

PDC2013  
Flagstaff, AZ, USA

IAA-PDC-13-03-19P

- Planetary Defense – Recent Progress & Plans
- NEO Discovery
- NEO Characterization
- Mitigation Techniques & Missions
- Impact Effects that Inform Warning, Mitigation & Costs
- Consequence Management & Education

### A new program to determine asteroid thermal properties

C. R. Nugent<sup>(1)</sup>, A. Mainzer<sup>(2)</sup>, J. Masiero<sup>(2)</sup>, T. Grav<sup>(3)</sup>, and J. Bauer<sup>(2)</sup>

<sup>(1)</sup>Department of Earth and Space Sciences, UCLA, 595 Charles Young Drive East,  
Los Angeles, CA 90095-1567, [cnugent@ucla.edu](mailto:cnugent@ucla.edu)

<sup>(2)</sup>Jet Propulsion Laboratory, California Institute of Technology,  
Pasadena, CA 91109

<sup>(3)</sup>Planetary Science Institute, Tucson, AZ

**Keywords:** Near-Earth asteroids, Potentially hazardous asteroids, thermophysical modeling, NEO characterization

### ABSTRACT

We present initial results from a new program to thermophysically model large numbers of Near-Earth Asteroids. Thermal inertia values produced by this program may reveal details about asteroid dynamics and surface processes. Thermal conductivity and heat capacity (elements of thermal inertia), are needed for predicting Yarkovsky drift magnitude, a non-gravitational force that affects asteroid dynamics (Bottke et al., 2002), that can be a factor in determining impact probability of potentially hazardous asteroids (Giorgini et al., 2002; Chesley, 2006; Giorgini et al., 2008; Milani et al., 2009).

This study leverages the wealth of infrared data on asteroids from the NEOWISE dataset. NEOWISE represents an enhancement that allowed for asteroid data to be extracted from WISE (Wide-field Infrared Survey Explorer) spacecraft observations. The WISE spacecraft observed more than 158,000 minor planets using four infrared wavelength bands (3.4, 4.6, 12 and 22  $\mu\text{m}$ ) (Wright et al., 2010; Mainzer et al., 2011a) over the duration of its mission. One advantage of this dataset was WISE's sun-synchronous, polar orbit around the Earth. This allowed the WISE spacecraft to survey all areas of the sky, producing a dataset that was essentially equally sensitive to asteroids with low and high inclination (Mainzer et al., 2011b). The four infrared wavelengths were observed simultaneously using beam splitters, eliminating uncertainty in the time between measurements in the different bands.

We aim to combine the NEOWISE dataset with complementary datasets such as existing shape models of asteroids derived from radar (Hudson, 1993) and lightcurve (Kaasalainen et al., 2002) observations. Constraints on shape, rotation rate, and spin axis can greatly reduce the number of free parameters needed for a thermophysical models.

Radar-based shape models, with their sensitivity to concavities, are particularly valuable to this work (Hudson, 1993; Magri et al., 2007). Concavities may correspond with dust pools or areas of very low thermal inertia. This phenomena was observed on (25143) Itokawa by the spacecraft Hayabusa (Fujiwara et al., 2006).

We present results from the first object considered, potentially hazardous asteroid (29075) 1950 DA. We use the shape models of Busch et al., (2007), which consist of a model corresponding to prograde rotation and a model corresponding with a retrograde rotation. Heat transport is modeled via a series of slabs that connect the surface temperature with a stable core temperature (after the work of Spencer et al., 1989). Monte Carlo runs are used to estimate errors.