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Comparison of velocity distribution function errors introduced by particle reweighting schemes in PIC-DSMC simulations[1] CHRISTOPHER MOORE, JEREMY BOERNER, STAN MOORE, KEITH CARTWRIGHT, TIMOTHY POINTON, Sandia Natl Labs — Many PIC simulations span many orders of magnitude in the plasma density and therefore a constant particle weight results in too few particles in regions (or time periods) of low density or too many particles when the density is high. The standard solution is to employ a reweighting scheme in which low-weight particles are merged in order to keep the number of particles per cell roughly constant while conserving mass and momentum. Unfortunately merger schemes distort a general velocity distribution function (VDF) of particles (one can conserve arbitrarily higher moments such as energy flux by merging N to M particles for N>M>1) and often merge routines act like artificial collisions that thermalize the distribution and lead to simulation error. We will compare the accuracy of the unique reweighting scheme used in our PIC-DSMC code and common reweighting schemes (e.g. redrawing from a constructed VDF or rouletting) through two benchmarks. The first compares the time varying VDF from various merge routines to an analytic solution for relaxation of a bimodal VDF to a Maxwellian through elastic collisions. The second benchmark compares error introduced in the VDF due to merging electrons during a breakdown simulation.

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