PQB Meeting

5/5/2016

PC History effect

- Pairsynch Pickup problem wasn’t all pairsynch pickup
- ~300ppm level decays in beam current during 30ms helicity window
- ~500ppm level shifts in beam current depending on flip sequence history
- ~1000ppm combined variation in charge asymmetry due to natural PC behavior when flipping at 30Hz
- PC History effect likely reduced by flipping more frequently
- PC History effect Aq variation can be harnessed as a PITA-scan like monitor check

Lisa's Thesis

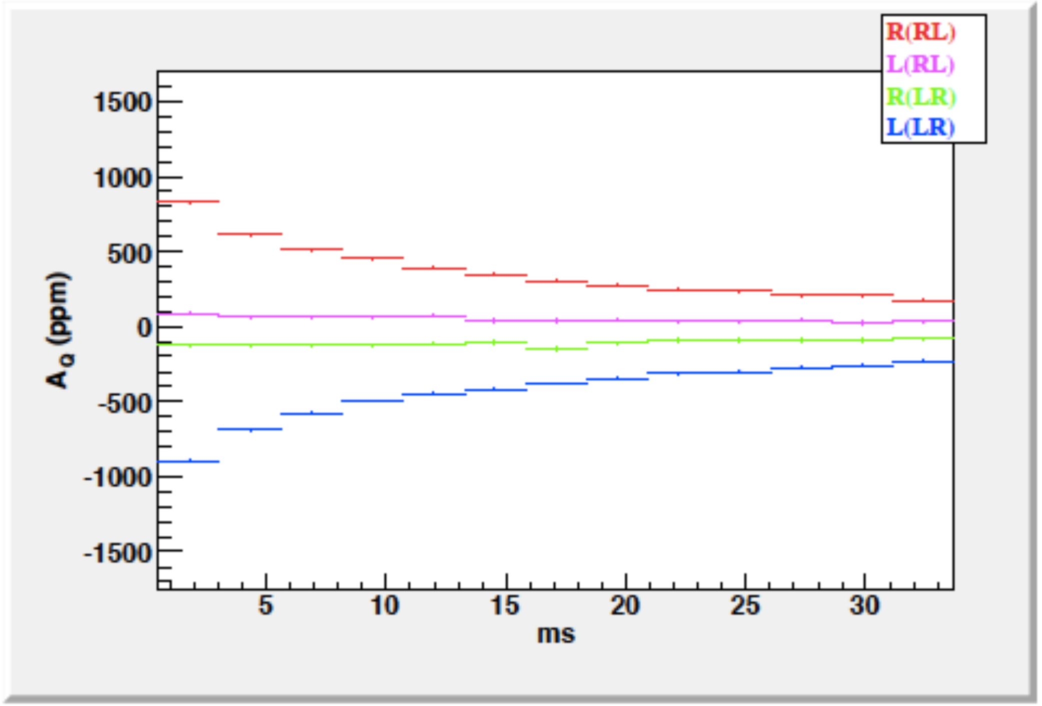


Figure 4.4. The charge asymmetry (ppm) versus time (ms) within a helicity window.

Lisa’s Thesis

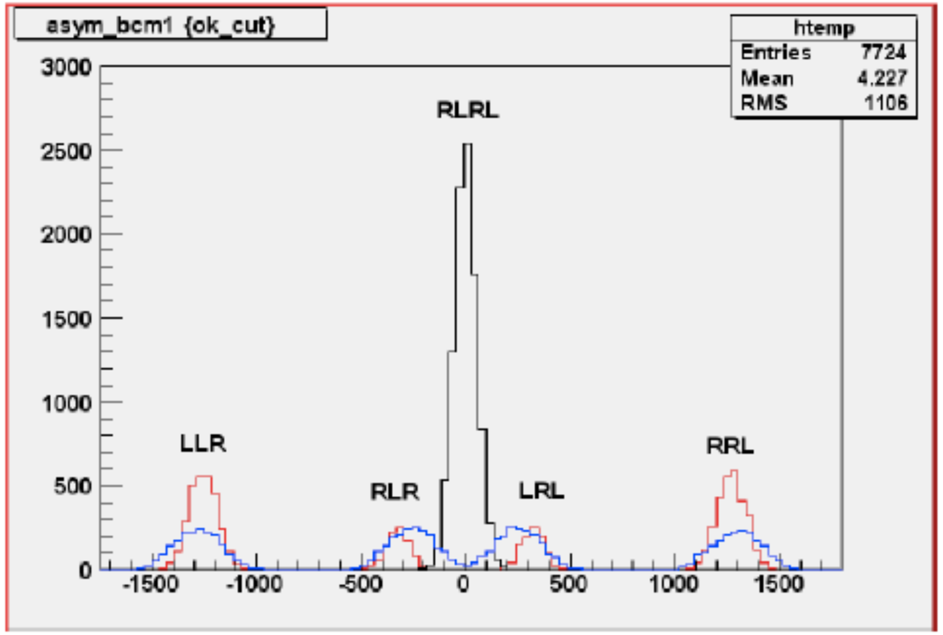
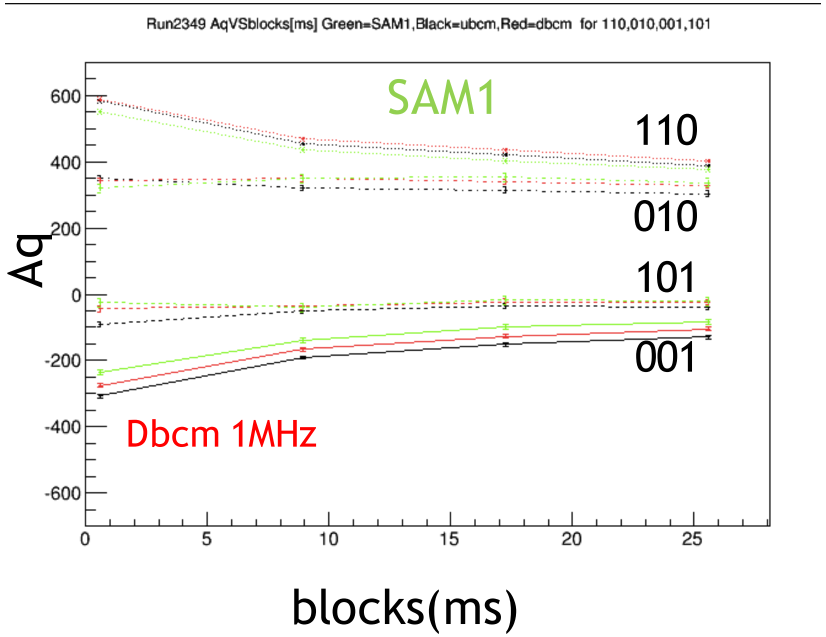
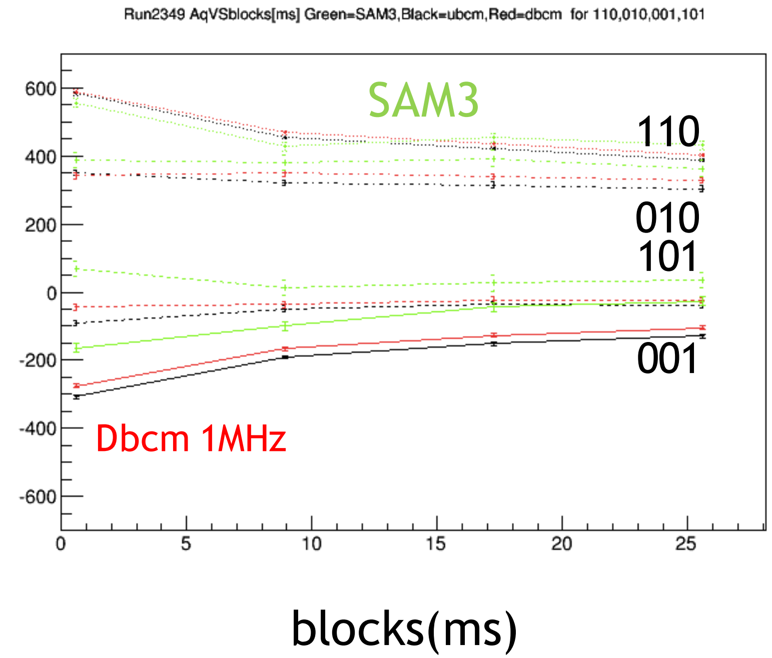
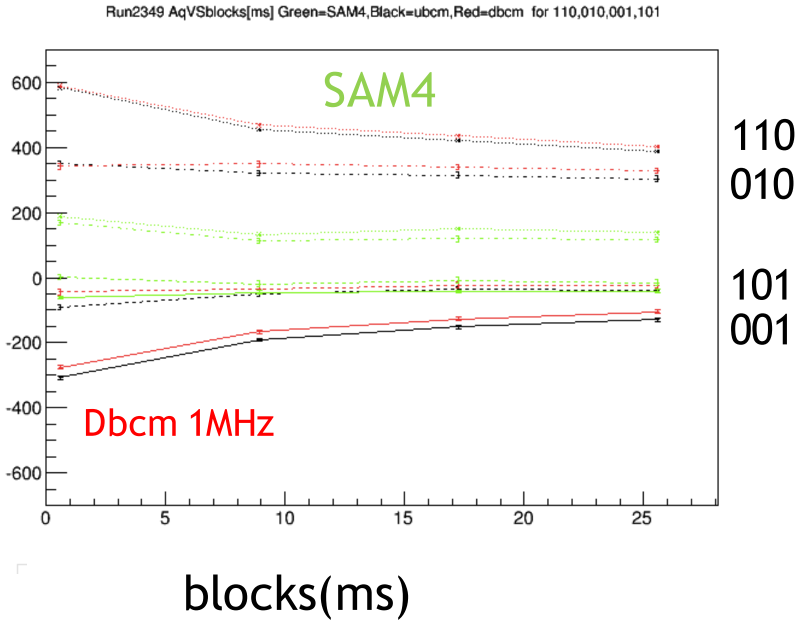
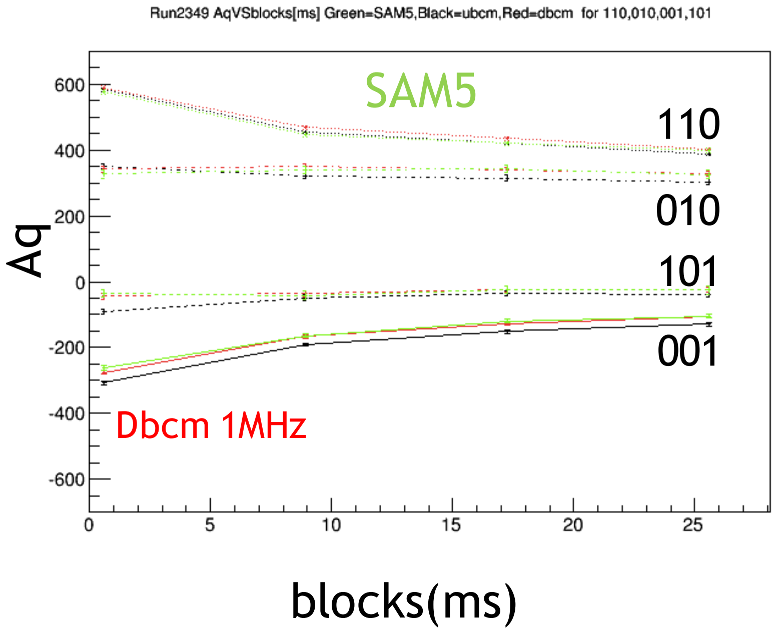


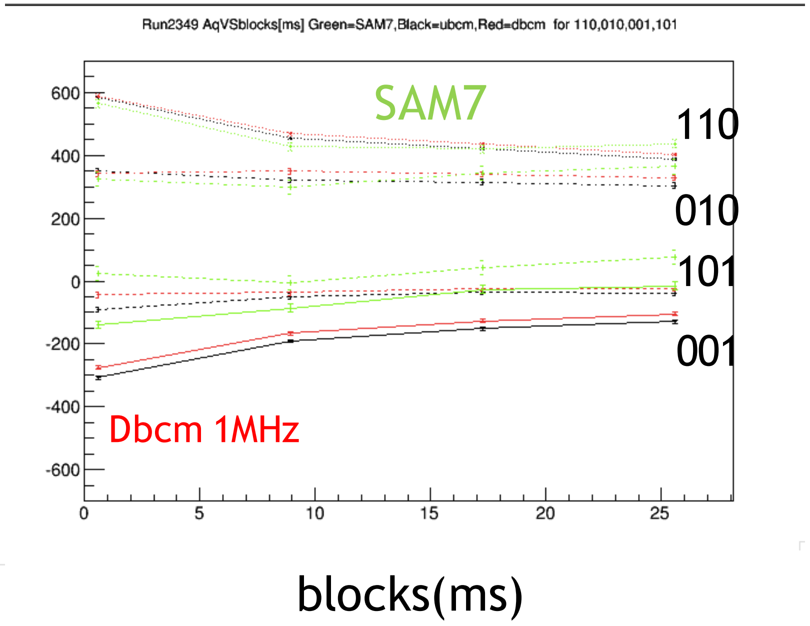
Figure 4.5. The multipeak structure of A_Q is shown for the quad-random (red), pair-random (blue), and pair-toggle (black) helicity patterns. The asymmetry is plotted in units of ppm.

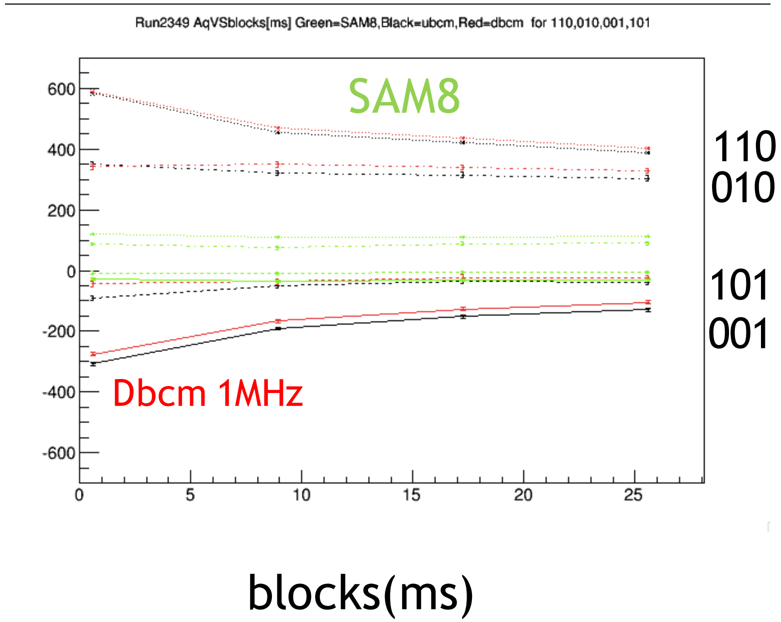

Run2349 AqVSblocks[ms] Green=SAM1,Black=ubcm,Red=dbcm for 110,010,001,101
SAM1
110
010
101
001
Dbcm 1MHz
Aq
blocks(ms)


Run2349 AqVSblocks[ms] Green=SAM3,Black=ubcm,Red=dbcm for 110,010,001,101
SAM3
110
010
101
001
Dbcm 1MHz
blocks(ms)


Run2349 AqVSblocks[ms] Green=SAM4,Black=ubcm,Red=dbcm for 110,010,001,101
SAM4
110
010
101
001
Dbcm 1MHz
blocks(ms)

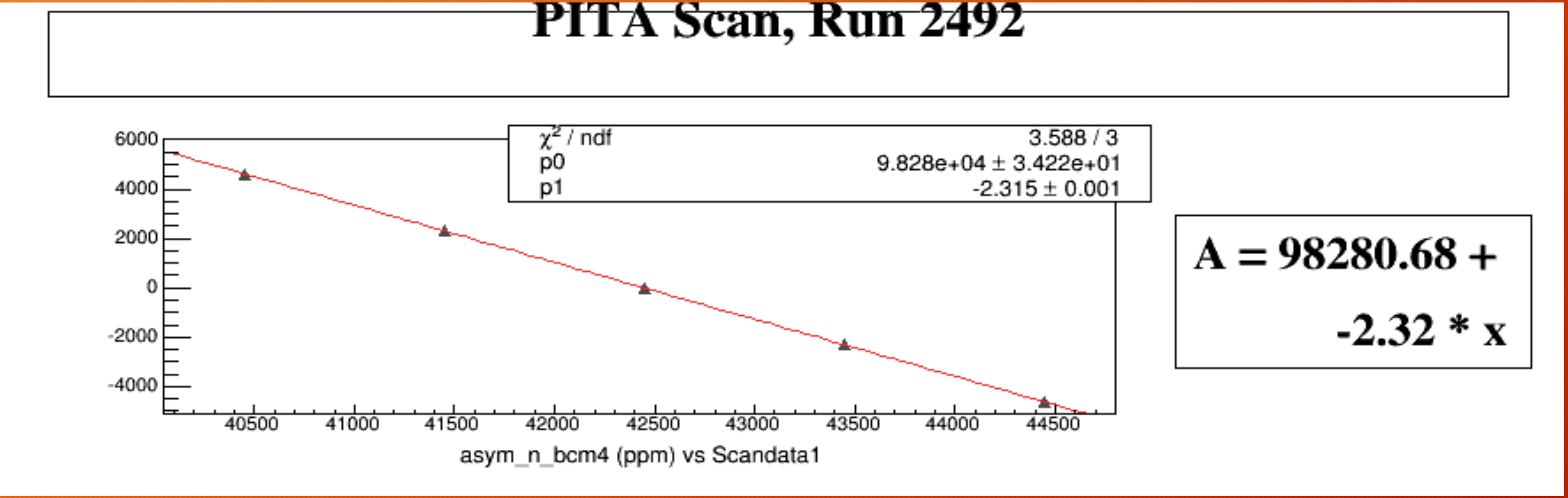

Run2349 AqVSblocks[ms] Green=SAM5,Black=ubcm,Red=dbcm for 110,010,001,101
SAM5
110
010
101
001
Dbcm 1MHz
Aq
blocks(ms)

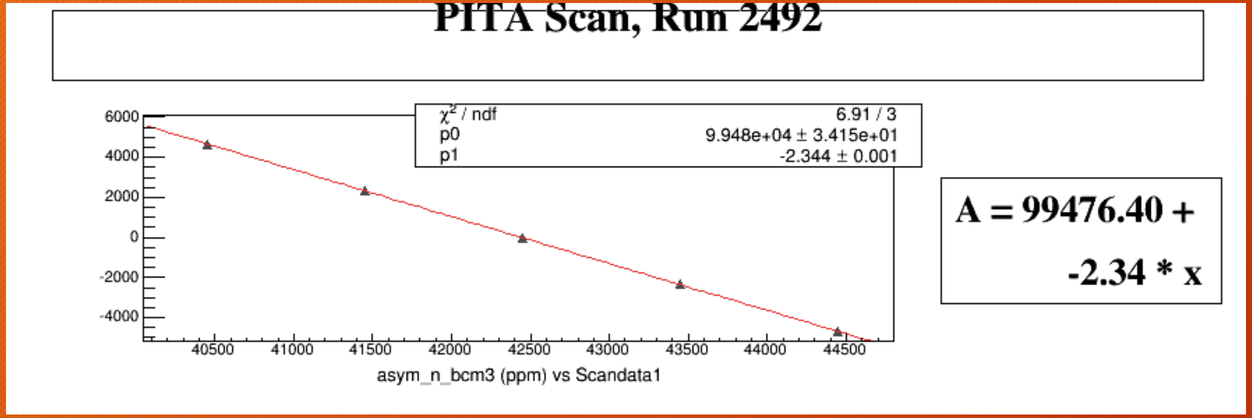

Run2349 AqVSblocks[ms] Green=SAM7,Black=ubcm,Red=dbcm for 110,010,001,101
SAM7
110
010
101
001
Dbcm 1MHz
blocks(ms)

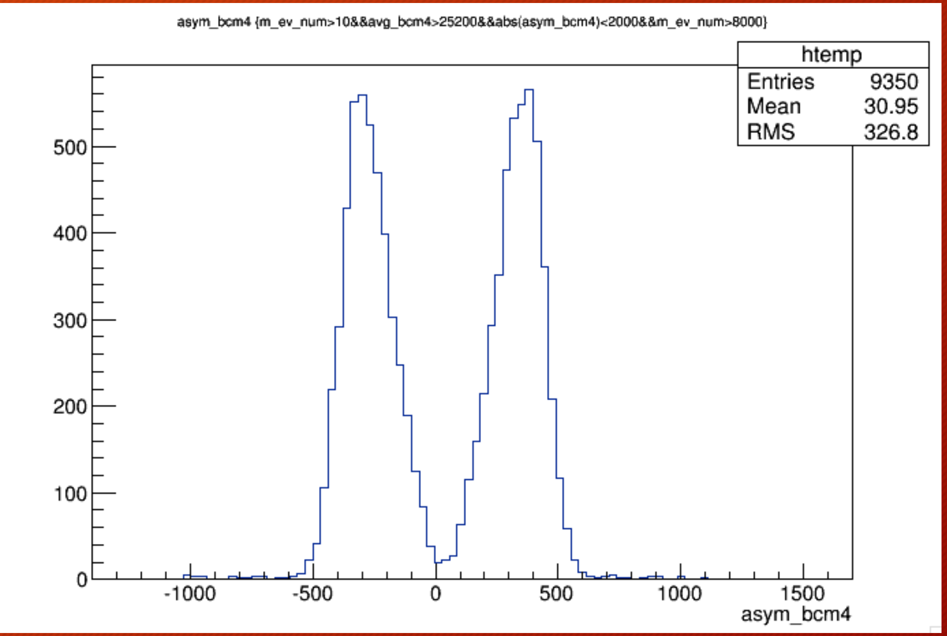

Run2349 AqVSblocks[ms] Green=SAM8,Black=ubcm,Red=dbcm for 110,010,001,101
SAM8
110
010
101
001
Dbcm 1MHz
blocks(ms)

PITA scan

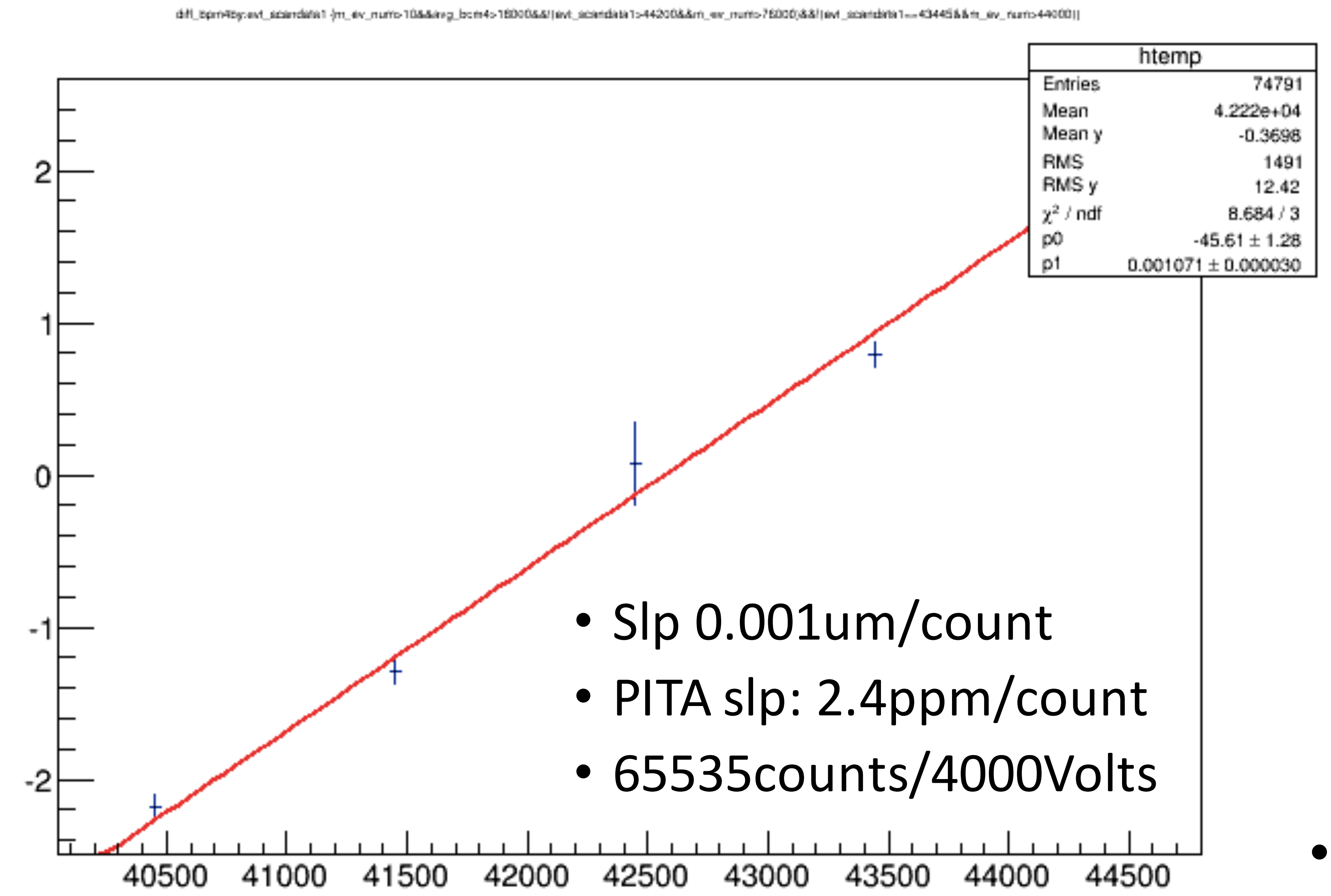
- Ciprian got a PITA scan
- 30Hz, IHWP in, +- 2000 counts (65535counts/4000V conversion factor)
- 1MHz dbcm indicates PITA slope of -38ppm/V (+-2000ppm measurement)
- LH2 target in, SAMs on, ~40-45uA
- Position Differences – go through 0 for some Voltages


PITA Scan, Run 2492
χ² / ndf 3.588 / 3
p0 9.828e+04 ± 3.422e+01
p1 -2.315 ± 0.001
6000
4000
2000
0
-2000
-4000
40500
41000
41500
42000
42500
43000
43500
44000
44500
asym_n_bcm4 (ppm) vs Scandata1
A = 98280.68 +
-2.32 * x


PITA Scan, Run 2492
χ² / ndf 6.91 / 3
p0 9.948e+04 ± 3.415e+01
p1 -2.344 ± 0.001
6000
4000
2000
0
-2000
-4000
40500
41000
41500
42000
42500
43000
43500
44000
44500
asym_n_bcm3 (ppm) vs Scandata1
A = 99476.40 +
-2.34 * x


asym_bcm4 {m_ev_num>10&&avg_bcm4>25200&&abs(asym_bcm4)<2000&&m_ev_num>8000}
htemp
Entries 9350
Mean 30.95
RMS 326.8
500
400
300
200
100
0
-1000
-500
0
500
1000
1500
asym_bcm4

PITA scan



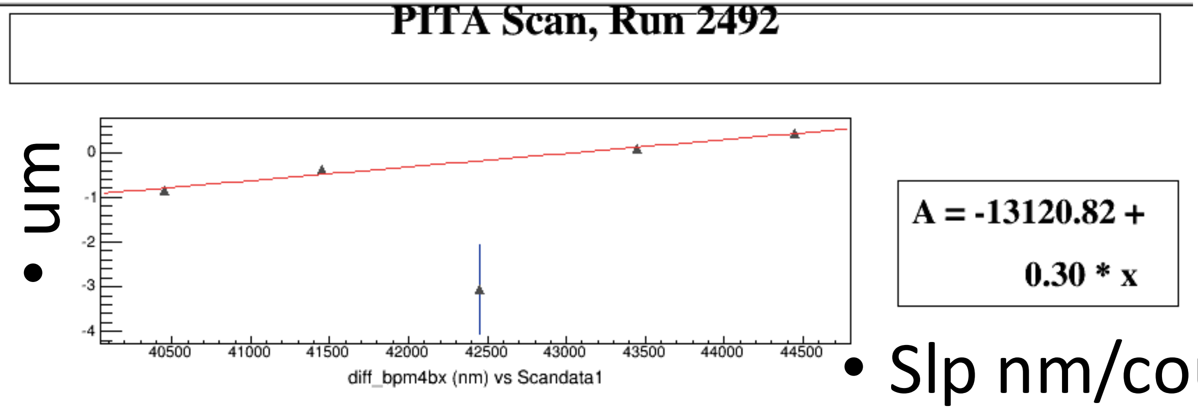
- Diff bpm4by[um]
- Slp 0.001um/count
- PITA slp: 2.4ppm/count
- 65535counts/4000Volts
- HV+ counts

PITA Scan

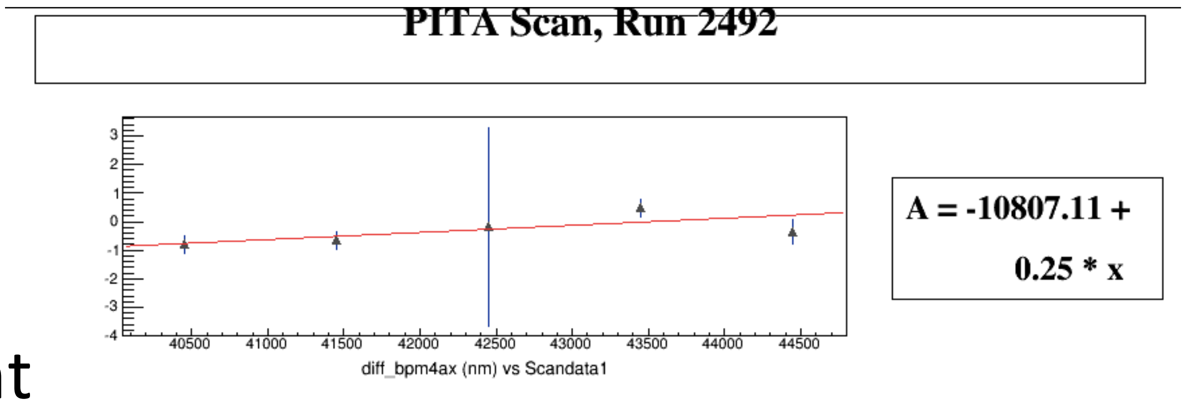
m_ev_num>10&&avg_bcm4>18000&&!(evt_scandata1>44200&&m_ev_num>76000)&&!(evt_scandata1==43445&&m_ev_num>44000)

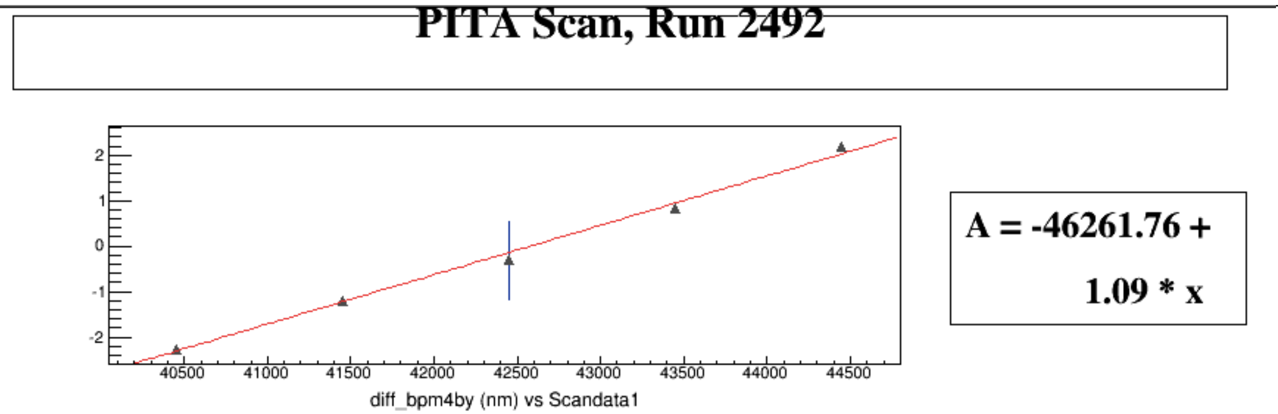
-2.34ppm/count

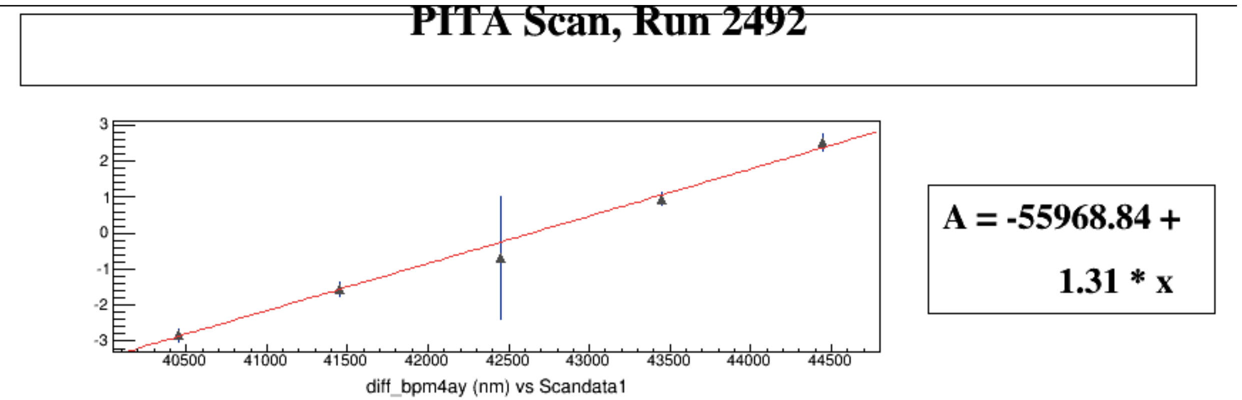
- um



- Slp nm/count



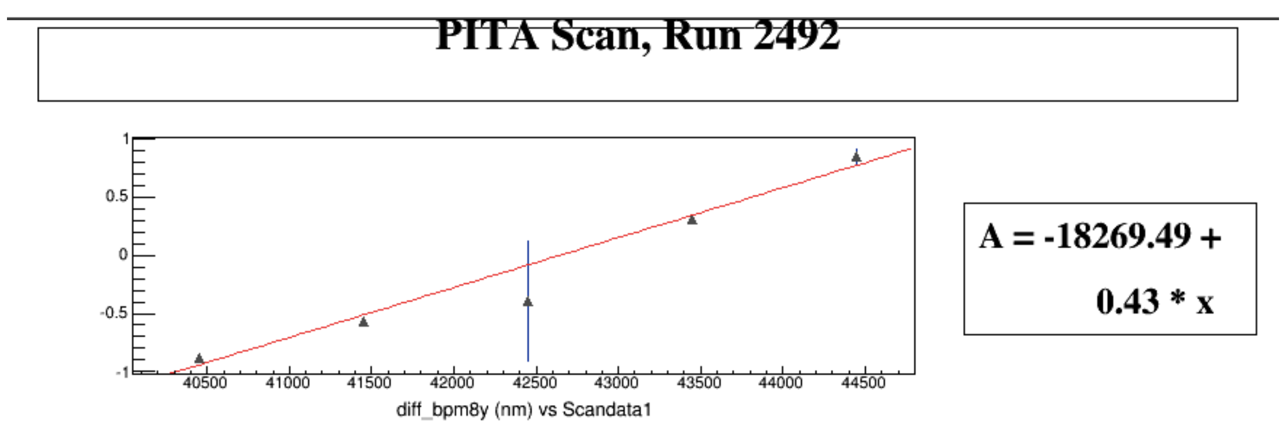


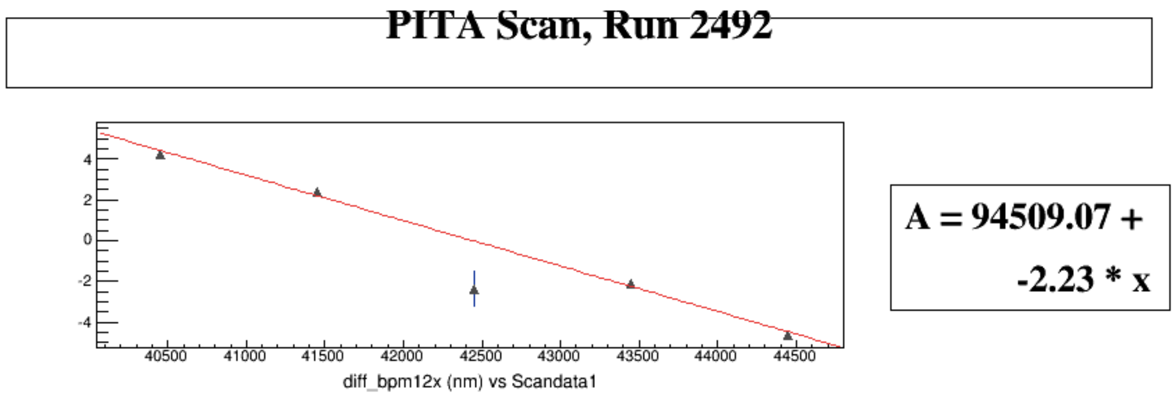


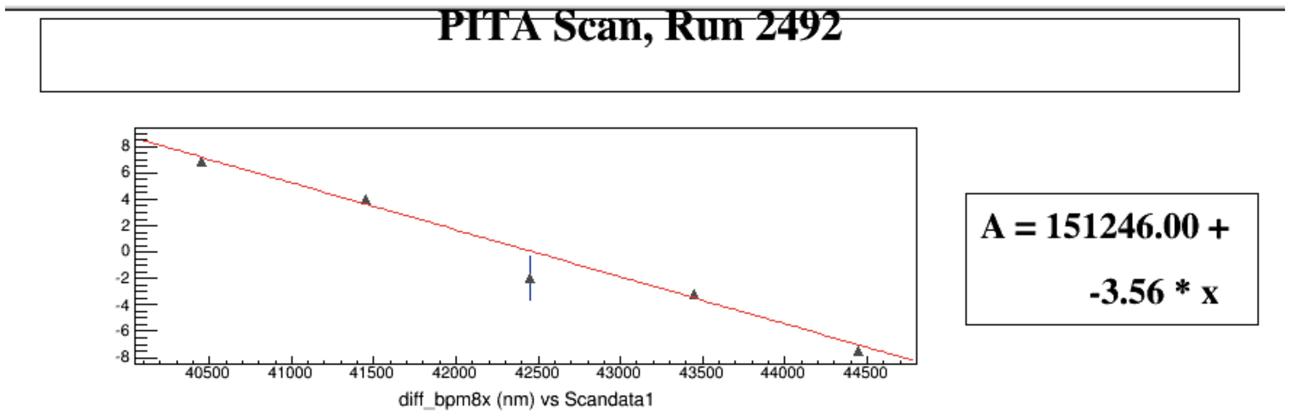
PITA Scan

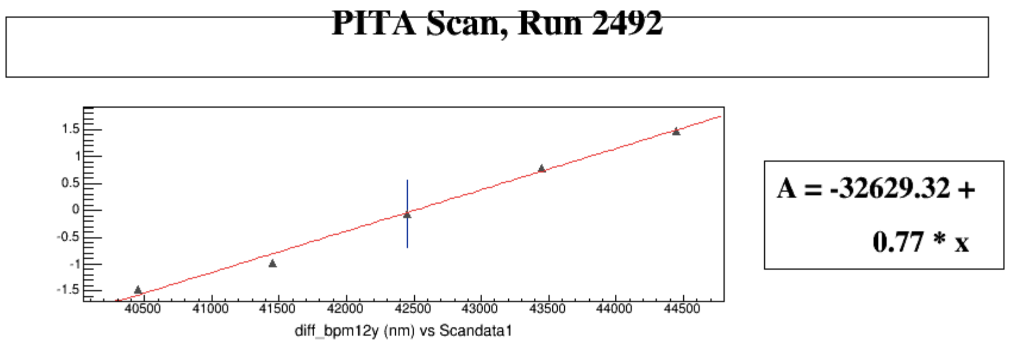
```
m_ev_num>10&&avg_bcm4>18000&&!(evt_scandat
a1>44200&&m_ev_num>76000)&&!(evt_scandata1
==43445&&m_ev_num>44000)
```

-2.34ppm/count





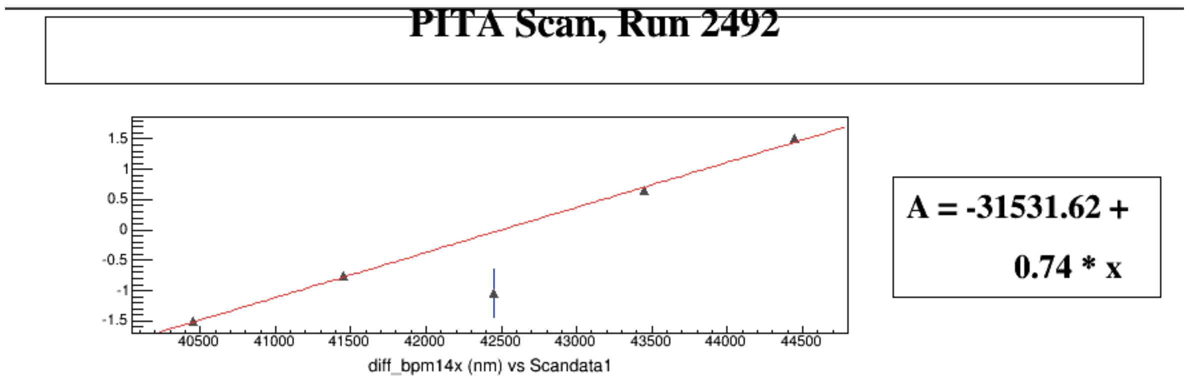


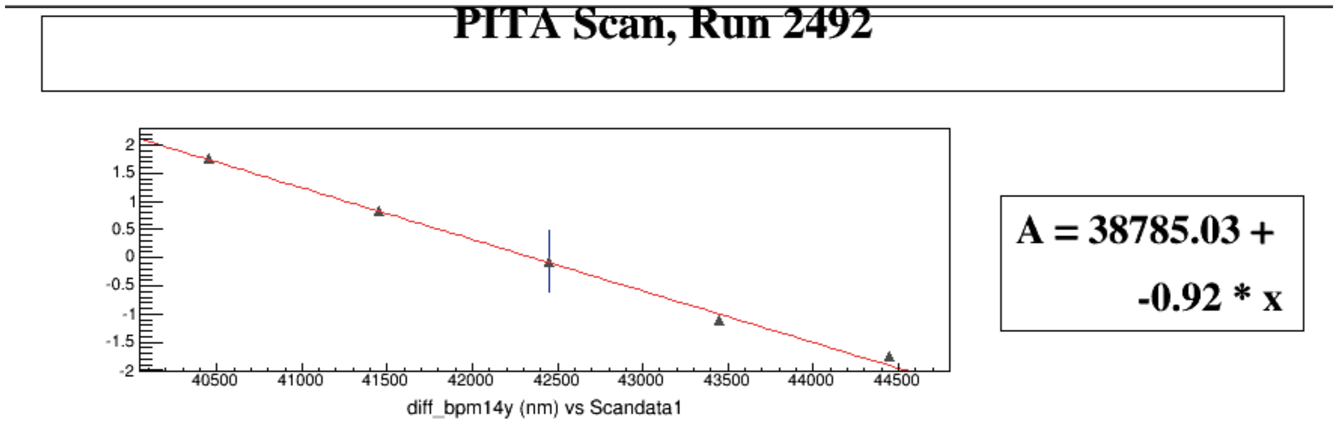


PITA Scan

```
m_ev_num>10&&avg_bcm4>18000&&!(evt_scandata1>44200&&m_ev_num>76000)&&!(evt_scandata1==43445&&m_ev_num>44000)
```

-2.34ppm/count





BPM and BCM noise

- Examine at 30Hz, 30Hz PS[0]=0, and 120Hz (ps=0)with subblocks
- Examine injector at 30Hz, 1kHz with samples per block set low and examining subblocks ps=0

8.8GeV, 45uA, 30Hz flip rate – Aq 40ppm

Run2498

1MHz down bcm:

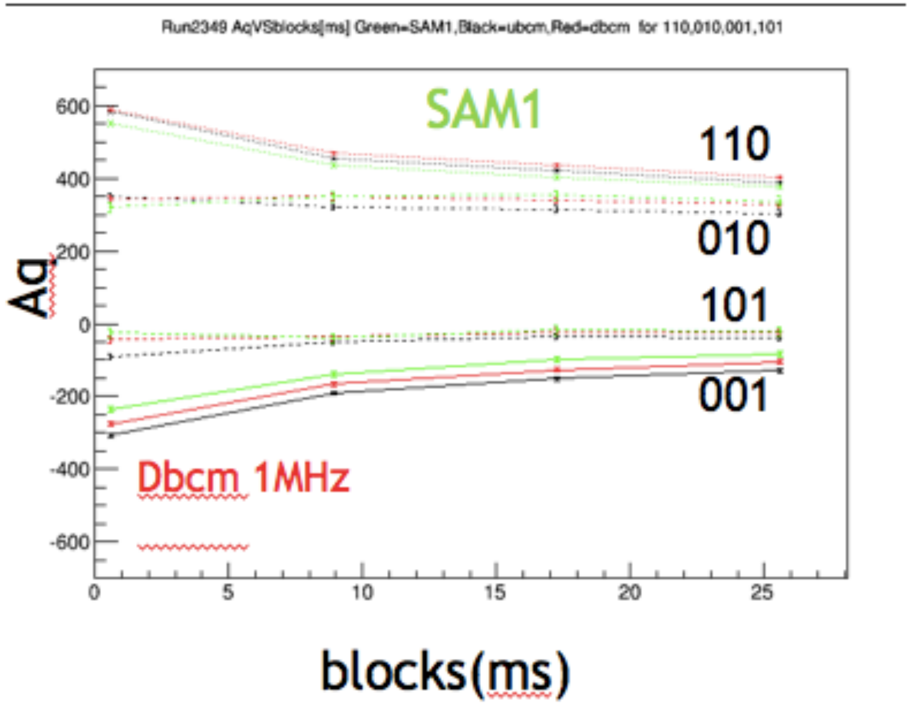
30Hz: Aq=42.7ppm (RMS 314ppm)

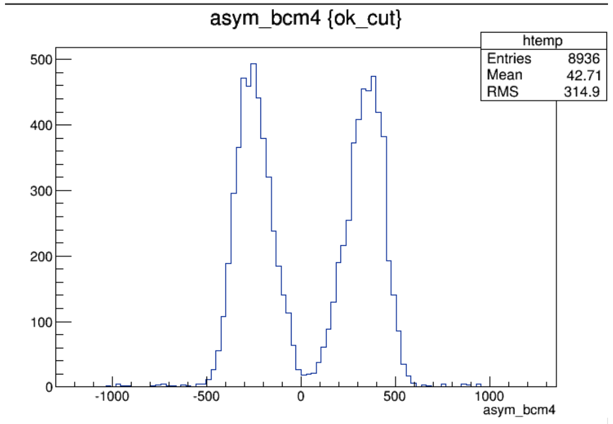
30Hz(PS=0): Aq (RMS 116.4ppm)

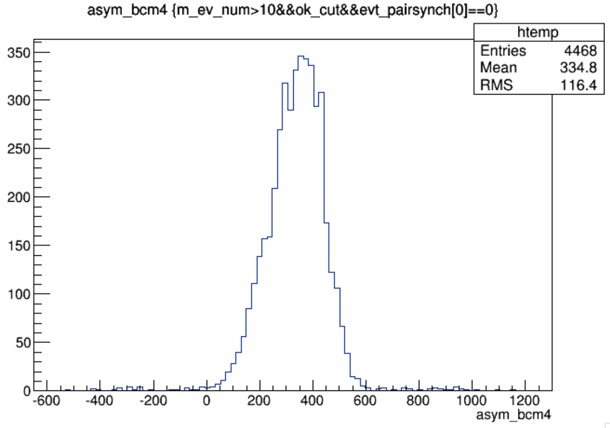
120Hz(blocks PS=0): Aq (RMS 483.2ppm) b1-b2/sum sensitive to 60Hz

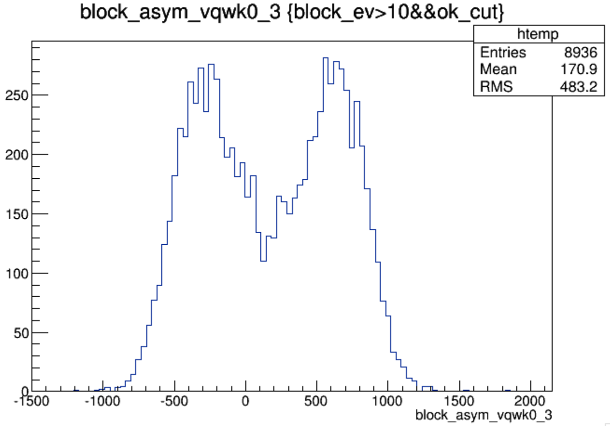
120Hz: Aq (RMS 96.99ppm)- 1/2(b1-b2/sum+b4-b3/sum)

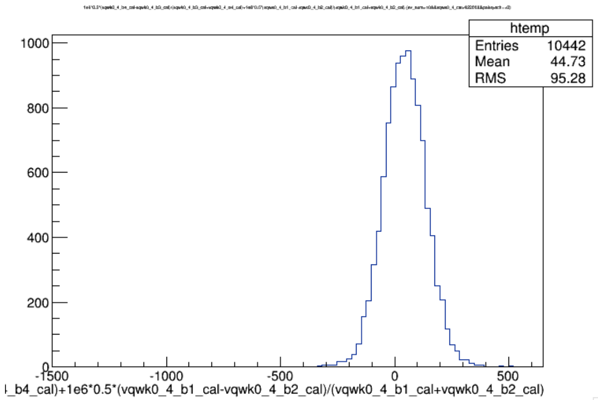
120Hz(PS=0): Aq (RMS 95.28ppm) - 1/2(b1-b2/sum+b4-b3/sum)











30Hz,60Hz,120Hz? Run2333 4.4GeV, 12uA The 1MHz system

			b1+b2-b4-b3/sum	1/2((b1-b2)/sum+(b4-b3)/sum)	b1-b2/sum
	30Hz RMS	30Hz *sqrt(2)	60Hz combo	120Hz combo	120Hzcombo
(<SAMpair15>-<SAMpair37>) RMS	160.9	227.5	211.4	206.5	298.0
(<SAMpair15>-dbcmnew) RMS	306.5	433.5	629.3	636.5	4318.0
(<SAMpair15>-dbcm1MHz) RMS	188.4	266.4	244.9	220.9	340.8
dbcm1MHz RMS	**576.4**	**815.1**	**774.3**	**548.9**	3013.0
(<SAMpair15>-<SAMpair37>) Mean and RMS PS[0]=0	145.0	205.1	211.1	205.6	297.4
ubcm1MHz -dbcm1MHz Mean and RMS	75.0	106.0	93.5	85.6	206.8
sqrt((<SAMpair15>-dbcmnew)^2-(<SAMpair15>-dbcm1MHz) ^2)	241.8	341.9	579.7	596.9	4304.5

- As we up the frequency… things improve
- DD in 1MHz system beats sqrt(2) statistics from 1/2data-> as we increase rep rate, we are 'winning' in that the level of noise at 30Hz is more than at 60Hz, 120Hz
- SAM normalized widths (after factoring in sqrt(2) from ½ data), decrease with frequency – we are 'winning' at higher frequencies in terms of noise

10GeV, 15uA, 30Hz flip rate – position differences RMS 10um

30Hz flip rate

Run2434

diff_bpm4ax : RMS width 10.39um
diff_bpm4ay : RMS width 10.39um
diff_bpm4bx : RMS width 12.91um
diff_bpm4by: RMS width 10.03um
diff_bpm8x: RMS width 21.27um
diff_bpm8y : RMS width 9.76um
diff_bpm12x: RMS width 13.39um
diff_bpm12y: RMS width 21.99um
diff_bpm14x: RMS width 6.55um
diff_bpm14y : RMS width 6.97um

30Hz PS=0

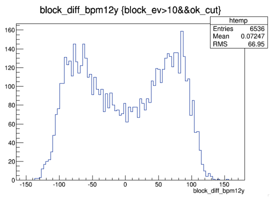
Run2434

diff_bpm4ax : RMS width 10.30um
diff_bpm4ay : RMS width 10.31um
diff_bpm4bx : RMS width 12.8um
diff_bpm4by: RMS width 10.01um
diff_bpm8x: RMS width 21.56um
diff_bpm8y : RMS width 9.76um
diff_bpm12x: RMS width 13.58um
diff_bpm12y: RMS width 21.91um
diff_bpm14x: RMS width 6.54um
diff_bpm14y : RMS width 6.97um

b1-b2/sum

Sensitive to 60Hz noise

120Hz PS=0



Run2434

diff_bpm4ax : RMS width 12.78um
diff_bpm4ay : RMS width 12.79um
diff_bpm4bx : RMS width 18.66um
diff_bpm4by: RMS width 16.34um
diff_bpm8x: RMS width 34.27um
diff_bpm8y : RMS width 36.33um
diff_bpm12x: RMS width 19.40um
diff_bpm12y: RMS width 66.9um
diff_bpm14x: RMS width 10.34um
diff_bpm14y : RMS width 15.07um

1/2(b1-b2/sum+b4-b3/sum)

Statistically ->2x larger RMS beat statistical expectation

120Hz

Run2434

diff_bpm4ax : RMS width 6.16um
diff_bpm4ay : RMS width 17.38um
diff_bpm4bx : RMS width 10.45um
diff_bpm4by: RMS width 23.85um
diff_bpm8x: RMS width 22.87um
diff_bpm8y : RMS width 47.04um
diff_bpm12x: RMS width 13.80um
diff_bpm12y: RMS width 27.82um
diff_bpm14x: RMS width 4.75um
diff_bpm14y : RMS width 13.77um

Injector Run1905 8.8GeV, 60uA

1/2(b1-b2/sum+b4-b3/sum)

- 30Hz: Aq=41.48ppm (RMS 220ppm)
- (samples 4*4041=16164)
- 30Hz: bpm1I06x : RMS 3.826um
- 30Hz: bpm1I06y RMS 2.407um
- 30Hz: bpm0L10x RMS 11.34um
- 30Hz: bpm0L10y RMS 1.678um

- 120HzAq (RMS 212.7ppm) - insensitive to 60Hz
- 120Hz(ps0=0): Aq (RMS 261.5ppm)
- 120Hz: bpm1I06x : RMS 3.13um
- 120Hz: bpm1I06y RMS 8.91um
- 120Hz: bpm0L10x RMS 18.90um
- 120Hz: bpm0L10y RMS 23.36um

Injector Run1902 8.8GeV, 60uA

- Samplesperblock 441 b1-b2: 1.13kHz: Aq= (RMS 531.3ppm)
- 1.13kHz: bpm1I06x b1-b2: RMS 6.06um
- 1.13kHz: bpm1I06y b1-b2: RMS 12.43um
- 1.13kHz: bpm0L10x b1-b2: RMS 16.48um
- 1.13kHz: bpm0L10y b1-b2: RMS 13.4um