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Direct continuum Boltzmann solver using spherical harmonic expansion[1] STEPHEN SWANEKAMP, DAVID KESSLER, ANDREW (STEVE) RICHARDSON, TZVETLINA PETROVA, Naval Research Laboratory, PLASMA PHYSICS DIVISION AND LABORATORY FOR COMPUTATIONAL PHYSICS TEAM — Low temperature, highly collisional plasma have many important applications including the interaction of the solar wind and coronal mass ejections with the atmosphere, biological applications, and the propagation of intense electron beams in rarefied gas. Modeling these plasmas involves the coupling of a model for the plasma dynamics with Maxwell's equations for determining the self-consistent electromagnetic fields. When the collisional mean-free path is small compared to gradient scale lengths, a fluid model can be used to treat the plasma dynamics. In the opposite limit, a kinetic model is required. A particle-in-cell (PIC) solver coupled with a Monte-Carlo collision algorithm is a common approach when a kinetic model is required. However, scattering collisions keep the velocity-space distribution nearly spherical, which can require thousands of particles per cell to adequately represent the distribution function. Alternatively, the Boltzmann equation can be solved directly on a six-dimensional grid. However, for highly collisional plasma with a nearly spherical velocity distribution, spectral methods based on spherical harmonics are attractive.

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