HK 17: Structure and Dynamics of Nuclei III

Time: Tuesday 17:00–19:00 Location: J-HS E

Group Report HK 17.1 Tue 17:00 J-HS E

Studying the nuclear electric-dipole response in multi-messenger experiments: A holistic view on ^{120,124}Sn — •Michael Weinert[1], Michelle Färber[1], Miriam Müscher[1], Deniz Savran[2], Philipp Scholz[1], Julius Wilhelmy[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]GSI, Darmstadt

Over the past decade, great effort has been put into experiments studying the low-energy electric-dipole response (LEDR) of atomic nuclei. The work horse experiments with bremsstrahlung-photon beams have been complemented by measurements using hadronic probes, following a multi-messenger approach.

For the isotopes ^{120,124}Sn, the most complete set of experiments has been performed, investigating the LEDR via real and virtual photon scattering as well as with hadronic probes, such as transfer reactions and proton and α-particle scattering at different incident energies. From earlier results, it is known that the comparison of the nuclear response to these different probes can shed vital light on the underlying nuclear structure [1-3]. This contribution will give an overview on the data sets available today. It will investigate similarities and differences between the measurements and try to anticipate systematic behavior along the tin isotopic chain.

Supported by DFG (ZI 510/7-1).

[1] J. Endres *et al.*, Phys. Rev. Lett. **105** (2010) 212503
[2] L. Pellegri *et al.*, Phys. Lett. B **738** (2014) 519
[3] D. Savran *et al.*, Phys. Lett. B **786** (2018) 16

HK 17.2 Tue 17:30 J-HS E

Measurement of the total Neutron-Removal Cross Section of ^{120} Sn at R^{3}B to determine Constraints on the Equation of State — •Ashton Falduto[1,2], Andrea Horvat[1,2], Dominic Rossi[1], Thomas Aumann[1,2], Carlos A. Bertulani[3,1], and Stefan Typel[1,2] for the R3B-Collaboration — [1]TU Darmstadt — [2]GSI Helmholzzentrum — [3]Texas A&M University- Commerce

The knowledge of the equation of state (EOS) for neutron-rich matter is fundamental for understanding properties of, e.g., neutron stars, core-collapse supernova, and neutron-rich nuclei. Deriving experimental constraints for the EOS is thus of utmost importance. The parameter for the slope of the symmetry energy at saturation (L), in the EOS for asymmetric nuclear matter has not yet been constrained well experimentally so far. If determined accurately, the neutron-skin thickness and the ground-state dipole polarizabilty can potentially provide much better constraints on L. It has been shown that through an accurate measurement of the total neutron-removal cross section, the value of L can be constrained.The R^{3}B setup has been upgraded to now include the neutron detector NeuLAND and the GLAD dipole magnet alongside our tracking setup, which will allow us to take measurements with high momentum resolution and large acceptance. This will allow us to get the accuracy required for constraining L. A first measurement for ^{120}Sn has already been completed using the FAIR phase 0 R^{3}B setup at GSI.

This project was supported by the BMBF project No. 05P15RDFN1 and the GSI-TU Darmstadt cooperation.

HK 17.3 Tue 17:45 J-HS E

Precise determination of the (γ,xn) cross sections for Sn isotopes — •Dmytro Symochko[1], Patrick van Beek[1], Takashi Arizumi[2], Thomas Aumann[1], Martin Baumann[1], Sergey Belyshev[3], Frank Leonel Bello Garrote[4], Tomas K. Eriksen[4], Vetle W. Ingeberg[4], Ioana Gheorghe[5], Philipp Kuchenbrod[1], Yiu-Wing Lui[6], Shuji Miyamoto[7], Wanja Paulsen[4], Line G. Pedersen[4], Fardous Reaz[4], Heiko Scheit[1], and Hiroaki Utsunomiya[2] — [1]Technische Universität Darmstadt, Germany — [2]Department of Physics, Konan University, Japan — [3]Lomonosov Moscow State University, Skobeltsyn Institute of Nuclear Physics — [4]Department of Physics, University of Oslo, Norway — [5]NP, "Horia Hulubei" National Institute for Physics and Nuclear Engineering (IFIN HH), Romania — [6]Cyclotron Institute, Texas A&M University — [7]Laboratory of Advanced Science and Technology for Industry, University of Hyogo

We performed measurements of the partial photoneutron cross-sections for ^{112,116,120,124}Sn isotopes in the energy range up to 4-neutron thresholds. The experiment utilized a quasi-monochromatic gamma-ray beam produced in the laser Compton back-scattering at the New-Subaru synchrotron radiation facility. A novel flat-efficiency neutron detector based on ^{3}He counters was used to detect the emitted neutrons and allowed the analysis with direct multiplicity sorting.

Details of the experiment and some preliminary results will be presented.

Supported by HMWK (LOEWE centre "Nuclear Photonics") and DFG (SFB1245).

HK 17.4 Tue 18:00 J-HS E

Study of the magnetic dipole respone of ^{58}Ni — •Isabelle Brandherm[1], Johann Isaak[1], Peter von Neumann-Cosel[1], Maximilian Spall[1], Jonny Birkhan[1], Sergej Bassauer[1], Maxim Singer[1], Antonio d'Alessio[1], Hiroaki Matsubara[2], and Atshushi Tamii[2] — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]RCNP, Osaka, Japan

A high resolution inelastic proton scattering experiment on ^{58}Ni at extreme forward angles, was performed at RCNP. This method has been proven to be an excellent tool to study the dipole response of nuclei. Measurements performed at afew hundred MeV incident energy and at 0° are particulary suited for the excitation of the isovector spin-flip M1 (IVSM1) resonance. The properties of the IVSM1 are e. g. used in the description of neutral-current neutrino interactions in supernovae. Another interesting phenomena is the so called quenching, which describes a systematically overestimation of the experimentally obtained magnetic dipole strength by microscopic model predictions. In this work first result towards an extraction of the magnetic dipole strength with a multipole decomposition analysis will be shown.

Supported by SFB 1245

HK 17.5 Tue 18:15 J-HS E

Low-energy dipole response of the halo nuclei ^{6,8}He — •Christopher Lehr[1] and Thomas Aumann[1,2] for the NeuLAND-SAMURAI-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

The heaviest bound helium isotopes ^{6}He and ^{8}He are 2- and 4-neutron halo nuclei with a clear alpha plus 2n and 4n structure.

The multi-neutron decay of ^{6}He and ^{8}He after heavy-ion induced electromagnetic excitation reactions has been measured kinematically complete to study the dipole response of these nuclei. The combination of the neutron detectors NEBULA and NeuLAND at the SAMURAI setup and the high beam intensities available at the RIKEN Nishina Center in Japan made this measurement possible for the first time. The experimental method is based on the measurement of the differential cross section via the invariant-mass method, which allows to extract the dipole strength distribution dB(E1)/dE and the photo-absorption cross section.

The analysis of the data is nearly finished and the neutron reconstruction and cross talk analysis for the challenging 4-neutron channel, in which good statistics could still be achieved, has been performed. During the talk preliminary results focusing on the ^{6}He and ^{8}He excitation energy spectra and the dipole strength distributions will be presented and discussed.

This work is supported by the DFG through grant no. SFB 1245, the GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

HK 17.6 Tue 18:30 J-HS E

Structure of ^{6}He in Halo EFT — •Matthias Göbel[1], Daniel R. Phillips[2], and Hans-Werner Hammer[1,3] — [1]IKP, TU Darmstadt — [2]Department of Physics and Astronomy, Ohio University — [3]EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Borromean two-neutron halo ^{6}He with its scale separations is well suited to a treatment in Halo EFT with the neutrons (n) and the α core as degrees of freedom. The s-wave nn interaction and the $^2P_{3/2}$ αn interaction as well as a three-body force are employed in our leading order analysis.

We study the structure of ^{6}He by calculating the momentum-space probability density by using Faddeev amplitudes. Based on the probability density we compute the nn relative energy distribution observed in α knockout reactions. We discuss the sensitivity to the nn scattering length and compare to model calculations.

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HK 17.7 Tue 18:45 J-HS E

Investigation of inelastic proton scattering at 0° for ^{16}O — •Maximilian Spall[1], Isabelle Brandherm[1], Antonio D'Alessio[1], Maxim Singer[1], Sergej Bassauer[1], Jonny Birkhan[1], Johann Isaak[1], Peter von Neumann-Cosel[1], Hitoshi Matsubara[2], and Atsushi Tamii[2] — [1]TU Darmstadt — [2]RCNP, Osaka University

In order to obtain a better understanding of the nuclear structure of ^{16}O, a high energy resolution measurement under extreme forward angles, including 0°, was performed at the Research Center for Nuclear Physics (RCNP) using a 295 MeV proton beam. Angular distributions for seperated excited states and a multipole decomposition of the cross sections are extracted. First results of the deduced monopole and dipole strength distributions will be presented.

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