Physics 309
Rutherford Scattering

1. A 5.30 MeV α particle is incident on a gold foil. Calculate the distance of closest approach for a head-on collision.

2. An electron beam has a current $I = 10$ nA where 1 nA $= 10^{-9}$A $= 10^{-9}$C/s where C is a Coulomb. How many electrons per second strike a target?

3. The density of thorium is $\rho = 11.7\ g/cm^3$. If you make a thorium foil of thickness $L = 50\ \mu m$, what is the areal density?

4. A particle detector has an active volume in the shape of a right circular cylinder. The endcaps of the cylinder each have a diameter $d = 6\ mm$. If the cylinder is oriented so one endcap faces a target that is a distance $R = 1.0\ m$ away, what is the solid angle Ω of the detector?

5. A beam of α-particles, of kinetic energy 5.30 MeV and intensity 10^4 particles/sec, is incident on a gold foil of density 19.3 g/cm^3 and thickness 1.0×10^{-5} cm. A detector of area 1.0 cm^2 is placed at a distance of 10 cm from the foil. If θ is the angle between the incident beam and a line from the center of the foil to the center of the detector, use the Rutherford scattering differential cross section to find the number of counts per hour at $\theta = 10^\circ$ and for $\theta = 45^\circ$.

6. A beam of α-particles, of kinetic energy 5.30 MeV and intensity 10^4 particles/sec, is incident on a foil of density 8.9 g/cm^3, atomic weight 63.6, and thickness 1.0×10^{-5} cm. A detector of area 1.0 cm^2 is placed at a distance of 10 cm from the foil. The count rate in the detector is 820 counts/hr at $\theta = 10^\circ$. What is the atomic number of the target?

For a discussion of Rutherford scattering consult the references in the list below.

a. C.R.Nave, *HyperPhysics*, `http://hyperphysics.phy-astr.gsu.edu/hbase/rutsca.html#c1`, last accessed 3/27/20.

b. C.R.Nave, *HyperPhysics*, `http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/crosec.html#c1`, last accessed 3/27/20.

c. C.R.Nave, *HyperPhysics*, `http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/ruthcross.html#c1`, last accessed 3/27/20.