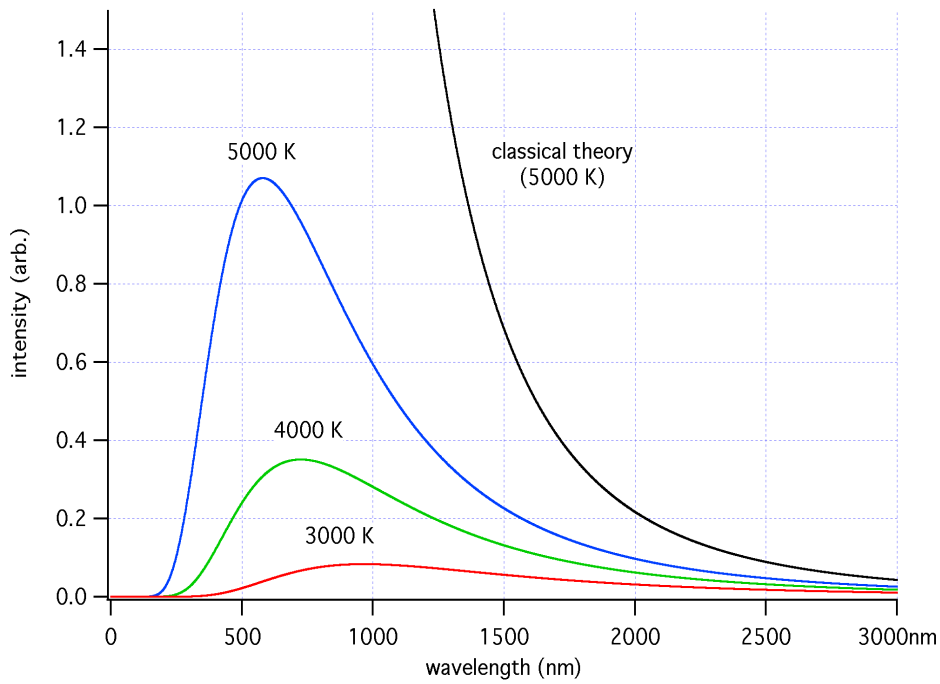


- Faraday's law

$$\oint \vec{E} \cdot d\vec{l} = - \frac{d}{dt} \int \vec{B} \cdot d\vec{a}$$

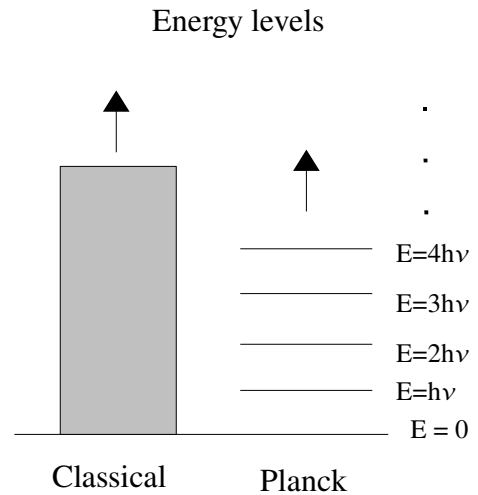
- Thermal Radiation (Blackbody Radiation)



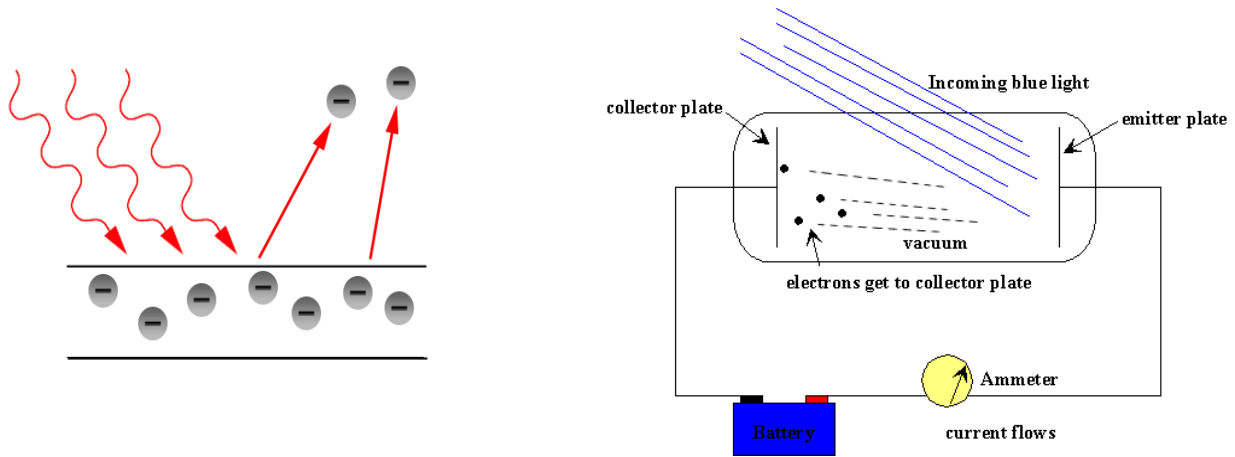
Intensity: $I(T) = \int_0^{\infty} R(\lambda, T) d\lambda$ $R(\lambda, T) = \frac{dI(T)}{d\lambda}$

Planck's postulate : $E = h\nu$

The average energy : $\bar{E}(\nu) = \frac{\sum_{n=0}^{\infty} E P(E)}{\sum_{n=0}^{\infty} P(E)} = \frac{h\nu}{e^{h\nu/k_B T} - 1}$

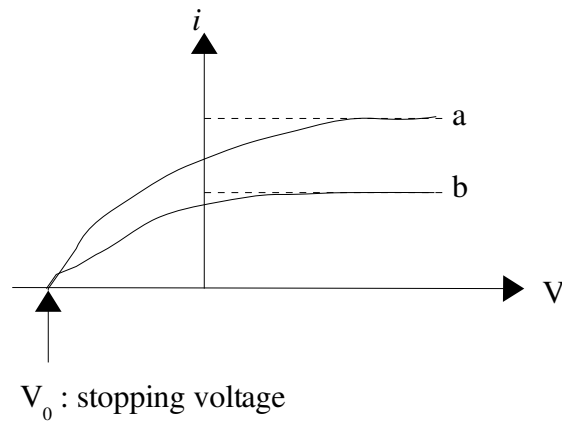


- Photoelectric Effect

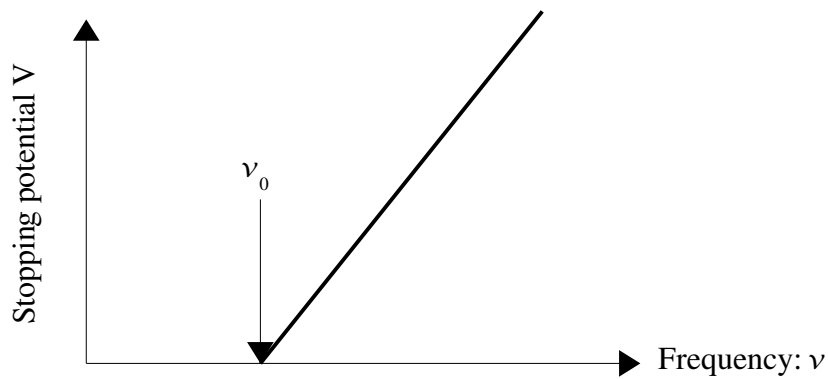


Characteristic curve:

(1) I - V curve



(2) V - ν curve



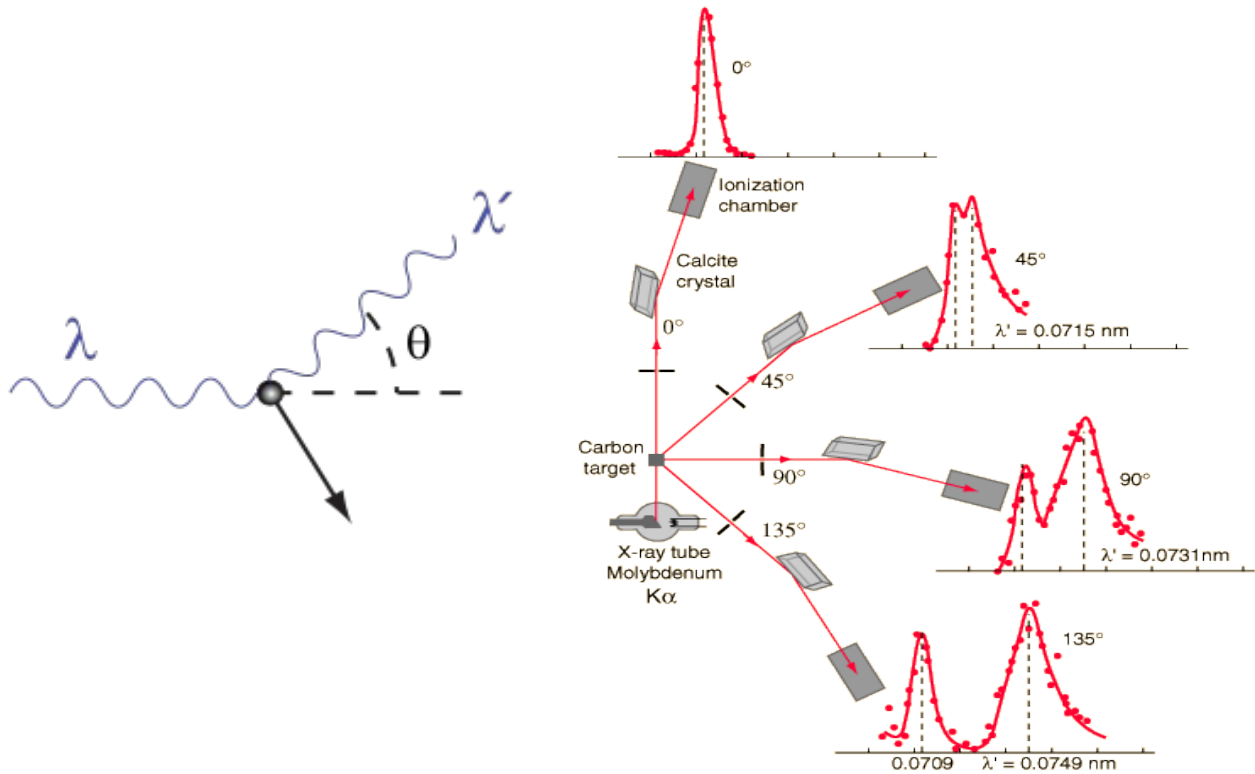
Einstein's explanation:

$$K = eV - W \quad W: \text{work required to remove one electron from the material}$$

$$\therefore K_{max} = h\nu - W_0$$

W_0 is called the work function, which is the minimum energy needed by an electron to pass through the metal surface and escape the attractive Coulomb force binding the electron.

- Compton X-ray scattering:



- (i) Conservation of momentum:

$$p_0 = p_1 \cos \theta + p \cos \phi$$

- (ii) Conservation of (relativistic) Energy:

$$E_0 + m_0 c^2 = E_1 + K + m_0 c^2$$

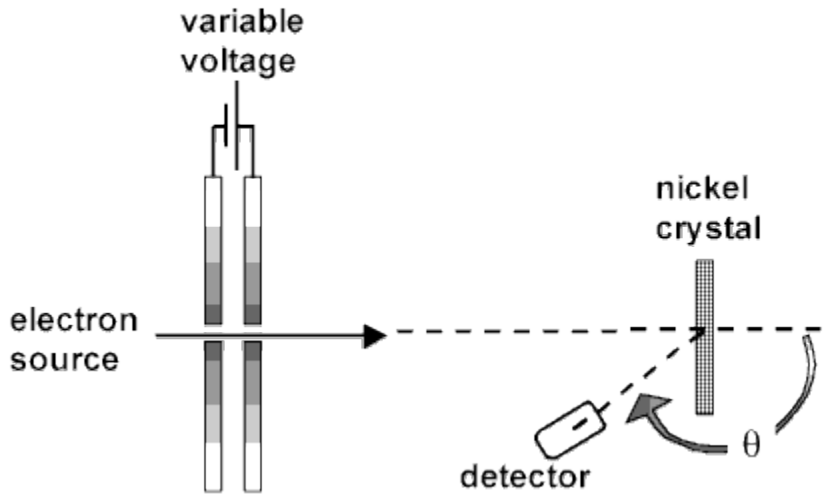


$$\lambda_1 - \lambda_0 = \frac{h}{m_e c} (1 - \cos \theta)$$

- de Broglie's postulate: particle-wave duality

de Broglie wavelength (mater wave) associated with a particle: $\lambda = \frac{h}{p}$

- Davisson-Germer Experiment: proof of de Broglie's postulate



Bragg relation: $n\lambda = 2d \sin\theta$

1924 de Broglie's hypothesis

1927 Davisson-Germer experiment

1929 Nobel Prize for de Broglie

Theory

$$\lambda = \frac{h}{mv} = 1.67 \text{ \AA} \text{ for } 54 \text{ V}$$

Experiment

Pathlength difference

$$d \sin \theta = 2.15 \sin 50^\circ = \lambda = 1.65 \text{ \AA}$$

for constructive interference

Nickel lattice spacing $d = 2.15 \text{ \AA}$

Not bad for a three year old idea!

