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Observations of a phase transition in the plasma characteristics across the HF radar spectral width boundary

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SuperDARN radars routinely observe a distinct transition from large spectral widths located at higher latitudes to low spectral widths located at lower latitudes. Because of its equatorward location, TIGER is very sensitive to the detection of spectral width boundaries (SWBs) in the nightside auroral ionosphere. These SWBs are often a reasonable proxy for the open-closed magnetic field line boundary in the pre-midnight sector, but not so in the dawn sector. The SWBs may actually be a better proxy for a transition in the height integrated Pedersen conductivity (1). Two-dimensional velocities estimated using the beam-swinging technique suggest the meso-scale (~100 km) convection is bursty in the high spectral width region, but slower and more laminar in the low spectral width region. Application of a Burg-type maximum entropy method suggests the occurrence of multi-peaked Doppler spectra is far greater in the high spectral width region, implying the concentration of small-scale (~10 km) circulation. Finally, the FITACF results show the large spectral width regions are dominated by Lorentzian Doppler spectra and the low spectral width regions are dominated by Gaussian spectra. Combined, these observations imply a phase transition from fast flowing, turbulent plasma with a correlation length of velocity fluctuations less than the scattering wavelength to a slower moving plasma with a correlation length greater than the scattering wavelength. The large conductivity of nightside auroral oval probably contributes to the formation of the phase transition, since enhanced Pedersen conductance acts like a low pass filter for electric field fluctuations mapping from the central plasma sheet.

(1) Parkinson, M. L., Chisham, G., Pinnock, M., Dyson, P. L., and Devlin, J. C.: Magnetic local time, substorm, and particle precipitation-related variations in the behaviour of SuperDARN Doppler spectral widths, *Annales Geophysicae*, 22, pp. 4103-4122, 2004.