Improving our Understanding of the Symmetry Energy

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Our recent efforts have focussed on microscopic predictions of the nuclear equation of state (EoS) under diverse conditions [1]. Our *ab initio* approach is microscopic and relativistic and employs the Dirac-Brueckner-Hartree-Fock method. Within this framework, nuclear matter proprties are derived self-consistently from realistic nuclear potentials.

We have been particularly concerned with investigations of isospin asymmetric matter, which reach out to a variety of systems, ranging from rare isotopes to neutron stars. The "common denominator" is the symmetry energy, which plays a crucial role in the formation of the neutron skin in neutron-rich nuclei and the radius of a neutron star. The *symmetry pressure* parameter, which displays the density dependence of the symmetry energy close to saturation density, is very sensitive to the details of theoretical models. High-precision measurements of the (strongly correlated) neutron skin in isospin-asymmetric nuclei, as they are expected from the JLab electroweak program, have the potential to discriminate among various equations of state.

This talk will review a broad spectrum of studies aimed at improving our knowledge of isospin asymmetric nuclear matter, including its extreme states with respect to density and/or spin and isospin asymmetry [2].

Most recently, we have explored the sensitivity of the total nucleus-nucleus reaction cross section to medium effects and isospin asymmetries [3]. Both major ingredients of the reaction cross section, namely the nuclear densities and the (medium-modified) nucleon-nucleon cross sections, are closely related to our microscopic EoS, making all aspects of the calculation internally consistent with one underlying nuclear interaction.

References

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[2] F. Sammarruca, *Phys. Rev. C* **83** (2011) 064304.
[3] F. Sammarruca and L. White, *Phys. Rev. C* **83** (2011) 064602.