HK 20: Struktur und Dynamik von Kernen

Zeit: Dienstag 16:30–19:00 Raum: P 4

Gruppenbericht HK 20.1 Di 16:30 P 4

Characterization of shell closures and the role of the monopole interaction and the symmetry energy of nuclei — •Dennis Mücher[1], Reiner Krücken[1,2], Roman Gernhäuser[1], Jan Jolie[3], Stefanie Klupp[1], Katharina Nowak[1], Norbert Pietralla[4], and Steven W. Yates[5] for the IS510-Collaboration — [1]Technische Universität München — [2]TRIUMF, Canada — [3]IKP Köln — [4]TU Darmstadt — [5]University of Kentucky

One of the main goals of modern nuclear structure research is to identify changes in the mean field or residual interaction when going towards exotic systems. To track such changes, different observables are available for the experimentalist, like effective single particle energies for odd nuclei or values for the electric quadrupole transition strength in even-even nuclei. In this talk we show that the isospin degree of freedom gives a similar sensitivity to changes in shell structure. In this case the observable is the low-lying magnetic transition strength. A smooth contribution from the symmetry energy is needed to develop a consistent picture, especially going towards light nuclei or close to the N=Z line. We demonstrate the sensitivity to (sub)shell closures in case of e.g. N=16 (^{24}O) or N=40 (^{68}Ni). We give an overview about our actual activities at ISOLDE as well as future plans towards HIE-ISOLDE related to such questions. Supported under BMBF (06MT9156), DFG (EXC153) and ENSAR.

HK 20.2 Di 17:00 P 4

Low density behaviour of nuclear symmetry energy — •Urnaa Badarch and Horst Lenske — Institut für Theoretische Physik, Universität Giessen

The nuclear symmetry energy is a fundamental quantity important for studying the structure of systems as diverse as the atomic nucleus and the neutron star. Considerable efforts have been made to ascertain the symmetry energy and its dependence on nuclear density. The theoretical studies are in agreement in general but differences in detail e.g. at sub- and supra-saturation density. The density behavior of the symmetry energy with respect to charge asymmetric nuclear matter is studied within the density functional derived from Density-Dependent Relativistic Hadron field (DDRH) theory. We explored the genuine contribution of the isovector and isoscalar mesons to the symmetry energy and the isospin dynamics of nuclear matter. The results of our calculation for the isospin dependence of nuclear symmetry energy and the effective pairing interaction in comparison to phenomenological approaches will be presented.

HK 20.3 Di 17:15 P 4

Isospin symmetry in the sd shell — •Andreas Wendt[1], Peter Reiter[1], and Jan Taprogge[2] for the S377-Collaboration — [1]Institut für Kernphysik, Universität zu Köln — [2]CSIC Madrid, Spain

Very neutron deficient sd-shell nuclei may exhibit large distortions of the isospin symmetry. Differences in transition matrix elements between mirror nuclei provide access to changing collective behavior, expected by recent theoretical calculations. For the $T = -3/2$ isotope ^{33}Ar matrix elements were deduced from relativistic Coulomb excitation using the PRESPEC setup at GSI. The ^{33}Ar ions were produced by fragmentation of a high-energy ^{36}Ar beam impinged on a secondary Au target at an energy of ≈150 AMeV. Gamma-rays were observed by the Ge Cluster detectors of the PRESPEC setup and recorded together with particle information obtained with *LYCCA*. The $B(E2)$ values of ^{33,36}Ar will be compared to results of new shell model calculations.

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HK 20.4 Di 17:30 P 4

Search for mixed-symmetry states in ^{98}Mo — •Tim Thomas[1,2], Volker Werner[2], Tan Ahn[2], Christian Bernards[1,2], Nathan Cooper[2], Matthew Hinton[2,3], Gabriela Ilie[2,4], Jan Jolie[1], and Desiree Radeck[1] — [1]IKP, Universität zu Köln — [2]WNSL, Yale University, USA — [3]University of Surrey, UK — [4]NIPNE, Măgurele-Ilfov, Români

In the framework of the sdf-IBM-2 excited 2+ and 3- mixed-symmetry states are predicted in the molybdenum isotopes [1,2]. Signatures for these states are strong M1 decays to the first excited 2+ state or to the first excited octupole state, respectively. Therefore, the knowledge of multipole mixing ratios is essential. In search for such signatures we investigated ^{98}Mo populated via the reaction ^{96}Zr$(\alpha, 2n)$ at the Wright Nuclear Structure Laboratory. The depopulating γ transitions were detected with the highly efficient Yrast Ball γ spectrometer which allowed for the analysis of the $\gamma\gamma$ angular correlation analysis. We present multipole mixing ratios, spins and branching ratios and discuss the results in comparison with neighboring nuclei.

[1] N. A. Smirnova et al., Nucl. Phys. A 678, 235 (2000)
[2] M. Scheck et al., Phys. Rev. C 81, 064305 (2010)

HK 20.5 Di 17:45 P 4

Quadrupolanregung gemischter Proton-Neutron Symmetrie des Kerns ^{132}Ba — •Thomas Möller[1], Christopher Bauer[1], Giulia Guastalla[2], Jörg Leske[1], Norbert Pietralla[1], Georgi Rainovski[3,1], Dariusz Seweryniak[4], Johannes Wiederhold[1] und Shaofei Zhu[4] — [1]Institut für Kernphysik, TU Darmstadt — [2]Gesellschaft für Schwerionenforschung, Darmstadt — [3]St. Kliment Ohridski Universität, Sofia, Bulgarien — [4]Argonne National Laboratory, Argonne, USA

Zur Untersuchung der Evolution der Quadrupolanregung gemischter Proton-Neutron Symmetrie, des $2^+_{1,\mathrm{ms}}$-Zustandes [1], in den Ba-Isotopen unterhalb N=78 wurde ein Experiment in inverser Coulomb-Anregung am Kern ^{132}Ba durchgeführt. Ionen dieses Kerns wurden durch den ATLAS Beschleuniger des Argonne National Laboratory auf 445 MeV beschleunigt und in einem dünnen ^{12}C Target angeregt. Gammaquanten wurden mit dem Gammasphere Spektrometer detektiert. Aus den beobachteten relativen Anregungswirkungsquerschnitten der beobachteten Zustände und deren elektromagnetischen Zerfällen wurden die Stärken der entvölkernden Übergänge bestimmt. Aus der $B(M1; 2^+_i \rightarrow 2^+_1)$-Verteilung wurden Fragmente des gemischt symmetrischen Zustandes identifiziert. Die Ergebnisse werden vorgestellt und diskutiert. Gefördert von der DFG unter Pi 393/2-2 und vom Land Hessen im Rahmen von HIC for FAIR.

[1] N. Pietralla *et al.*, Prog. Part. Nucl. Phys. **60** (2008) 225 - 282

HK 20.6 Di 18:00 P 4

Gorkov-Green's function calculations of open-shell nuclei — •Vittorio Soma — Extreme Matter Institute (EMMI) — TU-Darmstadt

Ab-initio approaches - starting from the sole knowledge of a realistic nuclear force - aim at eventually achieving parameter-free predictions of nuclear properties. Although considerable progress has been made in recent years, e.g. using couple-cluster or self-consistent Dyson-Green's function methods, ab-initio nuclear structure calculations of medium-mass and heavy nuclei are still restricted to a limited number of (doubly-magic) nuclei. Besides the challenging numerical scaling, one reason is the inadequate account of pairing correlations that is essential to any realistic treatment of single- and doubly-open shell nuclei.

We are currently developing an ab-initio many-body method based on Green's function theory in the Gorkov formalism that allows for an explicit treatment of pairing correlations. Such approach is therefore applicable to a much larger set (˜500) of semi-magic nuclei, including systems up to, e.g., the tin isotopic chain. The talk will introduce the context within which such nuclear calculations take place, describe the many-body method and present the first results in the calcium isotopes.

HK 20.7 Di 18:15 P 4

Transition radii from electron scattering at low momentum transferand the structure of 2^+ mixed-symmetry states — •Abdulrahman Scheikh Obeid, Andreas Krugmann, Peter von Neumann-Cosel, Norbert Pietralla, Iryna Poltoratska, Vladimir Ponomarev und Christopher Walz — Institut für Kernphysik, TU Darmstadt, Germany

A measurement of charge transition radii differences of 2^+ one-phonon states of vibrational nuclei deduced from electron scattering at low momentum transfer provides information about the different interferences of the dominant valence shell components [1]. It is demonstrated in a case of ^{92}Zr that the method based in model independent PWBA analysis is applicable in heavy nuclei and furthermore permits a precise

determination of the B(E2) strength of the 2^+ mixed-symmetry states. The results will be also compared to experimental results extracted using the QPM and to the result extracted using a (n,n′γ)experiment. [1] C. Walz et al., Phys. Rev. Lett. 106, 062501 (2011).

HK 20.8 Di 18:30 P 4

shell evolution in neutron-rich Al isotopes around N=20 — •CHIARA NOCIFORO for the FRS-S322-Collaboration — GSI, Darmstadt, Germany

The structure of nuclei in the region commonly referred as island of inversion has been extensively studied because of the anomalous breakdown of the N = 20 shell closure. Differently than in Ne, Na and Mg isotopes, the experimental two-neutron separation energy of the Al isotopes do not show anomalies and are well reproduced by large scale shell model calculations involving the full *sd* proton shell and the *pf* neutron shell as valence space. Recent magnetic moment measurements performed on the ^{33,34}Al isotopes have shown large discrepancies with shell model predictions, in the *sd* and *sdpf* model spaces, implying a possible extension of a deformed region beyond Z = 12. In order to study the evolution of the single particle occupancy in the Al isotopes we have measured the longitudinal momentum distributions of the ^{33,34,35}Al from one-neutron removal reactions and the corresponding cross sections at the Fragment Separator at GSI. The beam energy was around 900 MeV/u. The momentum distribution analysis has been performed in the eikonal framework. Comparing our results with shell model predictions, the inferred $2s_{1/2}$ neutron occupancy in the ^{33}Al ground state wave function is 20-40% lower than the predicted one. The inclusive data do not exclude the presence of intruder states. Some intruder l=1 occupancy is found in ^{34}Al although it is smaller than in ^{33}Mg.

HK 20.9 Di 18:45 P 4

Anregungsenergien von Teilchen-Loch-Zuständen in ^{208}Pb und die SDI Wechselwirkung — •ANDREAS HEUSLER[1], ROTISLAV V. JOLOS[2] und PETER VON BRENTANO[3] — [1]MPI-Kernphysik HD — [2]Joint Institute for Nuclear Research, RU-141980 Dubna, Russia — [3]Institut für Kernphysik, Universität zu Köln

Im schematischen Schalenmodell (SSM) haben alle Teilchen-Loch-Zustände mit einer bestimmten Konfiguration die gleiche Anregungsenergie. Im doppelt-magischen Kern ^{208}Pb sind 40 Zustände bekannt, welche die volle Stärke einer Teilchen-Loch-Konfiguration enthalten. Die Anregungsenergien dieser Zustände unterscheiden sich von der Vorhersage des SSM um −200 bis +600 keV. Von vielen weiteren Zuständen sind Spin, Parität und hauptsächliche Teilchen-Loch-Konfiguration bekannt. Die SDI Wechselwirkung (surface delta interaction) beschreibt die Aufspaltung der Teilchen-Loch-Multipletts im ^{208}Pb. Der einzige Parameter wird aus der Aufspaltung des $h^{+2\nu}_{9/2}$ Multipletts in ^{210}Po bestimmt. Die Anregungsenergien für beinahe 100 Zustände mit $E_x < 6.1$ MeV im ^{208}Pb werden mit der Vorhersage des erweiterten SSM verglichen.