SHAPE modeling of (4) Vesta for Dawn mission support and SHAPE inversion validation. C. R. Nugent[1], J. L. Margot[1], C. T. Russell[1], M. C. Nolan[2], C. Magri[3], and J. D. Giorgini[4]. [1]University of California, Los Angeles (Department of Earth and Space Scinces, 595 Charles Young Drive East, Los Angeles, CA, 90095-1567). [2]NAIC/Arecibo Observatory. [3]University of Maine at Farmington. [4]Jet Propulsion Laboratory/Caltech.

Introduction: Vesta was chosen as a target by the Dawn mission for its unique physical properties and the insight it can offer into the planetary formation process. Considered by some to be a protoplanet, it is thought to be the only asteroid with a differentiated, intact internal structure [1]. The second most massive object in the asteroid belt, it is believed to be the source of HED (Howardite, Eucrite, Diogenite) meteorites [2].

The Dawn spacecraft arrives at Vesta in July 2011. Once in orbit, it will spend the next year examining the asteroid with a visible camera and multiple spectrometers [3]. To maximize the mission's scientific return during its limited time in orbit, Dawn's trajectory needs to be carefully planned—but current spin axis orientation uncertainties preclude delivery to an optimal orbit.

The spin axis orientation of Vesta is known to 5 degrees at best [4], [5]. Without advance knowledge of when and by what angle surface features are illuminated, it is impossible to precisely plan a comprehensive mapping trajectory, or a trajectory to take stereo images. If a good orbit is not initially entered by Dawn, then valuable observing time will be wasted while the orbit is corrected. The spacecraft cannot linger at Vesta—it must depart on time to reach its next target, Ceres.

SHAPE Modeling: SHAPE software [6], [7] can invert radar images, light curves, and optical images to generate a 3-D model of an asteroid as well as characterize its spin state.

We combine all available good-quality Vesta observations to generate a new model with SHAPE. These observations include the delay-Doppler images acquired at Arecibo in 2003 [8] during the closest approach of Vesta this century. In addition, the model also incorporates light curve observations, taken between 1950 and 1992. Our long-term goal is to integrate Hubble Space Telescope images as well [4].

This is the most comprehensive modeling done of (4) Vesta to date. The spin pole estimate given by this modeling will help support Dawn mission planning, so that the mission's trajectory and time at Vesta will be optimized.

Model Validation: The Dawn visit to Vesta also represents an opportunity to thoroughly validate the implementation of the SHAPE software and the accuracy of the shape inversions.

Only one shape-modeled asteroid (25143 Itokawa) has also been observed by a spacecraft. However, radar coverage for this object was incomplete, which limited SHAPE's results [9], [10].

Arecibo Observations: We submitted a proposal for additional Arecibo delay-Doppler observations of Vesta during its close approach in late February 2010. They will cover sub-radar point latitudes of 22 degrees, improving radar coverage of the object (the 2003 observations covered 9-13 degrees). This new data will enhance the robustness of the resulting shape model and pole position. Preliminary results of the new data will be presented at the meeting.

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