CLIC-BDS Tuning Study with short L^*

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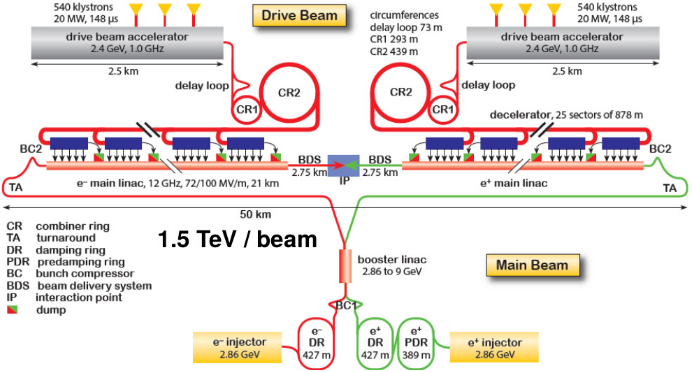
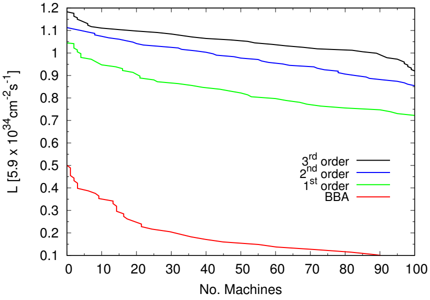
Outline

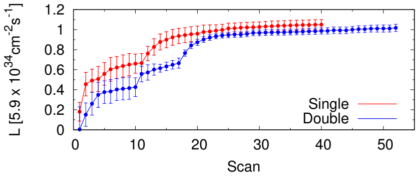
CLIC Footprint & Parameters [1]



Error	Unit	Value
$\mathcal{L}_0$	$[cm^{-2}s^{-1}]$	5.9x10^{34}
E_{CM}	[TeV]	3
$\beta^*_{x,y}$ / $\gamma\epsilon_{x,y}$ / $\sigma^*_{x,y}$	[mm / nm / nm]	7 , 0.068 / 660 , 20 / 45 , 1
L^*	[m]	3.5 (6.0)
f_{rep}	[Hz]	50

2-Beam Tuning Results (Static Imperfections)





90% of machines reached a $\mathcal{L} \geq 102\%\mathcal{L}_0$ [3]

After **15000** luminosity measurements

40% slower than single beam tuning

Machine Imperfections

Error	Unit	σ_{error}	
		CDR [1]	Present
e^- & e^+ Treatment	-	Single	Independently
BPM Transverse Alignment	[μm]	10	10
BPM Roll	[μrad]	-	300
BPM Resolution	[nm]	10	20
Magnet Transverse Alignment	[μm]	10	10
Magnet Roll	[μrad]	-	300
Magnet Strength	[%]	-	0.01
Ground Motion	[s]	-	0.02

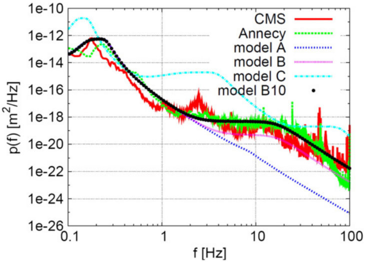
Tuning Algorithm

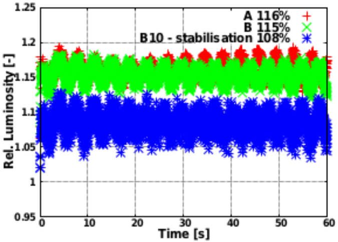
- Beam-Based Alignment Techniques
  - 1-to-1
  - Target Dispersion Steering
  - Multipole Alignment
- Linear Knobs (Sextupole displacements in transverse plane)
- Non-linear Knobs (Strength variation of normal and skew sextupoles)

Notes:
Knobs are scanned first to e^- and after to e^+
Parabola fit technique is used to scan the knobs
Each knob takes $\approx$ 20 measurements
Ground motion time lapse between $\mathcal{L}$ measurements is 0.02 s (*not realistic*)

CLIC Stability Requirements

- **Sub-nm Y-offset tolerances found for QF1 and QD0 [2]**
- Luminosity stability due to ground motion

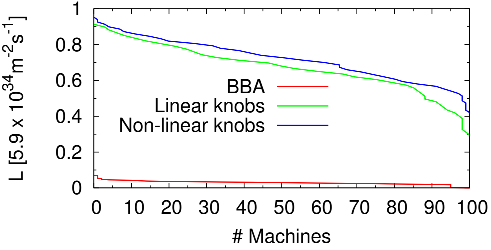




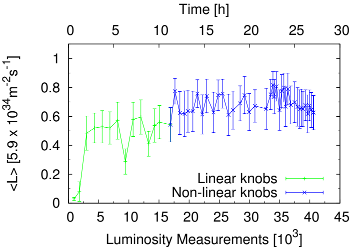
GM counter-measures:

- Active Stabilization System
- Orbit Feed-Back (*ATF2 Experiment* [4])
- Pre-isolator (*Required for stability)*
- *IP Feed-back (Offset removed)*

Tuning Results

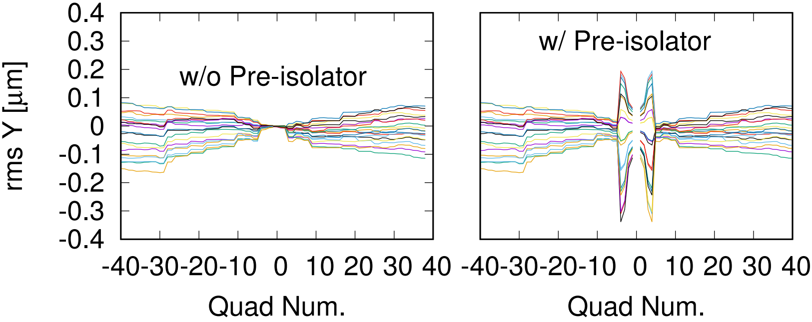


90 % machines reach 60 % of $\mathcal{L}_0$ after 47000 $\mathcal{L}$ measurements



Pre-isolator

Motion of the FD quadrupoles un-correlated to the rest of the beamlines



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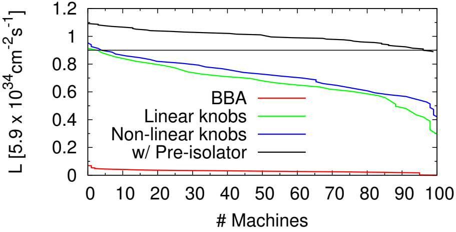
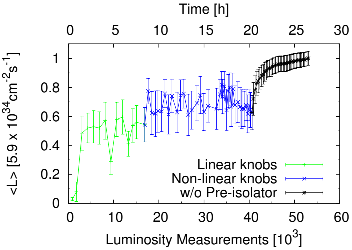
PRE-ISOLATOR

Tuning Results w/o Pre-isolator





90 % machines reach 91 % of $\mathcal{L}_0$ after 53000
28000 effective $\mathcal{L}$ measurements

Summary

Conclusions

Notable progress since CDR (2012)

- Tuning Procedure (Effective Tuning)
- Realistic Scenario (static + dynamic imperfections)
- Performance **achieved?**

90% of machines reached a $\mathcal{L} \geq 89\%\mathcal{L}_0$

Comparable* to ILC Studies [4] (90% of machines $\mathcal{L} \geq 91\%\mathcal{L}_0$)

Future Steps

- GM time lapse (2 s? including magnet movers/ps?)
- Use pair creations signal for tuning
- Dynamic errors missing: Power supplies, magnet movers,...
- Improvements on the tuning algorithm
  - Scan on smallest σ^*
  - Remove non-effective knobs

*Although the imperfection considered are different

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