

Demonstration of the $L^*=6$ m design and a longer BDS system at 3 TeV

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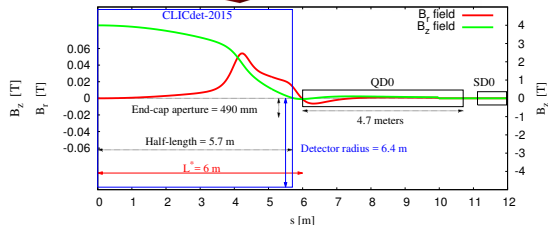
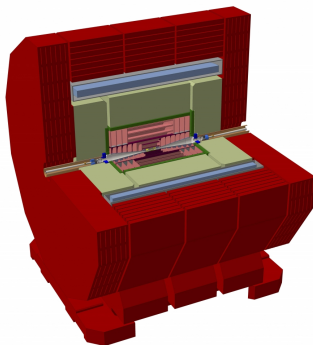
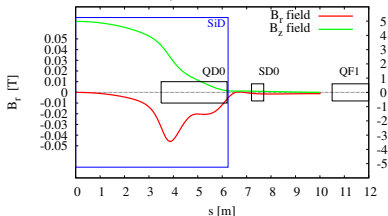
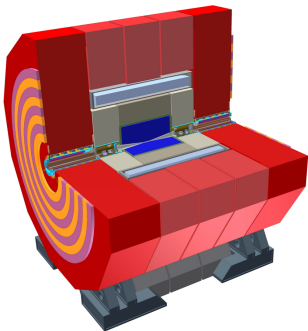


OUTLINES

- 1 Motivation for long L^* designs
- 2 $L^* = 6$ m status
 - Parameters and performances
 - Status of Tuning : $L^* = 3.5$ m vs $L^* = 6$ m
- 3 Longer FFS with Local correction and $L^* = 3.5$ m

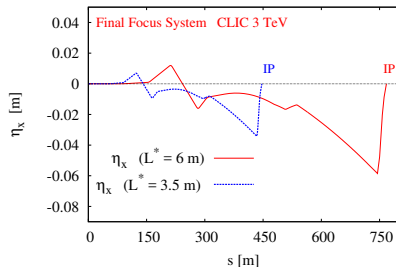
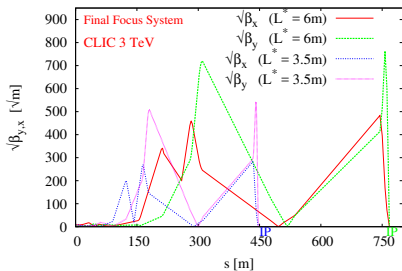
Motivations for longer L^*

No interplays between the solenoid field and QD0 field, reduces QD0 vibration, eases stabilization and access to QD0, increases forward acceptance

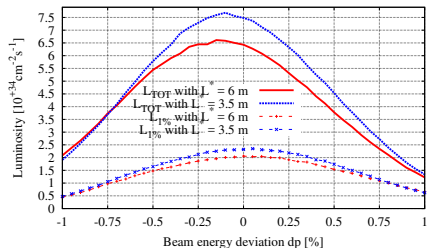


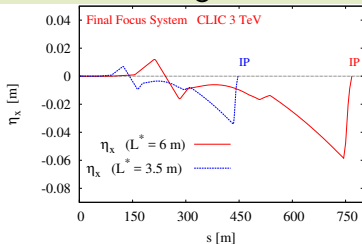


Parameters and performances with $L^* = 6$ m



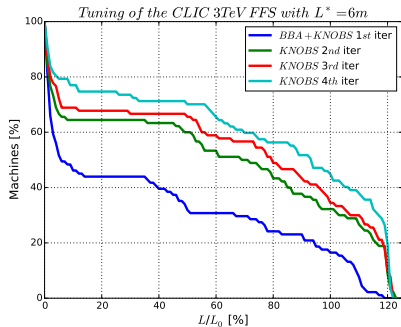
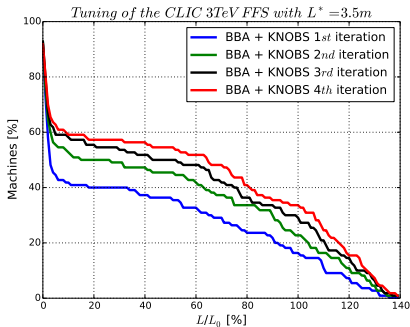
CLIC energy	3TeV	3TeV
L^* (m)	3.5	6
FFS length (m)	450	770
$\gamma\epsilon_x/\gamma\epsilon_y$ (nm)	660 / 20	660 / 20
β_x^*/β_y^* (mm)	7 / 0.068	7 / 0.10
σ_x^* ($\sigma_{x,design}^*$) (nm)	47.7 (40)	49.7 (40)
σ_y^* ($\sigma_{y,design}^*$) (nm)	1.8 (1)	2 (1)
L_{tot} ($L_{tot,design}$) ($10^{34} \text{cm}^{-2} \text{s}^{-1}$)	7.5 (5.9)	6.44 (5.9)
$L_{1\%}$ ($L_{1\%,design}$) ($10^{34} \text{cm}^{-2} \text{s}^{-1}$)	2.3 (2)	2.06 (2)
Chrom. ξ_y (L^*/β_y^*)	51500	60000

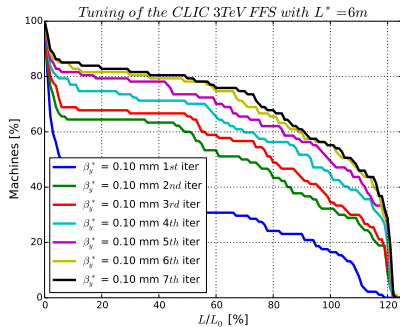
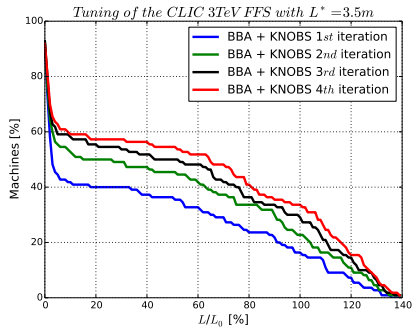
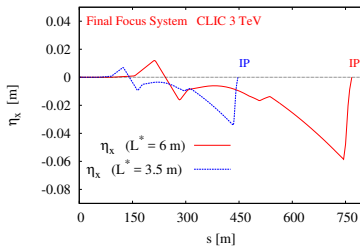


Status of Tuning : $L^* = 3.5$ m vs $L^* = 6$ m

Tuning simulation setup :

- $10\mu\text{m}$ transverse misalignment of QUADS, SEXT and BPMs
- 10 nm BPM resolution
- Correction with Linear knobs only (sextupole displacements)
- 100 machines simulated



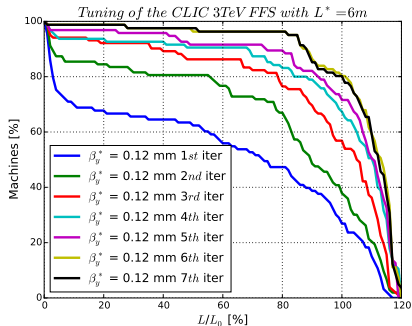
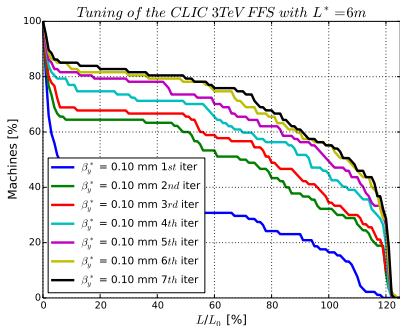
Status of Tuning : $L^* = 3.5$ m vs $L^* = 6$ m



Status of Tuning : $L^* = 3.5$ m vs $L^* = 6$ m

CLIC energy	3TeV	3TeV
L^* (m)	6	6
FFS length (m)	770	770
$\gamma\epsilon_x/\gamma\epsilon_y$ (nm)	660 / 20	660 / 20
β_x^*/β_y^* (mm)	7 / 0.10	7 / 0.12
σ_x^* ($\sigma_{x,design}^*$) (nm)	49.7 (40)	49.4 (40)
σ_y^* ($\sigma_{y,design}^*$) (nm)	2 (1)	1.9 (1)
L_{tot} ($L_{tot,design}$) ($10^{34}\text{cm}^{-2}\text{s}^{-1}$)	6.44 (5.9)	6.4 (5.9)
$L_{1\%}$ ($L_{1\%,design}$) ($10^{34}\text{cm}^{-2}\text{s}^{-1}$)	2.06 (2)	2.1 (2)
Chrom. ξ_y (L^*/β_y^*)	60000	50000

- H. sext. displ. effect on $\sigma_{x,y}^*$:
 $\Delta\sigma_x^* = k_s \Delta_x \beta_{x,s} \sigma_{x0}^*$
 $\Delta\sigma_y^* = k_s \Delta_x \beta_{y,s} \sigma_{y0}^*$
- V. sext. displacement :
 $\Delta\sigma_y^* = k_s \Delta_y \sigma_{x,s} |R_{34}^{s \rightarrow *}|$

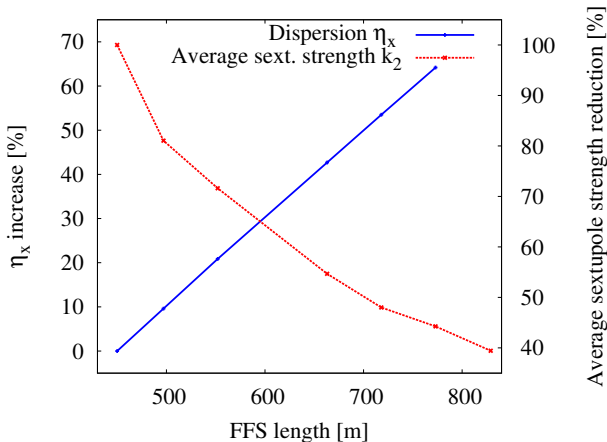


CLIC 3 TeV with $L^* = 3.5$ m

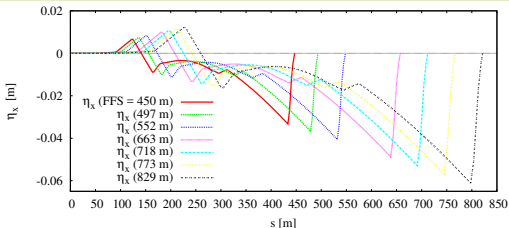
Longer FFS to ease the Tuning

Longer FFS with Local correction

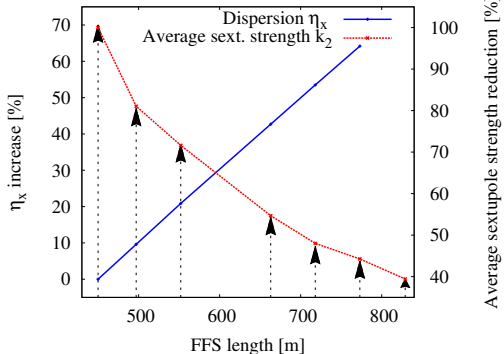
- At 3 TeV, increasing dispersion with bending magnets is **strongly limited by Synchrotron Radiation**
 \Rightarrow the window to increase dispersion is too small to significantly reduce k_2
- Alternatively, one can **increase the length of the FFS in order to increase dispersion** (reduce k_2)



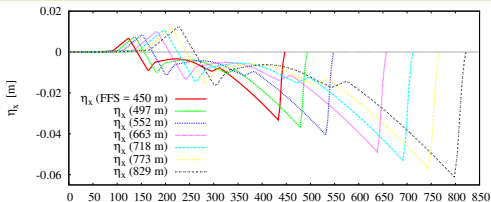
Longer FFS with Local correction



FFS length (m)	L_{tot} ($10^{34} \text{cm}^{-2} \text{s}^{-1}$)	$L_{1\%}$
450	7.04	2.28
497	7.1	2.33
552	7.2	2.34
663	7.2	2.38
718	7.06	2.38
773	7.01	2.34
829	6.95	2.34



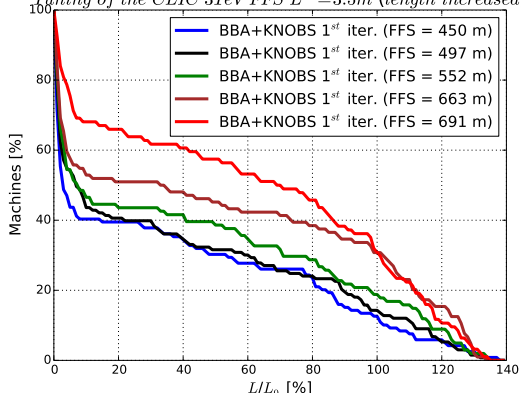
Tuning performances comparison



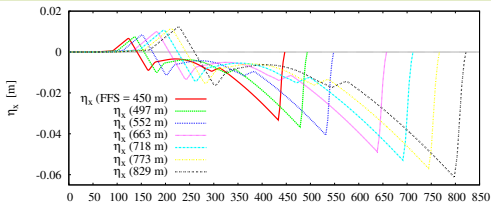
- Comparison of 400 Luminosity measurement (1 iteration of BBA and sextupole knobs tuning) for FFS increased

- Tuning efficiency increase with FFS length ($\approx 50\%$ length increase)

Tuning of the CLIC 3TeV FFS $L^* = 3.5$ m (length increased)



Tuning performances comparison

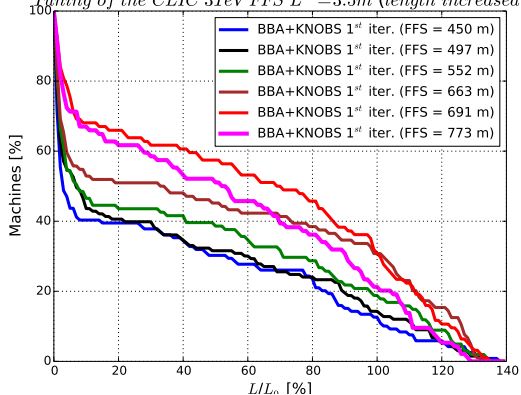


- Comparison of 400 Luminosity measurement (1 iteration of BBA and sextupole knobs tuning) for FFS increased

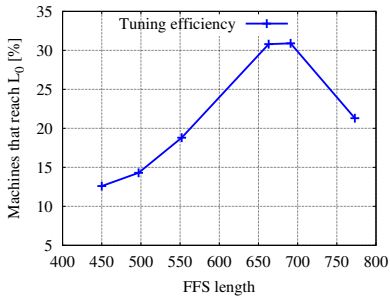
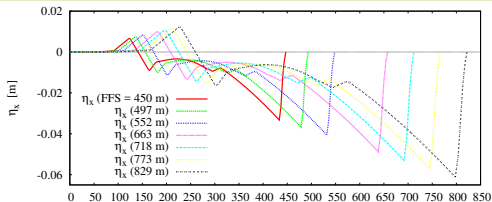
- Tuning efficiency increase with FFS length ($\approx 50\%$ length increase)

- Tuning efficiency start to decrease for longer FFS

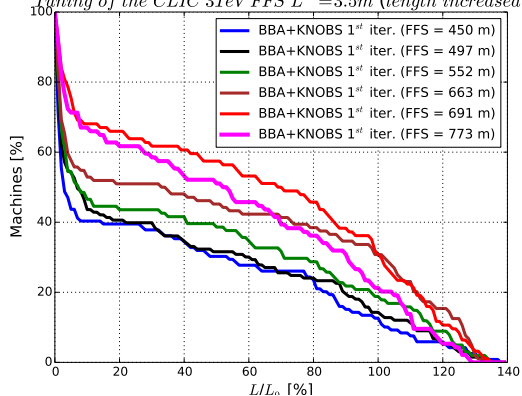
Tuning of the CLIC 3TeV FFS $L^ = 3.5$ m (length increased)*



Tuning performances comparison



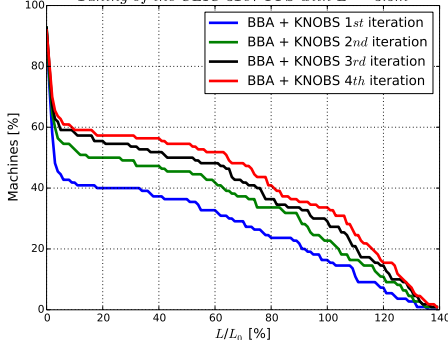
Tuning of the CLIC 3TeV FFS $L^ = 3.5$ m (length increased)*



Tuning performances comparison

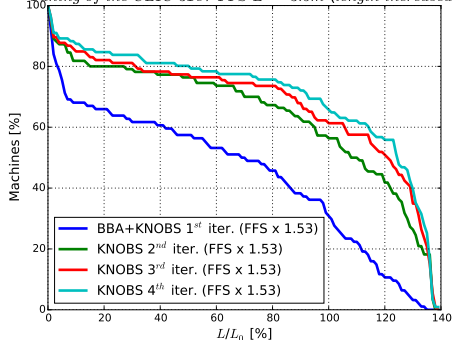
- 4th iteration : Nominal FFS length have 35% of machines that reach L_0
- 4th iteration : **Longer FFS length (x1.53) have 71% of machines that reach L_0**
- Number of Luminosity measurements \approx 1600

Tuning of the CLIC 3TeV FFS with $L^* = 3.5$ m



Nominal FFS length (Barbara Dalena's simulation)

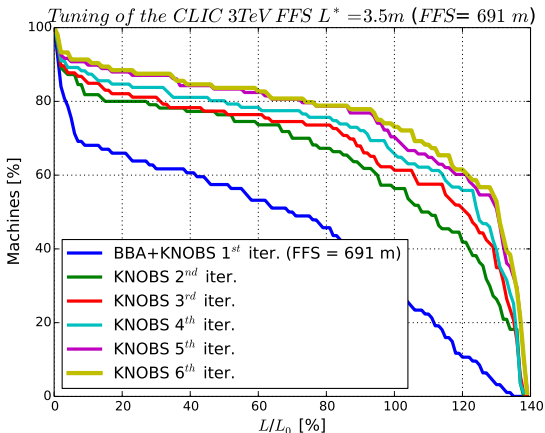
Tuning of the CLIC 3TeV FFS $L^* = 3.5$ m (length increased)



FFS length x 1.53

Tuning performances for FFS length increased by 53%

- 6th iteration : Nominal FFS length have 79% of machines that reach $0.9 \cdot L_0$
- 6th iteration : Nominal FFS length have 74% of machines that reach L_0
- 6th iteration : Nominal FFS length have 68% of machines that reach $1.1 \cdot L_0$
- **Luminosity measurements ≈ 2400**



Summary

For $L^* = 6$ m :

- Long L^* option FFS has been re-optimized based on tuning performances (increase of β_y^*)
- When only transverse misalignment is applied, **Tuning has been demonstrated with 90% of the machines that recover the design luminosity in 4400 luminosity measurements**
- Next step : demonstration of tuning feasibility with magnet strength errors and roll

For longer FFS with $L^* = 3.5$ m :

- Several longer FFS are being studied to check the impact on tuning performances
- All designs fulfill the luminosity requirements with approximately the same performance
- **Tuning performance increases with FFS length up to $\approx 50\%$ length increase, then reduces**