Current & Future Thermal IR Surveys and Thermal Modeling

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For most asteroids in the inner solar system, little about them is known beyond their orbital parameters and absolute visual magnitudes. Yet their physical properties, such as numbers, size, composition, and shapes, set powerful constraints on models of solar system formation and evolution, and on techniques for mitigation of potential impactors. Efforts to ascertain more information require additional measurements beyond the initial observations necessary for discovery and refinement of orbits. Remote thermal infrared (IR) measurements of asteroids can be used to determine a range of physical parameters for small solar system bodies and are complementary to the parameters that can be determined from radar and visible/near-infrared colors and spectroscopy. The number of parameters and degree of uncertainty associated with each that can be determined using thermal IR measurements depends on the quantity and quality of data available for each object, including wavelength, signal-to-noise ratio, viewing geometry, and other factors.

Thermophysical models offer the ability to derive the largest number of physical parameters such as rotational state, diameter, shape, thermal conductivity, heat capacity, etc., but they can be computationally expensive and can yield indeterminate results for some parameters depending on data quality. Other less complex models such as the Near-Earth Asteroid Thermal Model (NEATM; Harris 1998) and other variations offer faster methods for determining smaller numbers of parameters (e.g. diameter and infrared beaming). Here we compare the output of various thermal models and other methods of determining physical properties of asteroids such as stellar occultation and radar using existing thermal infrared surveys. Efforts to design the next generation of infrared surveys hinge on understanding the need for the quality and quantity of physical parameters that must be measured to provide a useful dataset for the future.