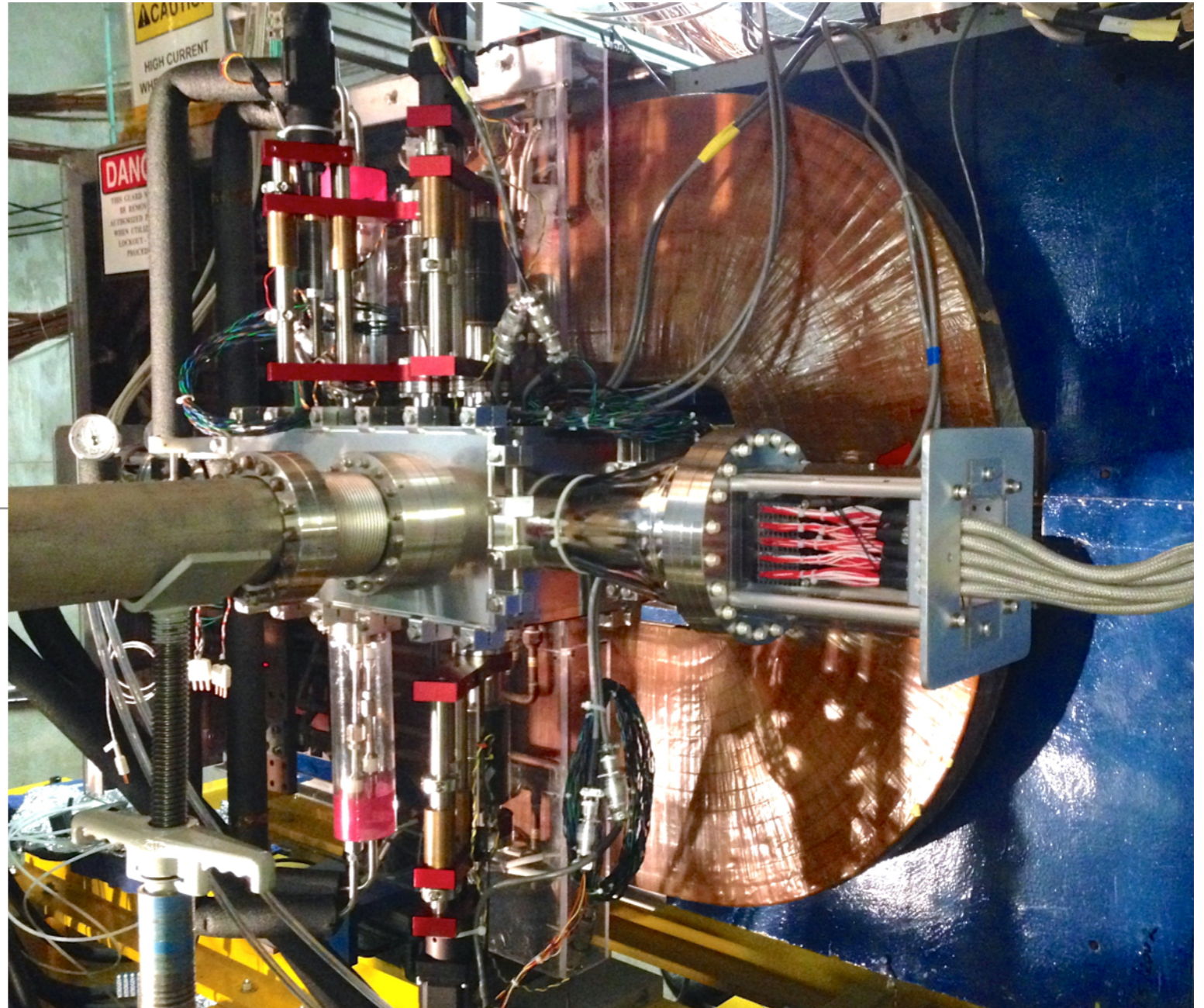


HPS SVT Status

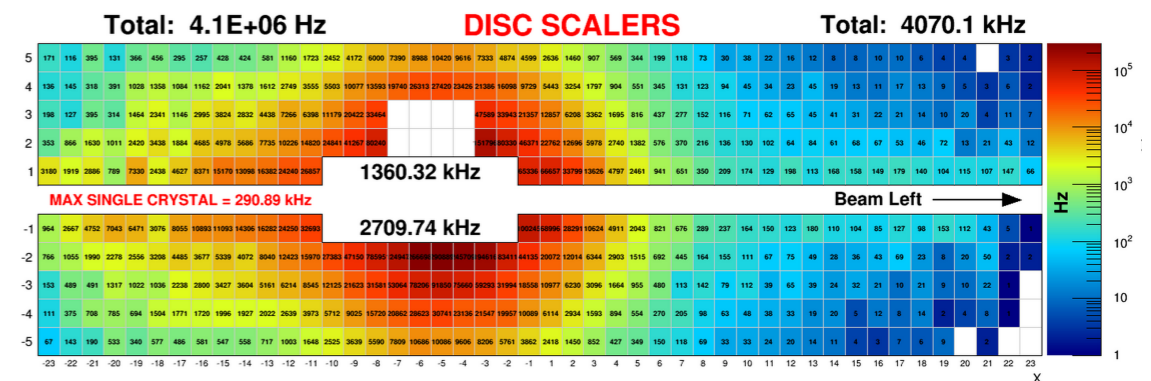
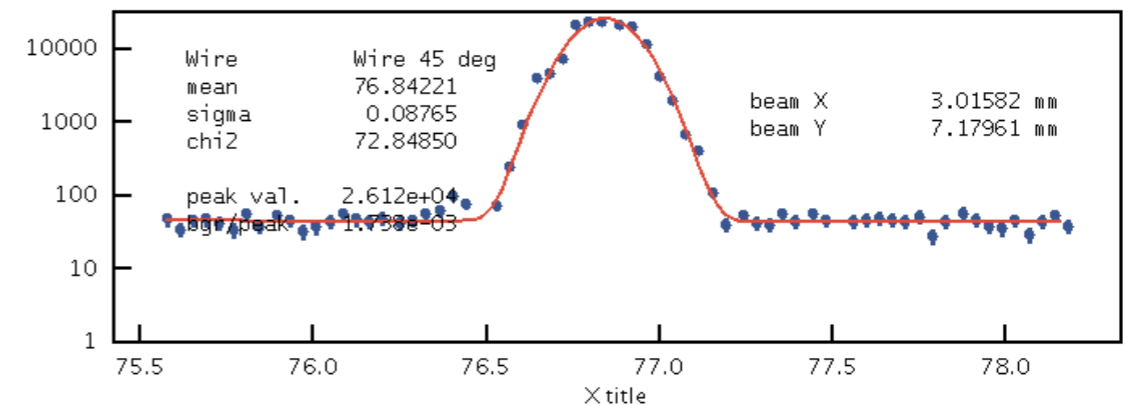
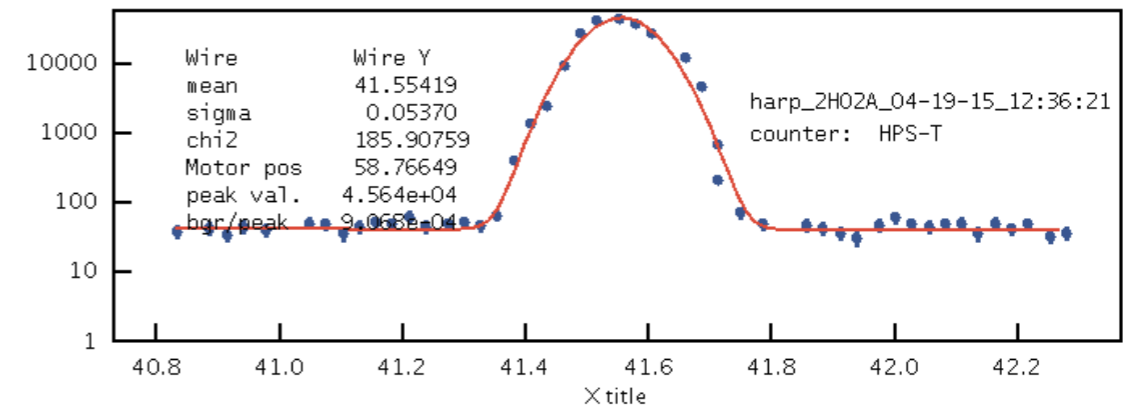
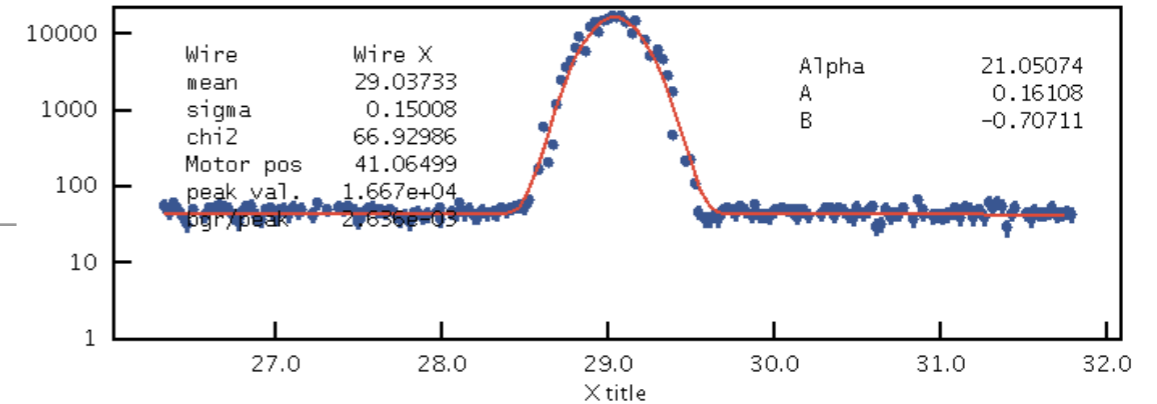
Tim Nelson - **SLAC**

April 22, 2015



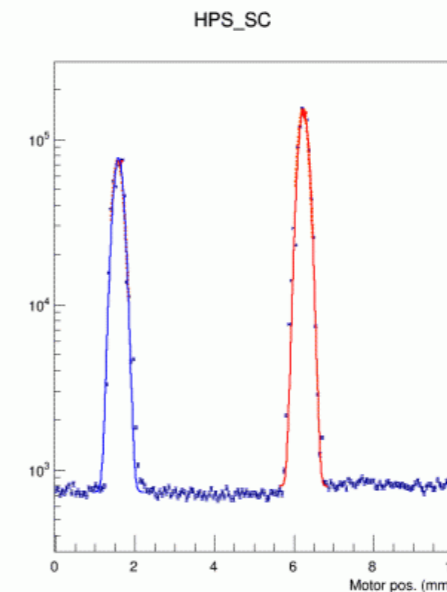
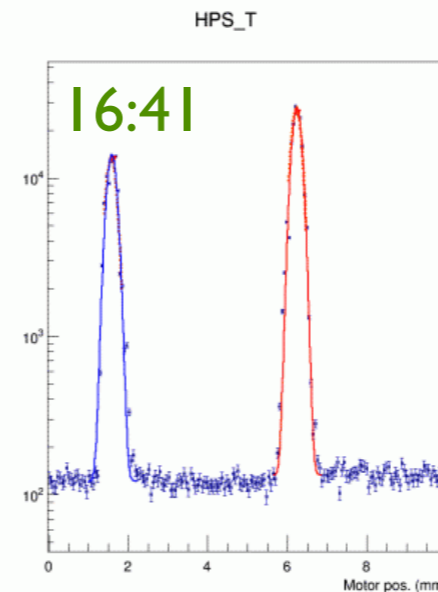
First HPS Data with SVT

- Reasonable beam sent to tagger dump during Sunday 4/19 swing and 4/20 owl: ~30 nA, good profile, tails $\sim 10^{-3}$, some visible motion.
- Sudden, large beam motion takes out highest occupancy ECal HV group in top for FEE.
- 4 mm collimator in and centered on beam.
- SVT wire scans performed. 350-500 μm discrepancy between top and bottom scans in y: can sort out later with tracks.
- SVT turned on and data taken fully open to time in trigger latency for APV25 pipeline readout.
- After timing in, SVT moved in with LI at $\pm 4\text{mm}$ to get tracks through all layers.
- Runs taken until the end of 4/20 owl: ~40M (?) events with SVT. (based on run spreadsheet)
- So far, only very small samples analyzed using monitoring software. (thanks to Per Hansson, Omar Moreno, Matt Graham, Sho Uemura)



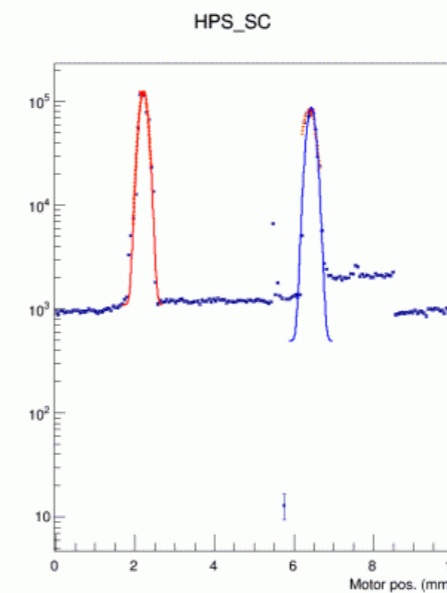
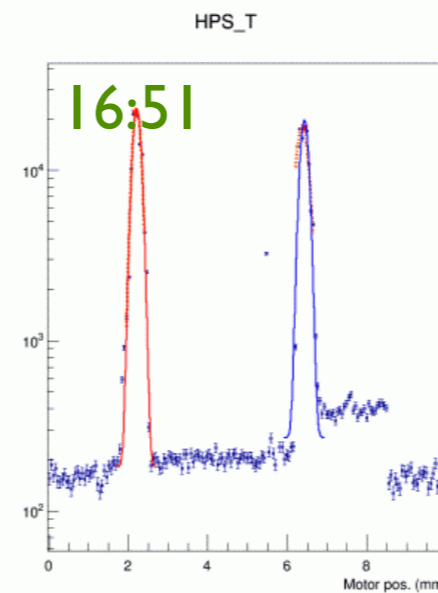
SVT Wire Scans

- Three scans of **vertical** beam position indicate 350-500 micron discrepancy between top and bottom measurements of beam position:
effect from vacuum induced deflection of SVT motors not perfectly corrected for.
- Two clean scans of **horizontal** beam position indicate good agreement between top and bottom.
- Caveat: scans take 10 minutes so there can be beam motion and current variation between/during scans.
- More scans and analysis of tracks in L1-3 (movable) vs. L4-6 (stationary) will allow us to understand this better.



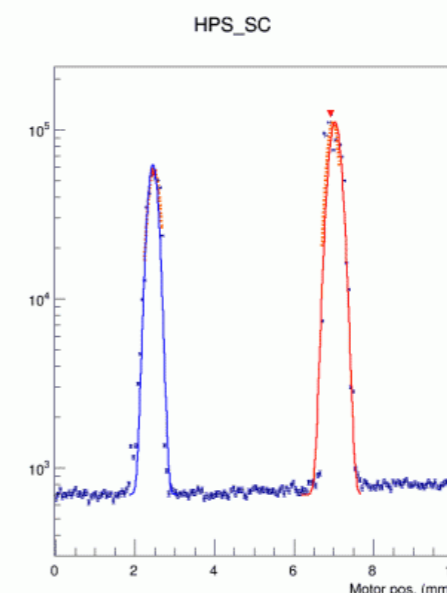
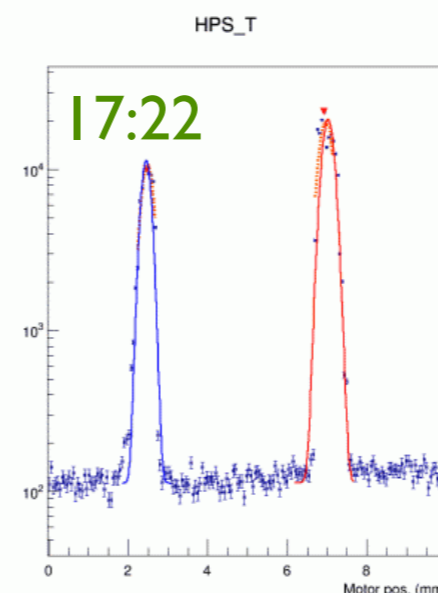
File: svt_bot_scan_0008.asc
Analyze from HPS_t counter
bot_mot_pos1 = 1.583 mm
bot_mot_pos2 = 6.238 mm
bot_wire_dist = 2.155 mm
bot_beam_Y = -0.249 mm
bot_beam_X = 1.310 mm
bot_mot_pos1 = 1.572 mm
bot_mot_pos2 = 6.229 mm
bot_wire_dist = 2.156 mm
bot_beam_Y = -0.254 mm
bot_beam_X = 1.318 mm

Analyze from HPS_SC counter
bot_mot_pos1 = 1.582 mm
bot_mot_pos2 = 6.238 mm
bot_wire_dist = 2.155 mm
bot_beam_Y = -0.250 mm
bot_beam_X = 1.312 mm
bot_mot_pos1 = 1.572 mm
bot_mot_pos2 = 6.229 mm
bot_wire_dist = 2.156 mm
bot_beam_Y = -0.254 mm
bot_beam_X = 1.318 mm



File: svt_top_scan_0010.asc
Analyze from HPS_t counter
top_mot_pos1 = 2.214 mm
top_mot_pos2 = 6.429 mm
top_wire_dist = 2.032 mm
top_beam_Y = 0.238 mm
top_beam_X = 0.523 mm
top_mot_pos1 = 2.213 mm
top_mot_pos2 = 6.375 mm
top_wire_dist = 2.006 mm
top_beam_Y = 0.238 mm
top_beam_X = 0.359 mm

Analyze from HPS_SC counter
top_mot_pos1 = 2.214 mm
top_mot_pos2 = 6.434 mm
top_wire_dist = 2.034 mm
top_beam_Y = 0.238 mm
top_beam_X = 0.536 mm
top_mot_pos1 = 2.213 mm
top_mot_pos2 = 6.379 mm
top_wire_dist = 2.008 mm
top_beam_Y = 0.238 mm
top_beam_X = 0.370 mm



File: svt_top_scan_0011.asc
Analyze from HPS_t counter
top_mot_pos1 = 2.448 mm
top_mot_pos2 = 7.024 mm
top_wire_dist = 2.206 mm
top_beam_Y = 0.125 mm
top_beam_X = 1.633 mm
top_mot_pos1 = 2.483 mm
top_mot_pos2 = 6.967 mm
top_wire_dist = 2.161 mm
top_beam_Y = 0.108 mm
top_beam_X = 1.348 mm

Analyze from HPS_SC counter
top_mot_pos1 = 2.449 mm
top_mot_pos2 = 7.028 mm
top_wire_dist = 2.207 mm
top_beam_Y = 0.125 mm
top_beam_X = 1.643 mm
top_mot_pos1 = 2.483 mm
top_mot_pos2 = 6.978 mm
top_wire_dist = 2.167 mm
top_beam_Y = 0.108 mm
top_beam_X = 1.385 mm

SVT Timing In

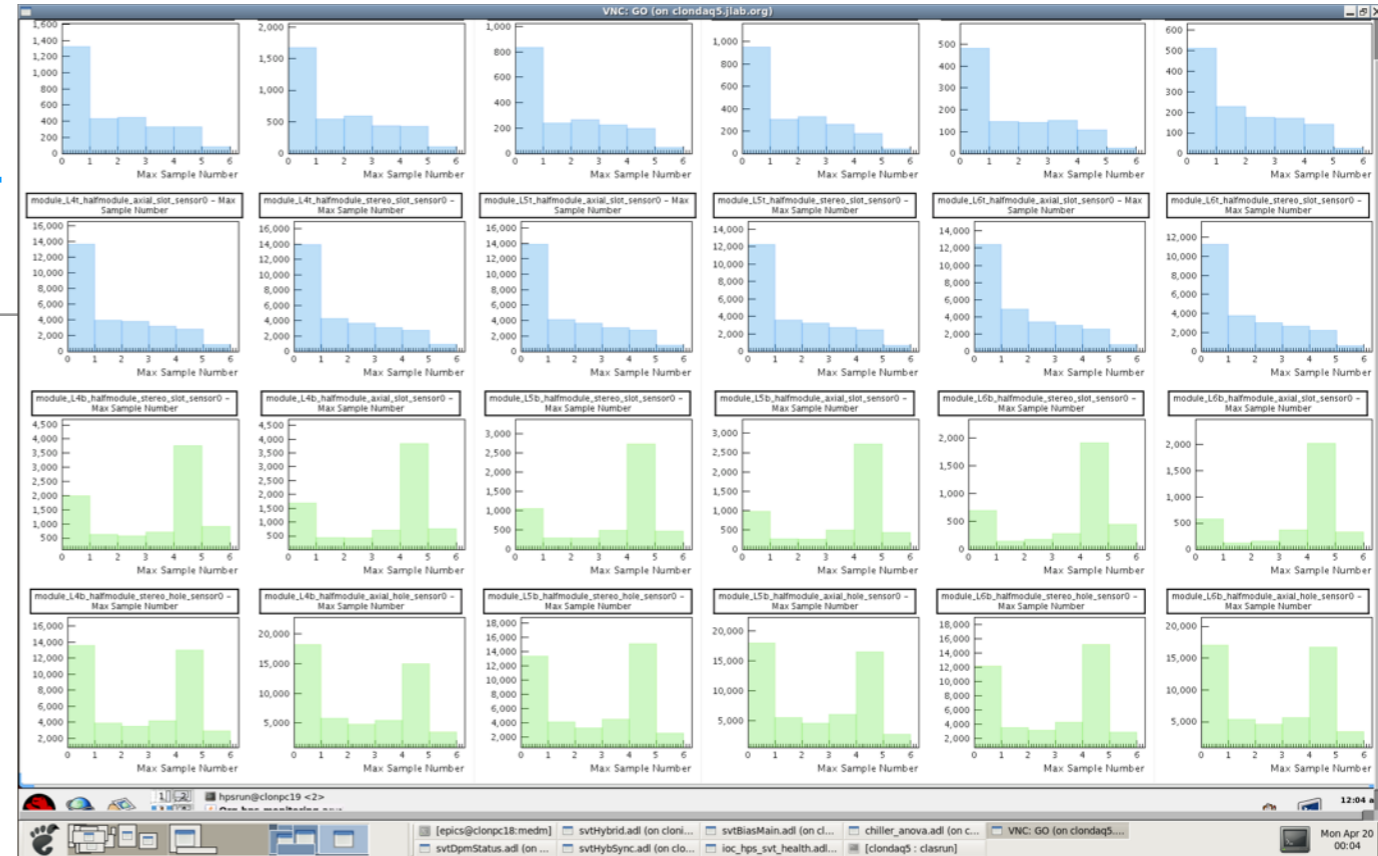
- SVT timed in with L1-3 fully open using L4-6 only.
- *Recall*: APV25 reads out six samples of the shaped signal pulse at 25 ns intervals.

- A hit is defined as three samples above threshold:
 $threshold = pedestal + 3 \times \sigma_{noise}$
- Plot sample number of highest sample to find correct latency.
 - Pileup hits make flat background in samples 2-5 (enhanced in first sample by long pileup tails and depleted in last by short rise time.)
 - triggered hits make clear peak within seconds of starting run.

Bottom-only Trigger: latency = 148

Top

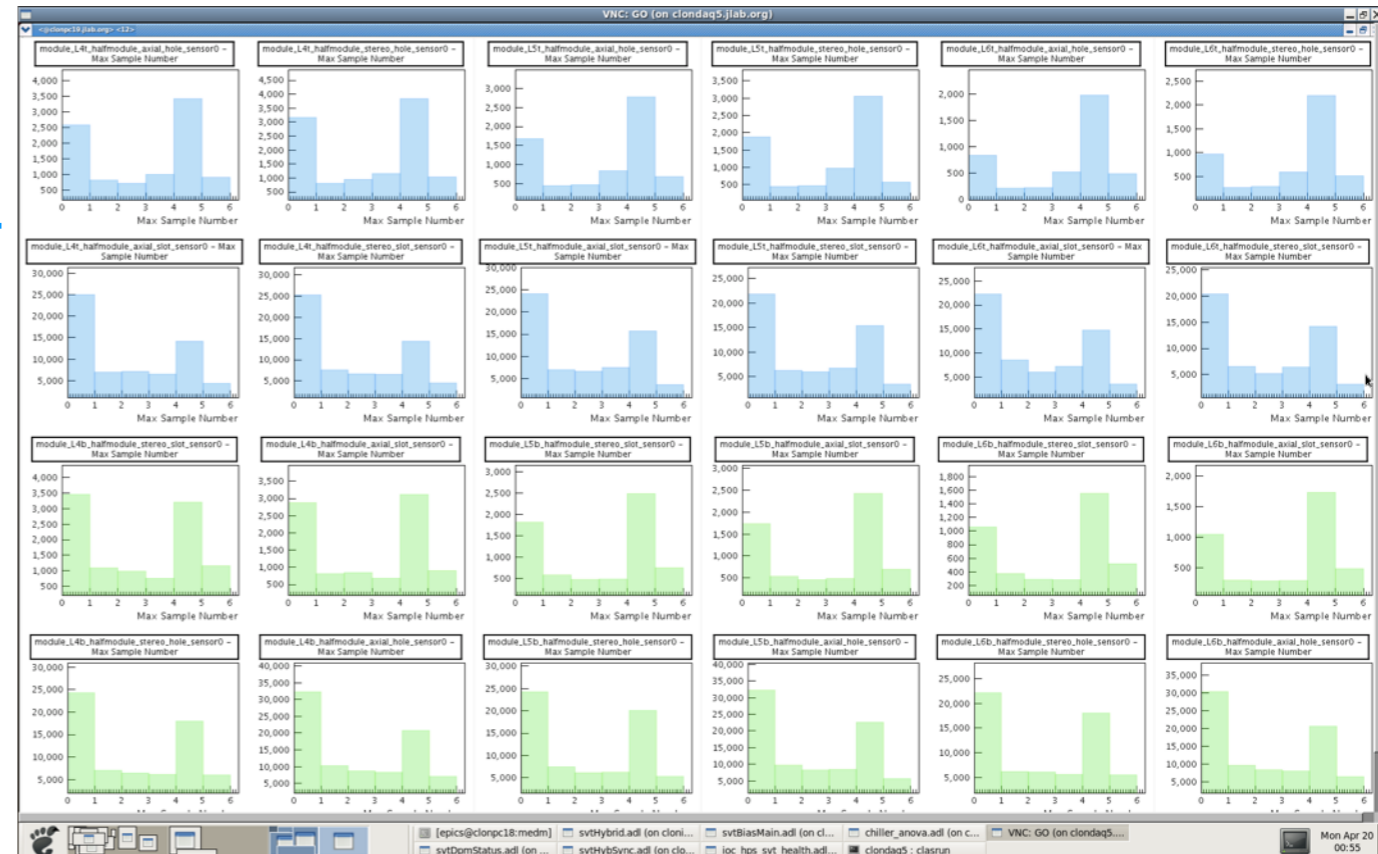
Bottom



Pair Trigger: latency = 148

Top

Bottom

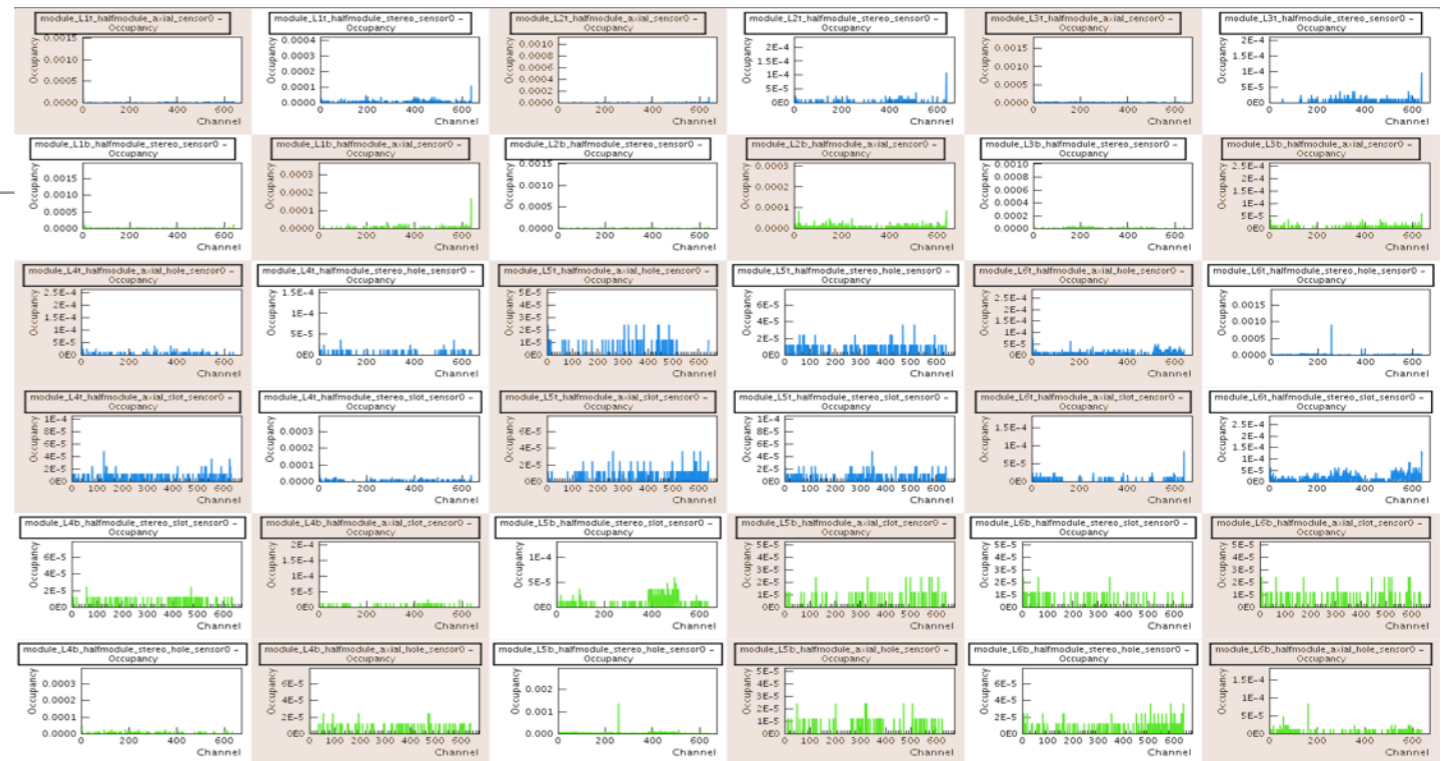


SVT Hits

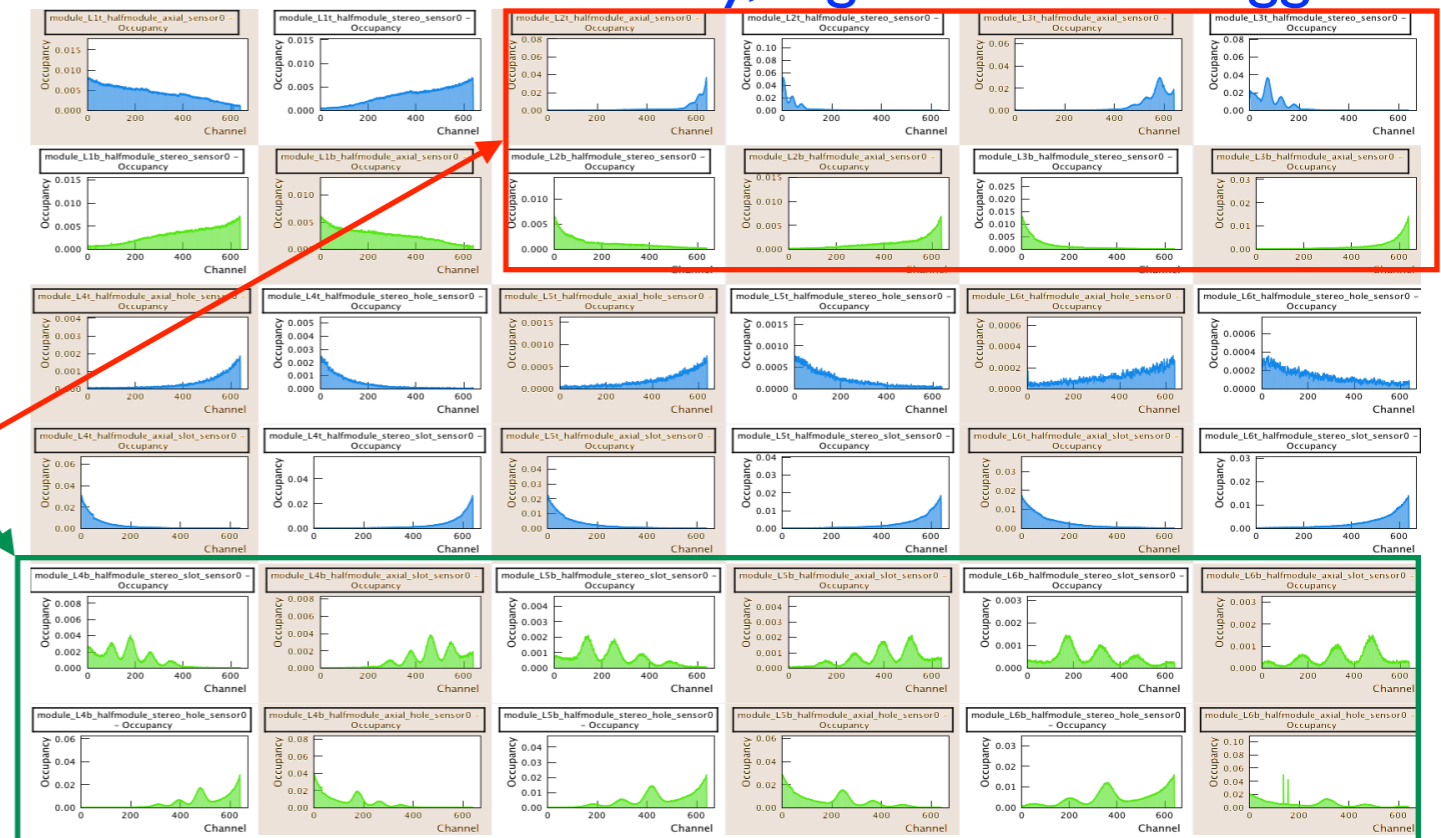
- Without beam:
 - Four of 23004 channels are bad.
 - A few more have noise occupancy above 10^{-4} .
- With beam: (blue=top, green=bottom)
 - Bottom only high-threshold trigger to select FEE.
 - Clearly see expected pattern of occupancy in all layers.
 - Can see enhancement at center of each crystal due to high ECal hit threshold selecting single-crystal trigger clusters.
 - Can see error in SVT DAQ map: L2-3 top and L2-3 bottom are swapped.

DAQ map fixed.

Without Beam



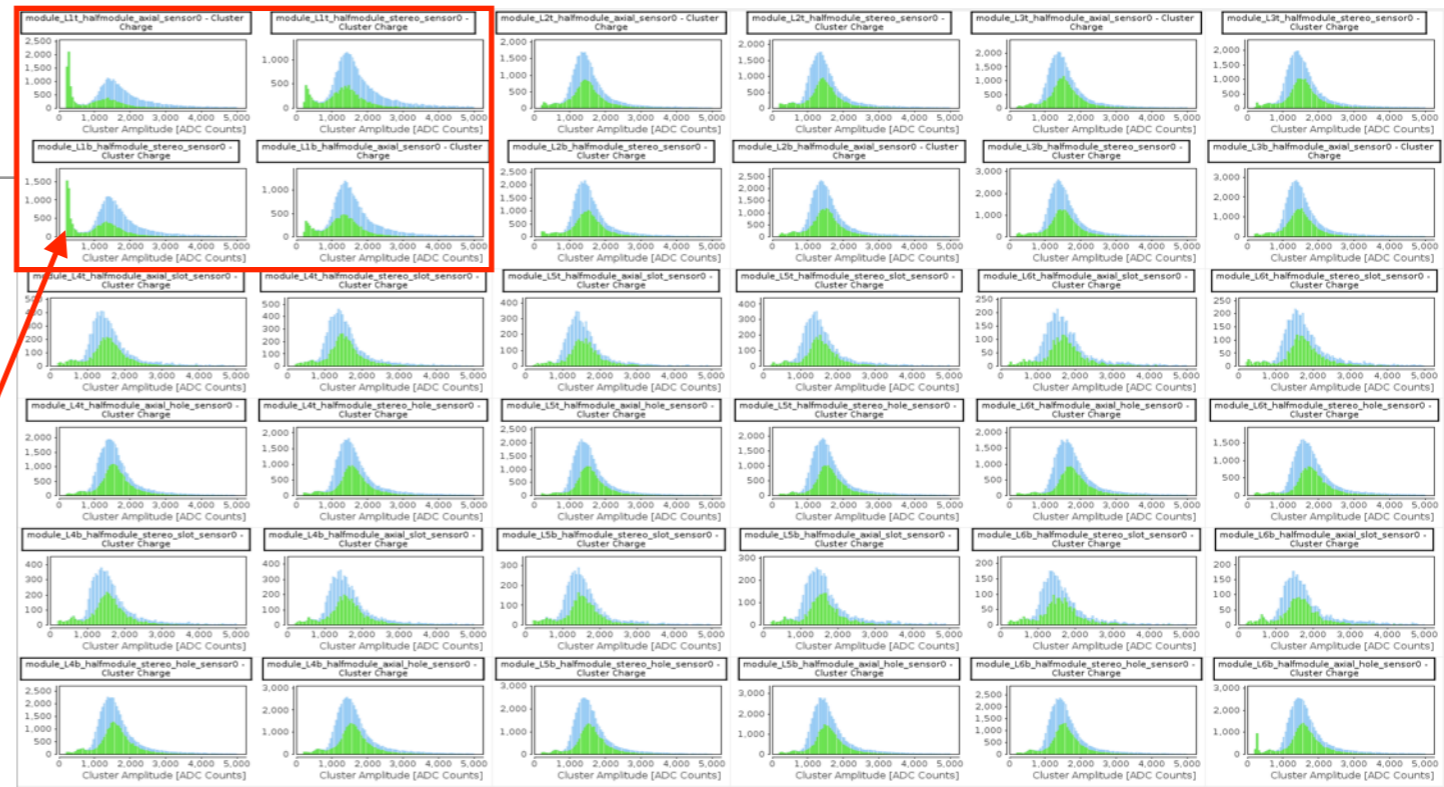
With Beam: bottom-only, high-threshold trigger



SVT Hit Amplitudes

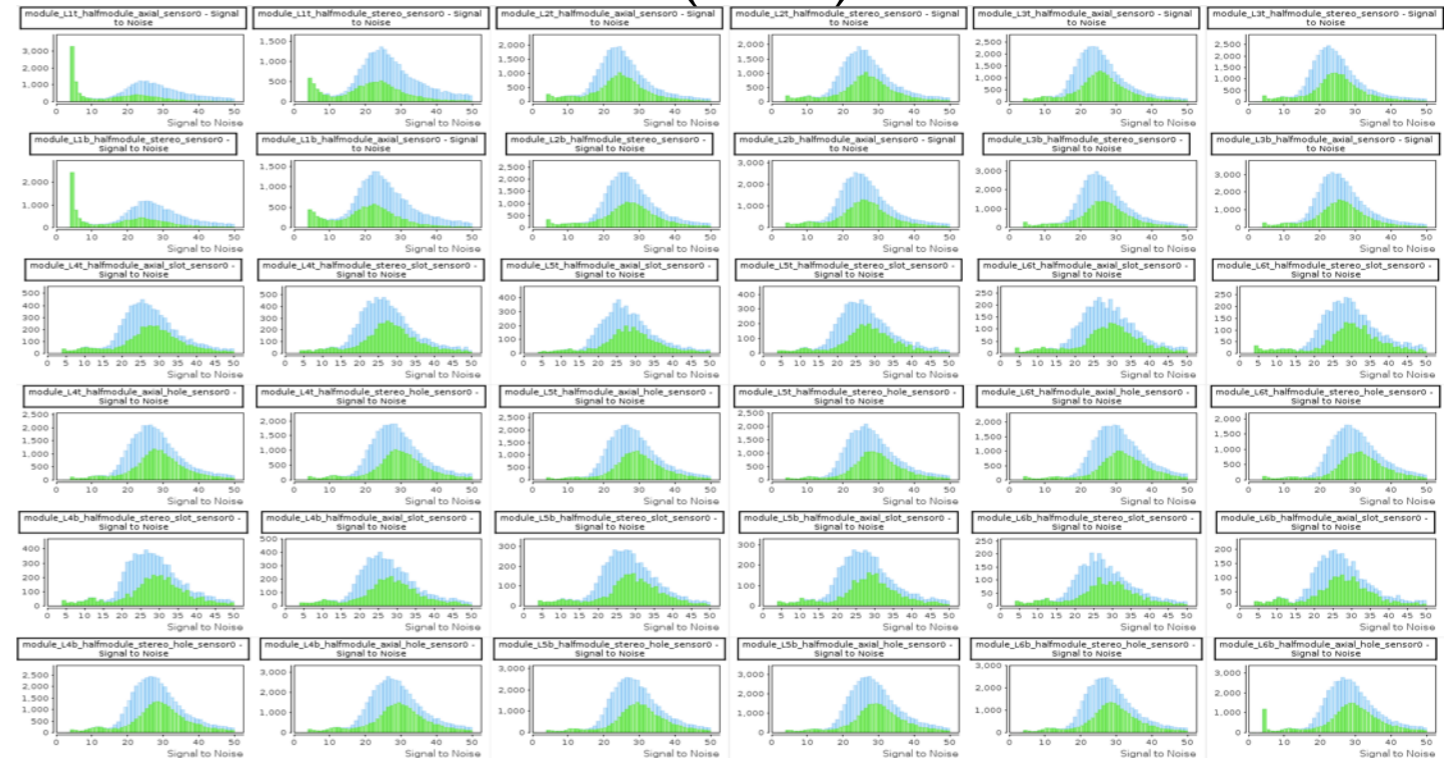
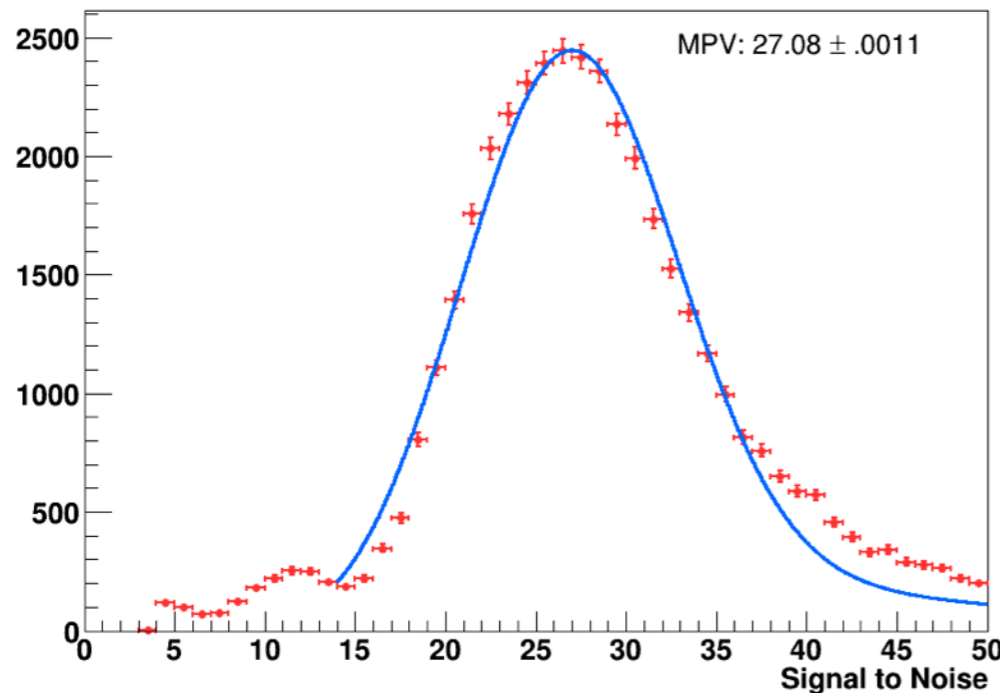
Signal Amplitude for **I-hit(>Ihit)** clusters (ADC counts)

- Signal amplitude is as expected
- Estimated S/N is excellent throughout the detector
- As expected, edge of peak from L-shell x-rays from W target is visible in Layer I, especially on side facing the target.



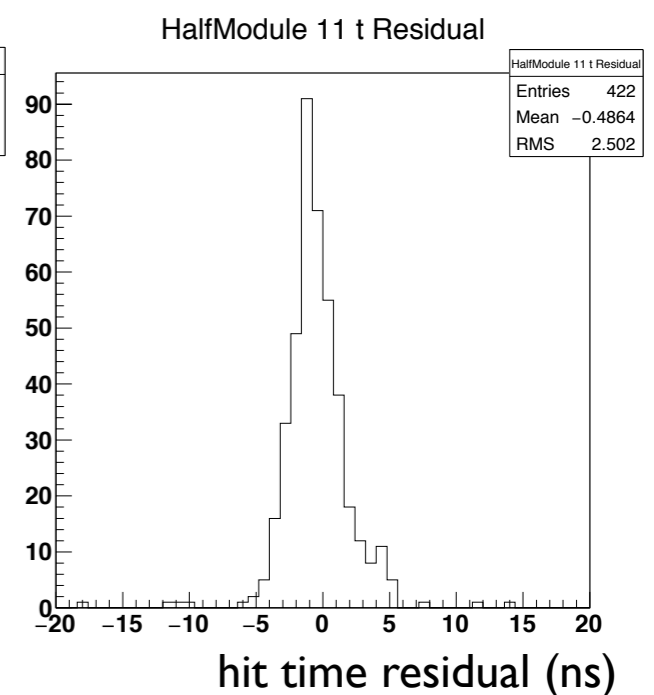
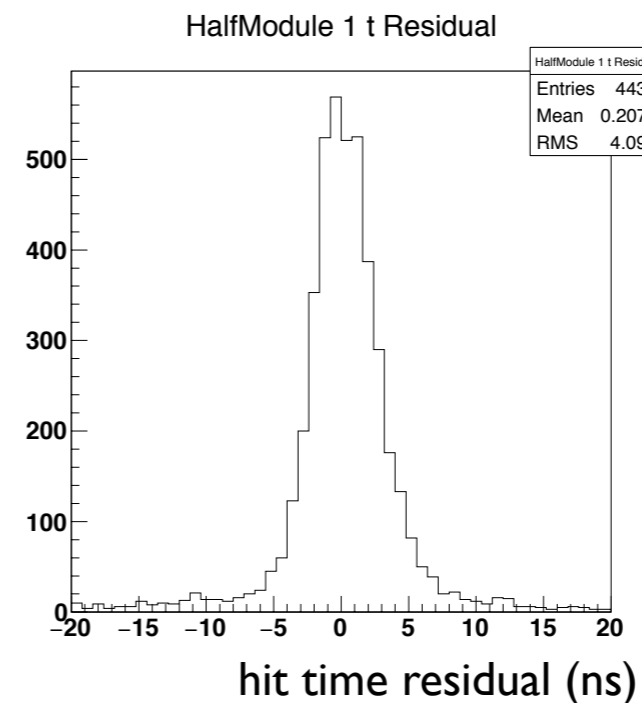
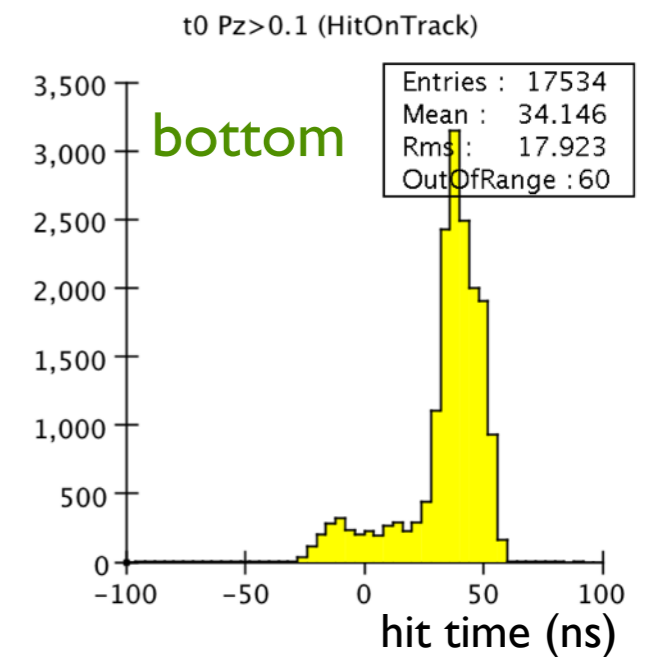
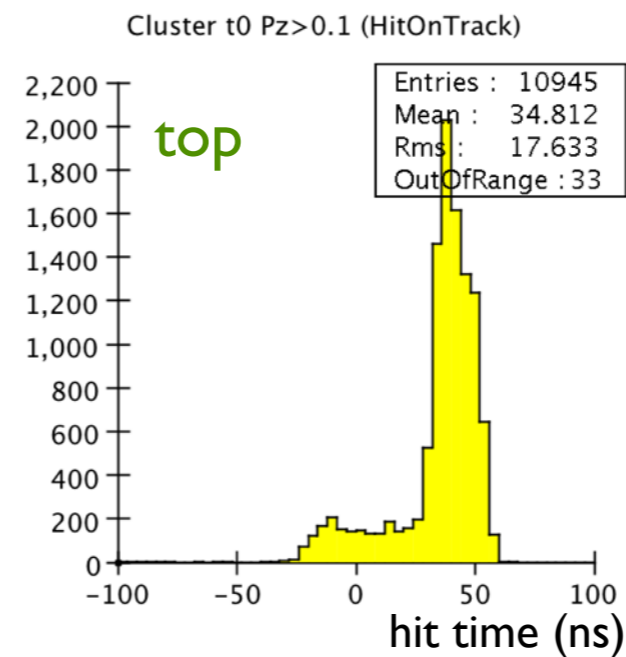
S/N for **I-hit(>Ihit)** clusters

Layer 4B Stereo Hole - Signal to Noise

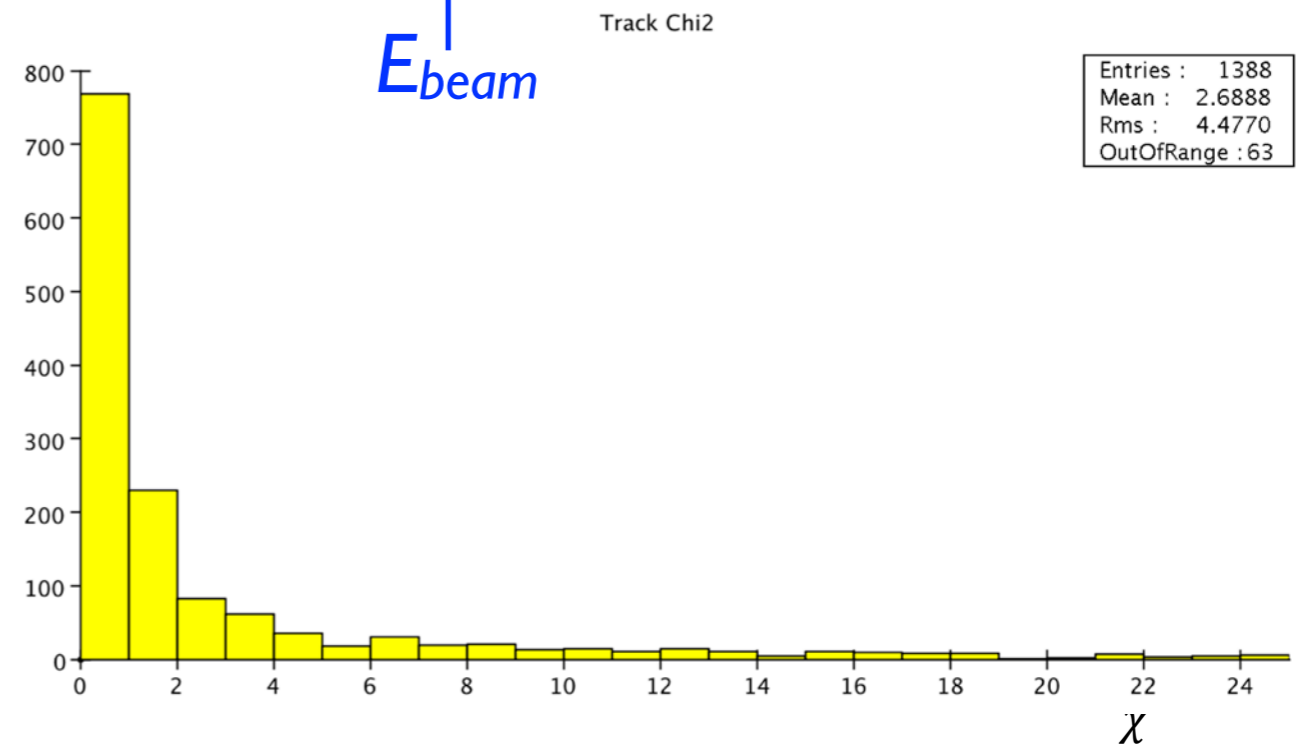
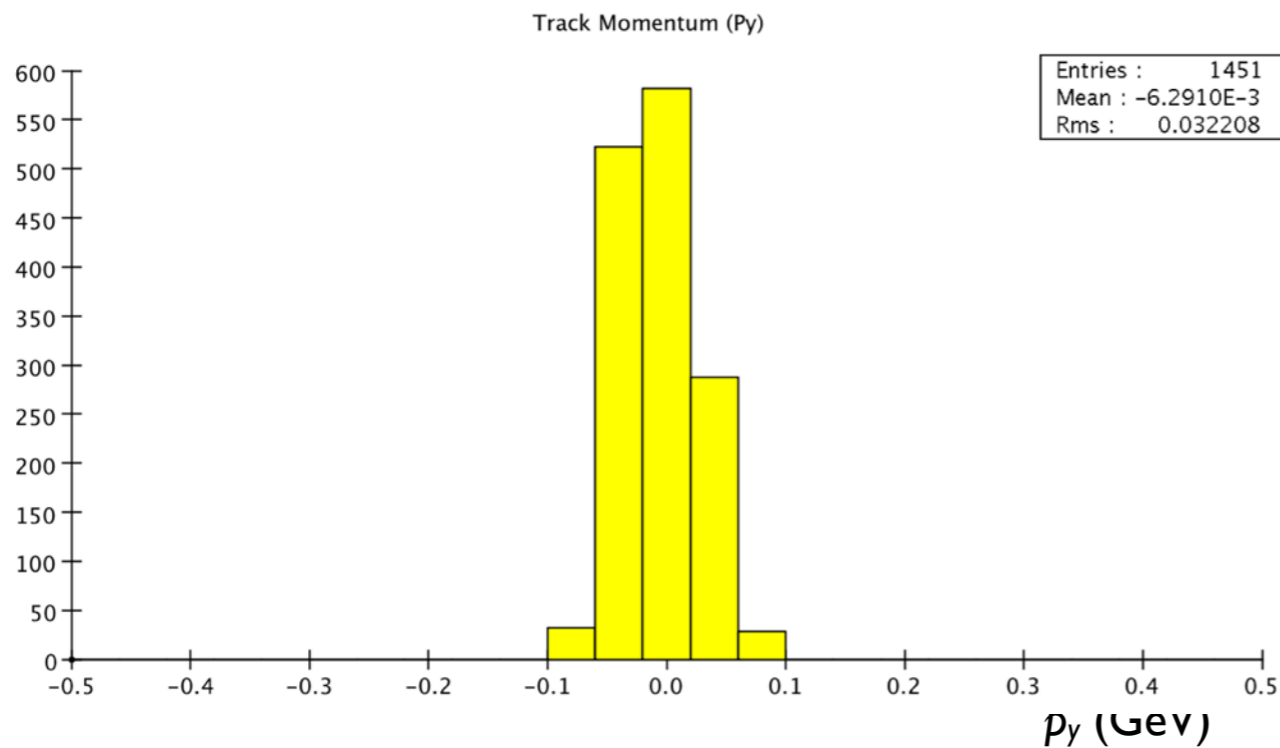
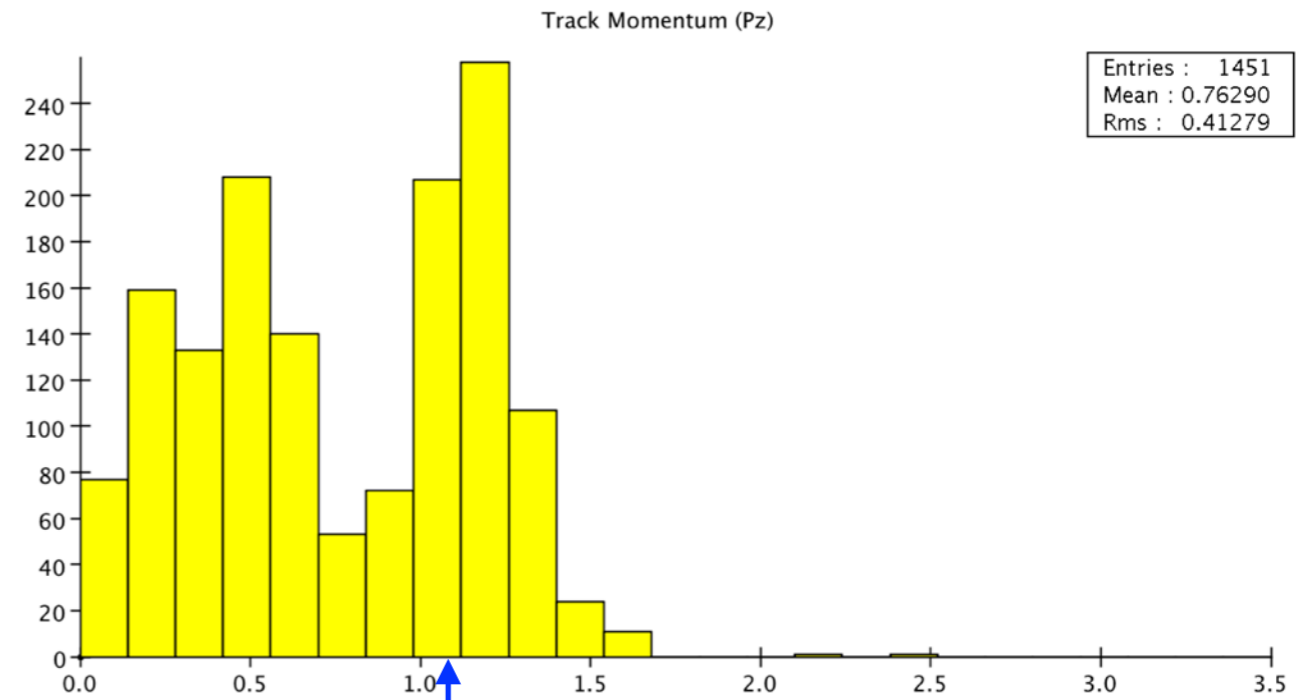
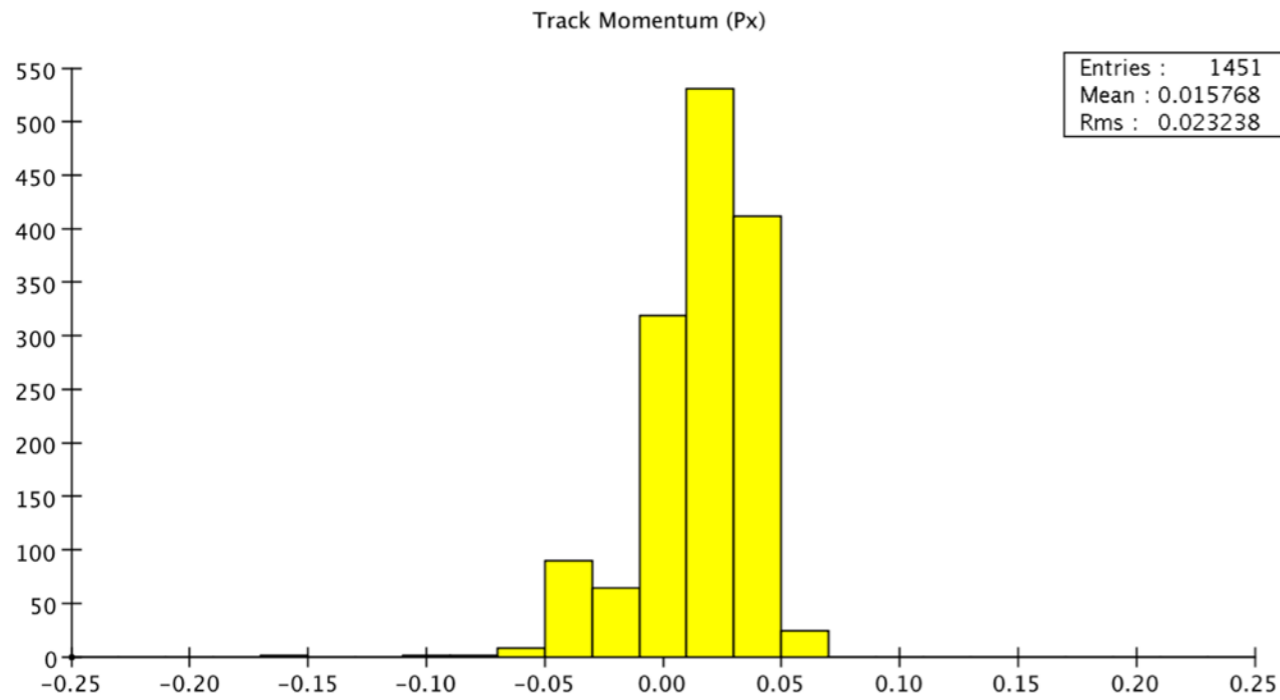


SVT Hit Timing

- Raw hit time plots show hits from triggered electrons on top of random pileup background.
- Hit time residuals ($t_{\text{hit}} - t_{\text{track}}$) look excellent out of the box. Further calibration will improve these.



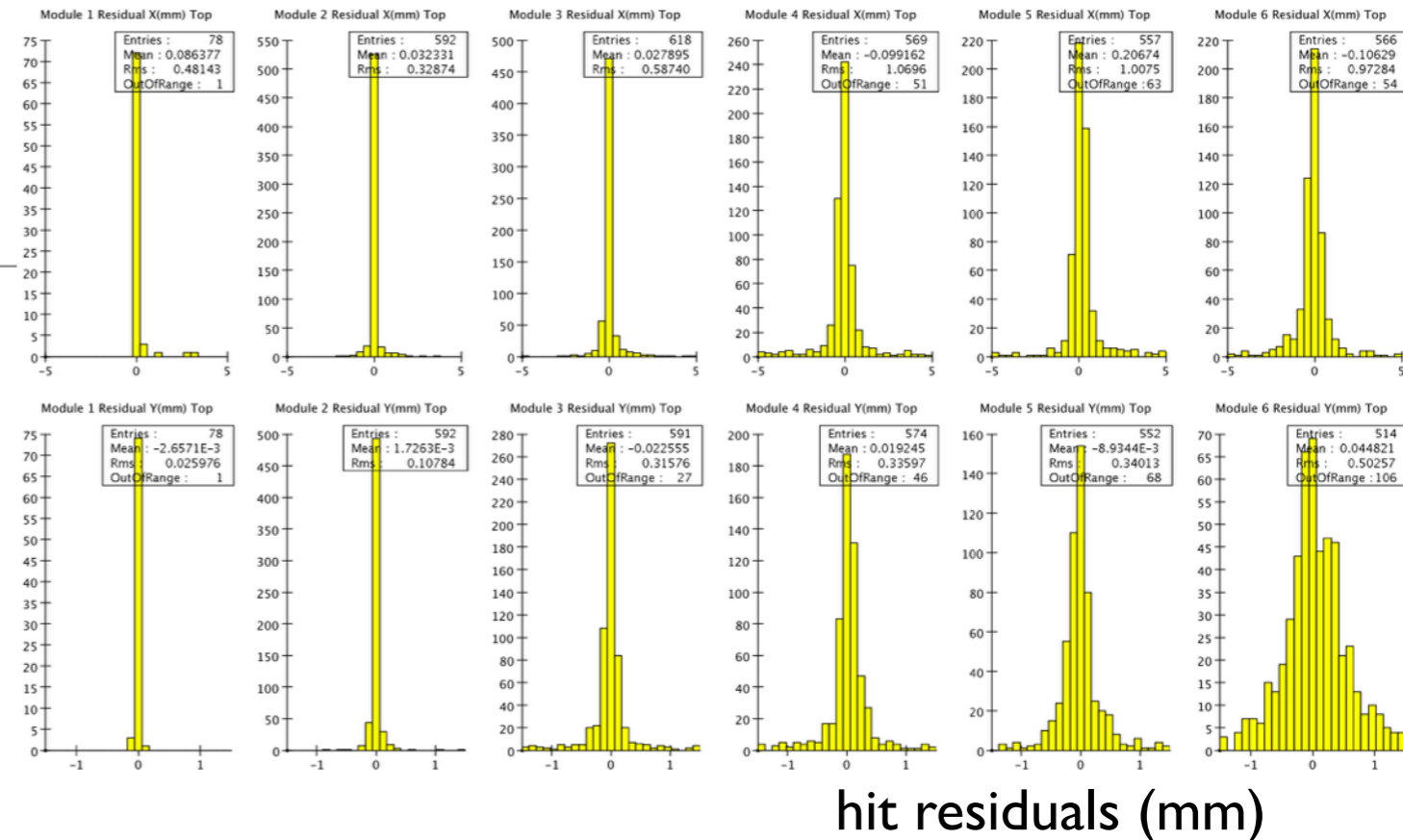
Track Momenta ($E_{\text{beam}} = 1.059 \text{ GeV}$)



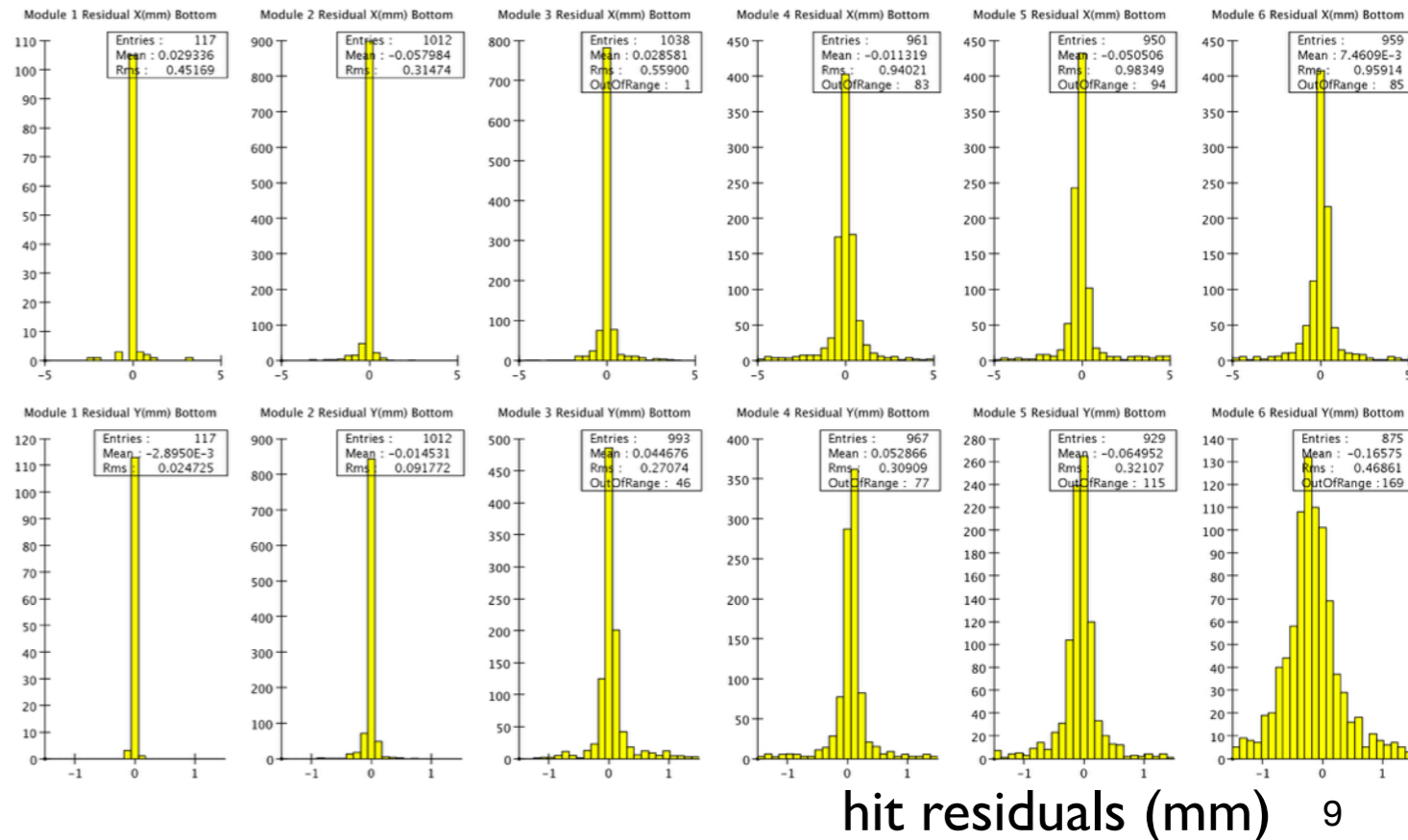
SVT Hit Residuals

- Tracks reconstructed using as-designed geometry and SVT opening angle from motor positions: *no alignment corrections applied.*
- Hit residuals in x and y w.r.t. to fitted helix at target position:
 - mean residuals are excellent ($21/24 < 100 \mu\text{m}$)
 - residual widths as expected for material in each layer.
- Understanding true opening angle (see slide 2 on SVT wire scans) with this data should improve these even before doing full detector alignment.

Top SVT position residuals

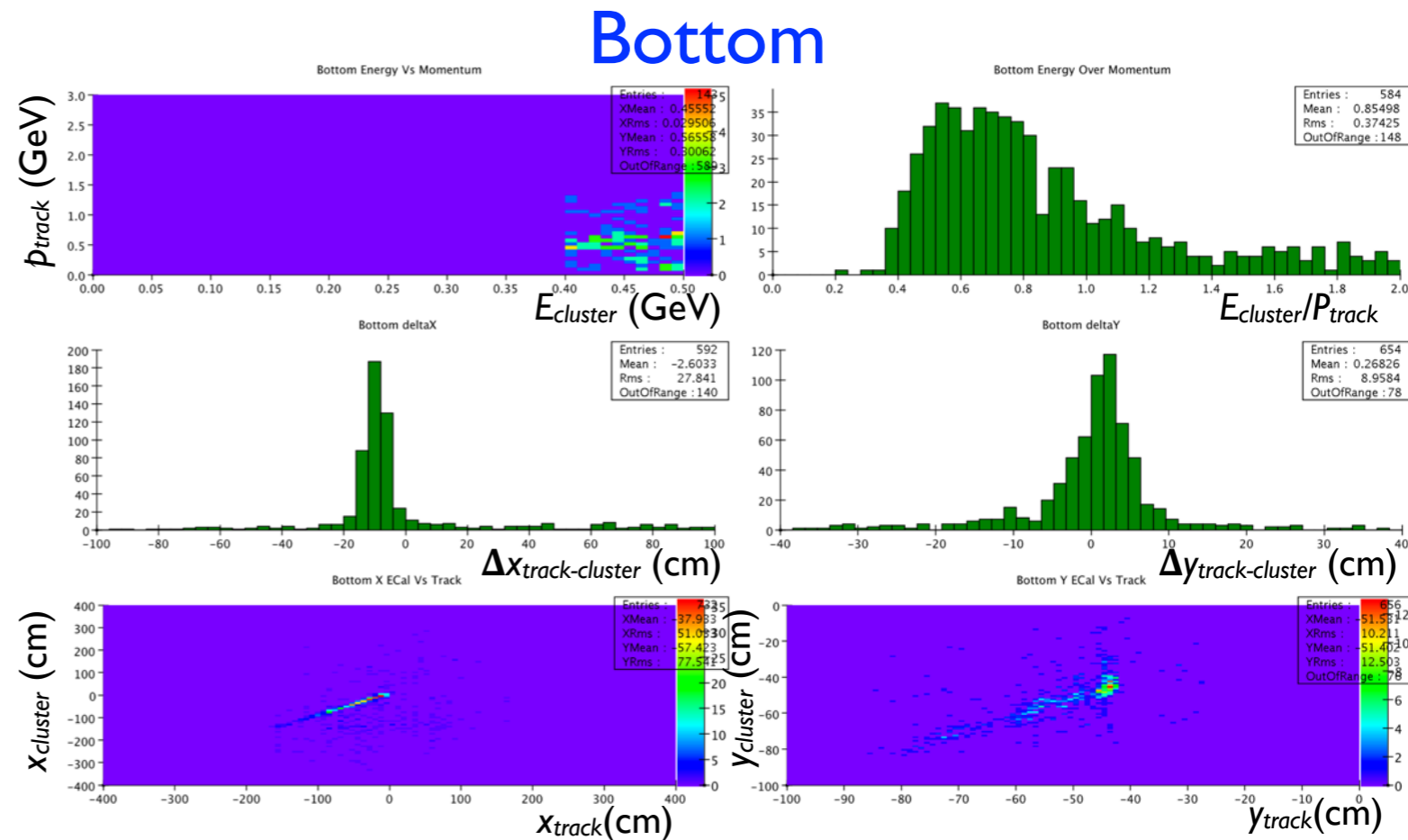
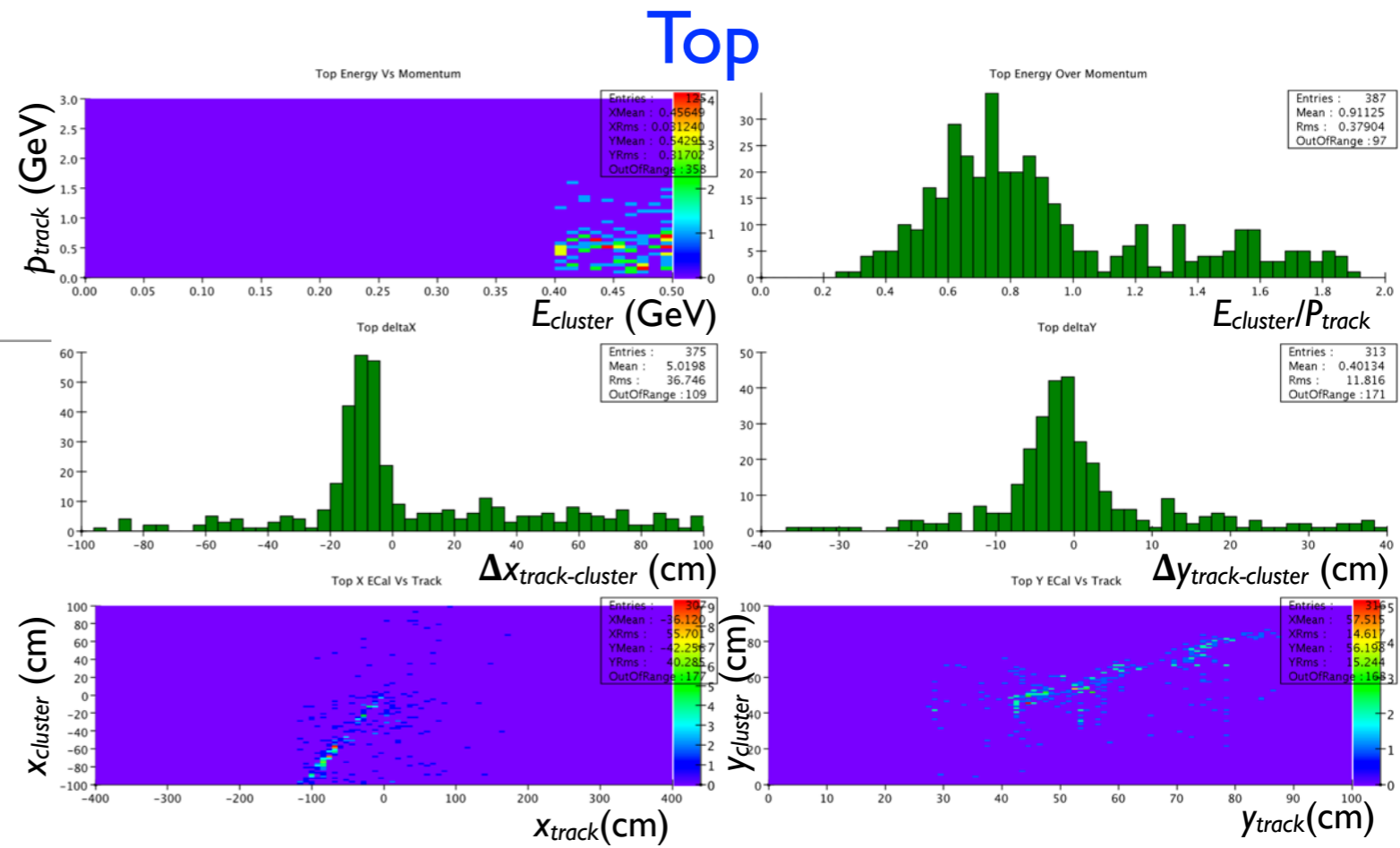


Bottom SVT position residuals



Track-ECal Matching

- Matching between SVT tracks extrapolated to ECal and ECal hit positions needs correction, but resolution in both is good.
- Uncorrected E/p is similarly good. Can see contribution from merged pileup at large E/p.



Summary

- SVT operated with beam first time during Sunday 4/19 swing shift.
- SVT was timed in and SVT moved closer to beam for first running.
- Beam quality was reasonably good and stable through the night.
- HPS collected >40M events fully integrated on Sunday night 4/19-4/20.
- We will learn more in the coming days, but the SVT is ready for physics.