Tuning of the Traditonal FFS

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Setup

- CLIC Traditional Final Focus System
- $\sqrt{s} = 3\text{TeV}$
- Integrated simulations: BBA+Tuning Knobs
- PLACET for tracking and Guinea-Pig for Luminosity calculations
- Initial random misalignment: $\sigma = 10\mu\text{m}$ RMS (x, y) for all elements
- BPM resolution: 10nm
- Corrector Block: BPM+Quadrupole+Corrector

Alignment procedure. (Andrea's script)

- Multipoles OFF:
  - 1:1 correction

$$\begin{pmatrix} b_x \\ b_y \end{pmatrix} = \begin{pmatrix} R_{xx} & 0 \\ 0 & R_{yy} \end{pmatrix} \begin{pmatrix} \theta_x \\ \theta_y \end{pmatrix}$$

  - DFS

$$\begin{pmatrix} b \\ \omega_1(\eta - \eta_0) \\ 0 \end{pmatrix} = \begin{pmatrix} R \\ \omega_1 D \\ \beta I \end{pmatrix} \begin{pmatrix} \theta_x \\ \theta_y \end{pmatrix}$$

- Multipole-Shunting
- Multipole Knobs
- Multipoles ON:
  - DFS

$$\begin{pmatrix} b \\ \omega_1(\eta - \eta_0) \\ 0 \end{pmatrix} = \begin{pmatrix} R \\ \omega_2 D \\ \beta I \end{pmatrix} \begin{pmatrix} \theta_x \\ \theta_y \end{pmatrix}$$

  - Multipole Shunting
  - Multipole Knobs

Tuning process

- Response Matrices
- Tune the free parameters $(\beta, \omega_1, \omega_2)$
- Optimize Gains
- BBA
- Knobs

Response Matrices

How to calculate response matrices:

- Orbit measurement via tracking.
- Optics: R_{12} elements.

Take into account:

- Nonlinearities.
- Synchrotron radiation.

Used here:

- Orbit measurement

Tuning of the weights

- 5 free parameters: (gain1, gain2, ω_1, ω_2, β)
- Tuning method
  - Fix gains.
  - Scan β.
  - Simplex on (ω_1, ω_2) average on 40 seeds.

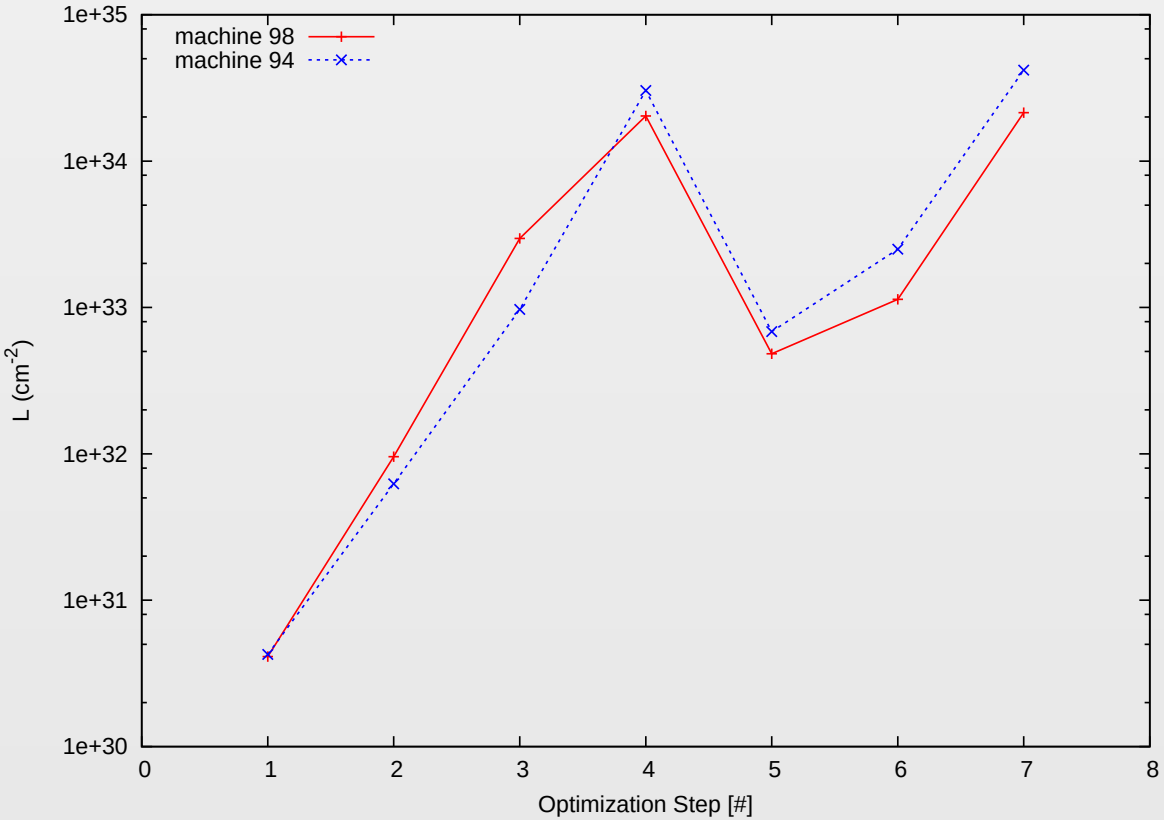
- We tried to optimize it but without success. We take the values obtained by Andrea for the Nominal CLIC FFS.
  - Gains: (0.7, 0.3)
  - $\beta = 10$
  - $\omega_1 = 635$
  - $\omega_2 = 11$

Tuning Knobs

- Tuning Knobs are calculated using SVD:
  - Beam covariances vs. 5 sextupole positions.
  - 10 Knobs are computed.
- Only 6 out of 10 Knobs ares used.
- Brent minimization algorithm.

Results

1: 1:1
2: DFS
3: Multipole Shunting
4: Knobs
5: DFS
6: Multipole Shunting
7: Knobs



Tuning results

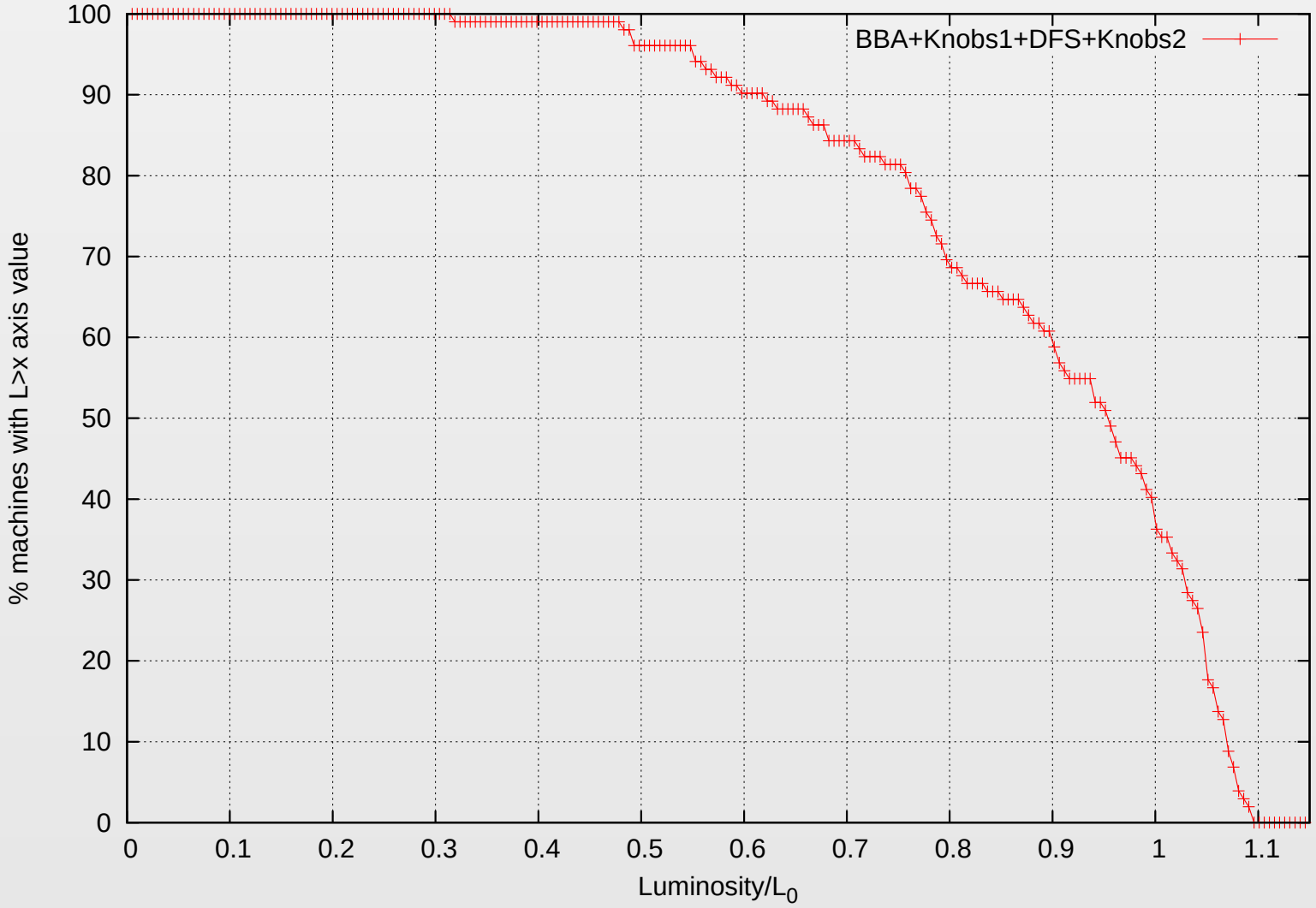


Figure: Tuning results for the Traditional correction scheme

Tuning results

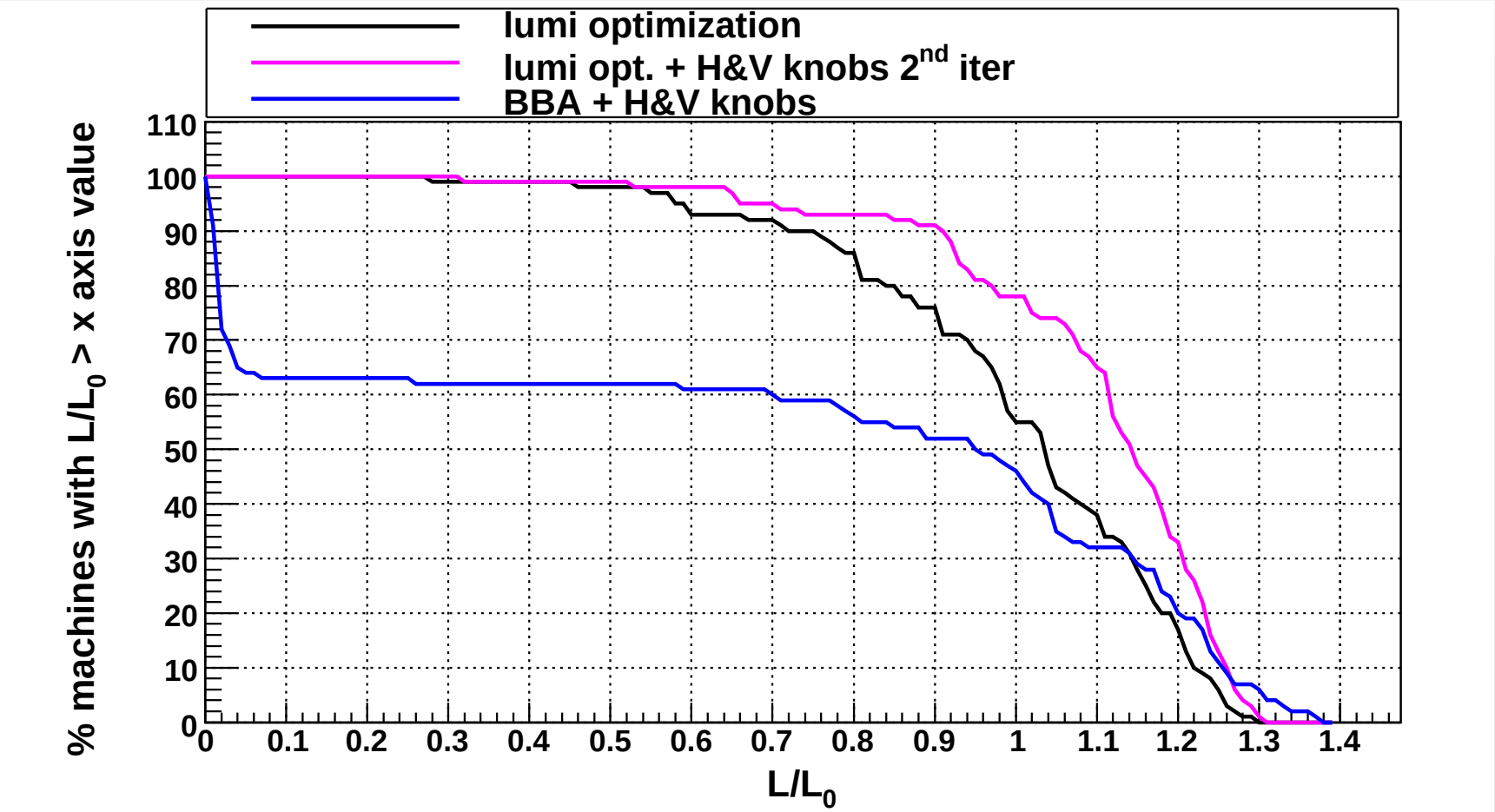


Figure: Tuning results for the Local correction scheme (Presented in CDR)

Conclusions

Results

- We have tested the Tuning algorithm for another different lattice successfully.
- Although non-optimal free parameters, the convergence is good.
- After only a first pass, the alignment of the FFS seems to be good.

Further studies

- Optimize free parameters.
- Introduce a new free parameter β_2.
- Second, third and more passes to see the final convergence of the algorithm.
- Tuning low energy options ($\sqrt{s} = 500\text{GeV}$)