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Analytical and Numerical Relativity Modeling of Binary Neutron Star Mergers (and Some Highlights from Binary Black Holes)

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Ground-based gravitational-wave observations of binary neutron stars (BNS) can, in principle, uncover the entire coalescence process spanning from the low-frequencies (few Hz, low-velocities) inspiral motion to the high-frequencies merger and remnant dynamics (in the kiloHertz regime). These observations hold the promise to deliver unprecedent insights on fundamental aspects of physics and astrophysics, as for example the nature of matter at extreme densities. The main part of this talk summarizes recent efforts towards modeling the complete BNS gravitational-wave spectrum, highlighting current and future application of the model in gravitational-wave astronomy. The last part of the talk reports on recent advances in modeling gravitational-waves from binary black holes (BBH) mergers using the same analytical/numerical relativity approach. The main results concern the construction of faithful waveform models from generic-orbits mergers and a Bayesian analysis of GW190521 that supports the possible first detection of a BBH dynamical encounter in astrophysical context.

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