HK 18 Theorie

Zeit: Dienstag 14:00–15:30 Raum: B

HK 18.1 Di 14:00 B

Chiral Dynamics of Baryons in a Lorentz Covariant Quark Model — •Valery Lyubovitskij, Amand Faessler, Thomas Gutsche, and Kem Pumsa-ard — Institute of Theoretical Physics, Tuebingen University, Auf der Morgenstelle 14, 72076 Tuebingen, Germany

We develop a manifestly Lorentz covariant chiral quark model for the study of baryons as bound states of constituent quarks dressed by a cloud of pseudoscalar mesons [1,2]. The approach is based on a non-linear chirally symmetric Lagrangian, which involves effective degrees of freedom - constituent quarks and the chiral (pseudoscalar meson) fields. In a first step, this Lagrangian can be used to perform a dressing of the constituent quarks by a cloud of light pseudoscalar mesons and other heavy states using the calculational technique of infrared dimensional regularization of loop diagrams. We calculate the dressed transition operators with a proper chiral expansion which are relevant for the interaction of quarks with external fields in the presence of a virtual meson cloud. In a second step, these dressed operators are used to calculate baryon matrix elements. Applications are worked out for the masses of the baryon octet, the meson-nucleon sigma terms, the magnetic moments of the baryon octet, the nucleon charge radii, the strong vector meson-nucleon couplings and the full momentum dependence of the electromagnetic form factors of the nucleon.

[1] A. Faessler, T. Gutsche, V.E. Lyubovitskij, K. Pumsa-ard, Prog. Part. Nucl. Phys. 55, 12 (2005). [2] A. Faessler, T. Gutsche, V.E. Lyubovitskij, K. Pumsa-ard, hep-ph/0511319.

HK 18.2 Di 14:15 B

Selbstkonsistente, thermische Massen leichter, skalarer und vektorieller Mesonen in einem linearen σ-Modell — •Stefan Strüber — Goethe-Universität Frankfurt a. M.

Der chirale Phasenübergang eines hadronischen Mediums als effektive Manifestation des Übergangs stark gebundener Kernmaterie zum Quark-Gluon-Plasma, kann mittels linearer σ-Modelle beschrieben werden. Dazu werden die für die Problemstellung relevanten, zugrundeliegenden Symmetrien der QCD bei der Modellierung der Kopplungsterme der interessierenden Freiheitsgrade berücksichtigt. Durch Selektion einer $U_L(2) \times U_R(2)$-Symmetrie und Vernachlässigung von Baryonen kann man sich auf die leichtesten Mesonen beschränken. Für das Verständnis von Dileptonenraten bei Kernkollisionsexperimenten ist insbesondere das Verhalten des ρ-Mesons im Bereich des chiralen Phasenübergangs von grosser Bedeutung. Die Realisierung des mesonischen Systems als thermischem Medium im Gleichgewicht lässt sich mit Hilfe des Imaginärzeit-Formalismuses bewerkstelligen. Die starken Kopplungen der Teilchen werden durch Verwendung selbstkonsistenter Vielteilchenresummationstechniken gewürdigt, was die Aufstellung von gekoppelten Schwinger-Dyson-Gleichungen ermöglicht. Deren Auswertung liefert die temperaturabhängigen Massen der leichten Skalarmesonen, die des ρ-, a_1- und f_1-Vektormesons, sowie die Energie des chiralen Kondensats, welches der Ordnungsparameter des chiralen Phasenübergangs ist. Im Bereich des Phasenübergangs, der je nach Vakuumsigmamasse, crossover, erster, oder zweiter Ordnung ist, entarten die chiralen Partner (z.B. das ρ- mit dem a_1-Meson).

HK 18.3 Di 14:30 B

Nuclear structure within the UCOM framework: Many-body calculations — •Panagiota Papakonstantinou, Robert Roth, Nils Paar, and Heiko Hergert — Institut für Kernphysik, T.U. Darmstadt

Correlated Hamiltonians derived from realistic nucleon-nucleon interactions within the Unitary Correlation Operator Method (UCOM) are employed in many-body calculations across the nuclear chart. Ground state properties of nuclei are examined within Hartree-Fock (HF) and HF-Bogolyubov method and within many-body Perturbation Theory (PT) and Configuration-Interaction method. The results show that residual ground-state long-range correlations not treated by the UCOM are perturbative. Binding energies are reproduced across the nuclear chart within PT. In order to improve the description of other ground-state observables, the possibility to employ a phenomenological three-body force is explored. Properties of collective states are calculated within standard and extended versions of the RPA. Our results reflect the properties of the UCOM Hamiltonian as an effective interaction and demonstrate the importance of LRC and second-order effects as well as the missing three-body force.

HK 18.4 Di 14:45 B

Nuclear Structure in the UCOM Framework: Few-Body Systems — •Heiko Hergert[1], Robert Roth[1], Panagiota Papakonstantinou[1], Nils Paar[1], Thomas Neff[2], and Hans Feldmeier[3] — [1]Institut für Kernphysik, TU Darmstadt — [2]NSCL, Michigan State University — [3]GSI Darmstadt

Recently, we have established the Unitary Correlation Operator Method (UCOM) [1,2] as a tool for using realistic NN-interactions in traditional methods of nuclear structure theory by explicitly treating correlations induced by the strong repulsive core and the tensor force. The resulting correlated interaction V_{UCOM} maintains phase-shift equivalence with the bare V_{NN}.

The main focus of this talk are No-Core Shell Model (NCSM) calculations with V_{UCOM}, which exhibit a significantly improved convergence. In addition, we obtain information on the interplay of short- and long-range correlations, which can be used to constrain V_{UCOM} further. In this context, we also discuss the inclusion of $3N$-forces. We present NCSM results for various p-shell nuclei (binding energies, spectra, etc.), which are in very good agreement with experiment.

In Fermionic Molecular Dynamics (FMD), V_{UCOM} is used in variational calculations up to $A = 60$. Projection techniques and configuration-mixing calculations provide access to excitations and recover important features like the 3α-structure of the Hoyle-state in ^{12}C.

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[1] R. Roth et al., Nucl. Phys. **A745** (2004) 3
[2] R. Roth et al., Phys. Rev. **C72** (2005) 034002

HK 18.5 Di 15:00 B

Nuclear response beyond the RPA approach — •Carlo Barbieri — GSI, Theory Department

Giant resonances are a source of information about the properties of nucleonic matter. Understanding these modes towards the drip lines will allow improved predictions in case of N/Z asymmetry and for low energy interaction with neutrinos. This talk reports about recent theoretical developments in this directions.

We use *self-consistent Green's function* (SCGF) theory and a Faddeev expansion to properly reproduce the distribution of single particle strength. The latter can have sizable impact on the behavior of the nuclear response, already at the 1p-1h level. The so obtained quasi-particles and -holes are used as a staring point in *dressed* RPA (DRPA) and in *interacting phonons* calculations. This approach is microscopic and based on realistic NN interactions.

Pilot work has been done for isotopes along the stability line, while the extension toward the drip lines is already in progress and will also be discussed.

HK 18.6 Di 15:15 B

Baryon self energies in the chiral loop expansion — •Alexander Semke and M.F.M. Lutz — GSI, Plankstr. 1, 64291 Darmstadt

We compute the self energies of the baryon octet and decuplet states at the one-loop level applying the manifestly covariant chiral Lagrangian. It is demonstrated that expressions consistent with the expectation of power counting rules arise if the self energies are decomposed according to the Passarino-Veltman scheme supplemented by a minimal subtraction. This defines a partial summation of the chiral expansion. A finite renormalization required to install chiral power counting rules leads to the presence of an infrared renormalization scale. Good convergence properties for the chiral loop expansion of the baryon octet and decuplet masses are obtained for natural values of the infrared scale. A prediction for the strange-quark matrix element of the nucleon is made.