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Simulating Radiation Transport in Curved Spacetimes EIRIK ENDEVE, CORY HAUCK, YULONG XING, CHRISTIAN CARDALL, Oak Ridge National Lab, ANTHONY MEZZACAPPA, University of Tennessee — We are developing methods for simulation of radiation transport in systems governed by strong gravity (e.g., neutrino transport in core-collapse supernovae). By employing conservative formulations of the general relativistic Boltzmann equation[1], we aim to develop methods that are (i) high-order accurate for computational efficiency; (ii) robust in the sense that the phase space density f preserves the maximum principle of the physical model ($f \in [0, 1]$ for fermions); and (iii) applicable to curvilinear coordinate systems to accommodate curved spacetimes, which result in gravity-induced frequency shift and angular aberration. Our approach is based on the Runge-Kutta discontinuous Galerkin method[2], which has many attractive properties, including high-order accuracy on a compact stencil. We present the physical model, describe our numerical methods, and show results from implementations in spherical and axial symmetry. Our tests show that the method is high-order accurate and strictly preserves the maximum principle on f. We also demonstrate the ability of our method to accurately include effects of a strong gravitational field.

[1]Cardall, C.Y., Endeve, E., & Mezzacappa 2013, Phys. Rev. D **88**, 023011
[2]Cockburn & Shu 2001, J. Sci. Comput. **16**, 173-261

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