Seeing the Invisible

Last year, NASA launched the Imager for Magnetopause-to-Auroral Global Exploration (IMAGE) spacecraft into orbit around the Earth. Since then, IMAGE scientists, led by mission principal investigator Dr. Jim Burch of Southwest Research Institute, have been analyzing data from this first-of-its-kind spacecraft. IMAGE's mission is to obtain pictures of the plasma that surrounds the Earth, particularly the plasma trapped by the Earth's magnetic fields, the magnetosphere. Aboard IMAGE are six instruments, each of which is designed to image the magnetosphere using distinctly different techniques. Three of the instruments rely on the detection and imaging of neutral atoms emitted by the magnetosphere to create pictures of the plasma. The neutral atoms are created when fast moving plasma ions strike cold, neutral atoms at the upper edge of the Earth's atmosphere. The fast ions steal electrons from the neutral atoms and become neutral themselves. By recording the intensity and direction of such neutral atom emission, images of the plasma can be created. Using neutral atom emission to remotely measure plasma properties was first developed for magnetic fusion experiments in the 60's and 70's. Recently, members of the Medium Energy Neutral Atom (MENA) imager team working with Professor Earl Scime of West Virginia University have demonstrated that it is possible to use MENA data to remotely measure the ion temperature of the plasma in the inner magnetosphere. The measured ion temperatures are in good agreement with temperature measurements made by spacecraft passing through the regions of space remotely imaged by the MENA instrument. This work demonstrates that neutral atom imaging from a single spacecraft can provide quantitative measurements of basic plasma properties over all of the inner magnetosphere. Such information can be used to improve models of magnetospheric behavior as scientists work towards a deeper understanding of the dynamics of the near-Earth space environment, i.e., "space weather." The MENA instrument principal investigator is Dr. Craig Pollock of Southwest Research Institute. Papers VP1.080 - Contact Earl Scime, WVU (304-293-3422, escime@wvu.edu), Craig Pollock, SWRI (cpollock@swri.edu).

Figure 1. Twenty minute (10 spins of IMAGE) averaged ion temperature images from the MENA instrument on August 12, 2000. The black circle in the center of each image indicates Earth. Geomagnetic dipole field lines are shown at MLT = 6, 12, 18, and 24 hours and L = 4 and L = 8. The noon field lines are drawn in red and the grid pattern corresponds to the azimuthal and polar angles of the MENA instrument data bins. The solid black dot and line indicates the location of the 1994-84 MPA spacecraft at 12:00 UT. The remotely measured ion temperatures agree with the local MPA spacecraft measurements.