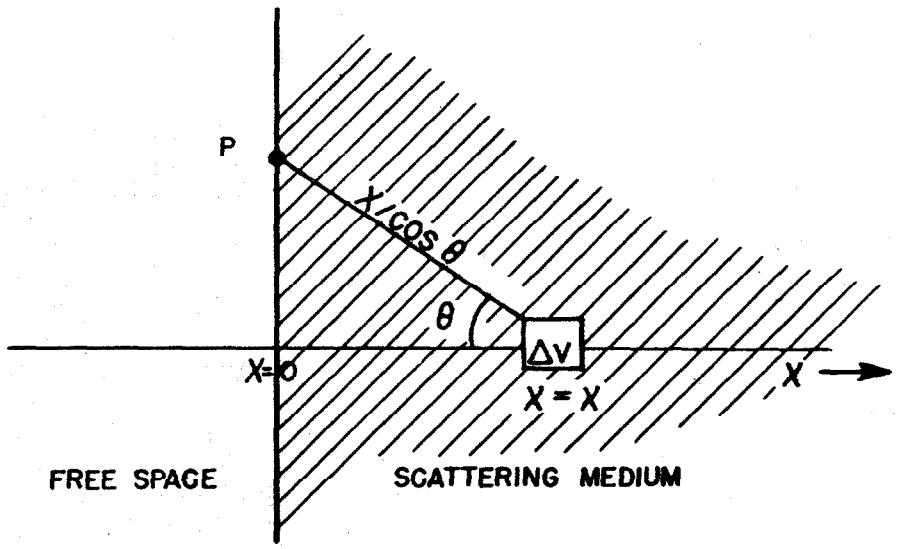


Figure 42. Neutron flux calculation at boundary.

Substituting for n [ $=p(\alpha+x)$] and rearranging this equation becomes:

$$(1/2)\int_{\theta=0}^{\pi/2} p(\alpha+x)(v/\lambda_t)e^{-x/(\lambda_t\cos\theta)}\sin\theta\, d\theta\, \Delta V$$

Consider the volume to have unit area perpendicular to the x axis and depth dx. Then integrating the foregoing expression over x would give the total number of neutrons each second coming to the surface from an infinite column of unit cross-sectional area perpendicular to the surface. But this is seen to be the flux or the number of neutrons crossing unit area of the surface per second, provided, of course, that everything can be assumed uniform perpendicular to the x direction. Thus the flux is:

$$(1/2)\int_0^{\infty}\int_0^{\pi/2} p(\alpha+x)(v/\lambda_t)e^{-x/(\lambda_t\cos\theta)}\sin\theta\, d\theta\, dx$$

Change variables to $\mu=\cos\theta$ and integrate first over x, then over $\mu$. The result is $(vp/2\lambda_t)$ $[(\alpha\lambda_t/2)+(\lambda_t/3)]$. Equating this to the previous result for the flux, $p\lambda_t v/3$ and solving for $\alpha$ gives $\alpha=(2/3)\lambda_t$. But $\alpha$ is the x intercept of the neutron flux. Therefore, we have shown that n vanishes at a distance $(2/3)\lambda_t$ outside the bounding surface.

It must be noted that this boundary condition really describes n at the boundary, not beyond the boundary. In particular, the boundary condition does not mean that n vanishes at $x=-(2/3)\lambda_t$ and is negative beyond that point. What has been proved is simply that *the density at a bounding surface behaves as though n is a linear function of x, vanishing at* $x=-(2/3)\lambda_t$.

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