

MULTIPLE ION VLASOV SIMULATIONS OF THE LOWER
BOUNDARY OF THE AURORAL UPWARD CURRENT REGION

Main, D. M.¹, Newman, D. L.¹, Ergun, R.²

¹Center for Integrated Plasma Studies, University of Colorado, UCB
390

²Laboratory for Atmospheric and Space Physics, 1234 Innovation
Drive, Boulder, Colorado 80303-7814

The upward current region is characterized by a strong anti-earthward ion beam with complimentary earthward travelling electrons. There is usually a density depression known as the auroral cavity associated with the anti-earthward ion beam along with the associated auroral lights at low altitudes caused by the earthward travelling electrons “showering” the upper atmosphere at about 100 km. At the interface between the upper ionosphere and the auroral cavity (between $\sim 3000 - 6000$ km), spacecraft (s/c) measurements indicate that there is usually a strong, localized parallel and perpendicular electric field (on the order of 100 to 500 mV/m). Using the electric field measurements together with the distribution functions measured from the FAST s/c, we have modelled this interface, known as the lower boundary, as a BGK double layer (DL) (Ergun et al., *phys. plasmas*, **9**, 3695-3704, 2002). We then evolve the BGK DL in an open boundary 1-D Vlasov simulation. We have also run simulations using a 2-D magnetized Vlasov simulation with both open and periodic boundary conditions. In 1-D we show that the dominant instability occurs when the slow H^+ acoustic beam mode and the fast O^+ acoustic beam mode couple (Bergman and Lotko, *JGR*, **91**, 7033-7045, 1986). Both O^+ and H^+ have been accelerated through the same potential drop and thus have different beam velocities in the auroral cavity. The linear growth of the $O - H$ instability saturates by trapping of the H^+ which then leads to H^+ phase space holes which propagate anti-earthward up the field line. These ion holes have electric field signatures that are similar to observations. In particular, the size of the holes are consistent with the holes observed by FAST. The ion holes are still seen in 2-D along with strong Bernstein waves in related periodic simulations. The Bernstein waves form after the H^+ holes have formed. There is also a shock type structure which forms in the simulation and propagates toward, and eventually interacts with, the DL. Once the shock type structure hits the DL, the strength of the DL weakens but the DL remains stable. The shock type structure that we see in the simulation may partially explain at least one FAST observation of a parallel electric field which cannot be explained by using a static BGK model. We conclude then that these simulation results are consistent with many features of the auroral cavity that have been observed using the FAST s/c: a strong density depression between the ionosphere and auroral cavity, a strong ion beam persistent for the entire simulation run, ion holes, Bernstein waves and a DL that is stable for the length of the simulation with no signs that it is becoming unstable.

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: main28395

Date Received: September 16, 2005

1. (a) Daniel Main
CIPS
University of Colorado
UCB 390
Boulder, CO
80304 United States
daniel.main@colorado.edu
- (b) 303-492-1398
- (c) (303) 492-0642
2. H - Waves in Plasma
3. (a)
4. C - Contributed Paper, Program
chair: Meers Openheim
5. No special instructions