Photopolarimetric properties of irregular dust particles modeled using *Sh*-matrix method

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The majority of cosmic dust particles and planetary aerosols have complex shape and structure. Rigorous modeling of light scattering by such particles, usually done using Discrete Dipole Approximation (DDA, see Draine and Flatau, OSA, 11, 1994), requires significant computer resources. An approach we present, *Sh*-matrix method technique (e.g., Petrov et al., JQSRT, 112, 2012), allows modeling quite complex particles using rather limited computer time and memory. The method is based on the T-matrix technique (e.g., Mishchenko et al., JQSRT, 55, 1996) and was developed after it had been found that the shape-dependent factors could be separated from the size- and refractive-index-dependent factors and presented as a shape matrix, or *Sh*-matrix. Size and refractive index dependences are incorporated through analytical operations on the *Sh*-matrix to produce the elements of *T*-matrix. *Sh*-matrix method keeps all advantages of the T-matrix method, including analytical averaging over particle orientation. Moreover, the surface integrals describing the *Sh*-matrix elements themselves can be solvable analytically for particles of any shape. This makes *Sh*-matrix approach an effective technique to simulate light scattering by particles of complex shape and surface structure. In this paper, we model irregular particles, presenting them as an ensemble of Gaussian random particles. The shape of these particles is described by a log-normal distribution of their radius length and direction (Muinonen, EMP, 72, 1996). Changing one of the parameters of this distribution, the correlation angle, we can model a variety of particles from spheres (correlation angle = 90 deg.) to irregular particles of random complex shapes, corresponding to small correlation angles. We survey the angular and spectral dependencies of intensity and polarization resulted from light scattering by such particles, studying how they depend on the particle shape, size, and composition. We apply the results of our modeling to interpretation of photopolarimetric observations of comets.