LIGHT BEHAVES LIKE

WAVE - DIFRACTION EXPERIMENT

and

PARTICLE – PHOTOELECTRIC EFFECT

dé Broglie

WHAT WE CONSIDER PARTICLES

CAN BEHAVE LIKE BOTH ALSO.

CAN A PARTICLE (ELECTRON)

BEHAVE LIKE WAVE?
de Broglie

YES

WITH WAVELENGTH GIVEN BY

\[ \lambda = \frac{h}{P} \]

\[ P = \text{momentum} = mv \]
DAVISSON GERMER EXPERIMENT
ELECTRONS WITH KNOW ENERGY
ARE FIRED AT CRYSTAL TARGET.
MEASURE NUMBER OF ELECTRONS AT DETECTOR AS FUNCTION OF ANGLE FOR DIFFERENT ENERGIES.

Intensity = radial distance along dashed line to data at angle \( \phi \)
AT $50^0$ LARGE NUMBER ARRIVE
AT DETECTOR.

WHY?

WAVES CAN INTERFER
CONSTRUCTIVELY!

BUT PARTICLES?

AT 54 eV MORE ELECTRONS.
IF de BROGLIE CORRECT WHAT WILL BE WAVELENGTH FOR 54eV ELECTRONS?

\[ KE = \frac{1}{2} mv^2 = (54eV)(1.6x10^{-19} \ \frac{J}{eV}) \]

SOLVE FOR \( v \)

\[ v = \sqrt{\frac{2(54eV)(1.6x10^{-19} \ \frac{J}{eV})}{m}} \]
\[ v = 4.36 \times 10^6 \frac{m}{s} \]

\[ p = m v = (9.1 \times 10^{-31} \text{ kg})(4.36 \times 10^6 \frac{m}{s}) \]

\[ p = 3.97 \times 10^{-24} \text{ kg} \frac{m}{s} \]
deBroglie

\[ \lambda = \frac{h}{P} = \frac{6.63 \times 10^{-34} \text{ Js}}{3.97 \times 10^{-24} \text{ kg m/s}} \]

\[ \lambda = 1.66 \times 10^{-10} \text{ m} \]
FOR “WAVES” REFLECTED OFF LATTICE

\[ n\lambda = d \sin \Theta \]

WHERE \( d \) SPACING BETWEEN LATTICE SITES

and

\( n \) IS THE NUMBER OF THE PEAK
\[ n\lambda = d \sin \Theta \]

USE

\[ n = 1 \]

\[ \lambda = 1.66 \times 10^{-10} \text{ m} \]

\[ d = 2.15 \times 10^{-10} \text{ m} \]

WHICH IS THE SPACING FOR NICKEL
(1)(1.66 \times 10^{-10} \, m) = (2.15 \times 10^{-10} \, m) \sin \Theta

\sin \Theta = \frac{(1.66 \times 10^{-10} \, m)}{(2.15 \times 10^{-10} \, m)} = 0.77

THUS

\Theta = 50^0