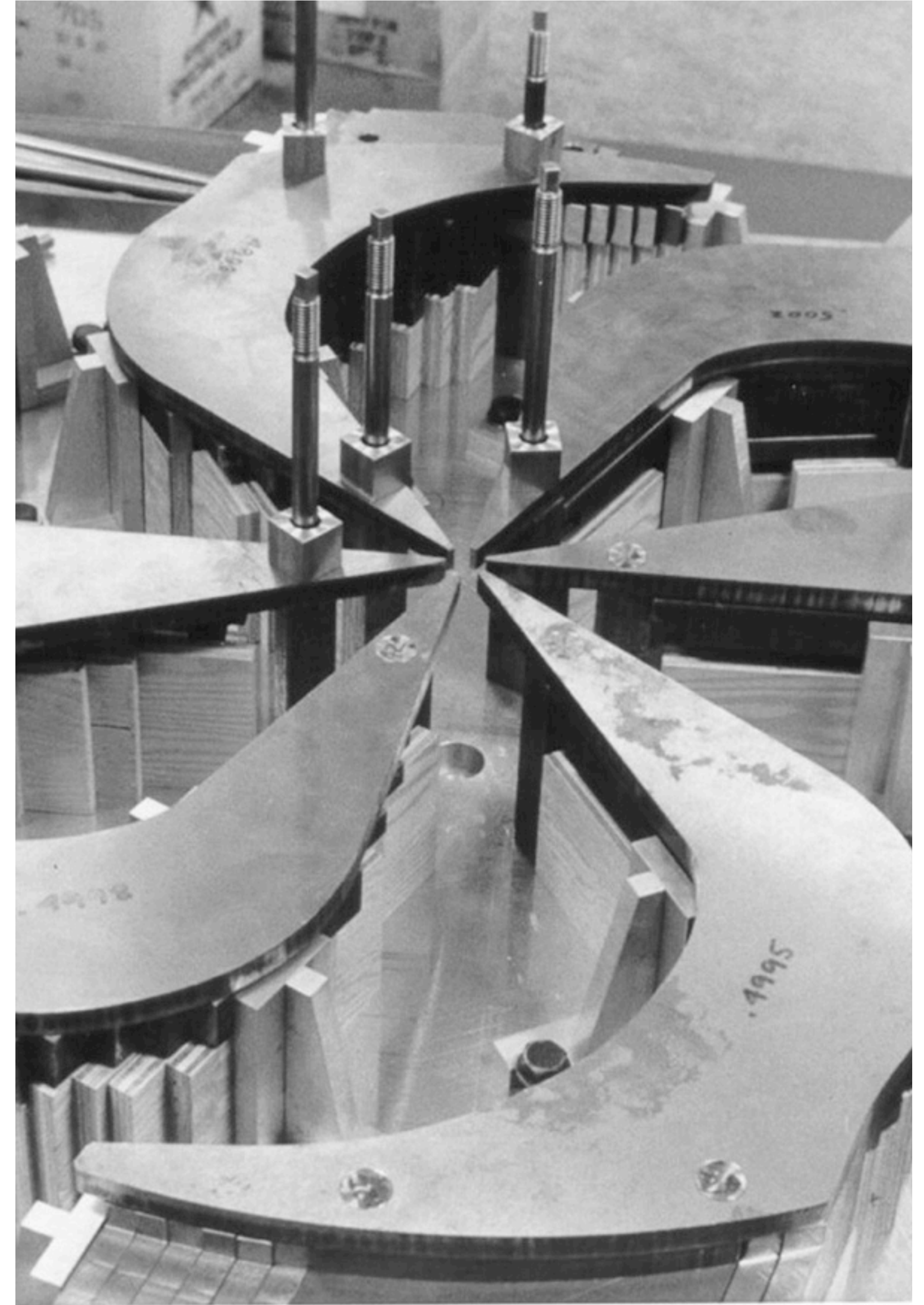


Commissioning Summary

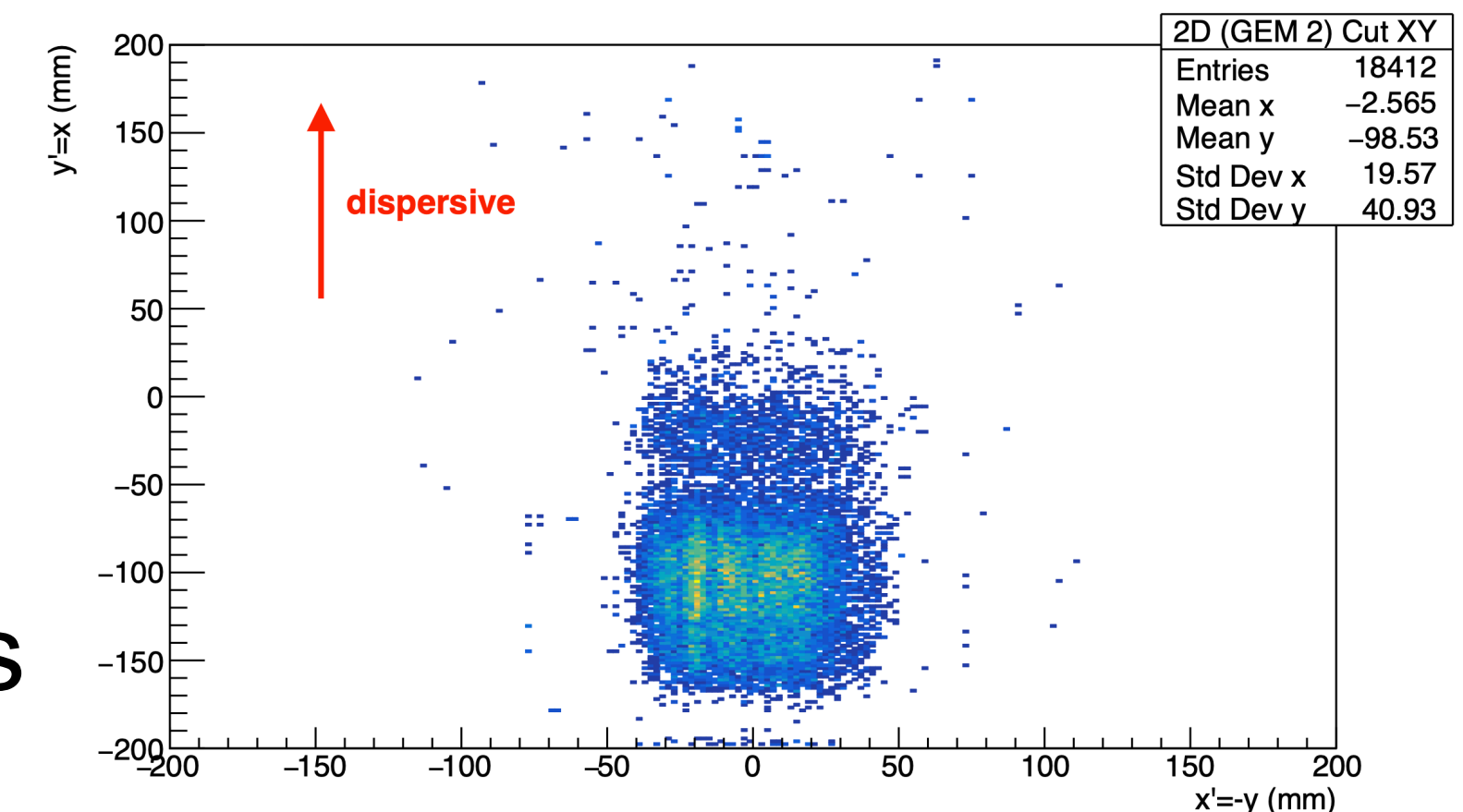
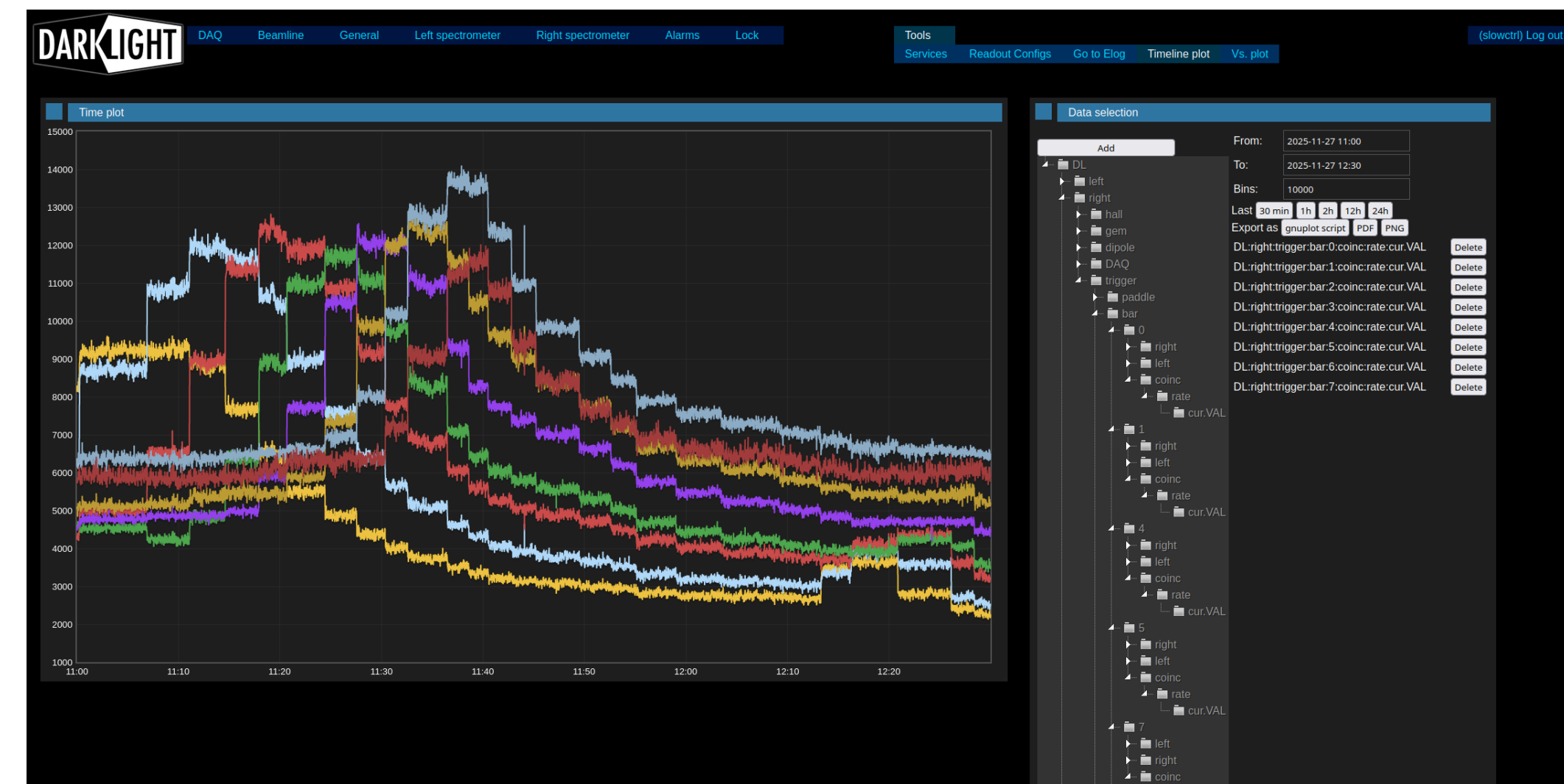
Laura Miller

DarkLight Collaboration Meeting
2026-05-18



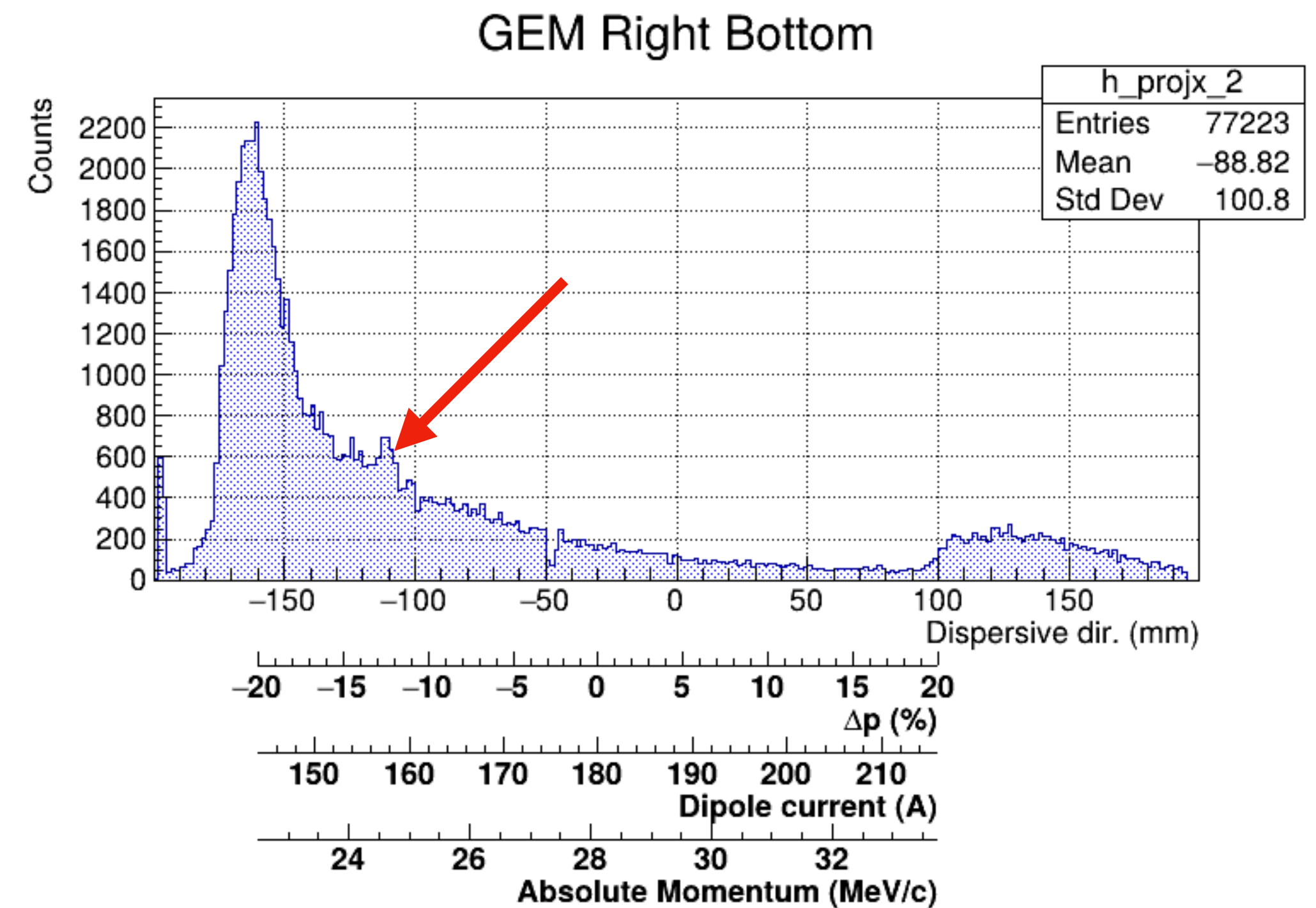
November 24th-30th

- Final checks on GEM data-taking, spectrometer polarity
- Polarity switch installed for the positron arm dipole
- Started taking beam at 24 MeV
- Saw evidence of what we thought was the elastic line in the triggers
- Did see Moller scattering evidence
- Readout errors
- Latency scan
- GEM and trigger correlation fixed, analysis developments

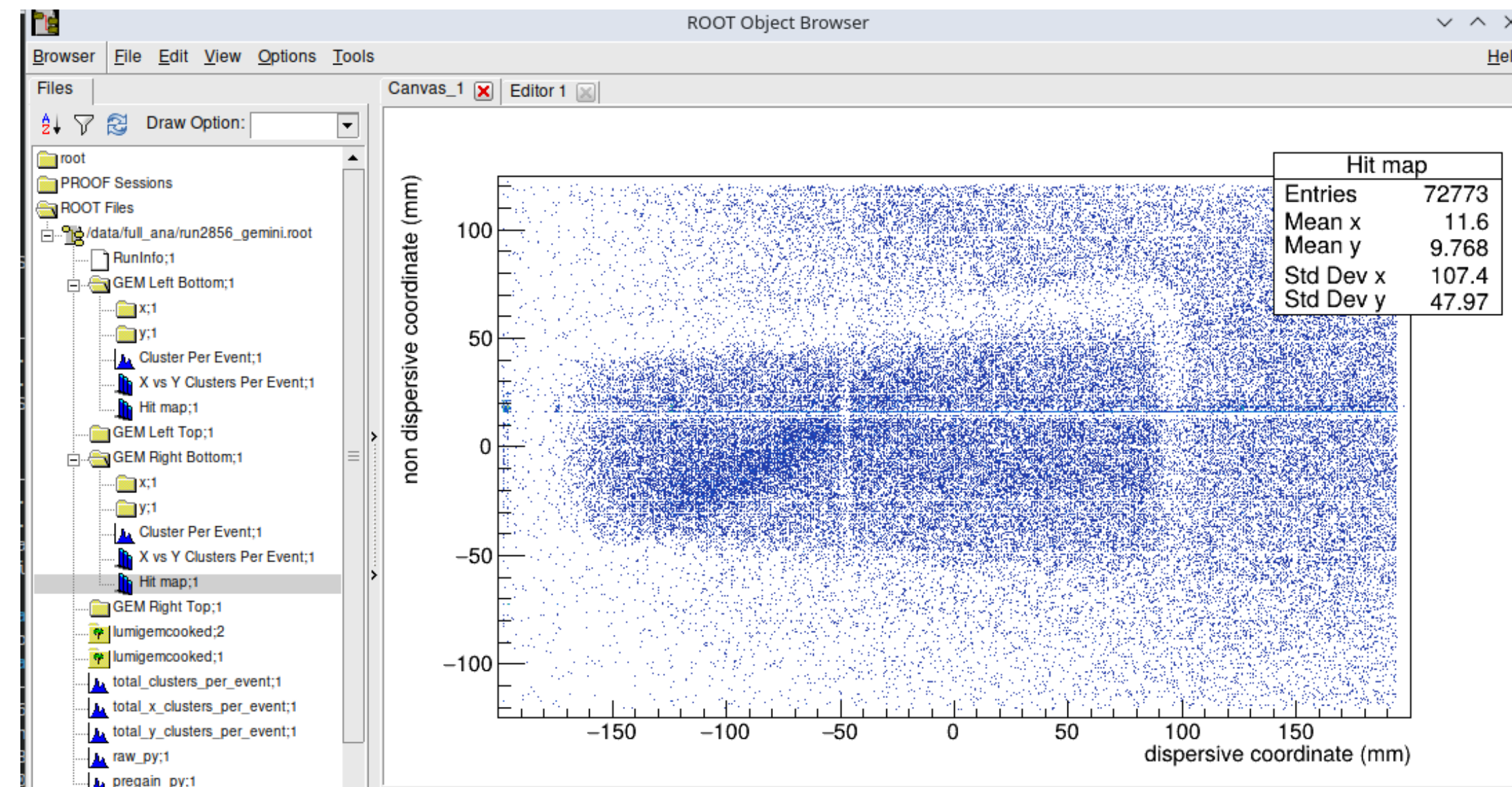


December 1st-7th

- Lead fully installed
- DAQ upgrades to handle high rates
- Hypothesized that background we were seeing was due to beam halo
- Remained at 24 MeV, began to experience very frequent EACA cavity trips
- Varied beam spot location
- Attempted to turn up duty factor to 2.5% but found that the GEMs could not take it
- 24.4 MeV, 1% DF, varying currents



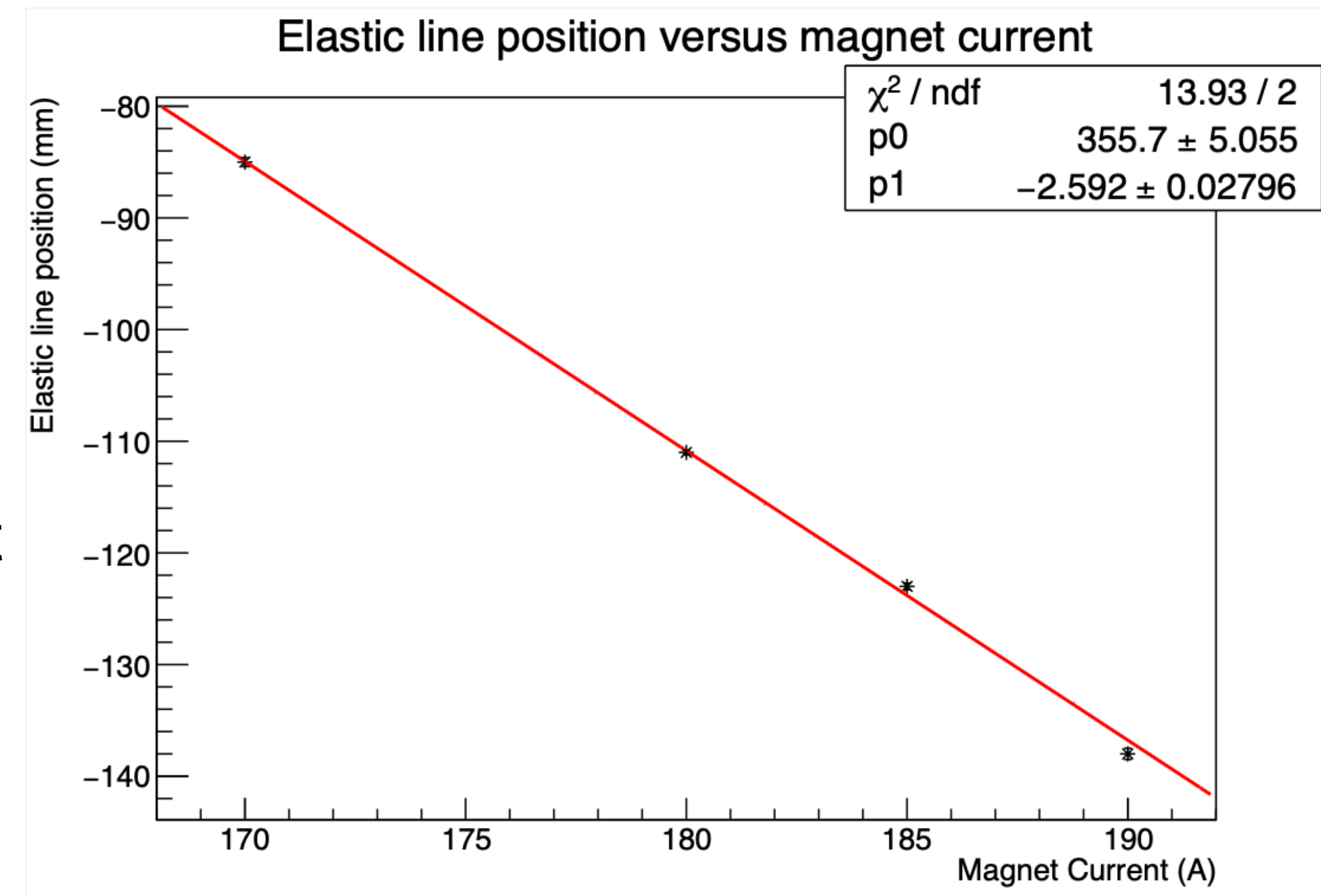
3



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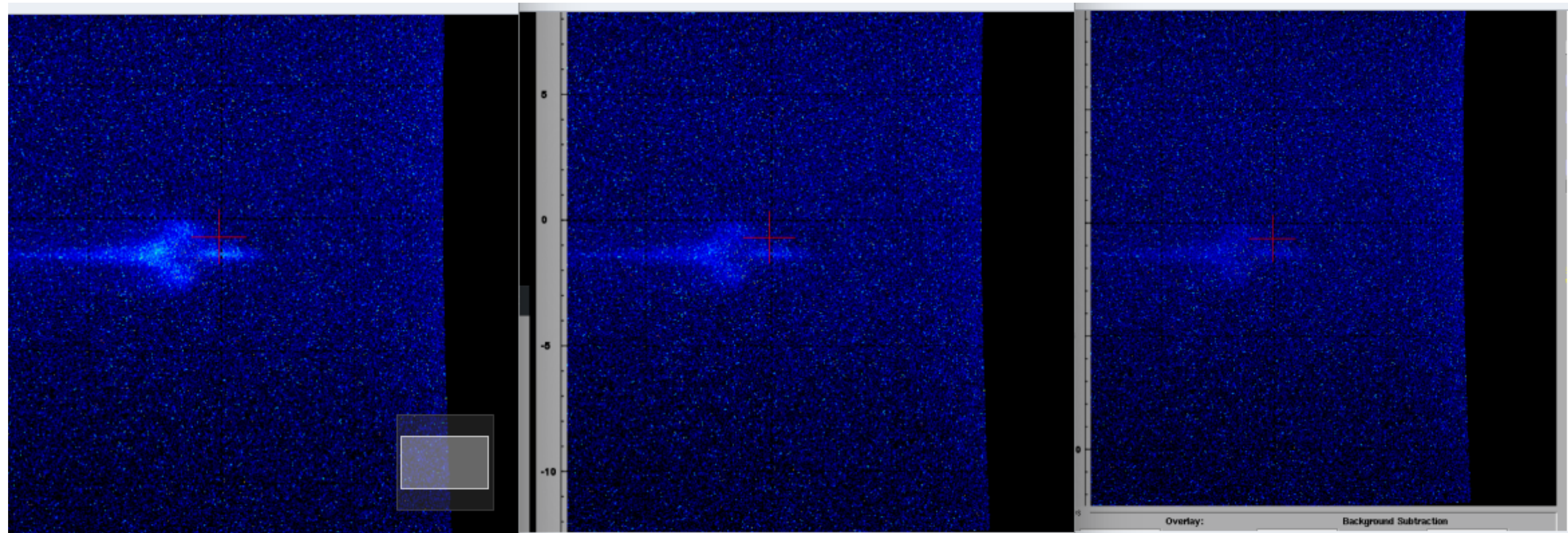
4



December 8th-14th

- Dark current investigations
 - Barium oxide on the grid, emitting electrons due to warm cathode
 - Turned down cathode temp

5

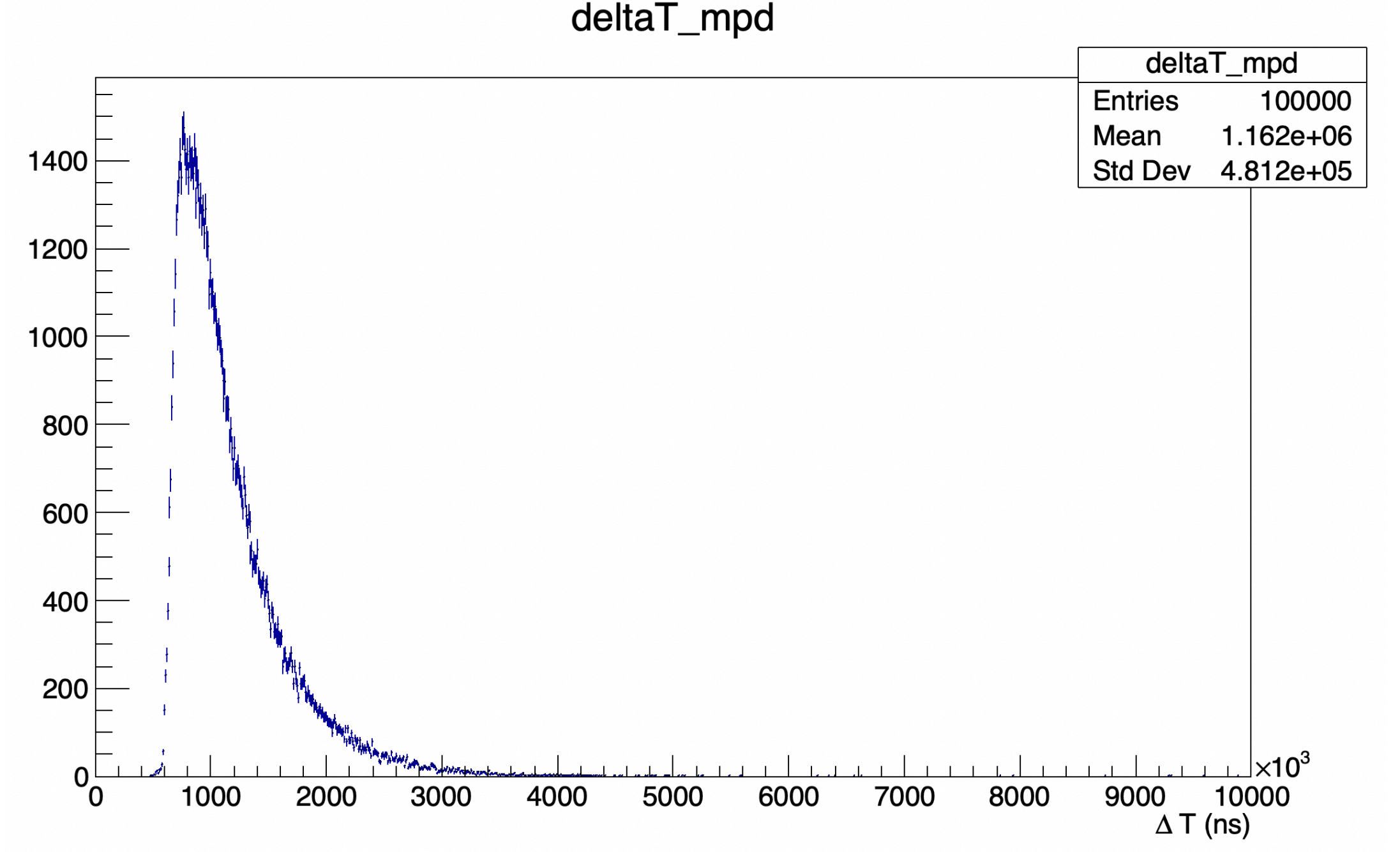
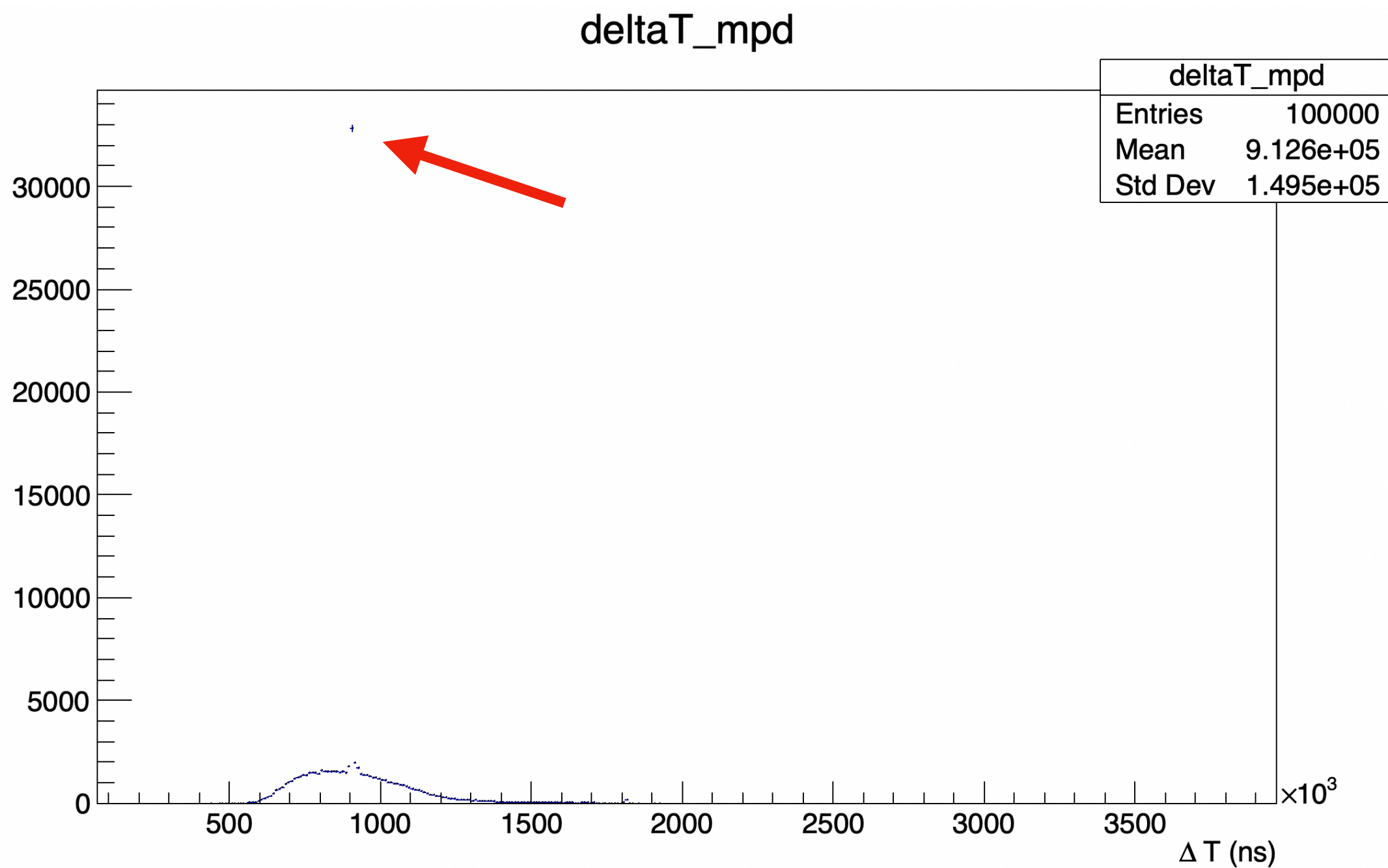
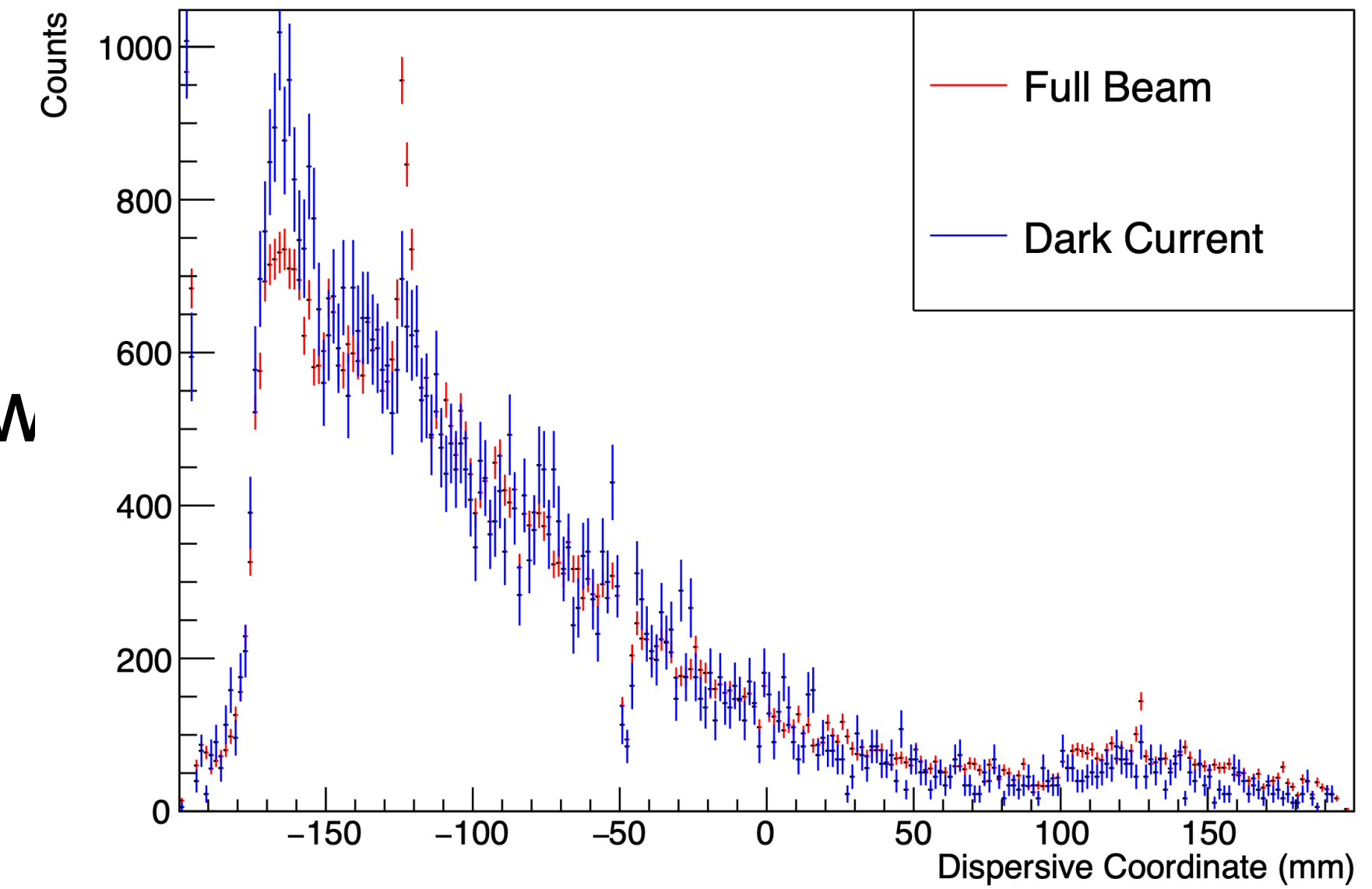


December 8th-14th

- Dark current investigations
 - Barium oxide on the grid, emitting electrons due to warm cathode
 - Turned down cathode temp
- Moved down to 20 MeV and saw some reduction in background
- EACA died and we moved to 10 MeV
- Veto implemented
- LG0 died

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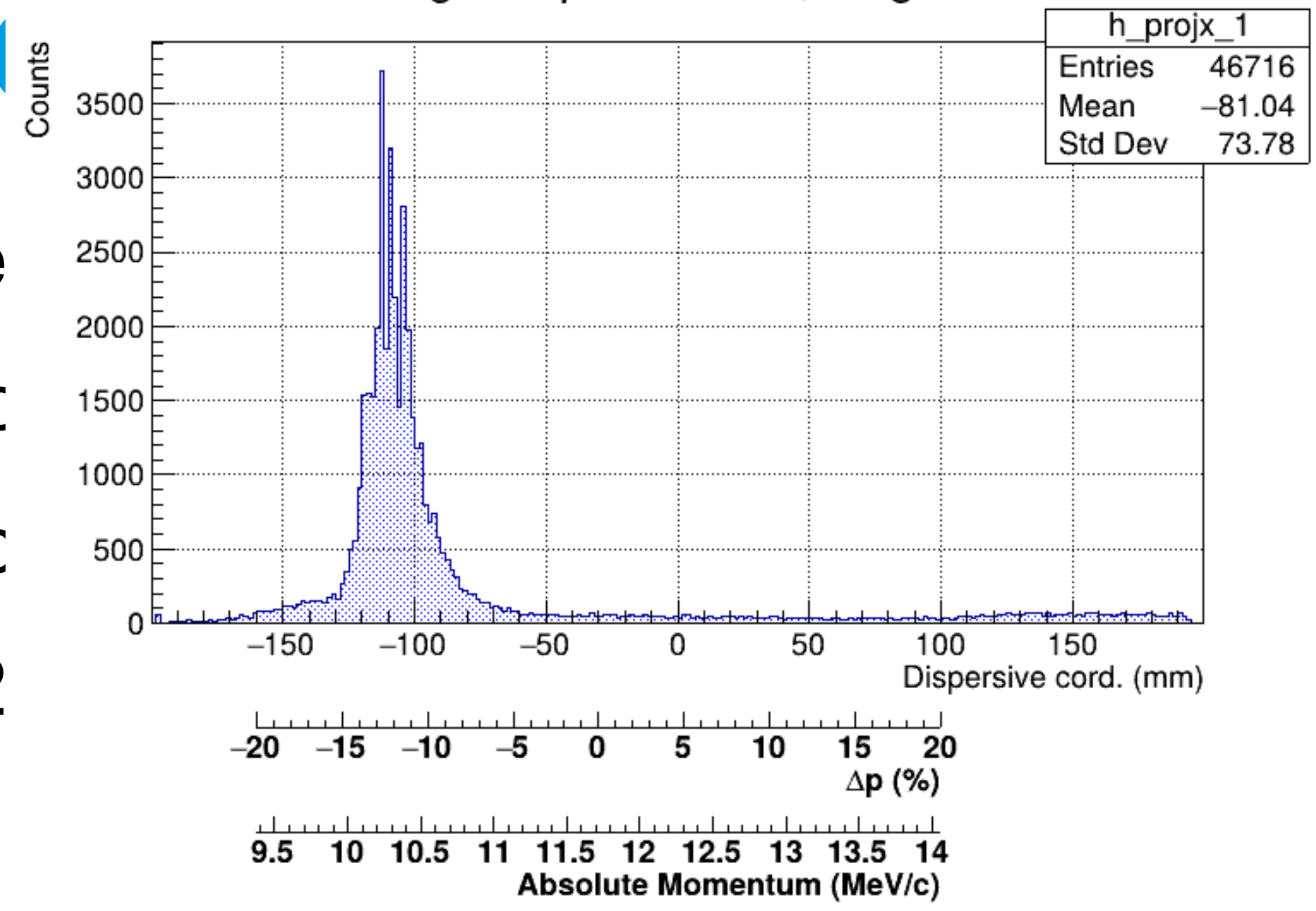
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- Dark current investigations
 - Barium oxide on the grid, emitting electrons due to warm cathode
 - Turned down cathode temp
- Moved down to 20 MeV and saw some reduction in background
- EACA died and we moved to 10 MeV
- Veto implemented
- LG0 died
- DAQ issues prevented from running at higher frequency
- Ran over weekend with 9.85 MeV collimated beam, 20 μA , 300 Hz bunch frequency, 1% duty factor

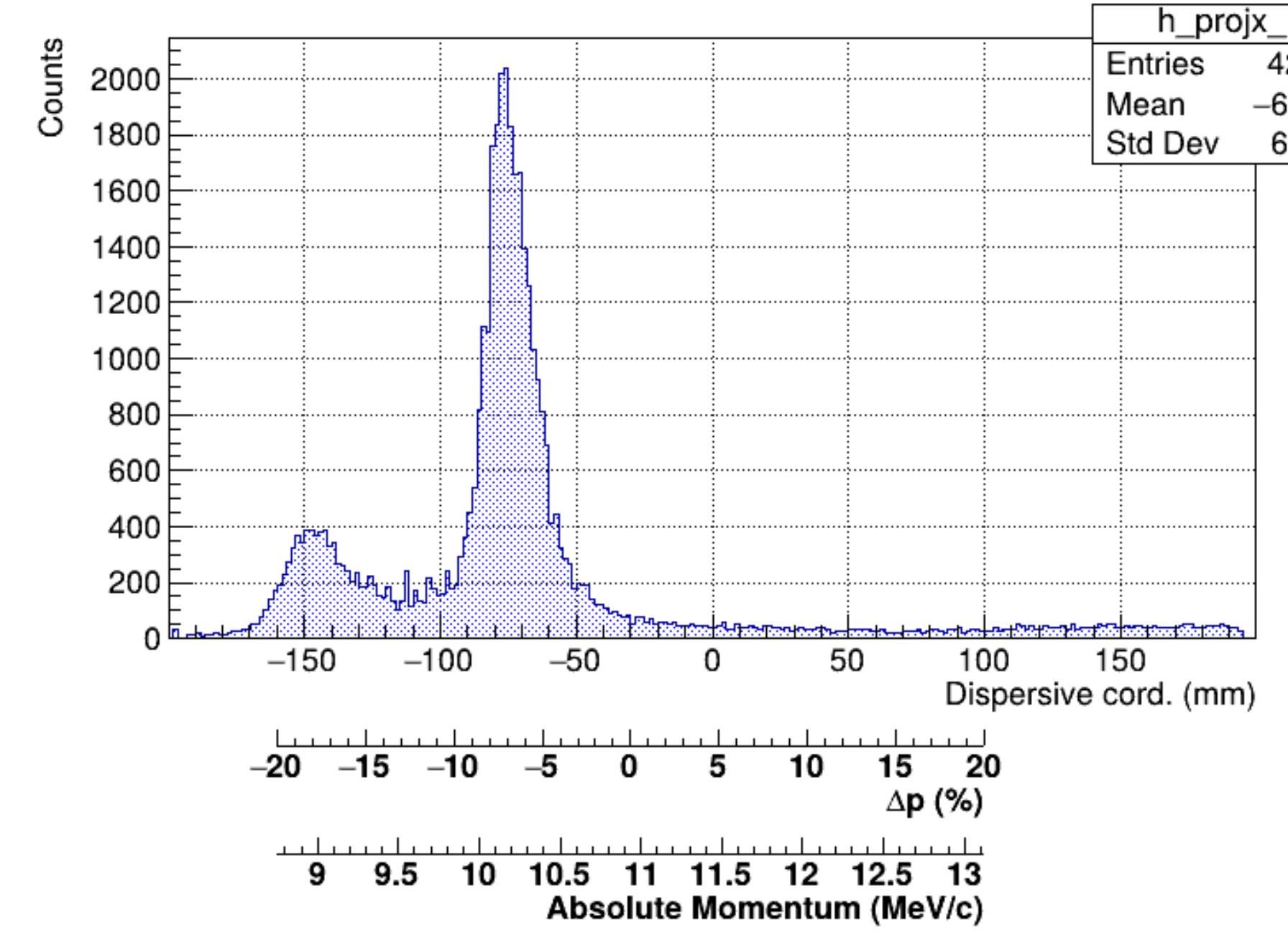
December

- Dark current investigation
- Barium oxide calibration
- Turned down current
- Moved down to 2 background
- EACA died and was replaced
- Veto implemented
- LG0 died
- DAQ issues prevented
- Ran over weeker frequency, 1% duty cycle

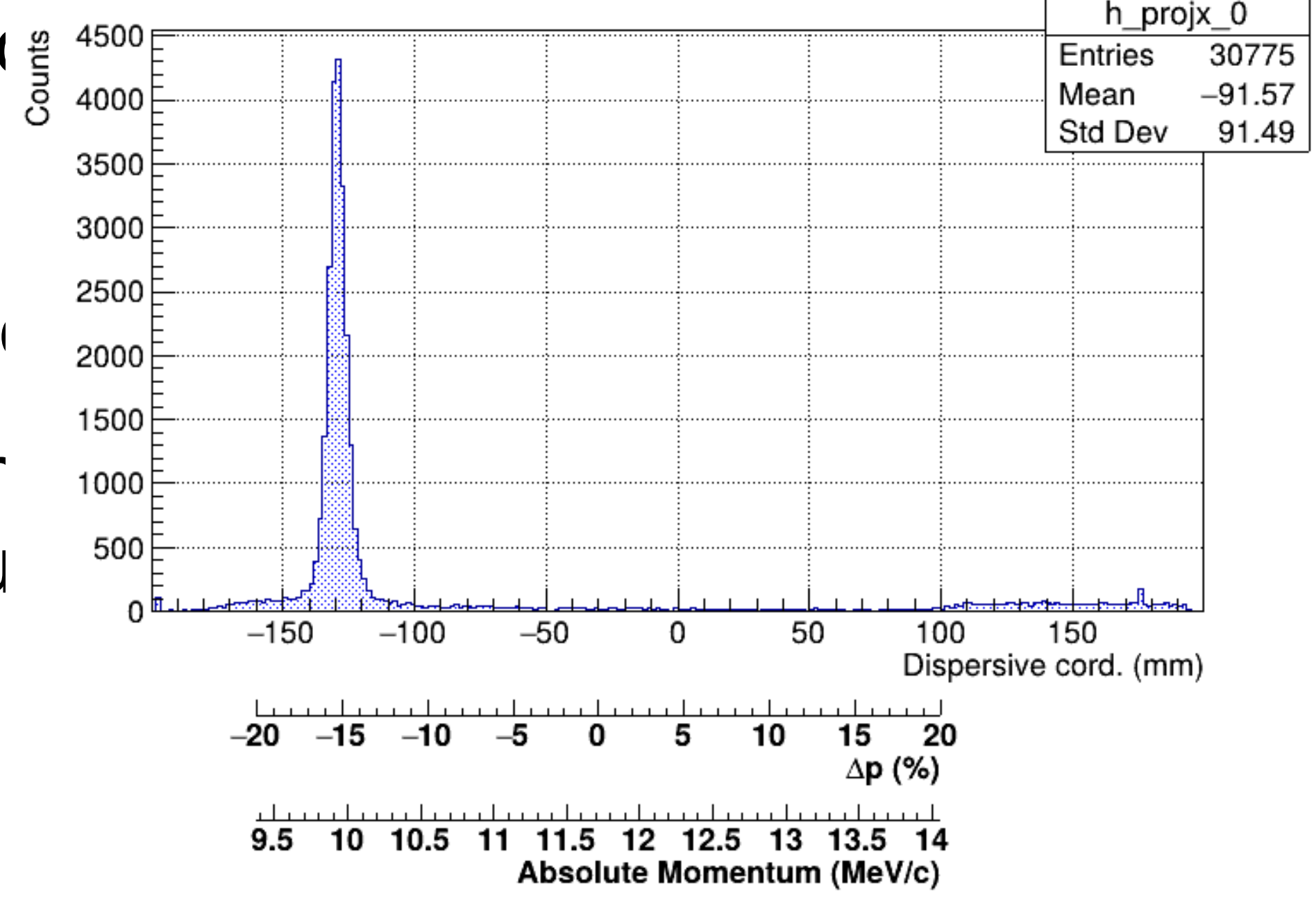
GEM Right Top Run 3201, Magnet 75 A



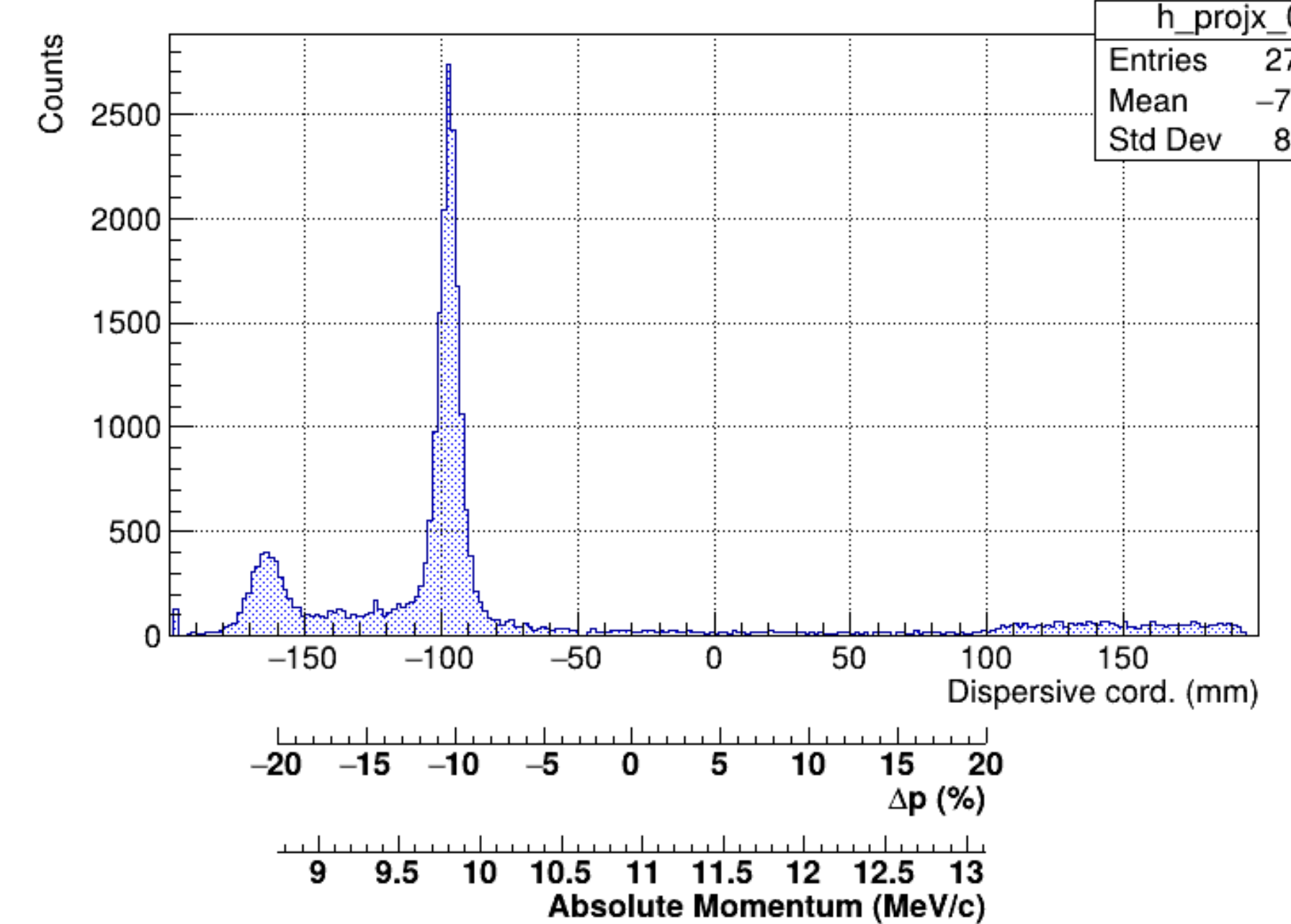
GEM Right Top Run 3202, Magnet 70 A



GEM Right Bottom Run 3201, Magnet 75 A



GEM Right Bottom Run 3202, Magnet 70 A



December 15th-21st

- Installed new LG0
- Veto updated to allow for both arms to be read out
- Found background was still too high with the collimator removed to perform meaningful measurements, but current is not known precisely
- Reseated loose APV card on LG1 and proceeded with more data taking
- Settled into relatively stable data-taking configuration
- GEM group prepped broken GEMs for shock treatment, eventually shipped back to Hampton

December 22nd-28th

- GEM group performed scans to try to characterize the saturation and the HV
- Continued work to characterize the background
- Beam turns off on December 24th for the holiday break

December 29th-January 4th

- MPD firmware update to allow for higher readout rate

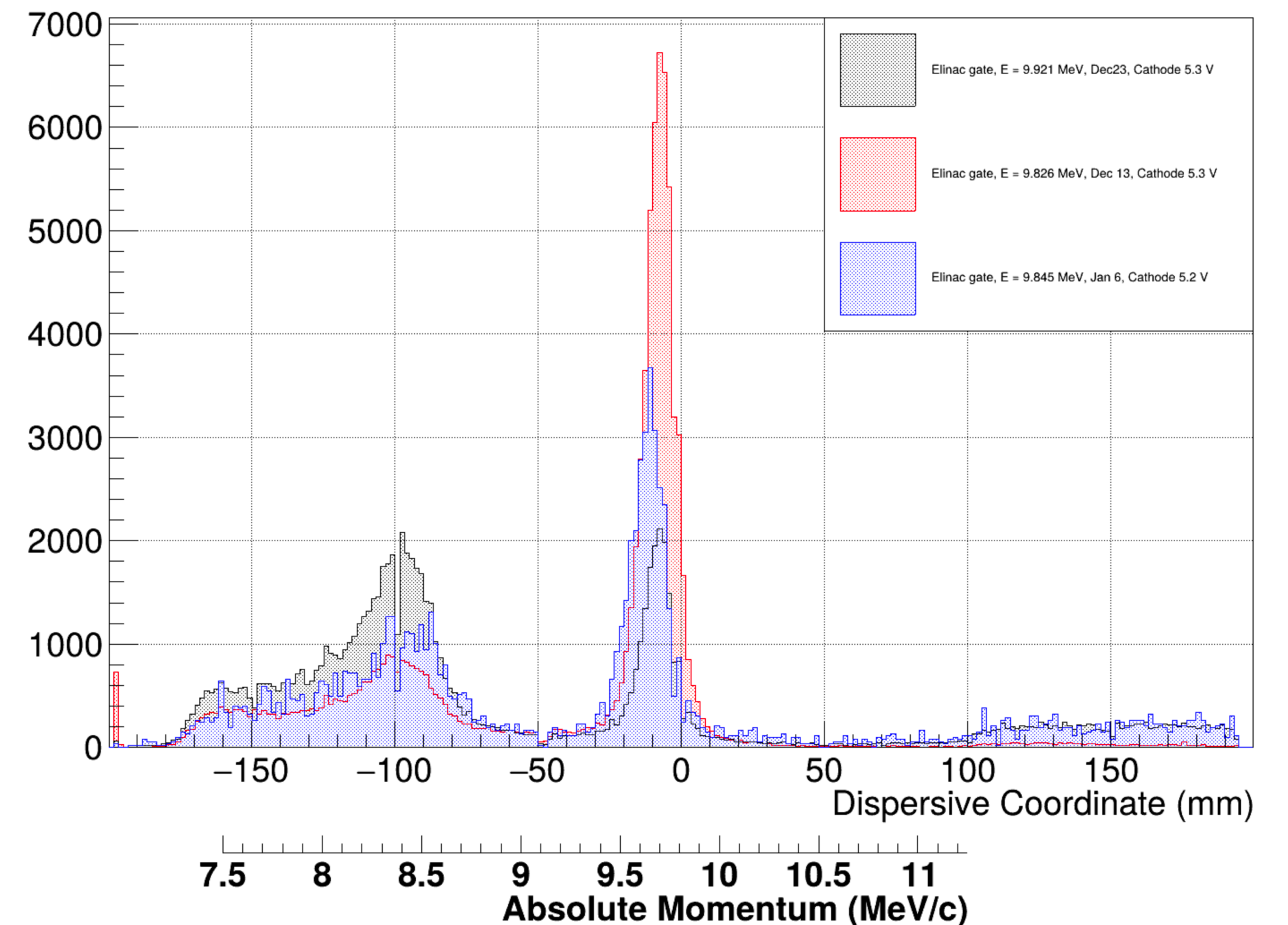
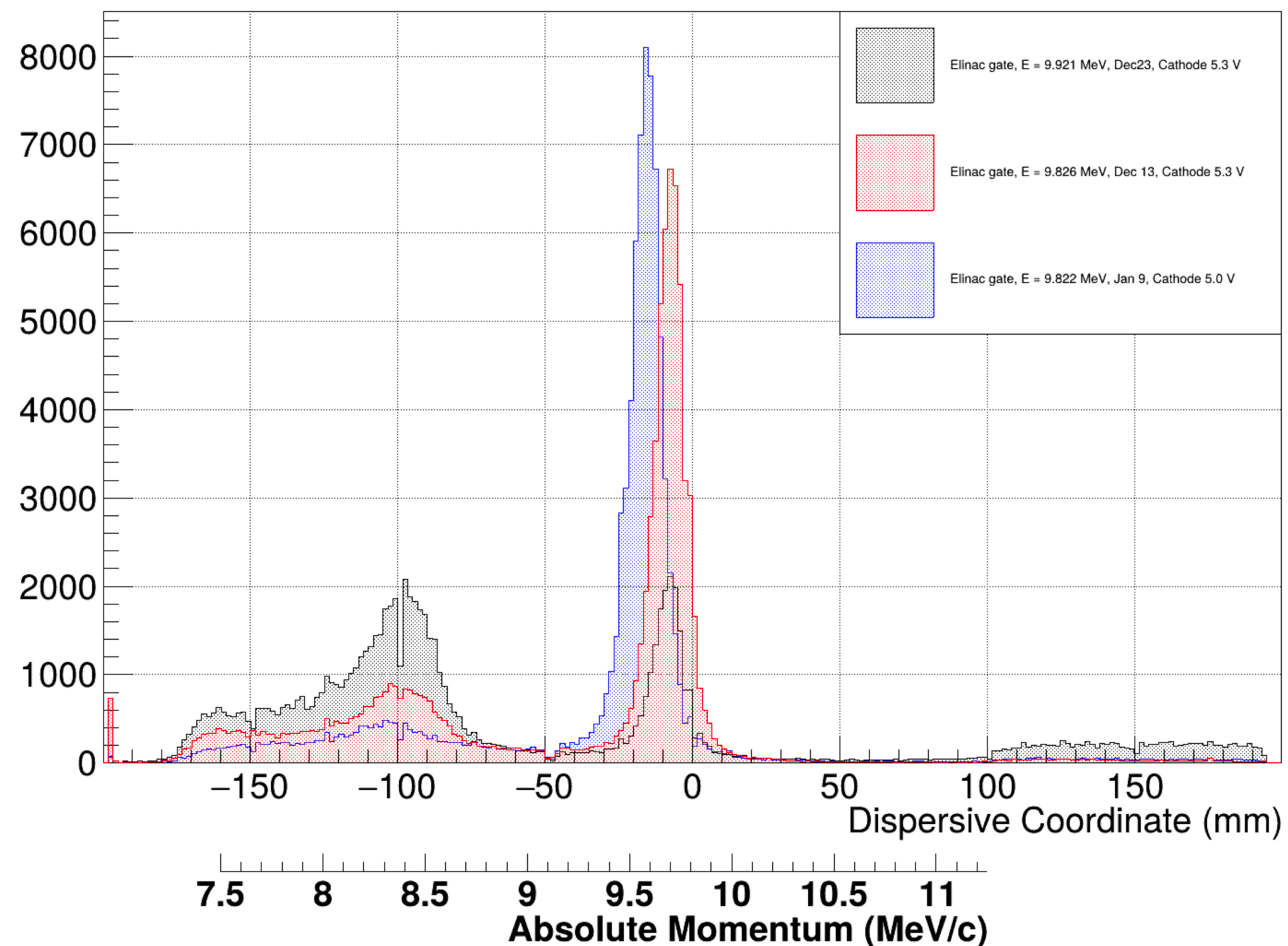
January 5th-11th

- Continued to vary eLinac settings to try to reduce the background consistently
- Cathode voltage reduced to 5.1 V, seemed to help the most
- Turned down to 5.0 V, which seemed to further help, tried to go lower but no output
- Built up statistics for Moller scattering, inelastic line at 10 MeV

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10 MeV scattering, right dipole set to 60 A

GEM Right Bottom Hit map



January 12th-18th

- Module arrived and was installed into EACA power supply
- Beam did not come back in the same condition it went down in, spent several days retuning at 10 MeV

January 19th-25th

- Were able to reestablish good 10 MeV running conditions
- 15 MeV tune completed, and data taken for measurements
- RG1 died and was replaced, the replacement also did not work
- Proceeded to take data with 3 GEMs for the remainder of the data-taking
- Moved to 20 MeV

January 26th-February 2nd

- RG0 exhibited some wandering current
- Attempted to take some coincidence data in addition to the usual measurements at 30 MeV, background was found to be quite high from the cavity
- Reduced energy to 25 MeV to try to reduce the background
 - Were able to get best signal to background ratio so far from the elastic line
- Took several days of coincidence data
- Were able to resolve beam bunch structure in the trigger
- Completed data-taking 8 AM February 2nd

Summary and next steps

- It is unclear if the GEMs can handle the current required for the full production run, and it is unclear if the efficiency will be high enough to complete production running
- The eLinac background due to the dark current presented a persistent problem throughout commissioning
 - Should be somewhat mitigated by the replacement of the cathode which will take place before further running

- Will also be revising the target ladder design to allow for better background reduction

	Moller (3 GEM)	Moller (4 GEM)	Elastic (3 GEM)	Elastic (4 GEM)	Inelastic	Coincidence
10 MeV	✗	✓	✗	✓	✗	✗
15 MeV	✗	✓	✗	✓	✗	✗
20 MeV	✓	✗	✓	✗	✗	✗
25 MeV	✓	✗	✓	✗	✗ (maybe)	✓ (maybe)
30 MeV	✓	✗	✓	✗	✗ (maybe)	✓ (maybe)

Questions

- What do we do about the GEMs?
- Can we do a useful analysis of the data taken during commissioning with:
 - The background from the eLinac in the state that it is?
 - The unknown current?
 - The lack of fourth GEM data for a large part of the data-taking?
- Should we retake data next time we do a run?