



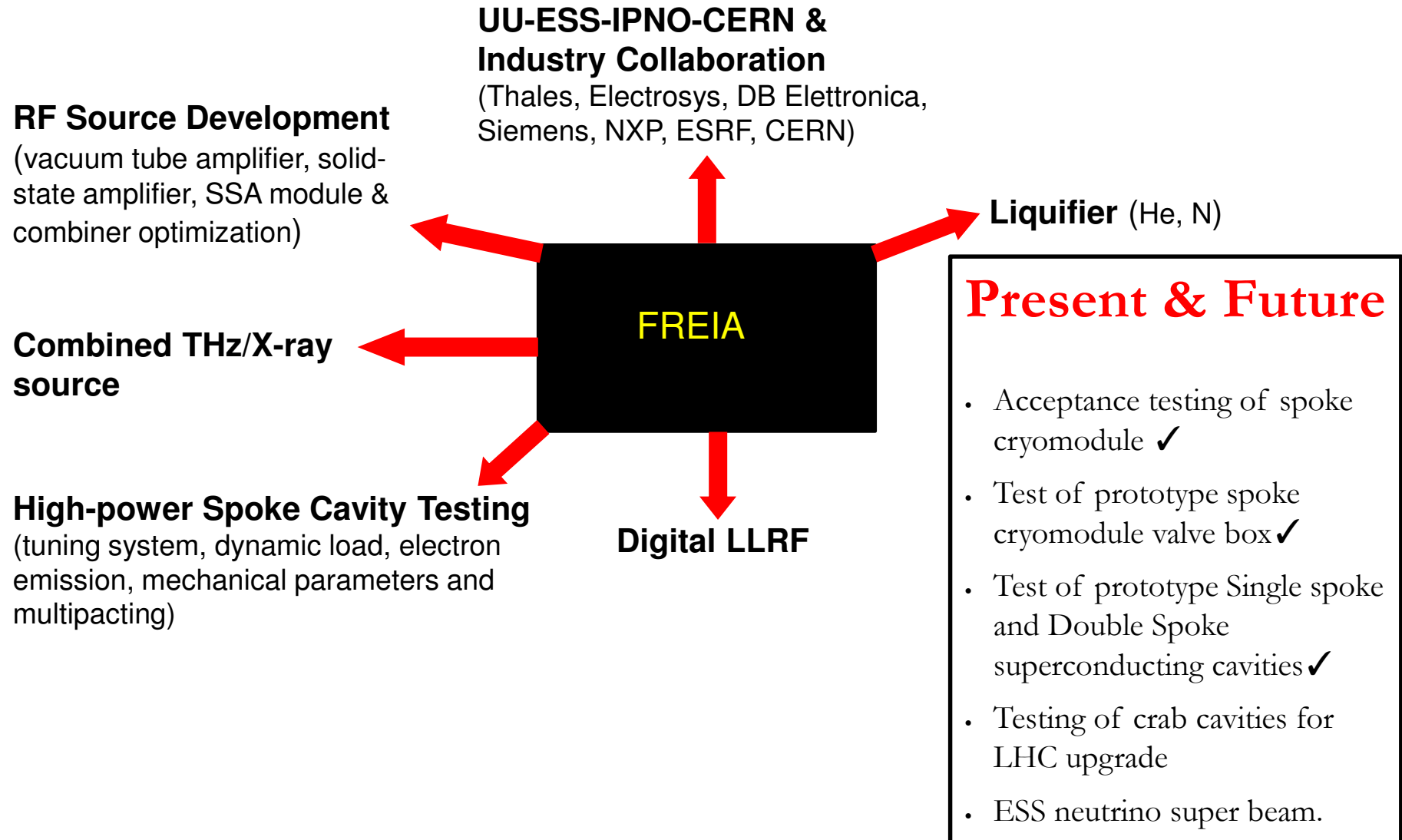
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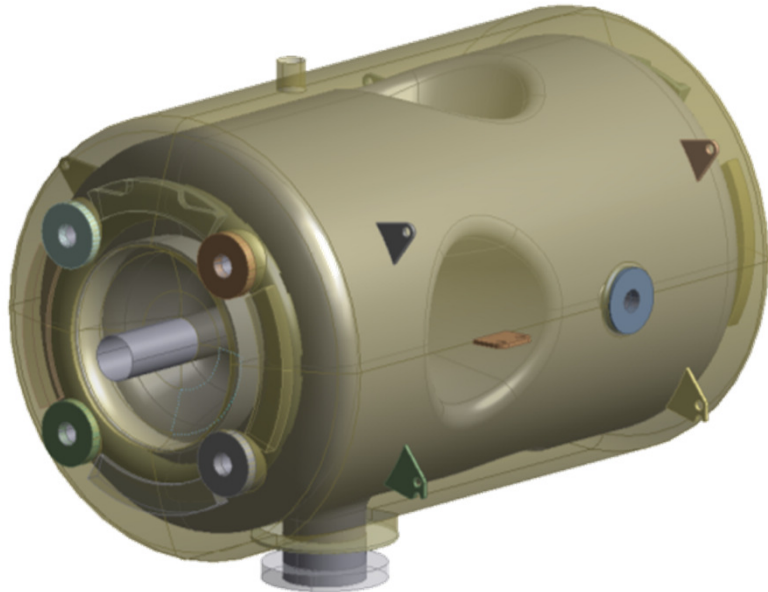
High-precision measurements of Superconducting cavities

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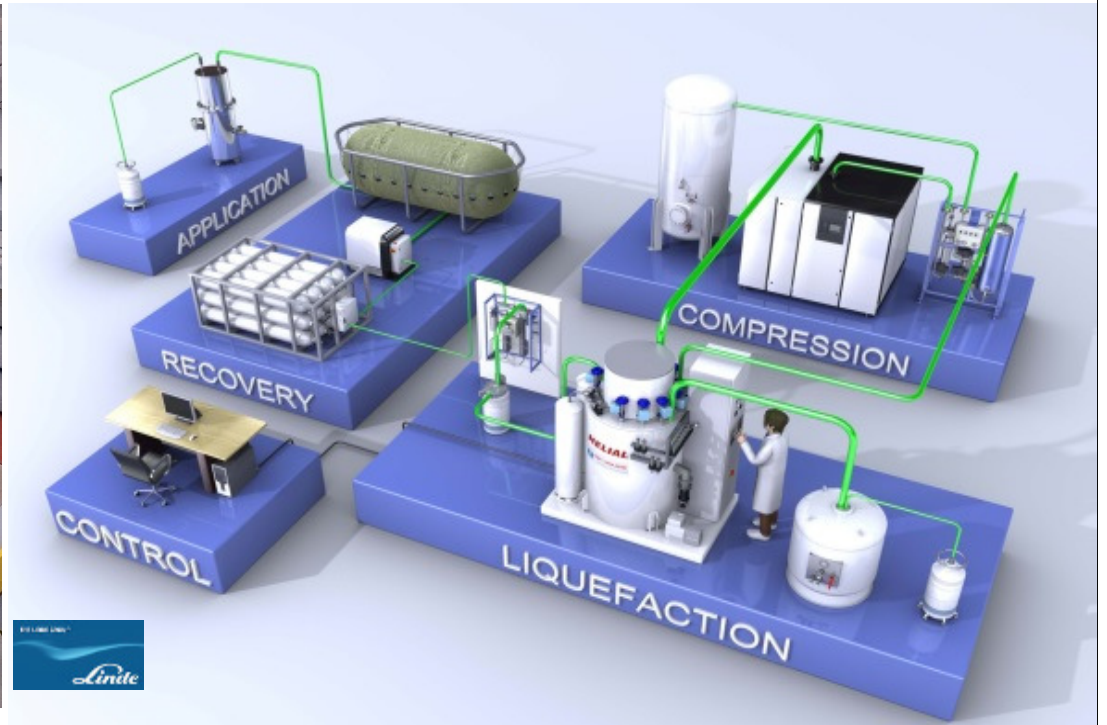




Courtesy of P. Duthil

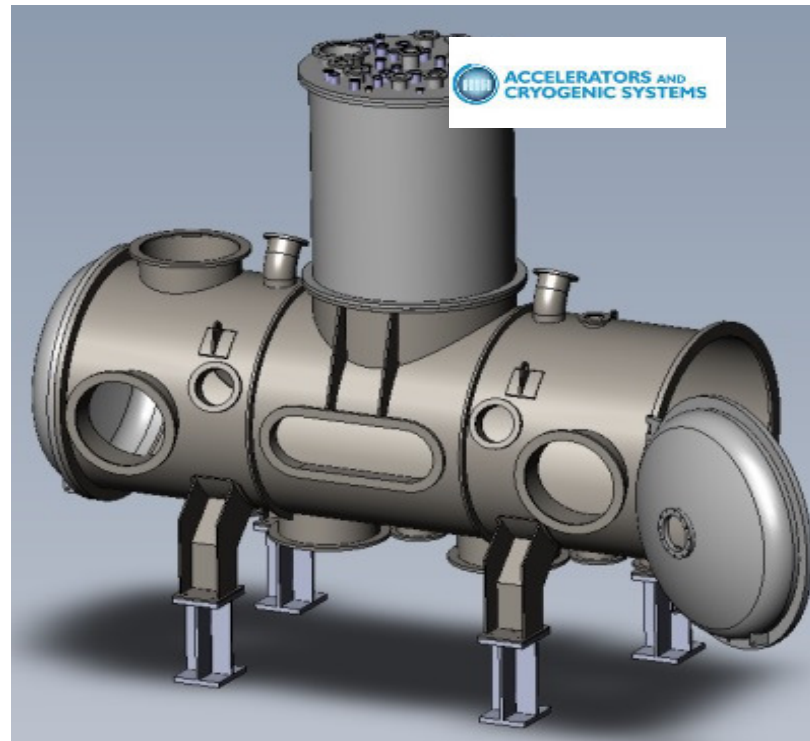


Spoke Cavity
(super - conducting)





Horizontal Cryostat

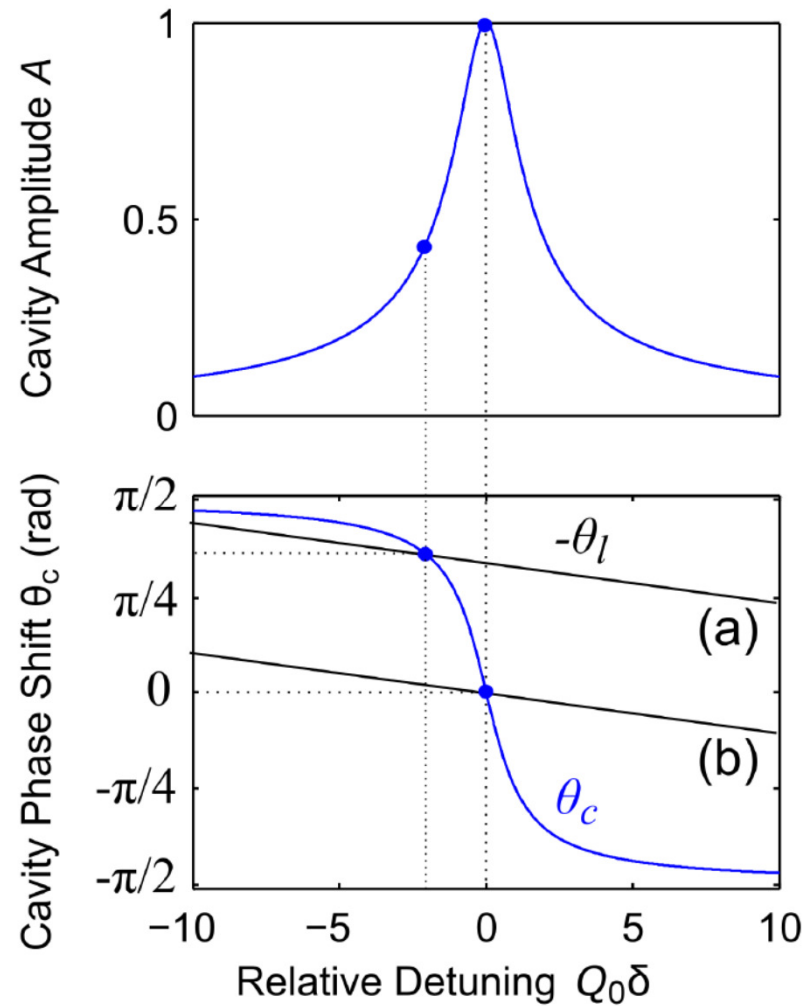


Courtesy of P. Duthil

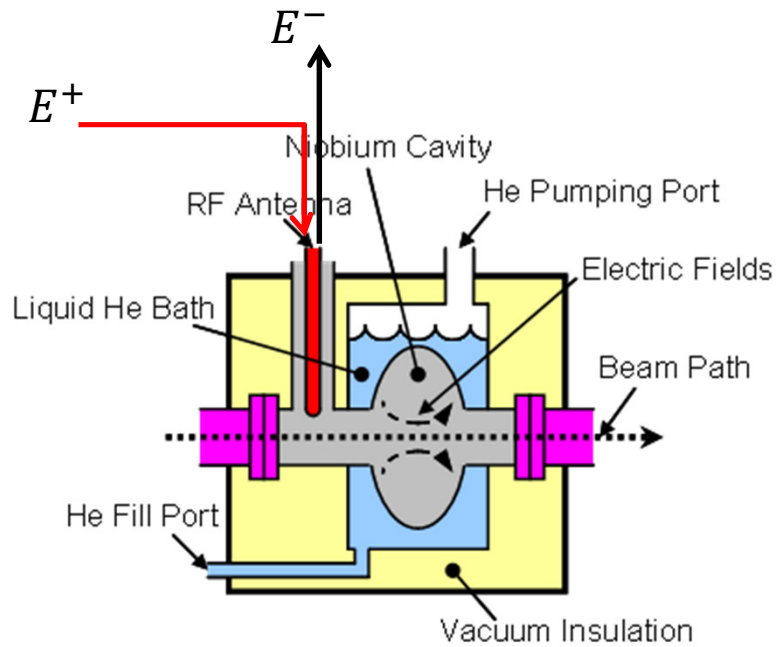


Spoke Cavity
(super - conducting)

$$\ddot{V} + \frac{\omega_c}{Q_L} \dot{V} + \omega_c^2 V = 2\omega_c (R/Q) I_i \quad Q_L = (Q_0^{-1} + Q_{ext}^{-1})^{-1}$$



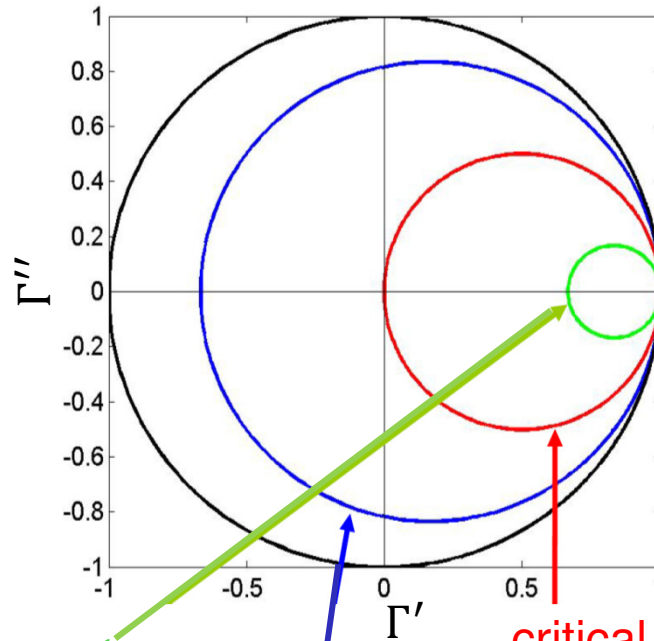
Reflection coefficient



$$\Gamma = \frac{E^-}{E^+} = \frac{\kappa - 1 + iQ_0\delta}{\kappa + 1 - iQ_0\delta}$$

$$\delta = \frac{Q_{ext} + Q_0}{Q_{ext}Q_0} \tan \theta_c$$

$$\left(\Gamma' + \frac{1}{1 + \kappa}\right)^2 + \Gamma''^2 = \left(\frac{\kappa}{1 + \kappa}\right)^2$$



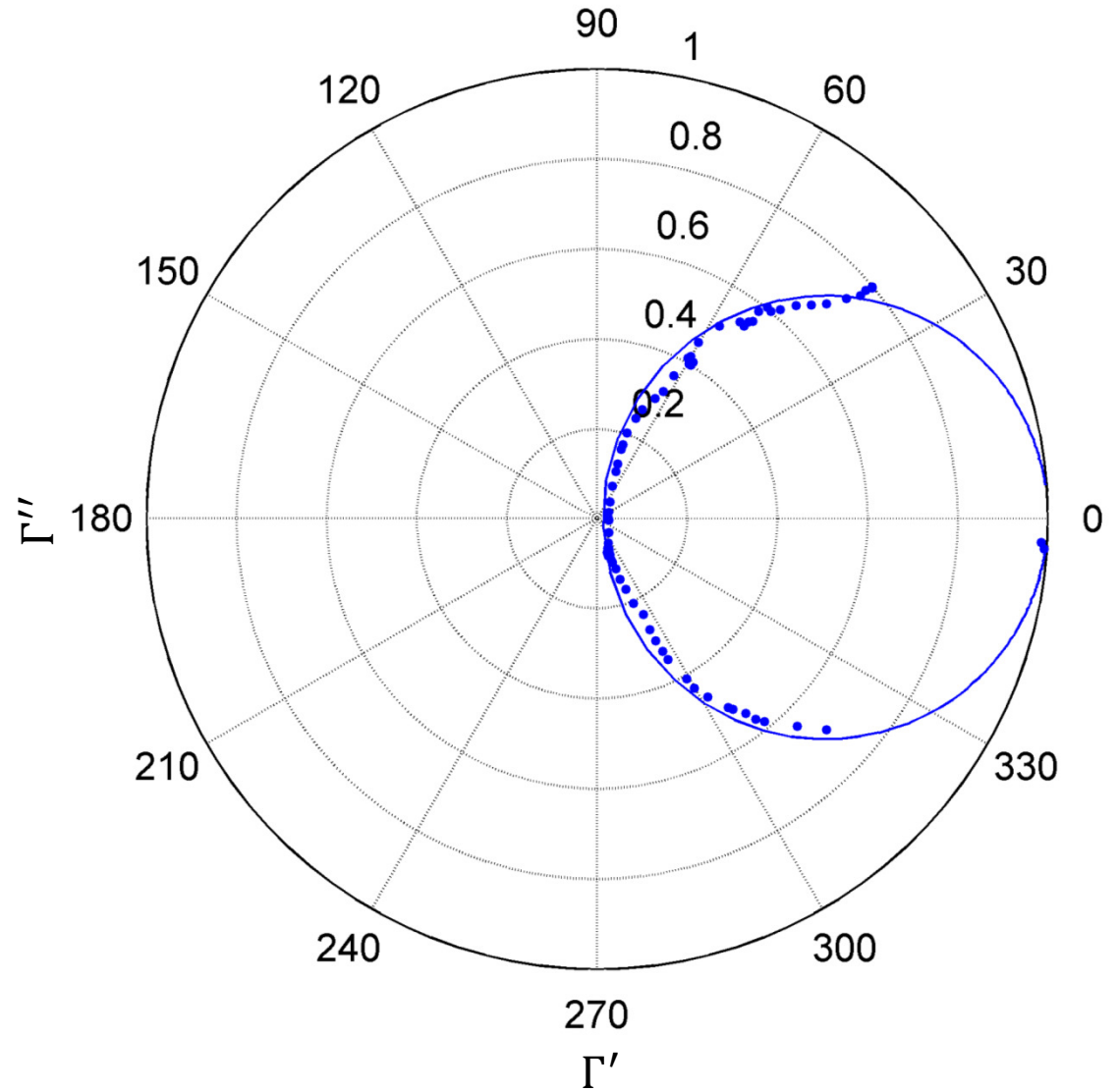
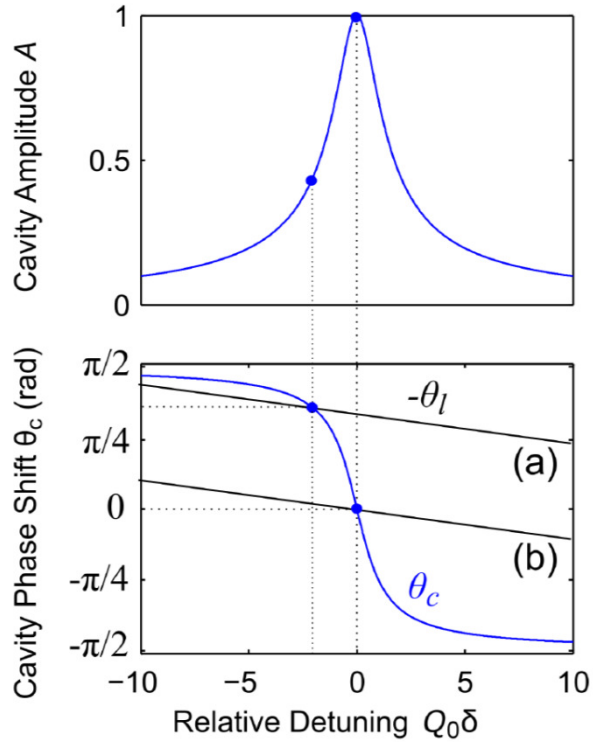
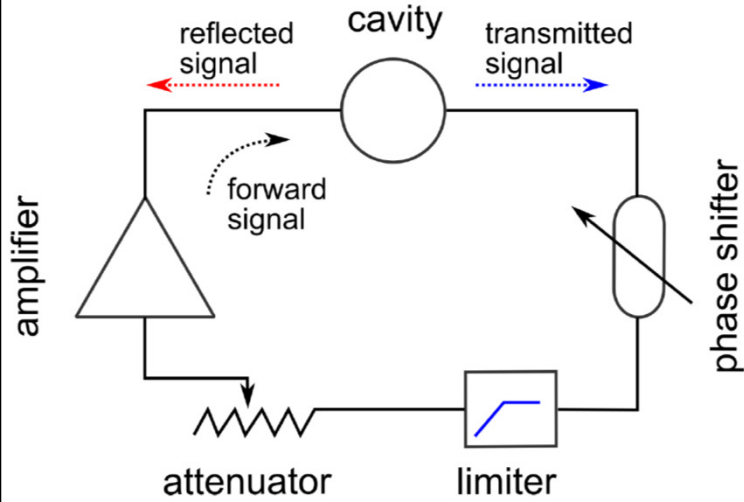
$$\kappa = \frac{Q_0}{Q_{ext}} = \frac{1}{\frac{1}{r} - 1}$$

under coupling $\kappa < 1$

over coupling $\kappa > 1$

critical coupling $\kappa = 1$

Normal conducting cavity

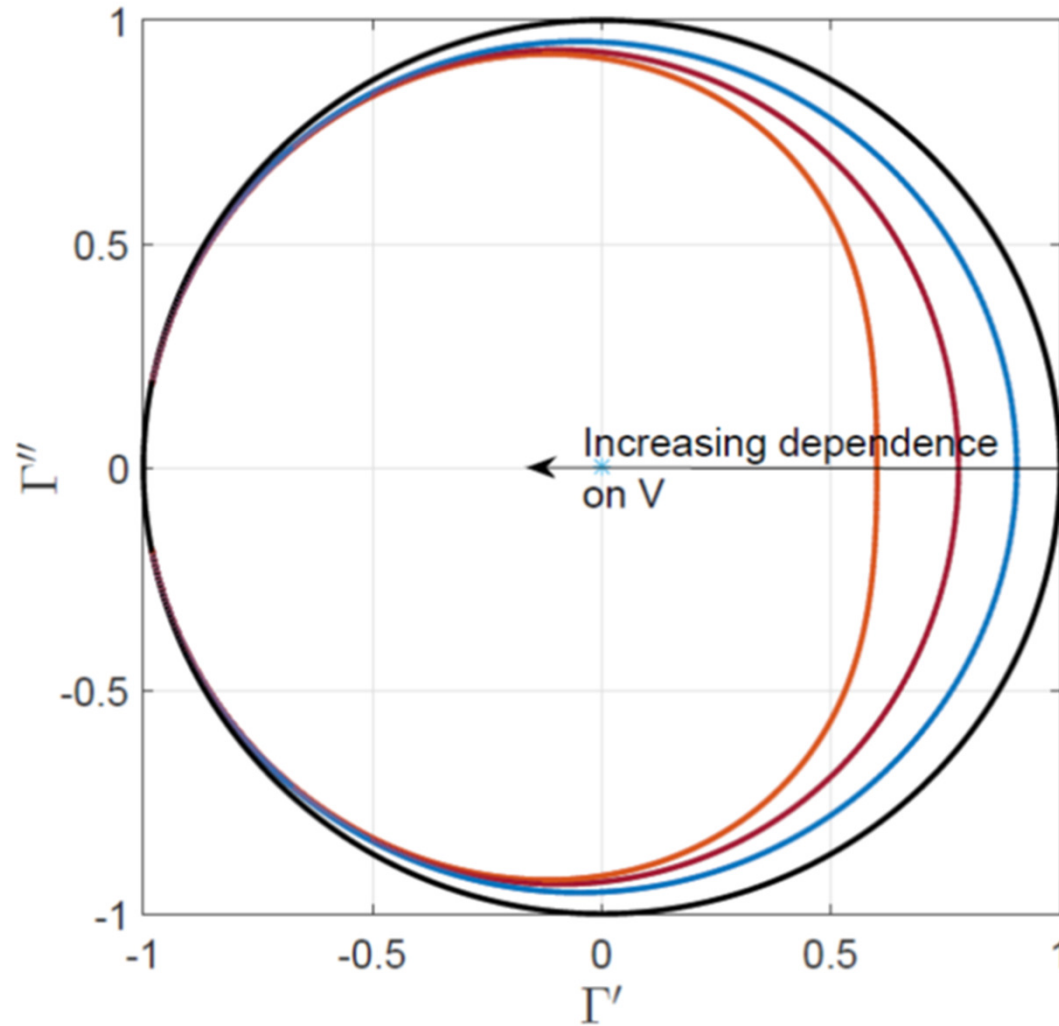


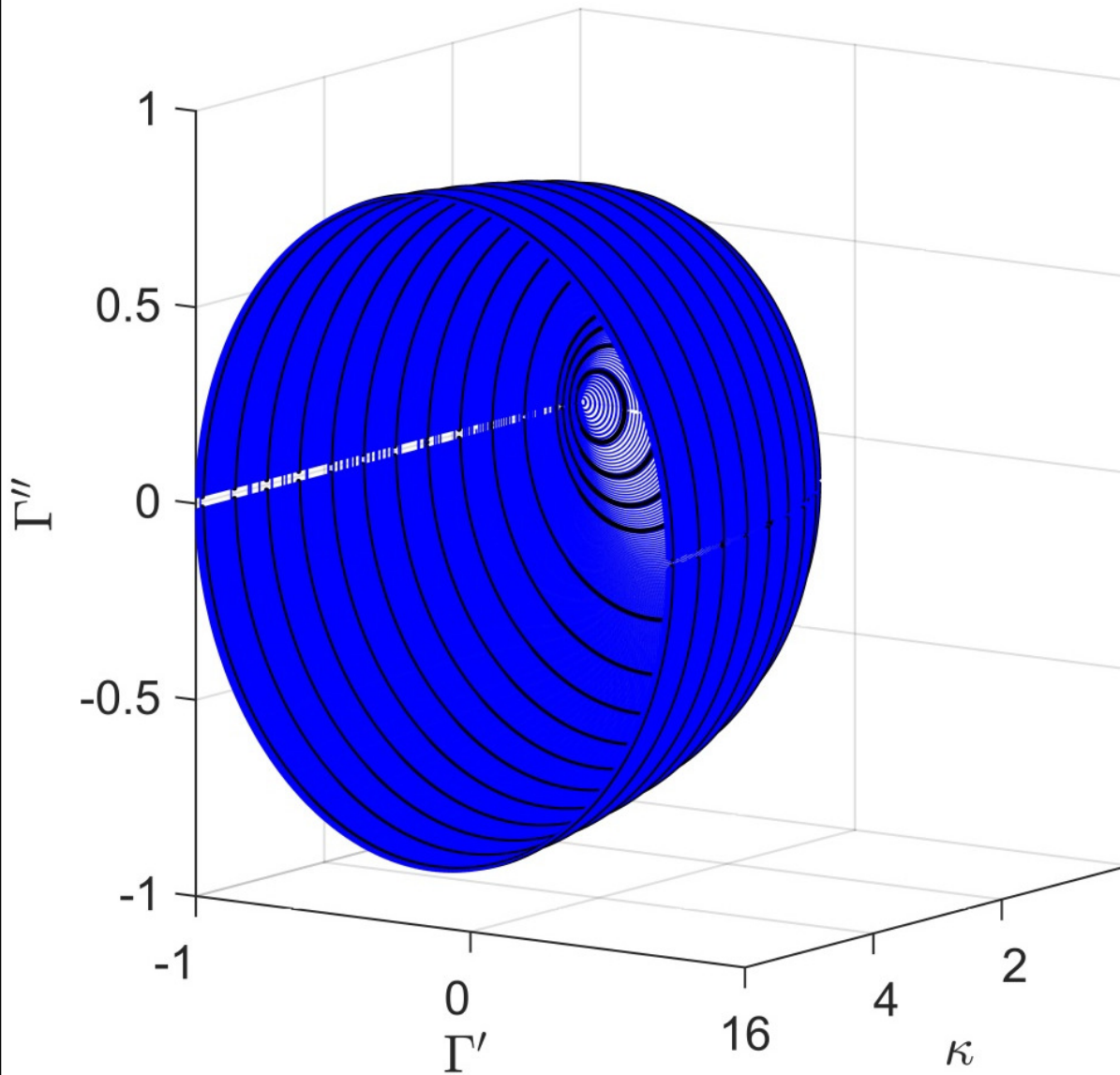
Superconducting cavity



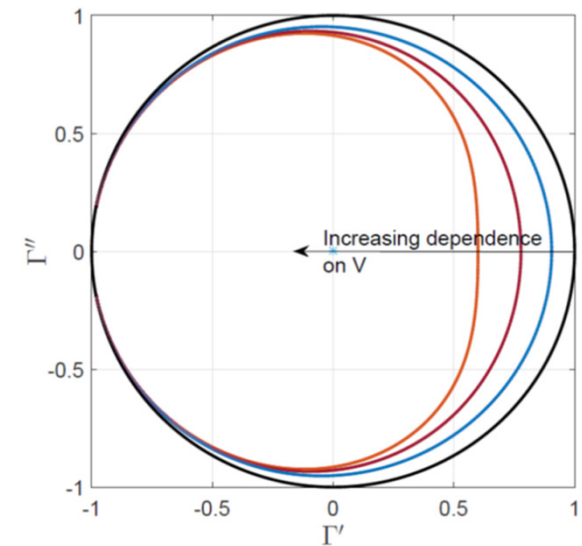
$$\left(\Gamma' + \frac{1}{1 + \kappa}\right)^2 + \Gamma''^2 = \left(\frac{\kappa}{1 + \kappa}\right)^2$$

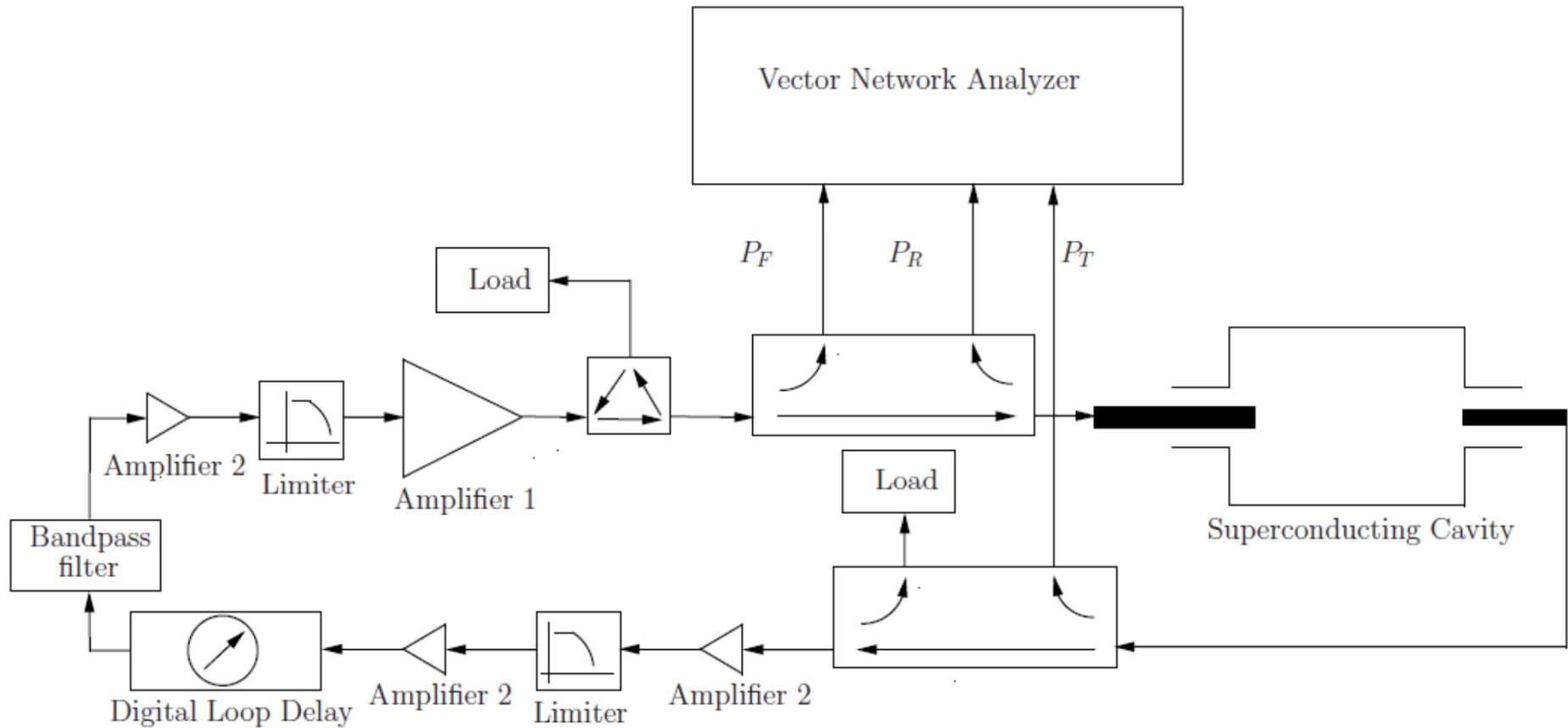
$$\kappa = \frac{Q_0(V)}{Q_{ext}}$$





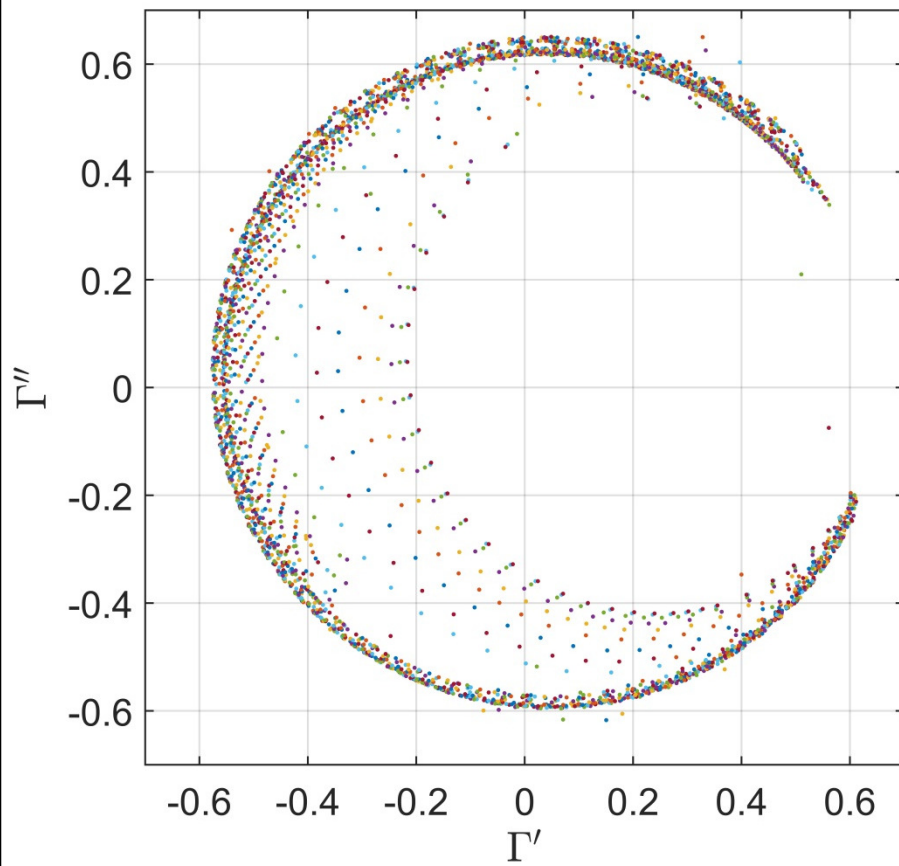
$$\left(\Gamma' + \frac{1}{1 + \kappa}\right)^2 + \Gamma''^2 = \left(\frac{\kappa}{1 + \kappa}\right)^2$$



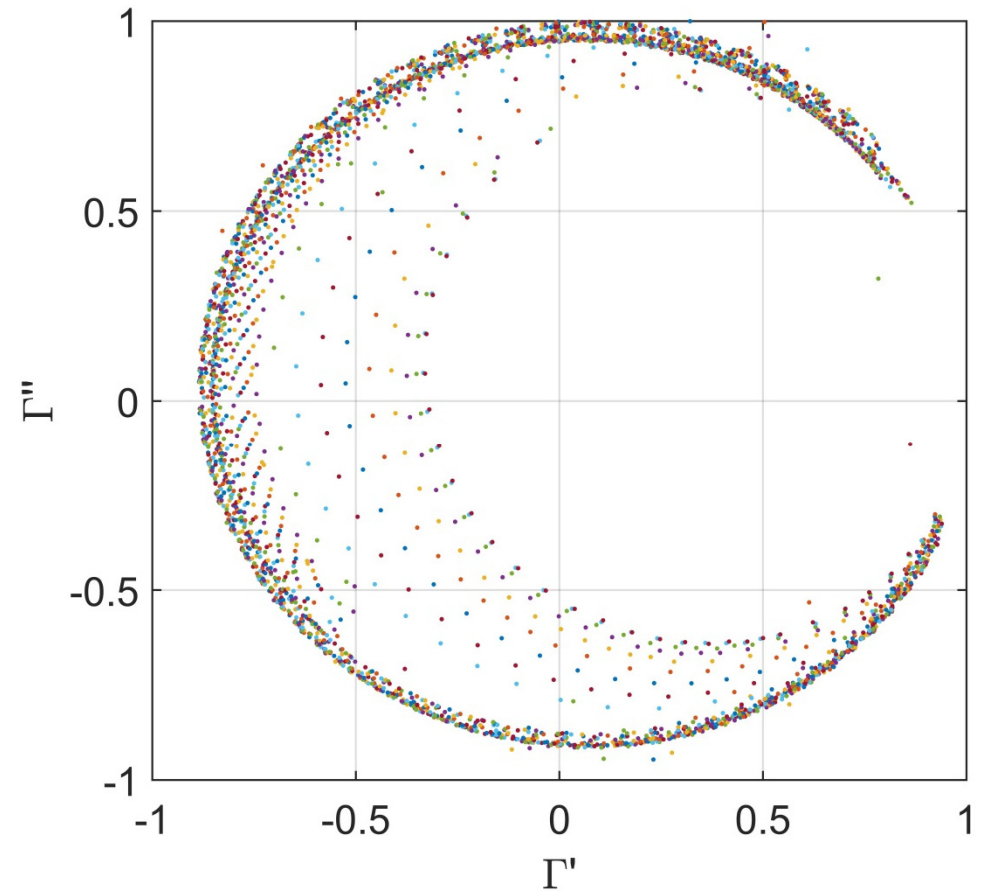




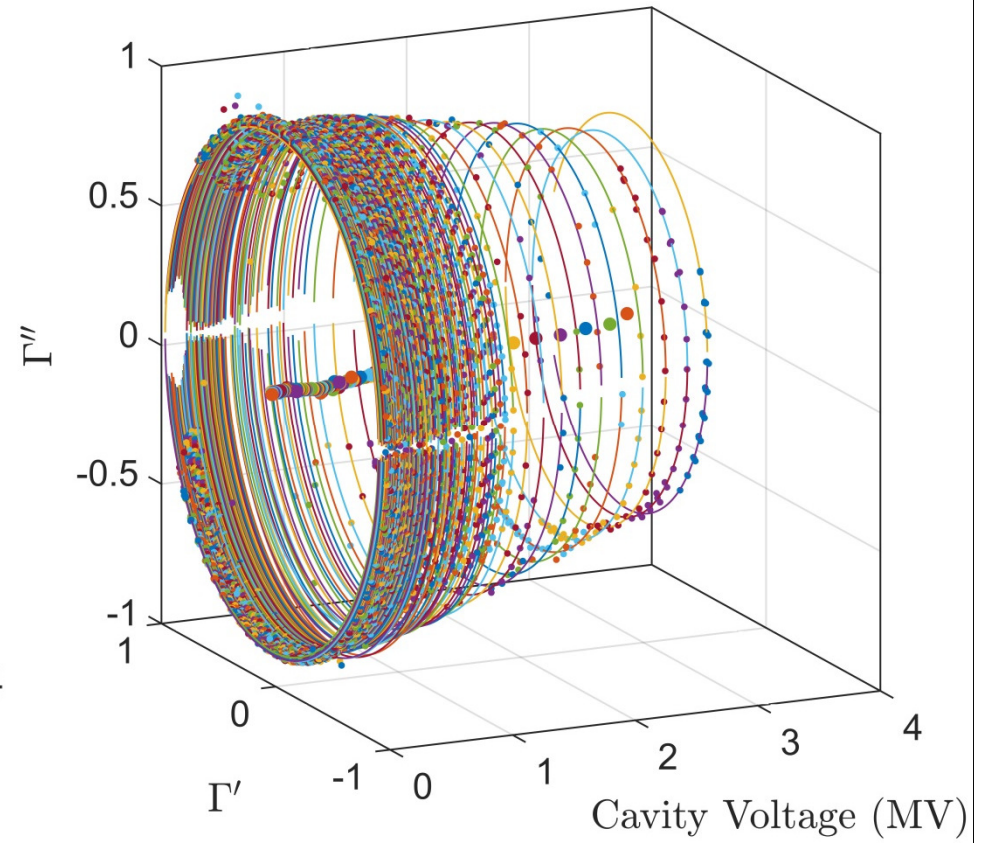
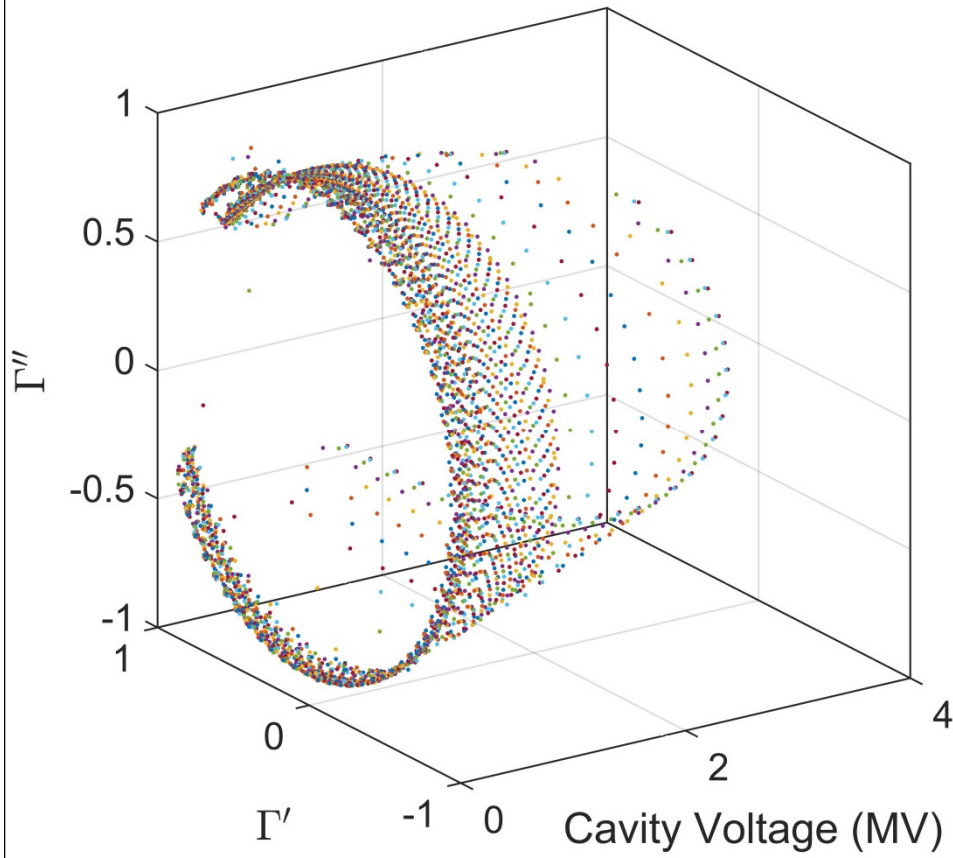
Before cable compensation



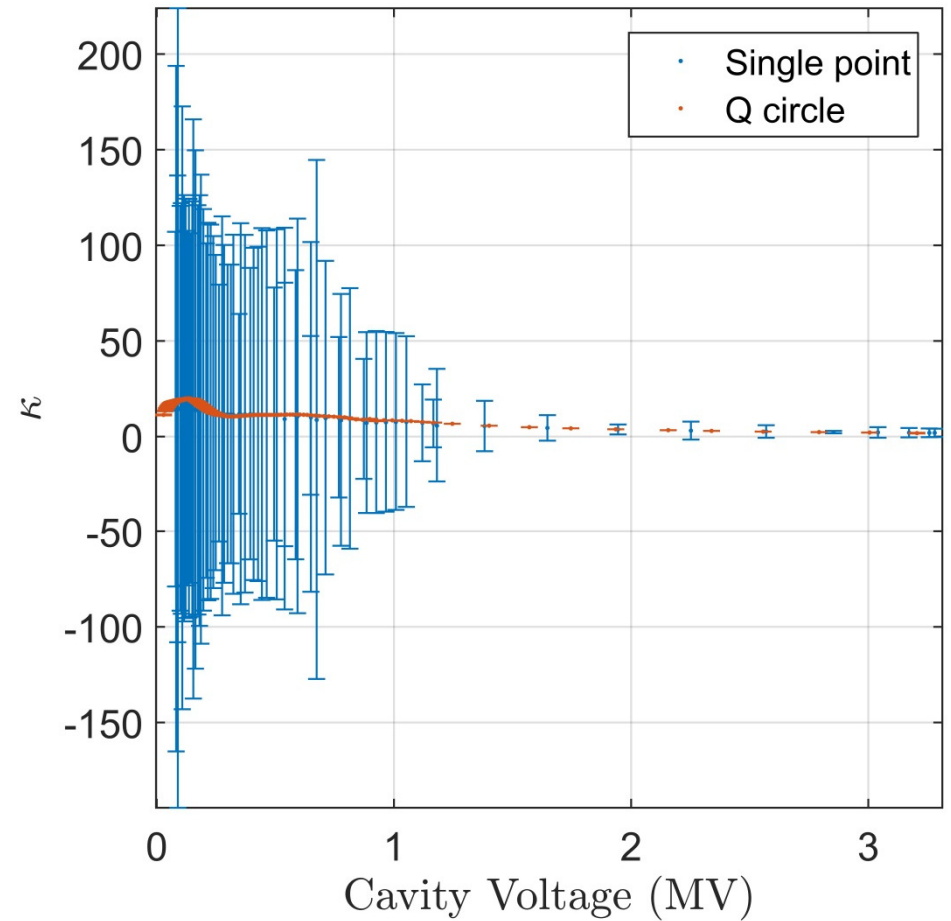
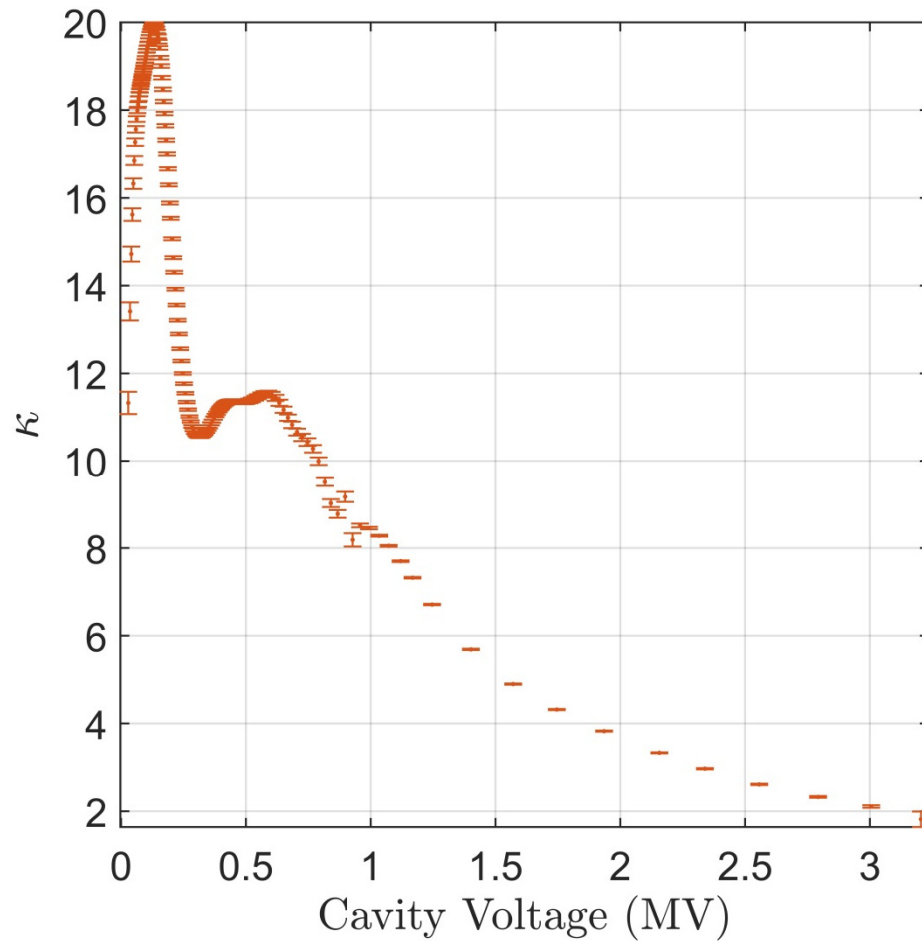
After cable compensation



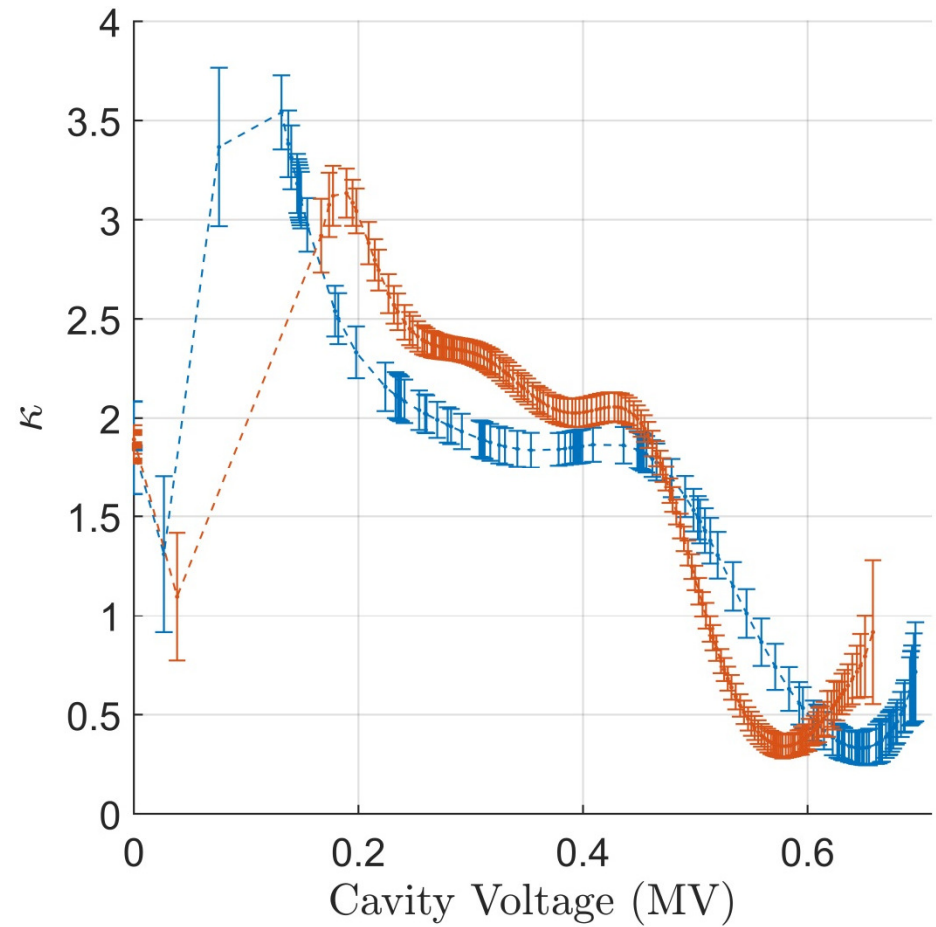
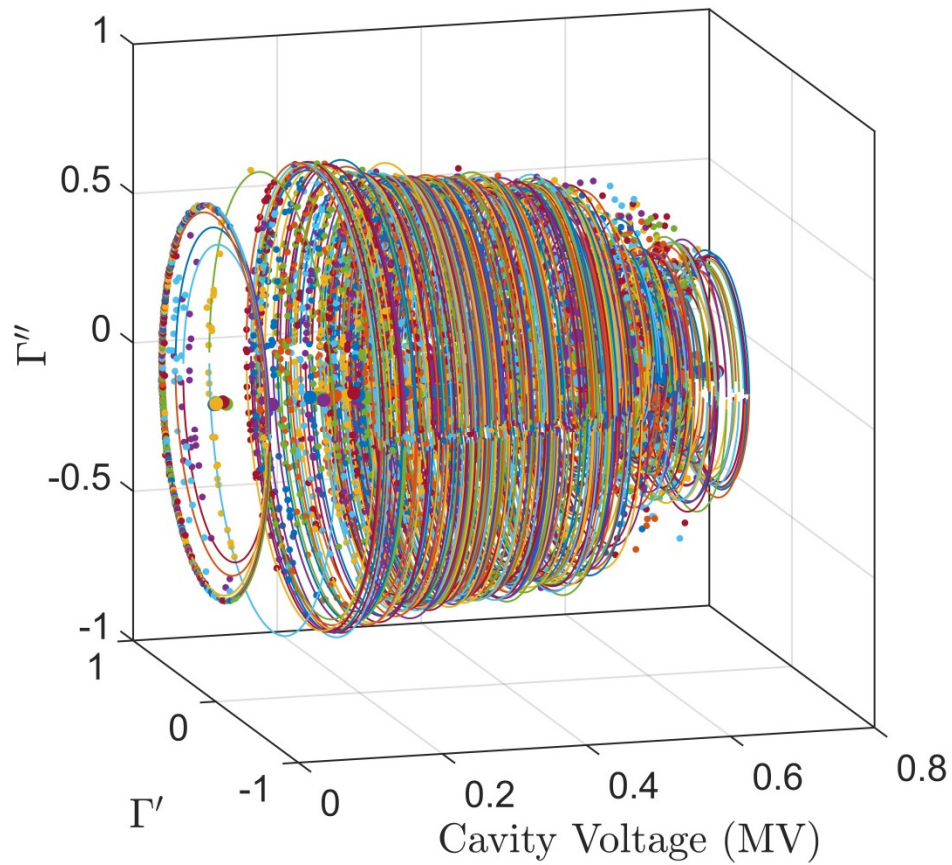
Q-surface



Double-spoke cavity



Single-spoke cavity





THANK YOU

Digital loop delay

