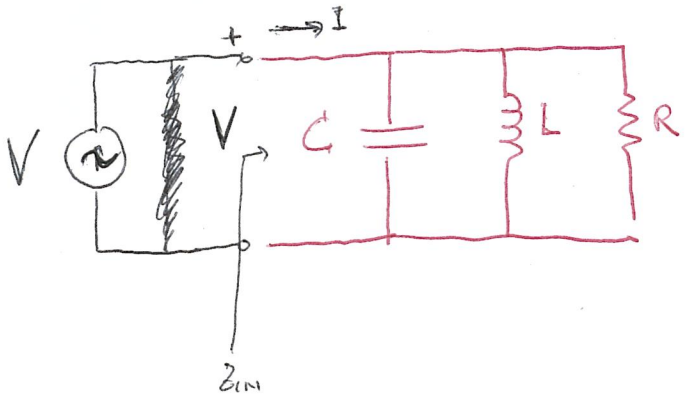
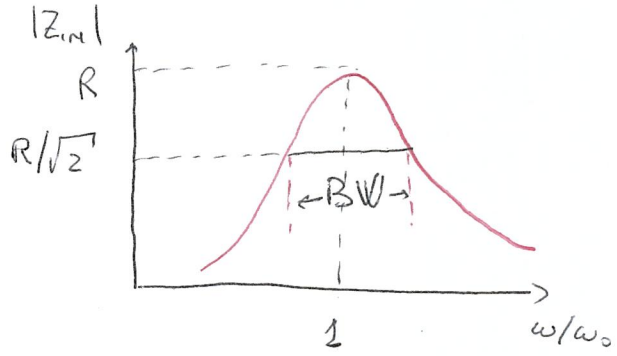
CIRCUITO EQUIVALENTE DI UNA CAVITA' RISONANTE

SONO POSSIBILI CIRCUITI SERIE E CIRCUITI PARALLELO





$$Z_{IN} = \left(\frac{1}{R} + \frac{1}{j\omega L} + j\omega C \right)^{-1} \qquad \omega_0 = \frac{1}{\sqrt{LC}}$$

P_{IN} POTENZA INVIATA NEL CIRCUITO $\qquad P_{IN} = \frac{1}{2} V I^* = \frac{1}{2} \frac{|V|^2}{Z_{IN}^*}$

$$P_{LOSS} = \frac{|V|^2}{2R} \qquad W_E = \frac{C|V|^2}{4} \qquad W_H = \frac{|V|^2}{4\omega^2 L^*}$$

$$Q_0 = \omega_0 \frac{W_m + W_E}{P_{LOSS}} = \frac{R}{\omega_0 L} = \omega_0 RC$$

VICINO ALLA RISONANZA

$$Z_{IN} \simeq \frac{R}{1 + 2j Q_0 \Delta\omega/\omega_0}$$

$$\frac{BW}{\omega_0} = \frac{1}{Q_0}$$

$$\frac{\Delta\omega_{3dB}}{\omega_0} = \frac{1}{Q_0}$$

CAVITA' ACCELERANTI

4 PARAMETRI FONDAMENTALI

FREQUENZA DI RISONANZA ω_0, f_0

FATTORE DI QUALITA' Q

R/Q $\qquad \frac{R}{Q} = \frac{V_0^2}{\omega_0 W}$

V_0 TENSIONE ACCELERANTE

W ENERGIA IMMAGAZZINATA

SHUNT IMPEDANCE

LINAC DEF $\qquad R = \frac{V_0^2}{P_d}$ $\qquad \left(\text{o } R = \frac{V_0^2}{2P_d} \right)$ CIRCUIT DEF.

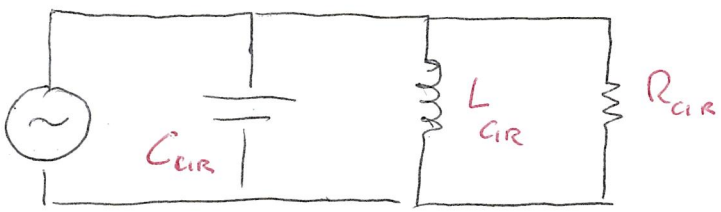
NOTE

$$V_0 = \int_0^L E(z, t(z))\, dz = \int_0^L E(z,) \exp\left[j \frac{\omega z}{\beta c} \right] dz$$

↳ ISTANTE IN CUI LA PARTICELLA E' IN z (TRANSIT TIME FACTOR ---)

R/Q DIPENDE SOLO DALLA GEOMETRIA

RIPORTATO AL MODELLO CIRCUITALE



$$R_{CIR} = R/2$$

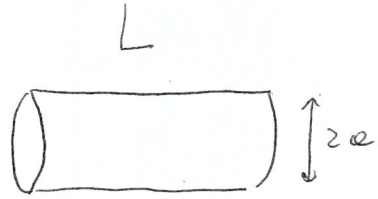
$$C_{CIR} = \frac{2}{\omega_0 R/Q}$$

$$L_{CIR} = \frac{1}{2\omega_0} R/Q$$

PILL BOX

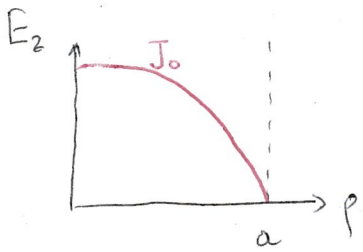
MODO FONDAMENTALE PER ACCELERAZIONE

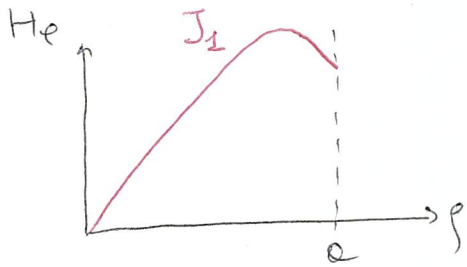
TM_{010}



$$E_z = E_0 J_0\left(\frac{\chi_{01}}{a}\rho\right) \qquad \chi_{mn} : \; J_m(\chi_{mn}) = 0$$

$$Z_0 H_\varphi = J\, E_0 J_1\left(\frac{\chi_{01}}{a}\rho\right)$$





$$W = 2\left[\frac{1}{4}\varepsilon_0 \int_V |E|^2 dz\right]$$

$$P_d = \frac{R_s}{2}\oint_S |H|^2 dS$$

$$Q = \frac{\omega_0 W}{P_d}$$

$$R_s = \sqrt{\frac{\omega_0 \mu}{2\sigma}} = \frac{1}{\sigma\delta}$$

PER TM_{010} SI DIMOSTRA CHE

$$Q = \frac{\omega W}{P_d} = \frac{1{,}2025\; Z_0}{R_s\,(1 + a/L)}$$

PER I PRIMI 10 MODI BASTANO

χ_{01} χ'_{11}

χ_{11} χ'_{21}

χ_{21}

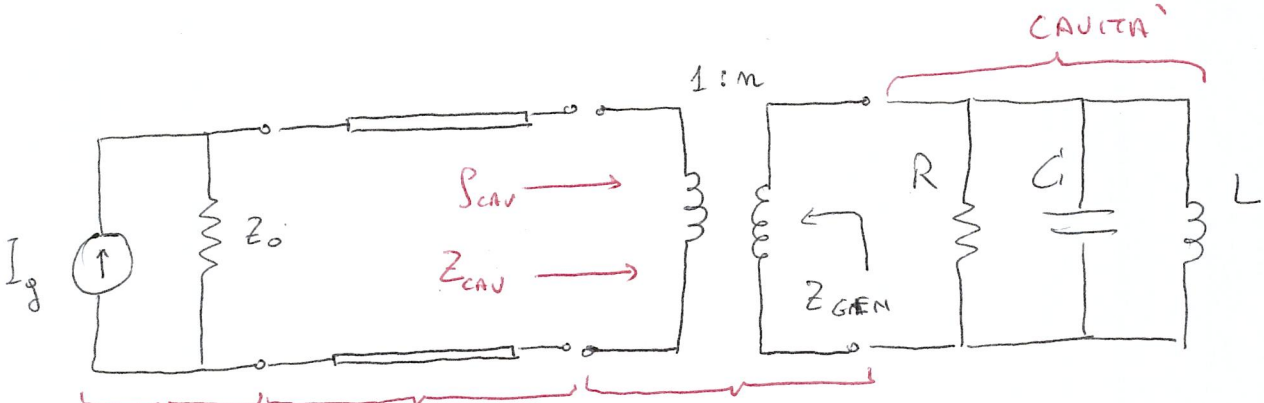
PER CASA:

a = 6 cm

L = 4,3 cm

} CALCOLARE I MODI FINO A 6 GHz

ACCOPPIAMENTO ~~SEMPRE~~ IN CAVITA'



$$\delta = \frac{f}{f_0} - \frac{f_0}{f} \approx \frac{2(f - f_0)}{f_0} = 2\frac{\Delta\omega}{\omega_0}$$

$$Z_{CAV} = \frac{R/n^2}{1 + j Q_0 \delta}$$

W ENERGIA IMMAGAZZINATA

P_{CAV} POTENZA PERSA SULLE PARETI DELLA CAVITA'

P_{EXT} " IRRADIATA ATTRAVERSO IL COUPLER E DISSIPATA SULL' IMPEDENZA DEL GENERATORE Z_0

($\Rightarrow$ LA CAVITA' VEDE IL GENERATORE COME UN ~~CARICO~~ CARICO AGGIUNTIVO)

LOADED Q $\quad Q_L = \dfrac{\omega_0 W}{P_{CAV} + P_{EXT}}$ $\qquad \dfrac{1}{Q_L} = \dfrac{1}{Q_0} + \dfrac{1}{Q_E}$

EXTERNAL Q $\quad Q_E = \dfrac{\omega_0 W}{P_{EXT}}$

COUPLING β $\quad \beta = \dfrac{P_{EXT}}{P_{CAV}} = \dfrac{Q_0}{Q_E} = \dfrac{R}{n^2 Z_0} \Rightarrow Q_L = \dfrac{Q_0}{1+\beta}$

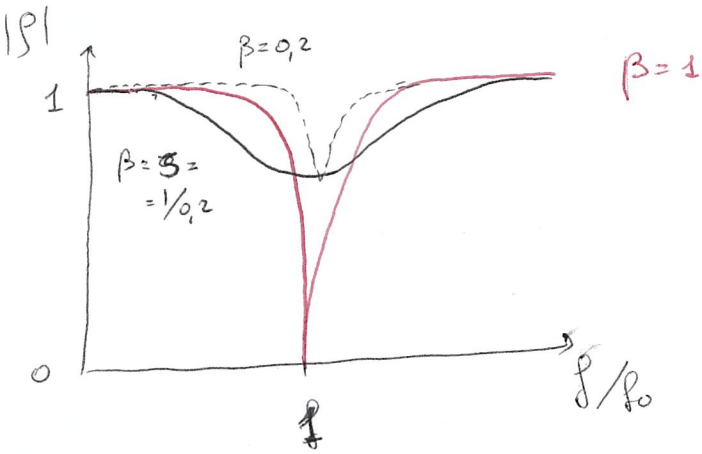
$$\rho_{cav} = \frac{Z_{cav} - Z_0}{Z_{cav} + Z_0} = \frac{\beta - 1 - j Q_0 \delta}{\beta + 1 + j Q_0 \delta}$$

$$|\rho| = \sqrt{\frac{\left(\frac{\beta-1}{\beta+1}\right)^2 + (Q_L \delta)^2}{1 + (Q_L \delta)^2}}$$

$$\left|\rho_{cav}\right|_{f=f_0} = \frac{\beta - 1}{\beta + 1}$$

$$Z_{cav} = Z_0 \frac{\beta}{1 + j Q_0 \delta}$$

β INFLUENZA
- → RIFLESSIONE ALLA PORTA DI INGRESSO
- → RAPPORTO TRA P_{cav} IN CAVITA' E POTENZA DISSIPATA SUL CARICO ESTERNO
- → LARGHEZZA DELLA RISONANZA

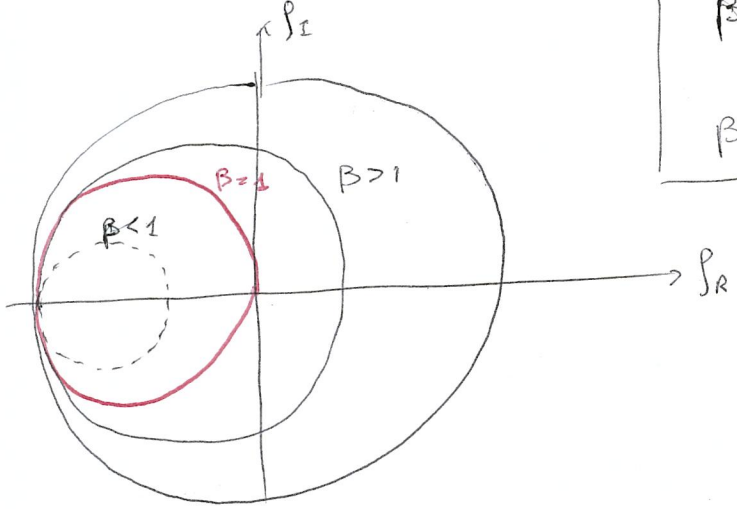


$\beta < 1$ SOTTO ACCOPPIATO

$\beta \geq 1$ ACCOPPIAMENTO CRITICO

$\beta > 1$ SOVRA ACCOPPIATO

CARTA DI SMITH

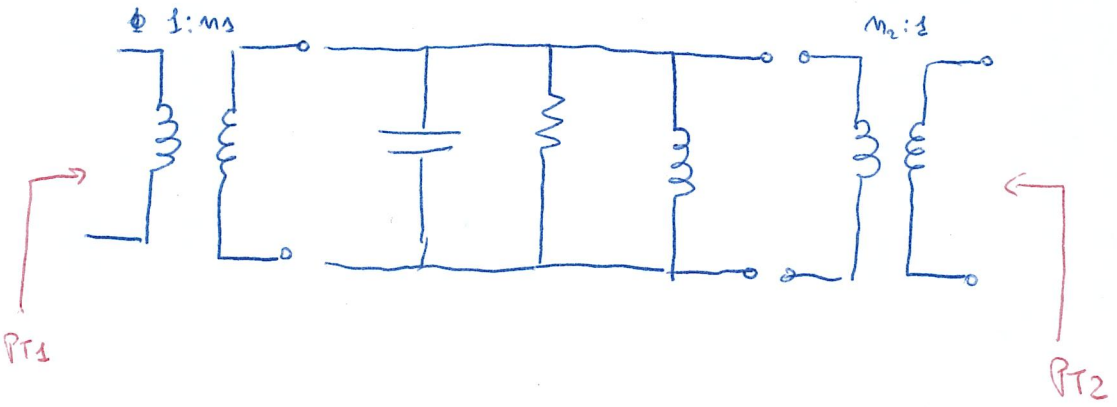


$\beta < 1$	$SWR = 1/\beta$
$\beta > 1$	$SWR = \beta$

FAR VEDERE LA FASE ---

CAVITA' ECCITATA DA DUE ANTENNE

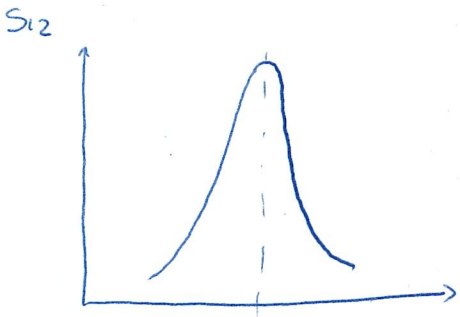
MISURE IN TRASMISSIONE



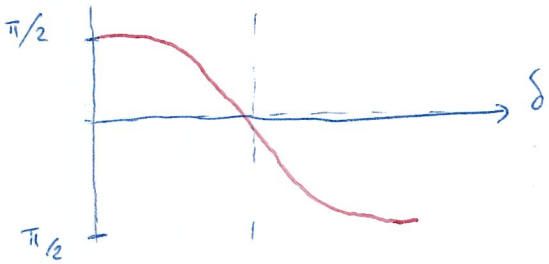
SI PUO' DIMOSTRARE CHE

$$S_{12} = \frac{\frac{2\beta}{1+2\beta}}{1 + J\frac{Q_0}{1+2\beta}\delta}$$

$\Rightarrow$ ECCITAZIONE SIMMETRICA



$$\delta = \left(\frac{f}{f_0} - \frac{f_0}{f}\right)$$



AUTOMATIC Q MEAS.

(VEDI PLOT)

$Q_L = \omega / \Delta\omega_{3dB}$ $\quad \beta \rightarrow S_{12}(f_0)$

(CALIBRATO!!)

SE $n_1 \neq n_2$

$$S_{12}(f) = \frac{2\sqrt{\beta_1 \beta_2}}{1+\beta_1+\beta_2} \Big/ \left(1 + J\frac{Q_0}{1+\beta_1+\beta_2}\delta\right)$$

$\rightsquigarrow$ $\beta \ll 1$

$$S_{12} \cong \frac{S_{12}(f_0)}{1 + J Q_0 \delta}$$

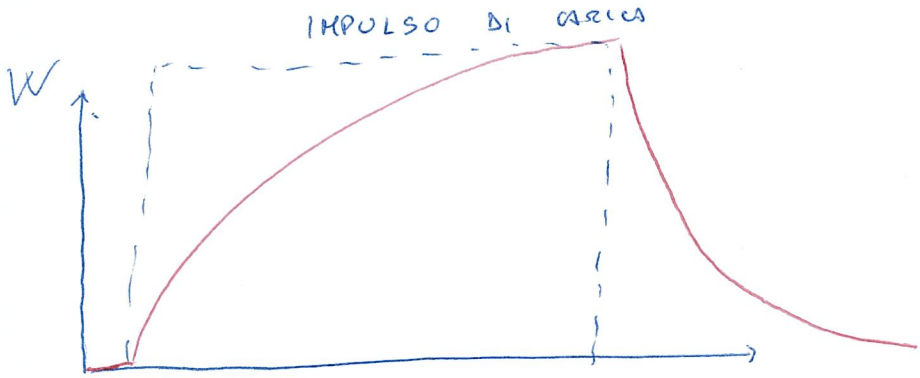
TRANSITORIO IN CAVITÀ

$$-dW = P_d\,dt = \frac{\omega W}{Q}\,dt$$

$$W(t) = W(0)\,e^{-\omega t/Q}$$

SE $W(0) = W_0$

$W(\infty) = 0$



$$W(t) = W(\infty)\left(1 - e^{-\omega t/Q}\right)$$

SE $W(0) = 0$

$W(\infty) = \text{cost}$