Enhanced electron release from the lunar night-side surface induced by solar-wind proton entry into the wake

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We study electron variations in the lunar wake induced by a newly found mechanism of solar-wind (SW) proton entry using SELENE (Kaguya) data. Recent observations around the Moon revealed so-called type-II entry of the SW protons into the near-Moon wake under an idealized IMF condition; that is, a part of SW protons is scattered/reflected on the lunar dayside and can come into the near-Moon wake to form a proton-governed region (PGR) when the interplanetary magnetic field (IMF) is dominated by the non-radial components (i.e. B_Y and/or B_Z). However, a possibility of the type-II entry under more general IMF condition with a non-negligible radial component (B_X) has not been considered yet. Here we report that a similar entry process takes place when a B_X component exists and even when it is dominant, which we name 'modified type-II entry'. The electron flux is enhanced in the region that the SW protons access via the modified type-II entry, which suggests that there forms a PGR to which ambient electrons are attracted. In particular, an enhancement of upgoing field-aligned electron beams shows that electrons are released from the lunar night-side surface toward the PGR along the magnetic field whose one end is connected to the Moon. These findings mean that the modified type-II entry as well as the original one plays a crucial role in the plasma environment of the near-Moon wake.