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Goldstone and Arecibo radar observations of (99942) Apophis in 2012-2013

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ABSTRACT

(99942) Apophis is one of the most important near-Earth asteroids ever discovered. It will make a very close approach on Friday, April 13, 2029, when it will pass at 4.9 Earth radii above Earth's surface. This will be the closest approach by an asteroid with $H \sim 19.1$ (Pravec et al., 2014) or brighter ever known in advance. We report radar observations of Apophis obtained during 2013 apparition. We observed Apophis on fourteen days at Goldstone (8560 MHz, 3.5 cm) and on five days at Arecibo (2380 MHz, 12.3 cm) between December 21, 2012 – March 16, 2013. Closest approach occurred on January 9 at a distance of 0.097 au. The highest resolution delay-Doppler images were achieved at Goldstone and they have range resolution of 75 m/pixel with 4 samples per baud, which gives an effective, but correlated pixel resolution of 18.75 m. The data suggest that Apophis is an elongated, asymmetric object that could be bi-lobate. The longest visible extent is over 400 m. We used the Pravec et al. (2014) lightcurve-derived shape and spin model of Apophis to test for non-principal axis rotation (NPA) and to estimate its size. The radar data are consistent with the NPA spin state and they constrain Apophis diameter to $D = 0.34 \pm 0.04$ km (3σ bounds). The radar data suggest that Apophis is radar-bright with a radar albedo of 0.25 ± 0.11 , and optically-bright with an optical albedo of 0.35 ± 0.10 . The optical albedo assumes $H = 19.09 \pm 0.19$ (Pravec et al. 2014). The most recent published value by Licandro et al. (2016) uses the same H value and obtains p_v in the range 0.24–0.33. Delbo et al. (2007) obtained albedo of 0.33 ± 0.08 assuming $H = 19.7 \pm 0.4$.

References

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