SOLUZIONE ES. 1

a) NUMERO DI MODI OSCILLANTI

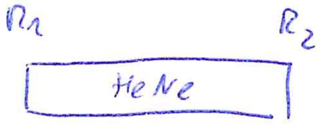
$$M = \frac{\Delta\nu_{DOPPLER}}{\Delta\nu_{FSR}}$$

$$\Delta\nu_{DOPPLER} = 2\nu_0 \cdot \sqrt{\frac{KT\,2\ln(2)}{m_{Ne}C^2}}$$

$$\nu_0 = \frac{c}{\lambda_0} = 473{,}76\ THz \simeq 474\ THz$$

$T = 400K$

$\Delta\nu_{DOPPLER} = 1{,}51\ GHz$



Per una cavità Fabry-Perot la condizione di risonanza è $L = \frac{m\lambda}{2n}$

$n \simeq 1$

$$\nu_m = m\frac{c}{2L} \rightarrow \Delta\nu_{FSR} = \frac{c}{2L} = 374{,}75\ MHz$$

$M \simeq 4$

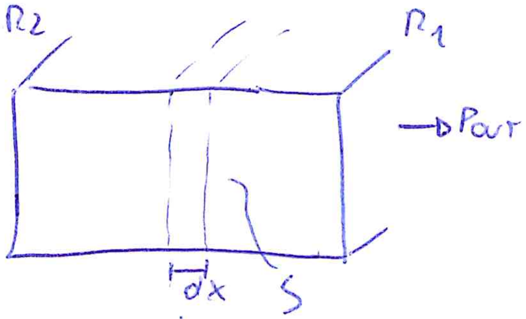
b) α_S?

$$T_{PH} = 33\,ns = \frac{n}{c\alpha_T} \rightarrow \alpha_T = \frac{1}{cT_{PH}} = 0{,}101\ m^{-1}$$

$$= \alpha_S + \frac{1}{2L}\ln\left(\frac{1}{R_1R_2}\right)$$

$$\alpha_S = \alpha_T - \frac{1}{2L} \ln\left(\frac{1}{R_1 R_2}\right) = 0{,}101\, m^{-1} - 0{,}039\, m^{-1} = 0{,}062$$

c) P_{OUT} ?



$$P_{OUT} = \phi_{PH_{OUT}} \cdot S \cdot h\nu_0 = \frac{1}{2} \phi_{PH} \cdot S h\nu_0 (1 - R_1)$$

IN REGIME STAZIONARIO, AD OGNI ISTANTE t, METÀ FOTONI VANNO A SX E METÀ A DESTRA

$$\phi_{PH} = \frac{N_{PH} \cdot S \cdot dx}{S \cdot dt} = N_{PH} \cdot \frac{c}{n}$$

QUINDI $P_{OUT} \simeq \frac{1}{2} N_{PH} \cdot \frac{c}{n} \cdot \left(\pi \frac{d^2}{4}\right) \cdot h\nu_0 (1 - R_1) =$

$= 7{,}48\, mW$

SOLUZIONE ESERCIZIO 2

a) Nota la lunghezza d'onda λ_0 è possibile ricavare E_{GAP} ricordando che

$$E_{PEAK}[eV] = \frac{1{,}24\ eV\text{-}\mu m}{\lambda_0} \approx E_G$$

$$E_G \simeq 1{,}55\ eV$$

b) $\Delta\lambda_{1/2}$?

$$\Delta E = 3KT$$

$$\hookrightarrow E = \frac{hc}{\lambda}$$

$$dE = -\frac{hc}{\lambda^2} \cdot d\lambda \Rightarrow |\Delta\lambda_{1/2}| = \frac{\lambda_0^2}{hc} \cdot \Delta E =$$

$$= \frac{\lambda_0^2}{hc} \cdot 3KT \simeq 40nm$$

c) $$\eta_{EQE} = \frac{d_{PH\ OUT}}{d_{e^-\ iniettati}} = \frac{P_{OUT}/h\nu}{I_F/q}$$

$$\lambda\nu = c \qquad \nu = \frac{c}{\lambda} = 374{,}7\ THz$$

$\eta_{ВЯЕ} = 0{,}322 \rightarrow 32{,}2\,\%$

$$\eta_{РСБ} = \frac{P_{АТОМ}}{P_{ОЗЛВ}} = \frac{P_{OUT}}{I_C \cdot V_F}$$

$$\hookrightarrow V_F = \frac{P_{OUT}}{I_F \cdot \eta_{РСБ}} = 10V$$

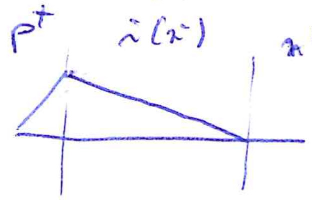
Soluzione es. 3

a) $I_{PH} \triangleq R \cdot P_0$

$$R = \eta \cdot \frac{q\lambda}{hc} = 0{,}322$$

$I_{PH} = 48{,}3\,nA$

b) In condizione di completo svuotamento il campo ha il seguente profilo



$$W_{DEP} = \sqrt{\frac{2\varepsilon_{si}}{q}\left(\phi_{Bi} + V_{REV}\right)\frac{1}{N_V}} = W$$

$$V_{REV} = \frac{q N_V W^2}{2\varepsilon_{si}} - \phi_{Bi} = 11{,}526\,V$$

c) $\tau_{RISPOSTA}^2 = \tau_{DRIFT}^2 + \tau_{RC}^2$

$$\tau_{DRIFT} = \frac{W}{v_{sat}} = 0{,}18\,ns = 180\,ps$$

$$\tau_{RC} = R_L \cdot \frac{\varepsilon \cdot A}{W} \qquad A = \pi \frac{d^2}{4} = 7 \cdot 10^{-8}\,m^2$$

$\tau_{RC} = 20{,}3\,ps$

$$\tau_{RISPOSTA} = \sqrt{\tau_{RC}^2 + \tau_{DRIFT}^2} \simeq \tau_{DRIFT}$$