

原子

- ドブロイ波長： $\lambda = \frac{h}{mv}$

- エネルギー $h\nu$

- 運動量 $p = \frac{h\nu}{c} = \frac{h}{\lambda}$

- コンプトン効果

$$\Delta\lambda = \lambda' - \lambda = \frac{h}{mc}(1 - \cos\phi)$$

エネルギー保存則

$$\frac{hc}{\lambda} = \frac{hc}{\lambda'} + \frac{1}{2}mv^2$$

運動量保存則

$$\frac{h}{\lambda} = \frac{h}{\lambda'} + mv$$

$$\begin{cases} \frac{h}{\lambda} = \frac{h}{\lambda'} \cos\phi + mv \cos\theta \\ 0 = \frac{h}{\lambda'} \sin\phi - mv \sin\theta \end{cases}$$

$$\cos\theta = \frac{1}{mv} \left(\frac{h}{\lambda} - \frac{h}{\lambda'} \cos\phi \right)$$

$$\sin\theta = \frac{1}{mv} \frac{h}{\lambda'} \sin\phi$$

$$(mv)^2 (\cos^2\theta + \sin^2\theta) = \left(\frac{h^2}{\lambda^2} + \frac{h^2}{\lambda'^2} - 2 \frac{h^2}{\lambda\lambda'} \cos\phi \right)$$

$$(mv)^2 = 2mhc \left(\frac{1}{\lambda} - \frac{1}{\lambda'} \right)$$

$$2mhc \left(\frac{1}{\lambda} - \frac{1}{\lambda'} \right) = \left(\frac{h^2}{\lambda^2} + \frac{h^2}{\lambda'^2} - 2 \frac{h^2}{\lambda\lambda'} \cos\phi \right)$$

$$\lambda' - \lambda = \frac{h}{2mc} \left(\frac{\lambda'}{\lambda} + \frac{\lambda}{\lambda'} - 2 \cos\phi \right)$$

$$\lambda \cong \lambda' \Rightarrow \frac{\lambda'}{\lambda} + \frac{\lambda}{\lambda'} \cong 2$$

$$\lambda' - \lambda = \frac{h}{mc} (1 - \cos\phi)$$



