Physics 31: Homework #4
Due Thursday, February 16, 2012

Problem A: A parallel beam of α particles with fixed kinetic energy is normally incident on a piece of gold foil.

(a) If 100 α particles per minute are detected at 20°, how many will be counted at 40, 60, 80, and 100°?

(b) If the kinetic energy of the incident α particles is doubled, how many scattered α particles will be observed at 20°?

(c) If the original α particles were incident on a copper foil of the same thickness, how many scattered α particles would be detected at 20°? The density of copper is 8.9 gm/cm^3, and the density of gold is 19.3 gm/cm^3.

Problem B: It is observed that α particles with kinetic energies of 13.9 MeV and higher, incident on copper foils, do not obey Rutherford's $[\sin(\theta/2)]^4$ law. Estimate the nuclear size of copper from this observation, assuming that the Cu nucleus remains fixed in a head on collision with an α particle.

Problem C: When a pebble is tossed into a pond, a circular wave pulse propagates outward from the disturbance. If you watch carefully, you will see a fine structure in the pulse consisting of surface ripples moving inward through the circular disturbance. Explain this effect in terms of group and phase velocity if the phase velocity of ripples is given by

$$v_{\mathrm{p}} = \sqrt{\frac{2\pi S}{\lambda \rho}},$$

where S is the surface tension and ρ is the density of the liquid.

Do the following problems in *Beiser:*
Chapter 3: 34, 38