



Type-II entry of solar wind protons into the lunar wake: Effects of magnetic connection to the night-side surface

Masaki N. Nishino (1), Masaki Fujimoto (2), Yoshifumi Saito (2), Hideo Tsunakawa (3), Yoshiya Kasahara (4), Mariko Kawamura (5,2), Masaki Matsushima (3), Futoshi Takahashi (3), Hidetoshi Shibuya (6), Hisayoshi Shimizu (7), Yoshitaka Goto (4), Kozo Hashimoto (8), Yoshiharu Omura (8), Atsushi Kumamoto (9), Takayuki Ono (9), and Shoichiro Yokota (2)

(1) Nagoya University, STE Laboratory, Nagoya, Japan (mnishino@stelab.nagoya-u.ac.jp, +81-52-747-6417), (2) ISAS/JAXA, Sagamihara, Kanagawa, Japan, (3) Tokyo Institute of Technology, Meguro-ku, Tokyo, Japan, (4) Kanazawa University, Kanazawa, Japan, (5) The University of Tokyo, (6) Kumamoto University, Kumamoto, Japan, (7) Earthquake Research Institute, The University of Tokyo, (8) RISH, Kyoto University, (9) Tohoku University

Our recent observations around the Moon revealed that so-called type-II (T2) entry of the solar wind protons into the near-Moon wake occurs when the IMF is dominated by the non-radial components (i.e. B_Y and/or B_Z). Under this condition a part of the solar wind protons scattered/reflected at the lunar dayside surface subsequently enters the central region of the near-Moon wake after a large-scale cycloid motion, which accelerates electrons along the field line into the wake. The situation handled in the previous studies is that the relevant magnetic field line is detached from the lunar surface, leaving a possibility of the T2 entry under magnetic connection left open. Here we report that the protons can access the central wake region that is magnetically connected to the lunar nightside surface, which we categorize into the T2 entry with magnetic connection to the lunar surface (T2MC). Furthermore we show that the energy of the electron beams induced by the proton entry into the wake depends on the magnetic connectivity. Strong electron acceleration (up to several hundred eV to 1 keV) along the magnetic field associated with the T2 entry is prominent when the field line has its both ends in the solar wind, that is, when the magnetic field is detached from the lunar surface (i.e. the previously-reported T2 entry that we rename to T2MD). On the other hand, no significant electron acceleration is found in the T2MC cases, although an enhancement of the electron flux associated with the T2 proton entry is evident. We also report that the T2 entry process takes place even under radial (B_X -dominated) IMF condition. Our results indicate that, while the T2 entry of solar wind protons into the wake itself does not require a special IMF condition but is a rather general phenomenon, the characteristic energy of associated electrons does show a strong dependence on the magnetic connectivity to the lunar surface.