N89-15010

COSMIC DUST COLLECTION WITH A SUB SATELLITE TETHERED TO A SPACE STATION

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The number concentration and density of 1 micron and submicron sized grains in interplanetary space, as well as their relation to the larger zodiacal dust particles, and the importance of the Beta meteoroid phenomenon are currently being questioned (1,2).

Current stratispheric collection with balloons and a high altitude aircraft has resulted in the accumulation of several hundred (perhaps a thousand) extraterrestrial particles larger than 10 microns; however, there are inherent problems with using this collection technique for the smallest particles less than 1 or 2 microns in size:

1) Strong contamination from small terrestrial particles in the stratisphere

2) Loss of time resolution and mixing of particles from different sources resulting from the long settling times of the particles as they fall slowly into the stratosphere from the upper atmosphere where they are decelerated

Attempts to obtain samples of the smallest micron and sub micron sized cosmic dust particles in space with collectors on board the space shuttle or satellites such as the Long Duration Exposure Facility (LDEF) are subject to two major difficulties:

1) Contamination by shuttle debris, rocket exhaust, and other orbiting man made debris

2) Hypervelocity impact speed on the order of tens of km/sec. resulting in destruction of the smallest particles with only small amounts of chemically fractionated impact debris remaining around impact craters.

A superior approach to the problem of how to collect large numbers of intact micron and sub micron sized cosmic dust particles in real time while avoiding terrestrial and man made contamination would be to employ a tethered subsatellite from a space station down into the earth's upper atmosphere. In this way orbital contaminants from the space station could be taken of the gradual deceleration of the hypervelocity particles by the earth's upper atmosphere.

Such a sub satellite tied to the space shuttle by a 100 km long tether is being developed by the Marshall Space Flight Center for the acquisition of upper atmospheric data. The author has previously proposed that cosmic dust collectors be affixed to the outside of such a sub satellite tethered to the space shuttle (3,4,5). However the maximum duration of deployment into the upper atmosphere is likely to be on the order of only a few hours, which is much shorter than what would be possible (several days) if the sub satellite were tethered to a space station maintaining altitude indefinitely. The number of particles collected intact or nearly so in this fashion should be at least a factor 10 greater than from the space shuttle. It is also possible that a permanent space station would allow the use of a tether even longer than the 100 km. long one scheduled for use on the space shuttle. This would allow even deeper penetration into the earth's upper atmosphere allowing for even more deceleration to be imposed on the hypervelocity partricles before impact onto the collectors. Of course the relative impact velocity is not likely to be less than the orbital velocity of the sub satellite except for those particles within two cones of solid angle alpha, one in the forward direction and one to the rear, whose cosmic velocity vectors are essentially parallel to and within a few km/sec of the satellite's. Laboratory impact simulation experiments have shown that high density particles impacting with velocities on the order of a few km/sec can survive impact intact or nearly so in appropriate target materials.

It should be noted that the same tethered collectors could also be employed to study the composition and flux of man made earth orbiting debris in any direction within 100 km or so of the space station. This would make it possible to monitor the build up of any debris belt in low earth orbit.

References

1) LeSergeant, L.B. and Lamy, P.L., 1980, *Icarus*, V. 43, p. 350
2) LeSergeant, L.B. et al., 1981, *Icarus*, V. 47, p. 270
3) Corso, G.J., 1983, *Journal Brit. Interplanetary Soc.*, V. 36, p. 403
4) Corso, G.J., 1984, *Lunar Planet. Sci. Conf. Abstracts XV*, 1984, p. 186
5) Corso, G.J., 1985, *Acta Astronautica*, V. 12, No. 4, p. 265-267