PRELIMINARY RESULTS OF A STUDY OF SOLID INTERPLANETARY MATTER IN THE VICINITY OF THE MOON

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Abstract

Full Text

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PRELIMINARY RESULTS OF A STUDY OF SOLID INTERPLANETARY MATTER IN THE VICINITY OF THE MOON

(Presented by Academician A. P. Vinogradov, July 2, 1966)

The study of meteoric matter on the artificial lunar satellite "Luna-10" was carried out with the aid of piezoelectric sensors attached to the satellite' s skin and sensitive to impacts of meteoric particles with masses of $7 \cdot 10^{-8}$ g and greater at particle velocities of 15 km/sec. The impact-sensitive surface amounted to 1.2 m^2.

Fig. 1. Projection onto the surface of the Moon of the portions of the satellite trajectory on which particle impacts were recorded. A black triangle denotes a recorded particle.

From April 3 to May 12, 1966, in 11 hr 50 min, 198 particle impacts were recorded, which amounts to $4 \cdot 10^{-3}$ impacts per 1 m^2 per second and exceeds the average for interplanetary space by 2 orders of magnitude.

It is known that in interplanetary space meteoric particles are for the most part combined into separate clusters, whose extent varies over wide limits; the spatial density of particles in them is nonuniform and may exceed the mean value by 1-2 orders of magnitude. However, the registration of an increased particle density in the vicinity of the Moon over a long period of time—as during the experiment on Luna-10—gives grounds to suppose that this cluster has a local character and is associated with the Moon.

The observations covered a region representing a shell surrounding the Moon, approximately 650 km thick and separated from the lunar surface by 355 km.

Fig. 2. Distribution of registered impacts by altitude

Figure 2: Fig. 2. Distribution of registered impacts by altitude

The exception was a small part of the shell, invisible from the Earth.

The registered particles were observed at various altitudes from 355 to 1050 km and were for the most part grouped into clusters extending from ~ 100 to ~ 900 km; moreover, no dependence of the spatial density of the particles on distance from the Moon was detected.

The increased density of matter in the vicinity of the Moon can, in our opinion, be explained by assuming that the source of the particles is the Moon itself. When meteoric bodies collide with the surface of the Moon, an explosion occurs with the ejection of a mass of lunar rock many times exceeding the mass of the impacting particle. At the same time, the degree of fragmentation of the ejected matter depends on the composition and structure of the lunar surface. The particles ejected in this way have a broad spectrum of velocities, with a maximum in the range $v = 1$–3 km/sec. After the explosion, part of the matter returns to the surface of the Moon, part leaves the vicinity of the Moon and goes off into interplanetary space, and still another part, under the combined action of the terrestrial and lunar fields and solar pressure, can exist for some time in orbits around the Moon. The possible number of such particles is not yet known to us, and special calculations are required to obtain quantitative estimates.

Fig. 2. Distribution of registered impacts by altitude

If our hypothesis is correct, then apparatus installed on an artificial satellite of the Moon should register particles of lunar origin (those leaving for interplanetary space and those in orbits around the Moon), as well as meteoric particles, whose number is small in comparison with the lunar ones.

In this case, for most particles one should adopt a velocity not of 15 km/sec, as we do for sporadic meteoric particles in near-Earth space, but within the limits of 1–3 km/sec, mentioned above; and since, in interpreting the data, we, as before, use the dependence $I \sim E$, where I is the pulse registered by the sensor and E is the particle energy, then in this case the value of the limiting registered particle mass increases to $\sim 10^{-6}$ g, and the spatial density of dust matter in the vicinity of the Moon will differ from the mean for interplanetary space by more than 4 orders of magnitude.

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Note: Figure translations are in progress. See original paper for figures.