PH-105 Assignment Sheet - 2 (Quantum Mechanics)

Umang Mathur

10. **A photon of energy $h\nu$ is scattered through 90° by an electron initially at rest. The scattered photon has a wavelength twice that of incident photon. Find the frequency of the incident photon and the recoil angle of the electron.**

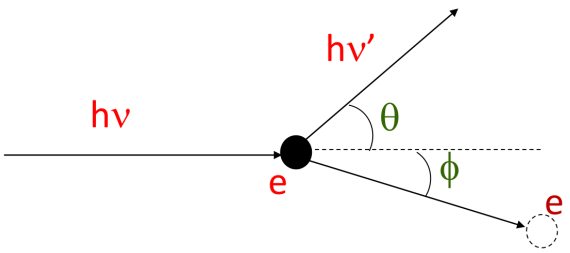
Solution :

In Compton Scattering, the relation between the final wavelength (λ') and the intial wavelength (λ) is given by:

$$\lambda' - \lambda = \frac{h}{m_o c}(1 - \cos\theta)$$

Given that $\lambda' = 2\lambda$ and $\theta = 90°$, we have $\lambda = \frac{h}{m_o c}$.
Hence, $\nu = \frac{c}{\lambda} = \frac{m_o c^2}{h} = 1.23 \times 10^{20} Hz$

Now, for the recoil angle of the electron,



Coserving momenta in the x-direction,

$$\frac{h}{\lambda} = \frac{h}{2\lambda}\cos\theta + p\cos\phi$$
$$\therefore p\cos\phi = \frac{h}{\lambda}$$

Coserving momenta in the y-direction,

$$p\sin\phi = \frac{h}{2\lambda}$$

We, therfore have, $\tan\phi = 0.5$
Therefore, $\phi = 26°34'$