

Abstract Submitted
for the DPP11 Meeting of
The American Physical Society

Ion Collection by a Sphere in a Magnetized Collisional Plasma¹

CHRISTIAN BERNT HAAKONSEN, IAN H. HUTCHINSON, MIT PSFC — Ion collection by a dust grain in a plasma is important in determining its charging and dynamics. In particular, the (local) floating potential on the grain's surface tends to that which balances the electron and ion currents, thus determining the grain's equilibrium surface charge (distribution). In tenuous plasmas with background magnetic fields the electron currents are affected by the magnetic field if the electron Larmor radius is comparable to or smaller than the size of the grain. This alters the floating potential, and thus ion collection. Strong magnetic fields may even give ion Larmor radii comparable to the grain size, further affecting collection. Examples of dust grains in such tenuous magnetized plasmas may include areas (e.g.) behind tokamak divertor plates, or dedicated dusty-plasma experiments with strong magnetic fields. The hybrid particle-in-cell (PIC) code SCEPTIC3D is used to study ion collection by a sphere in a magnetized collisional plasma. The collection by conducting and insulating spheres is examined, especially the effects of magnetization and charge-exchange collisions on the electron and ion currents to the sphere.

¹C.B. Haakonsen was supported in part by NSF/DOE Grant No. DE-FG02-06ER54512, and in part by an SCGF award administered by ORISE under DOE Contract No. DE-AC05-06OR23100.

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Date submitted: 14 Jul 2011

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