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Dust Collection on Serviceable Satellites

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One rationale for the Space Shuttle program which was dramatically realized during the repair of the Solar Maximum Mission (SMM) is the efficiency of in orbit satellite servicing. An unexpected benefit of this repair mission was the return of parts of the Solar Max satellite which had been exposed for four years to the space environment. Studies conducted on these "spare parts" have yielded valuable data on the micrometeorite flux and composition at shuttle altitudes during this time period. The scientific results from studies of the cosmic dust component of the observed particle impacts are not yet complete but it is clear from the preliminary data available that such studies will be a valuable adjunct to the studies of cosmic dust particles collected in the atmosphere.

The success of the initial studies of particles collected during repairs of the SMM spacecraft on a surface not specifically designed as a particle collector nor retrieved in a manner intended to minimize or eliminate local contamination raises the possibility that even more interesting results might be obtained if serviceable satellites were initially designed with these objectives in mind. All designs for modern satellites utilize some form of thermal blanket material in order to minimize thermal stresses inside the spacecraft. This is true of commercial and defense department payloads as well as of those built by NASA. Many satellites now incorporate a catch ring designed to enable them to be retrieved by the Space Shuttle's robot arm and either serviced in the cargo bay or returned to the ground. Many of NASA's advanced orbiting observatories such as the Hubble Space Telescope and SIRTF have been designed so that the on-board instrumentation can be changed on a regular basis. I propose that all future satellites be designed with standardized removeable sections of thermal blanket material which could be replaced during on-orbit servicing and returned to earth for detailed study.

At the very least, these panels could simply be easily removeable sections of the standard thermal blanket material which could be "peeled" on the ground to search the layers for dust particles and impact "tracks" through the various layers. Some calibration efforts using existing electrostatic dust accelerators could yield data on the expected penetration depth in the standard blanket material vs. impact angle and initial particle velocity. Since the impact angle is measurable if the entry hole can be traced through several sheets, it may be possible to detect hypervelocity impacts which could be due to extrasolar system grains. If the thermal blanket material does not contaminate the specimen, then it may be possible to chemically and isotopically characterize the more interesting finds.

Although it may be possible to design an efficient thermal blanket which is also optimized for particle collection (e.g., very thin layers of low-z, non-contaminating materials) the best design will be one which is relatively inexpensive (so that it is reasonable to ask <u>all</u> shuttle customers to place one or more of these on their spacecraft) and which has minimal effect on the thermal characteristics of the blankets. If <u>all</u> serviceable satellites were outfitted with such panels then it should be possible to collect a great deal of information on the flux and characteristics of both man-made and natural micrometeors as a function of orbital orientation and altitude for a very modest investment in flight equipment. The major expense will be the upkeep of the ground based analytical facilities.