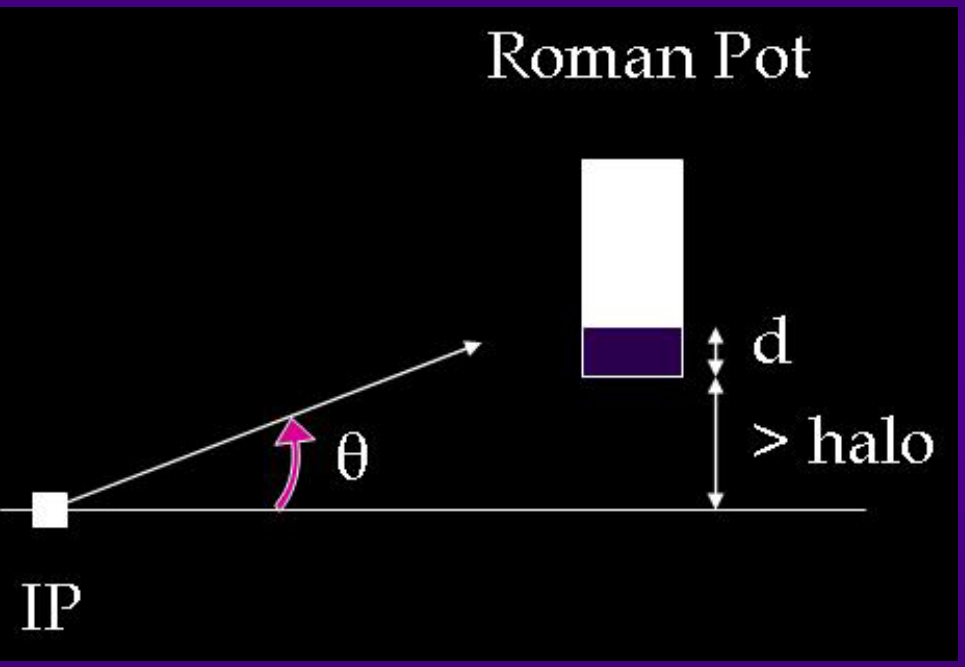
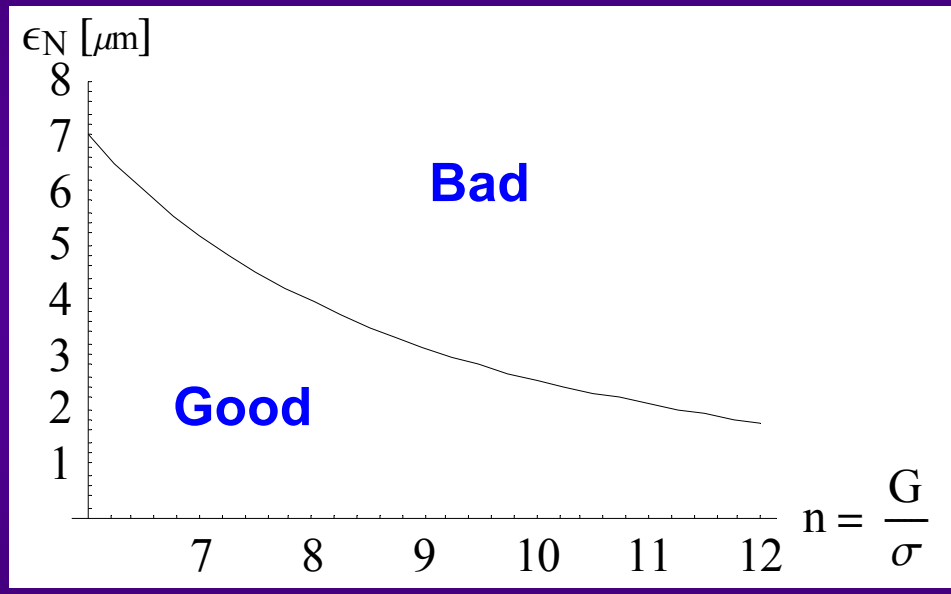
EMITTANCE LIMITATIONS DUE TO COLLECTIVE EFFECTS FOR THE TOTEM BEAMS

E. Metral and A. Verdier

Physics request ⇒ Elastic scattering observation

$$\theta_{min} \leq 10.1\,\mu rad$$



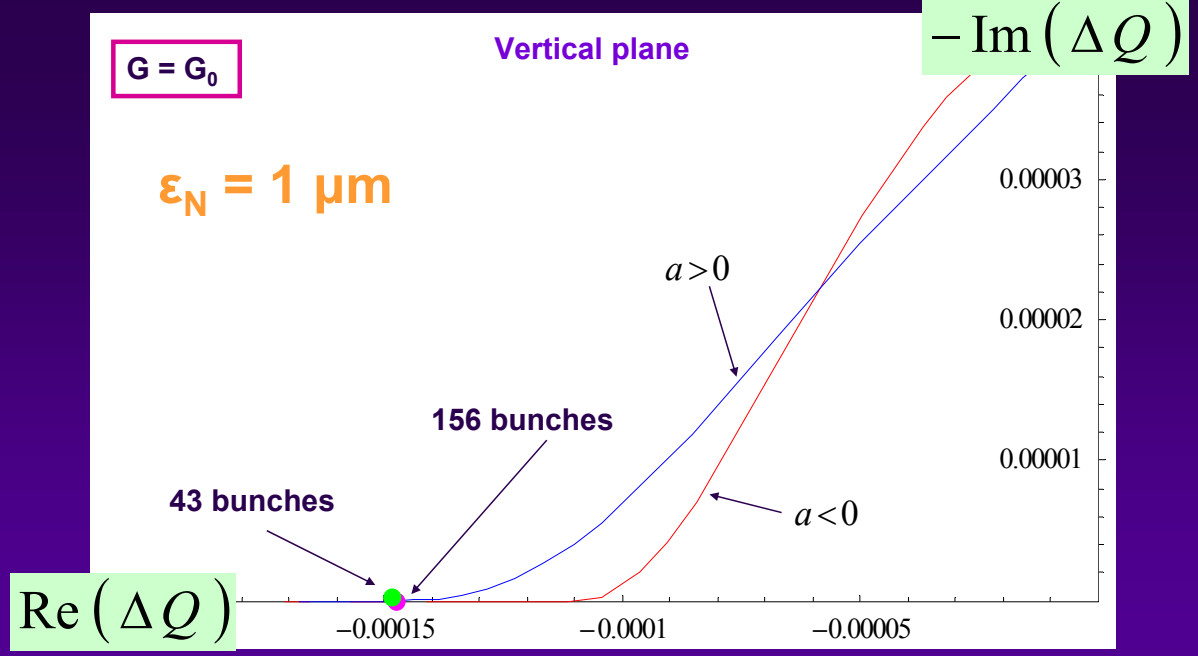


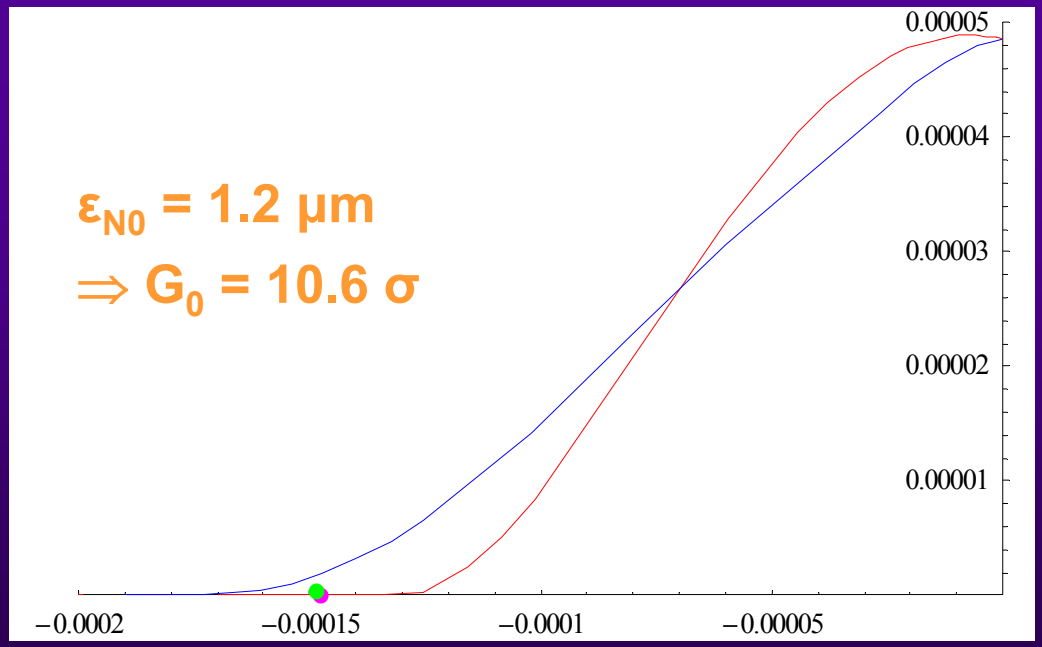
Stability diagrams (quasi-parabolic distribution) and collective tune shifts

$N_{b0} = 3\times10^{10}$ p/b

$G_0 = 6\ \sigma$ for the nominal LHC beam

$\Rightarrow \varepsilon_N = 3.75\ \mu m$





Good set of parameters :

$$\frac{N_b}{\varepsilon_N\, G^3} \le \frac{N_{b0}}{\varepsilon_{N0}\, G_0^3}$$

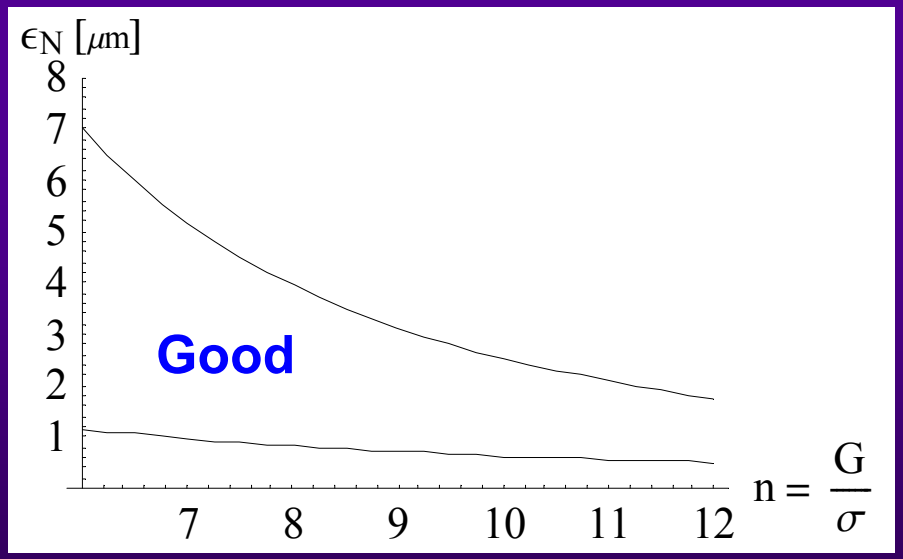
Conclusions (1/3)

$$G = G_0 \frac{n}{n_0} \sqrt{\frac{\varepsilon_N}{\varepsilon_{N0}}} \Rightarrow \varepsilon_{N0} \left(\frac{N_b}{N_{b0}} \right)^{2/5} \left(\frac{n_0}{n} \right)^{6/5} \leq \varepsilon_N \leq \frac{\beta_1 \gamma}{\beta} \left(\frac{L_{eff}\, \vartheta_{min} - d}{h\, n} \right)^2$$

Beam stability condition

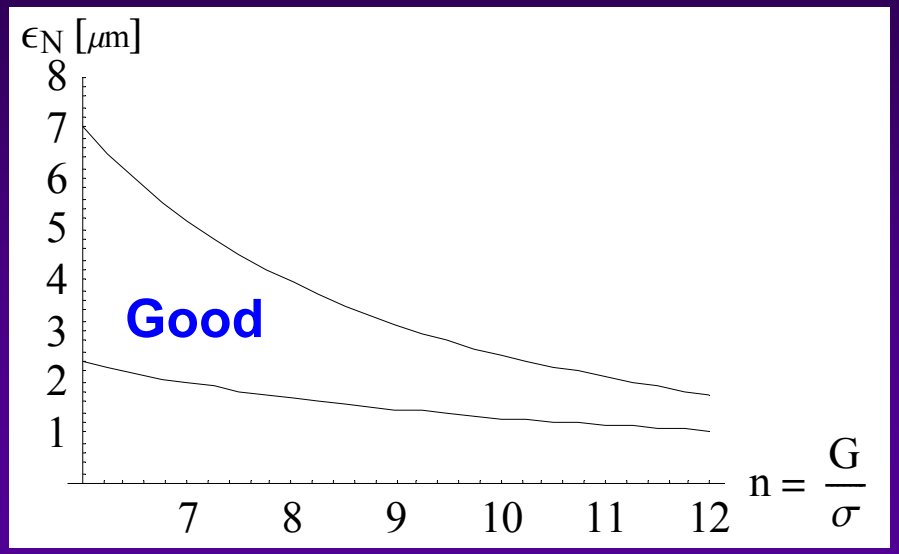
Physics request

$N_b = 5\times10^9$ p/b

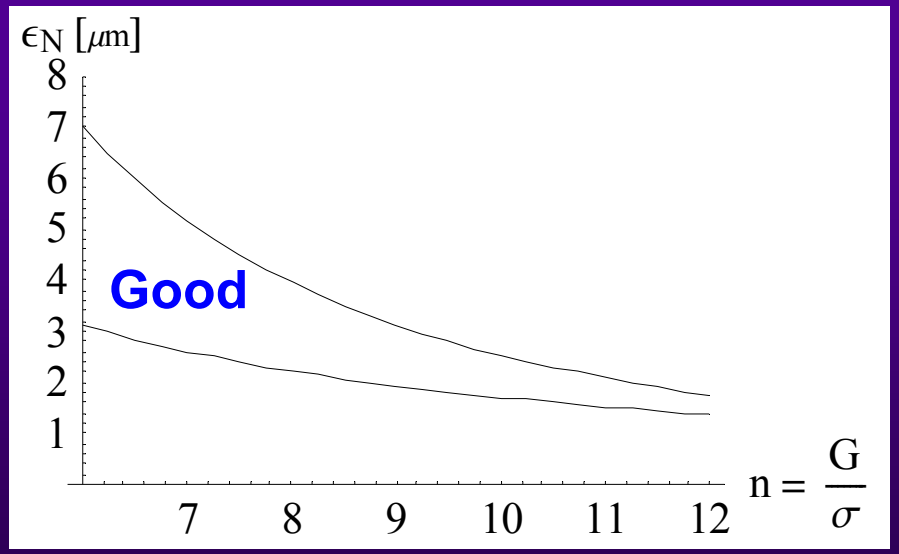


Conclusions (2/3)

$N_b = 3\times10^{10}$ p/b

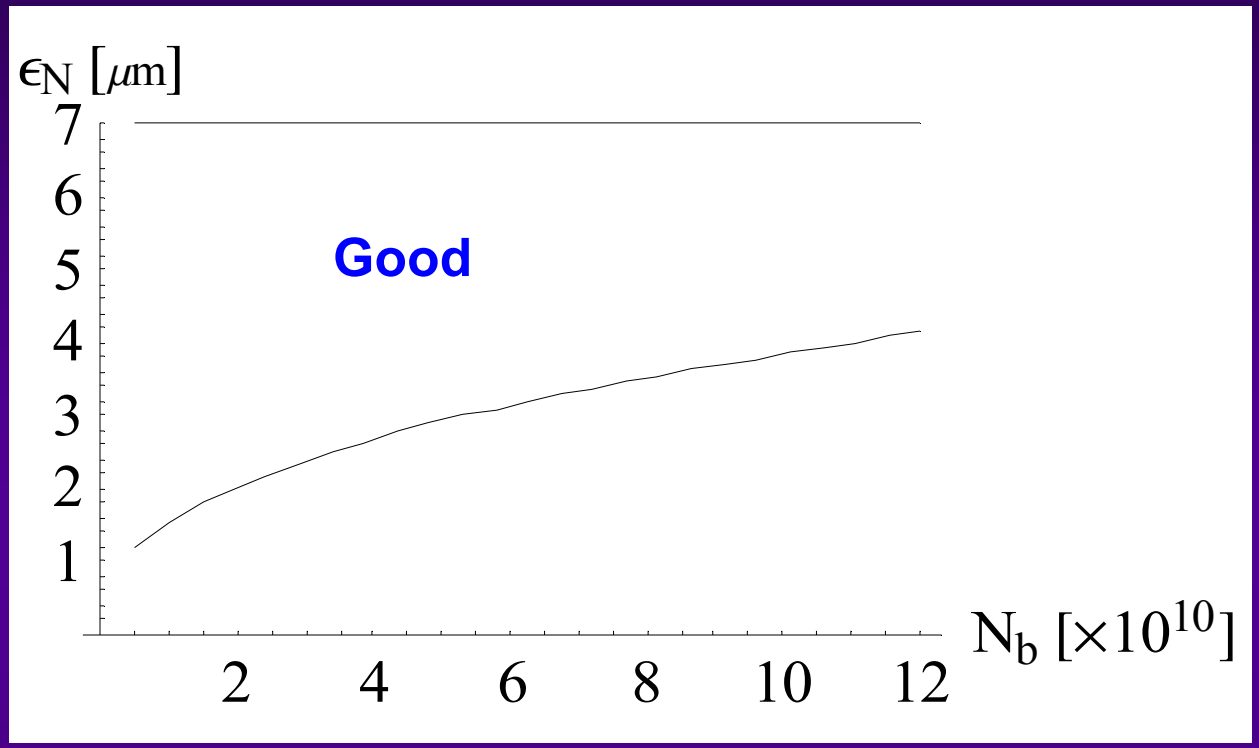


$N_b = 6\times10^{10}$ p/b



Conclusions (3/3)

G = 6 σ



⇒ **The smallest value of θ_{min} achievable is obtained for $N_b = 5\times10^9$ p/b, ε_N = 1.16 μm, G = 6 σ, and is given by**

$$\theta^0_{min} = 5.25\ \mu\text{rad}$$