NUCLEAR SCIENCE AND ENGINEERING: **26**, 580 (1966)

Letters to the Editor

Exact Solution of the Problem of Goldstein and Cohen

Goldstein and Cohen[1] have postulated that the effective resonance integral consistent with an approximate integral equation for the flux (as set up by them) can be exactly reproduced by admitting only a fraction λ of the scattering cross section of the absorbing nuclei. Their method of obtaining λ is to iterate on the integral equation and to equate the first and second approximations for the resonance integral. In particular, they consider the 192eV resonance of ^{238}U in a 1:1 mixture of ^{238}U and hydrogen. Dyos and Keane[2] have obtained a different value of λ for this problem by equating the first and the third approximations. Thus it is of interest to find the exact value of λ which satisfies the problem.

It has been shown[2] that the iterative process converges and therefore the effective resonance integral I can be approached by continued iteration. However, since the work in carrying out further iterations is prohibitive, we have adopted an alternative approach, obtaining I directly from a numerical solution of the integral equation.

Using the symbols defined in Ref. (2) the effective resonance integral is given by

$$I = \frac{\pi \sigma_0 \Gamma_\gamma}{2E_r} \int_{-\infty}^{\infty} \frac{1}{1+x^2} f(x)\, dx, \tag{1}$$

so that the value of λ satisfying

$$I_\lambda^{(1)} = I \tag{2}$$

is the exact solution of the Goldstein and Cohen problem.

The numerical procedure for the solution of equation (5) of Ref. (2) involves using Simpson's rule on the integral term leading to an expression for $f(x)$ in terms of its values at the points $x + rh$ (where $r = 1,\ldots,n$ and $nh = \epsilon$. Since $f(x)$ is unity for large values of x the equation is solved by a simple marching process. The values of $f(x)$ obtained are then used to evaluate I from Eq. (1) and hence λ from Eq. (2).

For the 192eV resonance of ^{238}U in a 1:1 mixture of ^{238}U and hydrogen we obtain $\lambda = 0.329$ which is to be compared with $\lambda = 0.264$ obtained by Goldstein and Cohen, and $\lambda = 0.31$ by Dyos and Keane.

T. S. Horner
A. Keane

Wollongong University College
Wollongong, New South Wales
Australia

.nuary 25, 1966

[1] R. GOLDSTEIN and E. R. COHEN, *Nucl. Sci. Eng.* 13, 132 (1962).
[2] M. W. DYOS and A. KEANE, "Iterative Solution of the Neutron Slowing Down Equation," *Nucl. Sci. Eng.*, this issue, p. 530.