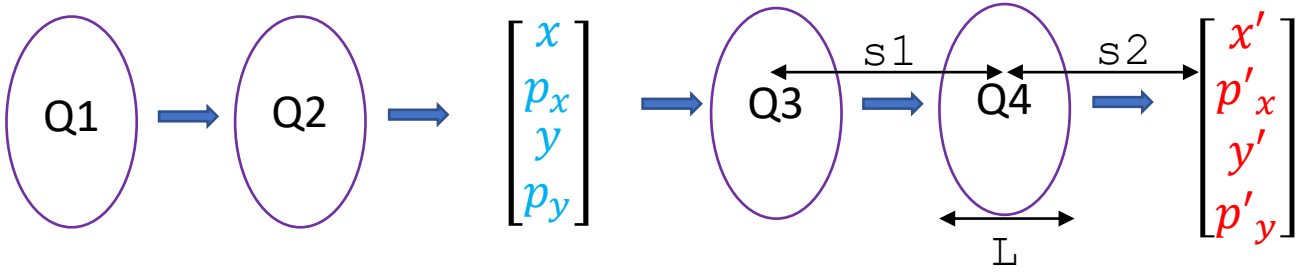
Slice Emittance Measurement

KS

29/7/2022



$$\therefore \begin{bmatrix} m_{11} & m_{12} \\ m_{21} & m_{22} \end{bmatrix} \begin{bmatrix} \omega_{11} & \omega_{12} \\ \omega_{21} & \omega_{22} \end{bmatrix} \begin{bmatrix} x \\ p_x \\ y \\ p_y \end{bmatrix} = \begin{bmatrix} x' \\ p'_x \\ y' \\ p'_y \end{bmatrix}$$

Machine Parameters

Vertical

$$\sqrt{\sigma'_y} = \frac{y'_{rms}}{\omega_{12}} \qquad \xi = \frac{\omega_{11}}{\omega_{12}}$$

$$\sigma'_y = a_y \xi^2 + b_y \xi + c_y$$

Horizontal

$$\sqrt{\sigma'_x} = \frac{x'_{rms}}{m_{12}} \qquad \upsilon = \frac{m_{11}}{m_{21}}$$

$$\sigma'_x = a_x \upsilon^2 + b_x \upsilon + c_x$$

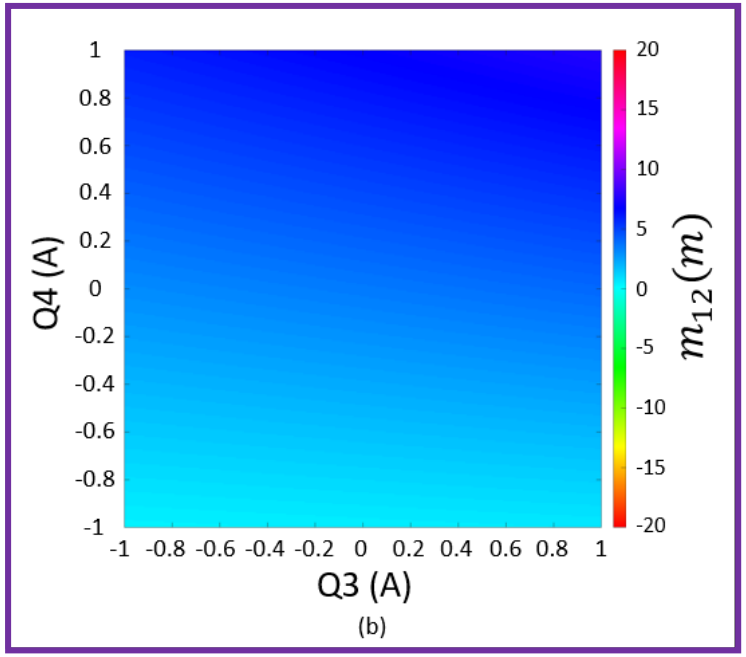
Beam Parameters

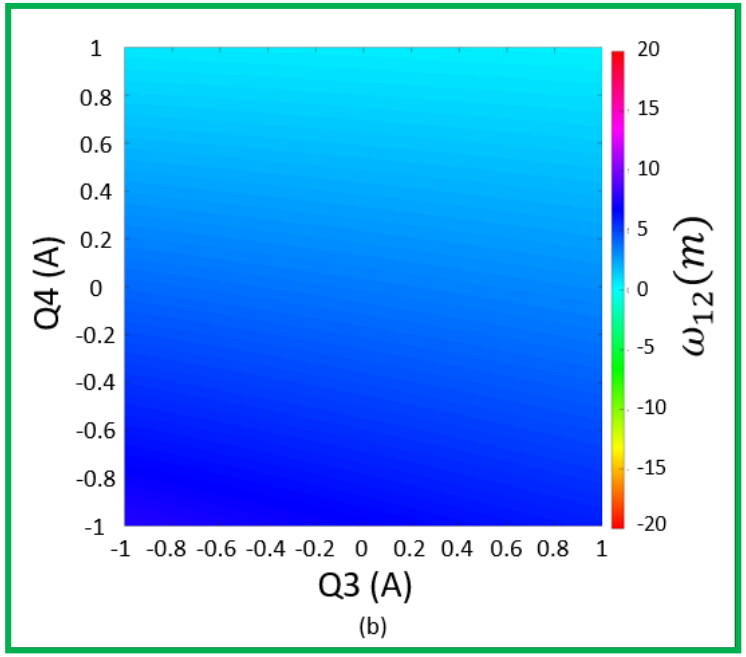
Vertical & Horizontal

Machine Parameters are related

$\omega_{12}(Q3, Q4) = m_{12}(-Q3, -Q4)$ $\xi(Q3, Q4) = \upsilon(-Q3, -Q4)$

180 deg rotation





$\sigma_y' = a_y\xi^2 + b_y\xi + c_y$

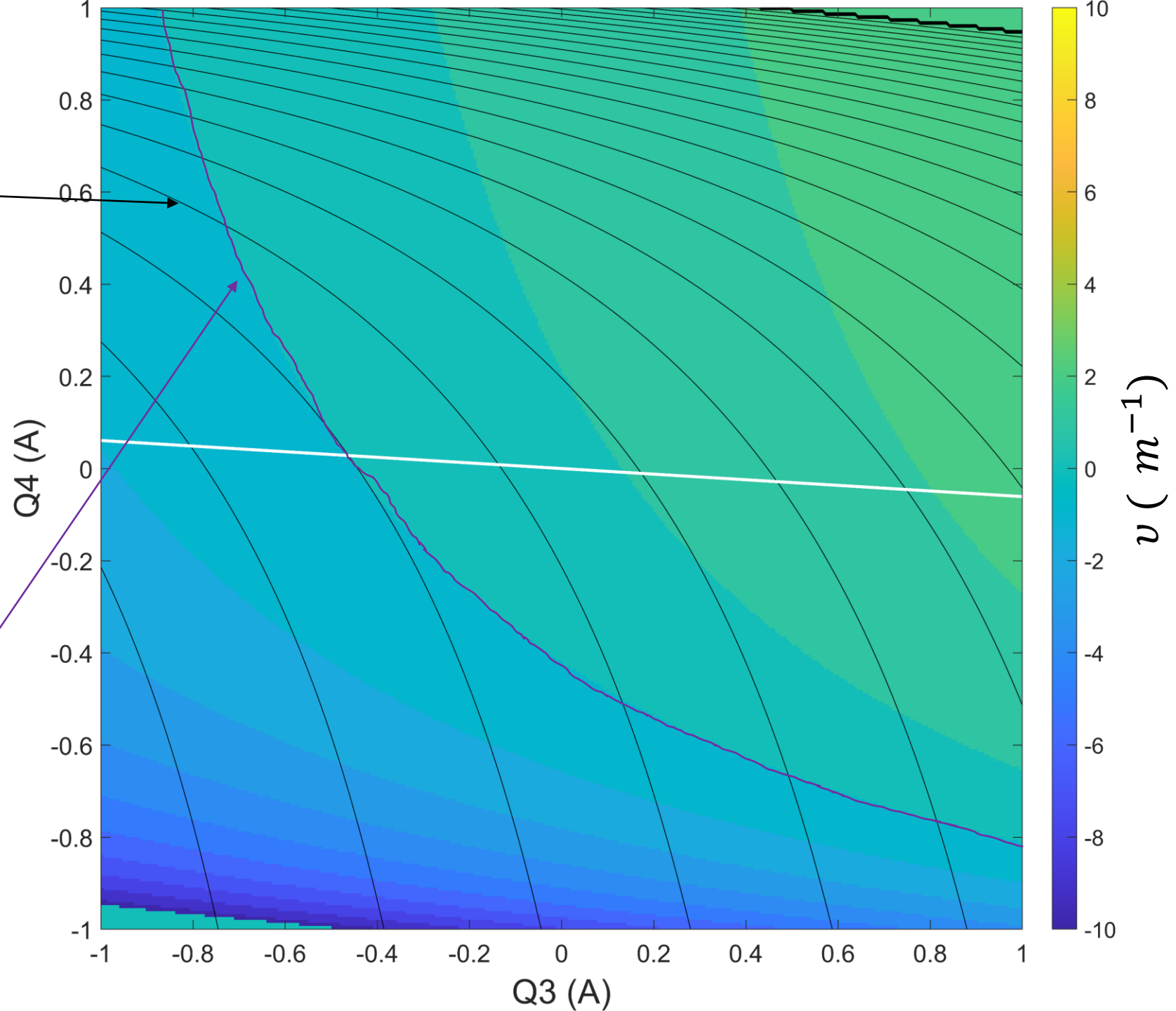
ξ is constant

σ_y' is constant

$\sigma_x' = a_x v^2 + b_x v + c_x$

v is constant

σ_x' is constant



ξ is constant

σ'_y is constant $\Rightarrow$ $\omega_{12}(Q3, Q4)\big|_{\xi=const.} = \omega_{12}(Q4)$

Only a machine property

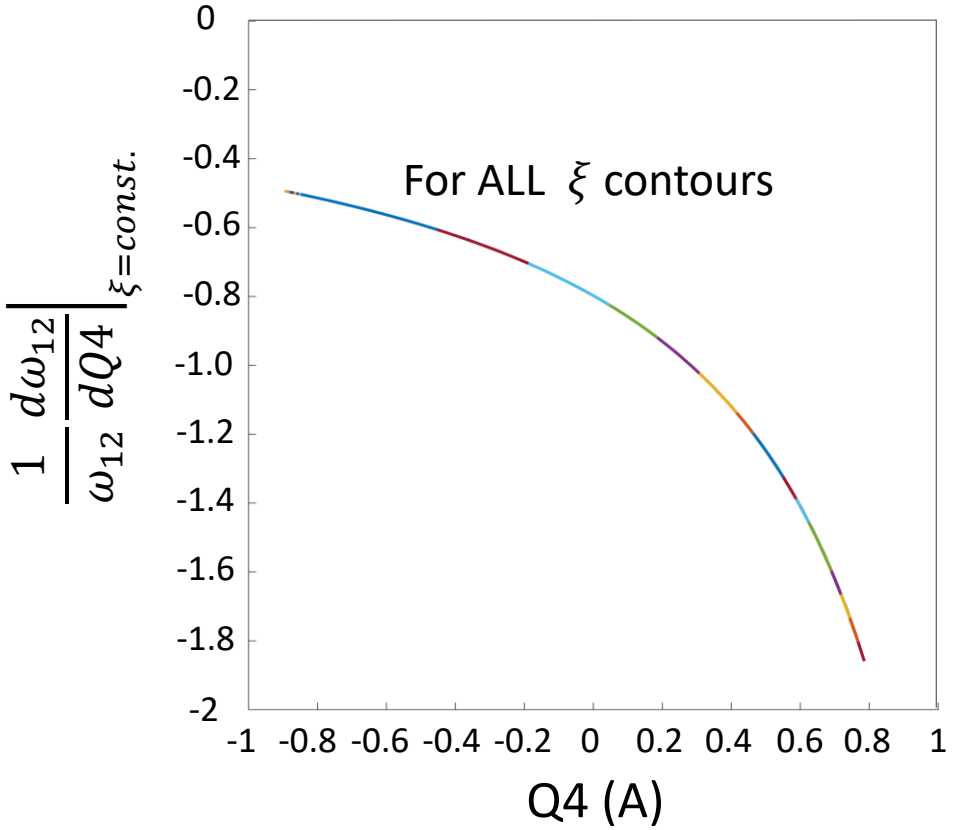
$$\left.\frac{d\ ln(y'_{rms})}{dQ4}\right|_{\xi=const.} = \left.\frac{1}{\omega_{12}}\frac{d\omega_{12}}{dQ4}\right|_{\xi=const.}$$

$$\left.\frac{1}{\omega_{12}}\frac{d\omega_{12}}{dQ4}\right|_{\xi=const.} \approx \frac{1}{aQ_4 + b} + c$$

Second order term of ω_{12} O($Q4^2$)

From thin lens

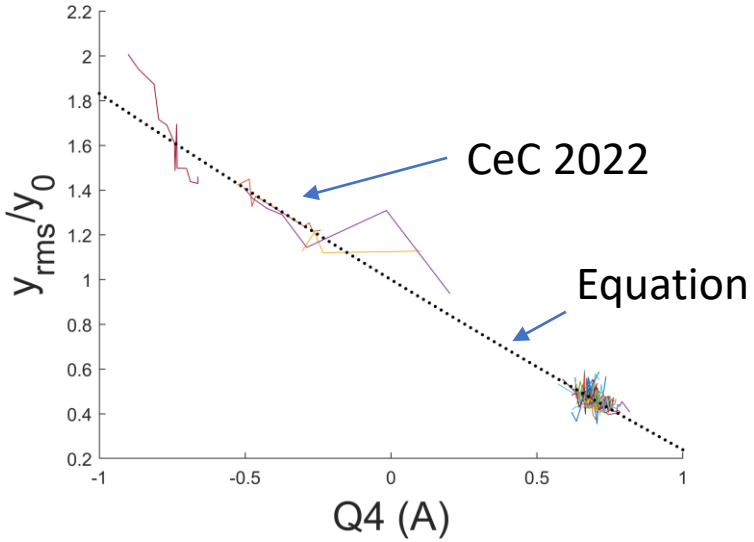
$$y_{rms}\big|_{\xi=const.} = y_0 \left(\frac{a}{b}Q_4 + 1\right)^{\frac{1}{a}} e^{c \cdot Q_4}$$

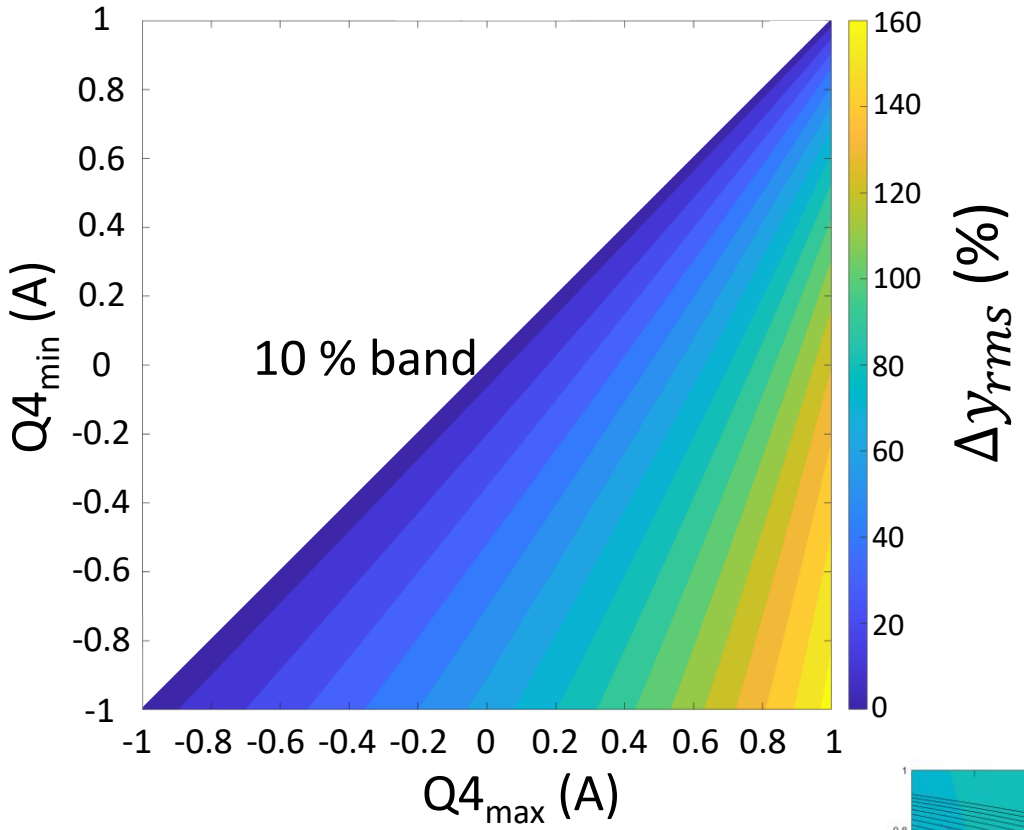


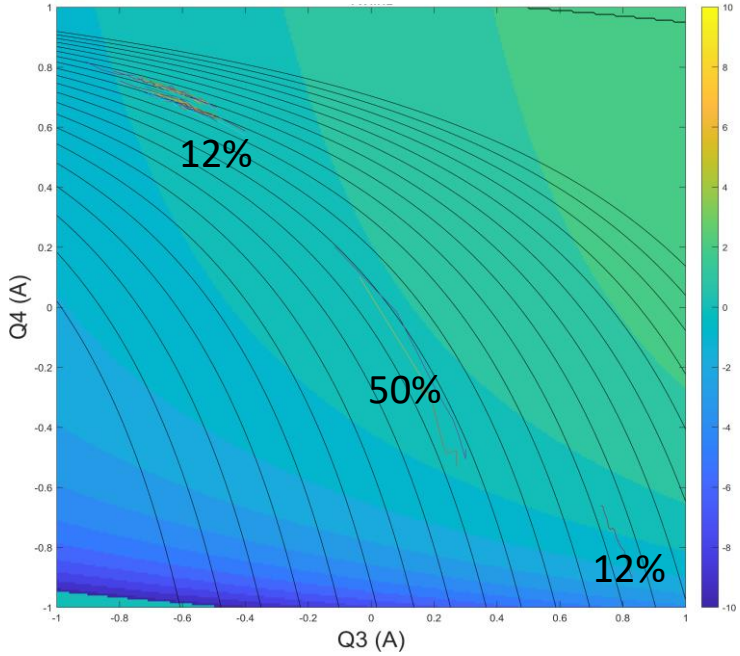
Thin lens	Thick lens

a = 1;
b = -1.2534;
c = 0;
* b =(s1+s2)/(s1s2L*Qk)
	a = 0.984620283;
	b = -1.320971736;
	c = -0.04;

$$y_{rms}\Big|_{\xi=const.} = y_0\left(\frac{a}{b}Q_4 + 1\right)^{\frac{1}{a}} e^{c\cdot Q_4}$$







So Q4 range will defines time resolve resolution

- focuses beam vertically with Q3 Q4
- Test 3 points σ_x' along the ξ contour
- Set Q3 Q4 according to the changes of υ that requires
- Change Q1 Q2 to re-focuses beam vertically
- Essentially, we shifted ξ contour to where contains the minimum σ_x'

$$\left.\frac{d\upsilon}{dQ4}\right|_{\xi=const.}$$