Development of the NASA MCAT Auxiliary Telescope for Orbital Debris Research

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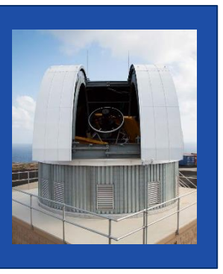
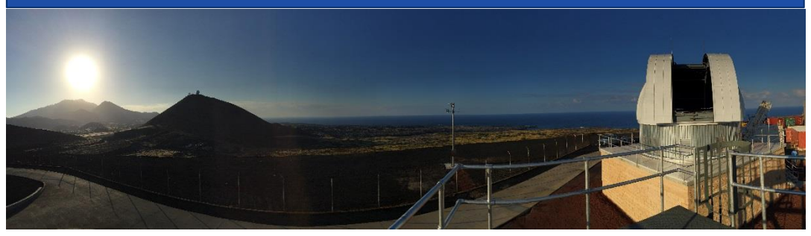


Abstract

The National Aeronautical and Space Administration (NASA) has recently deployed the Meter Class Autonomous Telescope (MCAT) to Ascension Island. MCAT will provide NASA with a dedicated optical sensor for observations of orbital debris with the goal of statistically sampling the orbital and photometric characteristics of the population from low Earth to Geosynchronous orbits. Additionally, a small auxiliary telescope, co-located with MCAT, is being deployed to augment its observations by providing near-simultaneous photometry and astrometry, as well as offloading low priority targets from MCAT's observing queue. It will also be available to provide observational measurements to the Space Surveillance Network for the United States Air Force.

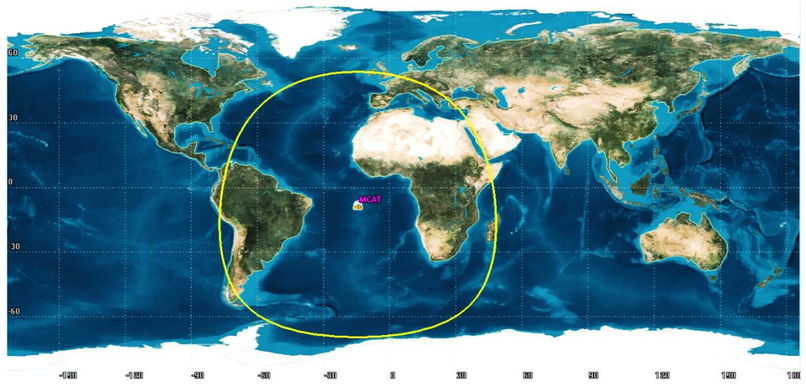
MCAT



MCAT is already deployed to Ascension Island and undergoing its final testing to begin full time operations in the fall of 2016. Some attributes include:

- 1.3 m, f/4 optical tube assembly.
- Double horseshoe equatorial mount.
- Spectral Instruments 1100 Series 4-port cryo-cooled camera (4 k x 4 k, 15 µm pixels).
- 0.68 degree field of view.
- Fully autonomous.
- Both dome and mount capable of fast tracking for observing objects in low Earth orbit.

Ascension Island



Located in the middle of the Atlantic ocean at 07º 56`S and 14º 22`W, Ascension Island provides access to the uncharacterized low inclination, low Earth orbit debris population and geostationary objects not accessible at other longitudes, and is home to a radar facility for potential future combined observations.

The Auxiliary Telescope

Above: MCAT dome and facility (left) and the future home of the JRBT in the 7 ft AstroHaven dome (right).

The James R. Benbrook Telescope (JRBT), named after a long time member and friend of the Orbital Debris Program Office, is designed to augment and complement the observations of the primary telescope. Its primary goal is to support initial orbit determination of uncatalogued debris by immediately and persistently tracking objects of interest detected by MCAT during survey operations. The JRBT is also perfectly situated to provide near-simultaneous observations of MCAT targets which, when combined with observing in different filters, will help to explore debris color-material type relationships.

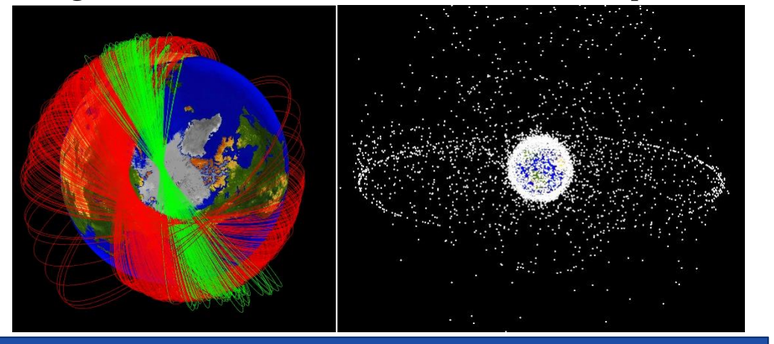
Assembled telescope being tested by Astelco Systems in Germany.

The components of the JRBT include:

- 0.4 m f/5.2 Officina Stellare RiLA 400 optical tube assembly.
- Astelco NTM-500 German equatorial mount.
- FLI ProLine PL4240 2 K x 2 K, 13.5 micron pixel camera.
- 0.76 degree field of view.
- FLI 10 position, dual color, filter wheel populated with the same filters as MCAT.
- Fully autonomous.
- Capable of fast tracking for observing objects in low Earth Orbit.

NASA Orbital Debris Program Office

- It is the charge of NASA's Orbital Debris Program Office (ODPO) to characterize the growing population of man-made space debris in orbit around the Earth.
- Understanding the current environment requires radar and optical observations of debris at all altitudes.
- MCAT and its smaller augmentation telescope are the Office's first fully autonomous sensors dedicated towards providing optical observations of the debris environment to ODPO.
- The data will help update models used to predict the future debris environment and provide insight into mitigation and remediation of the orbital debris problem.



Observing Methods

The tasking methods for JRBT have been designed to help optimize the observations of MCAT and augment the information obtained in a synergistic way. To that end, several tasking methods have been envisioned:

Refinement of Initial Orbit Determination: JRBT will provide persistent tracking of newly identified debris to refine their orbital elements while MCAT is allowed to continue survey operations.

Near Simultaneous Multi-Color Observations: JRBT can be tasked to take near-simultaneous observations in a complementary filter with MCAT. This can provide insight into debris material research currently being conducted at ODPO and help distinguish and compare unique debris objects, reducing the number of times the same object may be counted multiple times.

Seeing Monitor: JRBT will be capable of acting as a Differential Imaging Motion Monitor (DIMM) for independent seeing measurements if needed.

Deployment to Ascension

JRBT is undergoing preliminary testing and integration and should be deployed to Ascension before the end of 2016. It is expected soon after to begin regular operations in support of MCAT and the ODPO.