Verification of Collisional Models in the Aleph PIC-DSMC Code

JEREMIAH BOERNER, JOSE PACHECO, ANNE GRILLET, Sandia National Laboratories — Particle collisions play several important roles in plasma applications. Excitation and ionization collisions generate the plasma using kinetic energy extracted from applied electric fields. Elastic and inelastic collisions diffuse the flux of momentum and energy in charged and neutral species. Relaxation and recombination collisions often emit light, which enables a variety of experimental diagnostics. Therefore, high fidelity plasma models require accurate methods for simulating collisional dynamics. This work verifies key aspects of the collisional interaction algorithms in Aleph through a series of validation tests. Aleph is a massively parallel, 3D unstructured mesh, Particle-in-Cell (PIC) code, developed to model low temperature plasma applications. The interaction rates and particle selection methods are verified for Direct Simulation Monte Carlo (DSMC) two body interactions, three body interactions, and one body spontaneous reactions. The scattering kernels are verified for uniform isotropic and anisotropic screened Coulomb models. Favorable comparisons establish confidence in Aleph's capability to accurately model the suite of particle collisions.

Jeremiah Boerner
Sandia National Laboratories

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