

The research review on the plasma and dust environment of the moon toward the participation in NASA' s Artemis program

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Following the decision by the Japanese government on the participation in the NASA' s Artemis program, the task force members asked by the JAXA' s technical committee on the international space exploration intensively reviewed the research topics and their significance on the lunar environment exploration from the perspectives of science as well as engineering.

The moon which has no atmosphere is directly exposed to the solar wind plasma. The surface is consequently charged due to the deposition of the solar wind as well as the secondary emission of ions and photoelectrons from the surface. The dust particles which are micro grains covering the moon surface are also charged and their dynamics and distribution are to be investigated. Meanwhile, KAGUYA found many crustal magnetic field regions called lunar magnetic anomalies (LMA) scattered on the surface. Due to the solar wind interaction, a small scale magnetosphere is formed over LMA. KAGUYA observed ion reflection and deflection as well as various types of plasma waves when it passed over LMA. The exosphere is also found which is composed of neutral particles originated from the moon surface. In this paper, we will report the current understanding of the lunar plasma environment affected by the solar wind interaction.

In the lunar surface exploration, one of the most important objectives is the quest for evidence of water resources in the surface environment. In terms of solar wind interaction, we are curious to know how the continuous injection of the solar wind proton to the lunar surface can be associated with the generation of water resources. In this paper, we will also touch on this topic.

The altitude of the KAGUYA orbits is limited to approximately between 100km and 20km. To observe the plasma phenomena in detail occurring at low altitudes below 20km, multiple CubeSat released from the GATEWAY station will play an important role.

In this paper, we will report the review on the plasma and dust of the lunar environment summarized by the task force members asked by the JAXA' s technical committee on the international space exploration. We will also discuss the significance of the interactions between the solar wind plasma and the lunar environment from a viewpoint of solar-terrestrial physics.

Keywords: Artemis program, Lunar plasma environment, Lunar dust, Lunar magnetic anomaly, solar wind, water