Title:
Multi-dimensional Core-Collapse Supernova Simulations with the Isotropic Diffusion Source Approximation for Neutrino Transport

Abstract:

Due to the complexity of the core-collapse supernova explosion mechanism, simulations require not only high-performance super computers and the exploitation of GPUs, but also sophisticated approximations to capture the essential microphysics. I will present multi-dimensional core-collapse supernova simulations using the Isotropic Diffusion Source Approximation (IDSA) for the neutrino transport with the FLASH code. I will first demonstrate that the IDSA is an elegant and efficient neutrino radiation transfer scheme, which is portable to multiple hydrodynamics codes and fast enough to investigate long term evolutions in two and three dimensions. I then show axisymmetric simulations of several progenitors from Woosley et al. using the Lattimer & Swesty EOS (LS220) and the Hempel & Schaffner-Bielich EOS (e.g. DD2). I will demonstrate how the level of electron deleptonization during collapse affects the postbounce evolution and emphasize the importance of the nuclear input physics. Finally, I discuss important supernova ingredients for successful explosions, such as neutrino opacities, nuclear equation of states, general relativity corrections, and spacial dimensions.