Neutron Stars and the Dense Matter Equation of State

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Neutron stars provide a unique laboratory with which to study cold, dense matter. The observational quantities of primary astrophysics interest are the maximum mass and the typical radius of a neutron star. These quantities are related to the relative stiffness of neutron-rich matter at supernuclear densities and the density dependence of the nuclear symmetry energy near the nuclear saturation density. The measurements of these nuclear properties via nuclear systematics and structure, heavy-ion collisions and parity-violating electron scattering from neutron-rich nuclei, are discussed. Several new observations, including mass measurements of binary pulsars and a confirmed distance determination for a nearby cooling neutron star, will be summarized. Additionally addressed will be observations of thermal emissions from cooling neutron stars in globular clusters and thermonuclear explosions from accreting stars. It will be demonstrated how this astrophysical data, using Monte Carlo simulations and a Bayesian analysis, is shedding light on the parameters of the nuclear force and the pressure-density relation of extremely dense matter.

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