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Constraining the neutron star critical mass with long gamma-ray bursts

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The binary-driven hypernova (BdHN) model explains long GRBs associated with type Ic supernovae (SNe) with a binary composed of a carbon-oxygen (CO) star and a neutron star (NS) companion in close orbit. The CO core-collapse SN generates a newborn NS (new-NS) at its center and ejects the CO outer layers. This process triggers the GRB, starting from the accretion of ejecta onto the new-NS (via fallback) and the NS companion. We use a new, improved version of the numerical code for BdHN 3D simulations, which evolves the accreting NS in full general relativity for realistic nuclear equations of state (EOS). We shall catalog the outcome for different CO mass, NS mass, SN explosion energy and anisotropy, and orbital separations (periods) for various EOS to use GRB statistics to constrain the NS critical mass so the nuclear EOS. We also discuss additional astrophysical consequences of our calculations.

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