
ID de Contribution: **45** Type: **Invited Presentation**

# An overview of existing and new nuclear and astrophysical constraints on the equation of state of neutron-rich dense matter

*vendredi 13 septembre 2024 09:00 (30 minutes)*

Through continuous progress in nuclear theory and experiment and an increasing number of neutron-star observations, a multitude of information about the equation of state (EOS) for matter at extreme densities is available. Here, we apply these different pieces of data individually to a broad set of physics-agnostic candidate EOSs and analyze the resulting constraints. Specifically, we make use of information from chiral effective field theory, perturbative quantum chromodynamics, as well as data from heavy-ion collisions and the PREX-II and CREX experiments. We also investigate the impact of current mass and radius measurements of neutron stars, such as radio timing measurements of heavy pulsars, NICER data, and other X-ray observations. We augment these by reanalyses of the gravitational-wave (GW) signal GW170817, its associated kilonova AT2017gfo and gamma-ray burst afterglow, the GW signal GW190425, and the GRB211211A afterglow, where we use improved models for the tidal waveform and kilonova light curves. Additionally, we consider the postmerger fate of GW170817 and its consequences for the EOS. This large and diverse set of constraints is eventually combined in numerous ways to explore limits on quantities such as the typical neutron-star radius, the maximum neutron-star mass, the nuclear symmetry-energy parameters, and the speed of sound. Based on the priors from our EOS candidate set, we find the radius of the canonical 1.4 M⊙ neutron star to be 12.27+0.83-0.94 km and the TOV mass 2.26 +0.45 - 0.22, at 95% credibility, when including those constraints where systematic uncertainties are deemed small. A less conservative approach, combining all the presented constraints, similarly yields the radius of the canonical 1.4 M⊙ neutron star to be 12.20+0.53-0.50 km and the TOV mass 2.31 +0.08 - 0.20.

https://docs.google.com/presentation/d/1zV6YfZBue6czA_dXZHkE4uW9WDq2cN8NJ4hpP7b-EcQ/edit?usp=sharing

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**Classification de Session:** Combined analysis of nuclear and astrophysics information, Bayesian approach, and machine learning