Physics, FZ Jülich — [2]High Energy Physics Department, PNPI — [3]Institut für Kernphysik, Universität zu Köln — [4]III. Physikalisches Institut A, RWTH Aachen

Within the framework of an ISTC project the fusion reactions of double-polarized deuterium ($\vec{d}+\vec{d}\rightarrow{}^3H+p$, $\vec{d}+\vec{d}\rightarrow{}^3He+n$) will be analysed in order to study the influence of the vector and tensor polarization of the initial projectiles on the total cross sections. These results allow a conclusion on the change of the branching ration between the two fusion channels and, therefore, the neutron reduction for a future generation of fusion reactor. The measurements request the knowledge of the polarization of the deuteron beam and of the (gas)target. With an unpolarized target, the beam polarization can be determined by measuring the angular distributions of the outgoing particles ($^3He, p$ and ^3H) with use of the known analysing powers. Vice versa, additional data for the analysing powers can be obtained with a beam of known polarization, measured with a Lamb-shift polarimeter. The setup of the charged ejectile polarimeters is described.

HK 18.4 Di 14:45 HG V

Stark winkelsensitive Neutroneninterferometrie und Anwendungen in Neutronen- und Gravitationsphysik — •Josef Springer[1], Michael Zawisky[1], Hartmut Lemmel[1] und Martin Suda[1,2] — [1]Atominstitut, TU Wien, Wien, Österreich — [2]Austrian Institute of Technology, Wien, Österreich

Mithilfe eines neuen neutronen-interferometrischen Experimentes kann eine sehr hohe Winkelsensitivität - bis zu 0.000001 Bogensekunden - erreicht werden. Dabei wird der Phasenschub eines Neutronenstrahls, der nahe einer Braggbedingung durch einen Perfektkristall transmittiert wird, gemessen. Dieser Phasenschub ermöglicht zudem neue Perspektiven in der Messung der Elektron-Neutronstreulänge sowie einem Test nicht-Newtonschen Gravitationsverhaltens bei kleinen Abständen. Bei letzterem ist vor allem die potentielle Sensitivität bei Abständen im Submikrometerbereich interessant.

Für diese Experimente wurde das bislang größte Perfektkristall-Neutroneninterferometer hergestellt und der Phasenschub durch kohärente Strahlablenkung rund um eine Braggbedingung gemessen. Gute Übereinstimmung mit numerischen Rechnungen wurde dabei gefunden.

HK 18.5 Di 15:00 HG V

Spectrum of particles with short-ranged interactions in a harmonic potential — •Simon Tölle, Hans-Werner Hammer, and Bernard Metsch — Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn

The possibility to control short-ranged interactions of cold gases in optical traps by Feshbach-resonances makes these systems ideal candidates to study universal scale properties and Efimov physics. For A particles with equal mass m the energy spectrum in a trap, idealised by an harmonic potential, in the zero-range limit in leading order is determined by the Hamiltonian

$$H=\sum_{i=1}^{A}\left(\frac{|\vec{p}_i|^2}{2m}+\frac{1}{2}m\omega^2|x_i|^2\right)+\sum_{i<j}^{A}V_{ij}+\sum_{i<j<k}^{A}W_{ijk}\,,$$

where ω is the trapping frequency and V_{ij} and W_{ijk} are 2- and 3-particle contact interactions. In Jacobi-coordinates the centre-of-mass motion is separated. The Hamiltonian is regularised by restricting the coupled oscillator basis with a cutoff N. For a given N the corresponding Hamilton matrix is diagonalised numerically. The effective coupling constants are renormalised by the requirement that for each N the ground state energies of the 2- and 3-body sector match the exact results. The excitation spectrum can in general be extrapolated reliably for $N\rightarrow\infty$. Appropriate symmetries for identical bosons and fermions can be considered. Results for 2-, 3- and 4-particle systems will presented. First applications to physical systems like ^{6}Li will be discussed.

HK 18.6 Di 15:15 HG V

Untersuchung von Oktupolanregung in der Präparationspenningfalle von ISOLTRAP — •Marco Rosenbusch für die ISOLTRAP-Kollaboration — Universität Greifswald

In vielen Bereichen der Physik werden Penningfallen zum Speichern und Präparieren von Ionen genutzt. Für die Kernmassenspektroskopie bei ISOLTRAP [1] ist das massenselektive Kühlen von Ionen mit hohem Auflösungsvermögen ($R=\frac{m}{\delta m}=10^5$) eine wirksame Technik, um Ionen von isobaren Kontaminationen zu separieren. Dazu wird in einer puffergasgefüllten Präparationspenningfalle eine azimutale Quadrupolanregung auf der Zyklotronfrequenz $\nu_c=q/m\cdot B$ der zu zentrierenden Ionen eingestrahlt, um die Magnetronbewegung der Ionen in die schnellere Zyklotronbewegung umzuwandeln und diese im Puffergas zu kühlen [2]. In diesem Beitrag werden Untersuchungen zur Oktupolanregung als alternative Anregungsform vorgestellt, mit dem Ziel der Erhöhung des Auflösungsvermögens.

[1] M. Mukherjee *et al.*, Eur. Phys. J. A 35, 1-29(2008)
[2] G. Savard *et al.*, Phys. Lett. A 158, 247-252(1991)

HK 19: Nukleare Astrophysik I

Zeit: Dienstag 14:00–16:00 Raum: HG VI

Gruppenbericht HK 19.1 Di 14:00 HG VI

Exploiting the superior resolution of the Munich Q3D spectrograph for nuclear astrophysics — •Anuj Parikh[1], Thomas Faestermann[1], Ralf Hertenberger[2], Reiner Krücken[1], Hans Wirth[2], Thomas Behrens[1], Vinzenz Bildstein[1], Shawn Bishop[1], Alan Chen[3,4], Jason Clark[5], Catherine Deibel[5,6], Katrin Eppinger[1], Clemens Herlitzius[1], Christoph Hinke[1], Olga Lepyoshkina[1], Peter Maierbeck[1], Georg Rugel[1], Dominik Seiler[1], Kiana Setoodehnia[4], Kathrin Wimmer[1], and Chris Wrede[7] — [1]Physik Department E12, TU-München — [2]Fakultät für Physik, LMU-München — [3]Excellence Cluster Universe, TU-München — [4]Department of Physics and Astronomy, McMaster Univ. — [5]Physics Division, Argonne — [6]JINA, Michigan State Univ. — [7]CENPA, Univ. Washington

Classical novae are unique in nuclear astrophysics because most of the involved reaction rates are constrained by experiments. This allows one to judge which measurements are still necessary to improve the nuclear physics input to models. In this context, the ^{30}P(p,γ)^{31}S reaction rate needs to be better determined over nova temperatures. Direct measurements of this reaction are not possible yet, and so indirect techniques must be used. There has been significant recent activity on this issue, but difficulties have been encountered in nuclear spectroscopy studies (e.g., ^{31}P(^{3}He,t)^{31}S) due to experimental energy resolution. For this and other reactions, we discuss recent measurements using the superior resolution of the Munich Q3D spectrograph (ΔE/E$\approx$2 x 10^{-4}) that can improve determinations of thermonuclear rates.

Gruppenbericht HK 19.2 Di 14:30 HG VI

The high density QCD phase transition in compact stars — •Giuseppe Pagliara[1], Matthias Hempel[1], Irina Sagert[2], and Jurgen Schaffner-Bielich[1] — [1]Institut für Theoretische Physik, Ruprecht-Karls-Universität, Philosophenweg 16, D-69120, Heidelberg, Germany — [2]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Max von Laue–Str. 1, D-60438 Frankfurt, Germany

The study of the QCD phase diagram at high density is still in its infancy. A promising source of experimental informations comes from the physics of neutron stars, the core of which might reach densities up to ten times nuclear matter density. We review the different possible signals from neutrons stars which bring informations about the equation of state of strongly interacting matter from their birth, in a Supernova explosion [1], to the deleptonization era [2] and the early or late cooling, to eventually their final instants of life within the merger process in binary systems [3]. A special emphasis will be put on the modeling of the equation of state of matter from sub-saturation densities up to the large densities at which the chiral phase transition is believed to occur.

[1]Phys.Rev.Lett.102:081101,2009
[2]Phys.Rev.Lett.103:171102,2009
[3]Phys.Rev.Lett.103:011101,2009

HK 19.3 Di 15:00 HG VI

^{96}Ru(p,γ)^{97}Rh measurement at the GSI storage ring — •Rene Reifarth for the E062-Collaboration — GSI Helmholtzzentrum für

Schwerionenforschung GmbH, Darmstadt, 64291, Germany — J.W. Goethe Universität, Frankfurt a.M, 60438, Germany

The nucleosynthesis of elements beyond iron is dominated by neutron captures in the s and r processes. However, 32 so-called p-nuclei are thought to be produced in the p process, where proton-rich nuclei are made by sequences of photodisintegrations and (p,γ) reactions and following β^+ decays on existing r- and s-seed nuclei.

Cross section measurements on (p,γ) and (α,γ) reactions in the astrophysically interesting energy range are already very challenging on stable nuclei. Only a minute part of the nuclei involved in p-process networks, however, is stable. The most promising approach to determine the desired reaction rates is to produce the isotopes in Radioactive Ion Beam facilities and to investigate the reactions in inverse kinematics.

A pioneering experiment was recently performed at the Experimental Storage Ring (ESR) at GSI. Fully stripped ions of ^{96}Ru were injected into the storage ring and slowed down to a few MeV/nucleon. The reaction products were detected with different particle detectors.

This project is supported by the HGF Young Investigators Project VH-NG-327.

HK 19.4 Di 15:15 HG VI

Updated ^{14}N(p,γ)^{15}O data from LUNA — •Michele Marta[1], Daniel Bemmerer[1], Claus Rolfs[2], Frank Strieder[2], and Hanns-Peter Trautvetter[2] for the LUNA-Collaboration — [1]Forschungszentrum Dresden-Rossendorf, Dresden, Germany — [2]Institut für Experimentalphysik III, Ruhr-Universität Bochum, Bochum, Germany

The ^{14}N(p,γ)^{15}O reaction controls the rate of the hydrogen burning CNO cycle. By detecting solar CNO neutrinos (e.g. in Borexino, SNO+) one can in principle measure directly the carbon and nitrogen abundance at the center of the Sun. However this requires more precise nuclear data. Updated experimental results on capture to various excited states (as well as to the ground state) in ^{15}O are shown, together with improved branching ratios obtained for the $E_{\rm p} = 278$ keV resonance.

HK 19.5 Di 15:30 HG VI

Experiment zur ^{14}N(p,γ)^{15}O–Reaktion bei 0.6-2.0 MeV — •Daniel Bemmerer[1], Roland Beyer[1], Carlo Broggini[2], Antonio Caciolli[2], Martin Erhard[1,2], Zsolt Fülöp[3], Eckart Grosse[1], György Gyürky[3], Roland Hannaske[1], Arnd Rudolf Junghans[1], Michele Marta[1], Roberto Menegazzo[2], Chithra Nair[1], Ronald Schwengner[1], Tamas Szücs[1,3], Erik Trompler[1], Andreas Wagner[1] und Dmitry Yakorev[1] — [1]Forschungszentrum Dresden-Rossendorf (FZD), Dresden — [2]INFN Sezione di Padova, Padova, Italien — [3]ATOMKI, Debrecen, Ungarn

Die Rate des Bethe-Weizsäcker-Zyklus des Wasserstoffbrennens wird von der langsamsten Reaktion, ^{14}N(p,γ)^{15}O, bestimmt. Diese Reaktion ist kürzlich u.a. bei LUNA im Energiebereich unterhalb 0.5 MeV neu untersucht worden. Allerdings spielen auch höherenergetische Daten eine Rolle bei der Extrapolation des Wirkungsquerschnitts zu extrem niedrigen, unmessbaren Energien. Die Reaktion wurde jetzt am FZD-Tandetron im Energiebereich von 0.6-2.0 MeV neu untersucht. — Unterstützt von der Herbert-Quandt-Stiftung (Stipendium für T.S.) und der Europäischen Union (FP6 AIM RITA 025646).

HK 19.6 Di 15:45 HG VI

Measurement of the ^{15}O$(2p,\gamma)^{17}$Ne cross section by Coulomb Dissociation of ^{17}Ne — •Justyna Marganiec[1], Thomas Aumann[2], Michael Heil[2], Ralf Plag[2], and Felix Wamers[2] for the R3B-Collaboration — [1]ExtreMe Matter Institute EMMI, GSI Darmstadt, Darmstadt, Germany — [2]Kernreaktionen und Nuklear Astrophysik, GSI Darmstadt, Darmstadt, Germany

For the production of proton-rich nuclei during the *rp* process two-proton capture plays an important role. This process can bridge long-lived waiting points which otherwise hamper the mass flow between CNO material and the FeNi mass region. One of these waiting points is ^{15}O. The three-body radiative capture can proceed sequentially or directly from the three-body continuum. The rate of the ^{15}O$(2p,\gamma)^{17}$Ne reaction obtained using the two-successive-proton-capture model has been discussed in J. Görres *et al.* (*Phys. Rev. C* 51, 392, 1995). The role of continuum states (^{15}O+2p) for the rate calculation has been demonstrated in L.V Grigorenko, M.V. Zhukov (*Phys. Rev. C* 72, 015803, 2005). It has been suggested that the reaction rate can be enhanced by a few orders of magnitude by taking into account the three-body continuum. In order to verify these calculations, we have deduced the ^{15}O$(2p,\gamma)^{17}$Ne cross section by studying the time-reversed process, the Coulomb dissociation of ^{17}Ne, at the LAND/R^{3}B setup at GSI, using a ^{17}Ne secondary beam from the fragment separator FRS.

This project is supported by BMBF, EU (EURONS), and EMMI.

HK 20: Struktur und Dynamik von Kernen IV

Zeit: Dienstag 14:00–16:00 Raum: HG VII

Gruppenbericht HK 20.1 Di 14:00 HG VII

Density-dependent effective nucleon-nucleon interaction from chiral three-nucleon forces — •Jeremy Holt, Norbert Kaiser, and Wolfram Weise — Technische Universität München, Garching, Germany

We derive density-dependent corrections to the in-medium nucleon-nucleon interaction from the leading-order chiral three-nucleon force arising at next-to-next to leading order (N^{2}LO) in the chiral expansion. We consider first a medium of isospin symmetric nuclear matter with density ρ and subsequently generalize to a medium with a small isospin asymmetry. At leading order there are six distinct one-loop diagrams contributing to the in-medium nucleon-nucleon interaction, which we combine with the low-momentum potential $V_{\rm low-k}$ to obtain an effective density-dependent interaction. We suggest that these results should be useful for nuclear structure calculations of medium- and heavy-mass nuclei, where a direct implementation of the three-nucleon force is computationally prohibitive. We apply these results also to a study of the Fermi liquid parameters of symmetric nuclear matter that characterize the interaction of quasi-particles on the Fermi surface. Work supported in part by BMBF, GSI and by the DFG cluster of excellence: Origin and Structure of the Universe.

HK 20.2 Di 14:30 HG VII

Coulomb effects in pionless effective field theory — •Sebastian König[1,2] and Hans-Werner Hammer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn — [2]Bethe Center for Theoretical Physics, Universität Bonn

At very low energies, nuclear interactions can be considered purely short-ranged and even pion exchanges can be integrated out. The resulting pionless effective field theory has been successfully applied to the low-energy neutron-deuteron system. Moreover, it has been shown that Coulomb effects can be included to describe proton-deuteron scattering in the quartet channel using the same methods. We show how to improve the numerical convergence in the p-d system at very low-momenta. Furthermore, we present the extension to the doublet channel, where the Triton and He-3 bound states show up.

HK 20.3 Di 14:45 HG VII

Three-body bound states in finite volume with EFT — •Simon Kreuzer[1,2] and Hans-Werner Hammer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn — [2]Bethe Center for Theoretical Physics, Universität Bonn

Three particles with large scattering length display a universal spectrum of three-body bound states called "Efimov trimers". We calculate the modification of the Efimov trimers of three identical bosons in a finite cubic box and compute the dependence of their energies on the box size using effective field theory. The renormalization of the effective field theory in the finite volume is explicitly verified. We investigate the effects of partial wave mixing and study the behavior of shallow trimers near the dimer energy. Finally, we will present first results for the triton in a finite volume.

HK 20.4 Di 15:00 HG VII

Nuclear electromagnetic currents from chiral EFT — •Stefan Kölling[1,2], Evgeny Epelbaum[1,2], Hermann Krebs[2], and Ulf-G. Meissner[1,2] — [1]Forschungszentrum Jülich, Institut für Kernphysik (IKP-3) und Jülich Center for Hadron Physics, Jülich, Deutschland — [2]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie) und