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Black-hole formation in mergers of spinning neutron stars

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The mergers of neutron star binary systems are of great scientific interest as they can be used to explore and constrain the incompletely known Equation of State (EoS) at very high densities. Especially the formation of a black-hole due to a gravitational collapse is of interest. For a sufficiently high total binary mass the collapse occurs immediately after merging. This is called a prompt collapse and occurs if the mass exceeds a so called threshold mass. The threshold mass depends on the EoS and parameters of the binary system like the mass ratio and intrinsic spin. Quantifying those influences is therefore of interest considering unknown properties of neutron stars, constraining the EoS and mass ejection. Neutron stars in merging binary systems are assumed to be mostly irrotational but some have been observed to rotate rapidly with a spin period of a few tens of ms. The shortest spin period observed in a neutron star binary system so far has been 17ms. The intrinsic rotation of the neutron stars changes the total angular momentum in the system depending on its orientation relative to the orbital angular momentum. A high spin period could therefore have a noticeable impact on total angular momentum and thus effect the threshold mass. To systematically investigate this influence we discuss simulations with a relativistic hydrodynamical code considering various spin configurations for different mass ratios and EoS. We will describe the impact of orientation and magnitude of intrinsic spin as well as one or two rotating neutron stars.

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