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General Relativistic Turbulence in spherically symmetric Core-Collapse Supernovae simulations

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It is generally believed that General Relativity (GR) is of secondary importance in the explosion of core-collapse supernovae (CCSN). However, as 3D simulations are becoming more and more detailed, GR effects can be strong enough to change the hydrodynamics of the supernova and affect the explosion. Since a 3D simulation in full GR is computationally extremely challenging, it is valuable to modify simulations in a spherically symmetric spacetime to incorporate 3D effects. This permits exploration of the parameter dependence of CCSN with a minimum of computational resources. In this talk I will report on the formulation and implementation of general relativistic neutrino-driven turbulent convection in the spherically symmetric code GR1D. This is based upon STIR, the recently proposed Newtonian model based on mixing length theory of Couch et al. (2020). When the parameters of this model are calibrated to 3D simulations, we find that our GR formulation significantly alters the correspondence between progenitor mass and explosion vs. black-hole formation. We therefore believe that, going forward, simulating CCSN in full GR is of primary importance.

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