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Trajectory calculations of ion collection rates, forces, and energies on dust particles for finite ion inertia and mobility[1] TOSHISATO ONO, CHRISTOPHER HOGAN, UWE KORTSHAGEN, Department of Mechanical Engineering, University of Minnesota, Twin Cites — The charging and forces on dust particles near the edge of the plasma sheath are of interest for applications in the mitigation of contamination issues in semiconductor processing. In this work, the ion collection rate, force, and energy on negatively charged particles in an intermediate collisional regime are calculated using ion trajectory models accounting for a linear external field in the plasma sheath, ion inertia, and finite ion mobility. We show that in this system, dimensionless collision rates, forces, and incoming energies are dependent on the dimensionless external field strength (normalized by particle charge induced field) and an ion Stokes number, defining the ratio of ion inertia to gas resistance to motion. Results show that ion Stokes number has a drastic effect on collision rates, with a reduced effect on collection force and energy transfer. Interestingly at Stokes numbers above unity, ions adopt orbiting trajectories around particles with finite numbers of rotation before colliding or leaving the domain. Such orbits are observed over narrow impact parameter ranges. While individual ions can contribute negative momentum transfer to particles, in all cases, we find that the collection force is positive in the direction of initial ion flow.

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