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Nuclear Equation of State: Combining Neutron-Star Merger and Laboratory Constraints[1]

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The ground-breaking detection of the binary neutron-star merger event, GW170817 ushers in the era of Multi-Messenger Astrophysics. In addition to the tremendous contributions from astronomy where telescopes from four corners of the world provide observation of the kilonova and the emission spectroscopy of the neutron star merger event, knowledge in nuclear physics is one of the keys to unlock many facets of the neutron star. The nuclear Equation of State (EoS) is central to the understanding of the matter found in neutron stars and in explosive stellar environments, including the dynamics in neutron star mergers and core collapse supernovae in which many of the heavy elements are formed. Such environments are often very neutron-rich and their description requires extrapolating the properties of neutron-rich matter from that of symmetric matter containing equal numbers of neutrons and protons, more similar to the nuclei. This extrapolation is governed by the nuclear symmetry energy, which can be defined to be the difference in energy between the EoS of neutron matter and that of symmetric matter. This difference is particularly relevant to the internal structure of neutron stars and their cooling by neutrino emission. In this talk, I will discuss the latest results from experimental probes using heavy ion collisions with different isospin reactions to explore the symmetry energy from sub-normal to supra-normal density and its implication to the tidal deformability obtained in the neutron star merger.

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