

DYNAMICS OF SUBMICRON LUNAR EJECTA IN SELENOCENTRIC, CISLUNAR AND GEOCENTRIC SPACE: T. Hyde, W. M. Alexander, S. Goad, R. McDonald; Space Science Laboratory, Dept. of Physics, Baylor University, Waco, Texas 76798.

Recent studies /1/ of the orbital dynamics of micron and submicron lunar ejecta in selenocentric , cislunar and geocentric space have indicated that a pulse of these lunar ejecta intercepts the earth's magnetopause surface in a time correlation to the position of the earth, moon and earth-lunar phase angle (LPA) as seen in Fig. 1. In addition, /2/ it has been shown that the transport time of these particles through cislunar space to the magnetopause surface varies in such a manner as to effectively focus the particles due to this temporal variation. The efficient LPA position range for lunar ejecta transport with maximum magnetopause interception is between 80° and 160° for the 6 days of a lunar orbit time, which is approximately one-fourth of the lunar period. The lunar ejecta cumulative flux at the magnetopause boundary is at its maximum for an average of 36 hours. This represents a focusing effect of at least a factor of 3, but not more than a factor of 6.

An additional factor of major importance is that of lunar longitude at the time of impact of the primary particle /3/. While the LPA is a major determining positioning factor, the combination of LPA and longitude produces the maximum lunar ejecta cumulative flux onto the magnetopause surface. This is demonstrated in Table 1. The most important factor regarding sensitivity to longitude is the occurrence of non-random impact flux events. This is most noticeable for

periods of time during major meteor showers. Initially, the LPA will determine the percentage of these ejecta that are transported to the magnetopause surface. In an optimal LPA, the maximum lunar ejecta cumulative flux will occur when the lunar quarter (by longitude definition) is in the most favorable impact position with respect to the meteor shower radiant. For example, as seen in Table 1, a shower radiant that is essentially normal to the 3rd and 4th quarter with an LPA near 110°, results in greater than 90% of the produced ejecta intercepting the magnetopause surface.

Range of LPA's for maximum efficiency in the production of lunar ejecta to intercept the Earth's Magnetosphere

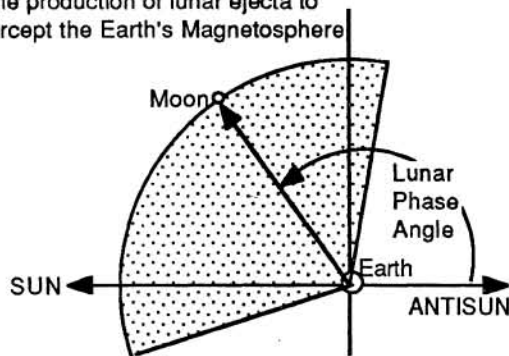


Figure 1.

TABLE I

LUNAR LONGITUDE QUARTER	AVERAGE PERCENT EMPs* INTERCEPT	MAXIMUM PERCENT EMPs* INTERCEPT	LPA°
1st	20.23	63.89	100
2nd	27.26	77.78	90
3rd	38.28	94.44	110
4th	33.25	90.28	110

*EMPs - Earth's Magnetopause surface

The above represents a summary of the research efforts to date. The following statements summarize the new unpublished work in this area that is reported in this paper /4/.

1. There is a definite correlation between both the height and the width of the ejecta percentage peak and the particle size. This height and width correlation also depends in part on whether or not the force calculations include Raleigh or Mie effects in determining the solar radiation pressure (SRP).

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2. There is no latitude correlation other than the fact that more ejecta intercept the magnetopause surface from 0° on the lunar surface than from angles greater than -40° or 40° .
3. There is a "pattern" to the x,y, z and vector magnitude velocities of the particle when they are plotted against the LPA which is relatively independent of either particle size, mass or density. Particle velocities at the magnetopause, on the other hand, do depend on the above. Another type of "pattern" exists when the above is plotted against capture percentage.
4. Various densities of particles have been studied and results tabulated. There appears to be no direct correlation between density and capture percentage even though there is a relationship between particle velocity and density. There is, however, a large change in the SRP force for different densities (due to the Mie effect) which in turn does alter the capture percentages.
5. A comprehensive study has been made of beta vs radius for various particle sizes and densities. This study shows not only that beta varies with radius but also with density and more importantly with absorption coefficient.
6. A definite correlation between various values of absorption coefficients and capture percentages exists. (The absorption coefficients determine in part the Mie effect on the SRP force.) This correlation also depends on factors such as particle size and density.

Initial studies /5/ of the dynamics of charged submicron lunar ejecta in the magnetosphere have reported a possible enhancement of 50 for the spatial density of these particles between L values of 1.7 and 6.0.

References:

- /1/W.M. Alexander & J. Corbin, Adv. Space Res. Vol. 1, #107 (1981).
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- /3/T. Hyde, MS Thesis, Baylor Univ. (1980)
- /4/T. Hyde, Ph.D Dissertation, Baylor Univ. (1988)
- /5/L. Lodhi, Ph.D Dissertation, Baylor Univ. (1987)