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Kinetic Modeling of the Lunar Dust-Plasma Environment

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Modeling of the lunar dust and plasma environment is a challenging task because a self-consistent model should include ions, electrons and dust particles and numerous other factors. However, most of the parameters are not well established or constrained by measurements in the lunar environment. More precisely, a comprehensive model should contain electrons originating from 1) the solar wind, 2) the lunar material (photoelectrons, secondary electrons) and 3) the lunar dust. Ions originate from the solar wind, the lunar material, the lunar exosphere and the dust. To model the role of the dust in the lunar plasma environment is a highly complex task since the properties of the dust particles in the exosphere are poorly known (e.g. mass, size, shape, conductivity) or not known (e.g. charge and photoelectron emission) and probably are time dependent. Models should also include the effects of interactions between the surface and solar wind and energetic particles, and micrometeorites. Largely different temporal and spatial scales are also a challenge for the numerical models. In addition, the modeling of a region on the Moon - for example on the South Pole - at a given time requires also knowledge of the solar illumination conditions at that time, mineralogical and electric properties of the local lunar surface, lunar magnetic anomalies, solar UV flux and the properties of the solar wind.

Harmful effects of lunar dust to technical devices and to human health as well as modeling of the properties of the lunar plasma and dust environment have been topics of two ESA funded projects L-DEPP and DPEM. In the presentation we will summarize some basic results and characteristics of plasma and fields near and around the Moon as studied and discovered in these projects. Especially, we analyse three different space and time scales by kinetic models: [1] the "microscale" region near surface with an electrostatic PIC (ions and electrons are particles) model, [2] the "mesoscale" region including lunar magnetic anomalies and [3] the global scale Moon-solar wind interaction with hybrid (ions as particles in massless electron fluid) models.