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Grid-based operator-splitting solvers for radiative transfer with sharply peaked sources

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Deterministic solution of the radiative transfer equation (RTE) on a fixed grid is a possible alternative to Monte Carlo photon tracking for light propagation in water and ice, for example in neutrino telescopes like BaikalGVD. However, the relevant sources, Cherenkov light from charged-particle tracks, are sharply localized in both space and direction. We present an implementation of a second-order Strang-split RTE solver in 3D space + 2D direction. It uses a spherical t-design angular grid ($10^2 - 10^4$ directions), a collision step that is exact in spherical-harmonic space for a Henyey-Greenstein phase function, and a semi-Lagrangian cubic-spline streaming step that conserves energy to $10^{-7} - 10^{-15}$. We study three obstacles to practical use: Ray effect, sharp sources (Gibbs oscillations), memory\speed cost. We discuss mitigation through uncollided-flux splitting and hybrid Monte Carlo-grid schemes. The work is ongoing.

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