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Simulating Binary Neutron Star Mergers: Implications for Multi-messenger Astronomy and Dark Matter Searches

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Throughout the Universe, many high-energy, cataclysmic astrophysical collisions of neutron stars are continuously occurring. These collisions provide an excellent testbed to probe the properties of supranuclear-dense matter, to study the production of heavy elements, to allow for an independent measurement of the expansion rate of our Universe, and to perform an indirect search for dark matter. Essential for such studies are reliable models describing the merger dynamics. Keeping this in mind, numerical-relativity simulations can be seen as a prerequisite for a reliable interpretation of multi-messenger events, and to further develop gravitational-wave and electromagnetic transient models. We show some of our most recent results and identify how simulation can be used for multi-messenger studies and how simulations including dark matter admixed stars will open the door to identify the presence of dark matter in binary neutron star mergers.

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