

What data do we have?  
What are we doing?  
What do we plan to do next?  
What do you want us to do?

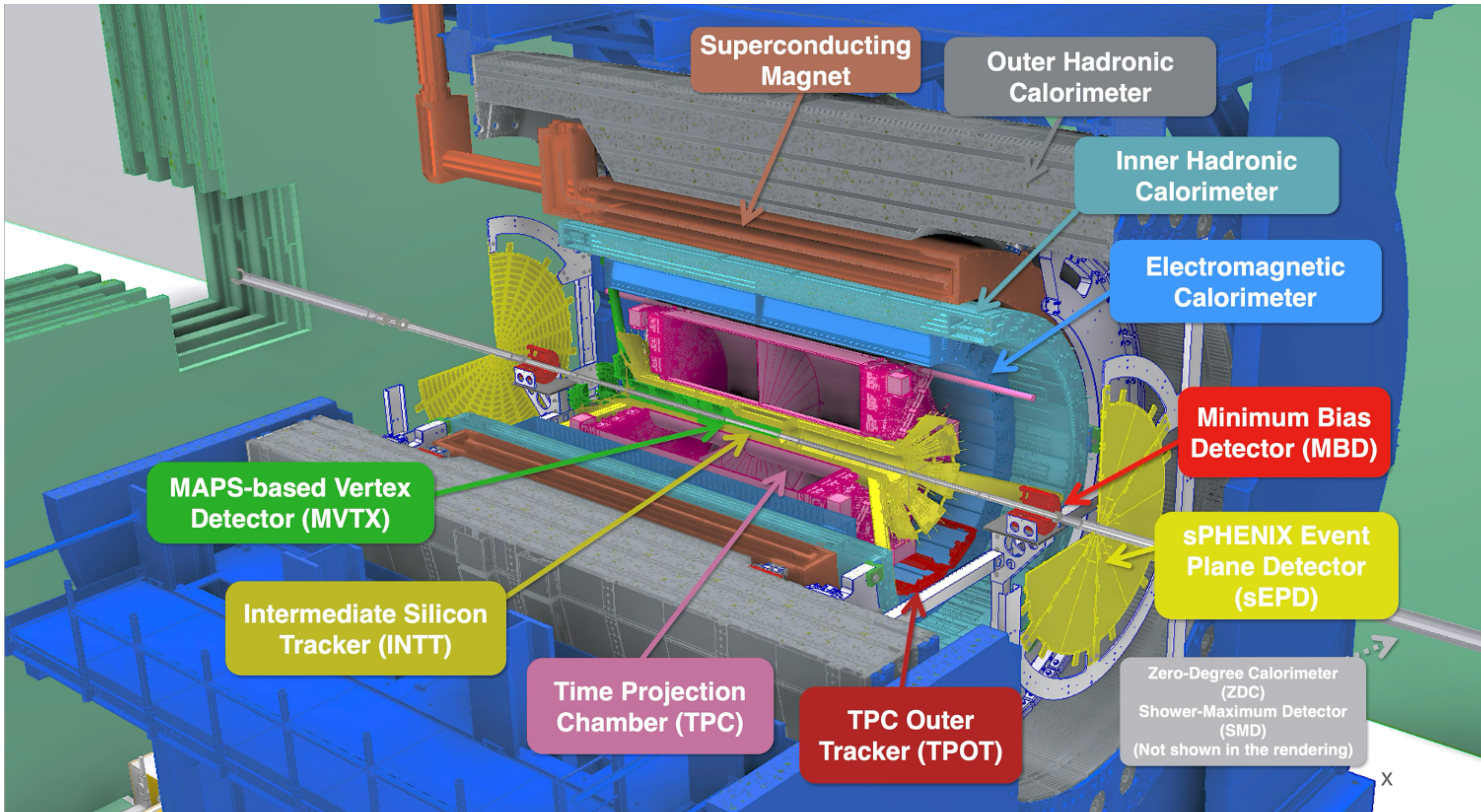
Raghav (Rithya) Kunnawalkam Elayavalli [she/they]  
Vanderbilt University

On behalf of the sPHENIX Collaboration

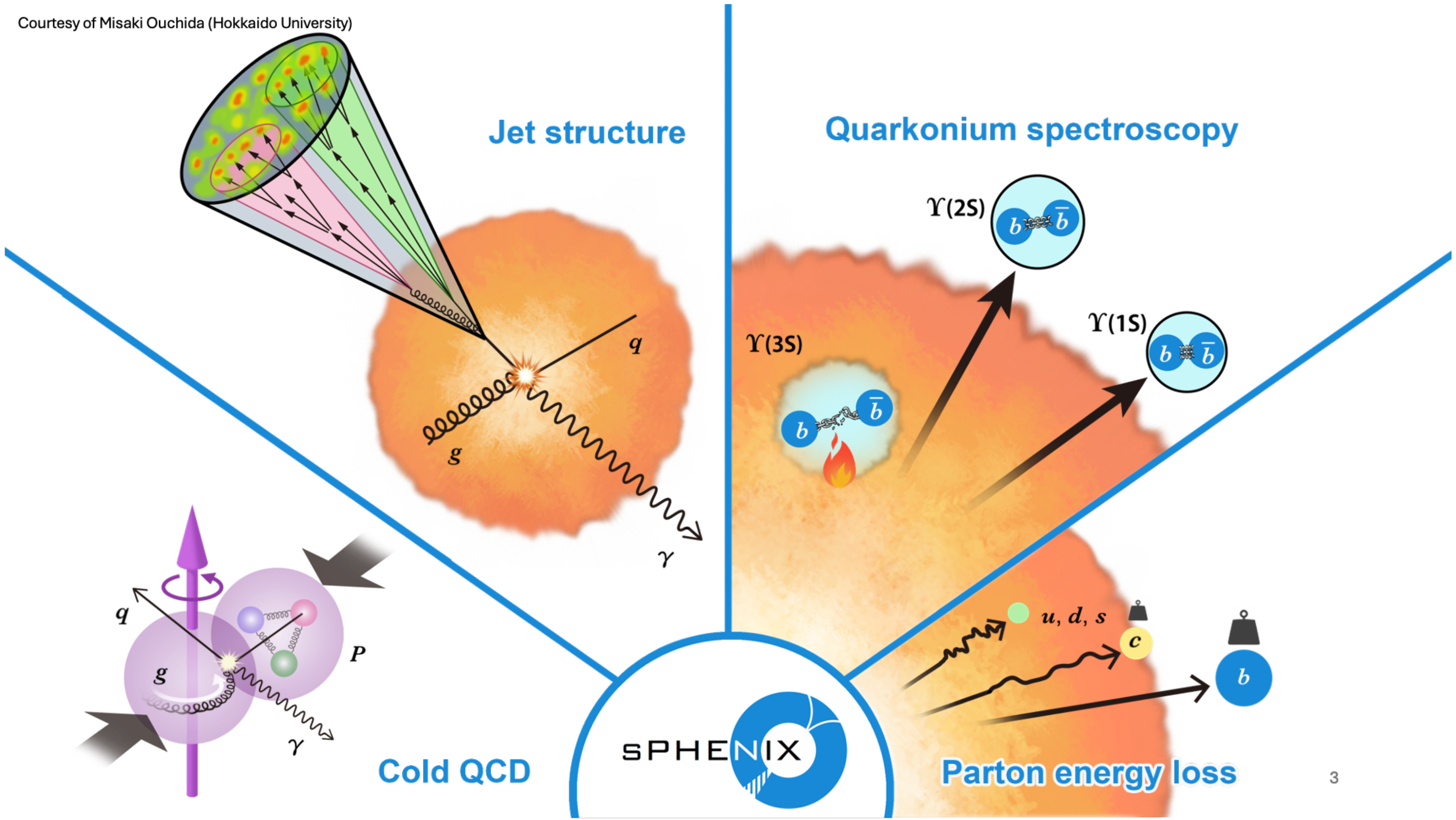


C3NT Workshop: Jet-soft dynamical medium interaction in  
high-energy heavy-ion collisions

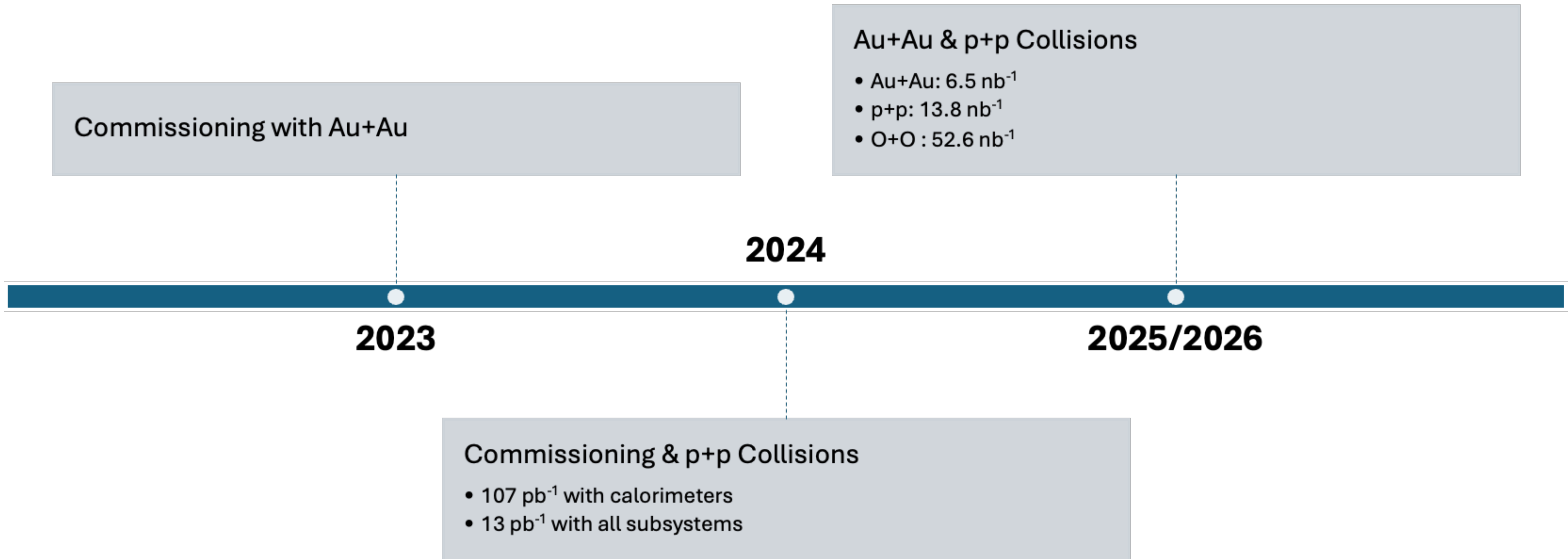
CCNU, Wuhan March 23th, 2026

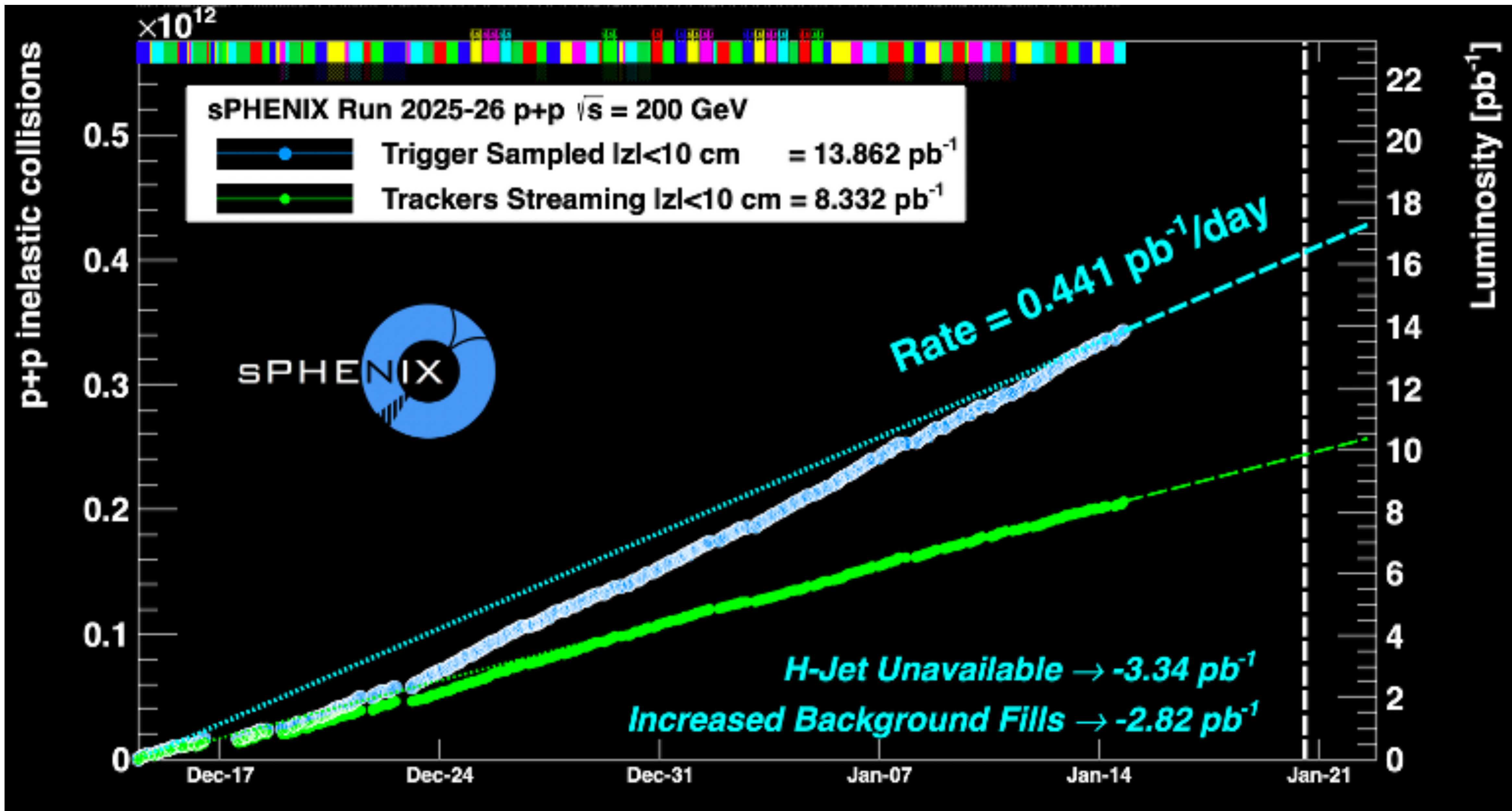


Courtesy of Misaki Ouchida (Hokkaido University)

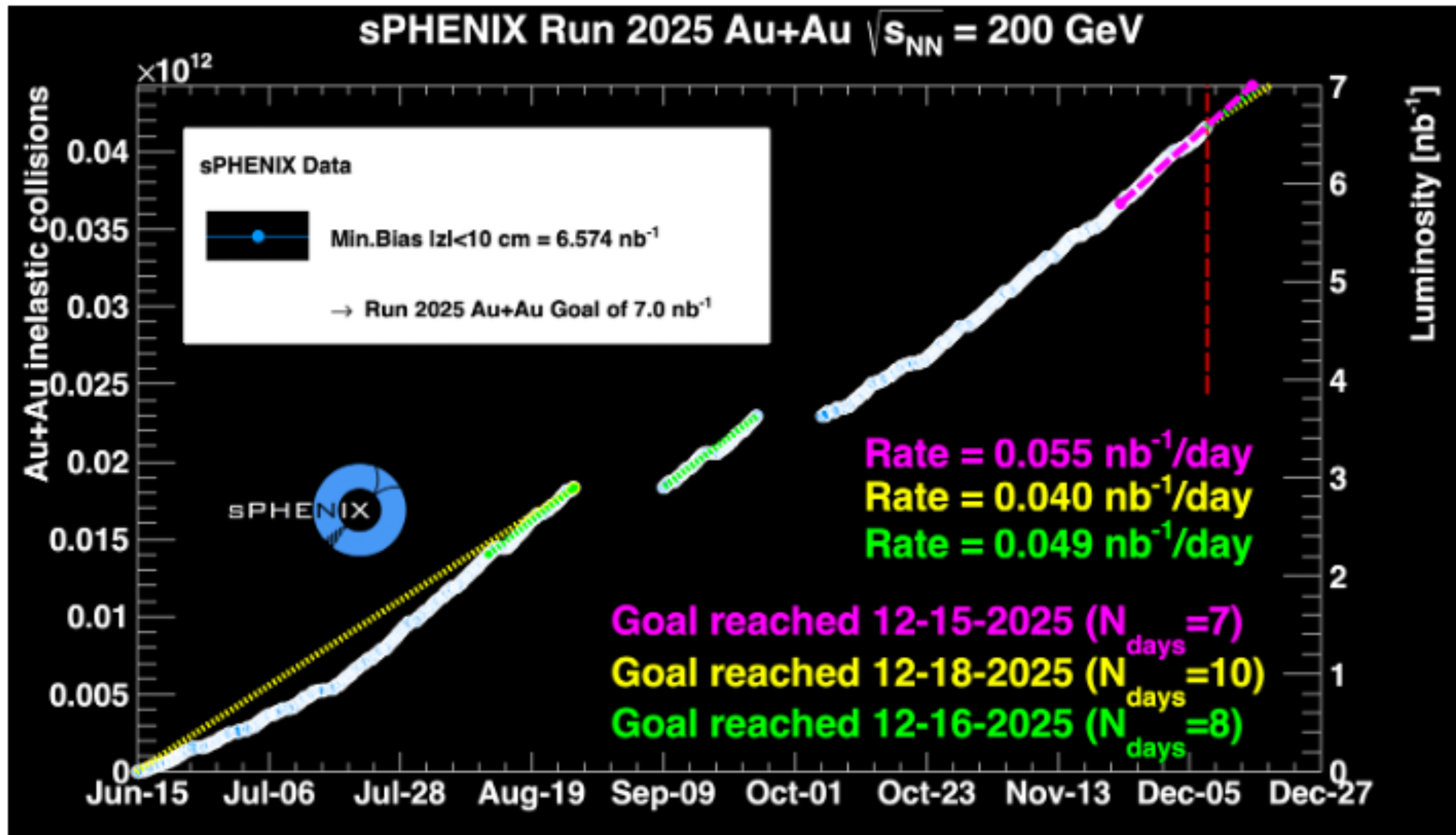


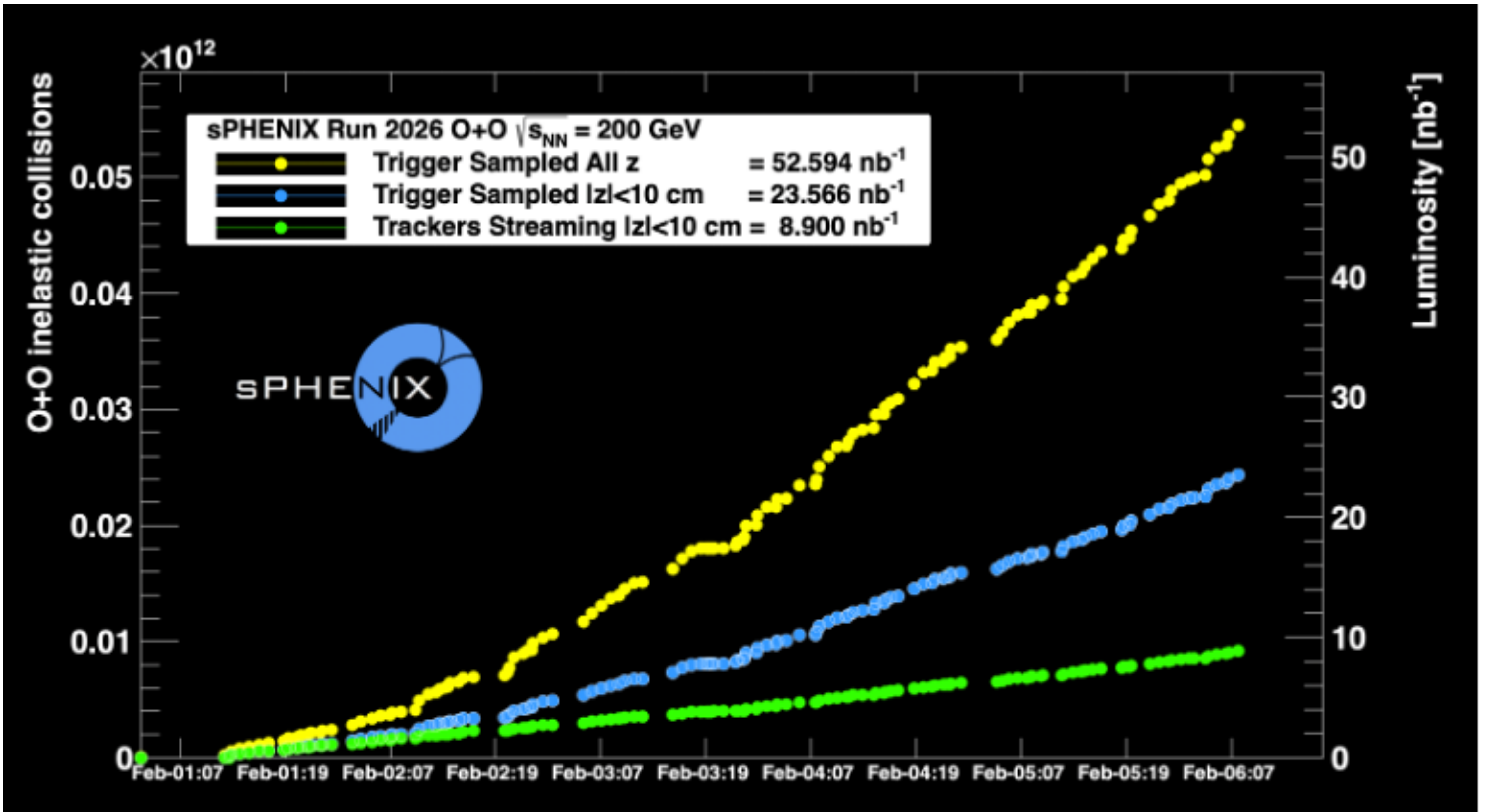
# Data-taking period





Rithya KE on behalf of sPHENIX @ C3NT 2026

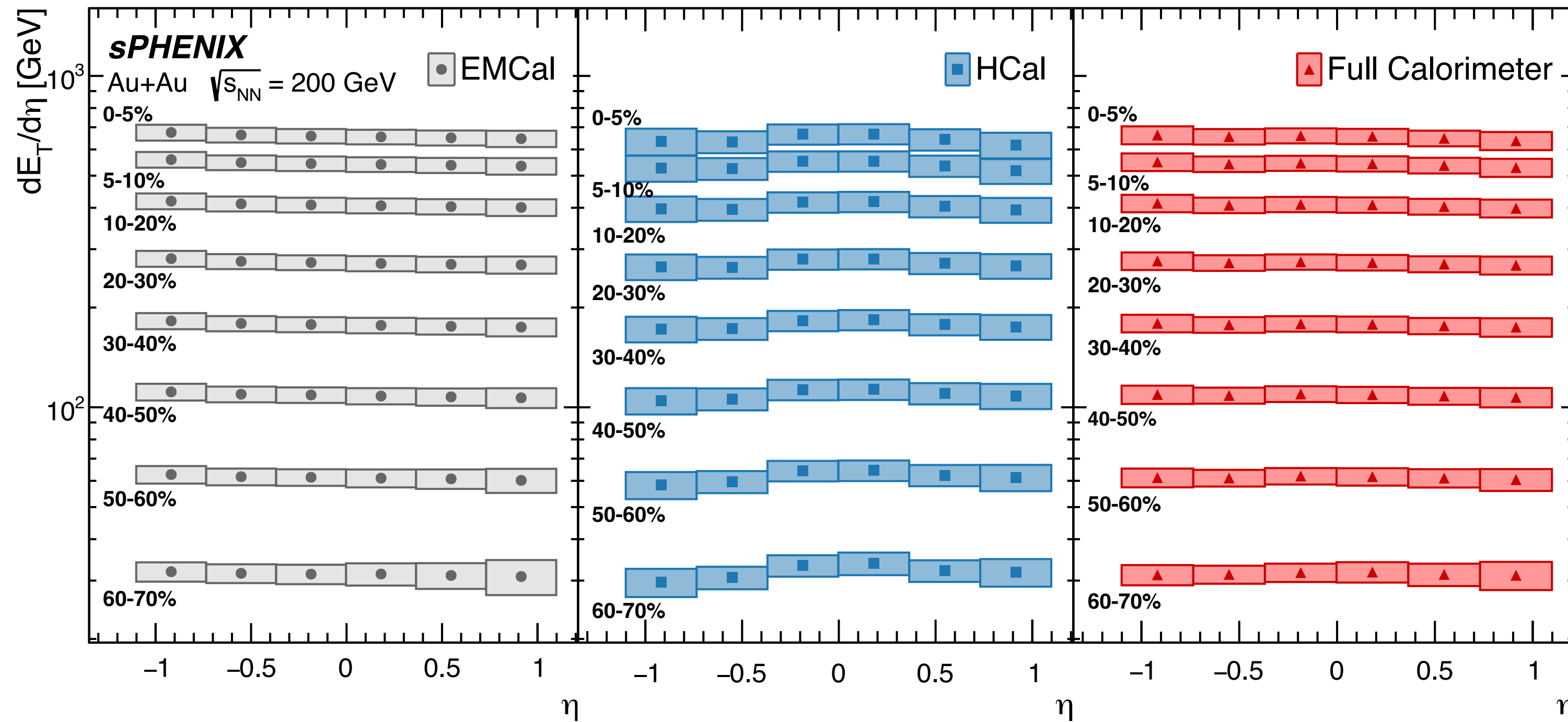




# What have we done so far?

- sPHENIX was the first entirely new detector to be commissioned back in 2023 at both major colliders in more than 2 decades
- Calorimeter subsystems (EMCal, Inner HCal, Outer HCal) were first commissioned and shown to perform within expectations
- TPC needed a gas mixture update in 2024 for a successful commissioning
- Now we have datasets from each of the collision systems physics results have started to be produced at a fast pace!

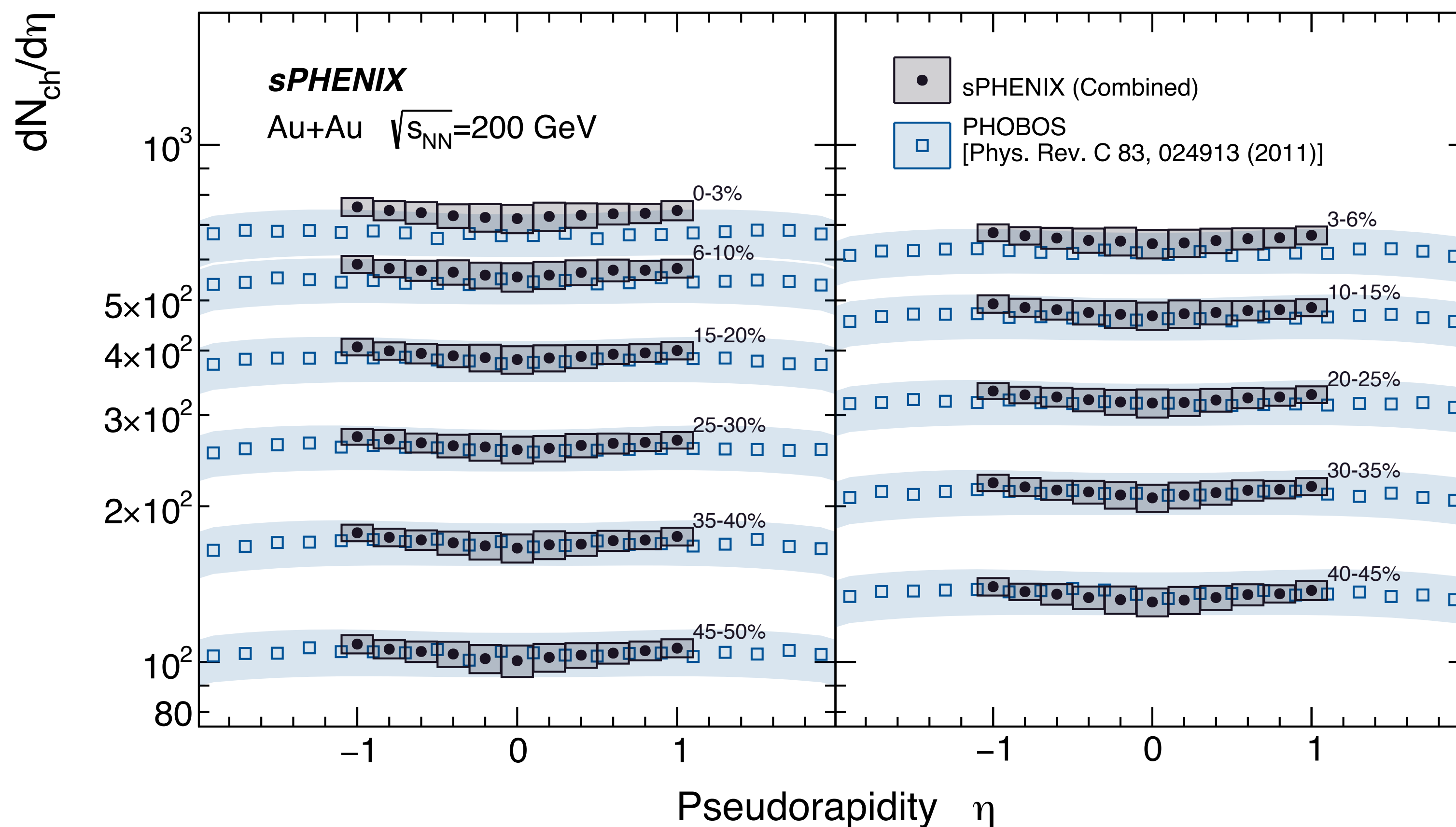
# First cross-checks : Calorimeters



*sPHENIX, PRC 112 (2025) 024908*

- Energy spread across pseudorapidity
- First measurement of energy in a hadronic calorimeter at mid-rapidity at RHIC
- Consistent results across each calorimeter subsystems

# First cross-checks: tracklets



- Charged hadron multiplicity across pseudorapidity
- Consistent with PHOBOS data

*sPHENIX, JHEP 08 (2025) 075*

# What are we doing now?

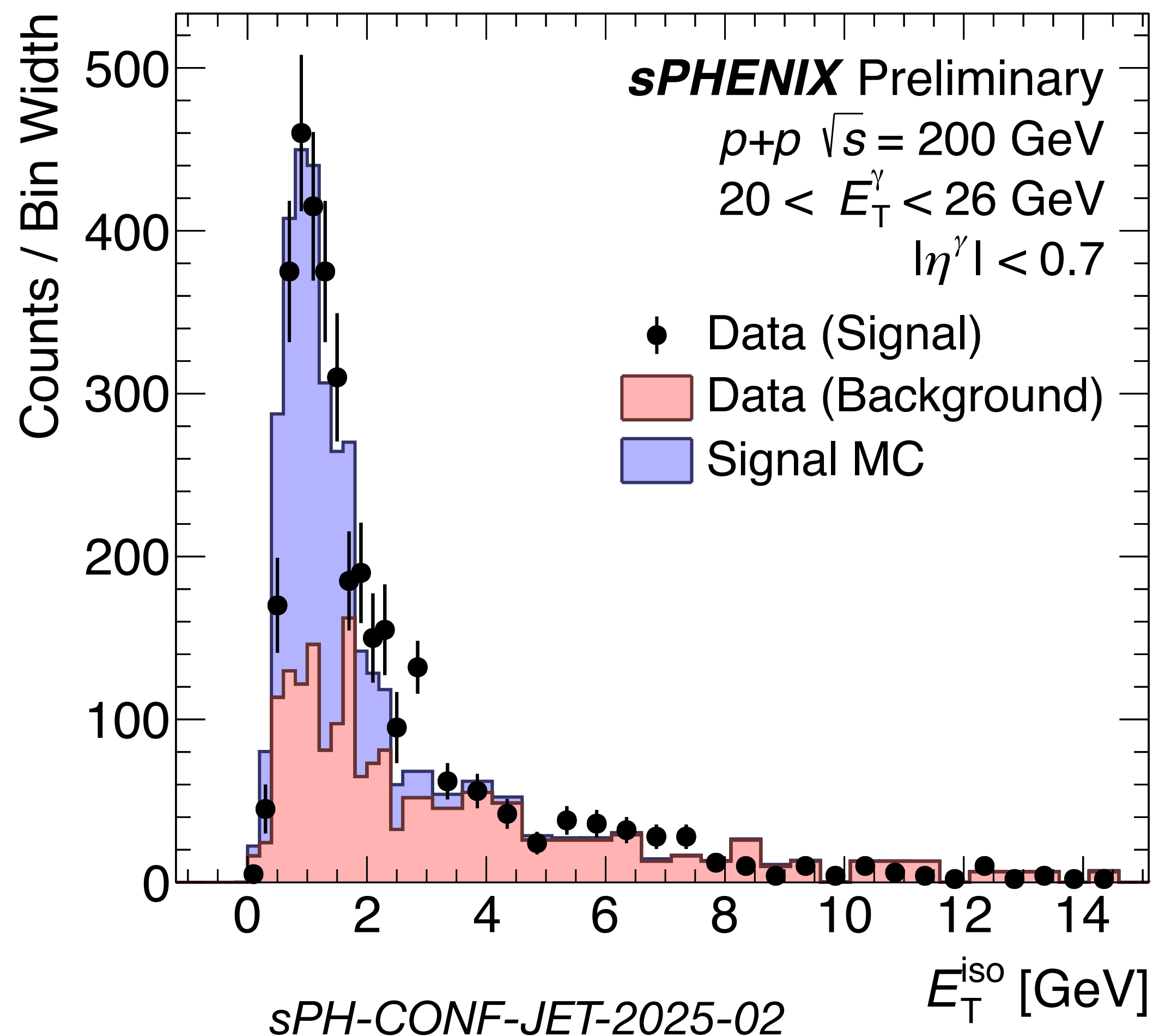
- In line with the 4 main physics programs of sPHENIX - coldQCD, Jet Structure, Heavy Flavor and Quarkonia
- sPHENIX as a jet detector (first check the spectra, then asymmetry and substructure)
- sPHENIX as a photon detector (standard candle for hard probes)
- sPHENIX as a heavy flavor detector (performance of tracking reconstruction of V0s)

<https://www.sphenix.bnl.gov/PublicResults>

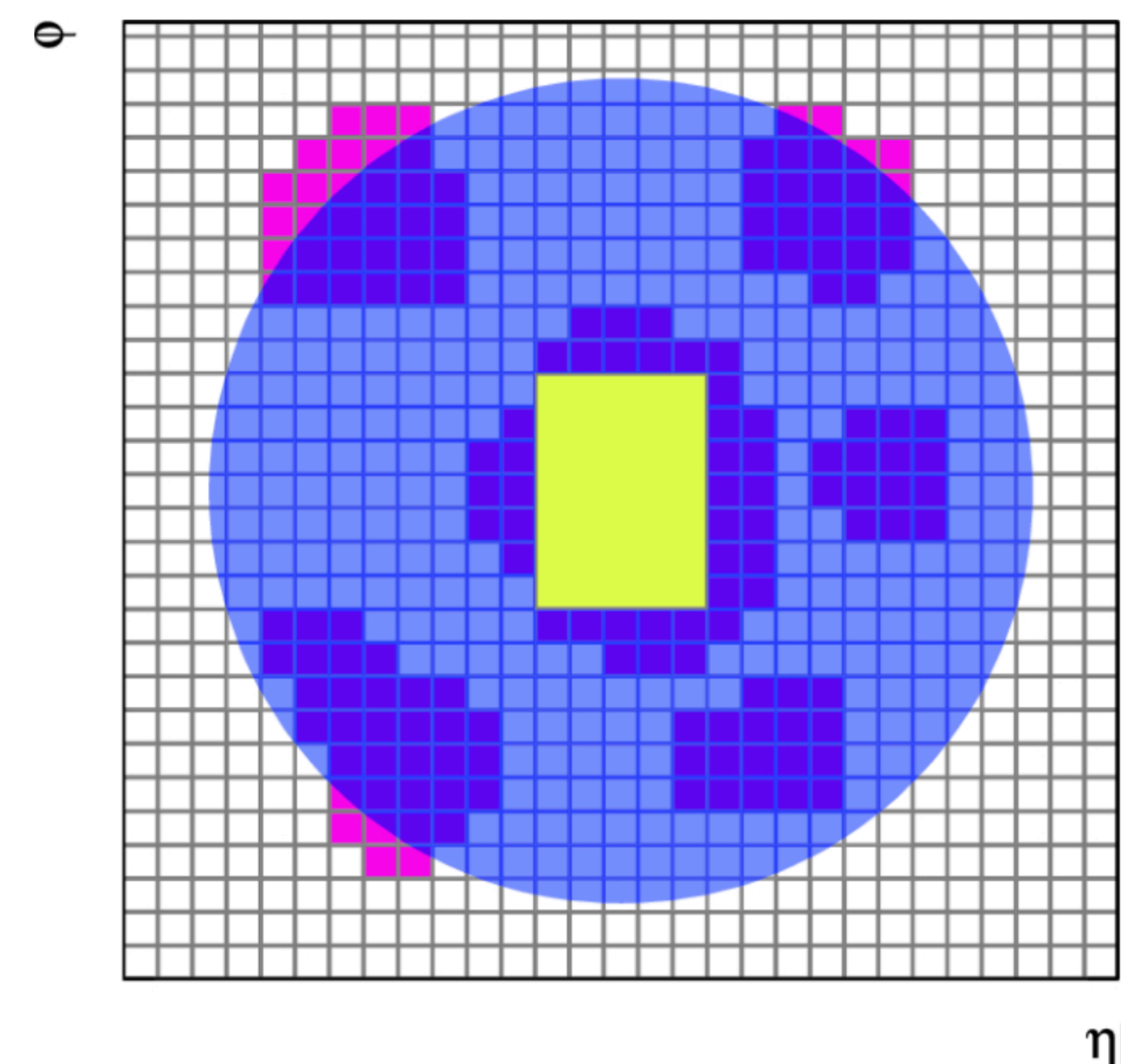
# What are we doing now?

- In line with the 4 main physics programs of sPHENIX - coldQCD, Jet Structure, Heavy Flavor and Quarkonia
- sPHENIX as a jet detector (first check the spectra, then asymmetry and substructure)
- sPHENIX as a photon detector (standard candle for hard probes)
- sPHENIX as a heavy flavor detector (performance of tracking reconstruction of V0s)
- This was the plan with Au+Au/pp ... Now with O+O, we can study the onset of jet quenching with finer precision and lower background!

# sPHENIX - the photon detector



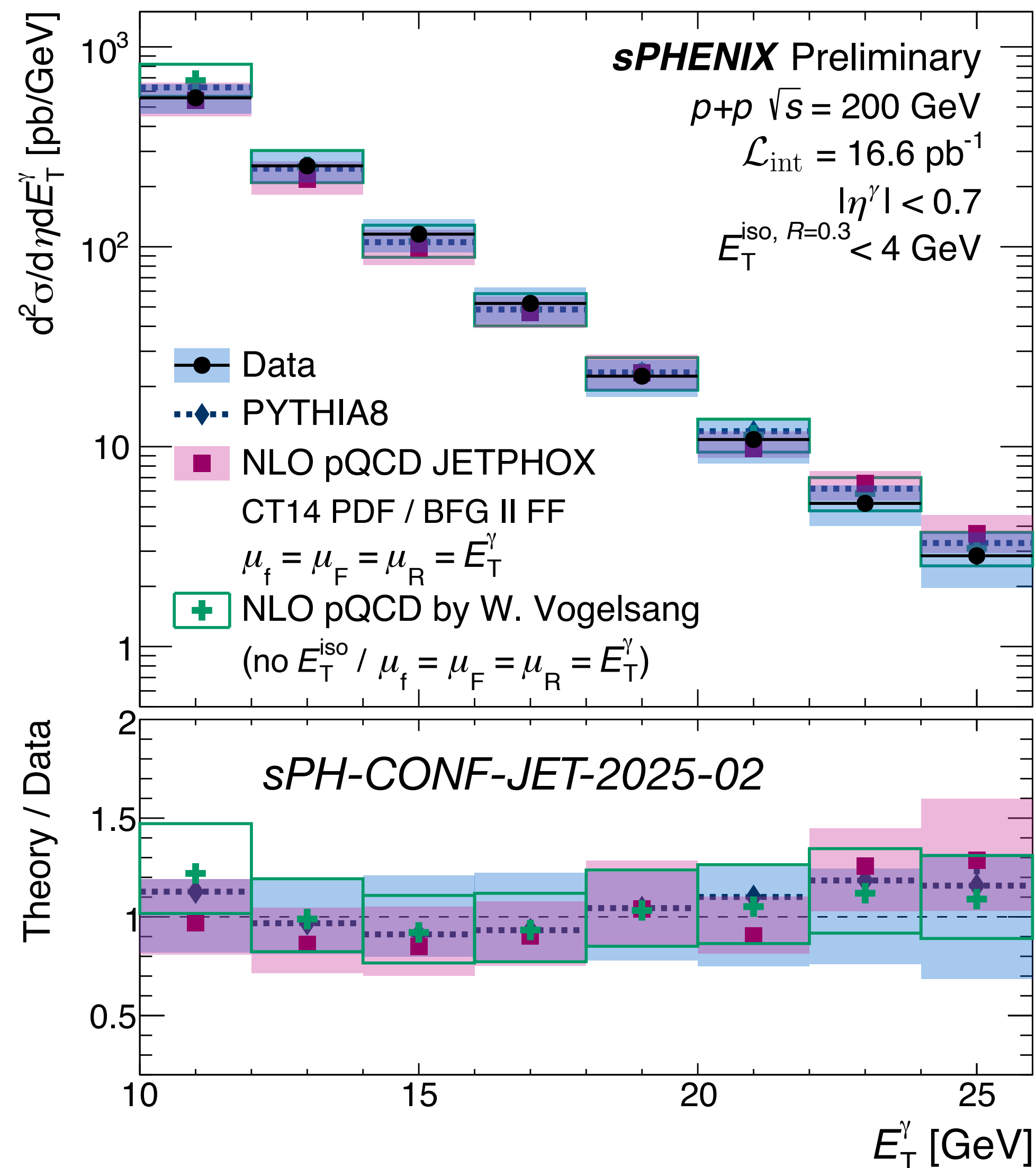
Manzoni, S. (2019) [https://doi.org/10.1007/978-3-030-24370-8\\_8](https://doi.org/10.1007/978-3-030-24370-8_8)



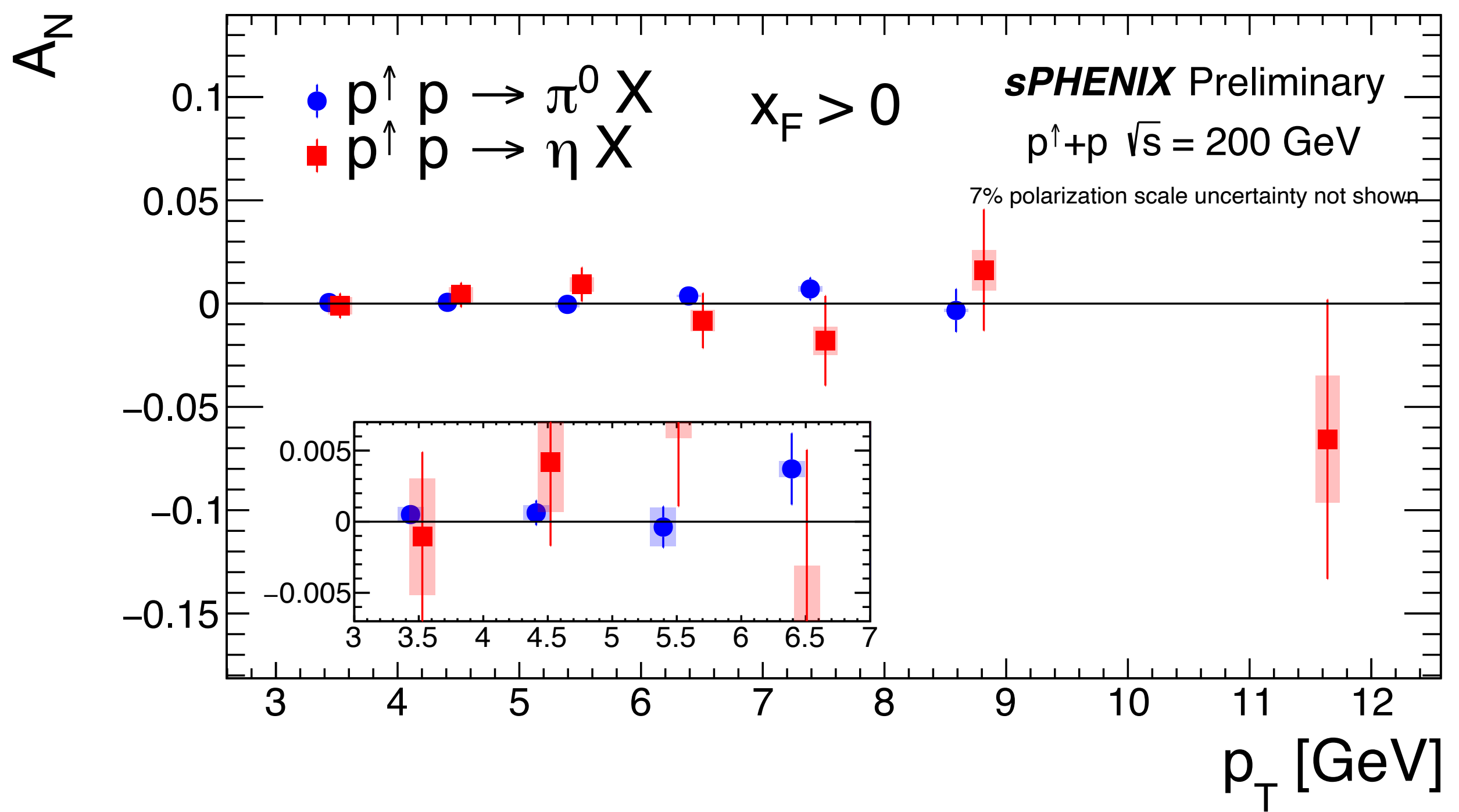
- Selecting isolated photons requires a good handle on your calorimeter clustering and overall performance

# sPHENIX - the photon detector

- Isolated photon spectra from pp collisions
- Fully unfolded and can be directly compared to pQCD calculations
- With further improvements in the final result, this measurement has sensitivity to NLO and PDFs
- Also is an important baseline for Au+Au (and now O+O)
- Also a first step towards  $\gamma$  + jet

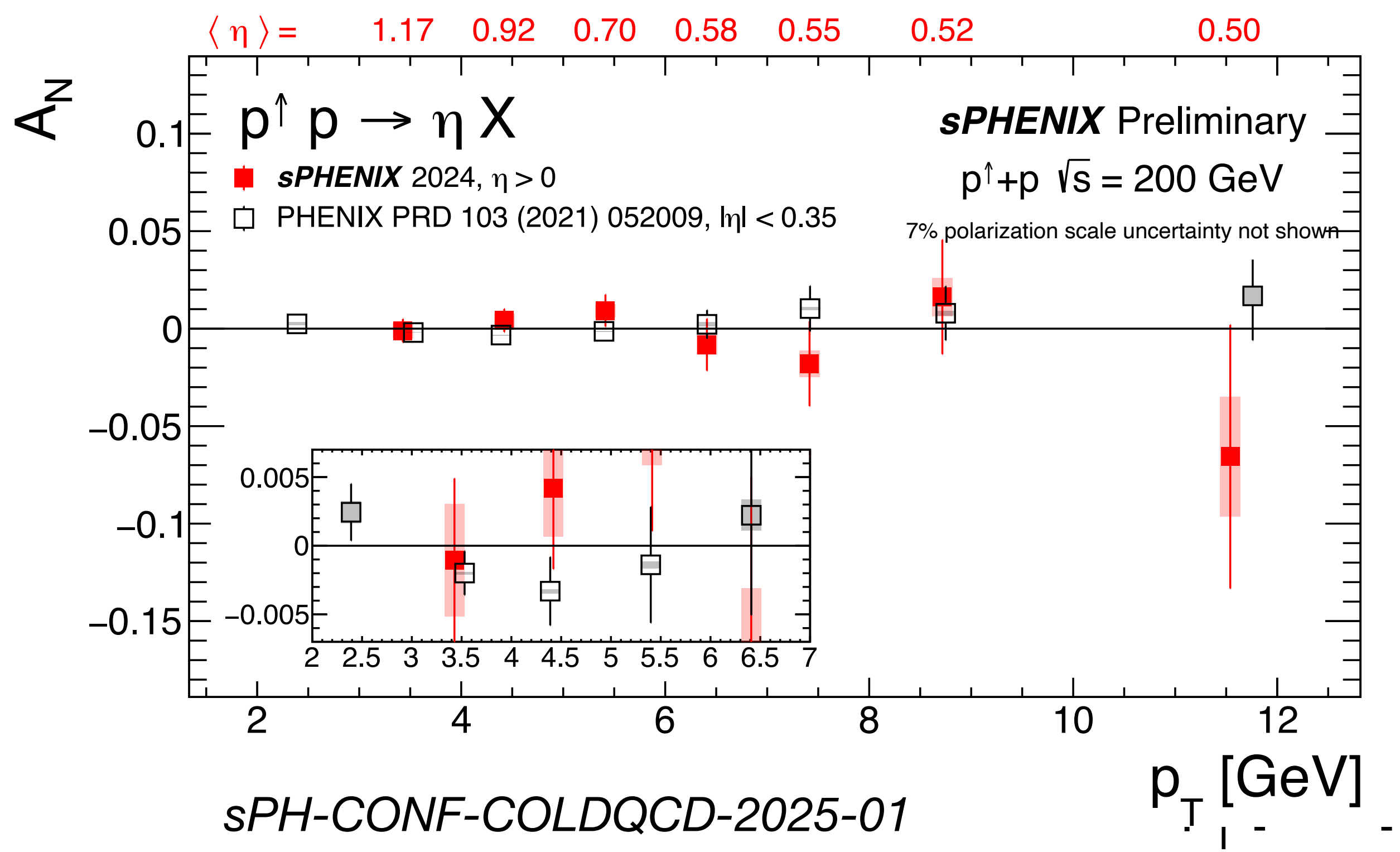


# sPHENIX - the high $p_T$ meson detector



- $\pi^0$ ,  $\eta$  meson have similar asymmetry
- Transverse single spin asymmetry measurements consistent with zero

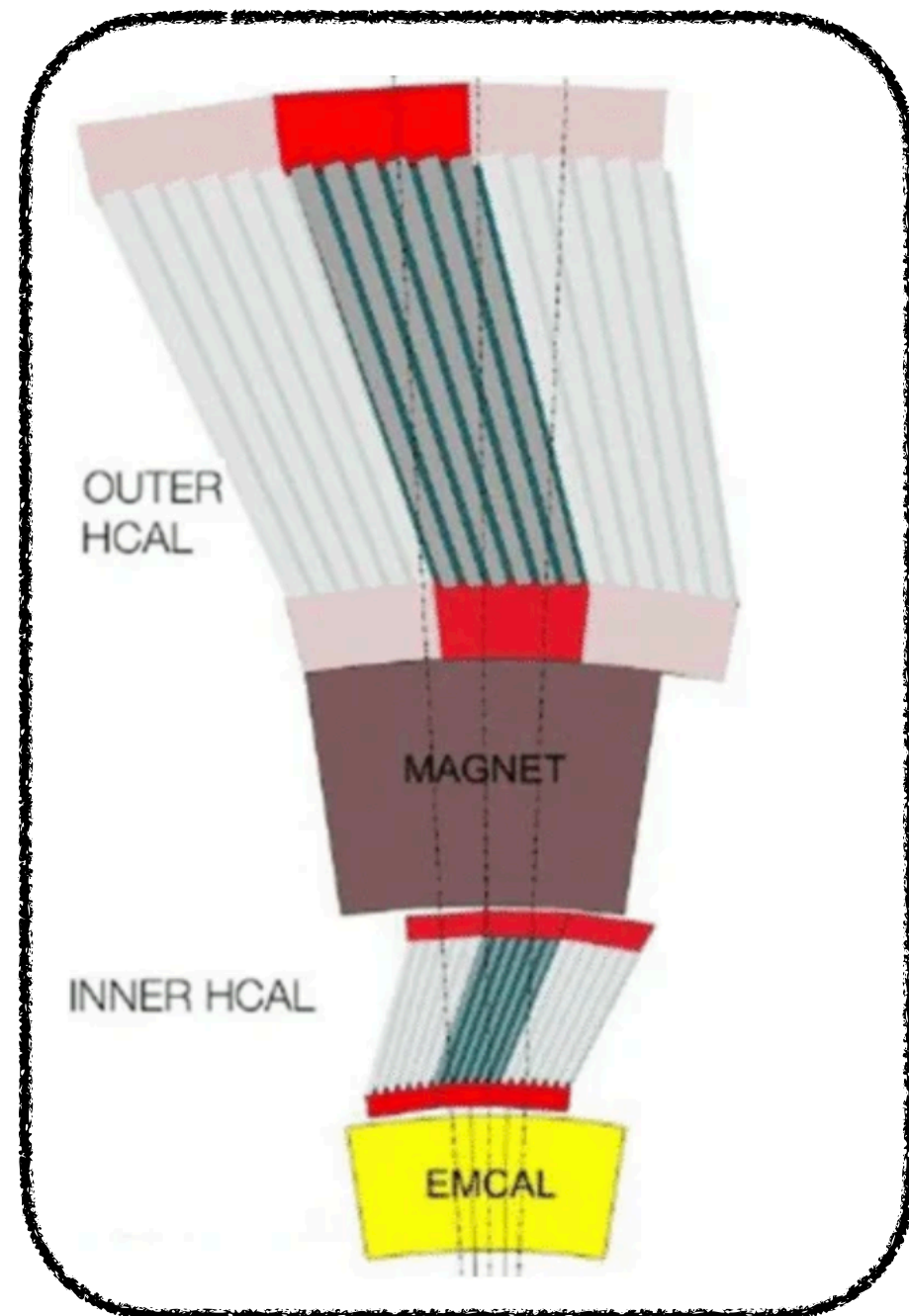
$$A(\phi) = \frac{N^\uparrow(\phi) - RN^\downarrow(\phi)}{N^\uparrow(\phi) + RN^\downarrow(\phi)}$$



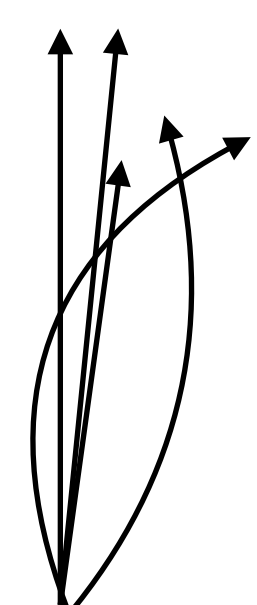
sPH-CONF-COLDQCD-2025-01

# sPHENIX - the jet detector - I

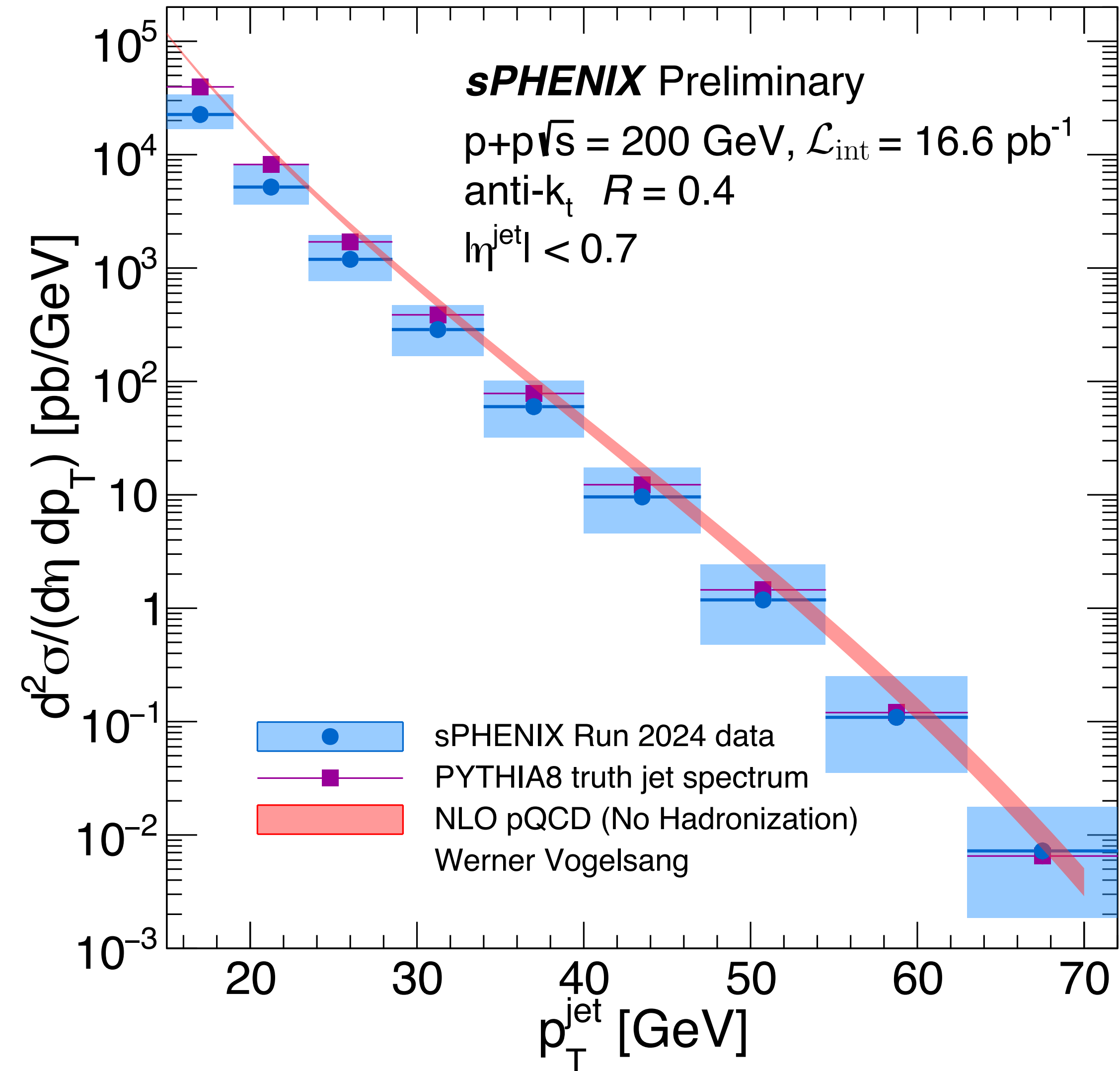
sPH-CONF-JET-2025-03



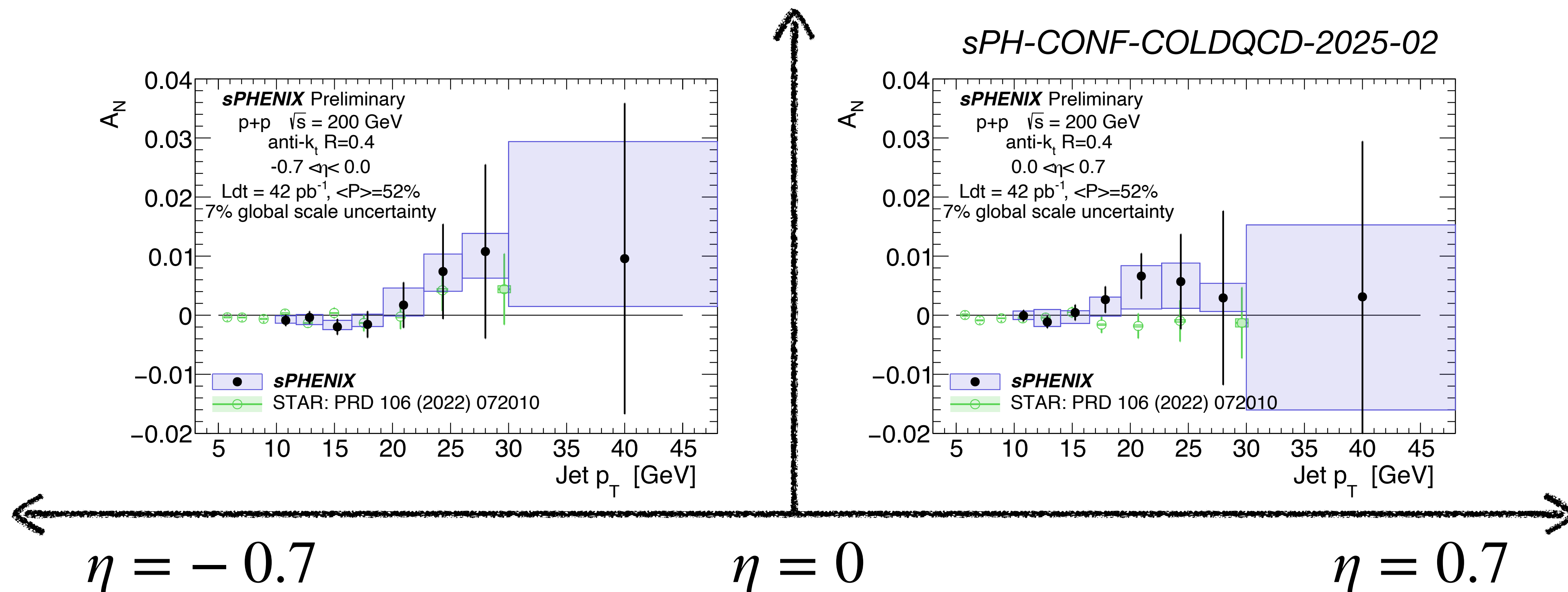
- First check with reconstructed calorimeter jets, unfolded back to particle level
- First time ever - jets up to 70 GeV!! ( $x \approx 0.7$  at RHIC)



- Systematic uncertainties are expected reduce with further studies including track+tower jets!

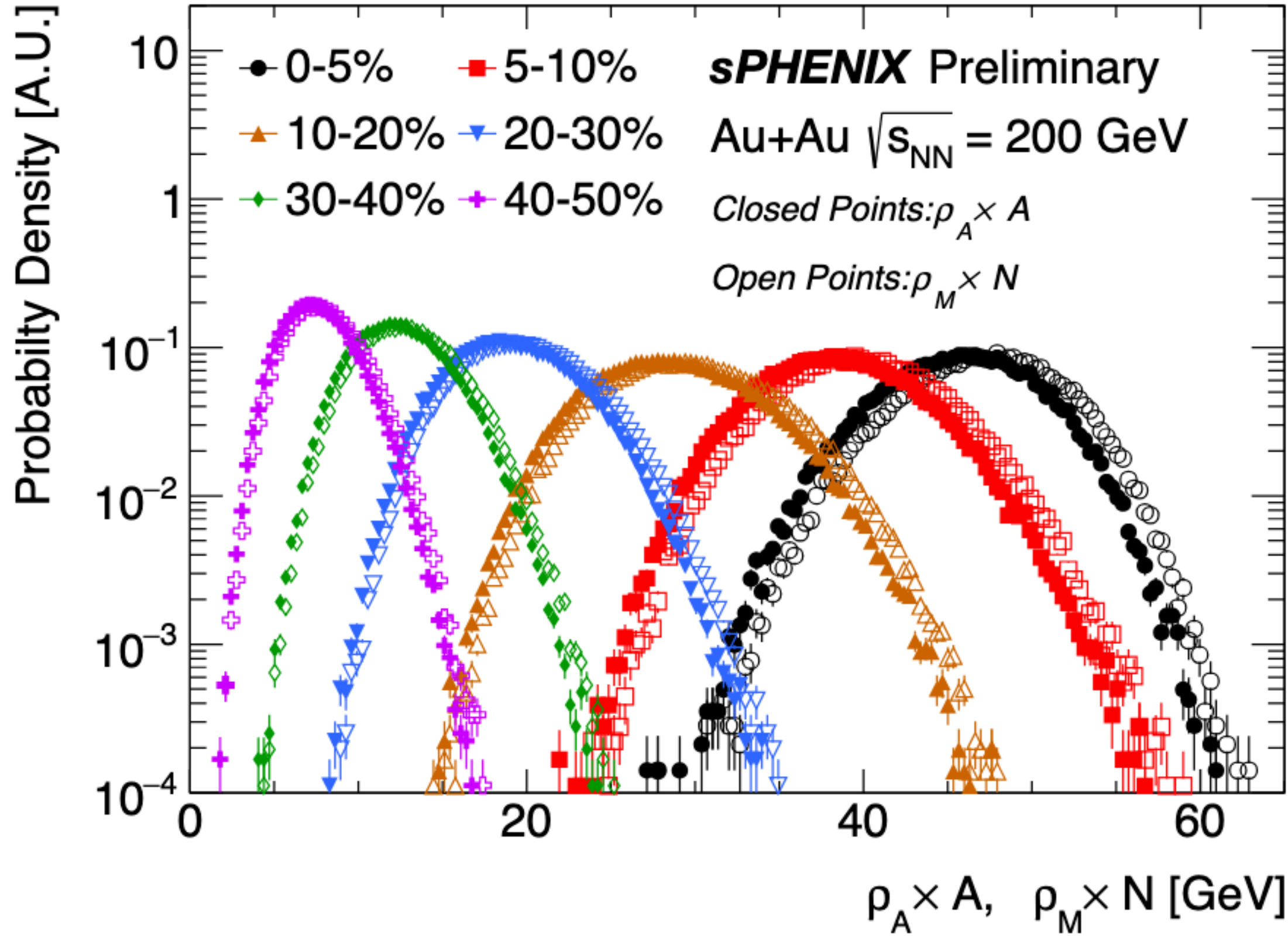
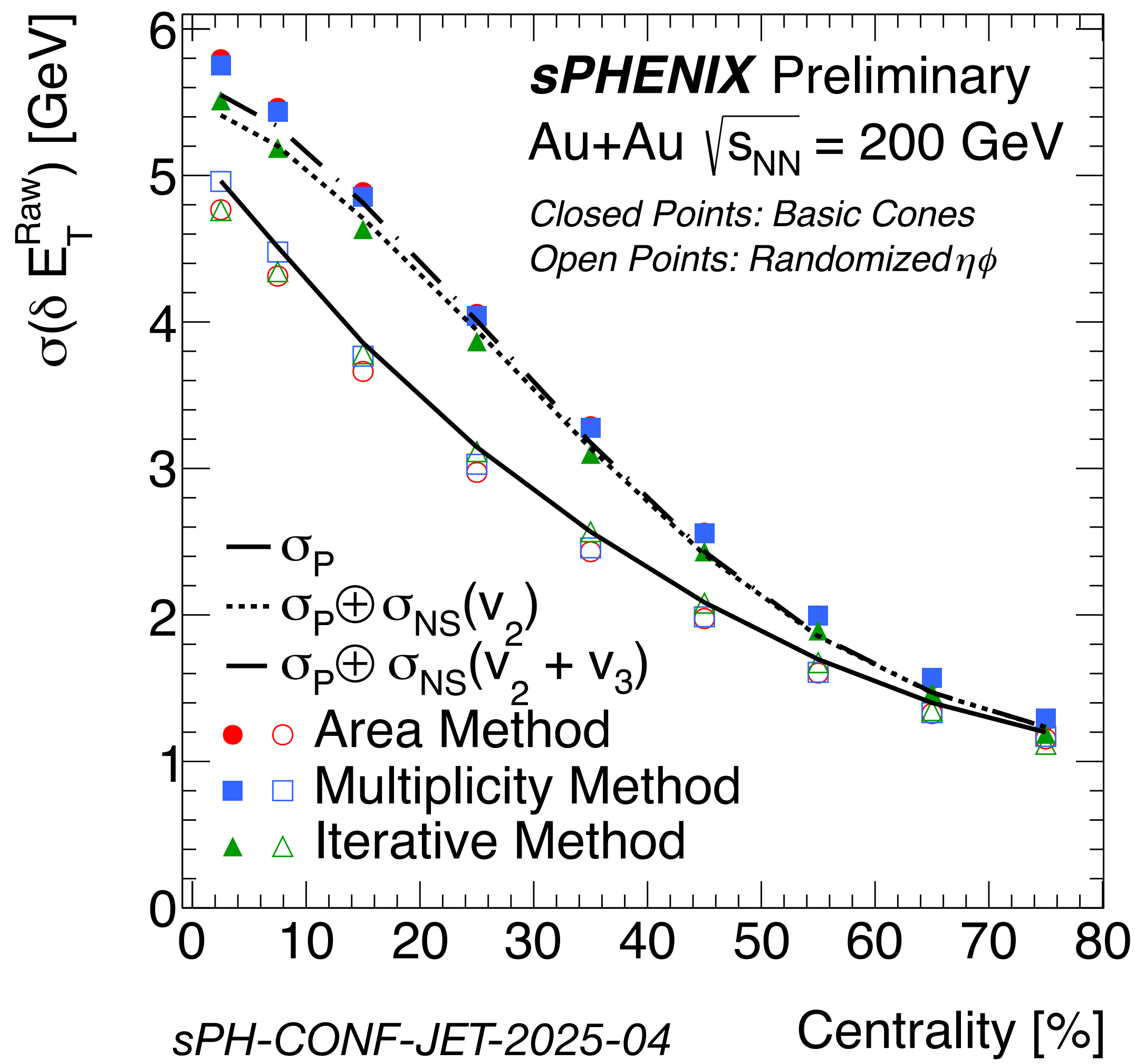


# sPHENIX - the jet detector - II



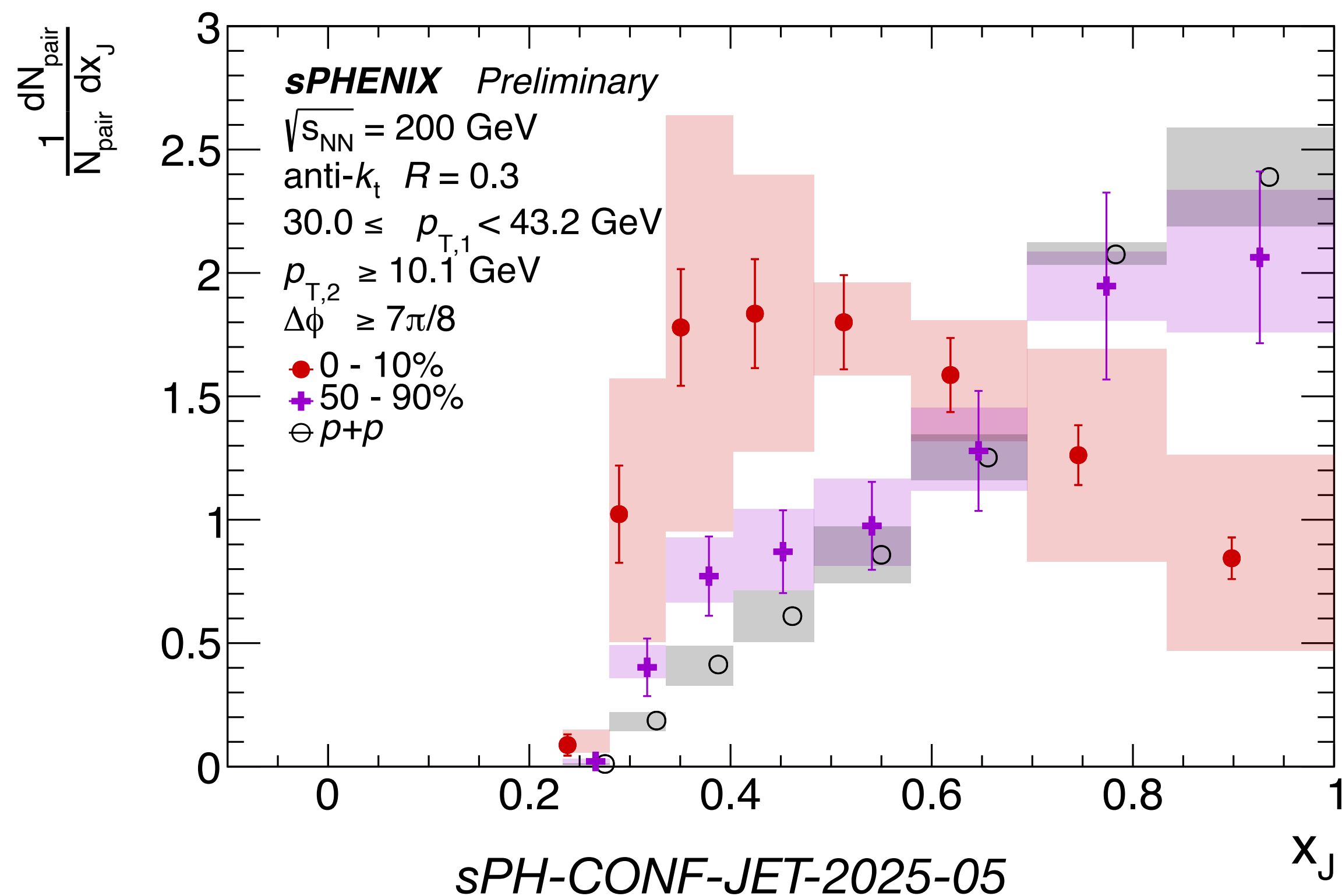
- Single-spin asymmetry for jets also consistent with zero and with STAR
- Ongoing work to extend to lower momenta and include more statistics!

# sPHENIX - the jet/underlying event detector



- First step towards quantifying jet background in Au+Au collisions!

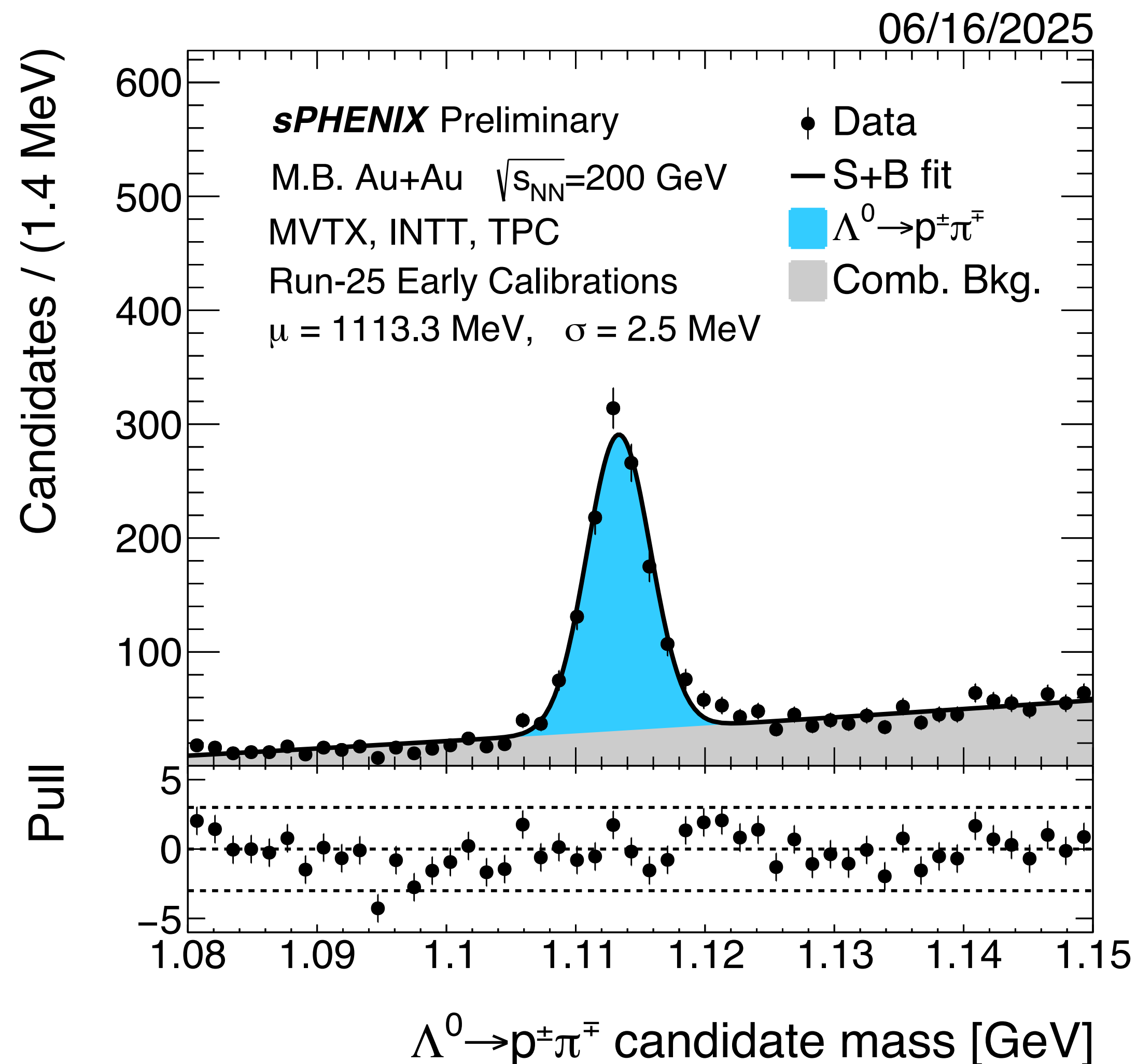
# sPHENIX - the jet detector - III



$$x_J = \frac{p_T^{\text{sublead-jet}}}{p_T^{\text{lead-jet}}}$$

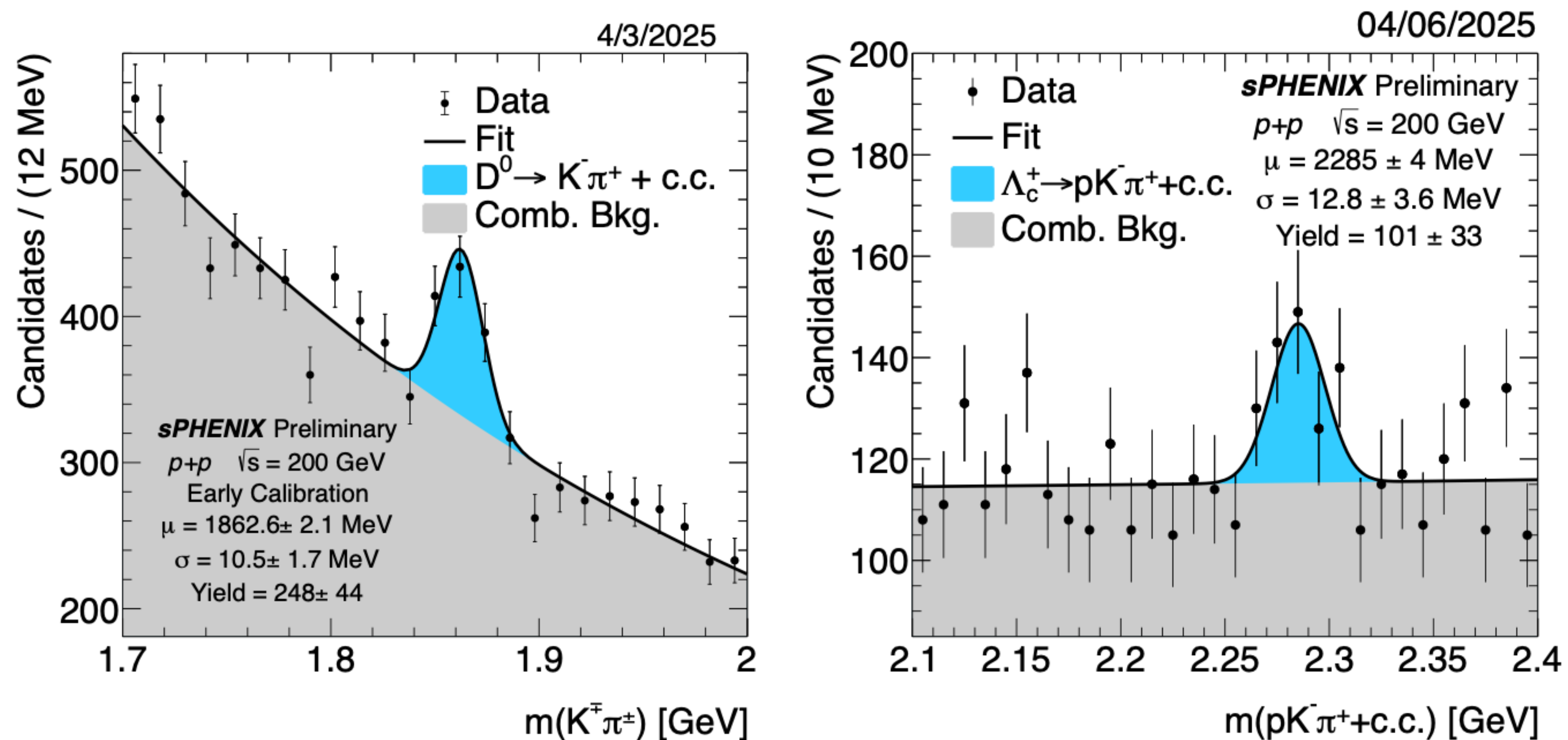
- Fully unfolded di-jet asymmetry shows significant modification
- Still only calorimeter jets - work underway with the full datasets to improve both stat and sys uncertainties
- Can be used as a calibrated probe of understanding surface bias at RHIC
- Similar results compared to earlier STAR measurements

# sPHENIX - The heavy flavor detector



- First look at tracking performance for  $\Lambda^0$  with early calibrations from Run25 data
- We also have ongoing studies to quantify the tracking efficiencies, resolutions and distortion corrections necessary for the precision we desire

# sPHENIX - The heavy flavor detector



- First look at heavy flavor resonances -  $D^0$  and  $\Lambda_c^+$ !!  
 (Final calibrations and cross-checks underway)

# What are we currently doing?

- We are now in full physics mode!
  - First publications/preliminary results occurred as we took data, performed calibrations, and unfolded for our corrected results simultaneously!
- Ongoing studies include  $\gamma$ +jet and di-jet asymmetries, jet substructure (soft drop and sub-jets), high  $E_T$  meson spectra, energy-energy correlators (both in-jet and full event), jet flow, heavy flavor resonances and their spectra etc...
  - Look forward to HP 2026 @ Nashville ([indico.cern.ch/event/1428985/](https://indico.cern.ch/event/1428985/))
- These results necessitate further studies on detector performance and optimally utilizing our data!

# What do you want us to do?

- High statistics and precise measurements are underway
- We are open to inputs from the theory and phenomenology community regarding what is the best measurement to proceed!
  - Given that RHIC now has significant O+O data that we would be able to offer a complementary study at a lower center of mass energy
- Hard probes measurements from RHIC are going to be an important baseline not just for pp/AA but also for the future ep, eA with the EIC
- High impact measurements from sPHENIX are a necessary pre-requisite to completing the RHIC science mission

# Bonus Slides