Summary of Beam Dynamics Working Group

2009.10.03.

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Sessions

- ML-RTML-BD Joint session -1 ← This summary
- ML-RTML-BD Joint session -2
- IR-BDS-BD Joint session

ML-RTML-BD Joint session -1

- Design of extraction line of single stage bunch compressor [Sergei Seletskiy]
- Emittance simulation of bunch compressors (2 and 1 stage) [Andrea Latina]
- Survey/Alignment simulation [John Dale]
- Emittance simulation of ML with BPM scale error [Kiyoshi Kubo]
- Comments/discussion on stray fields in long return lines

Design of extraction line of single stage bunch compressor [Sergei Seletskiy]

- Difficulty was: Reasonable beam size for both compressed (large E-spread) and uncompressed (small E-spread) beams.
  - Solved by putting several sextupoles
- We have a reliable design.

Solution of the Nonlinear Halo Problem
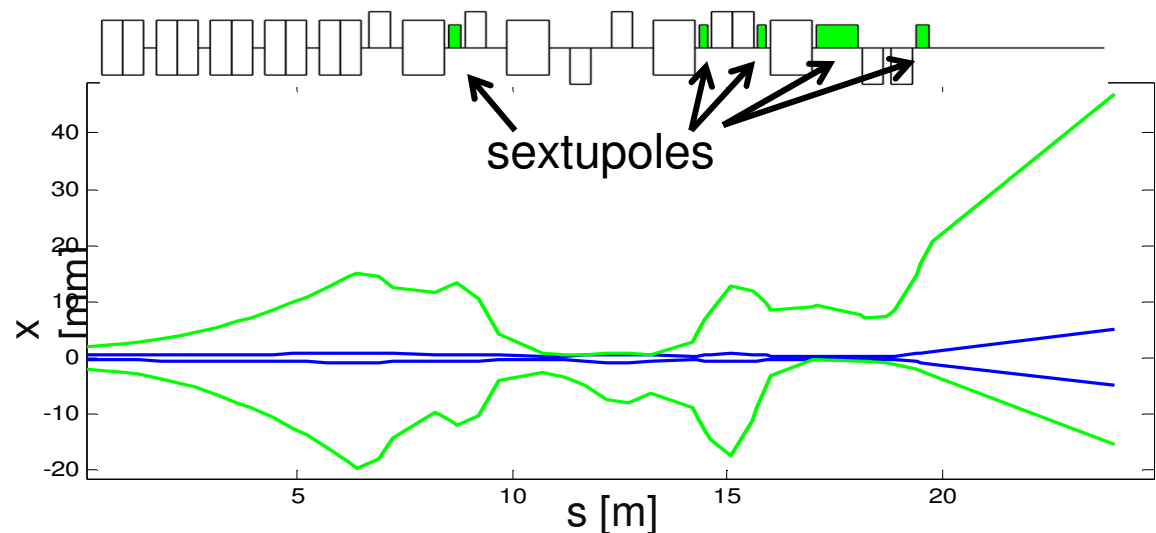
Emittance simulation of bunch compressors (2 and 1 stage) [Andrea Latina]

- Design of single stage bunch compressor was improved.
- Simulation of: 1-to-1 steering + DFS (Dispersion free steering) + Dispersion Bumps + Tilt Adjustment
- Need movers of several cryo-modules for cavity tilt adjustment.
- Then, emittance growth can be small enough.
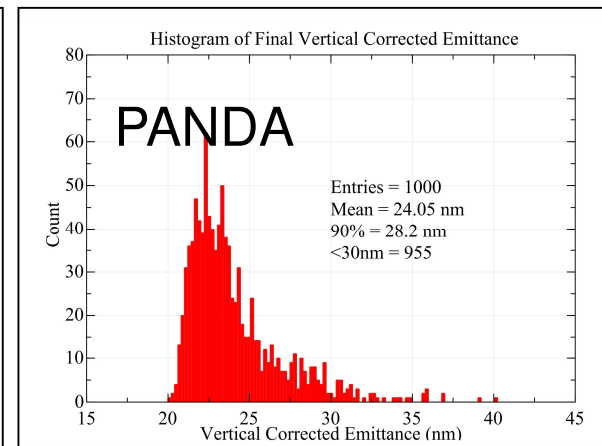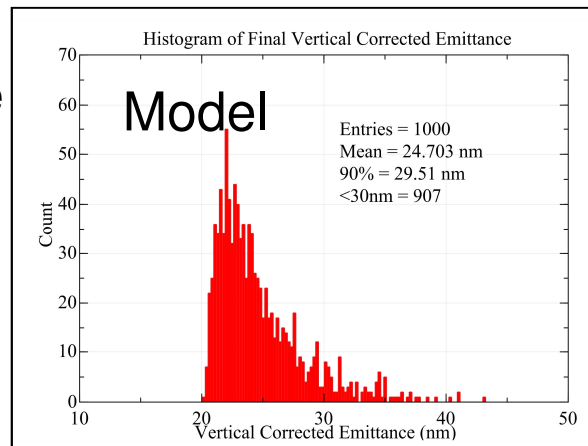- Similar results for single and 2- stage bunch compressors.
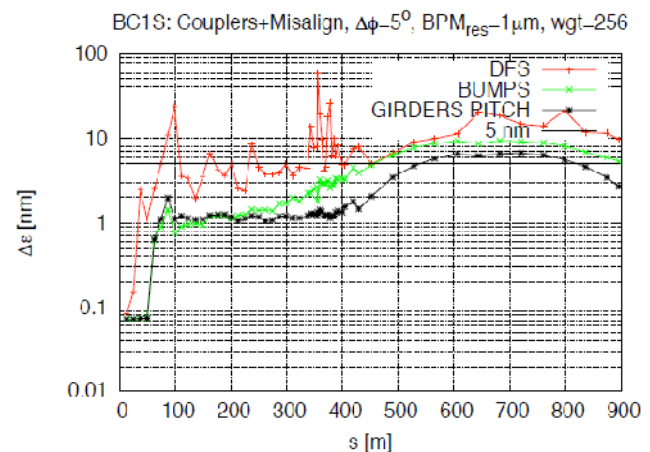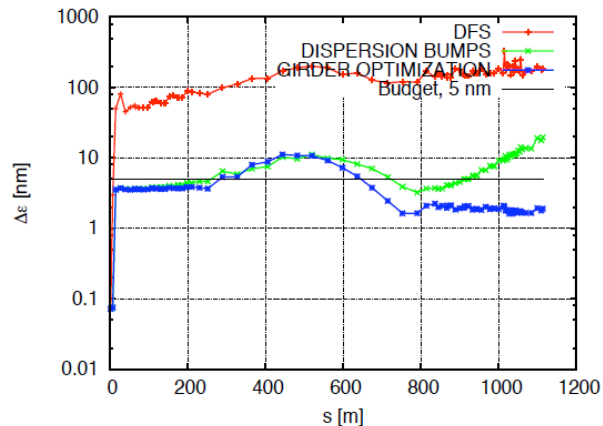
Survey/Alignment simulation [John Dale]

- Alignment + Steering correction (DFS) simulations using
  – Commercial code (PANDA)
  – Newly developed Simplified Network Model
- Simplified model gives a little worse but similar result of PANDA.
- Realistic modeling of survey/alignment is being improved.

Distribution of final emittance

100 alignment x 10 DFS

Model

Histogram of Final Vertical Corrected Emittance

Entries = 1000
Mean = 24.703 nm
90% = 29.51 nm
<30nm = 907

Count / Vertical Corrected Emittance (nm)

PANDA

Histogram of Final Vertical Corrected Emittance

Entries = 1000
Mean = 24.05 nm
90% = 28.2 nm
<30nm = 955

Count / Vertical Corrected Emittance (nm)

Emittance simulation of ML with BPM scale error
[Kiyoshi Kubo]

Problem is: DMS (Dispersion Matching Steering) is affected by BPM scale error, because design dispersion is non-zero at all BPM.
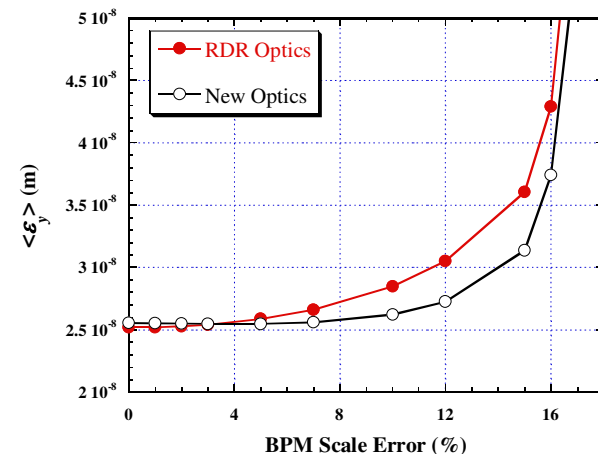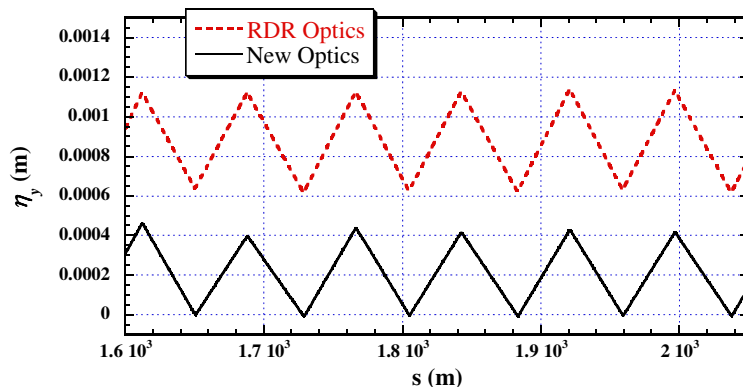
New optics was proposed to mitigate the effect.

* Zero dispersion at every other quad-BPM (every defocus Q)

* Less sensitive to BPM scale error

Tolerance of Main Linac BPM scale error:

"a few %" in old optics, about 10 % in new optics

"10 % is reasonable and achievable" [Manfred Wendt]

Comments on stray fields in RTML long return lines

- Time varying stray fields in long return line cause emittance growth.
- Estimated tolerance: < 2 nT, from simple assumptions.
- Need more realistic model for more accurate estimation.
- Need more measurements.
  - FNAL has some plans. But,
  - It is not likely we have enough data soon.
- It is a issue to be worried about.

Summary of Summary

- We have a reliable design of extraction line of BC.
- Low emittance can be preserved, if we have cryo-module movers. Both 1 and 2 stage BCs.
- Realistic modeling of survey/alignment is being improved.
- In newly proposed optics, tolerance of Main Linac BPM scale error is about 10 %, which is achievable.
- Stray field in long return line is a issue to be worried about.