HK 32: Structure and Dynamics of Nuclei VI

Zeit: Mittwoch 14:00–16:00 Raum: HZO 70

HK 32.1 Mi 14:00 HZO 70

Elastic NN-Scattering with Coupled NΔ-Channels in Chiral Effective Field Theory — •Susanne Strohmeier and Norbert Kaiser — Technische Universität München

We employ the dynamics of the coupled (NN, NΔ, ΔN, ΔΔ)-channels to study the elastic nucleon-nucleon scattering. The potentials arising from one- and two-pion exchange are derived from chiral effective field theory at next-to-leading order. Particular attention is paid to the subtraction of iterative contributions from the planar 2π-exchange box diagrams. The peripheral phase shifts and mixing angles are compared with the Nijmegen partial wave analysis up to I-waves. The short-range contact interaction in the coupled channels is constructed up to next-to-leading order (i.e. quadratic in momenta) and the associated low energy constants are determined in fits to NN-scattering data. The constraints on the low energy constants implied by a large-N_c counting are studied furthermore.
Work supported in part by DFG and NSFC (CRC110).

HK 32.2 Mi 14:15 HZO 70

Weinberg eigenvalue analysis based on chiral effective field theory interactions — •Jan Hoppe[1,2], Christian Drischler[3,1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Department of Physics, University of California, Berkeley — [4]Max-Planck-Institut für Kernphysik, Heidelberg

We present a comprehensive Weinberg eigenvalue analysis of a representative set of modern nucleon-nucleon interactions derived within chiral effective field theory, containing recently developed local, semi-local, and nonlocal potentials. We demonstrate that a direct comparison of numerical cutoff values of different interactions is in general misleading due to the different analytic form of regulators. Our detailed comparison of Weinberg eigenvalues provides various insights into properties of chiral potentials for different orders and partial waves. This shows that Weinberg eigenvalues could be used as a helpful monitoring scheme when constructing new interactions.

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HK 32.3 Mi 14:30 HZO 70

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

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.

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HK 32.4 Mi 14:45 HZO 70

Similarity Renormalization Group evolution for deuteron breakup in pionless effective field theory — •Marc Schönborn[1,2], Sebastian König[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

Similarity Renormalization Group (SRG) methods are used to evolve nuclear interactions towards diagonal form by decoupling high- and low-energy contributions while low-energy observables remain unchanged. To ensure this, all operators have to be evolved consistently along with the Hamiltonian. One of the simplest reactions where this can be studied, which still covers all relevant physics aspects, is deuteron breakup. In the past, SRG evolution of this process has been studied using potential models. At low energies, where pions are not resolved, pionless effective field theory is very well suited for the description of the breakup process. In this work, we discuss how this simplification can be used to gain further insights into the SRG evolution of operators.

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HK 32.5 Mi 15:00 HZO 70

Parametrisations of relativistic mean-field models with density dependent couplings — •Stefan Typel — Institut für Kernphysik, Technische Universität Darmstadt, Germany

Relativistic mean-field (RMF) models with density dependent (DD) couplings have been used successfully to describe finite nuclei and nuclear matter. They usually assume a dependence of the nucleon-meson couplings on the so-called vector density that is derived from the baryon current. A dependence on other densities, in particular the scalar density, was not really explored although suggested in early introductions of the DD-RMF approach. In this contribution, properties of nuclei, the corresponding equations of state (EoS) and symmetry energies of different DD-RMF models are compared using DD couplings of various functional form and dependence on vector and scalar densities. They are obtained by fitting the same set of nuclear observables. The choice of the dependence changes the EoS and the characteristic nuclear matter parameters. Problems of some of the models are identified.

HK 32.6 Mi 15:15 HZO 70

Hyperon single-particle and chemical potentials in nuclear matter from SU(3) chiral effective field theory — •Dominik Gerstung and Norbert Kaiser — Physik Department, Technische Universität München, D-85747 Garching, Germany

Brueckner theory is employed to calculate the single-particle potentials of nucleons and hyperons in nuclear matter. The underlying two-body interactions consist of the next-to-leading order chiral two-baryon potentials and effective density-dependent baryon-baryon interactions derived from the leading order chiral three-baryon forces. We compute the chemical potentials of neutrons and $\Lambda(1116)$-hyperons from the energy density of strongly interacting baryonic matter. The implications for the possible occurrence of strange baryons in neutron-star matter are discussed.

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HK 32.7 Mi 15:30 HZO 70

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 off-diagonal density matrices in terms of local densities and their derivatives. The resulting approximations for the density matrices are applied to calculate the energy density functionals arising from the contributions to the Hartree-Fock energy due to different local two- and three-nucleon interactions which were derived from chiral effective field theory and fit in recent calculations. The resulting energy-density functionals and their results for energies are presented and compared to other calculations.

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HK 32.8 Mi 15:45 HZO 70

Recent progress in effective field theory for collective rotations and vibrations of triaxial nuclei — •Qibo Chen[1], Norbert Kaiser[1], Ulf-G Meissner[2,3], and Jie Meng[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]State Key

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In recent years, effective field theory has achieved many successes in hadronic and low-energy nuclear physics. In this talk, the recent progress in EFT for collective rotation and vibration of triaxial nuclei is reviewed. The Hamiltonian for the triaxial rotor is constructed up to NLO. Its applicability is examined by comparing with a five-dimensional rotor-vibrator Hamiltonian for the description of the energy spectra in Ru isotopes. It is found that by taking into account the NLO corrections, the ground state band in the whole spin region and the γ-band in the low spin region are well described. The deviations for high-spin states in the γ-bands point towards the importance of including vibrational degrees of freedom in the EFT formulation. Hence, the vibrational degree of freedom is further included in the construction of EFT formulation and a Hamiltonian for collective rotation-vibration is derived.