Eq. (10.8) describes scattering from a single material, while the usual problem involves the multiple scattering of a particle traversing many different layers and mixtures. Since it is from a fit to a Molière distribution, it is incorrect to add the individual θ_0 contributions in quadrature; the result is systematically too small. It is much more accurate to apply Eq. (10.8) once, after finding x and X_0 for the combined scatterer.

Lynch and Dahl have extended this phenomenological approach, fitting Gaussian distributions to a variable fraction of the Molière distribution for arbitrary scatterers [25], and achieve accuracies of 2% or better.

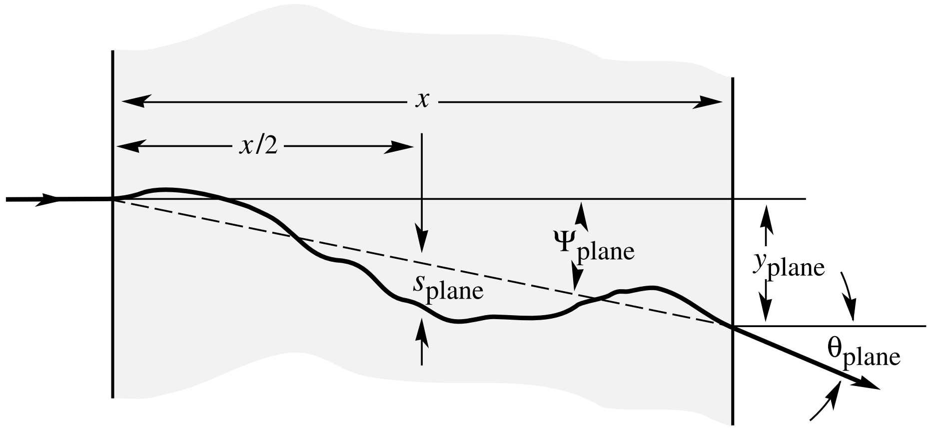

Figure 10.5: Quantities used to describe multiple Coulomb scattering. The particle is incident in the plane of the figure.

The nonprojected (space) and projected (plane) angular distributions are given approximately by [23]

$$\frac{1}{2\pi\,\theta_0^2}\,\exp\left(-\frac{\theta_{\text{space}}^2}{2\theta_0^2}\right)d\Omega\ , \tag{10.9}$$

$$\frac{1}{\sqrt{2\pi}\,\theta_0}\,\exp\left(-\frac{\theta_{\text{plane}}^2}{2\theta_0^2}\right)d\theta_{\text{plane}}\ , \tag{10.10}$$

where θ is the deflection angle. In this approximation, $\theta_{\text{space}}^2 \approx (\theta_{\text{plane},x}^2 + \theta_{\text{plane},y}^2)$, where the x and y axes are orthogonal to the direction of motion, and $d\Omega \approx d\theta_{\text{plane},x}\,d\theta_{\text{plane},y}$. Deflections into $\theta_{\text{plane},x}$ and $\theta_{\text{plane},y}$ are independent and identically distributed.

Figure 10.5 shows these and other quantities sometimes used to describe multiple Coulomb scattering. They are

$$\psi_{\text{plane}}^{\text{rms}} = \frac{1}{\sqrt{3}}\,\theta_{\text{plane}}^{\text{rms}} = \frac{1}{\sqrt{3}}\,\theta_0\ , \tag{10.11}$$

$$y_{\text{plane}}^{\text{rms}} = \frac{1}{\sqrt{3}}\,x\,\theta_{\text{plane}}^{\text{rms}} = \frac{1}{\sqrt{3}}\,x\,\theta_0\ , \tag{10.12}$$