Modeling Partially-Collisional Plasmas using Finite-size Particles with Internal Dynamics*

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We report recent results from our effort to develop "smart" particle methods. Unlike traditional PIC particles, the CPK (Complex Particle Kinetics) algorithm [1] allows particles with a Gaussian spatial profile and a Mawellian velocity distribution to evolve self-consistently. These particles are then split spatially and/or in velocity to probe for emerging features as the simulation progresses. Aggressive merging is employed to control the number of simulation particles. An algorithm for modeling collisional plasmas using point particles with Maxwellian velocity distributions has been developed and reproduces known Monte-Carlo PIC results with less noise and significantly fewer particles[2]. The combination of the CPK algorithm with our new collision algorithm should allow simulation of plasmas in the previously cost-prohibitive partially-collisional regime. Results from one-dimensional simulations will be compared to experimental data and 2 and 3-D results will be discussed.

[1] D.W. Hewett, "Fragmentation, merging, and internal dynamics for PIC simulation with finite size particles," accepted by *J. Comp. Phys*. (2003).

[2] D. J. Larson, "A Coulomb Collision Model for PIC Plasma Simulation," accepted by *J. Comp. Phys*. (2003).

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