Physics 3344 Professor Olness
Homework 12 (Chapter 14) December XX, 2018

**1) PROBLEM**

**14.7** ⋆ Calculate the solid angles subtended by the moon and by the sun, both as seen from the earth. Comment on your answers. (The radii of the moon and sun are $R_m = 1.74 \times 10^6$ m and $R_s = 6.96 \times 10^8$ m. Their distances from earth are $d_m = 3.84 \times 10^8$ m and $d_s = 1.50 \times 10^{11}$ m.)

**2) PROBLEM**

**14.11** ⋆⋆ The differential cross section for scattering 6.5-MeV alpha particles at 120° off a silver nucleus is about 0.5 barns/sr. If a total of $10^{10}$ alphas impinge on a silver foil of thickness 1 $\mu$m and if we detect the scattered particles using a counter of area 0.1 mm$^2$ at 120° and 1 cm from the target, about how many scattered alphas should we expect to count? (Silver has a specific gravity of 10.5, and atomic mass of 108.)

**3) PROBLEM**

For the exam problem 5b) we ASSUMED the scattering was isotropic as in example 14.5. For Rutherford scattering this is NOT correct as the correct relation is the differential cross section is below. Let's re-do this a bit more correctly.

a) Show that if we compute the total cross section using the Rutherford formula, we get infinity.

b) We will now neglect scattering ±10 Degrees. Calculate the total cross section for scattering between 10 and 180 degrees. We'll define this as our EFFECTIVE total cross section. Now compute the percentage of particles scattered in bins of 10 degrees; i.e. [10,20], [20,30]...[170,180]
Check that the total adds to 100%

## The Rutherford Formula

The differential cross section for scattering a charge $q$ off a fixed charge $Q$ is given by the **Rutherford formula**

$$\frac{d\sigma}{d\Omega} = \left( \frac{kqQ}{4E\sin^2(\theta/2)} \right)^2 . \qquad \text{[Eq. (14.32)]}$$