RADAR OBSERVATIONS OF BINARY NEAR-EARTH ASTEROID AND *JANUS* MISSION TARGET (175706) 1996 FG3. Lance A. M. Benner[1], Marina Brozovic[1], Jon D. Giorgini[1], Patrick A. Taylor[2], Michael C. Nolan[3], Ellen S. Howell[3], Michael W. Busch[4], Jean-Luc Margot[5], Shantanu P. Naidu[1], and Christopher Magri[6]. [1]Jet Propulsion Laboratory, California Institute of Technology. [2]Lunar and Planetary Institute, Universities Space Research Association. [3]Lunar and Planetary Laboratory, University of Arizona. [4]SETI Institute. [5]University of California, Los Angeles. [6]University of Maine at Farmington.

Introduction: We report Arecibo (2380 MHz, 13-cm) and Goldstone (8560 MHz, 3.5-cm) delay-Doppler radar observations of binary near-Earth asteroid (NEA) and *Janus* 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. 1996 FG3 is one of two targets of the proposed *Janus* mission recently selected for further development in NASA's SIMPLEx small spacecraft program.

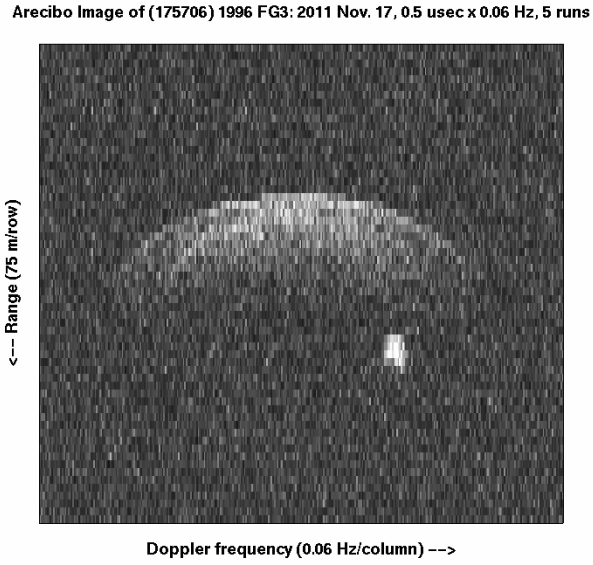

Figure 1. Arecibo delay-Doppler image of 1996 FG3 obtained on 2011 November 17. Range increases down and Doppler frequency increases to the right. Resolution is 75 m x 0.06 Hz.

Results: We obtained about 200 delay-Doppler images that provide thorough rotational coverage by the primary and reveal a rounded, slightly elongated object with a visible extent of ~0.9 km. 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 [1], and several radar-dark regions suggesting topographic depressions or areas with lower radar albedos (Fig. 1). The images sample a wide range of orbital positions by the secondary, resolve it in range and Doppler frequency (Fig. 1), show that it is moderately elongated and roughly 500 m in diameter, and suggest that its rotation is synchronous with the orbital period of 16.1 h estimated by Scheirich and Pravec [2].

Preliminary 3D modeling of the primary (Fig. 2) reveals a shape similar to a top with a pronounced ridge along the equator and a second, partial ridge at mid latitudes in the northern hemisphere. The model has an effective diameter of 1.8 km that is consistent with the diameter estimated from *WISE* spacecraft data (J. Masiero, pers. comm.). Radar imaging and modeling have revealed similar shapes for the primaries of numerous other binary and triple NEAs [1, 3, 4, 5, 6] and also for several NEAs not known to have companions [6, 7, 8]; similar shapes have recently been revealed by the *Hayabusa2* and *OSIRIS-REx* spacecraft at (162173) Ryugu [9] and (101955) Bennu [8, 10] The Arecibo radar images are suitable for modeling of the secondary and work is underway to estimate its 3D shape.

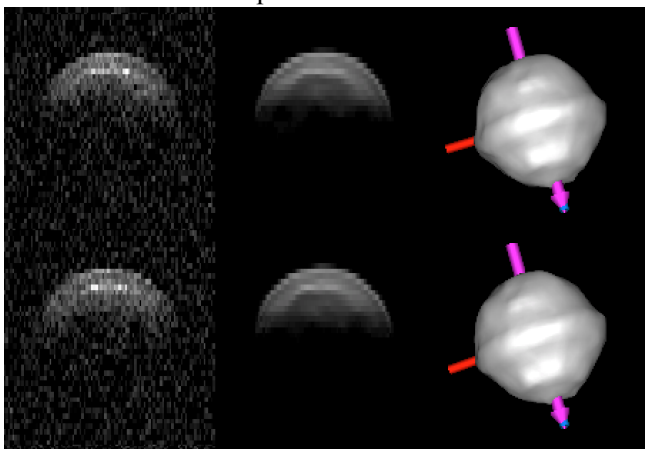

Figure 2. Selected delay-Doppler data (left), fits (middle), and plane-of-sky views (right) of the preliminary model of the primary from 2011 November 22.

Preliminary orbital fits yield a semimajor axis of 2.5 km and a system bulk density of ~1 g/cm^3. For plausible meteorite analogues for this C-class object

[11, 12], this implies a porosity of several tens of percent and probably requires that 1996 FG3 has a rubble pile interior.

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