Dense nuclear matter in the era of multimensenger astronomy

R. Lisboa, Leonardo A. Almeida, P. C. Ferreira
Escola de Ciências e Tecnologia, Universidade Federal do Rio Grande do Norte, 59078-970, Natal, Brasil
Rio Grande do Norte Natal, 59078-900, Brazil
ronai.lisboa@ufrn.br

Abstract

The equation of state (EoS) of compact objects incorporate ingredients that are dependent on adjustable parameters and existing simulations allow for a wide range of energy and pressure densities, temperatures and electromagnetic fields. There is a pursuit for an EoS that adequately describes the properties expected according to theoretical nuclear physics and are also compatible with astrophysical observations. Astrophysical data made available by the Laser Interferometer Gravitational Wave Observatory/Virgo, such as events GW170817 and GW1900425, as well as traces of radioactive decay due to nucleosynthesis processes after merger of neutron stars (as the ones registered due to Kilonova event AT2017gfo), can impose restrictions on the maximum mass and radius that can be observed for these compact objects. In this talk, we will present a review of the current literature on how some nuclear physical quantities can be constrained from multi-messenger astronomical data.

Key words: equation of state, gravitational waves, binary neutron stars.

References

[1] Abbott, B. P. et al. GW170817: observation of gravitational waves from a binary neutron star inspiral. Phys. Rev. Lett. 119, 161101 (2017).

[2] Abbott, B. et al. GW190425: observation of a compact binary coalescence with total mass $\sim 3.4\, M_{\odot}$. Astrophys. J. Lett. 892, L3 (2020).

[3] Abbott, B. P. et al. Gravitational waves and gamma-rays from a binary neutron star merger: GW170817 and GRB 170817A. Astrophys. J. 848, L13 (2017).

[4] Abbott, B. P. et al. Properties of the binary neutron star merger GW170817. Phys. Rev. X 9, 011001 (2019).

[5] M. Jacobi, et al. Effects of nuclear matter properties in neutron star mergersm. MNRAS, 527, (2024).

[6] Huth, S., Pang, P.T.H., Tews, I. et al. Constraining neutron-star matter with microscopic and macroscopic collisions. Nature 606, 276–280 (2022).