Solar-wind contribution to the current measured in Lunar Dust Experiment†

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New evidences for impact-generated dust exosphere come from the LDEX on board the Lunar Atmosphere and Dust Environment Explorer (LADEE), including a permanent, asymmetric dust cloud around the Moon and a correlation between density enhancements and annual meteor showers [Horányi et al., 2015]. However, the density of 0.1-μm-sized grains that were measured as integrated current [Horányi et al., 2014] showed no dependence on the altitude, which was inconsistent with previous observations and suggested there should be some other current sources [Szalay and Horányi, 2015]. Actually, ions with energy less than 30 eV can also contribute to the measured current of LDEX, which come from several sources such as lunar ionosphere, backscattered SW protons and sputtering of ENAs [Horányi et al., 2015]. Ions from lunar ionosphere can be accelerated into LDEX by the convection electric field of solar wind (SW) and detected as current [Poppe et al., 2014]. But near the terminator, the electric field is almost perpendicular to the LDEX boresight and the current should be very small, then other sources, such as SW, get important. Szalay and Horányi [2015] reported a correlation between the current and SW density, but without a further discussion.

Here we present evidences for SW-generated current. We show that direct SW influx on the night side can cause large current, while the backscattered energetic neutral atoms (ENAs) on the dayside can bring a good correlation between the current and SW density. It is found that the current favors a lower SW speed and a smaller SW incident angle, but the dependences are also affected by solar zenith angle (SZA) and the scattering function of ENAs. Picked-up ions can enhance the current when the angle between the convection electric field and LDEX's normal is larger than 90°. But when the angle is smaller than 90°, the enhancement is negligible.

Since the current is mainly caused by backscattered SW ENAs, the dust density should be further smaller than the value of 10^2 m^{-3} estimated by Szalay and Horányi [2015] and closer to the recent measurements from Clementine and LRO, which provides a positive evidence for impact-generated dust exosphere.

References

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