Z-vertex calculation for run2024

Takashi Hachiya

Introduction

- INTT started taking data from end of Apr. INTT-z vertex is one of the important reference for sPHENIX
  - X-Y vertex is also important

- We, ChengWei, Mahiro developed the z-vertex reconstruction code from the last year. Their studies are very useful
  - $\sigma_Z(Au+Au) \sim 2mm, \quad \sigma_Z(p+p) \sim 1 \sim 2cm \ \ from\ simulation$

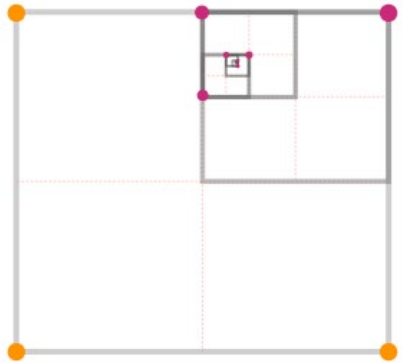
- We are requested to prepare the Fun4All module to calculate z-vertex prior to the run2024 data taking.
  - I prepared them using their development.

Fun4All Module

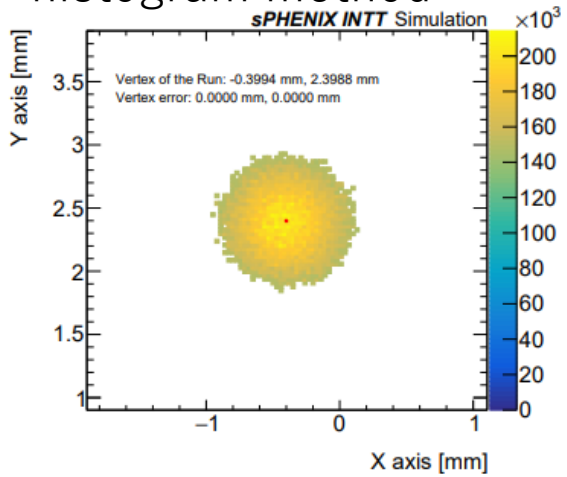
1. XY-vertex calculation
   - X-Y vertex, use all tracklets from N events
   - InttXYVertexFinder.h/cc (Fun4All class)
     - A wrapper of INTTXYvtx class which ChengWei made
   - Alg: 1st :quadrant method, 2nd : histograming X-Y DCA wrt BC from Quad
2. Z-vertex calculation
   - Z-vertex, event by event
   - InttZVertexFinder.h/cc (Fun4All class)
     - A wrapper of INTTZvtx class which ChengWei made
   - Algorithm : Line filled method (Filling the possible coverage of the track uniformly) w/ Gaussian fitting
   - XY-vertex position is a input parameter

- Output objects
  - InttVertexMap : container class
  - InttVertex3D: x, y, z and additional info such as ntracklets, chi2/ndf,
    - Class name will be changed to InttVertex

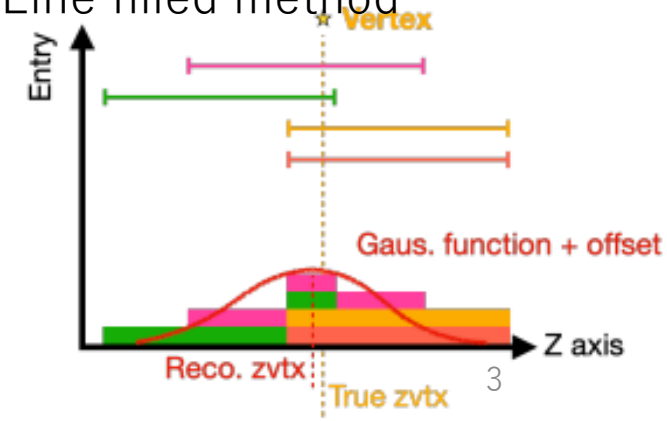
quadrant method



histogram method



Line filled method



Workflow

XY –vertex calculation

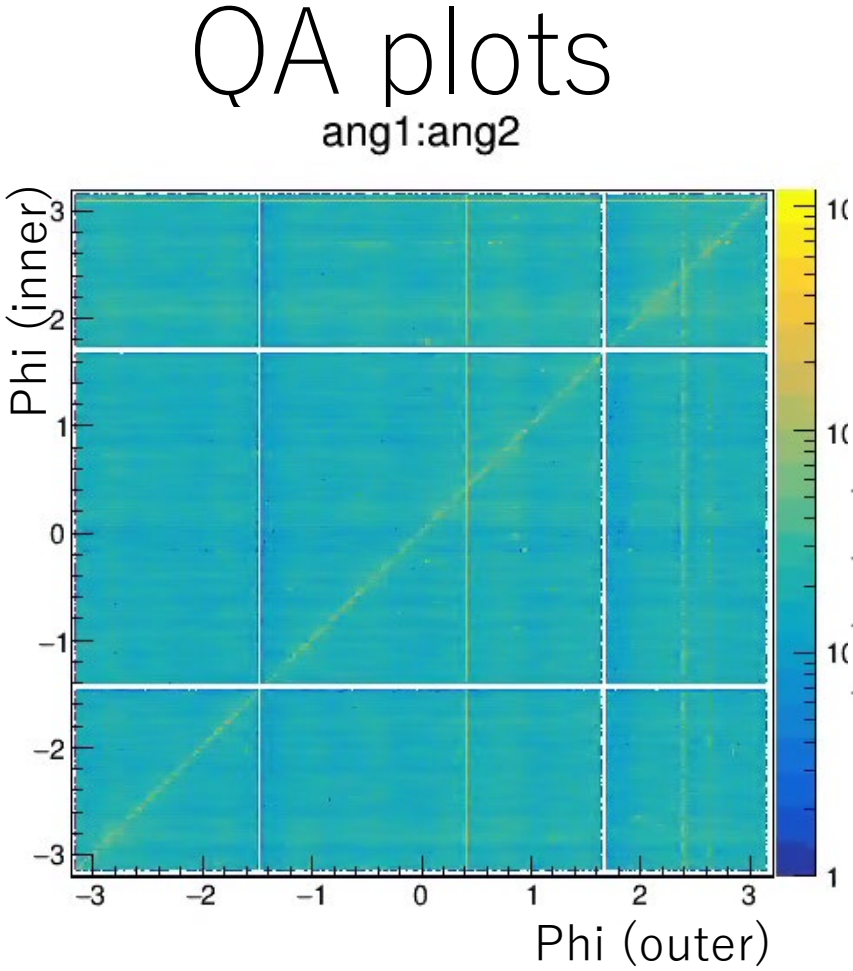
- Calculate w/ Nevents (500)
- 2 InttVertex objects in node
  1. X-Y quadrant method, Z=-9999
  2. X-Y histogram method, Z=-9999

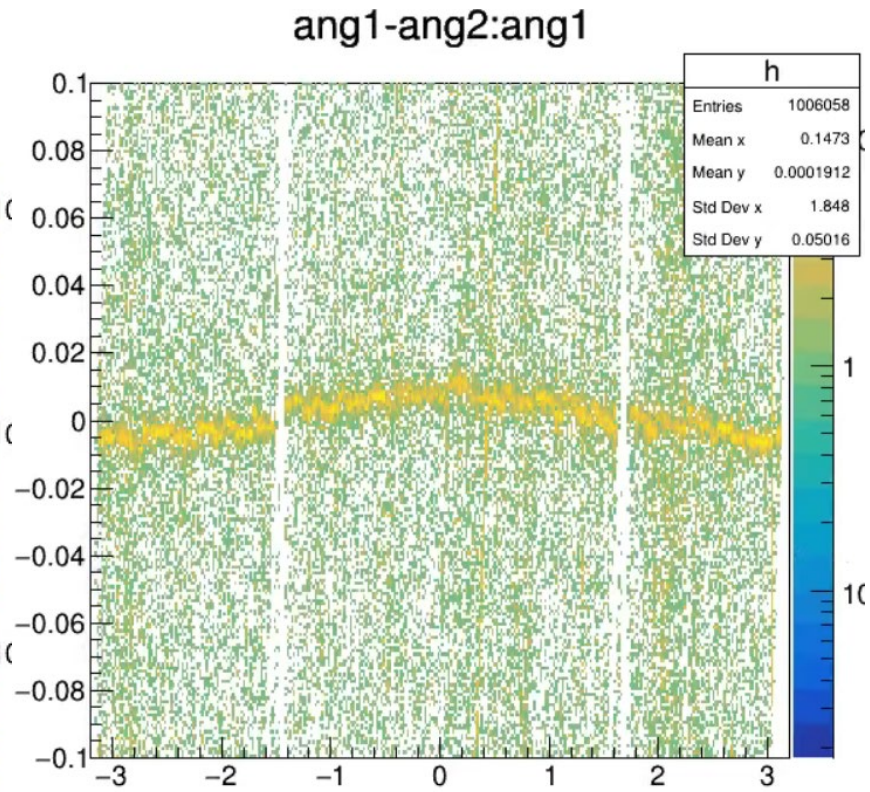
Z –vertex calculation

- Calculate Z event by event
  - XY beam center is set by hand
- A InttVertex objects in node
  3. Z : Line fill method, XY : beam center
- Analysis cuts are relaxed from original value
  - Ntracklets >= 2, Ncluster >= 4
  - dphi <0.05

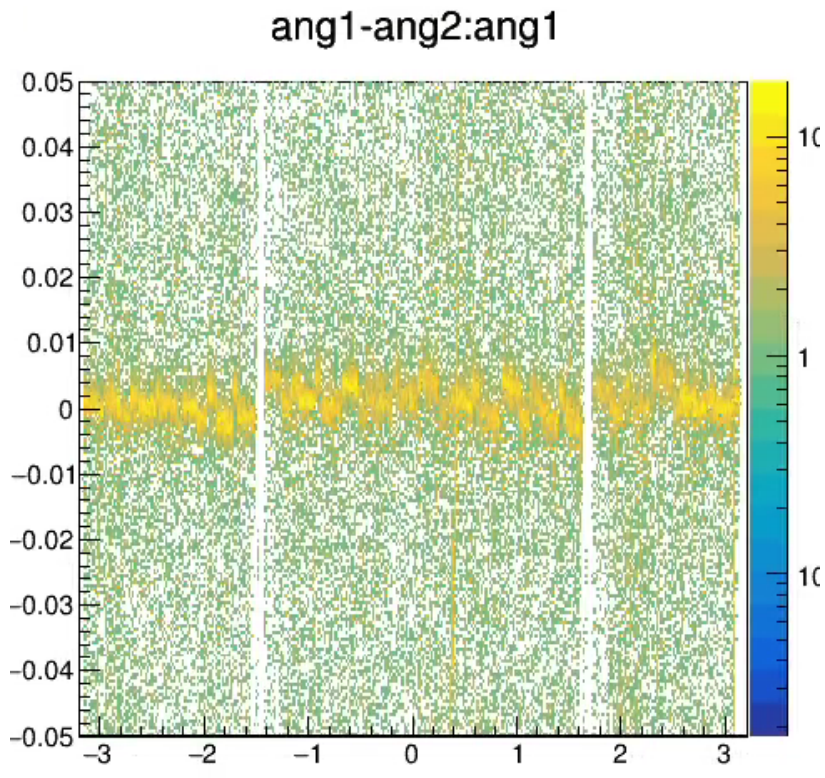
- Code is available in INTT git
  - https://github.com/sPHENIX-Collaboration/INTT/tree/main/general_codes/hachiya/INTTVtx/src
- I will do PR if it is OK with all of you
- To do next
  - Connect these output
  - XY vertex and Z vertex code is independent for now

QA plots



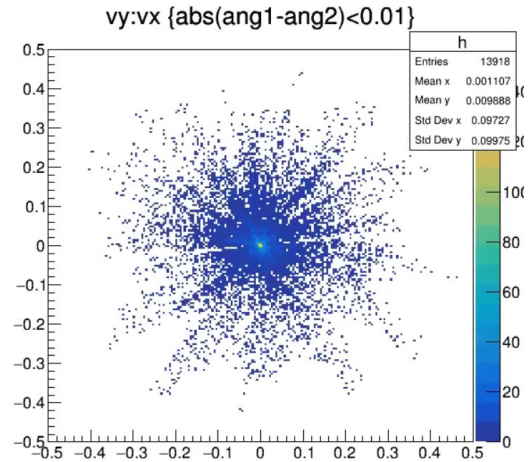


Sin curve since origin=(0,0)



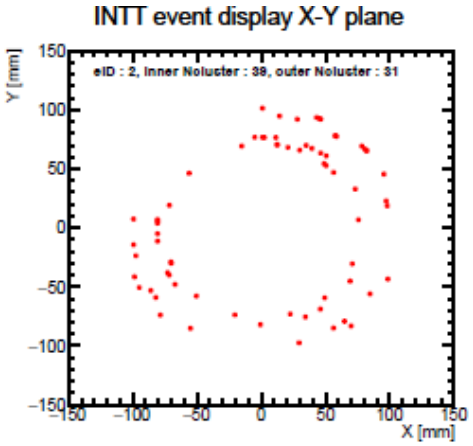
Straight line w/
BC = (-0.019, 0.198)(cm)

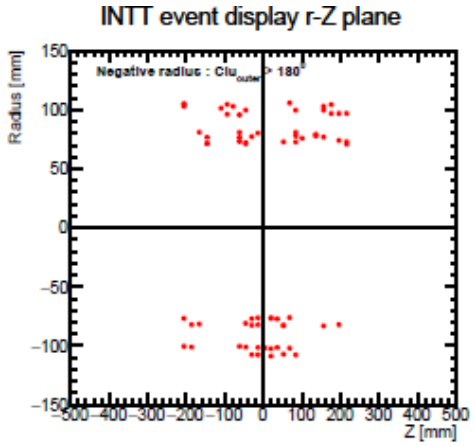
- BC is obtained by InttXYVertexFinder
  - A small offset still remain?
  - Survey geometry is used

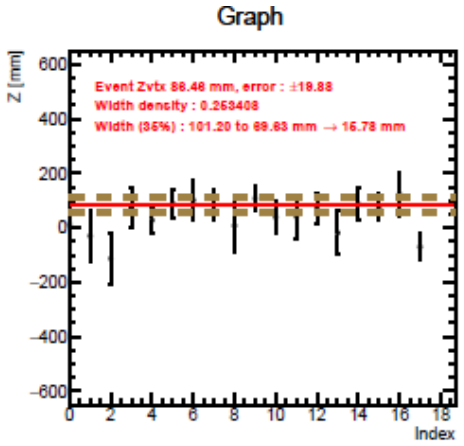


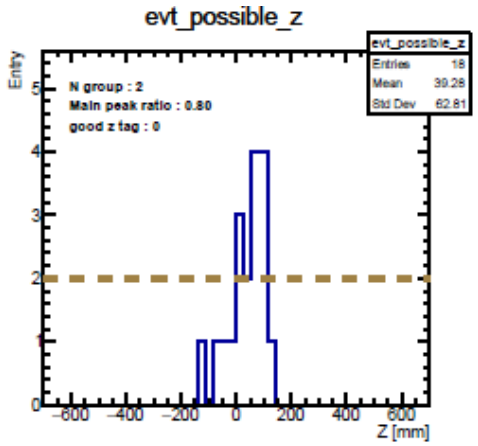
QA plots from InttZVertexFinder

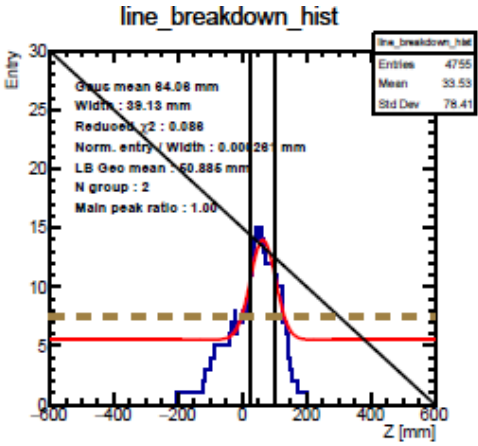
Original (ChengWei's) QA plots are all saved to PDF (if necessary)

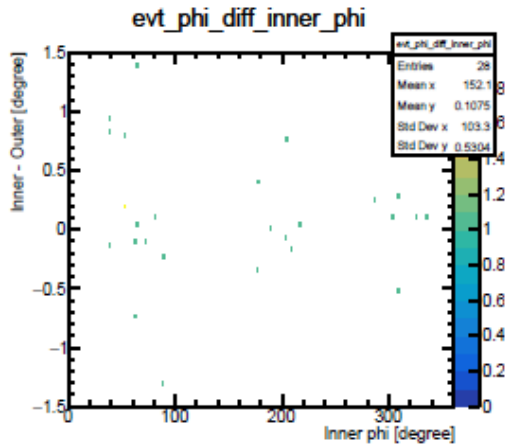


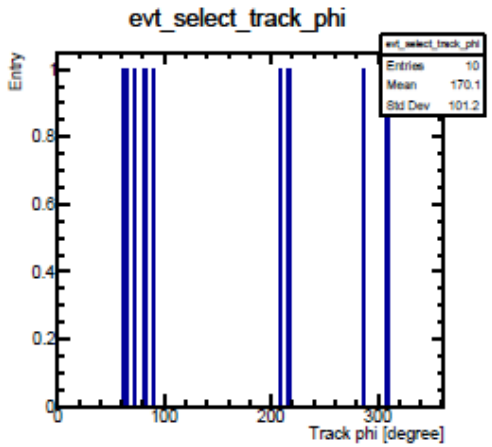


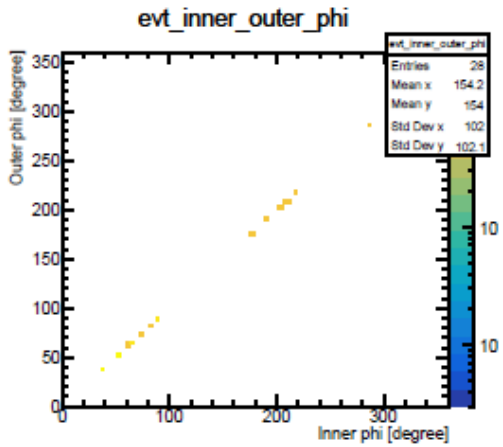


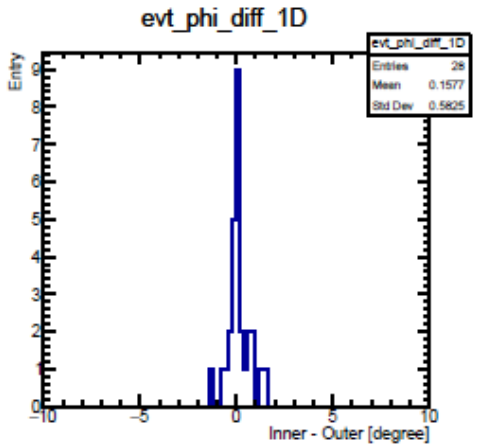




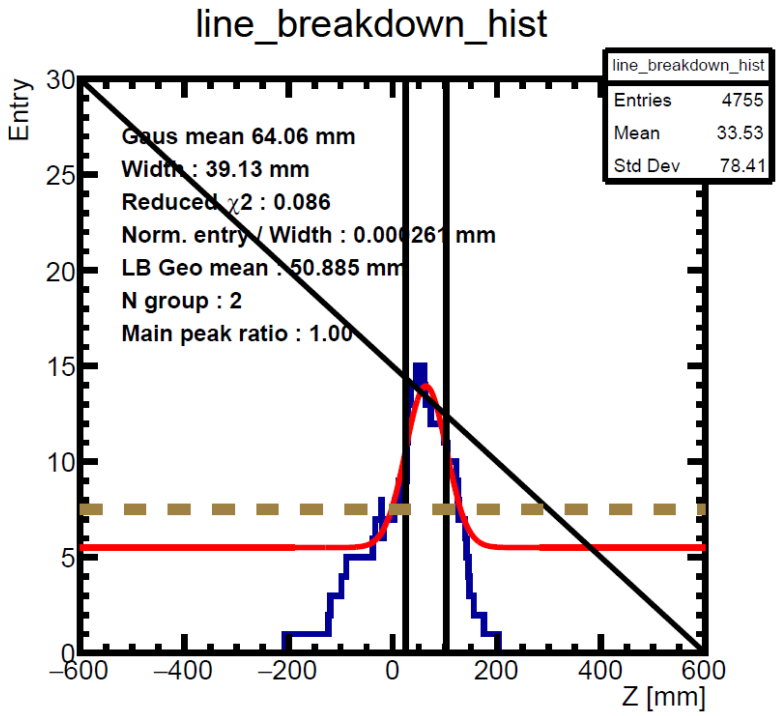


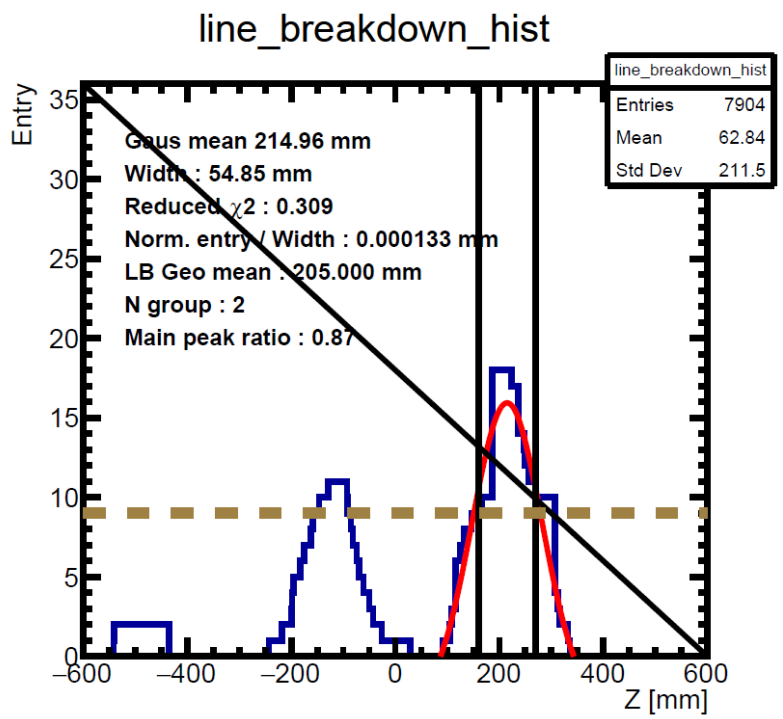


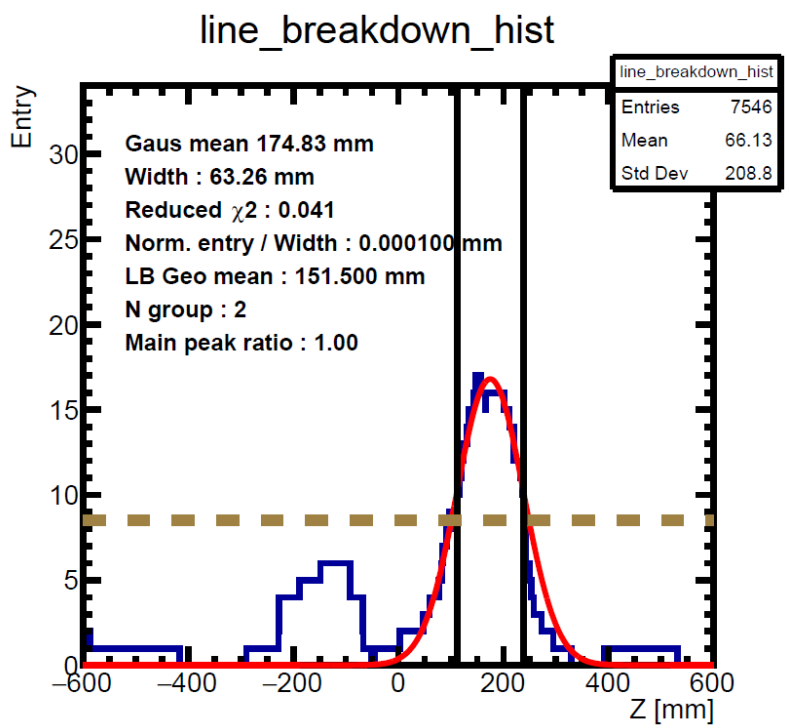




Some events has multiple peak in Z

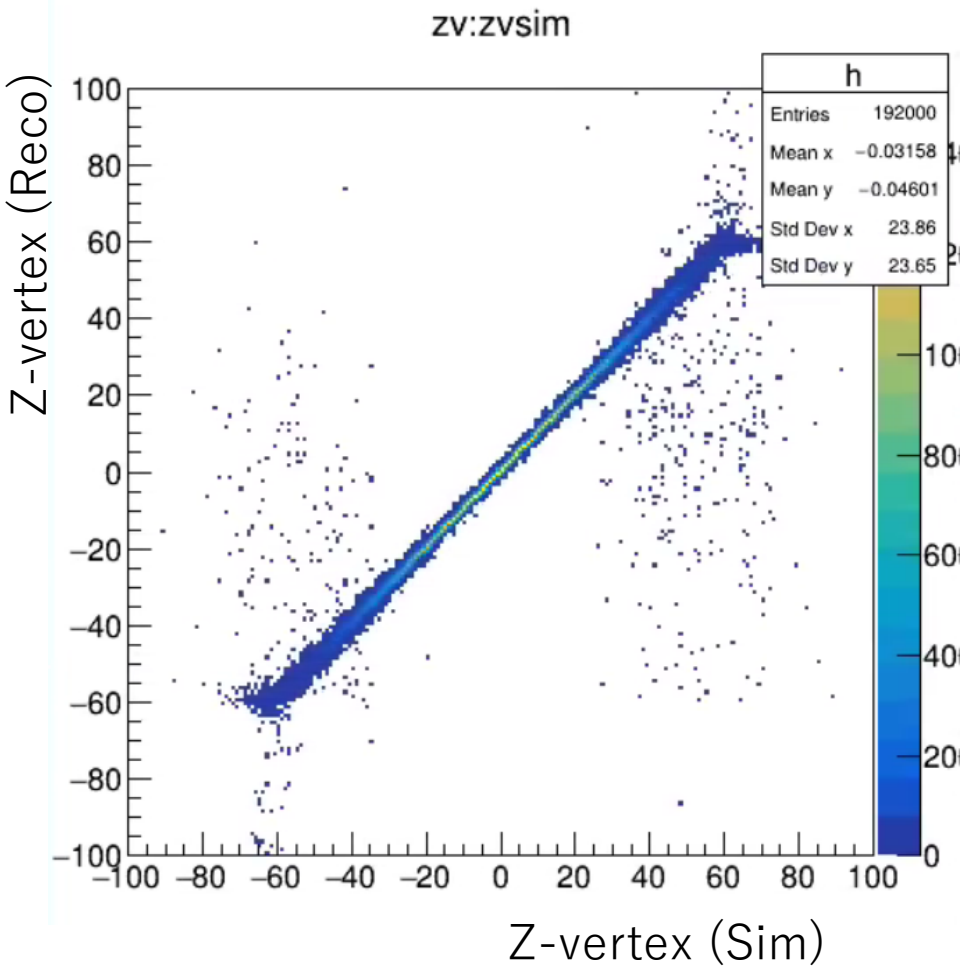


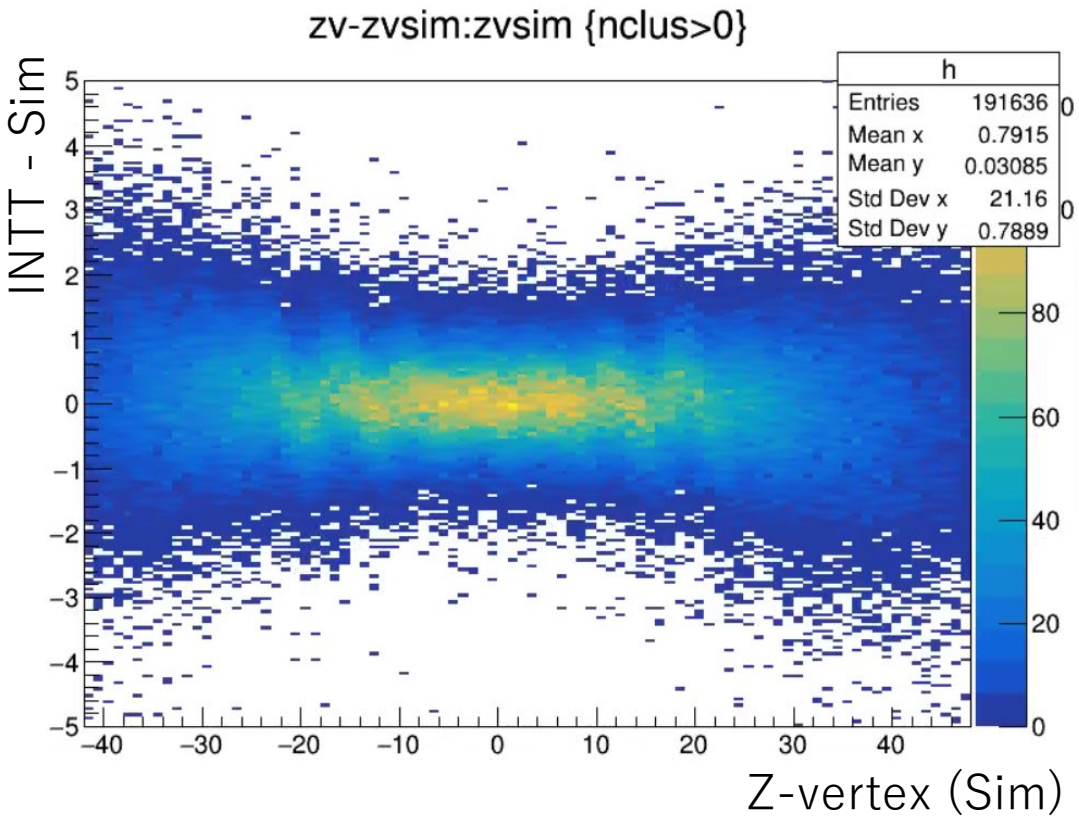




- Need to study in more detail

Verification by Sim (PYTHIA+Detector)

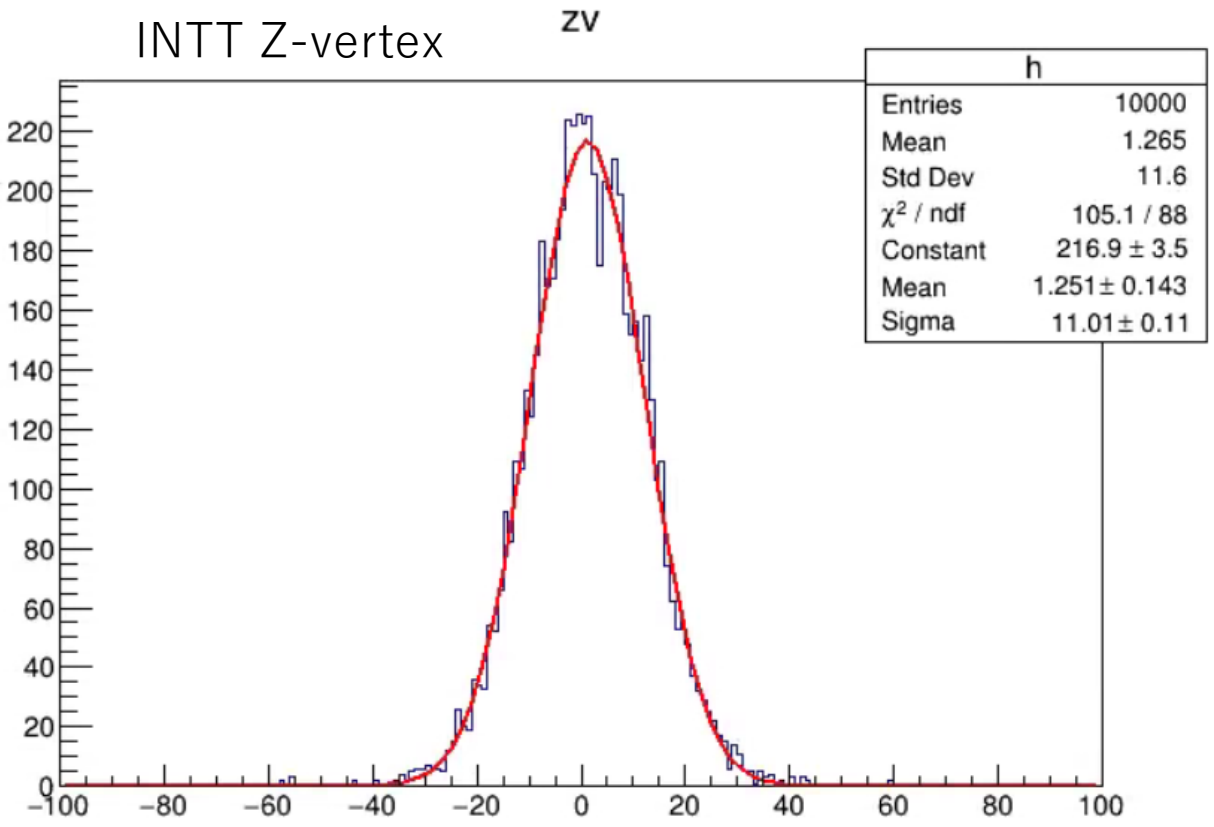


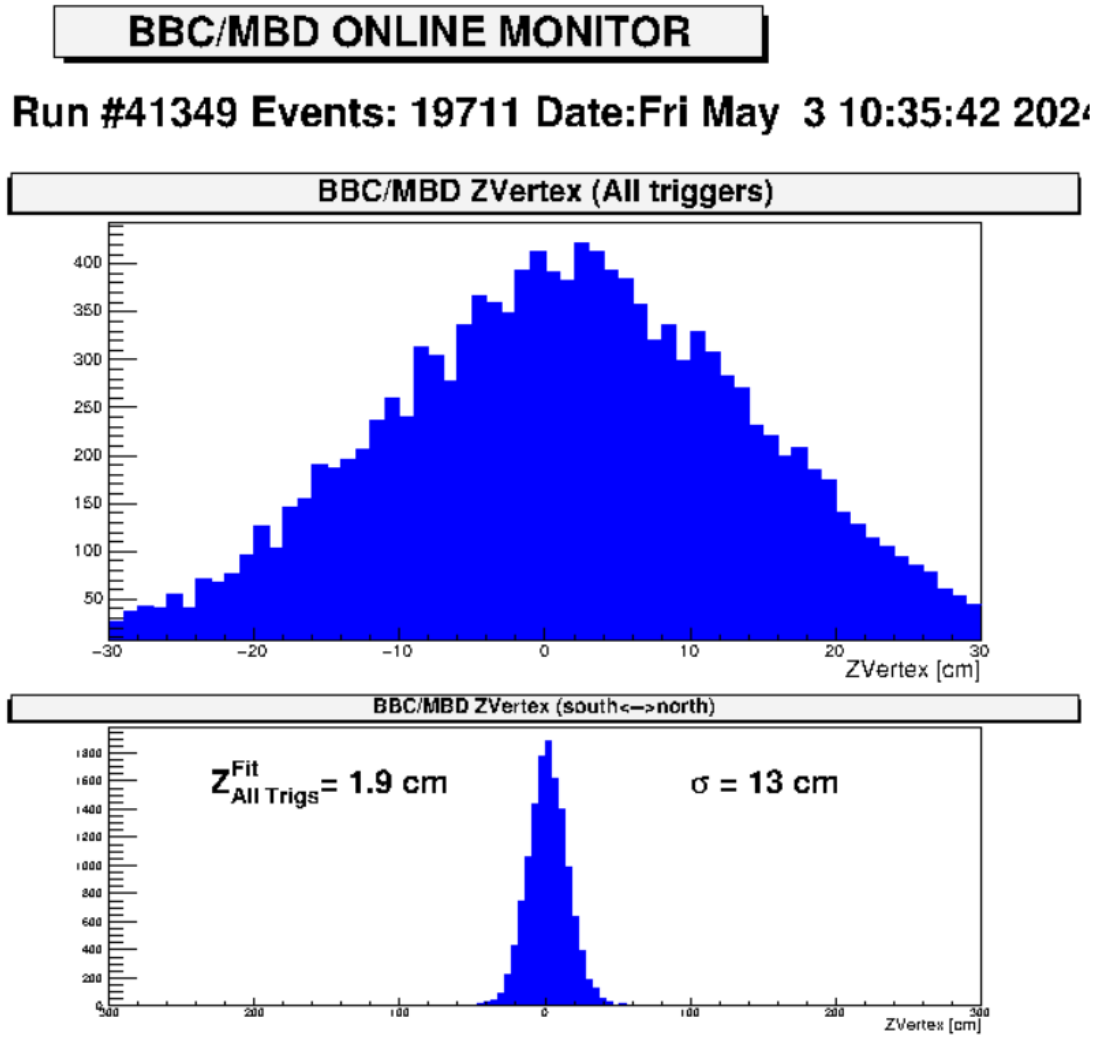


- Clear correlation. Width of these diff ~ 0.8cm
- Wiggling structure can be due to the large Z strip length + small Ntrack cut (2 tracks)

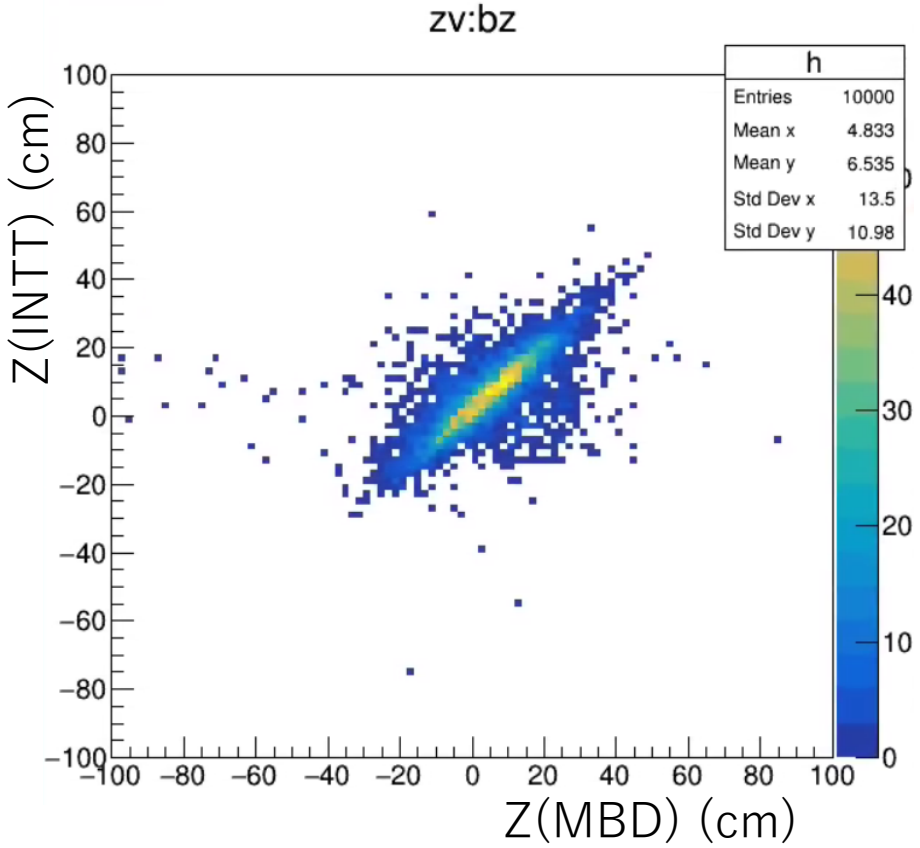
Z-vertex : INTT vs MBD

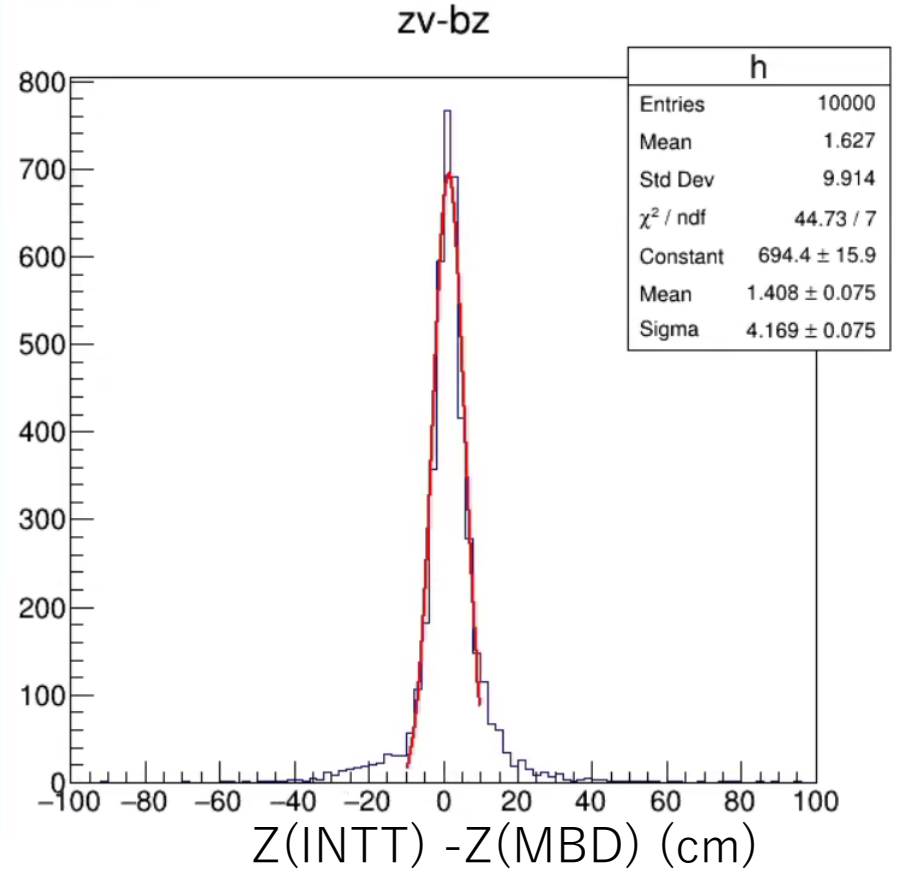
INTT Z-vertex





Z-vertex correlation for 41421 (May 4th, w/ good calib from this run)

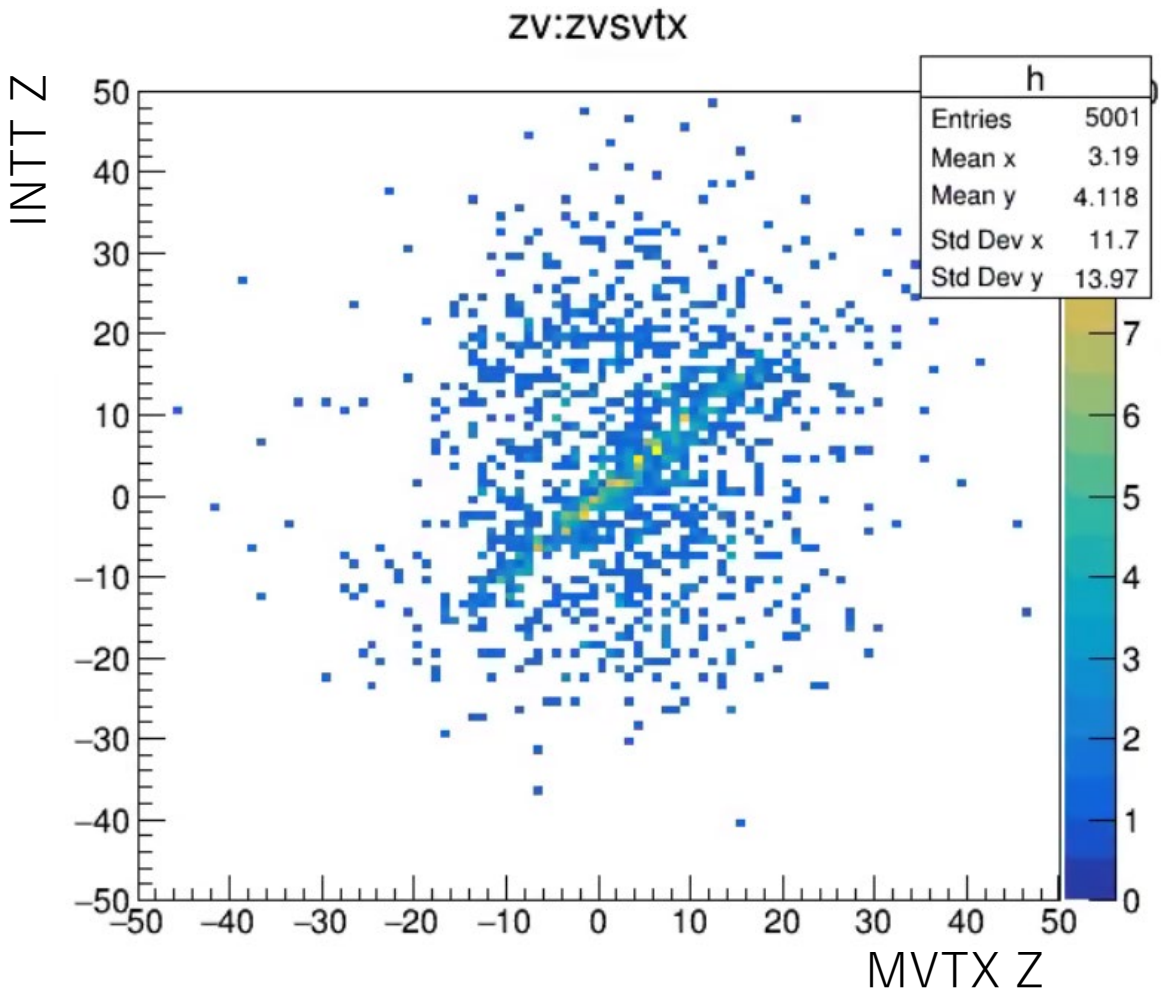


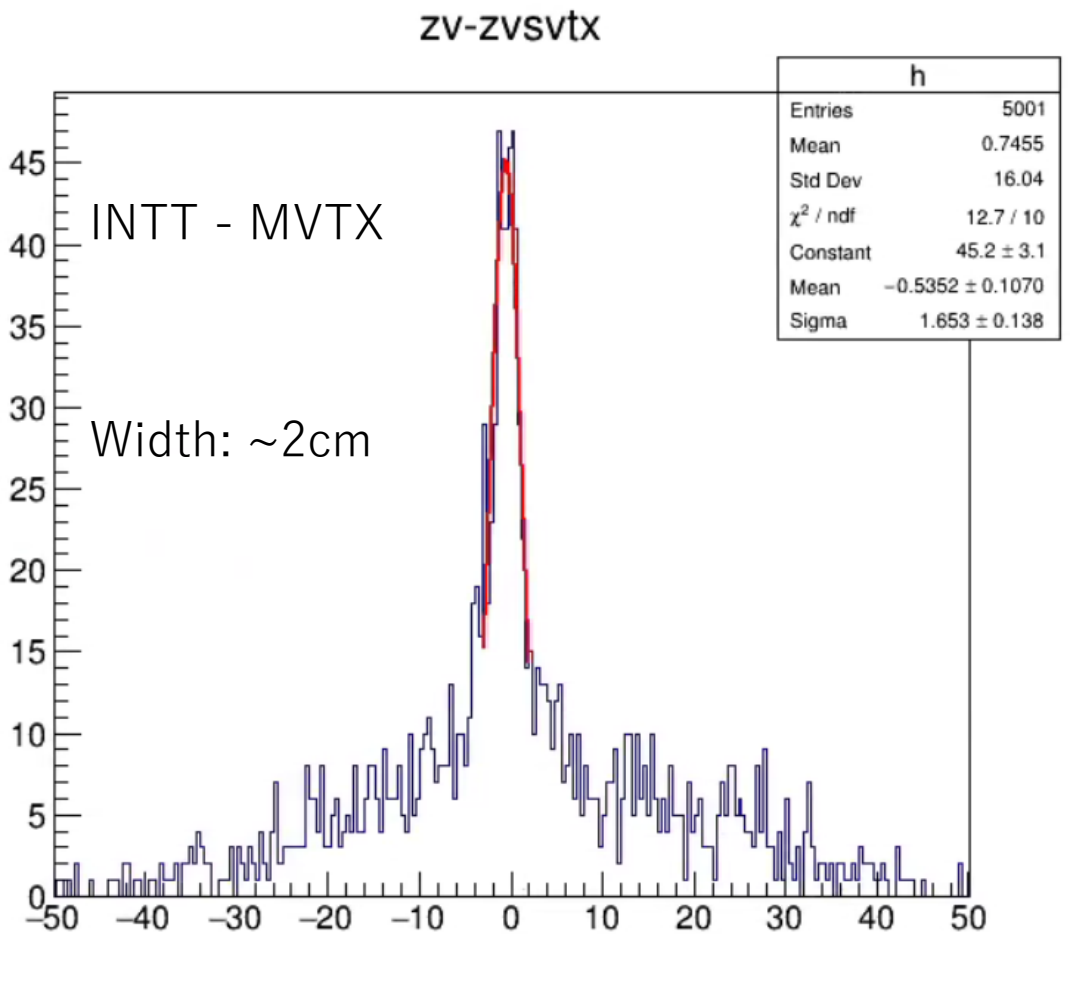


- Calibration applied
  - Mickey gave us MBD parameter
  - Jaein made INTT parameter

Width of the Z-diff is 4.2cm

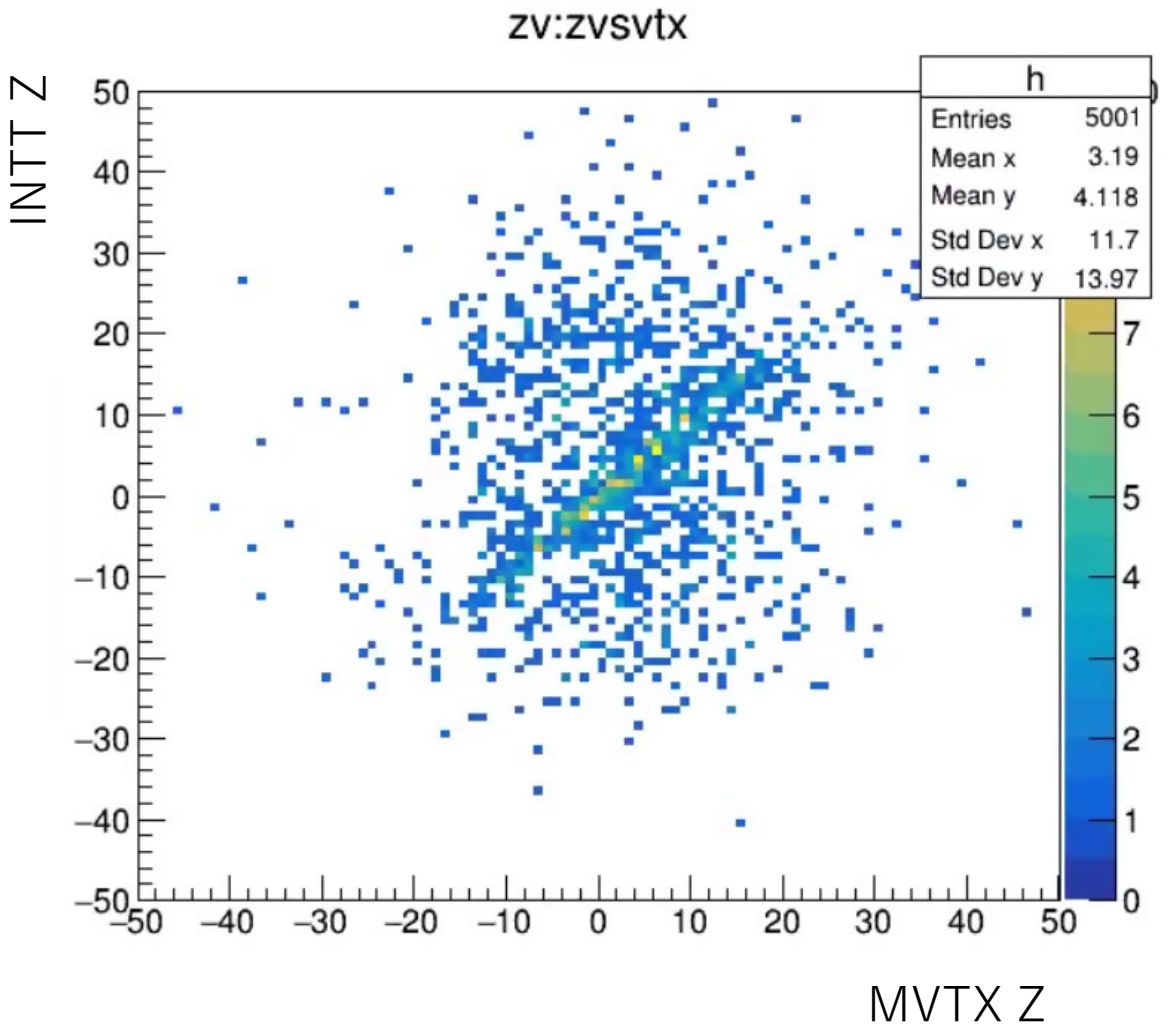
Z vertex INTT vs MVTX (run41661)

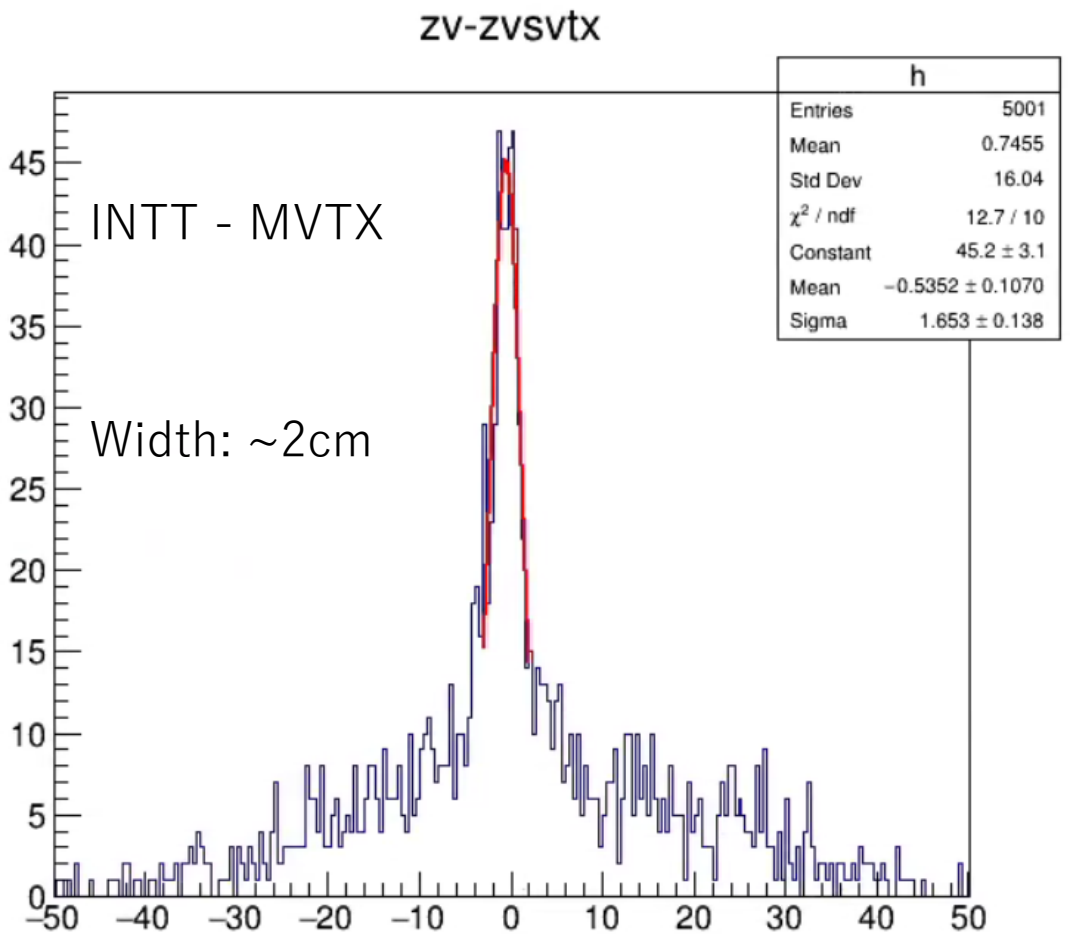




- Clear correlation w/ some grass for the first time
- MVTX can have a lot of BG and not synced yet

Z vertex INTT vs MBD (run41661)





Summary

- INTT started taking data for p+p 200 GeV from Apr. 28 (Sun)
- Results obtained in this 10 days.
- Hardware is working well, Reco soft working well

- **Best & Greatest progress in sPHENIX**

- Next, prepare B-ON data