Electrons as Waves

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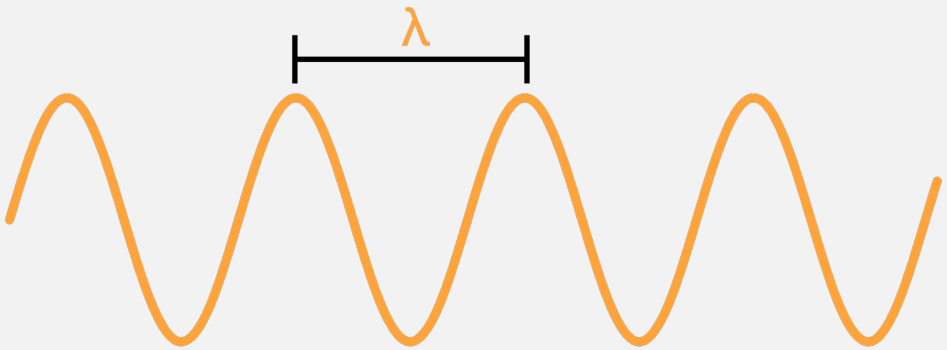
LIGHT

Q: What is light?

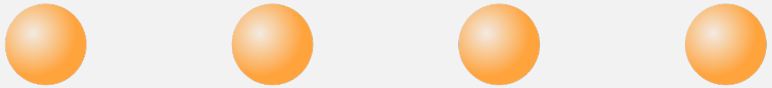
Is it a wave that carries energy?

LIGHT AS A WAVE



Is it a stream of tiny packets of energy (called photons)?

LIGHT AS A STREAM OF PARTICLES/PHOTONS



A: It behaves as both a wave and a particle.

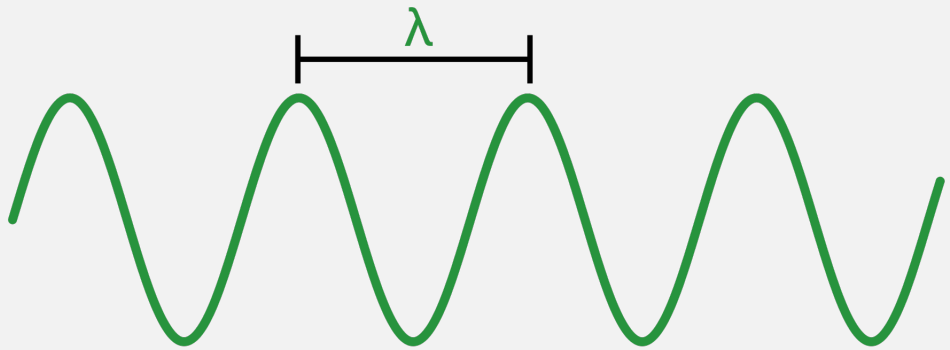
PHOTON: a quantized packet of light with a specific wavelength

WAVE-PARTICLE DUALITY: light behaves as both a wave *and* a particle

ELECTRONS

Q: What is an electron?

Is it a wave that carries energy? ELECTRON AS A WAVE



Is it a negatively charged particle? ELECTRON AS A PARTICLE

A: It behaves as both a wave and a particle.

ELECTRONS BEHAVE VERY MUCH LIKE LIGHT!

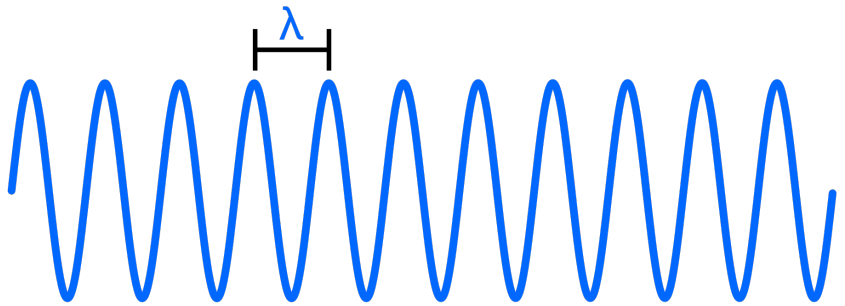
de Broglie Wavelength (λ)

Understand the relationship between the de Broglie wavelength (λ) and the mass (m) of a particle.

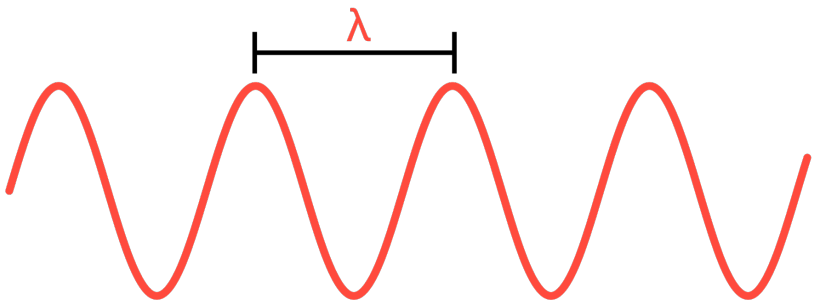
$$E = mc^2 \qquad \lambda = \frac{h}{mu}$$

Property		Value	Units
Energy	E		J
de Broglie Wavelength	λ		nm
Particle mass	m		kg
Particle speed	*u*		m/s
Planck's constant	*h*	6.626×10^{-34}	J·s

HEAVY PARTICLE
SHORT DE BROGLIE
WAVELENGTH



LIGHT PARTICLE
LONG DE BROGLIE
WAVELENGTH



Which of the following particles would have the shortest de Broglie wavelength?

PARTICLE	MASS (m)	SPEED (*u*)	de Broglie Wavelength (λ)
Electron	9.11×10^{-28} g	4.05×10^{6} m/s	
Person	80.0 kg	15 mi/hr	
Earth	6.0×10^{27} g	3.0×10^{4} m/s	

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