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Modeling the solar wind interaction with the Moon

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Traditionally, bodies that lack a significant atmosphere and internal magnetic fields, such as the Moon and asteroids, have been considered passive obstacles to the solar wind. The solar wind ions and electrons directly impact the surface of the bodies due to their lack of atmosphere, and the interplanetary magnetic field passes through the obstacle relatively undisturbed. Since the solar wind is absorbed by the bodies, a wake is created behind the object.
This wake is gradually filled by solar wind plasma downstream of the body, through thermal expansion and the resulting ambipolar electric field, along the magnetic field lines, as has been observed for the Moon.
However, recent observations of solar wind protons reflected by the Lunar surface show that this simplified picture of atmosphereless bodies as passive absorbers of the solar wind is incomplete [Saito, Y., et al. (2008), Geophys. Res. Lett., 35, L24205, doi:10.1029/2008GL036077].
Using a hybrid model (particle ions and massless fluid electrons) of the Moon's interaction with the solar wind that include these backscattered protons we demonstrate that non-thermal protons reflected by the lunar surface, as observed, propagate far from the Moon and disturb the upstream solar wind. Previous models of the Moon's interaction with the solar wind have not included this process.