# Mass dependence of solar wind ion reflection over lunar crustal magnetic anomalies

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The Moon is located outside the Earth's magnetosphere at a rate of about 80% except for the full moon period. The solar wind can directly interact with the lunar surface since the Moon has neither thick atmosphere nor global magnetic field. Since the discovery of locally magnetized regions called the lunar magnetic anomalies in 1960s, the interaction between the lunar magnetic anomalies and the solar wind is one of the typical science targets of the lunar plasma environment research. The solar wind consists of H+ as a major component, several percent of He++ as a second major component, and a small amount of heavier ions. It is known that the flux of the magnetically reflected solar wind ions is about ten percent of the incident solar wind ion flux. Although ion mass is an important parameter of the magnetic reflection process, mass dependence of the reflected ions is not known at all.
The purpose of this study is to understand the ion reflection process over lunar magnetic anomalies, using the data obtained by low energy charged particle analyzers MAP-PACE and magnetometer MAP-LMAG on Kaguya.
As a result of the analysis of the reflected ions, we have found that solar wind H+ and He++ are both reflected by magnetic anomalies. Although the reflected ions have higher temperature than the incident solar wind ions, the reflected He++ ions have lower velocity and flux than the reflected H+ ions. The temperature of reflected ions is related to the energy difference between vertical and tangential directions. Since the vertically reflected ions can penetrate to low altitude, the vertically reflected ions are more significantly heated and decelerated than the tangentially reflected ions. It clearly indicates the existence of a non-adiabatic interaction between solar wind ions and lunar magnetic anomalies. Since high energy ions have larger larmor radius, the high energy ions can penetrate deeper into the magnetic anomalies than the low energy ions. Therefore, the amount of the solar wind ions that impact the Moon surface depends on the ion species.
Ion reflection occurs at all astronomical bodies that has intrinsic magnetic field. Lunar magnetic anomaly is one of the examples that have the smallest scale in the solar system. The knowledge acquired by this study is useful not only to understand lunar plasma environment, but also to understand plasma environment around various astronomical bodies.

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