Probing the Nuclear Equation of State from the Existence of a $\sim 2.6\ M_{\odot}$ Neutron Star: The GW190814 Puzzle *

A. Kanakis-Pegios, P.S. Koliogiannis and Ch.C. Moustakidis
Department of Theoretical Physics, Aristotle University of Thessaloniki

On 14 August 2019, the LIGO/Virgo collaboration observed a compact object with mass $\sim 2.59^{+0.08}_{-0.09}\ M_{\odot}$, as a component of a system where the main companion was a black hole with mass $\sim 23\ M_{\odot}$. A scientific debate initiated concerning the identification of the low mass component, as it falls into the neutron star–black hole mass gap. The understanding of the nature of GW190814 event will offer rich information concerning open issues, the speed of sound and the possible phase transition into other degrees of freedom. In the present work, we made an effort to probe the nuclear equation of state along with the GW190814 event [1]. Firstly, we examine possible constraints on the nuclear equation of state inferred from the consideration that the low mass companion is a slow or rapidly rotating neutron star. In this case, the role of the upper bounds on the speed of sound is revealed, in connection with the dense nuclear matter properties. Secondly, we systematically study the tidal deformability of a possible high mass candidate existing as an individual star or as a component one in a binary neutron star system. As the tidal deformability and radius are quantities very sensitive on the neutron star equation of state, they are excellent counters on dense matter properties. We conjecture that similar isolated neutron stars or systems may exist in the universe and their possible future observation will shed light on the maximum neutron star mass problem.

* The research work was supported by the Hellenic Foundation for Research and Innovation (HFRI) under the 3rd Call for HFRI PhD Fellowships (Fellowship Number: 5657).

[1] A. Kanakis-Pegios, P.S. Koliogiannis, and Ch.C. Moustakidis, Symmetry **13**(2), 183 (2021); **https://doi.org/10.3390/sym13020183**