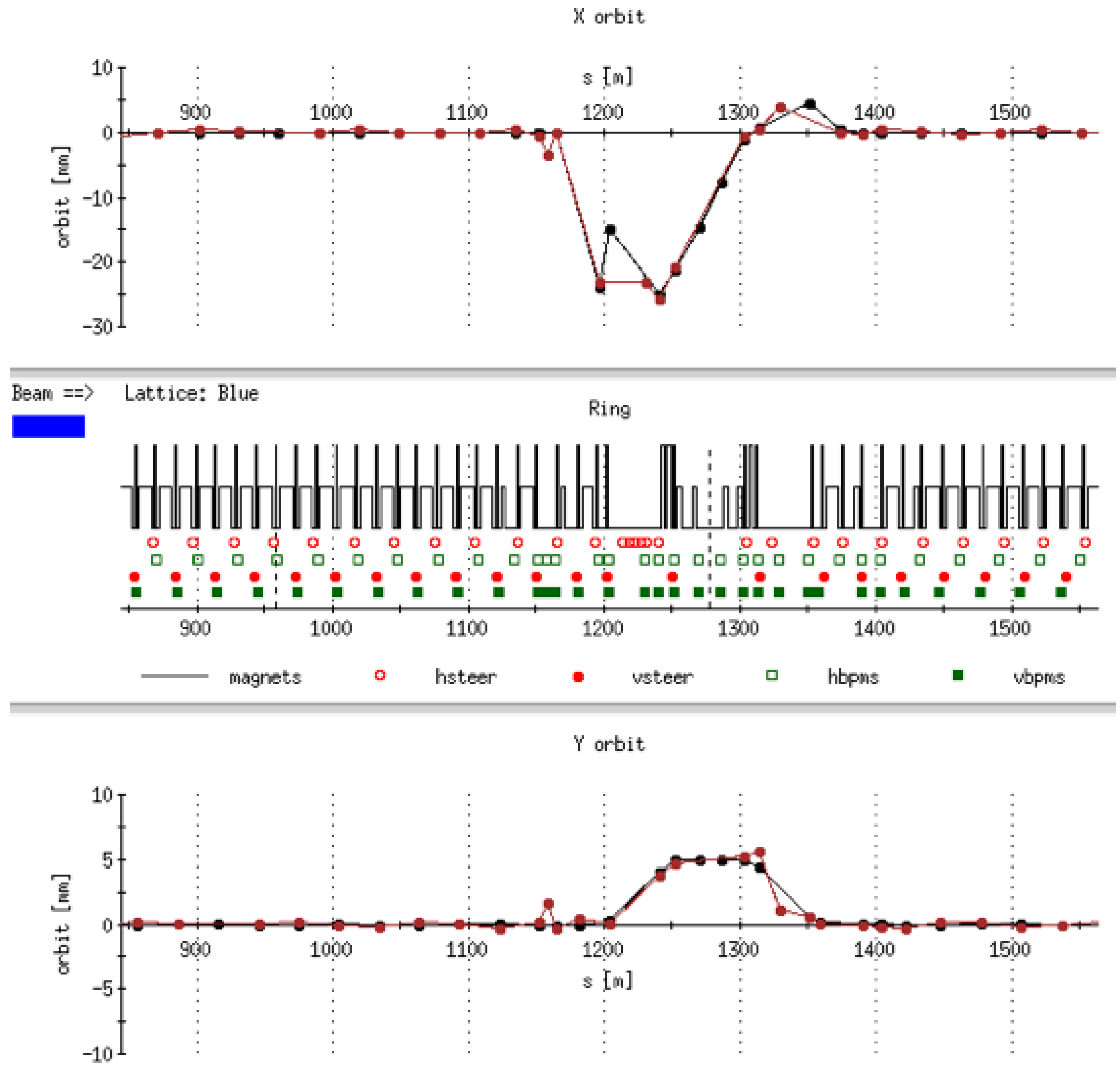
RHIC Spin Flipper Commissioning

M. Bai, M. Brennan, C. Dawson, Y. Makdisi, P. Oddo,
C. Pai, P. Pile, P. Rosas, T. Roser

What was done in May 2 APEX Session?

- Re-established the DC spin rotators at 1000A with local bumps at Q3 and Q4

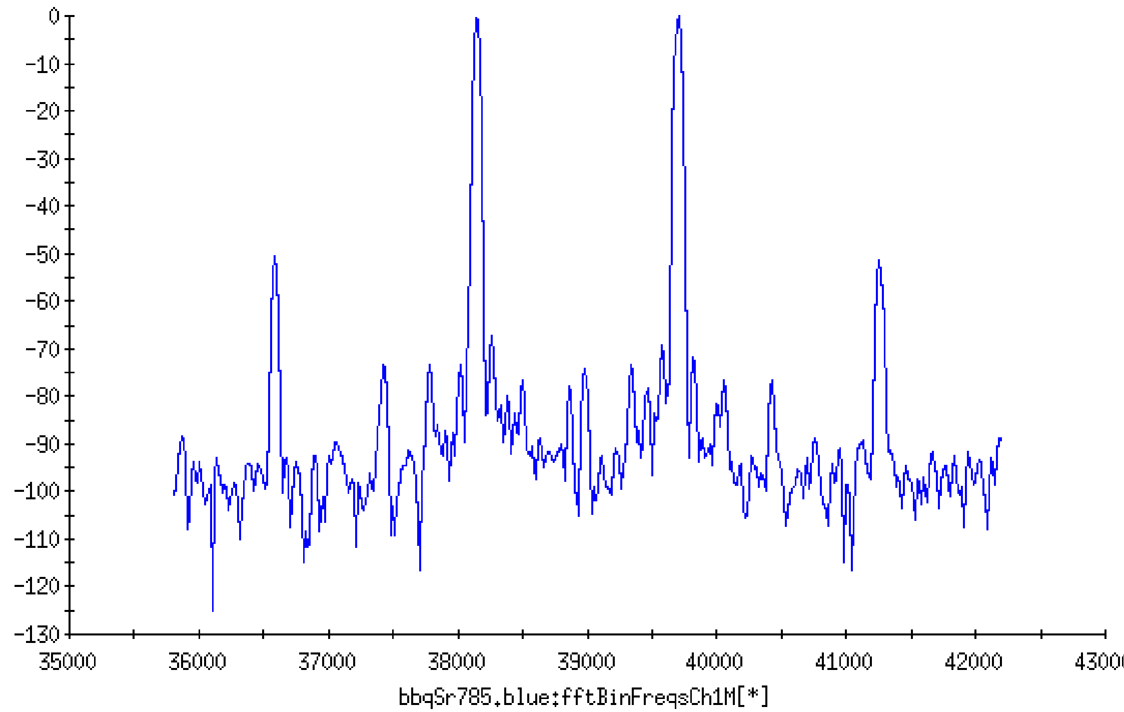


What was done in May 2 APEX Session

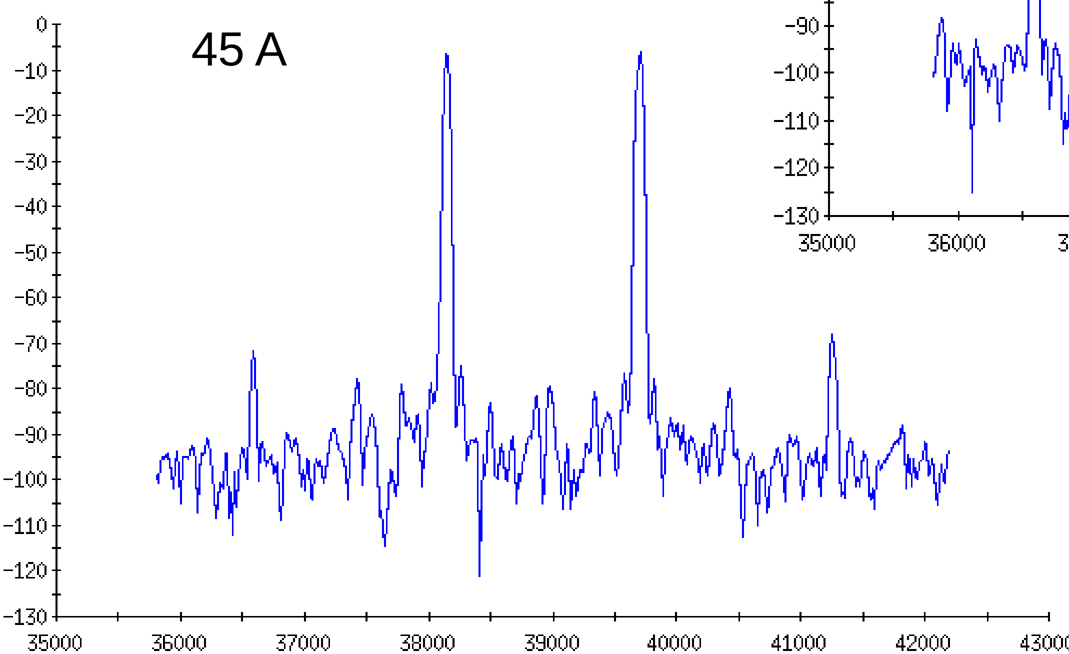
- Checked AC dipole #4 and #5 individually at 90A and 45A

vertical DSA

90 A



45 A

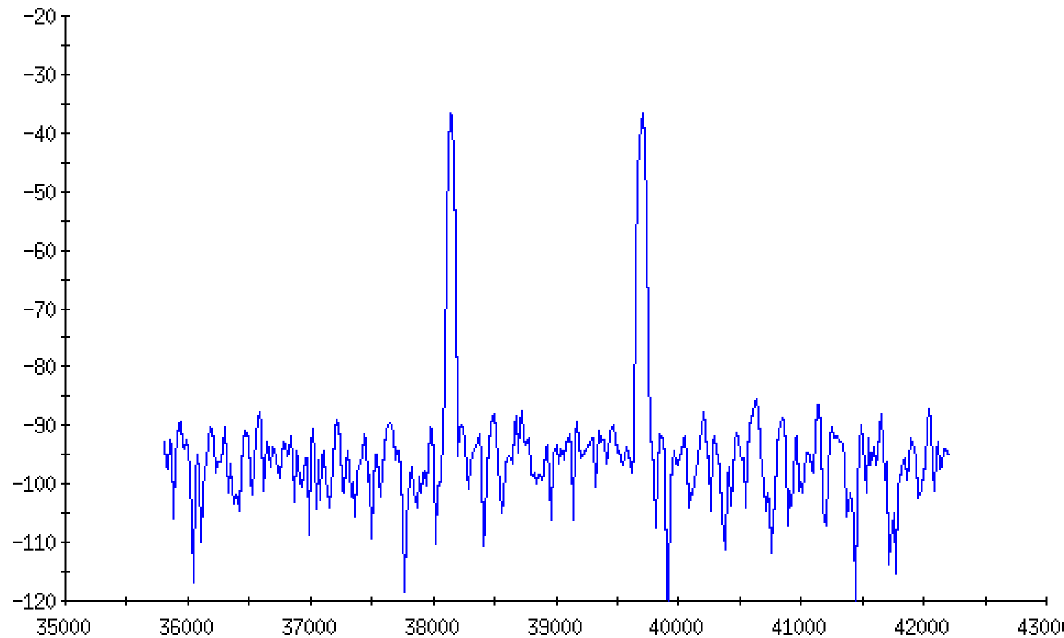


What was done in May 2 APEX Session

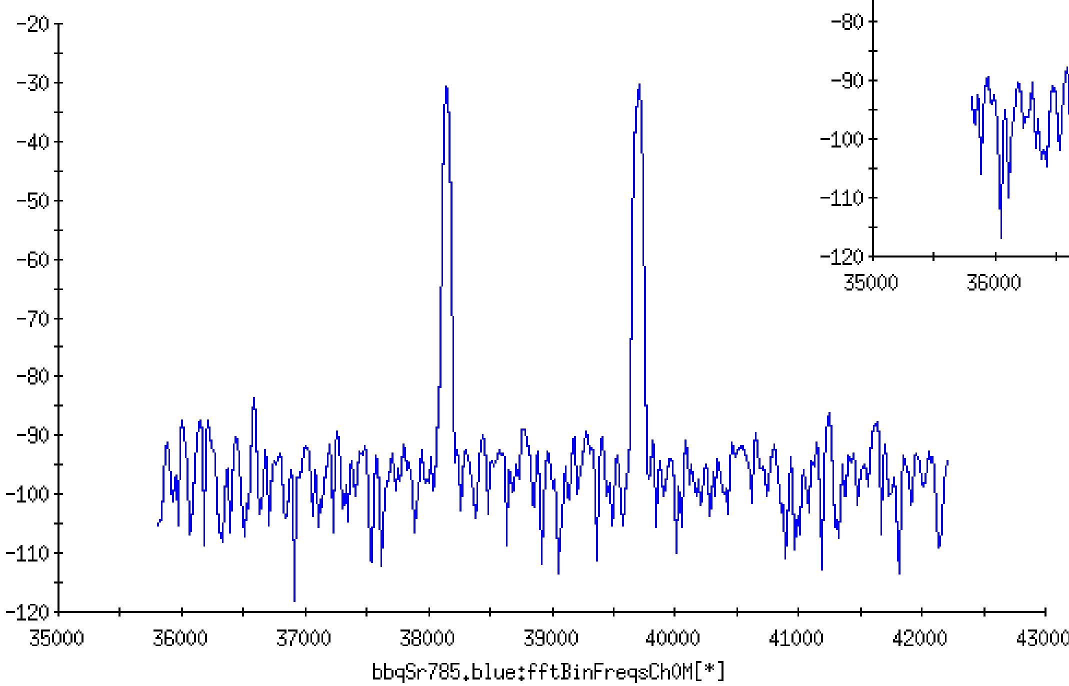
- Checked AC dipole #4 and #5 individually at 90A and 45A

Horizontal DSA

45A



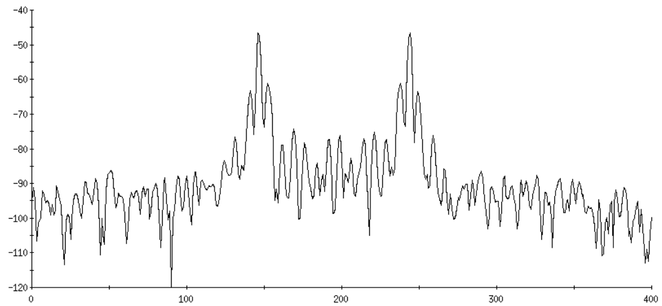
90A

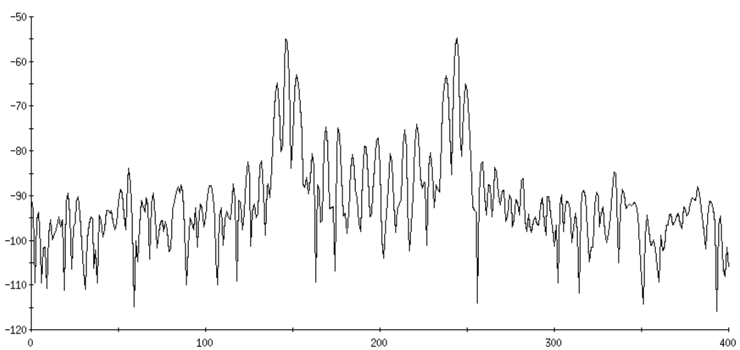


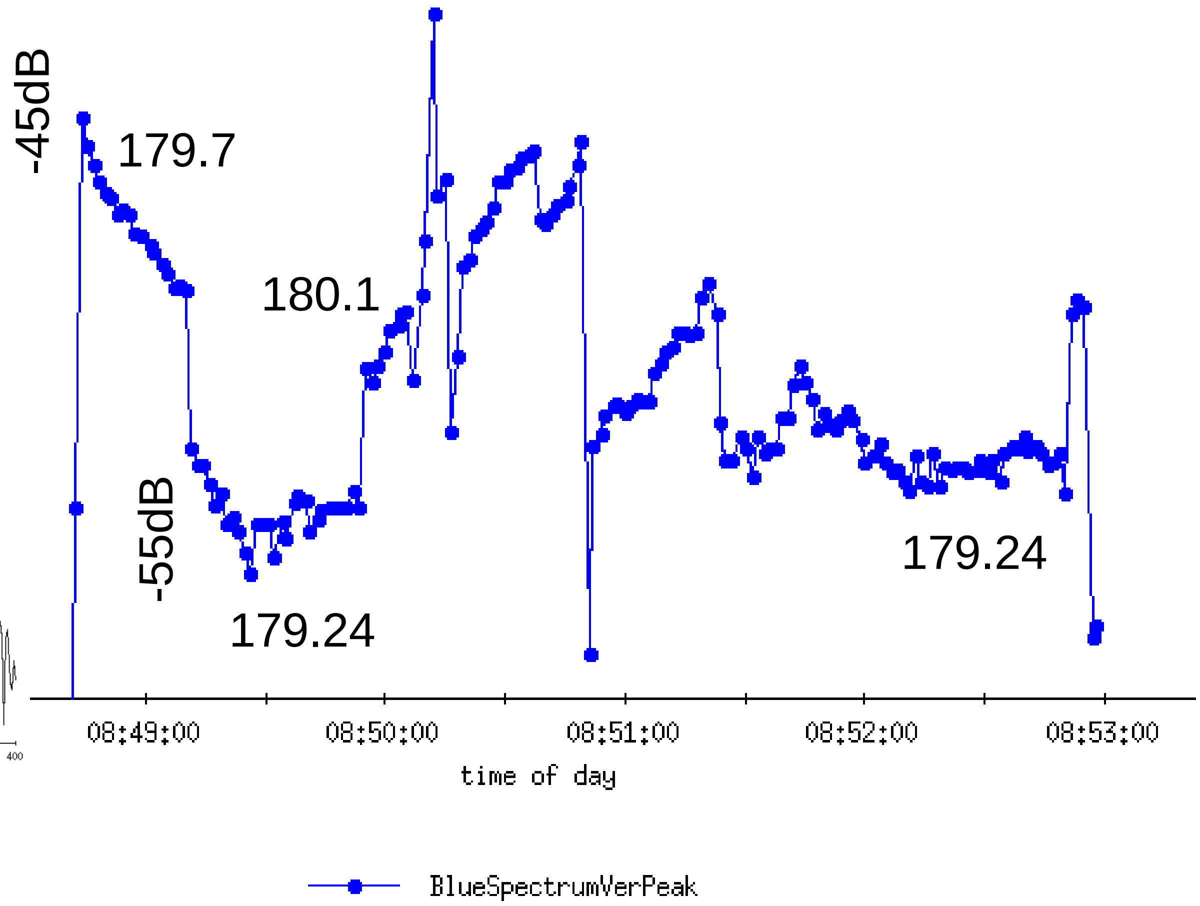
What was done in May 2 APEX Session

- Re-establish the first AC dipole bumps, #1-#2-#3

Amplitude: 45A-90A-45A
Best phase of #1 is at 179.24





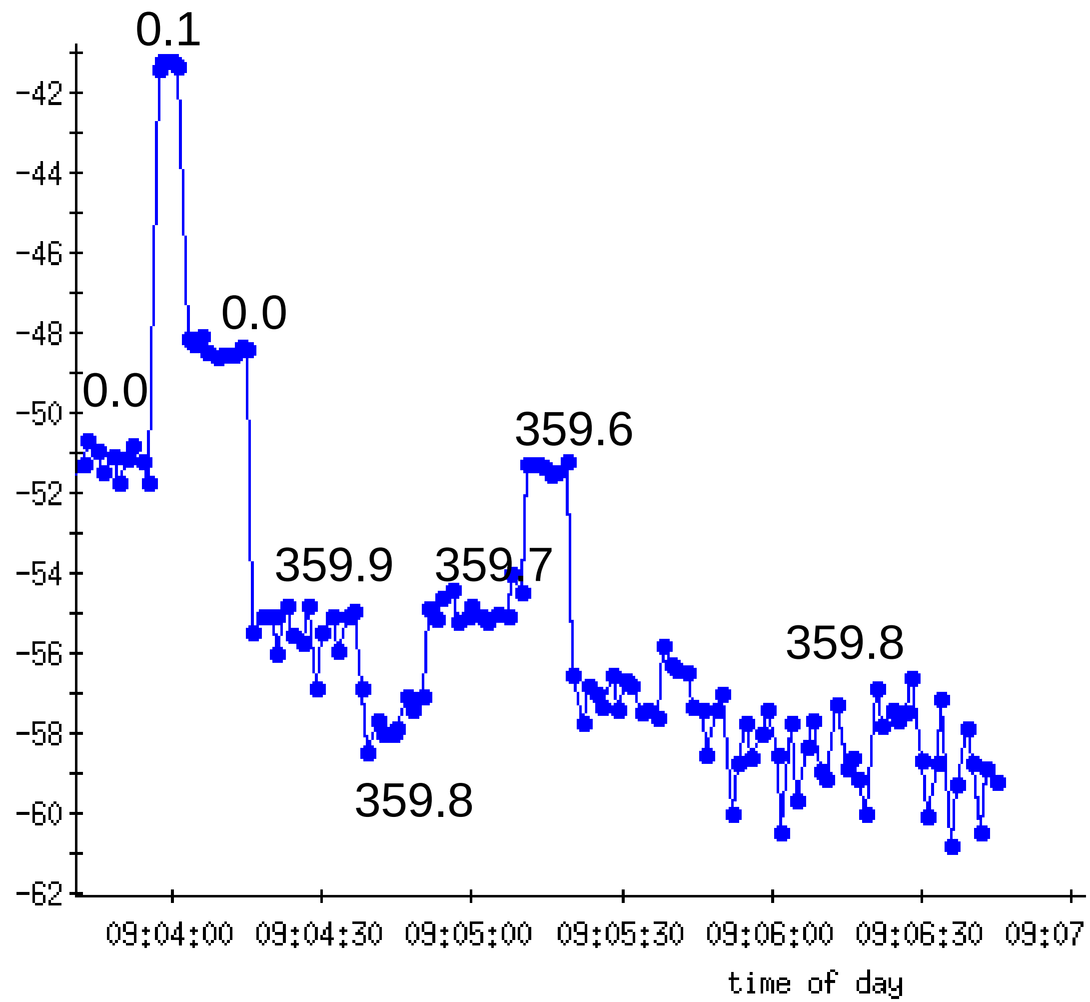


What was done in May 2 APEX Session

- Optimize bump #1 by scanning #2 ac dipole phase

Amplitude: 45A-90A-45A
Kept # 1 phase at 179.23

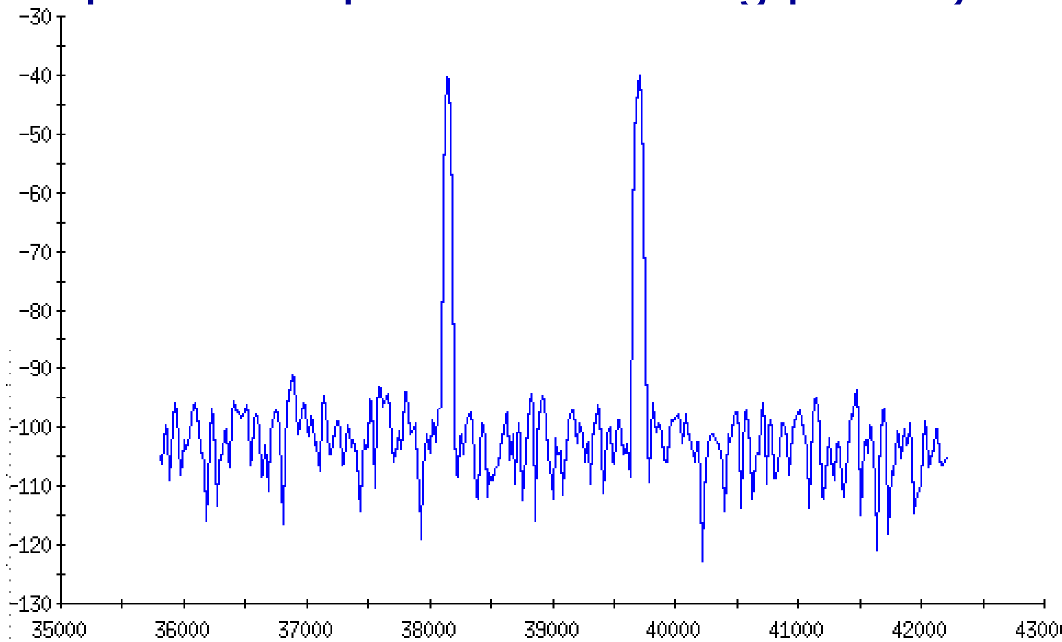
Best phase for # 2 is 359.8
This reflects that the phase difference has contributions both from time of flight as well As errors in the amplifiers

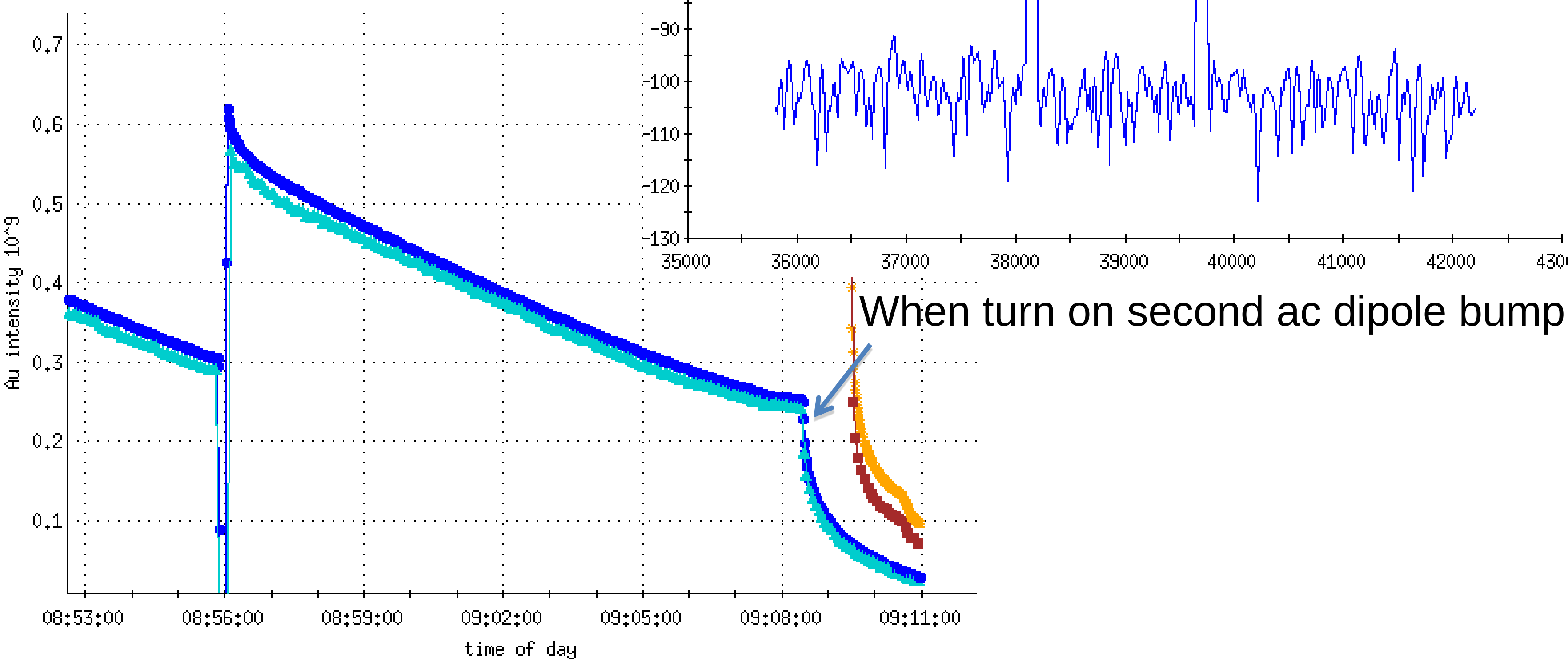


What was done in May 2 APEX Session

- Discovered #5 ac dipole power amplifier has wrong polarity

Amplitude: 45A-90A-45A
Phase: 180 – 0 – 180



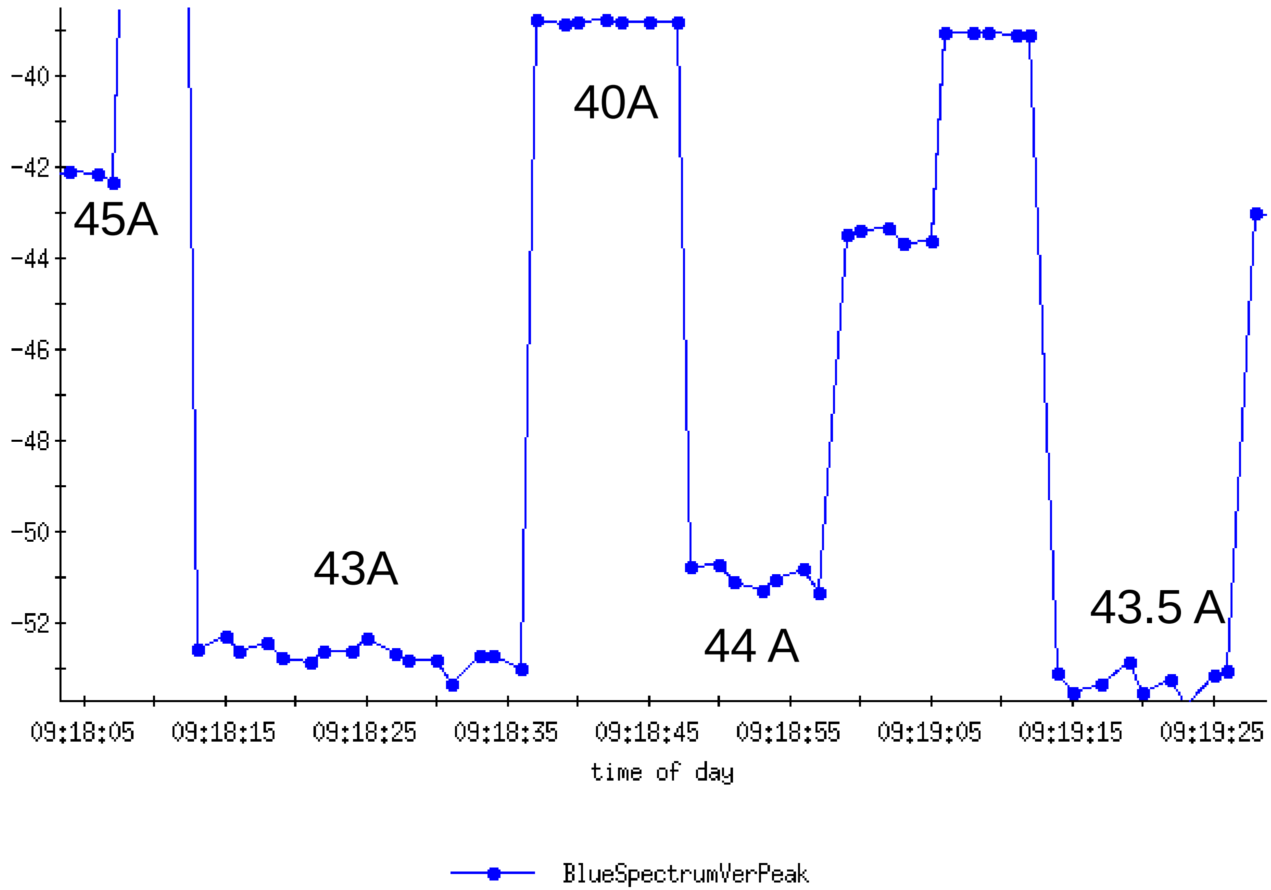


What was done in May 2 APEX Session

- optimizing #2 ac dipole bump

Phase: 180 – 0 – 359.7

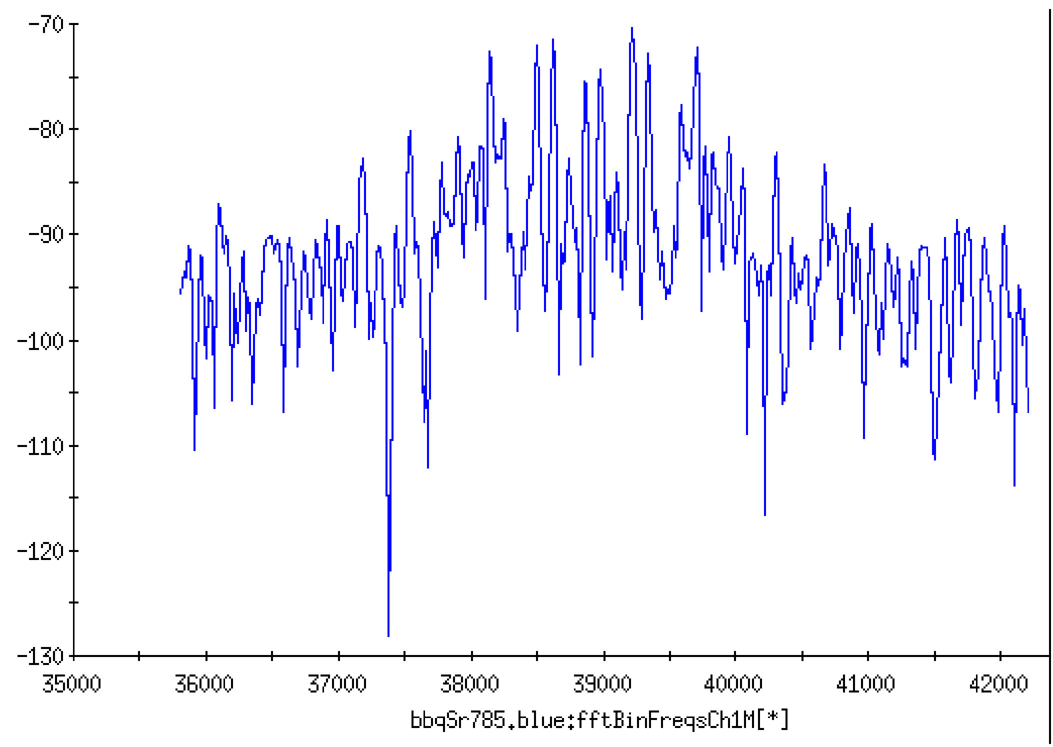
Scan #3 Amplitude:

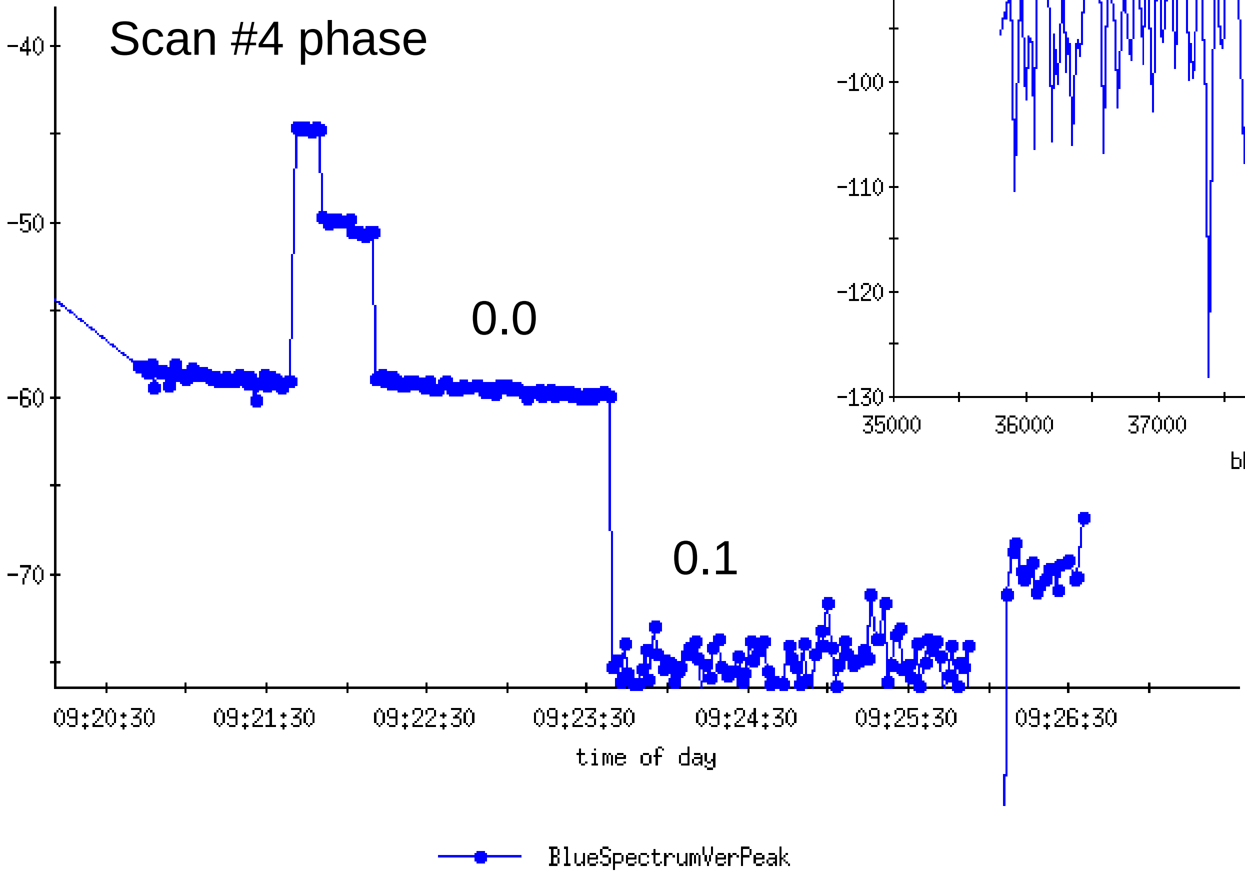


What was done in May 2 APEX Session

- Optimized #2 ac dipole bump

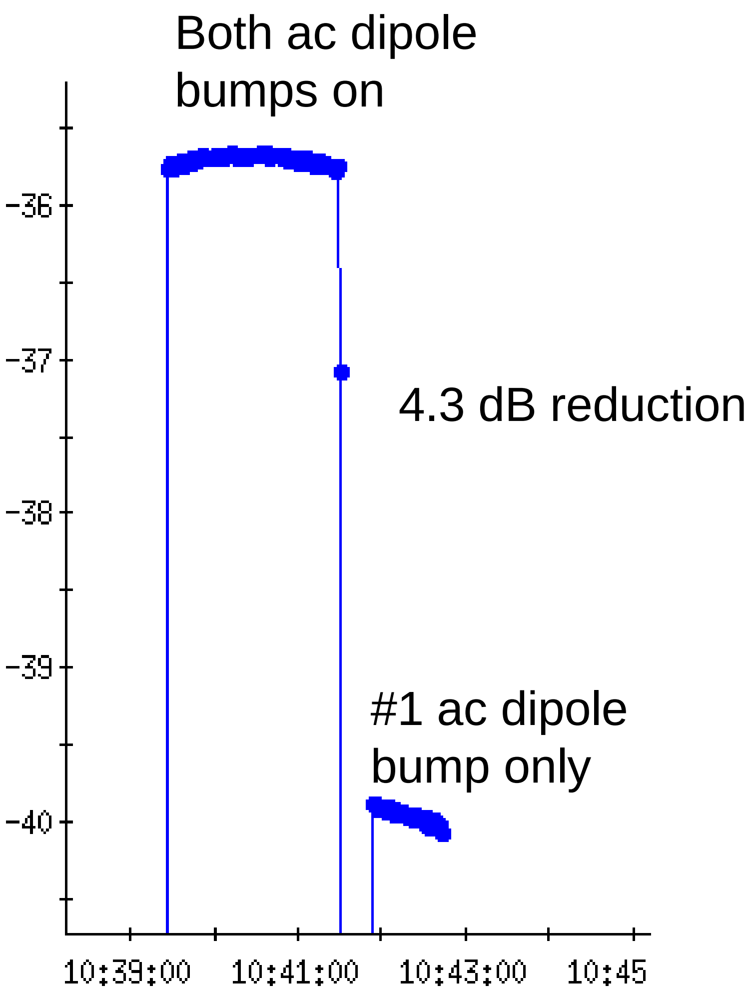
Initial Phase: 180 – 0 – 359.7
Amplitude: 43.5 – 90 -- 44

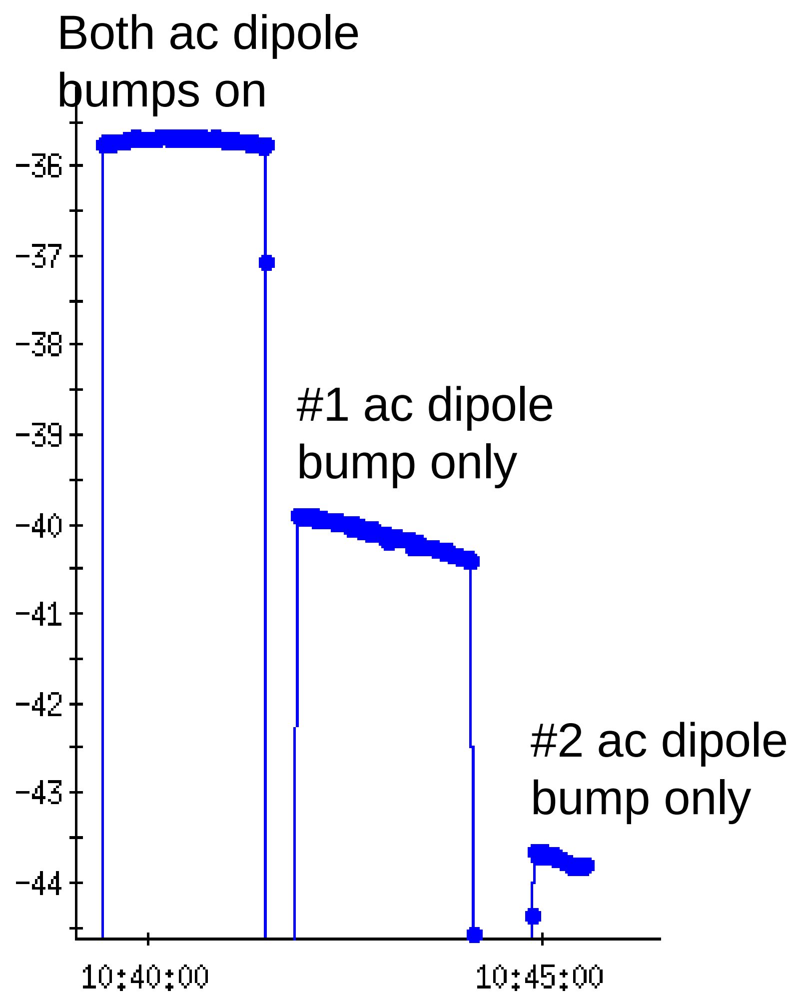




What was done in May 2 APEX Session

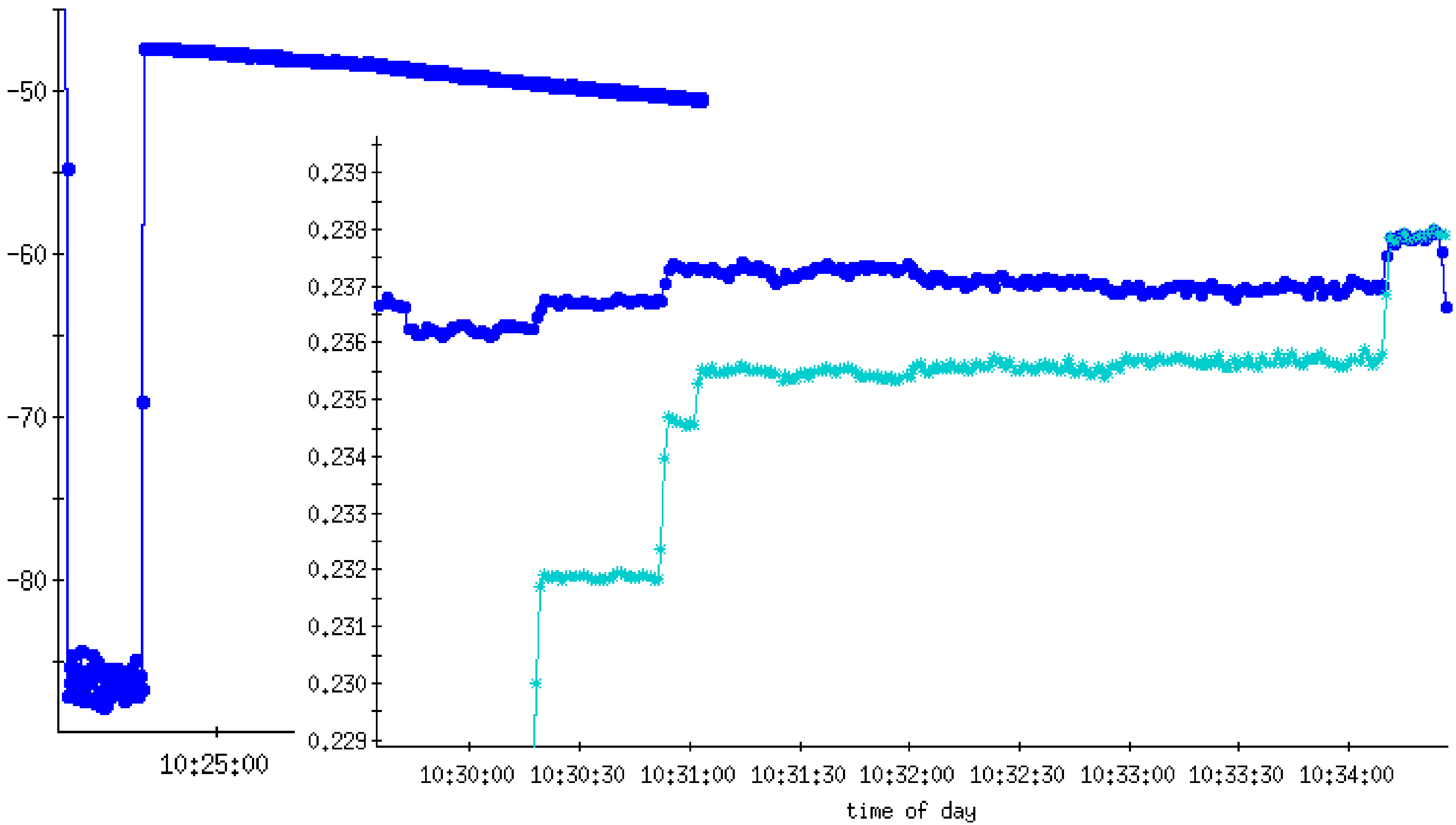
- H DSA response with ac dipole bumps w.o. DC dipoles





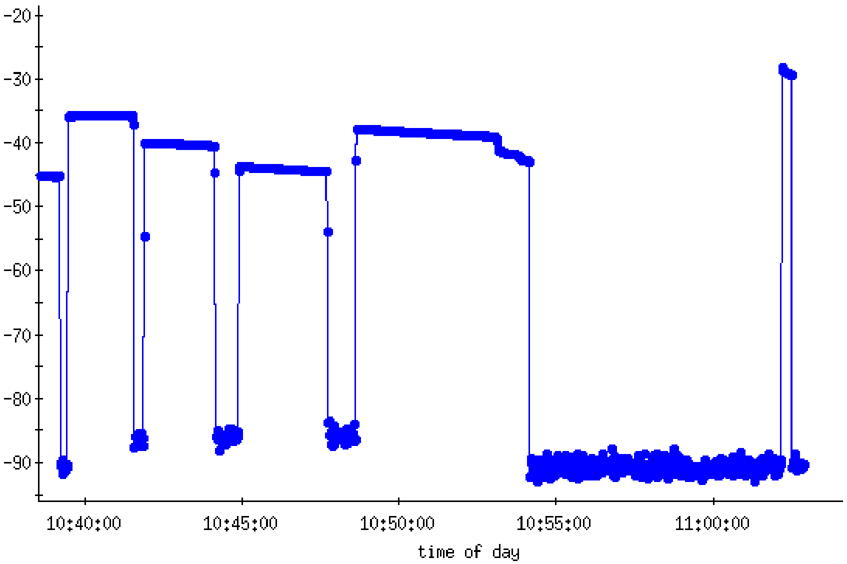
What was done in May 2 APEX Session

- H DSA response with ac dipole bumps as function of tunes



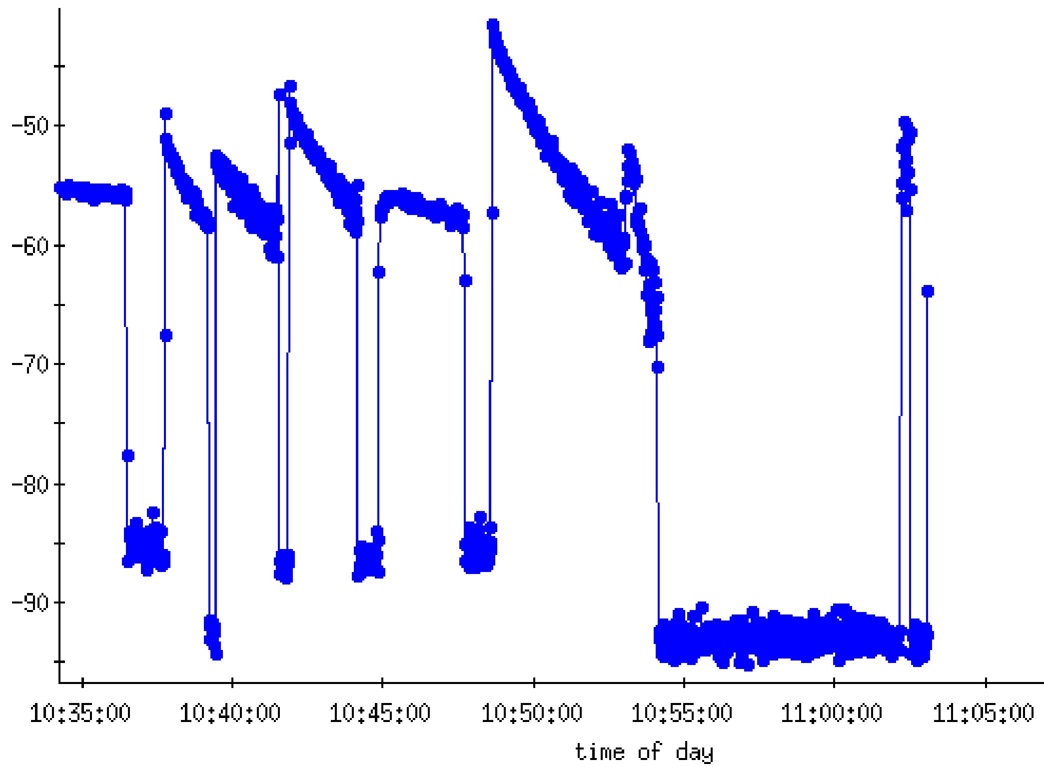
What was done in May 2 APEX Session

- DSA response with ac dipole bumps w. DC dipoles



H DSA peak

V DSA peak



Note, two blue bunches were injected after 11am.

Conclusions

- Closure of ac dipoles is sensitive to the phase between each ac dipole. It comes from both time of flight and errors from each power amplifier

- Second ac dipole bump has much better closure than 1st ac dipole bump. Needs to be understood, #4 and #5 power amplifier may have better linear response. Hope to be mitigated with more effective amplitude feedback.

- First ac dipole bump setting was not very reproducible when the power amplifier were cooled down and brought back on. Optimized phase turned out to be off ~0.22 degrees

- Seth is setting up the RHIC scanner to allow us to automatically/systematically minimize the V DSA peak by scanning the phase/amplitude of the selected ac dipole

Conclusions

- Study the horizontal DSA response due to the ac dipole bumps
  - With single ac dipole, the H DSA response does scale linearly with the strength of the ac dipole
  - In reasonable decoupled ring, H DSA response remained constant with the distance between H and V tunes
  - with DC dipole bump on/off
    - The H DSA response is independent of DC dipole bump on or off
    - the H DSA response scaled with # of ac dipole bumps
  - Data seems to indicate H DSA response is due to the path length change from the ac dipole bumps
    - For 100 Gm ac dipole amplitude, the H oscillation due to the path length change is ~0.0165um with both ac dipole bumps
    - Here assumed, dispersion function is ~ 1 m
    - Single ac dipole V response, ~ 0.55mm assuming:
      - Brho ~ 81.0, gamma=10.5
      - Beta function ~49m(acd), ~100m(DSA)

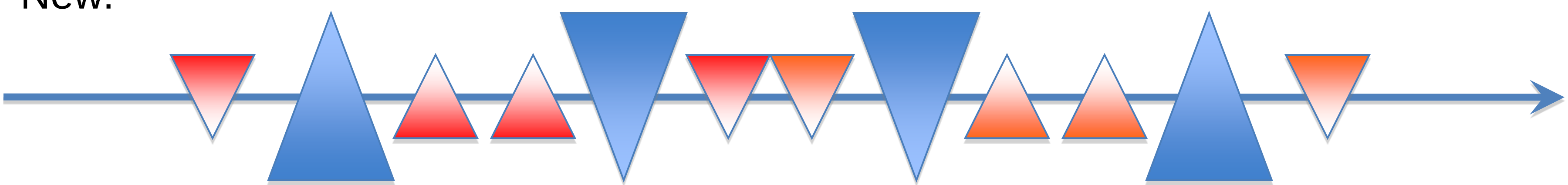
New Spin Flipper Design: Thomas

Now:

Rotating field strength: $2\psi_V \sin(2\psi_H) + orbit\ effect\,(non - rotating)$

$$= 1.00\ \psi_V \ \ for\ \psi_H = 15^o$$

New:



Rotating field strength: $4\psi_V \sin(\psi_H/2)\sin(\psi_H)$

$$= 0.14\ \psi_V \ \ for\ \psi_H = 15^o$$

$$= 0.52\ \psi_V \ \ for\ \psi_H = 30^o$$

$$= 1.08\ \psi_V \ \ for\ \psi_H = 45^o$$