

Multispecies structure-preserving particle discretization of the Landau collision operator

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This paper proposes a novel numerical integrator for modeling multispecies Coulomb collisions in kinetic plasmas. The proposed scheme provides an energy-, momentum-, and positivity-preserving particle discretization of the nonlinear Landau collision operator, extending the works of J.A. Carrillo et al., *Journal of Computational Physics*, 7, 100066 (2020) and E. Hirvijoki, *Plasma Physics and Controlled Fusion*, 63, 044003 (2021). The discrete-time conservation properties are analyzed both algebraically and numerically, and an efficient, GPU-parallelized implementation is validated against inhomogeneous temperature relaxation, isotropization and thermalization examples. The results agree with analytical estimates, confirming the method capable of reproducing physics.

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