

## NASA's Optical Measurement Program 2014

H. Cowardin (JACOBS), S. Lederer (NASA), G. Stansbery (NASA), P. Seitzer (University of Michigan), B. Buckalew (JACOBS), K. Abercromby (California Polytechnic State University), E. Barker (LZ Technology)

The Optical Measurements Group (OMG) within the NASA Orbital Debris Program Office (ODPO) addresses U.S. National Space Policy goals by monitoring and characterizing debris. Since 2001, the OMG has used the Michigan Orbital Debris Survey Telescope (MODEST) at Cerro Tololo Inter-American Observatory (CTIO) in Chile for general orbital debris survey. The 0.6-m Schmidt MODEST provides calibrated astronomical data of GEO targets, both catalogued and uncatalogued debris, with excellent image quality. The data are utilized by the ODPO modeling group and are included in the Orbital Debris Engineering Model (ORDEM) v. 3.0. MODEST and the CTIO/SMARTS (Small and Moderate Aperture Research Telescope System) 0.9 m both acquire filter photometric data, as well as synchronously observing targets in selected optical filters. This information provides data used in material composition studies as well as longer orbital arc data on the same target, without time delay or bias from a rotating, tumbling, or spinning target.

NASA, in collaboration with the University of Michigan, began using the twin 6.5-m Magellan telescopes at Las Campanas Observatory in Chile for deep imaging (Baade) and spectroscopic data (Clay) in 2011. Through the data acquired on Baade, debris have been detected that are ~3 magnitudes fainter than detections with MODEST, while the data from Clay provide better resolved information used in material characterization analyses via selected bandpasses.

To better characterize and model optical data, the Optical Measurements Center (OMC) at NASA/JSC has been in operation since 2005, resulting in a database of comparison laboratory data. The OMC is designed to emulate illumination conditions in space using equipment and techniques that parallel telescopic observations and source-target-sensor orientations.

Lastly, the OMG is building the Meter Class Autonomous Telescope (MCAT) at Ascension Island. The 1.3-m telescope is designed to observe GEO and LEO targets, using a modified Ritchey-Chrétien configuration on a double horseshoe equatorial mount to allow tracking objects at LEO rates through the dome's keyhole at zenith.

Through the data collection techniques employed at these unique facilities, NASA's ODPO has developed a multi-faceted approach to characterize the orbital debris risk to satellites in various altitudes and provide material characterization of debris via photometric and spectroscopic measurements. Ultimately, the data are used in conjunction with in-situ and radar measurements to provide accurate data for models of our space environment and service spacecraft risk assessment.