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Gravitational wave signature of proto-neutron star convection

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Gravitational waves provide a unique opportunity to better constrain the dynamics in the interior of proto-neutron stars during core collapse supernovae. Convective motions inside the proto-neutron star play an important role in determining neutron star magnetic fields. In paticular, numerical models suggest that a convective dynamo could explain magnetar formation in presence of fast rotation. Using 3D MHD simulations of proto-neutron star convective zones, we compute the gravitational wave emission from turbulent convection and study the impacts of both rotation and dynamo action. We derive physical scalings that reproduce quantitatively several aspects of the numerical results. Given the potentially long duration of the signal, we find that the typical strain and frequency range could allow its detection by current GW detectors in a nearby supernova explosion, and may be a primary target for next generation of GW detectors. In some cases, the signal may even capture the growth of a magnetic field due to dynamo action.

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