Onsite report, cryo-week #11 (June 27 - July 3)

Cheng-Wei Shih
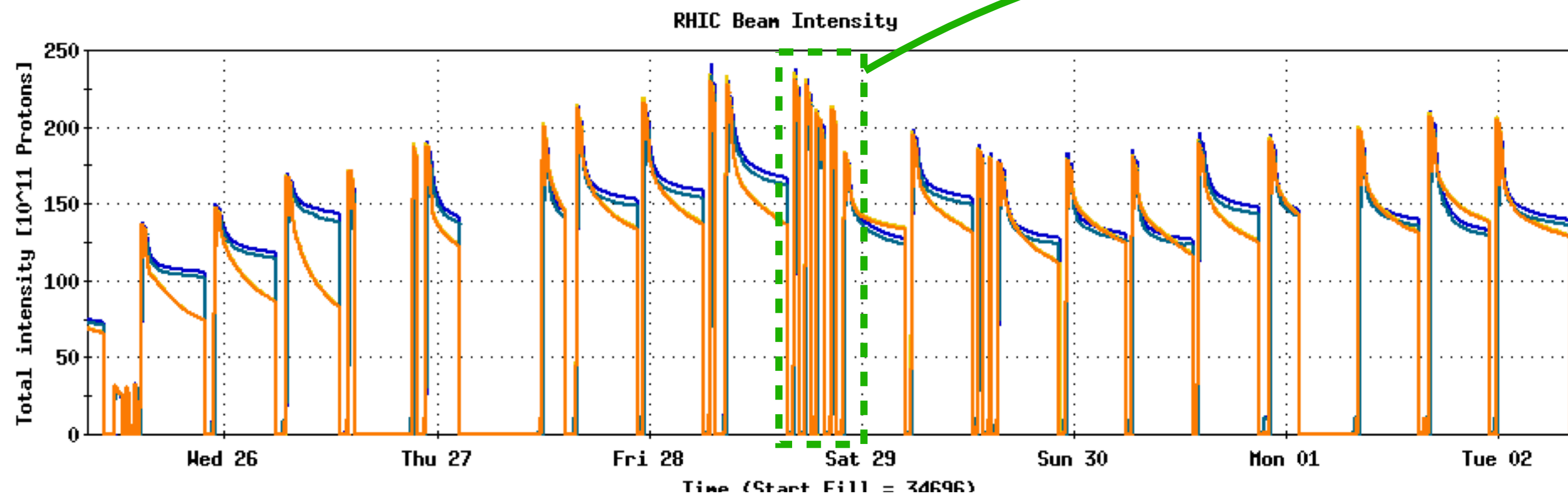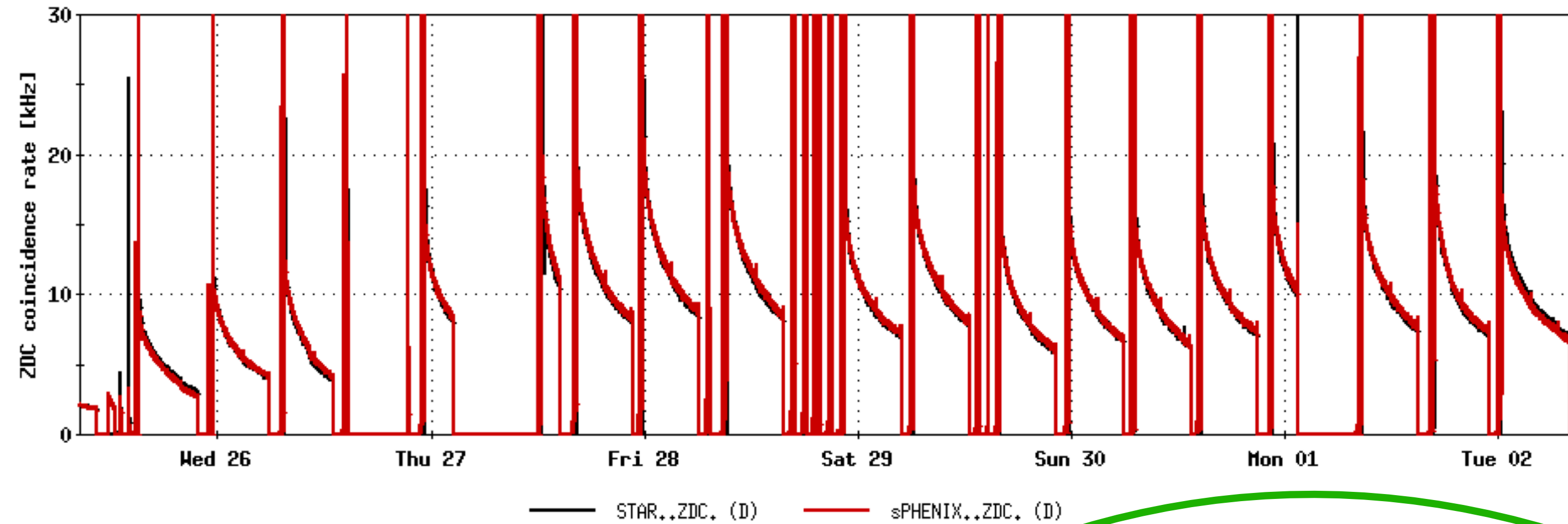
National Central University & RIKEN

sPHENIX
國立中央大學 National Central University
RIKEN

Overview of RHIC@IP8

sPHENIX

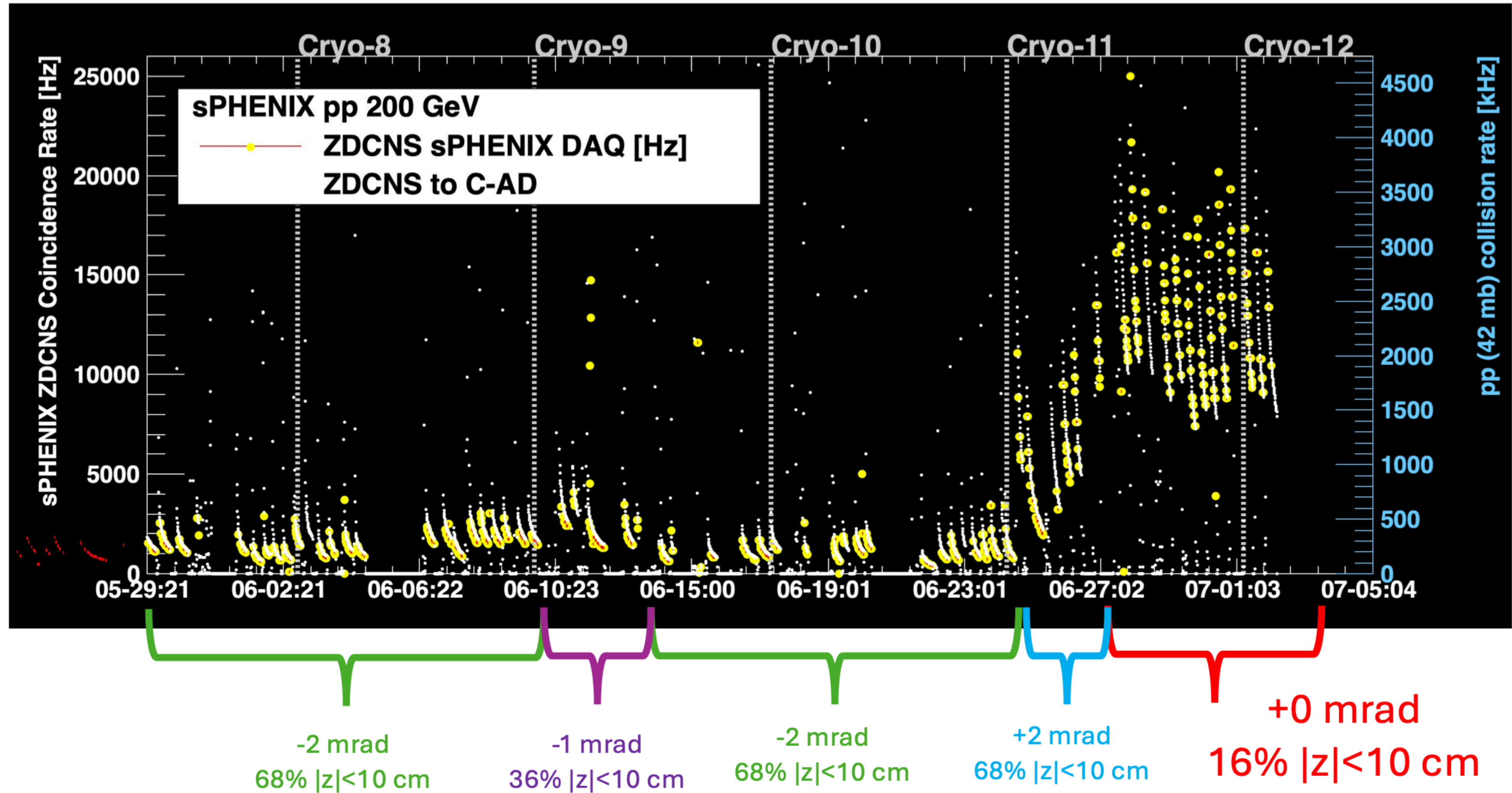- We have one dedicated run with zero-crossing for spin study (2024/6/30)

Try with higher beam intensity, not stable, move to lower intensity for the rest of the fills

Intensity up to 2.0e11 at store, currently operating with 1.7-1.8e11 at injection
very low beam background (different from what STAR sees, is it reasonable ?)
Zero crossing all the week

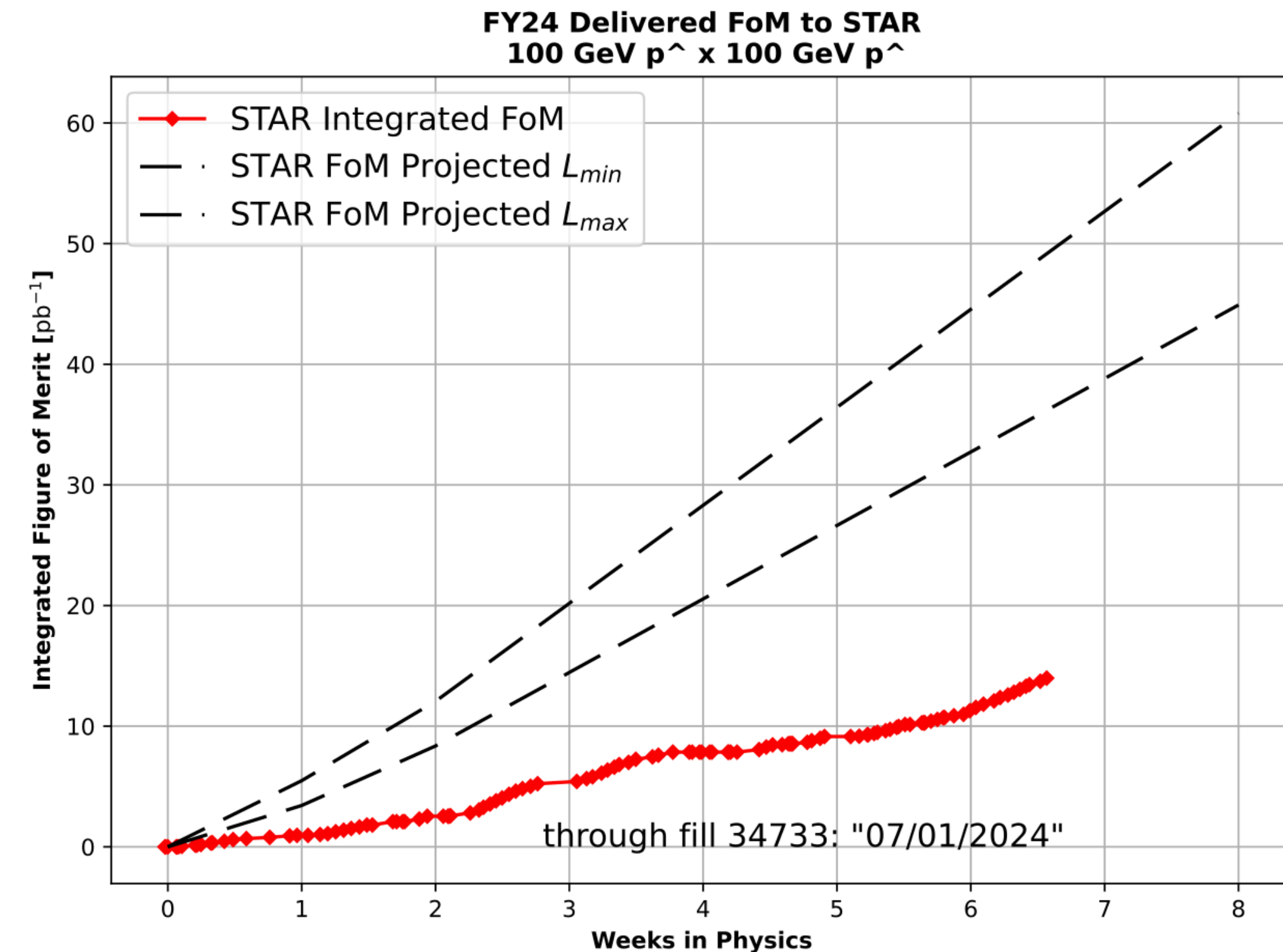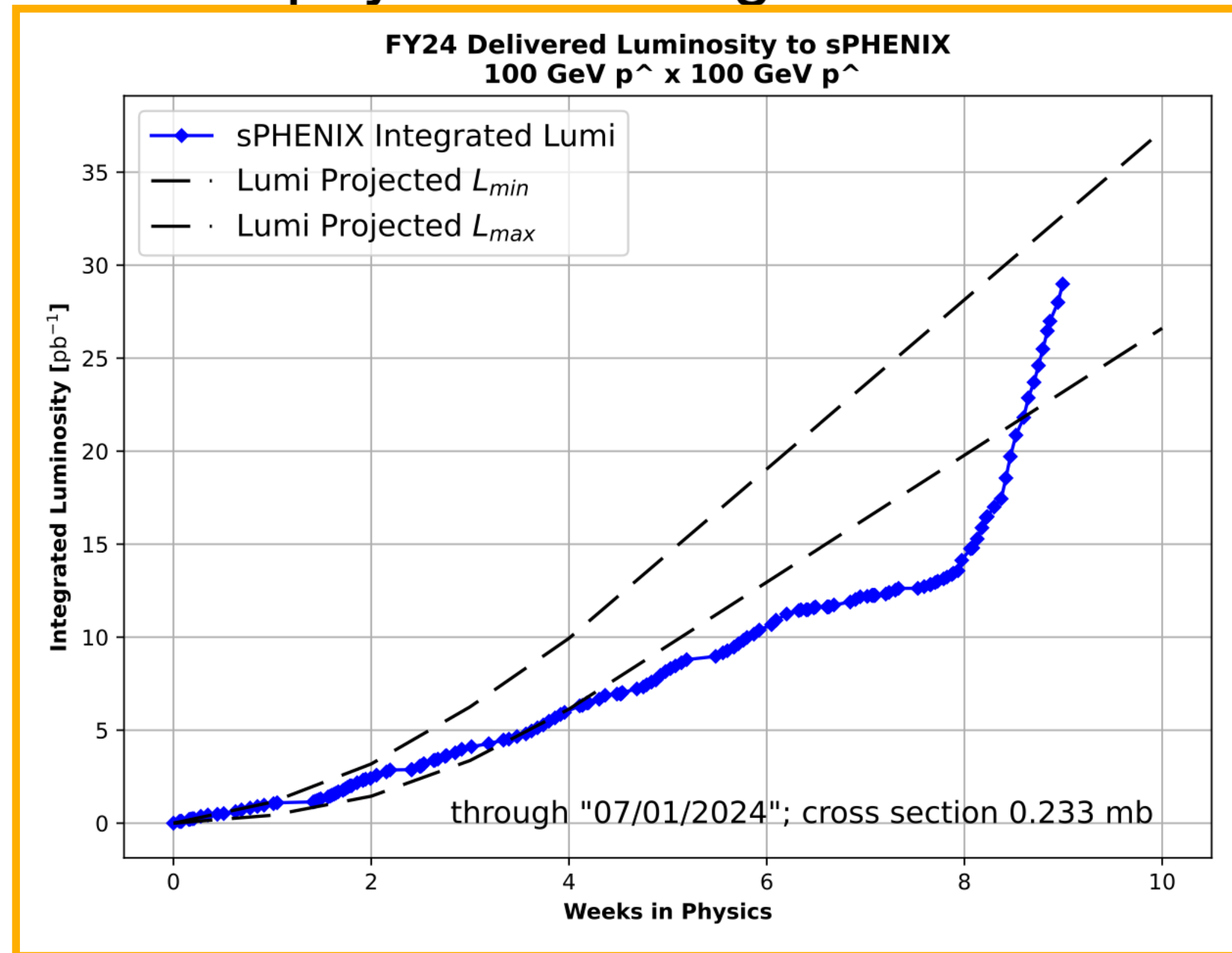## 111x111 physics running since 4/30. Preliminary luminosity accounting

RHIC delivered luminosity at IP8 back to the original estimation window, which is good. We might be able to have the accumulated luminosity 45 pb⁻¹ eventually, for part of the physics program
Remember, the boost is mostly because of the zero crossing angle (vertex Z width: ~ 60 cm)
Only ~14.6% (or even fewer) of events are within ±10 cm

STAR Delivered Luminosity
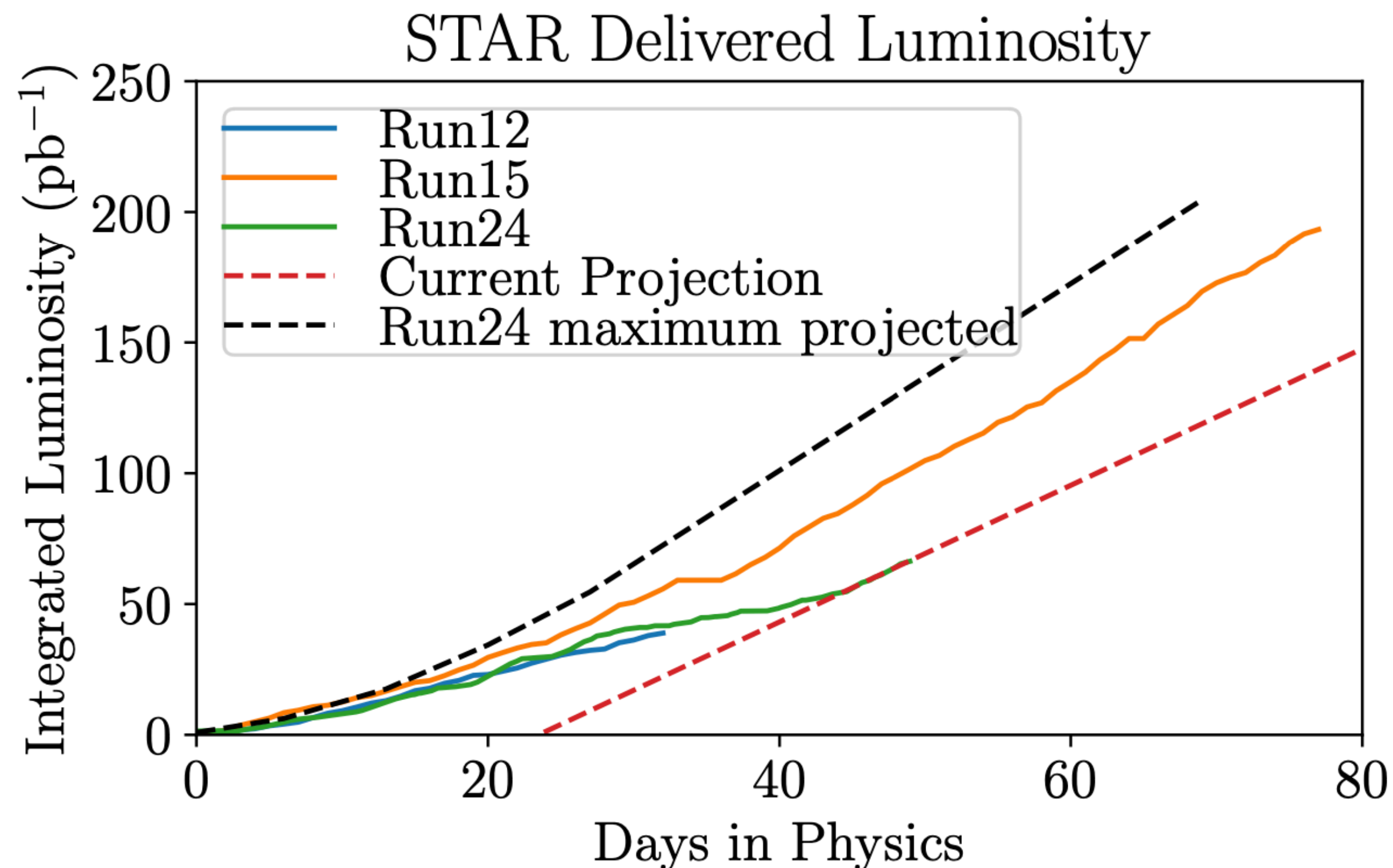
RHIC is touching their limit in delivering the luminosity!

But not enough to part of sPHENIX physics programs

- Current projection corresponds to 18.3 pb^{-1} delivered/week where $L_{max}, L_{min} =$ 25, 17.0 pb^{-1}/week

- Exceeding 18.3 pb^{-1}/week will require one IR operating with a crossing angle, beta-squeezing, or the implementation of Lumi sharing

sPHENIX plan

sPHENIX Plans

- Continue running at 0 crossing angle and integrating high statistics with photon/jet triggers.   Exciting part of sPHENIX physics program!

- Streaming readout with MVTX & INTT provides some tracking physics.

- Continue to improve data taking efficiency.

- In parallel, working to have TPC running with isobutane next week.

- Future options with regards to changing to crossing angle depends on next TPC working point evaluation.

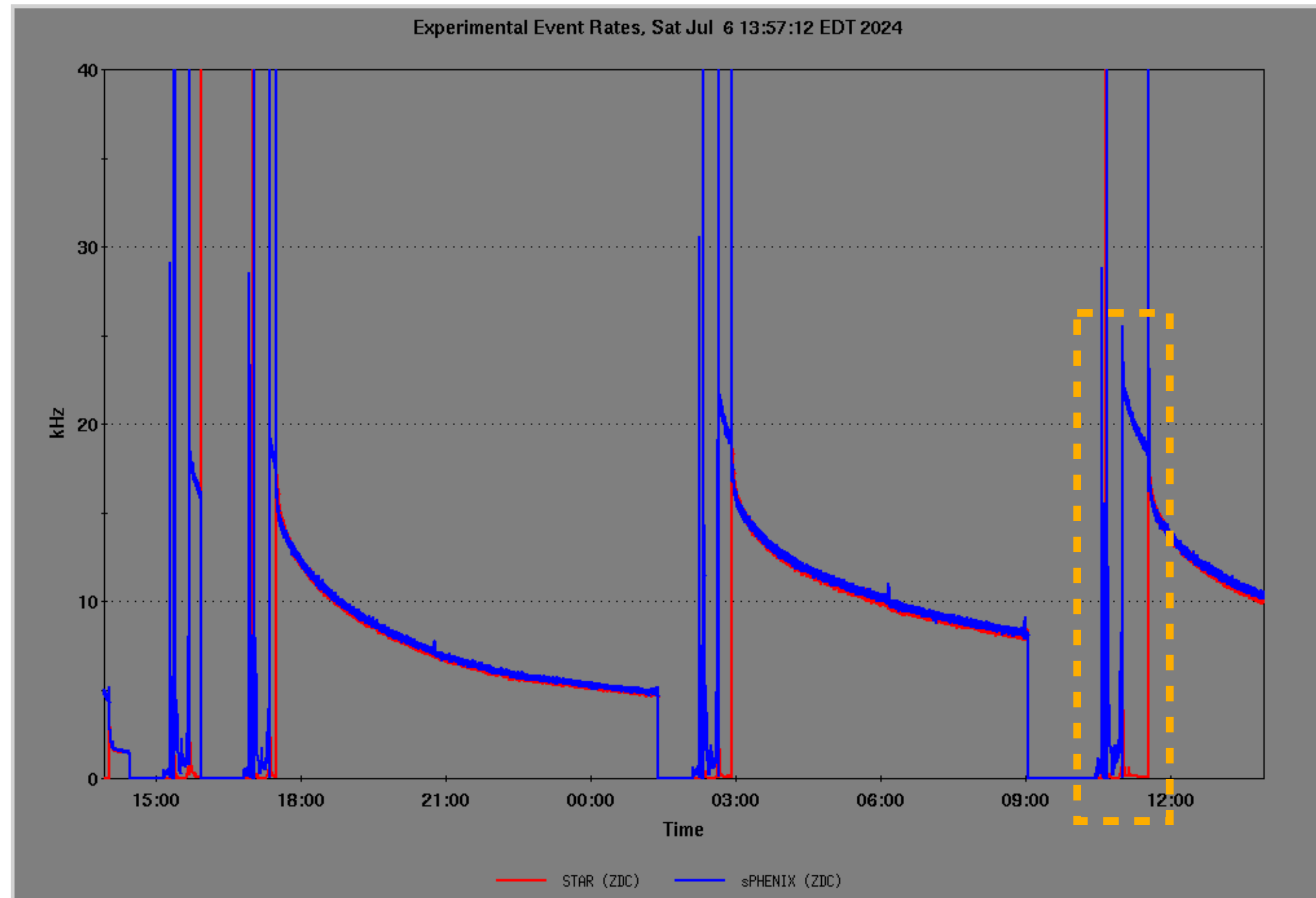7/2/24   sPHENIX 2024   122

- There is a plan from CAD to do one more vernier scan with zero-crossing and current ZDC configuration (in favor of RHIC_+2 mrad)
  - Is it ok? and conflicts ?
  - It seems that we will run with 0 Xing for a while, should we propose to move the ZDC back ?

New trial studied by CAD

Trial starts from evening July 5

Experimental Event Rates, Sat Jul 6 13:57:12 EDT 2024

Try to increase the beam intensity while still holding the zero-crossing for both experiments
→ trade off: one has to start the collision later
RHIC can handle 1.74e11 with 0-Xing without any delay, for the beam intensity higher than that, one has to wait

July 8, 2024 III

Status and issues

- Physics ran with up to 2.1e11/bunch at physics
- 2x lost stores since Friday due to sector 10 lead flows (current driver card replaced last week, replaced a flow card and a cable on July 4th).
- AC watch: 1010A AC down (to be investigated), 1004A-PS AC unit has insufficient capacity (temporary unit to be put in place)
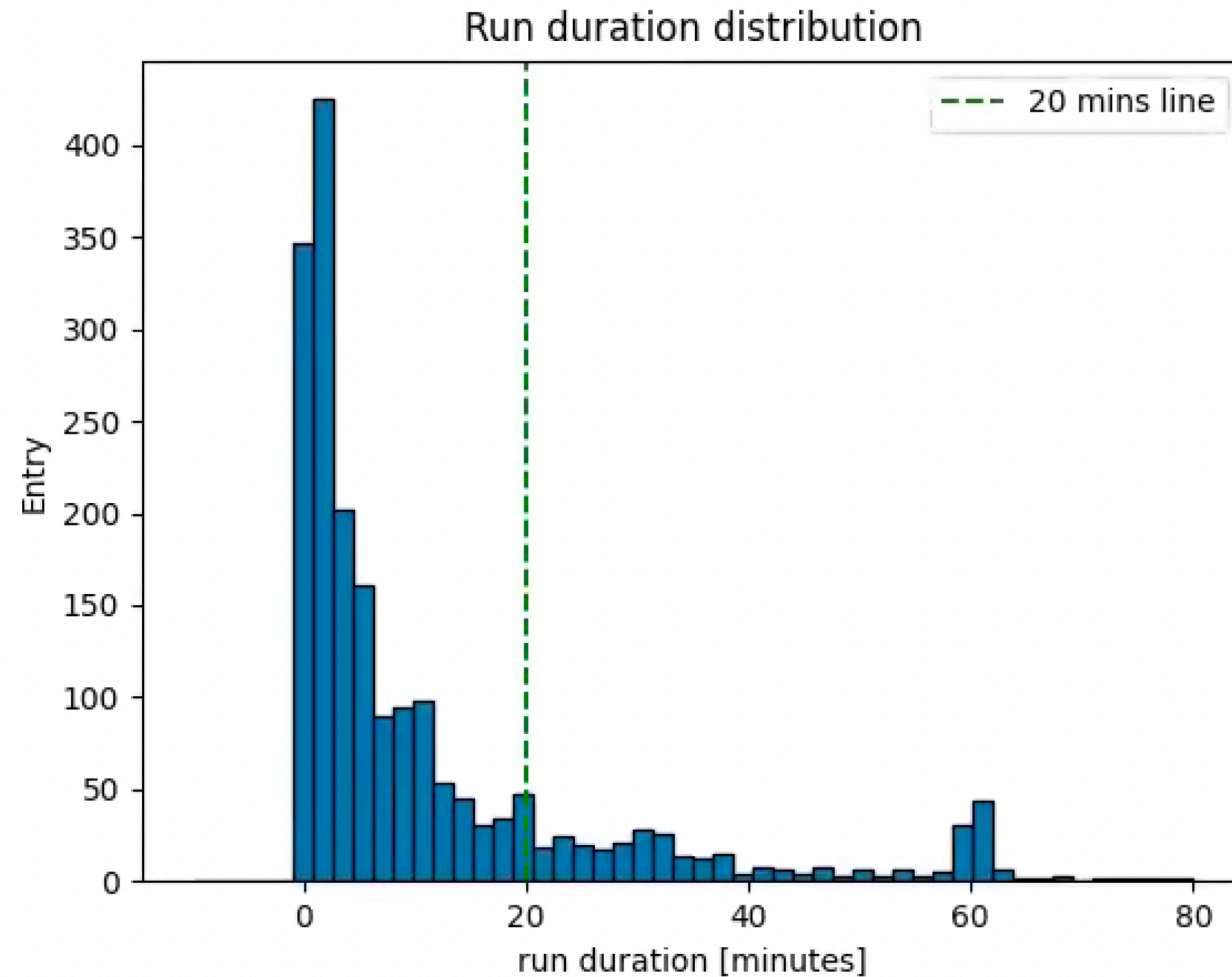
Plan for the day

- Physics

Updates

- Cryo on sector 10 lead flows
- AC
- STAR
- sPHENIX

Brookhaven
National Laboratory

One Vernier scan is planned this week (with zero-crossing)

Distribution of the run duration

- Requirements:
  - run_type = physics
  - run_number > 1
  - run_start_year = 2024
  - run_end_year = 2024

Run duration distribution

```
[ecie9969@sphnx04 spin_database_ana]$ clea
-bash: clea: command not found
[ecie9969@sphnx04 spin_database_ana]$ python3 run_duration_dist.py
total runs:  1970
runs greater than 10 mins:   642
runs greater than 15 mins:   466
runs greater than 20 mins:   366
```

Slide from Joe

- Momentum resolution can get us everything but upsilons
- However, need to be able to find the tracks…
- 4.3 kV seems to be the threshold for real operating conditions with nitrogen
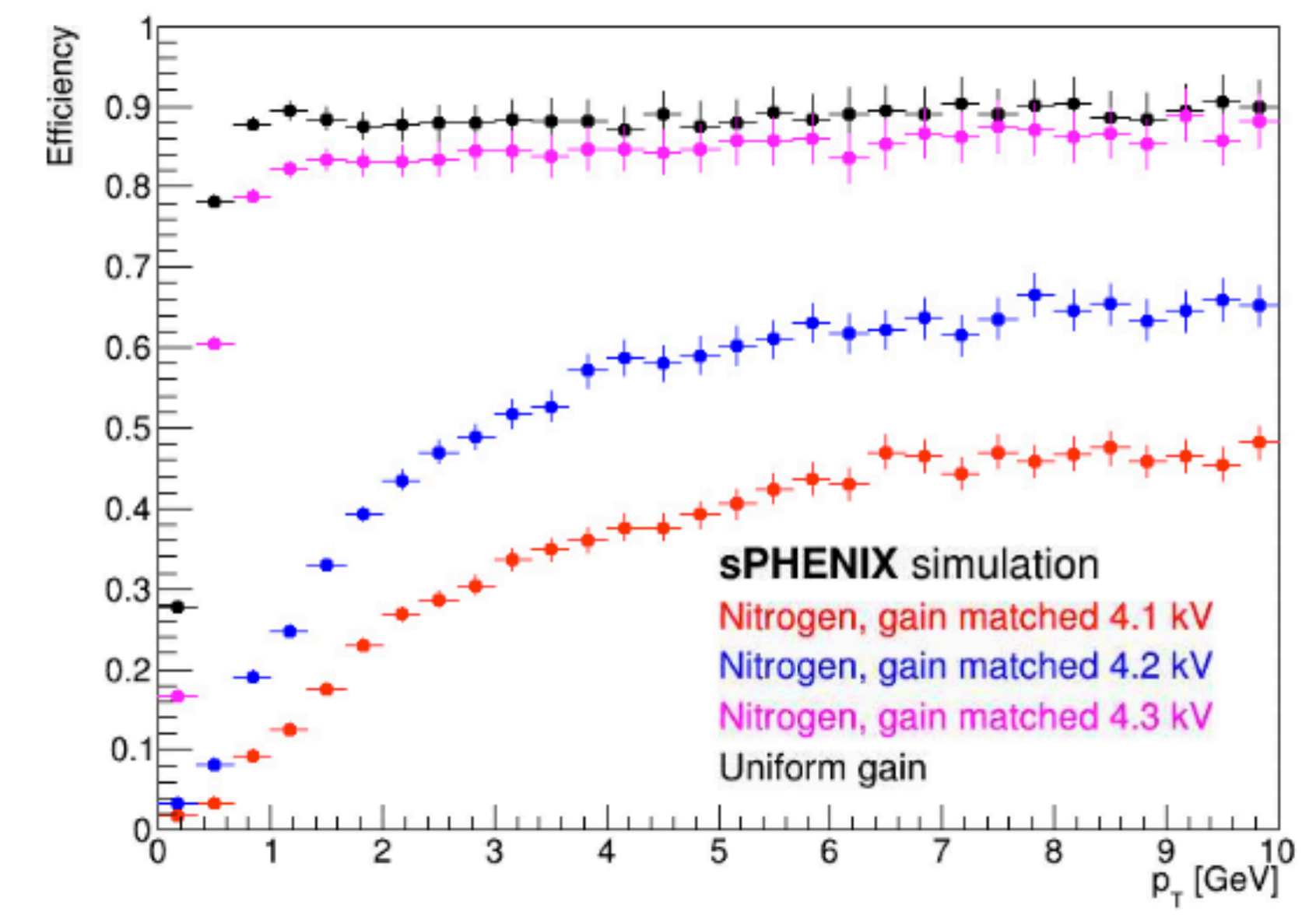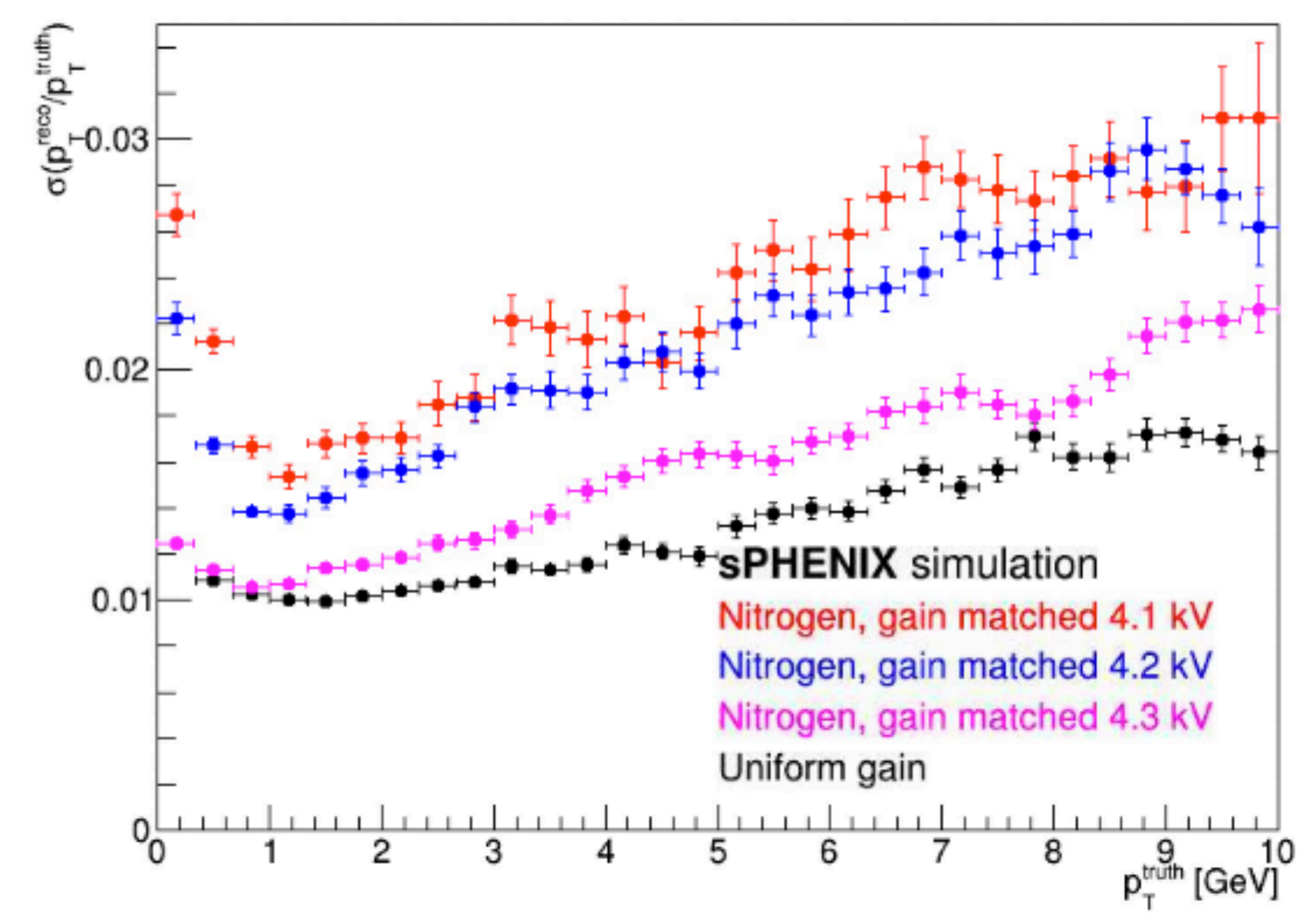
7

Devon Loomis (Michigan)

With the help of Nitrogen and operating with GEM HV 4.1 kV, the TPC performance is
not enough for physics (too low efficiency)

Means of Gaussian Fits for All Setting
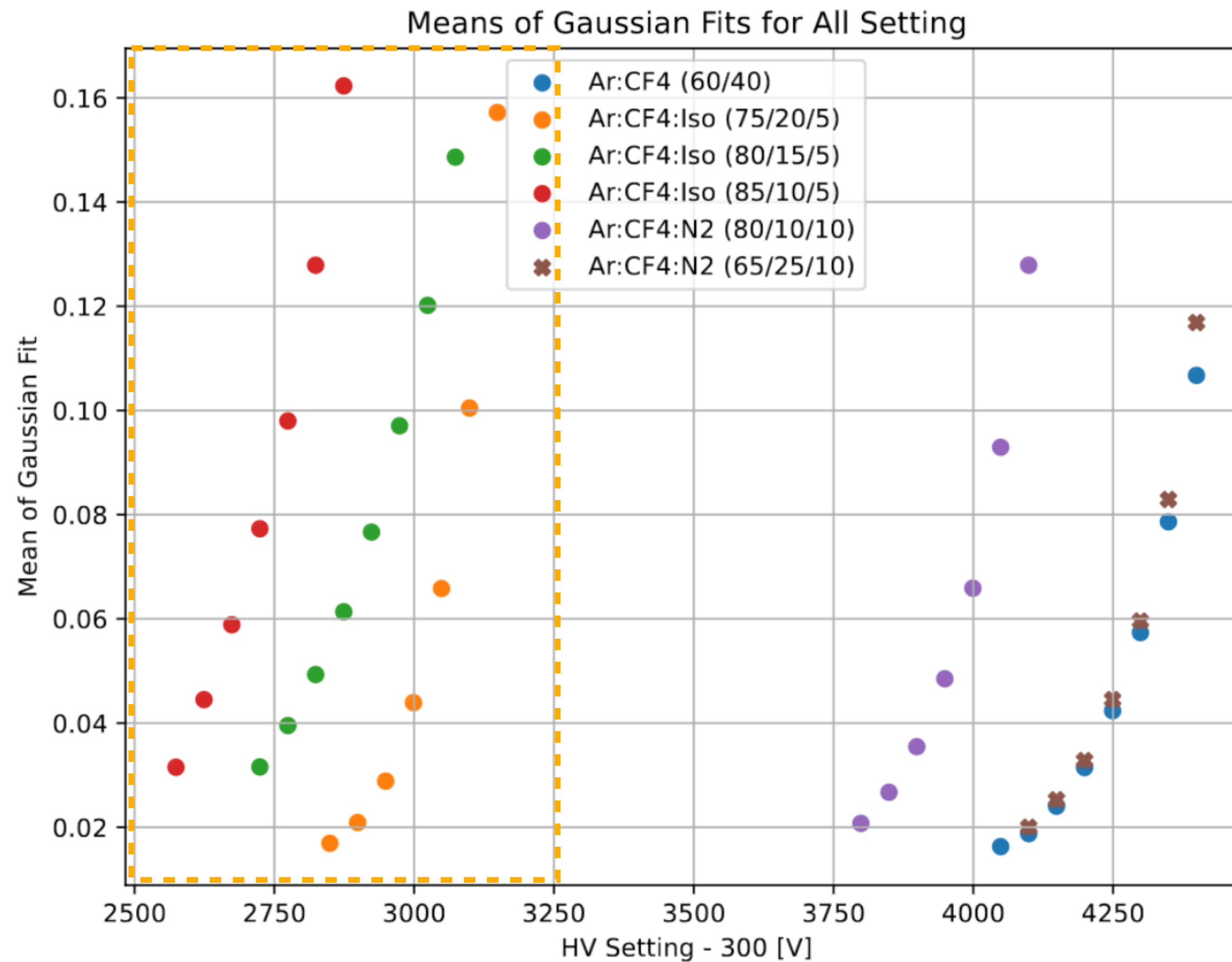
People is now putting the hope on the isobutane
The flammable gas which requires more paper work
Discussion/decision will be happened tomorrow.We may have chance to flow it into TPC late this week

- Integrate the PSQL DBs of **spinDB** and **daq**
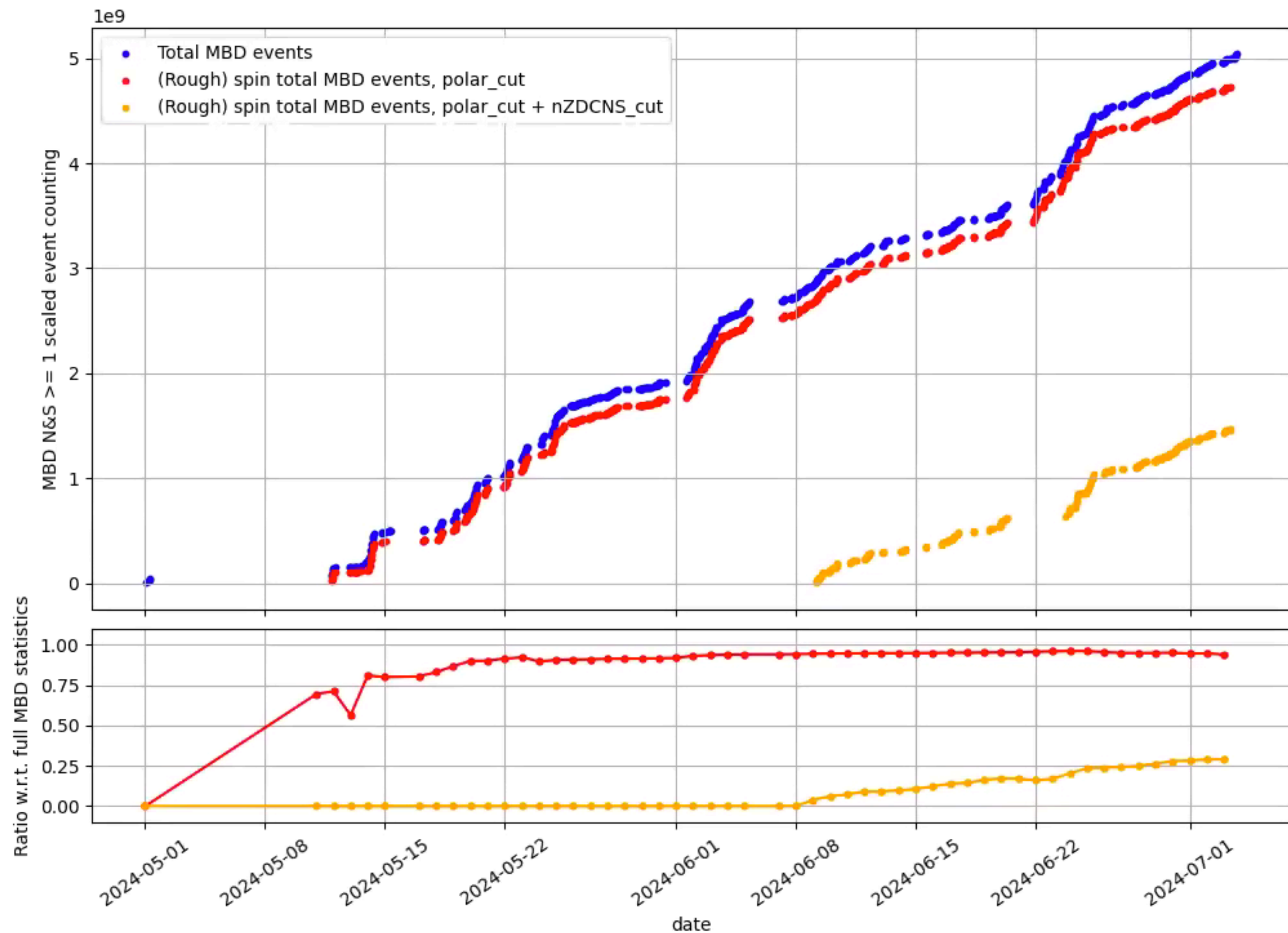
- Y axis : Scaled N event of MBD N&S >= 1
- Requirements (**all data points**):
  - run_type = physics
  - run_number > 1
  - run_start_year = 2024
  - run_end_year = 2024
  - run_duration > 10 mins

- Red additional requirements:
  - Fill_polarblue > 25%
  - Fill_polaryellow > 25%

- Orange additional requirements:
  - Fill_polarblue > 25%
  - Fill_polaryellow > 25%
  - Scaled_ZDCNS_Nevent > 500
  - GL1P available

Thanks Devon for maintaining the spinDB!

Interpretation: shows the fraction of the data that is useful to the spin physics program comparing to that of for the rest of physics programs

Accumulated N events

- Integrate the PSQL DBs of **spinDB** and **daq**

- Y axis : Scaled N event of MBD N&S >= 1
- Requirements (**all data points**):
  - run_type = physics
  - run_number > 1
  - run_start_year = 2024
  - run_end_year = 2024
  - run_duration > 10 mins

- Red additional requirements:
  - Fill_polarblue > 25%
  - Fill_polaryellow > 25%

- Orange additional requirements:
  - Fill_polarblue > 25%
  - Fill_polaryellow > 25%
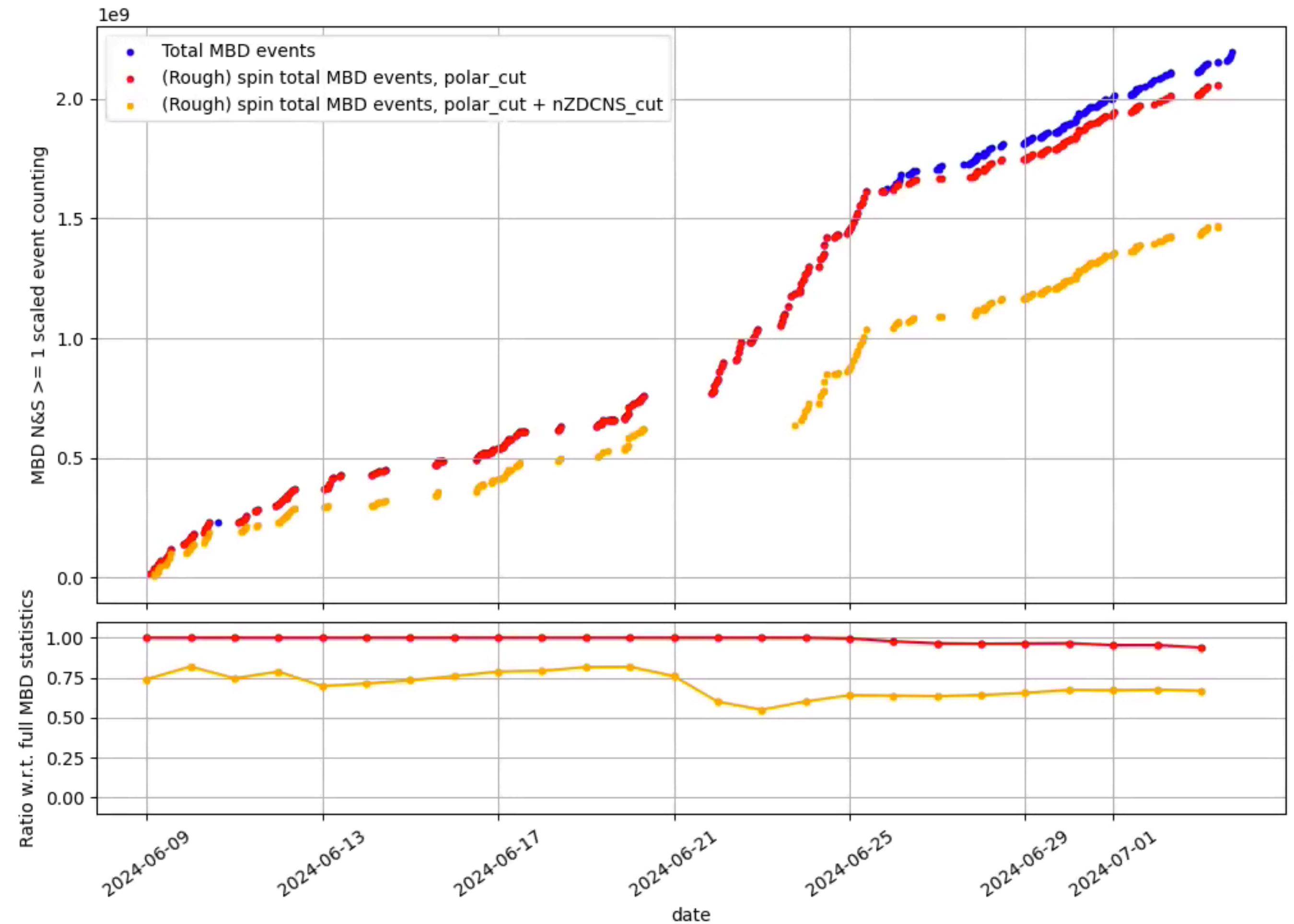 - Scaled_ZDCNS_Nevent > 500
  - GL1P available

Do the counting when GL1P is available

Stability monitoring: beam polarization

- Integrate the PSQL DBs of **spinDB** and **daq**

- Y axis : Beam polarization
- Requirements:
  - run_type = physics
  - run_number > 1
  - run_start_year = 2024
  - run_end_year = 2024
  - run_duration > 10 mins

Beam polarization vs. time
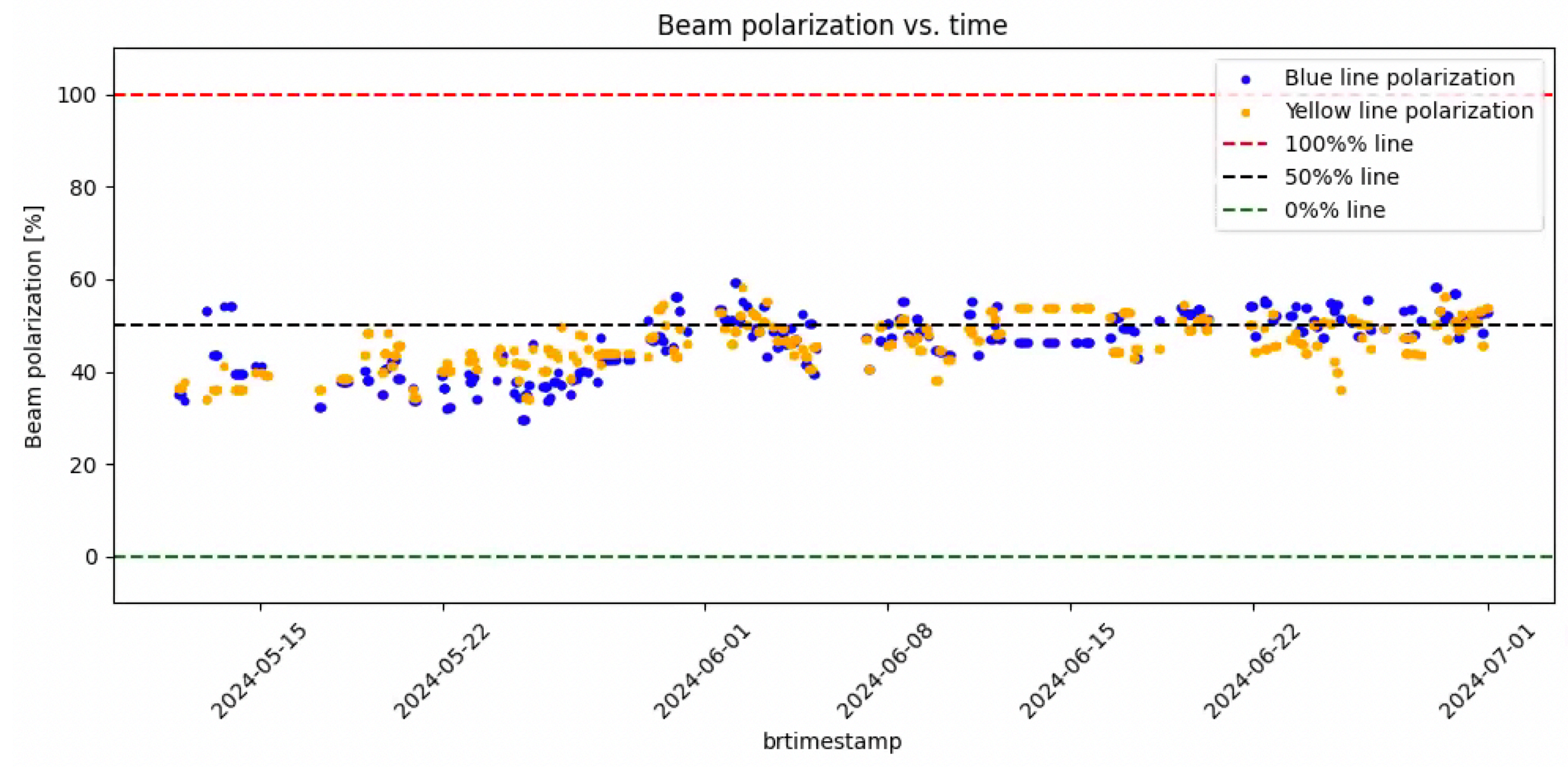
N ZDCNS triggered event

- Integrate the PSQL DBs of **spinDB** and **daq**

- Y axis : N ZDCNS triggered event
- Requirements (**all data points**):
  - run_type = physics
  - run_number > 1
  - run_start_year = 2024
  - run_end_year = 2024
  - run_duration > 10 mins

- Additional requirements:
  - Fill_polarblue > 25%
  - Fill_polaryellow > 25%

N ZDCNS event vs. runID
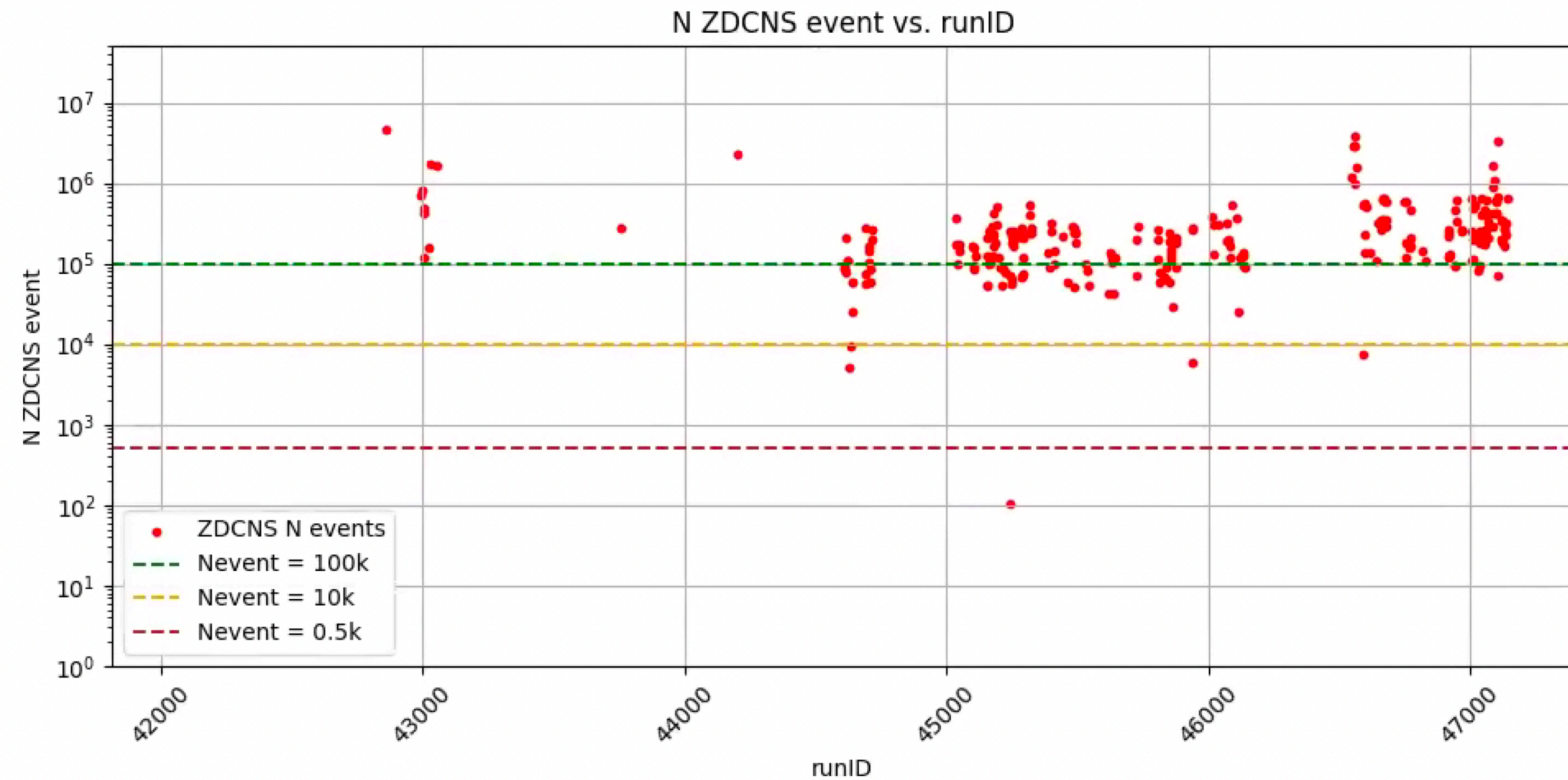
ZDC coincidence trigger rate

- From DAQ database
- Requirements:
  - run_type = physics
  - run_number > 1
  - run_start_year = 2024
  - run_end_year = 2024
  - run_duration > 10 mins
  - Scaled_ZDCNS_Nevent > 200

Talked to Jamie about the issue, default setting updated Now we can have ~ 330 Hz

Dedicated runs

Manual prescale setting

Automation prescale setting
But in general lower than 200 Hz

brtimestamp vs. ZDC scaled trigger rate
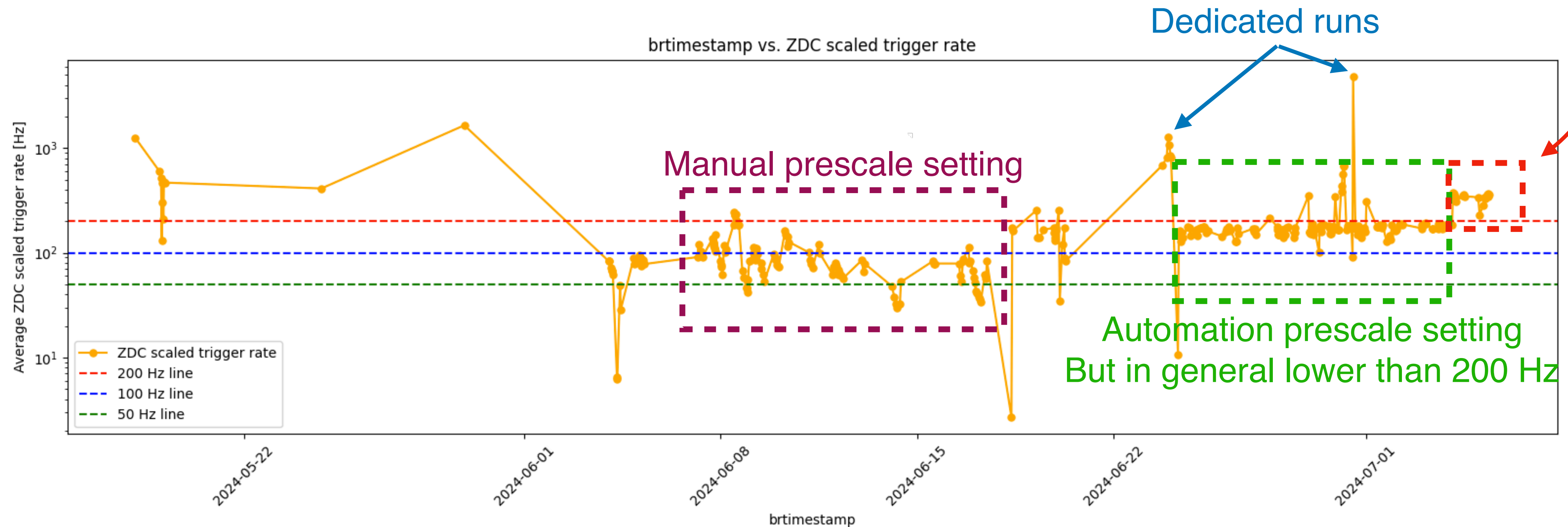
In-time pile-up?

People are working on increasing the beam intensity (over 2e11 per bunch, which is what Run15 achieved **in the test**)
→ in-time pile-up starts to happen more severely

From run2024 mattermost, July 7th, 2024

James Nagle 6:36 AM

That is okay - the ranges need adjusting for these very high luminosities where double collisions with a crossing play a larger role.
Great job by the Shift Crew getting this run started so efficiently 🥦

I guess in-time pile-up is not a good thing for cold-QCD program?
How to monitor multiple-vertices events? → Maybe sPHENIX has never thought about this…?
How to reject such events? → MVTX might have the capability to reconstruct multiple vertices, but within vertex Z ±10 cm,
and not to mention that MVTX is running in the full streaming readout mode with the strobe length of ~ 5 μm

Bunch quality stability ?

SPINMONDRAW_3 Run 47202, Time: Tue Jul 2 01:35:25 2024
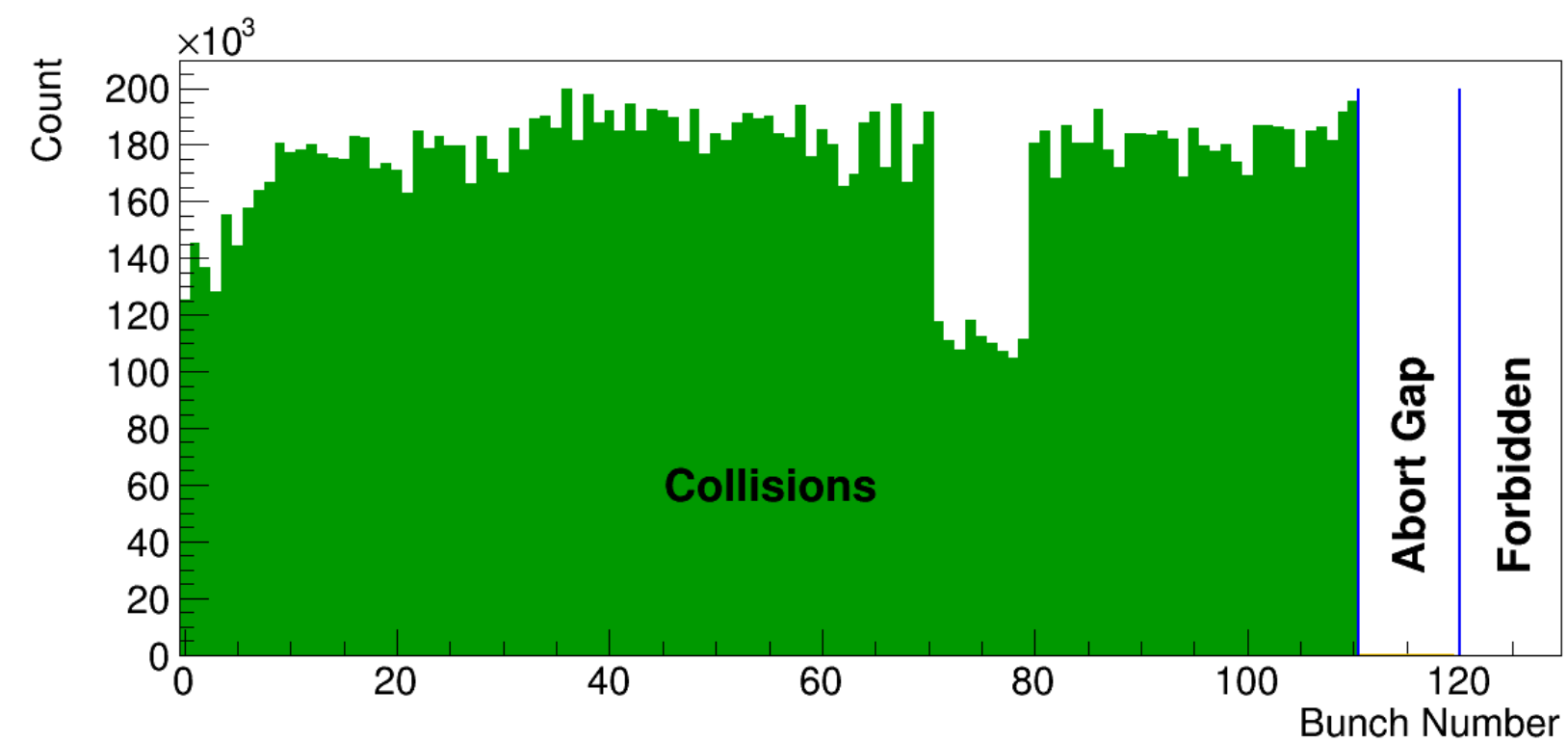
SPINMONDRAW_3 Run 47146, Time: Mon Jul 1 09:26:55 2024
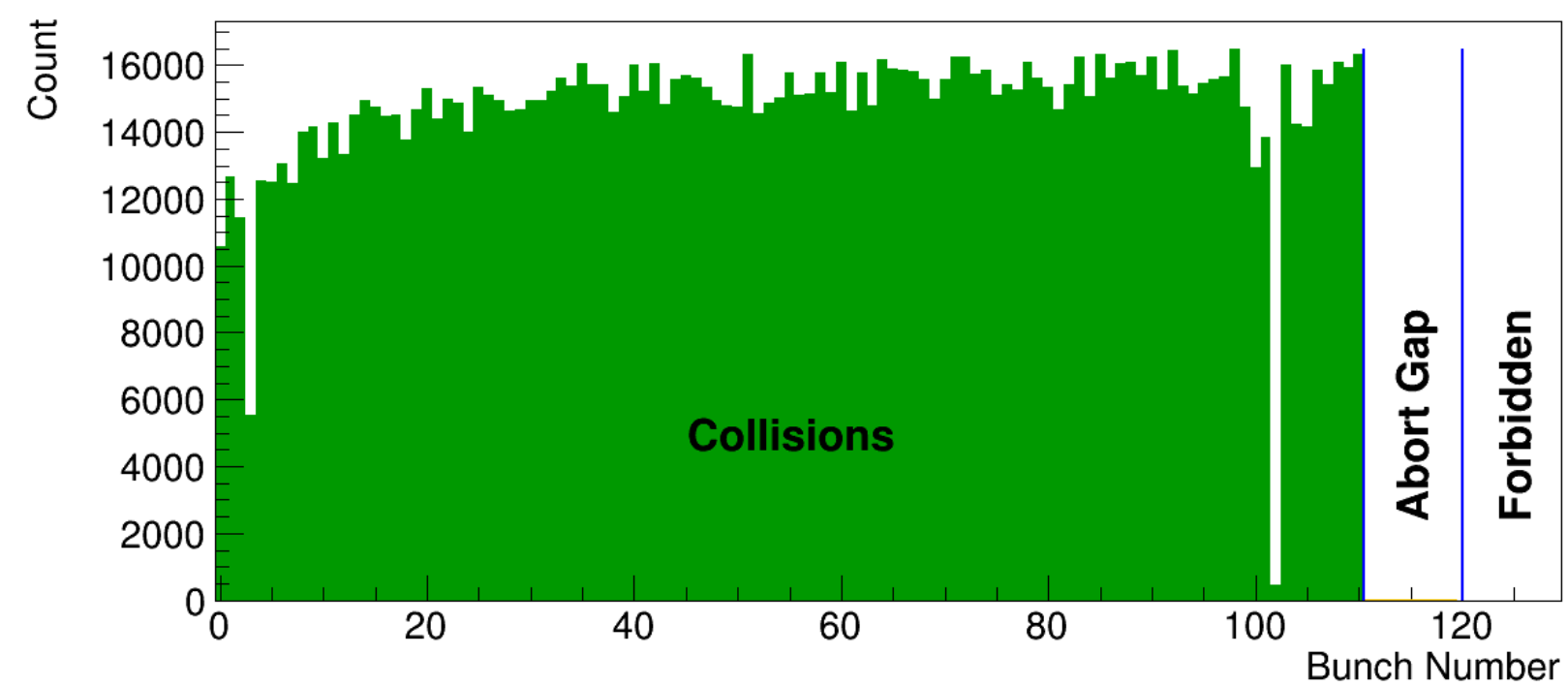
SPINMONDRAW_3 Run 47495, Time: Sat Jul 6 00:42:06 2024

Is it ok? may be just indicating that some bunches have lower beam intensity?

About moving the ZDC position

- Has informed Jamie about our demand, which is moving the ZDC back to center if sPHENIX still running with 0-Xing, the survey can be later

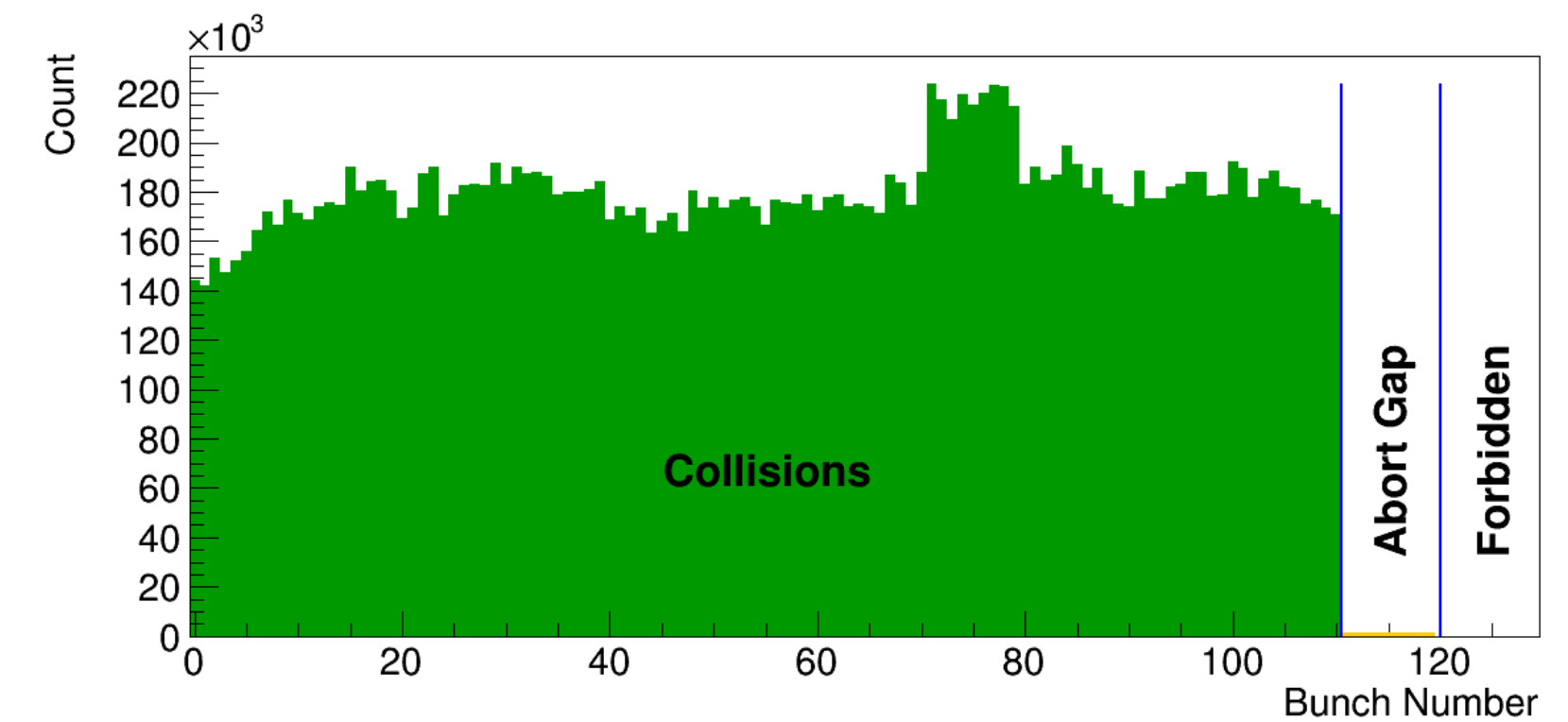- (Small) caveat: The RHIC tunnel is now in the level of ODH1 (used to be ODH0), which requires more training → will be back to ODH0 this week

- Was informed that John would start to look for technicians who can work on it → not yet received any update on this

- Have to keep in mind that we might move back to 2 mrad crossing in the coming future
  - Will be a problem (maybe?) If we can not make it to have survey before change back

The production QA

- As far as I know, the goal is just to know whether this is a good run to be used for the further spin analysis or not

- By doing so, we need to have some measured variables for the runs, and write them into the database, and then we can judge whether the runs are good or not based on some references

- The "references" are basically data-driven, they can be determined by the majority from the runs OR by some dedicated runs

- anything missing ?

The production QA plan 1

- Vincent has a nice framework which directly reads the ZDC .prdf file in the SDCC regardless the triggers of event
  - It's fast, takes 2 hour to handle a one-hour run
- (I think) it's kind of semi-offline, or entirely offline, which means we still have wait the file got transferred to the SDCC

- (promisingly) we can have some parameters be written into the spinDB
  - some variables we are interested in as to diagnose the run spin quality
  - spinDB, maintained by Devon. Devon has the C++ based code to be the interface with the PSQL DB

- Additional marco (C++/python) to make the stability plots (variables as a function of time), and to determine the categorization cut values and do the spin run QA by extracting the information from the spinDB

- Dedicated neutron selection can be studied and determined by Jaein

We plan to go with this approach

The production QA plan 1

- Pros:
  - It's fast by saying that we can have the infrastructure ready very soon
- Cons:
  - It starts from prdf file, not DST (or it's a pros?)
  - It might not be the direction what the sPHENIX collaboration would prefer to have

- Question:
  - Enough statistic to do the run-by-run study ?

We plan to go with this approach

Summary for sPHENIX

- sPHENIX is now accumulating the statistic of ~10 pb^{-1} for full Z and ~4 pb^{-1} for vertex Z ±10 cm. If sPHENIX continues running with zero-crossing, we might be able to preserve 45 pb^{-1} in run24 for the **calorimeters** (full Z acceptance)

- The decision of sPHENIX is most likely to be having the 2 mrad crossing back **only if** sPHENIX TPC is proved to be functional (with isobutane + zero-suppression)

- The current performance of TPC is not enough for physics

- CAD is trying to increase the beam intensity (> 1.8e11) with 0-Xing at both IPs, which requires the delay of collision at STAR. How much we should worry about the in-time pile-up?

Summary for spin program

- The drop of ZDC trigger events of some bunches seems to be possible. Not all the bunches have collisions in STAR, which means some of the bunches should have the intensity drop quicker

- The amount of statistic useful for spin analysis is ~25% out of the total statistic, and ~75% if the counting starts after having the GL1P

- Right now, we have ZDCNS coin. trigger with the rate of ~330 Hz

- We don't see the crossing dependency of asymmetry. More investigations and selection optimizations are needed

- We are working on the implementation of the infrastructure for the production QA / stability monitoring / performance study (The current scheme is kind of deviating from sPHENIX main stream)

- One request from Kin to present the asymmetry study with different crossing, and the reason/ motivation of changing the ZDC position in the operation board meeting on Friday

Back up

sPHENIX accumulated luminosity
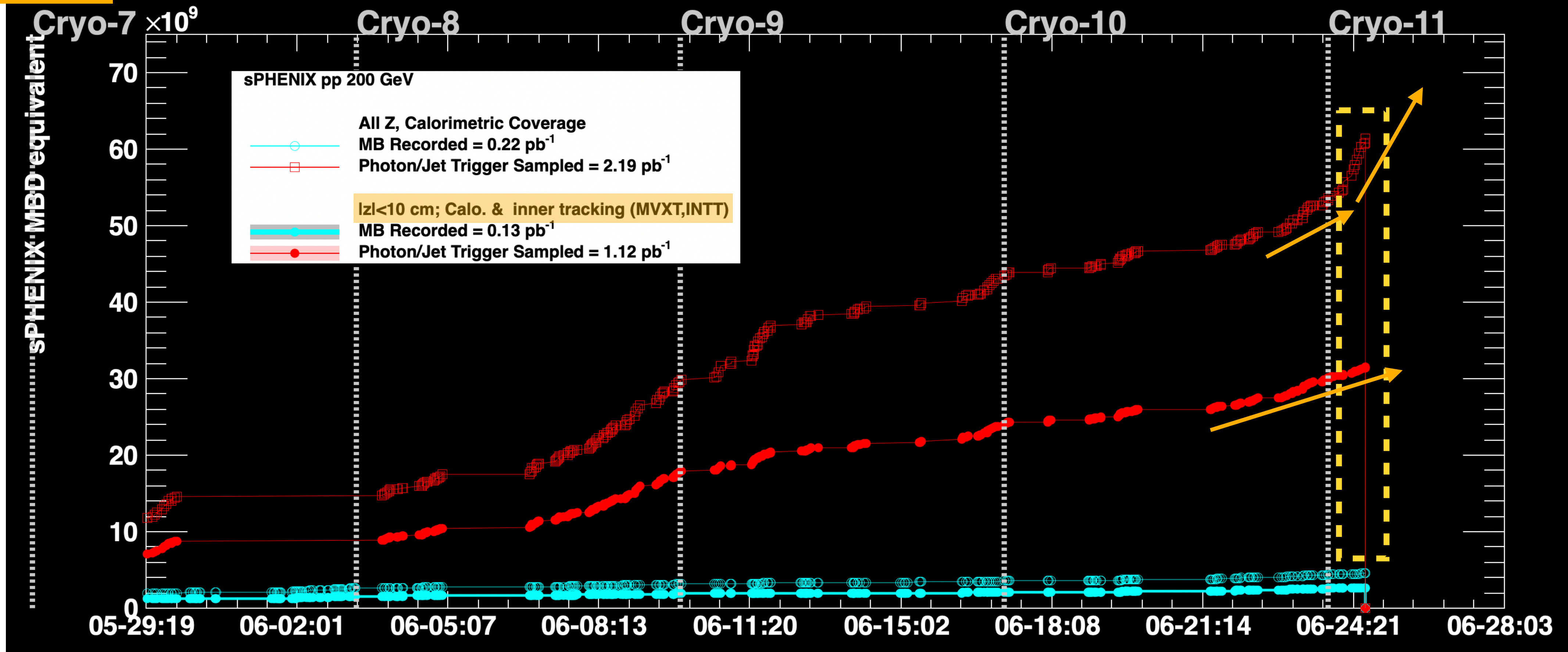
Plan was for ZDCNS 10k Hz w/ 65% in |z| < 10 cm. But running zero-crossing has us running near 10 kHz w/ 16% in |z| < 10 cm.

It enables some key parts of the sPHENIX program, and leaves others with a major loss of statistics (75% reduction in B-jets, jet frag. func., Upsilons). Still worth investigating options to recover some of this loss.

The production QA plan 2

- We also have a ZDC/SMD ntuplizer maintained by Devon and Jaein, and we also have the

- We can in principle have it in the production QA
  - It produces the QA plots from the website, meanwhile, it can generate the ntuple files we need
- We also have the analysis macros available which can handle the analysis after having the ntuple files
  - Need Devon's interface code to write the variables of interest into spinDB

- Pros:
  - running based on DST
  - Fits to sPHENIX anticipation
  - can merge runs
- Cons:
  - Takes longer time to have the DST ready (order of days, but should be minor)
  - the current production QA has the issue processing the full events of the run

The production QA plan 3

- Anything else that I didn't think about ?

Crossing dependency of asymmetry?

Cheng-Wei Shih (NCU, Taiwan)