THE NEED FOR SPEED IN NEAR-EARTH ASTEROID CHARACTERIZATION. J.L. Galache[1], C.L. Beeson[2], K.K. McLeod[3] and M. Elvis[4], [1]Harvard-Smithsonian Center forAstrophysics and IAU Minor Planet Center (jlgalache@cfa.harvard.edu) , [2](**charlie.beeson@sky.com**), [3]Wellesley College (kmcleod@wellesley.edu), [4]Harvard-Smithsonian Center for Astrophysics (melvis@cfa.harvard.edu).

Introduction: Near-Earth asteroids (NEAs) are being discovered at a rate of ~1500/year. Characterization of NEAs instead proceeds at about 10% of this rate, whether for accurate orbits, spectroscopy or light curves. Whether the interest is in Solar System formation and history, spacecraft and human visits, hazard mitigation or commercial exploitation, a rate of NEA characterization comparable to their discovery rate is desirable.

We have used the discovery circumstances and properties of the currently known population of NEAs to quantify the challenges that ground-based observers face in making follow-up observations [1].

We find that rapid (within days) follow-up is essential using 4-meter telescopes or larger.

NEA Discoveries: Over the past 30 years NEA discoveries have trended towards both fainter and smaller objects. As of 2014 <V>~20 and <H>~22 (Figure 1).

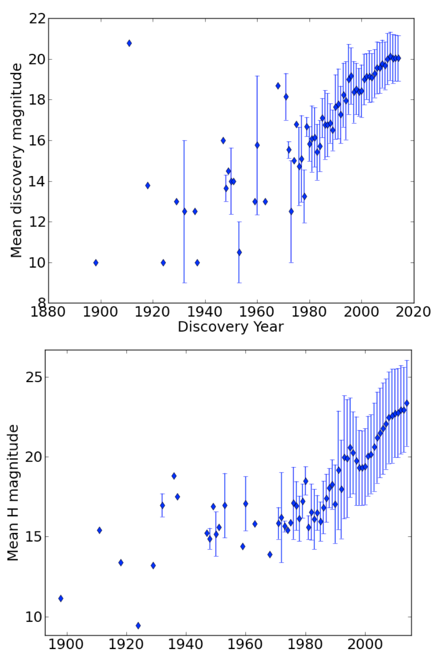

Figure 1. Mean NEA discovery magnitude (top) and H-magnitude (bottom) vs year.

Small NEAs are more demanding of follow-up observations than larger ones.

Follow-up speed: Because small asteroids must be much closer to be detected the typical small NEA is 5 magnitudes fainter on all subsequent apparitions in the decade after discovery. That requires that all follow-up observations occur during the discovery apparition.

Virtually all NEAs are discovered within 0.5 magnitudes of their brightest value during the discovery apparition, and then begin to fade. Figure 2 shows the fraction of NEAs brighter than a given magnitude (colored curves) vs days after discovery.

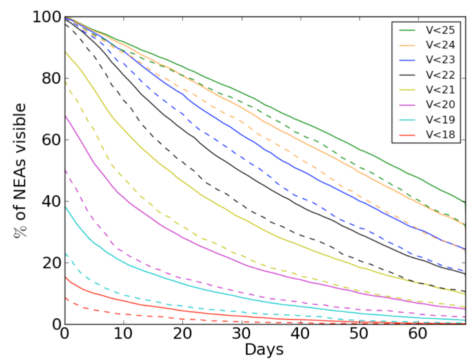

Figure 2. Fading of NEAs after their discovery.

Spectroscopy: SpEX on IRTF can take spectra of NEAs down to V~19, so after 10 days only ~20% of newly discovered NEAS are accessible. An optical spectrograph on an telescope with an IRTF-sized primary mirror could instead reach to V~22, making ~80% of newly discovered NEAs accessible after 10 days. Hence, despite the loss of more detailed diagnostice features in the near-IR, the optical band is the only one for which spectroscopic follow-up of the bulk of new NEA discoveries can be carried out.

Orbit determination: Most small (H>22) NEAs have poorly determined MOC orbit codes (Figure 3).

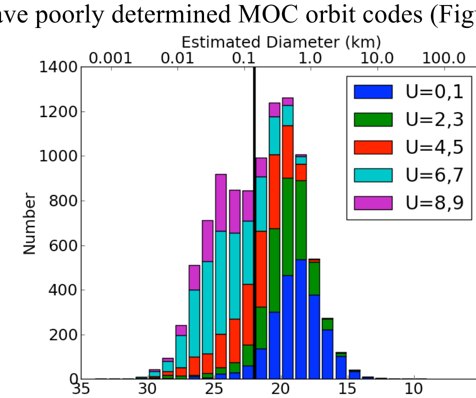

Figure 3. Orbit uncertainty codes vs H mag for NEAs. Higher numbers are more uncertain.

An orbit code U>6 means that the NEA is effectively lost. Hence orbit determination is the most urgent requirement for NEA follow-up. To do so requires a longer arc length on the orbit, and so a larger telescope to follow the NEA for >1 month (Figure 4.)

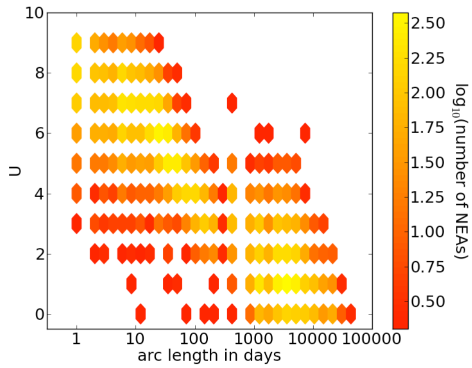

Figure 4. Orbit uncertainty code vs. arc length

Carrying out the necessary astrometric and spectroscopic measurements to keep pace with the current discovery rate and magnitudes requires most or all of a dedicated 4-meter class telescope.

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References:

[1] Galache et al. 2015, Planetary & Space Science, 111, 155.