Gravitational Waves from Fallback Accretion and Black Hole Formation in Long Gamma-Ray Bursts

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The collapsar scenario for long gamma-ray bursts (GRBs), detailed by fallback accretion onto a nascent neutron star and subsequent collapse to a black hole, presents a promising source of gravitational waves (GWs) in the sensitive band for ground-based GW detectors. We introduce a new set of phenomenological waveforms for BH formation and different types of stellar collapse. These models take into consideration realistic mass-radius evolutions using multiple finite-temperature equations of state, internal circulation patterns within the neutron star and go through the stages of black hole ringdown in order to constrain mass accretion rates and fragmentation instabilities. We outline the analysis to search for such GW signals, and explore their detectability with second- and third-generation ground-based GW detectors using public O2 and recolored data provided by the LIGO Scientific Collaboration and the Virgo Collaboration.