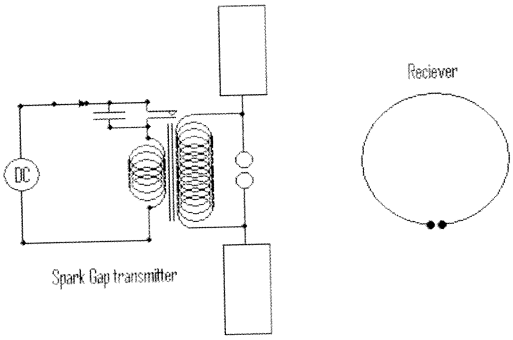
Photoelectric Effect

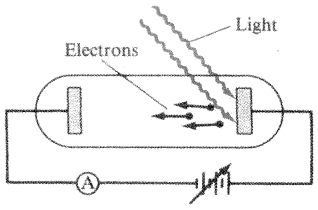


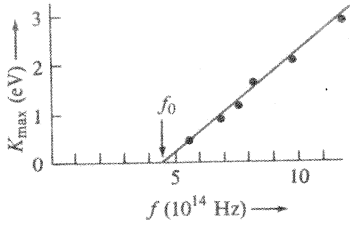
- 1887 Heinrich Hertz observed EM waves w/ spark gap.
  - sparks less intense in dark
- 1890 P. Lenard investigated the photoelectric effect.
  - determined e^- emission
- 1905 A. Einstein - "quantization of light" $\boxed{E=h\nu}$

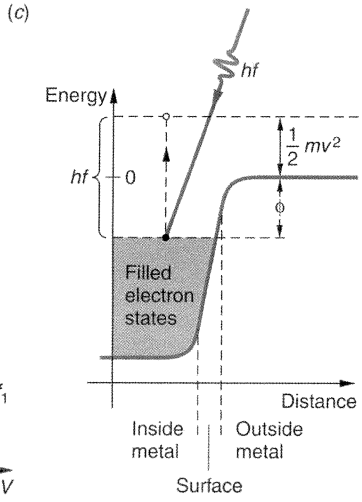
$$eV_0 = KE_{max} = h\nu - \phi$$

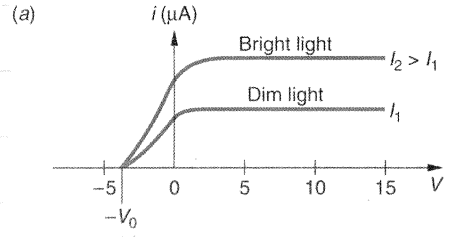
(eV_0: stopping potential; $h\nu$: photon energy; ϕ: work function.)

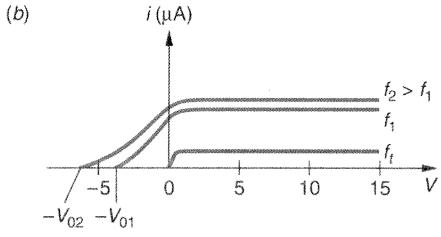
- 1926 Gilbert Lewis "photons"











- classically: expect more intense light to have higher stopping potential
  : expect long delay while less intense light builds up energy to release electron.

a) classical time lag: potassium: $\phi = 2.22\,eV$

$$t = \frac{\phi}{R \cdot A} = \frac{2.22\,eV}{100\,W/(100\,m)^2 \cdot \pi(1\,\text{Å})^2} = 18.8\,min$$

b) quantum: for $\lambda = 400\,nm$

$$\frac{t}{atom} = \frac{h\nu}{R \cdot A} = \frac{3.10\,eV}{100\,W/(100\,m)^2 \cdot \pi(1\,\text{Å})^2} = 26.3\,min$$

- microscopic units

$\vec{F}=m\vec{g}$ $\quad \vec{F}=q\vec{E}$ $\quad 1J = 1C \cdot 1V$

$U=mgh$ $\quad \boxed{U=qV}$ $\quad eV = 1.6\times10^{-19}\,\underbrace{C \cdot 1V}_{J}$

qV: $1eV = 1.6\times10^{-19}\,J$

kT: $300K \approx 25\,meV$

hc: $hc = 1240\,eV \cdot nm$