

Probing Symmetry Energy of Dense Neutron-Rich Matter

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Neutron-rich matter exists naturally in neutron stars and some nuclei. It can also be created during mergers of neutron stars in space and collisions between two heavy nuclei in terrestrial nuclear laboratories. The nature and Equation of State (EOS) of such matter are still very poorly known while they have broad impacts on many interesting issues in both astrophysics and nuclear physics. In particular, nuclear symmetry energy encoding the energy cost to make nuclear matter more neutron rich has been the most uncertain part of the EOS of dense neutron-rich nucleonic matter. It affects the masses, radii, tidal deformations, cooling rates and frequencies of various oscillation modes of isolated neutron stars as well as the strain amplitude and frequencies of gravitational waves from neutron star mergers, besides its many effects on structures of nuclei and their collisions. In this talk, we will first review some recent progresses in constraining nuclear symmetry energy up to about twice the saturation density of nuclear matter especially since GW170817 and then discuss possible causes for the still very uncertain high-density behavior of nuclear symmetry energy. We focus on examining the role of tensor force induced nucleon-nucleon short-range-correlations (SRC) and the related high-momentum tail of single-nucleon momentum distribution on high-density nuclear symmetry energy.

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