Black Box for Satellites
by
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The space environment is known to have deleterious effects on the health of satellites in space. One component of the space environment is hypervelocity particles, including space debris and meteoroids. Hypervelocity particles impact satellites at speeds ranging from 8 km/s to 72 km/s on a regular basis, yet remain poorly understood. While the probability of mechanical threat from a hypervelocity impact is low due to the sparsity of particles large enough to penetrate a spacecraft, the possibility of electrical damage is higher. Electrical damage can result from the plasma generated by the impact and the associated RF emission. In my talk, I will present results of statistical analysis of the correlation between meteoroid flux and electrical anomalies that have been observed on spacecraft. This analysis will also reveal our lack of knowledge on satellite anomalies and the difficult circumstances faced by satellite operators when diagnosing anomalies and failures.

In order to better understand the role of the space environment on the health of the spacecraft, we propose the concept of a satellite black box, which is essentially a proposed suite of sensors that will monitor different aspects of the space environment. This black box would be a compact module comprising radiation sensors, discharge monitors, RF, optical and plasma sensors. We are currently focusing on the development of hypervelocity impact sensors and specifically on the development of miniature transient plasma analyzers for plasma measurements. I shall present results from the numerical simulations of the sensor geometry and talk about the novel fabrication approach that we have adopted.