Status of CesrTA Optics
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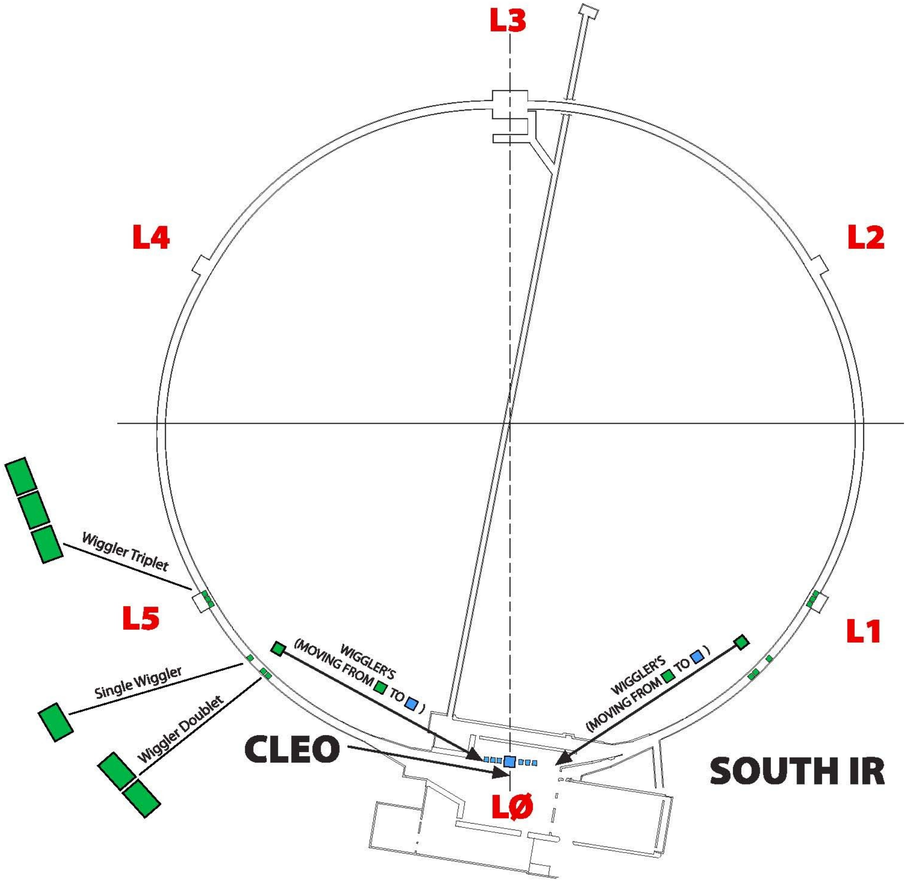
Overview

- CesrTA Lattice Design
- CESR Reconfiguration Summary
- Transition to High-Tune, Low-Emittance Optics
- Initial Measurements
- Summary and Prospects: LET Plans for January

Design Parameters

- CESR wigglers are similar to the proposed ILC damping ring wigglers
- Placing wigglers in regions of zero-dispersion lowers the minimum achievable emittance by a factor of 4
- We can already create zero-dispersion regions in 6 of the 12 wigglers
  - Remaining 6 must move to L0 straight, where we can create another zero-dispersion region

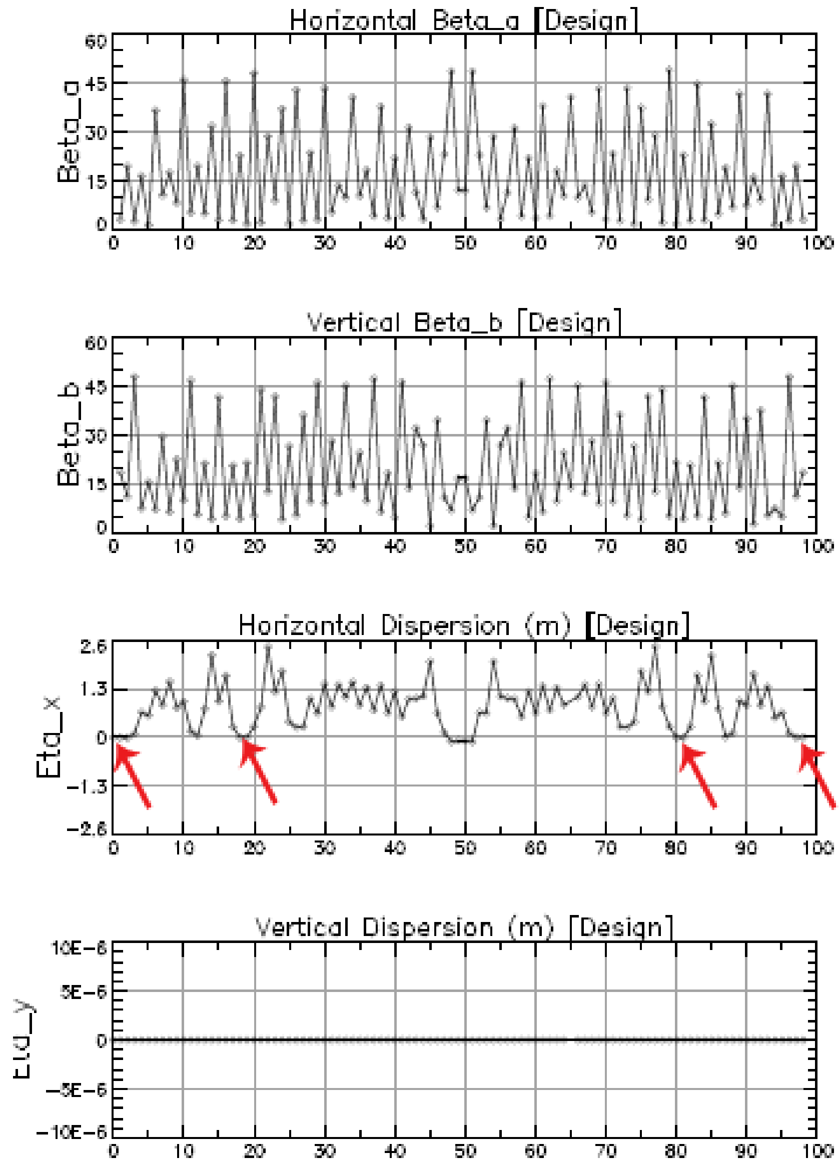


CesrTA Design Parameters

Right: design betas, dispersion

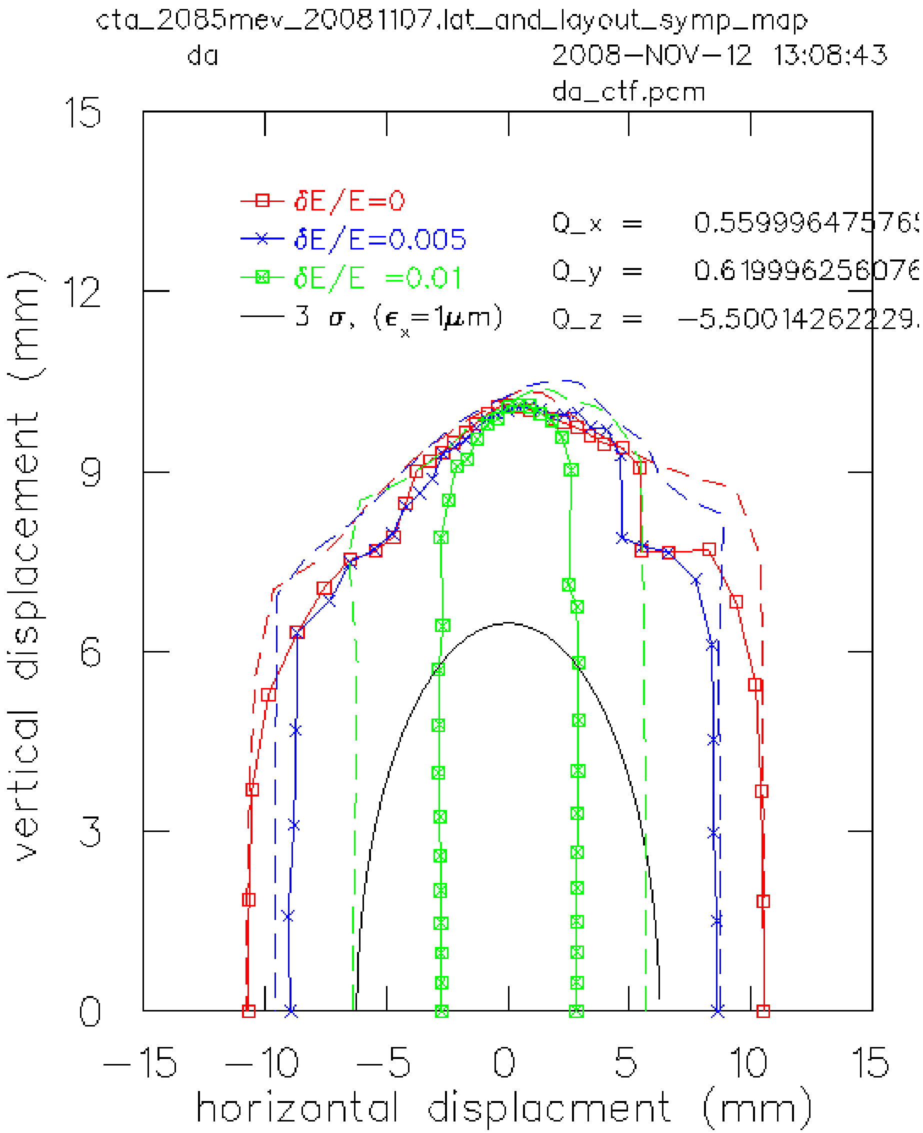
Below: design parameters

Parameter	**Value**
Energy	2.085 GeV
No. Wigglers	12
Wiggler B	1.9 T
Qx	14.57
Qy	9.62
Qz	0.055
ε_x	2.6 nm
α_c	6.76e-3



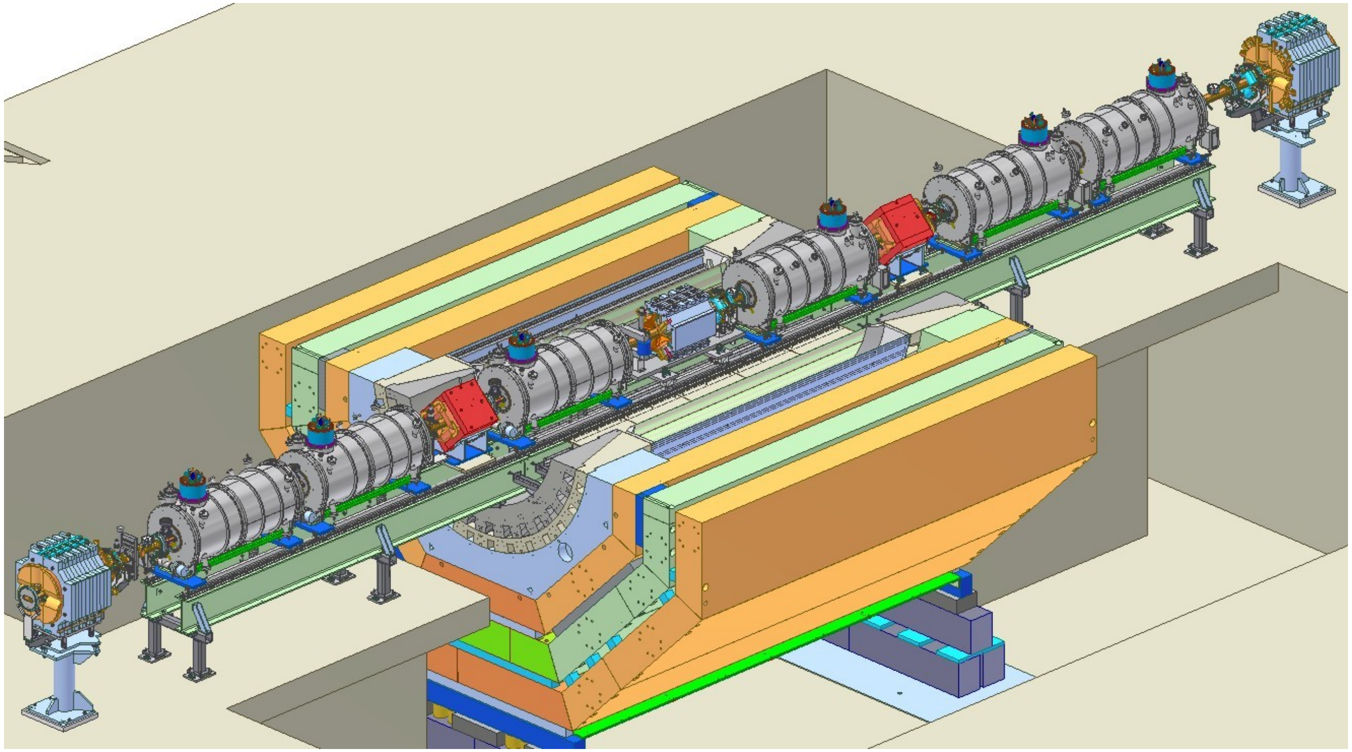
Dynamic Aperture

- Black line on plot shows 3σ injection envelope
- 1% energy deviation is well within 1σ requirement for injection



CESR Reconfiguration

- Successfully reconfigured CESR in July-September:
  - Removed drift chamber in CLEO detector
  - Removed IR solenoid / quadrupoles, other final focus elements
  - Moved the 6 wigglers in 14-15E/W to L0 area
  - Full survey / alignment after relocating the wigglers

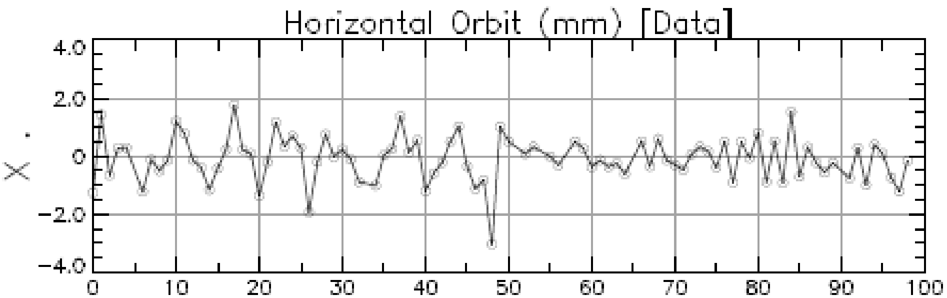


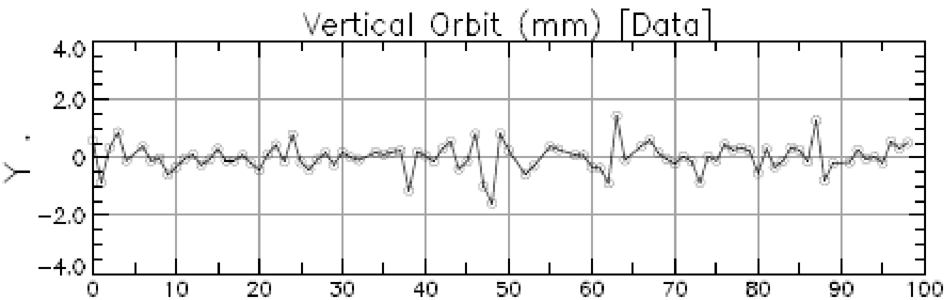
Transitioning to Low-ε Optics

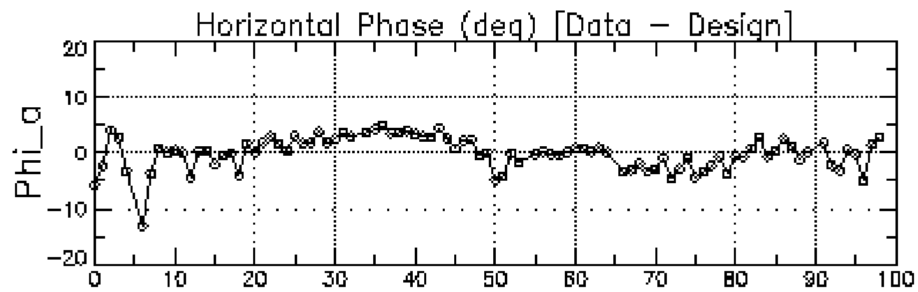
- Going from low-tune to high-tune (Qx = 14.57) optics is not trivial
- Transition in steps:
  - Start in June optics: Qx = 10.57, keeping the arcs identical and modifying L0 and L3 to account for new magnet structures
  - Ramp up the 6 wigglers in L0 to 1.9T (still low-tune), compensating for wiggler focusing with quads
  - Least confidence in new L0 quads, therefore increase horizontal tune to 14.57, but hold new L0 quads constant
    - We are able to do this thanks to independently-powered quads
    - Result: immediately stored beam
  - Finally load low-emittance optics to achieve zero dispersion in L0 wigglers
- We now have good injection in both e+/e- conditions
- First pass correction of orbit, betatron phase and coupling were completed

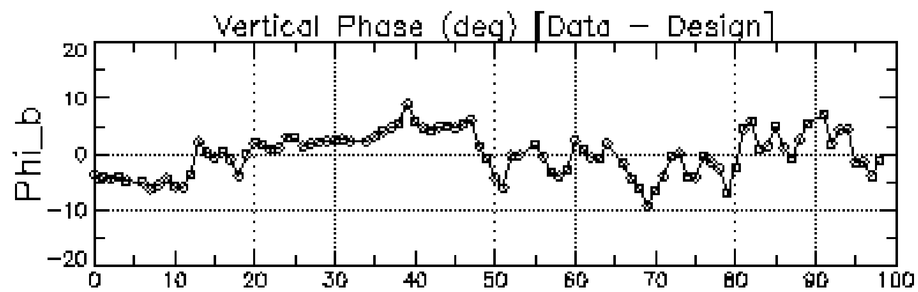
Measurements

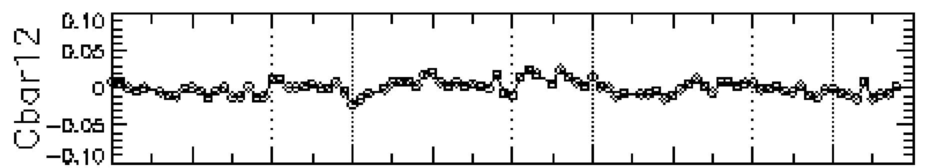
Measurements from the final high tune, low-emittance optics:









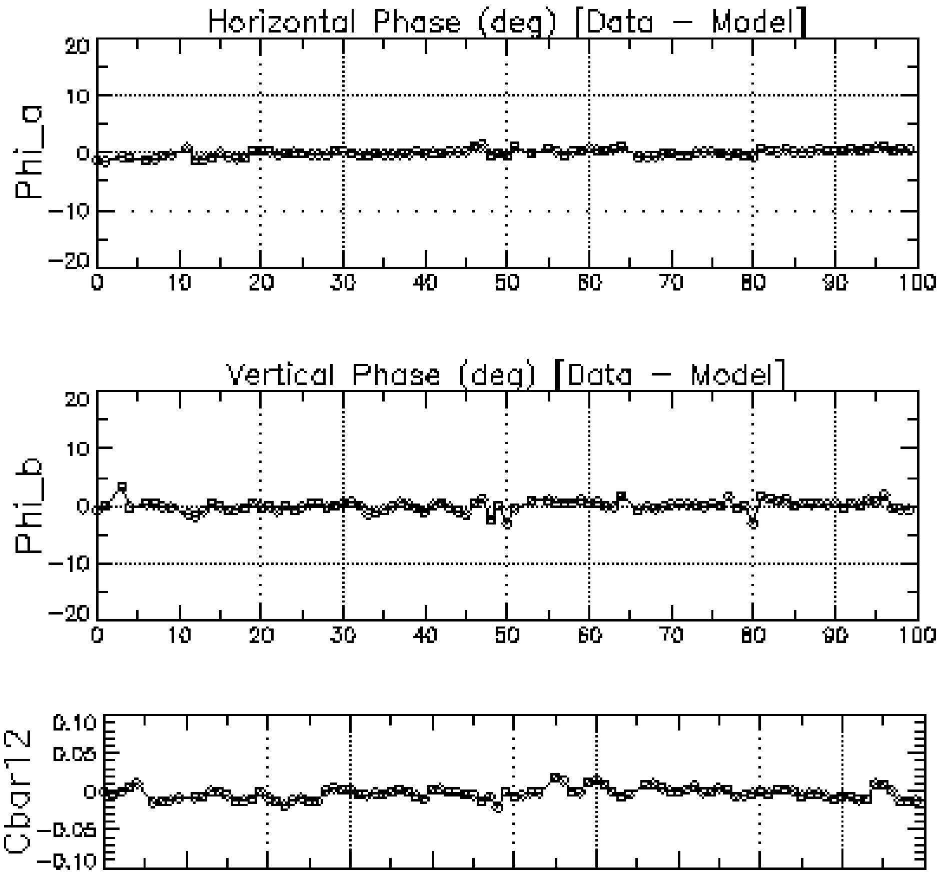


RMS cbar12 = 0.009

Note: Correcting orbit, phase and coupling is an iterative process. These are results from the first pass of corrections.

Compare: Typical Phase/Coupling Correction

- Example of a typical phase/coupling correction from June CesrTA run (actual data):

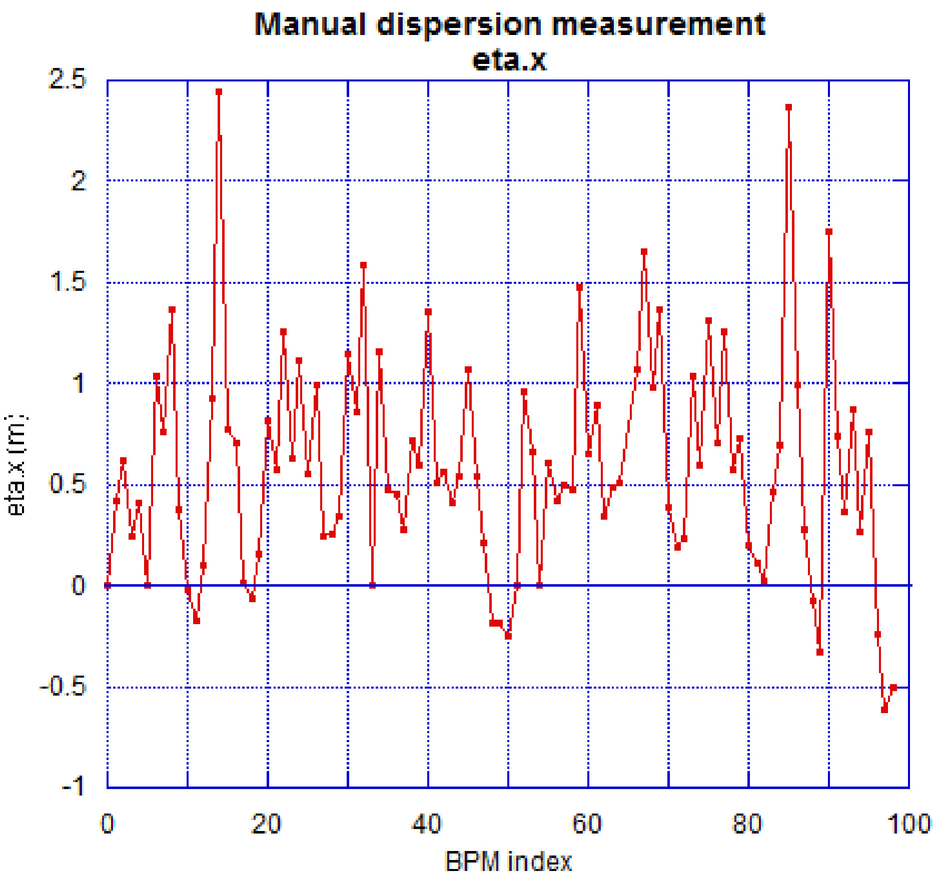


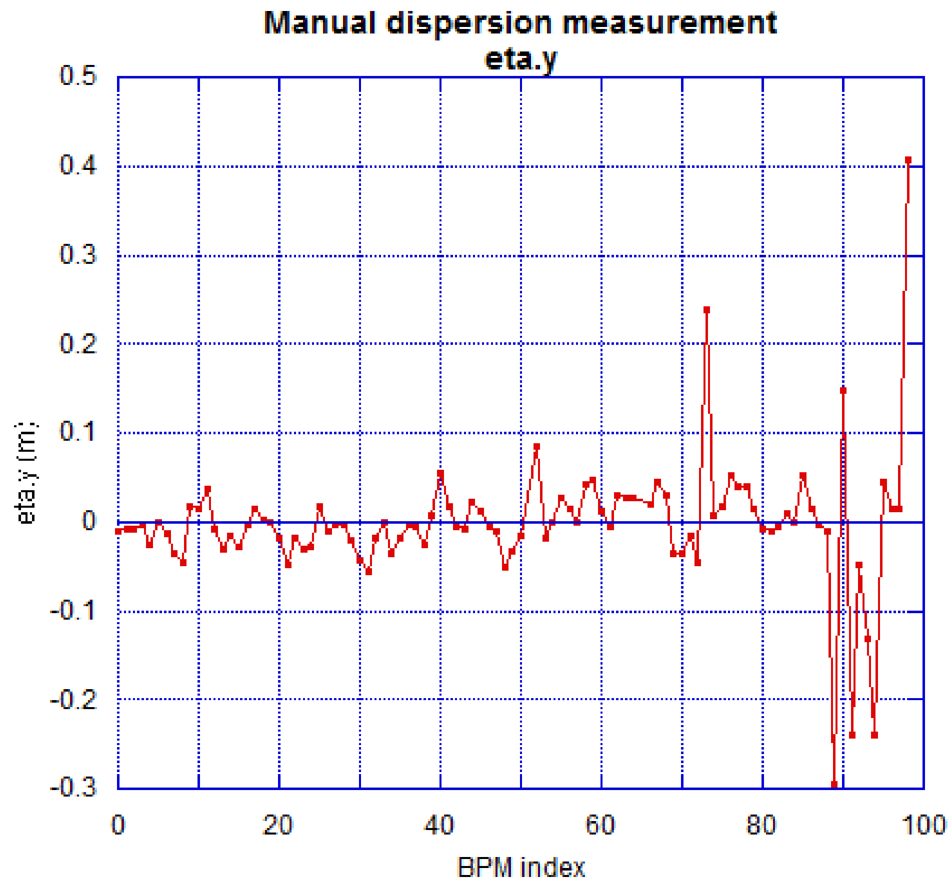
RMS = 0.008

Note: 5.3GeV, low-tune conditions, no wigglers on

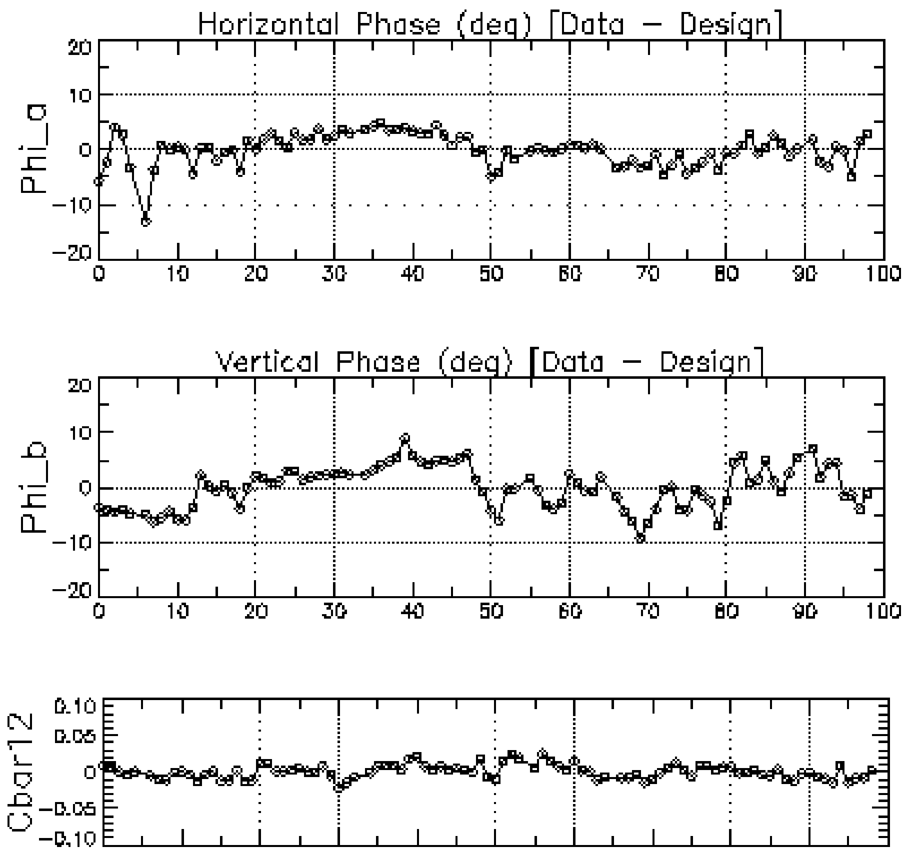
Dispersion Measurement

- Measured dispersion:

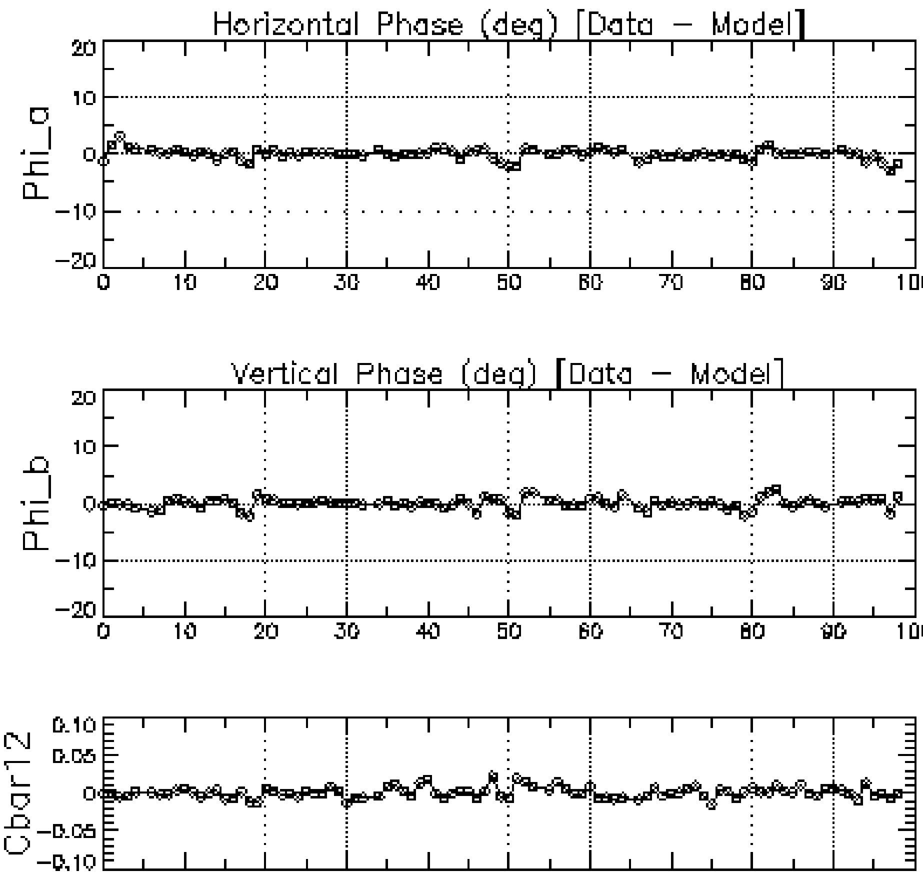




Phase, Coupling Correction



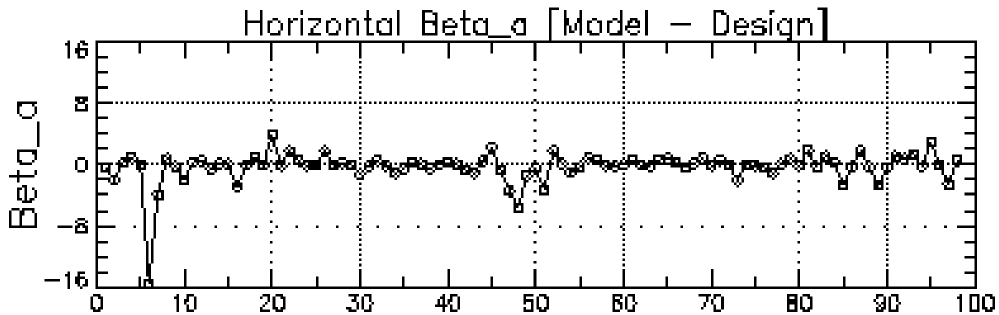
First pass of phase / coupling corrections



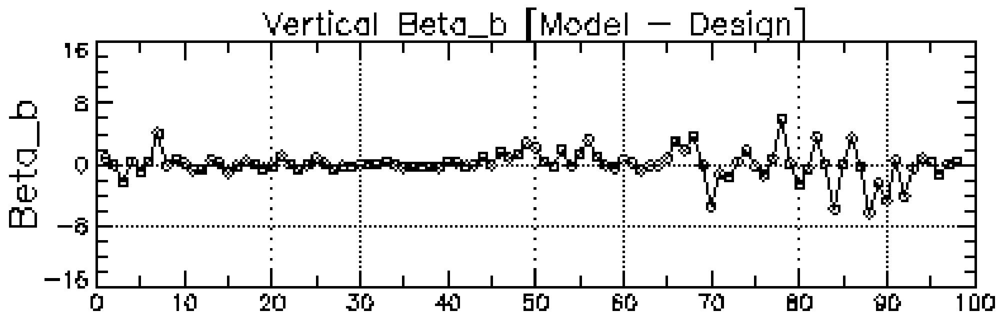
Expected level of corrections

Model Beta Errors

- After fitting the phase and coupling with all quad and skew quad strengths, we can look at the resulting model beta
- Compare to the design betas (take difference):



RMS = 2.0

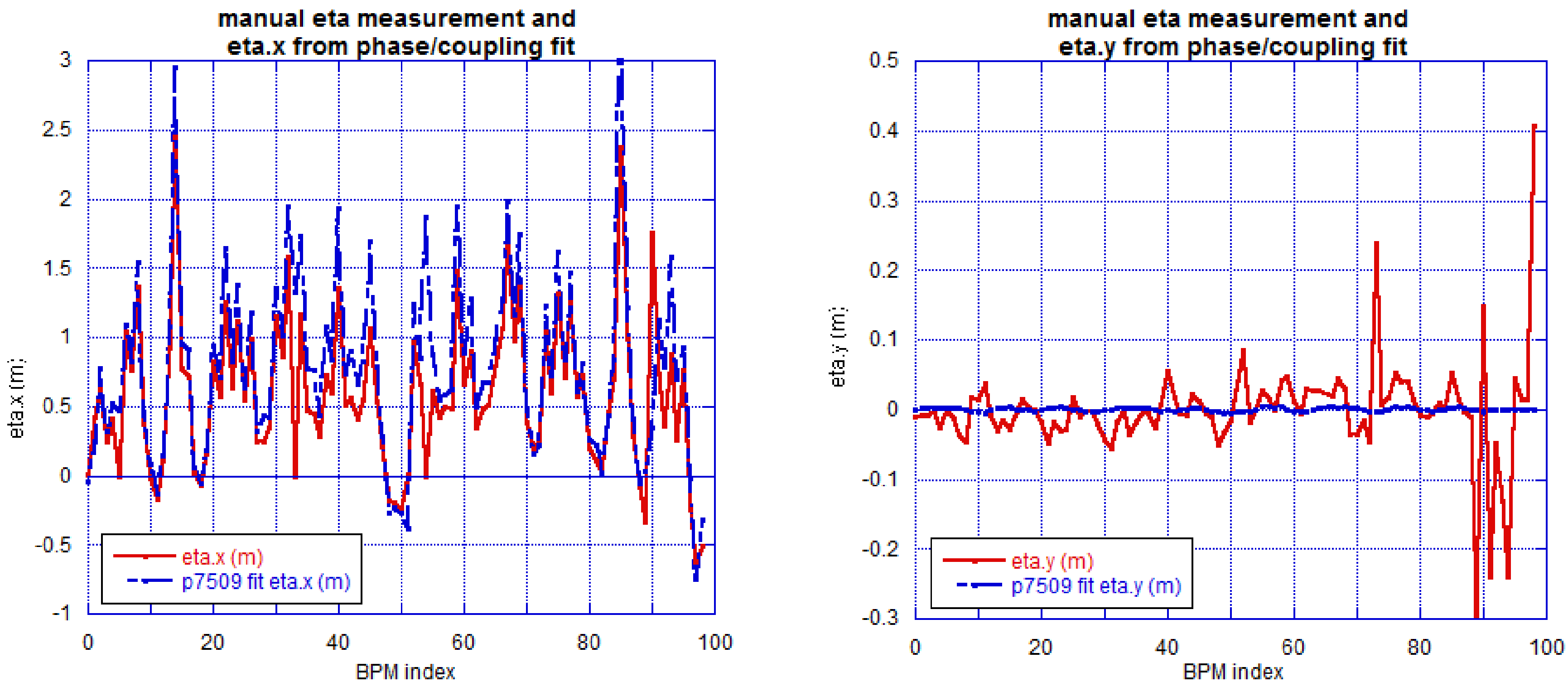


RMS = 0.046

- Phase/coupling measurements are more sensitive to quad strength errors than betas

Dispersion Measurement

- Fitting phase and coupling also produces a model for the dispersion
- Compare this model to the manual dispersion measurement:



- Results indicate that when we correct the phase and coupling, we will correct the horizontal dispersion as well
- Corrected horizontal dispersion would be zero in L0
- Vertical quad offsets are not included in this model

Summary

- Successfully transitioned to CesrTA optics
- New high-tune, low-emittance optics have been loaded, with acceptable injection
- First measurements of orbit, phase, coupling, and dispersion indicate we are in good condition
- Prepared to correct optics in January with a variety of tools

Low-Emittance Tuning Plan

- Determine BPM gain errors

- Steering magnets
- Quads/skew quads
- Quad offsets, vertical correctors

- BPM tilts, “shear”