The Wave-Like Properties of Particles

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1 De Broglie's Hypothesis

- After Einstein's theory, it was determined that light has dual particle-wave nature
- In 1924, Louis de Broglie proposes a hypothesis:
  - Any object moving with a momentum p is associated with a wave of wavelength λ, where:

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

  - λ refers to the "De Broglie" wavelength, h is the Planck constant, and p is the momentum
  - For experimental measurement of the wave–like behavior of particles, the double and single-slit experiments were performed

2 Experimental Evidence for De Broglie Waves

- Particle Diffraction Experiment
  - For light of wavelength λ incident on a slit of width a, the diffraction pattern has a minimum at angles:

$$\boxed{a\sin(\theta) = n\lambda, \qquad n = 1, 2, 3, \cdots}$$

  - Each of the atoms acts as a scatter
  - The scattered electron waves interfere
  - The crystal serves as a diffraction grating
  - The maxima occurs at angle:

$$\boxed{d\sin(\phi) = n\lambda}$$

  - Where λ is the de Broglie wavelength