

# sPHENIX Run Report

## RHIC/AGS Annual Users' Meeting

2026 May 12

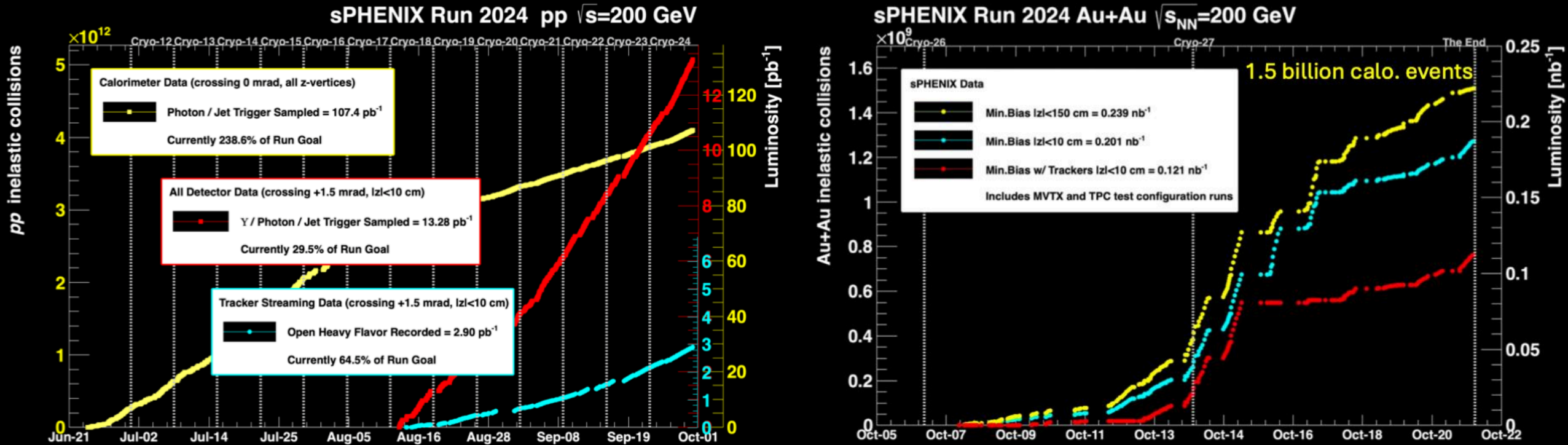
Rosi Reed  
Lehigh University  
sPHENIX Run Coordinator



Ron Belmont  
UNC Greensboro  
sPHENIX Deputy Run Coordinator



# sPHENIX at the end of Run24



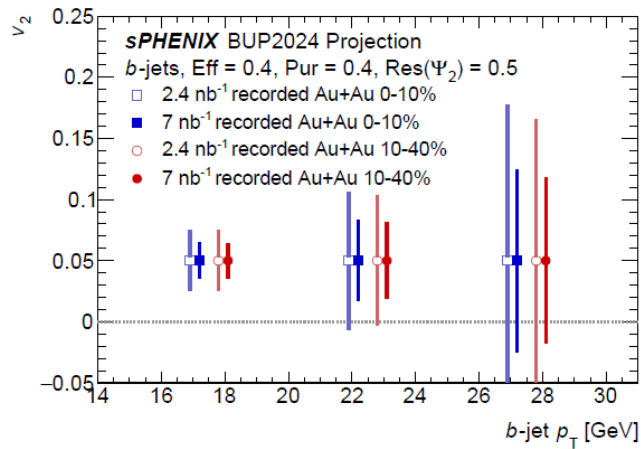
- Calorimeter commissioning completed July 2024
- Tracking p+p commissioning completed August 2024 (Au+Au commissioning ongoing)
- **238% goal for calo**, **65% goal for streaming**, **30% goal for all subsystem**

# PAC24 sPHENIX program goals

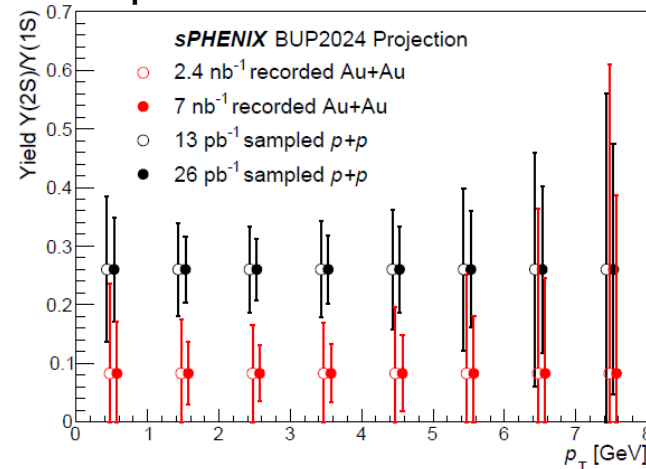


- Core program goals
  - 7/nb Au+Au
  - 45/pb p+p
- Additional program goals
  - 80/nb p+Au
  - 13/nb O+O

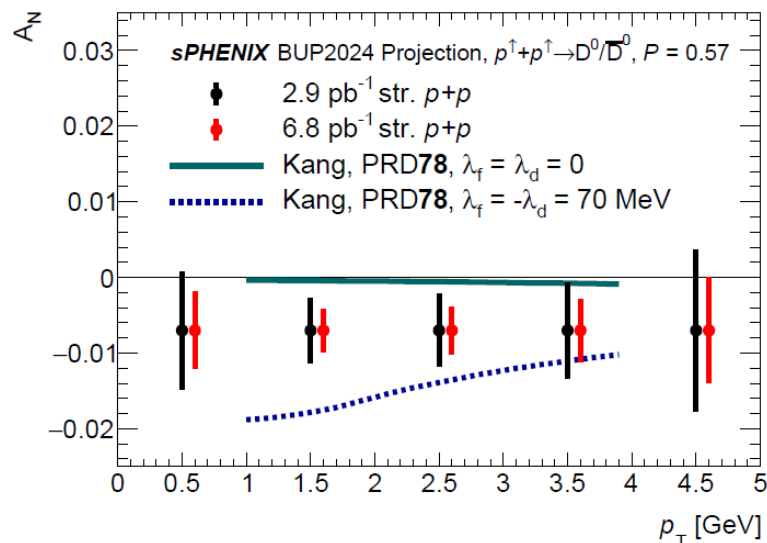
b-jet projections



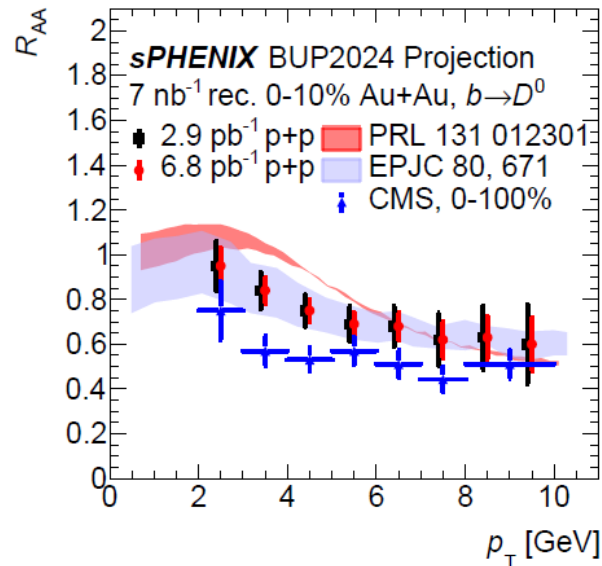
Upsilon 2S/1S



D0 single spin asymmetry



non-prompt D0

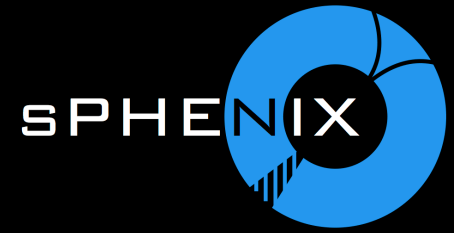


# sPHENIX Physics Goals for Run25

- Record ~all of the 7/nb Au+Au data needed for physics program
- Double the p+p data from 13/pb to 26/pb
- Additional data to enhance program (p+Au or O+O)

Run-25 Projection, sPHENIX Physics Target <b>7 nb<sup>-1</sup> (50B events)</b>		
Collision Species	Cryoweeks	Projected luminosity,  z  < 10 cm
Au+Au 200 GeV	20	2.8 – 5.4 nb <sup>-1</sup> recorded
Au+Au 200 GeV	28	4.2 – 8.1 nb <sup>-1</sup> recorded
Once Au+Au target is met, ordered priority list for additional running in FY26:		
Collision Species	Physics weeks	Projected luminosity,  z  < 10 cm
1. p+p 200 GeV	8	13 pb <sup>-1</sup> sampled + 3.9 pb <sup>-1</sup> streaming
2. p+Au 200 GeV	5	80 nb <sup>-1</sup> sampled + 24 nb <sup>-1</sup> streaming
3. O+O 200 GeV	2	13 nb <sup>-1</sup> sampled + 3.9 nb <sup>-1</sup> streaming

# (Very) Brief Run History



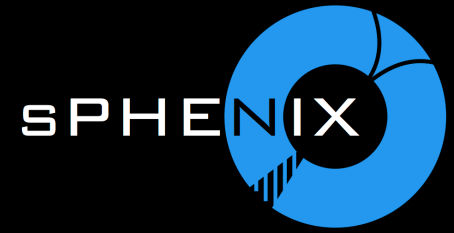
- February 19, 2025: first shift change meeting
- March 26: blue cold hipot failure
- June 9: first Au+Au collisions
- August 25: Squirrel incident
- August 26–September 10: 69 kV power line repair and recovery
- September 25—October 6: unexpected beam abort and vacuum window repair
- December 8: final Au+Au collisions - 94% of Run goal

# (Very) Brief Run History



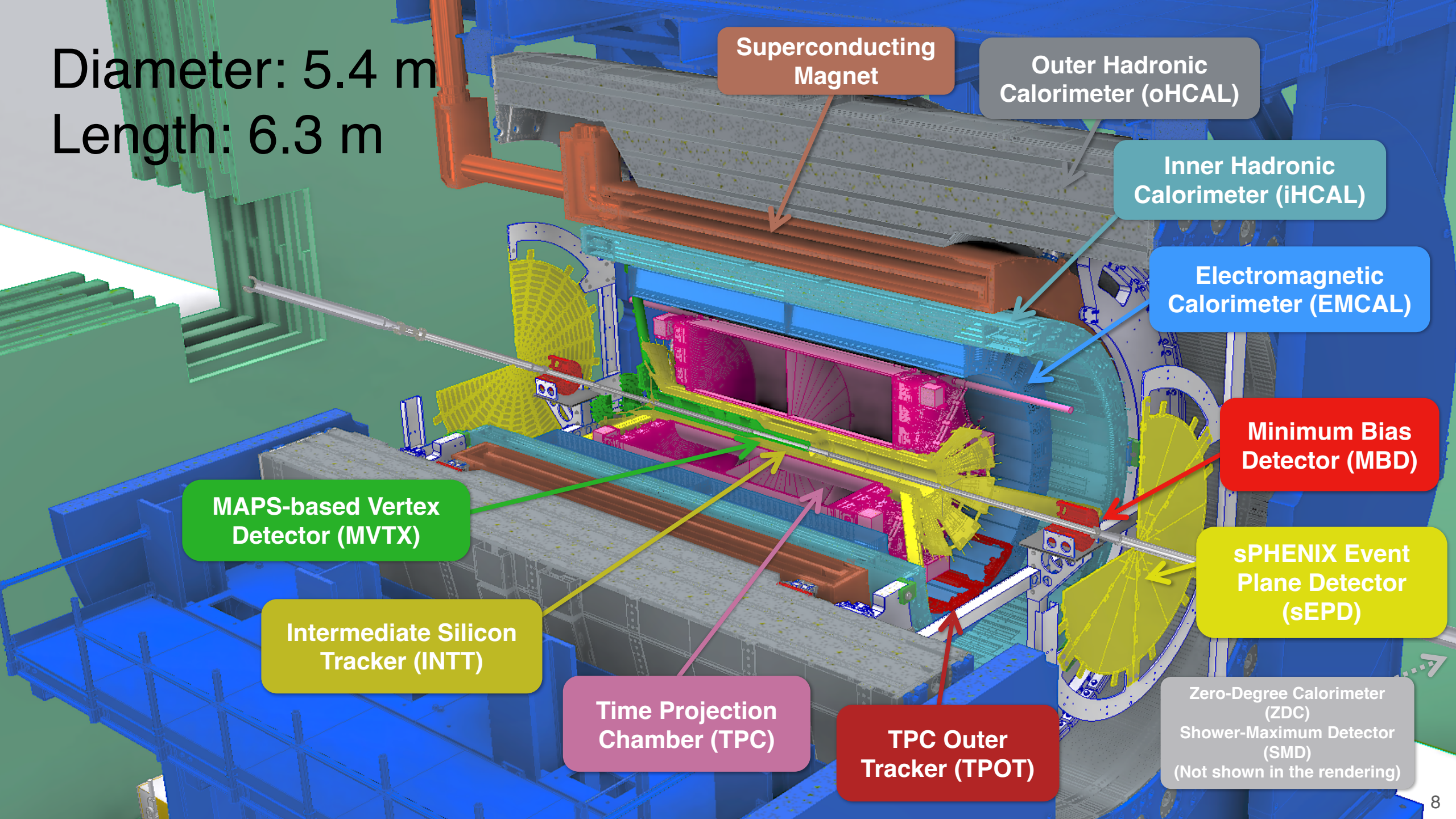
- December 10, 2025: first p+p collisions
- January 20, 2026: final p+p collisions - 130% of Run goal
- January 20-30: APEX and FXT interregnum (sPHENIX taking cosmics)
- January 31: first O+O collisions
- February 6: final O+O collisions - 182% of Run goal
- February 9-10: TPC final calibration
- February 22: final shift change meeting and end of operations—more than 1 year from start of Run!

# Outline



- sPHENIX
- Pre-collision work
- Au+Au
- p+p
- O+O
- Post-collision work, summary and outlook

Diameter: 5.4 m  
Length: 6.3 m



Superconducting Magnet

Outer Hadronic Calorimeter (oHCAL)

Inner Hadronic Calorimeter (iHCAL)

Electromagnetic Calorimeter (EMCAL)

Minimum Bias Detector (MBD)

MAPS-based Vertex Detector (MVTX)

sPHENIX Event Plane Detector (sEPD)

Intermediate Silicon Tracker (INTT)

Time Projection Chamber (TPC)

TPC Outer Tracker (TPOT)

Zero-Degree Calorimeter (ZDC)  
Shower-Maximum Detector (SMD)  
(Not shown in the rendering)

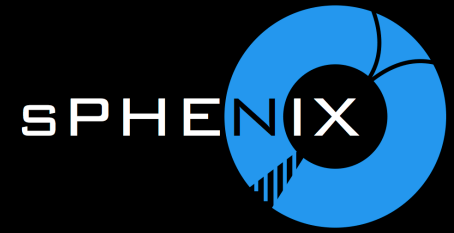
# Nominal Operations



- Calorimeter system and global detectors are triggered only
  - Trigger system runs at up to 15 kHz
    - First UPP achieved June 24, 2025
- Tracking system designed to run in continuous streaming readout (enables additional open HF physics)
  - Throughput and data storage limits streaming fraction
  - sPHENIX original goal to stream 10% of the time  
45/pb of trigger-sampled means 4.5/pb of streaming
  - Streaming goal upgraded to 30% for Run25  
13/pb of trigger-sampled means 3.9/pb of streaming



# Intermission



- sPHENIX
- **Pre-collision work**
- Au+Au
- p+p
- O+O
- Post-collision work, summary and outlook

# “Start” of Run Party: March 28, 2025



- Original plan for first Au+Au collisions around March 31
- Blue cold hipot failure on March 26 changed things

# Pre-collision work



- TPC line laser development (debugging, alignment, laser dances)
  - Used to measure electric field, static distortion corrections
- TPC improvements
  - Upgraded GEM power supplies: possible to make real-time gain changes
  - Change to higher-purity CF<sub>4</sub> (occasional transmission issues)

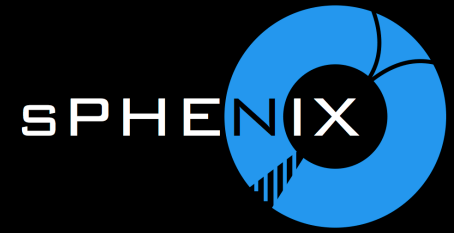


# Pre-collision work



- ECW system debugging, repairs, upgrades
- Many many thanks to Marianna, Kevin, Larry, others for the massive effort

# Pre-collision work



ECW CHILLER SAGA



SUMMER IS COMING

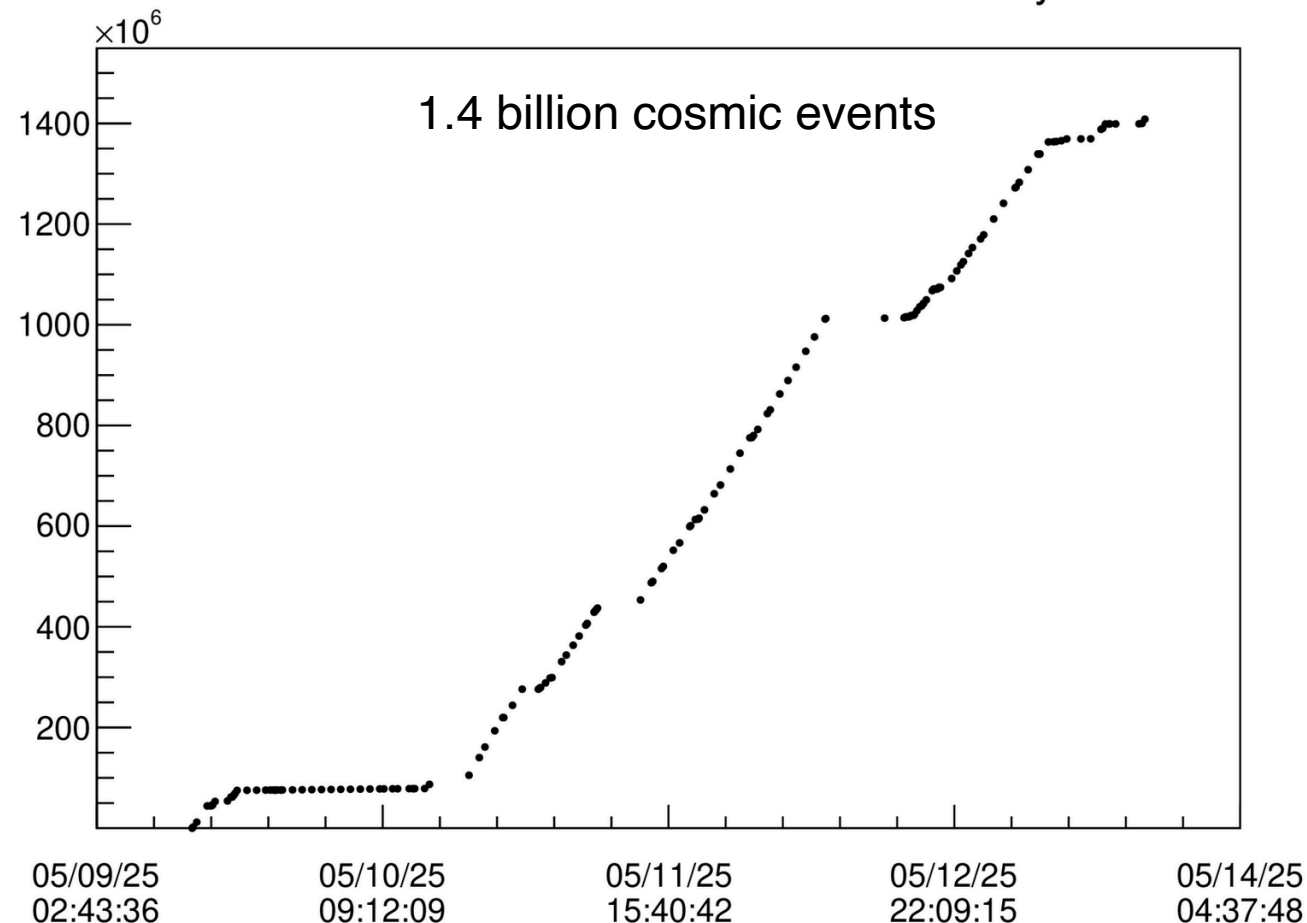
- ECW system debugging, repairs, upgrades
- Many many thanks to Marianna, Kevin, Larry, others for the massive effort

# Pre-collision work



- Dry Run May 9-14
  - Stress test systems
  - Validate improvements/upgrades
- DAQ upgrades and quality of life improvements
  - Parallelization to improve DAQ uptime
  - Automation of common debugging steps
- More than 1000 hours of cosmics
  - HCal calibrations
  - Tracking alignment

Cumulative events recorded in sPHENIX dry run



# Intermission



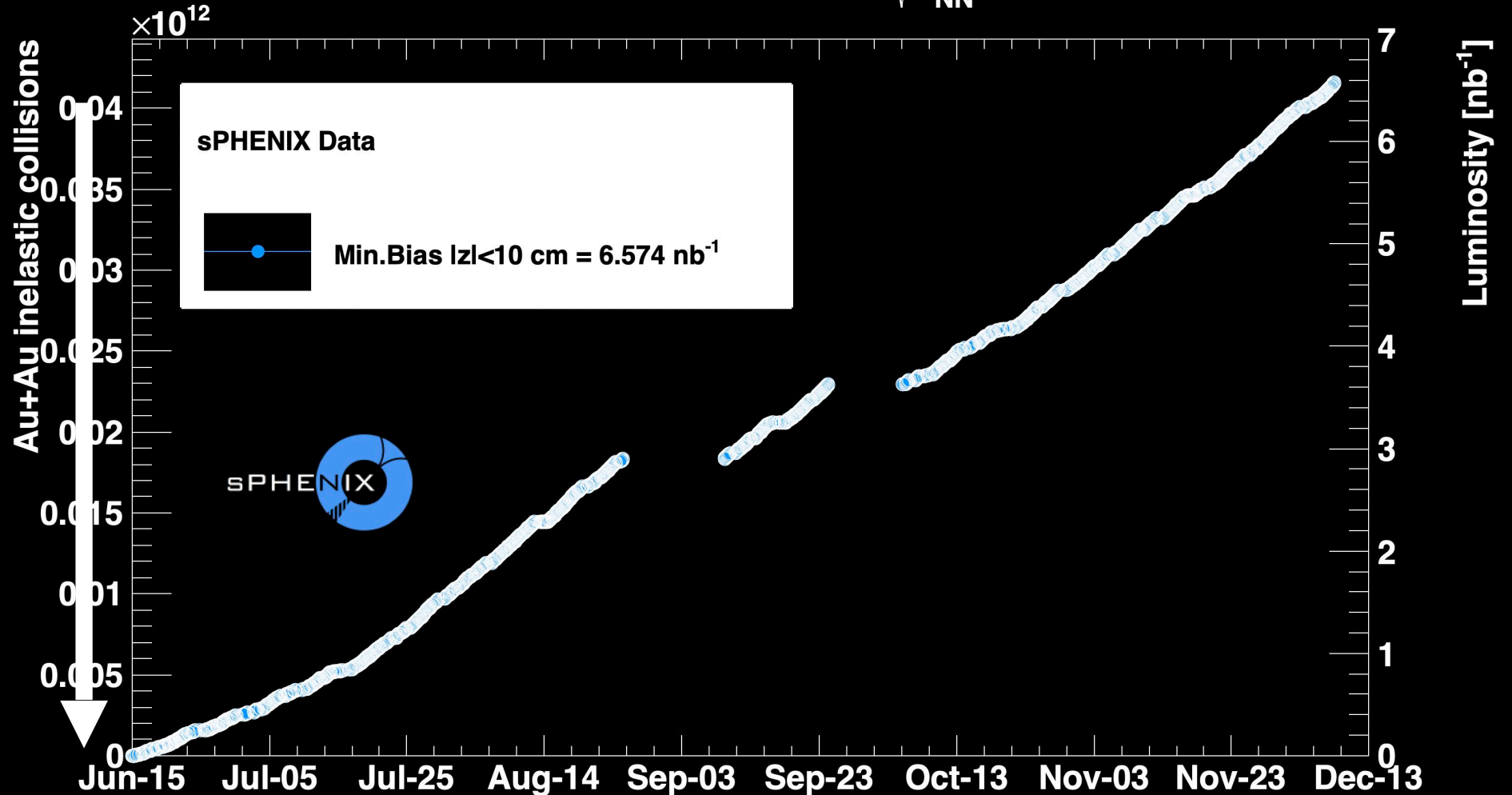
- sPHENIX
- Pre-collision work
- **Au+Au**
- p+p
- O+O
- Post-collision work, summary and outlook

# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

June 9  
First collisions  
and  
experiment  
setup

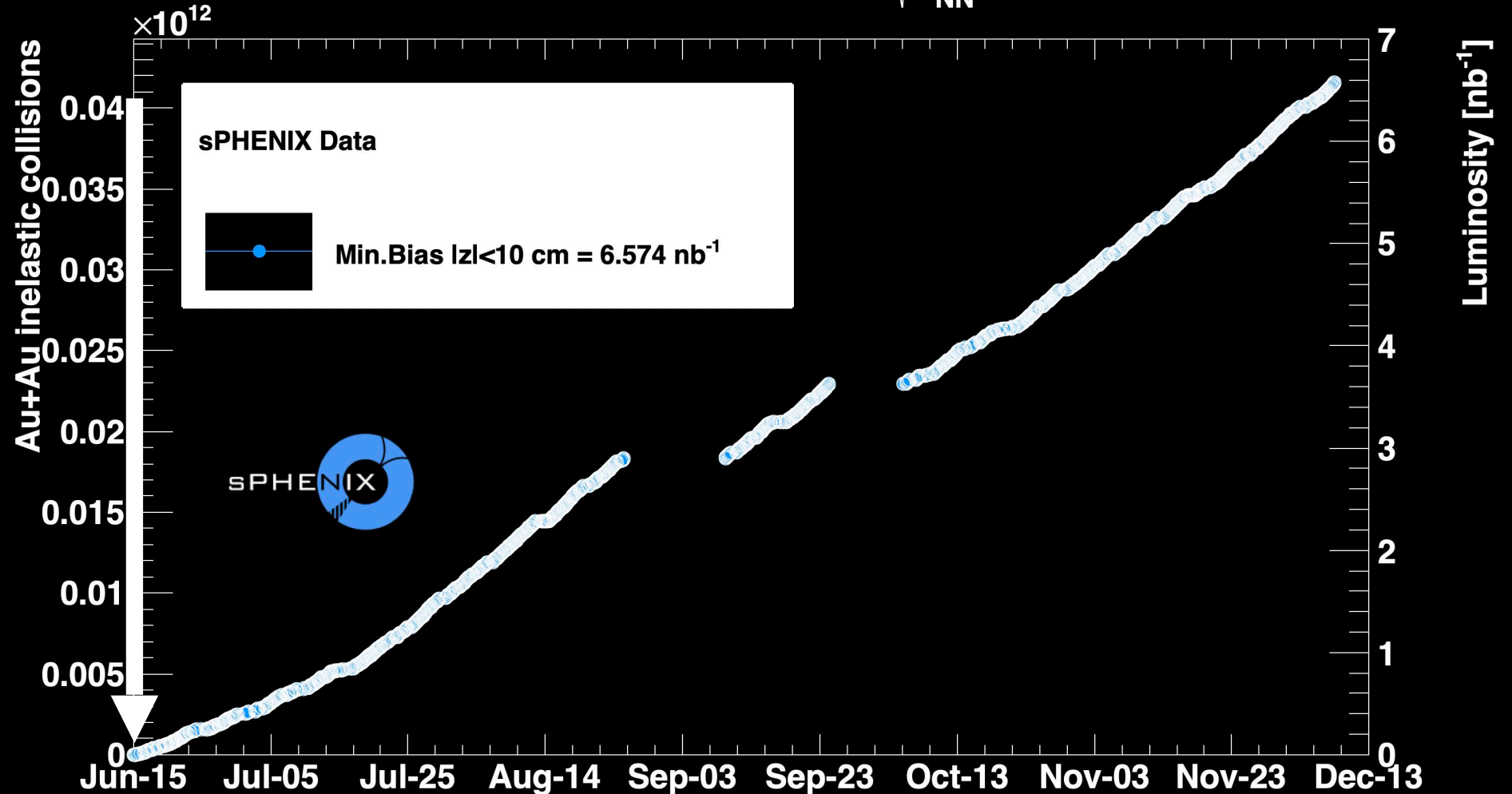


# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

June 15  
sPHENIX  
starts  
luminosity  
counting

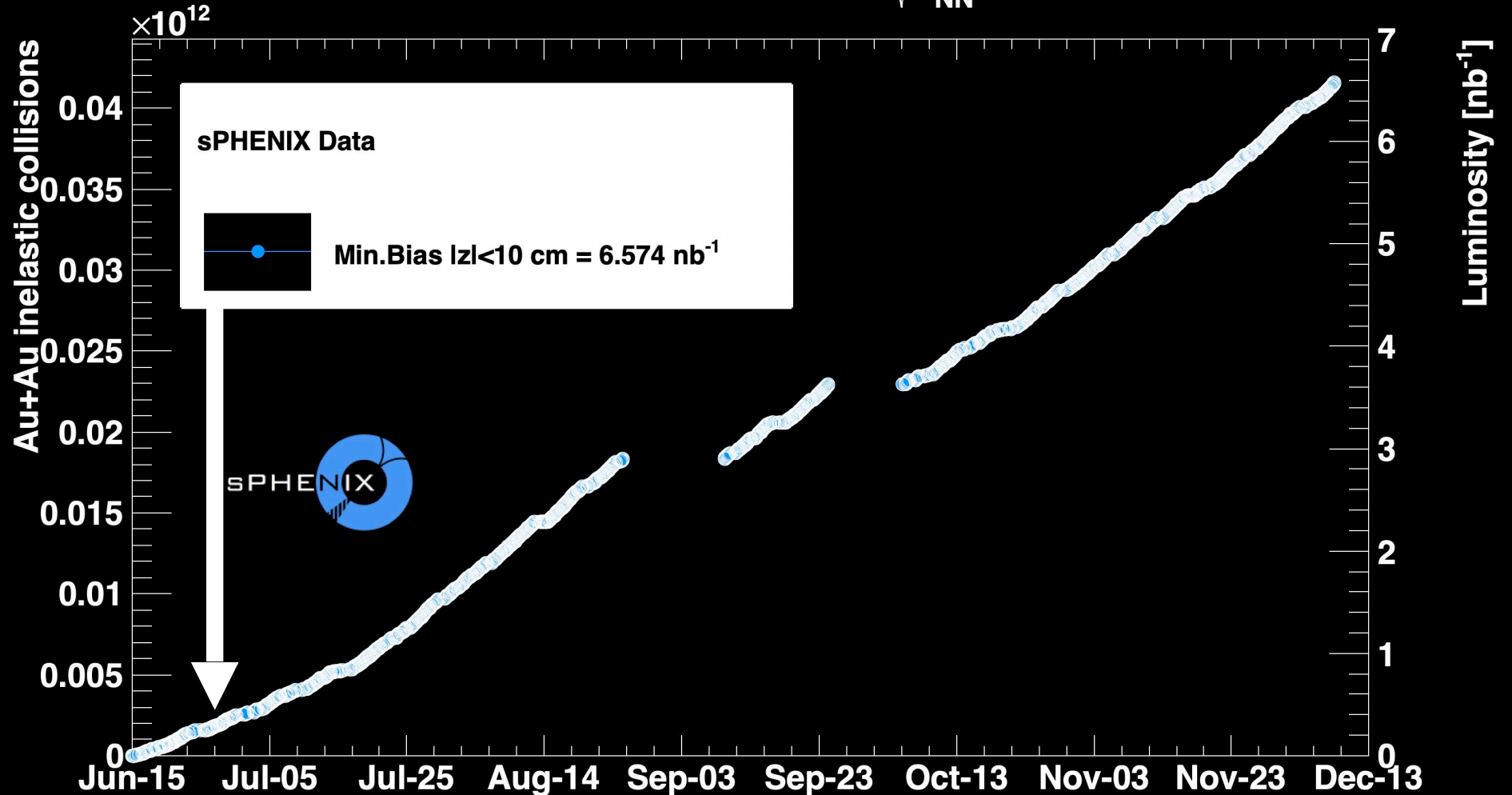


# Au+Au Luminosity and Timeline

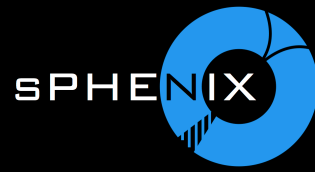


sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

June 24  
15 kHz UPP  
achieved



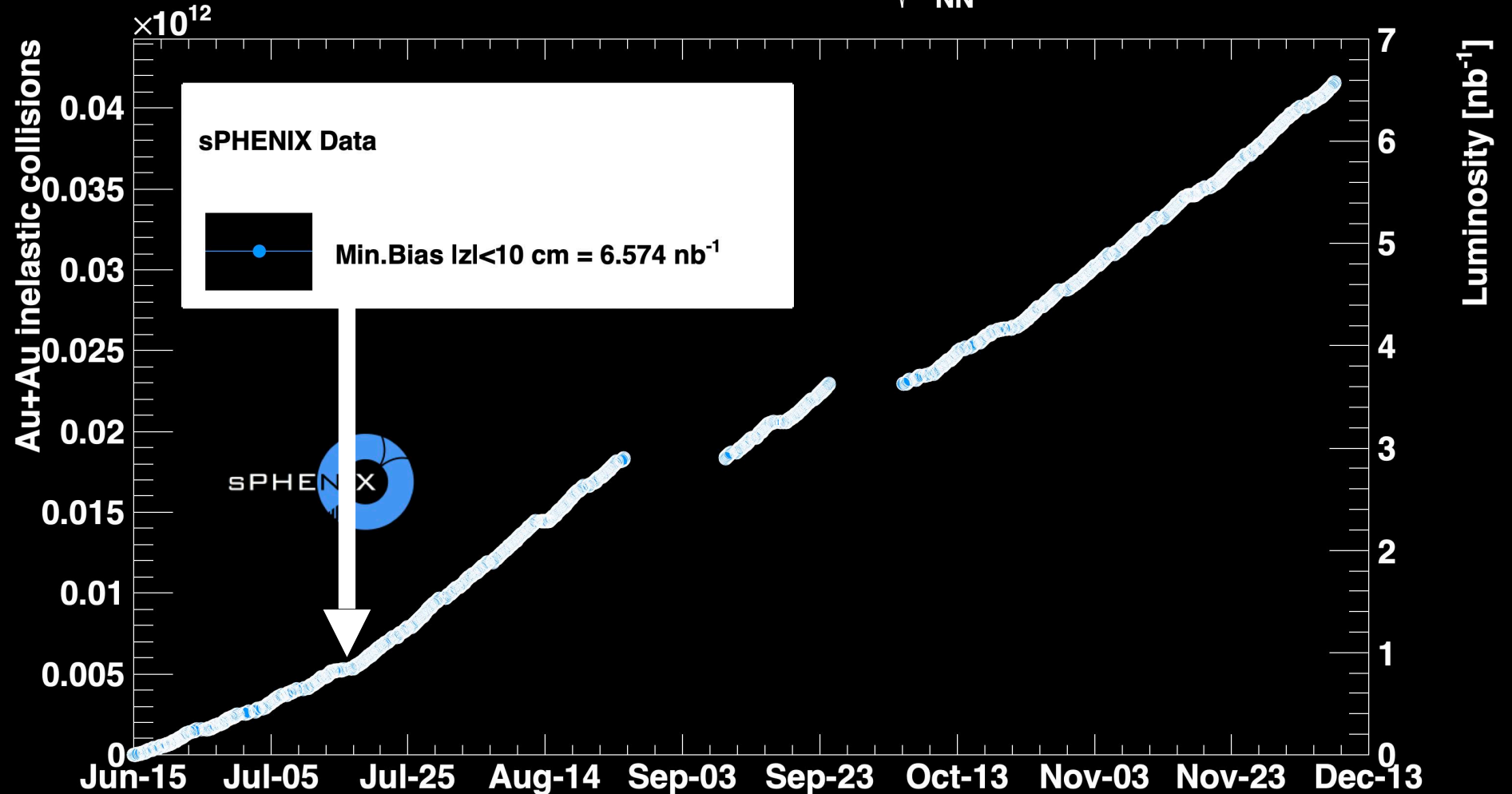
# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

July 17

Vernier Scan



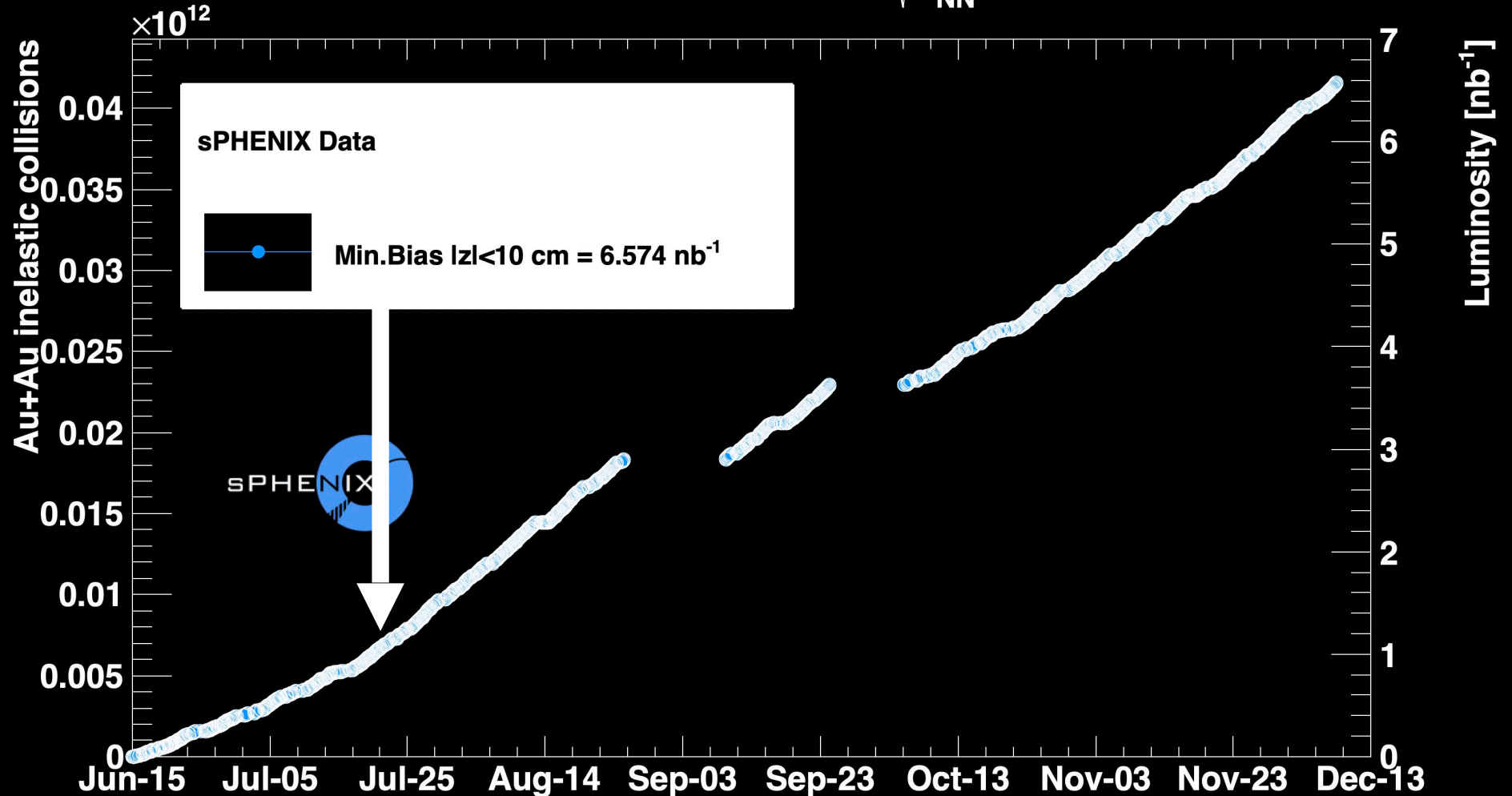
# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

July 22

Crossing angle scan for TPC verified 1 mrad is optimal



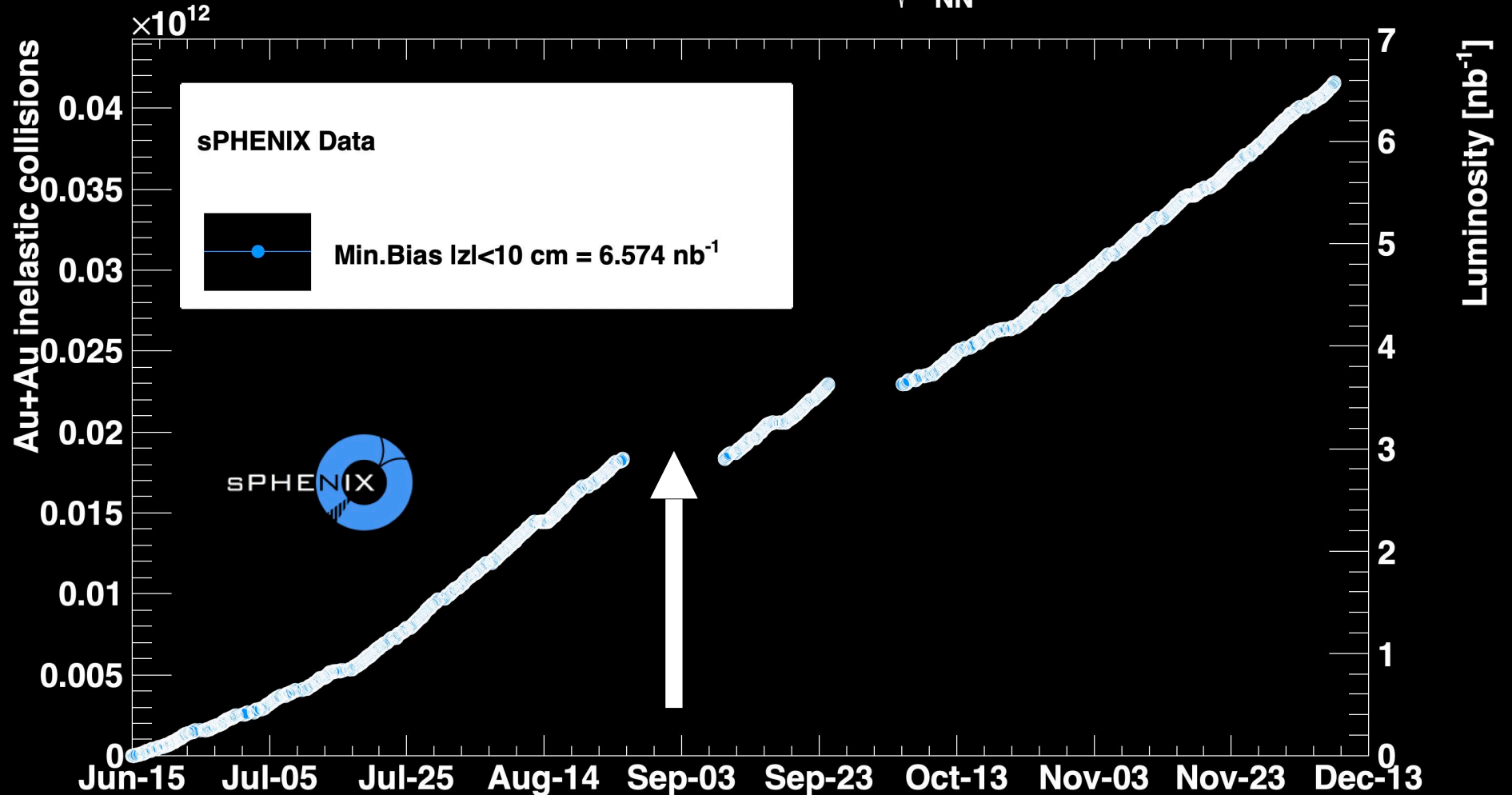
# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

August 25 —  
September 10

Squirrel  
incident and 69  
kV line repair



# Au+Au Luminosity and Timeline

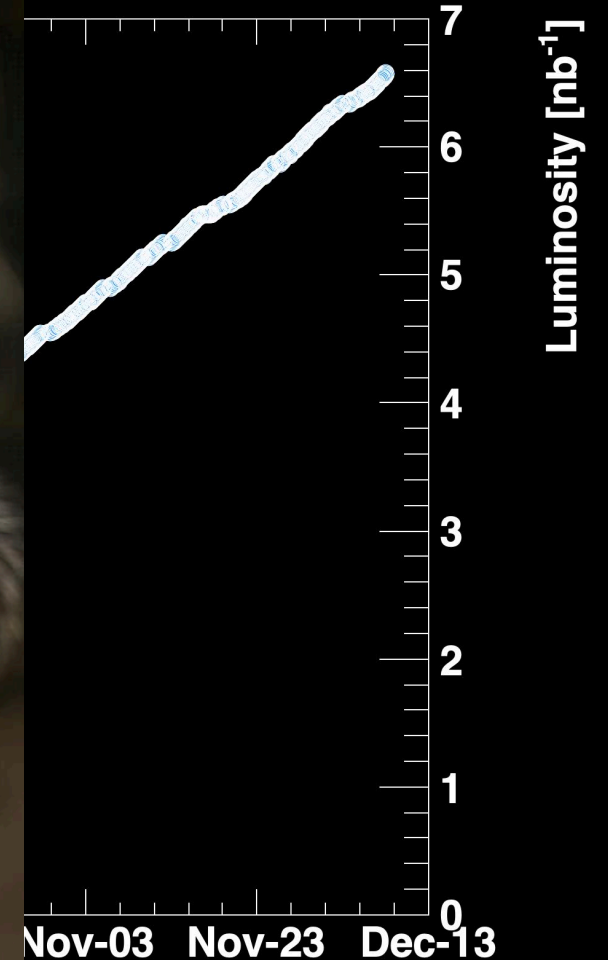


August 25 —  
September 10

Squirrel  
incident and 69  
kV line repair



00 GeV



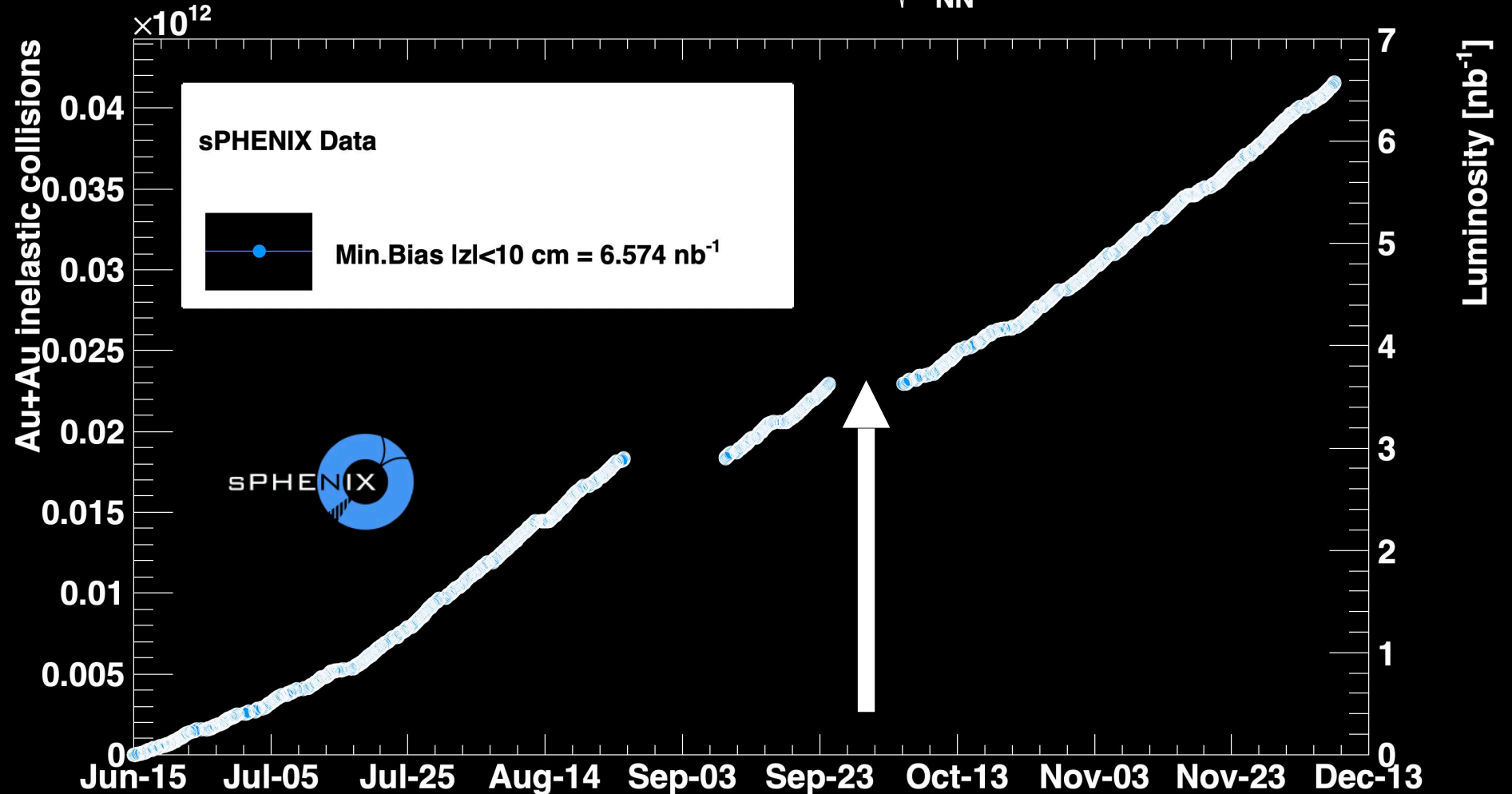
# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

September 25  
— October 6

Beam abort  
and vacuum  
window repair



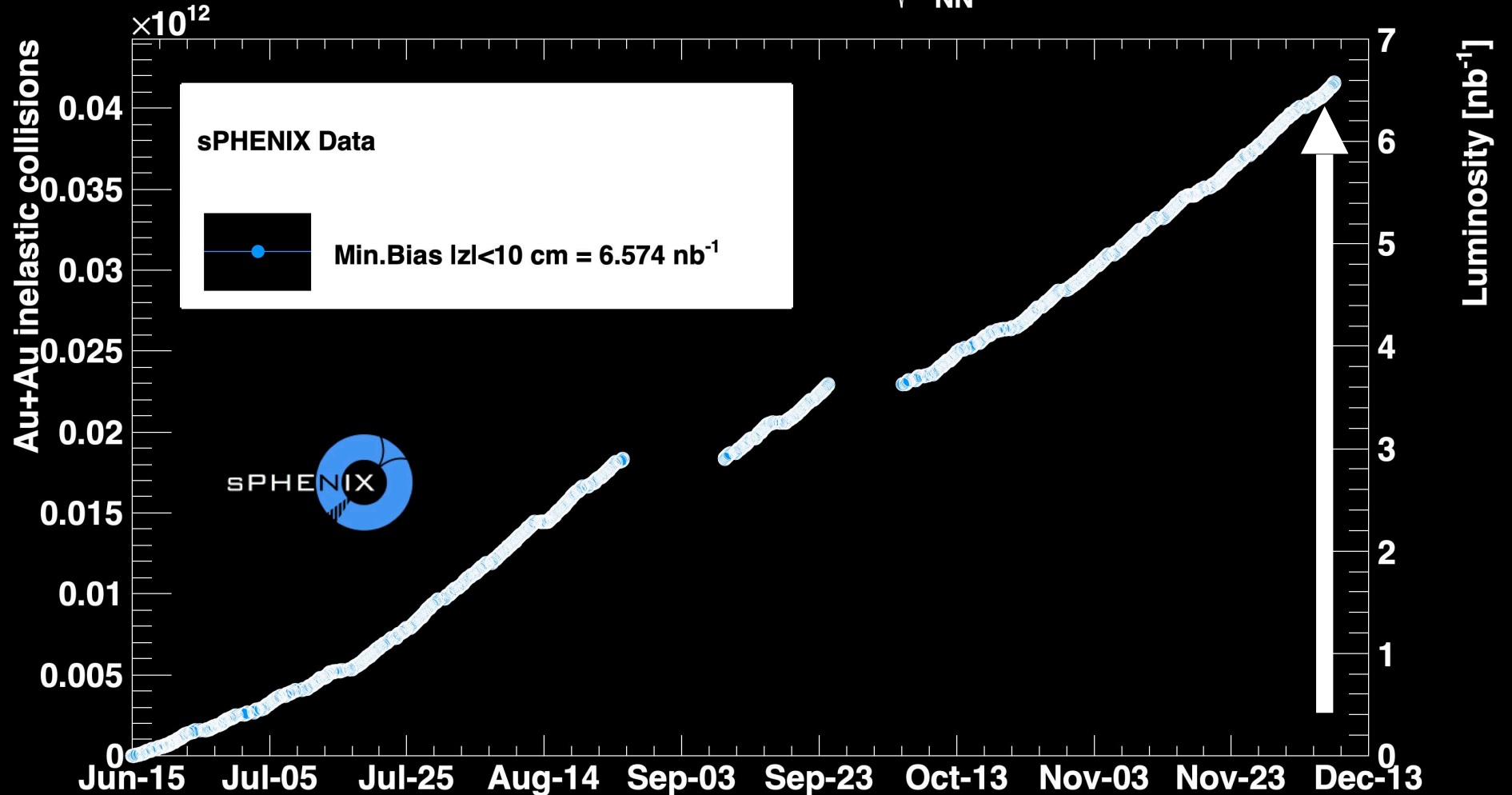
# Au+Au Luminosity and Timeline



sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

December 3

PAC-  
recommended  
90% of 7/nb  
goal reached



# Au+Au Luminosity and Timeline

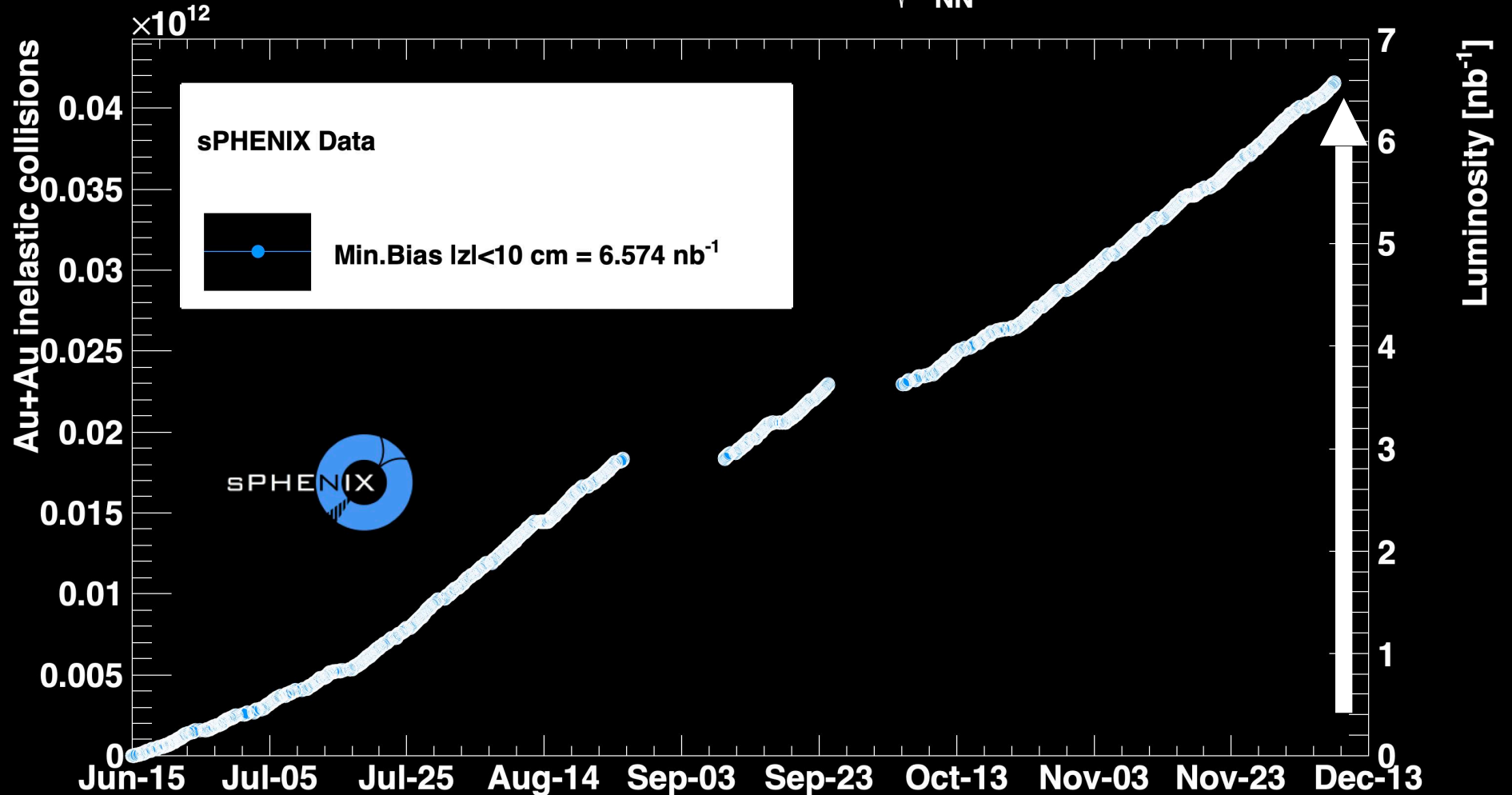


sPHENIX Run 2025 Au+Au  $\sqrt{s_{NN}} = 200$  GeV

December 8

Final Au+Au collisions

6.574/nb recorded, 94% of 7/nb goal



# Au+Au Luminosity and Timeline



December 8

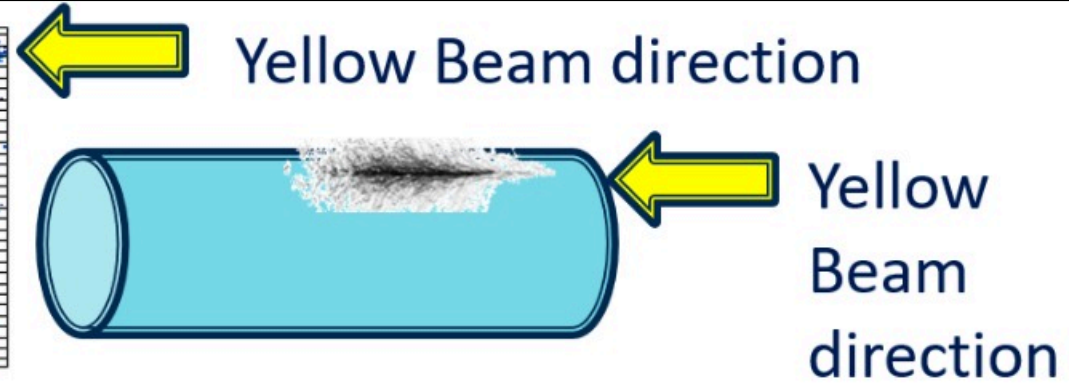
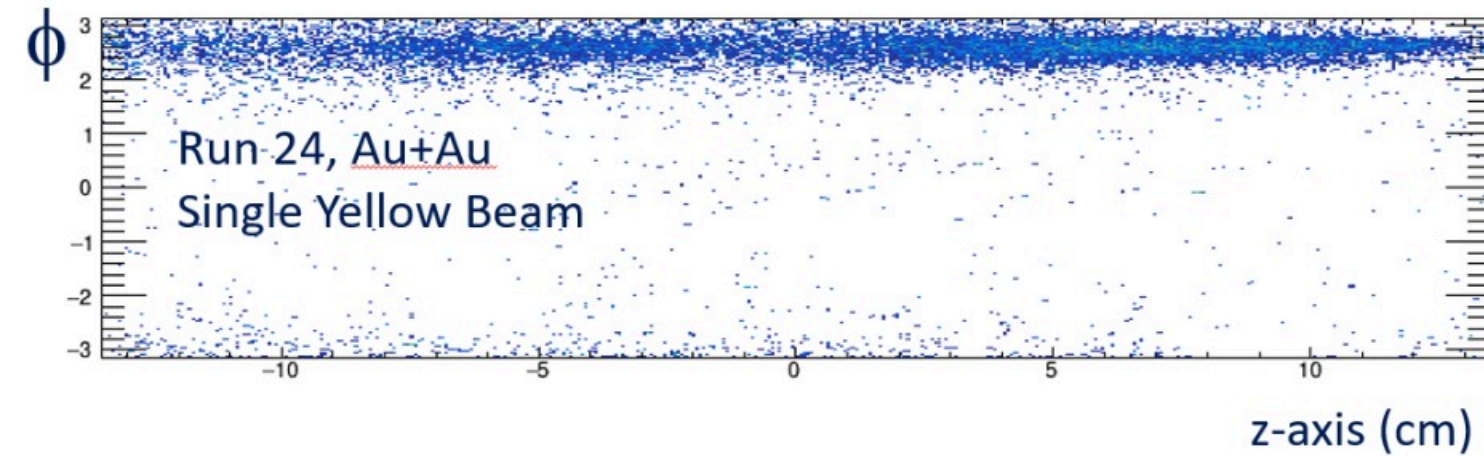
Final Au+Au collisions

6.574/nb recorded, 94% of 7/nb goal

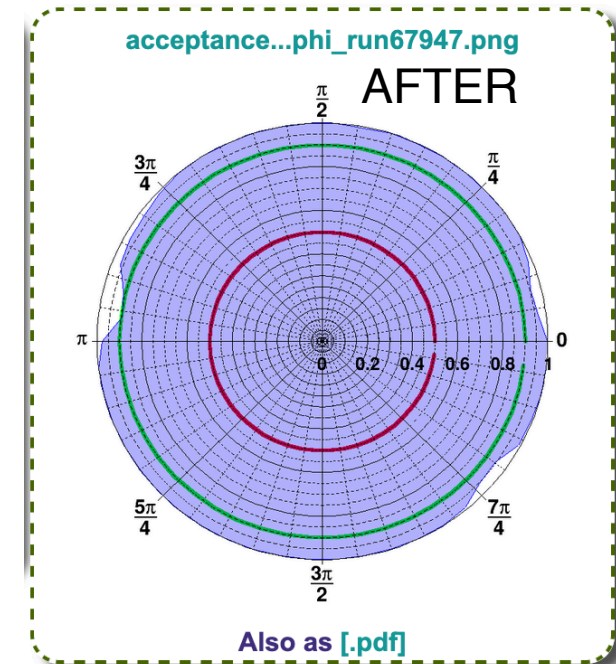
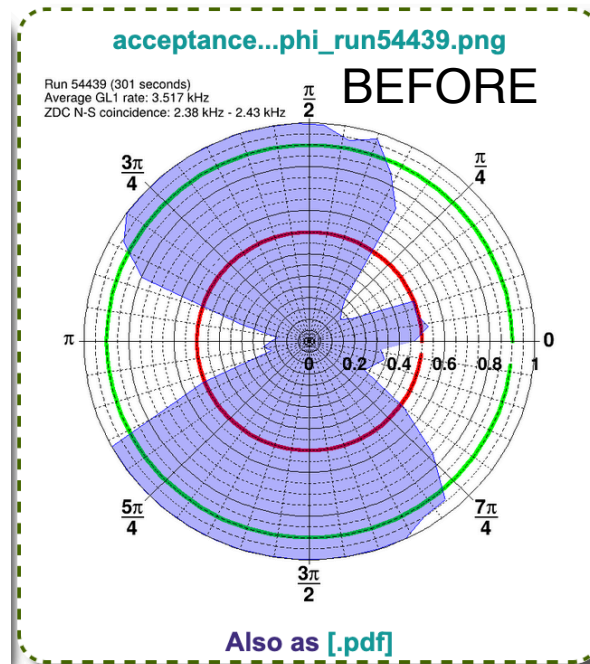


Rosi Reed and Ron Belmont

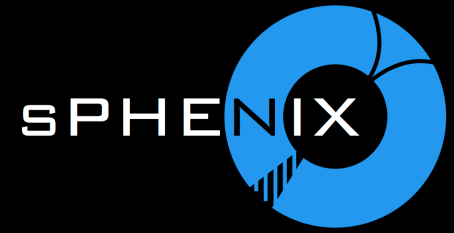
# Au+Au Operations — MVTX



- Many thanks to Angelika, Travis, Vincent, Kiel, and others in C-AD
- Mitigation: mask removal + triggered mode



# Intermission



- sPHENIX
- Pre-collision work
- Au+Au
- p+p
- O+O
- Post-collision work, summary and outlook

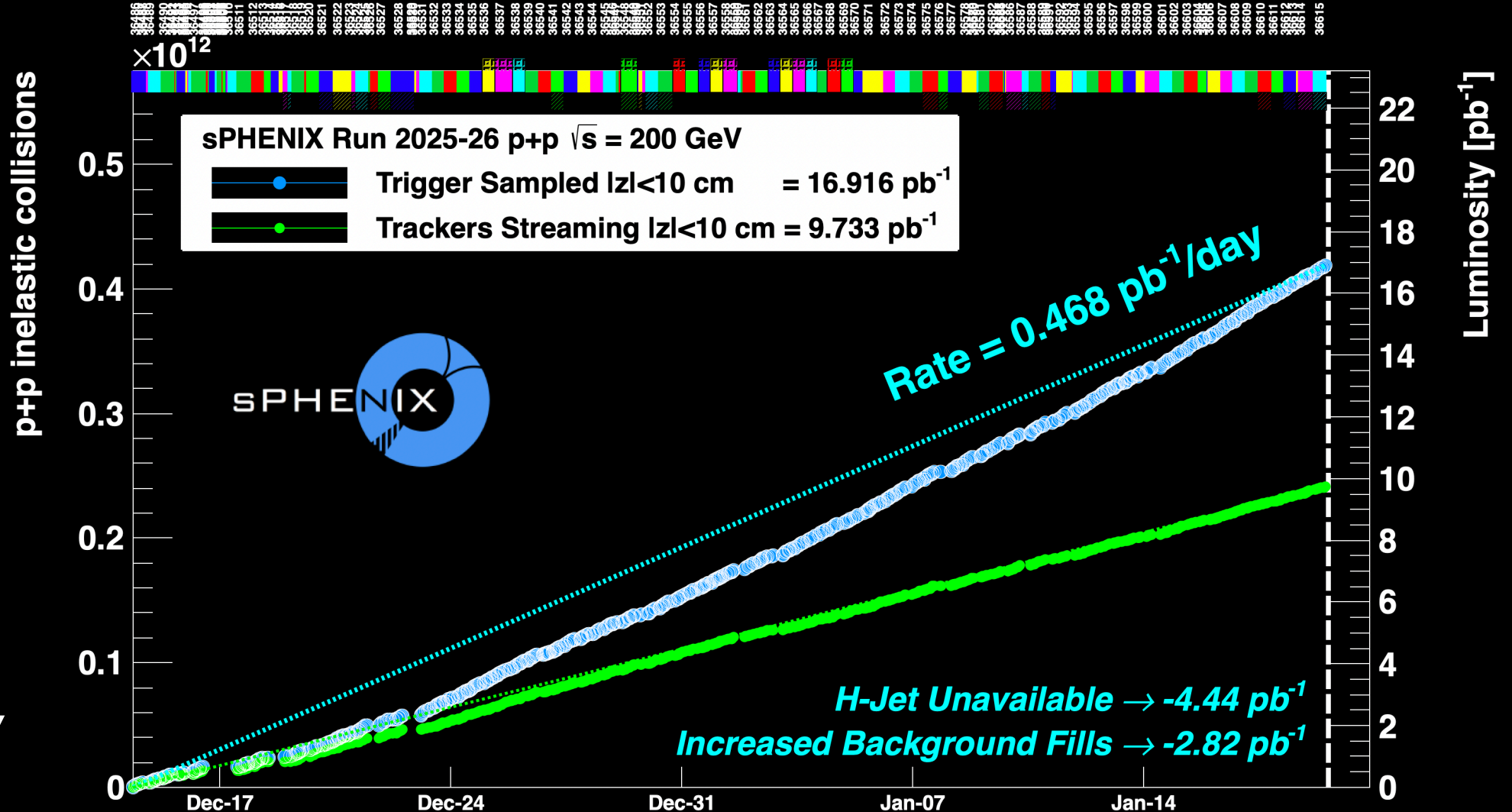
# p+p Luminosity and Timeline



December 10

First p+p collisions and experimental setup (especially trigger)

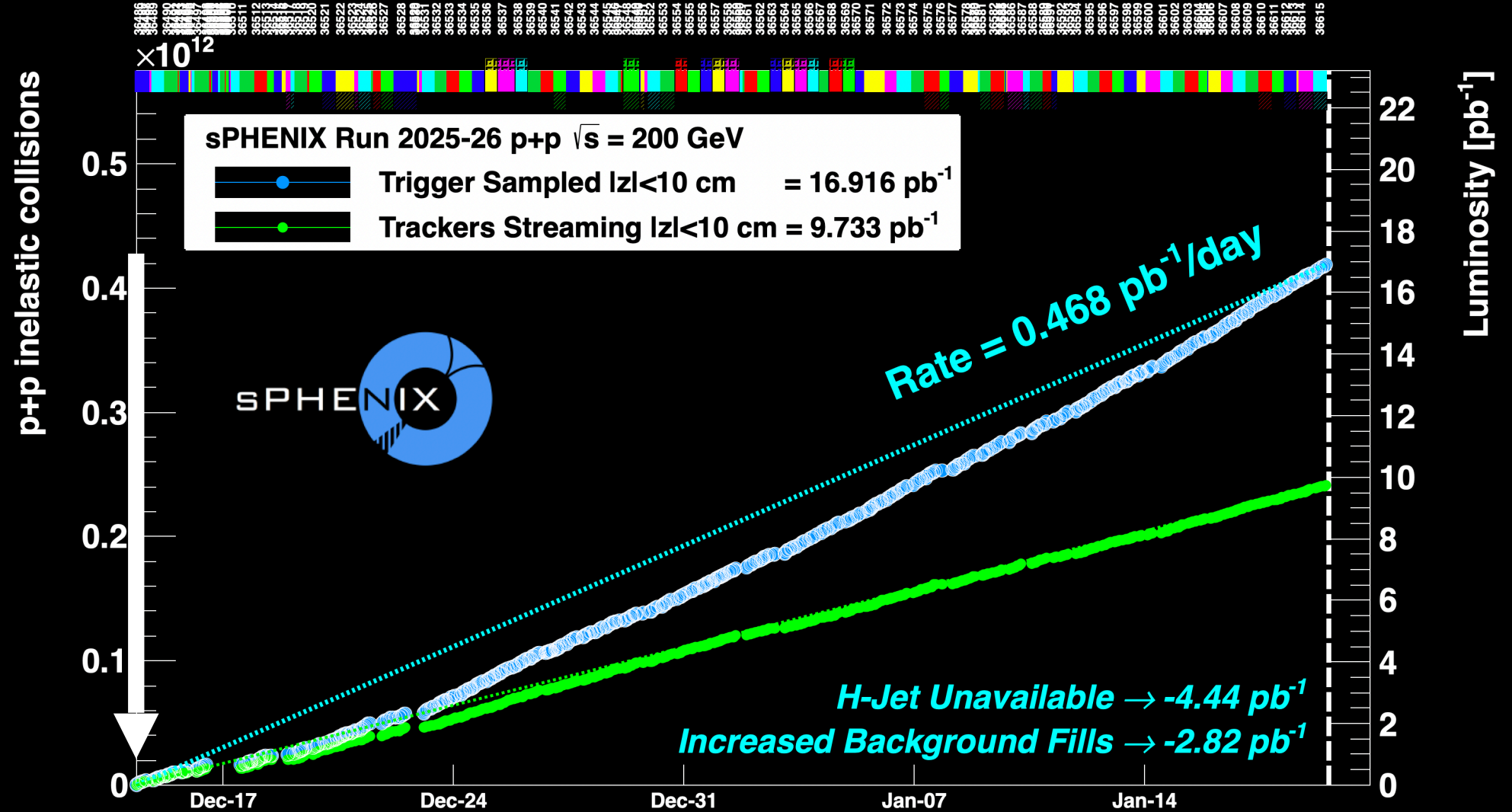
Only two days after end of Au+Au!



# p+p Luminosity and Timeline



December 14  
sPHEENIX  
starts  
luminosity  
counting

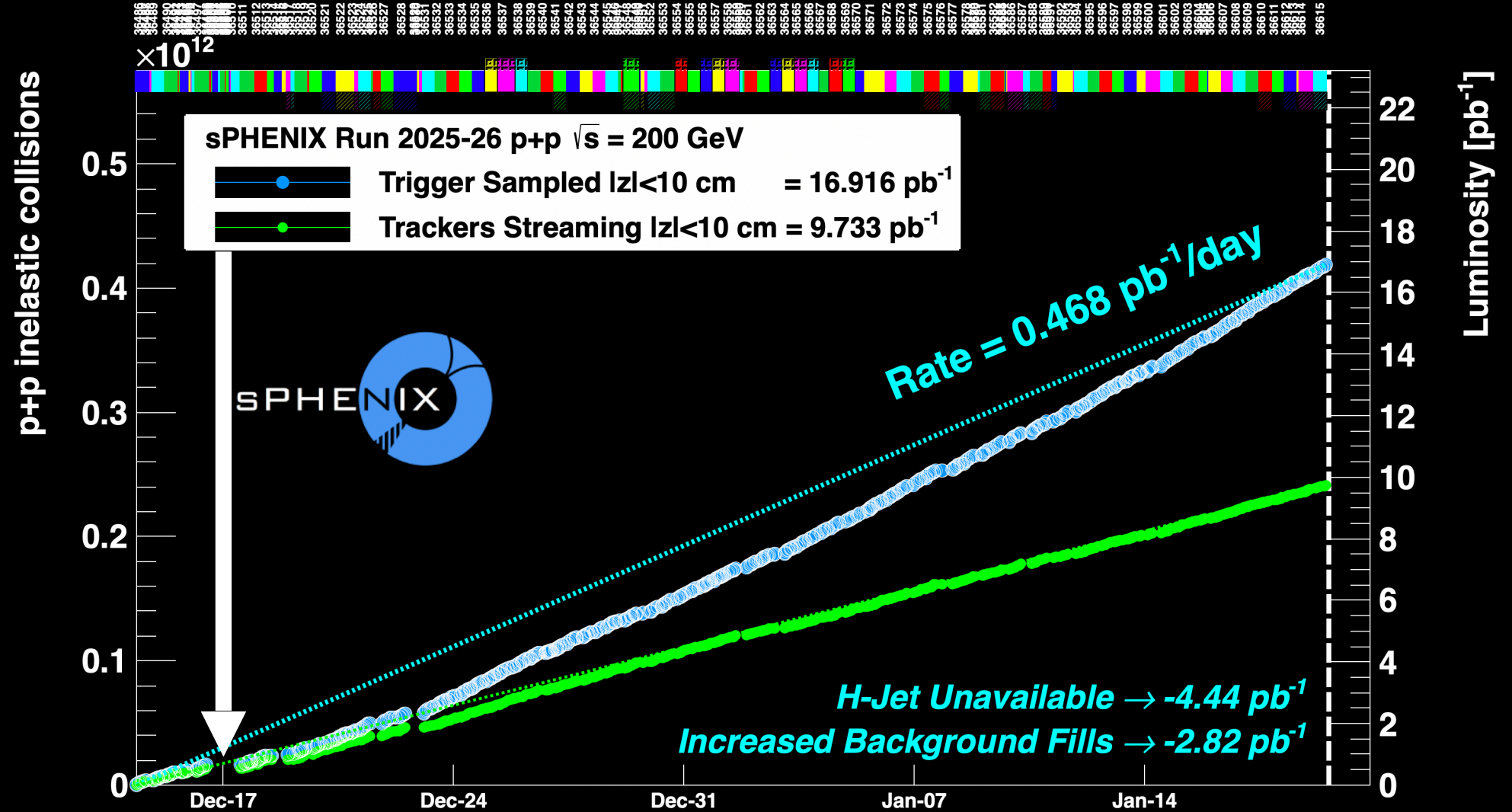


# p+p Luminosity and Timeline

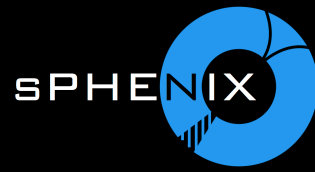


December 17

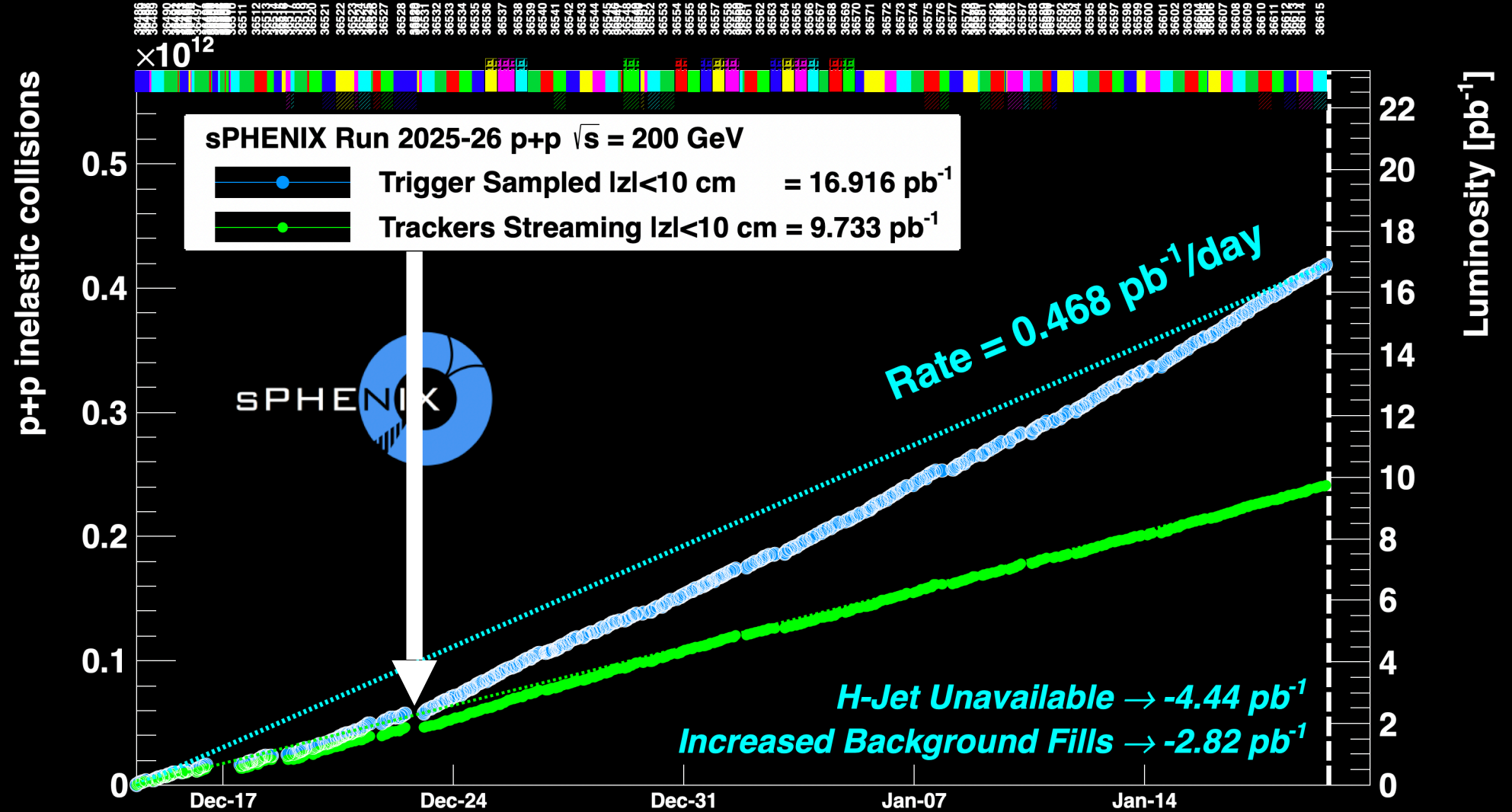
APEX



# p+p Luminosity and Timeline



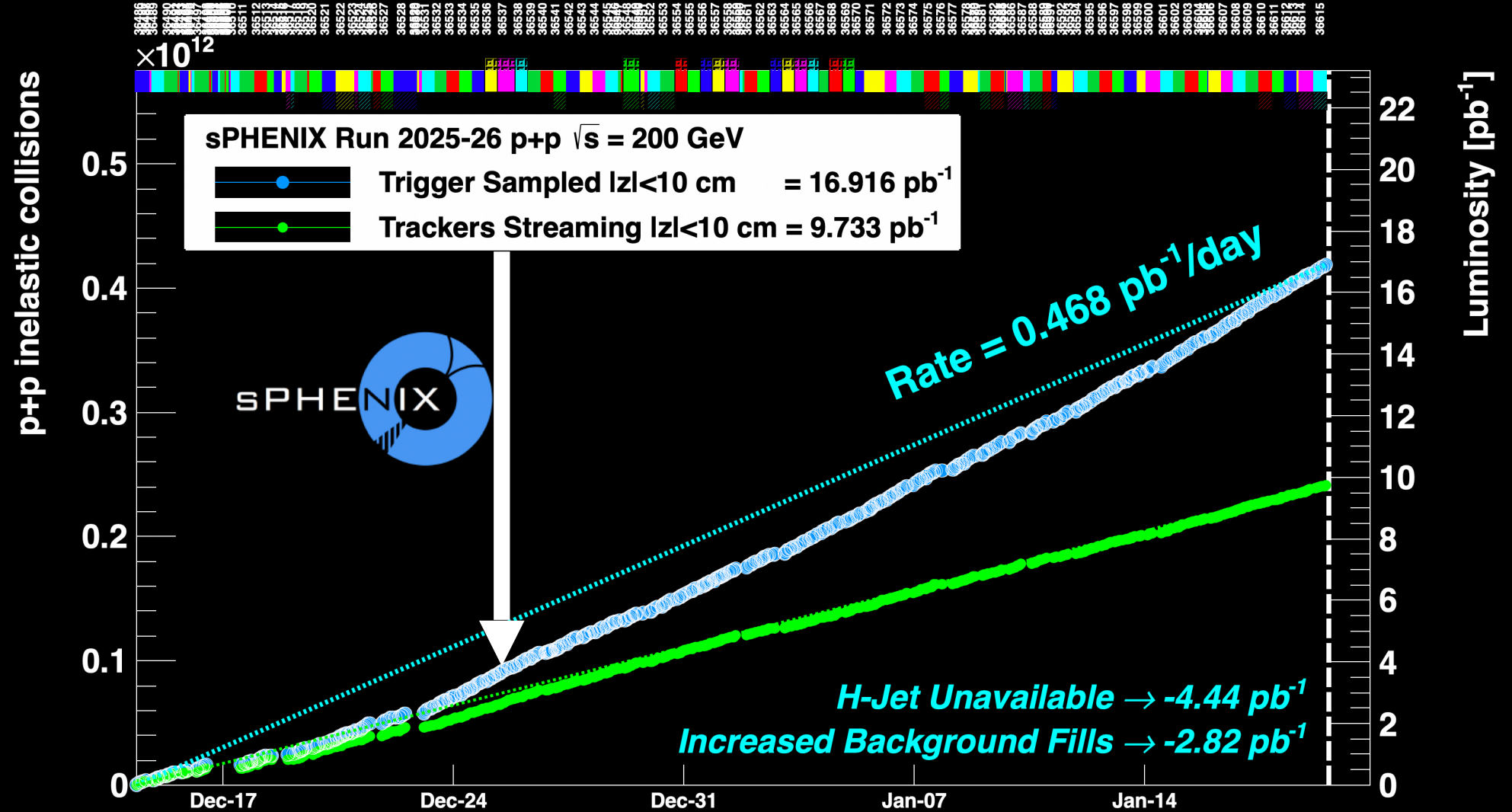
December 23  
Maintenance  
Day



# p+p Luminosity and Timeline



December 25  
Santa comes  
to 1008

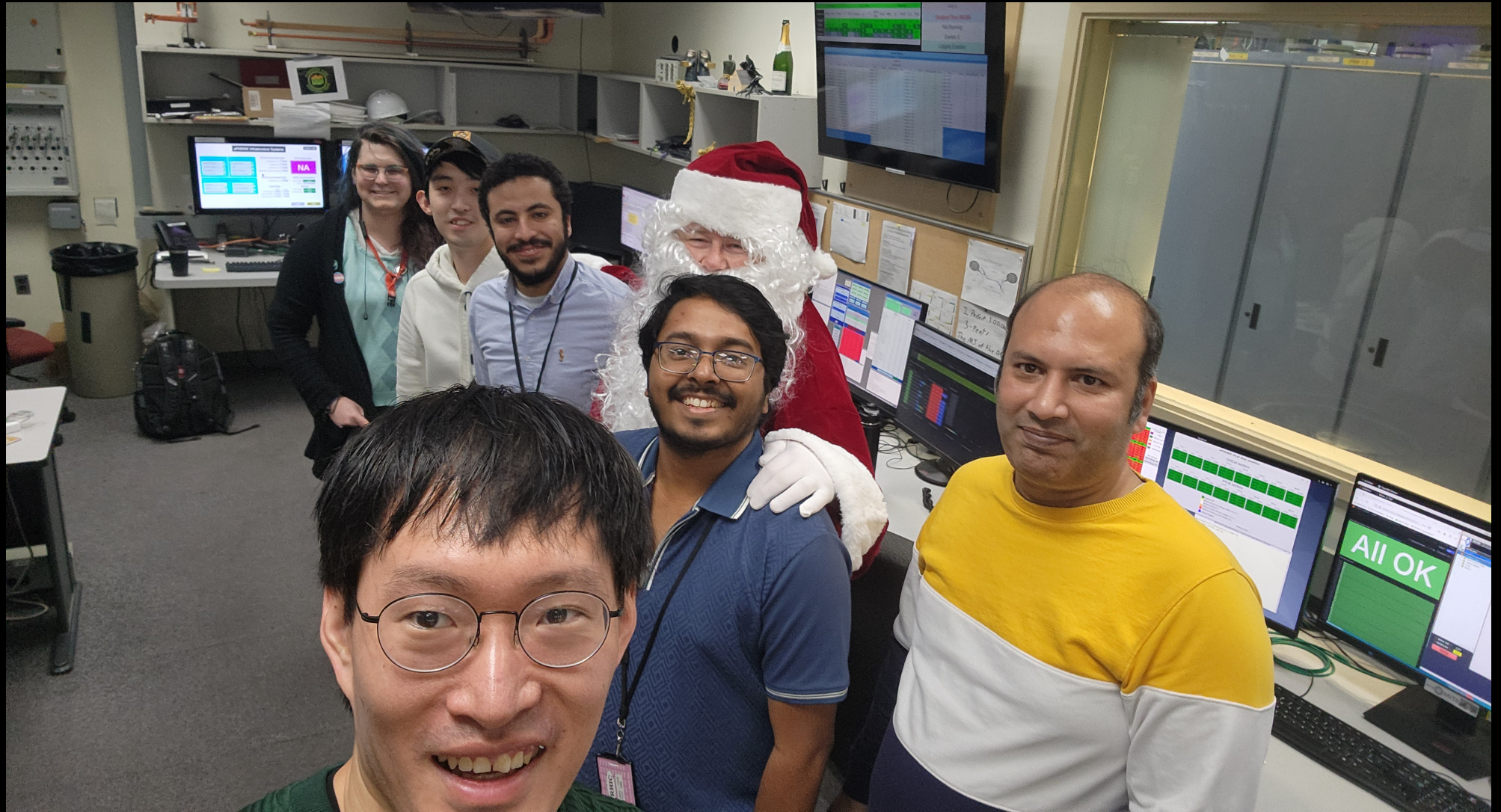


# p+p Luminosity and Timeline



December 25

Santa comes  
to 1008

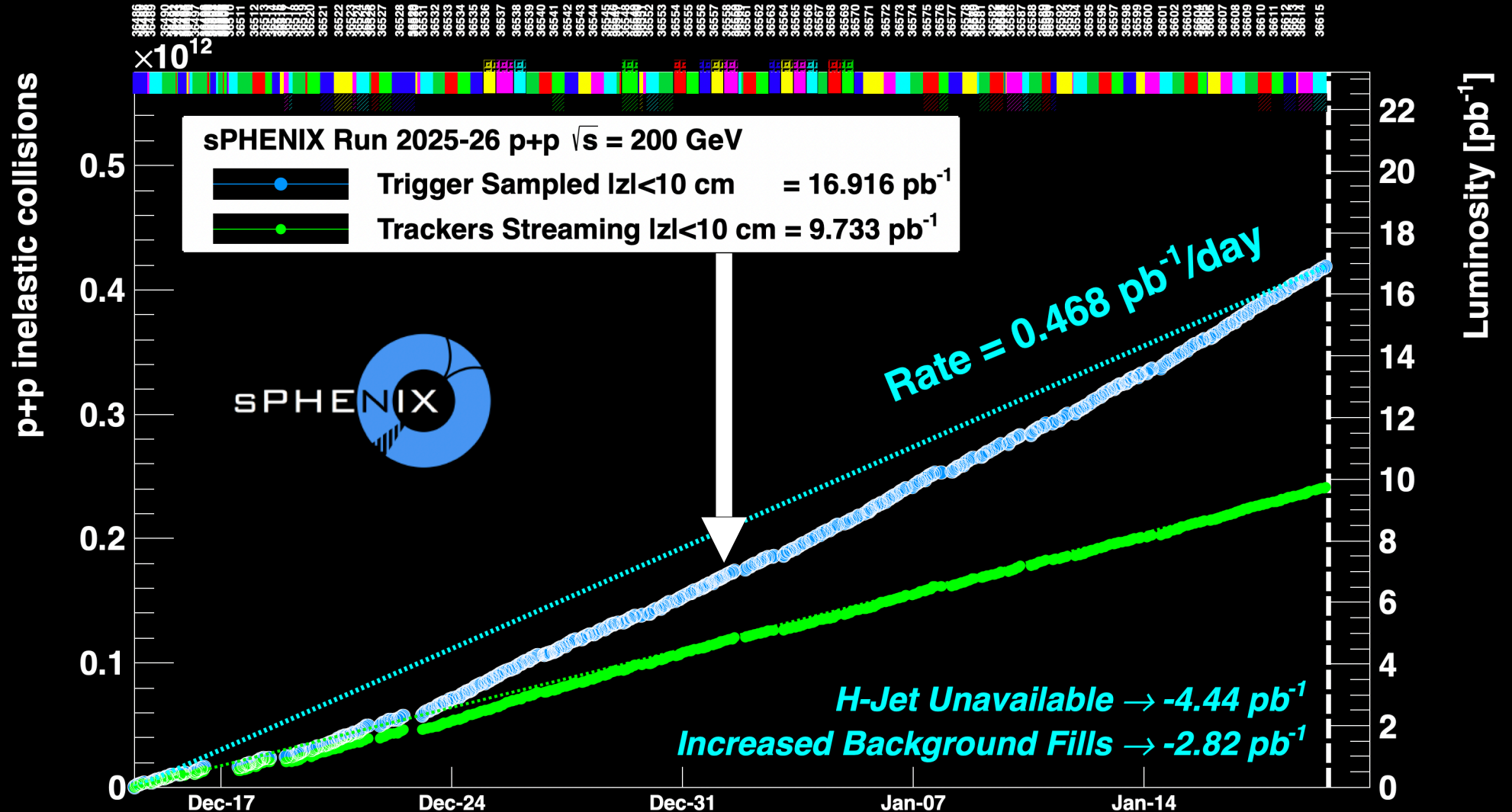


# p+p Luminosity and Timeline



January 1

sPHENIX rings  
in the new year



# p+p Luminosity and Timeline

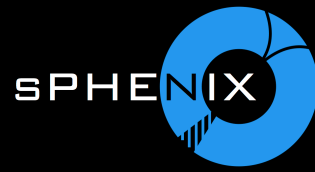


January 1

sPHENIX rings  
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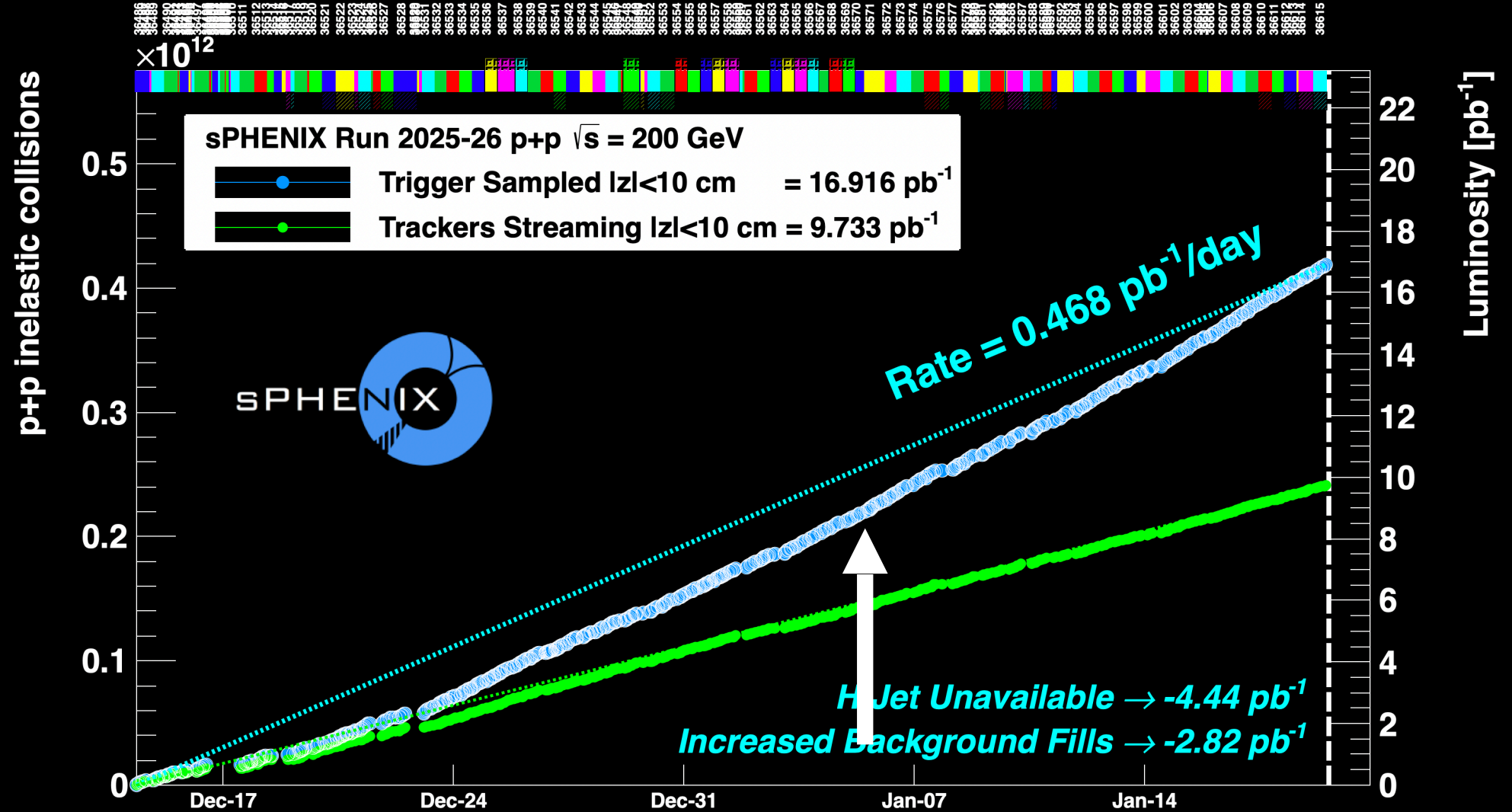


# p+p Luminosity and Timeline



January 5

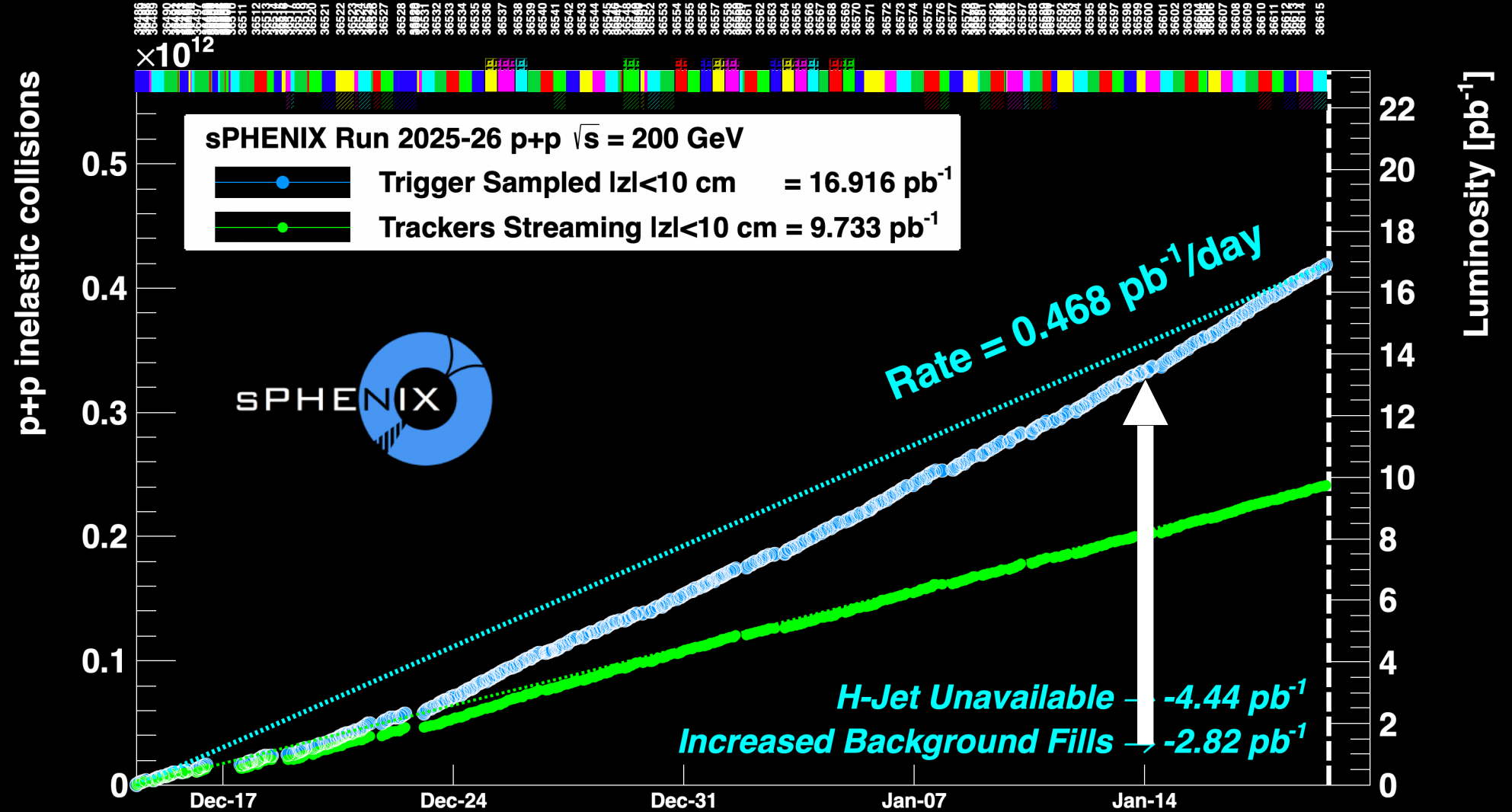
Vernier Scan



# p+p Luminosity and Timeline



January 14  
100% of 13/pb goal reached



# p+p Luminosity and Timeline

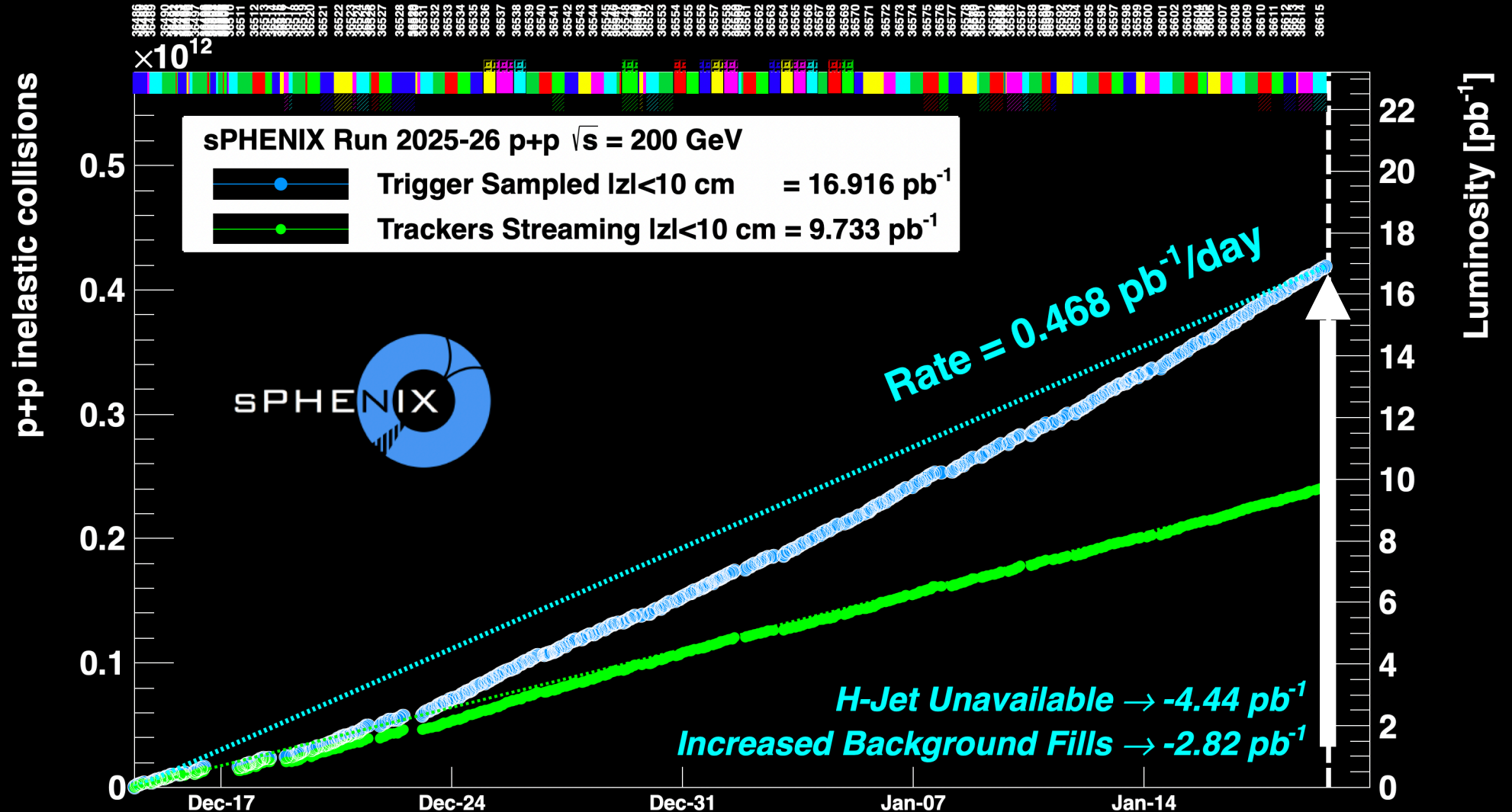


January 20

Final of p+p collisions

16.916/pb sampled, 130% of goal

9.733/pb stream, 249% of goal



# p+p Luminosity and Timeline



January 20

Final of p+p collisions

16.916/pb sampled, 130% of goal

9.733/pb stream, 249% of goal

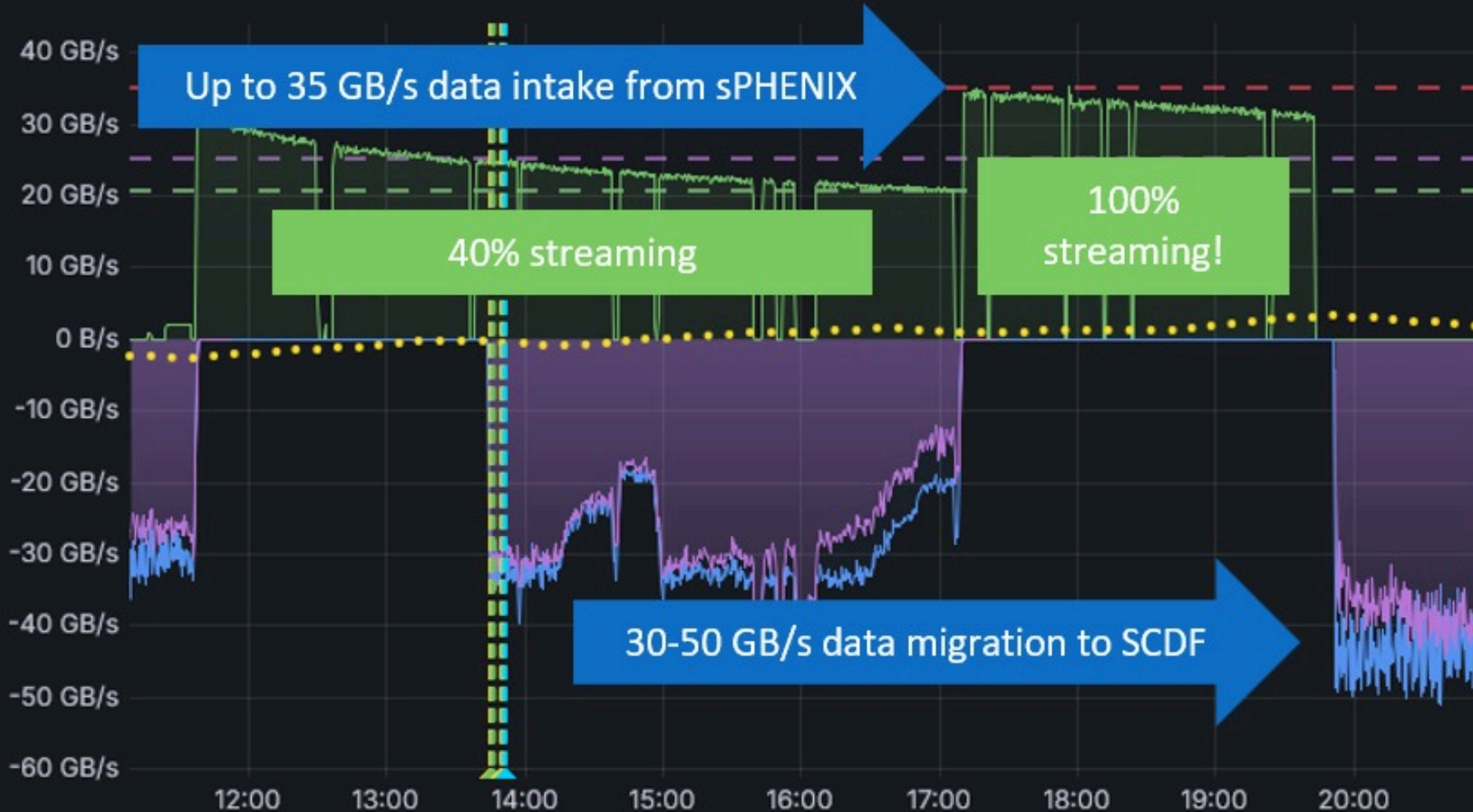


# p+p Operations



Buffer Box Network

sPHENIX Data In/Out (single fill on Jan 19)



- During p+p we were able to operate in 100% streaming mode later in the store
- World-first for 100% streaming in polarized collisions

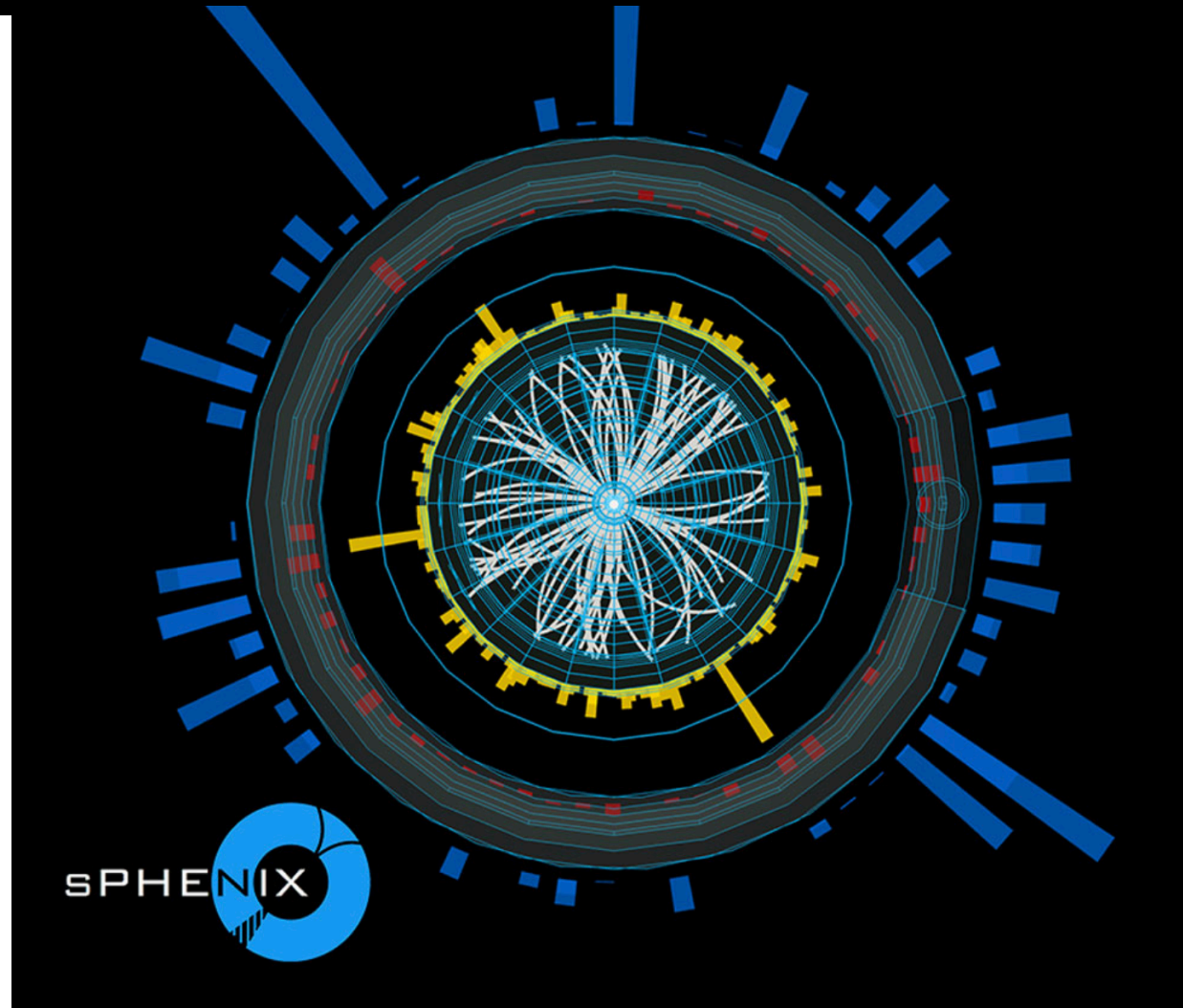
# Intermission

- sPHENIX
- Pre-collision work
- Au+Au
- p+p
- O+O
- Post-collision work, summary and outlook

# Run25 O+O



- Numerous discussions among sPHENIX, STAR, C-AD, and BNL Management to decide what to do with the small amount of remaining time following the completion of p+p
  - Not enough time for p+Au (need 5-7 weeks, have 2-3 weeks)
  - APEX, STAR Fixed Target, and then return to full energy nuclear collisions with O+O
  - RHIC collisions ended on February 6



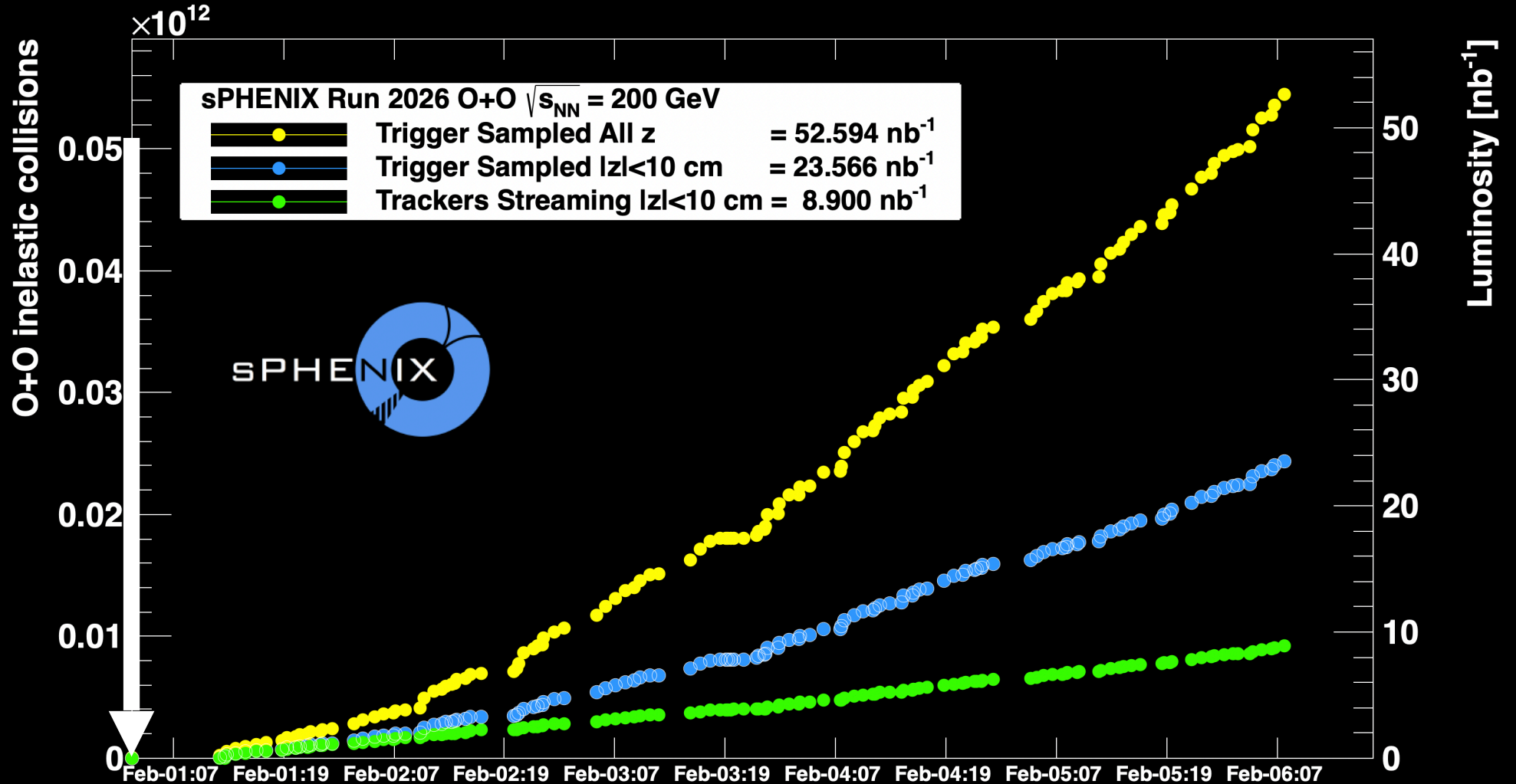
# O+O Luminosity and Timeline



January 31

C-AD does all machine development in a single 16 hour shift!

First collisions just before midnight



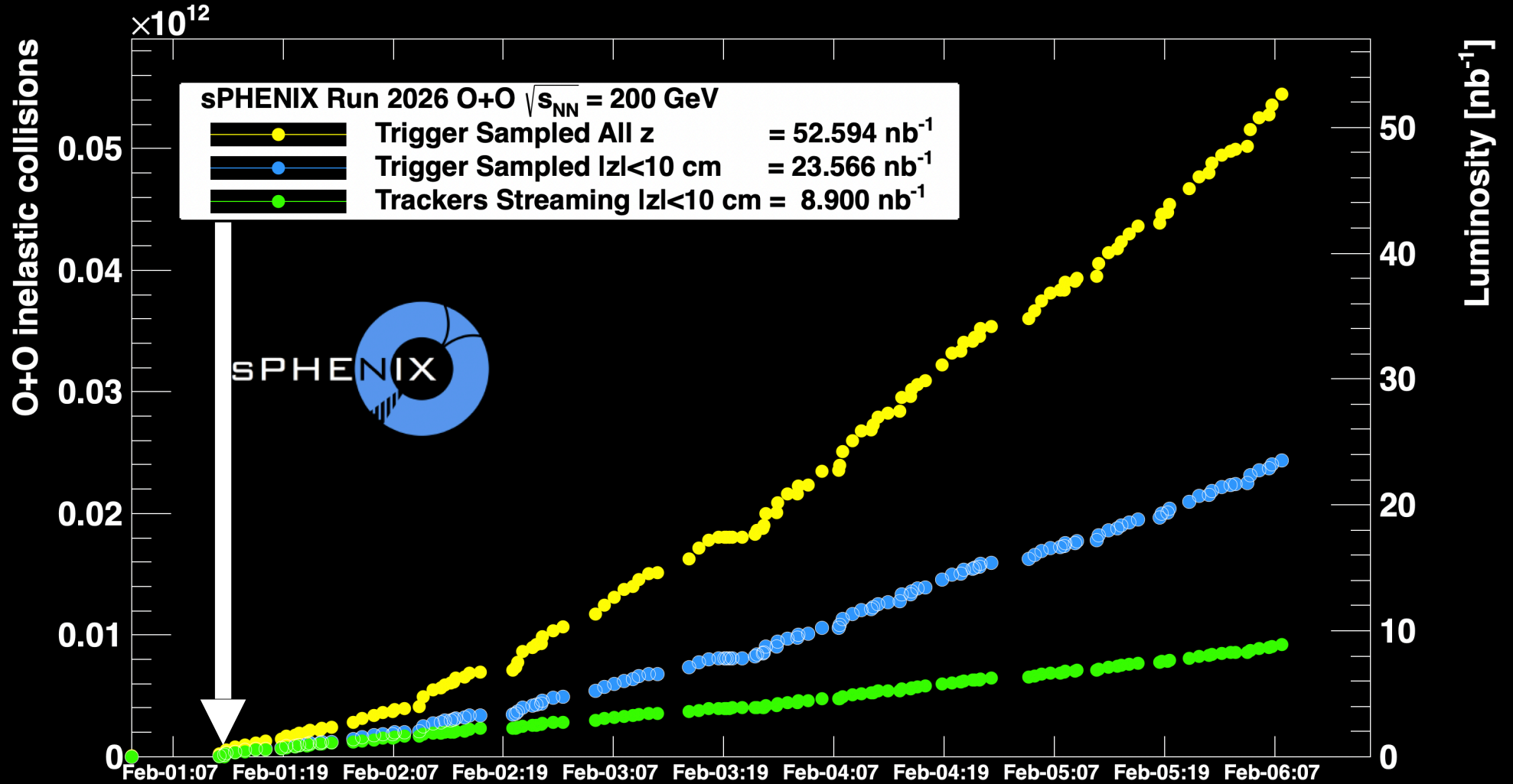
# O+O Luminosity and Timeline



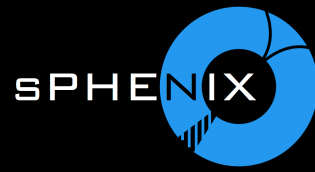
February 1

sPHEENIX starts luminosity counting shortly after first collisions

(complex, pp-like trigger setup)



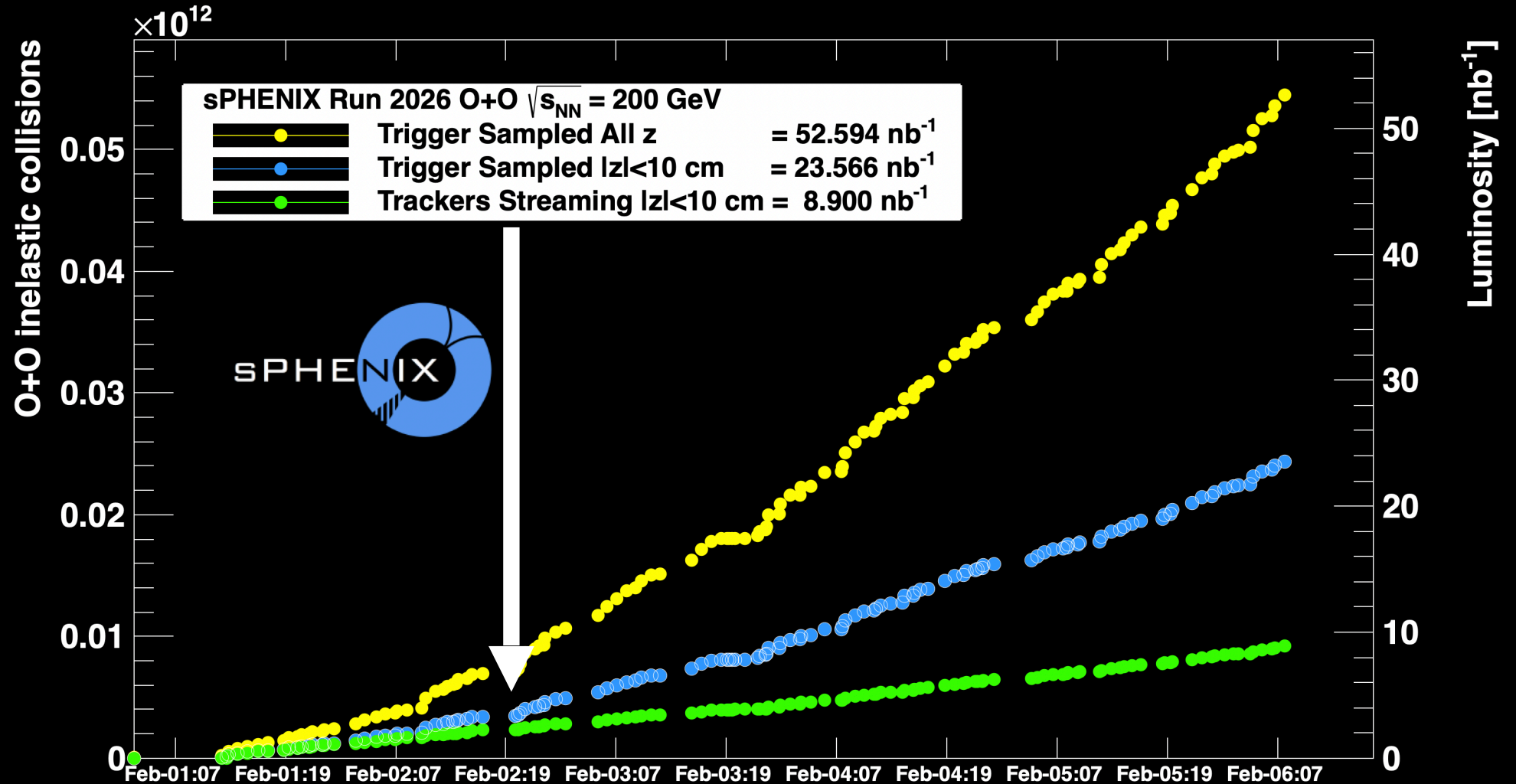
# O+O Luminosity and Timeline



February 2

Vernier Scan

Brief 0.5 mrad test (returned to 0.75 mrad)

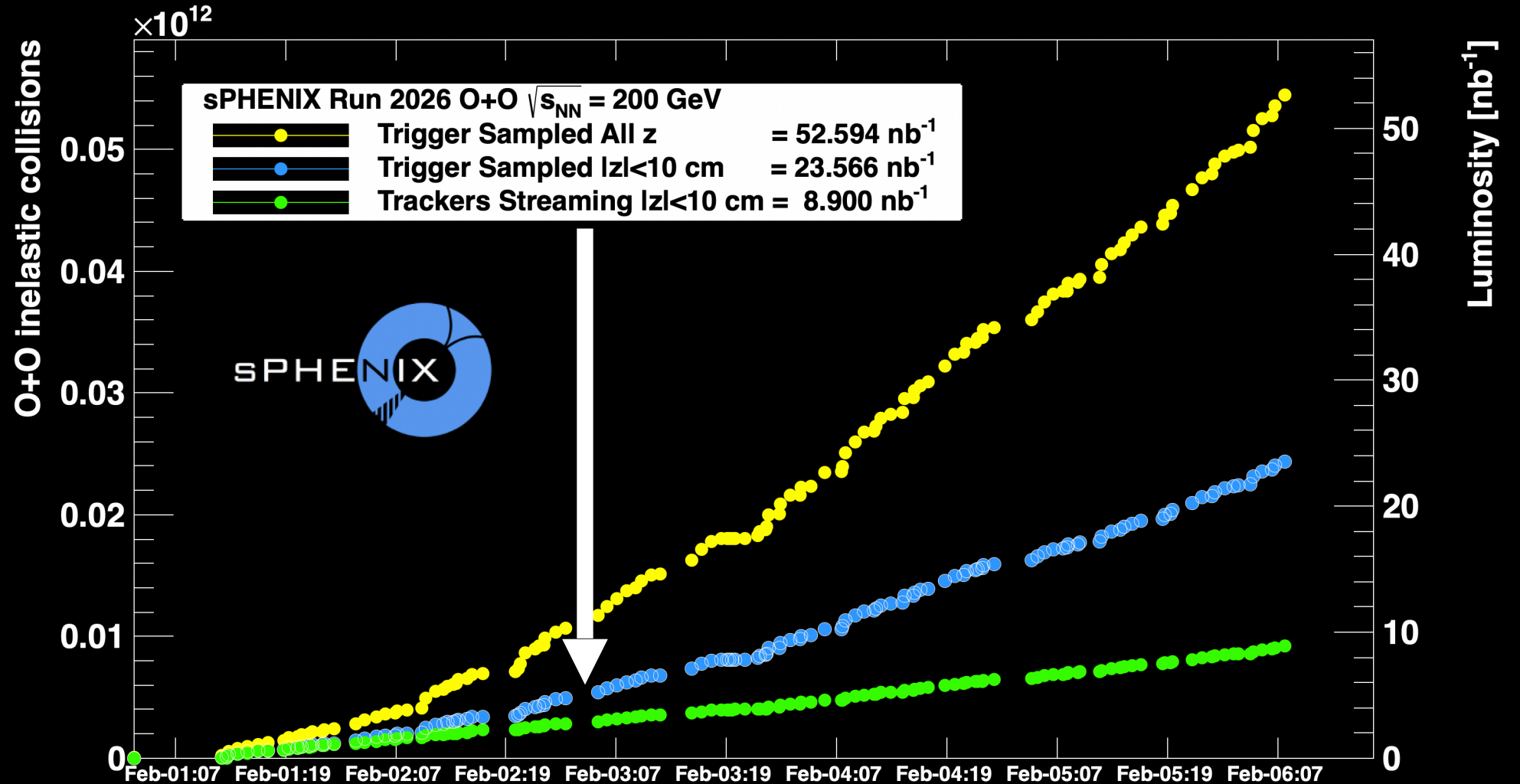


# O+O Luminosity and Timeline



February 3

“At least 4/nb”

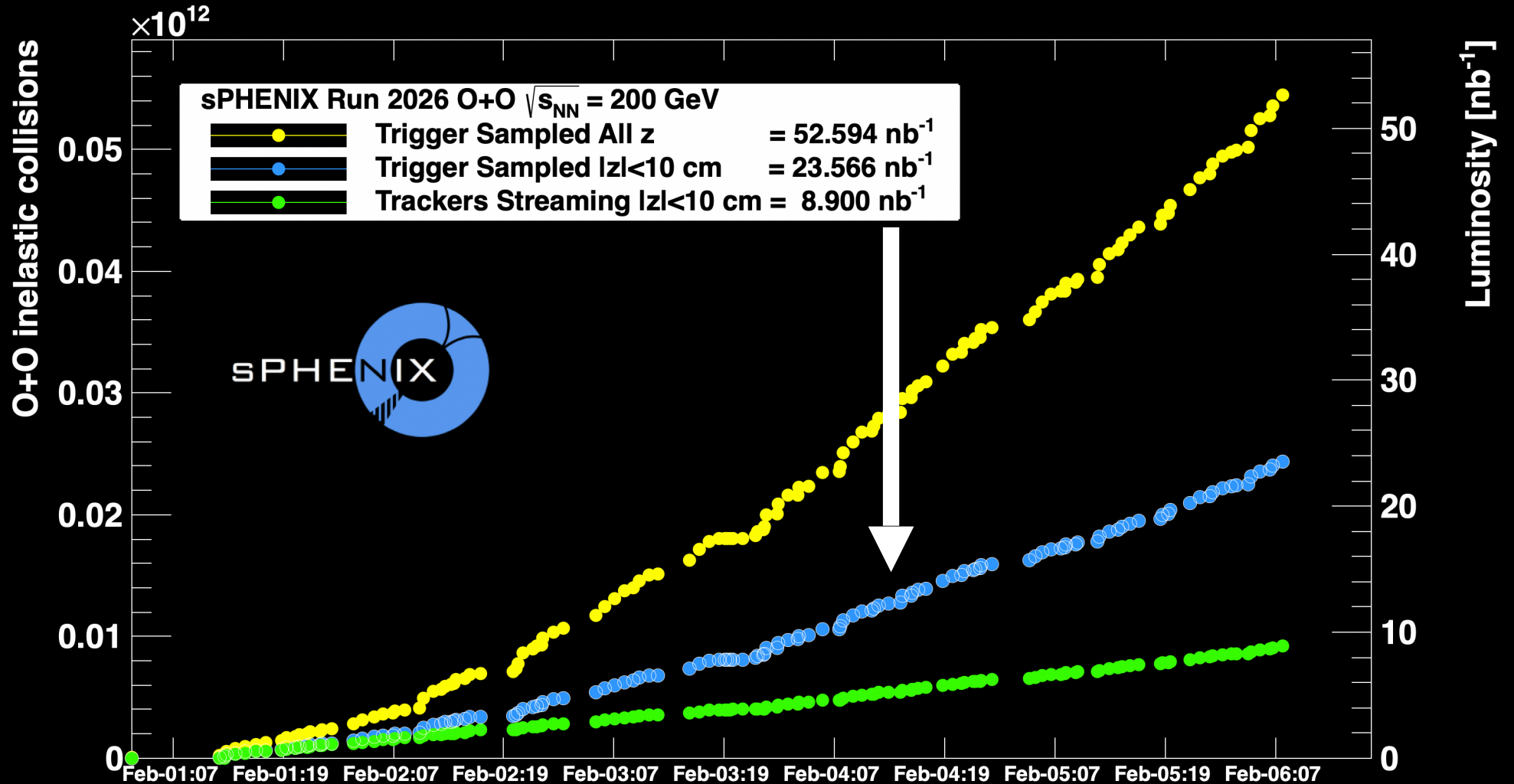


# O+O Luminosity and Timeline



February 4

Two-week program goal of 13/nb achieved after about 4 days of running



# O+O Luminosity and Timeline

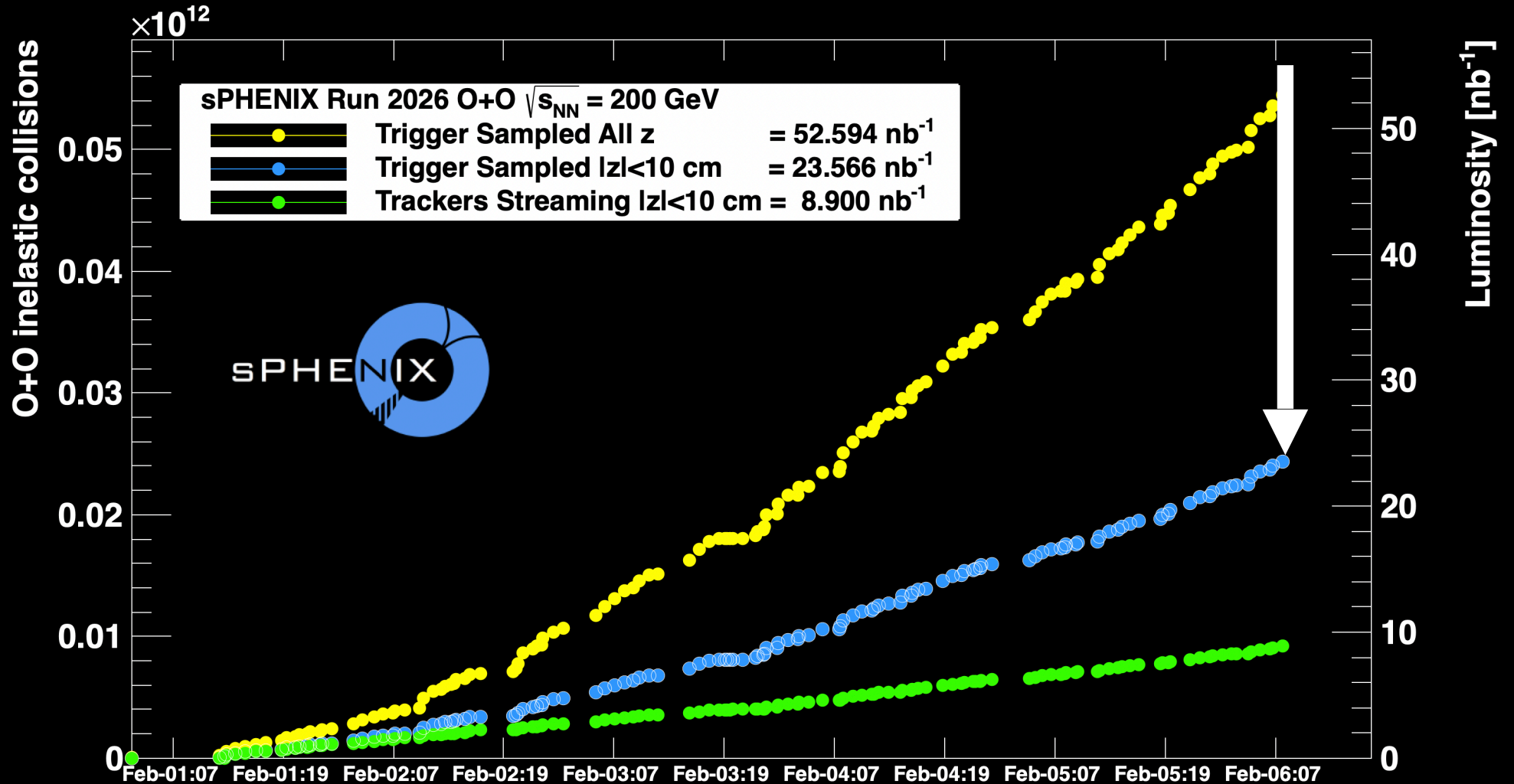


February 6

23.566/nb  
sampled, 182%  
of goal

8.900/nb  
tracking, 228%  
of goal

52.594/nb calo,  
404% of goal



# THE END: Friday 2026-02-06 at 9:08 EST



# Intermission

- sPHENIX
- Pre-collision work
- Au+Au
- p+p
- O+O
- **Post-collision work, summary and outlook**

# Post-collision operations



Feb 6–20  
TPC line laser calibrations



Feb 21  
Final shift crew, final cosmic run



Detector and lights off

Feb 22–24  
Historic blizzard  
20 inches at BNL



# 647 shifts covered by 193 shifters



# Summary



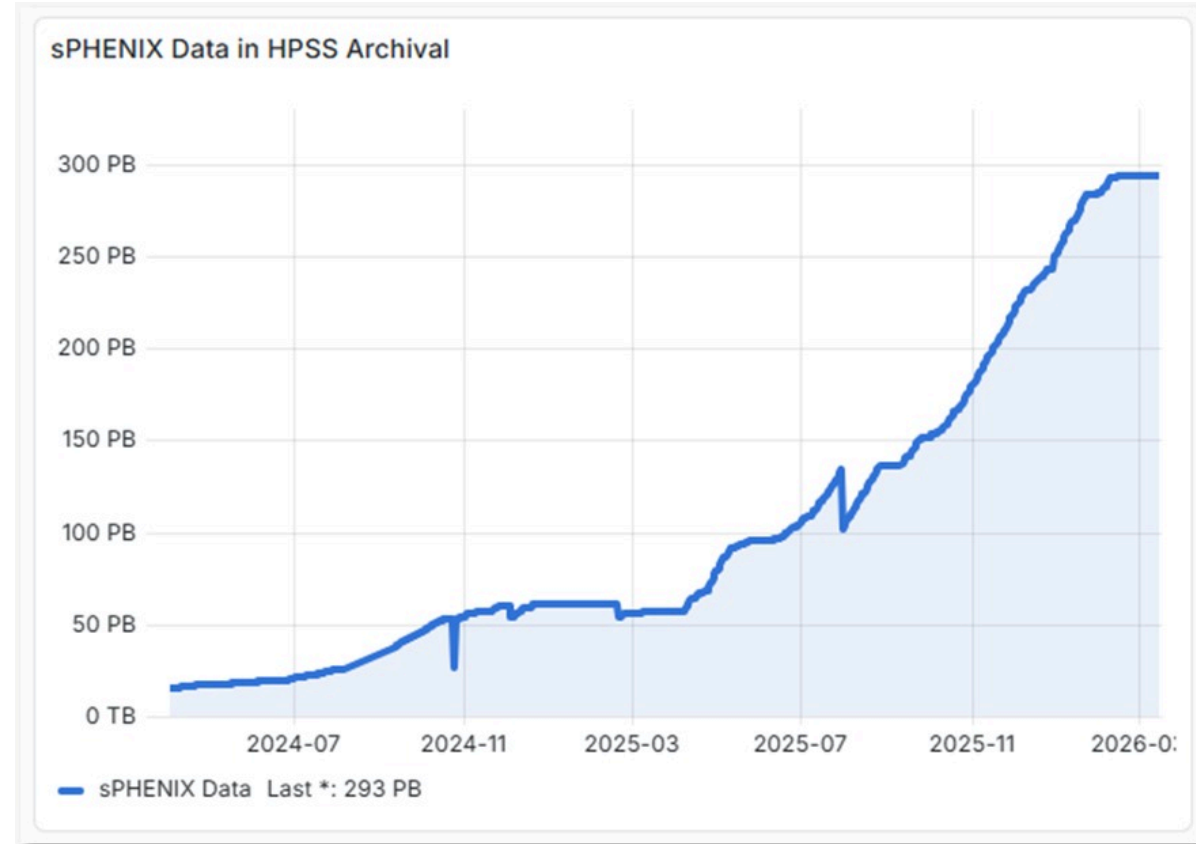
- 369 shift change meetings
- 182 days of Au+Au, 6.6/nb, 94% of goal
- 41 days of p+p, 16.7/pb, 130% of goal
- 5.3 days of O+O, 23.6/nb, 182% of goal
- Many thanks to the ALD and BNL for supporting the RHIC science mission
- Phenomenal, heroic efforts by C-AD and MCR made this possible— thanks!!



# Summary



- sPHENIX data taking has come to an end
- The era of sPHENIX analysis is upon us!  
More than 200 PB in Run25 and nearly 300 PB total



# sPHENIX at AUM26



- Tanner Mengel: sPHENIX Physics Highlights [plenary]
- Megan Connors: Completing the sPHENIX Scientific Mission [plenary]
- Mariia Mitrankova: Measurements of EM-probes at PHENIX and sPHENIX [workshop]
- Hanpu Jiang: Recent Jet Measurements from sPHENIX [workshop]
- Shuhang Li: sPHENIX CycleGAN [workshop]
- David Park: sPHENIX Foundation Models [workshop]
- Chenxi Ma: Study of Differential Nonlinearity in TPC Cluster Reconstruction [poster]
- Chenliang Jin: Direct Laser Likelihood Fit Method for sPhenix TPC Distortion Study [poster]
  
- Expect to see some collaborators among awardees as well!
  
- And be sure to check out non-sPHENIX talks by sPHENIX collaborators
  - Tristan Protzman: STAR Run Report
  - Yeonju Go: Jets & Hard Probes workshop summary
  - Cameron Dean: AI/ML workshop summary
  - Axel Dress: The status of the field before RHIC
  - Bill Zajc: PHENIX spokesperson talk
  - Gunther Roland: PHOBOS spokesperson talk
  - Rosi Reed: from RHIC to EIC
  - John Lajoie: Lessons from RHIC in designing ePIC

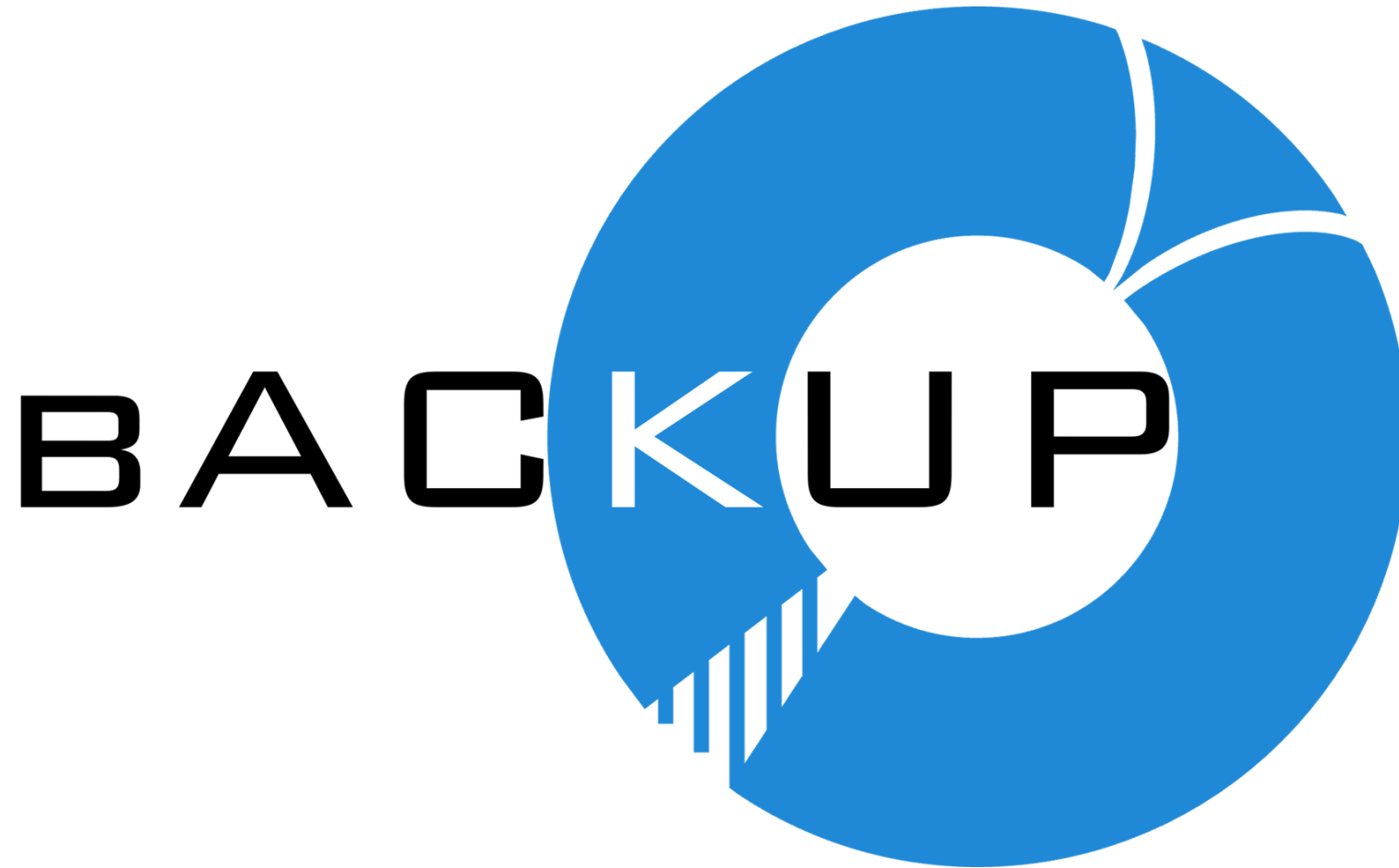
# Many Thanks to the Previous Run Coordinators



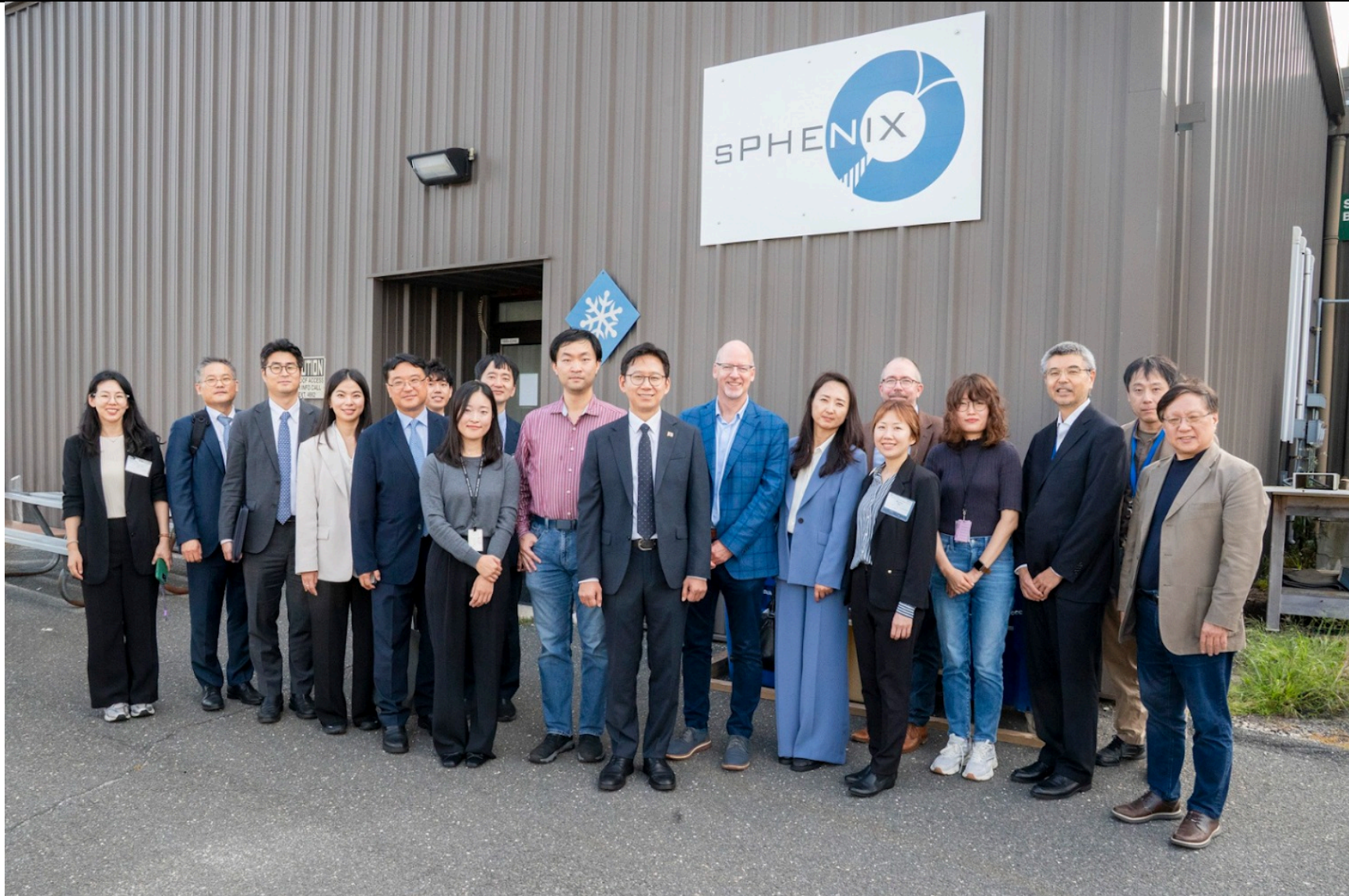
- The massive success of Run25 would not have been possible without the dedication and tireless efforts of the previous Run Coordinators
- Run23: Stefan Bathe
- Run24: Jamie Nagle

• NB: Sam approves

# Intermission



# Visit from Minister of Science of Korea and delegation: September 23, 2025



# Visit from Nobel Laureate Barry Barish and CalTech delegation: April 28, 2025



Rosi Reed and Ron Belmont

# Au+Au Operations — TPC



- TPC GEM current load and data volume very sensitive to backgrounds
- Tests determined 1.0 mrad crossing was optimal

