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ASTEROID LIGHTCURVE PHASE-SHIFT FROM PHOTOMETRIC SURFACE PROPERTIES

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ABSTRACT

Asteroid lightcurves are an important tool for the determination of shape and rotation parameters of asteroids. In lightcurve studies simple analytical scattering laws are typically used for modeling the photometric properties of the asteroid surface [1].

We have simulated asteroid lightcurves for simple shape models using a realistic semi-analytical surface scattering law [2]. The scattering law includes shadowing effects computed through numerical ray-tracing simulation [3]. We computed lightcurves in a variety of illumination geometries for both the traditional Lommel-Seeliger law and our semi-numerical law.
We observe a shift in the rotational phase of the lightcurves compared to the simple Lommel-Seeliger law. This shift depends on the observational geometry (phase angle) as well as the parameters of the scattering law and the direction of the spin axis of the asteroid. For Near-Earth Objects, the phase shift is likely to be larger than for main-belt asteroids because they are observed at a wider range of observational geometries.

The phase shift has implications for other results which are based on asteroid lightcurve analysis, such as spin-state and shape determination [1]. Knowledge of the spin-state and shape of an asteroid is required to compute the effects of thermal and radiation forces on the asteroid's orbit.

The phase shift is subtle, and may currently be difficult to observe due to uncertainties in lightcurve data. As the quality of data continues to improve, smaller effects need to be taken into account in models. We are working to better

characterize the effects of the asteroids shape and surface properties on the phase shift, to determine how significant the phase shift is in studies of real asteroids.

References

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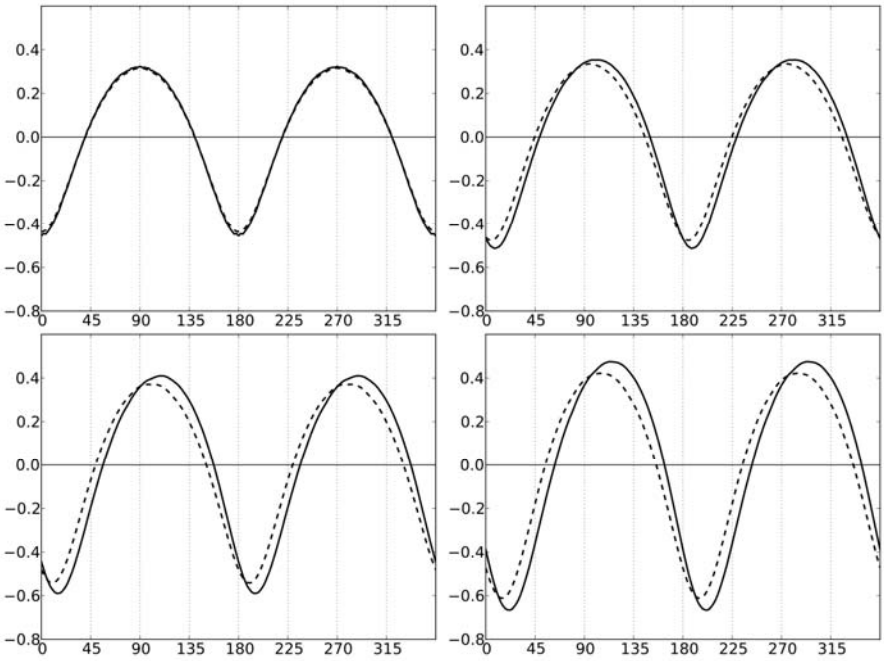

Figure 1: Lightcurve comparison between Lommel-Seeliger (dashed line) and our scattering model (solid line). The body is a tri-axial ellipsoid rotating about its shortest axis. Solar phase angle from top left: 0°, 10°, 20° and 30°.