

BPM status

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1. raw signal received in antenna VS recorded ADC data(linear region):

$$\phi = f(A_+ - A_{0+}) = a(A_+ - A_{0+} + b)$$

2. rewritten diff/sum value(temp value):

$$x_b = \frac{(A_+ - A_{0+} + b_+) - g_x(A_- - A_{0-} + b_-)}{(A_+ - A_{0+} + b_+) + g_x(A_- - A_{0-} + b_-)}$$

3. nonlinearity correction for diff/sum(temp value):

$$x = rx_b \left(\frac{1}{x_b^2 + y_b^2} - \frac{1}{\sqrt{x_b^2 + y_b^2}} \sqrt{\frac{1}{x_b^2 + y_b^2} - 1} \right)$$

4. Calibrate with harp data

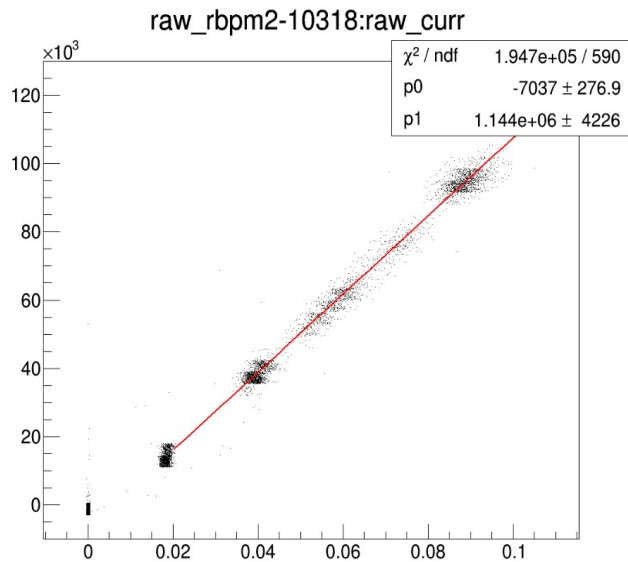
$$x_{harp} = c_0 + c_1 x + c_2 y$$

$$y_{harp} = c_0' + c_1' y + c_2' x$$

Position from harp, already transfered to BPM local coordinate(use su

Constants

$$\phi = f(A_+ - A_{0+}) = a(A_+ - A_{+0} + b)$$



b: got from linear fit for current VS recorded ADC data

- Some bpm calibrations did the calibration for several currents
- Each harp scan position(one point) corresponding to several runs with different current(100nA,75nA,50nA)
- Assumption: those runs with different current have same beam position
- Influence: key parameter to eliminate the current effect, let calculated position immune to fluctuating current(50~100nA), especially for the difference of $b_+ - b_-$

Constants

$$x_b = \frac{(A_+ - A_{0+} + b_+) - g_x(A_- - A_{0-} + b_-)}{(A_+ - A_{0+} + b_+) + g_x(A_- - A_{0-} + b_-)}$$

$$x_{harp} = c_0 + c_1 x + c_2 y$$

c_0 and g_x :

- Influence: affect calculated center position, can be replaced each other
i.e. set special g_x to let $c_0 \rightarrow 0$

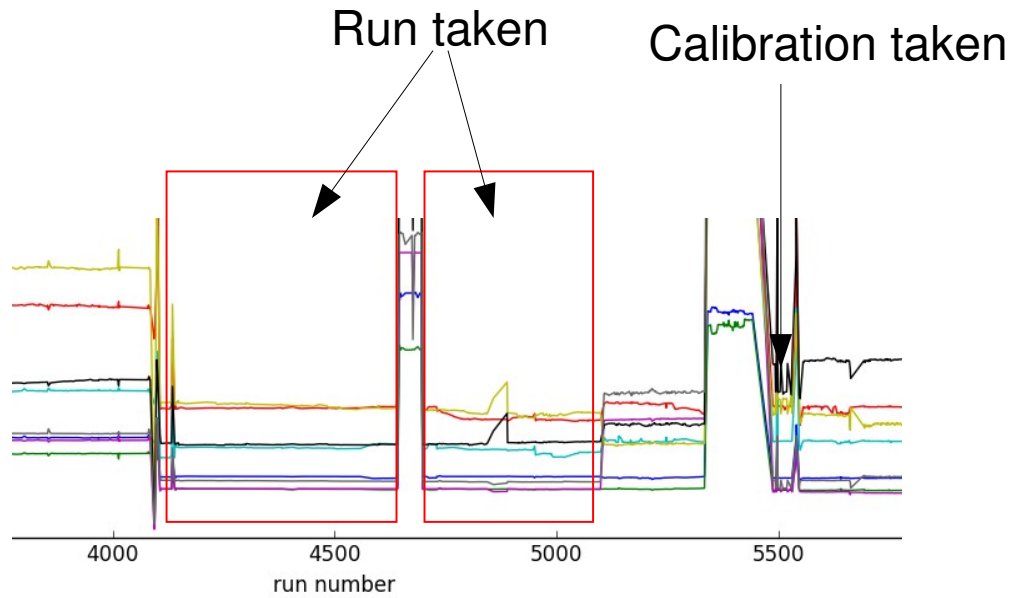
Constants

$$x = r x_b \left(\frac{1}{x_b^2 + y_b^2} - \frac{1}{\sqrt{x_b^2 + y_b^2}} \sqrt{\frac{1}{x_b^2 + y_b^2} - 1} \right)$$
$$x_{harp} = c_0 + c_1 x + c_2 y$$

r: Radius for BPM chamber, use design value from design diagram

r1: scaling parameter, usually ~1

r2: rotation parameter, usually ~0



harp scan in 5/3 (straight through, with 100nA/75nA/50nA)

harp scan in 4/11 (with field setting, with 100nA/75nA/50nA)

Pedestal difference between production and calibration run

0503 calibration	2952.319	10307.621	28551.01	20952.291	10566.053	29978.754	32015.141	10785.678
	A y+	y-	x+	x-	B y+	y-	x+	x-
4.11~4.25 production	18195.239	10557.746	28147.99	17415.789	10606.517	29418.012	20492.982	12469.639

(pedestal change 1000 will affect calculated position about 0.25mm)

$$\phi = f(A_{+} - A_{0+}) = a(A_{+} - A_{+0} + b)$$

b value comparison between 4.11 calibration run and 5.3 calibration run
 (they both have 100/75/50nA calibrations)
 They are closed

0503 calibration	-11147	-6948	-19789	-14462	-8477	-16293	-18094	-8768	
	A y+	y-		x+	x-	B y+	y-		x+
0411 calibration	-10838	-7892	-22642	-14833	-9409	-16124	-18122	-10141	

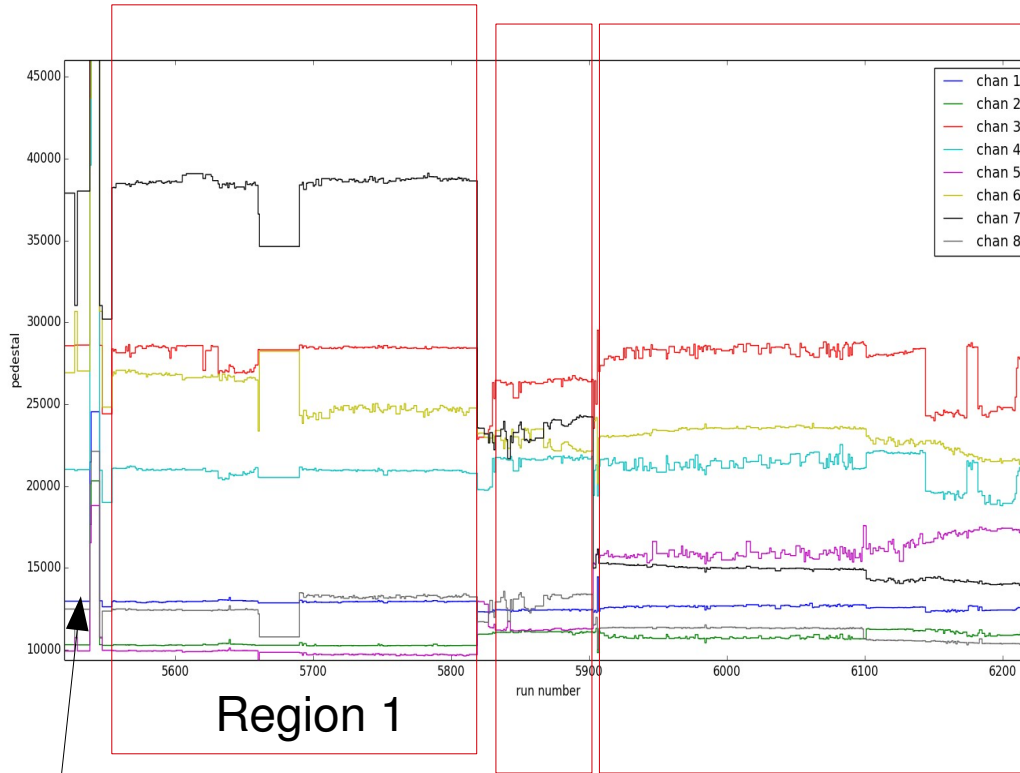
(difference of b+ and b- increase 1000 will increase current effect ~0.15mm/40nA)

Although pedestal for some channels changed a lot from 4.25 to 5.3, the calibration constant got from 0503 harp scan is still working for 4.11~4.25 production (use the nearest pedestal value for each runs)

Comparing the result (same run calculated by using different constant)

- Using 0503 calibration: x: -1.6mm, y: -2.1mm (uncertainty > 0.3mm, without pedestal part)
- Using 0411 calibration: x: -2.2mm, y: -1.9mm (uncertainty > 0.6mm, without pedestal part)

BPM Setting 5.3~5.18



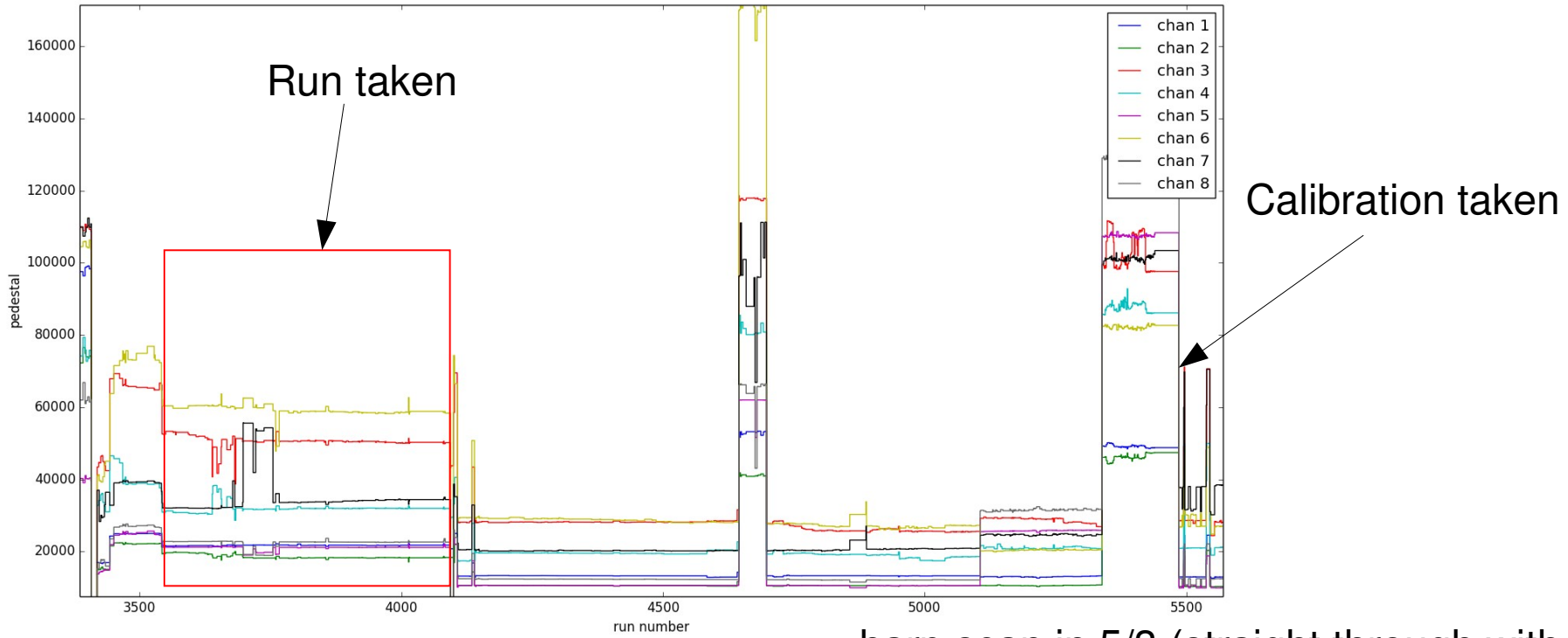
Calibration taken

Region 1 : 5690~5812 2.2GeV,5T longitudinal
Best situation,
same pedestal value with calibration run

Region 2: 5828~5902 2.2GeV,5T longitudinal
BPM B pedestal value changed

Region 3: 5904~6218 2.2/3.3GeV,5T
BPM B pedestal value changed
Use 0510 b value, but 0503 constant

BPM Setting 3.31~4.11 2.2GeV 2.5T

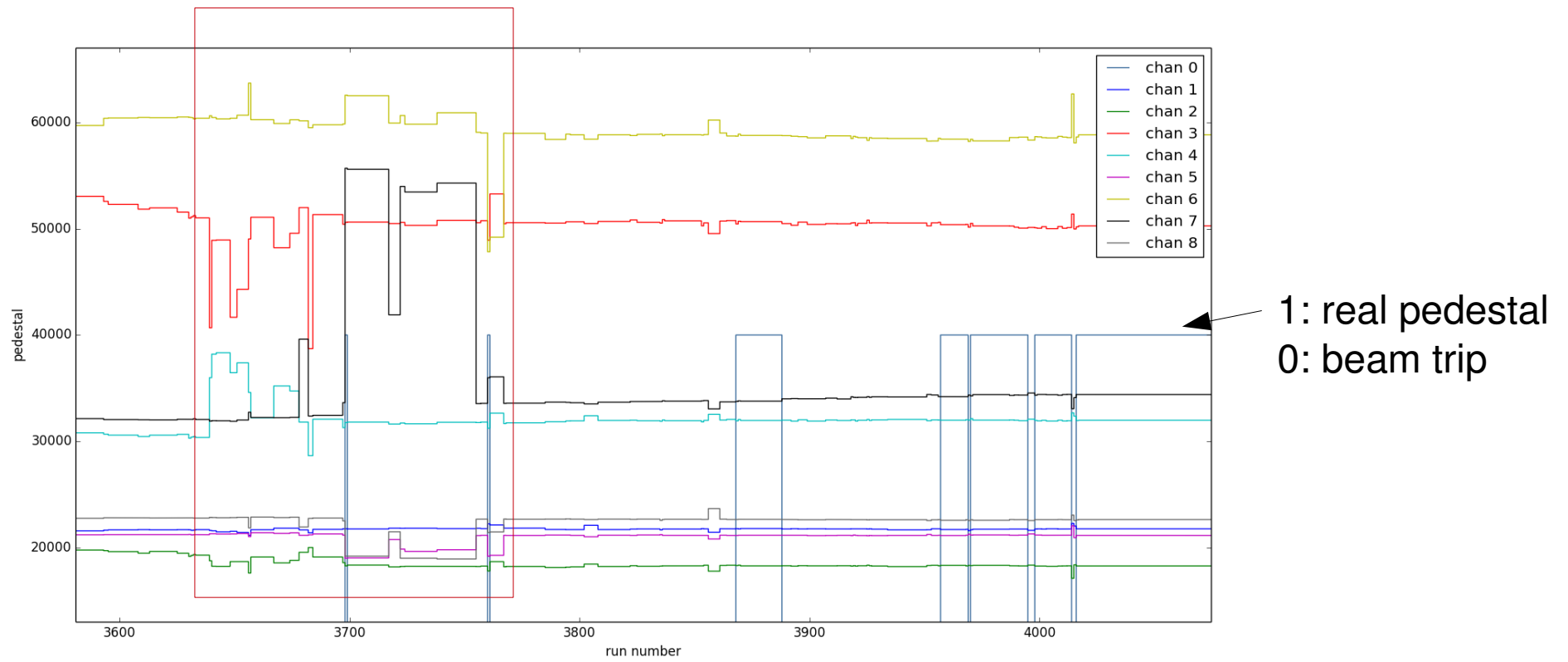


harp scan in 5/3 (straight through, with only 50nA)

harp scan in 4/11 (with field setting, with only 50nA)

Pedestal difference between production and calibration run

0503 calibration	21416	17611	49151	39979	16580	43736	59984	20183
	A y+	y-	x+	x-	B y+	y-	x+	x-
3.31-4.11 production	21818	18553	50336	31306	21238	59379	32735	22730



Abnormal pedestal value
Checking it run by run now.

$$\phi = f(A_{+} - A_{0+}) = a(A_{+} - A_{+0} + b)$$

5/3 calibration run only have 50nA calibration run, no ideal same position runs with different current

What I did:

- Choose two closed runs with different current, assume they have same position

3592 production run 43nA(with position lock)
 3593 dilution run 82nA

$$x_{harp} = c_0 + c_1 x + c_2 y$$

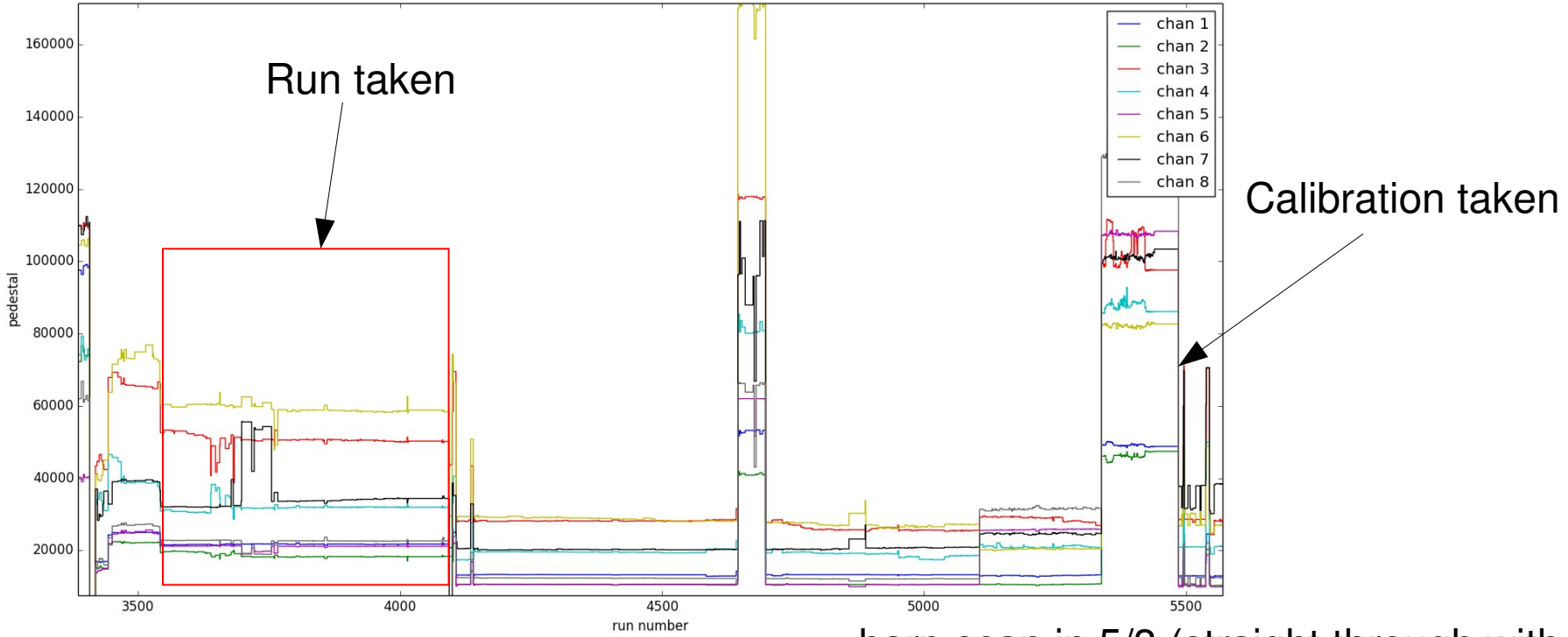
- Get b value, manually adjust b a little bit, let $c_1 \sim 1$
- Use this b to check another group runs, also assume they have same position

3790(36nA)	x	y
a	-0.8	0.16
b	-1.08	-0.18
3793(43nA)	x	y
a	-0.65	0.08
b	-0.97	-0.28

Comparing the result(same run calculated by using different constant)

- Using 0503 calibration: x: -0.7mm, y:-1.8mm (uncertainty>0.3mm,without pedestal part)
- Using 0411 calibration: x: -1.2mm, y:-1.6mm (uncertainty>0.6mm,without pedestal part)

BPM Setting 3.31~4.11 2.2GeV 2.5T

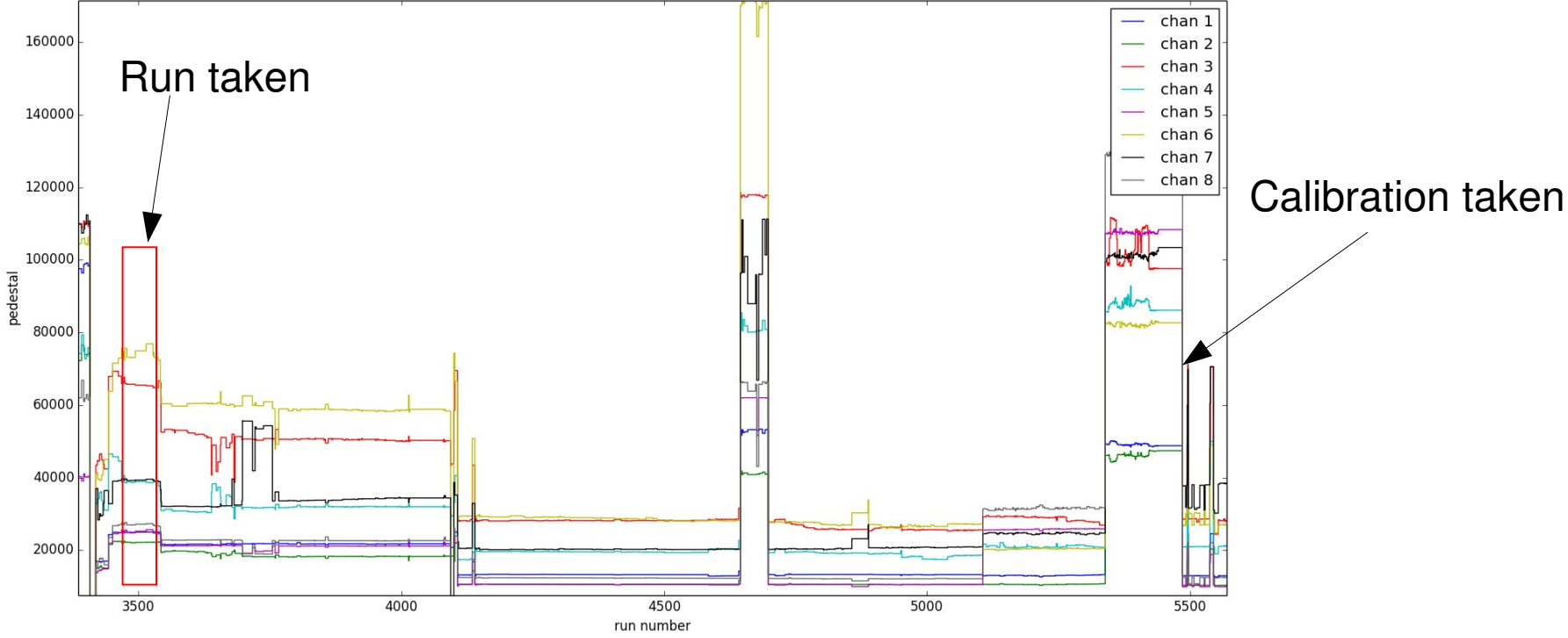


harp scan in 5/3 (straight through, with only 50nA)

harp scan in 4/11 (with field setting, with only 50nA)

Pedestal difference between production and calibration run

0503 calibration	21416	17611	49151	39979	16580	43736	59984	20183	
	A y+	y-		x+	x-	B y+	y-		x+
3.31-4.11 production	21818	18553	50336	31306	21238	59379	32735	22730	x-



Use same method as 3.31~4.11,
But no reference detection

Pedestal difference between production and calibration run

0503 calibration	24542	20230	71155	49854	18757	48877	69813	22119	
	A y+	y-		x+	x-	B y+	y-	x+	x-
3.29~3.31 production	25038	22144	64759	38776	24818	73620	39202	26867	

BPM Setting ~3.14 optics(autogain)

Still no idea about it

The closed one for div=2 is harp scan at 3.12 which div=3, but with field setting

