



Wire-Cell ProtoDUNE Local Meeting

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Chung-Ang University
Jul22, 2026 (Wed)

Wire-Cell DNN Signal Processing

Track Angle Performance Evaluation

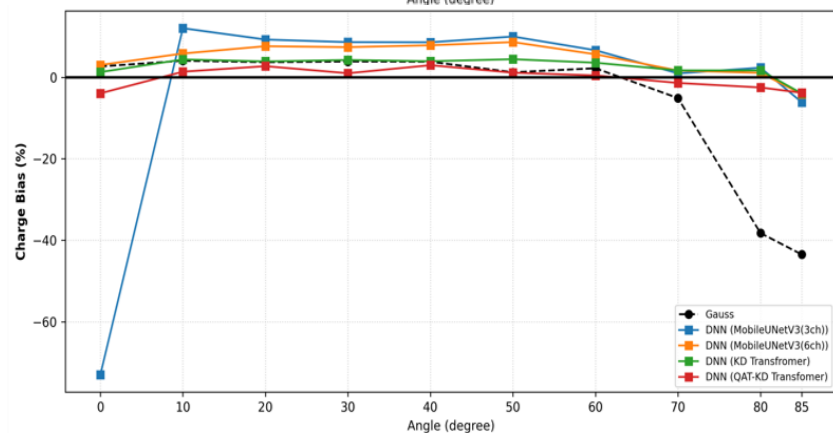
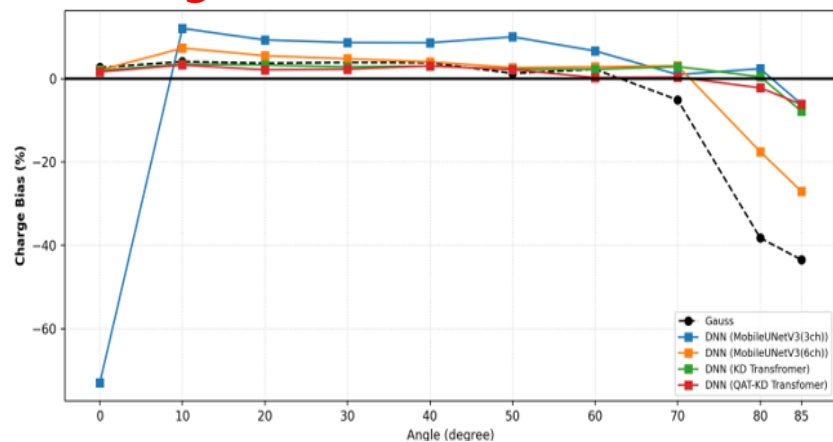
- rebin factor: 4
- mask threshold: 0.2
- No L1SP

- 6ch Models performed better.
- KD improved the performance.
- KD and QAT-KD are similar.

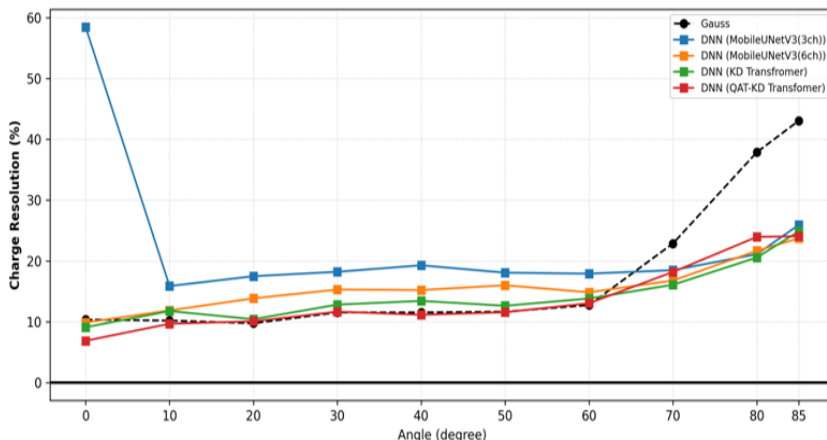
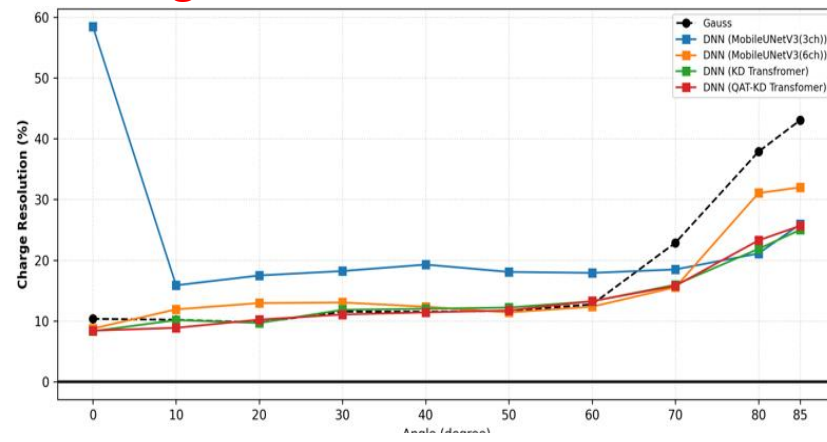
1st row: Production Models in `wire-cell-data`

2nd row: Reproduced models

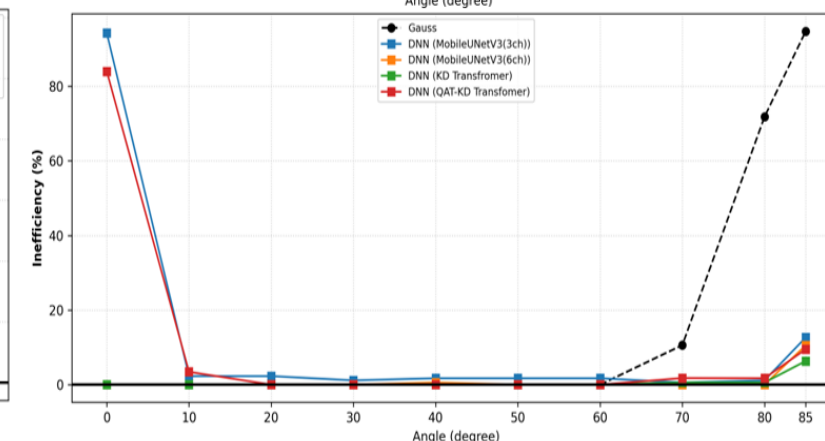
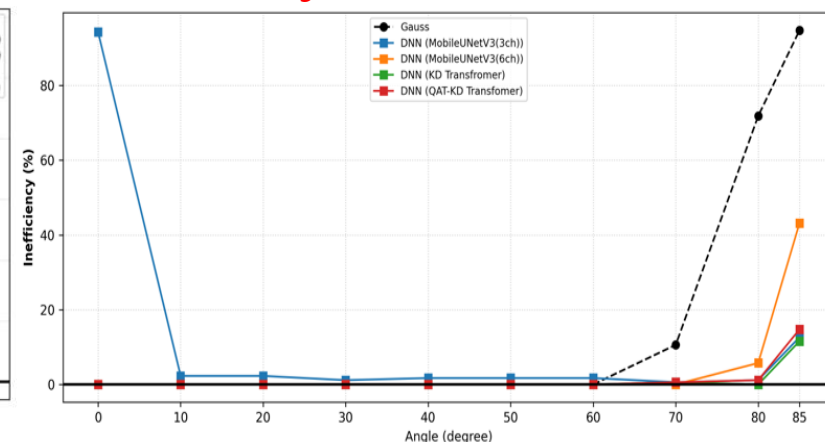
Charge Bias



Charge Resolution



Inefficiency

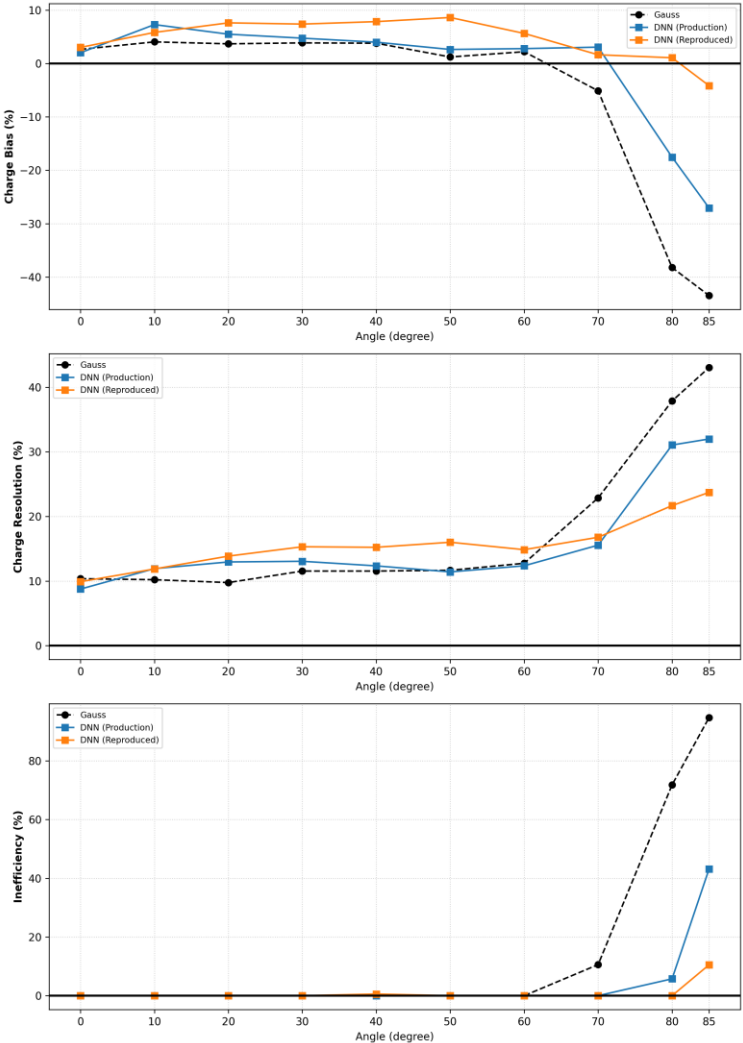


Wire-Cell DNN Signal Processing

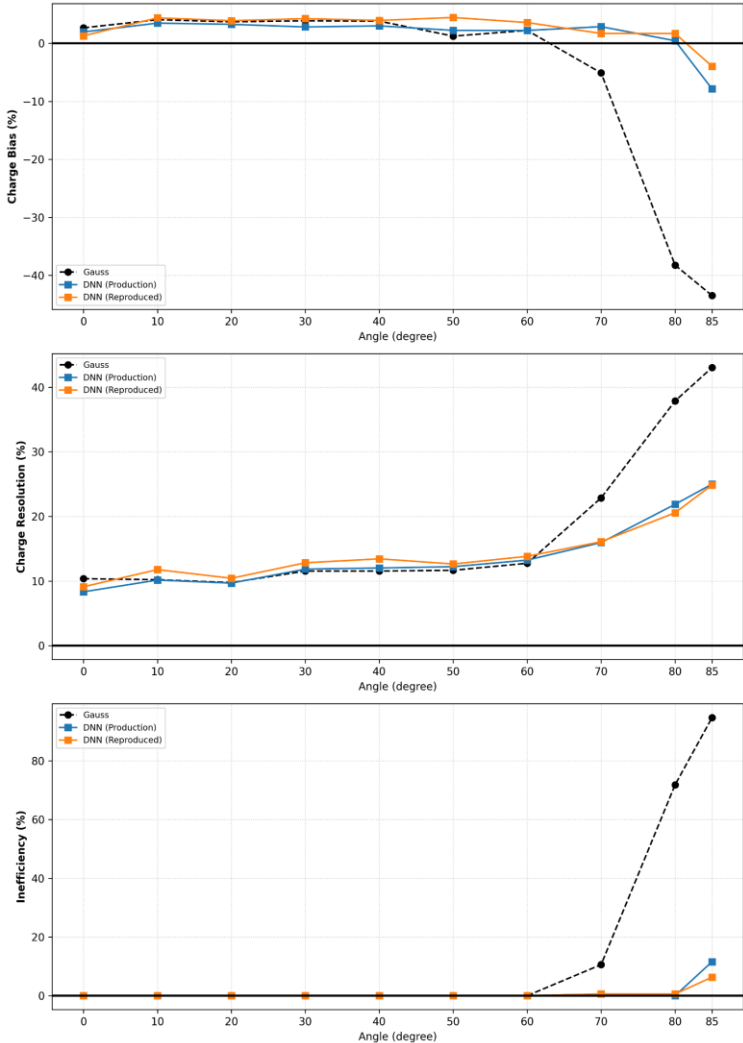
Track Angle Performance Evaluation

Production models VS Reproduced models

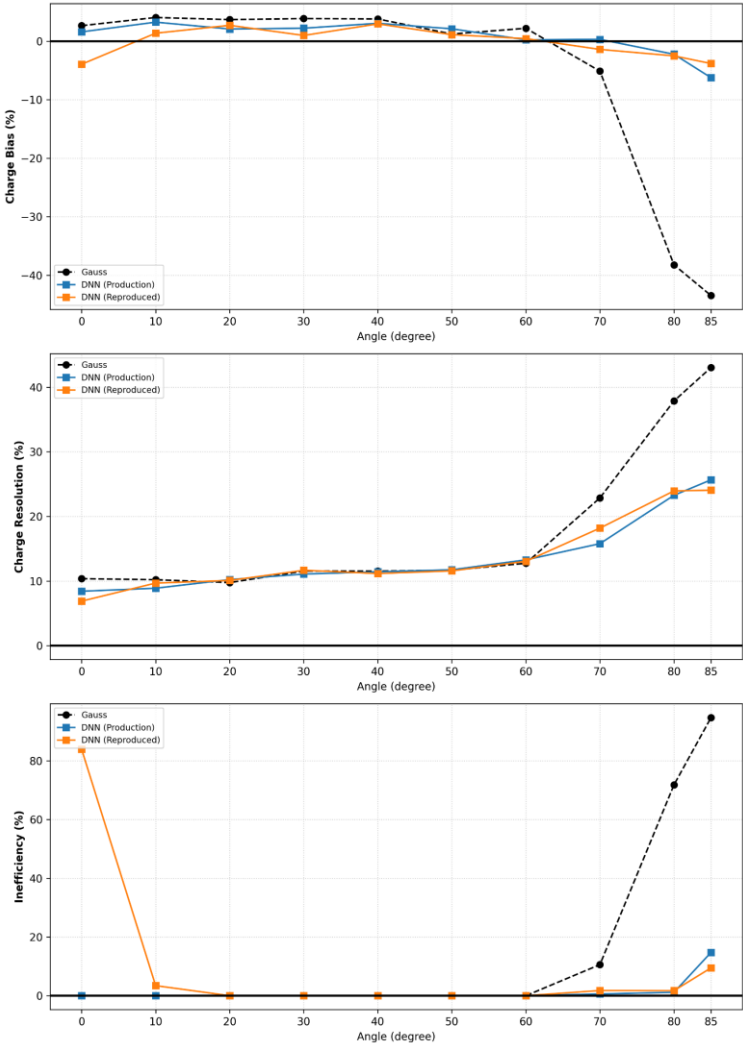
- Baseline(6ch)



- KD



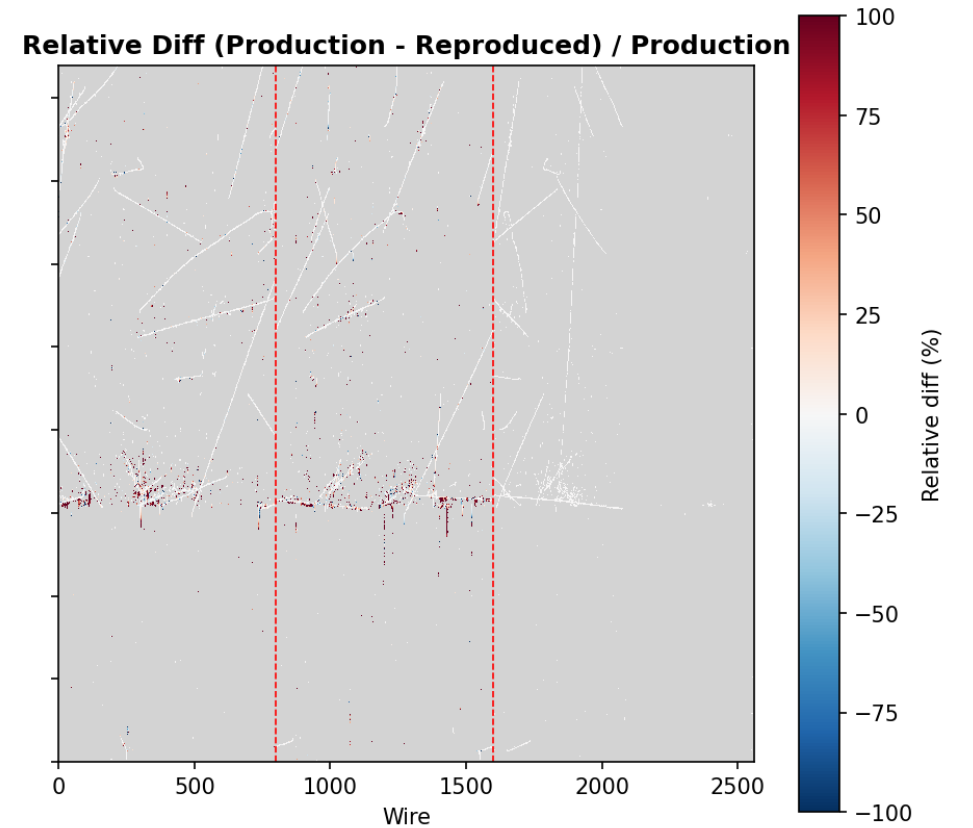
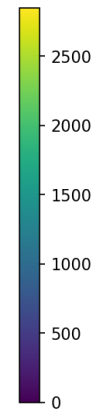
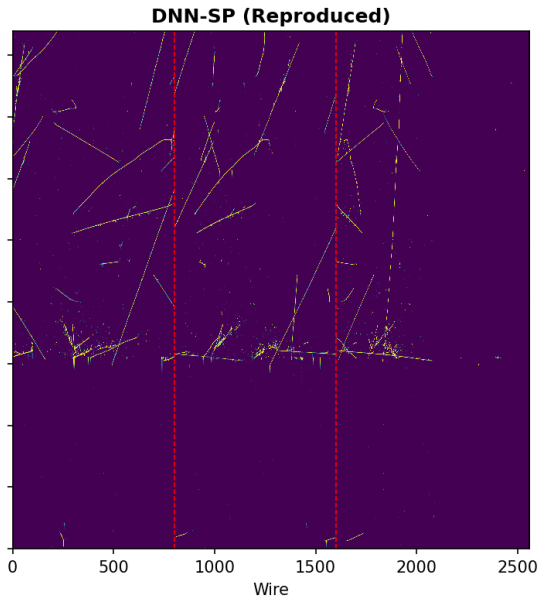
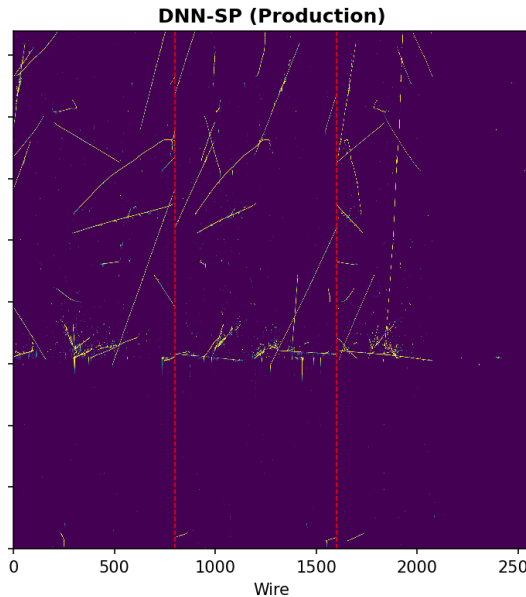
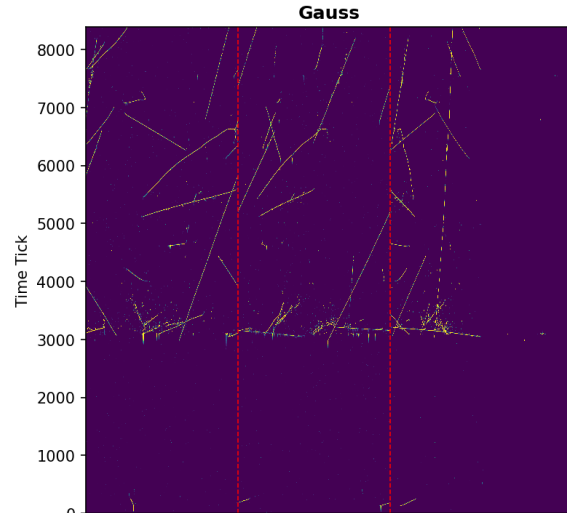
- QAT-KD



Wire-Cell DNN Signal Processing

Data Processing

Run 026763 – event 225 (APA2): Baseline



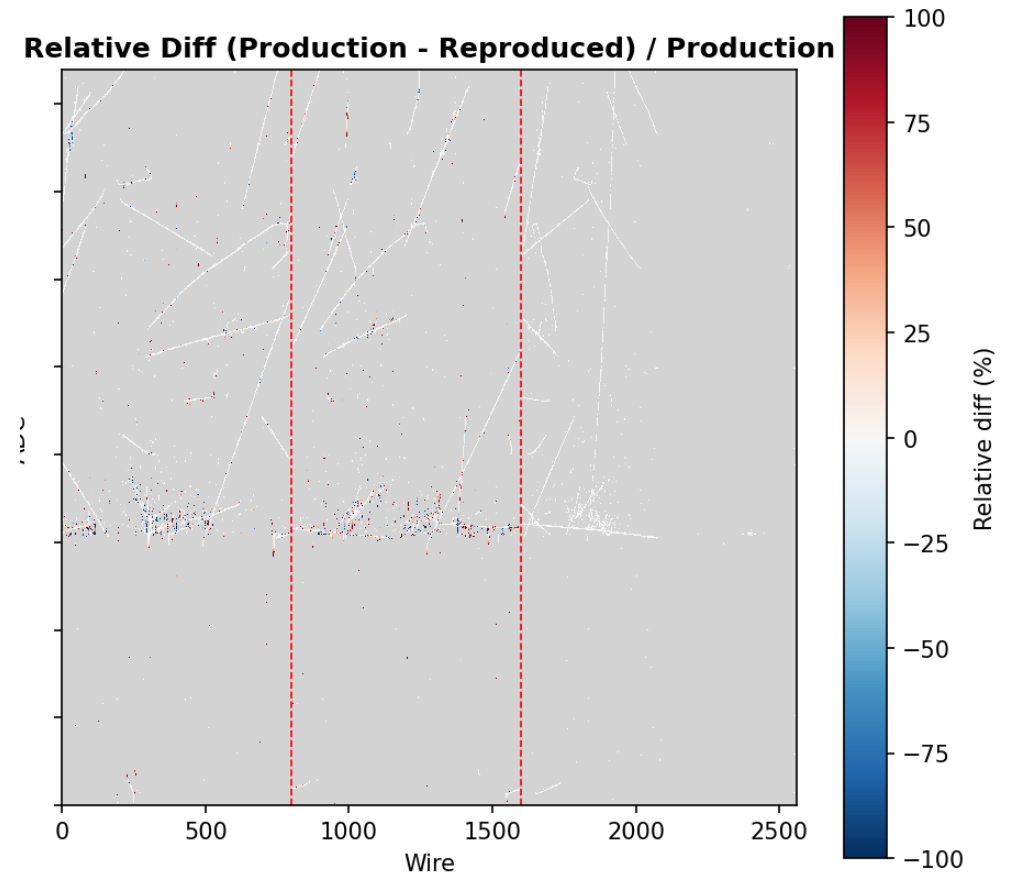
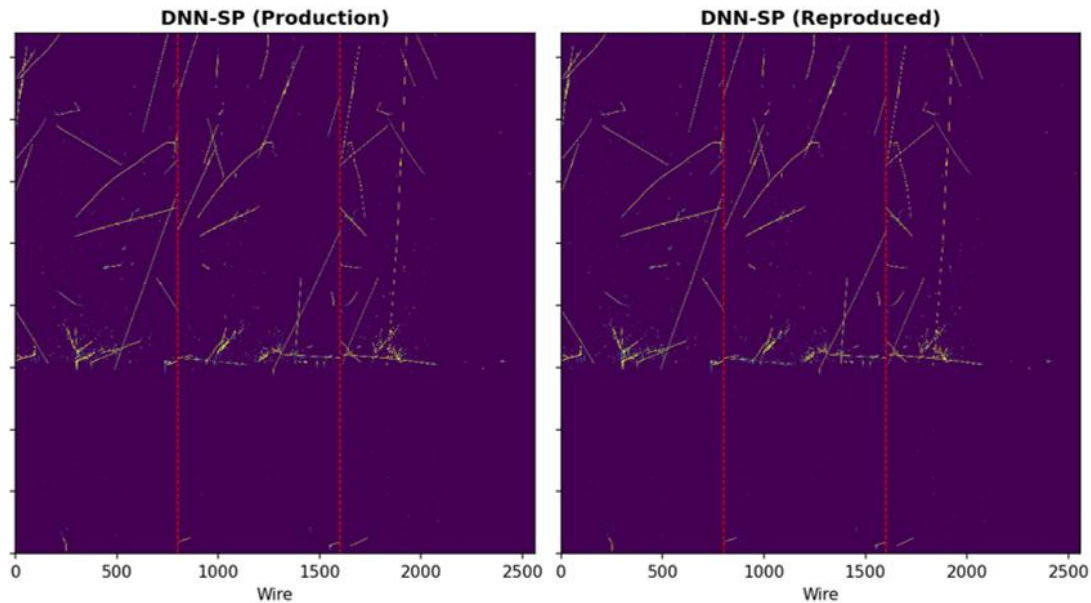
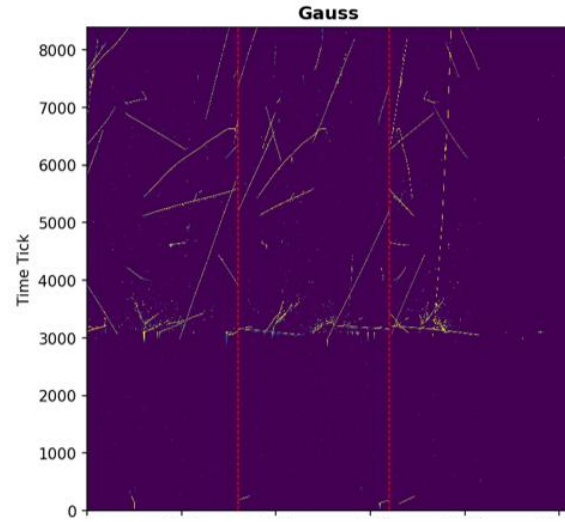
- To check how they similar, use weighted IoU b/w them

```
"APA1": 0.9860763826885098,  
"APA2": 0.9637012069664505,  
"APA3": 0.961846329582032,  
"APA4": 0.98240072359455
```

Wire-Cell DNN Signal Processing

Data Processing

Run 026763 – event 225 (APA2): KD

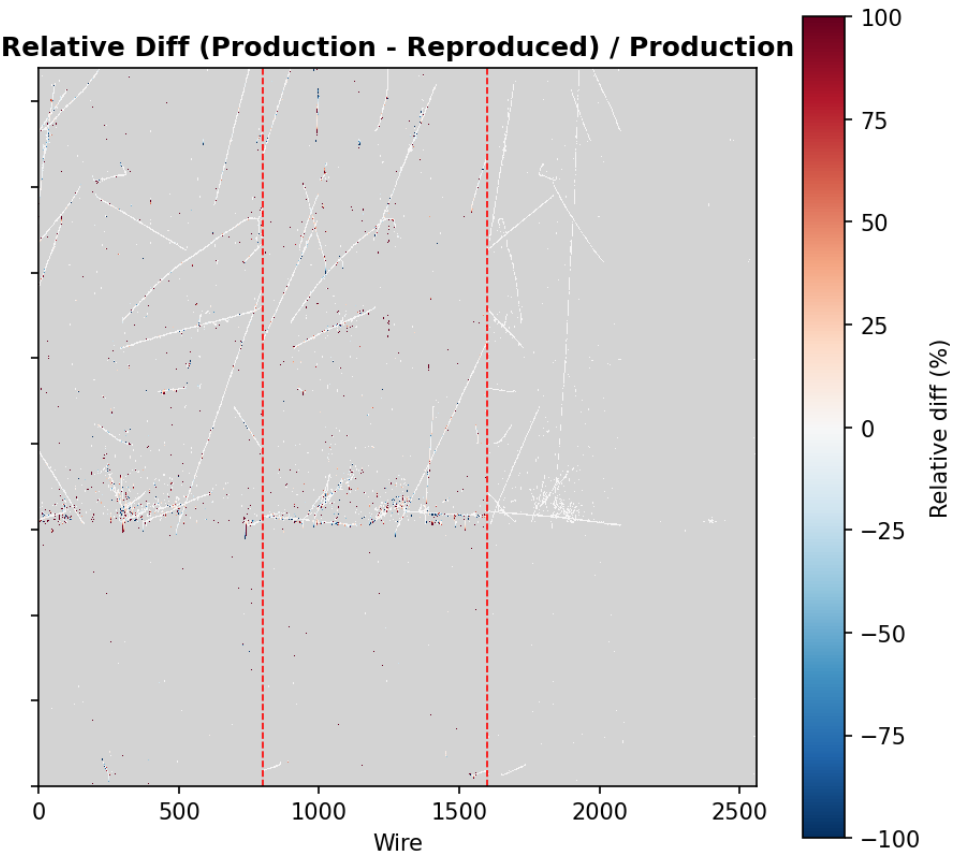
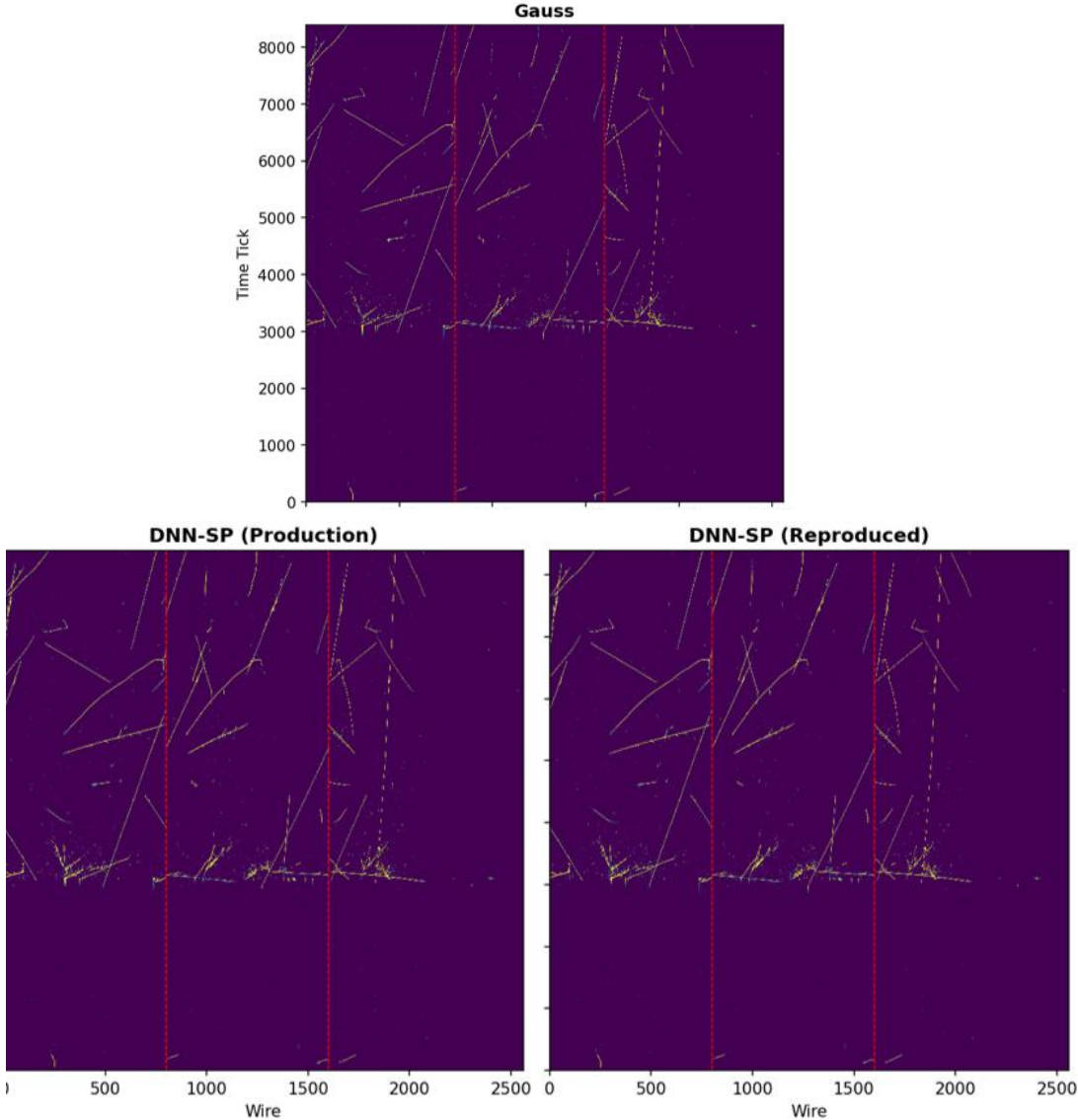


"APA1": 0.9859609320046578,
"APA2": 0.961353138603662,
"APA3": 0.9643495969113064,
"APA4": 0.9829708252055591

Wire-Cell DNN Signal Processing

Data Processing

Run 026763 – event 225 (APA2): QAT-KD



"APA1": 0.9863117627390757,
"APA2": 0.9641320900971604,
"APA3": 0.9565305685005011,
"APA4": 0.9752324622960108

Wire-Cell 3D Imaging

Depo-Blob Center Comparison

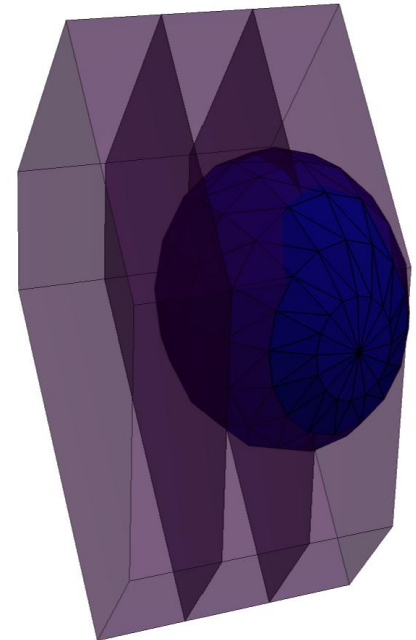
- Depo is a continuous object with longitudinal and transverse Gaussian distributions.
 - > Approximated as a 3D ellipsoid with boundaries at 3σ in longitudinal and transverse directions.

Depo Center Definition

- Depo initial position $(t, x_{initial}, y, z)$ -> After drift $(t + \Delta t, x_{response\ plane}, y, z)$
- Since time offset (t_{offset}) b/w depo & blobs exists, depo initial position $(t, x_{initial}, y, z)$ couldn't be compared directly with blob centers.
- Instead, use $x = x_{response\ plane} - v_{drift} \cdot (\Delta t + t_{offset})$

Reconstructed Blob Center

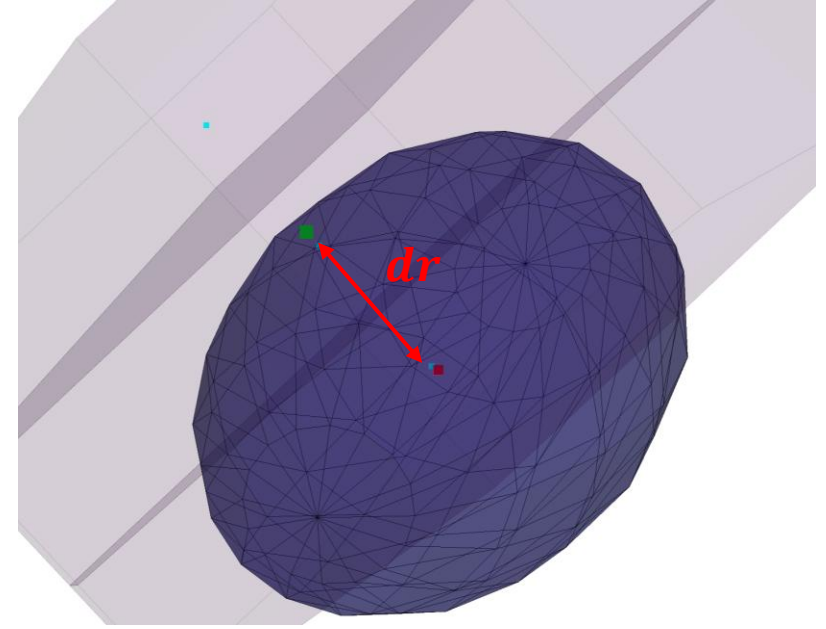
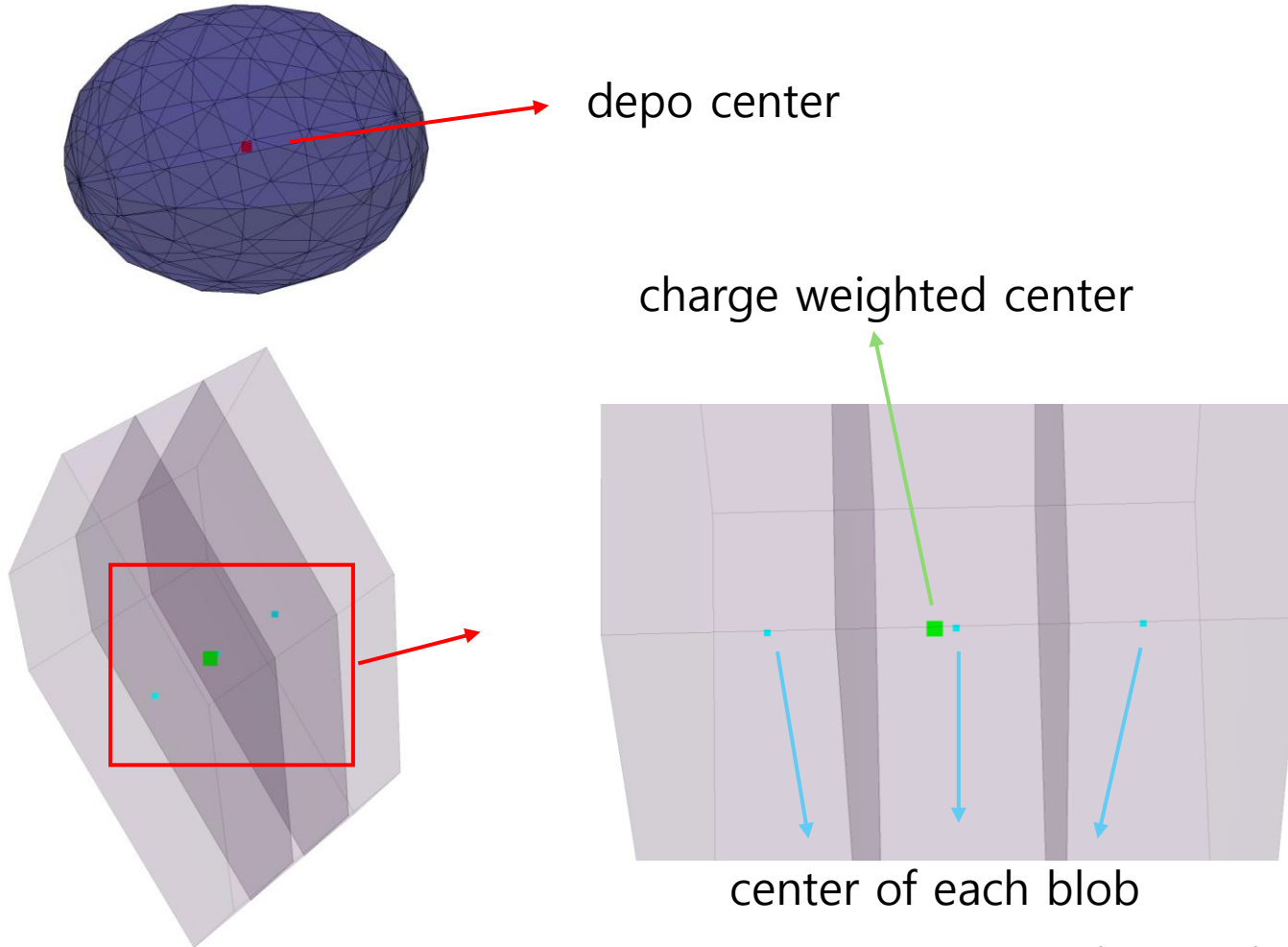
- Depo spans more than one slice, 3 – 4 blobs are matched to one depo.
- To compare depo & blob center one-to-one,
 - Find center of each blob as an average of all corners.
 - Calculate charge weighted average center of 3 – 4 centers
 - This charge weighted center is one-to-one matched with the depo.



Wire-Cell 3D Imaging

Depo-Blob Center Comparison

Example



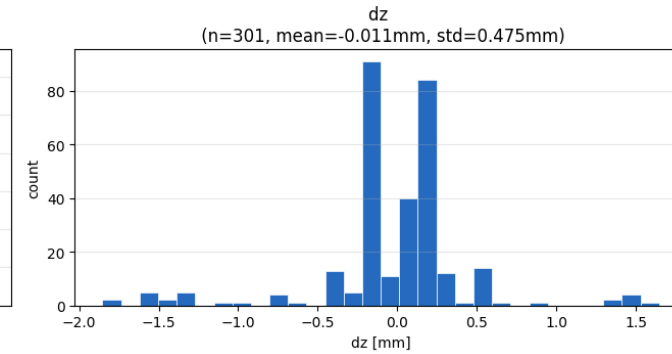
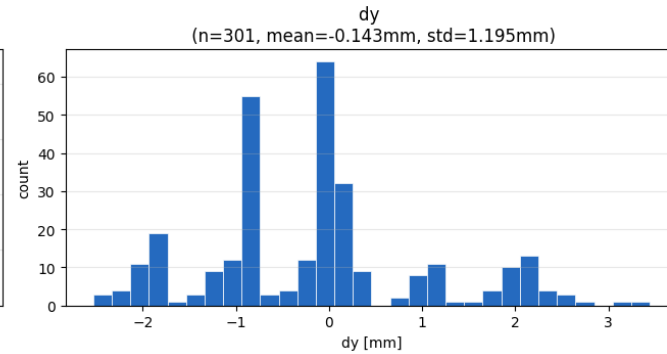
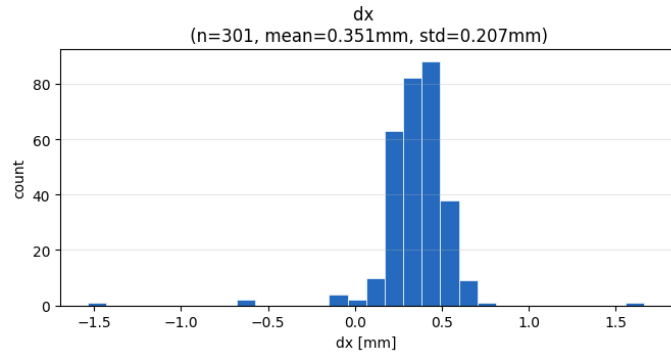
Wire-Cell 3D Imaging

Depo-Blob Center Comparison

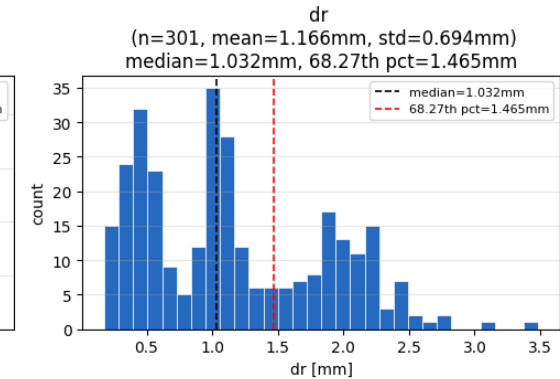
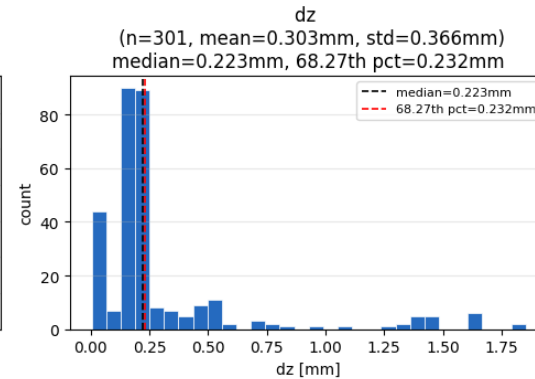
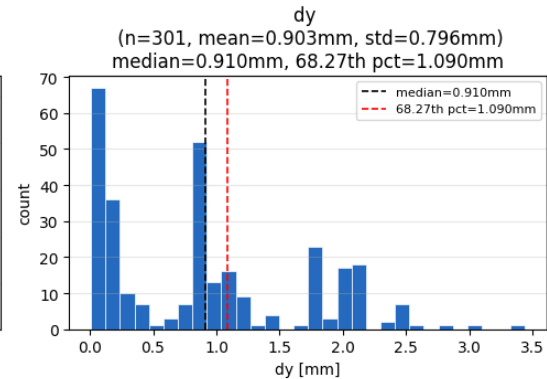
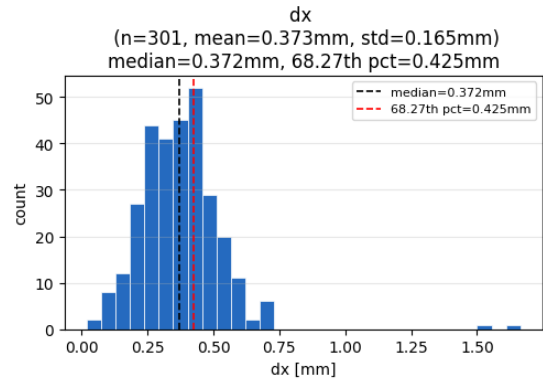
- 306 point depos in PDHD APA2
- dx , dy , dz = blob's charge weighted center – depo center

Dimension	Median	68.27% Percentile
x [mm]	0.372	0.425
y [mm]	0.910	1.090
z [mm]	0.223	0.232
r [mm]	1.032	1.465

Depo center vs. charge-weighted blob center



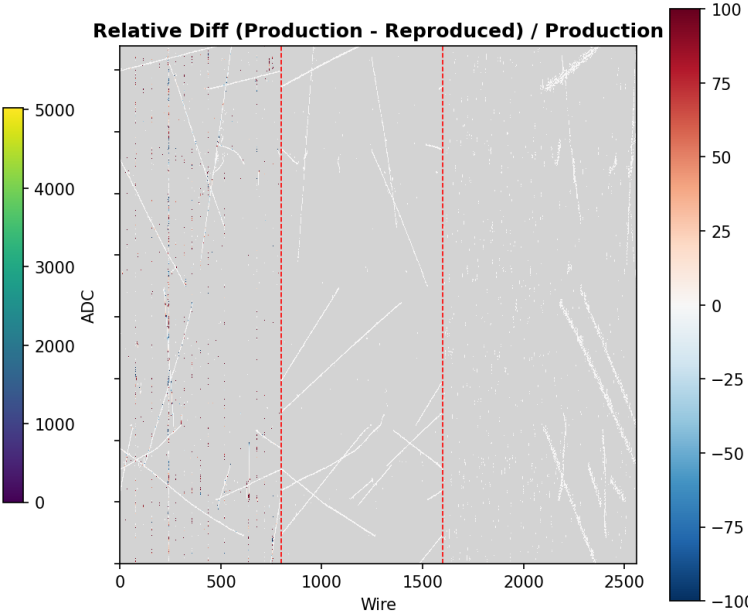
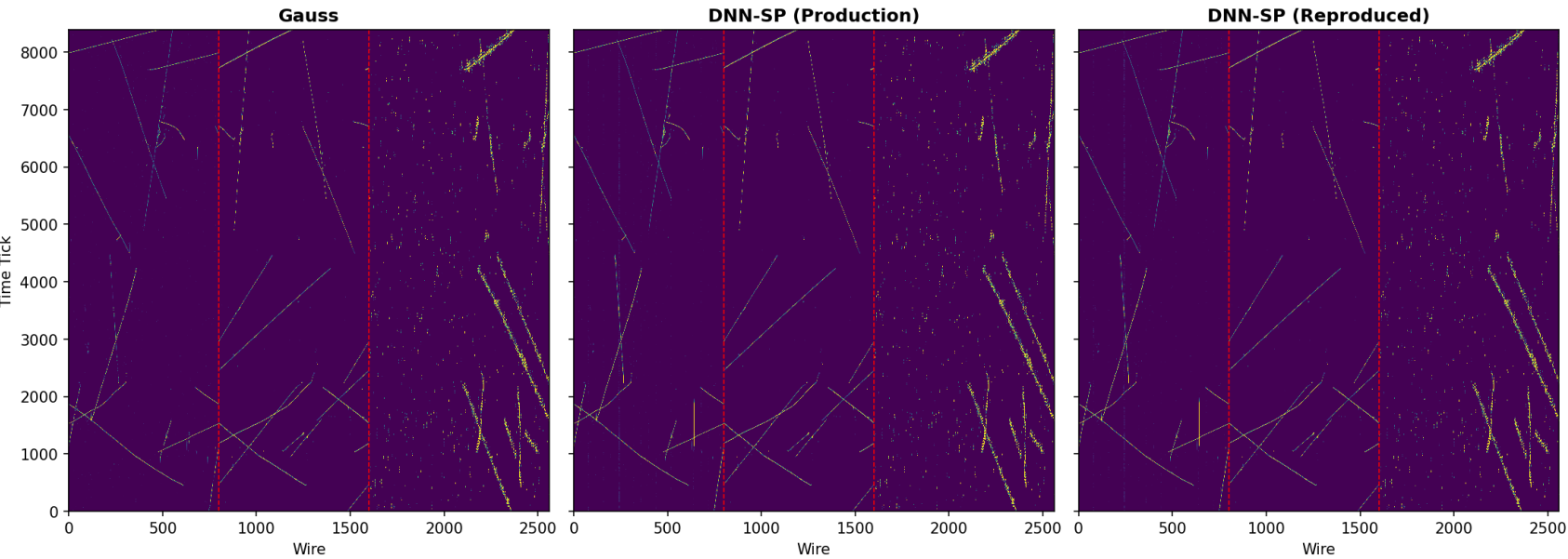
Depo center vs. charge-weighted blob center



Backup

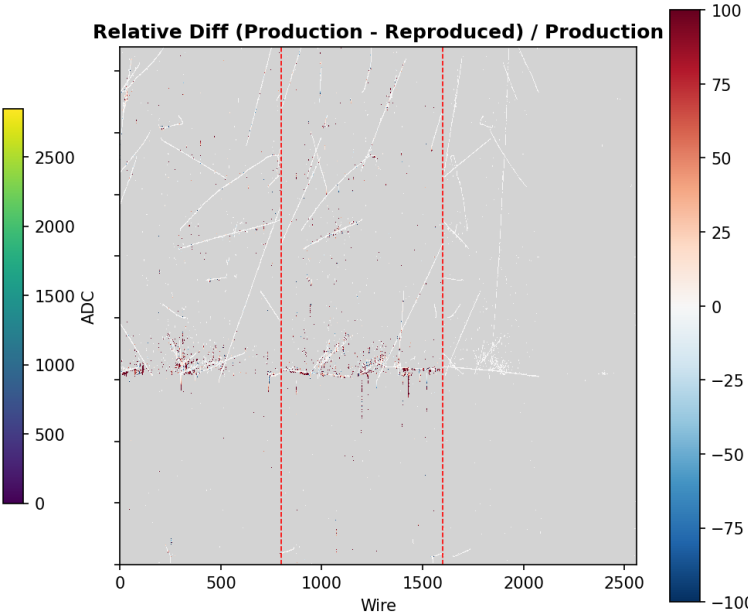
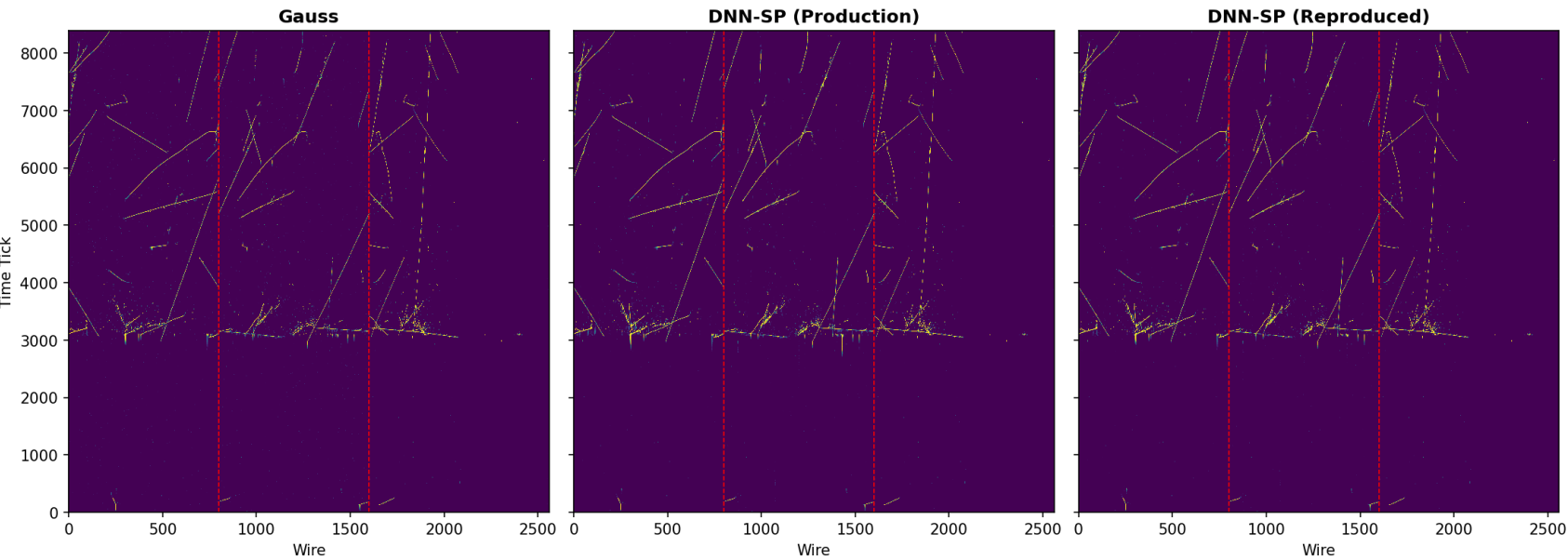
Run 026763 – event 225 (APA1): Baseline

base_mbv3 : g4-rec-0 (group 225)



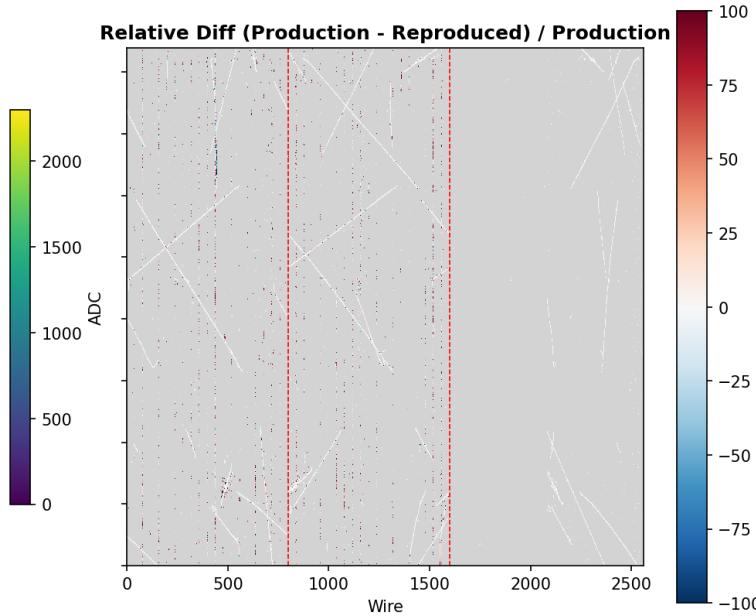
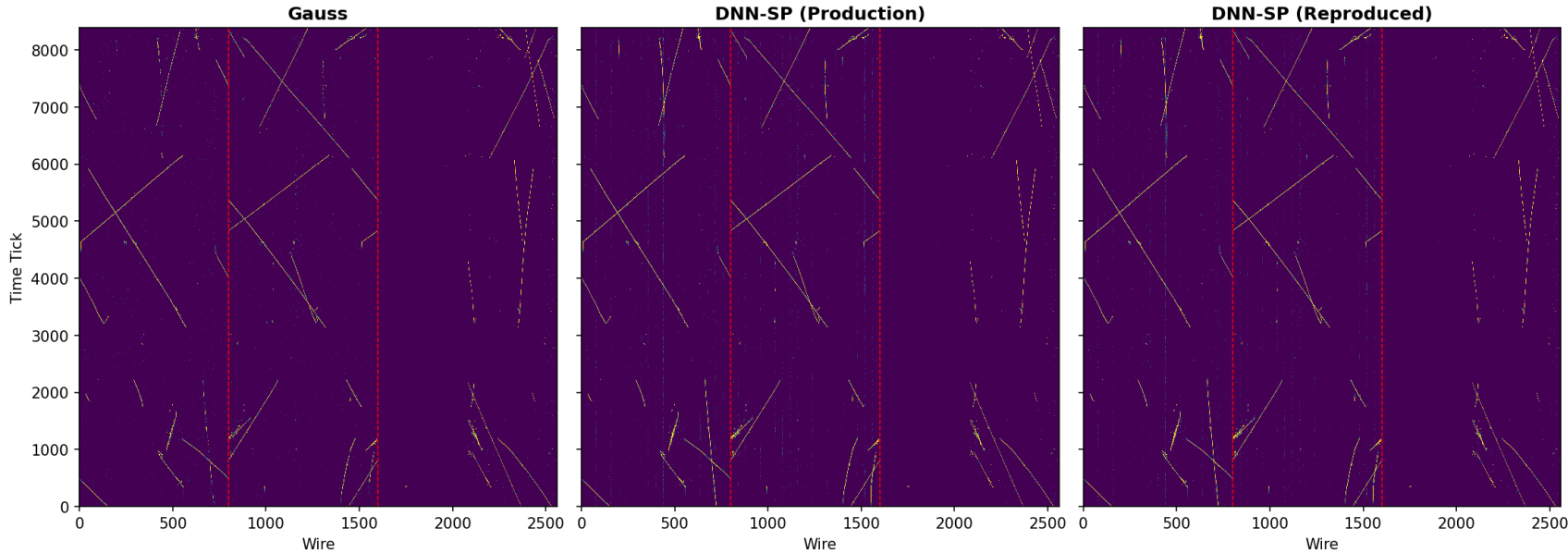
Run 026763 – event 225 (APA2): Baseline

base_mbv3 : g4-rec-1 (group 225)



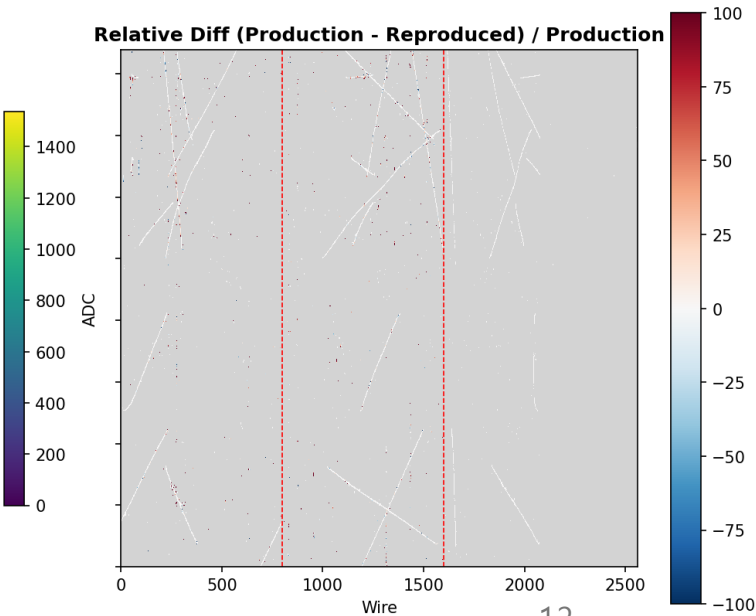
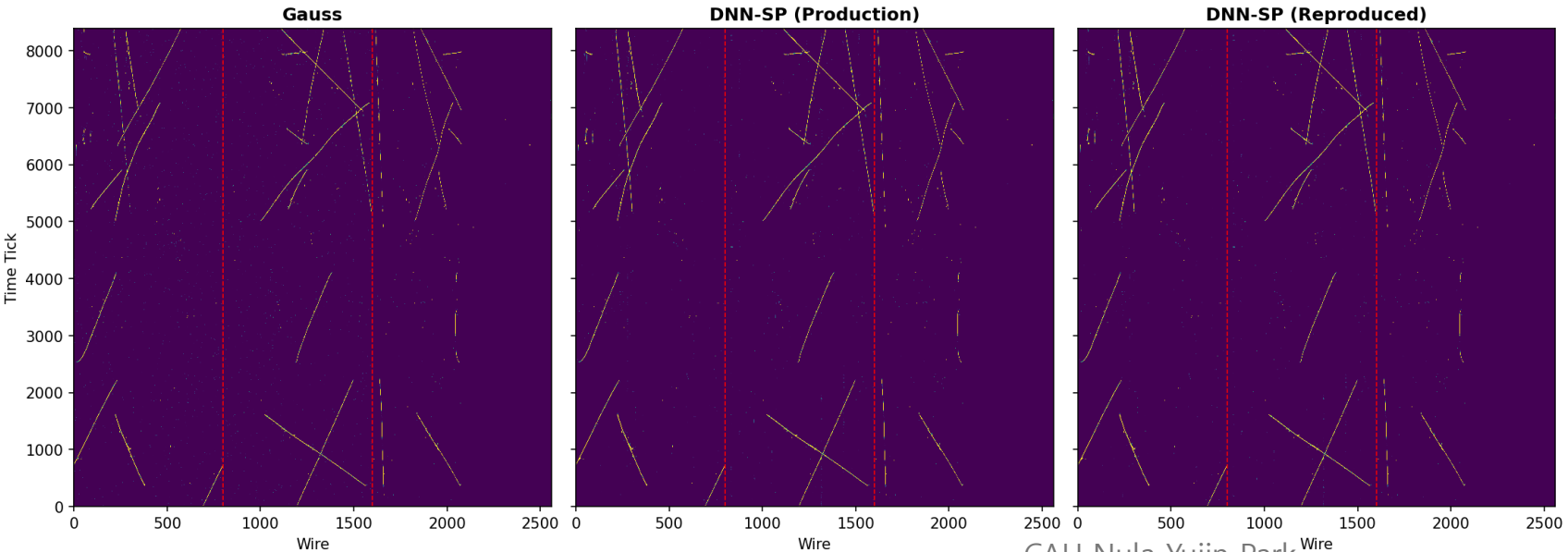
Run 026763 – event 225 (APA3): Baseline

base_mbv3 : g4-rec-2 (group 225)



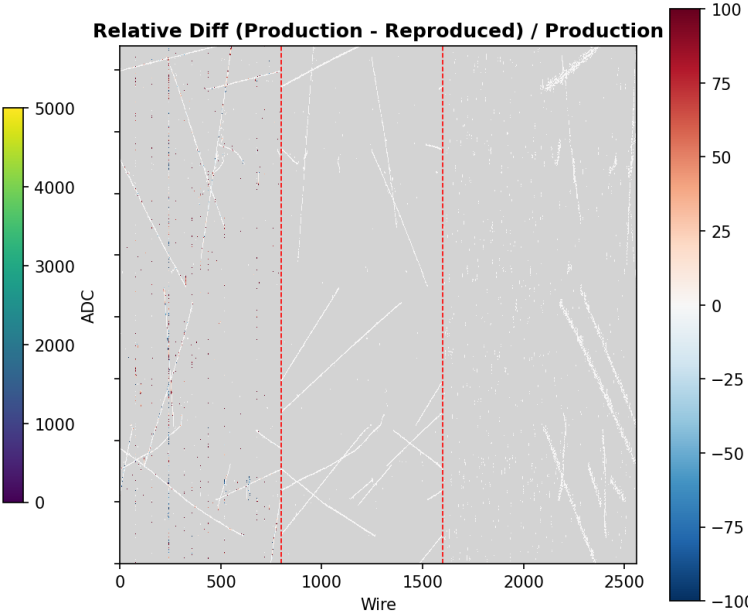
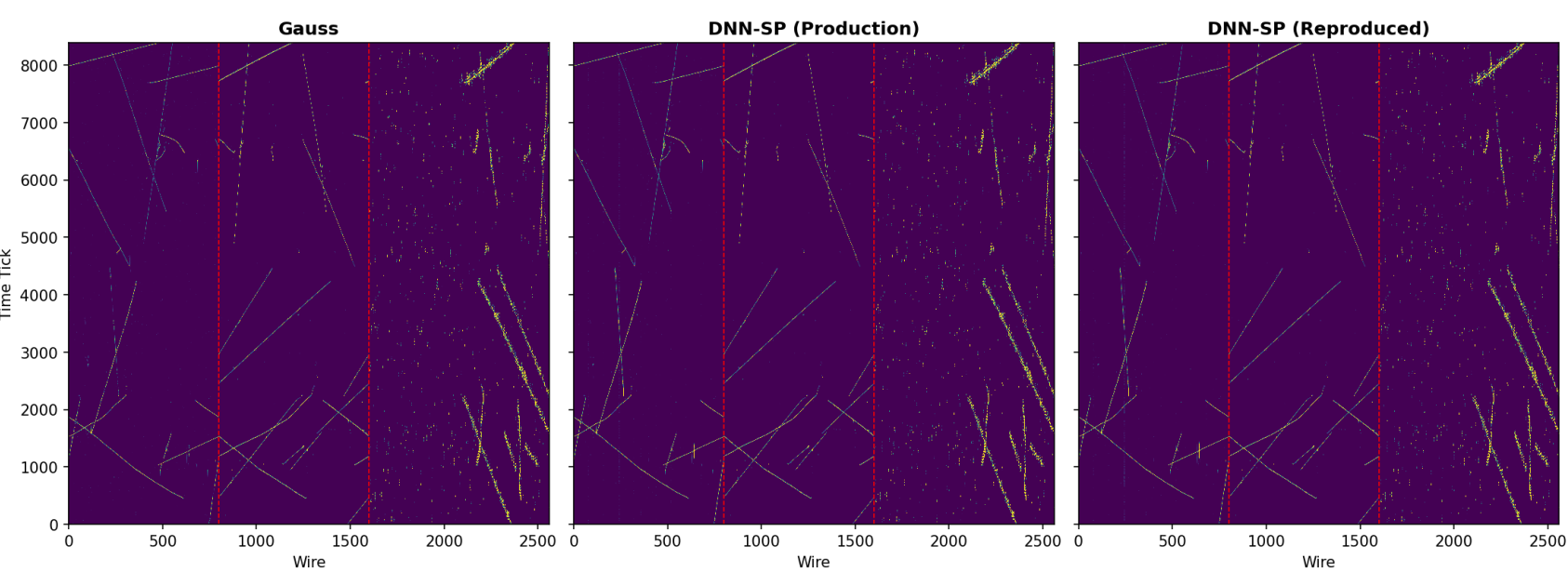
Run 026763 – event 225 (APA4): Baseline

base_mbv3 : g4-rec-3 (group 225)



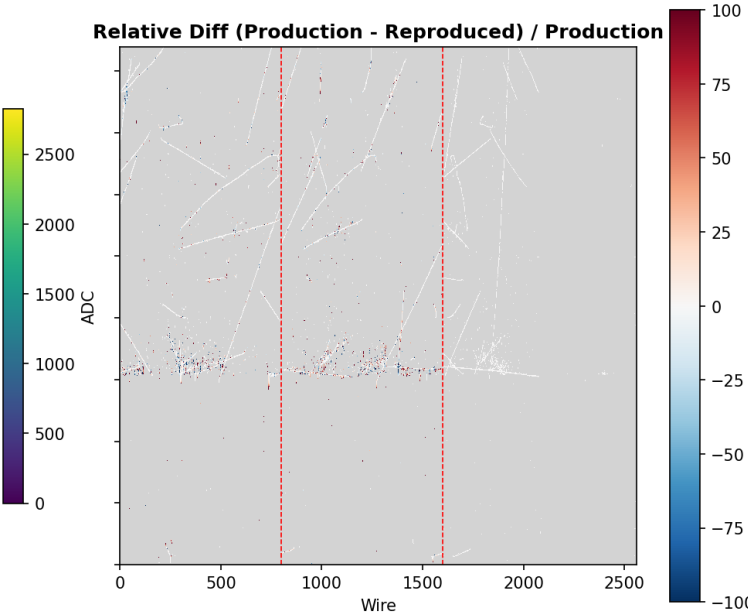
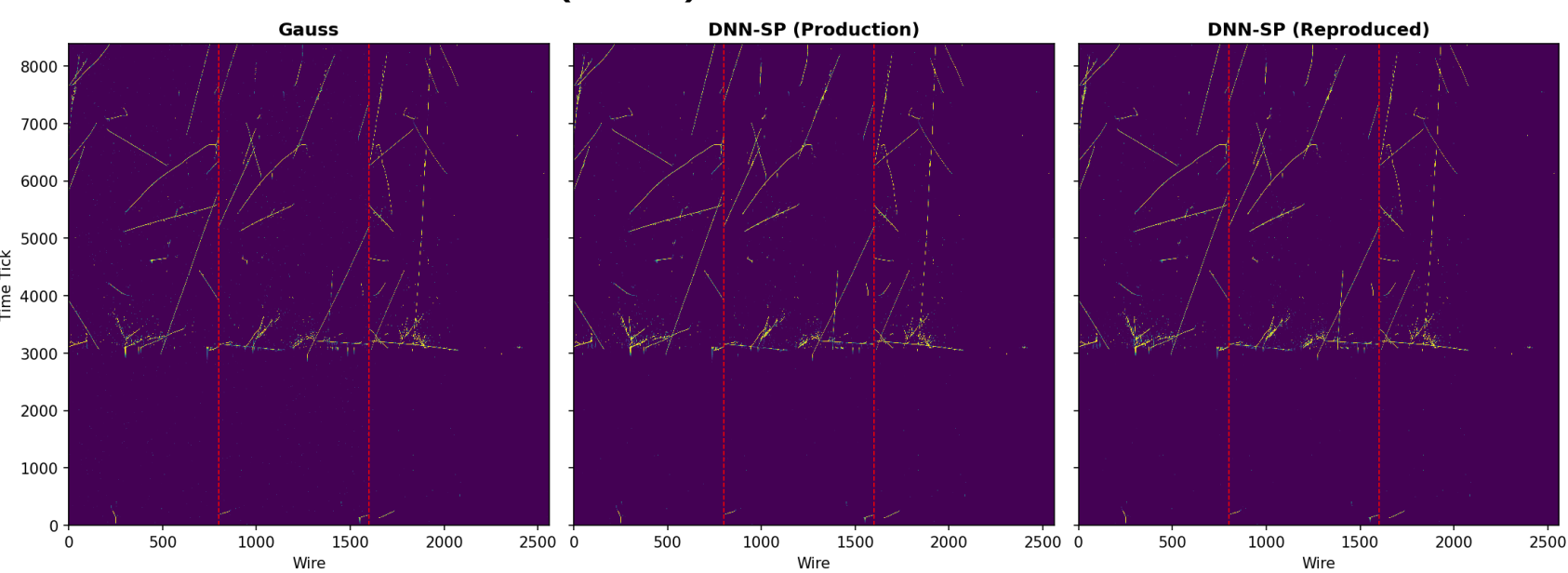
Run 026763 – event 225 (APA1): KD

distill_transformer : g4-rec-0 (group 225)



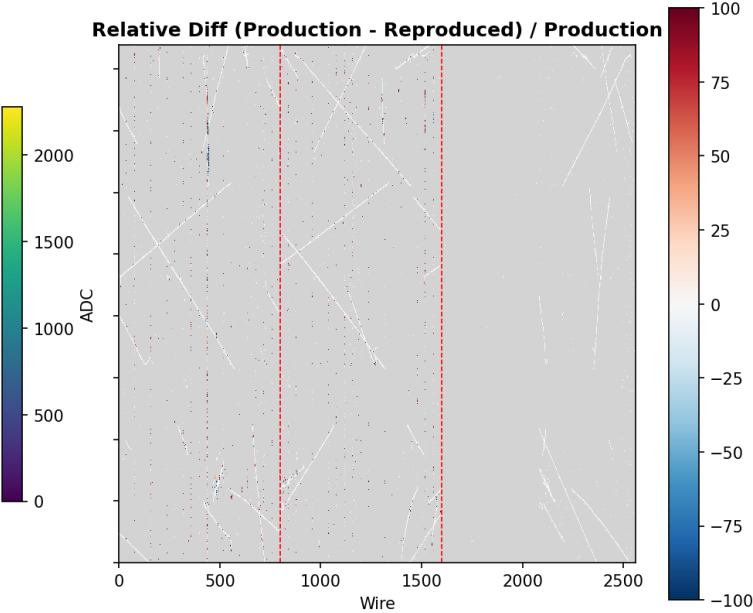
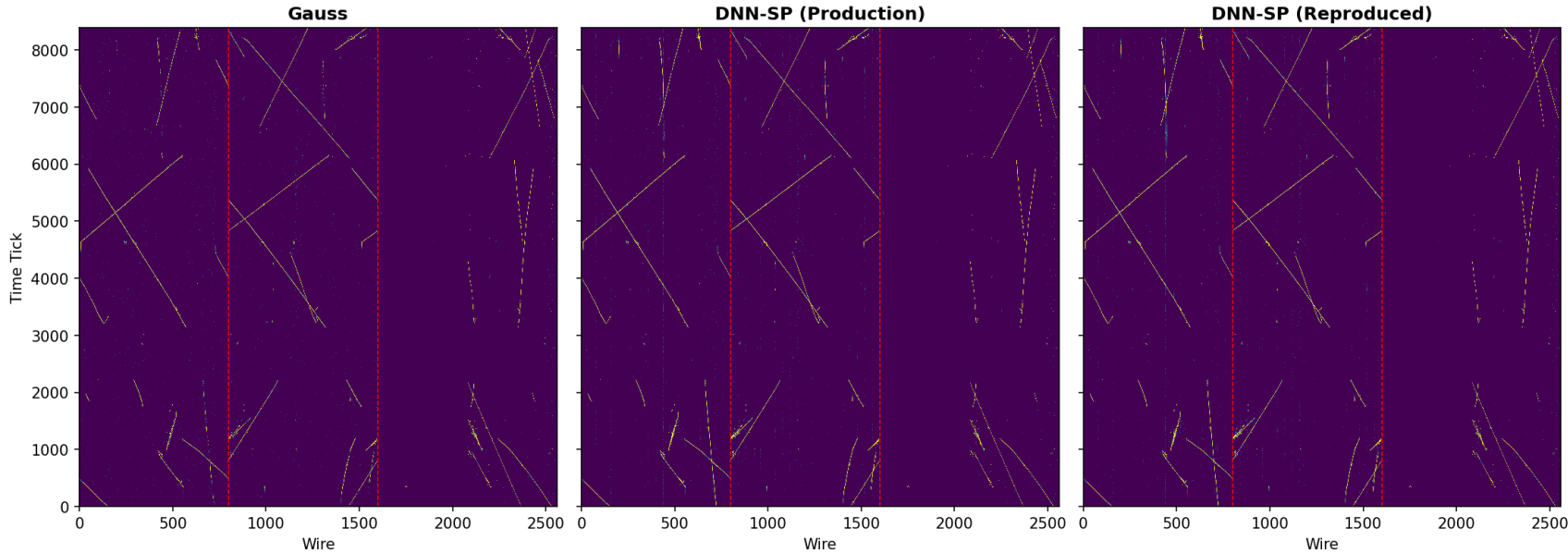
Run 026763 – event 225 (APA2): KD

distill_transformer : g4-rec-1 (group 225)



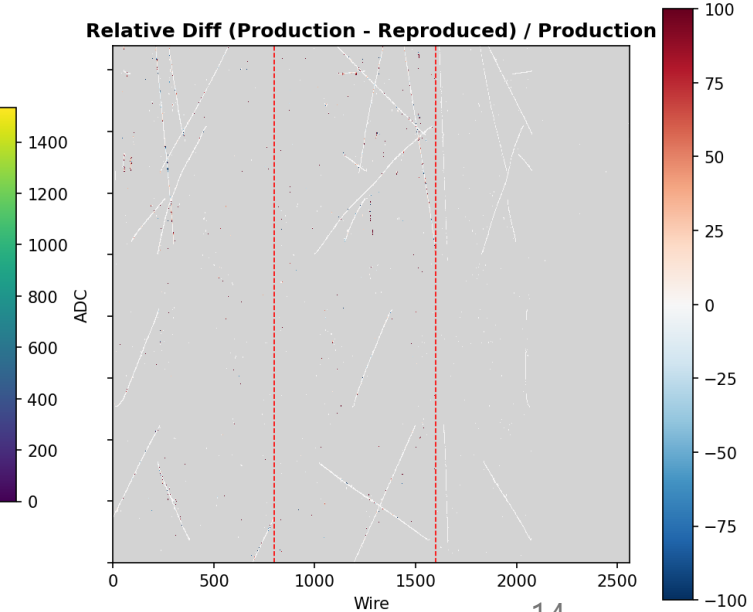
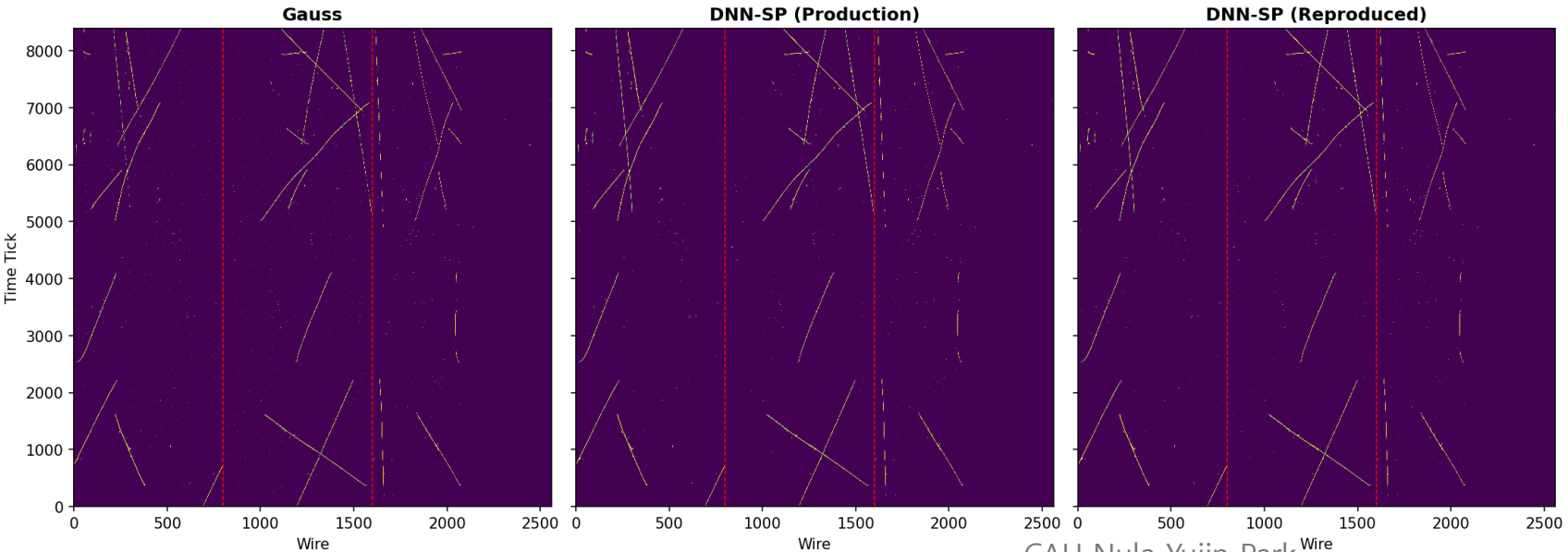
Run 026763 – event 225 (APA3): KD

distill_transformer : g4-rec-2 (group 225)



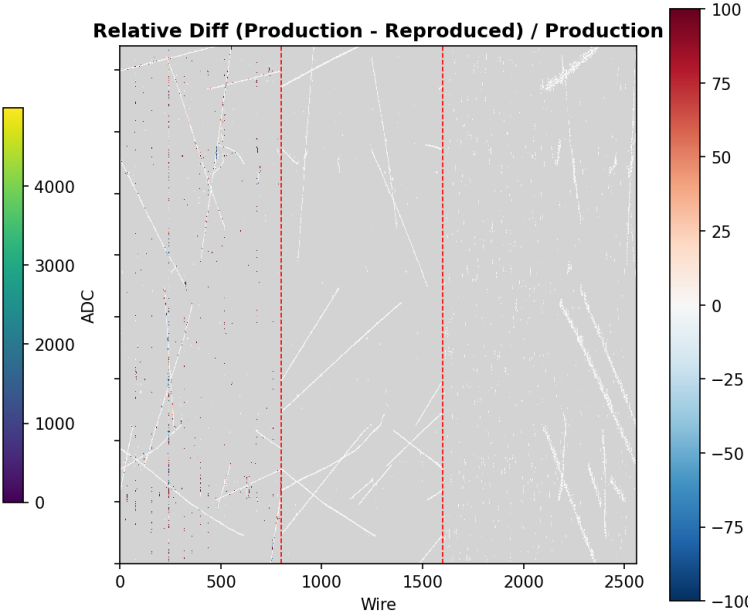
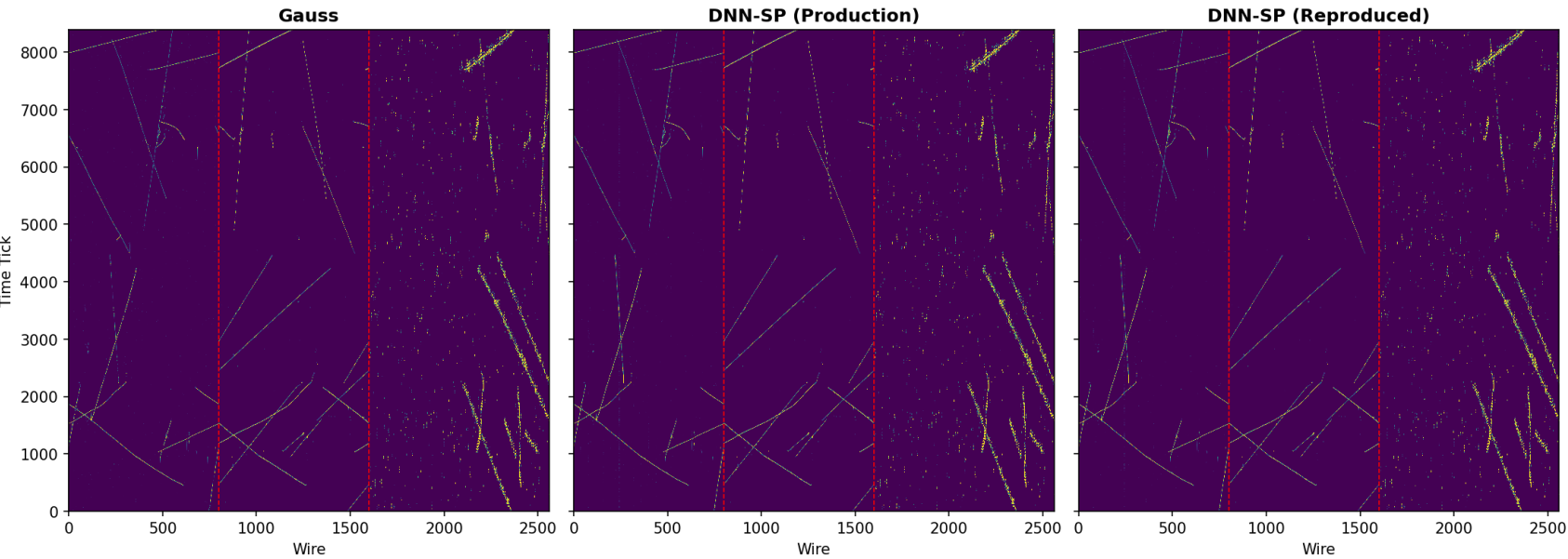
Run 026763 – event 225 (APA4): KD

distill_transformer : g4-rec-3 (group 225)



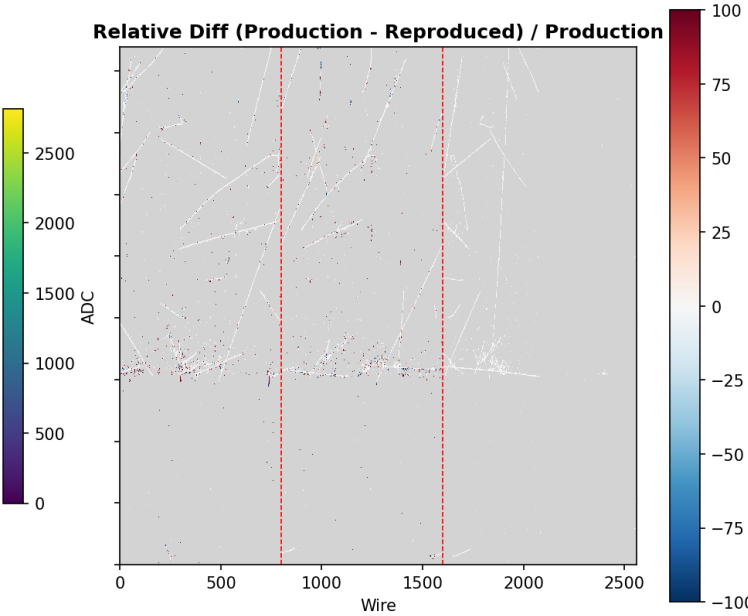
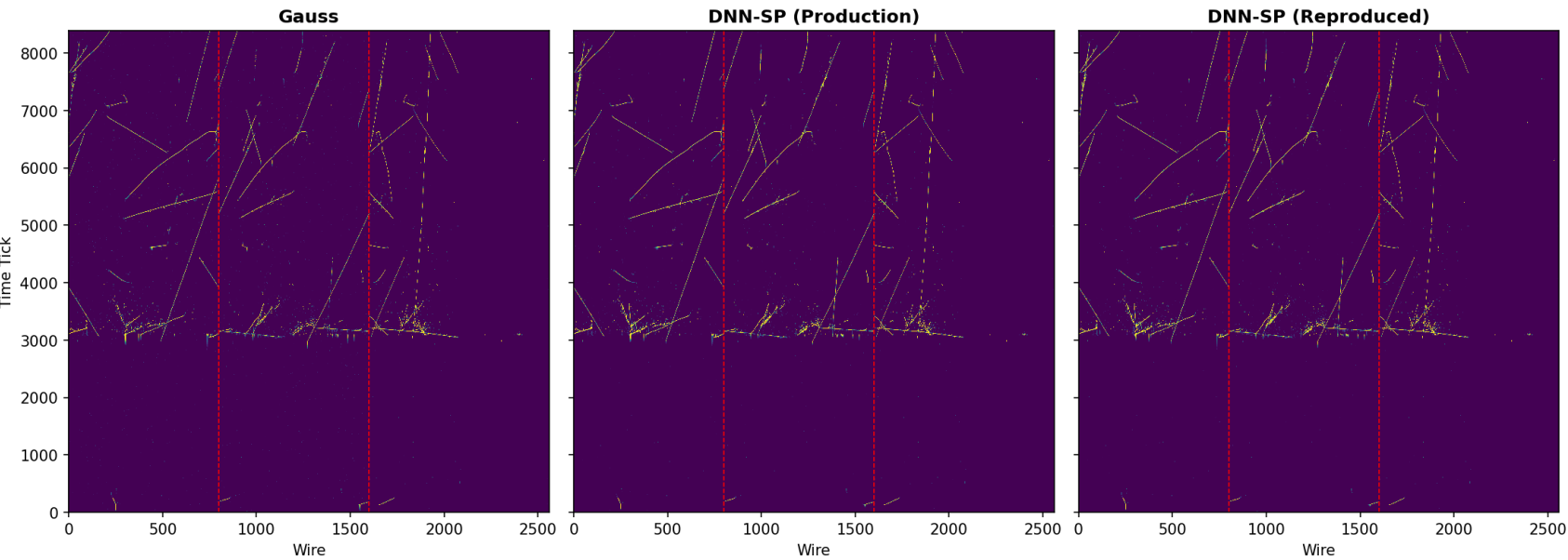
Run 026763 – event 225 (APA1): QAT - KD

qat_transformer : g4-rec-0 (group 225)



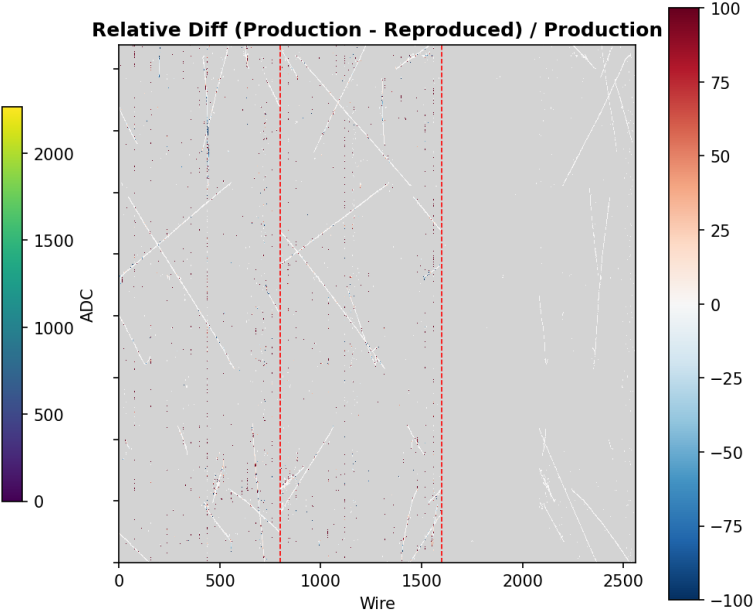
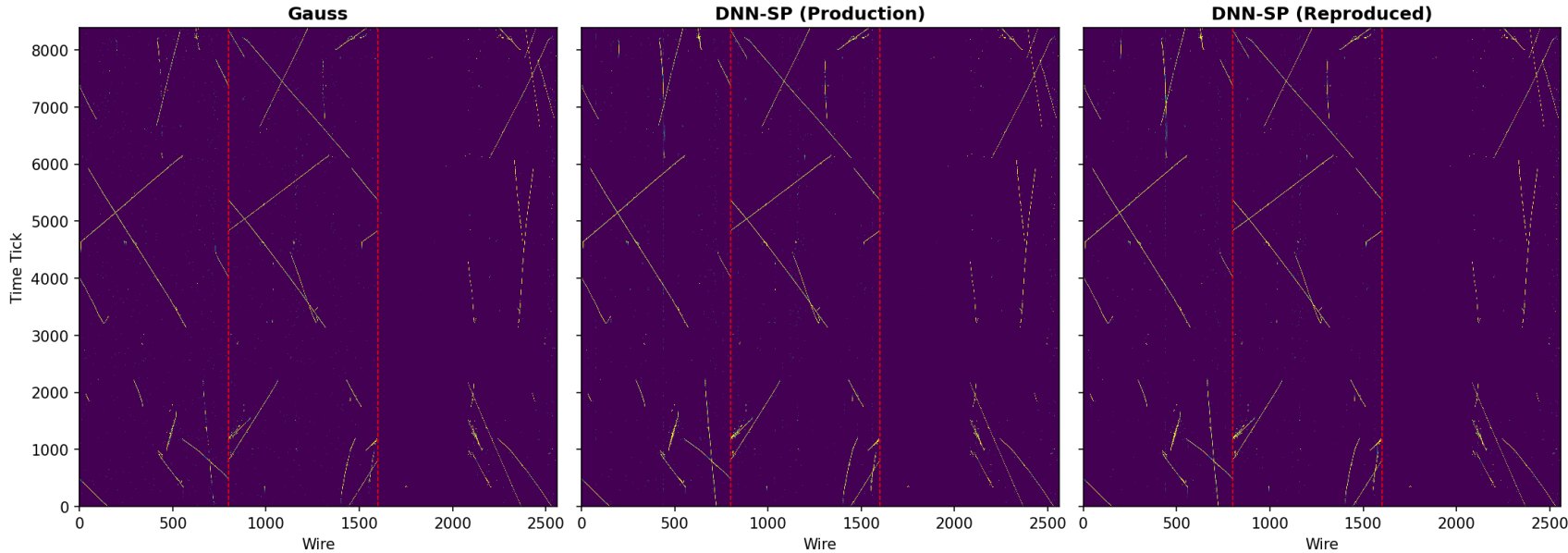
Run 026763 – event 225 (APA2): QAT - KD

qat_transformer : g4-rec-1 (group 225)



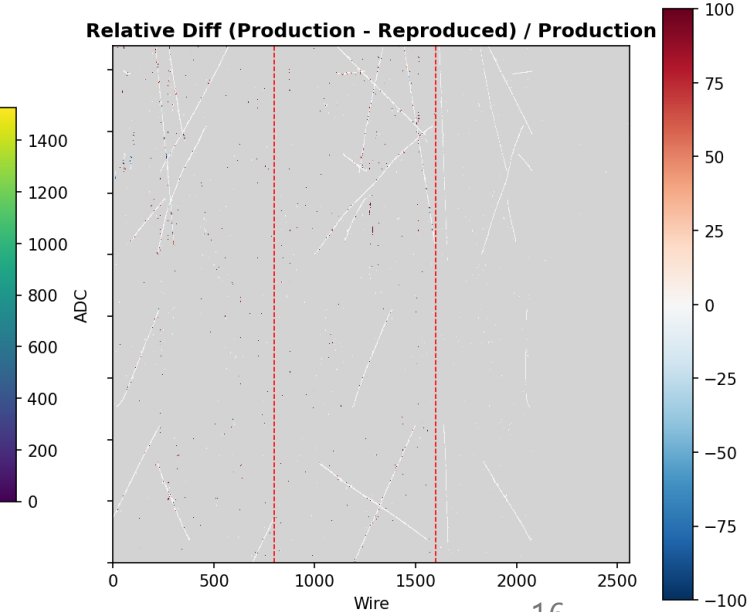
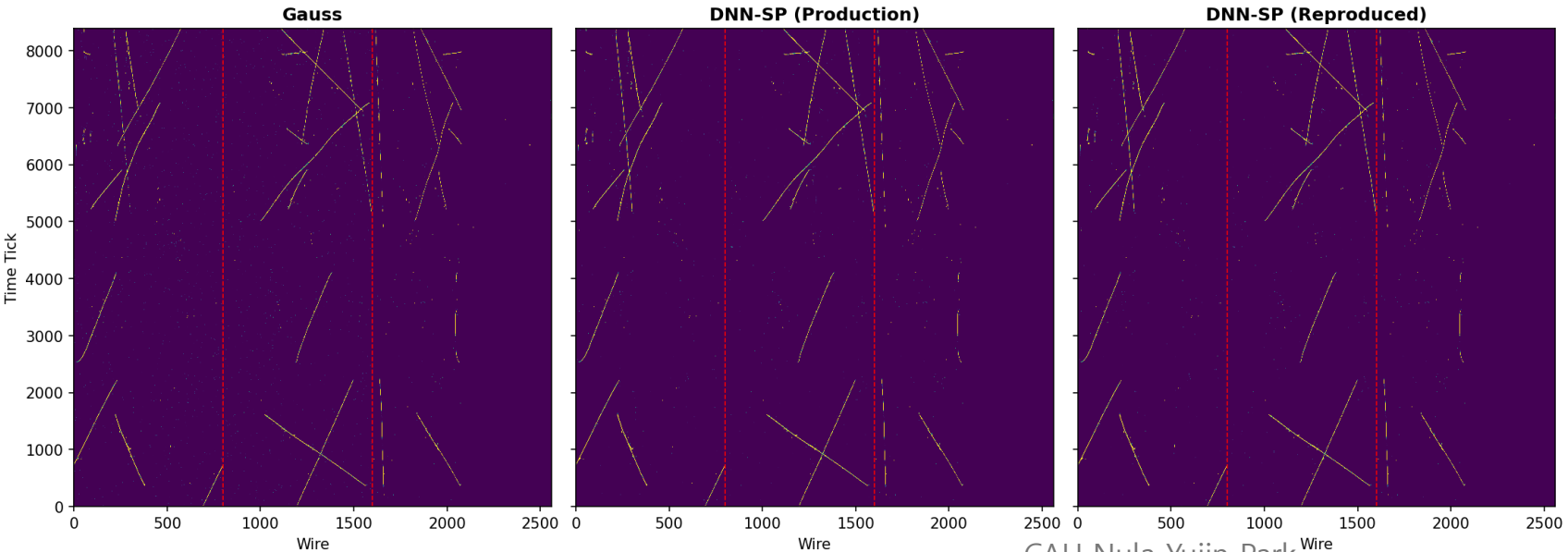
Run 026763 – event 225 (APA3): QAT - KD

qat_transformer : g4-rec-2 (group 225)



Run 026763 – event 225 (APA4): QAT - KD

qat_transformer : g4-rec-3 (group 225)



time offset = 314.2us

Depo center vs. charge-weighted blob center

