APEX Studies: Accelerating w. Near 3rd Order Resonance

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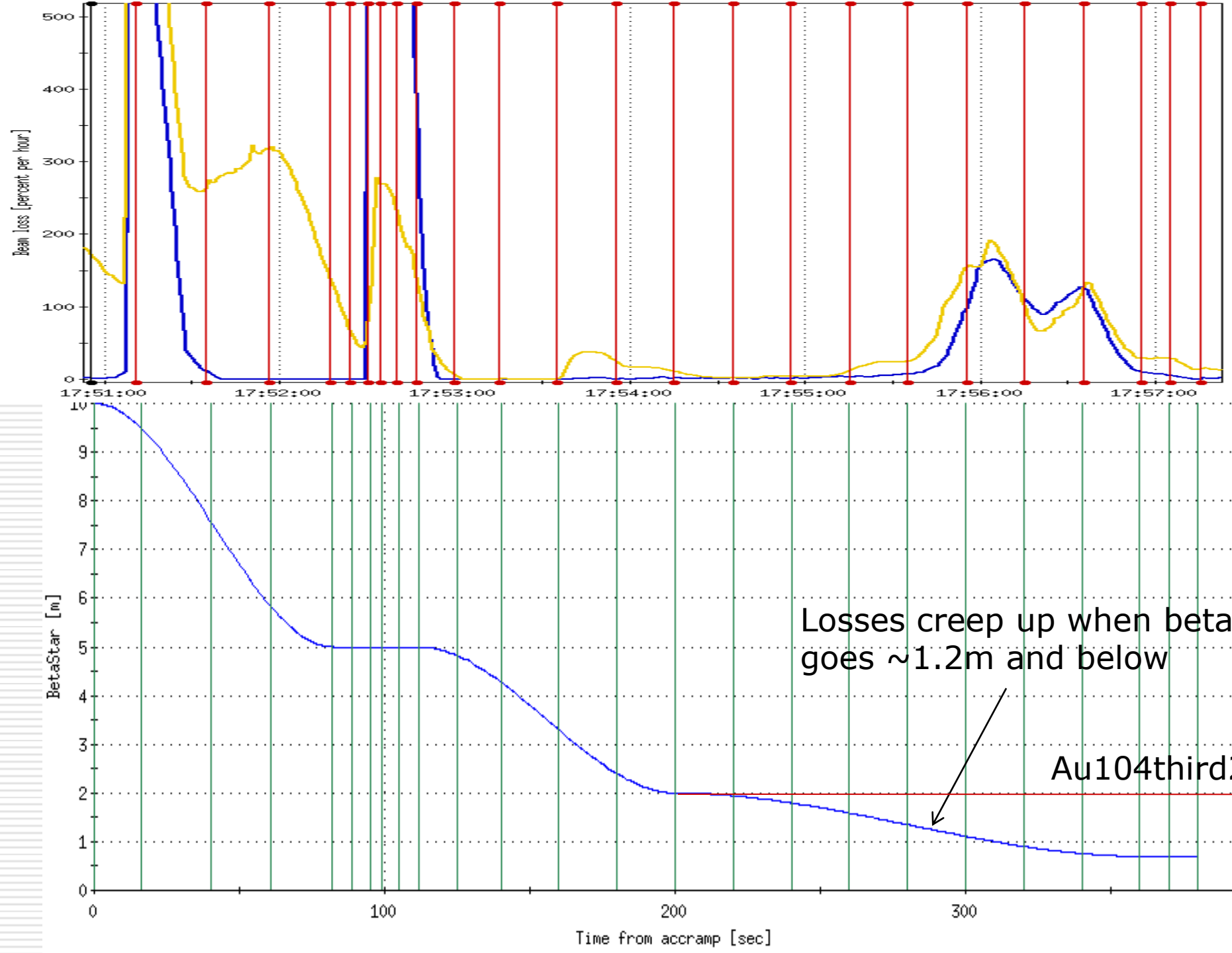
Status: Au104third

- Developed ramp Au104third
  - Working point at Qx=31.31(Yellow),31.36(Blue), Qy=32.325(Yellow), Qy=32.343(Blue
  - Beta* at IP6 and IP8 gets squeezed from 10m at injection to 0.7m at store during acceleration
- 23 Blue bunches and 56 Yellow bunches made to store energy with ~1x10^9 bunches intensity
  - Blue working pt: 0.358, 0.343 and Yellow working pt: 0.31, 0.325
  - Bunch intensity is about ~1.x10^9
- Tried 111x111 ramp, but failed due to permit pull triggered by beam losses in Blue
  - Correlated with beta* squeeze below 1m.

Current Status: Au104third2

- Difference between Au104third2 and Au104third
  - beta* squeeze from 1.7m to 0.7m is stopped for the final part of the ramp

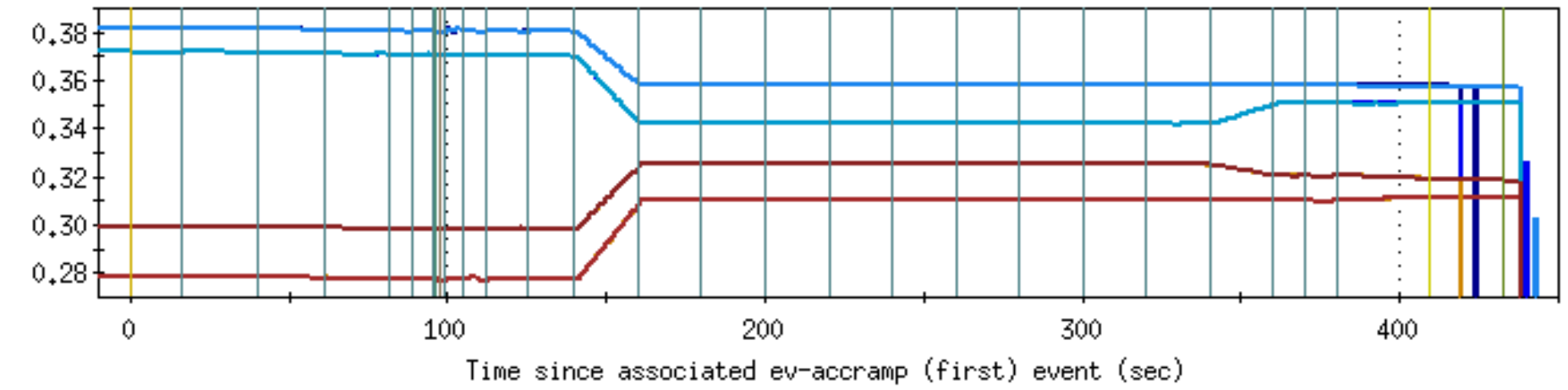
- Tested Au104third2 by Don and other ps experts without beam
  - Different QPA table from Au104
  - Change between difference ramp needs 2 hours.

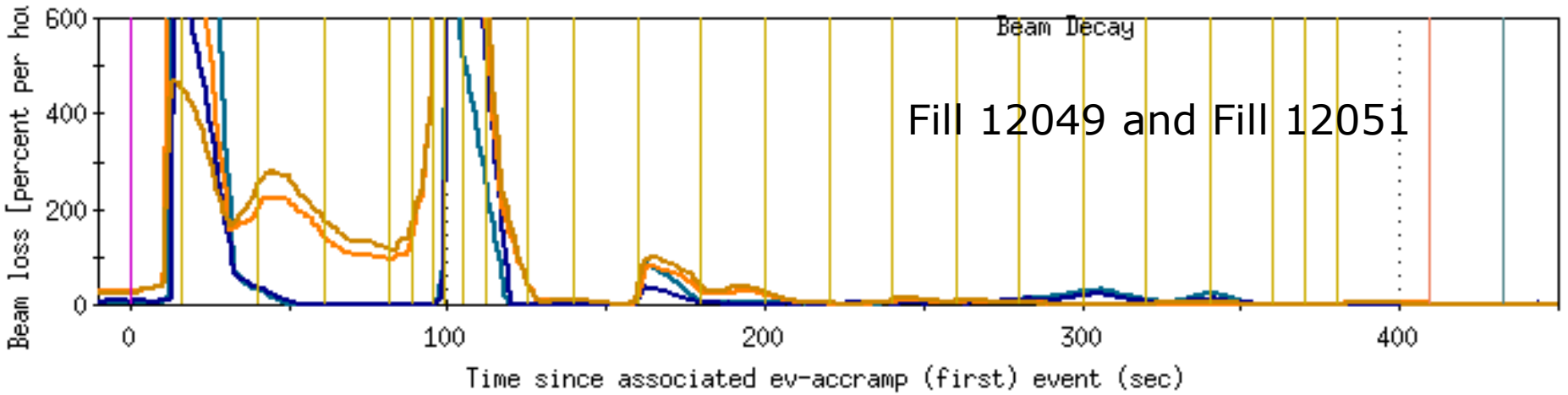

Beam loss [percent per hour]
500
400
300
200
100
0
17:51:00
17:52:00
17:53:00
17:54:00
17:55:00
17:56:00
17:57:00
BetaStar [m]
10
9
8
7
6
5
4
3
2
1
0
0
100
200
300
400
Time from accramp [sec]
Losses creep up when beta* goes ~1.2m and below
Au104third2

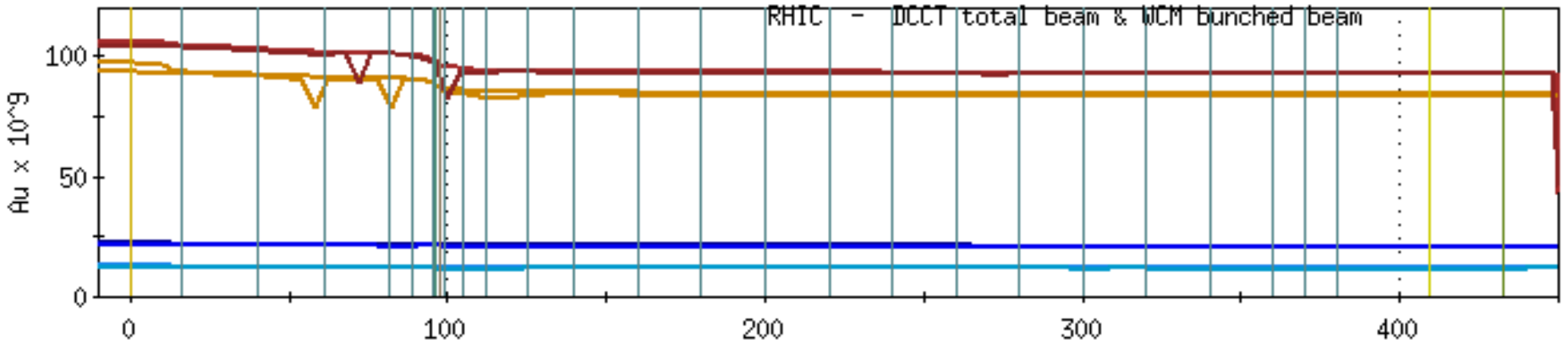
Current Status: Au104third2

- Chromaticity along the ramp in both rings was measured with tune feedback on. Vertical chromaticity in both rings after tune swing was adjusted to minimize the beam losses
- Yellow made to top energy twice with 111 bunches (~1e9 ppb injected). Vertical tune of 0.325 (del = 0.008).
- The post-tune swing part of the ramp (when we are near resonance) is nearly lossless.
- Major stumbling block is blue transition loss (unrelated to resonance).

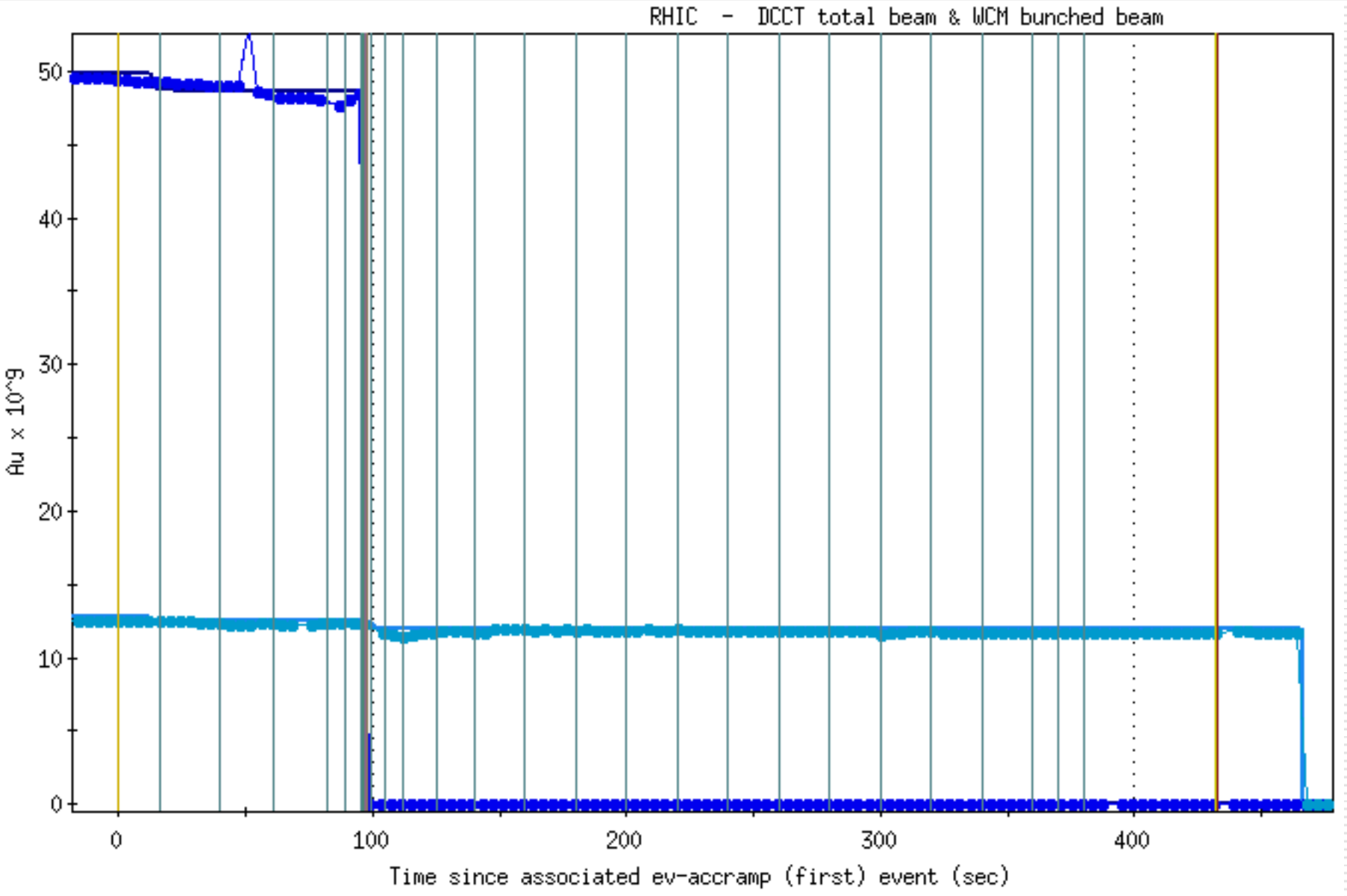
From Vincent's APEX presentation


0.38
0.36
0.34
0.32
0.30
0.28
0
100
200
300
400
Time since associated ev-accramp (first) event (sec)


Beam loss [percent per hou
600
400
200
0
Beam Decay
Fill 12049 and Fill 12051
0
100
200
300
400
Time since associated ev-accramp (first) event (sec)


RHIC - DCCT total beam & WCM bunched beam
Au x 10^9
100
50
0
0
100
200
300
400

Blue transition problem



what are missing for completing the study?

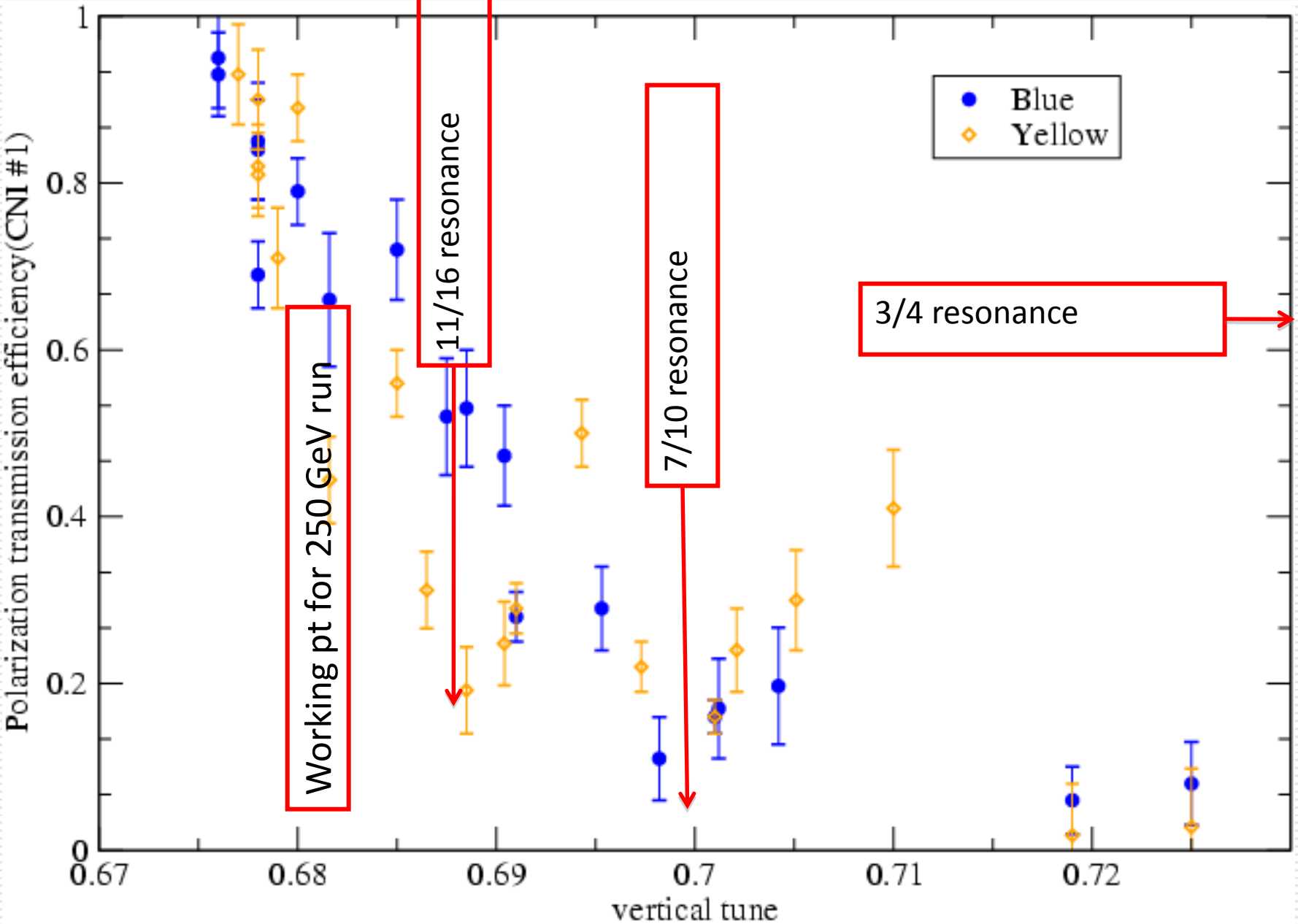
- Explore the chromaticity space with Qy at 0.008 away from 1/3. For high intensity proton beam, ~ 2 units of chromaticity is needed for keep the beam from being unstable
  - Can we still ramp 111 bunches with ~2 units of vertical chrom?
- Explore how much closer we can push Qy to 1/3
  - Tune scan at a step size of 0.0005
- Demonstrate the reproducibility of the ramp
- ramp 111x111 to store
- need ~ 24 hours development time

Plans

- Switch from the current physics ramp Au106 to Au104third2: 2 hours
- Measure chromaticity with 6x6 ramp
- Adjust chromaticity
  - in Yellow later part of the ramp to be ~2 units. Check whether we can still ramp 111 bunches
  - In Blue, chromaticity before and after transition
- If successful, tune scan at a step size of 0.0005
- Repeat the ramp with tune closest to 1/3 for 3~4 times

- If time allows, spend 2~3 ramps to fix the Blue transition problem, may take 2~3 ramps
- If successful, ramp 111x111

Motivation


Polarization transmission efficiency(CNI #1)
vertical tune
Blue
Yellow
Working pt for 250 GeV run
11/16 resonance
7/10 resonance
3/4 resonance
0
0.2
0.4
0.6
0.8
1
0.67
0.68
0.69
0.7
0.71
0.72