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Spectral modeling for the Chelyabinsk meteorite at UV-Vis-NIR wavelengths

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We are developing a new light-scattering code based on the SIRIS-code[1], which simulates light scattering by Gaussian-random-sphere particles that are large compared to the wavelength of the incident light. SIRIS traces rays according to geometric optics and radiative transfer, utilizing both Fresnel reflections and refractions at material interfaces and diffuse interactions within the material. Absorption is accounted for within the material both due to the complex refractive index and the diffuse interactions.

The University of Helsinki integrating-sphere spectrometer has been utilized to measure the reflectance spectra of the light-colored, dark-colored and impact-melt lithology of the Chelyabinsk meteorite at UV-Vis-NIR wavelengths (0.25-3.2 microns). X-ray microtomography images of the three lithologies have also been taken. The light-colored lithology has the highest reflectance and shows broad absorption bands of olivine and pyroxene near 1.0 and 2.0 microns. The dark-colored lithology has a flat spectrum with diminished intensity. The impact-melt lithology is somewhere between the light-colored and dark-colored lithologies in terms of its spectrum[2]. The differences in the spectra are caused by different patterns of iron and iron sulfides in the samples that can be seen in the x-ray microtomography and scanning electron microscope images. We utilize the new light-scattering code to model the effects of iron and iron sulfides in the spectra of the three lithologies of the Chelyabinsk meteorite by entering the physical properties, such as refractive indexes, of the three lithologies as input parameters for the computations.

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References: [1] Muinonen K. et al. (2009) JQSRT, 110, 1628–1639. [2] Kohout T. et al. (2014) Icarus, 228, 78–85.