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Extracting high-density symmetry energy from the observations of neutron stars and gravitational waves

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By numerically inverting the Tolman-Oppenheimer-Volkov (TOV) equation using an explicitly isospin-dependent parametric Equation of State (EOS) of dense neutron-rich nucleonic matter, a restricted EOS parameter space is established using observational constraints on the radius, maximum mass, tidal deformability and causality condition of neutron stars (NSs). Rather robust upper and lower boundaries on nuclear symmetry energies are extracted from the observational constraints up to about twice the saturation density ρ_0 of nuclear matter. Moreover, the absolutely maximum mass of neutron stars is found to be 2.40 Msun. In addition, we study the implications of the very recently reported mass M = 2.17 Msun of PSR J0740+6620 on the equation of state (EOS) of super-dense neutron-rich nuclear matter with respect to existing constraints on the EOS based on the mass M = 2.01 Msun of PSR J0348+0432 and found some of the most widely used and previously well tested model EOSs are hard to simultaneously predict a maximum mass higher than 2.17 Msun and a pressure consistent with that extracted from GW170817.

Abstract Type

Poster

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