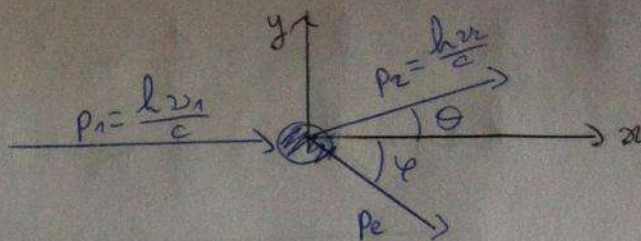


TAI exo 2



$$1) E_1 = E_2 + E_c$$

$$h\nu_1 = h\nu_2 + \frac{1}{2} m_e v^2$$

Sur O_x : $p_1 = p_2 \cos \theta + p_e \cos \varphi$

Sur O_y : $0 = p_2 \sin \theta + p_e \sin \varphi$

$$2) \text{ Nous avons : } \begin{cases} p_e \cos \varphi = \frac{h\nu_1}{c} - \frac{h\nu_2}{c} \cos \theta = \frac{h}{c} (\nu_1 - \nu_2 \cos \theta) \\ p_e \sin \varphi = -\frac{h\nu_2}{c} \sin \theta \end{cases}$$

$$\Rightarrow \begin{cases} p_e^2 \cos^2 \varphi = \left(\frac{h}{c}\right)^2 (\nu_1 - \nu_2 \cos \theta)^2 \\ p_e^2 \sin^2 \varphi = \left(-\frac{h\nu_2}{c} \sin \theta\right)^2 \end{cases}$$

$$p_e^2 (\underbrace{\cos^2 \varphi + \sin^2 \varphi}_1) = \left(\frac{h}{c}\right)^2 (\nu_1 - \nu_2 \cos \theta)^2 + \left(\frac{h\nu_2}{c} \sin \theta\right)^2$$

$$\Rightarrow p_e^2 c^2 = h^2 (\nu_1^2 + \nu_2^2 \cos^2 \theta - 2\nu_1 \nu_2 \cos \theta) + h^2 \nu_2^2 \sin^2 \theta$$

$$\Rightarrow p_e^2 c^2 = h^2 (\nu_1^2 + \nu_2^2 (\cos^2 \theta + \sin^2 \theta) - 2\nu_1 \nu_2 \cos \theta)$$

$$\Rightarrow p_e^2 c^2 = h^2 (\nu_1^2 + \nu_2^2 - 2\nu_1 \nu_2 \cos \theta)$$

$$\Rightarrow \boxed{p_e^2 c^2 = h^2 (\nu_1^2 + \nu_2^2) - 2h^2 \nu_1 \nu_2 \cos \theta}$$

$$3) \text{ Si } \nu_1 \approx \nu_2 : p_e^2 c^2 = h^2 (\nu_1^2 + \nu_2^2) - 2h^2 \nu_1 \nu_2 \cos \theta$$

$$\text{Devient} \rightarrow m_e^2 v^2 c^2 = 2h^2 \nu_1^2 - 2h^2 \nu_1^2 \cos \theta$$

$$= 2h^2 \nu_1^2 (1 - \cos \theta)$$

$$= 2h^2 \nu_1^2 \cdot 2 \sin^2(\theta/2)$$

$$= 4h^2 \nu_1^2 \sin^2(\theta/2)$$

$$\Rightarrow \boxed{m_e v c = 2h \nu_1 \sin(\theta/2)}$$

Or $h\nu_1 - h\nu_2 = \frac{1}{2} m_e v^2$ (cf Q1)

$$h\nu_1 - h\nu_2 = \frac{1}{2} m_e \frac{4 h^2 \nu_1^2 \sin^2(\theta/2)}{m_e^2 c^2}$$

$$\boxed{\nu_1 - \nu_2 = \frac{2 h \nu_1^2 \sin^2(\theta/2)}{m_e c^2}}$$

4) Pour $\theta = 90^\circ$

$$\Delta\nu = \frac{2 h \sin^2(\theta/2)}{m_e \cdot \lambda^2} = \frac{2 \times 6,62 \cdot 10^{-34} \cdot \sin^2(90/2)}{9,1 \cdot 10^{-31} \times 0,1 \cdot 10^{-9}}$$

$$\Rightarrow \Delta\nu = 7,27 \cdot 10^6 \text{ Hz}$$

$$\frac{\Delta\nu}{\nu_1} = \frac{7,27 \cdot 10^6 \times 0,1 \cdot 10^9}{3 \cdot 10^8} = \boxed{2,42 \cdot 10^{-12}}$$

Approximation correcte.