Prospects for Arecibo Radar Investigation of Mathilde

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'l'he Near-Earth Asteroid Rendezvous (NEAR) flyby of 253 Mathilde on June 27, 1997, produced a mass estimate accurate to about 6% and a volume estimate accurate to about 20%. Arecibo radar reconnaissance of Mathilde can improve upon these volume determinations in a significant way and can contribute additional valuable constraints on the asteroid's physical properties. The 418-hour periodicity seen in Mathilde's lightcurves (Mottola et al. 1995, Planet. Space Sci. 43, 1609-1613) that leads one to expect the echo's signal-to-noise ratio (SNR) to exceed 100/date during several weeks centered on Nov. 1, 1997, near Mathilde's approach to 1.3 AU from Earth. SNR increases as the square root of the integration time, so in principle a multidate dataset's SNR can greatly exceed the peak single-date value. SNR approximates the number of delay/Doppler resolution cells with useful dynamic range that a dataset can place on a target, which is comparable to the number of shape parameters in a physical model estimated from radar images. If, as suggested by Mottola et al., Mathilde is a non-principal-axis (NPA) rotator like Toutatis, radar reconnaissance could provide strong constraints on the shape, on the location of the center of mass within that shape, on the eight parameters needed to specify the NF'A spin state (two ratios of the principal moments of inertia, Euler angles that orient the principal axes at a specified epoch, and the instantaneous spin vector at that. epoch), and hence on the internal density distribution. At this writing, it is not known whether the upgraded Arecibo telescope will return to operation soon enough to image Mathilde in 1997. Arecibo opportunities in 2001 and 2014 can produce peak single-date SNRs more than twice as high as in 1997. The suite of Earth-Mathilde directions during the 1997-2014 opportunities are quite favorable to radar refinement of Mathilde's physical properties .