PHYSICS OF REGION-2 CURRENTS

RICHARD WOLF

Rice University, Houston, Texas, USA, email:rawolf@rice.edu

A tutorial will be presented on the physics of region-2 currents, based primarily on results from the Rice Convection Model (RCM), which uses the Vasyliunas equation to calculate the currents from the computed pressure gradient and a magnetic field model. In self-consistent calculations like the RCM, the gradient of pressure or entropy at the inner edge of the plasma sheet drives Birkeland currents that act to shield the region earthward and equatorward of it from the full force of magnetospheric convection. However, the shielding is only partial and is particularly ineffective in times when the interplanetary magnetic field is strongly southward or is rapidly varying in time. The electric field that leaks through the shielding is called the prompt-penetration electric field and can have dramatic effects on the structure of the low-latitude ionosphere. Its observed characteristics are reasonably consistent with RCM results. RCM simulations also suggest that region-2 currents also play an important role in determining the structure of Sub-Auroral Polarization Stream (SAPS), Polarization Jet (PJ), and Sub-Auroral Ionization Drift (SAID) events, which occur just equatorward of the diffuse aurora. Two physical mechanisms will be discussed for the formation of the Harang discontinuity, which lies near local midnight and adjacent to the region-2 currents. The effects of plasma-sheet inhomogeneities on auroral Birkeland currents and electric fields will also be discussed. Flux tubes of reduced entropy, usually called "bubbles", move earthward and equatorward through the plasma sheet and auroral zone, disturbing the region-2 currents when they encounter the inner edge of the plasma sheet. It is suggested that the interaction of the bubble with the region-2 currents affects the injection of particles to the geosynchronous-orbit region during a substorm.

Plasma sheet, Birkeland currents, convection

Richard Wolf, Physics and Astronomy Dept., Rice University MS108, P. O. Box 1892, Houston, TX 77251,