Bodies that lack a significant atmosphere and internal magnetic fields, such as the Moon and asteroids, can to a first approximation be considered passive absorbers of the solar wind. The solar wind ions and electrons directly impact the surface of these bodies due to the lack of atmosphere, and the interplanetary magnetic field passes through the obstacle relatively undisturbed because the bodies are assumed to be non-conductive. Since the solar wind is absorbed by the body, 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. Here we study this plasma expansion into a vacuum using a hybrid plasma solver [1]. In the hybrid approximation, ions are treated as particles, and electrons as a massless fluid. We also derive corresponding one- and two-dimensional model problems that account for the absorbing obstacle. It is found that the absorbing obstacle create ion velocity distributions that are far from the assumed upstream thermal Maxwellian distributions. Such distributions can give rise to different plasma instabilities that has been observed in the Lunar wake.

References