4/17/15

QUANTUM MECHANICS II (524)
PROJECT Realistic cross section and resonances (hand in May 1)

The project involves an extension of the scattering process to include an absorbing potential. The relevant potential contains several ingredients. A central real potential given by

$$V f(r, R_V, a_V),$$

where the radial dependence is given by

$$f(r, R, a)) = \frac{1}{1 + e^{(r-R)/a}}.$$

The parameters are given by $V = -46.1$ MeV, $R_V = r_V A^{1/3}$, $r_V = 1.2$ fm, $a_V = 0.7$ fm and $A = 40$. In addition to this real potential we need an absorptive one of the following form

$$i \left[W_V f(r, R_W, a_W) - 4 a_W W_S \frac{d}{dr} f(r, R_W, a_W) \right],$$

with parameters $W_V = -0.4$ MeV, $W_S = -5.96$ MeV, $R_W = r_W A^{1/3}$, $r_W = 1.25$ fm, $a_W = 0.7$ fm. The consequence of including an absorbing potential is that the scattering wave function will also develop an imaginary component. Modify your program to include this complex potential. Then modify the analysis of the asymptotic wave function by including the possibility the $|\eta_\ell(k)| < 1$, where $\eta_\ell(k)$ used to written as $e^{2i\delta_\ell}$ so δ_ℓ is now complex. Some relevant material is discussed in Gottfried but you have to come up with correct matching outside the range of the potential where the wave is again a linear combination of spherical Bessel and Neumann functions. Solve the scattering problem for this potential at $E = 10$ MeV and make sure that the cross section contains all non-vanishing partial-wave contributions.