

PHYS 402 Homework---Due Friday April 29

1. Consider a beam of particles of m moving with velocity v towards a target. The beam has a density of particles of ρ and is kept on for a time T . Scattering from the target is known to be isotropic (all directions are the same) and to have a total cross section of σ (for particles incident with an energy of $\frac{1}{2}mv^2$). There is a detector of cross sectional area A located a distance R from the target and at an angle θ relative to the beam direction. Find an expression for the total number of particles hitting the detector under the assumption that $A \ll R^2$.

2. Consider the following scattering state wave function.

$$\psi(\vec{r}, t) = e^{ikz} + \frac{(-\sin(kr) + i(1 - e^{-\beta r^2})\cos(kr))}{kr}$$
 which is valid for all distances and

where β is a constant.

- a. Show that the $f(\vartheta) = i/k$ for all scattering angles.
- b. Find the differential cross-section.
- c. Find the total cross-section.
- d. Show that the only partial wave with a nonzero c_l is the s wave ($l=0$).
- e. Find c_0 .
- f. Find the phase shift δ_0 .