

Nuclei in the Cosmos (NIC XVII)



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The Nuclear Equation of State from Experiments and Astronomical Observations

Abstract: With recent advances in astronomical observations, major progress has been made in determining the pressure of neutron star matter at high density. This pressure is constrained by the neutron star deformability, determined from gravitational waves emitted in a neutron-star merger, and measurements of radii for two neutron stars using a new X-ray observatory on the International Space Station. Previous studies have relied on nuclear theory calculations to constrain the equation of state at low density. Here we use a combination of 15 constraints composed of three astronomical observations and twelve nuclear experimental constraints that extend over a wide range of densities. A Bayesian inference framework is then used to obtain a comprehensive nuclear equation of state. This data-centric result provides benchmarks for theoretical calculations and modeling of nuclear matter and neutron stars. Furthermore, it provides insights on the composition of neutron stars and their cooling via neutrino radiation.

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