

Vlasov simulation of the interaction between the solar wind and a dielectric body with magnetic anomaly

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The interaction of a plasma flow with an unmagnetized object is quite different from that with a magnetized object such as the Earth. Due to the absence of the global magnetic field, the unmagnetized object absorbs plasma particles which reach the surface, generating a plasma cavity called "wake" in the anti-solar side of the object. Since the velocity of the solar wind (SW) is larger than the thermal velocity of ions, ions cannot penetrate into the nightside of the moon. However, ions were observed in the deep wake by a Japanese spacecraft SELENE (KAGUYA) which is orbiting the moon in a polar orbit around 100km altitude. A key mechanism of this phenomenon is thought to be scattering of SW ions at the lunar dayside surface by an interaction between the Interplanetary Magnetic Field (IMF) and a lunar magnetic anomaly. In the present study, we examine entry processes of ions into the wake due to the interaction between IMF and the magnetic anomaly via a full-kinetic Vlasov simulation.

There are two processes that the ion entry into the wake. A shock is formed by the interaction between the dipole magnetic field and the SW. A part of SW ions are reflected at the shock and enter the wake due to the ion gyro motion. On the other hand, the electric field toward the body is generated by the negative charge on the nightside surface. SW ions enter the wake due to the out-of-plane magnetic convection induced by the electric field.

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