RADAR AND INFRARED OBSERVATIONS OF NEAR-EARTH ASTEROID 3200 PHAETHON.

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Introduction: Near-Earth asteroid 3200 Phaethon is one of the largest bodies categorized as potentially hazardous to Earth and is widely believed to be the parent body of the Geminid meteor shower. Though classified as an asteroid, Phaethon undergoes episodic activity, much like a comet, during its perihelion passages. Furthermore, Phaethon is the target of the Japan Aerospace Exploration Agency (JAXA) mission Demonstration and Experiment of Space Technology for INterplanetary voYage, Phaethon fLyby and dUst Science (DESTINY$^+$) scheduled to launch in 2022. Phaethon's approach in December within 0.069 au of Earth was the closest since its discovery and presented the best opportunity to characterize this object prior to the DESTINY$^+$ launch date.

Observations: We observed Phaethon with the Arecibo planetary radar system from 2017 December 15 to 19 obtaining range-Doppler images with complete rotational coverage at a resolution of 75 meters per pixel and used the Goldstone Solar System Radar to collect echo power spectra of Phaethon almost daily from December 11 to 21. We also collected rotationally resolved infrared spectra of Phaethon on four dates between December 6 and 15 using the NASA InfraRed Telescope Facility (IRTF).

Results: Radar images reveal a roughly spheroidal shape 6 kilometers in diameter, somewhat larger than previously estimated [1], with no indication of satellites nor a comet-like coma skirt. Surface features are subtle at the 75-meter resolution of the Arecibo radar images, barring two prominent features: a concavity near the equator and a radar dark feature near one of the poles. Figure 1 shows the dark feature that may be a polar crater or a relatively flat region compared to the local topography. Comparisons to the convex shape model and spin state derived from lightcurve data [1] will be made and preliminary shape modeling results will be presented. Reduction of the infrared data will determine the albedo and thermal inertia, constrain the surface roughness, and reveal any changes in thermal characteristics with rotation.

Figure 1. Arecibo radar image of 3200 Phaethon with 75-meter resolution. The echo is rather non-descript, though there is a prominent radar dark feature (circled in red) near one of the poles.

References: [1] Hanuš, J., et al. (2016) *A&A, 592*, A34.

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