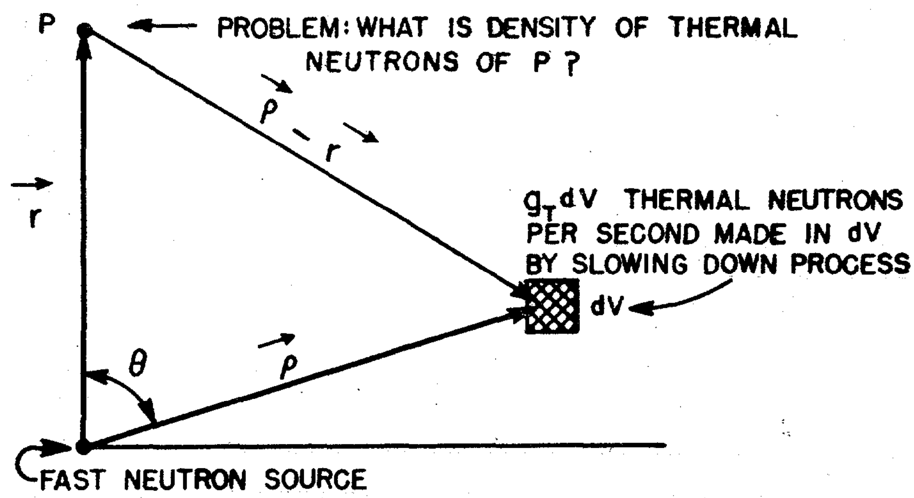

Figure 40. Point source of fast neutrons.

density (see point P in Figure 40). Now point P is a distance $|\vec{\rho} - \vec{r}| = \sqrt{\rho^2 + r^2 - 2\rho r \cos\theta}$ from the source q_T dV. As a consequence, the density of thermal neutrons observed at P from this source is given by equation (7-6) with the appropriate source strength and radial distance substituted:

$$\left(\begin{array}{l}\text{Thermal neutrons at P}\\ \text{from source at dV}\end{array}\right) = \left(\frac{3q_T dV}{4\pi\lambda_t v}\right) \cdot \frac{e^{-|\vec{\rho} - \vec{r}|/L}}{|\vec{\rho} - \vec{r}|}$$

Adding up the contributions from all sources means we integrate over dV. Substituting for q_T, $|\vec{\rho} - \vec{r}|$, carrying out the integration over the azimuthal angle ϕ and changing variable $\mu = \cos\theta$ finally gives:

(Thermal neutron density at distance r from fast neutron source of strength Q)

$$n(r) = \frac{3Q}{2\lambda_t v(4\pi\tau)^{3/2}} \int_{\rho=0}^{\infty} \int_{\mu=-1}^{+1} e^{-\rho^2/4\tau} \cdot \frac{e^{-\sqrt{\rho^2 + r^2 - 2\rho r\mu}/L}}{\sqrt{\rho^2 + r^2 - 2\rho r\mu}} \rho^2 d\rho\, d\mu \qquad (7\text{-}7)$$

In equation (7-7) λ_t, v, τ, and L are the transport mean free path, velocity, age, and diffusion length for thermal neutrons.