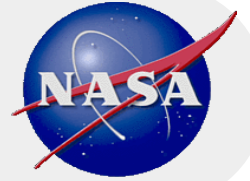


NASA Measurements Summary for the IADC Working Group 1

Dr. Sue Lederer
NASA Johnson Space Center

*Presented at IADC
7 to 10 May 2019 Rome, Italy*



NASA Radar Measurements since April 2018

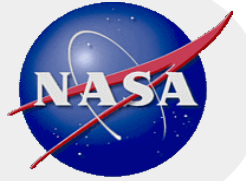
- **The HUSIR radar: ~480 hours of orbital debris data collected**
 - HUSIR transmitter nominal ~250 kW operation throughout FY18 and FY19
 - Approximately 2/3 of data at 75° elevation, 90° azimuth
 - Approximately 1/3 split between 20° and 10° elevation, 180° azimuth
- **The Haystack Auxiliary (HAX) radar: ~338 hours collected**
 - Transmitter nominal ~40 kW operation for data collection
 - Tube failed at end of FY18, new tube expected later this FY
- **Goldstone Radar: ~64 hours collected**
 - New bistatic pointing geometry data collection started in July 2018
 - Transmitter power reduced due to failed transmitter tubes, expected to be at nominal 440 kW by end of FY
 - CY16 and CY17 data used in ORDEM 3.1 validation
- **Debris Radar Automated Data Inspection System (DRADIS) is being developed to replace legacy signal processing software.**
 - DRADIS-processed HUSIR data from FY14 – FY17 data used in ORDEM 3.1
 - Full Operating Capability (FOC) release later this FY



Aeronautics and Space Administration

MCAT 1.3m Optical Telescope

Ascension Island (7° 58' S, 14° 24' W)



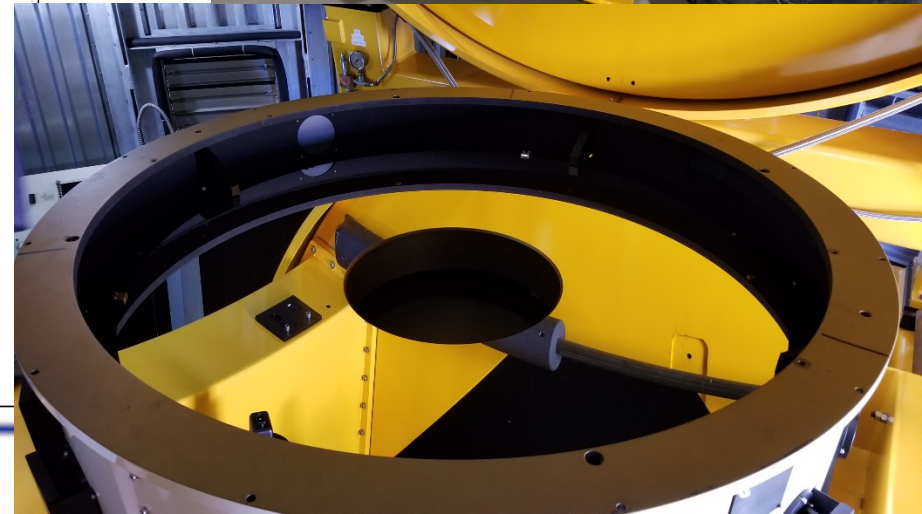
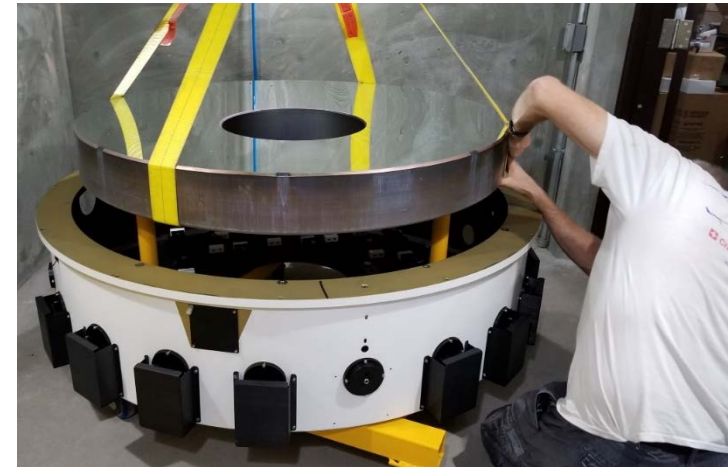
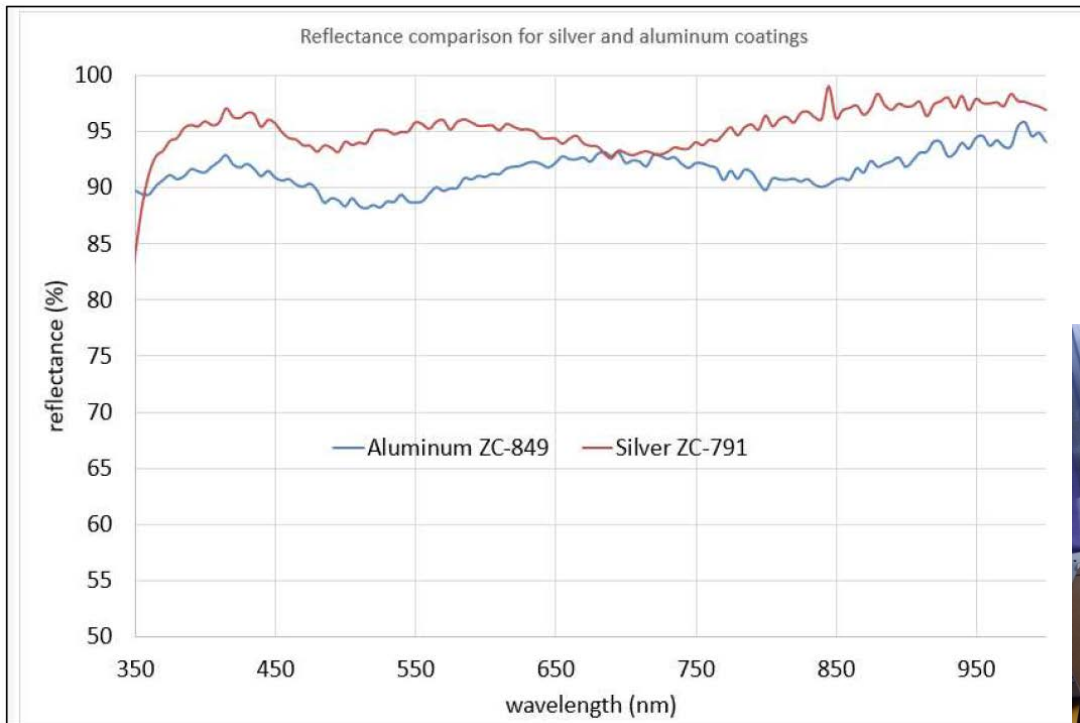
- **MCAT Goal: Statistically characterize under-sampled orbital regimes**
 - Monitor and assess orbital debris environment by *surveying, detecting, tracking* from LEO to GEO
- **Status**
 - Autonomous data collection & reduction
 - GEO, Rate Track, and TLE tracking
 - Calibration and survey data
 - Weather monitoring, start-up, shut-down
- **Installed 7-foot ObservaDome for 0.4m telescope**
- **Mirror recoating complete**

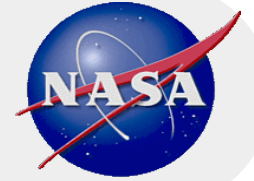


ZeCoat Corporation

• Protected/Enhanced Silver

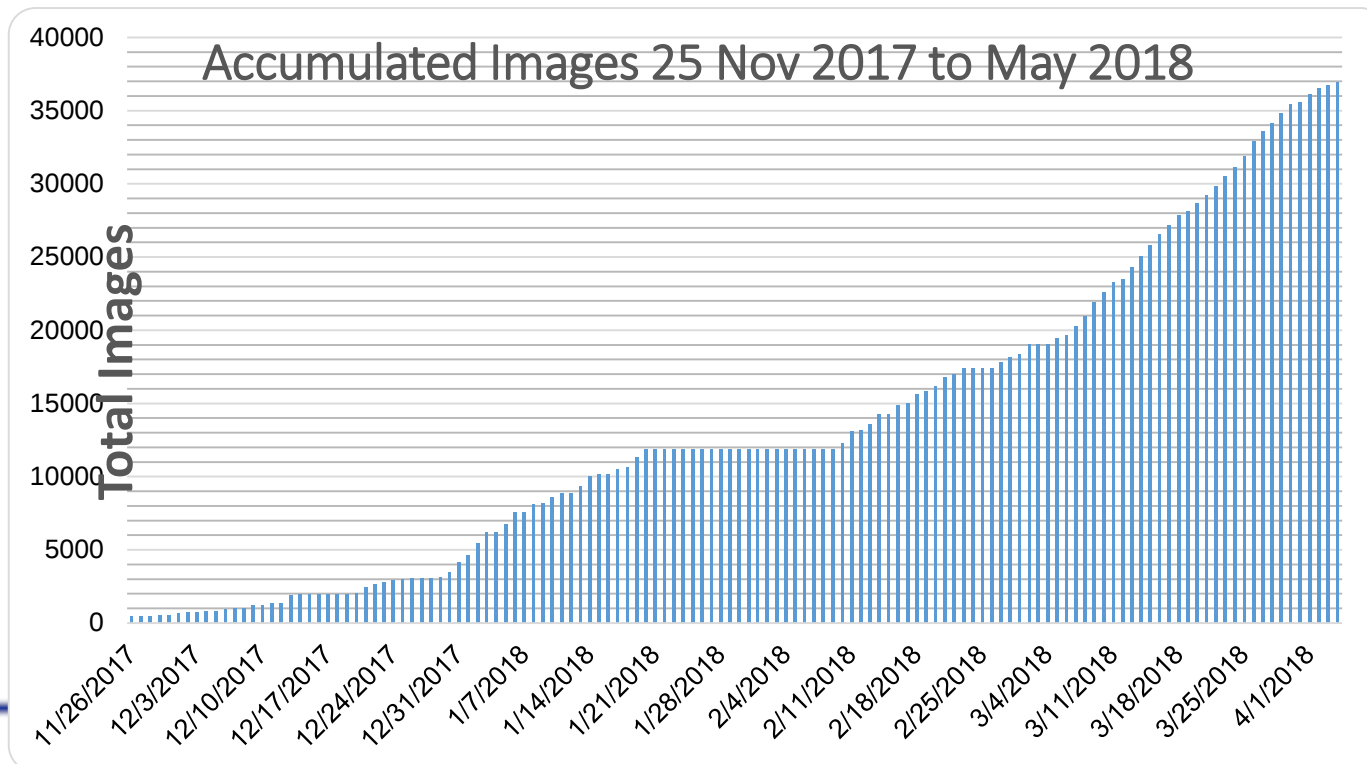
- Design by Lawrence Livermore (LLNL); Enhancement developed for Kepler
- 95.3% ave reflective across entire MCAT bandpass (**TOP CURVE**)
- Passes all durability tests, salt solubility, salt-fog, etc
- Coated on: Kepler, misc mirrors for Keck, Magellan, McDonald





GEO IOC Acceptance Summary

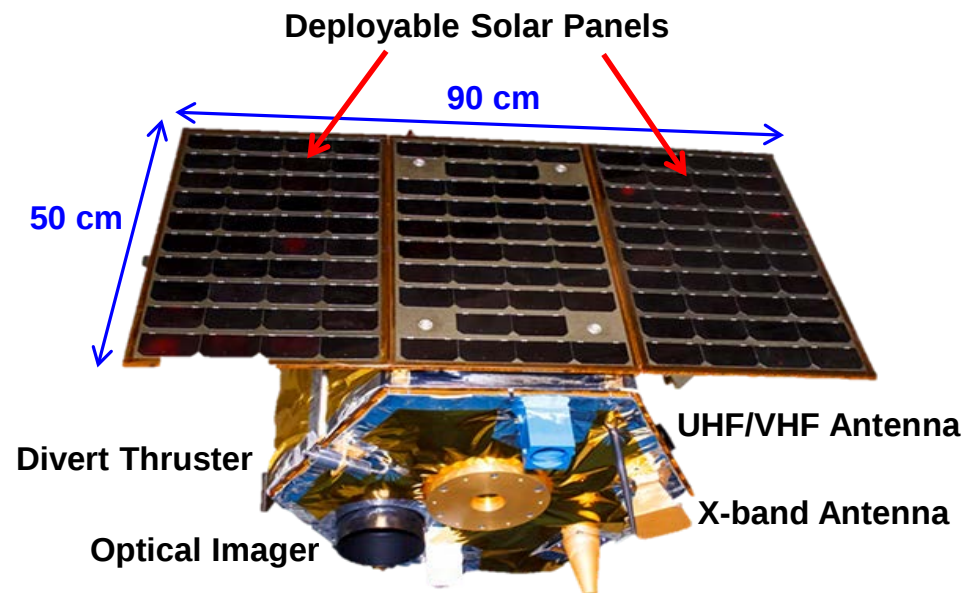
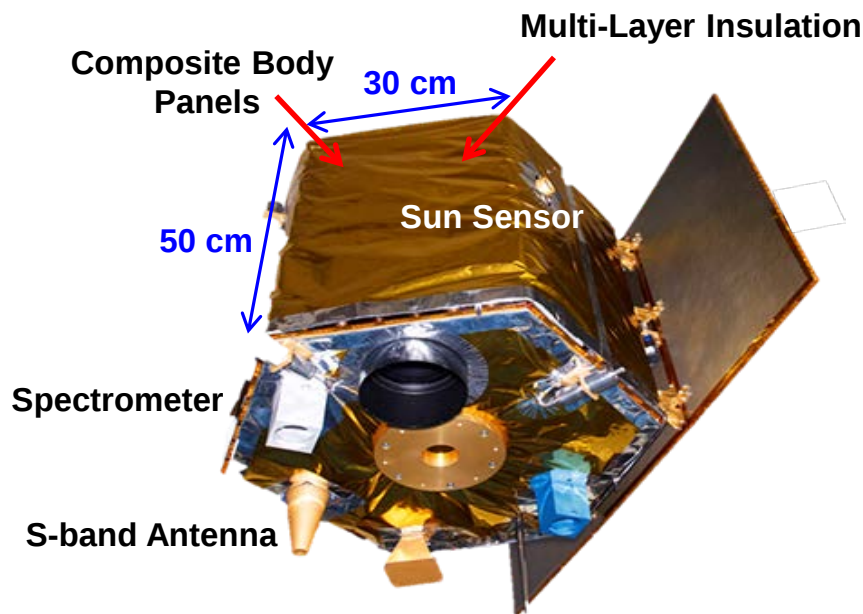
- **GEO Survey Initial Operational Capability Burn-in phase prior to mirror-removal**
 - Safe operations
 - Burn-in
 - **62** days of continuous operations - Required = 30 days
 - Total Images = **25,460** – Required = 9,000 images
 - Total Hours = **282.9** – Required = 150



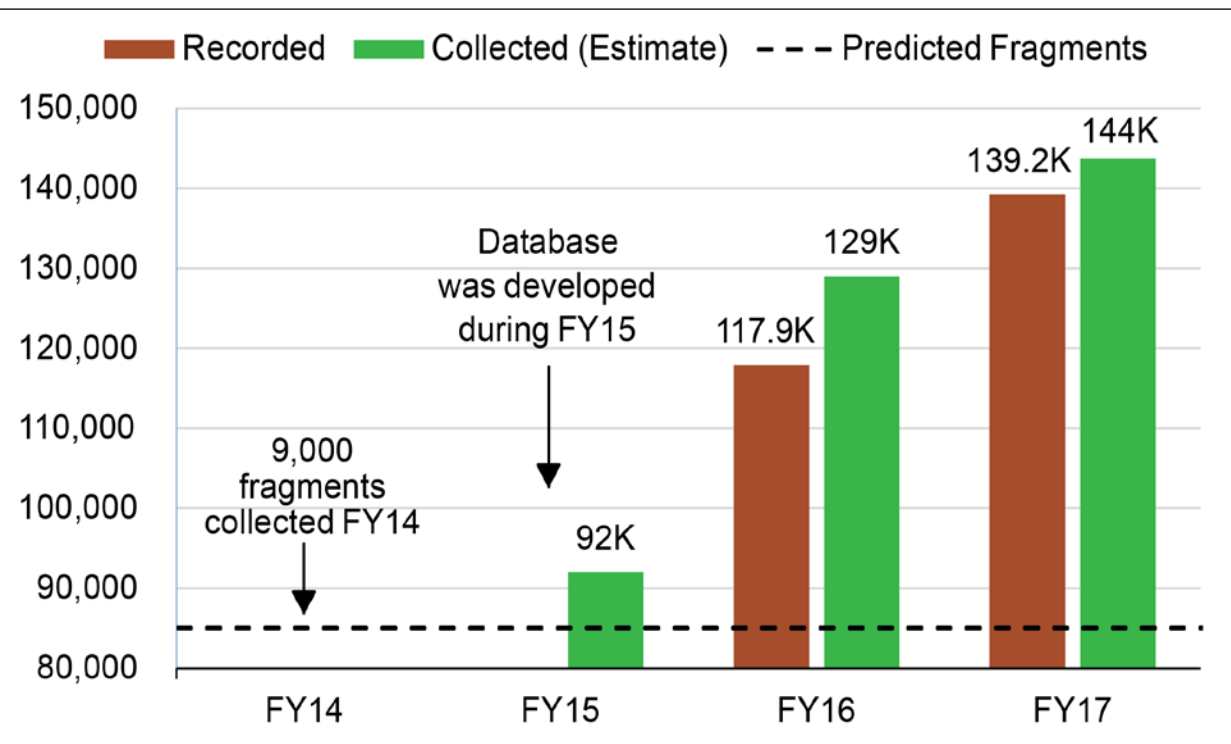
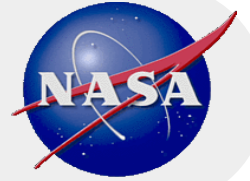


DebrisSat

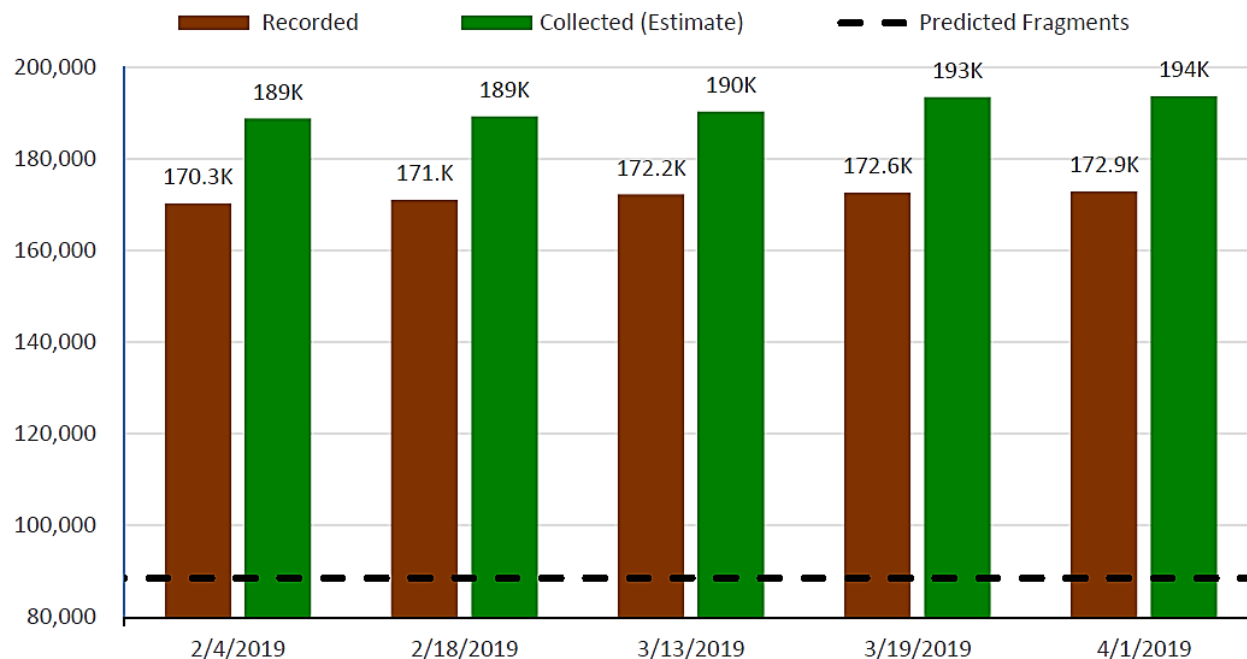
- **Purpose:** Replicate a hyper-velocity fragmentation event using **modern-day spacecraft materials** and construction techniques to better improve the existing DoD and NASA **breakup models** & to **update damage equations** for non-spherical projectiles



Data Collection



- **Collect, measure, & characterize all fragments, including MLI and solar panel pieces, down to ~2 mm in size**
 - Size, shape
 - Density distributions



- **Radar, photometric, and spectral measurements for selected fragments**
 - Support improvements to radar and optical size-estimation models