

$$\lambda_x = 0,1 \text{ nm.}$$

$$p_1 = \frac{h\nu_1}{c}$$

$$p_e = \frac{h\nu_2}{c}$$

→ conservation de la quantité de mouv.
→ conservation de l'énergie.

✓ Conservation de l'énergie

$$\sum E_f = \sum E_i$$

$$E_{\gamma 2} + E_{eg} = E_{\gamma 1} + E_{ei}$$

énergie du photon et de l'électron.

$$p_2 c + E_{eg} = p_1 c + E_{ei}$$

énergie du photon.

$$p_2 c + \sqrt{p_e^2 c^2 + m_e^2 c^4} = p_1 c + \sqrt{p_{e1}^2 c^2 + m_e^2 c^4}$$

$$p_2 c + \sqrt{p_e^2 c^2 + m_e^2 c^4} = p_1 c + m_e c^2$$

$$\boxed{\sqrt{p_e^2 c^2 + m_e^2 c^4} = p_1 c - p_2 c + m_e c^2}$$

Isoler la racine

Pour aller plus loin:

$$\sqrt{p_e^2 c^2 + m_e^2 c^4} = c(p_1 - p_2) + m_e c^2$$

Factoriser c.

$$p_e^2 c^2 + m_e^2 c^4 = (c(p_1 - p_2) + m_e c^2)^2$$

Élever au carré.

$$p_e^2 c^2 + m_e^2 c^4 = c^2 (p_1 - p_2)^2 + m_e^2 c^4 + 2 m_e c^3 (p_1 - p_2).$$

Développement.

$$\boxed{p_e^2 = (p_1 - p_2)^2 + 2 m_e c (p_1 - p_2)}$$

Simplifier. *

Conservation de la quantité de mouvement selon l'axe x.

$$\sum p_{xg} = \sum p_{xi}$$

$$p_2 \cos(\theta) + p_e \cos(\varphi) = p_1$$

Décomposition selon l'axe x.

$$p_e \cos(\varphi) = p_1 - p_2 \cos(\theta)$$

$$\boxed{p_e^2 \cos^2(\varphi) = p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2 \cos^2(\theta)}$$

Conservation de la quantité de mouvement selon l'axe y.

$$\sum p_{yg} = \sum p_{yi}$$

$$p_2 \sin(\theta) + p_e \sin(\varphi) = 0$$

$$p_e \sin(\varphi) = -p_2 \sin(\theta)$$

$$\boxed{p_e^2 \sin^2(\varphi) = p_2^2 \sin^2(\theta)}$$

2/ Addition des Equations.

relation Trigo:

$$\cos^2 \alpha + \sin^2 \alpha = 1.$$

$$[p_e^2 \cos^2(\theta)] + [p_e^2 \sin^2(\theta)] = [p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2 \cos^2(\theta)] + [p_2^2 \sin^2(\theta)]$$

$$p_e^2 (\cos^2(\theta) + \sin^2(\theta)) = p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2 [\cos^2(\theta) + \sin^2(\theta)]$$

$$p_e^2 = p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2$$

$$p_e^2 = \left(\frac{h v_1}{c}\right)^2 + \left(\frac{h v_2}{c}\right)^2 - 2 \frac{h^2}{c^2} v_1 v_2 \cos(\theta)$$

$$\Rightarrow p_e^2 c^2 = h^2 (v_1^2 + v_2^2) - 2 h^2 v_1 v_2 \cos(\theta).$$

3/ Soustraire Equations (2)

$$[p_e^2] - [p_e^2] = -[(p_1 - p_2)^2 + 2 m_e c (p_1 - p_2)] + [p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2]$$

$$0 = p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2 - (p_1 - p_2)^2 - 2 m_e c (p_1 - p_2)$$

$$0 = p_1^2 - 2 p_1 p_2 \cos(\theta) + p_2^2 - (p_1^2 + p_2^2 - 2 p_1 p_2) - 2 m_e c (p_1 - p_2)$$

$$0 = -2 p_1 p_2 \cos(\theta) + 2 p_1 p_2 - 2 m_e h (v_1 - v_2)$$

$$2 m_e h \Delta v = 2 p_1 p_2 (1 - \cos(\theta))$$

$$2 m_e h \Delta v = 2 \frac{h^2}{c^2} v_1 v_2 (1 - \cos(\theta))$$

$$v_1 \approx v_2$$

$$\Rightarrow \Delta v = \frac{h v^2}{c^2 m_e} (1 - \cos(\theta))$$

$$4/ \Delta v = \frac{h}{m_e \lambda^2} (1 - \cos(\theta))$$

$$\Delta v = \frac{6,62 \cdot 10^{-34}}{9,1 \cdot 10^{-31} \times (0,1 \cdot 10^{-9})^2} (1 - \cos(90))$$

$$\Delta v = 7,27 \cdot 10^{16} \text{ Hz}$$

$$\frac{\Delta v}{v_1} = \frac{7,26 \cdot 10^{16} \times 0,1 \cdot 10^{-9}}{3 \cdot 10^8} = 0,024$$

$\Rightarrow$ difference très faible