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Theory and simulation of m=0 Bernstein modes in a non-neutral plasma GRANT W. HART, ROSS L. SPENCER, M. TAKESHI NAKATA, Brigham Young University — Axisymmetric upper-hybrid oscillations have been known to exist in non-neutral plasmas and FTICR/MS devices for a number of years. However, because they are electrostatic in nature and axisymmetric, they are self-shielding and therefore difficult to detect in long systems. When non-zero temperature is included the modes become analogous to Bernstein modes in slab geometry. 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 (where the density is constant) the perturbed velocity is proportional to the Bessel function $\mathrm{J}_1(\alpha r)$, with α having a distinct value for each mode. We have simulated these modes in our $r-\theta$ particle-in-cell code that includes a full Lorentz-force mover and find that in a mostly flat-top plasma the perturbed velocity closely matches this theoretical prediction. The dispersion relation derived from the theory also matches the values of ω and α seen in the simulation. There are still a few unresolved difficulties with the model. First, it is difficult to find the appropriate boundary condition to apply at the plasma edge. Second, the fundamental mode is undamped but all higher modes appear to be Landau damped. Progress in understanding these issues will be discussed.

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