Dispersion measurement in the CLIC BDS

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Headlines

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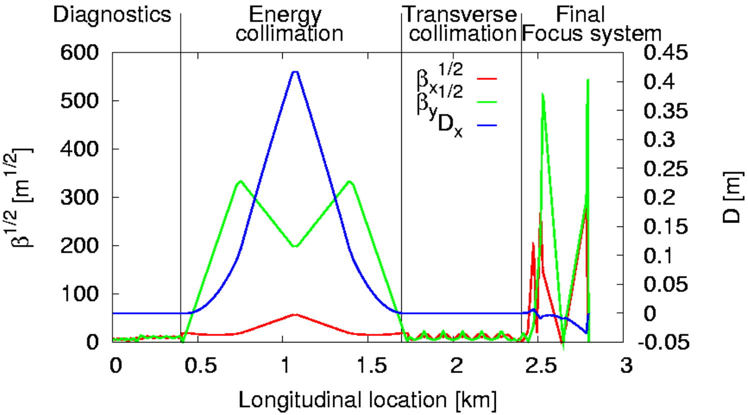
Introduction

On Line Dispersion Measurement

Results

Conclusion and prospects

CLIC Beam Delivery System



Concept

Motivation

- Huge dispersion and β function in BDS (collimation section).
- Very precise BPMs will be available.
- $\Rightarrow$ good possibility to reconstruct jitter.
- Dispersion measurement using jitter ?

Headlines

On Line Dispersion Measurement

Principle

- Measure pulse to pulse beam position variation at each BPM.
- Reconstruct the parameter at injection : $x, x', y, y', \frac{\Delta E}{E}$ using first order TM.
- Get the dispersion from the correlation between the position measurements and reconstructed $\frac{\Delta E}{E}$ at each BPM.
- Fit the dispersion at injection from all individual measurements.

Advantage

Non invasive measurement !

Simulation Parameters

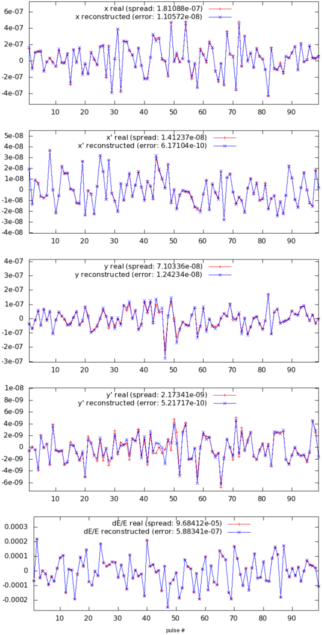
Perfect Lattice

- BPM resolution : 10nm.
- Injected beam jitter : 10% of σ_x,$\sigma_{x'}$, σ_y and $\sigma_{y'}$.
- Energy beam jitter : $\frac{dE}{E} = 10^{-4}$.

Reconstruction

- Use all BPMs not in FF for jitter determination.
- Use all BPMs not in FF for injected dispersion fit.

Reconstruct the parameter at injection



Headlines

Introduction

On Line Dispersion Measurement

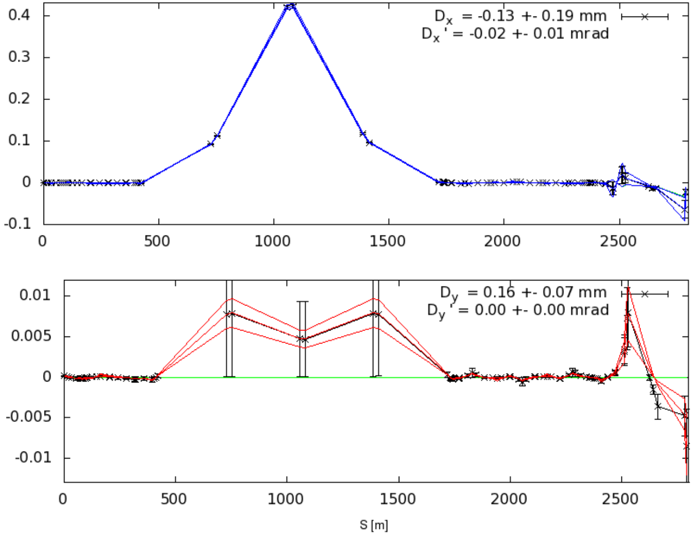
Results

- Dispersion Measurement Results
- Realistic lattice
- With Injected dispersion

Conclusion and prospects

Dispersion measurement

No dispersion at injection



Comparison with other methods

"Classical" measurement

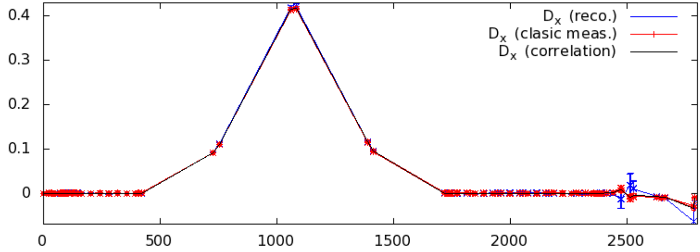
- look at trajectory for $\frac{dE}{E} = -10^{-4}$, $\frac{dE}{E} = 0$ and $\frac{dE}{E} = 10^{-4}$.
- compute $D1$, $D2$ and $D3$ to get idea of non-linearities
  - $D1_X = \frac{X_{+dE} - X_{-dE}}{2\frac{dE}{E}}$
  - $D2_X = \frac{X_{+dE} - X_0}{\frac{dE}{E}}$
  - $D3_X = \frac{X_0 - X_{-dE}}{\frac{dE}{E}}$

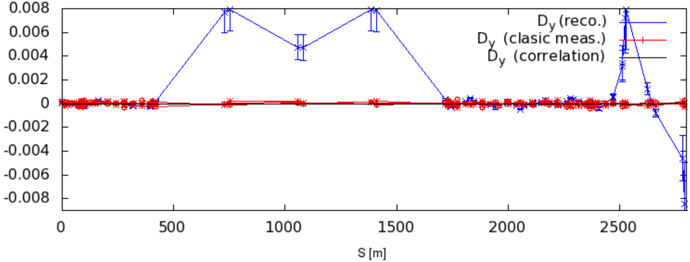
Beam Correlation

- Look at the beam phase space to get dispersion.
- Real definition of the dispersion
- Only in simulation ...

Comparison with other methods

No dispersion at injection





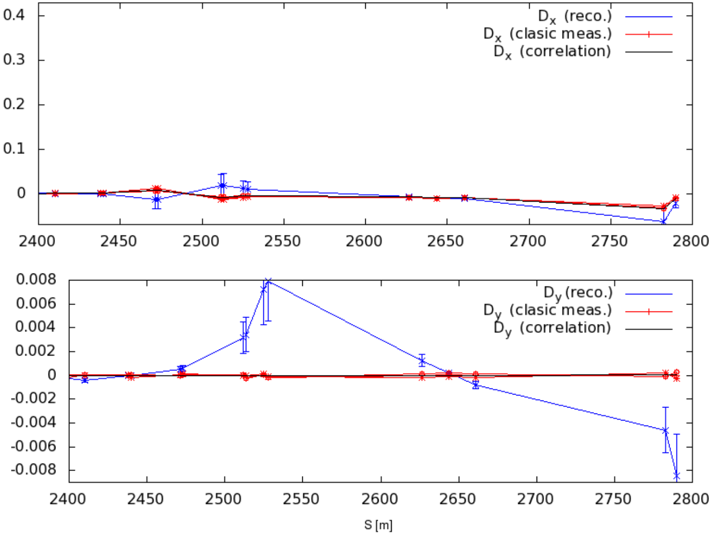
Dispersion measurement

Comments

- About 10mm D_x and D_y reconstruction systematics.
- Errors appear mostly in the FF.
- Due to large non-linearities in FF.

Dispersion measurement (in FF)

No dispersion at injection



Simulation Parameters

Disturbed Lattice

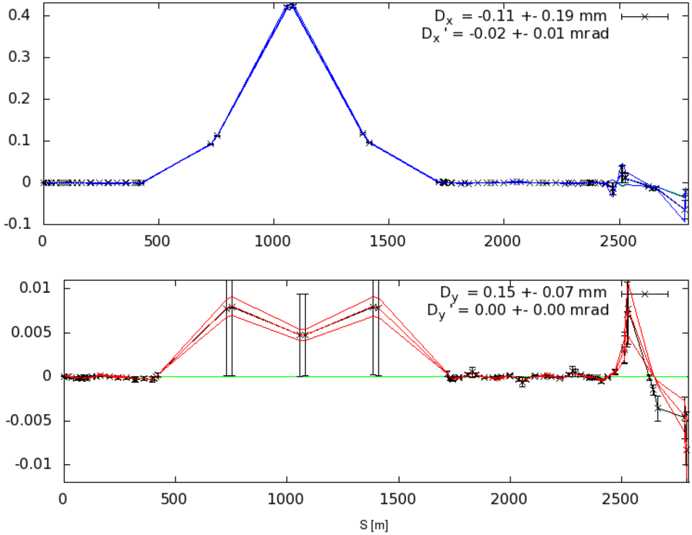
- Initial BPM and quads misalignments : 10μm.
- BPM resolution : 10nm.
- Trajectory correction.
- Injected beam jitter : 10% of σ_x,$\sigma_{x'}$, σ_y and $\sigma_{y'}$.
- Energy beam jitter : $\frac{dE}{E} = 10^{-4}$.
- $\frac{dK}{K}$ in quadrupoles : 10^{-4}.

Reconstruction

- Use BPMs not in FF for jitter determination.
- Use all BPMs not in FF for injected dispersion fit.

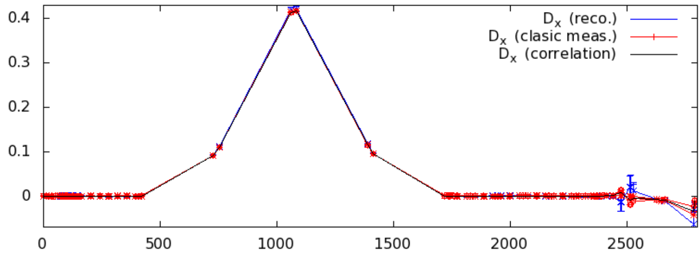
Dispersion measurement

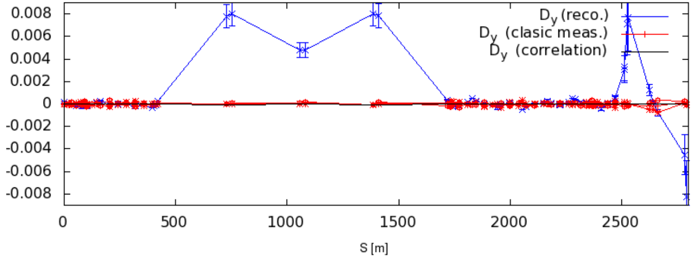
No dispersion at injection



Comparison with other methods

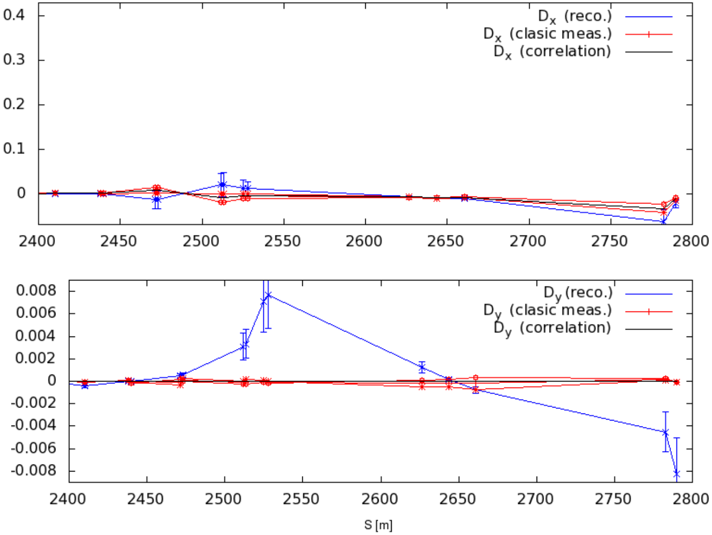
No dispersion at injection





Dispersion measurement (in FF)

No dispersion at injection



Simulation Parameters

Disturbed Lattice

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- $\frac{dK}{K}$ in quadrupoles : 10^{-4}.
- $D_x(inj) = 10$cm.

Reconstruction

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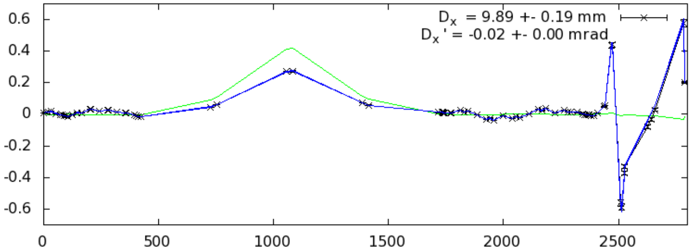
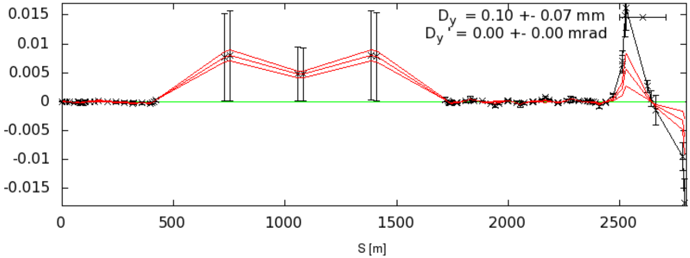
- Use all BPMs not in FF for injected dispersion fit.

Dispersion measurement

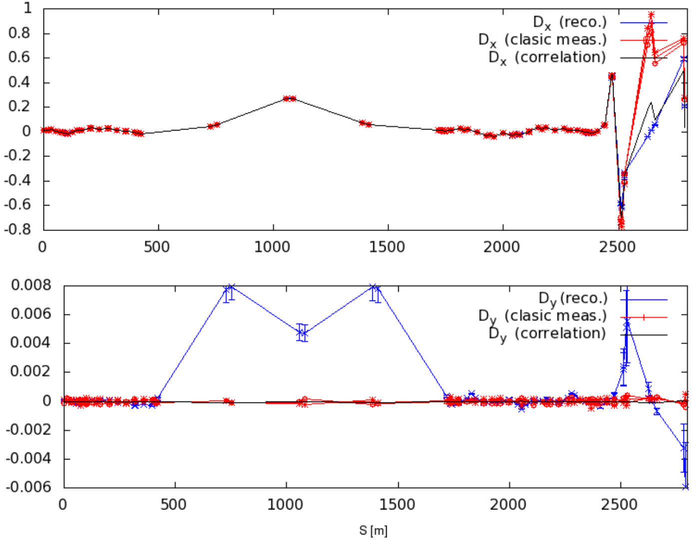
$D_x(inj) = 10\text{cm}$





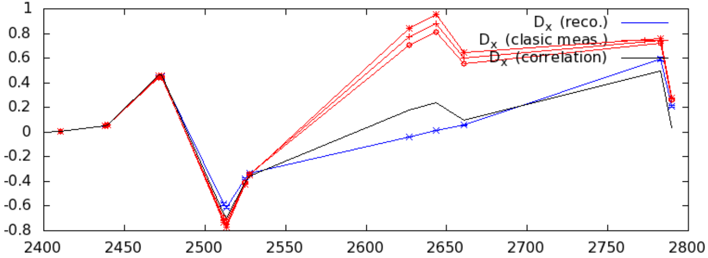
Comparison with other methods

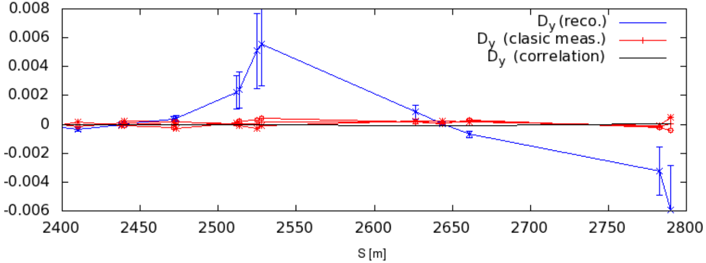
$D_x(inj) = 10\text{cm}$



Dispersion measurement (in FF)

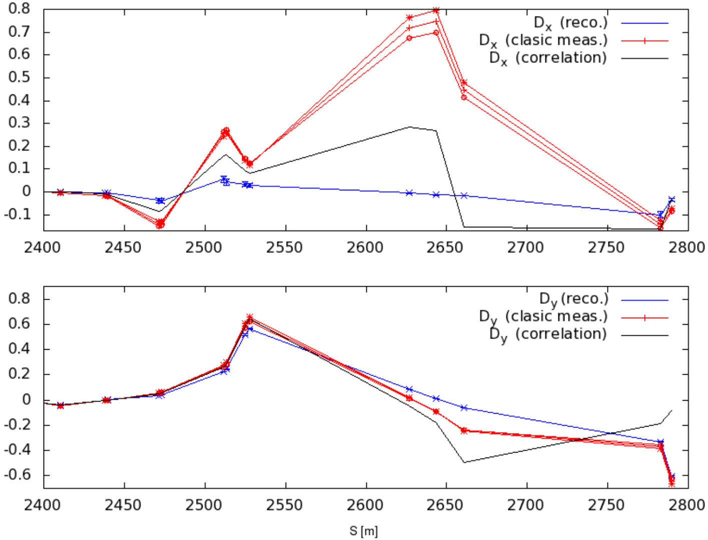
$D_x(inj) = 10\text{cm}$





Dispersion measurement (in FF)

$D_y(inj) = 10\text{cm}$



Headlines

Conclusion and prospects

Conclusion

- Non-intrusive method to measure dispersion in BDS.
- Doesn't work well in FF (systematics from non-linearity).
- Robust (expected errors has little influence).
- But may perform better than the usual method if D leak.
- $dD_x(inj) \simeq 0.2\text{mm}$, $dD_y(inj) \simeq 0.1\text{mm}$

Prospect

- Take non linearities into account.