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Global influence of lunar crustal fields on the solar wind flow

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The Moon has neither a strong, global magnetic field nor a dense atmosphere, and the solar wind is mainly absorbed by the lunar regolith. However, there are regions of magnetized crust, called magnetic anomalies. Various in-orbit measurements by plasma and magnetic field instrument have indicated that the magnetic anomalies interact with the solar wind. The formation of bow-shocks and plasma voids above the magnetic anomalies were also suggested as well from magnetic field and electron measurement. However, our understanding on the interaction and formation of the mini-magnetosphere is very limited, especially from a perspective of a global picture of the interaction.
In this talk, we discuss the global influence of lunar magnetic anomalies on the solar wind and on the lunar surface, based on maps of solar wind proton fluxes deflected by the magnetic anomalies. The maps are produced using data from the Solar WInd Monitor (SWIM) onboard the Chandrayaan-1 spacecraft. We found very high reflection efficiencies. The estimated reflection efficiency was $\sim$1% if we averaged over the entire farside hemisphere. Over strong magnetic anomaly region (10% of the area), the reflection efficiency was $\sim$10%; and over the strongest region (0.1% of the area), the reflection efficiency reached up to 50%. Reflections are also detected over weak (<3 nT at 30 km altitude) and small-scale (<100 km) magnetic anomalies, which might be explained by charge separation and the resulting electric potential. Strong reflection from a wide area implies that the magnetic anomalies act as a magnetosphere-like obstacle, affecting the upstream solar wind. It also reduces the implantation rate of the solar wind protons to the lunar surface, which may affect space weathering near the magnetic anomalies.