Osciladores Coerentes

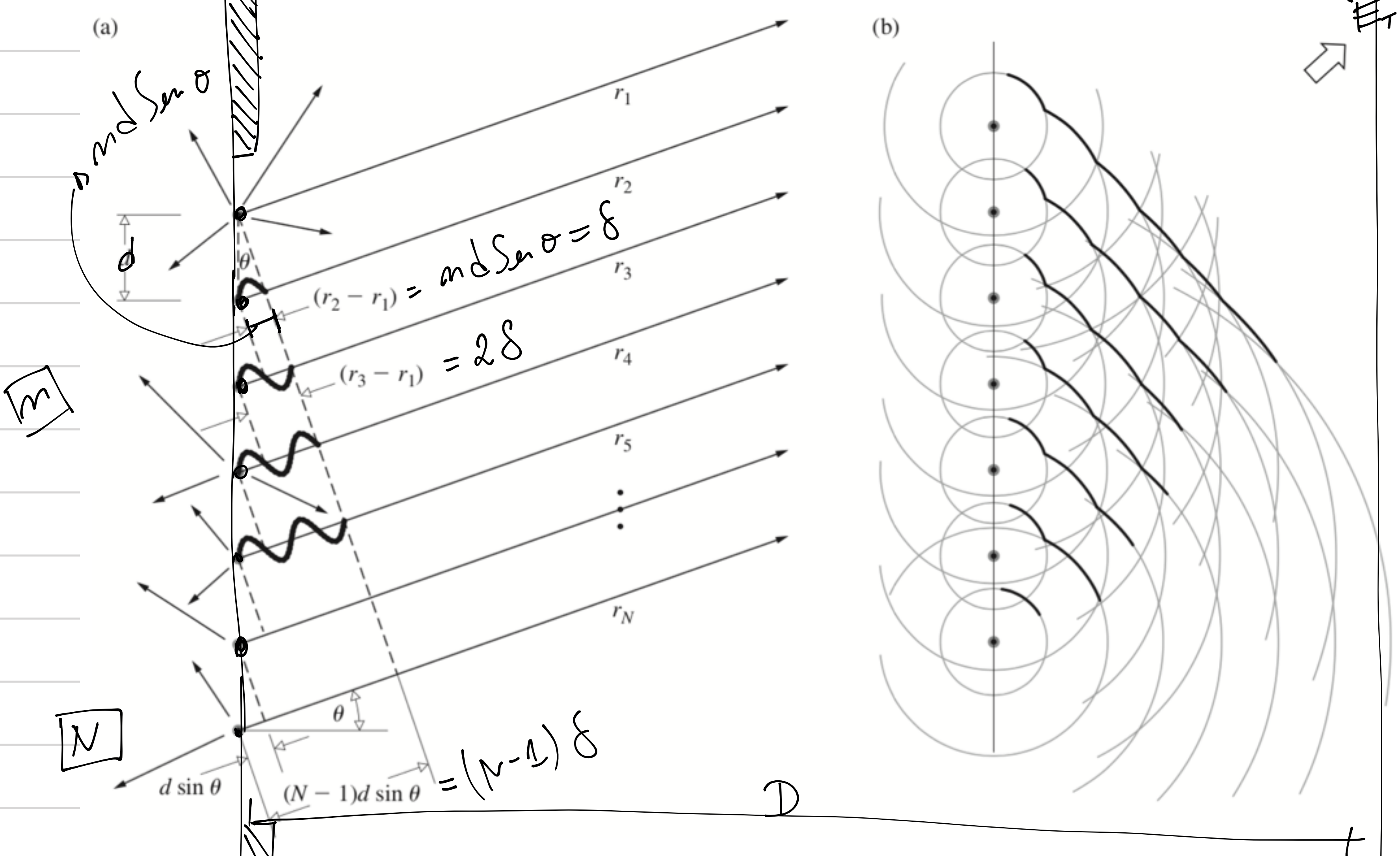


Figure 10.4 A linear array of in-phase coherent oscillators. (*a*) Note that at the angle shown $\delta = \pi$, while at $\theta = 0$, δ would be zero. (*b*) One of many sets of wavefronts emitted from a line of coherent point sources.

$D \gg d$

$$\vec{E}_T = \vec{E}_1 + \vec{E}_2 + E_3 + \cdots + \vec{E}_N$$

$$\vec{E}_{01}(r_1) \simeq \vec{E}_{02}(r_2) = \vec{E}_{0N}(r_N) \simeq E_0(r)$$

→ Escalar, Complexo

A $\quad \vec{E}_T$

$$\tilde{E}_T = E_0(r)\, e^{i(kr_1 - \omega t)} + E_0(r)\, e^{i(kr_2 - \omega t)} + \cdots E_0(r)\, e^{i(kr_N - \omega t)}$$

$$\left(e^{ikr_1} \cdot e^{-ikr_1}\right)$$

$$\tilde{E}_T = E_0(r)\, e^{i(kr_1 - \omega t)} \left[1 + e^{i(kr_2 - kr_1)} + \cdots + e^{i(kr_N - kr_1)} \right]$$

$\delta = k_0 \Lambda \qquad \Lambda =$ dif do caminho óptico

$\Lambda = m d \,\mathrm{Sen}\,\theta$

$$\tilde{E} = E_{0(r)}\, e^{i(Kr_1-\omega t)}\left[1 + e^{i\delta} + e^{i2\delta} + \dots + e^{i(N-1)\delta}\right]$$

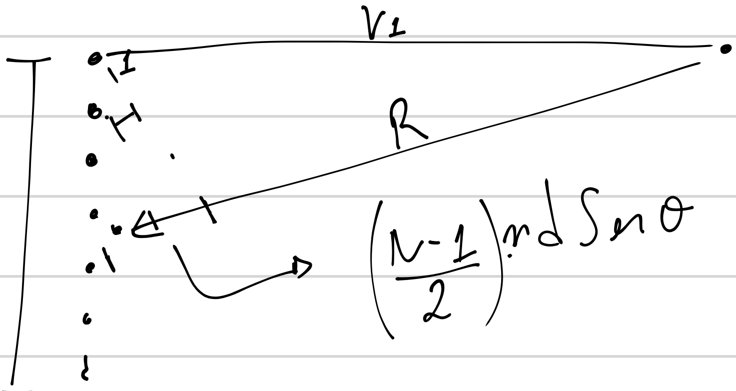
$$\boxed{\tilde{E} = E_{0(r)} \cdot e^{i(Kr_1-\omega t)}\left(\frac{e^{iN\delta}-1}{e^{i\delta}-1}\right)}$$

→ no anteparo devido a N fendas

$$\frac{e^{i\frac{N}{2}\delta}\left(e^{i\frac{N}{2}\delta} - e^{-i\frac{N}{2}\delta}\right)}{e^{i\delta/2}\left(e^{i\delta/2} - e^{-i\delta/2}\right)} = e^{i\left(\frac{N}{2}\delta - \frac{\delta}{2}\right)} \cdot \frac{\operatorname{Sen}\left(\frac{N}{2}\delta\right)}{\operatorname{Sen}\left(\frac{\delta}{2}\right)}$$

$$\boxed{\operatorname{Sen} a = \frac{e^{ia} - e^{-ia}}{2i}}$$

$$\tilde{E} = E_{0(r)}\, e^{i(Kr_1-\omega t)} \cdot e^{i\frac{(N-1)}{2}\delta}\left[\frac{\operatorname{Sen}\left(\frac{N\delta}{2}\right)}{\operatorname{Sen}(\delta/2)}\right]$$



$$\left(\frac{N-1}{2}\right) n d \operatorname{Sen}\theta \qquad \left(\frac{N-1}{2}\right)\delta$$

$$\delta = K_0 \Lambda$$
$$= K_0 \cdot n d \operatorname{Sen}\theta$$

$$R - r_1 = \frac{N-1}{2} n d \operatorname{Sen}\theta \Rightarrow \boxed{R = \frac{(N-1)}{2} n d \operatorname{Sen}\theta + r_1}$$

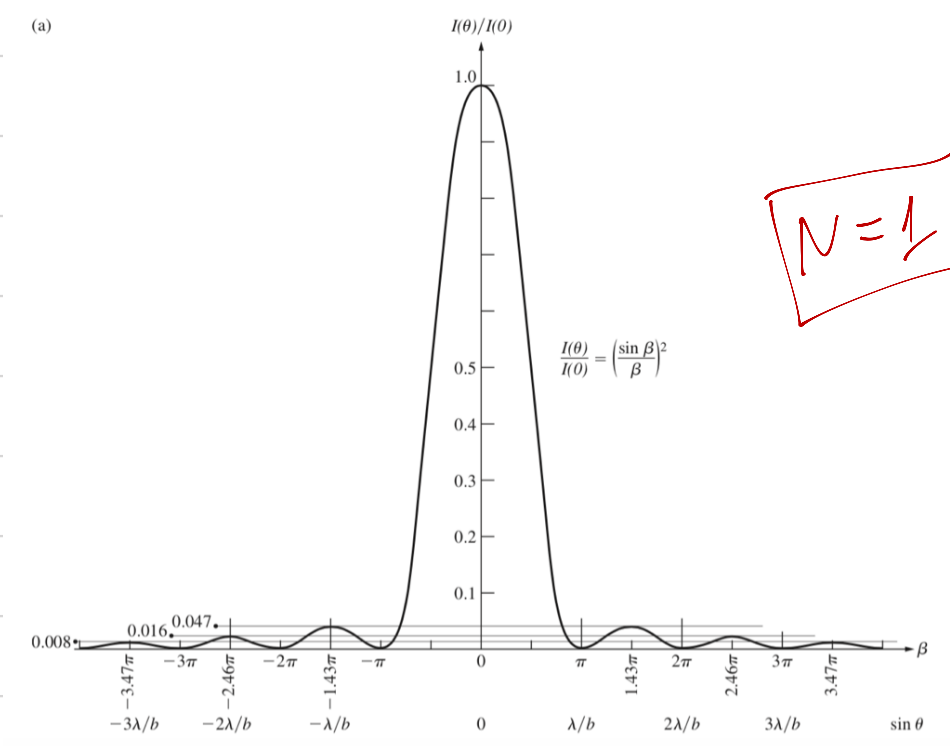
$$\tilde{E} = E_{0(r)}\, e^{-i\omega t} \cdot e^{i\left(Kr_1 + \left(\frac{N-1}{2}\right)\frac{K}{K_0 \cdot n} d \operatorname{Sen}\theta\right)}\left[\quad\right]$$

$$\tilde{E} = E_{0(r)}\, e^{-i\omega t} \cdot e^{iKR}\left[\quad\right]$$

$$\vec{E} = E_0 l r\, e^{i(KR-\omega t)} \cdot \left[\frac{\mathrm{Sen}\left(\frac{N\delta}{2}\right)}{\mathrm{Sen}\,\delta/2}\right]$$

$$I \propto \frac{E\cdot E^*}{2}$$

$$\boxed{I = I_0\,\frac{\mathrm{Sen}^2\left(\frac{N\delta}{2}\right)}{\mathrm{Sen}^2(\delta/2)}}$$



$$\boxed{N=1}$$

$N=2$

$$I = I_0\,\frac{\mathrm{Sen}^2\left(\cancel{2}\cdot\frac{\delta}{\cancel{2}}\right)}{\mathrm{Sen}^2(\delta/2)} = I_0\,\frac{\left(2\,\cancel{\mathrm{Sen}\frac{\delta}{2}}\cdot\cos\frac{\delta}{2}\right)^2}{\cancel{\mathrm{Sen}^2(\delta/2)}}$$

$$\boxed{\mathrm{Sen}\,2x = 2\,\mathrm{Sen}\,x\cdot\cos x}$$

$$\boxed{I = 4I_0\cos^2\frac{\delta}{2}}$$ → fenda duplo

$\delta = K_0\Lambda$
$= K_0 n d\,\mathrm{Sen}\,\theta$
$$\boxed{\delta = K d\,\mathrm{Sen}\,\theta}$$

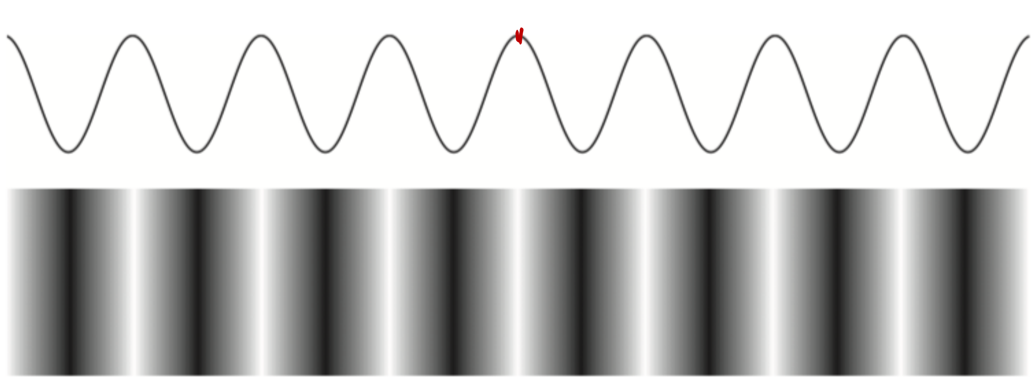


Figure 9.4 Cosine-squared fringes associated with far-field double-beam interference. The oscillating curve is a bit of an idealization, since the fringes actually lose contrast at both right and left extremes.

Osciladores Coerentes - fonte contínua

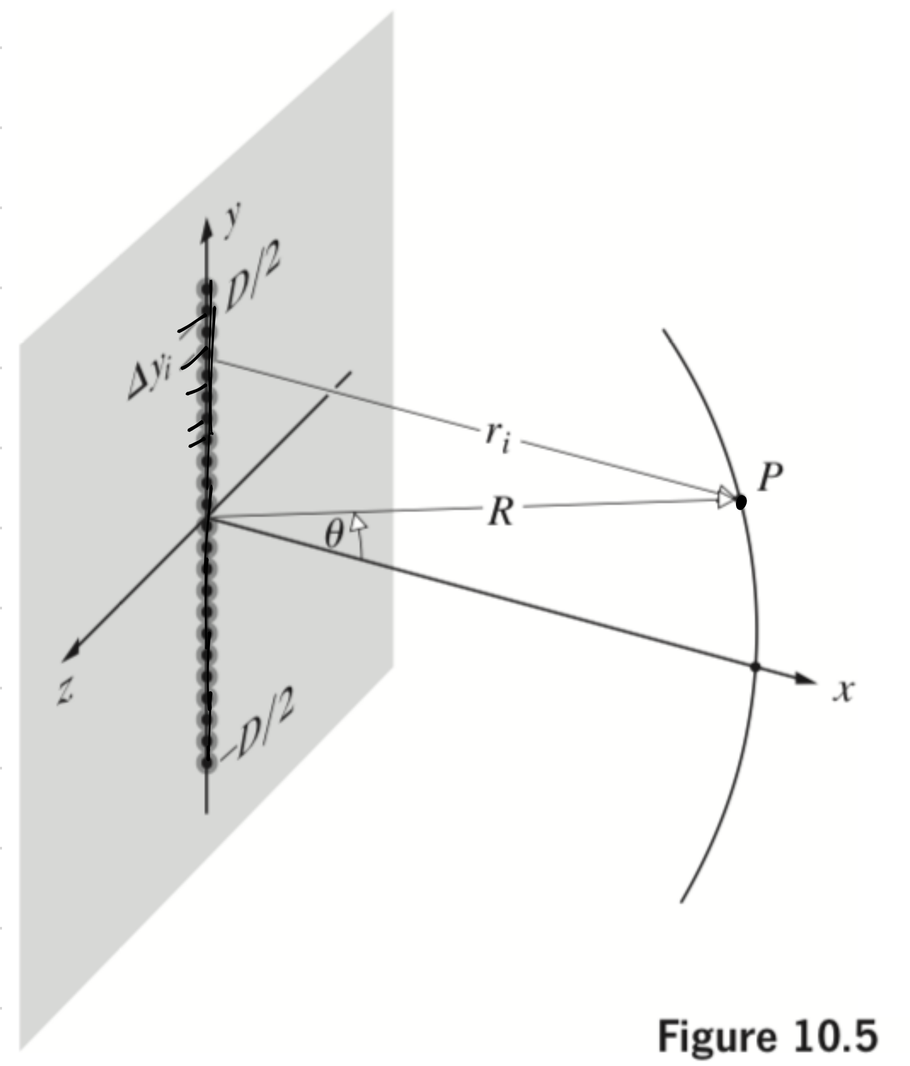


Figure 10.5 A coherent line source.

$$E = \left(\frac{\mathcal{E}_0}{r}\right) \operatorname{Sen}(\omega t - kr)$$

$\mathcal{E}_0 \rightarrow$ intensidade da fonte
$N \rightarrow$ nº de fontes

$$\boxed{\mathcal{E}_L \equiv \frac{1}{D} \lim_{N \to \infty} (\mathcal{E}_0 \cdot N)}$$

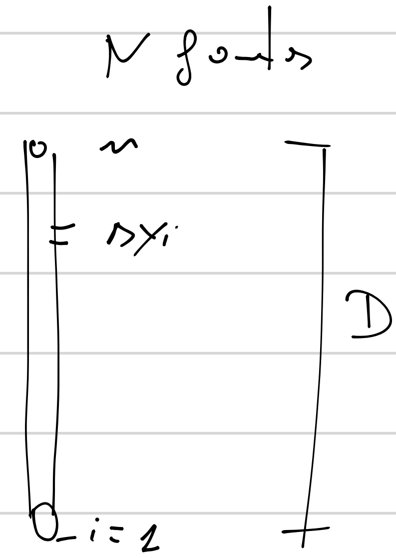
$\mathcal{E}_L =$ Intensidade do campo elétrico por unidade de comprimento

$\Delta y_i \rightarrow$ Segmento da fonte

$\left[(\Delta y_i)\left(\frac{N}{D}\right)\right] \rightarrow$ nº de fontes

$$E_i = \left[\frac{\varepsilon_0}{r}\,\mathrm{sen}(\omega t - kr)\right]\left(\Delta y_i \cdot \frac{N}{D}\right)$$

$$E_i = \underbrace{\left(\frac{\varepsilon_0 N}{D}\right)}_{\varepsilon_L}\frac{1}{r_i}\,\mathrm{sen}(\omega t - kr_i)\,\Delta y_i$$



$$E_T = \sum_{i=1}^{n} E_i = \varepsilon_L \sum \frac{1}{r_i}\,\mathrm{sen}(\omega t - kr_i)\,\Delta y_i$$

$$E_T = \varepsilon_L \int_{-D/2}^{+D/2} \frac{\mathrm{sen}(\omega t - kr)}{r}\,dy \qquad \boxed{r = r(y)}$$