POLARIZACIÓN

luz → ondas transversales

↳ perturbaciones del $\underline{E}$ y $\underline{B}$

$\underline{E} \perp \underline{B}$ y la dir. de prop. $\underline{E} \times \underline{B}$

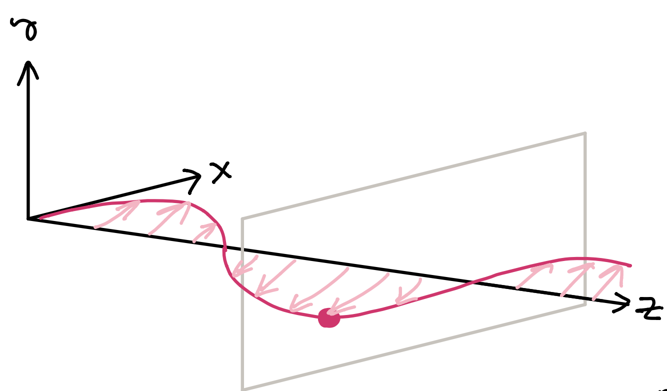
POLARIZACIÓN → dir. de $\underline{E}$

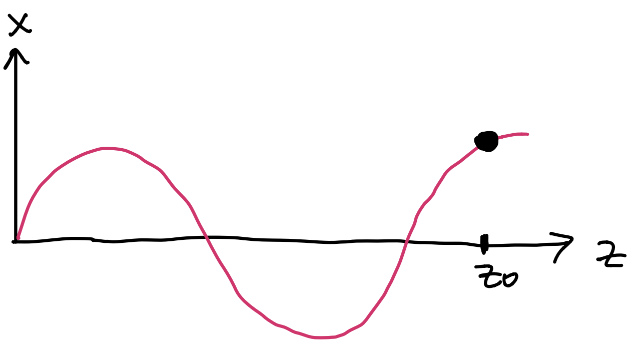
dir. de prop. $\hat{z}$ → $\underline{E}$ vive en $\hat{x} - \hat{y}$

$$\underline{E} = E_x(z,t)\,\hat{x} + E_y(z,t)\,\hat{y}$$

$$\begin{cases} E_x = E_{0x} \cos(kz - \omega t) \\ E_y = E_{0y} \cos(kz - \omega t + \phi) \end{cases}$$

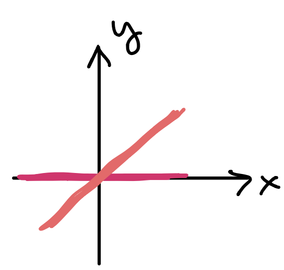
- en punto z fijo $(z=0)$
  - $E_{0y} = 0$



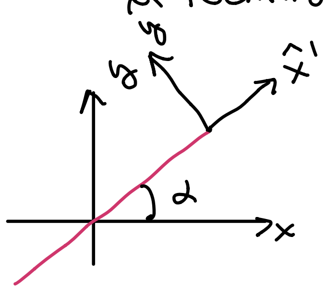


pl z fijo

$E_{0x} \cos(-\omega t)$



~ POLARIZACIÓN LINEAL.



en el sist. $\hat{x}' - \hat{y}'$

$$\underline{E} = E_0 \cos(\omega t - kz)\,\hat{x}'$$

$$\hat{x}' = \cos\alpha\,\hat{x} + \sin\alpha\,\hat{y}$$

$$\rightarrow \quad \underline{E} = E_0 \cos\alpha \cos(\omega t - kz)\,\hat{x} + E_0 \sin\alpha \cos(\omega t - kz)\,\hat{y}$$

$$= E_0 \cos\alpha \cos(\omega t - kz)\left[\hat{x} + \underbrace{\frac{\sin\alpha}{\cos\alpha}}_{= \operatorname{tg}\alpha}\hat{y}\right]$$

$$E_{0x} \equiv E_0 \cos\alpha \qquad \rightarrow \quad \frac{E_{0y}}{E_{0x}} = \operatorname{tg}\alpha$$

$$E_{0y} \equiv E_0 \sin\alpha \qquad\qquad\qquad\qquad \uparrow$$

- $E_{0x} = E_{0y} = E_0$, $\phi = -\frac{\pi}{2}$

$$\underline{E} = E_0\left[\cos(kz - \omega t)\,\hat{x} + \cos(\underbrace{kz - \omega t}_{x} \underbrace{-\tfrac{\pi}{2}}_{y})\,\hat{y}\right]$$

$$\cos(x \pm y) = \cos(x)\cos(y) \mp \sin(x)\sin(y)$$

$$\Rightarrow \quad \cos\left(kz - \omega t - \frac{\pi}{2}\right) = \cos(kz - \omega t)\overbrace{\cos\left(\frac{\pi}{2}\right)}^{=0}$$

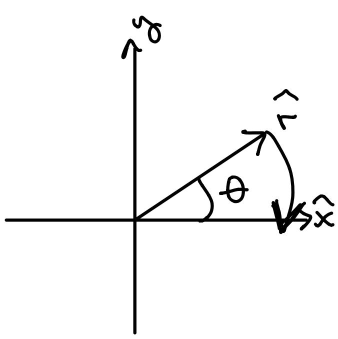
$$+ \sin(kz - \omega t)\underbrace{\sin\left(\frac{\pi}{2}\right)}_{=1}$$

$$= \sin(kz - \omega t)$$

$$\rightarrow \quad \underline{E} = E_0\left[\cos(kz - \omega t)\,\hat{x} + \sin(kz - \omega t)\,\hat{y}\right]$$

$z = 0$

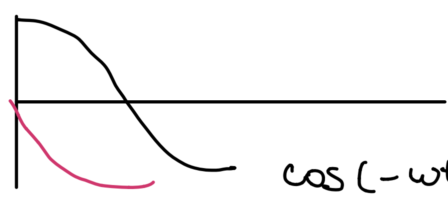
$$= E_0\left[\cos(-\omega t)\,\hat{x} + \sin(-\omega t)\,\hat{y}\right]$$



$$\hat{r} = \cos(\theta)\,\hat{x} + \sin(\theta)\,\hat{y}$$

$$\theta = -\omega t$$

$$\uparrow \uparrow$$



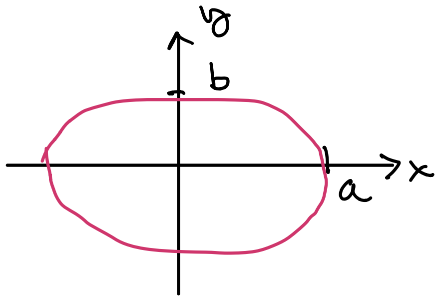
$\cos(-\omega t) = \cos(\omega t)$

$\uparrow \sin(-\omega t) = -\sin(\omega t)$

- $E_{0x} = E_{0y}$ $\quad \phi = -\frac{\pi}{2} \rightarrow$ POLARIZACIÓN CIRCULAR HORARIA

$\phi = \frac{\pi}{2} \rightarrow$ ANTI-HORARIA

Si $E_{0x} \neq E_{0y}$ y $\phi = \pm\frac{\pi}{2}$?



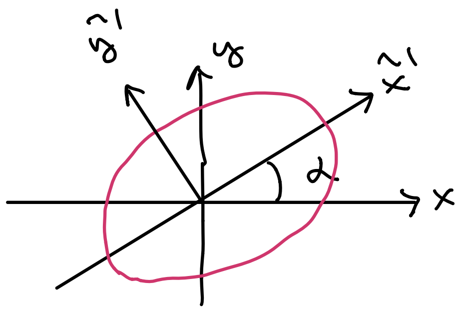
$$\begin{cases} x = a\cos(t) \\ y = b\cos(t) \end{cases}$$

$t \in [0, 2\pi)$

↳ $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ec. de una elipse

$\phi = \pi/2$

↳ $\underline{E} = E_{0x}\cos(kz - \omega t)\,\hat{x} + E_{0y}\sin(kz - \omega t)\,\hat{y}$



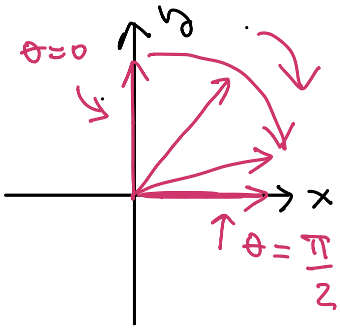
en $\hat{x}' - \hat{y}'$

$\underline{E} = E'_{0x}\cos(kz - \omega t)\,\hat{x}' + E'_{0y}\sin(kz - \omega t)\,\hat{y}'$

PROBLEMA 1

a) $E_x = E\sin(kz - \omega t)$

$E_y = E\cos(kz - \omega t)$ $\rightarrow$ polarización circular



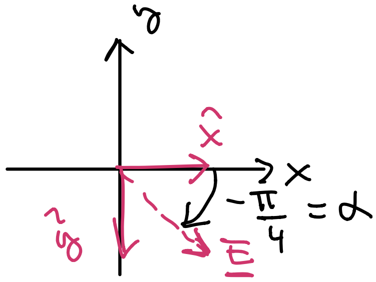
$\theta \equiv kz - wt$

sentido horario

(c) $E_x = E \sin(kz - wt)$ $\rightarrow \phi = 0$ POL. LINEAL.

$E_y = -E \sin(kz - wt)$

$\underline{E} = E \sin(kz - wt) \left[\hat{x} - \hat{y} \right]$

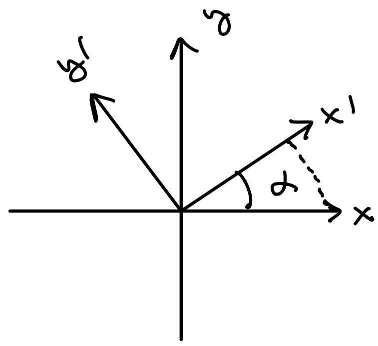


$-1 = \frac{E_{oy}}{E_{ox}} = \operatorname{tg}(\alpha)$

$\operatorname{tg}(\alpha) = -1 \Rightarrow \alpha = \frac{-\pi}{4}$

(b) $\begin{cases} E_x = E\cos(kz - wt) \\ E_y = E\cos(kz - wt + \frac{\pi}{4}) \end{cases}$

POL. ELÍPTICA que forma un ángulo de $\frac{\pi}{4}$



$\alpha = \frac{\pi}{4}$

$\hat{x})$ $\cos\alpha\ \hat{x}' - \sin\alpha\ \hat{y}'$

$\hat{y})$ $\sin\alpha\ \hat{x}' + \cos\alpha\ \hat{y}'$

$$\underline{E} = E\left[\cos(\overbrace{kz - wt}^{\equiv\theta})\ \hat{x} + \cos(kz - wt + \overbrace{\tfrac{\pi}{4}}^{=\phi})\ \hat{y} \right]$$

$\hat{x}')$ $E_{x'} = E\left[\cos\theta \cos\alpha + \cos(\theta + \phi)\sin\alpha \right]$

$\hat{y}')$ $E_{y'} = E\left[-\cos\theta \sin\alpha + \cos(\theta + \phi)\cos\alpha \right]$

$$\underline{E} = E_{x'}\,\hat{x}' + E_{y'}\,\hat{y}'$$

$$E_{x'} = E\cos\alpha\left[\cos\theta + \cos(\theta+\phi)\cancel{\frac{\sin\alpha}{\cos\alpha}}\right]$$

$$E_{y'} = E\cos\alpha\left[-\cos\theta\,\cancel{\frac{\sin\alpha}{\cos\alpha}} + \cos(\theta+\phi)\right]$$

$$\alpha = \frac{\pi}{4} \rightarrow \sin\left(\frac{\pi}{4}\right) = \cos\left(\frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}$$

$$\begin{cases} E_{x'} = E\cos\alpha\left[\cos\theta + \cos(\theta+\phi)\right] & \leftarrow (1) \\ E_{y'} = E\cos\alpha\left[-\cos\theta + \cos(\theta+\phi)\right] & \leftarrow (2) \end{cases}$$

$$(1) = 2\cos\left(\frac{\phi}{2}\right)\cos\left(\theta+\frac{\phi}{2}\right)$$

$$(2) = -2\sin(\phi/2)\sin(\theta+\phi/2)$$

$$\underline{E} = \overbrace{2E\cos\alpha\cos\left(\frac{\phi}{2}\right)}^{E_{ox}}\cos\left(kz-\omega t+\frac{\phi}{2}\right)\hat{x}'$$
$$\underbrace{-\,2E\cos\alpha\sin(\phi/2)}_{E_{oy}}\sin(kz-\omega t+\phi/2)\,\hat{y}'$$

Desf. relativo $\frac{\pi}{2}$

$E_{ox} \neq E_{oy}$

$$\underline{E} = E_{ox}\cos\left(kz-\omega t+\frac{\phi}{2}\right)\hat{x}' + E_{oy}\sin\left(kz-\omega t+\frac{\phi}{2}\right)$$