Beam check- pedestal study

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Beam Energy 2254 GeV
-- beam information versus Run Number

Two issues to check
• Current dependence
• Suddenly jumps
Beam Energy 2254 GeV
-- beam information versus Current

Two issues to check/study
• Study/remove Current dependence
• To understand the suddenly jumps
Remove the current dependence

- Ebeam=2.2GeV, momentum 2.049GeV, Longitudinal 5T – best situation
- Each mark stands for one run in the plot
Beam Energy 2254 GeV – New Database

After removing current dependence
Run 5706-5877
Position Jumps

- Ebeam=2.2GeV, momentum **1.886GeV**, Longitudinal 5T – best situation

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**new database**

- **new database**
- **new database**
- **new database**
- **new database**

- **tg_x (mm)**
- **tg_y (mm)**
- **tg_phi (dx/dz mmrad)**
- **tg_theta (dy/dz mmrad)**

1.5 hours beam down (target anneal) between run 5816 and run 5818
Carbon cover added near run 5817, see halog

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**Beam x (Horizontal) vs Current**

**Beam y (Vertical) vs Current**

**Beam Tilt Angle dx/dz vs Current**

**Beam Tilt Angle dy/dz vs Current**
Position Jumps

• Ebeam=2.2GeV, momentum 1.886GeV, Longitudinal 5T – best situation

• Data yields almost no change for the setting
• Simulation show 15% decrease compare run 5811 vs 5820 !!!

• Carbon cover add near run 5817, will change pedestal
• The previous method to get pedestal: use the close beam trip or pedestal run
• So the pedestal change already considered before

• Need check pedestal?
• Pengjia recalculating pedestal
Pedestal Study

- How to select pedestal from beam trip

- Difference from the previous pedestal study:
  - Use 0.1 nA cut (previous is 2 nA)
  - 2000 additional events (about 2s due to helicity trigger) cut at the beginning and end of the cutted range (same as the previous one)
  - Removed run with pedestal events less than 10000 (previous is 100)
  - rms of 1st chan of BPM A pedestal must less than 1000 (new here)
  - rms of 3rd chan of BPM B pedestal must less than 2100 (new here)
  - Pengjia manually removed weird pedestal jumps by eye (did in the old one, may need to check with yield/simulation)
Run 5811

Total Entry: 1.2M
Trip entry: 45k

BPM raw for whole run

Current for whole run (uA)

Current for tripped part (uA)

BPM raw for tripped part (after applying the cut in page 8)

Page 9
Run 5820

Total Entry: 1.2M
Trip entry: 14k

BPM raw for whole run

Current for whole run (uA)

Current for tripped part (uA)

BPM raw for tripped part (after applying the cut in page 8)
Run 5824

Total Entry: 350k
Trip entry: 30k

BPM raw for whole run

Current for whole run (uA)

Current for tripped part (uA)

BPM raw for tripped part (after applying the cut in page 8)

Page 11
Run 5832

BPMA 1 vs entry
BPMA 2 vs entry
BPMA 3 vs entry
BPMA 4 vs entry
BPMB 1 vs entry
BPMB 2 vs entry
BPMB 3 vs entry
BPMB 4 vs entry

Current vs entry (c<0.1nA)

Current for whole run (uA)
Current for tripped part (uA)
BPM raw for tripped part (after applying the cut in page 8)

Total Entry: 300k
Trip entry: 60k
BPM raw for whole run

Page 12
Pedestals (previous and new) for each BPM channel

- no manually removed for this range
- both study drawn in same color for each channel
- Pedestal comparison for these two study: mostly overlapped, almost no change
- Missing one channel 8 in plot
- Channel 1-4 : BPMA

Channel 1
Channel 2
Channel 3
Channel 4
Channel 5
Channel 6
Channel 7

Trough: Run 5817 - 5827
Rising: 5828 - 5830
Weighted-moving averaged pedestal

• We have limited beam trips, to take advantage of the nearby beam trips

• Previous method: find the closet one (beam trip or pedestal run) as the pedestal

• New method: consider (beam trip or pedestal run) within 12 hours in same bpm gain settings
  Weight = events * abs(43200 – start time)/ sigma^2

Advantage:
• smaller sigma has larger weight
• closer run has larger weight
• more tripped events has larger weight
Pedestals before and after applying moving average

near 5817, added carbon cover for BPM receiver (real pedestal change)

near 5903, added carbon cover again for BPM receiver

Trough removed? Weighting with issue?
Pengjia manually removed 5817-5824 due to rms >2100 for channel-7
### Beam positions at target

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**Position change before and after applying moving averaged pedestal**

Better stability of calculated position?

Compared run 5816 to 5818, target x change -2.47mm (-2.92mm) for new (previous) method, no much difference. Target y change more use new method.

Simulation from yields still not agree with data!!

ax,ay,bx,by are in bpm local coord
tgtx,tgty are in hall coord
Summary

- Beam position jumps partly due to the real pedestal change, partly may due to the real position change? But data yields not change!

- Averaging method can get a better stability, but may also bring bias? Weight less hours, maybe 6hours?

- BPM pedestal correct?

- Any other suggestions for next step?

- Thank Pengjia for continuous help!

However, did not see ~1mm change for x, y in both BPMA and BPMB
Yields no change && EPICS beam position not change?