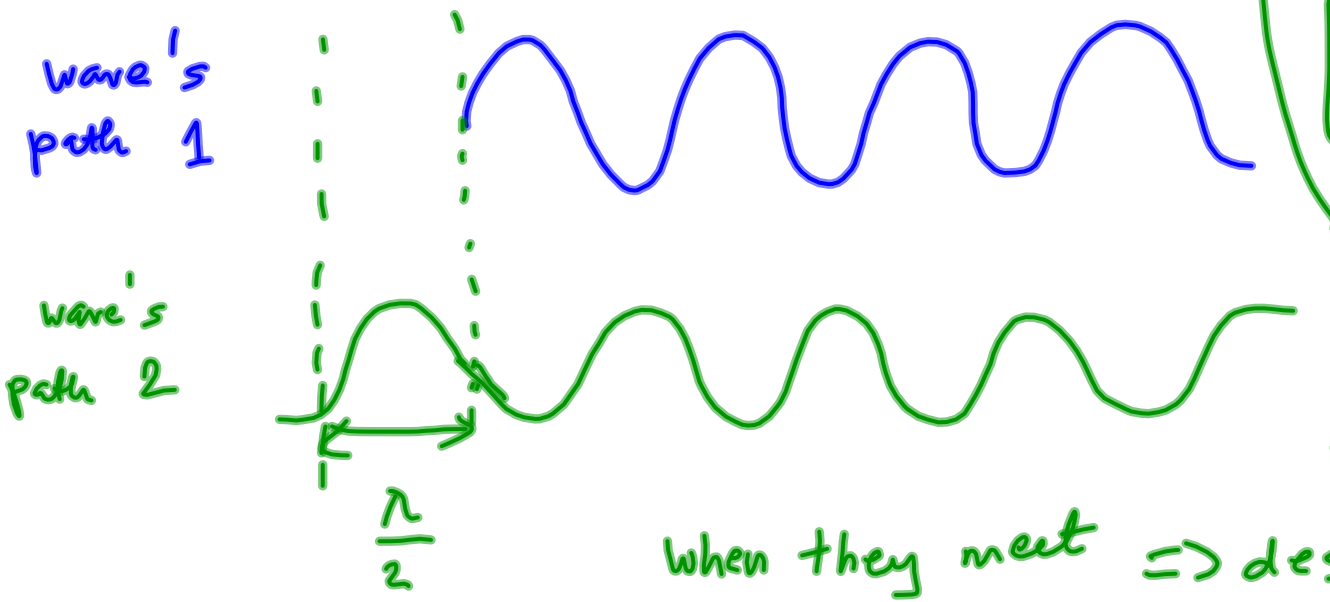
Electromagnetic wave including light also produce constructive & destructive interference as electic & magnetic field obey superposition principle.

What is wavup?

Electromagnetic field

Assume

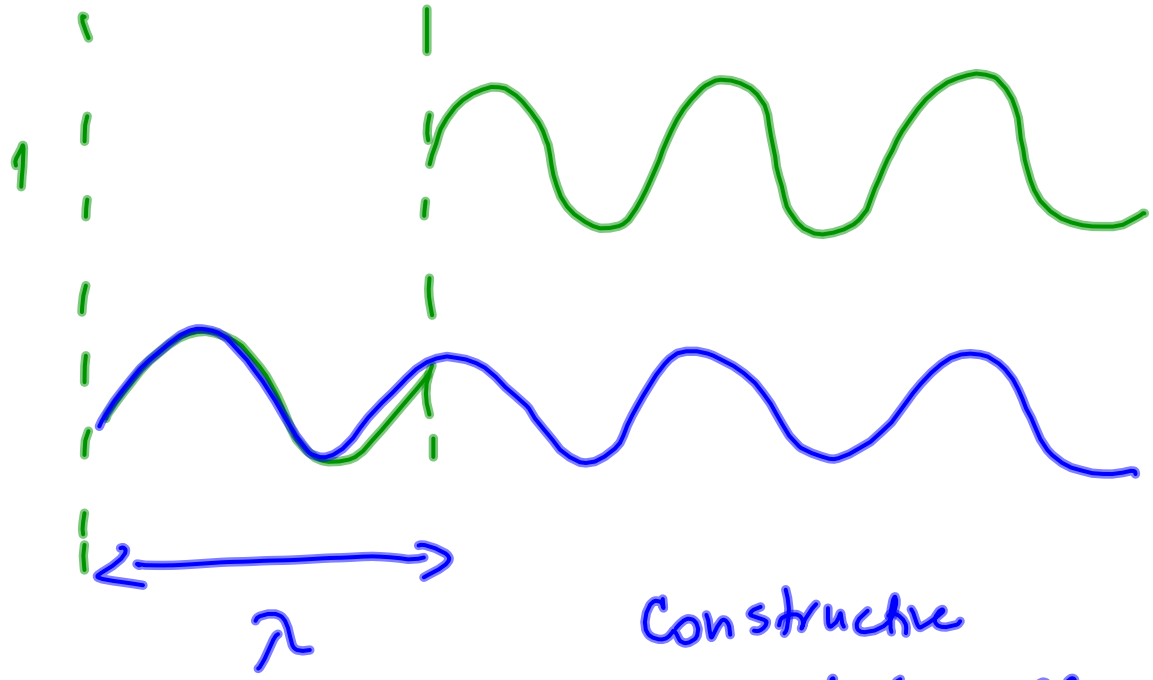


$(2m+1)\cdot\frac{\lambda}{2}$

$(m+\frac{1}{2})\cdot\lambda$

odd integer multiple of half wavelength

when they meet $\Rightarrow$ destructive interference



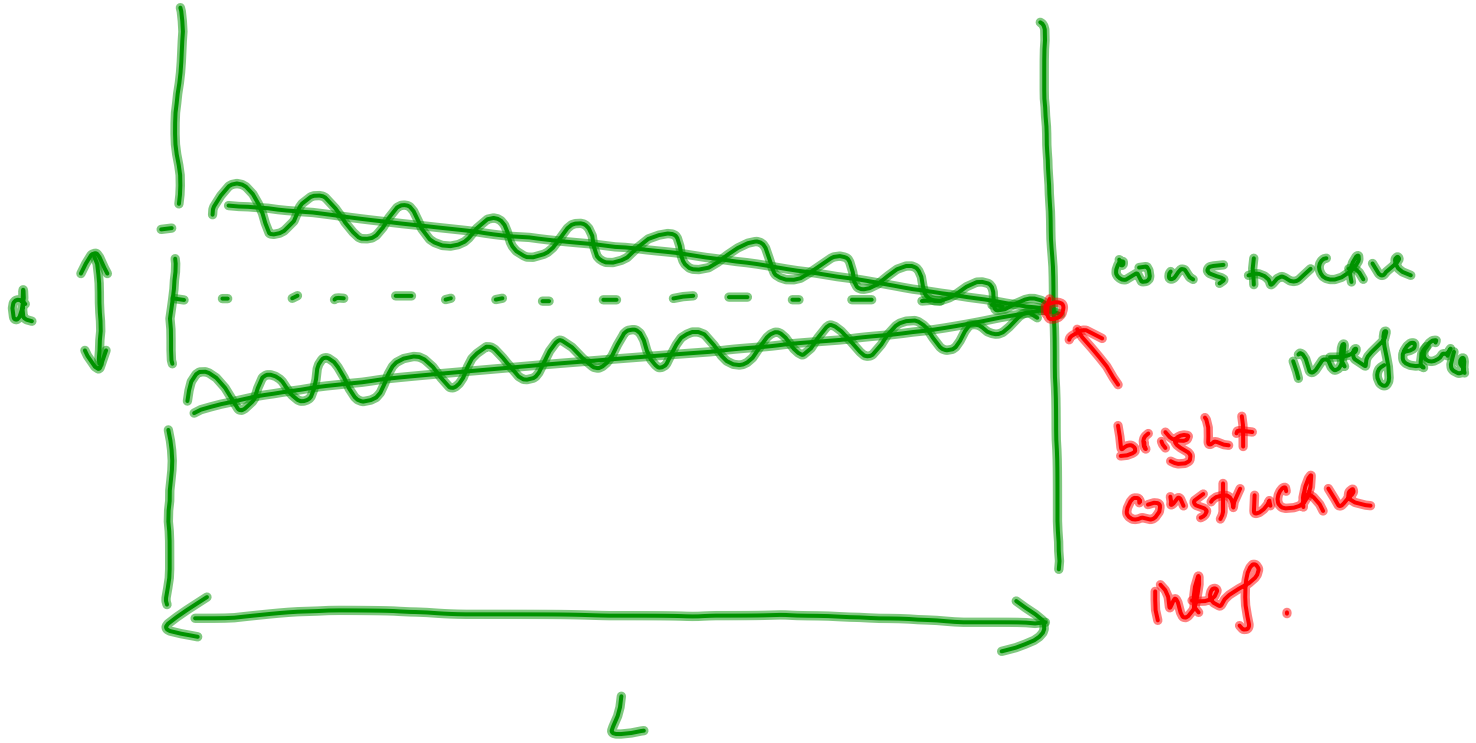
$m\lambda$

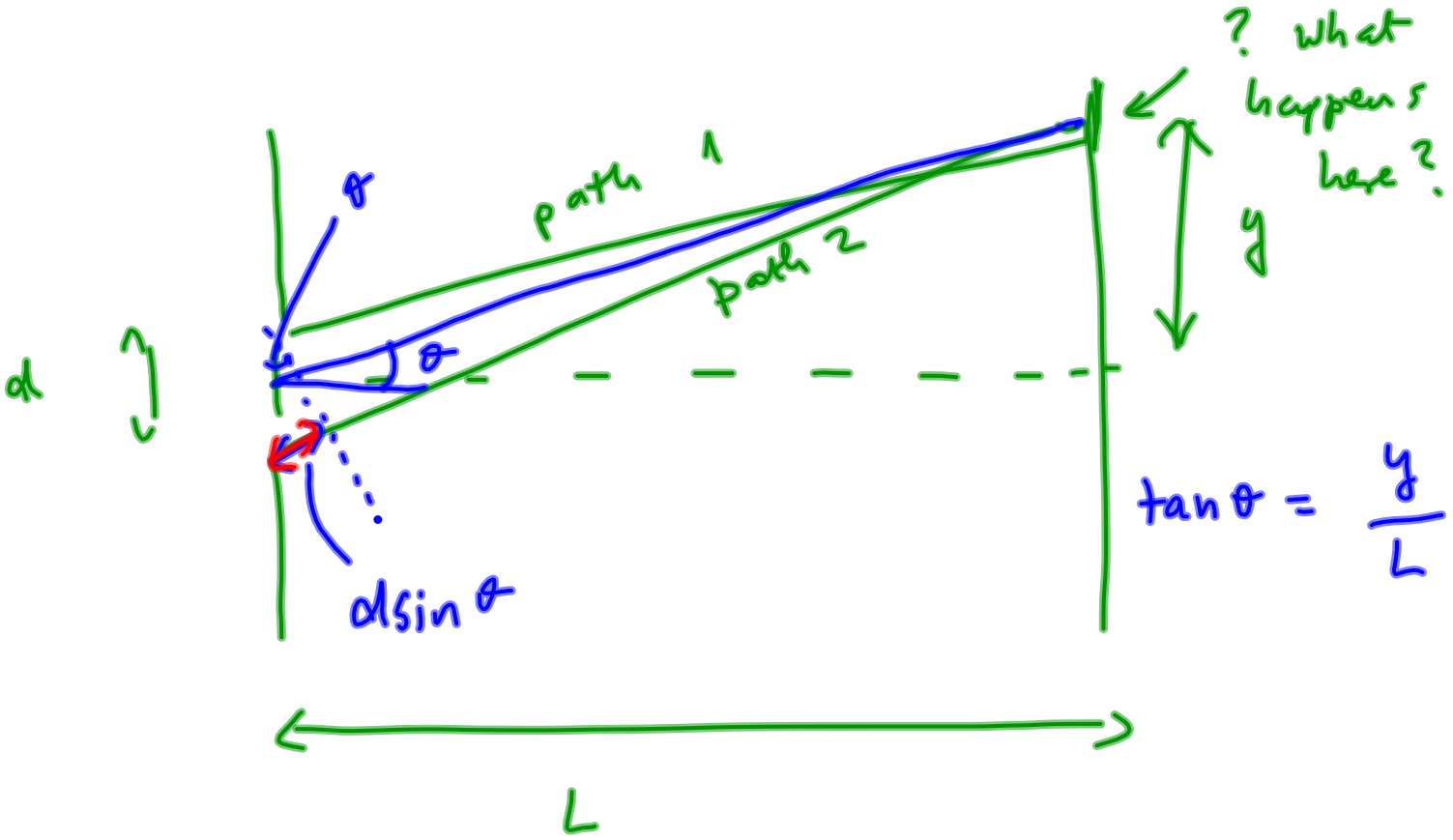
$m = 0, 1, 2 \ldots$

Constructive interference

in between waves also interfere, superimpose

Double slit interference




? what happens here?
path 1
path 2
θ
d
y
dsinθ
tanθ = y/L
L

If $L >> d$ the paths are nearly parallel & differ by $d \sin\theta$

$d \sin\theta = m\lambda$ constructive interference bright dot

$d \sin\theta = \left(m + \frac{1}{2}\right)\lambda$ destructive interf. dark

$m = 0, 1, 2, \ldots$

- typically $\lambda << d \Rightarrow \theta$ small

$\sin\theta \sim \tan\theta = \frac{y}{L}$

$d \sin\theta = m\lambda$

$d \cdot \frac{y}{L} = m\lambda$ or

$y_{bright} = m \frac{L \cdot \lambda}{d}$ bright fringes

$y_{dark} = \left(m + \frac{1}{2}\right) \cdot \frac{L\lambda}{d}$ dark fringes

$$\Delta y = y_{m+1} - y_m = \frac{\lambda \cdot L}{d}$$

- increasing d (the distance between slits)
  y increases & fringes are closer together
- Δy is independent of m, any adjacent bright fringes have the same spacing & dark fringes are exactly in between

Intensity for double slit:

$$I = 4 I_1 \cos^2 \frac{\pi d}{\lambda \cdot L} y$$

where I_1 (single slit)

Example

Two slits 0.075 mm apart are located 1.5 m from the screen. Laser light shining through the slits produces

an interference pattern whose third order bright fringe is 3.8 cm from the screen center. Find the light's wavelength.

$\lambda, L, d, \theta, y, m$

$m = 3$

$y_{bright} = 3.8\ cm$

$$y_{bright} = m\frac{\lambda L}{d}$$

- check $\lambda << d$ → good thing to check

$d = 0.075\ mm$ $L = 1.5\ m$ $\lambda = 633\ nm$

Diffraction grating

- multiple slits (instead of 2)
- interference of N overlapping waves
- there will be N waves arriving to the screen at angle θ_m (diffraction angle)

$$d \sin\theta_m = m\lambda \qquad y_m = L \tan\theta_m$$