25 Sep 2012

Celal Zaim Gil
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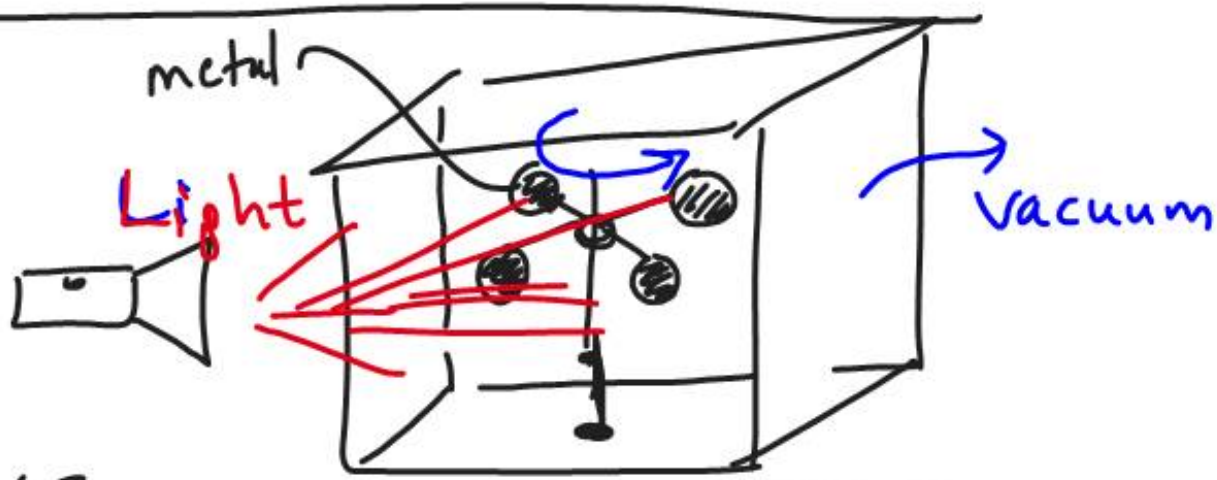
PHOTONICS & DEVICES (ECE 631)



PHOTON

is a particle

ZERO rest mass

$c = 3 \times 10^8$ m/s in vacuum

$$E = h \cdot \nu \quad | \quad eV, J$$

it has energy & momentum

h: Planck's constant

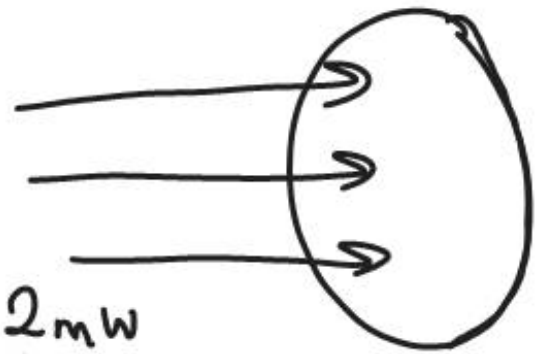
ν: frequency

Light intensity $\Rightarrow I$ (irradiance)

$I \Rightarrow (W/m^2)$ $2\,mW/m^2$ intensity

$\lambda = 1\,\mu m$ $\boxed{C = \lambda \cdot \nu}$ speed of light = $\nu \times \lambda$

how many photons we have in a $A = 1\,m^2$ area



$I = \frac{2\,mW}{m^2}$ $A = 1\,m^2$

Power = 2mW

$Watt = \frac{(energy)\ Joule/cV}{sec} = \frac{E}{sec}$

in 1 sec.

$E = 2\,mJ$

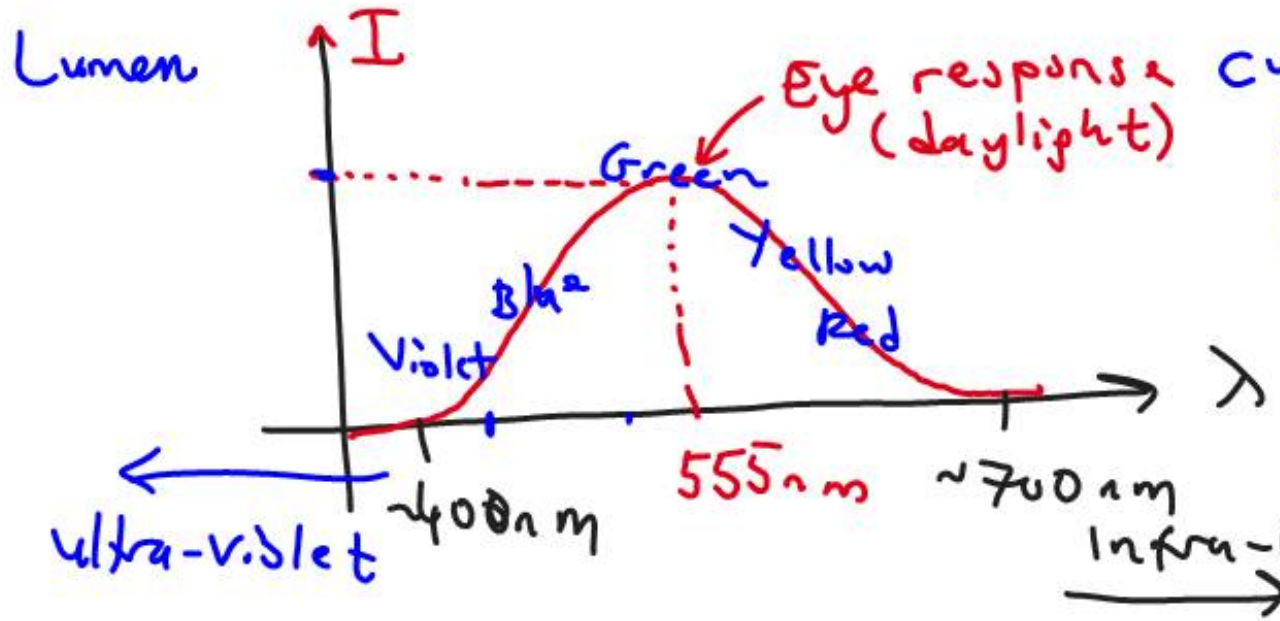
$number\ of\ photons = \frac{E}{h\nu}$

$$\nu = \frac{3\times10^{8}\ m/s}{1\times10^{-6}\ m} = 3\times10^{14}\ Hz$$

$$E = h\cdot\nu = 6.626\times10^{-34}\ J.s \times 3\times10^{14}\ /s$$

$$E \simeq 19.8\times10^{-20}\ J.$$

$$\text{Number of photons} = \frac{2\times10^{-3}\ J}{19.8\times10^{-20}\ J} \cong \frac{10^{-2}}{10^{-20}} \cong 10^{18}\ \text{photons}$$

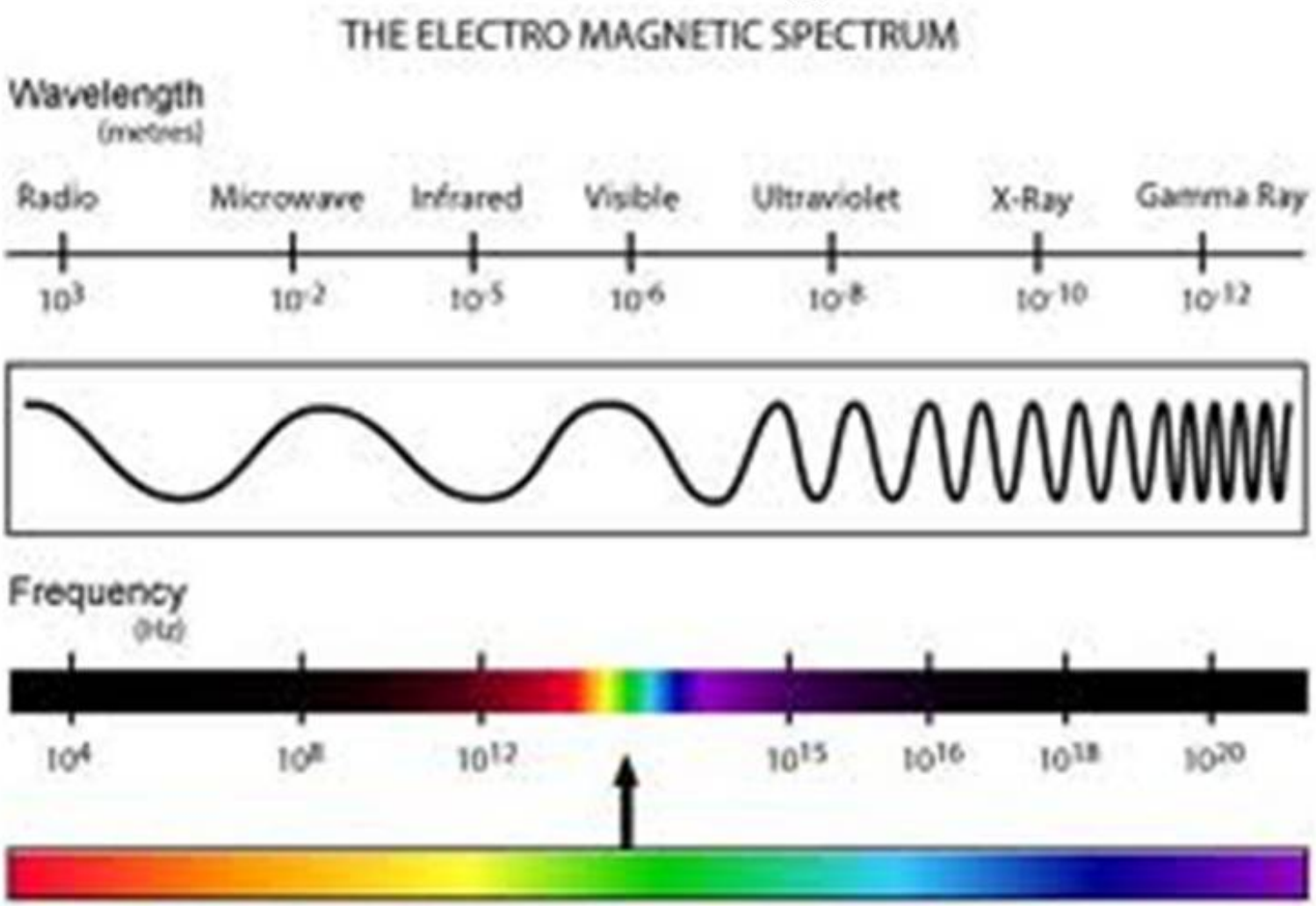


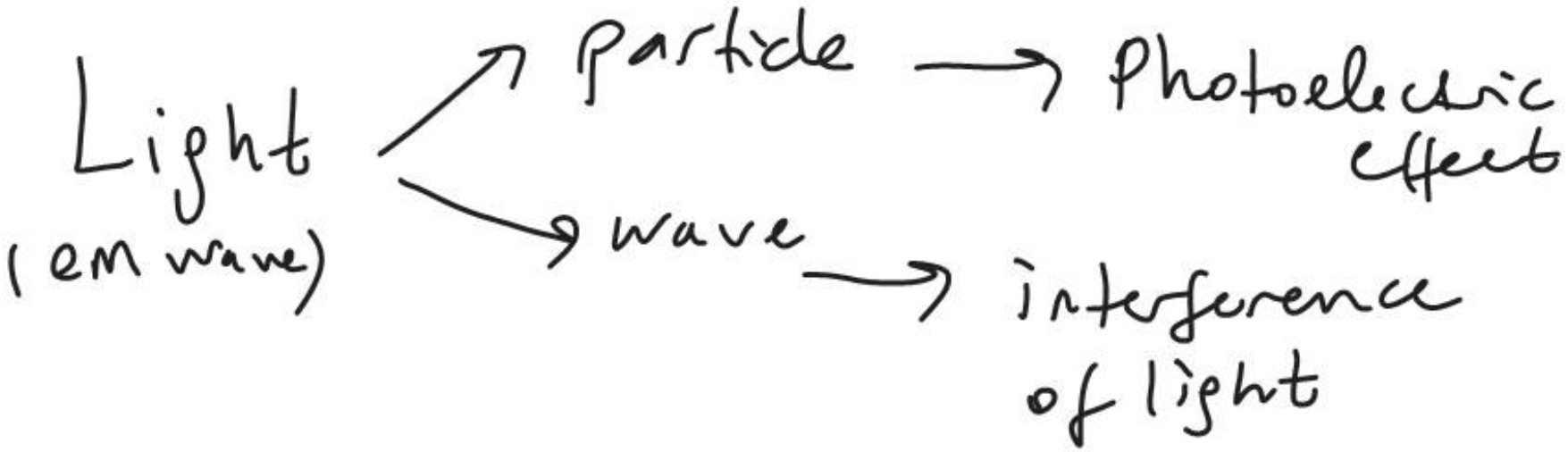
P = Watt → Lumen

↓ Radiometry

↓ photometry

Light ⇒ electromagnetic wave




Light
(EM wave)
particle
Photoelectric effect
wave
interference of light