

Cavity spectrum: plan/curved mirror

Calculates the cavity spectrum and the frequency distance between TEM₀₀ and higher order modes m+n. Two curved mirrors possible. Programm made by T. Legero.

Parameter

- Radius of curvature of mirror R1: R1= 1 m
- Radius of curvature of mirror R2: R2= 1000000000 m
- Cavity Length: L= 0.48 m
- Reflectivity of mirrors: R= 0.99998
- Speed of light: c= 299792458 m/s

Step 1: Calculate the Free-Spectral-Rang and Gouy-Phase

- Free-Spectral-Rang: FSR
- Gouy-Phase: Gouy

$$FSR = \frac{c}{2 \cdot L} \quad Gouy = \frac{FSR}{\pi} \cdot \arccos \left(\sqrt{\left(1 - \frac{L}{R1}\right) \cdot \left(1 - \frac{L}{R2}\right)} \right)$$

⇒

- FSR = 312.284 MHz
- Gouy = 76.0824 MHz

Step 2: Calculate the frequency difference between TEM₀₀ and TEM_{mn}

- TEM mode number: mn
- Next TEM₀₀: w
- Frequency difference between TEM₀₀ and TEM_{mn}: Delta

$$\Delta = FSR - mn \cdot Gouy$$

- Define maximum of mn and w:
 - mn_{max} = 100
 - w_{max} = 100
- Define maximum of shown frequency difference to TEM₀₀:
 - abs(delta(mn,w)) < 10E6
- Frequency difference von (q-w)ter höherer Mode mn zu q-ter TEM₀₀-Mode (Matrix):

$$\Delta(mn,w) = w \cdot FSR - mn \cdot Gouy$$

⇒

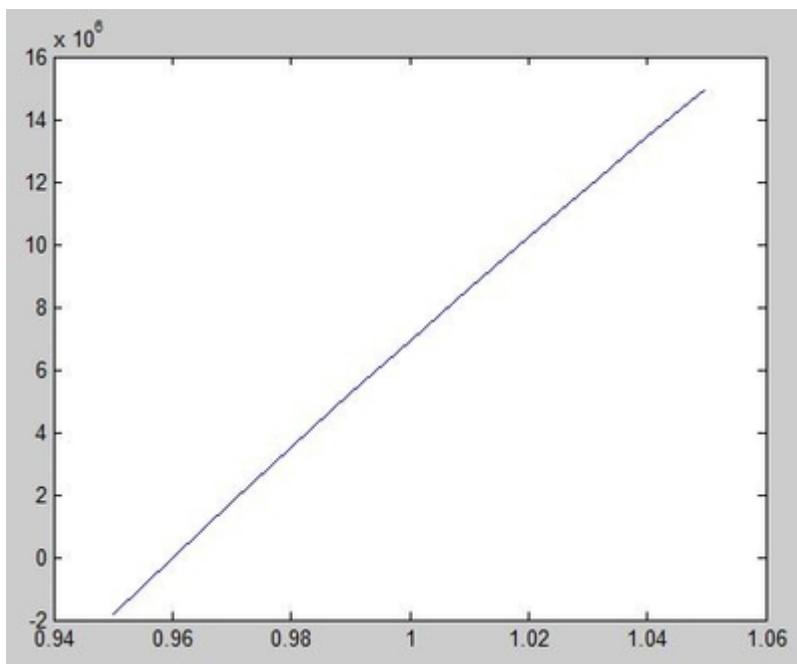
Freq. diff. of $m+n = 4$ higher order mode to 00-mode is 7.95436 MHz
 Freq. diff. of $m+n = 37$ higher order mode to 00-mode is -4.49309 MHz
 Freq. diff. of $m+n = 41$ higher order mode to 00-mode is 3.46128 MHz
 Freq. diff. of $m+n = 74$ higher order mode to 00-mode is -8.98616 MHz
 Freq. diff. of $m+n = 78$ higher order mode to 00-mode is -1.03181 MHz
 Freq. diff. of $m+n = 82$ higher order mode to 00-mode is 6.92256 MHz

Step 3: Calculate the frequency difference between TEM₀₀ and the nearest TEM_{mn}

- Define the Modenumber of Higher-Order-Mode to plot (next Mode to 00):
 - $mn = 4$
- Define the Vary Mirror-Curvature:
 - $R = 0.95:0.01:1.05$
- Frequency difference between TEM₀₀ and TEM_{mn}:

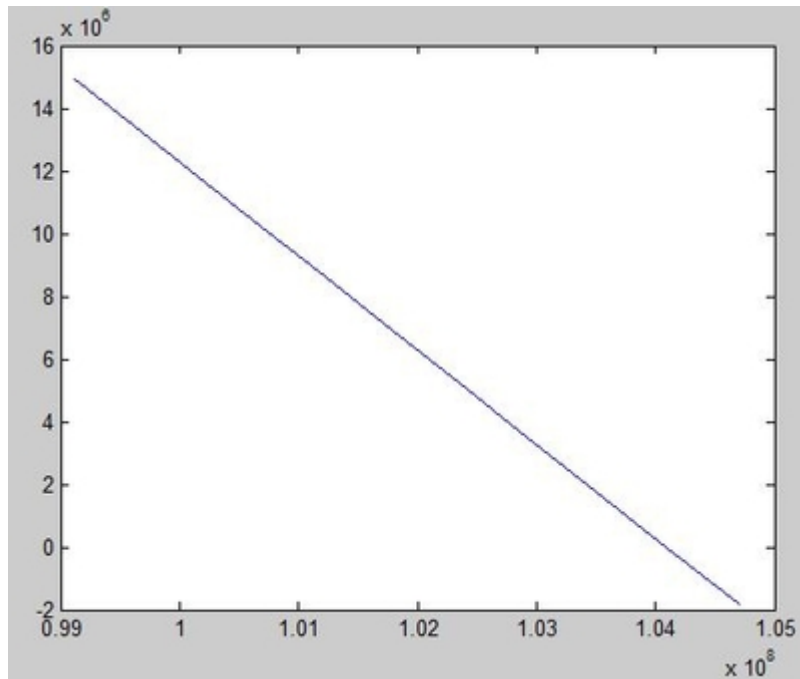
$$\Delta = \text{FSR} - mn \cdot \text{Gouy}$$

- `plot(R,Delta)` **[Important!]**:

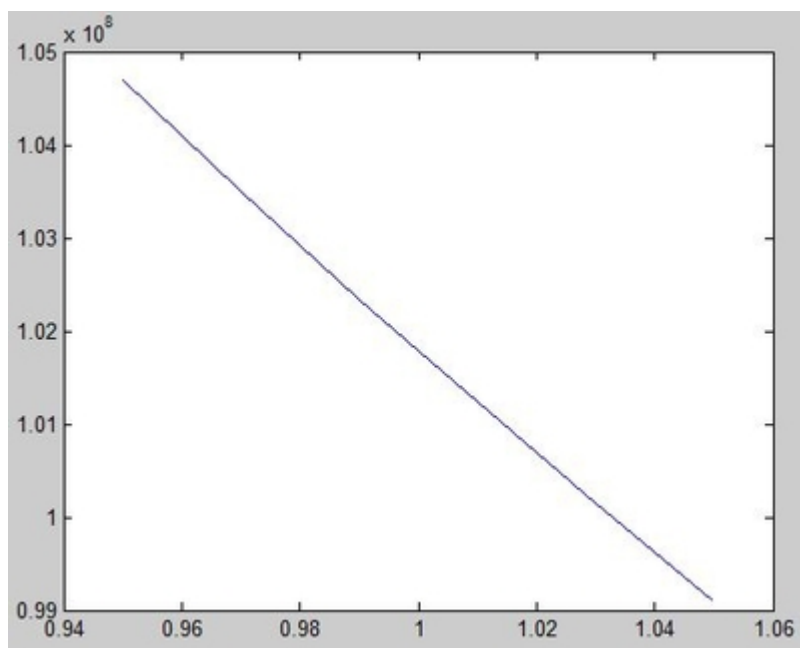


Achtung: ROC wird hoffentlich >1m werden, damit die $m+n = 3$ Mode weiter weg ist!

- `plot(Gouy,Delta)`:



- plot(R,Gouy):



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