Argonne NATIONAL LABORATORY

PHY Seminar

Physics Division Seminar

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Extracting Equation of State of Dense Matter From Nuclear Experiments and Gravitational Wave Observations

Host: Daniel Santiago

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Despite eighteen orders of magnitude in size, understanding the density distribution of neutrons in medium-to-heavy nuclei has a profound impact on the structure and composition of neutron stars. In particular, the development of a neutron skin in neutron-rich nuclei has important consequences in constraining effective nuclear interaction models that aim to describe within a single unified framework the dynamics of both atomic nuclei and neutron stars. On the experimental front, the parity-violating electron scattering measurements that are currently taking place at Jefferson National Accelerator Facility (JLAB) aim to measure neutron skins with enough precisions. On the observational front, the Neutron star Interior Composition Explorer (NICER) will confront nuclear physics with unique measurements of neutron star radii with high precisions. While terrestrial heavy ion-collision experiments test the equation of state (EOS) of dense matter at twice nuclear density, the historical first direct detection of gravitational waves from a binary neutron star merger (GW170817) by the LIGO-Virgo collaboration has already provided fundamental new insights into the nature of dense matter. In particular, since the gravitational-wave signal is sensitive to the underlying EOS, limits on the tidal polarizability inferred from the observation translate into constraints on the bulk properties of the EOS of neutron-rich matter. In this talk, I will discuss our recent works in this area, where we employed a set of realistic models of the equation of state (EOS) and confronted our predictions with the measured tidal deformability from the binary neutron star merger, and inferred useful constraints on the density dependence of the nuclear symmetry energy, neutron skins, as well as the radii of neutron stars.