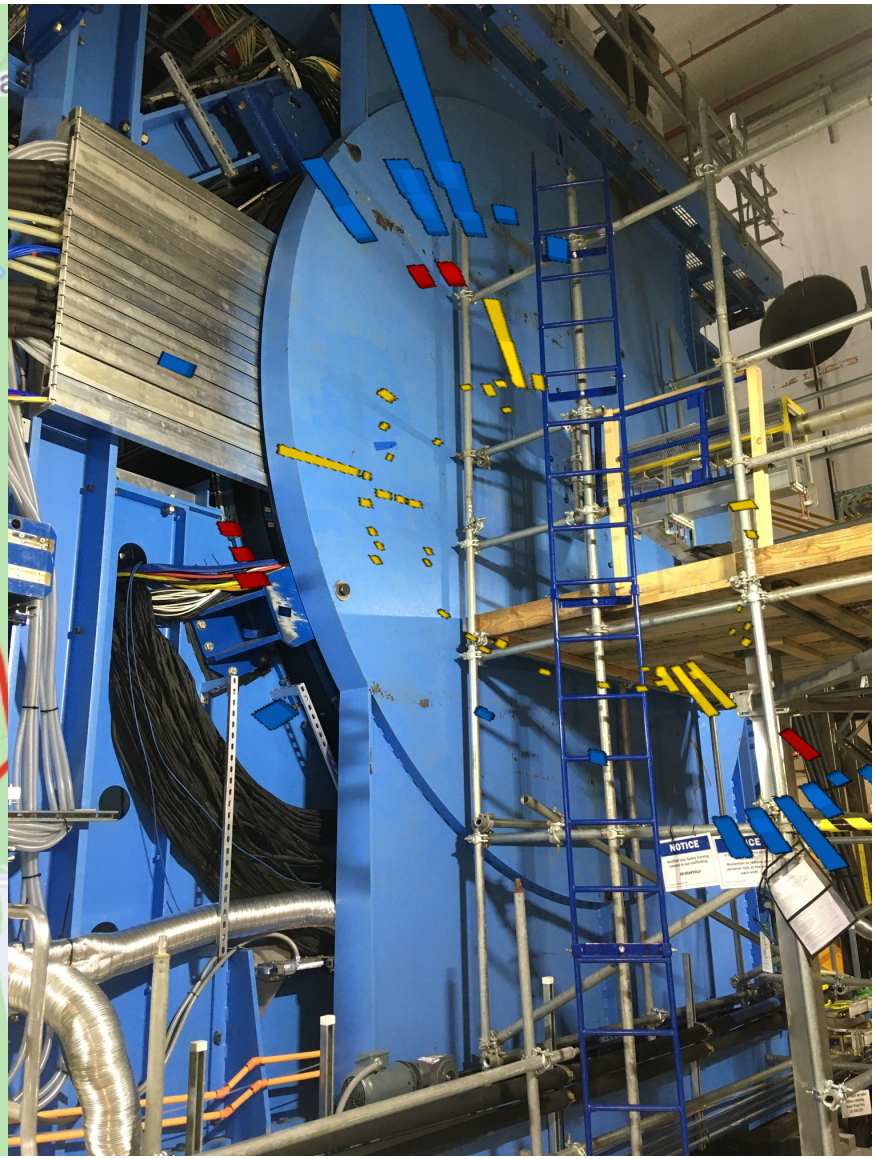
sPHENIX Status
RHIC Coordination Meeting
July 9, 2024

Jamie Nagle
University of Colorado Boulder
sPHENIX Run Coordinator



sPHENIX Collaboration

Highlighting early career collaborators

sPHENIX Hero: Samuel Liechty

How long have you been working in sPHENIX and at what institution?

I have been working in sPHENIX for just over a year now. I'm technically at CU Boulder, but the majority of this time has been spent on site at BNL.

What is the focus of your work on the sPHENIX experiment?

I mainly focus on debugging/optimizing the DAQ and trigger. The DAQ tends to meltdown any time I attempt analysis on any calorimeter data.

Where were you born and what is your educational background before your current position?

I was born in Ames, Iowa, then moved to Utah when I was 10. I studied astrophysics at BYU and then taught physics and math at a high school for a year before heading off to grad school.

What is the title of your Ph.D. or tentative title? Awards or biggest talk highlight?

I have no idea yet I imagine it will have to do with jet measurements, but I'm afraid I won't be able to write it on all the debugging techniques for the DAQ. Since joining sPHENIX I haven't had the opportunity to present anything, but before that I was able to present work at the Four Corners Meeting. That was on the variable star analyses I did in my undergrad.

How did you decide to go into heavy ion or spin research?

After finishing my undergrad I decided I'd like to move on to a field that's a little more hands-on. I saw that Jamie's group fit that need and that he had an interest in quark-gluon plasma, which scratched the astrophysics itch as well. Despite going completely over my head at the start I found the discussions in his group meetings fascinating and I wanted to learn more, so here I am! It's easy to get lost in the nitty gritty, but every once in a while I step back and realize that the physics we're doing is just plain ol' cool.

What do you like to do in your spare time?

When there's a climbing gym nearby I like to go rock climbing and bouldering. Outside of that I'm a bona fide nerd--lots of videogames and lots of Dungeons and Dragons.

sPHENIX Hero: Raul Guidolini Cecato

How long have you been working in sPHENIX and at what institution?

Since I joined BNL, in 2021.

What is the focus of your work on the sPHENIX experiment?

I work with the readout electronics of the INTT, notably the FELIX boards.

Where were you born and what is your educational background before your current position?

I was born in the State of Espirito Santo, in Brazil. I got a degree in Electrical Engineering from State University of Campinas, also in Brazil.

What is the most exciting work of your career so far?

I was fortunate enough to be in the Brazilian Light Source when they were putting together the brand new Sirius Synchrotron Light Source. It was quite inspiring to see people from such different backgrounds trying to build something so complex, and playing my tiny part in it as a RF intern (for 2 years working with LLRF firmware) was kind of awesome.

How did you decide to take the career path you are on?

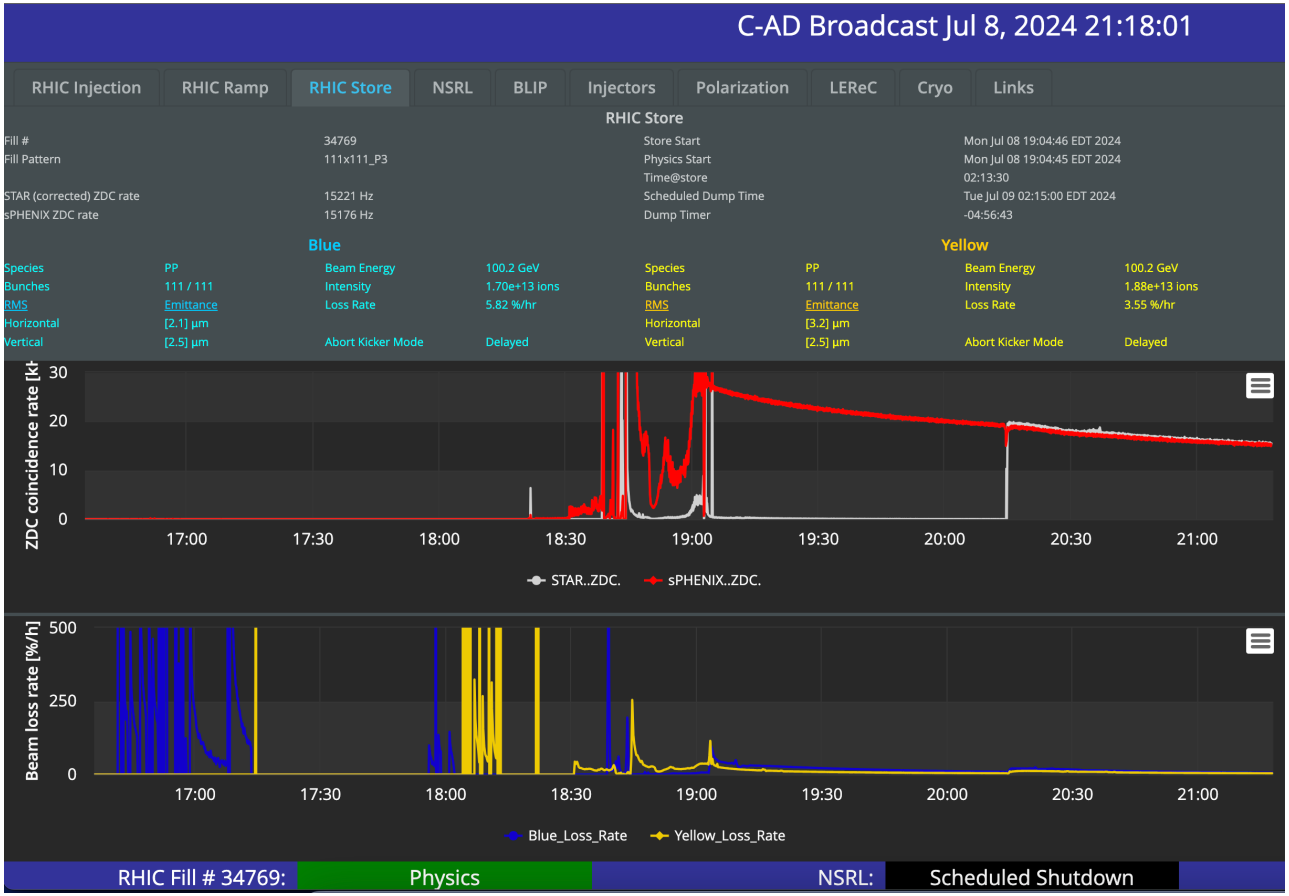
The high school I attended combined regular high school curriculum with a technical education, so I'm also a chemistry technician. After that, I knew I wanted to better understand how some gadgets we use daily worked. And maybe lasers. Can I change my answer to lasers? Anyway, at the time Electrical Engineering seemed like a good fit, and going to the Brazilian Light Source opened my eyes to the possibilities of the National Labs.

What do you like to do in your spare time?

It depends a lot on my mood, but drinking a beer, going to the beach and hiking are always strong choices for me. Living on Long Island also allowed me to take up kayaking, which is a good way to avoid those anoying ticks. Going to NYC's parks, museums and breweries once in a while, why not?

https://www.sphenix.bnl.gov/node/1751378401

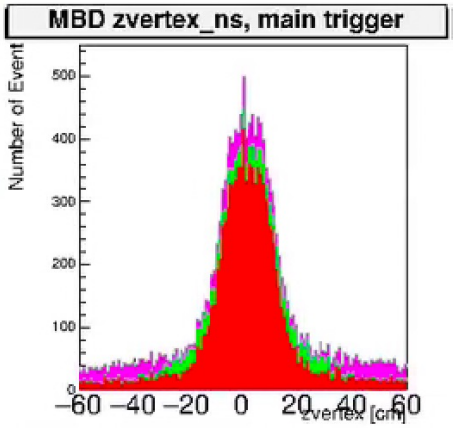
sPHENIX is feeling the love.... Best store this run...

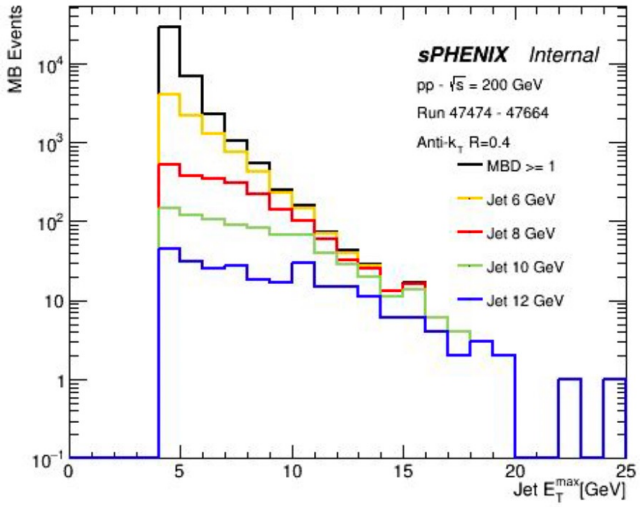


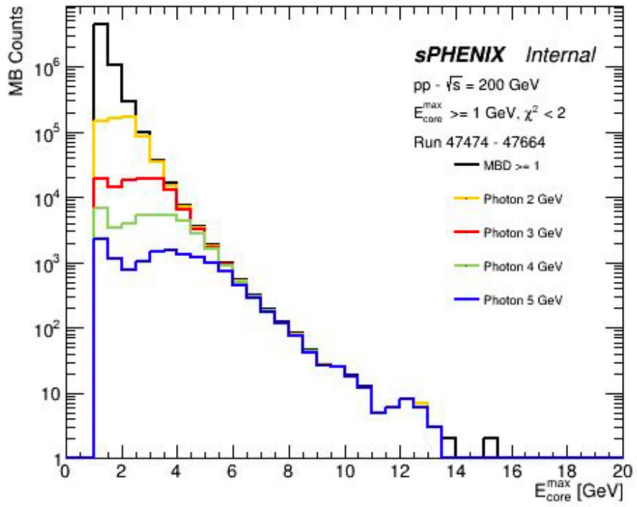
Notable Items

Sharpened trigger turn on curves.
Photon / Jet triggers continue to sample all luminosity and can handle much more.

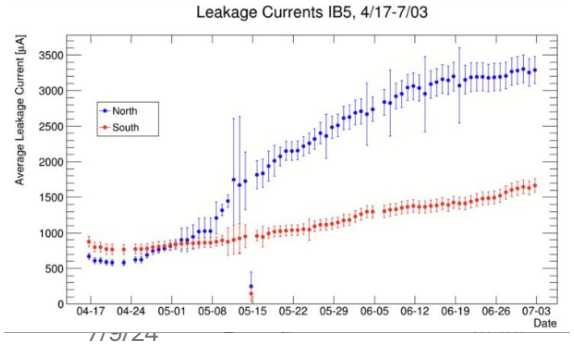
Min. Bias sample |z|< 10 cm

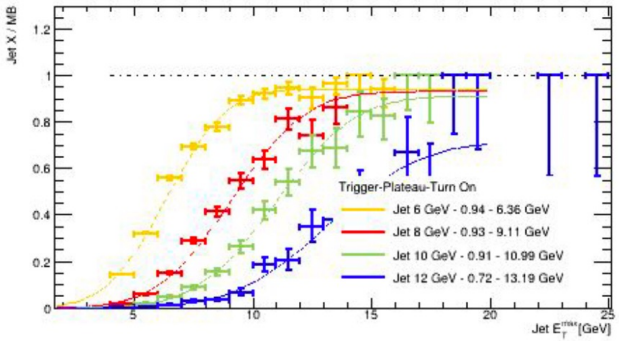


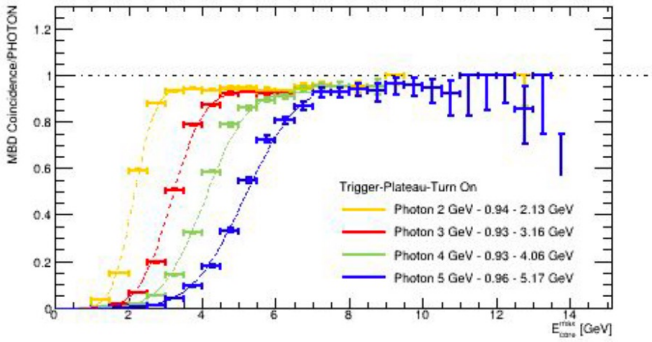


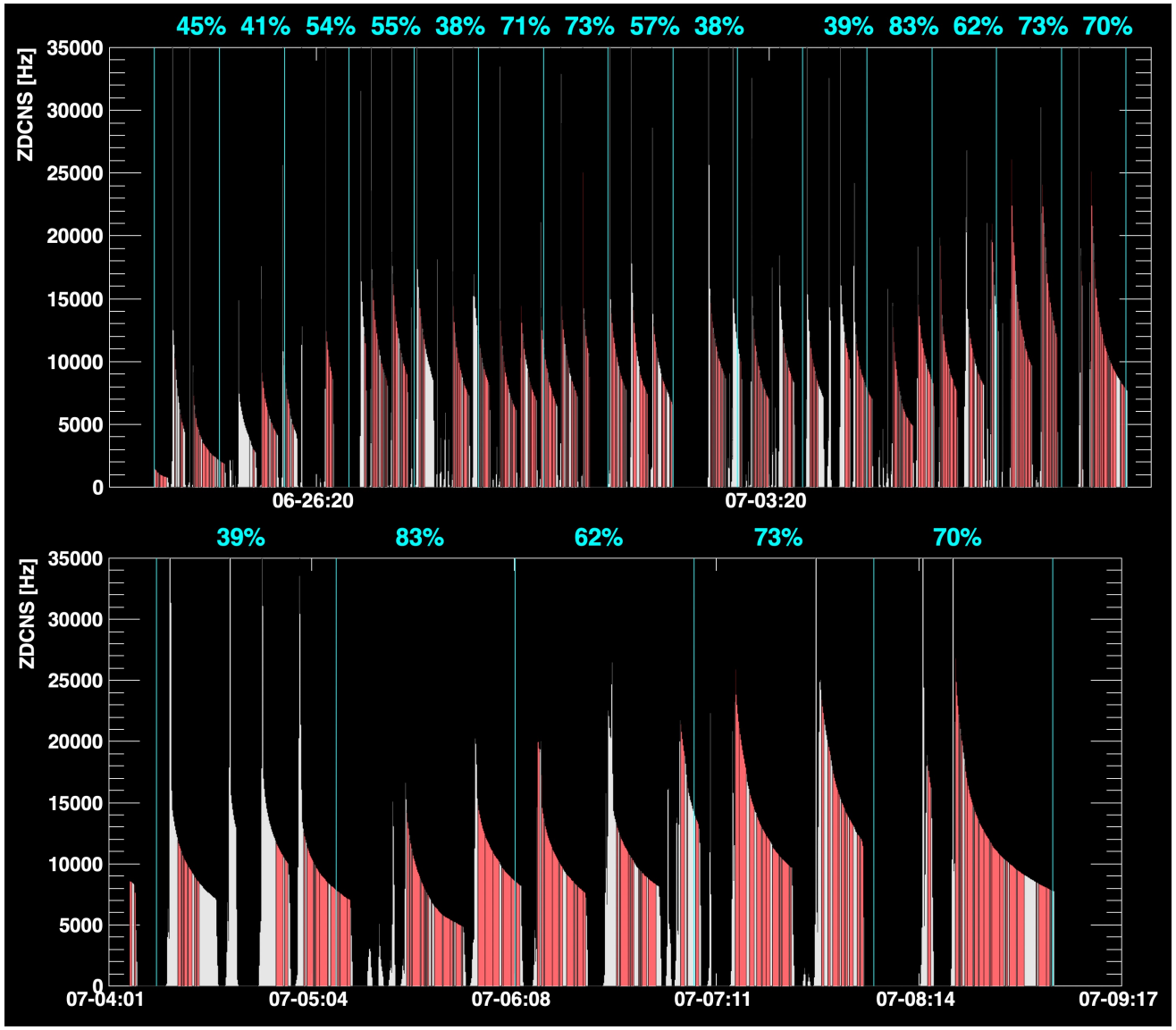


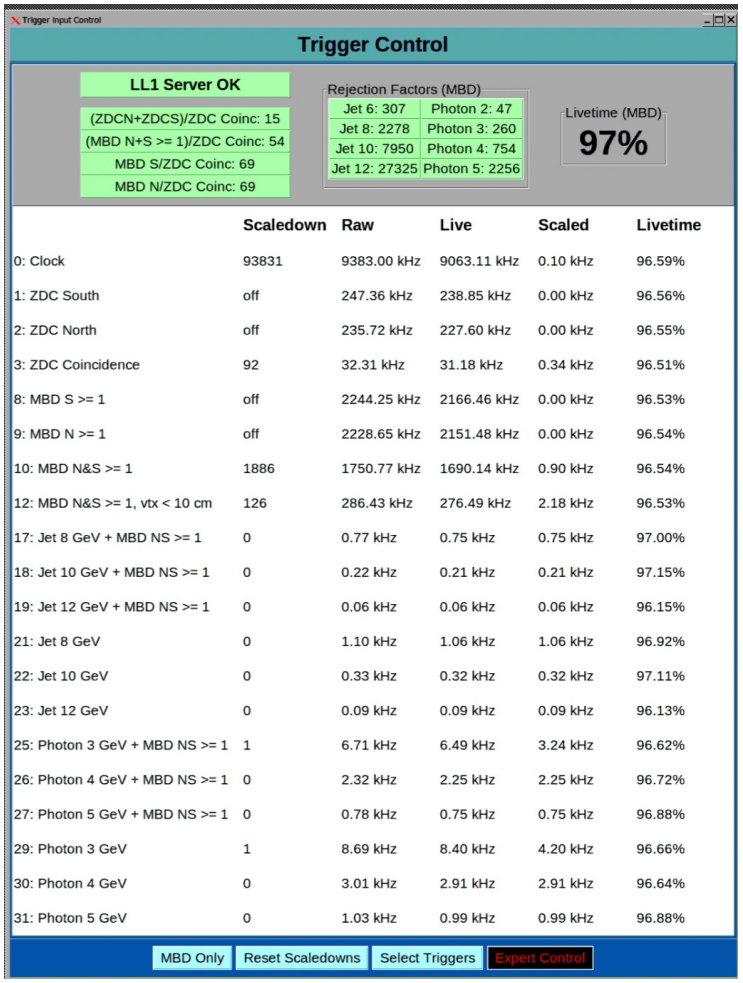
Low backgrounds

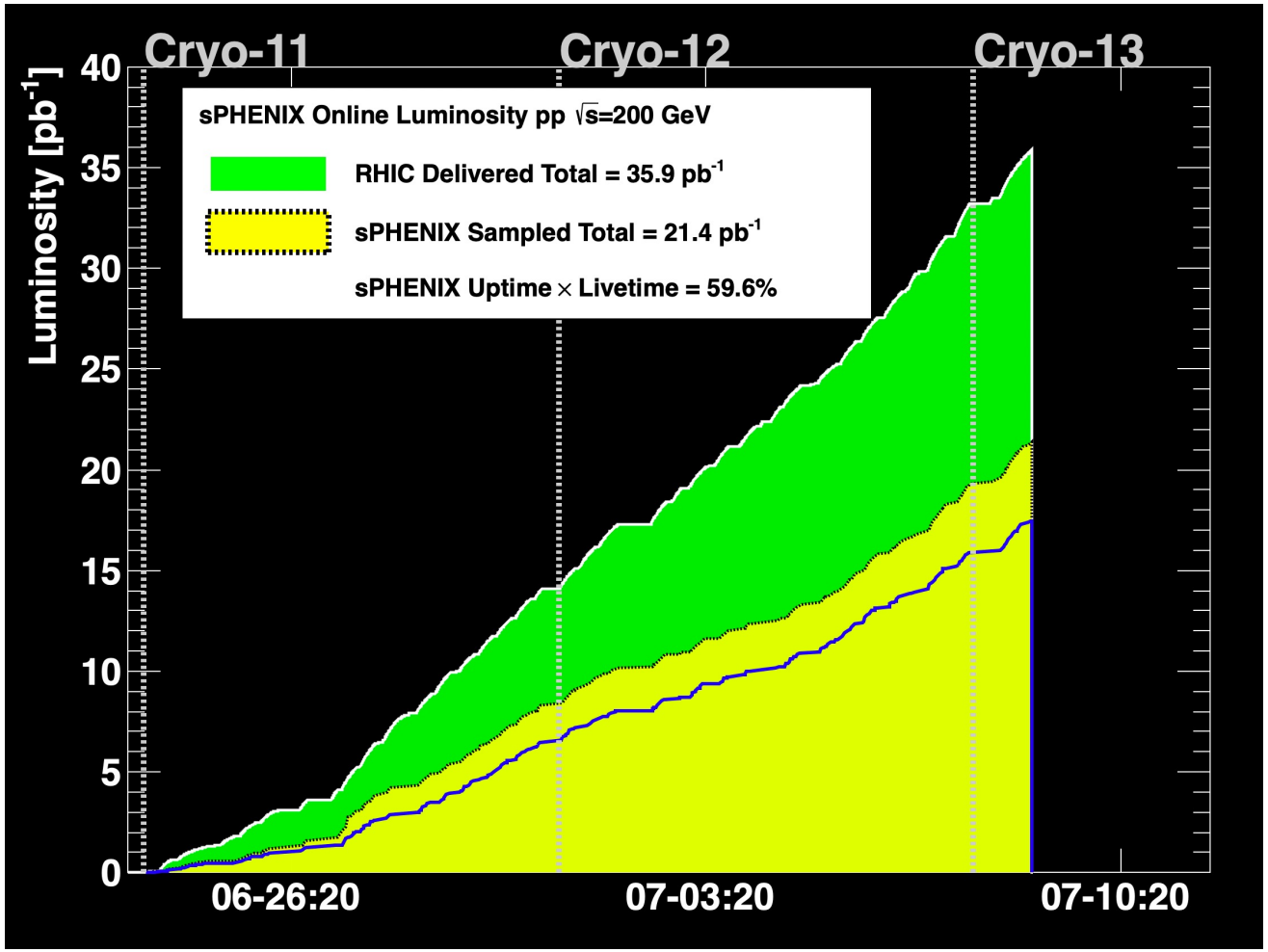







45% 41% 54% 55% 38% 71% 73% 57% 38% 39% 83% 62% 73% 70%
ZDCNS [Hz]
35000
30000
25000
20000
15000
10000
5000
0
06-26:20
07-03:20
39% 83% 62% 73% 70%
ZDCNS [Hz]
07-04:01
07-05:04
07-06:08
07-07:11
07-08:14
07-09:17


Trigger Input Control
Trigger Control
LL1 Server OK
(ZDCN+ZDCS)/ZDC Coinc: 15
(MBD N+S >= 1)/ZDC Coinc: 54
MBD S/ZDC Coinc: 69
MBD N/ZDC Coinc: 69
Rejection Factors (MBD)
Jet 6: 307
Photon 2: 47
Jet 8: 2278
Photon 3: 260
Jet 10: 7950
Photon 4: 754
Jet 12: 27325
Photon 5: 2256
Livetime (MBD)
97%
Scaledown Raw Live Scaled Livetime
0: Clock 93831 9383.00 kHz 9063.11 kHz 0.10 kHz 96.59%
1: ZDC South off 247.36 kHz 238.85 kHz 0.00 kHz 96.56%
2: ZDC North off 235.72 kHz 227.60 kHz 0.00 kHz 96.55%
3: ZDC Coincidence 92 32.31 kHz 31.18 kHz 0.34 kHz 96.51%
8: MBD S >= 1 off 2244.25 kHz 2166.46 kHz 0.00 kHz 96.53%
9: MBD N >= 1 off 2228.65 kHz 2151.48 kHz 0.00 kHz 96.54%
10: MBD N&S >= 1 1886 1750.77 kHz 1690.14 kHz 0.90 kHz 96.54%
12: MBD N&S >= 1, vtx < 10 cm 126 286.43 kHz 276.49 kHz 2.18 kHz 96.53%
17: Jet 8 GeV + MBD NS >= 1 0 0.77 kHz 0.75 kHz 0.75 kHz 97.00%
18: Jet 10 GeV + MBD NS >= 1 0 0.22 kHz 0.21 kHz 0.21 kHz 97.15%
19: Jet 12 GeV + MBD NS >= 1 0 0.06 kHz 0.06 kHz 0.06 kHz 96.15%
21: Jet 8 GeV 0 1.10 kHz 1.06 kHz 1.06 kHz 96.92%
22: Jet 10 GeV 0 0.33 kHz 0.32 kHz 0.32 kHz 97.11%
23: Jet 12 GeV 0 0.09 kHz 0.09 kHz 0.09 kHz 96.13%
25: Photon 3 GeV + MBD NS >= 1 1 6.71 kHz 6.49 kHz 3.24 kHz 96.62%
26: Photon 4 GeV + MBD NS >= 1 0 2.32 kHz 2.25 kHz 2.25 kHz 96.72%
27: Photon 5 GeV + MBD NS >= 1 0 0.78 kHz 0.75 kHz 0.75 kHz 96.88%
29: Photon 3 GeV 1 8.69 kHz 8.40 kHz 4.20 kHz 96.66%
30: Photon 4 GeV 0 3.01 kHz 2.91 kHz 2.91 kHz 96.64%
31: Photon 5 GeV 0 1.03 kHz 0.99 kHz 0.99 kHz 96.88%
MBD Only
Reset Scaledowns
Select Triggers
Expert Control

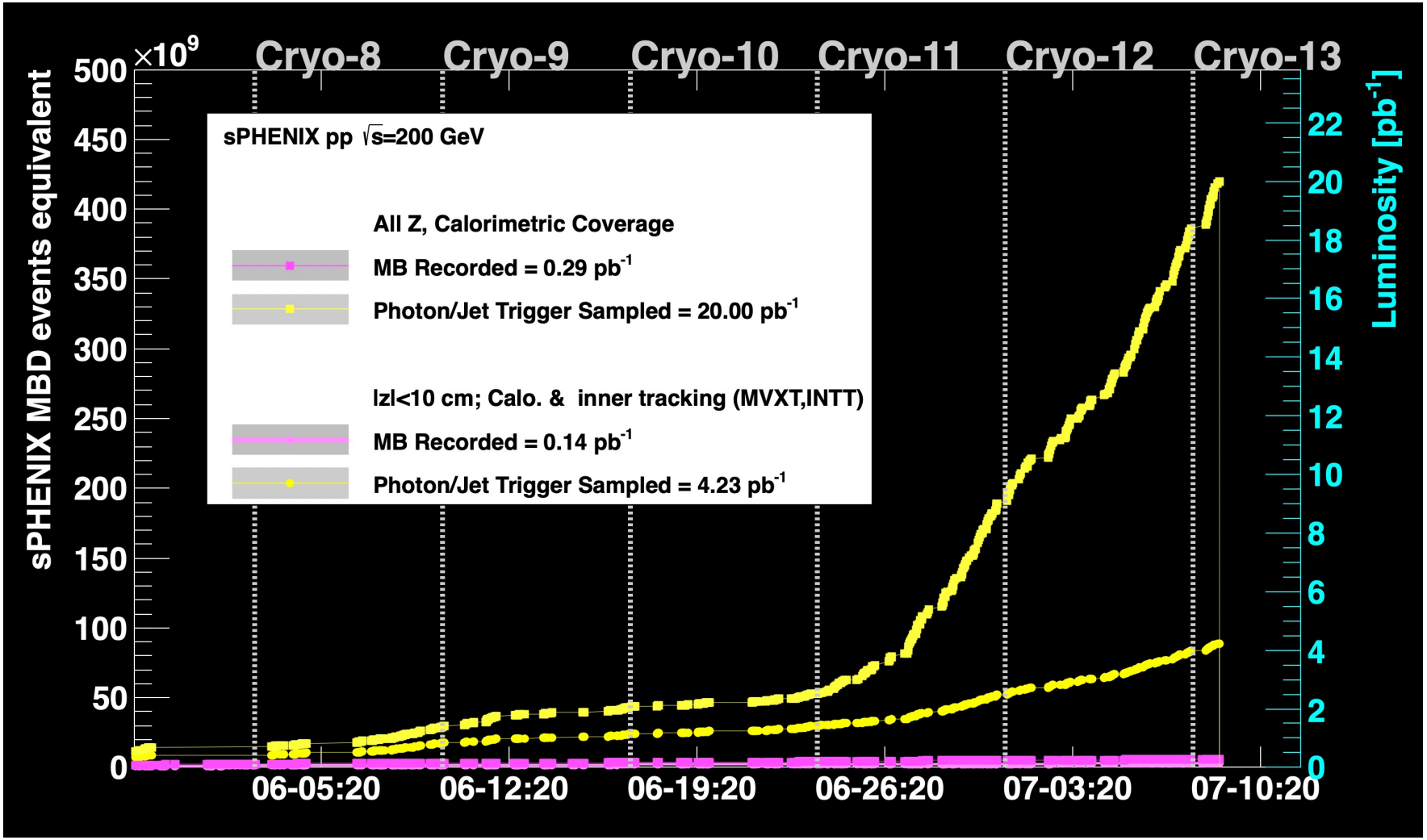


Graph showing the last two weeks since changing to zero crossing angle.

sPHENIX Beam Use Proposal target for first run with pp and new triggers is 60%.

We are aiming higher and are getting there.

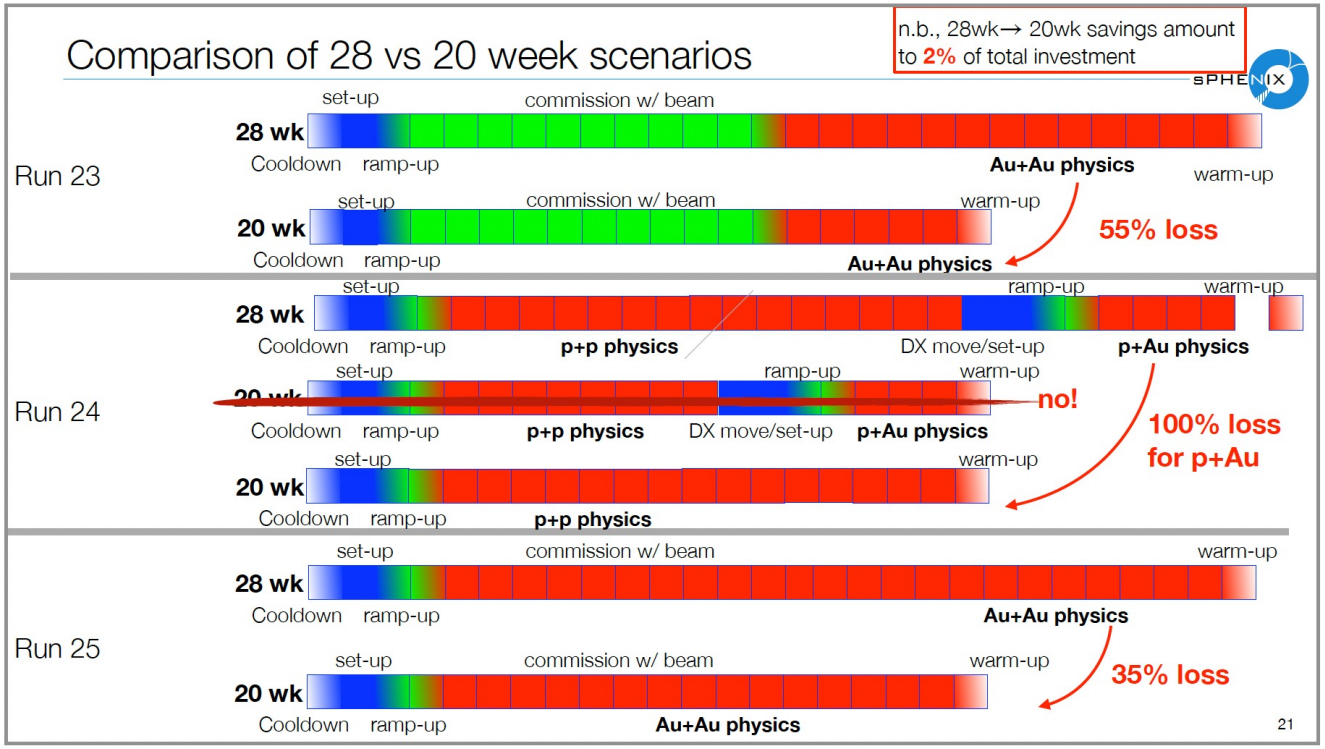
Slight difference between values – depends on ZDC coincidence to C-AD or through sPHENIX DAQ or via MBD. Vernier Scan for Thursday will resolve exact cross section.


sPHENIX MBD events equivalent
×10^9
500
450
400
350
300
250
200
150
100
50
0
Cryo-8
Cryo-9
Cryo-10
Cryo-11
Cryo-12
Cryo-13
sPHENIX pp √s=200 GeV
All Z, Calorimetric Coverage
MB Recorded = 0.29 pb^-1
Photon/Jet Trigger Sampled = 20.00 pb^-1
|z|<10 cm; Calo. & inner tracking (MVXT,INTT)
MB Recorded = 0.14 pb^-1
Photon/Jet Trigger Sampled = 4.23 pb^-1
Luminosity [pb^-1]
22
20
18
16
14
12
10
8
6
4
2
0
06-05:20
06-12:20
06-19:20
06-26:20
07-03:20
07-10:20

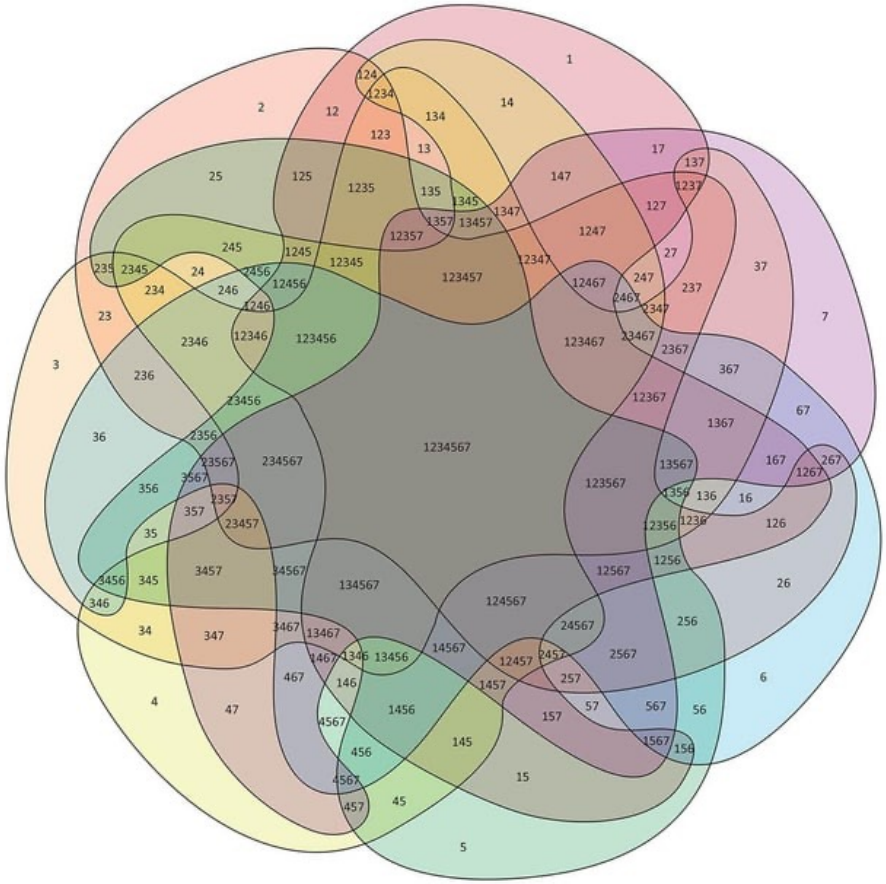
What are sPHENIX pp physics goals **without the TPC?**

Reminder: BUP 2021

G. Roland PAC presentation 2021

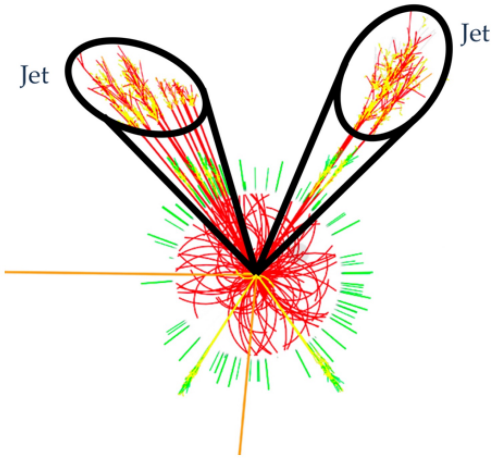


sPHENIX Physics Venn Diagram



sPHENIX is collecting excellent calorimeter data sample (all z)

Huge Jet, Dijet, π^0, η Sample



Photon-jet events are rare, and critical both for baseline to AuAu jet quenching measurements, but also for *in situ* Jet Energy Scale (JES) uncertainty

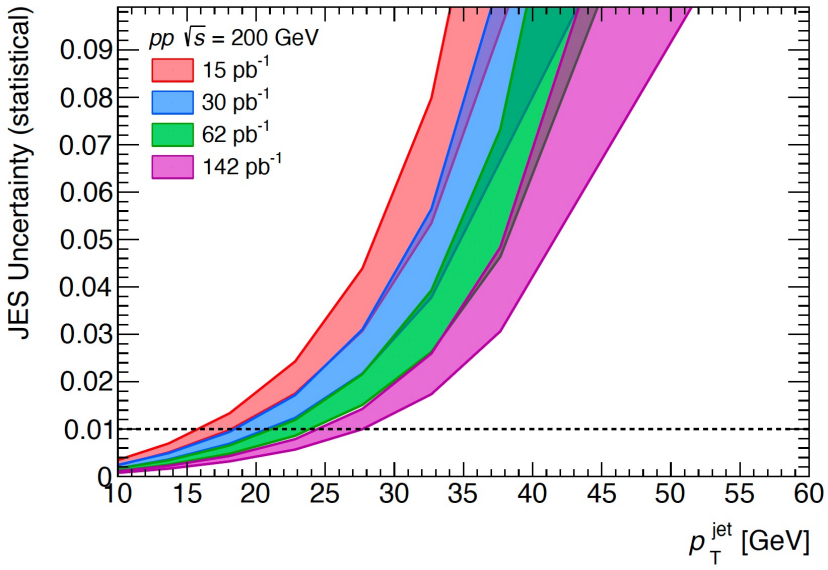


Figure 5.1: The projected sPHENIX statistical uncertainty contribution to the Jet Energy Scale (JES) uncertainty as determined from the "golden channel" via photon-jet direct balance studies. The dashed line at 1% represents a final JES uncertainty goal.

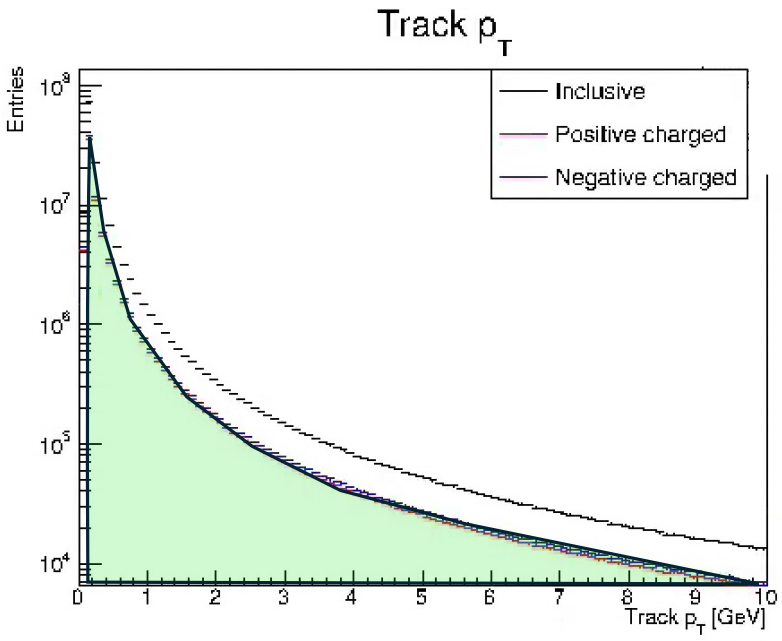
sPHENIX is collecting a smaller sample for jet structure (|z|<10 cm)

Jet sample also enables rich program of jet fragmentation functions, jet-medium response, substructure…all of which need tracking information

INTT + MVTX + vertex constraint yield good track sample with ~5% momentum resolution at 1 GeV.

Actively working on matching to outer TPOT and EMCal for large improvement in $\Delta p/p$

Thus, much of this program is in the data we are collecting now, but only 15-18% of the total collisions within |z| < 10 cm.

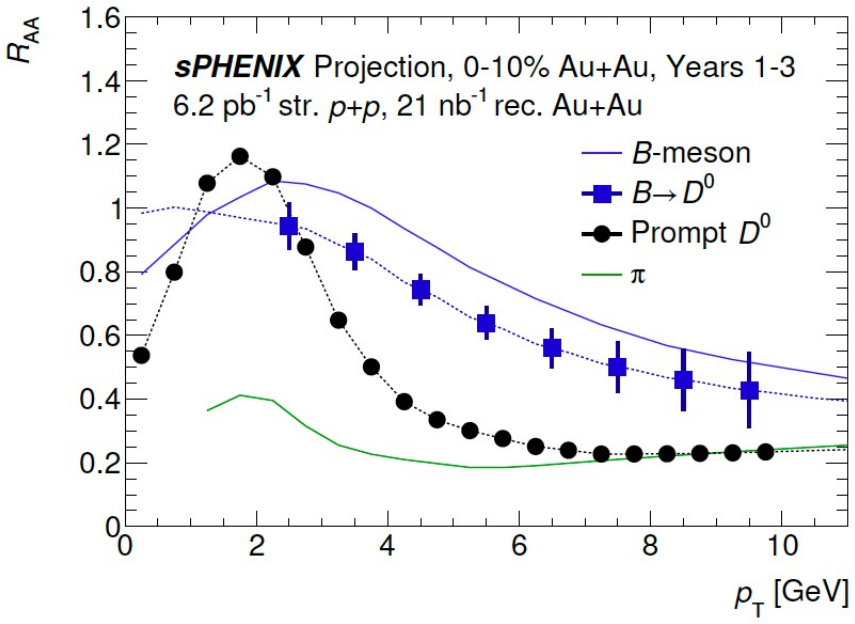


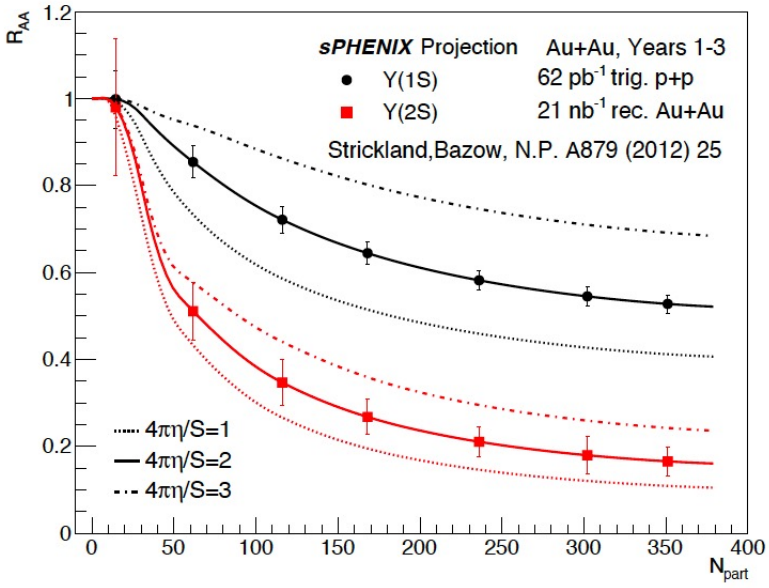
sPHENIX is collecting a smaller sample for jet structure (|z|<10 cm)

Open heavy flavor without TPC – very challenging.

B-jet program without TPC – not possible.

Upsilon state separation without TPC – not possible.





TPC Status Report

Slides from last week.

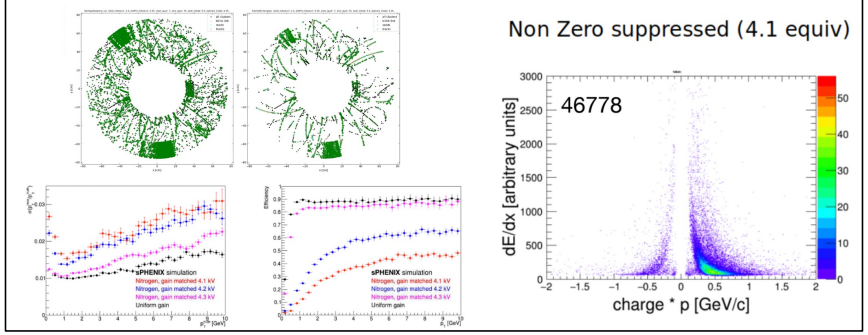
In parallel with work on safety approval, significant preparation work in progress at sPHENIX. If approved for isobutane, ready to run early next week.

In parallel, currently running with nitrogen gas mixture at lower voltage and 100% streaming to identify spark event precursors.

In parallel, working on TPC readout and firmware finalization.

TPC Status Report

Nitrogen gas admixture helped with stability. Ran at 4.05-4.1 kV for 24 hours with data taking with all other subsystems and with and without zero suppression. Learned a great deal, and this is not a "physics capable" working point.



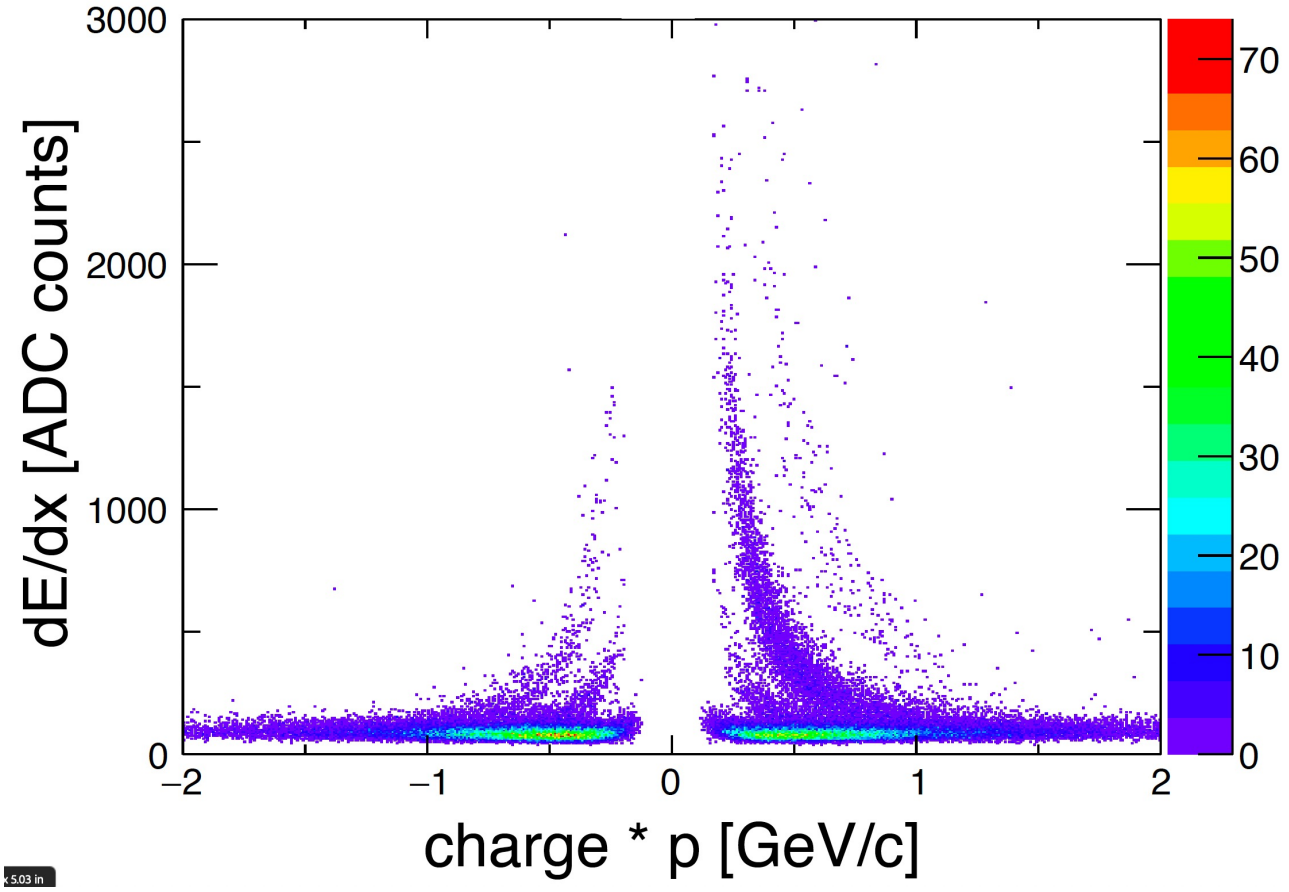
sPHENIX has worked with ESSHQ of C-AD and BNL SME in the USI process in order to use up to 5% isobutane to get to more efficient operating voltages for the TPC in sPHENIX.

- They want to confirm with BHSO before giving us the USI approval.
- In parallel, sPHENIX is making the necessary implementation of hardware/software for the monitoring and protection systems as written for the USI review (in the IR & Gas-Mixing House) and will use N_2 to test the controls.
- Isobutane was dispatched yesterday and hopefully, sPHENIX will receive it this week.
- If there are no problems, sPHENIX expect to have everything in place to begin flowing isobutane sometime next week and can begin the flow **if all the approvals are complete.**

TPC Performance with N_2 gas mixture at 4.3 kV.

At this Voltage, cannot operate TPC safely.

However, it means that with improved stability, the performance is encouraging.



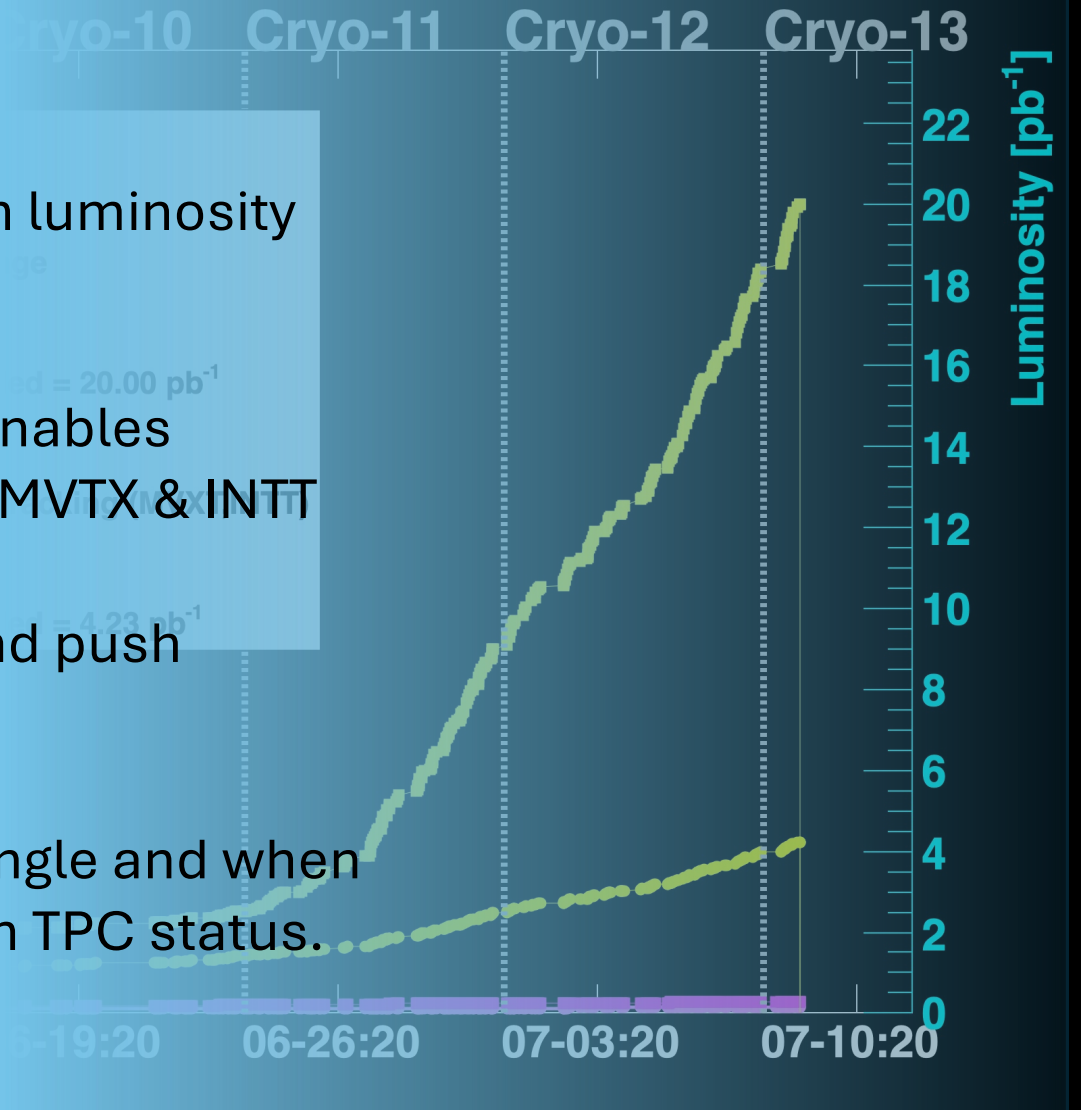
Summary

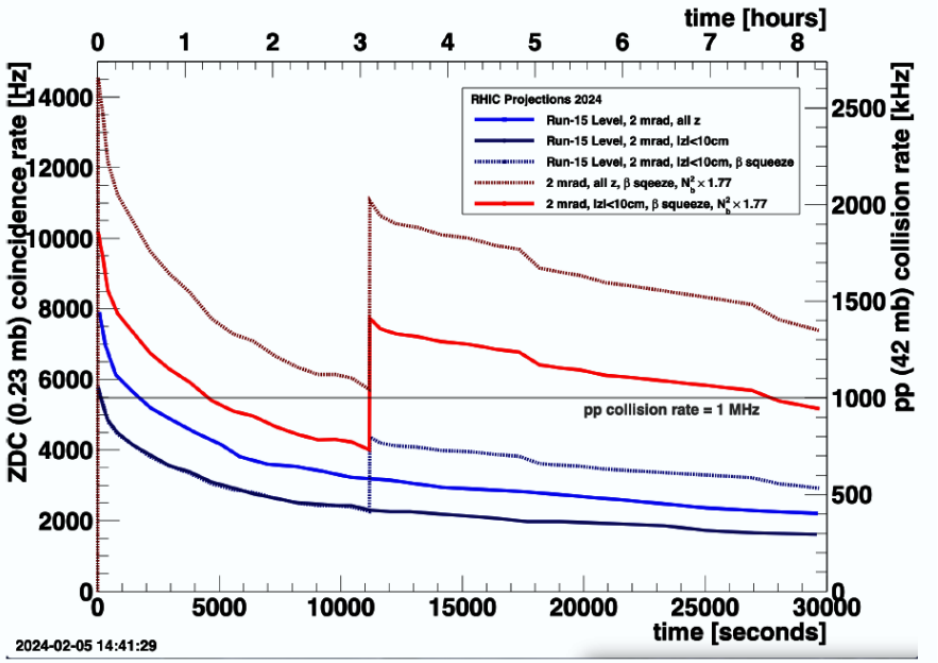
sPHENIX is efficiently using the high luminosity provided and can take more.

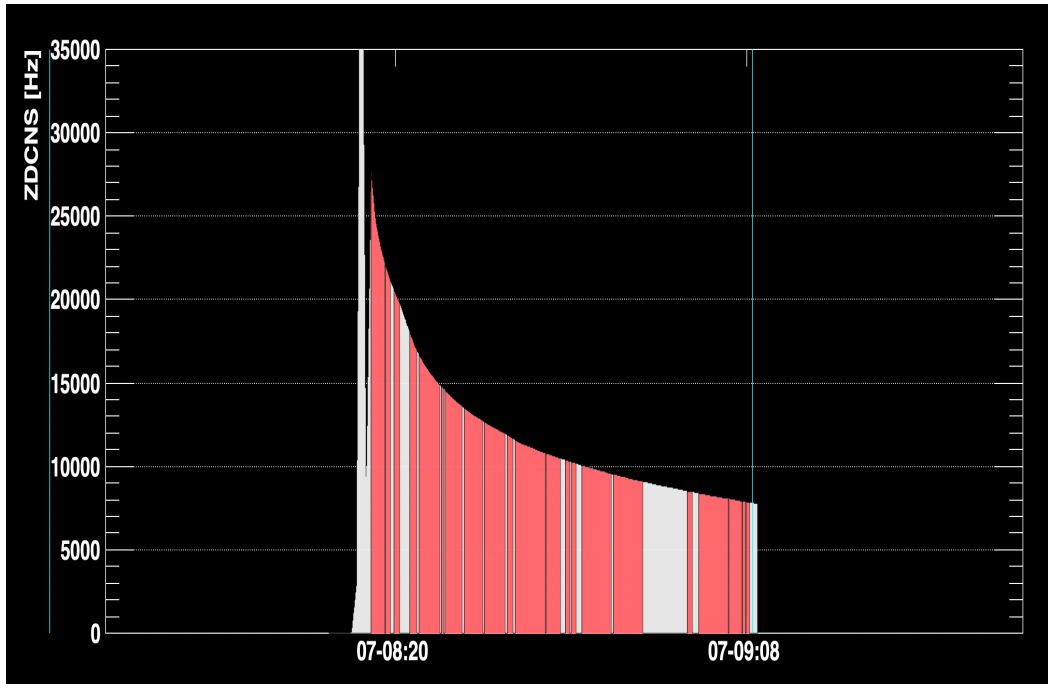
Smaller sample within |z| < 10 cm enables significant additional program with MVTX & INTT

Working hard to bring TPC online and push towards full physics program.

When we switch back to crossing angle and when we would want AuAu all depends on TPC status.







> 20 kHz for all z-vertices (but σ≅50-60 cm)

~ 3 kHz for |z| < 10 cm