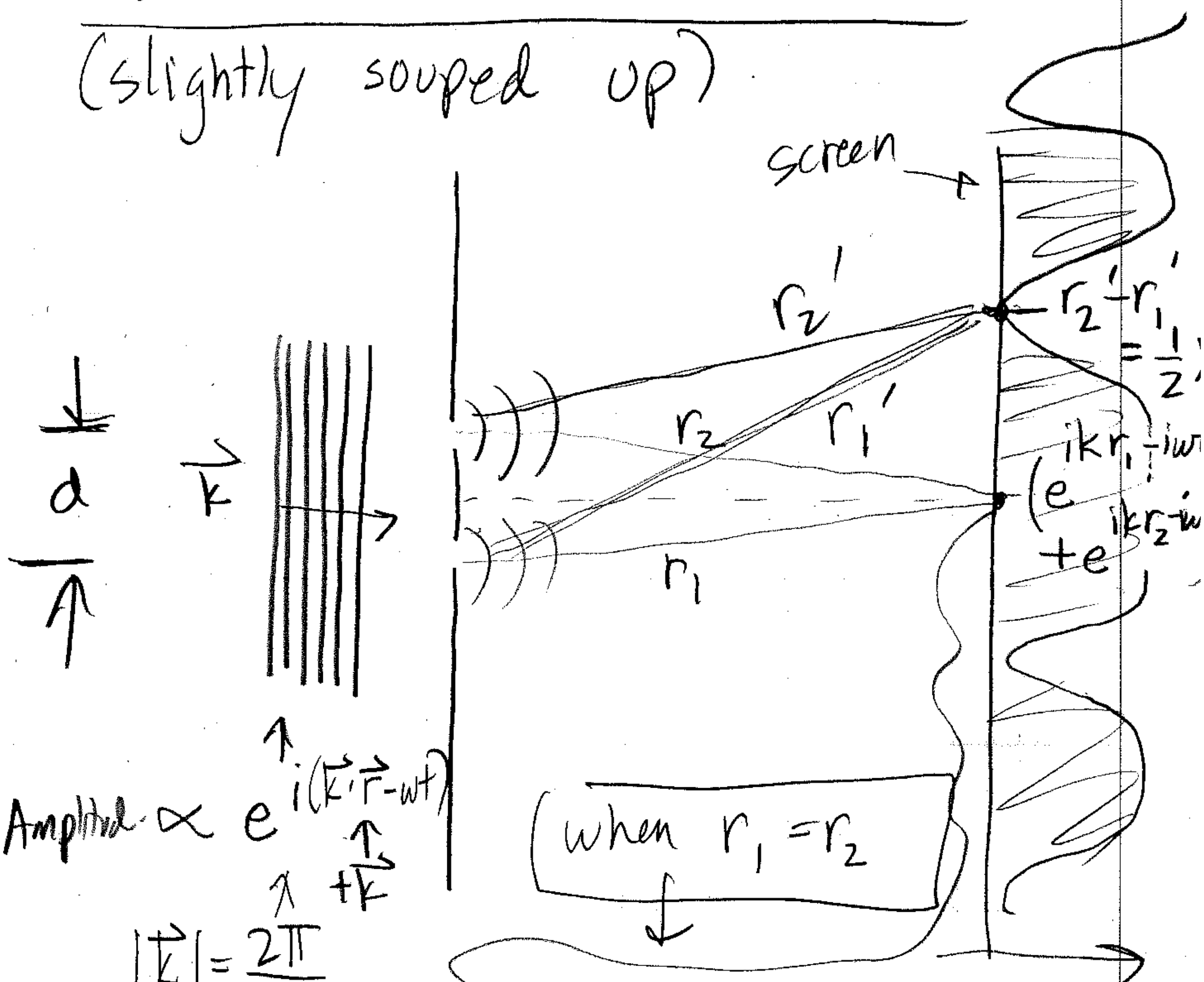
Double Slit Interference

(slightly souped up)



Amplitude $\propto e^{i(\vec{k}\cdot\vec{r}-\omega t)}$

$\vec{k}$

$|\vec{k}| = \frac{2\pi}{\lambda_0}$

vacuum

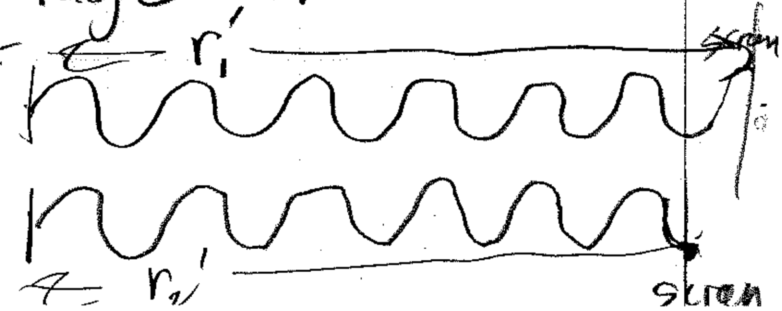
2 (electric field strength)

Intensity $\propto$ 4 times! (compared to 1 slit)

→ average over time.

Zero: route 1' slit

route 2' sl



math of this ...

$$e^{ikr_1' - i\omega t} + e^{ikr_2' - i\omega t}$$

$$= e^{ikr_2' - i\omega t}\left(e^{ik(r_1' - r_2')} - 1\right)$$

$$|\text{Amplitude}| = \left| e^{ik(r_1' - r_2')} - 1 \right|$$

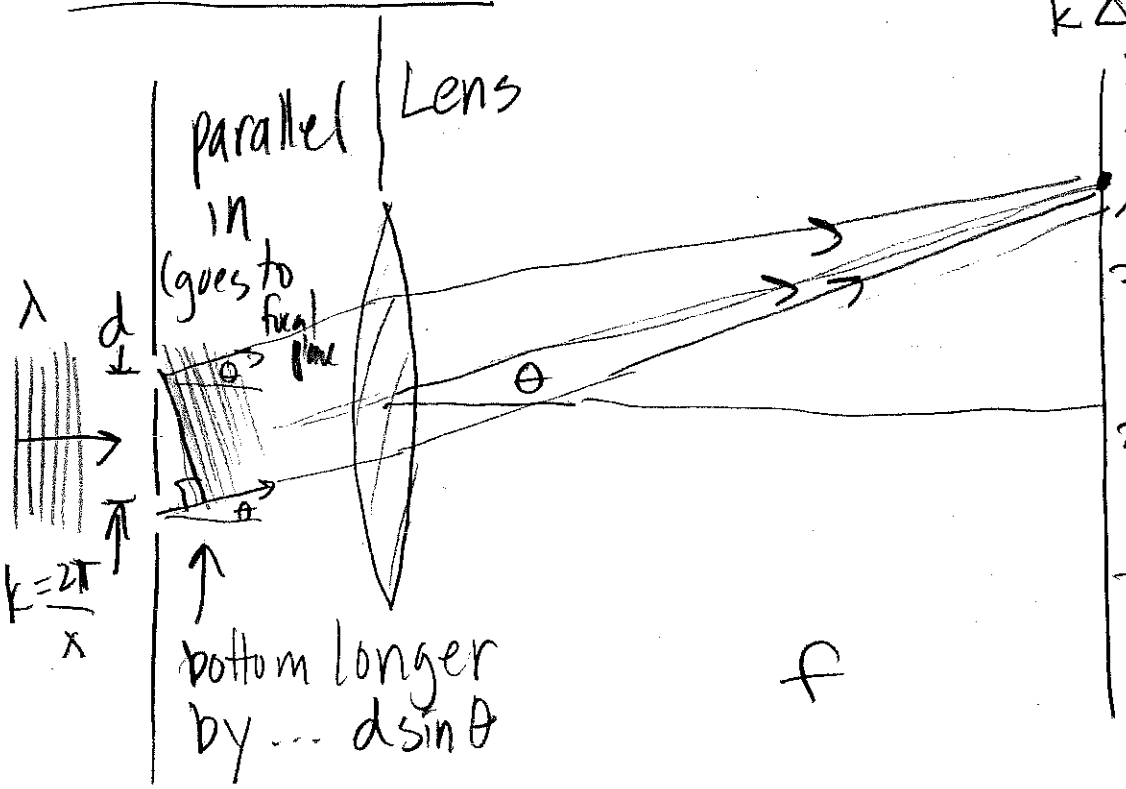
↑ vanishes when... $ik(r_1' - r_2') = i\pi$

$$= \frac{2\pi}{\lambda}(r_1' - r_2') = \pi$$

$$r_1' - r_2' = \frac{1}{2}\lambda$$

Lens trick (look near slits)

$k\Delta r = \frac{2\pi}{\lambda} d\sin\theta = ?$



max

$$\frac{2\pi}{\lambda} d\sin\theta = n 2\pi$$

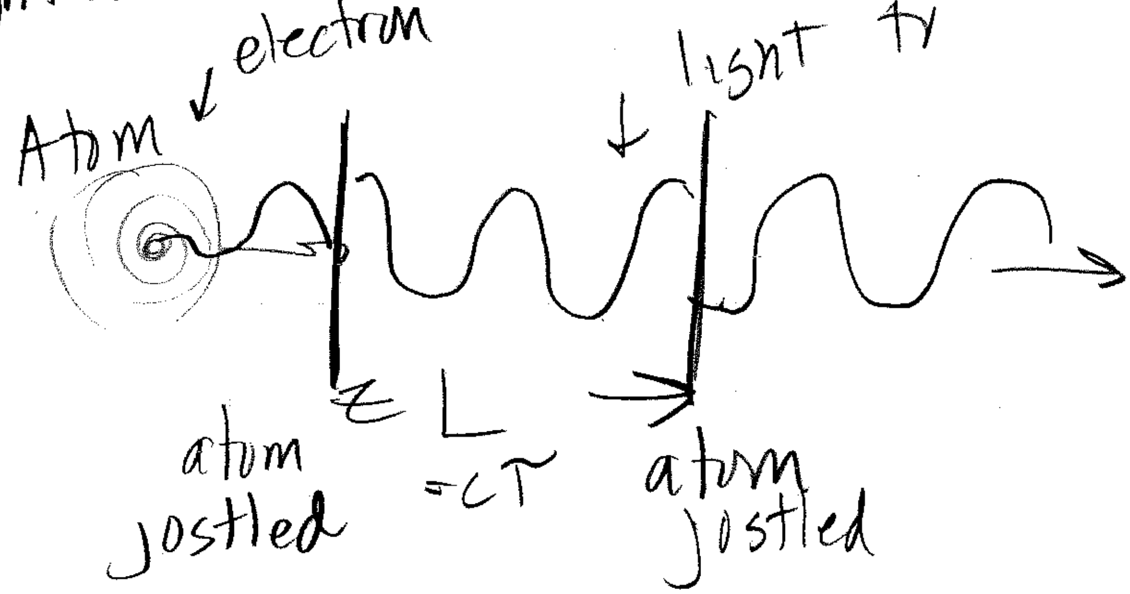
$$\sin\theta = n\frac{\lambda}{d}$$

min

$$\sin\theta = \left(n + \frac{1}{2}\right)\frac{\lambda}{d}$$

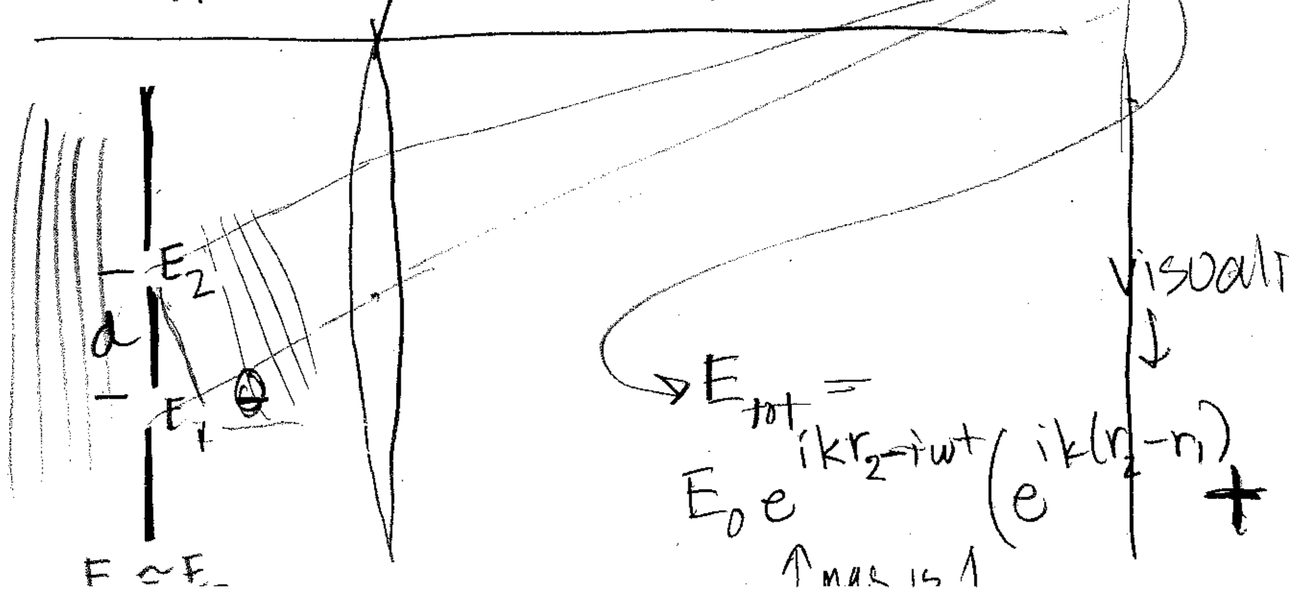
Coherence

About properties of source of light...



typical τ between jostles, times c is called the "coherence length... if $d\sin\theta > L$, cannot count on "stable phase relationship"

Intensity and Interference



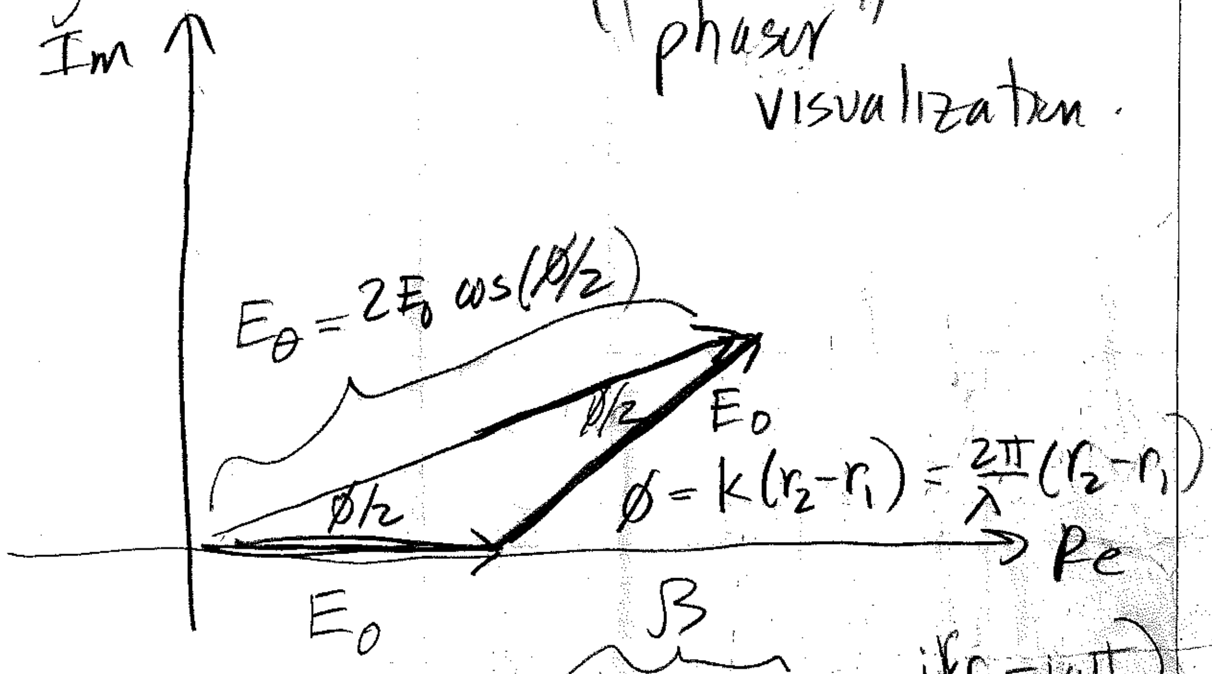
$$E_{tot} = E_0 e^{ikr_2 - i\omega t}\left(e^{ik(r_2 - r_1)} + 1\right)$$

↑ max is 1

$E \approx E$

Like Fig 9

"phasor" visualization.



$$E_{tot} = 2E_0 \cos\Big(\underbrace{\frac{2\pi}{\lambda} d \sin\theta}_{\beta}\Big) e^{i(kr_2 - i\omega t)}$$

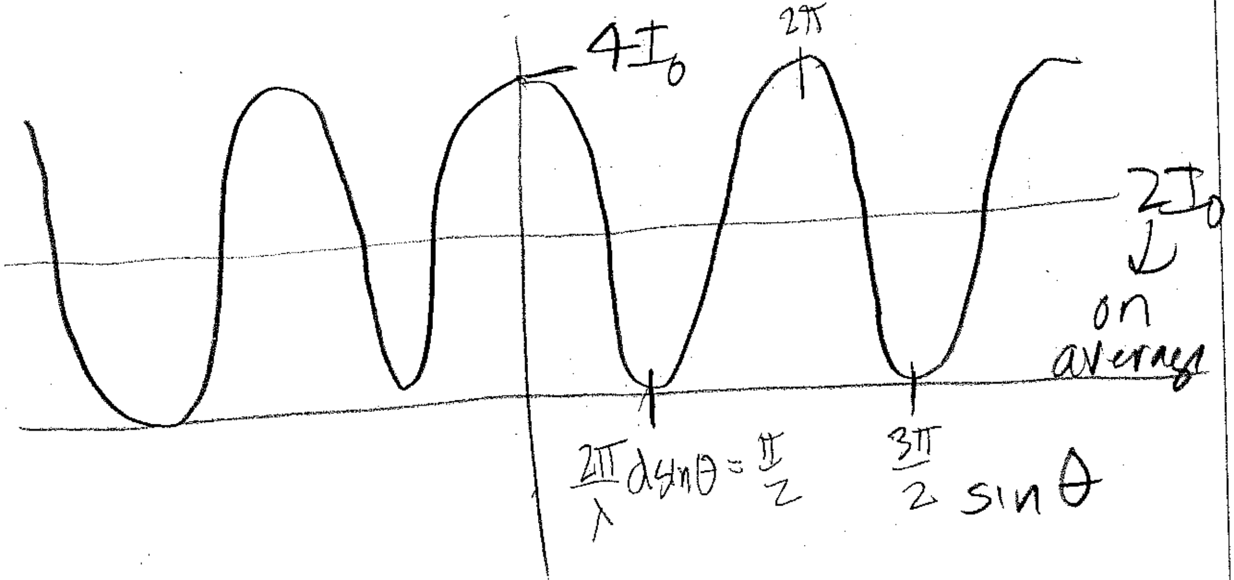
$$I = \frac{1}{2\mu_0 c} E^2$$

mks $\quad \mu_0 = 4\pi \cdot 10^{-7}$

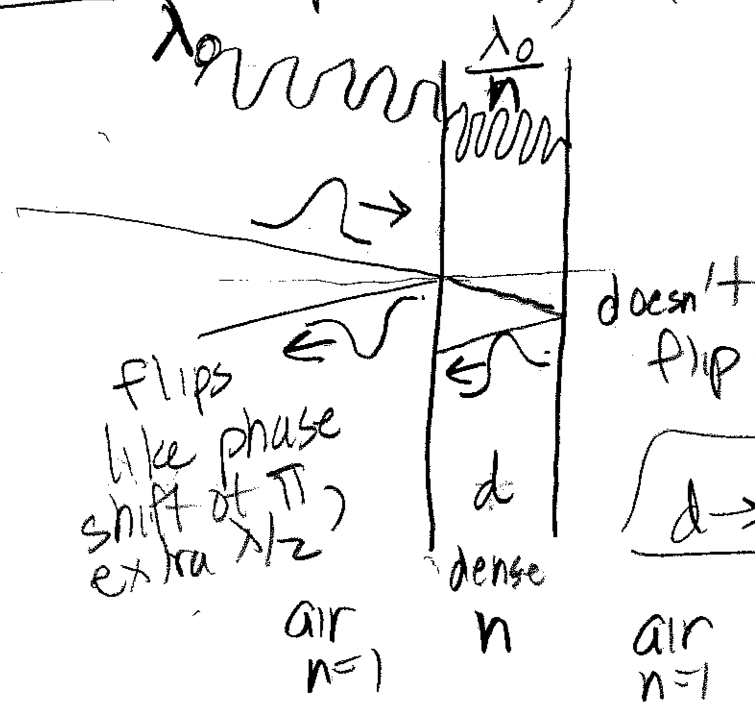
$= (0, \pm 1, \pm 2, \ldots) \times 2\pi$ max

$= (2m+1)\pi$, $m = 0, \pm 1, \ldots$

$$I_\theta = 4 I_0^2 \cos^2\left(\frac{2\pi}{\lambda} d \sin\theta\right)$$



Thin Films Soap bobbles, oil on water.



d→0 think.

assome θ=0

$$\frac{2d}{(\lambda_0/n)} - \frac{1}{2} = 0, 1, 2, \ldots \quad \text{maximum}$$

↑ reflection at front

\# wavelengths

$$\frac{2nd}{\lambda_0} = m + \frac{1}{2}_{max}$$

$$\boxed{d = \frac{\lambda_0}{2n}\left(m + \frac{1}{2}\right)}$$ maximum

d→0

$$\frac{2d}{(\lambda_0/n)} - \frac{1}{2} = -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}$$

$$\boxed{d = \frac{\lambda_0}{2n} \cdot m}$$ minimum.