Characterizing Orbital Debris and Spacecrafts through a Multi-Analytical Approach

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ABSTRACT

Defining the risks present to both crewed and robotic spacecrafts is part of NASA's mission, and is critical to keep these resources out of harms way. Characterizing orbital debris is an essential part of this mission. We present a proof-of-concept study that employs multiple techniques to demonstrate the efficacy of each approach.

The targets of this study are IDCSPs (Initial Defense Communications Satellite Program). 35 of these satellites were launched by the US in the mid-1960s and were the first US communications satellites in the GEO regime. They were emplaced in slightly sub-synchronous orbits. These targets were chosen for this proof-of-concept study for the simplicity of their observable exterior surfaces. The satellites are 26-sided polygons (86cm in diameter), initially spin-stabilized and covered on all sides in solar panels.

Data presented here include: (a) visible broadband photometry (Johnson B and Cousins R bands) taken with the University of Michigan's 0.6-m aperture Curtis-Schmidt telescope MODEST (for Michigan Orbital DEbris Survey Telescope) in Chile in November, 2011, (b) laboratory broadband photometry (Johnson BV Cousins RI) of solar cells, obtained using the Optical Measurements Center (OMC) at NASA/JSC (see Cowardin et al., this meeting for more details), (c) visible-band spectra taken using the Magellan 6.5m Baade Telescope at Las Campanas Observatory in Chile in March, 2012 (see also Seitzer et al., this meeting), and (d) visible-band laboratory spectra of solar cells using a Field Spectrometer.

Color-color plots using broadband photometry (e.g. B-R vs. R-I) demonstrate that different material types fall into distinct areas on the plots (Cowardin, AMOS 2010). Spectra will be binned in wavelength to compare with photometry results and plotted on the same graph for comparison. This allows us to compare lab data with telescopic data, and photometric results with spectroscopic results. In addition, the spectral response of solar cells in the visible wavelength regime varies from relatively flat (modern 'black' solar cells with uniform albedo as a function of wavelength) to older solar cells whose reflectivity is sharply peaked in the blue (similar to the IDCSP solar cells). With a target like IDCSPs, the material type is known a priori. Therefore, this study will also be used to determine whether laboratory spectra of pre-launch (pristine) solar cells differ from the telescopic spectra of IDCSPs that have been exposed to the harsh environment of space for ~45 years to investigate whether space weathering effects are evident.