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Neutron Star Masses and Radii

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Recent observations of thermal emissions from quiescent and isolated cooling neutron stars and of photospheric radius expansions in X-ray bursters can be used to estimate their masses and radii. Although the observational uncertainties for each source are considerable, they can be used to snugly constrain the mass-radius relation if it is assumed that a single such relation fits all neutron stars. In addition, limits to the underlying dense matter pressure as a function of density (i.e., the equation of state) can be deduced if it is appropriately parametrized. Values of the underlying parameters can be inferred with a Bayesian analysis using the combined mass-radius information from observations. It is shown that the subnuclear equation of state is consistent with that of neutron matter from recent estimates. Also, the deduced nuclear incompressibility, skewness and symmetry parameters are surprisingly compatible with nuclear systematics and experiment. The density dependence of the nuclear symmetry energy is predicted to be small, leading to relatively small values for the neutron skin thickness of lead. Furthermore, the neutron star maximum mass, to 90% confidence, is predicted to be greater than 1.85 solar masses.

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