

Computer simulations on measurements of space potentials on the Earth's moon surface

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Since the conductivities of the earth's moon are quite low and non-uniform, its surface charges locally in plasma environments. So-called "surface differential charging" is an important issue in human activities on the moon. The aspect of the charging depends greatly on the plasma environment around the moon. Differences in photoelectron emissions in sunlight and shade also have a significant impact. For example, the charging situation is completely different depending on whether the moon is in the solar wind or in the night side of the earth's magnetosphere. Knowing the spatial potential on the moon, therefore, is quite important for human activities on the moon. The most common method for measuring space potentials is the Langmuir probe. However, the method is not so effective on the moon, because plasma densities are expected to be very low, especially in the shaded region. Furthermore, spatial scales in human activities on the moon are basically inside the Debye length. That causes complexities in measurement techniques of space potentials and understanding electrostatic environments through observation results. Furthermore, artificial structural objects such as moon rovers or moon bases as well as humans with spacesuits affect the space potential. The present paper focuses on computer simulations of a method for measuring the spatial electrostatic potential on the lunar surface. The particle-in-cell simulations dealing with the inner boundaries of simulation models enable us to simulate electrostatic environments on the moon. In the present paper, we introduce the simulation model for measuring space potential on the moon and discuss the measurement technique of the electrostatic environments of the lunar surface.

Keywords: lunar surface, electrostatic environment, differential charging, particle-in-cell simulation, human activity on the moon, Langmuir probe