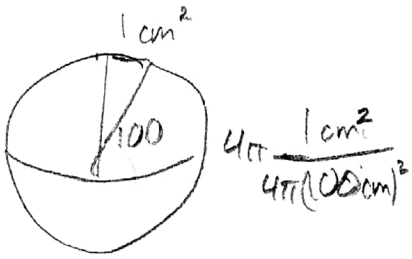
2015 I: Q3 Diagnostics

(a.) $\frac{N_{scatt}}{N_{inc}} = n_e L \sigma$

$10^{14}\,cm^{-3}$, $1\,cm$, $\sigma \sim 0.67 \times 10^{-24}\,cm^2$



$\frac{N_{detected}}{N_{scatt}} = 10^{-4} \Rightarrow N_d = N_{in}(nL\sigma)\frac{1}{10^4} > 10^4$

$0.67 \times 10^{-10} > 10^8$

$E \sim \hbar\omega \sim \hbar c k \sim \hbar \frac{c 2\pi}{\lambda}$ $\quad N_{in} \approx \frac{1}{0.67} \times 10^{18}$

$\lambda = 693 \times 10^{-9}\,m = 6.9 \times 10^{-5}\,cm$

$\frac{18}{.6} \approx 25$

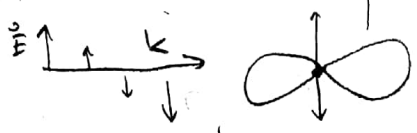
$E \sim 6\frac{(6.6)(3)}{(6.9)} \frac{\times 10^{10}\,cm/s}{\times 10^{-5}\,cm} \frac{1}{0.67} \times 10^{18} \times 10^{-34}$

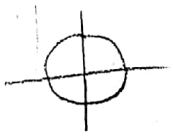
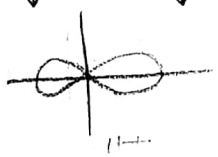
$15 + 17 = 32 - 34 = -2$ $\quad = 2.5 \times 10^{-2}\,J$

$E > 2.5\,J$

(b) If the laser is polarized, we have $\frac{d\sigma}{d\Omega} = r_e^2 \sin^2\theta$

so want the detector to be placed in the plane with $\hat{n} \parallel \hat{E}$.



(c.) was  now 

$d\Omega = \sin\theta\, d\theta\, d\phi$ $\quad \theta: 0 \to \pi$ $\quad \phi: 0 \to 2\pi$

$\int \frac{\sigma}{4\pi} d\Omega = \sigma$ $\qquad \int r_e^2 \sin^3\theta\, d\theta d\phi = \frac{8\pi}{3} r_e^2 = \sigma$

$N_{det}' = N_s \int_{-1/100}^{1/100} \int_{-1/100}^{1/100} r_e^2 \cos^3\theta\, d\theta d\phi \approx r_e^2 \frac{2}{100}\frac{2}{100} \sim r_e^2 \frac{4}{10^4} = \frac{\sigma}{2}\frac{1}{10^4}$

$E \sim N_{det}$ so new laser energy $\sim 10^4$ less