Definition: Light can behave differently depending on the experiment being conducted

de Broglie's formulas:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

larger matter

Not photons

Example 1:

What de Broglie wavelength is associated with a 0.1kg ball moving at 19 m/s?

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

$$\lambda = \frac{6.63\times10^{-34}}{0.1(19)}$$

$$\lambda = 3.49\times10^{-34}\,m$$

Comparaison: Diameter of hydrogen atom $1.2\times10^{-10}\,m$

What is the momentum of a photon with a wavelength of 1.2x10^-12 m

$\lambda = 1.2\times10^{-12}\,m$ $\quad \lambda = \frac{h}{p}$ $\quad p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{1.2\times10^{-12}} = 5.25\times10^{-22}\,kg\,\frac{m}{s}$

What de Broglie wavelength is associated with an electron that has been accelerated from rest through

a potential difference of 52V

voltage

$V = 52V$

$m_e = 9.1\times10^{-31}\,kg$

$q = 1.6\times10^{-19}\,c$

$$\Delta V = \frac{\Delta E}{q}$$

$$\Delta E = q\Delta V$$

$$= 1.6\times10^{-19}\cdot 52$$

$$\Delta E = 8.32\times10^{-18}\,J$$

$$\Delta E = E_k = \frac{1}{2}mv^2$$

$$8.32\times10^{-18} = \frac{1}{2}(9.1\times10^{-31})v^2$$

$$v = \sqrt{\frac{2(8.32\times10^{-18})}{9.1\times10^{-31}}}$$

$$v = 4.28\times10^{6}\,m/s$$

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

speed

$$= \frac{6.63\times10^{-34}}{9.1\times10^{-31}(4.28\times10^{6})}$$

$$= 1.7\times10^{-10}\,m$$

4.929×10^{-64} m

$v = f\lambda$

$v = 225308$ m/s

$\lambda = 4.929 \times 10^{-64}$ m

$f = 4.57 \times 10^{68}$ Hz