SPACE DEBRIS SYMPOSIUM (A6)
Measurements (1)

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FURTHER ANALYSIS OF INFRARED SPECTROPHOTOMETRIC OBSERVATIONS OF HIGH AREA TO MASS RATIO (HAMR) OBJECTS IN GEO

Abstract

Optical surveys have identified a class of high area-to-mass ratio (HAMR) objects in the vicinity of the Geostationary Earth Orbit (GEO) ring*. The exact origin and nature of these objects are not well known, although their proximity to the GEO belt poses a hazard to active GEO satellites. The prevalent conjecture is that many of these objects may be thermal materials shed from derelict spacecraft in 'graveyard' orbits above the GEO ring. Due to their high area-to-mass ratios and unknown attitude dynamics and material characteristics, solar radiation pressure (SRP) perturbs their orbits in ways that makes it difficult to predict their orbital trajectories over periods of time exceeding a week or less. To better understand and track these objects and infer their origins, we have made observations that allow us to determine physical characteristics that will improve the non-conservative force modeling used for orbit determination (OD) and prediction. Information on their temperatures, areas, emissivities, and albedos may be obtained from thermal infrared and visible measurements. Simultaneous observations in the thermal infrared and visible wavelengths may allow disentangling of projected area, albedo, and object emissivity.

Further analysis and modeling of observational data on various HAMR objects collected at the AMOS observatory 3.6 m AEOS telescope are presented. The thermal-IR spectra of these low-earth orbit objects acquired by the Broadband Array Spectrograph System (BASS) span wavelengths 3 to 13 μm and constitute a unique data set, providing a means of measuring object fluxes in the infrared and visible wavelengths. These, in turn, allow temperatures and emissivity-area products to be calculated, and in some cases provide information on rotation rates. We compare our observational results with the outputs of simple models, in terms of infrared flux and orbital characteristics. The resulting temperatures and rotation rates are used in SRP acceleration models to demonstrate improvements in OD and prediction

performance relative to models which assume default ambient temperature and static attitude dynamics. Additionally, we have the capability and plans to measure material properties with the same instrument in the lab as used at the telescope to facilitate direct comparisons.

*Schildknecht, et al., "Properties of the High Area-to-mass Ratio Space Debris Population in GEO," AMOS Tech. Conf., Wailea, Hawaii, Sept, 2005.