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(I) Extreme plasma heating and flows in Earth's ionosphere

Tuesday, 7 June 2022 11:45 (30 minutes)

During quiet times, Earth's ionosphere is characterized by relatively cool temperatures of 2,000 K (~0.2 eV) and less. However, the ionosphere can be highly disturbed in the presence of the aurora, which during active periods deposits hundreds of GW into the high-latitude atmosphere via the ionosphere. This energy comes from the magnetosphere in the form charged particle precipitation, Joule or frictional heating in the lower ionosphere, and wave-particle interactions at higher altitudes. The latter pathway can result in ion temperatures of the order of a million K –comparable the temperature of the solar corona. While such extremes have been measured for many decades in the magnetosphere, until recently they were not reported below 500 km altitude –within the main ionosphere –presumably due to damping and dissipation caused by collisional interaction with the neutral atmosphere. However, high-time-resolution imaging of particle distribution functions made possible by the Swarm and ePOP satellite missions has in fact revealed the presence of extreme temperatures within the main ionosphere (Shen et al.,2018) - typically in highly localized regions of the order or less than 1 km wide, which are traversed in only a fraction of a second by a satellite in low Earth orbit. This talk will describe a new generation of particle instrument that has made possible the detection and characterization of these extreme regions, and their importance to geophysics and plasma physics.

Shen, Y. et al. (2018). Low-altitude ion heating, downflowing ions, and BBELF waves in the return current region. Journal of Geophysical Research: Space Physics, 123(4), pp.3087-3110.

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