Injection drift correction

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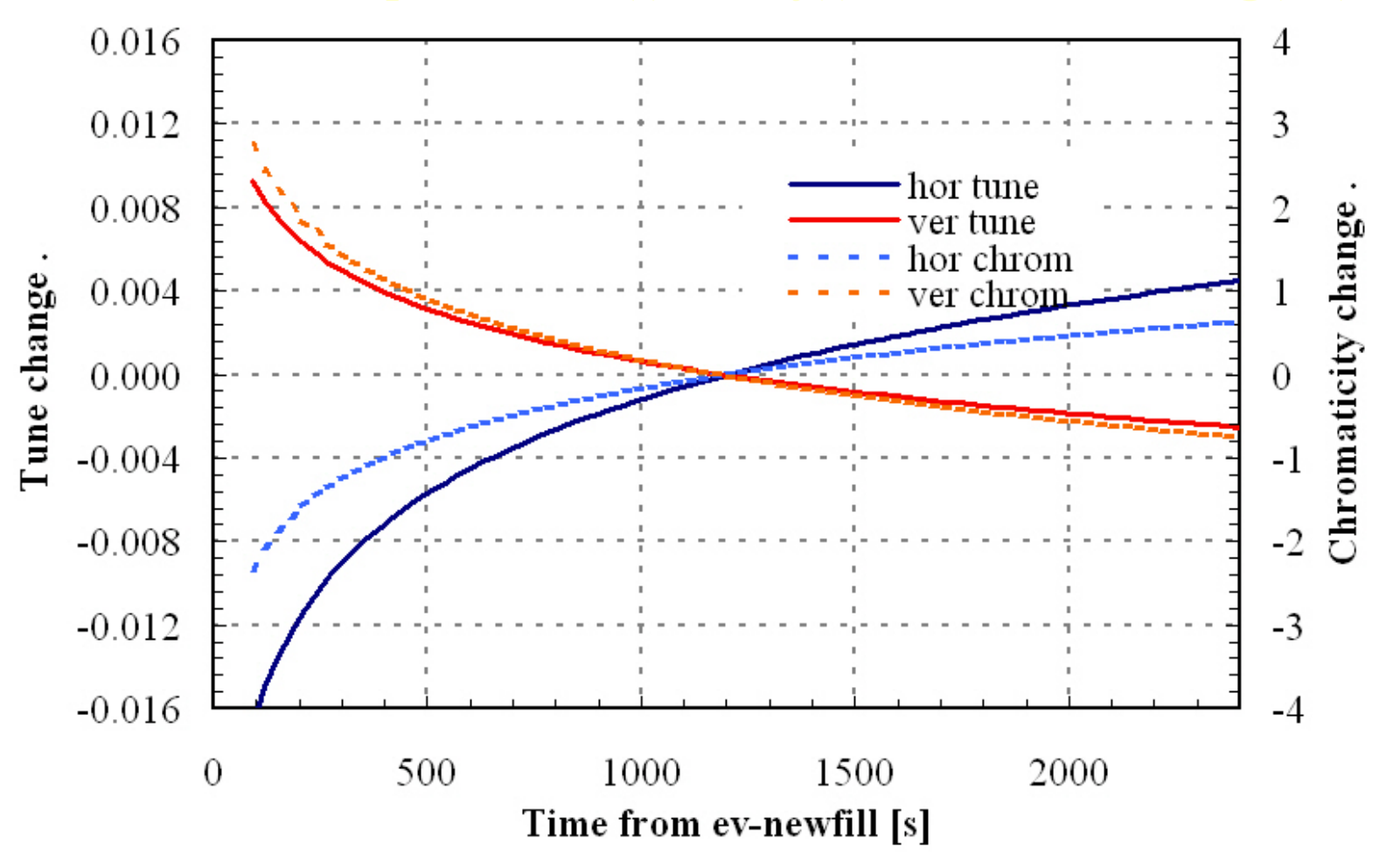
Motivation

- Drift of dipole, quadrupole, and sextupole fields at injection requires waiting period
  (~10 min per fill, ~2 days per run species)
  to obtain reproducible conditions
  [main cause of drift is persistent current decay]

- Drift compensation allows for immediate injection after injection plateau is reached, under reproducible conditions

Preparation 1: tune and chroma drift models

Use time-dependent Q(t) and ξ(t) of form A+B log(t/τ)

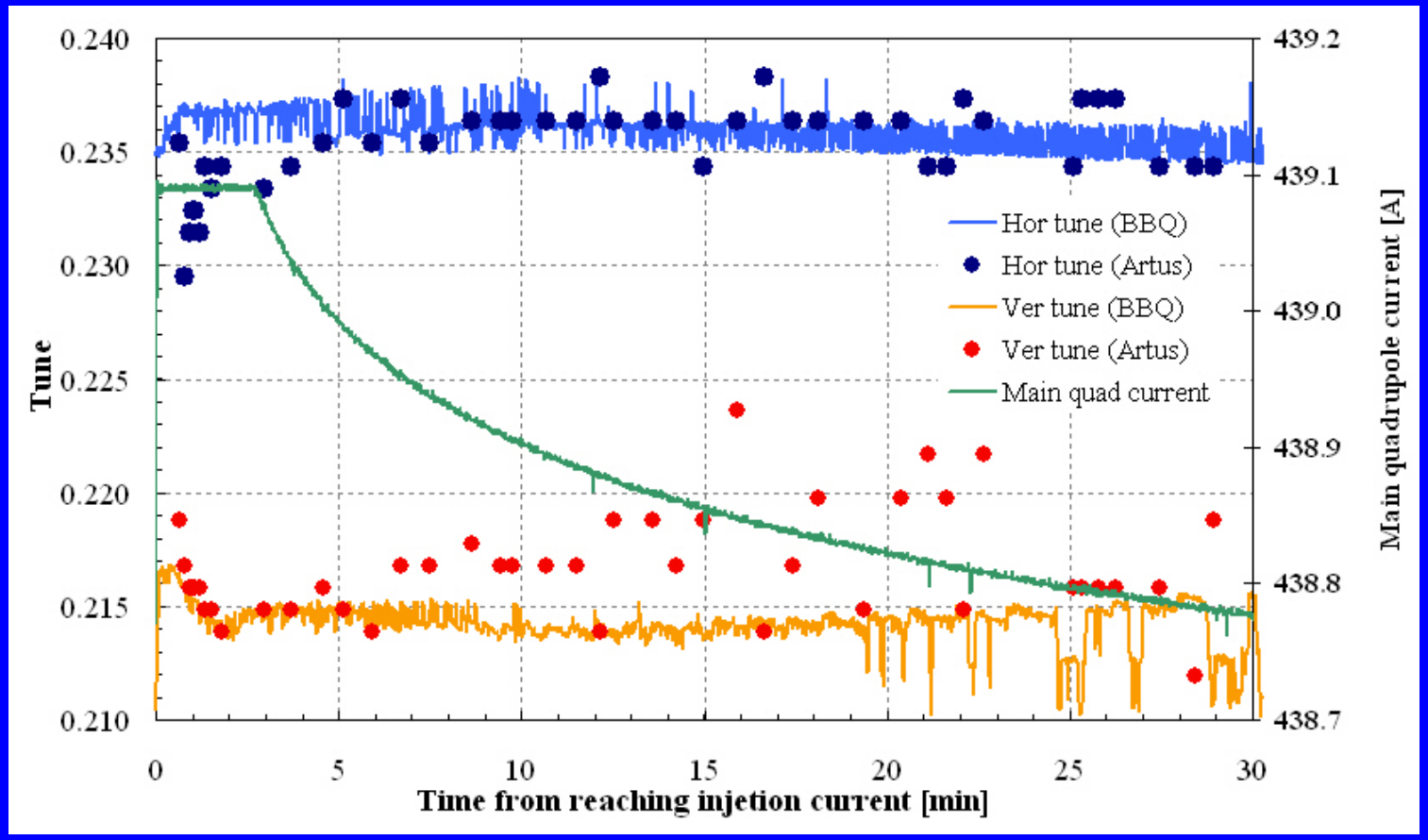


Coefficients A,B obtained from fit to measured Q(t) and ξ(t)

Use only Q(t) in 1st test.

Test 1: tune drift compensation on injection plateau

05/16/2007 fill 8786 to 8787



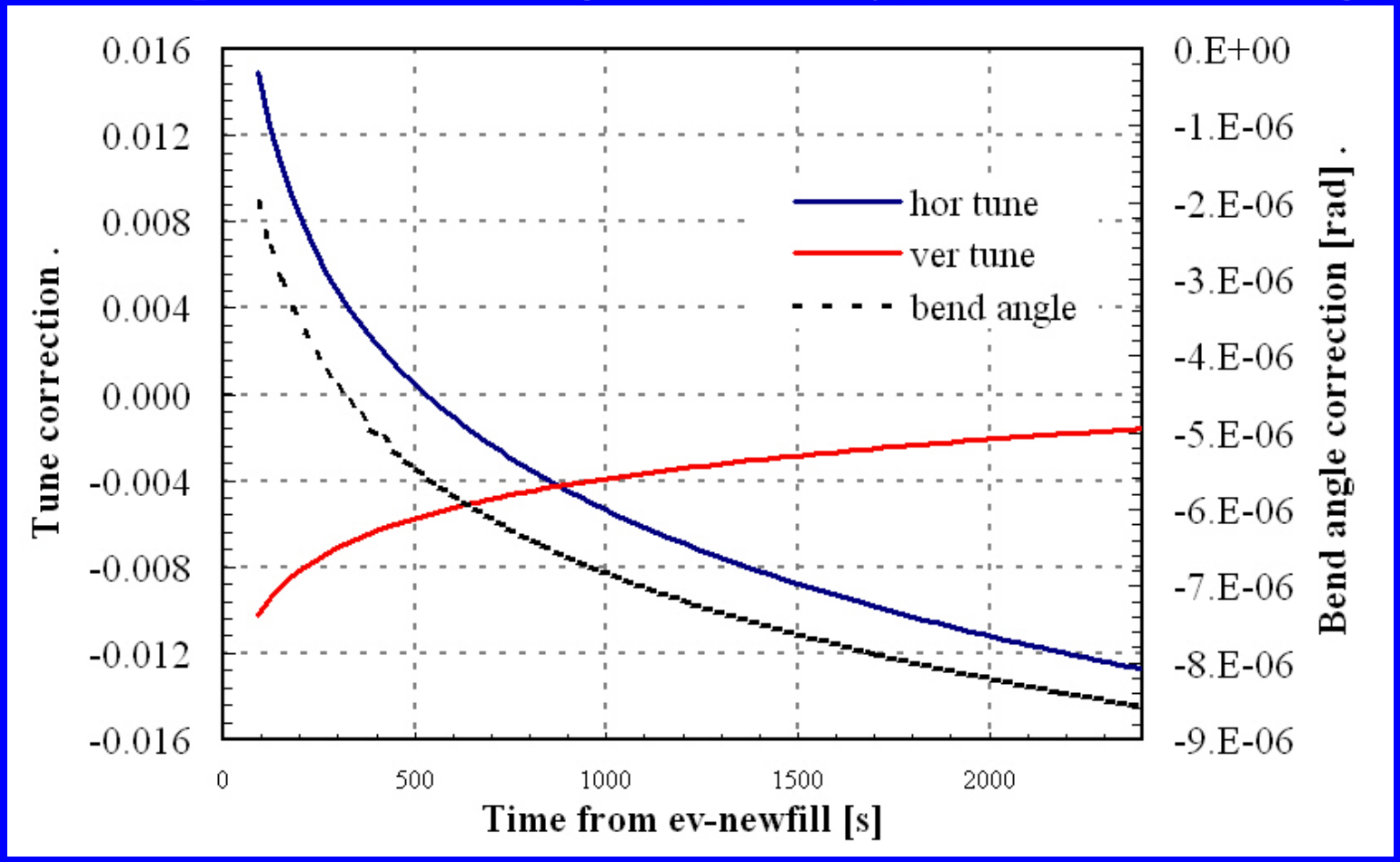
7e-4 change in main quadrupole current over 30 min

Needed to change tunes in injection stone: dQ_x +0.01, dQ_y –0.01

Tunes held constant over 30 min.

Preparation 2: orbit and tune drift model (V. Ptitsyn)

Use time-dependent bend angle $\theta(t)$ and $\xi(t)$ of form $A+B\log(t/\tau)$



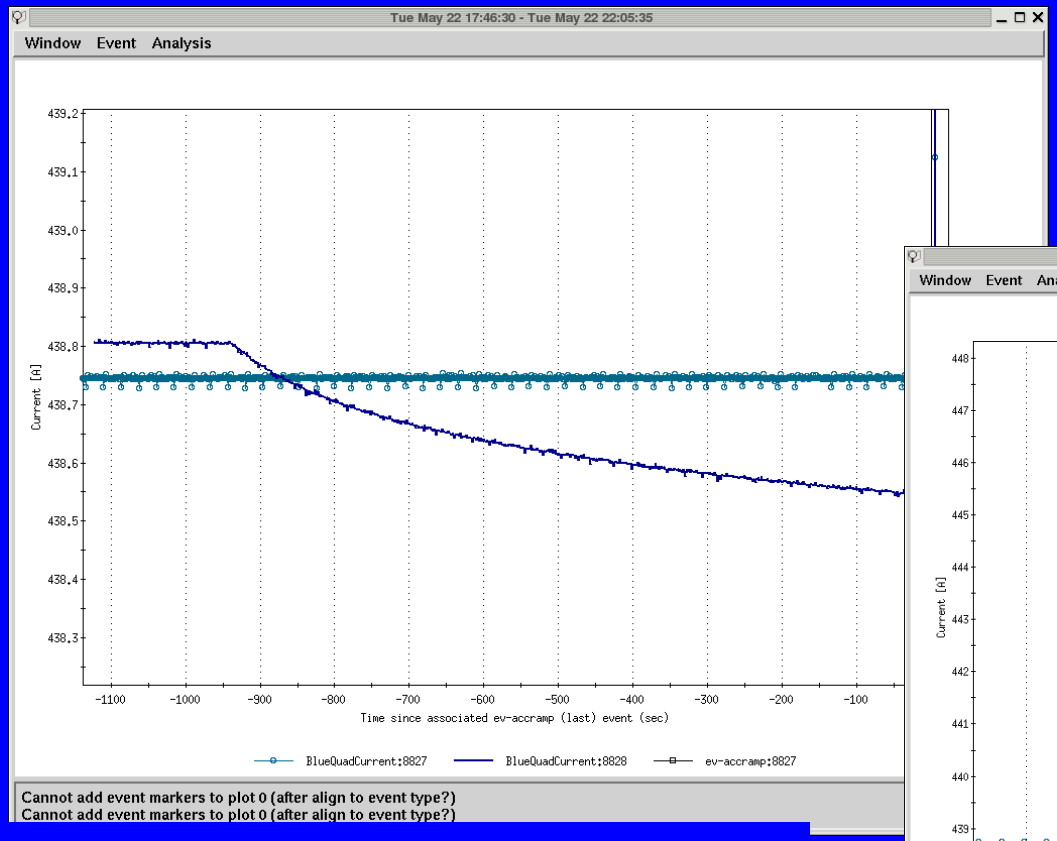
Coeff. A,B obtained from fit to measured mean orbit and Q(t) changes

<u>Orbit changes also lead to tune changes</u> (measured directly, add to previous correction).

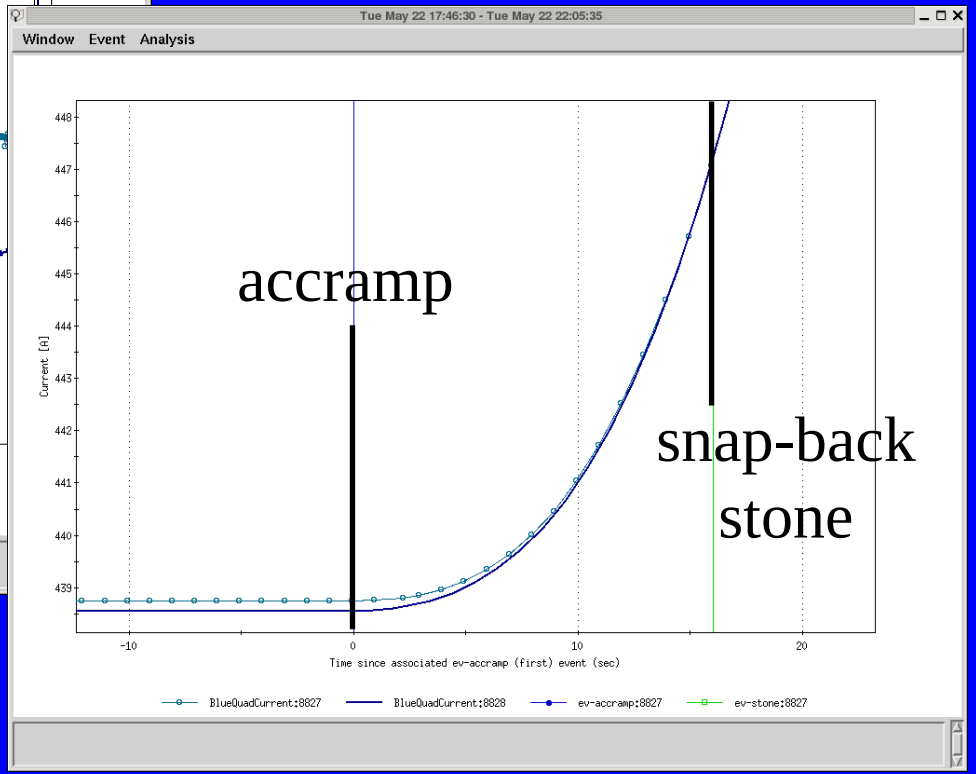
Test 2: orbit & tune drift compensation, snap-back

05/22/2007 fill 8827 to 8828

- Injection not ready for 5min – too late for proper compensation
- But demonstrated quadrupole compensation unwinding in snap-back



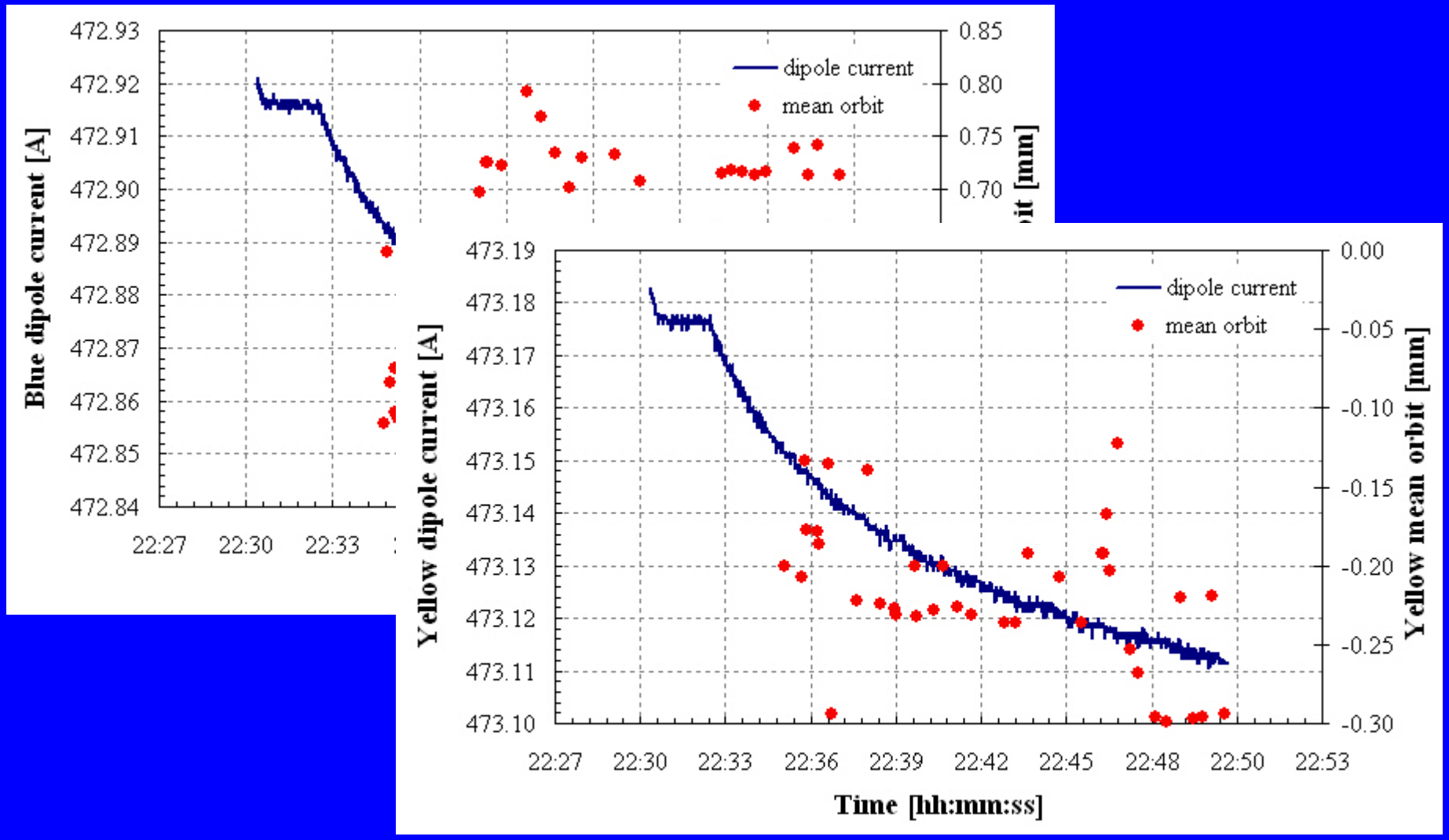
← Main quad current without and with compensation



Main quad current without → and with unwinding

Test 2: orbit & tune drift compensation, snap-back

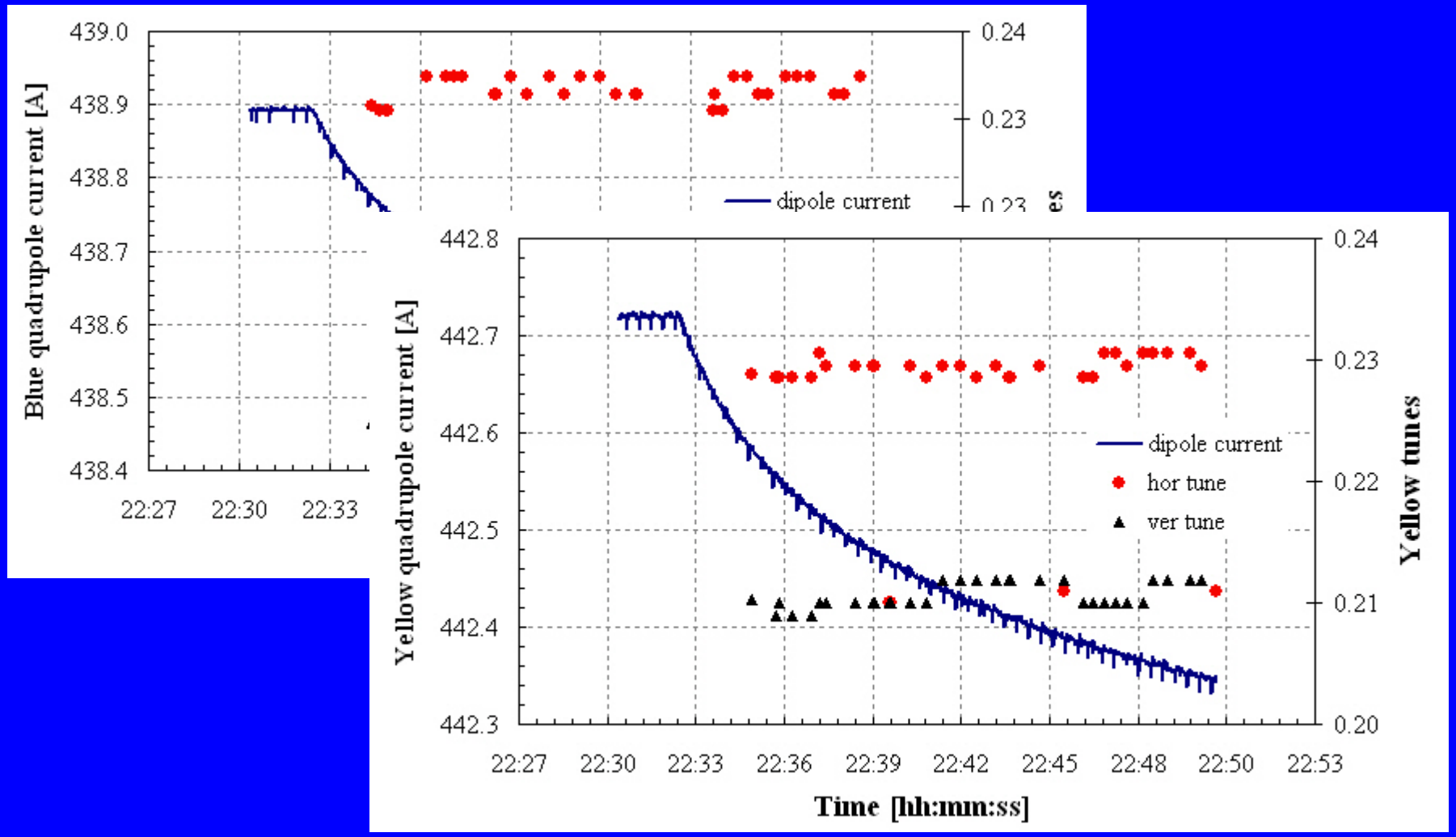
06/05/2007 fill 8913 to 8914



Uncompensated mean orbit drift is ~1 mm/30min.

Test 2: orbit & tune drift compensation, snap-back

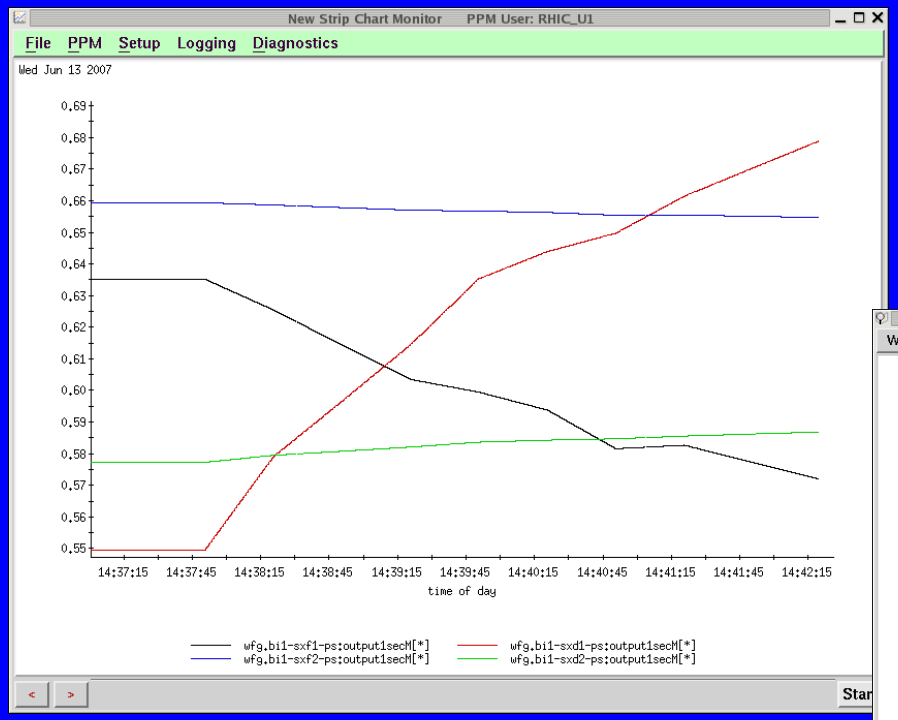
06/05/2007 fill 8913 to 8914



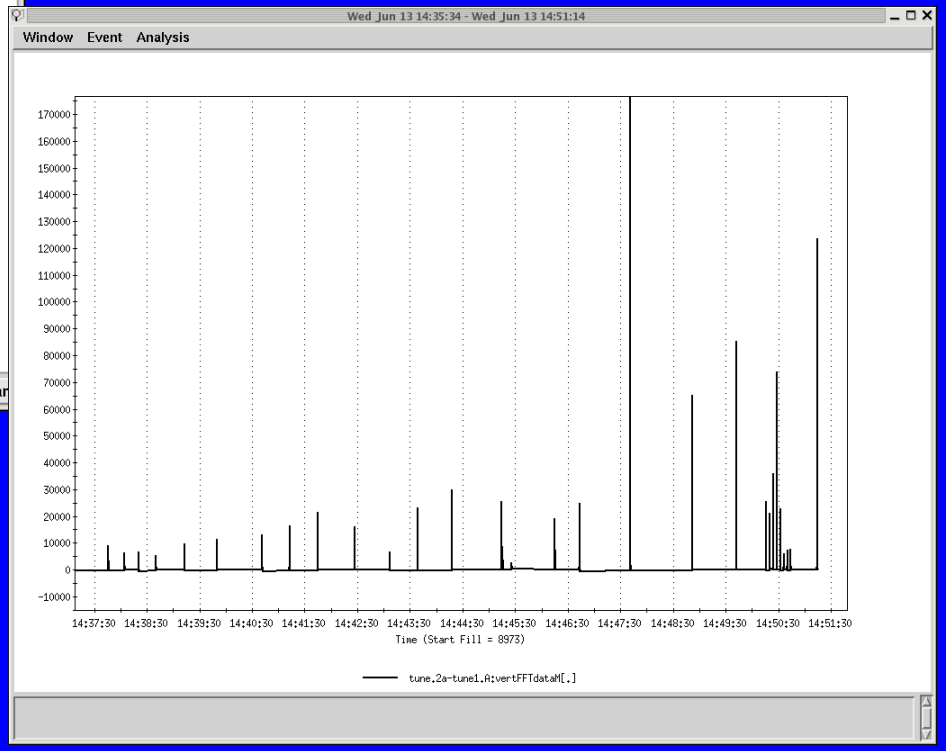
Uncompensated tune drift is ~0.02/30min.

Test 3: orbit, tune & chromaticity drift compensation

06/13/2007 fill 8972 to 8973



← sextupole currents change



chromaticity also changes →
(change in coherence)

Chromaticity drift correction failed (implementation problem.)

Implementation for operation

- Still need to demonstrate chromaticity drift compensation
  (failure was understood by A. Marusic)

- A. Marusic transferred knowledge to J. Morris

- Can continue work after normal start-up
  (d-Au turn-around time will be larger than Au-Au)

Summary

- Injection drift compensation should allow for faster turn-around times (on average)

- Demonstrated in 2007:
  - Combined dipole and quadrupole drift correction
  - Correction unwinding in snap-back

- Not successful in 2007:
  - Sextupole drift correction

- Implementation for operation possible, not highest priority, still requires some work