ARE THE RADAR SCATTERING PROPERTIES OF NEAR-EARTH ASTEROIDS CORRELATED WITH SIZE, SHAPE, OR SPIN? Alessondra Springmann, P. A. Taylor, E. S. Howell, M. C. Nolan, Arecibo Observatory, National Astronomy and Ionosphere Center, Arecibo, Puerto Rico, USA (sondy@naic.edu)

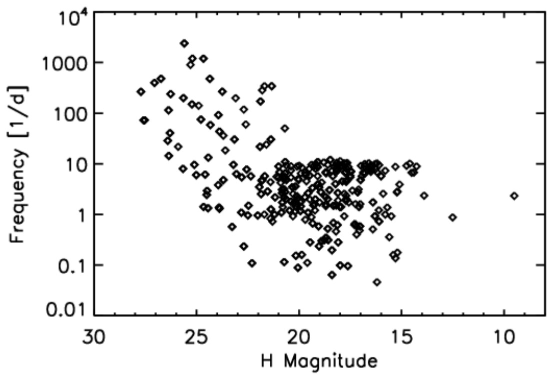

Figure 1: Radar-based rotation estimates with spin rate in rotations per day versus absolute magnitude.

Radar is a unique tool for investigating the near-Earth asteroid (NEA) population, providing size, shape, spin, and surface information of tens of bodies per year. We report on the ongoing investigation of NEAs using Arecibo Observatory's planetary radar system [1]. Radar observations reveal NEAs surfaces ranging from smooth to rough and compositions ranging from stony to metallic, as well as object size. By measuring the radar bandwidths and polarization ratios for these NEAs we can correlate their rotation rates with surface properties. These relationships are of interest for asteroid formation models as well as for characterizing asteroids as targets for human space missions.

Data were obtained at Arecibo Observatory between 1998 and 2012 using S-band (λ12.6-cm) radar by transmitting a continuous radio wave (CW) of monochromatic, circularly polarized signal and simultaneously measuring the strength of the echoes in both same (SC) and opposite sense (OC) polarizations. The ratio of SC to OC polarization is a measure of the asteroid's surface roughness at the scale of the transmitted wavelength [2]. A high polarization ratio indicates a rougher surface at the decimeter scale, which could be due to mineralogy as well as surface morphology [3].

Doppler broadening depends on both size and spin vector alignment of the target, so with a size estimate we can constrain the spin rate of an observed NEA. We observe NEOs that pass within a volume of space near the Earth, making our sampling bias different from that of optical or thermal infrared surveys or lightcurve studies.

We extend the work of [3], who found correlations between polarization ratio and spectral type, to search for further correlations between polarization ratios and radar cross-sections and the sizes, spins, and shapes of almost 300 NEAs.

One possible correlation to examine is the surface properties of the small, ultra-rapid rotator population. A number of radar-detected NEAs with H $>$ 21 break the spin barrier [4] of roughly 10 rotations per day (Fig. 1; from [1]). We might expect small, ultra-rapid rotators to have surface roughness characteristics different from those NEAs with thick regoliths. Polarization ratios may also change with shape or composition. Through exploring the radar properties of NEAs we can better understand their formation and evolution.

References

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