Photoelectric effect Hertz (1887)

1.) Polished metal plates irradiated may emit e^-

"photo e" → photo-electric current

2.) There is a threshold frequency ν_0; only for $\nu > \nu_0$ there is current.

ν_0 depends on the metal and the config. of atoms at the surface.

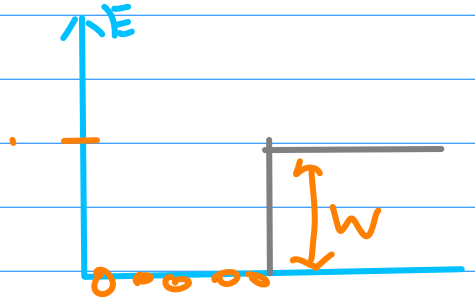
3.) Magnitude of current (i) ∝ light intensity.

4.) Energy of the photo e^-'s is independent of the intensity of light.

[E_{e^-} ↑ as linearly with ν of light]

Einstein (1905): light is composed of Quanta (photons)

with energy $E = h\nu$



W = work function

↓

Energy needed to release an e^-.

Einstein's prediction → $E_{e^-} = \frac{1}{2} m v^2 = E_\gamma - W$

E_γ ↑ energy of photon

Millikan (1915): Verified Einstein's conjecture

h is measured to better than 1%.

Example: Shine UV light $\lambda = 290$ nm on a metal with $W = 4.05$ eV. What is the energy E_e & speed.

$4.05 \times 1.6 \times 10^{-19} = [6.4 + (0.08)] \times 10^{-19}$

$= 6.48 \times 10^{-19}$ J

$$\frac{6.67 \times 10^{-34} \quad 3 \times 10^{8}}{290} = \frac{20 \times 10^{-26}}{29 \times 10^{-9}}$$

$$= \frac{200}{29} \times 10^{-26+9} =$$

$$= \frac{200}{29} \times 10^{-19}$$

$$E_e = 6.67 \times 10^{-19} \text{ J}$$

$$\frac{1}{2} m v^2 = 6.67 \times 10^{-19} \text{ J}$$

$$E = h\nu = \frac{2\pi\hbar c}{\lambda} = \frac{2\pi \times 200 \times 10^{6}\,eV \times 10^{-15}\,m}{2\pi \times 1\,m}$$

$$\hbar c \simeq 200\ MeV \cdot fm$$