

# Intermediate Silicon Tracker in sPHENIX at RHIC

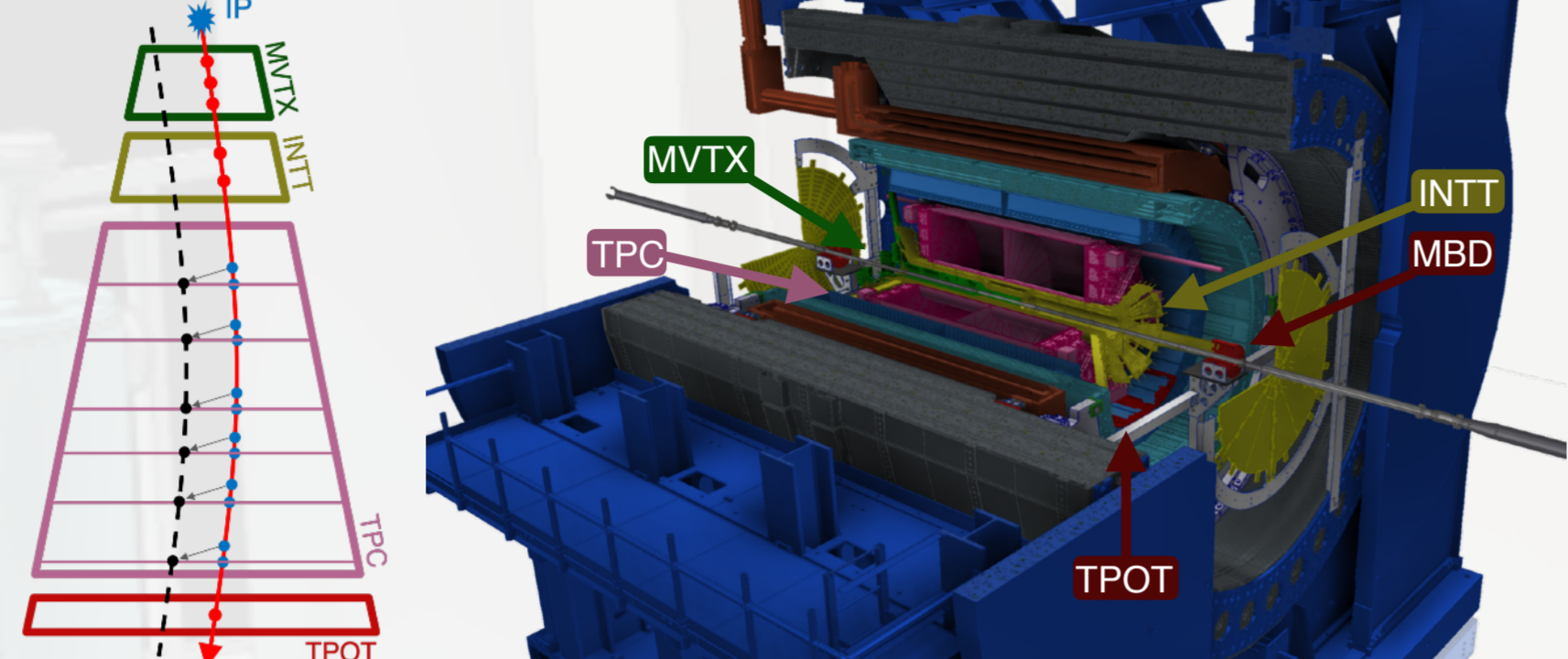
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## sPHENIX: Full barrel calorimeters, 1.4 T solenoid and excellent tracking system

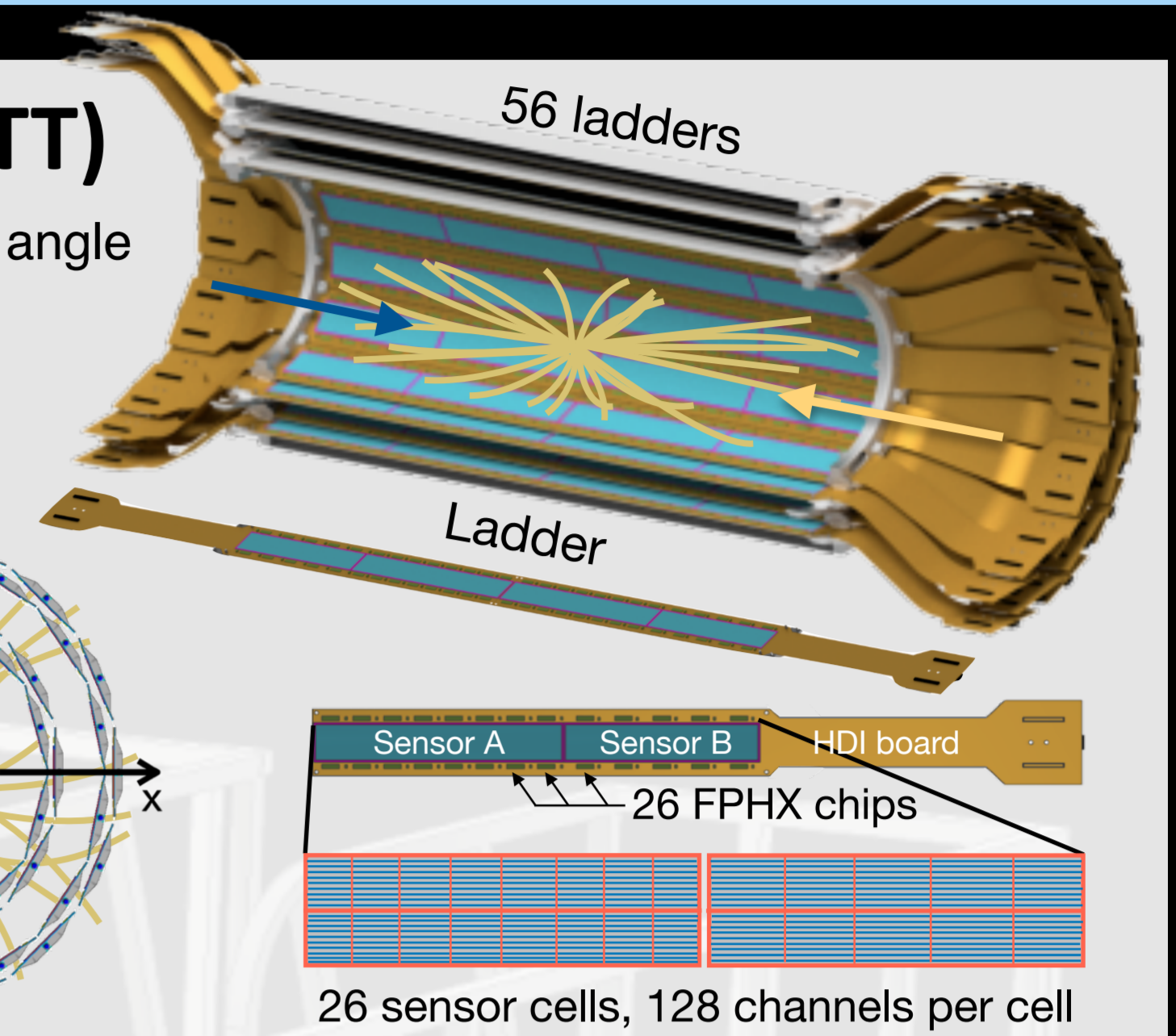
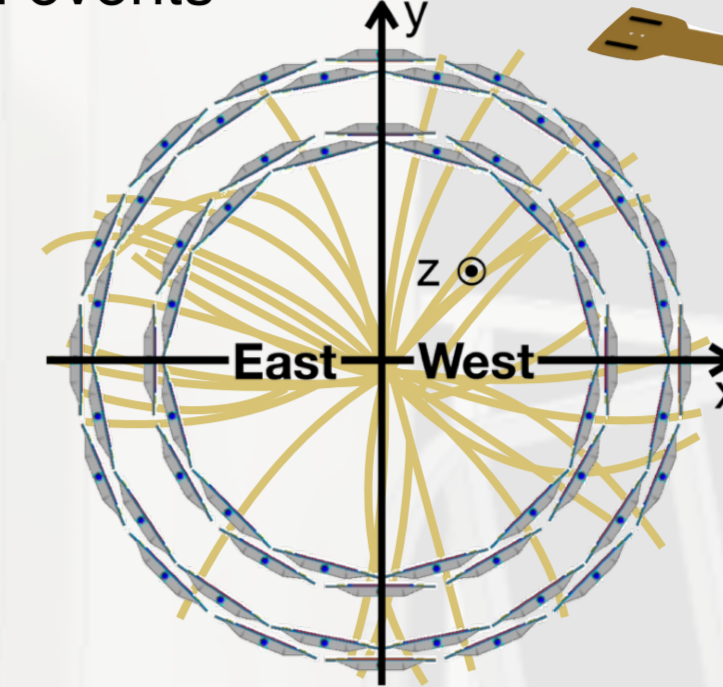
- MVTX: MAPS-based Vertex Detector
  - Precise vertex measurement → Heavy flavor
- INTT: Intermediate Silicon Tracker
  - Superb timing resolution → Proton spin
- TPC: Time Projection Chamber
  - Precise momentum measurement → Upsilon  $\Upsilon(3S)$
- TPOT: TPC Outer Tracker
  - Additional space point outside TPC → TPC distortion



## Intermediate Silicon Tracker (INTT)

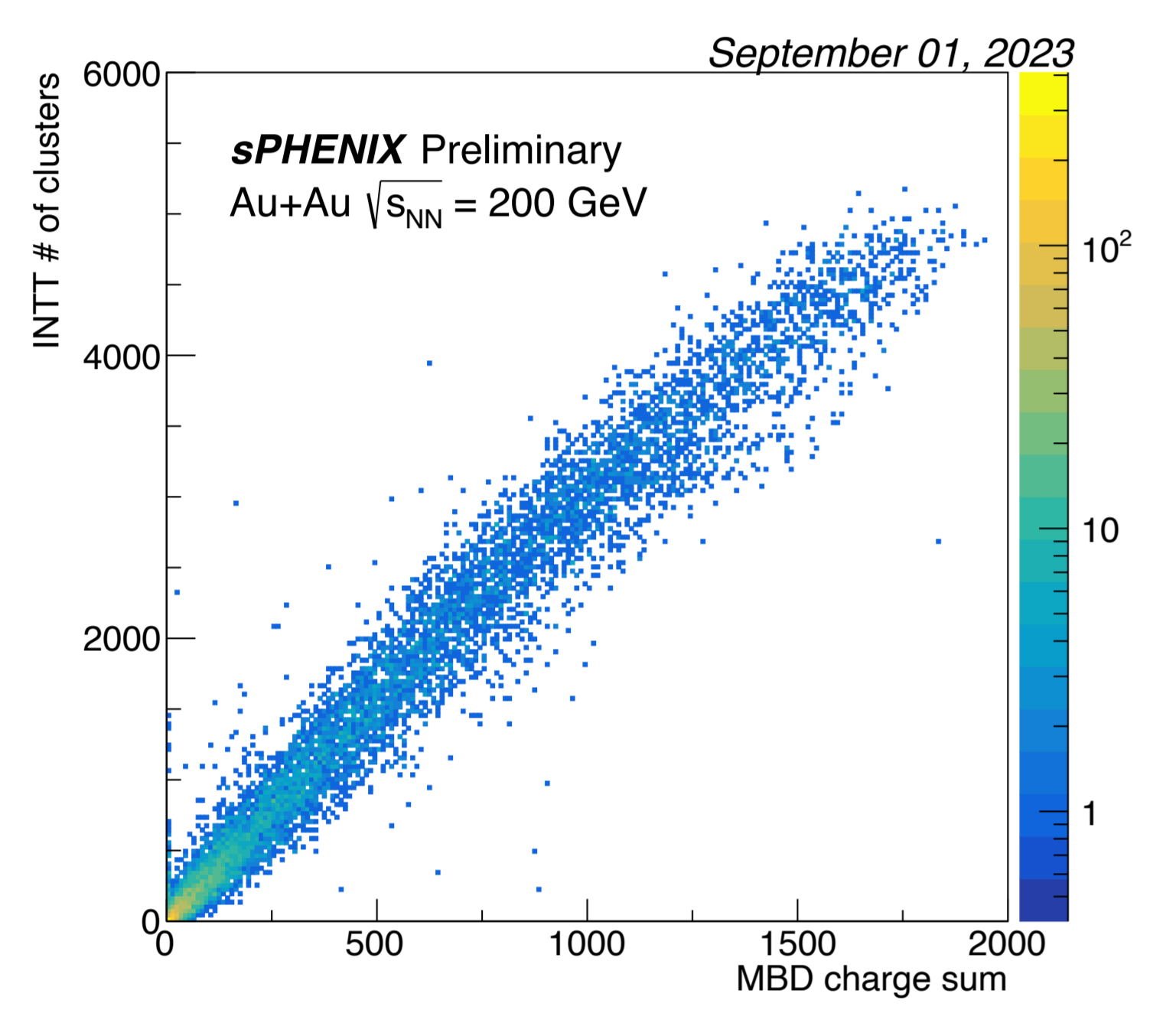
- Strip width 78  $\mu\text{m}$  → Excellent spatial resolution in  $\phi$  angle
- Between the MVTX and TPC → Bridge the tracks
- Single-bunch-crossing (106 ns) timing resolution → Associate individual tracks and events
- Streaming readout capability → All collision events recorded

| Element         | Value     | Unit    |
|-----------------|-----------|---------|
| Material budget | 1.08%     | $X/X_0$ |
| Radius          | 7.5 or 10 | cm      |
| Strip length    | 16 or 20  | mm      |
| Total channels  | ~ 373k    | channel |

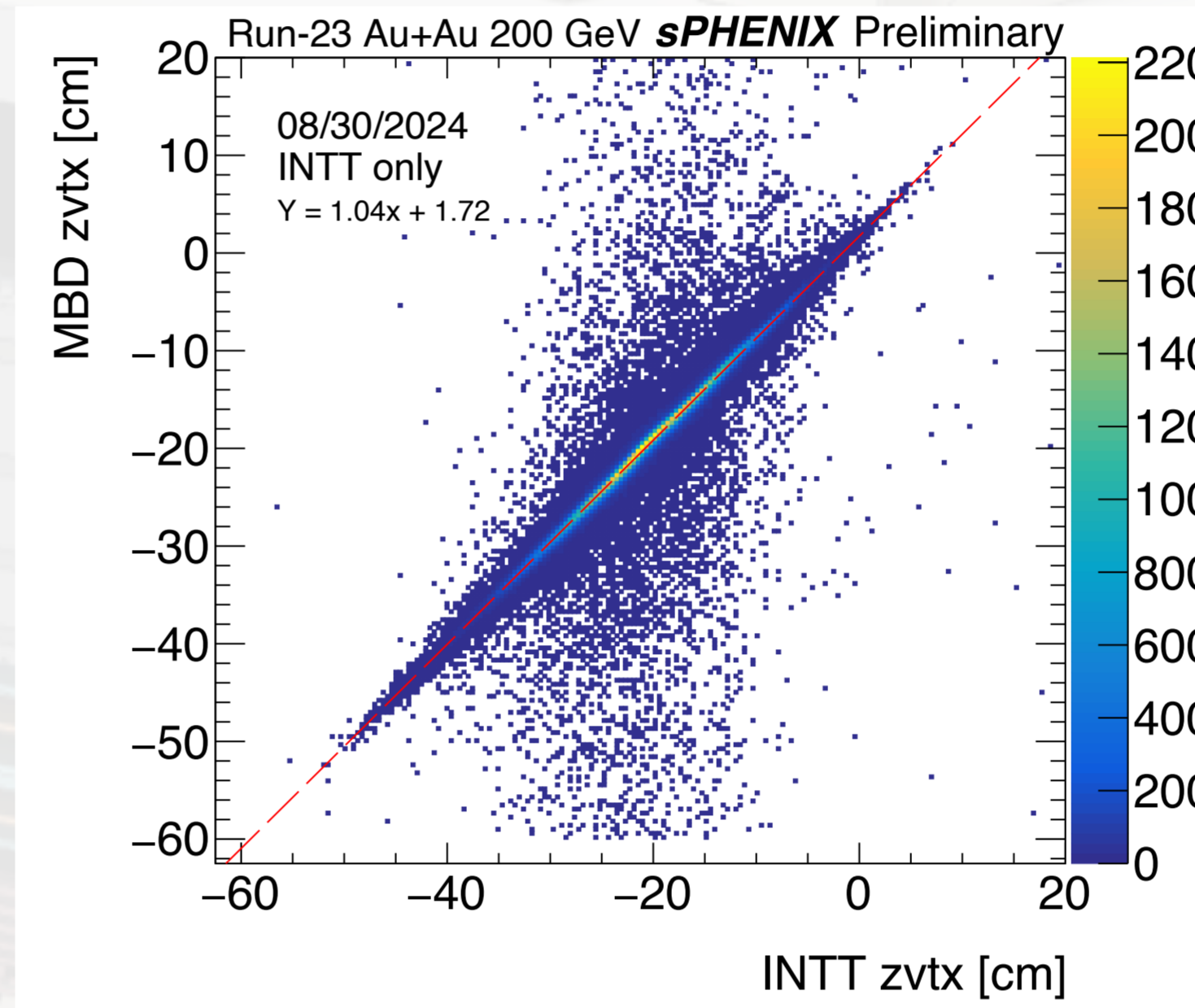
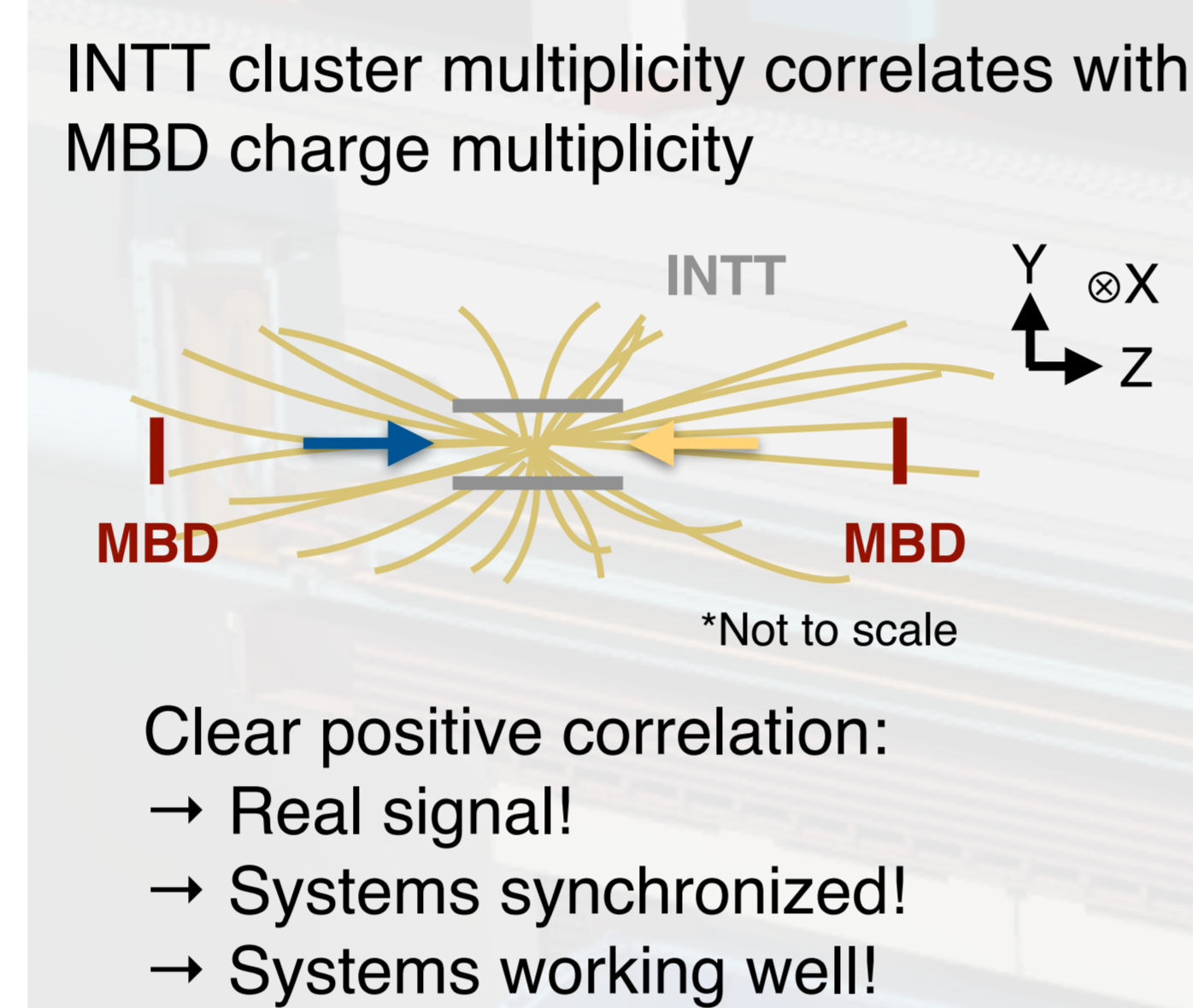


After more than 10 years of preparation, sPHENIX started to take the collision data in May 2023!

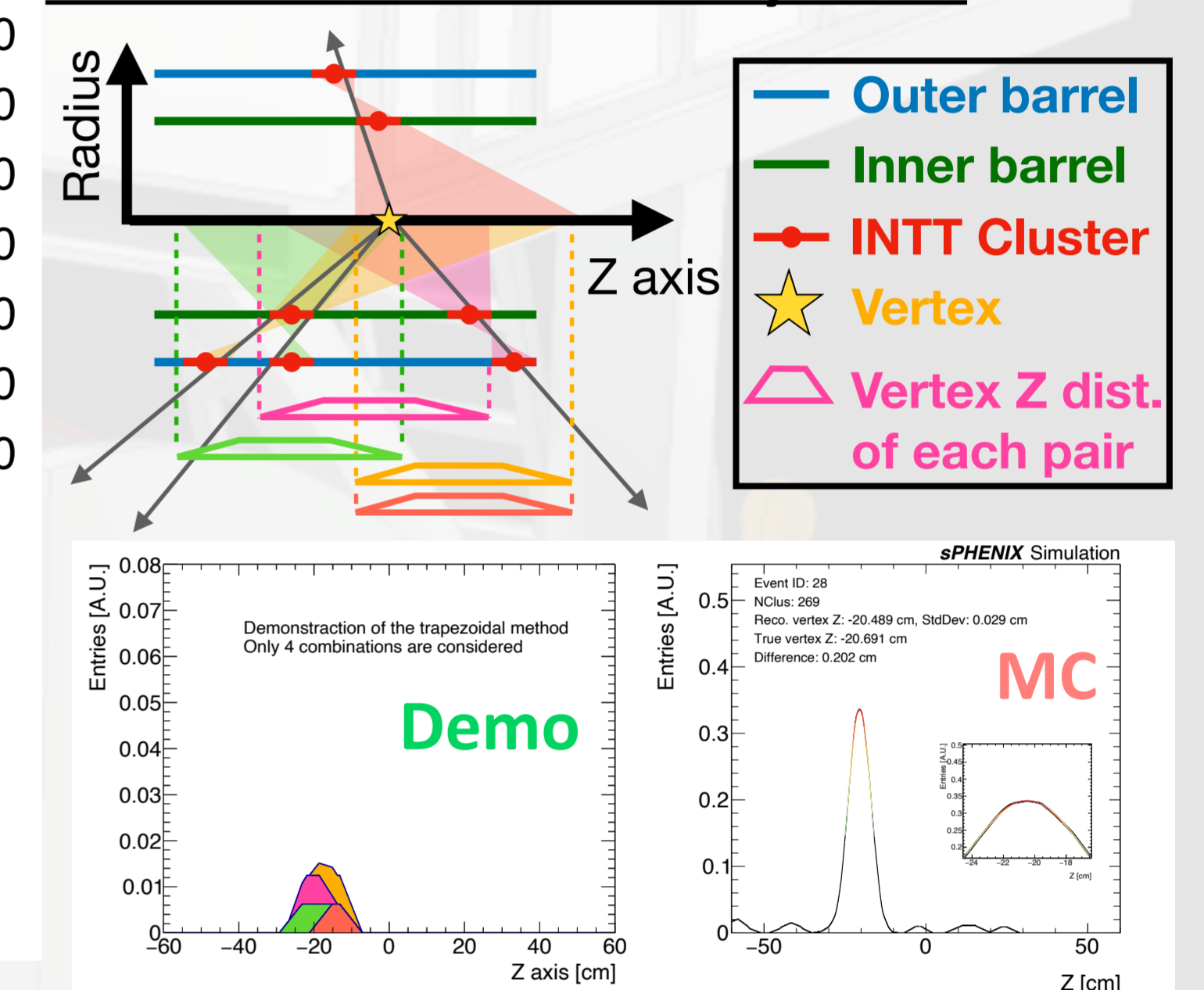
## Run 2023 data taking with Au+Au collisions (INTT was operating in triggered readout mode)



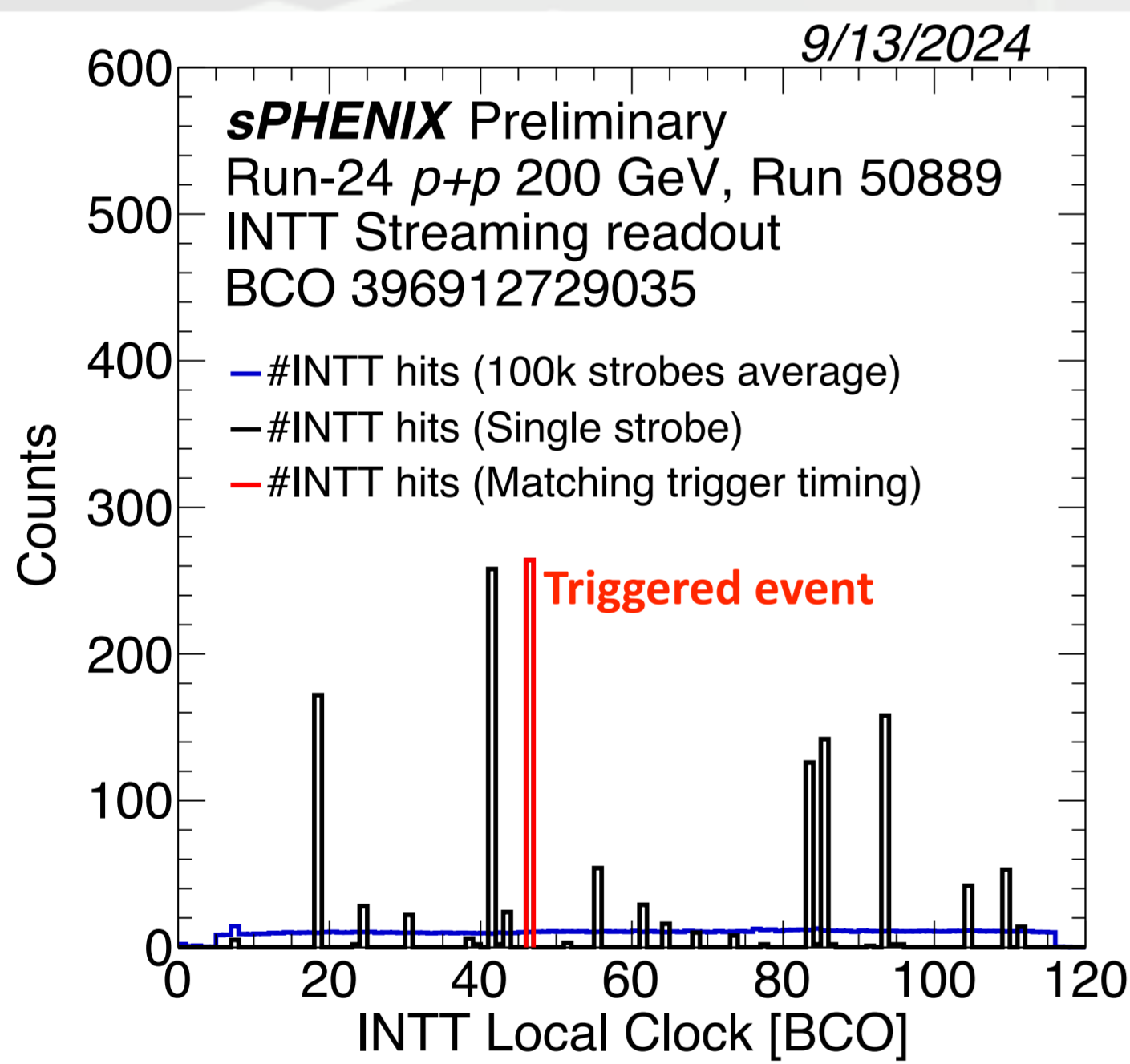
### See collisions with other detector!



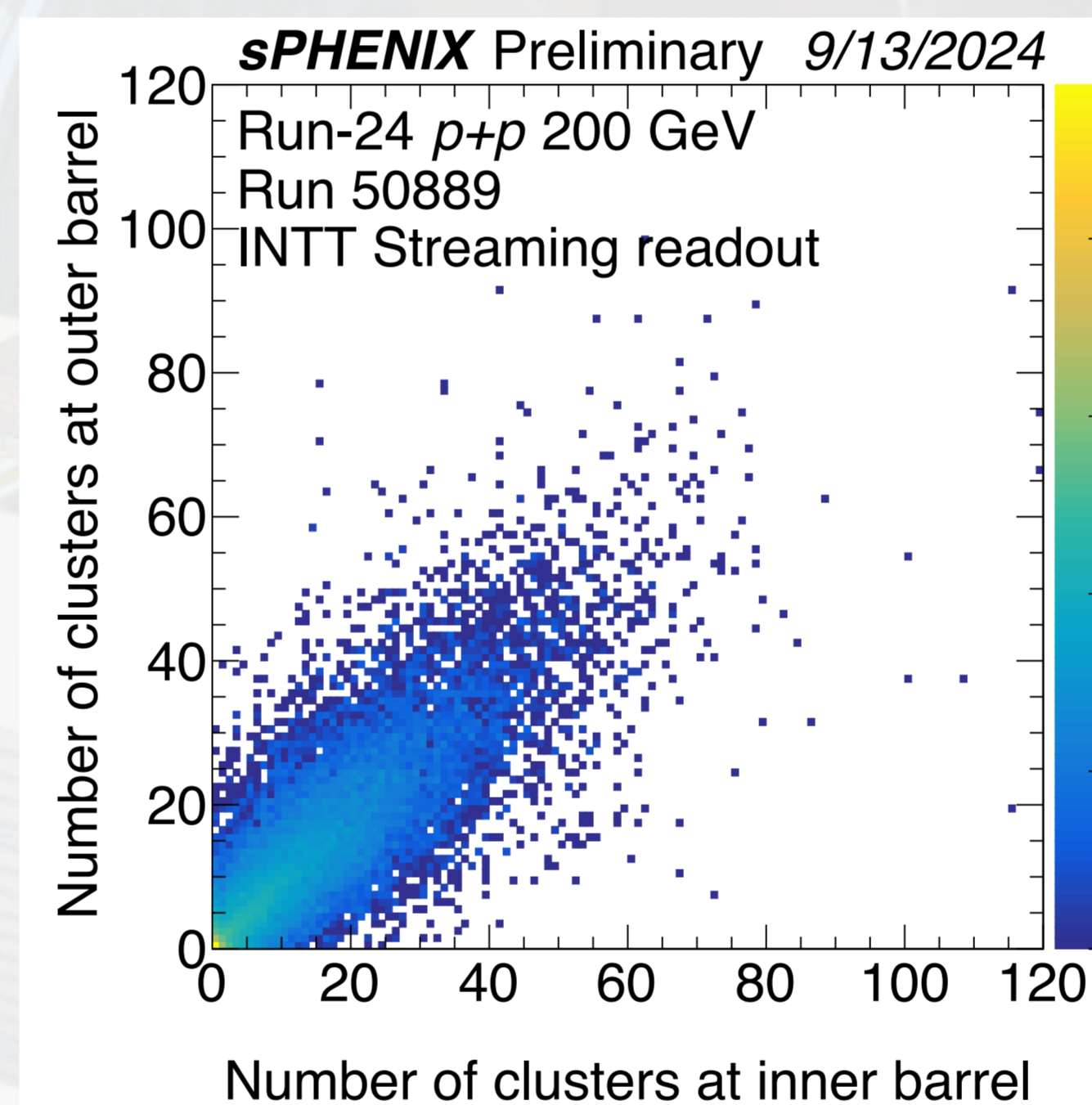
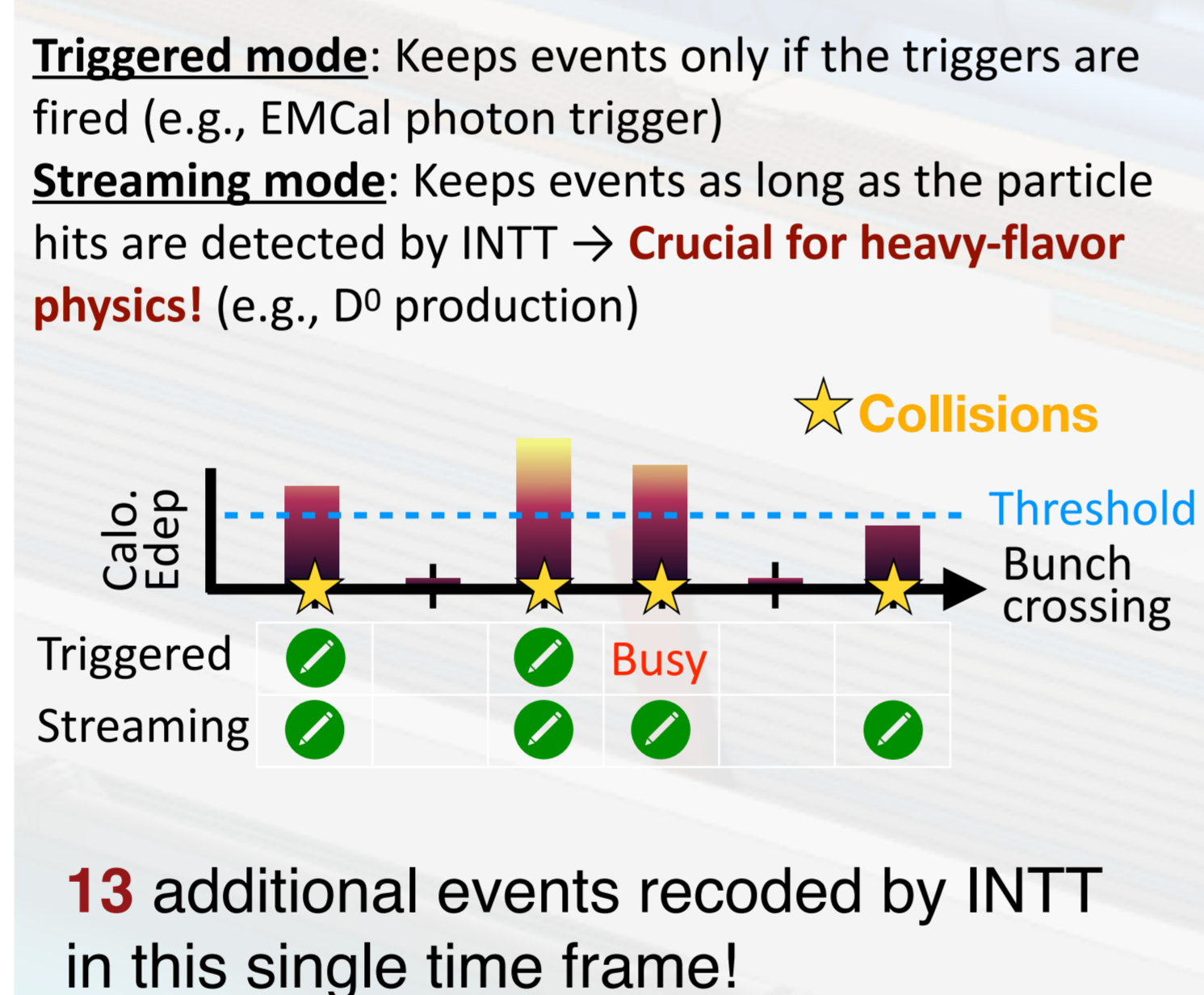
### Z vertex reconstructed by INTT!



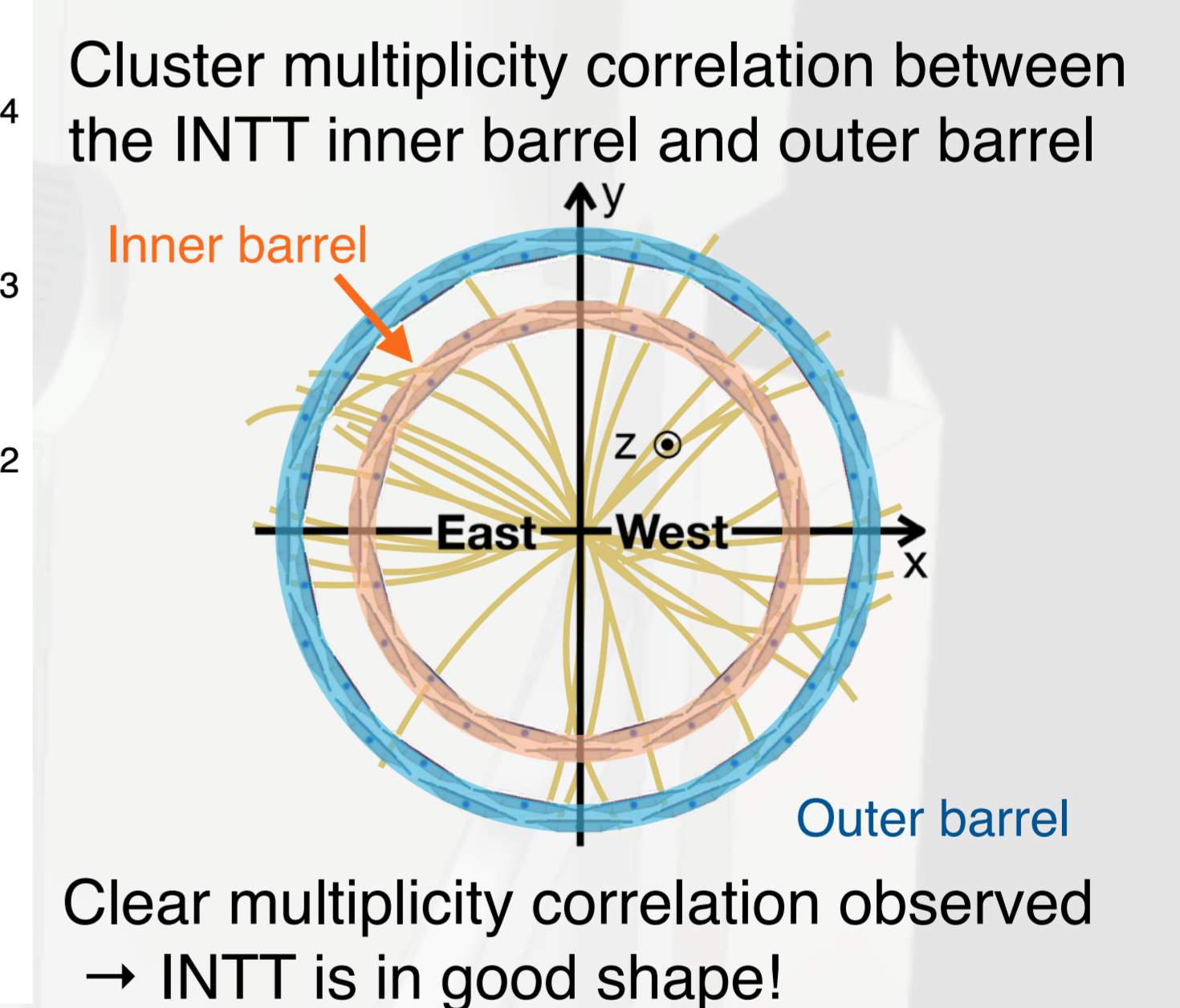
## Run 2024 data taking with proton+proton collisions (Results of INTT in streaming readout mode are shown)



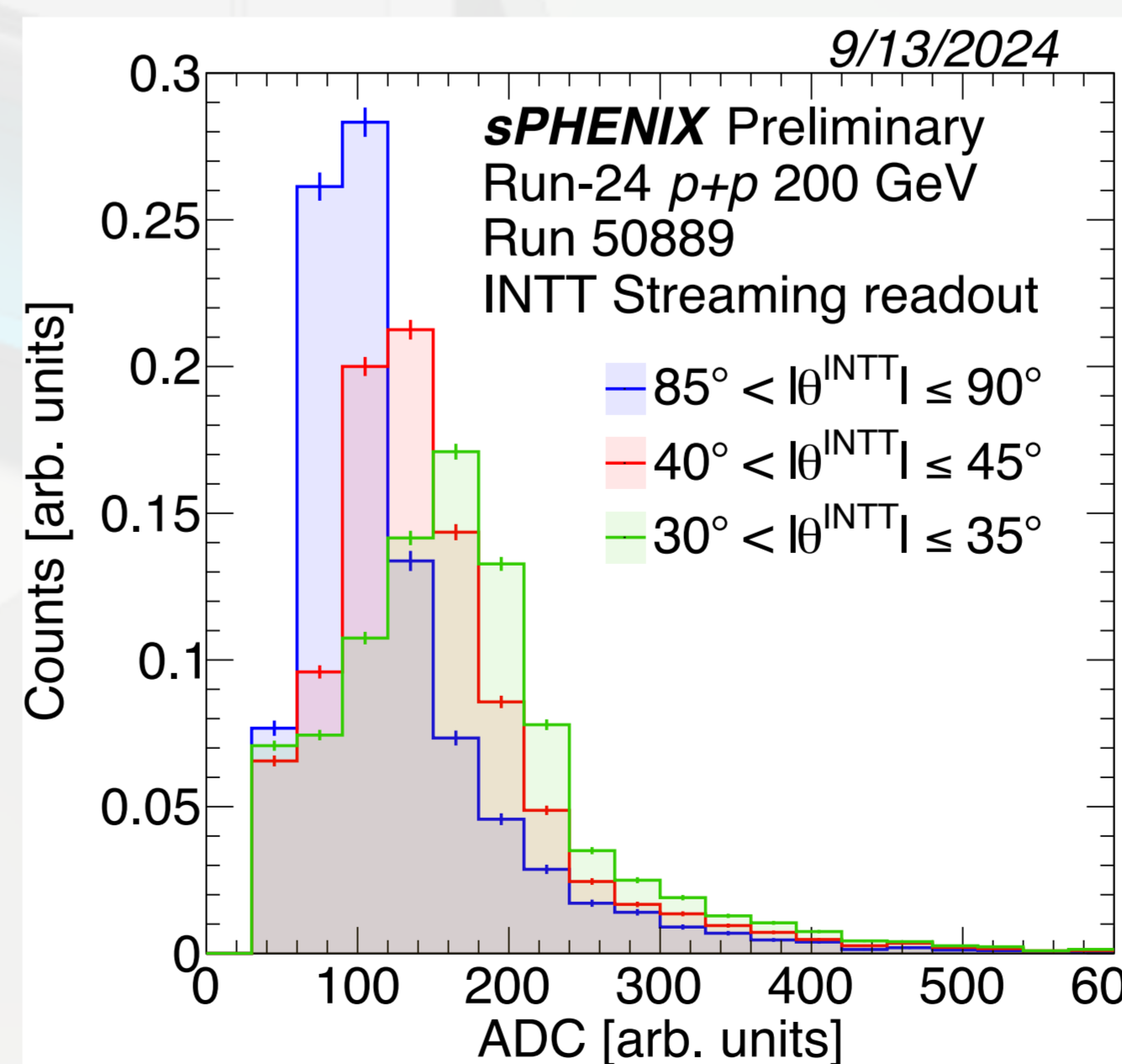
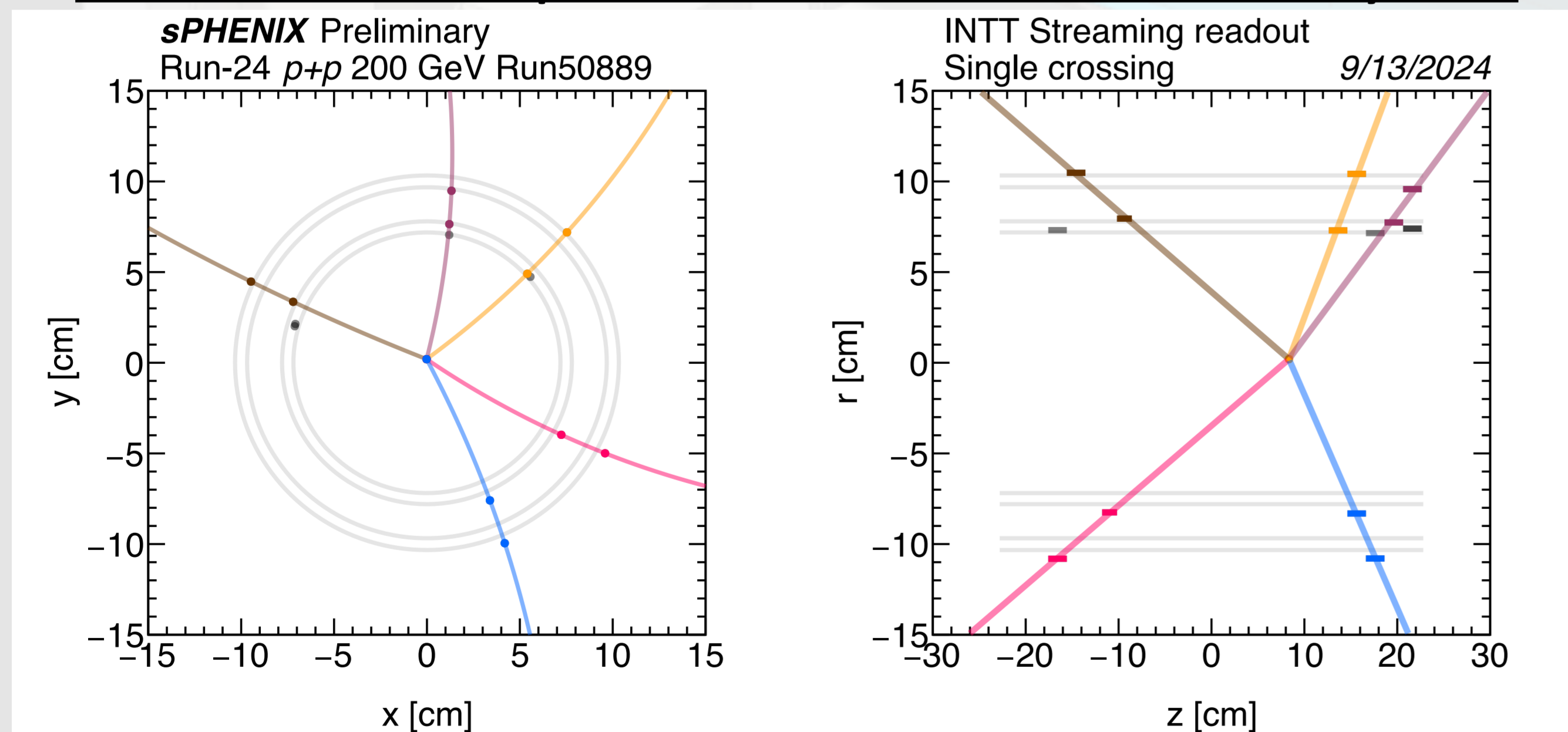
### Why streaming readout mode?



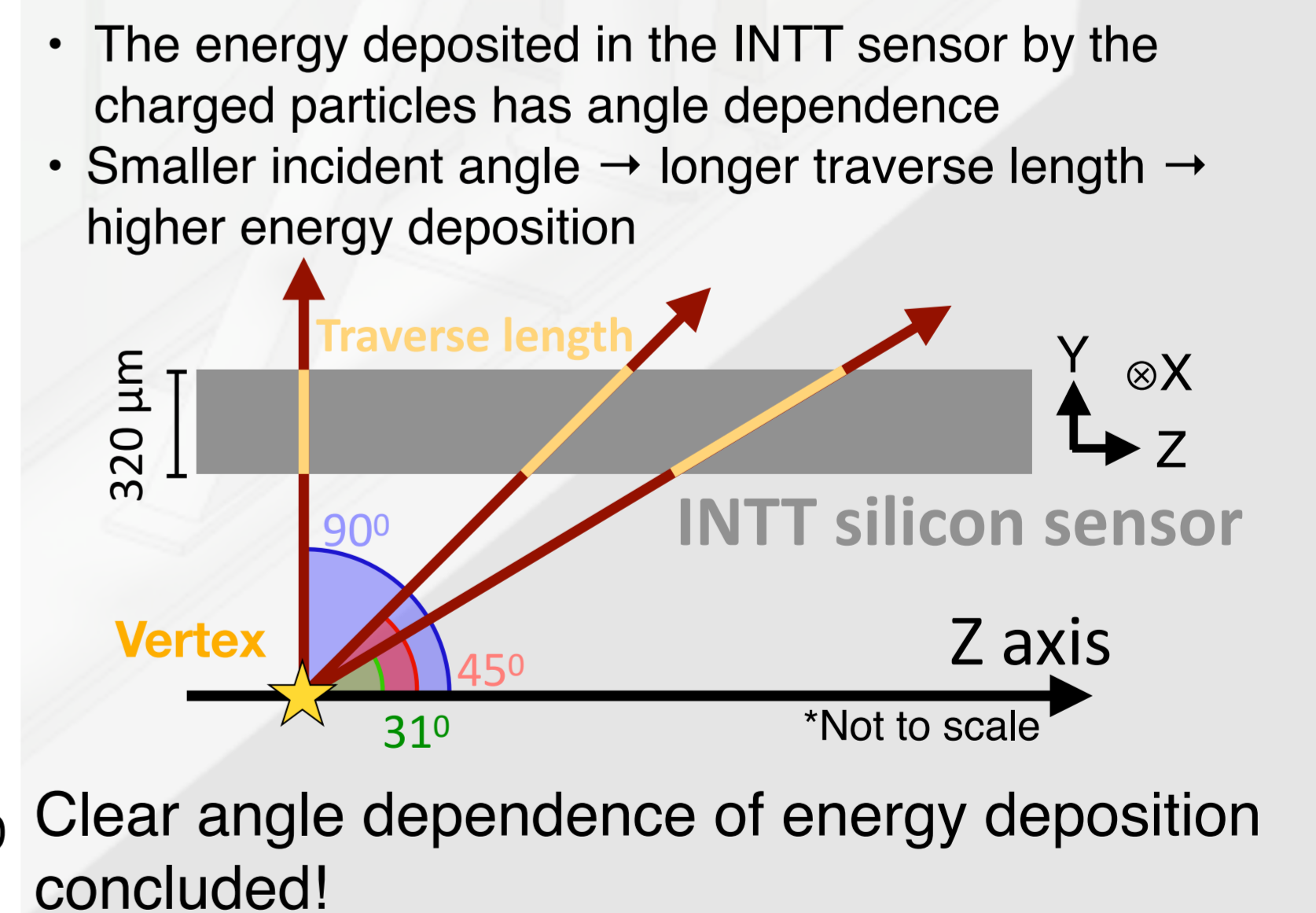
### Internal performance cross check!



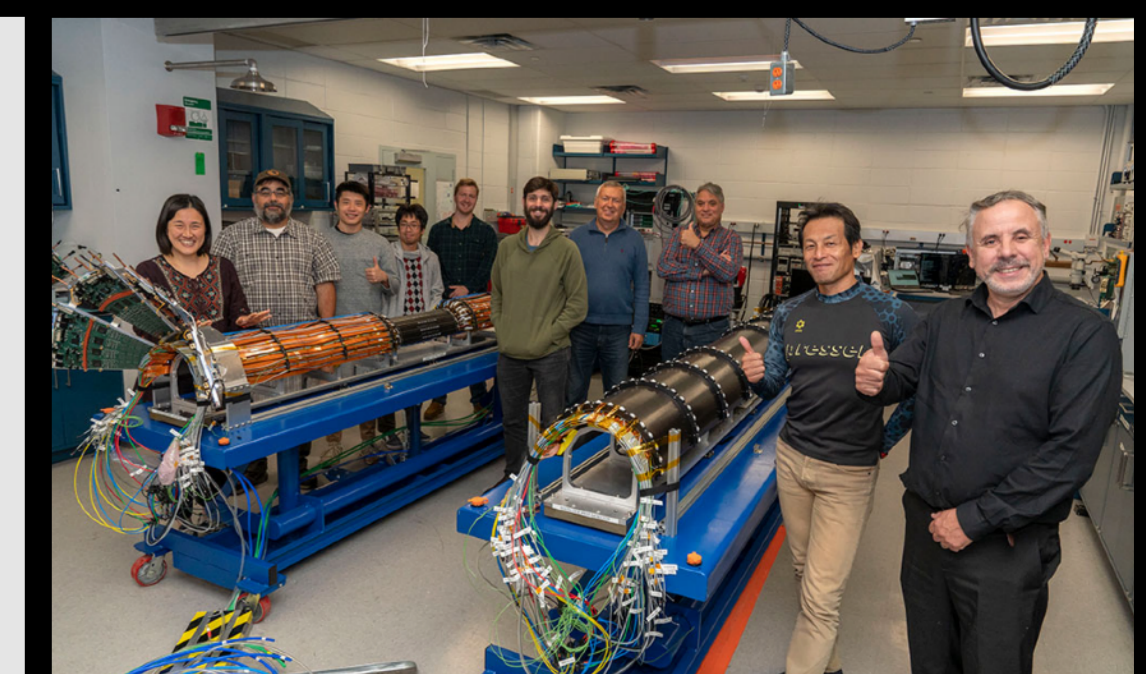
### Check data in detail: particle tracks can be reconstructed by INTT!



### INTT energy-deposit distribution!



**Conclusions:** The single-bunch-crossing timing resolution of INTT makes it the only tracking detector of sPHENIX capable of associating individual tracks and events. In Run 2023, sPHENIX started commissioning with Au+Au collisions, during which a correlation in multiplicity between INTT and MBD was identified. Besides, the Z vertices reconstructed by INTT and MBD showed a positive correlation with a slope close to unity. During Run 2024, when sPHENIX collected p+p collision data, INTT transitioned to the streaming readout mode. This is crucial for heavy-flavor physics as all collision events can be recorded. In streaming readout mode, a clear multiplicity correlation was observed between the INTT inner and outer barrels. In addition, the developed INTT tracklet analysis was able to reconstruct the particle tracks. Moreover, the distinct particle incident angle dependence of energy deposition in the INTT sensor was concluded. INTT has been confirmed to be in good shape and reliable in Run 2023 and Run 2024! With the substantial statistics taken in both years, sPHENIX is going to deliver exciting physics results!



\* Not all INTT members included