping us understand astrophysical phenomena, the chemical history of the Galaxy, and the origins of the diverse isotopic abundances found on earth. What we infer from observations, however, depends upon a robust understanding of the underlying nuclear physics. The difficulties involved in producing and studying short-lived isotopes are particularly problematic for understanding stellar explosions. While new facilities and experimental techniques have recently spurred significant progress in our understanding of the light, proton-rich nuclei that are important for thermonuclear explosions like novae and X-ray bursts, studies of neutron-rich nuclei that are crucial for understanding the origins of the heavy elements are still quite challenging. We will survey recent progress in the nuclear physics that is important for explosive nucleosynthesis with a focus on the experimental capabilities driving innovation. We will also outline major outstanding questions and the prospects for future laboratory measurements to address these issues.
08:30	**Direct Measurements of Cross Section of Astrophysical Interest (00h30')** *Speaker: IMBRIANI, Gianluca* New direct experimental methods and techniques, combined with the development of new theoretical tools have opened new avenues to explore nuclear reactions of significance for nucleosynthesis at or near the actual temperatures of stellar burning. The main problem of direct measurements is determined by the background signals, which, together with the low cross sections, set a limit to the energy range that can be investigated with a simple setup on the Earth surface. Essentially there are three sources of background, i.e. cosmic rays, environmental radioactivity and beam-target induced nuclear reactions. Each of these sources produces background of different nature and energy, so that each reaction to be studied deserves a special care in suppressing the relevant background component. I will show different experimental approaches that have been used to study processes of astrophysical interest. In particular, I will focus my attention on underground experiments and recoil mass separator approach.
09:00	**Neutron Rich Matter and Neutron Stars and Their Crusts (00h30')** *Speaker: HOROWITZ, Charles* Neutron rich matter is at the heart of many fundamental questions in Nuclear Physics and Astrophysics. What are the high density phases of QCD? Where did the chemical elements come from? What is the structure of many compact and energetic objects in the heavens, and what determines their electromagnetic, neutrino, and gravitational-wave radiations? Moreover, neutron rich matter is being studied with an extraordinary variety of new tools such as FRIB and the Laser Interferometer Gravitational Wave Observatory (LIGO). We describe the Lead Radius Experiment (PREX) that is using parity violation to measure the neutron radius in 208Pb. This has important implications for neutron stars and their crusts. Using large scale molecular dynamics, we model neutron rich matter. We find neutron star crust to be the strongest material known, some 10 billion times stronger than steel. It can support mountains on rotating neutron stars big enough to generate detectable gravitational waves. Finally, we describe a new equation of state for supernova and neutron star merger simulations based on the Virial expansion at low densities, and large scale relativistic mean field calculations.
09:30	**Core-Collapse Supernovae as a Testbed of Nuclear and Neutrino Physics (00h30')** *Speaker: JANKA, Hans-Thomas* In my talk I will review the status of modeling core-collapse supernovae and the associated signals, in particular neutrinos and gravitational waves. The dependence on the properties of the equation of state of dense matter will be discussed.

Coffee Break - Chan Centre (10:00-10:30)

Nuclear Reactions Plenary Session - Chan Centre (10:30-12:30)

time	title
10:30	**Reactions with Exotic Nuclei: Results and Challenges (00h30')** *Speaker: ROUSSEL-CHOMAZ, Patricia* Reactions with exotic nuclei are nowadays studied in many laboratories around the world in various energy ranges, allowing to tackle with different probes, important issues related to the bulk properties and to the structure of these exotic nuclei. Matter radii can be inferred from elastic scattering data at high energy. Collective properties such as giant resonances are investigated via inelastic scattering or break-up reactions because of their interest and implications in nuclear and astrophysical phenomenology (nuclear compressibility, asymmetry term in the nuclear EOS, new modes associated to the excess neutrons…). Transfer reactions have already produced a wealth of information on the single particle structure of nuclei away from stability and have allowed to produce light nuclei at the limit of the drip lines and even beyond. In addition, the specificity of reaction dynamics in the case of exotic nuclei is also a subject of broad interest. Some of the latest results obtained from reactions with exotic nuclei will be presented, together with the new experimental tools which have been developed to achieve them. Finally the challenges for the next years will be discussed.
11:00	**Ab Initio Theory of Light-Ion Reactions (00h30')** *Speaker: NAVRATIL, Petr* The exact treatment of nuclei starting from the constituent nucleons and the fundamental interactions among them has been a long-standing goal in nuclear physics. Above all nuclear scattering and reactions, which require the solution of the many-body quantum-mechanical problem in the continuum, represent a theoretical and computational challenge for ab initio approaches. After a brief overview of the field, I will present a new ab initio many-body approach [1] capable of describing simultaneously both bound and scattering states in light nuclei. By combining the resonating-group method (RGM) with the ab initio no-core shell model (NCSM), we complement a microscopic-cluster technique with the use of realistic interactions, and a microscopic and consistent description of the nucleon clusters. I will show results for neutron and proton scattering on light nuclei, including n-7Li and p-7Be. I will also discuss our progress towards the ab initio calculation of 3He-4He scattering and the first results of the d-3H fusion calculation obtained within our ab initio NCSM/RGM approach. [1] S. Quaglioni and P. Navratil, Phys. Rev. Lett. 101, 092501 (2008); Phys. Rev. C 79, 044606 (2009).
11:30	**Superheavy Nuclei from 48Ca-Induced Reactions (00h30')** *Speaker: OGANESSIAN, Yuri* One of the fundamental outcomes of the nuclear shell model is the prediction of the “stability islands” in the domain of the hypothetical superheavy elements. The enhanced stability has been expected for the deformed nuclei near Z=108 and N=162, yet much stronger effect has been predicted for heavier spherical nuclei close to the shells Z=114 and N=184, next to the doubly-magic nucleus 208Pb (Z=82, N=126). The talk is devoted to the experimental verification of these predictions – the synthesis and study of both the decay and chemical properties of the superheavy elements. For the synthesis of the heavy nuclei fusion reactions of the nuclei of 208Pb, 209Bi with the projectiles of 50Ti, 54Cr, …70Zn (cold fusion) have been used that allowed to investigate decay of the nuclides with Z=104-113 and N=151-165 in the region of the deformed shells Z=108 and N=162. The nuclides Z=110-113 (T1/2 ~ ms) produced in these reactions [1, 2] undergo sequential α-decays with total decay time of seconds. The synthesis of even heavier and more neutron-rich nuclei has been carried out in the fusion reactions of 226Ra, 233,238U, 237Np, 242,244Pu, 245,248Cm, 249Bk and 249Cf with the 48Ca projectiles (hot fusion), that made it possible to study decay
12:00	**Recent Highlights in Fragmentation Reactions (00h30')** *Speaker: BENLLIURE, Jose* The operation of the first heavy-ion synchrotrons in the 80s triggered important research programs around fragmentation reactions. The production of nuclei far from stability [1] and the use of these reactions to investigate structural [2] and dynamical [3] properties of nuclei are clear examples. Thirty years later, these reactions still play a decisive role in experimental nuclear physics. Projectile fragmentation is at the base of many next generation radioactive beam facilities for extending the present limits of the chart of nuclides [4]. Moreover, the combination of advanced detection setups with relativistic radioactive beams also make possible to perform accurate investigations of these reactions opening new opportunities for nuclear structure research or the characterization of asymmetric nuclear matter. In this presentation we will review recent achievements using fragmentation reactions. [1] T.M.J. Symons, 4th Int. Conf. on Nuclei Far from Stability, CERN 81-09, 668 (1981). [2] I. Tanihata et al., Phys. Lett. B 206, 592 (1985). [3] C.J. Waddington and P.S. Freier, Phys. Rev. C 31, 888 (1985). [4] D.J. Morrissey and B.M. Sherril, In-Flight Separation of Projectile Fragments, Lect. Notes Phys. 651, 113 (2004)

HN1 - Forest Sciences Centre 1003 (14:00-15:40)

time	title
14:00	**Nuclear Medium Effects from Hadronic Atoms (00h25')** *Speaker: GAL, Avraham* In this talk I review how comprehensive hadronic atom data consisting of level shifts, widths and yields across the periodic table, and analyzed in terms of density dependent optical potentials, have become instrumental in studying medium modifications of pions, antikaons and of Sigma hyperons in nuclei, as reviewed by E. Friedman and A. Gal, Phys. Rept. 452 (2007) 89. I will focus on recent developments in antikaon--nuclear physics, where a strongly attractive nuclear potential of order 150--200 MeV in nuclear matter is suggested by fits to K--atom data. This has interesting possible repercussions on antikaon quasibound nuclear states, on the composition of strange hadronic matter and on kaon condensation, as reviewed recently by D. Gazda, E. Friedman, A. Gal and J. Mares, Nucl. Phys. A 835 (2010) 287.
14:25	**Antikaon-Nuclear Few-Body Problems: Theory Status (00h25')** *Speaker: WEISE, Wolfram* Chiral SU(3) dynamics, as the low-energy realization of QCD with strange quarks, provides a controlled framework to describe interactions of antikaons with nucleon and nuclei. These interactions are driven by the KbarN and pion-hyperon coupled channels and the formation of the Lambda(1405) as a quasibound KbarN state and pion-sigma hyperon resonance. In this context the present status of KbarN threshold physics is summarized; variational and Faddeev calculations in search for quasibound KbarNN clusters are discussed, and an outlook is given concerning the interpretation of recent data for pi-sigma invariant mass spectra.
14:50	**Antikaon Nucleon/Nucleus Interaction – Experiments (00h25')** *Speaker: ZMESKAL, Johann* One of the most important, yet unsolved, problems in hadron physics is how the hadron masses is generated and how the hadron interactions change in the nuclear medium. With AMADEUS at LN Frascati the antikaon nucleon/nucleus interaction at low-energy will be studied, such as low-energy antikaon scattering and reaction cross sections on hydrogen and helium isotopes. In addition high statistic data will become available on properties of hyperon resonances, such as lambda (1405) and sigma (1385). Moreover, a dedicated search for the existence of antikaon-mediated deeply bound nuclear systems is part of the AMADEUS program. If such exotic states exist, they will indeed offer ideal conditions for investigating the way in which the spontaneous and explicit chiral symmetry breaking patterns of low-energy QCD change in the nuclear medium. Another exciting way to study systems with strangeness (S=-1, S=-2) will be the annihilation process of stopped antiprotons in light nuclear targets. Di-baryon systems or tri-baryon systems with strangeness S=-2 might be formed and could be studied with a dedicated setup as planned for experiments at CERN-AD, J-PARC and in future at FAIR.
15:15	**Kaonic-Helium X-Rays (00h25')** *Speaker: HAYANO, Ryugo* The long-standing "Kaonic-helium puzzle", i.e., the discrepancies between the measured and calculated strong-interaction shift of the 2p-level of kaonic helium 4, has been solved by the KEK E570 experiment; the measured 2p-level shift was 2+-2(stat.)+-2(syst.) eV, thus agreeing with a majority of the theoretical calculations. The 2p-level width was also found to be small (< 17 eV). The smallness of the kaonic helium-4 2p-level shift has recently been confirmed by the SIDDHARTA collaboration at DAPhiNE. Both of these experiments have used state-of-the-art silicon drift detectors (SDDs) as the X-ray detectors, and have used elaborate in-situ calibration methods. In order to further study the low-energy kaon-nucleus interaction, the SIDDHARTA collaboration has also taken some kaonic helium-3 data, and the J-PARC E17 experiment will soon measure the kaonic helium-3 2p-level shift and width to high precision. Implications of these measurements on the study of kaon-nucleus bound states will be discussed.

NI3 - Life Sciences Centre 1510 (14:00-15:35)

time	title
14:00	**Nuclear Forensics: A Methodology Applicable to Nuclear Safeguards and Nuclear Security (00h25')** *Speaker: MAYER, Klaus* Nuclear Forensics is a methodology that aims a re-estabishing the history of nuclear material of unknown origin. It is based on indicators that arise from known relationships between material characteristics and process history. To this end, we can make use of parameters such as the isotopic composition of the nuclear material, the isotopic composition of accompanying elements, the chemical impurities, the macroscopic appearance and the microstructure of the material. In the present paper, we will discuss the opportunities for attribution of nuclear material offered by nuclear forensics and its limitations. Particular attention will be given to the role of nuclear reactions and the information on the neutron irradiation history that can be obtained through a detailed analysis of the products of the nuclear reactions. Such reactions include the radioactive decay of the nuclear material, but also reactions with neutrons. When uranium is exposed to neutrons, plutonium is formed, as well as 236U. We will illustrate the methodology using the example of a piece of uranium metal that dates back to the German nuclear program in the 1940's.
14:25	**Nuclear Physics R at the US Department of Energy Directed to Nuclear Energy (00h25')** *Speaker: SCHROEDER, Lee* Renewed interest in the United States with respect to nuclear energy and its advanced nuclear fuel cycles as a "carbon-free" energy source is expected to play an enhanced role throughout the remainder of this century. Associated nuclear physics R focused on advanced nuclear fuel cycles will play a critical role in advancing nuclear energy in the US. Present R efforts supported by the US Department of Energy, including experimental programs and existing facilities, as well as the role of advanced modeling and simulations, will be presented.
14:50	**Using Exotic Atoms to Keep Borders Safe (00h15')** *Speaker: STOCKI, Trevor* Muons, created by a particle accelerator, can be used to scan cargo for special nuclear materials (SNM). Preliminary results show that by measuring the characteristic x-rays induced by muons, one can detect these materials. These muons exist long enough and are penetrating enough that they can be used to actively scan cargo to ensure the non-proliferation of SNM. A set of “proof-of-concept” experiments have been performed to show that active muon analysis can be used. Experiments were performed at high intensity, medium energy particle accelerators (TRIUMF and PSI). Negative muons form exotic atoms with one electron replaced by the muon. Since the muon is captured in an excited state, it will give off x-rays which can be detected by high purity germanium detectors and which can identify the nuclide. The muonic x-rays corresponding to the SNM of interest have been measured, even with the use of various shielding configurations composed of lead, iron, polyethylene, or fibreglass. These preliminary results show that muons can be successfully used to find shielded SNM. The safety of North Americans can be protected by the use of this technology.
15:05	**Application of Accelerator Mass Spectrometry to Archaeology, Geography and Environmental Science (00h15')** *Speaker: KRETSCHMER, Wolfgang* Accelerator mass spectrometry (AMS) is an ultrasenstive method for the measurement of isotope ratios of a long lived radioisotope to a stable isotope (e.g. 14C/12C \approx 10-12 - 10-15) with numerous applications in interdisciplinary research. The Erlangen AMS facility, based on an EN tandem accelerator and a hybrid sputter ion source for solid and gaseous samples is well suited for age determination of carbonaceous materials for periods of up to 50.000 years. Some interesting archaeological applications of AMS will be shown, e.g. the 14C dating of a “Persian mummy”. The application to geography is demonstrated by the investigation of wood samples from historic monasteries, temples and secular buildings in Tibet and Nepal. Here the 14C measurements in combination with tree ring structure enable a highly resolved annual information about climatic variability in Tibet and the Himalayas in earlier times than that of the currently available dates. For applications concerning the origin of environmental compounds the 14C content can be used, since biogenic samples contain 14C in natural concentration whereas anthropogenic samples contain no 14C due to their formation via fossil materials.
15:20	**Fission Cross-Sections of Minor Actinides for Advanced Reactor Systems: New Data from n_TOF (CERN) (00h15')** *Speaker: COLONNA, Nicola* Recently, a growing concern over CO2 emission and related greenhouse effects has stimulated a renewed interest in nuclear energy. A large effort is being devoted to the development of advanced nuclear systems that would overcome major drawbacks of current reactors, such as the production of high-radiotoxic nuclear waste. The design of these systems require accurate nuclear data on a large number of isotopes, in particular plutonium, minor actinides, long-lived fission fragments and structural materials. An important contribution to the field is being provided by the neutron time-of-flight facility n_TOF at CERN. The wide energy spectrum and very high instantaneous neutron flux make this facility suitable for collecting accurate data on several isotopes relevant for Generation IV reactors. Capture and fission cross-sections have been measured on isotopes involved in the U/Th fuel cycle, as well as on minor actinides (Np, Am and Cm) relevant for advanced system. In this talk, the main results on neutron-induced fission cross-sections obtained at n_TOF will be presented, and their impact on Gen IV systems discussed, together with an overview of future programs on nuclear technology.

NN1 - Forest Sciences Centre 1001 (14:00-15:35)

time	title
14:00	**Neutrinoless Double Beta Decay and Nuclear Structure (00h25')** *Speaker: POVES, Alfredo* The neutrinoless double beta decay has the key to the Majorana nature of the neutrinos and can set the absolute scale of their masses. In this presentation I will examine the basic ingredients entering the theoretical predictions of the half-lives of the double beta decay processes, with emission of two neutrinos and neutrinoless. I will then summarize the state of the art of the calculated nuclear matrix elements for the neutrinoless mode, making a critical evaluation of the most commonly used nuclear structure models. In order to ascertain their relative adequacy, I will explore the role played by the two dominant nuclear correlations, pairing and quadrupole, in the values of the nuclear matrix elements. Finally, I will present the range of half-lives predicted for the neutrinoless decays, depending on the different hierarchies of the neutrino masses
14:25	**Understanding Neutrino Mixing: Precision Measurements of Neutrino Oscillation (00h25')** *Speaker: HEEGER, Karsten* Neutrino mass and mixing are amongst the major discoveries of recent years and demand that we make the first significant revision of the Standard Model in decades. From the discovery of neutrino oscillation with atmospheric and solar neutrinos to the study of antineutrino disappearance at reactors, non-accelerator experiments have played a key role in developing our understanding of neutrino mixing. Accelerator experiments make precision measurements of neutrino oscillation in the laboratory, search for sterile neutrinos, and provide a path towards the study of CP violation in the lepton sector. I will review our current experimental knowledge of neutrino oscillation and outline prospects for future precision measurements.
14:50	**The 8B Neutrino Spectrum (00h15')** *Speaker: FYNBO, Hans. O. U.* Knowledge of the energy spectrum of the neutrinos emitted in the beta decay of 8B in the interior of the Sun is needed in order to interpret the neutrino spectrum measured on Earth. Experimentally, the 8B neutrino spectrum may be extracted from the measurements of the beta-delayed alpha spectrum. Two recent measurements [1,2] give consistent results, but disagree with a third recent measurement [3]. In order to clarify the situation we have performed two new measurements of the beta-delayed alpha spectrum using two different experimental techniques. Special care was paid to the energy calibration. Both approaches give an improved handle on systematics compared to [1,2,3] and cross checks give improved confidence in the results. In this contribution our two experimental approaches will be discussed, the measured alpha spectrum will be compared to the existing ones and the implications for the neutrino spectrum will be clarified. [1] W.T. Winter et al., Phys. Rev. C73, (2006) 25503. [2] M. Bhattacharya et al., Phys. Rev. C73 (2006) 55802. [3] C.E. Ortiz et al., Phys. Rev. Lett. 85 (2000) 2909.
15:05	**The Double Chooz Experiment: A Search for the Mixing Angle theta13 (00h15')** *Speaker: MUELLER, Thomas* Double Chooz is an experiment which consists of two liquid scintillator antineutrino detectors located 380 m and 1 km from the reactor cores at the CHOOZ nuclear power station located in northern France. The use of two detectors constructed to be as nearly identical as possible is the primary distinguishing characteristic of Double Chooz. By comparing the electron antineutrino flux at two detectors, Double Chooz will be remarkably sensitive to transformation of electron antineutrinos into other neutrino flavors whose amplitude is set by the last unknown mixing angle theta13. The reactor antineutrinos are detected through the charged current interaction with free protons, commonly referred to as inverse beta decay. The signature of non-zero theta13 is the "disappearance" of some reactor antineutrinos over a distance of order 1 km. The scientific goals and historical context of the Double Chooz experiment will first be reviewed. Then the experimental site, the detectors currently under construction, and the measurement to be made will be described. Finally, conclusions on expected level of systematics and sensitivity to the mixing angle will be drawn.
15:20	**MINERvA Neutrino Scattering Experiment (00h15')** *Speaker: RANSOME, Ronald* MINERvA is a neutrino scattering experiment at the NuMI beamline of FNAL which began data taking in fall 2009. MINERvA is a high resolution, fully active detector designed to study the interaction of neutrinos with nuclei. The fiducial volume of the detector consists of 3 tons of plastic scintillator. In addition, targets of 4He, C, H2O, Fe, and Pb will allow detailed studies of the A dependence of neutrino cross sections. Some of the objectives of MINERvA are to measure the axial form factor of the nucleon with unprecedented precision, measure nuclear shadowing of F2 and compare with muon scattering, study quark-hadron duality with neutrino scattering in comparison with electron scattering, and measure coherent pion production. We present an overview of the physics objectives, estimated uncertainties of the measurements, along with a description of the detector and a sample of the first measurements.

NR3 - Forest Sciences Centre 1005 (14:00-15:35)

time	title
14:00	**Status of Breakup Reaction Theory (00h25')** *Speaker: OGATA, Kazuyuki* I will review present status of breakup reaction theory. Emphasis is placed on the recent progress of reaction studies on unstable nuclei by means of the method of Continuum Discretized Coupled Channels (CDCC). Five subjects below will be covered. 1) Four-body breakup processes for 6He induced reaction. 2) Dynamical relativistic correction to the electric coupling potential and its effects on breakup observables. 3) Microscopic description of projectile breakup processes. 4) Description of ternary processes based on CDCC and its application to the triple-alpha reaction. 5) New approach to the incomplete fusion (or inclusive breakup) processes with CDCC.
14:25	**Breakup Reactions of Neutron Drip Line Nuclei Near N=20 (00h25')** *Speaker: NAKAMURA, Takashi* Recent experimental results on Coulomb and nuclear breakup of 22C and 31Ne at the new generation RI-beam facility, RIBF, at RIKEN will be presented. Coulomb breakup is a useful tool to study enhanced E1 transition at low excitation energies (soft E1 excitation), which appears uniquely for halo nuclei. By taking advantage of substantially upgraded RI beam intensity of the new facility, we measured Coulomb breakup of very exotic nuclei 22C and 31Ne on Pb target at about 230MeV/nucleon, for the first time. The obtained inclusive Coulomb breakup cross sections were found significantly large for both nuclei, which gives the evidence of 2n halo structure of 22C and 1n halo structure of 31Ne[1]. Furthermore, the momentum distribution of the fragment following the 2n(1n) removal of 22C(31Ne) on C target was found very narrow, giving additional evidence of halo structure. The on-going project of SAMURAI/NEBULA at RIBF, which would enable full exclusive breakup measurement of exotic nuclei, is also shown. [1] T. Nakamura et al., Phys. Rev. Lett. 103, 262501 (2009).
14:50	**Study of the 11Li Beta Decay to High Energy States in 11Be (00h15')** *Speaker: MADURGA FLORES, Miguel* The discovery of the nuclear halo has renewed the interest in studying drip-line light nuclei and the beta decay is a perfect probe of the halo poperties as it is a well known process. Early studies of the beta decay of two neutron halo nuclei[1] showed a transition of super-allowed type to a level close to the Q$_{\beta}$ value, with B(GT) close to the decay of the di-neutron, suggesting the direct decay of the halo neutrons. However, Hamamoto and Sagawa[2] proposed that this transitions are due to the lowering of the Gamow-Teller Giant Resonance in neutron rich nuclei. The challenge in studying the decay to high energy states in drip-line nuclei is the appearance of multi-particle breakup channels. We present here the analysis of all charged particle decay channels of the two most high excited states in ^{11}Be fed in the decay of ^{11}Li. The branching ratio of the 18 MeV state point to a super-allowed transition, even if the BR to the βd channel is not included, as it occurs to the continuum[3]. This supports the GTGR hypothesis by Hamamoto. [1] M.J.G. Borge et al.,ZPA 340(1991)255 [2] I. Hamamoto and H.Sagawa,PRC 48(1993)R960 [3] R. Raabe et al.,PRL 101(2008)212501
15:05	**A Panorama of CDCC Calculations for Deuteron Induced Reactions: From Elastic Cross Sections to Transfer and Inelastic Ones (00h15')** *Speaker: CHAU, Huu-Tai Pierre* In the 70's, the Continuum Discretized Coupled Channels (CDCC) formalism was independently proposed by R. C. Johnson and G. H. Rawitscher to describe the deuteron induced reactions by explicitly including the breakup channels. Since then, it has been widely studied and quite successfully used to analyze deuteron elastic cross sections. More recently it has been extended to deal with weakly bound projectiles such as Li and to include the projectile excitations. It has also been extended to 4-body systems. In this contribution, an overview of the calculations that can be performed within the CDCC approach to analyze deuteron induced reactions will be given. First, we will present a recent extension of the CDCC formalism which accounts for the target excitations allowing us to determine (d,d') cross sections. After the derivation of the coupled equations, we compare some calculated inelastic cross sections with experimental data. Then it is shown that the CDCC formalism can also be a useful tool to determine (d,p) or (d,n) cross sections and to extract the associated spectroscopic factors. This will be illustrated for nuclei with N~32 which have been intensively investigated.
15:20	**NN Dynamic Effects on the Breakup of One-Neutron Halo 11Be, on a Proton Target (00h15')** *Speaker: CRESPO, Raquel* A comparison between full few-body Faddeev/Alt-Grassberger-Sandhas (Faddeev/AGS) [1,2] and continuum-discretized coupled channels (CDCC) [3] calculations is made for the resonant and nonresonant breakup of 11Be on proton target at 63.7 MeV/u incident energy where there is available data. A simplified two-body model is used for 11Be which involves an inert 10Be(0+) core and a valence neutron. We show that the breakup reaction observables are very sensitive to a realistic choice of the underlying NN potential. Insight is made on the sensitivity of the calculated observables to the nucleon-nucleon potential dynamical input, in particular its L-dependence. An analysis is also made, on the effect of the description of the 11Be excited state on the calculated breakup observables. 1. L.D. Faddeev, Zh. Eksp. Theor. Fiz. 39, 1459 (1960) [Sov. Phys. JETP 12, 1014 (1961)]. 2. E.O. Alt, P. Grassberger, and W. Sandhas, Nucl. Phys. B 2, 167 (1967). 3. N. Austern, Y. Iseri, M. Kamim.

NR5 - Forest Sciences Centre 1221 (14:00-15:40)

time	title
14:00	**Primary Fragment Reconstruction in Heavy Ion Reactions Near Fermi Energy (00h25')** *Speaker: RODRIGUES, Marcia* In the multifragmentation regime of heavy ion reactions in the Fermi energy domain the intermediate mass fragments (IMFs) are copiously produced and provide a unique probe to study reaction mechanisms and nuclear properties. However, most of IMFs experimentally measured are not direct reaction products (primary) but are the decay products after the sequential cooling of the excited primary fragments (secondary). The secondary decay has been revealed to be important in previous works and puts in question some experimentally extracted observables which do not take secondary decay into account. The aim of this work is to reconstruct the yields of the primary fragments experimentally in order to extract information on the primary source and to refine the reaction dynamics. The reconstruction is made by taking advantage of the kinematical focusing of light particles in the direction of the associated secondary IMF. The reaction systems 64Zn+112Sn and 64Ni+124Sn have been studied at 40 A MeV. Correlations between all light particles, including neutrons, and the IMF are being employed to evaluate the mass and charge of the (average) parent of the detected IMF. The analysis is underway.
14:25	**Bimodality: A Sign of a Liquid-Gas Phase Transition or of a Critical Phenomenon? (00h15')** *Speaker: AICHELIN, joerg* Two decades after its discovery the origin of multifragmentation is still far from being settled mainly because statistical and dynamical models predict very similar results for several key observables. Recently it has been observed that the high statistics INDRA data show bimodality which has been considered as the desired smoking gun signal for a first order phase transition. It came as a surprise that programs which simulate the reaction from the initial separation of projectile and target up to the formation of the final fragment, like the Quantum Molecular Dynamics approach, predict the very same bimodality and even its experimental energy dependence although they do not show any evidence that in these reactions a first order phase transition takes place. They predict in addition many nonthermal details of the reactions. Bimodality can be identified up to energies of 1AGeV. In the presentation we demonstrate why bimodality is not a smoking gun for a first order but rather points towards the first observation of a critical phenomenon in nuclear physics, the appearance of a bifurcation in the reaction path where small fluctuations decide which of the pathes is taken.
14:40	**Observation of Critical Behavior from Nuclear Fragment Yield Ratios (00h15')** *Speaker: TRIPATHI, Rahul* Nuclear fragment yield data has been analyzed using Landau free energy description to investigate the critical phenomena in the fragmentation of quasi-projectile in the reactions 78,86Kr+58,64Ni at beam energy of 35 MeV/nucleon. The data on mirror nuclei yield ratio (A=3 and 7) showed an exponential dependence on the isospin asymmetry of the quasi-projectile. This is consistent with the Landau free energy description at lower isospin asymmetry of the source for which higher order terms (4th and 6th) can be ignored. The slope parameter gave a reasonable estimate of the nuclear symmetry energy. The slope parameter was observed to decrease with increasing excitation energy of the quasi-projectile. An analysis in Landau approach, similar to the conventional isoscaling, also yielded the slope parameter close to that obtained from the analysis of mirror nuclei yield ratio data.
14:55	**Production of Heavy Clusters (up to A=10) by Coalescence during the Intranuclear Cascade Phase of Spallation Reactions (00h15')** *Speaker: CUGNON, Joseph* Production of heavy clusters (Li, Be, B...O) with energies above the evaporative contribution have been observed in experiments performed at COSY-Julich with p beams of 1.2 and 2.5 GeV on heavy targets by the NESSI and the PISA collaboration. The formation of clusters does not occur naturally in the intra nuclear cascade picture which relies on the hypothesis of independent NN interactions. However we have lately obtained good results with the code INCL4 for the production of H and He isotopes using a coalescence of nucleons (around a "leading" nucleon escaping from the target nucleus) and a limited number of parameters (radial position of the leading nucleon and coalescence radius in phase space). We have now extended the method to heavier ions (up to A=10). The coalescence is defined in phase space and a criterion based on minimal excitation energy gives a natural and realistic weighting between the various possible isotopes formed during the procedure. Results will be presented. They are in reasonable agreement with experimental data for both excitation functions and angular distributions. They also indicate how and why some clusters are preferentially produced by cascade.

15:10	**Nuclear Temperatures from the Evaporation Fragment Spectra and Possible Life-Time Effect (00h15')** *Speaker: RAY, AMLAN* The temperature of a compound nucleus(having fixed excitation energy) should decrease for the higher values of its spin angular momentum and so the spectra of the heavier evaporation fragments emitted from the compound nucleus should have progressively steeper slopes. To test this idea, we formed the same compound nucleus 105Ag at the same excitation energy (76 MeV) and with very similar spin distribution by 16O+89Y and 12C+93Nb reactions and studied back-angle alpha to carbon particle emissions. The compound nucleus character of the reaction was established from the angular distribution of the emitted fragments and the lack of any entrance channel dependence of the angle-integrated yields of the fragments. It was found that the temperatures as obtained from the slopes of alpha, Be, B and C spectra remained about 3.0 MeV and was about 4.2 MeV for the Li spectrum, whereas statistical model codes predict decrease of the corresponding temperatures from 3.0 MeV(for alpha) to 1.65 MeV(for carbon). The result could not be understood by adjusting the parameters of the statistical models and might imply the effect of the lifetime of the exit channel fragment plus residual dinuclear system.
15:25	**The Roles of Deformation and Orientation in Heavy-Ion Collisions Induced by Light Deformed Nuclei at Intermediate Energy (00h15')** *Speaker: CAI, Xiangzhou* It is expected that the deformed nuclei induced reaction can result in obviously different dynamical processes compared with the spherical cases. Recently,studies of deformed U+U collisions at relativistic energies suggested that deformation systems are more likely to create QGP and may resolve many outstanding problems. However, the knowledge about deformation effect is very poor at intermediate energies. The reaction dynamics of axisymmetric deformed 24Mg+24Mg collisions have been investigated systematically by IDQMD model. It is found that nuclear stopping power R, multiplicity of fragments and elliptic flow v2 are very sensitive to the initial deformations and orientations.Body-body collisions lead to larger R than tip-tip collisions while the situation reverses at energies exceed 75MeV/n. It reflects the different effects of initial space configurations at different energies. The V2 of different deformed central body-body collisions have no-zero values and can be scaled together by eccentricity. The scaled v2 of mid-central spherical collisions shows different behaviors. It indicates the geometric shapes play an essential role in v2 of deformed reaction system.

NS3 - Life Sciences Centre 2 (14:00-15:40)

time	title
14:25	**Role of Correlations in the Quenching of Spectroscopic Factors (00h15')** *Speaker: BARBIERI, Carlo* The causes for the quenching of single-particle strength have been investigated by comparing the standard shell-model to Green's function theory--with large no-core spaces. The study was performed for quasiparticles around 56Ni and 48Ca. A large part of the quenching (about 1/2) originated form the coupling with collective excitations, lying in the giant resonance region. These require calculations beyond the standard shell-model. One can therefore distinguish three mechanisms: short-range correlations (that give the smallest impact on quenching), long-range-collective modes, and long-range effects due to configuration mixing near the Fermi surface. The coupling to collective modes also affects the asymmetry dependence of spectroscopic factors. The study of these effects is ongoing and the current results will be discussed.
14:40	**Proton-Rich Nuclear Structure and Mirror Asymmetry Investigated by beta-Decay Spectroscopy of 24Si (00h15')** *Speaker: ICHIKAWA, Yuichi* We performed the beta-decay spectroscopy on 24Si in order to study characteristic properties of proton-rich nuclear structure from a perspective of mirror asymmetry. In a proton-rich nucleus a weakly-bound proton, especially in the s orbital, plays an important role. Thomas-Ehrman shift which is one of the mirror asymmetry induced by the weakly-bound s-orbital proton was observed in low-lying 1+ states between mirror nuclei of 24Al and 24Na. The Thomas-Ehrman shift of the single particle energy for the proton's s orbital induces a change in configuration of the wave function. The change can be estimated as mirror asymmetry of Gamow-Teller transition strength B(GT). Therefore we carried out the beta-decay spectroscopy on 24Si to determine the B(GT) to the low-lying 1+ states in 24Al. The experiment was carried out at RIPS facility. In this presentation, we will report the experimental results. In order to clarify the behavior of the weakly-bound s orbital, discussion on the mirror asymmetry of B(GT) through the comparison with theoretical calculation which takes into account the Thomas-Ehrman shift will be also given.
14:55	**Nuclear Shell Evolution and In-Medium NN Interaction (00h15')** *Speaker: SMIRNOVA, Nadya* We investigate the mechanisms responsible for changes of the nuclear shell structure depending on N/Z ratio. We perform the spin-tensor decomposition of an effective two-body shell-model interaction and then study single-particle (s.p.) energy variations in a series of isotopes or isotones. The technique allows to separate unambiguously contributions of the central, vector and tensor components of the realistic effective interaction. We show that while the global trend of the nuclear binding energy is mainly due to the central term of the effective interaction, local variations of s.p. energies are governed by various components of the NN force. Two most important contributions to the s.p. energy evolution are confirmed to be the central spin-isospin-exchange term and the tensor term, with the role of the latter being almost exclusive when considering behavior of spin-orbit partners. From the analysis of a well-fitted realistic interaction in sdpf shell model space, we reveal the role played by the different terms in the variation of the N=16, N=20 and N=28 shell gaps in neutron rich nuclei. Spin-tensor contents of a microscopic interaction and a fitted one are compared.
15:10	**Occupancy of Deeply Bound Valence Neutron Orbits in 37Ca (00h15')** *Speaker: BüRGER, Alexander* The ground and first excited states in proton-rich 36Ca have been populated by knock-out of deeply bound neutrons in 37Ca at intermediate beam energy and were then studied using gamma-ray spectroscopy in coincidence with the residues. The energy of the first 2+ state in 36Ca was found to be 3036(11) keV, indicating a sizable N=16 gap similar to the Z=16 gap observed in the mirror nucleus, 36S. Partial cross-sections for the knock-out reactions and momentum distributions of the residues have been measured both for the ground and the 2+ state. We will present the analysis in the framework of the eikonal approximation, which allowed to identify the angular momentum L of the removed neutrons. The extracted spectroscopic factor for the ground state is found to be in a 'normal' ratio to the shell-model value, with typical reduction for nuclei with these binding energies. For the 2+ state, however, we measured a reduced cross section, which would result in a strongly reduced spectroscopic factor---but calculations indicate that this relatively small cross section in coincidence with a gamma ray is due to competition of gamma- and proton-emission decay modes from the excited state.
15:25	**High Precision Penning Trap Mass Spectrometry of Rare Isotopes Produced by Projectile Fragmentation (00h15')** *Speaker: KWIATKOWSKI, Anna* At present the Low Energy Beam and Ion Trap (LEBIT) is the only facility to combine high precision Penning trap mass spectrometry with fast beam projectile fragmentation. Located at the National Superconducting Cyclotron Laboratory, LEBIT accesses radionuclides produced in a chemically independent process with minimal decay losses. Its recent exotic mass measurements include 66As, 63-66Fe, and 32Si. 66As is a candidate to test the Conserved Vector Current (CVC) hypothesis. The masses of the neutron-rich iron isotopes provide additional information about the mass surface and the subshell closure at N = 40. 32Si is a member of the A = 32, T = 2 quintet; its measurement permits the most stringent test of the validity of the isobaric multiplet mass equation (IMME). An overview of some recent measurements will be presented as well as certain techniques for advanced ion manipulation.

NS9 - Life Sciences Centre 3 (14:00-15:40)

time	title
14:00	**Mass Measurements on Halo Nuclei in Penning Traps (00h25')** *Speaker: ETTENAUER, Stephan* Light nuclei with mass numbers of up to A≈12 represent one of the most actively studied area on the nuclear chart as they exhibit very unusual features such as halo nuclei in which loosely bound nucleons orbit a nucleus' core. These nuclides are thus ideal testing grounds for nuclear structure research, especially as the region has also become accessible by a variety of theoretical models including ab-initio methods. Binding energies and nuclear charge radii are valuable benchmark parameters as their experimental determination is model independent. While binding energies are solely based on nuclear masses, charge radii can be extracted by combining high precision atomic laser spectroscopy, mass measurements, and atomic physics calculation. This talk will report on recent mass measurements on halo nuclei of He, Li, and Be isotopes at the TITAN Penning trap system at ISAC/ TRIUMF. Here measurements have for the first time become feasible for isotopes with half-lives even below 10 ms.
14:25	**Neutron Halo in Deformed Nuclei (00h15')** *Speaker: ZHOU, Shan-Gui* Halo phenomena in deformed nuclei are investigated within a deformed relativistic Hartree Bogoliubov (DRHB) theory. These weakly bound quantum systems present interesting examples for the study of the interdependence between the deformation of the core and the particles in the halo. Contributions of the halo, deformation effects, and large spatial extensions of these systems are described in a fully self-consistent way by the DRHB equations in a spherical Woods-Saxon basis with the proper asymptotic behavior at large distance from the nuclear center. Magnesium isotopes are studied and detailed results are presented for the deformed neutron-rich and weakly bound nucleus ^{44}Mg. The core of this nucleus is prolate, but the halo has a slightly oblate shape. This indicates a decoupling of the halo orbitals from the deformation of the core. The conditions for this decoupling and experimental signatures related to such a phenomenon are discussed. Ref. Shan-Gui Zhou, Jie Meng, P. Ring, and En-Guang Zhao, arXiv: 0909.1600 [nucl-th]
14:40	**Resonances and Continuum States of Drip-Line Nuclei Using the Complex Scaling Method (00h15')** *Speaker: MYO, Takayuki* Many states of unstable nuclei near the drip-line are observed as resonances and continuum states. The complex scaling method (CSM) is a powerful tool to describe the nuclear unbound states. CSM gives the correct continuum level density for many-body decaying states, which includes every effect of resonances and continuum states. We apply CSM to He, Li and Be isotopes based on the cluster models consisting of core and valence neutrons as, 1. The Coulomb breakup strengths of halo nuclei, such as 6He, 11Li and 11Be into three- and two-body systems. We discuss the roles of resonances and continuum states and also the core excitations in their breakup reactions. 2. Spectroscopic factors of resonances and continuum states of He isotopes in relation with their neutron removal strengths. 3. Five-body monopole breakup strengths of 8He, which is useful to discuss the various binary correlations such as 7He+n / 6He+2n continuum states and also dineutrons. [1] T. Myo, K. Kato, H. Toki and K. Ikeda, Phys. Rev. C76(2007)024305. [2] T. Myo, R. Ando, K. Kato, Phys. Rev. C 80(2009)014315. [3] T. Myo, K. Kato and K. Ikeda, Phys. Rev. C76(2007)054309.
14:55	**Direct Observation of the Glue Pairing the Halo of the Nucleus 11Li (00h15')** *Speaker: VIGEZZI, Enrico* Making use of the microscopic, nuclear field theory ground state wavefunction of 11Li calculated taking into account the interplay between bare and medium polarization pairing interaction acting between Cooper pair partners, one can calculate absolute two–particle transfer cross sections associated with the reaction 11Li + p → 9Li + t recently measured at TRIUMF. Taking into account successive, simultaneous and non–orthogonality contributions to the transfer process, theory leads to an overall account of the experimental findings [1]. The ratio between the excited 1/2− and the ground state cross sections provides, for the first time, unambiguous confirmation of the important role played by collective vibrations on nuclear pairing. In the present case, that played by the quadrupole phonon of 9Li on the binding of the 11Li neutron (halo) Cooper pair to the core. In fact, the pick–up reaction on such a weakly bound system, cannot populate directly the quadrupole vibration of 9Li. The only possibility of doing so is that of forcing the virtual phonon being exchanged between the 11Li halo neutrons to become a real excitation of the residual nucleus. [1] arXiv:0912.0847

15:10	**Two-Neutron Excitations in Light Neutron Rich Nuclei Studied via the (18O,16O) Reaction at 84 MeV (00h15')** *Speaker: CAVALLARO, Manuela* A study of two-neutron excitations in 11Be and 13B has been done by the (18O,16O) transfer reaction at 84 MeV incident energy. This corresponds to about 10 times the Coulomb barrier and is safely low to reduce the influence of deep inelastic mechanism. In such conditions detailed information about nuclear structure can be cleanly accessed. In particular the (18O,16O) reaction has been used to study the dynamical effects of pairing correlations in nuclei. Recently, the study of the 13C(18O,16O)15C reaction at 84 MeV has shown the appearance of striking phenomena in the energy spectra of 15C connected with the transfer of the neutron pair. In the experiment performed at INFN-LNS (Italy) the 16O ejectiles has been momentum analyzed by the MAGNEX spectrometer. The achieved energy resolution (80 keV) has allowed to identify several known excited states in the reaction products. Thanks to the MAGNEX large energy acceptance (+/- 20%), excitation energy spectra has been produced for the first time up to 20 MeV. Angular distributions for the transitions to several states has been measured allowing to draw interesting conclusions on the role of pairing in the structure of 11Be and 13B.
15:25	**Charge Radii of Halo Nuclei in the Gamow Shell Model (00h15')** *Speaker: PAPADIMITRIOU, GEORGIOS* We calculated the (6,8)He charge radii in the framework of the Gamow Shell Model (GSM). The charge radius reflects both the size of the halo, due to the motion of the alpha-core around the nuclear center of mass (CoM), and also provides us with information on how the several subsystems interact with each other. The motivation for this work was given by the recent very precise measurements (6,8)He, 11Li and 11Be charge radii. In our GSM calculations we used a Hamiltonian that is free from spurious CoM motion by adopting an intrinsic set of coordinates. We are convinced that for 6He the charge radius is very sensitive to i) the halo extent, namely the binding of the system and ii) the p3/2 occupation. This observation will help us to constrain our Hamiltonian and construct an effective interaction in the p and p-sd shells. We also performed an application of the Density Matrix Renormalization Group (DMRG) truncation algorithm to calculate the charge radius of 8He. This was the first application of DMRG to calculate observables other than energy. The results were very promising and they open a window in applying GSM plus DMRG to heavier systems 11Li and 11Be.

SM3 - Life Sciences Centre 1410 (14:00-15:40)

time	title
14:00	**The MuLan Experiment: A New Measurement of the Fermi Constant (00h25')** *Speaker: CAREY, Robert* Three of the most important inputs to the Standard Model of Elementary particle physics are the fine structure constant, α, the mass of the Z and the Fermi constant, G_F, the last of which is determined through measurements of the muon lifetime. Until about 10 years ago, incomplete theoretical calculations limited the precision with which G_F could be extracted from experiment. When van Ritbergen and Stuart finished their work on the missing radiative corrections in 1999, the precision was entirely limited by knowledge of the muon lifetime, paving the way for a new measurement. The MuLan collaboration published its first result in 2007 (11 ppm on τ_{μ}, 5.5 ppm on G_F) and will soon publish the final results from large production runs in 2006 and 2007. We expect that the overall error on τ_{μ} will lie between 1 and 2 ppm. In my talk, I will explain how this very simple measurement is made and describe our strategies for controlling the systematic errors. I hope to convince you that it is still possible to do interesting and important experiments in particle physics with a relatively small budget.
14:25	**Search for Muon to Electron Conversion at J-PARC (00h15')** *Speaker: KUNO, Yoshitaka* We would like to present the status of the COMET experiment, which aims at searching for muon to electron conversion in a muonic atom at J-PARC with an experimental sensitivity of better than 10^{-16}. The muon to electron conversion is one of the processes of charged lepton flavor violation (cLFV). Physics of cLFV has attracted much attention from theorists and experimentalists since cLFV would have a potential to find a clue of physics beyond the Standard Model. In particular, muon to electron conversion in a muonic atom has been identified as a next-generation process to improve a sensitivity beyond the MEG at PSI. The aimed sensitivity with the COMET is a factor of 10,000 better than the previous bounds. The COMET proposal has been approved at the stage-1 level at J-PARC, Japan in 2009, and the detailed design works and R are being undertaken. In addition, R for the subsequent project called thePRISM with an experimental sensitivity of better than 10^{-18} has started in the international framework. In this paper, we would like to present physics motivation and report all the experimental status on the COMET.
14:40	**Search for Trapped Antihydrogen (00h15')** *Speaker: FUJIWARA, Makoto* ALPHA is an international project at CERN, whose prime goal is to perform precision fundamental symmetry tests on antihydrogen, including CPT and in the long term, the Weak Equivalence Principle. Stable trapping of the anti-atoms would facilitate such tests. Substantial numbers of antihydrogen atoms have been produced previously, but their trapping has not yet been demonstrated. In the ALPHA apparatus, cold plasmas of typically 3x10^4 antiprotons and of 4x10^6 positrons are mixed in a Penning trap to form cold antihydrogen. A multipolar magnetic trap of depth 0.5 Kelvin is superimposed on the Penning trap to confine the anti-atoms. The ALPHA experiment features a 30,000 channel silicon vertex detector in order to identify the expected small number of trapped anit-atoms. Since its first beam in 2006, ALPHA has been making substantial progress towards trapping of antihydrogen. In 2009, we have reached, for the first time, the detection sensitivity and trap conditions for which observation of antihydrogen trapping can be realistically expected. In this talk, we will present results from this run. Development towards microwave spectroscopy of antihydrogen will also be discussed.
14:55	**Measuring the Muon's Anomalous Magnetic Moment to 0.14 Parts Per Million: The New (g-2) Experiment (00h15')** *Speaker: GRAY, Frederick* The anomalous magnetic moment (g-2) of the muon was measured with a precision of 0.54 ppm in experiment 821 at Brookhaven National Laboratory. A discrepancy of 3.2 standard deviations between this experimental value and the prediction of the Standard Model has persisted since 2004; it remains unexplained in spite of considerable theoretical refinement. This comparison has provided a hint of the possibility of physics beyond the Standard Model, but it also imposes strong constraints on those possibilities, which include supersymmetry and extra dimensions. The collaboration is preparing to relocate the experiment to Fermilab to continue towards a proposed precision of 0.14 ppm. This will require 20 times more recorded decays than in the previous measurement, with corresponding improvements in the systematic uncertainties. This presentation will describe the theoretical developments and the experimental upgrades that provide a compelling motivation for this program.

15:10	**Measurements of the Correlation Parameters in MOT from Beta Decay of 38mK and Polarized 37K Atoms. Status of the Experiment (00h15')** *Speaker: GORELOV, Alexandre* MOT technique has given a new breath to beta decay in search for new physics in the medium energy range. Studying the beta decay of trapped atoms allows an accurate detection of unperturbed recoiling nuclei in coincidence with beta particle, resulting in the precise measurements of correlation parameters. This technique also makes possible a high polarization of trapped atoms and allows measurements of the spin dependent observables. Our first runs with trapped 38mK and 37K atoms, delivered from ISAC, resulted in the measurements of beta-neutrino correlation parameter a=0.9992(44) in 38mK decay and measurements of B_nu=0.755(24) in decay of polarized 37K. In search for physics beyond Standard Model, they gave us the best in the world limits on the presence of scalar interaction in superallowed Fermi decays (PRL 94,142501, 2005) and meaningful limits on existence of right-handed currents in weak interaction (Phys.Let. B649,370,2007). Analysis of the data revealed sources of major systematic errors in both experiments. Presented ongoing upgrade of apparatus and a new target on ISAC should allow us to reach an accuracy of measurements of 0.1% for 38mK and of 0.2-0.3% for 37K.
15:25	**Limits on Tensor-Type Weak Currents from the Beta-Asymmetry Parameter in Nuclear Decays (00h15')** *Speaker: WAUTERS, Frederik* Beta-decay correlation measurements are a powerful tool to probe the properties of the weak interaction at low energies. For example, the beta-asymmetry parameter of a pure Gamow-Teller (GT) transition is well suited to search for a tensor-type weak interaction. Here, we will present the beta-asymmetry parameter of GT decays of 114In and 60Co. Our results are the most accurate available today for nuclear decays. They are in agreement with the Standard Model and set limits on tensor-type charged weak currents. After being implanted or diffused into a metallic host foil, the radioactive 114In and 60Co nuclei were polarized with the Low-Temperature Nuclear Orientation method. The beta-particles were observed using Si or high-purity Ge detectors, directly facing the sample foil. Extensive GEANT4 simulations were performed to gain control over the systematic effects, mostly scattering of beta-particles, which used to limit the precision of these type of experiments to several percent. The recoil corrections on the beta-asymmetry parameter of these isotopes were addressed for the first time, enabling us to interpret our results in terms of non-Standard Model physics.

Coffee Break - Forest and Life Sciences Centre Atriums (15:40-16:10)

HD1 - Life Sciences Centre 1410 (16:10-17:50)

time	title
16:10	**A New Energy Loss Mechanism at Strong Coupling (00h25')** *Speaker: CASALDERREY SOLANA, Jorge* We show that the propagation of a heavy quark in a strongly coupled plasma leads to the emission of Cherenkov-like mesons, if these mesons survive deconfinement. This mechanism originates from a universal property any gauge theory with a gravity dual: mesons in the deconfined plasma become space-like. We discuss possible phenomenological consequences of this observation.
16:35	**Bulk Viscosity and the Trace Anomaly in QCD (00h15')** *Speaker: FERNANDEZ-FRAILE, Daniel* We present our recent results concerning the diagrammatic calculation of transport coefficients in quantum field theory. We focus on the recently conjectured relation by Kharzeev et al. between the bulk viscosity and the trace anomaly in QCD, and we present an explicit calculation where this relation is accurately tested. We also comment on sum rules, and applications to other systems.
16:50	**Exploring the Initial State in Relativistic Heavy Ion Collisions (00h15')** *Speaker: DAVID, Gabor* While the most spectacular effects seen in relativistic heavy ion collisions are attributed to the formation of a strongly interacting, hot and dense medium (final state), there is a rapidly growing consensus that the initial state of the incoming relativistic nuclei is in part responsible for the observed phenomena. The initial state is best studied in d+Au collisions where only cold nuclear matter is present and probed by a single proton or neutron. Based on the latest results from the PHENIX experiment at RHIC (BNL) from the high statistics 2008 data taking period we will review the nuclear modification factors at central and forward rapidities as well as the status and lessons learned from central-forward and forward-forward correlations which provide an important test of gluon saturation in the Au nucleus at low x.
17:05	**Probing Resonance Matter with Virtual Photons (00h15')** *Speaker: GALATYUK, Tetyana* HADES has measured di-electron production in C+C, Ar+KCl, p+p, d+p and p+Nb collisions. The new HADES results confirm the previous DLS data, which could not satisfactorily be explained by various transport models for more than a decade. For a better understanding of the dielectron production in heavy ion collisions HADES has studied elementary NN interactions at E = 1.25 GeV. For the first time, the electron pairs were reconstructed from quasi-free np sub-reactions by detecting the proton spectator from the deuteron breakup. A large difference in di-electron production in p+p and n+p reactions measured at the same beam energy is observed. There is evidence that the appropriate superposition of the di-electron yields measured in pp and np (NN reference) can explain the C+C dielectron yields in the mass region of 0.15 < Me+e- < 0.5 GeV/c^2. On the other hand, a direct comparison of the NN reference spectrum with the e+e- invariant mass distribution measured in the heavier system Ar+KCl at 1.76 GeV/u shows an excess yield above the reference, which we attribute to radiation from resonance matter. Results of the p+Nb data analysis will be presented too.
17:20	**Di-Jet Correlations in Heavy-Ion Collisions at RHIC Energies Within the Microscopic HSD Transport Approach (00h15')** *Speaker: LINNYK, Olena* We present a systematic study of correlations in pseudorapidity and azimuthal angle for high-p_T charged hadrons in heavy-ion collisions at the top RHIC energy within the Hadron-String Dynamics (HSD) transport approach. The study shows that a significant part of the high p_T hadron attenuation seen experimentally can be attributed to inelastic interactions of 'leading' pre-hadrons with the dense hadronic environment. It turns out that the 'far-side' correlations are suppressed by up to 60\% in central collisions due to the pre-hadronic interactions in line with earlier studies. Since a much larger suppression is observed experimentally in central reactions there should be strong additional partonic interactions in the dense QGP medium created in Au+Au collisions at RHIC. Furthermore, our calculations do not show a 'ridge' on the near-side which also indicates additional non-hadronic correlations.
17:35	**Chemical and Kinetic Equilibrations via Radiative Parton Transport (00h15')** *Speaker: ZHANG, Bin* A hot and dense partonic system can be produced in the early stage of a central relativistic heavy ion collision. How it equilibrates is important for the extraction of Quark-Gluon Plasma properties. We study the chemical and kinetic equilibrations of the Quark-Gluon Plasma using a radiative transport model. Thermal and Color-Glass-Condensate motivated initial conditions are used. We observe that screened parton interactions always lead to partial pressure isotropization. Different initial pressure anisotropies result in the same asymptotic evolution. Comparison of evolutions with and without radiative processes shows that chemical equilibration interacts with kinetic equilibration and radiative processes contribute significantly to pressure isotropization.

HN2 - Forest Sciences Centre 1003 (16:10-17:50)

time	title
16:10	**Structure of p-Shell Hypernuclei (00h25')** *Speaker: MILLENER, D.J.* A total of 22 gamma-rays, including nine doublet spacings, have been observed with the Hyperball and Hyperball-2 Ge-detector arrays in six p-shell hypernuclei. The interpretation of this data will be discussed in terms of shell-model calculations in which hyperons in s orbits are coupled to p-shell core nuclei. Both Lambda-hypernuclear and Sigma-hypernuclear configurations are included because LambdaN-SigmaN (Lambda-Sigma) coupling is an important feature of the YN interaction. The spin-dependent terms in the LambdaN interaction and the Lambda-Sigma coupling both lead to state-dependent energy shifts of the Lambda-hypernuclear states. Most of the data can be accounted for using a consistent set of p(N)s(Y) two-body matrix elements. Some problems arise for the spacing of levels based on different core states. The fitted matrix elements can be compared with those deduced from YN extensions of the Nijmegen NN potential models.
16:35	**Selected Issues on Hadron Properties in Nuclei (00h25')** *Speaker: OSET, Eulogio* In this talk I will report on some issues involving hadron properties in nuclei. I will show how the study of the $\Lambda(1520)$ in a nuclear medium can bring about information on the nature of this resonance as mostly a bound state of \pi \Sigma(1385) predicted by chiral unitary theory. Comments about omega in the medium will be made, reporting on the information that can be obtained with photoproduction of this particle in nuclei. Concerning possible deeply bound kaonic states in nuclei and the strength of the Kbar nucleus potential, I will report on recent theoretical work on the (K^-,p) reaction in nuclei with kaons in flight and show that the data does not call for a deep potential, as has been claimed. I will also show how some of the recent X,Y,Z resonances recently discovered in Babar and Belle are renormalized in the nuclear medium with a look on the FAIR facility. Finally, I will show results on the renormalization of K* in the nuclear medium, which appear to be more spectacular than those evaluated, and measured, for the \rho in the medium.
17:00	**Experiments on Hadrons in Nuclei (00h25')** *Speaker: SCHADMAND, Susan* The status of experiments on hadron properties in nuclei will be discussed. Recent experiments focus on the production and decay of mesons in nuclei. The findings need to be understood together with results from elementary reactions where the input of the new WASA-at-COSY facility will be outlined. Finally, the presentation aims to provide an introduction to the session.
17:25	**Studies of K- Absorption on Light Nuclei and the Search for Bound Nuclear Kaonic States (00h25')** *Speaker: FILIPPI, Alessandra* The knowledge on K- absorption on a multibaryonic system, still rather incomplete, has recently gained a fresh boost. New experiments have been performed to test the claim for the existence of bound nuclear kaonic clusters, expected to be narrow enough to be observable. The existence of such strange clusters is still a controversial matter. Several experimental indications for their presence have been recently collected, but alternative theoretical explanations account for the observed experimental signatures without resorting to exotic processes. A summary of the experimental results achieved in the study of reactions induced by K-'s (by the FINUDA and E549 experiments) or by other probes (by, for instance, FOPI, OBELIX and DISTO) will be shown and compared to the state-of-art theoretical developments. In particular, recent results by FINUDA (LNF, Italy) in the study of final states featuring (Lambda p), (Lambda d) and (Lambda t) pairs will be presented. They are based on the joint analysis of momentum spectra, of invariant and missing mass distributions and of angular correlations of the emitted pairs.

NA3 - Forest Sciences Centre 1221 (16:10-17:50)

time	title
16:10	**Neutron Capture Studies at the National Ignition Facility (00h25')** *Speaker: BRUNE, Carl* The National Ignition Facility (NIF) at Lawrence Livermore National Laboratory is a laser-driven inertial confinement fusion facility which came on line in September 2009. The NIF laser system can deliver up to 1.8 MJ of energy to a capsule, causing it to compress and reach core temperatures of several 10^7 K and densities of several hundred g/cm^3. Under these conditions, several measurements of basic nuclear physics interest are possible. In particular, copious quantities of neutrons may be produced. With the proper capsule design, a significant fraction of these neutrons will be thermalized, allowing for the study of neutron-capture reactions of interest to the s-process. Capture reactions may be measured via direct gamma-ray detection or radiochemistry. Some possible measurements and the present status of the facility will be discussed.
16:35	**Nuclear Astrophysics at n_TOF, CERN (00h15')** *Speaker: TAGLIENTE, Giuseppe* Astrophysics is approaching a stage where a number of long-standing central questions about our Universe can finally be addressed within a consistent and quantitative way. In this context, the quest for the origin of the chemical elements plays a prominent role: This contribution is focusing on the production of the heavy elements beyond Fe by ongoing neutron capture nucleosynthesis in evolved stars and supernova explosions with corresponding constraints for Galactic chemical evolution. Taking advantage of the innovative feature of the n_TOF facility at CERN, in particular the high instantaneous flux, the high energy resolution and low background, accurate data on neutron capture cross section have been obtained for branch-point radioactive isotopes, as well as for stable isotopes with small cross-sections which act as bottleneck in the s-process reaction flow. After a description of the n_TOF facility, the main results of the Nuclear Astrophysics program of the n_TOF collaboration will be presented in this talk, together with their implications on the models of stellar nucleosynthesis. The future experimental program planned at n_TOF in this field will finally be discussed.
16:50	**Pair Decay Width of the Hoyle State and Carbon Production in Stars (00h15')** *Speaker: VON NEUMANN-COSEL, Peter* Electron scattering off the first excited 0+ state in 12C (the Hoyle state) has been measured at the S-DALINAC and used to extract the pair decay width in a model-independent approach applicable at low momentum transfers. Alternatively, a novel analysis method of form factor data covering a broad momentum transfer range [1] is presented which avoids the shortcomings of the usually applied Fourier-Bessel expansion. Discrepancies between previous results [2] are resolved, and the uncertainty is reduced by a factor of four. A precise knowledge of the pair decay width is mandatory for quantitative studies of some key issues [3-5] in the modeling of supernovae and of AGB stars as a source of the slow-neutron nucleosynthesis process, and the present results provide the required accuracy. [1] M. Chernykh et al., Phys. Rev. Lett. 98, 032501 (2007). [2] H. Crannell et al., Nucl. Phys. A758, 399c (2005). [3] H. O. U. Fynbo et al., Nature 433, 136 (2005). [4] C. Tur, A. Heger, and S.M. Austin, Ap. J. 671, 821 (2007); 702, 1068 (2009). [5] F. Herwig, S. M. Austin, and J. C. Lattanzio, Phys. Rev. C 73, 025802 (2006).
17:05	**Three-Body Calculation of Triple-Alpha Reaction at Low Energies (00h15')** *Speaker: ISHIKAWA, Souichi* The reaction rate of the nonresonant triple-alpha process at low temperatures being of importance on accreting white dwarfs and neutron stars, is calculated through that of the inverse process, 12C(2+) + gamma -> 3-alpha. For this, Schroedinger equations in a 3-alpha cluster model of 12C are directly solved by the Faddeev method with including long-range Coulomb interactions, which has been successfully applied to three-nucleon problem [S. Ishikawa, Phys. Rev. C 80, 054002 (2009)]. Nuclear Hamiltonian consists of an alpha-alpha potential, which reproduces the 8Be resonance state, together with three-body potentials to reproduce 12C bound states. At the moment, calculations have been performed for E < 300 keV, being adequate to obtain up to T_7 = 5. Our (preliminary) results agree with the standard by NACRE compilation [C. Angulo et al., Nucl. Phys. A. 656, 3 (1999)] within an order, which means our results are factors of 10^15 to 10^28 smaller than recent three-body reaction calculations [K. Ogata et al., Prog. Theor. Phys. 122, 1055 (2009)]. Numerical check and extension for higher energies of calculations are in progress.

17:20	**How Well Do We Understand the Rates for Heavy-Ion Fusion Reactions which are Important in Stellar Evolution? (00h15')** *Speaker: JIANG, Cheng Lie* A new phenomenon, heavy-ion fusion hindrance, has been discovered several years ago for medium-mass systems. Subsequent studies have shown that this is a common behavior for all heavy-ion systems, including those reactions which are important in explosive stellar evolution; e.g., in supernovae, X-ray-bursts and reactions in the crusts of accreting neutron star. Previous extrapolations as well as new model-calculations are found to be too high at low energies, and fusion hindrance will have a strong influence there. A detailed knowledge of the cross sections in that energy range for astrophysically interesting fusion systems (whose Q values are always positive) is critical in order to develop reliable predictions of reaction rates. Recent progress in this field, including measurements and theoretical calculations, especially for systems with positive Q values, will be discussed.
17:35	**Recent Beta-Decay Measurements of r-Process A~110 Nuclei at the National Superconducting Cyclotron Laboratory (00h15')** *Speaker: PEREIRA, Jorge* The beta-decay of neutron-rich nuclei plays a crucial role in the r-process, governing its speed and pre freeze-out abundance distribution. Beta-delayed neutron emission also defines the final (observed) r-process abundances, and provides an alternative source of neutrons in low entropy r-process scenarios. Besides their direct astrophysical implication, these gross properties can be used as nuclear-structure probes in regions of nuclei near the r-process path, where more detailed spectroscopic studies are prohibitive owing to the low production rates. In this context, the National Superconducting Cyclotron Laboratory (NSCL) offers unique opportunities to investigate actual r-process nuclei. Several beta-decay experiment campaigns have been undertaken in recent years, covering a wide region of the r-process path that spans from 78Ni to the neighbourhood of 110Zr. The most recent results from these experiments will be presented with emphasis on the evolution of nuclear structure in terms of deformation. The impact of the measured data on the r-process will be discussed in detail from quantitative and qualitative perspectives.

NF3 - Life Sciences Centre 1510 (16:10-17:50)

time	title
16:10	**Gas Catchers and the Production of Radioactive Nuclear Beams (00h25')** *Speaker: SAVARD, Guy* Gas catcher systems offer a new approach to the production of radioactive nuclear beams. They can be used to thermalize radioactive recoils from many types of production mechanisms and turn them into a low-energy beam of good ion optical quality that is suitable for post-acceleration or studies at low energy. This approach is essentially independent of the chemical properties of the radioactive recoils and is being implemented with recoils obtained from fusion-evaporation, fission, deep inelastic and fragmentation reactions. A review of the basic technology and capabilities will be presented together with an overview of the various facilities recently commissioned or under construction or preparation that will use this approach.
16:35	**Status and Science Opportunities of the Gamma-Ray Tracking Detector Array GRETINA (00h15')** *Speaker: LEE, I-Yang* A gamma ray energy tracking detector array is a novel and extremely powerful detector system and could provide broad science opportunities. These include the study the evolution of nuclear properties of exotic nuclei, the structure of the heaviest elements, nuclear properties at extreme of angular momentum, and studies in nuclear astrophysics as well as fundamental symmetry. Especially for radioactive beams experiments, such detector will be needed to overcome the low intensity and high background associated with the most exotic beams. A tracking array GRETINA is being constructed in US and I will discuss the status of the project and the research plan after its expected completion date of early 2012.
16:50	**Cooling Highly Charged Ions with Cold Electrons and Protons - the TITAN CPET Project at TRIUMF (00h15')** *Speaker: GWINNER, Gerald* Accurate masses of short-lived nuclei are needed to improve nuclear models, to test the conserved vector hypothesis, test the unitarity of the Cabibbo-Kobayashi-Maskawa quark mixing matrix, and for application in astrophysics. The TITAN facility at TRIUMF is expanding mass measurements of unstable nuclei to using highly charged ions (HCI) bred in an electron beam ion trap. The HCI extracted from the EBIT will have energy spreads of tens of eV/charge or more. After direct injection into the mass measurement trap, this spread would lead to large ion clouds susceptible to magnetic field inhomogeneities and decreased sensitivity of the time-of-flight method employed to measure the cyclotron frequency. The TITAN cooler Penning trap, currently under construction, will cool HCI by storing them simultaneously with cold electrons or protons. We will present the status of the project.
17:05	**A Plan to Construct a Rare Isotope Accelerator Facility in Korea (00h15')** *Speaker: HONG, Seung-Woo* The Korean government announced in January 2009 a plan to construct a heavy ion accelerator facility for producing radioactive ion beams in the framework of a mega project called the International Science & Business Belt. Since then, a planning work for the construction of a heavy ion accelerator is underway supported by the government. The construction of this facility will be a cornerstone for basic science research in Korea. This facility, tentatively referred to as KoRIA (Korea Rare Isotope Accelerator), is to be used for multipurpose research, including nuclear science, atomic, material and bio-medical sciences. To produce the radioactive ion beams, both ISOL and In-flight fragmentation methods are being considered. Post-acceleration of the radioactive ion beams may be done up to a couple of hundreds MeV. The conceptual design study is expected to start soon, and the present status of the planning will be presented.
17:20	**Simulations for the Future e-Linac Converter (00h15')** *Speaker: LEBOIS, Matthieu* In the next years, TRIUMF activity will be focused on building a new facility to be able to produce very intense neutron rich radioactive ion beams using ISOL technique. The e-linac primary beam, that will induce the fission, is an intense electron beam (50 MeV energy and 10 mA intensity). This beam is sent on an uranium carbide target (UCx), but due to its power, it is essential to insert a converter on the beam path to avoid a target vaporization. In this presentation, I will give an overview of the various techniques I used to determinate a suitable geometry for this converter. In this work, Bremsstralhung process that produce the useful gamma had to be carefully taken into account. For this, use of the reference toolbox for particle simulations : GEANT4 was mandoratory. For the first time, thanks to GEANT4 adaptability, the three major photonuclear processes that takes place in the target: (gamma, fission), (gamma,n) and (gamma,2n) were introduced in a simulation. Based on GEANT4 results, using ANSYS®, a thermal simulation of the system cooling was performed to confirm its resistance the beam exposure. At the end, an appropriate geometry for the future e-linac converter is proposed.

17:35 **The SPIRAL2 Project and Experiments with High-Intensity Rare Isotope Beams (00h15')**

Speaker: LEWITOWICZ, Marek

The SPIRAL 2 facility at GANIL, which entered recently in the construction phase consists of a new superconducting linear accelerator delivering high intensity, up to 40 MeV, light (proton, deuteron, 3-4He) beams as well as a large variety of 14.5 MeV/nucl. heavy-ion beams and the associated Rare Isotope Beam facility. Using a dedicated converter and the 5 mA deuteron beam, a neutron-induced fission rate is expected to approach 10e14 fissions/s for high-density UCx target. The energies of accelerated RIBs will reach 7-8 MeV/nucl. for fission fragments and 20 MeV/nucl. for neutron-deficient nuclei. The physics case of SPIRAL 2 is based on the use of high intensity RIBs & stable-ion beams and on possibilities to perform several experiments simultaneously. A use of these beams at a new low-energy ISOL facility (DESIR) and their acceleration to several MeV/nucl. will open new possibilities in nuclear structure physics, nuclear astrophysics and reaction dynamics studies. The high intensities (up to 10e11 pps) and a high cost of RIBs impose a use of the most efficient and innovative detection systems like ACTAR, FAZIA, GASPARD, HELIOS, NEDA, PARIS and a new separator/spectrometer S3.

NN2 - Forest Sciences Centre 1001 (16:10-17:50)

time	title
16:10	**Present Experimental Techniques, Results and Plans for Searches on Double Beta Decay (00h25')** *Speaker: FIORINI, Ettore* The various techniques planned or adopted to search for neutrinoless double beta decay will be reviewed and compared. The results obtained so far on this lepton non conserving process will be critically reported. The present situation of the more important double beta decay experiments , mainly aiming to search for the neutrinoless channel will be briefly reviewedwith their expected sensitivities in determining or constraining the effective neutrino mass.
16:35	**EXO-200 (00h15')** *Speaker: MACKAY, Derek* EXO-200 (Entriched Xenon Observatory – 200kg) is a low-background underground double-beta decay experiment that contains 200kg of Xenon, isotopically enriched to 80% in Xenon-136. EXO-200 will measure both the scintillation light and the ionization signal of the Xenon decay in order to detect the as yet unobserved two neutrino double beta decay mode, which conserves lepton number, and to put a competitive limit on the rate of the zero neutrino double beta decay mode. EXO-200 is currently under 2000 meters water equivalent of overburden at the WIPP site in New Mexico and is undergoing final construction and commissioning.
16:50	**Neutrino Interactions with Nucleons and Nuclei (00h15')** *Speaker: MOSEL, Ulrich* Neutrino oscillations and nuclear physics are closely connected. Questions such as what are the mass-differences?, what are the mixing angles? and is there CP violation in neutrino-interactions? are presently at the focus of neutrino long baseline experiments. A critical quantity in all these experiments is the neutrino-energy which cannot be measured, but must be reconstructed from the detected particles. All of these experiments use nuclear targets and it is thus mandatory to understand the electroweak interactions in the nuclear medium and the final state interactions of the particles produced in these interactions. In this talk it is shown that in current experiments such as K2K, MiniBooNE and T2K there is a strong entanglement of quasielastic processes and pion production. It is also shown how these processes affect the energy reconstruction and possibly also the surprisingly high values of the axial mass of the nucleon extracted from these experiments.
17:05	**The Hunt for theta13 at Daya Bay (00h15')** *Speaker: WANG, Wei* Neutrino flavor oscillation induced by neutrino mass eigenstate mixing has become the most plausible explanation of the results of solar, atmospheric, long-baseline and reactor neutrino experiments. Despite these results in recent years, we still know very little about the third angle, theta13, in the PMNS neutrino mixing matrix. The current best upper limit is sin^2 2theta13<0.17 at 90% C.L. The Daya Bay reactor neutrino experiment in China is designed to reach a sensitivity of 0.01 at 90% C.L. in sin^2 2theta13, independent of the Dirac CP phase value. It has the highest designed sensitivity among the current reactor neutrino experiments under construction. Determining the value of sin^2 2theta13 to 0.01 sensitivity level independent of the Dirac CP phase is important for the planning of the next generation of appearance neutrino oscillation experiments for exploring CP symmetry. The Daya Bay experiment will start taking data with the first two near detectors at the end of 2010. Data taking with the full complement of eight detectors will start in 2011. In this talk, we present the design, simulation and current status of the Daya Bay neutrino experiment.
17:20	**In Trap bb Decay Spectroscopy at TITAN (00h15')** *Speaker: BRUNNER, Thomas* In order to determine the nature of the neutrino several very sensitive experiments are presently searching for evidence of neutrinoless double beta decay. In this special lepton number violating decay, a complex nuclear matrix element connects the half life of this process with the effective neutrino mass. The measurement of electron-capture branching ratios (ECBR) of odd-odd intermediate transition nuclei in a bb-decay offers an ideal benchmark to determine nuclear matrix elements. For this, a new technique has been developed and tested at TRIUMF's TITAN facility. Intermediate transition nuclei will be stored in an open access Penning ion trap that allows their nuclear decays to be observed in-situ. The 5 T magnetic field guides the betas out of the trap. Thus, EC X-rays can be detected radially with ideally no beta background contribution. During preliminary experiments with 107In and 126Cs the performance of X-ray and b-detectors as well as the experimental setup as a whole has been tested. In both experiments it was possible to store ~1e5 ions in the Penning trap and determine their ECBR. This contribution will present results of this new method of in-trap-decay spectroscopy.

17:35 **GERDA - Commisioning the New Neutrinoless Double Beta Experiment on 76Ge (00h15')**

Speaker: MEIERHOFER, Georg

The Majorana nature of the neutrino is still an open question and due to the high priority of this question neutrinoless double beta decay experiments are persued at several laboratories with different isotopes. 76Ge is a candidate which excels due to advanced high-resolution detector technology. A new concept for background reduction has been developed to prove or refute a previous claim. All 8 diodes from IGEX and Heidelberg-Moscow have been refurbished with resolutions below 4keV FWHM. Low-mass holders have been constructed for immersion in to the cryoliquid to avoid possible background contributions from nearby material. GERDA is being installed in Hall A of the Laboratori Nazionali di Gran Sasso (LNGS). By March 2010 the 10m diameter and 9.5m high water tank is equipped with reflector foils and 66 PMTs for the active muon veto. In addition the water will shield the stainless steel cryostat inside which holds 64m^3 liquid argon to shield and cool the germanium diodes. A clean room with a glovebox permits to mount the diodes together with cryogenic FE electronics for immersion. The cryogenic infrastructure is running. GERDA is ready for the first signals from the detectors.

NR4 - Forest Sciences Centre 1005 (16:10-17:45)

time	title
16:10	**Neutron Transfer Reactions with Rare Isotope Beams Near 132Sn (00h25')** *Speaker: CIZEWSKI, Jolie* Nucleon transfer reactions on closed shell nuclei provide critical tests of the nuclear shell model and enable the assignment of quantum numbers and deduction of spectroscopic factors for single-particle excitations. New studies with rare isotopes are needed to understand shell structure away from stability and calculate direct capture rates. The 130,132Sn and 134Te (d,p) reactions have been performed in inverse kinematics with rare isotope beams and CD2 targets at the Holifield Radioactive Ion Beam Facility at Oak Ridge National Laboratory. Reaction protons were measured with silicon strip detectors, including a partial implementation of ORRUBA. Candidates for the 2f7/2, 3p3/2, 3p1/2, and 2f5/2 excitations across the N=82 gap were identified in 131,133Sn and 135Te. Measurements of cross sections as a function of angle facilitated the analysis of angular momentum transferred and deduction of spectroscopic factors and asymptotic normalization coefficients. The present talk will describe the experiment and analysis and summarize the results. This work is supported in part by the U.S. Department of Energy and National Science Foundation.
16:35	**Improving Transfer Reaction Models (00h25')** *Speaker: NUNES, filomena* Transfer reactions have been a preferred tool to study spectroscopic properties of nuclei and have been widely used to determine single particle structure across the nuclear chart. Currently, the spectroscopy of exotic nuclei can be studied using inverse kinematics. A number of studies in the last decade hold promise for applying this technique more broadly, especially in new generation rare isotope facilities, where beam rates will be enhanced. In order to use the transfer reaction method to determine detailed structure and discriminate between effective interactions used in many-body theories it is essential that the reaction model be reliable. The standard approximations being used by the various experimental groups in the extraction of spectroscopic factors include the Born approximation, the adiabatic approximation and the zero-range approximation. We quantify the errors introduced when using these approximations across the nuclear chart as well as for the various energy regimes at which these experiments are performed. Finally we also comment on the magnitude of the corrections that are needed to account properly for three-body effects.
17:00	**Enhancement of the Two Neutron Transfer Channel in the 18O Induced Reactions at 84 MeV (00h15')** *Speaker: CARBONE, Diana* A systematic study of particle-particle correlations in different nuclei has been done by transfer reactions induced by 18O Tandem beam at 84 MeV incident energy. This corresponds to about ten times the Coulomb barrier for light targets as 9Be, and is around the barrier for the heavier one, 208Pb. In addition the incident energy is safely low to reduce the influence of deep inelastic mechanism. In these conditions detailed information about nuclear structure can be accessed. The experiment has been performed this year at the INFN – LNS (Italy) using a 18O beam on different targets as 9Be, 11B, 13C, 28Si, 58Ni, 64Ni, 120Sn and 208Pb. The ejectiles have been momentum analyzed by the MAGNEX spectrometer. The achieved mass resolution (about 1/160) has allowed to identify the reaction products corresponding to different reaction channels, such as one and two neutron or proton transfer, inelastic scattering etc. The integrated cross sections show an enhanced yield for the transfer of two neutrons compared to one. This striking result demonstrates that the (18O,16O) reaction proceeds mainly by the direct transfer of the neutron pair, instead of being a second order process.
17:15	**Low Energy Nuclear Reactions with RIBRAS, Radioactive Ion Beam in Brazil, System (00h15')** *Speaker: GUIMARAES, Valdir* The possibility of using radioactive (exotic) nuclear beams has opened an exciting field of investigation in nuclear physics with strong implications in areas such as nuclear astrophysics. To produce low energy RNB, the University of Sao Paulo, Brazil decided to use a system based on superconducting solenoids, the RIBRAS system [1]. Many experiments with radioactive light particles beams such as 6He, 7Be and 8Li have been performed to investigate low energy reactions such as elastic scattering and transfer reactions, which could provide useful information on the structure of light nuclei near the dripline and astrophysics. In this contribution we will present the results for our recent scientific program using this facility which includes elastic scattering and transfer reactions of 6He halo nucleus on 9Be, 27Al, 51V and 120Sn targets and 8Li on 9Be, 12C and 51V targets. The total reaction cross section has been extracted from the elastic scattering data and spectroscopic factors have been extracted from the transfer reactions. [1] R. Lichtenthaler et al., Eur. Phys. J. A 25, S-01, 733 (2005)

17:30 **Role of Three-Body Forces in Proton and Heavy-Ion Scatterings (00h15')**

Speaker: FURUMOTO, Takenori

The three-body forces (TBF) effect is known to play an important role on the nuclear saturation property, which can be demonstrated typically in the Brueckner (G-matrix) theory. Recently, we have proposed new complex G-matrix interactions CEG07, from which nucleon-nucleus (NA) and nucleus-nucleus (AA) folding potentials are obtained. The CEG07 G-matrices are derived from the free-space nucleon-nucleon interaction, the Extended Soft Core (ESC) model, including the TBF contributions composed of the three-body repulsive (TBR) and attractive (TBA) components. Using CEG07, we have analyzed the elastic scattering of NA and AA systems. For NA systems, we have tested the optical potentials obtained by the single-folding procedure with CEG07 in the cases of the proton elastic scattering. We have further applied the CEG07 G-matrix to the AA systms in the framework of the double-folding model and analyzed the elastic scattering of complex nuclei systems at E/A = 70 $\sim$ 135 MeV. The TBF (especially TBR) effect is clearly seen in all cases investigated. The roles of individual contributions of the TBR and TBA have also been studied in detail.

NS10 - Life Sciences Centre 3 (16:10-17:50)

time	title
16:35	**Nuclear Spectroscopy of the Heaviest Elements (00h15')** *Speaker: BERRYMAN, Jill* Recently, it has become possible to perform detailed spectroscopy on nuclei beyond Z=100, with the aim of understanding the underlying single-particle structure of superheavy elements. A number of such experiments have been performed at the 88-Inch Cyclotron of the Lawrence Berkeley National Laboratory using the Berkeley Gas Filled Separator (BGS), coupled with delayed gamma ray and electron decay spectroscopy. Experiments have been performed on 253,254No (Z=102), 257Rf (Z=104), and 261Sg (Z=106), and highlighted results include the following. An isomeric one-quasineutron state has been identified in 261Sg, which has the highest Z and A of any nucleus in which the electromagnetic decay of an isomeric state has been observed to date. Spectroscopy of delayed gamma rays and electrons from 257Rf resulted in the identification of a K isomer, which likely decays to a rotational band built on the [725]11/2- Nilsson level. In 253,254No, several multi-quasiparticle isomers have been identified, which decay into lower lying rotational structures. Such results provide new information on the properties of transactinide nuclei, which is important for testing models of the heaviest elements.
16:50	**Hyperdeformed Fission Resonances Observed in 232U (00h15')** *Speaker: CSIGE, Lóránt* The fission probability of 232U has been measured using the 231Pa(3He,df) reaction with an energy resolution of 11 keV in the excitation energy region of E=4.0–6.4 MeV. A number of sub-barrier fission resonances have been observed for the first time below E=4.8 MeV and interpreted as rotational bands with a rotational parameter characteristic to a hyperdeformed nuclear shape (1.96(11) keV). The K values of the bands were deduced by measuring the angular distribution of the associated fission fragments. The fission barrier parameters of 232U have been determined by analyzing the overall features of the fission probability. A deep third minimum with an excitation energy of 3.2(2) MeV was found, suggesting that in the case of 232U fission proceeds via strong reflection asymmetric shapes. Besides, a rather low inner barrier height of 4.0(3) MeV could be established, giving rise to expect so far unobserved short-lived fission isomers in 232U. Given our new results, the resonances around E=5.0 MeV could be assigned to states built on the second barrier (transition states). This could be the first time that such states have been observed with high resolution in the fission probability.
17:05	**Shape Transition in the Neutron-Deficient Polonium Isotopes (00h15')** *Speaker: BASTIN, Beyhan* In the region around the Z=82 shell closure with neutron number around midshell between N=82 and N=126, shape coexistence occurs at low excitation energy. This phenomenon is well-established in the neutron-deficient Po isotopes as evidenced by low-lying rotational like bands intruding in the low-energy structure. While the onset of the collectivity in the light Po isotopes is reasonably well established experimentally, questions remain concerning the sign of deformation and the magnitude of the mixing between different configurations. Furthermore, controversy is present with respect to the transition from the vibrational-like character of the heavier Po isotopes to a structure driven by shape coexistence as observed in the lighter Po isotopes. From level systematics it appears that 200Po lies at the borderline between these two regimes. Recently, the spectroscopy of this key nucleus was performed using post-accelerated (up to 2.85 MeV/u) radioactive beam from REX-ISOLDE (CERN) followed by Coulomb excitation in a ‘safe’ energy domain. The gamma rays were detected by the MINIBALL detector array. First results, such as the transition strength, will be presented and discussed.
17:20	**Dipole States in 238U (00h15')** *Speaker: KARWOWSKI, Hugon* Beams of intense, nearly monoenergetic, 100% polarized gamma-rays were used to perform nuclear resonance fluorescence experiments at the High-Intensity Gamma Source (HIGS) at the Triangle Universities Nuclear Laboratory. Low energy dipole excitations in 238U were studied in the energy range of 2.8 – 4.2 MeV. Excitation energies, parities, decay widths, branching ratios and transition strengths of ~40 previously unknown levels excited via dipole transitions have been determined and precise experimental information on the distribution of M1 and E1 transitions in 238U has been obtained. These measurements form a unique data set that will be used for comparison with theoretical models of collective excitations of heavy, deformed nuclei.

17:35 **Two-Particle Separation Energies in the Superdeformed Well (00h15')**

Speaker: WILSON, Anna

The location of nuclear closed shells, as evidenced through discontinuities in binding energy and one- and two-particle separation energy systematics, remains one of the simplest tests of global nuclear models. How shell gaps evolve, whether with increasing mass, increasing neutron:proton ratio or increasing deformation, is still uncertain, and it has recently been suggested that one must go beyond a static meanfield picture to include the effects of dynamic fluctuations in the nuclear shape even in the ground state. The identification of key properties which may distinguish between competing approaches is thus vital. Our measurement of the energy and spin of superdeformed states in 190Hg expands the number of isotopes with A~190 in which binding energies at superdeformation are known. Comparison with neighbouring nuclei shows that two-proton separation energies are higher in the superdeformed state than in the normal state, despite the lower Coulomb barrier and lower total binding energy. This somewhat counterintuitive result provides a critical test for global nuclear models.

NS4 - Life Sciences Centre 2 (16:10-17:50)

time	title
16:10	**Collective Motion in Complex Nuclei (00h25')** *Speaker: EGIDO, J. Luis* The experimental activity developed in the last years far away from stability led to exciting discoveries. In the last years new theories have been developed to provide a theoretical basis for the understanding of the new phenomena. In this contribution we present a review on modern beyond mean field theories (BMFT) which allow the study of complex nuclei far away from stability. The basic ingredients in a BMFT are the generation of highly correlated symmetry conserving wave functions (w.f.) and the subsequent configuration mixing calculations. The basis product w.f. are generated by considering the quadrupole (deformation parameters beta and gamma) and the monopole (pairing vibrations) degrees of freedom. The broken symmetries are restored by projection on particle number (Variation After Projection) and triaxial angular momentum (Variation Before projection). The configuration mixing is performed by the Hill-Wheeler equation whose solution provides the energy spectrum and allows the calculation of transition probabilities. Several applications with the finite range density dependent Gogny force to current nuclear structure issues are presented.
16:35	**Coulomb Excitation on the 182,184,186,188Hg Nuclei (00h15')** *Speaker: HUYSE, Mark* Since isotope shift measurements first observed a sharp shape transition in the ground states of light odd-mass mercury isotopes, shape coexistence has been an actively studied phenomenon by means of decay and in-beam spectroscopy. Coulomb excitation at safe energies serves as a powerful technique to investigate the magnitude of transitions between low-lying states, revealing information on the mixing of the different bands. Pure beams of 182,184,186,188Hg were delivered by the ISOLDE radioactive beam facility to a stable Cd target (112Cd or 114Cd) placed in the middle of the MINIBALL gamma spectrometer. Observed deexcitation rates, together with known lifetimes enable the transitional quadrupole matrix elements connecting different states to be extracted. Also the sign of the diagonal matrix element of the first excited 2+ state, containing the information about the nuclear quadrupole deformation, will experimentally be determined. In addition to the decay of the first 2+ state, transitions from the second 2+ state and from the first 4+ state have been observed during the experiment.
16:50	**Beyond Mean-Field Methods: Status and Perspectives (00h15')** *Speaker: HEENEN, Paul-Henri* Methods including correlations beyond a mean-field approach have been applied to a large variety of nuclei. The first applications were based on the use of a Skyrme energy functional but now variants exist based on the Gogny interaction and on relativistic Lagrangians. The restoration of rotational and particle number symmetries has permitted to determine spectra in a non ambiguous way and to make direct comparison with experimental data. I will present some very recent applications to Hg, Pb and Po neutron deficient isotopes for which the comparison with the experimental data has been extremely enlightening. I will also discuss the extension of the method that are underway and I will give an overview of the difficulties and the problems which remain to be solved.
17:05	**Measurement of the Isovector Spin Monopole Resonance via the 208Pb,90Zr(t,3He) Reactions at 300MeV/u (00h15')** *Speaker: MIKI, Kenjiro* The isovector spin monopole resonance (IVSMR) is a kind of giant resonance and has long been a major topic in the study of spin-isospin responses in nuclei. Since the IVSMR is a breathing mode with spin and isospin flips, it can be related to the nuclear matter compressibility with spin and isospin degrees of freedom. In spite of the importance of the IVSMR, the IVSMR has not been clearly identified especially for the beta+ side. In order to establish the IVSMR(beta+), we measured the 208Pb,90Zr(t,3He) reactions at 300MeV/u at the RIBF facility at RIKEN. The triton beam of 300MeV/u was produced by the fragmentation of the 4He beam of 320MeV/u, and was bombarded onto the secondary targets. Scattered 3He particles are momentum-analyzed by the newly constructed SHARAQ spectrometer. This is the first physics measurement utilizing SHARAQ. The double differential cross section spectra for the 208Pb,90Zr(t,3He) reactions are obtained at 0<Ex<70MeV excitation energy and 0<theta<3deg scattering angles. In this presentation, the obtained spectra and the obtained signatures for the IVSMR(beta+) will be presented.
17:20	**Lifetime and Electromagnetic Transition Rate Measurements in 16C and 20C (00h15')** *Speaker: PETRI, Marina* The search for new nuclear structure effects due to weak nucleon binding is of great interest. B(E2:2+→0+) measurements can provide information on such phenomena, particularly where the low-lying 2+ state has a predominant neutron excitation. Neutron-rich carbon isotopes have received a great deal of attention recently in regards to the question of spatially extended and possibly de-coupled valence neutrons. The observation of low B(E2) values is cited as one of the main pieces of experimental evidence for a reduced coupling in these nuclei. We will present data from a direct lifetime measurement of the 2+ states in 16,20C obtained in experiments carried out at the NSCL using the recoil distance method. We find the B(E2) value for 16C to be consistent with recent measurements. The data for 20C indicates an increasing B(E2) relative to 16,18C, contrary to what may have been expected if the valence neutrons were “de-coupled” from the core. We interpret this in terms of an increased proton amplitude in the 20C 2+ state due to a weakening of proton p3/2-p1/2 spin-orbit splitting with increasing neutron number, caused by the interaction between valence neutrons and protons.

17:35 **Relativistic Hartree-Fock-RPA Calculations of Charge-Exchange Excitations in Nuclei (00h15')**

Speaker: LIANG, Haozhao

Charge-exchange excitations play central roles in many important issues of nuclear physics and astrophysics, such as the beta-decay of nuclei, neutrino-nucleus cross sections, neutron star and supernova evolutions. In this work, a fully self-consistent charge-exchange relativistic random phase approximation based on the relativistic Hartree-Fock approach is presented. Using effective Lagrangians which can describe at a quantitative level the ground state properties of spherical nuclei, this RPA approach is applied to investigate a number of issues: the nuclear spin-isospin resonances, isospin symmetry-breaking corrections for the superallowed beta decays, and the charged-current neutrino-nucleus cross sections. For the Gamow-Teller and spin-dipole resonances, it is found that a very satisfactory agreement with the experimental data can be obtained without readjusting the effective Lagrangian. The isoscalar mesons are found to play an essential role via the exchange terms, a feature not present in usual RMF-RPA models. For the isospin symmetry-breaking corrections, it is found that they are sensitive to the proper inclusion of the exchange contributions to the Coulomb mean field.

Poster Session 2 - Life Sciences Centre Atrium (19:30-21:30)

title	board
Immediate Practical Applications of a Basic Nuclear Physics Laboratory (00h00') *Speaker: CARTER, H. Kennon* This talk will present ideas on how a fortuitous melding of existing and funded capabilities at the basic research nuclear physics facility, Holifield Radioactive Ion Beam Facility at ORNL (HRIBF), could provide crucial data for practical applications in today's nuclear energy community at a very modest cost. The result would be increased knowledge of essential nuclear data required to support modeling and simulation efforts for advanced reactor fuel cycles, transportation and safety. Extensive experimental capabilities exist at the HRIBF that enable researchers to carry out basic studies on nuclei far from stability. To extend these studies, two new devices have recently been funded: ORISS – Oak Ridge Isomer Spectrometer and Separator and MTAS – Modular Total Absorption Spectrometer. The MTAS will be the largest of its type and ORISS will provide pure beams. Coupling these new devices to the existing online separator, UNISOR, would provide the most comprehensive and precise determination anywhere of the decay properties of nuclei that contribute to "decay heat". This talk will describe the need, the capabilities and conceptual program to obtain these nuclear data.	
A New Facility for Non-Destructive Assay with a Time-Tagged 252Cf Source (00h00') *Speaker: FABRIS, Daniela* A new facility for materials Non-Destructive Analysis, based on a time-tagged 252Cf source, is now in operation. As stated in our previous studies [1,2] the material recognition is obtained by measuring simultaneously transmission of neutrons and gamma rays from a time-tagged spontaneous fission source. Direct signatures of light elements such as C,N,O in the sample, normally used to identify threat organic materials, are obtained from the measured transmission versus neutron energy. Heavy elements are discriminated by measuring transmission gamma rays spectrum as a function of energy, taking advantage from the wide energy range of the fission gamma rays. The present system employs 8 ultra-fast plastic scintillators for time-of-flight measurements. Those detector provides a 2D reconstruction of average Z inside the sample by measuring the ratio of neutrons and gamma rays attenuation. A standard NaI(Tl) scintillator is placed behind this array to perform energy-dependent gamma-ray attenuation measurements. Results of the material recognition obtained with the present system will be presented. [1] G. Viesti et al, NIM A593 (2008) 592. [2] G. Viesti et al, NIM A606 (2009) 816.	
Safety Management of Radioactive Waste Containing Tritium and Carbon-14 in Romania (00h00') *Speaker: IONITA, Gheorghe* Romania its only one European country which has implemented and developed CANDU technology based on natural uranium and heavy water for producing of nuclear energy. Two CANDU-6 reactors of 660 MWh, are in commercial operation since 1996 and 2007 and others 2 similar reactors are planned to be built and to be put in operation in 2015 within Canada Nuclear Power Plant. The use of CANDU technology, beside of development of research activities in others two research reactors and current peaceful applications of nuclear energy are producing a significant volume of radioactive waste containing tritium and carbon-14, in Romania. The safety management of these radioactive waste it's an action of the first priority and includes not only strategic and politics aspects but and a lot of scientific issues whose solving has to contribute to the minimization of their volume an to decrease of total activity.	
Neutron Transport Code for Radiation Damage by Spallation Neutrons (00h00') *Speaker: KUMAR, VINOD* Energy of the spallation neutrons extends from fraction of MeV to the beam energy and this opens up several non elastic channels along with the elastic ones. Not only the neutrons but the elastically scattered nuclei of the material lose energy in elastic cascade and in electronic processes and the material is damaged at a fast rate. Compared to the radiation damage by a charged particle there exist only a few codes for the damage by the neutrons. For the Monte Carlo simulation, the developed code assumes the irradiated material to be in the static state and makes use of the ENDF data libraries up to several tens of MeV and for higher energies data of cross sections is generated by the TALYS code. The results of simulation are verified by conducting experiments using the neutron spectrum of the AmBe source and estimation of surface defects by AFM and overall effect of bulk defects by the measurement of change in electrical resistance of the irradiated samples. An attempt is made to estimate the displacement per atom and to correlate it with the experimental observations.	

Liquid Xenon Detectors for Positron Emission Tomography (00h00')

Speaker: MICELI, Alice

Positron emission tomography (PET) is a functional imaging technique based on detection of 511 keV annihilation photons following positron decay. Gamma ray detectors based on liquid xenon are excellent candidates for PET because they can achieve high sensitivity, good position resolution, good time resolution to decrease the random coincidence rate, good energy resolution to reject scattered photons, high count rate capability, and uniform response throughout the field of view. In this presentation, we will describe a novel micro-PET scanner under development at TRIUMF. The LXePET system consists of 12 sectors arranged in a ring geometry. Each sector includes a high precision time projection chamber filled with liquid xenon viewed by two arrays of avalanche photodiodes. The detector takes advantage of the combined measurement of scintillation light and ionization charge. Simulation studies show that an energy resolution of 8% (FWHM) and a sensitivity of > 15% can be achieved with the proposed micro-PET scanner. First results of a single micro-PET sector will be presented.

Precision Cross Section Measurements on GaAs Using Monoenergetic Neutron Beams (00h00')

Speaker: RAUT, R.

GaAs is an important semiconductor material with wide applications in research and industry. This work describes the cross section measurements on GaAs, at neutron energies ranging from 7.5 MeV to 15 MeV, carried out at TUNL. Quasi-monoenergetic neutrons are produced via the 2H(d,n)3He reaction, known for it's high yield in the chosen energy regime. GaAs samples were activated along with Au and Al foils for the estimation of the integrated neutron flux. The residual activity was measured using high resolution gamma spectroscopy, for identification of the populated channels and in determining the corresponding cross sections. The reactions studied include the measurements of 69Ga(n,2n)68Ga, 69Ga(n,p)69mZn, 71Ga(n,p)71mZn, 75As(n,2n)74As and 75As(n,p)75Ge. The results are compared with the existing literature data as well as the evaluations and found to be in reasonable agreement. The theoretical calculations based on Hauser-Feshbach statistical model formalism is currently in progress and will be compared with the above results.

GEANT4 Simulations to Determine the Radiation Dose from a Simple Alpha Radiation Exposure System for Irradiation of Adherent Cell Lines (00h00')

Speaker: STOCKI, Trevor

Radon gas (222Rn), an alpha particle emitter with alpha emitting progeny, is ubiquitous in our environment. Epidemiological studies have shown that exposure to 222Rn can significantly increase the risk of developing lung cancer. To determine the relative biological effectiveness (RBE) of the particles in different human cell-lines (glioblastoma, epithelial, and endothelial), an alpha radiation exposure system (ARES) was constructed. The ARES source was a 241Am electroplated stainless steel disc. For stable growth of the cell lines and transmittance of the alpha particles, cell culture dishes were constructed with a mylar membrane. The dosimetry of the system was calculated by Monte Carlo simulation using GEANT4 and was validated using SRIM2008, which was used to calculate the energy deposited by alpha particles in the material and the dosage to the cells. Overall, the resulting alpha radiation exposure system was found to be reliable, accurate and able to deliver a uniform dose to the cells. The ARES will be used in studies to determine RBEs, to assess chromosomal and gene expression changes, DNA damage and repair, and cell survival following alpha irradiation.

North Korean Nuclear Test of October 9th, 2006: The Utilization of Health Canada’s Radionuclide Monitoring Network and Environment Canada’s Atmospheric Transport and Dispersion Modelling (00h00')

Speaker: STOCKI, Trevor

Since January 1959, Health Canada has monitored environmental levels of radioactive fallout, to ensure the health and well being of Canadians. This work has evolved to include explosion verification for the Comprehensive nuclear-Test-Ban Treaty by monitoring the concentration of radioxenon in the atmosphere. Detection of Xe at Yellowknife by Health Canada’s monitoring system combined with Environment Canada’s atmospheric transport and dispersion models (ATDM) and seismic timing data have shown that the source of this Xe was most likely from the North Korean nuclear test of October 9th, 2006. Historical and real time monitoring data on the distribution of Xe releases from Chalk River Labs, the major source of anthropogenic background to Yellowknife were studied. Careful review of other large Xe-133 measurements at Yellowknife with ATDM was used to understand the October 2006 measurements of Xe. This allowed us to conclude that the Xe-133 detected at Yellowknife could be attributed to a release from the October nuclear test in North Korea. Health Canada and Environment Canada have demonstrated that Xe detection combined with ATDM is a viable technology for treaty verification.

The Cosmic Ray Inspection and Passive Tomography Project (00h00')

Speaker: STOCKI, Trevor J.

The CRIPT (Cosmic Ray Inspection and Passive Tomography) project aims to use cosmic ray muons, to scan cargo for special nuclear materials (SNM) and nuclear fuel waste containers. By measuring the deflection angle of the muon after it exits a container, one can determine whether or not SNM are present. In the case of the nuclear fuel waste containers, one can determine if the fuel is still present within the container. Different detector approaches are being evaluated by considering the performance, cost, and robustness of several technologies. Simulations have been performed to help design the detectors and to determine the effectiveness of the proposed techniques. Realistic cargo containers will be simulated and methods will be developed to scan nuclear fuel waste containers with high precision.

Project on Nuclear Spin Imaging (NSI) at RCNP (00h00')

Speaker: TANAKA, Masayoshi

We started an application program of nuclear spin physics to Nuclear Spin Imaging (NSP) with 3He, 13C, 19F, 31P highly polarized by means of the Brute force method and subsequent rapid melting where a strong magnetic field (~ 17 T) and a very low temperature (< 20 mK) are employed. In the intial step of our project, we are currently developing a device to create the highly polarized 3He gas. This gas will then be introduced to the MRI(Magnetic Resonance Imaging), and used for the medical diagnosis of the lung images. In the next phase of the project, other polarized nuclei are planned to be used for not only medical diagnosis, but also basic life sciences including studies of molecular biology and genetic engineering.

Modification of Isomeric State Lifetimes in Plasmas Generated with High Intensity Lasers (00h00')

Speaker: TARISIEN, Medhi

In the last decade, the development of high intensity lasers has opened up new opportunities for nuclear physics studies in extreme conditions which cannot be reached with conventional particle accelerators. A laser is a unique tool to produce simultaneously hot and dense plasma and very high fluxes of photon or particle bunches in very short duration pulses. It is then possible to create isomeric nuclei and investigate their decay properties in such hot and dense plasmas. In these new media, the interaction between the nuclei and their electronic cloud may modify nuclear properties such as apparent decay periods. This is of prime importance in particular for the issue of energy storage in nuclei. We will focus on the 84Rb first isomeric state case, as an illustration of the new domains of nuclear physics opened up by UHI lasers.

Screening Effect of d+d Fusion in Metallic Targets at E<20keV Energy Region (00h00')

Speaker: WANG, Tieshan

Low energy d+d fusion reaction at far below Coulomb barrier region may be affect the surrounded environment strongly, this phenomena are observed by different groups in the world, and it is called as screening effect. The reaction cross section may be significantly enhanced due to this effect. Thus, a modification to the existed d+d, d+t and d+ Li etc. fusion reaction data may be necessary in the condensed matter. In this work, the screening effect of d-d reaction in different metallic targets e.g. Rh, Yb, Be, Al, Au, Sm, Pd, etc. has been studied and the screen potential in various metals has been obtained. The potential is strongly material related. At the same time, experimental results are found to be various in different beam-target conditions, e.g. temperature, beam intensity etc.. A simulation based on the charged particle spectrum is applied for obtaining the deuterium distribution in target, and the ratio of proton to triton emitted from the d+d reaction is used to modify the potential inside targets. New results based on the modified deuterium distribution are more reliable. The further experiment and dada analysis are still undergoing.

Triggerless Micro Vertex Detector with Low Material Budget for the PANDA Experiment (00h00')

Speaker: CALVO, Daniela

Besides the typical features characterizing silicon detectors in High Energy Physics, as good spatial resolution, energy loss measurement, limited material budget and radiation hardness, the Micro Vertex Detector (MVD) for the PANDA experiment (at FAIR) is requested to cope with special requirements. The study of many physics channels at an expected high antiproton-proton annihilation rate of 2·10^7ann/s is asking for a triggerless readout with a continuous data transmission and a good time resolution. Large dynamic range and a very low material budget are needed to measure low momentum particles down to a few 100 MeV/c. The inhomogeneous distribution of the radiation damage with a strong peak in the forward direction enforces an asymmetric layout. The MVD is composed by: hybrid pixel modules (100 x 100um^2 pixel) with thin silicon epitaxial sensors and readout ASICs developed in 130nm CMOS technology and double sided silicon microstrip detectors (~100um pitch), with supporting mechanics based on carbon fibres. Carbon foam layers will improve the heat transfer towards the cooling system based on water and working in depression mode. The last developments and results will be reported.

The FRIBs Upgrade (00h00')

Speaker: DE NAPOLI, Marzio

The FRIBs facility at the LNS produces since a few years, Radioactive Ion Beams (RIBs) at intermediate energies, by projectile fragmentation [1]. The possibility of using the produced RIBs as secondary beams in nuclear physics experiments by applying the tagging technique, i.e. the identification, event-by-event, in charge, mass and energy of each ion of the RIBs cocktail selected by the fragment separator, before it interacts with the secondary target, has been demonstrated [2]. For the near future, an upgrade of the FRIBs facility is planned. A new configuration of the Fragment Separator, consisting in adding two new quadrupoles in front of the first dipole and by replacing the six quadrupoles located between the two dipoles with others of larger diameter, would be able to increase the acceptance of the beam line and therefore the yield of the produced radioactive beams. Also the present tagging setup will be modified in view of the gain intensity, in order to sustain the higher foreseen incoming rate. Status and perspectives of the facility will be presented. [1] G. Raciti, et al. NIM B 266 (2008) 4632. [2] G. Raciti, et al. PRL 100 (2008) 192503.

First Radioactive-Ion-Beam Experiments with the Silicon Highly-Segmented Array for Reactions and Coulex (00h00')

Speaker: DIGET, Christian Aaen

The Silicon Highly-segmented Array for Reactions and Coulex (SHARC) is a new multi-purpose array for charged-particle detection. The array is used for radioactive-ion-beam studies at the ISAC-II accelerator facility at TRIUMF [R. Laxdal, et al., Proc. of LINAC08, 97 (2008)] in conjunction with the TIGRESS gamma-ray spectrometer [C. E. Svensson, et al., J. Phys. G 31, S1663 (2005)]. SHARC has now been completed and the physics programme utilising the array commenced. This programme addresses a diverse set of outstanding nuclear-physics questions and range from indirect studies of astrophysical reactions to studies of nuclear structure. A variety of reactions will be studied including neutron, two-neutron, deuteron, and alpha transfer as well as fusion evaporation, deep-inelastic scattering, and Coulomb excitation of radioactive nuclei. The very compact array has a high spatial resolution, a large solid angle coverage, particle identification where necessary, and is used in various dynamic ranges in energy, thereby allowing studies as diverse as the above. The performance and versatility of the array will be presented along with data from the first radioactive-ion-beam experiments.

Pulse Shape Analysis for the TIGRESS Clover Array (00h00')

Speaker: DJONGOLOV, Martin

Position reconstruction of gamma-ray interactions via response function analysis of the modern highly-segmented Germanium spectrometers is a challenging mathematical task. Typically, the number of time samples used in experimental pulses is much lower than the number of available interaction points (represented by calculated basis pulses). This renders the search for both individual interaction sites and weights (energies) from a single linear combination of pulses to be an ill-defined inverse problem. Multiple interactions are common in single segments and thus the large number of basis pulses and the presence of noise move any proposed solution away from the global minimum. The latter calls for a detailed study on the final uncertainty in the position of the candidate sites. In this presentation we will highlight some theoretical details of the mathematical problem. The result from application of available algorithms to real TIGRESS data analysis will be also discussed.

Extraction and Ionization of Neutron-Rich Fission Products at TRIGA-SPEC (00h00')

Speaker: EIBACH, Martin

Nuclear ground-state properties of neutron-rich nuclides are of high interest since they are required to improve nucleosynthesis calculations for the rapid neutron capture process (r-process) either using the data directly or by improving the nuclear models in this region. The TRIGA-SPEC experiment aims to extend the border of well-known masses, charge-radii and nuclear moments further into the neutron-rich area of the nuclide chart. By irradiating an actinoide target with thermal neutrons at the research reactor TRIGA-Mainz, a large variety of fission products can be produced, which are then thermalized inside a gas-filled target chamber. The thermalized fission products attach to carbon aerosol particles and are guided through a capillary to a skimmer system to separate them from the carrier gas before injection into an ECR ion source. Here, the clusters will break up and release the attached isotopes, which are then ionized, mass separated and transferred to the experiment. The status of the gas-jet system including the already detected radionuclides, transport-time and transport efficiency as well as the status of the ECR ion source will be presented.

Radioactive Beam Production with Isotope Separation On Line Method for SPIRAL 2 (00h00')

Speaker: LEWITOWICZ, Marek

The future facility SPIRAL 2 at GANIL aims at producing radioactive isotopes using not only neutron induced fission from high density UCx target, but from other nuclear reactions such as deep inelastic transfer, fusion evaporation, etc [1]. The design of the different targets and ion source units are progressing as well as the final design of the neutron converter. The different solutions for the developed target and ion source units and the current design status will be presented together with intensity estimates for some of the beam that should be available at the start of SPIRAL 2 and their extrapolation to nominal operation conditions. [1] White Book of SPIRAL 2

Nuclear Laser Spectroscopy in Superfluid Helium for the Measurement of Spins and Moments of Exotic Nuclei (00h00')

Speaker: FURUKAWA, Takeshi

Nuclear spins and electromagnetic moments are often key observables for studying nuclear structures. To measure the spins and moments of low yield radioisotopes (RIs) which are difficult to measure with existing methods, we have been developing a new laser spectroscopic method "OROCHI (Optical RI-atom Observation in Condensed Helium as Ion-catcher)." This OROCHI is based on the combination of superfluid helium liquid (He II) as a stopper of RI beam and in-situ laser spectroscopy of RI atoms. Using the remarkable properties of He II such as characteristic spectra of immersed atoms, it is feasible to measure nuclear spins and moments of extremely low yield (<1 pps) RIs . So far, we have demonstrated that nuclear spins and moments can be obtained with OROCHI from atomic Zeeman and hyperfine splittings using stable Rb and Cs isotopes. Recently we have successfully applied OROCHI to stable Ag and Au isotopes. This achievement will enable us to investigate exotic Ag and Au isotopes, in particular the mysterious high-spin (21+) isomer state of 94Ag for the first time. Details of the OROCHI, the recent developments, and the preparation toward the online experiments will be presented.

The Future SPICE Ancillary Detector for TIGRESS (00h00')

Speaker: GARNSWORTHY, Adam

Design work is underway for the future SPectrometer for Internal Conversion Electrons (SPICE) ancillary detector system which will be coupled to the TIGRESS Ge array at TRIUMF's ISAC II. SPICE will use a rare-earth permanent magnetic lens to collect and transport Internal Conversion Electrons (ICEs), emitted from the internal decay of nuclear states populated in nuclear reactions, to a set of semiconductor detectors which are shielded from direct view of the production site. This arrangement aims to optimize the signal-to-noise ratio observed in the electron detectors by minimizing backgrounds resulting from photons, back-scattered electrons, beta decay, delta electrons and secondary electrons. SPICE will have a particular sensitivity to higher energy ICEs between 500keV and 4MeV which will facilitate studies of shape coexistence and shell evolution in exotic nuclei. An overview of the design considerations, unique physics applications and expected performance of the device will be presented.

First Measurements with the BEta deLayEd Neutron Detector (BELEN-20) at the JYFL Penning Trap (00h00')

Speaker: GóMEZ HORNILLOS, Mª Belén

A prototype version of the BEta deLayEd Neutron detector which is being developed for the FAIR/DESPEC experiment has been used for the 1st time in an experiment at JYFL (Finland) in Nov 09. This first run was primarily intended to commission the detector and verify the working principles for future experiments. A new trigger-less DAQ has been developed for these measurements. This DAQ time stamps the events from the different channels and allows complete flexibility to construct correlations offline. This provides full offline control over the data to achieve the optimum background removal without reducing the statistics and make BELEN superior to previous detectors of this type. An isotopically pure beam was obtained using IGISOL and the JYFLTRAP Penning trap and implanted on a movable tape. The radioactivity was accumulated during 3T1/2, while the measurement period was extended up to 10T1/2 . The measurements were performed for known delayed neutron emitters 88Br, 94,95Rb, 138I and 138Te. The first four, with well known neutron emission probabilities, and a 252Cf source will be used to obtain the counter detection efficiency and tune the MC simulations.

An Advanced Ion Trap System for Rare Nuclides at FAIR: MATS (00h00')

Speaker: HERFURTH, Frank

MATS at FAIR stands for “Precision Measurements of very short-lived nuclei using an Advanced Trapping System for highly charged ions” and includes high precision mass measurements and in trap conversion electron and alpha spectroscopy. The experimental setup is a combination of a radio-frequency quadrupole for beam shaping, an electron beam ion trap for charge breeding, ion traps for beam preparation and decay spectroscopy, and a high precision Penning trap system for mass measurements. MATS will be installed in the low energy branch of the Superconducting Fragment Separator (Super-FRS) to profit from the worldwide unique production of heavy, neutron-rich nuclei of all elements. The necessary technical developments have already been started in different places. A test and prototype facility is installed at the TRIGA research reactor at the Mainz University. Other components like a radio-frequency quadrupole or the electron beam ion trap are prepared in Jyväskylä and Heidelberg, respectively. Recently, the technical design report (TDR) that summarizes the technical challenges and solutions has been submitted and is in the refereeing process.

The ALTO Facility for the Production of Rare Nuclei (00h00')

Speaker: IBRAHIM, Fadi

The ALTO facility (Accélérateur Linéaire et Tandem d'Orsay) at Institut de Physique Nucléaire d'Orsay is ready for operation. The aim of this facility is to provide neutron rich isotope beams for both nuclear physics study (away from the valley of stability) and developments dedicated to next generation facilities such as SPIRAL2. The neutron rich isotopes are produced by photofission of 238U induced by the 50 MeV electrons from the linear accelerator. The isotopes coming out of the fission target effuse towards an ion source to form a beam that is analyzed through the on line separator PARRNe. Additional experimental beam lines are currently under construction. First experimental results will be presented.

SAMURAI-TPC at RIKEN-RIBF for the Study of Nuclear Equation of State (00h00')

Speaker: ISOBE, Tadaaki

The nuclear Equation of State (EoS) is a fundamental property of nuclear matter that describes the relationships between the parameters for a nuclear system, such as energy, and temperature. Understanding nuclear EoS has been one of the major goals for nuclear physics in our quest to understand the properties of nuclei and dense nuclear matter. The EoS also plays an important role in our understanding of the nature of neutron stars. An international collaboration to study the nuclear EoS has been formed recently. The collaboration of the Symmetry Energy Project planned to install a Time Projection Chamber (TPC) into the SAMURAI dipole magnet at the Radioactive Ion Beam Facility (RIBF). RIBF is the accelerator complex located at RIKEN, Japan and it can produce a variety of unstable nuclei as secondary beams. With the TPC, we plan to perform experiments to measure charged pions, protons and light ions as probes to study the asymmetric nuclear matter. In transport calculations, the pi+/pi- ratios are expected to give strong constraints on the EoS asymmetry term at supranormal density. The design and the status of the SAMURAI-TPC detector development will be presented at this talk.

The Focusing Disc DIRC for the PANDA Experiment at FAIR (00h00')

Speaker: KERI, Tibor

The Focusing Disc DIRC is a novel Detector concept for particle identification based on detection of internally-reflected Cherenkov light. A thin disc of 1 m radius will be used as radiator and for light transportation. At the rim bars by crystal are foreseen to perform passive chromatic correction. Focusing elements map the angles of the propagating photons to spatial positions on the focal plane of photon detection devices. This novel 2D(+1T) detector concept contributes to the outstanding particle identification performance of the general purpose PANDA detector. The aims of the PANDA experiment are to address fundamental questions of the strong force, to explore the structure of the nucleon and to search for new matter. In this presentation the technical design, the current status of the development and recent results from prototype test experiments for the Focusing Disc DIRC will be presented.

National Array of Neutron Detectors (NAND) a Versatile Setup for Studies on Reaction Dynamics (00h00')

Speaker: KOMALAN SATHEEDAS, Golda

The importance of exploring the heavy-ion reaction dynamics at bombarding energies near and few tens of MeV above the Coulomb barrier is well recognized internationally. In order to facilitate research in this direction an array of 30 neutron detector , National Array of Neutron Detectors (NAND), has been setup at Inter University Accelerator Centre, New Delhi. The primary motivation behind the setup is to use heavy ion beam from 15 UD Pelletron and upgraded LINAC booster facility to study the reaction mechanism more efficiently by the measurement of neutron energy and angular distribution produced in heavy ion-induced nuclear reactions. This setup is flexible and can be used for inclusive and exclusive measurements of neutrons. This facility is being extensively used for the study of fusion-fission reaction mechanisms. Neutrons in coincidence with gamma-rays can also be studied in a close geometry. This enables us to carry out neutron tagged gamma-ray spectroscopy of (HI,xn) reaction channels of fusion evaporation process . Performance of the various aspects of this array will be reported.

High Energy Response of TIGRESS Detectors: Absolute Efficiency and Hit Pattern Distributions (00h00')

Speaker: KSHETRI, Ritesh

The gamma-rays from standard radioactive sources and the beta decay of a radioactive 11Be beam have been used to investigate the high energy performance of seven TIGRESS detectors up to an energy of 8 MeV. The measurements of the absolute full energy peak detection efficiency and the hit pattern distributions at clover, crystal and segment levels have been performed as a function of gamma-ray energy. The absolute efficiency at 1332 keV and 7974 keV are found to be 3.94(1) % and 0.69(6) % respectively. The segment hit pattern distribution shows that the full energy peak efficiency is dominated by double hit events above 1 MeV. Simulations from earlier studies have been compared to experimental data.

HYbrid Recoil Mass Analyzer (HYRA) - A Unique, Dual Mode Spectrometer at IUAC, New Delhi (00h00')

Speaker: NARAYANASAMY, Madhavan

A unique, dual stage, dual mode spectrometer/separator HYRA is being set up at Inter University Accelerator Centre, New Delhi downstream of superconducting LINAC accelerator. HYRA is optimised to access heavy nuclei produced in fusion evaporation reactions using gas-filled mode, medium mass nuclei produced through inverse kinematics in vacuum mode and to produce light, low intensity secondary beams from direct reactions. The first stage consisting of two large magnetic dipoles (operable in momentum achromat mode too) has already been set up and used in gas-filled mode to select heavy evaporation residues (ER) or elastic recoils with good efficiency and primary beam rejection. The second stage consisting of an energy dispersionless, mass dispersive electrostatic dipole-magnetic dipole combination is ready to be commissioned this year. The spectrometer, funded by Department of Science and Technology, Government of India, is planned to be used in stand-alone mode for reaction cross section measurements as well as in conjunction with Indian National Gamma Array for ER tagged gamma spectroscopy or with a spin spectrometer for ER tagged fusion spin distribution measurements.

Characterizing VANDLE Modules (00h00')

Speaker: PETERS, William

With upcoming facilities capable of exploring the nuclear landscape even farther from stability, neutron detection will become increasingly vital to compliment established techniques that detect charged particles. The Versatile Array of Neutron Detectors at Low Energy (VANDLE) is a new array of plastic scintillator bars being developed at the Holifield Radioactive Ion Beam Facility (HRIBF) at Oak Ridge National Laboratory (ORNL). With two different sized detector modules, the array is sensitive to neutrons with energies between 0.2 and 20 MeV. The modular design enables optimization of configurations for particular experiments, such as beta-delayed neutron measurements, and (d,n) reactions in inverse kinematics with rare isotope beams. Results from earlier measurements to characterize and simulate the light collection properties of prototype VANDLE modules, including timing resolution and efficiency, will be presented. Motivations for decisions concerning design features such as wrapping material and PMT coupling will also be discussed, as well as recent experimental tests with the PIXIE digital data acquisition system.

Active Target Developments (00h00')

Speaker: ROUSSEL-CHOMAZ, Patricia

Active targets, ATs provide high efficiency, very low detection threshold and ion tracking capabilities giving angular distribution and energy spectra measurements. The validity of the method was demonstrated with the first generation of detection set-ups developed at Bordeaux[1] and Ganil [2-3]. The ACTAR (ACTive TARget) collaboration has promotes an R & D program to define the characteristics of ACTAR [4], namely a highly segmented cathode (25 pads/cm2), reaching a large dynamic range in energy and time, self-triggering and high-data rate capabilities. A specific R & D program called GET (General Electronics for TPC) is in progress. It will be a modular, microelectronic based scale-free system able to read various TPC and AT-TPC. The design and the status of the ACTAR and GET developments will be presented at this talk. [1] J. Giovinazzo et al., Phys. Rev. Lett. 99 (2007) 102501 [2] C. Demonchy et al., Nucl. Instrum. Methods A 583 (2007) 341. [3] I. Tanihata et al., Phys. Rev. Lett 100 (2008) 192502. [4] H. Alvarez Pol, ActarSim, http://fpsalmon.usc.es/r3b/ActarSimACTAR.shtml

The SPES Project: A Second Generation ISOL Facility (00h00')

Speaker: PRETE, gianfranco

SPES (Selective Production of Exotic Species) is an INFN project to develop a Radioactive Ion Beam (RIB) facility as an intermediate step toward EURISOL. The Laboratori Nazionali di Legnaro (LNL) was chosen as site for the facility due to the presence of the PIAVE-ALPI superconductive linac accelerator, which will be used as re-accelerator for the RIBs. The SPES project is based on the ISOL method with an UCx Direct Target and makes use of a proton driver of at least 40 MeV energy and 200 microA current. Neutron-rich radioactive beams will be produced by Uranium fission at an expected fission rate in the target in the order of 10E13 fissions per second. The key feature of SPES is to provide high intensity and high-quality beams of neutron-rich nuclei to perform forefront research in nuclear structure, reaction dynamics and interdisciplinary fields. The exotic isotopes will be re-accelerated at energies higher than 10AMeV for masses in the region of A=130 amu. Expected rate on target is in the order of 10E9 pps.

Reconstruction of Multi-Hit Events in Si-Strip+CsI(Tl) Telescope (00h00')

Speakers: RANA, Tapan Kumar, BHATTACHARYA, Chandana

Charged particle detector arrays consisting of Si-Strip +CsI(Tl) detector telescopes are now widely in use for precision nuclear physics experiments requiring high granularity and energy resolution. One such array, consisting of 24 Si-Si-CsI(Tl) telescopes, is being built for the upcoming K500 superconducting cyclotron at Variable Energy Cyclotron Centre (VECC), Kolkata. A common problem with such arrays is reconstruction of multi-hit events; as the granularity of Si strip detector is large compared to the CsI(Tl) detector, there is a possibility that in one event more than one particles pass through multiple strips but finally stop in same CsI(Tl) detector. For such event, the energy deposited in CsI(Tl) will be the sum of energies of all the particles which hit at different dE detectors, and hence gives inadequate information for their full identification (particle types, energies etc.). Even partial recovery of such multi-hit data will enhance the performance of such arrays to a large extent. Here, we present an algorithm, which has been tested for reconstruction of multi-hit events upto Z=6 from simulated data for the VECC array.

Detection Properties and Radiation Damage Effects of SIC Diodes (00h00')

Speaker: RAPISARDA, Elisa

The response signal of SiC Schottky diodes to light ions and its dependence on radiation damage has been investigated. Three SiC types with different doping concentrations have been used to detect alpha particles, 12C and 16O ions at energies between 5 and 37.6 MeV. The diode depletion-thickness, the linearity of the response, the energy resolution, the signal rise-time and the Charge Collection Efficiency (CCE) were measured for different values of the applied reverse bias. In two SiC types minority charge carriers, generated by the incoming ion in the neutral region, diffuse to the depleted layer and are finally collected. From a best fit procedure, the minority carriers diffusion length and lifetimes are extracted and the dependence of the lifetime on the doping concentration is investigated. Finally, the radiation damage produced by 16O ions was evaluated by measuring the degradation of both the signal pulse-height and the energy resolution as a function of the ions fluence. The data show that SiC material is radiation harder than silicon but diodes having a factor 20 lower doping concentration exhibit a radiation hardness reduced by 60%.

Investigations of Energy Dependence of Saturation Thickness of Multiply Backscattered Gamma Photons in Elements and Alloys - An Inverse Matrix Approach (00h00')

Speaker: SABHARWAL, Arvind

In Compton scattering experiments employing thick targets, one observes that the numbers of multiply backscattered photons increases with increase in target thickness and then saturate at a particular target thickness called saturation thickness. The energy of gamma photons continues to decrease as the number of scatterings increases in the sample having finite dimensions when one deals in depth of the sample. In present experiment, an independent study of energy and intensity distributions of 279-, 320-, 511-, 662 keV, and 1.12 MeV gamma rays multiply backscattered from targets of different atomic numbers of various thicknesses and alloys is carried out in a backscattering geometry. The backscattered photons are detected by a NaI(Tl) scintillation detector, whose detector response unscrambling the observed pulse-height distribution to a photon energy spectrum, is obtained with the help of an 12 x 12 inverse response matrix. The present experimental results confirm that for thick targets, there is significant contribution of multiply backscattered radiations emerging from the targets, having energy equal to that of singly scattered Compton process.

Indian National Gamma Array at IUAC (00h00')

Speaker: SIVARAMAKRISHNAN, Muralithar

A 4pi multi-detector gamma-ray spectrometer, Indian National Gamma Array (INGA) was set up at the Inter University Accelerator Centre, New Delhi, to study nuclear structure at high spins. The array is based on twenty four Compton-suppressed Clover Germanium detectors with a total photo peak efficiency ~ 5 %. The spectrometer with the in-house developed sub-systems, mechanical mount for detectors, high voltage power supplies, front-end electronics and an automatic liquid nitrogen filling system are described. The performance of the array is persented. Since its commissioning, the array was used in a number of nuclear spectroscopic investigations.

Neutron-Rich Rare-Isotope Production in Peripheral Heavy-Ion Collisions at 15 MeV/Nucleon (00h00')

Speaker: SOULIOTIS, George A.

Neutron-rich nuclides have traditionally been produced in spallation reactions, fission and "cold" projectile fragmentation. In addition, the search for new routes is currently of great importance to reach out towards the neutron-drip line. At the Cyclotron Institute, we have undertaken a systematic study of the production cross sections of neutron-rich rare isotopes from binary collisions of neutron-rich beams on heavy neutron-rich targets below the Fermi energy. Recently, the reactions of 15 MeV/nucleon 86Kr and 40Ar on 64,58Ni and 124,112Sn targets have been studied using the MARS recoil separator. We observed large production cross sections of neutron-rich projectile residues in these reactions. From a practical viewpoint, such reactions offer an attractive approach with high intensity stable beams, as well as, in two-stage production schemes (namely by using a neutron-rich RIB on a neutron-rich target). Finally, possibilities of further studies that will be offered by re-accelerated radioactive beams from the RIB upgrade of the Texas A facility, and, in the future, from the Facility for Rare Isotope Beams (FRIB) in the US will be outlined.

Design of a Very Thin Target for Hyperon Production Using Antiprotons at FAIR (00h00')

Speaker: SZYMANSKA, Katarzyna

The future developments of the hypernuclear as well as of the exotic hyper-atom physics will require the production of statistically significant amounts of doubly strange X- hyperons [1,2]. In the PANDA experiment, at the future FAIR complex. These hyperons are planned to be produced via antiproton reactions on nuclei inside the HESR ring. The nuclear target will be located inside the antiproton beam pipe. It sizes and density, together with the antiproton beam profile will play a crucial role in the hyperon production rate, beam losses and background on the detector. To maximize the former effect and minimize the latter ones the width and thickness has been evaluated to be of the order of some microns. Some prototypes of the target have been constructed and their mechanical and thermal properties are under test. Further tests concerning the stress produced by the impulse transfer from a charged particle beam are planned in the next future. All the results concerning the calculated and measured performances will be presented. [1] F. Iazzi et al., Hyperfine Interact. 193, 89 (2009). [2] K. Tanida et al., Hyperfine Interact. 193, 81 (2009).

How to Characterize 1E12 Energetic Particles in a Picoseconds Bunch? (00h00')

Speaker: TARISIEN, Medhi

The development made over the past decade in Ultra High Intensity (UHI) laser has made it possible to accelerate bunches of particles in a very short duration. These particles can be electrons with energies up to 1GeV, photons produced by Bremsstrahlung, or ions, in particular protons, of several tens of MeV. These bunches contain around 1E12 particles with continuous energy distributions and last tens of picoseconds. To meet the challenge of characterizing these bunches of particles (energetic and spatial distributions), we have developed a technique based on nuclear activation that complement those traditionally used by the plasma physics community. A 32 detector system has been built in association with GEANT4 simulations in order to characterize shot by shot the incident particles produced in view of nuclear physics experiments under extreme conditions.

Facility Upgrade at Texas A & M University for Accelerated Radioactive Beams (00h00')

Speaker: TRIBBLE, Robert

The Cyclotron Institute is now in the fifth year of an upgrade project that will soon lead to accelerated radioactive ion beams at intermediate energies. The upgrade is being funded by the U.S. Department of Energy, The Robert Welch Foundation and Texas A & M University. As a first step in the upgrade, the K150 cyclotron has been refurbished and instrumented with an ECR ion source for beams from helium to uranium and a negative-ion source for proton and deuteron beams. The K150 cyclotron will be used both as a stand-alone machine for boosting existing radioactive ion beam capabilities and as a driver to produce radioactive ions which will be stopped in ion-guide cells, charge boosted in an ECR ion source, transported and reaccelerated in our K500 superconducting cyclotron. Both light-ion guides, based on the IGISOL design, and heavy ion-guides based on the Argonne National Laboratory design are being developed for the facility. Details about the upgrade project will be given including the concept, funding, the present status and future schedule.

Optimising FPGA Firmware Algorithms for Spectroscopic Performance of the TIGRESS Digital Data Acquisition System (00h00')

Speaker: WILLIAMS, Scott

TIGRESS is an array of up to sixteen HPGe clover detectors situated at the ISAC-II facility at TRIUMF, Canada. The TIGRESS data acquisition system is based upon custom-designed VXI/VME modules with onboard FPGAs for signal processing. At present there are two modules in use for TIGRESS, the TIG-10 module, a ten channel 100 MHz card used to digitize the signals from the clovers, and the TIG-64 module, a sixty-four channel 50 MHz card for silicon detectors. Each uses a custom firmware designed for onboard signal processing giving Moving Window Deconvolution (MWD) energy and Constant Fraction Discrimination (CFD) time information along with the output of the digitized samples. The performance of these algorithms has been investigated and optimised for each detector/module combination. This optimisation has already resulted in energy resolutions, for the detectors in situ, that are equivalent to those obtained when using an analogue system. Various CFD and related algorithms are being investigated, particularly for the germanium detectors that exhibit a very non-linear rising pulse shape. The results of this optimisation for both timing and energy resolution will be presented.

The HPGe Virtual Point Detector Concept for Radioactive Volume-Ring Sources by MCNP4c Simulation (00h00')

Speaker: NASRABADI, M.N.

Validity of a virtual point detector model (implying existence of a point where all interactions virtually occur) was investigated for measurements of radioactive volume-ring sources. The correlations of the count rates with the distance between the virtual point detector and the detector face for radioactive volume-ring sources with various radii was studied by MCNP4c simulation and experimental data. Furthermore, the dependence of the virtual point detector distance to the gamma energy intensity and sources with various radii was studied.

Development of a Technique Using MCNPX Code for Determination of Nitrogen Content of Explosive Materials Using Prompt Gamma Neutron Activation Analysis Method (00h00')

Speaker: NASRABADI, M.N.

Nuclear-based explosive detection methods can detect explosives by identifying their elemental components, especially nitrogen. Thermal neutron capture reactions have been used for detecting prompt gamma 10.8 MeV following radioactive neutron capture by 14N nuclei. We aimed to study the feasibility of using field-portable prompt gamma neutron activation analysis (PGNAA) along with improved nuclear equipment to detect and identify explosives, illicit substances or landmines. A 252Cf radio-isotopic source was embedded in a cylinder made of high-density polyethylene (HDPE) and the cylinder was then placed in another cylindrical container filled with water. Measurements were performed on high nitrogen content compounds such as melamine (C3H6N6). Melamine powder in a HDPE bottle was placed underneath the vessel containing water and the neutron source. Gamma rays were detected using a NaI(Tl) crystal. The results were simulated with MCNPX code calculations. The theoretical calculations and experimental measurements were in good agreement indicating that this method can be used for detection of explosives and illicit drugs.

Reaction Cross-Section Predictions for Nucleon Induced Reactions (00h00')

Speaker: NOBRE, Gustavo

A microscopic calculation of the optical potential for nucleon-nucleus scattering has been performed by explicitly coupling the elastic channel to all the particle-hole (p-h) excitation states in the target and to all relevant pickup channels. These p-h states may be regarded as doorway states through which the flux flows to more complicated configurations, and to long-lived compound nucleus resonances. We calculated the reaction cross sections for the nucleon induced reactions on the targets 40,48Ca, 58Ni, 90Zr and 144Sm using the QRPA description of target excitations, coupling to all inelastic open channels, and coupling to all transfer channels corresponding to the formation of a deuteron. The results of such calculations were compared to predictions of a well-established optical potential and with experimental data, reaching very good agreement. The inclusion of couplings to pickup channels were an important contribution to the absorption. For the first time, calculations of excitations account for all of the observed reaction cross-sections, at least for incident energies above 10 MeV.

Measurements of (d,n) Cross Sections Using Deuterated Liquid Scintillators (00h00')

Speaker: OJARUEGA, Mitaire

The exothermic reactions 3H(d,n) 4He and 2H(d,n)3He are commonly used as major sources to investigate monoenergetic neutrons for energies above 2 MeV. We have used the d+d and d+t nuclear reactions to calibrate and obtain neutron spectra from a specially designed deuterated (C6D6) liquid scintillator array. Preliminary cross section results from 13C(d,n)14N at 9 MeV and 2H(d,n)3He at 9 and 16 MeVs have been measured using the detector array and will be presented. The measured angular distributions for the 13C(d,n)14N reaction cross section were compared with distorted-wave Born approximation (DWBA) calculations. Experimental and simulated results will be discussed.

Photoexcitation of Isomeric States in the Reactions (gamma,n) and (gamma,2n) on 113In Nuclei in the Range 12-35 MeV (00h00')

Speaker: PALVANOV, Satimbay

In the present work results of investigation of the isomeric yield ratios and cross-section ratios of the reactions 113In(gamma,n)112m,gIn and 113In(gamma,2n)111m,gIn in the energy range of 12-35 MeV with energy step of 1 MeV are presented. The isomeric yield ratios were measured by the induced radioactivity method. Samples of natural In have been irradiated in the bremsstrahlung beam of the betatron SB-50 of Institute of Applied Physics of National University of Uzbekistan. Isomeric ratio of the yields of reactions (gamma,2n) at energies 33, 34 and 35 MeV are 0.13 (1), 0.12 (1) and 0.12 (1), respectively. The energy dependence of isomeric yield ratios of reactions (gamma,n) and (gamma,2n) in the 25-35 MeV energy range are obtained at first. The experimental results are compared with those calculated within the framework of cascade-evaporation model.

Fusion of 9Be with 124Sn (00h00')

Speaker: PARKAR, Vivek

The complete and incomplete fusion cross-sections for 9Be+124Sn system have been deduced from the online gamma ray measurement technique, as all major evaporation residues formed in this reaction are stable. The extracted complete fusion cross-sections showed a suppression of ~ 28 % compared to the coupled channel calculations. The projectile dependence for fusion on 124Sn target has also been studied and found that for 9Be nuclei the enhancement at below barrier energies is substantial compared to that of tightly bound nuclei.

Nuclear Muon Capture on the Deuteron - the MuSun Experiment (00h00')

Speaker: PETITJEAN, Claude

The new mu-d capture experiment conducted at PSI by the MuSun collaboration is presented. Like the previous experiment on mu-p capture this is a high precision lifetime measurement to determine the doublet capture rate of the mu-d atom. Contrary to mu-p the mu-d capture experiment must be carried out in cold deuterium gas to keep the hfs structure under control. Therefore, a new Cryo-TPC was developed which operates in ultra-pure deuterium gas at 30K and acts as active muon stop target and as well as muon tracker. The physics goal of the MuSun experiment is the determination of the L_1A parameter in effective field theories. This parameter calibrates the p + p fusion reaction of the sun, and also the nu + d scattering process observed by the SNO neutrino detector. The experimental setup of the new Cryo-TPC will be described and data showing the performance during the first test runs with muon beam will be presented.

Dynamical Dipole in Heavy-Ion Reactions (00h00')

Speaker: PIERROUTSAKOU, Dimitra

An experimental overview on an interesting feature of dipole excitation in heavy-ion collisions, the dynamical dipole mode (DD), predicted to occur between interacting ions with a large charge asymmetry will be presented. Using the DD as a probe and employing radioactive beams, new possibilities for the investigation of the symmetry energy at sub-saturation density are foreseen and will be discussed. As a fast cooling mechanism on the fusion path, the prompt dipole radiation could be of interest for the synthesis of superheavy elements through hot fusion reactions. To shed light in this direction and to study if pre-equilibrium effects survive in heavier systems, we extended our previous study (performed for A=130) to the 192Pb compound nucleus, formed at an excitation energy of 232 MeV, by using the 40Ca + 152Sm and 48Ca +144Sm reactions at Elab= 440 MeV and 485 MeV, respectively. Preliminary results of this measurement, done with the aim to search for the dynamical dipole mode in both evaporation and fission events for the first time in this mass region, will be presented.

Time-Dependent Green's Functions Approach to Nuclear Reactions (00h00')

Speaker: RIOS HUGUET, Arnau

Nonequilibrium Green's functions represent a powerful framework to study the time evolution of quantum many-body systems. A major advantage of this approach is the possibility of including consistently, in the time evolution of nuclear systems, correlations beyond the mean-field level and memory effects. This is particularly relevant for the case of central low-energy reactions, such as fusion, where dissipative effects fully come into play. As a first example of the potential of this approach, we have implemented the mean-field dynamics of one-dimensional nuclear slab collisions. We will describe the role of the off-diagonal elements of the Green's functions for such systems, quantifying their importance via a super-operator cut-off field technique. The impact of off-diagonal elements in the associated Wigner distributions will also be assessed. Finally, results for the extension of the dynamics to a correlated case, in which the self-energy is treated within the Born approximation, will be presented.

Complete Set of Deuteron Analyzing Powers for dp Elastic Scattering at 250 MeV/nucleon and Three Nucleon Forces (00h00')

Speaker: SEKIGUCHI, Kimiko

Study of three nucleon forces (3NFs) is essentially important in clarifying nuclear phenomena. Few nucleon scattering at intermediate energies ($E/A \sim 200~\rm MeV$) is one attractive approach to investigate the dynamical aspects of 3NFs, such as momentum and/or spin dependences. At RIKEN RI Beam Factory (RIBF) the experimental programs of few nucleon scattering with polarized deuterons beams at intermediate energies are in progress . As the first step a complete set of deuteron analyzing powers for deuteron--proton elastic scattering has been measured in a wide angular range $\theta_{\rm c.m.}=40^\circ--160° with 250 MeV/nucleon polarized deuteron beams by using the beam line polarimeter BigDpol. The obtained high precision data are compared with the Faddeev calculations based on modern nucleon-nucleon (NN) potentials alone or combined with 3NFs. Large discrepancies between pure NN theory and data, which are not resolved by the current 3NFs, are found at the c.m. backward angles for almost all the deuteron analyzing powers. These discrepancies are quite similar to what was found for the cross section at the same energy.

Study of Incomplete Fusion Reaction Dynamics in 16O+181Ta (00h00')

Speaker: SINGH, Bhanu Prakash

Recently, efforts have been made to study the dynamics of incomplete fusion (ICF) reactions at energies from near the Coulomb barrier (CB) to well above it. Though, the ICF reactions have been extensively studied however, the energy and mass asymmetry dependence of ICF reactions is still not well explored. In order to obtain detailed information regarding the ICF reaction dynamics and to study its energy dependence, excitation functions (EFs) and forward recoil range distributions (FRRDs) for a large number of reaction products in 16O+181Ta have been measured at incident beam energies ranging from the CB to well above it, using energetic 16O ion beam obtained from the 15UD-Pelletron accelerator, at the Inter-University Accelerator Center, New Delhi, India. The residues have been identified on the basis of their characteristic gamma-ray energies and measured half-lives. Analysis of data for EFs and RRDs has indicated significant contribution from ICF channels. The mass asymmetry dependence of ICF contributions is found to depend on projectile structure as well as beam energy. Further details of the measurements and analysis will be presented.

Complete and Incomplete Fusion Dynamics in ^{20}Ne + ^{165}Ho Collision at $\approx$ 4-8 MeV/Nucleon and Mass-Asymmetry Effect on Incomplete Fusion (00h00')

Speaker: SINGH, D.

The excitation functions for the evaporation residues produced in the following reactions; ^{182}Ir(3n), ^{182}Os(p2n), ^{179}Re(α2n), ^{178}Re(α3n), ^{177}Re(α4n), ^{177}W(αp3n), ^{178m}Ta(α2pn), ^{177}Ta(2α), ^{176}Ta(2αn), ^{174}Ta(2α3n), ^{173}Hf (2αp3n) and ^{166}Tm(4α3n) produced in the system ^{20}Ne + ^{165}Ho have been measured in the energy range $\approx$ 88-164 MeV, using catcher foil activation technique followed by gamma-ray spectrometry. The measured excitation functions have been compared with statistical model code PACE-2. The enhancement in the measured excitation functions for the residues produced in some alpha emission channels over the predictions of PACE-2 indicates the presence of significant contributions from incomplete fusion in addition to complete fusion reaction. The results indicate the occurrence of incomplete fusion involving break-up of projectile followed by fusion of one of the fragments with target nucleus ^{165}Ho. The present data also suggest that ICF probability is more in a mass-asymmetric system than in mass-symmetric system.

Insights into the Presence of Incomplete Fusion at Low Projectile Energies (00h00')

Speakers: SINGH, Pushpendra P., SINGH, B. P.

The existence of incomplete fusion (ICF) at low projectile energies gained significant interest and extensively investigated in recent years (see references). The effects of various entrance channel parameters, such as; (a) projectile energy, (b) mass-asymmetry, and (c) the input angular momenta, on the onset and strength of ICF have been explored. The ICF is found to compete with complete fusion (CF) even at energies as low as ≈15% above the Coulomb barrier. The low energy ICF is believed to be originated from high input angular momenta driven into the system due to large impact parameters. Influence of ICF on CF has been studied. For better insight into ICF dynamics, the forward-recoil-range distributions of fused composites have been measured. The spin-distributions and feeding-intensity profiles have been measured to probe entirely different de-excitation patterns involved in CF and ICF products. The systematics achieved from aforementioned studies will be presented during the conference. References: Pushpendra P. Singh, et al., Phys. Lett. B671, 20-24 (2009); Phys. Rev. C80, 064603 (2009); Phys. Rev. C78, 017602 (2008), Phys. Rev. C77, 014607 (2007), Ph.D., Thesis (2008).

The Theory of Partial Fusion (00h00')

Speaker: THOMPSON, Ian

We need, when there is a simultaneous absorption of one part of a composite system, to find the quantum-mechanical scattering amplitudes for another part, in order to distinguish incomplete from complete fusion. Using fission probabilities from 239Pu(d,pf), for example, does not give correct (n,f) cross sections if it was assumed that all (d,p) transfer reactions lead to compound nucleus formation. Various attempts to extend reaction theory to describe more general outcomes give different results, so I follow Austern and sum over the final states of just one (neutron) particle of a few-body system (eg. deuteron), and show how partial sums of the cross sections to those states can be expressed as integrals of the imaginary component of that particle's optical potential. In this derivation we need not make any first-order approximations in the entrance channel wave functions, and can ensure post-prior equivalence for the transfer matrix elements. We compare with experiments, and previous predictions of the competition between escape (breakup) and compound nucleus formation (absorption) in neutron captures. Prepared by LLNL under Contract DE-AC52-07NA27344.

Surface Boiling, a New Type of Thermodynamical Instability of Finite Nuclear Systems (00h00')

Speaker: TOKE, Jan

Limits of thermodynamical stability of bulk nuclear matter and finite nuclear systems are explored within the framework of interacting Fermi Gas model in Thomas-Fermi approximation. It is found that a hypothetical bulk matter with a typical nuclear binding energy of 16 MeV/A becomes unstable with respect to common boiling at a rather high excitation energy per nucleon of approximately 13.5 MeV, corresponding to a boiling temperature of approximately 11 MeV. A finite system of A=100, in contrast, is seen to become unstable already below 5 MeV/A of excitation, at a temperature below 6 MeV. However, in the case of a finite system it is the surface profile and not the bulk matter that becomes thermodynamically unstable. This instability results in boiling off of surface matter only while draining energy from the bulk. This phenomenon leaves an experimental fingerprint in the form of a boiling plateau on the caloric curve of temperature plotted versus excitation energy per nucleon.

Screening Potential for 6Li+d Reaction Measured with Solid/Liquid Li Target and Ionic Screening Effect (00h00')

Speaker: WANG, Tieshan

Low energy nuclear reaction is often affected strongly by the environment. The low energy nuclear reactions in metal environments — where target nuclei are surrounded by conduction electrons— have been studied by several authors. The screening potentials of the d+d , Li+d and Li+p reactions under such conditions were found to be very large in many metals. We have developed another environment, i.e., liquid Li, in which Li+ ions move freely in a sea of conduction electrons, and which has a much higher density . The liquid Li may be regarded as a low-temperature high-density plasma consisting of classical Li+ ions and quantum electrons. The results on the 6Li+d reaction with liquid Li target will be shown. The effects of the solid-liquid phase transition are clearly seen in the reaction rates. Of particular interest is the fact that the yields for the liquid target are always larger than those for the solid. Preliminary analysis for the T ~ 250^\circ C shows that screening potential for the liquid Li is about 550 eV and is about 150 eV larger than that for solid. The difference is due to the screening of the Li+ ions. The temperature dependence of the screening potential is also discussed.

Competition Between Fusion-Fission and Quasifission Processes in the 32S+182,184W (00h00')

Speaker: ZHANG, Huanqiao

The fission angular distributions for 32S+184W at seven energies(119-144 MeV) were performed at HI-13 tandem accelerator of CIAE. The experimental fission excitation function, fragment angular anisotropies and mean square angular momentum of CN are obtained. The measured fission cross sections of 32S+182,184W, which are from this work and literature, are decomposed into fusion-fission(FF), quasi-fission(QF) and fast fission contributions using the DNS model. The total evaporation residue and fusion-fission excitation functions are calculated in the framework of the advanced statistical model. The hindrance to complete fusion at small collision energies increases due to the increase of QF events and it is explained by the elongated shape of the dinuclear system which is formed in collisions with small orientation angles to the beam direction. An increase of the hindrance to complete fusion at large beam energies is explained by the dependence of the QF and intrinsic fusion barriers of dinuclear system on its angular momentum: at large angular momentum the QF barrier decreases and the intrinsic fusion barrier increases. In these reactions the contributions of FF and QF are comparable.

Recent Highlights of Mass Measurements at ISOLTRAP (00h00')

Speaker: KREIM, Susanne

Precision mass measurements are performed at the mass spectrometer ISOLTRAP with a relative mass uncertainty reaching routinely down to 1*10^-8. The time-of-flight detection technique is employed to determine the frequency of an ion stored in a Penning trap, from which the mass can be extracted. The system has studied nuclides with half-lives below 100ms and production yields of less than 1000 ions per second, supplied by the isotope separator ISOLDE at CERN. The nuclides investigated range from light systems - such as 17Ne - to heavy ones - such as 229Rn, thus, giving insight into numerous physics topics. In the period from 2007-2010, ISOLTRAP has delivered data for nuclear structure studies concerning shell closures and residual interaction. Among those, regions at closed shells were probed around N=50, N=82, N=126. It also provides valuable input for neutron and proton rapid capture processes in stellar environments with isotopes of Se, Br, Ag, Rb, Kr, Cd, Xe, Rn. In addition, the electroweak interaction examined in the case of super-allowed beta emitters such as 22Mg, 26mAl, 38Ca, and 74Rb. In this contribtion, recent results and developments at ISOLTRAP will be presented.

Non-Empirical Pairing Functional from Low-Momentum Two- and Three-Body Interactions (00h00')

Speaker: LESINSKI, Thomas

We present systematic calculations of pairing gaps in semi-magic nuclei across the nuclear chart using the Energy Density Functional method. A non-empirical pairing functional is derived at lowest order in the low-momentum, vacuum two-nucleon interaction, including the Coulomb force, and chiral three-nucleon interaction. The particle-hole part of the functional is built to reproduce the Hartree-Fock level density obtained with the same interaction. Energies of odd nuclei are calculated self-consistently in the equal-filling approximation, which allows a direct comparison to odd-even mass difference data. We assess the relative contributions of two-body and three-body direct terms, blocking, and missing higher-order terms of the perturbative expansion to pairing in finite nuclei. It is shown that including a three-body force lowers gaps enough to make a significant contributions from such higher-order terms necessary, in agreement with previous estimates.

Search for Multiphonon Vibrations in 180Os (00h00')

Speaker: LUMLEY, Nicola

Centred around mass A \approx 180 there is a small pocket of nuclei for which gamma vibrations can compete with rotations as the favoured mode of excitation. A study of 182Os provided the first evidence for multiphonon vibrations built on a high-K isomer [1]. To continue the search for multiphonon vibrations the high-spin states of 180Os were populated in the 150Nd(36S,6n) fusion-evaporation reaction at Argonne National Laboratory. The subsequent transitions were detected by the Gammasphere array. Two isomeric states have been observed in 180Os with K > 21 and K > 25 and half lives of 0.8 +/- 0.2 μs and 72 +/- 6 ns, respectively. Newly identified prompt structures for these isomers have been extracted up to spins of I > 30. The possible multi-quasiparticle configurations for the isomers will be presented in terms of g-factors and BCS calculations. The rotational and vibrational characteristics for the prompt structures will be discussed in terms of the aligned angular momentum and Shell Corrected Tilted Axis Calculations. [1] L K Pattison et. al. PRL 91, 182501 (2003)

Wobbling Motion − How Much Have We Learned About It? (00h00')

Speaker: MA, Wenchao

Wobbling-phonon excitation, characterized by a sequence of rotational bands with increasing number of wobbling quanta, is uniquely related to triaxial nuclear shape. Such an exotic mode has been predicted in 1970s, but has only been observed recently in odd−Z, even−N nuclei 161−167Lu and 167Ta. Extensive searches in neighboring nuclei revealed a number of bands associated with large deformation. Some bands in Hf, Yb, Tm, and Er nuclei were suggested to be triaxial strongly deformed bands. However, the wobbling mode has not been observed in any even-even system. Theoretical studies based on particle-plus-rotor model, cranked Nilsson calculations, and microscopic calculations using the random phase approximation indicated the crucial role of the rotation aligned proton i13/2 intruder orbital in odd-Z nuclei allowing the wobbling mode compete energetically with other excitations. But the wobbling bands in even-even system should be observed if the Bohr-Mottelson model is correct. The anharmonicity of the wobbling phonon spectrum and the spin-dependence of wobbling excitation energy are among other problems that we do not understand well. Current data will be presented and discussed.

Relativistic Continuum Random Phase Approximation and Assessment of Inconsistency (00h00')

Speaker: MA, Zhong-yu

A fully consistent relativistic continuum random phase approximation (RCRPA) is constructed in terms of the Green's function technique. In this method the contribution of the continuum spectrum to nuclear excitations is treated exactly by the single particle Green's function, which includes also the negative energy states in the Dirac sea in the no sea approximation. The single particle Green's function is calculated numerically by a proper product of regular and irregular solutions of the Dirac equation. The calculations are fully consistent: the effective Lagrangian with NL3 is used both to describe the properties of the bound state and the particle-hole residual interactions in the nuclear collective excitations. The numerical results are checked by the inverse energy weighted sum rules, which are obtained from the constraint relativistic mean field theory. The effects of the self-consistency violations are assessed, particularly those of the currents and Coulomb interaction to various collective multipole excitations are discussed.

Recent Achievements on the Pseudospin Symmetry in Atomic Nuclei (00h00')

Speaker: MARCOS, Saturnino

The pseudospin symmetry (PSS) in atomic nuclei was originally associated to the frequently observed quasi-degeneracy of pseudospin doublets (PSD) in nuclei. It is said that a PSD exhibits PSS if its two pseudospin partners have the same energy. In the relativistic mean field approximation, a nucleon in a nucleus is considered as moving in two very strong fields: an attractive scalar field, S, and a repulsive vector field, V, that are almost equal in magnitude, so that one has S+V<<|S-V|. In the recent years, the explanation of the PSS in the framework of the relativistic models has been based, mainly, on the two following hypotheses: The magnitude of S+V or that of the pseudospin-orbit potential (PSOP) is small enough to consider the PSS slightly broken in nuclei. The aim of this contribution is: A) To show that the two previous statements fail to describe the PSS. B) To show that the effect of the PSOP can be considered larger than that of the spin-orbit potential. C) To propose a new explanation of the PSS in nuclei based on the specific form of the S+V potential, rather than on its small magnitude, and the effect of the spin-orbit interaction.

The Neutron Skin Thickness Within Relativistic Mean-Field Models Including the Delta Meson (00h00')

Speaker: MARINELLI, José Ricardo

In the present work we obtain the neutron skin thickness, binding energy, the rms charge radius and the asymmetry as obtained by initially polarized elastic electron scattering within the solution of a density dependent relativistic model. This density dependence in imposed using two known techniques: the first one is to include non-linear coupling terms in the mesonic degrees of freedom (NL models) and the second, keeping only linear terms but using density dependent couplings (DDH models) between barions and mesons. Both methods are known to give excellent results for most of the nuclear matter and finite nuclei properties, but give a somewhat big values for the neutron skin thickness as measured with the present experimental uncertainty as well as when compared with non-relativistic Skyrme force calculations. Recently, besides the usual scalar , vector and isovector-vector mesons, the scalar-isovector delta meson has also been considered, both for finite nuclei and for astrophysical applications. Here we also include the delta in our calculation and analyze its role for the neutron skin problem, presenting results for several nuclei.

Properties of Drip-Line Nuclei with an m-Scheme Cluster-Orbital Shell Model Approach (00h00')

Speaker: MASUI, Hiroshi

Recent progresses on both the theoretical and experimental studies enables us to investigate the nuclei for the neutron and proton drip lines. The inclusion of the continuum is accomplished by an alternative approach. In the drip line region of the oxygen isotopes, the abrupt increase of the r.m.s.radius at 23O is observed from the analysis of the reaction cross section. We developed an extension of the COSM approach to treat the dynamics of the core, and qualitatively explained the origin of the abrupt increase of the r.m.s.radius of the oxygen isotopes. Further, we discuss the role of the unbound states in the COSM approach. We investigated the contribution of the continuum and resonant poles in the helium isotopes and compared with the GSM results. In this work, we propose an m-scheme approach of COSM to overcome the limitation on the number of valence nucleons in COSM. We perform calculations for oxygen isotopes and examine the interaction dependence of the valence nucleon on the energies and r.m.s.radii. We also show the densities of the isotopes and discuss the relation between the density and nucleon-nucleon interaction.

Precise Branching Ratio of 24mAl Beta Decay (00h00')

Speaker: MATSUTA, Kensaku

Branching ratio of the beta decay from 24mAl isomer state (1+) at 0.426 MeV to the ground state of 24Mg (0+) has been precisely determined, in order to solve inconsistency by factor of 2 between the beta-decay ft value of this transition and the Gamow-Teller (GT) transition strength from 24Mg to 24mAl deduced from the Charge-exchange reactions. 24mAl was produced in the collision of 24Mg on (CH2)n at 100 MeV/n, at HIMAC of NIRS (National Institute of Radiological Sciences). The 24mAl nuclei were separated in the fragment separator, and were implanted in the center of 5-mm-thick plastic scintillation counter. Beta rays emitted from the implanted 24mAl were detected by the plastic counter, and the gamma rays were observed by a HPGe detector placed behind the plastic. From the ratio between the beta rays and the 0.426 MeV gamma rays, branching ratio of the 24mAl decay to the 24Mg ground state is precisely determined. The present branching ratio of the beta decay is as large as twice of the old value. The newly determined ft value for the beta transition became quite consistent with the B(GT) strength.

Interacting Fermions in Nuclear Physics - from Bound States to Feshbach Resonances (00h00')

Speaker: MEKJIAN, Aram

A finite temperature model of strongly correlated nucleons interacting with a two body interaction with underlying nuclear isospin symmetries is developed. The interaction used in this study contains a long range attraction and short range repulsive hard core. The role of bound states and Feshbach resonances on the thermal properties of a spin 1/2, isospin 1/2 system of protons and neutrons can be studied using this interaction. Expressions are developed for varying proton fraction in a virial expansion of the equation of state EOS. The bound state is the spin one , isospin zero , S- wave state of the system, the deuteron. The resonant like virtual structures which arise in the spin zero, isopin 1 , S- wave channels channels have very large scattering lengths. Vary the proton fraction tunes over the Feshbach resonance and bound states. An analytic expression for the second virial coefficient is given. The ratio of the effective range to quantum thermal volume persists as a limiting scale in the unitary limit. The entropy is shown to vary cubically with this ratio while the interaction energy, EOS and compressibilty vary linearly. The ratio viscosity to entropy density is evaluated

Magnetic Dipole Moment of Cu-58 from beta-NMR Measurements (00h00')

Speaker: NAGATOMO, T.

Nuclei near the double magic nucleus 56Ni are of particular interest in investigating structure and interactions in the pf-shell region. The N = Z odd-odd nucleus 58Cu(Ipi = 1+, T1/2 = 3.2 s) with one proton and one nerutron outside the 56Ni core is the best suited system for the study of proton-neutron interaction in a pf shell nucleus. Then, we are planning to determine the electromagnetic moments of 58Cu by means of the beta-NMR technique. A spin polarized 58Cu beam was produced through the charge exchange reaction of 58Ni with a Be target, using a 63A MeV 58Ni beam provided by the K540 RIKEN Ring Cyclotron. The 58Cu nuclei emitted at angles in between 0.75^\circ and 4.1^\circ were separated by RIPS and implanted into a catcher sample of single crystalline Si (B doped) at 15 K. The finite polarization of about 0.2% was observed and then the beta-NMR spectrum for 58Cu in Si was obtained. As a result, the magnetic moment of 58Cu was determined to be 0.46(3) nm. This is in agreement with the recent results on the laser spectroscopy by Stone et al. [PRC77,067302] and Cocolios et al. [PRC81,014314] and supports that the p3/2-p3/2 configuration is dominant in the ground state of 58Cu.

The Odd-Even Staggering in 122-124Xe and 124-128Ba Nuclei (00h00')

Speaker: MITTAL, H. M.

The gamma-band energy staggering in low-spin, low- energy spectra of even-even 122-124Xe and 124-128Ba nuclei are discussed. The energy levels of ground and gamma band energies are calculated by the Soft Rotor Formula (SRF). The staggering is a function of spin has been analyzed in order to derive the information on the type of triaxiality present in 122-124Xe and 124-128Ba nuclei. The staggering indices of gamma-soft and triaxial nuclei are also calculated by this SRF formula. It is found that these staggering indices have opposite signs and provide clear distinction between -soft and triaxial nuclei.

Study of Triaxiality in Xe-Pt Nuclei (00h00')

Speaker: MITTAL, H.M.

The beta and gamma deformation of rigid triaxial rotor model of Davydov and Fillipov have been calculated for Xe-Pt nuclei. The triaxiality is the key property of the ground state as well as the excited states of nucleus. The beta and gamma of the collective model are the basic descriptor of the nuclear equilibrium shape and structure. These parameters follow the smooth trajectories against the p-factor, defined as (p = (Np+Nn)/NpNn). The smooth variation between deformation parameters and p-factor are shown by dividing the Xe-Pt nuclei i.e. Z=50-82, N=82-126 in to four quadrants viz, quadrant I and III for p-p and h-h bosons subspace and II, IV for p-h and h-p bosons subspace respectively. The relative contribution of beta and gamma decrease and increase in a complementary way, and should be more informative to the structure of the nuclei.

Symmetric and Non-Symmetric Muonic Atoms-Molecules Studies (00h00')

Speaker: MOHAMMADI, Saeed

The muonic helium atom (3He+2mu-e- or 4He+2mu-e-) is the simplest example of a three body atomic system with bound particles of widely different masses. This simple system can provide a sensitive test for the three body Schr"odinger wave function determination of the magnetic moment of the mu- as a test of CPT (Charge conjugation-Parity-Time reversal) invariance. The atom is produced in the reaction of capture of the negative muon by the positive helium ion. It is one of the products in the process of muon catalyzed fusion, and its spectroscopic properties have to be therefore studied carefully to understand the fusion reactions property. In this system, the negative muon is bound closely to the nucleus in the ground state of the atom; the orbital radius of the muon is about 400 times smaller than that of the electron due to their mass ratio and different charge screenings Therefore, in the simplest approximation, the muonic helium atom can be considered to be hydrogen-like with a pseudo nucleus (mu3He)+ or (mu4He)+. Here, we concentrate on the computation of the lowest order hyperfine splitting and other properties of muonic helium atoms (3He+2mu-e- and 4He+2mu-e-) in the ground state.

Neutron Densities from Parity-Violating Elastic Electron Scattering (00h00')

Speaker: MORENO DIAZ, Oscar

We discuss parity-violating elastic electron scattering as a complementary tool for precise determination of neutron densities in nuclei. We study nuclear isovector and isoscalar densities for N>Z and for N=Z stable nuclei obtained within the selfconsistent mean field approximation. We compare the values of the parity-violating asymmetry (PVA) at low and intermediate q-values for different N/Z and A values. Distorted wave calculations of PVA are shown and are compared to plane wave impulse approximation. We discuss how to extract the ratio between neutron and proton rms radii and monopole form factors from theoretical and experimental asymmetries. We focus on several N=Z cases to study the influence of nuclear isospin mixing in PVA. The effect of strangeness content of the nucleon on the PVA is also taken into account. [1] O. Moreno, P. Sarriguren, E. Moya de Guerra and J. M. Udias, J. Phys. G: Nucl. and Part. Phys. 37 (2010); O. Moreno, P. Sarriguren, E. Moya de Guerra, J. M. Udias, T. W. Donnelly and I. Sick, Nucl. Phys. A 828 (2009) 306.

Remodeling the Spin-Orbit Term of Skyrme Energy Density Functionals (00h00')

Speaker: MORENO DIAZ, OSCAR

We review the Skyrme interaction as first introduced by Vautherin and Brink in the Hartree-Fock formalism to construct the energy density functional and, more especifically, the two-body spin-orbit term. Problems with this term were already pointed out by Skyrme. We discuss possible options that allow for more flexibility in the spin-orbit dependent terms of the energy density functional and of the selfconsistent mean field potential. Focusing in particular on the recently measured spectroscopic factors in germanium and selenium isotopes, we show that using different neutron and proton spin-orbit coupling constants, together with pairing and deformation, greatly improves the agreement with experiment [1]. Results on spectroscopic factors, rms radii and other collective and single particle properties of germanium and selenium isotopes obtained with the new and old parametrizations of the constrained HF(Sk3)+BCS potential will be shown. Particular attention is given to the two-neutrino double-beta decay matrix element in the A=76 system. [1] O. Moreno, E. Moya de Guerra, P. Sarriguren and Amand Faessler, arXiv:1002.1608 [nucl-th].

Role of Tensor Force in Light Nuclei Based on the Tensor Optimized Shell Model (00h00')

Speaker: MYO, Takayuki

We investigate the role of tensor correlations in light nuclei, which produces the high momentum component. We employ a shell model type prescription, in which the 2p2h excitations are fully optimized to include the high momentum components. We call this method as the tensor optimized shell model (TOSM). The short-range correlation is treated in the unitary correlation operator method (UCOM). We show the results of the TOSM+UCOM for light nuclei using the bare interaction. In 4He, the major 2p state is the p1/2 of a proton-neutron pair induced by the tensor force. This 2p2h excitation causes the Pauli-blocking in the He isotopes for the p1/2 orbit of extra neutrons, which contributes to the p-wave splittings. We also apply TOSM to the Li isotopes, in particular, 11Li. We explain the magic number breaking of N=8 in 11Li by treating the tensor correlation explicitly in TOSM. The Pauli-blocking for the tensor correlation produces the energy loss in the p^2 component in 11Li, which relatively increases the s^2 component. [1] T. Myo, H. Toki, and K. Ikeda, Prog. Theor. Phys. 121 (2009) 511. [2] T. Myo, K. Kato, H. Toki and K. Ikeda, Phys. Rev. C76 (2007) 024305.

Precise Nuclear Moments of Extremely Proton Rich Nucleus 23Al (00h00')

Speaker: NAGATOMO, Takashi

The magnetic moment and the electric quadrupole moment for the ground state of 23Al have been determined by the beta-NMR and NQR techniques. The one proton separation energy of 23Al is extremely small (125 keV) and 23Al is expected to have an exotic structure. Experiment was performed at RIKEN Nishina Center. Polarized 23Al nuclei were produced through high energy nuclear collisions of 100 MeV/u 24Mg ions and 9Be nuclei in a production target. The polarized 23Al nuclei were produced by restriction of their outgoing momenta and emission angles by utilizing the fragment separator RIPS. After the separation, the polarized 23Al nuclei were implanted into Si and Al2O3 single crystal plates for the measurements of the magnetic moment and the electric quadrupole, respectively. Applying the beta-NMR and NQR technique, we obtained the precise magnetic moment μ and the electric quadrupole moment Q as |mu| = 3.8881(14) mu N and |Q| = 167.6 (92) mb. We will discuss the possible nuclear structure of 23Al by comparing with the mirror nuclei 23Ne and the other nuclei around 23Al such as 22Mg which is known to have well deformed structure.

Relative Even and Odd Parity Levels within the Nuclei in the Iron Region (00h00')

Shell Model Monte-Carlo Method (SMMC) has been used in the recent years for nuclear level density (NLD) calculations. This method is not only able to calculate NLD as a function of energy, spin and isospin but also as a function of parity although the calculations are time consuming and complicated. In the current study, we used a new method for the calculation of relative even and odd parity levels in which nucleons were considered as statically independent particles. Using this method for 58Fe revealed that the NLDs of even and odd parities for the even-even nuclei are not equal at low energy levels. Therefore this method allows description of transformation from low excitation energies where there is only a single parity to high excitation energies where the probabilities for the two parities are the same. Using our method for 56Fe and 60Ni, was shown that the extracted results were comparable with those of the SMMC method. Then it convinced us that our method is correct and is applicable for other even-even nuclei such as 58Fe.

Isospin Dependence of Nuclear Level Density of 40Ca Considering Symmetry Energy and Pairing Corrections (00h00')

Speaker: NASRABADI, M.N.

In this study, the single-particle level densities are calculated by using the isospin dependent nuclear level density (NLD) formula. The calculations are performed using the experimental data for 40Ca achieved from 36Ar (alpha,) 40Ca resonances. Considering the symmetry energy and parity corrections, the NLDs at the excitation energy, E=20MeV are calculated and the maximum possible isospin in the range from ground state up to this excitation energy is estimated. The first correction led to reduced level densities and the later resulted in decreased densities for some of the levels while increased densities for the others. It is observed that the maximum level density occurs at T=0 and at low energies for which the experimental data are available there is a good agreement between calculated and experimental data.

Extracting Temperature and Mass Dependence of Nuclear Level Density Parameter of 60Co and 160Tb Nuclei (00h00')

Speaker: NASRABADI, M.N.

The nuclear level density parameters of 60Co and 160Tb nuclei are calculated in the framework of modified Thomas – Fermi approximation corrected for the continuum effect. Using the influence of momentum and frequency dependence on the effective mass, the experimental nuclear level density parameters of these nuclei are reproduced well. In addition, the temperature and mass dependence of nuclear level density parameter are studied and an analytical relation is presented for it. A reasonable agreement between experimental and theoretical is found.

Coherent π^+ Photoproduction on ^{3}He (00h00')

Speaker: NASSERIPOUR, Rakhsha

Comparing an elementary meson-production process on a free nucleon with the same process inside a nucleus is useful in developing our understanding of nuclear structure and the long-range part of the nucleon-nucleon interaction described by the one-pion-exchange model. In the present analysis, we have measured the differential cross section for the γ^{3}He$\rightarrow \pi^+ t$ reaction channel as a function of photon-beam energy, pion-scattering angle in the C.M. frame, and the momentum transferred to the nucleus. Studying this channel is ideal for understanding the interaction of pions with nuclei and for searching for possible effects mediated by nucleon resonances in nuclear matter. This reaction was studied using the CLAS Spectrometer at Jefferson Lab. Real photons in the energy range from 0.35 to 1.55 GeV were incident on a cryogenic liquid ^{3}He target. Theoretical predictions to date cannot explain the large cross sections except at backward angles, showing that additional components must be added to the model. Results will be presented and discussed.

The Morinaga Nucleus: A New Challenge to Mean-Field and Collective Models (00h00')

Speaker: ORCE, Nico

The highly-efficient and segmented HPGe TIGRESS array at TRIUMF permits Coulomb-excitation studies of the relatively high-lying first 2+ states found in light nuclei. A puzzling case which still challenges nuclear models concerns the shape of one of the most abundant nucleus in the solar system, 20Ne. The collective model, shell model and mean-field calculations consistently underestimate the spectroscopic quadrupole moment of the first 2+ state by at least 30% [1]. Previous reorientation-effect (RE) measurements yield a large Qs(2+)=-0.23(3) eb. However, 2 out of 3 RE results were obtained at 'unsafe' energies. Here, we present the first measurement of Qs(2+) using 20Ne beams at `safe' energies. Morinaga postulated that cluster structures emerge gradually as the internal energy of the nucleus is increased [2]. The anomalous 2+ energy, large monopole strengths and a comparatively low alpha-threshold, together with the anomalously large Qs(2+) measured in this work, supports such a scenario. That is, shape mixing between the ground-state band and the developing alpha clusterings. [1] R. H. Spear, Phys. Rep. 73, 369 (1981). [2] H. Morinaga, Phys. Rev. 101, 254 (1956).

The Deformed 0+ State in 34Si (00h00')

Speaker: PASCHALIS, S

The energy of the lowest deformed 2-particle 2-hole (2p2h) 0+ state is a key observable directly related to the size of the neutron N=20 shell closure. 34Si with 14 protons and 20 neutrons lies at the boundary to the “island of inversion”, where the deformed 2p2h 0+ state is the ground state in even-A nuclei. In 34Si the 2p2h 0+ is expected to be particularly low lying – in some theories it is even predicted to lie below the first 2+ state. While there have been a number of attempts, using various techniques, no experiment to date has been able to firmly locate the 34Si 2p2h 0+ state although a number of candidates have been suggested. Here we present, for the first time, data obtained from a fusion-evaporation reaction 18O(18O, 2p) to produce 34Si. Gammasphere and Microball were used to detect gamma-gamma coincidences and charged particles (two protons), respectively. The increased sensitivity of this experiment using gamma-gamma coincidences and a high charged-particle detection efficiency helped to exclude previously reported candidates and provided a stringent limit on the anticipated gamma-decay from the first 2+ state to the 2p2h 0+ state.

Anatomy of Neck Configuration in Fission Decay (00h00')

Speaker: PATRA, S. K.

The anatomy of neck configuration in the fission decay of Uranium and Thorium isotopes is investigated in a microscopic study using Relativistic mean field theory. The study includes ^{236}U and ^{232}Th in the valley of stability and exotic neutron rich isotopes ^{250}U, ^{256}U, ^{260}U, ^{240}Th, ^{250}Th, ^{256}Th likely to play important role in the r-process nucleosynthesis in stellar evolution. Following the static fission path, the neck configurations are generated and their composition in terms of the number of neutrons and protons are obtained showing the progressive rise in the neutron component with the increase of mass number. Strong correlation between the neutron multiplicity in the fission decay and the number of neutrons in the neck is seen. The maximum neutron-proton ratio is about 5 for ^{260}U and ^{256}Th suggestive of the inhibition of the fission decay in still heavier isotopes. Neck as precursor of a new mode of fission decay like multi-fragmentation fission may also be inferred from this study.

Band Structures and Deformations of Rare-Earth Nuclei (00h00')

Speaker: PRAHARAJ, C. R.

The rare-earth region contains a great many quadrupole deformed nuclei with rotational band structures. Many rotational bands and their various properties are experimentally known for a large number of nuclei. There are still a number of nuclei, a little away from the stability valley, which have not been so well studied so far. In this work we present a systematic theoretical study of Ba-Hf even-even nuclei covering a range of neutron numbers using deformed Hartree-Fock and angular momentum projection theory . In performing a deformed HF calculation, a substantial part of the residual interaction among nucleons in shell-model orbits is included in the deformed field and one needs only a few particle-hole configurations to obtain an adequate description of the low-energy properties of nuclei. The calculation reproduces substantially the systematics of ground and excited bands in experimentally known cases and shows that a good number of nuclei, away from the stability valley, are quite deformed with rotational band structures. It is strongly suggested that such band structures should be studied experimentally.

2He Decay from 18Ne Excited States: Status and Perspectives (00h00')

Speaker: RAPISARDA, Elisa

We will report on the first experimental evidence for diproton emission from the 6.15 MeV 18Ne (1-) level. The secondary 18Ne beam was produced using the in-flight FRIBs facility of the Laboratori Nazionali del Sud in Catania. 18Ne levels were populated by Coulomb excitation on a natPb target. Several levels were identified in the excitation energy spectrum built by kinematic reconstruction from the 17F+p and 16O+2p fully measured decay events. The study of the relative momentum and angle correlation of the two protons, analysed in the excitation energy window 5.9<E*<6.5 MeV, clearly disentangles the diproton and democratic or virtual sequential decay mechanisms contributions to the 2p emission. Moreover, in the 16O+2p decay channel the population of high-lying known and unknown states in 18Ne Coulomb excitation was observed. New analysis on data obtained in a recent experiment seems to indicate the possibility that correlated two protons emission occurs in such states despite the predominant democratic or true sequential three-body mechanism. This observation provide new hint for the interpretation of the phenomenon.

Spectroscopy of 37Ar, 36Cl and Role of fp Orbitals (00h00')

Speaker: RAY, Sudatta

Recent studies have indicated that the intruder orbitals from the fp shell play an important role in the structure of nuclei in the upper sd shell. Involvement of orbitals from fp shell indicates the need for changes of the sd-fp energy gap [1-4] for reliable reproduction of negative parity and high spin positive parity states of these nuclei. This change, apart from being real - may be due to the effective interaction used and/or the particular truncation scheme involved. This aspect is an important issue in this mass region and more elaborate studies are being pursued for a definite conclusion. We have studied 35Cl [1] and 30P [2] in this mass region to investigate the role of the intruders. Recently, large basis cross-shell shell model calculations have also been done to understand the role of the intruder orbitals in the structure of 36Cl and 37Ar which we have studied using gamma spectroscopic techniques [4]. 1. Ritesh Kshetri et al., Nucl. Phys. A 781 (2007) 277. 2. Indrani Ray et al., Phys. Rev. C 76 (2007) 034315. 3. M. Ionescu-Bujor et al., Phys. Rev. C 80, 034314 (2009). 4. Sudatta Ray et al., Proc. DAE-BRNS Symp. Nucl. Phys. (India) 53 (2008)

Importance Truncated No-Core Shell Model for Ab Initio Nuclear Spectroscopy (00h00')

Speaker: ROTH, Robert

The no-core shell model (NCSM) is one of the most universal and powerful ab initio tools for the description of nuclear ground and excited states including all relevant spectroscopic observables. The principal limitation of the NCSM results from the rapid growth of the basis dimension with particle number and model space cutoff, which makes converged calculations in the upper p-shell and beyond very costly or even impossible. In order to extend the range of predictive NCSM calculations we use an adaptive importance truncation (IT) of the model space thus restricting it to basis states relevant for the description of a selected set of eigenstates. We discuss the concept of the IT-NCSM for the simultaneous calculation of ground and excited states and address some technical aspects, such as threshold extrapolations and perturbative corrections. We apply the IT-NCSM in connection with QCD-based nuclear interactions for the description of the low-lying states in p- and sd-shell nuclei, including spectroscopic observables such as B(E2) transition strengths.

Fine Structure of the Giant M1 Resonance in 90Zr (00h00')

Speaker: RUSEV, Gencho

The strength and the location of the giant M1 resonance in medium and heavy nuclei has been a long-standing and major problem in nuclear structure physics. Numerous experiments were performed on 90Zr in the past three decades searching for this M1 resonance. Contradicting results obtained for the strength of the M1 resonance led to deduced quenching factors varying from 1.6 to 4.0 in comparison with model predictions. The High Intensity Gamma-ray Source of the Triangle Universities Nuclear Laboratory in connection with high-resolution Ge detectors opens up the possibility to precisely deduce the strengths and locations of individual M1 transitions, whom distribution comprises the giant M1 resonance, and to distinguish them unambiguously from the E1 and E2 de-excitations. We will present the results of an investigation of the fine structure of the giant M1 resonance in 90Zr performed with polarized and mono-energetic photon beams from 7 to 11 MeV at HIGS. The strength in numerous observed M1 transitions will be compared with the predictions of shell model and with calculations using the quasiparticle-random-phase approximation with a Wood-Saxon potential.

Nuclear Resonance Fluorescence Measurements by Quasi-Monochromatic, Linearly Polarized Photon Beams (00h00')

Speaker: SHIZUMA, Toshiyuki

Magnetic dipole (M1) transitions in atomic nuclei have attracted increasing attention in nuclear physics and nuclear astrophysics. The knowledge of the M1 response allows one to elucidate the details of nuclear dynamics. It is also important for the estimate neutral current neutrino-nucleus cross sections for supernova explosion, because of the close relationship between the M1 excitation and neutrino-nucleus processes. Low-lying electromagnetic transitions can be studied by the method of nuclear resonance fluorescence (NRF). Recently, it has been shown that quasi-monochromatic, linearly polarized photon beams from inverse laser Compton scattering has considerably increased experimental sensitivity and to enable one to detect the fine structure of relatively weak M1 transitions. In this report, results of the NRF measurements on nuclei around lead and iron region will be presented. The M1 resonance below the neutron separation energy is resolved in to individual transitions. The experimental results are compared with theoretical predictions based on self-consistent RPA and Shell model calculations. The role of the tensor interaction in giant M1 resonance region is discussed.

An Effective Neutrinoless Double-Beta-Decay Operator in the Shell-Model (00h00')

Speaker: SHUKLA, Deepshikha

Nuclear matrix elements are crucial inputs in the extraction of effective neutrino mass from measurement of neutrinoless double-beta-decay. Towards this end we construct effective operators using the Lee-Suzuki transformation scheme. We give an update of our investigations of this shell-model effective operator.

Level Structure of 29Mg: Possible Intruder States in a Nucleus Close to the Island of Inversion (00h00')

Speaker: TAJIRI, Kunihiko

The structure of neutron-rich nuclei around island of inversion attracts much attention because of anomalies related with disappearance of N=20 magicity. To clarify the shell evolution, we have investigated the level structure of 29Mg by observing the beta-decay asymmetry for spin-polarized 29Na at ISAC-I of TRIUMF. The beta-decay asymmetry parameters and gamma-ray intensities have successfully assigned many levels in 29Mg: Two levels at 2.614 and 3.224 MeV were definitely assigned for the first time to be 1/2+ and 3/2+, respectively, and other five levels were also assigned tentatively. The observed levels and log ft values were compared with the shell model calculations using NuShell code with USD interactions. The level energies, log ft values and the decay properties of all the assigned levels were explained well by assuming sd-shell configurations. However, two levels at 1.095 and 1.430 MeV associated with large log ft values could not be reproduced by the calculations. The MCSM calculation taking into account the intruder configurations predicted 3/2- and 7/2- levels around 1 MeV. This fact strongly suggest negative parity assignments for the 1.095 and 1.430 MeV levels.

Precise Measurements of Interaction Cross Sections for Ne and Na Isotopes, Towards the Vicinity of Neutron-Drip Line (00h00')

Speaker: TAKECHI, Maya

During the past several tens of years, our knowledges about the features of exotic nuclei have been much enhanced. In 1980s, neutron halo structure of neutron drip-line nucleus, which is one of the most notable abnormal features of exotic nuclei, have been found. Recently, other (or related) features of unstable nuclei such as vanishing of magic numbers and observation of new magic number have been reported and discussed. Nowadays, for the further unified understanding of nuclear structures from the stability line to the exotic region, more extensive experimental or theoretical studies are desirable. In the present talk, very precise and systematic interaction cross section data for Ne and Na isotopes, from the stable line to the vicinity of neutron-drip line which have been recently measured at RIKEN, RI-beam Factory will be reported. Interaction cross sections for 31-32Ne and 34-35Na have been measured for the first time and possible lower (p or s)-orbital halo structures for 29Ne and 31Ne will be discussed from the extraordinarily large interaction cross section values of them, which indicate the collapse of the conventional shell structures in those exotic nuclei.

Triaxiality of Superdeformed States in 40Ar (00h00')

Speaker: TANIGUCHI, Yasutaka

Superdeformed (SD) states in 40Ar, which were identified quite recently, have been studied using the deformed-basis antisymmetrized molecular dynamics. Low energy states were calculated by the parity and angular momentum projection (AMP) and the generator coordinate method (GCM). Basis wave functions were obtained by the energy variation with a constraint on the quadrupole deformation parameter beta, while other quantities such as triaxiality gamma were optimized by the energy variation. By the GCM calculation, an SD band is obtained just above the ground band. The SD band involves a K pi = 2+ side band due to the triaxiality. The calculated quadrupole electric transition strengths of the SD band reproduce well the experimental values. Triaxiality is significantly important to understand low-lying states.

In-Medium Similarity Renormalization Group for Finite Nuclei (00h00')

Speaker: TSUKIYAMA, Koshiroh

To understand many-body phenomena from nucleonic interactions is a very important goal in nuclear physics. Ab-initio calculations are available for some of the nuclear observables up to medium-mass nuclei. It is also important to construct a effective interactions and operators for many-body methods defined in a restricted subspace of the Hilbert space, so as to give the detail description of various excitations and spectroscopies. The renormalization group (RG) perspective is very useful for this purpose, because RG can provide a non-perturbative summation and extract right degrees of freedom in different energy scales and systems. We propose a new method, In-medium Similarity Renormalization Group (SRG) and apply to the closed-shell nuclei from 4He to 40Ca[1] and light nuclei for the first time. We derive the SRG transformation in many-body medium, which provides a non-perturbative way to obtain the ground state energy and effective interactions for valence particles in the shell model. The remarkable agreement with the exact solutions manifests the accuracy of the method, showing the size-extensivity and non-perturbative feature of the theory. [1] K.T. et al., to be submitted.

Hypernuclei and Low Momentum Part of Hyperon-Nucleon Interactions (00h00')

Speaker: TZENG, Yiharn

Low momentum part matrix elements of hyperon-nucleon interactions are calculated from the Julich and the Nijmegan NSC89 and NSC97 potentials. These elements together with the low memtum parts of nucleon-nucleon interactions obtained from various realistic potentials are then used in a two-frequency folded diagram method to examine hypernuclear properties. Structures of several hypernuclei are investigated. Results are compared with those from much more sophiticated G-matrix elements. The validity of of the low momentum part matrix element method in the hypernuclear calculations is studied carefully and discussed.

An Extended Thomas Fermi Theory for N \approx Z and Neutron Rich Nuclei Incorporating Clustering at the Nuclear Surface (00h00')

Speaker: USMANI, Qamar

We develop for the first time a macroscopic semi-phenomenological theory for nuclei which takes into account clustering at the nuclear surface, a phenomenon which normally cannot be described in HF or RMF theories. Theory is based on an extended version of Thomas Fermi theory. Clustering is included through a universal clustering parameter c in the equation of state of the nuclear matter which incorporates all the possible clusters. This has a direct bearing on the symmetry energy. The density dependence of the symmetry energy and its dependence on c is constrained from the binding energies of nuclei and the recently obtained accurate neutron matter equation of state using Argonne v8' and U-IX interactions. Geometrical considerations coupled with the universal behavior of neutron gas at sub-nuclear densities then leads to symmetry energy which has significant contribution from quartic term in isospin, approximately 18% of quadratic term. The theory incorporates regions of nuclei which do not favor clustering including neutron rich nuclei and explains the experimentally extracted symmetry energies at low densities with a new insight on clustering at the nuclear surface.

Excited State Lifetime Measurements in Rare Earth Nuclei with Fast Electronics (00h00')

Speaker: WERNER, Volker

We investigate the collectivity of the lowest excited 2+ state of even-even rare earth nuclei. Since the collectivity of this state should directly correlate to the size of the valence space, a maximum value of its B(E2) excitation strength at mid-shell should be expected. However, recent compilations of data on B(E2) strengths and g factors of 2+1 states show a saturation toward mid-shell, rather then an monotone linear rise as would be expected from collective models. Much of the lifetime data on these states stem from experiments employing only few HPGe detectors and plunger devices, but without gamma-gamma coincidences and therefore subject to possible systematic error. We are currently remeasuring 2+1 lifetimes in rare earth nuclei using fast scintillators, by measuring directly the time difference between population and depopulation of the state via gamma-rays. First results obtained at WNSL lead to some significant corrections of known data. First experiments were conducted with BaF2 detectors, whereas recently we employed LaBr3 detectors with superior energy resolution. The performance of both detector types will be compared.

Nuclear Matter Properties and Equation of State in Asymmetric Nuclear Matter (00h00')

Speaker: YOSHIDA, SATOSHI

We have discussed correlations between the neutron skin thickness and equation of state (EOS) in [1] and between the isovector nuclear matter properties and the neutron skin thickness in [2] with the Skyrme Hartree-Fock (SHF) and the relativistic mean field (RMF) models. In [2], we could indicate analytically the pressure of the neutron matter by the isoscalar and isovector nuclear matter properties and the power of the density-dependent force which is one of parameters in the Skyrme interaction, and we showed that the neutron skin thickness would give the information about not only the neutron equation of state but also the isovector nuclear matter properties and the parameterization of the Skyrme interaction by using the linear correlation between the pressure of the neutron matter and the neutron skin thickness of ^{208}Pb in the SHF model. This time we will discuss further correlations among nuclear matter properties, the neutron EOS and the pressure of the neutron matter in both of the SHF and RMF models analytically. [1] S.Yoshida and H.Sagawa Phys.Rev.C69,024318 (2004). [2] S.Yoshida and H.Sagawa Phys.Rev.C73,044320 (2006).

Octupole Deformation for the Critical-Point Candidate Nucleus ^{152}Sm in a Reflection-Asymmetric Relativistic Mean-Field Approach (00h00')

Speaker: ZHANG, Wei

The potential energy surfaces of even-even $^{146-156}$Sm are investigated in the constrained reflection-asymmetric relativistic mean-field approach. It is shown that the critical-point candidate nucleus ^{152}Sm marks the shape/phase transition not only from $U(5)$ to $SU(3)$ symmetry, but also from the octupole deformed ground state in ^{150}Sm to quadrupole deformed ground state in ^{154}Sm. By including the octupole degree of freedom, an energy gap near Fermi surface for single-particle levels in ^{152}Sm with $\beta_2 = 0.14 \sim 0.26$ is found, and the important role of the octupole deformation driving pair, $\nu 2f_{7/2}$ and $\nu 1i_{13/2}$, is demonstrated. Additionally, the dependences of the result on the parameter sets as well as the BCS pairing correlations with constant pairing gap or constant pairing strength are analyzed.

A New Idea of the Experiment Searching for mu-e Conversion (00h00')

Speaker: AOKI, Masaharu

A new experiment searching for muon-electron conversion by fully utilizing the high-power pulsed proton beam available at J-PARC MLF will be discussed. Both a Monte Carlo simulation and a test measurement indicated that the muonic carbon atom formation rate in a muon target of MLF J-PARC is approximately 10^{10}/sec for 1 MW operation of the RCS. The muonic atom formation rate in an Aluminum muon stopper located close to the muon target will be more than 10^{9}/sec. With this high formation rate of the muonic atoms, it is possible to perform a competitive search for muon-electron conversion from the muon stopper placed nearby the production target at the level of 10^{-14}, nearly two orders of magnitude below current limits. A new secondary beam line at the High-Momentum Decay Muon port will be dedicated to extract 105-MeV/c electrons from the muon stopper. A high performance kicker system is used in the secondary beam line to eliminate the prompt beam burst. This beam line can be also used for a new muon g-2 experiment planned at MLF.

Q_EC Value Measurements of Superallowed beta Emitters at JYFLTRAP (00h00')

Speaker: ERONEN, Tommi

The most precise V_ud value of the Cabibbo-Kobayashi-Maskawa (CKM) quark-mixing matrix is derived from superallowed beta decays. Currently there are 13 superallowed transitions that are determined precisely enough to contribute to the world-average value. The three experimental quantities that are required are the branching ratio (BR) of the superallowed transition, the half-life of the parent state (T_1/2) and the decay energy (Q_EC). Since 2006, Q_EC values of 11 different superallowed transitions ranging from 34-Cl to 62-Ga have been determined with JYFLTRAP. Since IGISOL always provides both mother and daughter nuclei, the Q_EC values have been determined by directly measuring their frequency ratios. Using this doublet technique and an RF excitation with time-separated oscillatory fields, a Q_EC value precision down to the 50 eV level has been reached. Interfering isomeric states often appear in N=Z nuclei. They are removed prior to a frequency measurement using the so-called Ramsey cleaning method developed at JYFLTRAP, which can reach ppm resolution in 100 ms cleaning time. Measurement of Q_EC values of the lightest of the 13 cases, 10-C and 14-O, will be done in May.

Magnetic Field Stabilization for 129Xe EDM Search Experiment (00h00')

Speaker: FURUKAWA, Takeshi

Detection of a permanent electric dipole moment (EDM) is one of the most intriguing issues in recent physics studies because a finite value of such an EDM would reveal the presence of new physics beyond the standard model. To search for an EDM of a diamagnetic atom with a precision 10 times better than the present limit, we are developing a new experimental scheme using a maser precession of 129Xe atomic spin in a static magnetic field. One of the most essential point to achieve such accuracies is the stability of the magnetic field, which is directly governed by drifts of current flow in a solenoid coil to generate the magnetic field. To suppress large drifts of coil current due to the fluctuation of surrounding environments such as temperatures, we have developed a new stabilized current source based on a feedback system which is devised to correct the current measured with a high precision current meter. Using this new current source, we have reduced successfully the drifts of coil current at least 100 times compared to commercially available current sources. Details of the stabilized current source and the resulting stability of the measured maser frequency will be presented.

A Search for Axion-Like Particles Using the CAST Spectrometer at CERN (00h00')

Speaker: HASINOFF, Michael

The axion is a pseudoscalar particle which was postulated by Peccei and Quinn as the simplest solution to the “strong-CP” problem – the observation that the strong interaction does not violate CP symmetry. Using a decommissioned LHC test magnet (B=9.0T,L=9.3m) the CAST collaboration has been searching for hypothetical axion-like particles emitted from the sun since 2003. The expected axion signature is a low energy x-ray with an average energy of ~4 keV. Three separate low-background x-ray detectors are now being utilized in this search -- two thin micromesh gas detectors, and a small Si CCD detector, which is situated at the focal plane of an x-ray mirror telescope system. Our vacuum data, collected in 2003-4 provide the world’s best limit on the axion-photon coupling, g_a gamma < 0.88 x 10^-10 GeV^-1 for m_a < 0.02 eV. By placing He gas in the magnet bore we are able to maintain the axion-photon coherence and extend the mass search range into the region of the theoretical predictions. The 4He data yield g_a gamma < 2.2 x 10^-10 for m_a < 0.4 eV, also a world limit. With 3He gas in the magnet bore we should be able to reach m_a ~1.0 eV by the end of 2010.

The New Neutron Electric Dipole Experiment at Paul Scherrer Institut (00h00')

Speaker: HENNECK, Reinhold

At Paul Scherrer Institut (PSI) we are setting up a new experiment for an improved measurement of the neutron electric dipole moment, d_n. The existence of a non-zero value would violate both parity and time reversal symmetry and, assuming CPT invariance, might reveal new sources of CP violation and shed light on the baryon asymmetry problem. The new experiment aims at a two orders of magnitude reduction of the experimental uncertainty over the current best limit (d_n < 2.9 x 10-26 ecm). This will be achieved mainly by (1) the much higher ultracold neutron flux from the new PSI source, (2) better magnetic field control with improved magnetometry and (3) a double chamber configuration with opposite electric field directions. In the first phase of the experiment we will use an upgrade of the RAL/Sussex/ILL group's apparatus (which has produced the current best result) moved to PSI. The final sensitivity will be achieved in a further step with a new spectrometer, presently in the design phase.

Polarimeter Development for an Electric Dipole Moment Search in a Storage Ring (00h00')

Speaker: IMIG, Astrid

An electric dipole moment (EDM) aligned with the spin of a particle or nucleus violates both parity conservation and time reversal invariance. Standard Model predictions are much below current or anticipated experimental sensitivity levels; an observation within the next generation of searches would represent a new signature of CP violation and a possible understanding through super-symmetry of the matter-antimatter asymmetry of the universe. This presentation describes an EDM search using a storage ring with a charged particle sensitivity level approaching 10-29 e•cm. The EDM signal is a precession as small as 10-6 rad arising from electric fields transverse to the beam velocity. Tests with the EDDA detector at the Forschungszentrum-Jülich Cooler Synchrotron (COSY) using 235 MeV deuterons demonstrated that high polarimeter efficiency (up to 1%) is possible using a thick carbon block as an analyzer target. By defining new observables sensitive to systematic geometry and rate errors, the effects of such errors can be reduced in the polarization measurements to levels below 10-6.

Search for an EDM in Diamagnetic Atom 129Xe with Nuclear Spin Maser Technique (00h00')

Speaker: INOUE, Takeshi

Permanent electric dipole moment (EDM), if finite, of a particle will be an irrefutable evidence of physics beyond the standard model (SM). In particular, an EDM of diamagnetic atom is considered to stem from P, T-violating component of the NN interaction, and thus poses on models beyond the SM a constraint which is different from those from the neutron and paramagnetic atom EDMs. We adopt a 129Xe spin maser, aiming at an ultrahigh sensitivity search for an EDM in a diamagnetic Xe atom. The adopted maser maintains the spin precession by applying a feedback field generated from an optically detected precession signal. Recently, we have attained a frequency precision of 9.3 nHz. Detailed study of operation has revealed that the main factors that limit the present frequency precision are the variations of environmental field and temperature. Also, it has been shown that the power of the pumping laser is not sufficient to fully polarize Xe nuclear spins. Thus, we have introduced a high power laser with reduced linewidth to stabilize the maser amplitude. We will report on the performance of the apparatus and discuss future prospect of our 129Xe EDM search with a 10^{-30} ecm precision.

Towards a New Study of the Electron-Neutrino Angular Correlation in the Decay of Magneto-Optically Trapped 6He (00h00')

Speaker: KNECHT, Andreas

Studies of nuclear beta decay have a long standing history in testing the Standard Model of particle physics. With the dominant (V-A) structure of the weak interaction determined, measurements of the angular correlation between the electron and neutrino momenta in nuclear beta decay can be used to search for scalar and tensor contributions to the weak interaction. The current best measurement on the electron-neutrino angular correlation coefficient in the decay of 6He dates back to 1963 by measuring the energy spectrum of the recoiling 6Li nucleus and amounts to -0.3343 +/- 0.0030. Its compatibility with the Standard Model expectation allows to constrain tensor contributions to (|C_T|^2+|C'_T|^2)/(|C_A|^2+|C'_A|^2)<0.4%. We intend to improve on this measurement by confining 6He atoms in a magneto-optical trap and detecting the recoiling nucleus and emitted electron in coincidence. The foreseen sensitivity in the measurement of the angular correlation coefficient will be approximately 0.1%. Here, we will present the details and current status of the experiment focussing on the performance of the 6He production and the magneto-optical trapping of the 6He atoms.

Test of Time Reversal Symmetry with Transverse Muon Polarization in Charged Kaon Decays (00h00')

Speaker: KOHL, Michael

The Time Reversal Experiment with Kaons (TREK) at J-PARC aims to find New Physics beyond the Standard Model by measuring the T-violating transverse polarization P_T of muons in the $K^{+}_{\mu3}$ decay of stopped kaons. TREK will use a high-intensity kaon beam and the upgraded apparatus of the E-246 experiment from KEK-PS. The sensitivity for P_T of 10^{-4} at J-PARC is improved by a factor of 20 compared to the current E-246 limit, well in the allowed range of theoretical preditions involving New Physics from exotic scalar interactions. An overview of the planned experiment, results from recent R & D activities, and the current project status will be presented.

Planck Scale Effects in a Quantum Field Theory Framework (00h00')

Speaker: MAZóN JAREñO, Diego

Modified dispersion relations are our best chance to test possible deviations of special relativity coming from Planck scale effects. We consider their introduction in a quantum field theory framework and the possible phenomenological consequences in particle and astroparticle physics. The possibility of having a broken or a deformed symmetry scenario in such an extension is explored. We show new constraints on Lorentz invariance deviations from atom-recoil experiments.

Development of High-Sensitivity NMOR Magnetometry for an EDM Experiment (00h00')

Speaker: NANAO, Tsubasa

Developments are in progress aiming at the search for a permanent Electric Dipole Moment (EDM) in 129Xe atom using the low-frequency nuclear spin maser. In the EDM experiment, drifts in the applied static magnetic field in a relatively long time scale are the dominating source of errors in frequency determination. The stability of the applied field and its monitoring by use of a high-sensitivity magnetometer are the essential and indispensable part of an EDM experiment. Therefore we are developing a magnetometer based on Nonlinear Magneto-Optical Rotation (NMOR) in a Rb vapor cell. The sharp response to the magnetic field in this apparatus relies on a long-lived atomic spin alignment induced by linear polarized laser light, it is thus essential for its sensitivity to suppress the relaxation of atomic coherence. Coating the inner walls of the cell with an antirelaxation layer and inclusion of a buffer gas in the cell are useful for preventing atoms from depolarizing collisions. We obtained several NMOR spectra for Rb in cylindrical cells with coating or buffer gas. We will present the obtained NMOR spectra and report on the present status for development of the NMOR magnetometer.

PENeLOPE, on the Way Towards a New Precise Neutron Lifetime Measurement (00h00')

Speaker: PICKER, Ruediger

A precise knowledge of neutron lifetime opens the way to determine the coupling constants of weak interaction precisely and also the element Vud of the Cabibbo-Kobayashi-Maskawa matrix. Hence, measurements of the lifetime provide direct tests of the standard model of particle physics. The most successful measurements have been made storing ultra-cold neutrons (UCN) that have energies of only a few hundred neV. However, a recent result from a UCN trapping experiment disagrees with the PDG average of 885.7 \pm 0.8 s by roughly 6 standard deviations. To resolve this discrepancy, we are developing PENeLOPE, a superconducting magnetic trap for UCN at Technische Universität München, Physik Department E18. The UCN will be trapped in a multipole field of a flux density up to 2 T and will be bound by the gravitational potential to the top. This makes the extraction and detection of the decay protons (and electrons) possible and allows a direct measurement of the neutron decay rate. Our envisaged precision of < 0.1 s demands almost lossless storage and good knowledge of systematic errors. The talk will describe how we want to achieve this and present the current status of the development.

Status of the Radon EDM Experiment (00h00')

Speaker: TARDIFF, Eric

A permanent electric dipole moment (EDM) larger than that generated by the CKM phase in the standard model (SM) would be a signal of new physics, including CKM-independent CP violation. Many proposed extensions to the SM could contain new sources of CP violation that would generate such an EDM. Past measurements have resulted in upper limits on EDMs and thus on the possible parameter spaces of those beyond-the-SM theories. Many more experimental programs are under way, each with their own advantages. Some isotopes of radon are expected to have octupole-deformed nuclei which enhance the strength of the atomic EDM generated by the presence of fundamental CP-odd nuclear forces, making the Radon EDM experiment an attractive candidate for an EDM discovery. Recent development work has focused on the optimization of the gas handling equipment and the polarization techniques using isotopes of xenon. The optimization of the polarization equipment is ongoing. 221Rn and 223Rn were produced at TRIUMF in tests of an actinide target in December. More tests are expected later this year to study the nuclear structure and EDM enhancement factors of those isotopes.

The ${\mathcal F}t$ Value of ^{19}Ne and its Relevance to Low-Energy Tests of the Standard Model (00h00')

Speaker: TRIAMBAK, Smarajit

Precise measurements of correlation coefficients from ^{19}Ne decay provide an excellent opportunity to probe for non $V-A$ interactions in the charged weak current. In particular, the measured beta asymmetry from the decay of polarized ^{19}Ne nuclei constitutes the most sensitive search for right-handed interactions beyond the Standard Model. Presently there exist three reported measurements of this coefficient, all of which are inconsistent with the Standard Model. While the first measurement yields a null signal for right-handed currents, it also indicates an unexpectedly large forbidden second-class tensor contribution. The other two measurements differ significantly from the former, are in excellent agreement with each other and indicate the exact opposite. In this presentation we report a high-precision measurement of the ft value of ^{19}Ne decay to its analog state in ^{19}F in an attempt to address the aforementioned discrepancies. The implications of this measurement to place bounds on right-handed and scalar interactions, its relation to the parity nonconserving nucleon-nucleon interaction, and possible impact on future CKM unitarity tests will be discussed.

A Test Bench for the Polarization Study of 129Xe for an EDM Search Experiment (00h00')

Speaker: TSUCHIYA, Masato

Permanent electric dipole moment (EDM) is an observable that reflects T violation and verifies models beyond the standard model. The EDM is detected as a frequency change of the spin precession upon reversed of an applied electric field from the parallel to antiparallel direction to a magnetic field. We aim to search for an EDM in a 129Xe atom because 129Xe is a stable isotope and a technique to polarize its spin is established. The size of spin polarization is one of the important parameters that govern the frequency precision. The polarization achieved for 129Xe in a glass cell depends critically on treatment of the inner surface of the cell, shape of the cell, buffer gas, temperature, and the pumping laser. In order to find the optimum conditions for the 129Xe polarization, systematic research for a lot of 129Xe cells with varying conditions for production are necessary. Thus we constructed a test bench system for the polarization assessment by means of the adiabatic fast passage NMR method. The system includes an antivibration device for the pickup coils and RF field orthogonality correction. We will present the system performance and discuss 129Xe spin polarization of cells.

Probing Fundamental Symmetries with Radium Ion and Atoms (00h00')

Speaker: WILSCHUT, Hans

Radium ions and atoms are probably the most advantageous probes of the fundamental symmetries associated with parity and time-reversal. This is mainly due to the atomic properties of radium. The TRImP group is engaged in experiments leading to a new measurement of the Weinberg angle at low momentum transfer via atomic parity violation in the Ra ion and a search for a permanent electric dipole moment in the Ra atom, i.e. time-reversal violation beyond the Standard Model. An important aspect of these measurements is the correct prediction of the atomic properties of Ra isotopes. Both theoretical and experimental effort is needed and is part of our current research. A range of isotopes ($A < 215$) can be produced at our facility using 204,206 Pb beams on a carbon target and with the TRImP dual magnetic separator and thermal ionizer. Atomic spectroscopy, e.g. measuring the hyperfinesplitting, has been done on both groundstate and excited states of singly charged isotopes in a Paul trap. Atomic 225Ra is currently obtained from a 229Th source. Spectroscopy on the atomic beam has been successful. A cooling and trapping scheme, as done by us for Ba, is being developped for Ra.

Student Poster Session 2 - Life Sciences Centre Atrium (19:30-21:30)

title	board
Validation of Nuclear Reaction Models Relevant to Cosmic-Ray Neutron Induced Single-Event Effects in Microelectronics (00h00') *Speaker: ABE, Shin-ichiro* Single-event effects (SEEs) induced by cosmic-ray neutrons are one of key reliability issues for advanced microelectronic devices. Since the SEEs are initiated by nuclear interaction of neutrons with constituent materials, reliable nuclear reaction models ranging from MeV to GeV are required in SEE simulations. We use PHITS (Particle and Heavy Ion Transport code System) that contains some nuclear reaction models, such as INC model, QMD model and "event generator mode (e-mode)" with the evaluated nuclear data libraries. The accuracy of these nuclear reaction models is validated by comparison with experimental data of neutron-induced reactions on silicon. Comparisons of calculated and measured data for light-ion production indicate that the e-mode calculation with JENDL-3.3 provides better agreement with the experimental data below 20 MeV, and the QMD model reproduces them well above 20 MeV. Since there is no measurement of light-ion production from silicon for neutron energies more than 100 MeV, the production yields have been newly measured by using 175 MeV quasi mono-energetic neutrons at the The Svedberg Laboratory. The data are also compared with the present PHITS calculation.	
Proposed Construction and Modernization of a One Meter Radius Cyclotron (00h00') *Speaker: ANDREW, Anne* Cyclotrons have been in use for over 75 years but few meter radius cyclotrons have been built using modern technologies. This proposal describes the construction of a one meter radius cyclotron with lead or concrete shielding. It would be housed in an 11.75 m^2 room on the 3rd floor of a campus building. The cyclotron would be equipped with modern data collection technology with the interface and apparatus located in the same room. The design of the cyclotron would resemble cyclotrons built in the middle of the 20th century but modified to accommodate for technological advancements. This cyclotron would be capable of energies in the range of 25 MeV to 70 MeV which would be sufficient for accelerating protons. The cyclotron would be built and maintained by undergraduate senior physics students with supervision from faculty. Upon completion of the cyclotron, the apparatus would be used in Junior Lab to demonstrate fundamental experiments in nuclear physics. Though no new discoveries are likely to occur from the use of a one meter radius cyclotron, it would be useful in the development and training of undergraduate physics students preparing for industry or graduate studies.	
Study of the Activity of Sixteen Standard Radioisotopes Available at the Central Department of Physics, Tribhuval University, Kirtipur, Kathmandu, Nepal (00h00') *Speaker: ARYAL, Chinta Mani* We intend to present the activity of 16 radioisotopes used in the nuclear lab of Central Department of Physics (CDP), TU, Nepal. The 16 radioisotopes are Cs-137, Sr-90, Co-60, Na-22, Ra-226(A), Ra-226(B), Am-241(A), Am-241(B), S-542/1, S-542/2, S-542/3, S-542/4, S-542/5, S-α, S-β and S-γ. These were purchased during 1989 to 1995. We carried out the absorption expt. to estimate the present activity of these radioisotopes. For this, GM counter and Al absorber were used. Standard Cs-137 source was used to calibrate the GM counter. Our aim is to provide the present activity of available source with respect to the standard γ and β source (Co-60 and Sr-90). The activity of S-α is found 15 times more than the activity of Co-60 source. Similarly, the activity of S-542/1, S-542/4, Am-241(A), Cs-137 and Sr-90 are found to be more than 2 times than that of the standard Co-60 source. It is also found that the activity of S-α source is 2.7 times stronger that of standard β source Sr-90. We recommend, only source Co-60, Cs-137, Am-241(A), S-542/1 and S-542/4 can be used as standard γ source and only Sr-90 as a β source in the laboratory work at the CDP, TU, Nepal.	
Monte Carlo Background Control : A Different Way to Remove Background Neutrons (00h00') *Speaker: BOISJOLI, Mark* The objective of the HERACLES (Heavy-ions Reactions Array Caracteristic for Light Excited Systems)2001 experiement is to study emission sources speed, multiplicity and temperatures. The SAUNA software (System Adaptable by User for Nuclear Analysis with HERACLES) has been developed to analyze and process the different data from HERACLES. Inside SAUNA, the Monte Carlo Background Control (MCBC) has been created to remove neutrons coming from the background. In this presentation, the neutron emission from 78Kr+181Ta at 40 MeV/nucleon, 36Ar+181Ta at 35 and 50 MeV/nucleon, and 36Ar+58Ni at 35 and 50 MeV/nucleon will be studied. After a description of MCBC method, a comparaison between the two different methods used to remove background neutrons, the spectrum substraction and MCBC, through the time-of-flight (TOF) spectras will be done. After the energy calibration, energy spectras can be obtained.	

Sodium-Cooled Fast Reactors: Assessment of the Homogeneous Transmutation with Uranium and Thorium Cycles (00h00')

Speaker: BRIZI, Julie

Nuclear energy systems of the future must rise to the twin challenges of sustainable energy production and nuclear waste reduction. Sodium-cooled Fast Reactors (SFR) appear to be the technology that is the closest to industrial deployment in the coming decades. However, standard SFR's face the problem of positive void coefficients and significant production of Minor Actinides (MA) if transmutation is not performed. Different methods of MA transmutation using either uranium or thorium fuel cycles were performed for a SFR. These neutronics simulations used MURE (MCNP Utility for Reactors Evolution), a C++ object-oriented code that performs nuclear reactor time-evolution using successive calls to the widely-used particle transport code MCNP. For each strategy, the Sodium void coefficients and the radiotoxicities of the waste were determined. A scenario taking into account the radiotoxicity of waste produced each year and the radiotoxicity of the core (which becomes a waste when the SFR is shut down) is considered. A method is proposed to assess the advantages of the homogeneous transmutation and to compare different fuel cycle strategies for SFR, in terms of total waste production.

Study on Determination of Antimony in Environmental Samples by Instrumental Neutron Activation Analysis (00h00')

Speaker: GOMES MARTINS, Tassiane Cristina

There is an increasing interest in the determination of antimony in environmental samples since this element is cumulative and potentially toxic at very low concentrations. Moreover, the quantification of antimony presents difficulties due to its low concentrations in the samples and to the interference problem in the analyses. In this study, instrumental neutron activation procedure was established in order to obtain reliable results for Sb determination in environmental samples. For this study eigth reference materials were selected. Aliquots of these materials and synthetic standard of Sb were irradiated at the IEA- R1 nuclear reactor under a thermal neutron flux of about 5x1012 n cm-2 s-1 for 8 or 16 hours. The induced gamma activities of 122Sb and 124Sb were measured using a hyperpure Ge detector. Antimony concentrations were calculated by comparative method and the uncertainties of the results were estimated using statistical counting errors of the sample and standard. Results obtained in these analyses showed a good agreement with the relative errors varying from 0.78 to 13.8%, within the ranges of certified values at the significance level of 68%.

129I Present in Animal Thyroid and Fresh Water in Argentina (00h00')

Speaker: NEGRI, Agustin Eduardo

The 129I radioisotope (half-life: 15.7 Ma), produced mainly by nuclear reprocessing plants, have been extendely used as oceanic tracer, and as nuclear-activity monitor as well in the northern hemisphere. However, there is up to now very scarce information (from different matrixes and different decades) of the South-American subcontinent. At the TANDAR Laboratory we have started a research program aiming to the use of 129I as environmental tracer in Argentina. The 129I, coming either by water or by atmospheric fallout over pasture fields, is naturally concentrated by grazing cattle in their thyroids glands. Hence, bovine thyroids and fresh water samples coming from all over Argentina were chemically processed in order to extract the contained iodine. These samples were analyzed by Accelerated Mass Spectrometry, at VERA facility, to determine the concentration of 129I relative to the stable 127I. The concentration of iodine was established by means of Inductively-Coupled-Plasma Mass Spectrometry or Gas Chromatography. Preliminary results present 129I/127I ratios in the range from 10^-9 to 10^-11 compatible with previous measurements made of samples from the southern hemisphere.

Measurements of Fragment Mass Yields from Neutron-Induced Fission of 238U and 232Th in the Energy Range from 10-60 MeV (00h00')

Speaker: SIMUTKIN, Vasily

The theory of neutron-induced nuclear fission is quite successful in explanation of thermal energy fission, but it meets problems at intermediate neutron energies, i.e., from 10 to 200 MeV. Experimental data on various nuclear fission observables are required for the verification of theoretical models. We have measured pre-neutron emission fission fragment mass yields for the 238U(n,f) and 232Th(n,f) reactions in the energy range from 10 to 60 MeV. The data for 232Th has been measured at the first time and only one measurement for 238U has been done before by Zöller [1]. The experiments have been performed at the neutron beam facility CYCLONE at Louvain-la-Neuve. As a fission fragment detector, a multi-section Frisch-gridded ionization chamber has been used. Experimental techniques as well as preliminary results are presented. The mass yields have also been corrected for the mass dispersion. The data analysis of experimental data has shown that the symmetric fission is much stronger pronounced in case of 232Th than of 238U. [1] C.M. Zöller, Ph.D. thesis, TH Darmstadt, 1995

Advances in Complex Gamma-Ray Spectra Analysis (00h00')

Speaker: SUVAILA, Rares

The gamma ray spectrometry laboratory of the University of Bucharest was designed for the analysis of low-level radioactivity samples. High efficiency shielded HPGe detectors are used. Efficiency calibration is achieved by complementing experimental calibration with Monte Carlo computation carried out using GESPECOR, also applied for the evaluation of coincidence summing corrections. Efficiency transfer method and newly developed response matrix procedure are applied. Low detection/decision limits are challenging, and the method to respond to this situation is presented. Using a blank sample in the same experimental conditions as the actual sample turns out benefic for precise peak subtraction. Procedures for peak finding were developed, which include analysis of the peak area/FWHM ratios, hypergeometric alert, in order to establish confidence limits concerning the actual existence of a of a certain peak in the spectrum. The method is oriented to numeric solutions rather than developing complex fitting functions that might not be appropriate. Development of a software insuring retrospective predictability and asking for human intervention in controversial situations is in progress.

The Application of Feed-Forward Neural Network for the X-Ray Image Fusion (00h00')

Speaker: ZHANG, jian

Under the current urgent circumstances of the aviation security, all countries are intensifying the security inspection. In the view of the particularities of dangerous goods, simulating the x-ray images of the superimposed objects to train inspectors, would become a convenient and effective way to improve their abilities of recognizing threatening goods, which is just the focus of this paper—based on the x-ray images of two individual objects, simulating one x-ray image of overlapping the two ones. In this paper, depending on the learning algorithm ‘OWO-HWO’, and an innovative network structure approximation algorithm, we design a three layers feed-forward neural network. Using this system, we calculate the MSE (Mean Square Error) of color index and gray value on the experimental data, which indicates its premium properties of fusing x-ray images. Then, we test the noise resisting ability of this system, which demonstrates that, when the SNR (Signal Noise Ratio) is over 40dB, it could always keep good stability. Finally, we use the x-ray images of some common objects to visually display the fusing effect of this algorithm.

Performance Evaluation of Silicon Drift Detectors for a Precision X-Ray Spectroscopy of Kaonic Helium-3 Atom (00h00')

Speaker: HASHIMOTO, Tadashi

Nowadays, the use of Silicon Drift Detectors (SDDs) is becoming popular for x-ray spectroscopy of kaonic atoms. An SDD is characterized by a small anode, which is independent of active area, thereby resulting in a good energy resolution. In addition, its thin active layer suppresses the Compton background, and sub-microsecond time resolution allows effective timing selections. We are preparing SDDs for a precision x-ray spectroscopy of kaonic helium-3 (J-PARC E17), which aims to determine the strong-interaction-induced 2p level shift with a precision of better than 2 eV. Thus, basic studies of SDDs are essential to minimize systematic errors. In our experiment, SDDs and preamplifiers are operated in a cryogenic target system. Since their low-temperature behaviors were not known well, we for the first time investigated the temperature dependence of energy resolution and time resolution. Then, the optimal operational condition was established. Furthermore, we performed basic studies such as long-term stability, incident x-ray position and angle dependences of SDD responses. In this contribution, the result of the SDD basic studies and prospect toward J-PARC E17 are presented.

Collinear Laser Spectroscopy with Reverse-Extracted Bunched Beams at TRIUMF (00h00')

Speaker: MANE, Ernesto

The use of gas-filled linear Paul traps to cool and bunch ion beams has allowed high sensitivity spectroscopy with laser-induced fluorescence detection to be undertaken. To date it had only been demonstrated at the IGISOL and ISOLDE facilities. At the Ion Trap setup for Atomic and Nuclear science (TITAN) in ISAC-TRIUMF, laser spectroscopy with cooled and bunched beams has been pioneered for radioactive 78,78mRb. The ions were reverse-extracted from TITAN's trap to the laser beam line, neutralized in a Na-filled charge-exchange cell and excited with a counter-propagating laser beam from a Ti:Sa laser. The ions were Doppler-tuned as a function of a voltage applied to the Na cell and the subsequent fluorescence from the D2 line was recorded with a red-sensitive photomultiplier tube. The trap provided typically 50 ion bunches per second, each bunch with a temporal length of 1.6 micro-seconds, and containing 1000-10000 ions/bunch. A gate was set in order to accept photons only within the time window defined by the bunch, thus giving a background suppression factor of up to 1.2 x 10^4. This result paves the way for further investigations aimed at determining the charge radius of 74Rb.

Integrating Compton Photon Polarimetry in Hall A of Jefferson Lab (00h00')

Speaker: PARNO, Diana

A wide range of nucleon and nuclear structure experiments in Jefferson Lab's Hall A require precise, continuous measurements of the polarization of the electron beam. Electrons are scattered off photons in a 5-kW Fabry-Perot cavity; by measuring an asymmetry in the integrated signal of the scattered photons detected in a GSO crystal, we can make non-invasive, continuous measurements of the beam polarization. Our goal is to achieve 1% statistical error within two hours of running. We will discuss the design and analyzing power of our method and present preliminary polarization results for experiments conducted at beam energies from 1.05 to 5.9 GeV and photon rates from 5 to 100 kHz.

Novel Techniques for Hot Cavity Catchers and Gas Cells at IGISOL (00h00')

Speaker: REPONEN, Mikael Reponen

Two projects are underway in the LASER-IGISOL group at the JYFL Accelerator laboratory, aiming to improve the selectivity and efficiency of existing recoil catcher systems. Though the projects have very different approaches they share the same ion production mechanism, namely resonant laser ionization. Firstly, we present an novel approach, using the well known method of induction heating, for achieving catcher temperatures exceeding 2000ºC. The catcher design has been derived from FEBIAD systems, albeit simplified, allowing the heating system and the catcher to be decoupled. Second topic concerns the gas cell-based LIST method. In this method, the recoils are first neutralized in the cell and are selectively re-ionized using counter-propagating laser beams within a sextupole ion guide (SPIG). In order for the LIST method to be efficient, the laser beam and gas jet have to be overlapped spatially for a sufficiently long interaction length. Well collimated jets have been produced at IGISOL using both sonic and supersonic jets to fulfill this requirement. Both of the jet types have been coupled with the SPIG structure.

A Complementary Laser System for ISOLDE-RILIS at CERN (00h00')

Speaker: ROTHE, Sebastian

The resonant laser ion source (RILIS) is a powerful tool for efficient and selective production of radioactive ion beams at ISOL facilities. To avoid isobaric background, highly selective stepwise resonant ionization is applied, using up to three different laser wavelengths. Due to their advantages in terms of stability and reliability, an all solid-state titanium:sapphire (Ti:Sa) system is either already in use or considered for installation at the majority of ISOL facilities worldwide. Such an all solid-state Ti:Sa laser system is presently installed at the ISOLDE-RILIS at CERN alongside the well-established dye laser system. The primary objective of this complementary laser system is a reduction in the RILIS downtime during laser configuration changes for the ionization of different elements, as requested by ISOLDE users. Secondary benefits such as better beam quality and power stability, and therefore lower maintenance during operation, are expected. The progress of these activities at CERN will be discussed and prospective projects such as in-source spectroscopy and refined on-line RILIS control and surveillance will be covered.

Influence of Finite Range Effects in Knockout Reactions (00h00')

Speaker: JOSHI, Bhushan

Proper Finite Range DWIA calculations have been performed for the first time. For this the finite range t-matrix has been evaluated using realistic interactions. For the (a,2a) reactions the FR-DWIA calculations have indicated extreme sensitivity to the short range component of the t-matrix effective interaction. With these FR-DWIA calculations the vagaries of the energy dependent α-spectroscopic factors, have been understood using the well established nuclear radii and distorting optical potentials. Using repulsive core a-a interaction two order of magnitude enhancement is explained in (a,2a) reaction. Fully attractive a-a potential predicts results similar to the ZR-DWIA calculations. FR-DWIA calculation is a new tool to investigate nature of the nuclear potential Heavy cluster knockout reaction such as 16O(12C, 2 12C)a has been performed and results are found to be found to be enhanced by over 30 times more than the (a,2a) results. The (C,2C) results supports a short range repulsive nature of C-C potential upto ~3 fm Similar study can be made to probe short range behaviour of p-p, pi-p and K+n systems to study the dibaryons, delta resonance and the pentaquark

Channel Coupling Effects on the Fusion Excitation Functions for 28Si+90,94Zr in Sub and Near Barrier Regions (00h00')

Speaker: KALKAL, Sunil

Fusion excitation functions and angular distributions of evaporation residues have been measured for 28Si+90,94Zr systems around the Coulomb barrier using Heavy Ion Reaction Analyzer (HIRA) at IUAC. For both systems, experimental fusion cross sections are strongly enhanced compared to the predictions of one dimensional barrier penetration model below the barrier. Coupled channels formalism has been employed to explain the enhancement, theoretically using CCFULL. The enhancement could be explained by couplings of inelastic states of the projectile and target in 28Si+90Zr system. In the sub-barrier region, the measured fusion cross sections for 28Si+94Zr turned out to be about an order of magnitude higher than the ones for 28Si+90Zr system. This observation indicates the importance of multi-nucleon transfer reaction channels with positive Q-values in the enhancement as 90,94Zr are believed to have similar collective strengths. This implies that no strong isotopic dependence of fusion cross sections is expected as far as couplings to collective inelastic states are concerned. In addition, the role of projectile deformation and multi-phonon couplings in enhancement is also studied.

Measurement of Transfer Reaction Cross Sections for 28Si + 90,94Zr in Sub and Near Barrier Regions (00h00')

Speaker: KALKAL, Sunil

Multinucleon transfer reactions for 28Si+90,94Zr systems have been studied at sub and near barrier energies using Heavy Ion Reaction Analyzer (HIRA). The studies revolve around the quantitative effect of transfer channel couplings on the fusion cross sections around the Coulomb barrier. As 90Zr has closed neutron shell and 94Zr has four neutrons outside, so one can investigate the effects of shell closure and pairing correlations on multi-nucleon transfer mechanism. Kinematic coincidence was set up to reduce the background. At the target chamber, 14 elements BGO array was mounted for gamma detection in coincidence with recoils to obtain ground state and excited state transfer strengths. We could clearly resolve m/q ambiguity by time of flight technique. From Q-value considerations, it turned out that pick-up channels were neutron transfer whereas stripping channels were proton transfer. In case of 28Si+94Zr, slope parameter is almost same for two, three and four nucleon pick-up channels. In case of 28Si+90Zr, the slope parameter for two neutron pick-up is less than one neutron pick-up. The experimental and theoretical excitation energy spectra (using GRAZING) match reasonably well

Mass Independence and Asymmetry of the Reaction: Multi-Fragmentation as an Example (00h00')

Speaker: KAUR, Varinder

Heavy-Ion Collisions have always played a fascinating role in exploring various aspects of nuclear dynamics such as fusion-fission, multifragmentation and particle production. Several different experiments involving both the symmetric and asymmetric reactions have been performed during the last few years . The asymmetry of the reaction is defined by the asymmetry parameter $\eta = (AT - AP)/(AT+AP)$; AT and AP are, respectively, the masses of target and projectile. We present a complete systematics i.e. mass asymmetry, center of mass energy and equations of state dependences. The simulations have been carried out at different beam energies between 50 MeV/nucleon and 600 MeV/nucleon within the framework of IQMD model. Here our aim is to pin down the effect of mass asymmetry on reaction dynamics. To see the effect of mass asymmetry, the simulations of different asymmetric reactions 8O16 + 54Xe136, 14Si28 + 54Xe124, 16S32 + 50Sn120, 20Ca40 + 50Sn112, 24Cr50+ 44Ru102 , 26Fe56+ 44Ru196 have been carried out by keeping the total mass equal to 152. All calculations have been carried out in center of mass system and keeping the effect of Coloumb force zero.

The Interaction of Neutrons and the Slowing Down Power of Various Elements (00h00')

Speakers: KHAN, Tahirzeb, AJAZ, Muhammad

The interaction & slowing down power of the materials for various neutron cross sections were studied & plotted. The graphs show the alternate maxima & minima in slowing down power occur at various cross-section at various angles alternately. The peaks in the slowing down power arise due to the existence of resonance levels in the nuclei.

A New Parameterization Scheme for Determination of a Safe Lower Limit of Impact Parameter for Coulomb Excitation Experiments (00h00')

Speaker: KHARAB, Rajesh

We have checked the adequacy of various available parameterization schemes proposed for the determination of the safe lower limit of impact parameter needed to ensure the pure Coulomb excitation process i.e nil absorption effects in the Coulomb excitation experiments. The absorption effects are found to be non-zero for all of these parameterization schemes at experimental mid-target beam energies. Thus in the present work we have proposed a new parameterization scheme which is found to be more appropriate not only at experimental mid-target beam energies but also for a wide range of incident beam energies as far as absorption effects are concerned. This scheme may be used for planning absorption free Coulomb excitation experiments in future.

The Role of Various Ingredients Used in Proximity Potential in Heavy-Ion Fusion Reactions: New Extension (00h00')

Speaker: DUTT, Ishwar

We attempt to modify the original proximity potential using up-to-date knowledge of the universal function, surface energy coefficients and nuclear radii available in the literature. Our detailed study over 390 experimentally studied reactions reveal that the deviation w.r.t. experimental data for fusion barrier heights is closed to zero line.

Alpha-Production Yield in the Reaction 6Li+159Tb (00h00')

Speaker: PRADHAN, MUKESH KUMAR

Understanding the reactions mechanisms with loosely bound projectiles has become very important, especially because of the recent availability of radioactive ion beams, and the quest for superheavy elements by the fusion of nuclei near the drip line. In fusion with loosely bound nuclei, breakup can become an important process and influence the flux going into fusion. Fusion cross section measurements for 11,10B+159Tb and 7,6Li+159Tb [1,2] have shown alpha-particle emanating channel to be the favoured incomplete fusion process. To investigate this further, we performed an inclusive measurement of the alpha-particles produced in the reaction 6Li+159Tb, at energies spanning the Coulomb barrier. The measured total alpha-yields have been compared with the theoretical calculations. CDCC calculations done to estimate the breakup alpha-yield largly underpredict the data. In addition to breakup, transfer contributions determined from DWBA calculations indicate n-transfer to be a very important contributor to the alpha-yield in this reaction. The interesting results will be presented at the conference. References: 1) A. Mukherjee et al., Phys. Lett. B636, 91 (2006) 2) M.K. Pradhan et al.,

Multichannel Reactions Using the Adiabatic Expansion Method (00h00')

Speaker: ROMERO-REDONDO, Carolina

When studying nuclear reactions, using the Adiabatic Expansion Method has the great advantage of giving a clear distinction between all the possible outgoing channels. The phase shift of a scattering process is easily obtained from the long distance wave function. Nevertheless, it is well known that calculating the wave functions at long distances implies needing to calculate accurately enough, up to very long distances, a large amount of adiabatic potentials. This makes the calculation very delicate and computationally very expensive. In this work we solve these technical difficulties using two integral relations derived from the Kohn Variational principle, since the phase shift information is also contained, this time in a more subtle way, in the short distance part of the wave function. We study the general form of the integral relations in multichannel processes making possible the application of the method in different low energy reactions, including elastic, inelastic and rearrangement processes. We study convergence of the K-matrix in adiabatic potentials as well as the convergence of the cross section in terms of partial waves.

Study of Fission Mass Distributions in 215Fr (00h00')

Speaker: SELABOINA, Appanna Babu

Observations of the presence of quasifission(QF) in less fissile systems is a matter of intense research in recent years .Evidence of onset of quasi-fission even in asymmetric reactions forming less fissile systems appear to be a very puzzling phenomena. Earlier dynamical models predict that the QF occurs when ZpZt>=1600. However recently QF has been observed with fusion of asymmetric systems like 19F+197Au(ZpZt=632). Later the angular distribution results showed there is no evidence of non compound nucleus fission(NCNF). It seems mass distribution of fragments produced in these reactions showed evidence of QF while their angular distributions showed no evidence of non-equilibrium fission. In one of our recent work, we have studied fission fragment angular distributions for the system 18O+197Au which is having entrance channel mass asymmetry very much similar to 19F+197Au and observed that there is no evidence of NCNF. In this context inorder to understand the relaxation mechanism of various degrees of freedom in detail, in less fissile systems, we have studied the mass distribution measurements for the two reactions 11B+204Pb and 18O+197Au leading to same compound nucleus 215Fr.

Effect of System Size on the Traditional Signatures of Critical Behavior in Projectile Multifragmentation (00h00')

Speaker: TALUKDAR, Rupalim

The effect of system size on a number of traditionally accepted signatures of critical behavior have been examined for different projectile multifragmentation systems at around a few GeV per nucleon. The results obtained from the studies on Mg-Em and Kr-Em and their comparison with the results of Au-C, clear evidences of size effect could be observed in terms of height and position of the peaks of the studied parameters.

Development of a Beam Profile Monitor for Antiproton Annihilation Cross Section Measurement at ASACUSA Collaboration (00h00')

Speaker: TODOROKI, Koichi

The ASACUSA collaboration will attempt to measure antiproton annihilation cross section[1] at 100keV for the first time using the Antiproton Decelerator of CERN. We will use a radio frequency quadrupole decelerator[2] to reduce the kinetic energy of the antiprotons from 5MeV to 100keV. The 100-keV antiprotons strike thin target foils and the charged pions emerging from antiproton annihilations are counted to derive the cross section. We will also provide feedback to some optical potential models which calculate the cross section at that region[3]. For this experiment, we are designing a micro channel plate beam profile monitor with segmented anodes arranged in a XY configuration. This detector has a spatial resolution of 4mm and active area of 40*40mm^2. It will be used to ensure that the beam pulse containing thousands of antiprotons is precisely guided to the target position. This will help us to minimize the background counts from antiprotons missing the target and annihilating in the walls of the apparatus. [1]M.Corradini et al., Hyperf.Interact. 194(2009)305 [2]M.Hori et al., Phys.Rev.Lett. 91,123401(2003) [3]C.J.Batty, E.Friedman and A.Gal, Nucl.Phys.A 689(2001)721

Probing Nuclear EOS and NN Cross Section via Shock Wave in Heavy-Ion Collisions from Hundreds of MeV/Nucleon to GeV/Nucleon (00h00')

Speaker: ZHANG, Guo-Qiang

Shock wave phenomena have been keeping as an interesting focus in heavy-ion collisions, not only at the ultra-relativistic energy, but also at the intermediate energy range. Using fluid dynamics theory and concerned models, nuclear physics pioneers have given some important and interesting results, such as the sound speed, the incompressibility of nuclear matter and density isomers. However, these works are limited at macroscopic level and thus give only limited information during the whole process of heavy-ion collisions. Here, we use the QMD and BUU to study shock wave in heavy ion collision from hundreds of MeV/nucleon to GeV/nucleon. By bombarding a light nucleus on a heavy target, we get the final state angular distributions of nucleons and extract various Mach Cone angles to calculate the sound speed of nuclear matter at different bombarding energies. Furthermore, different EOS are adopted in comparison with experiment data. Finally, the effects of different nucleon-nucleon cross sections are also investigated. We find that the Mach Cone angle depends on the nucleon-nucleon cross sections greatly.

Isoscaling from 1st-Channel and All-Channel Decay by GEMINI (00h00')

Speaker: ZHOU, Pei

The isoscaling property has been found in the analysis of multifragmentation experiments in nuclear physics. The isotopic composition of the nuclear reaction products contains important information of the role of the isospin in the reaction process. N/Z degree of freedom and its equilibration, as well as the isospin asymmetry dependent term of the nuclear equation of state(EOS), has motivated detailed measurements of the isotopic distributions of reaction products. The isoscaling parameter usually denoted by αdepends upon both the symmetry energy coefficient and the isotopic contents of the dissociating systems. Isoscaling has been obtained in different reactions and theoretical Calculations, but no agreement have been reached on whether the secondary decay effect can be bypassed or not. In this work, we discuss the all-channel sequential decay effect by the sequential decay model GEMINI and some observables, which is sensitive to the isospin degree of freedom, from the present study.

Parity Violating Electron Scattering Measurements of Neutron Densities (00h00')

Speaker: BAN, Shufang

We explore possible follow on parity violating electron scattering measurements of neutron densities to the lead radius experiment (PREX). The PREX experiment uses parity violation to measure the neutron radius in 208Pb, and just took data at Jefferson Laboratory this Spring. We review PREX and the determination of its statistical error. Then we present statistical error estimates for a number of other neutron density measurements (48Ca and 120Sn) and we conclude that several measurements are feasible. We hope that this paper will lead to discussion of the physics impacts of these additional parity violating measurements of neutron densities.

Deformation, Single State Dominance and Other Issues Relevant to Single and Double Beta Decays (00h00')

Speaker: MORENO DIAZ, Oscar

We study the effects of nuclear deformation on specific (A=48, A=76 and A=150) double beta decay transitions and on their corresponding Gamow-Teller branches. To describe the single- and double-beta decays we use a deformed quasiparticle random phase approximation, built on a selfconsistent deformed mean field with Skyrme interaction and pairing. We show in particular how deformation effects are crucial to get the right two-neutrino double-beta decay matrix elements in 48Ca going to 48Ti and 150Nd going to 150Sm. We also study the effects of pairing, particle-hole and particle-particle residual interactions as well as of the Skyrme parametrization, and investigate the issue of single state dominance (SSD) [1] in two-neutrino double-beta decay. We find that deformation and fragmentation of spherical single particle strengths work against SSD, while restricting the valence space and increasing the particle-particle residual interaction favors SSD. [1] O. Moreno, R. Alvarez-Rodriguez, P. Sarriguren, E. Moya de Guerra, F. Simkovic and A. Faessler, J. Phys. G: Nucl. Part. Phys. 35 (2008) 015106.

High Spin Spectroscopy in ^{109}In (00h00')

Speaker: NEGI, D.

High spin states of ^{109}In have been investigated for the search of shears mechanism. The experiment was performed using the reaction ^{96}Zr(^{19}F,6n)^{109}In at a beam energy of 105 MeV with INGA at IUAC, which at the time of experiment comprised of 14 Clover detectors. Level scheme of ^{109}In have been considerably modified and a new M1 band similar to a band of $^{105, 107}$In have been found. These bands in ^{105}In, ^{107}In and ^{109}In exhibits similar behavior as evident from the plot of angular momentum versus rotational frequency, indicating a similar configurations for these bands. The tilted axis calculations (TAC) have been performed for the band both before and after the alignment, indicating the presence of shears mechanism in the band. The results present the evolution of shears mechanism in lower mass odd Indium isotopes.

Proton-Nucleus Reaction Cross Sections for Identification of Surface Nucleons (00h00')

Speaker: NISHIMURA, Daiki

The halo and skin structures at the nuclear surface have attracted much interest for their exotic nature. Additionally, these structures contain important information on the basic nuclear force and equation of state of nuclear matter. In studies of nuclear surface, it is often important to know proton and neutron density distributions independently. Utilizing the fact that proton-neutron cross sections are much larger than proton-proton cross sections in the intermediate energy region, the proton and neutron distributions at the nuclear surface can be determined independently for nuclei with known density by proton-nucleus reaction cross sections in this energy region from the Glauber theory. To demonstrate this, we have measured reaction cross sections for a neutron halo nucleus 11Be and a proton halo nucleus 8B on proton target at 40A ~ 120A MeV by the transmission method using the HIMAC heavy ion synchrotron. Our results support that the constituent of halo in 11Be is neutron dominantly and that of 8B is proton dominantly. Thus, we confirmed that proton-nucleus cross section is a good probe for identification of proton/neutron at the nuclear surface.

Charge Radii of Halo Nuclei in the Gamow Shell Model (00h00')

Speaker: PAPADIMITRIOU, Georgios

We calculated the (6,8)He charge radii in the framework of the Gamow Shell Model (GSM). The charge radius reflects both the size of the halo, due to the motion of the alpha-core around the nuclear center of mass (CoM), and also provides us with information on how the several subsystems interact with each other. The motivation for this work was given by the recent very precise measurements (6,8)He, 11Li and 11Be charge radii. In our GSM calculations we used a Hamiltonian that is free from spurious CoM motion by adopting an intrinsic set of coordinates. We are convinced that for 6He the charge radius is very sensitive to i) the halo extent, namely the binding of the system and ii) the p3/2 occupation. This observation will help us to constrain our Hamiltonian and construct an effective interaction in the p and p-sd shells. We also performed an application of the Density Matrix Renormalization Group (DMRG) truncation algorithm to calculate the charge radius of 8He. This was the first application of DMRG to calculate observables other than energy. The results were very promising and they open a window in applying GSM plus DMRG to heavier systems 11Li and 11Be.

Magnetic Rotation and Shape Coexistence in 144Dy (00h00')

Speaker: PROCTER, Mark

The known level scheme of 144Dy has been extended and lifetime measurements made with the recoil-distance Doppler-shift method. Reduced transition probabilities and deformations have been determined for four low-lying members of the ground-state band. These states form part of the first observed band crossing, giving information on the change in nuclear deformation resulting from the rearrangement of h11/2 protons in the nucleus. Two bands built upon excited 10+ states have been assigned proton h11/2 prolate and neutron h11/2 oblate configurations with t=12(2) ps and 0.01 ns<t<16 ns, respectively. These long lifetimes are reasoned to be a result of shape coexistence at low energy and moderate spin. A known four-quasiparticle dipole band has been extended to higher spin and lifetime measurements suggest a long-lived band-head state. In this case, the excited states in the band may be consistent with a shears model interpretation of a magnetic dipole rotor. However, the measured B(M1)/B(E2) branching ratios reveal a larger than expected deformed rotational component compared with that in the analogous band in the lower-mass isotone 142Gd.

Lifetime Measurements in 98Ru Using Inverse Coulomb Excitation (00h00')

Speaker: RADECK, D.

The nucleus 98Ru plays an important role in understanding how proton-neutron collectivity evolves into deformed nuclei. To obtain a comprehensive understanding of its structure, absolute transition strengths are of great interest. We remeasured the lifetimes of the 2+(1,2) and 4+1 states in 98Ru in order to reduce their uncertainties and resolve the disagreement of the measured lifetimes for the 4+1 state in the literature. Coulomb excitation in inverse kinematics was used to populate the states in 98Ru, and by using the New Yale Plunger Device (NYPD), the Recoil Distance Doppler Shift (RDDS) method could be employed. This technique, combined with the inverse Coulex reaction, yields high precision lifetimes but requires several corrections due to relativistic and deorientation effects. Both results and corrections are discussed. In addition, the new results on the absolute transition strengths are compared to known data on other nuclei in the mass region. This work was supported by the US Department of Energy under grant no. DE-FG02-91ER-40609.

On the Self-Interaction Problem for Nuclear Density Functionals (00h00')

Speaker: RAIMONDI, Francesco

Empirical efforts to improve models for atomic nuclei include the systematic method we recently proposed to construct nuclear density functionals using higher-order derivatives of densities. Instead of postulating these expressions, this type of gradient expansions can also be derived using expansion methods such as the density-matrix expansion (DME) proposed by Negele and Vautherin. However, the functionals obtained from these methods usually violate the Pauli principle leading to self-interaction issues. In the context of DFT, this is not a problem, but for many applications it is very useful to have self-interaction free models in the form of effective pseudopotential (PP). Such self-interaction free effective PPs allow for the whole traditional many-body artillery to be used without encountering problems like infinities in overlaps between wave functions. In this work we derive conditions which ensure that this type of quasi-local functionals have a correspondence with underlying effective PPs. The direct access to the underlying PPs provides also a better insight on the symmetries imposed on the functionals: in particular galileian and gauge symmetries have been investigated.

Search for Anti Magnetic Rotation in the 110Cd (00h00')

Speaker: ROY, Santosh

In last one decade, tilted axis rotation (TAR).received overwhelming success in describing the rotation like bands (M1 band or magnetic rotation band) predominantly decaying by magnetic dipole transitions observed in weakly deformed nuclei. Till date, only few AMR band has been observed and all were in Cd isotopes. It is due to the fact that AMR requires double Shears structures which allow the valance nucleons to mimic the orientation of the atomic dipole of aniferromagnets. The even-even Cd isotopes may generate such double Shears geometry with single particle configuration p(g9/2)-2Xn(h11/2)2. In this case, each proton holes combines with one of the neutron particles and hence the double Shears forms. It is to be noted that such single particle structure makes the magnetic moments of two Shears anti-aligned resulting no net magnetic moment. However, the presence of Rz(j) symmetry for such structures ensure that such band should decay only by weak E2 transitions with falling trends in transition rates. In the present work, an attempt has been made to search for AMR in the positive parity ground state band of 110Cd.

Microscopic Analysis of Shape Mixing in Low-Lying States of Proton-Rich Nuclei in the Se-Kr Region (00h00')

Speaker: SATO, Koichi

Using the five-dimensional (5D) quadrupole collective Hamiltonian, we study the oblate-prolate shape coexistence/mixing phenomena in the low-lying states of proton-rich nuclei in the A=70-90 region from a viewpoint of oblate-prolate symmetry and its breaking. To derive the collective Hamiltonian microscopically, we have developed a new method, on the basis of the adiabatic self-consistent collective coordinate method, for determining the collective potential, the vibrational and rotational inertial masses appearing in it. By solving the collective Schoedinger equation, we calculate excitation spectra, spectroscopic quadrupole moments and electric quadrupole transition probabilities among low-lying states. The result of calculation clearly indicates the dominant role of the large-amplitude vibration in the triaxial shape degree of freedom. It also exhibits an interesting effect of rotation, which may be called ‘rotational hindrance of oblate-prolate shape mixing’, that is, growth of localization of the collective wave function in the (beta, gamma) deformation space assisted by the rotational motion.

Cooling of Highly Charged Ions at TITAN - CPET (00h00')

Speaker: SIMON, Vanessa

Accurate mass measurements provide vital information and offer key knowledge in the description of nuclear astrophysical processes, nuclear structure, and for tests of fundamental symmetries, such as the unitarity of the CKM quark mixing matrix. TITAN is an experimental setup dedicated to high precision mass measurement of short lived nuclei. The lifetime of radioactive nuclei restricts the achievable mass resolution, which is proportional to the observation time in resonance based mass spectrometry. One way to bypass this restriction is by increasing the charge state. This can uniquely be done at TITAN, but results in an energy spread of tens of eV/q., which in turn disturbs the mass measurement in the precision Penning trap. A Cooler PEnning Trap (CPET) is being developed to cool HCIs prior to the mass measurement. Electron and proton cooling with will be tested. Additionally, CPET will incorporate mass selective cooling techniques, which provide specific mass-to-charge ratios for the extracted ion. This new concept of preparing HCI in a Penning trap as well as the status of the project will be presented.

Symmetry Restoration with the Lipkin Method (00h00')

Speaker: TOIVANEN, Pekka

I have studied the restoration of translational and rotational symmetries with the Lipkin method. Several approximate methods to restore broken symmetries have been used in the past. A considerable advantage with the Lipkin method is that it allows the calculation of an approximate VAP-energy (Variation After Projection) without performing the actual symmetry projection. Because of this the calculations, while still maintaining a good precision, require a much smaller numerical effort than exact VAP, and it is therefore possible to apply the method to several broken symmetries simultaneously. According to Lipkin's idea, minimizing the energy of a symmetry-restored mean-field state can be replaced by minimizing a corrected energy of a symmetry-broken state with the Peierls-Yoccoz mass. The basic idea of the Lipkin method is to flatten the projected energy by subtracting from it the center-of-mass kinetic energy with the PY mass, which can be calculated from the energy and overlap kernels. The method was originally formulated for the case of translational symmetry and at the moment I am working on extending it to the treatment of rotational symmetry.

The Development of Pure Beta-NQR Techniques for Nuclear Structure Studies (00h00')

Speaker: VOSS, A.

A beta-NQR spectrometer becomes a powerful tool to study changes in nuclear ground state properties along isotopic chains when coupled to a laser excitation beamline to polarise the nuclei of interest. Recently, the beta-NQR technique in a zero magnetic field has been applied first-time to measure a ratio of static quadrupole moments. An initial experiment using this technique improved the precision of the ratio of the electric quadrupole moments between ^9Li and ^8^Li. This is working towards a precise determination of the static quadrupole deformation of the halo nucleus ^11Li. Previous experiments point to this ratio being consistent with or greater than one. If indeed a ratio of greater than one could be confirmed, the increase in the RMS charge radius from ^9Li to ^11Li could be explained by the ^11Li di-neutron halo polarising the core. Results from the initial experiment carried out at the TRIUMF-ISAC facility will be presented along with an outlook on measuring ^11Li.

Recoil Distance Method Lifetime Measurement of the First 2+ State in 18C (00h00')

Speaker: VOSS, Philip

Electromagnetic transition strengths are directly obtainable from lifetime measurements and shed light on the evolution of nuclear structure as one proceeds further from the valley of stability. Lifetime investigations using the Recoil Distance Method have been successfully carried out at NSCL through the coupling of the Segmented Germanium Array and the NSCL/K"oln plunger [1,2]. During a recent NSCL campaign, the collectivity and shape evolution of neutron-rich carbon isotopes were studied by lifetime measurements of the first excited state to ground state transition in 16,18,20C. The data, analysis, and results of the lifetime measurement for 18C will be presented. The state of interest in 18C was populated by a one-proton knockout reaction at the target position of the S800 spectrograph. Particle-gated gamma-ray spectra were collected at five plunger target-degrader separation distances. Gamma-ray lineshape analysis as a function of separation distance yields a lifetime result consistent with recently reported measurements [3]. [1] K. Starosta et al., PRL 99, 042503 (2007). [2] A. Dewald et al., PRC 78, 051302 (R) (2008). [3] H.J. Ong et al., PRC 78, 014308 (2008).

Investigation of Single-Particle Structure in 26Na Using the New SHARC Array (00h00')

Speaker: WILSON, Gemma

For neutron rich nuclei far from stability, it is known that the magic number N=20 disappears [1]. Recent experiments, such as 24Ne(d,p)25Ne with the TIARA array [2] showed the breakdown of the N=20 magic number in favour of N=16. Theoretical work by Otsuka, Utsuno and collaborators [3] has highlighted the importance of sodium isotope structure in quantifying the evolution of single particle energies approaching the N=20 island of inversion. The first of a series of neutron transfer experiments has been conducted using the SHARC [4] and TIGRESS [5] arrays at the ISAC-2 facility at TRIUMF. The overall aim of these experiments is to study in detail the disappearance of the N=20 shell gap in very neutron rich sodium isotopes, as evidenced by a rise in energy for the nu(d3/2) orbital and the relative lowering of the nu(f7/2) and nu(p3/2) orbitals. The 25Na(d,p)26Na is expected to populate the same neutron states as in the SPIRAL experiment with 24Ne [2], but couple to the odd d5/2 proton. SHARC, the Silicon Highly-segmented Array for Reactions and Coulex, is a multi-purpose array for charged particle detection, which features high spatial resolution and a large solid angle coverage.

Surface-Peaked Effective Mass and its Influence on Single-Particle Spectra of N=Z Nuclei (00h00')

Speaker: ZALEWSKI, Maciej

Calculations for nuclear matter with realistic nucleon-nucleon interaction suggest isoscalar effective mass (IEM) of a nucleon at the saturation density equal to ~0.8. On the other hand empirical data on the single-particle (SP) levels density at the Fermi energy in finite nuclei, which are consistent with IEM equal unity. These contradicting results are related to the fact that in nuclei the SP levels couple to low-lying collective surface vibrations. It leads to an increase of the IEM at the surface. This effect can be taken into account by taking IEM to be considerably smaller than one inside the nucleus and larger than one at the nuclear surface so that it may give one when averaged over the nuclear volume. In present work we explore the surface-peaked IEM within a fully self-consistent model. We approach the problem by enriching the Skyrme-type local energy density functional with new terms depending on kinetic density and derivatives of the particle density. With these terms we have been able to obtain surface-peaked effective mass in a self-consistent way. They appear to strongly influence the spin-orbit splittings and centroids of single-particle levels.

Towards an Atomic Parity Violation Measurement with Laser-Trapped Francium at ISAC (00h00')

Speaker: COLLISTER, Robert

In atoms, extremely weak electric dipole transitions between states of the same parity are induced by the parity-violating exchange of Z-bosons between the electrons and the quarks in the nucleus, an effect known as atomic parity violation (APV). By measuring this amplitude we can study neutral-current weak interactions with atomic physics methods and search for ‘new’ physics such as extra gauge bosons and leptoquarks. APV is strongly enhanced in heavy atoms, but the atomic structure calculations necessary to extract the weak physics are currently only accurate enough for alkali atoms. This makes francium, the heaviest alkali, a premier choice for a new APV experiment. However, Fr has no stable isotopes, must be produced at a radioactive beam facility such as TRIUMF's ISAC in Vancouver, and needs to be accumulated in a laser trap to achieve the required sample density for APV tests. We will report on progress towards performing APV experiments using the new actinide target at ISAC, including a microwave-based measurement of the anapole moment in a chain of Fr isotopes.

Ultra-High Precision Half-Life and Branching-Ratio Measurements for the Superallowed beta+ Emitter ^26mAl (00h00')

Speaker: FINLAY, Paul

When corrected for radiative and Coulomb effects, the ft values for superallowed 0+ to 0+ beta decays provide the most precise value of V_ud. The nuclear structure dependent correction for ^26mAl is much smaller than the other twelve precision superallowed cases, making it an ideal case to reduce the experimental errors contributing to the Ft value. A branching ratio and half-life measurement for ^26mAl has been made at the ISAC facility at TRIUMF. The half-life was measured via a 4 pi continuous gas flow proportional counter, and with a precision of 0.01%, represents the most precise measurement of any superallowed half-life to date. The branching ratio was measured with the 8 pi Spectrometer, an array of 20 HPGe detectors. Of the non-analog decay branches of ^26mAl, only that to the first 2+ level in ^26Mg could have a measureable branching ratio. Our analysis improves the upper limit on this non-superallowed beta transition. These results, combined with recent Q-value measurements, yield the most precisely determined ft and Ft value for any nucleus, providing a benchmark against which to test the other superallowed cases.

SNS Neutron Electric Dipole Moment: Dielectric Behavior of Superfluid Helium and Prototype Superfluid Ion Detector (00h00')

Speaker: KARCZ, Maciej

The present experimental limit of the nEDM d_n<6x10^-26 e cm just touches on the range of predictions from theories beyond the Standard Model. The search for the nEDM is a search for T-symmetry violation and is of fundamental importance as it can help account for the baryon asymmetry of the universe. The new search for the nEDM at the SNS at ORNL seeks to improve the present limit on the nEDM by two orders of magnitude. The nature of this experiment requires strong electric fields in superfluid helium. As part of the nEDM effort, we studied the dielectric behavior of superfluid and have found a hysteretic trend, likely caused by heterogeneous nucleation in liquid helium, which permits electric fields in excess of the field required by the nEDM experiment to achieve the expected sensitivity. Furthermore, we are testing the possibility of using the in situ electric field to collect ionswhich results in the nEDM experiment and has the potential of higher efficiency than expected scintillation signals. Results of high voltage breakdown test and the ion pulse detections in superfluid helium, at the temperature and field strength relevant to the nEDM experiment will be presented.

An Experimental Search on the Electron EDM Based on Solid-State Techniques (00h00')

Speaker: KIM, Young Jin

A discovery of a permanent electric dipole moment of the electron (eEDM) would provide crucial information about the nature of T-violation and imply new sources of CP-violation beyond the Standard Model. We are pursuing research that would improve the present experimental limit of the eEDM using a new technique in solid-state systems at 4K. The experiment uses a Gadolinium Gallium Garnet sample with a large magnetic response, that can be measured using the Superconducting Quantum Interference Device as the magnetometer. In this presentation, I will discuss the progress to control the systematic effects, including the design and implementation of a 24-bit DAQ system with ultra-low level of channel crosstalk, the control of the high voltage drift from the supply, and the observed difference between the polycrystalline and single-crystal samples. Currently, the experiment is free of sources that could produce spurious signal at 10^-24 e-cm level. We are currently integrating of data, with the goal to push the limit of eEDM to 10^-25 e-cm level. Further enhancement of the eEDM sensitivity would require operating the experiment at sub-Kelvin temperatures.

A Novel Approach to Measure the Electric Dipole Moment of 129Xenon (00h00')

Speaker: KUCHLER, Florian

Permanent electric dipole moments (EDM) of fundamental systems are promising systems to find new CP violation, with the diamagnetic atom 129Xe being a particularly interesting candidate for an EDM search. Although the current experimental limit of d_Xe < 4.0e-27 ecm is several orders of magnitude higher than Standard Model (SM) prediction, extensions of the SM require much larger EDMs. Our experiment is based on microscopic hyper-polarized liquid xenon droplets on a micro-fabricated structure, placed in a low-field NMR setup. Implementation of rotating electric fields enables a conceptually new EDM measurement technique, allowing thorough investigation of systematic effects. Still, a Ramsey-type spin precession experiment with static electric field can be realized at similar sensitivity within the same setup. Employing superconducting pick-up coils and highly sensitive LTc-SQUIDs, a large array of independent measurements can be performed simultaneously with different configurations. With our approach we aim to finally lower the limit on the EDM of 129Xe by more than three orders of magnitude.

Beta-Neutrino Angular Correlation Measurement Using Trapped 8Li ions (00h00')

Speaker: LI, Gang

In the Standard Model, the weak interaction has a strict V-A form. The existence of exotic couplings can be tested by measuring the beta-neutrino angular correlation in beta decay. To search for this correlation, the Beta decay Paul Trap (BPT) has been built at Argonne National Laboratory. We have demonstrated the capability of producing and transferring a low-energy, bunched, and isotopically pure beam of 8Li ions. In BPT the ions are cooled to sub-eV energies, and confined in a volume of less than 1 mm^3. The nearly pure Gamow-Teller decay of 8Li makes it very sensitive to tensor interaction. The light mass, large Q value, and fact that 8Be immediately breaks up into two alphas of equal and opposite momenta in the center of mass results in Doppler shifts orders of magnitude greater than those sought in other beta-nu correlation measurements. The complete decay kinematics can be determined by measuring the momenta of two alphas and the direction of the beta with four sets of double-sided silicon strip detectors. We expect to measure the angular correlation coefficient to a precision of 1% in 2010.

Precision Measurements of Parity Violation in Polarized Cold Neutron Capture on Proton: the NPDGamma Experiment (00h00')

Speaker: MEI, Jiawei

The NPDGamma experiment proposes to measure the asymmetry of the gamma ray direction relative to the neutron spin when polarized neutrons capture on protons. The asymmetry results from the weak parity-violating hadronic interaction. The goal is to measure the asymmetry with 1e-8 sensitivity. Such a measurement will provide a theoretically clean value of the weak pion-nucleon coupling, resolving a long standing controversy in nuclear physics, and also provide a clean value of C(3S1-3P1) in pionless EFT. Phase one of the experiment completed at the Los Alamos Neutron Science Center (LANSCE) reports a result consistent with zero: -1.1 +/- 2.1 (stat) +/- 0.2 (sys) e-7. The experiment is under construction at Oak Ridge National Laboratory, to be installed at the Fundamental Neutron Physics Beam (FNPB) line at the Spallation Neutron Source (SNS). The liquid parahydrogen target currently being modified at the Indiana University (IUCMB), will be moved to SNS in 2010. The phase 2 data will be taken in 2010 as well. An overview of the experiment and related physics will be provided.

Electron Transverse Polarimeter for the MTV Experiment at TRIUMF (00h00')

Speaker: ONISHI, Junichi

A new experimental project of MTV-S1183 is started at TRIUMF [1], aiming to achieve the highest precision test of time reversal symmetry in polarized nuclear beta decay. In this experiment, existence of T-violating transverse polarization of electrons emitted from polarized nucleus is examined, using a multi-wire drift chamber (MWDC) as an electron tracking detector in order to measure Mott scattering asymmetries. In this presentation, technical aspects of the electron polarimetry are going to be presented. The Mott polarimeter, MWDC, consists of six sense layers. In order to improve the real scattering event purity, a new intelligent triggering system using FPGA module to perform on-line hit pattern recognition, is developed. The new triggering system has been installed for the experiment in November 2009 at TRIUMF-ISAC. In addition to the triggering system, buffering DAQ system and gas upgrade R results, which are required to satisfy the high counting rate, will be also presented at the conference. [1] J. Murata, “Test of Time Reversal Symmetry using polarized 8Li at TRIUMF-ISAC”, in this conference.

Geant4 Simulations for the Radon Electric Dipole Moment Search at TRIUMF (00h00')

Speaker: RAND, Evan

The existence of a permanent electric dipole moment (EDM) requires the violation of time-reversal symmetry (T) or, equivalently, the violation of charge conjugation C and parity P (CP). Although no particle EDM has yet been found, current theories beyond the Standard Model, e.g. multiple-Higgs theories, left-right symmetry, and supersymmetry (SUSY), generally predict EDMs within current experimental reach. In fact, present limits on the EDMs of the neutron, electron and ^{199}Hg atom have significantly reduced the parameter spaces of these models. The measurement of a non-zero EDM would represent a clear signal of CP violation from physics beyond the Standard Model. The search for an EDM with radon has an enticing feature. Recent theoretical calculations predict substantial enhancements in the atomic EDMs for atoms with octupole-deformed nuclei, making odd-A Rn isotopes prime candidates for the EDM search. Such measurements require extensive development work and simulation studies. The Geant4 simulations presented here are an essential aspect of these developments.

WITCH, a Double Penning Trap Experiment for Weak Interaction Studies (00h00')

Speaker: VAN GORP, Simon

The WITCH set-up (Weak Interaction Trap for Charged Particles) that was installed at ISOLDE/CERN combines a double Penning trap system to store radioactive ions and a retardation spectrometer to probe the energy of the daughter recoil ions. The primary aim is to search for scalar and/or tensor interactions in nuclear beta decay by precisely determining the beta-neutrino angular correlation coefficient a. This can be extracted from the measured energy spectrum of the recoiling nuclei after beta decay. The set-up is now operational and the first recoil ion spectrum was measured in the decay of 124. Although statistics were not sufficient and systematic effects have not yet been adressed in detail to extract weak interaction information, the charge state distribution of the recoiling 124Sn daughter ions could be derived. The set-up was upgraded (better vacuum, buffer gas purification, electropolished electrodes) and further optimized to allow for measurements with the nucleus 35Ar. Such measurement was already performed and allowed the investigation of systematic and unwanted effects in the system. At present these data is being analyzed to allow for a longer measurement of 35Ar.

Analysis of the eta->e+e-e+e- Double Dalitz Decay (00h00')

Speaker: WURM, Patrick

The Wide Angle Shower Apparatus detector (WASA) - operated at the Cooler Synchrotron (COSY-J"ulich) - is a large-acceptance detector to study the decay-channels of light mesons ranging up into the strange quark sector. A large number of eta-mesons is being produced in proton-deuteron and proton-proton. The huge amount of data permits the study of very rare eta-decay channels. One of these channels is the double Dalitz decay, where the eta-meson decays via two virtual photons into two electron-positron pairs. By introducing the Form Factor, this decay can be related to the QED process, where the eta-meson decays into two real photons. The Form Factor depends on the squared invariant mass of the lepton pairs and allows one to study the structure of the decay mechanism. Currently, there is only an experimental upper limit for the branching ratio. One objective of the WASA-at-COSY experiment is to find a new upper limit for this decay channel. The status of the analysis of this challenging decay channel and preliminary results will be presented.

Wednesday 07 July 2010

New Facilities and Instrumentation Plenary Session - Chan Centre (08:00-10:00)

time	title
08:00	**Overview Hadron Facilities (00h30')** *Speaker: NAGAMIYA, Shoji* About ten years ago (2001) a new accelerator project to provide high-intensity proton beams proceeded into its construction phase. This project is called the J-PARC (Japan Proton Accelerator Research Complex), and it was completed about a year ago in 2009. The construction was done under a cooperation of two institutions, KEK and JAEA. The goal of the project is to provide 1 MW proton beams at 3 GeV and 0.75 MW beams at 50 GeV, by having four major beam ports: neutrons, muons, hadrons primarily for kaons, and neutrinos. In this presentation, I would like to review on-going and planned programs in hadron experimental hall and in neutrino experimental hall at J-PARC. In the world, other hadron facilities are also available or they are under construction. The most promising facility is FAIR at GSI. I would also like to cover this FAIR facility togetehr with working world hadron facilities, such as FNAL and Frascati, as much as time allows.
08:30	**Present and Future RIB Facilities (00h30')** *Speaker: FULTON, Brian* Over the past decade a range of facilities have been built which produce accelerated beams of short-lived radioactive nuclei. The advent of these beams has revolutionised nuclear physics research by removing the straightjacket that Nature had held us in when only the few stable nuclei were available to be used to initiate nuclear reactions. We can now probe further, and in more detail, towards the limits of nuclear stability, uncovering new structural phenomena and measuring the key nuclear reactions that control the energy output and element production in explosive astrophysical sites. A new generation of facilities is now under construction or planning that will have the capability to extend our reach ever further. In this talk we will survey the capabilities and time lines of these facilities, as well as looking at the science areas that each will address.
09:00	**Facilities for the Energy Frontier of Nuclear Physics (00h30')** *Speaker: JOWETT, John M* The Relativistic Heavy Ion Collider at BNL has been exploring the energy frontier of nuclear physics since 2001. Its performance, flexibility and continued innovative upgrading can sustain its physics output for years to come. Now, the Large Hadron Collider at CERN is about to extend the frontier energy of laboratory nuclear collisions by more than an order of magnitude. In the coming years, its physics reach will evolve towards still higher energy, luminosity and varying collision species, within performance bounds set by accelerator technology and by nuclear physics itself. Complementary high-energy facilities will include fixed-target collisions at the CERN SPS, the FAIR complex at GSI and possible electron-ion colliders based on CEBAF at JLAB, RHIC at BNL or the LHC at CERN.
09:30	**Developments in Underground Facilities (00h30')** *Speaker: SMITH, Nigel* There have recently been major developments in the provision of space for deep underground experiments in various facilities around the world, with significant progress on the planning, construction and available occupancy of both new and existing sites. This talk will review the current status of deep underground facilitates, focussed on those that provide the deep shielding and clean environment required for rare event searches, such as neutrino, dark matter and nuclear astrophysics studies. The talk will discuss the various types of facility available world-wide, the characteristics of these facilities, progress on development plans, and the science programmes undertaken within these sites.

Nuclear Applications and Interdisciplinary Research Plenary Session - Chan Centre (10:00-12:00)

time	title
10:00	**Energy Future and Nuclear Physics (00h30')** *Speaker: DEAN, David* The Department of Energy is the largest funder of physical sciences in the U.S. with a broad portfolio that includes Nuclear Physics, the topic of this conference. The Department funds a portfolio of research from basic science to applications in areas related to energy research and national security. Increasing world-wide energy demands, continuing dependence on fossil fuels for that energy, and an ever increasing concentration of atmospheric Green House Gases resulting from burning fossil fuels, creates a need for research that can significantly impact the energy sector. I will discuss the scientific landscape at the Department and its intersections with future energy production and consumption.
10:30	Coffee Break (00h30')
11:30	**The TRIUMF-ISAC beta-NMR Facility: New Tools for Nanoscience (00h30')** *Speaker: MACFARLANE, W.A.* Aside from the measurement of nuclear magnetic moments, beta detected NMR, and its close relative muon spin rotation, employ the asymmetric emission of the beta particle to study the material in which the beta-active probe is located, analogous to conventional stable-nucleus NMR. The nuclear detection, however, makes some measurements feasible that cannot be done by conventional NMR because of signal limitations, for example, studying isolated atomic defects in the dilute limit. At TRIUMF-ISAC, a new facility has recently been commissioned that is dedicated to using beta-NMR to study depth dependent magnetic properties in solids, novel materials and heterostructures. Electrostatic deceleration of the low energy beam of beta-radioactive probe ions (principally 8Li+) is used to vary the energy (and implantation depth) of the probes in a practical range from about 300 nanometers down to a few nm. After surveying the capabilities of this facility, a brief review of recent results in magnetic, superconducting and semiconductor materials will be presented.

Award Session - Chan Centre (12:00-13:20)

Introduction and best poster and presentation award 1st IUPAP young scientist award 2nd IUPAP young scientist award 3rd IUPAP young scientist award

Thursday 08 July 2010

Hadron Structure Plenary Session - Chan Centre (08:00-10:00)

time	title
08:00	**Hadrons in Lattice QCD (00h30')** *Speaker: FODOR, Zoltan* Lattice QCD arrived to a new era, in which phenomenologically relevant calculations can now be carried out on the lattice by taking quark masses close to their physical values and by extrapolating results to the continuum limit in a controlled manner. I illustrate this new era by showing a couple of full results of hadron physics.
08:30	**Hadron Spectroscopy: An Experimental Overview (00h30')** *Speaker: GIANOTTI, Paola* Quantum Chromodynamic is the theory of the strong interaction, but the properties of hadrons cannot be directly calculated from the QCD Lagrangian. Alternative approaches are then used: Lattice QCD, Effective Field Theories, chiral dynamics, and the constituent quark model. To test these different approaches, precise measurements of hadron properties are needed. This is the main motivation for the hadron spectroscopy experiments carried out since many years with different probes and different environments. Recently, the majority of the new results have been obtained using e+-e− colliders by experiments like BaBar, Belle, BES, CLEOc. These, on one hand, have determined big progresses in the field, while on the other hand, have discovered a large number of states with properties that cannot be easily and exhaustively explained by any theory. In this review, I'll make an excursus through the experimental results showing which are the best successes of the theory, and pointing out where we have still some problems in accommodating the new states with the theoretical expectations. Hints on future perspectives, offered by the forthcoming experimental programs, will be also given.
09:00	**Nuclear Forces from QCD, and Effective Field Theory (00h30')** *Speaker: KAPLAN, David* The discovery of QCD has greatly changed the scope of nuclear physics, which has expanded its boundaries to encompass relativistic heavy ion physics, hadronic structure, and theories of quark matter in compact stars. For decades though, the problem of placing nuclear structure theory on a QCD foundation has defied solution. Recently, through a marriage between lattice QCD and effective field theory, along with advances in algorithms and computer technology, it is becoming evident that QCD will soon have a major impact on understanding the structure and dynamics of nuclei.
09:30	**Quarks in Orbit: the Puzzling Quest for L (00h30')** *Speaker: MAKINS, Naomi* It is well established that the spins of the quarks account for little of the proton's spin, and the growing body of data on the gluon spins suggests a modest polarization. Where is the rest? The quest for a solution to the Spin Puzzle must turn to its most mysterious and least accessible component: the orbital angular momentum of the partons. L is a familiar friend in the study of non-relativistic bound states such as the atom and the nucleus, but not so for the proton. The quest to understand quark orbital angular momentum is beset by many challenges, including the search for a theoretical definition of L that permits both interpretation and measurement. The experimental status of the spin puzzle will be summarized, then a selection of recent data will be presented that shows glimpses of quarks in orbital motion, both within the proton and in the process of hadron formation in high-energy collisions. An overview will be presented of the ongoing theoretical efforts to understand these data and to determine how best to measure -- and think about -- L within the proton.

Coffee Break - Chan Centre (10:00-10:30)

Nuclear Structure Plenary Session - Chan Centre (10:30-12:30)

time	title
10:30	**In-Beam Gamma-Ray Spectroscopy Towards the Drip Lines (00h30')** *Speaker: GADE, Alexandra* The often surprising properties of neutron-rich nuclei have prompted extensive experimental and theoretical studies aimed at identifying the driving forces behind the dramatic changes encountered in the exotic regime. In-beam nuclear spectroscopy with fast beams and thick reaction targets – where gamma-ray spectroscopy is used to tag the final state – provides information on the single-particle structure as well as on collective degrees of freedom in nuclei that are available for experiments at beam rates of only a few ions/s. Recent results from nuclear spectroscopy experiments that utilize the interplay of nuclear-structure effects and nuclear reactions will be presented.
11:00	**Advances in Nuclear Structure Theory (00h30')** *Speaker: SCHWENK, Achim* I will discuss recent highlights and frontiers in understanding and predicting nuclei and the structure of strongly-interacting matter, with a focus on neutron-rich systems.
11:30	**Current Developments in Nuclear Density Functional Methods (00h30')** *Speaker: DOBACZEWSKI, Jacek* Density functional theory (DFT) became a universal approach to compute the ground state and excited configurations of many-electron systems held together by an external one-body potential in condensed-matter, atomic, and molecular physics. At present, the DFT strategy is also intensely studied and applied in the area of nuclear structure. The nuclear DFT, a natural extension of the self-consistent mean-field theory, is a tool of choice for computations of ground-state properties and low-lying excitations of medium-mass and heavy nuclei. Over the past thirty-odd years, a lot of experience was accumulated in implementing, adjusting, and using the density-functional methods in nuclei. Nevertheless, this research direction is still extremely actively pursued in nuclear physics. In particular, current developments concentrate on (i) attempts to improve the performance and precision delivered by the nuclear density-functional methods, (ii) derivations of density functionals from first principles rooted in the low-energy chromodynamics and effective theories, and (iii) including effects of low-energy correlations and symmetry restoration. The present talk will present an overview of recent results and achievements gained in nuclear density-functional methods.
12:00	**Precision Measurement of Ground-State Properties for Nuclear Structure Studies (00h30')** *Speaker: BLAUM, Klaus* Atomic physics techniques like Penning trap mass spectrometry and laser spectroscopy have provided sensitive and high-precision tools for a detailed study of nuclear ground-state properties far from the valley of stability. Mass, moment and nuclear charge radii measurements in long isotopic and isotonic chains have allowed, e.g., to extract nuclear structure information such as shell and subshell closures, the onset of deformation, the coexistence of nuclear shapes at nearly degenerate energies, and so on. This contribution covers experimental techniques to study nuclear ground state properties and their applications not only for nuclear structure studies but also for other fields as, e.g., nuclear astrophysics since to a large extent, the paths of element formation are determined by ground (and partly isomeric)-state properties of nuclei.

HD2 - Life Sciences Centre 1410 (14:00-15:40)

time	title
14:00	**In-Medium Modification of Hadrons (00h25')** *Speaker: HEMMICK, Thomas* The idealized Quark-Gluon Plasma is a state in which bound hadrons have melted into their more fundamental constituents; quarks and gluons. In reality, this effect is not simply binary (bound or unbound), since numerous more gradual effects such as collisional broadening, modifications due to mean fields, and chiral symmetry restoration have the capacity to change the center and width of mesonic states. Although all states with lifetimes longer than the plasma state will return to their vacuum values, states that have short enough lifetimes and decay exclusively to non-strongly-interacting probes (photons or leptons) will decay while experiencing a modification. This talk will give an overview of in-medium measurements of hadron properties and their modification.
14:25	**Magnetic Aspects of QCD at Finite Density and Temperature (00h15')** *Speaker: TATSUMI, Toshitaka* We discuss two magnetic aspects in the QCD phase diagram: one is the spontaneous magnetization [1] and the other is the spin-density wave (SDW) [2]. The former is a ferromagnetic ordering with uniform order parameter, while the latter is an anti-ferromagnetic ordering characterized by the spatially modulated order parameter. A possibility of ferromagnetism has been suggested by the use of OGE interaction and further studied within the Fermi-liquid theory [3]. We can see that quark matter behaves like marginal Fermi-liquid [4]. On the other hand the possibility of SDW has been discussed in relation to the restoration path of chiral symmetry. It is driven by the nesting effect of the Fermi surface. Here we discuss their emergence in a unified way by using the NJL model and figure out some features. These may affect the thermal as well as magnetic evolutions of compact stars. [1] T. Tatsumi, Phys. Lett. B489 (2000) 280. [2] T. Tatsumi and E. Nakano, hep-ph/040829; Phys. Rev. D71 (2005) 114006. [3] T. Tatsumi and K. Sato, Phys. Lett. B663 (2008) 322; B672(2009) 132. K. Sato and T. Tatsumi, Nucl.Phys. A826 (2009) 74. [4] R.P. Smith et al., Nature 455 (2008) 1220.
14:40	**Dilepton Production from Parton Interactions in the Early Stage of Relativistic Heavy-Ion Collisions (00h15')** *Speaker: LINNYK, Olena* The parton-hadron-string dynamics (PHSD) transport approach describes the non-equilibrium evolution of relativistic heavy-ion collisions: from the initial hard scatterings to the partonic phase in the early hot reaction region followed by hadronization and off-shell hadron propagation and interactions. The description of partons in PHSD is based on the dynamical quasiparticle model (DQPM) matched to reproduce lattice QCD results in thermodynamic equilibrium. Here we address the dilepton production from the parton interactions in the early stage of relativistic heavy-ion collisions. We derive the off-shell cross sections of q+qbar->l^+l^-, q+qbar->g+l^+l^- and q+g->q+l^+l^- by dressing quark and gluon lines with the effective propagators from the DQPM. Dilepton production in In+In collisions at 158 AGeV and in Au+Au at Sqrt(s)=200 GeV is calculated by implementing these processes into the PHSD transport approach. By comparing to the double differential dilepton data of the NA60 and PHENIX Collaborations in mass and pT, we study the relative importance of different dilepton production mechanisms and point out the regions in phase space where partonic channels are dominant.
14:55	**Particle Production in Nucleus-Nucleus Collisions at the SPS and the QCD Phase Diagram (00h15')** *Speaker: STROEBELE, Herbert* We will review recent results on particle production in nucleus-nucleus collisions as measured by the NA49 experiment at the CERN-SPS. In order to collect information on the properties of matter described by the QCD phase diagram systematic studies of particle production as function of system size and center-of-mass energy have been performed. Rapidity distributions of produced strange and non-strange hadrons as well as net-baryons and fluctuations of various event-by-event observables will be discussed. The results on particle yields clearly indicate that the studied systems have chemical freeze-out parameters close to a band in the QCD phase diagram in which the hadron-parton phase transition should occur. Even the critical end point of the phase transition line, if it exists, may be within reach. It will be discussed what can be learned in this respect from the existing data and what they imply for future experiments.
15:10	**First Photon Physics with ALICE (00h15')** *Speaker: ROEHRICH, Dieter* Direct photons are produced during the entire evolution of nucleus-nucleus collisions. Since photons interact only electromagnetically with the hot nuclear matter, they carry undistorted information about its properties. Decay photons are used to measure nuclear modification factors of neutral mesons, pi0, eta, omega, etc. Photon-jet and photon-hadron correlations can serve as probes of parton energy loss. The ALICE experiment at LHC exploits various photon detection techniques. The Photon Spectrometer (PHOS) is a high-resolution electromagnetic calorimeter dedicated to the precise measurement of direct photon and neutral meson yields in pp and AA collisions at mid-rapidity in a pT range up to 100 GeV/c. It is augmented by a second electromagnetic calorimeter (EMCAL). And as an independent measurement to the calorimeters one can use the high resolution central tracking system to reconstruct gammas, pi0s and etas via photon conversions. In this talk the main focus will be on the performance of the gamma and pi0 reconstruction achieved with PHOS in p+p collisions. First results on pi0 transverse momentum spectra and gamma-hadron correlations will be presented.

15:25 **Pi0 and Eta Reconstruction from Photon Conversions in ALICE for First p-p Collisions at the LHC (00h15')**

Speaker: AAMODT, Kenneth

In order to extract a direct photon signal from the large background dominated by pi0 and eta decays, one needs to know the pi0 and eta spectra to a high precision. The high-resolution central tracking system can be used, as an alternative to a direct measurement in the ALICE calorimeters, to reconstruct pi0s and etas through photon conversions. This will improve the overall systematic errors, and serve as a cross check to the calorimeter approach. Knowledge of the material budget is crucial for the extraction of the absolute yield. The statistics is comparable to that of the photon spectrometer (PHOS), and the reconstruction method can also be applied for Pb-Pb collisions. Moreover, the implementation of a photon conversion trigger in the High Level Trigger (HLT) framework gives the possibility of identifying pi0s and etas online, and increasing the statistics at higher momentum. Preliminary results on neutral meson production from the accumulated statistics of p-p collisions at 900GeV will be shown in the presentation.

HN3 - Forest Sciences Centre 1003 (14:00-15:35)

time	title
14:00	**Two-Nucleon Emission with Electromagnetic Probes (00h25')** *Speaker: GRABMAYR, Peter* Modern nucleon-nucleon potentials permit calculations of ground state wave functions for light nuclei with high precision and good agreement even for several excited states, if three-body forces are included. However, the same potentials are unable to describe on the same footing reactions where one or two nucleons are knocked out. Potentials distinguish themselves only in their off-shell character. Experiments with real and virtual photons at intermediate energies are presented which aim at probing the short-range and tensor components of the NN interaction by knocking pp and np pairs from 16O and 3He. The various reaction mechanisms (IC,FSI,MEC) and the NN interaction are interrelated making the analysis ambiguous. Recent results and strategies are discussed.
14:25	**Role of Short-Range Correlations in Nuclei (00h25')** *Speaker: RIOS HUGUET, Arnau* The present theoretical understanding of the role of short-range correlations in nuclei near stability is reviewed. Two effects are identified in particular: first, the depletion of mean-field single-particle strength that is no longer available to participate in low-lying excitations. Second, the admixture of high-momentum nucleons in the ground state that is implied by the vanishing relative wave functions of pairs in the medium. The role of the tensor force will be further clarified by discussing isospin-polarized matter. It is demonstrated that the depletion of the proton and neutron Fermi seas depends strongly on the nuclear tensor force and appears to be determined by nucleon-nucleon scattering data. The increased role of short-range and tensor correlations for the minority species makes the case for further experimental scrutiny of nuclei with large neutron excess. Appropriate data of single- and two-nucleon knockout experiments are employed to illustrate the role of short-range and tensor correlations.
14:50	**Hard Photodisintegration of a Proton Pair (00h15')** *Speaker: POMERANTZ, Ishay* We present data for the energy dependence of the high energy 90° c.m. photodisintegration of proton-pairs in ^{3}He [1]: \[\frac{d\sigma}{dt}(\gamma+{\rm ^3He} \to p+p+n) \] in kinematics corresponding to the proton pair (and the spectator neutron) nearly at rest in the initial state. Cross-section measurements were taken for eight photon energies in the range of 0.8 - 4.7 GeV. Scaling of the cross section by s^{-11} was observed, in agreement with the constituent counting rule prediction, but commencing at $E_\gamma\ \approx$ 2.2 GeV, rather than 1 GeV as in the deuteron (pn pair) breakup. The magnitude of the scaled cross section $(s^{11}\frac{d\sigma}{dt})$ for pp pair breakup was found to be dramatically lower than for the breakup of pn pairs and theoretical predictions. At energies below the scaling region, the scaled cross section was found to present a strong energy-dependent structure not observed in the pn breakup. The data indicate a transition from three-nucleon hadronic photodisintegration processes at low energies to two-nucleon quark-dominated photodisintegration processes at high energies. [1] I. Pomerantz et al., Phys. Lett. B 684 (2010) 10610
15:05	**Strangeness Production in Hot Dense Matter (00h15')** *Speaker: TOLOS, Laura* The properties of strange mesons (K and $\bar K$ and $\bar K^*$) in nuclear matter at finite temperature are studied using a unitary approach in coupled channels. The kaon-nucleon interaction incorporates s- and p-wave contributions within a chiral model while the interaction of $\bar K^*$ with nucleons is obtained in the framework of the local hidden gauge formalism. The in-medium solution accounts for Pauli blocking effects, mean-field binding on baryons, and meson self-energies. We calculate K, $\bar K$ and $\bar K^*$ (off-shell) spectral functions and single particle properties. We also analyze the energy weighted sum rules of the kaon propagator as a quality test of model calculations. We finally discuss the implications for the decay of the ϕ meson in this hot and dense medium.
15:20	**Hadrons in Strongly Interacting Matter (00h15')** *Speaker: MOSEL, Ulrich* We review the current status of theories and experiments aiming at an understanding and a determination of the properties of light vector and scalar mesons inside strongly interacting hadronic matter. Starting from a discussion of the relevant symmetries of QCD and their connection with the hadronic description through QCD sum rules we then discuss hadronic models used to calculate the in-medium self-energies of hadrons and their spectral functions. The difficulties to link these calculated properties to actual observables are emphasized. Finally, we review in detail all the running experiments searching for in-medium changes of vector and scalar mesons, both with relativistic heavy-ion reactions as well as with elementary reactions on (cold) nuclei. Inconsistencies among experimental results are discussed. While almost all experiments observe a considerable broadening of vector mesons inside the nuclear medium, no evidence for mass changes is observed in the majority of the experiments.

HS3 - Forest Sciences Centre 1001 (14:00-15:35)

time	title
14:00	**Experiments on Few-Nucleon Systems at MAMI and Beyond (00h25')** *Speaker: DISTLER, Michael O.* The study of the nuclear structure of He-3 plays a particular role at the Mainz Microtron (MAMI), since polarization degrees of freedom for the first time provide a complete experimental access to the small, but important partial wave amplitudes (S'-, D-waves) of the He-3 ground-state wave function. Besides that, the knowledge on the He-3 structure is a prerequisite in order to analyze a special type of polarization experiments where the He-3 target serves as a target of polarized neutrons. In order to promote these goals, a polarized He-3-target for electron scattering experiments has been developed at Mainz. A number of experiments, including the determination of the neutron electric form factor (Gen), inclusive electron scattering on He-3 and He-4, and a test of the D-state component of the He-3 nucleus in spin-dependent quasi-elastic electron scattering will be presented. First results of a triple-polarization experiment will be shown, where, in addition, the spin of the knocked out proton is analyzed. By using this deuteron-tagging method spin-polarized He-3 might serve as an effective polarized proton target for electron scattering experiments.
14:25	**Compton Scattering from Deuterium and the Polarizabilities of the Neutron (00h15')** *Speaker: MYERS, Luke* The electric and magnetic polarizabilities of the proton are now well known, owing to Compton scattering measurements on hydrogen targets; however, the neutron polarizabilities are still quite uncertain. To investigate this problem, a multi-institutional collaboration is conducting an elastic Compton scattering experiment on deuterium at MAX-Lab (Lund University, Sweden) with ~100 MeV photons. We have assembled at one laboratory, for the first time, three of the world's largest NaI detectors — CATS (from Mainz), BUNI (from Boston University), and DIANA (from the University of Kentucky) — each having better than ~2% photon energy resolution. We have measured elastic Compton scattering cross sections at 60^o, 90^o, 120^o and 150^o using tagged photons in the energy range 60-115 MeV in 5 MeV steps. This will substantially increase the world's set of elastic Compton scattering data from deuterium and will provide valuable input for effective field theory (EFT) calculations. Based on fits using these EFT inputs, new values for the neutron electric and magnetic polarizabilities will be obtained with greater accuracy than has previously been achieved.
14:40	**Extraction of P11 Resonance from pi-N Data and Its Stability (00h15')** *Speaker: NAKAMURA, Satoshi* An important question to address in resonance physics is how much resonance poles and residues extracted from data depend on a model used for the extraction, and on the precision of data. We address this question with the dynamical coupled-channel model developed in Excited Baryon Analysis Center (EBAC) at JLab. I report results, focusing on the P11 pi-N scattering. After explaining how resonance poles and residues are extracted with the analytic continuation, we examine the model-dependence of the poles by varying parameters significantly within the EBAC model, keeping the fit to SAID P11 amplitude. We find that two Roper poles are fairly stable against the variation. However, for higher energies, the number of poles can change depending on how the parameters fitted within error bars; this indicates the necessity of more precise pi-N data. We find that the residues are perhaps more model-dependent. We also developed a model with a bare nucleon which forms the physical nucleon after being dressed by the meson-cloud. With this model, we still find a good stability of the Roper poles. We also discuss dynamical contents of the Roper poles from the bare N model and the EBAC model.
14:55	**Hyperon-Nucleon Scattering from Lattice QCD (00h15')** *Speaker: LIN, Huey-Wen* The recent discovery of anithypernuclei (antihypertritium) at RHIC has extended our understanding of nuclei incorporating hyperons along with the usual nucleons. Such strange matter may also be created in extreme environments, such as the core of a neutron star. To further understand strange nuclear matter, we need to expand our knowledge of the YN (hyperon-nucleon) and even YY (hyperon-hyperon) interactions, for which the fast decay of strange matter prevents experiment from providing strong constraints. Lattice QCD offers the chance to study such interactions from the first principles of QCD. In this presentation, I will report on a state-of-the-art hyperon-nucleon scattering calculation in lattice QCD.
15:10	**Effective Field Theories for Nuclear Few-Body Systems (00h25')** *Speaker: PLATTER, Lucas* Relating the observables of nuclear structure to the underlying theory of the strong interactions requires a model-independent framework that respects the underlying symmetries of quantum chromodynamics. Effective field theories are a consistent and systematically improvable approach that facilitate this. I will give an overview of the application of effective field theories (EFTs) to nuclear systems. In particular, I will discuss the pionless EFT appropriate for low-energy nuclear systems, the pionfull EFT and the Halo EFT that is an EFT tailored to the description of Halo nuclei such as Lithium-11. Furthermore, I will outline the steps that have to be taken in the near future to advance this exciting subfield of nuclear physics.

NA4 - Forest Sciences Centre 1221 (14:00-15:35)

time	title
14:00	**Toward a Model-Independent Equation of State of Neutron-Star Matter (00h25')** *Speaker: PRAKASH, Madappa* The largest measured mass of a neutron star establishes the ultimate energy density of observable cold baryonic matter. The number of neutron star mass measurements in X-ray binaries, double neutron star binaries, neutron star-white dwarf binaries and neutron star-main sequence star binaries is rapidly growing. Many reports of neutron star masses exceeding 2 solar masses exist, albeit with far less accuracy than the 1.4414^+0.0002_ -0.0002 in the 1913+16 double neutron star binary. Although inherently difficult, estimates of radii in some cases are emerging. Concommitantly, techniques to determine masses and radii of individual neutron stars are being devised. Accurate determinations of masses and radii of several individual neutron stars are necessary to establish the equation of state (EOS) of neuton-star matter in a model-independent way. The theoretical approach to achieve this goal exploits the one-to-one correspondence between an EOS and the mass versus radius relationship. The extent to which several measured masses and radii of individual neutron stars (with inherent observational errors) can establish a model-independent EOS through an inversion of the stellar structure equations will be addressed. Observational advances required to make significant progress will be highlighted.
14:25	**Imprints of the Nuclear Symmetry Energy on Properties of Neutron Stars (00h25')** *Speaker: LI, Bao-An* The density dependence of nuclear symmetry energy especially at supra-saturation densities has been among the most uncertain properties of neutron-rich nuclear matter. Fortunately, significant progress has been made recently in constraining the symmetry energy especially at sub-saturation densities using data from heavy-ion reaction experiments. While many uncertainties still remain, the partially constrained symmetry energy can already help us better understand several properties of neutron stars. In this talk, we will examine imprints of the symmetry energy on the mass-radius relationship, core-crust transition density, moment of inertia and binding energy of neutron stars. Effects of the symmetry energy on the strength and frequency of gravitational waves and stability of neutron stars will also be discussed.
14:50	**Liquid-Gas Mixed Phase in Nuclear Matter at Finite Temperature (00h15')** *Speaker: MARUYAMA, Toshiki* Liquid-gas (LG) phase transition and the relevant equation of state (EOS) is one of the most important subjects in nuclear physics and astrophysics. In the crust region of compact stars or supernovae we can expect non-uniform matter with exotic shapes called pasta as a mixed phase during the liquid-gas phase transition. It is not only interesting theoretically but may affect the mechanical and thermodynamical properties of compact stars. We explore the geometrical structure of LG mixed phase by using relativistic mean-field model. To get the EOS of the system, the Maxwell construction is found to be applicable to symmetric nuclear matter, where protons and neutrons behave simultaneously. For asymmetric nuclear matter, on the other hand, the phase equilibrium is obtained by fully solving the Gibbs conditions since the components in the L and G phases are completely different. We also discuss the effects of surface and the Coulomb interaction on the mixed phase.
15:05	**Shear Viscosity of Antikaon Condensed Matter in Hot Neutron Star (00h15')** *Speaker: BANIK, Sarmistha* Shear viscosity plays an important role in neutron star physics. We calculate the shear viscosity in the presence of K^- condensates, using Boltzmann kinetic equation. The equation of state (EoS) which is an input to this calculation, is constructed using RMF model. We consider a first order phase transition from charge neutral and beta-equilibrated nuclear matter to K^- condensed phase in a hot neutron star after the emission of trapped neutrinos. Antikaons form a s-wave condensation and do not take part in momentum transfer during collisions with other particles such as nucleons and leptons. However, the onset of K^- condensation influences the particle fraction and EoS which, in turn, have important consequences for the total shear viscosity. We find that the lepton shear viscosity, hence the total viscosity drops steeply once K^- condensates set in. However, the proton shear viscosity whose contribution to the total shear viscosity was negligible compared to that of leptons in nucleons only matter, now becomes significant in K^- condensed matter. It even exceeds the neutron as well lepton shear viscosities at higher density. Hence total shear viscosity rises again.

15:20 **New Equation of State for Supernova (00h15')**

Speaker: SHEN, Gang

We calculate the equation of state (EoS) of nuclear matter for a wide range of temperatures, densities, and proton fractions for use in supernova and neutron star merger simulations. We employ a full relativistic mean field (RMF) calculation for matter at intermediate density and high density, and the Virial expansion of a nonideal gas for matter at low density. This is an improvement over the Lattimer-Swesty equation of state and the H. Shen and Toki equation of state. We use the RMF parameter set NL3, and approximate the unit cell for non-uniform nuclear matter as a spherical Wigner-Seitz cell, wherein the mean fields of nucleons are solved fully self-consistently. The Virial gas consists of neutrons, protons, alpha particles, and 8980 species of nuclei from FRDM mass tables. As the density decreases, the mean field results match smoothly to the Virial gas. At very low density, the Virial expansion reduces to nuclear statistical equilibrium. We tabulate the resulting EoS at over 180,000 grid points in temperature T = 0 - 80 MeV, density nB = 10−8 - 1.6 fm−3, and proton fraction YP = 0 - 0.56. This table will soon be available for supernova and neutron star merger simulations.

NF4 - Life Sciences Centre 1510 (14:00-15:40)

time	title
14:00	**New Facilities for Underground Nuclear Astrophysics (00h25')** *Speaker: STRIEDER, Frank* It is in the nature of astrophysics that many of the objects we try to understand are inaccessible. Thus, it is important that those aspects that can be studied in the laboratory be rather well understood. The nuclear fusion reactions are an example for such aspects. They influence sensitively the nucleosynthesis of the elements in the earliest stages of the universe and in all the objects formed thereafter, control the associated energy generation, neutrino luminosity, and evolution of stars. Almost 20 years ago a new experimental approach for the study of nuclear reactions based on an underground accelerator laboratory, called LUNA, was initiated at the Gran Sasso underground laboratory. This project demonstrated the research potential of such a facility. Several key reactions could be studied, some directly at the Gamow peak for the solar hydrogen burning. Presently, there exist proposals for new underground laboratories dedicated to nuclear astrophysics in Europe and USA. To reduce significantly the cosmic-ray background events at higher gamma-ray energies in the detectors, the laboratories should be several hundred meters underground, while the natural background is minimized naturally in a salt environment. However, an underground laboratory has its special virtue for gamma- and neutron-spectroscopic studies.
14:25	**Commissioning of the New High-Intensity Ultracold Neutron Source at the Paul Scherrer Institut (00h15')** *Speaker: LAUSS, Bernhard* Commissioning of the new high intensity ultracold neutron (UCN) source at the Paul Scherrer Institut, Switzerland has started. The design goal is to surpass by a factor of ~100 the current ultracold neutron densities available for fundamental physics research such as the search for a neutron electric dipole moment. The source is based on neutron production via spallation of protons on lead, followed by neutron thermalization in heavy water and cooling in a solid deuterium crystal to cold and ultracold energies. A successful beam test with up to 2mA protons onto the spallation target was conducted in Dec.2009. As of Feb.2010, major parts of the source have already been commissioned; the other components are already installed or prepared for final mounting. The installation is on the right track for the first scheduled cool-down in late spring 2010. We will give an overview of the source, present its working principle, status, and first data.
14:40	**TRIGA-TRAP: The First Penning Trap Mass Spectrometer at a Research Reactor (00h15')** *Speaker: NAGY, Szilard* Experimental, model independent data of ground-state properties in particular high-precision atomic masses of neutron-rich nuclides are needed for nuclear structure studies, to test the predictive power of nuclear mass models, or as input to r-process nucleosynthesis calculations. The goal of the TRIGA-TRAP experiment at the research reactor TRIGA Mainz is to perform high-precision mass measurements on neutron-rich fission products produced on-line by thermal neutron induced fission of a target inside the reactor. Several lanthanoid and actinoid nuclides as well as carbon cluster ions for calibration purposes can be routinely produced with a newly developed laser ablation ions source. Besides fundamental research, TRIGA-TRAP is a test bench for the development of efficient ion detection techniques, which will enable mass measurements ultimately on a single singly-charged ion with a half-life of the order of one second. To this end, a unique combination of the commonly used time-of-flight and the non-destructive image current detection technique is realized in an on-line mass spectrometer. An overview of the experiment will be given, with the emphasis on the first results.
14:55	**A Pulsed Superthermal UCN Source at the TRIGA Mainz (00h15')** *Speaker: LAUER, Thorsten* Research in fundamental physics with the free neutron is one of the key tools for testing the Standard Model at low energies. Significant improvements of the experimental performance using ultracold neutrons (UCN) require reduction of both systematic and statistical errors. The development of new UCN sources based on the superthermal concept is therefore an important step for the success of future fundamental physics with ultracold neutrons. Besides the construction of new huge UCN sources at several big research centers around the world, which are mainly based on the use of either solid deuterium or superfluid helium as UCN converter, there exists also the idea of competitive UCN sources using pulsed reactors of the TRIGA type. To demonstrate the feasibility of a UCN source at these reactors, a superthermal UCN source based on solid deuterium was built at the tangential beamport C of the reactor TRIGA Mainz. Based on the experience obtained during three years of succesfull operation and optimisation, a second upgraded source was built for the radial beamport D. This new source schould increase the actually available UCN densities of 4 UCN/cm^3 by minium one order of magnitude.

15:10	**A New Ultracold Neutron Source for EDM Measurement (00h15')** *Speaker: MASUDA, Yasuhiro* The neutron EDM is a key parameter to understand CP violation in the universe. The standard model can't explain the baryon asymmetry. We need new theory beyond the standard model. The supersymmetric theory predicts a neutron EDM of 10^-26 to 10^-27 e.cm, while the recent Grenoble measurement showed the upper limit of 3 x 10^-26 e.cm. The experimental error is limited by the counting statistics. We have built a new ultracold neutron (UCN) source to improve the counting statistics. Our UCN source uses a new concept of UCN production, namely a neutron cooling by means of phonons in a superfluid helium, which is placed in a spallation neutron source. We produced the world's highest UCN density for experiments with the world's smallest proton beam power. In this conference, we will discuss the properties of this UCN source and how to extract UCN from the source to experiments in comparison with world's new UCN sources. We will also discuss a new idea for EDM measurement by using this new UCN source.
15:25	**iThemba LABS K600 High Energy-Resolution Zero-Degree Facility for Medium-Energy Hadronic Scattering (00h15')** *Speaker: NEVELING, R* The investigation of medium-energy hadronic scattering at zero degrees has the advantage of being very selective to excitations with low angular momentum transfer. This simplifies analysis of the many contributions to the spectra due to the complex nature of the nuclear interaction. Only a few facilities exist worldwide where high energy-resolution measurements of this nature can be performed. The K600 Zero-Degree Facility at iThemba LABS, South Africa, was recently successfully developed. Good excitation energy-resolution was achieved by utilizing beam dispersion-matching techniques. Measurements were performed for inelastic proton scattering at an incident energy of 200 MeV for targets ranging from 27Al to 208Pb. Excitation energy resolution of 50 keV (FWHM) was achieved. A reasonable background subtraction procedure allows for the extraction of excitation energy spectra with low background. Measurements of the (p,t) reaction at 100 MeV benefit from a large difference in magnetic rigidity between the scattered and primary particles, resulting in almost background-free spectra with excitation energy resolution of 35 keV (FWHM) and scattering angle resolution of 0.6 degrees.

NR6 - Forest Sciences Centre 1005 (14:00-15:40)

time	title
14:00	**Effects of Nuclear Orientation on Fusion and Fission Process for Reactions Using 238U Target Nucleus (00h25')** *Speaker: NISHIO, Katsuhisa* Motivated by the production of superheavy elements (SHEs) up to Z=118 [1] in the actinide-based reactions, we measured the evaporaion residue (ER) cross-sections for 30Si + 238U and 34S + 238U to investigate the effects of nuclear deformation on fusion. Measurement was carried out at GSI. In the sub-barrier reaction, we produced the isotopes 264Sg and 268Hs (new isotope), respectively, as 4n channel [2] by taking advantage of the lowering of Coulomb barrier due to prolate deformation of 238U. From the cross-sections of 263Sg and 267Hs (5n) measured at the above-barrier, we conclude that fusion dominates in 30Si + 238U, whreas quasifission dominates in 34S + 238U. We also measured the fission fragment mass distributions at the JAEA tandem accelerator. We observed enhanced asymmeric fission when beam energies were decreased to sub-barrier [3]. The results were reproduced by the fluctuation - dissipation model. The calculated fusion probabilities are consistent with the results obtained from the ER cross-sections. [1] Yu.Ts. Oganessian, J. Phys. G, 34, R165 (2007). [2] K. Nishio et al., Eur. Phys. J. A, 29, 281 (2006). [3] K. Nishio et al., Phys. Rev. C, 77, 064607 (2008).
14:25	**Chemical Investigation of Element 114: Indication for a Massive Relativistic Effect in Chemistry (00h15')** *Speaker: DRESSLER, Rugard* The systematic order of the periodic table places element 114 into group 14. The enhancing metallic character with increasing atomic number is a typical trend along the main groups 13-17 of the periodic table. Relativistic calculations of the electronic struc¬ture suggest an increased chemical stability of the elemental atomic state for element 114. We present first experiments measuring the interaction of 287114 and 288114 with a gold surface in a thermochromatographic setup using a temperature gradient from 300 K down to 110 K. Based on the observed deposition pattern of three decay events an adsorption enthalpy of element 114 on gold of -(34+20-3) kJ/mol (68% c.i.) was deduced. The comparison between theoretical values and our experimental result concludes the formation of a noble-gas like weak physisorption bond between atomic 114 and a gold surface in contrast to the expectations from the relativistic models and from empirical predictions. Element 114 reveals a substantially increased stability of the elemental state, which might be explained with a closed shell electronic structure originating from massive relativistic effects acting on the outermost s- and p-electrons.
14:40	**Search for Heavy and Superheavy Systems in 197Au + 232Th Collisions Near the Coulomb Barrier (00h15')** *Speaker: BARBUI, Marina* The reaction 197Au + 232Th at 7.5 AMeV was studied using the BigSol spectrometer at Texas A Theoretical calculations suggest that this reaction could be used as an alternative method to produce heavy and superheavy elements. During the short interaction time, heavy systems of interacting nucleons are formed and, due to the strong energy dissipation, a large number nucleons can be transferred. The larger the lifetime of the decaying giant system, the larger the possible number of transferred nucleons. Moreover shell effects may help in the formation of heavy nuclei in the region of the island of stability. Reaction products emitted in an angular range from 6 to 16 degrees were collected at the entrance of the BigSol spectrometer and detected at the focal plane using a segmented ionization chamber. Four position sensitive PPAC detectors placed along the ion’s flight path were used to track the product trajectories and measure the times of flight. A few events with atomic number larger than 100 were identified and survived the pile-up filtering. The experimental results are presented and compared with theoretical calculations performed with the Constraint Molecular Dynamic code.
14:55	**Synthesis of a New Element with Atomic Number Z=117 (00h15')** *Speaker: HAMILTON, Joseph* The synthesis of a previously unknown element Z=117 can provide crucial new tests of the shell structure near the Island of Stability around N=184. Here we report the synthesis of {293,294}117 (N=176,177) in the 48Ca + 249Bk 4n and 3n reactions. The 249Bk was produced and separated at ORNL. The experiments were performed employing the Dubna Gas-Filled Recoil Separator and the heavy-ion cyclotron U-400. The position resolution (FWHM) of the strip detector in registering correlated decay chains of the recoil-a1- a2 - a3 - SF type, did not exceed 0.6 mm. At an energy of 252 MeV and total beam dose of 2.4 x 1019, we observed five position-correlated decay chains with average T1/2 = 14(+11,-4) ms and Ea = 11.03(8) MeV for {293}117. At a 48Ca energy of 245 MeV to observe the 3n reaction channel, a new decay chain was detected involving six consecutive a-decays and ending in SF, T1/2=78(+320,-35) ms, Ea=10.81(10) MeV for {294}117. The new element with Z= 117 and A= 293, 294 has been synthesized and 11 new more neutron-rich, longer-lived isotopes identified to give new stronger support for the island of stability.

15:10 **Monte Carlo Analysis of Fragment-Mass Distributions for Heavy Nuclei Fission Induced by Intermediate and High Energy Probes (00h15')**

Speaker: ANDRADE-SEGUNDO, Evandro

Recent experiments have shown that the multimode approach for describing the fission process leads to good agreement with the observed results. A systematic analysis of the parameters obtained by fitting the fission-fragment mass distribution to the spontaneous and low-energy data has shown that the values for those parameters present smooth dependence on the nuclear mass number. In this work it is shown that the same values obtained for low-energy fission can be used for the relevant parameters to describe high-energy fission results for fragment mass distributions. To calculate the fission-fragment mass distributions, a Monte Carlo simulation of intermediate energy nuclear reaction is performed with the CRISP code. The fission-fragment masses are calculated according to the multimode approach obtained by using the Statistical Scission Model. Simulations for fission induced by 660 MeV protons on 241Am and 237Np, and for fission on 238U induced by Bremmstrahlung gammas with end-point energies at 50 MeV and 3500 MeV are shown, and the results are compared to recent experimental data.

15:25 **Enhancement of Sub-Barrier Fusion of the Two-Neutron Halo Nucleus 6He on 209Bi and 238U (00h15')**

Speaker: HUSSEIN, Mahir S.

We present clear evidence of the enhancement of the fusion probability of the Borromean nucleus 6He on 209Bi and on 238U at sub-barrier energies. This is in contrast to the conclusions reached by Raabe et al. (Nature 431 (2004) 823), where it was claimed that no such enhancement ensues in the 6He + 238U system, we find that a proper account of the static effects of the halo as manifested in the use of the correct matter density of 6He used in the double folding model, and used to calculate the tunneling probability, would lead to a fusion cross section which contains the above mentioned enhancement, and consequently a comparison with the data would not show any visible effect of the halo. We have redone and extended the analysis of Raabe et al. by using the recently proposed Universal Fusion Function, which only contains normal effects. The effect of the coupling to the breakup channel leads to a reduction in fusion, but this was found to be confined to energies in the vicinity of the Coulomb barrier. At lower energies the static effects of the halo dominates over the dynamical breakup coupling leading to an enhanced tunneling and fusion.

NS11 - Life Sciences Centre 3 (14:00-15:40)

time	title
14:00	**Spectroscopy of the Heaviest Elements (Theory) (00h25')** *Speaker: AFANASJEV, Anatoli* The questions of the existence limits and the properties of shell-stabilized superheavy nuclei have been a driving force behind experimental and theoretical efforts to investigate the spectroscopy of the heaviest nuclei. Unfortunately, theoretical predictions for superheavy nuclei differ considerably. In such a situation, heavy nuclei of actinide region play a role of testing ground for many theoretical approaches. Systematic study of these nuclei allows to put the error bars on theoretical description of the properties of superheavy nuclei. The present status of our understanding of heavy and superheavy nuclei within covariant density functional theory (CDFT) will be presented. I will concentrate on several aspects which define the shell structure and stability of superheavy nuclei, such as (i) single-particle degrees of freedom, (ii) role of pairing, and (iii) the fission barriers.
14:25	**SHIPTRAP: Direct Mass Spectrometry of Transfermium Nuclides (00h15')** *Speaker: HERFURTH, Frank* To determine location and extension of the island of spherically, shell-stabilized nuclei predicted around Z = 114 and N = 184 it is decisive to know the structure of nuclides in that region. In particular the knowledge of masses is important as they link to binding energies and, hence, the shell structure evolution. The Penning trap SHIPTRAP has been conceived for precision experiments of heavy nuclei beyond fermium (Z > 100). Installed at GSI, Darmstadt, behind the separator for heavy ion products (SHIP) it has recently performed the first direct mass measurements beyond fermium. The masses of the nobelium isotopes 252No, 253No and 254No have been measured directly with high precision. They provide new anchor points in this region and the results can be used to determine masses of heavier short-lived nuclides up to darmstadtium (Z = 110) with the help of known alpha decay energies. Efforts to increase sensitivity and efficiency to reach the region of super-heavy elements, which are produced with cross-sections of at best some picobarn, are ongoing at SHIPTRAP. Moreover, the investigations are extended towards trap-assisted decay- and laser spectroscopy of trans-fermium element
14:40	**E1 and M1 Strength Distribution in 208Pb (00h15')** *Speaker: TAMII, Atsushi* Electric dipole (E1) and magnetic dipole (M1) resonances are two of fundamental collective excitation modes in nuclei. The electric pygmy dipole resonance (PDR) is expected to occur in nuclei with neutron excess at around the neutron separation energy (S_n). Microscopic models qualitatively agree as an oscillation of a neutron skin against an approximately isospin-saturated core. In the same energy region concentration of M1 strengths is also expected in heavy nuclei. The overall strength distribtuion of those excitation modes are, however, still not understood well, since the strengths around the S_n have been difficult to be accessed by both (gamma,gamma') and (gamma,n) measurements, which are suitable for measuring strengths below and above the S_n, respectively. Recently we have established an experimental technique to measure proton inelastic scattering around a scattering angle of zero degrees with high-resolution including spin-transfer. The technique has been applied for 208Pb to study the overall E1 and M1 strength distributions separately in an energy region of 5-25 MeV. We will present the results and discussions in the conference.
14:55	**Study of Valence Neutrons in 130,136Xe with HELIOS (00h15')** *Speaker: KAY, B. P.* The new helical orbit spectrometer, HELIOS, at Argonne National Laboratory is designed for studying reactions in inverse kinematics for nuclei that are easier to produce as beams rather than targets. We explored the valence neutrons in two Xe isotopes using the neutron-adding (d,p) reaction on 136Xe and 130Xe. These studies address two areas of current interest: the evolution of single-particle states in the N = 82 isotones, and nuclear structure relevant to the potential neutrinoless double beta decay of 130Te. A beam energy of 10 MeV per nucleon was used for each species, and an excitation-energy resolution of <100 keV was achieved in the outgoing proton spectra. Simultaneous measurements of elastic scattering at small angles enabled absolute cross sections to be measured and also provided continuous target monitoring. The instrument performs in a way that is very promising for future radioactive beam studies.
15:10	**Neutron Vacancies Outside N=82 Isotones (00h15')** *Speaker: HOWARD, Alan* Recent work has been carried out linking shifts in single-particle energy levels across several series of isotopes and isotones with the tensor part of the nucleon-nucleon interaction [1][2]. In the present work a systematic study was carried out of the N=81 nuclei 137Ba, 139Ce, 141Nd and 143Sm, all of which exhibit states at low energies characterised by single-neutron hole excitations below the N=82 closed core. These states were populated through the single-neutron removal reactions (p,d) and (3He,alpha) at energies of 23 and 40 MeV, respectively. Light ejectiles were momentum analysed using the Yale split-pole spectrograph. The transferred angular momenta were inferred using angular distributions and ratios of cross sections between the two reactions. The energy centroids of the underlying single-particle states were reconstructed from the observed fragments using spectroscopic factors deduced from a DWBA analysis of the measured cross sections. The results will be discussed with reference to the expected effects of the tensor interaction. [1] T. Otsuka et al., Phys. Rev. Lett. 95, 232502 (2005) [2] B. P. Kay et al., Phys. Lett. B 658, 216-21 (2008)

15:25 **High Resolution Particle Spectroscopy in 208Pb (00h15')**

Speaker: HEUSLER, Andreas

By using the Q3D magnetic spectrograph of the Maier-Leibnitz-Laboratorium at München, particle-hole states in 208Pb are investigated. With the reactions 208Pb(p,p') and 207Pb(d,p) at a resolution of 3 keV, more than 250 states in 208Pb below Ex = 8.2 MeV are observed. Excitation energies are derived with uncertainties of 0.1 keV for strongly excited states by calibration with known data from the Nuclear Data Sheets. 208Pb(p,p') via isobaric analog resonances (IAR) in 209Bi allows to determine the neutron particle-hole components of each state in 208Pb. The selective excitation in an IAR yields the parity for each state. By the excitation in different IAR, a dozen doublets of states in 208Pb with distances less than 2 keV are resolved. The spin and the dominant neutron particle-hole configurations of some state are determined from the mean cross section and the shape of the angular distribution for 208Pb(p,p'). From about 120 particle-hole states predicted by the shell model in 208Pb below Ex = 6.5 MeV, about 80 states with negative parity and 30 states with positive parity are identified. Spin, parity and spectroscopic factors are determined for each state.

NS5 - Life Sciences Centre 2 (14:00-15:40)

time	title
14:00	**Nuclear Structure in the 78Ni Region Studied with Decay Spectroscopy Methods (00h25')** *Speaker: RYKACZEWSKI, Krzysztof Piotr* The development of new “ranging-out” technique for post-accelerated radioactive beams allowed us to perform very selective beta-decay studies of nuclei in the doubly-magic 78Ni region [1]. The measurements include the determination of the beta-delayed neutron branching ratio and properties of levels involved in the beta-decay process. Our reliably measured bn-branching ratios for the decays of Cu and Ga isotopes were found to be two to five times higher than previously reported values. The experimental evidence for merging of the n3s1/2 and n2d5/2 orbitals beyond N=50 was interpreted as a signature for a new emerging sub-shell closure at N=58. This concept is supported by the spherical HFB calculations using the SkOT functional involving the tensor term in the nucleon-nucleon interaction. [1] Winger et al., PRL 102,142502 (2009) and submitted to PR C
14:25	**Evidence for Reduced Collectivity Around Mid-Shell in Semimagic Sn Isotopes from New Lifetime Measurements (00h15')** *Speaker: JUNGCLAUS, Andrea* In recent studies of the B(E2;0--2) strength in the Sn isotopes filling the lower half of the N=50-82 major neutron shell, a sudden increase in strength has been observed between the mid-shell isotope 116Sn and its neighbor 114Sn, with the values then staying nearly constant within the experimental uncertainties down to 106Sn. This surprising behavior contrasts with both the naive expectation of highest collectivity around mid-shell and the results of modern large-scale shell model calculations. In order to verify the increase of the E2 transition probability between 116Sn and 114Sn we performed precise measurements of the lifetimes of the first excited 2+ states in the stable even Sn isotopes 112-124Sn using the Doppler shift attenuation (DSA) technique. For the isotopes 112Sn, 114Sn and 116Sn the B(E2) values deduced from the measured lifetimes are in severe disagreement with the previously reported values and indicate a minimum at N=66. The observed deviation from a maximum at mid-shell is attributed to the obstructive effect of the s1/2 neutron orbital in generating collectivity when near the Fermi level. This work has recently been submitted to Physical Review Letters.
14:40	**Partial-Wave Contributions to Pairing in Nuclei (00h15')** *Speaker: BARONI, Simone* We present a detailed study of partial-wave contributions of nuclear forces to pairing in nuclei. For T = 1, J = 0 pairing, partial waves beyond the standard 1S0 channel play an interesting role for the pair formation in nuclei. The additional contributions are dominated by the repulsive 3P1 partial wave. Their effects, and generally spin-triplet nuclear forces between paired nucleons, are influenced by the interplay of spin-orbit partners. In addition, we show that nuclear forces favor T = 1, J = 0 over T = 0, J = 1 pairing, except in low-j orbitals. This is in contrast to the free-space motivation that suggests the formation of deuteron-like T = 0 pairs in N = Z nuclei.
14:55	**Coulomb Excitation and Quadrupole Moments in the A~80 Region (00h15')** *Speaker: GALINDO-URIBARRI, Alfredo* At the Holifield Radioactive Ion Beam Facility in Oak Ridge National Laboratory, we have performed a series of experiments in the mass A~80 region using both Coulomb Excitation mechanism and Radioactive Ion Beams to measure the reduced transition probability B(E2; 0+ \to 2+). In order to go a step further we are exploring the determination of the electric quadrupole moment, Q, of the first excited state 2+ in the radioactive nucleus 78Ge. For an even-even nucleus, the static quadrupole moment of the first excited state gives a measurement of the deviation of the nuclear charge distribution from a spherical symmetry, and can be determined measuring the reorientation effect in Coulomb Excitation. The measurement of such a basic indicator of the nuclear structure has particular importance in transitional regions such as the germanium isotopic chain. We report on the use of the least squares analysis code GOSIA to determine Q for the 21+ states of the stable nuclei 78,82Se. These results are part of the cross check analysis that currently is undergoing for the determination of the quadrupole moment of the radioactive nuclei 78Ge.
15:10	**Linear Response Calculation Using the Canonical-Basis TDHFB with a Schematic Pairing Functional (00h15')** *Speaker: NAKATSUKASA, Takashi* The time-dependent Hartree-Fock-Bogoliubov (TDHFB) theory is capable of describing nuclear dynamics in a wide range of nuclei from light- to heavy-mass regions. However, it requires large computational resources as well as significant effort for coding. We propose an alternative feasible approach, ``Canonical-basis TDHFB" (CbTDHFB). The drawback of the method is that it cannot be applicable to the neutron drip-line because of the simple form of the pairing functional. However, the computational task of CbTDHFB is comparable to that of TDHF, yet it can take account of the nuclear superfluidity and dynamical pairing effects. The CbTDHFB has conservation properties identical to the full TDHFB, such as the energy expectation value, the average particle number, and the Nambu-Goldstone modes. The numerical calculations in the three-dimensional real space also demonstrate that, despite of its simplicity, its small-amplitude limit is almost identical to the quasi-particle random-phase approximation (QRPA). We show a systematic calculation of electric dipole and quadrupole responses in stable and unstable nuclei, to demonstrate its capability and possible exotic modes of excitation.

15:25 **Self-Consistent Description of Shape Coexistence in the A \simeq 100 Zr Nuclei (00h15')**

Speaker: PETROVICI, Alexandrina

The self-consistent description of the properties of neutron-rich nuclei in the A=100 region is one of the most exciting and challenging nuclear structure problems. The isotopic chain of neutron-rich Zr nuclei offers an example of rapid transition from spherical to deformed shape with a possible identification of the sudden onset of quadrupole deformation between N=58 and 60. For a realistic description of shape coexistence a beyond mean field approach is required. We present the first results obtained within the $complex$ Excited Vampir variational approach with symmetry projection before variation for a chain of even Zr nuclei. We use a large model space above the 40Ca core built out of 1p_{1/2}, 1p_{3/2}, 0f_{5/2}, 0f_{7/2}, 2s_{1/2}, 1d_{3/2}, 1d_{5/2}, 0g_{7/2}, 0g_{9/2}, and 0h_{11/2} spherical orbitals for protons and neutrons. The effective interaction is obtained from a G-matrix based on Bonn A potential. Our investigation revealed the importance of particular neutron-proton monopole correlations and indicates shape transition with increasing neutron number and variable shape mixing at low and high spins for positive parity states in Zr nuclei.

Coffee Break - Forest and Life Sciences Centre Atriums (15:40-16:10)

HD3 - Life Sciences Centre 1410 (16:10-17:50)

time	title
16:10	**Monte-Carlo Simulations for the Hard Probes in Heavy-Ion Collisions (00h25')** *Speaker: SCHENKE, Bjoern* I review recent developments in Monte-Carlo simulations for high-energy nucleus-nucleus collisions. After discussing different approaches I present results for one and two-body observables in Au+Au collisions obtained with MARTINI. This simulation combines PYTHIA and the McGill-AMY scheme to describe the evolution of hard partons in a soft background, which is described using relativistic 3+1D ideal hydrodynamics. The range of applicability of this combined approach is explored by the study of small systems like Cu+Cu at different centralities. I will close with a discussion of future challenges and possibilities of Monte-Carlo simulations.
16:35	**Energy Loss and Elliptic Flow of Heavy Quarks Traversing a Quark Gluon Plasma (00h15')** *Speakers: AICHELIN, joerg, GOSSIAUX, pol* It is assumed that in ultrarelativistic heavy ion collisions a plasma of quarks and gluons is produced but it is difficult to study its properties because light mesons are sensitive to the transition temperature only. The situation is much better for heavy quarks which are created in hard processes. Here perturbative QCD allows for the calculation of the production cross sections and therefore the final and initial momentum distribution can be directly compared. We study the collisional and radiative interaction of heavy quarks with the plasma with help of a Boltzmann equation embedded in a hydrodynamical calculation for the expanding plasma. The cross section of the elementary interactions are calculated by perturbative QCD using a running coupling constant and an effective infrared regulator determined by hard thermal loop calculations With these new features the experimental centrality dependence of R_{AA} as a function of p_t as well as the elliptic flow v_2, can be reproduced. It turns out in addition that not only the elementary interaction between heavy quarks and plasma particles but also the details of the expansion of the plasma influence the results.
16:50	**Strangeness Measurements at LHC with ALICE (00h15')** *Speaker: STACHEL, Johanna* The ALICE experiment at the CERN LHC has excellent capabilities in particle identification, momentum resolution as well as primary and secondary vertex resolution. In relativistic heavy-ion collisions, strange particles can be used to probe the chemical equilibration of the QGP expected to be formed for very high energy densities. In proton-proton collisions, the study of strange particle production will serve as baseline for heavy ion collisions. They will help for the characterization of the underlying event structure and for the validation of statistical models and/or QCD-inspired models. ALICE experiment has started its data taking activity on 2009 with p-p collisions at 900 GeV and it will soon start data taking with p-p collisions at 7 TeV. Extraction of transverse momentum spectra of strange particles (as K0s, Lambda, anti-Lambda, and phi) and of the yield of Xi- + anti-Xi+ is going on with 900 GeV data and it will be carried out with 7 TeV p-p data soon after their collection. A review of the first results obtained on strangeness production at 900 GeV and at 7 TeV c.m. energy, namely yields, ratios of yields at midrapidity and transverse momentum spectra will be presented
17:05	**Heavy Ion Physics with CMS (00h15')** *Speaker: KUNDE, Gerd J.* We present the capabilities of the CMS experiment to explore the heavy-ion physics programme offered by the CERN Large Hadron Collider (LHC). Collisions of lead nuclei at energies up to $\sqrt{s_{NN}}$ = 5.5 TeV will probe quark and gluon matter at unprecedented values of energy density. The prime goal of this research is to study the fundamental theory of the strong interaction (QCD) in extreme conditions of temperature, density and parton momentum fraction. We give the overview of the potential of CMS to carry out a full set of representative Pb-Pb measurements both in "soft" and "hard" regimes. Measurements include "bulk" observables -- charged hadron multiplicity, low p_T inclusive hadron identified spectra and elliptic flow -- which provide information on the collective properties of the system; as well as perturbative processes -- such as quarkonia, heavy-quarks, jets, γ-jet, and high p_T hadrons --- which yield "tomographic" information of the hottest and densest phases of the reaction. In addition, the corresponding measurements that have been performed on early p+p collision data will be reviewed. The talk will focus on the very first measurements expected from the first LHC run in 2010.

17:20	**Flow and Energy Loss Measurements in PHENIX: Probes for Hot QCD Matter (00h15')** *Speaker: NOUICER, Rachid* Two of the most interesting experimental results obtained by PHENIX in heavy-ion reactions at RHIC collider energies are the large collective flow, apparently created at the partonic level, and the large suppression of hadron production at high transverse momenta which is interpreted to be the result of a large energy loss by the precursor parton on its path through the dense matter, primarily due to gluon radiation. Both of these measurements, flow and nuclear modification factors, are consider probes for hot QCD matter. In this talk, I will review the latest results of the flow as well the nuclear modification factors for identified particles, which include neutral pion, light favors (strange hadrons), heavy favors and photons. These results will be shown as a function of transverse momentum, centrality and rapidity in different collision systems and energies, and compared with different models calculations.
17:35	**Heavy Ion Physics with the ATLAS Detector (00h15')** *Speaker: STEINBERG, Peter* The ATLAS experiment will be taking data in the expected Pb+Pb run in late 2010. ATLAS is a hermetic detector, consisting of layers of charged particle tracking, highly segmented calorimetry and a precise muon tracking system. While designed for proton-proton collisions, it has also been shown to perform very well in the high multiplicity heavy ion environment. The expected performance for global variables, fully-reconstructed jets, quarkonia and tagged photons will be discussed, in the context of measurements made in proton-proton collisions at CM energies of 900 GeV and 7 TeV.

HN4 - Forest Sciences Centre 1003 (16:10-17:50)

time	title
16:35	**Strange Multibaryons Studied in the 4He(K-_(stopped), Lambda N) Reaction (00h15')** *Speaker: SUZUKI, Takatoshi* As result of KEK-PS E549, candidates of strange tribaryonic states reported in the KEK-PS E471 were not confirmed in the 4He(stopped K-,N) inclusive missing mass spectra, and strict upper limits for the both p and n emission channels were obtained for "narrow" states. Meanwhile, unresolved non-mesonic intensities were observed around 3140 MeV/c2 as the candidates of "broad" tribaryonic states, and they had essentially similar properties with possible K-pp candidate reported in the FINUDA and DISTO experiments. In order to discriminate possible multibaryon signals from expected non-mesonic absorption processes, we have investigated correlations of coincident Lambda N pairs to establish the two-nucleon absorption processes and multibaryonic signals stepwise. We clearly observed Lambda branches of non-mesonic two-nucleon absorptions as well-separable processes, and their existence and properties were definitely established. Furthermore, mysterious non-mesonic reaction strengths, which indicate possible signals of the non-mesonic decay of strange multibaryon states with large widths, have been separately identified on the normalized Lambda N spectra.
16:50	**Experimental Evidence for the Two Nucleon Induced Non-Mesonic Weak Decay of p-shell Lambda Hypernuclei (00h15')** *Speaker: BUFALINO, Stefania* The importance of the two-nucleon induced non mesonic weak decay (TNNMWD) of Lambda hypernuclei was pointed out on theoretical arguments almost 20 years ago. Several theoretical calculations showed that the process could account for ~30% of the total decay rate. By taking advantage of the tracking capabilities of the FINUDA detector at DAFNE-LNF and of the data collected on all the p-shell hypernuclei, careful analysis on the measured proton spectra, with good energy resolution (~2% FWHM at 80 MeV) showed that the contribution of the TNNMWD to the one-proton induced decay rate (G2/Gp) is (0.43+-0.25), corresponding to a contribution of ~24% of the TNNMWD to the total non mesonic decay rate [1]. This result is in agreement with a recent determination by experiments at KEK[2]. We have continued the analysis considering the spectra of neutrons in coincidence with protons; this events were clearly identified and confirmed the expectations for the TNNMWD process. The analysis is in an advanced stage of progress, with the aim of confirming the previous result [1] with a reduced error. [1] The FINUDA Coll., M. Agnello at al., PLB 685 (2010) 247 [2] H. Bhang, at al., EPJ. A 33 (2007)
17:05	**Binding Energy of 7 _Lambda Li and Test of Charge Symmetry Breaking in the Lambda N Interaction (00h15')** *Speaker: HASHIMOTO, OSAMU* It is well known that the mass differences of the 4 _Lambda He and 4 _Lambda H T=1/2 hypernuclei both for the ground 0+ and excited 1+ states are not fully understood and is though the difference could be attributed to charge symmetry breaking (CSB) of the \Lambda N interaction. In addition of the T=1/2 iso-doublet of A=4 hypernuclear system, the T=1 iso-triplet of the A=7 hypernuclear system offers opportunity to test CSB. Although the binding energies of the light hypernuclei including the 7 _Lambda Li and the 7 _Lambda Be were measured by emulsion experiments, the binding energy of the the 7 _Lambda He is not reliably determined due to very poor emulsion data. The present experiment, JLab e01-011, was carried out at JLab Hall C as the 2nd generation precision hypernuclear spectroscopy by the (e,e'K+) reaction with a new high-resolution kaon spectrometer(HKS), and the excitation spectrum with the 7Li target was measured. The obtained binding energy of 7 _Lambda He together with those of the 7_Lambda Be ground state and the T=1 7_Lambda Li excited state was compared with the recent calculation by Hiyama. et. al.
17:20	**Two Lambda Hyperons in Double Hypernuclei (00h15')** *Speaker: NAKAZAWA, Kazuma* Double-Lambda(L) hypernuclei give us information about the L-L interaction which is valuable for obtaining a unified understanding of Baryon-Baryon interaction in SU(3)-flavor symmetry. Nuclear physics with double strangeness also guide us to multi-strangeness systems such as “strange matter”. However experimental data are very limited so far. Very recently, we have carried out detection of nearly one thousand events with Xi- hyperon capture at rest in nuclear emulsion. Among them, production and decay topology of double-L hypernucleus has been shown in 8 events. As for uniquely identified Nagara event (6He_LL), although it was published in PRL(2001), binding energy (BLL) and interaction energy (DBLL) of two Lambda hyperons should be revised due to the change of the mass of Xi-hyperon by 0.4 MeV in Particle Data (2008). Under the check of consistency of the DBLL with that of Nagara event, other three events, named Mikage, Demachiyanagi and Hida event, were found to be 6He_LL, 10Be_LL and (12Be_LL or 11Be_LL) as the most probable case, respectively. In our contribution, we will discuss the BLL and the DBLL using data of the above nuclei and two old events.

17:35 **Structures and Productions of Typical sd-Shell Hypernuclei in Shell-Model Calculations (00h15')**

Speaker: UMEYA, Atsushi

Detailed hypernuclear studies have been mainly focused on structures of p-shell systems. The (\pi+, K+) reaction experiments and the \gamma-ray measurements from p-shell hypernuclei provide us with remarkable possibility of high-precision spectroscopic studies on theoretical side. Recently, also the (e, e' K+) reaction experiments at JLab have been proved to be very fruitful in disclosing hypernuclear structure details within the energy resolution of few hundreds of keV. These aspects encourage us to perform theoretical study of sd-shell hypernuclear structures, because even the \Lambda single-particle energies and its interplay with nuclear core excitations are not well known in these medium-mass systems. In general, there should be more bound states of \Lambda in sd-shell hypernuclei so that we can expect novel aspect of hyperon coupling with nuclear rotational excitations. We anticipate innovated (K-, \pi-) reaction experiments to be done at J-PARC, as well as (e, e' K+) experiments at JLab. As a starting typical example, we calculate energy levels and production cross sections of hypernuclei with A=18--20 by using a multi-configuration shell model.

HS4 - Forest Sciences Centre 1001 (16:10-17:50)

time	title
16:10	**Plans for Hadronic Structure Studies at J-PARC (00h25')** *Speaker: KUMANO, S.* The J-PARC (Japan Proton Accelerator Research Complex)* is a multipurpose facility from material and life sciences with neutrons and muons to nuclear and particle physics with various secondary beams (pions, kaons, neutrinos, and so on) as well as primary-beam protons. It provides an intensity frontier with 30-50 GeV proton beam for hadron physics. Its projects cover a wide range of hadron physics from strongly interacting many-body systems with an extended hadronic degree of freedom, strangeness, to new forms of hadrons. At the first stage of the J-PARC operation, hadron topics are mainly on strangeness nuclear physics such as hypernuclei and kaonic nuclei. Then, the studies could be extended to exotic hadron searches, chiral dynamics in nuclear medium, structure functions, hard exclusive processes, and spin structure of the nucleon. I explain these hadron-physics projects. *http://j-parc.jp/index-e.html
16:35	**The Jefferson Lab 12 GeV Upgrade (00h25')** *Speaker: MCKEOWN, Robert* The JLab 12 GeV Upgrade project is presented. The maximum energy of the electron beam will be increased to 12 GeV, retaining the beam quality and practical limitations on the beam current. This enables a new program of a systematic search for hybrid mesons with exotic quantum numbers, predicted both by QCD phenomenology addressing the problem of confinement, and by lattice calculations. The increase in the kinematic coverage will also allow to extend the studies of the nucleon structure in exclusive, semi-exclusive and inclusive processes. The program includes an upgrade of the instrumentation in three existing halls and construction of a new hall.
17:00	**Hadronic Physics with Antiprotons at FAIR (00h25')** *Speaker: BETTONI, Diego* The physics program of the future FAIR facility covers a wide range of topics that address central issues of strong interactions and QCD. Some of the highlights of the scientific program are: - charmonium spectroscopy; - Open charm spectroscopy; - search for exotic hadrons (glueballs and hybrids) in the charmonium mass range; - study of in-medium modifications of meson masses, particularly in the heavy quark sector; - study of nucleon structure (wide-angle Compton scattering, electromagnetic form factors of the proton). In addition to that the possibility to polarize antiprotons in combination with an internal gas target will provide access to a wealth of single- and double-spin observables, opening up the possibility to perform new unique measurements, in particular: - the first measurement of the transversity distribution of the valence quarks in the proton; - the first measurement of the moduli and relative phase of the electromagnetic form factors of the proton in the timelike region. The antiproton beams of unprecedented intensity and quality in the energy range of 1 GeV to 15 GeV delivered by FAIR will be an excellent tool to address these fundamental questions.
17:25	**Opportunities for an Electron Ion Collider (00h25')** *Speaker: KINNEY, Edward* A new electron-ion collider is proposed to study the nature of gluonic fields, in the nucleon and in nuclei, with unprecedented precision. The broad experimental program that has been developed will require high luminosity, polarized electron and light ion beams, unpolarized heavy ion beams, and the large center-of-mass energies only possible at colliders. The primary measurements that motivate such a facility will be described in the context of their relation to fundamental questions about QCD-governed matter, both in normal and extreme conditions. In addition, a brief summary of the proposed realizations of the electron-ion collider, ELIC and eRHIC, will also be presented.

NA5 - Forest Sciences Centre 1221 (16:10-17:45)

time	title
16:10	**Probing Neutron Star Interiors via Crustal Cooling in Transient X-Ray Binaries (00h25')** *Speaker: BROWN, Edward* A profound reason to study neutron stars is that they provide a gateway to explore the behavior of matter under extreme density and pressure conditions. When residing in X-ray binaries, neutron stars accrete matter from a companion star. This process induces a series of non-equilibrium nuclear reactions that deposit heat deep in the neutron star crust. In transient X-ray binaries, the accretion switches off at some point, which allows the gained heat to be radiated as thermal emission from the neutron star surface. By studying this thermal relaxation, one can probe important stellar parameters, such as the thermal conductivity of the crust and the dominant cooling mechanism operating in the core, and investigate a variety of processes occurring in the extreme density and pressure environments in the neutron star interior. In this presentation I will discuss the recent observational progress this field.
16:35	**Pycnonuclear Burning of 12C in Accreting Neutron Stars (00h25')** *Speaker: GASQUES, Leandro* Pycnonuclear burning may occur in dense and cold cores of white dwarfs and in the crust of an accreting neutron star. In this regime, the reaction rate depends mainly on the density and is nearly independent of temperature. In such conditions, neighboring nuclei may penetrate the Coulomb barrier and fuse owing to zero-point motion vibrations in their lattice sites. Carbon ignition has been suggested as a trigger of superbursts in surface layers of accreting neutron stars. While in most of the scenarios pure carbon burning dominates the energy production, in the pycnonuclear regime the ignition conditions and associated nucleosynthesis may be affected by the presence of other elements. In general, pycnonuclear burning regimes may not be limited to carbon induced fusion reactions only, but may be driven by a broad range of fusion reactions between stable and neutron rich isotopes. A phenomenological formula for the reaction rate which covers different nuclear burning regimes in dense matter is presented. The rate is determined by Coulomb barrier penetration in dense environments and by the astrophysical S-factor at low energies.
17:00	**Gamow-Teller and First-Forbidden Transition Strengths in Astrophysical Processes (00h15')** *Speaker: SUZUKI, Toshio* Gamow-Teller (GT) and first-forbidden (FF) transitions in nuclei and their possible consequenses on astrophysical processes in stars are discussed. (1) GT transition strengths in fp-shell nuclei are studied by shell model calculations with the use of new shell model Hamiltonians, GXPF1. Neutrino-nucleus reaction cross sections are re-evaluated and compared with previous investigations. Proton emission cross sections on ^{56}Ni are pointed out to be enhanced and lead to the enhancement of the production yields of ^{55}Mn and ^{59}Co in population III stars. (2) Next, electron capture reactions on Ni and Fe isotopes in steller environments are studied. The capture rates are found to depend sensitively on the distributions of the GT strengths. (3) Finally, Beta decays of the N=126 isotones are studied by shell model calculations taking into account both the GT and FF transitions. The FF transitions are found to be important to reduce the half-lives by twice to several times of those by the GT contributions only. Possible implications of the short half-lives of the waiting point nuclei on the r-process nucleosynthesis are discussed for various astrophysical conditions.
17:15	**Neutron Star Crust in Strong Magnetic Fields (00h15')** *Speaker: BANDYOPADHYAY, Debades* We investigate the stability of nuclei in the inner crust of a neutron star in the presence of strong magnetic fields using the Thomas-Fermi model. In the inner crust nuclei are immersed in a nucleonic gas as well as a uniform background of electrons. Nuclei are also arranged in a lattice. The Wigner-Seitz approximation is adopted in this calculation. Each lattice volume is replaced by a spherical cell. We demonstrate the effects of Landau quantization of electrons on the structure and stability of nuclei in the inner crust. In strong magnetic fields, the electron number density is enhanced compared with the zero field case. Consequently the proton number density in the cell is affected through the charge neutrality. We obtain the nucleus corresponding to a baryon density minimizing the free energy of the cell. The cell size at every density point is appreciably reduced in the presence of strong magnetic fields compared with the corresponding zero field case. Further we find nuclei with smaller mass number in the presence of strong magnetic fields than those of the zero field. We discuss these results in connection with the transport properties of the crust in magnetars.

17:30 **Gamow-Teller Transitions for Neutron-Rich Nuclei in the Superburst by the Deformed QRPA(DQRPA) (00h15')**

Speaker: HA, Eunja

Most of the nuclei participating in the nucleosynthesis are deformed nuclei. Since the conventional approach to understanding the nuclear structure is based on the spherical symmetry, one needs to develop the formalism including the deformation explicitly. To describe deformed nuclei, we started from the deformed axially symmetric Woods-Saxon potential based on the Nillson basis, and performed deformed BCS and deformed QRPA. In this work, we used two different methods for residual interactions. One is a separable Gamow-Teller residual interaction. The other is a realistic two-body interaction taken by Brueckner G-matrix based on the Bonn potential. For the application, we calculated the Gamow-Teller (GT) transition for the deformed nuclei at the surface of the neutron star, where electron captures are important heat sources for the carbon flash. Since the heating is mainly by the odd-even mass staggering, we include explicitly neutron-proton pairing as well as nn and pp pairing correlations at the Deformed BCS stage.

NF5 - Life Sciences Centre 1510 (16:10-17:50)

time	title
16:35	**ALICE-PHOS Performance at the LHC First Collisions (00h15')** *Speaker: SUGITATE, Toru* The PHOton Spectrometer (PHOS) consisting of 17,920 PWO crystals coupled with APD is designed to measures electro-magnetic particles emitted in high-energy heavy-ion collisions as well as proton reactions in the ALICE experiment at CERN-LHC. PHOS covers the central rapidity of |eta|‹0.12 with an azimuth extent of 100º. Its fine segmented structure with a small Moliere radius of PWO allows us to identify neutral pions up to pT=80GeV/c by measuring two photons from its decay. First three modules out of five were installed in summer 2009 and kept in operation for cosmic-ray measurements until the LHC commissioning resumed. After observing beam-splash events, clear collision events of proton on proton were detected on November 23. Photon-like signals in PHOS were identified and an invariant mass spectrum shows a clear pi0 peak. For precise measurements, intensive energy calibration is underway utilizing MIP energy deposition in each PWO cell by cosmic-rays as well as charged hadrons from the collisions. The PHOS performance during the first LHC commissioning and progress on energy calibration will be reported as well as expected outputs based on the present LHC operation scenario.
16:50	**Construction and Beam Commissioning of Hadron Experimental Hall at J-PARC (00h15')** *Speaker: TAKAHASHI, Hitoshi* The new facility J-PARC has been constructed in Tokai, Japan. It aims at providing intense proton beams of 750 kW for next-generation particle and nuclear physics experiments. The Hadron Experimental Hall (HD-hall) is one of the two facilities at the J-PARC Main Ring and utilizes various secondary particles produced by the slowly extracted primary proton beam. We have constructed two charged secondary beam lines. The K1.8 beam line transports separated charged secondaries with the maximum momentum of 2 GeV/c. Secondary particles are purified by two electrostatic separators (ESSs). The K1.8BR beam line is branched from the K1.8 at the bending magnet downstream of the first ESS. The K1.8BR delivers separated charged beams with the momentum up to 1.1 GeV/c. On January 27, 2009, the first beam was successfully extracted to the HD-hall and transported to the beam dump. The first secondary beam extractions to the K1.8BR and K1.8 beam lines succeeded on February and October, 2009, respectively. Careful beam tunings of the beam lines are now in progress. In this paper, the summary of the construction of the beam lines and current status of the beam commissioning are presented.
17:05	**Commissioning of the J-PARC K1.8 Beam Line and the Beam Spectrometer (00h15')** *Speaker: TAKAHASHI, Tomonori* The J-PARC Hadron Facility have begun to provide secondary beams to the K1.8 beam line and the commissioning of the beam line has started from October 2009. This beam line has two stage electro-static separators (ESS) and two mass slits to purify the Kaon beams and the high resolution spectrometer system at the end. Although the primary proton beam power was very limited at this moment (a few percent of the designed value of J-PARC), we confirmed the validity of the double stage ESS scheme and measured the yield of Kaons above 10 k / spill. After the beam tuning, the K1.8 will be used for various experiments of strange nuclear systems, such as strangeness -1 and -2 hypernuclei and a penta-quark baryon. In this contribution, status of the K1.8 and the beam spectrometer system and its performance will be reported.
17:20	**The First Experiment at the J-PARC K1.8 Beam Line Using the SKS Spectrometer (00h15')** *Speaker: SHIROTORI, Kotaro* Following the completion of the J-PARC Hadron facility at February 2009, the hadronic beams have begun to be delivered to the experimental areas. The K1.8 beam line is the host of several hypernuclear and exotic hadron experiments. These include $\X$ hypernuclear spectroscopy, $\L$ hypernuclear $\g$-ray spectroscopy and a penta-quark baryon search, all of which require the Superconducting Kaon Spectrometer system (SKS) together with the K1.8 beam line spectrometer. For this reason, a successful operation of SKS is absolutely necessary and its performance directly affects the quality of the experiments. A series of in-beam data in order to evaluate the SKS performance has been taken successfully with all detectors being operational since October 2009. Especially the performance of the SKS was investigated using the p($\p^-$, K$^+$)S^- reaction with the 1.25-GeV/c pion beam. The measured resolution of S^- missing mass was 1.6 MeV/c^2(FWHM) corresponding to 3-MeV/c(FWHM) momentum resolution of SKS. During the commissioning runs, we found the performance of SKS up to our expectation and we have taken preliminary physics data.

17:35 **Beam Commissioning of K1.8BR Beamline at J-PARC Hadron Hall (00h15')**

Speaker: SUZUKI, Takatoshi

The K1.8BR, which had been originally designed as a low-energy Kaon beamline up to 1.1 GeV/c at J-PARC hadron hall, started its operation at Feb. 2009 with the first slow-extracted primary proton beam from 50 GeV proton synchrotron, and the beam commissioning for E15/E17/E31 is now underway. Following the first Kaon confirmation, we have executed about 150 hours of continuous operational machine time from Oct. 2009 to Feb. 2010, and made successful and rapid progress of the beam commissioning for kaon, especially at 0.75 GeV/c beam momentum adopted by E17 as the first experiment to be completed at the hadron hall. In the beam commissioning, we have constructed online PID triggers under unseparated condition, and proceeded to optimize the beamline to kaon by operating the electro-static separator, K1.8ES1. After the successful finding of the kaon setting, we have measured the yields of kaon and pbar, K/others ratio, and their dependences to production targets (Ni/Pt), slit conditions, and beam momentum, quantitatively. The central momentum and momentum distribution of the secondary beam was determined by TOF measurement of proton with a flight distance of 17m.

NR7 - Forest Sciences Centre 1005 (16:10-17:50)

time	title
16:10	**Symmetry Energy of the Nuclear Equation of State (00h25')** *Speaker: GRECO, Vincenzo* The Equation of State of nuclear matter (EoS) depends on the asymmetry in the neutron-proton content and it is studied in terms of the so called Symmetry Energy. The density behavior of the Symmetry Energy is still very controversial especially at high density despite its relevance in nuclear astrophysics, in particular for supernovae explosions and neutron star structure. On the basis of transport theory we investigate the dynamics of heavy ion collisions ranging from intermediate to relativistic energies. This allows to explore the proper baryon and isospin density space to extract information on the isospin-dependent part of the EoS. Results sensitive to the compression stage of the reaction are discussed for nucleon/cluster emissions, collective flows and meson production. The possibility to shed light on the controversial neutron/proton effective mass splitting in asymmetric matter is suggested. A large symmetry repulsion at high baryon density will also lead to an “earlier” deconfinement transition in neutron-rich matter. In particular the transition line is lowered to a phase space region accessible to the new planned heavy-ion facilities, e.g. the FAIR/NICA projects.
16:35	**Investigation of the Symmetry Energy from the Transverse Collective Flow of Intermediate Mass Fragments (00h15')** *Speaker: YENNELLO, Sherry* The transverse flow of intermediate mass fragments (IMFs) has been investigated for the 35 MeV/u 70Zn+70Zn, 64Zn+64Zn, and 64Ni+64Ni systems. A transition from the IMF transverse flow strongly depending on the mass of the system, in the most violent collisions, to a dependence on the charge of the system, for the peripheral reactions, is shown. This demonstrates the importance of both mass and charge dependent forces in the transverse flow. The antisymmetrized molecular dynamics model was used to investigate the sensitivity of the IMF transverse flow to the density dependence of the symmetry energy. The best agreement between the experiment and theory was achieved with a stiff density dependence of the symmetry energy.
16:50	**Dipolar Degree of Freedom and Dynamical Correlations in Isospin Equilibration Processes (00h15')** *Speaker: PAPA, Massimo* The asymptotic time derivative of the total dipole obtained by measuring charge and velocity of the clusters and protons produced in a heavy ions collision [1] is proposed as an useful observable to investigate on the Isospin equilibration phenomenon [2] in multi-fragmentation processes. The study has been developed to describe charge/mass equilibration processes involving the gas and the clusters "phases" of the total system formed during the early stage of a collision. General properties of this observable and the links with others isospin dependent phenomena [3] related to the main clusters are discussed.In particular, the 40Cl+28Si system at 40 MeV/nucleon is investigated by means of semiclassical microscopic many-body calculations based on the CoMD-II model. The study of the dynamical many-body correlations produced by the model also shows how the proposed observable is rather sensitive to different parameterizations of the isospin dependent interaction [4] . [1] M.Papa and G.Giuliani: arXiv:0910.292321 [nucl-th] (2009). [2] Bao-an Li, Phys. Rep. 464, (2008) 113-281. [3] M. Papa et al, Phys. Rev. C 72, (2005) 064608. [4] M. Papa et al, EPJA (2009) 117
17:05	**Effect of Isospin Dependent Cross-Section on the Transverse in Plane Flow at Intermediate Energy (00h15')** *Speaker: KUMAR, Suneel* The introduction of collective motion of particles in heavy ion collision is very important step towards the understanding the excited nuclear matter. This motion of particles can be studied by directed flow, elliptical flow and differential flow. The interesting phenomena of disappearance of directed flow at certain incident energy is observed, when one move from low incident energy (attaractive interactions) to higher enery(repulsive interactions). This incident energy is defined as balance energy. This found to sensitive towards equation of state and nucleon-nucleon cross-section. To pin down the effect of nn cross-section on balance energy we have simulated different reactions from 6C12+6C12 to 79Au197+79Au197, for which the experimental balance energy is available. The results are compared with the theoretical models BUU & QMD as well as with the experimental finding. The balance energy is found to be strongly dependent isospin dependent cross-section. It is concluded that the enhanced isospin dependent cross-section plays a significant role for the lighter system.

17:20	**Probing the Equation of State of Asymmetric Nuclear Matter with Isospin Diffusion and Stopping in Heavy-Ion Collisions (00h15')** *Speaker: VERDE, Giuseppe* Isospin effects in heavy-ion collisions probe the equation of state for asymmetric nuclear matter. Knowledge of the density dependence of the symmetry energy is important in nuclear physics and in astrophysics, due to its links to neutron skins of exotic nuclei and important properties of neutron stars. We will show results from the study of isospin asymmetric Sn+Sn collisions at E/A=35 MeV and 50 MeV, collected with the LASSA and the Chimera detectors at the NSCL of MSU and at the LNS of INFN, respectively. The diffusion of neutrons and protons between projectiles and targets with different N/Z-asymmetries is studied by means of imbalance ratios measurements. The obtained results and their comparison to transport model simulations provide constraints on the density dependence of the symmetry energy. The systematic study of these phenomena at different impact parameters also allows us to explore isospin transparency and stopping phenomena in more central collisions, with important implications about the attainment of chemical equilibrium in central collisions at 35 MeV/nucleon. Future perspectives to study the symmetry energy at both low and high densities will be also presented.
17:35	**Light Charged Fragments Analysis in the 36Ar+58Ni and 58Ni+58Ni Reactions (00h15')** *Speaker: GAUTHIER, Jérôme* The existence of a third emission source between the target and the projectile in heavy-ion reactions has been shown some years ago. Recent studies seem to show that this zone has a N/Z ratio higher than the N/Z of the whole system. These results suggest a neutron enrichment of the mid-rapidity. The two first campaigns of the INDRA detector provide a very high amount of well-identified and calibrated data. So, this allows us to make a good selection of the mid-rapidity for 36Ar+58Ni and 58Ni+58Ni reactions from 32 to 84 AMeV. Light particles and fragments (Z=1 to 4) investigation show an interesting behavior depending upon the emission source, the system and the beam energy. However, INDRA is designed to study the most central collisions. Our own detector, HERACLES, which will receive the ISAC-II beams, has been designed to study peripheral collisions. The capacity of ISAC-II to deliver exotic beams is another very useful feature allowing us to add the isospin variable to the experiment.

NS12 - Life Sciences Centre 3 (16:10-17:50)

time	title
16:10	**Recent Achievements in Chemical Studies of Heaviest Elements (00h25')** *Speaker: GAEGGELER, Heinz* The accessibility of nuclides in the so-called island of super heavy elements using fusion reactions between 48Ca projectiles and actinide targets (see e.g. Yu.Ts. Oganessian, this conference) paved the way for chemists to investigate properties at the cutting edge of Mendeleev's periodic table: due to relativistic effects a "collapse" of the basic principle of Mendeleev's periodic table is expected to occur. Many chemical studies of light transactinides, e.g. Rf, Db, Sg, Bh and Hs revealed, however, a rather expected behavior as members of their respective group. With recent chemical studies of Cn (Z=112) and Z = 114, both having closed (sub)shells (7s2 6d10 and 7s2 6d10 7p2, respectively), a new era started: chemical properties of 7p-elements are expected to be significantly influenced by a high spin-orbit splitting between the 7p1/2 and 7p3/2 sub-shells. The current status on chemical investigation performed with these two elements at FLNR in Dubna will be given. Such chemical investigations are currently also being performed at GSI Darmstadt using the TASCA separator. Moreover, theoretical predictions on chemical properties of these two elements will be briefly outlined.
16:35	**Lambda Hypernuclei Spectroscopy in the Wide Mass Range by the (e,e'K+) Reaction at JLab Hall-C (00h15')** *Speaker: NAKAMURA, Satoshi* In year 2009, we have successfully carried out the third generation Lambda hypernuclear spectroscopy (E05-115) by the (e,e'K+) reaction at Jefferson Lab Hall-C. By introducing a newly developed high-resolution electron spectrometer (HES) and the high resolution kaon spectrometer (HKS) which was already used in year 2005, we designed experiment to improve statistics, and signal-to-noise ratio simultaneously. We have taken data in wide mass range from A=7 (enriched Li7) to as large as A=52 (Cr52). The experimental techniques which worked fine in the second generation experiment (JLab E01-011), introduction of a new kaon spectrometer (HKS) and optimized electron spectrometer's configuration (tilt method), are adopted again in the third generation experiment. I will explain how we improved the experiment from the second generation experiment and will report the current status of analysis including preliminary results.
16:50	**Properties of Resonances in 12C Close to the Triple Alpha Threshold (00h15')** *Speaker: ALCORTA, Martin* The structure of 12C is a long standing problem in nuclear physics. Cluster correlations are known to strongly influence the lowest states which makes this nucleus a challenge to theory. Lower resonances decay into three alpha particles and until recently it was not possible to completely characterize these decays. A complete kinematics study of the 10B(3He,paaa) and 11B(3He,daaa) reactions has been performed to study the breakup of 12C resonances close to the triple-alpha threshold. The energy and widths of various resonances up to 15 MeV have been determined with greater accuracy and in some cases with discrepancies from literature values. The detection of the individual alpha particles allows us to extract partial alpha widths of the natural parity resonances. The ghost peak of the 8Be ground state was included in the extraction of the partial alpha widths and was found to have a significant effect on the partial alpha widths of states just above the triple-alpha threshold. In this contribution the properties of resonances in 12C will be presented and variations from literature values will be discussed. The partial alpha widths will be presented and compared to theory.
17:05	**Identification of 45 New Neutron-Rich Isotopes Produced by In-Flight Fission of 345 MeV/nucleon 238U at RIKEN RI Beam Factory (00h15')** *Speaker: KUBO, Toshiyuki* We have conducted a search for new isotopes using in-flight fission of a 345 MeV/nucleon 238U beam at the RI Beam Factory (RIBF) [1] at the RIKEN Nishina Center, aiming to expand the frontier of accessible neutron-rich exotic nuclei. Fission fragments were analyzed and identified by using the superconducting in-flight separator BigRIPS, [2,3] which has been designed as a two-stage separator with large acceptance so that excellent features of in-flight fission can be exploited. We observed 45 new neutron-rich isotopes over a wide range of atomic numbers ranging from ~25 to ~55. For Pd, we observed the new isotopes 127Pd and 128Pd, and reached the r-process waiting point at the N=82 neutron magic number. The present results demonstrate the great potential of the RIBF, which promises to vastly expand the accessible region of exotic nuclei, moving towards the drip-line as the primary beam intensity increases over time. [1] Y. Yano, Nucl. Instr. and Meth. B 261, 1009 (2007). [2] T. Kubo, Nucl. Instr. and Meth. B 204, 97 (2003). [3] Ohnishi et al., J. Phys. Soci. Japan, 77, 083201 (2008).

17:20	**Correlation Studies of the 6Be Low-Energy Spectrum (00h15')** *Speaker: CHUDOBA, Vratislav* Two-proton democratic ground state decay (or "true" 2p radioactivity) is a generic phenomenon beyond the proton dripline. The classes of decay are now under active investigation in several exotic nuclear systems. 6Be is the lightest nuclear system possesing this property and an evident benchmark case. Studies of this system should shed the light on the other 2p emitters as well. Experiment dedicated to the studies of the 6Be structure has been carried out on fragment separator ACCULINNA of the Flerov Laboratory of Nuclear Reactions (JINR, Dubna, Russia). 6Be states were populated in the charge-exchange reaction of 6Li beam on the cryogenic hydrogen target at beam energies of 25 and 35 MeV/A. The 6Be decay products were measured by two annular position sensitive telescopes consisting of silicon strip and CsI(Tl) detectors. The low-lying energy spectrum of 6Be was reconstructed by invariation mass method from tripple coincidence (alpha, p, p) events. Angular distributions of the p(6Li, 6Be)n reaction has been investigated. Complete three-body correlation for the decay of 6Be ground and first excited state has been analyzed.
17:35	**The Atomic Mass Evaluation - Present and Future (00h15')** *Speaker: WANG, MENG* The atomic-mass evaluation AME, created in 1950s by A.H. Wapstra and continued since 1980 with Georges Audi, has gained its reputation in the last six decades from their careful analysis and evaluation of data. The atomic mass tables, the main production of the AME, are widely used in fundamental researches like nuclear structure as well as in applications to astrophysics and nuclear energy. The latest published results of the AME appeared in 2003: Ame2003. After the publication of Ame2003, large amount of data emerged from the mass measurements by Penning traps and storage rings, as well as the nuclear decay and reaction energy measurements. A new project called "AME-future" is now running aiming at new tables to be published in 2013: Ame2013. The project involves collaborators from IMP-Lanzhou, CSNSM-Orsay, GSI-Darmstadt, ANL-Argonne and MPIK-Heidelberg. The present status of AME and the working structure will be presented. With the newly included data from several groups, the mass surface far from the stability valley seems to lie higher than was earlier believed. Impact on astrophysical calculations will be discussed.

NS6 - Life Sciences Centre 2 (16:10-17:50)

time	title
16:10	**New Results on Octupole Collectivity (00h25')** *Speaker: CARPENTER, Michael P.* Octupole correlations play an important role in determining the level structure of nuclei throughout the periodic chart. Microscopically, octupole correlations are the result of the long-range, octupole-octupole interaction between nucleons occupying pairs of orbitals which differ in both orbital and total angular momentum by 3 units. A review of some of the most recent findings on octupole correlations will be given. Emphasis will be placed on new results from the actinide region, where two distinct collective modes have long been identified: octupole vibration and octupole deformation. These new results include negative parity structures which appear to evolve from an octupole vibration into a static octupole deformed mode. In addition, newly observed rotational structures built on an excited 0+ state have been tentatively associated with a double-octupole phonon excitation. These newly observed properties can be successively described by calculations based on the concept of rotational-aligned octupole phonon condensation.
16:35	**Symmetry Restoration with the Lipkin Method (00h15')** *Speaker: TOIVANEN, Pekka* I have studied the restoration of translational and rotational symmetries with the Lipkin method. Several approximate methods to restore broken symmetries have been used in the past. A considerable advantage with the Lipkin method is that it allows the calculation of an approximate VAP-energy (Variation After Projection) without performing the actual symmetry projection. Because of this the calculations, while still maintaining a good precision, require a much smaller numerical effort than exact VAP, and it is therefore possible to apply the method to several broken symmetries simultaneously. According to Lipkin's idea, minimizing the energy of a symmetry-restored mean-field state can be replaced by minimizing a corrected energy of a symmetry-broken state with the Peierls-Yoccoz mass. The basic idea of the Lipkin method is to flatten the projected energy by subtracting from it the center-of-mass kinetic energy with the PY mass, which can be calculated from the energy and overlap kernels. The method was originally formulated for the case of translational symmetry and at the moment I am working on extending it to the treatment of rotational symmetry.
16:50	**Nuclear Structure of Neutron-Rich Nb and Mo Isotopes Studied by beta- and Isomeric Decay Spectroscopy at RIBF (00h15')** *Speaker: WATANABE, Hiroshi* Neutron-rich nuclei with A~110 have attracted considerable interest because prolate-oblate shape coexistence is expected to occur in this region. The shape transition in nuclei with Z>40 is ascribed to the presence of triaxiality. Probing level properties of neutron-rich Nb and Mo isotopes is of great importance to understand the onset of triaxial deformation. However, spectroscopic information on excited states in these nuclei is scarce so far because of the difficulty in access to such neutron-rich region. Neutron-rich Nb and Mo isotopes have been produced using in-flight fission of 238U beams at 345 AMeV, followed by separation and identification through the BigRIPS spectrometer. Identified particles were implanted into an active stopper being composed of nine double-sided silicon detectors stacked compactly, that also serves as a detector for beta rays which are associated with the preceding implantation based on geometrical information. gamma rays were detected by four Compton-suppressed Clover-type Ge detectors. New results obtained in the first decay spectroscopy experiment at RIBF will be presented, particularly focusing on level properties of neutron-rich Nb and Mo isotopes.
17:05	**Deformation in the Neutron Rich Region Around N=40 (00h15')** *Speaker: ZHU, Shaofei* Numerous studies have recently focused on understanding the structure of neutron-rich nuclei in the f-p shell between Ca and Ni. Of particular note is the observation of a N=32 subshell closure in 52Ca, 54Ti and 56Cr. Recent measurements have tracked the excitation energy of the first 2+ and 4+ states in the Fe and Cr isotopes up to N=40. In both isotopic chains, the excitation energies for these two states continue to decrease, suggesting the onset of collectivity with increasing neutron number. In fact, N=40 64Cr appears to be deformed in its ground state in contrast to its isotone 68Ni which has all the characteristics of a doubly-magic nucleus. We have performed studies to identify high spin states in neutron-rich Cr, Fe and Ni isotopes between N=32 and 40 with both fusion evaporation and deep inelastic reactions. A number of rotational bands, including some associated with superdeformation, have been found. They all involve as least one g9/2 neutron in their configuration. These findings will be reviewed, with particular emphasis on the insights they provide in understanding the role of deformation in the structural properties of the N=40 isotones at low spin.

17:20	**Reaction Dynamics and Nuclear Structure Studies via Deep Inelastic Collisions with Heavy-Ions: First Assignment of Spin and Parity in Neutron Rich Ca Nuclei (00h15')** *Speaker: LEONI, Silvia* The population and gamma decay of neutron rich nuclei around 48Ca was measured at LNL with the PRISMA-CLARA setup, using deep-inelastic collisions (DIC) on 64Ni, at an energy ~2.5 times above the Coulomb barrier. The reaction properties of the most relevant products will be presented, focusing on total cross sections and angular distributions energy integrated and associated to the population of specific excited states. The analysis provides information on basic physical quantities, such as nuclear potentials, spectroscopic factors, and pair transfer. Gamma spectroscopy studies based, for the first time. on angular distributions and polarization measurements will also be shown, allowing a firm spin and parity assignment for a number of excited states of one and two nucleons transfer channels. Special emphasis will be given to the search for candidates for particle-vibration coupling in 49Ca, for which lifetimes measurements are also performed. Both reaction and gamma spectroscopy studies therefore demonstrate the relevance of DIC with heavy ions for the investigation of neutron rich systems.
17:35	**Collectivity of Exotic Heavy Fe Isotopes (00h15')** *Speaker: IWASAKI, Hironori* The properties of exotic neutron rich nuclei between the proton shell closures Z=20 and Z=28 are of particular interest for the understanding of shell structure at the large neutron excess. Effects related to the energy gap between the neutron fp and 1g9/2 shells lead to a strong variation of collectivity for nuclei around N=40. Whereas 68Ni was found to have doubly magic properties, this was not observed in neighbouring nuclei. Recent shell model calculations for the neutron rich Fe isotopes clearly revealed the difficulty to describe nuclei in this mass region and resulted in large deviations of the predicted collectivity depending on the used valence space. However, no experimental data on transition strengths existed for the very exotic nuclei 64,66Fe. Here we present newest model independent results on absolute transition strengths of the lowest excited states in 62,64,66Fe measured using the Recoil Distance Doppler-Shift method. The experiments were performed at NSCL with the Cologne-NSCL plunger device using Coulomb excitation in inverse kinematics at energies of 80 MeV/u. Our results yield higher collectivity for 64,66Fe than expected and allow tests of new calculations.

Friday 09 July 2010

Standard Model Tests and Fundamental Symmetries Plenary Session - Chan Centre (08:30-10:30)

time	title
08:30	**Precision Electroweak Tests of the Standard Model (00h30')** *Speaker: MARCIANO, William* Three precison tests of the Standard Model are briefly described. Included are 1) CKM Unitarity, 2) W mass vs the Weak Mixing Angle and 3) The muon anomalous magnetic moment. Sensitivities for probing "New Physics" and anticipated future experimental improvements are discussed.
09:00	**Particle Electric Dipole Moments (00h30')** *Speaker: FIERLINGER, Peter* Since the 1950's people search for permanent electric dipole moments (EDM) of fundamental systems. A non-zero EDM would be an unambiguous manifestation of parity (P) and time reversal symmetry (T) violation. Assuming conservation of CPT, T violation in a fundamental system also means CP violation. Although the Standard Model of particle physics (SM) includes measured CP violation, it cannot account for the observed baryon-asymmetry in the Universe by many orders of magnitude. EDMs are considered promising candidate systems to find new CP violation, as this turns out to be a natural consequence of many theories beyond the SM. The experimental limit for the EDM of the neutron, d_n < 2.9E-26 e.cm, is still large compared to the SM predicition, d_n ~ 1E-32 e.cm. While this prediction is far beyond achievable sensitivities, already the current limits rule out many theories beyond the SM. Theories for TeV scale physics, like Supersymmetry, require EDMs within reach of the oncoming generation of experiments. The current status in the field, new ideas and selected searches for the EDM of the neutron and other systems will be discussed in this talk.
09:30	**Precision Tests of Discrete Symmetries with Radioactive Isotopes (00h30')** *Speaker: JUNGMANN, klaus* Discrete symmetries offer unique possibilities to test standard particle theory and have a robust discovery potential to find new physics beyond it. In particular, new precision experiments are coming up which exploit trapped radioactive ions and atoms to measure precisely parity (P) violation in atoms, to find time reversal (T) violation in searches for permanent electric dipole moments as well as for testing CPT/ Lorentz invariance in other than electromagnetic interactions. Heavy, e.g. Ra isotopes, offer for most of these experiments relatively large observable effects due to high enhancement factors.
10:00	**Indirect Searches for Physics Beyond the Standard Model with Electron and Muon Beams (00h30')** *Speaker: KUMAR, Krishna* In order to comprehensively search for physics above the electroweak scale, it is important to continue to push the precision and accuracy of electroweak measurements at lower energy scales and to search for rare and forbidden processes with increased sensitivity. In this talk, we review the status of such experiments, with emphasis on those that use intermediate energy electron and muon beams. We discuss future experiments, in various stages of planning, focusing on those that are sensitive to the high energy dynamics that could lead to potential LHC discoveries as well as those that have sensitivity beyond the reach of the LHC.

Coffee Break - Chan Centre (10:30-11:00)

Neutrinos and Nuclei Plenary Session - Chan Centre (11:00-13:15)

time	title
11:00	**Solar Neutrino Experiments: Recent Results and Future Prospects (00h30')** *Speaker: CHEN, Mark* Recent results from SNO and Borexino have explored a lower energy portion of the 8B solar neutrino spectrum and find the data points lower than the prediction from "standard" MSW oscillations with LMA region mixing parameters. Is there new physics here? Recent determinations of solar chemical abundances seem to conflict with solar model calculations of helioseismology observables. Both of these questions can be probed with the upcoming SNO+ experiment that aims at: a) precise measurements of the survival probability of pep solar neutrinos that could reveal sub-dominant oscillation effects, and b) measuring the flux of CNO solar neutrinos that is directly related to solar core metallicity.
11:30	**Status of Double Beta Decay Experiments (00h30')** *Speaker: SUZUKI, Yoichiro* Neutrino-less Double Beta Decay is the only practical experiment to explore the Majorana nature of neutrinos. In recent years the success of the neutrino oscillation experiments has brought new insight into neutrino massses and mixings, which has made us ppossible to obtain a practctical prediction for the effrective neutrino mass of double beta decay. We now have a clear experimental target sensitivity to look for double beta decay. In this presentation, we will summarize the status of the double beta decay experiments and present prospects in future.
12:00	**Dark Matter Searches and Highlights (00h30')** *Speaker: SUMNER, Timothy* A review will be given of the current status of direct dark matter searches around the world with emphasis on the more recent advances and highlights. Comments on the prospects for the mid-term and long-term future will be offered.
12:30	**Neutrino Mass and Oscillations (00h30')** *Speaker: SCHOLBERG, Kate* I will review the status of neutrino mass and oscillation experiments, and discuss prospects for the future.
13:00	**Student and Young Scholar Awards (00h15')** *Speaker: DILLING, Jens*