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Michigan Institute for Plasma Science and Engineering

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Plasma Irregularities in the Earth's Ionosphere and Plasmasphere

Plasma irregularities in the ionosphere and plasmasphere can adversely affect space-based communication and navigation systems. Even with research for over 50 years to understand the generation mechanism(s) of these irregularities, uncertainties remain. Plasma irregularities often occur in the post-sunset, ionosphere equatorial *F* region broadening in altitude over tens of kilometers due to formation of 'electron clouds with scale sizes of 30 meters' – equatorial spread *F* (ESF). Subsequent observational data find ESF to be a complex phenomenon that involves a wide range of spatial and temporal scales: from 10s km to 10s cm and from 10s min to 10s msec producing large-scale electron density 'bubbles' or 'plumes' that develop in nighttime equatorial ionosphere. We will use the first-principles whole atmosphere models WACCM-X and HIAMCM coupled to the ionosphere/plasmasphere model SAMI3 to investigate the onset and evolution of equatorial spread F on a global scale. The earth's plasmasphere is a cold, relatively dense plasma on closed magnetic field lines extending from ~ 1000 km to several earth radii. Although this region has often been considered to be quiescent, observations suggest that it is often times structured with plasma ducts. The underlying mechanism(s) to generate these ducts is unclear. Again, we will use WACCM-X and HIAMCM coupled SAMI3 to investigate the development of plasmasphere ducts and longitudinal corrugations in the plasmasphere density.

About the Speaker: Dr. Joseph Huba is a Vice President at Syntek Technologies. Dr. Huba was at the Naval Research Laboratory as a NRC/NRL post-doc (1975 - 1977), contractor (1977 - 1981), and federal employee (1981 - 2018). He was Head of the Space Plasma Physics Section of the Beam Physics Branch at the Naval Research Laboratory (1995-2018) and Head of the Geophysical and Plasma Dynamics Branch at the Naval Research Laboratory from 1983 until 1989. His current research interests include the study of ionospheric and magnetospheric processes and modeling the earth's ionosphere/plasmasphere system. He has performed numerous linear and nonlinear studies of a wide variety of plasma instabilities (most notably the lower-hybrid-drift instability). He has written a 3D Hall MHD code (VooDoo) based upon a novel algorithm that he developed to study 2D and 3D Hall magnetic reconnection physics. He has developed (with Dr. G. Joyce) the NRL ionosphere/plasmasphere models SAMI2 and SAMI3 and promoted the SAMI2 Open Source Project. Dr. Huba has over 240 publications in refereed journals in these areas.