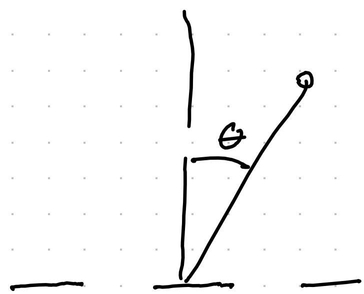
grating interferometer



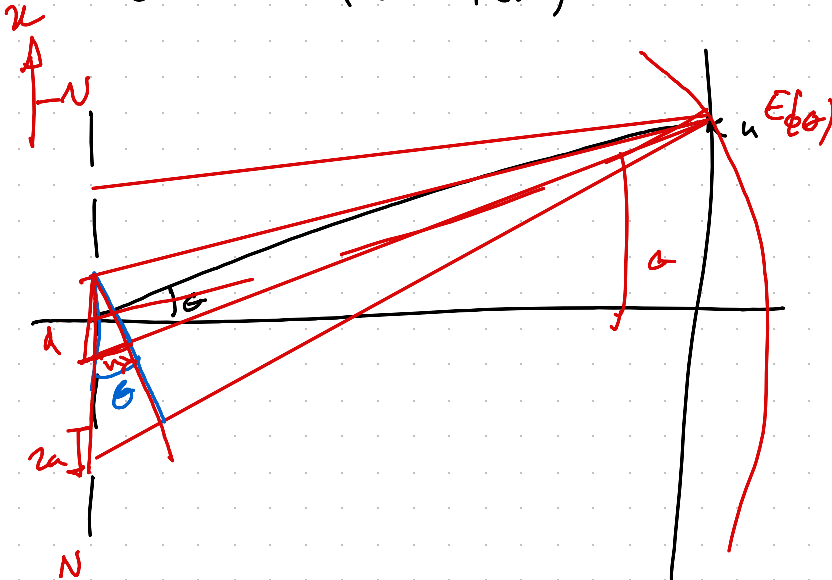
$d \sin\theta = m\lambda$

$\lambda = 633\ nm$

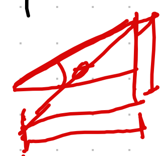
$d = 2\ \mu m$

$\theta \simeq 18.45^\circ$

$$\vec{E} = \vec{E_0}\cos(\omega t - kx)$$



$\sin\theta = \frac{a}{u}$



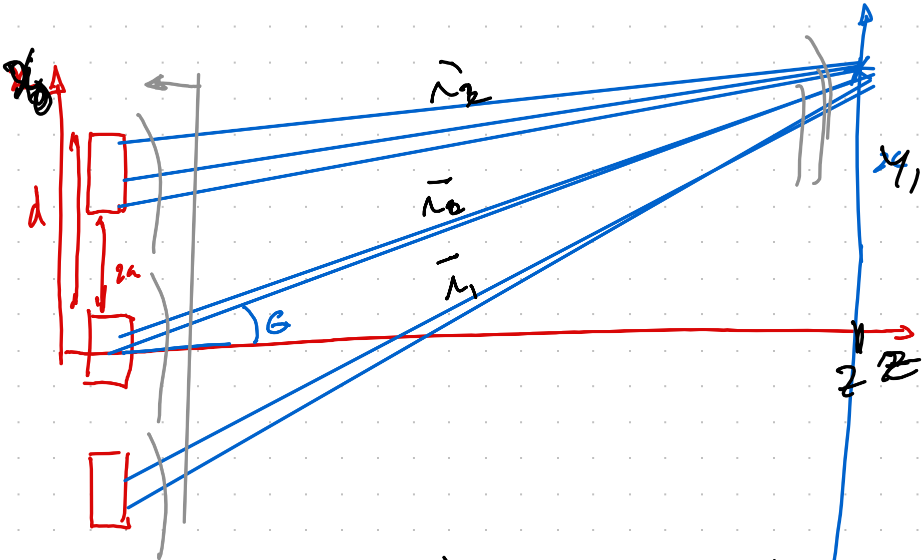
path difference $= n\lambda$

$$E(\theta) = E_0 \sum_{n=-N}^{N} \int_{-a}^{a} e^{i(k(nd+x)\sin\theta)}\, dx$$

$$2E_0 \left(\sum_{n=-N}^{+N} e^{iknd\sin\theta} \right) \left(\int_{0}^{+a} e^{ikx\sin\theta}\, dx \right)$$

$$= E_0 \left(\frac{\sin\left(\left(N+\frac{1}{2}\right) kd\sin\theta\right)}{\sin\left(\frac{1}{2} kd\sin\theta\right)} \right) \left(2a \frac{\sin(ka\sin\theta)}{ka\sin\theta} \right)$$

$$I(\theta) = |E_0 (A)|^2$$



$$E = E_0 \exp\left(i\left(\omega t - \underbrace{k\vec{r}}\right)\right) = E_0 \exp(-ik\vec{r}) \exp(\omega t)$$

$\sin\theta = \dfrac{y_1}{r_0}$

$r_0 = \dfrac{y_1}{\sin\theta}$

$r_2 = \dfrac{y_1 - y_0}{\sin\theta}$

~~Now~~

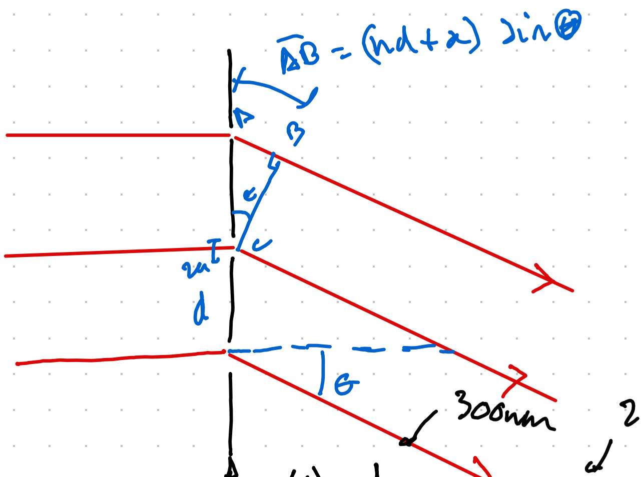
$$r_0 = \sqrt{y_1^2 + z^2}$$

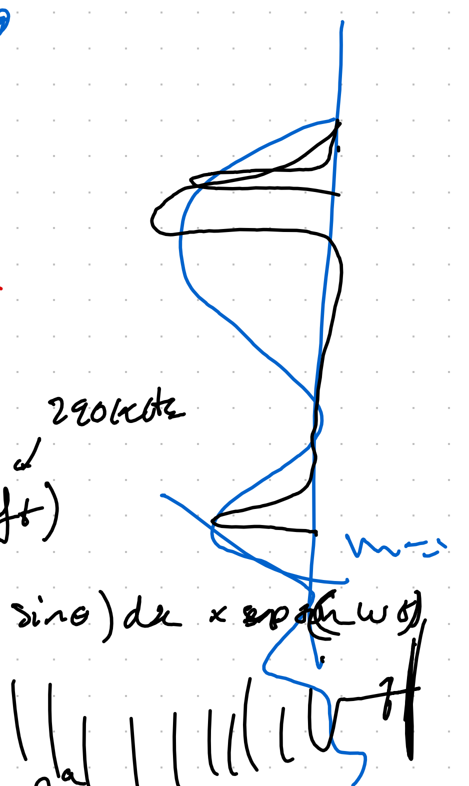
$$r_x = \left|\sqrt{(y_1 + x_0)^2 + z^2}\right|$$

$$E = E_0 \exp(\omega t) \exp(ik|\vec{r}|)$$

$$E_i = E_0 \exp(\omega t) \exp\left(ik\sqrt{(y_1 - x_i)^2 + z^2}\right)$$

$$E = E_0 \exp(\omega t) \int_{-X}^{X} \exp\left(ik\sqrt{(y - x)^2 + z^2}\right)$$





$x_d(t) = \Delta x \exp(2\pi i f t)$

$$E(\theta) = E_0 \sum_{n=-N}^{+N} \int_{-a}^{a} \exp(ik(nd+x)\sin\theta)\,dx \times \exp(i\omega t)$$

$$= E_0 \sum_{n=-N}^{+N} \exp(ik\,nd\sin\theta) \times \int_{-\infty}^{\infty} e^{ikx\sin\theta}\,dx$$

$A = k\sin\theta$

$$\int_{-a+x_d(t)}^{+a+x_d(t)} e^{ikx\sin\theta}$$

$|E(\theta)|^2$

$$E_0\left(\frac{\sin((N+1/2)kd\sin\theta)}{\sin(1/2\,kd\sin\theta)}\right)\cancel{\left(2a\frac{\sin(ka\sin\theta)}{ka\sin\theta}\right)}\exp(i\omega t)$$

$E_1 \exp(\omega t - kx)$ $\qquad \dfrac{2\exp(ikx_d(t)\sin\theta)\sin(ka\sin\theta)}{k\sin\theta}$

$$E(\theta) = E_0\left(\frac{\sin((N+1/2)kd\sin\theta)}{\sin(1/2\,kd\sin\theta)}\right) \times$$

$$\times\left(\frac{2\exp(ikx_d(t)\sin\theta)\sin(ka\sin\theta)}{k\sin\theta}\right)$$

$= t =$

$\alpha(\exp(i(\omega t)))$

$$E(\theta) = E_0\left(\frac{\sin((N+1/2)kd\sin\theta)}{\sin(1/2\,kd\sin\theta)}\right)\left(\frac{2\sin(ka\sin\theta)}{k\sin\theta}\right)\times$$

amplitude →

$$\times \exp(i(\underbrace{\omega t + ikx_d(t)\sin\theta}_{\text{phase}}))$$

for $\theta_1 = 18$ deg

$\sin\theta_1 = 0.30 \rightarrow$ 0.30 değerler altında

$k = \dfrac{2\pi}{\lambda}$

$$E(\theta) = E_0 \frac{\sin((N+1/2)d}{\sin(\frac{\pi}{\lambda}d\sin\theta)} \times 2\sin\left(\frac{2\pi}{\lambda}a\sin\theta\right)$$

$$\times \exp\left[i\left(\omega t + \frac{2\pi}{\lambda}x_d(t)\sin\theta\right)\right]$$

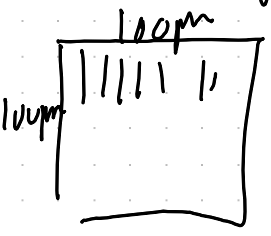
$d = 1\mu m$

$a = d/2 = 0.5\mu m$

$\lambda = 633$ nm

$N = 50$

$\sin\theta = \dfrac{m\lambda}{d}$



$N = 50$