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Modelling of reflectance spectra of mineral assemblages combining Mie's and Hapke's theories

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Fitting bi-directional reflectance (BDR) spectra of minerals and intimate mixtures of minerals, as those forming asteroidal regoliths, to Hapke's reflectance mixing model allows the determination of both single-scattering albedo and single-particle phase function. However, the determination of albedo depends on the assumed phenomenological wavelength-dependent phase function model (e. g., phase functions of Legendre and Henyey-Greenstein types with variable coefficients), which makes this a barely defined problem. Also, to retrieve grain-size and abundance of component minerals from BDR spectra, a better modelling strategy is required because albedo and phase function are both wavelength- and size dependent.

In this work, we describe a methodology for modelling BDR spectra of mineral assemblages, which combines Mie scattering and Hapke's theories. Scattering properties such as albedo and phase function are calculated using Mie's theory from optical constants and grain-size distribution of component minerals. BDR spectra can then be calculated using Hapke's reflectance mixing model. The optical constants are calculated using a multiple oscillator model whose parameters are to be fitted.

Our preliminary results show significant discrepancies between albedo spectra determined with the current methodology and Hapke's modelling framework. We analyse these results and discuss the consequences for modelling of asteroid reflectance spectra.