

1. SECTION: OPTICAL MEDIA AND MATERIALS

9

1. SCATTERING

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1. SECTION : OPTICAL MEDIA AND MATERIALS

1. SCATTERING

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The parameters of each scattering sphere, with which we will hereafter operate, are radius a and refractive index m . External medium of scattering spheres is empty atmosphere, i.e., medium with refractive index $n = 1$. Incident optical wave is assumed to be plane, monochromatic (with wavelength λ), generally non-polarized.

Briefly, Maxwell's equations are solved in spherical coordinates through equations of variables. The incident plane wave is expanded in Legendre polynomials so the solutions inside and outside the sphere can be matched at the boundary. The solution sought is at a distance r much larger than the wavelength λ ($r \gg \lambda$), in the so-called far-field zone.

Because the scattered radiation is polarized depending, the far-field solution is expressed in terms of two scattering functions. We denote by $S_1(\theta)$ the normalized amplitudes of the flux scattered through angle θ ; the subscripts 1 and 2 refer to flux polarized normal to the scattering plane, and parallel to it, respectively. The normalization is made relative to the amplitude incident on the sphere cross section. For simplification of the solution, it is usually assumed, that the amplitude of the incident wave is equal to 1.

The scattering angle θ is the angle between the direction of the incident light beam and the direction or axis of observation, with the scattering particle (sphere) at the vertex of the angle. By convention, zero scattering angle describes the case where the observer (or detector) looks into the light source.

In the far-field zone the spherical wave-like components of scattered radiation are given by the following expressions:

$$E_{\perp} = \frac{1}{r} e^{-ikr} S_1(\theta) \cos \theta \quad (1-1)$$

$$E_{\parallel} = \frac{1}{r} e^{-ikr} S_2(\theta) \sin \theta \quad (1-2)$$

According to Mie theory scattering functions $S_1(\theta)$ and $S_2(\theta)$ are given by