

Run23 INTT and sPHENIX Commissioning status and results Genki Nukazuka (RIKEN/RBRC)



April. 4th 2023
Young@sPHENIX



Run23, Timeline

- April :
 - All detectors had been installed except sEPD.
- May/1? :
 - Commissioning with beam started.
- Aug/01:
 - The trouble with the RHIC valve box happened.
- Aug/03:
 - HCAL cosmic trigger implemented. Commissioning with cosmic rays started.
- Aug/04:
 - ALD decision to end the run
- Aug/05:
 - Switch to two-person shifts
- Sep/13:
 - INTT was turned off in preparation for TPC repair. End of cosmics data taking for all tracking detectors.
- Sep/29:
 - End of shift operation at 24:00.
- Oct/02:
 - End of Run party





Run23, Commissioning, INTT

The status of most of the commissioning topics was presented at [the recent workshop at RIKEN](#).

Timing	Title	Speaker
28/09/2023 10:55	sPHENIX status	Genki Nukazuka (RIKEN)
28/09/2023 11:15	sPHENIX実験-中間飛跡検出器INTTを用いたトラッキングアルゴリズム開発について	Hinako Tsujibata (NWU)
28/09/2023 13:00	sPHENIX実験における中間飛跡検出器 INTT 用シリコンセンサーでのエネルギー損失測定の評価	Yuka Sugiyama (NWU)
28/09/2023 13:15	topical: jets and heavy-flavors	Takashi Hachiya (NWU)
28/09/2023 13:50	中間飛跡検出器INTTのノイズ解析	Ryota Shishikura (Rikkyo)
28/09/2023 14:05	sPHENIX-INTTシリコン検出器が示す200GeV金原子核衝突におけるヒットクラスター数の検証	Tomoya Kato (Rikkyo)
28/09/2023 14:50	sPHENIX-INTT検出器でのmultiplicity測定	Misaki Hata (NWU)
28/09/2023 15:20	高エネルギー重イオン衝突実験sPHENIXにおけるジェット再構成の研究	Mai Watanabe (NWU)
28/09/2023 17:15	sPHENIX-INTTシリコン検出器の信号振幅バイアス電圧依存性の研究	Takahiro Kikuchi (Rikkyo)
29/09/2023 15:00	sPHENIX実験INTT検出器のデータ収集タイミングの調整とパイルアップについて	Mai Kano (NWU)
29/09/2023 15:15	Development of an Event Display for INTT Detector at sPHENIX	Manami Fujiwara (NWU)



The released plots were summarized in [the sPHENIX wiki](#).

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Released results

The released results are summarized here.

The link to ePHENIX notes contains the index agenda of "Approved Preliminary plots from ePHENIX Commissioning" meetings. It also helps you find a collection of them (PDF's, PPTX's, Keynotes).

Contents [view]
1 Aug/14/2023
1-1 BCD (BROOKHOLM)
1-2 BCD (BROOKHOLM)
2 Aug/25/2023
3 Aug/18/2023
4 July/08/2023
5 July/14/2023
6 June/14/2023

Aug/31/2023 [edit | edit source]

Index:

- Cosmic ray event display under the magnetic field together with MVTX and TPOT

BCD 12633080911 [edit | edit source]

- TC event displays without the magnetic field together with MVTX, TPOT and TPC
- TC event display 1
- TC event display 2 (vtx)
- TC event display 3
- TC event display 4 (vtx)

BCD 12643080911 [edit | edit source]

- TC event display 1
- TC event display 2 (vtx)
- TC event display 3

Aug/23/2023 [edit | edit source]

The following people should add their own plots here:

- Mai K.T (dmesd)
- Mai K.T (clusters on the inner and the outer barrel)
- Masaaki (ADC distribution of all PHOX chips)
- T.MBD charge vs INTT clusters
- Takanori (INTT clusters vs $\Delta\eta$, INTT $\Delta\eta$, vtx)
- Hiroko (Correlations of clusters between various combinations)
- Chang Wei GO event displays
- Masumi (The INTT event display)

GEMO DOESN'T DO IT!!

Aug/18/2023 [edit | edit source]

Links, slides, videos: Results from MVTX, INTT, and TPOT. Slides, Videos

- a view of MVTX hits and INTT hits from the cosmic ray measurement (Run25475)
- a view of MVTX hits and INTT hits from the cosmic ray measurement (Run25475), the other event
- a view of MVTX hits and INTT hits from the cosmic ray measurement (Run25475)
- a view of MVTX hits and INTT hits from the cosmic ray measurement (Run25475), the other event
- Event display of MVTX hits and INTT hits
- a view of MVTX hits and INTT hits from the cosmic ray measurement (Run25475), the other event again
- Event display of MVTX hits and INTT hits, the other event
- a view of MVTX hits and INTT hits from the cosmic ray measurement (Run25475), the other event again and again
- Event display of MVTX hits and INTT hits, the other event again (see BCD in the file name)
- Event display of MVTX hits, INTT hits, and TPOT hits
- Event display of MVTX hits, INTT hits, and TPOT hits, the other event

July/28/2023 [edit | edit source]

Links:

- MBD charge vs the number of INTT clusters (same as July/21/23)
- MBD charge vs the number of INTT hits (same as July/21/23)

Link:

- INTT $\Delta\eta$
- INTT $\Delta\eta$ vs MBD $\Delta\eta$

July/21/2023 [edit | edit source]

Link:

- MBD charge vs the number of INTT clusters
- MBD charge vs the number of INTT hits
- The number of TPOT clusters vs the number of INTT (or INTH) clusters (slides)
- Note of TPOT vs INTT

June/14/2023 [edit | edit source]

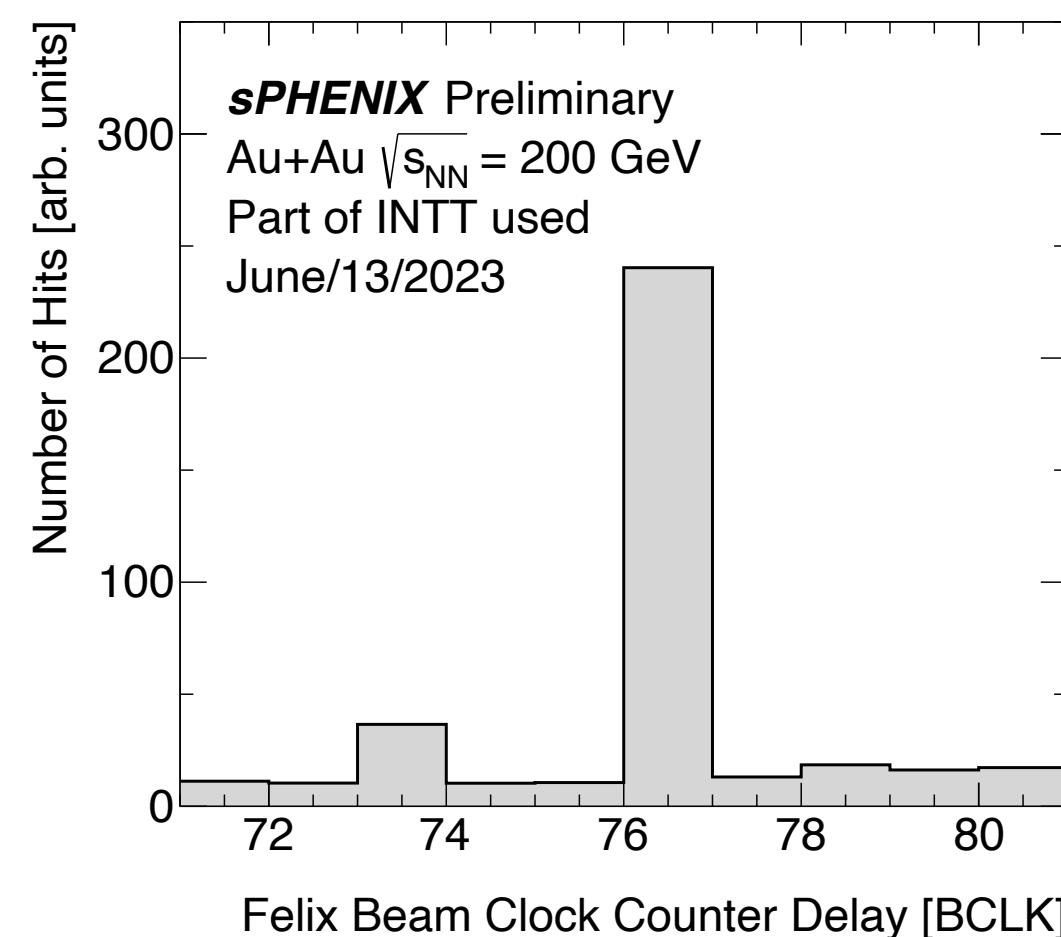
Link:

- Evidence of beam-mis
- Correlation of the number of hits on the inner or outer barrel from a single FLLX
- Correlation of the number of clusters on the inner or outer barrel from a single FLLX
- Correlation between FLLXs: the number of clusters from m22 vs m23

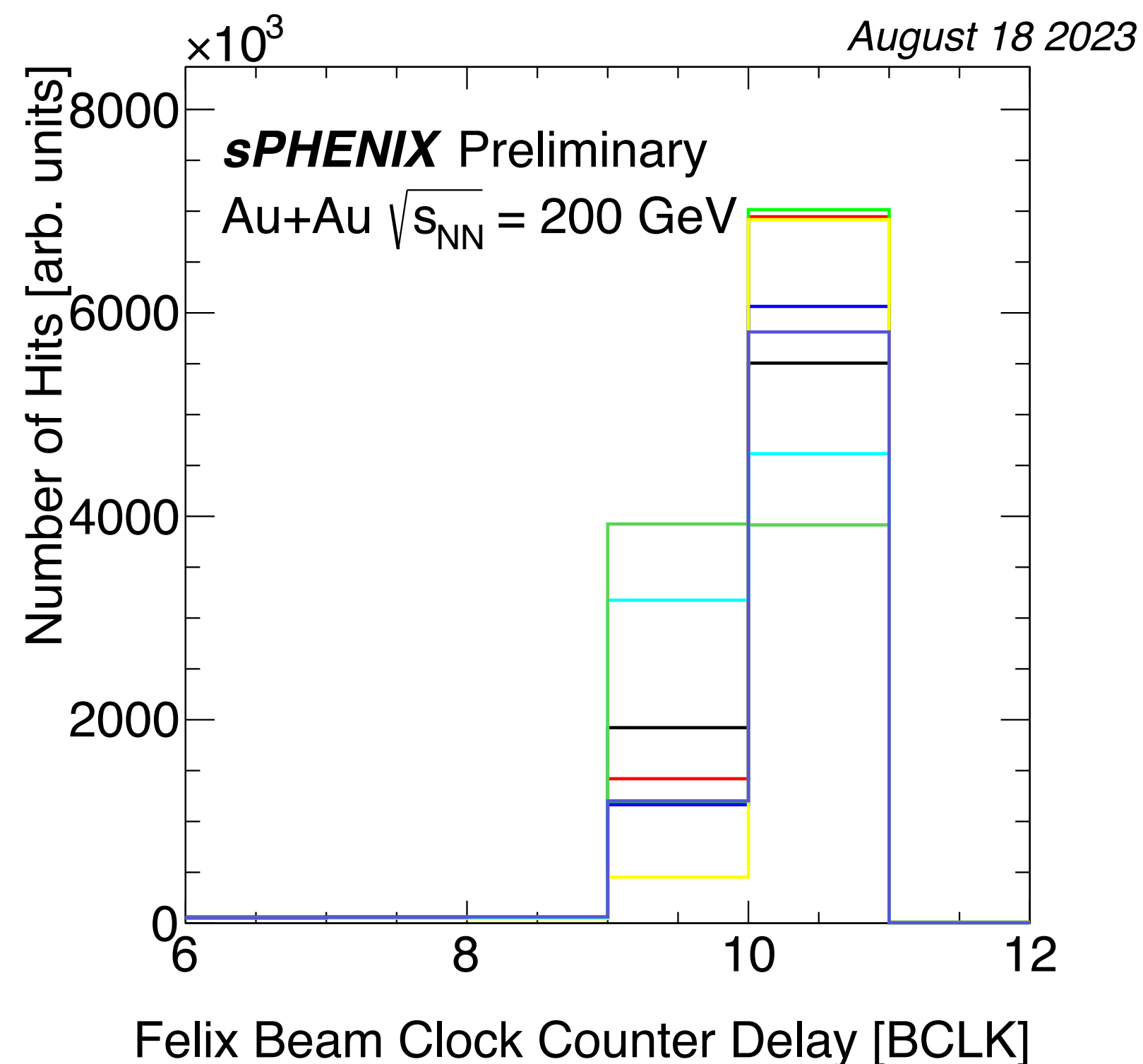


Run23, Commissioning, INTT

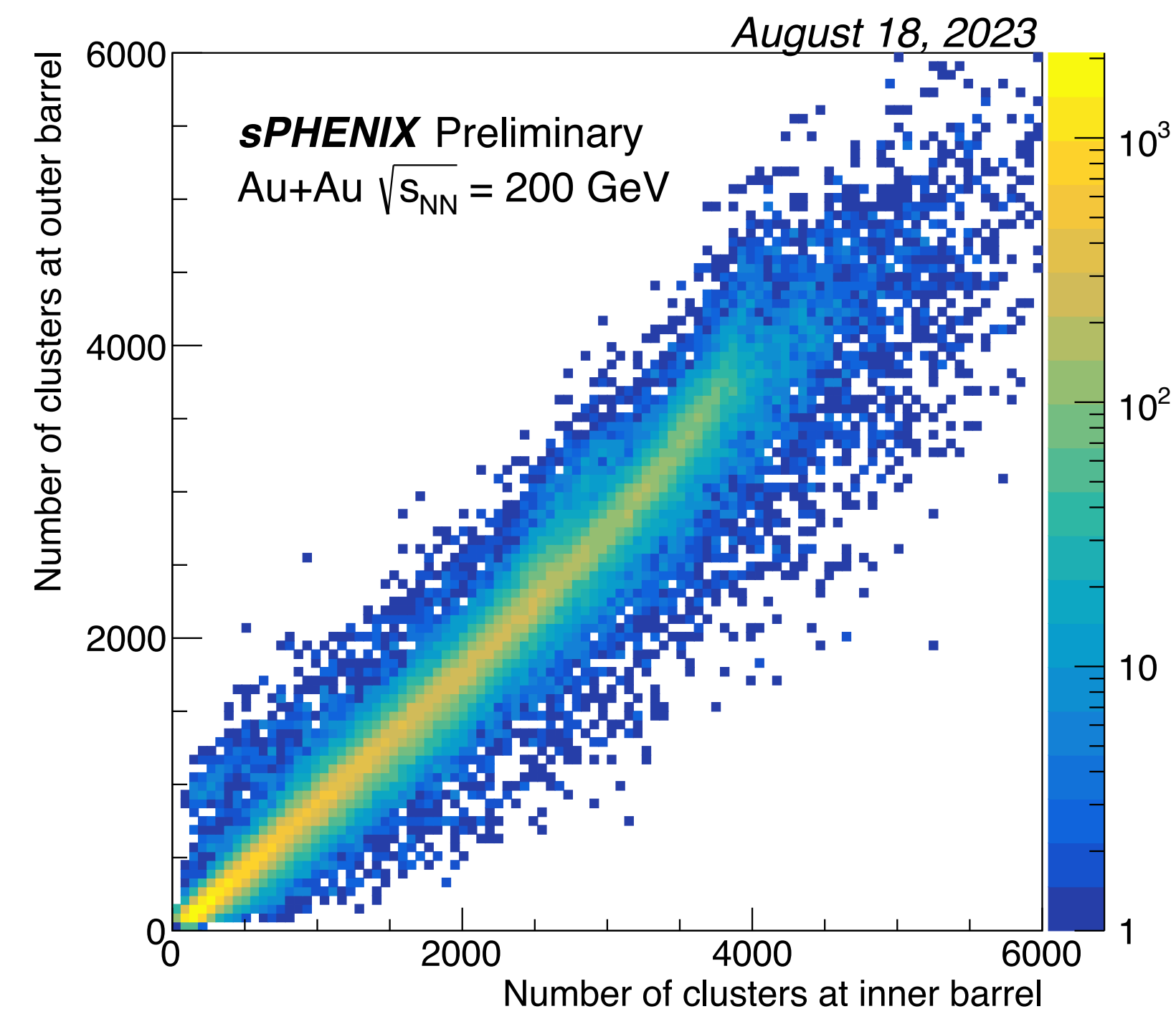
Commissioning with beam



**The first evidence of timed-in.
Only 1/8 part of INTT.
Released on June/13/2023.**



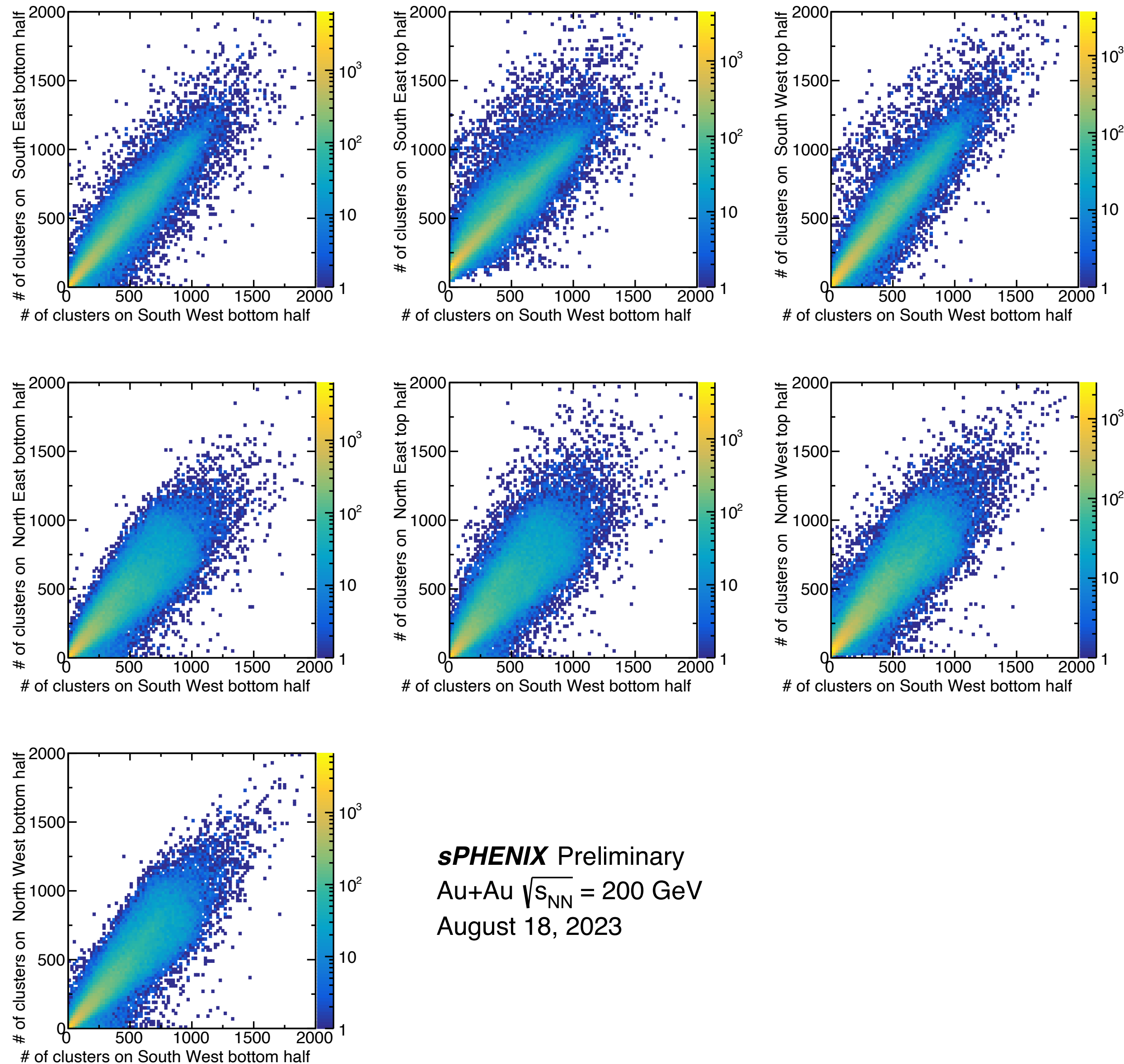
**Evidence of the timing resolution within 2 BCO.
Released on Aug/18/2023.**



**Evidence of healthy operation of INTT.
#clusters on the inner barrel and the outer barrel.
Released on Aug/18/2023.**



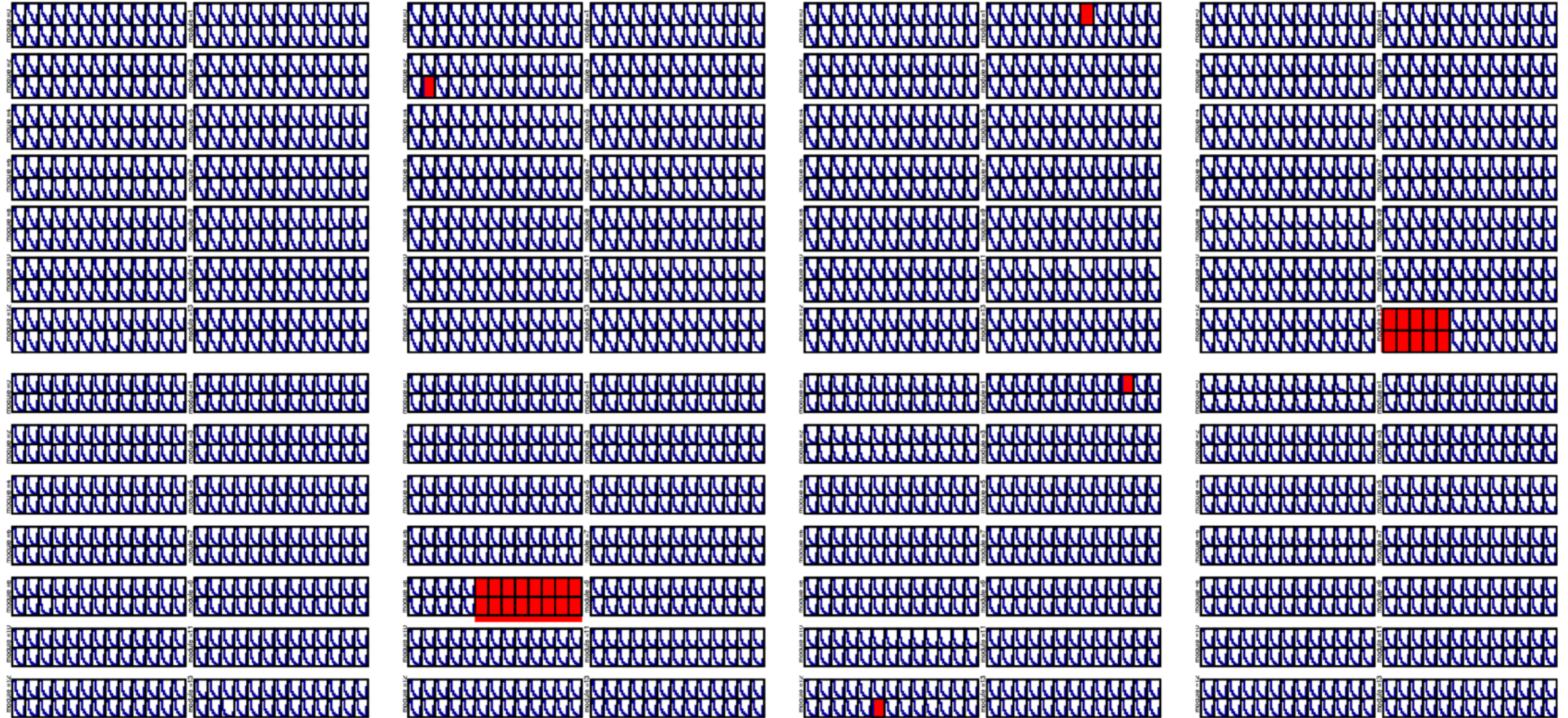
Run23, Commissioning, INTT



*s***PHENIX** Preliminary
 Au+Au $\sqrt{s_{NN}} = 200$ GeV
 August 18, 2023

**Correlations of #clusters
 between the south west bottom half of INTT
 and the other parts.
 Released on Aug/18/2023.**

August 18, 2023



ADC distribution of all FPHX chips.

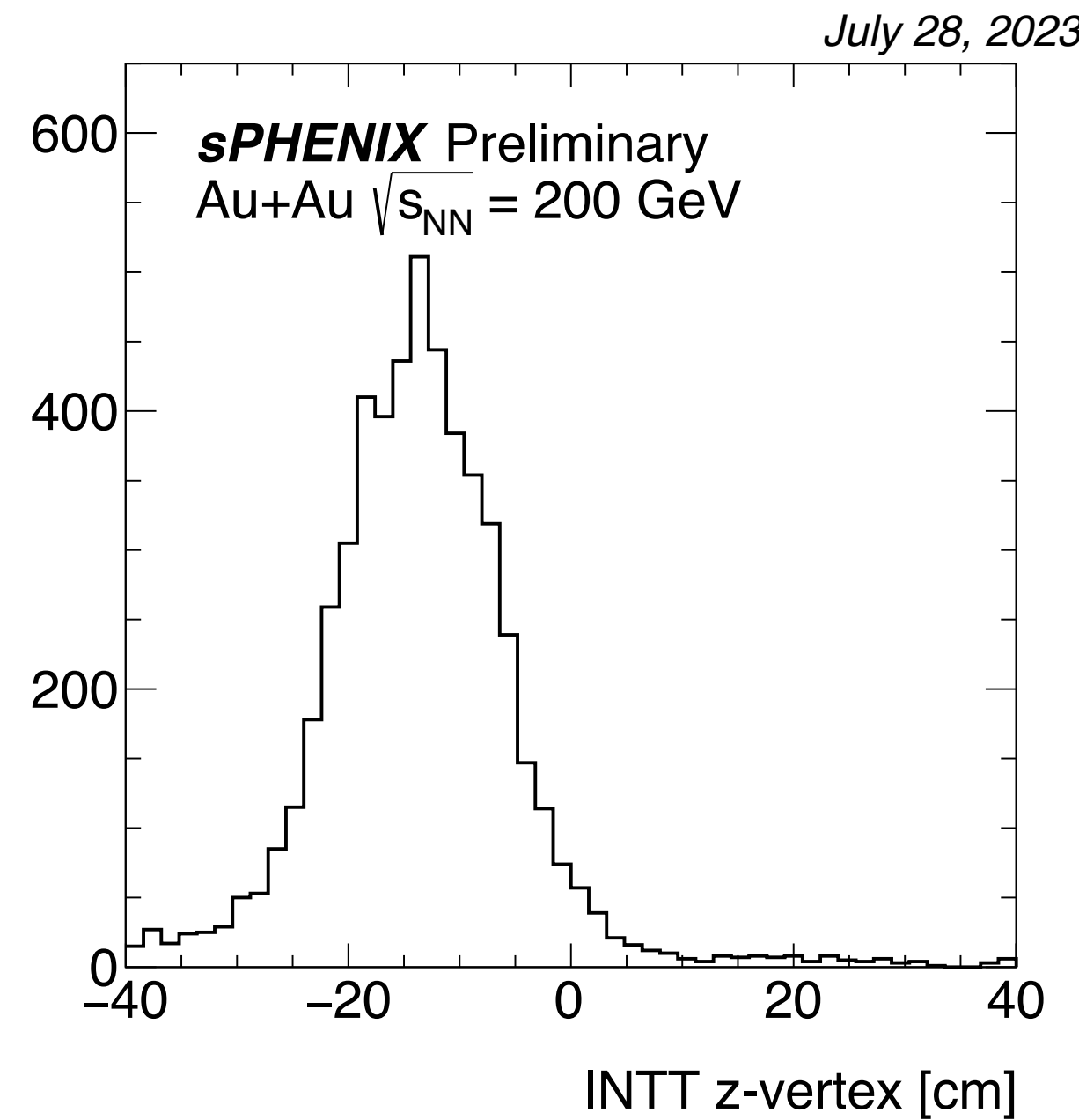
It means most of the chips (2882 / 2912 ~ 0.990) are in good condition.

Released on Aug/18/2023.

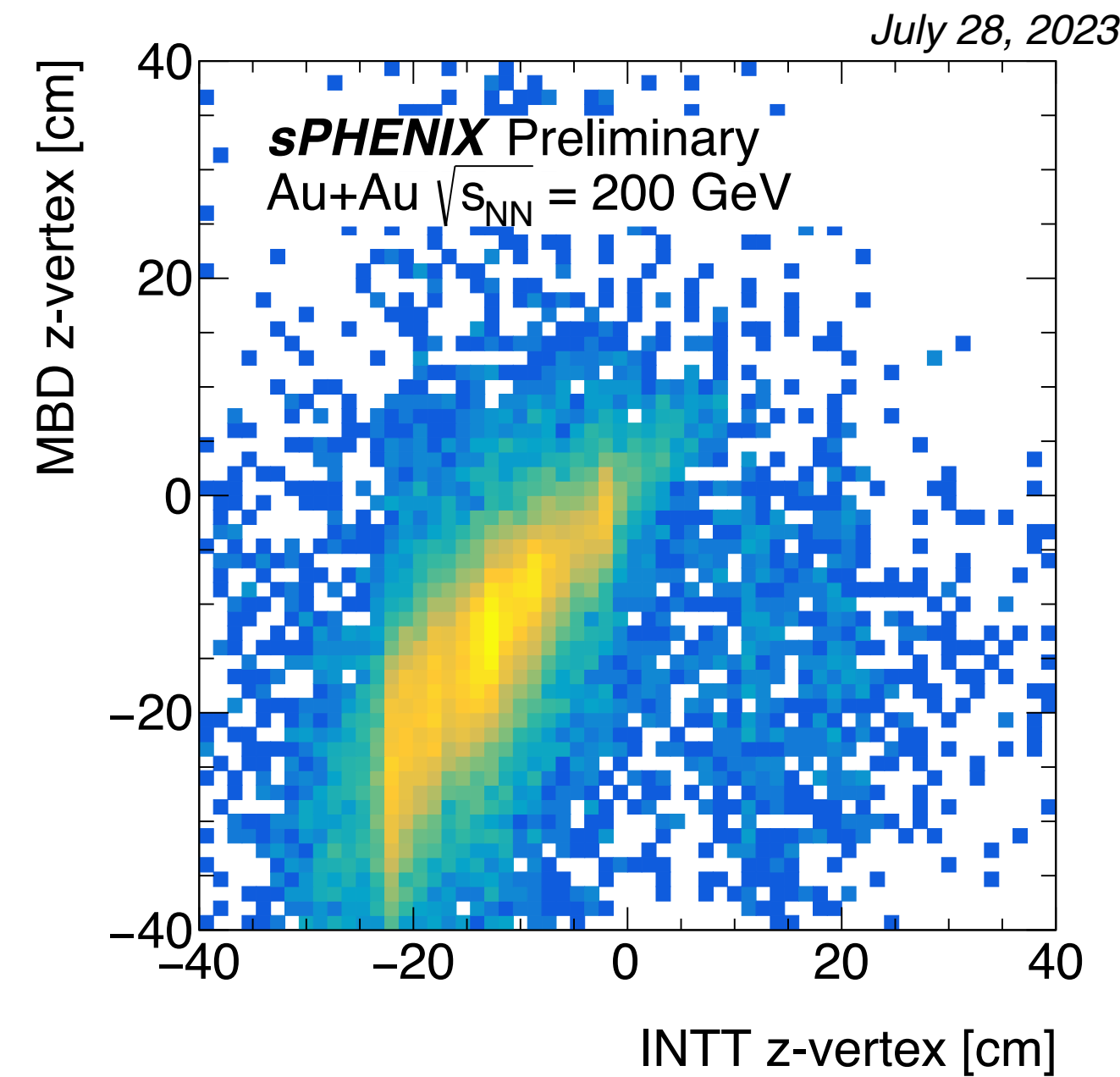
sPHENIX Preliminary
Au+Au $\sqrt{s_{NN}} = 200$ GeV



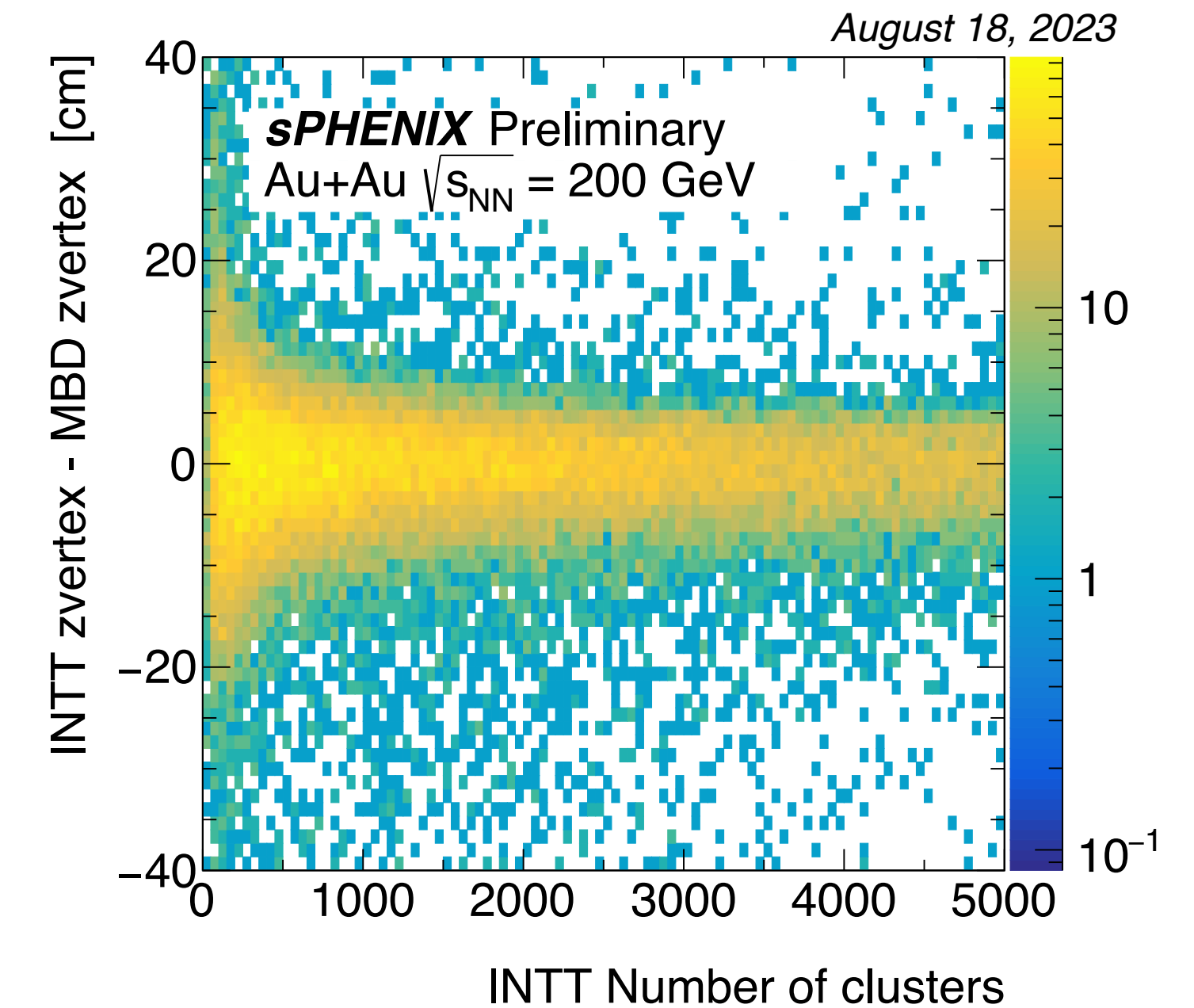
Run23, Commissioning, INTT



z_{vtx} distribution reconstructed by INTT.
Released on Aug/18/2023.



A correlation of z_{vtx} reconstructed by INTT and MBD.
Released on Aug/18/2023.

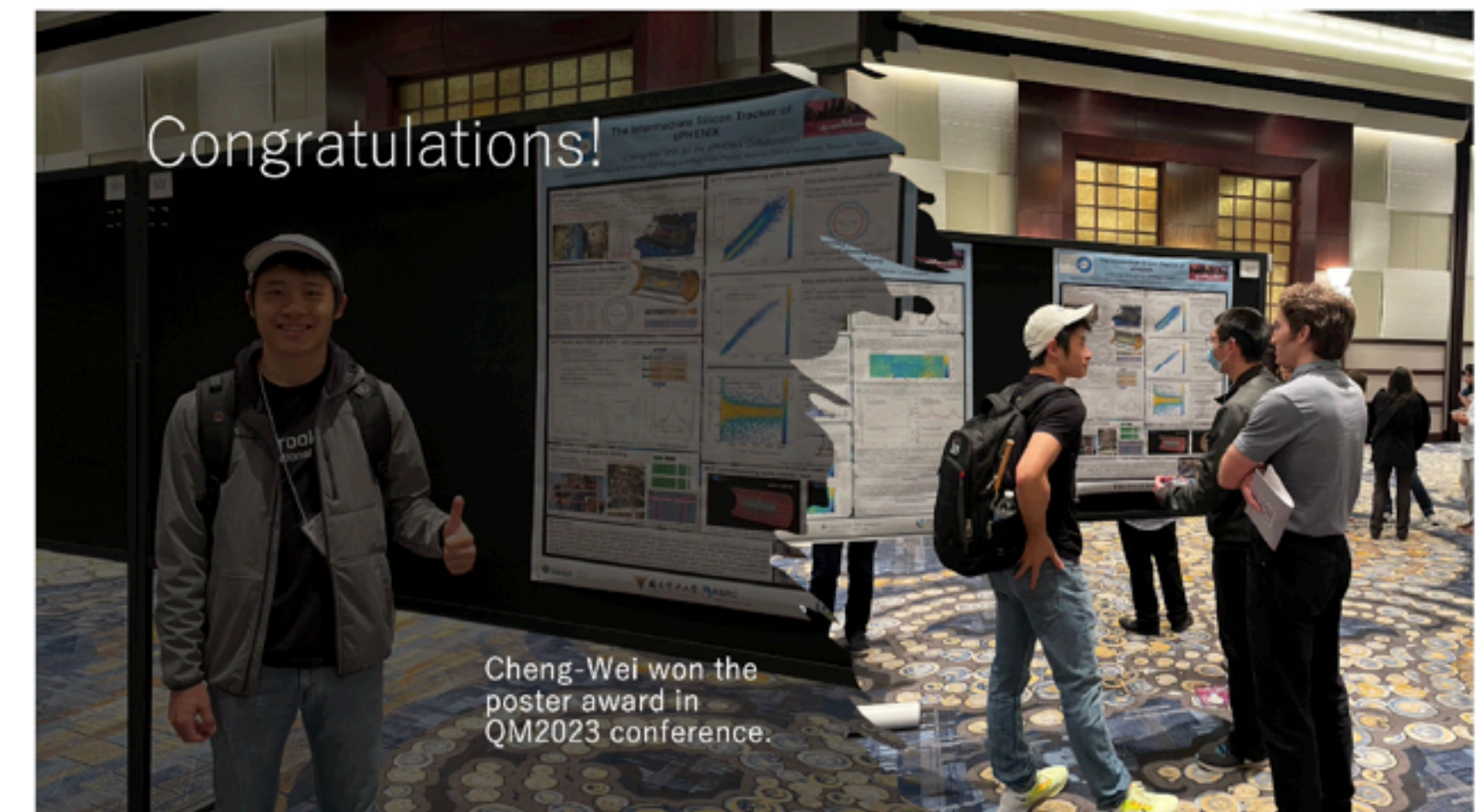
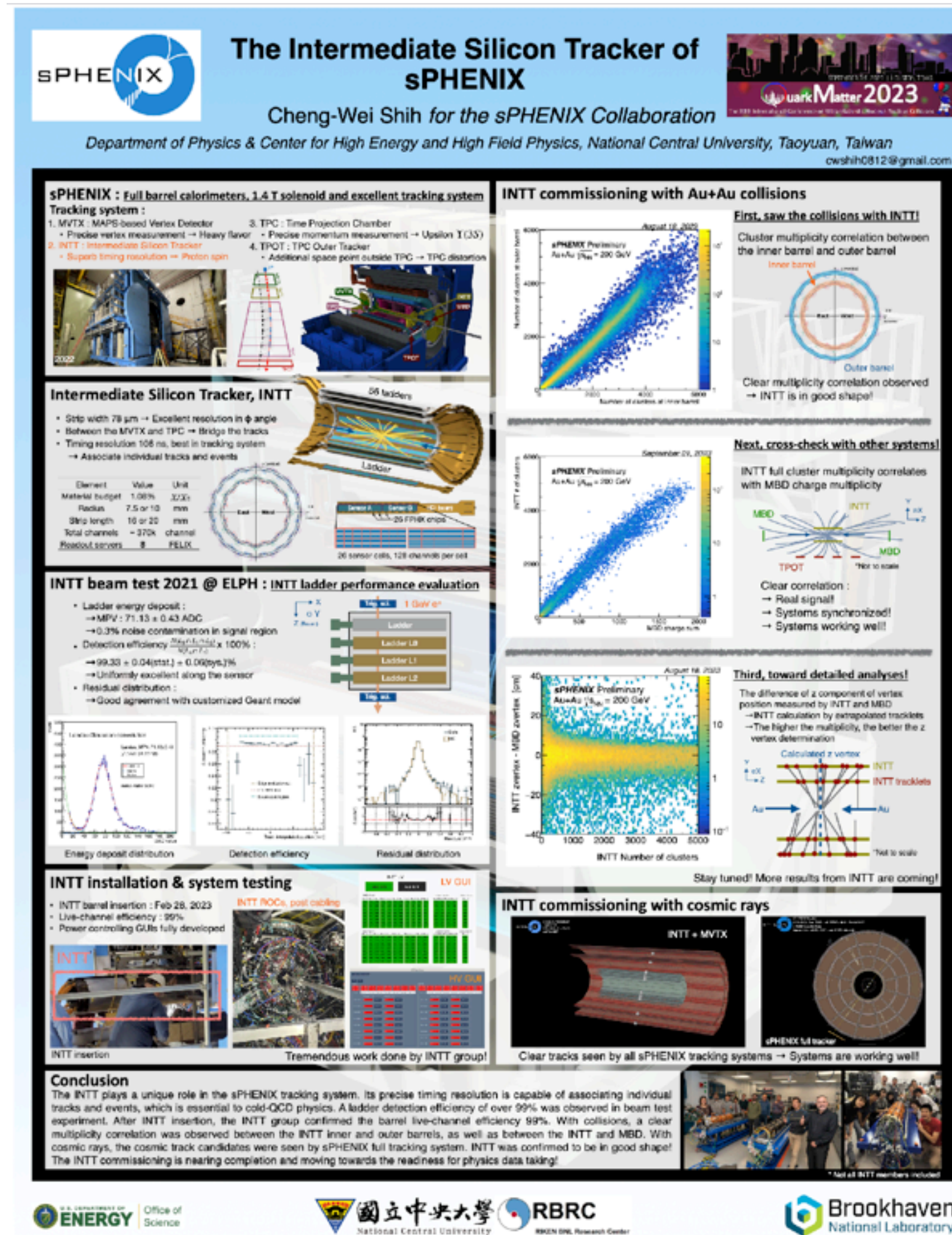


A correlation between #INTT clusters and the difference of z_{vtx} reconstructed by MBD and INTT.
Released on Aug/18/2023.



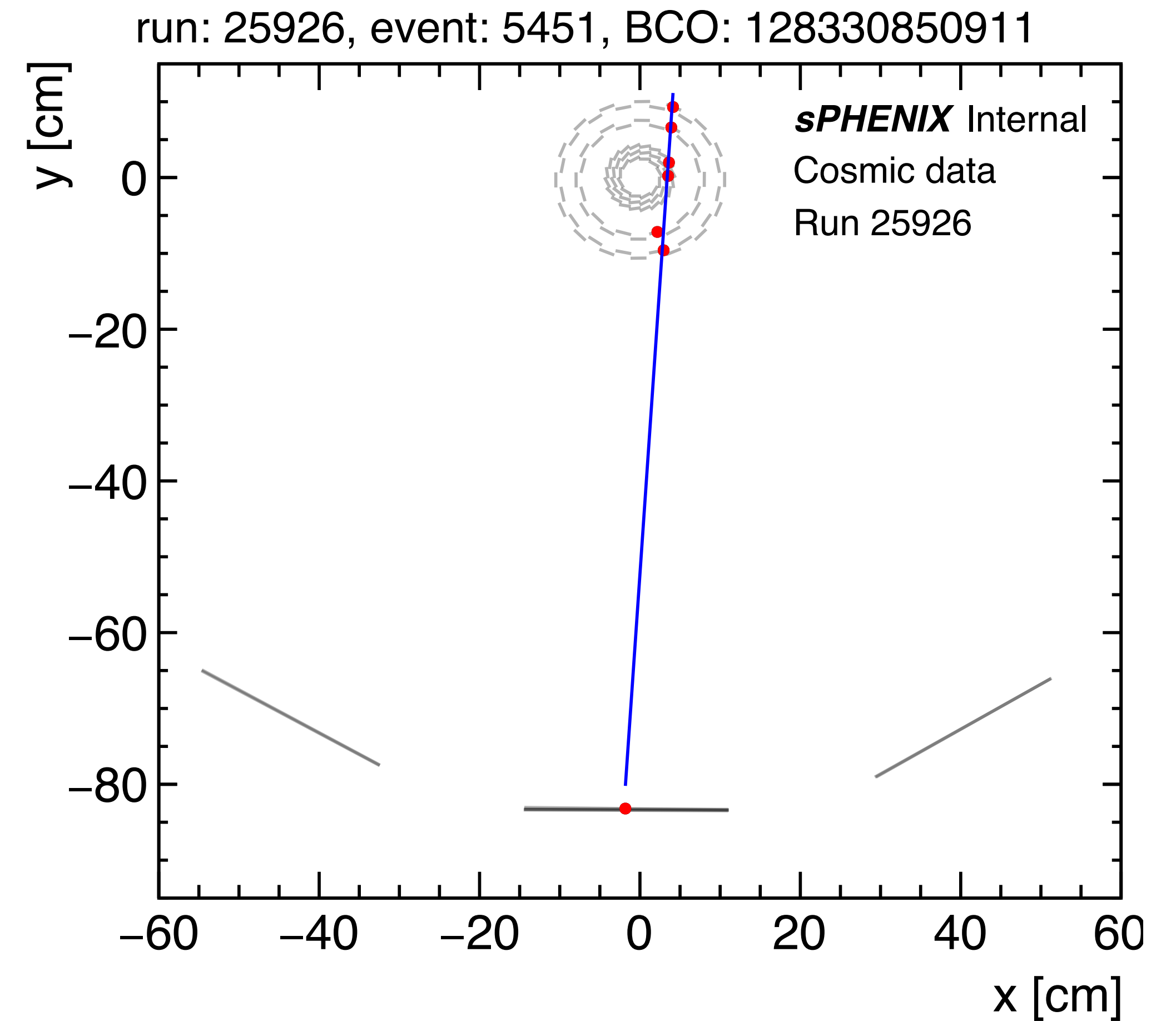
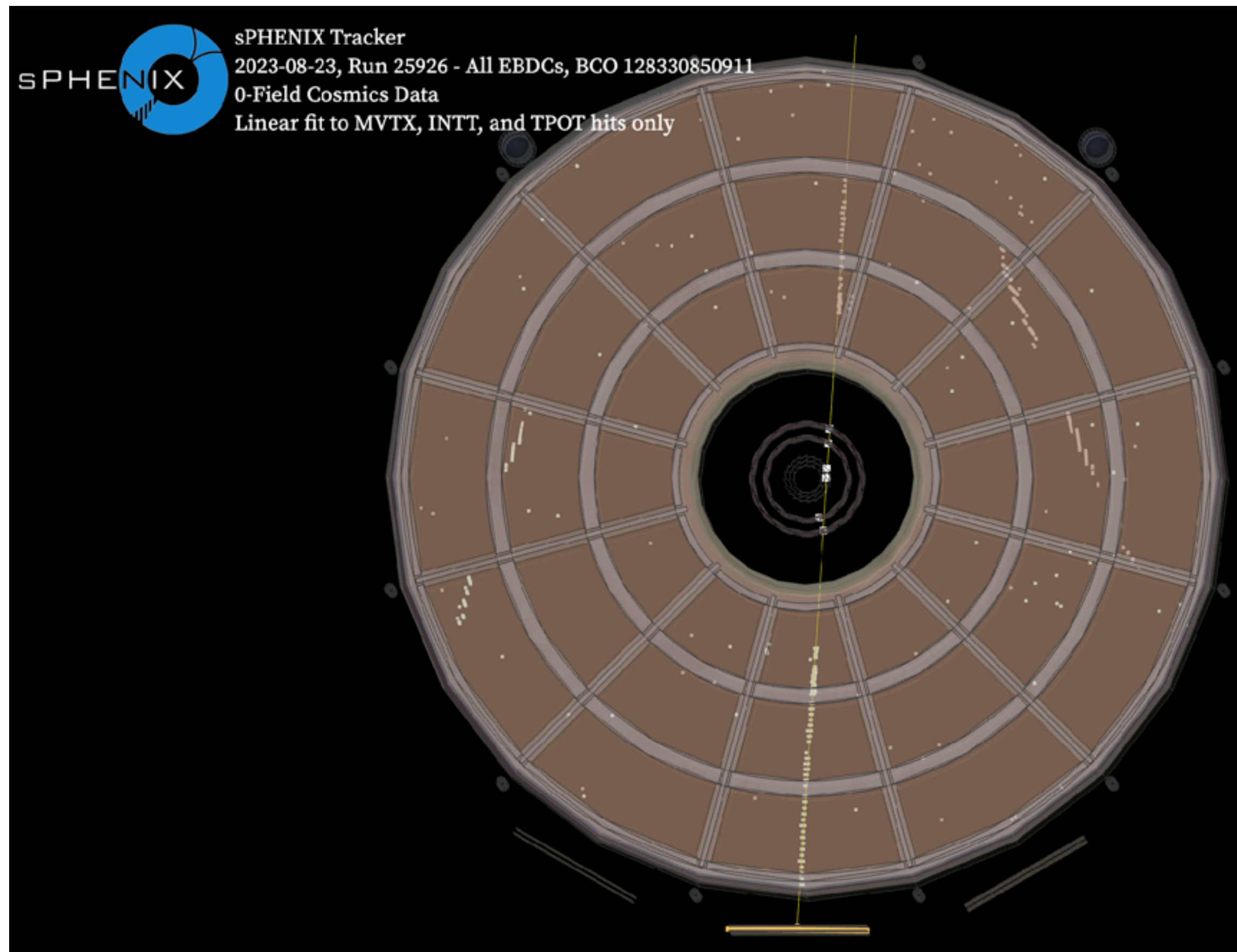
Run23, Commissioning, INTT

Our colleague, Cheng-Wei Shih, from National Central University, Taiwan, won the poster award in QuarkMatter2023 for “The Intermediate Silicon Tracker of sPHENIX”.





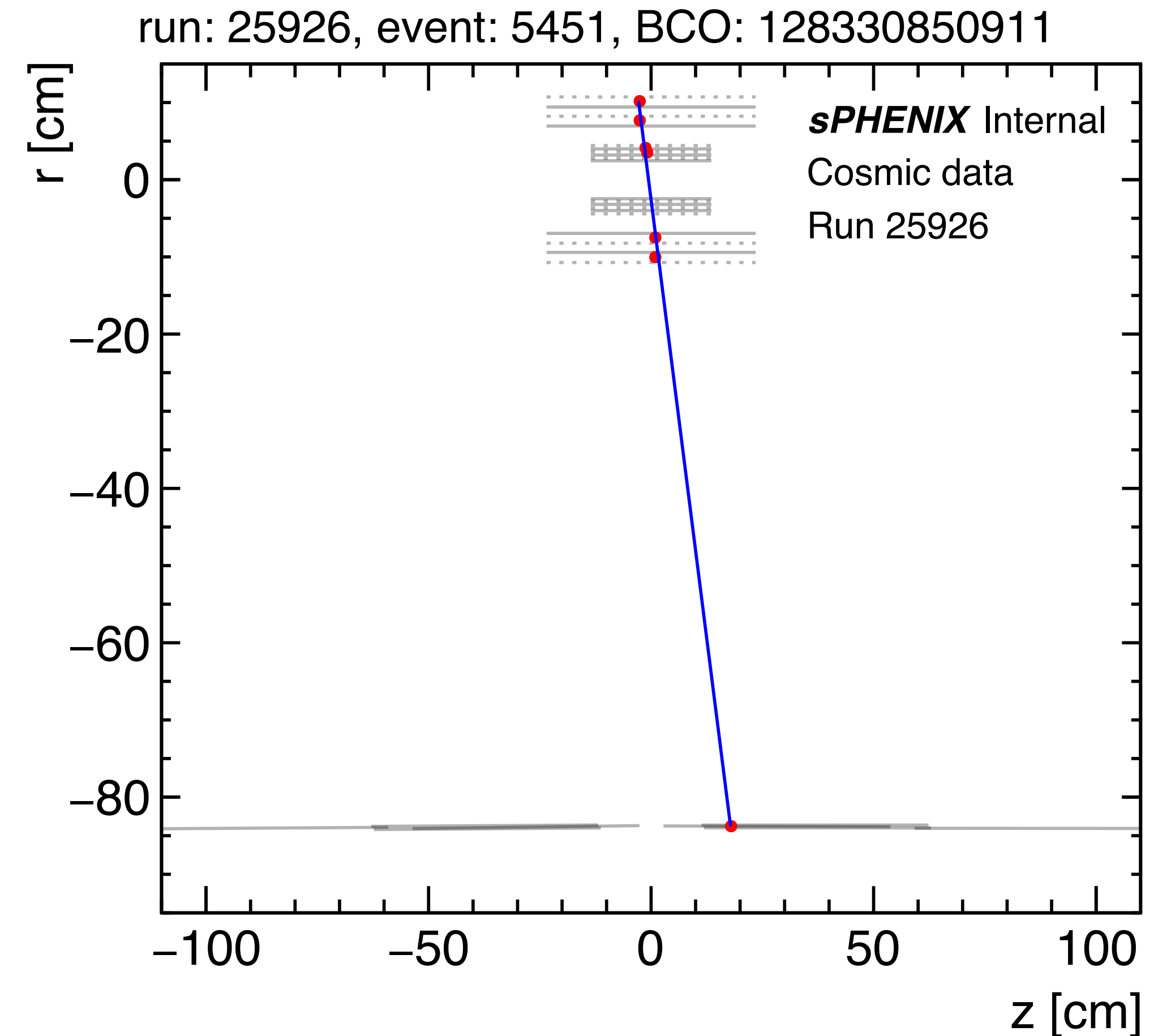
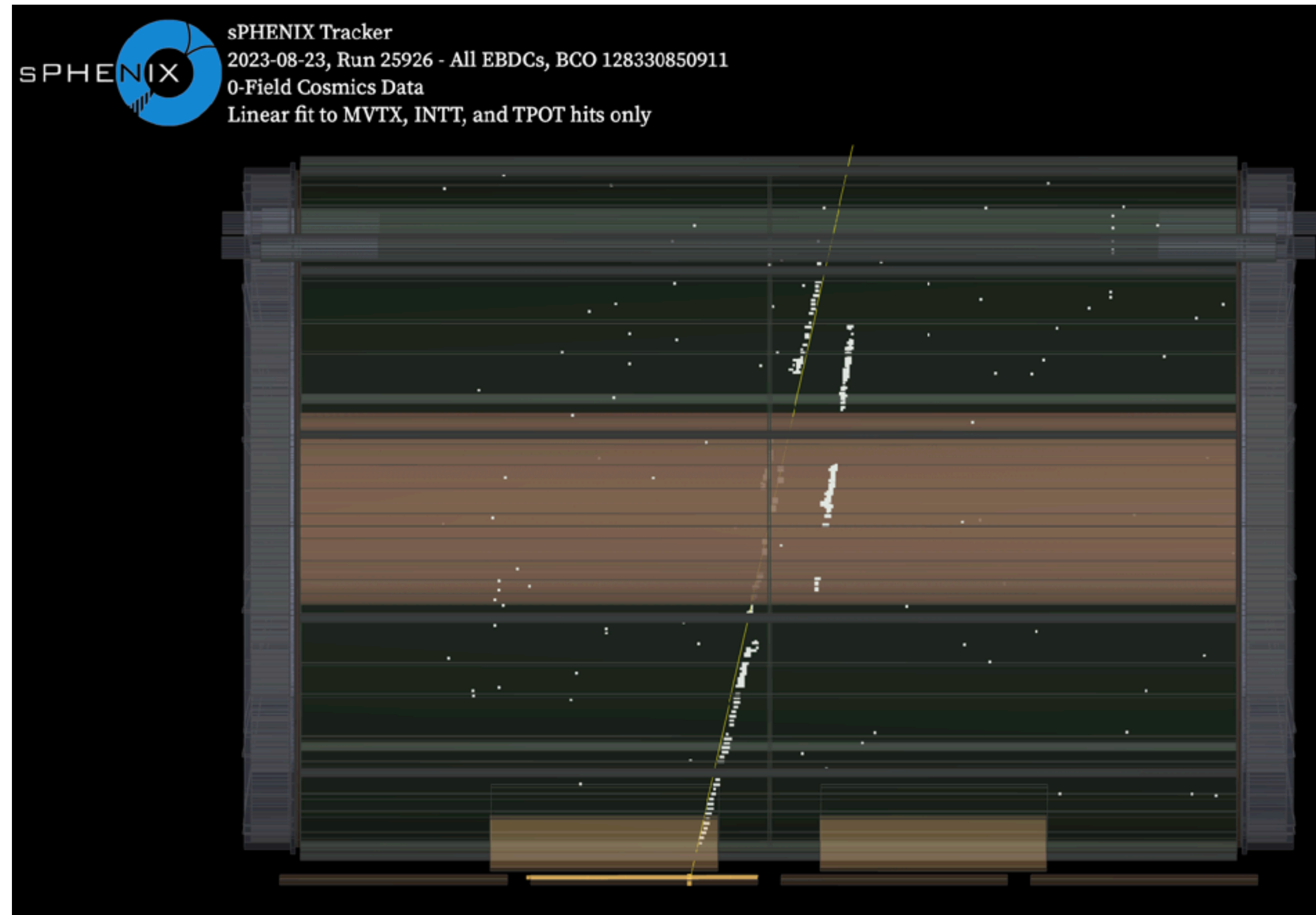
Run23, Commissioning, INTT



Cosmic ray measurements together
with MVTX, TPC, and TPOT.



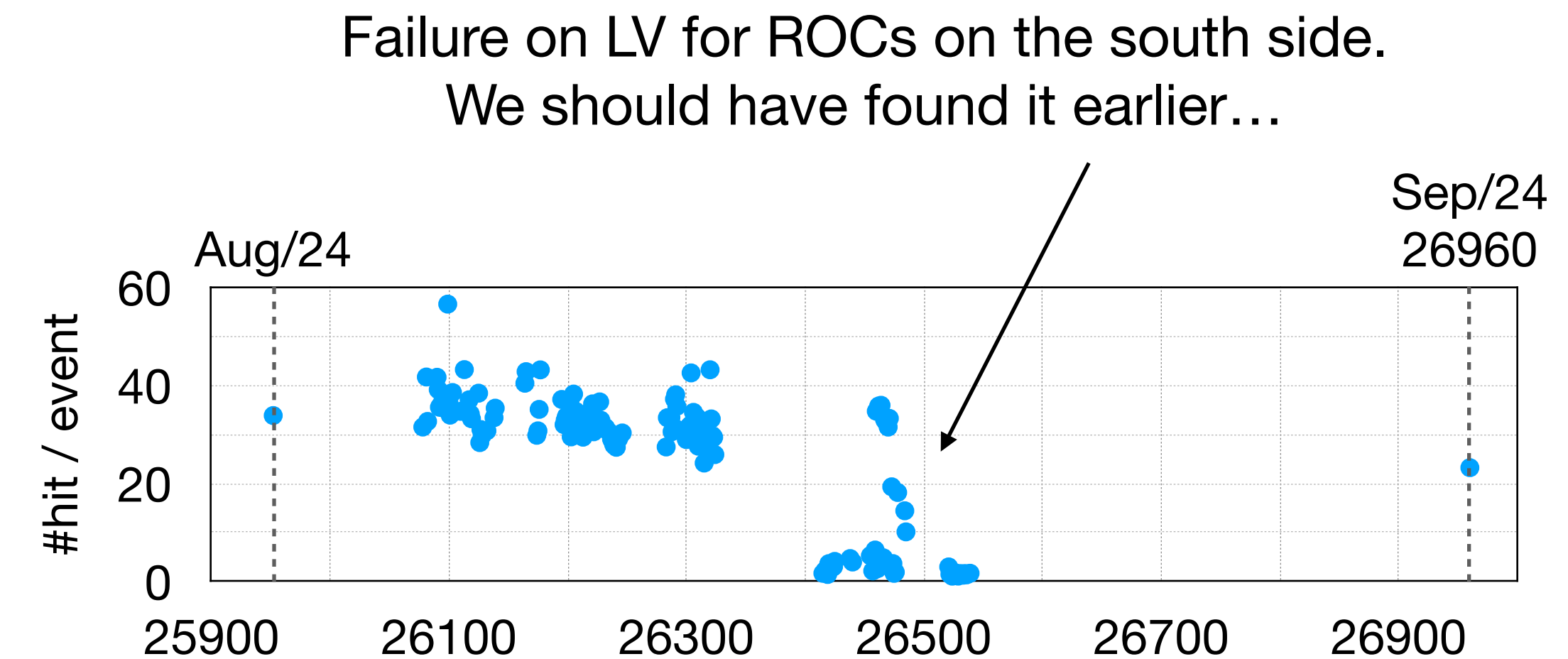
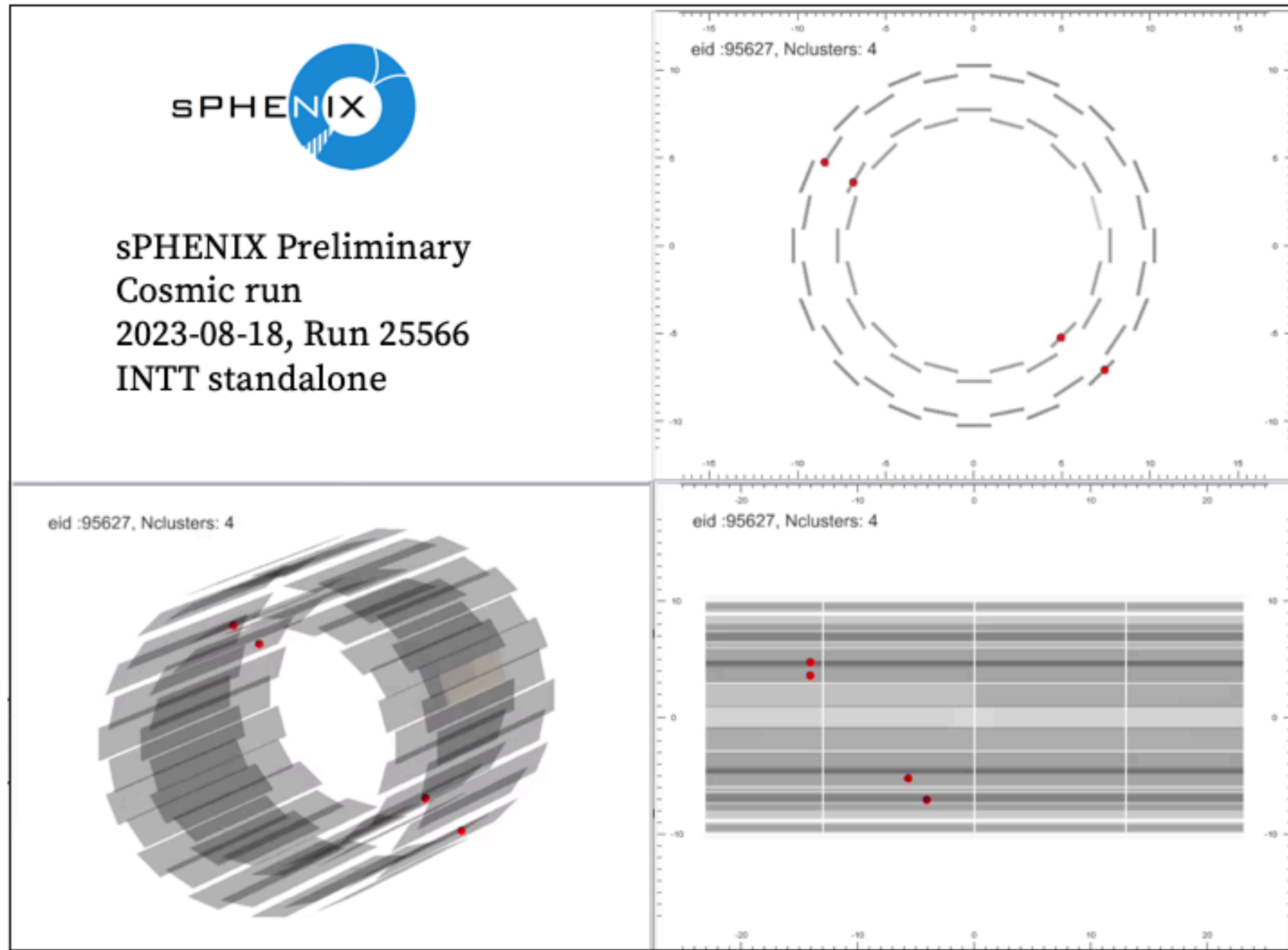
Run23, Commissioning, INTT



Cosmic ray measurements together
with MVTX, TPC, and TPOT.



Run23, Commissioning, INTT



#hit/event as a function of runs.

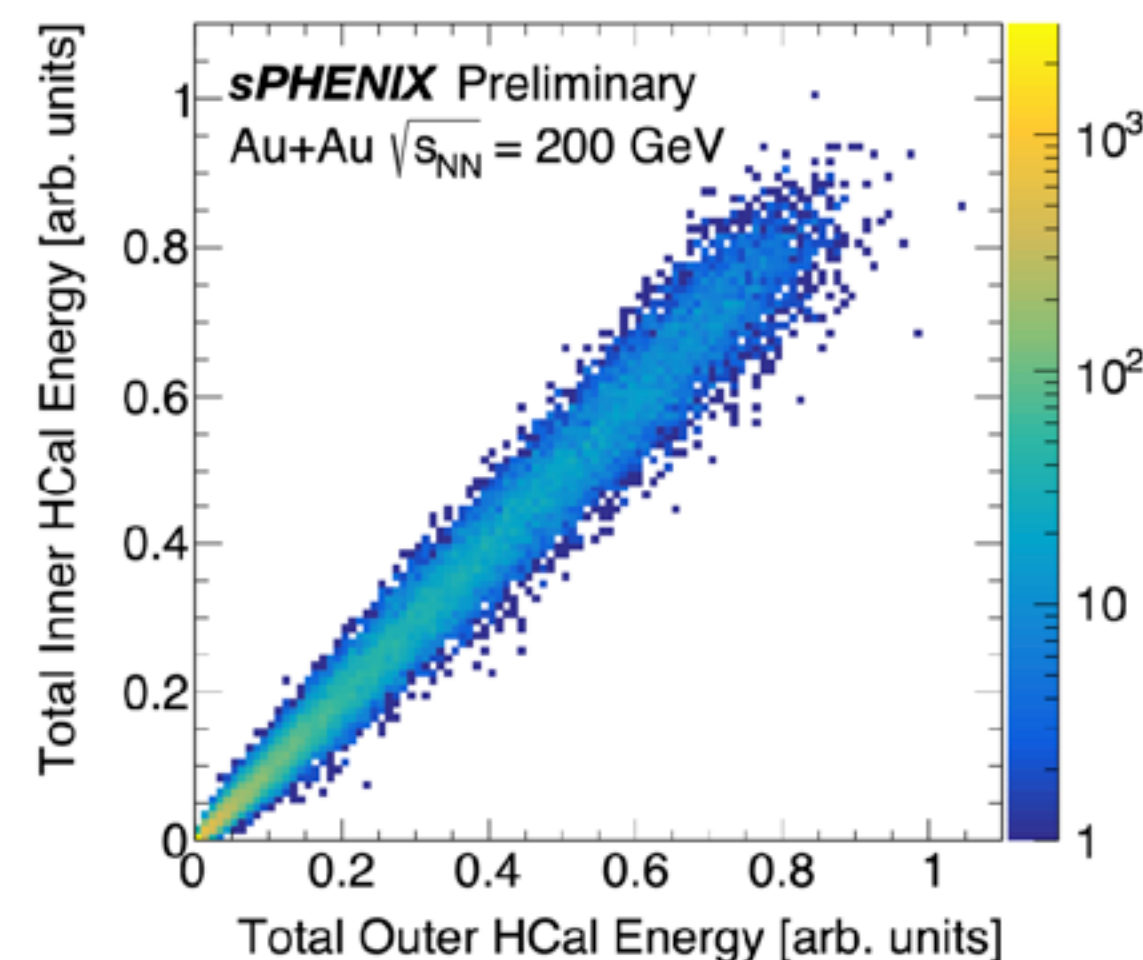
Hot channels were not excluded in this analysis.

INTT was operated on for 1 month in stable condition.

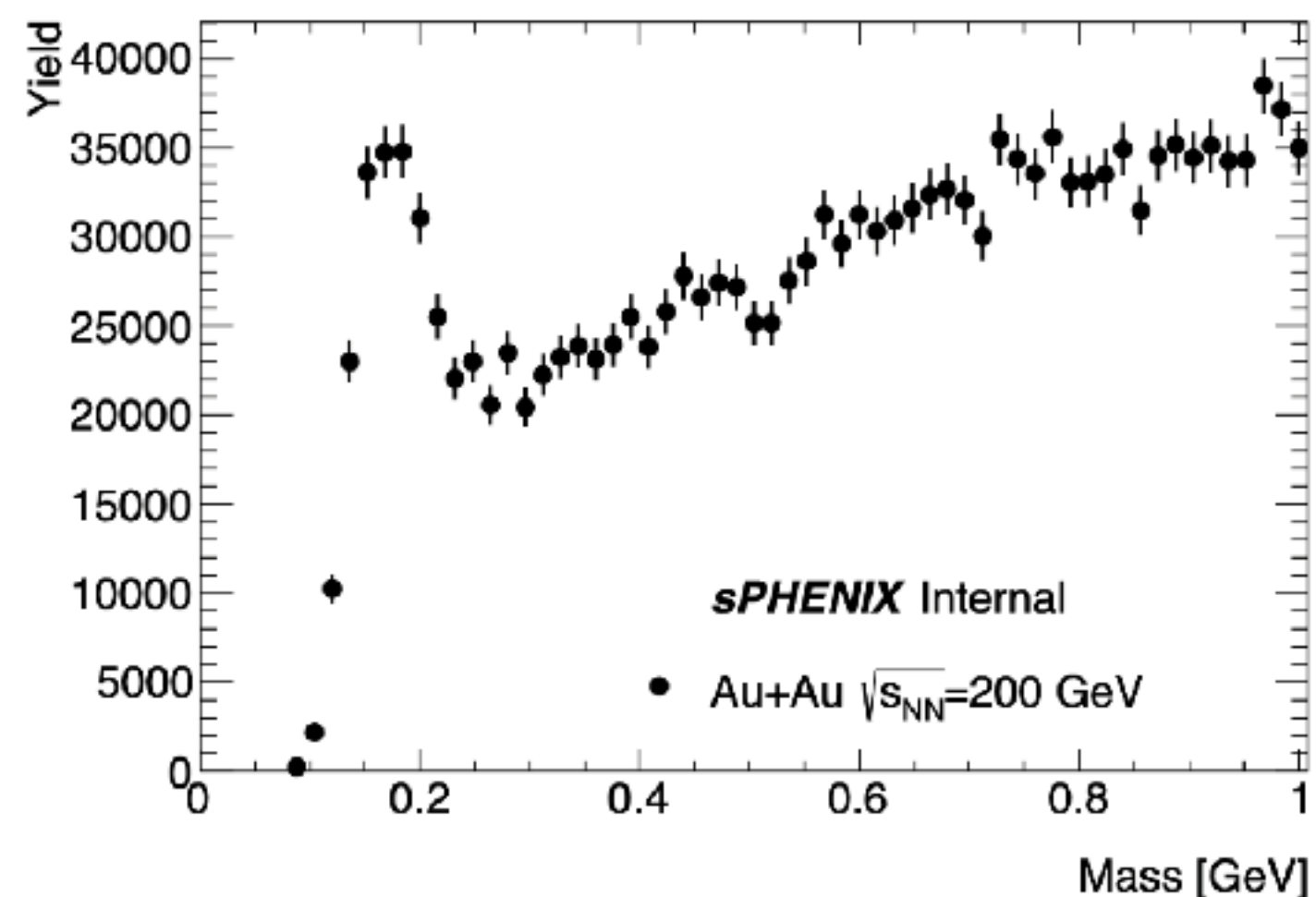
#hit/event depends on the trigger condition.

Standalone Cosmic ray measurements.

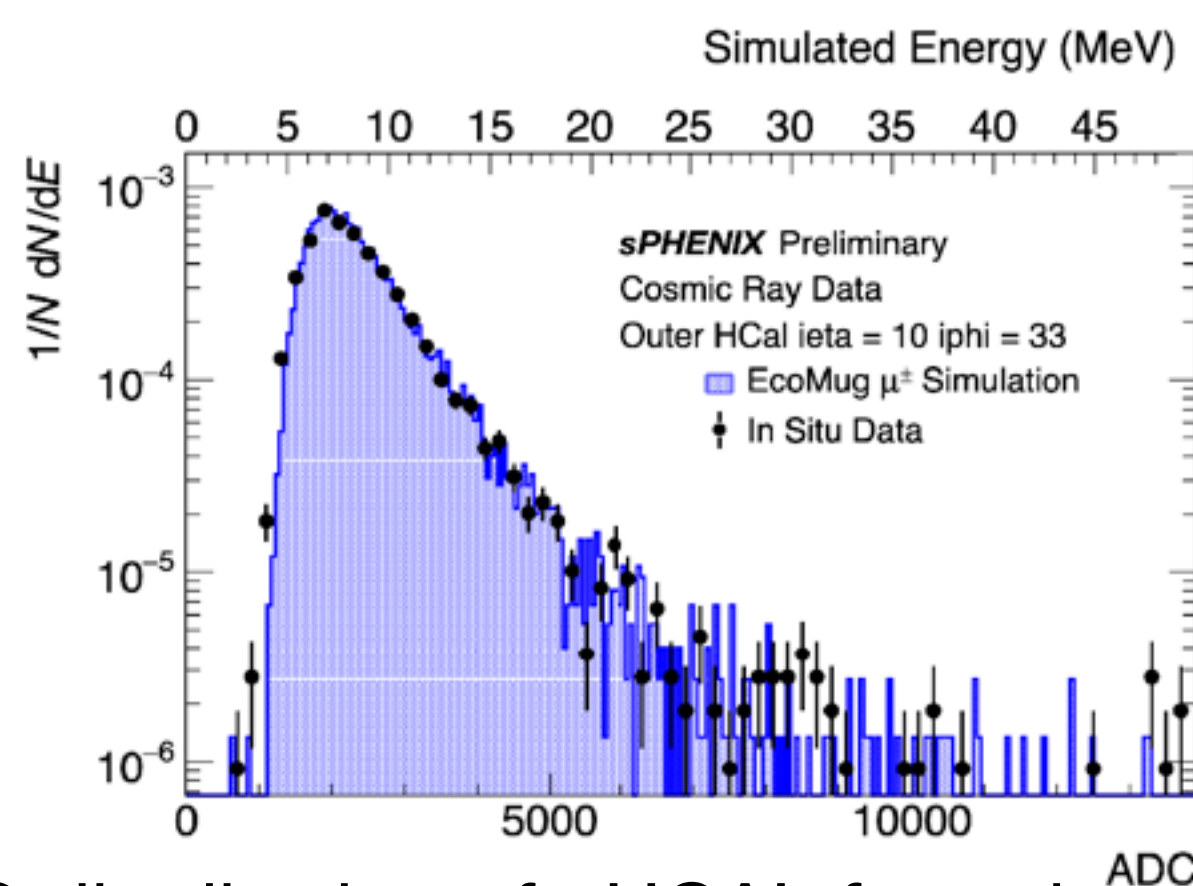
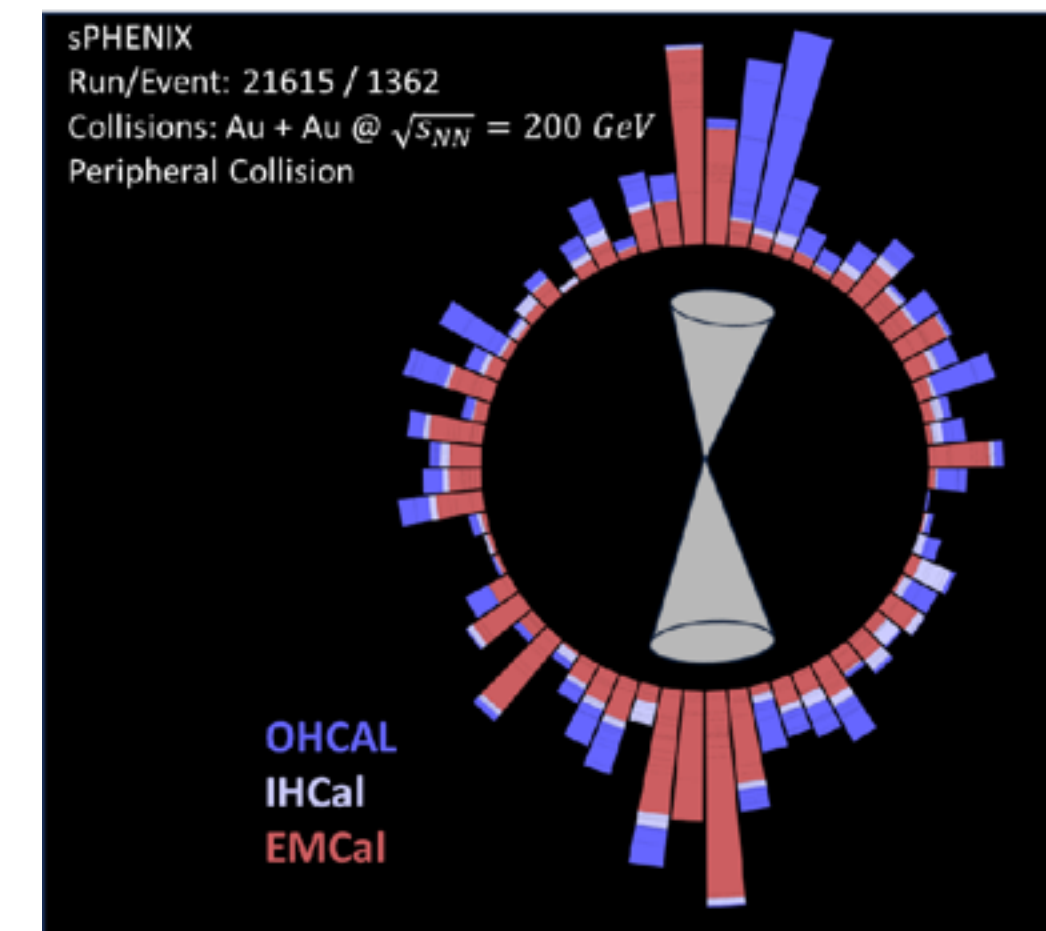
Run23, Commissioning, Calorimeters



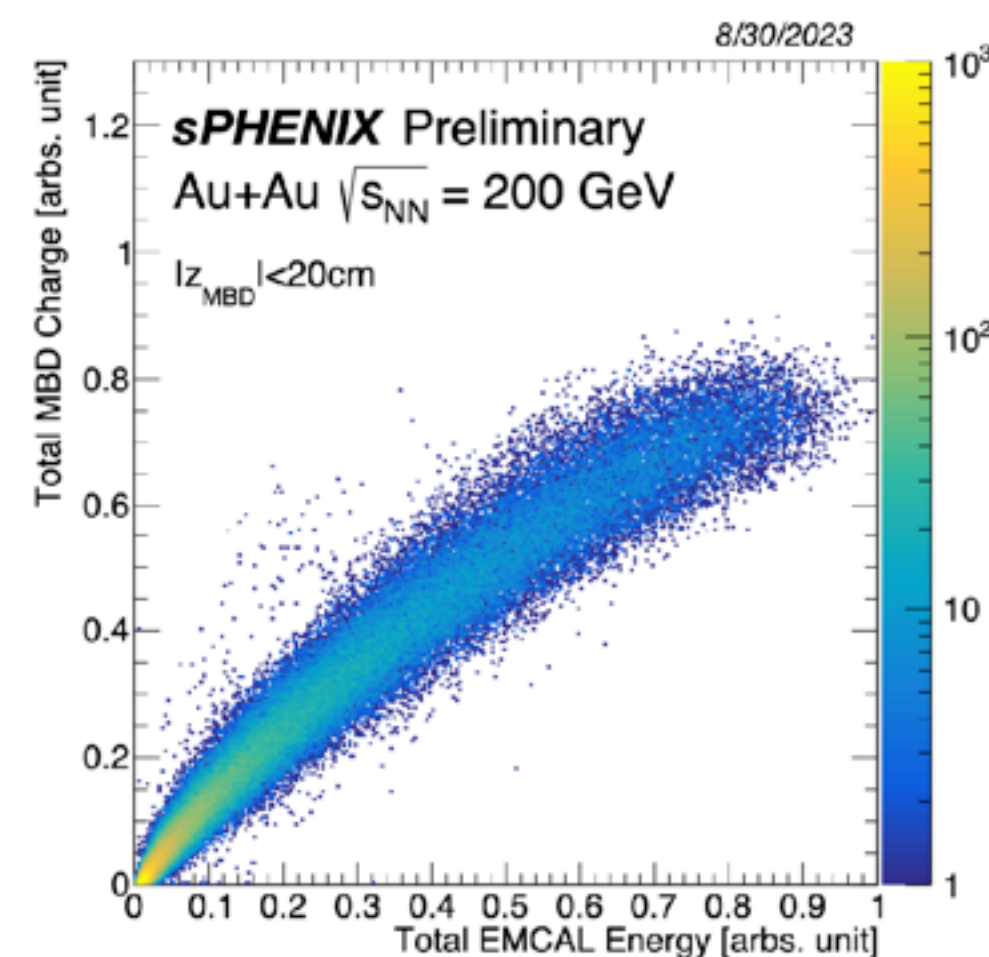
Correlation of measured energy by oHCAL and iHCAL.



EMCAL measured π^0 signal from $\gamma + \gamma$. A di-jet (like?) event obtained in 2023.



ADC distribution of oHCAL from the cosmic runs and comparison to the simulation.

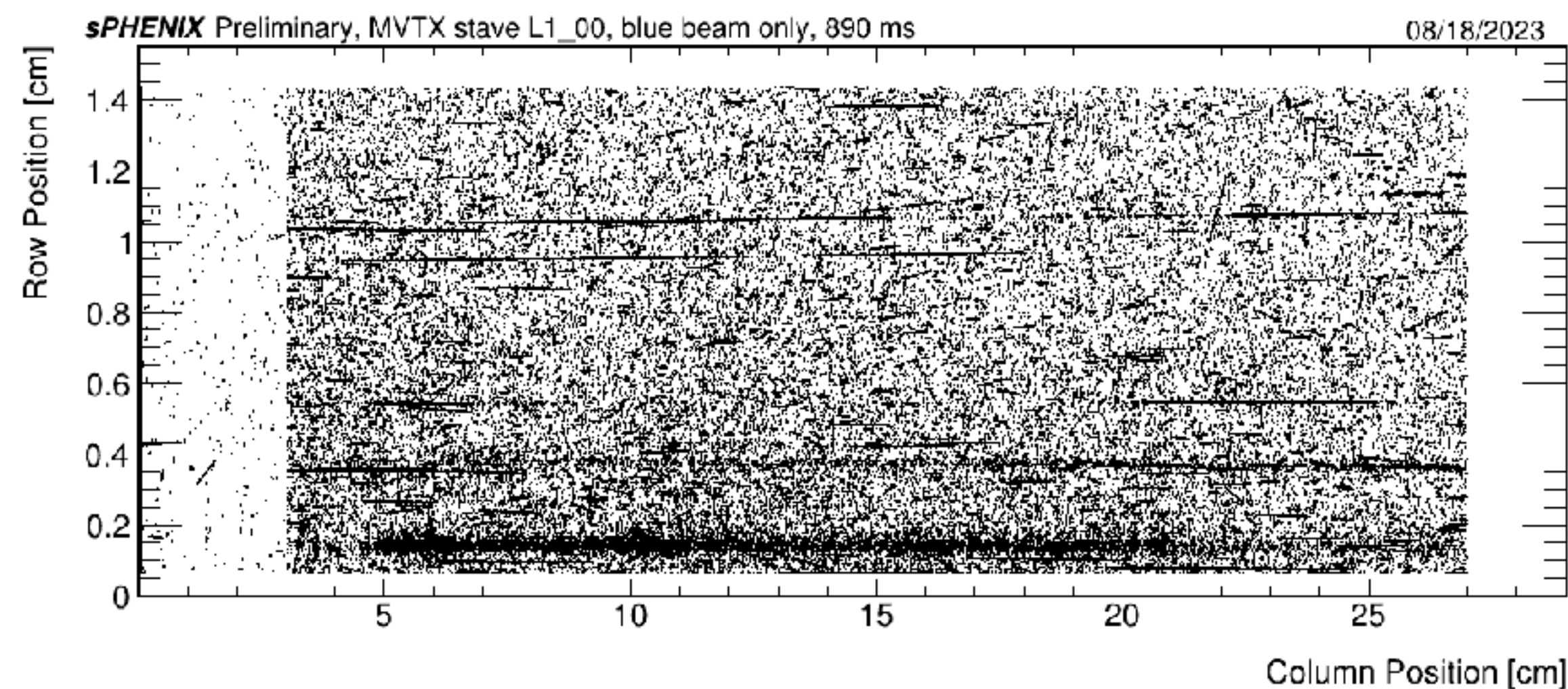
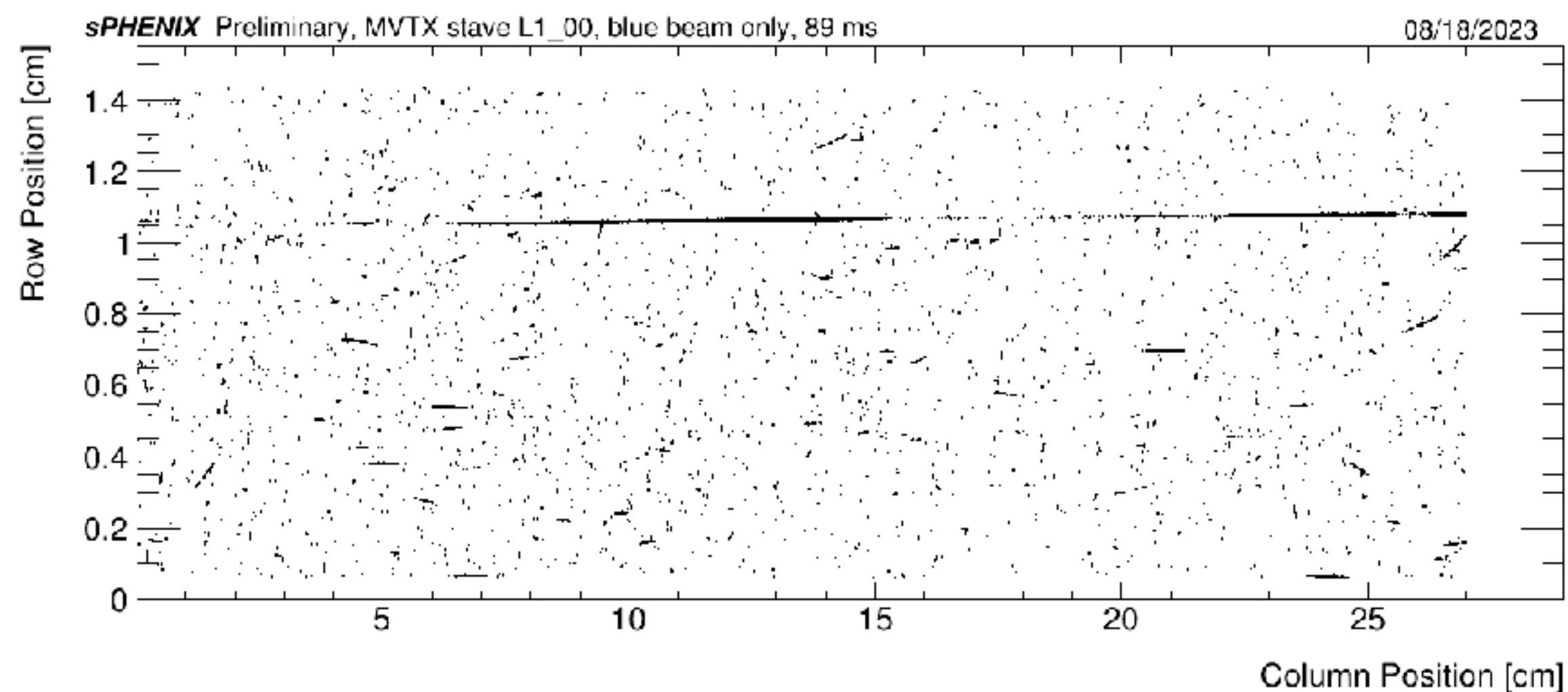


Correlation b/w EMCAL energy and MBD charge.



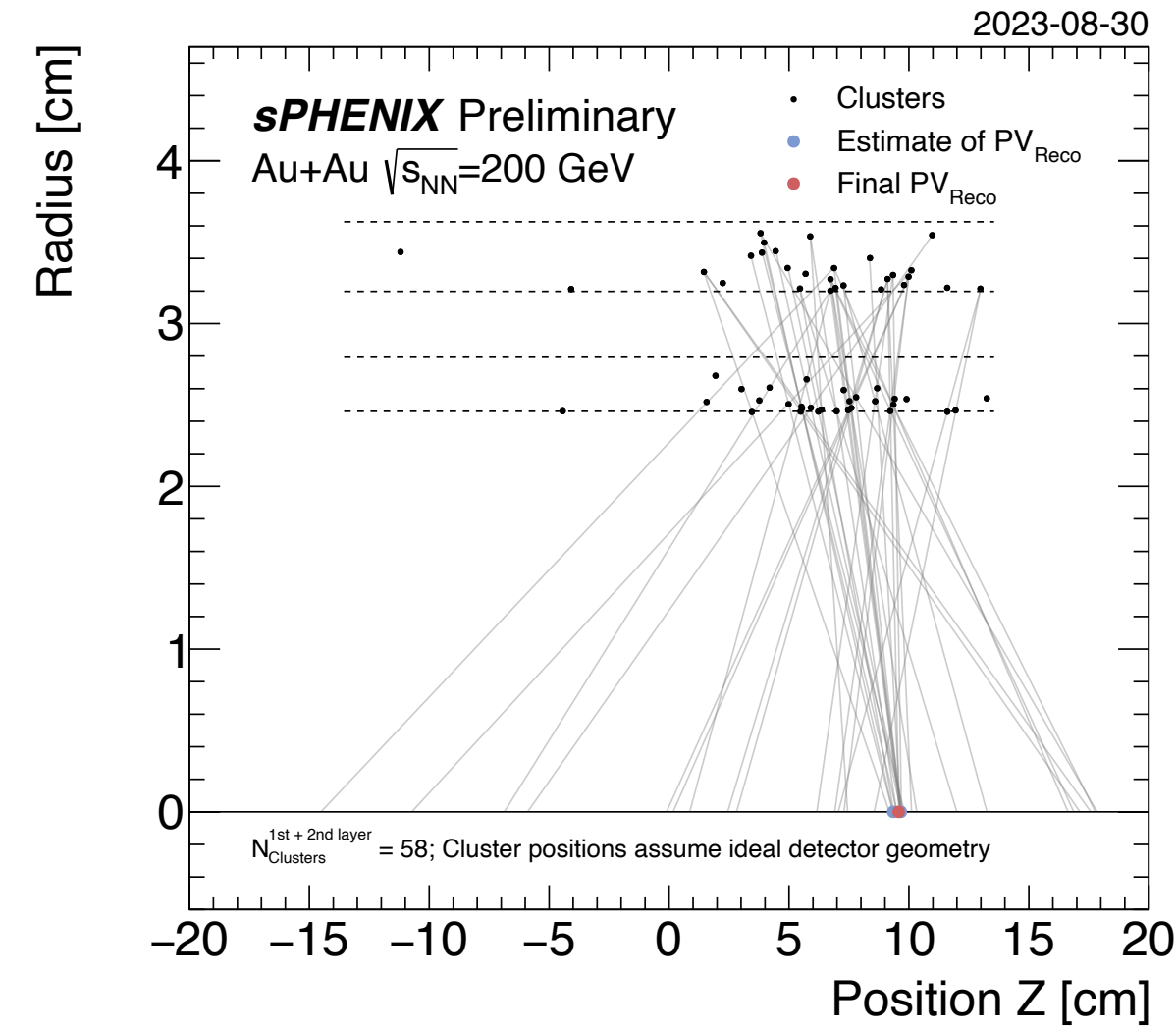
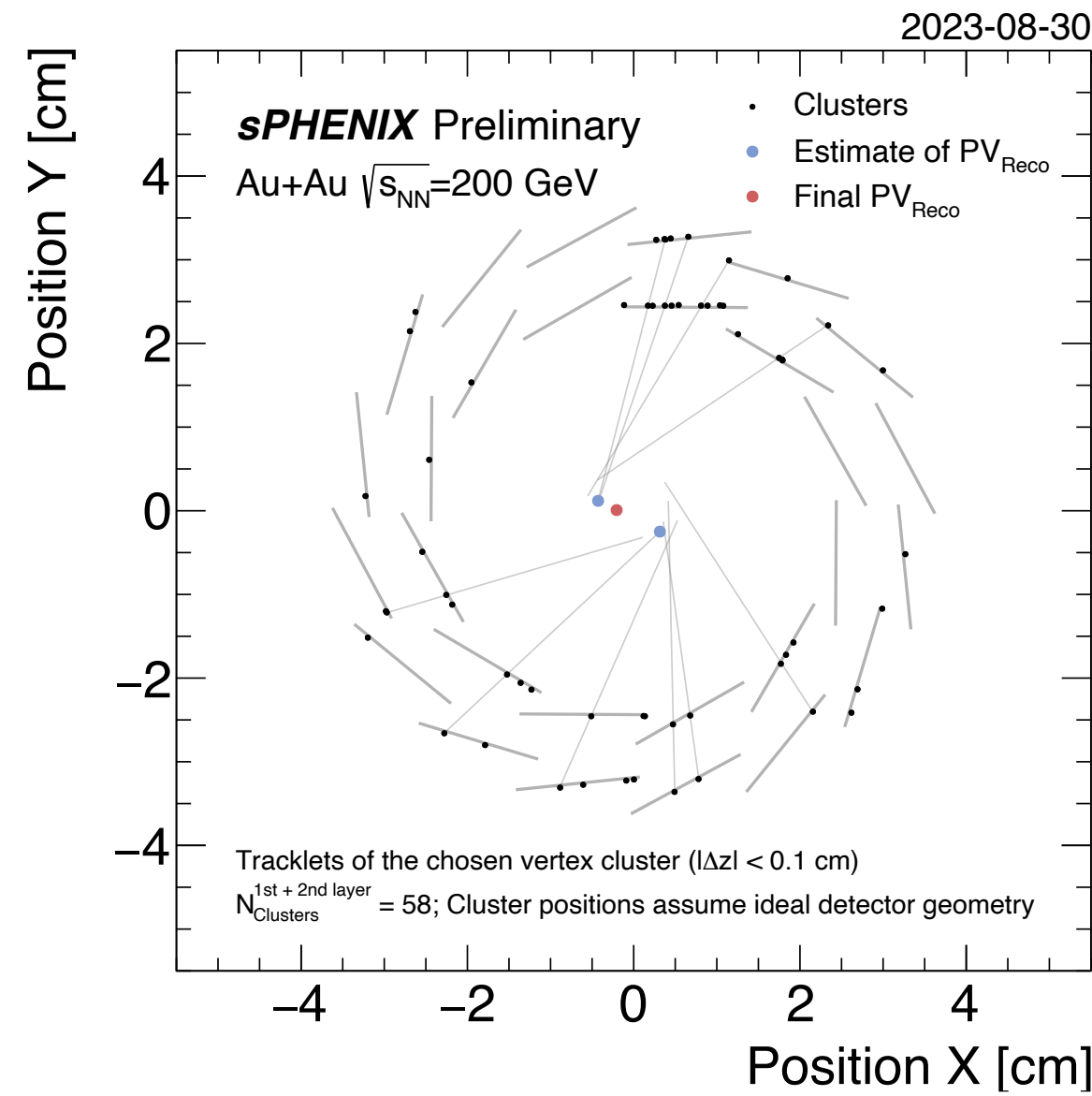
Run23, Commissioning, MVTX

The background measurements with only a blue beam.

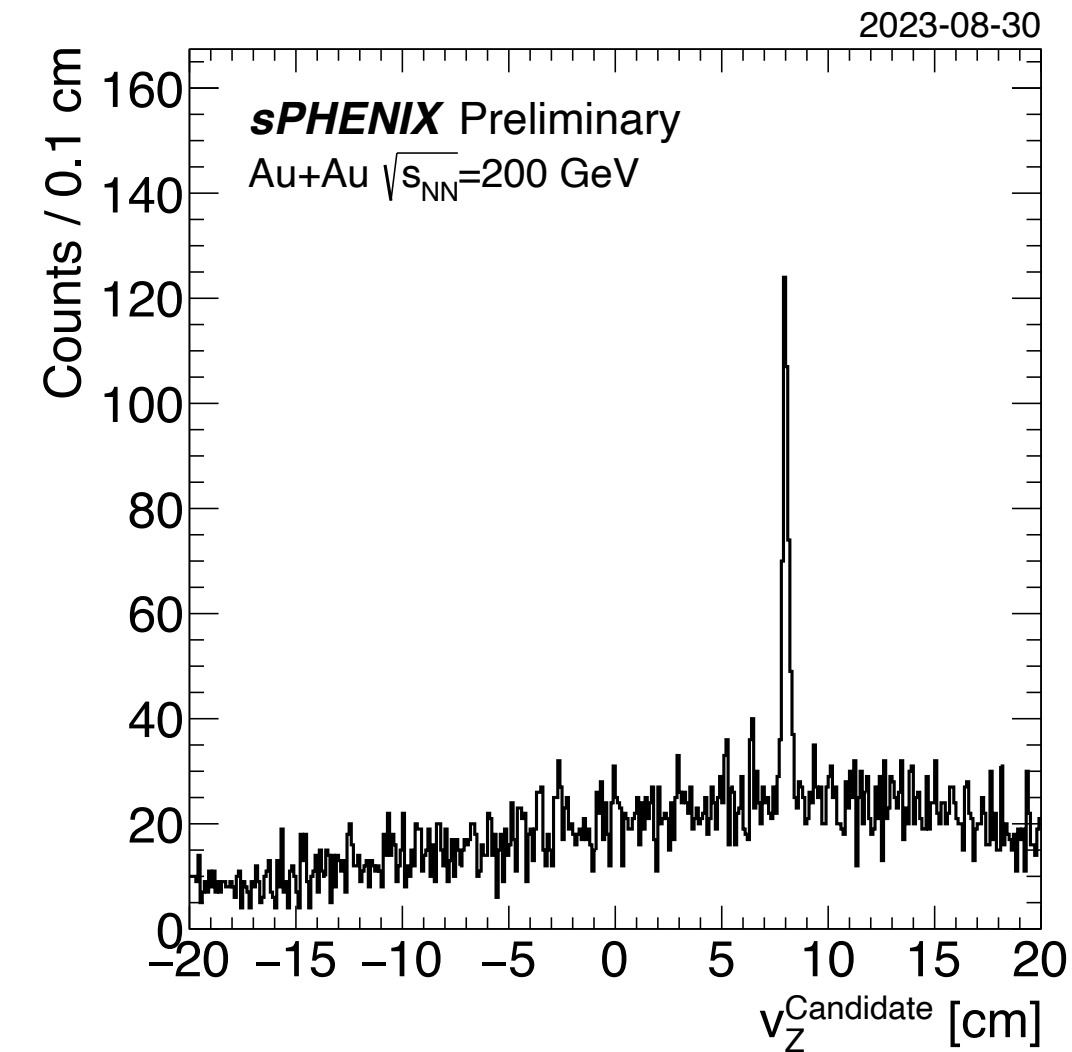
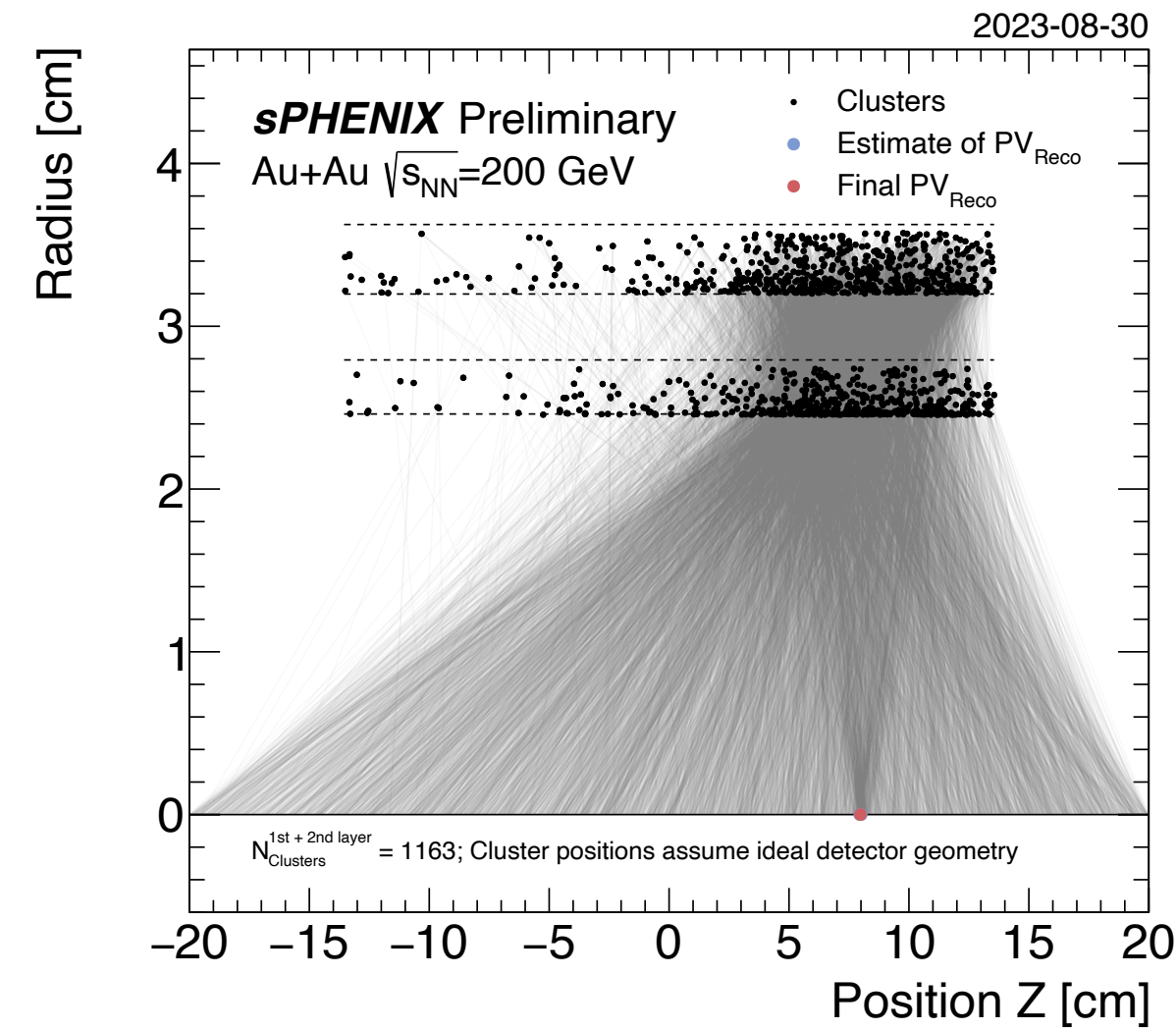
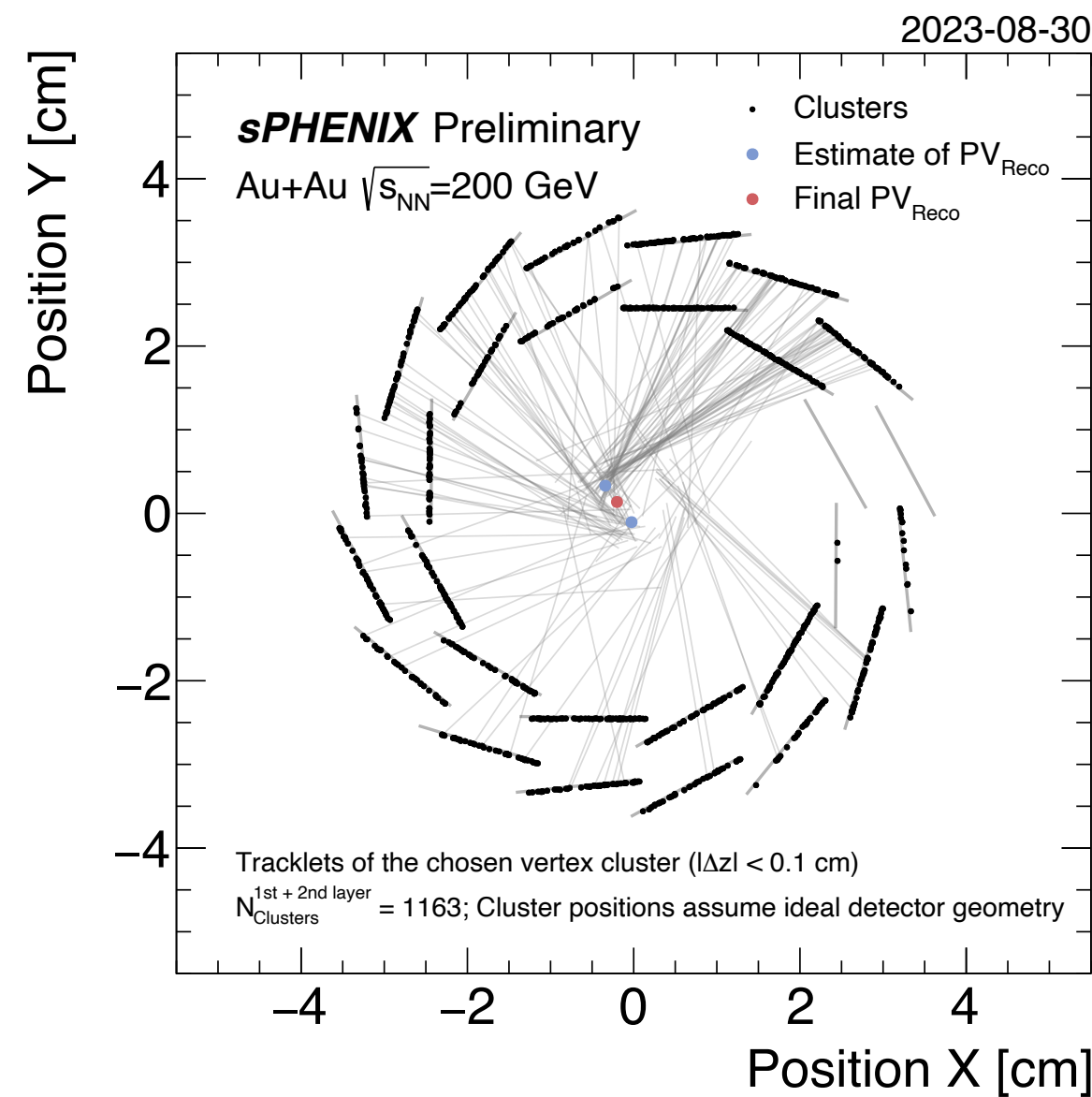




Run23, Commissioning, MVTX

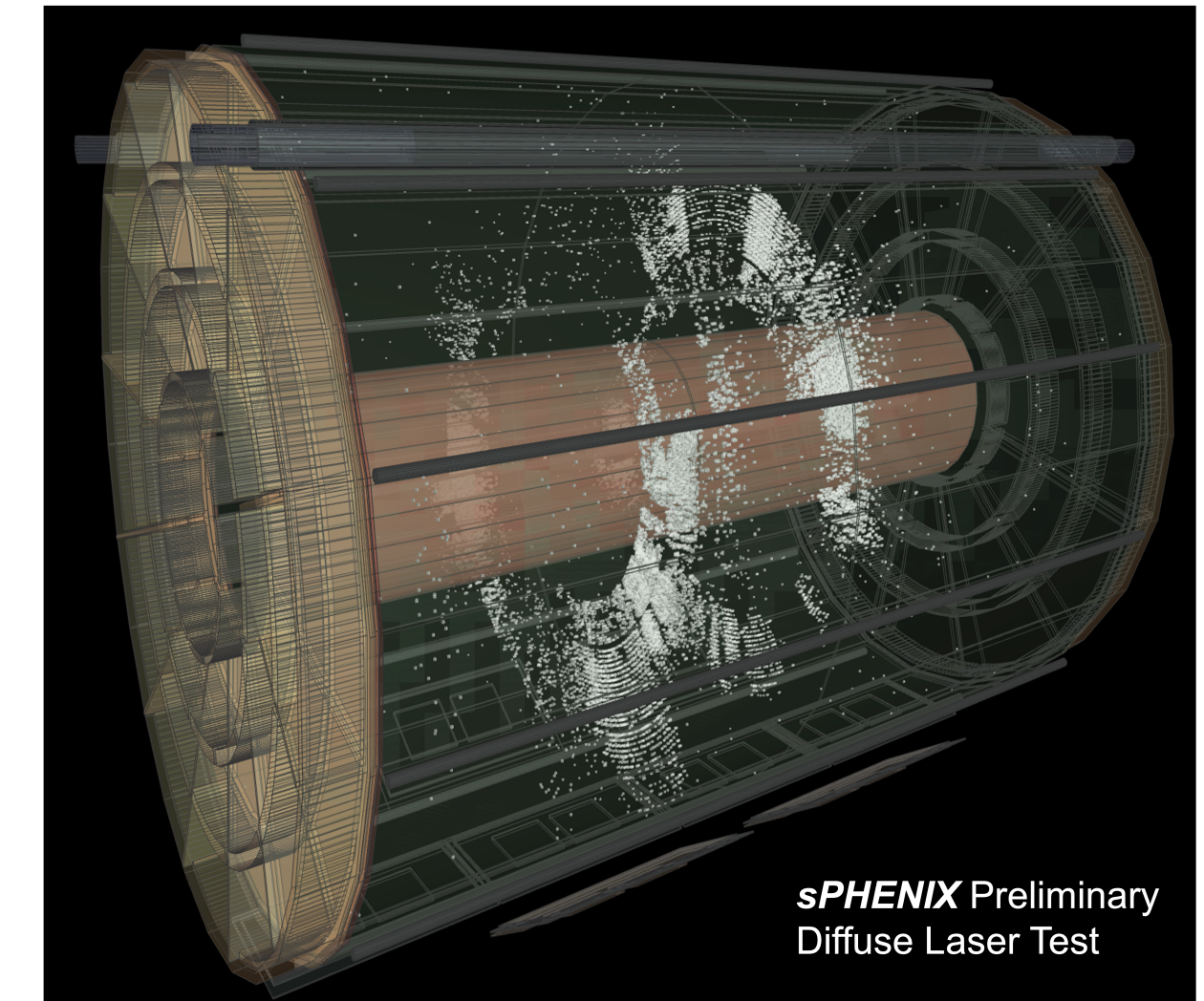


Event displays shown in QM2023.

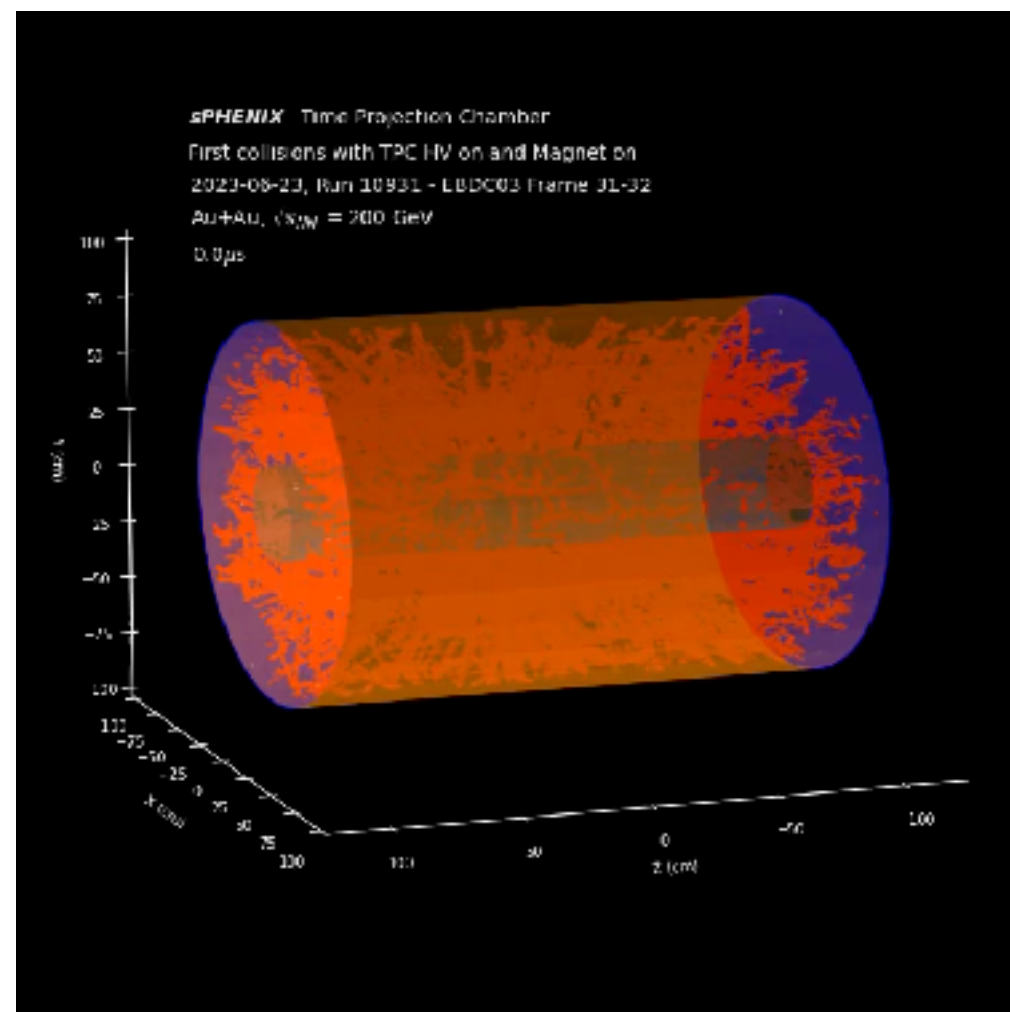




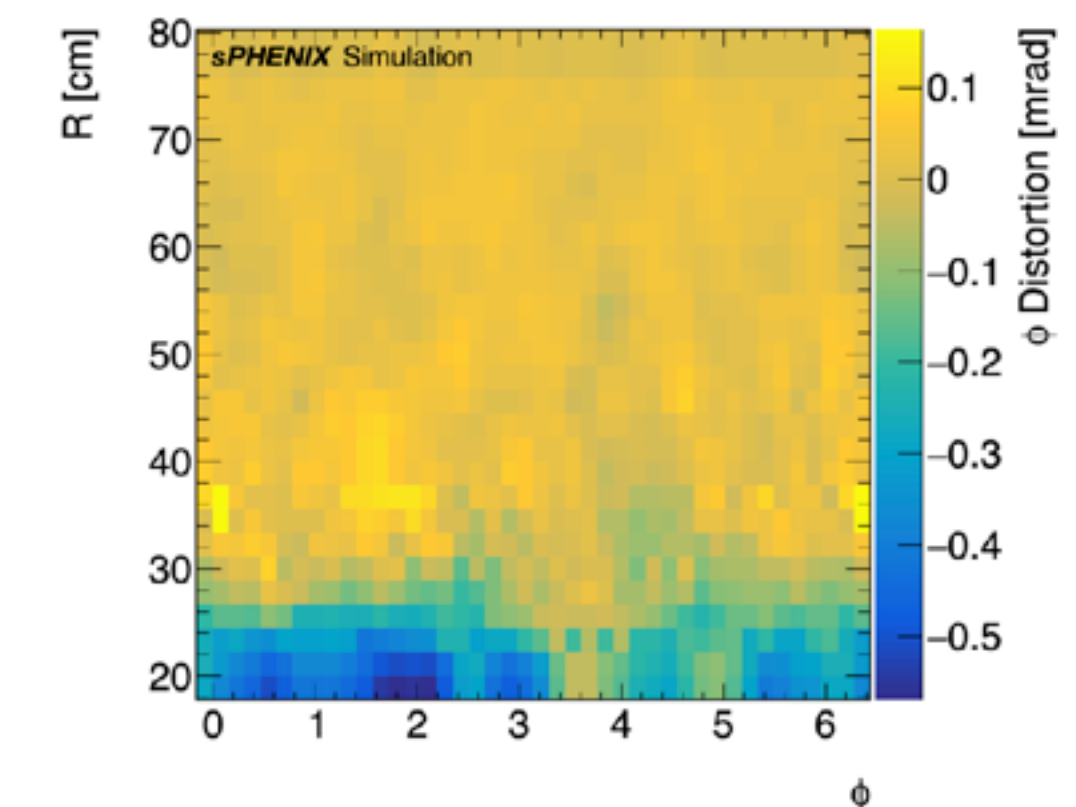
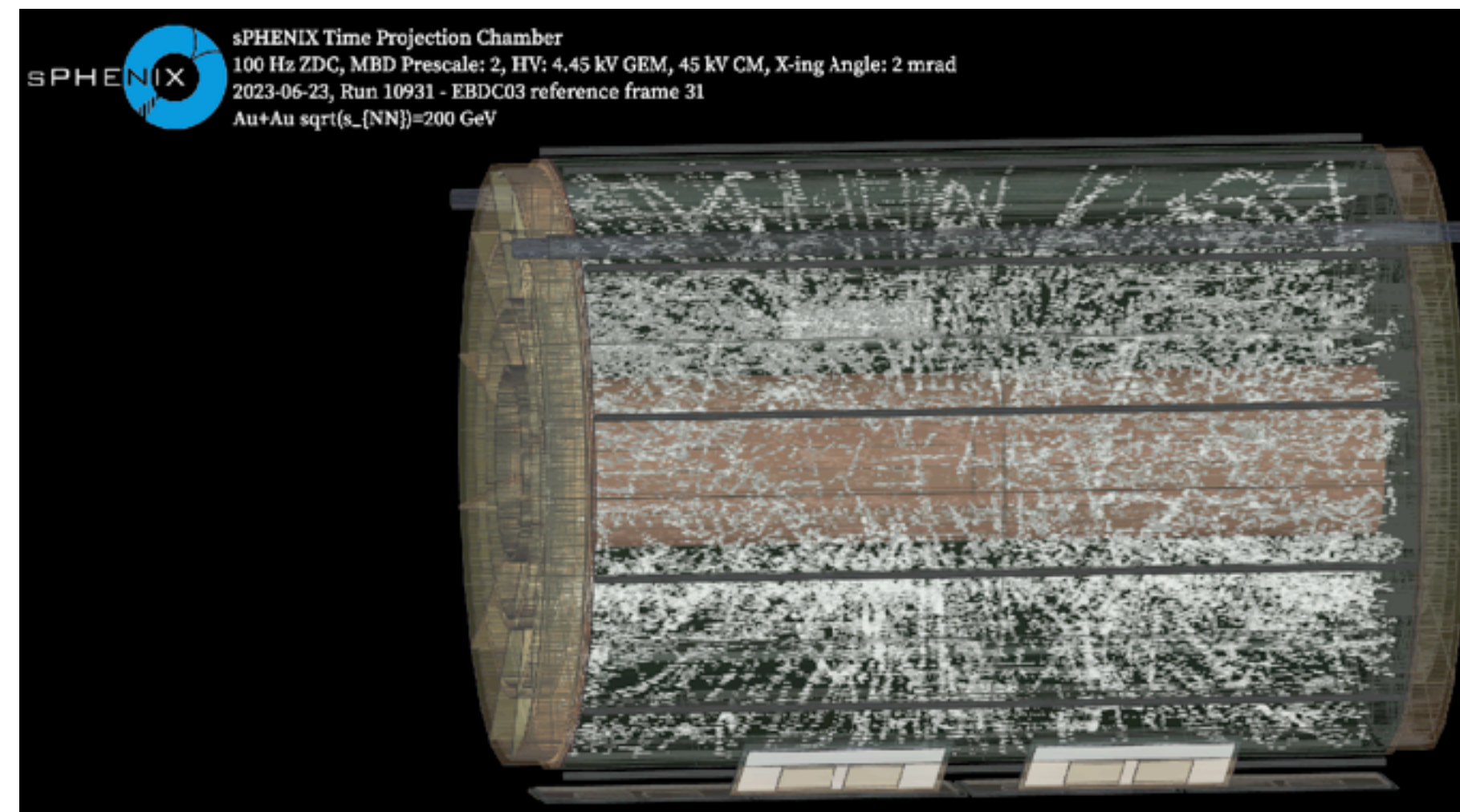
Run23, Commissioning, TPC



Event display of the diffuse laser test.
It demonstrates how the electrons from the diffuse laser flash travel as a sheet through the TPC.



Event display of frame 31, run 10931 (June/23/2023)



Simulated distortion fluctuation in ϕ .

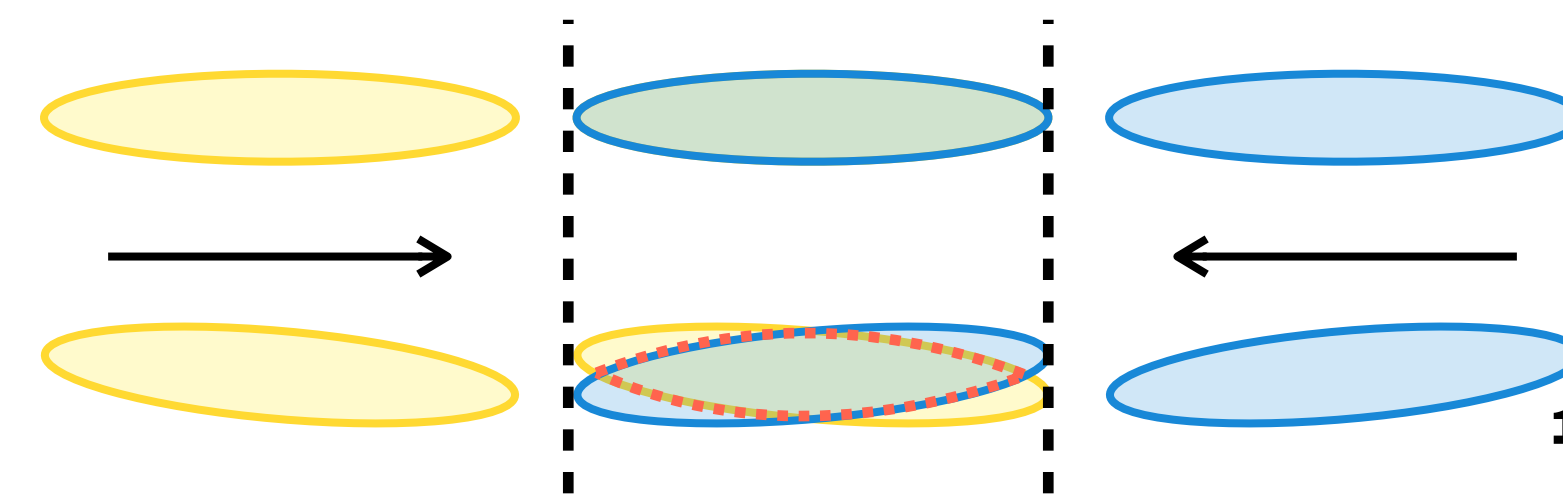


SPHENIX Status

New Input From Run 2023

Year	Beam	$\sqrt{s_{NN}}$ (GeV)	Data Taking (Weeks)	Luminosity, ($ z < 10$ cm)	
				Recorded	Sampled
2023	Au + Au	200	9	3.7 nb ⁻¹	4.5 nb ⁻¹

- The unexpected end of the run.
 - We proposed **carrying 6 weeks of Au+Au measurements over 2024**.
 - How we proceed (Au+Au, then $p^\uparrow + p^\uparrow$ or vice versa) is not determined yet.
- New luminosity estimation by RHIC.
 - RHIC made **a new luminosity estimation** based on the results in 2023.
 - The luminosity of **Au+Au is not affected a lot**, though $p^\uparrow + p^\uparrow$ is **decreased by 1/5**.
- Luminosity estimation with a beam crossing angle.
 - **A non-zero beam crossing angle is needed** to limit the distribution of the collision points in z-direction.
 - According to our measurement in 2023, **it affects luminosity**.





Proposed Plan

Year	Beam	$\sqrt{s_{NN}}$ (GeV)	Data Taking (Weeks)	Luminosity, ($ z < 10$ cm)	
				Min. Bias	Calo.
2024	$p^\uparrow + p^\uparrow$	200	12	0.3 pb^{-1} (5 kHz)	45 pb^{-1}
2024	$p^\uparrow + \text{Au}$	200	5	0.003 pb^{-1}	11 pb^{-1}
2025	Au + Au	200	20.5	13 nb^{-1}	21 nb^{-1}

Beam Use Proposal 2022

Scenario-A

First Au+Au for commissioning,
then $p^\uparrow + p^\uparrow$.

Scenario-B

First $p^\uparrow + p^\uparrow$ for both
commissioning and physics,
then Au+Au for physics.

Year	Scenario	Beam	Data Taking (Weeks)	Luminosity, ($ z < 10$ cm)	
				Min. Bias	Calo.
2024	A	Au + Au	Only Commissioing		
2024	A	$p^\uparrow + p^\uparrow$	13/17/21	$0.34/0.44/0.54 \text{ pb}^{-1}$	$23/31/39 \text{ pb}^{-1}$
2024	B	$p^\uparrow + p^\uparrow$	9/13/17	$0.23/0.34/0.44 \text{ pb}^{-1}$	$15/23/31 \text{ pb}^{-1}$
2024	B	Au + Au	3	0.4 nb^{-1}	

Beam Use Proposal 2023

Year	Beam	Data Taking (Weeks)	Luminosity, ($ z < 10$ cm)
			Min. Bias
2025	Au + Au	20.5 /24.5	5.2 /6.3 nb ⁻¹

BACKUP SLIDES

sPHENIX Runs: Effect by the Beam Crossing Angle to Luminosity

Crossing angle θ	$L(\theta, \text{all } z) / L(\theta = 0, \text{all } z)$	$L(\theta, z < 10 \text{ cm}) / L(\theta, \text{all } z)$	σ_z in sPHENIX [cm]	Lumi/Week all z [μb^{-1}]	Lumi/Week ($ z < 10 \text{ cm}$) [μb^{-1}]
0 mrad	1.0	0.30	26	2210	660
1 mrad	0.30	0.52	14	660	340
2 mrad	0.15	0.79	8	330	260

Table 2.1: Summary of projected 2025 Au+Au luminosity production under different crossing angle scenarios. The luminosity/week is based on the average of the minimum and maximum projection. The vertex width σ_z , and thus the vertex factor $L(\theta, |z| < 10 \text{ cm}) / L(\theta, \text{all } z)$, is taken from direct measurements in sPHENIX in 2023 Au+Au running, as suggested by C-AD. All other values are taken directly from C-AD guidance. The right column, which is the luminosity per week within the narrow vertex, is the relevant quantity for sPHENIX physics.