HK 37: Structure and Dynamics of Nuclei VII

Zeit: Mittwoch 14:00–16:00 Raum: HS 16

Gruppenbericht HK 37.1 Mi 14:00 HS 16

Behavior of the collective rotor in wobbling motion — •Qibo Chen[1], Egor Streck[1], Norbert Kaiser[1], and Ulf-G. Meissner[2,3,4] — [1]Physik-Department, Technische Universität München, D-85747 Garching, Germany — [2]Helmholtz-Institut für Strahlen- und Kernphysik and Bethe Center for Theoretical Physics, Universität Bonn, D-53115 Bonn, Germany — [3]Institute for Advanced Simulation, Institut für Kernphysik, Jülich Center for Hadron Physics and JARA-HPC, Forschungszentrum Jülich, D-52425 Jülich, Germany — [4]Ivane Javakhishvili Tbilisi State University, 0186 Tbilisi, Georgia

In recent years, the investigation of wobbling motion of triaxially deformed nuclei has become one of hottest topics in nuclear structure physics. In our work [1], the behavior of the collective rotor in wobbling motion is investigated within the particle-rotor model for ^{135}Pr by transforming the rotational wave functions from the K-representation to the R-representation. The evolution of the wobbling mode in ^{135}Pr, from transverse at low spins to longitudinal at high spins, is illustrated by the azimuthal plot. The coupling schemes of the angular momenta of the rotor ($\vec{R}$) and the high-j particle ($\vec{j}$) for transverse and longitudinal wobbling are obtained from the analysis of R-plots and K_R-plots.

Work supported by CRC 110 (DFG Grant No. TRR110 and NSFC Grant No. 11621131001), CAS PIFI (Grant No. 2018DM0034), and by VolkswagenStiftung (Grant No. 93562).

[1] E. Streck, Q. B. Chen, N. Kaiser, and Ulf-G. Meißner, Phys. Rev. C 98, 044314 (2018).

HK 37.2 Mi 14:30 HS 16

Weak decays within an effective theory — •Catharina Brase[1,2], Eduardo A. Coello Pérez[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We explore Gamow-Teller and forbidden β decays within an effective theory. In the effective theory, nuclei are described as spherical cores coupled to a neutron and/or proton, depending on the nucleus of interest. We calculate the matrix elements for β decays into low-lying states of the daughter nucleus and estimate the associated theoretical uncertainty based on the power counting and Bayesian methods. Our results for Gamow-Teller and unique first-forbidden β decays are in good agreement with experiment within the estimated uncertainties.

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HK 37.3 Mi 14:45 HS 16

Electroweak currents from chiral EFT in few-nucleon systems — •Rodric Seutin[1,2,3], Sebastian König[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

Using chiral EFT one is able to construct current operators at the many-body level. As a result of this, it is guaranteed that the current operators can be evaluated consistently with the appropriate nuclear wave functions, obtained as well from chiral interactions. This consistency is a key advantage of the EFT framework. In this talk, we discuss the development of electroweak currents in few-nucleon systems and their applications to electromagnetic form factors as well as electroweak transitions in light nuclei. In particular we look at triton and helium-3.

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HK 37.4 Mi 15:00 HS 16

Probing novel nuclear forces with the IM-SRG — •Jan Hoppe[1,2], Kai Hebeler[1,2], Achim Schwenk[1,2,3], and Johannes Simonis[4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]Institut für Kernphysik and PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

We apply consistent nucleon-nucleon plus three-nucleon interactions at N^{3}LO in chiral effective field theory with realistic saturation properties in the in-medium similarity renormalization group. To this end we use three-nucleon forces fitted within a new Monte-Carlo framework to saturation properties and the triton binding energy. We present results for ground-state energies as well as charge radii of closed- and open-shell nuclei, with the goal to explore connections between predictions for finite nuclei and nuclear-matter properties. We further investigate this by the impact of variations of the low-energy constants on our results.

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HK 37.5 Mi 15:15 HS 16

Derivation of a density-dependent in-medium NN interaction from subleading chiral three-nucleon forces — •Bhawani Singh and Norbert Kaiser — Technische Universität München

We derive from the subleading contributions from the chiral three-nucleon force (in particular the long-range terms) a density-dependent two-nucleon interaction V_{med} in isospin-symmetric nuclear matter. The contributions to V_{med} are derived from the topologies of 3N-diagrams ($1\pi1\pi$-exchange, $1\pi2\pi$-exchange, the ring diagrams) by joining an out-going nucleon line to another in-going nucleon line or by closing a nucleon line to a loop independent with the implementation of the medium insertion.
The momentum and k_f-dependent potentials associated with the isospin operators $(1, \vec{\tau}_1 \cdot \vec{\tau}_2)$ and five spin structures are expressed in terms of loop functions which are either given in closed analytical from or require at most one numerical integration.
Our results for V_{med} are most helpful to implement subleading chiral 3N forces into nuclear many-body calculations.
Work supported in part by DFG, NSFC (CRC110) and The Tata Trusts.

HK 37.6 Mi 15:30 HS 16

Energy-density functionals from local chiral interactions — •Lars Zurek[1,2], Eduardo Antonio Coello Pérez[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We employ the density-matrix expansion introduced by Negele and Vautherin and further developed by Gebremariam et al. in order to rewrite one-body density matrices in terms of local densities and their derivatives. The resulting approximations for the density matrices are applied to calculate energy-density functionals at the Hartree-Fock level based on local interactions derived from chiral effective field theory. The accuracy of this approach is investigated and analyzed for various approximations and choices in the density-matrix expansion.

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HK 37.7 Mi 15:45 HS 16

Extraction of nuclear parameters from spectra of heavy muonic atoms — •Niklas Michel, Natalia S. Oreshkina, and Christoph H. Keitel — Max Planck Institute for Nuclear Physics, Heidelberg, Germany

We consider bound states between an atomic nucleus and a muon, so called muonic atoms. Such systems can be considered as hydrogen-like and therefore the spectra can be predicted with high accuracy [1,2]. Just as in common electronic atoms, there is fine and hyperfine splitting, but the significance of the various contributions differs dramatically. In particular, nuclear structure effects can scale up to 50% of the binding energy, and vacuum polarization effects due to virtual electron-positron pairs are larger than all other corrections from quantum electrodynamics. We calculate the level structure in heavy muonic atoms and analyze the dependence on nuclear parameters like quadrupole moments and RMS charge radii. In connection with recent experiments performed by the muX Collaboration, we discuss the extraction of nuclear parameters from measured x-ray spectra of muonic

atoms.

[1] N. Michel, N. S. Oreshkina, C. H. Keitel, Phys. Rev. A 96, 032510

[2] N. Michel, N. S. Oreshkina, arXiv:1809.06623