OSS09-2009-000004

Abstract for an Invited Paper
for the OSS09 Meeting of
the American Physical Society

Magnetosphere Imaging - the Era of Space Weather Maps

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The Earth's magnetosphere is a dynamic structure that is driven by events on the Sun through its interaction with the solar wind. Until recently, the bulk of the magnetosphere (ionized hydrogen) could not be remotely imaged. Instead, our understanding of magnetospheric structure and dynamics was pieced together by years of measurements from individual spacecraft scattered throughout the magnetosphere. In this talk, I will describe a relatively new method of remotely imaging magnetospheric plasmas. The technique is based on the detection and imaging of neutral atom emission, i.e., particle instead of photon imaging. Neutral atom imagers are currently in orbit around the Earth and Saturn. I will present recent measurements from the terrestrial imagers and discuss how the ion temperature of the magnetospheric plasma can be determined from the neutral atom emission. Weak neutral atom emission during quiet, less active, intervals is problematic for remote ion temperature measurements. However, using a superposed-epoch analysis and a novel image-summing algorithm, it is possible to image the quiet time magnetosphere. The evolution of the inner ring current, ion temperature, and plasmasheet structure as a function of magnetospheric activity, as well as the implications for space weather forecasting, will be reviewed.