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Gravitational Wave Signals from 3D GRMHD simulations of Core-Collapse Supernovae

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With the increasing number of gravitational wave detections by the LIGO-Virgo-KAGRA (LVK) Collaboration, as well as the prospect of the upcoming 3rd generation detectors such as the Einstein Telescope and Cosmic Explorer, we will need to be able to identify the gravitational wave source and extract properties of the source from the detector data. In order to do this effectively, we must develop templates of possible gravitational waves signals emitted from the expected sources. One of the events for which gravitational wave signatures can be detected are Core-collapse supernovae (CCSNe), some of the most energetic explosions in the universe. Gravitational wave observations from CCSNe, would allow us to probe for information from the stellar interior during collapse and the subsequent explosion. Through numerical simulations we can investigate these signatures and among other things gain a better insight into the mechanism driving the explosion. We seek to present results from some of the first production-level GPU based simulations of stellar core-collapse supernovae for a variety of pre-supernova model set-ups using the GPU-accelerated dynamical-spacetime general relativistic magneto-hydrodynamics code GRaM-X, which extends the general relativistic magneto-hydrodynamics (GRMHD) capability of the Einstein Toolkit. We model four CCSNe in 3D, without any symmetry assumptions, varying the rotation rate of the progenitor. Each of the simulations extends for about 100ms post-bounce and the respective gravitational wave signatures are extracted and analyzed for potential detectability with future detectors.

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