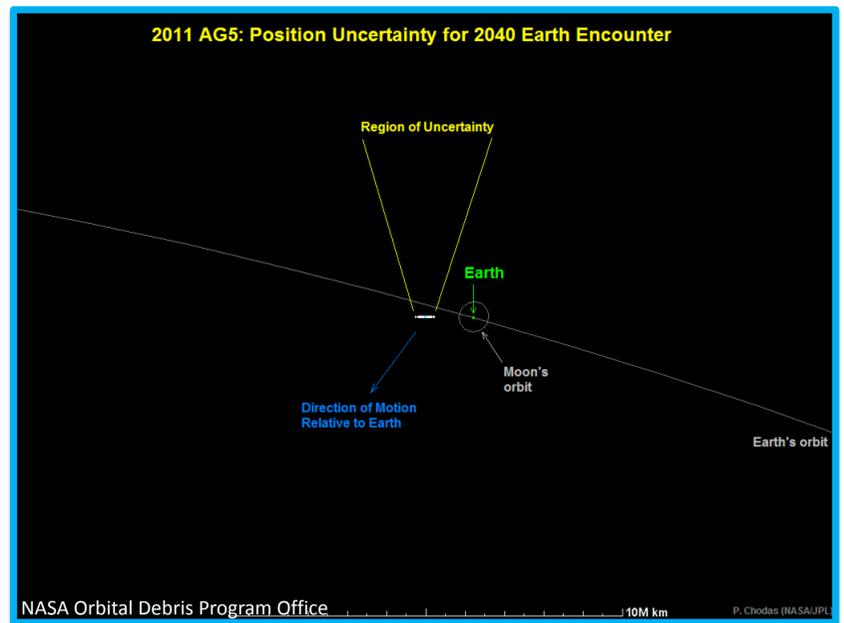
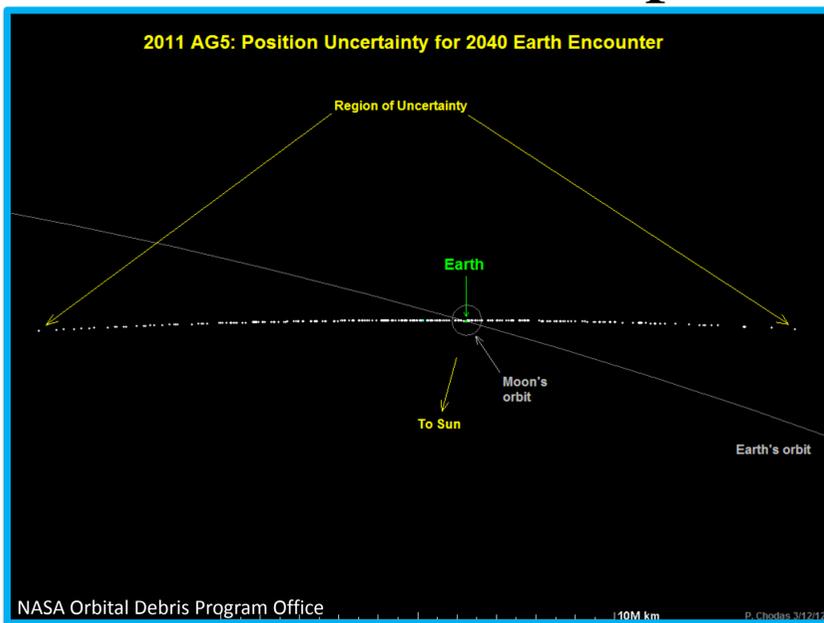


# Planetary Protection Possibilities with a Thirty Meter Telescope

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**ABSTRACT:** Planetary protection includes surveying for earth threatening asteroids as well as monitoring man made earth orbiting debris. There is continuous monitoring of all earth orbiting debris > 10 cm. The debris monitoring predicts when and where the debris will reenter the earth's atmosphere, detects new objects, predicts the orbits of all objects, calculates possible conjunctions (collisions), determines ownership of debris and provides a catalog of orbital objects to satellite operators for asset protection. The US monitoring network keeps track of approximately 17,000 objects. Of these, approximately 3,600 are operational satellites. The remaining 13,400 objects are orbital debris of different types. The objects are scattered from Low Earth Orbit out to Geo-synchronous orbit. The GEO objects are the most difficult to identify from earth due to the long range (~40,000 Km). Extremely Large Telescopes such as the TMT can assist in the identification of orbital debris due to the large light gathering area, the exquisite imaging resolution and the fine spectral resolution capabilities of the TMT first light instruments. Simulated examples of the TMT capabilities for viewing GEO synchronous orbital objects will be presented along with a brief discussion of TMT periodic observing in a monitoring network.

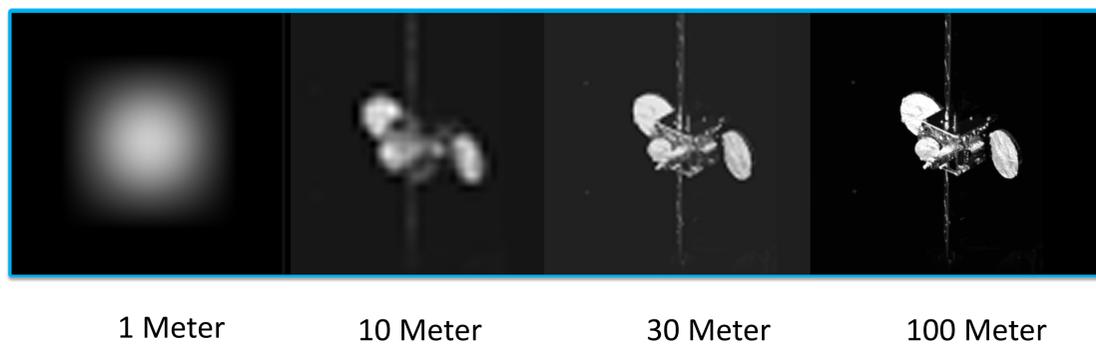
## Asteroid Ephemeris Refinement



The position data obtained for near-Earth asteroid 2011 AG5 in October 2012 was used to update its orbit and dramatically reduce its future orbital uncertainties in February 2040. On the left, the asteroid's possible positions in space (region of uncertainty) prior to the orbit improvement is an extremely lengthy arc that includes the position of the Earth. Hence an Earth collision could not be ruled out. However, the observational data in October 2012 allowed a sixty-fold improvement in the 2040 region of uncertainty and the plot on the right shows that this, now much smaller, arc no longer includes the Earth. Hence an Earth impact by 2011 AG5 in February 2040 is no longer possible. Credit: NASA ORBITAL DEBRIS OFFICE

## Orbital Debris Characterization

### Simulated Images of GEO Object



These are simulated images assuming a wavelength of 0.5 microns and perfect adaptive optics correction. Representative images for apertures from 1 meter to 100 meters are shown. The 30 meter aperture clearly resolves features on the object and has an effective resolution of 12 inches at a range of 36,000,000 meters.