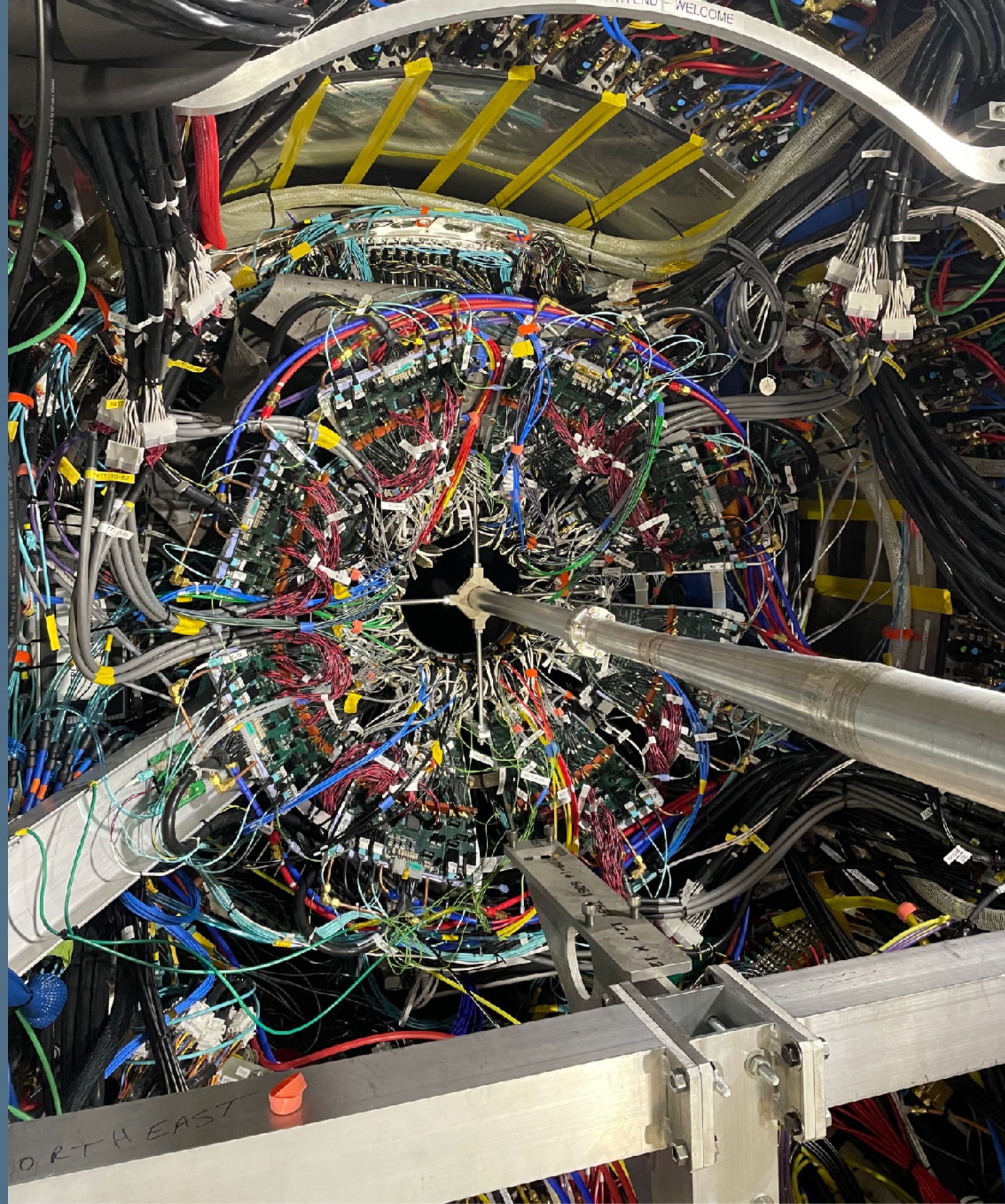


sPEHNIX INTT - Vertex with MC

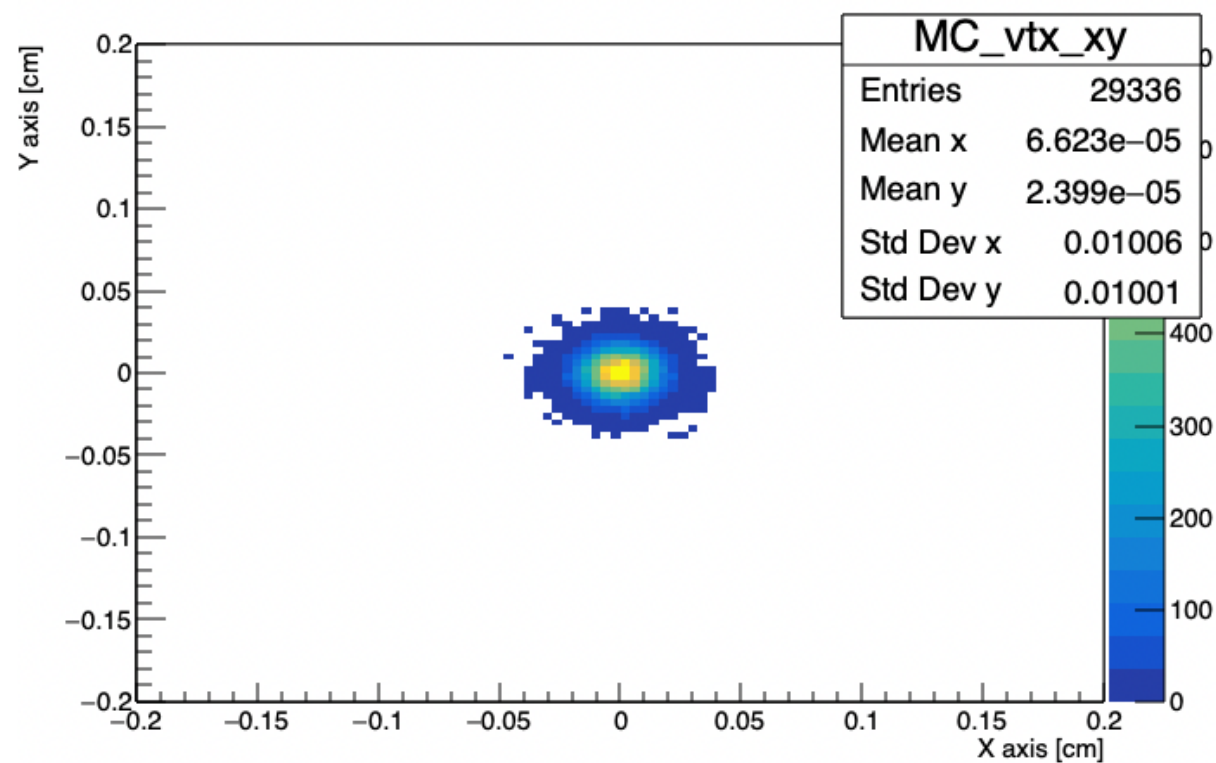
Cheng-Wei Shih, Chia-Ming Kuo
National Central University



MC sanity check

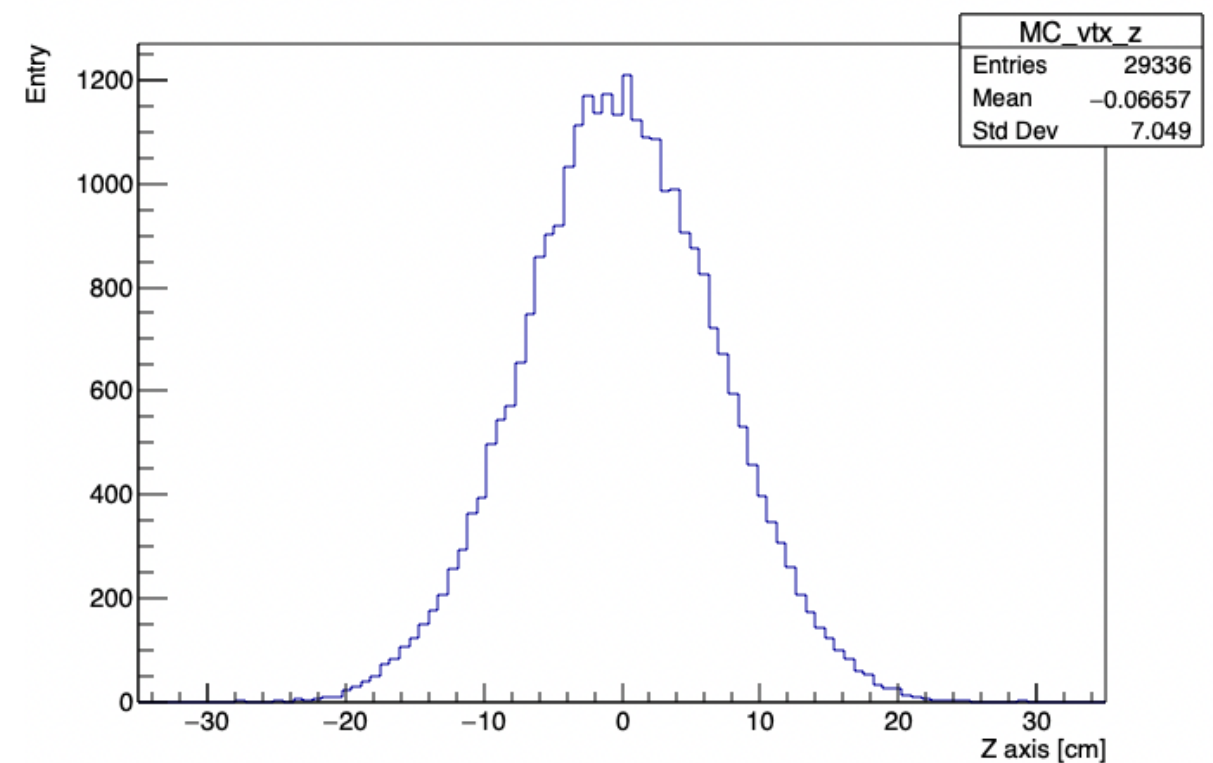
- MC file : /sphenix/tg/tg01/bulk/dNdeta_INTT_run2023/data/simulation/ana.376/HIJING/fullSim/magOff/detectorAligned/dstSet_00000/dNdeta-sim-HIJING-000-[0000 → 151].root
- N event : 30400

True VT_X_{xy}



True VT_X_{xy} $\approx$ (0, 0)

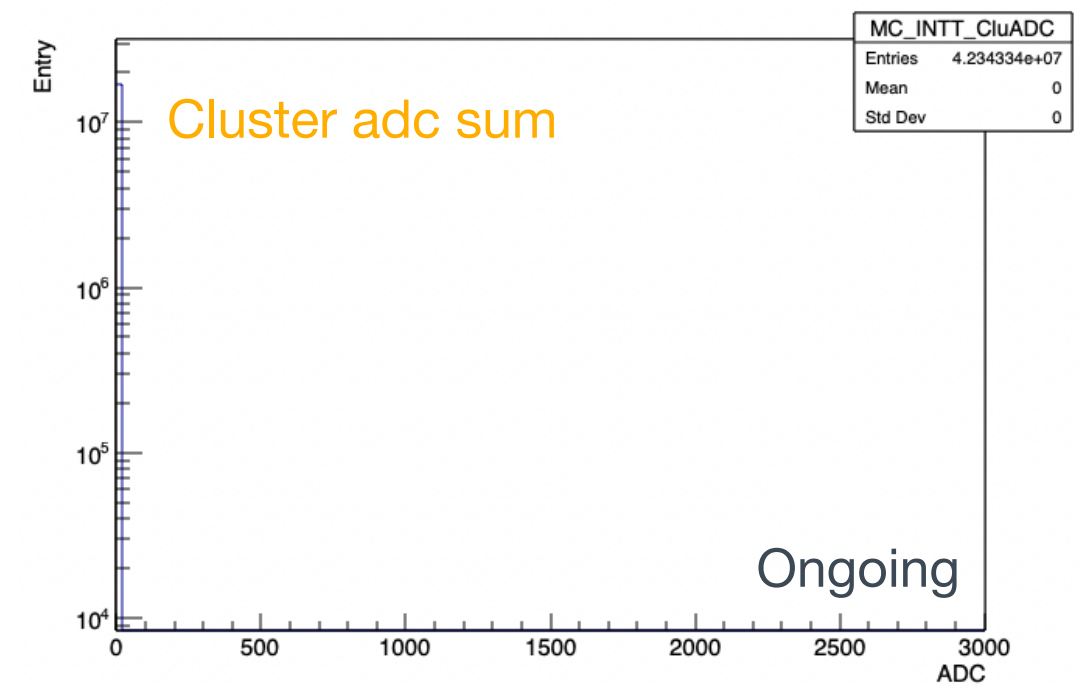
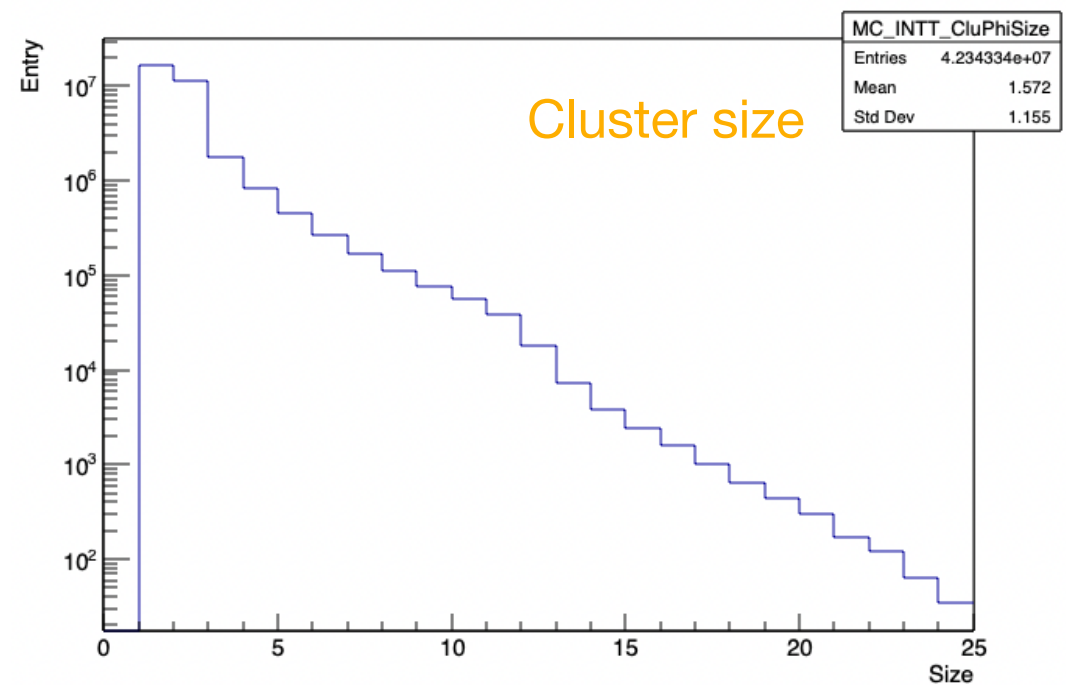
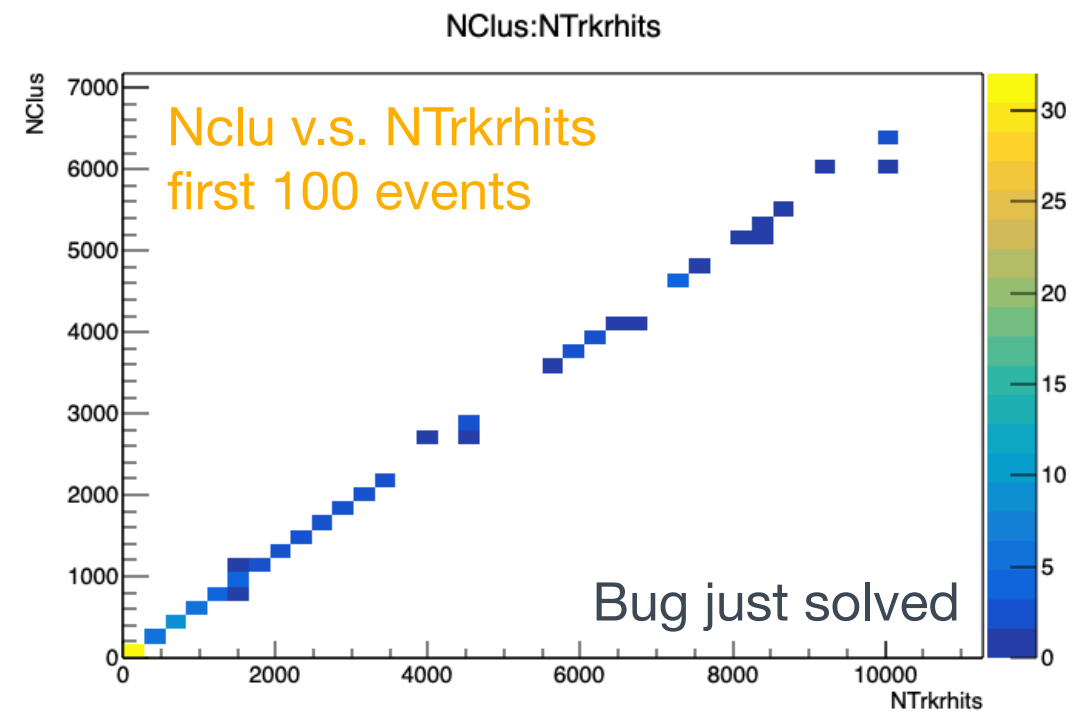
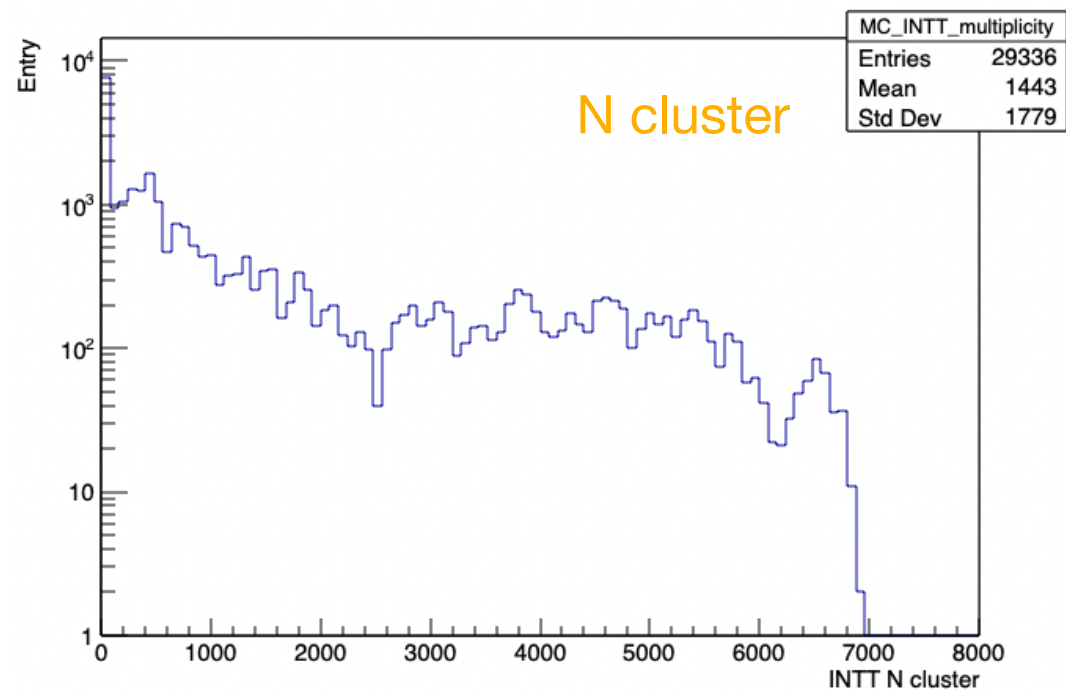
True VT_X_z



MC generated by Cameron, event info. extracted by Hao-Ren's module

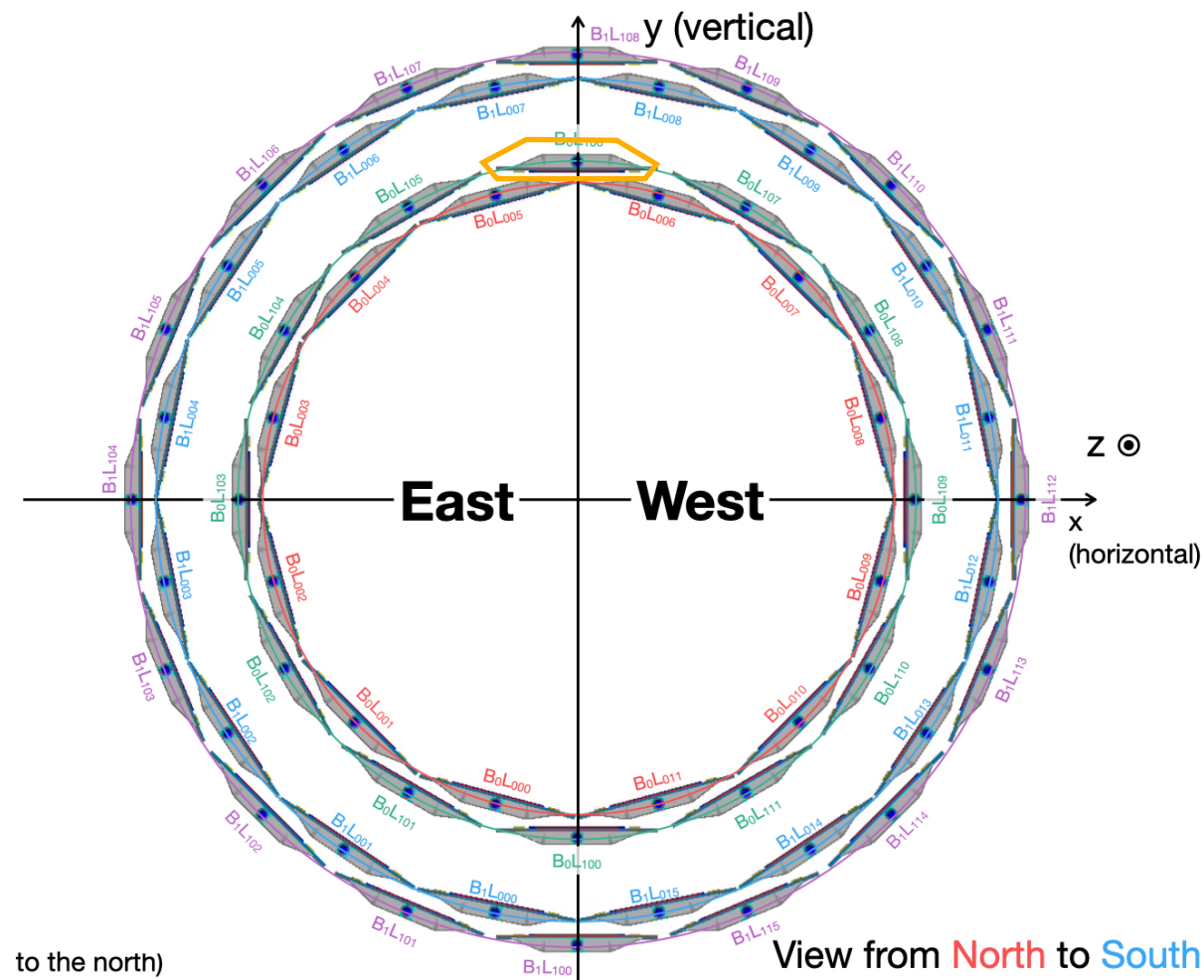
MC sanity check

- MC file : /sphenix/tg/tg01/bulk/dNdeta_INTT_run2023/data/simulation/ana.376/HIJING/fullSim/magOff/detectorAligned/dstSet_00000/dNdeta-sim-HIJING-000-[0000 → 151].root
- N event : 30400

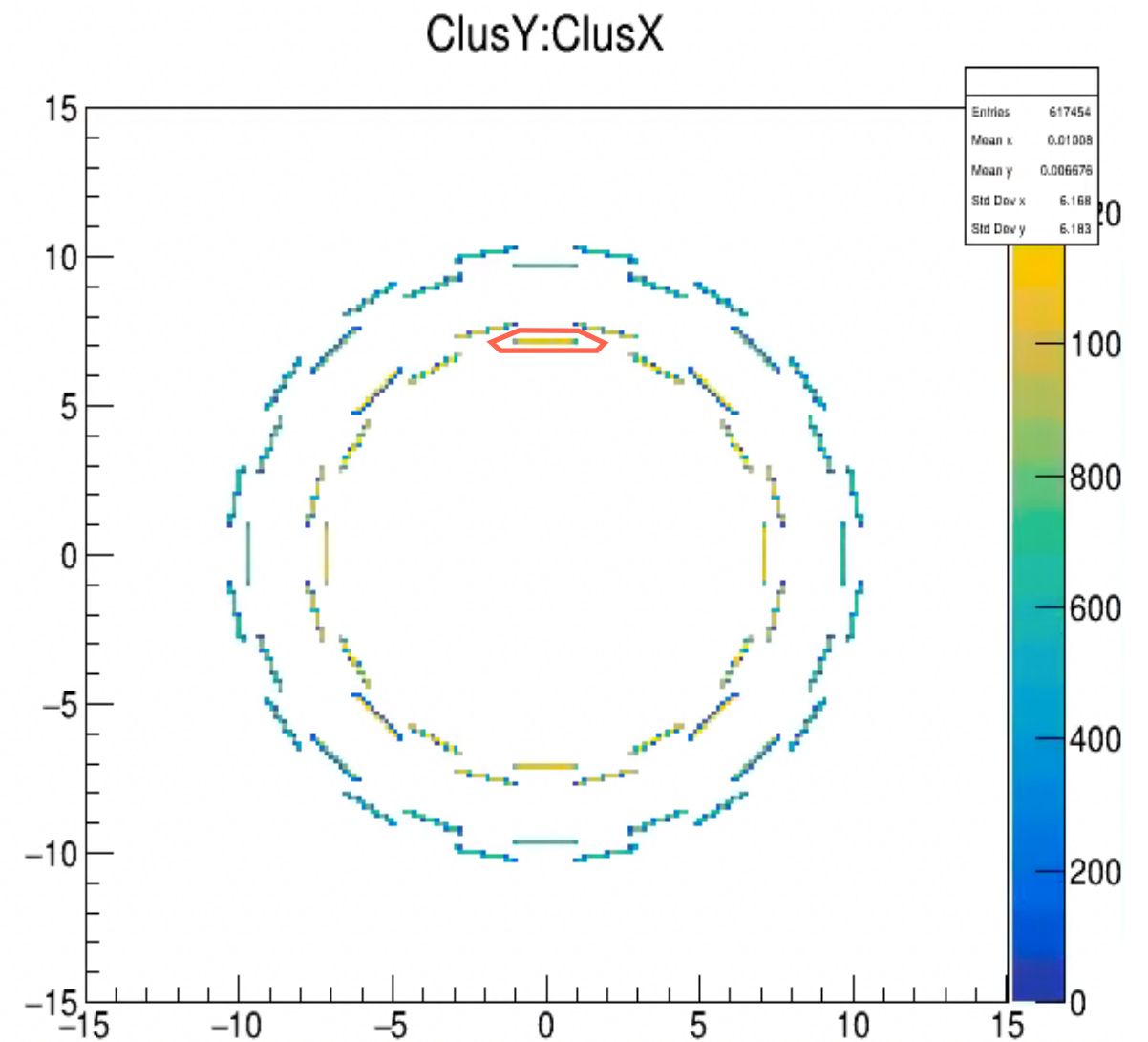


MC generated by Cameron, event info. extracted by Hao-Ren's module

Official INTT geometry



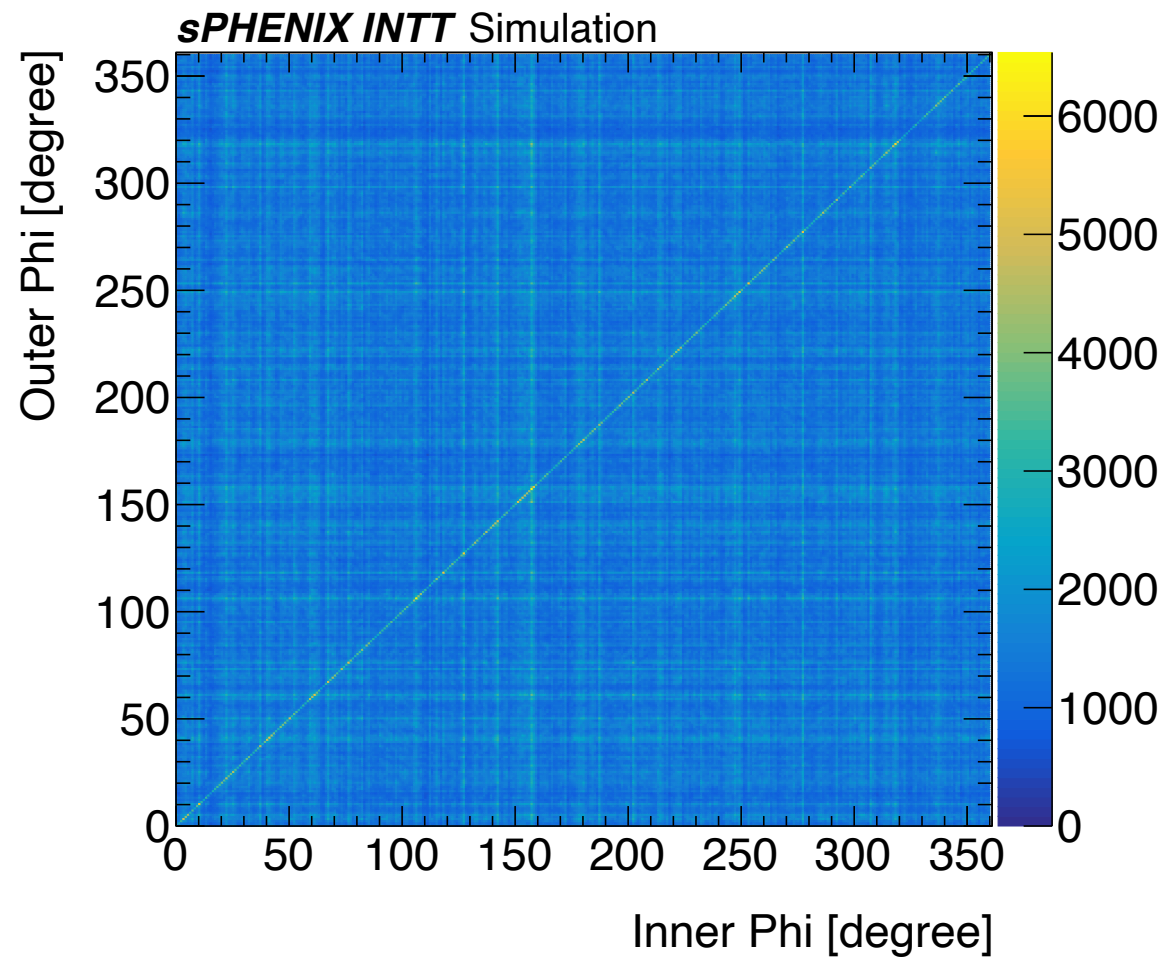
Current MC geometry



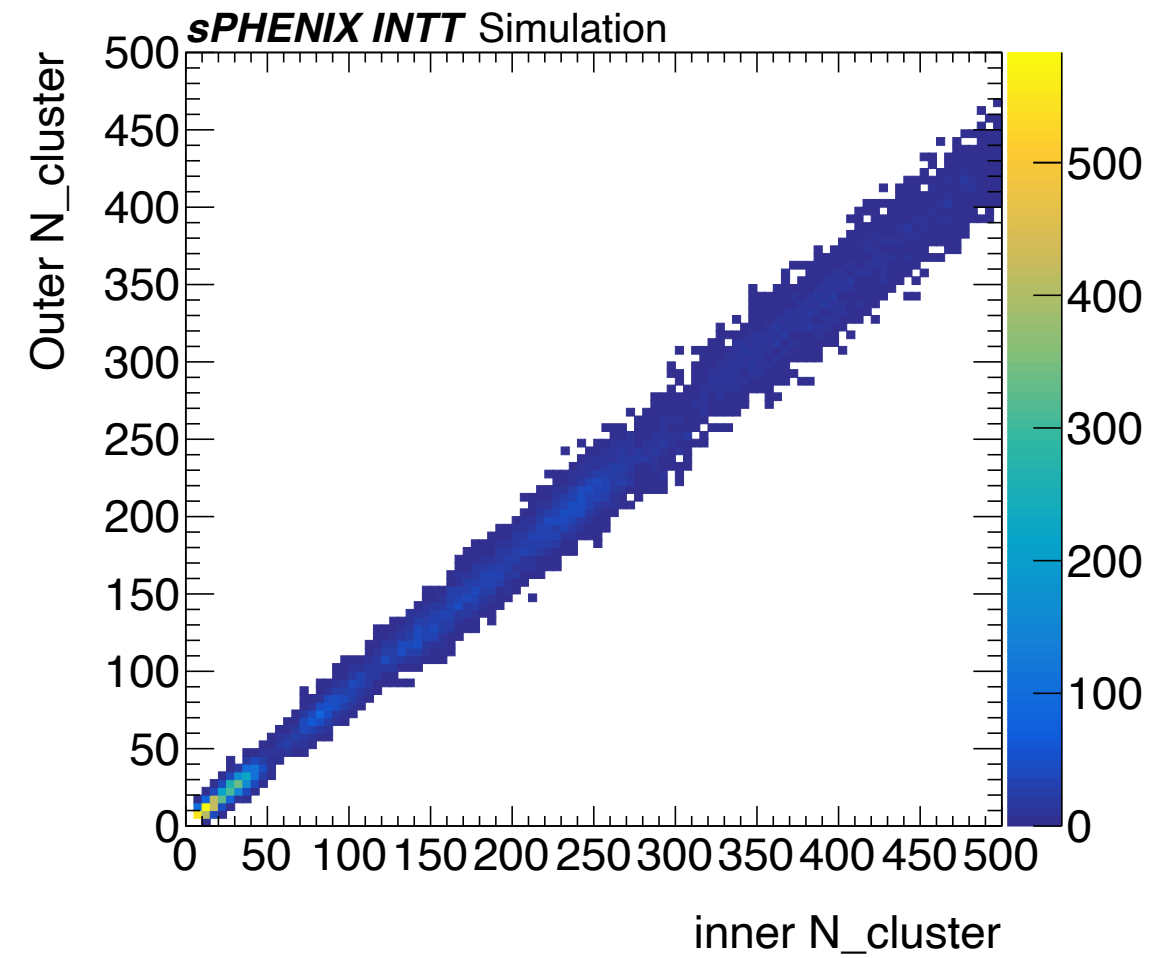
INTT geometry in G4 can be updated
(It was done in principle, maybe due to different versions)

MC generated by Cameron, event info. extracted by Hao-Ren's module

Cluster- ϕ correlation



N cluster correlation
(Inner & outer barrel)

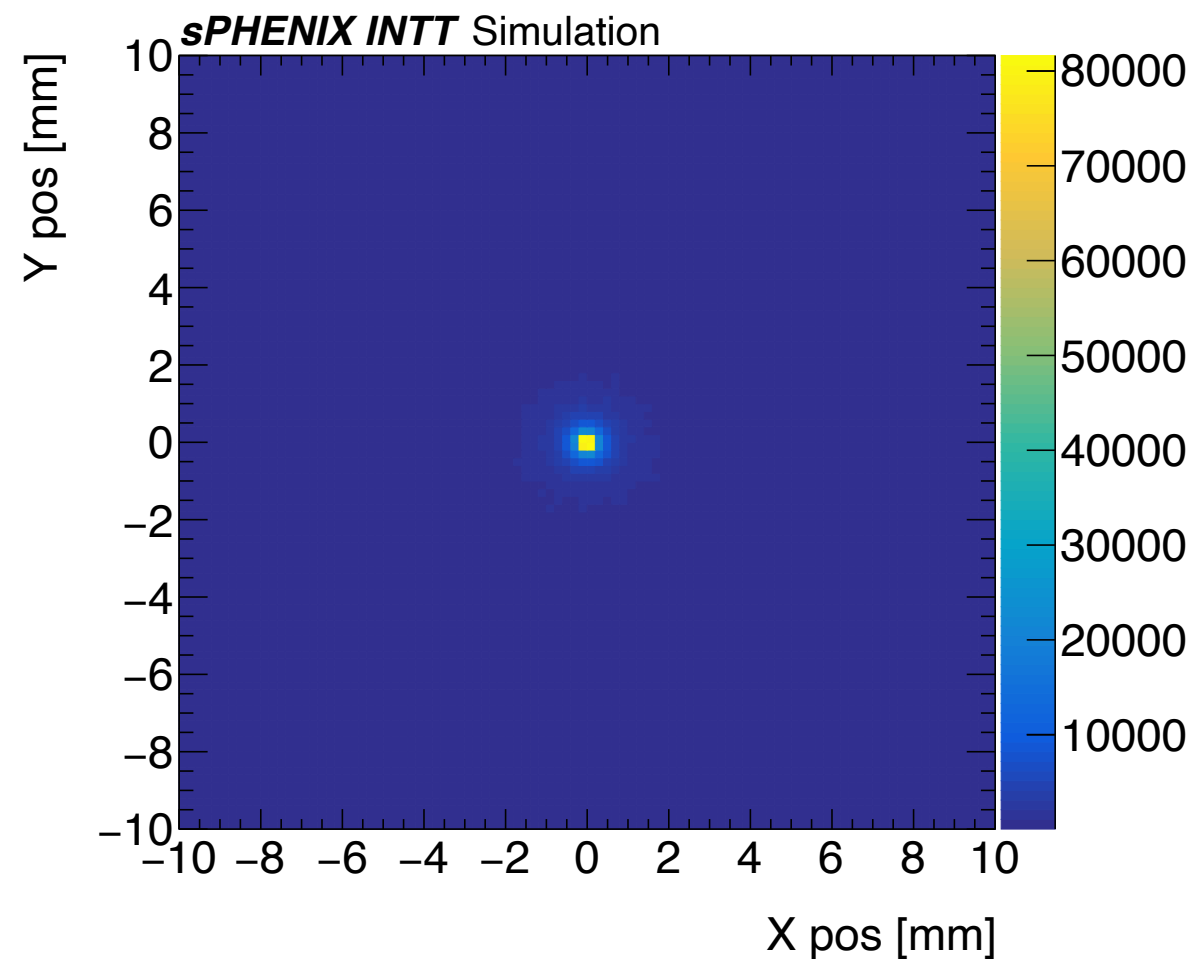
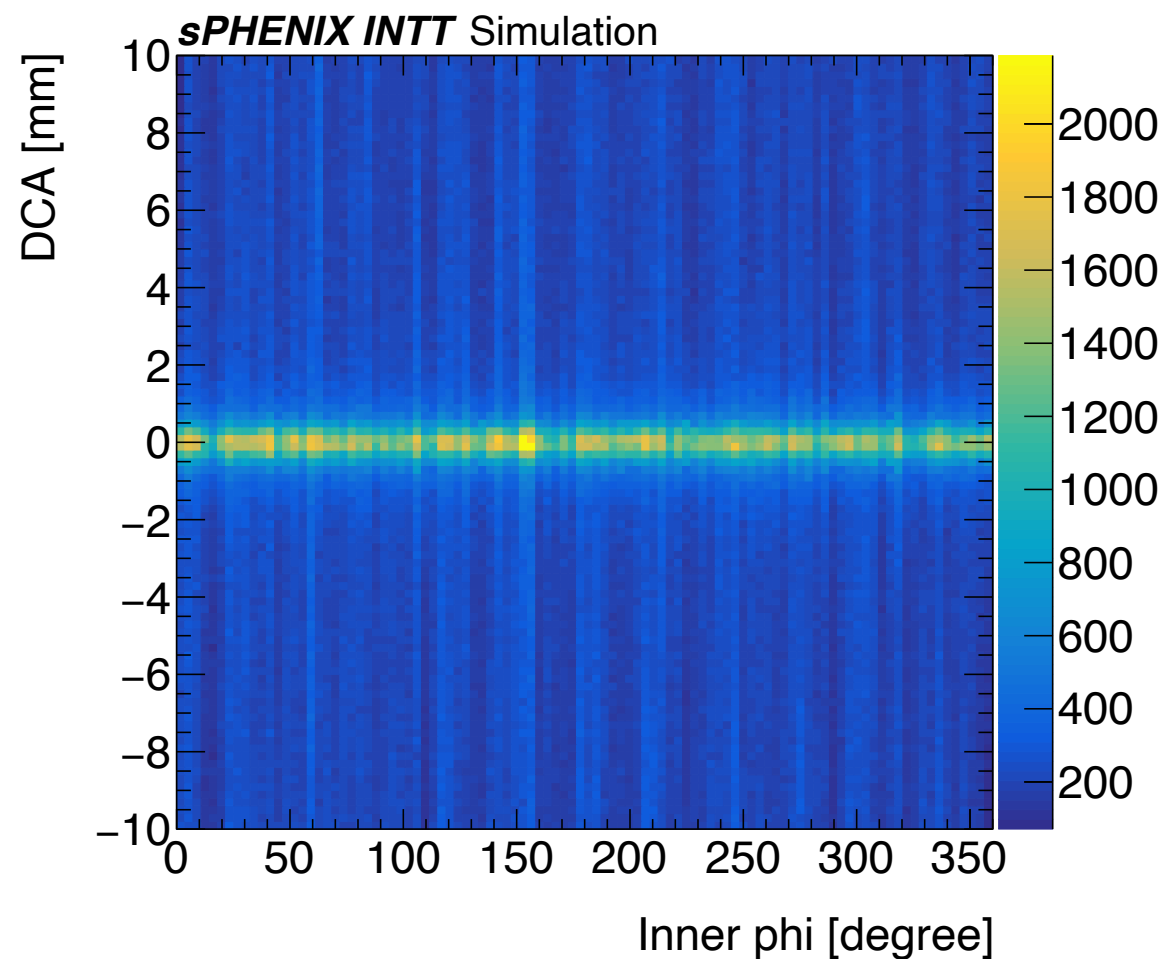


MC generated by Cameron, event info. extracted by Hao-Ren's module

VTX_{xy} determination - MC

Giving VTX_{xy} (0, 0)

Low multiplicity region used
 $20 < N_{clu} < 500$, Cluster size < 5 , $\Delta\phi < 5.72$
30.4k events



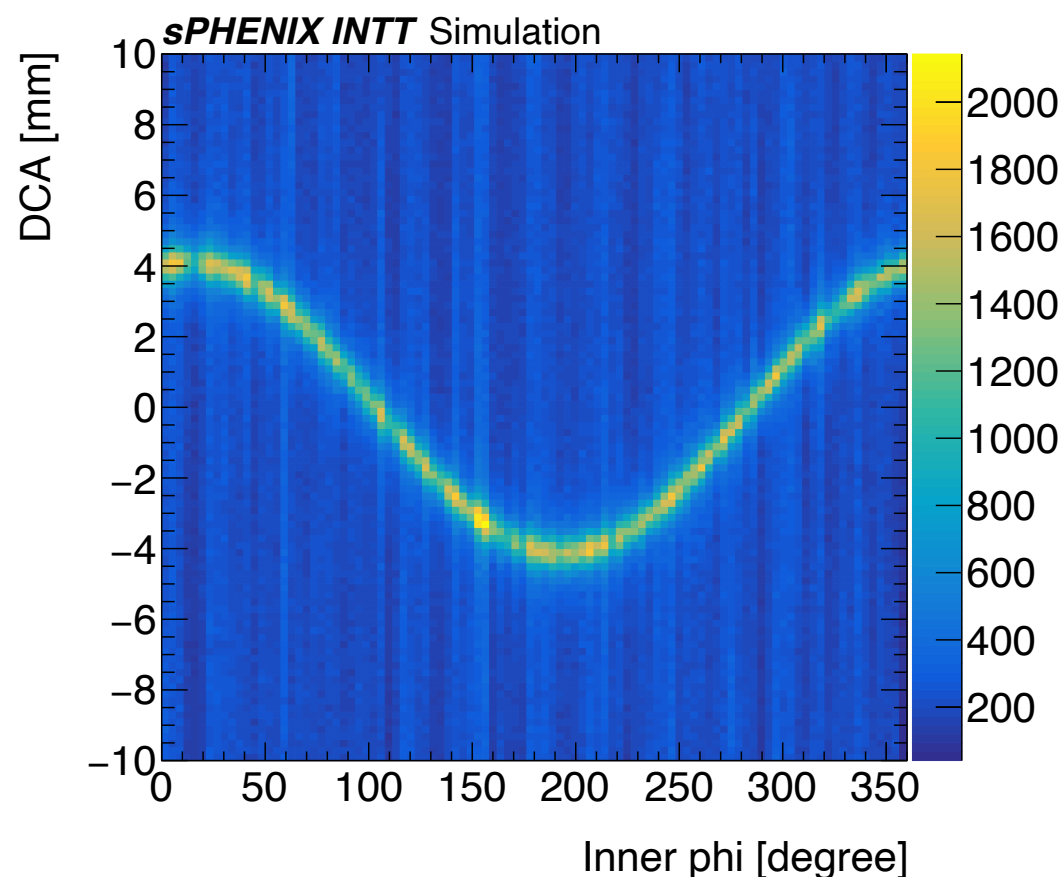
The correlation b/w DCA distance and Clu_ϕ is as flat as expected

VTX_{xy} method validation - MC

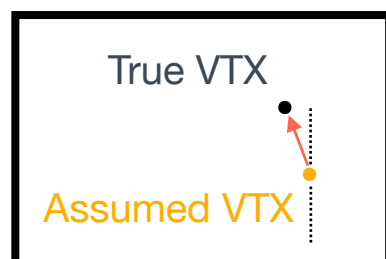
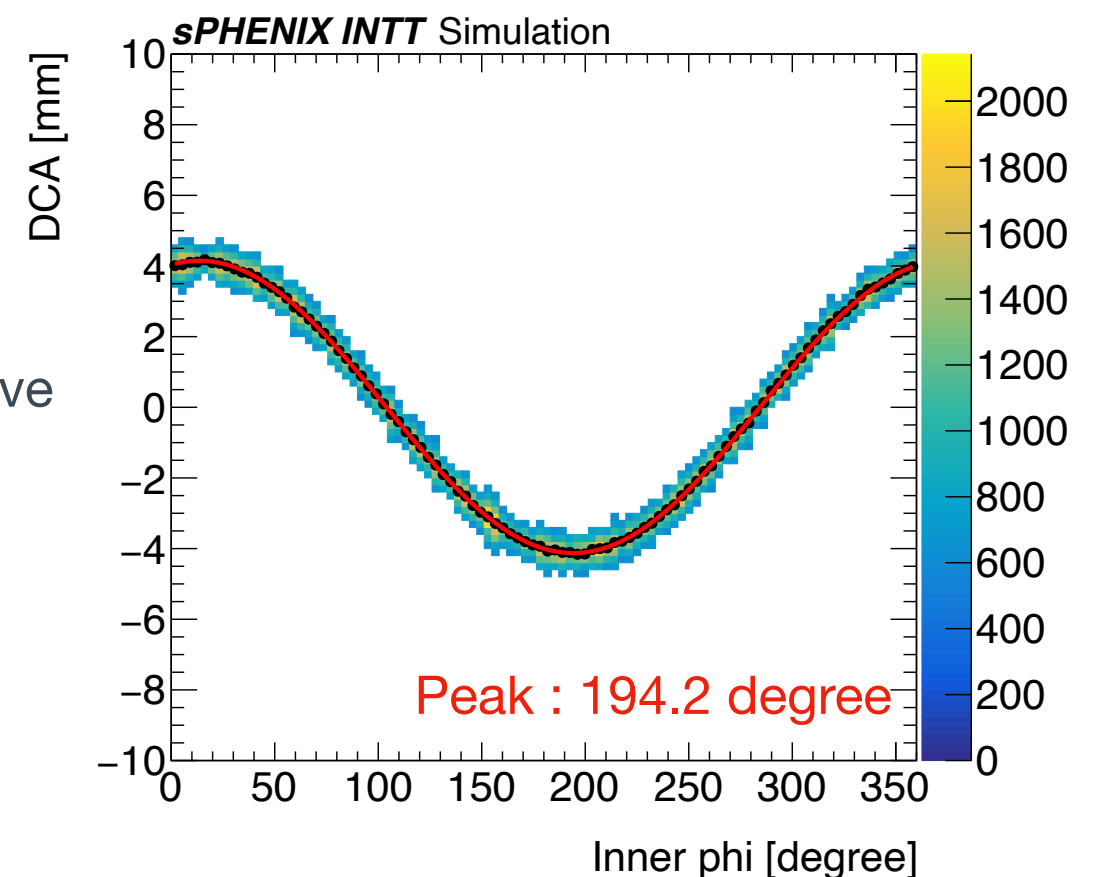
1. Assume VTX_{xy} (1, -4 mm)

Low multiplicity region used
 $20 < N_{clu} < 500$, Cluster size < 5 , $\Delta\phi < 5.72$
30.4k events

Fit function : $-A \cos[B(x + C)] + D$
Fit with TProfile (range 50 to 250 degree)



Background remove
(count > 600)



NO.	NAME	VALUE	ERROR	SIZE	DERIVATIVE
1	[A]	<u>4.13822e+00</u>	3.08526e-03	1.72728e-05	-9.31193e-01
2	[B]	<u>1.73888e-02</u>	1.21664e-05	4.89690e-08	1.44102e+02
3	[C]	<u>-1.94197e+02</u>	1.75910e-02	2.43306e-04	-3.81408e-02
4	[D]	<u>1.10743e-02</u>	3.48196e-03	1.22960e-05	1.34456e+00

The fit indicates how much the correction should be

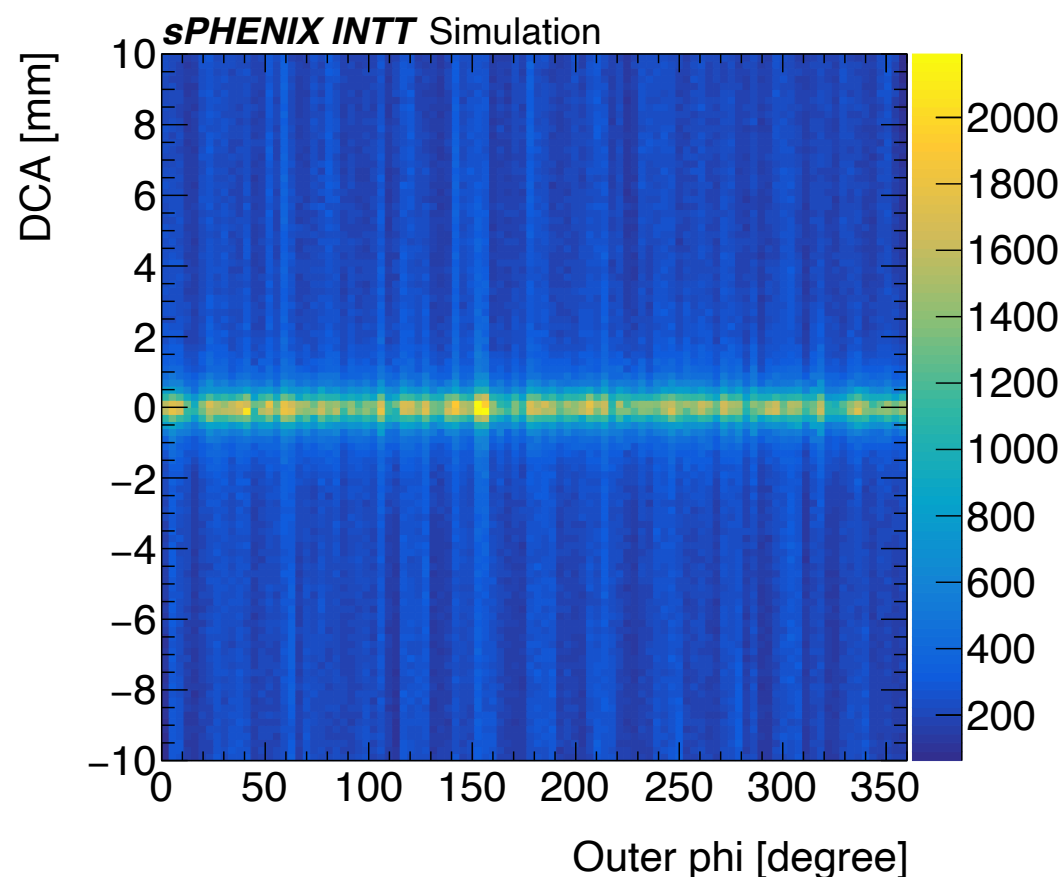
Correction : (-1.015 mm, 4.012 mm) → Current VTX_{xy} : (-0.015 mm, 0.012 mm)

VTX_{xy} method validation - MC

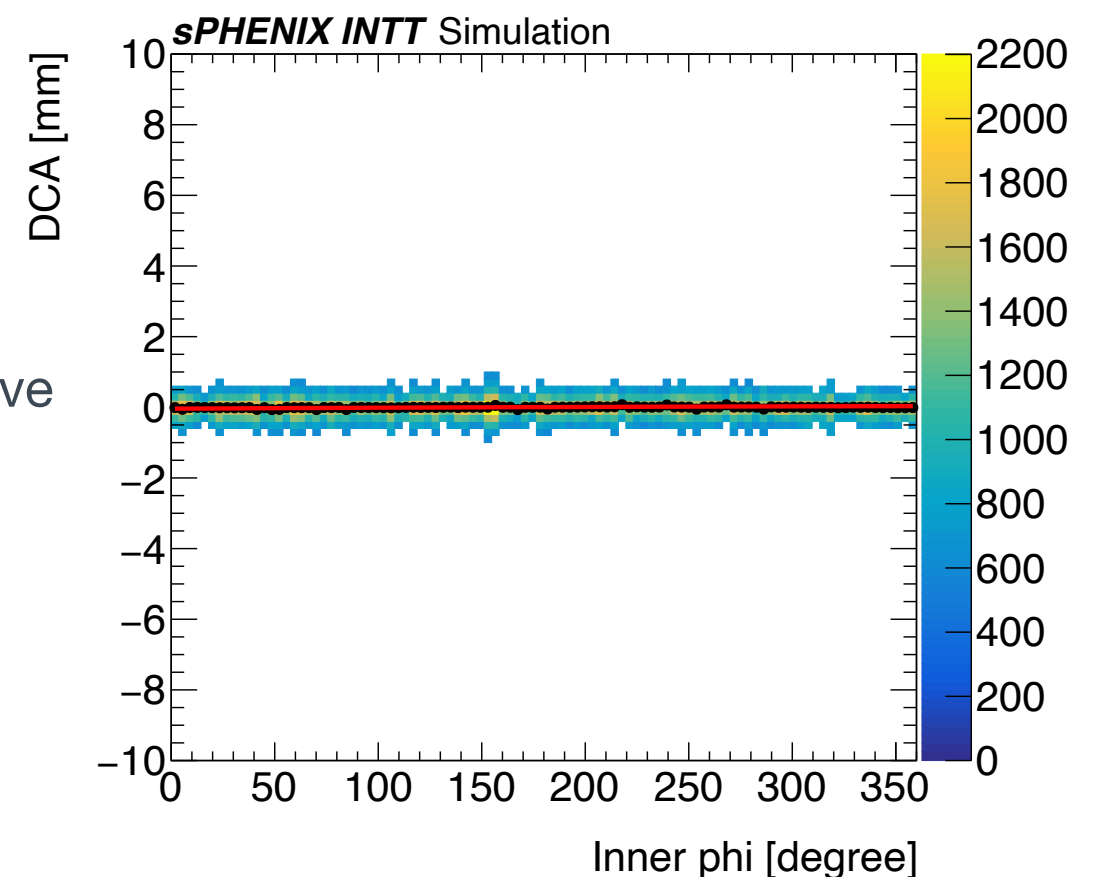
2. Assume VTX_{xy} (-0.015 mm, 0.012 mm)

Low multiplicity region used
 $20 < N_{clu} < 500$, Cluster size < 5 , $\Delta\phi < 5.72$
30.4k events

Fit function : $-A \cos[B(x + C)] + D$
Fit with TProfile (range 50 to 250 degree)



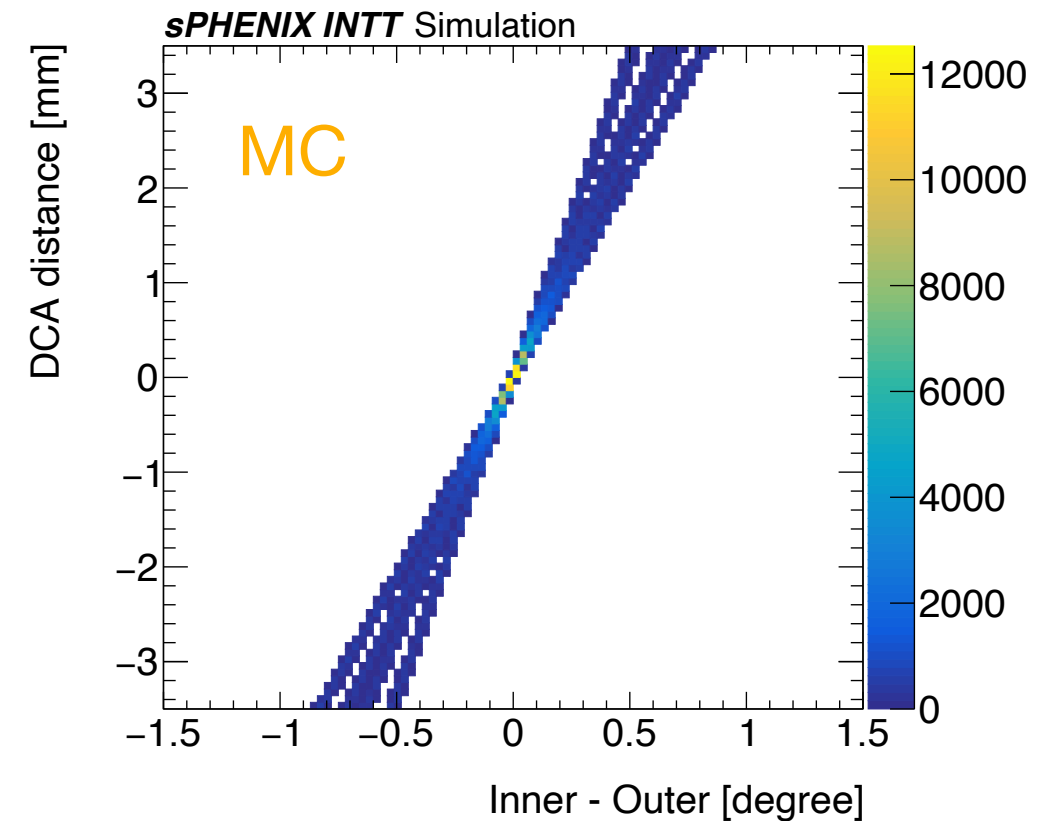
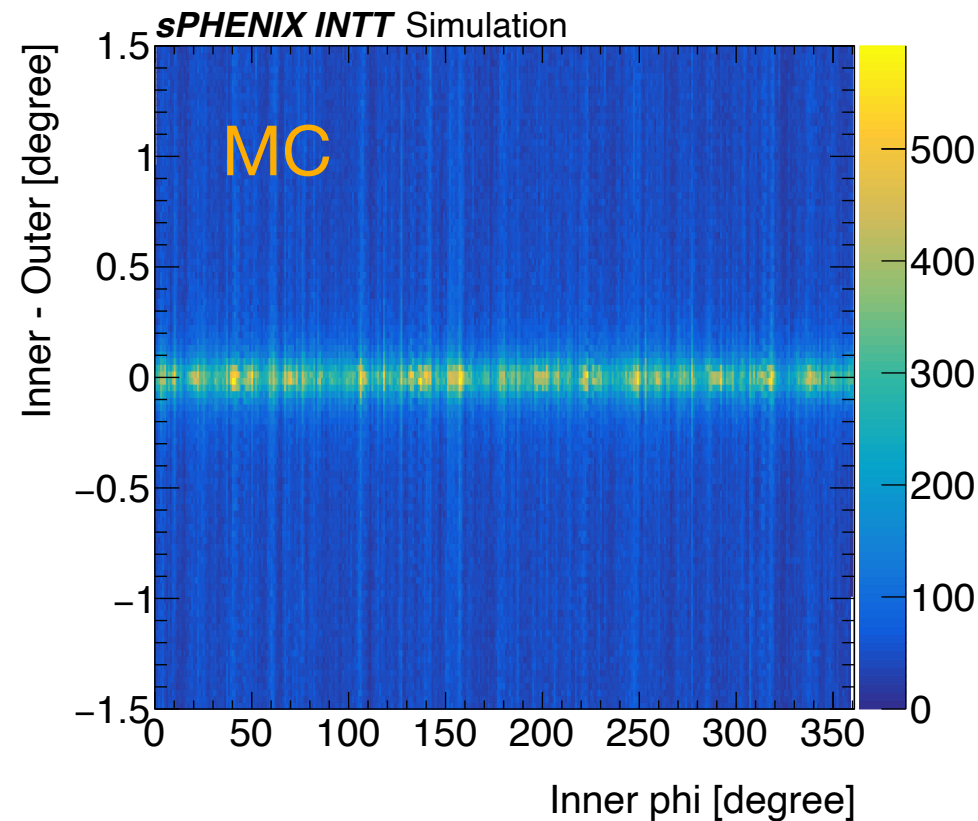
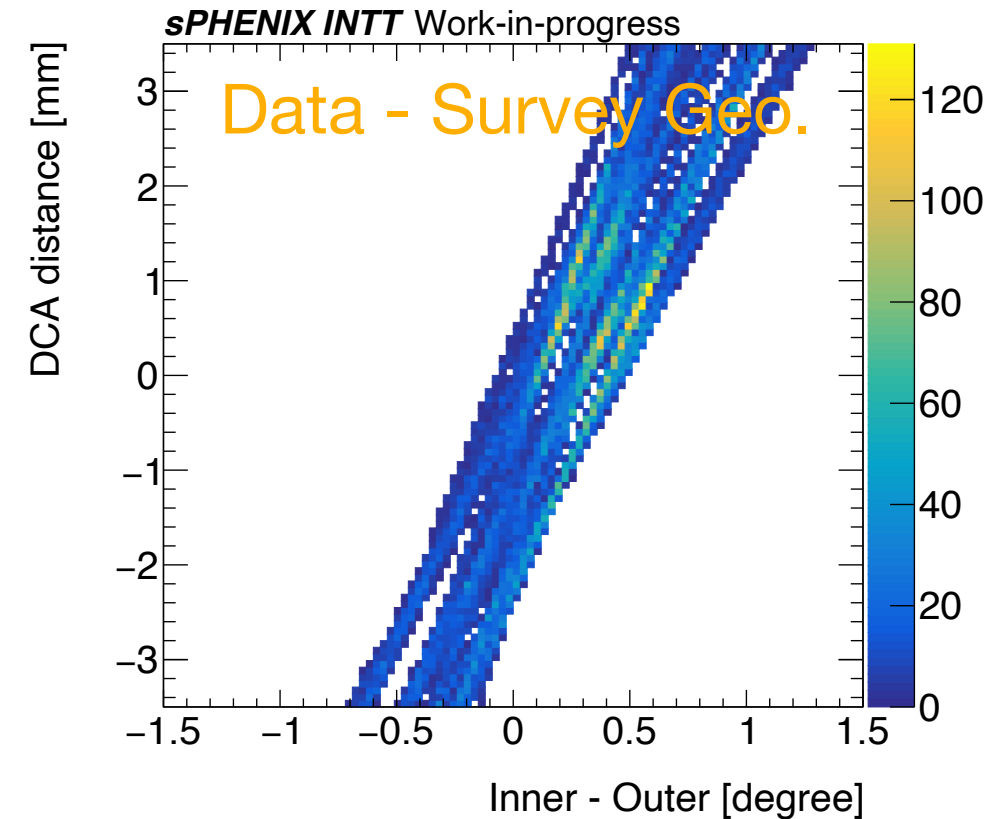
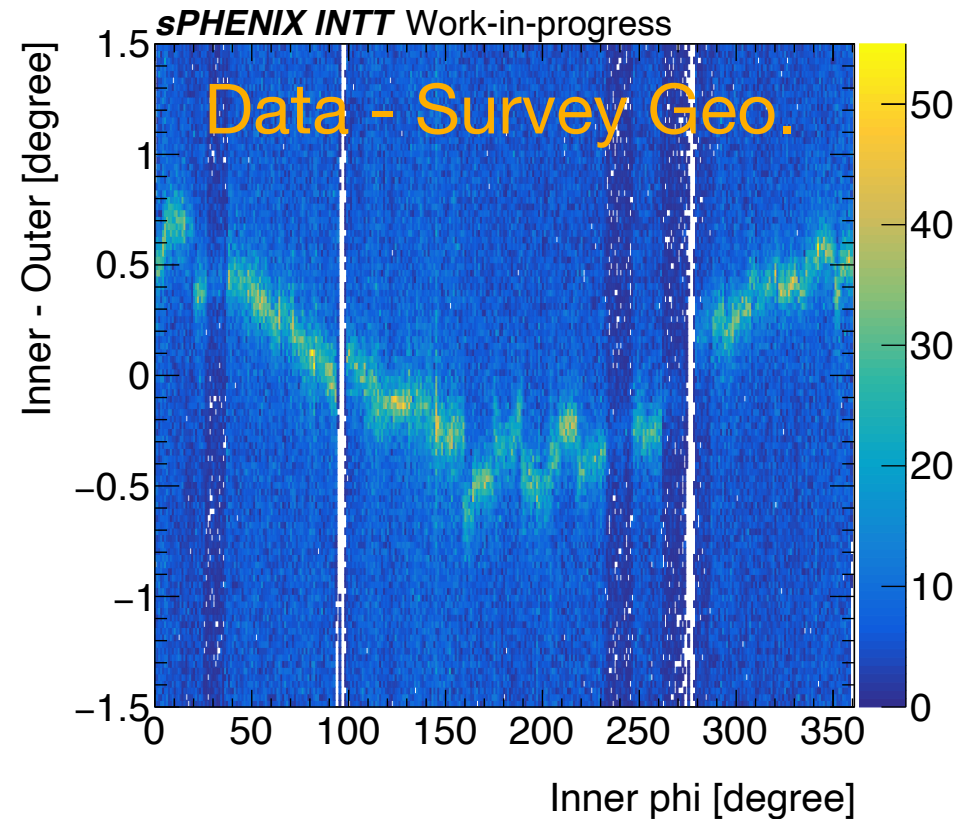
Background remove
(count > 600)



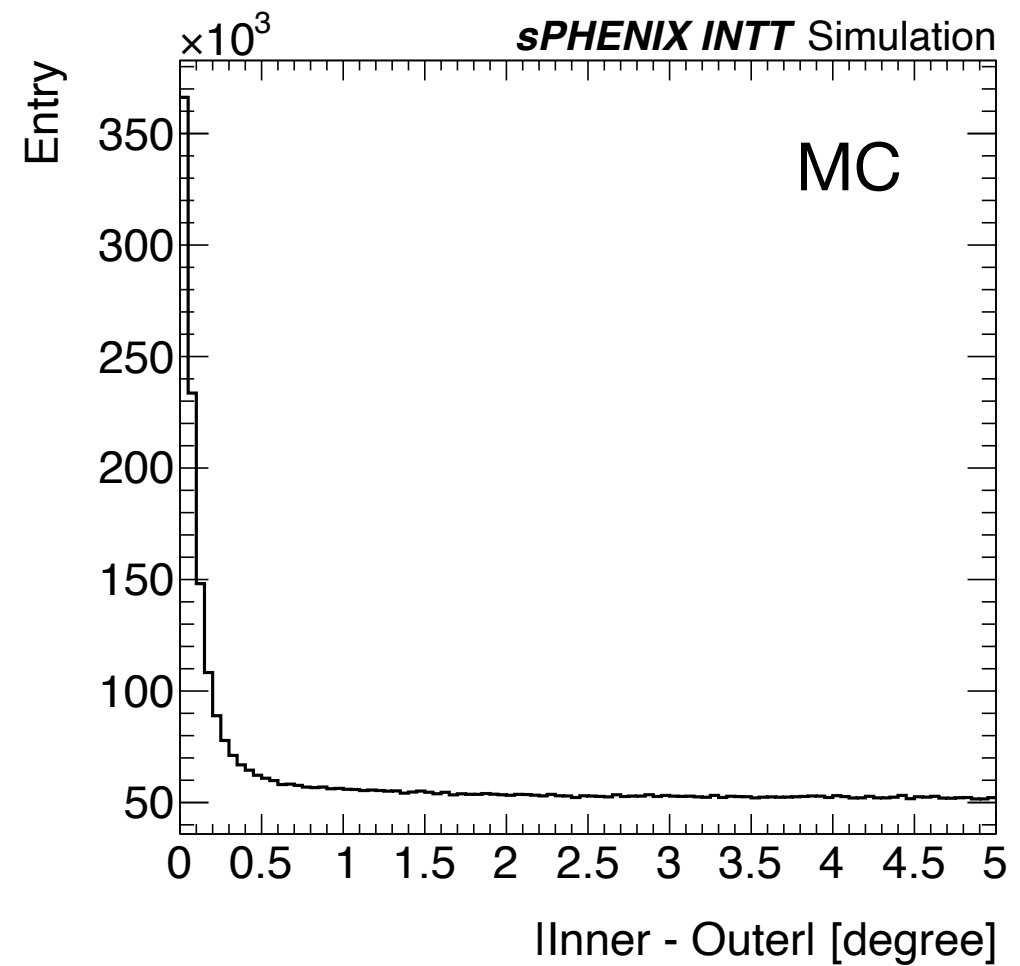
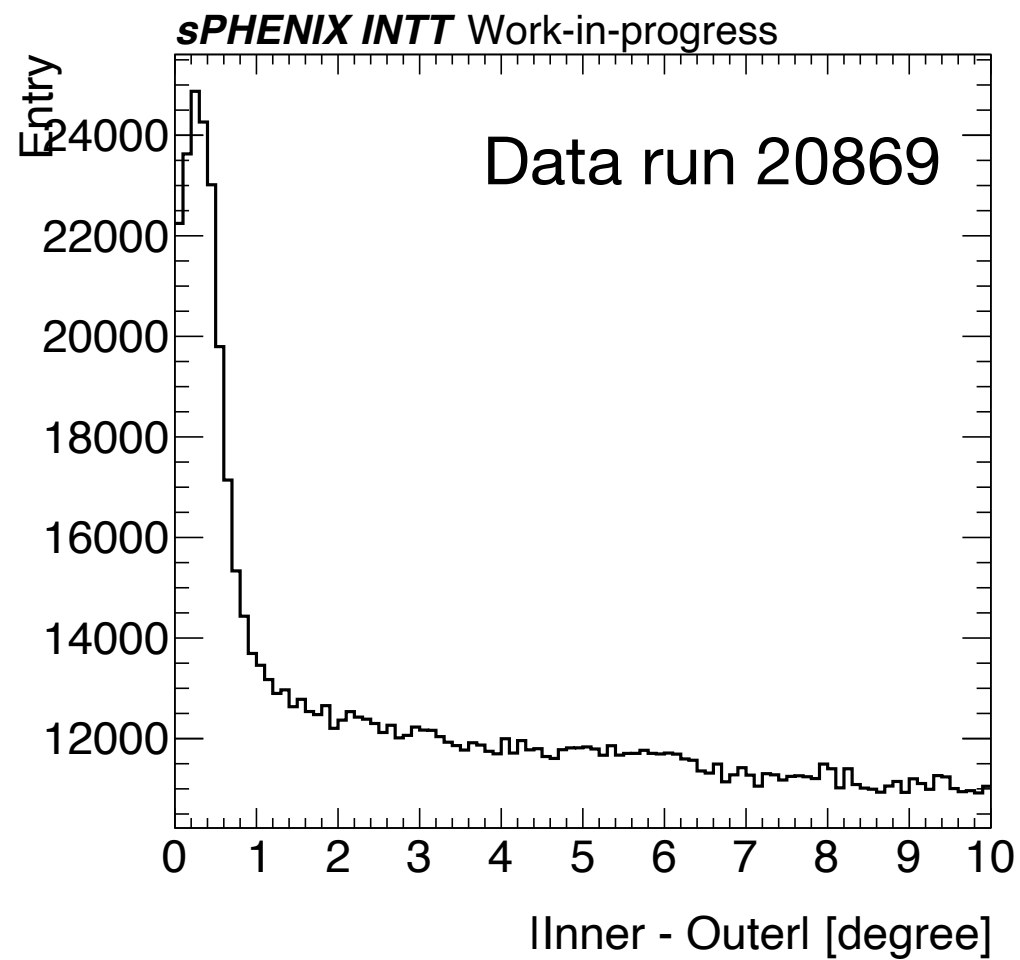
NO.	NAME	VALUE	ERROR	SIZE	DERIVATIVE
1	[A]	-2.77510e-01	1.12456e-01	-1.05715e-02	-4.07666e+01
2	[B]	1.47797e-03	4.53455e-04	-4.49408e-05	-5.40136e+03
3	[C]	-5.28379e+02	1.00195e+02	-6.53307e+00	1.65291e-02
4	[D]	-2.35934e-01	1.08616e-01	-9.99620e-03	5.66810e+01

The current VTX finding method works

Geometry check

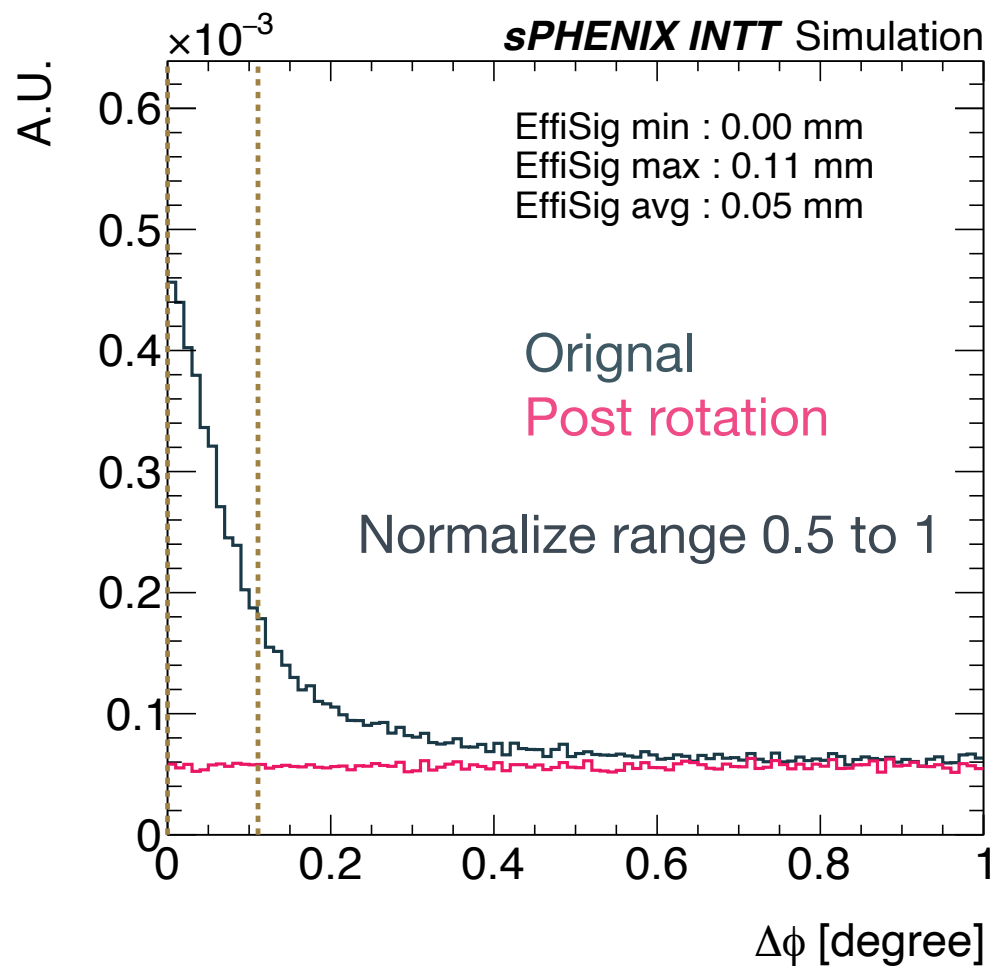
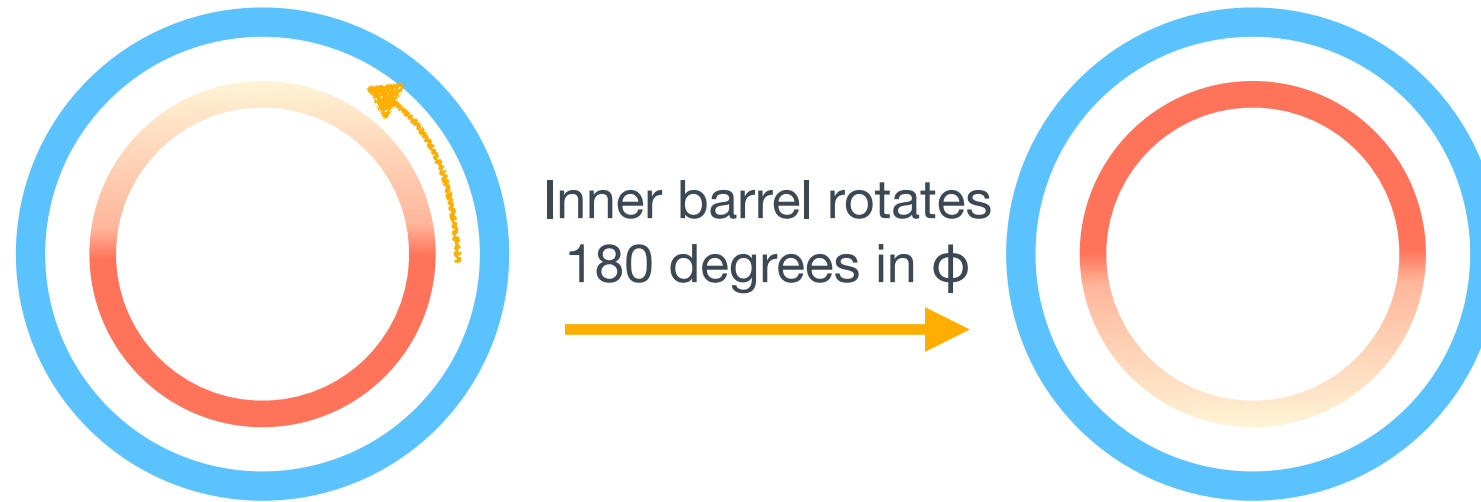


MC provides the ideals how should those correlations be if the geometry is perfectly correct



MC provides the ideals how should those correlations be if the geometry is perfectly correct

180 degree rotation of inner-layer clusters around the beam axis (angle ϕ)



PHOBOS, PhysRevC.83.024913

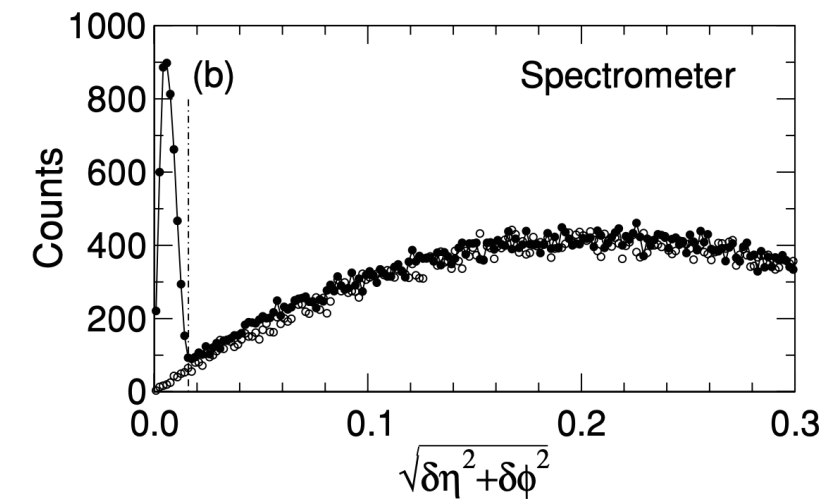


FIG. 8. Illustration of the combinatorial background subtraction for non-vertex tracks for (a) Vertex detector and (b) Spectrometer tracklet analysis. The solid points represent the actual detector geometry, whereas the open points were obtained after a 180° rotation of one of the detector layers around the beam axis in order to estimate the combinatorial background in the acceptance region represented by vertical dash-dotted lines.

The angle-difference distribution post inner-barrel rotation has no peak, as expected

VTX_z method validation - MC

Assume VTX_{xy} (-0.015 mm, 0.012 mm)

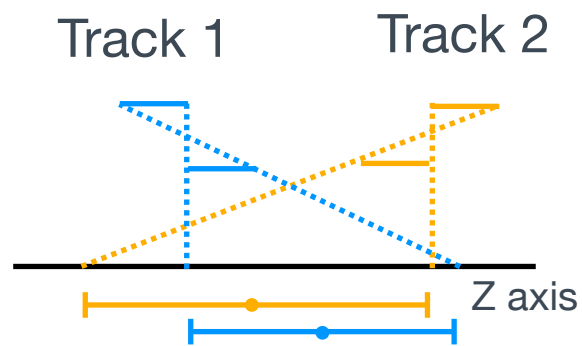
20k events

NTrueVTX = 1, Nclu > 20, Cluster size < 5, $\Delta\phi < 0.11$, $|DCA| < 0.5$ mm

All the combinations were considered (one cluster can be involved in several tracklets)

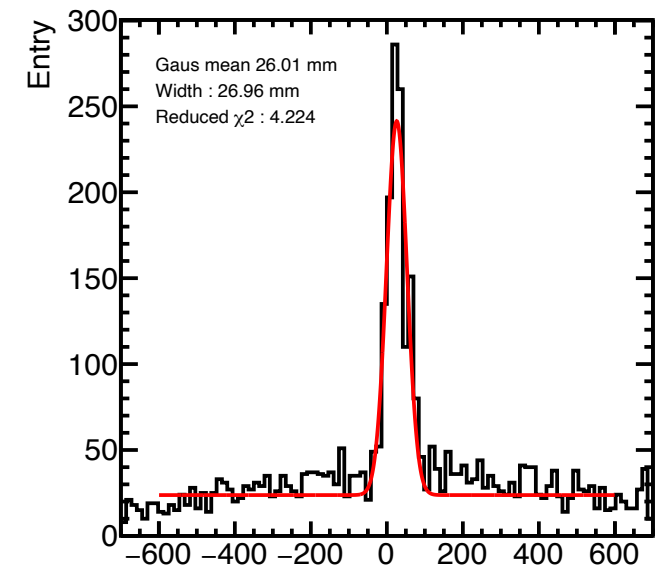
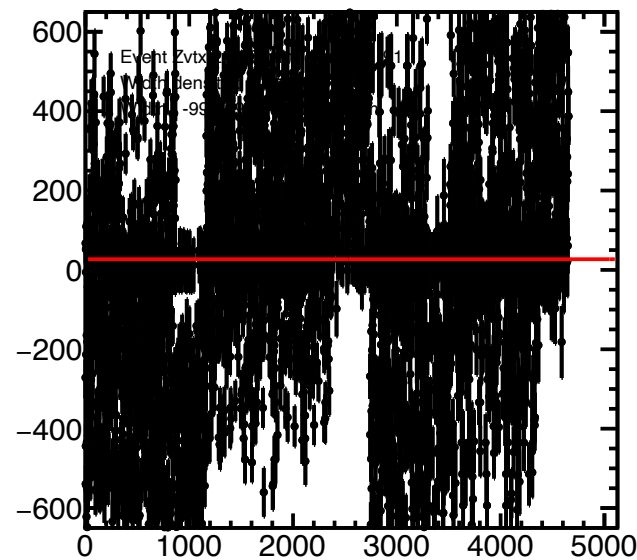
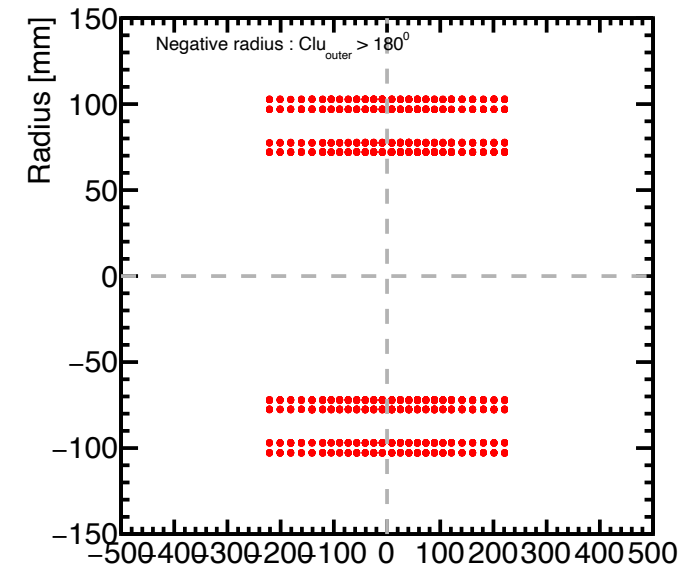
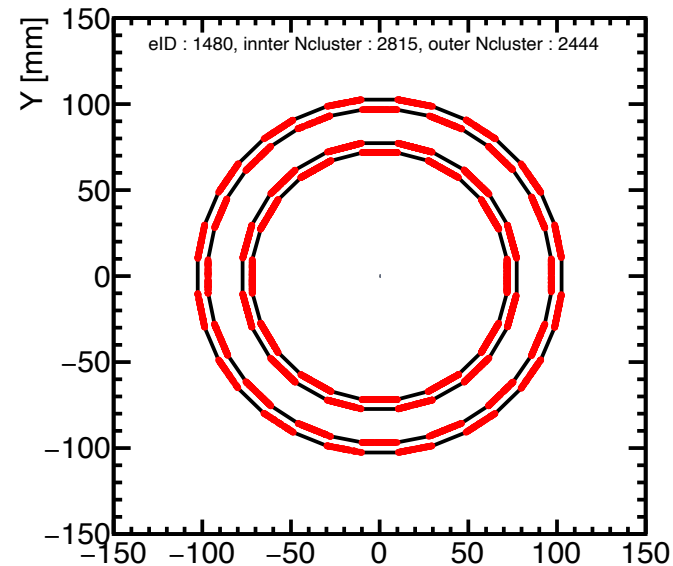
NClus : 5259

Zvtx range is calculated for tracklet passes the selections



Possible zvtx ranges provide constraints

Mean of the range is filled into histogram



The histogram method with a Gaussian fitting can strongly suppress the background for high NClus region

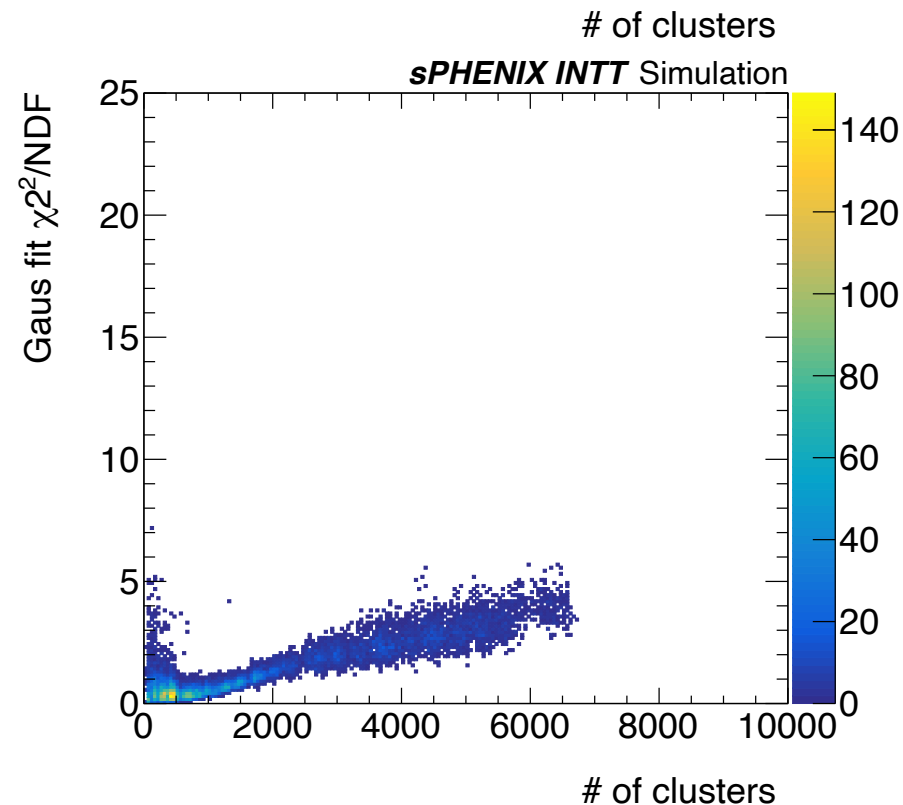
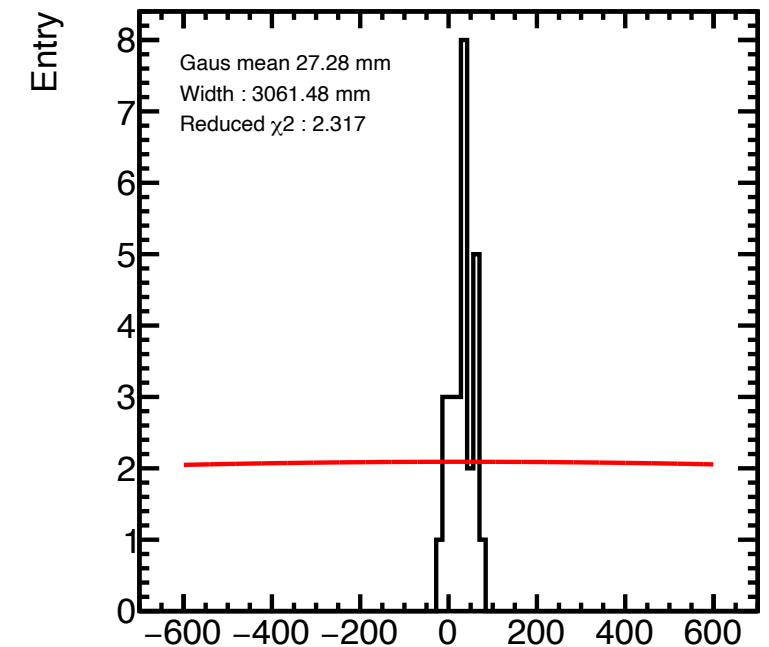
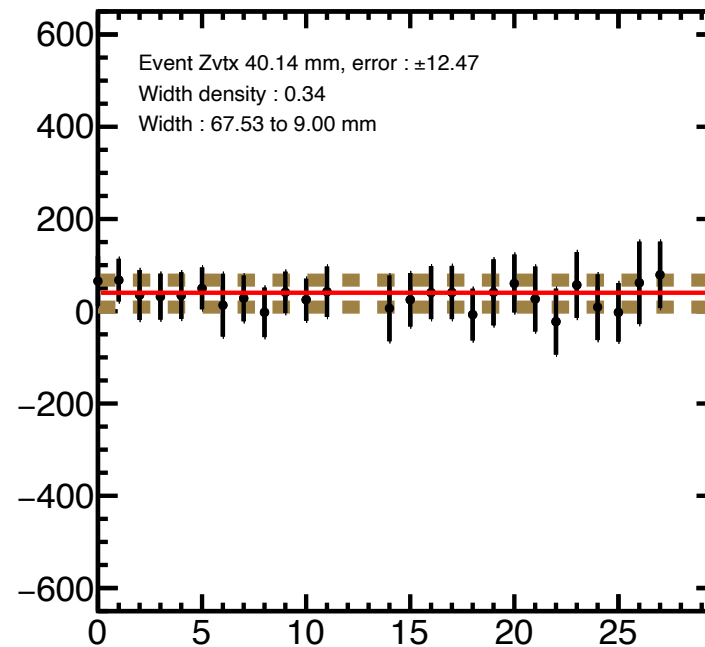
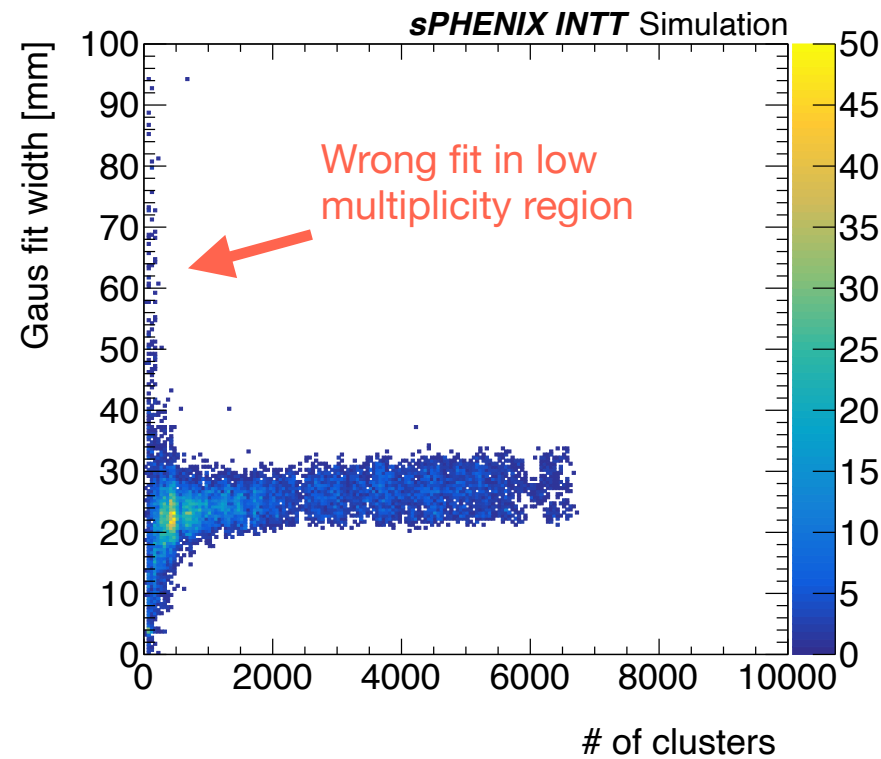
VTX_z method validation - MC

Assume VTX_{xy} (-0.015 mm, 0.012 mm)

20k events

NTrueVTX = 1, Nclu > 20, Cluster size < 5, $\Delta\phi < 0.11$, $|DCA| < 0.5$ mm

All the combinations were considered (one cluster can be involved in several tracklets)



For the fit range finder

- If NClus < 1000 :
 - Try both methods, the one with smaller range is taken
- else :
 - Only use the Gaussian fitting
- Do the pol0 fitting with error bars after range found

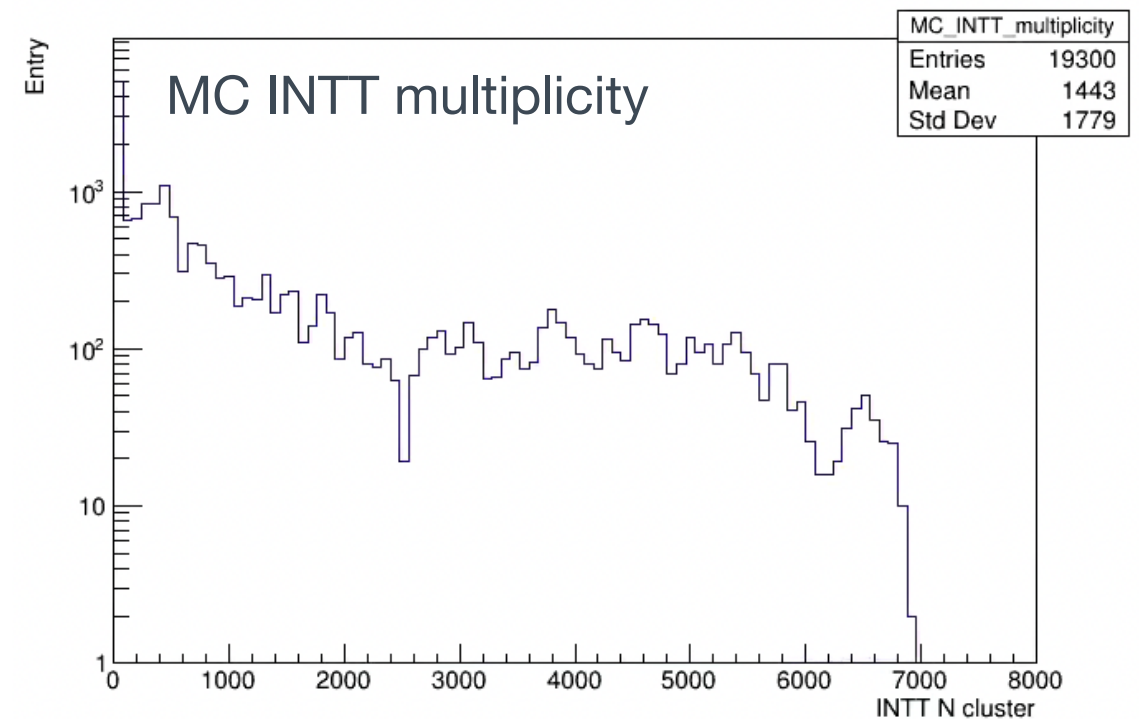
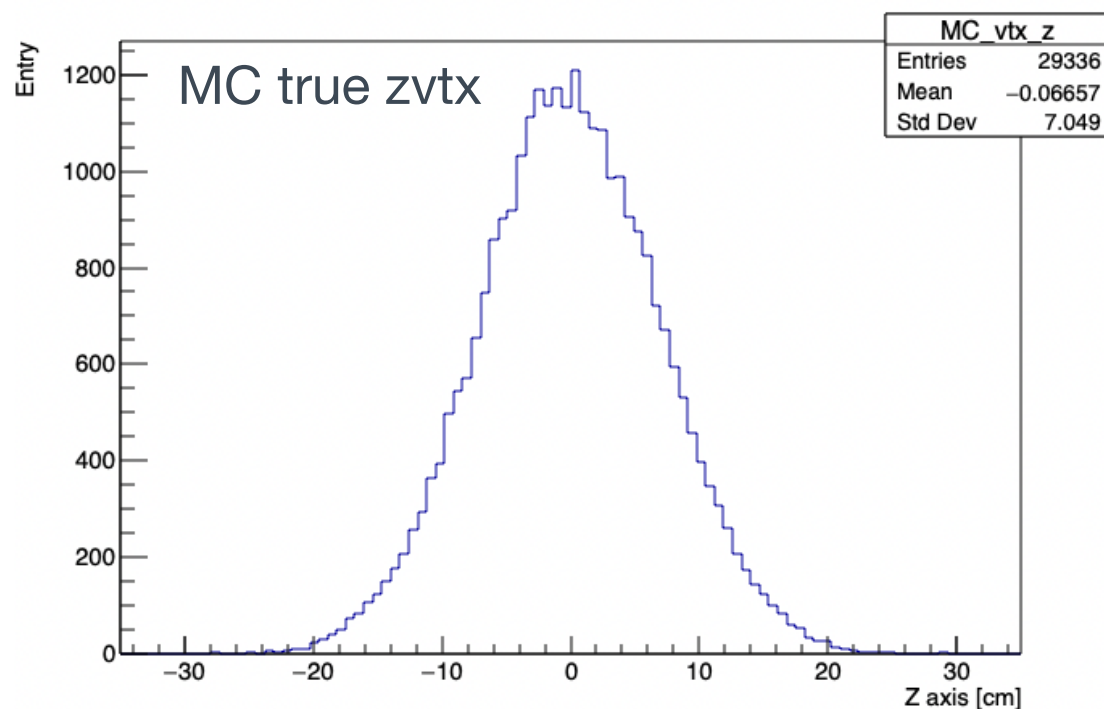
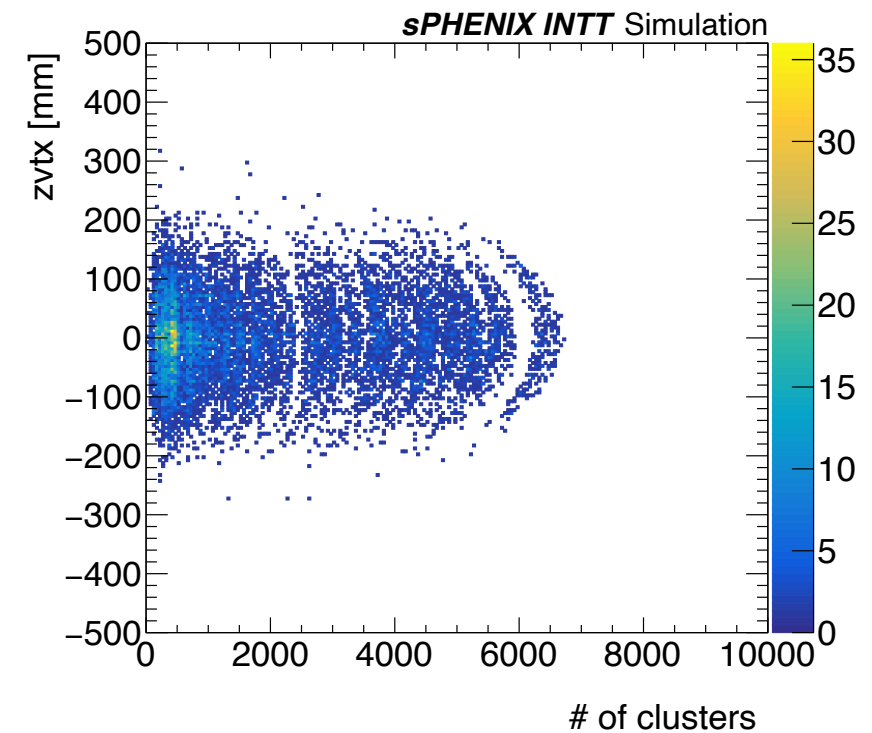
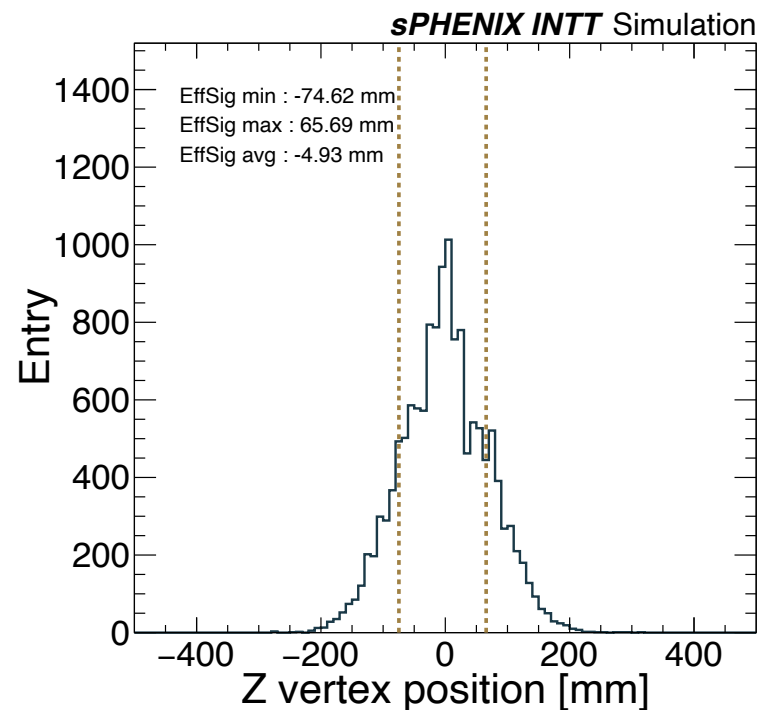
VTX_z method validation - MC

Assume VTX_{xy} (-0.015 mm, 0.012 mm)

20k events

NTrueVTX = 1, Nclu > 20, Cluster size < 5, $\Delta\phi < 0.11$, $|DCA| < 0.5$ mm

All the combinations were considered (one cluster can be involved in several tracklets)

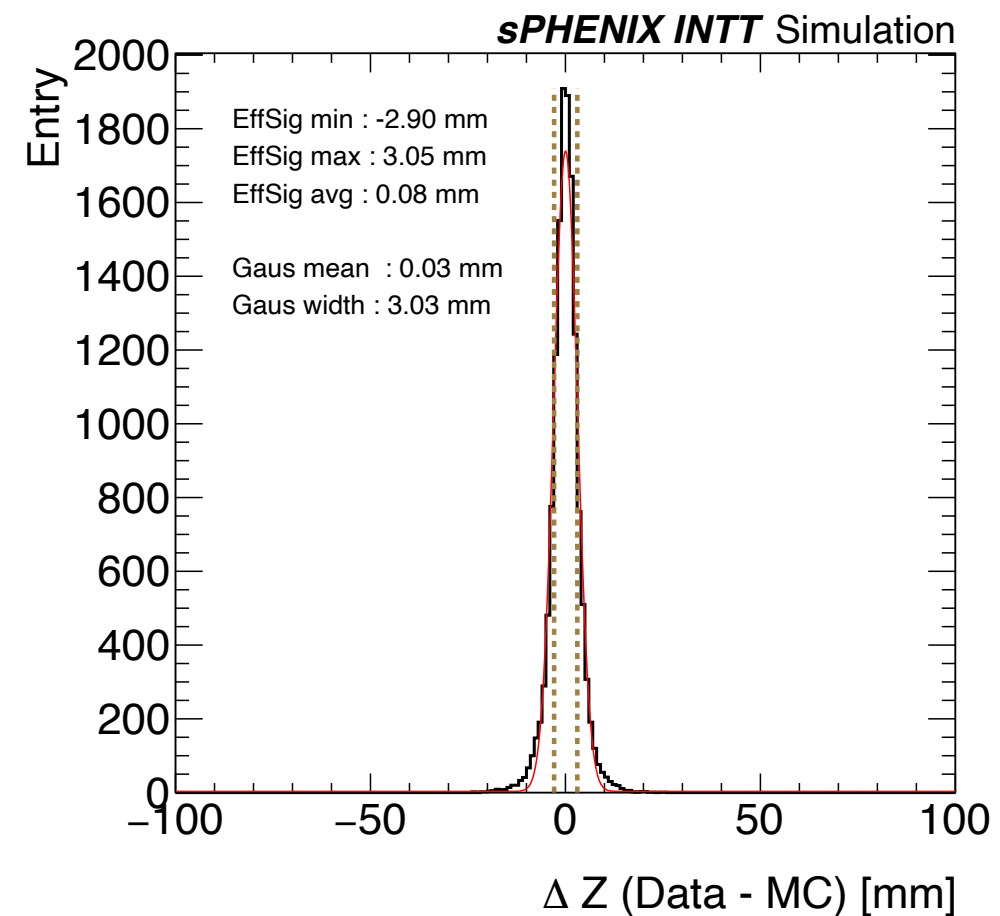
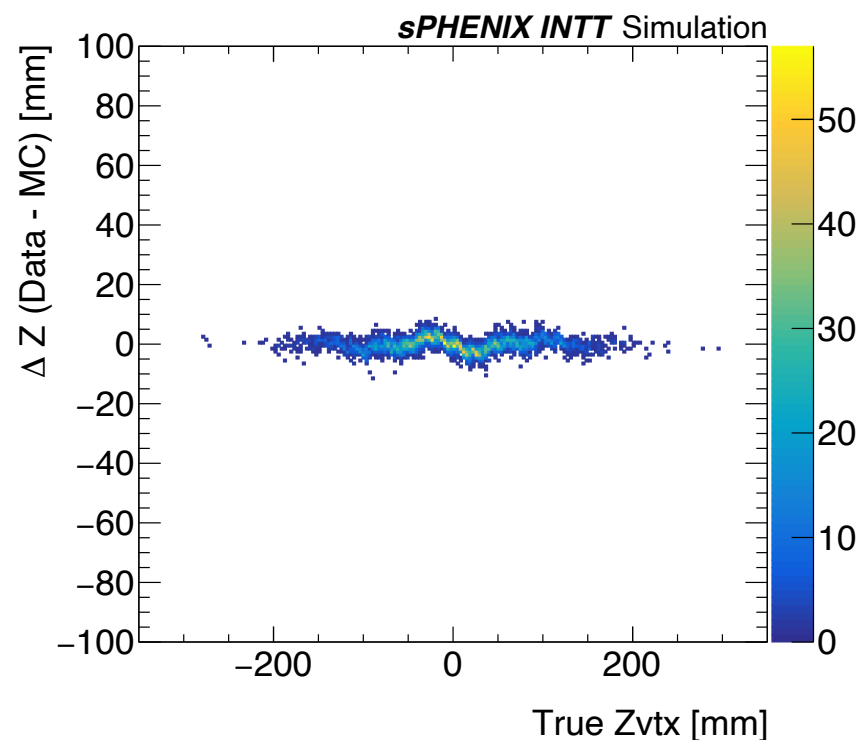
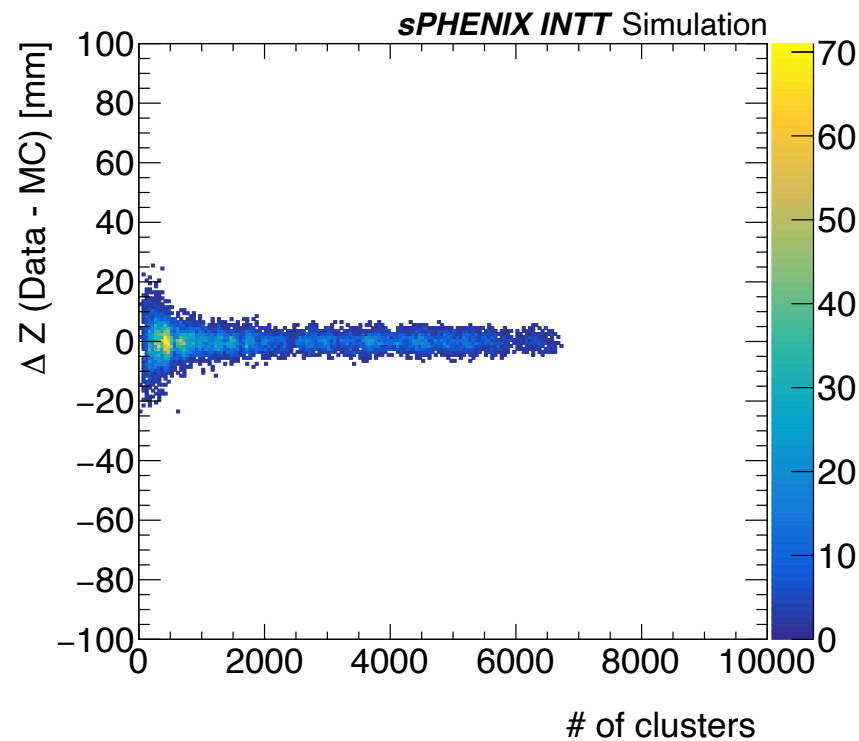


Assume VTX_{xy} (-0.015 mm, 0.012 mm)

20k events

NTrueVTX = 1, Nclu > 20, Cluster size < 5, $\Delta\phi < 0.11$, $|DCA| < 0.5$ mm

All the combinations were considered (one cluster can be involved in several tracklets)



Gaus width : 3.03 mm
EffSig width : 2.975 mm

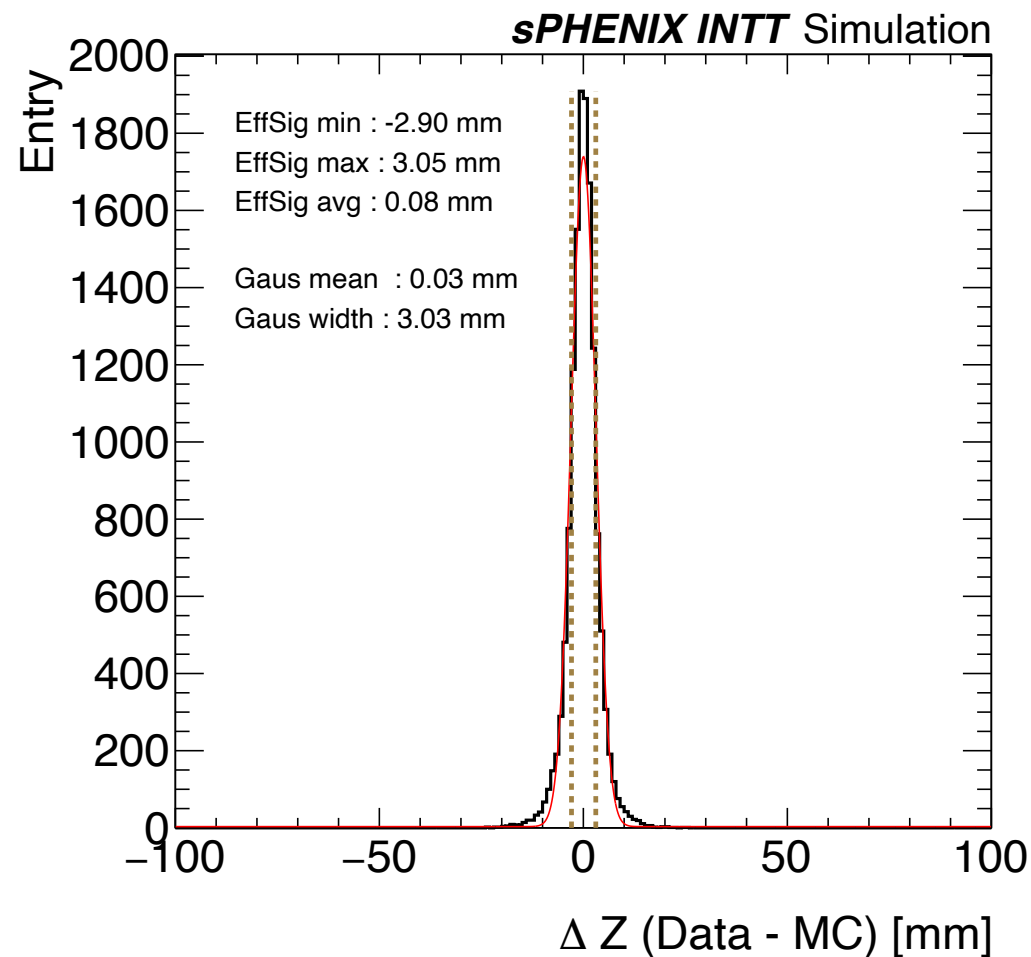
So far the best resolution achieved with INTT

Assume VTX_{xy} (-0.015 mm, 0.012 mm)

20k events

NTrueVTX = 1, Nclu > 20, Cluster size < 5, $\Delta\phi < 0.11$, |DCA| < 0.5 mm

All the combinations were considered (one cluster can be involved in several tracklets)



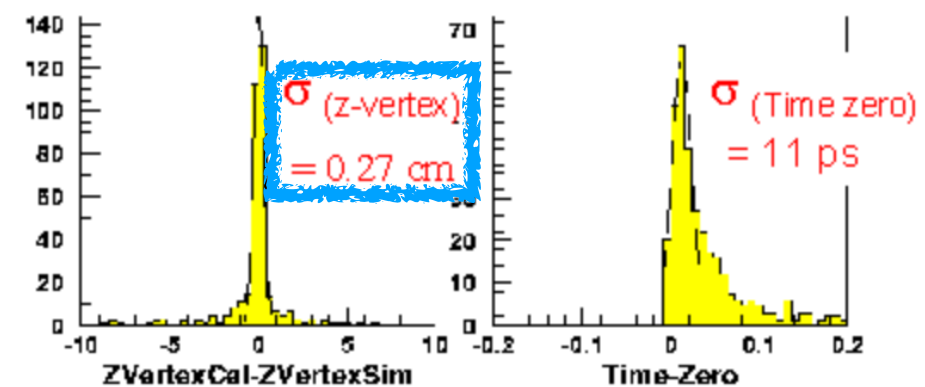
Gaus width : 3.03 mm
EffSig width : 2.975 mm

PHENIX BBC
Feb/26/98 Computing meeting
Hiroaki Ohnishi

Z-vertex resolution and Time-zero

- Data used → hji_119auminbsq04_051697.dat
hji_129auminbsq02_051697.dat
hji_164auminbsq01_051697.dat
(analyzed 412 minimum bias Au+Au HIJING event.)

- Average over all TDC value was used.



We might not need to rely on MBD z ?

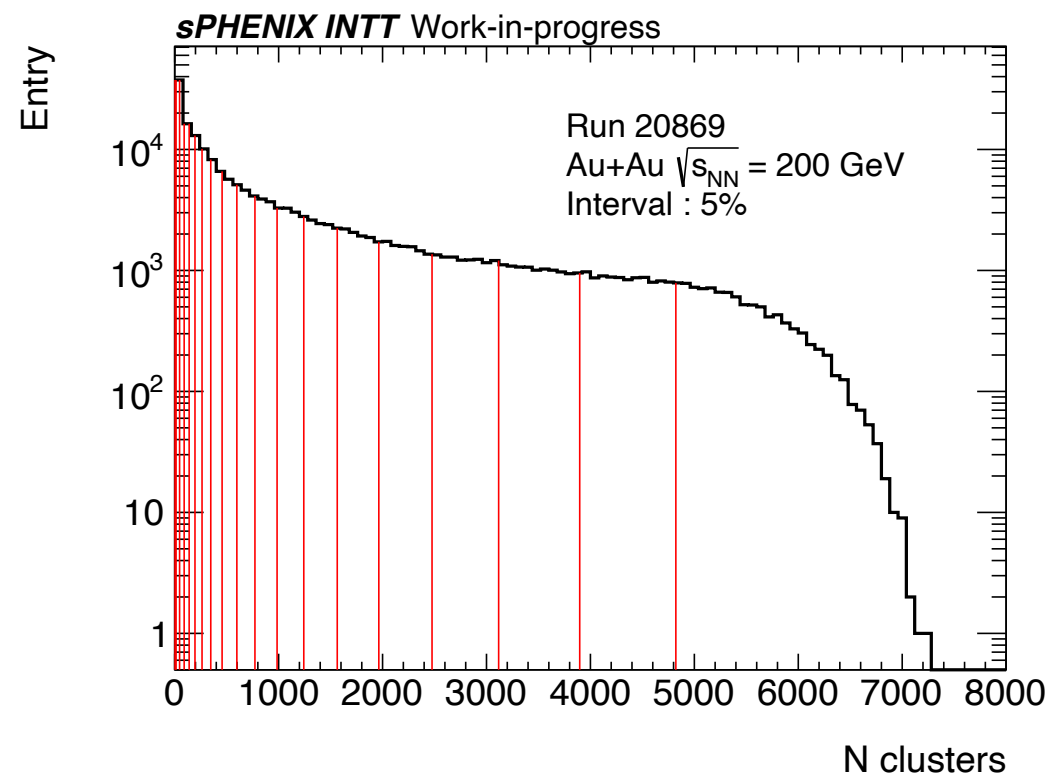
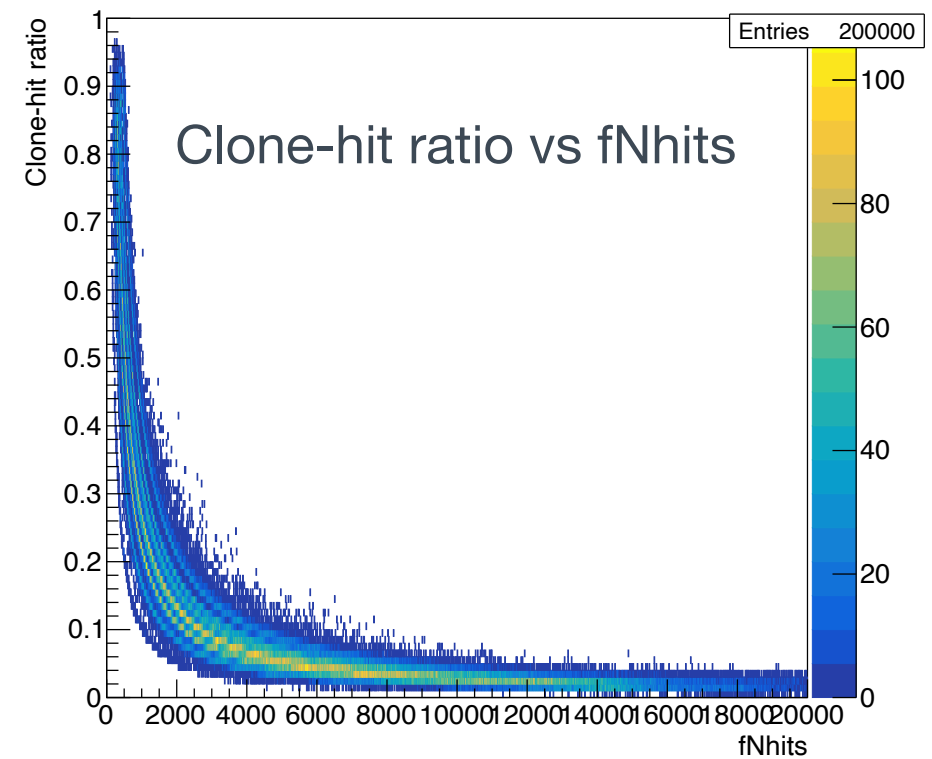
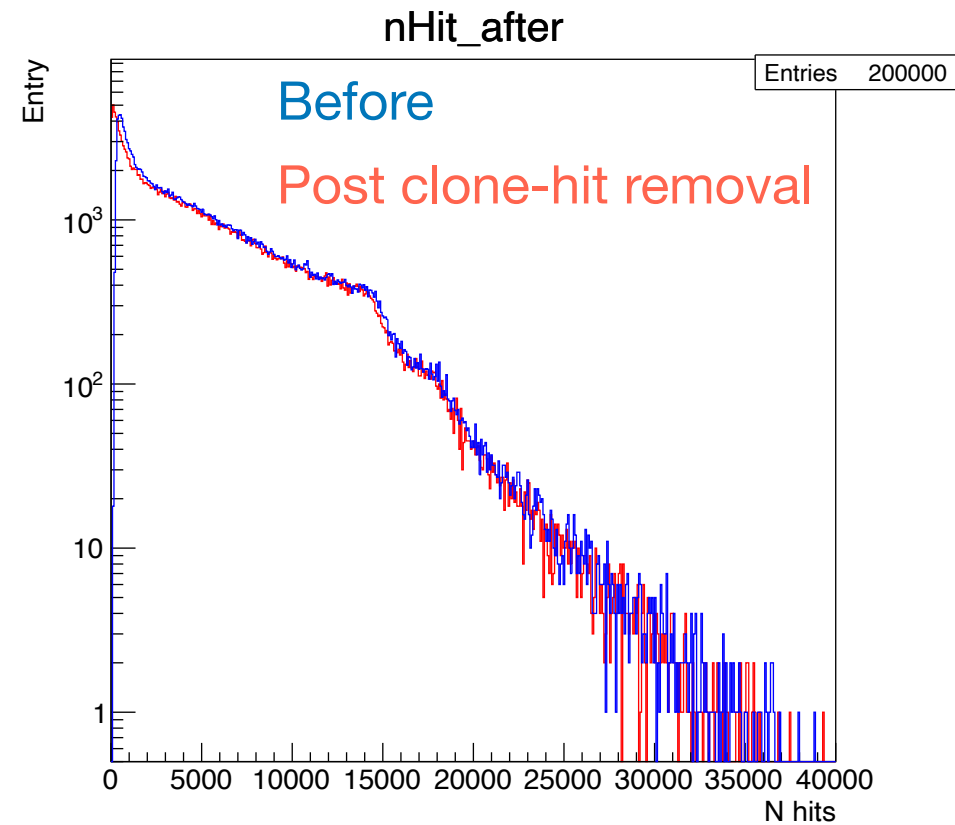
- INTT $dN/d\eta$ MC was checked
 - No major wrong so far
 - Cluster adc always 0 → under investigation
 - Geometry can be updated
- VTX_{xy} method was tested
 - Seemed to be working well
- Correlation plots comparing with MC indicates that INTT geometry has the room to be optimized
- First trial of background estimation was performed. There is no peak after rotation
- VTX_z resolution was measured in full multiplicity region
 - The histogram method with Gaussian fit can greatly suppress the background
 - Hybrid mode was employed for fit range determination
 - Seemed to be working well
 - Current resolution : 3 mm

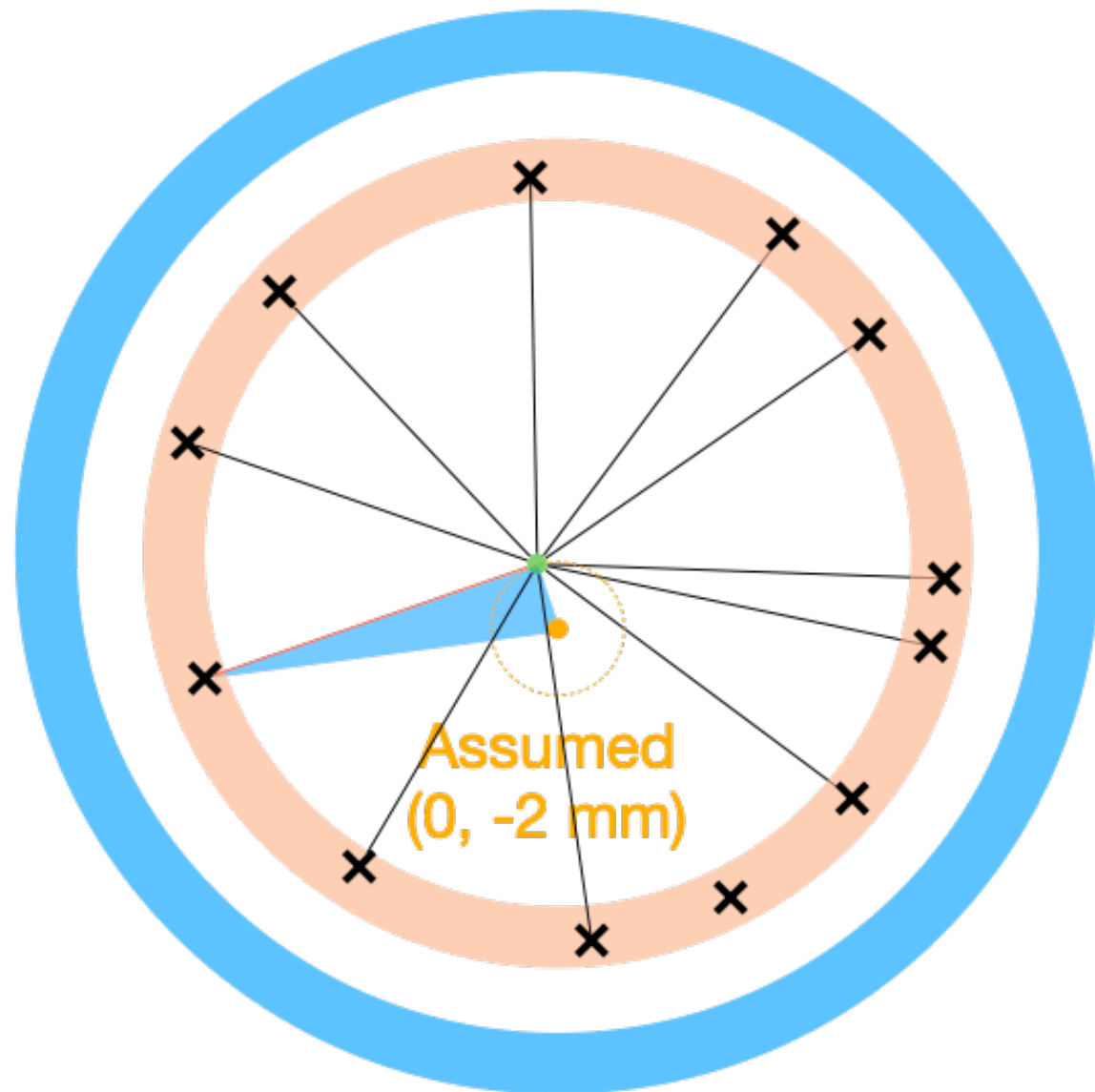
- Cameron will re run the MC with new INTT geometry and shifted z vertex distribution
 - Re-run the analysis afterwards
- Implement the method with data and compare with MBDz

Backup

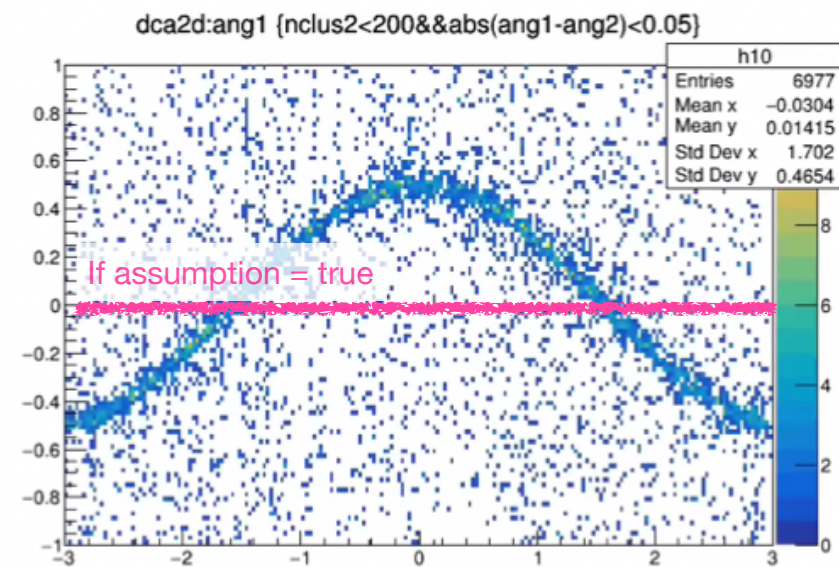
INTT hits & clusters - run 20869

First 200k events were checked



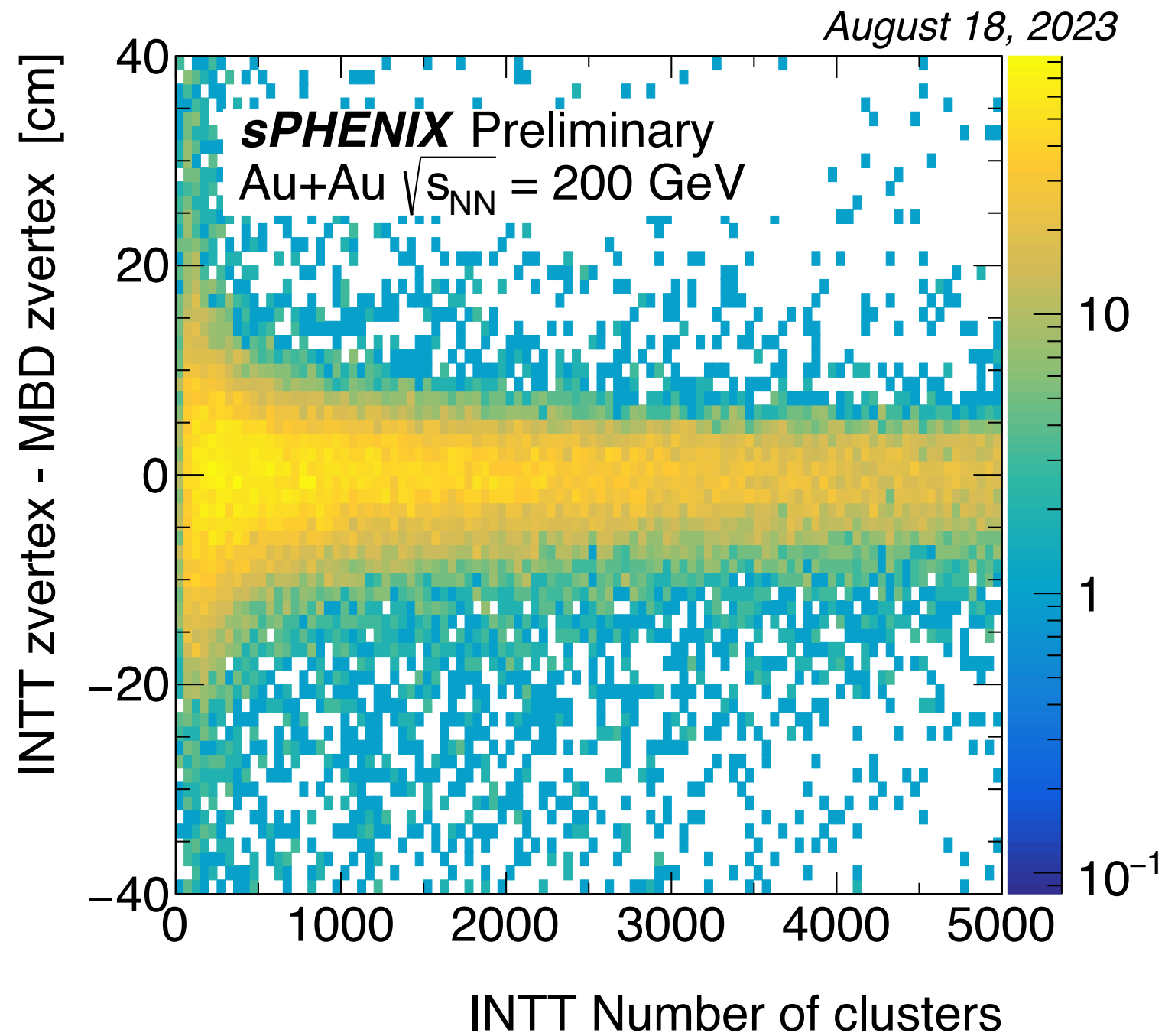


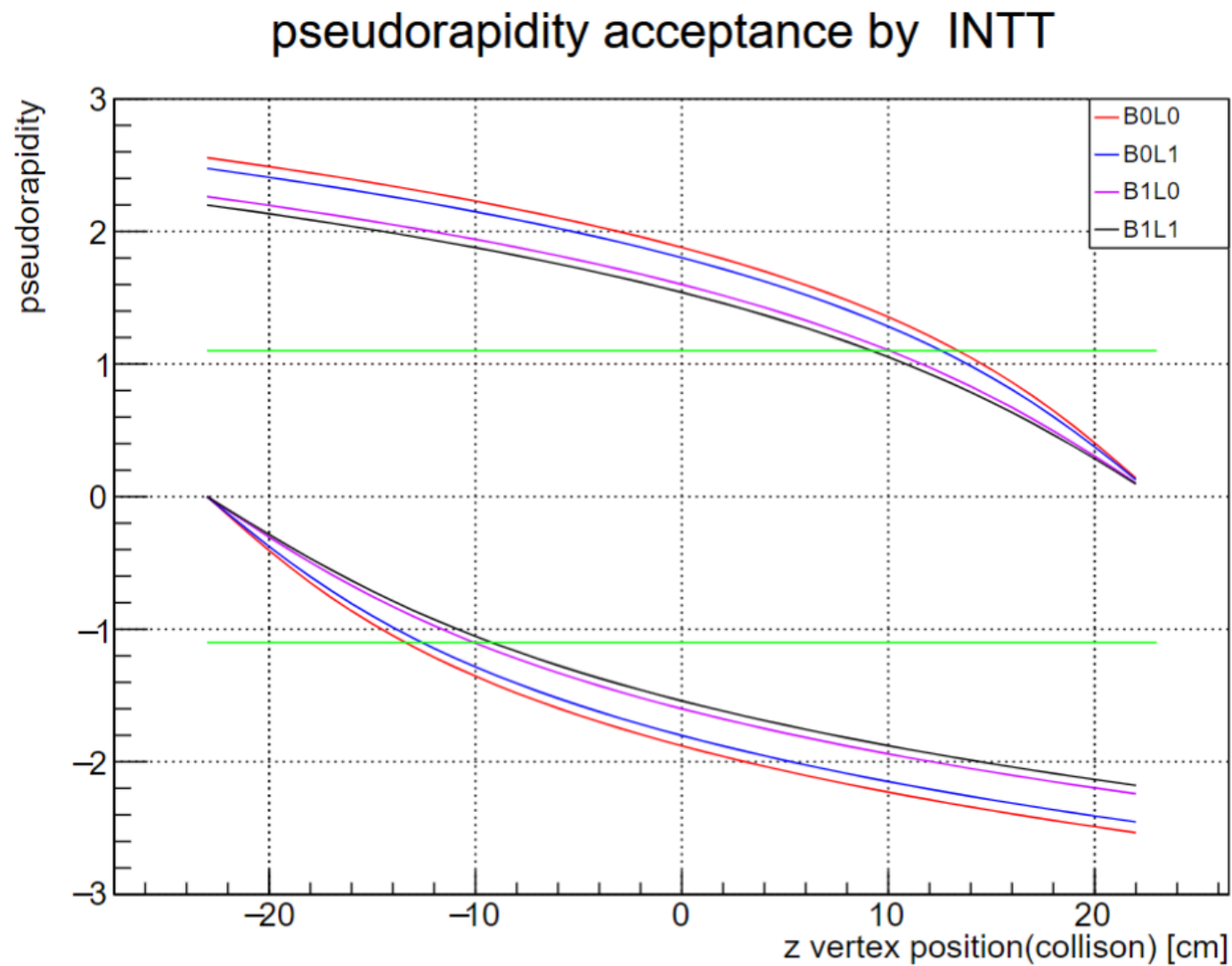
SIM(PYTHIA + Zerofield) @ BeamSpot (0, -5mm)



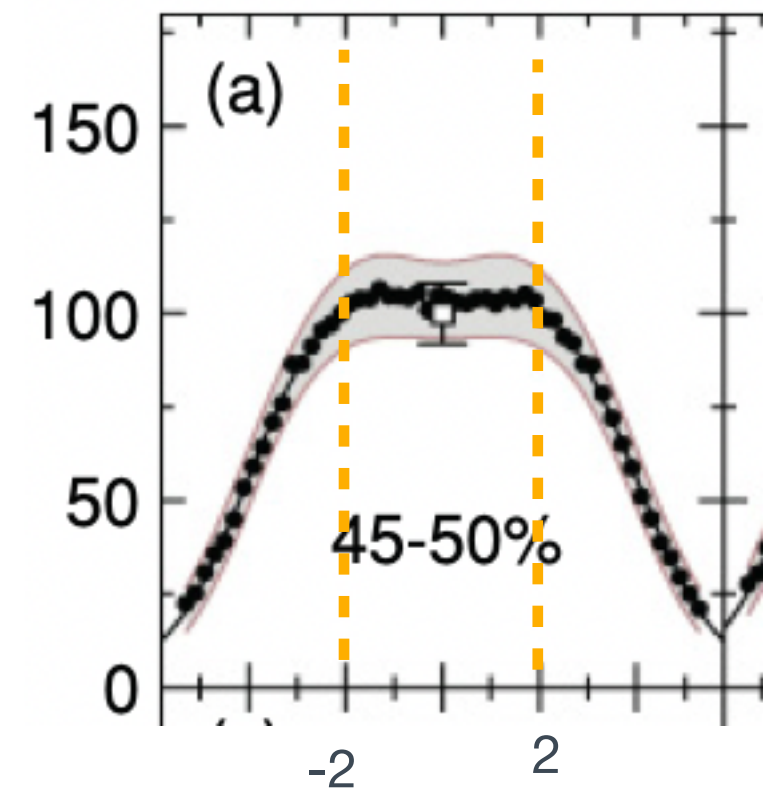
Sim is generated at (0,0) but calculate DCA (0, -5mm)

Plot by Takashi for the method validation





Plot made by Tomoya

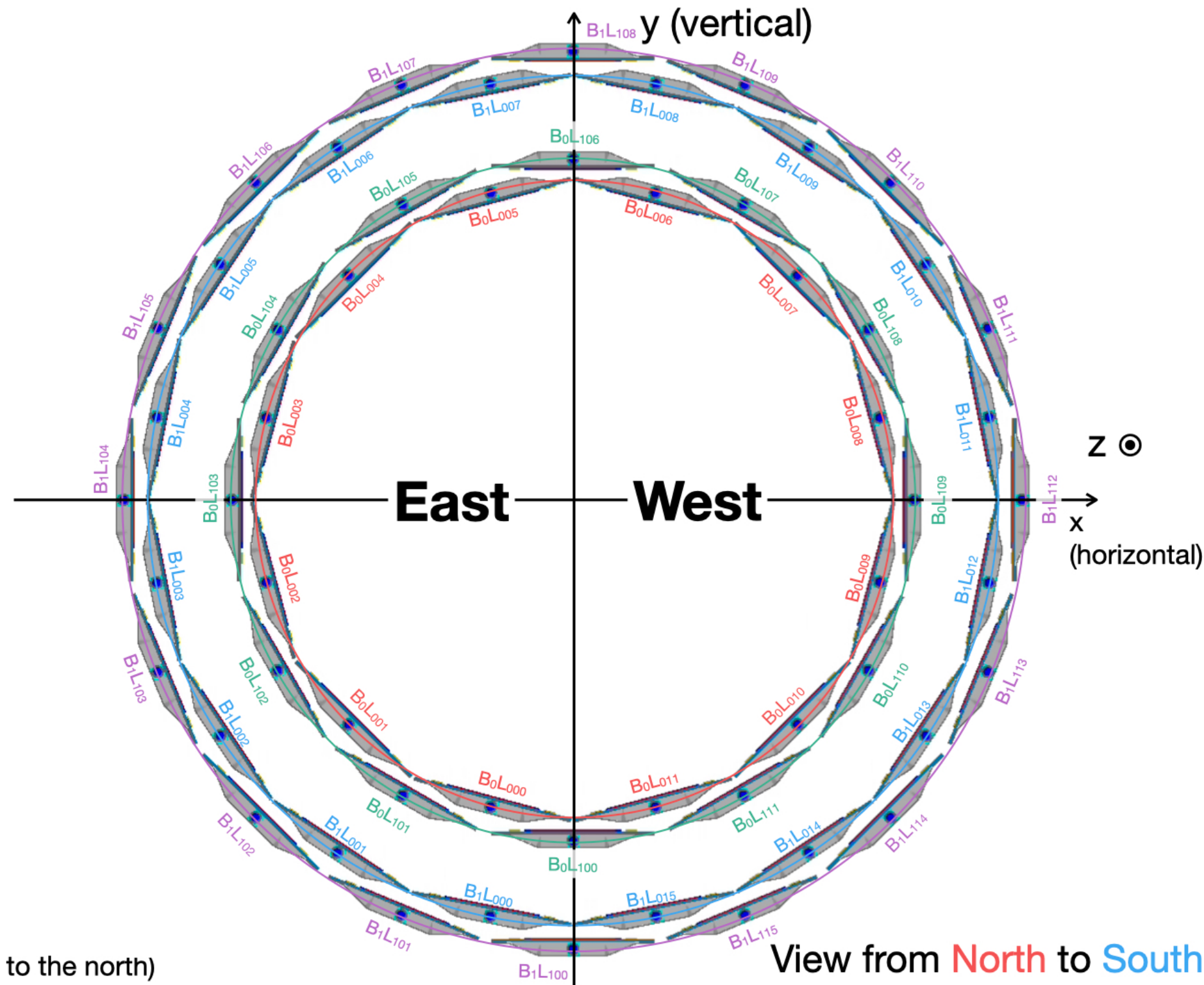


Notation: $B_x L_{yzz}$

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-handed coordinate)

x-axis: $\vec{y} \times \vec{z}$

y-axis: Vertically upward direction

z-axis: The blue beam direction (pointing to the north)

View from North to South