HK 48: Struktur und Dynamik von Kernen

Zeit: Donnerstag 16:30–19:00 Raum: HZ 4

Gruppenbericht HK 48.1 Do 16:30 HZ 4

Hochauflösende Elektronenstreuung am S-DALINAC und Experimente zu Monopolmatrixelementen und gemischtsymmetrischen Zuständen * — •Andreas Krugmann, Simela Aslanidou, Sergej Bassauer, Jonny Birkhan, Michaela Hilcker, Alexander Hufnagel, Florian Hug, Frederic Kornas, Christoph Kremer, Peter von Neumann-Cosel, Norbert Pietralla und Gerhart Steinhilber — Institut für Kernphysik, TU Darmstadt

Im Herbst 2013 wurden hochauflösende Elektronenstreuexperimente am 169° Spektrometer des supraleitenden Elektronenlinearbeschleunigers S-DALINAC durchgeführt. Durch die erstmalige Nutzung von nichtisochroner Rezirkulierung des e^--Strahls und einer Dispersionsanpassung zwischen Strahl und Spektrometer, sowie der erfolgreichen Inbetriebnahme einer digitalen HF-Regelung konnten extrem stabile Strahlbedingungen für Hochenergieelektronenstreuexperimente geschaffen und Energieauflösungen von bis zu 22 keV (FWHM) bei 75 MeV erreicht werden. In diesem Gruppenvortrag werden sowohl die Modernisierungen des Detektorsystems erläutert als auch auf die vorläufigen Ergebnisse zur Bestimmung von Monopolmatrixelementen in den Kernen ^{150}Nd und ^{196}Pt eingegangen, die einen empfindlichen Test einer möglichen Realisierung der X(5) und O(6) Symmetrien des Modells wechselwirkender Bosonen in realen Kernen erlauben. Des weiteren werden experimentelle Formfaktoren zu symmetrischen und gemischtsymmetrischen 2^+ Zuständen in den Kernen ^{94}Zr und ^{96}Zr diskutiert.

* Gefördert von der DFG durch den SFB 634.

Gruppenbericht HK 48.2 Do 17:00 HZ 4

Measurements of (p,2p) and (p,pn) quasi-free knockout reactions in inverse kinematics — •Alina Movsesyan[1,2] and Valerii Panin[1,2] for the R3B-Collaboration — [1]IKP, TU Darmstadt, Deutschland — [2]GSI, Darmstadt, Deutschland

We will present results from benchmark experiments dedicated to investigations of nuclear structure with proton-induced quasi-free scattering (QFS) reactions in inverse kinematics at relativistic energies. Kinematically complete measurements were undertaken, making use of the ALADIN/LAND-R^{3}B setup at GSI Darmstadt, which allow for analysis of (p,2p) and (p,pn) reactions. Similar technique with an upgraded setup will be used for the future R^{3}B program at FAIR/GSI, for studies of the single-particle (SP) structure and the role of N-N correlations in very exotic nuclei. One-neutron and one-proton quasi-free knockout reactions on ^{12}C will be presented, followed by heavier, unstable ^{57}Ni nucleus. The QFS signature has been observed by angular correlations of the knocked out nucleon and recoiled target proton. Cross sections for knocking out a proton/neutron from corresponding SP states have been measured. In combination with a reaction theory, they provide information on the reduction of spectroscopic strength for these states. The deduced spectroscopic/reduction factors and the branching between proton knockout from p- and deeper lying s-shells from ^{12}C will be compared to results of (e,e'p), (p,2p) and (d,^{3}He) reactions. The results of ^{57}Ni will be compared to previous findings from knockout reactions on Be target. The work is supported by BMBF, GSI TU Darmstadt Cooperation Contract, HIC for FAIR and NAVI.

HK 48.3 Do 17:30 HZ 4

The Two-Proton Halo Nucleus ^{17}Ne Studied in High-Energy Nuclear Breakup Reactions — •Felix Wamers[1,2,3,4], Justyna Marganiec[3,1,4], Thomas Aumann[3,4], Carlos Bertulani[5], Leonid Chulkov[4,6], Michael Heil[4], Ralf Plag[4,7], Deniz Savran[1,2], and Haik Simon[4] for the R3B-Collaboration — [1]EMMI, GSI, Darmstadt, Germany — [2]FIAS, Frankfurt, Germany — [3]IKP, TU Darmstadt, Darmstadt, Germany — [4]GSI, Darmstadt, Germany — [5]Texas A&M University-Commerce, Commerce, USA — [6]NRC Kurchatov Institute, Moscow, Russian Federation — [7]Goethe Universität, Frankfurt, Germany

We report on exclusive measurements of nuclear breakup reactions of highly-energetic (500 MeV) unstable ^{17}Ne beams impinging on light targets in an experiment at the R^{3}B-LAND complete-kinematics reaction setup at GSI. Focusing on the properties of beam-like ^{15}O-p (= ^{16}F) systems produced in one-proton-removal reactions, we are presenting a comprehensive analysis of the s-/d-wave configuration mixing of the ^{17}Ne valence-proton pair that is used to quantify its halo-nature. The results include the ^{15}O-p relative-energy spectrum, ^{16}F momentum distributions, and their corresponding momentum profile.

This work was supported by the Alliance Program of the Helmholtz Association (HA216/EMMI), by NAVI, by the German Federal Ministry for Education and Research (BMBF) (project 05P12RDFN8), by HIC for FAIR, by Eurons (European Commission contract no. 506065), and by the GSI-TU Darmstadt cooperation.

HK 48.4 Do 17:45 HZ 4

Status of the MLLTRAP system [*] — •Christine Weber, Robert Meissner, Peter Müller, and Peter Thirolf — Fakultät für Physik, LMU - München, 85748 Garching

The MLLTRAP Penning trap system serves as a development environment, both for mass spectrometry as well as for decay spectroscopy experiments [1] at Europe's upcoming facilities for low-energy experiments with exotic isotopes. High-precision mass spectrometry in a Penning trap is carried out via a determination of a stored ion's cyclotron frequency. These experiments are planned at the future DESIR facility of SPIRAL2 in France [2].

A novel detector-trap system is presently being built for the realization of direct in-situ decay spectroscopy experiments of stored ions at MATS [3] at FAIR. This setup combines the high-resolution purification capabilities of a Penning trap with a customized detector-trap. It serves for the ion storage as well as for the detection of the emitted decay products. In this way, novel types of nuclear decay spectroscopy experiments are becoming feasible, which are free from any background or scattering effects from a source material. This contribution gives an outline on the future perspectives of MLLTRAP and the present status of the development work.

[1] C.Weber et al., Int. J. of Mass Spectrometry 349-350, 270 (2013).
[2] B. Blank et al., Int. J. of Mass Spectrometry 349-350, 264 (2013).
[3] D. Rodriguez et al., Eur. Phys. J. Special Topics 183, 1 (2010).
[*] Supported by BMBF (06ML9148, 05P12WMFNE), DFG (HA 1101/14-1), and MLL.

HK 48.5 Do 18:00 HZ 4

Ab Initio Nuclear Structure and Reactions with Chiral Three-Body Forces — •Joachim Langhammer[1], Petr Navratil[2], Robert Roth[1], and Angelo Calci[1] — [1]Institut für Kernphysik - Theoriezentrum, TU Darmstadt — [2]TRIUMF, Vancouver, Canada

One major ambition of ab initio nuclear theory is the description of nuclear-structure and reaction observables on equal footing. This is accomplished by combining the no-core shell model (NCSM) with the resonating-group method (RGM) to a unified ab initio approach to bound and continuum states, which is developed further to the no-core shell model with continuum (NCSMC). We present the formal developments to include three-nucleon interactions in both the NCSM/RGM and NCSMC formalism. This provides the possibility to assess the predictive power of chiral two- and three-nucleon forces in the variety of scattering observables. We study three-nucleon force effects on phase-shifts, cross sections and analyzing powers in first ab-initio studies of nucleon-^{4}He scattering with chiral two- and three-nucleon forces. Finally, we focus on heavier target nuclei using the NCSMC, e.g., in neutron-^{8}Be scattering and study the impact of the continuum on the spectrum of ^{9}Be.

Supported by DFG (SFB 634), HIC for FAIR, and BMBF(06DA9040I).

HK 48.6 Do 18:15 HZ 4

Perturbation Theory for Ab Initio Nuclear Structure? — •Alexander Tichai, Joachim Langhammer, and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt

Many-body perturbation theory provides a standard tool for the calculation of energies and observables. It turns out that convergence properties of perturbation series are very sensitive to the partitioning of the Hamiltonian in use. We choose Hartree-Fock (HF) basis functions as a starting point for a perturbative expansion. A recursive treatment enables us to investigate energy corrections up to order 30 for light nuclei. Furthermore we present third-order energy corrections to the correlation energy for closed-shell nuclei over the whole mass range up to ^{208}Pb. The HF basis leads to a perturbation series with better convergence properties compared to Harmonic Oscillator (HO) basis sets

and obviates the use of resummation techniques.

We use a two- and three-body interaction constructed from chiral effective field theory transformed through similarity renormalization group techniques (SRG). We show consistency of our results to coupled-cluster calculations and give an outline of degenerate Hartree-Fock perturbation theory for open-shell nuclei and excited states.

∗ Supported by DFG (SFB 634), HIC for FAIR and BMBF (06DA7047I)

HK 48.7 Do 18:30 HZ 4

Proton-induced knockout reactions with netron-rich Oxygen Isotopes at R^3B — •Leyla Atar for the R3B-Collaboration — IKP, TU Darmstadt — GSI

Proton-induced knockout reactions are one of the main goal of the experimental program at the future R^3B (Reactions with Relativistic Radioactive Bemas) Experiment at FAIR. It allows us to obtain spectroscopic information about valence and deeply bound single-nucleon states and to study their evolution over a large variation in isospin. Recent studies have shown that the occupancies of loosely bound valence nucleons in neutron- or proton-rich nuclei have a spectroscopic factor close to unity, whereas single-particle strength for deeply bound nucleons is suppressed in isospin asymmetric systems compared to the predictions of the many-body shell model. Further experimental and theoretical studies are needed for a qualitative and quantitative understanding. For this aim a series of measurements have been performed on the complete oxygen isotopic chain using the existing experimental setup LAND/R^3B at GSI. We will present the main scientific goals, the concepts of the experiment and the preliminary results.
This work is supported by BMBF project 06 DA 7047 I.

HK 48.8 Do 18:45 HZ 4

Search for beta-delayed protons from ^{11}Be — •Oliver Forstner for the IS541-Collaboration — VERA Laboratory, University of Vienna, Austria — Stefan-Meyer-Institut, Austrian Academy of Sciences, Vienna, Austria — CERN, Geneva, Switzerland

The one-neutron halo nucleus ^{11}Be can emit a proton in a beta decay of the halo neutron. However, due to the Q-value of this decay channel (280.7±0.3 keV) the expected branching ratio will be very low – most estimates are a few times 10^{-8} – and the detection of the outgoing proton with a kinetic energy of a few hundred keV is challenging. Therefore our attempt was to detect the remaining nucleus ^{10}Be with the help of accelerator mass spectrometry (AMS). AMS is a highly sensitive tool to detect radioisotopes at the ultra-trace level. A beam of ^{11}Be ions was produced at the ISOLDE facility at CERN and implanted in a collection sample. The sample was transferred to the VERA AMS facility at the University of Vienna where the ^{10}Be content was determined. In my talk I will present details of the experiment and results of the successful detection of this rare decay channel.