THE ROTATION RATE DISTRIBUTION OF SMALL NEAR-EARTH OBJECTS.

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Introduction: The currently known distribution of rotation periods of Near-Earth Objects (NEOs) shows a remarkable separation between objects larger and smaller than ~150 meters. All objects larger than ~150 meters with measured periods (with a single known exception) rotate more slowly than the 2.2 h rubble-pile limit, while at smaller diameters a significant population of faster rotating objects appears. The fast rotators are under centrifugal tension, and may or may not be monolithic [1]. The spin rate distribution of all small NEOs has been significantly affected by the YORP effect [2 and references therein]. Consequently, the detailed distribution in rotation period, size, and light curve amplitude is an important constraint on both material properties and the role of radiation-recoil torques.

Observational Program: In 2006 a program of NEO photometry was initiated at the 2.4-meter telescope at the MDM Observatory on Kitt Peak, with the intent of searching for fast-rotating asteroids (FRAs) in the diameter range from ~20 to ~800 meters. Target NEOs with $H > 19$ and $V < 20$ are chosen from the ESA Spaceguard System's "Priority List" and the Minor Planet Center's list of new objects. Nominally each object is observed over a 4-hour window. Typical maximum frame rates are 90 to 100 seconds, with random time delays inserted to avoid problems with aliasing. This strategy can reliably detect rotation periods between 2 minutes and 2 hours, with light curve amplitudes >0.05 mag in good observing conditions.

Results: To date, 39 NEOs have been observed in the absolute magnitude range $25.7 > H > 18.3$. Of these, only 5 are definite fast rotators, with periods between 0.037 h and 1.8 h. Figure 1 shows these objects in the period-diameter plane, along with the objects for which we obtain the most secure lower limits on period. We find no fast-rotating objects in the several-hundred-meter transition region, where strength-dominated objects may be expected to appear [1]. We find an abundance of slowly rotating objects, with $P >$ 10 h, for $21 < H < 23$, suggesting that the impression from current published data that the majority of NEOs smaller than 150 m are fast rotators is incorrect. Among the smallest objects ($H > 23$), however, we find that at least 3 out of 6 (50%) are detected as FRAs, compared with 7% for the larger objects. This may indicate that for objects smaller than ~80 meters, YORP may dominate over all other torques.

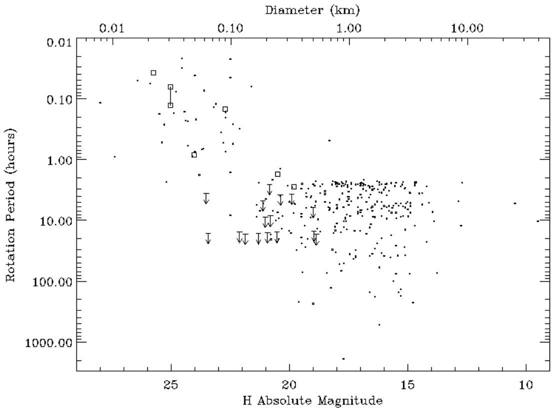

Figure 1. Distribution of NEOs in the absolute magnitude-rotation period plane, from the Warner & Harris catalog. Diameter scale along the top axis is computed assuming spherical objects with an albedo of 0.18. Small points indicate previously measured objects; squares and limits are from this work. The two points connected by a line indicate an object where the factor of 2 ambiguity in period cannot be resolved from the light curve.

Further Work: We are using these results, along with simulated light curves, to constrain the actual rotation rate distribution as a function of absolute magnitude and light curve amplitude (i.e., axis ratio). The simulations are being done using a thermophysical asteroid code (TACO), in development at Ohio University. Ensembles of objects are generated using the "Gaussian random sphere" formalism [3] and folded through our observational selection and sensitivity functions. We will report on the results of these simulations in our presentation.

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References:

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