IN SITU MEASUREMENTS OF INTERPLANETARY DUST IN THE INNER SOLAR SYSTEM

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The Helios 1 spacecraft was launched in December 1974 into a heliocentric orbit of 0.3 AU perihelion distance. It carries on board a micrometeoroid experiment which contains two sensors with a total sensitive area of 121 cm^2. The ecliptic sensor measures dust particles which have trajectories with elevations from -45° to $+55^{\circ}$ with respect to the ecliptic plane. The south sensor detects dust particles from -90° to -4°. The ecliptic sensor is covered by a thin film (3000 Å parylene coated with 750 Å aluminium) as protection against solar radiation. The other sensor is shielded by the spacecraft rim from direct sunlight and has an open aperture. Micrometeoroids are detected by the electric charge produced upon impact and the ions are mass analysed in a time-of-flight-spectrometer. During the first 6 orbits of Helios 1 around the sun the experiment registered a total of 168 meteoroids, 52 particles were detected by the ecliptic sensor and 116 particles by the south sensor. Most impacts on the ecliptic sensor were observed when it was pointing in the direction of motion of Helios (apex direction). In contrast to that the south sensor detected most impacts when it was facing in between the solar and antapex directions. Orbit analysis showed that the "apex" particles which are predominantly detected by the ecliptic sensor have eccentricities $e < 0.4$ or semimajor axes $a < 0.5$ AU. From comparison with corresponding data from the south sensor it is concluded that the average inclination of these particles is below 30°. The excess of impacts on the south sensor have orbit eccentricities $e > 0.5$ AU. β-meteoroids which leave the solar system on hyperbolic orbits are directly identified by the imbalance of outgoing (away from the sun) and ingoing particles. Mass analyses of the spectra showed that 40% of the observed spectra have the peak abundance above mass 35 amu which are preliminarily identified as iron meteoroids. 40% of the spectra have the peak abundance below mass 35 amu which correspond to chondritic composition. 20% of the spectra could not be identified in either class.

REFERENCE

Grün, E., Pailer, N., Fechtig, H., and Kissel, J., 1979: Planetary Space Sci. (submitted).

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DISCUSSION

Stanley: For what fraction of the Helios events do you obtain spectra? Also, will you comment on the chemistry implied for Helios particles as compared to those Brownlee collects, which are mostly chondritic?
Grün: We obtained spectra for all recorded impacts because impacts are finally defined by coincidence of charge pulses on the electron-ion grid and on the multiplier. Brownlee's particles are generally larger ($>10^{-9}$g) than the particles most abundantly observed by Helios ($<10^{-9}$g). Therefore a difference in the chemistry is not surprising.

Sekanina: Is it correct that the only evidence against the possibility that a significant fraction of the particles detected by the south sensor have high-inclination orbits is that such orbits have been shown unlikely for meteoroids that give rise to meteor phenomena?
Grün: No; there is evidence also from zodiacal light observations. For example, Singer and Banderman (1967) found that the average inclination does not exceed 30°. In addition, observation of highly inclined orbits is unlikely since the probability of observation decreases as i/sin i.

Lamy: What is the main role of the aluminized front film on the ecliptic sensor? Does the fact that the south sensor "sees" the solar wind directly introduce spurious counts?
Grün: The main reason for the front film on the ecliptic sensor is a thermal consideration, especially, close to the Sun. We found no correlation of the impacts recorded by the south sensor with solar and interplanetary plasma and high-energy particle events. Further, we see no possibility that these effects can produce all signals which are required for the positive identification of an impact.

Hanner: You stated that the observed radial gradient is compatible with the Helios zodiacal light experiment. But do your measurements refer to the same dust population as that producing the zodiacal light?
Grün: No; it is generally accepted that the zodiacal light is produced mainly by particles of 10^{-9}g to 10^{-6}g, while the Helios experiment detected most of its impacts below that mass range. Only a few of our recorded particles may have masses in the range relevant to zodiacal light.

Millman: You mention two main chemical types of dust particles that you detect, the chondritic and the iron types. Have you correlated these chemical types with the natures of the corresponding orbits?
Grün: The identification into chemically different particles is still preliminary. Up to now we have not found a strong differentiation into different orbital classes among the chemically different particles. But there is a weak indication that the particles with high iron content are predominantly found in the "eccentric" low-density particle population.

Lokanadham: Do you find any grouping of micrometeoroids with heliocentric distance during the period December 7 to December 17?
Grün: No; up to now we have not found any significant clustering of impacts on Helios.