Project Details

ROSES ID: NNH06ZDA001N
Selection Year: 2007
Program Element: Independent Investigation

Topic: Investigate the Global Distribution, Sources and Effects of Large Electron Density Gradients at Middle and Low Latitudes

Project Title:
Advanced computer modeling of the lunar plasma environment in the dynamic terrestrial magnetosphere

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Summary:
This proposal seeks to use an advanced 3D multi-fluid model in conjunction with Lunar Prospector data to quantify the plasma environment when the Moon is in the Earth's magnetotail from quiet to storm conditions. The proposed work seeks use Lunar Prospector data from the magnetometer/electron reflectometer (MAG/ER) to first quantitatively validate the modeling and then develop a full 3D perspective of the Moon's near space environment under varying conditions within the Earth's magnetosphere. The multi-fluid model incorporates ion cyclotron and multi-ion species effects similar to hybrid codes but the fluid treatment enables grid refinement down to as small as 10 km can be achieved (or nearly an order of magnitude better hybrid codes). This high resolution is unique to the multi-fluid modeling, and will allow for incorporation of the lunar magnetic anomalies to determine how they modify plasma transport and acceleration on the back side of the Moon. The multi-fluid treatment is able to generate electron spectrogram to enhance comparison with data and is also able to incorporate the mixing of the different ions species, observations that Lunar Prospector was unable to make. These capabilities are unique to the proposed work and through the proposed data/model synthesis, we can develop a global 3D picture of the Moon/Earth interaction out of 1D satellite traces that will address three critical questions:

1. What are the the composition, energy, density, and velocity of ions near the Moon for (a) quiet conditions and (b) sub-storm/storm conditions?

2. What is the overall geometry of the cavity and wake region of the Moon, specifically what are the asymmetries of the wake for different incident terrestrial magnetospheric plasma conditions?

3. What role, if any, do the magnetic anomalies play in modifying the above?

This work addresses Strategic Sub-goal 3B by developing an understanding of the space environment around the Moon and the plasma acceleration processes that can lead to energetic particle populations in this region. The work also addresses Strategic Sub-goal 3C by quantifying potential radiation hazards with regard to human habitation on the Moon.

Publication References:

Summary: no summary

Reference: Winglee, R. M.; Harnett, E. M.; (2007), Radiation mitigation at the Moon by the terrestrial magnetosphere, Geophysical Research Letters, Volume 34, Issue 21, CiteID L21103, doi: 10.1029/2007GL030507

Summary: no summary

Reference: Harnett, E. M.; (2010), Deflection and enhancement of solar energy particle flux at the Moon by structures within the terrestrial magnetosphere, Journal of Geophysical Research: Space Physics, Volume 115, Issue A1, CiteID A01210, doi:

10.1029/2009JA014209