Recreating in situ measurements of potentially hazardous meteoroids

Althea Moorhead

Meteoroids that are larger than about a microgram can be hazardous to astronauts; those larger than about a milligram can damage spacecraft surfaces. On average, a microgram-sized particle impacts one square meter of exposed surface area every 8 months; for milligram-sized particles, this timescale is closer to 1700 years. The relatively low rate of large impacts is beneficial for properly shielded spacecraft, but detrimental to data collection. Nevertheless, several missions, including the Pegasus and Long Duration Exposure Facility (LDEF) satellites, have measured the potentially hazardous meteoroid flux at the low end of this mass range.

The damage done to a spacecraft is a function of the impactor's size, density, speed, and impact angle as well as the material properties of the spacecraft surface. Thus, spacecraft damage cannot be directly compared to a mass-limited meteoroid flux. It is instead necessary to first re-weight the mass- limited flux to a damage-limited flux using a ballistic limit equation. We demonstrate a method for computing and re-weighting meteoroid fluxes using version 3 of NASA's Meteoroid Engineering Model and two different formulations of ballistic limit equation. We re-weight fluxes to [1] a constant penetration depth and [2] a constant crater diameter and compare each result to the data record from Pegasus and LDEF, respectively.