$$E_x^m = \frac{2\mathcal{N}}{L}\sqrt{c}\cdot \sin\left(\frac{m\pi z}{L}\right)\cdot \sin\left(\frac{m\pi c t}{L}\right)$$ E_{xm} ηλεκτρικό πεδίο m τρόπου

$$B_y^m = \frac{2\mathcal{N}}{L}\frac{1}{\sqrt{c}}\cdot \cos\left(\frac{m\pi z}{L}\right)\cdot \cos\left(\frac{m\pi c t}{L}\right)$$ B_{ym} μαγνητικό πεδίο m τρόπου

$$U = \frac{\varepsilon_0}{2}E^2 + \frac{1}{2\mu_0}B^2 \qquad U_m = \frac{\varepsilon_0}{2}\frac{4\mathcal{N}^2 c}{L^2}\left[\sin^2\left(\frac{m\pi z}{L}\right)\sin^2\left(\frac{m\pi c t}{L}\right) + \cos^2\left(\frac{m\pi z}{L}\right)\cos^2\left(\frac{m\pi c t}{L}\right)\right]$$

πυκνότητα ενέργειας m τρόπου

$$E_m = \int_{V=LS} d^3r\, U$$

$$E_m = \frac{\varepsilon_0 c \mathcal{N}^2 S}{L^3}\left[L^2\sin^2\left(\frac{m\pi c t}{L}\right) + L^2\cos^2\left(\frac{m\pi c t}{L}\right)\right] = \frac{\varepsilon_0 c \mathcal{N}^2 S}{L}$$ ενέργεια m τρόπου κλασικά

$$q_m(t) := L\sin\left(\frac{m\pi c t}{L}\right)$$ γενικευμένη θέση

$$\dot{q}_m(t) := (m\pi c)\cdot\cos\left(\frac{m\pi c t}{L}\right)$$ γενικευμένη ταχύτητα

$$E_m = \frac{\varepsilon_0 c \mathcal{N}^2 S}{L^3}\left[(q_m(t))^2 + \left(\frac{L}{m\pi c}\right)^2(\dot{q}_m(t))^2\right]$$

Αναλογία με ΑΑΤ

$$E = \frac{K}{2}x^2 + \frac{M}{2}v^2 = \frac{K}{2}\left[x^2 + \frac{M}{K}v^2\right]$$

$$K = \frac{2\varepsilon_0 c \mathcal{N}^2 S}{L^3} \qquad M_m = \frac{2\varepsilon_0 \mathcal{N}^2 S}{L c m^2 \pi^2}$$

$$K = M_m \omega_m^2$$

$$\omega_m = \frac{m\pi c}{L}$$

$$\mathcal{N}^2 = \frac{M_m L c m^2 \pi^2}{2\varepsilon_0 S}$$

$$E_m = \frac{M_m \omega_m^2}{2}(q_m(t))^2 + \frac{M_m}{2}(\dot{q}_m(t))^2$$

↓ κβαντικό αντίστοιχο

$$\hat{H}_{HM,m} = \frac{M_m \omega_m^2}{2}(\hat{q}_m(t))^2 + \frac{M_m}{2}(\hat{\dot{q}}_m(t))^2$$ χαμιλτονιανή m τρόπου HM πεδίου

$$E_{m,n_m} = \hbar\omega_m\left(n_m + \frac{1}{2}\right)$$ $m \in \mathbb{N}^*$, $n_m \in \mathbb{N}$ ιδιοτιμές ενέργειας m τρόπου HM πεδίου

$$\hat{H}_{HM} = \sum_m \hat{H}_{HM,m}$$ χαμιλτονιανή HM πεδίου

$$\hat{E}_x^m(z,t) = \frac{2\sqrt{c}}{L^2}\,\mathcal{N}\,\sin\left(\frac{m\pi z}{L}\right)\cdot\hat{q}_m(t)$$

$$\hat{B}_y^m(z,t) = \frac{2}{L\sqrt{c}}\,\omega\,\frac{1}{m\pi c}\,\cos\left(\frac{m\pi z}{L}\right)\cdot\hat{\dot{q}}_m(t)$$

^ κβαντικά...

$$\mathcal{N} = \left[\frac{m^2\pi^2 M_m L c}{2\varepsilon_0 S}\right]^{1/2} \qquad \omega_m = \frac{m\pi c}{L}$$

$$\hat{E}_x^m(z,t) = \left[\frac{4\,c\,m^2\pi^2 M_m L c}{L^4\;2\varepsilon_0 S}\right]^{1/2}\sin\left(\frac{m\pi z}{L}\right)\cdot\hat{q}_m(t)$$

$$= \left[\frac{2M_m\omega_m^2}{\varepsilon_0 V}\right]^{1/2}\cdot\sin\left(\frac{m\pi z}{L}\right)\cdot\hat{q}_m(t)$$

$$\hat{B}_y^m(z,t) = \left[\frac{4\,m^2\pi^2 M_m L c}{L^2 c\, m^2\pi^2 c^2\, 2\varepsilon_0 S}\right]^{1/2}\cos\left(\frac{m\pi z}{L}\right)\hat{\dot{q}}_m(t)$$

$$= \frac{1}{c}\left[\frac{2M_m}{\varepsilon_0 V}\right]^{1/2}\cdot\cos\left(\frac{m\pi z}{L}\right)\cdot\hat{\dot{q}}_m(t)$$

ΜΟΝΑΔΕΣ

$$\left[\frac{E_x^m(z,t)}{B_y^m(z,t)}\right] = \left[\frac{\omega_m c\;\; q_m(t)}{\dot{q}_m(t)}\right] = \frac{m}{s} = [c]$$