Jefferson Lab
Thomas Jefferson National Accelerator Facility

Beamline performance

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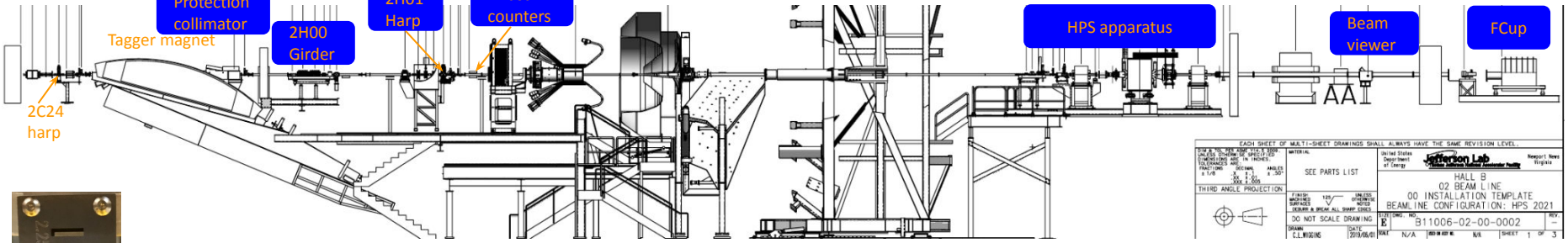
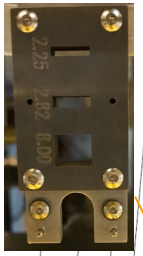
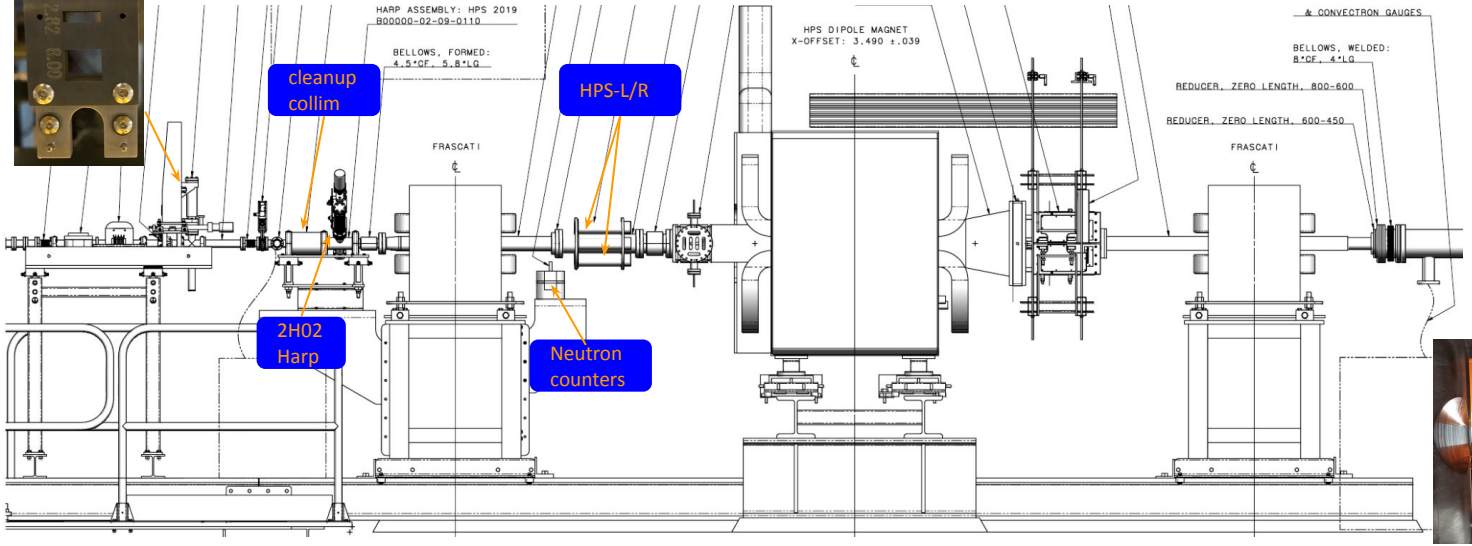
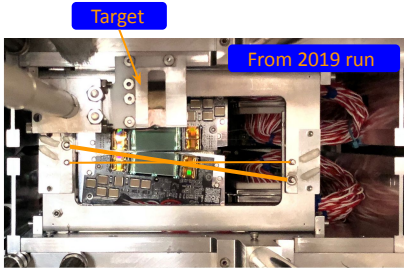
HPS collaboration meeting
Nov 15-18, 2021

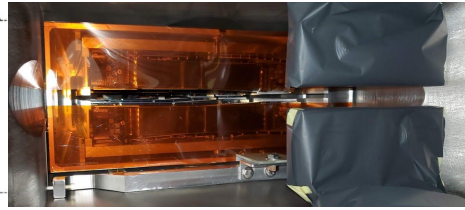
Beamline Engineering drawings











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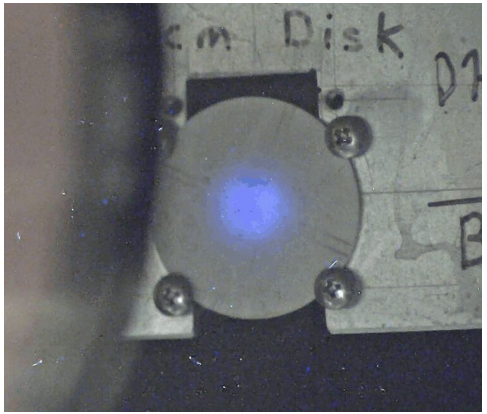
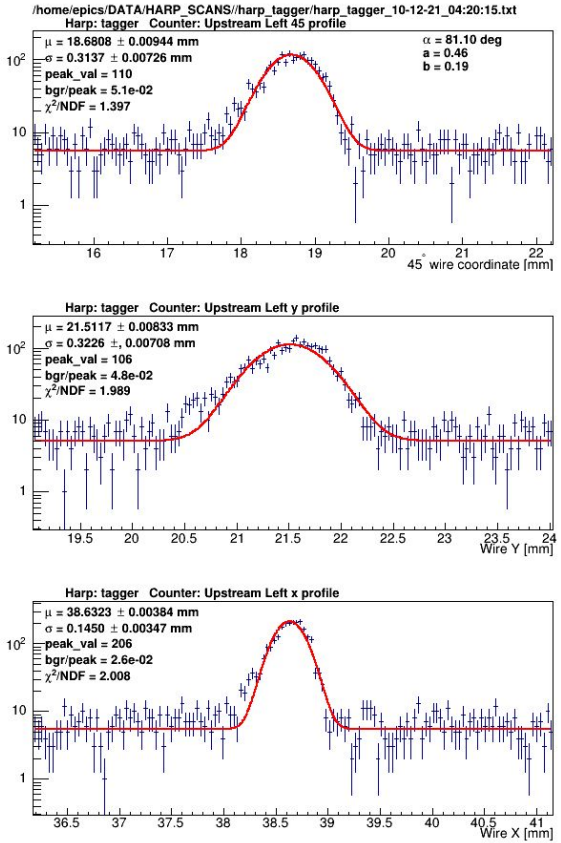
Beam Tuning: Beam to tagger dump

Before sending the beam to the FCup the beam first sent to the tagger dump:

- To make sure halo counts are not too high
- Beam positions on harps are where they are supposed to be
- The position on the tagger viewer is correct
    - There was an instance when 2 A difference in the tagger magnet current made the significant vertical beam spot shift on the tagger viewer





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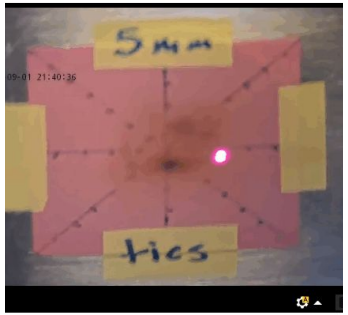
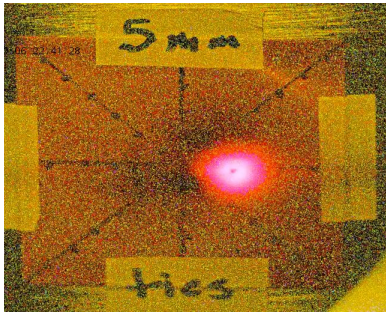
Beam Tuning: Beam to Faraday Cup

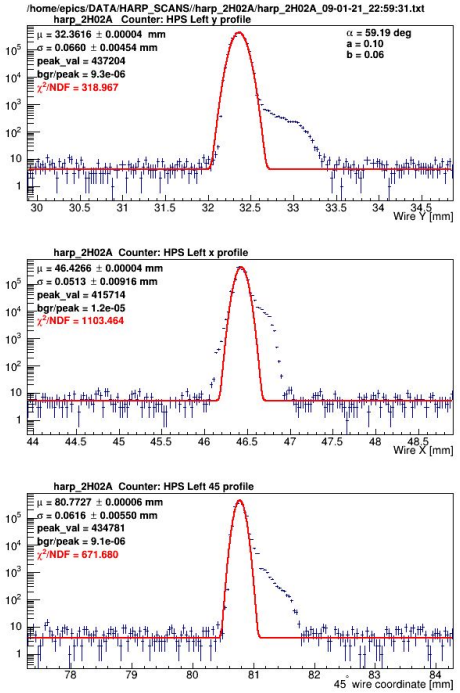
First week was not easy. There were significant tails at 2H02. This was fixed on Sep. 9. The throught the whole run we didn't have any significant issues on the beam profile on the HPS side.

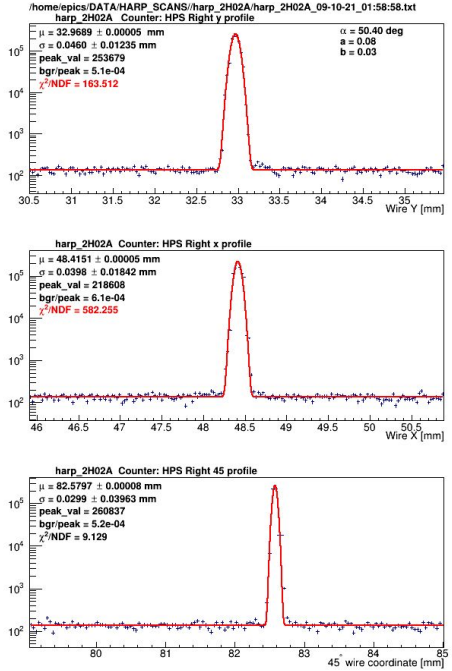
No target



W/ 20 μm W







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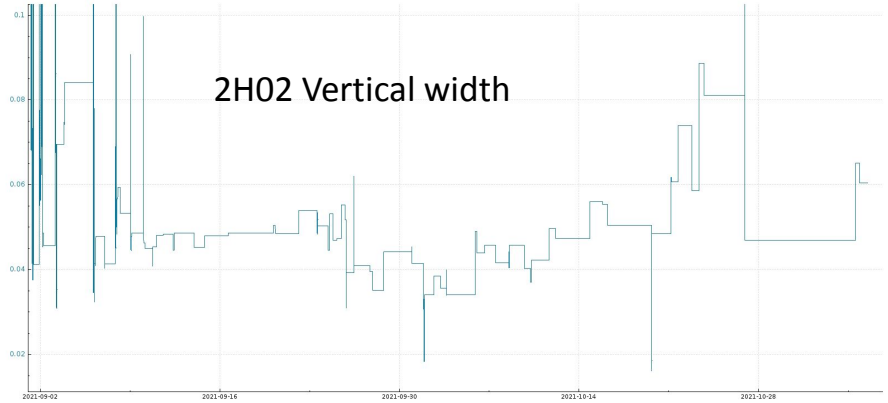
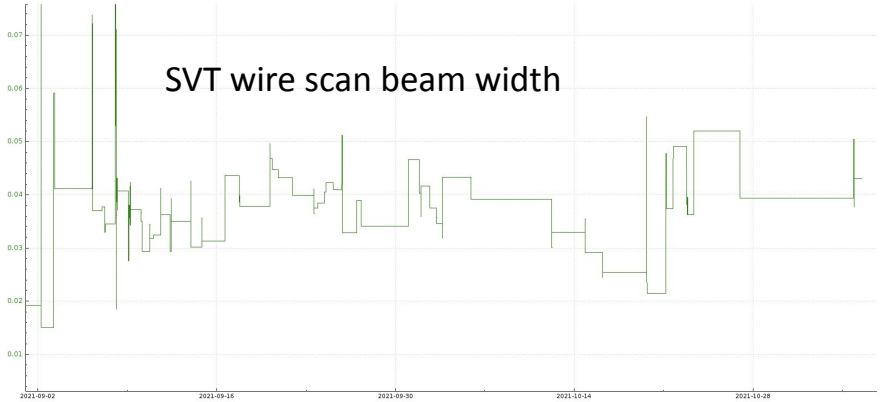
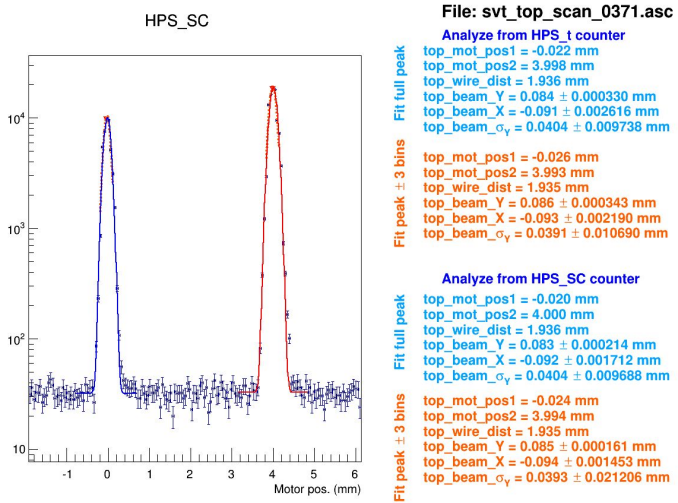
Beam width at 2H02 and at the target





At 2H02 harp, the beam vertical profile was mostly under 60μm, while at the target it was mostly under 50 μm.



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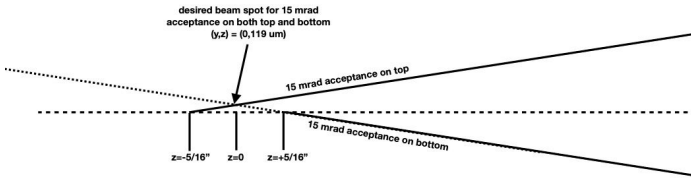
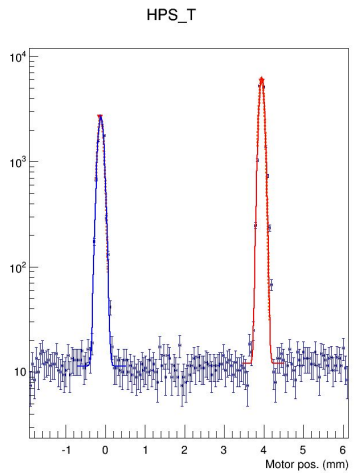
Shifting the beam up by 119 μm

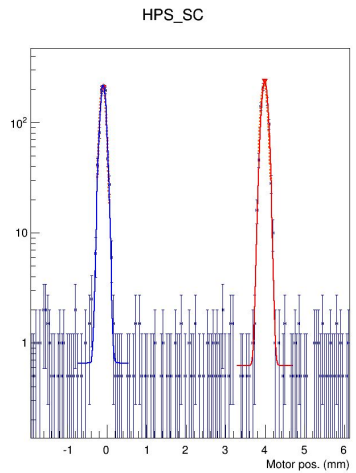
Up until Sept 23 we were positioning the beam on SVT at X=0±200μm Y=0±50μm

On Sep 23 Tim and Cameron proposed to move the beam up by 119 μm in order to have an equal acceptance for tracks in the bottom and top halves of SVT



See Tim's log entry for details https://logbooks.jlab.org/entry/3911243





File: svt_top_scan_0342.asc

Analyze from HPS_t counter

Fit full peak
top_mot_pos1 = -0.122 mm
top_mot_pos2 = 3.941 mm
top_wire_dist = 1.957 mm
top_beam_Y = 0.132 ± 0.000359 mm
top_beam_X = 0.043 ± 0.002692 mm
top_beam_σ_Y = 0.0334 ± 0.016329 mm

Fit peak ± 3 bins
top_mot_pos1 = -0.121 mm
top_mot_pos2 = 3.942 mm
top_wire_dist = 1.957 mm
top_beam_Y = 0.132 ± 0.000392 mm
top_beam_X = 0.043 ± 0.002505 mm
top_beam_σ_Y = 0.0336 ± 0.016218 mm

Analyze from HPS_SC counter

Fit full peak
top_mot_pos1 = -0.098 mm
top_mot_pos2 = 3.975 mm
top_wire_dist = 1.962 mm
top_beam_Y = 0.121 ± 0.001262 mm
top_beam_X = 0.074 ± 0.011532 mm
top_beam_σ_Y = 0.0344 ± 0.016020 mm

Fit peak ± 3 bins
top_mot_pos1 = -0.098 mm
top_mot_pos2 = 3.974 mm
top_wire_dist = 1.961 mm
top_beam_Y = 0.121 ± 0.001292 mm
top_beam_X = 0.072 ± 0.008342 mm
top_beam_σ_Y = 0.0340 ± 0.032374 mm

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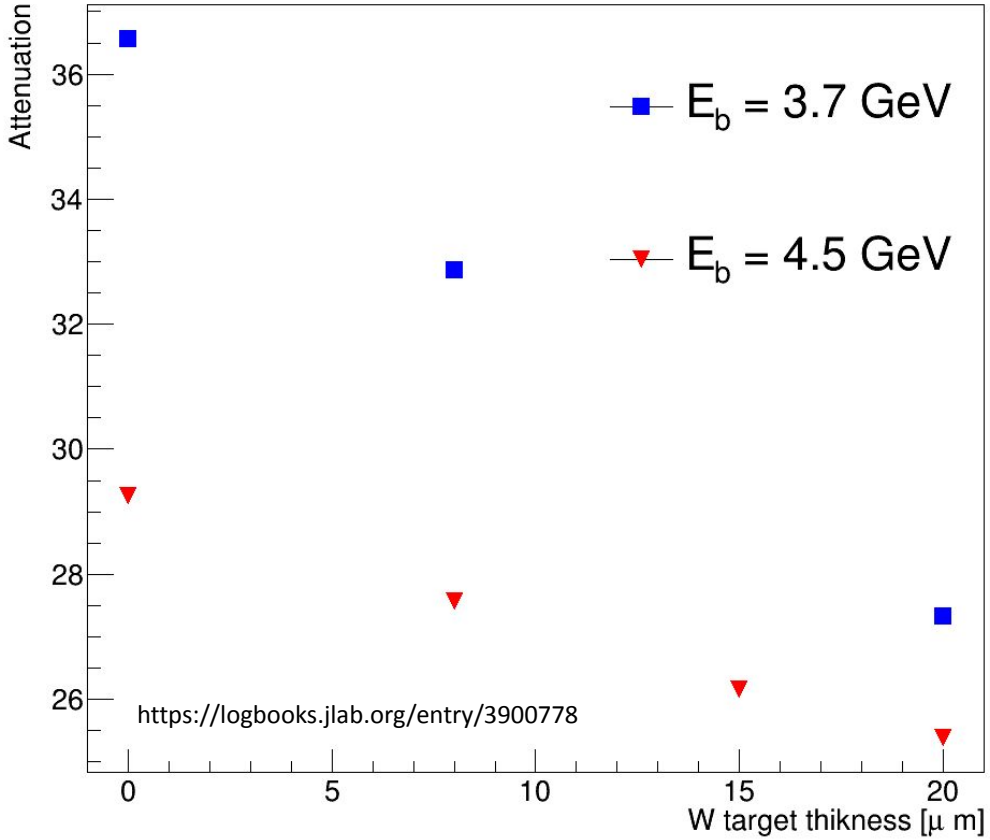
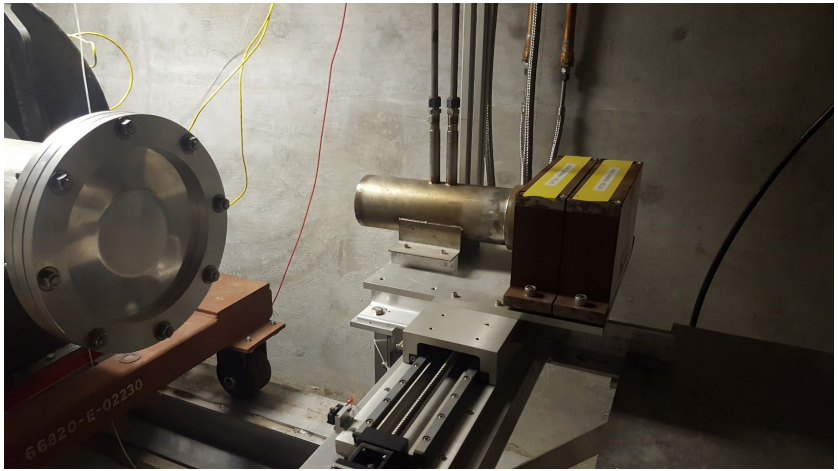
The beam blocker attenuation



3.7 GeV at 120 nA requires the beam blocker

Before starting production runs, we calculated the beam blocker attenuation for each target.

Significant dependence on the target thickness. Thicker target scatters more and in addition the magnetic field spreads them more and by pass the beam blocker.



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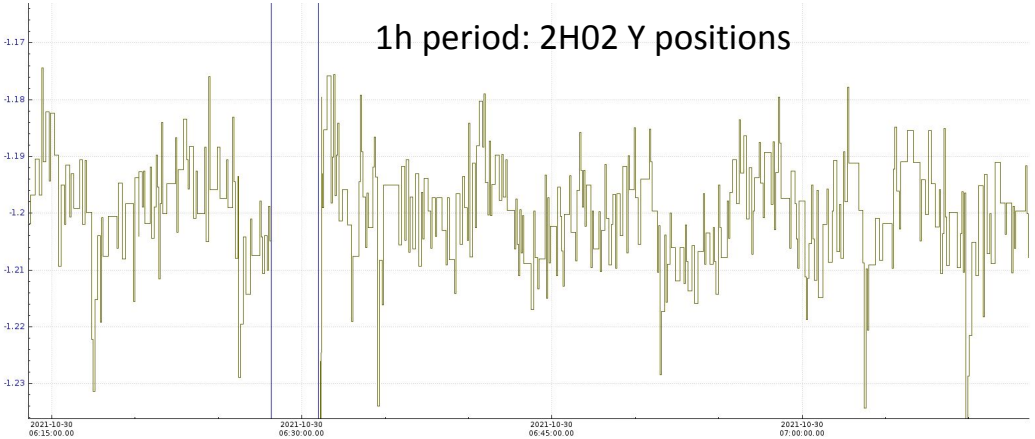
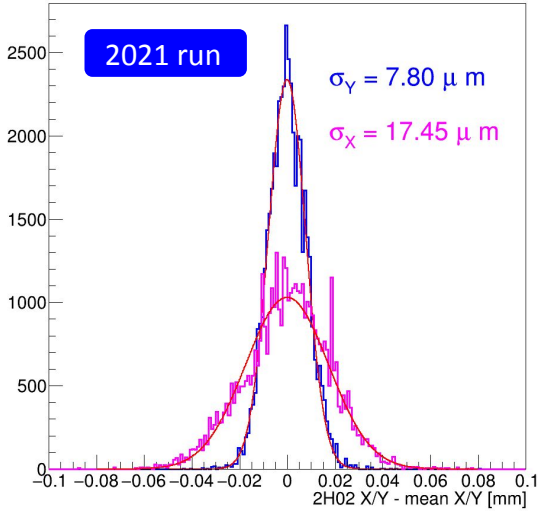
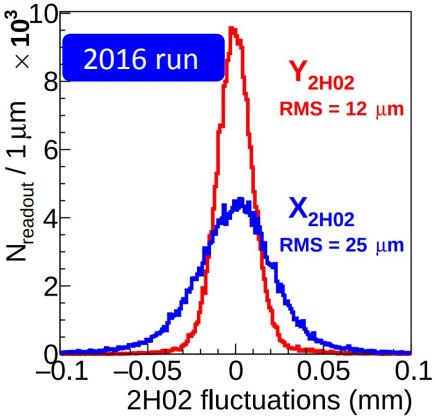
Beam position stability

We have about 50% better beam stability at 2H02 compared to the 2016 run.



≈15 h period on Oct 29





After long downtimes, most of the time we just did one harp and SVT wire scans just to confirm beam position, we almost didn't lose time tuning the beam

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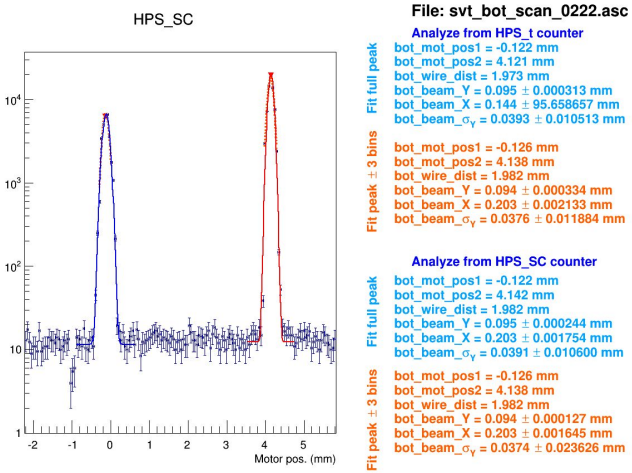
One pass beam

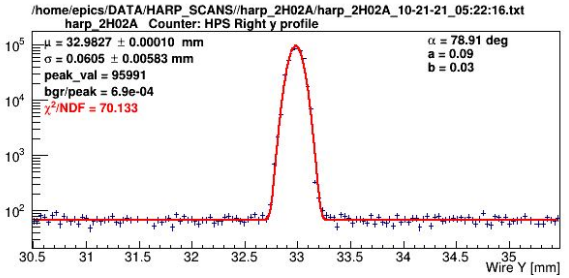
Oct-18 to Oct 25 We run one pass beam: 1922 MeV

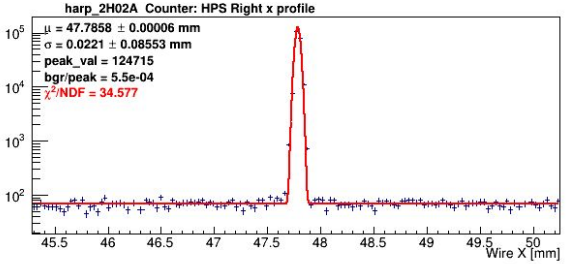
- We were able to get the beam back to FCup only couple of days after, but it was related to various accelerator issues: LCW leak etc...

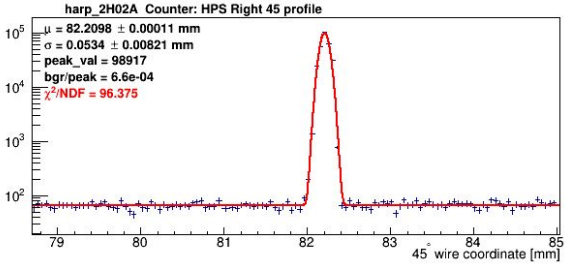
Beam quality wise: There was no any issue with the pass1 beam

- Similar beam profile
- Similar beam stability
- We run 70 nA
- We did not use FCup









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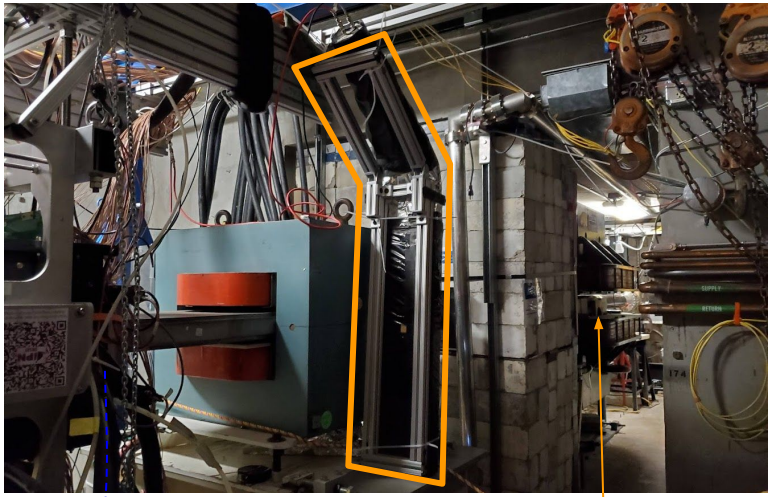
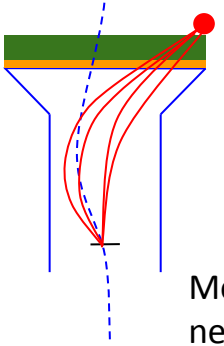
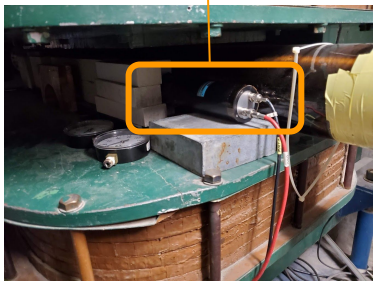
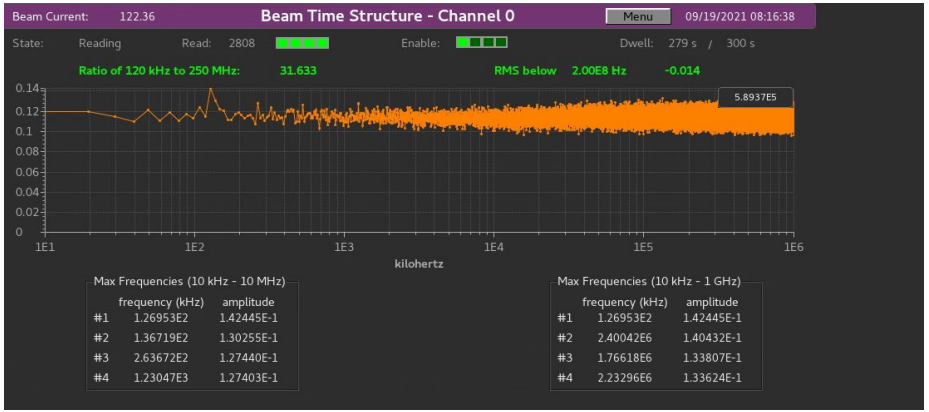
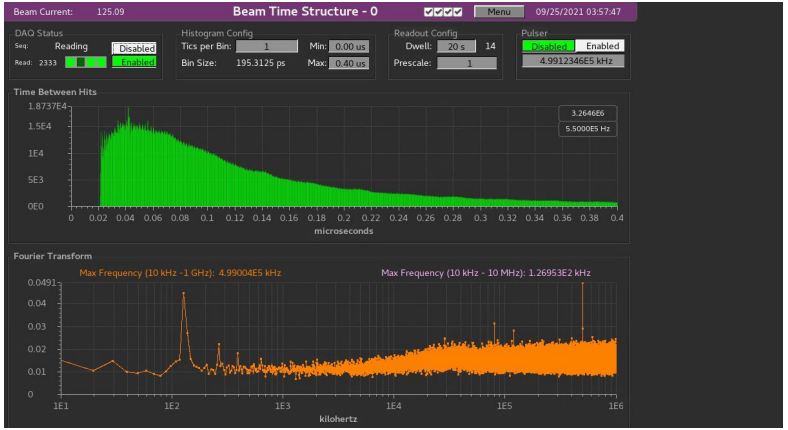
Beam time structure











Move the halo counter to the downstream tunnel near the viewer to reduce the acceptance.

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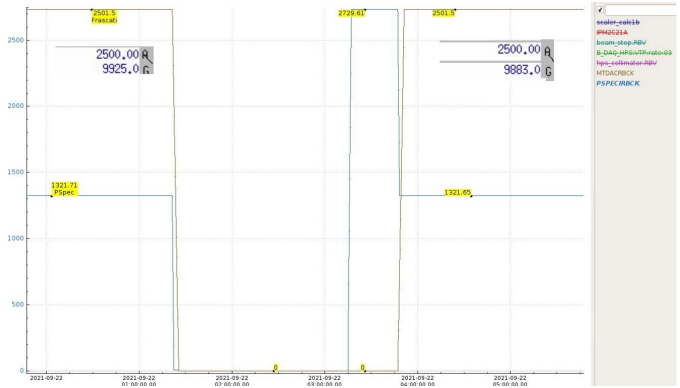
Issues

- Chicane improperly rumped up
- BPM freeze out
- Vacuum

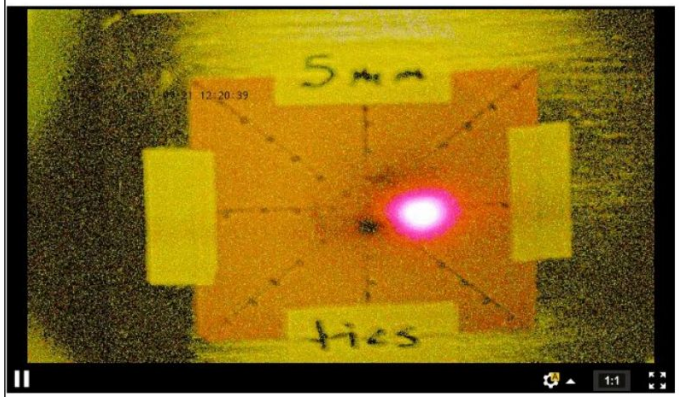
Chicane



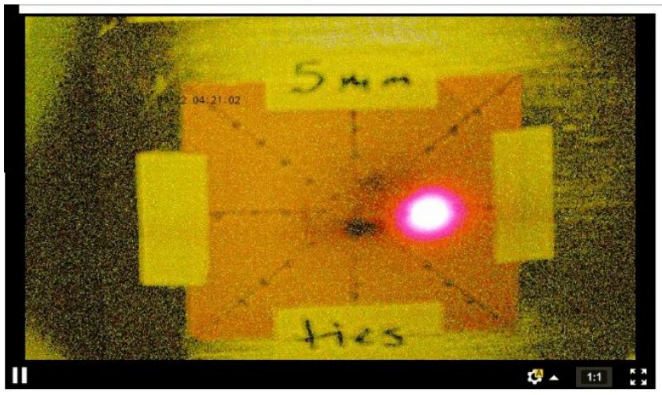
Only Frascati field is affected.

Note: those runs are still valid runs, but might need special MC, and perhaps different cuts for Beam Spot Constrain candidates.

On Sep. 21, Before Chicane mis-setting



On Sep. 22, after mis-powering the chicane



16 prod. runs affected, and highlighted in the run spreadsheet.

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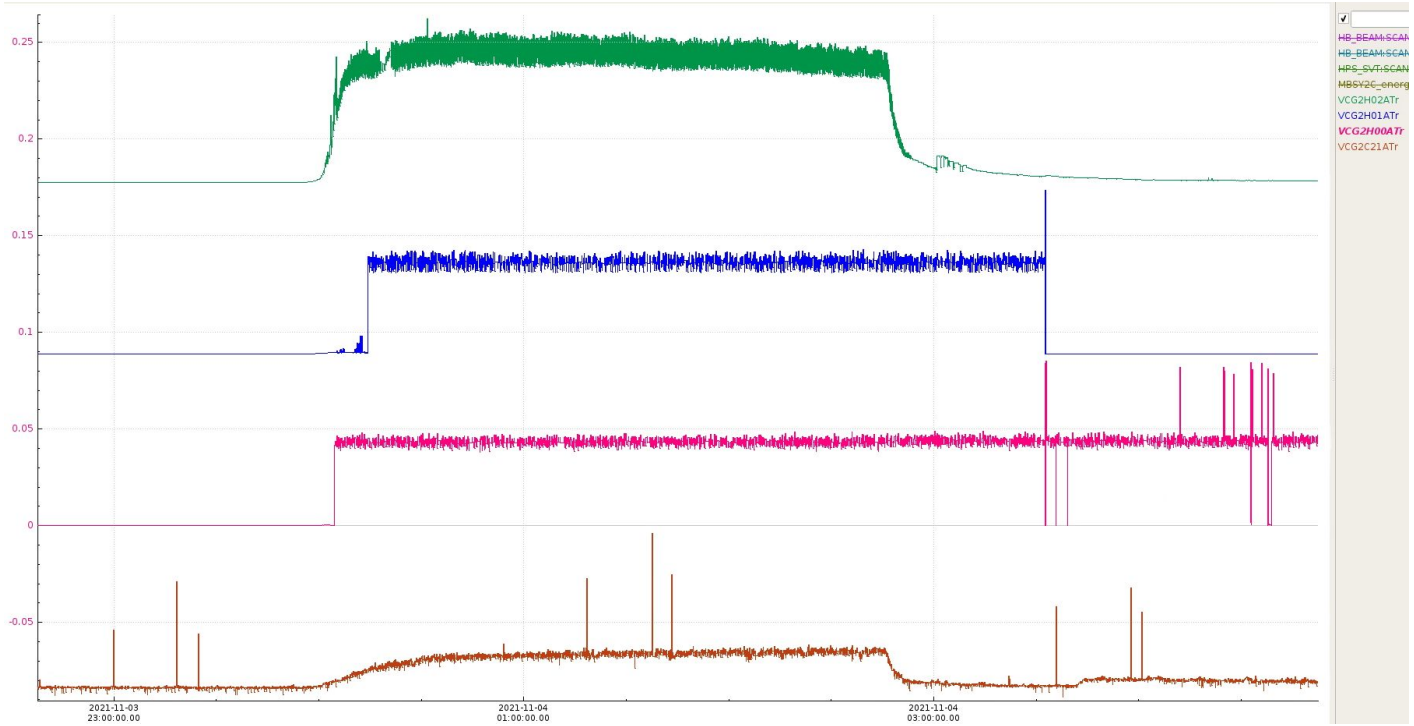
Beam position freezout

This issue occurred during previous runs as well.

MCC folks with Calvin installed poly blocks in front of BPM receivers, thinking this might be a radiation issue, though it didn't actually help.

Vacuum issues

2H00 pump failed on Nov.4. Within a week we got a good vacuum again.



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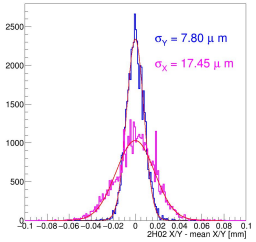
Summary

- Very good beam profile throughout the entire run
  - σ_Y < 50 μm
  - Beam stability < 10 μm



- Most of the time we just did single harp and SVT wire scans just to confirm beam profile

- No significant downtime because of the beamline