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Observations of GEO Debris with the Magellan 6.5-m Telescopes¹

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Optical observations of geosynchronous orbit (GEO) debris are important to address two questions:

1. What is the distribution function of objects at GEO as a function of brightness? With some assumptions, this can be used to infer a size distribution.
2. Can we determine what the likely composition of individual GEO debris pieces is from studies of the spectral reflectance of these objects?

In this paper we report on optical observations with the 6.5-m Magellan telescopes at Las Campanas Observatory in Chile that attempt to answer both questions.

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Imaging observations over a 0.5 degree diameter field-of-view have detected a significant population of optically faint debris candidates with $R > 19^{\text{th}}$ magnitude, corresponding to a size smaller than 20 cm assuming an albedo of 0.175. Many of these objects show brightness variations larger than a factor of 2, suggesting either irregular shapes or albedo variations or both. The object detection rate (per square degree per hour) shows an increase over the rate measured in the 0.6-m MODEST observations, implying an increase in the population at optically fainter levels. Assuming that the albedo distribution is the same for both samples, this corresponds to an increase in the population of smaller size debris.

To study the second issue, calibrated reflectance spectroscopy has been obtained of a sample of GEO and near GEO objects with orbits in the public U.S. Space Surveillance Network catalog. With a 6.5-m telescope, the exposures times are short (30 seconds or less), and provide simultaneous wavelength coverage from 4500 to 8000 Angstroms. If the observed objects are tumbling, then simultaneous coverage and short exposure times are essential for a realistic assessment of the object's spectral signature. We will compare the calibrated spectra with lab-based measurements of simple spacecraft surfaces composed of a single material.