1.8: Diffuse Reflection and Transmission

A scattering layer of finite optical thickness t may be used to model e.g. a planetary ring. If we use the Lommel-Seeliger model, then the reflected radiance of such a layer may be determined by changing the upper limit of the integral in equation (20) so that

$$L_r = \frac{\varpi_0 \mathbf{F}}{4\pi\mu} \times \int_0^t \exp\left[-\tau\left(\frac{1}{\mu_0}+\frac{1}{\mu}\right)\right] d\tau \tag{1.8.1}$$

resulting in

$$L_r = \frac{w_0}{4\pi}\frac{1}{\mu+\mu_0} \times \left[1-\exp\left\{-t\left(\frac{1}{\mu_0}+\frac{1}{\mu}\right)\right\}\right]\mu_0 \mathbf{F} \tag{1.8.2}$$

For the transmitted radiance, it is readily shown that

$$dL_t = \frac{\varpi_0 \mathbf{F} e^{-\tau/\mu_0}}{4\pi\mu} e^{-(t-\tau)/\mu} d\tau \tag{1.8.3}$$

and in the special case $\mu = \mu_0$, integration results in

$$L_t = \frac{\varpi_0 \mathbf{F} t}{4\pi\mu_0} e^{-t/\mu_0} \tag{1.8.4}$$

and otherwise

$$L_t = \frac{\varpi_0 \mathbf{F}}{4\pi}\frac{\mu_0}{\mu-\mu_0}\left[e^{-t/\mu} - e^{-t/\mu_0}\right] \tag{1.8.5}$$

In all cases the values of μ and μ_0 are positive; some authors even explicitly put in absolute value symbols to emphasise this point!