



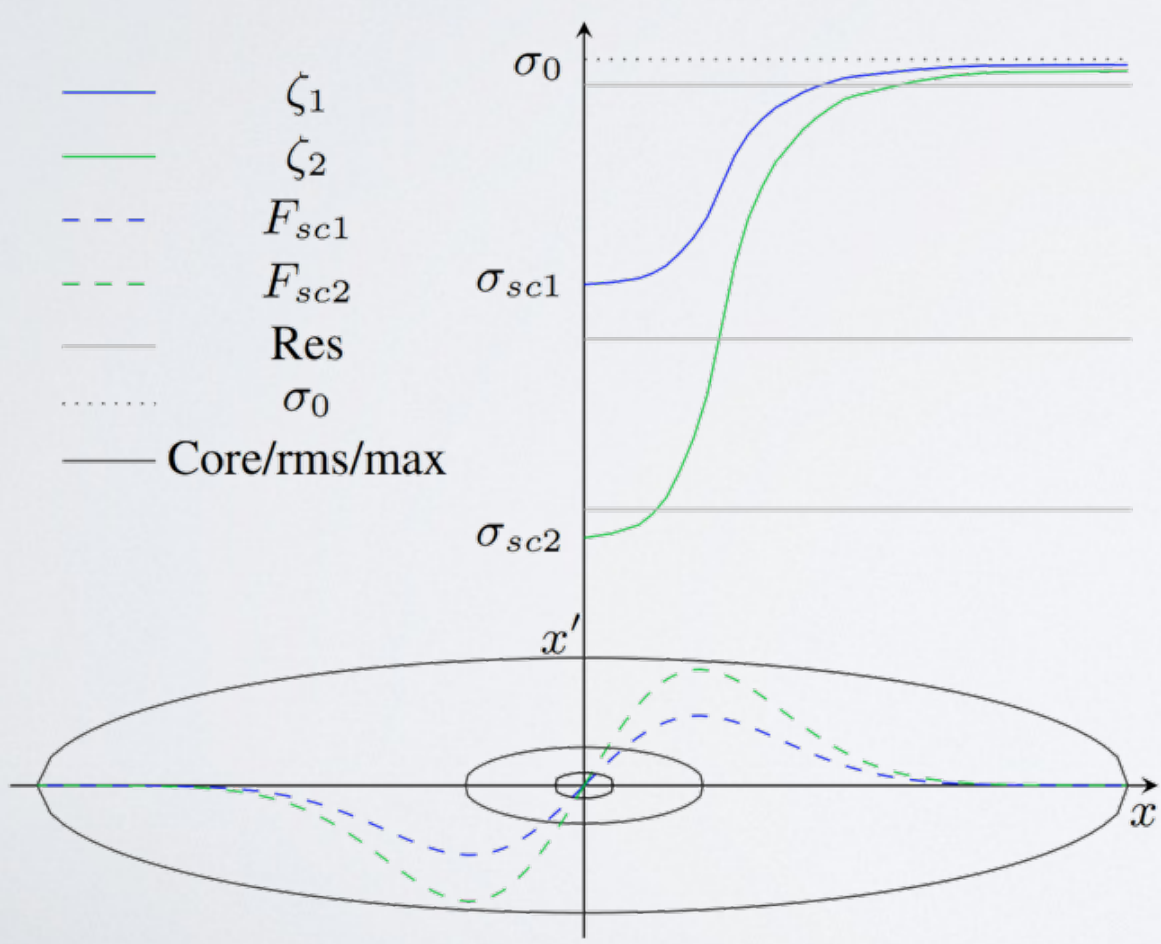
# ON THE CHOICE OF LINAC PARAMETERS FOR MINIMAL BEAM LOSSES

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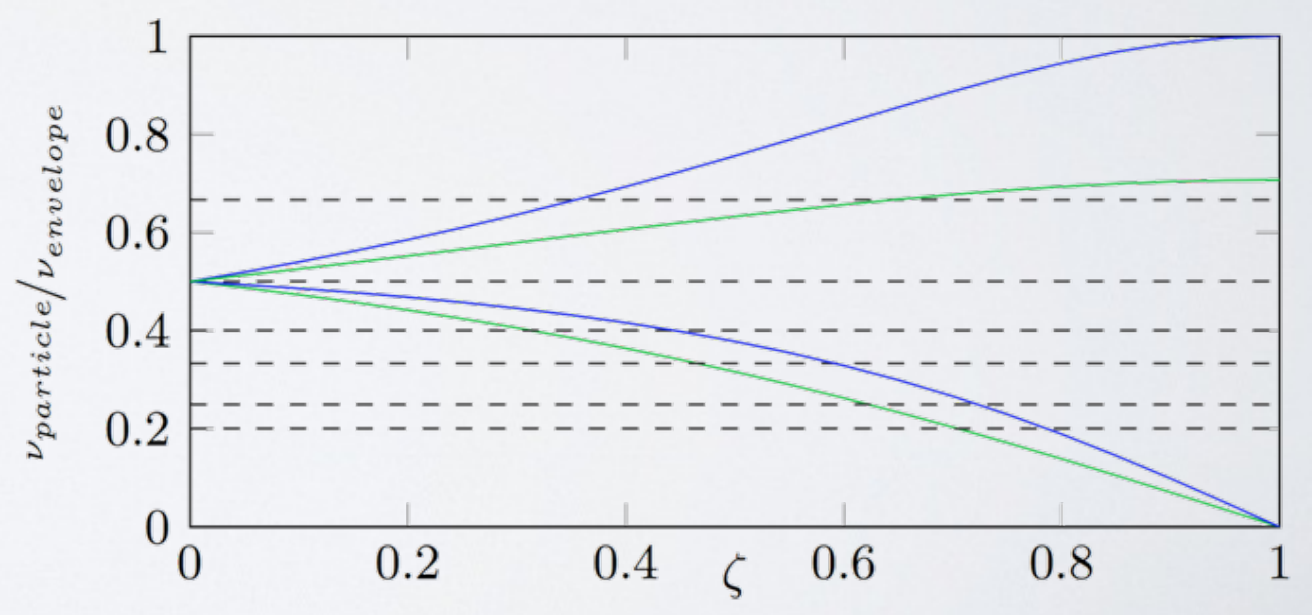
2014-March-20

EuCARD2 Workshop on Accelerator Driven Systems

- How we can reduce the space charge induced losses?



$$\zeta_t = \frac{\sigma_{0t} - \sigma_t}{\sigma_{0t}} \quad \zeta_l = \frac{\sigma_{0l} - \sigma_l}{\sigma_{0l}} \quad (\zeta = 1 - \eta),$$



# THEORY

$$\sigma_t a^2 = 5 \epsilon_{rms} t$$

$$\sigma_l b^2 = 5 \epsilon_{rms} l$$

$$\sigma_t^2 = \sigma_{0t}^2 - K \frac{1 - f f_z(b/a)}{2a^2 b}$$

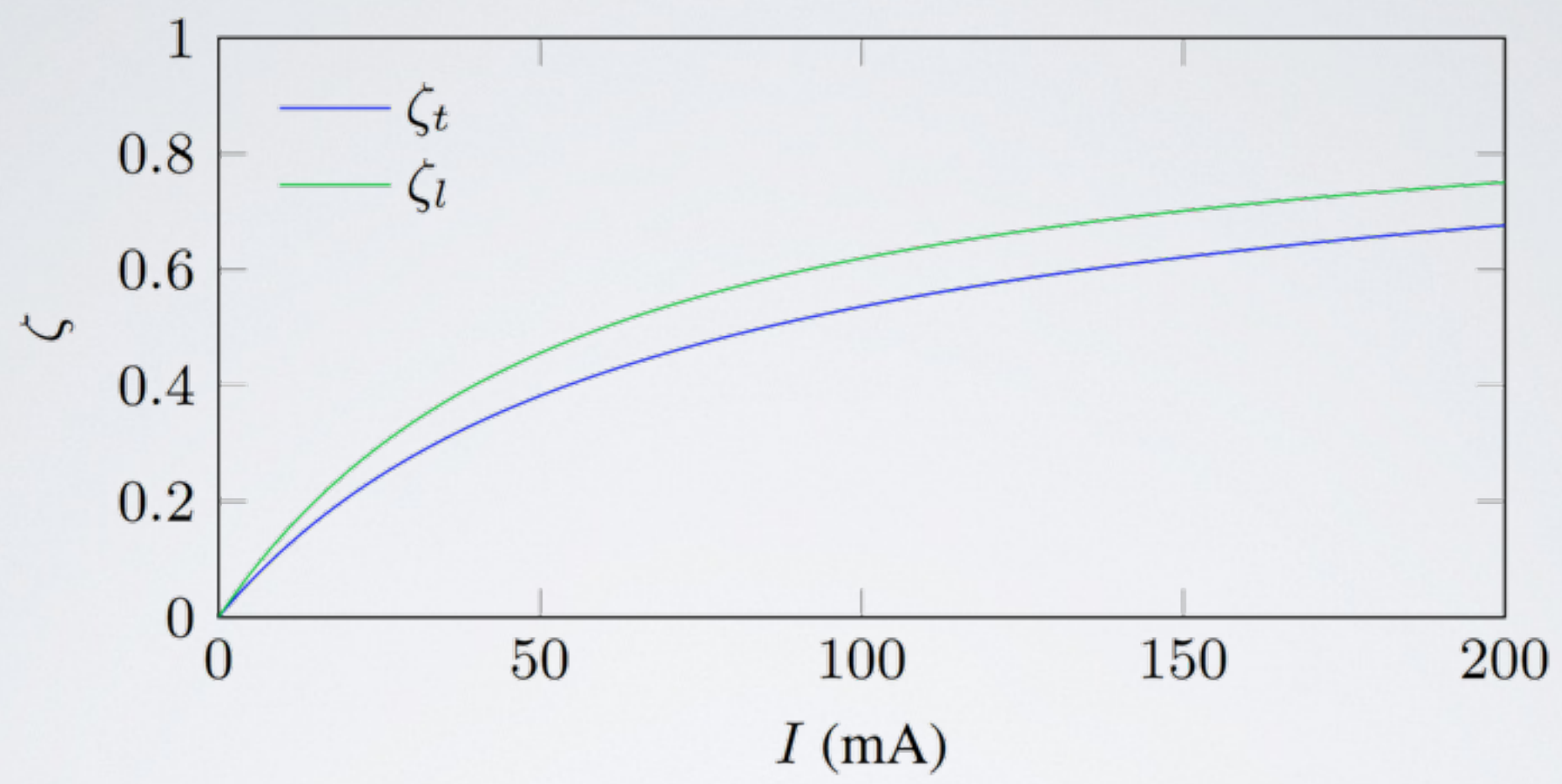
$$\sigma_l^2 = \sigma_{0l}^2 - K \frac{f f_z(b/a)}{a^2 b},$$

$$K = \frac{3eN\lambda I}{4\pi\epsilon_0 c m_0 c^2 \beta_s^2 \gamma_s^3},$$

$$f f_z(b_b/a) = \frac{1}{(b_b/a)^2 - 1} \left( \frac{(b_b/a) \cosh^{-1}(b_b/a)}{\sqrt{(b_b/a)^2 - 1}} - 1 \right) \quad b_b/a > 1$$

$$f f_z(b_b/a) = \frac{1}{1 - (b_b/a)^2} \left( 1 - \frac{(b_b/a) \cos^{-1}(b_b/a)}{\sqrt{1 - (b_b/a)^2}} \right) \quad b_b/a < 1$$

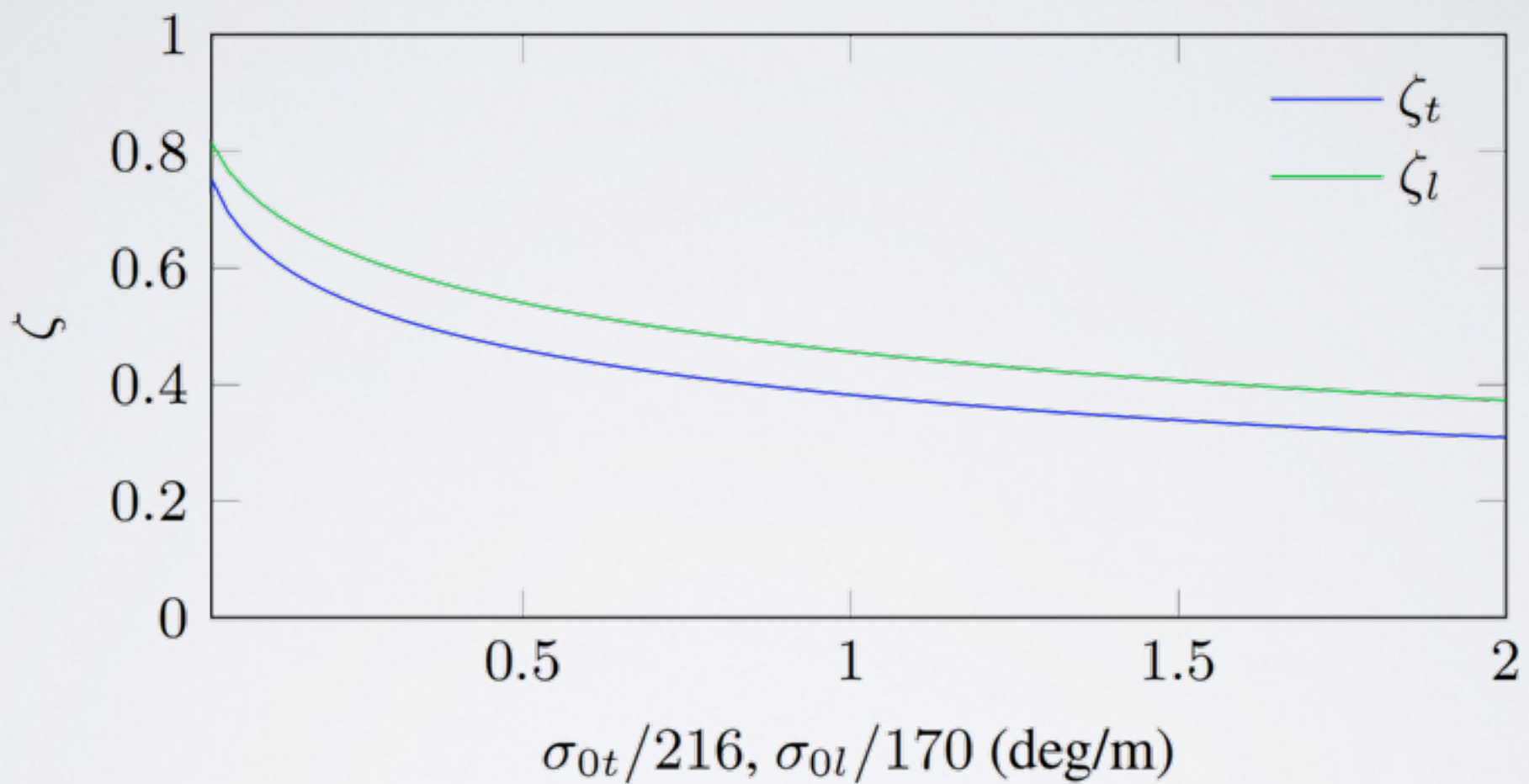




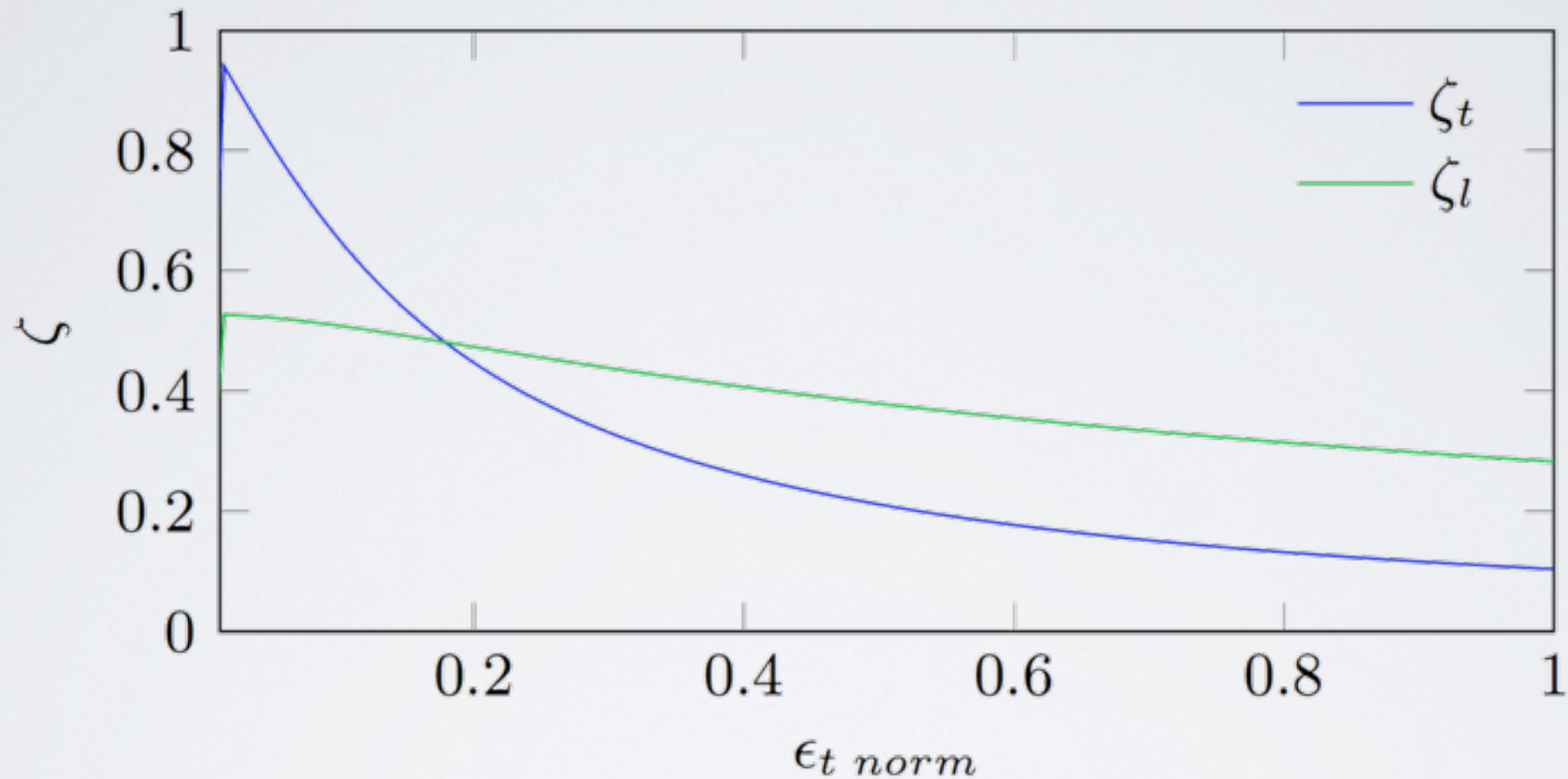
- The equation could be simplified for spherical bunches:

$$\epsilon_{rms\ t} \sigma_l = \epsilon_{rms\ l} \sigma_t$$

$$\sigma_t^2 + \alpha \frac{I}{\epsilon_t^{3/2}} \sigma_t^{3/2} - \sigma_{0t}^2 = 0,$$

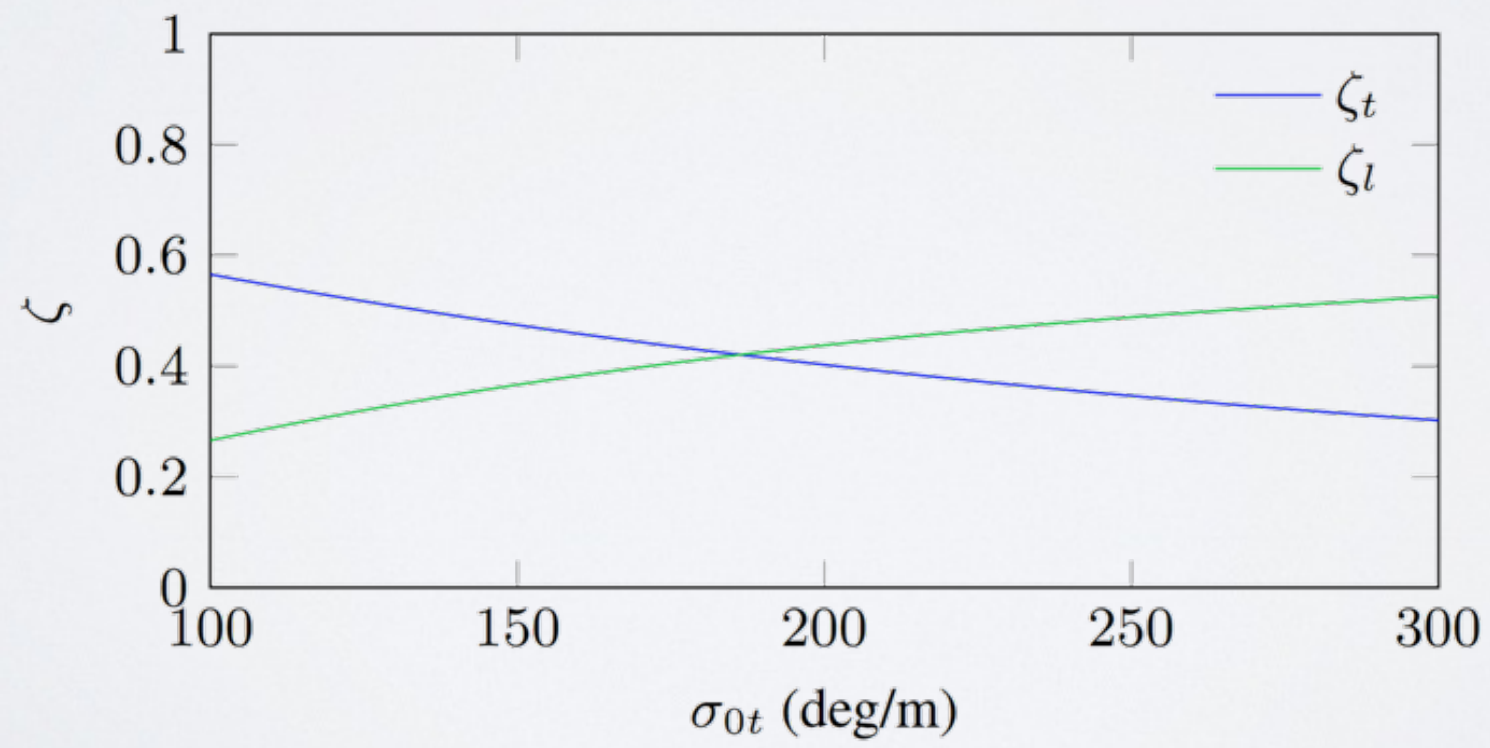
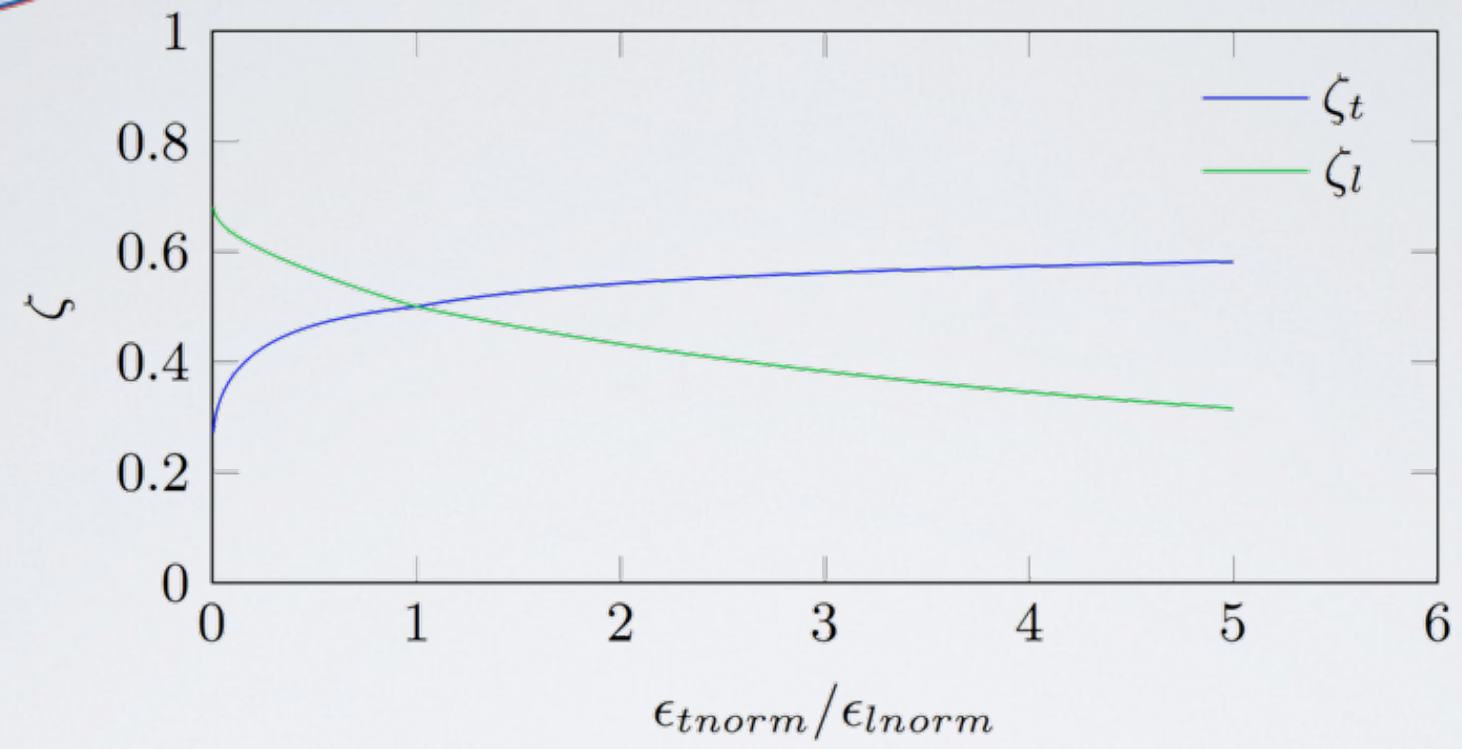


- The harder the beam is focused, the lower is the effect of space charge

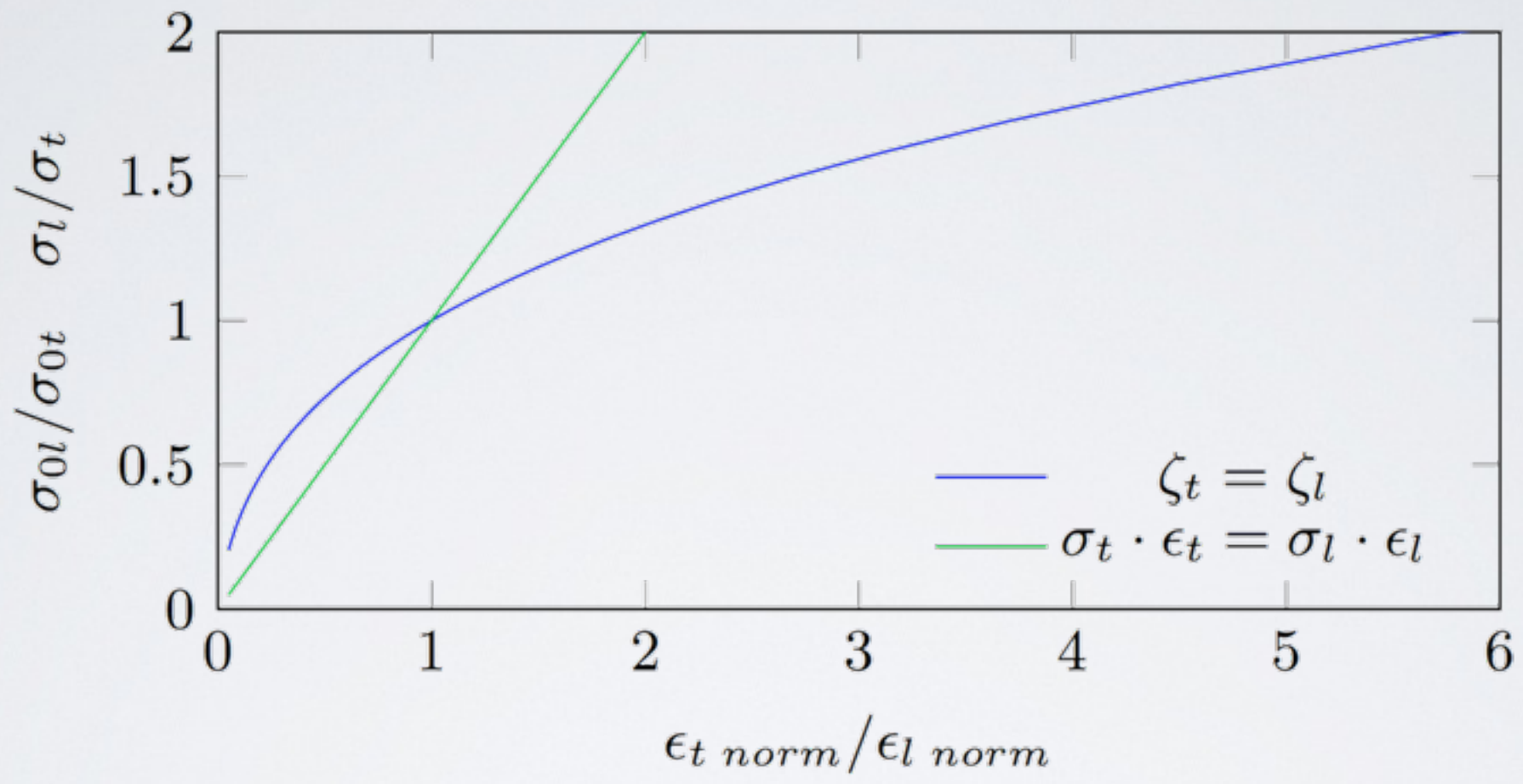


- Reducing the emittance in one plane reduces the space charge effect, but the aperture is the limit!

# EQUI-RTS







- The equipartition design rule vs. the equi - Relative Tune Spread, EQR



- The linac beams are usually pretty spherical and choosing a EQP point, results in lower space charge forces.
- This has caused the confusion that EQP linacs are more “robust”, however, this study shows that the EQR is better choice for the working point