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GW transient searches to probe Neutron star physics

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Transient gravitational wave emission can originate by phenomena associated with neutron stars (NSs) oscillations modes, such as hyperflares from galactic magnetars and binary coalescence. Potential signals related to these events are generally not well-modeled, requiring robust, morphology-independent analysis techniques. In particular, the coalescence of binary neutron stars (BNS) is a promising source of gravitational waves detectable by the advanced LIGO and Virgo interferometers. The mass of the binary system and the NS equation of state (EoS) can lead to different scenarios for the system evolution: prompt collapse to black hole, formation of a remnant hypermassive (HMNS) or supramassive (SMNS) neutron star with a delay collapse to black hole, or even a stable NS. In case of HMNS or SMNS formation, the newly-born NS is strongly perturbed: among the excited modes of the NS, the fundamental (quadrupolar) one is expected to produce in the emitted GW spectrum a strong peak typically in the kHz range. Therefore the characterization of the spectrum of the post merger phase (PMNS) allows to infer astrophysical properties of the source and to constrains on the EoS. With Advanced interferometer detectors, we may soon use BNS to investigate matter in an extremely dense state. We will discuss the research on the spectral properties of GWs due to BNS, focusing on the PM phase, and the analysis, under development, to unfold properties of the compact object; we will report the observing scenarios in the upcoming data taking of the interferometers network.

Experimental Collaboration

LIGO-Virgo Collaboration

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