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Entropy-Based Accelerated Monte Carlo Methods for Coulomb Collisions[1] LEE RICKETSON, MARK ROSIN, RUSSEL CAFLISCH, UCLA, BRUCE COHEN, ANDRIS DIMITS, LLNL — We present a computational method for the simulation of Coulomb collisions in plasmas that significantly improves upon our earlier hybrid method, which combines a Monte Carlo particle scheme and a fluid dynamic solver in a single uniform method across phase space. The hybrid method represents the velocity distribution function $f(v)$ as the sum of a Maxwellian $M(v)$ and a collection of discrete particles $g(v)$. M evolves in space and time through fluid equations, and g through a Monte Carlo particle in cell (PIC) method. Interactions between M and g are mediated by mean fields and simulated collisions. Computational resources are reallocated by (de-)thermalization processes that move particles from g to M and vice versa. We present a new algorithm for performing these (de-)thermalizations that is more accurate and rigorously justifiable than previous efforts. This new algorithm assigns a passive scalar to each simulated particle that approximates a "relative entropy." Particles are thermalized (dethermalized) when this quantity is sufficiently small (large). We present results from numerical simulations of two test problems - a two temperature Maxwellian and a bump-on-tail distribution, finding a computational savings between a factor of 5 and 20 over PIC.

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