

Space Charge Study

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from PS: up to 12×10^{10} protons in a single bunch at $p = 14 \text{ GeV}/c$

parameters (in SPS, at 1σ , rms) $\epsilon_{x,N} = 3.43 \mu\text{m}$, $\epsilon_{y,N} = 3.75 \mu\text{m}$
 $\sigma_{\Delta p/p} = 1.9 \times 10^{-3}$ $\sigma_t = 1.65 \text{ ns}$ $\epsilon_L = 0.55 \text{ eVs}$ $\text{RF}_{\text{HV}} = 1.5 \text{ MV}$
 maximum space charge tune shift estimate in SPS, for 10^{11} protons

$$\Delta Q_x = \frac{r_c}{2^{1/4} \omega^3} \frac{N}{2^{1/4} \beta_z} \int_0^L \frac{-x}{\beta_x(\beta_x + \beta_y)} ds = 0.16$$

$$\Delta Q_y = \frac{r_c}{2^{1/4} \omega^3} \frac{N}{2^{1/4} \beta_z} \int_0^L \frac{-y}{\beta_y(\beta_x + \beta_y)} ds = 0.21$$

Best lifetimes just below $Q \approx 0.25$ (like $Q_y = .246$)

avoid very low tunes < 0.15 , or close to half integer (> 0.4)

Note:

The space charge tune spread in this MD is about 4x the expected for nominal LHC (at 26 GeV in the SPS, 10^{11})