

Modeling the incoherent scatter radar spectrum perpendicular to \vec{B} and estimation of F-region plasma parameters at Jicamarca

Erhan Kudeki and Marco Milla

Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Illinois, USA

Abstract

Accurate incoherent scatter (IS) F -region plasma drifts are routinely carried out at Jicamarca using antenna beams pointing perpendicular to \vec{B} [Kudeki *et al.*, 1999]. Such measurements are possible because the IS spectrum narrows down considerably at small magnetic aspect angles. In fact, the measured spectra are even narrower than theoretical predictions based on collisionless F -region models and it was recognized only recently that Coulomb collisions need to be included in the theory to achieve a realistic fits to observed spectra. We have extended the collisional F -region model of [Sulzer and González, 1999] to include radar propagation angles perpendicular to \vec{B} . The procedure derives the electron and ion Gordeyev integrals from random 3D trajectories simulated for charged particles embedded in a magnetized plasma with suppressed collective interactions. The trajectories are randomized by Coulomb collisions as described by the Fokker-Planck equation of Rosenbluth *et al.* [1957]. Because of the complicated dependence of the electron Gordeyev integral on different ionospheric parameters, a numerical library of such functions had to be developed for an F -region oxygen plasma. The library spans a set of densities, temperatures, and magnetic fields as needed for Jicamarca F -region applications. The Gordeyev integrals are then utilized in standard IS models [e.g., Kudeki and Milla, 2006] for producing theoretical IS spectra and (north-south baseline) cross-spectra to be fitted to Jicamarca observations. Preliminary results of estimated F -region temperatures will be presented.

References

Kudeki, E., and M. A. Milla, Incoherent scatter spectrum theory for modes propagating perpendicular to the geomagnetic field, *Journal of Geophysical Research*, 111, 1–3, 2006.

- Kudeki, E., S. Bhattacharya, and R. F. Woodman, A new approach in incoherent scatter F region $E \times B$ drift measurements at Jicamarca, *Journal of Geophysical Research*, *104*, 28,145–28,162, 1999.
- Rosenbluth, M. N., W. M. MacDonald, and D. L. Judd, Fokker-planck equation for an inverse-square force, *Physical Review*, *107*, 1–6, 1957.
- Sulzer, M. P., and S. A. González, The effect of electron Coulomb collisions on the incoherent scatter spectrum in the F region at Jicamarca, *Journal of Geophysical Research*, *104*, 22,535–22,551, 1999.