Kaguya observations of the lunar plasma environment in the terrestrial foreshock

Masaki N Nishino[1]; Yoshifumi Saito[2]; Hideo Tsunakawa[3]; Yasunori Tsugawa[4]; Yuki Harada[5]; Futoshi Takahashi[6]; Masaki Fujimoto[7]; Shoichiro Yokota[2]; Masaki Matsushima[8]; Hidetoshi Shibuya[9]; Hisayoshi Shimizu[10]
[1] STEL, Nagoya University; [2] ISAS; [3] Dept. Earth Planet. Sci., Tokyo TECH; [4] STEL, Nagoya Univ.; [5] Dept. of Geophys., Kyoto Univ.; [6] Kyushu Univ.; [7] ISAS, JAXA; [8] Dept Earth & Planetary Sciences, Tokyo Tech; [9] Dep't Earth & Env., Kumamoto Univ.; [10] ERI, University of Tokyo

There forms a tenuous region behind the Moon in the solar wind, as the lunar dayside surface adsorbs most of the incident solar wind plasma. Entry processes of solar wind plasma into this tenuous region, which is called the lunar wake, have been widely studied. In addition to gradual refilling of the wake by the ambient solar wind, it has been known that a portion of solar wind protons that are scattered at the dayside surface or deflected by crustal magnetic fields can enter the wake (i.e. type-2 entry). However, proton entry into the deepest lunar wake (i.e. anti-subsolar region at low altitude) by the type-2 process needs specific solar wind conditions. Here we report, using data from Kaguya spacecraft in orbit around the Moon, that solar wind ions reflected at the terrestrial bow shock easily access the deepest lunar wake, when the Moon is located in the foreshock. When the spacecraft location is magnetically connected to the lunar night-side surface, the kinetic energy of upward-going field-aligned electron beams decreases or electron beams disappear during the reflected-ion events, which shows that the intrusion of the shock-reflected ions and electrons into the wake changes the electrostatic potential of the lunar night-side surface. In the foreshock closer to the bow shock, the reflected ions are almost continuously detected both on the nightside and on the dayside. This is because large gyroradii comparable to the spatial scale of the Moon let these ions access even low-altitude region on the dayside. In addition, low-frequency waves in the magnetic field associated with the shock-reflected ions are also detected through the period. We will present a comprehensive understanding of the lunar plasma environment in the foreshock.