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Numerical parameter constraints for accurate PIC-DSMC simulation of breakdown from arc initiation to stable arcs[1] CHRISTOPHER MOORE, MATTHEW HOPKINS, STAN MOORE, JEREMIAH BOERNER, KEITH CARTWRIGHT, Sandia Natl Labs — Simulation of breakdown is important for understanding and designing a variety of applications such as mitigating undesirable discharge events. Such simulations need to be accurate through early time arc initiation to late time stable arc behavior. Here we examine constraints on the timestep and mesh size required for arc simulations using the particle-in-cell (PIC) method with direct simulation Monte Carlo (DMSC) collisions. Accurate simulation of electron avalanche across a fixed voltage drop and constant neutral density (reduced field of 1000 Td) was found to require a timestep $\sim 1/100$ of the mean time between collisions and a mesh size $\sim 1/25$ the mean free path. These constraints are much smaller than the typical PIC-DSMC requirements for timestep and mesh size. Both constraints are related to the fact that charged particles are accelerated by the external field. Thus gradients in the electron energy distribution function can exist at scales smaller than the mean free path and these must be resolved by the mesh size for accurate collision rates. Additionally, the timestep must be small enough that the particle energy change due to the fields be small in order to capture gradients in the cross sections versus energy.

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