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Letters to the Editor

Some Comments Concerning the Discrete Eigenvalue

I. INTRODUCTION

As alternatives to the "exact" expression given in Ref. 1 for the discrete eigenvalue defined (for the simplest of all nontrivial problems in transport theory) as the positive zero of

$$\Lambda(z) = 1 + \frac{cz}{2}\int_{-1}^{1}\frac{d\mu}{\mu - z} \ , \tag{1}$$

we report (again) the two "exact" expressions reported in Refs. 2 and 3:

$$\nu_0 = (1-c)^{-1/2}\exp\left\{-\frac{1}{\pi}\int_0^1 \Theta(c,x)\,\frac{dx}{x}\right\} \tag{2a}$$

and

$$\nu_0 = \left\{\frac{3-2c}{3-3c} - \frac{2}{\pi}\int_0^1 x\Theta(c,x)\,dx\right\}^{1/2} \tag{2b}$$

where, using *continuous* values on $[0,\pi]$ of the arctan function, we write

$$\Theta(c,x) = \arctan\left\{\frac{c\pi x}{2[1 - cx\,\mathrm{arctanh}(x)]}\right\} \ . \tag{3}$$

II. RESULTS

We have found, using the Maple V (release 4) software package and the three lines of code given in Sec. III, that we can evaluate Eqs. (2) for various cases of $c \in [0.06, 0.9999999999999]$ to obtain results we believe to be correct to, say, at least 20 significant figures. We note that for $c = 0.06$ the value of ν_0 is already equal to unity to 14 significant figures, and so we did not pursue modifications to our three-line code that could be required for smaller values of c. In addition, we would like to point out that Eqs. (2) are valid also for reactor physics cases where we can have $c > 1$.

Finally, we note that we found

$$\nu_0 = 18.26472572652667373356$$

for the case of $c = 0.999$, and so we believe the result quoted in Ref. 1 is correct to only three or four significant figures and not to the eight figures listed.

III. MAPLE CODE

```
f:=(c,x) → arctan(c∗Pi∗x,2∗(1−c∗x∗arctanh(x)));
y1:=(c) → evalf(exp(−evalf(Int(f(c,x)/x,x=0..1,28))/Pi)/
   sqrt(1−c),28);
y2:=(c) → evalf(sqrt((3−2∗c)/(3−3∗c)−2∗evalf(Int(x∗f
   (c,x),x=0..1,28))/Pi),28);
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