HK 7: Nuclear Structure and Dynamics II

Time: Monday 14:00–16:00 Location: H-ZO 50

Invited Group Report HK 7.1 Mo 14:00 H-ZO 50

Applications of in-medium chiral dynamics — •Paolo Finelli[1], Norbert Kaiser[2], Dario Vretenar[3], and Wolfram Weise[2] — [1]Physics Department, University of Bologna and INFN (Italy) — [2]Physik Department, Technische Universität München — [3]Physics Department, University of Zagreb (Croatia)

A relativistic nuclear energy density functional is developed, guided by two important features that establish connections with chiral dynamics and the symmetry breaking pattern of low-energy QCD:

a) strong scalar and vector fields related to in-medium changes of QCD vacuum condensates;

b) long- and intermediate-range interactions generated by one-and two-pion exchange, derived from in-medium chiral perturbation theory, with explicit inclusion of $\Delta(1232)$ excitations.

Applications are presented for the the description of ground-state properties and collective excitations of medium and heavy nuclei.

The extension to hypernuclei will also be presented, showing a new interpretation of the Λ-nucleus spin-orbit potential.

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HK 7.2 Mo 14:30 H-ZO 50

Symmetry interaction and Many-body correlations. — •Massimo Papa — Istituto Nazionale Fisica Nucleare Catania Via. S.Sofia 64 95123 Catania (Italy)

Many-body correlations generated by the symmetry potential are spontaneusly generated in molecular dynamics approaches. The effect of these correlations on the collision dynamics at Fermi energies is discussed. In particular we show that two-body correlations generated by the symmetry potential are able to produce large effects in simple observables such as the charge distributions. A comparison with the predictions, based on EOS static calculations, is also discussed.

HK 7.3 Mo 14:45 H-ZO 50

Transformation of nuclear potentials from partial wave representation into operator representation — •Dennis Weber, Hans Feldmeier, and Thomas Neff — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Realistic interactions reproduce the nucleon-nucleon scattering data and the properties of the deuteron. There exist several transformation methods to include short-range correlations for applications in many-body methods. Two of these transformation methods are the "Unitary Correlation Operator Method" (UCOM) and the "Similarity Renormalization Group Method" (SRG).

The potentials often are not given in the operator representation but by matrix elements in momentum space. However some many-body approaches like "Fermionic Molecular Dynamics" (FMD) can only use the operator representation. In this case the operator representation has to be determined from the matrix elements of the potential.

We show a method to extract the operator representation of a potential from the partial wave basis matrix elements for the UCOM- and the SRG-transformed Argonne V18 potential and to study the "nonlocality" of the interaction.

HK 7.4 Mo 15:00 H-ZO 50

Femtoscopy in nuclear dynamics — •Giuseppe Verde — INFN, Sezione di Catania, Catania, Italy

Intensity interferometry and imaging techniques will be presented as tools to probe the space-time properties of nuclear reactions [1]. Applications to p-p correlation functions measured in collisions at E/A=50-150 MeV will be shown to disentangling fast pre-equilibrium and slow evaporative emissions [1]. The profile (space-time image) of the emitting source also probes nuclear transport properties and the density dependence of the symmetry energy, relevant to both nuclear physics and astrophysics [2]. The extension of the technique to complex particles will also be discussed [3].

Correlation techniques are also used to access spectroscopic properties of unbound nuclei [4]. An application to the sequential and simultaneous decay of unbound states of ^{10}C into two protons and two alphas will be described [4]. This study shows that these techniques can provide tools to access the dynamics and spectroscopy of exotic nuclei, an interesting perspectives for future radioactive beam facilities.

[1] G. Verde et al., European Physical Journal A 30 (2006) 81; G. Verde et al., Physical Review C 65 (2002) 054609

[2] G. Verde et al., Physical Review C 67 (2003) 034606, L.W. Chen et al., Physical Review C 69 (2004) 054606

[3] G. Verde et al., Physics Letters B 653 (2007) 12

[4] W.P Tan et al., Physical Review C 69 (2004) 061304, F. Grenier et al., Nuclear Physics A 811 (2008) 233

HK 7.5 Mo 15:15 H-ZO 50

High-Density Symmetry Energy in Heavy Ion Collisions* — Vaia Prassa[1], Theodoros Gaitanos[2], Graziella Ferini[3], Maria Colonna[3], Massimo Di Toro[3], Vincenzo Greco[3], and •Hermann Wolter[4] — [1]Univ. of Thessaloniki, Greece — [2]Inst. Theor. Physics, Univ. Giessen, Germany — [3]INFN; Lab. Naz. del Sud, Catania, Italy — [4]Univ. of Munich, Munich, Germany

The density dependence of the nuclear symmetry energy is an issue of great current interest with respect to exotic nuclear structure, heavy ion collisions, neutron stars and supernovae. However, there are large differences in the predictions of theoretical models and rather few experimental constraints. This is particularly true for the symmetry energy at densities above saturation. Generally the symmetry energy is small relative to the bulk energy, and thus one has to rely on differences and ratios of observables. We discuss predictions for possible observables in relativistic heavy ion collisions, which have the potentiual of constraining the high density symmetry energy: (1) proton/neutron and light cluster flow and pre-equilibrium emission, and (2) pion and kaon production, especially yield ratios. We will particularly discuss the robustness of the predictions.

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HK 7.6 Mo 15:30 H-ZO 50

Chiral Effective Field Theory for Nuclear Matter — •Andre Lacour[1], Jose Antonio Oller[2], and Ulf-G. Meissner[1,3] — [1]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn, Nußallee 14-16, D-53115 Bonn, Germany — [2]Departamento de Fisica. Universidad de Murcia. E-30071 Murcia, Spain — [3]Forschungszentrum Jülich, Institut für Kernphysik (Theorie), D-52425 Jülich, Germany

A novel chiral power counting for nuclear matter with nucleons and pions as degrees of freedom will be presented. This allows for systematic expansion taking into account both local as well as pion-mediated inter-nucleon interactions. It also identifies some non-perturbative string of diagrams, related to NN initial and final state interactions, to be resummed. We have applied this power counting to the pion self-energy in asymmetric nuclear matter.

HK 7.7 Mo 15:45 H-ZO 50

Relativistic random-phase approximation with density-dependent meson-nucleon couplings at finite temperature — •Yifei Niu[1,2], Nils Paar[2], Dario Vretenar[2], and Jie Meng[1] — [1]State Key Lab Nucl. Phys. & Tech., School of Physics, Peking University, Beijing 100871, China — [2]Physics Department, Faculty of Science, University of Zagreb, Zagreb 10000, Croatia

The fully self-consistent relativistic random-phase approximation (RRPA) framework based on effective interactions with a phenomenological density dependence is extended to finite temperatures. The RRPA configuration space is built from the spectrum of single-nucleon states at finite temperature obtained by the temperature dependent relativistic mean field (RMF-T) theory based on effective Lagrangian with density dependent meson-nucleon vertex functions. As an illustration, the dependence of binding energy, radius, entropy and single particle levels on temperature for spherical nucleus ^{208}Pb is investigated in RMF-T theory. The finite temperature RRPA has been employed in studies of giant monopole and dipole resonances, and the evolution of resonance properties has been studied as a function of temperature. In addition, exotic modes of excitation have been systematically explored at finite temperatures, with an emphasis on the case of pygmy dipole resonances.