HK 40 Theorie

Zeit: Mittwoch 14:00–16:00 Raum: TU MA005

Gruppenbericht

HK 40.1 Mi 14:00 TU MA005

Nuclear structure calculations of nuclei in the *p*- and *sd*-shell — •Thomas Neff[1], Alberto Cribeiro[1], Hans Feldmeier[1], Heiko Hergert[2], and Robert Roth[2] — [1]Gesellschaft für Schwerionenforschung (GSI), Darmstadt — [2]Institut für Kernphysik, Technische Universität Darmstadt

The structure of nuclei in the *p*- and *sd*-shell is studied in the Fermionic Molecular Dynamics (FMD) approach. No a-priori assumptions about single-particle states or cluster features are made. Many-particle states are given by parity and angular-momentum projected Slater determinants. Projection after variation as well as variation after projection and multiconfiguration calculations in the sense of the generator coordinate method is used. An effective interaction derived from the realistic Argonne V18 interactions by means of an explicit treatment of short-range central and tensor correlations is employed for all nuclei.

The evolution of shell- and cluster properties in He, Be and C isotopes is studied. Spectra, radii, densities and formfactors are calculated and compared to experiment. First calculations of resonances within the FMD approach will be presented.

(1) R. Roth, T. Neff, H. Hergert, H. Feldmeier, Nucl. Phys. **A745**, 3 (2004)
(2) T. Neff, H. Feldmeier, R. Roth, Nucl. Phys. **A738**, 357 (2004)
(3) T. Neff, H. Feldmeier, Nucl. Phys. **A713**, 311 (2002)

HK 40.2 Mi 14:30 TU MA005

Nuclear Structure in the UCOM Framework — •Heiko Hergert[1], Robert Roth[1], Thomas Neff[2], Hans Feldmeier[1,2], Nils Paar[1], and Panagiota Papakonstantinou[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Darmstadt

The Unitary Correlation Operator Method (UCOM) [1] provides a way to use modern NN-interactions in conjunction with simple many-body states by explicitly handling correlations induced by the strong repulsive core and the tensor force. The correlated interaction V_{UCOM} is by construction phase-shift equivalent to the bare V_{NN} and given in a closed operator representation. Conceptual relations and differences to the renormalization group-based approach of V_{low-k} are discussed. Benchmark calculations using V_{UCOM} in the No-Core Shell Model exhibit a significantly improved convergence due to the prediagonalization caused by the correlation operators.

V_{UCOM} is applied to variational calculations using the Gaussian trial states of Fermionic Molecular Dynamics (FMD), covering the whole nuclear chart up to $A = 60$. Angular momentum projection is performed in order to obtain physical ground states and collective rotational spectra. Other collective excitations are accessible via configuration-mixing calculations or explicit time-evolution. Heavier nuclei are addressed in Hartree-Fock-type calculations (HF, HFB, RPA, etc.).

Work supported by the DFG (SFB 634).
[1] R. Roth, T. Neff, H. Hergert, H. Feldmeier, Nucl. Phys. A745 (2004) 3 (e-print: nucl-th/0406021).

HK 40.3 Mi 14:45 TU MA005

Collective excitation phenomena and beta-decays in exotic nuclei — •Nils Paar[1], Tamara Niksic[2], Peter Ring[2], and Dario Vretenar[3] — [1]TU-Darmstadt — [2]TU-Muenchen — [3]University of Zagreb

The excitation phenomena in unstable nuclei are analyzed in the framework of the relativistic quasiparticle RPA which is extended to include new interactions with density-dependent meson-nucleon couplings. The properties of the pygmy dipole resonance (PDR) are examined within isotopic chains, showing that already at moderate proton-neutron asymmetry the PDR peak energy is located above the neutron emission threshold, resulting with important implications for (gama,gama') experiments and r-process calculations. A method is suggested for determining the size of the neutron skin, based on the difference of the excitation energies of the Gamow-Teller resonance and the isobaric analog state. In addition, the present model is also employed in calculations of beta-decay half-lives of nuclei of the relevance for the r-process.

Work supported in part by DFG.
N. Paar et al., Phys. Rev. C 67, 034312 (2003).
D. Vretenar et al., Phys. Rev. Lett. 91, 262502 (2003).
N. Paar et al., Phys. Rev. C 69, 054303 (2004).
N. Paar et al., nucl-th/0404055, submitted to Phys. Lett. B (2004).

HK 40.4 Mi 15:00 TU MA005

Description of the double beta decay within continuum QRPA — •Vadim Rodin and Amand Faessler — Institut für Theoretische Physik, Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen, Deutschland

Observation of the neutrinoless double beta decay ($0\nu\beta\beta$) can provide important information on the Majorana nature of the neutrinos and on their absolute mass scale [1]. It is crucial that the determination of the effective Majorana mass from experimental data can be only as good as the knowledge of the nuclear matrix elements $M_{0\nu}$ to which the $0\nu\beta\beta$-decay rates are proportional. Thus, to interpret the data accurately one will need to better understand the nuclear structure effects important for the description of the matrix elements.

In the present work a continuum QRPA (CQRPA) approach is applied for the first time to calculate $0\nu\beta\beta$ and $2\nu\beta\beta$ nuclear matrix elements. Correct description of highly excited nuclear states provided by CQRPA is found to have appreciable effect on high-multipole contribution to $M_{0\nu}$. The calculation results are compared with those [2] obtained recently within the standard QRPA.

[1] A. Faessler and F. Šimkovic, J. Phys. G **24** (1998) 2139
[2] V. A. Rodin, A. Faessler, F. Simkovic and P. Vogel, Phys. Rev. C **68** (2003) 044302

HK 40.5 Mi 15:15 TU MA005

Application of the $V_{low\,k}$ Renormalization Group Method to Hyperon-Nucleon Systems — •Mathias Wagner[1], Bernd-Jochen Schaefer[1], Jochen Wambach[1,2], T.T.S. Kuo[3] und G.E. Brown[3] — [1]Institut für Kernphysik, TU Darmstadt, D-64289 Darmstadt,Germany — [2]Gesellschaft für Schwerionenforschung GSI, D-64291 Darmstadt,Germany — [3]Department of Physics and Astronomy, State University of New York,Stony Brook, NY 11794-3800, USA

In this talk we present results of the $V_{low\,k}$ Renormalization Group (RG) method applied to Hyperon-Nucleon systems. Recently this method has been successfully applied to Nucleon-Nucleon (NN) systems by the Stony Book group. They obtained a unique low momentum NN potential.

We start with a brief introduction to $V_{low\,k}$ and explain the basics of the method. In the following we apply the method to the YN-systems, using realistic Nijmegen Hyperon-Nucleon potentials as starting point. Although the Nijmegen models are quite different we also see a convergence to a unique YN $V_{low\,k}$.

HK 40.6 Mi 15:30 TU MA005

Ab initio calculation of the ^{4}He system — •Martin Trini[1], G.M. Hale[2], and H.M. Hofmann[1] — [1]Institute for Theoretical Physics III, University of Erlangen-Nuernberg, 91058 Erlangen, Germany — [2]Los Alamos National Laboratory, Los Alamos, NM 87544, USA

We report on a consistent, microscopic calculation of the bound and scattering states in the ^{4}He system. The calculations are done in the framework of the resonating group model with realistic two- and three-nucleon potentials. We compare the calculated phase shifts to a recent R-matrix analysis and to data. In addition radiative capture reactions leading to ^{4}He are calculated in the long wave-length limit and compared to recent data. The overall agreement is very good. To improve on the three-nucleon forces we call for new experiments.

HK 40.7 Mi 15:45 TU MA005

Eigenschaften des Spektrums entlang der O(6)-U(5) Trajektorie des sd-IBM-1 — •St. Heinze[1], P. Cejnar[2] und J. Jolie[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Institut of Particle and Nuclear Physics, Charles University

Entlang dieser Trajektorie existiert eine zusätzliche O(5)-Symmetrie. Die zugehörige Quantenzahl ist die Seniorität. Spektren zu verschiedenen O(5)-Quantenzahlen sind sehr einfach Strukturiert. Dies ist überaschend, da auf der O(6)-U(5) Trajektorie ein Phasenübergang zweiter Ordnung zu finden ist. Es werden verschiedene spektrale Eigenschaften gezeigt und die Verteilung der Verzweigungspunkte des Quantenhamiltonians untersucht. Diese Verteilung wird mit der eines Phasenübergangs erster Ordnung verglichen und eine Verbindung zwischen thermodynamischen und

Quantenphasenübergängen plausibel gemacht.