INTT various updates

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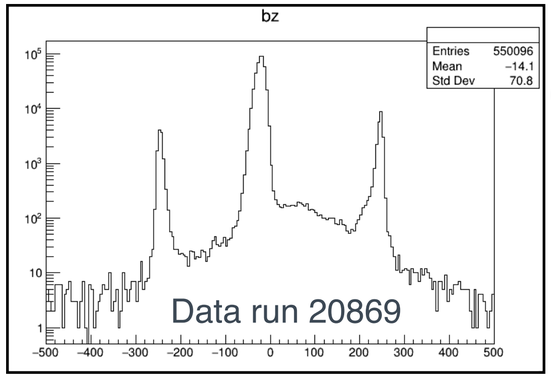
INTT meeting

sPHENIX INTT sPHENIX 國立中央大學 National Central University

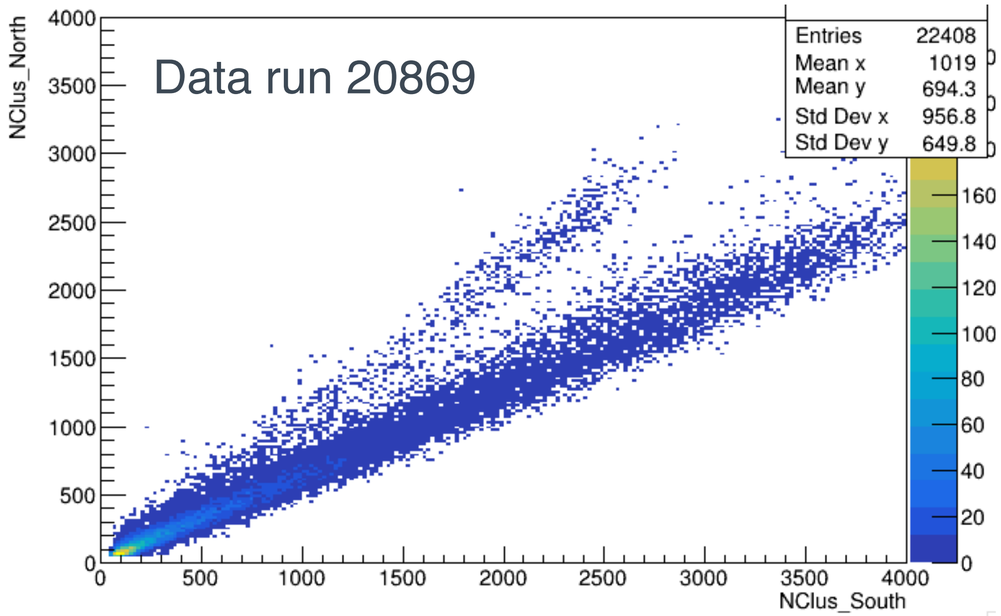
INTT N cluster correlation, north & south

- Private files for INTT and MBD
- File synchronized by code
- INTT cut: N_clu_south > 50 && N_clu_north > 50

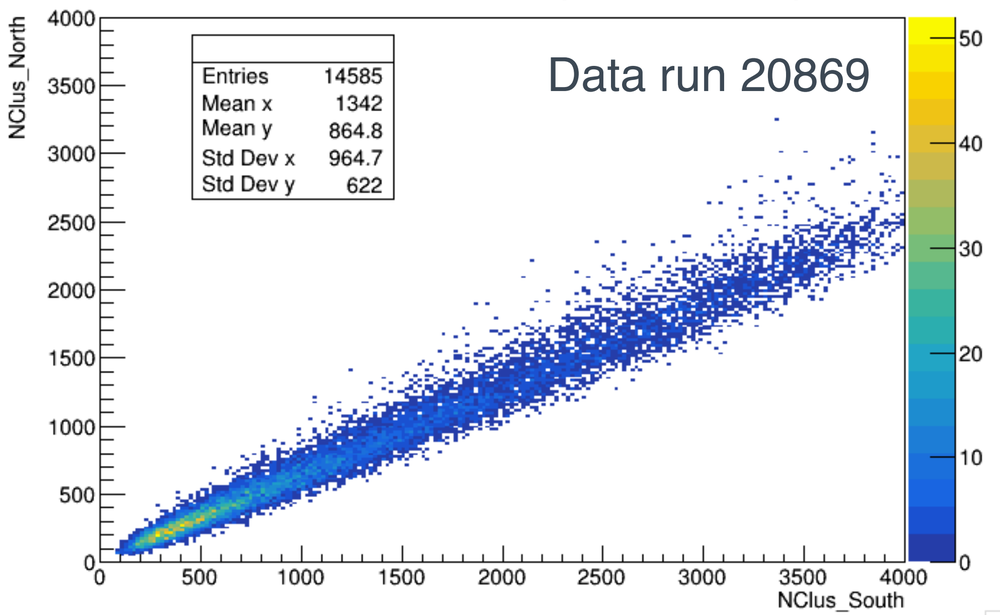


MBD zvtx
Old file (has two structures)

No MBD cut



MBD cut
-40 cm < bz < 0 cm && bqs > 50 && bqn > 50



The events in the second group have the zvtx outside the majority distribution
Can be suppressed by the zvtx cut

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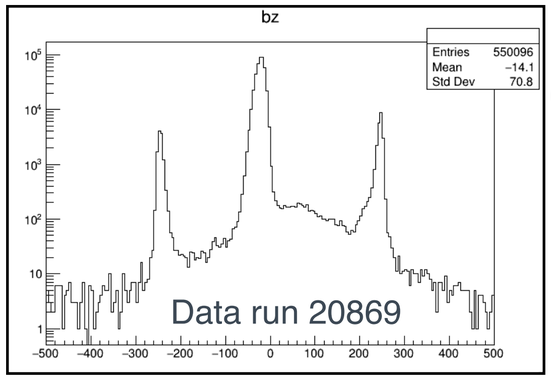

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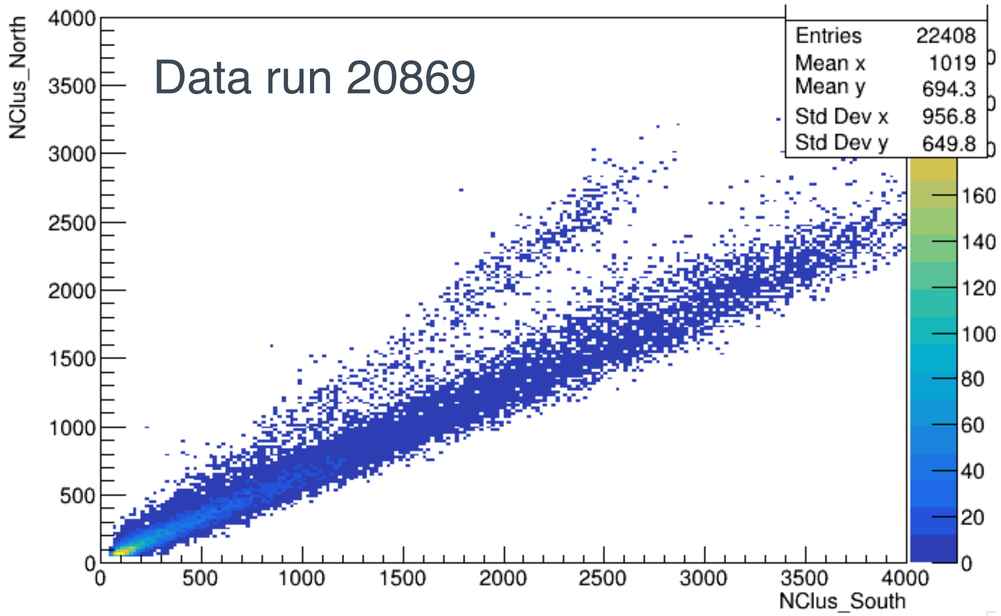

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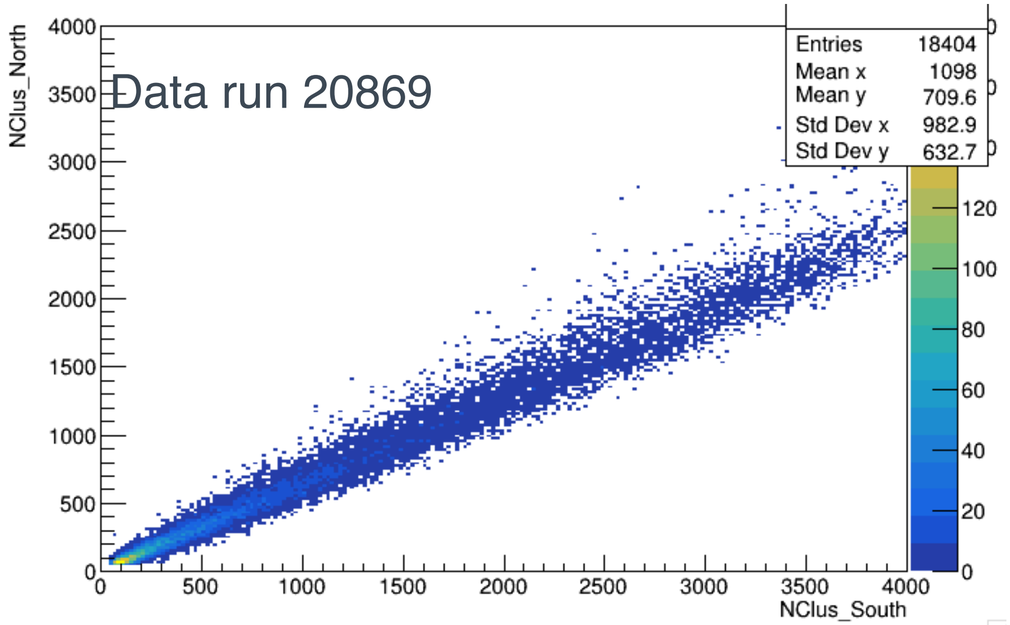

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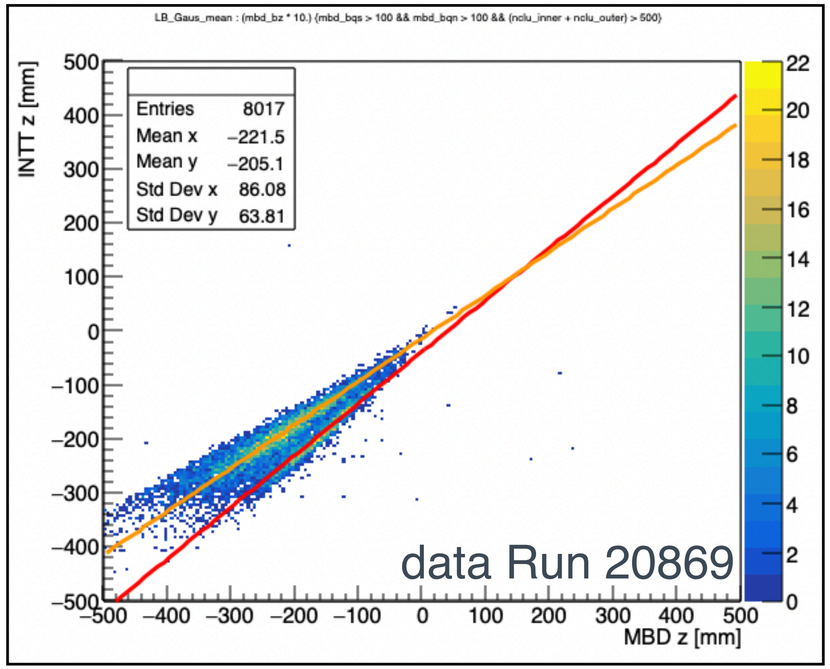
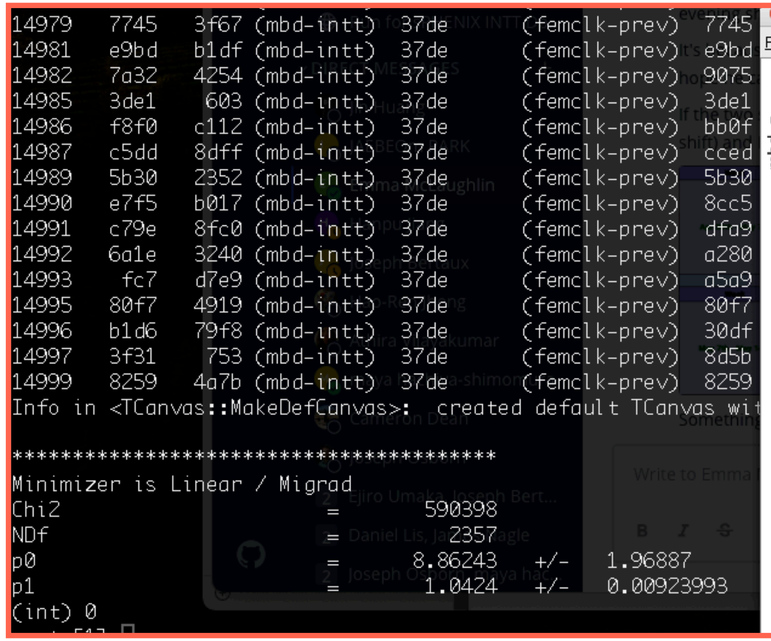
INTT Z - MBD Z consistency

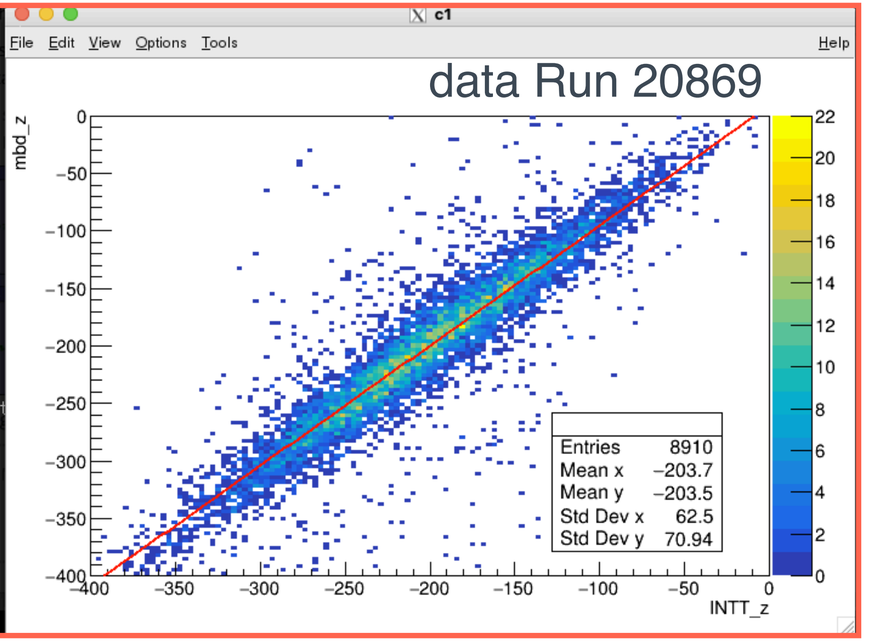
data Run 20869

Nov 27 2023



New update from Mickey last week

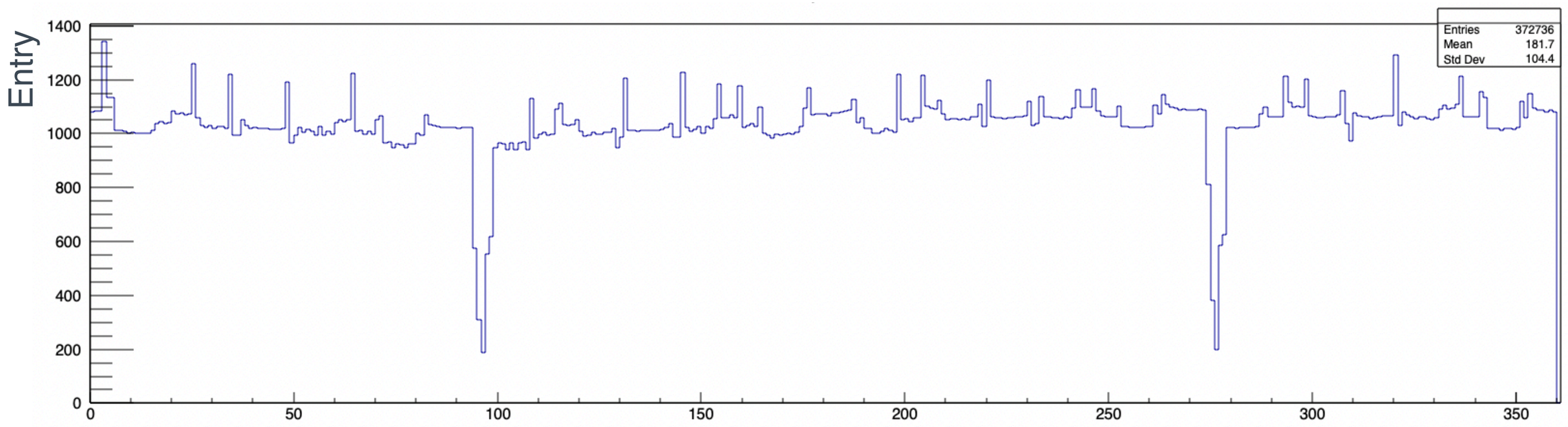




Purpose to modify the INTT G4

- Goal: to reproduce the open region we saw with the survey data in Geant4 simulation

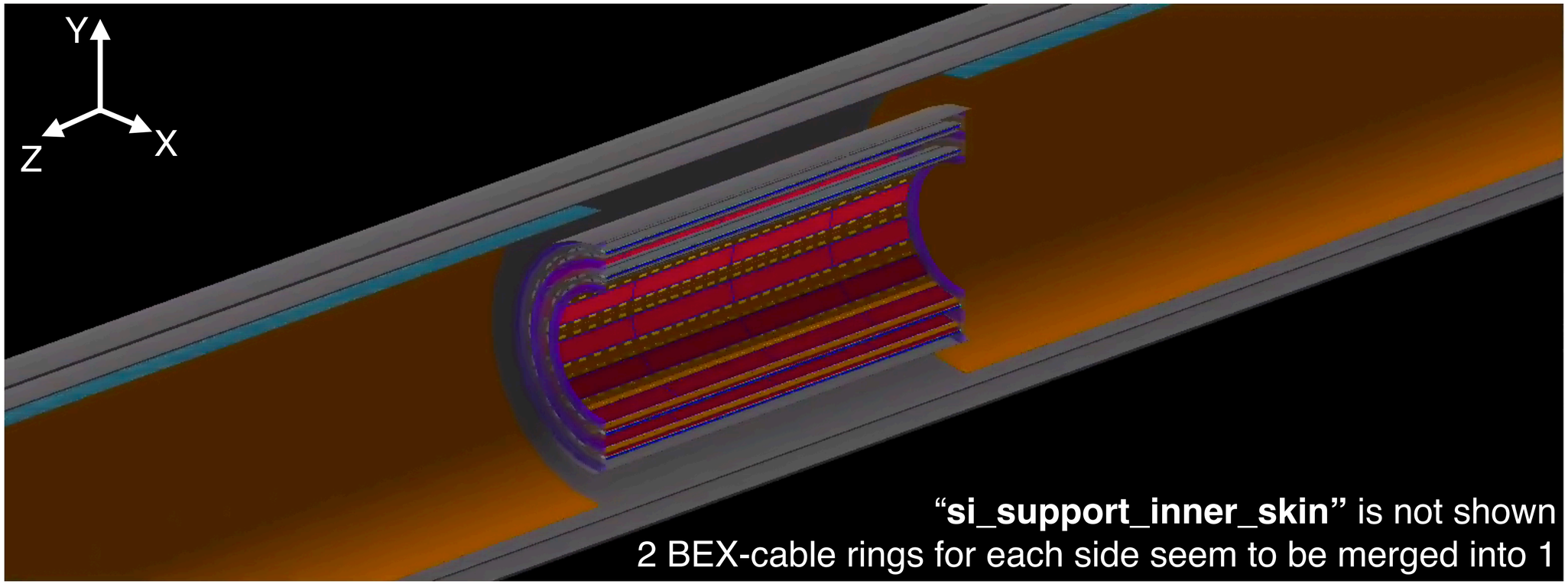
Full survey data with 3.32 mm correction in radius included
The ϕ positions of all the **INTT channels** were filled in the histogram



Presentation in 2023/Oct/18

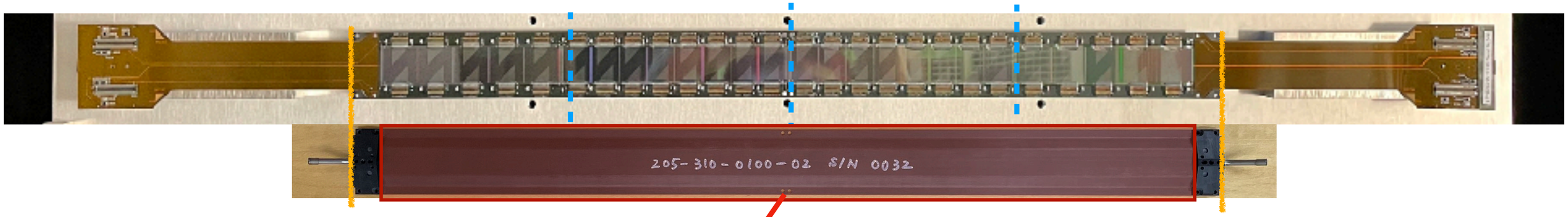
INTT Geant4 original status

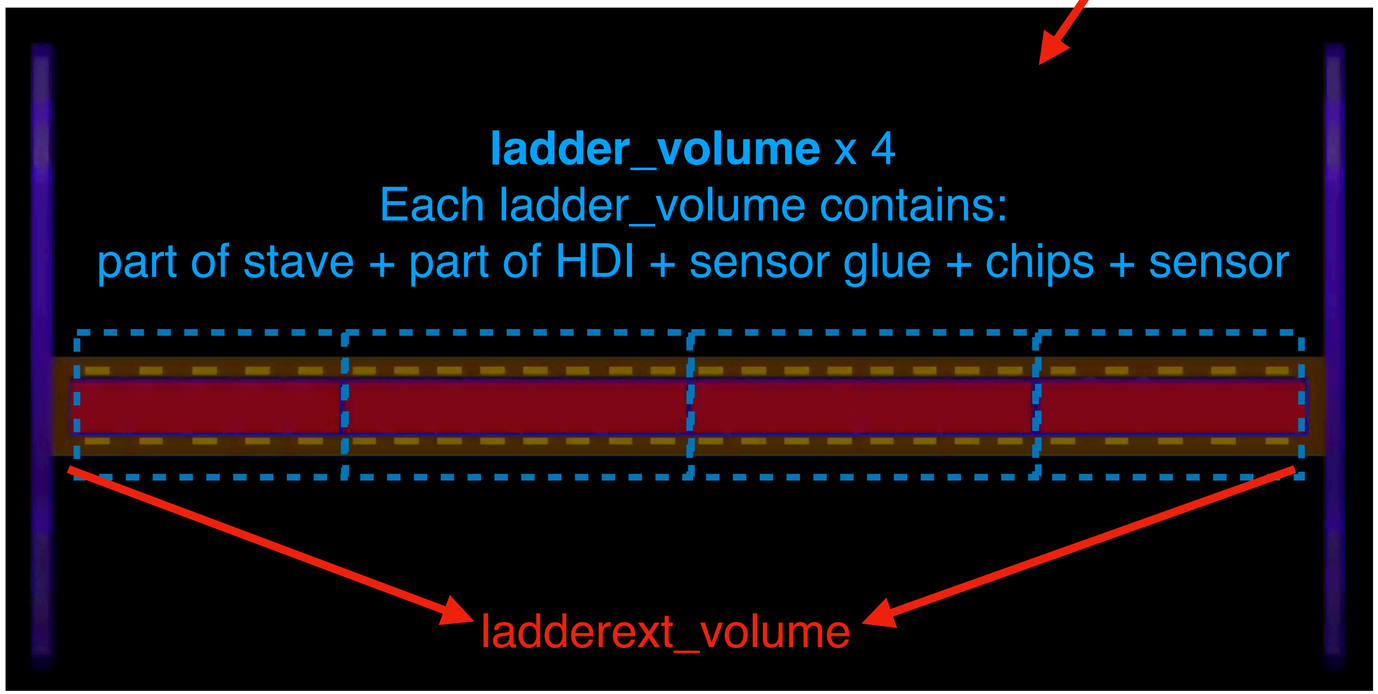
- Overall speaking, it's well made and lots of work has been done. Beautiful structure!
- Geometry: more and less **ideal geometry**
  - Some numbers are not "that" correct (sensor radius and z position), but should be minor
- No half-barrel structure introduced. All the components are independent and have the same center reference, the **trackerenvelope**

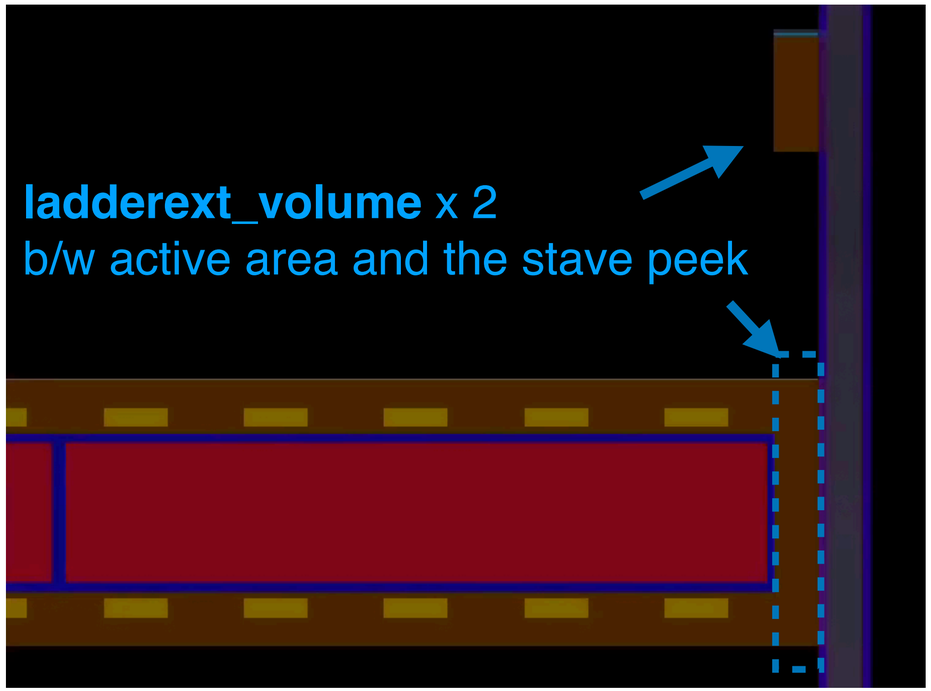


INTT Geant4 original status - ladder within peek

- Ladder **within** the peek is composed of 4 **ladder_volume** + 2 **ladderext_volume**



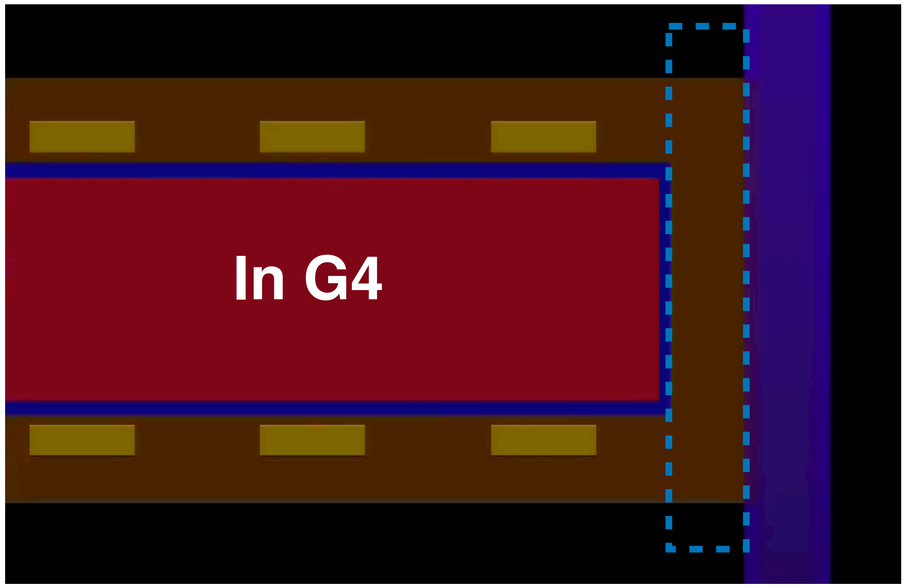


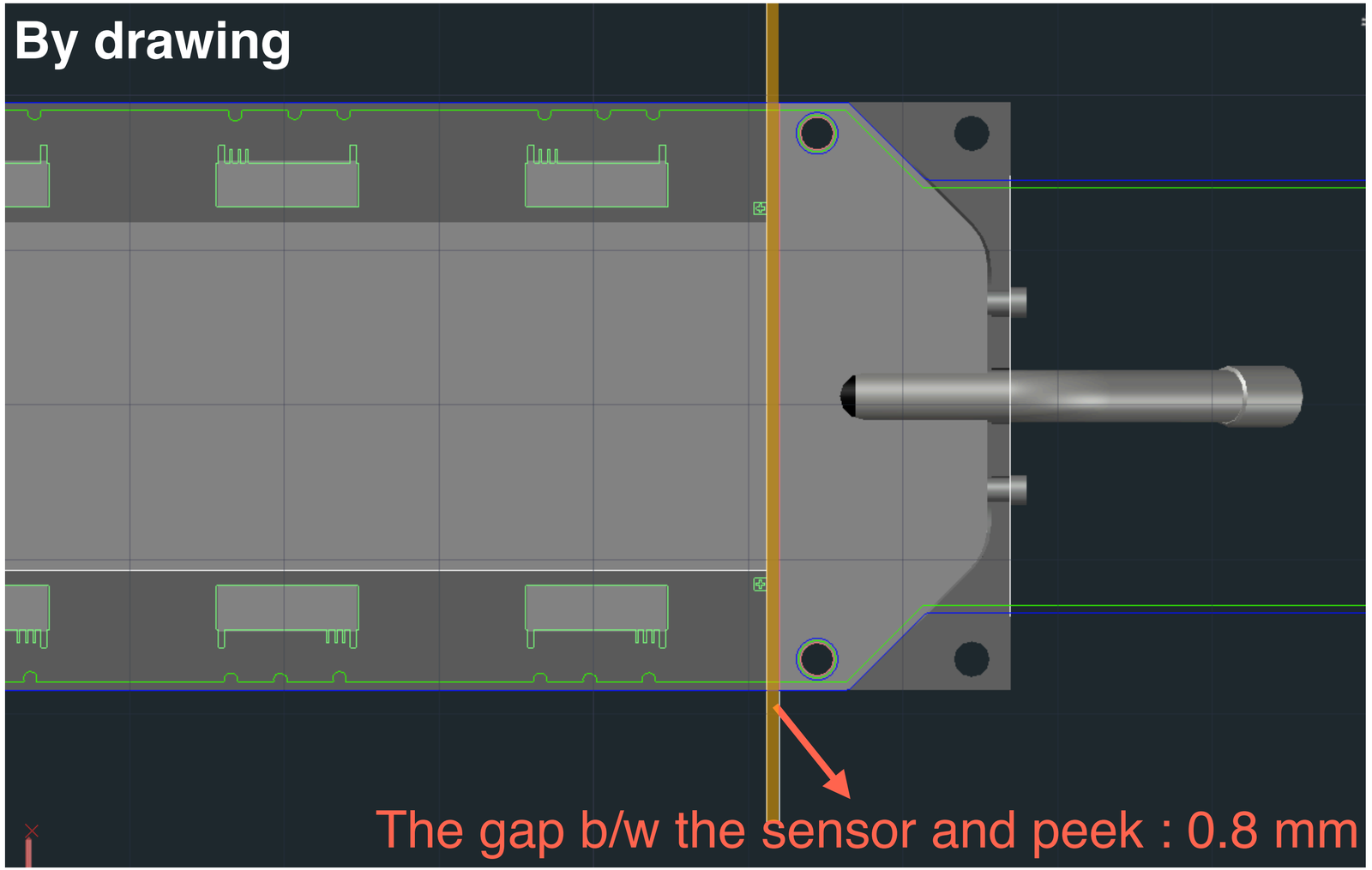


INTT Geant4 original status - ladder within peek

- Ladder **within** the peek is composed of 4 **ladder_volume** + 2 **ladderext_volume**

ladderext_volume
b/w active area and the stave peek
length: 7.622 mm

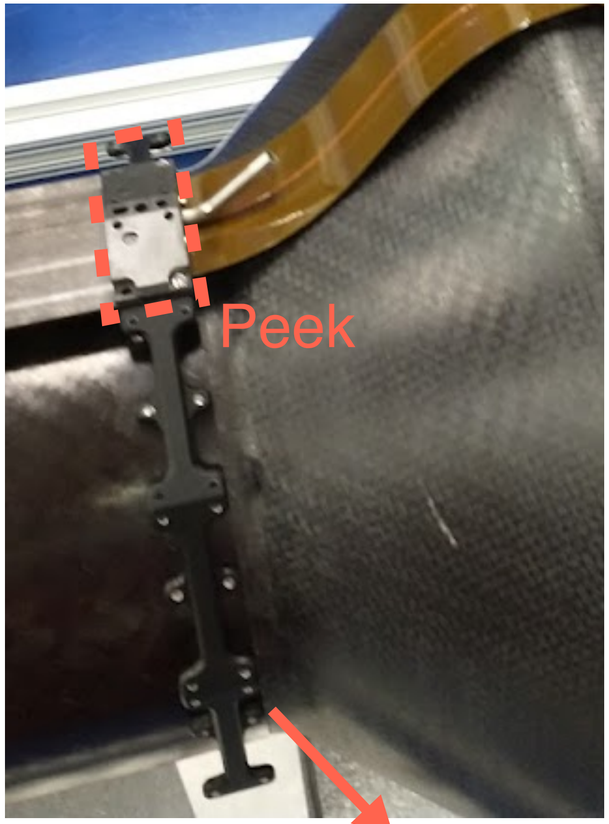


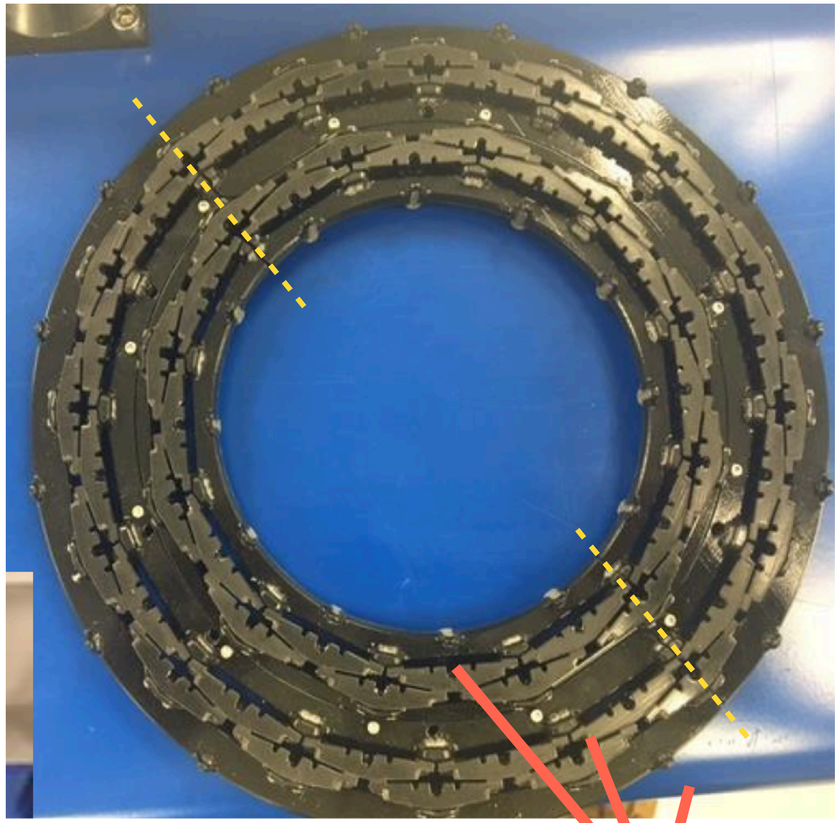


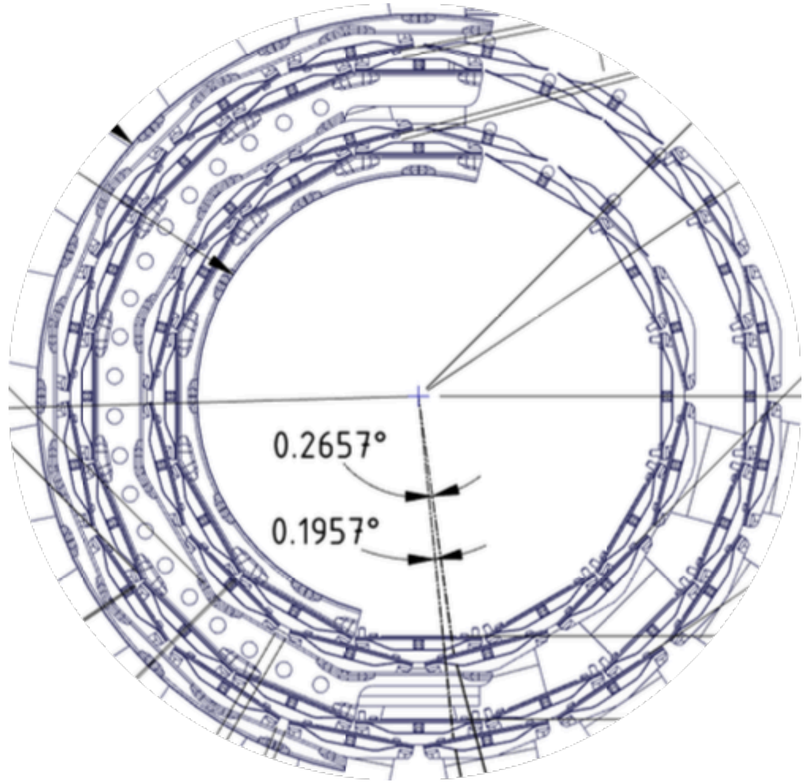
The length of **ladderext_volume** is overestimated (possibly mimicked to the peek region when designed)

INTT Geant4 original status - peek region

- Peek region: stack with stave peeks and metal support rings
- Geant4 approach: introduce the rings with different materials to mimic the reality
  - **Metal ring** for support structure & **CF ring** for stave peeks







Purple: metal
Grey: carbon fiber

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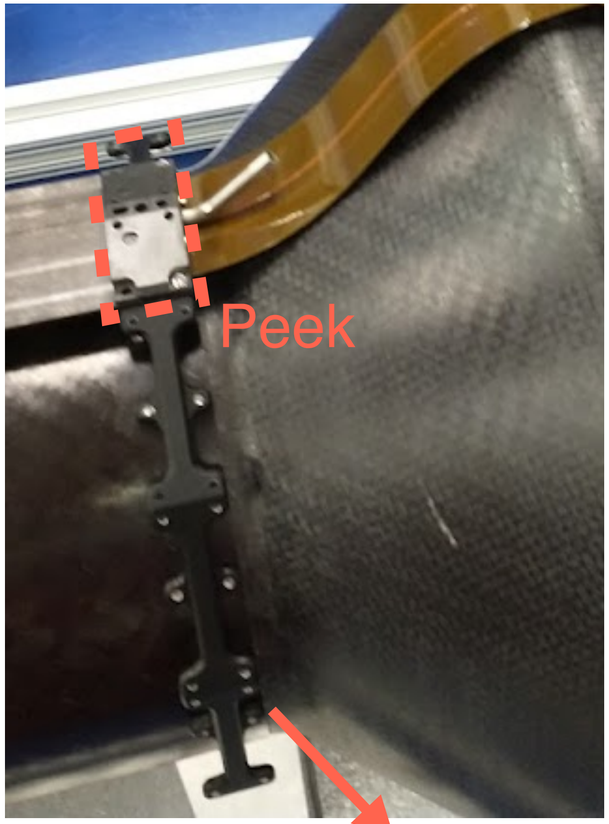

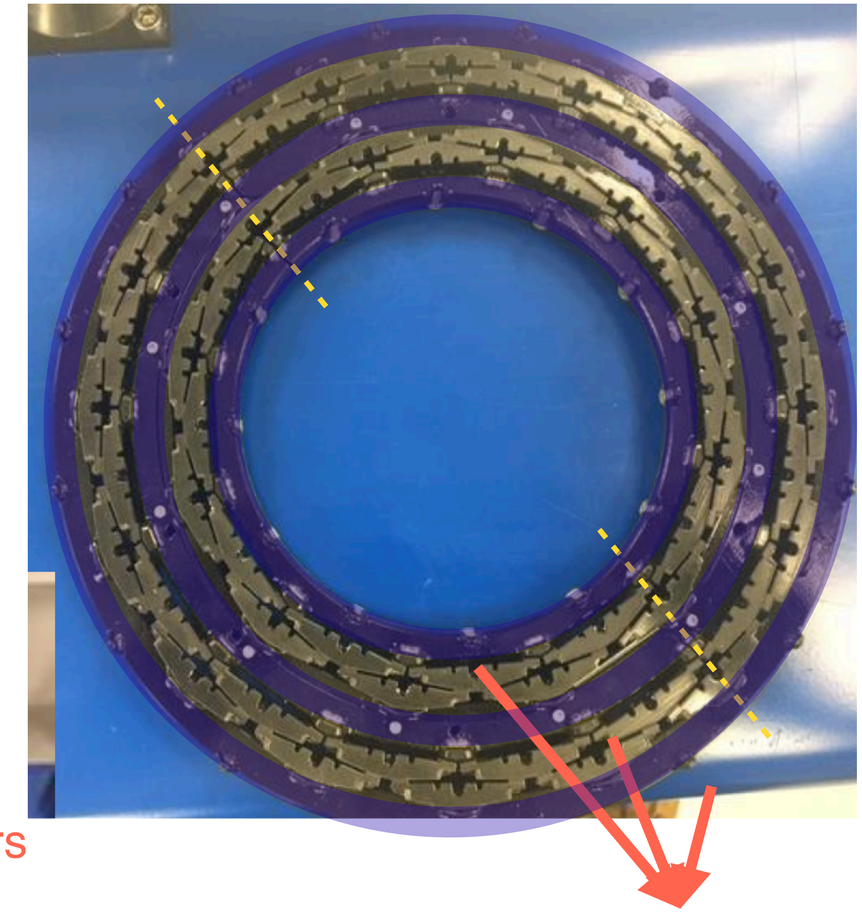

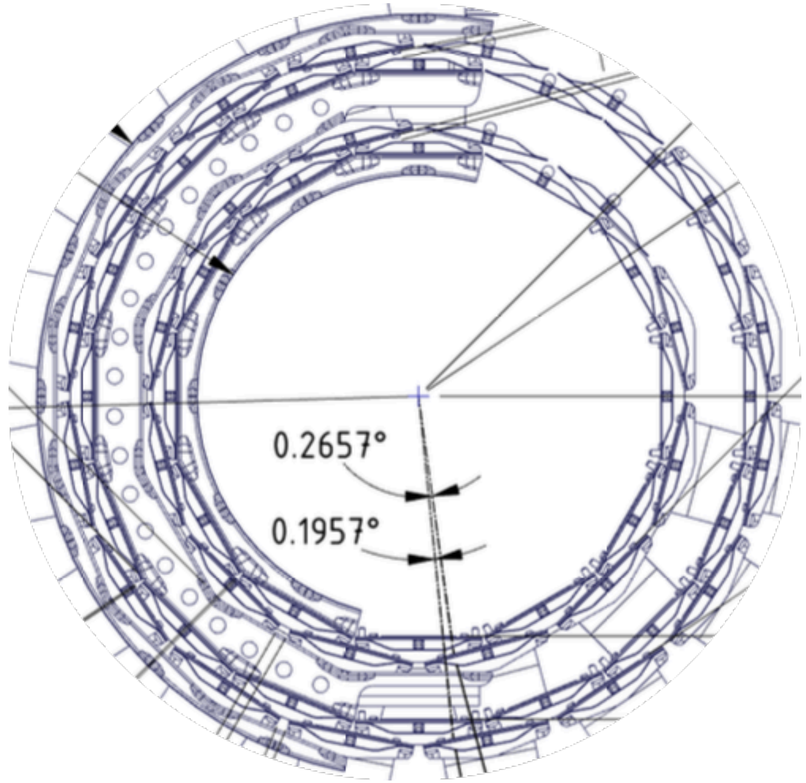

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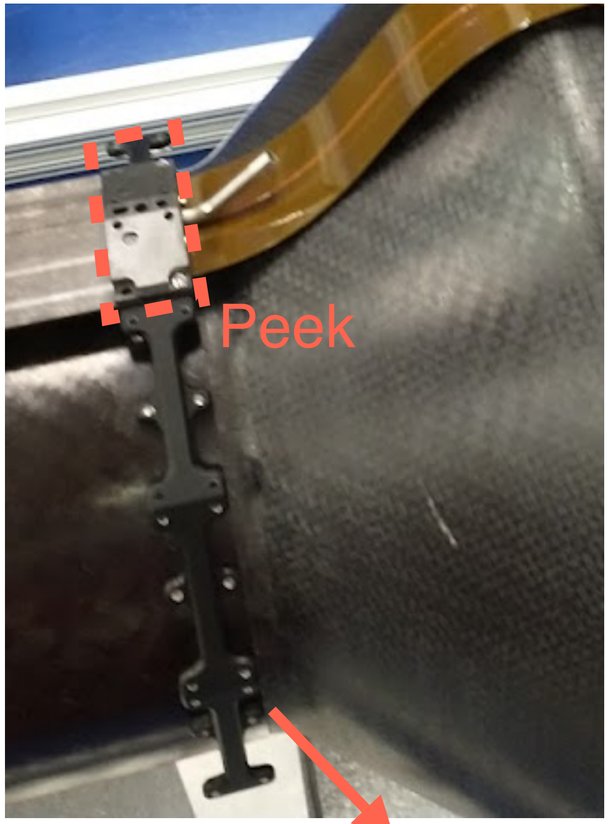

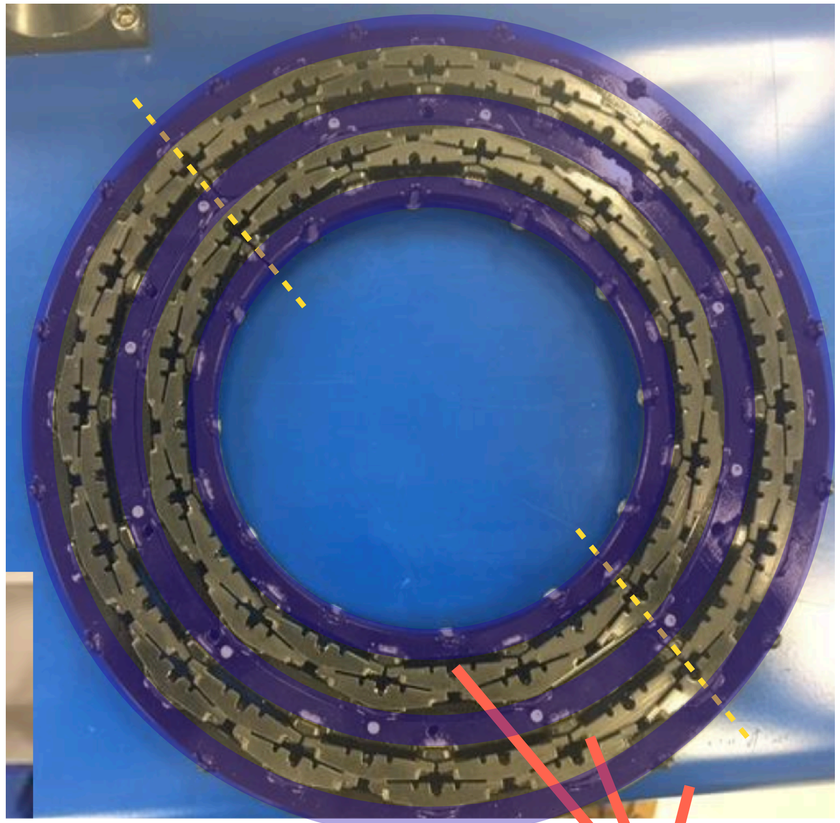

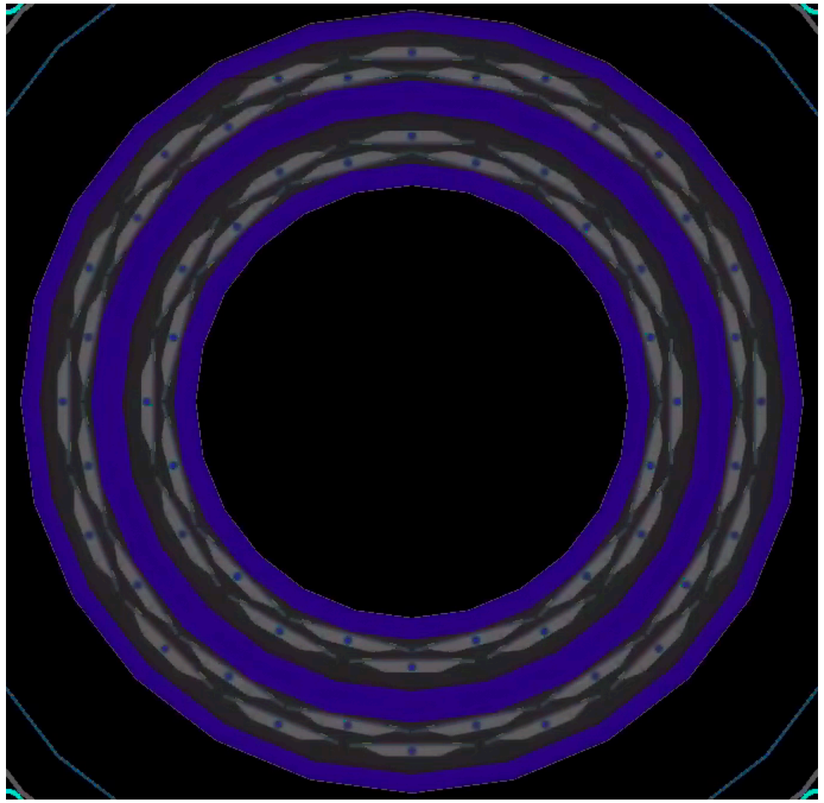

INTT Geant4 original status - peek region

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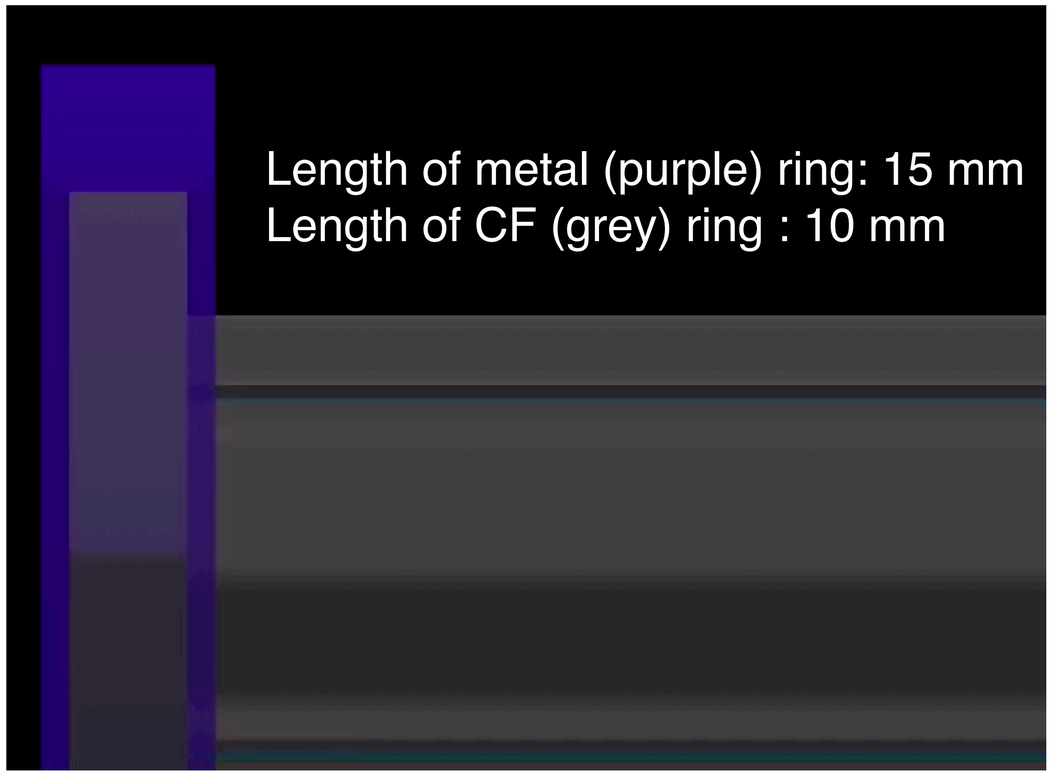
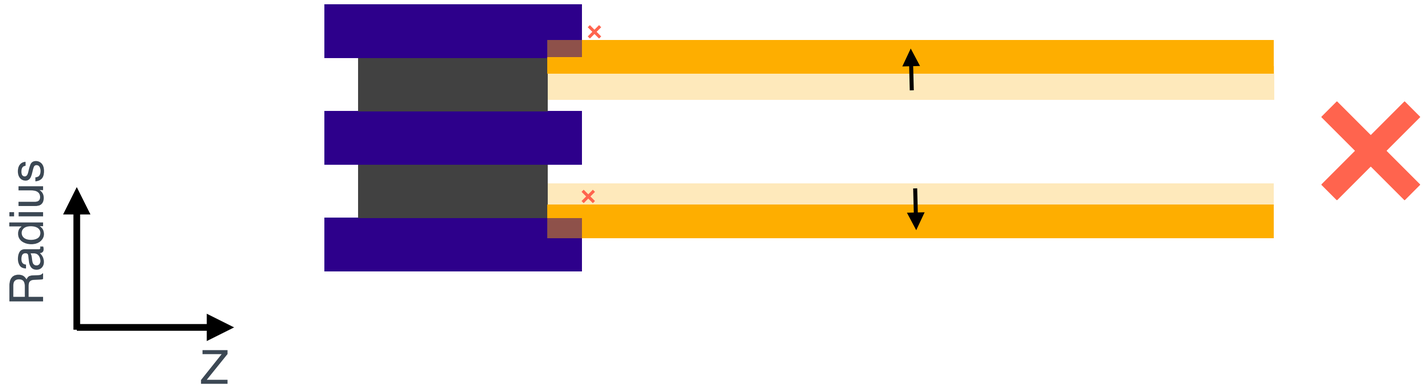


Ideal geo., ladders have no overlap with metal ring

Ladders may overlap with metal ring if the radius were changed



The lengths of both types of rings is expected to be **15 mm**. Will confirm with Dan Caca

Suggestion from tracking group

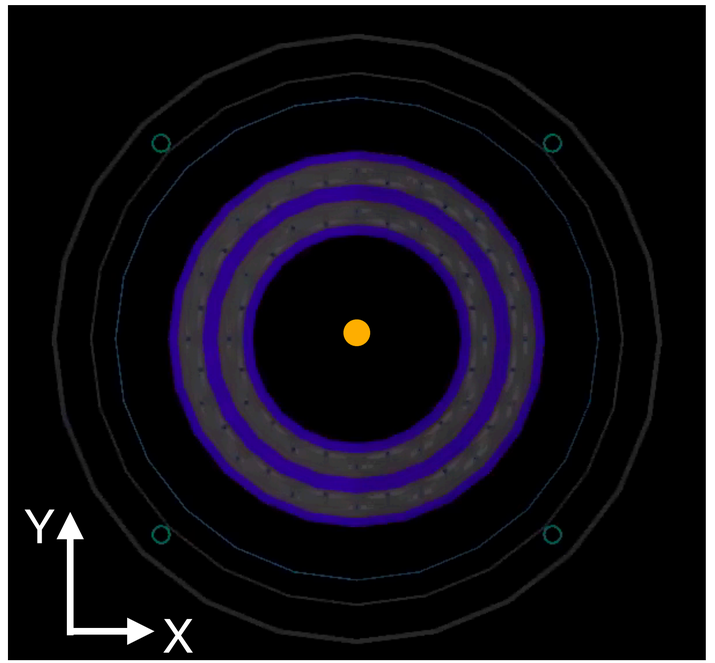
- Introduce the “half-barrel” structure
  - Put everything in a new introduced **half_barrel_volume**
  - Introduce the systematic offset of the two barrels
  - Pros: no additional overlap errors because of the barrel displacement
  - Cons:
    - Content of half_barrel_volume should have:
      - 28 ladders, **half** CF ring, **half** metal ring and **half** CF support skin, etc.
    - Have to perform a **major surgery** to change almost the whole structure of the code

Suggestion from tracking group

Original setup

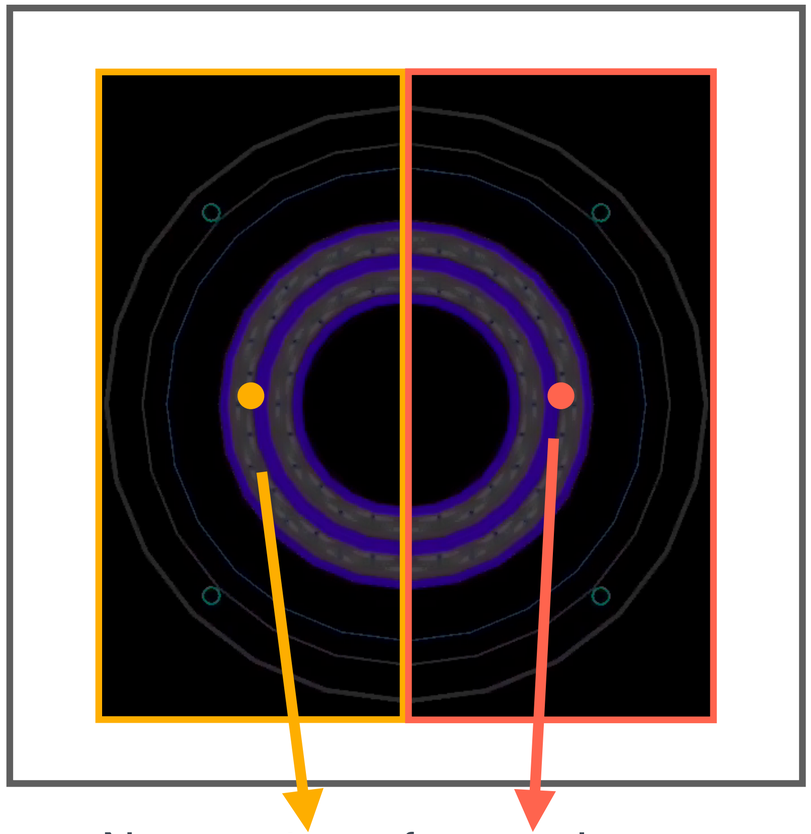
Tracking group suggestion:
half-barrel introduction, and change the half-barrel position afterwards

trackerenvelop volume



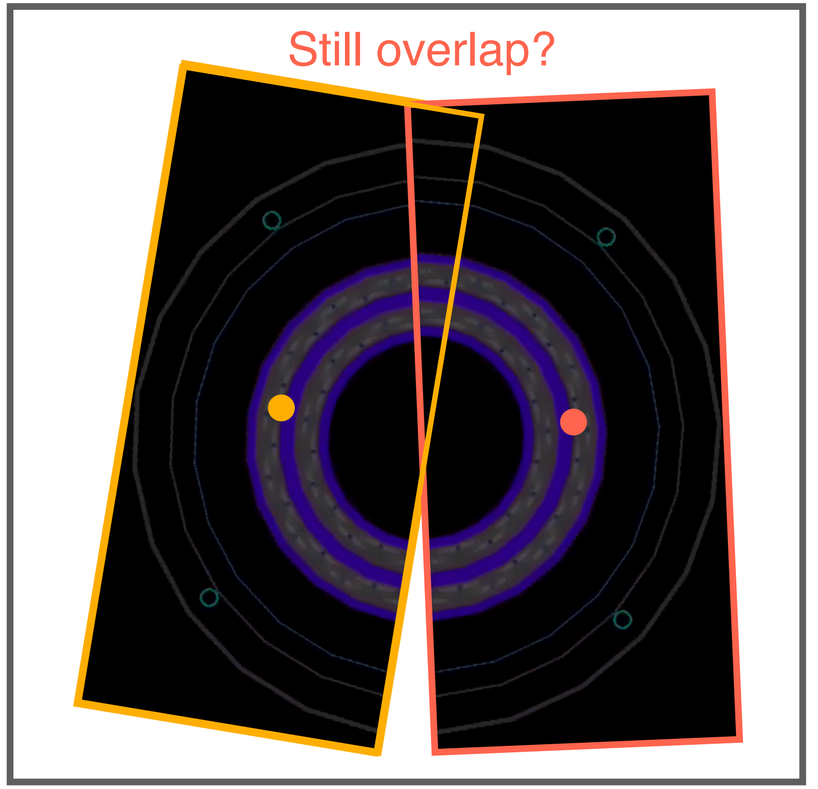
Components share the same center with mother_volume

trackerenvelop volume



New centers of new volumes

trackerenvelop volume



Doable, won't be too accurate and time consuming

Direction of survey implementation

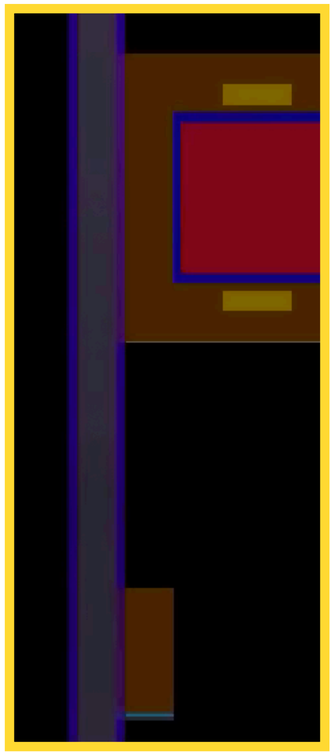
- Survey provided by Joseph can provide
  1. Sensor position w.r.t. sPHENIX coordinate (224 sensors x 6 DoF)
  2. Ladder position w.r.t. sPHENIX coordinate (56 ladders x 6 DoF) ✓
     - Review of the goal: reproduce the opening

- Plan
  1. Correct the length and position of **ladderext_volume**, 7.622 mm → 0.8 mm ✓
  2. Correct the length and position of **CF ring**, 10 mm → 15 mm ✓
  3. Correct the position of **metal ring**, make it attach to the **ladderext_volume** ✓
  4. Modify the position XY and rotation about z axis of all **ladder_volume** and **ladderext_volume** by the survey data △
  5. Modify the center positions of the **metal** and **CF rings** in XY plane

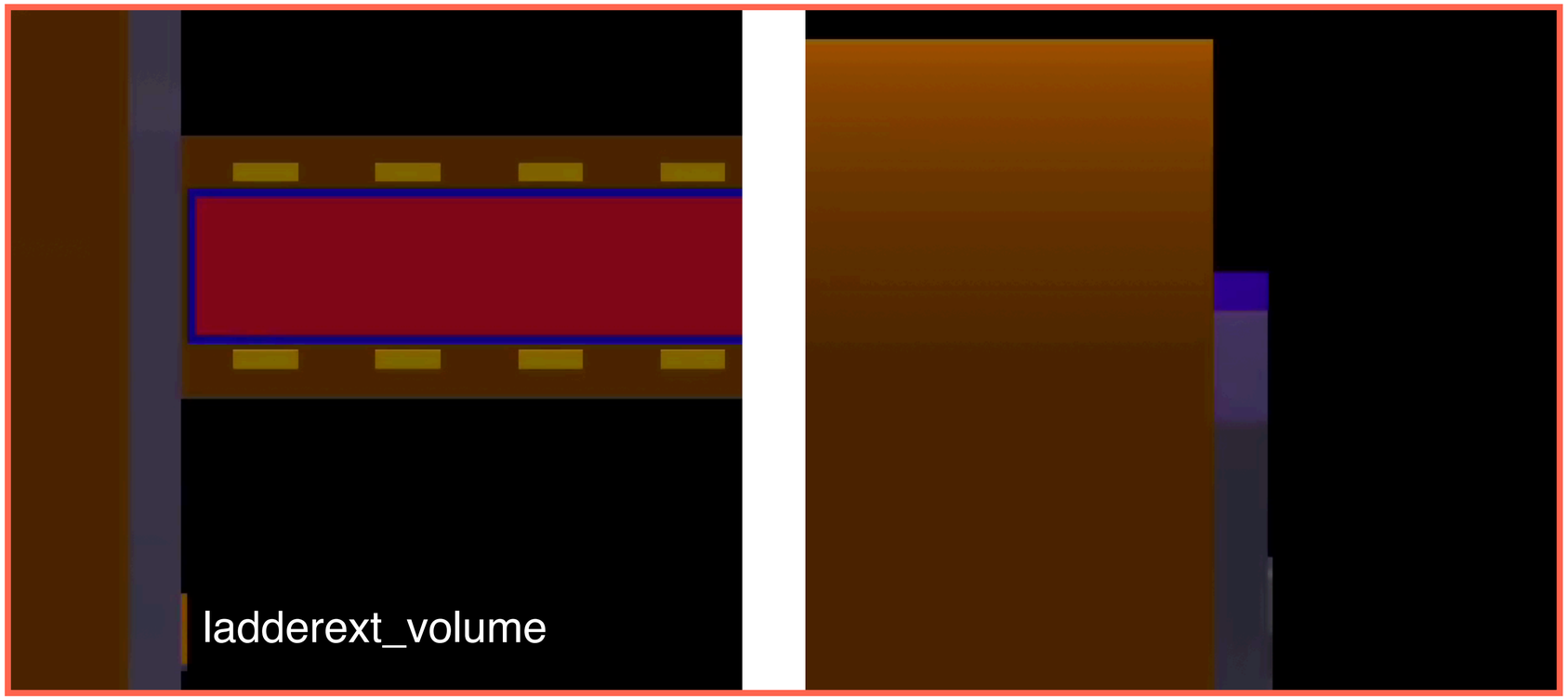
Current status

- ladderext_volume correction done
- End (metal and CF) ring correction done
- Able to load the survey geometry and change the ladder XY position and rotation about z

Orignal

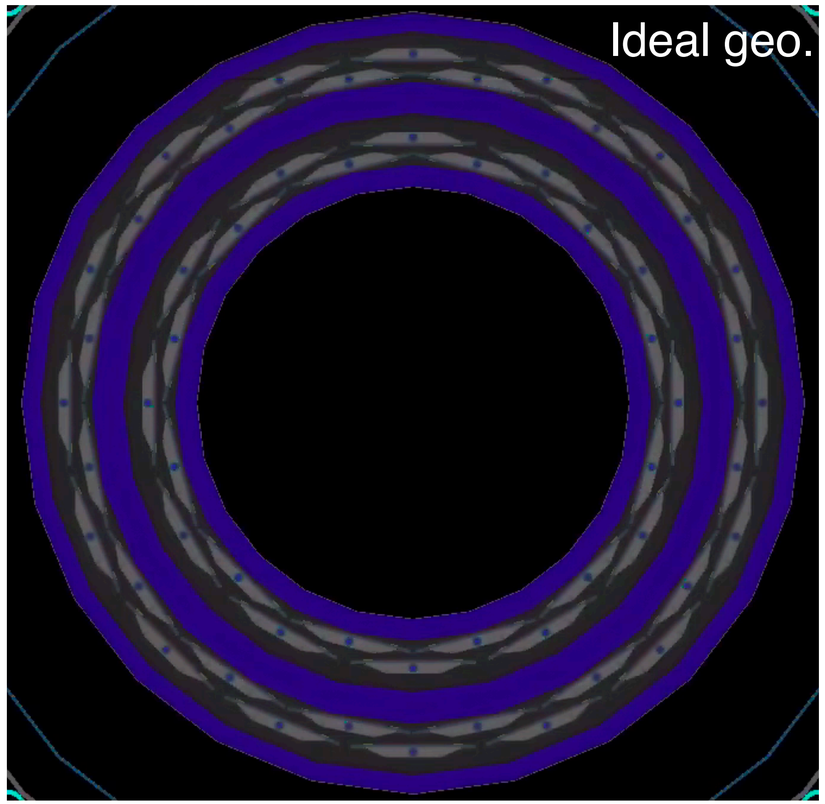


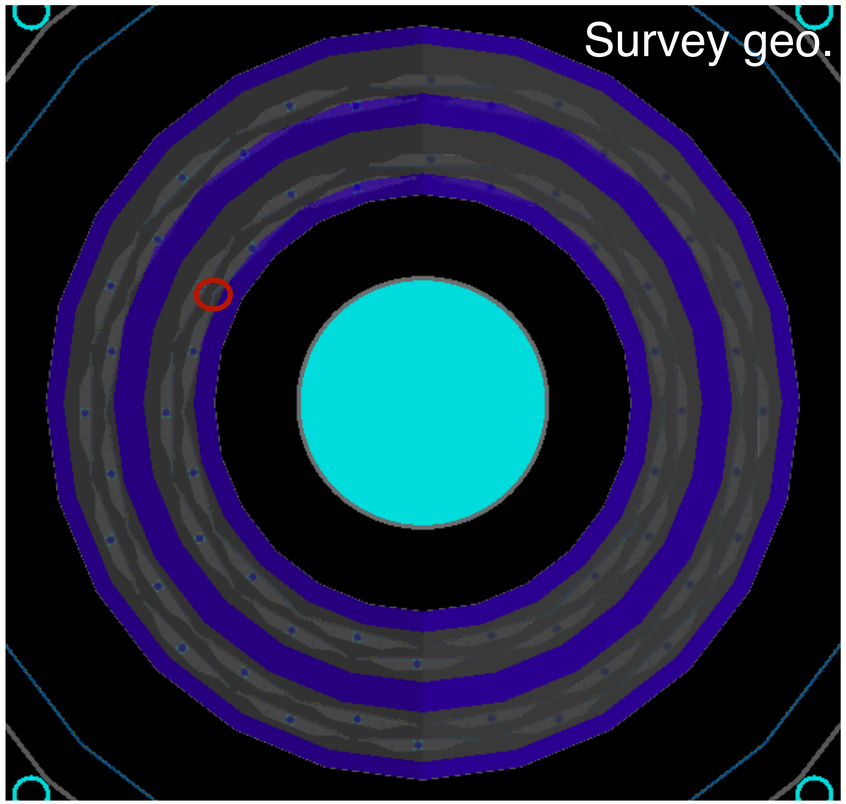
Post correction

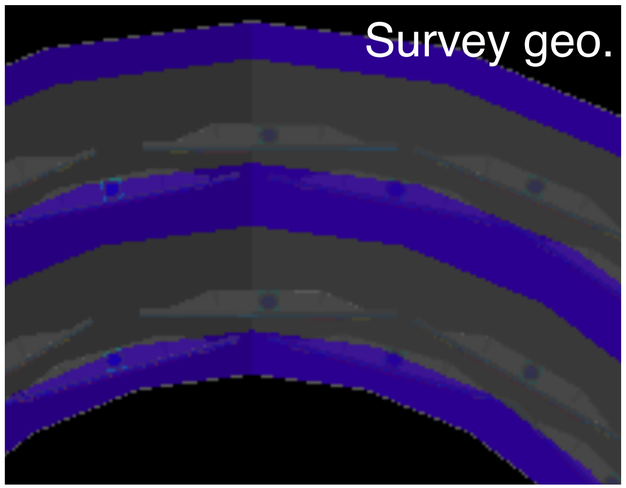


Current status

- ladderext_volume correction done
- End (metal and CF) ring correction done
- Able to load the survey geometry and change the ladder XY position and rotation about z
- Have the overlap errors b/w ladders







No more overlap errors b/w ladderext_volume and end rings

Todo list for G4 survey implementation

- Address the overlap errors b/w ladder_volume
  - Calculate the radius of the survey ladders
  - Survey data confirmation with Joseph
  - Optimize the radius correction of the survey data
- Contact with Daniel Caca to understand the final design supporting ring, and the real shell close situation
- Calculate the overall displacement of all ladders to modify the center positions of all the metal and CF rings

Summary for the G4 survey implementation

- The current method seems to be most efficient way to achieve to **goal**
- It may not and shouldn’t be the final version for the diverse sPHENIX analyses
  - The sensor translation and rotation were not yet included
  - The objects with the **G4Tube** structure may have to be modified

Streaming readout

- The overview slide of sPHENIX streaming readout by Jin

		Year-2 , 0-crossing in current setup Per-kHz M.B. trigger	Year-2, 2mrad-crossing in current setup Per-5kHz M.B. trigger	Year -2 w/ Streaming tracker (in this projection)	Year -2+4 w/ Streaming tracker
M.B. $p+p$	Data recorded	Each 1k Hz M.B. trigger with 2×10^{-4} of M.B. collisions triggered	Each **5k** Hz M.B. trigger with 2×10^{-4} of M.B. collisions triggered	10% M.B. events streaming recorded	
	Statistics	0.4 Billion M.B. events 0.01 pb^{-1} recorded	13 Billion M.B. events 0.15 pb^{-1} recorded	200 Billion M.B. events 5 pb^{-1} recorded	800 Billion M.B. events 20 pb^{-1} recorded
Physics reach	$B \to D^0 \to \pi K$	250 events	3.8k events	120k events	500k events
				Reference in R_{AA} for B→D^0	
	$D^0 \to \pi K$ pair	250 events	3.8k events	120k events.	500k events
				Diffusion of c-quarks in angular space	
	$\Lambda_c \to \pi K p$	500 events	8k events	250k events.	1M events
				Charm hadronization in p+p; reference for $A+A$	
	Prompt D^0→πK	75k events	1.1M events	40 Million events.	150 Million events
				Pinging down tri-gluon correlation via single spin asymmetry	

Streaming readout

- The overview slide of sPHENIX streaming readout by Jin

		sPHENIX in Current day-1 setup	sPHENIX w/ Streaming tracker
TPC	DAQ hardware	FEE → DAM → EBDC	Not Changed
	Firmware & Software	Record 13 μs data following a trigger (one TPC drift window), which provide one beam crossing (0.1 μs) of complete collision data	Record 20 μs data following a trigger, providing 7 μs of complete collision data
	Peak data rate	192 Gbps	288 Gbps
INTT	DAQ hardware	ROC → FEM → DCM2 → JSEB2 → Server	ROC → DAM → EBDC New construction of DAM and EBDC following TPC production
	Firmware & Software	Triggered readout of 1 beam crossing (0.1 μs) per trigger	Streaming readout of 7 μs of data following a trigger
	Peak data rate	0.01 Gbps	0.8 Gbps
MVTX	DAQ hardware	FEE → DAM → EBDC	Not Changed
	Firmware & Software	Record one strobe time window of data following a trigger (5-10 μs)	Continue recording strobe time windows until accumulating at least 7 μs of complete collision data
	Peak data rate	3 Gbps	6 Gbps

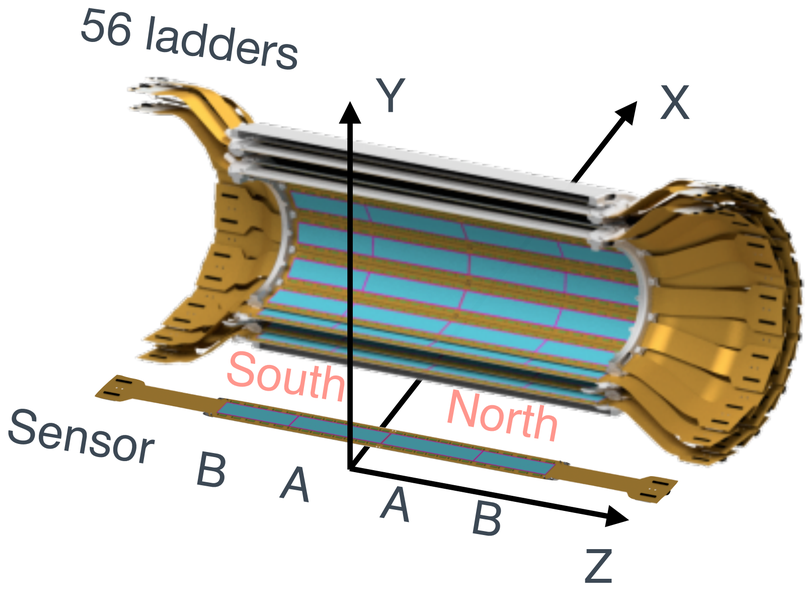
0.1 GB/s, the current estimation by the tracking group

Talked to Jin Huang, it seems to be fine if INTT generates ~10Gbps (1.25 GB/s) of data, according to the sPHENIX computing plan
It might be a problem for the case of 10 GB/s

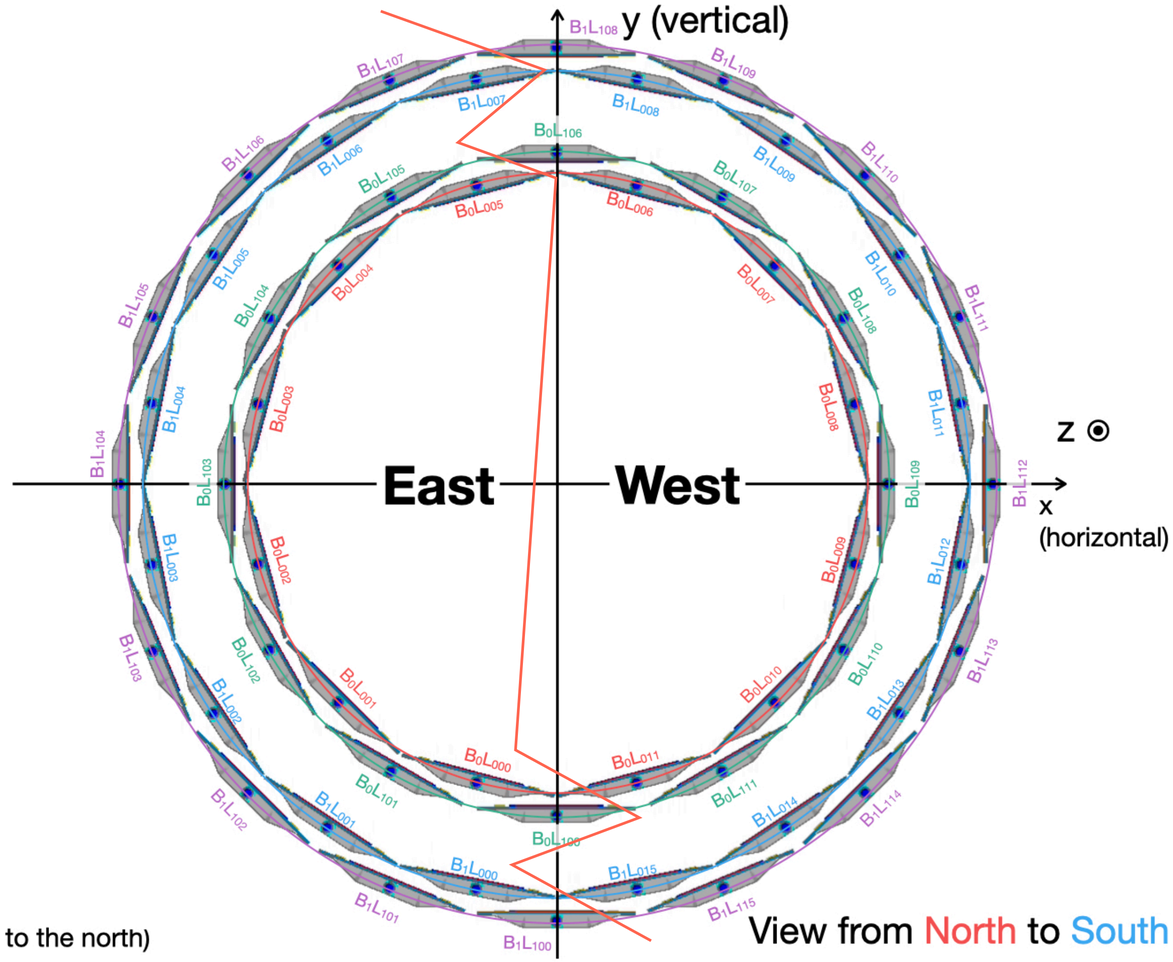
Back up

INTT geometry

INTT: 2 sensors X 2 sides of half-ladders X 56 ladders = 224 sensors



Notation: B_xL_{yzz}
- x: Barrel ID (0 for inner or 1 for outer)
- y: Layer ID (0 for inner or 1 for outer)
- zz: Ladder ID (from 0 to 15)



Axis (Right-haded coordinate)
- x-axis: $\vec{y} \times \vec{z}$
- y-axis: Vertically upward direction
- z-axis: The blue beam direction (pointing to the north)