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Constraints on the equation of state of dense nuclear matter from the tidal deformability of neutron stars

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Abstract

Neutron stars constitute a very promising natural laboratory for studying the properties of dense nuclear matter and the equation of state. One microscopic parameter that is of great interest is the speed of sound, especially the upper bound on it. This work is based on the idea to examine possible constraints on the speed of sound by using neutron stars. For this purpose, in our study, we use the observed effective tidal deformability from binary neutron star systems as a tool to impose constraints on the equation of state through the upper bound on the speed of sound [1]. The maximum mass scenario is also investigated. In our approach, we parametrize the stiffness of the equation of state by using the speed of sound, for various transition density values. The two recent observations of binary neutron star mergers from LIGO/VIRGO have been used to impose robust constraints. Furthermore, we extended our study in the hypothetical scenario of a very massive neutron star by using the recent observation of the GW190814 event [2]. We study the tidal deformability of such a neutron star for both individual and binary system cases. The existence of such a neutron star cannot be excluded according to our study. Furthermore, we postulate what kind of future observations would be useful to impose more stringent constraints on the properties of the equation of state.

References

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