Abstract Submitted
for the DPP08 Meeting of
The American Physical Society

Magnetized ion collection by oblique surfaces including self-consistent drifts: Mach-probes of arbitrary shape I.H. HUTCHINSON, MIT Plasma Science and Fusion Center — A complete analytic theory for magnetized Mach-probes, when cross-field diffusion is neglected, is presented. It is shown that the full self-consistent quasi-neutral fluid drift equations around an ion-collecting probe of arbitrary 3-D shape, in a magnetized isothermal plasma with background parallel and perpendicular flow, can be solved exactly. The resulting flux to the probe (per unit area perpendicular to B) is $n_\infty c_s \exp(-1 - M_\parallel + M_\perp \cot\theta)$, where θ is the angle between the surface and B in the plane of background-drift. This exponential dependence is in good agreement with prior numerical fits of the diffusive case. The (background) perpendicular Mach number, $M_\perp$, is that arising from the sum of ExB and, counter-intuitively, *electron* (not ion) diamagnetic drifts. Fluid displacements in the magnetic presheath are important, and included in this expression, but give rise to small additional terms at some orientations. Temperature-gradient diamagnetic drifts can be added, but only approximately: both electron and ion drifts contribute. Corrections of order Larmor radius divided by electrode-dimensions are also evaluated. They can bias the results for small probes.

Ian Hutchinson
MIT

Date submitted: 11 Jul 2008 Electronic form version 1.4