HK 59: Nuclear Structure and Dynamics II

Time: Wednesday 16:30–19:00 Location: H-ZO 50

Group Report HK 59.1 We 16:30 H-ZO 50

Studies of Light Unbound Nuclear Systems — •Yuliya Aksyutina for the LAND-s245-Collaboration — Gesellschaft für Schwerionenforschung(GSI), D-64291 Darmstadt

The results on an experiment at the SIS-FRS facility (GSI, Darmstadt, Germany) with relativistic beams of ^{8}He, ^{11}Li and ^{14}Be impinging on a liquid hydrogen target will be discussed. The experimental setup, consisting of the neutron detector LAND, the dipole spectrometer ALADIN and different types of tracking detectors, allows for a reconstruction of the momentum vectors of all reaction products in coincidence. Neutron(proton) knockout reactions lead to formation of unbound systems. Their properties are investigated by reconstructing the invariant-mass spectra as well as by studying the angular correlations between the reaction products. The observed systems are ^{7}He, ^{9}He, ^{10}He, ^{10}Li, ^{12}Li, ^{13}Li and ^{13}Be. The talk is devoted to a discussion of the obtained results for these unbound isotopes and the physics interpretation of the data.

HK 59.2 We 17:00 H-ZO 50

The Investigation of the Coulomb Breakup Effect on the 6-He Elastic Scattering — •Yasemin Kucuk[1], Ismail Boztosun[1], and Nicholas Keeley[2] — [1]Erciyes University, Department of Physics, Kayseri, Turkey — [2]The Andrzej Soltan Institute, Department of Nuclear Reactions, Poland

The elastic scattering of the halo nuclei from the heavier target exhibits a different behavior from the standart Fresnel-type diffraction at energies near the Coulomb barrier. In this paper, we have performed the CDCC calculations for 6-He elastic scattering from the different targets to investigate the effect of the Coulomb breakup coupling and we have observed that the deviation from the standard diffraction behavior due to strong breakup coupling starts at around ZT= 60.

HK 59.3 We 17:15 H-ZO 50

Microscopic cluster model of ^{5}H and ^{5}He ($T = 3/2$) — •Pierre Descouvemont and Abderrahim Adahchour — Physique Nucléaire Théorique, Université Libre de Bruxelles (ULB), B1050 Brussels, Belgium

We use the Generator Coordinate Method to investigate the ^{5}H and ^{5}He systems in the hyperspherical formalism. The microscopic wave functions are described by a ^{3}H+n+n cluster structure for ^{5}H, and by a mixing of ^{3}H+p+n and ^{3}He+n+n configurations for ^{5}He. The resonance properties are analyzed with the Analytic coupling in the Continuum Constant (ACCC) method. For ^{5}H, we find results consistent with the literature, but the ground-state width is lower than in previous works. The calculation suggests $J = 1/2^{+}$ and $J = 3/2^{+}$ states in ^{5}He which correspond to the isobaric analog states of low-lying levels in ^{5}H. A $J = 1/2^{+}; T = 3/2$ state is found near $E_x = 21.3$ MeV in ^{5}He, with a width of $\Gamma \approx 1$ MeV.

HK 59.4 We 17:30 H-ZO 50

The optical potential for the subbarrier elastic scattering of light weakly-bound deuteron-like nuclei — •Lesya Borowska[1,2], Kostyantyn Terenetsky[2], Volodymyr Verbitsky[2], and Stephan Fritzsche[3,4] — [1]Universität Bonn, Auf dem Hügel 20, D-53121 Bonn, Germany — [2]Institute for Nuclear Research, National Academy of Sciences of Ukraine, Nauky Prospekt 47, 03680 Kyiv, Ukraine — [3]Gesellschaft für Schwerionenforschung (GSI), Planckstrasse 1, D-64291 Darmstadt, Germany — [4]Frankfurt Institute for Advanced Studies, D-60438 Frankfurt am Main, Germany

The elastic scattering of light weakly-bound deuteron-like nuclei in the field of heavy targets has been studied for collision energies below and near the Coulomb barrier. Based on the assumption that the deuteron-like nucleus follows the projectile adiabatically along its classical trajectory [1], an analytical expression for the optical potential is derived which describes both, the (electrical) polarization as well as the breakup of the projectile in the field of the target. Detailed computations with this optical potential have been carried out for the elastic scattering of ^{6}He + ^{208}Pb at energies 14 MeV and 16 MeV near to the Coulomb barrier. It is demonstrated that the polarization of the weakly-bound deuteron-like nucleus leads to a clear decrease of the (elastic) scattering cross section in excellent agreement with a recent measurement by Sanchez-Benitez *et al.* [Nucl. Phys. A **803**, 30 (2008)]

[1] L. Borowska, K. Terenetsky, V. Verbitsky, S. Fritzsche, Phys. Rev. C **76**, 034606 (2007)

HK 59.5 We 17:45 H-ZO 50

Breakup correlations and continuum spectroscopy of two-neutron halo nuclei — Jan S. Vaagen[1], •Sergey N. Ershov[2], and Boris V. Danilin[3] — [1]Department of Physics and Technology, University of Bergen, — [2]Joint Institute for Nuclear Research, 141980 Dubna, Russia — [3]Russian Research Center "The Kurchatov Institute", 123182 Moscow, Russia

Continuum spectroscopy implies a consistent analysis of a variety of exclusive and inclusive cross sections accessible in kinematically complete experiments. Theoretical analysis of experimental data on different energy correlations of the three fragments from breakup of ^{6}He on lead and carbon targets at collision energy 30 MeV/nucleon, obtained at GANIL, is presented. The applied theory is based on a microscopic four-body distorted wave approach to breakup reactions and uses the three-body model for the nuclear structure of the two-neutron Borromean halo projectile nucleus ^{6}He. The method of hyperspherical harmonics was used for consistent calculations of the ground state wave function and low-lying three-body continuum states including monopole, dipole and quadrupole excitations. Theoretical calculations reproduce quite well the low-lying excitation spectrum and fragment momentum correlations near breakup threshold. Dipole excitation dominates in the spectrum from fragmentation on the lead target, while for fragmentation on carbon excitation of the known 2^{+} three-body resonance is also important. The theory has previously been successfully tested on 240 MeV/nucleon energy data from GSI. The theory is also applicable to other Borromean nuclei: $11^{L}i$, etc.

HK 59.6 We 18:00 H-ZO 50

Shape coexistence in the neutron-rich isotope ^{13}B with $N = 8$ studied by lifetime measurements of the excited states — •Hironori Iwasaki[1], Alfred Dewald[1], Christoph Fransen[1], Adrian Gelberg[1], Matthias Hackstein[1], Jan Jolie[1], Pavel Petkov[1,2], Thomas Pissulla[1], Wolfram Rother[1], and Karl-oskar Zell[1] — [1]IKP, Köln, Germany — [2]INRNE, Sofia, Bulgaria

The lifetime measurement for the excited states in the neutron-rich nucleus ^{13}B has been performed, at the FN tandem facility in the University of Cologne, by the Doppler-shift attenuation method with the ^{7}Li(^{7}Li,p)^{13}B reaction. Anomalously hindered strength was found for the transition between the second excited states at 3.53 MeV and the ground state. A comparison with the modern shell model calculations suggests the spin and parity (J^{π}) of $3/2^{-}$ for the 3.53-MeV state with the hindered transition strengths to the ground state with J^{π}=$3/2^{-}$, providing a consistent picture for the shape coexistence in the neutron-rich isotope ^{13}B with $N = 8$. Experimental results will be presented and discussed in terms of the shell evolution in the light neutron-rich nuclei around $N = 8$.

HK 59.7 We 18:15 H-ZO 50

Bestimmung der Kernladungsradien von ^{7,10}Be und dem Neutronen-Halokern ^{11}Be — •Dirk Tiedemann[2], Zoran Andjlkovic[1], Klaus Blaum[3], Marc Bissell[4], Radu Cazan[2], Christopher Geppert[1,5], Magdalena Kowalska[6], Jörg Krämer[2], Andreas Krieger[2], Rainer Neugart[2], Rodolfo Sanchez[1], Ferdinand Schmidt-Kaler[7], Monika Zakova[2], Deyan Yordanov[3], Claus Zimmermann[5] und Wilfried Nörtershäuser[1,2] — [1]GSI, Darmstadt — [2]Universität, Mainz — [3]MPI-Kernphysik, Heidelberg — [4]Universität Leuven, Belgien — [5]Universität Tübingen — [6]CERN, Genf, Schweiz — [7]Universität Ulm

Die Bestimmung der Kernladungsradien von neutronenreichen kurzlebigen Isotopen der leichten Elemente He, Li und Be ist für die Kernphysik von großem Interesse, da sie modernen ab-initio Rechnungen der Kernstruktur zugänglich sind und Isotope mit exotischer Kernstruktur - so genannte Halo-Kern - existieren. Der Ladungsradius kann über die Messung der Isotopieverschiebung bestimmt werden, stellt jedoch höchste Anforderungen an Experiment und Theorie. Um die Kernladungsradien zu extrahieren, müssen die Isotopieverschiebung und der Masseneffekt mit einer relativen Genauigkeit von 10^{-5} gemessen bzw. berechnet werden. Dies ist für den $2s_{1/2} \rightarrow 2p_{1/2}$ Übergang in Be-Ionen jetzt erreicht worden. Dazu wurden mit einem Frequenzkamm

die Übergangsfrequenzen der Isotope in kollinearer und anti-kollinearer Geometrie an ISOLDE /CERN vermessen und daraus die Kernladungsradien mit einem relativen Fehler kleiner 1 Prozent extrahiert.

HK 59.8 We 18:30 H-ZO 50

Neutron knockout from Borromean halo: the target dependence — •Christoph Langer for the LAND-s245-Collaboration — Institut für Kernphysik, Universität Frankfurt, D-60438 Frankfurt am Main, Germany

The halo nuclei ^{11}Li, ^{8}He and ^{14}Be were studied at GSI Darmstadt. In the FRS-LAND setup a mixed secondary beam consisting of nuclei with similar A/Z ratio was impinging on targets made of carbon, polyethylene and liquid hydrogen in order to study their contributions to different knockout reactions. A spectroscopic analysis of the borromean halo system ^{6}He is presented. The one-neutron-breakup channel using a liquid hydrogen target was used to extract invariant mass spectra and a missing momentum distribution of the ^{5}He subsystem for an incoming beam at around 240 MeV/A. These results are compared with literature and an earlier experiment performed with a carbon and polyethylene target only. Here, the proton related cross sections were obtained by subtracting the carbon background from the polyethylene data. Furthermore it was possible to reconstruct the total cross section of the one-neutron-knockout channel of ^{6}He. *This project is supported by the HGF Young Investigators Project VH-NG-327*

HK 59.9 We 18:45 H-ZO 50

β decay studies of ^{11}Li, ^{11}Be and ^{8}B with an implantation technique — •Jeroen Büscher for the E1030 and P08 experiments-Collaboration — Katholieke Universiteit Leuven, Leuven, Belgium

The charged particle emission in the β decay of the halo nuclei ^{11}Li and ^{11}Be were studied at the ISAC facility at TRIUMF by implanting postaccelerated ^{11}Li ions into a segmented silicon detector. The high degree of pixelazation, the small active volume of the detector and the precise energy of the radioactive ion beam are the key features of the experimental setup. Among the advantages of the method are a good precision of the overall normalization and a reduction of the background due to β radiation. A precise branching ratio for both the deuteron and triton emission channel in the β decay of ^{11}Li was measured together with an energy spectrum of the emitted charged particles. The results provide important information on the decay and open up a new means to study the halo wave function of ^{11}Li. In addition to these results the charged particle emission in the β decay of the daughter nucleus ^{11}Be could be measured. We will also report on the first results of a recent experiment measuring the ^{8}B neutrino spectrum. This result is derived from the energy spectrum of the 2 α particles emitted in the β decay of ^{8}B. This measurement was performed using the same technique, implanting the ^{8}B ions at KVI in Groningen, The Netherlands.