Abstract Submitted
for the DPP10 Meeting of
The American Physical Society

Axisymmetric Bernstein modes in a non-neutral plasma: Boundary conditions and 6/7 of the Brillouin limit GRANT W. HART, ROSS L. SPENCER, Brigham Young University — Axisymmetric Bernstein modes exist in a cylindrical non-neutral plasma in the vicinity of the cyclotron frequency. Using a kinetic-theory model we have analyzed the theory of these modes in a rigid-rotor thermal equilibrium. We find that in the central region of the plasma (where the density is constant) the perturbed velocity is proportional to the Bessel function $\mathrm{J}_1(kr)$, with k having a distinct value for each mode. There are two distinct modes with separate ωs for each k. We have improved our simulation of these modes in our $r - \theta$ PIC code by finding a set of parameters where we can both resolve the Debye length and avoid Landau damping of the modes. We find that in a thermal equilibrium plasma the perturbed velocity closely matches this $\mathrm{J}_1(kr)$ in the interior of the plasma. The dispersion relation derived from the theory also matches the values of ω and k seen in the simulation. We also see the two families of modes in the simulation at different frequencies for the same initial velocity perturbation in the plasma. The boundary conditions that need to be applied to constrain k at the free boundary of the plasma are unclear from the physics and appear to be different for the two modes. The theory also breaks down in a region surrounding 6/7 of the Brillouin limit. Progress in understanding these issues will be discussed.

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Date submitted: 18 Jul 2010 Electronic form version 1.4