

# Incoherent backscatter radar measurements at Jicamarca with a beam pointed perpendicular to

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**Abstract.** Doppler spectra of 50 MHz F-region incoherent backscattered signals detected at Jicamarca will be presented. The measurements were conducted with the Jicamarca radar beams pointed perpendicular to the ambient magnetic field  $\vec{B}$ . Consequently, the Doppler spectra contain a sharp cusplike feature centered about the bulk  $\vec{E} \times \vec{B}$  velocity of the ionospheric plasma [Kudeki *et al.* 1999]. The overall shape of the spectrum about the mean Doppler velocity represents a beam weighted superposition of incoherent scatter spectra corresponding to small magnetic aspect angles. Incoherent scatter theory based models for the measured spectra indicate that the spectral width is regulated by the electron temperature  $T_e$ . However, unless electron Coulomb collisions are included in the model, unrealistically low  $T_e$  estimates are obtained via model fitting of the measured spectra. The collisions broaden the incoherent scatter spectra at very small magnetic aspect angles (due to cross-field diffusion), but reduce the spectral width at larger aspect angles by reducing the rate of parallel diffusion as pointed out first by Sulzer and Gonzales [1999]. Spectral width reduction due to electron collisions is particularly important in measurements made close to perpendicularity to the ambient magnetic field. As a consequence, estimation of  $T_e$  from incoherent scatter spectra measured at small magnetic aspect angles requires the knowledge of electron collision frequency and plasma density profiles in F-region.

Recent multi-receiver (north-south antenna separation) and dual-polarization (O- and X-mode) F-region incoherent scatter measurements conducted at Jicamarca will be presented. The north-south and O-X cross-spectra of the backscattered signals provide additional information about the ionospheric plasma. Differential phase information extracted from O-X cross-spectra provides estimates of the absolute electron density profiles near the F-region peak. The normalized magnitude of the north-south cross-spectra (coherence) is sensitive to  $T_e/T_i$ . Therefore, joint inversions of the incoherent scatter self- and cross-spectra holds the potential for the estimation of all the state parameters describing the F-region plasma at low-latitudes.

## References

- Kudeki, E., S. Bhattacharyya, and R. F. Woodman, *J. Geophys. Res.*, **107**, 1999.
- Sulzer, M. P., and S. A. Gonzales, The effect of electron coulomb collisions on the incoherent scatter spectrum in the f region at jicamarca, *J. Geophys. Res.*, **104A**, 22,535, 1999.

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