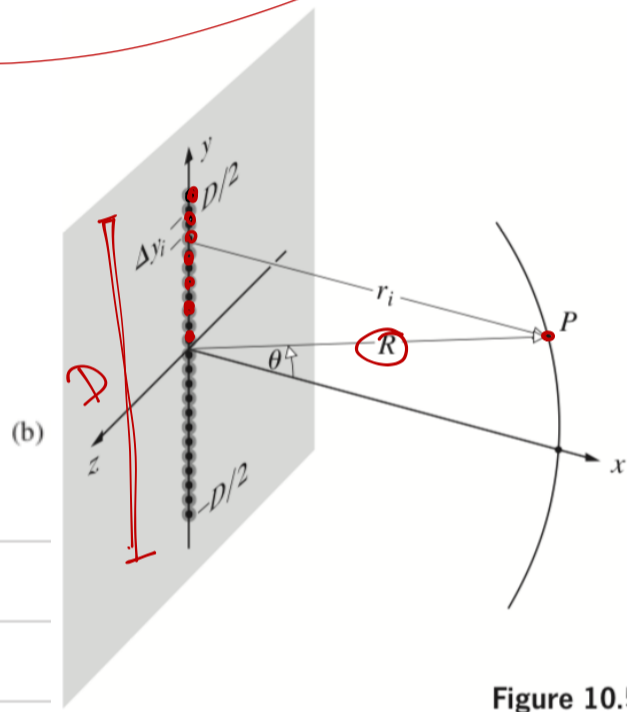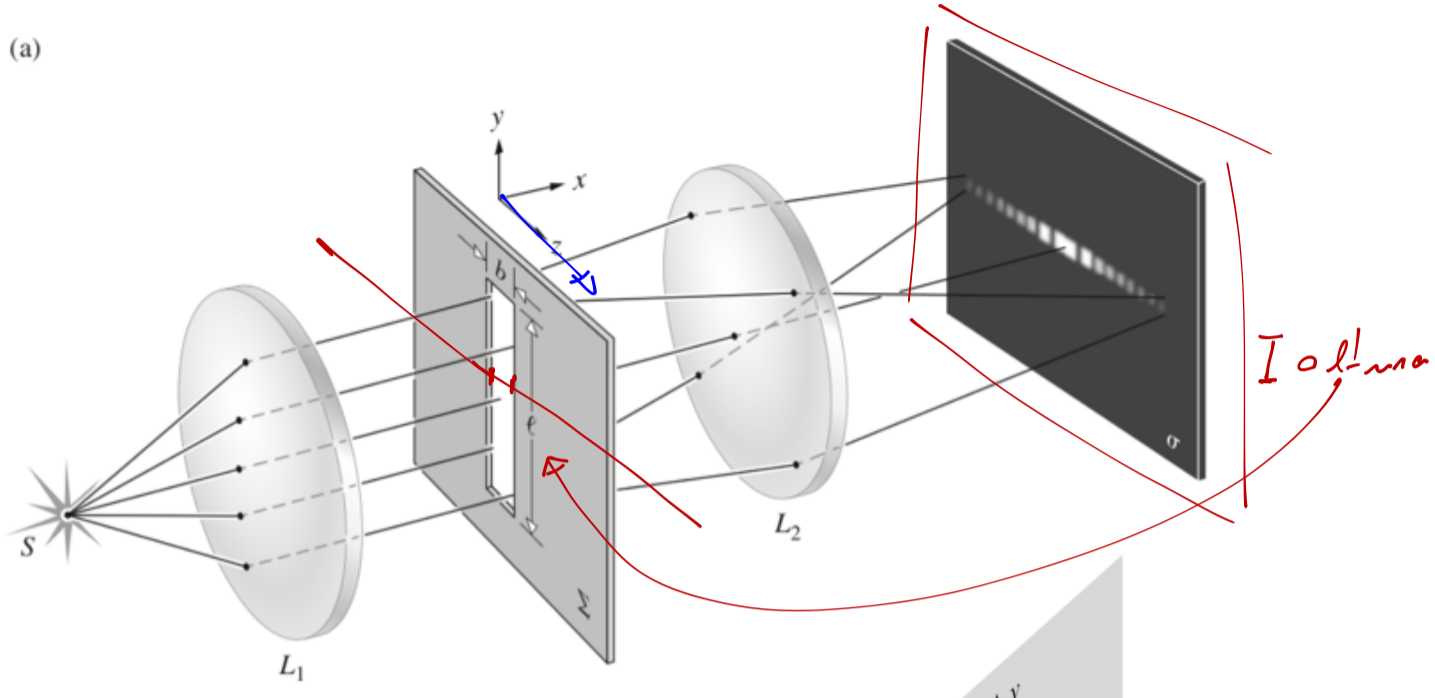# Fendo Simples

(a)

I ofluna

(b)

Figure 10.5 A coherent line source.

E_T

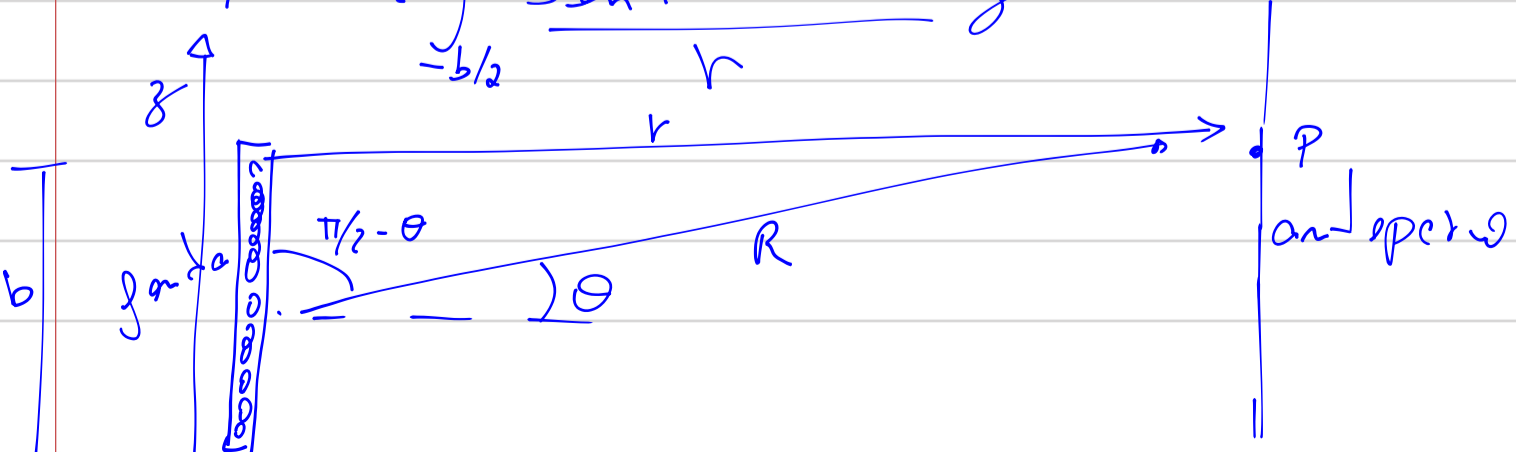$$E_T = E_L \int_{-D/2}^{+D/2} \frac{Sen(\omega t - kr)}{r} \, dy$$

$$dE_T = \frac{E_L \, Sen(\omega t - kr) \, dy}{R} \qquad (r \cong R)$$

$\neq$ b I no elopen $\longrightarrow$ $\neq$ de fase

Fendo Simples $\tilde{m}$ $\neq$ de lamplitude

$$E_T = E_L \int_{-b/2}^{+b/2} \frac{Sen(\omega t - kr) \, dz}{r}$$

$\pi/2 - \theta$ r P aunopetro

θ R

b $\int a \pi/a$

$$r^2 = z^2 + R^2 - 2zR \underbrace{\cos(\pi/2 - \theta)}_{\longrightarrow \, \text{Sen}\,\theta}$$

$$\left(\frac{r}{R}\right)^2 = 1 + \left(\frac{z}{R}\right)^2 - 2\left(\frac{z}{R}\right)\text{Sen}\,\theta$$

$$\left(\frac{r}{R}\right) = \sqrt{1 + \left(\frac{z}{R}\right)^2 - 2\left(\frac{z}{R}\right)\text{Sen}\,\theta}$$

expandindo isto $f(x)$ numa Série Maclaurin

$$f(r) = \left(\frac{r}{R}\right) \qquad\qquad x = \left(\frac{z}{R}\right)$$

$$f(x) = \left[1 + x^2 - 2x\,\text{Sen}\,\theta\right]^{1/2}$$

$$f(x) = \sum_{m=0}^{\infty} a_m (x-a)^m \qquad\qquad a_m = \frac{f^m(a)}{m!}$$

$$\frac{r}{R} = 1 - \text{Sen}\,\theta\left(\frac{z}{R}\right) + \frac{\cos^2\theta}{2}\left(\frac{z}{R}\right)^2$$

$$r = R - z\,\text{Sen}\,\theta + \frac{z^2}{2R}\cos^2\theta$$

$$E_T = \frac{E_L}{R}\int_{-b/2}^{+b/2}\text{Sen}\left[\omega t - KR + Kz\,\text{Sen}\,\theta + \underbrace{\frac{Kz^2}{2R}\cos^2\theta}_{\longrightarrow \, \text{pequeno} \; \rightarrow \; \text{desprezado}}\right]dz$$

$$E_T = \frac{E_L}{R}\int_{-b/2}^{+b/2}\text{Sen}\left[\omega t - KR + Kz\,\text{Sen}\,\theta\right]dz$$

$$\rightarrow \text{Sen}(a+b) = \text{Sen}\,a\,\cos b + \text{Sen}\,b\,\cos a$$

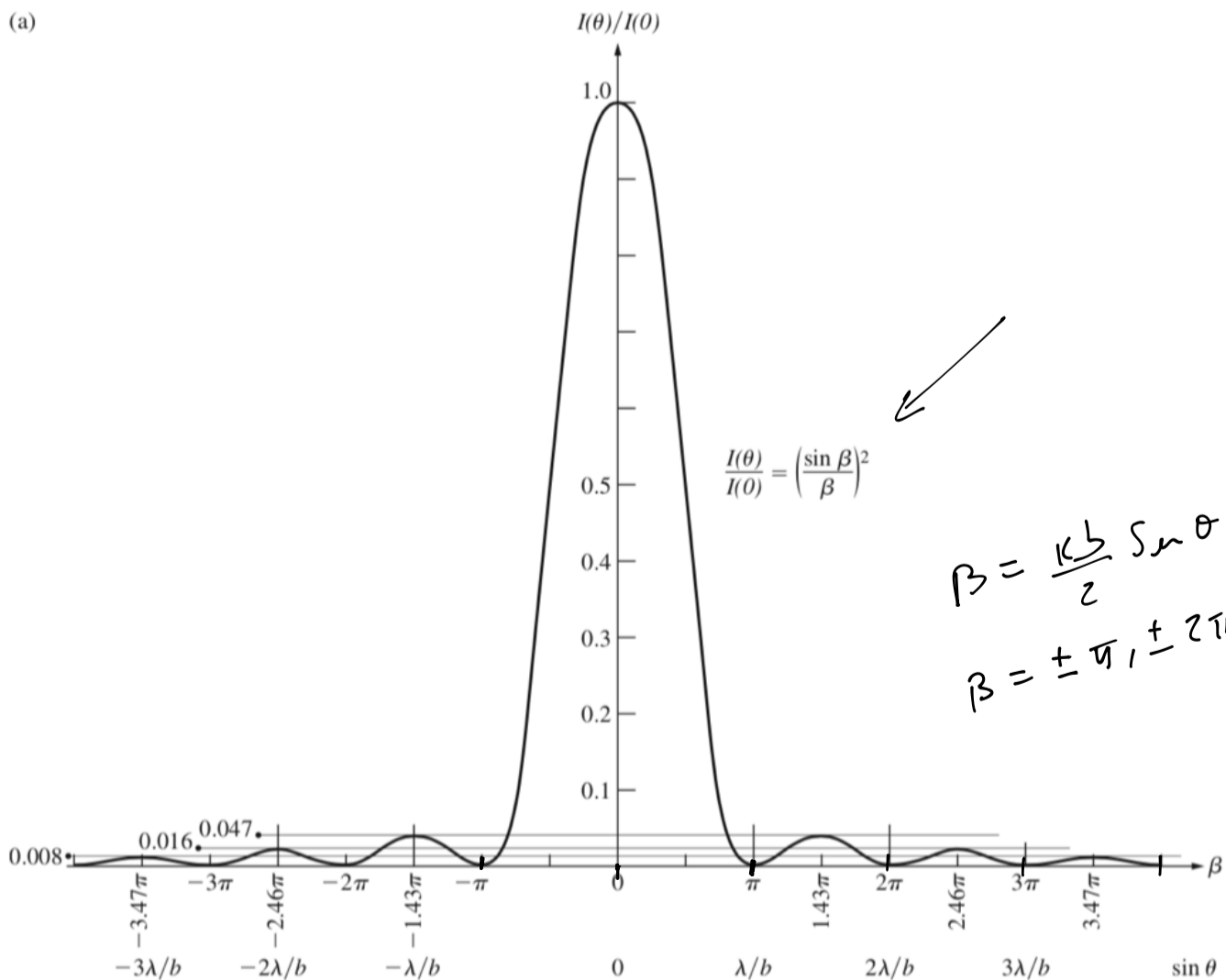$$E_T = \frac{E_L}{R} \frac{Sen(\omega t - KR)}{K\frac{b}{2}Sen\theta} \cdot Sen\left(K\frac{b}{2}Sen\theta\right)$$

$$\beta = \frac{Kb}{2}Sen\theta$$

$$E_T = \frac{E_L}{R} \underbrace{Sen(\omega t - KR)}_{1/2} \cdot \left[\frac{Sen\beta}{\beta}\right]$$

$$I = \langle E_T^2 \rangle_T \nearrow$$

$$I = \frac{E_L^2}{R} \cdot \frac{1}{2} \cdot \frac{Sen^2\beta}{\beta^2}$$

$$\boxed{I = J_0 \left(\frac{Sen\beta}{\beta}\right)^2}$$

Fenda Simples

→ aprox de Fraunhofer (Campo distante)

→ ondas planas ⟶ anteparo

(a)

$I(\theta)/I(0)$

$$\frac{I(\theta)}{I(0)} = \left(\frac{\sin\beta}{\beta}\right)^2$$

$$\beta = \frac{Kb}{2}Sen\theta$$

$$\beta = \pm\pi, \pm 2\pi$$

1.0

0.5

0.4

0.3

0.2

0.1

0.008 0.016 0.047

-3.47π -3π -2.46π -2π -1.43π $-\pi$ 0 π 1.43π 2π 2.46π 3π 3.47π β

$-3\lambda/b$ $-2\lambda/b$ $-\lambda/b$ 0 λ/b $2\lambda/b$ $3\lambda/b$ $\sin\theta$
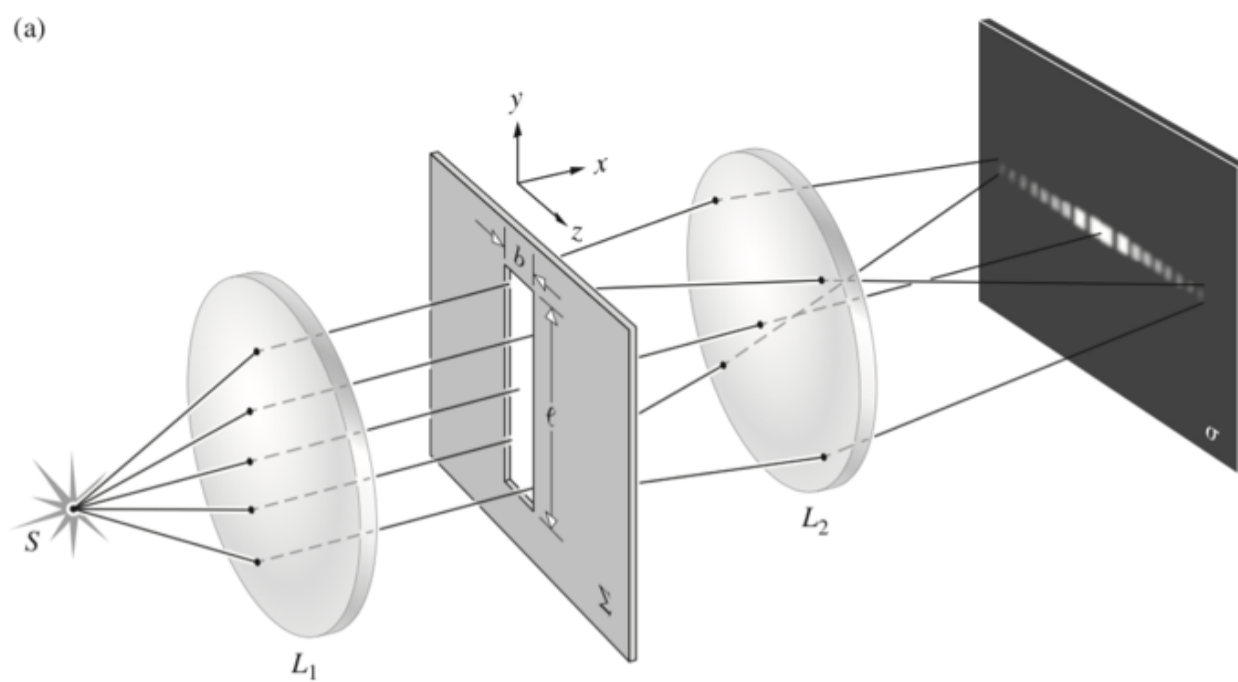
(b)

Figure 10.6 (a) Single-slit Fraunhofer diffraction. (b) Diffraction pattern of a single vertical slit under point-source illumination. (E.H.)