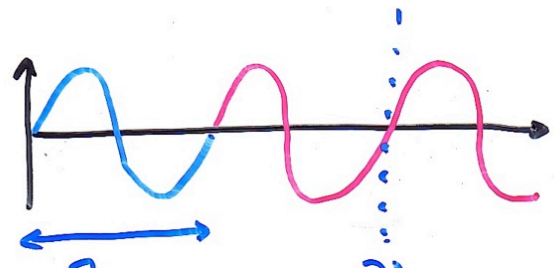
Waves



λ wavelength

ν frequency = #waves/second

UNITS: m (wavelength); $\frac{1}{s}$ or s^{-1} or Hz (Hertz) (frequency)

Speed of wave = wavelength × frequency

$\frac{m}{s}$ = m × $\frac{1}{s}$

sound waves travel ≈ 300 m/s

$$u = \lambda \nu$$

ex: Sound wave, with $\lambda = 30\,m$, what is ν?

$$u = \lambda \cdot \nu$$

$$\nu = \frac{u}{\lambda} = \frac{300\ m/s}{30\ m} = 10\ \frac{1}{s} = 10\ s^{-1} = 10\ Hz$$

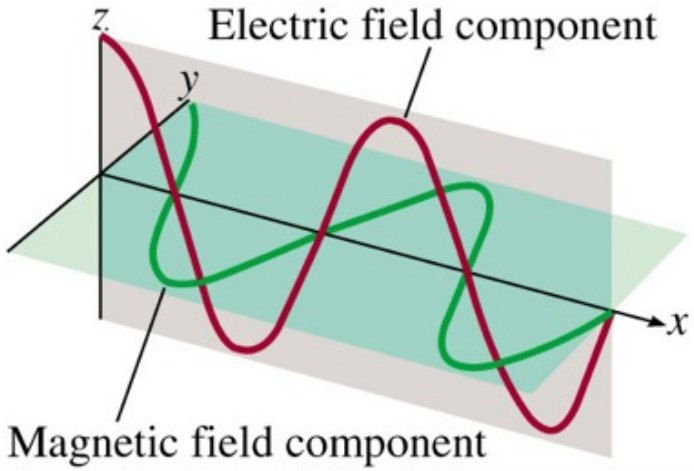
"Light" is an electromagnetic (EM) wave.

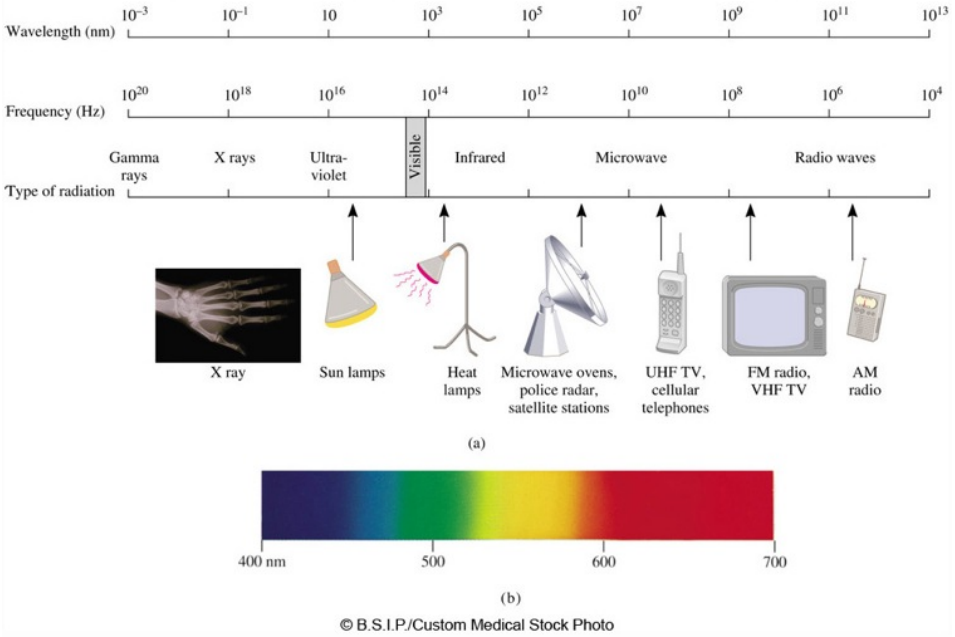
moves @ a speed = $3.00 \times 10^8\ m/s$

$c = 3.00 \times 10^8\ m/s$

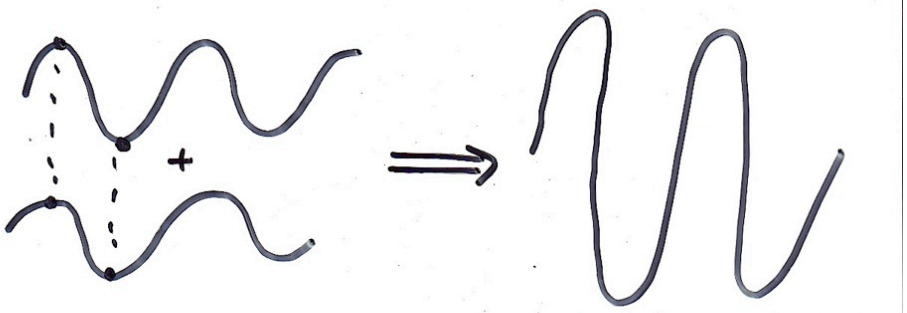
γ-rays
X-rays
UV-rays
VIS-light
IR-rays
μ-waves
Radio-waves

-all EM waves.

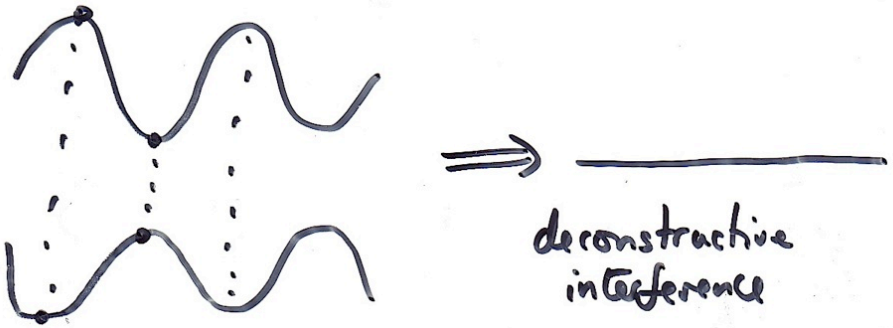




Light : Wave ?

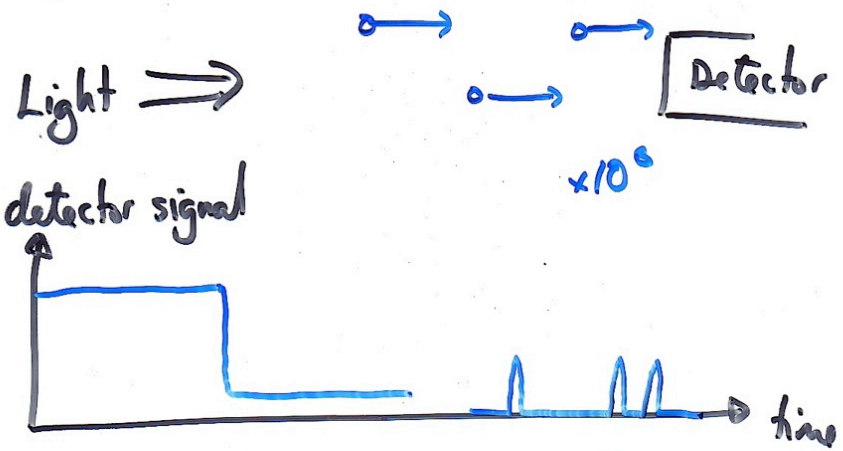


constructive interference



deconstructive interference

Light: Particles



BRIGHT LIGHT — DIM — Really DIM

Light: Wave ✓
Particle ✓

Wave-Particle duality

Individual particles of light: PHOTONS

Energy of each photon

$$E = h \cdot \nu$$

(h: Planck's Constant, ν: frequency)

$$h = 6.626 \times 10^{-34}\ J \cdot s$$

Since light: $c = \nu\lambda$

$$\Rightarrow \nu = \frac{c}{\lambda}$$

$$\Rightarrow \boxed{E = h \cdot \nu = \frac{hc}{\lambda}}$$

$E \propto \nu$

$\propto 1/\lambda$

Red light: $\lambda = 700.\ nm$ $\quad c = 3.00 \times 10^8\ m/s$

$n = \times 10^{-9}$ $\quad \lambda = 700. \times 10^{-9}\ m$

$$E_{photon} = h\nu = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34}\ J \cdot s \times 3.00 \times 10^8\ m/s}{700. \times 10^{-9}\ m}$$

$$= 2.84 \times 10^{-19}\ J$$

Blue light: $\lambda = 400.\ nm$

$= 400. \times 10^{-9}\ m$

$$E_{photon} = \frac{h \cdot c}{\lambda} = 4.97 \times 10^{-19}\ J$$

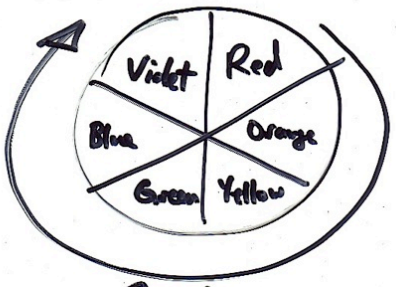
$E_{blue} > E_{red}$

$\lambda_{blue} < \lambda_{red}$

UV-light

$\lambda_{uv} < \lambda_{Blue}$

$\Rightarrow E_{uv} > E_{Blue} > E_{red}$

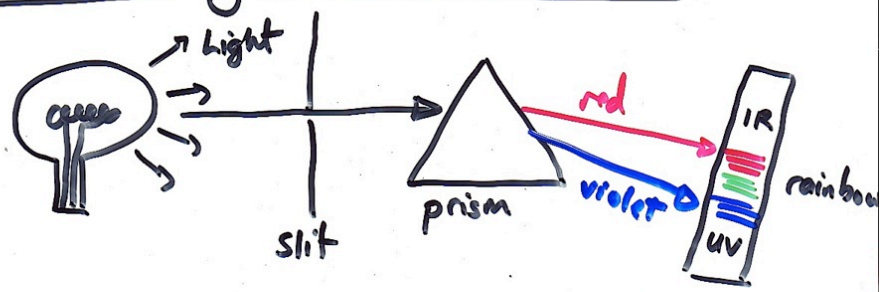


λ decreases
$\Rightarrow$ Ephoton increases

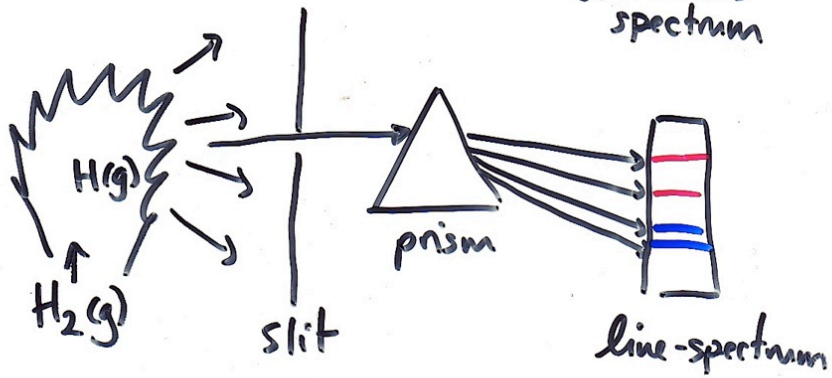
Blue colors arise from absorption of orange light $\lambda\uparrow \Rightarrow E\downarrow$

Red colors arise from absorption of green light. $\lambda\downarrow \Rightarrow E\uparrow$

Bohr's theory of the H-atom



continuous spectrum



DISCRETE colors