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Thermal Effects on the Tidal Deformability of Neutron Stars

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Abstract

The study of neutron star merger by the detection of the emitted gravitational waves is one of the most promised tools to study the properties of dense nuclear matter at high densities. It is worth to claim that do not exist, up to now, strong evidence that the temperature of the stars is zero during the last orbits before coalescing. Contrariwise, there are some theoretical predictions that the temperature of the star may be even a few MeV [1–3]. According to the main theory the tides transfer mechanical energy and angular momentum to the star at the expense of the orbit, and friction within the star then converts the mechanical energy into heat. During the inspiral, these effects are potentially detectable as a deviation of the orbital decay rate from the General Relativistic point-mass result, or as an electromagnetic precursor if heating ejects the outer layers of the star. Different treatments have been used to estimate the transfer of energy and the size of the tidal friction, leading to different conclusions about the importance of pre-merger tidal effects [4]. In the present work we study the effect of temperature on tidal deformability of neutron star during the merger process. We employ a class of hot equations of state originated from various nuclear models [5]. We found that even for low values of temperature ($T < 1$ MeV) the effects are small but not negligible. Moreover, it is very interesting the founding that although the temperature affects both the tidal Love numbers and the radius of the stars has negligible effects on combination of the above quantities that is the dimensionless tidal deformability. Finally, the consequences of our predictions on the information gained from gravitational waves observations concerning the bulk neutron star properties (mass, radius, tidal deformability and e.t.c.) and the corresponding constraints on nuclear equation of state, are discussed and analyzed.

References

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