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Characterization of accretion discs from binary neutron star mergers

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Accretion discs formed in binary neutron star (BNS) mergers are the engine responsible for many relevant physical processes. Numerical simulations of accretion discs have been used to investigate the outcome of such processes, but the initial configuration of the disc lack of an unique analytical description and some assumptions are still needed. In this work we analyze in detail the properties of accretion discs from 44 BNS merger simulations, with the aim of furnishing reliable initial conditions and a comprehensive characterization of the accretion discs. We found that the discs are thick, with an aspect ratio decreasing with the mass ratio of the binary from ~ 0.7 to 0.3. Despite the disc sample spans a broad range in mass and angular momentum, their ratio is independent on the equation of state (EOS) and on the mass ratio of the binary. We have found that this can be traced back to the rotational profile of the disc, characterized by a constant specific angular momentum of 3 − 5 × 10¹⁶ cm² s^{−1}. The entropy per baryon and the electron fraction depend on the mass ratio of the binary. For small mass ratio they follow a sigmoidal distribution with the density, for which we provide a detailed description and a fit. The disc properties discussed in this work can be used as a robust set of initial conditions for future long-term simulations of accretion discs from BNS mergers, posing the basis for a progress in the quantitative study of the outflow properties.

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