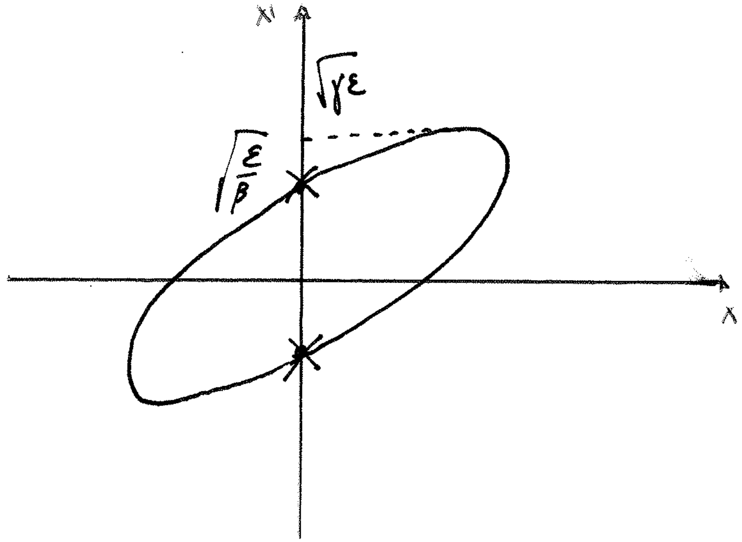
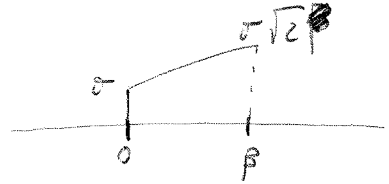


β : distance over which the beam size changes by $\sqrt{2}$



$\alpha = -\frac{1}{2}\frac{\partial\beta}{\partial z}$ → $\alpha = 0$ at the waist
(β at a minimum)

$\gamma = \frac{1+\alpha^2}{\beta}$

area of the ellipse : $A = \pi\varepsilon =$

$= \pi\left(\gamma \cdot x^2 + 2\alpha x x' + \beta \cdot x'^2\right)$

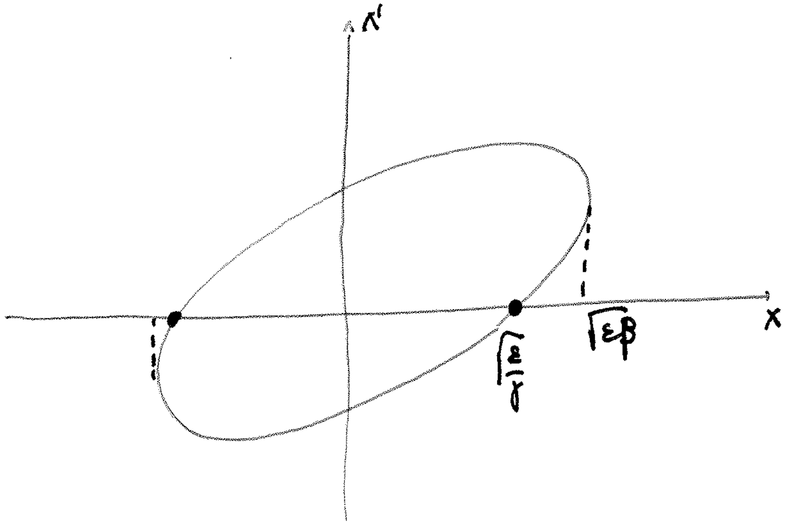
on average, $x' = 0$: divergence of the beam is the rms divergence angle on axis
↓
meaning $x = 0$

$x'_{max} = \sqrt{\gamma\varepsilon}$: it does not change → no variation of $\underline{p}$ in vacuum

AND: it's a number → no statistical meaning

$\sqrt{\gamma\varepsilon}$ is not correlated with σ

FOILS : θ^2 is summed to the divergence correlated with σ



σ : rms transverse position

In the contrary, for σ
we look at the distribution of positions, considering all the angles.

By definition of the ellipse, it contains 68 % of the charge