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Gravitational-Wave Astronomy and the Internal Properties of Hypermassive Neutron Stars in the Context of the Long-Awaited Event GW170817

Abstract

Not even two years after the first detection of a gravitational wave (GW) emanated from the inward spiral and merger of pairs of black holes by LIGO, GWs from a binary neutron star merger has been recently discovered by the LIGO/VIRGO collaboration (GW170817). This long-awaited event in conjunction with the independently detected gamma-ray burst (GRB170817A) and further electromagnetic radiation marked the beginning of the new field of gravitational-wave and multi-messenger astronomy. The neutron star merger scenario of GW170817 is in good agreement with numerical simulations of binary neutron star mergers performed in full general relativistic hydrodynamics. With the use of the extracted tidal deformation of the two neutron stars in the late inspiral phase of GW170817 it is possible to constrain the equation of state (EOS) of neutron star matter - however the most interesting part of the GW, the post-merger GW emission, has so far not been observed but will possibly be detected within the next observing run. Based on a large number of numerical-relativity simulations of merging neutron star binaries, the emitted GWs and the interior structure of the generated hypermassive neutron stars (HMNS) in the post-merger phase have been analyzed in detail (see Phys. Rev. D 96, 043004 (2017)). The talk will focus on the potential appearance of a hadron-quark phase transition in the interior region of the HMNS and its conjunction with the spectral properties of the emitted GW.