General parameters:

$f_0 := 2.9985 \cdot 10^9$ $\quad w_0 := 2 \cdot \pi \cdot f_0$ $\quad k := 1$

Field to power proportionality constant

$\Delta t_{out\_p} := 0.65 \cdot 10^{-6}$ $\quad t_1 := 3.85\ 10^{-6}$ $\quad t_2 := t_1 + \Delta t_{out\_p}$ $\quad t_2 = 4.5 \cdot 10^{-6}$

$Q_{0\_final} := 144 \cdot 10^3$ $\quad \beta_{final} := 7.3$

Coupling factor:

B=Q0/Qe=Pem/Pc

$\beta := 0.1, 0.2 .. 20$

$$Q_L(\beta, Q_0) := \frac{Q_0}{(1+\beta)}$$

Loaded cavity time constant (Tc) and steady-state emitted field (L):

Tc=2+Ql/w

L=2*B/(1+B)

$$T_c(\beta, Q_0) := 2 \cdot \frac{Q_L(\beta, Q_0)}{w_0}$$

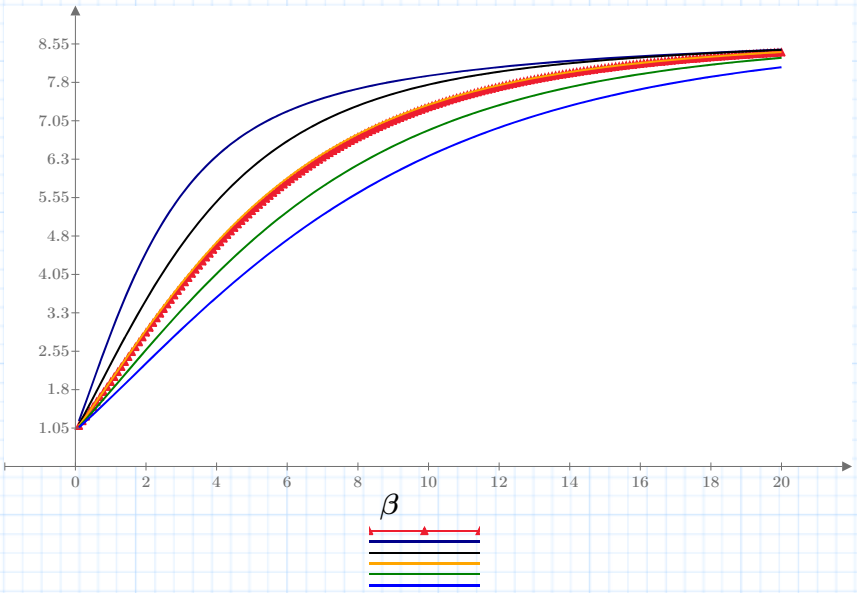
$$\alpha(\beta) := 2 \cdot \frac{\beta}{(1+\beta)}$$

Field calculation:

$$E_{max}(\beta, Q_0) := \alpha(\beta) \cdot \left(1 - \exp\left(\frac{-t_1}{T_c(\beta, Q_0)}\right)\right) + 1$$

$$P_{max}(\beta, Q_0) := k \cdot E_{max}(\beta, Q_0)^2$$

$$Q_{0m} := \begin{bmatrix} 0.6 \cdot 10^5 \\ 0.8 \cdot 10^5 \\ 1 \cdot 10^5 \\ 1.2 \cdot 10^5 \\ 1.4 \cdot 10^5 \\ 1.6 \cdot 10^5 \\ 1.8 \cdot 10^5 \\ 2 \cdot 10^5 \\ 2.2 \cdot 10^5 \\ 2.4 \cdot 10^5 \\ 2.6 \cdot 10^5 \end{bmatrix}$$



$P_{max}(\beta, Q_{0\_final})$

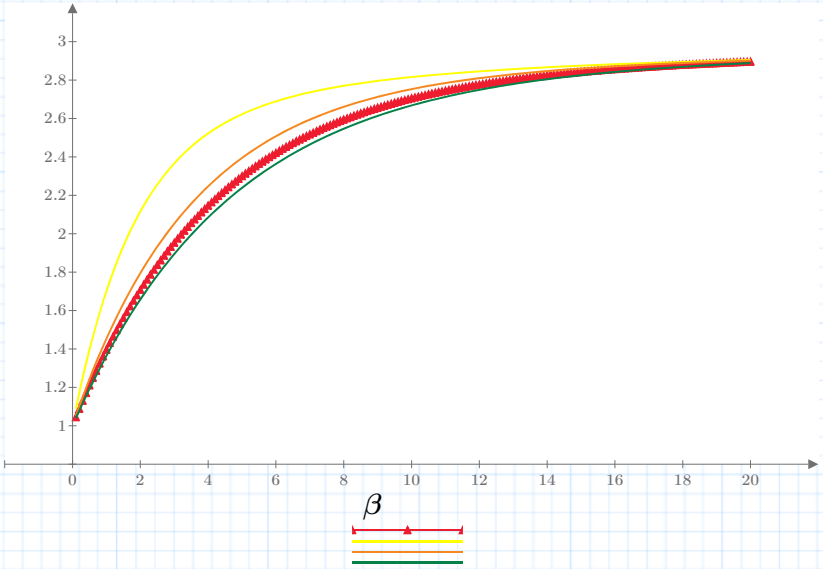
$P_{max}(\beta, Q_{0m_0})$

$P_{max}(\beta, Q_{0m_2})$

$P_{max}(\beta, Q_{0m_4})$

$P_{max}(\beta, Q_{0m_6})$

$P_{max}(\beta, Q_{0m_8})$



$E_{max}(\beta, Q_{0\_final})$

$E_{max}(\beta, Q_{0m_0})$

$E_{max}(\beta, Q_{0m_3})$

$E_{max}(\beta, Q_{0m_5})$

Compressed pulse energy calculation:

$$E_{out\_compressed}(t, \beta, Q_0) := \alpha(\beta) \cdot \left(\left(2 - \exp\left(\frac{-t_1}{T_c(\beta, Q_0)} \right) \right) \exp\left(\frac{-(t - t_1)}{T_c(\beta, Q_0)} \right) - 1 \right) + 1$$

$E_{out\_compressed}(t, \beta_{final}, Q_{0\_final})$

$E_{out\_compressed}(t, 5, Q_{0m_6})$

$E_{out\_compressed}(t, 7, Q_{0m_6})$

$E_{out\_compressed}(t, 9, Q_{0m_8})$

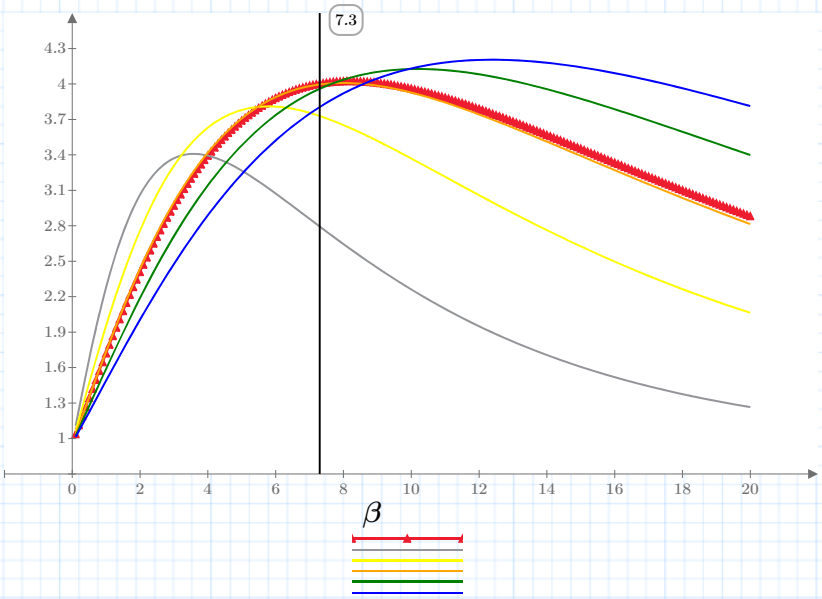
$$\xi(\beta, Q_0) := \int_{t_1}^{t_2} \left(E_{out\_compressed}(t, \beta, Q_0) \right)^2 dt$$

$$\eta_{eff\_phaseflip} := 0.96$$

$$\xi_{out\_pulse\_avg}(\beta, Q_0) := \frac{\xi(\beta, Q_0)}{\Delta t_{out\_p}} \cdot \eta_{eff\_phaseflip}$$

$$\xi_{out\_pulse\_avg}(\beta_{final}, Q_{0\_final}) = 4.002$$

Coupling factor and Q analysis



$\xi_{out\_pulse\_avg}(\beta, Q_{0\_final})$

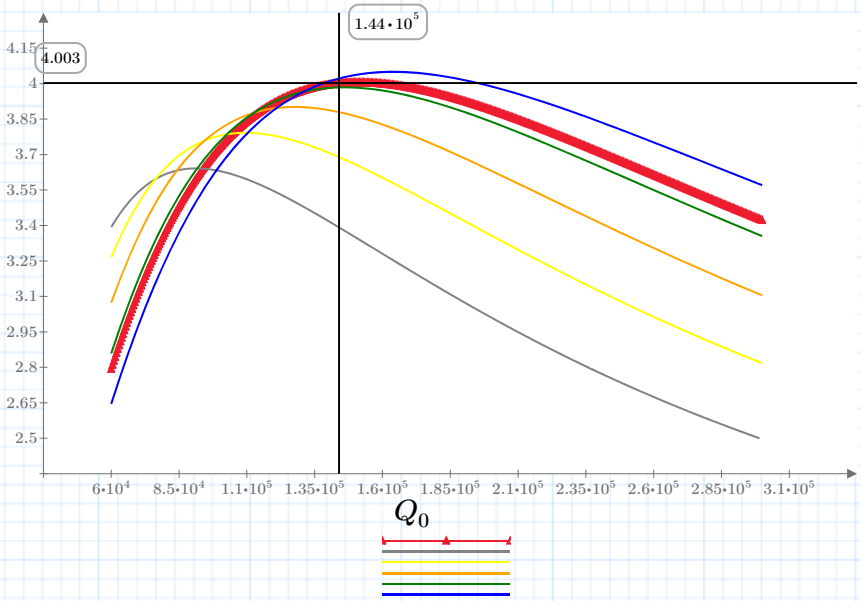
$\xi_{out\_pulse\_avg}(\beta, Q_{0m_0})$

$\xi_{out\_pulse\_avg}(\beta, Q_{0m_2})$

$\xi_{out\_pulse\_avg}(\beta, Q_{0m_4})$

$\xi_{out\_pulse\_avg}(\beta, Q_{0m_6})$

$\xi_{out\_pulse\_avg}(\beta, Q_{0m_8})$



$\xi_{out\_pulse\_avg}(\beta_{final}, Q_0)$

$\xi_{out\_pulse\_avg}(4, Q_0)$

$\xi_{out\_pulse\_avg}(5, Q_0)$

$\xi_{out\_pulse\_avg}(6, Q_0)$

$\xi_{out\_pulse\_avg}(7, Q_0)$

$\xi_{out\_pulse\_avg}(8, Q_0)$

SLED in use:

Params definition

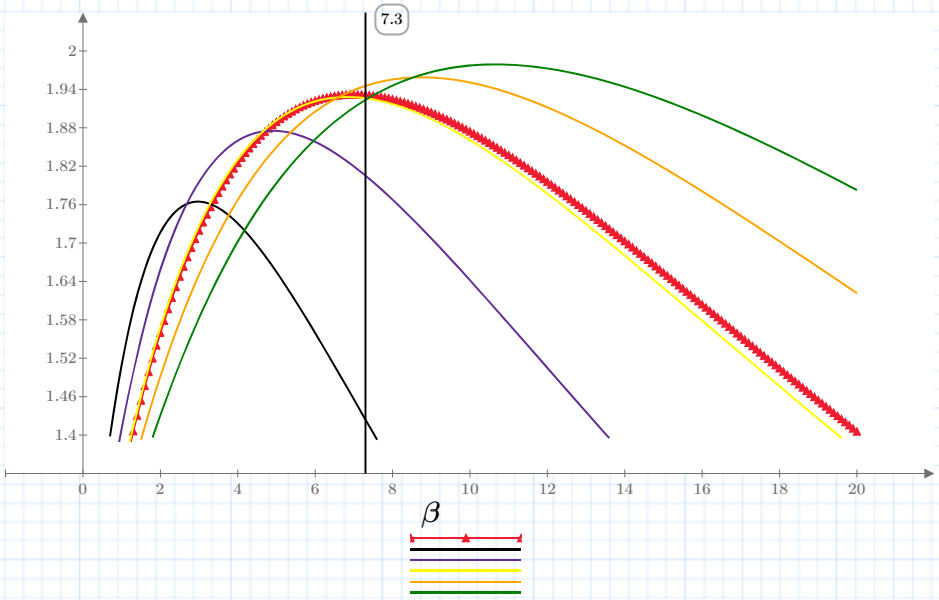
$g := 0.681$ Slope of structure group velocity

$T_f := \Delta t_{out\_p}$ Structure filling time

$$C_p(\beta, Q_0) := 1 + \frac{T_f}{T_c(\beta, Q_0) \cdot \ln(1-g)}$$

$$V_{max}(\beta, Q_0) := \frac{\alpha(\beta)}{g \cdot C_p(\beta, Q_0)} \cdot \exp\left(\frac{-T_f}{T_c(\beta, Q_0)}\right)\left(2 - \exp\left(\frac{-t_1}{T_c(\beta, Q_0)}\right)\right) \cdot \left(1 - (1-g)^{C_p(\beta, Q_0)}\right) - \alpha(\beta) + 1$$

$V_{max}(\beta_{final}, Q_{0\_final}) = 1.931$



$V_{max}(\beta, Q_{0\_final})$

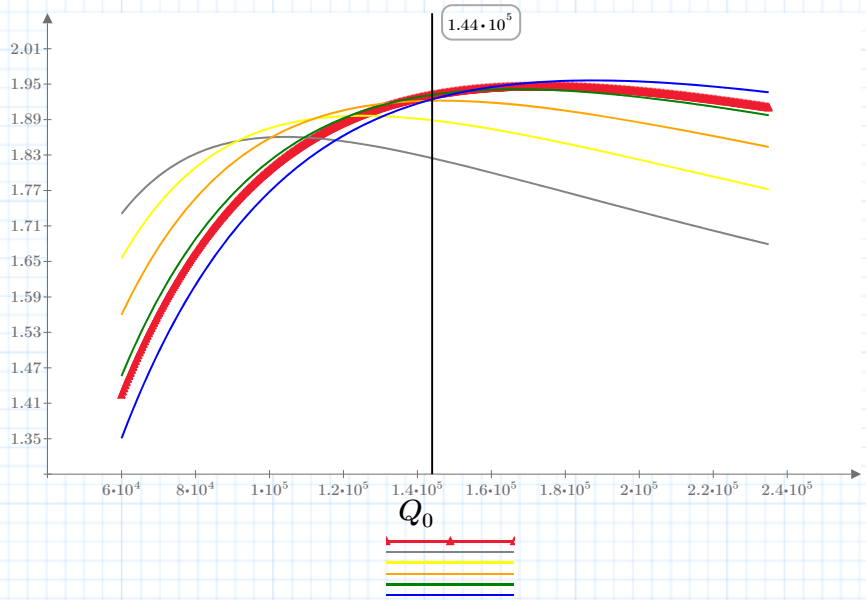
$V_{max}(\beta, Q_{0m_0})$

$V_{max}(\beta, Q_{0m_2})$

$V_{max}(\beta, Q_{0m_4})$

$V_{max}(\beta, Q_{0m_6})$

$V_{max}(\beta, Q_{0m_8})$



$V_{max}(\beta_{final}, Q_0)$

$V_{max}(4, Q_0)$

$V_{max}(5, Q_0)$

$V_{max}(6, Q_0)$

$V_{max}(7, Q_0)$

$V_{max}(8, Q_0)$

Spherical cavity dimensioning:

$Q_{0\_opt} := 1.8 \cdot 10^5$

$\delta_{Cu}(f) := \frac{0.066}{\sqrt{f}}$ skin effect of copper

$\delta_{Cu\_f0} := \delta_{Cu}(f_0)$ $\delta_{Cu\_f0} = 1.205 \cdot 10^{-6}$

1.195 @ 3 GHz according to other sources

$a := Q_{0\_opt} \cdot \delta_{Cu\_f0} \cdot m = 0.217\ m$ sphere radius

$u_{np} := 14.066$

$f_{res} := \frac{u_{np}}{2 \cdot \pi \cdot a \cdot \sqrt{\varepsilon_0 \cdot \mu_0}} = (3.093 \cdot 10^9)\ \frac{1}{m} \cdot \frac{m}{s}$