Solar wind proton access deep into the near-Moon wake observed by SELENE (KAGUYA)

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We study solar wind (SW) entry deep into the near-Moon wake using SELENE (KAGUYA) data. The moon spends more than 80 percent of time staying in the solar wind (SW), where a quasi-vacuum region called the lunar wake is formed on the night side. A part of SW electrons, having higher thermal speeds than ions come to the lunar night-side region more easily than SW ions, and resultant electron-rich status of the lunar wake yields a bipolar (inward) electric field at the wake boundary. Therefore, it has been widely supposed that SW ions can be gradually accelerated toward the lunar night side along the SW magnetic field by the bipolar electric field. Here we show that SW protons access the deepest lunar wake (anti-subsolar region at ˜100 km altitude), and that the entry yields strong asymmetry of the near-Moon wake environment. Particle trajectory calculations demonstrate that these SW protons are once scattered at the lunar dayside surface, picked-up by the SW motional electric field, and finally come into the deepest wake. Our results mean that the SW protons scattered at the lunar dayside surface and coming into the night side region are crucial for plasma environment in the wake, suggesting absorption of ambient SW electrons into the wake to maintain quasi neutrality.