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Rapid Response Characterization of Potential NEO Impactors

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ABSTRACT

Surveys for Near Earth Objects (NEOs) are increasingly yielding predictions up to a few days in advance of extremely close encounters (< 0.001 AU; 0.4 lunar distances) and Earth-impacts (asteroids 2008 TC3, 2014 AA, 2018 LA). In response to these interesting discoveries we have implemented a rapid response plan to employ ground-based telescopic facilities to obtain physical characterization data of select NEO targets. This plan, active since 2008, currently involves the use of Lowell Observatory's 4.3m Discovery Channel Telescope (DCT) in Arizona, NASA's 3.0m Infrared Telescope Facility (IRTF)

on Mauna Kea in Hawaii, and the 4.1m Southern Astrophysical Research Telescope (SOAR) in central Chile. Through programs in place at each of these telescopes we have the ability to respond within a few hours to any newly discovered NEO that is a potential impactor. There are three primary objectives to this program:

(1) We aim to test observational protocols and exercise the capabilities of these telescope facilities in order to identify operational issues that might impair the collection of data for truly hazardous impactors. Our targets are observationally challenging for a number of reasons (faintness, high non-sidereal motion) and thus provide an opportunity to gain experience across a range of facilities and types of observations.

(2) We aim to investigate the compositional and rotational properties of NEOs that are potential Earth impactors. This includes objects down to decameter or even meter size scales, which are an understudied component of the NEO population.

(3) We aim to probe for evidence of physical changes due to gravitational interactions with the Earth for those objects that do not impact but flyby at small geocentric distances (<0.001 AU, ~20 Earth radii). Predicted physical changes would include a change in rotation state (e.g. Scheeres et al. 2000, Icarus 147, 106), shape deformation (e.g. Richardson et a. 1998, Icarus 134, 47), or mobilization of surface material, which could manifest as changes in spectral properties (e.g. Binzel et al. 2010, Nature 463, 331). Observational evidence of such effects can provide important insight in to the surface and structural properties of NEOs that cannot be obtained through other means.

In this presentation we will discuss highlights from this program, some of the challenges that face a program of this nature, and prospects for future observations.

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