

Plasma Environment of the Moon

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The Moon, commonly thought of as an unmagnetized and airless body, actually possesses localized regions of intrinsic magnetism and a very thin exosphere. The Moon's surface, exosphere, and magnetic fields are subject to a constant bombardment of supersonic solar wind plasma from the Sun, which provides one of the sources and also a sink for the exosphere. The surface-plasma interaction also generates a near-surface sheath and an extended wake region that takes many lunar radii to refill. In magnetized regions the Moon-plasma interaction is significantly altered. Lunar magnetic fields, despite their small scale, are observed to reflect a portion of the incoming solar wind, and the subsequent interaction drives a host of plasma instabilities, including what may represent the smallest collisionless shocks in the solar system. They also shield a portion of the lunar surface, with implications for the evolution of the regolith and the thin exosphere generated from the surface.

I will discuss the lunar plasma environment, including the exospheric interaction, the near-surface sheath, the wake, and lunar magnetic fields and their unique interactions with the solar wind. Understanding how plasma interacts with small-scale magnetic and electric field structures such as those formed in the lunar environment may be relevant in understanding fundamental processes such as magnetic reconnection and the formation of collisionless shock waves. Many aspects of the lunar environment have a spatial scale small in comparison to typical solar wind plasma length scales, and the Moon therefore presents a natural physics laboratory for the study of kinetic plasma processes.