

## INFRARED TELESCOPE FACILITY'S SPECTROGRAPH OBSERVATIONS OF HUMAN-MADE SPACE OBJECTS

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### ABSTRACT

Presented here are the results of the Infrared Telescope Facility (IRTF) spectral observations of human-made space objects taken from 2006 to 2008. The data collected using the SpeX infrared spectrograph cover the wavelength range 0.7-2.5  $\mu\text{m}$ . Overall, data were collected on 20 different orbiting objects at or near the geosynchronous (GEO) regime. Four of the objects were controlled spacecraft, seven were non-controlled spacecraft, five were rocket bodies, and the final four were cataloged as debris pieces. The remotely collected data are compared to the laboratory-collected reflectance data on typical spacecraft materials, thereby general materials are identified but not specific types. These results highlight the usefulness of observations in the infrared by focusing on features from hydrocarbons, silicon, and thermal emission. The spacecraft, both the controlled and non-controlled, show distinct features due to the presence of solar panels, whereas the rocket bodies do not. Signature variations between rocket bodies, due to the presence of various metals and paints on their surfaces, show a clear distinction from those objects with solar panels, demonstrating that one can distinguish most spacecraft from rocket bodies through infrared spectrum analysis. Finally, the debris pieces tend to show featureless, dark spectra. These results show that the laboratory data in its current state give excellent indications as to the nature of the surface materials on the objects. Further telescopic data collection and model updates to include noise, surface roughness, and material degradation are necessary to make better assessments of orbital object material types. However, based on the current state of the comparison between the observations and the laboratory data, infrared spectroscopic data are adequate to classify objects in GEO as spacecraft, rocket bodies, or debris.