

Physics 418, Homework Assignment

Due in Class, Wednesday, January 28, 2004

1. Consider a scattering apparatus which has the following components:
 - a source of α -particles with kinetic energy 8.4 MeV and a flux of 3.0×10^6 particles/cm²/sec in a beam with a transverse area of 1 mm²;
 - a Gold target (density = 19.3 g/cm³) with transverse dimensions larger than the beam, and thickness of 2.6 μ m,
 - an alpha detector subtending a solid angle $\Delta\Omega = 0.001$ steradians which can be moved to different positions in the polar angle, θ .
 - (a) Make a table of the number of α -particles per second hitting the alpha detector when it is placed at angles of 5°, 10°, 30°, 60°, 90° and 120°.
 - (b) Plot these results in a graph. Use a vertical log scale for the number of particles, and a horizontal linear scale using $\sin(\frac{\theta}{2})$.
2. Repeat Problem 1, but replace each Gold nucleus by a hard sphere with radius, $R = 9.5 \times 10^{-15}$ m.
3. Re-plot the data in 1(b), but change the horizontal axis from θ to the momentum transfer squared,

$$\begin{aligned} p^2 &= 2(mv)^2(1 - \cos(\theta)) \\ &= 4(mv)^2 \sin^2\left(\frac{\theta}{2}\right) \end{aligned}$$