Eletromagnetismo Avançado
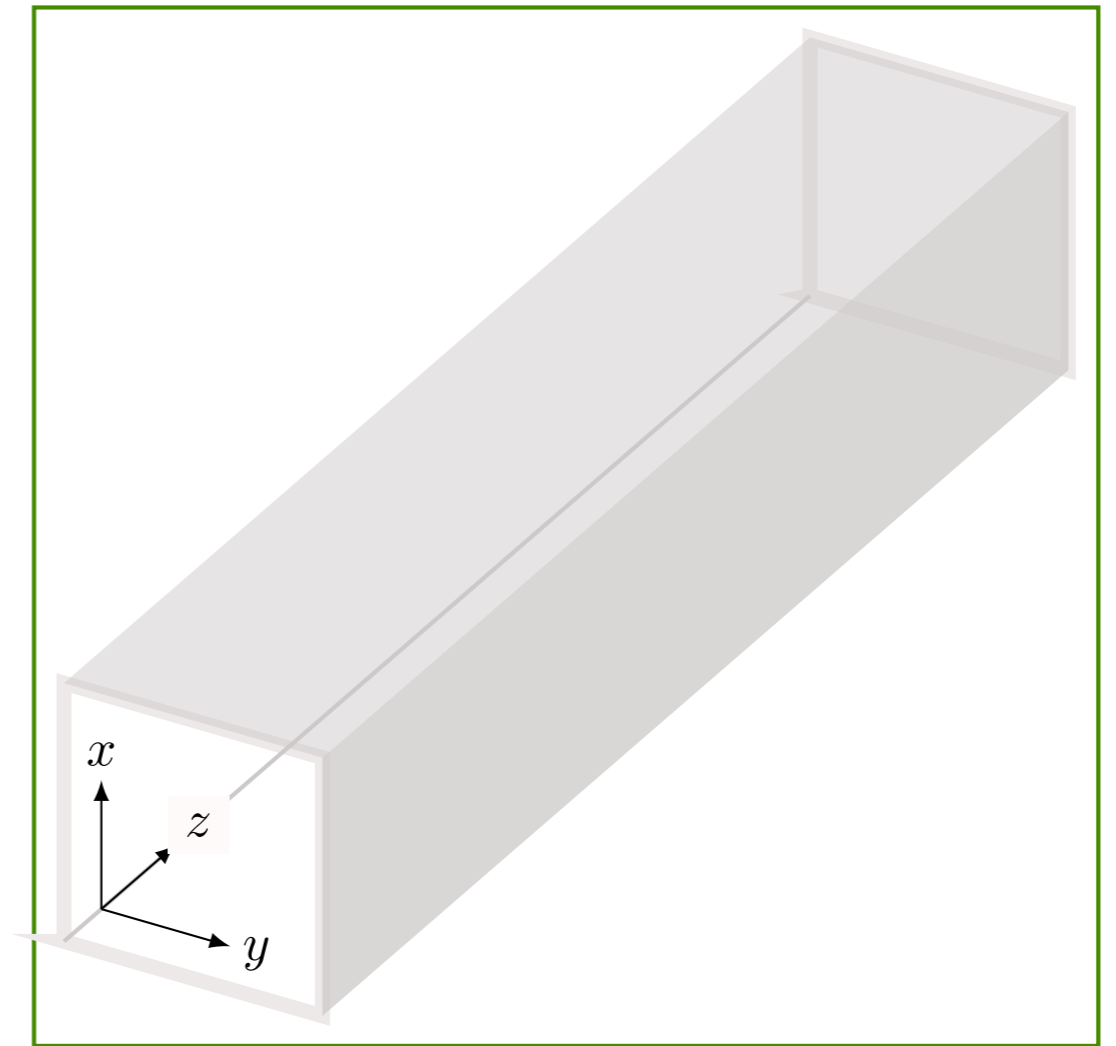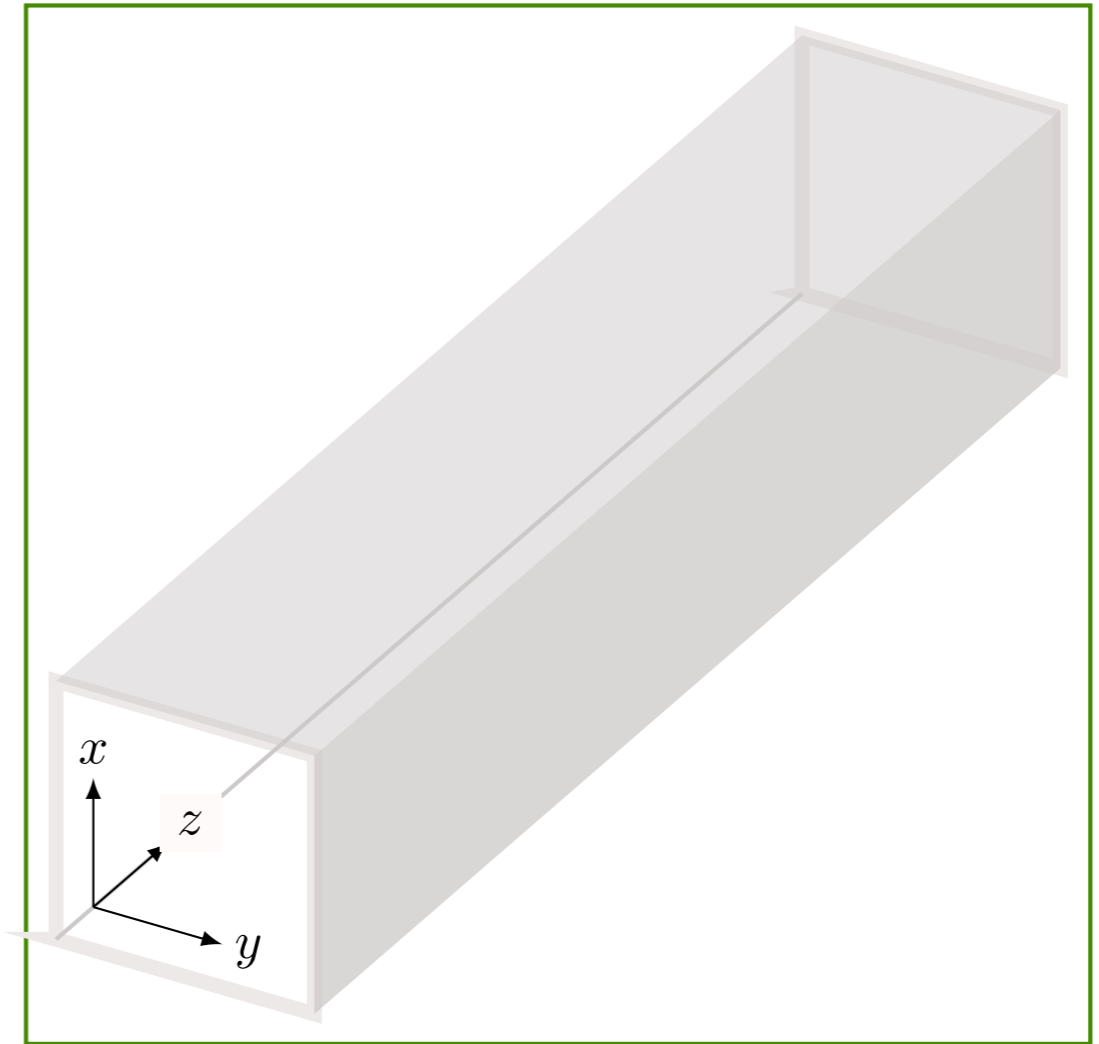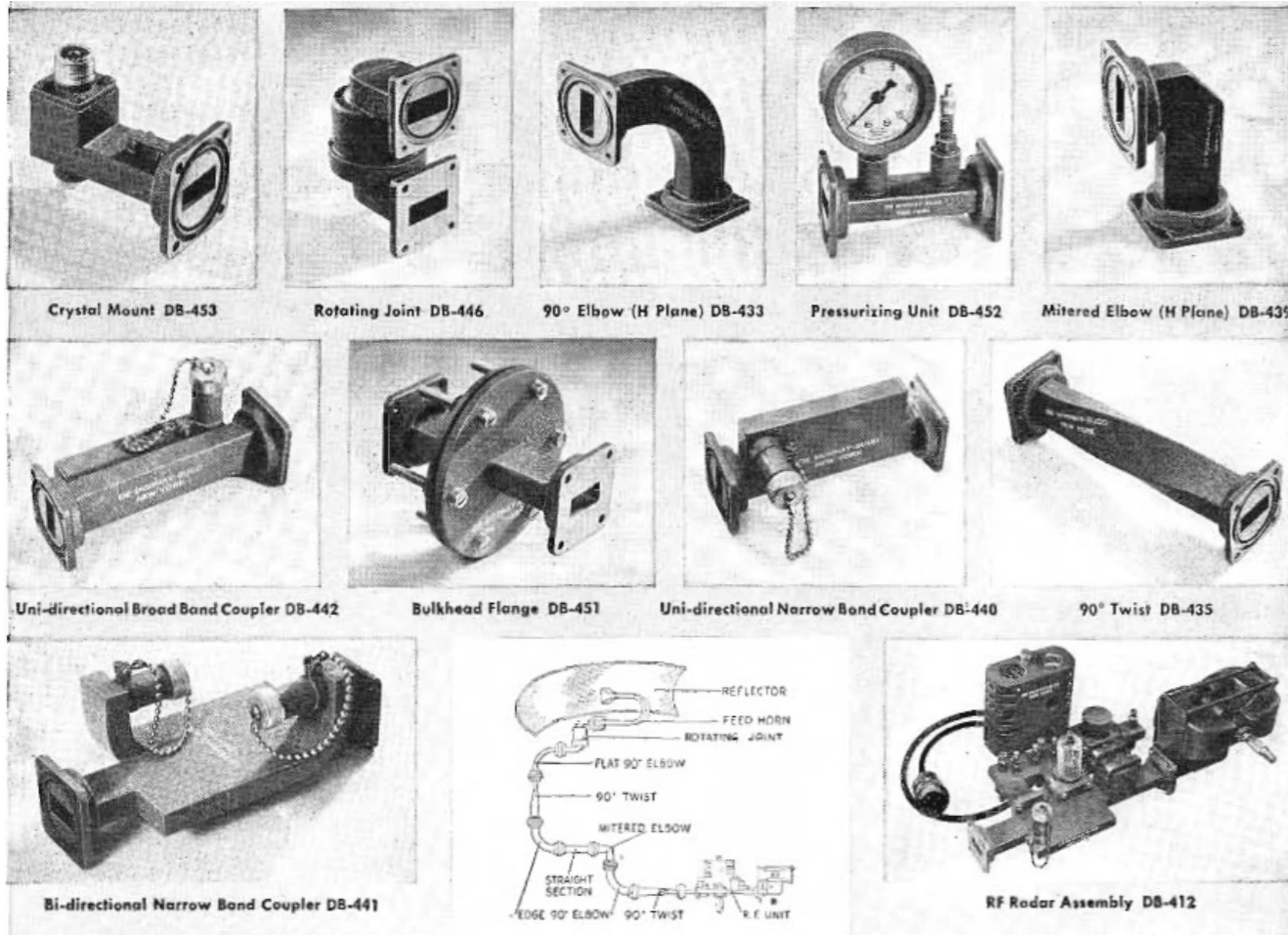
2º ciclo
Aula de 8 outubro

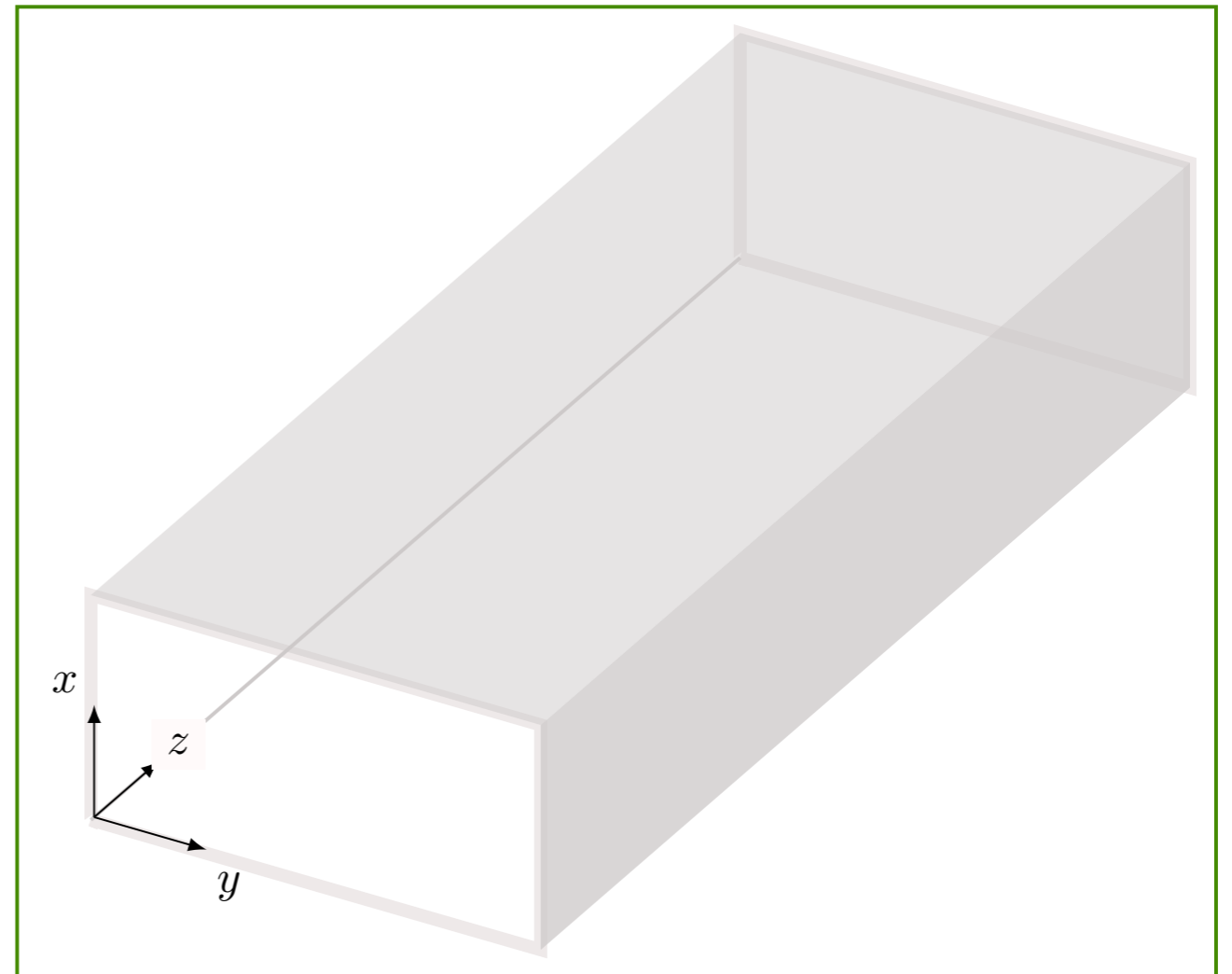# Guias de ondas

Guias de ondas
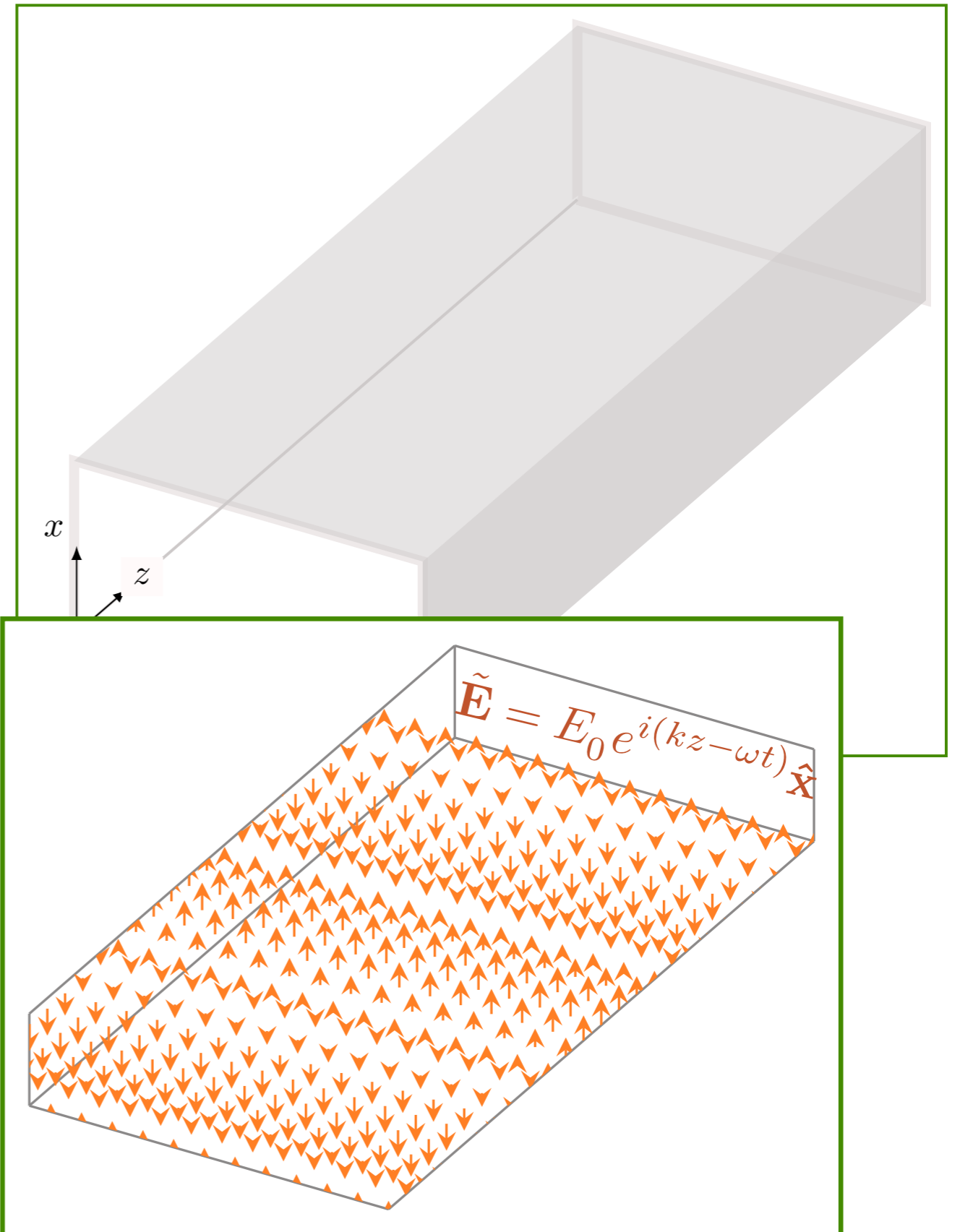
$\mathbf{E}_\parallel = 0$

$B_\perp = 0$

Guias de ondas

$$\mathbf{E}_{\parallel} = 0$$

$$B_{\perp} = 0$$

x

z

$$\tilde{\boldsymbol{E}} = E_0\, e^{i(kz - \omega t)}\hat{\mathbf{x}}$$

Guias de ondas

$\mathbf{E}_\parallel = 0$

$B_\perp = 0$

$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x,y)e^{ikz-\omega t}$

$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x,y)e^{ikz-\omega t}$

Guias de ondas

$\mathbf{E}_\parallel = 0$

$B_\perp = 0$

$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x, y)e^{ikz - \omega t}$

$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x, y)e^{ikz - \omega t}$

$\tilde{\mathbf{E}}_0 = E_x \hat{x} + E_y \hat{y} + E_z \hat{z}$

$\tilde{\mathbf{B}}_0 = B_x \hat{x} + B_y \hat{y} + B_z \hat{z}$
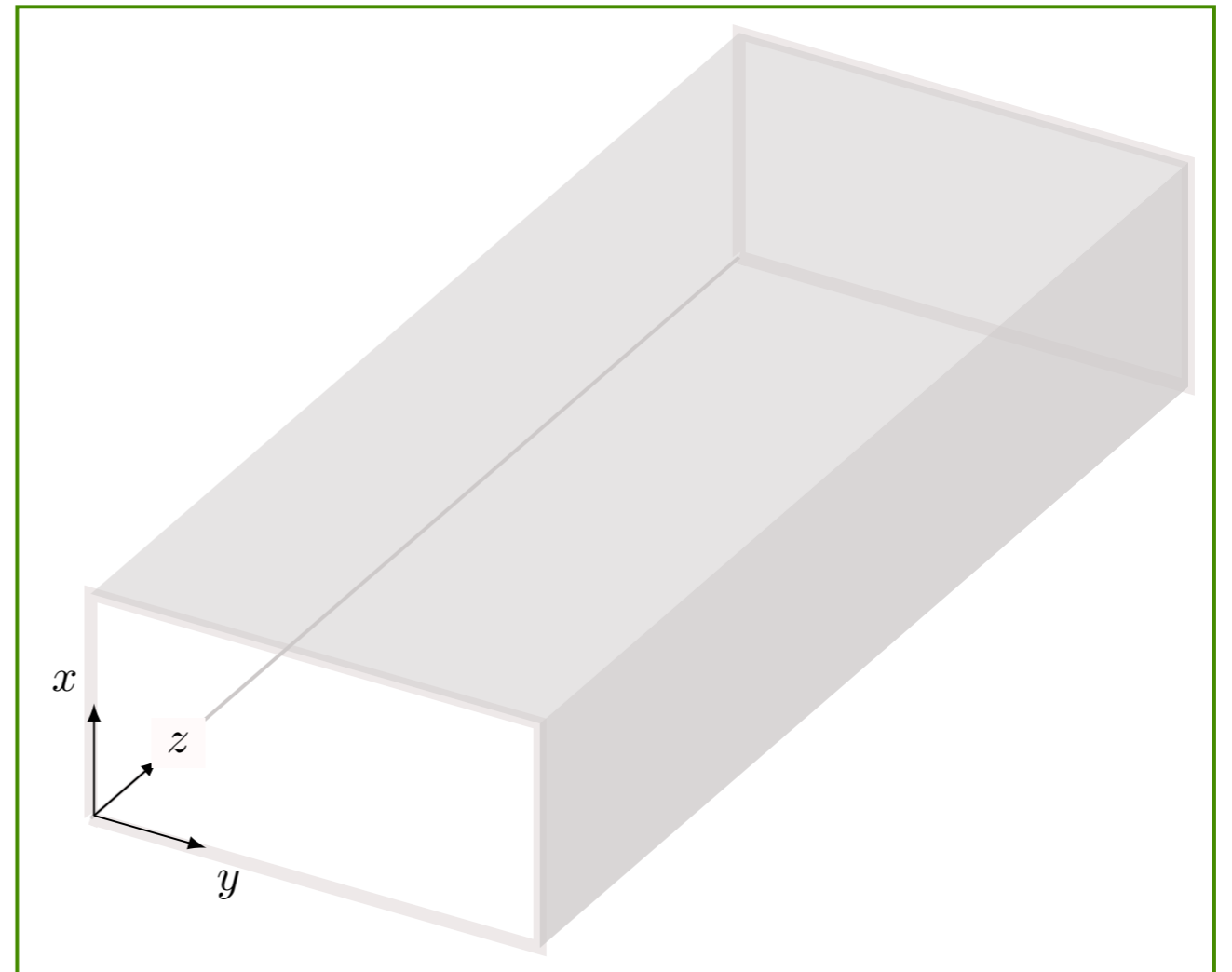

x

y

$E_z \neq 0 \vee B_z \neq 0$

x

z

y

Guias de ondas

$\mathbf{E}_\parallel = 0$

$B_\perp = 0$

$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x,y)e^{ikz-\omega t}$

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$\tilde{\mathbf{E}}_0 = E_x\hat{x} + E_y\hat{y} + E_z\hat{z}$

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$E_z \neq 0 \vee B_z \neq 0$

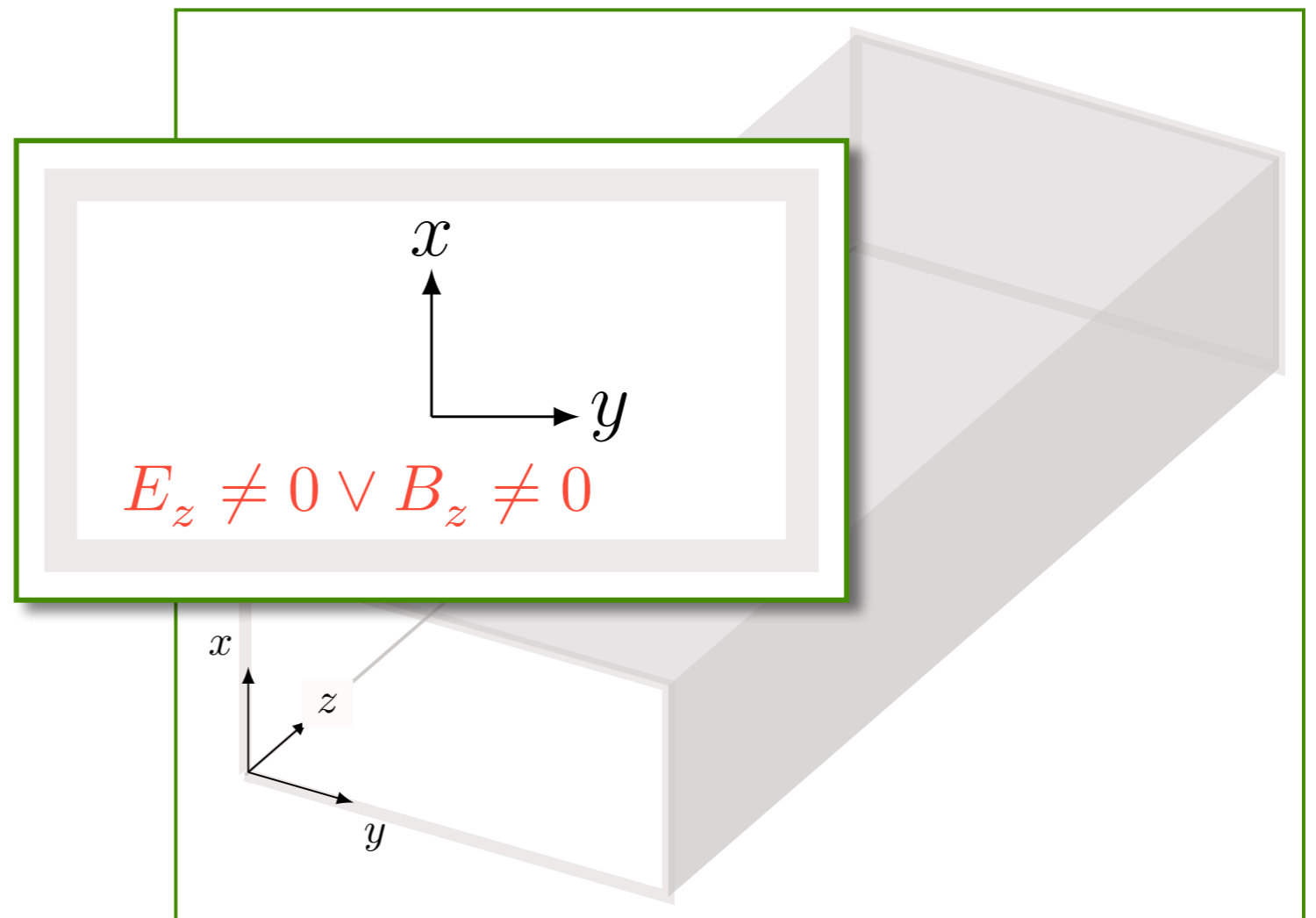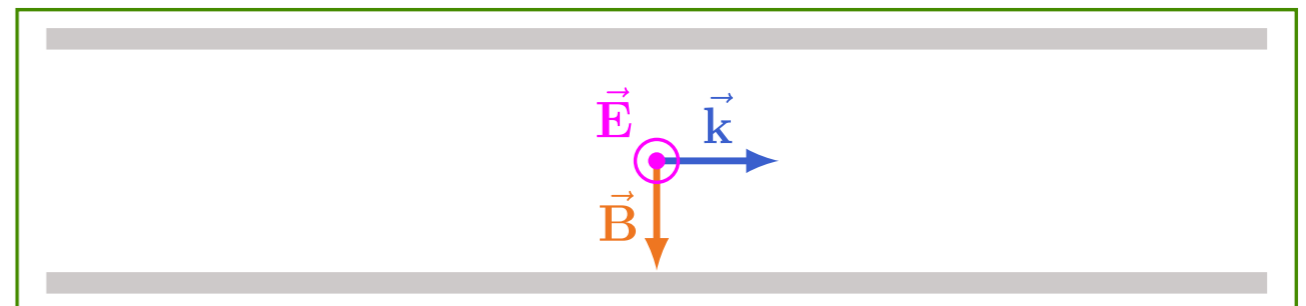$$\mathbf{E}_{\parallel} = 0$$

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$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x, y)e^{ikz - \omega t}$$

$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x, y)e^{ikz - \omega t}$$

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x

y

$E_z \neq 0 \vee B_z \neq 0$

x

z

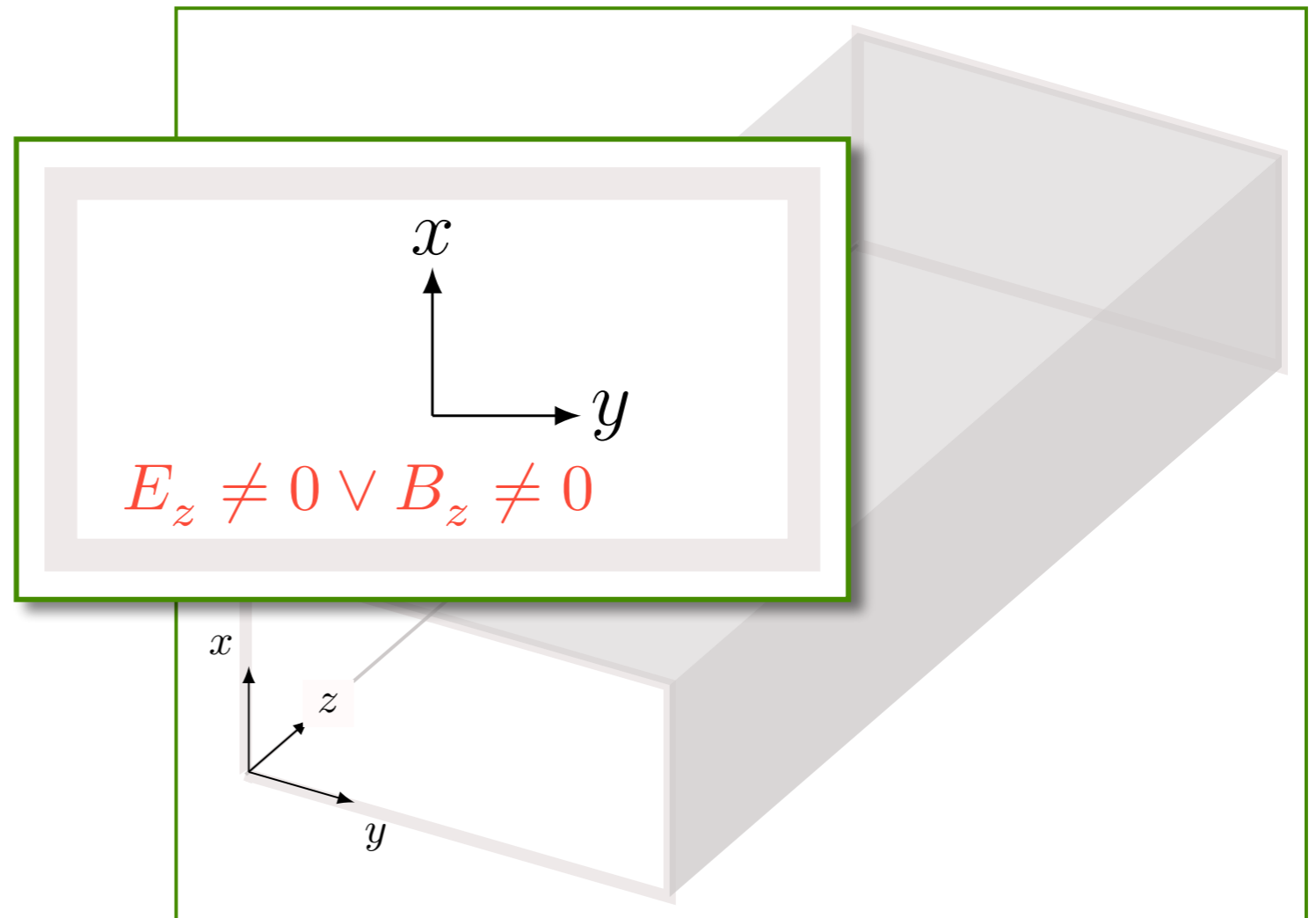y

Guias de ondas

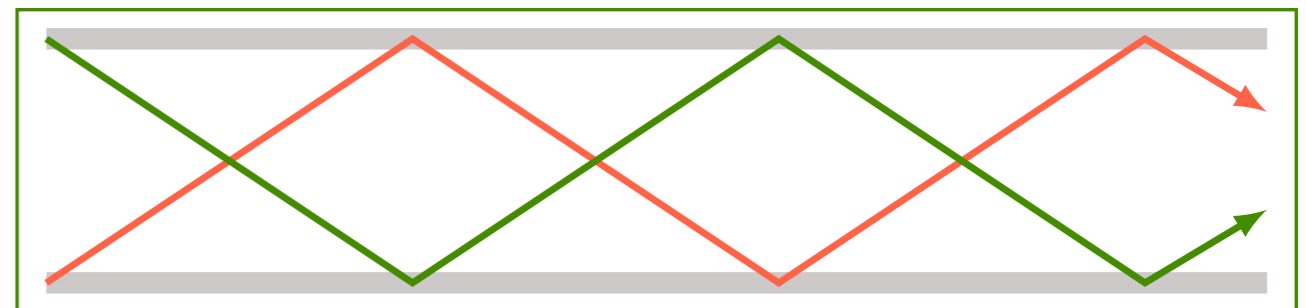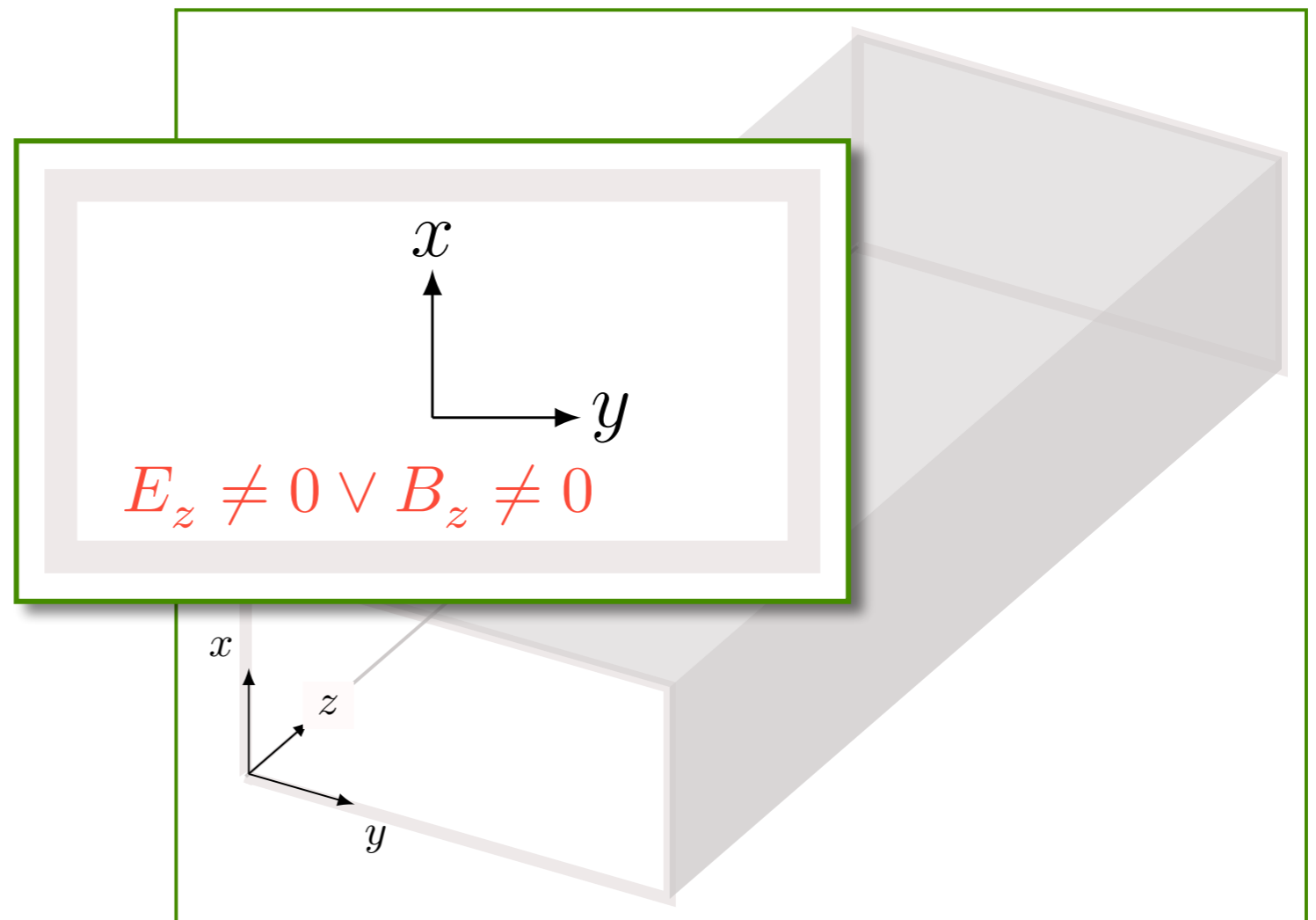$$\mathbf{E}_{\parallel} = 0$$

$$B_{\perp} = 0$$

$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x, y)e^{ikz - \omega t}$$

$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x, y)e^{ikz - \omega t}$$
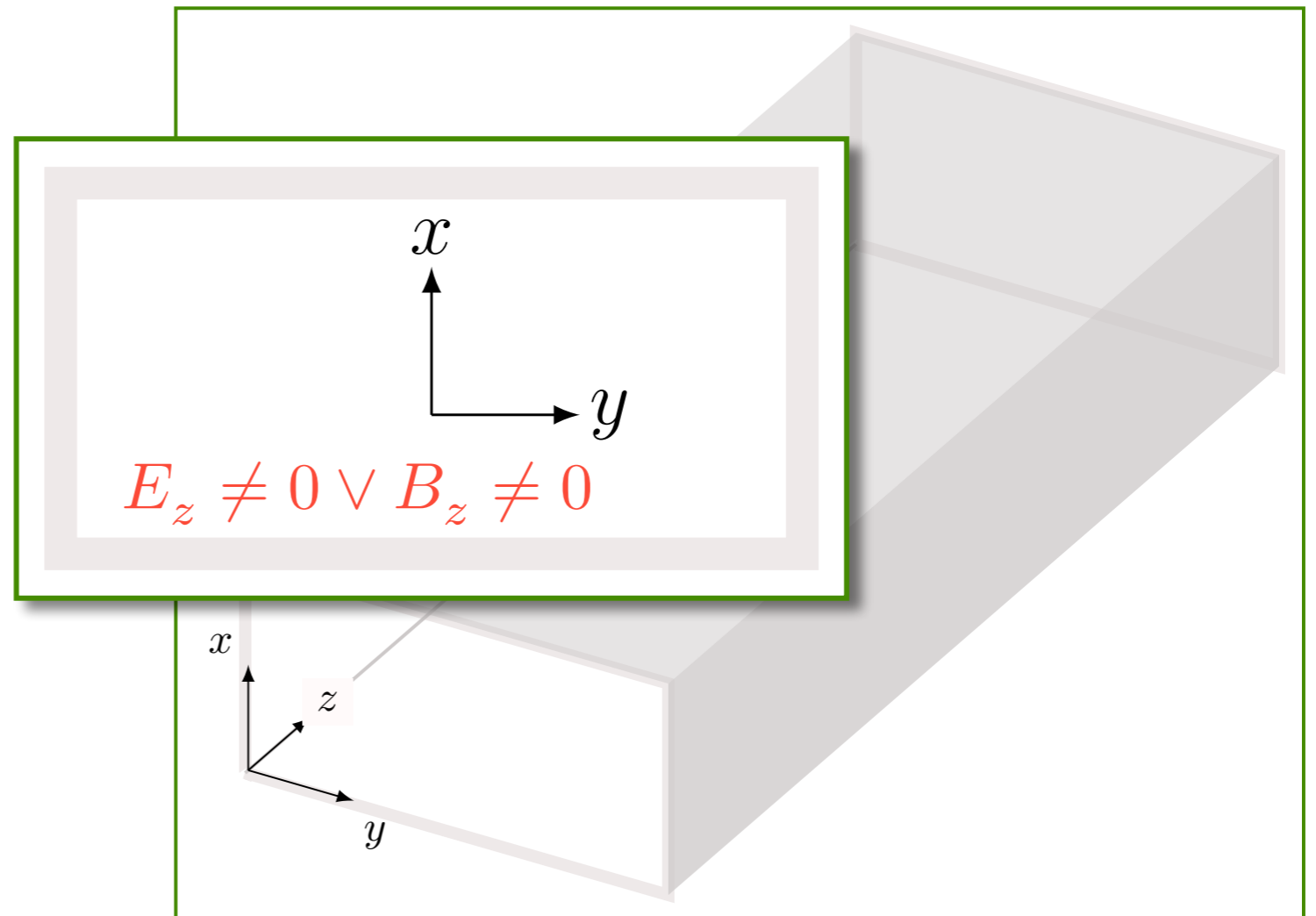
$$\tilde{\mathbf{E}}_0 = E_x\hat{x} + E_y\hat{y} + E_z\hat{z}$$

$$\tilde{\mathbf{B}}_0 = B_x\hat{x} + B_y\hat{y} + B_z\hat{z}$$

$$E_z = 0 \Rightarrow \quad T_E$$

$$B_z = 0 \Rightarrow \quad T_M$$

$$E_z = B_z = 0 \Rightarrow \quad T_{EM}$$

$$E_z \neq 0 \vee B_z \neq 0$$

$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x,y)e^{ikz-\omega t}$$

$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x,y)e^{ikz-\omega t}$$

$$\mathbf{E}_\parallel = 0$$

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$$\tilde{\mathbf{E}}_0 = E_x\hat{x} + E_y\hat{y} + E_z\hat{z}$$

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$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right)\tilde{B}_z = \frac{1}{c^2}\frac{\partial^2 \tilde{B}_z}{\partial t^2}$$

T_E

Guias de ondas

$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x, y)e^{ikz-\omega t}$$

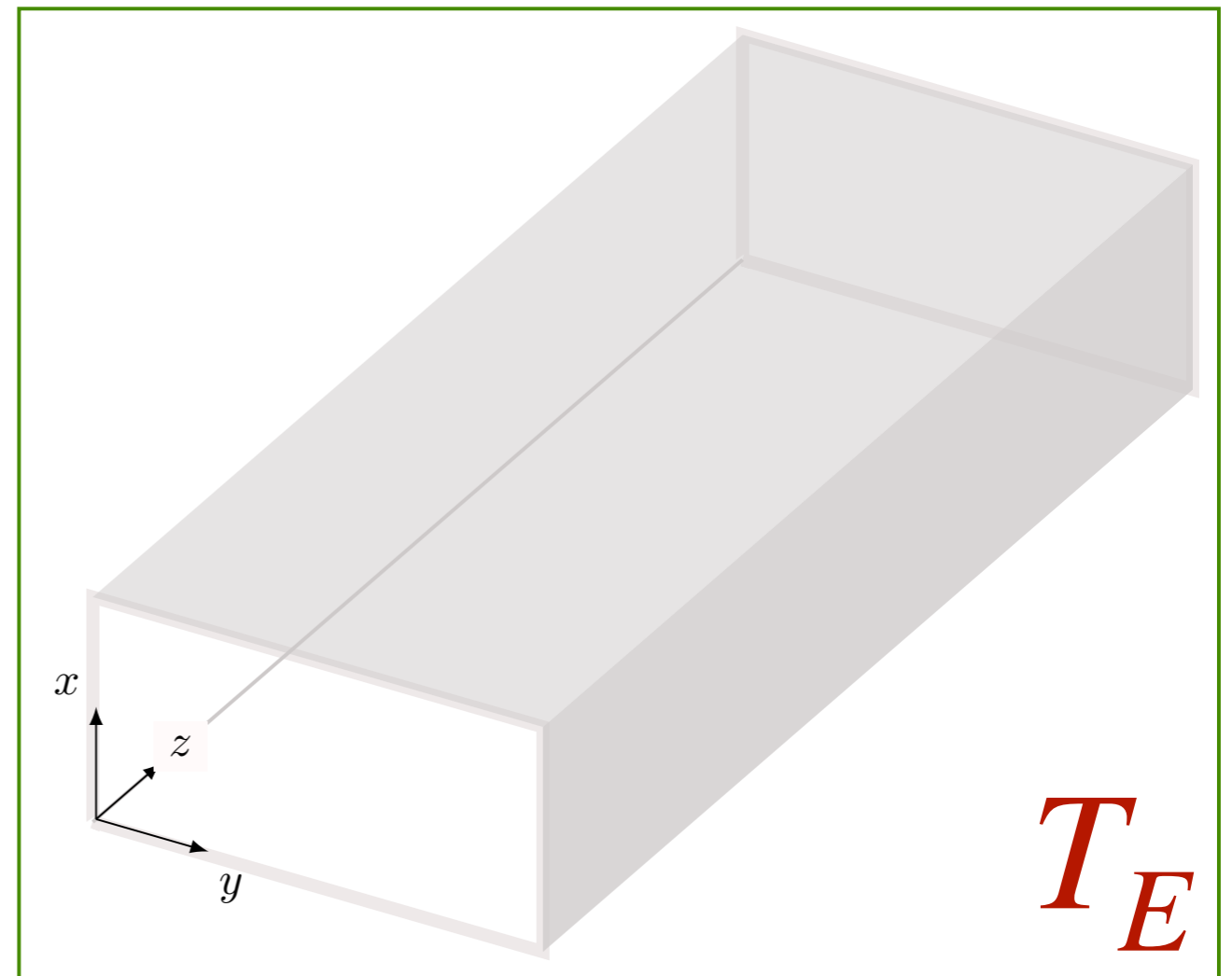$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x, y)e^{ikz-\omega t}$$
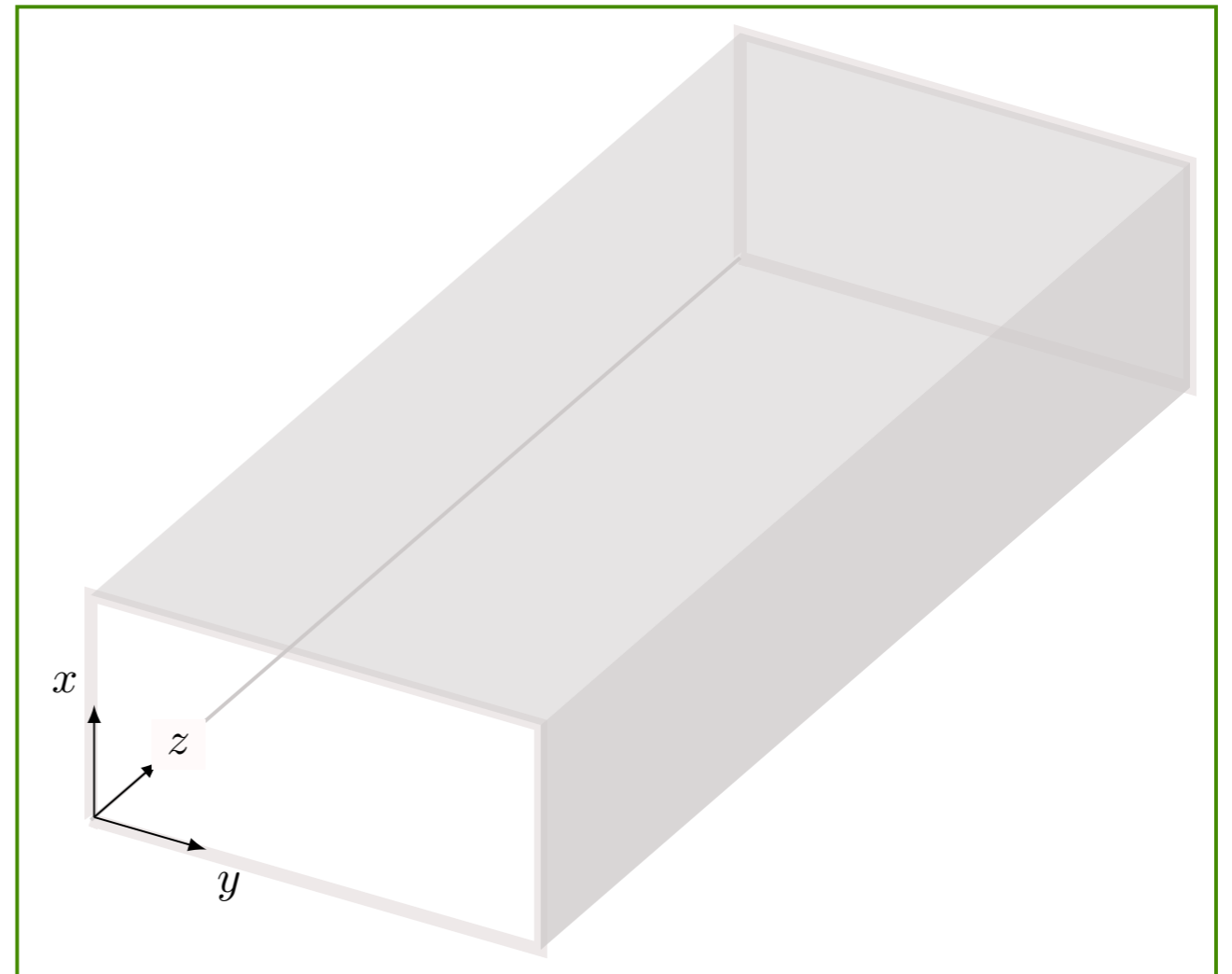
$$\mathbf{E}_\parallel = 0$$

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$$\tilde{\mathbf{E}}_0 = E_x\hat{x} + E_y\hat{y} + E_z\hat{z}$$

$$\tilde{\mathbf{B}}_0 = B_x\hat{x} + B_y\hat{y} + B_z\hat{z}$$

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} - k^2 + \left(\frac{\omega}{c}\right)^2\right)B_z = 0 \qquad B_z = X(x)Y(y)$$

$$Y\frac{\mathrm{d}^2 X}{\mathrm{d}x^2} + X\frac{\mathrm{d}^2 Y}{\mathrm{d}y^2} = XY\left(k^2 - \left(\frac{\omega}{c}\right)^2\right)$$

$$Y\frac{\mathrm{d}^2 X}{\mathrm{d}x^2} + X\frac{\mathrm{d}^2 Y}{\mathrm{d}y^2} = XY\left(k^2 - (\frac{\omega}{c})^2\right)$$

Guias de ondas

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$$B_z = X(x)Y(y)$$

$$X(x) = A\cos(k_x x) + B\sin(k_x x)$$

$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x, y)e^{ikz - \omega t}$$

$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x, y)e^{ikz - \omega t}$$

$$\mathbf{E}_\parallel = 0$$
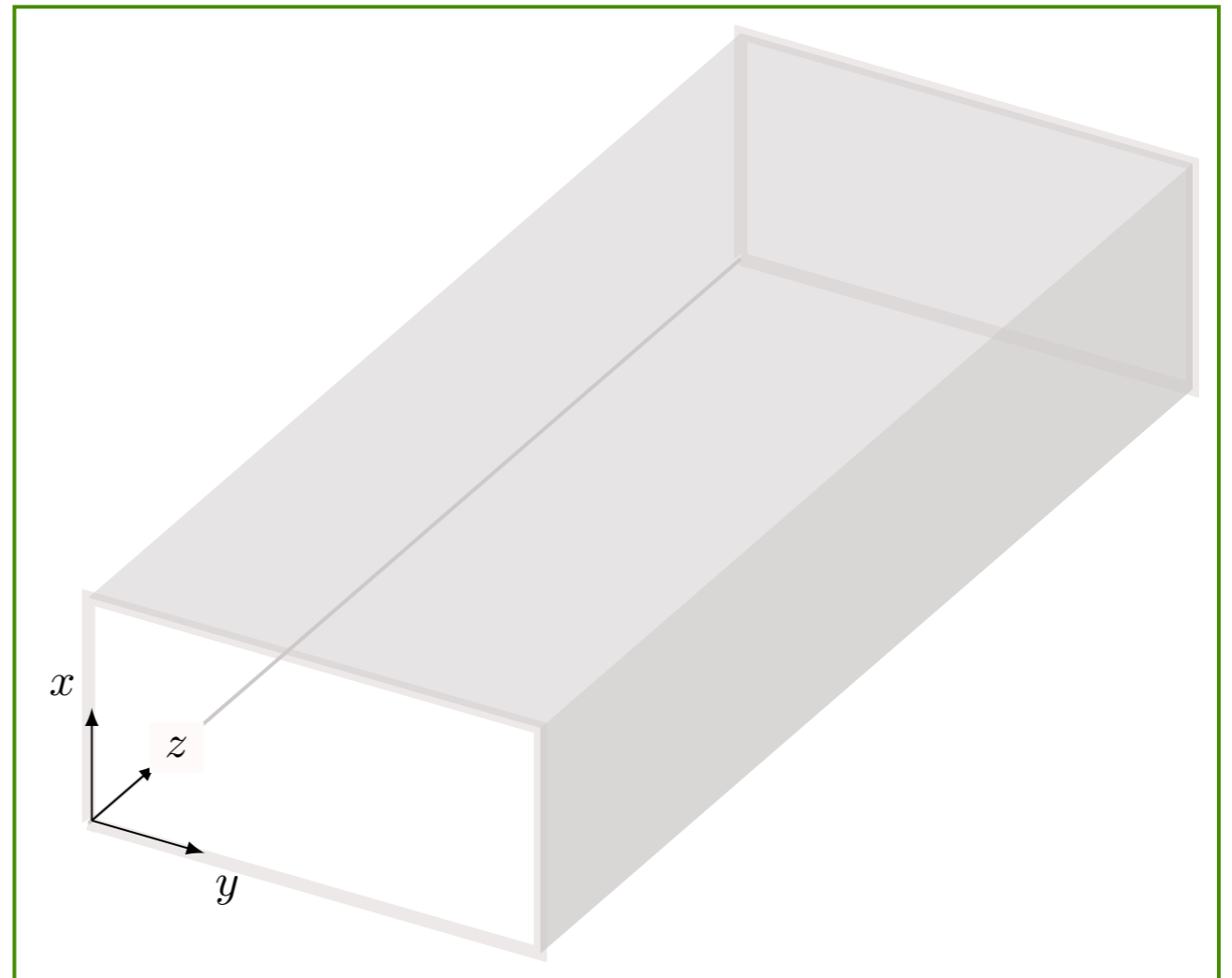
$$B_\perp = 0$$

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$$B_z = X(x)Y(y)$$

$$X(x) = A\cos(k_x x) + B\sin(k_x x)$$

$$\frac{\mathrm{d}X}{\mathrm{d}x} = 0 \qquad (x = 0, x = a)$$

$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x, y)e^{ikz-\omega t}$$

$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x, y)e^{ikz-\omega t}$$
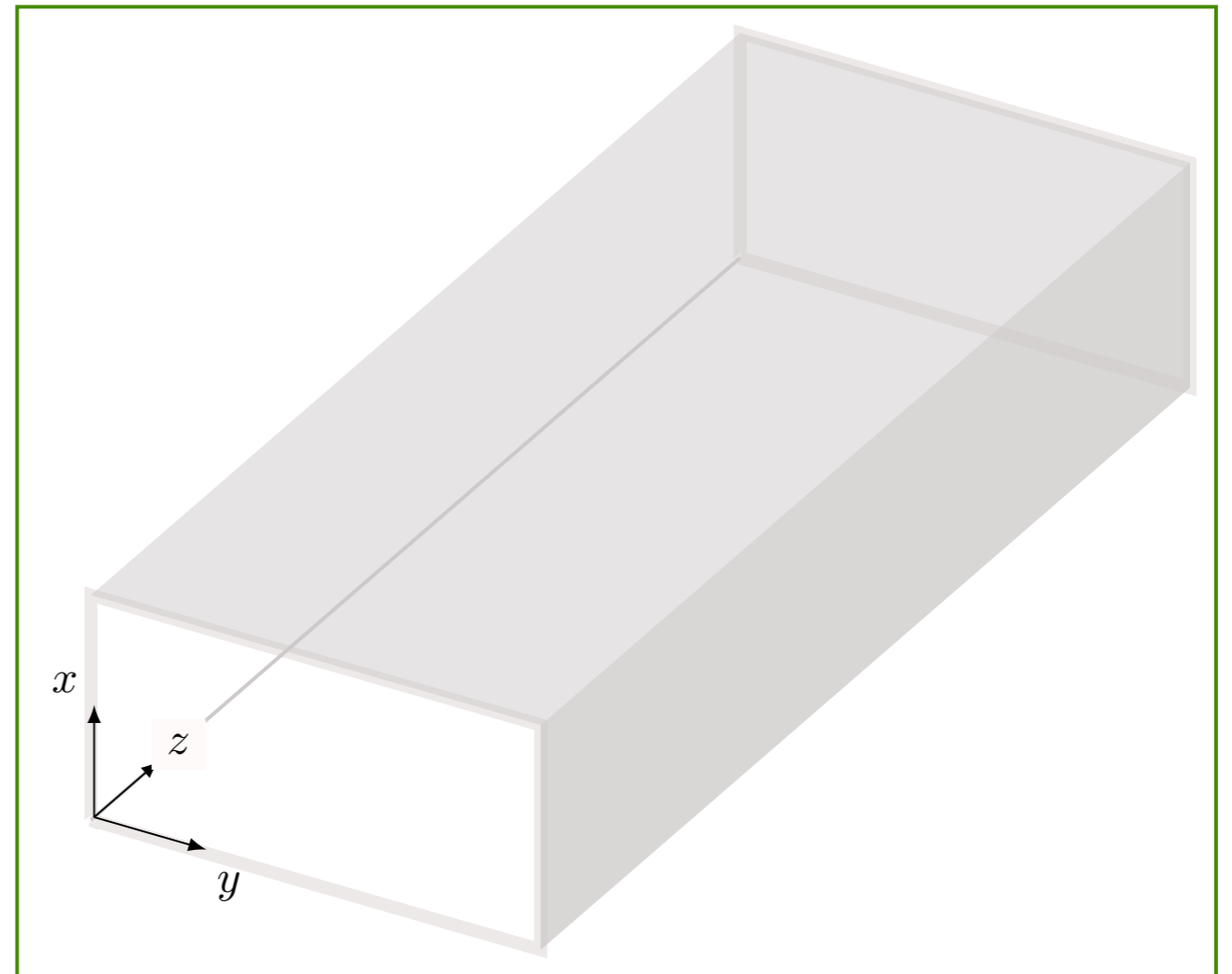
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$$B_z = X(x)Y(y)$$

$$B_z(x, y) = B_0 \cos\left(n\frac{\pi x}{a}\right)\cos\left(m\frac{\pi y}{b}\right) \qquad (m, n = 0, 1, 2, \ldots)$$

x

z

y

Guias de ondas

$$\tilde{\mathbf{E}} = \tilde{\mathbf{E}}_0(x,y)e^{ikz-\omega t}$$

$$\tilde{\mathbf{B}} = \tilde{\mathbf{B}}_0(x,y)e^{ikz-\omega t}$$
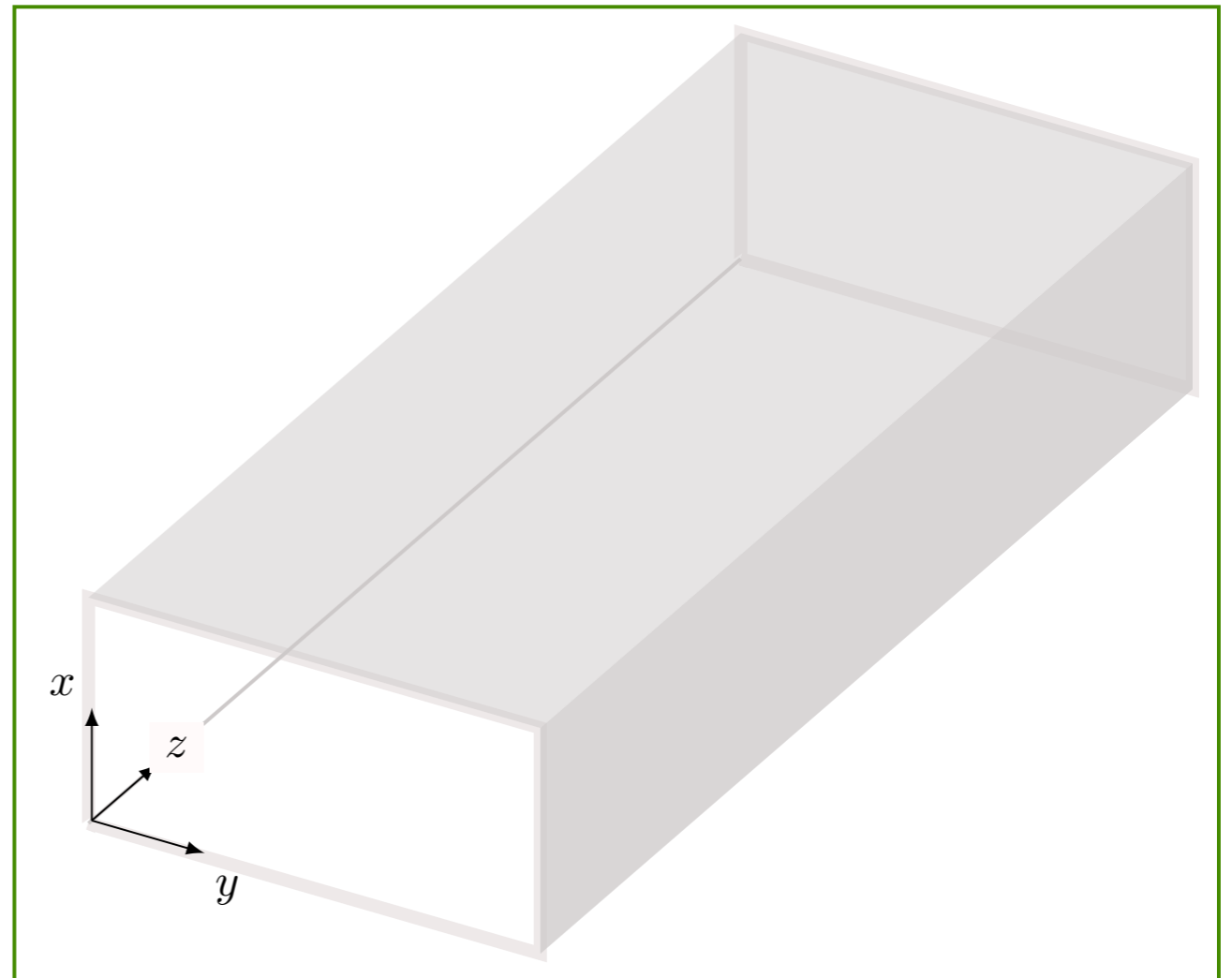
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$$B_z(x,y) = B_0\cos\left(n\frac{\pi x}{a}\right)\cos\left(m\frac{\pi y}{b}\right) \qquad (m,n = 0,1,2,\dots)$$

$$k = \sqrt{\left(\frac{\omega}{c}\right)^2 - \pi^2\left(\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2\right)}$$