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The Rotationally-resolved surface properties of (433) Eros from thermophysical modeling

M. L. Hinkle (1), E. S. Howell (2), Y. R. Fernández (1), R. J. Vervack, Jr. (3), C. Magri (4), A. S. Rivkin (3), S. E. Marshall (1, 5), J. L. Crowell (6).
(1) University of Central Florida, Orlando, Florida, USA (Mary.Hinkle@knights.ucf.edu), (2) University of Arizona, Tucson, Arizona, USA, (3) Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, USA, (4) University of Maine - Farmington, Farmington, Maine, USA, (5) National Atmospheric and Ionospheric Center/Arecibo Observatory, Arecibo, Puerto Rico, USA, (6) Space and Naval Warfare Systems Center, San Diego, California, USA.

Abstract

We present results from a shape-based, rotationally-resolved thermophysical model of near-Earth asteroid Eros, using near-IR spectra over 19 epochs from 2009-2019 covering a variety of viewing geometries and rotational phases. Results from the NEAR spacecraft were used as input parameters to the model, allowing us to study Eros at wavelengths not measured by NEAR, specifically the thermal near-IR ($\lambda > 3.5$ microns) regime.

1.Introduction

Spacecraft exploration is capable of characterizing individual asteroids in great detail, obtaining "ground truth" measurements of the asteroid's scattering, topographic, and regolith properties. This information can in turn be used to interpret data at other wavelengths, in particular wavelength regimes that the spacecraft was not equipped to measure. Near Earth asteroid (433) Eros was explored by the NEAR-Shoemaker spacecraft in 2000-2001. NEAR's near-IR spectrometer observed Eros's surface at wavelengths of 0.8-2.5 microns, leaving Eros's thermal near-IR properties unstudied by the spacecraft.

Our team combines high-fidelity shape models and near-IR spectroscopic data obtained over multiple viewing geometries and rotational phases with our thermophysical model to describe the global and local properties of NEA surfaces in more detail than is possible with simpler approaches. Our technique, which samples both the thermal emission and reflectance simultaneously, allows for the thermal and scattering properties of different regions on the surface to be investigated, thus enabling a better understanding of the heterogeneity of an object's surface in addition to its global properties. Previous analyses of NEAs by our group combined radar shape models and comprehensive near-IR data to successfully investigate variation over the surfaces of NEAs not explored by spacecraft [1],[2],[3]. We present results from our study of (433) Eros, a particularly interesting object given the availability of detailed information from NEAR.

2.Observations & Summary

We observed Eros in the near-IR using the NASA/IRTF SpeX[4] instrument in LXD Long mode over 13 nights in 2009-2019. The combined 19 nights of observational data span a variety of viewing geometries and rotation phases, showing many different regions of Eros's surface. We will show results from thermophysical modeling of Eros using our code SHERMAN[5] and will discuss how Eros's thermal emission varies over the surface and what that implies for the heterogeneity of Eros's surface properties.

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