LINNAEUS: Boosting near-Earth asteroid characterization rates

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Without knowing the size and composition of Near-Earth asteroids (NEAs) it is hard to assess their threat or their promise as either Earth-impactors or targets for exploration, retrieval or resources.

The factor of about 10 uncertainty in albedo that exists with only an optical H magnitude in hand leads to a factor 30 uncertainty in volume and more in mass. A simple classification into carbonaceous, stony or metallic limits the albedo range to a factor about 2, the volume to a factor of about 2.5 and mass to about 5 (Mainzer et al. 2011, Thomas et al. 2011).

NEAs are being discovered at a rate of about 1000/year, and this rate will soon increase by a factor of several with upgrades to the Catalina Sky Survey and the greater use of Pan-STARRS-1 for NEA work from 2014 onwards. However, NEA characterization is falling well behind discovery, forming a bottleneck for programs. The largest program of 0.8-2.5 micron near-IR spectroscopy, the MIT-IRTF program, obtains about 100 NEA spectra/year, for an accumulated total of about 1000 spectra (mostly at $H < 15$, R.P. Binzel, priv.comm.). At current rates it will take 100 years to obtain compositions, sizes, and shapes of the roughly 20,000 $H<22$ NEAs. Moreover, NEAs fade quickly after discovery and are mostly much fainter on a subsequent apparition, so that rapid follow-up at discovery is essential (Beeson et al. 2014, see also Galache et al., this meeting).

LINNAEUS is the program we have proposed in response to this need. Optical spectroscopy is sufficient to accomplish C/S/X classification and is much more sensitive than near-infrared spectroscopy. LINNAEUS combines 50% of the observing time on the Kitt Peak 2.1 meter telescope with an optimized low-resolution 0.4-0.9 micron optical spectrograph, the SED Machine (Ben-Mazi et al. 2013), to obtain 1200–2000 NEO spectra per year for a total of 4200 − 7000 spectra in 3.5 years of observing. LINNAEUS would provide an order of magnitude increase over current rates, keeping characterization up to the pace of expected discoveries. For a 20% extra investment LINNAEUS could use 100% of the Kitt Peak 2.1 meter, roughly doubling the number of NEAs with spectra.

References: Beeson C. et al. (2014), in preparation. Ben-Ami S. et al. (2013) in Ground-based and Airborne Instrumentation for Astronomy IV, eds. Ian S. McLean,S.K. Ramsay and H. Takami, Proceedings of SPIE, Vol. 8446, 844686. Thomas, C.A., et al., (2011), Astrophysical Journal, 142, 85. Mainzer A., et al. (2012) Astrophysical Journal, 745, 7.