Measurements with lower chromaticity

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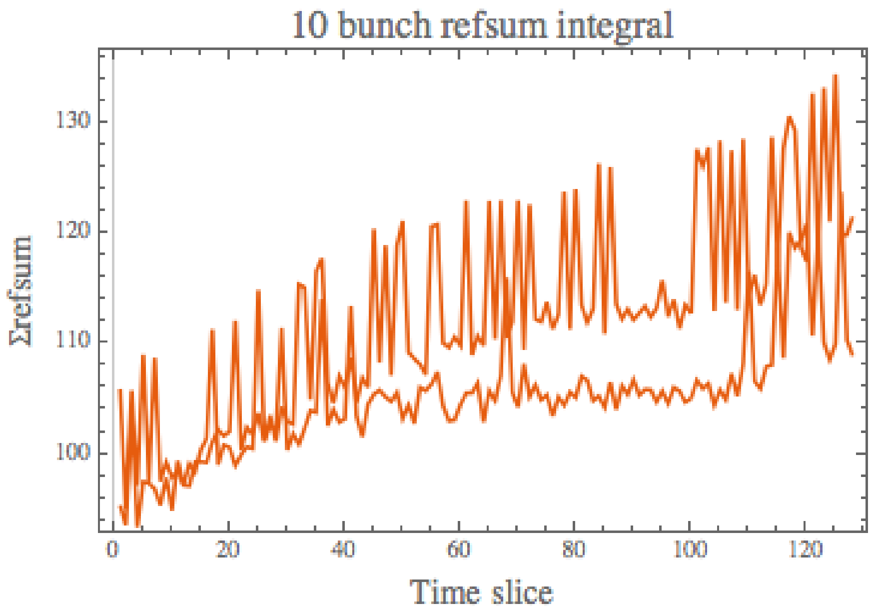
Effect of lowering chroms

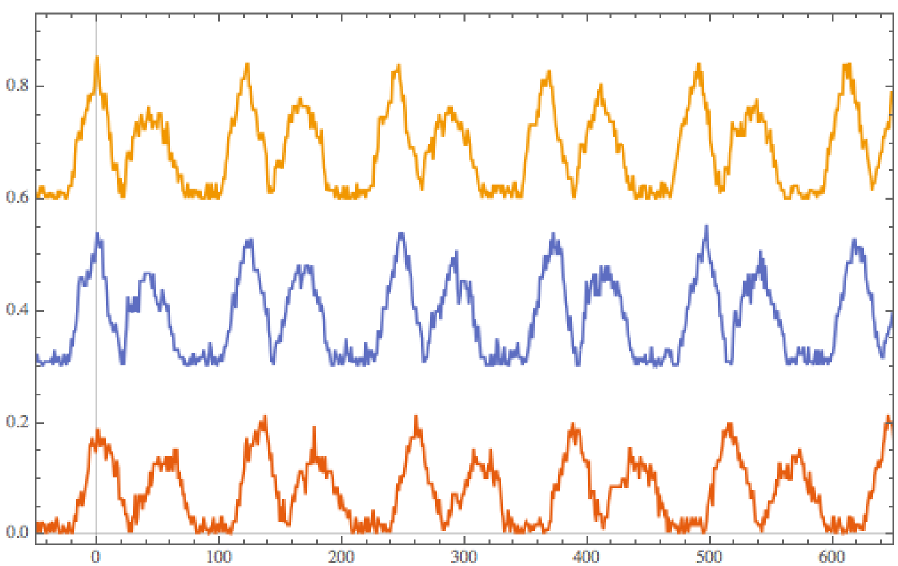
- Dampers must be on
  - Previous attempts by setting SXL=0 and -3 made chromaticies POSITIVE!
    - This caused the beam to go unstable. In fact, if not for the dampers, the beam would completely fall out.
  - There is **no** head-tail instability.
- Does lowering chromaticity improve beam lifetime?
  - It does in MI and Tevatron. But what about Booster?

No head-tail with positive chroms

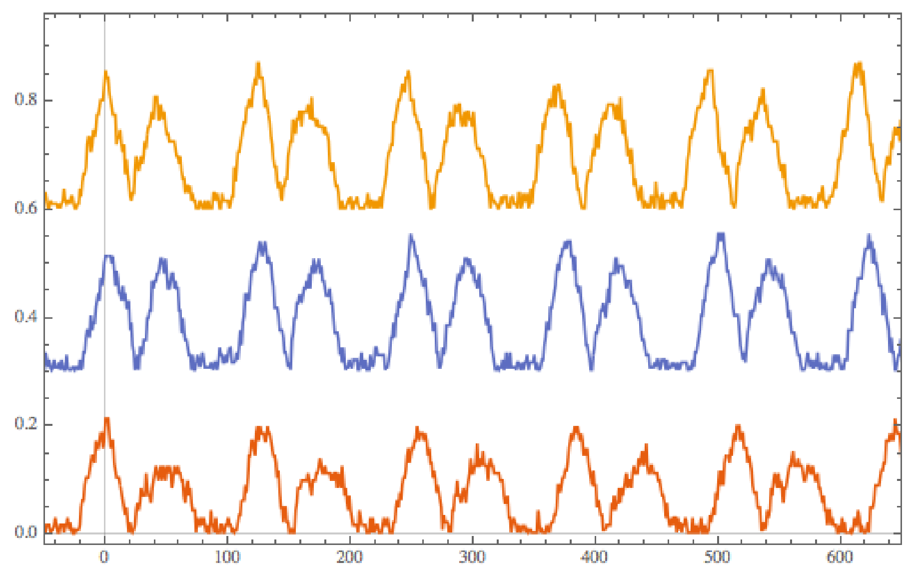


Clearly beam falls out but it is not from head-tail because I cannot tell the difference between nominal and positive chroms.

Using MADX, Cx = -31 and Cy = +26

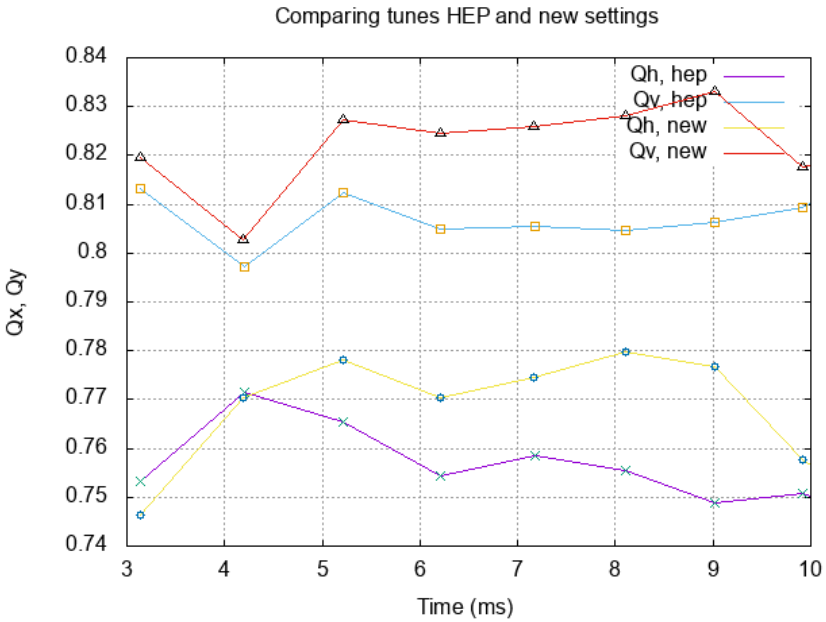


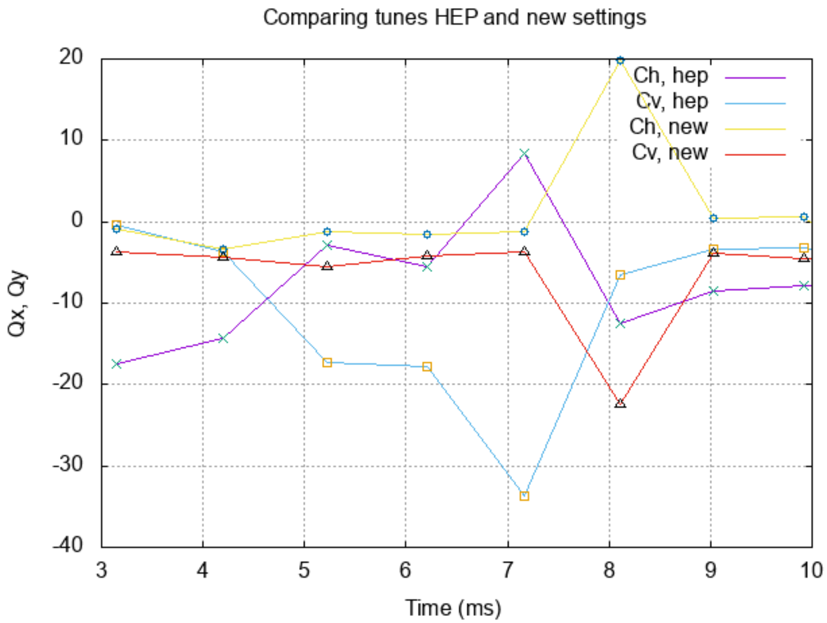
SXL = -3 A



HEP

As found and new tunes and chromaticity





Notice that Ch (HEP) is -20 units ~3ms and Cv ~-30 units around 7 ms.

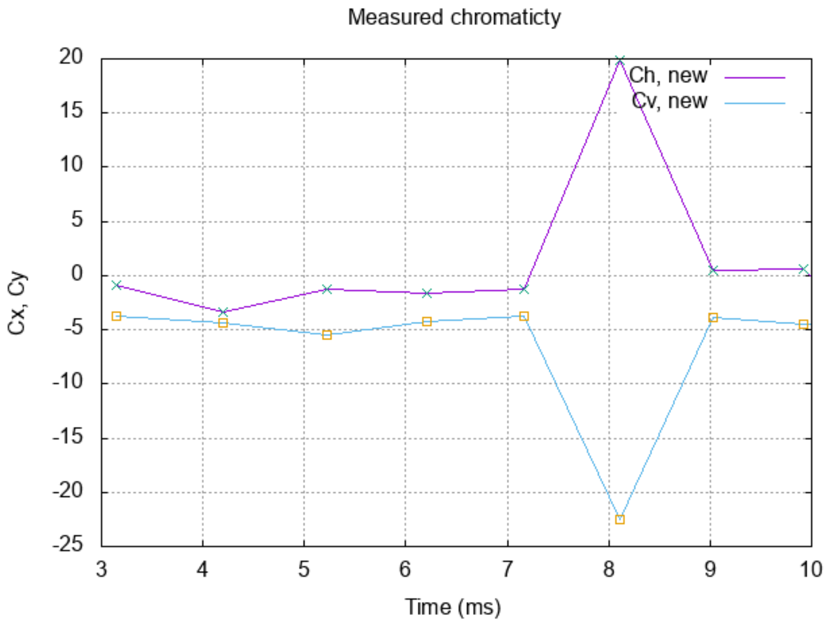
There is some weirdness going on at 8 ms for new settings. Hard to believe singple point chroms that behave like this.

SXL and SXS settings and results

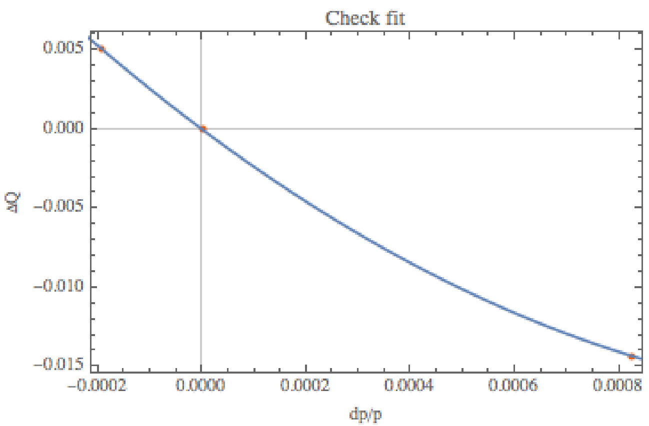
time	SXS
1.6	1.5
2.4	1.5
2.9	1.5
3.7	1.0
4.6	1.0
5.6	1.0
6.5	1.0
7.3	1.0
8.1	2.0
8.6	1.0
9.0	1.0

time	SXL
1.68	7.00
2.89	7.00
3.69	7.00
4.59	7.00
5.59	7.00
6.49	7.00
7.29	8.50

Moved tunes up by 0.02 in both horz and vert tunes from 5 ms to 9 ms.

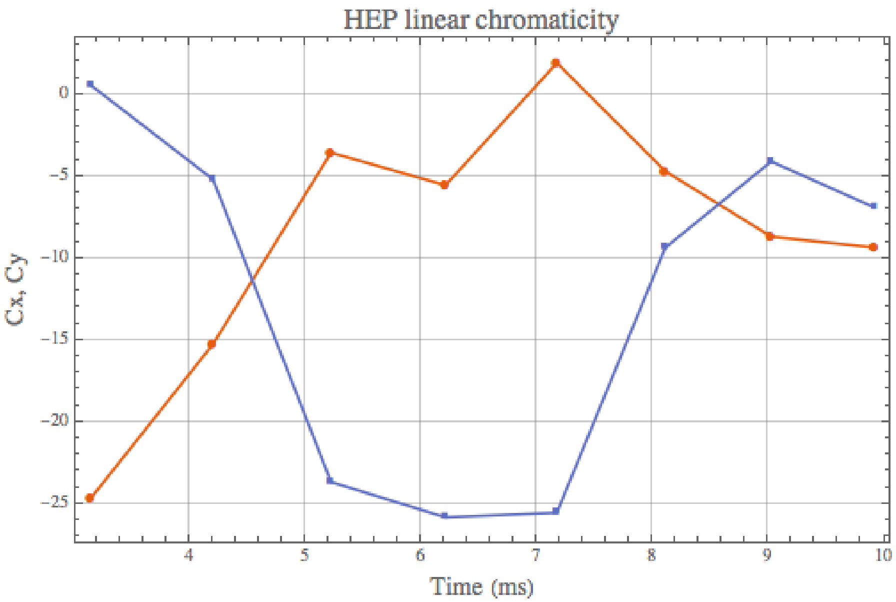


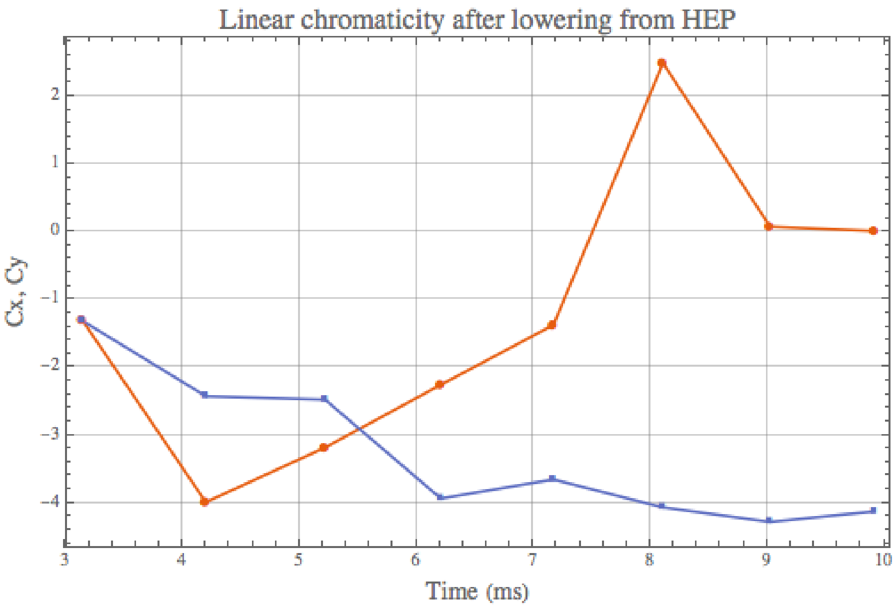
Redid chromaticity assuming non-linear chromaticity



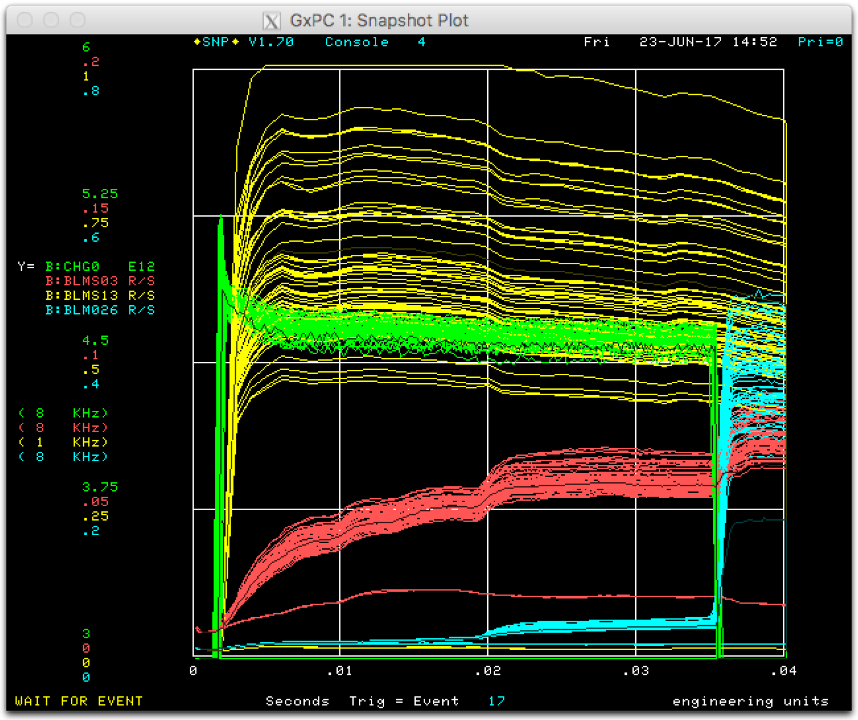
Chandra found that chroms were quite different for ROF=+1 mm vs -1 mm. So we did a 3 point fit to find Ch and Cv.

There is still an odd ball at 8 ms.





No change in injection efficiency



Used 12.4 turns like in $15.
No visible increase in efficiency ~90%.
No visible increase in losses.

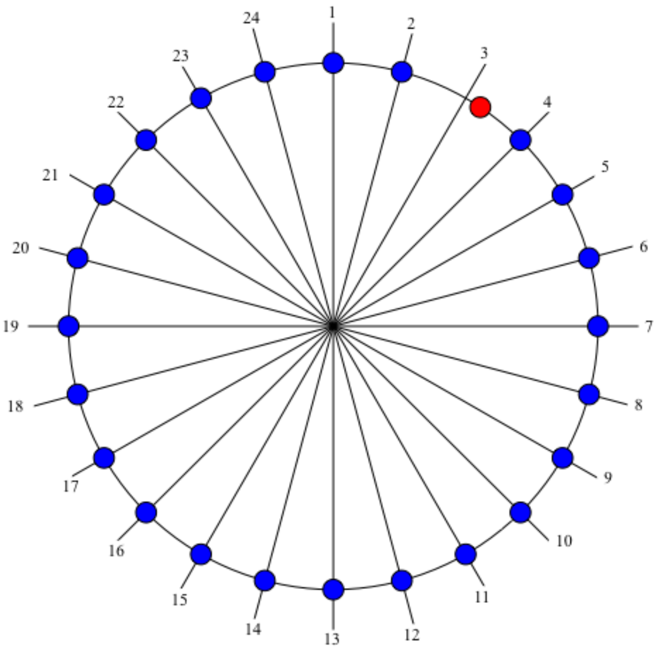
Moving tunes UP away from 1/2 integer did not show improvement.

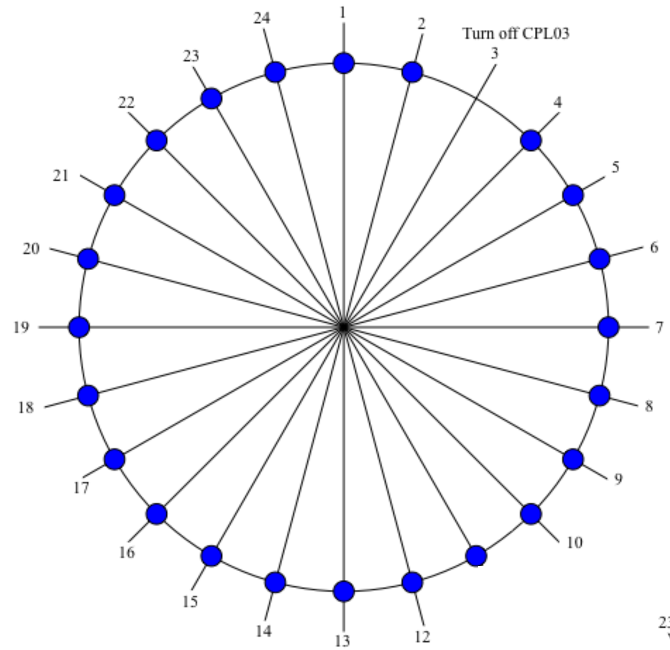
There is a limit of how much tune change is available <u>even with dampers ON</u> at this intensity:

- Max horz tune change +0.08
- Max vert tune change +0.04

Lowering chromaticity does not improve beam lifetime!

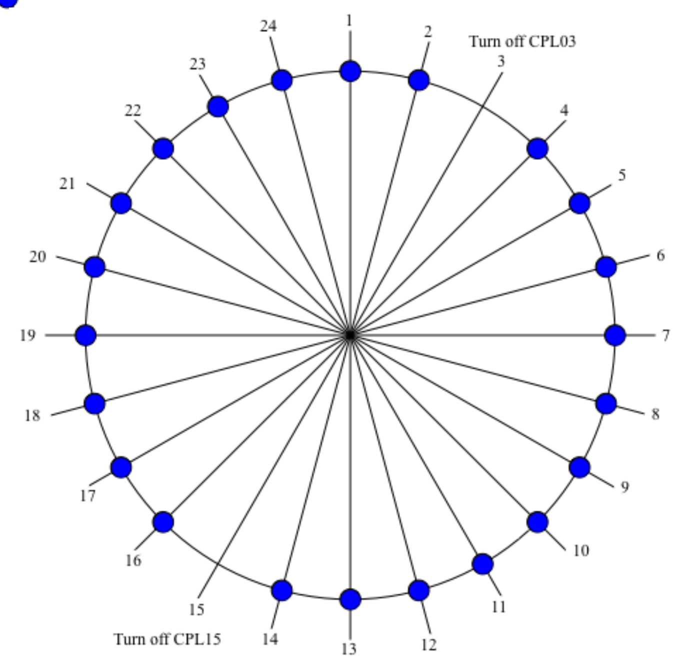
Kiyomi's 3rd order resonance experiment





If the source of the 3rd order resonance is coming from the displaced CPL03, then:

- Turning off CPL03 only could still give us a 3rd order resonance.
- Turning off CPL03 and CPL15, shouldn't 3rd order be diminished?
  - If 3rd order remains, does this mean source of 3rd order is not at CPL03 or there is no 3rd order?



Again, back to same old song ...

- Is this still a 3rd order resonance problem?
  - Do we really have a dynamics problem?
- Is this an aperture problem?
  - Is beam already too big?
- Or dipole ripple problem: what’s the switching frequency of the corrector dipole power supplies?
  - See JPARC paper where they have a 100 kHz dipole ripple on their injection bump magnets that causes halo: https://journals.aps.org/prab/pdf/10.1103/PhysRevAccelBeams.20.060402

JPAC twin peak losses from injection bump magnet noise

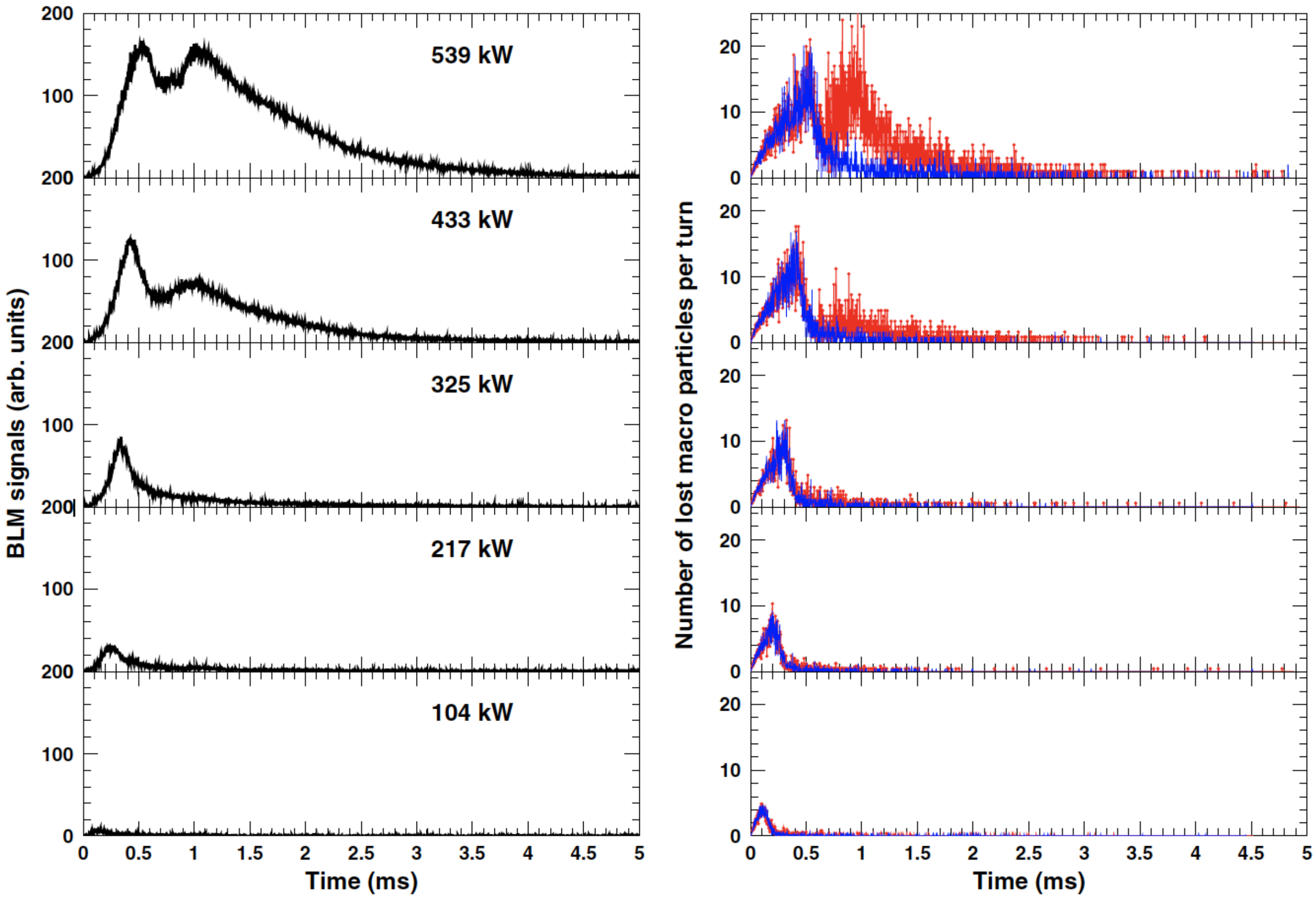
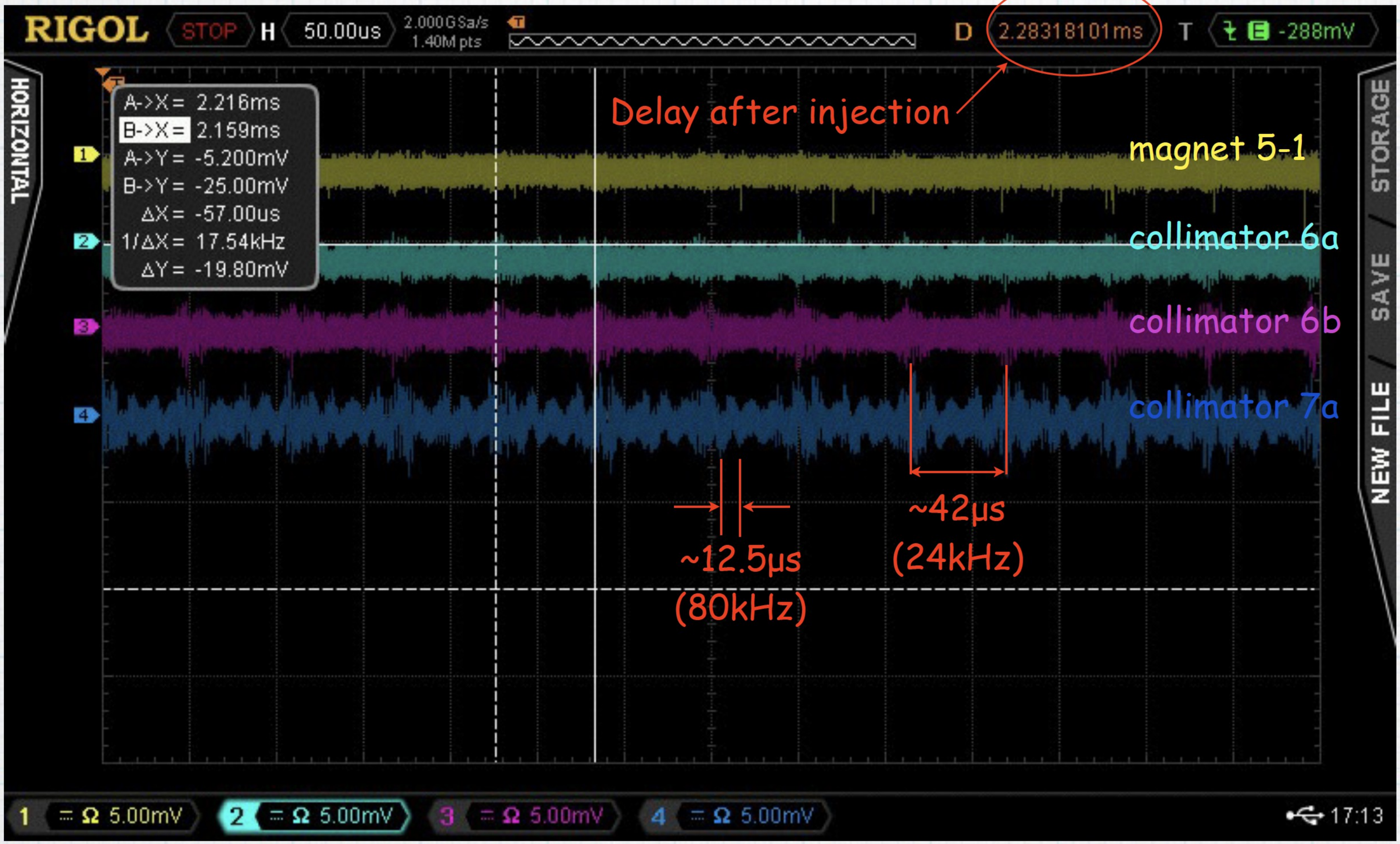


FIG. 12. (Left) Scintillation-type BLM signals for the first 5 ms measured at the collimator section with the injection painting parameter of ID 8 for various beam intensities from 104 to 539 kW. (Right) Corresponding numerical simulation results obtained with (red) and without (blue) the dipole field ripple.



Filename: noise01.jpg
Event: $15
Single pulse

Note delay after start of injection!

Data Taken: 6/26/17 ~17:00

Measurements by R. Tesarek from fast BLMs at the locations indicated above.