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Gravitational waves from core-collapse supernovae with strong rotation and magnetic fields

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Core-collapse supernovae (CCSN) are an important formation channel for astrophysical compact objects that release huge quantities of gravitational binding energy in the form of neutrino emission, energetic ejecta and gravitational waves (GW).
The latter represent an extraordinary tool to probe the properties of the forming proto-neutron star (PNS), such as its mass and radius, and the characteristics of the convective motions occurring within it. Multi-dimensional numerical simulations are therefore a fundamental instrument to investigate the complexity of the GW emission and deduce the physical properties of the system from the observed signal.
I will briefly present our current understanding of the numerical modeling of GW emission from CCSN with a particular focus on the impact of rapid rotation, showing the connection between the onset of corotational instabilities within the PNS and the emission of strong gravitational signals.
I will then show some preliminary results that take into account the presence of magnetic fields and their effect on both the PNS dynamics and the related multi-messanger emission.

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