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Thornado-hydro: A Discontinous Galerkin Method for Supernova Hydrodynamics with Nuclear Equations of State[1] DAVID POCHIK, Ohio State University, BRANDON BARKER, Michigan State University, EIRIK ENDEVE, Oak Ridge National Laboratory, JESSE BUFFALOE, University of Tennessee, SAMUEL DUNHAM, Vanderbilt University, NICK ROBERTS, ANTHONY MEZZACAPPA, University of Tennessee — We present hydrodynamics results from the toolkit for high-order neutrino radiation hydrodynamics (thornado), which is being developed for multiphysics simulations of core-collapse supernovae (CCSNe), and related problems, with Runge-Kutta discontinuous Galerkin (RKDG) methods [1]. Our method includes extensions – a slope limiter to prevent non-physical oscillations and a bound-enforcing limiter to prevent non-physical states – to the standard RKDG framework, to accommodate a tabulated nuclear equation of state (EoS). The numerical results from test problems in idealized settings demonstrate the efficacy of the extended method. Taking important steps toward full CCSN simulations with thornado, our method is then applied to the problem of adiabatic collapse, shock formation, and shock propagation in spherical symmetry, initiated with a 15 Solar mass progenitor. In this application, the bound-enforcing limiter improves robustness of the RKDG method, but slope limiting in characteristic fields is vulnerable to phase transitions in the EoS. We also include preliminary work of coupling this method with two-moment neutrino transport. [1] Pochik et al. 2021, ApJS (accepted, arXiv:2011.04680)

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