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Two types of solar wind proton entry into the near-Moon wake revealed by SELENE (Kaguya)

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Abstract

We study solar wind (SW) intrusion into the near-Moon wake using plasma data obtained by the SELENE (KAGUYA) spacecraft. It has been believed that the electromagnetic environment in the lunar wake strongly depends on the amount of the high-energy component of SW electrons, and that SW protons gradually come into the distant wake along the interplanetary magnetic field due to the bipolar electric field around the wake boundary [1-4]. Here we report two types of SW proton entry into the near-Moon wake, using plasma and magnetic field data obtained by the SELENE (Kaguya) spacecraft at 100 km height from the lunar surface [5]. One mechanism (we call Type-1) is direct SW proton entry accompanied by pairwise energy gain-loss features [6], and the other (Type-2) is entry of SW protons that were once reflected/scattered [7] at the dayside lunar surface. Both types of SW proton entry occurs in the direction perpendicular to the interplanetary magnetic field, but only Type-2 mechanism lets the SW protons come into the wake center (i.e. the low-altitude equatorial region in the noon-midnight meridian). When Type-2 mechanism occurs, the SW electrons are absorbed along the magnetic field by the ion-rich environment on the lunar night side. Our results show that the electromagnetic environment in the near-Moon wake, which usually depends on the ambient SW electrons, can be at times decided primarily by the SW protons coming deep into the near-Moon wake.

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