Bpm study
-- check beam position

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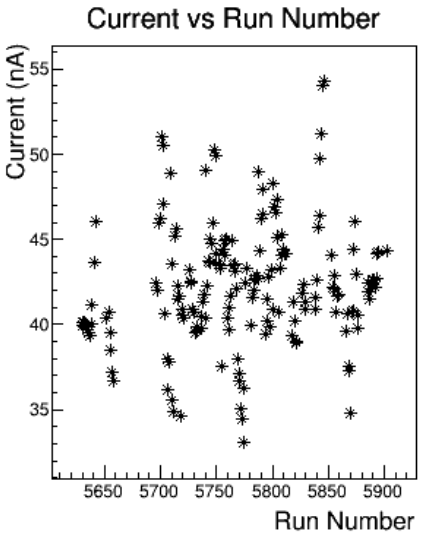
01/04/2017

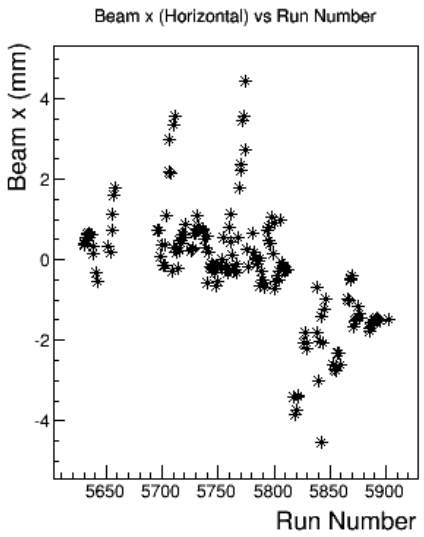
BPM pedestal Study

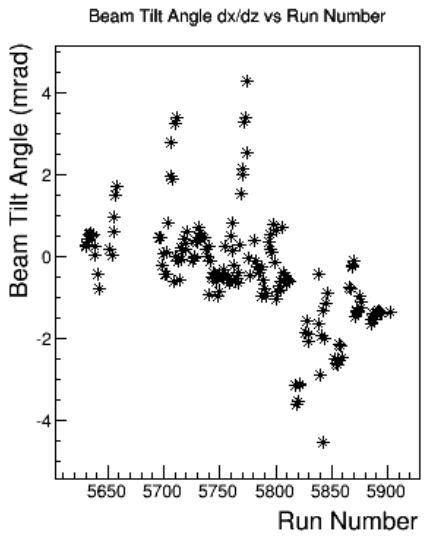
- Goal: To help resolve the yields drift problems
- Today
  - Study the jump – calibrated position changed while yields not change

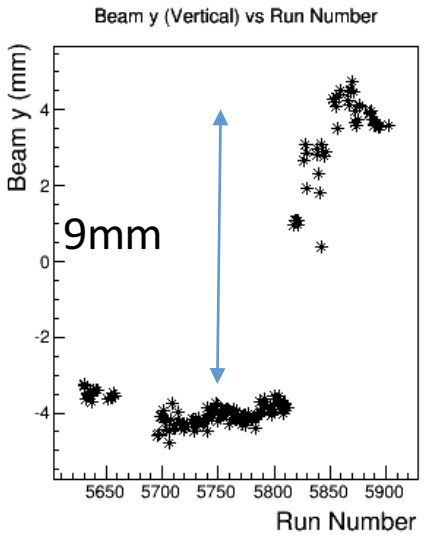
Recall Beam Position Issue

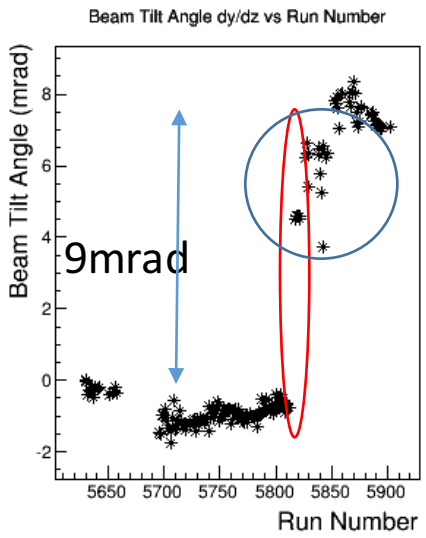
Energy 2254 GeV -- beam information versus Run Number











Use Pengjia's database

How to deal with beam jumps here:

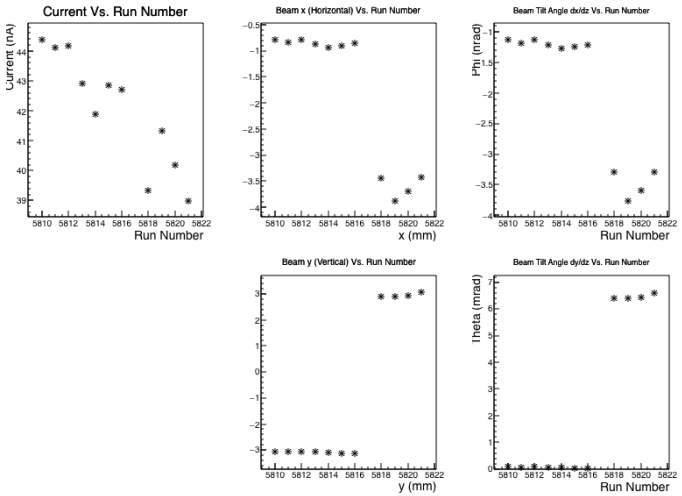
Two types of beam position jumps

a) Red circle part (after adding the carbon cover, run 5816), jump about 6mm or 6mrad? But yields no change

b) Blue circle part (run 5838-5851, continuous taking data, position jump back and forth, spread 3mm or 3mrad)
yields change within 3%

Ebeam=2.2GeV, momentum 1.886GeV, Longitudinal 5T – 1st type jump

run	materialID	Momentum	current/nA	yield(use 6mm Raster cut)	BPMA x (mm)	BPMA y (mm)	BPMB x (mm)	BPMB y (mm)	Horizontal tg_x (mm)	tg_phi=dx/dz (mrad)	Vertical tg_y (mm)	tg_theta =dy/dz (mrad)
5809	17	1.8857	44.07	1	-1.39	-2.35	-1.23	-2.57	-0.9	-1.23	-3.11	0.04
5810	17	1.8857	44.39	1.005	-1.37	-2.34	-1.19	-2.57	-0.78	-1.12	-3.05	0.08
5811	17	1.8857	44.12	1.003	-1.37	-2.34	-1.2	-2.56	-0.84	-1.18	-3.06	0.06
5812	17	1.8857	44.17	1.001	-1.37	-2.35	-1.18	-2.57	-0.78	-1.12	-3.05	0.08
5813	17	1.8857	42.92	0.997	-1.36	-2.34	-1.2	-2.56	-0.87	-1.21	-3.07	0.05
5814	17	1.8857	41.89	1.01	-1.39	-2.34	-1.24	-2.56	-0.94	-1.27	-3.09	0.05
5815	17	1.8857	42.84	1.005	-1.39	-2.35	-1.23	-2.58	-0.9	-1.24	-3.11	0.03
5816	17	1.8857	42.72	1.004	-1.36	-2.37	-1.2	-2.59	-0.85	-1.21	-3.11	0.03
5818	17	1.8857	39.35	1.002	-1.86	-2.02	-1.31	-0.64	-3.45	-3.3	2.89	6.4
5819	17	1.8857	41.33	1.006	-1.84	-2.02	-1.39	-0.57	-3.87	-3.76	2.89	6.39
5820	17	1.8857	40.19	1.005	-1.84	-2.02	-1.35	-0.59	-3.7	-3.59	2.93	6.43
5821	17	1.8857	39	1.021	-1.84	-2.02	-1.27	-0.59	-3.42	-3.29	3.08	6.59
5822	17	1.8857	38.88	1.006	-1.86	-2.02	-1.3	-0.61	-3.47	-3.33	2.99	6.51



1.5 hours beam down (target anneal) between run 5816 and run 5818

Carbon cover added after run 5816

Calibrated Beam position Jump happened when beam back

X jump -2.6mm; y jump 6.0mm

Theta jump 6.37mrad; phi jump -1.8mrad

Data Yields within 1% for the momentum setting

Usually 1mm (1mrad) shift change yields ~3%

Ebeam=2.2GeV, momentum 1.886GeV, Longitudinal 5T – 1st type jump

Run	Current /nA	BPMA 1 Ped	BPMA 2 Ped	BPMA 3 Ped	BPMA 4 Ped	BPMB 1 Ped	BPMB 2 Ped	BPMB 3 Ped	BPMB 4 Ped	BPMA x (mm)	BPMA y (mm)	BPMB x (mm)	BPMB y (mm)	Horizontal tg_x (mm)	tg_phi =dx/dz (mrad)	Vertical tg_y (mm)	tg_theta =dy/dz (mrad)
5811	44.12	12958.9	10269.2	28438.7	20938.9	9690.3	24686.4	38748.7	13262.3	-1.37	-2.34	-1.2	-2.56	-0.84	-1.18	-3.06	0.06
5812	44.17	12958.9	10268.9	28439.8	20937.2	9690.7	24687.3	38744.7	13261.7	-1.37	-2.35	-1.18	-2.57	-0.78	-1.12	-3.05	0.08
5813	42.92	12959	10268.8	28440.4	20935.9	9690.6	24686.6	38742.3	13261.9	-1.36	-2.34	-1.2	-2.56	-0.87	-1.21	-3.07	0.05
5814	41.89	12959.1	10268.8	28440.6	20934.9	9690.3	24684.5	38741	13262.9	-1.39	-2.34	-1.24	-2.56	-0.94	-1.27	-3.09	0.05
5815	42.84	12959.1	10268.8	28440.8	20934	9689.9	24682.1	38740	13264	-1.39	-2.35	-1.23	-2.58	-0.9	-1.24	-3.11	0.03
5816	42.72	12959.2	10268.8	28441	20932.9	9689.5	24679.3	38739.3	13265.2	-1.36	-2.37	-1.2	-2.59	-0.85	-1.21	-3.11	0.03
5818	39.35	12412.3	11070	25768.7	21291.5	11193.8	23134.9	23097.8	12869	-1.86	-2.02	-1.31	-0.64	-3.45	-3.3	2.89	6.4
5819	41.33	12412.8	11070.5	25787.7	21304.2	11191.6	23135.4	23100.4	12872.8	-1.84	-2.02	-1.39	-0.57	-3.87	-3.76	2.89	6.39
5820	40.19	12413.3	11070.9	25803.9	21314.9	11189.8	23134.7	23103	12876.4	-1.84	-2.02	-1.35	-0.59	-3.7	-3.59	2.93	6.43
5821	39	12413.7	11071.3	25819.1	21325	11188.2	23132.6	23106.5	12880.6	-1.84	-2.02	-1.27	-0.59	-3.42	-3.29	3.08	6.59
5822	38.88	12413.8	11071.5	25823	21327.6	11187.8	23132.1	23107.4	12881.6	-1.86	-2.02	-1.3	-0.61	-3.47	-3.33	2.99	6.51
5823	38.95	12414.2	11071.8	25834.3	21335	11186.6	23130.5	23110	12884.6	-1.82	-2	-1.27	-0.6	-3.43	-3.29	2.99	6.46
5824	44.33	12414.2	11071.9	25836.5	21336.5	11186.4	23130.2	23110.5	12885.2	-1.81	-2.1	-1.4	-0.66	-3.91	-3.88	2.68	6.21
5825	45.06	12414.3	11072	25840.4	21339.1	11186	23129.7	23111.3	12886.3	-1.82	-2.07	-1.44	-0.61	-4.05	-3.99	2.74	6.25
5826	47.12	12414.4	11072.1	25843.8	21341.4	11185.6	23129.2	23112.1	12887.2	-1.78	-2.06	-1.4	-0.61	-3.99	-3.96	2.72	6.2
5827	41.87	12415.2	11072.9	25870.3	21359	11182.9	23125.8	23117.8	12894	-1.82	-2.04	-1.04	-0.73	-2.55	-2.41	3.1	6.61
5828	42.37	12415.8	11073.6	25892.6	21373.7	11181.8	23127.3	23115.5	12892.1	-1.83	-2.03	-0.9	-0.74	-2.08	-1.91	3.32	6.83
5829	40.86	12417.1	11075.4	25935.5	21402.6	11180	23135.5	23100.2	12877.7	-1.83	-2.03	-1.26	-0.69	-3.25	-3.12	2.78	6.28
5830	41.3	12418.1	11076.7	25967.6	21424.4	11178.6	23142	23090	12868.1	-1.82	-2.04	-1	-0.79	-2.3	-2.15	2.98	6.48

We saw big pedestal jumps for both BPMA and BPMB

BPMA x change from -1.36mm to -1.86mm, y change from -2.37mm to -2.02mm

Ebeam=2.2GeV, momentum 1.886GeV, Longitudinal 5T – 1st type jump

Run	Current /nA	BPMA 1 Ped	BPMA 2 Ped	BPMA 3 Ped	BPMA 4 Ped	BPMB 1 Ped	BPMB 2 Ped	BPMB 3 Ped	BPMB 4 Ped	BPMA x (mm)	BPMA y (mm)	BPMB x (mm)	BPMB y (mm)	Horizontal tg_x (mm)	tg_phi =dx/dz (mrad)	Vertical tg_y (mm)	tg_theta =dy/dz (mrad)
5811	44.12	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.34	-1.16	-2.64	-0.59	-0.93	-3.26	-0.15
5812	44.17	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.36	-2.35	-1.15	-2.65	-0.54	-0.88	-3.25	-0.13
5813	42.92	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.34	-1.17	-2.65	-0.61	-0.96	-3.27	-0.17
5814	41.89	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.38	-2.34	-1.2	-2.65	-0.68	-1.01	-3.3	-0.18
5815	42.84	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.38	-2.35	-1.2	-2.66	-0.66	-0.99	-3.32	-0.19
5816	42.72	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.37	-1.16	-2.68	-0.6	-0.96	-3.31	-0.19
5818	39.35	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.34	-2.34	-7.47	0.6	-26.08	-27.54	-5.72	-2.73
5819	41.33	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.33	-7.21	0.61	-25.29	-26.7	-5.21	-2.2
5820	40.19	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.33	-2.34	-7.35	0.62	-25.79	-27.24	-5.45	-2.45
5821	39	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.32	-2.34	-7.48	0.66	-26.28	-27.76	-5.61	-2.62
5822	38.88	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.33	-2.35	-7.56	0.64	-26.48	-27.96	-5.77	-2.78
5823	38.95	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.3	-2.33	-7.5	0.65	-26.35	-27.83	-5.73	-2.78
5824	44.33	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.39	-6.68	0.42	-23.43	-24.8	-4.62	-1.54
5825	45.06	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.37	-2.35	-6.64	0.46	-23.26	-24.58	-4.44	-1.36
5826	47.12	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.36	-2.33	-6.28	0.41	-22.07	-23.34	-3.97	-0.9
5827	41.87	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.34	-2.34	-6.52	0.41	-22.84	-24.15	-4.43	-1.38
5828	42.37	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.33	-6.26	0.39	-21.98	-23.25	-4.01	-0.95
5829	40.86	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.35	-2.33	-6.89	0.46	-24.02	-25.37	-5.03	-2.01
5830	41.3	12960.8	10273.7	28466.8	20890.4	9634.3	24319.8	38692.9	13401.6	-1.34	-2.34	-6.55	0.35	-22.83	-24.15	-4.68	-1.64

This table use the same pedestal (from run 5816)

BPMA pos no jumps????

Note: for BPMA, the same database for run 5816~5830; for BPMB, pengjia use different database

Recall BPM Calibration

- The calculation of beam position (pengjia technote):

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

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

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

Beam pos

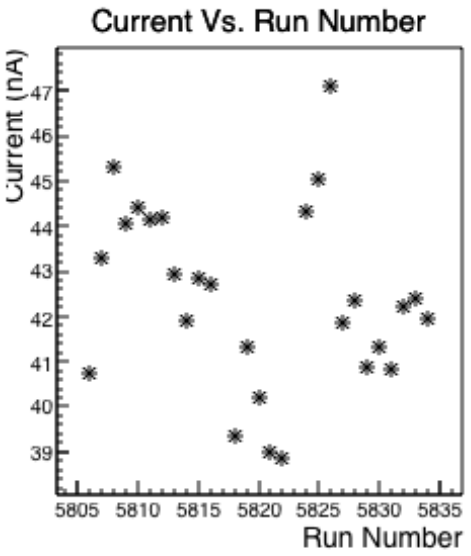
$$x_{BPMreal_{BPM}} = c_0 + c_1 x + c_2 y$$

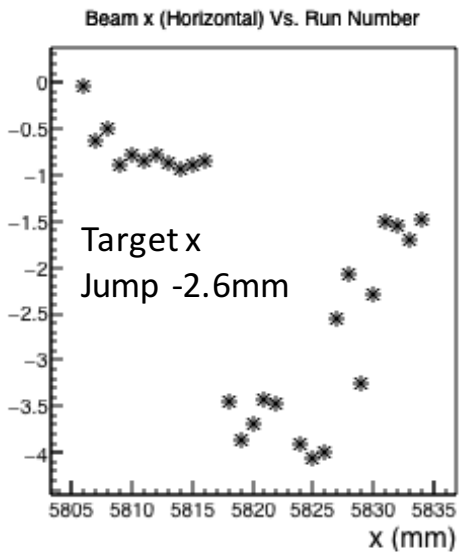
$$y_{BPMreal_{BPM}} = c_0' + c_1' x + c_2' y$$

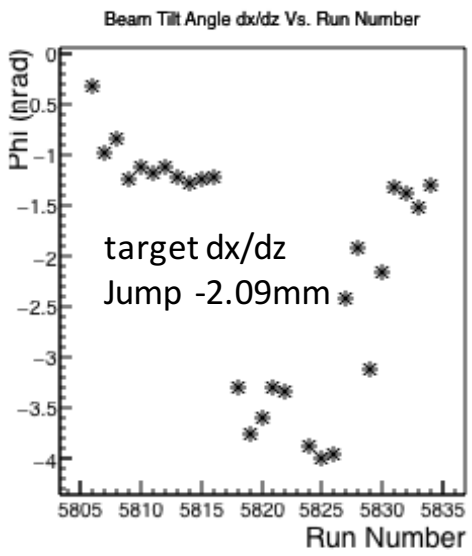
- A_+, A_-: bpm raw signal for + and – channel
- A_{+ped}, A_{-ped} : bpm pedestal for + and – channel
- b_+, b_-: offset, calibration constant
- $g_x, c_0, c_1, c_2, c_0', c_1', c_2'$: calibration constant

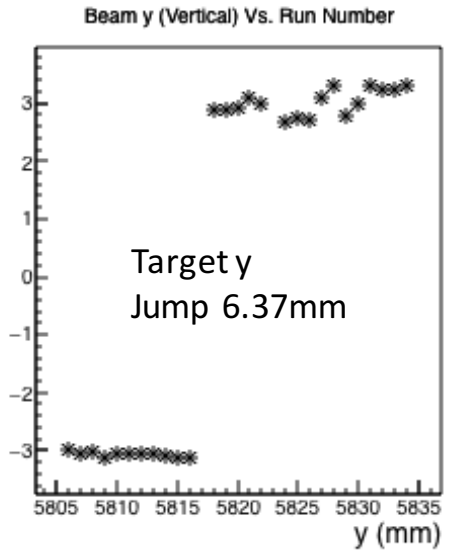
- To keep pedestal not change for run 5816 and 5818 equals to change b to make offset= $A_{+ped} - b_+$not change
- here assume the filter not change the total offset signal= $A_+ - offset$

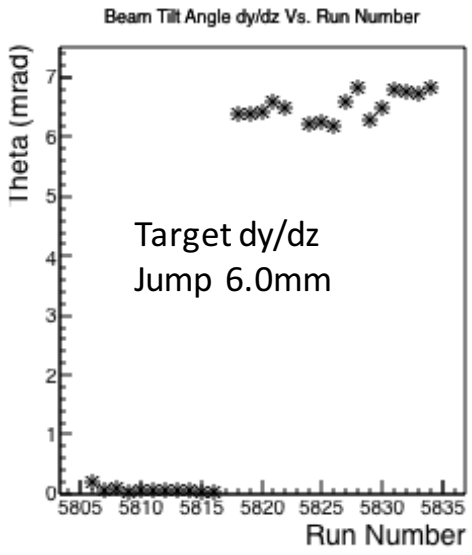
Beam Position Jump Issue











Use Pengjia database

Beam position at target
for run 5805-5830

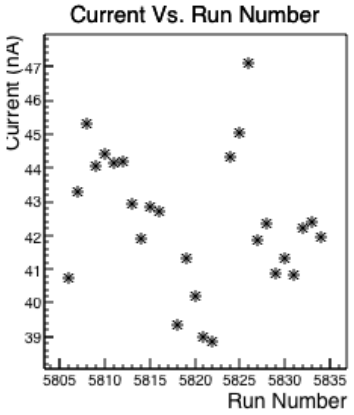
1.5 hours beam down (target anneal)
between run 5816 and run 5818

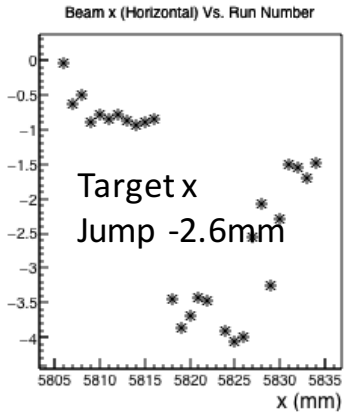
Carbon cover added after run 5816

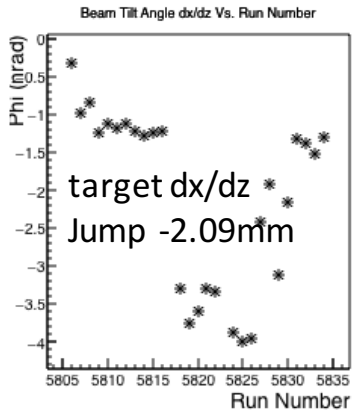
Calibrated Beam position Jump
happened when beam back

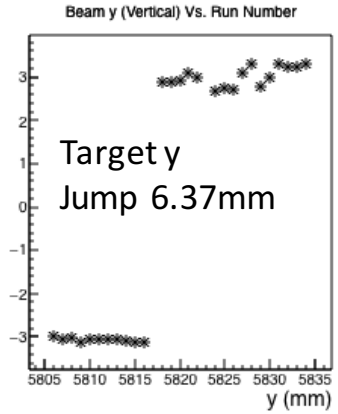
Beam Position Jump Issue

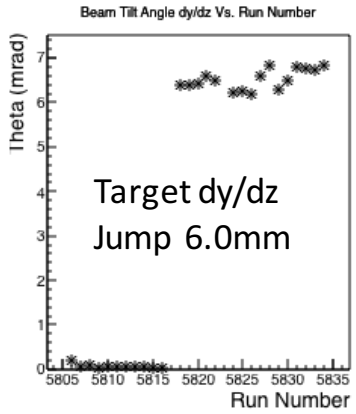
Previous



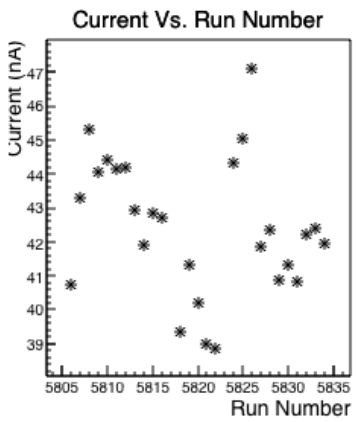


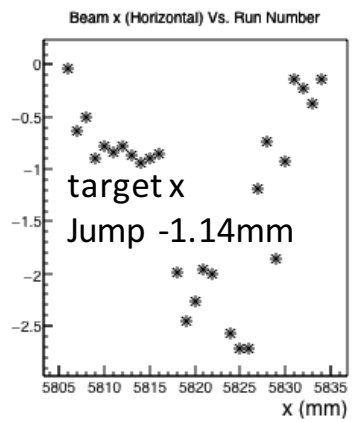


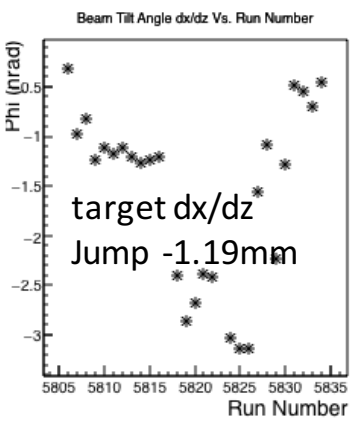


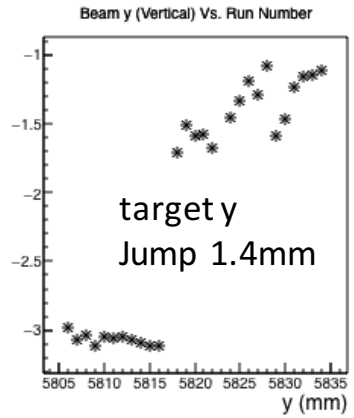


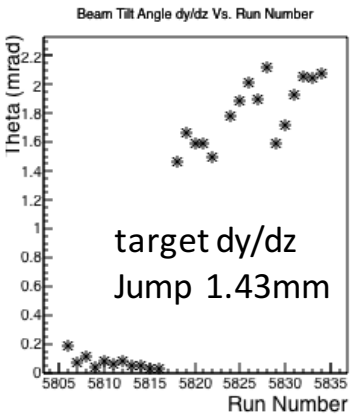
Make the total offset not change after adding carbon filter



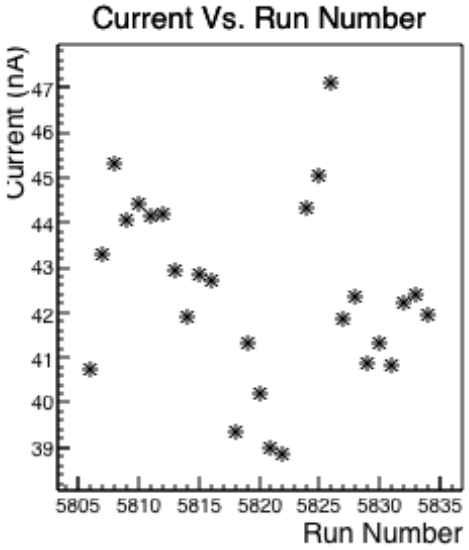


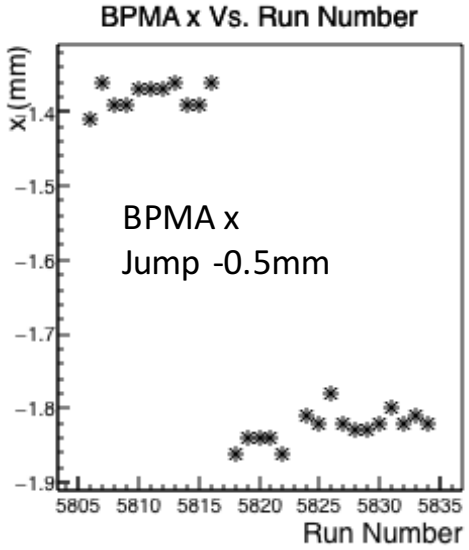


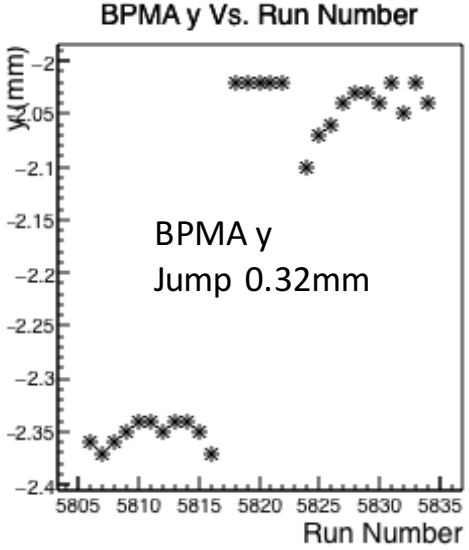


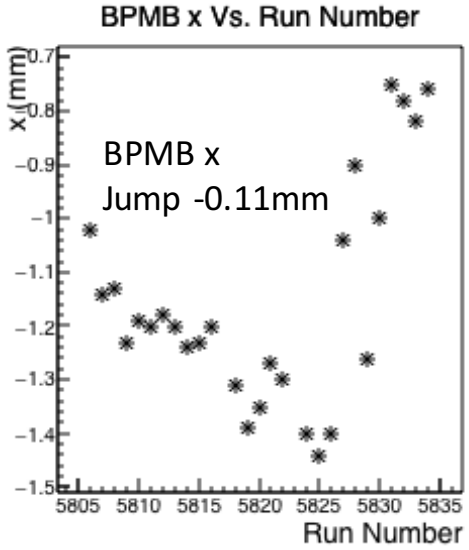


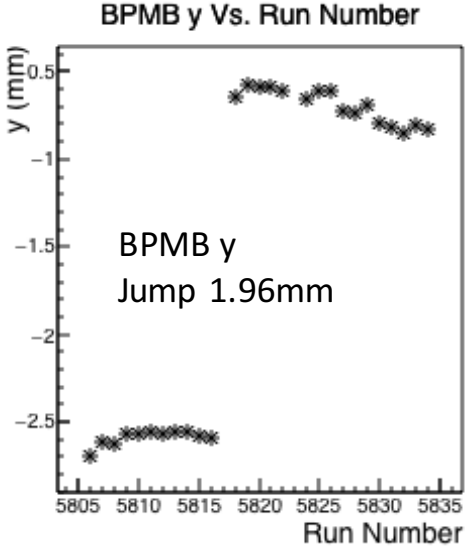
Beam Position Jump Issue









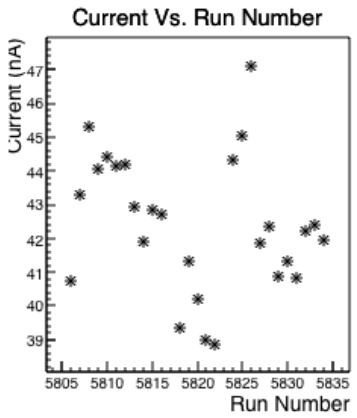


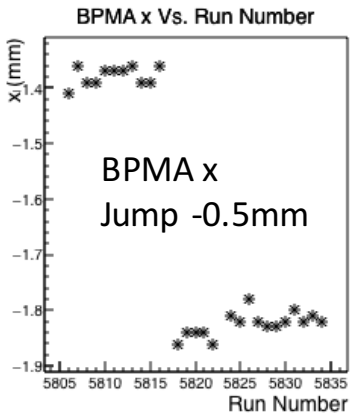
Beam position x (y) at BPMA and BPMB for run 5805-5830

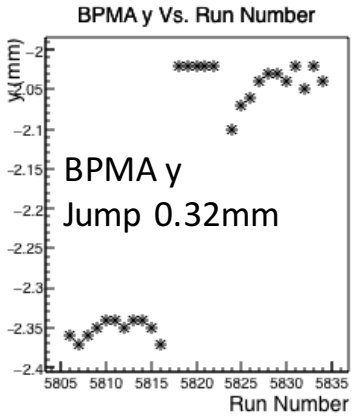
In bpm local coordinates

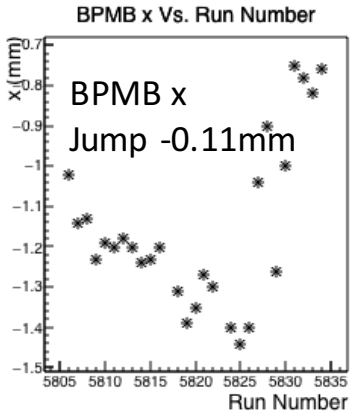
Beam Position Jump Issue

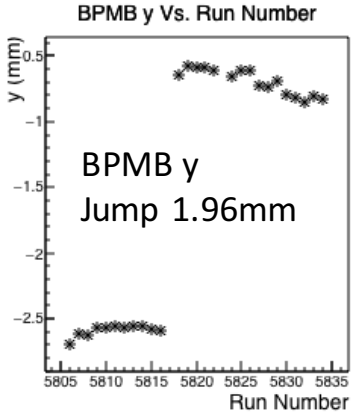
Previous



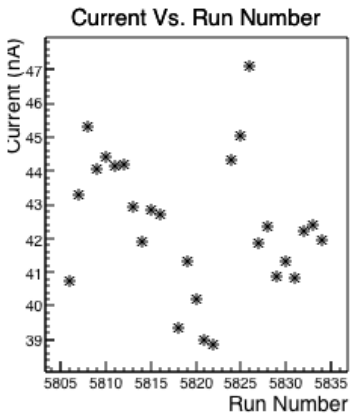


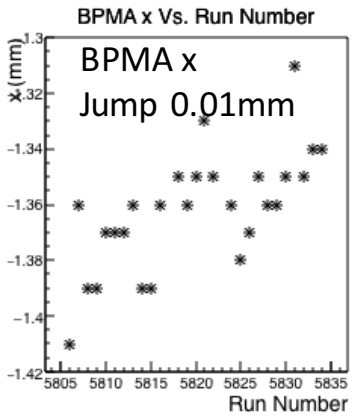


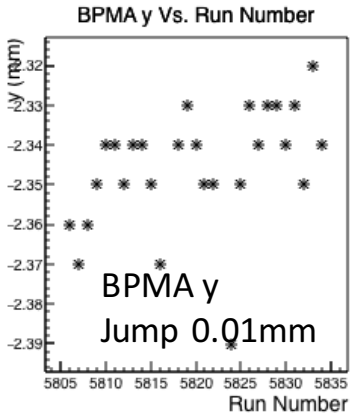


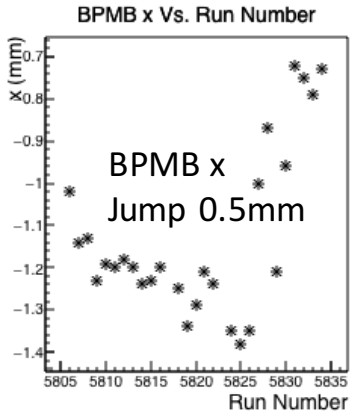


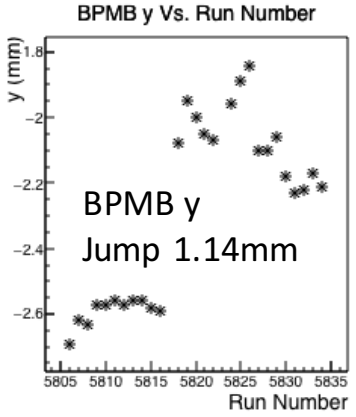
Make the total offset not change after adding carbon filter











- Continue Looking at other jumps
- Any suggestions?