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Plasma Physics of the Subauroral Geospace

Abstract: A review is given of the current state-of-the-art of experimental studies and the theoretical understanding of meso- and small-scale structure of the subauroral geospace, connecting ionospheric structures to plasma wave processes in the turbulent plasmasphere boundary layer (TPBL). Free energy for plasma waves comes from diamagnetic electron and ion currents in the entry layer near the plasma sheet boundary and near the TPBL inner boundary, respectively, and anisotropic distributions of energetic ions inside the TPBL and interior to the inner boundary. Collisionless heating of the plasmaspheric particles gives downward heat and suprathermal electron fluxes sufficient to provide the F-region electron temperature greater than 6000 K. This leads to the formation of specific density troughs in the ionospheric regions in the absence of strong electric fields and upward plasma flows. Small-scale MHD wave structures (SAPSWS) and irregular density troughs emerge on the duskside, coincident with the substorm current wedge development. Numerical simulations show that the ionospheric feedback instability significantly contributes to the SAPSWS formation. Antiparallel temperature and density gradients inside the subauroral troughs lead to the temperature gradient instability. The latter and the gradient-drift instability lead to enhanced decameter-scale irregularities responsible for subauroral HF radar backscatter.