

**ARECIBO AND GOLDSTONE RADAR OBSERVATIONS OF BINARY NEAR-EARTH ASTEROID AND *MARCO POLO-R* MISSION TARGET (175706) 1996 FG3.** L. A. M. Benner<sup>1</sup>, M. Brozovic<sup>1</sup>, J. D. Giorgini<sup>1</sup>, K. J. Lawrence<sup>1</sup>, P. A. Taylor<sup>2</sup>, M. C. Nolan<sup>2</sup>, E. S. Howell<sup>2</sup>, M. W. Busch<sup>3</sup>, J. L. Margot<sup>3</sup>, S. P. Naidu<sup>3</sup>, C. Magri<sup>4</sup>, and M. K. Shepard<sup>5</sup>. <sup>1</sup>Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA, 91109, USA, <sup>2</sup>Arecibo Observatory, National Astronomy and Ionosphere Center, HC3 Box 53995, Arecibo PR 00612, USA, <sup>3</sup>University of California Los Angeles, Department of Earth and Space Sciences, 595 Charles Young Dr. E, Los Angeles CA 90095, USA, <sup>4</sup>University of Maine at Farmington, 173 High Street – Preble Hall, Farmington, ME 04938, USA, <sup>5</sup>Department of Geography and Geosciences, Bloomsburg University, 400 E. Second Street, Bloomsburg PA 17815, USA.

We report Arecibo (2380 MHz, 13-cm) and Goldstone (8560 MHz, 3.5-cm) delay-Doppler radar observations of binary near-Earth asteroid and *Marco Polo-R* mission target (175706) 1996 FG3 that were obtained on nine dates between November 6–December 17, 2011. The images achieve resolutions as fine as 75 m in range and place hundreds of pixels on the primary.

The images provide thorough rotational coverage by the primary, which is a relatively rapid rotator with a period of 3.6 h [1], and reveal a rounded, slightly elongated object with a visible extent of  $\sim 0.9$  km. If the visible extent is about  $\frac{1}{2}$  of the actual extent, which would be true for a sphere, then the diameter is about 1.8 km (Fig. 1). The primary has features along its leading edge that resemble the signature of the pronounced ridge on the equator of binary asteroid (66391) 1999 KW4 [2].

The images sample a wide range of orbital positions by the secondary. The images resolve the secondary in range and Doppler frequency, show that it is elongated and roughly 500 m in diameter, and suggest that its rotation is synchronous (or nearly so) with its orbital period of 16.1 h [3]. Scheirich and Pravec [3] modeled lightcurves to estimate the system's orbital parameters and obtained a low eccentricity and a pole direction suggesting that the subradar latitude was close to the equator throughout the radar observations. We observe a maximum range separation of  $\sim 2.5$  km that establishes a lower bound on the semimajor axis.

We obtain a circular polarization ratio SC/OC =  $0.34 \pm 0.02$  that is comparable to those of 433 Eros ( $0.27 \pm 0.06$ ) [4] and 25143 Itokawa ( $0.28 \pm 0.04$ ) [5], suggesting similar degrees of near-surface roughness.

The radar data will yield a 3D model of the primary, possibly a coarse-resolution model of the secondary, more precise orbit fitting, and estimates of the system's mass and bulk density.

**References:** [1] Pravec, P., et al. (2006). *Icarus*, 181, 63-93. [2] Ostro, S. J., et al. (2006) *Science*, 314, 1276–1280. [3] Scheirich, P., and Pravec, P. (2009) *Icarus*, 200, 531-547. [4] Magri, C., et al. (2001) *Meteoritics & Planet. Sci.* 36, 1697–1709. [5] Ostro, S. J., et al. (2004). *Meteoritics & Planet. Sci.*, 39, 407-424.

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**1996 FG3: 2011 Nov. 22**

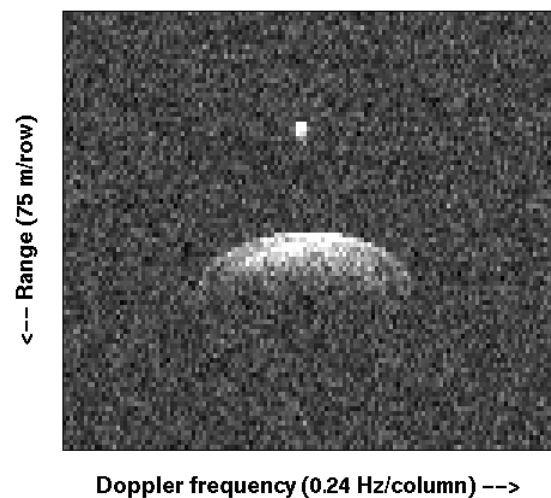


Figure 1. Arecibo radar image of 1996 FG3.