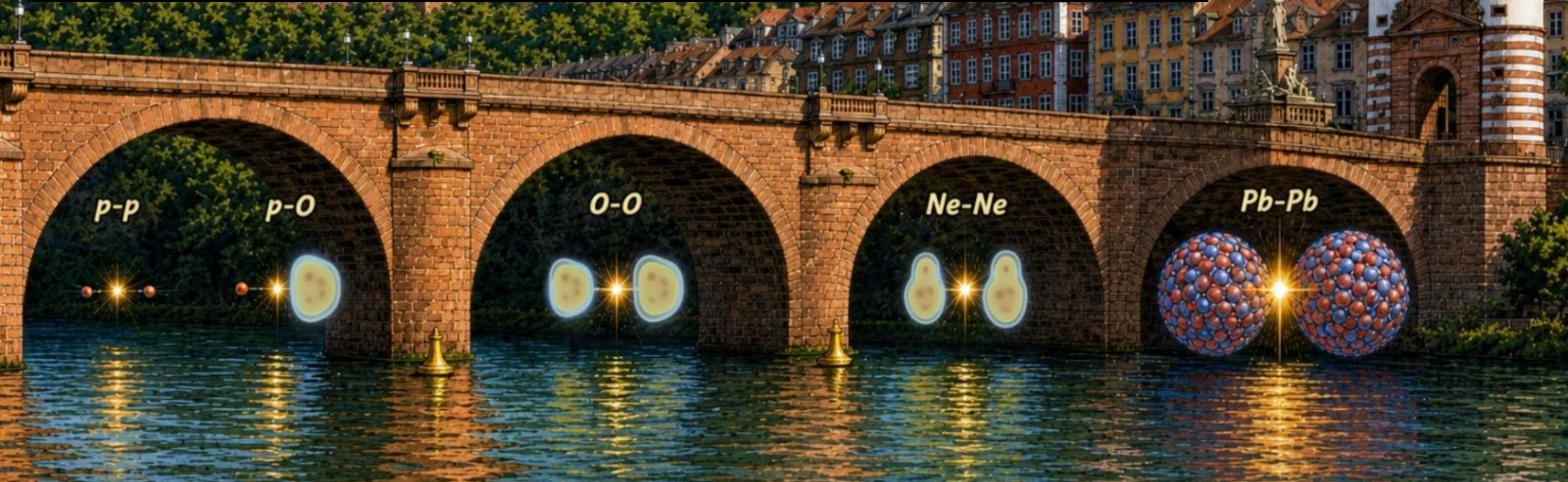


The sPHENIX physics program in O+O collisions at RHIC

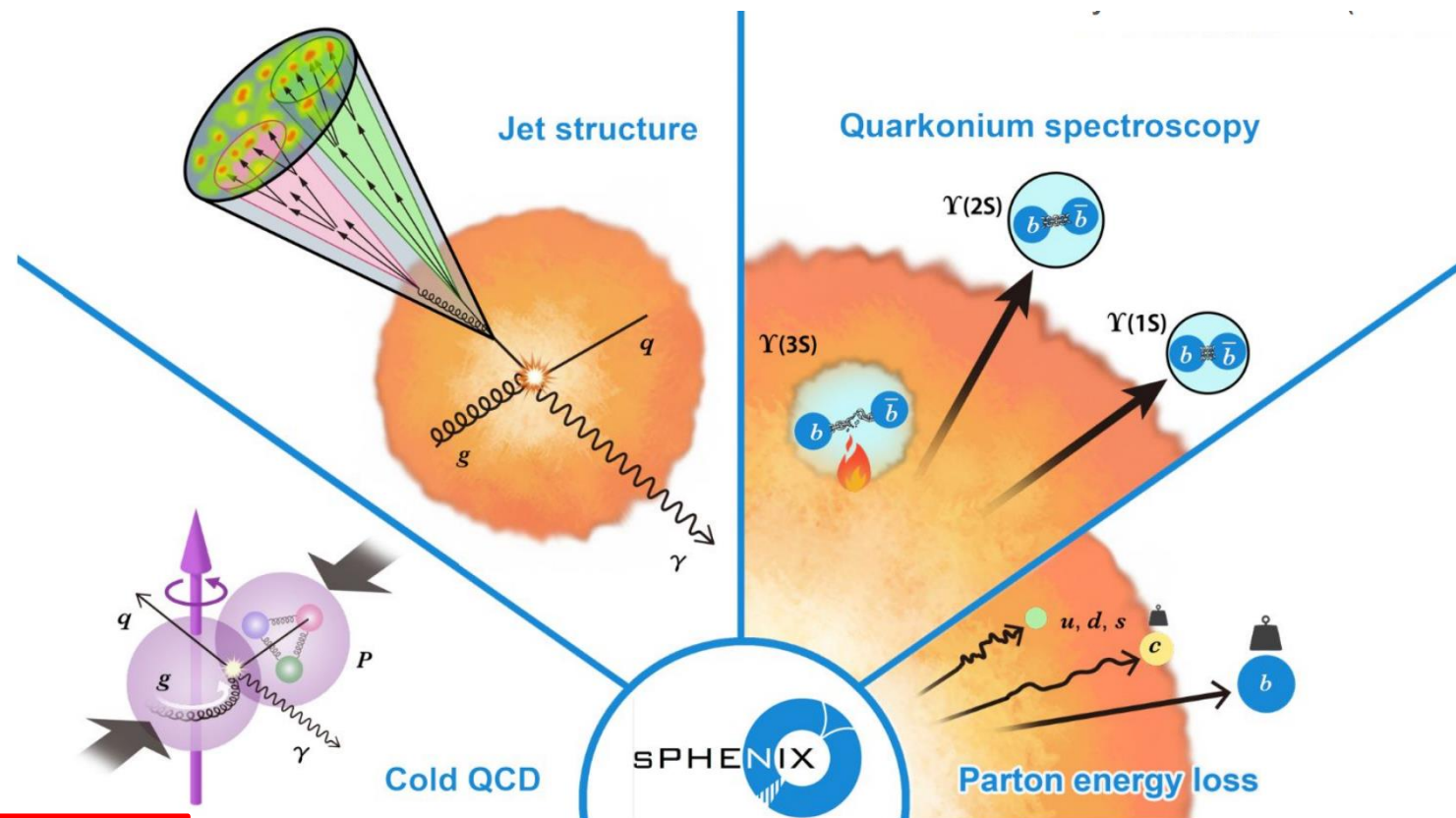
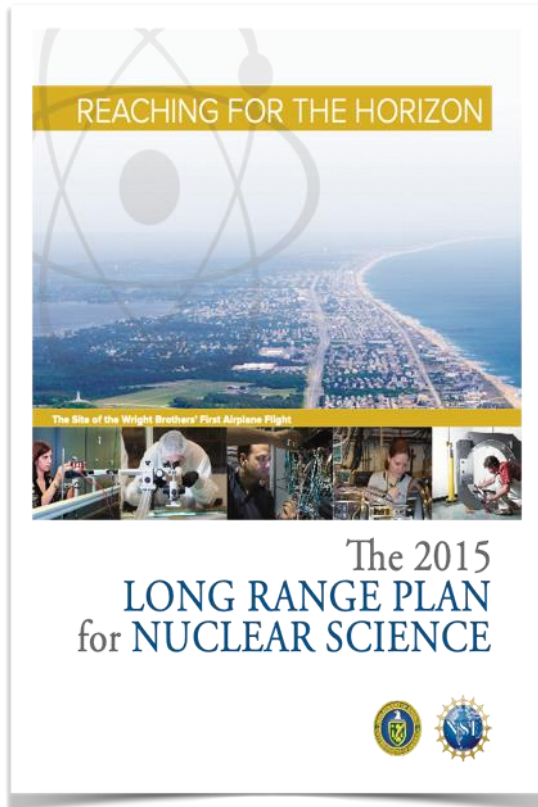
September 21st, 2026



Rosi Reed
Lehigh University
on behalf of the sPHENIX Collaboration

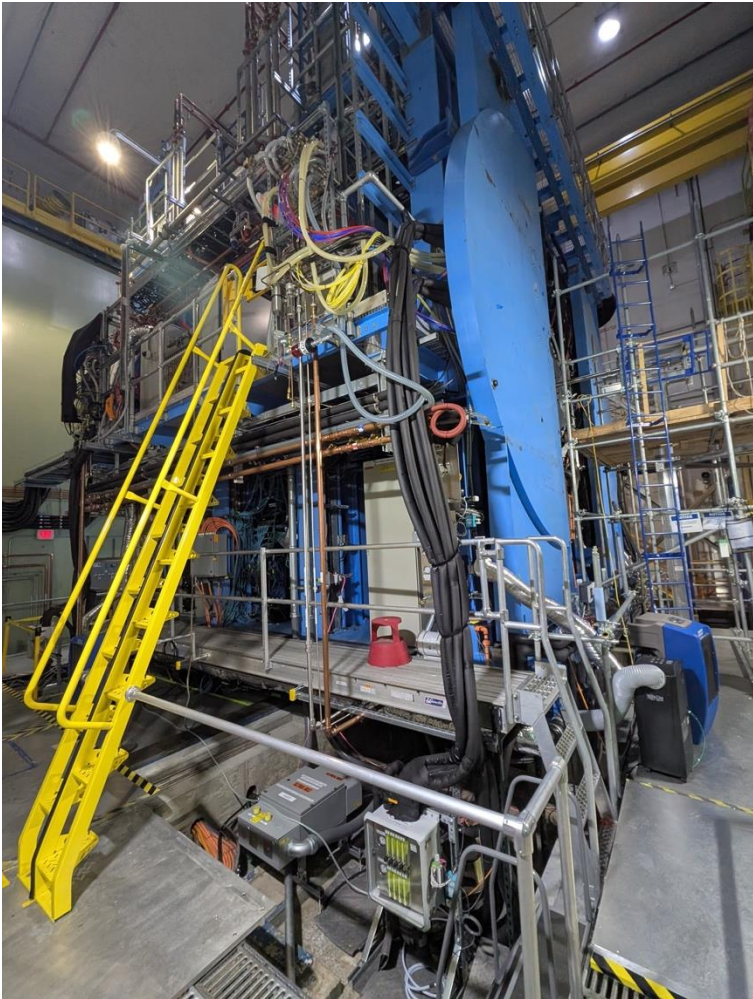
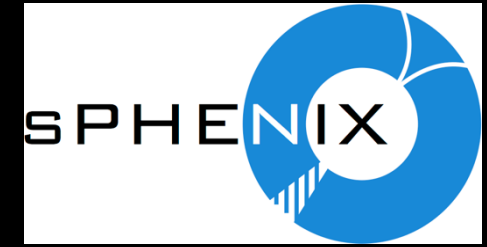


sPHENIX Science Mission



“Probe the inner workings of QGP by resolving its properties at shorter and shorter length scales. The complementarity of [RHIC and the LHC] is essential to this goal, as is a **state-of-the-art jet detector at RHIC, called sPHENIX.**”

sPHENIX Detector and Program



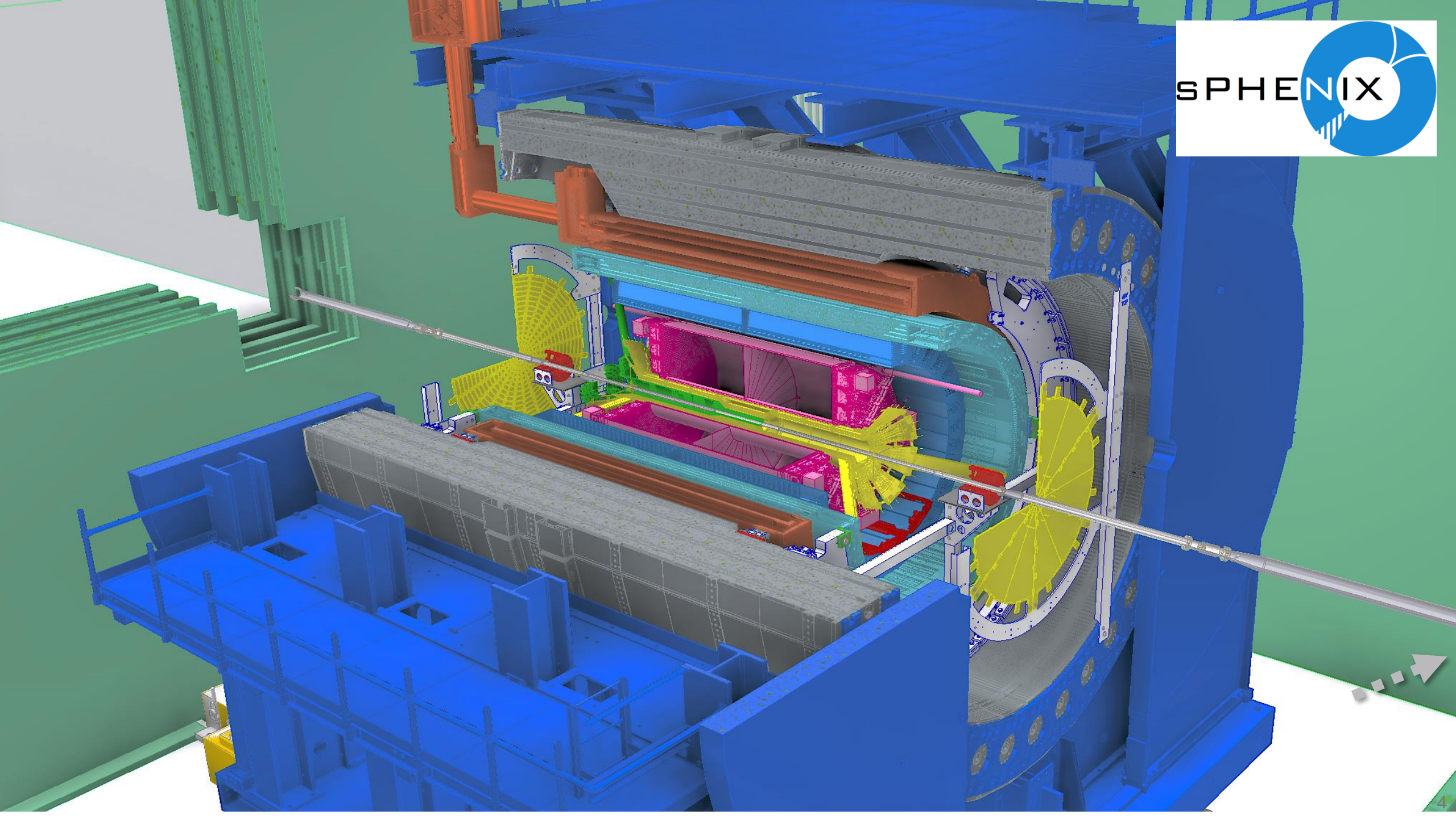
Detector installation completed in 2023

2023: Detector Commissioning with Au+Au

2024: Polarized p+p, Au+Au Commissioning

2025: Au+Au, polarized p+p, O+O

p+p	Au+Au	O+O
115 pb ⁻¹ Jet/ γ triggers	6.6 nb ⁻¹ Minimum Bias Trigger	53 nb ⁻¹ Jet/ γ triggers
11 pb pb ⁻¹ Streaming (Trackers)		8.9 nb ⁻¹ Streaming (Trackers)



Multi-subsystem tracking for
precision vertexing
 $O(10\mu\text{m})$, **timing** and
momentum resolution $\Delta p/p$
 $\sim 1\%$ at 500 MeV with PID via
 dE/dx at momentum



MAPS-based Vertex
Detector (MVTX)

Intermediate Silicon
Tracker (INTT)

Time Projection
Chamber (TPC)

TPC Outer Tracker
(TPOT)

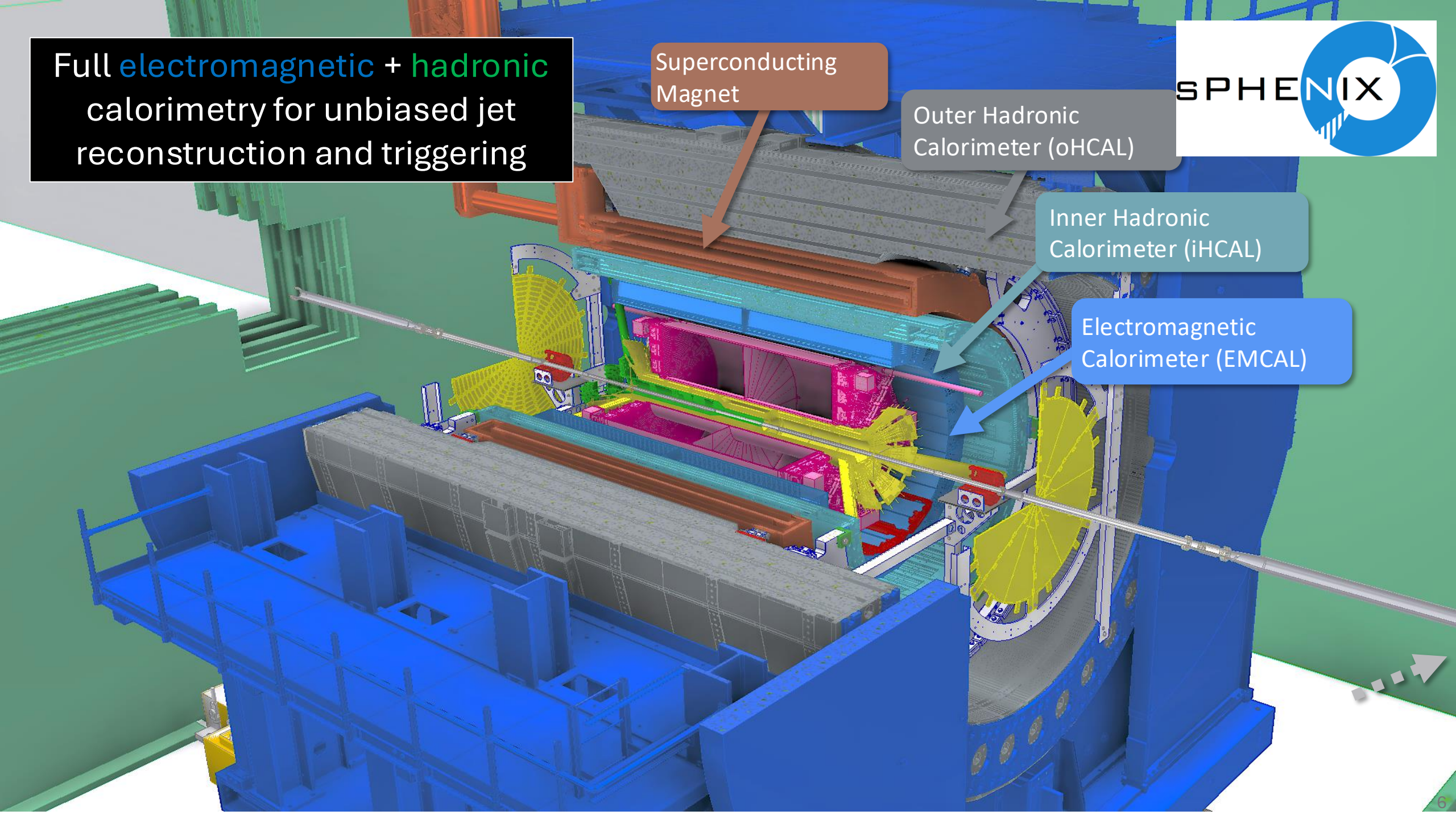
Full **electromagnetic** + **hadronic**
calorimetry for unbiased jet
reconstruction and triggering

Superconducting
Magnet

Outer Hadronic
Calorimeter (oHCAL)

Inner Hadronic
Calorimeter (iHCAL)

Electromagnetic
Calorimeter (EMCAL)



Forward Detectors for
Event selection,
Centrality calibration,
and **Event Plane**
determination

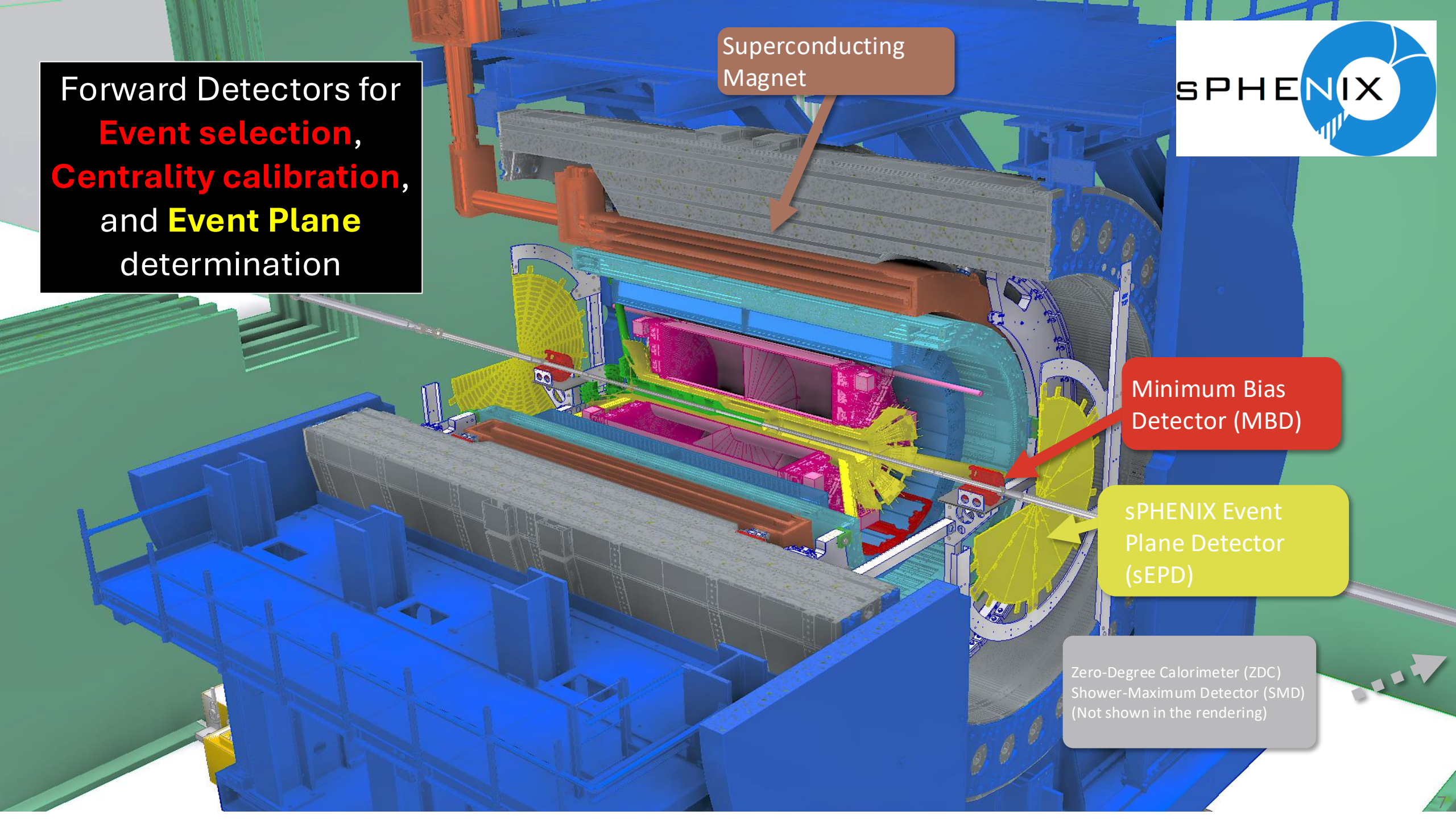
Superconducting
Magnet

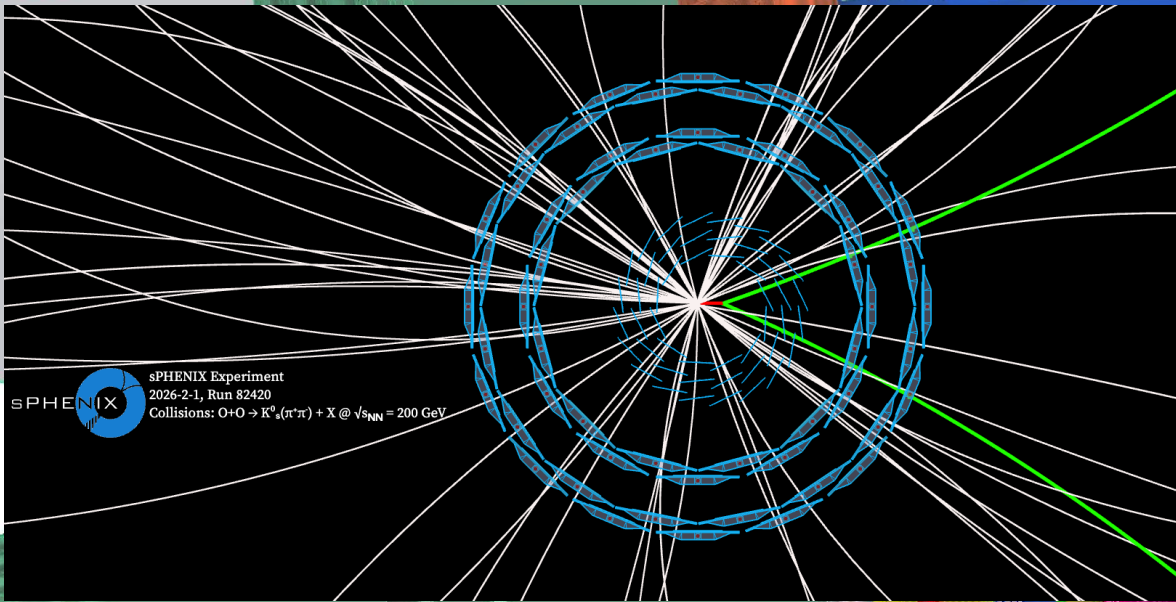


Minimum Bias
Detector (MBD)

sPHENIX Event
Plane Detector
(sEPD)

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





Superconducting Magnet

Outer Hadronic Calorimeter (oHCAL)

Inner Hadronic Calorimeter (iHCAL)

Electromagnetic Calorimeter (EMCAL)

Minimum Bias Detector (MBD)

sPHENIX Event Plane Detector (sEPD)

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

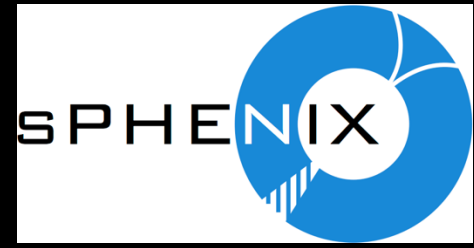
MAPS-based Vertex Detector (MVTX)

Intermediate Silicon Tracker (INTT)

Time Projection Chamber (TPC)

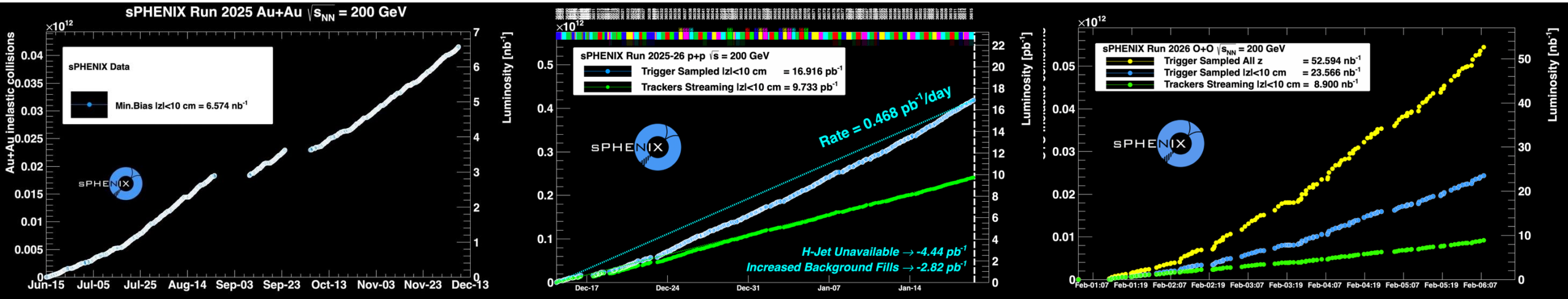
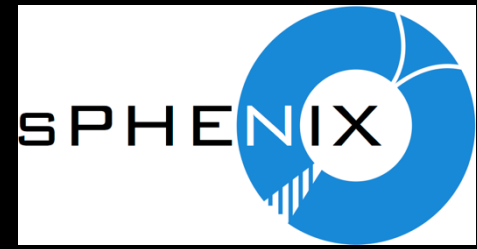
TPC Outer Tracker (TPOT)

Nominal Operations



- Calorimeter system and global detectors run in triggered only
 - Trigger system runs at up to 15 kHz!
- Tracking system designed to run in continuous streaming readout mode
 - Enables additional open HF physics
 - Streaming goal of 30% for Run25
 - 13/pb of trigger-sampled = 3.9/pb of streaming
 - First polarized 100% streaming collider detector in the world
- Recorded ~300 PB of data

Run 25 in a Nutshell

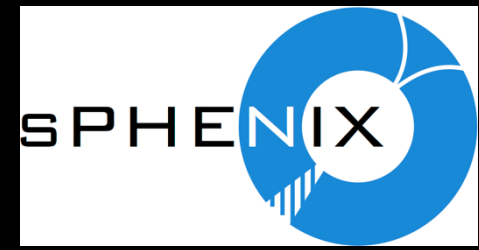


- June 9, 2025: first Au+Au collisions
- December 8, 2025: final Au+Au collisions
- December 10, 2025: first p+p collisions
- January 20, 2026: final p+p collisions
- January 20-30, 2026: STAR FXT
- January 31, 2026: first O+O collisions
- February 6, 2026: final O+O collisions



Post-collision operations

The end of RHIC Operations



**Entering the era of
analysis!**



Feb 6–20
Last cosmic and TPC laser
calibrations recorded



Feb 21
Final shift crew, final cosmic run



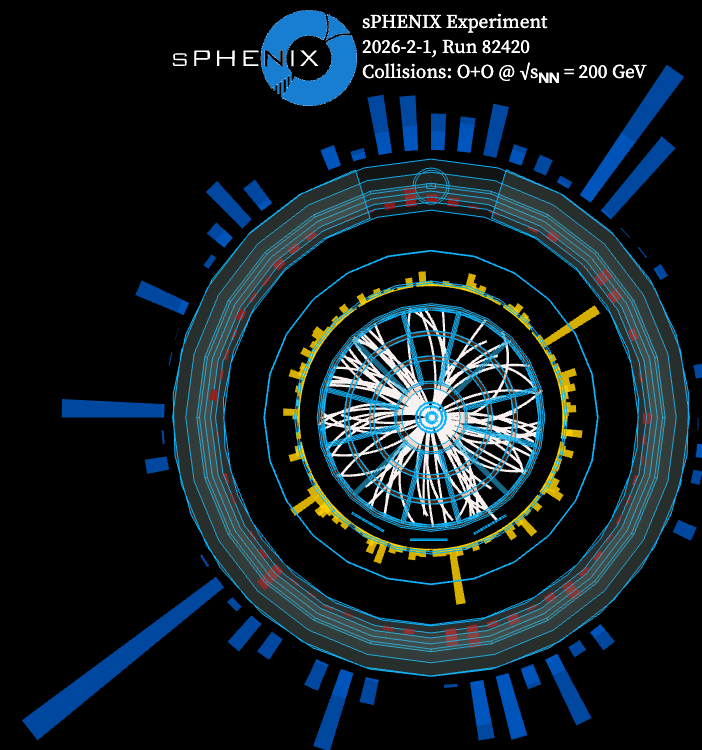
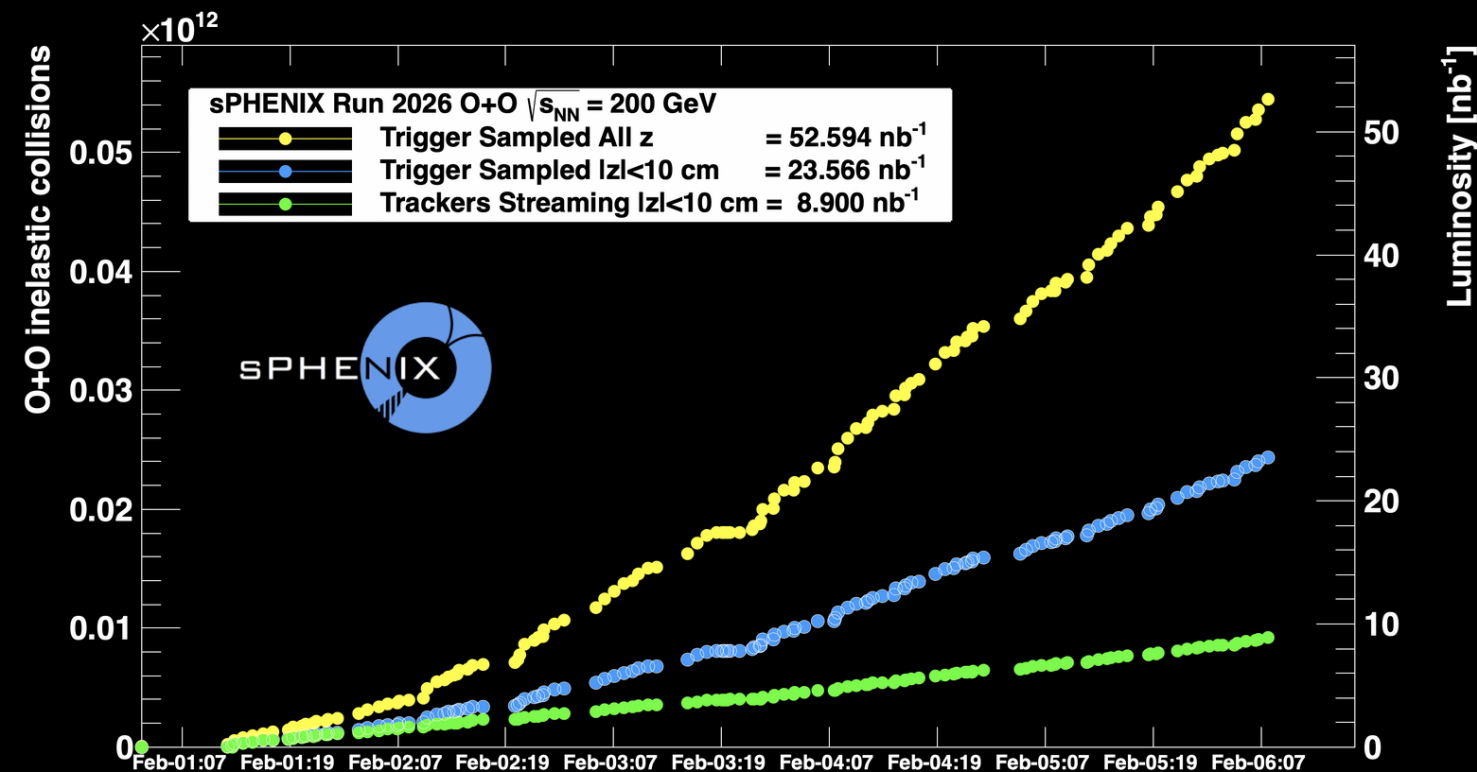
Detector and lights off

Feb 22–24
Historic blizzard
20 inches at BNL



Many thanks to the 193 members of sPHENIX who
provided the 647 shifts needed for 1 year of
continuous operations!

O+O running



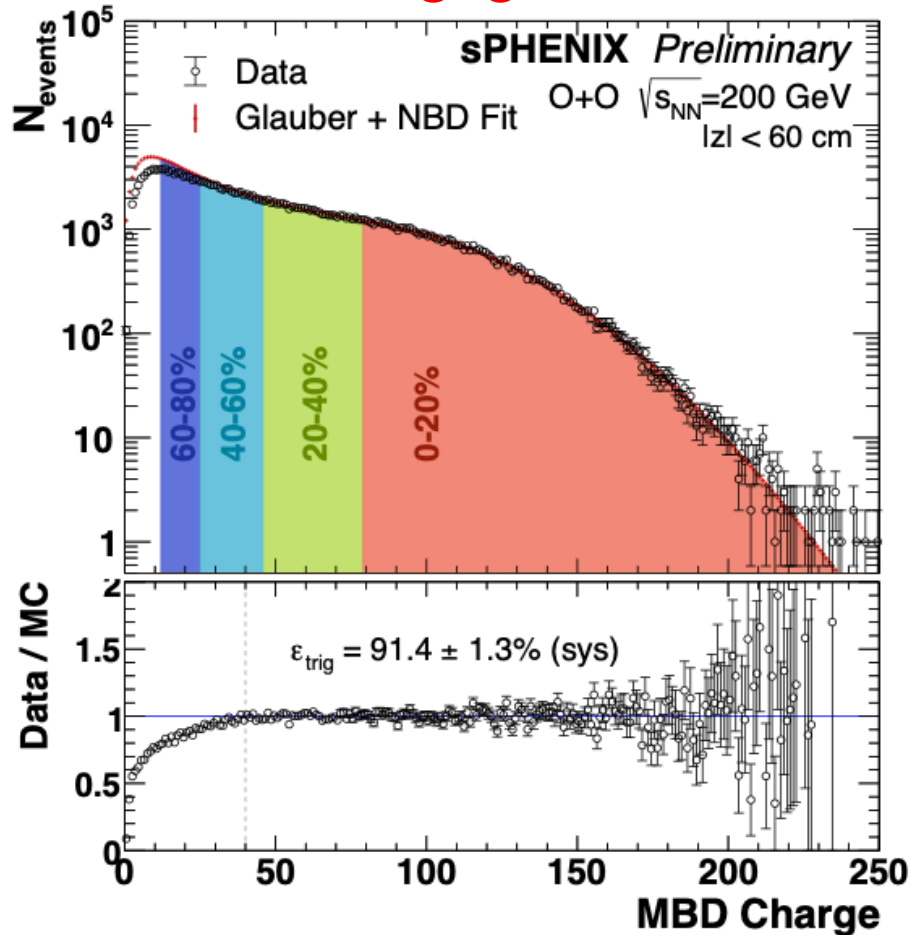
- Minimum bias trigger (MBD) efficiency is $89.5 \pm 1.1\%$, pile-up contamination $< 1\%$
- 93% of the data taken at 0.75 mRad crossing angle
- $\sigma_{\text{inel}} = 1189 \pm 44 \text{ mb}$

O+O Centrality

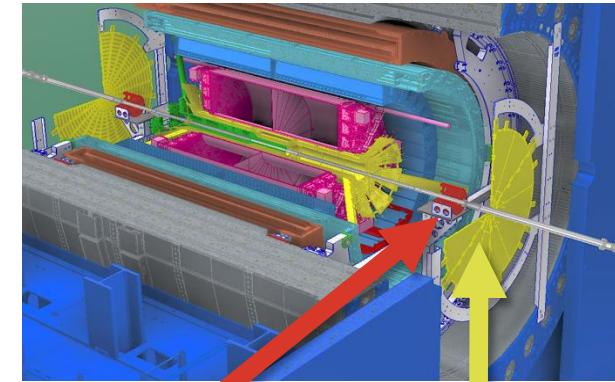
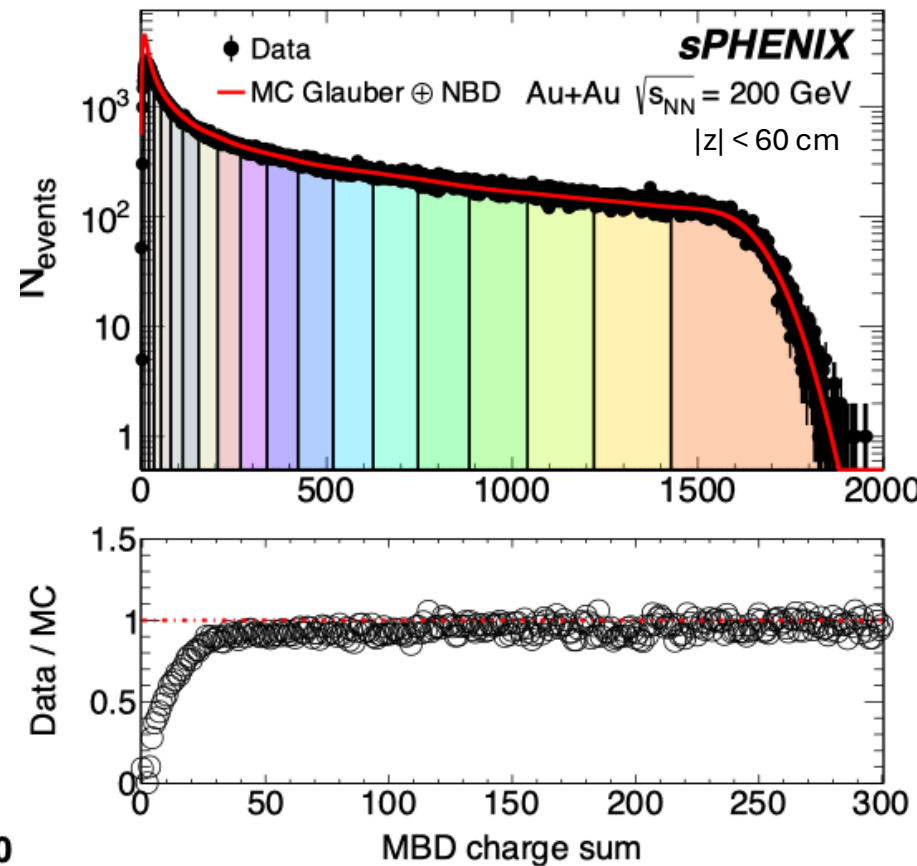


Minimum bias detector (MBD) used for triggering and centrality calibration

O+O



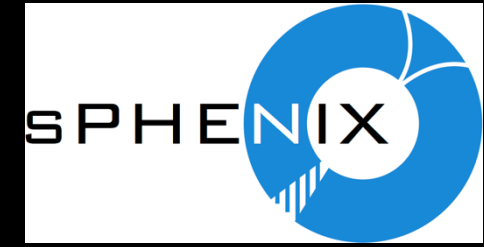
Au+Au



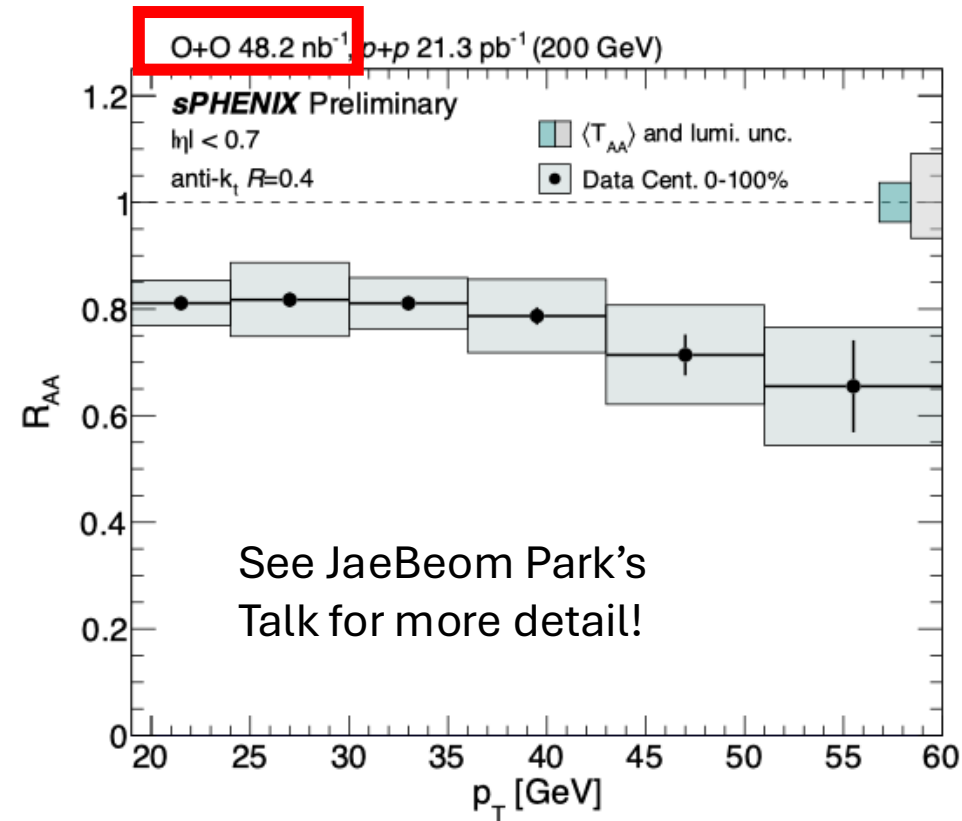
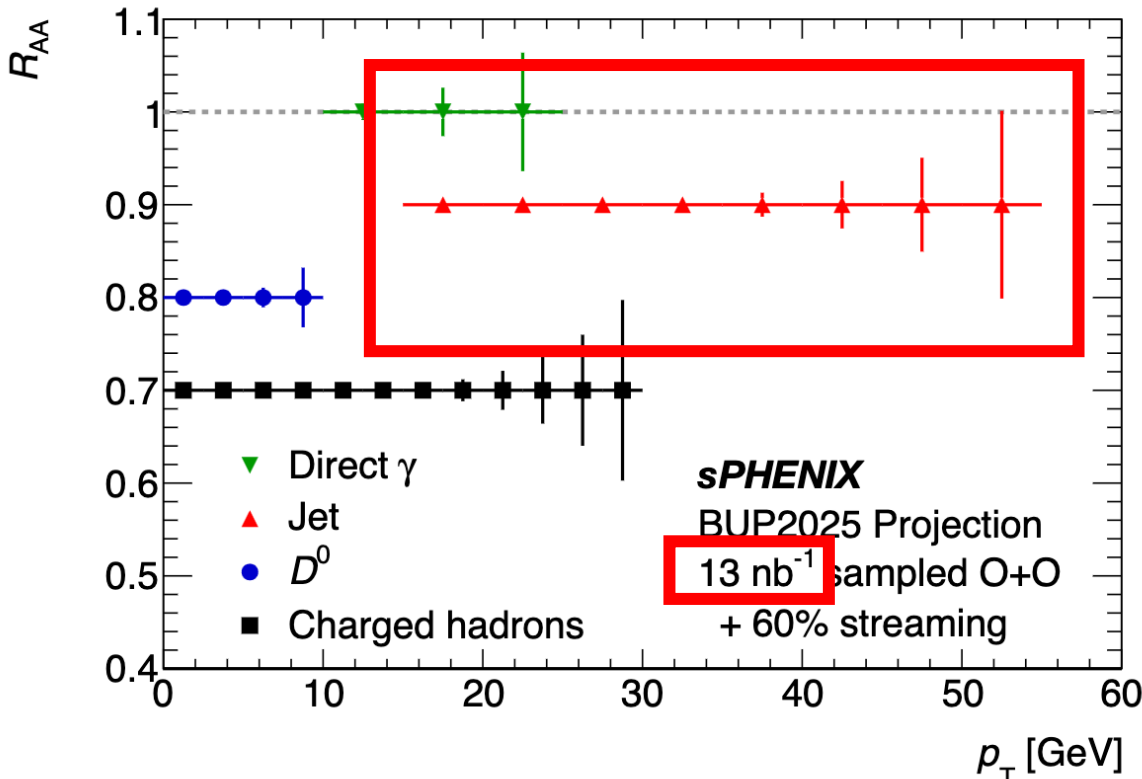
Minimum Bias Detector (MBD)

sPHENIX Event Plane Detector (sEPD)

Jet Nuclear Modification in O+O



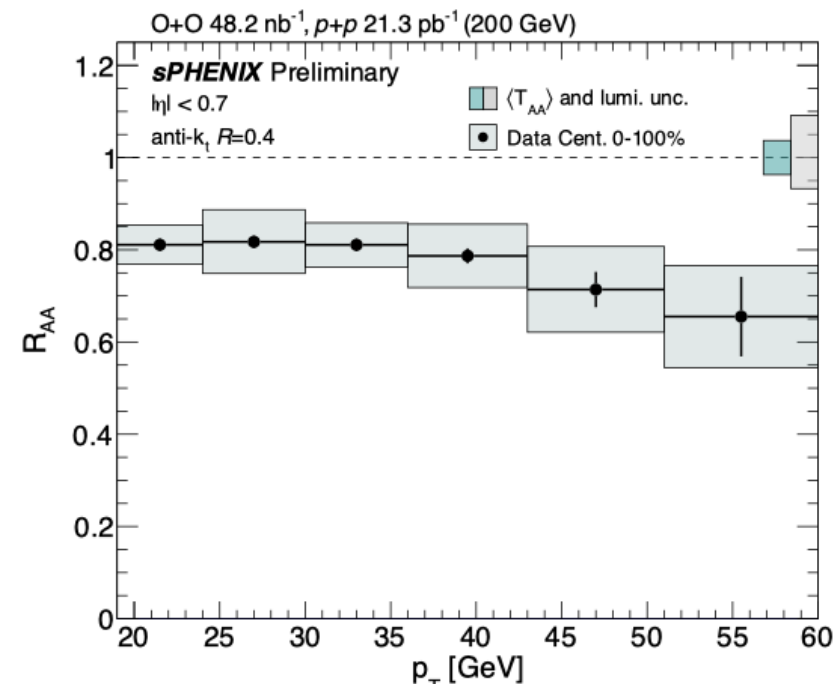
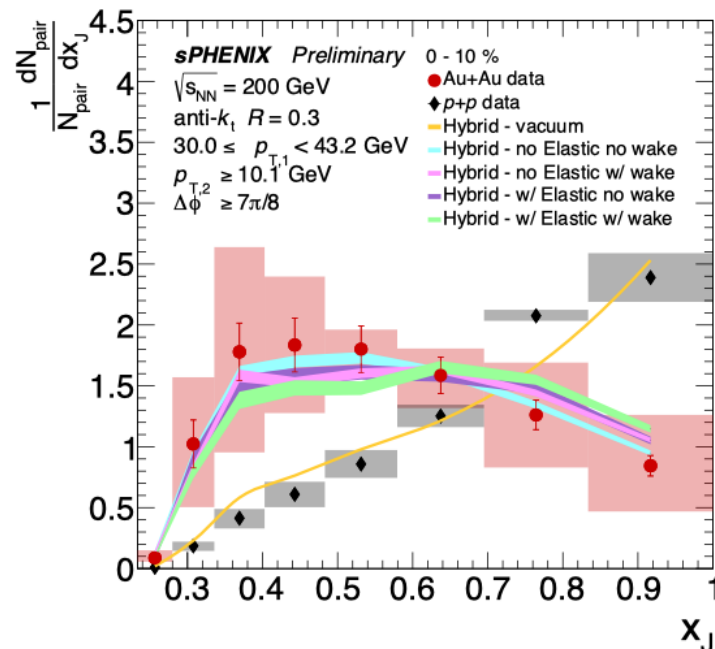
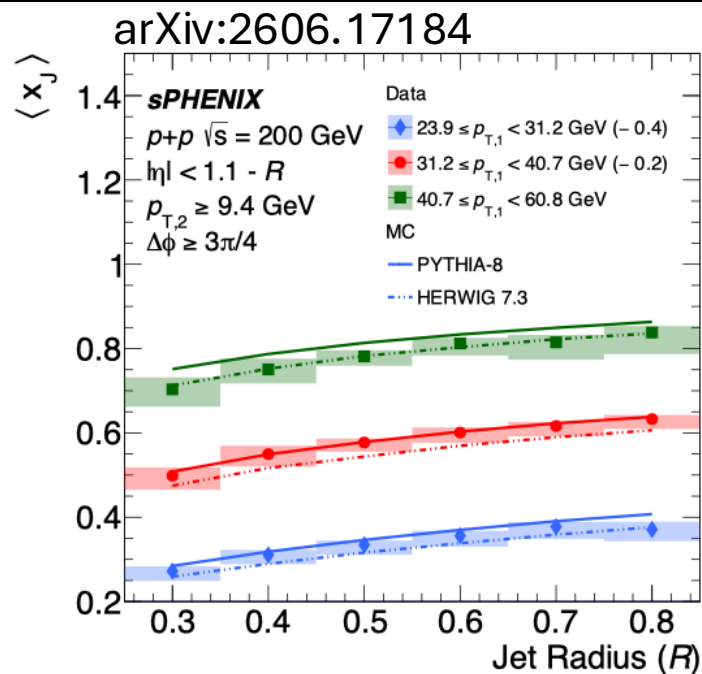
Predicted uncertainties from sPHENIX BUP



Fast turn around for Calorimeter-only jets allows for a first jet R_{OO} at RHIC
 Suppression of jet yields in O+O with a weak dependence on p_T

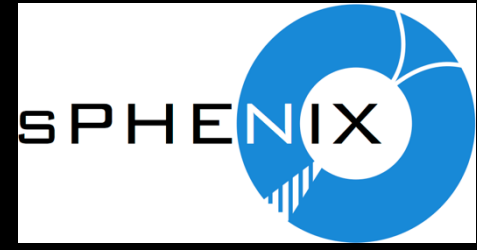
- Centrality ordering in R_{CP} indicates quenching result of hot QCD matter

Possibility of dijet measurement in O+O

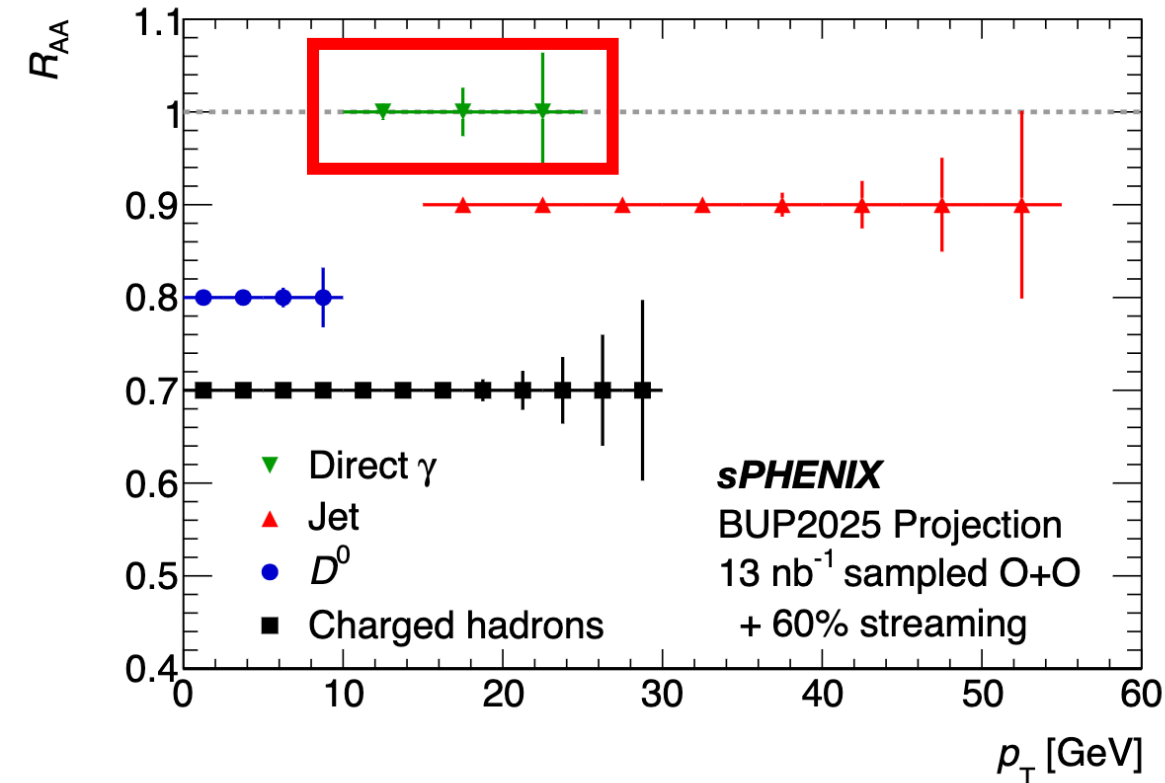


- Path-length is tunable via centrality, real QGP jet quenching effect should increase with centrality
 - E_{loss} fluctuations broaden x_J , complicates path-length interpretation
 - γ -jet removes this ambiguity since the γ is an unbiased tag of the initial parton E
- Direct probe of energy-loss balance, adds to inclusive jet measurements such as the nuclear modification factor

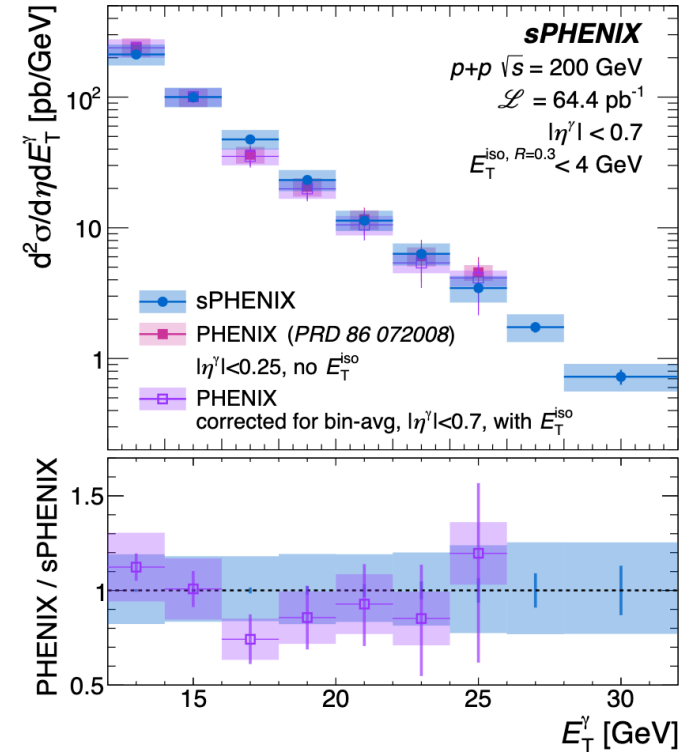
γ -jet in in O+O



Predicted uncertainties from sPHENIX BUP



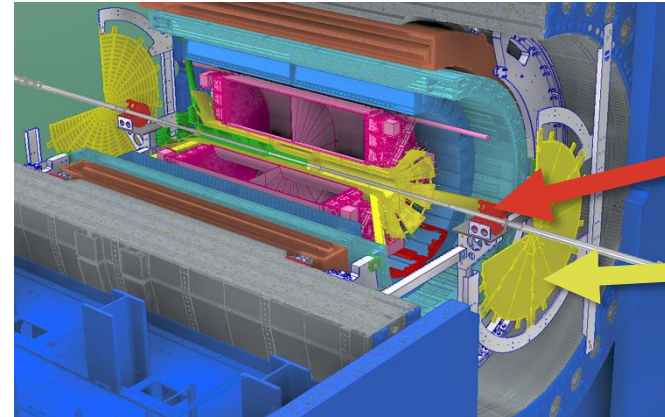
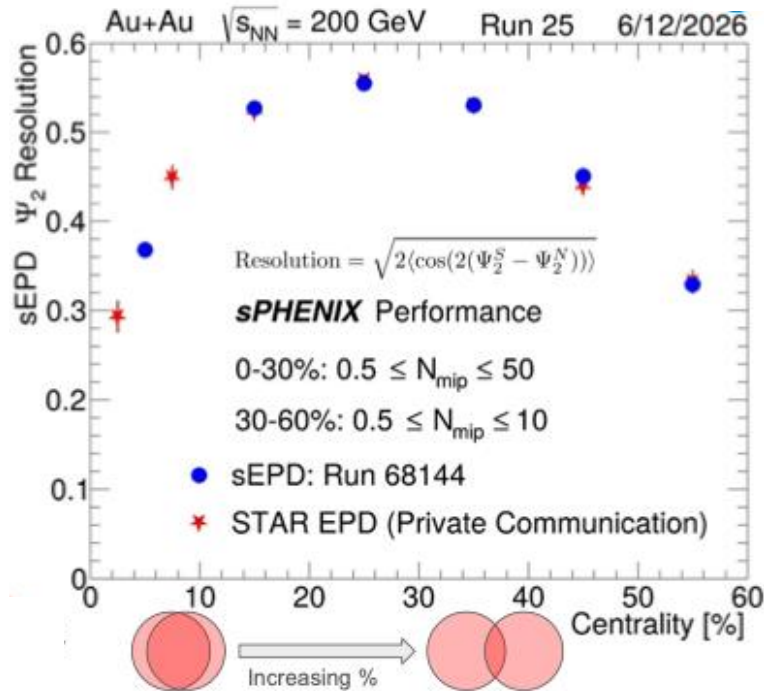
Arxiv:2607.03892



Run 24
p+p

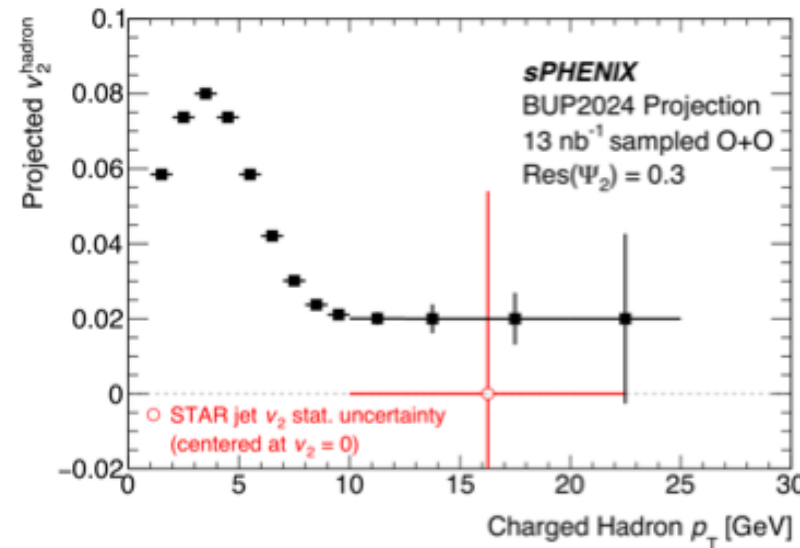
γ -jet measurements in O+O also benefit from the faster turn around time for calorimeter only jets → Initial prompt photon measurements agree well with previous measurements

Possibility of jet azimuthal anisotropy in O+O



Minimum Bias
Detector (MBD)

sPHENIX Event
Plane Detector
(sEPD)



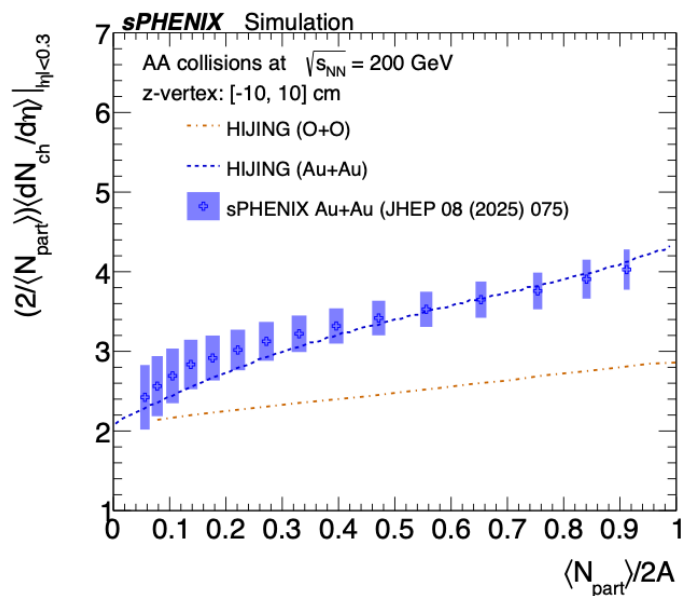
Need to account for selection bias effects in O+O

- J. Park et al
- Arxiv:2507.03603

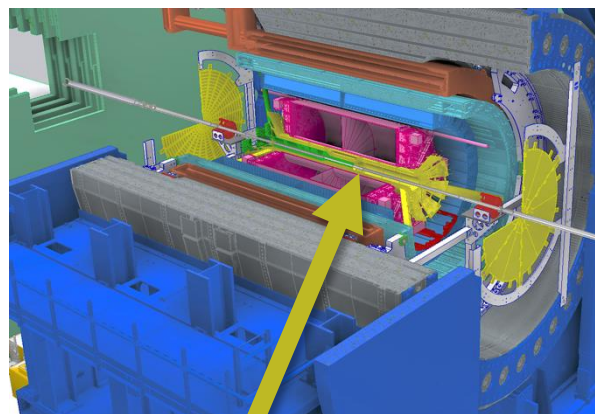
Jet azimuthal anisotropy may improve our understanding of a jet quenching signal in O+O

- Stay tuned!

Charged Hadron Multiplicity

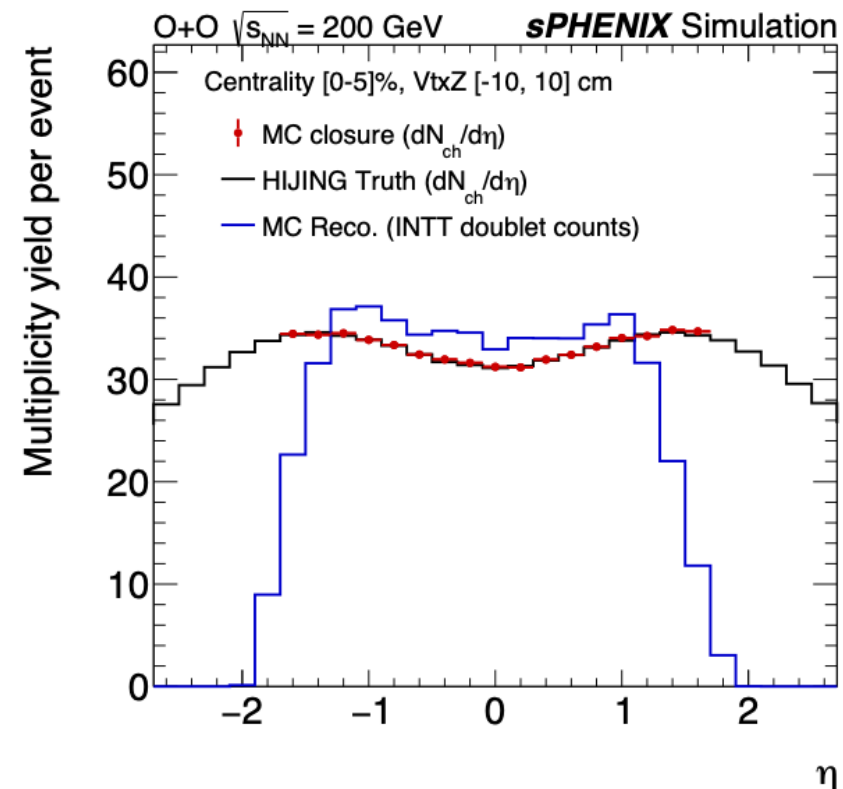


- Field-off data from Run 2024
- Agrees with previous measurements from other experiments
- INTT-standalone approach



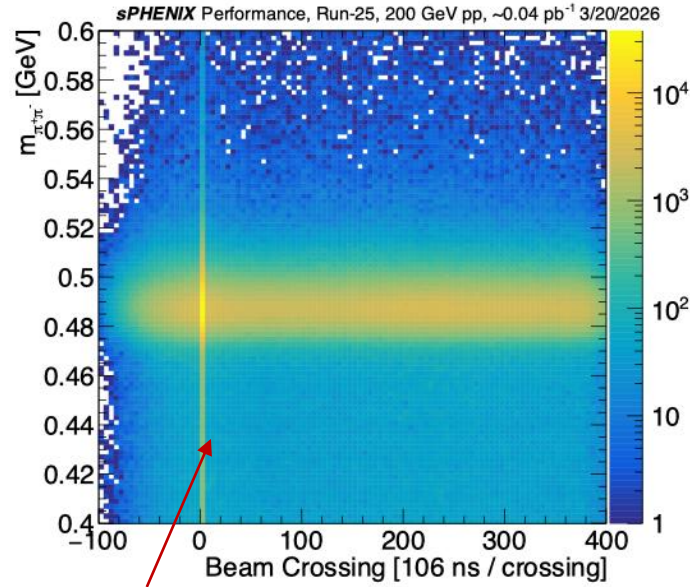
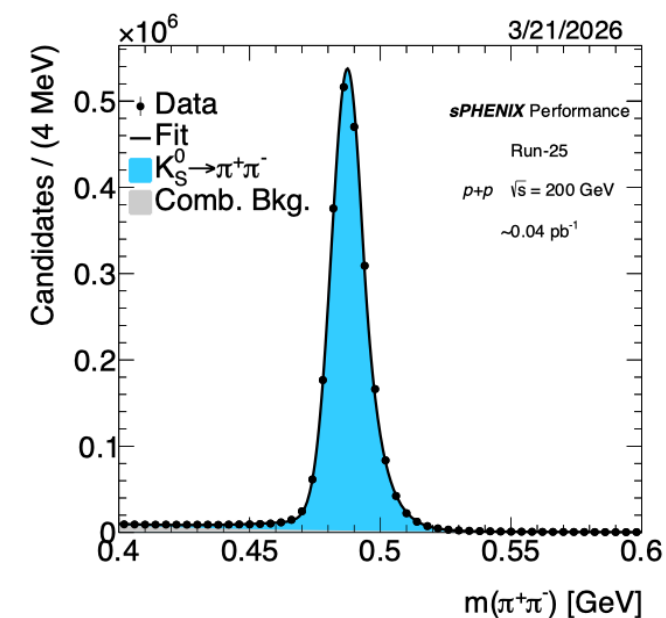
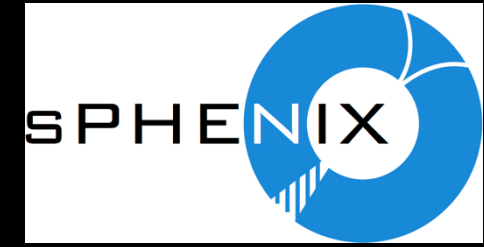
Intermediate Silicon Tracker (INTT)

Coming soon to a conference near you!

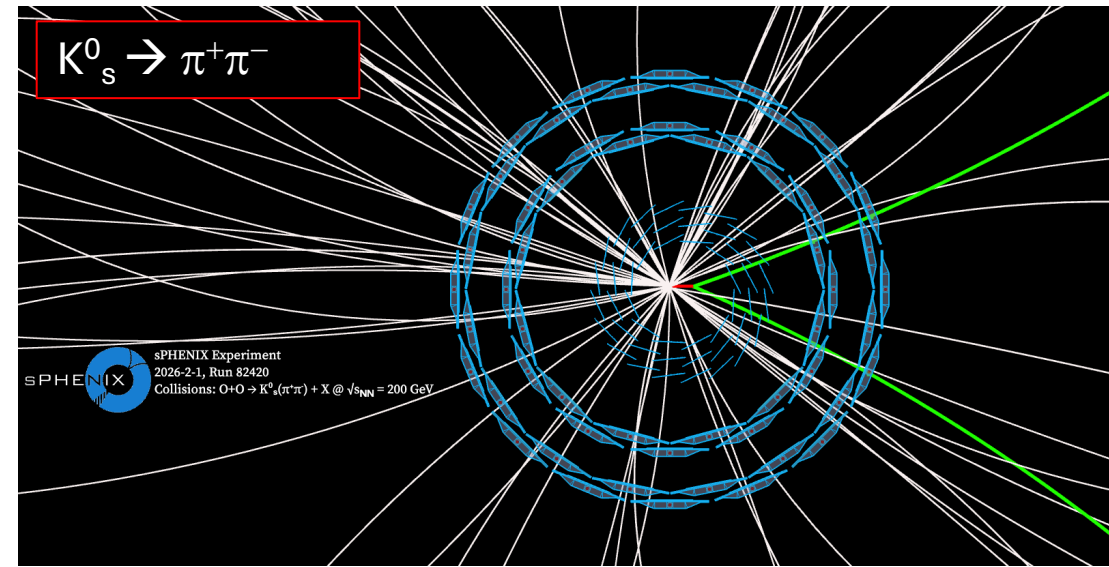


Good closure for $dN_{ch}/d\eta$
HIJING MC predicts relatively yield in O+O compared to the Au+Au

K_s^0 extended readout performance



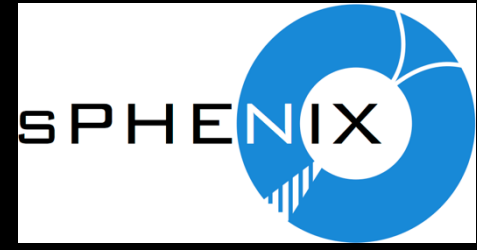
Triggered bunch crossing



- Data recorded after trigger bunch crossing
- Demonstrates successful extended streaming readout ~ 200 kHz p+p collision recording rate $\rightarrow$ critical for heavy flavor program
- $K_s^0/\Lambda \rightarrow$ baryon/meson enhancement comparison to Au+Au

- Light flavor mesons in O+O validate calibrations
- Open flavor measurements will be unique at RHIC
 - Clean signal for energy loss

Conclusions



- Run 25 O+O delivered **182% of the run goal**, with excellent MBD triggering (89.5% efficiency)
- **First jet R_{00} at RHIC**: preliminary suppression comparable to peripheral Au+Au
- Simulations of charged hadron multiplicity in O+O shows good closure with HIJING, benchmarking the INTT for the O+O program
- Dijet x_j and jet v_2 measurements are enabled by this dataset (building on the Au+Au dijet energy-loss precedent)
 - Both will be **direct, path-length-sensitive tests** of medium formation in O+O. Stay tuned!
- Demonstrated first trigger+streaming readout at scale, setting up high-statistics tracking analyses (open HF, K_s^0) for the full O+O program
- The large O+O data set will allow sPHENIX to understand the matter produced in these small system collisions