



Moon originating heavy ions associated with CIR

Yoshifumi Saito (1), Shoichiro Yokota (1), Masaki Nishino (2), and Hideo Tsunakawa (3)

(1) Institute of Space and Astronautical Science, STP, Sagami-hara, Kanagawa, Japan (saito@stp.isas.jaxa.jp), (2) Solar-Terrestrial Environment Laboratory, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, JAPAN, (3) Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Meguro-ku, Tokyo, JAPAN.

Existence of a tenuous alkali atmosphere around the Moon was discovered by ground-based optical observations in 1980s. Since then the generation mechanism of the alkali atmosphere has been actively investigated. Currently, photon-stimulated desorption is regarded as the major generation process of the lunar alkali atmosphere such as sodium and potassium. MAP-PACE-IMA on Kaguya found four typical ion populations on the dayside of the Moon. These include (1) solar wind protons backscattered at the lunar surface, (2) solar wind protons reflected by magnetic anomalies on the lunar surface, (3) reflected/backscattered protons picked-up by the solar wind, and (4) ions originating from the lunar surface/lunar exosphere. One of these populations: (4) ions originating from the lunar surface/lunar exosphere usually consisted of heavy ions such as carbon, oxygen, sodium, and potassium. Some of these ions were generated on the lunar surface by photon-stimulated desorption especially for alkali ions such as sodium and potassium and some others were generated by solar wind sputtering. Photo-ionized neutral particles were also included in these ions. These heavy ions were accelerated by the solar wind convection electric field and detected by the ion energy mass spectrometer MAP-PACE-IMA on Kaguya. Since the gyro-radius of these heavy ions was much larger than the Moon, the energy of these ions detected at 100km altitude was in most cases lower than the incident solar wind ion energy.

Two special examples were found where the energy of the heavy ions was higher than the incident solar wind ion energy. These high-energy heavy ions were observed on the dayside of the Moon when CIR (Corotating Interaction Region) passed the Moon. The high energy heavy ions were observed for several hours with the highest heavy ion flux observed when the solar wind pressure increased due to the passage of the CIR. The mass spectrum of the heavy ions observed associated with CIR showed H⁺, He⁺⁺, He⁺, C⁺, O⁺, Na⁺, Mg⁺, Al⁺, K⁺, and Ti⁺. Although many observational features of the alkali ions around the Moon show that the major generation mechanism of the lunar alkali ion is photon-stimulated desorption, existence of the high-energy heavy ions associated with CIR indicates that the contribution of the solar wind sputtering becomes important when the solar wind pressure is high.