Beamline Performance during the Spring Run

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HPS Collaboration Meeting

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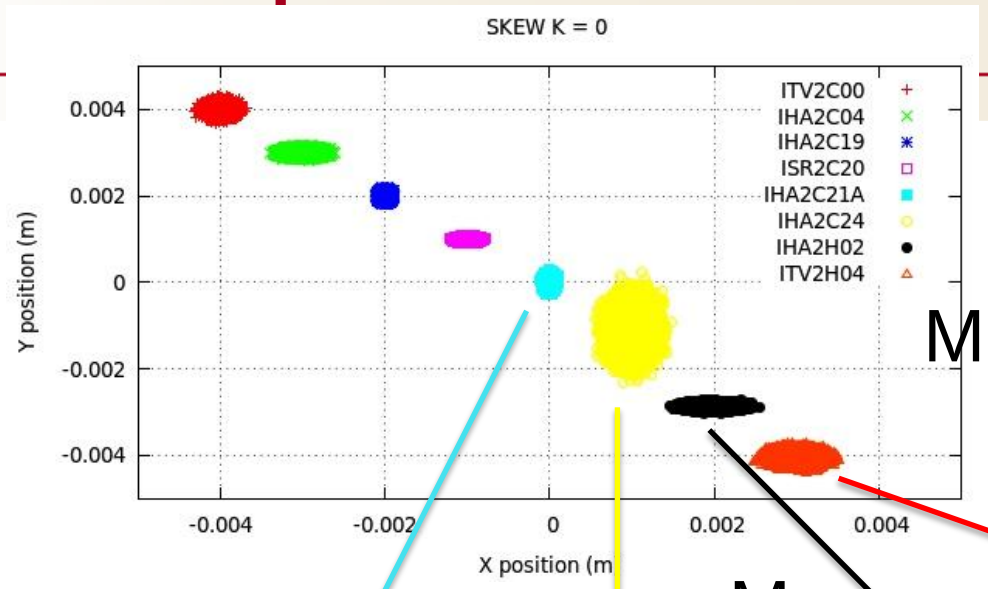
U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

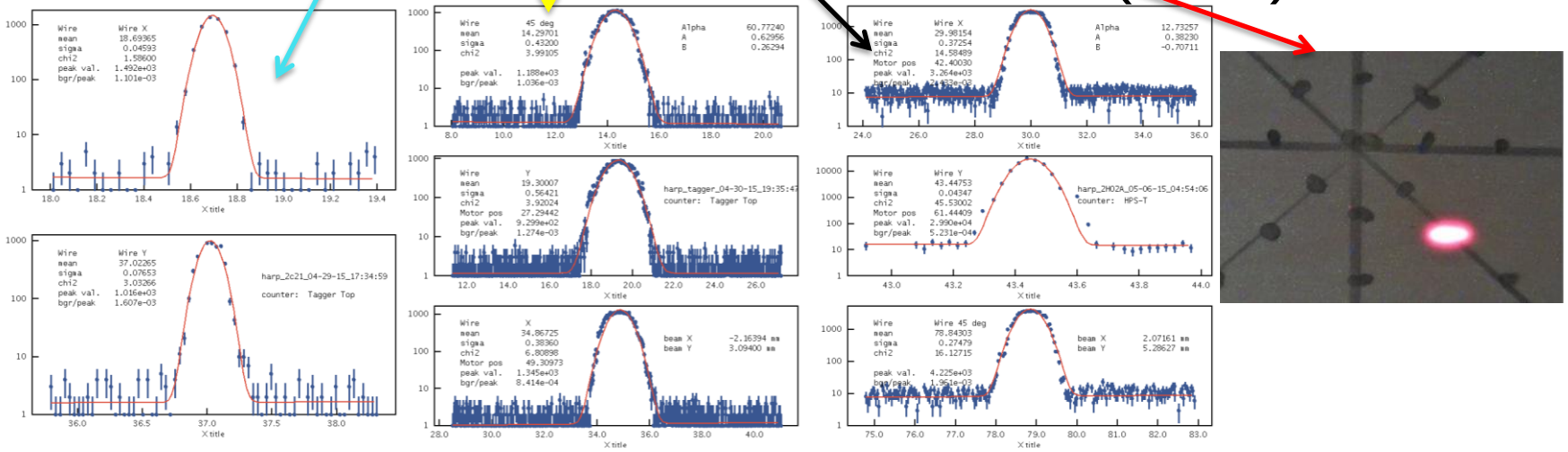
Beam profile: model and measurement (Stepan)

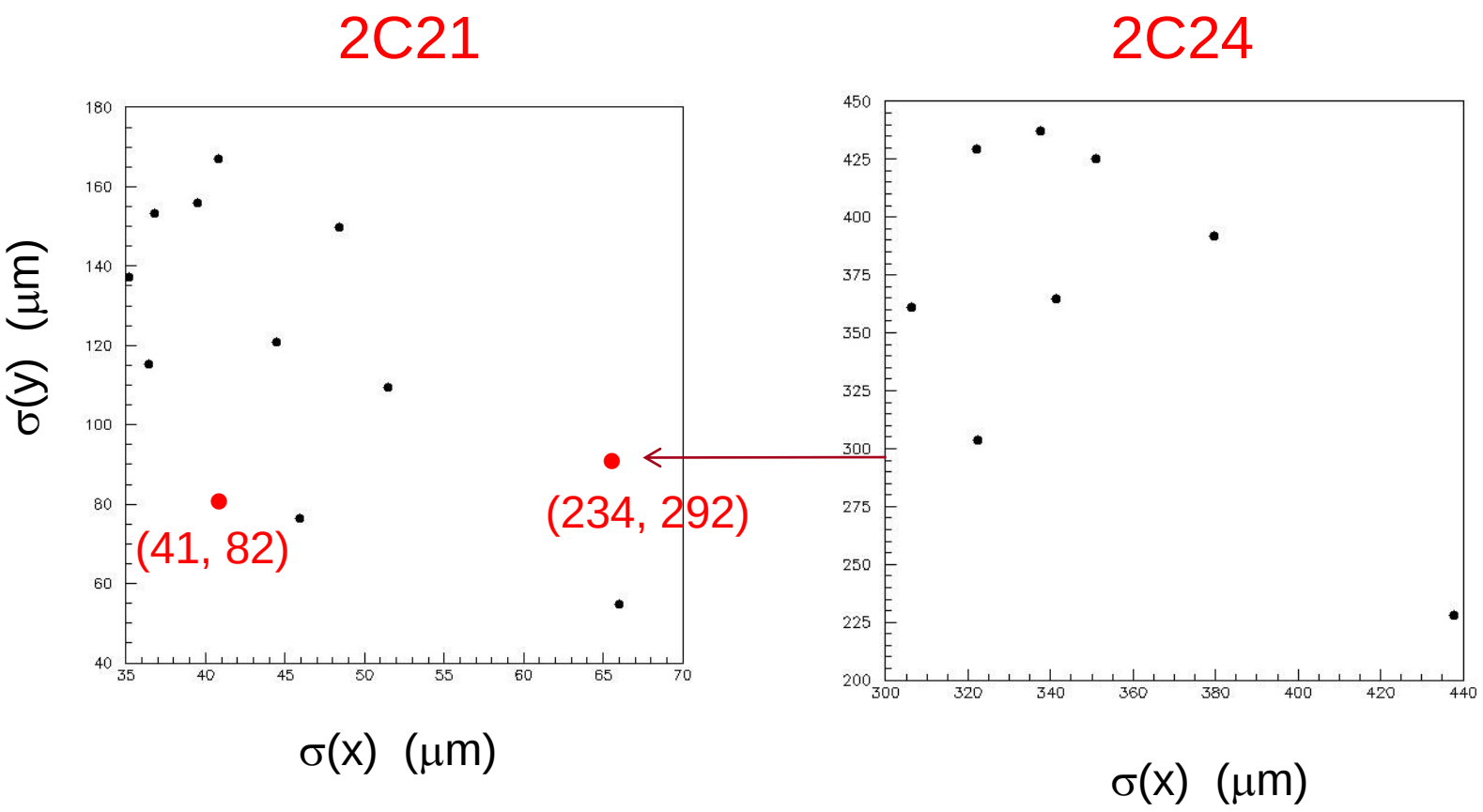


Model

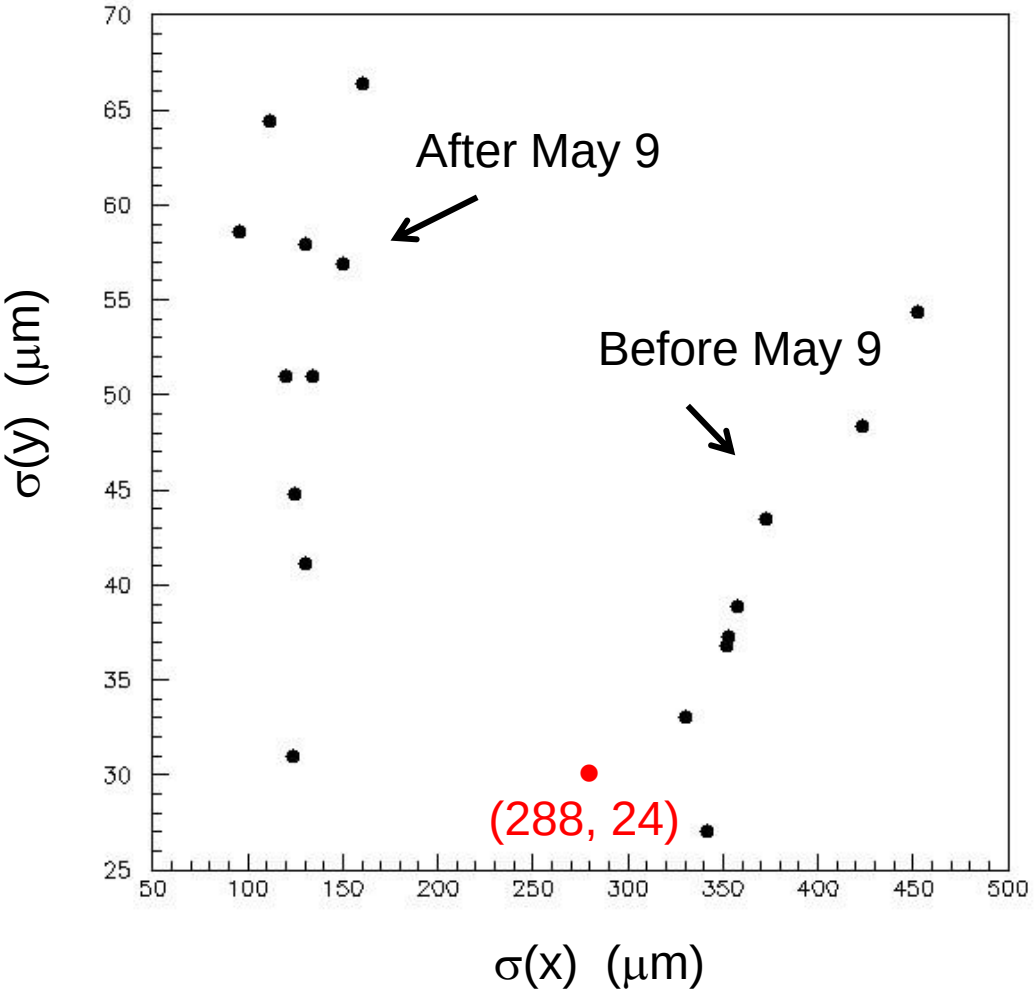
Diagnostic	X_{RMS} (μm)	Y_{RMS} (μm)
ITV2C00	72	69
IHA2C04	90	39
IHA2C19	27	42
ISR2C20	48	20
IHA2C21A	41	82
IHA2C24	234	292
IHA2H02A	288	30
HPS-Target	289	24
ITV2H04	292	91

Measurements (HPS)

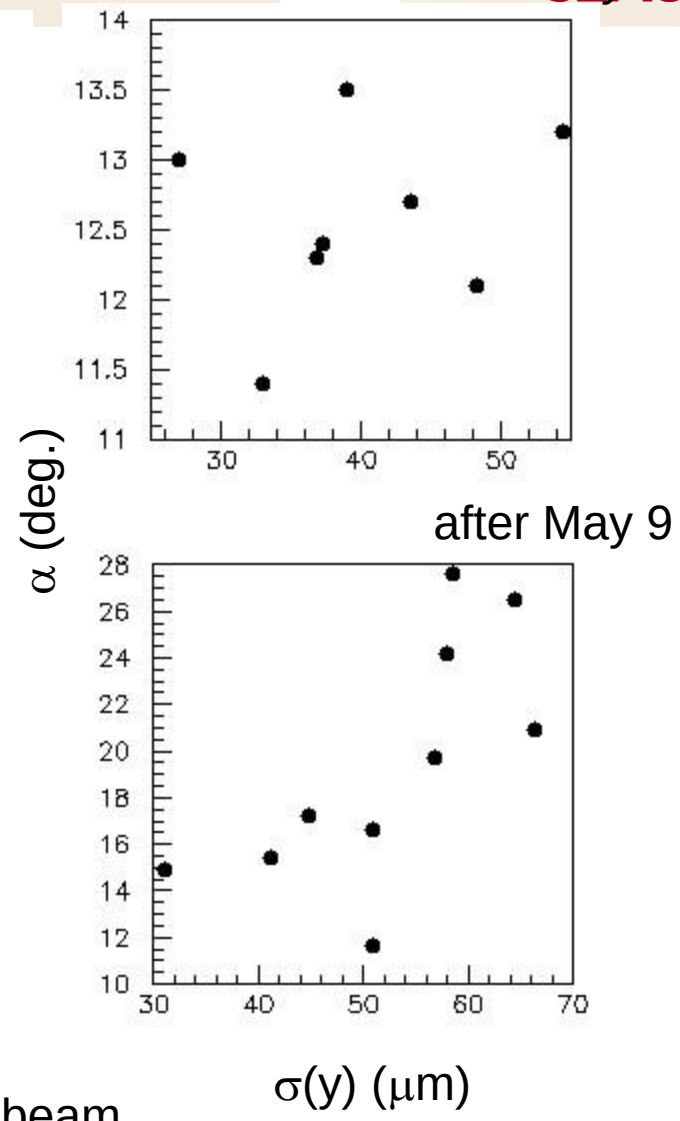



2C21
2C24
σ(y) (μm)
σ(x) (μm)
(41, 82)
(234, 292)
σ(x) (μm)

2H02

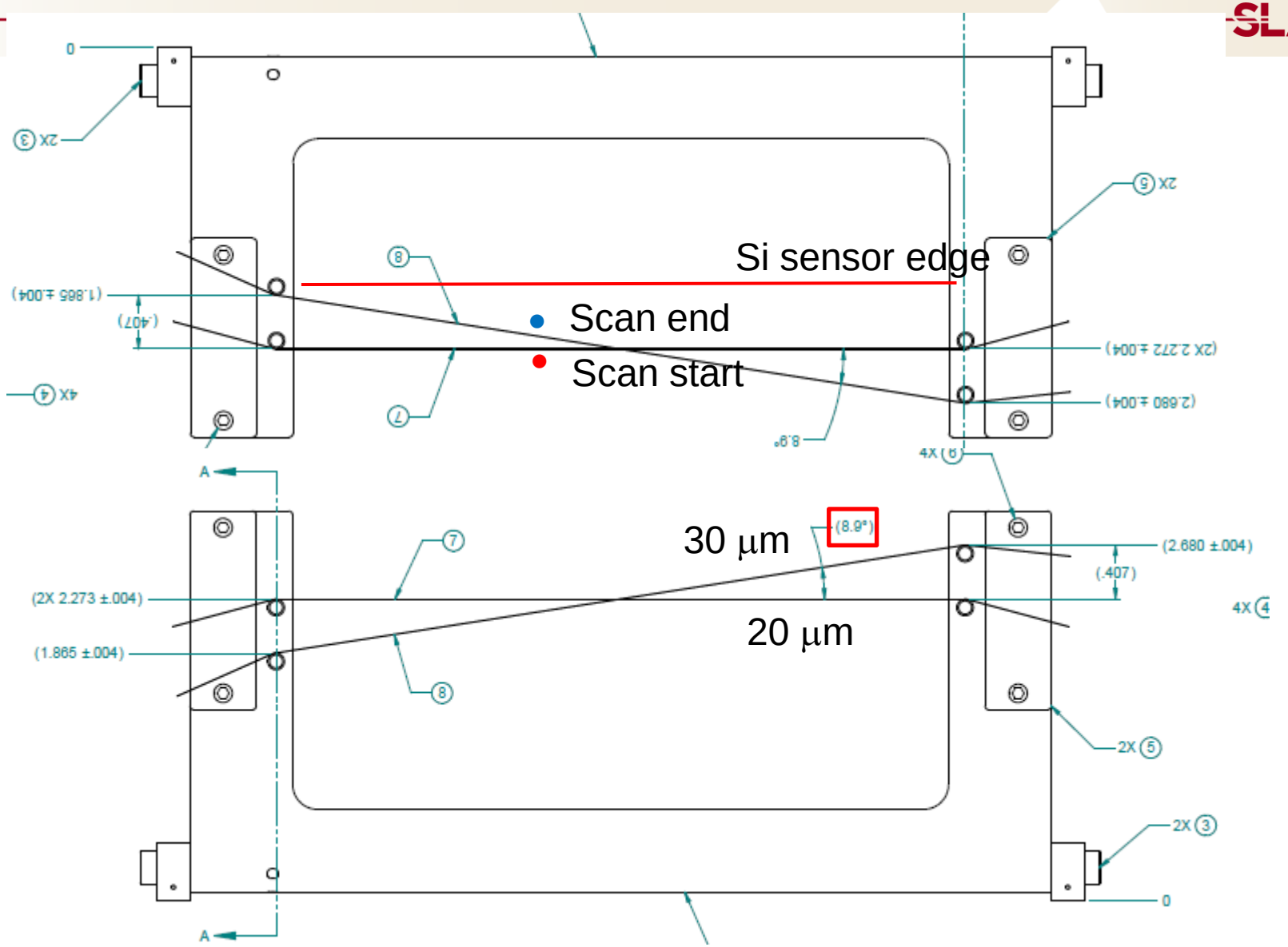


Skew Angle



We did not ask MCC to deliver small σ(y) beam.

SVT Wire Scanner

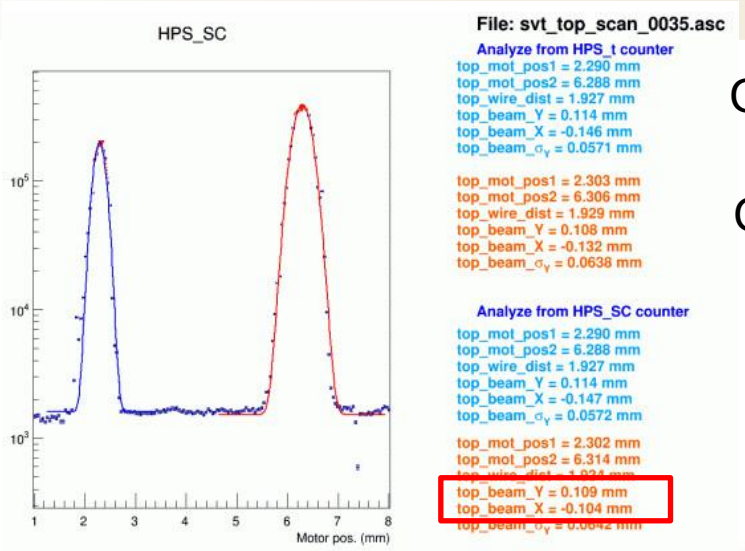


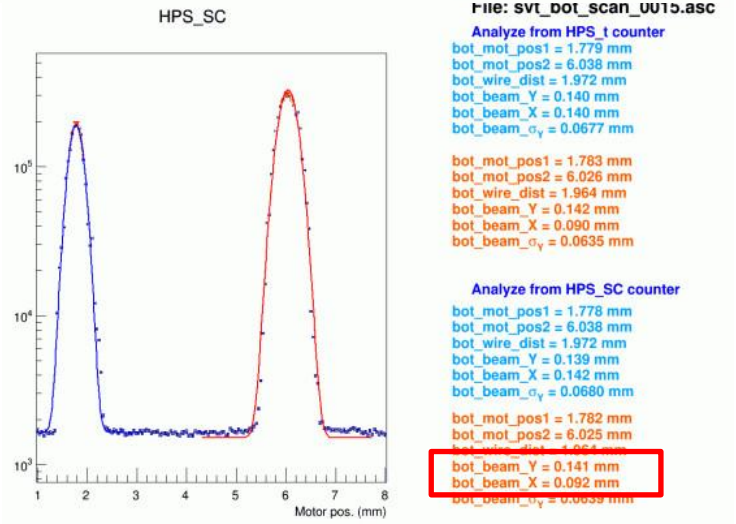
SVT Wire Scanner

SLAC

- SVT wire scanner is to measure beam position relative to the SVT sensor edge.
  - To place the beam in the middle of the SVT coordinate.
- Linear stage was calibrated against the sensor edge with a mil reproducibility before vacuum pump down.
- Vacuum deformation screwed up the calibration, and there was an uncertainty of ~300 μm in the top and bottom sensor positions.
  - The dial gauges were supposed to measure the vacuum deformation, but they did not work.
- SVT track-based re-calibration was made, and the top and bottom coordinates were brought to agreement with less than ~50 μm uncertainty.

May 1 03:09





Gaussian fit to full peak

Gaussian fit to peak and ±4 data points

- It takes ~10 min. to do one scan and the beam must be stable.

- Y position error < 50 μm
- X position error ~200 μm

May 1 19:47

File: svt_top_scan_0037.asc

Analyze from HPS_t counter

top_mot_pos1 = 2.443 mm
top_mot_pos2 = 6.523 mm
top_wire_dist = 1.967 mm
top_beam_Y = 0.040 mm
top_beam_X = 0.106 mm
top_beam_σ_Y = 0.0233 mm

top_mot_pos1 = 2.444 mm
top_mot_pos2 = 6.525 mm
top_wire_dist = 1.967 mm
top_beam_Y = 0.040 mm
top_beam_X = 0.109 mm
top_beam_σ_Y = 0.0231 mm

Analyze from HPS_SC counter

top_mot_pos1 = 2.444 mm
top_mot_pos2 = 6.522 mm
top_wire_dist = 1.966 mm
top_beam_Y = 0.040 mm
top_beam_X = 0.101 mm
top_beam_σ_Y = 0.0232 mm

top_mot_pos1 = 2.444 mm
top_mot_pos2 = 6.524 mm
top_wire_dist = 1.967 mm
top_beam_Y = 0.040 mm
top_beam_X = 0.106 mm
top_beam_σ_Y = 0.0231 mm

File: svt_bot_scan_0016.asc

Analyze from HPS_t counter

bot_mot_pos1 = 1.654 mm
bot_mot_pos2 = 5.762 mm
bot_wire_dist = 1.902 mm
bot_beam_Y = 0.082 mm
bot_beam_X = -0.307 mm
bot_beam_σ_Y = 0.0822 mm

bot_mot_pos1 = 1.659 mm
bot_mot_pos2 = 5.751 mm
bot_wire_dist = 1.894 mm
bot_beam_Y = 0.084 mm
bot_beam_X = -0.356 mm
bot_beam_σ_Y = 0.1004 mm

Analyze from HPS_SC counter

bot_mot_pos1 = 1.654 mm
bot_mot_pos2 = 5.761 mm
bot_wire_dist = 1.902 mm
bot_beam_Y = 0.082 mm
bot_beam_X = -0.308 mm
bot_beam_σ_Y = 0.0824 mm

bot_mot_pos1 = 1.660 mm
bot_mot_pos2 = 5.749 mm
bot_wire_dist = 1.893 mm
bot_beam_Y = 0.084 mm
bot_beam_X = -0.361 mm
bot_beam_σ_Y = 0.0971 mm

May 12 18:45

File: svt_top_scan_0042.asc

Analyze from HPS_t counter

top_mot_pos1 = 2.344 mm
top_mot_pos2 = 6.384 mm
top_wire_dist = 1.947 mm
top_beam_Y = 0.088 mm
top_beam_X = -0.017 mm
top_beam_σ_Y = 0.0673 mm

top_mot_pos1 = 2.340 mm
top_mot_pos2 = 6.413 mm
top_wire_dist = 1.963 mm
top_beam_Y = 0.090 mm
top_beam_X = 0.084 mm
top_beam_σ_Y = 0.0691 mm

Analyze from HPS_SC counter

top_mot_pos1 = 2.344 mm
top_mot_pos2 = 6.434 mm
top_wire_dist = 1.971 mm
top_beam_Y = 0.088 mm
top_beam_X = 0.136 mm
top_beam_σ_Y = 0.0667 mm

top_mot_pos1 = 2.342 mm
top_mot_pos2 = 6.410 mm
top_wire_dist = 1.961 mm
top_beam_Y = 0.089 mm
top_beam_X = 0.068 mm
top_beam_σ_Y = 0.0696 mm

File: svt_bot_scan_0017.asc

Analyze from HPS_t counter

bot_mot_pos1 = 1.557 mm
bot_mot_pos2 = 5.738 mm
bot_wire_dist = 1.936 mm
bot_beam_Y = 0.037 mm
bot_beam_X = -0.090 mm
bot_beam_σ_Y = 0.0750 mm

bot_mot_pos1 = 1.545 mm
bot_mot_pos2 = 5.718 mm
bot_wire_dist = 1.932 mm
bot_beam_Y = 0.032 mm
bot_beam_X = -0.115 mm
bot_beam_σ_Y = 0.0665 mm

Analyze from HPS_SC counter

bot_mot_pos1 = 1.557 mm
bot_mot_pos2 = 5.738 mm
bot_wire_dist = 1.936 mm
bot_beam_Y = 0.037 mm
bot_beam_X = -0.091 mm
bot_beam_σ_Y = 0.0753 mm

bot_mot_pos1 = 1.546 mm
bot_mot_pos2 = 5.717 mm
bot_wire_dist = 1.931 mm
bot_beam_Y = 0.032 mm
bot_beam_X = -0.122 mm
bot_beam_σ_Y = 0.0668 mm

May 12 19:39

File: svt_top_scan_0045.asc

Analyze from HPS_t counter

top_mot_pos1 = 2.631 mm
top_mot_pos2 = 6.608 mm
top_wire_dist = 1.916 mm
top_beam_Y = -0.050 mm
top_beam_X = -0.214 mm
top_beam_σ_Y = 0.0797 mm

top_mot_pos1 = 2.643 mm
top_mot_pos2 = 6.647 mm
top_wire_dist = 1.930 mm
top_beam_Y = -0.056 mm
top_beam_X = -0.127 mm
top_beam_σ_Y = 0.1045 mm

Analyze from HPS_SC counter

top_mot_pos1 = 2.631 mm
top_mot_pos2 = 6.607 mm
top_wire_dist = 1.916 mm
top_beam_Y = -0.050 mm
top_beam_X = -0.216 mm
top_beam_σ_Y = 0.0797 mm

top_mot_pos1 = 2.642 mm
top_mot_pos2 = 6.647 mm
top_wire_dist = 1.930 mm
top_beam_Y = -0.055 mm
top_beam_X = -0.125 mm
top_beam_σ_Y = 0.1026 mm

File: svt_bot_scan_0018.asc

Analyze from HPS_t counter

bot_mot_pos1 = 1.404 mm
bot_mot_pos2 = 5.609 mm
bot_wire_dist = 1.947 mm
bot_beam_Y = -0.034 mm
bot_beam_X = -0.019 mm
bot_beam_σ_Y = 0.0625 mm

bot_mot_pos1 = 1.389 mm
bot_mot_pos2 = 5.608 mm
bot_wire_dist = 1.954 mm
bot_beam_Y = -0.041 mm
bot_beam_X = 0.024 mm
bot_beam_σ_Y = 0.0707 mm

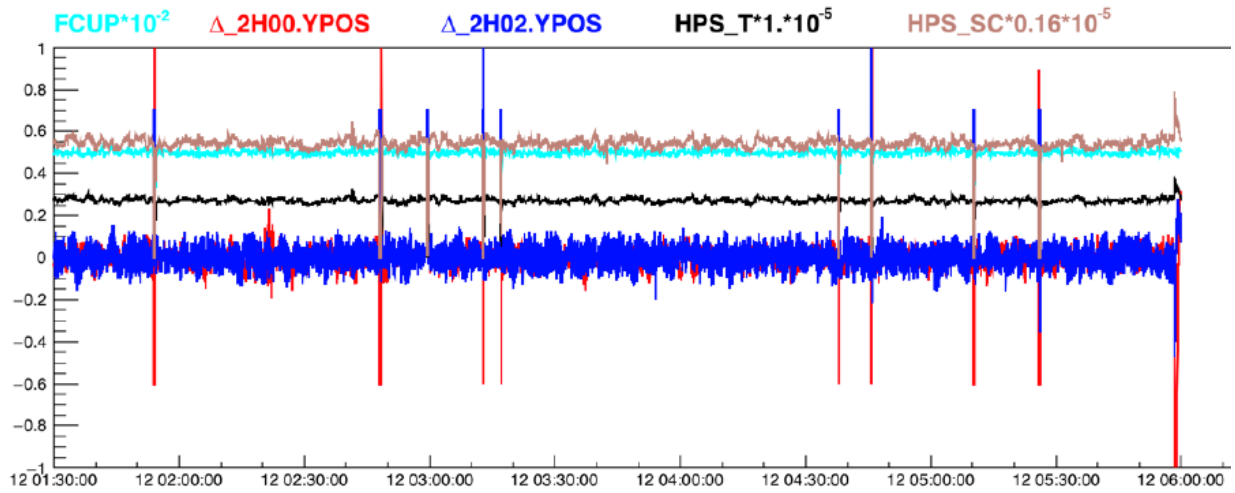
Analyze from HPS_SC counter

bot_mot_pos1 = 1.404 mm
bot_mot_pos2 = 5.608 mm
bot_wire_dist = 1.947 mm
bot_beam_Y = -0.034 mm
bot_beam_X = -0.022 mm
bot_beam_σ_Y = 0.0624 mm

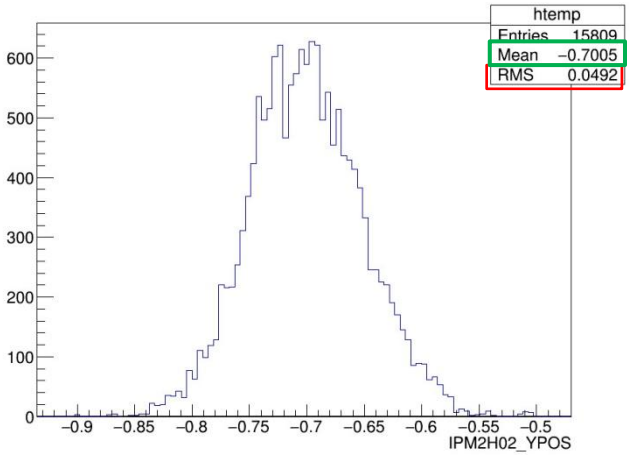
bot_mot_pos1 = 1.389 mm
bot_mot_pos2 = 5.602 mm
bot_wire_dist = 1.951 mm
bot_beam_Y = -0.041 mm
bot_beam_X = 0.006 mm
bot_beam_σ_Y = 0.0698 mm

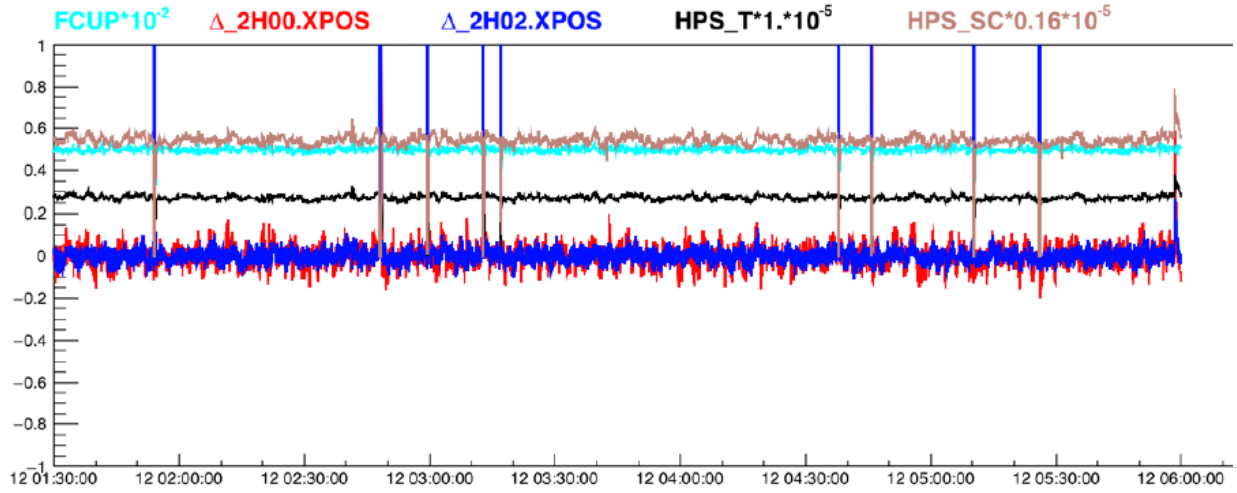
Beam Stability

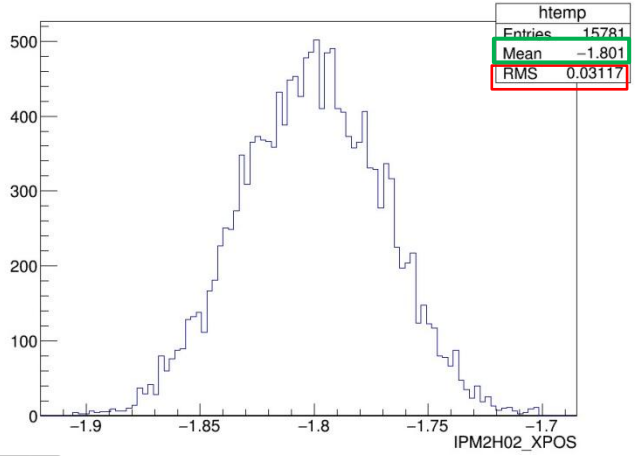
May 12



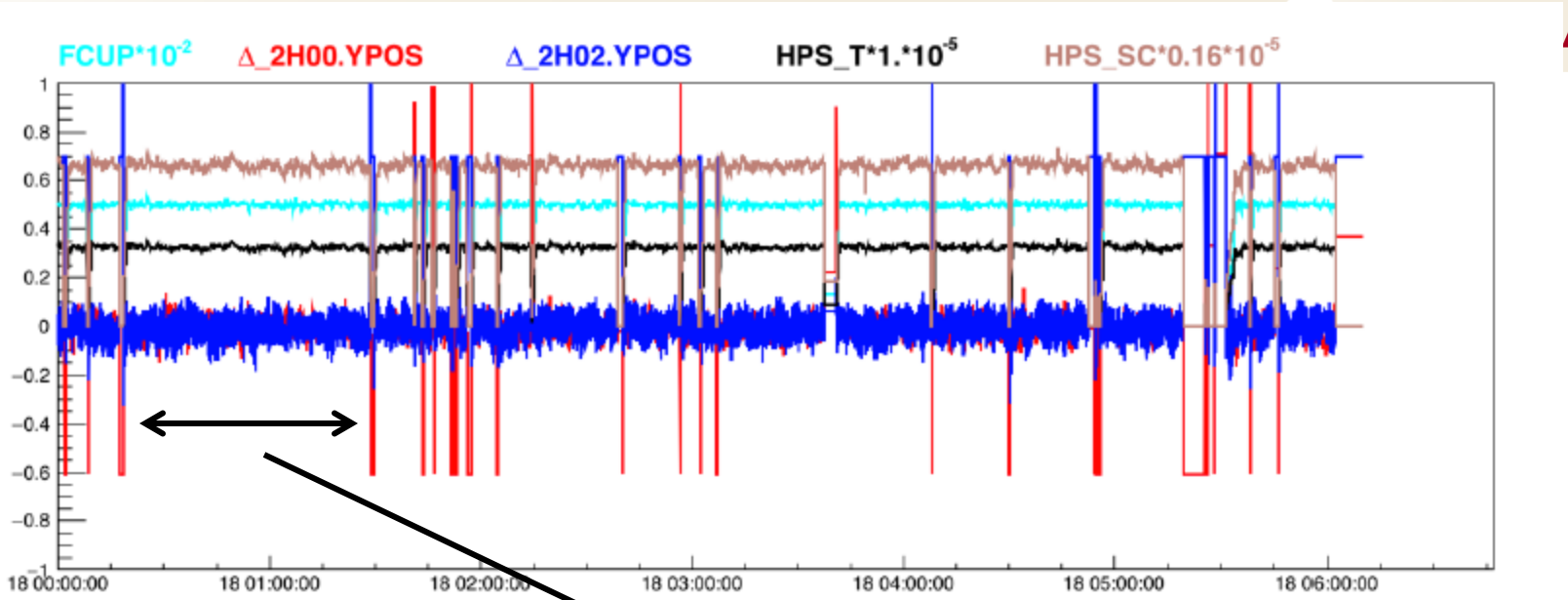
2H02

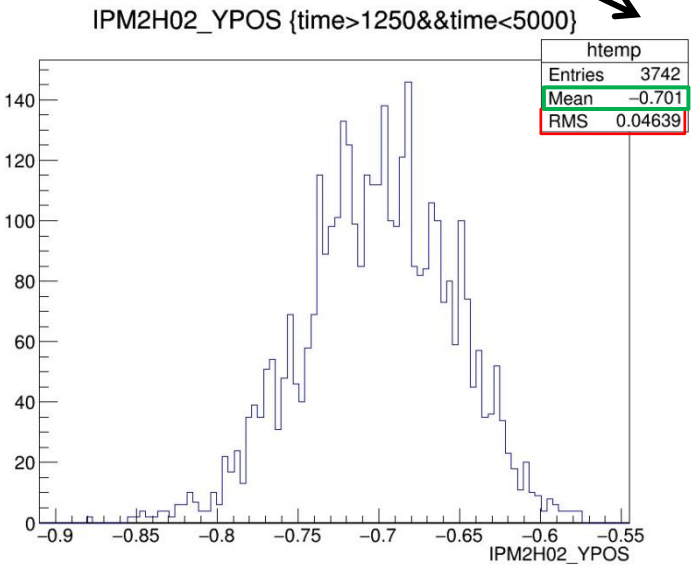


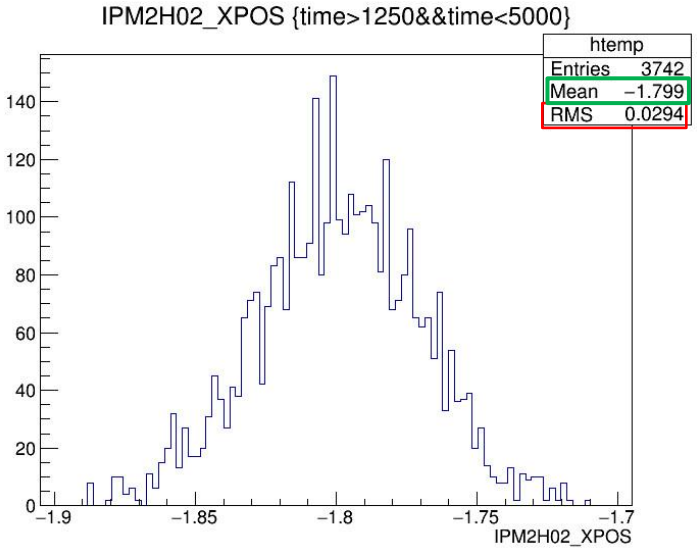




May 18

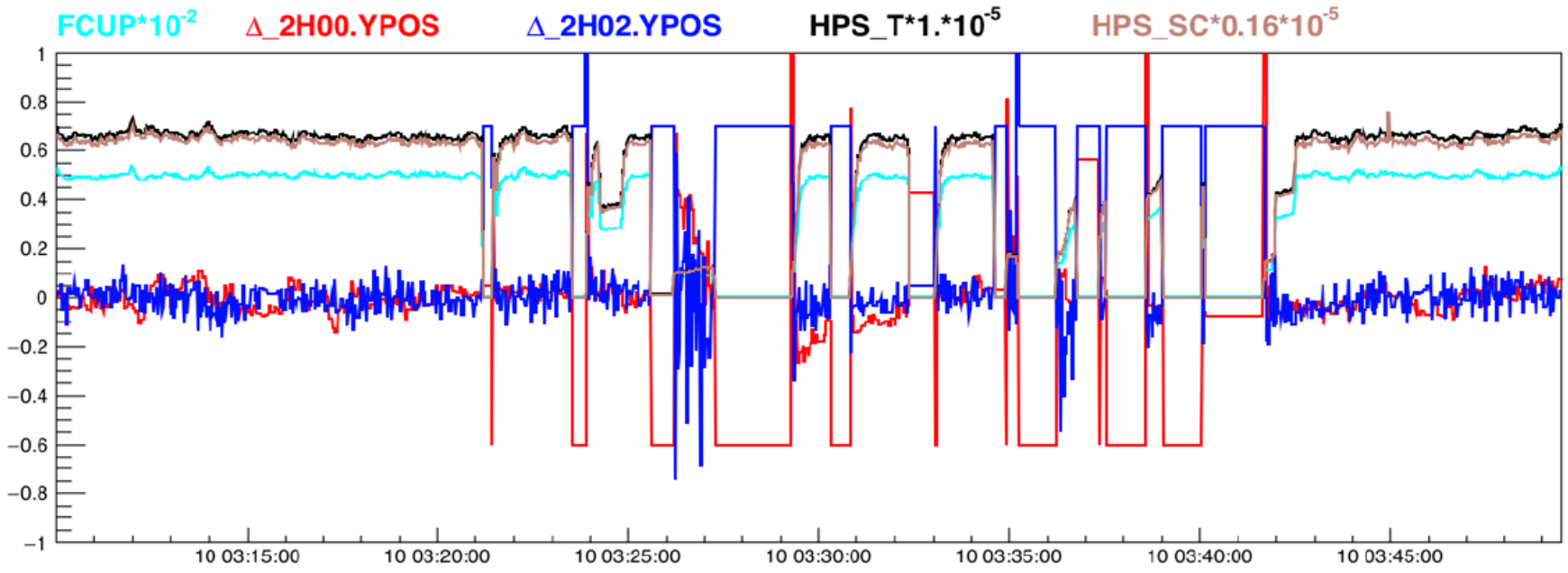

FCUP*10^-2
Δ_2H00.YPOS
Δ_2H02.YPOS
HPS_T*1.*10^-5
HPS_SC*0.16*10^-5
18 00:00:00
18 01:00:00
18 02:00:00
18 03:00:00
18 04:00:00
18 05:00:00
18 06:00:00


IPM2H02_YPOS {time>1250&&time<5000}
htemp
Entries 3742
Mean −0.701
RMS 0.04639
IPM2H02_YPOS


IPM2H02_XPOS {time>1250&&time<5000}
htemp
Entries 3742
Mean −1.799
RMS 0.0294
IPM2H02_XPOS

Hall A tuning affects our beam.

Sunday May 10 - 3:30am

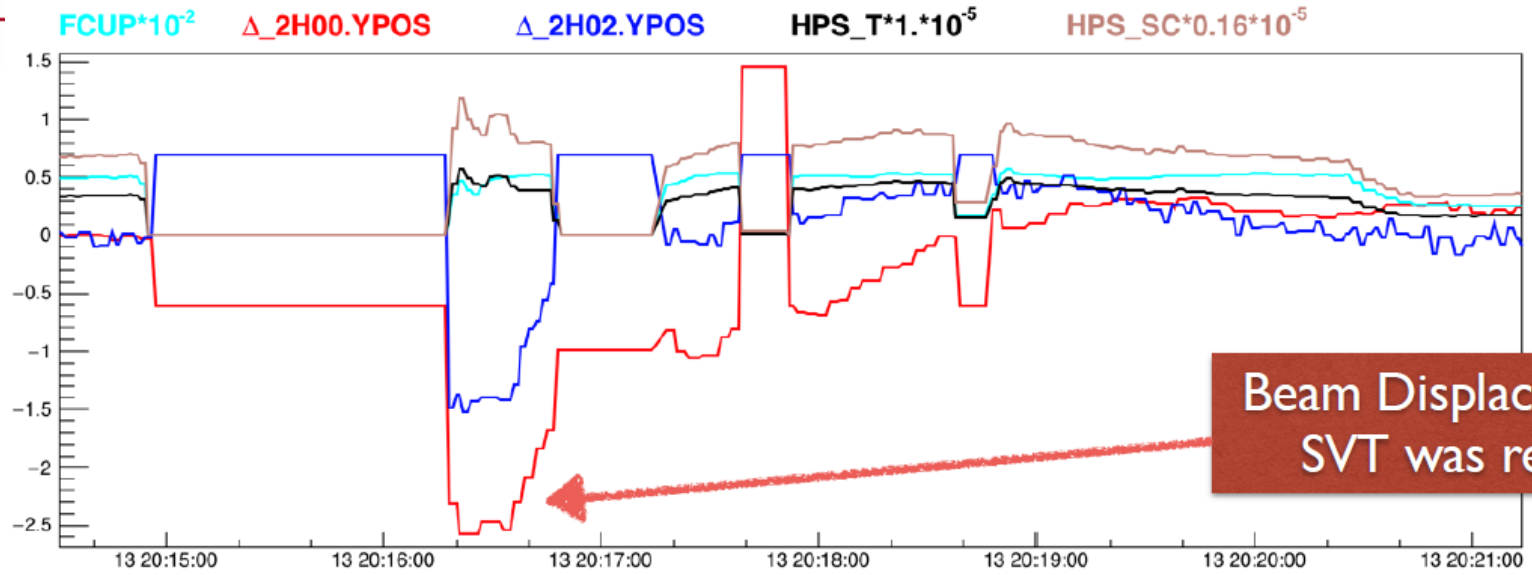


From logs:

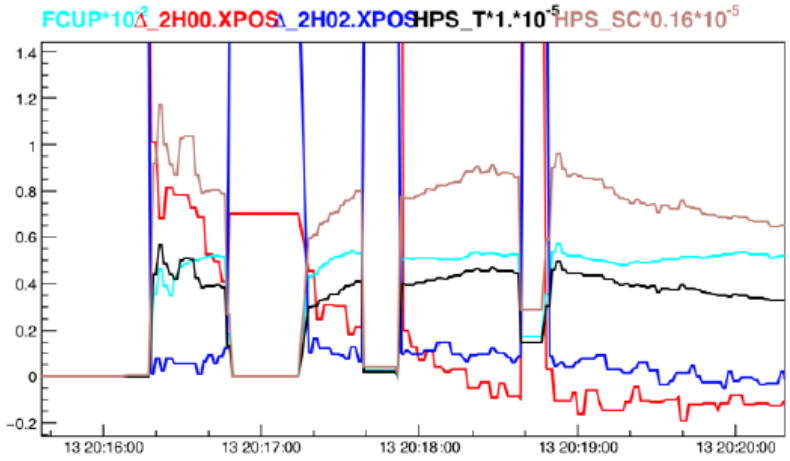
03:41 The beam trips off often and I called MCC. They are trying to deliver a beam to Hall A and therefore switched off the current locks.

Crew chief adjusted the energy in the north linac. We have smoother beam now.

Wednesday May 13th FSD events



Beam Displacement real, SVT was retracted.



The Logs indicate an FSD trip 18:42 and 20:15:

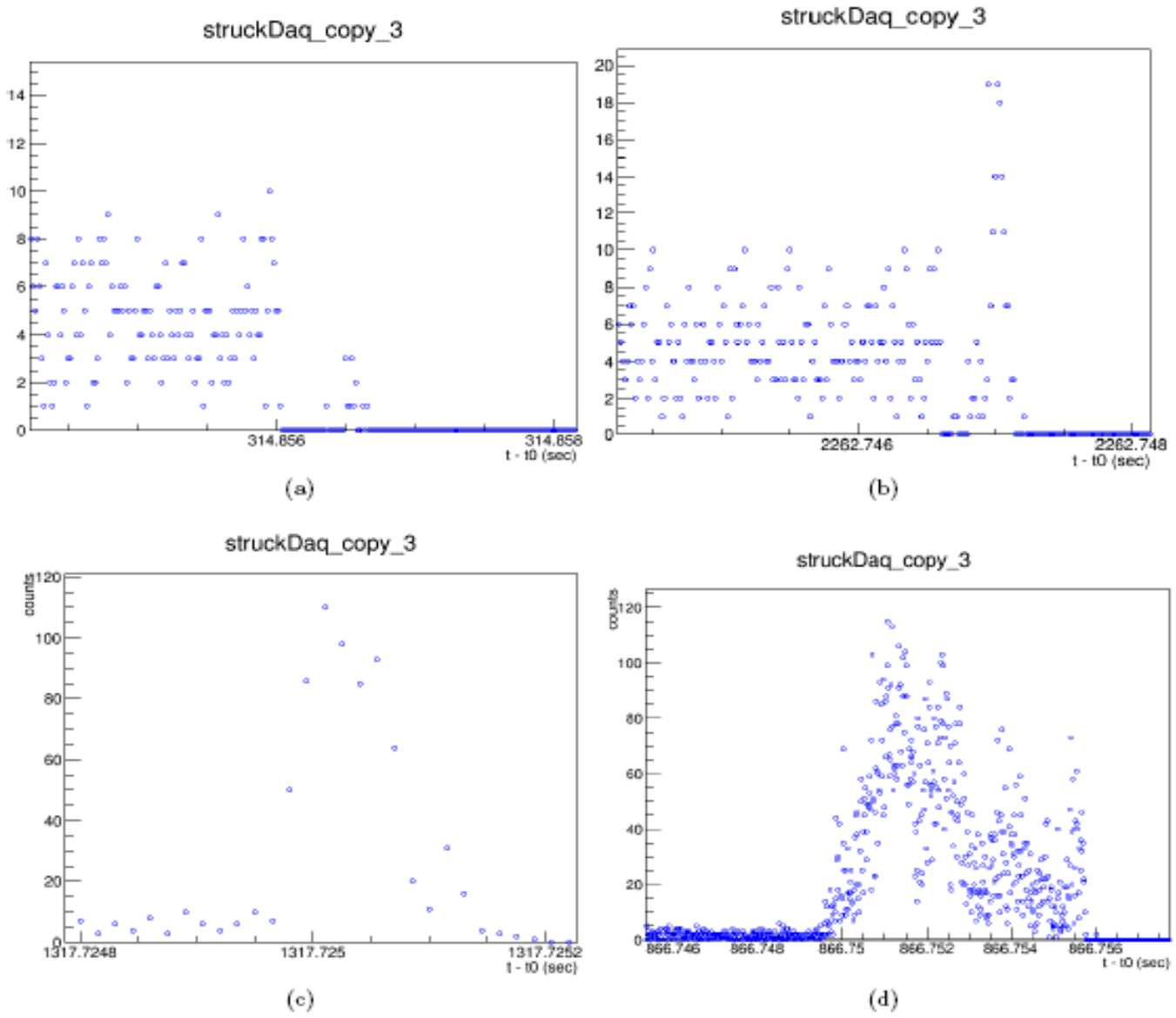
20:15 FSD halo counter trip
move SVT out, end run, request beam back
beam coming back very unstable. Request reduction to 25 nA while they tune.
increasing current in 5 nA steps
moved SVT back to +-0.5. Bias currents now slightly higher (L1 bot stereo just below 1 uA). Occupancies unchanged (~1.3% worst)
** New procedure for bringing beam back from trips that doesn't require FSD masking: come back at 25 nA and then increase slowly **

Moving SVT OUT was probably a good idea here.

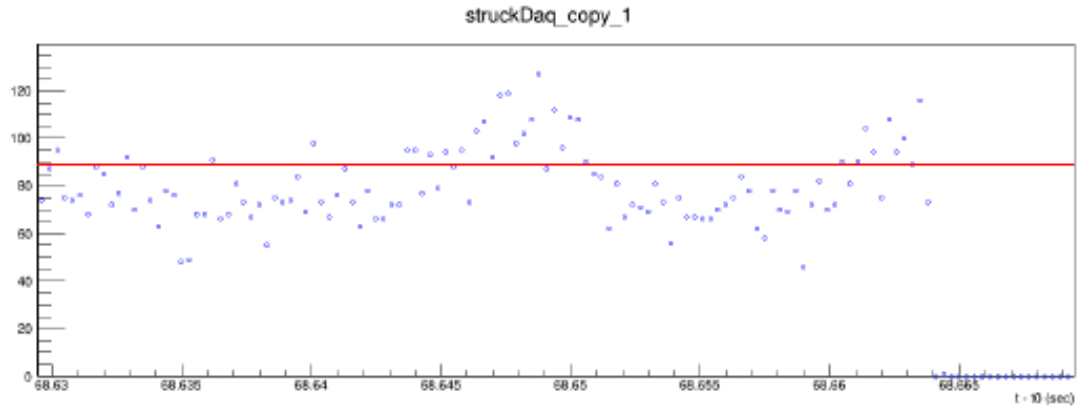
Beam Stability

- Maurik generated root files containing MYA data.
  - HPS Meeting May 27, 2015
- Beam after May 10 was very high quality and very stable.
  - IPM2H02_XPOS = -1.8 mm
  - IPM2H02_YPOS = -0.7 mm
  - RMS(IPM2H02_XPOS) = 29 μm
  - RMS(IPM2H02_YPOS) = 46 μm
  - BMP intrinsic resolution: 10 ~15 μm at 50 nA
- Beam tuning in other Halls adversely affects our beam.
- We clearly need the FSD, and we need to have good recovery procedure from FSD trips.

Beam motion before trip (Rafo)



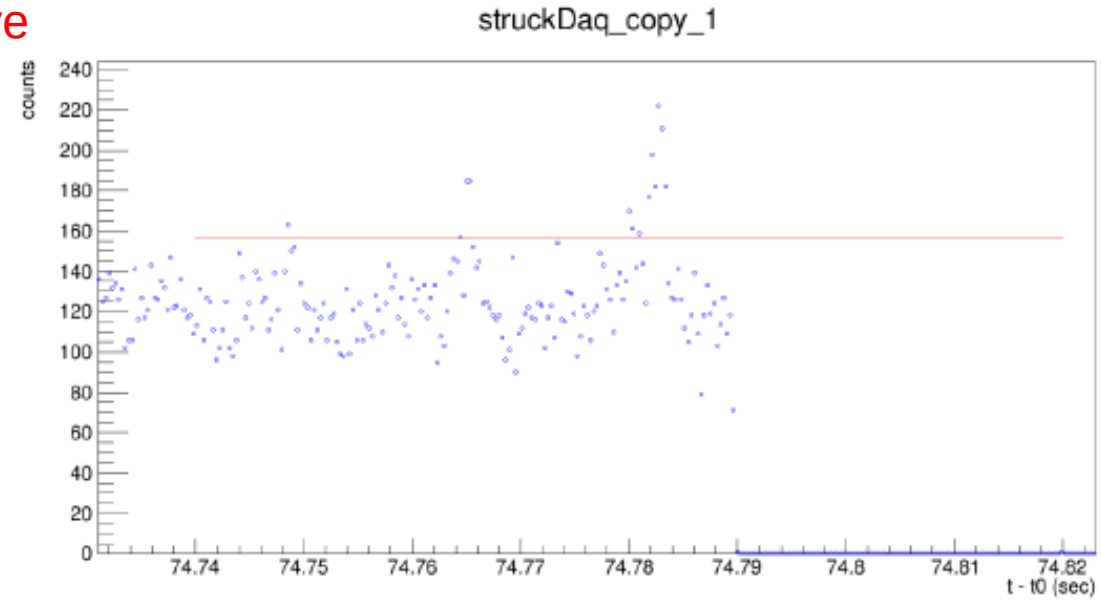
Setting FSD threshold



(a)

10 ms integration time

Threshold was set at 30% above nominal.



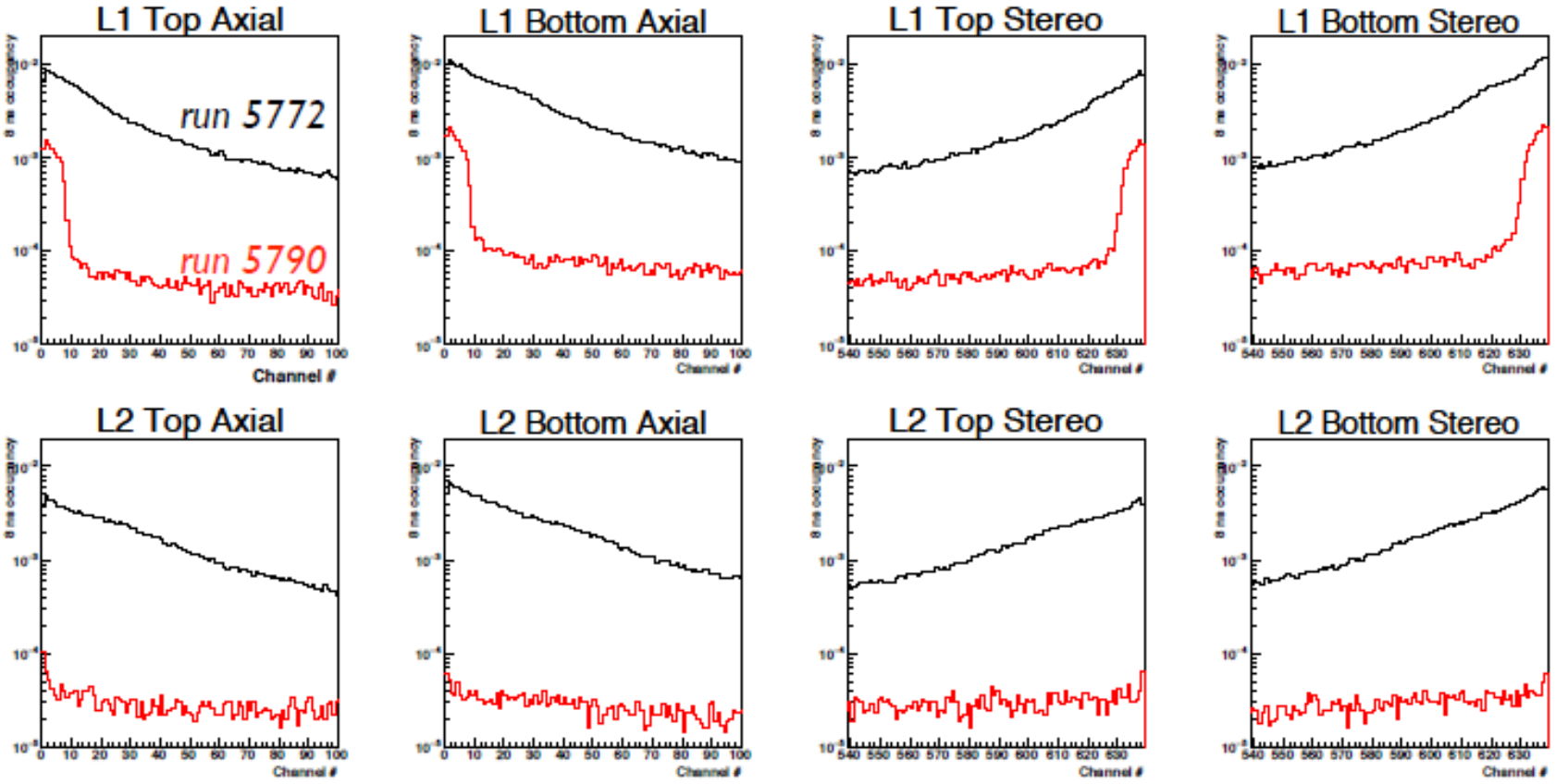
(b)

5 ms integration time

Beam halo

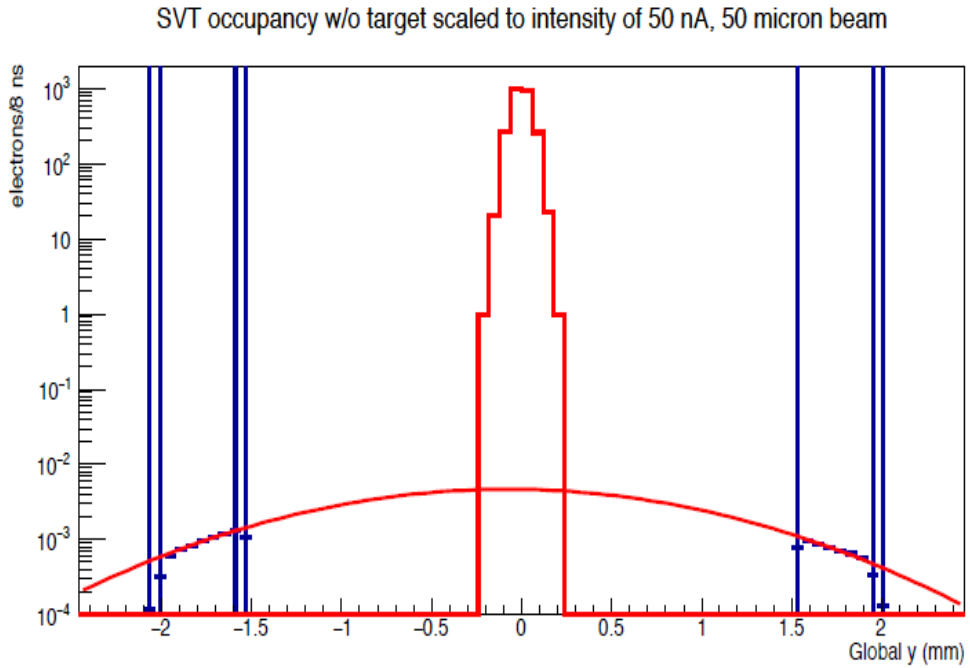
Excess Occupancy at Edges of L1 Sensors (Tim)

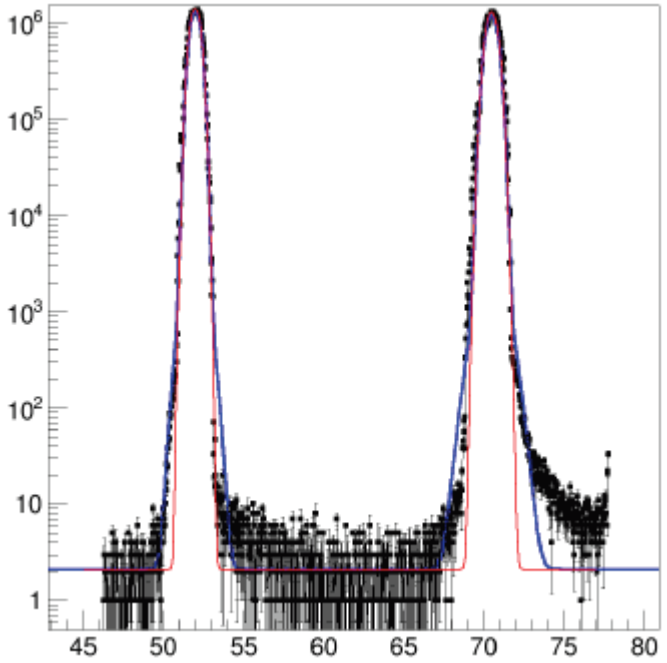
Effect is clearly seen in comparing runs with and without target



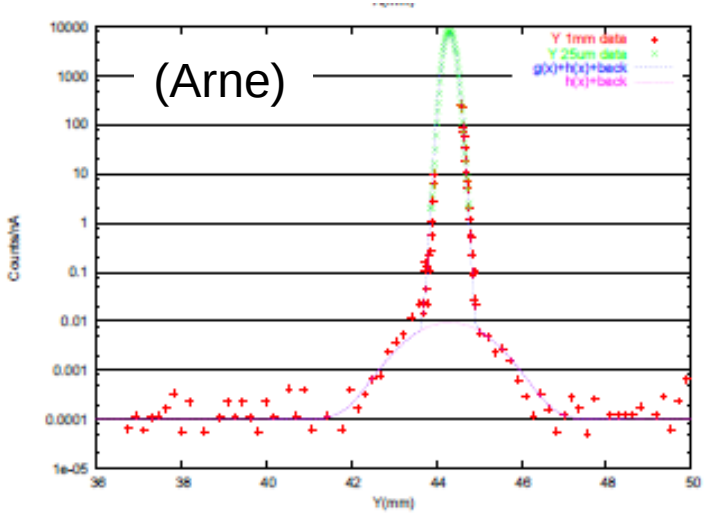
Occupancy is roughly 1/5 of physics occupancy, in 8-10 60μm strips.

2C24 scan using thick wire (FX)

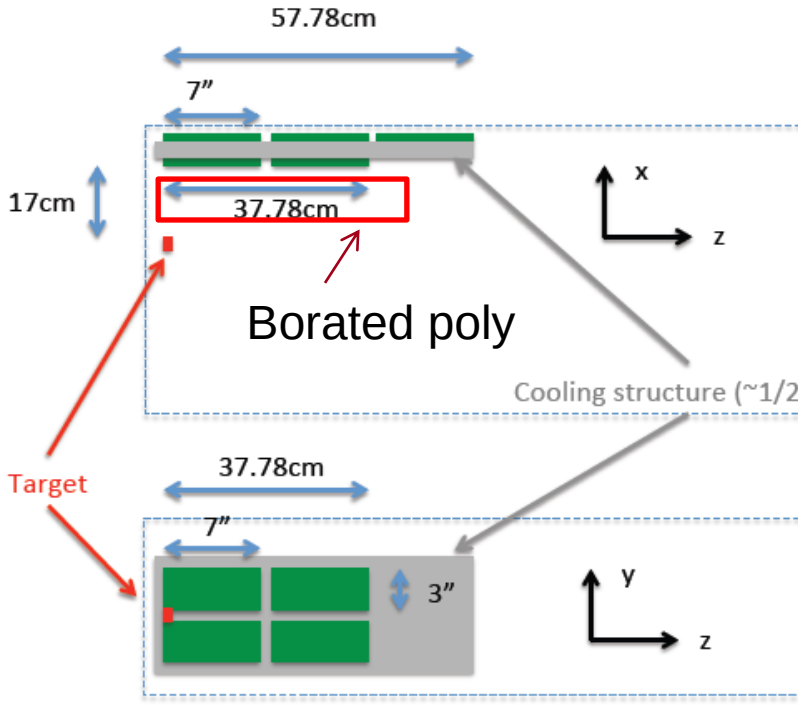




(Arne)



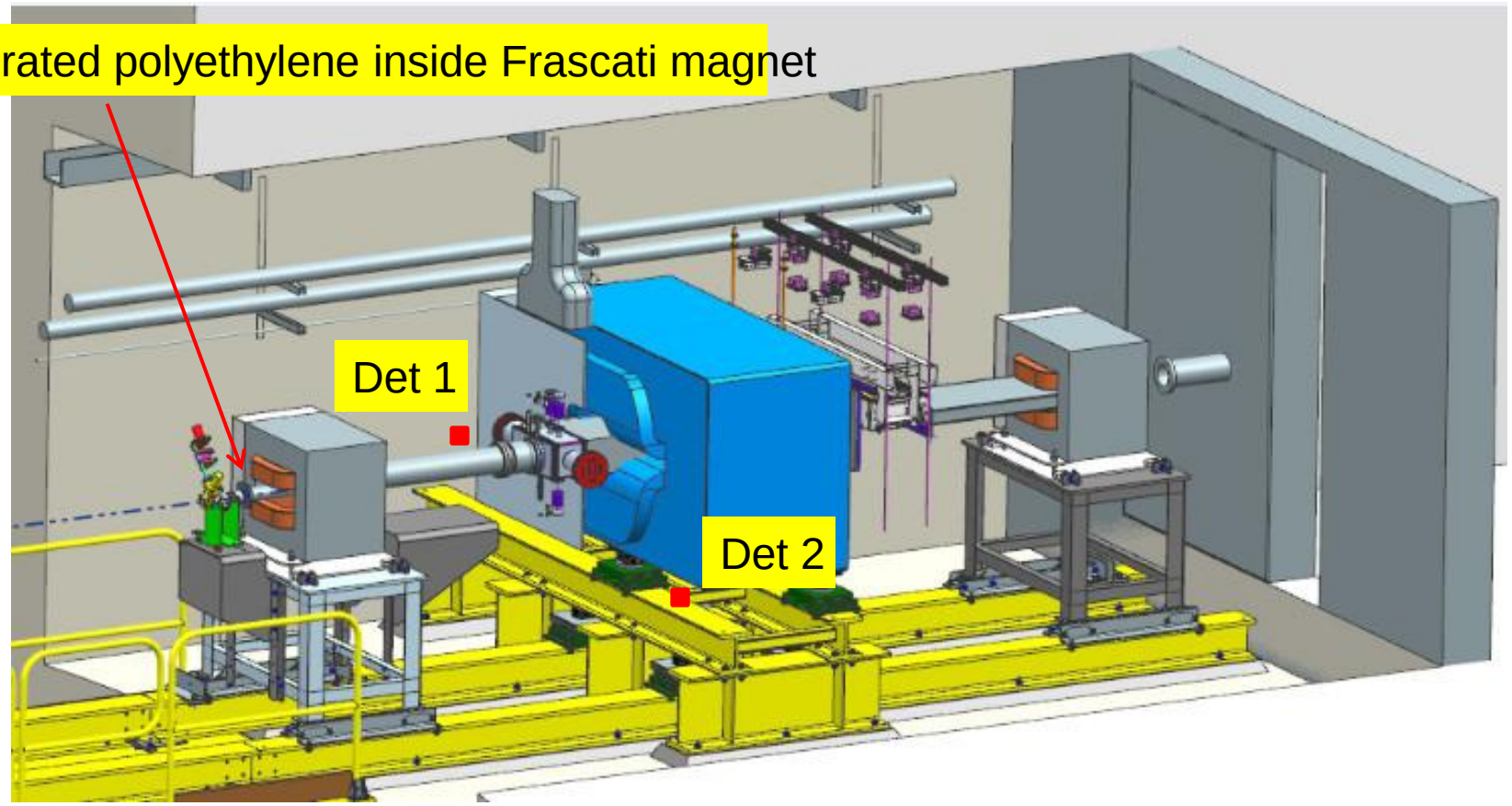
Neutrons and X-rays at FE Boards

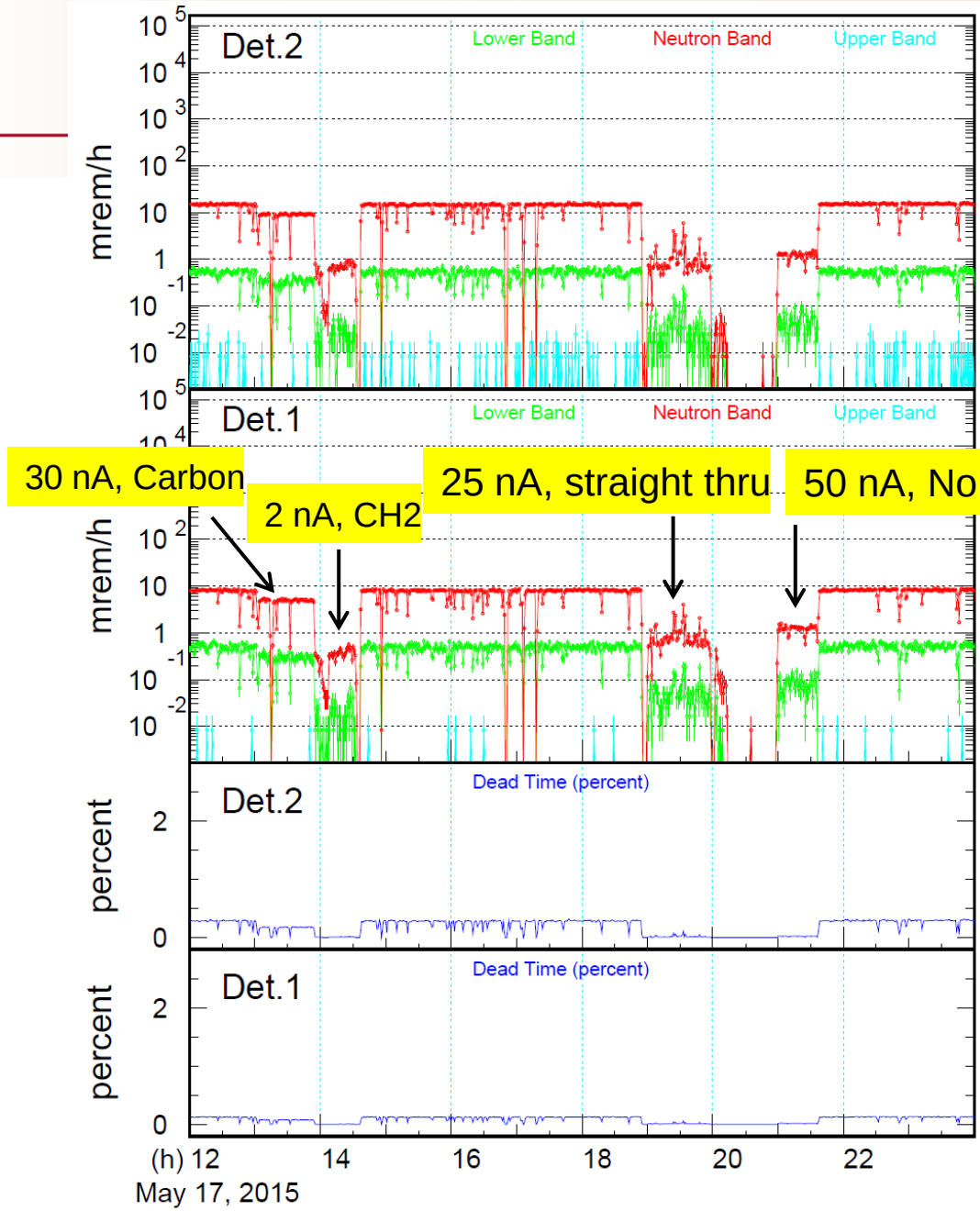


- Radiation damage to FPGA was a big worry.
- 2 “-thick borated poly was installed between the target and the FE boards.
  - Cut the neutron flux by ½.
  - Completely absorbed X-rays.
    - L-shell X-rays seen in Layer 1. Academic interest to measure the X-ray rates.
- Borated poly was installed in the beam left inside of the first Frascati magnet.
- Neutron flux from upstream beam line was unknown.

Neutron detectors from JLab Radiation Physics Group

BF_3 gas proportional counter wrapped in polyethylene
Sensitive to neutrons Tn < 100 eV.
Polyethylene for energy moderation.



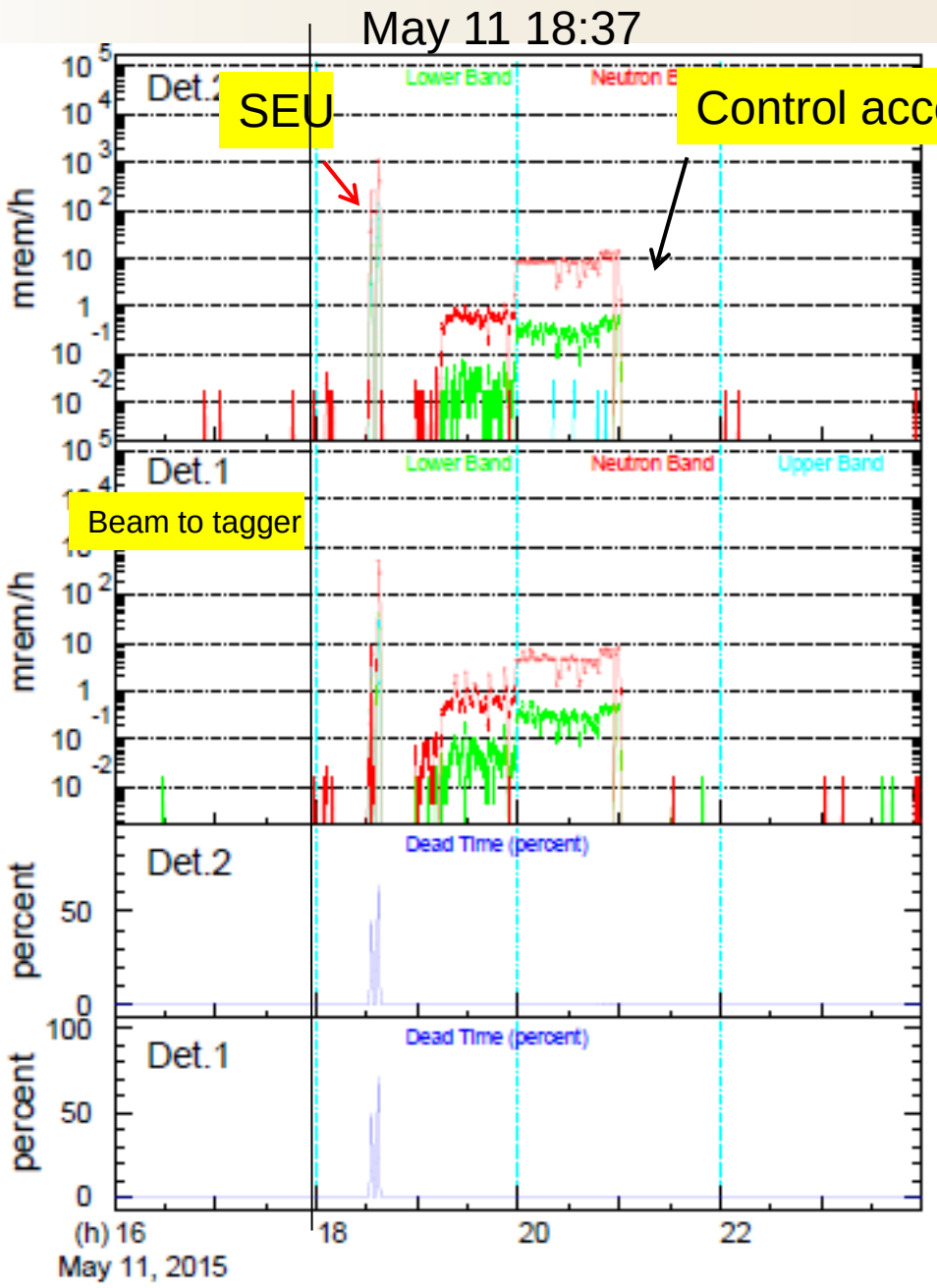


< 10^{-2} mrem/hour from upstream

~1 mrem/hour between tagger and HP

~9 mrem/hour from target

Flux goes up during beam tuning.



FEB 0 firmware image got corrupted.
Had an access to reload the image.
HPS_T not HPS_SC shot up.
→ The spikes may not be neutrons.

ELOG 3340172

18:00 Beam to tagger dump
harp scans look good
18:20 PSpec power supply reads 'MPS not ready'
This appears to be normal.
We put 10 in 'current set' and then got 'MPS ready'
18:22 ramping chicane magnets
18:22 tagger ramping down
18:25 pairspec magnet at 2700 A, waiting 30 minutes
18:35 frascati (minitorus PS) set to 369.6
SEU→
18:41 tagger magnet did not degauss properly.
MCC is turning it back on and then trying again
18:55 pairspec set 369.6 A, frascati being cycled to 3500 A prior to being set to 707 A (oops)
18:45 start bringing up daq
19:15 request beam

1 SEU/Day at 8000 n's/cm^2/sec (Pelle)
~100 n's/cm^2/sec at FPGA from Target (Fluka)