April FFB beam test results

Xiang Zhang, UVa

April feedback tests:

https://logbooks.jlab.org/entry/4288735

https://logbooks.jlab.org/entry/4288694

Run 16070 and 16071- Octet pattern RMS results

240 Hz: HelBoard: 100us Tsettle, 4066.65us Tstable, Octet, 16 windows delay; HAPTB command: "setTimeHAPTB(30, 1400)"; VQWK vqwksamples=505.

16070: FFB is on and 16071: FFB is off.

Octet pattern difference

Run	FFB	Δ rms (micron) 4a X	Δ rms (micron) 4a Y	Δ rms (micron) 4e X	Δ rms (micron) 4e Y	Δ rms (micron) 4aX - 4eX	Δ rms (micron) 4aY – 4eY
16071	off	6.3 ± 0.1	4.5 ± 0.1	5.8 ± 0.1	5.2 ± 0.1	0.86 ± 0.02	0.93 ± 0.02
16070	on	6.3 ± 0.2	21.4 ± 0.6	6.3 ± 1.7	24.4 ± 0.7	0.85 ± 0.02	2.80 ± 0.08

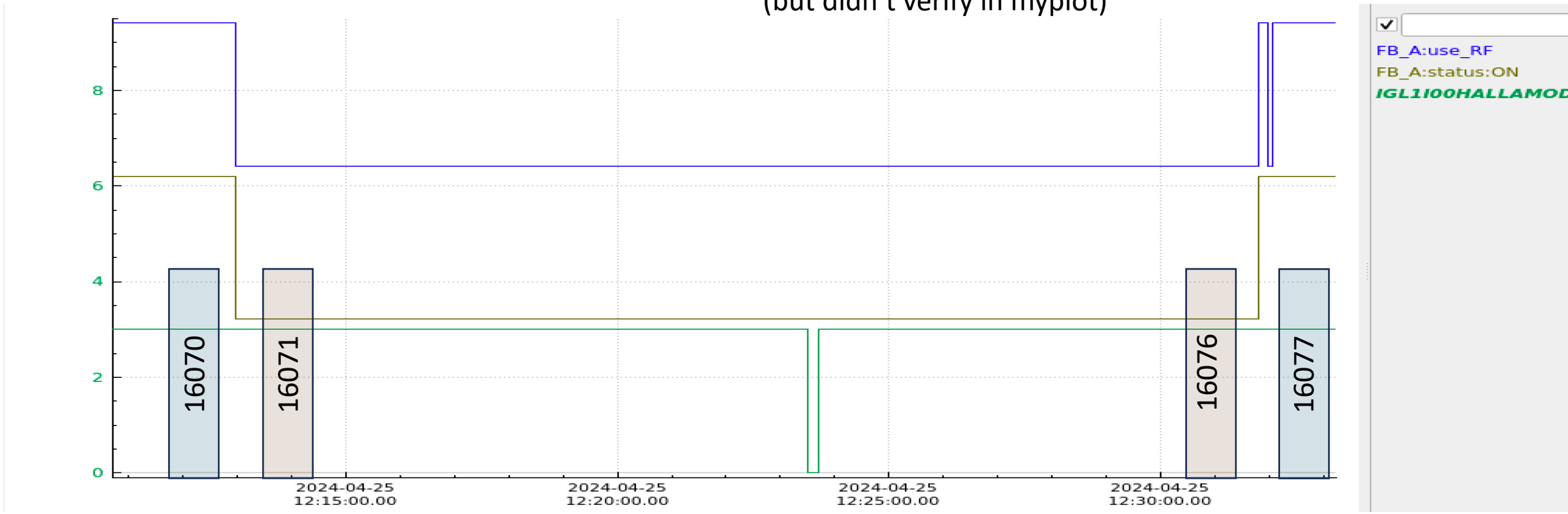
FFB increases the width in vertical direction

```
[apar@adaq3 /adaq2/data1/apar]$ ls -al parity22_ch_1607*
-rw-r--r-- 1 apar a-adaq   24739840 Apr 25 12:12 parity22_ch_16070.dat
-rw-r--r-- 1 apar a-adaq   23396352 Apr 25 12:14 parity22_ch_16071.dat
-rw-r--r-- 1 apar a-adaq   86147072 Apr 25 12:20 parity22_ch_16072.dat
-rw-r--r-- 1 apar a-adaq   27197440 Apr 25 12:22 parity22_ch_16073.dat
-rw-r--r-- 1 apar a-adaq   25133056 Apr 25 12:23 parity22_ch_16074.dat
-rw-r--r-- 1 apar a-adaq  168525824 Apr 25 12:28 parity22_ch_16075.dat
-rw-r--r-- 1 apar a-adaq  379617280 Apr 25 12:31 parity22_ch_16076.dat
-rw-r--r-- 1 apar a-adaq  223248384 Apr 25 12:33 parity22_ch_16077.dat
-rw-r--r-- 1 apar a-adaq 1733459968 Apr 25 13:03 parity22_ch_16078.dat
-rw-r--r-- 1 apar a-adaq 3802136576 Apr 25 13:35 parity22_ch_16079.dat
```

Run 16070: 240Hz, FFB ON, FFB energy ON
Run 16071: 240Hz, FFB OFF, FFB energy OFF

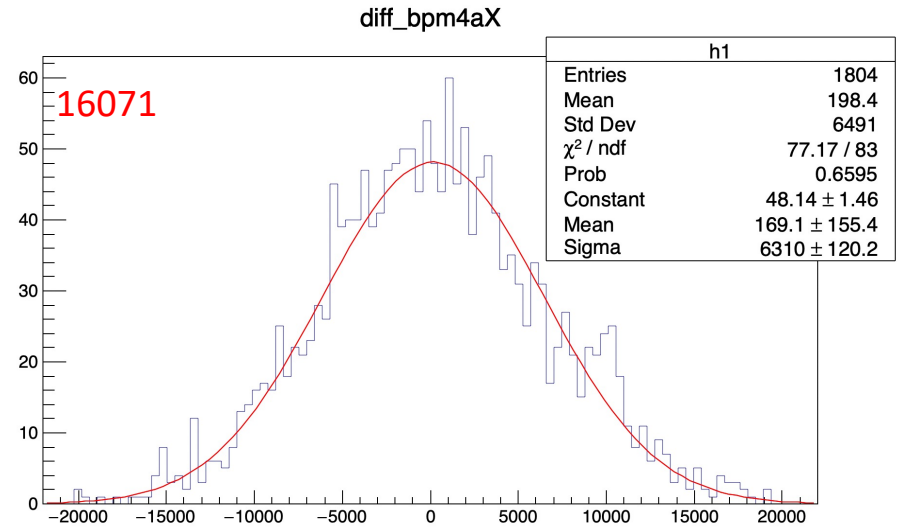
Run 16076: 1920Hz, FFB and FFB-energy OFF
Run 16077: 1920Hz, FFB and FFB-energy ON

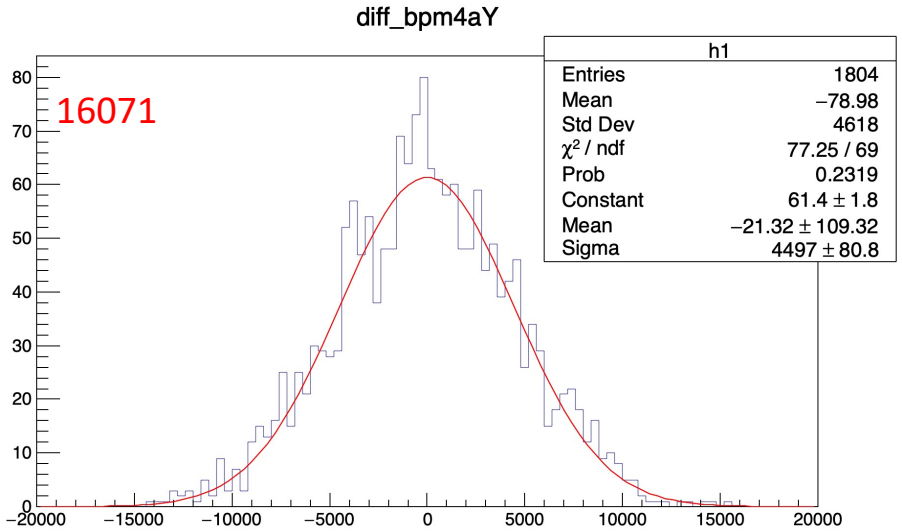
I believe feed forward was disabled in all April tests
(but didn't verify in myplot)



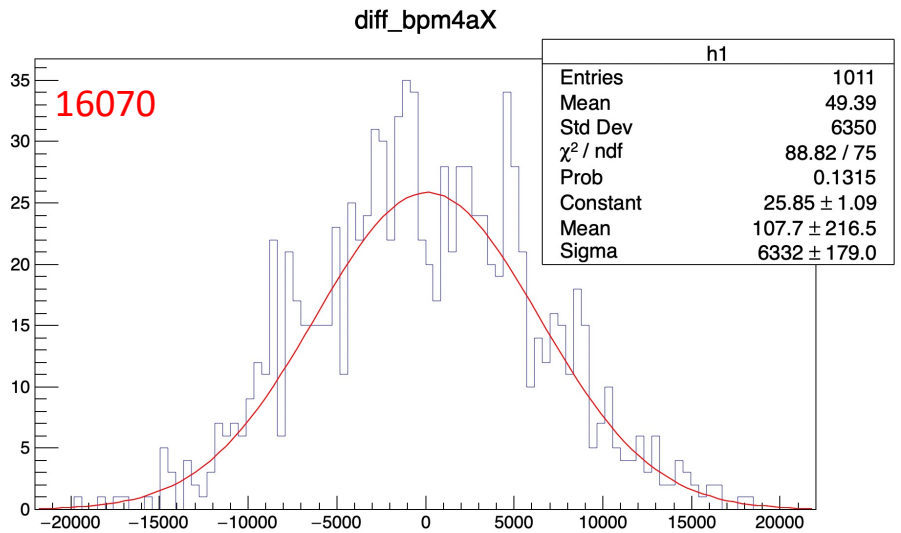
Multiplet plots for 240 Hz

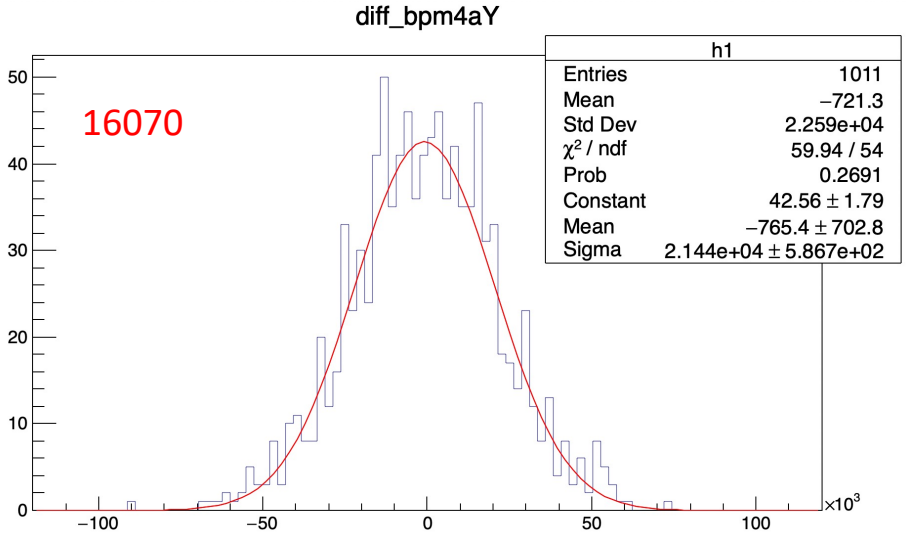
OFF





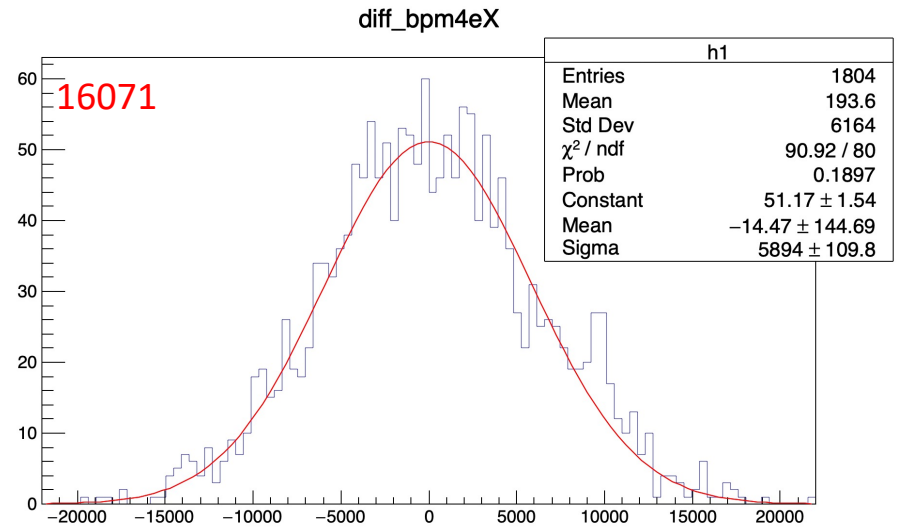
ON

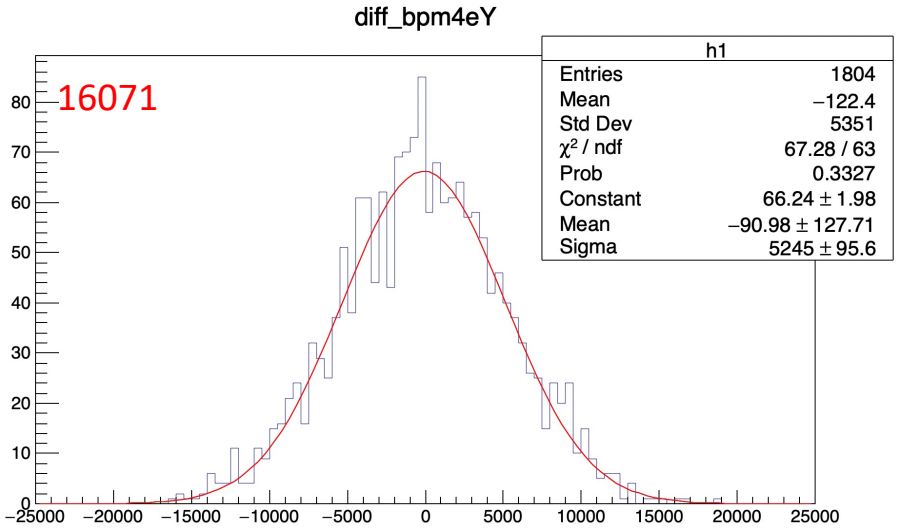




Multiplet plots for 240 Hz

OFF





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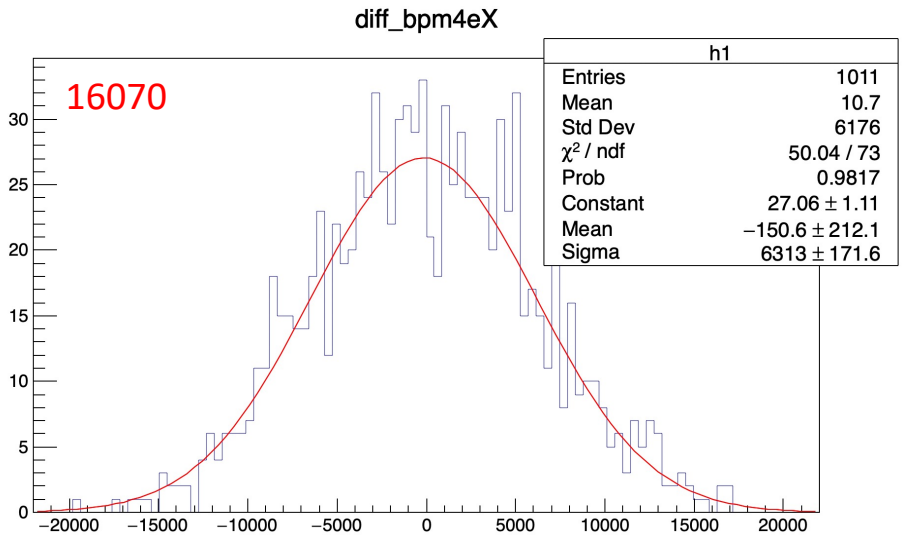
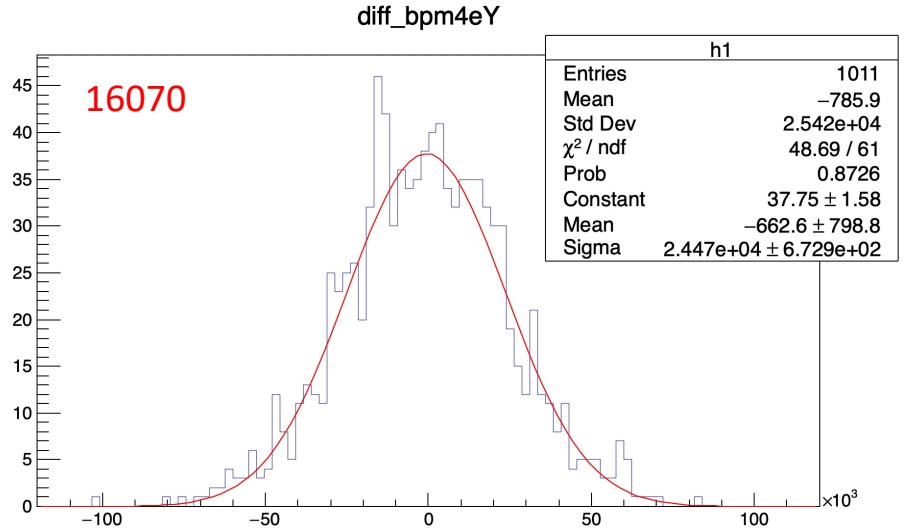
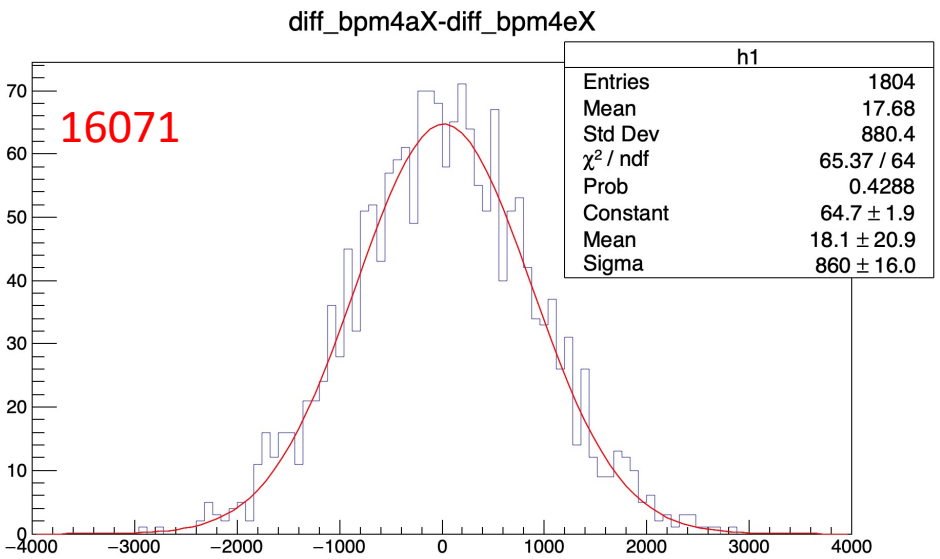


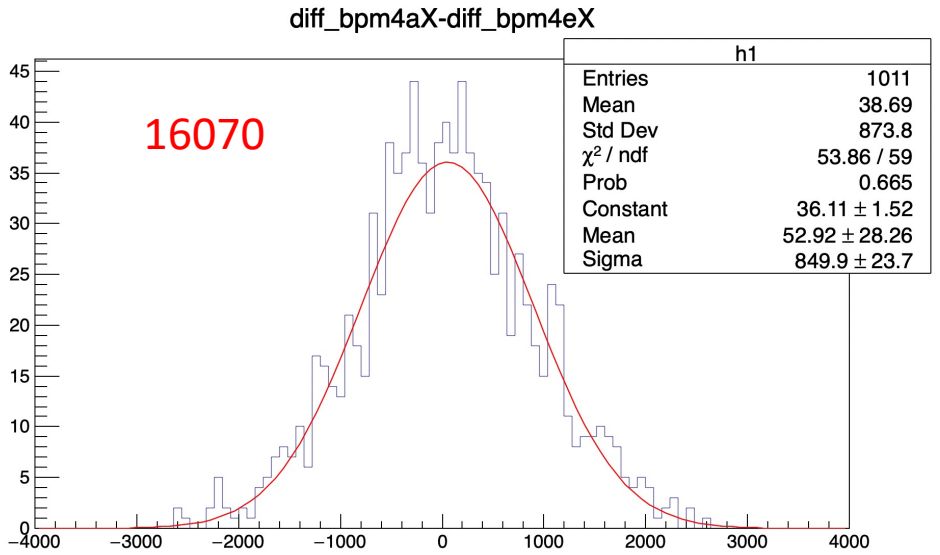


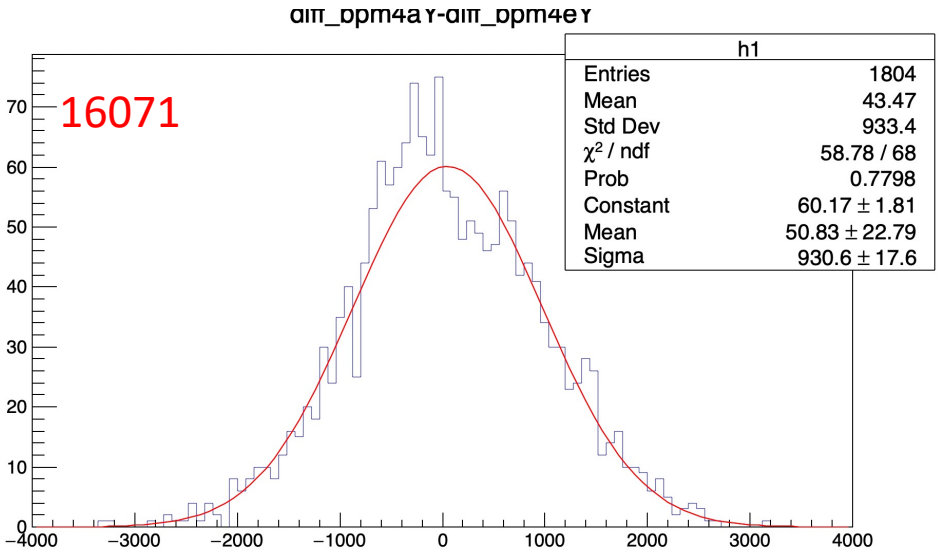
Multiplet plots for 240 Hz

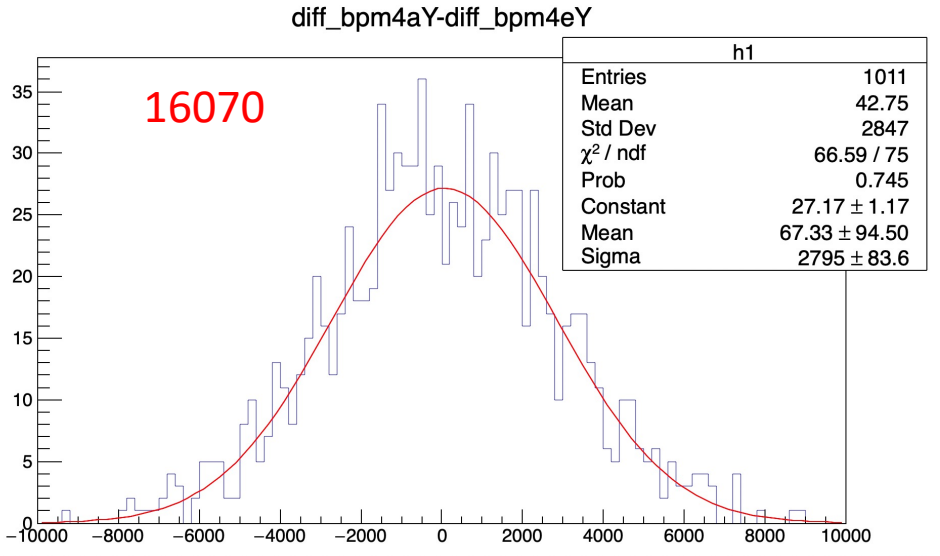
OFF

ON









Run 16070 and 16071- pair difference RMS results

240 Hz: HelBoard: 100us Tsettle, 4066.65us Tstable, Octet, 16 windows delay; HAPTB command: "setTimeHAPTB(30, 1400)"; VQWK vqwksamples=505.

16070: FFB is on and 16071: FFB is off.

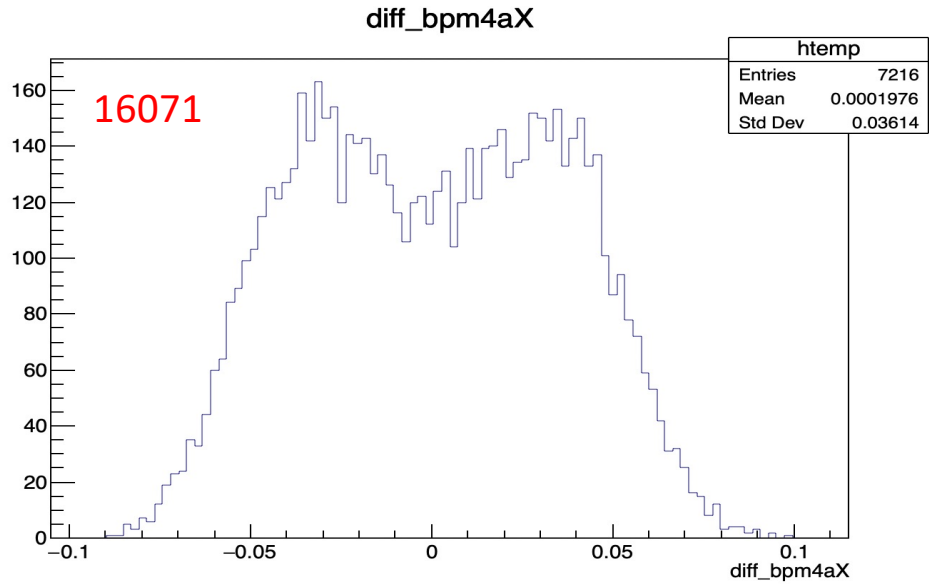
pairwise difference

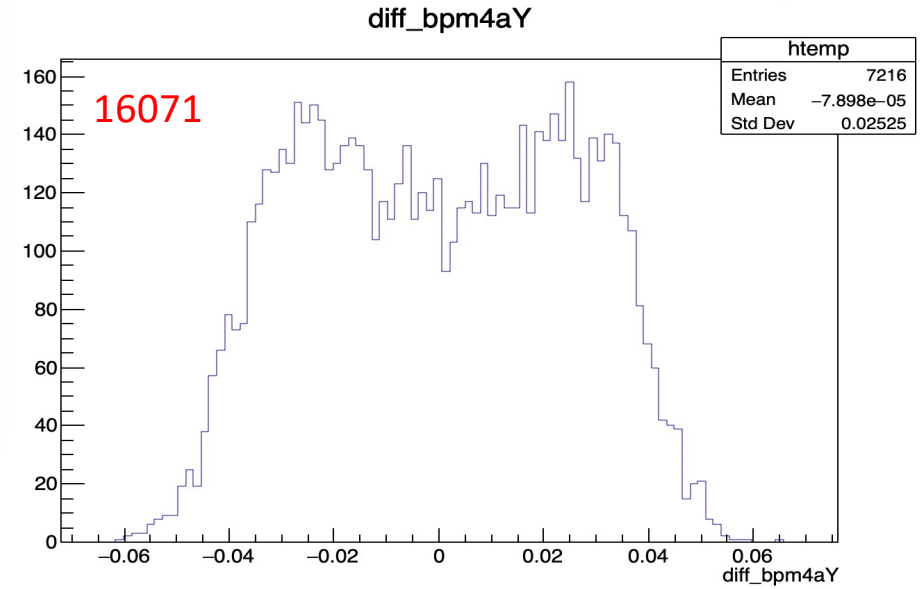
Run	FFB	Δ rms (micron) 4a X	Δ rms (micron) 4a Y	Δ rms (micron) 4e X	Δ rms (micron) 4e Y
16071	off	36	25	34	28
16070	on	26	48	28	54

FFB increases the width in vertical direction, decreases in the horizontal direction

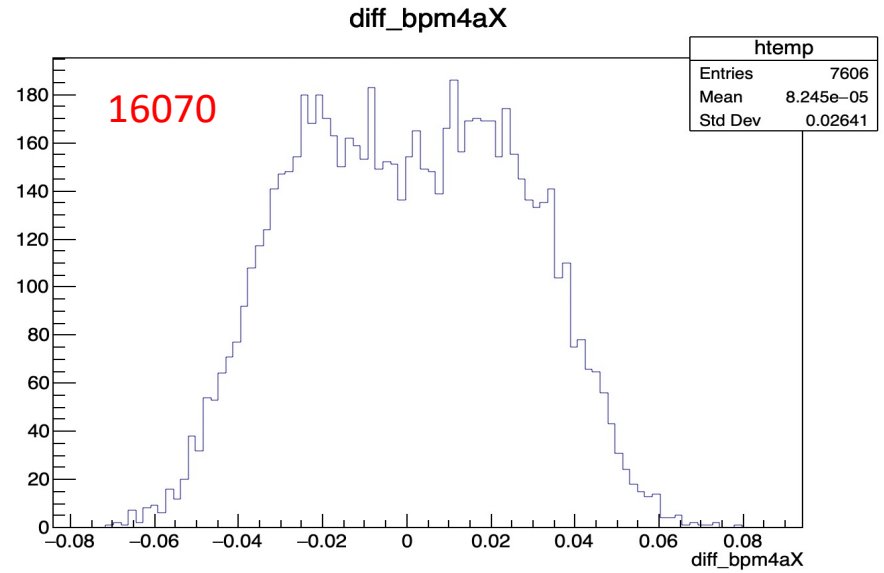
pair plots for 240 Hz

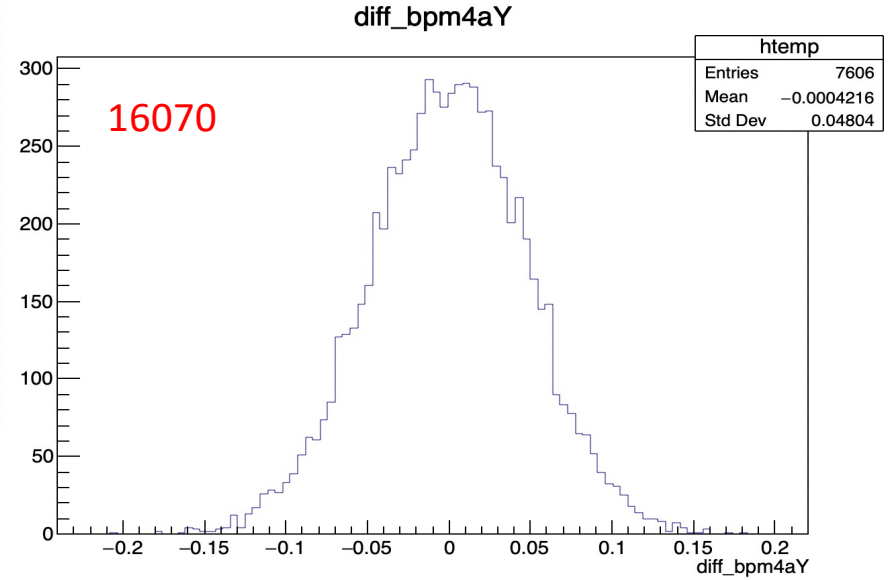
OFF





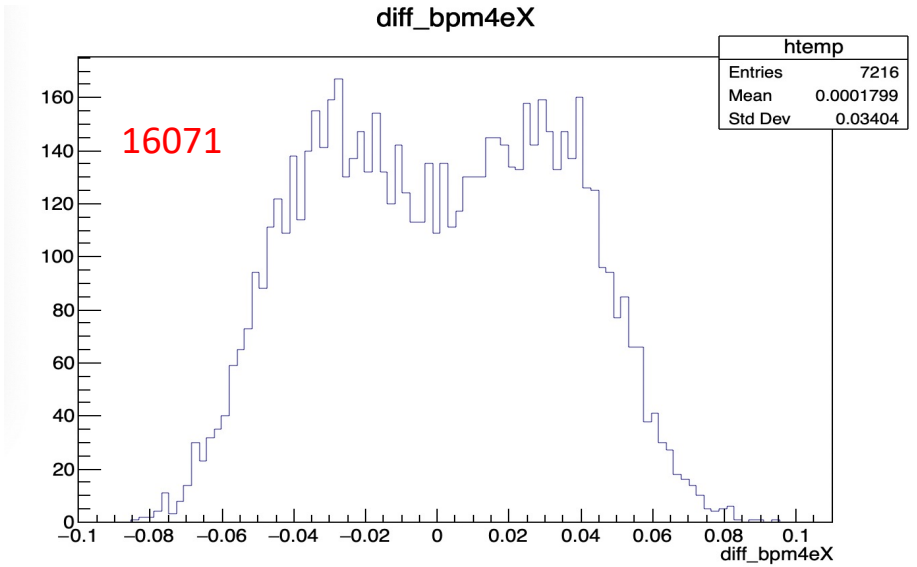
ON

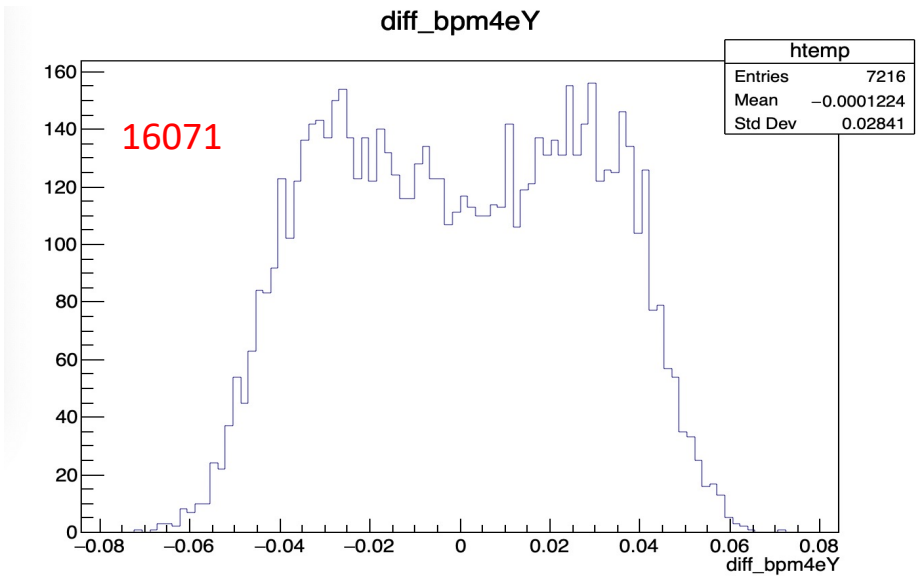




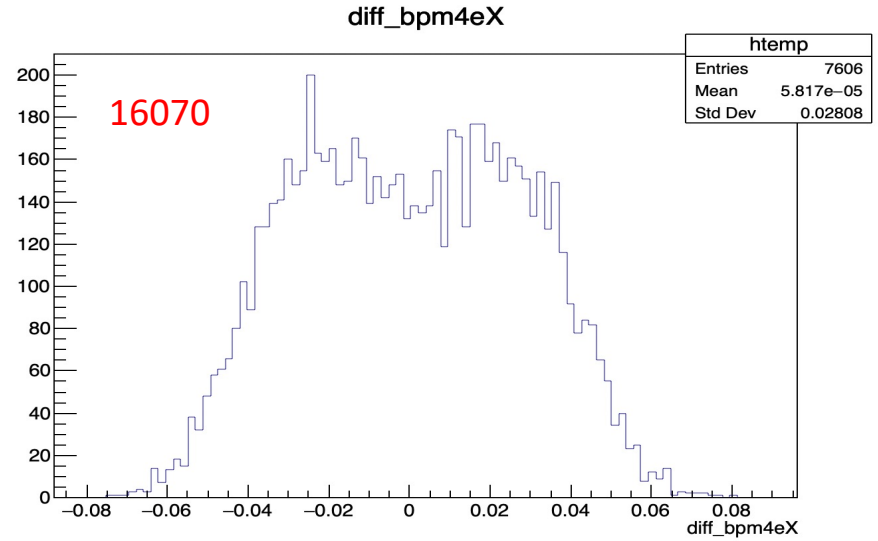
pair plots for 240 Hz

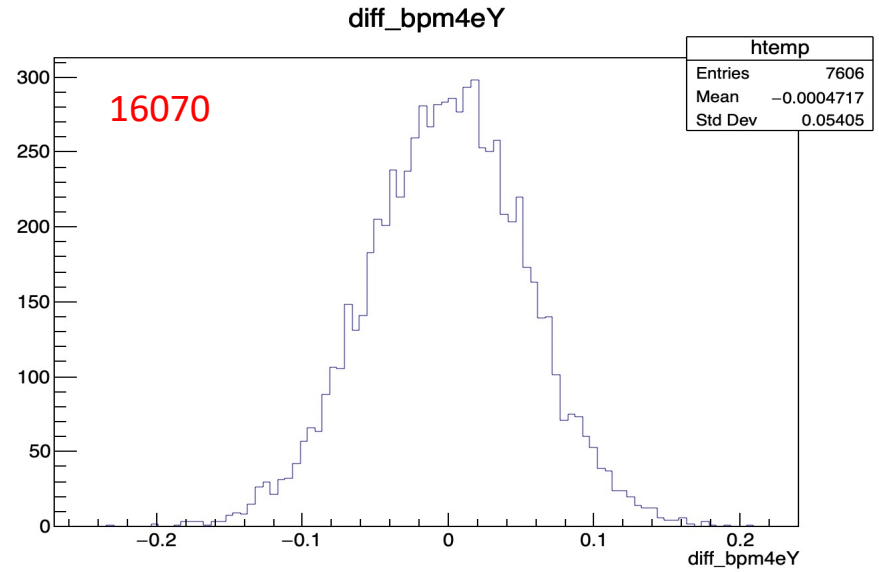
OFF





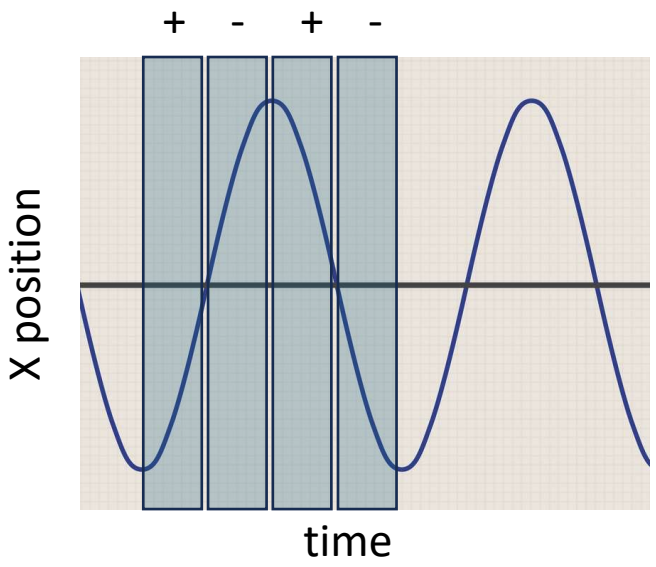
ON

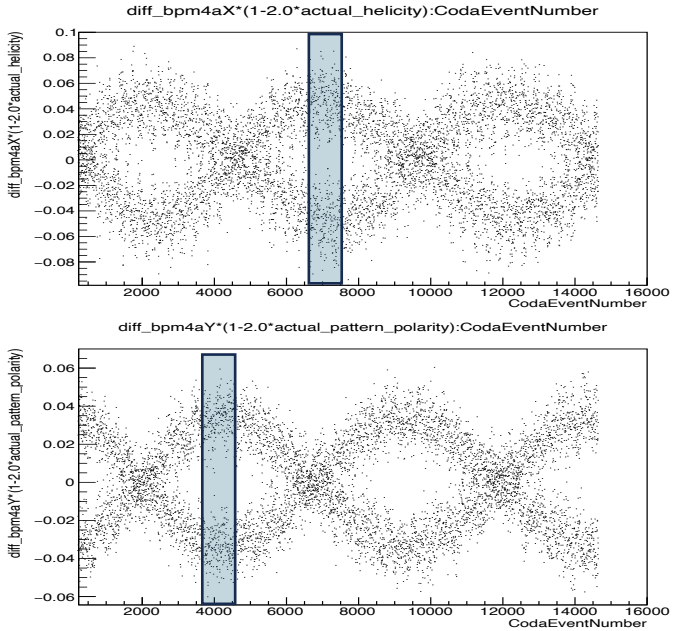


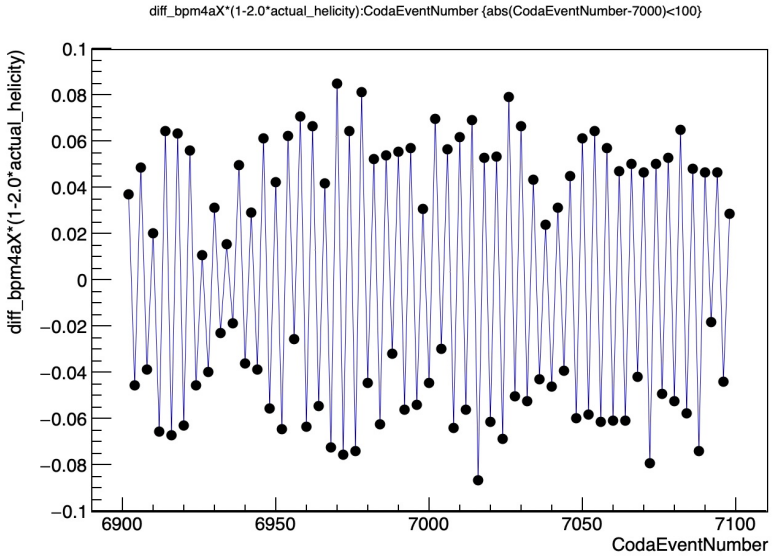


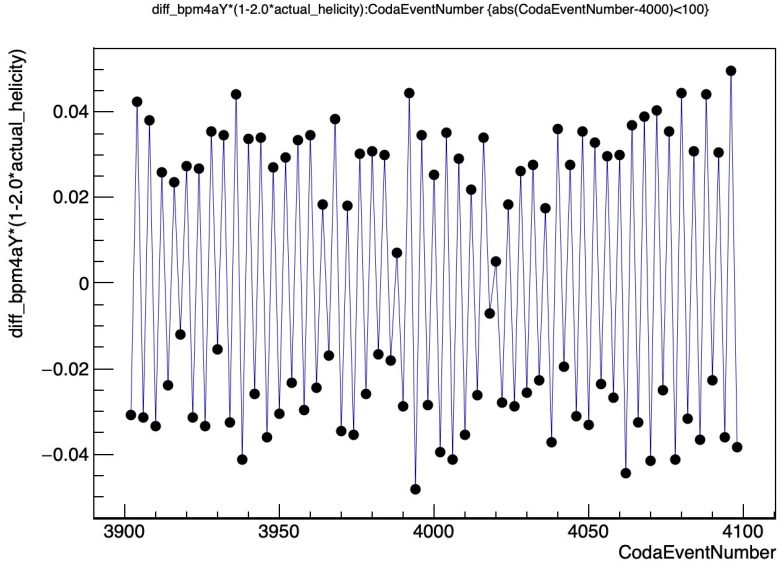
Looking for noise coherent with flip frequency

- Look at “pair difference”. For 240 Hz flip, this mean 4 windows (two pairs) per 60Hz cycle
- Assigned polarization is in 2-quartet pattern (+--+-++-) or complement
- Sign correct each pair, so that our pair difference is always calculated for two windows as (+,-) (+,-) (+,-) (+,-)



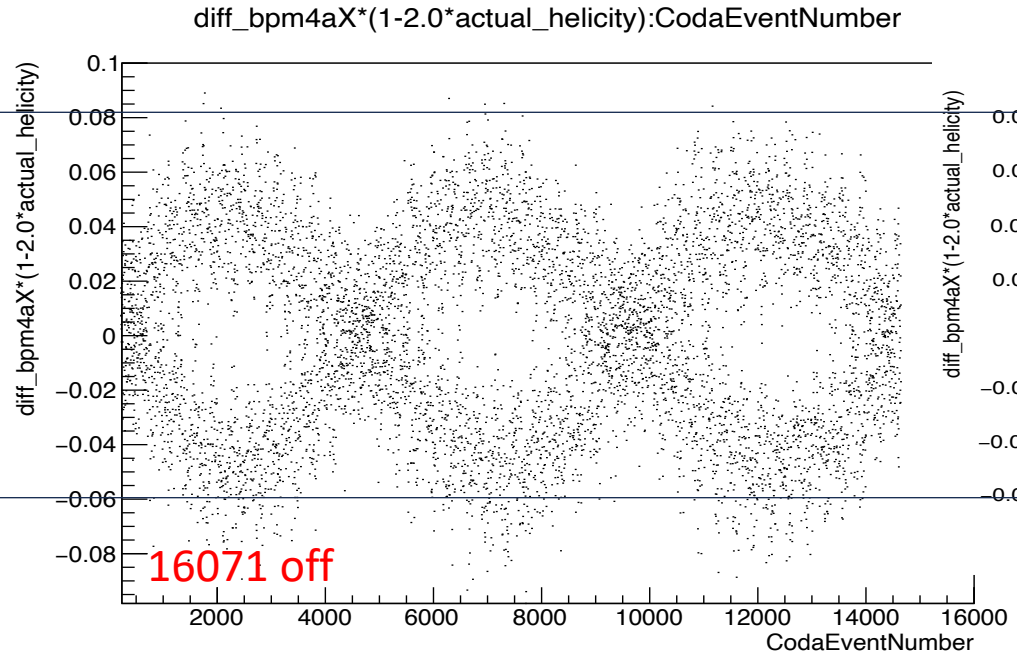


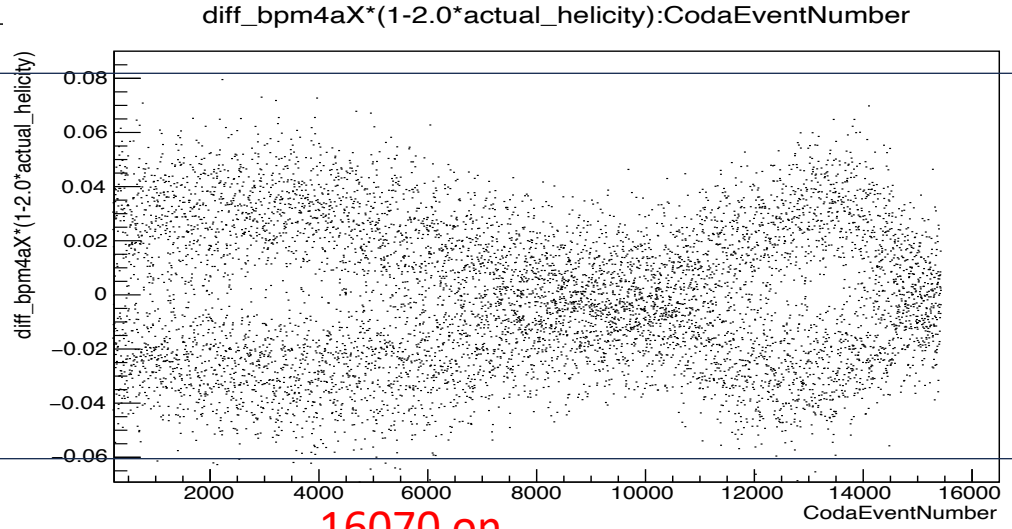




Up-down pattern demonstrates noise is at 60Hz frequency

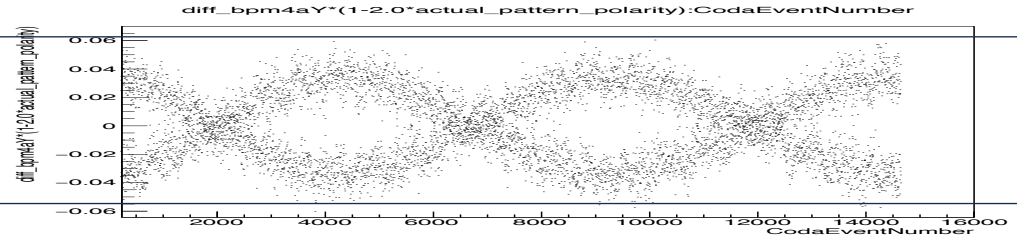
To put in context: scale FFB OFF to plot of ON



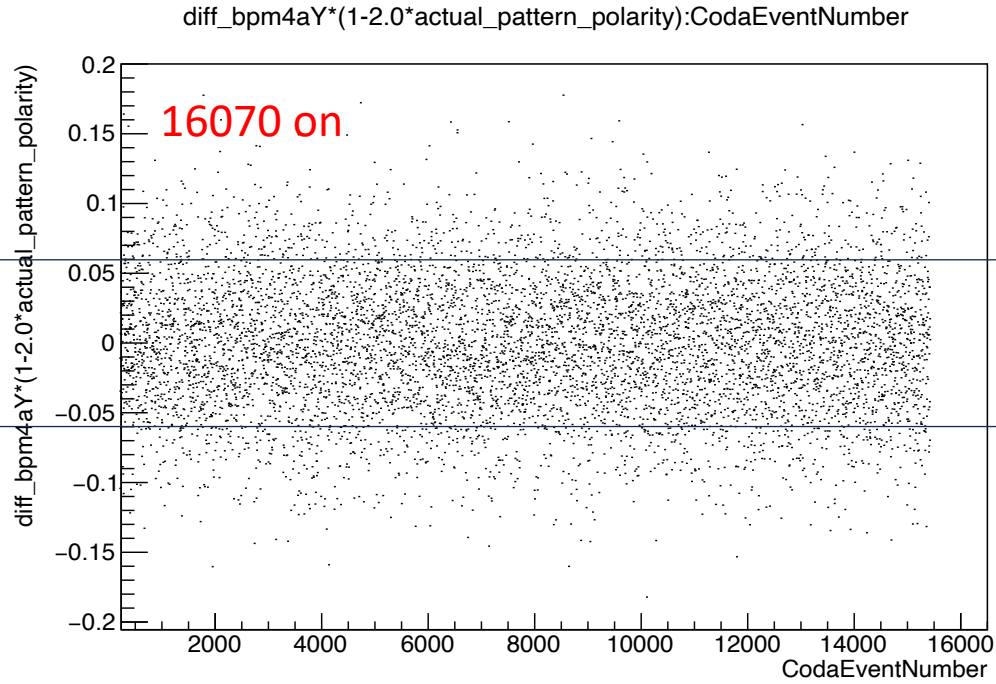


horizontal: 60 Hz separation is only slightly reduced, but variability or phase slip looks different

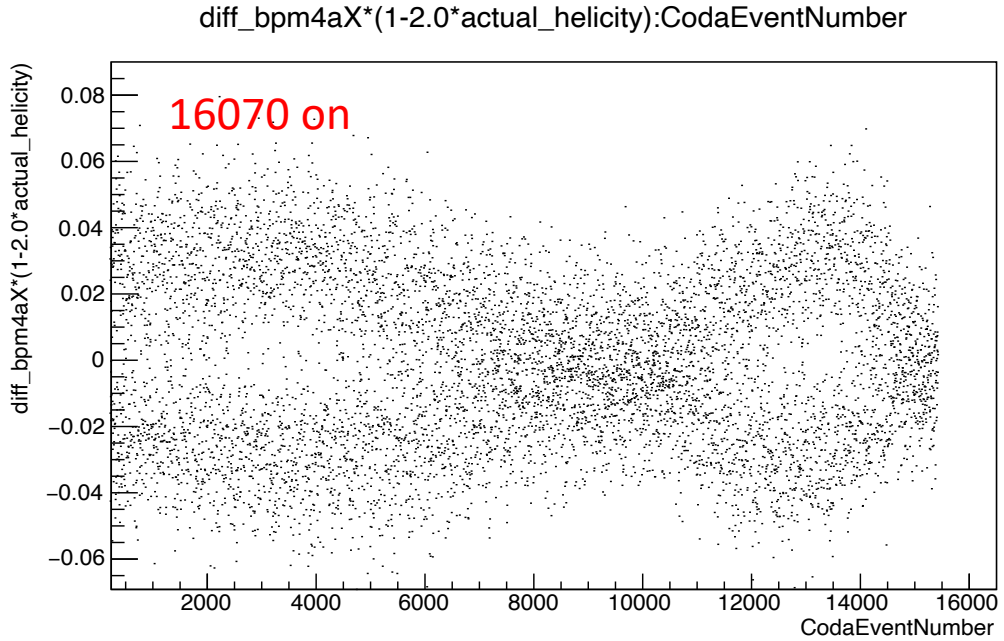
16071 off

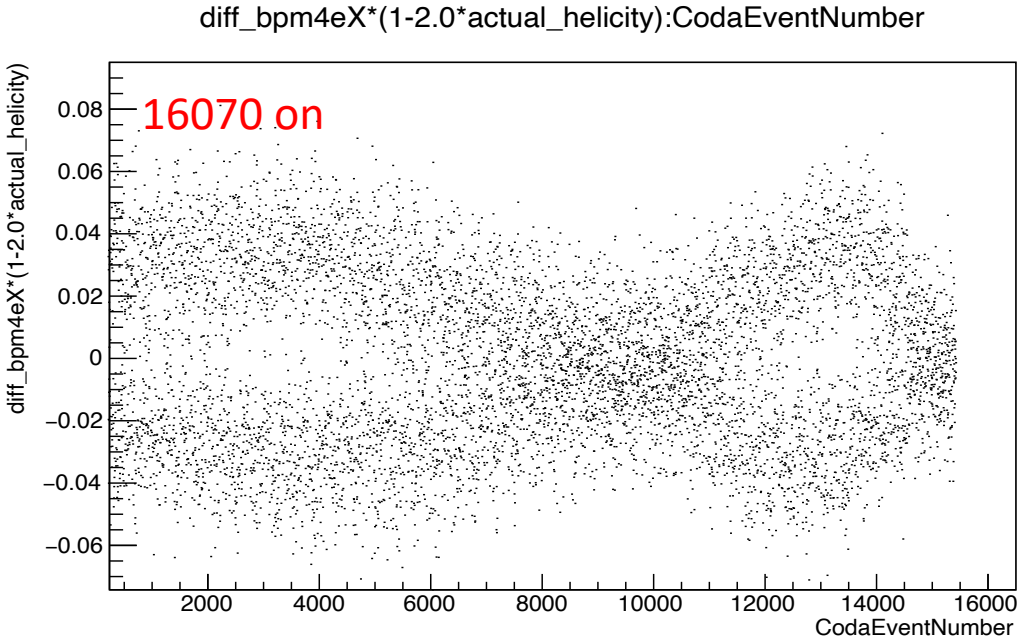


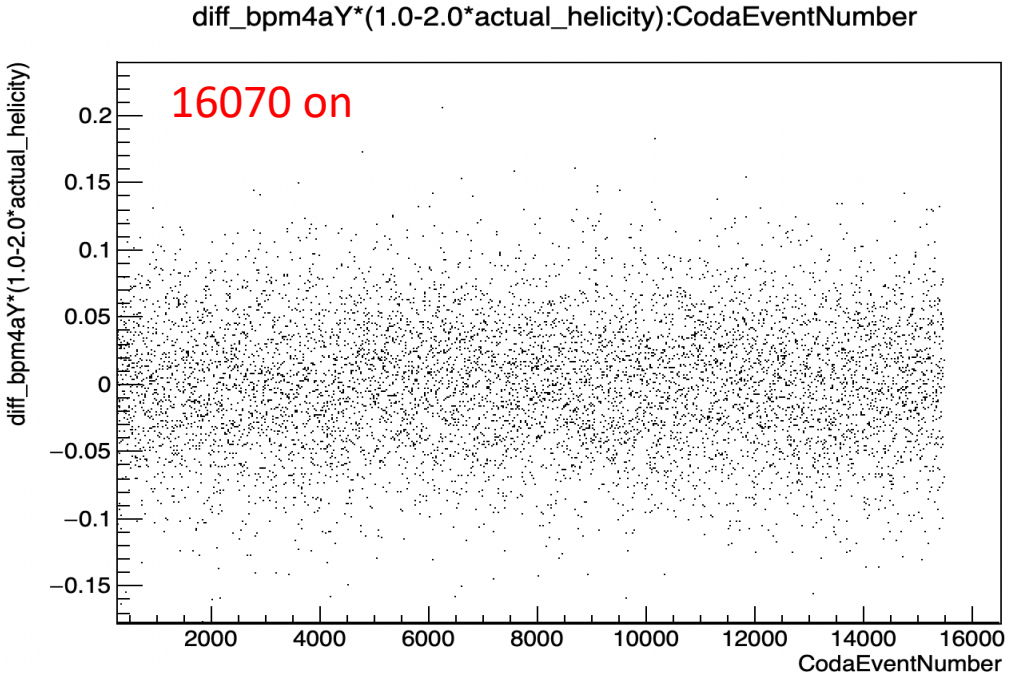
vertical: 60 Hz separation is invisible but dominant uncorrelated noise is introduced

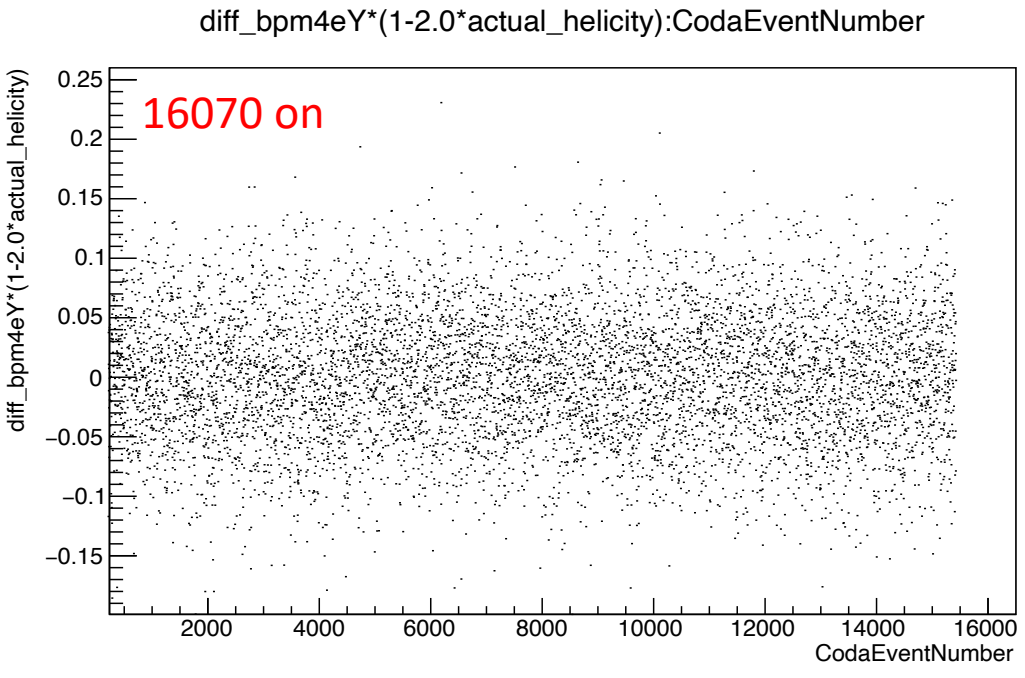


Pair results for 240 Hz

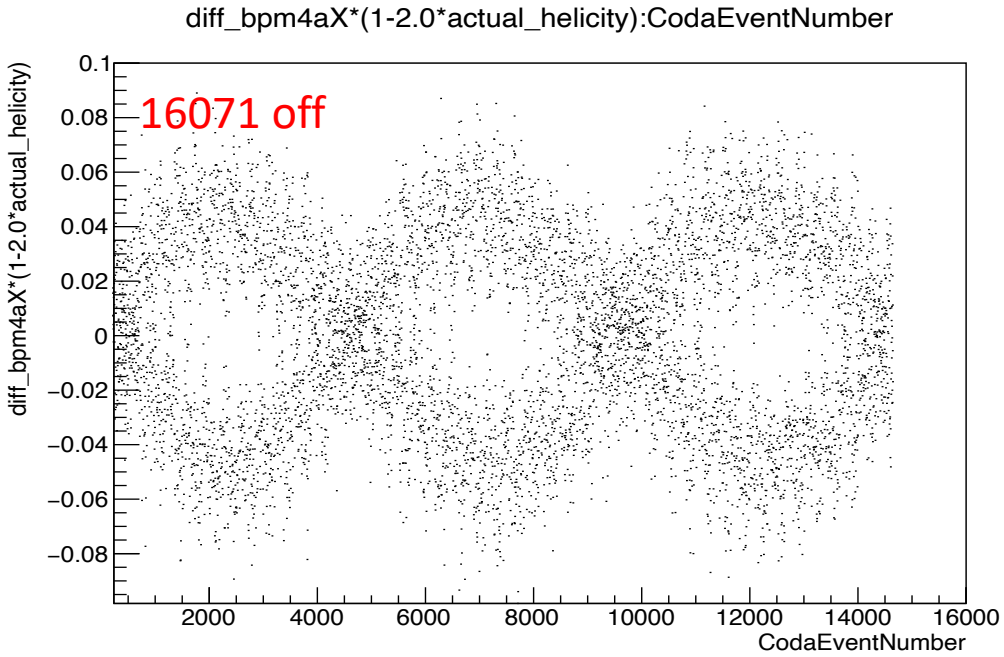


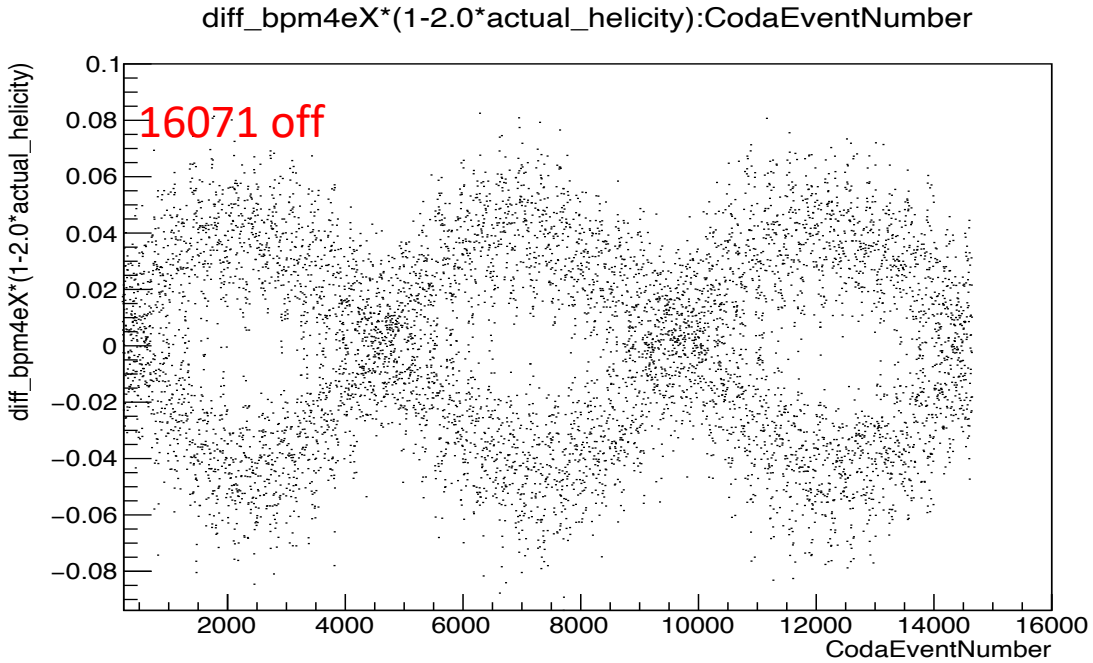


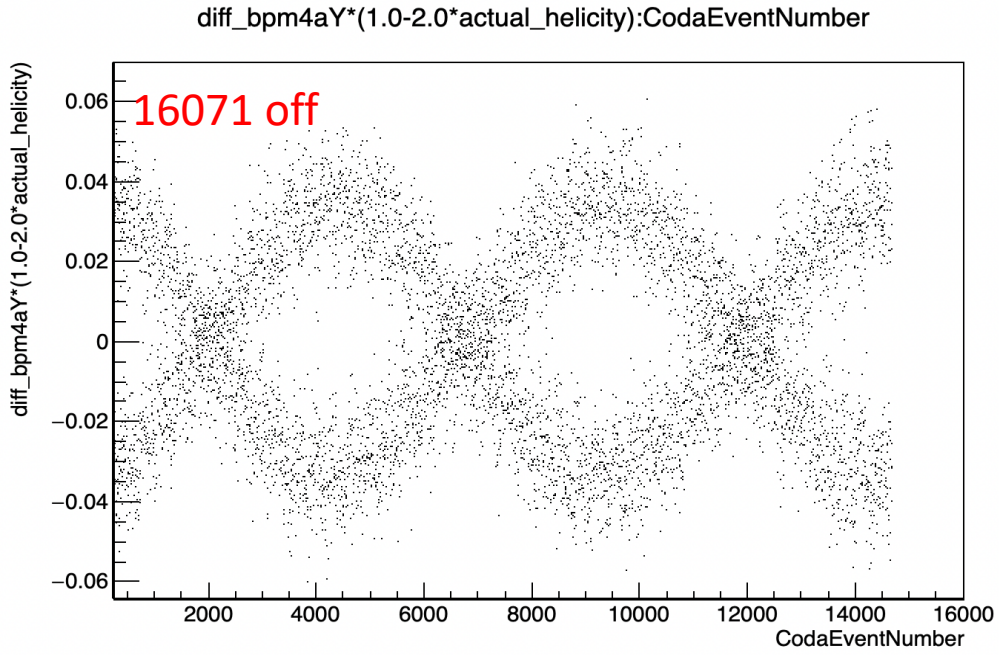


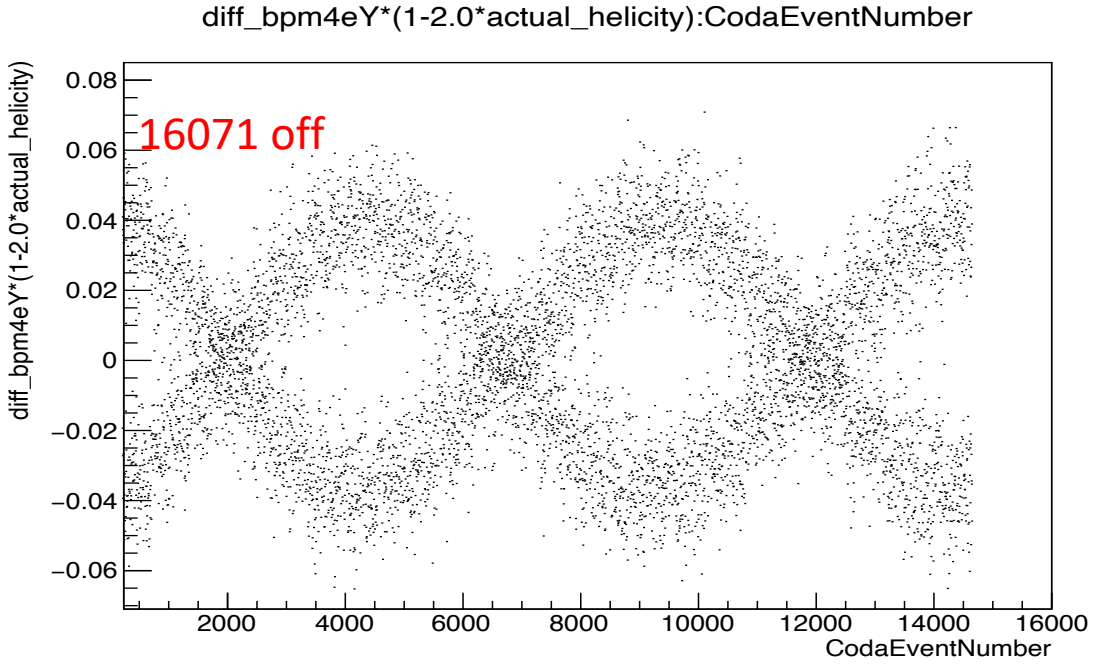


Pair results for 240 Hz

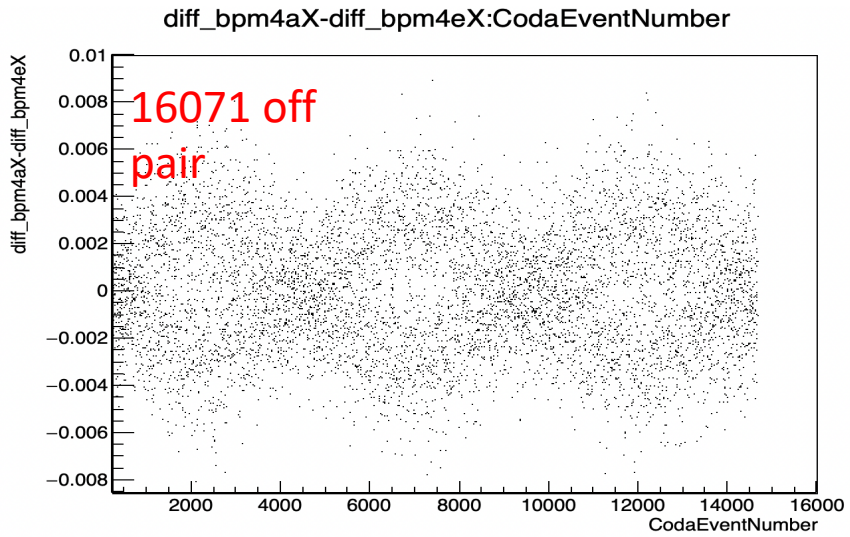


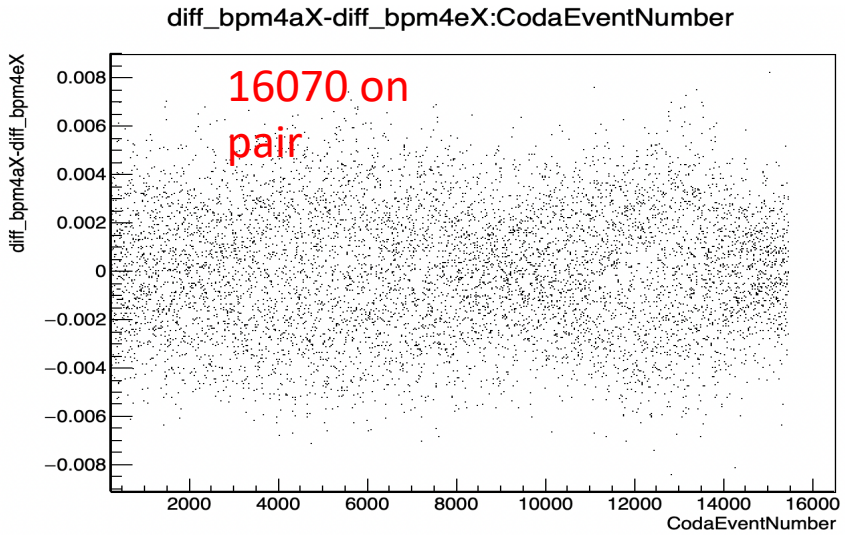


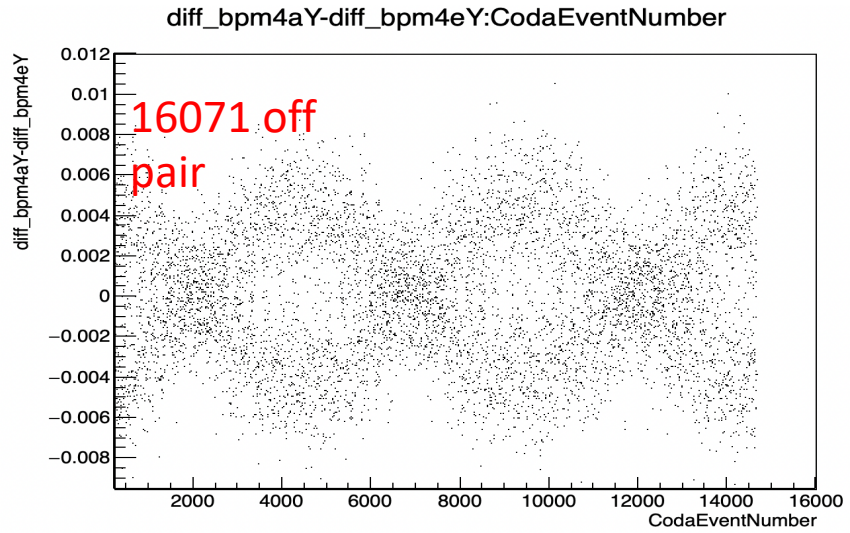


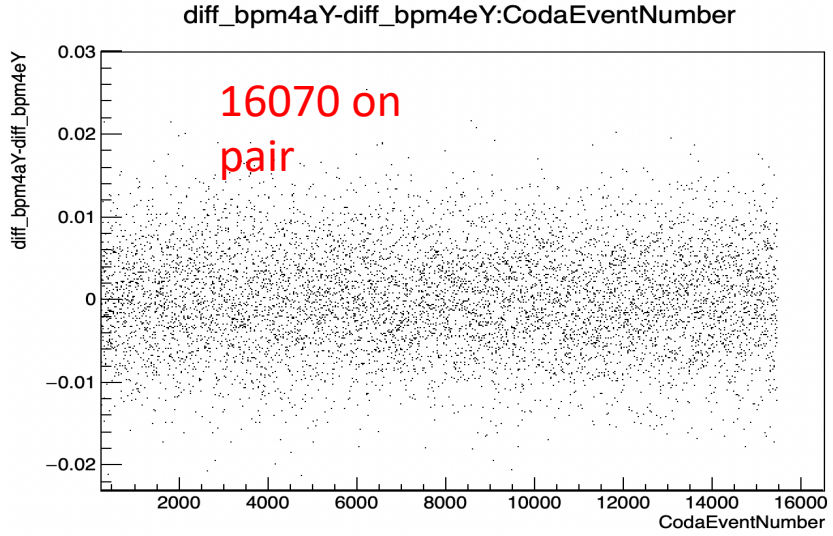


Pair results for 240 Hz









Run 16070 and 16071- pair difference mean results

240 Hz: HelBoard: 100us Tsettle, 4066.65us Tstable, Octet, 16 windows delay; HAPTB command: "setTimeHAPTB(30, 1400)"; VQWK vqwksamples=505.

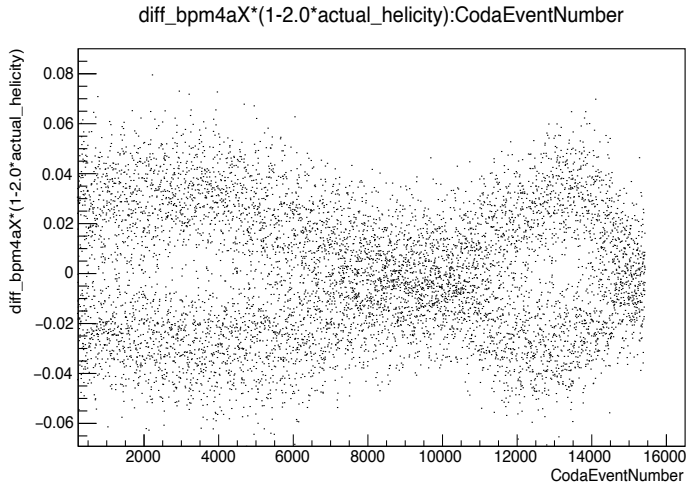
16070: FFB is on and 16071: FFB is off.

pairwise difference

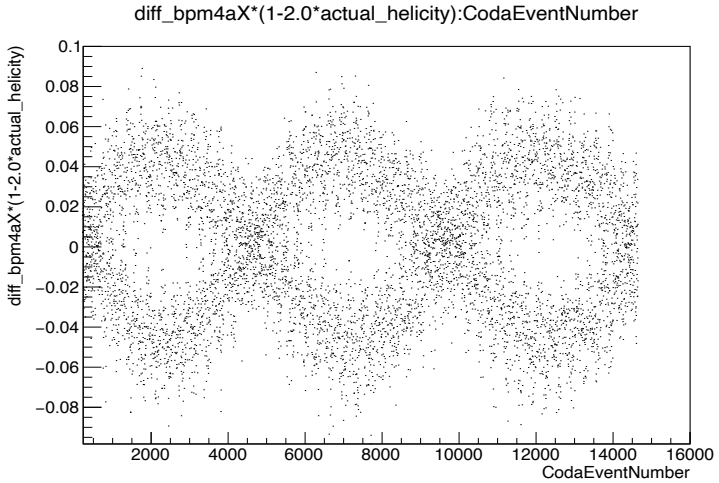
Run	FFB	Δ mean (micron) 4a X	Δ mean (micron) 4a Y	Δ mean (micron) 4e X	Δ mean (micron) 4e Y
16071	off	0.2 ± 0.4	0.1 ± 0.3	0.2 ± 0.4	0.1 ± 0.3
16070	on	-0.1 ± 0.3	-0.4 ± 0.6	0.1 ± 0.3	-0.5 ± 0.6

This are small relative to beam noise averages

Phase slip:



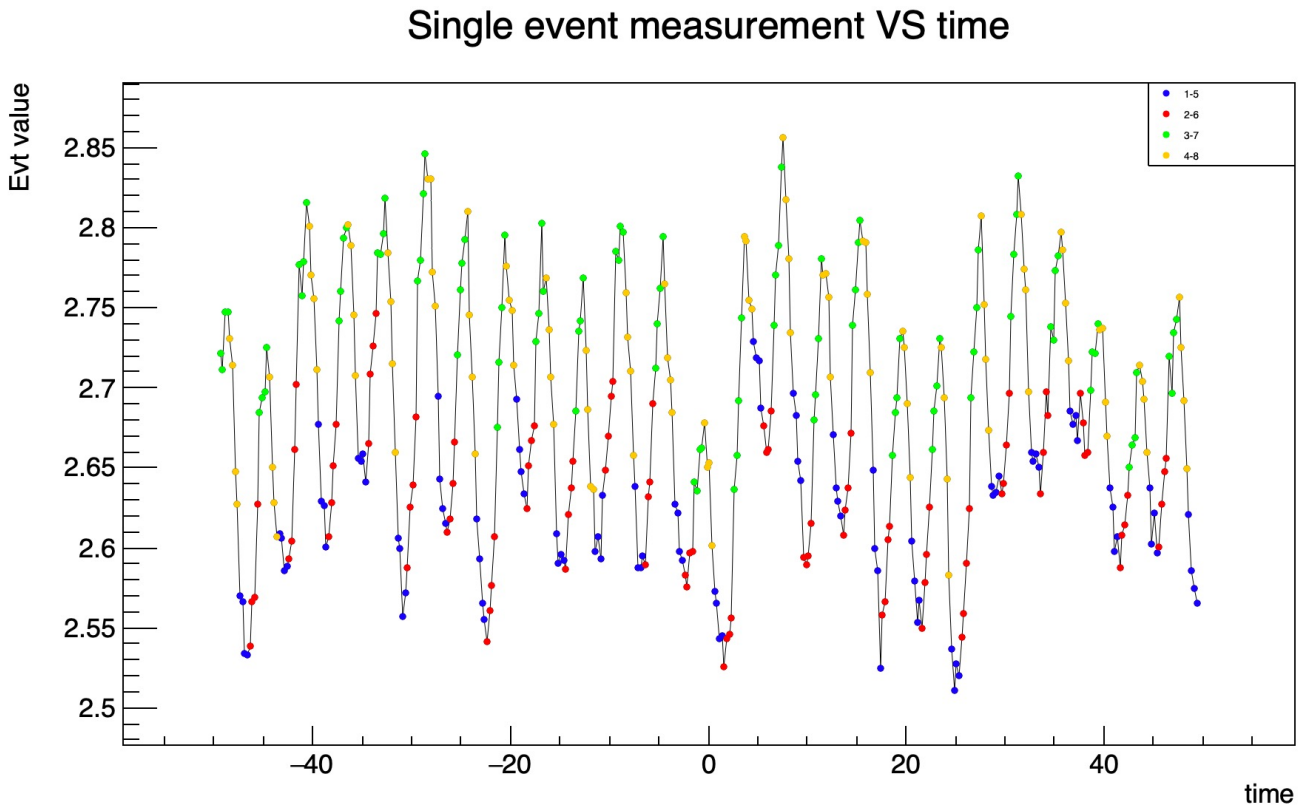
240 Hz: HelBoard: 100us Tsettle, 4066.65us Tstable,
Octet, 16 windows delay; HAPTB command: “setTimeHAPTB(30,1400)”;
VQWK vqwksamples=505.



4166.65 us repeat vs. 4166.66 us 240 Hz.
Phase slip = 4 ppm / cycle, so one wave in 250,000 cycles, 1041 seconds.
This run was only about 60 seconds long, so the phase drift is external,
at about 1 wave per 10000 events, or about 100 ppm / cycle
This is probably due to line noise drift.

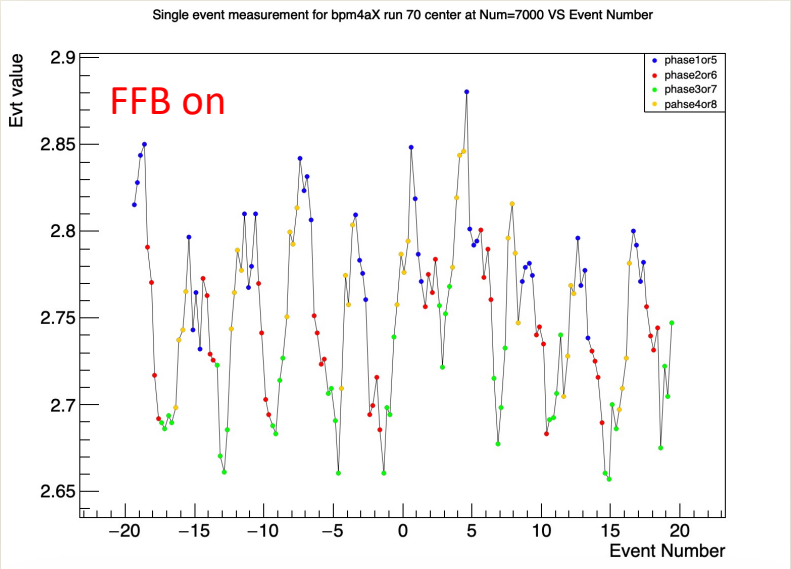
The result for 16070 FFB on

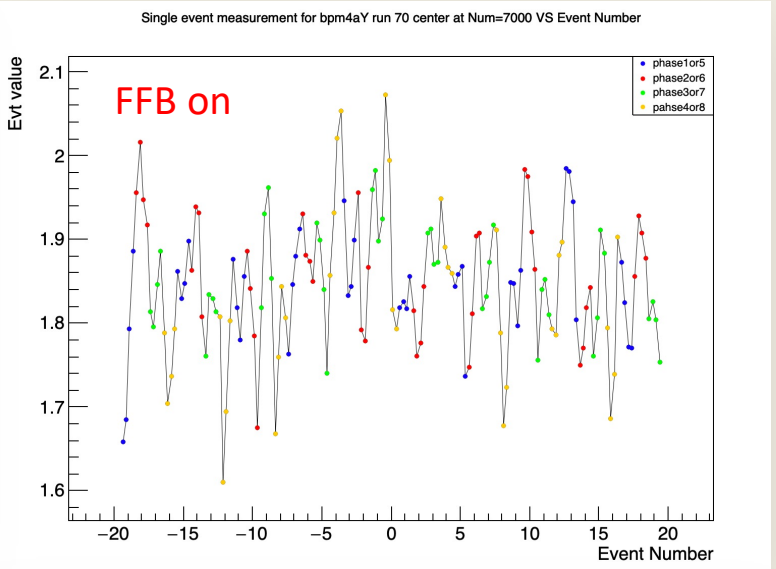
- We can see there are sequence for each measures and the 60hz noise.
- Colors indicate phase of 240 Hz measurement relative to 60Hz:
blue,red, green,gold
- Each 240Hz measurement window plotted as 4 “subblock” measurements, so effectively 960Hz data points

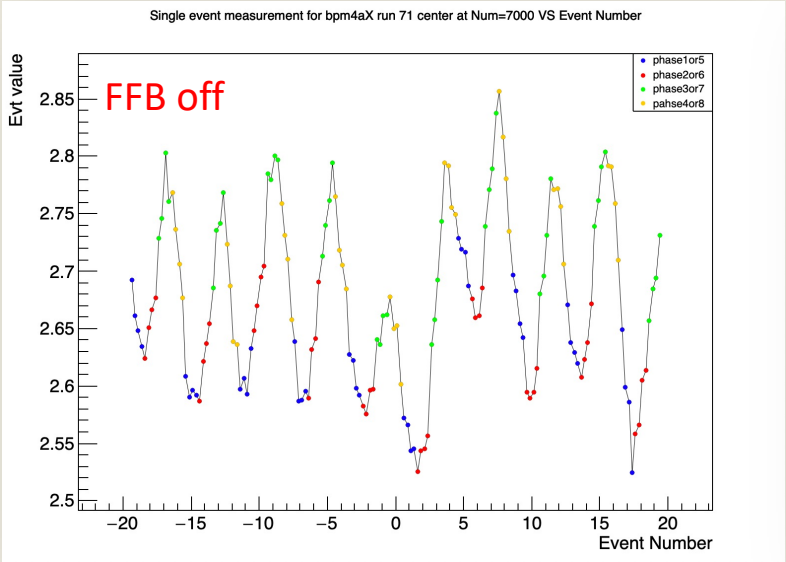


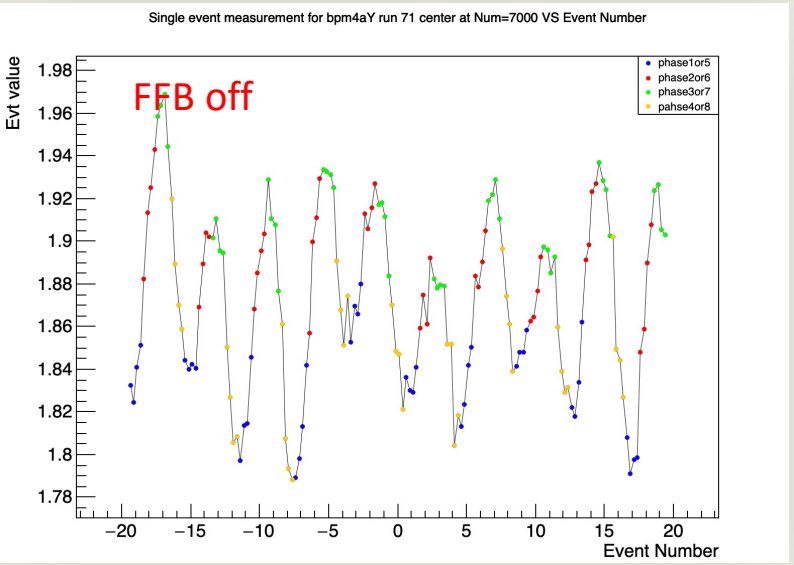
16070 and 16071 position bpm4aX and 4aY 240 Hz

- Here are the position plots for bpm4aX and bpm4aY.
- The one label as run 70 have FFB on
- The on label as run 71 on the bottom have FFB off
- 60 Hz noise apparent in X for OFF/ON, and Y for OFF. With FFB ON, the Y position has large noise of higher frequency, and is not dominated by 60 Hz



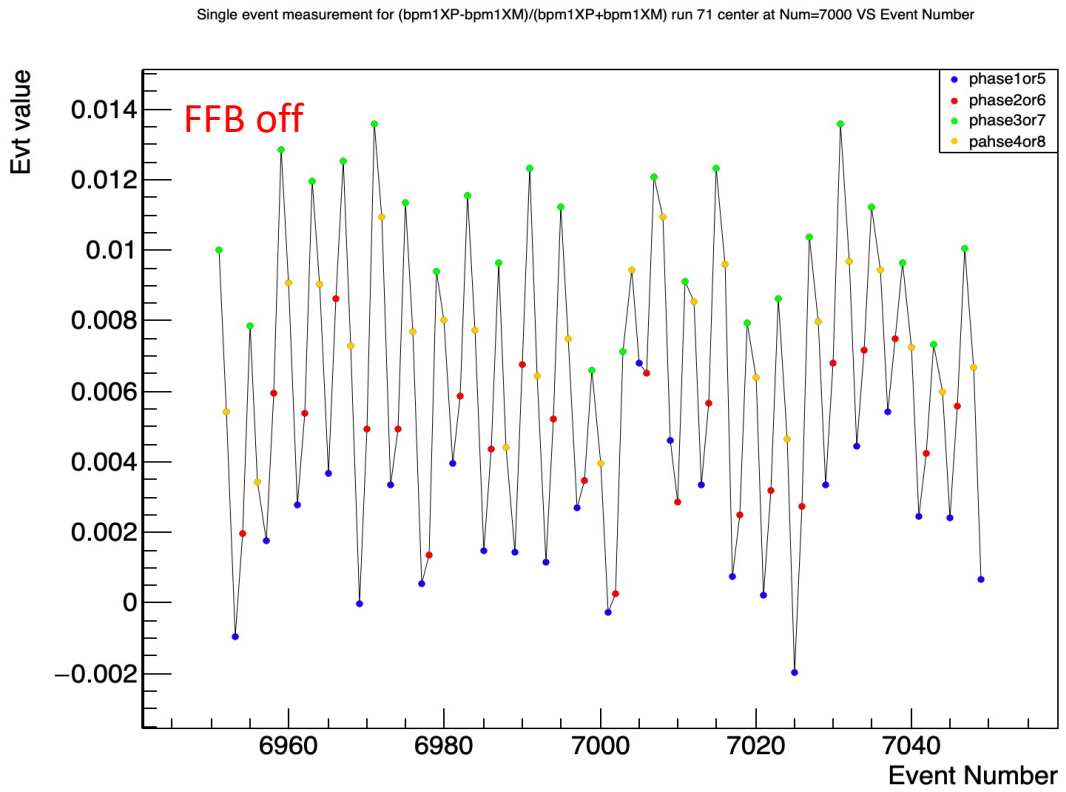


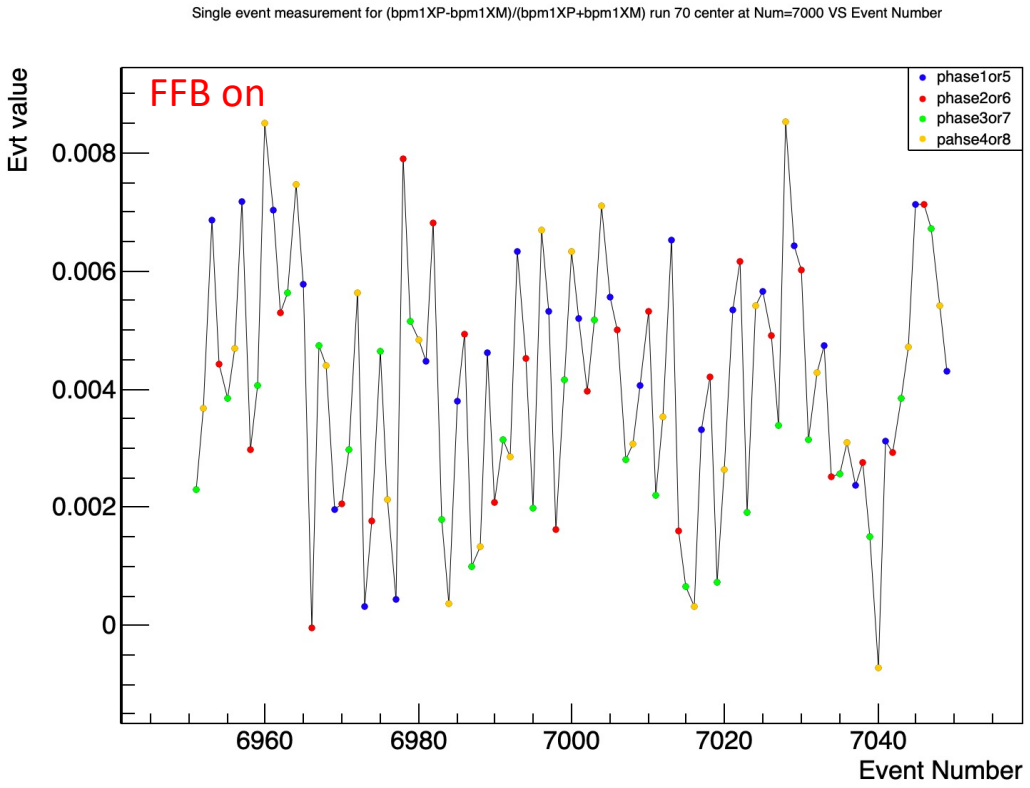




Asym for bpm1X (XP-XM)/(XP+XM) for run 16071 FFB off and 16070 FFB on. Frequency 240 Hz

A single BPM wire pair, at 1H01, is the only other readout. It also shows 60Hz noise for ON and OFF. (Rotated wires, so this combines X and Y dimensions. FFB OFF is a little scrambled.)





RMS for multiplet differences in Run 16076 and 16077 1920 Hz

FFB	RUN mul	Δ rms (micron) 4aX	Δ rms (micron) 4aY	Δ rms (micron) 4eX	Δ rms (micron) 4eY	Δ rms (micron) 4aX-4eX	Δ rms (micron) 4aY-4eY
off	16076	3.8	3.5	3.7	3.8	1.9	1.9
on	16077	5.0	13.7	4.8	15.4	1.9	2.5

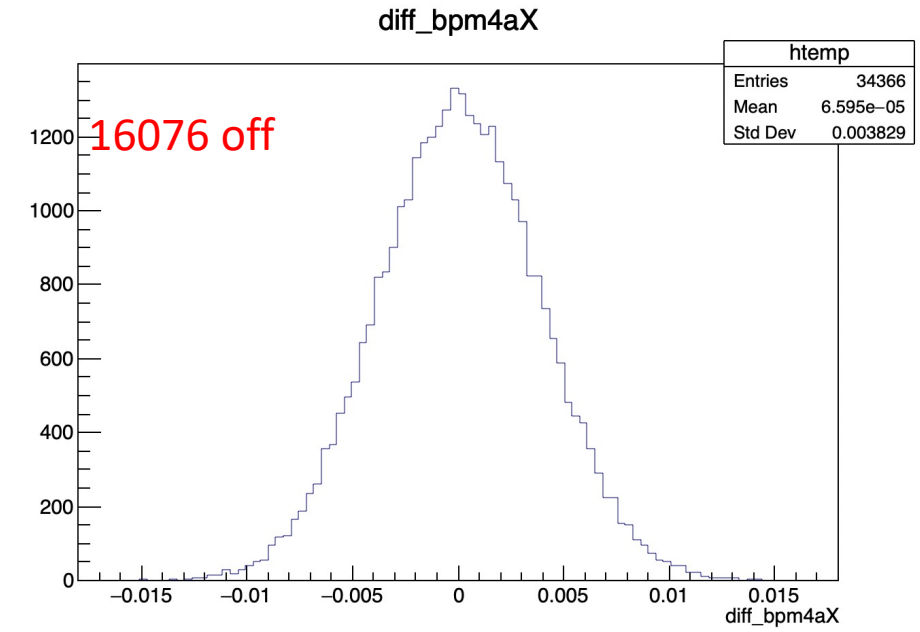
As before, noise in Y goes up when FFB is turned on.
At this integration period, noise also increases in X (but less so) when FFB is activated.

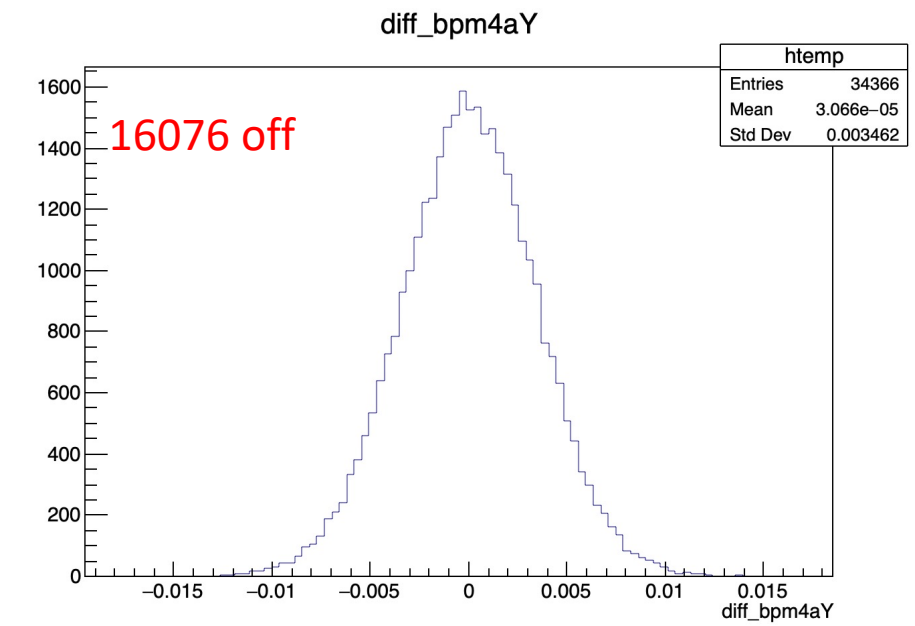
Run 16076 and 16077- multiplet difference mean results 1920 Hz

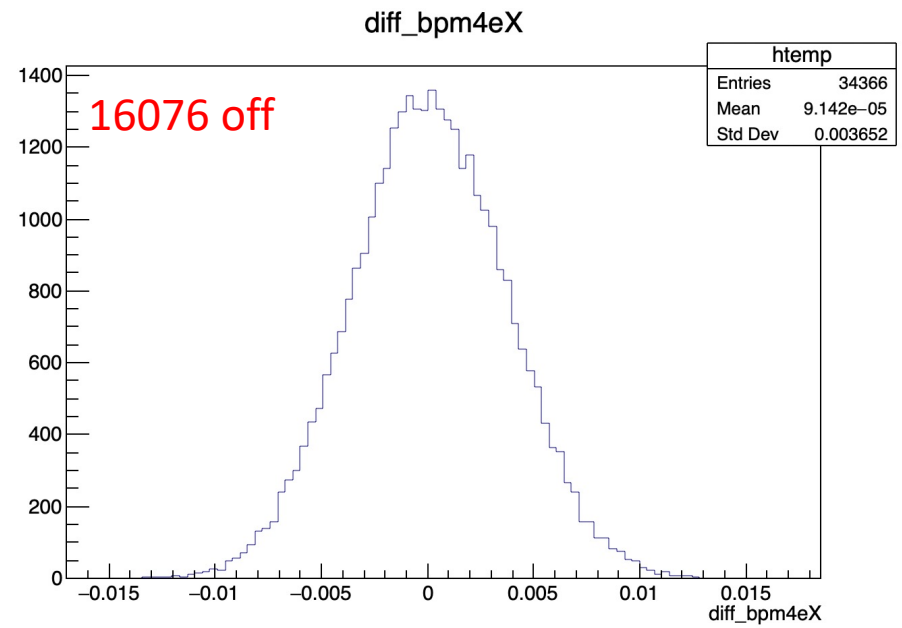
1920 Hz: HelBoard: 40us Tsettle, 480.85us Tstable, Octet, 16 windows delay; HAPTB command: "setTimeHAPTB(4, 180)"; VQWK vqwksamples=58.
16076 is FFB off and 16077 is FFB on

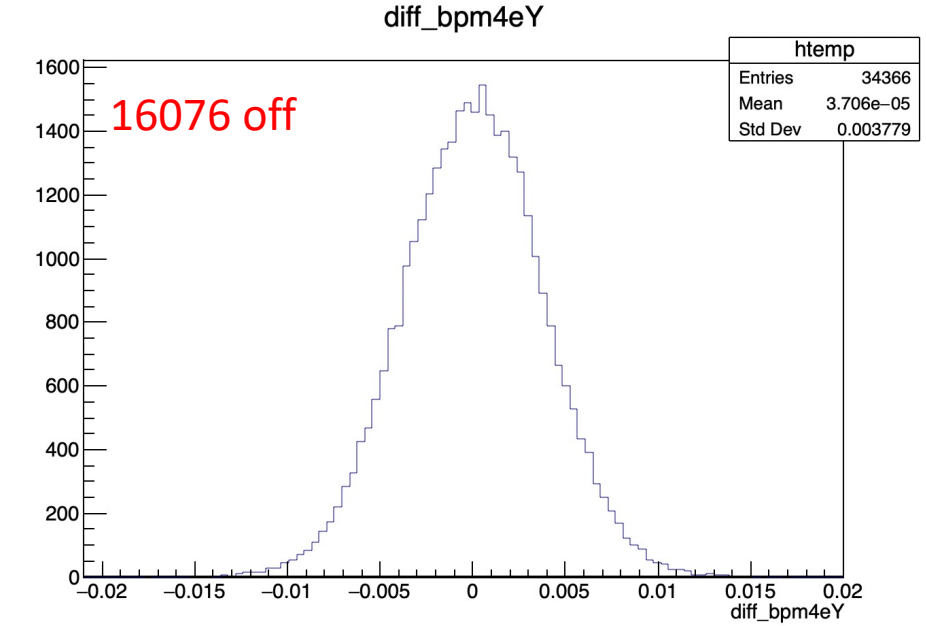
FFB	RUN mul	Δ mean (micron) 4aX	Δ mean (micron) 4aY	Δ mean (micron) 4eX	Δ mean (micron) 4eY	Δ mean (micron) 4aX-4eX	Δ mean (micron) 4aY-4eY
off	16076	0.06 ± 0.02	0.03 ± 0.02	0.09 ± 0.02	0.04 ± 0.02	-0.03 ± 0.01	-0.006 ± 0.010
on	16077	0.09 ± 0.03	0.16 ± 0.10	0.07 ± 0.03	0.20 ± 0.11	0.02 ± 0.01	0.04 ± 0.02

Multiplet results for 1920 Hz

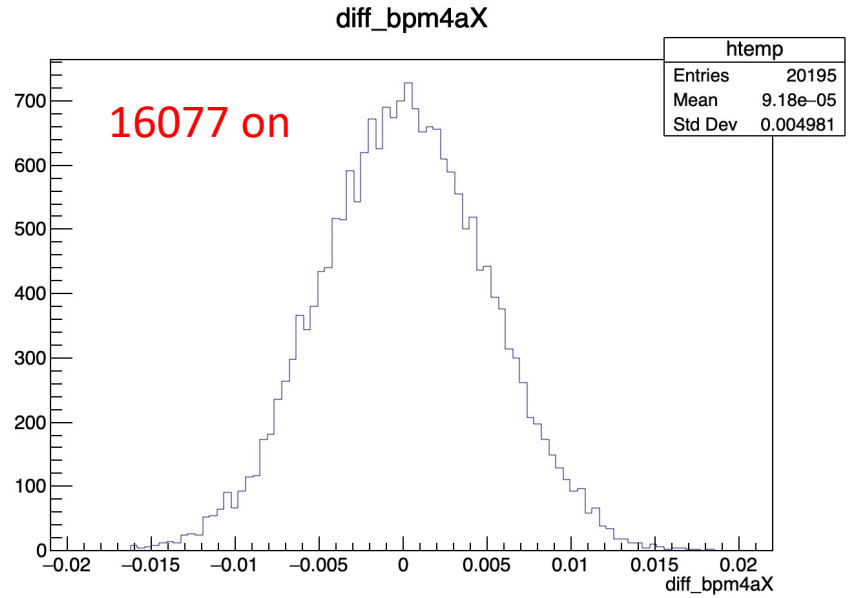


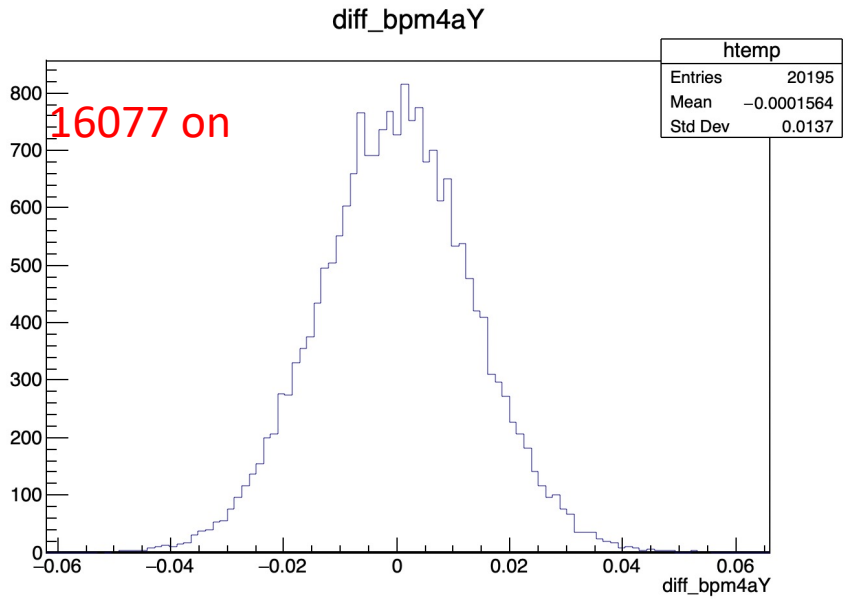


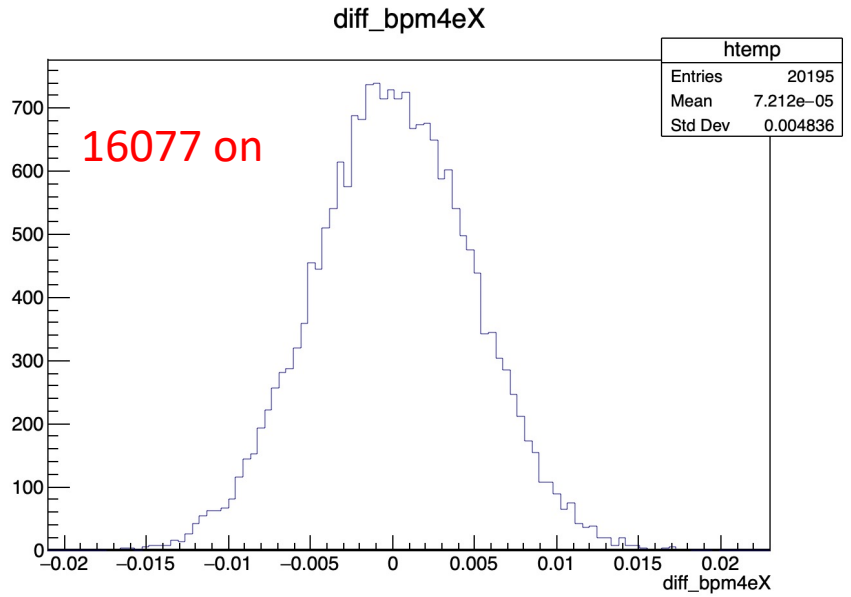


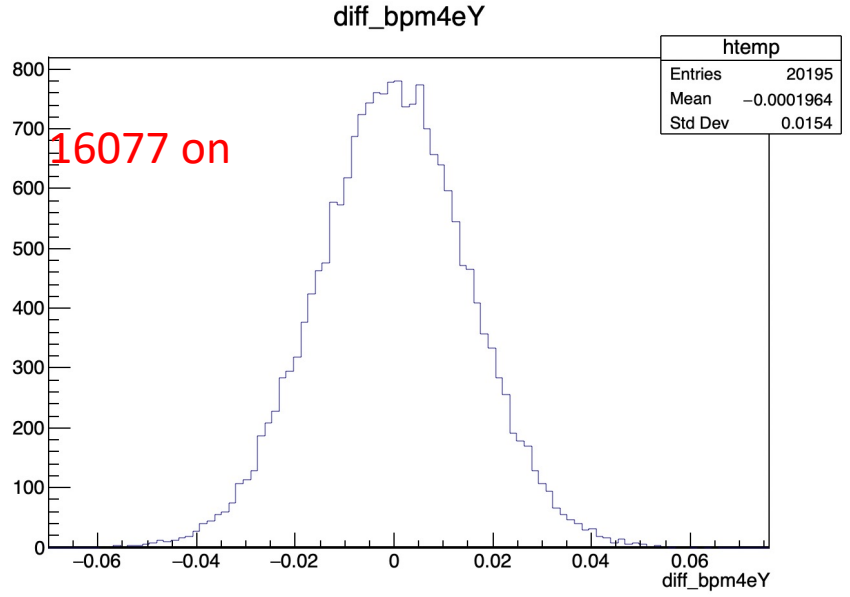


Multiplet results for 1920 Hz

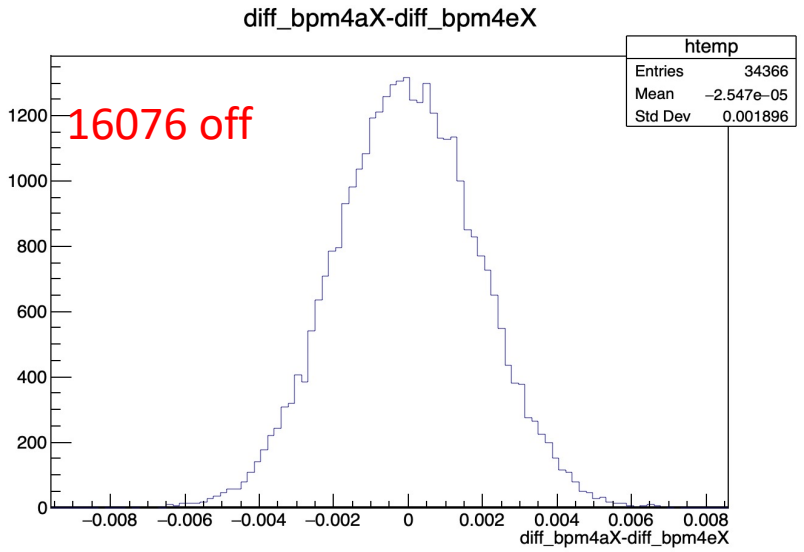


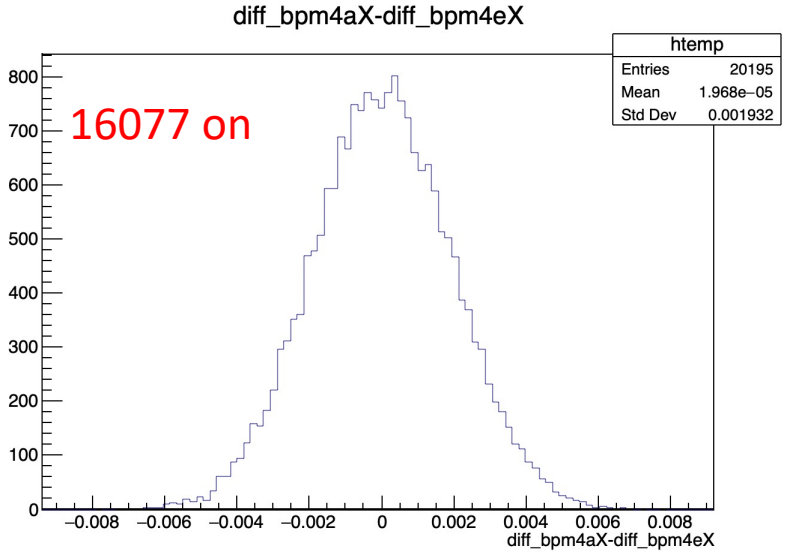


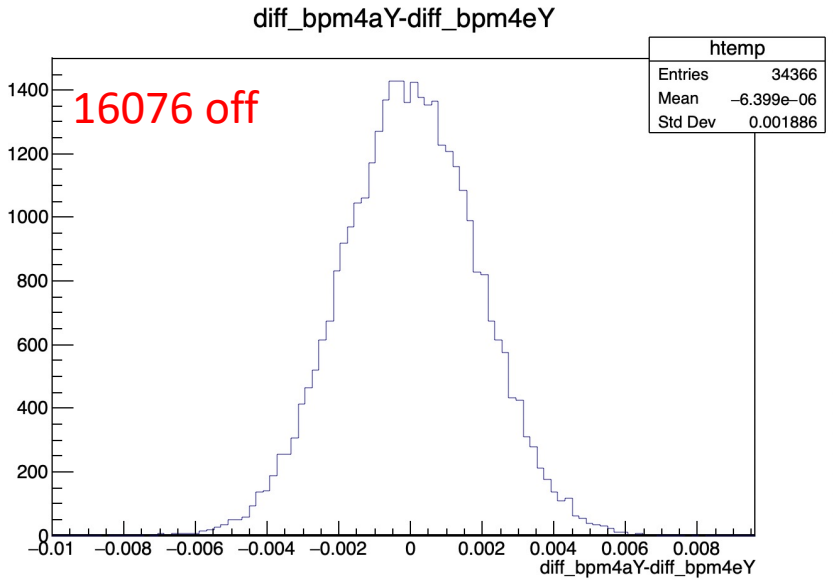


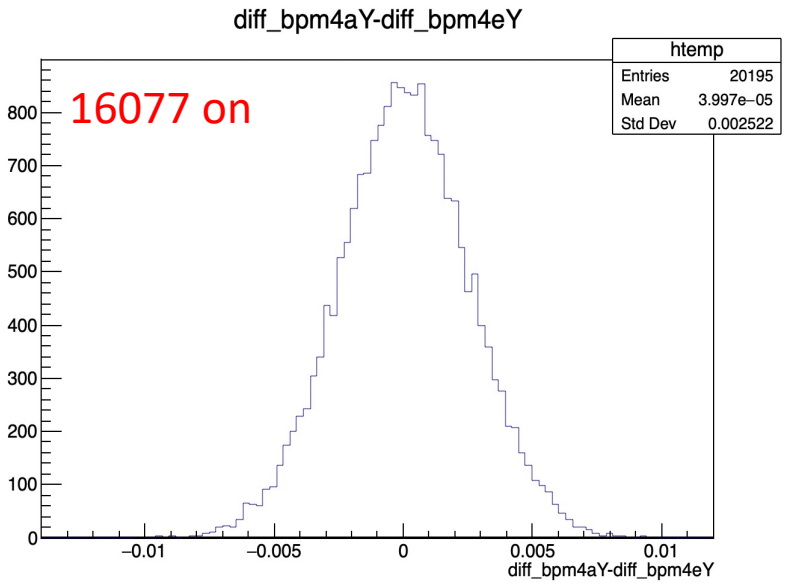


Multiplet results for 1920 Hz

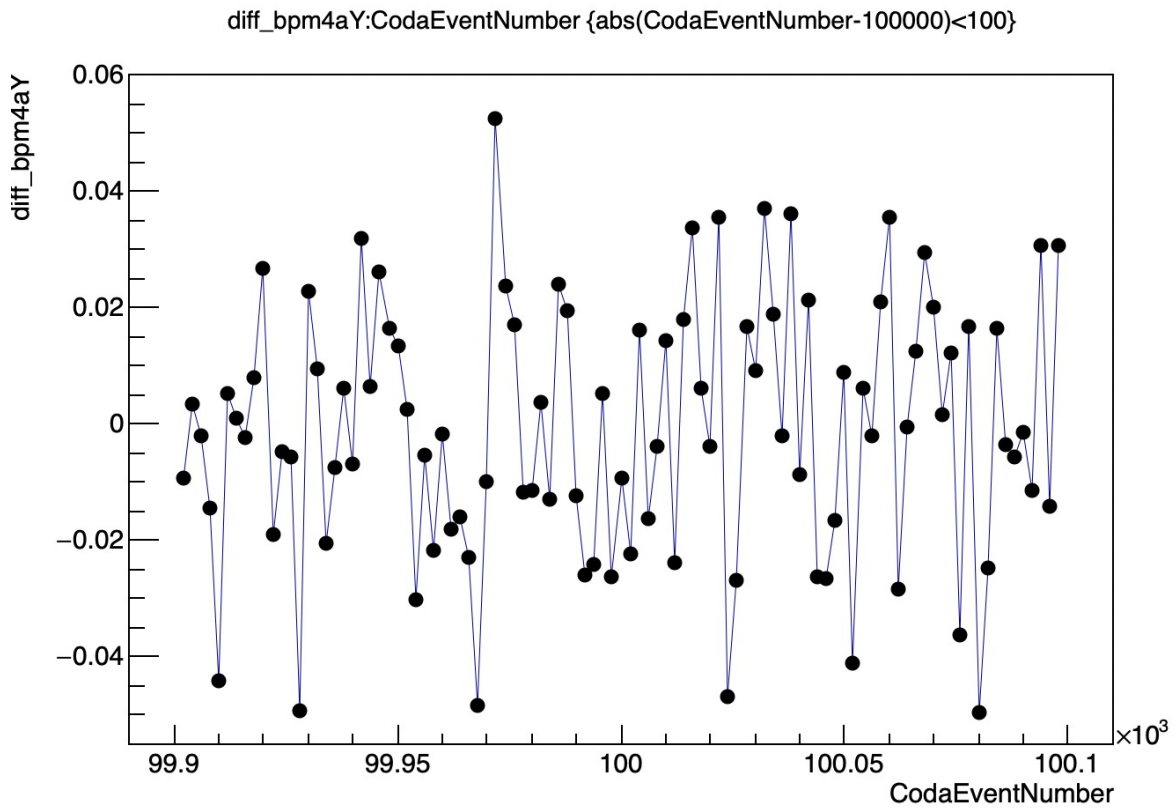


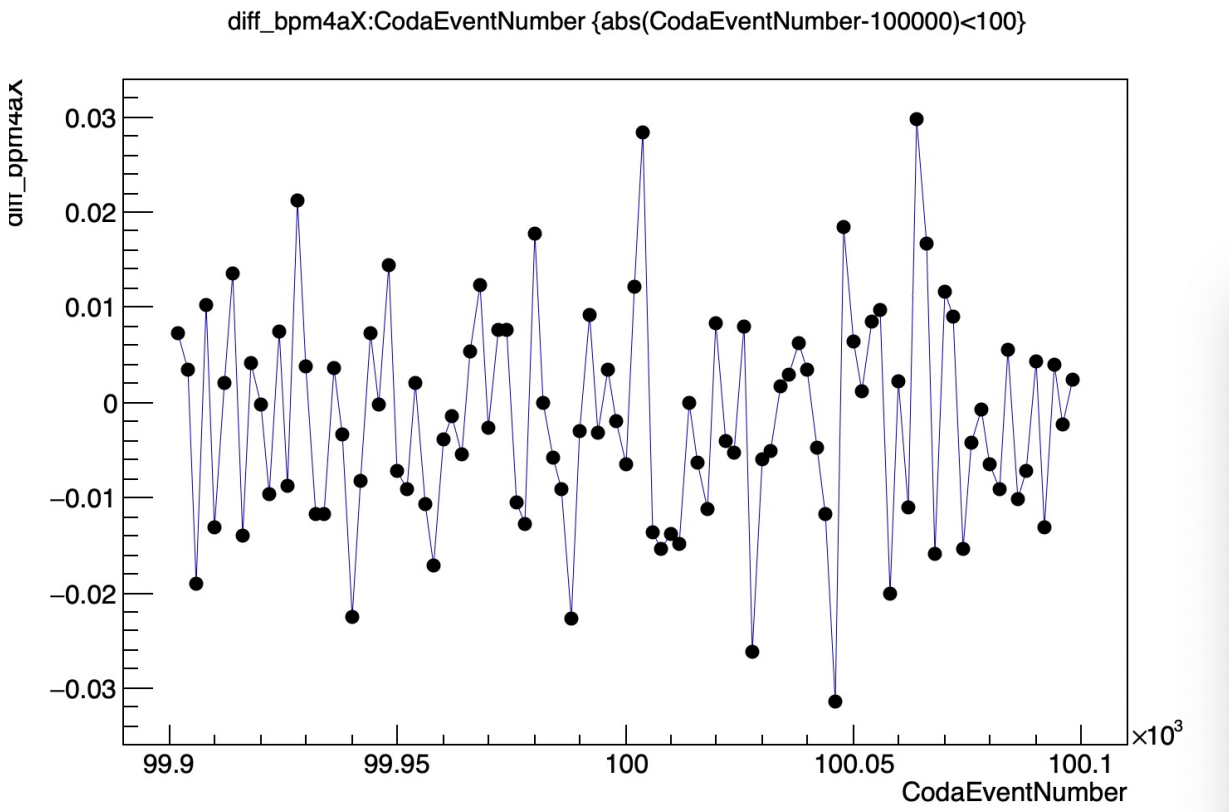






Run 16077 FFB on diff VS Time: not clear about the result hard to see the pattern





Run 16076 and 16077- pair difference mean results 1920 Hz

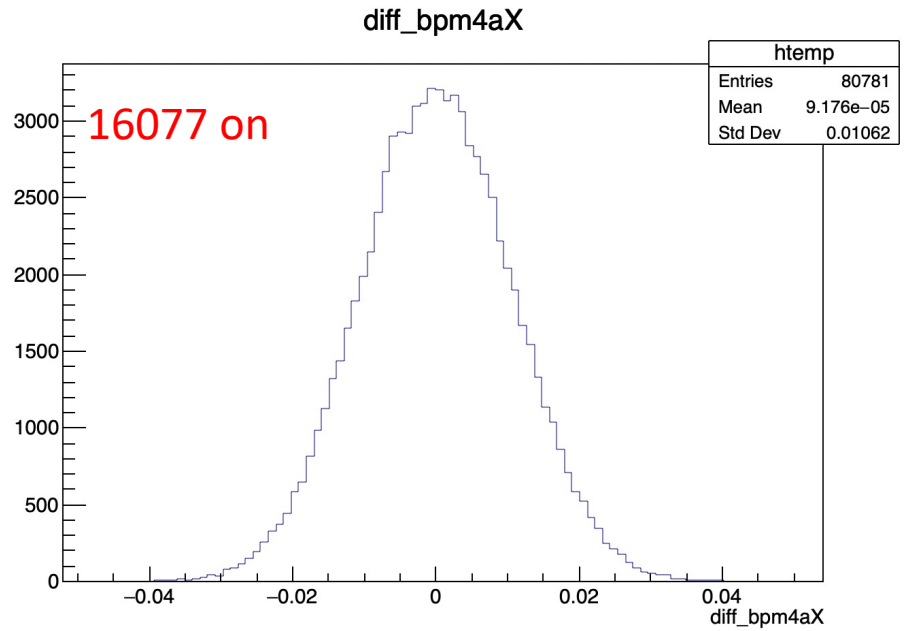
1920 Hz: HelBoard: 40us Tsettle, 480.85us Tstable, Octet, 16 windows delay; HAPTB command: "setTimeHAPTB(4, 180)"; VQWK vqwksamples=58.
16076 is FFB off and 16077 is FFB on

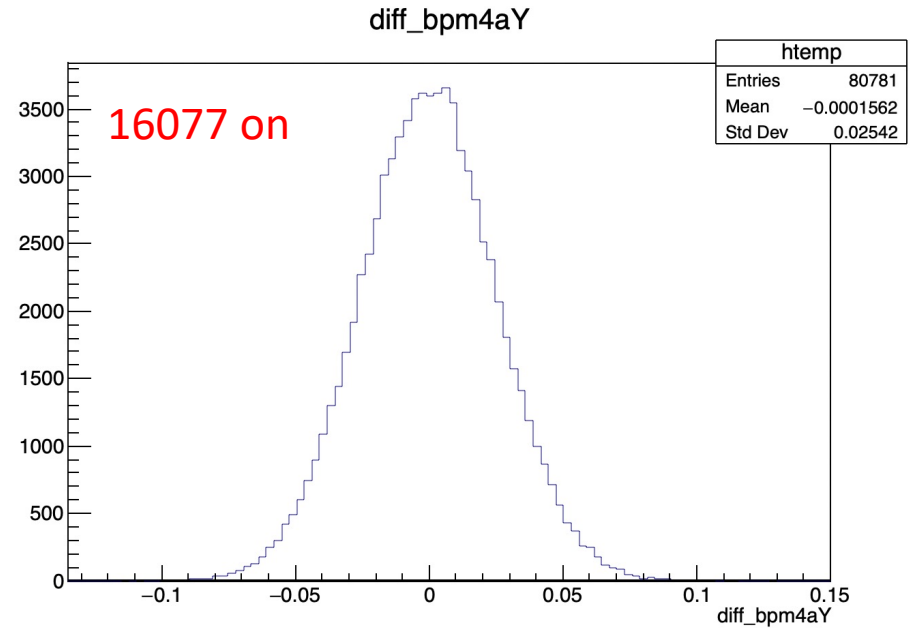
FFB	RUN pr	Δ mean (micron) 4aX	Δ mean (micron) 4aY	Δ mean (micron) 4eX	Δ mean (micron) 4eY	Δ mean (micron) 4aX-4eX	Δ mean (micron) 4aY-4eY
off	16076	0.07 ± 0.03	0.03 ± 0.02	0.09 ± 0.02	0.04 ± 0.02	-0.03 ± 0.01	-0.06 ± 0.01
on	16077	0.09 ± 0.04	-0.16 ± 0.09	0.07 ± 0.04	-0.20 ± 0.10	0.02 ± 0.01	0.04 ± 0.02

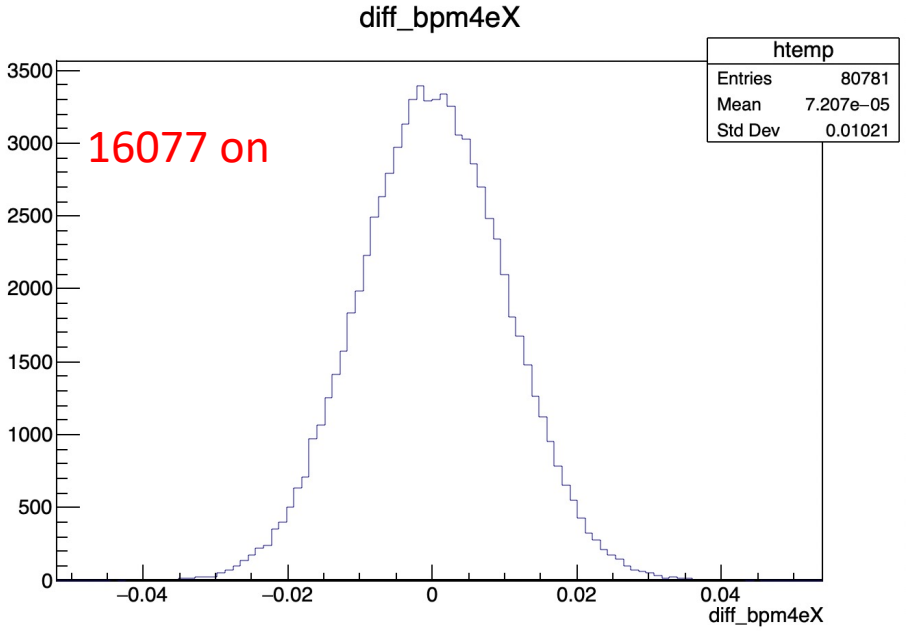
RMS for pair differences in Run 16076 and 16077

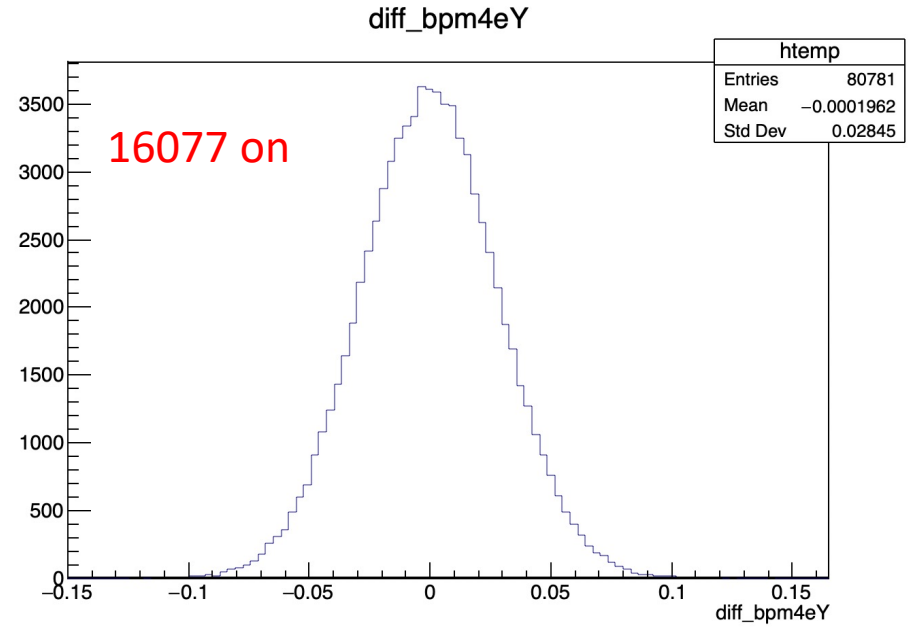
FFB	RUN pr	$\Delta\, rms$ (micron) 4aX	$\Delta\, rms$ (micron) 4aY	$\Delta\, rms$ (micron) 4eX	$\Delta\, rms$ (micron) 4eY	$\Delta\, rms$ (micron) 4aX-4eX	$\Delta\, rms$ (micron) 4aY-4eY
off	16076	10.0	8.2	9.3	8.8	3.7	3.6
on	16077	10.6	25.4	10.2	28.5	3.7	4.7

Pair results for 1920 Hz

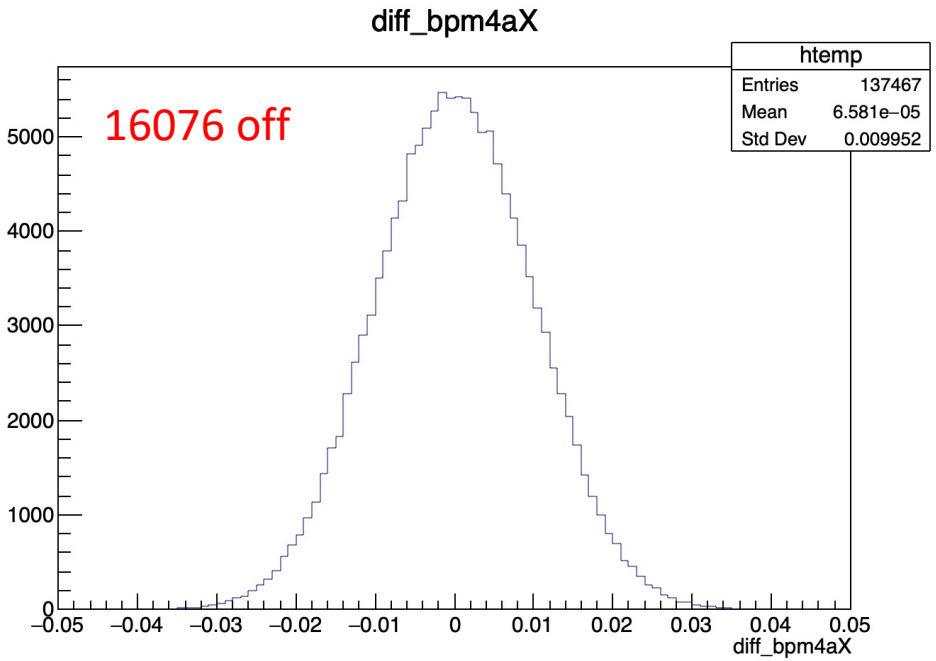


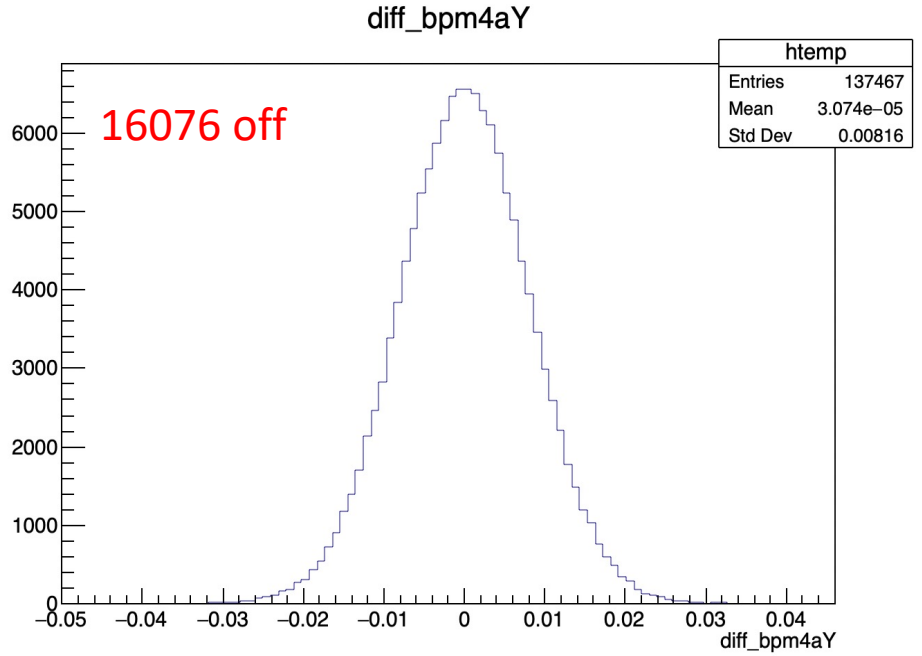


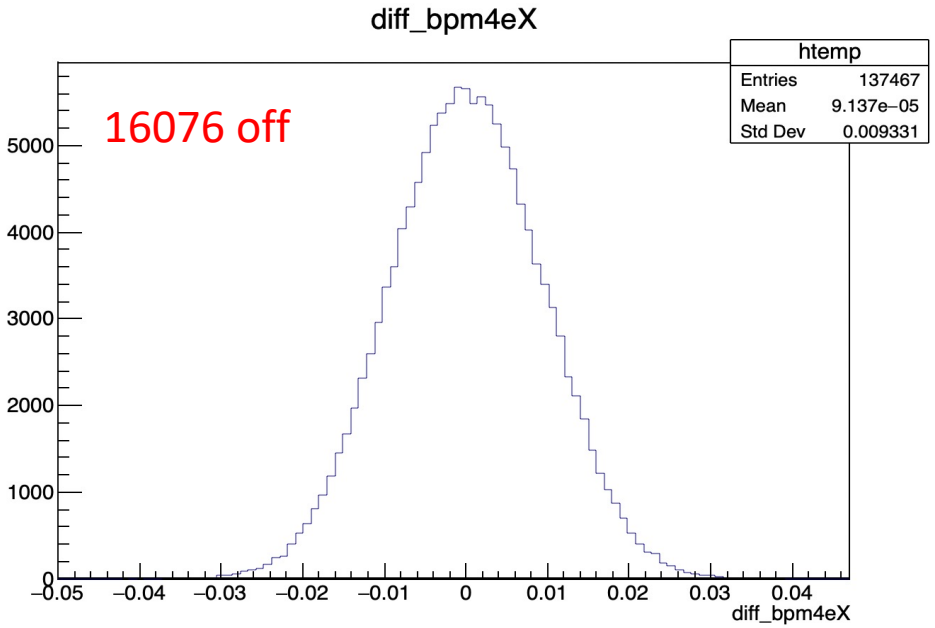


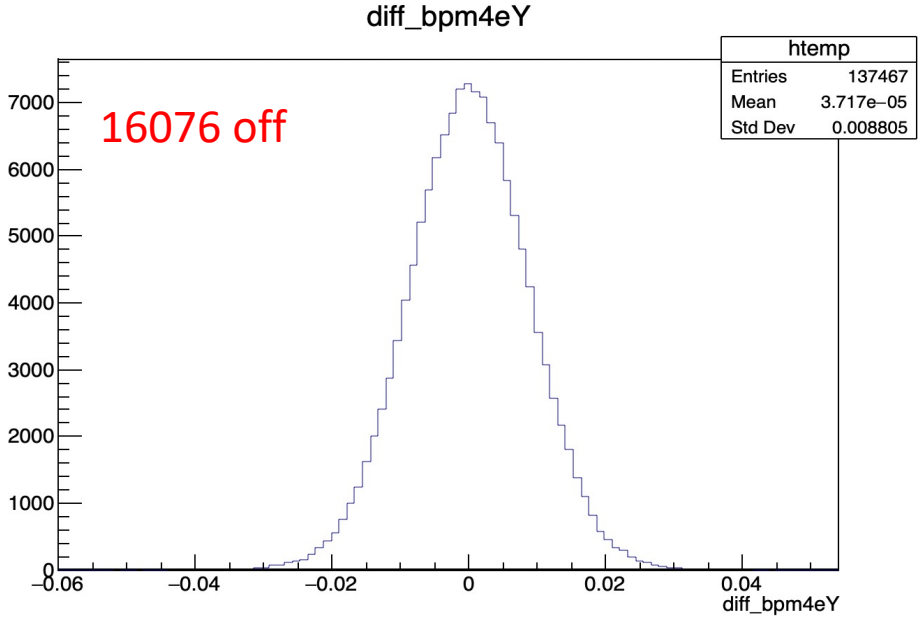


Pair results for 1920 Hz

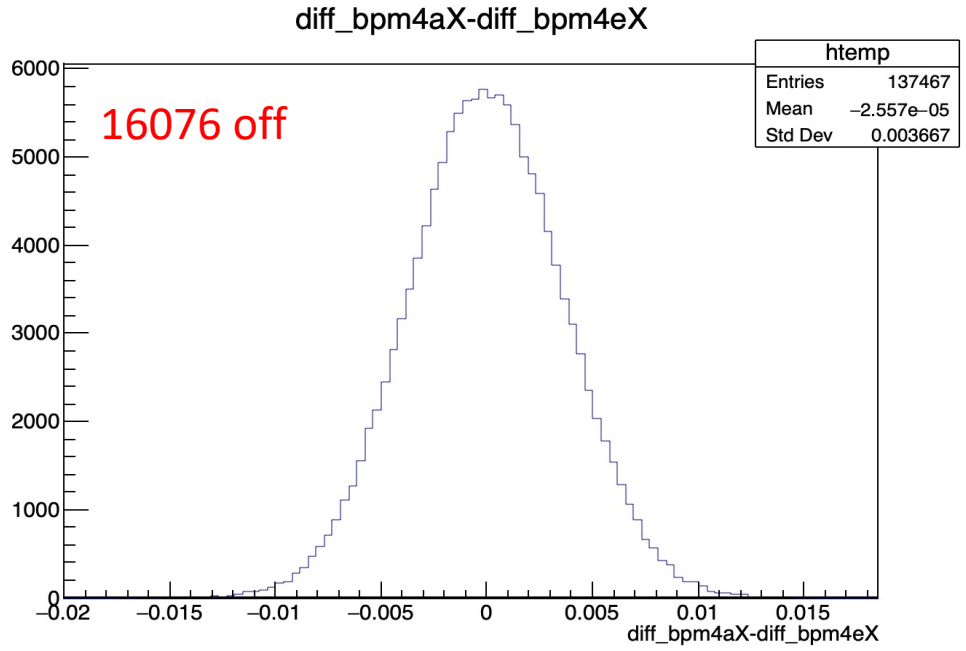


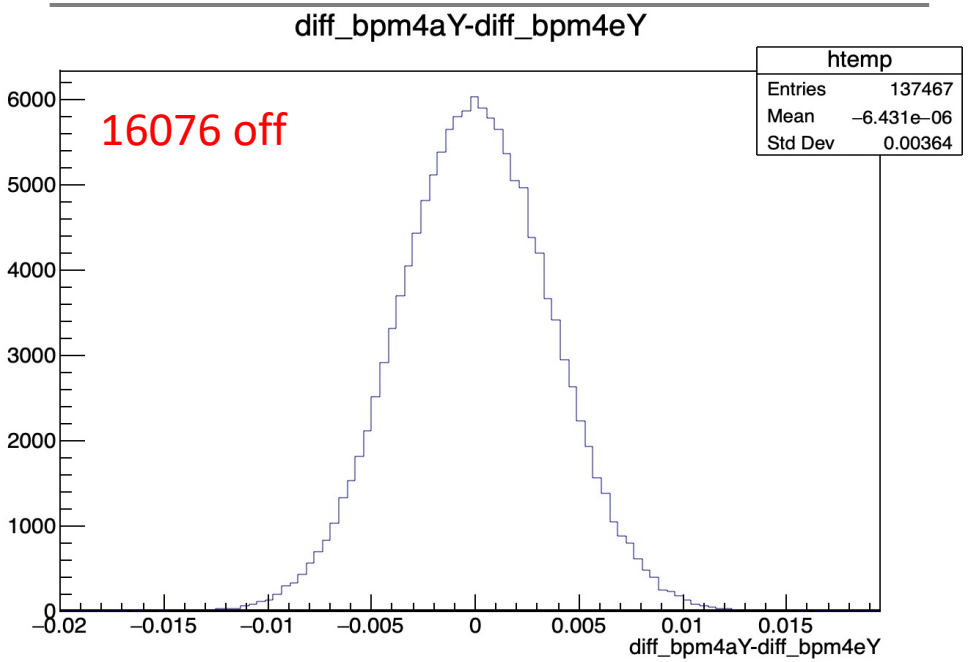


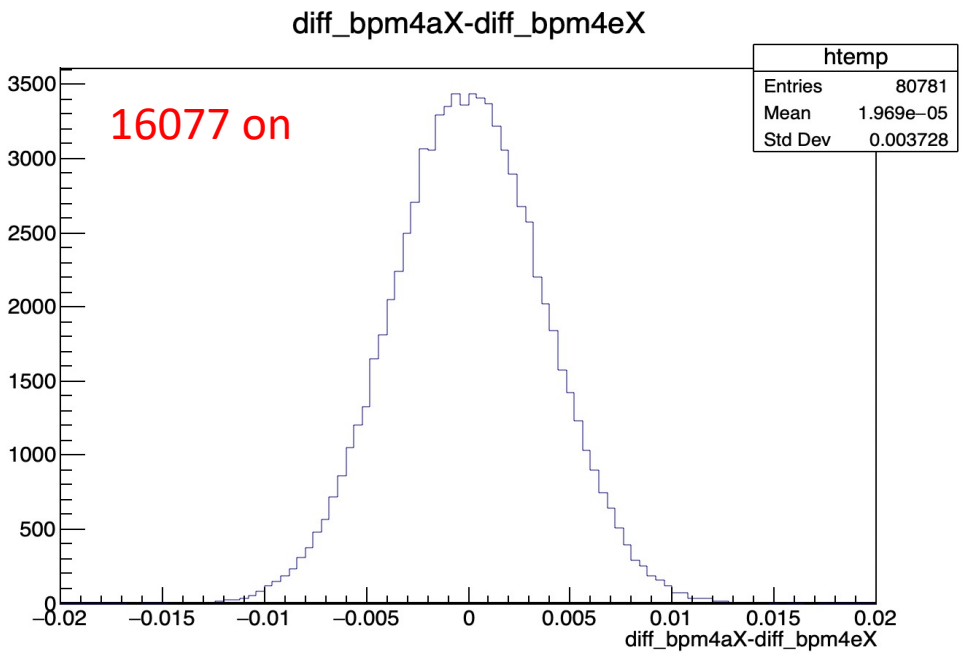


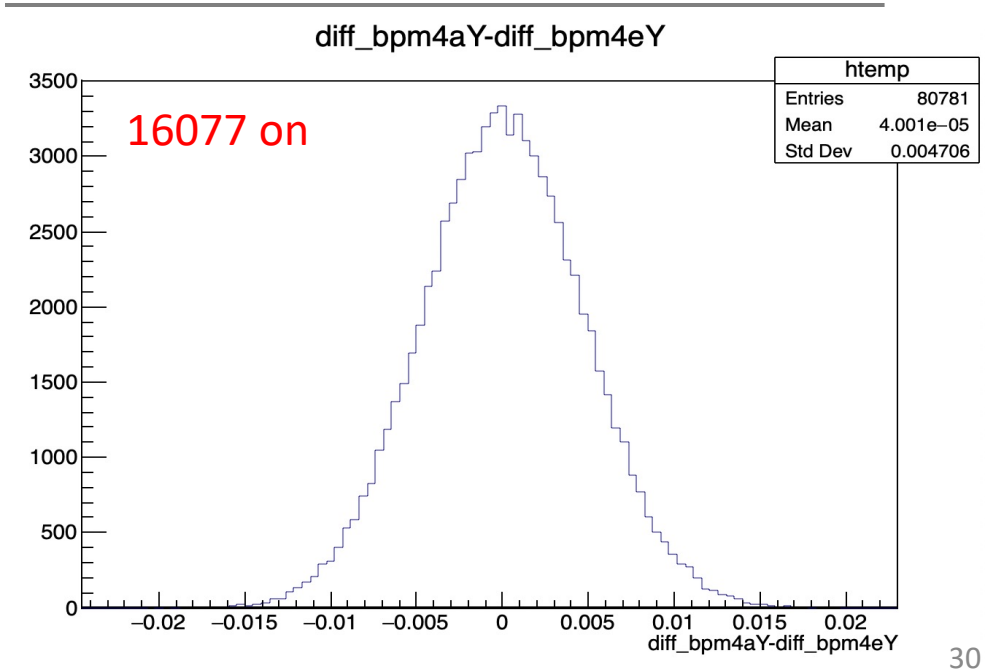


Pair results for 1920 Hz



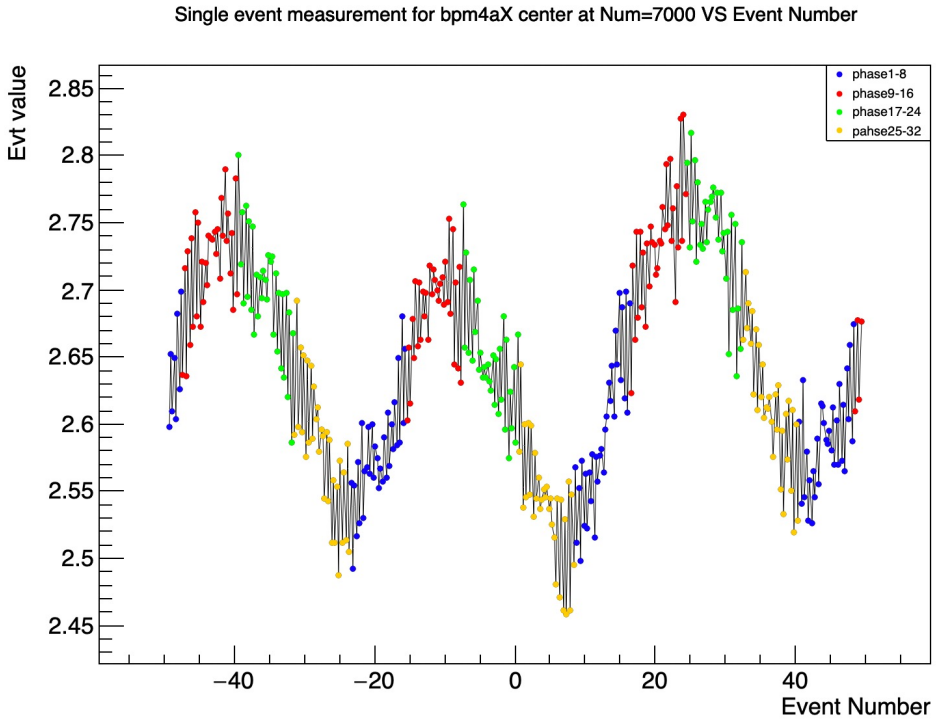


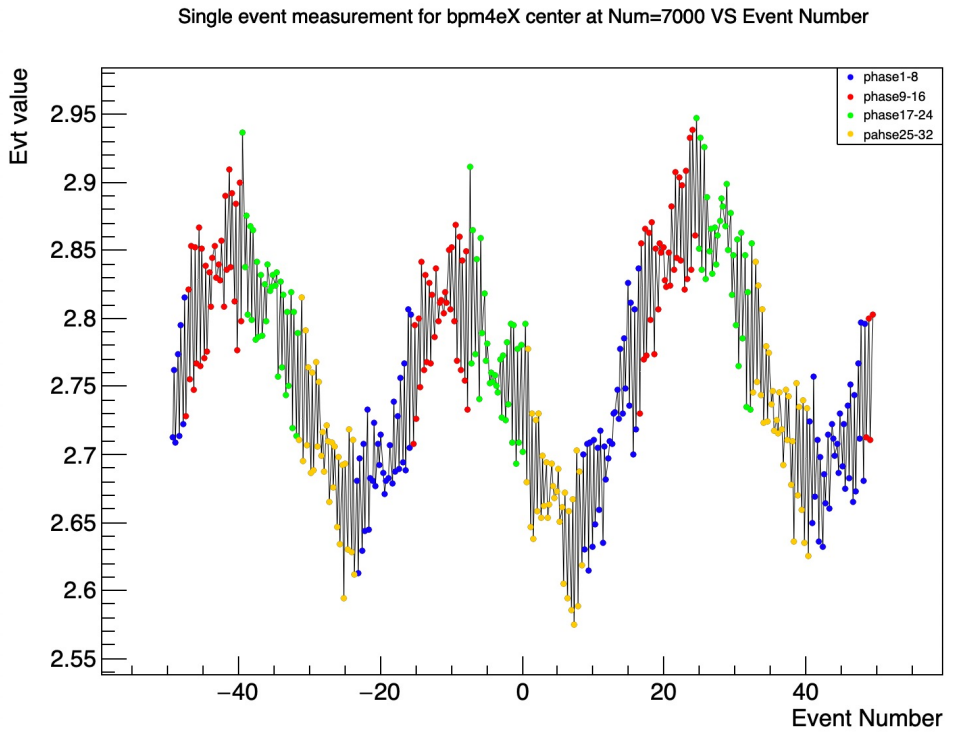




Position bpm4aX vs time and bpm4eX – FFB off

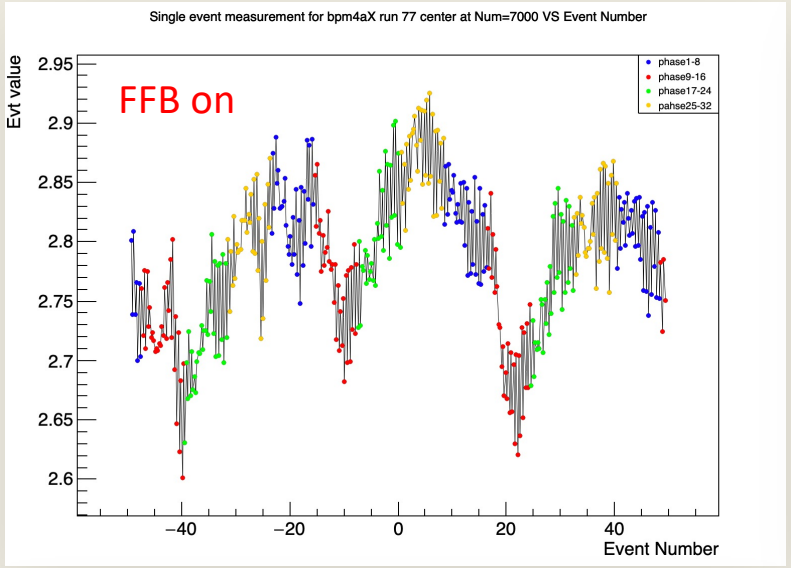
- We can see there are some sequence in our result. Around 60 Hz.
- the Y range are the same we can see the width for 4e is bigger than 4a
- As before, colors represent 25% of 60Hz cycle, blue:red:green:gold
- 4x subblocks, so effectively 7680 Hz sampling
- Now some fast noise is apparent. Note phase slip in fast noise (amplitude modulates)

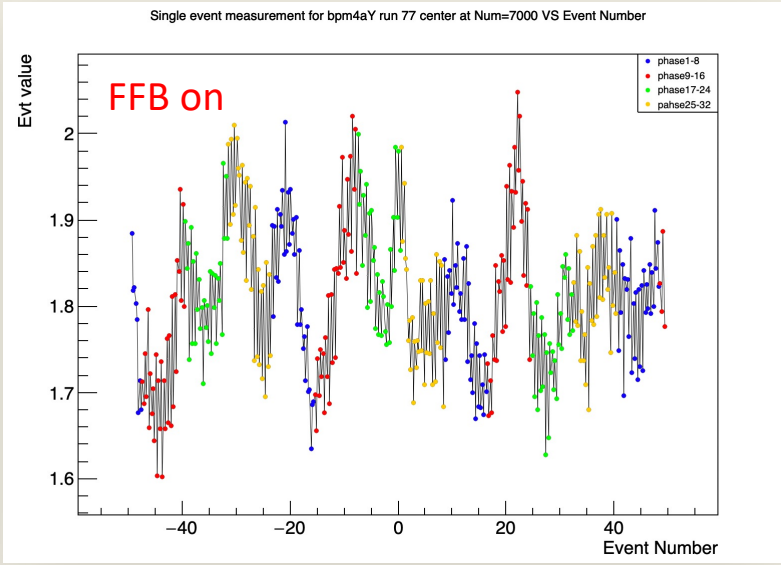


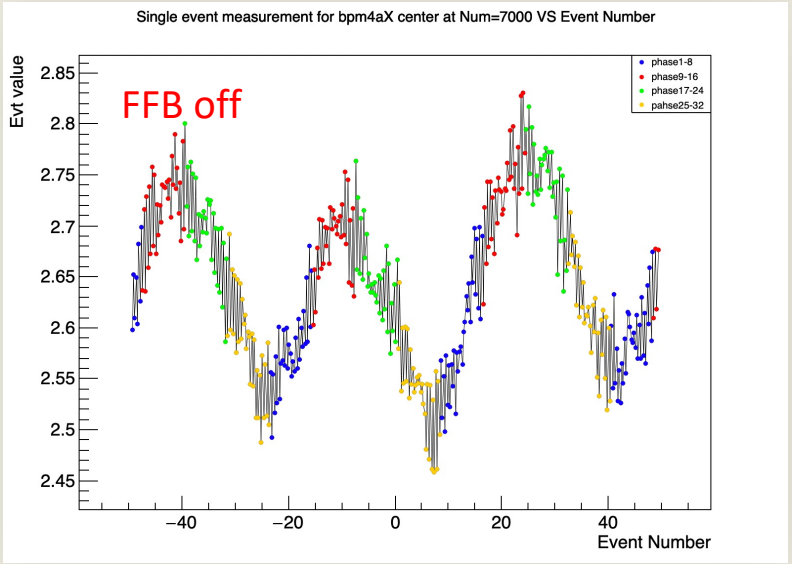


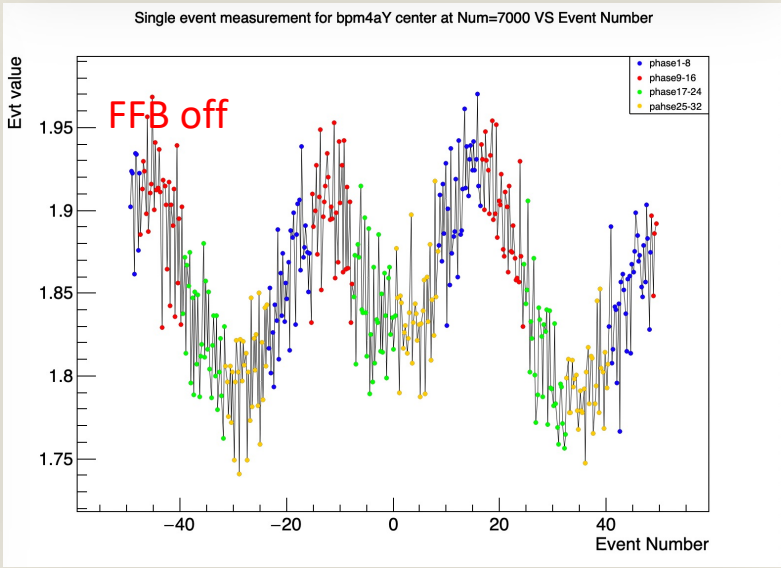
16076 and 16077 position bpm4aX and 4aY 1920Hz

- Here are the position plots for bpm4aX and bpm4aY.
- The one label as run 77 have FFB on
- For the ones on the bottom have FFB off
- We can see both of them have 60 noise and for FFB on the pattern is more chaotic
- Keep in mind: slightly different vertical scales for each plot



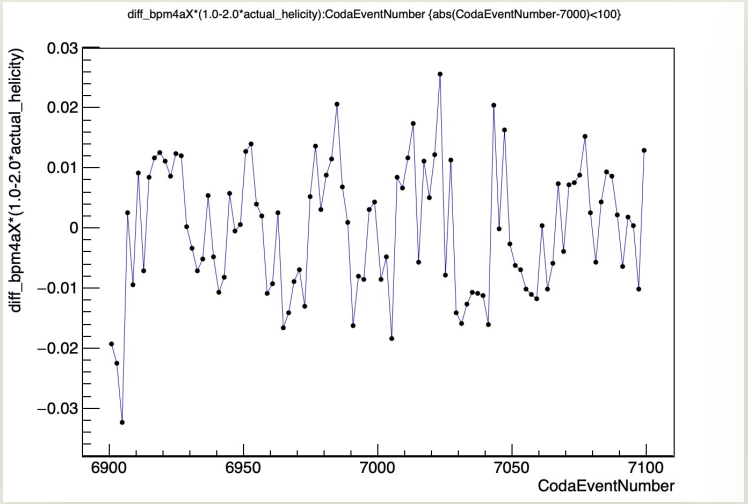


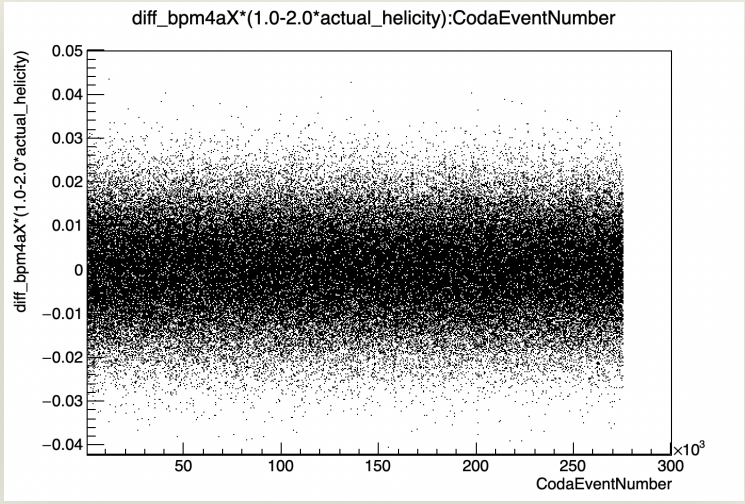


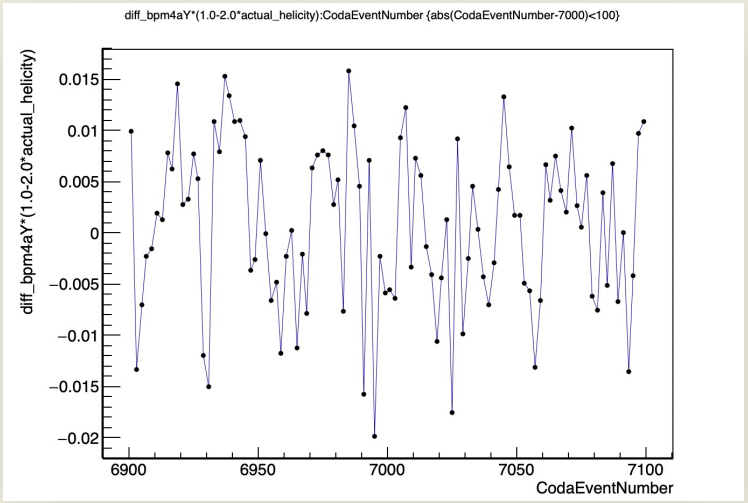


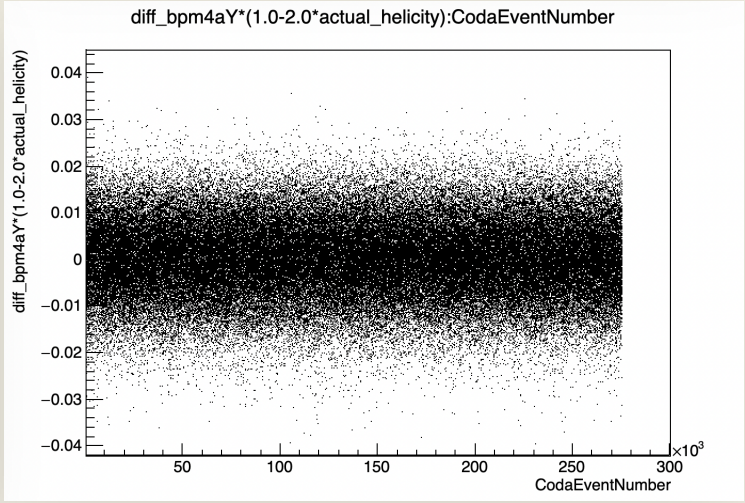
16076 FFB off Diff_bpm4aX and 4aY 1920Hz

- Here are the pair plots for bpm4aX and bpm4aY.
- The left are for CodaEventNumber around 7000 ± 100.
- The right are all range.
- We can not see a clear pattern for the noise. It is hard to say we have a 60hz noise



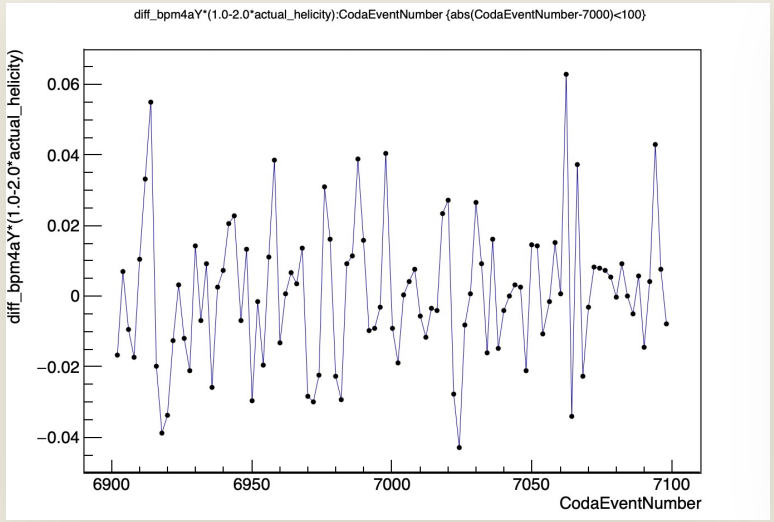


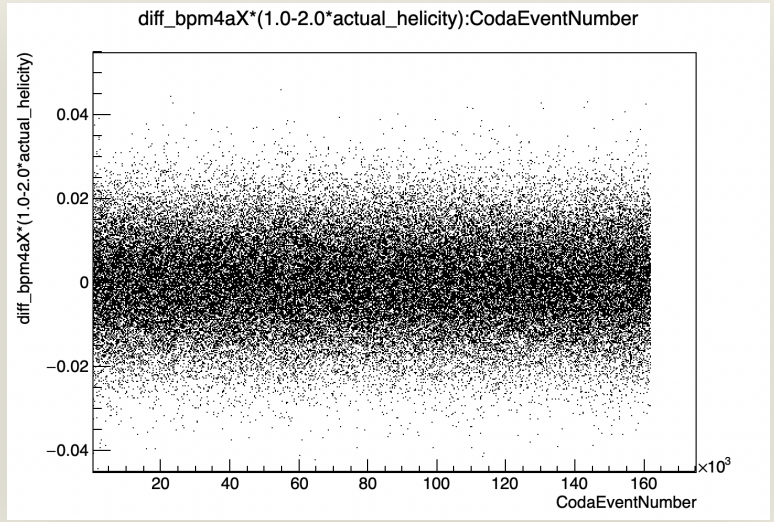


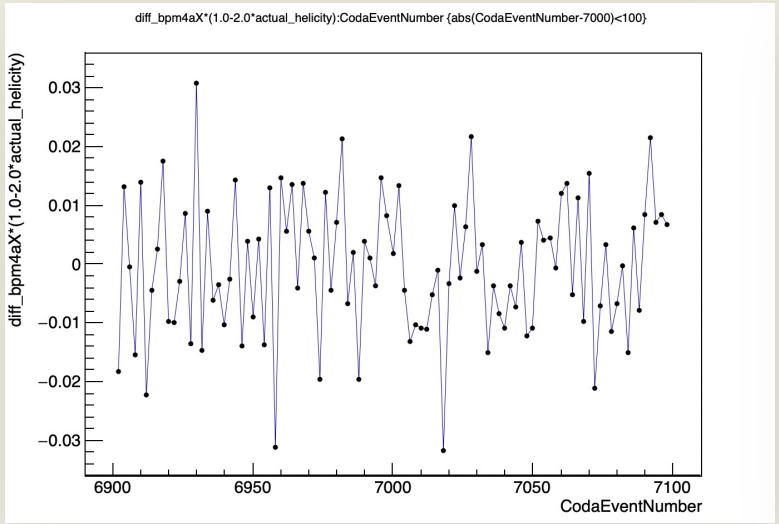


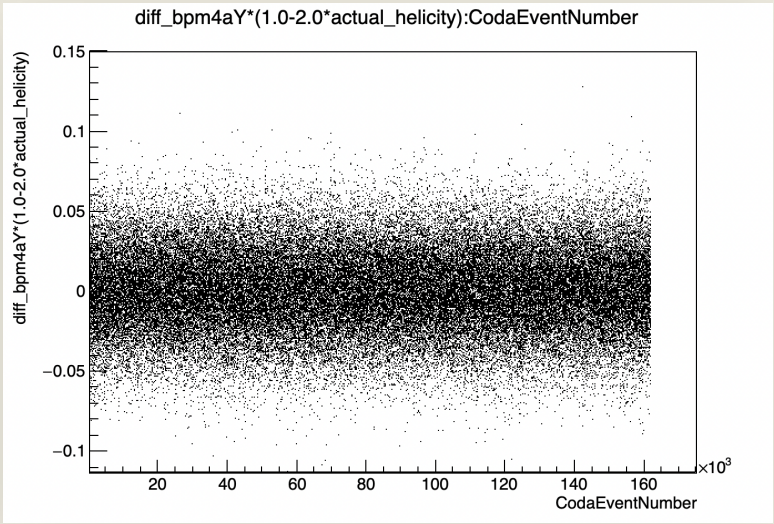
16077 FFB on Diff_bpm4aX and 4aY 1920Hz

- Here are the pair plots for bpm4aX and bpm4aY.
- The left are for CodaEventNumber around 7000 ± 100.
- The right are all range.
- We can not see a clear pattern for the noise. It is hard to say we have a 60hz noise



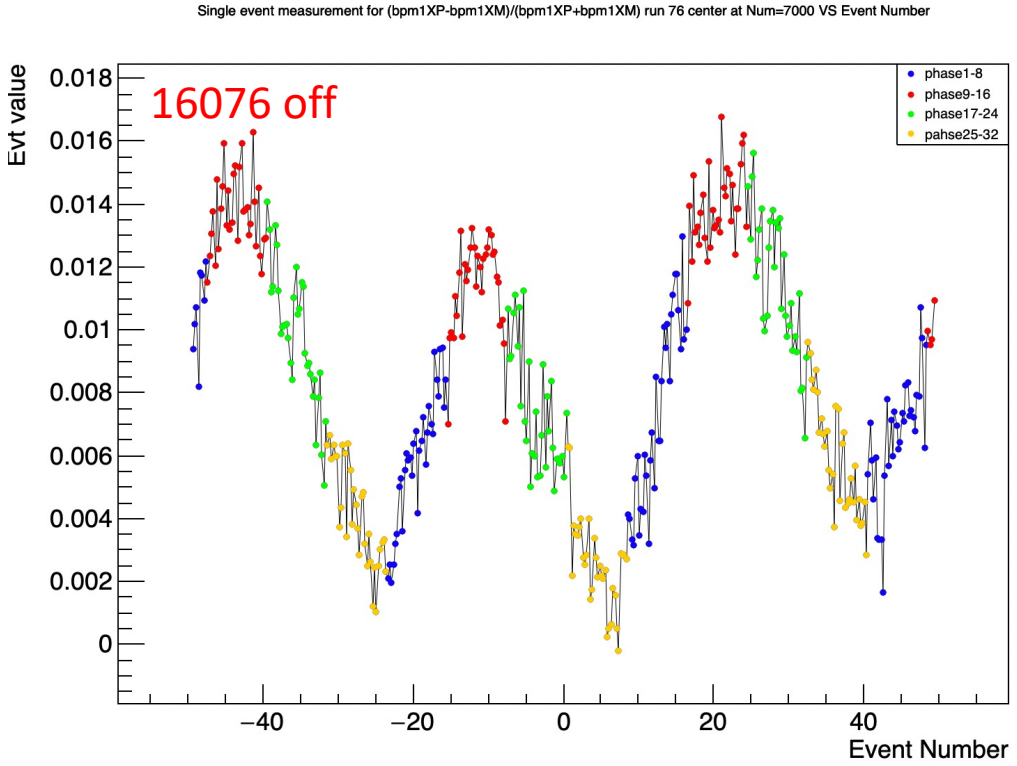


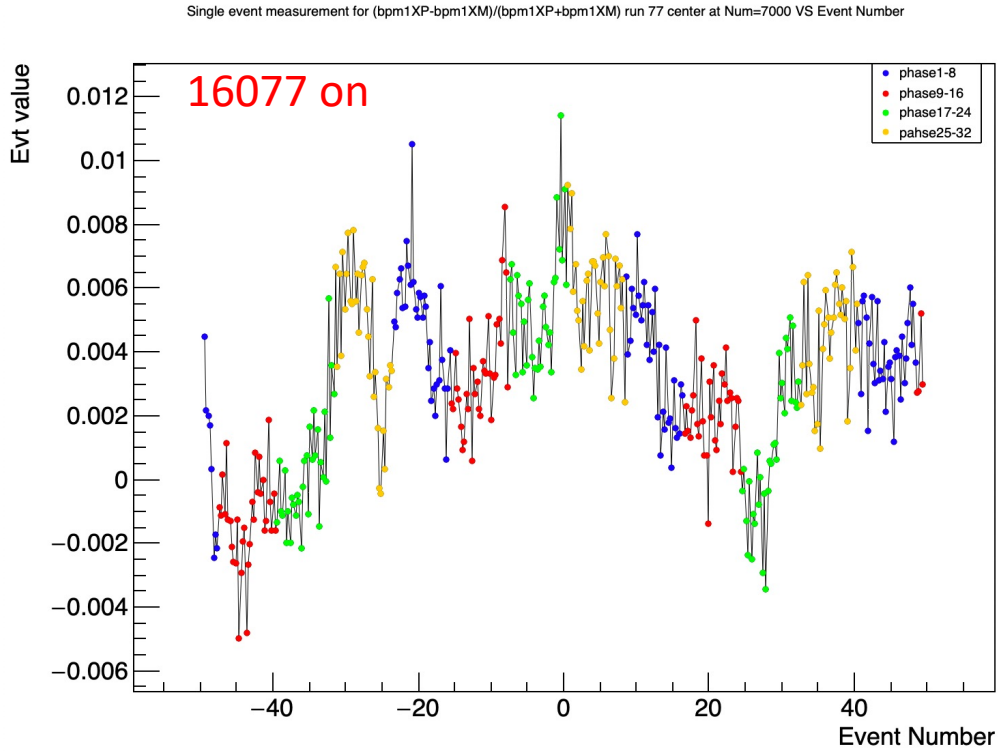




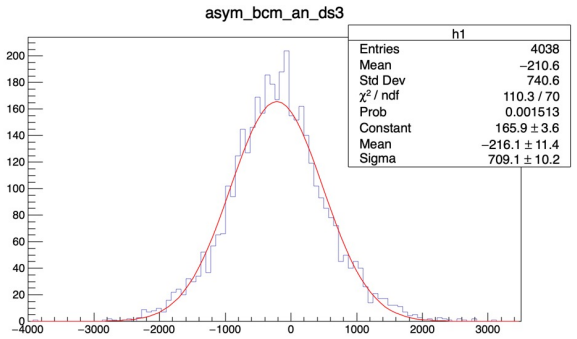
Asym for bpm1X (XP-XM)/(XP+XM) for run 16076 FFB off and 16077 FFB on. Frequency 1920 Hz

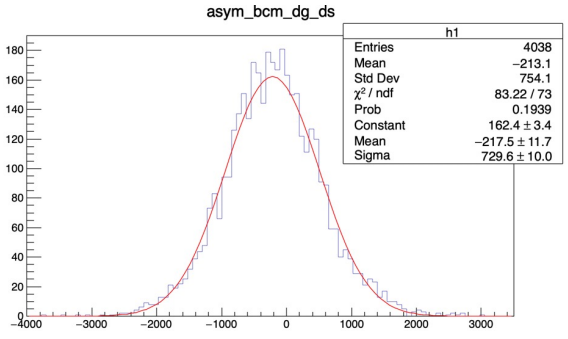
A single BPM wire pair, at 1H01, is the only other readout. Note that fast noise is also visible here, before raster.

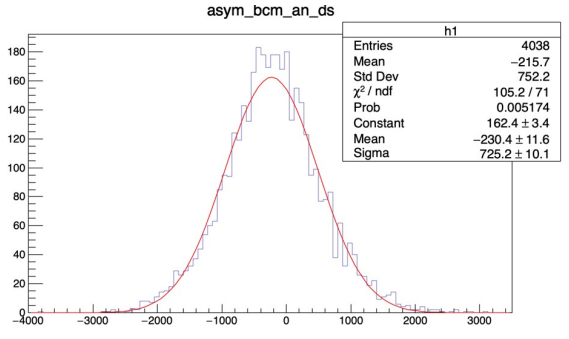


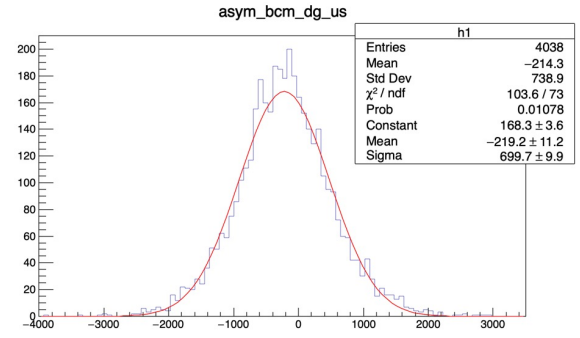


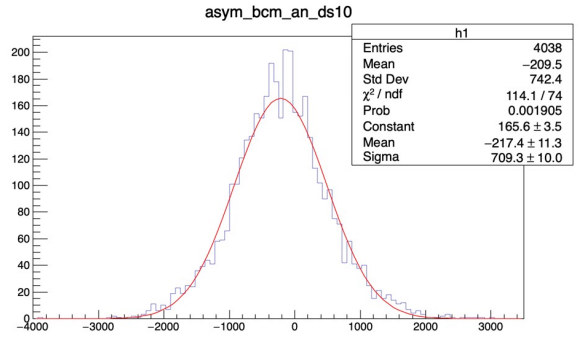
Backup





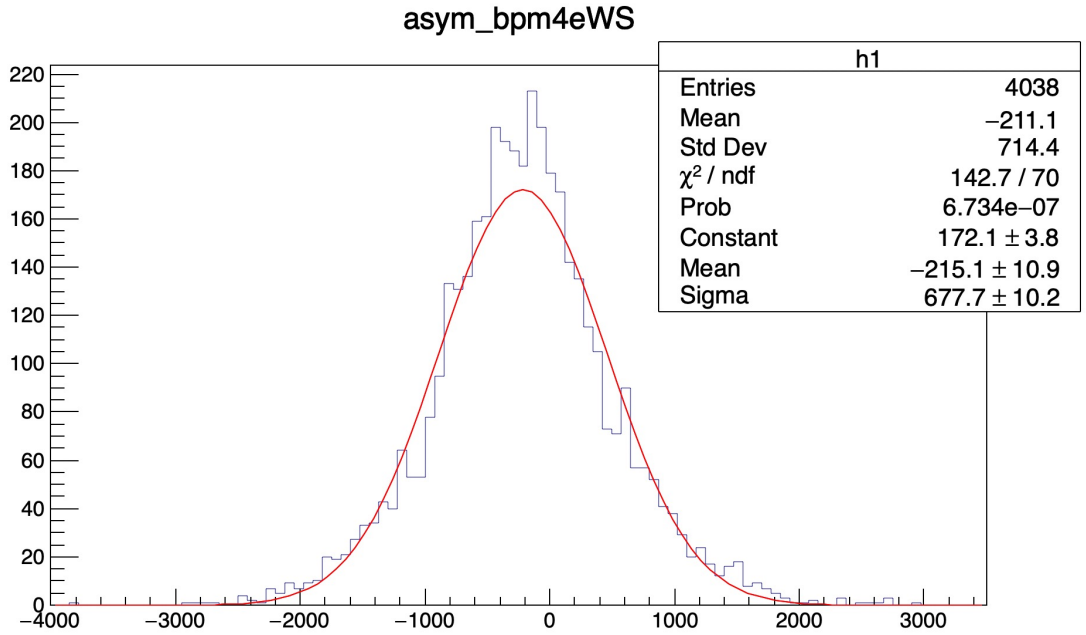


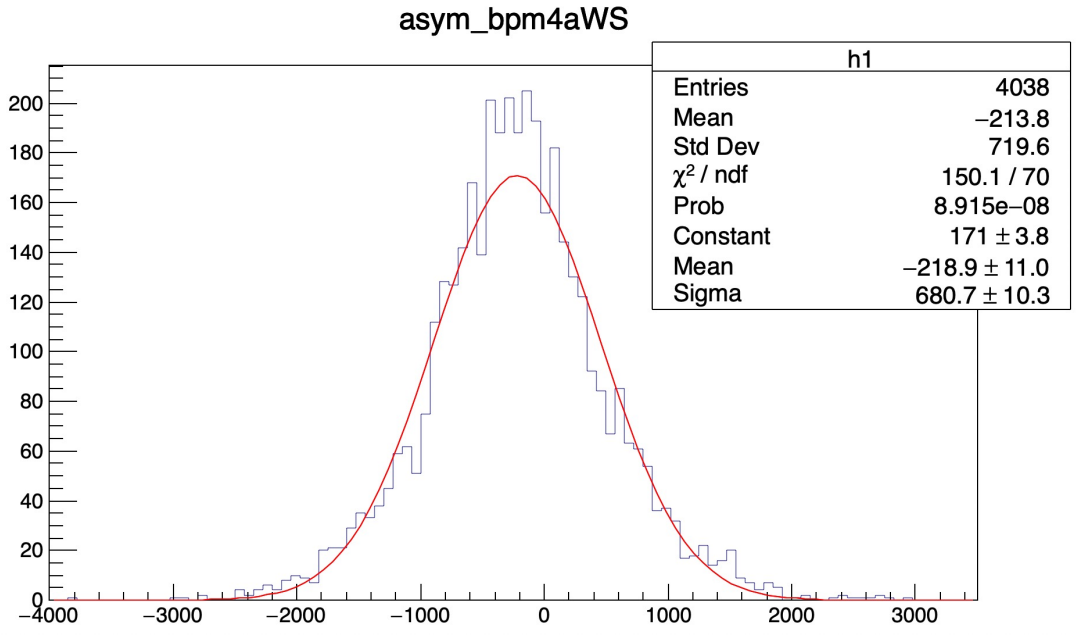


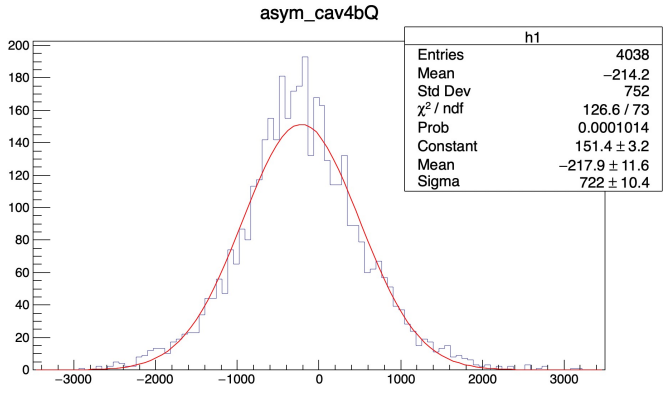


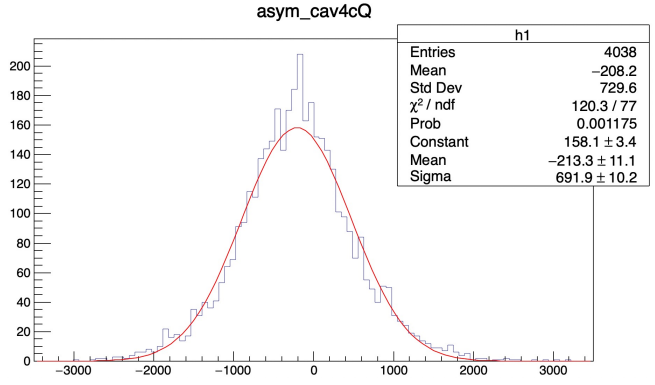
BCMs in calibration run 16069

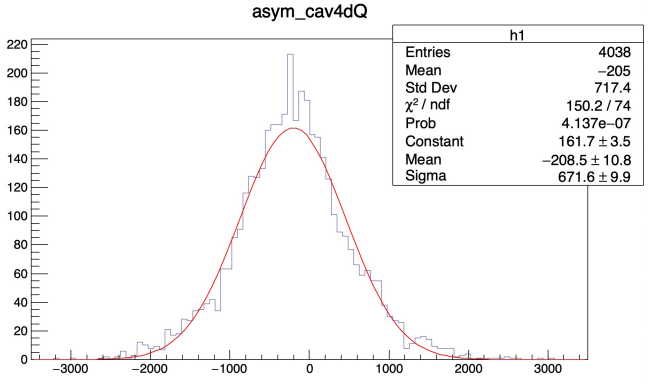
- I am currently utilizing scandata1 to plot current versus hw_sum. I identify the first pedestal using bcm_an_ds3 and then compare the remaining data with bcm_an_ds3 to determine their respective pedestal
- Asym for different bcm read out
- Beam current for 8 uA and 9 uA
- FFB on
- 240 Hz: HelBoard: 100us Tsettle, 4066.65us Tstable, Octet, 16 windows delay; HAPTB command: "setTimeHAPTB(30, 1400)"; VQWK vqwksamples=505.


asym_bpm4eWS
h1
Entries 4038
Mean −211.1
Std Dev 714.4
χ² / ndf 142.7 / 70
Prob 6.734e−07
Constant 172.1 ± 3.8
Mean −215.1 ± 10.9
Sigma 677.7 ± 10.2


asym_bpm4aWS
h1
Entries 4038
Mean −213.8
Std Dev 719.6
χ² / ndf 150.1 / 70
Prob 8.915e−08
Constant 171 ± 3.8
Mean −218.9 ± 11.0
Sigma 680.7 ± 10.3


asym_cav4bQ
h1
Entries 4038
Mean −214.2
Std Dev 752
χ² / ndf 126.6 / 73
Prob 0.0001014
Constant 151.4 ± 3.2
Mean −217.9 ± 11.6
Sigma 722 ± 10.4


asym_cav4cQ
h1
Entries 4038
Mean −208.2
Std Dev 729.6
χ² / ndf 120.3 / 77
Prob 0.001175
Constant 158.1 ± 3.4
Mean −213.3 ± 11.1
Sigma 691.9 ± 10.2


asym_cav4dQ
h1
Entries 4038
Mean −205
Std Dev 717.4
χ² / ndf 150.2 / 74
Prob 4.137e−07
Constant 161.7 ± 3.5
Mean −208.5 ± 10.8
Sigma 671.6 ± 9.9