There are other ways to measure L and related constants for water. Some are described in a paper by Fermi and Amaldi, Phys. Rev. 49:899 (1936). The diffusion length is dependent upon temperature. For water, the relation is:

$$L = 2.64 + 0.0061\,T$$
$$(L \text{ in cm, } T \text{ in } ^\circ C) \qquad (7\text{-}9)$$

As shown in equation (7-2), the diffusion length is related to the mean free path for absorption (Λ) and the transport mean free path (λ_t). Knowing L and λ_t, we can calculate Λ , or vice versa.

For a substance such as graphite, the diffusion length is so large as to make the method just described impractical for determination of L. The one-dimensional approximation will not be valid when L is of the order of the dimensions of the medium. As a consequence, the three-dimensional problem must be solved.

The physical arrangement is shown in Figure 44. A fast neutron source is at point P (u,u,0) on the bottom surface of the graphite pile. The height of the pile is much larger than the diffusion length, whereas the edge dimensions "a" are of the same order of magnitude as L. The slowing down equation, $\nabla^2 q - (\partial q/\partial \tau) = 0$, can be solved for this arrangement by use of Fourier analysis (same methods as used in solution of heat conduction problems). The result is:

$$q = (4/a^2)(Q/\sqrt{4\pi\tau})\ e^{-z^2/4\tau} \sum_{r,s=1}^{\infty} e^{-\pi^2\tau(r^2 + s^2)/u} \sin(\pi r x/a) \sin(\pi r y/a)$$

$$(Q = \text{source strength} = \text{fast neutrons/sec}) \qquad (7\text{-}10)$$

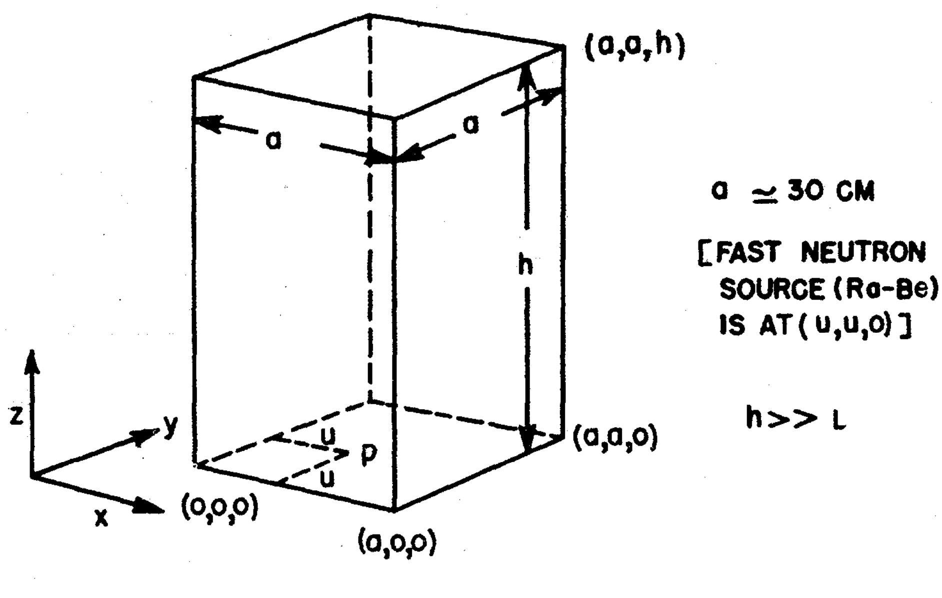

Figure 44. Measurement of diffusion length in graphite.

a-93-71