A REALISTIC LIGHT-SCATTERING MODEL FOR ROUGH PARTICULATE SURFACES H. Parviainen and K. Muinonen, Observatory, Tähtitorninmäki (PO Box 14), 00014 University of Helsinki, Finland

Introduction: A realistic model for the reflectance of a particulate medium with a rough surface is necessary when interpreting both disk-resolved and disk-integrated observations of atmosphereless solar-system bodies. Due to the complexity of the effects arising from the medium porosity and surface roughness, the analytical models are bound to be based on approximations. Here we investigate the effects due to one of the common approximations, the omission of the azimuth angle between the incident and emergent directions.

Simulations: We have implemented a geometric-optics Monte-Carlo light-scattering code to study the volume and rough-surface effects on reflectance from particulate media mimicking the asteroid regolith[1]. The media were generated using Monte-Carlo packing, and roughened versions of the media were obtained by combining the packed media with two-dimensional random fields representing surface roughness. The output of the simulations was a numerical reflectance model as a function of the angle of incidence ι, angle of emergence ϵ, azimuth angle φ, scattering order, medium volume density, and two rough-surface parameters.

Results: In Fig. 1a, we show the results for a simulation with realistic medium parameters as a function of ϵ, φ=0, and four values for ι. In Fig. 1b, we show the results for varying φ, three ι, and $\epsilon = \iota$. In Fig. 2 we show the reflectance model applied to an fictitious asteroid geometry, simulating a disk-resolved observation. Figure 2a shows the complete reflectance model with azimuthal effects, and Fig. 2b shows what happens if φ=0, and only ι and ϵ are used. Finally, Fig. 2c shows the difference of the two images.

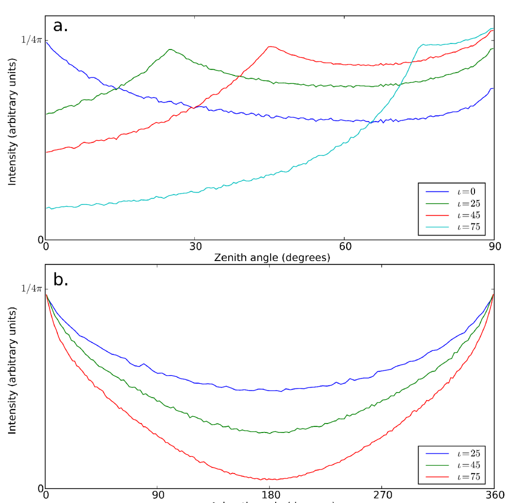

Figure 1: A simulated reflectance model as a function of angles of emergence.

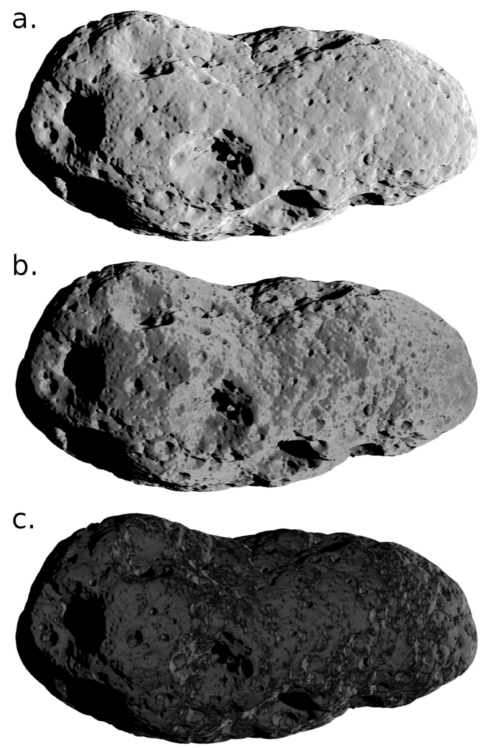

Figure 2: A simulated reflectance model applied to a fictitious asteroid geometry with and without azimuthal effects, and the difference between the two cases.

The brightening near the opposition as a function of the angles of emergence and incidence is explained by the volume and rough-surface shadowing, and included in most of the analytical models. Nevertheless, reflectance also varies substantially as a function of φ, even when $\epsilon = \iota$. This φ dependency is often omitted from the analytic models. The differences between Figs. 2a and 2b are clear. Maximum disk-resolved difference in brightness is ~50% of the model with azimuthal effects included.

In conclusion, the azimuth angle plays an important role in the reflectance of rough particulate media. Azimuth angle dependence should not be omitted from an analytical model including shadowing effects, but should be modeled together with the angles of emergence and incidence.

References: [1] Parviainen H. and Muinonen K. (2007) JQSRT, *106,* 398–416.