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Extended emission from fallback accretion onto merger remnants

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Using a set of general-relativistic magnetohydrodynamics simulations that include proper neutrino transfer, we assess for the first time the role played by the fallback accretion onto the remnant from a binary neutron-star merger over a timescale of hundreds of seconds. In particular, we find that, independently of the equation of state, the properties of the binary, and the fate of the remnant, the fallback material reaches a total mass of ⍰ 10^{−3} ⍰⍰, i.e., about 50% of the unbound matter, and that the fallback accretion rate follows a power-law in time with slope ~ ⍰^{−5/3}. Interestingly, the timescale of the fallback and the corresponding accretion luminosity are in good agreement with the so-called "extended emission" observed in short gamma-ray bursts (GRBs). Using a simple electromagnetic emission model based on the self-consistent thermodynamical state of the fallback material heated by r-process nucleosynthesis, we show that this fallback material can shine in the gamma- and X-rays with luminosities ⍰ 10^{48} erg/s for hundreds of seconds, thus making it a good and natural candidate to explain the extended emission in short GRBs. In addition, our model for the emission by the fallback material reproduces well and rather naturally some of the phenomenological traits of the extended emission, such as its softer spectra with respect to the prompt emission and the presence of exponential cutoffs in time. Our results clearly highlight that fallback flows onto merger remnants cannot be neglected and the corresponding emission represents a very promising and largely unexplored avenue to explain the complex phenomenology of GRBs.

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