

Shape Modeling of near-Earth Asteroid (53319) 1999 JM8 from Goldstone and Arecibo Radar Images. M. Brozovic¹, L.A.M. Benner¹, M.C. Nolan², S.J. Ostro¹, J.L. Margot³, J.D. Giorgini¹, E.S. Howell², C. Magri⁴, M.W. Busch⁵, P.A. Taylor², M.K. Shepard⁶, ¹Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena CA 91109, USA, marina.brozovic@jpl.nasa.gov, ²Arecibo Observatory, HC3 Box 53995, Arecibo PR 00612, USA, ³University of California Los Angeles, Department of Earth and Space Sciences, 595 Charles Young Dr. E, Los Angeles CA 90095, USA, ⁴University of Maine at Farmington, 173 High Street – Preble Hall, Farmington, ME 04938, USA, ⁵University of California Los Angeles, Department of Earth and Space Sciences, 595 Charles Young Dr. E, Los Angeles CA 90095, USA, ⁶Department of Geography and Geosciences, Bloomsburg University, 400 E. Second Street, Bloomsburg PA 17815, USA

Introduction: 1999 JM8 has a diameter of ~ 7 km and is one of the largest objects in the near-Earth population. Delay-Doppler images obtained from July 18 to Aug. 9, 1999 at Arecibo (S-band, 2380-MHz, 13-cm) and Goldstone (X-band, 8560-MHz, 3.5-cm) provide one of the most detailed and extensive radar imaging datasets available. Resolutions as fine as 15 m in range revealed a wealth of topographic features: prominent facets, crater-like concavities that are a few tens to more than a thousand meters in diameter, and a “horn-like” bulge that sticks out from an overall rounded pole-on silhouette (Benner et al., 2002). Benner et al. (2002) also found that 1999 JM8 is a non-principal-axis (NPA) rotator with a dominant period of ~ 7 days.

We report preliminary shape modeling of this intriguing object. Our initial modeling assumption was that 1999 JM8 rotates about its short principal axis (PA rotation) with ~ 45 deg/day. We found no candidate pole that can fit all the data under the assumption of PA rotation. However, a subset of the data from Aug. 1-9 can be fit with PA rotation (Fig. 1) and we obtain a model that resembles an ellipsoid with an equivalent diameter of ~ 6.4 km. The preliminary model has a conspicuous localized bulge that at some orientations gives a “triangular” appearance to the radar echoes.

Our modeling is ongoing but it clearly suggests that 1999 JM8 is likely quite far from a short-axis-mode (SAM) spin state. Instead, the evidence suggests that this object is a long-axis-mode (LAM) non-principal axis rotator, as was previously found for 4197 Toutatis by Hudson and Ostro (1995).

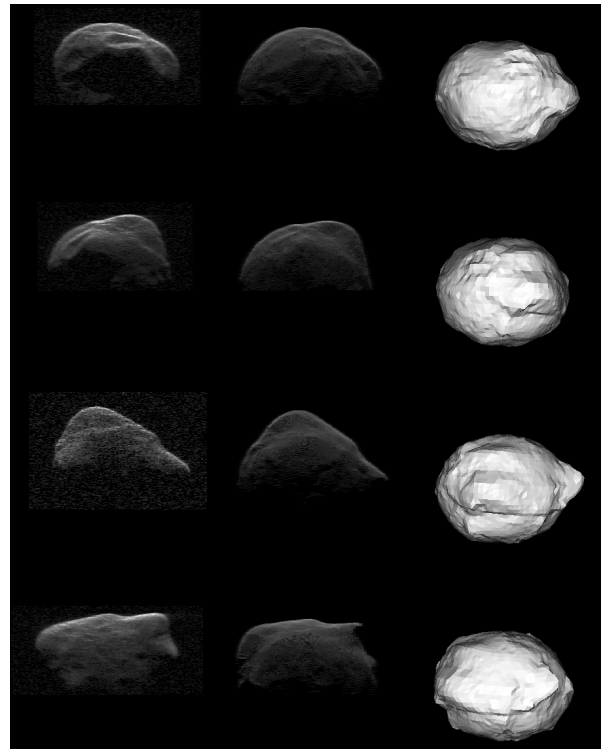


Fig 1: Representative sequence of Arecibo delay-Doppler images from 1999 Aug. 2-5 (left), synthetic radar images produced from the shape model (middle), and plane-of-sky views (right). Time delay increases from top to bottom with a resolution of $0.1 \mu\text{s}$ (15 m) and Doppler frequency increases from left to right with a resolution of 0.008 Hz. The plane-of-sky view is contained in 10×10 km square with 301×301 pixels.

References:

- [1] L.A.M. Benner et al. (2002) *Meteoritics & Planet. Sci.*, **37**, 779-792.
- [2] R.S. Hudson and S.J. Ostro (1995) *Science* **270**, 84-86.