Brief update on SPS HeadTail simulations

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Framework

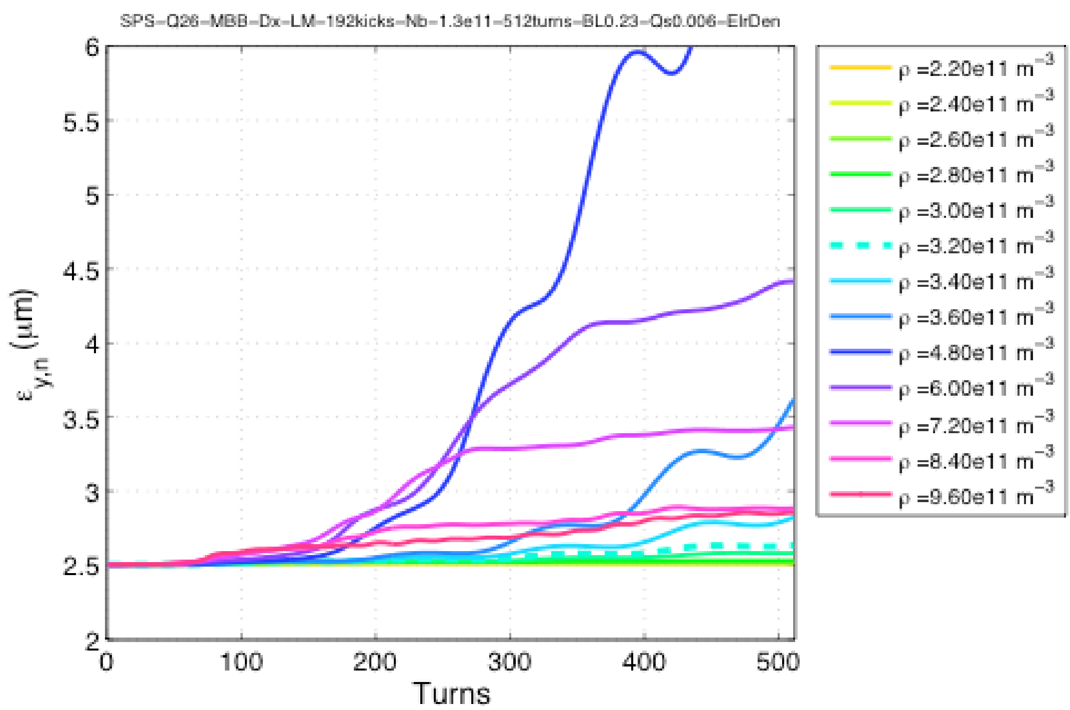
- Comparing the impact of machine optics on beam stability in the presence of electron clouds
- Simulations performed with HeadTail-ElectronCloud flavour

Parameter	Low γ_t optics	Nominal SPS optics
Bunch length (rms)	0.23 m	0.23 m
Momentum spread	0.002	0.002
RF-voltage	5.75 MV	2 MV
Synchrotron tune at inj.	0.017	0.0059
Momentum compaction	0.00308	0.00192
Transition energy (γ_t)	18	22.8
Tunes (horizontal/vertical)	20.13/20.16	26.13/26.16

Instability threshold

- We can distinguish 2 regimes:
  - Coherent regime → < 5e11 m^{-3}
  - Incoherent regime → > 6e11 m^{-3}

- The threshold for coherent instability is not always uniquely defined
- It should be defined consistently however:
  - We are in the coherent regime
  - We have an emittance increase by 4 %
- The incoherent regime is sensitive to numerical parameters such as:
  - Number of kick sections, number of grid point, …
  - It seem to ameliorate the emittance degradation for higher cloud densities

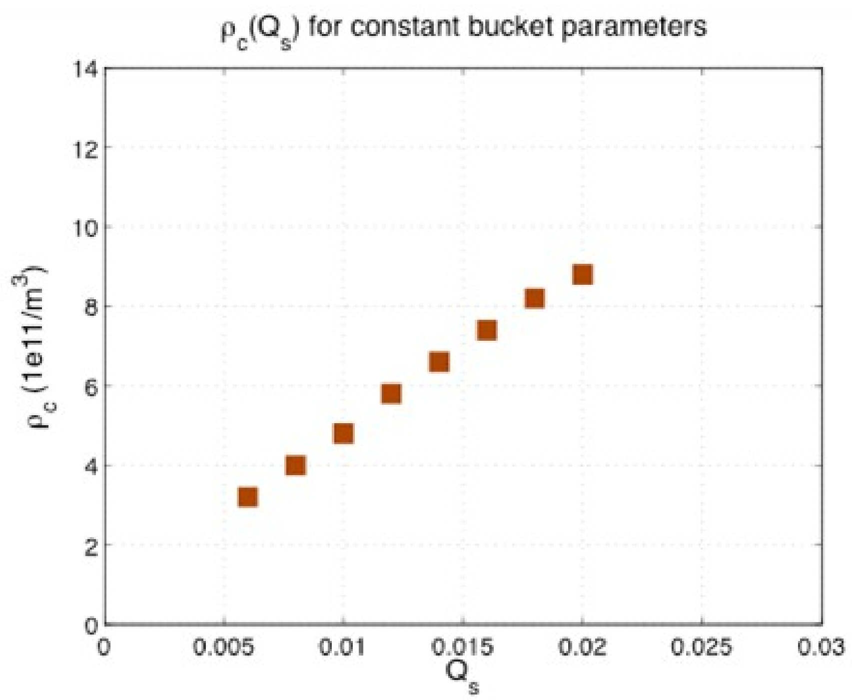


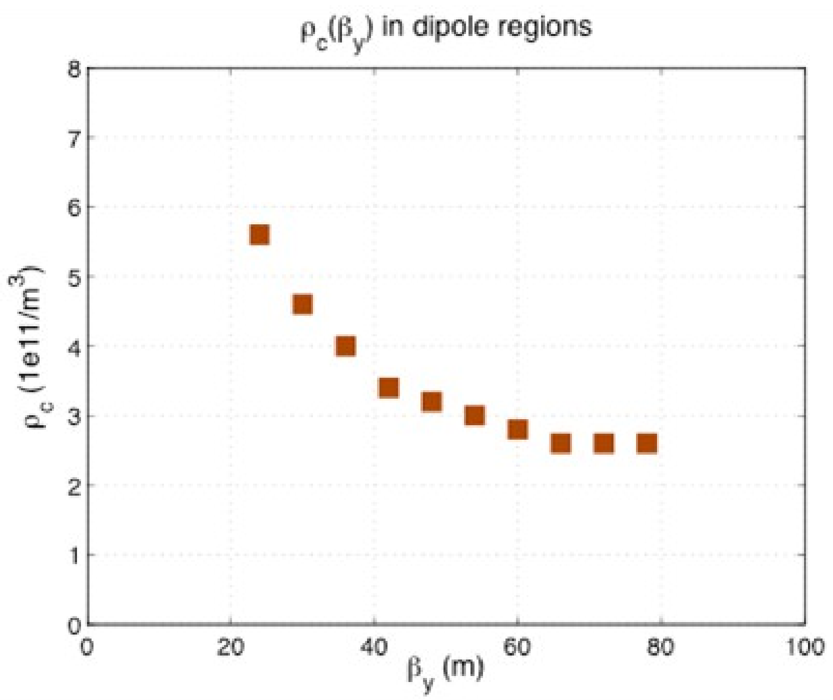
Scaling laws

- Scaling law for Head-Tail instabilities

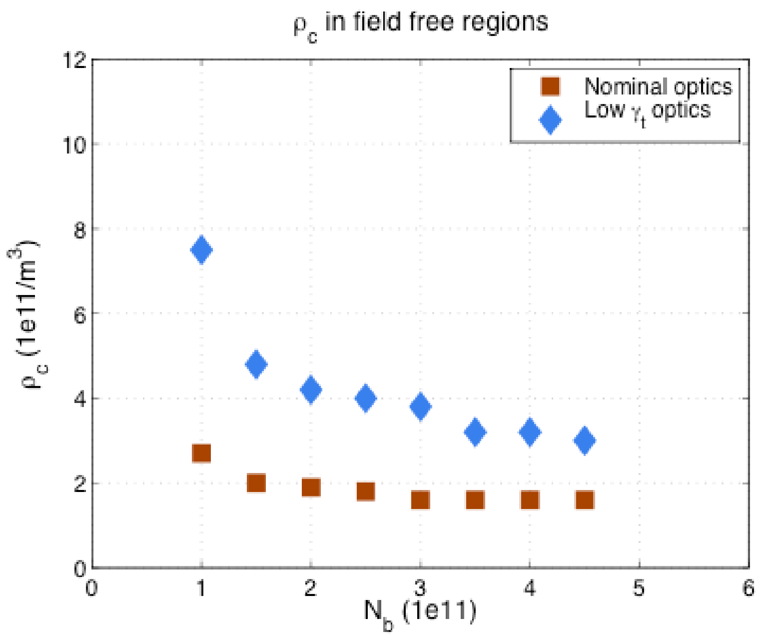
  [K. Ohmi, F. Zimmermann]: $\rho_{\mathrm{thr}} = \dfrac{2\,\gamma\,Q_s}{\pi\,r_e\,L\,\beta_y} \sim \dfrac{Q_s}{\beta_y}$

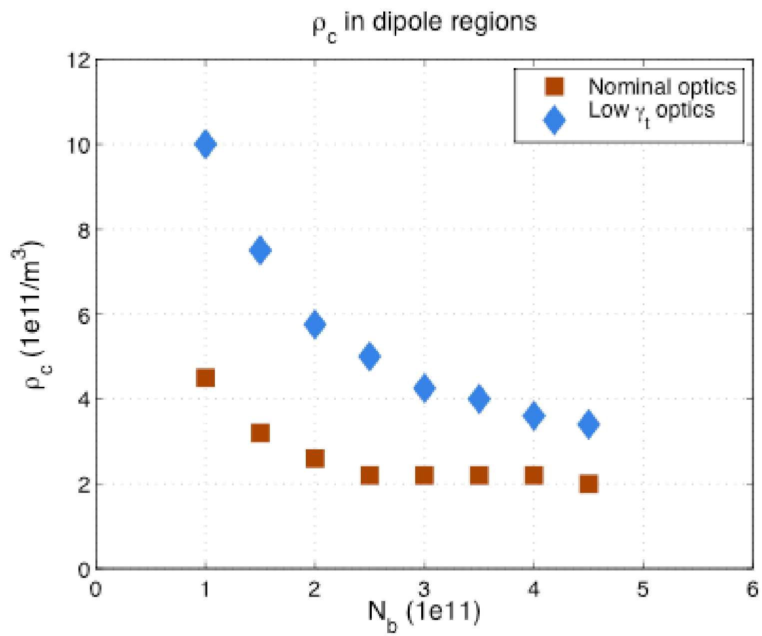
- No investigation on the coefficient





Comparison of two optics





- Comparison of optics
  - Cloud density threshold values for different bunch intensities for the two optics parameter sets
- Straight sections and bending magnets
  - Threshold increase for low γ_t-optics for both regions
  - Straight section → threshold increase ~ 2.3 on average
  - Bending magnet → threshold increase ~ 2.0 on average