



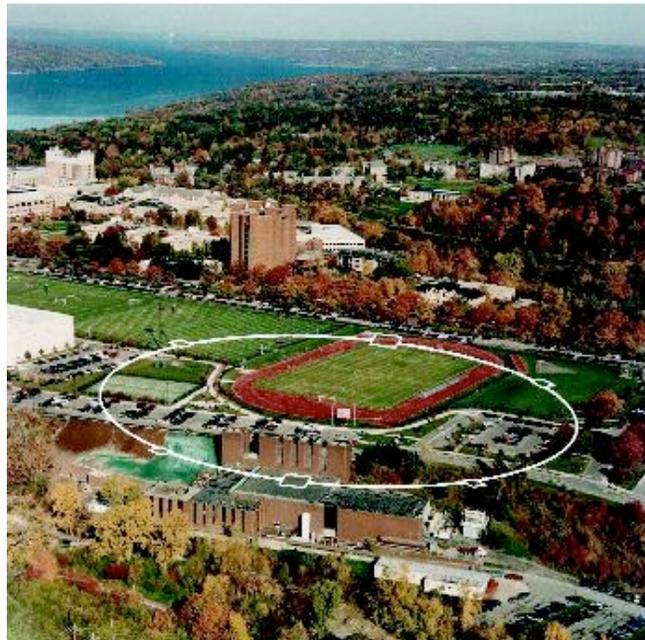
Cornell University
Laboratory for Elementary-Particle Physics



CesrTA Low Emittance Tuning Overview

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- **Machine Layout**

- Reconfiguration of CESR for low emittance operation is complete, including
 - Removal of IR (low β) quadrupoles and CLEO solenoid
 - Redeployment of damping wigglers to zero dispersion straights

- **Optics**

- Stored beam in high tune, low emittance optics ($\epsilon_x = 2.6$ nm)
 - Established efficient injection of both electrons and positrons

- **Survey**

- Network of reference monuments has been established
- Dipole rolls $< 300\mu\text{rad}$
- Quadrupole vertical offset, $\sigma \sim 125\mu\text{m}$
- Quad movers permit rapid and precise adjustment of vertical offset



- **Analysis tools**
 - Gain mapping software:
 - determine gain of individual BPM buttons by fitting to measured orbits
 - ORM analysis software
 - Fit orbit, dispersion, phase, coupling data simultaneously
 - ultimately to determine BPM tilt and shear
 - Betatron phase/coupling measurement and analysis/correction software
 - Software for analysis of zero corrector orbits - beam based alignment of quadrupole offsets and dipole rolls
 - Dispersion measurement - orbit difference, and phase-amplitude measurement of synchrotron oscillation
 - CESR control system (VMS) networked with linux cluster so that we can run all of the measurement and analysis software on fast CPUs
- **Instrumentation (various stages of development)**
 - Beam size monitors
 - x-ray imaging - measurement of positron beam size with few micron resolution in January 09
 - Measurement of peak valley ratio of vertically polarized visible synchrotron light
 - Beam position monitors
 - Bunch by bunch/turn by turn BPM electronics



- **Optics**
 - Restore low emittance optics
 - Iterate phase/coupling/orbit measurement and correction
- **BPM characterization**
 - Gain mapping and ORM measurements and analysis
 - Installation of new BPM electronics over the course of the run
(BPM characterization will be a bit of moving target and an opportunity to exercise analysis tools)



- **Low emittance tuning**

- Correction of quad offsets and dipole rolls based on analysis of zero vertical corrector orbits (survey crew standing by)
- Measurement and correction of vertical dispersion using
 - Vertical steering (~60 correctors)
 - Sextupoles (78)
 - skew quadrupoles (16)
- Real time feedback from xBSM → real time tuning of vertical emittance using closed orbit, dispersion, and coupling bumps
- Measurement of dependence of lifetime on bunch current and beam size

Low emittance tuning promises to be very labor intensive and we look forward to the participation of our collaborators in the next run