LUNAR NIGHTSIDE ELECTRON FLUXES. D. L. Reasoner, NAS/NRC Senior Postdoctoral Fellow, NASA/MSFC, Huntsville, AL 35812, on leave from the Department of Space Physics, Rice University, Houston, TX.

Data from the lunar-surface-based Charged Particle Lunar Environment Experiment (CPLEE) have been examined for particle fluxes incident upon lunar nightside regions when the instrument was viewing into the downstream solar-wind cavity. In contrast to the predictions of supersonic flow theory, weak but significant electron fluxes are observed throughout the lunar night. Through an examination of the data and correlations with interplanetary magnetic field (IMF) data from Explorer 35 and with the geomagnetic index Kp, it was possible to separate the fluxes into three distinct categories. These will be defined and illustrated in the discussion to follow.

An example of lunar night electron observations is shown in Figure 1. The bottom panel shows the counting rate due to 200 eV electrons and the top two panels show the latitude (Ø) and the longitude (Ø) of the IMF in the geocentric solar ecliptic coordinate system. The dotted lines on the plot of Ø indicate ranges where the IMF lines connect from the moon to the earth's bow shock. The flux events at 0215-0230 and at 0300-0400 are seen to occur only when the moon is connected to the earth's bow shock along field lines. We refer to these as Type I fluxes, and assert that they are produced at the earth's bow shock. Electron densities and temperatures for these bow shock events were in the range 2 - 4 x 10^3 cm^-3 and 150 - 250 eV respectively. These events are the subject of a forthcoming report in the Journal of Geophysical Research and will not be discussed further here.

The other, lower intensity (Type II) events, are seen to be uncorrelated with IMF direction. Furthermore, they are uncorrelated with Kp; and, although the events are sporadic, the intensity of the individual events remains quite constant throughout the lunar night period. Their temperatures are in the range 90 - 120 eV and densities are in the range 0.5 - 2 x 10^3 cm^-3. These facts suggest that they originate as a result of lunar-solar wind interactions but that the interaction region is removed from the immediate lunar vicinity. Michel (1968) has proposed a model of lunar-solar wind interactions featuring a weak shock located 4 - 5 R_M downstream of the moon which arises as a result of solar wind converging to fill the downstream void region. Since the Type I fluxes show that suprathermal electrons propagate upstream of the earth's bow shock, we therefore suggest that the Type II events are the result of similar processes at the downstream lunar wake shock.

The third type of electron fluxes occur only near the lunar terminators. They are first seen at the dusk terminator when the masking effect of lunar surface photoelectrons disappears, and persist for up to two days after terminator, gradually decreasing in intensity as the instrument moves away from the terminator. The same effect occurs as the instrument approaches the dawn terminator. These electrons have densities ranging up to 2 x 10^2 cm^-3 and temperatures up to 200 eV. Furthermore, they display a strong correlation with Kp, being essentially absent when Kp is 1+ or less. The existence of lunar limb shocks has been inferred from lunar orbiting magnetometer data (Russell, 1973); and therefore we conclude that these Type III electrons are due to solar wind electrons which have been thermalized and scattered to the
LUNAR NIGHTSIDE ELECTRON FLUXES

Reasoner, D. L.

lunar surface by lunar limb shocks.

In summary, we have identified three distinct categories of lunar night-side electron fluxes. Of the three, two of these are shown to be most likely due to lunar limb and downstream shocks resulting from lunar-solar wind interactions.

REFERENCES


LUNAR NIGHTSIDE ELECTRON FLUXES

Reasoner, D. L.,

Data of May 25, 1971 illustrating Type I and Type II electron flux events. The lower panel is the counting rate due to 200 eV electrons, and the top two panels are the interplanetary magnetic field latitude (θ) and longitude (Φ). The dotted lines on the Φ plot are the boundaries of the zones where the IMF connects from the moon to the earth's bow shock. The electron flux events at 0215 and 0300 (Type I) are seen to occur when there is field line connection to the bow shock; and, therefore, these electrons originate at the bow shock. The other lower-intensity events (Type II) are uncorrelated with IMF direction and are assumed (see text) to be a result of lunar-solar wind interactions.

Figure 1 - courtesy Journal of Geophysical Research.