Evaluation of τ by experiment using a Ra-Be neutron source shows that the source has three well-defined neutron energies, giving three superposed distributions. The following table gives the age values for the three components in graphite at different energies and the percentage of each component present.

TABLE 2 – Ra-Be NEUTRONS IN GRAPHITE

PER CENT	τ (INDIUM RESONANCE), CM^2	τ (IODINE RESONANCE), CM^2
15.0	130	54
69.3	340	268
15.7	815	736

Such data are sometimes given in terms of the range r_0, which is equal to $2\sqrt{\tau}$.

From the data of Table 2, it is apparent that at 30 cm or so from the source, q will be very small. In this case, the "source" term in the slow neutron diffusion differential equation (7-3) will be small. The slow neutron density n will be a solution to equation (7-4), i.e.,

$$\nabla^2 n - (1/L^2)n = 0$$

at such distances from the source. Because of the boundary conditions (the slow neutrons are produced by slowing down from the Ra-Be source), the solution is assumed to have the form:

$$n = \sum_{r,s=1}^{\infty} n_{rs}(z) \sin(\pi r x/a) \sin(\pi s y/a)$$

Substituting this into the differential equation gives an equation for $n_{rs}(z)$:

$$\frac{d^2 n_{rs}}{dz^2} - \left[\frac{\pi^2}{a^2}(r^2 + s^2) + \frac{1}{L^2}\right] n_{rs} = 0$$

This equation has a simple exponential solution, $\exp(-z/b_{rs})$, with b_{rs} equal to the reciprocal of the square root of the expression in brackets. Thus, the solution for n is:

$$n = \sum_{r,s=1}^{\infty} e^{-z/b_{rs}} \sin(\pi r x/a) \sin(\pi s y/a) \qquad (7\text{-}11)$$

$$\text{with} \quad (1/b_{rs}^2) = (\pi^2/a^2)(r^2 + s^2) + (1/L^2)$$

It can be seen that as r and s increase the exponential damps out rapidly with increasing z. Experimentally it suffices to compare activation measurements by slow neutrons in such a column for the r = s = 1 component:

$$n = e^{-z/b_{11}} \sin(\pi x/a) \sin(\pi y/a) \qquad (7\text{-}12)$$

$$\text{with} \quad (1/b_{11}) = \sqrt{(2\pi^2/a^2) + (1/L^2)}$$

For a typical graphite sample, the constants are: density = 1.551 gm/cm³; b_{11} = 28.38 cm; a = 150.49 cm. Since the neutron density does not vanish exactly at the edge, we must add

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