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Tidal deformations of hybrid stars with elastic phases

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Gravitational wave astronomy is expected to provide independent constraints on neutron star properties, such as their equation of state. This is possible with the measurements of binary components' tidal deformability, which alter the point-particle gravitational waveforms of neutron-star binaries. I'll discuss some tidal deformability effects due to the elasticity/solidity of the hadronic phase in a hybrid neutron star. I employ the framework of nonradial perturbations with zero frequency and study hadronic phases presenting elastic aspects when perturbed (with the shear modulus approximately 1% of the pressure). I'll show that the relative tidal deformation change in a hybrid star with a perfect-fluid quark phase and a hadronic phase presenting an elastic part is never larger than about $2-4\%$ (with respect to a perfect-fluid counterpart). These maximum changes occur when the elastic region of a hybrid star is larger than approximately 60% of the star's radius, which may happen when its quark phase is small and the density jump is large enough, or even when a hybrid star has an elastic mixed phase. For other cases, tidal deformation changes due to an elastic crust are negligible ($10^{-5}-10^{-1}\%$), therefore unlikely to be measured even with third generation detectors. Thus, only when the size of the elastic hadronic region of a hybrid star is over half of its radius, the effects of elasticity could have a noticeable impact on tidal deformations.

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