Observation of heavy ions around the Moon by KAGUYA MAP-PACE

Takaaki Tanaka[1]; Yoshifumi Saito[2]; Shoichiro Yokota[3]; Kazushi Asamura[3]; Hideo Tsunakawa[4]; Yoshifumi Saito KAGUYA MAP-PACE Team[5]; TSUNAKAWA, Hideo KAGUYA MAP-LMAG Team[5]

[1] Dept. of Earth and Planetary Sci., Tokyo Univ.; [2] ISAS; [3] ISAS/JAXA; [4] Dept. Earth Planet. Sci., Tokyo TECH; [5] -

The Moon is surrounded by extremely tenuous alkali atmosphere. The atmosphere is enough thin to be regarded as exosphere that is called surface-bounded exosphere. It has been observed by ground-based technique on many occasions since its discovery. These observations suggest the existence of sodium or potassium ions originating from the lunar surface and exosphere. However, there has been almost no in-situ observations of these heavy ions by satellite borne plasma analyzers. So far, these ions were measured at several 10s Rm (Moon radius) away from the Moon or farther. In these observations, Na^+ or K^+ whose existence was predicted by ground-based observations was not detected as dominant component of heavy ions from the Moon while O^+, Al^+ or Si^+ group was clearly detected.

Japanese lunar orbiter KAGUYA, which was launched on September 14, 2007, has in-situ plasma analyzers named MAP-PACE (MAgnetic field and Plasma experiment - Plasma energy Angle and Composition Experiment) in order to investigate the plasma environment at 100km altitude around the Moon. IMA (Ion Mass Analyzer), one of the MAP-PACE sensors, has discovered heavy ions that are not contained in the solar wind. In this study, we will report the initial results of the Moon-related heavy ion observation by IMA. When the Moon is in the solar wind, the generated moon-related ions are accelerated and transported by an interplanetary electric field E=-VxB where V is the solar-wind bulk velocity and B the interplanetary magnetic field. Most of these pick-up ions are swept away from the Moon. At 100km altitude, these pick-up ions are presumably not fully accelerated and have the energy below several hundred electron volts under typical solar-wind condition. In order to discriminate the moon-related ions from the solar wind ions, we have selected the low energy data below the energy of the main component of the solar wind. The obtained data shows that IMA has detected heavy ions which contains Na^+/Mg^+ and $Ar^+/K^+/Ca^+$ components when the Moon is in the solar wind. Though we need to carry out accurate quantitative analysis, these Na^+ and K^+ mass group ions are detected as much as O^+ ions. The results are consistent with the past ground-based observations. When the Moon is in the Earth's plasma sheet, we have also found alkali ions. In the plasma sheet, O^+ ions are observed in relatively broad energy range (from several electron volts to several kilo electron volts), and they are the main heavy ion component.