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Shielding efficiency of lunar magnetic anomalies: Observations from SARA on board Chandrayaan-1

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Abstract

SARA produced the first image of a mini-magneto-sphere above a lunar magnetic anomaly using energetic neutral atoms. It was shown that this magnetosphere is able to reduce the impinging solar wind flux onto the surface by more than 50%. Having analyzed all available observations by SARA, we report on the shielding efficiency of these anomalies by presenting correlations between solar wind flux, local magnetic field strength and reduction in reflected flux.

1. Introduction

SARA (the Sub-keV Atom Reflecting Analyser), is an energetic neutral mass spectrometer on board Chandrayaan-1 and measured concurrently the solar wind ions precipitating onto the lunar surface and the neutrals which are reflected back. Wieser et al. (2009) presented SARA data showing that up to 20% of the impinging solar wind ions are reflected back as energetic hydrogen atoms [1]. Lin et al. predicted that local magnetic anomalies could shield the lunar surface from the impinging solar wind ions [2]. Wieser et al. confirmed these predictions by presenting the first image of a mini-magnetosphere above a lunar magnetic anomaly using energetic neutral atoms [3].

2. Observations

During the Chandrayaan-1 mission SARA observed 15 different magnetic anomalies. Lunar Prospector measured maximal field strengths from < 10 nT to 30 nT in these regions. The solar wind dynamic pressure for the time intervals, during which these anomalies were observed, ranges from less than one nPa to several nPa, according to WIND measurements.

3. Results

There is a clear correlation between the magnetic field strength, the solar wind dynamic pressure and the shielding efficiency. Our results show that the stronger the magnetic field and the lower the solar wind dynamic pressure the bigger the shielding efficiency. For a strong magnetic field and a relatively low solar wind pressure, a shielding efficiency of up to ~70 % is observed. On the other hand, if the magnetic field of the anomaly is relatively weak or the solar wind pressure is very strong, the shielding efficiency can be reduced to a point where no reduction in reflected flux is observable at all.

4. Summary and Conclusions

We present the first statistical analysis of the shielding efficiency of lunar local magnetic anomalies against solar wind. A strong correlation between the field strength, the solar wind dynamic pressure and the reduction in flux is reported.

References

[1] Wieser et al.: Extremely high hydrogen reflection from regolith in space, Planetary and Space Science, Vol. 57, pp. 2132-2134, 2009.

[2] Lin et al.: Lunar surface magnetic fields and their interaction with the solar wind: Results from Lunar Prospector, Science, Vol. 281, pp. 1480-1484, 1998.

[3] Wieser et al.: First observation of a mini-magnetosphere above a lunar magnetic anomaly using energetic neutral atoms, Geophysical Research Letters, Vol. 37, 2010.