

# Optics

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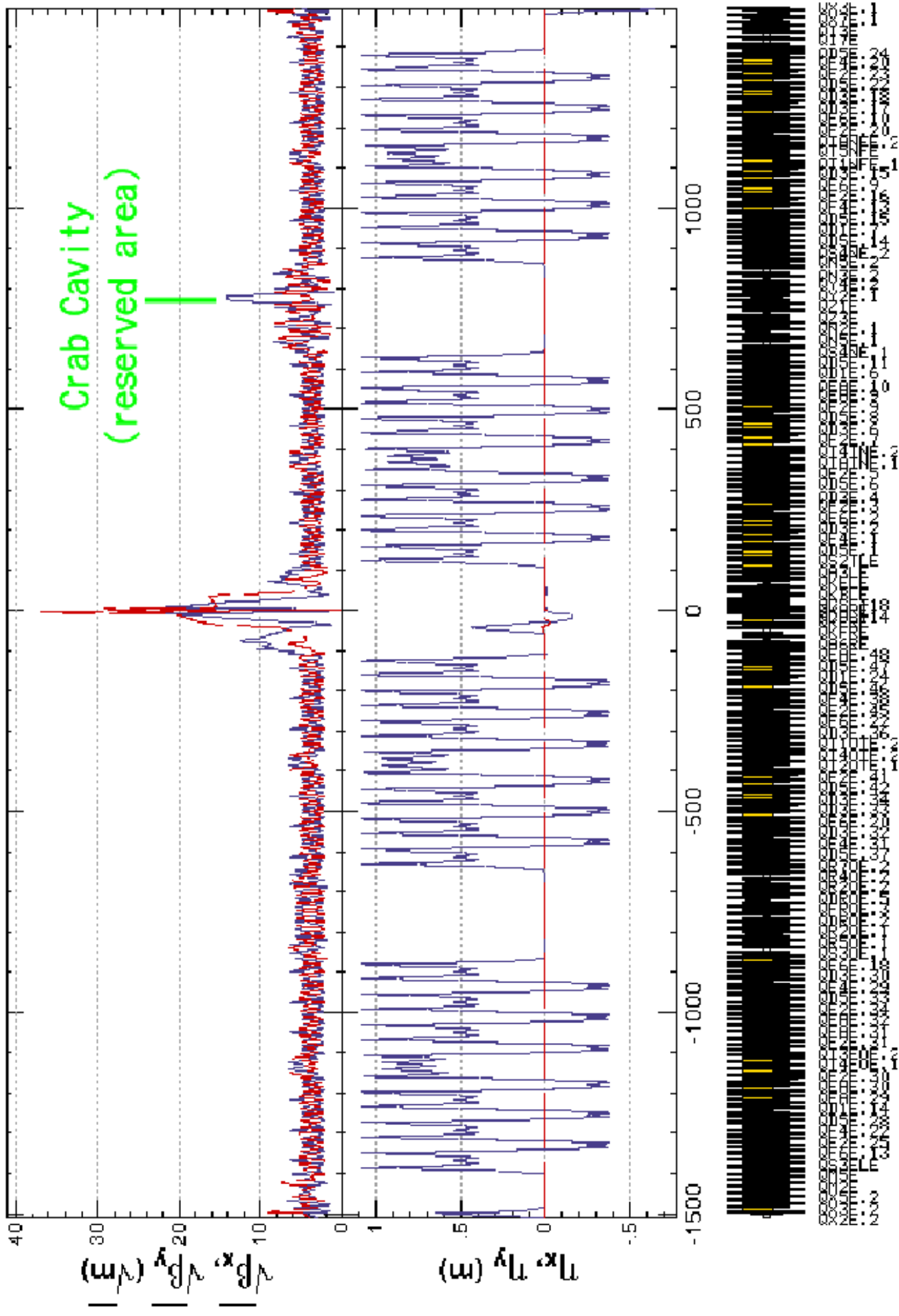
- Lattice Upgrade in Summer 2005
- Off-Momentum Beta Correction in LER

# Lattice Upgrade in Summer 2005

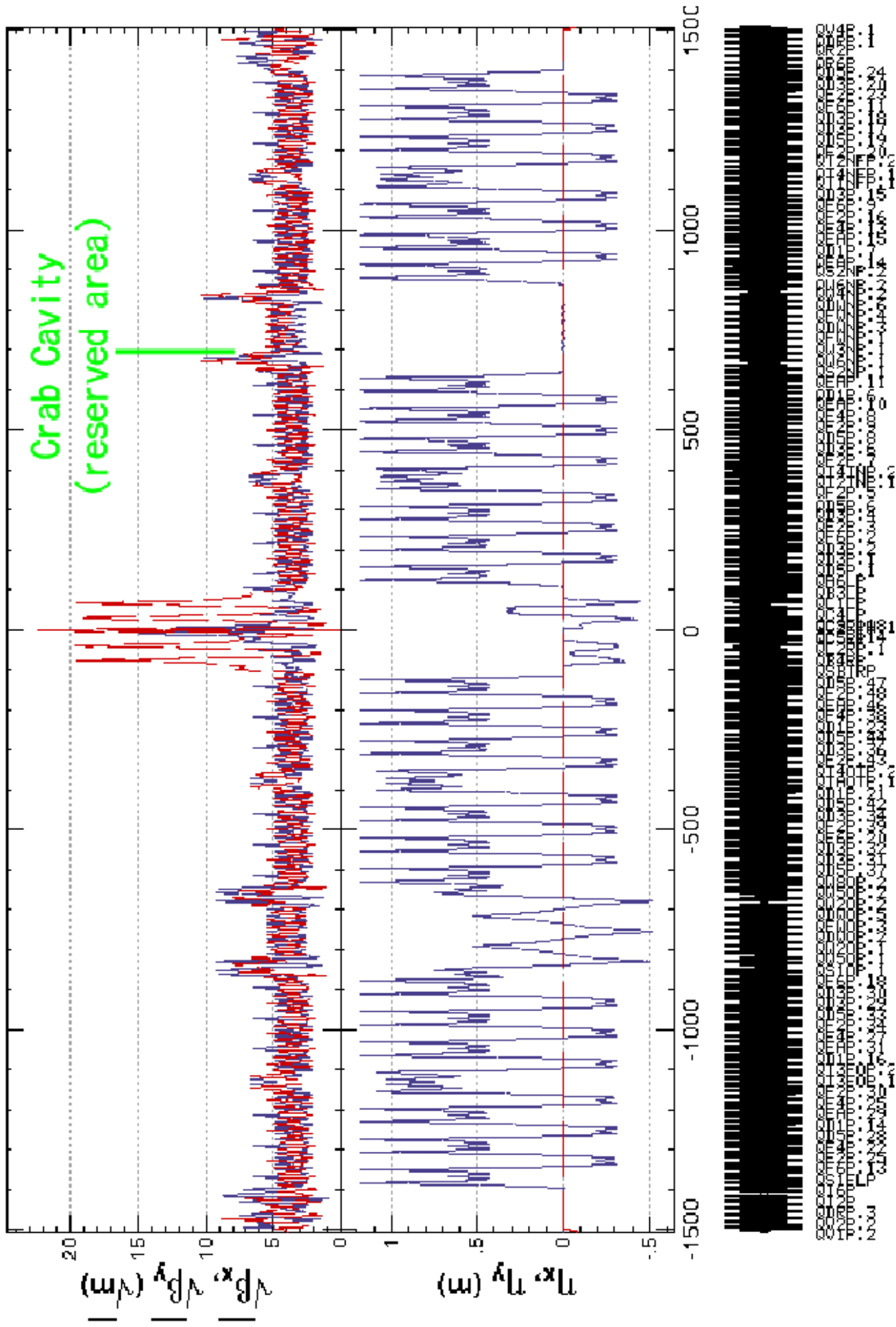
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- KEKB Lattice is upgraded for installing crab cavity in Summer 2005
  - lattice design is presented in MAC2005
- Optics tuning items in autumn run
  - HER total tune is adjusted with optics before summer
    - ▶ Localize change of phase advance into NIKKO section
    - ▶ Total tune: (43.514, 40.580) → (44.514, 41.580)
    - ▶ Because of poor luminosity at new working point(43.514, 40.580)
  - LER horizontal phase advance at SR monitor line(**withdrawal**)
    - ▶ In order to observe crabbing bunch by streak camera
    - ▶ Withdraw because of poor luminosity
    - ▶ Present Sensitivity:  $\text{Cos}[\Delta \phi_{\text{IP-SRM}}] \sim 0.6$

# HER optics before Spring shutdown



# LER optics before Spring shutdown



# Off-Momentum Beta Correction(1/8)

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## Motivation

- Disagreement between machine and model optics
  - Disagreement of chromaticity curve of tune is observed
  - Model optics tuned adiabatically in operation has discontinuity in chromaticity curve(  $\nu$  ,  $\beta^*$  ,  $\alpha^*$  )
  - Applying sextupole parameters, which has wide dynamic aperture in model, to machine is often failed(machine becomes unstable)

## Basic Idea

- Assume the disagreement of momentum dependence of optics as the error of **sextupole field**
- Correct chromaticity error of tune  $\nu$  , beta function  $\beta(s)$  and phase advance  $\phi(s)$  by introducing fudge factor to sextupole field

# Off-Momentum Beta Correction(2/8)

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How to measure off-momentum optics

- Apply beta measurement scheme with revolution frequency shift by master oscillator
  - ▶  $\frac{\Delta p}{p_0} = - \left( \alpha_c - \frac{1}{\gamma^2} \right)^{-1} \frac{\Delta f}{f_0}$
  - ▶ Momentum Compaction Factor  $\alpha_c \sim 3 \times 10^{-4}$
  - ▶ Lorentz Factor  $\gamma \sim 7 \times 10^3$
  - ▶ Measure at  $\Delta f = 0, \pm 200, \pm 400\text{Hz} (\pm 2.3 \times 10^{-3} \text{ in } \Delta p/p_0)$
- Measured Informations at each momentum points
  - Tune  $\nu$  (Tune Meter)
  - Beta Function  $\beta$  (s)
  - Phase Advance  $\phi$  (s)

# Off-Momentum Beta Correction(3/8)

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How to correct off-momentum optics

- Adjust measured momentum dependency  $\Delta \nu(\delta) \equiv \nu - \nu_0, \Delta \beta(\delta) / \beta_0 \equiv (\beta - \beta_0) / \beta_0$  and  $\Delta \phi(\delta) \equiv \phi - \phi_0$  with model optics

- ▶  $\delta \equiv \Delta p/p_0$
- ▶  $\nu_0, \beta_0, \phi_0 \equiv \nu, \beta, \phi|_{\delta=0}$

- Response matrix between fudge factor and  $\Delta \nu(\delta), \Delta \beta(\delta) / \beta_0$  and  $\Delta \phi(\delta)$  of model optics is given by numerical derivative

- ▶  $dK_2 / dAF \equiv K_2$
- ▶ AF is amplitude fudge factor for sextupole power supply

- Correction fudge  $\Delta AF$  is obtained from model response matrix and difference between measured optics and model optics by using SVD

# Off-Momentum Beta Correction(4/8)

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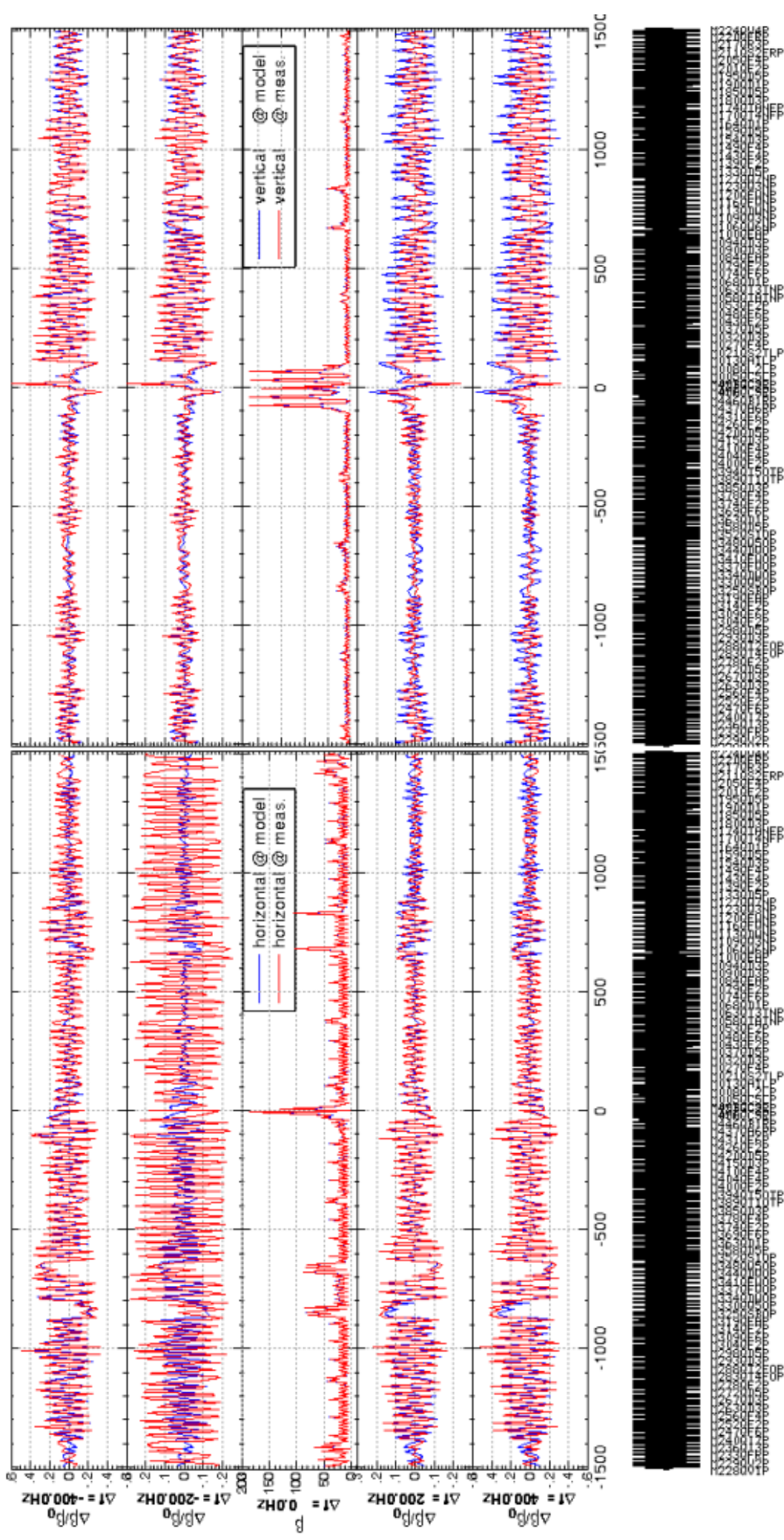
How to apply sextupole correction fudge

- Update  $K_2$  and AF with keeping  $K_2$  AF product
  - Update scheme:  $K_2 \rightarrow (1 + \Delta AF) K_2$ ,  $AF \rightarrow AF / (1 + \Delta AF)$ 
    - ▶  $\Delta AF$  is the fudge to adjust model optics to measured optics
  - Don't change real sextupole field at this time
    - ▶ In order to avoid breaking XY-coupling, dispersion and beta corrections by orbit offset at sextupole



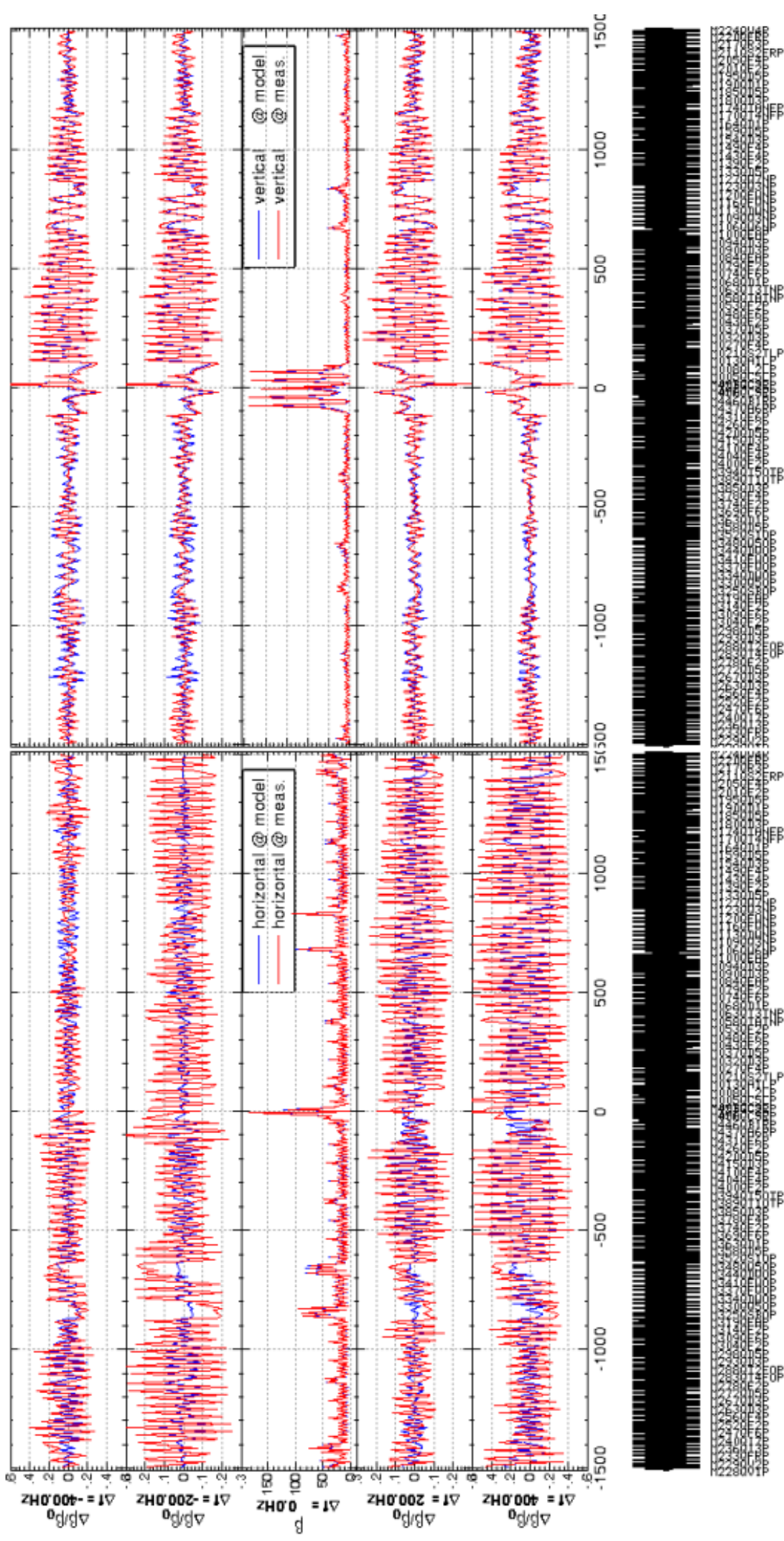
# Off-Momentum Beta Correction(5/8)

$\beta$  (s) before correction[2005/11/12] ( $\nu$  : 45.514/43.550)



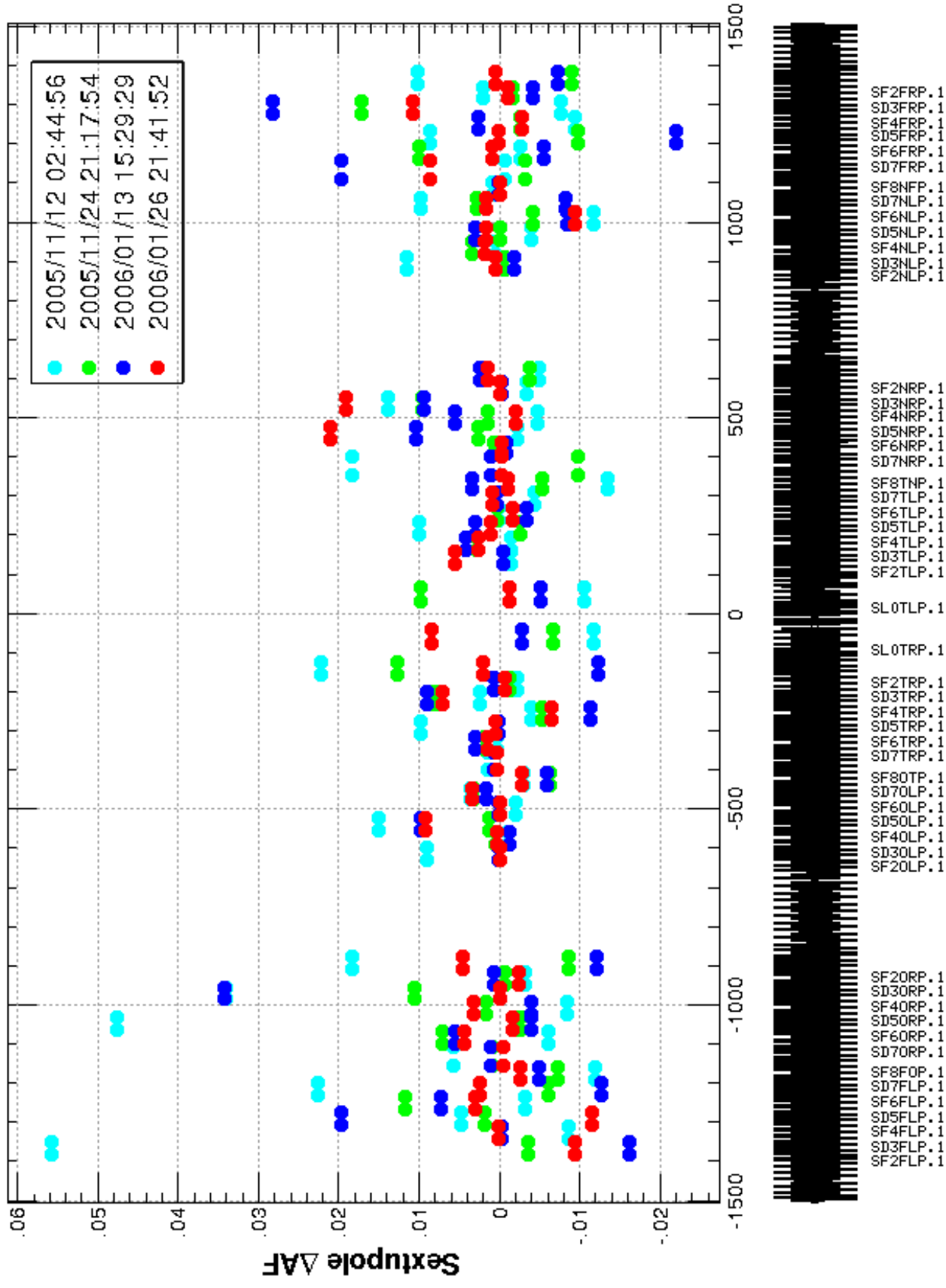
# Off-Momentum Beta Correction(6/8)

$\beta$  (s) after correction[2006/01/26] ( $\nu$  : 45.507/43.534)



# Off-Momentum Beta Correction(7/8)

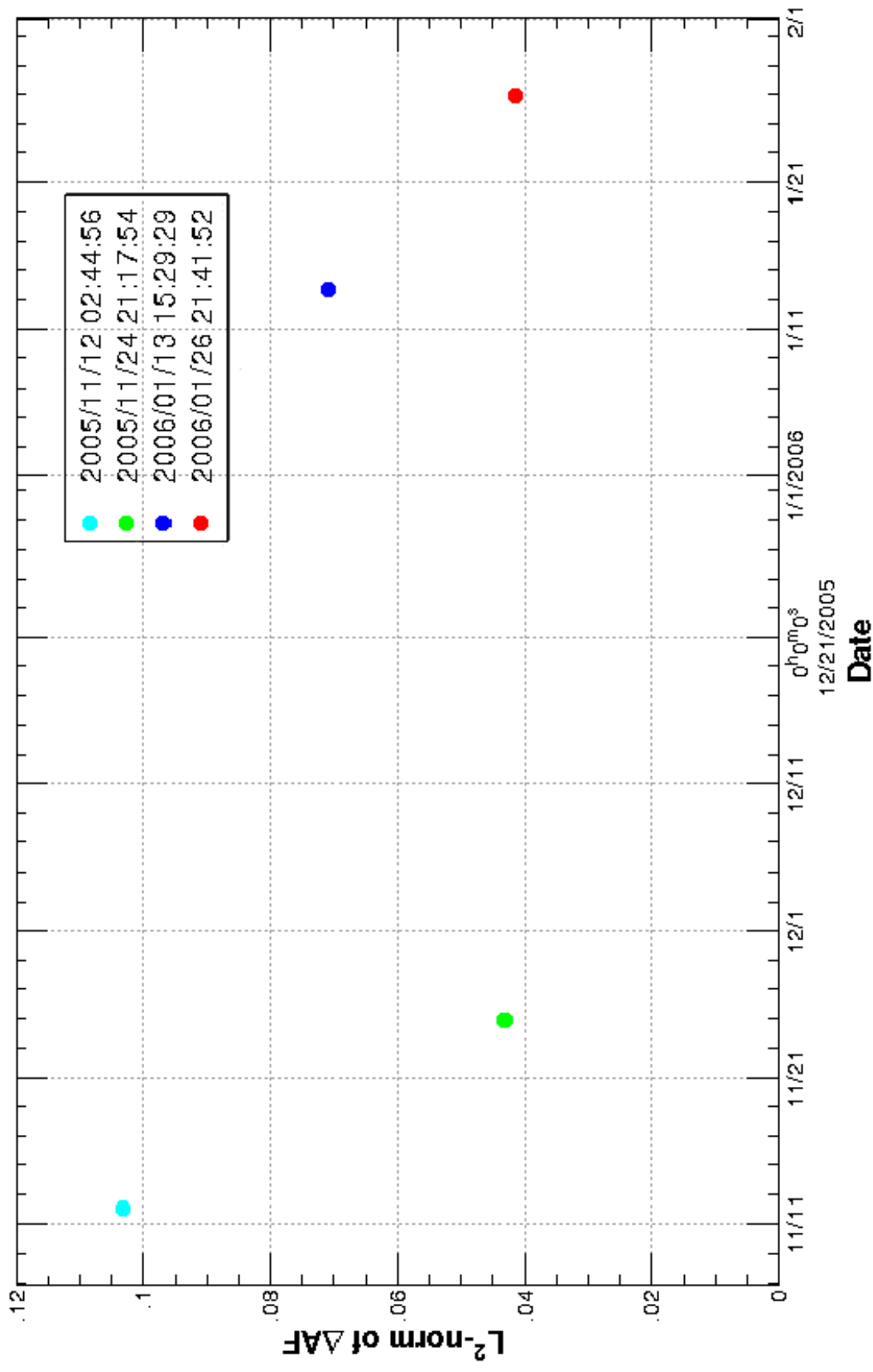
## History of Correction Fudges



# Off-Momentum Beta Correction(8/8)

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## History of Correction Fudge norms



# Summary

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- Lattice Upgrade in Summer 2005
  - Ready for crab cavity install
  - Peak luminosity is updated
- Off-Momentum Beta Correction
  - Start to use results of off-momentum beta measurement
  - Searching good barometer to evaluate progress of off-momentum correction
  - On-line correction tool is under developing