HK 16: Structure and Dynamics of Nuclei 3

Time: Monday 17:00–19:00 Location: T/HS2

HK 16.1 Mon 17:00 T/HS2

The nuclear structure input to astrophysics — •Nadia Tsoneva[1,2] and Horst Lenske[1] — [1]Institut für Theoretische Physik, Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gieβen, Germany — [2]Institute for Nuclear Research and Nuclear Energy, 1784 Sofia, Bulgaria

The impact of low-energy multipole excitations and pygmy resonances on radiative neutron and proton capture reactions cross sections in nuclei close to the β-stability line is investigated. For this purpose, a microscopic theoretical approach based on self-consistent density functional theory and QRPA formalism supplemented by multi-phonon degrees of freedom, is implemented in a statistical reaction model. The advantage of the method is the fully microscopic nuclear structure input which incorporates low-energy multiphonon excitations, pygmy resonances and core polarization effects related to giant resonances in a unified way. Of particular interest are the pygmy resonances which are found important for the description of nuclear reaction rates of the nucleosynthesis. Calculations of the cross sections of the reactions ^{85}Kr(n,γ)^{86}Kr, ^{87}Sr(n,γ)^{88}Sr and ^{89}Y(p,γ)^{90}Zr are discussed in comparison with the experiment. For the cross sections of the reactions ^{89}Zr(n,γ)^{90}Zr and ^{91}Mo(n,γ)^{92}Mo theoretical predictions are made.The work is supported by BMBF grant 05P12RGFTE.

HK 16.2 Mon 17:15 T/HS2

Cross section measurements of the elastic electron - deuteron scattering at MAMI — •Yvonne Kohl for the A1-Collaboration — Universität Mainz, Institut für Kernphysik

The electromagnetic form factors of light nuclei provide a sensitive test of our understanding of nuclei. Because the deuteron has spin one, three form factors are needed to fully describe the electromagnetic structure of the deuteron. Especially the deuteron charge radius is a favourite observable to compare experiment and calculation. Recently, an extensive measurement campaign has been performed at MAMI (Mainzer Microtron) to determine the deuteron charge radius using elastic electron scattering - with the aim to halve the error compared to previous such experiments. The experiment took place at the 3-spectrometer facility of the A1-collaboration. Cross section measurements of the elastic electron-deuteron scattering have been performed for 180 different kinematic settings in the low momentum transfer region. From these, the charge form factor can precisely be determined. Fitting the form factor with an appropiate fit function, the radius can then be determined from the slope at zero momentum transfer. The determined radius could then be used as a counterweight to the value obtained from the advanced atomic Lamb shift measurements, thus providing additional insight to the proton radius puzzle.

HK 16.3 Mon 17:30 T/HS2

Yields of hypernuclear fragments in experiments at MAMI — •Florian Schulz, Patrick Achenbach, Konstantin Bob, Anselm Esser, and Josef Pochodzalla — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz

Hypernuclear decay-pion experiments have been performed at the Mainz Microtron MAMI, aimed at the precise measurement of the ground state binding energy of Λ-hypernuclei produced in fragmentation reactions.

Predictions of the yields of hypernuclear isotopes in this experiments are based on model calculations. Starting with a highly excited state of a Λ-hypernucleus, formed in the electro-production process, the fragmentation is evaluated within a statistical decay model. The excitation energies contributing to the formation of hyperfragments are in the range of 10-50 MeV. The different fragmentation yields and ratios were determined for light target nuclei up to carbon.

By comparing this predictions with the experimentally observed yield ratios, it will be possible to extract information on the initial nucleus and its excitation energy. This can grant a deeper understanding of the whole production process within the model framework.

HK 16.4 Mon 17:45 T/HS2

Antihyperon-Hyperon production in antiproton-proton annihilations with PANDA at FAIR — •Michael Papenbrock for the PANDA-Collaboration — Department of Nuclear Physics and Astronomy, Uppsala University, Uppsala, Sweden

The production of antihyperon-hyperon pairs in antiproton-proton annihilations involves the annihilation of at least one light (u, d) quark-antiquark pair and the creation of a heavier (s, c, b) pair. Production of strange hyperons occur in an energy region in which QCD is difficult to predict. By studying hyperon production we learn about the strong interaction in this energy region, i.e. the confinement domain. It is an open question what the relevant degrees of freedom are: quarks and gluons, or hadrons. Spin observables is an excellent tool in order to better understand the physical processes. These are accessible via the weak, parity violating decay of the hyperon which results in an angular asymmetry of the decay products. The future PANDA experiment at FAIR is going to be ideally suited to study spin physics on hyperons with both high precision and high statistics.

Since hyperons decay weakly and thus have long life-times, their decay vertices are displaced with respect to the production point. This sets high demands on precise track reconstruction. A pattern recognition algorithm is currently under development, with the ability to reconstruct tracks originating in displaced vertices.

Simulation studies done by the Uppsala group as well as the status of the development will be presented and discussed.

HK 16.5 Mon 18:00 T/HS2

Polarization correlations from electron-impact excitation of multipolarity L=3-5 in 208Pb and 89Y nuclei — •Doris Jakubassa-Amundsen — Mathematics Institute, LMU Munich, Germany

The DWBA formalism is used to calculate differential excitation cross sections and to predict spin asymmetries for the scattering of spin-polarized electrons from heavy nuclei. Polarization correlations between the incoming and the scattered electron are a sensitive tool to study the various nuclear models inherent in the transition densities. By selecting the lowest 3- and 5- states of 208Pb it is found that the spin asymmetries for elastic and inelastic electron scattering are comparably large as long as the contribution from the current-current interaction is negligible. The investigation of the 89Y nucleus with its large magnetic transition densities shows, however, a strong quenching of the transverse polarization correlations at backward scattering angles.

HK 16.6 Mon 18:15 T/HS2

Thermodynamics of the symmetry energy and the equation of state of isospin-asymmetric nuclear matter — •Corbinian Wellenhofer[1], Jeremy W. Holt[2], Norbert Kaiser[1], and Wolfram Weise[1,3] — [1]Physik Department, Technische Universität München — [2]Department of Physics, University of Washington, Seattle — [3]ECT*, Villa Tambosi, Trento

Knowledge of the thermodynamic properties of the nuclear symmetry energy is essential for the study of heavy-ion collisions and a multitude of astrophysical phenomena. In this work, we investigate the density and temperature dependence of the symmetry energy using many-body perturbation theory with microscopic chiral nuclear forces. The calculational methods and nuclear force models are benchmarked against empirical constraints for isospin-symmetric nuclear matter and the virial expansion of low-density neutron matter. It is found that whereas the symmetry free energy and entropy both increase uniformly with temperature, the symmetry energy exhibits almost universal behavior.

Moreover, we show results for the equation of state of isospin-asymmetric nuclear matter, obtained from the parabolic approximation. The different thermodynamic instabilities at subsaturation densities are examined, and we construct the equation of state corresponding to an equilibrium liquid-gas phase transition by means of the generalized Maxwell construction for two-component fluids.

This work is supported in part by DFG and NSFC (CRC 110).

HK 16.7 Mon 18:30 T/HS2

High resolution electron scattering on ^{96}Zr — •Christoph Kremer, Sergej Bassauer, Andreas Krugmann, Anna Maria Krumbholz, Norbert Pietralla, Maxim Singer und Peter von Neumann-Cosel — Institut für Kernphysik TU Darmstadt

The low-energy structure of the nucleus ^{96}Zr is interesting for numerous reasons - especially the strong octupole correlation leading to an excitation of the prominent 3_1^- state with the largest known ground-state transition strength ($B(E3, 3_1^+ \to 0_1^+) = 57(4) W.u.$) of all nuclei. Even though this nucleus is a good testing ground for nuclear structure theories [1] some low-energy observables are known with insufficient precision. Especially the transitions strenghts of low-lying 2^+ states, which are important for the identification of mixed-symmetry states, have large uncertainties. Electron scattering at low impulse transfer has been shown to be capable of obtaining these $B(E2)$ values with high precision [2]. A ^{96}Zr(e,e') experiment has recently been performed at the superconducting electron linear accelerator S-DALINAC at Darmstadt using the high-resolution LINTOTT spectrometer. The experiment and preliminary results will be presented.

[1] K. Sieja *et al.*, Phys. Rev. C **79**, 064310 (2009)
[2] A. Scheikh Obeid *et al.*, Phys. Rev. C **87**, 014337 (2013), Phys. Rev. C **89**, 037301 (2014)

This work is supported by the DFG under contract SFB 634.

HK 16.8 Mon 18:45 T/HS2

Identifizierung des Proton-Paarungsvibrationszustands in 208Pb — •Andreas Heusler — Gustav-Kirchhoff-Str. 7/1, 69120 Heidelberg

Der Proton-Paarungsvibrationszustands in ^{208}Pb wird bei $E_x = 5667$ keV identifiziert.

Die Kriterien zur Identifzierung beruhen auf Daten aus den Reaktionen ^{208}Pb(p,p') und ^{208}Pb(d,d'), die mit dem Q3D Magnetspektrografen am MLL in Garching gewonnen [1] wurden sowie der Feststellung, dass nur Zustände mit natürlicher Parität bei ^{208}Pb(α, α') angeregt werden.

Nach Rechnungen von Blomqvist el al. [2, 3] ergibt sich aus der Anregungsenergie des 0^+ Zustands bei $E_x = 5667$ keV die Mischungsmatrix der drei ersten angeregten 0^+ Zustände in ^{208}Pb. Der Proton-Paarungsvibrationszustand is demnach zu 90% rein, während der Neutron-Paarungsvibrationszustand und der Doppeloktupol-Vibrationszustand im Verhältnis 1:2 gemischt sind.

[1] A. Heusler, T. Faestermann, R. Hertenberger, H.-F. Wirth, P. von Brentano Phys. Rev. C 89:024322 (2014) [2] J. Blomqvist. Phys. Lett. B33:541 (1970) [3] P. Curutchet, J. Blomqvist, R.J. Liotta, G.G. Dussel, C. Pomar, S.L. Reich Phys. Lett. B208:331 (1988)