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Particle simulations on plasma and dust environment near lunar vertical holes

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Japanese lunar explorer ”Kaguya” has discovered vertical holes on the Moon surface. The diameter and depth of the holes are both in a range of 50 through 100 m, which produces a higher depth-to-diameter ratio than typical impact craters. The holes are thus expected to create characteristic plasma and dust environment around it. It is of practical importance to assess such a distinctive environment, reminding that a future landing mission plans to explore the lunar holes and caverns associating to the holes.

In the present study, we apply our original particle-in-cell simulator EMSES, which have been used to study spacecraft-plasma interactions, to assessment of day-side plasma environment around lunar vertical holes. We have a three-dimensional computational domain including a simplified lunar hole structure and introduce a solar wind plasma inflow to the lunar surface. We also simulate the photoelectron emission from the lunar surface by taking into account the presence or absence of sunlight illumination, and its incident angle. We will show simulation results on the properties of lunar surface charging near the hole and its dependence on changing solar wind plasma conditions. We also report the progress of further investigations into dust grain environment around the hole, based on the electrostatic environment self-consistently computed by our simulator.

Keywords: Moon, vertical hole, space plasma, lunar surface charging, dust grain, PIC simulation