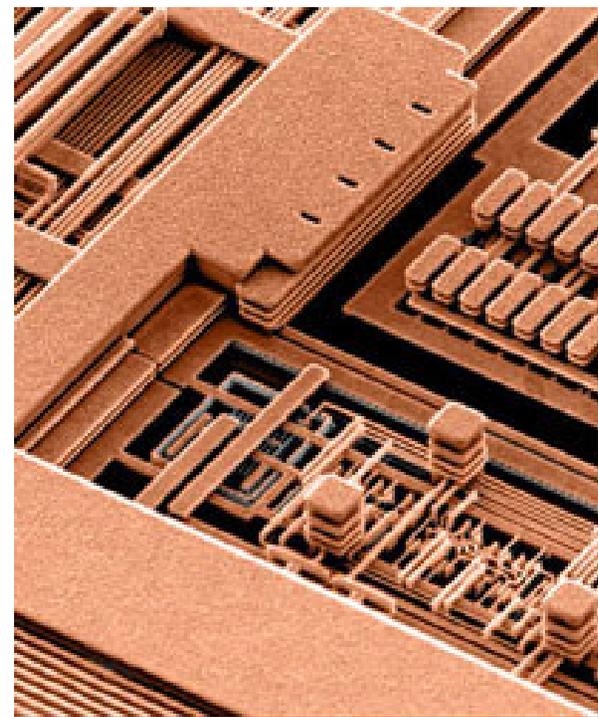


Beta* squeeze and measurement

Fulvia Pilat



Beam Experiments Meeting
BNL, September 16-17 2004





Overview

- Motivation
- Results from Run-4
- Beta* measurements (Yun)
- Beta* squeeze for Run-5
- Experiment beta* measurement - proposal



motivation

- Luminosity

beta*+0.85-0.9 possible with existing PS

beta*~0.5 possible with rework of q89 PS

(the latter of interest for PP program luminosity development)

- Dynamic beta* squeeze at store

of interest for RHIC II (e-cooling)

- IR design with beta*~0.3m

e-RHIC design

new detector design(s) (PAC)



Results Run-4 - timeline

Fulvia, Johannes, Vadim, Walter Wittmer + operations

□ February 25

test beta* knobs, solve PS leads problems, data for beta* measurement

□ March 2

Squeeze 12% in Phenix (both rings)

□ March 11

Attempt IP8 and IP6 14% together → bug, only 1 ring

□ March 16

Squeeze 12% IP6 and IP8 both rings

→ results



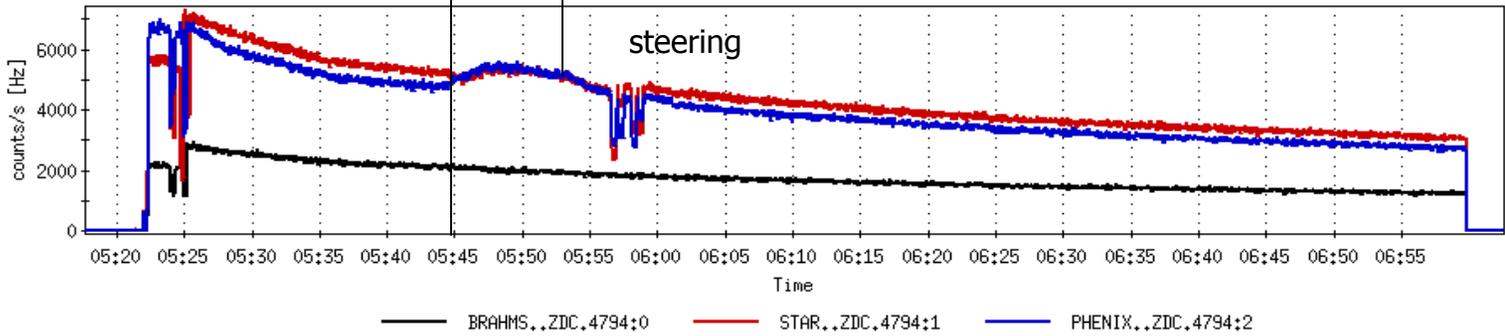
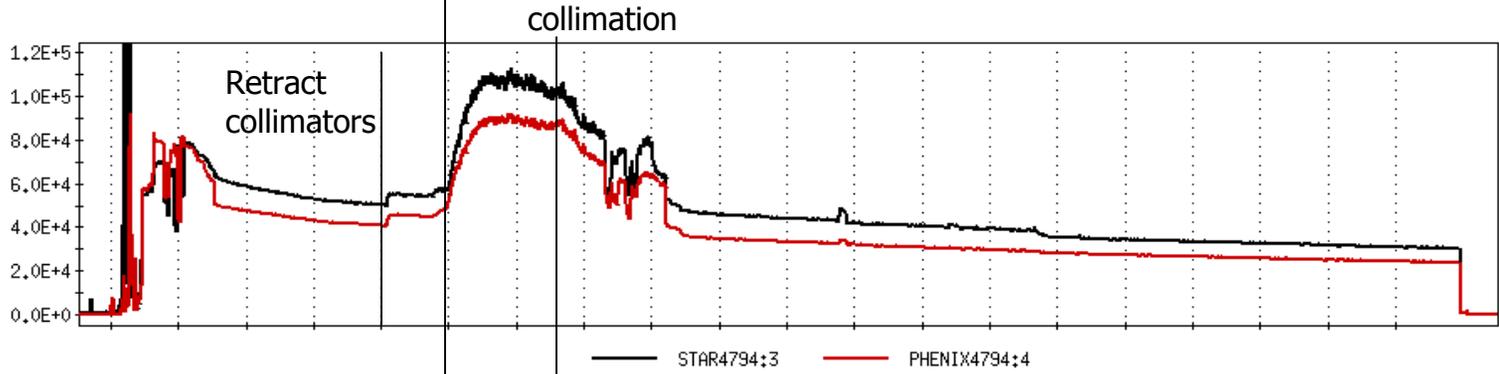
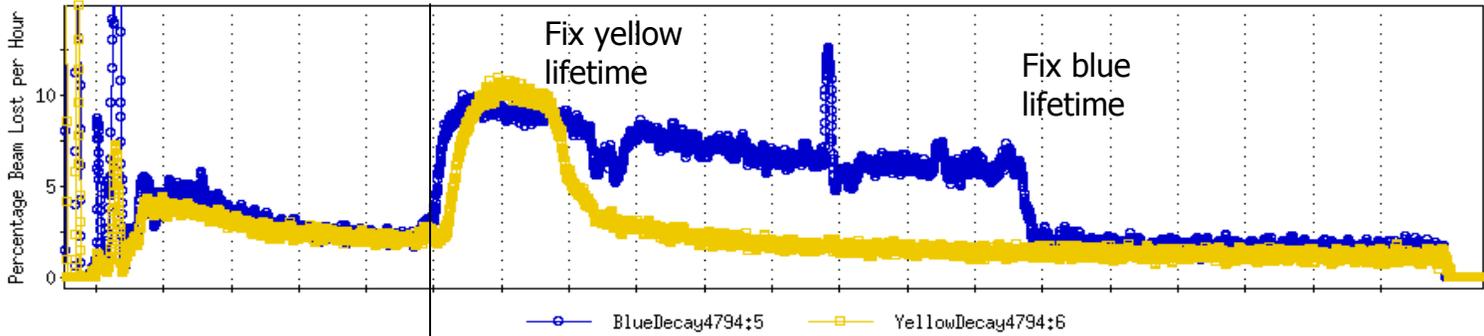
Beta* squeeze (IP6 and IP8)

PROCEDURE:

- ❑ Ramp 45x45 – normal physics conditions
- ❑ Steering, collimation → STAR and PHENIX data taking
~10-15 min
- ❑ Take collimator out
- ❑ Squeeze **12%** (both beams)
- ❑ Fix **lifetime** (yellow → 0.003 retuning
blue → decoupling + tune fix)
- ❑ **Auto-steering, collimation**
 - STAR and PHENIX **data taking** (STAR TPC included)

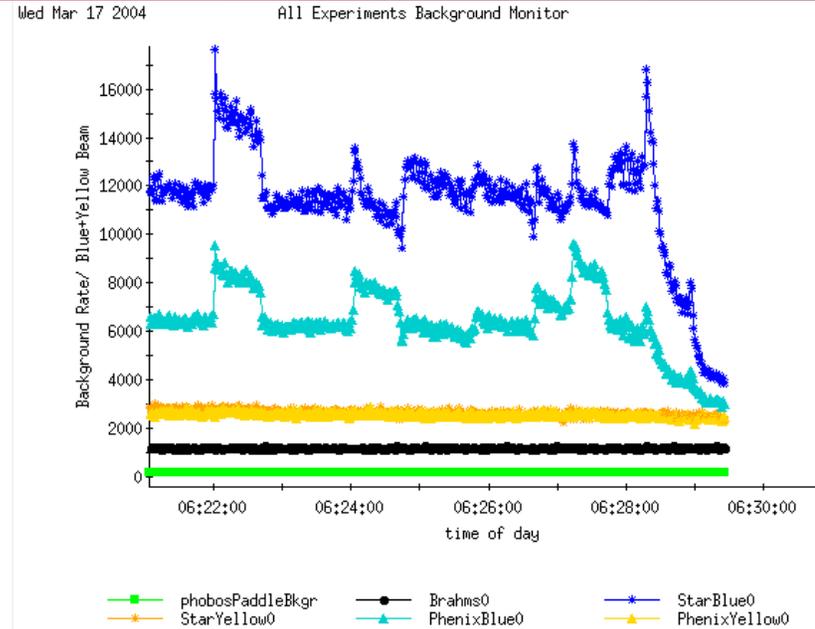
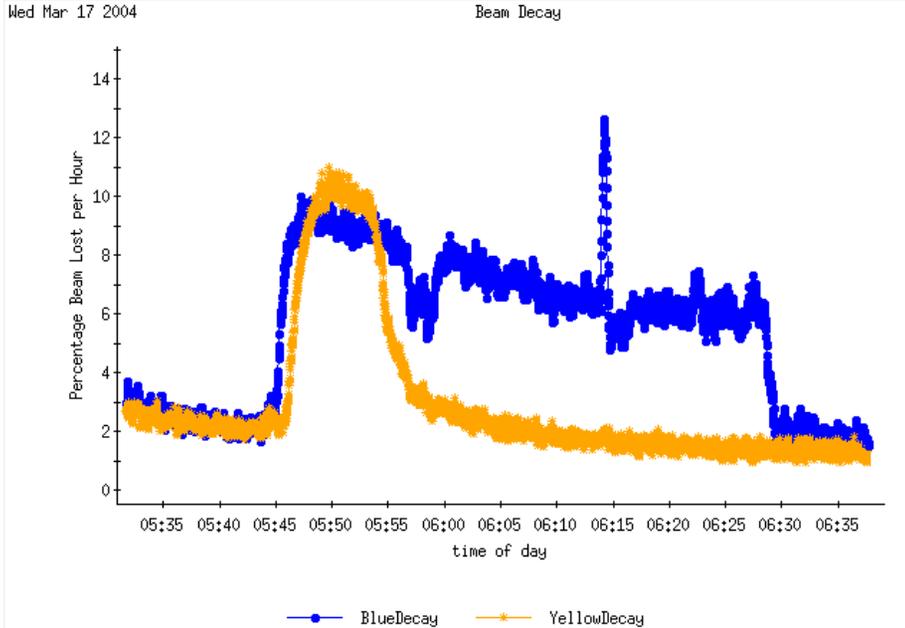


GPM story





Decay and background

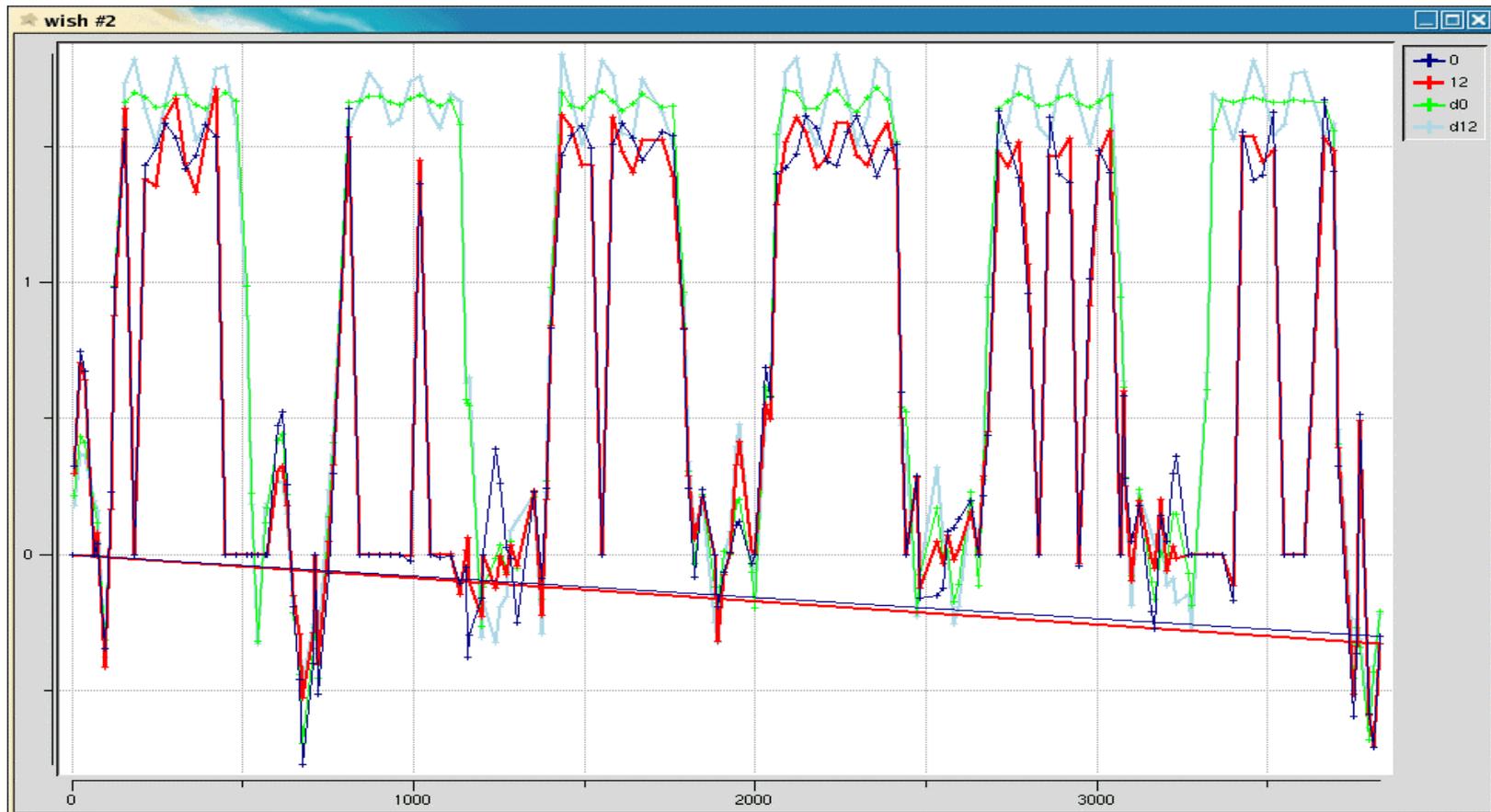


At the end of the set-up experiments could take data
More work on collimation needed to turn it into an operational scenario



Dispersion

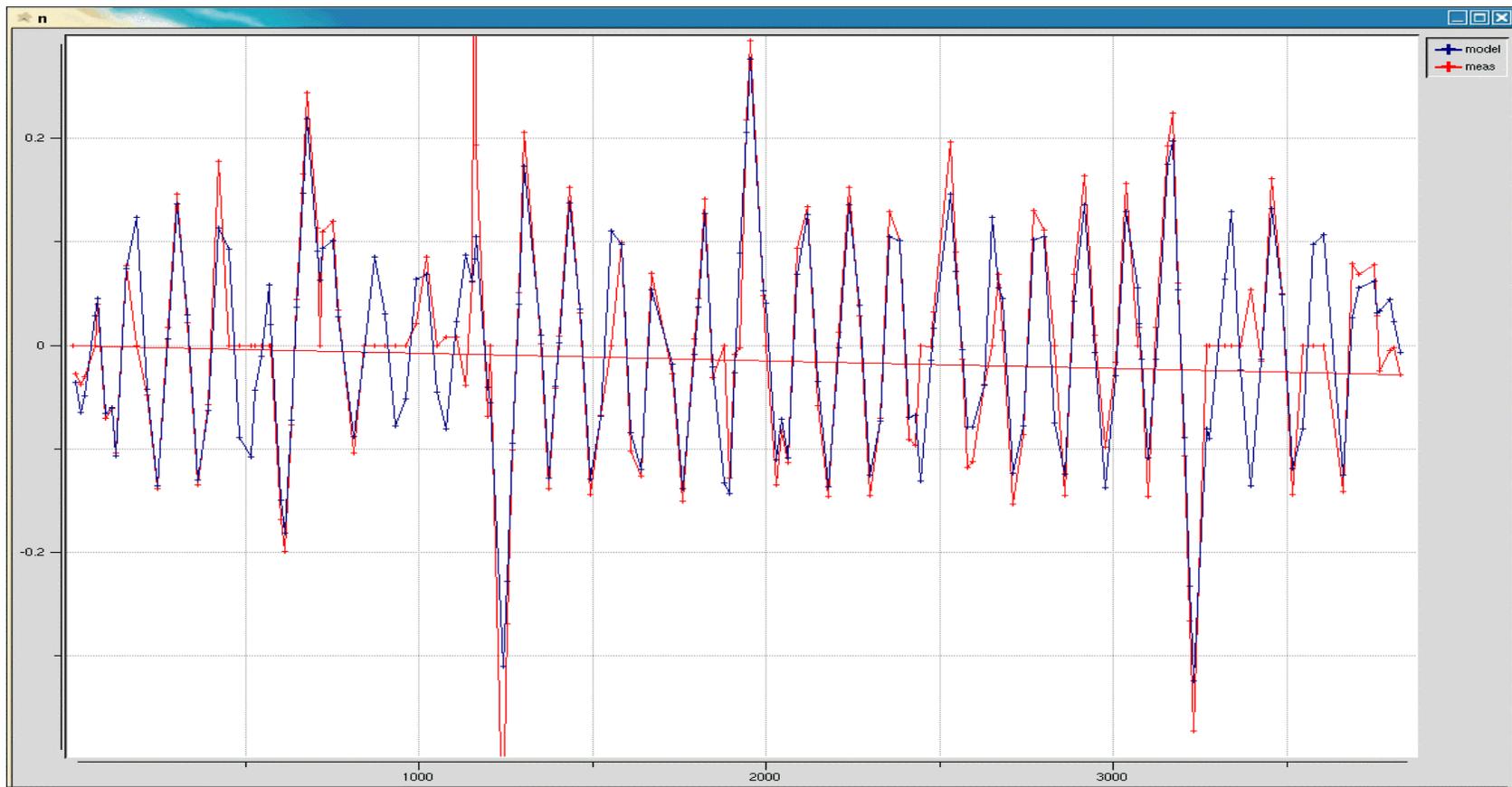
Model vs. measurements for knobs on and off
The error do not come from the knobs





Dispersion – cont'

Prediction for the dispersion effect coming from the knob vs. measurement → remarkable agreement





Beta* measurements

POSSIBLE METHOD FOR IP OPTICS MEASUREMENT

Y. Luo, D. Trbojevic

- General Discussion of the β function measurements
- Candidate Methods for RHIC β^* Measurement
- β^* Measurement From Phase Advances
- β Twist Measurement
- $D_{x,y}^*$ Measurement
- IP Coupling Measurement
- Steps For RHIC Linear Optics Modeling
- Full Coupling Treatment



Possible methods

- Method 1: One Q1 strength knob/ scan / modulation

$$\begin{aligned}\beta \text{ at Q1: } \Delta Q &= \frac{1}{4\pi} \bar{\beta} \Delta k l \\ \beta^* \text{ at IP: } \beta_s &= \beta^* + s^2 / \beta^*\end{aligned}$$

Not precise measurement due to the principle and the tune measurement

- Method 2: Two Q1s' strength knob $\pm \Delta k$, measure the second order ΔQ

$$\begin{aligned}\Delta Q &= \Delta k l (\beta_+ - \beta_-) / 4\pi \\ \beta^* &= \beta_{design}^* \times (1 + \kappa \eta^2) \\ \eta &= \langle \beta_+ - \beta_- \rangle\end{aligned}$$

Dedicated for symmetric optics, seldom used method.

- Method 3: β measurements at DXBPMs using AC dipole, derive β^*
 β measurement resolution problem due to the small phase advances in IR



Measure β^* from phase advance

- The phase advances at the two DXBPMs can be precisely measured
- The phase advances between the two DXBPMs

$$\begin{aligned}\Delta\phi &= \Delta\phi_{Left} + \Delta\phi_{Right} \\ \Delta\phi &= \int_{Left} \frac{1}{\beta_s} ds + \int_{Right} \frac{1}{\beta_s} ds \\ \beta(s) &= \beta^* + \frac{s^2}{\beta^*}\end{aligned}$$

The total phase advance only decided by the distances and β^*

- We assume the β twist ($\alpha = 0$) located in the center of two BPMs (If not at the center, discussed later)

$$\Delta\phi = 2 \times \int_0^{L/2} \frac{1}{\beta^* + s^2/\beta^*} ds = 2 \arctan\left(\frac{L}{2\beta^*}\right)$$



β^* measurement – Run-4

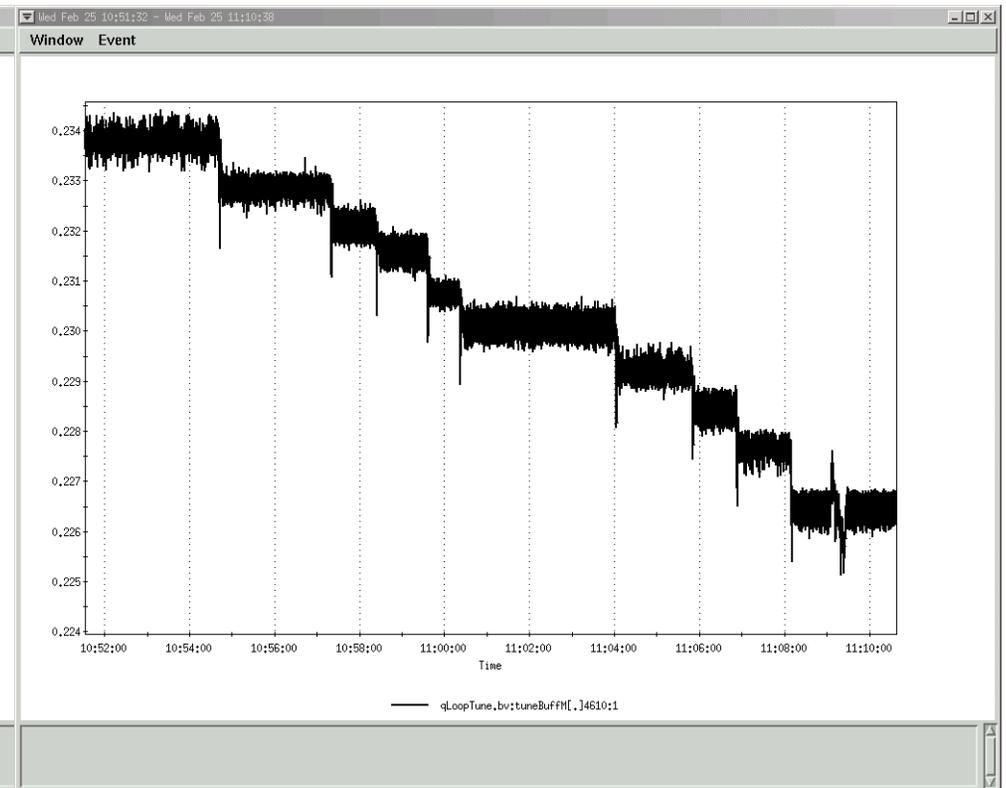
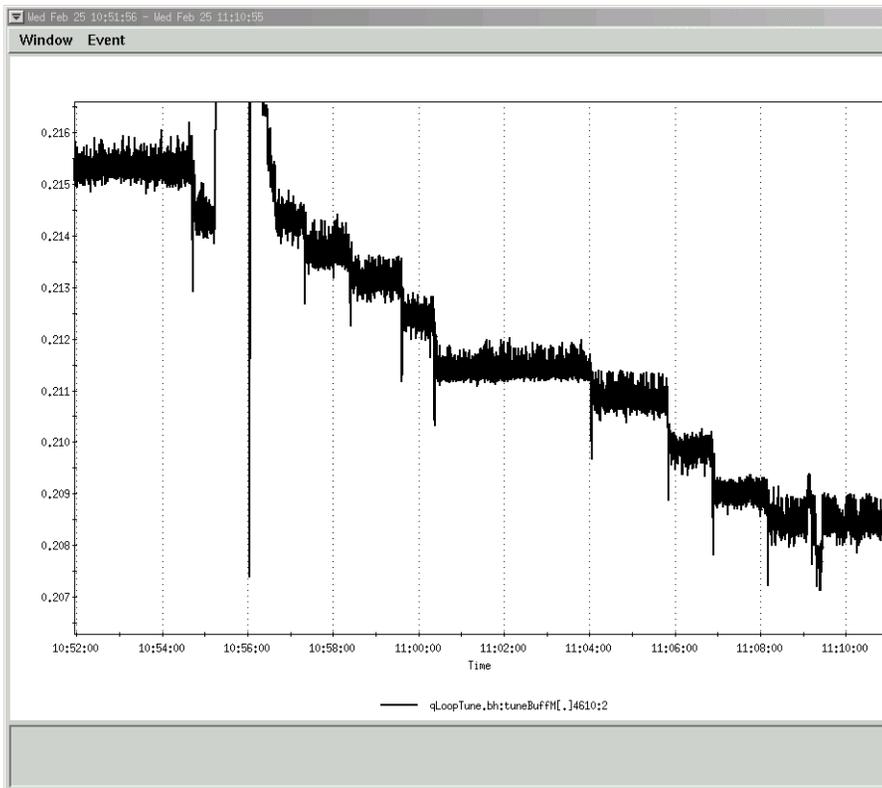
- Center orbit in IR8, separate tunes
- Varied bo7-qd1 and bi8-qd1 by $-\Delta K$ and $+\Delta K$ in the range from 0 to 0.001 in steps of 0.0001 and took (PLL) tune shift data for β^* measure
(anti-symmetric excitation minimizes beta-beat for symmetric optics)



DK scan in q1's in blue IR8

Horizontal tune

Vertical tune



- verify the quadratic dependence
- assess impact of anti-symmetric optics) → measured beta* value (Fulvia, Yun)



Proposed experiments

□ Beta* squeeze 0.85-0.9

during ramp-up if program allows
early beam experiment session
needs online fitting (or new ramp)
(Fulvia + RHIC operation team)

□ Beta* measurements

to be better defined soon in a proposal
(Fulvia, Yun, Dejan, Vadim, Mei, Todd....)