Surface composition of (4) Vesta by modelling light scattering

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Understanding light scattering on planetary surfaces is an open problem. Spectroscopic, photometric, and polarimetric features depend strongly on a number of surface properties that can also be affected by space weathering. The surface composition of asteroids has been studied in numerous laboratory experiments and by using empirical models, such as the Hapke model [1], but never before using numerical simulations based on the first principles in light scattering.

We have recently developed a new simulation framework to model the spectroscopy, photometry, and polarimetry of planetary surfaces. This approach is used to study asteroid (4) Vesta. We combine approximate multiple scattering codes SIRIS4 [2–4] and RT-CB [5], and an exact multiple scattering code JVIE [6] that utilizes the volume-integral equation method to account for both the wavelength-scale particles and particles that are larger than the wavelength. With our model, we derive the complex refractive indices and particle size distribution of Vesta's regolith, and thus explain the observed negative linear polarization, opposition effect, and spectral features in the UV-vis-NIR wavelength region.

References

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