PEP-II Status

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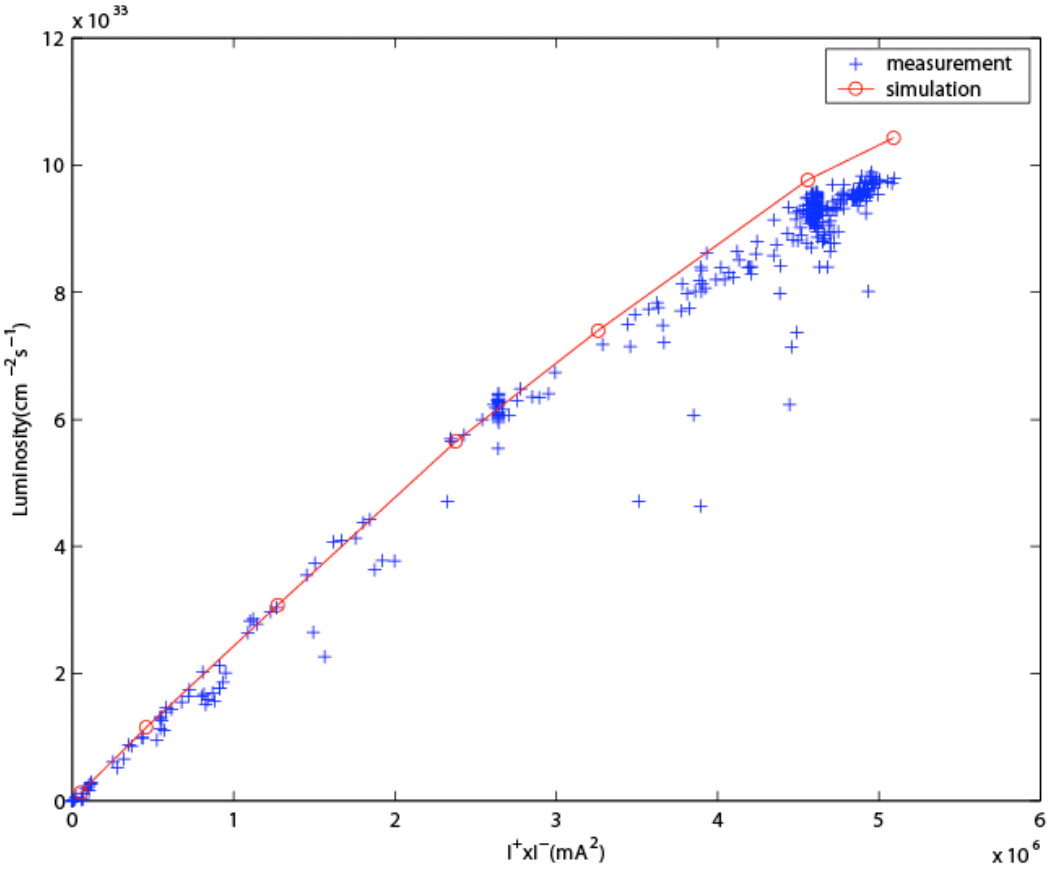
KEK

KEKB MAC Meeting

Parameters	Description(10/4/05)	LER(e^+)	HER(e^-)
E(Gev)	beam energy	3.1	9.0
N_b	bunch population	7.783×10^{10} (1.70 mA)	4.585×10^{10} (1.00 mA)
β_x^*(cm)	beta x at the IP	40	35.0
β_y^*(cm)	beta y at the IP	1.08	1.08
ε_x(nm-rad)	emittance x	33.0	55.0
ε_y(nm-rad)	emittance y	1.50	1.30
ν_x	x tune	0.5250	0.5160
ν_y	y tune	0.5790	0.6223
ν_s	synchrotron tune	0.032	0.049
σ_z(cm)	bunch length	1.25	1.15
σ_p	energy spread	6.5×10^{-4}	6.1×10^{-4}
τ_t(turn)	transverse damping time	9800	5030
τ_l(turn)	longitudinal damping time	4800	2573

Peak Luminosity October 10, 2005

(I^+=2940mA, I^-=1733mA, n_b=1732)



beam-beam parameters:

$$\xi_x^+ = 0.098$$

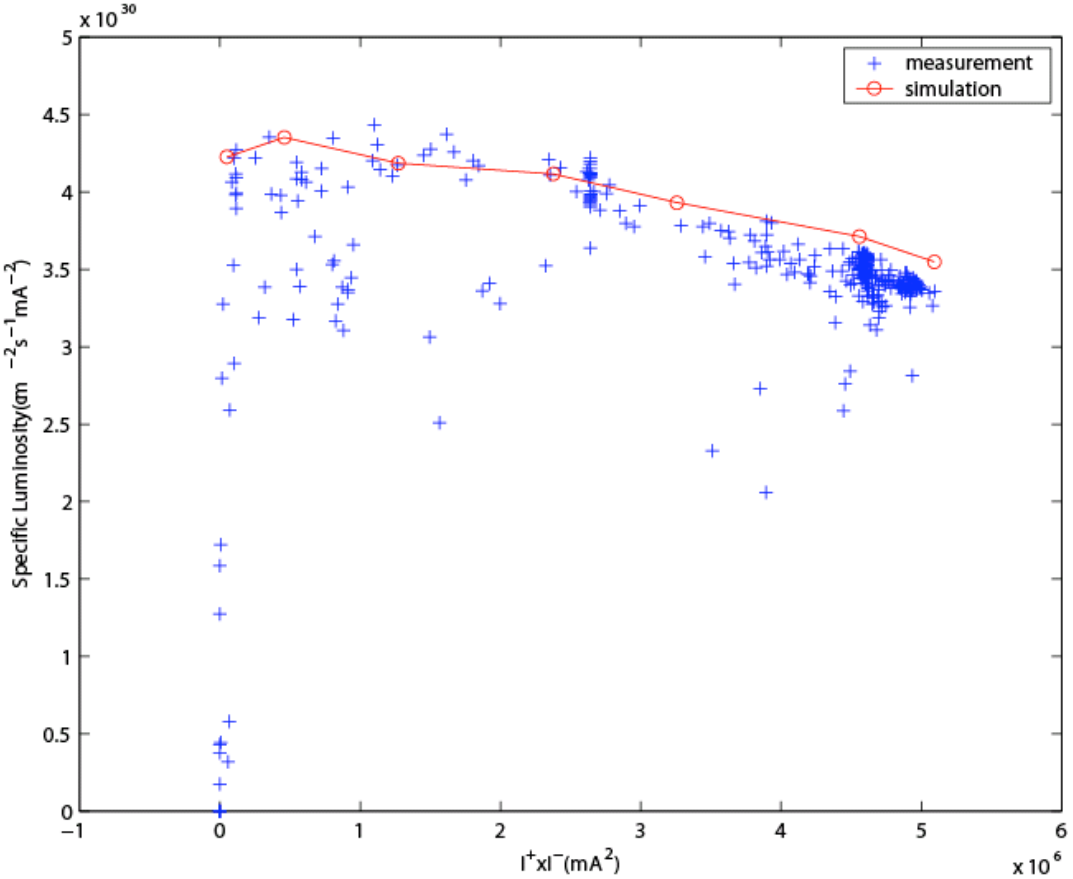
$$\xi_y^+ = 0.070$$

$$\xi_x^- = 0.086$$

$$\xi_y^- = 0.037$$

Data taken in the history buffer for a 24 hours period.
The simulation used an approximately fixed current ratio.

Specific Luminosity October 10, 2005
(I^+=2940mA, I^-=1733mA, n_b=1732)



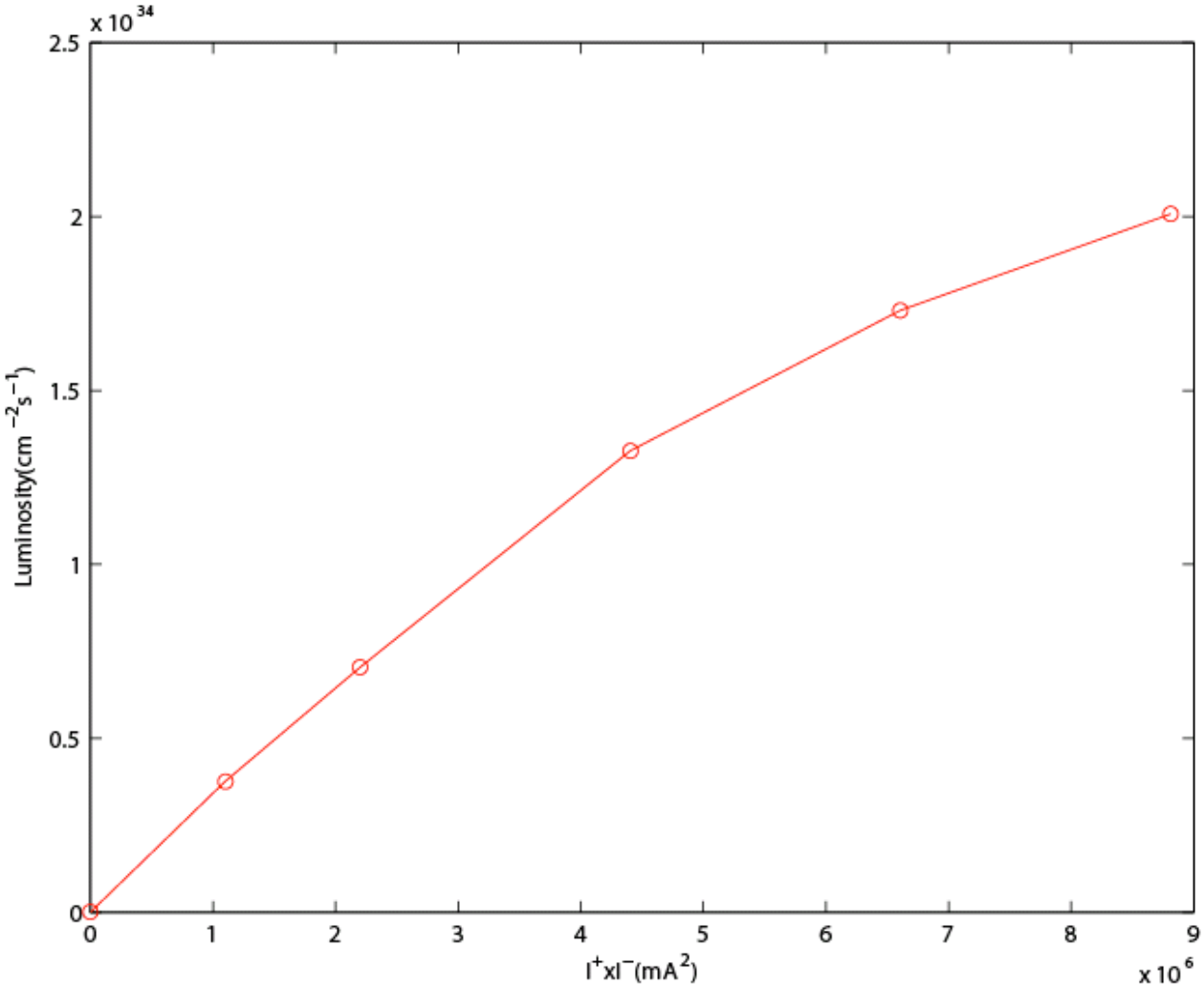
Data taken in the history buffer for a 24 hours period.
The simulation used an approximately fixed current ratio.

Projected Luminosity: 2E34 $cm^{-2}s^{-1}$ in 2007

- HER 90^0 lattices to lower momentum compaction factor and beam emittance
- Low-beta optics near $\beta_y^* = 8$ mm
- Use wiggler in the LER as a damping wiggler
- More RF stations in the HER, LER?
- More currents 4000/2200 mA in the machine
- Shorten the bunch length to 9 mm
- Adequate dynamic aperture to ensure a good beam-beam lifetime

Parameters	Description(2007)	LER(e^+)	HER(e^-)
E(Gev)	beam energy	3.1	9.0
N_b	bunch population	1.066×10^{11} (2.325 mA)	5.865×10^{10} (1.279 mA)
β_x^*(cm)	beta x at the IP	30	30
β_y^*(cm)	beta y at the IP	0.85	0.80
ε_x(nm-rad)	emittance x	30.0	40.0
ε_y(nm-rad)	emittance y	1.20	1.80
ν_x	x tune	0.5162	0.5203
ν_y	y tune	0.5509	0.6103
ν_s	synchrotron tune	0.0381	0.049
σ_z(cm)	bunch length	0.95	0.90
σ_p	energy spread	6.5×10^{-4}	6.1×10^{-4}
τ_t(turn)	transverse damping time	8424	5030
τ_l(turn)	longitudinal damping time	4128	2573

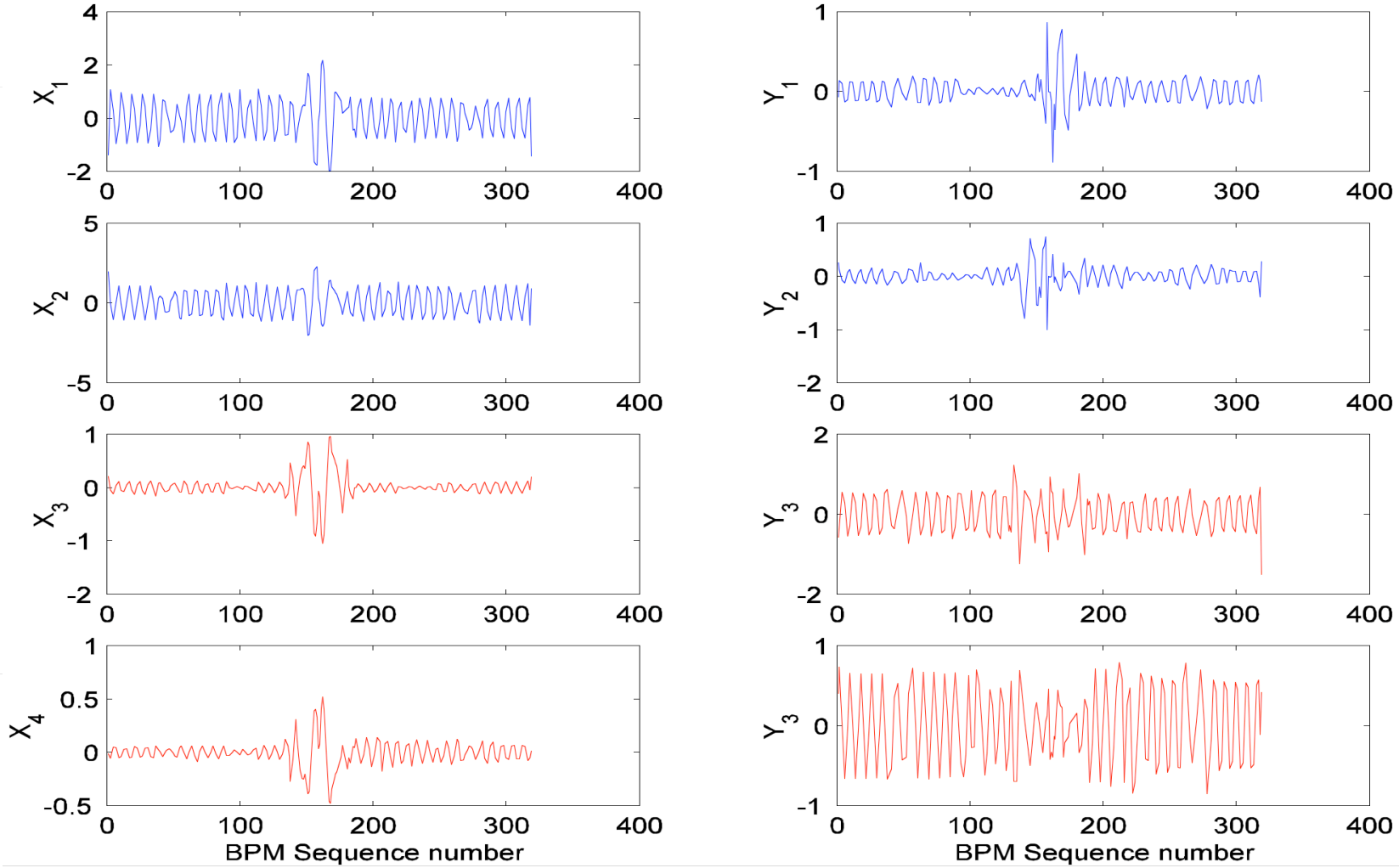
Projected Luminosity: 2E34 $cm^{-2}s^{-1}$



Recent Activities

- PEP-II has been limited by the vacuum bursts near the interaction region since the beginning of this year.
- The stable beam currents below 1550mA/1250mA. The luminosity is limited at half of its maximum reached value.
- The exact cause of the problem is unknown. The most popular suspect is the tiles used as HOM absorbers. The replacement of those vacuum chambers are underway.
- Since the beam currents, we are trying to make progress to improve specific luminosity.

Four Orthogonal Orbits Extracted Using FFT (Yiton Yan)



R-Matrix Elements and Orbits

$$R_{12}^{ab} = (x_1^a x_2^b - x_2^a x_1^b)/Q_{12} + (x_3^a x_4^b - x_4^a x_3^b)/Q_{34}$$

$$R_{14}^{ab} = (y_1^a x_2^b - y_2^a x_1^b)/Q_{12} + (y_3^a x_4^b - y_4^a x_3^b)/Q_{34}$$

$$R_{32}^{ab} = (x_1^a y_2^b - x_2^a y_1^b)/Q_{12} + (x_3^a y_4^b - x_4^a y_3^b)/Q_{34}$$

$$R_{34}^{ab} = (y_1^a y_2^b - y_2^a y_1^b)/Q_{12} + (y_3^a y_4^b - y_4^a y_3^b)/Q_{34}$$

where *a* and *b* are indices for the locations of the beam position monitors, Q_{12} and Q_{34} are invariant amplitude of the orbits.

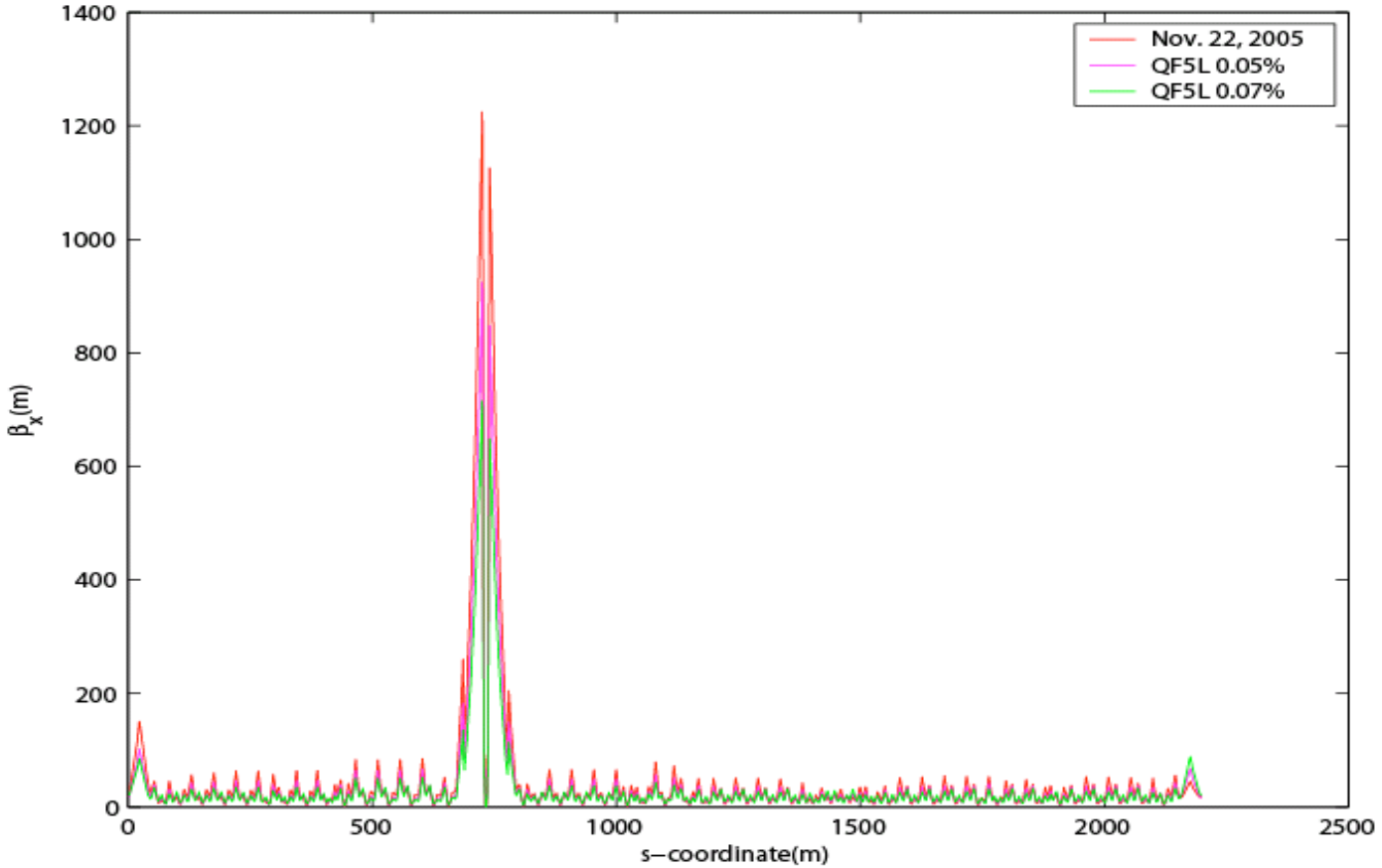
J. Irwin and Y.T. Yan, *Proc. The 7th EPAC p151, (2000)*

Beta Beating Correction in the HER

Feb. 16, 2006

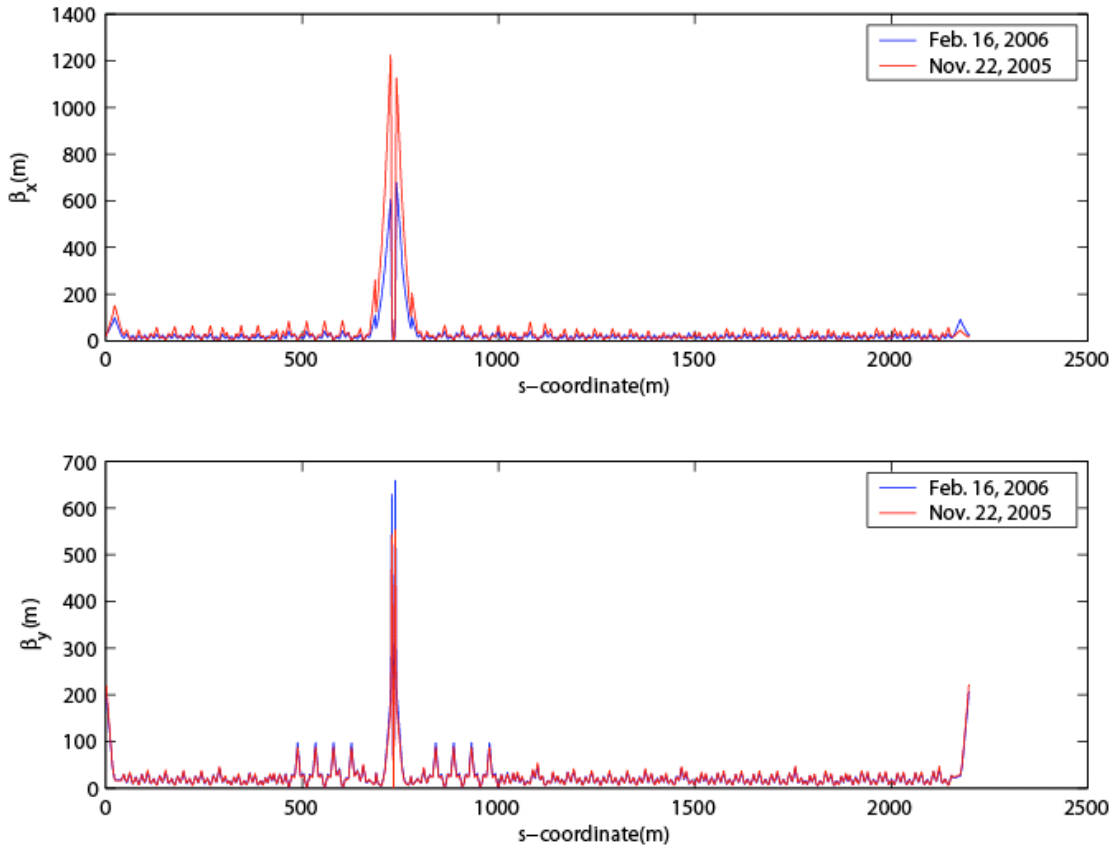
- Reduce the beta beating in the HER from 250% to 15%
  - Predicted the correction with an accurate model using MIA and LEGO
  - Tweaked single quadrupole: QF5L by +0.225%
  - Moved closer to half integer ν_x=0.516
- Reduced coupling in the HER within several hours, compared with several days, using MIA
  - Reached specific luminosity of 4.0
  - Tweak of skew quadrupoles for additional 15% gain

Prediction from MIA/LEGO Model



Horizontal tune is fixed with tune trombones back to 0.516.

Comparison of β Functions

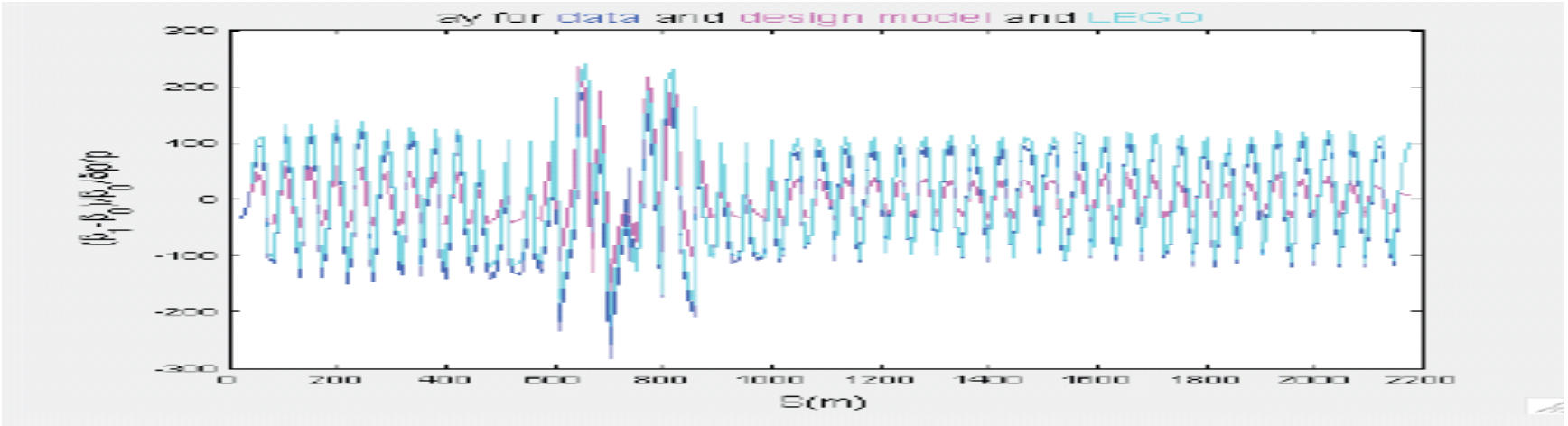


Actual tweak of QF5L was twice larger than predicted.

Chromatic Optics for the HER

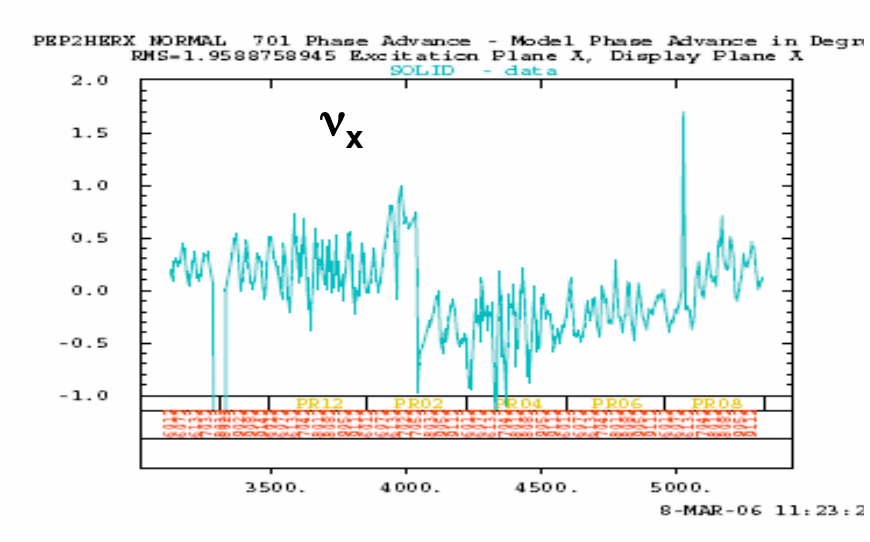
Feb. 16, 2006

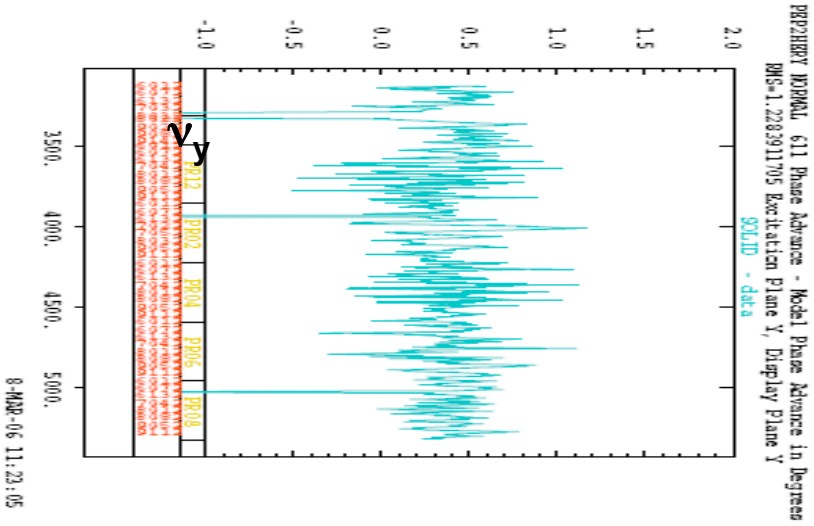
- Measured chromatic optics and dynamic aperture in HER
  - Excellent agreement between measurements and LEGO model in the chromatic optics
  - Improvement of understanding of nonlinear dynamics including sextupoles

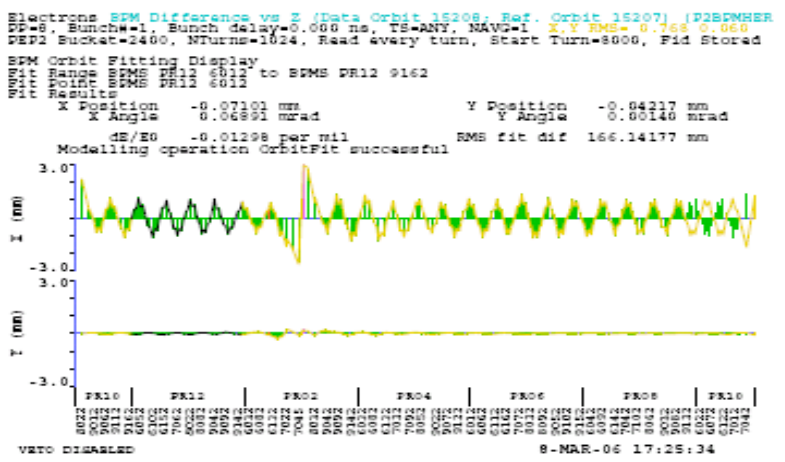


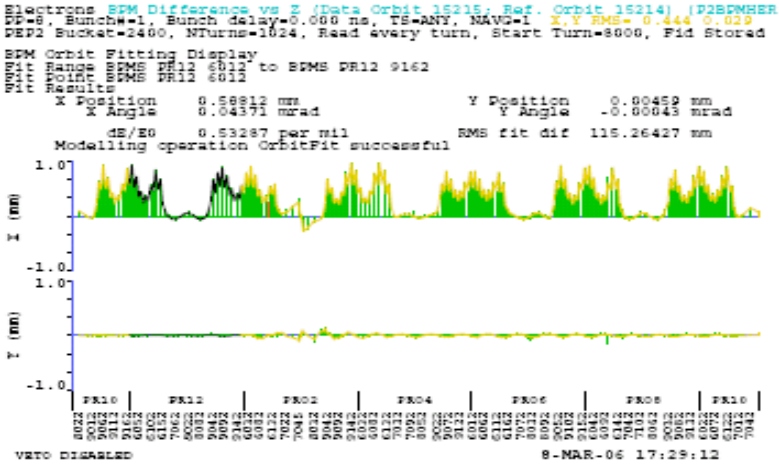
J. Yocky, P. Raimondi

Built Beam-Based Online Model for HER Within Four Hours (March 7, 2006, Mark Woodley and Yiton Yan)









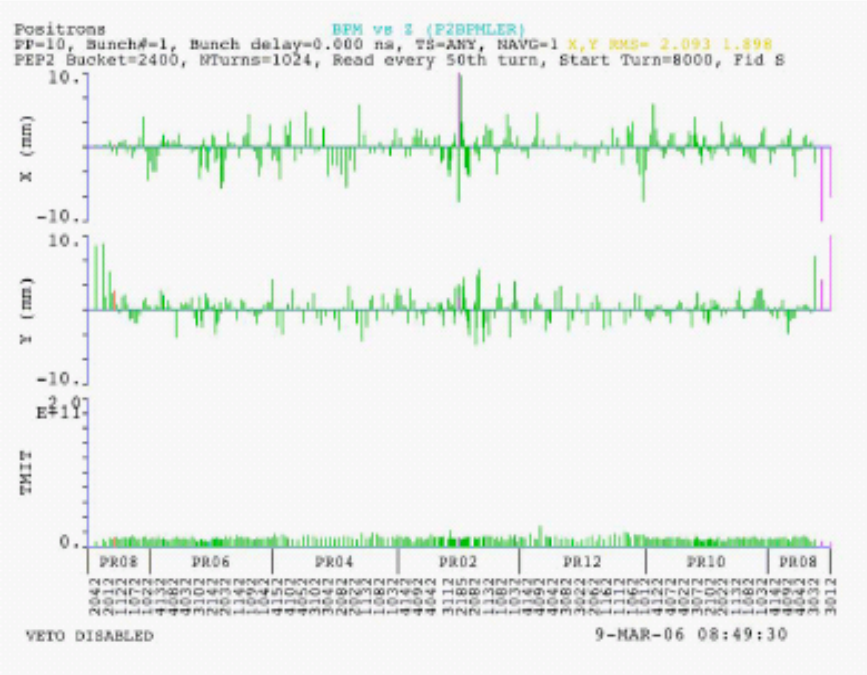
x-oscillation

dispersions

Steering in LER

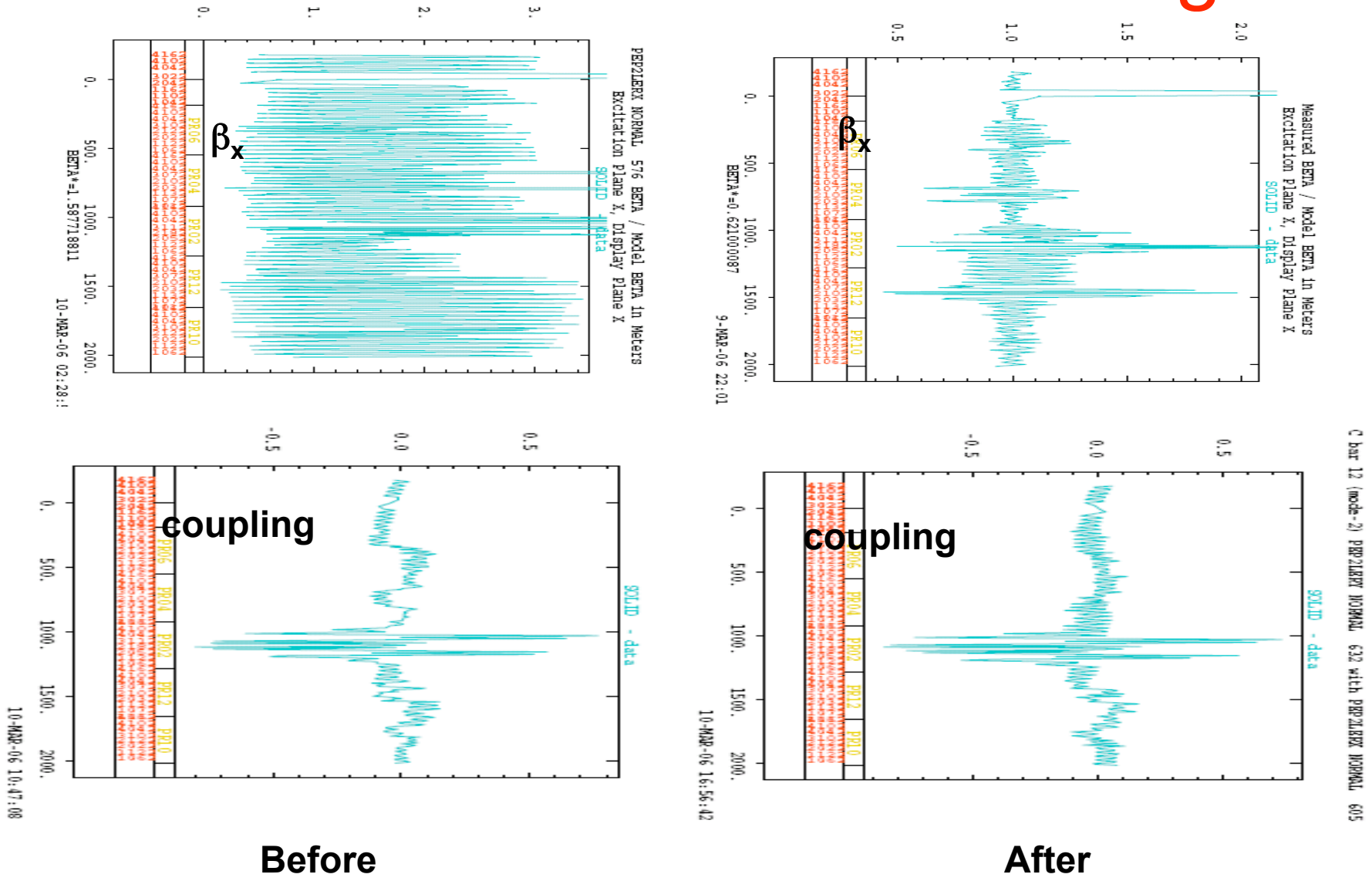
March 9, 2006

- Before: and After:



J. Turner, J. Yocky, F.J. Decker, please note that the scaled was reduced by a factor of two.

Beta Beating and Coupling Correction After the Steering



Before

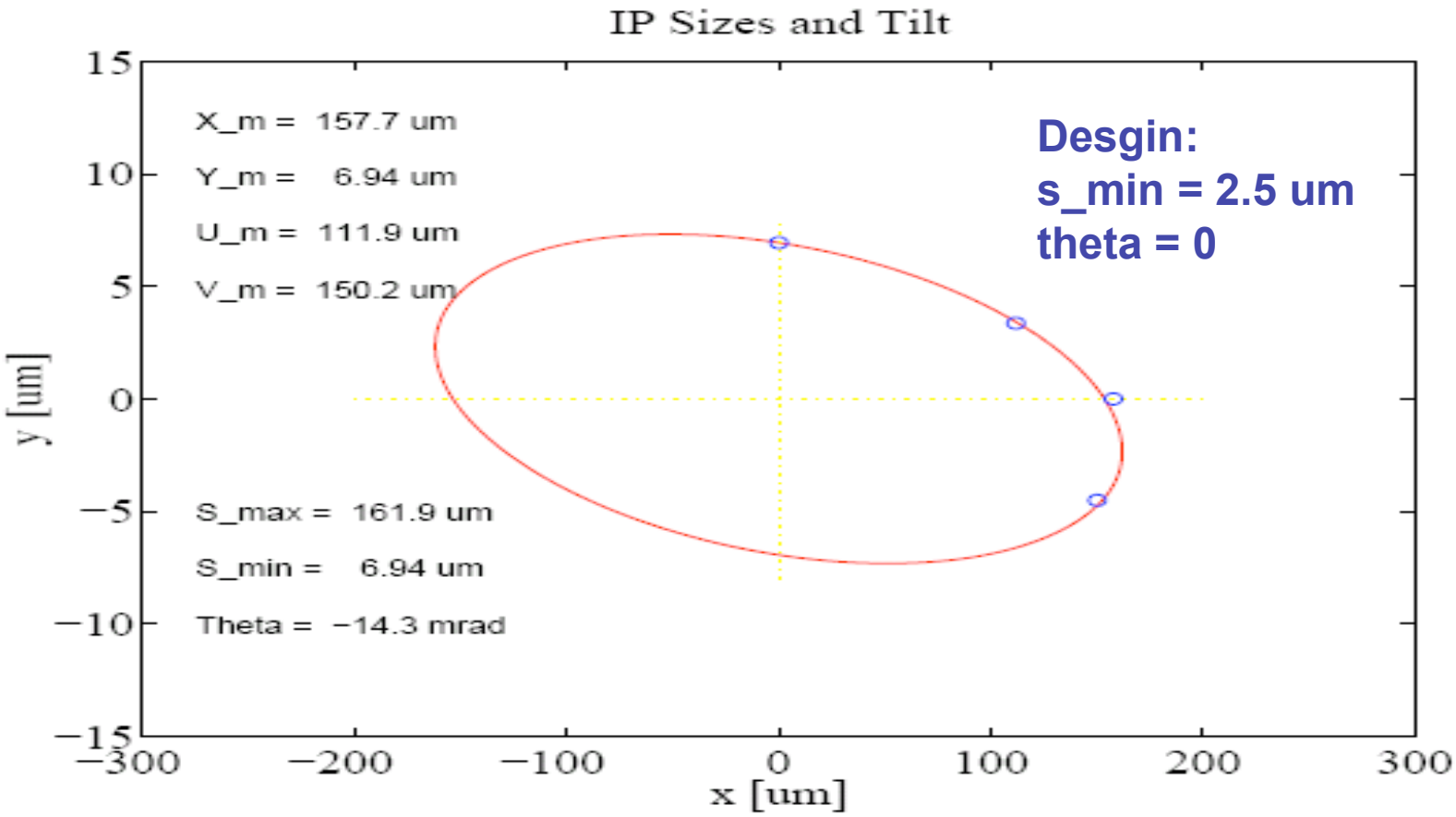
After

Summary of Achievements

- Built fast and accurate online model in several hours and the model is used in the control room
- Developed and tested correction schemes to correct beta beating and coupling in arcs
- Reduce the amplitude of orbit by at least a factor of two in the LER
- Reduced the beta beating in both machine below to 20%
- Developed a systematic and orthogonal procedure to correct optics after a major change of lattice
  - IR match using MIA
  - Arcs correction using MIA->LEGO
    - Beta beating
    - Dispersions
    - Coupling
- Nearly all milestones set by the end of March were reached
- Most important, we worked at a term for a common goal

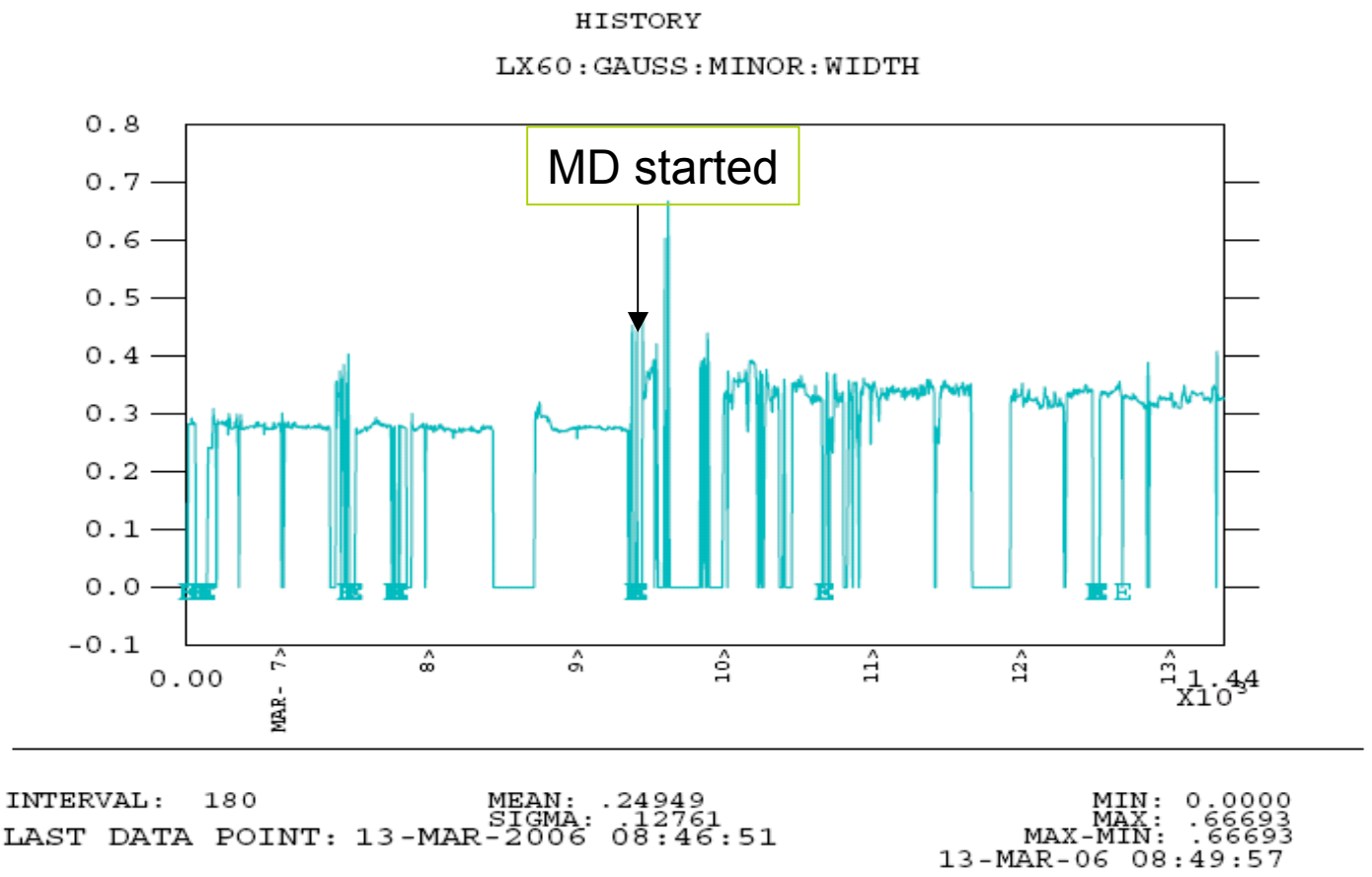
Beam-Beam Scan After the Steering,

Mike Sullivan, March 11, 2006

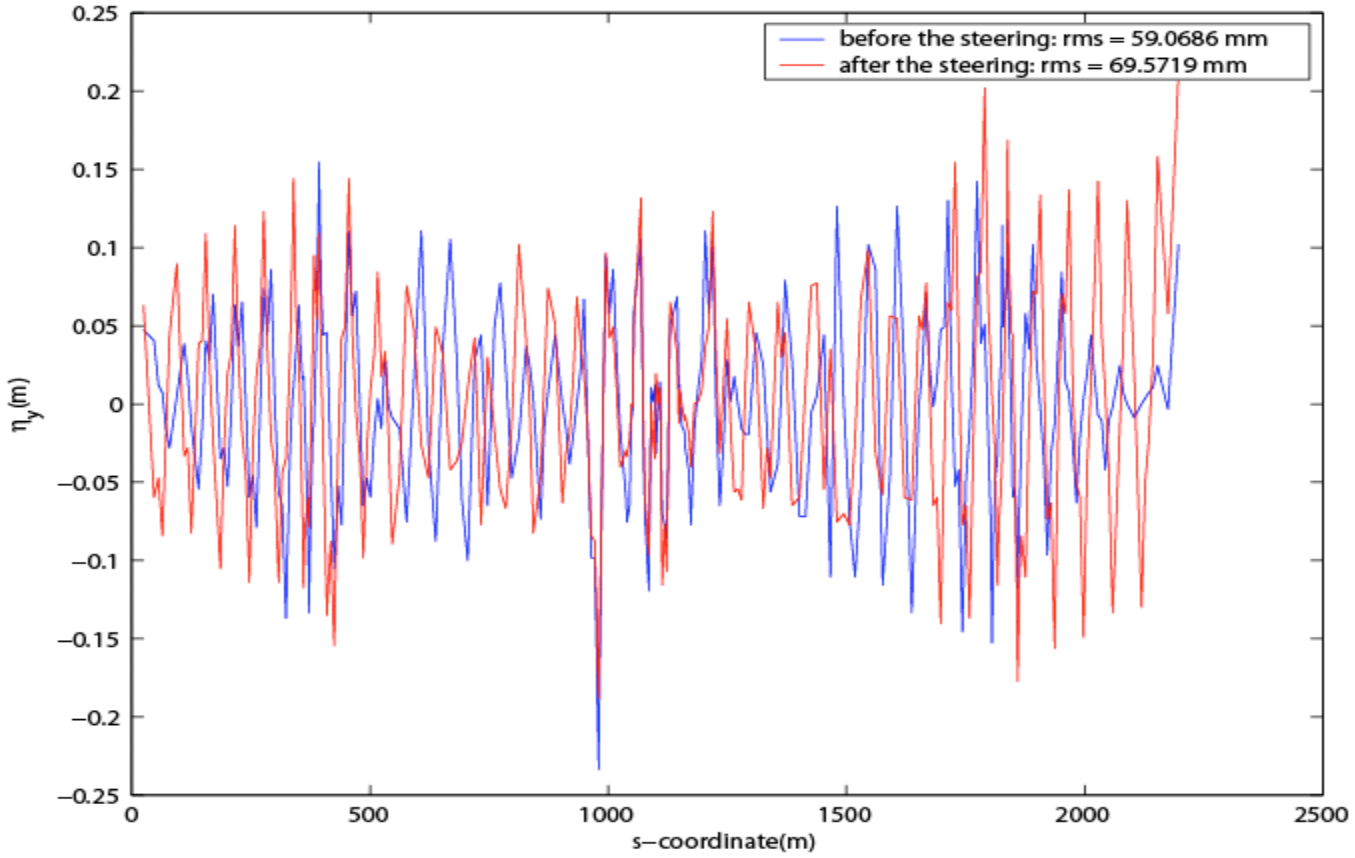


The best specific luminosity is 5.4×10^{30} $cm^{-2}s^{-1}mA^{-2}$. Σ_y is 6.45 um.

Vertical Beam Size at SXM



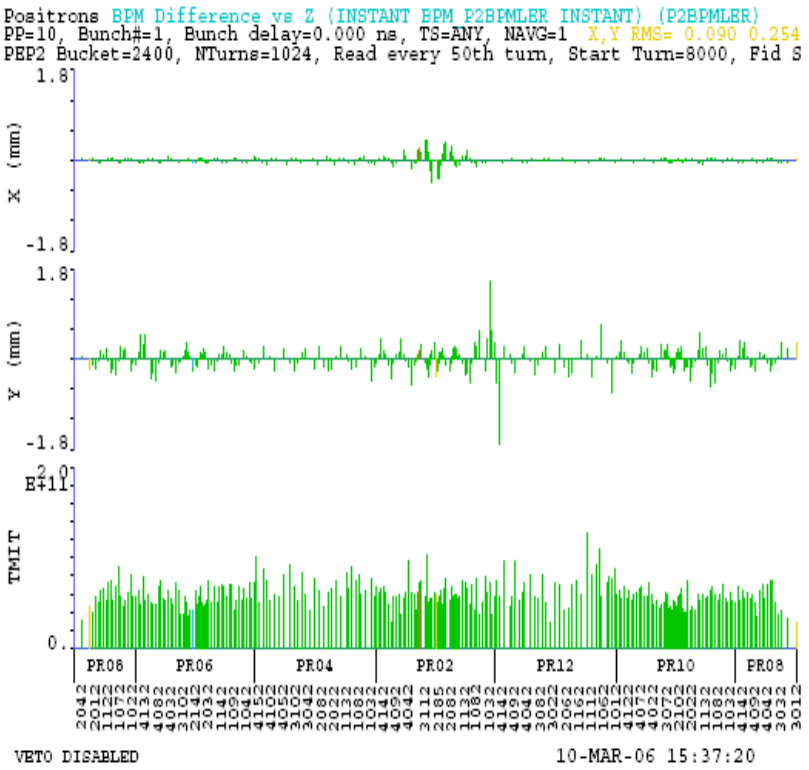
Vertical Dispersions in the LER



We need to reduce the vertical dispersion as soon as possible.

Vertical Anti-Symmetric Bumps

20% of solution



- Bumps were not quite closed
- Updated MIA online model could help
- Vertical dispersions in MIA and LEGO did not agreed well enough
- LEGO needs direct access to the dispersion measurement