HK 50: Kernphysik / Spektroskopie II

Zeit: Freitag 14:00–16:00 Raum: 2G

Gruppenbericht HK 50.1 Fr 14:00 2G

Structure and reactions of light nuclei in the Fermionic Molecular Dynamics approach — •Thomas Neff[1], Hans Feldmeier[1], Sonia Bacca[1], Robert Cussons[1], Ramin Torabi[1], Benjamin Hellwig[1], and Robert Roth[2] — [1]GSI, Darmstadt — [2]Institut für Kernphysik, TU Darmstadt

Light nuclei show a wealth of exotic phenomena like clustering and halos. We aim at a consistent description of light nuclei in the Fermionic Molecular Dynamics (FMD) approach, a microscopic many-body model that uses Slater determinants built with Gaussian wave packets as basis states. We employ an effective interaction derived from the realistic Argonne V18 interaction by explicitly implementing short-range central and tensor correlations using the Unitary Correlation Operator Method.

We will show results for nuclei in the *p*- and *sd*-shell, looking at binding energies, spectra, charge and matter radii, electromagnetic and weak transitions. The FMD wave functions can be analyzed with respect to clustering and shell model occupations. The structure of ^{12}C will be analyzed in detail with a special emphasis on the Hoyle and other cluster states. The implementation of resonance and scattering boundary conditions also allow us to study low-energy nuclear reactions like the radiative capture reaction ^{3}He(α,γ)^{7}Be.

HK 50.2 Fr 14:30 2G

Studies of Light Unbound Nuclear Systems — •Yuliya Aksyutina for the S245-Collaboration — Gesellschaft fur Schwerionenforschung (GSI), D-64291 Darmstadt

The results of an experiment performed 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. The main goals of this experiment are twofold. The collected data provides information on the structure of the drip-line nuclei ^{8}He, ^{11}Li, ^{14}Be and on the reaction mechanisms of these nuclei using a liquid hydrogen target. Futhermore, studies of unbound, exotic nuclear systems, which result from final state interactions between the different reaction products are performed. 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 results obtained for observed resonances and the physics interpretation of the data.

HK 50.3 Fr 14:45 2G

Geometry of Borromean Halo Nuclei. — •Mahir Hussein — Max-Planck-Institut fuer Physik komplexer Systeme, Noethnitzer Strasse 38, D-01187, Dresden

We discuss the geometry of the highly quantal nuclear three-body systems composed of a core plus two loosely bound particles. These Borromean nuclei have no single bound two-body subsystem. Correlation plays a prominent role. From consideration of the $B(E1)$ value extracted from electromagnetic dissociation, in conjunction with HBT-type analysis of the two valence-halo particles correlation, we show that an estimate of the over-all geometry can be deduced. In particular we find that the opening angle between the two neutrons in ^{6}He and ^{11}Li are, respectively, $\theta_{nn} = {83^{\circ}}^{+20}_{-10}$ and ${66^{\circ}}^{+22}_{-18}$. These angles are reduced by about 12$\%$ if the laser spectroscopy values of the rms charge radii are used to obtain the rms distance between the cores and the center of mass of the two neutrons. The opening angle in the case of ^{11}Li is more than 25$\%$ larger than recently reported by Nakamura \cite{Nak06}. The analysis is extended to ^{14}Be and the two-proton Borromean nucleus ^{17}% $Ne where complete data is still not available. Using available experimental data and recent theoretical calculations we find, $\theta_{nn} = {64^{0}}^{+9}_{-10}$ and $\theta_{pp} = 110^{0}$, respectively. The determining physical quantities are the pair-core separation energy and the scattering lengths of the pair particles.

HK 50.4 Fr 15:00 2G

Study of the nuclear matter distribution of exotic Be and B nuclei — •S. Ilieva[1], F. Aksouh[1], G.D. Alkhazov[2], K.-H. Behr[1], A. Bleile[1], A. Bruenle[1], L. Chulkov[3], A.V. Dobrovolsky[2], P. Egelhof[1], H. Geissel[1], G. Ickert[1], A. Inglessi[1], R. Kanungo[1], A.V. Khanzadeev[2], O. Kiselev[1], G.A. Korolev[2], X.C. Le[1], Y. Litvinov[1], W. Niebur[1], C. Nociforo[1], D.M. Seliverstov[2], L.O. Sergeev[2], V.A. Volkov[3], A.A. Vorobyov[2], H. Weick[1], V.I. Yatsoura[2], and A.A. Zhdanov[2] — [1]Gesellschaft für Schwerionenforschung (GSI), 64291 Darmstadt, Germany — [2]Petersburg Nuclear Physics Institute (PNPI), 188300 Gatchina, Russia — [3]Kurchatov Institute, 123182 Moscow, Russia

Exotic nuclei close to the drip-lines have revealed an interesting type of nuclear structure with a widely extended matter distribution of loosely bound valence nucleons(halo) surrounding a compact core.

In the present work the differential cross sections for small-angle proton elastic scattering on the ^{12,14}Be and ^{8}B isotopes were analyzed. The experiment was performed at energies near 700 MeV/u in inverse kinematics using the active target detector IKAR at GSI, Darmstadt.

The measured cross sections were analyzed with the aid of the Glauber multiple-scattering theory. Nuclear matter radii and radial matter distributions have been deduced. The nuclear matter distribution for ^{14}Be exhibits a pronounced neutron halo structure while for ^{8}B a proton halo is observed. The obtained data allow for a test of various theoretical model calculations of the structure of the studied isotopes.

HK 50.5 Fr 15:15 2G

Highly excited sharp states in ^{9}B observed in a high-resolution (^{3}He,t) measurement — •Clemens Scholl[1], Yoshitaka Fujita[2], Tatsuya Adachi[2], Peter von Brentano[1], Hisanobu Hashimoto[3], Kichiji Hatanaka[3], Hiroaki Matsubara[3], Kohsuke Nakanishi[4], Yasuhiro Sakemi[3], Yoshihiro Shimbara[5], Yukio Shimizu[3], Yuji Tameshige[3], Atsushi Tamii[3], Masaru Yosoi[3], and Remco Zegers[5,6] — [1]Institut für Kernphysik, Universität zu Köln, Deutschland — [2]Department of Physics, Osaka University, Japan — [3]Research Center for Nuclear Physics, Osaka, Japan — [4]CNS, Tokyo University, RIKEN Campus, Wako, Japan — [5]NSCL, Michigan State University, East Lansing, USA — [6]Department of Physics and Astronomy, MSU, East Lansing, USA

A high energy-resolution ^{9}Be(^{3}He,t)^{9}B experiment was performed at 0° and an intermediate incident energy of 140 MeV/nucleon at RCNP Osaka. This setup is a sensitive tool for Gamow-Teller transition strengths. The $2\alpha + p$ channel is open even for the ground state of ^{9}B, and thus some of the strongly excited low-lying states have decay widths in the order of 1 MeV. With a high sensitivity obtained by the high-resolution of the (^{3}He, t) reaction however, several weak but sharp states were observed at excitation energies higher than 14 MeV. The weak excitations of these states suggest that they have a different shape structure from the ground state which has a well-developed cluster structure, while the narrow decay widths of these states suggest that a proton decay is prohibited by the isospin selection rule.

HK 50.6 Fr 15:30 2G

Electroexcitation of the first $1/2^{+}$ state in ^{9}Be and ^{11}B* — •Oleksiy Burda[1], Alex Brown[2], Christian Forssén[3], Peter von Neumann-Cosel[1], and Achim Richter[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [2]NSCL, Michigan State University, East Lancing, USA — [3]Chalmers University of Technology, Göteborg, Sweden

There is renewed interest in very light nuclei due to the progress in *ab initio* calculations like the no-core shell model (NCSM) applied to their structure. We present high-resolution inelastic electron scattering experiments on ^{9}Be and ^{11}B performed at the S-DALINAC. The low-energy level structure of the ^{9}Be nucleus has long been a matter of interest, in particular with respect to the strength of three-body $\alpha + \alpha + n$ cluster configurations. The B($E1$) strength for the transition to the $1/2^{+}$ state extracted from the longitudinal form factor is a factor of two smaller than found from real photon scattering experiments indicating a violation of Siegert's theorem. In ^{11}B, the longitudinal form factor of the transition to the $1/2^{+}$ state shows pronounced selectivity of a deep-hole $0s_{1/2} \rightarrow 1p_{3/2}$ admixture to the dominant $1p_{3/2} \rightarrow 1s_{1/2}$ configuration.

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HK 50.7 Fr 15:45 2G

Bandenstrukturen in ^{12}Be — •Hans-Gerhard Bohlen[1], Wolfram von Oertzen[1,2], Rumiana Kalpakchieva[3,4], Thomas N. Massey[5], Steven M. Grimes[5], Tzanka Kokalova[1], Matko Milin[6] und Christian Schulz[1] — [1]Hahn-Meitner-Institut, Berlin, Germany — [2]Freie Universität, Berlin, Germany — [3]FLNR, JINR, Dubna, Russia — [4]Bulg. Acad. Science, Sofia, Bulgaria — [5]Ohio University, Athens, USA — [6]Ruder Boŝković Institute, Zagreb, Croatia

Das neutronenreiche Beryllium-Isotop ^{12}Be wurde am Q3D-Magnetspektrometer des Hahn-Meitner-Instituts Berlin mit mehreren Transferreaktionen untersucht, die jeweils besonders gut geeignet sind zur Besetzung bestimmter Cluster- und auch anderer Strukturen. Dabei handelt es sich um (1) die 2p-Pickup-Reaktion ^{14}C(^{12}C, ^{14}O)^{12}Be, (2) den doppelten Ladungsaustausch ^{12}C(^{14}C, ^{14}O)^{12}Be, (3) die 2n-Stripping-Reaktion ^{10}Be(^{14}N, ^{12}N)^{12}Be, und die beiden 3n-Stripping-Reaktionen (4) ^{9}Be(^{12}C, ^{9}C)^{12}Be und (5) ^{9}Be(^{15}N, ^{12}N)^{12}Be bei Einschußenergien von 15 - 24 AMeV. Aus der Systematik der bevölkerten Zustände können verschiedene Bandenstrukturen abgeleitet werden. Diese werden mit anderen Daten und theoretischen Modellrechnungen verglichen.