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Plasma Characteristics Revealed Through Dust Dynamics[1]

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The plasma characteristics within a sheath near a charged boundary are difficult to determine experimentally, as most probes perturb the sheath structure they are intended to measure. However, micron-sized dust grains can be levitated within the sheath with minimal perturbative effects. The charged dust can self-assemble into ordered structures which are very sensitive to changes in the confining electric fields. The dynamics of the grains can be used to map the forces due to electric fields present in the sheath, but the particle charge and electric field are difficult to measure independently. The problem is further complicated by the ion wake field which develops downstream of the dust grains in a flowing plasma. Here we use a molecular dynamics simulation of ion flow past dust grains to investigate the interaction between the charged dust particles and ions. The charging and dynamics of the grains are coupled self-consistently and derived from the ion-dust interactions. Comparison of the modeled dust-plasma interactions with experimental data allows determination of quantities such as the charge on individual grains, the electric field within the region, the ion density, and the ion flow velocity.

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