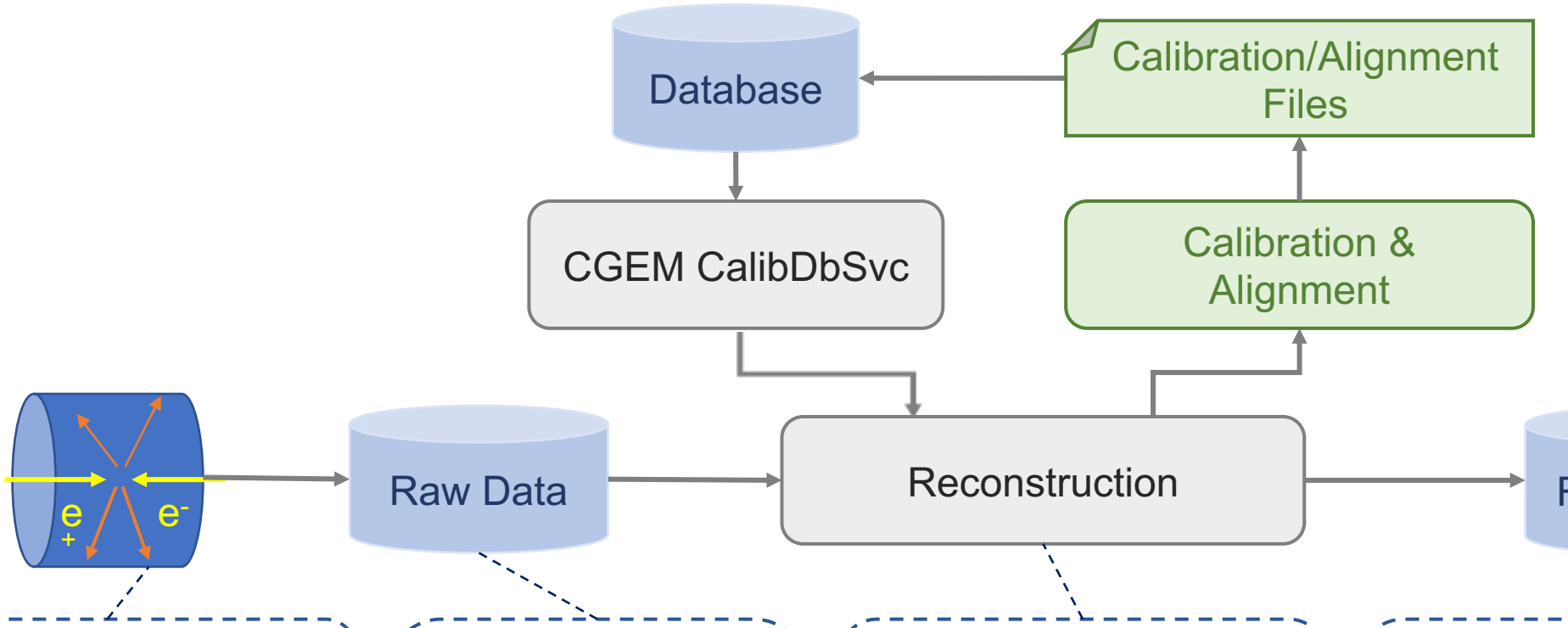
Performance Study of CGEM-IT Based on C.C. Method

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Collaboration Meeting in Winter,
Nov. 29 - Dec. 4, 2026, Beijing

Workflow



Detector configuration
HV, threshold, …

Raw data status
Hit map
Noise level
Charge distribution (saturation)

C.C. Cluster status
Cluster size
Charge saturation ratio

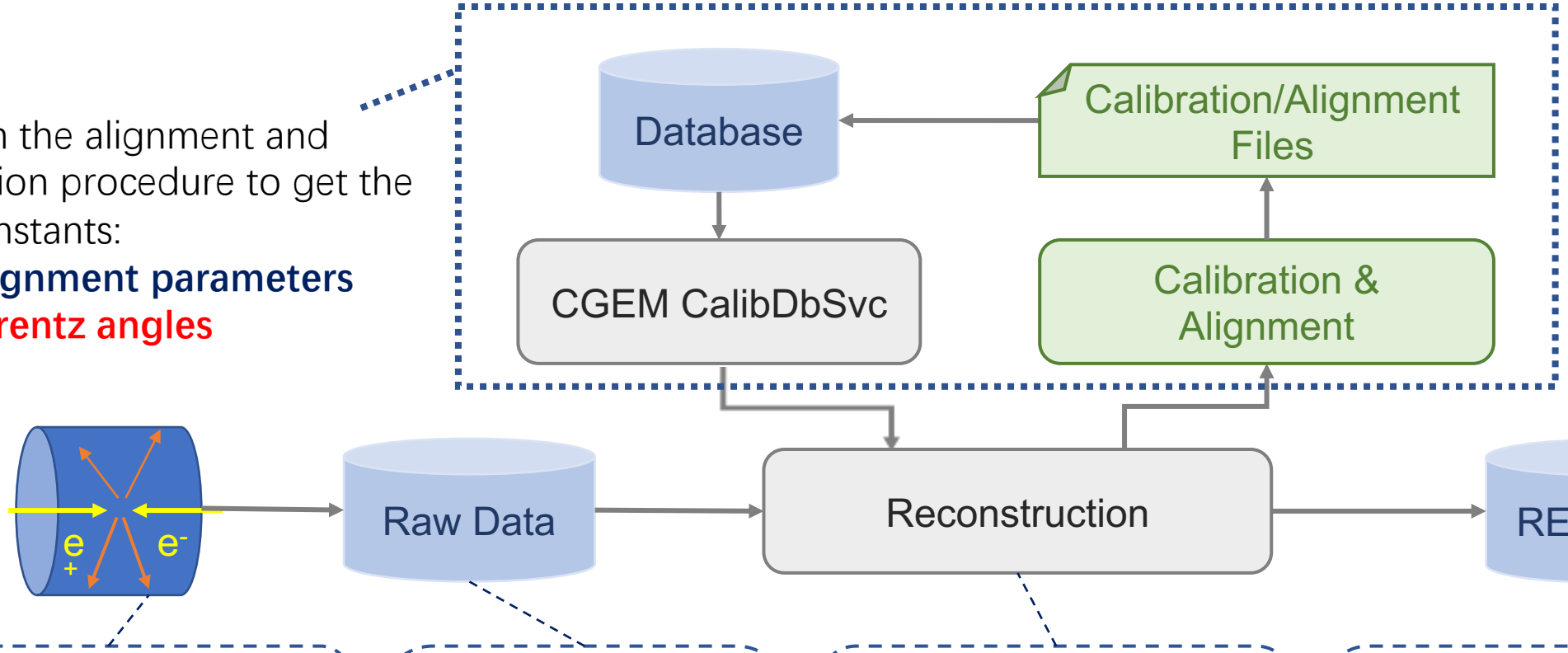
Detector Performances
Spatial resolution
Hit efficiency
Momentum resolution

Workflow

Perform the alignment and calibration procedure to get the vital constants:

Alignment parameters

Lorentz angles



Detector configuration
HV, threshold, …

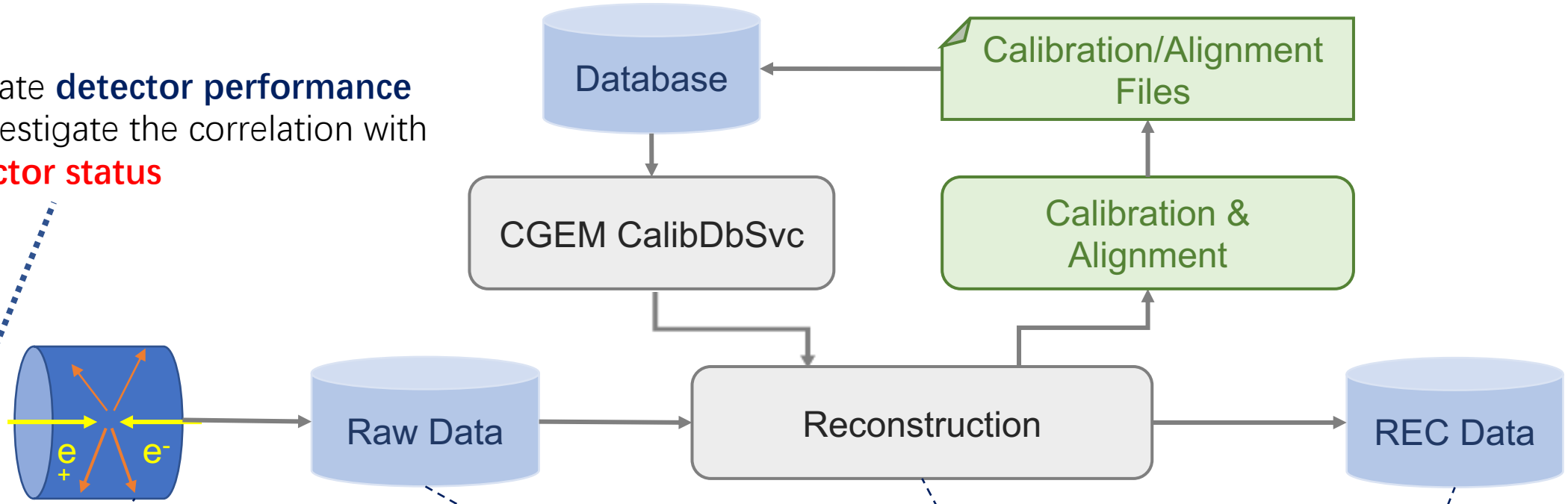
Raw data status
Hit map
Noise level
Charge distribution (saturation)

C.C. Cluster status
Cluster size
Charge saturation ratio

Detector Performances
Spatial resolution
Hit efficiency
Momentum resolution

Workflow

Evaluate **detector performance**
& investigate the correlation with
detector status



Detector configuration
HV, threshold, …

Raw data status
Hit map
Noise level
Charge distribution (saturation)

C.C. Cluster status
Cluster size
Charge saturation ratio

Detector Performances
Spatial resolution
Hit efficiency
Momentum resolution

C.C.-based Alignment & Calibration

WIP

Align. ✓

Target parameters:
$\delta x, \delta y, \delta z, \theta_z$
(fixed MDC)
Data sample:
cosmic-rays without magnetic field

Track reconstructed with:
Only ODC

Method:
Residual parameterization

Calib. ✓

Target parameters:
Lorentz angle (initial)
Data sample:
cosmic-rays with magnetic field

Track reconstructed with:
Only ODC

Method:
Residual histogramming

Align. ✓

Target parameters:
$\delta x, \delta y, \delta z, \theta_x, \theta_y, \theta_z$
MDC align. para.
Data sample:
cosmic-rays with magnetic field

Track reconstructed with:
CGEM + ODC

Method:
Millepede

Calib. ✓

Target parameters:
Lorentz angle,
Fine-grained sigma
Data sample:
Bhabha,
$\psi' \to \pi^+\pi^- J/\psi$

Track reconstructed with:
CGEM + ODC

Method:
Residual histogramming

Align.

(details in Jiazhen's report)

Target:
Precise alignment

Data sample:
Dimu & Cosmic-rays

Track reconstructed with:
ODC + CGEM

Method:
Based on Kalman track fit

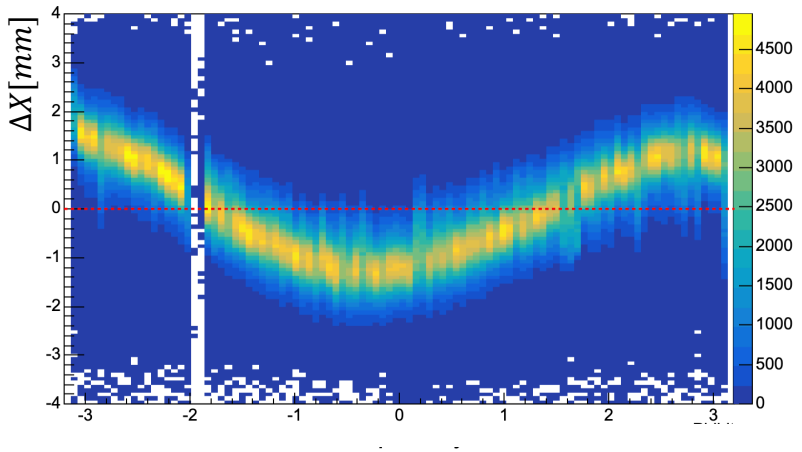
Status of Alignment

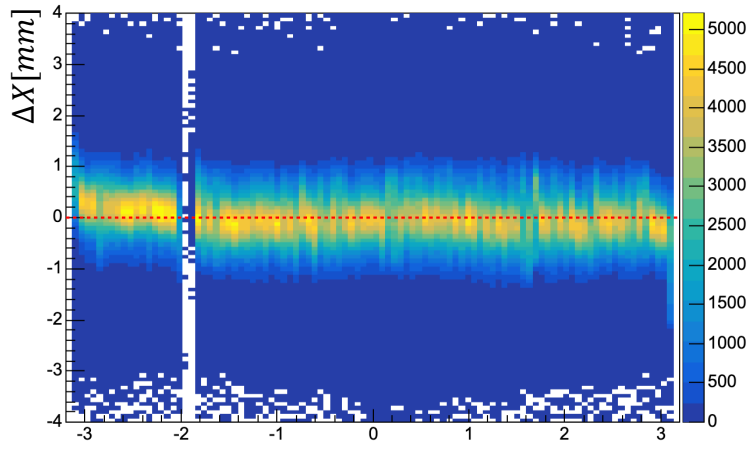
Data sample: online barrel Bhabha
@4680 on 2026.06.06

Before align. (layer1)

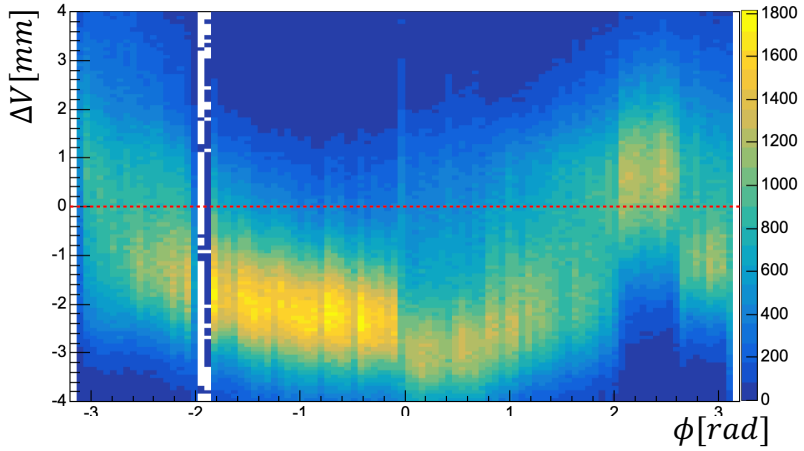
After align. (layer1)

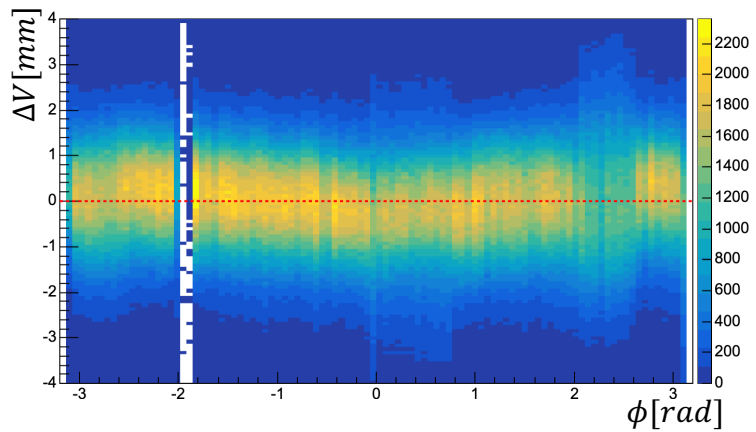
X view





V view





Geometric misalignment largely corrected.

Status of Calibration: Lorentz Angle

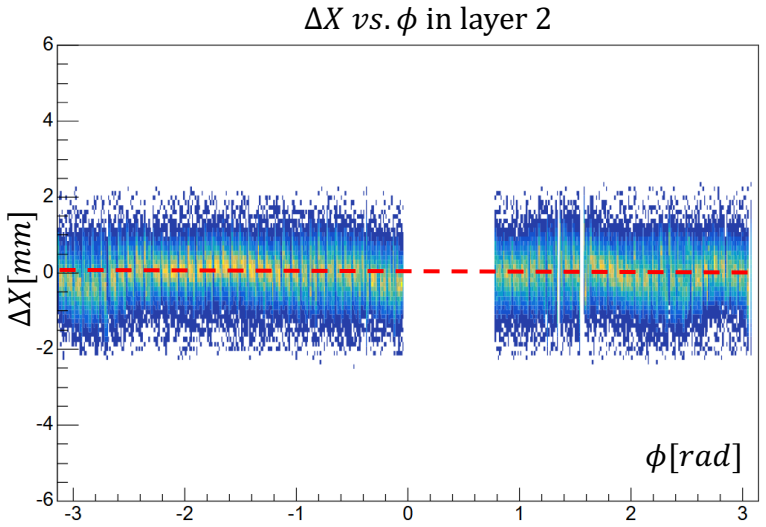
- ✓ Calibration workflow fully established (details in my report in Yantai)
- ✓ Lorentz angle calibrated

Data sample: online barrel Bhabha @4680 on 2026.03.01

	Layer1	Layer2	Layer3
Lorentz Angle [degree]	13.52	16.42 (top) 17.31 (bottom)	12.93 (top) 12.94 (bottom)

High Voltage Config			
	Layer 1	Layer 2	Layer 3
DRIFT	750	750	750
IND	850	700	800
T1	600	400	600
T2	600	400	600

Lorentz angle roughly consistent with high voltage configuration

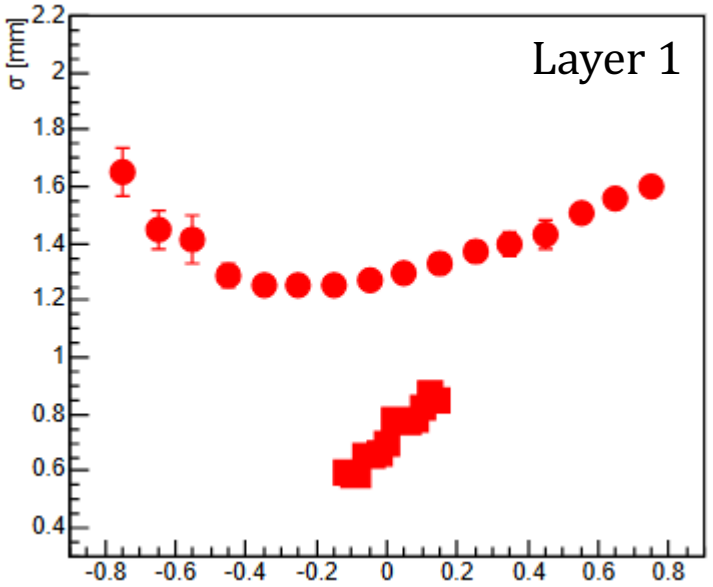


Lorentz angle difference between two sheets in layer 2,
due to Local residual distortions beyond alignment correction

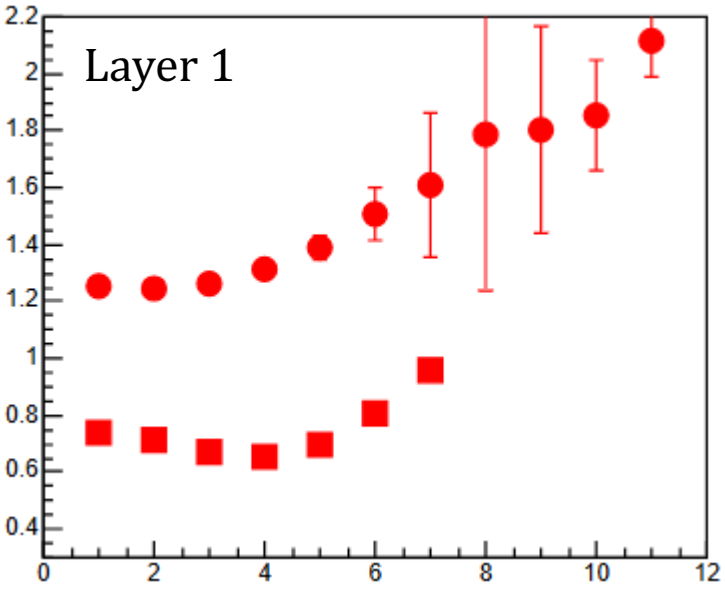
Reliable Lorentz angle correction values provided for reconstruction.

Status of Calibration: Fine-grained sigma

✓ Entrance-angle-dependent σ calibrated



✓ Cluster-size-dependent σ calibrated



Data sample: $\psi' \to \pi^+\pi^- J/\psi$, 2026.02.10 - 02.24

■ X view ● V view

Entrance-angle- and cluster-size- dependent σ applied in reconstruction for more accurate cluster weighting in track fitting

C.C.-based Alignment & Calibration

Align. ✓

Target parameters:
$\delta x, \delta y, \delta z, \theta_z$
(fixed MDC)
Data sample:
cosmic-rays
without
magnetic field

Track
reconstructed with:
Only ODC

Method:
Residual
parameterization

Calib. ✓

Target parameters:
Lorentz angle
(initial)
Data sample:
cosmic-rays
with magnetic
field

Track
reconstructed with:
Only ODC

Method:
Residual
histogramming

Align. ✓

Target parameters:
$\delta x, \delta y, \delta z, \theta_x, \theta_y, \theta_z$
MDC align. para.
Data sample:
cosmic-rays
with magnetic
field

Track
reconstructed with:
CGEM + ODC

Method:
Millepede

Calib. ✓

Target parameters:
Lorentz angle,
Fine-grained sigma
Data sample:
Bhabha,
$\psi' \to \pi^+\pi^- J/\psi$

Track reconstructed
with:
CGEM + ODC

Method:
Residual
histogramming

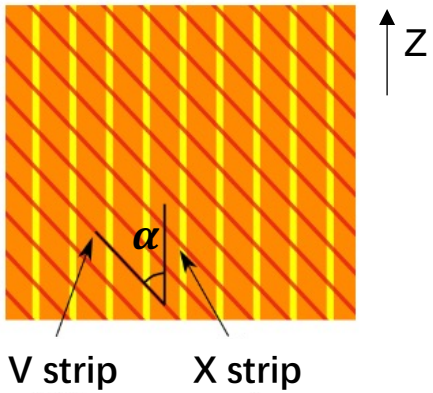
BOSS 8.1.0

Performance study

Spatial Resolution: overall values

Data sample: online barrel Bhabha @3686 on 260220

	Layer1	Layer2	Layer3
σ_X [mm]	0.54	0.52	0.52
σ_V [mm]	1.1	0.95	0.81
σ_z [mm]	1.5	1.7	1.5



α: L1: 46.69°
L2: -31.03°
L3: 32.92°

In X, V:

Layer 1 performs worst

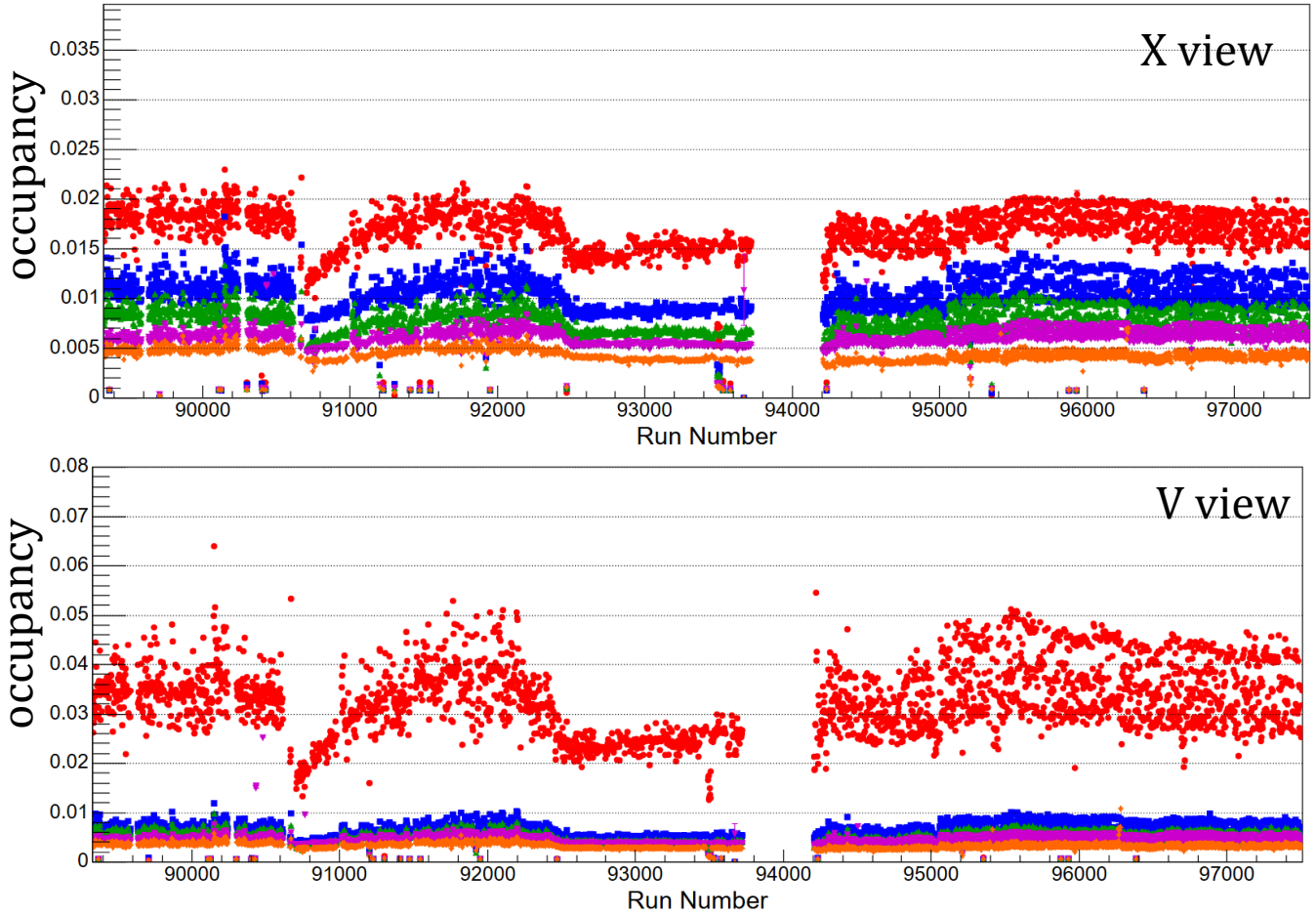
In Z:

- The combined contributions of X and V
- With larger stereo angle of V strips, layer1 performs close to layer2

Spatial Resolution: overall values

Resolution variation with layers due to:

1. Beam-induced background



Data sample:
online barrel Bhabha
from 2026.01.12 to 2026.11.24

- Layer1
- Layer2 bottom
- Layer2 top
- Layer3 bottom
- Layer3 top

Layer 1 experiences the highest background.

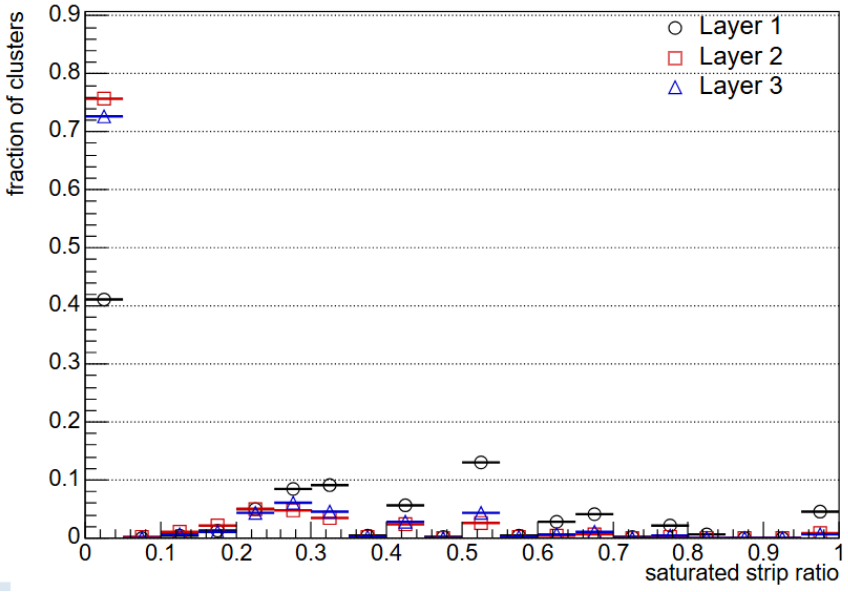
Spatial Resolution: overall values

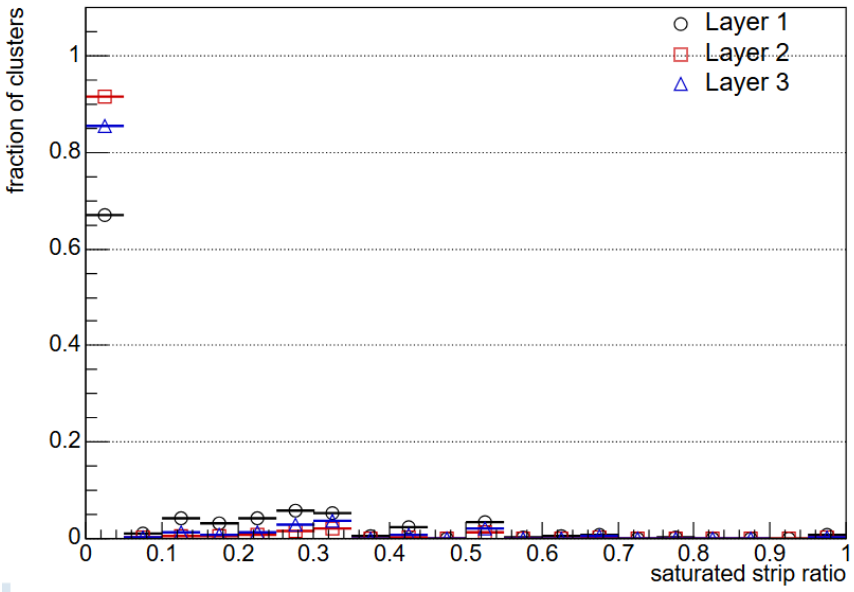
Data sample:
online barrel Bhabha
@3686 on 260220

Resolution variation with layers due to:

2. Charge saturation

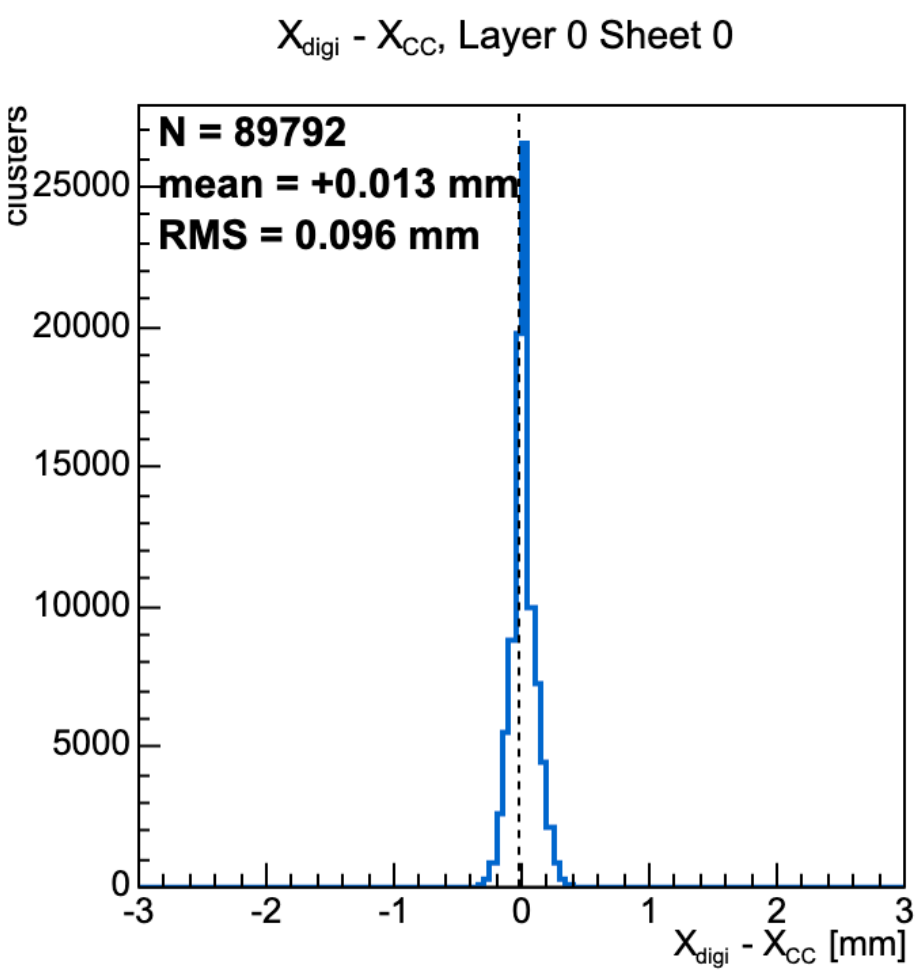
$$\text{Saturated strip ratio} = \frac{\text{N of strips with saturated Q within a cluster}}{\text{N of strips within the cluster(cluster size)}}$$

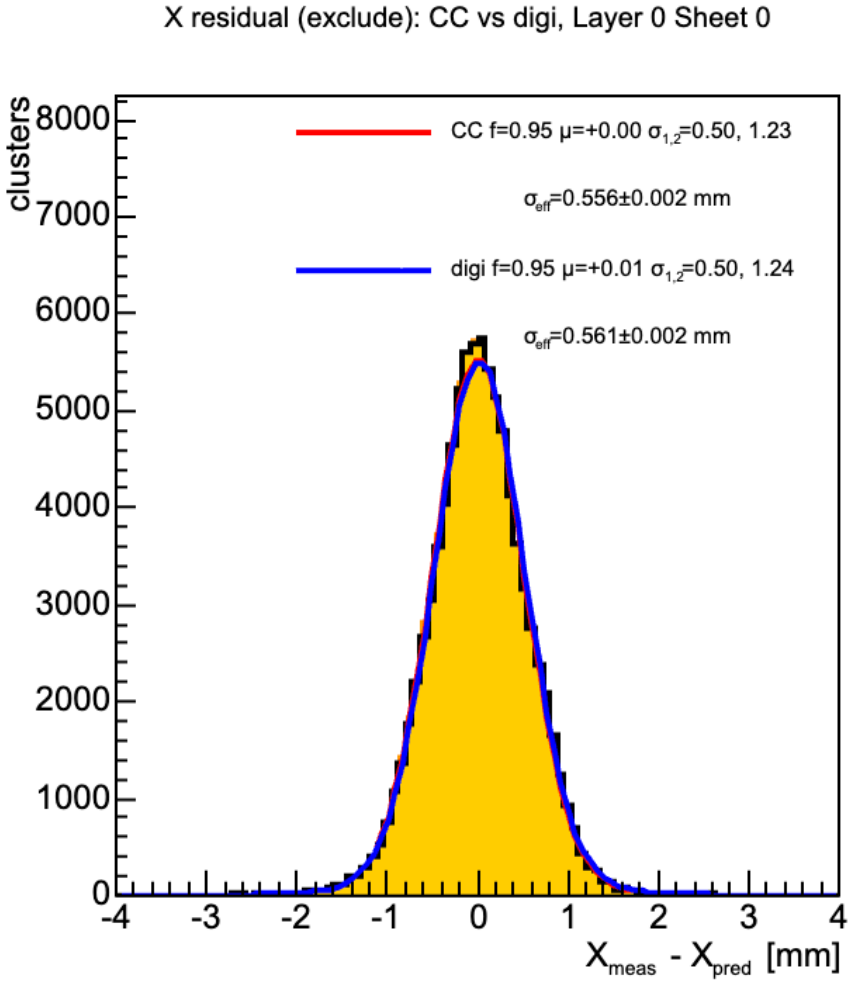




Largest saturation ratio in Layer 1

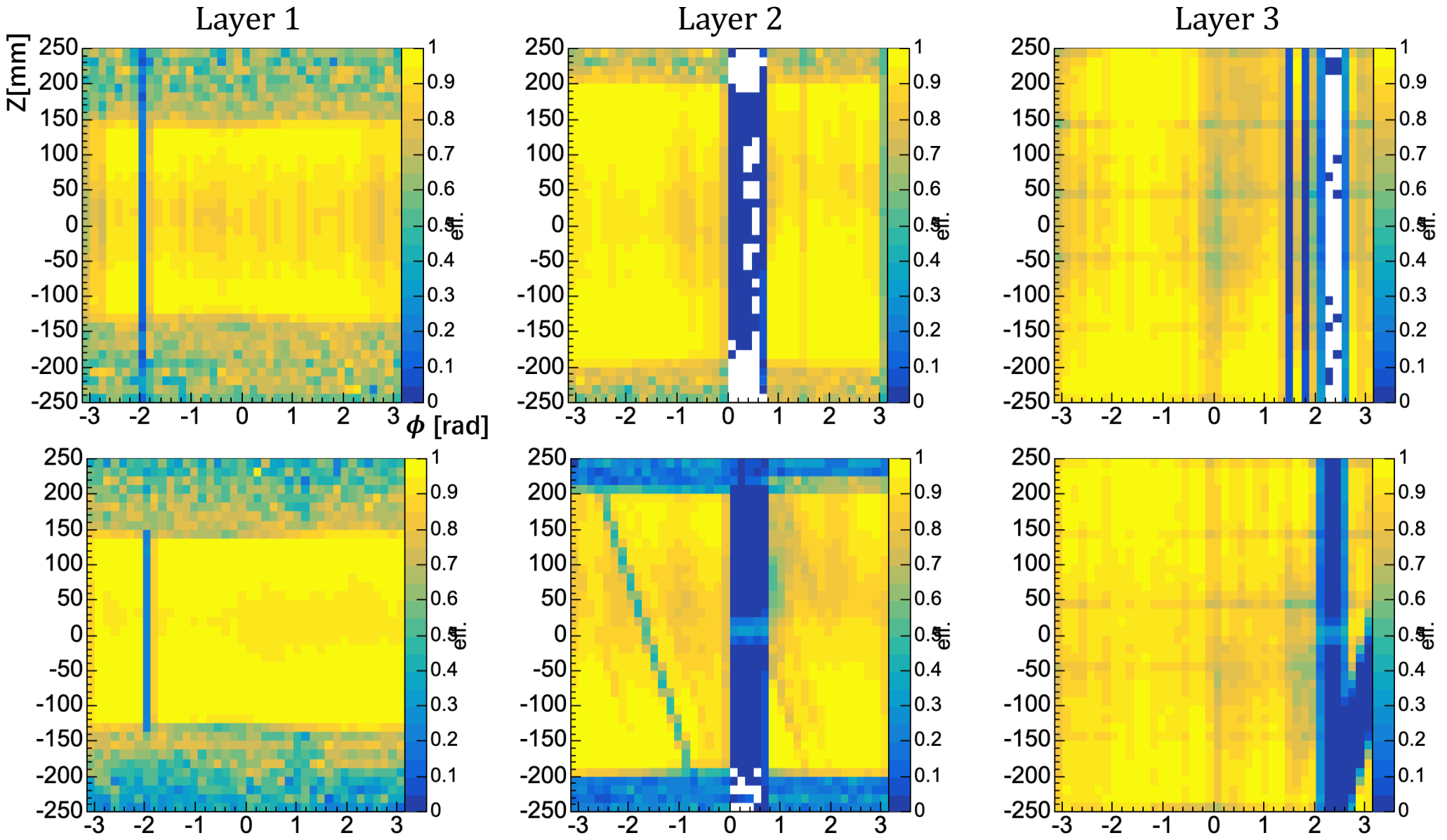
Data sample:
online barrel Bhabha





1D-Cluster Efficiency

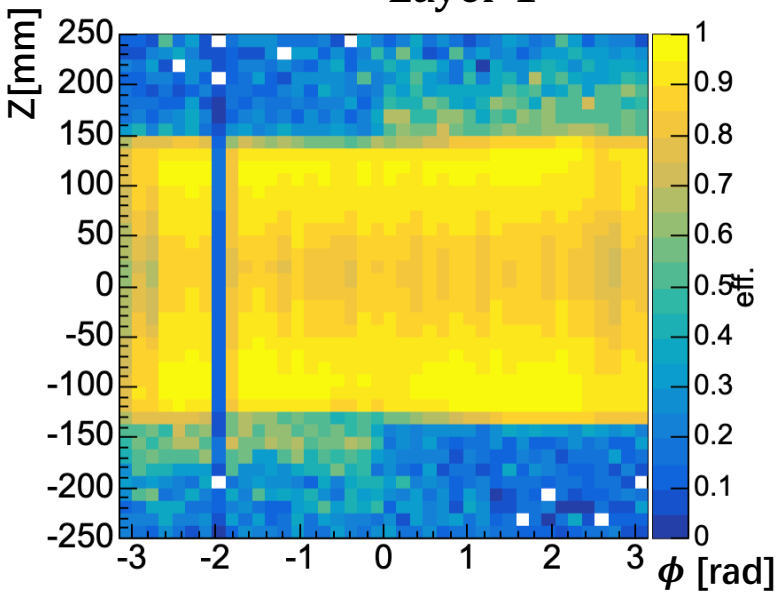
Data sample:
online barrel Bhabha @4680
Run 97300-97508 , round20



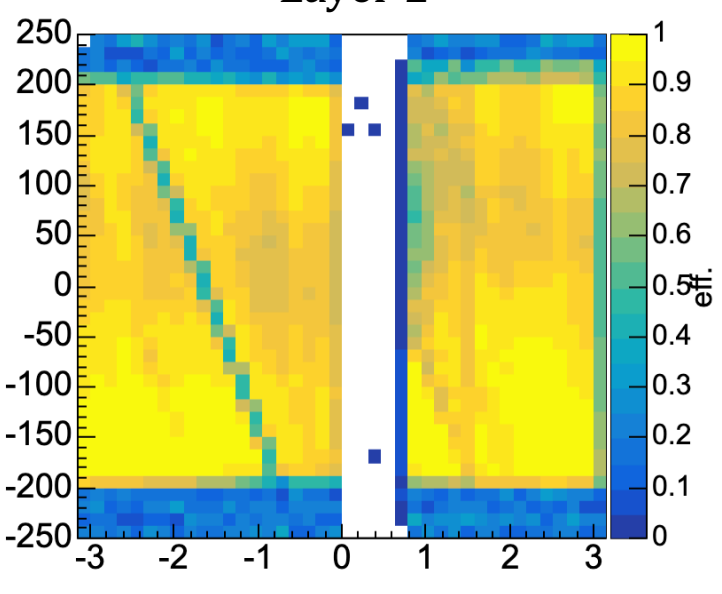
2D-Cluster Efficiency

Data sample:
online barrel Bhabha @4680
Run 97300-97508 , round20

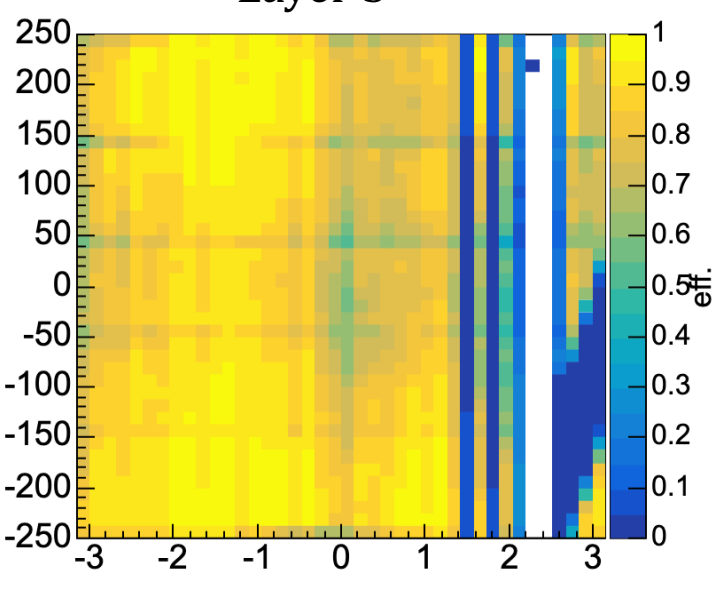
Layer 1



Layer 2



Layer 3

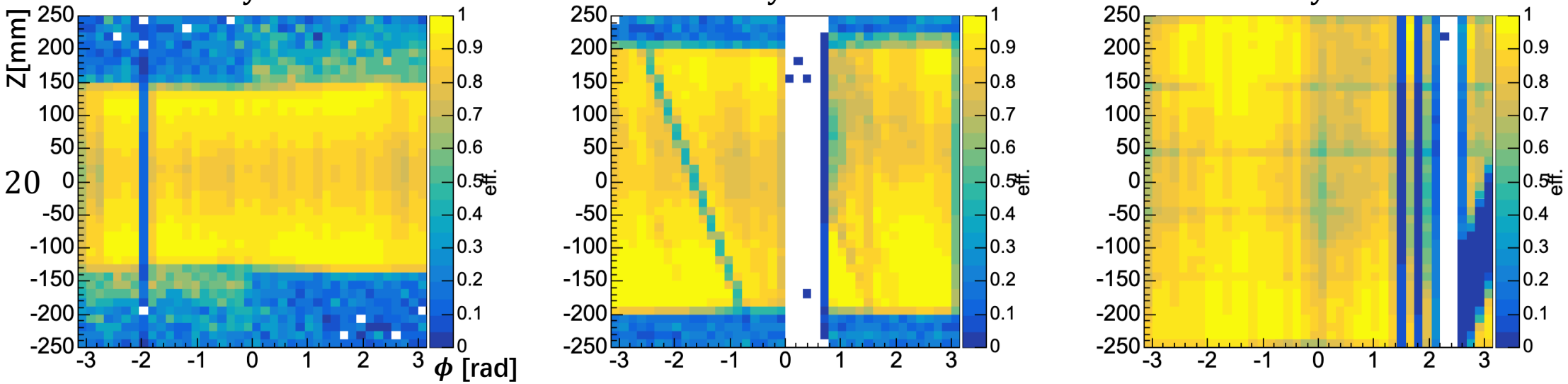


2D-Cluster Efficiency

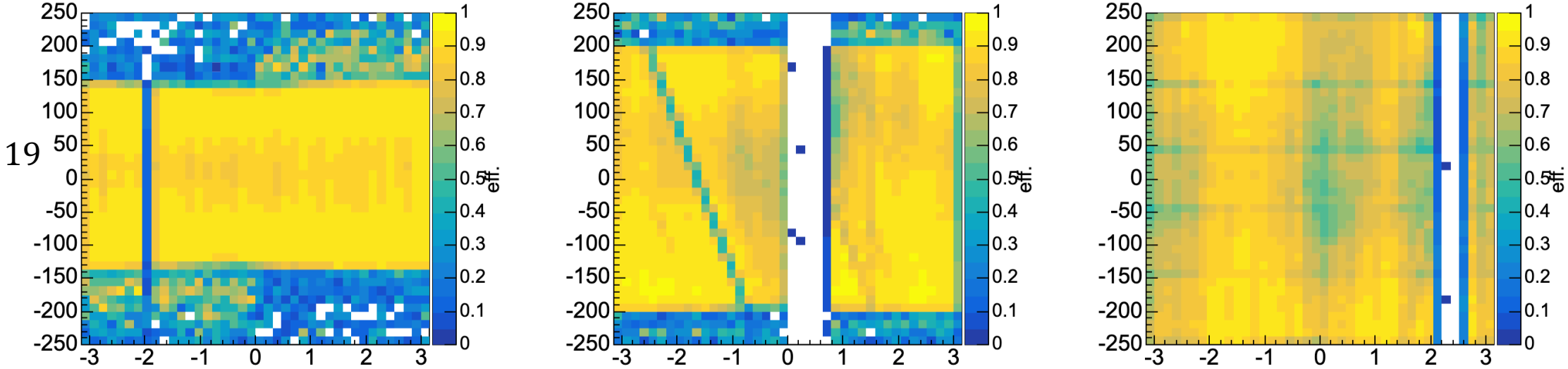
Data sample:
online barrel Bhabha @4680
Run 97300-97508, round 20
Run 93682-93722, round 19

Layer 1 | Layer 2 | Layer 3

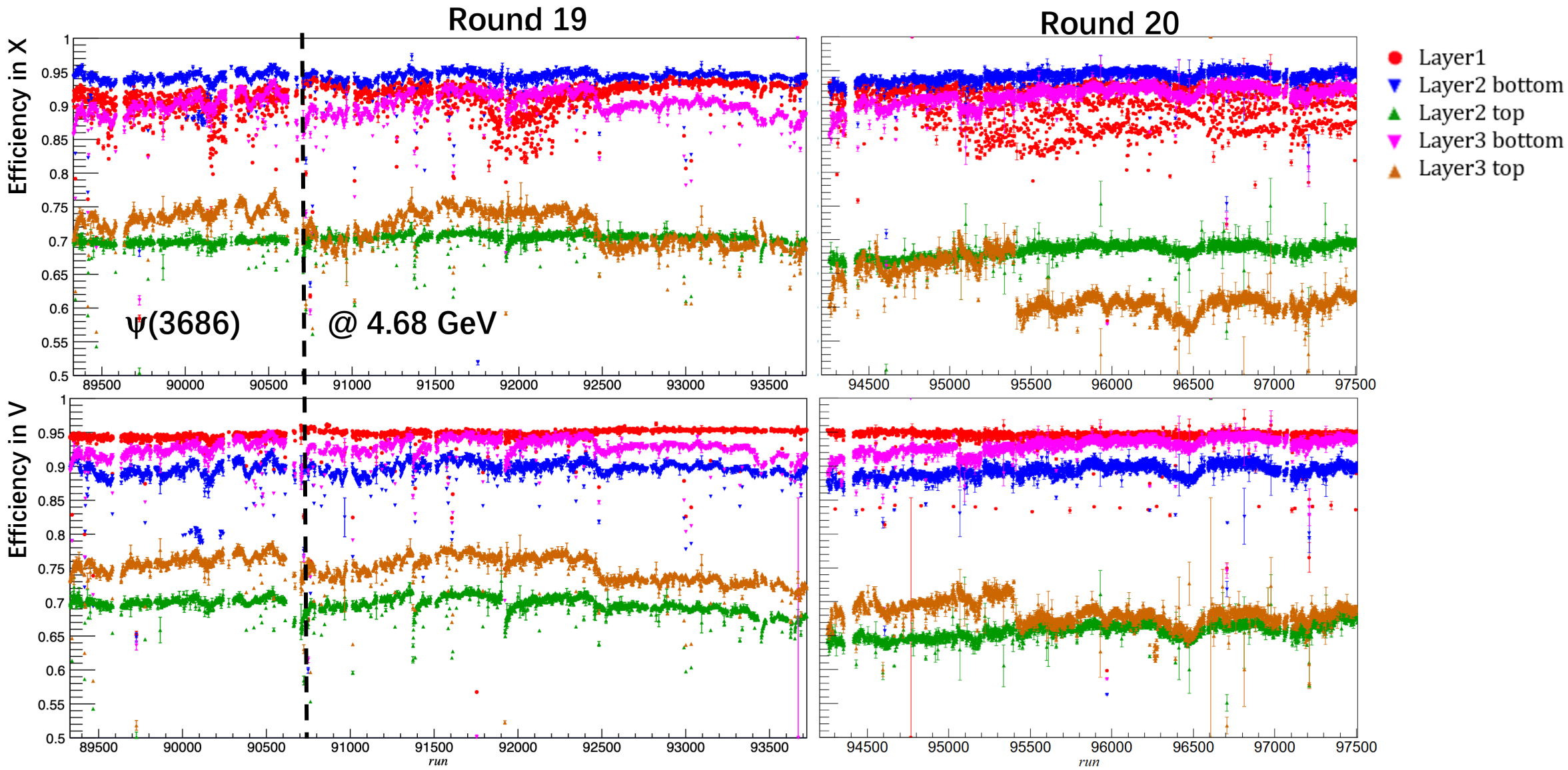
Round 20



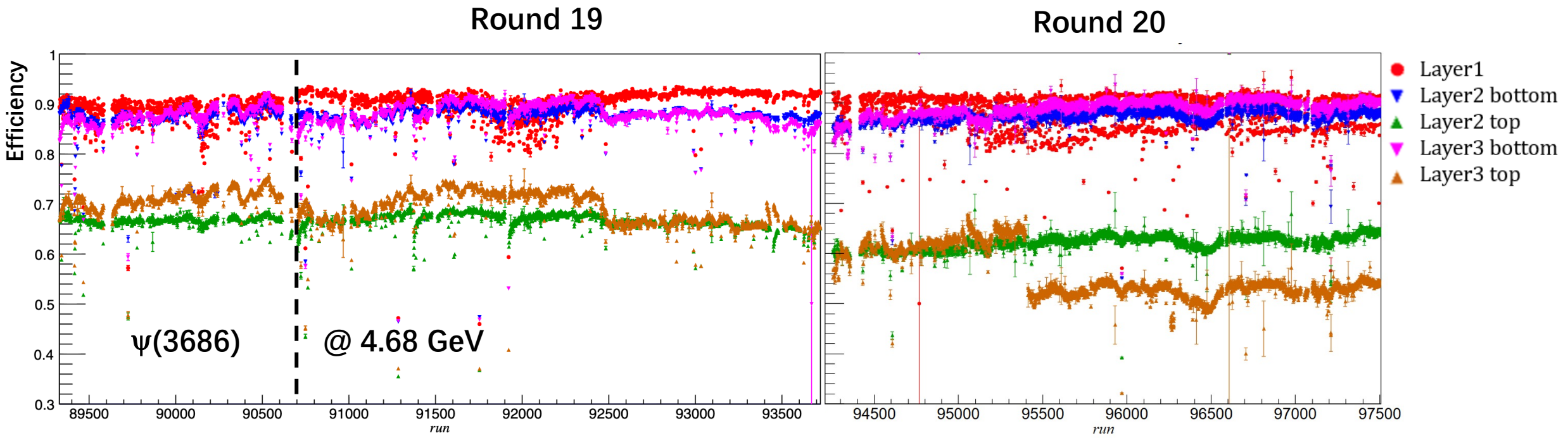
Round 19



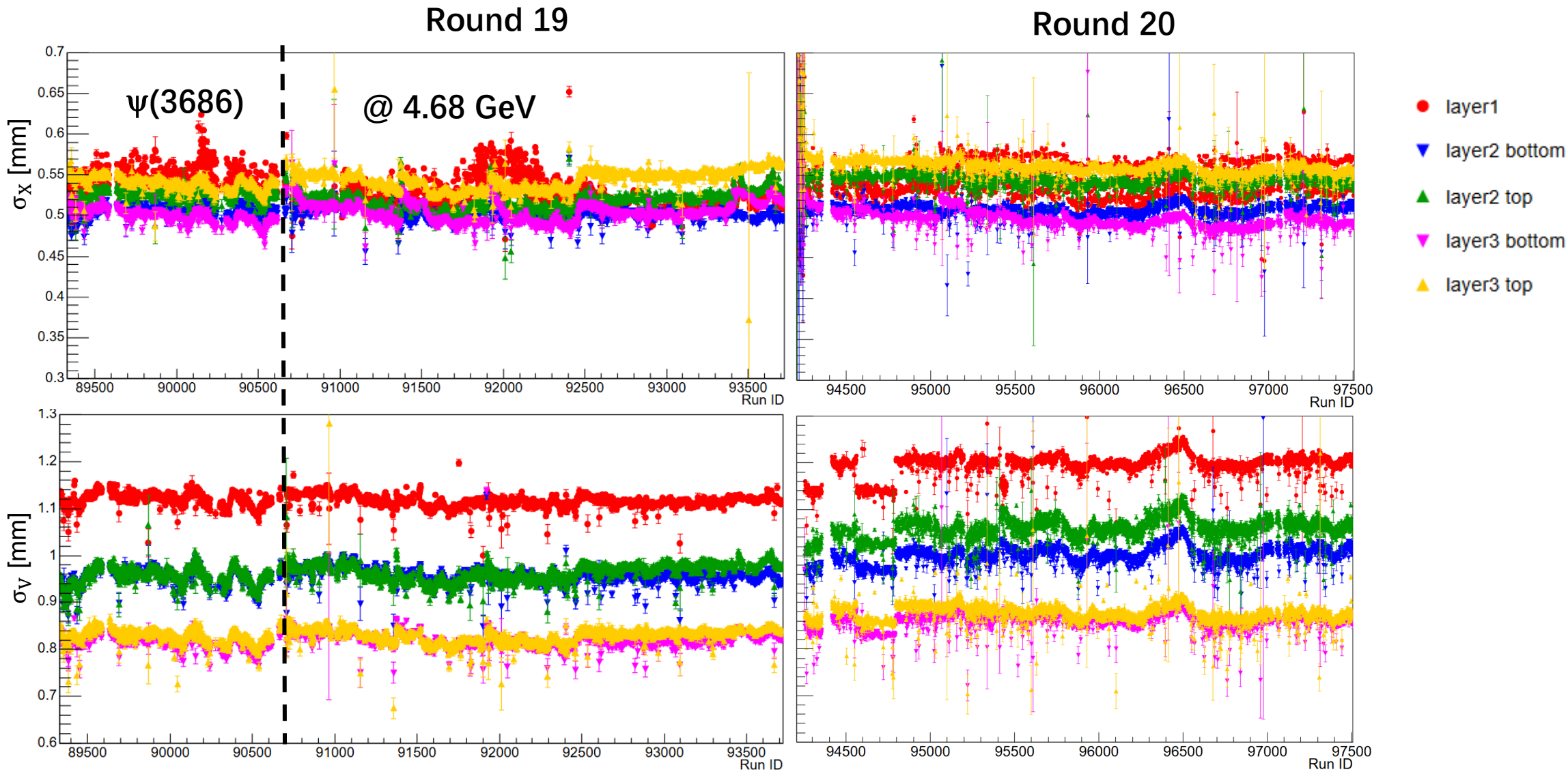
Run-by-run Stability: 1D-Cluster Efficiency



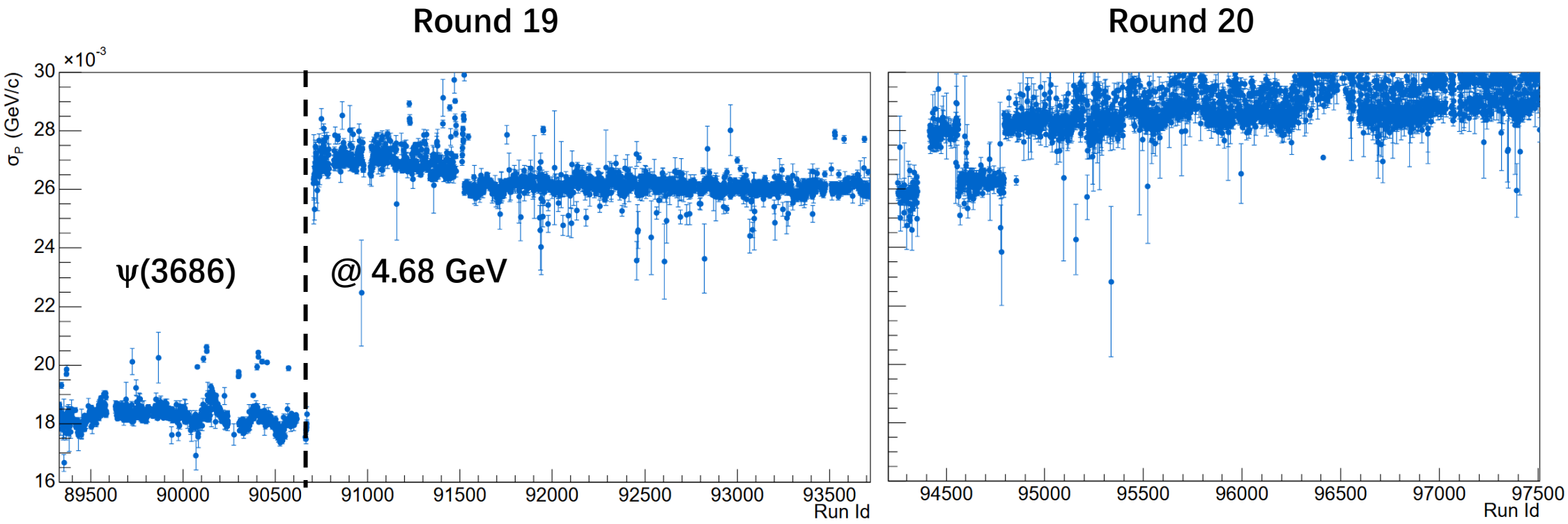
Run-by-run Stability: 2-D Cluster Efficiency



Run-by-run Stability: Spatial Resolution



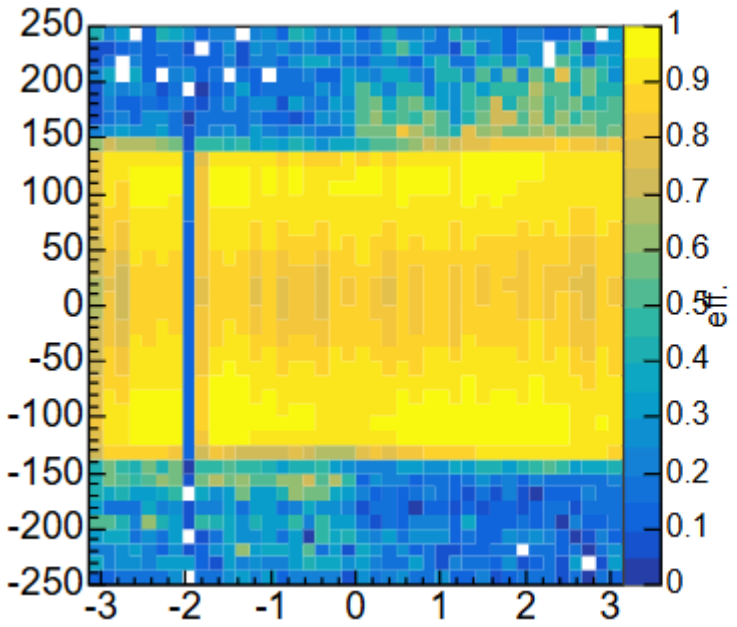
Run-by-run Stability: Momentum Resolution

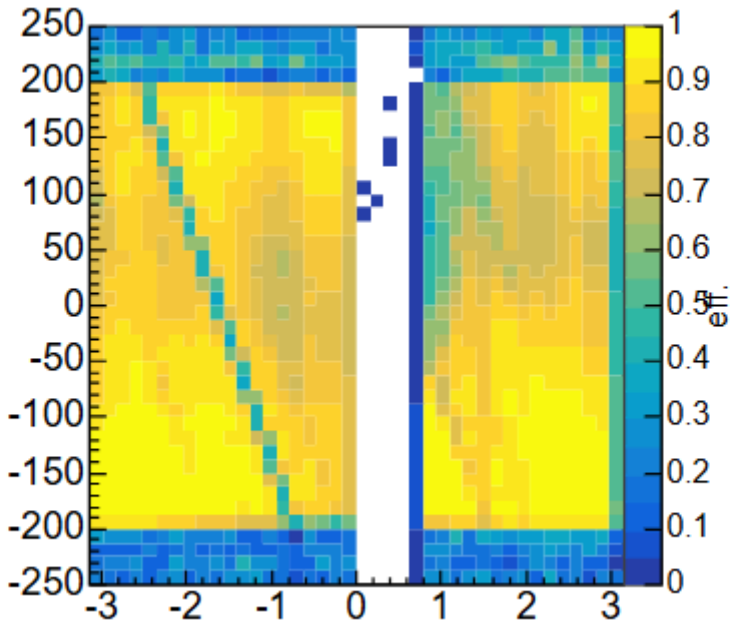


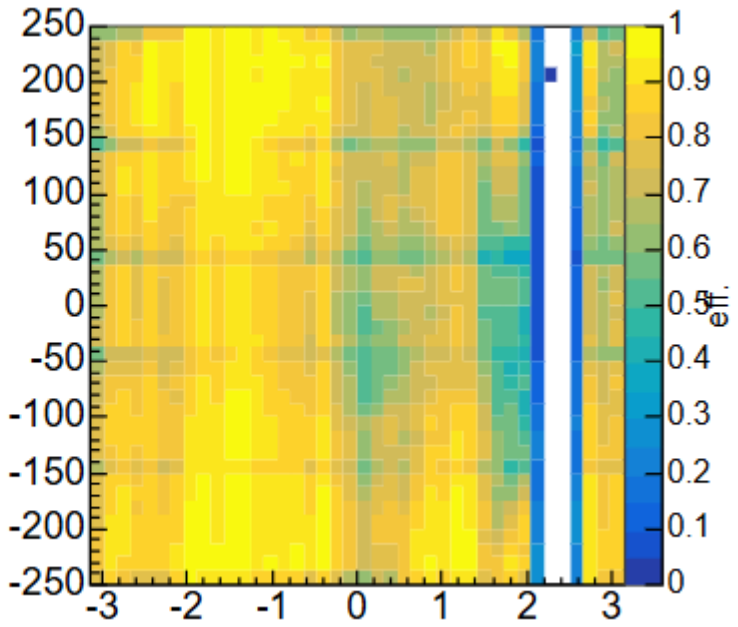
Summary

Back up

Data sample:
online barrel Bhabha @4680
Run 94800-95000, round 20

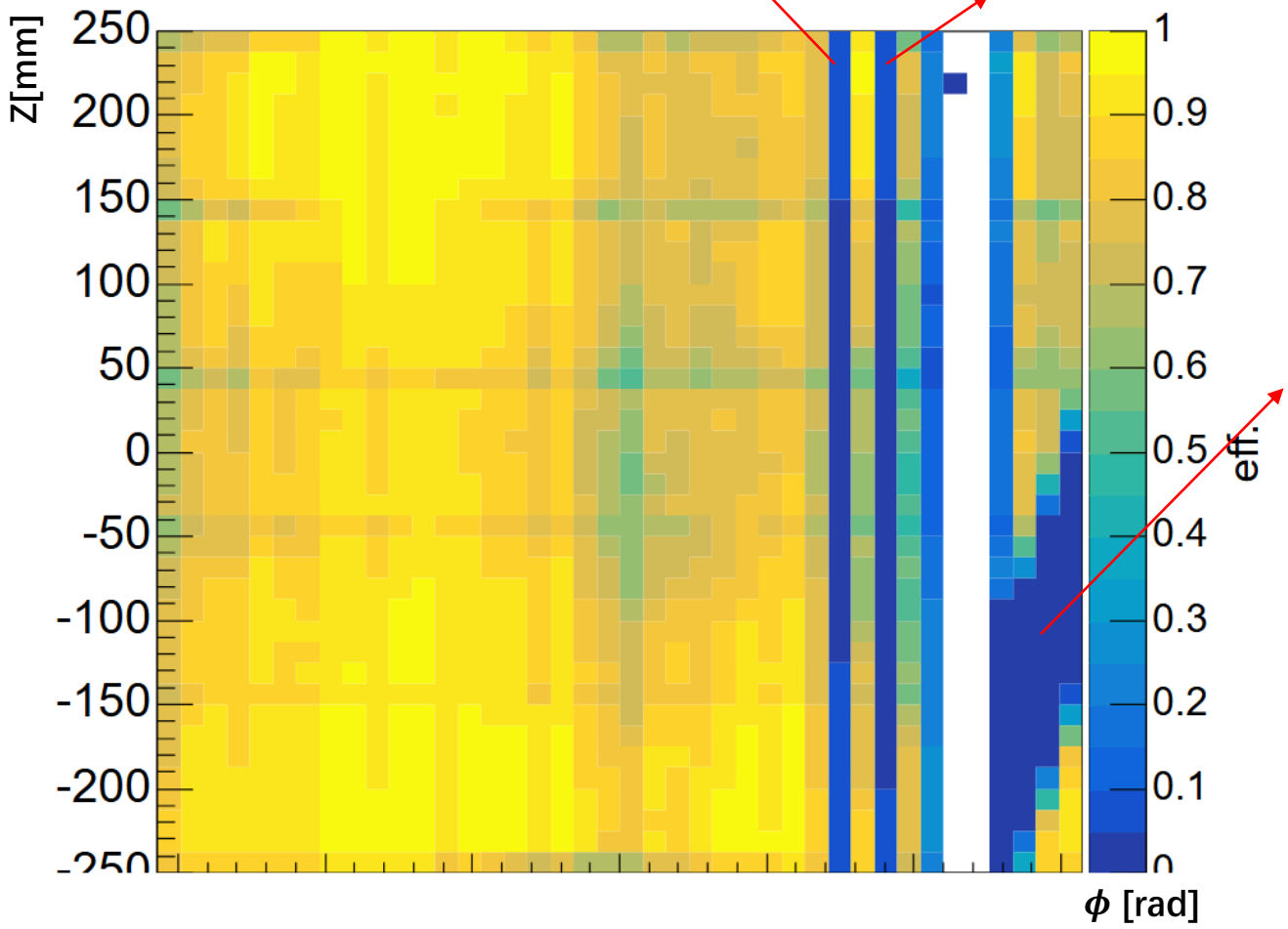






(rough)
ϕ: 1.38~1.57 rad
X strip ID: 365~415

(rough)
ϕ: 1.72~1.88 rad
X strip ID: 455~498



(rough)
V: 660~742.5 mm
V strip ID: (999~1124)