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Modelling of light scattering by absorbing facetted particles

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For the interpretation of light scattering data from instruments like the Small Ice Detector (SID) [1] the creation of databases of scattering patterns of known particle morphologies is extremely useful. Exact methods like T-matrix [2] and semi-exact methods like the finite difference time domain (FDTD) method [3] and the discrete dipole approximation (DDA) [4] can be used for computations of light-scattering properties for non-axisymmetric particles. Those methods that are most versatile and can be applied to arbitrary particle morphologies are computationally most demanding and cannot be used if the objects are much larger than the wavelength. For objects much larger than the wavelength, approximate methods, such as the geometric optics approximation [5] or hybrid methods combing geometrical and physical optics, e.g. [6-8], have to be used.

Here we present a method for approximating light scattering properties of strongly absorbing facetted particles, which are large compared to the wavelength. It consists in adding the approximated external diffraction and reflection far fields and is demonstrated for a smooth hexagonal prism. It is investigated, how these two field components including the interference between them contribute to the resulting scattering pattern. This computationally fast method is extended towards prisms with slightly rough surfaces by introducing a surface scaling factor in order to account for edge effects on subfacets forming the rough surface. These effects become more pronounced with decreasing subfacet dimension to wavelength ratio. Azimuthally resolved light scattering patterns, phase functions and degree of linear polarisation obtained by this method and by the Discrete Dipole Approximation are compared for hexagonal prisms with smooth and slightly rough surfaces, respectively.

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