Building CCSN Explosion Simulation with Spectral Two-Moment Neutrino Transport Using FLASH
RAN CHU, University of Tennessee, Knoxville, AUSTIN HARRIS, EIRIK ENDEVE, Oak Ridge National Laboratory, ANTHONY MEZZACAPPA, University of Tennessee, Knoxville — We are developing the toolkit for high-order neutrino-radiation hydrodynamics (thornado) to simulate in an efficient and robust manner core-collapse supernova (CCSN) explosions. thornado implements spectral two-moment neutrino transport with a high-order discontinuous Galerkin method and implicit-explicit time stepping. More details of our numerical methods are presented in previous publications\(^1\). WeakLib\(^3\) is a microphysics library that provides input microphysics (equations of state (EoS) and neutrino opacities) by table interpolation. thornado and WeakLib have been coupled with FLASH\(^4\) as external libraries. With this enhanced FLASH code, we hope to simulate CCSN explosions in multiple dimensions with self gravity, hydrodynamics, spectral two-moment neutrino transport, the Steiner, Hempel and Fischer (SFHo)\(^5\) EoS, and “Bruenn 85”\(^6\) neutrino opacities. Here we present select physically motivated test problems and preliminary results from gravitational collapse.

\(^1\)Endeve et al. 2015, JCP, 287, 151-183
\(^2\)Chu et al. 2019, JCP, 389,62-93
\(^3\)WeakLib: https://github.com/starkiller-astro/weaklib
\(^4\)Fryxell et al. 2000, AJSS, 131.1, 273
\(^6\)Bruenn, S. W. 1985, AJSS, 58, 771-841

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