Missing Link Magnetosphere-Ionosphere Imager (MiLiMII)

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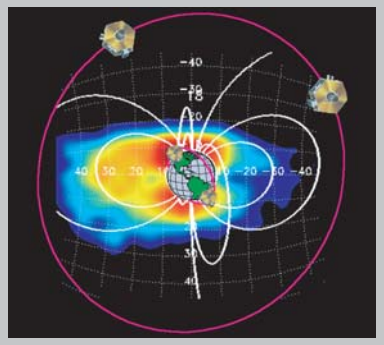
MISSION



STRATEGY

- Two high altitude spacecraft with global ENA and EUV imaging magnetosphere, and high resolution global spectroscopic FUV imaging of the I-T system
- Ground radar measurements coordinated with space-based sensors

MISSION DESCRIPTION

ORBIT: 2 spacecraft in ~8 R_E circular orbit, 75-90 deg inclination
LIFETIME: 2 year life, 5 year goal
PAYLOAD:
- 2-4 Imaging instruments nadir pointing
- Ground-based radar network covers 30 to 90 deg north (and south?) latitudes
- Low Altitude Spacecraft Data as Available

GLOBAL

Global imaging tecniques to investigate the magnetosphere-ionosphere-thermosphere as one coupled system.

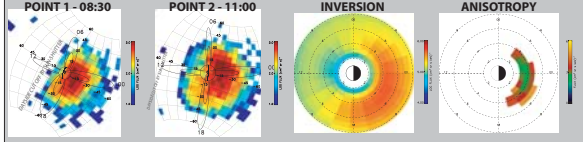
CONTINUOUS

High circular orbit outside radiation belts allows continuous imaging throughouts storms. Due to the radiation belts, only about a third of one given storm can be imaged by the IMAGE mission.

MULTIPOINT

Multiple vantage point allows continuous coverage and increased information about anisotropic ion distributions through ENA imaging.

TEST WITH IMAGE/HENA NIGHTSIDE RING CURRENT



A constrained linear inversion technique was applied to several IMAGE/HENA images obtained from multiple vantage points at 08:00-11:00 UT 17 April 2002. The technique allows the pitch-angle information to be retrieved. The obtained anisotropy (J_perp/J_para) inside the 30% errorcontour is shown to the right. The obtained anisotropy of ~2 agrees well with independent observations.

SCIENCE

Understand the large scale electrodynamics of the middle-inner magnetosphere/ionosphere system.

DISCOVERING GLOBAL CONNECTIONS

The ionosphere, plasmasphere, ring current and radiation belt are components of one coupled system, thatcannot be understood by its components alone. Global, simultaneous and continuous information about the ELECTRIC and MAGNETIC FIELD, PLASMASPHERE, RING CURRENT PRESSURE, AND IONOSPHERIC CONDUCTIVITY are required to understand it. Global imaging tools are in place to retrieve global information about these quantities.

SCIENCE QUESTIONS

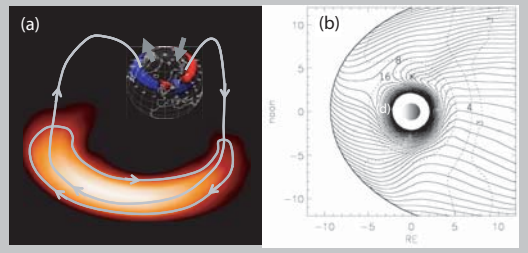
1. What is the dynamic linkage between middle-inner magnetospheric convection electric fields and the ionospheric conductivity?

2. How is plasma energized and transported into the inner magnetosphere?

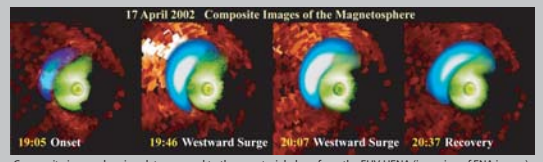
3. How does the ionosphere/thermosphere respond to magnetospheric electromagnetic forcing?

4. What are the essential aspects of inter-hemispherical auroral non-conjugacy and what are their implications for fundamental magnetospheric dynamics?

COUPLING IN THE INNER MAGNETOSPHERE



Pressure driven currents (a) close through the ionosphere which modifies the electric field of the inner magnetosphere (b). The electric field depends on the ionospheric conductivity distribution, which in turn depends on the external energy input such as the auroral precipitation and solar EUV flux. The electric field also depends on how the pressure driven currents close through the ionosphere. Our current understanding of the electric field of the inner magnetosphere is based on plasmasphere and ring current observations from IMAGE and modeling (b).



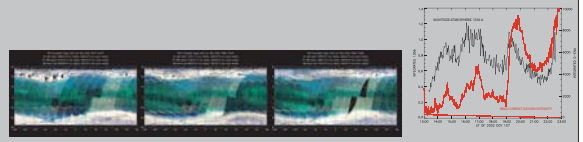
Composite image showing data mapped to the equatorial plane from the FUV, HENA (inversion of ENA image), and EUV imagers on board IMAGE. The sun is to the right. This event illustrates the coupling at work: The outer layers of the evening side plasmasphere (green) are "scraped" off in a westward motion. The ring current (blue) and the aurora (red) show intensifications and simultaneous westward motion. This is due to a complex interplay between the pressure driven currents (ring current closure) and the conductivity set up by the auroral precipitation, as well as the substorm induced transient electric field set up by the magnetic dipolarization. Without imaging, this connection would have been impossible to discover.

SCIENCE...

RADIATION BELT COUPLING

- Radiation belt energization and loss depends on wave-particle interactions at the plasmapause. Therefore, the plasmaspheric distribution is essential input for understanding when and where radiation belt energization and loss takes place.
- Waves (EMIC, chorus) are generated in the vicinity of the plasmapause by keV ions and electrons injected into the inner magnetosphere. Therefore, the global electric and magnetic field is essential to understand where the keV ions interact with the plasmasphere to generate waves.
- The drift of radiation belt particles are governed by the magnetic field. The magnetic field of the inner magnetosphere is governed to a large extent by the ring current pressure. During the main-phase the radiation belts move outward due to the increasing ring current pressure, and move in during the recovery. This constitutes an adiabatic effect, which is essential to separate from the non-adiabatic energization effects. An accurate global magnetic field is required.

IONOSPHERE AND ATMOSPHERE



REQUIREMENTS

QUANTITY	**ELECTRIC FIELD** **PLASMASPHERE DENSITY**	**RING CURRENT PRESSURE**	**IONOSPHERIC/ THERMOSPHERIC PLASMA MOTIONS** **CONDUCTIVITY** **AURORA**
MEASUREMENT	**EUV** - Continuous dual point imaging - 60 s time resolution - FOV and sensitivity sufficient for L<8	**ENA** - Continuous dual point imaging - 2° angular resolution - 30 s time resolution - H, O mass resolution - 3-300 keV/nucleon	**FUV** - LBH-short: 15 km, 10 s, 10 R - LBH-long: 15 km, 10 s, 10 R - 1356 A: 10 km, 10 s, 10 R - Ly-alpha: 100 km, 60 s, 100 R
TECHNOLOGY	**EUV** - Improved mirrors - Extended FOV	**ENA** - Improved UV rejection - Increased G-factor - Thin foils	**FUV** - Compacter design - Increased sensitivity