Early SRC Results from XEM2 Experiment

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Outline

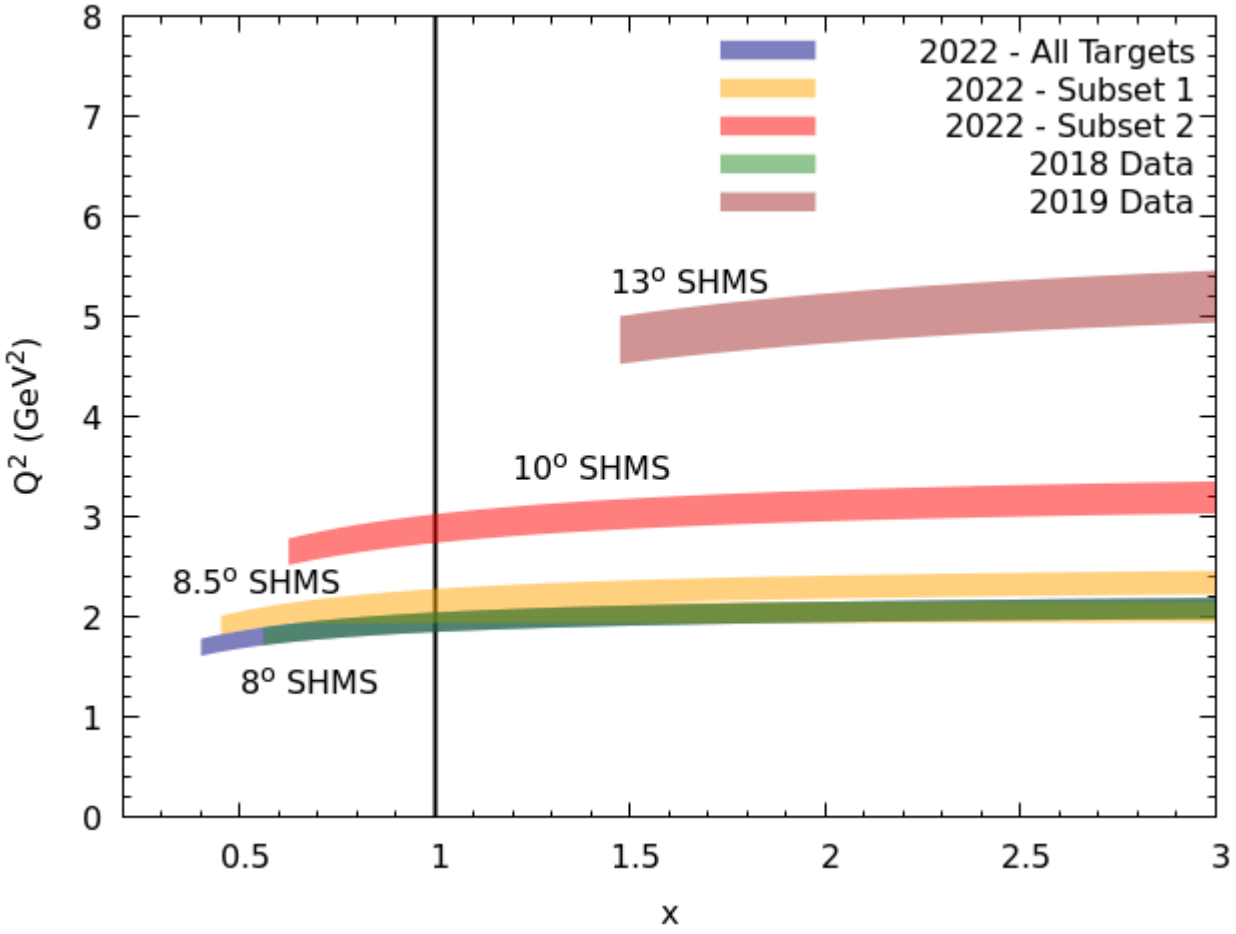
Commissioning Dataset

- Kinematics
- Absolute Cross Sections
- a_2 ratios for $^{10}\mathrm{B}$ and $^{11}\mathrm{B}$
- a_2 vs. Scaled Nuclear Density

Full Dataset

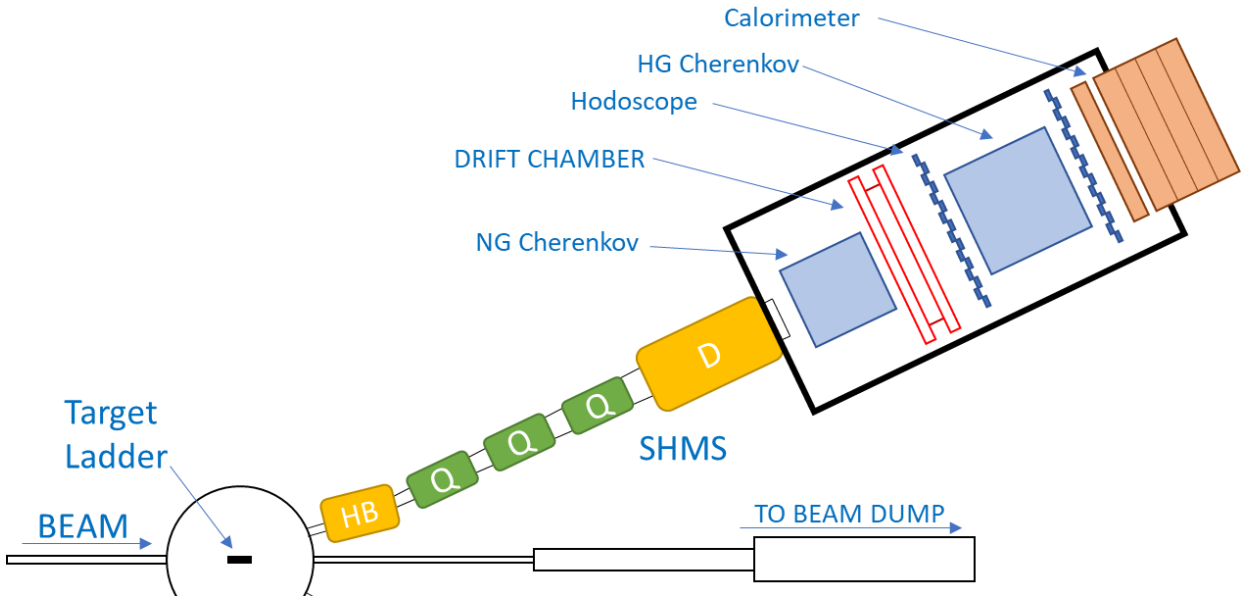
- *Online* Physics Results (Yield Ratios)
- Studies (Boiling, BCMs, Paddle Study, Electronic Live time
- Future work

XEM2 SRC Kinematics



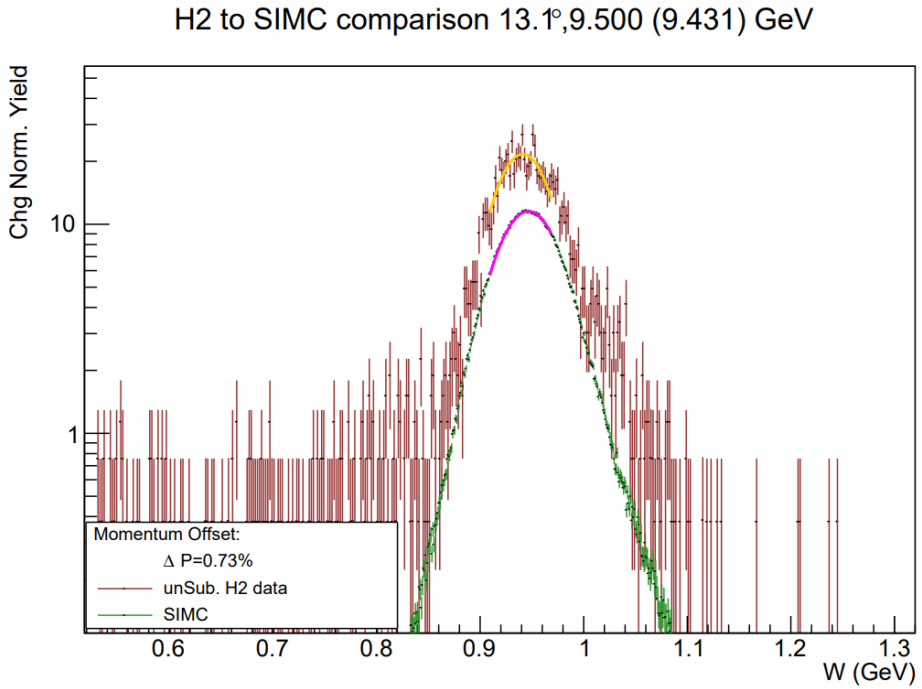
Focus of this Talk

- 13˚ (commissioning data)
- 8˚ (Full Experiment)

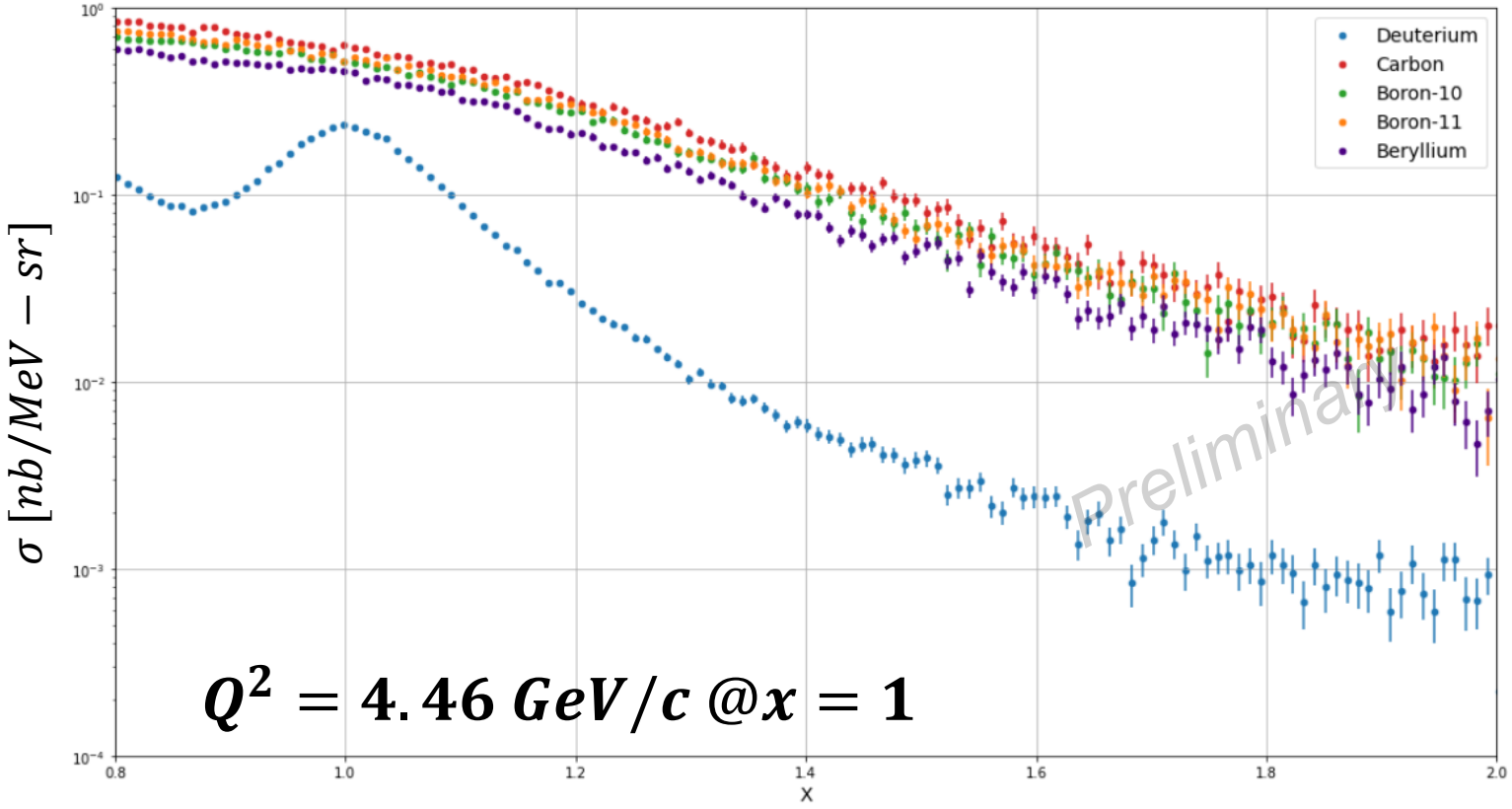


Results on B10 and B11 (2019)

Linear offset in central momentum based on Hydrogen elastic at 8.5 GeV/c, 9.0 GeV and 9.5 GeV



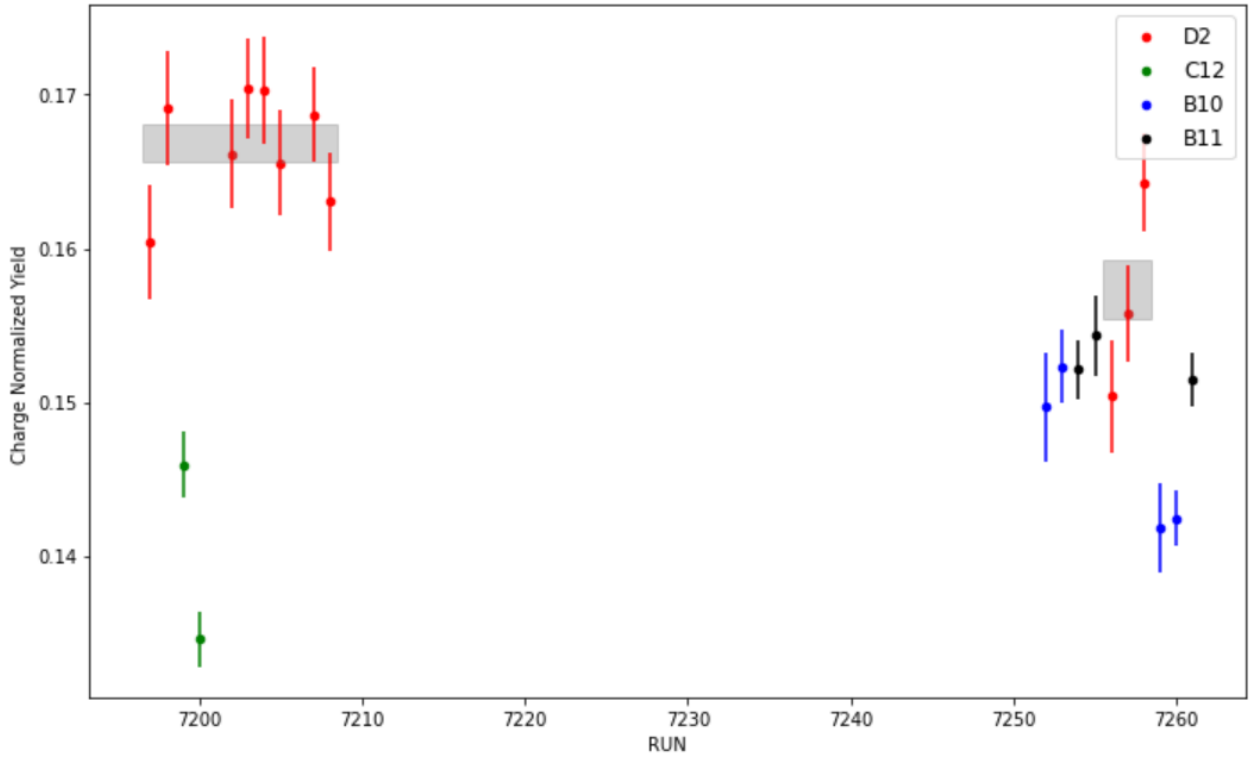
Nominal Acceptance

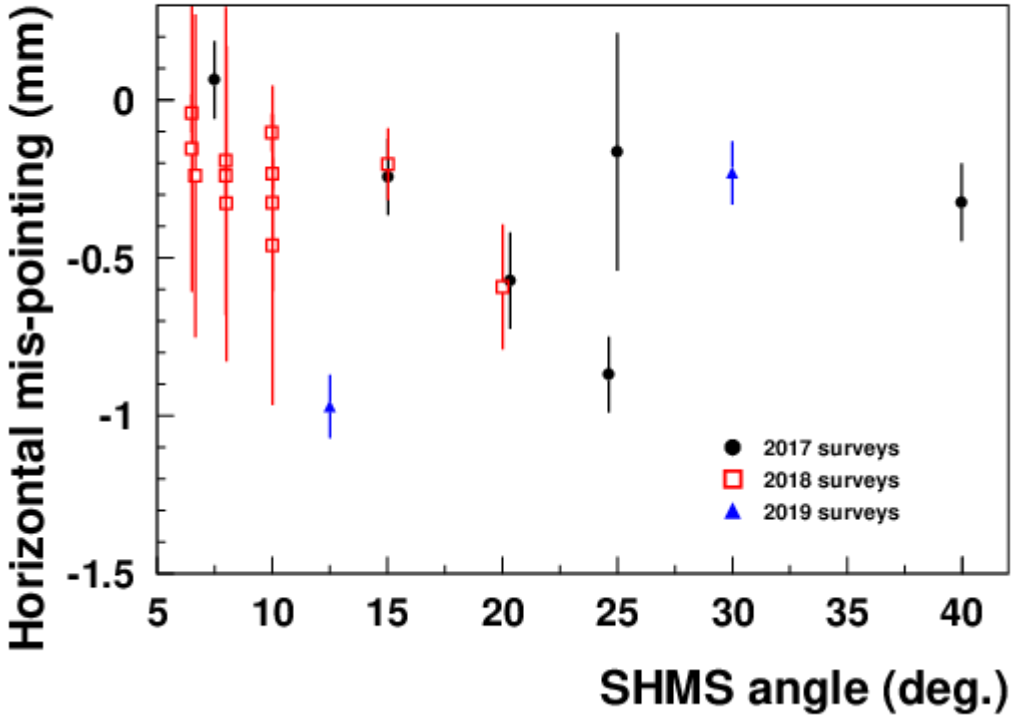


Statistical errors only

Difference in Yield between Days

- The SHMS was rotated between settings
  - Variation of 1mm seen in SHMS horizontal mis-pointing. Leads to a 0.11% momentum offset between day 1 and day 2 of data taking.



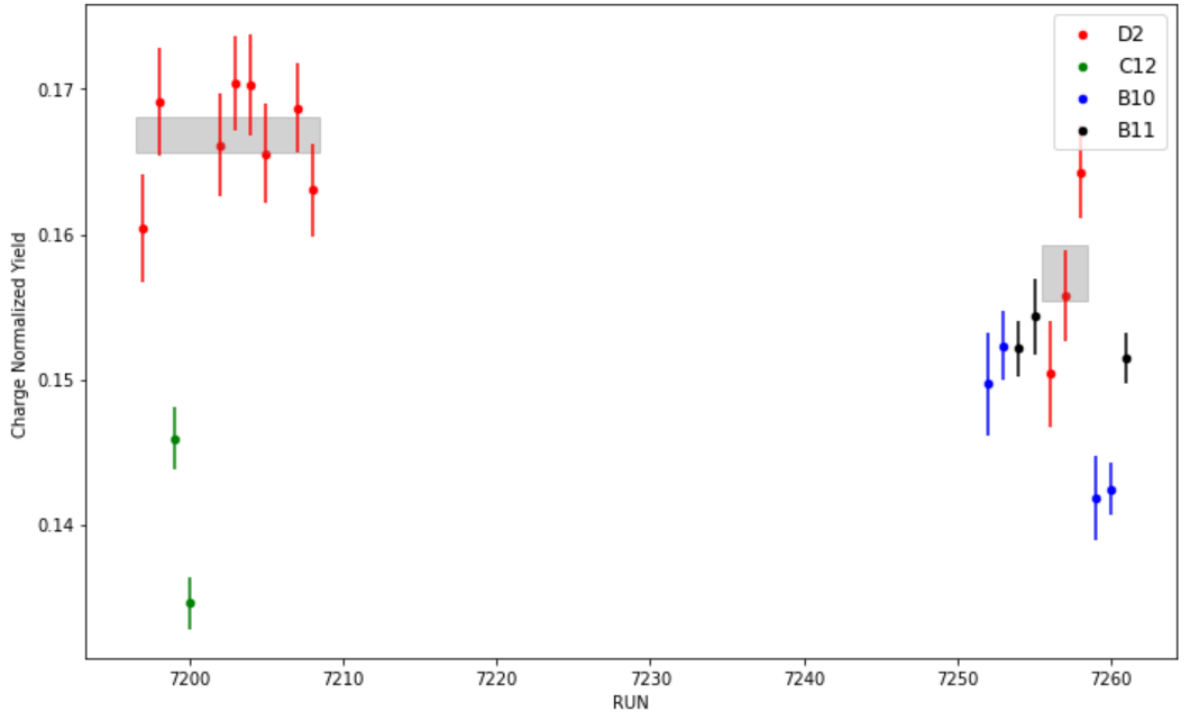


Results on B10 and B11 (2019)

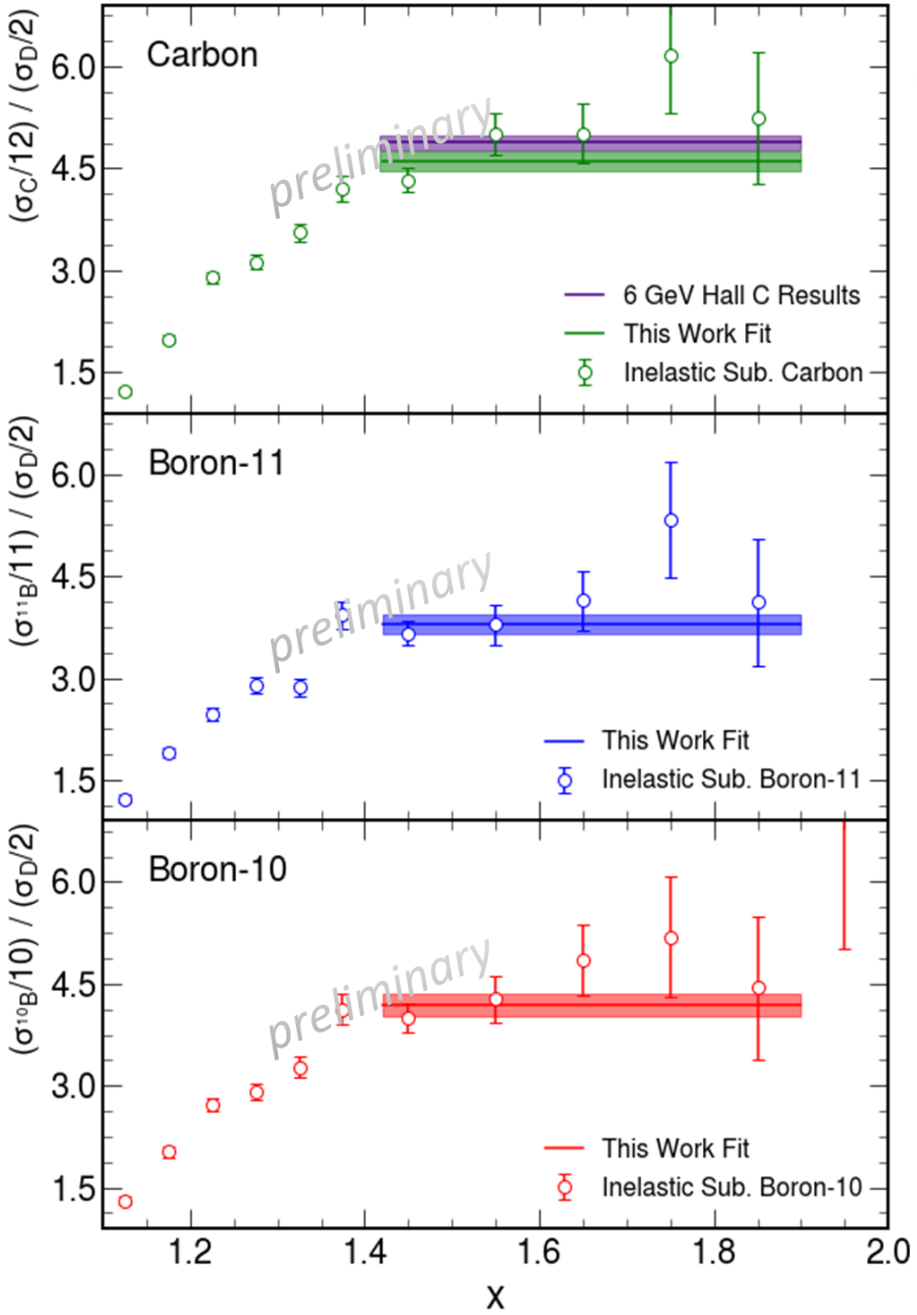
First measurements of ^{10}B and ^{11}B

Target nuclei was boron carbide

Carbon was taken the day previously

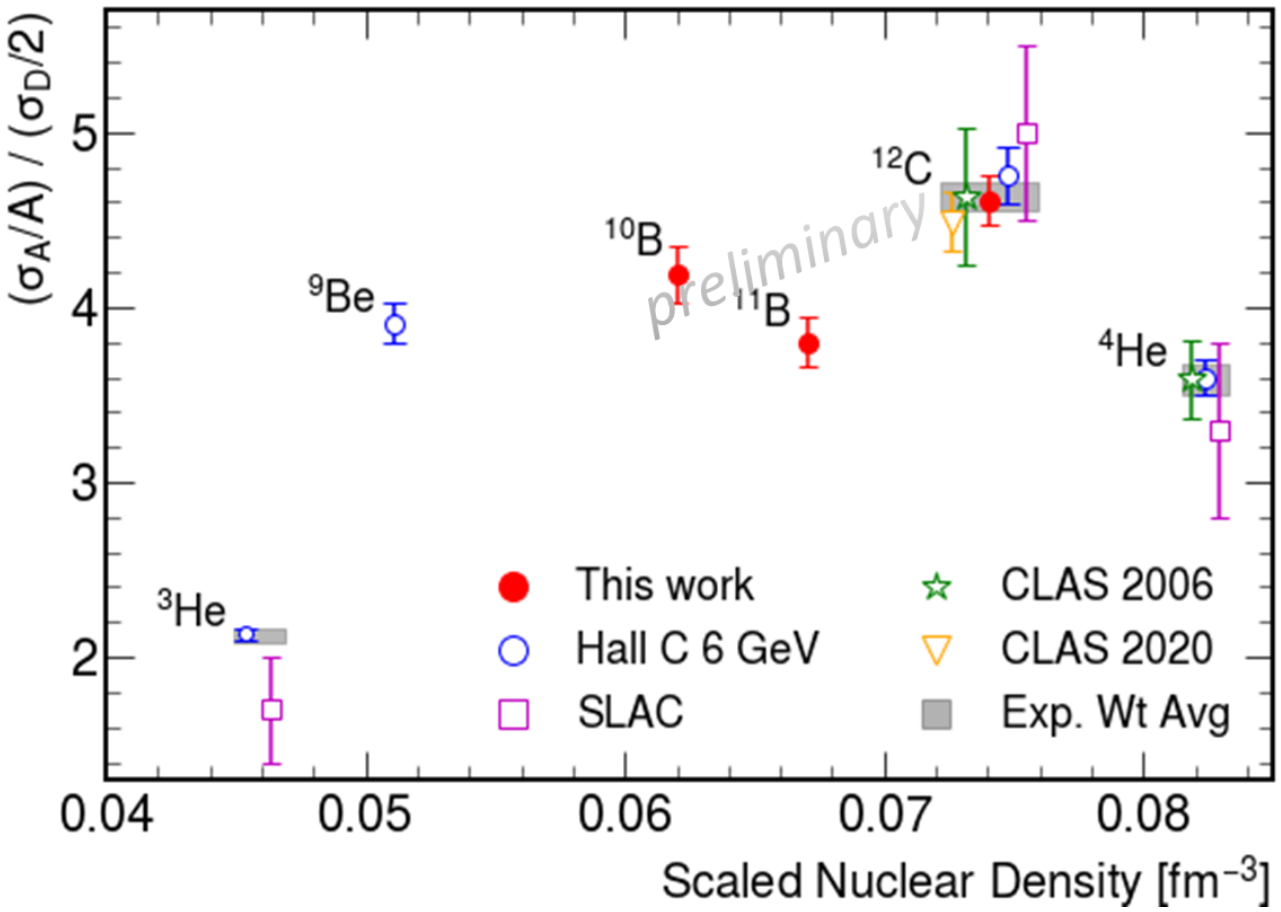


Statistical errors only (2σ here, systematic errors will decrease significance slightly)



Results on B10 and B11 (2019)

First measurements of B10/B11
Expand knowledge of EMC-SRC correlation on light nuclei

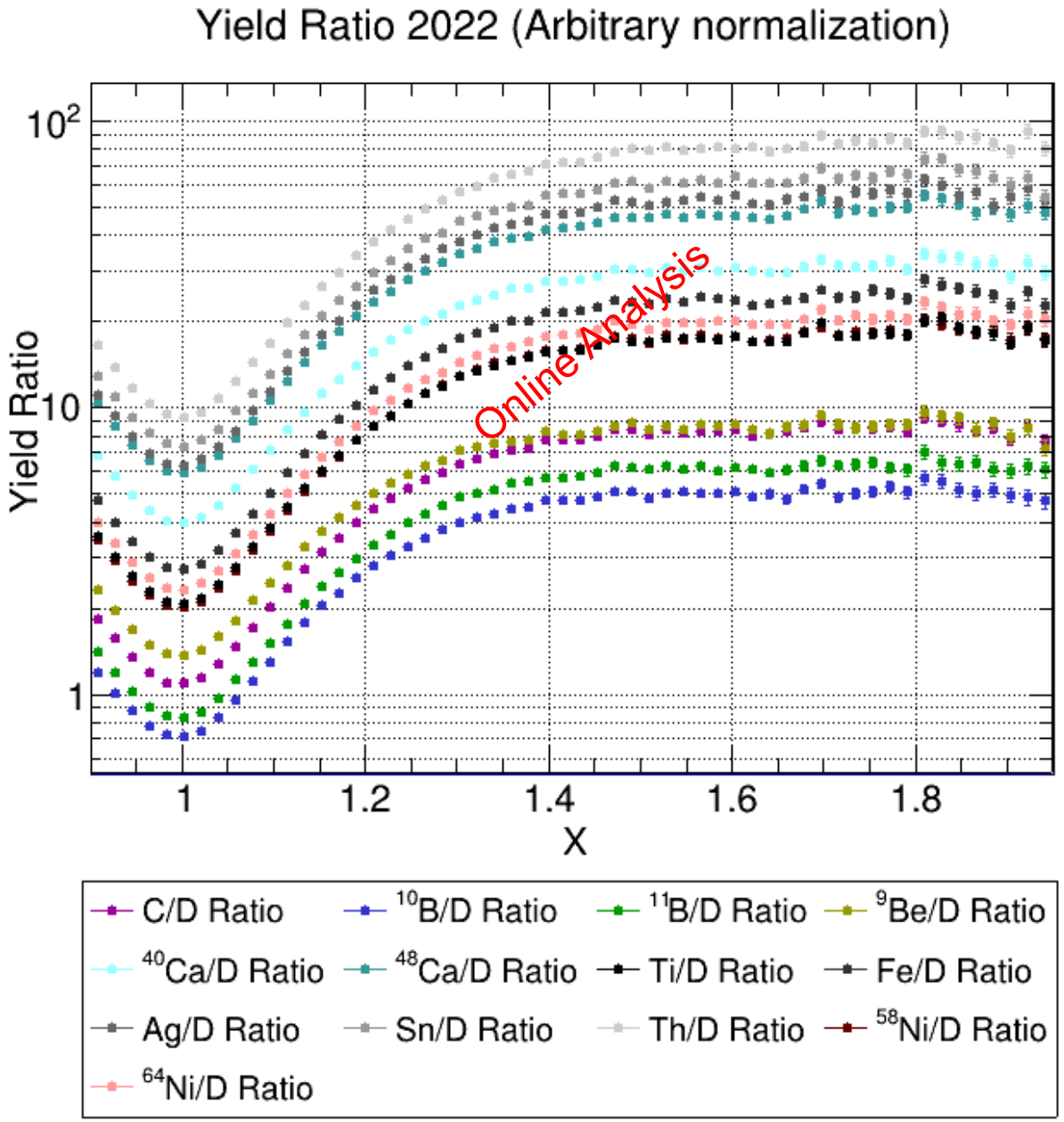


Statistical errors only

Online Physics Results – 2N SRCs

Preliminary 2N SRC Charge Normalized Yields (2023)

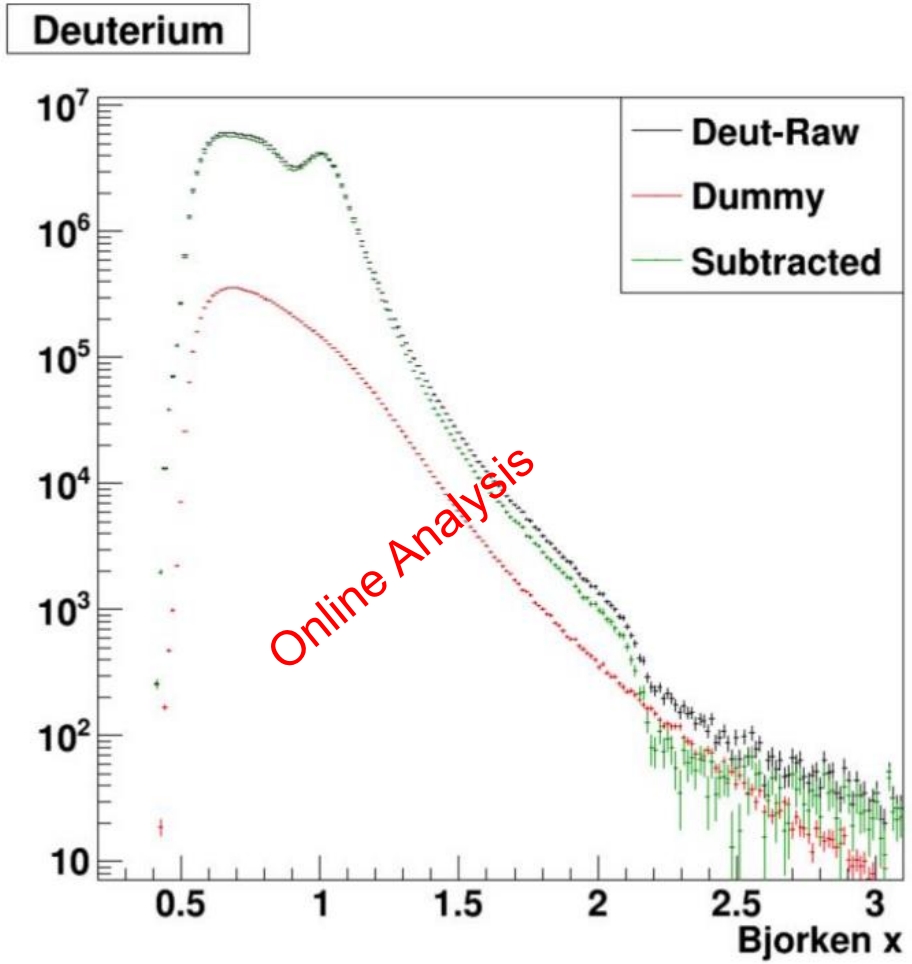
- Statistical error bars shown for all targets on first target ladder (taken last week!)
- Quick to first pass because of the experience gained with the previous data
  - ✓ Online Calibrations
  - ✓ Live-time measurements
  - ✓ Optics checks
  - ✓ BCM checks
  - ✓ Carbon and Aluminum subtraction

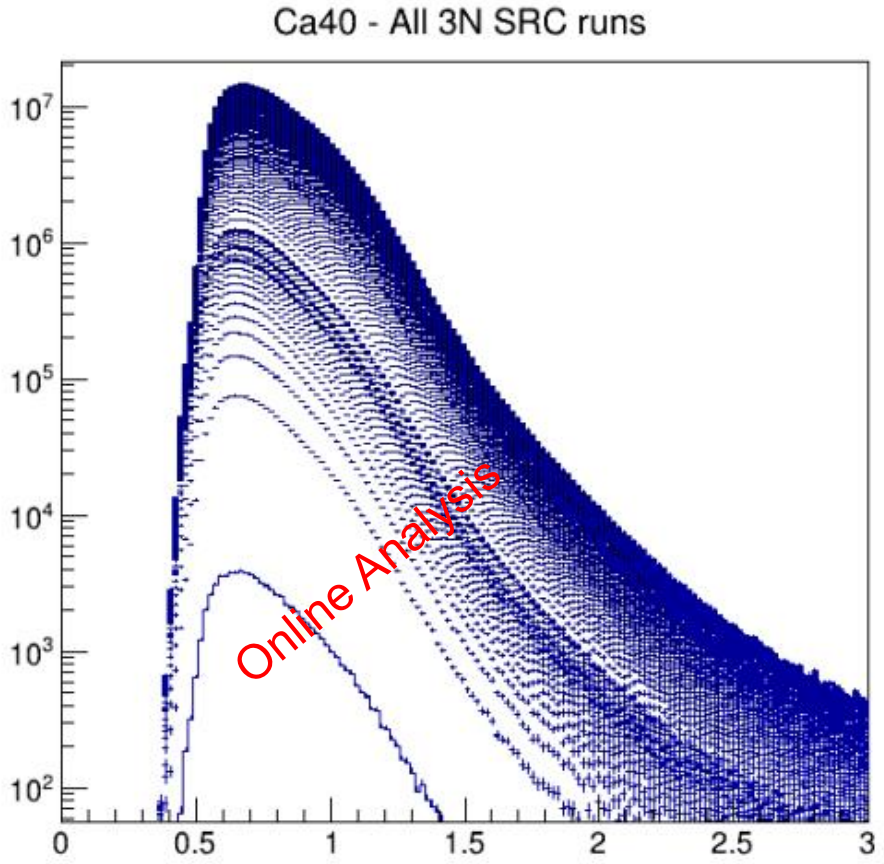


Online Physics Results – 3N SRCs

Preliminary 3N SRC Charge Normalized Yields Ca40 & D2 (2023)

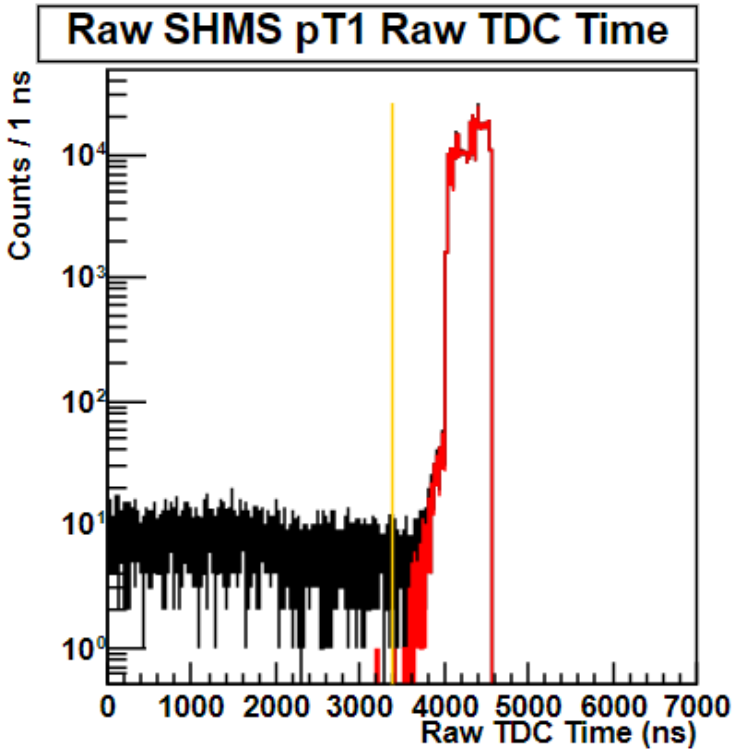
- Al subtraction on D2, Quick stack of all runs on Ca40

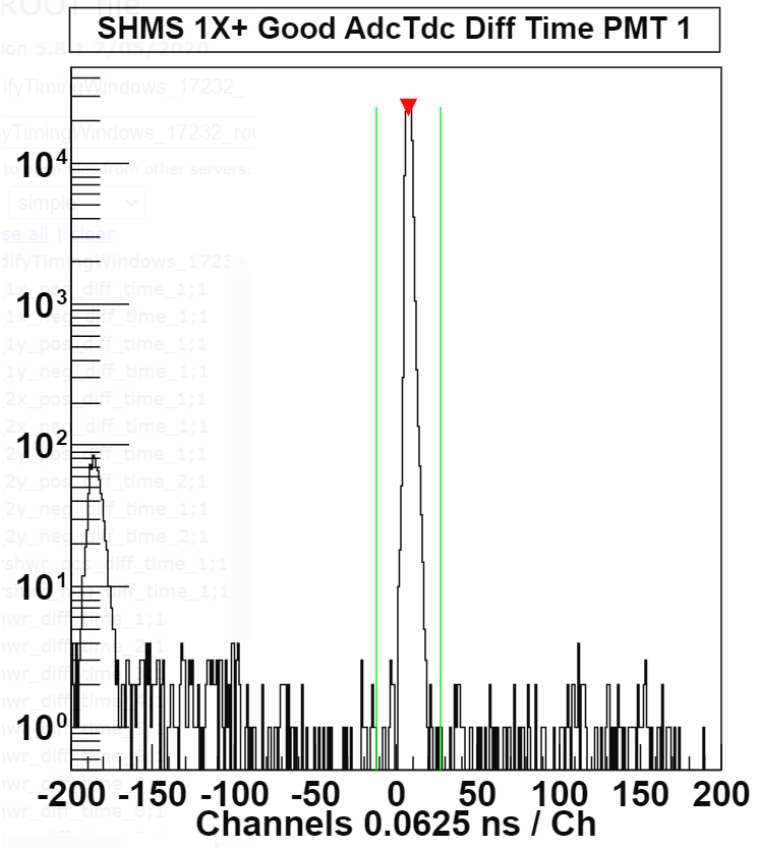


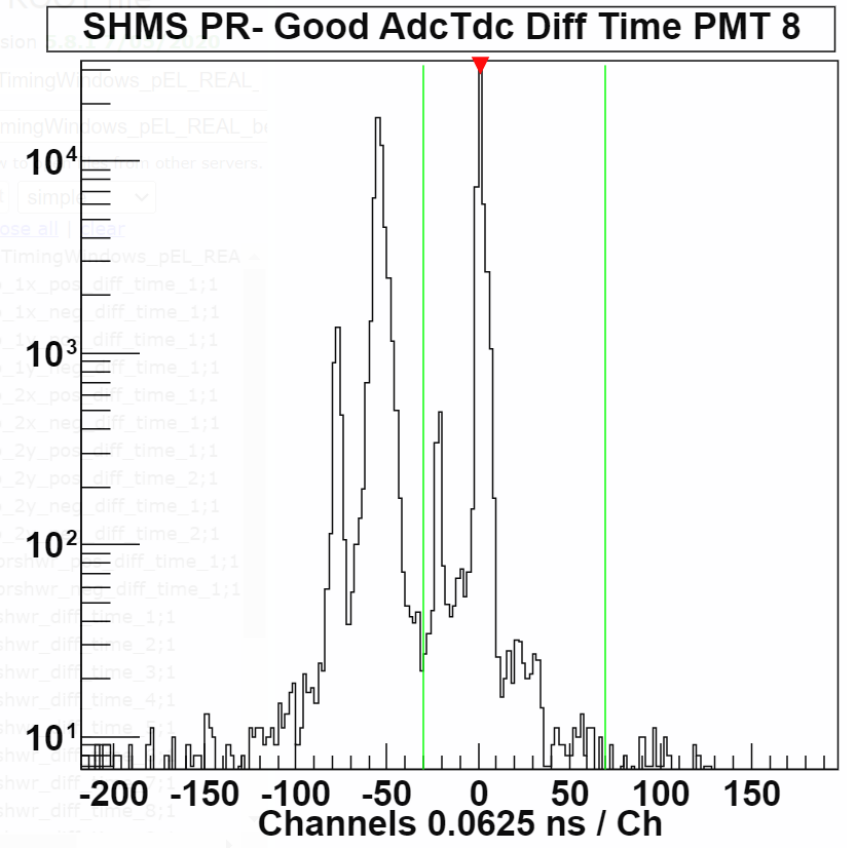


pass1 Detector Calibrations – Timing Windows & Reference Times

Low-level signals have been selected







pass1 Detector Calibrations – Calorimeter, Drift Chambers & NGC

SHMS calorimeter calibrated with Q2 defocused run

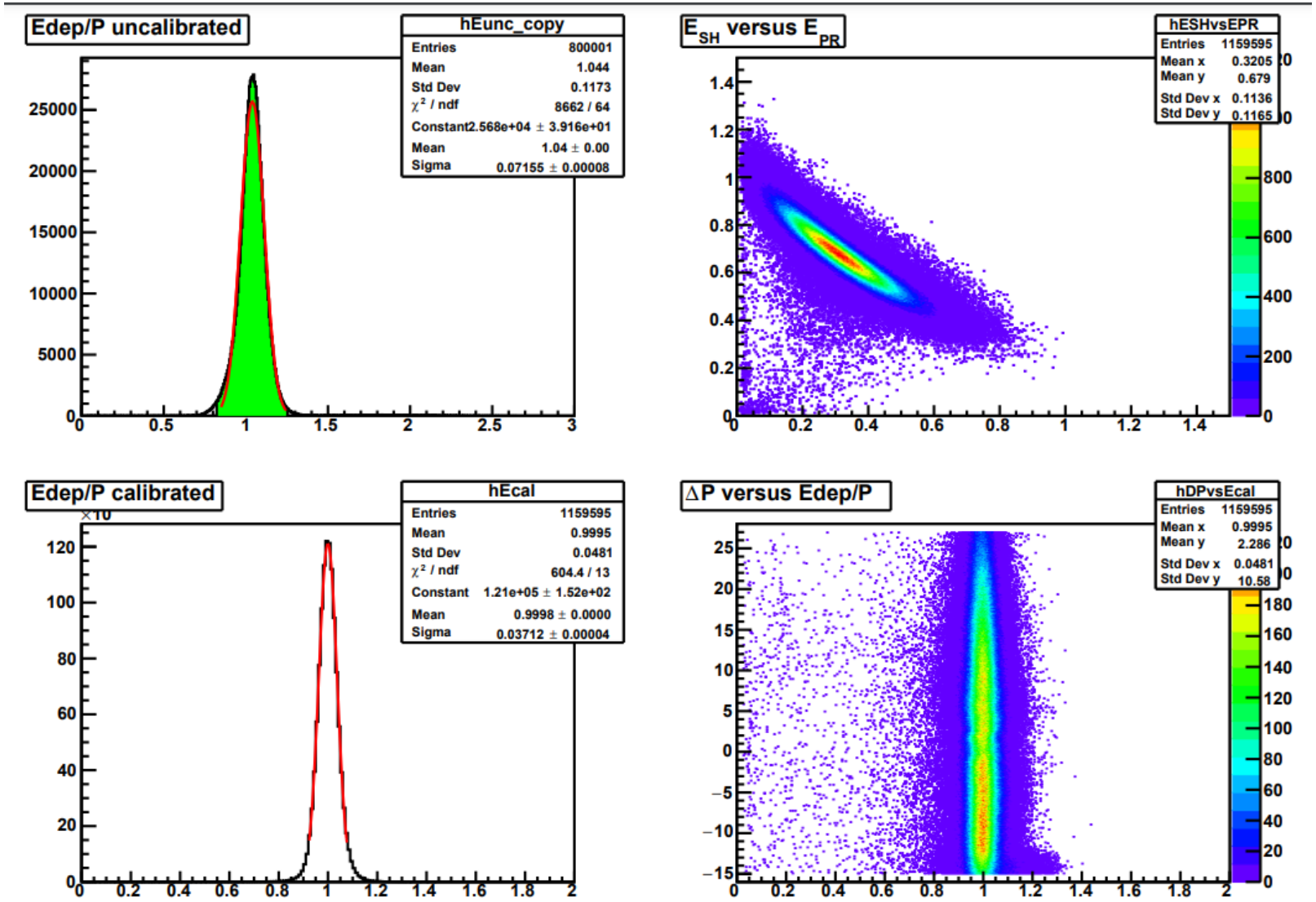
- Needs done for each setting nominally.
- Needs compared to delta scan performed at beginning of experiment.

It would be nice if the calorimeters didn't need calibrated at every different momentum setting

Drift Chamber calibration hasn't been done since CaFe.

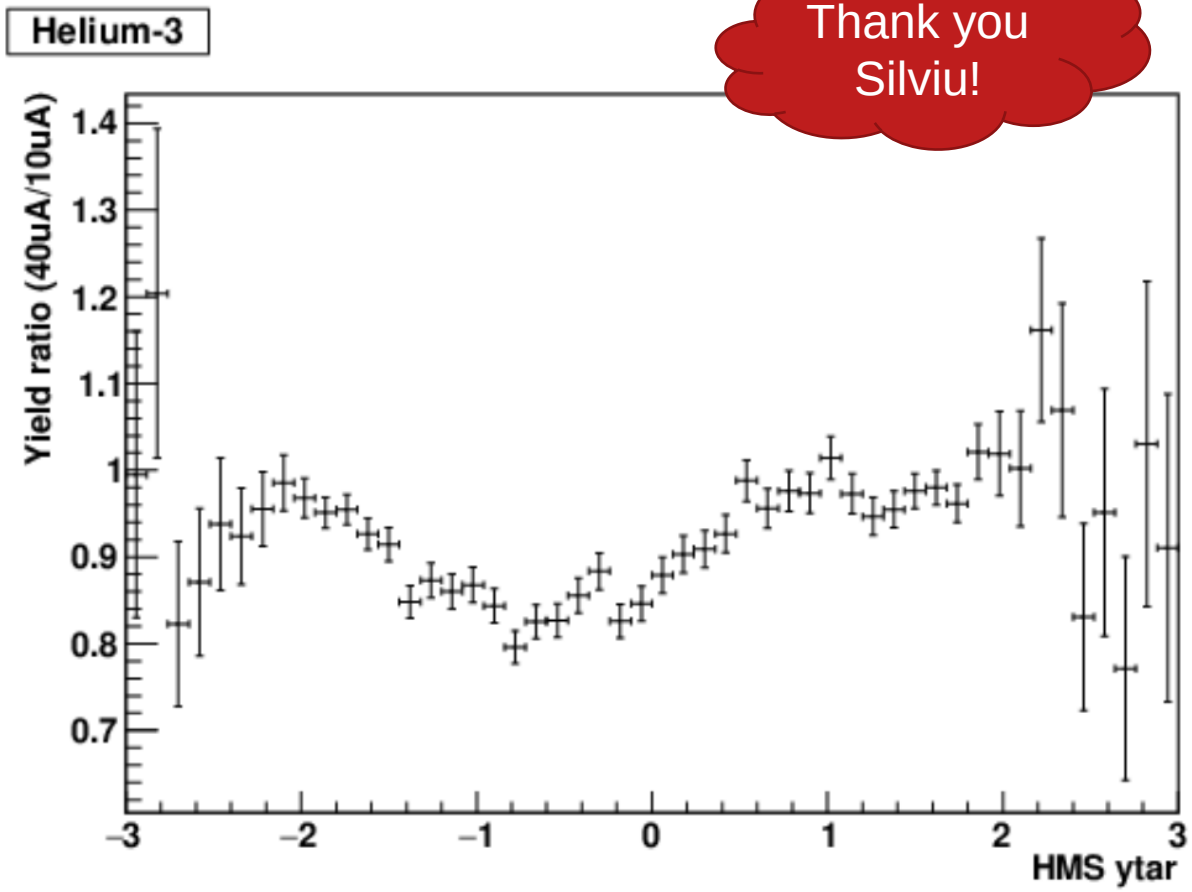
- It looks acceptable most of the time.

NGC – See Cameron Cotton's Talk tomorrow morning!

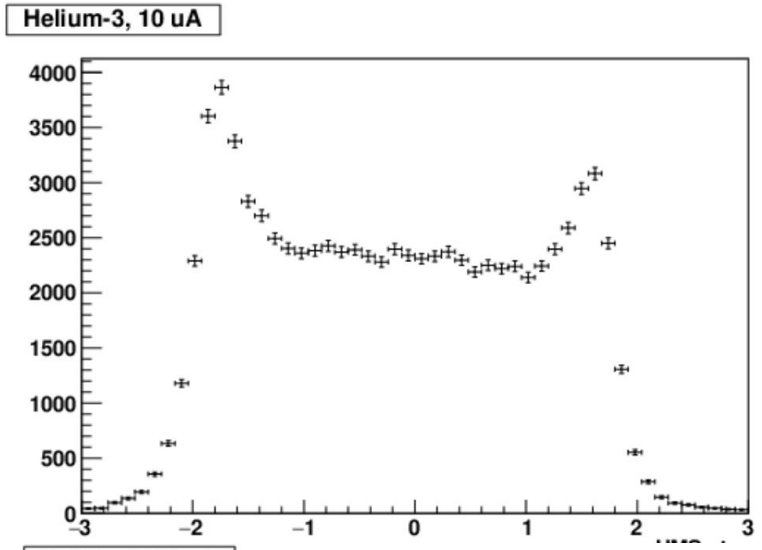


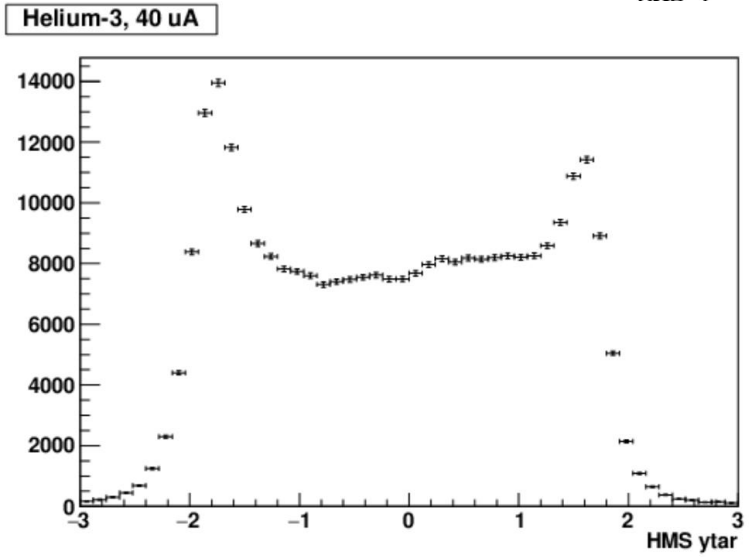
Online Studies – Luminosity (Cryogenic Boiling) & cryogen EOS

Should do a tracking analysis.
There is also ytar dependent boiling in thicker helium targets that needs accounted for



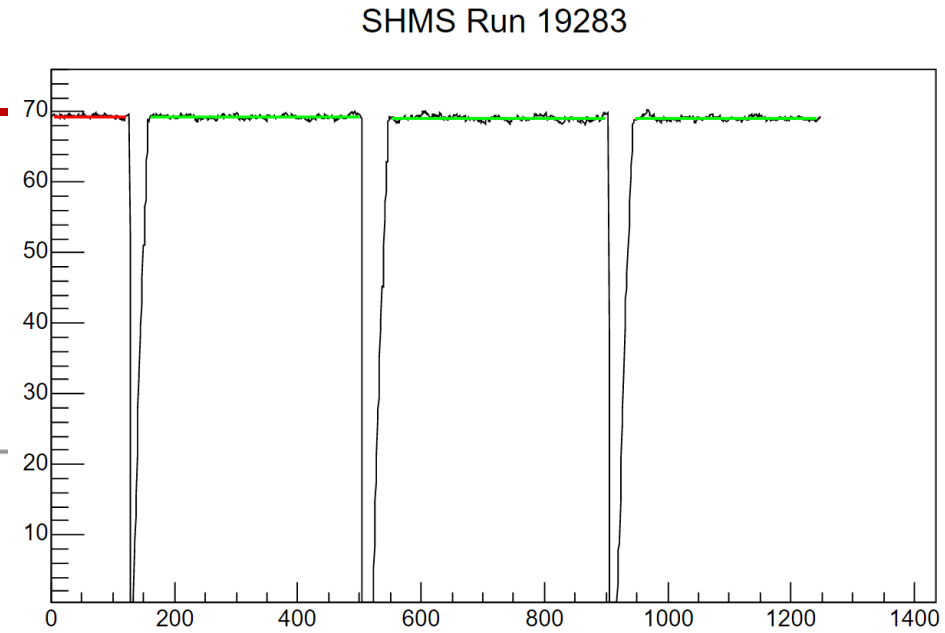
Thank you Silviu!

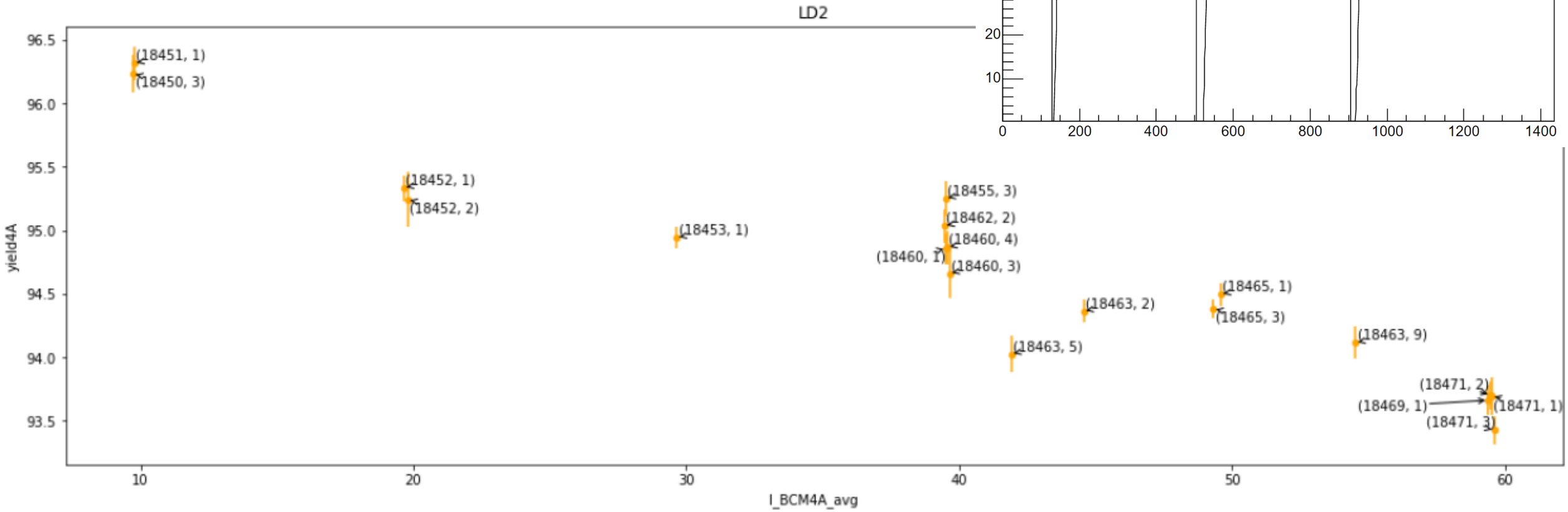




Online Studies – Luminosity (Cryogenic Boiling)

What if we split up the beam ON and beam OFF times and gave a buffer on either end, so the target is in a ‘steady state’?

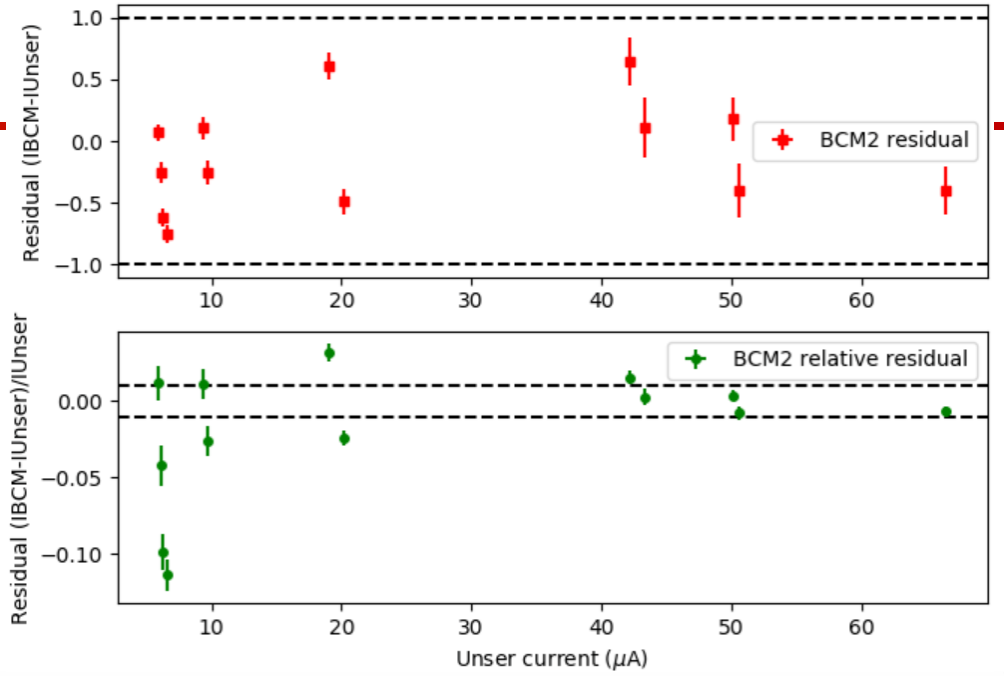


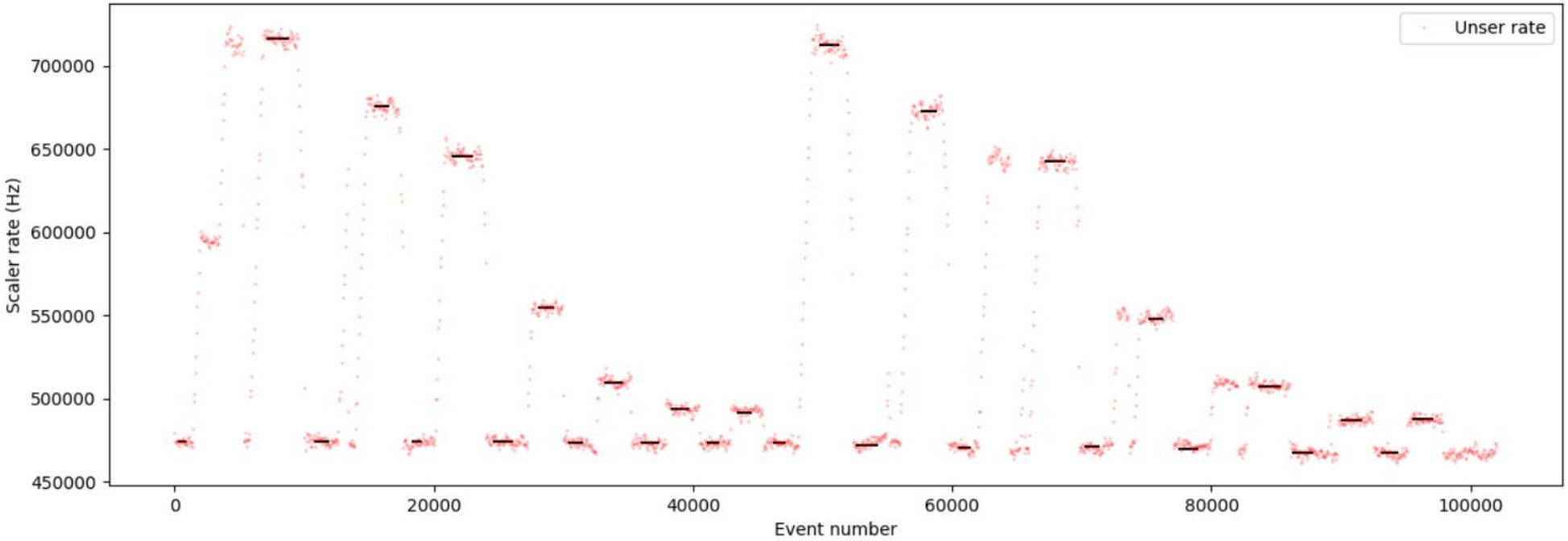


Online Studies – BCM stability / BCM scans

BCM calibrations performed with quite stable results

- Some discrepancy at low currents compared to Unser as expected.
- Active temperature loop went out for a portion of the run. We have redundant BCMs and they are stable over longer periods.
- Should check that MCC is taking the beam completely away when doing a BCM scan

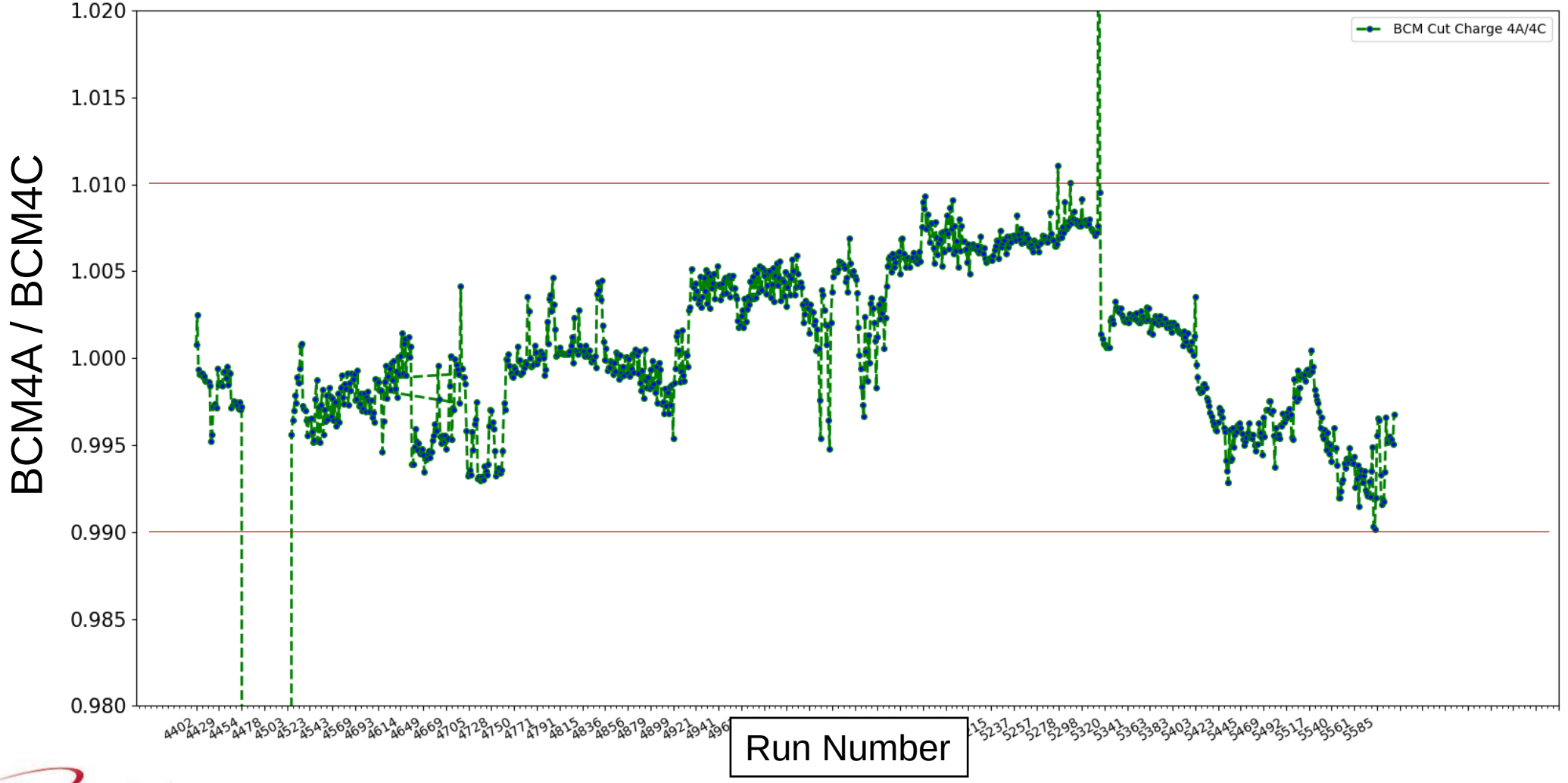




Online Studies – BCM stability / BCM scans

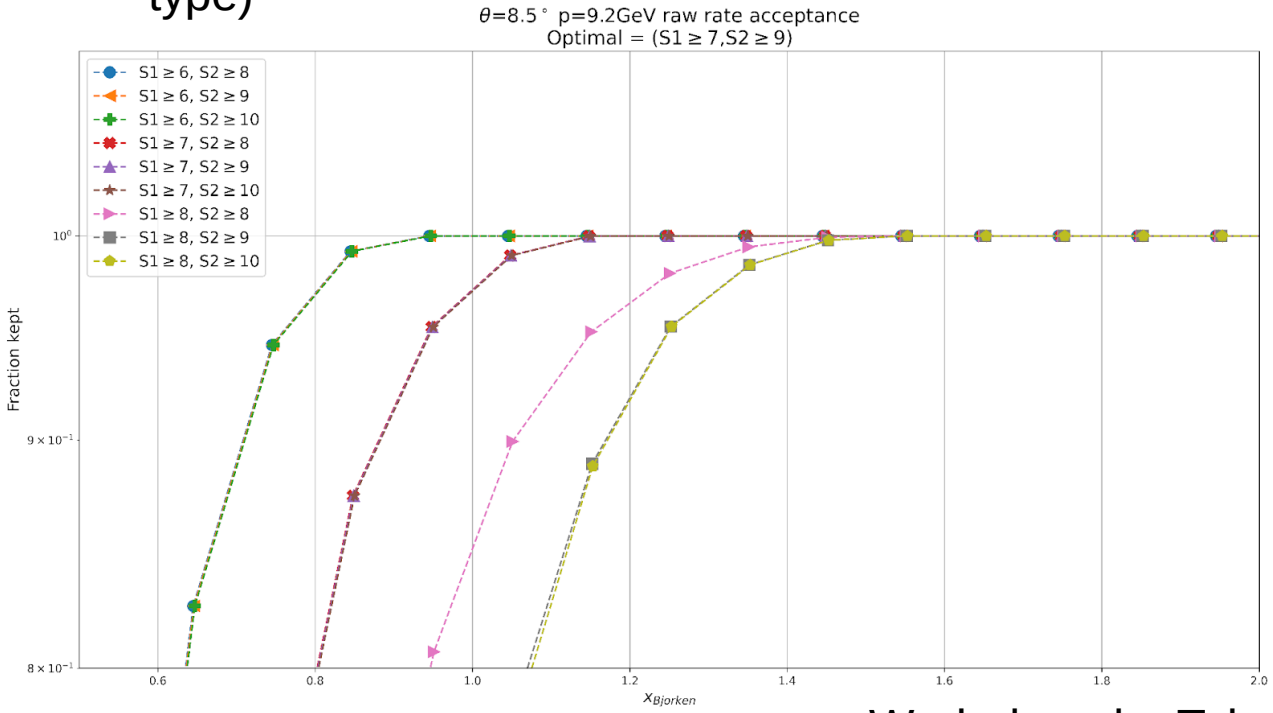
BCMs are quite stable over long periods.

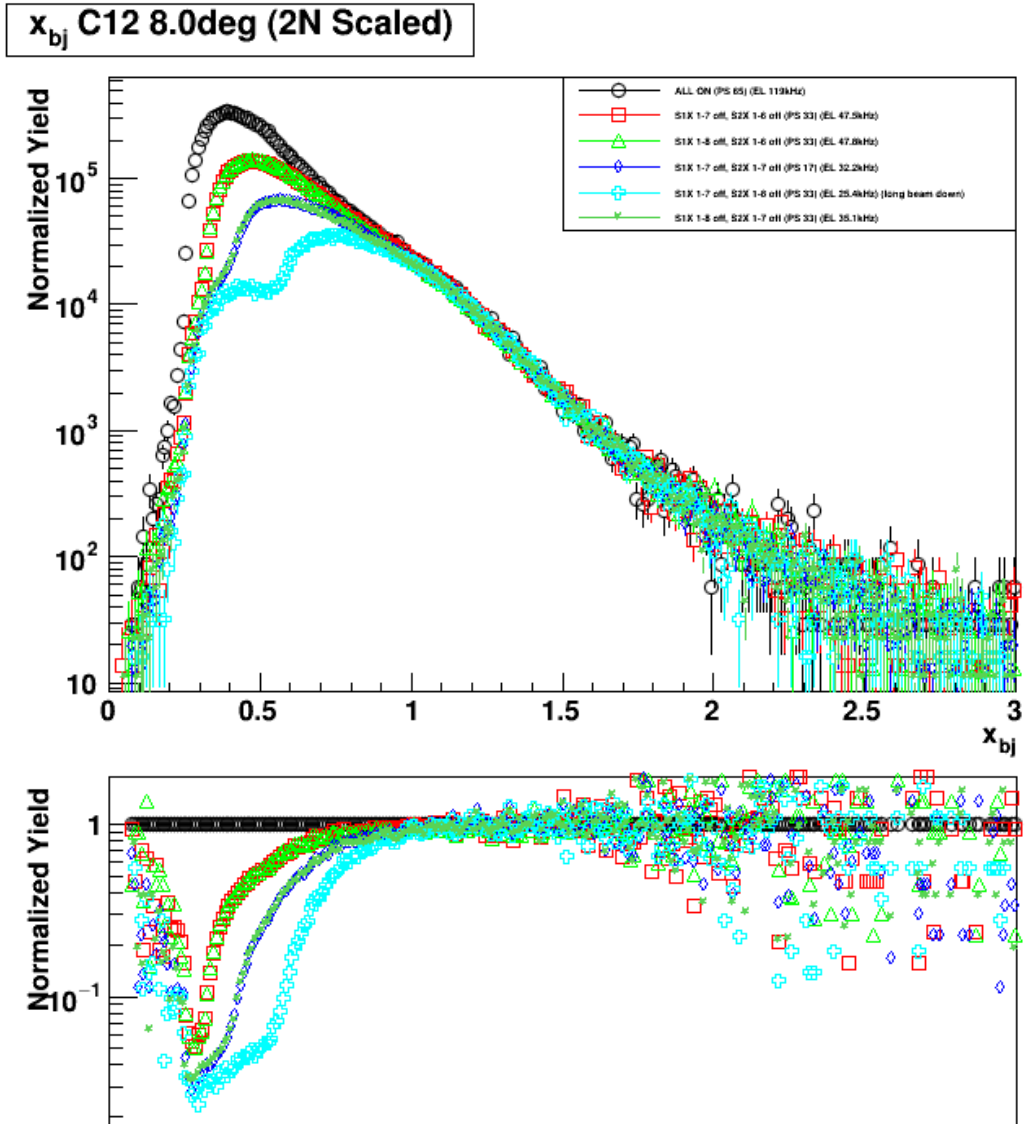
Plot provided by Abhyuday Sharda



Online Studies – DAQ Rate / Paddle Studies

- It was critical to reduce DIS rate by turning off paddles.
- Paddle study ensured no differences in cross-section of interest as paddles were turned off.
- Pre-scaled rate was bumped up to 8kHz for the SHMS after studying it. (We only used one trigger type)

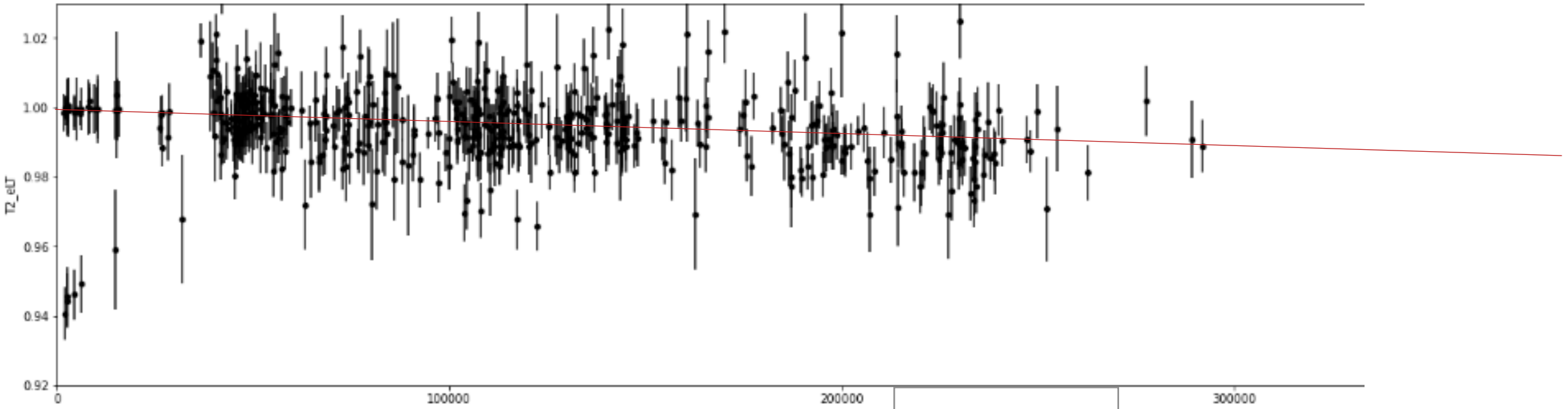




Work done by Tyler Hague

Online Studies – Electronic Live-Time

- First check of electronic live-time using EDTM (single trigger type)
- With the small gates and capping S1X (S2Y) rates to ~1MHz we see predictable electronic live-time.
- Lots of scatter. Need a tight current cut on both scaler (TS) and trigger (T) trees. With more time and effort this will be a global parameterization for electronic deadtime. (Won't need EDTM system for every run)



Summary & Outlook

- Rich physics program between experiments E12-06-105 and E12-10-008
  - 2N SRCs, EMC Effect, investigation of SRC-EMC correlation
  - Superfast quark distributions, high-x QCD moments, high-x nuclear structure function

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Post-Docs and Graduate Students

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Tyler Hague
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Shujie Li
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To be photographed:
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Sebastian M - SMU

Thank You!