

Impact of MPGDs on Tracking

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Study Definitions: Configuration Settings



❖ **Goal:** Determine impact of MPGD spatial resolution on tracking performance

Software Versions:

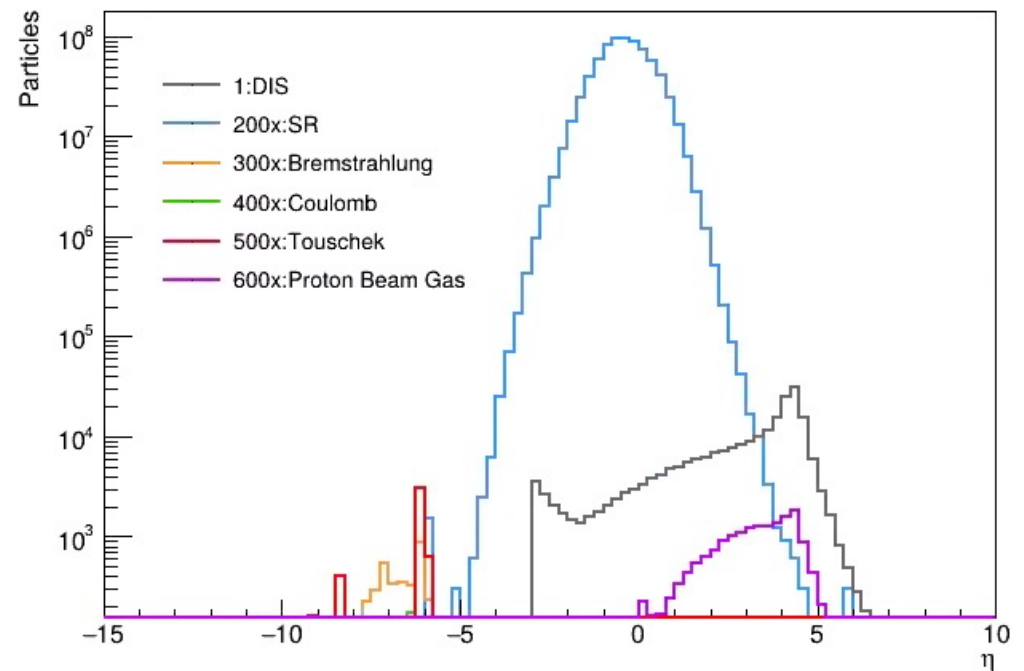
- epic:
- EICrecon: 1.34.0

Simulation Files:

- 10k events
- Full background + 1 DIS (NC -- forced) signal per $2\mu s$ time window
- Energy: $10 \text{ GeV} \times 275 \text{ GeV}$
- $Q^2 > 1 \text{ GeV}^2$

Detector Configuration:

- epic_Craterlake.xml



Study Definitions: MPGD Geometry



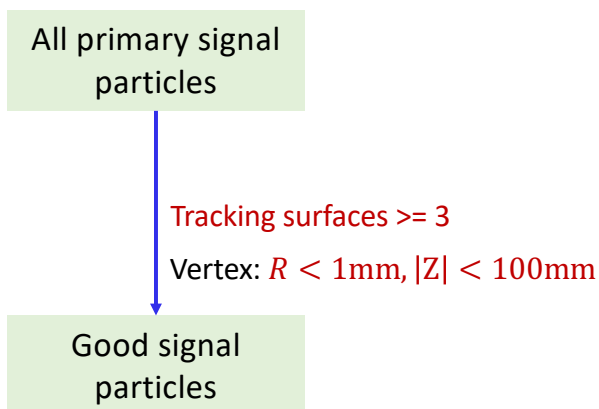
Detector	Z_{\min} [mm]	Z_{\max} [mm]	R [mm]
BOT	-1795	1845	735
CyMBaL	-1025	1450	550 - 605

Detector	R_{\min} [mm]	R_{\max} [mm]	$\sim Z$ [mm]
L1-ECT	70	400	-1205
L2-ECT	70	400	-1080
H1-ECT	81	400	1505
H2-ECT	81	400	1631

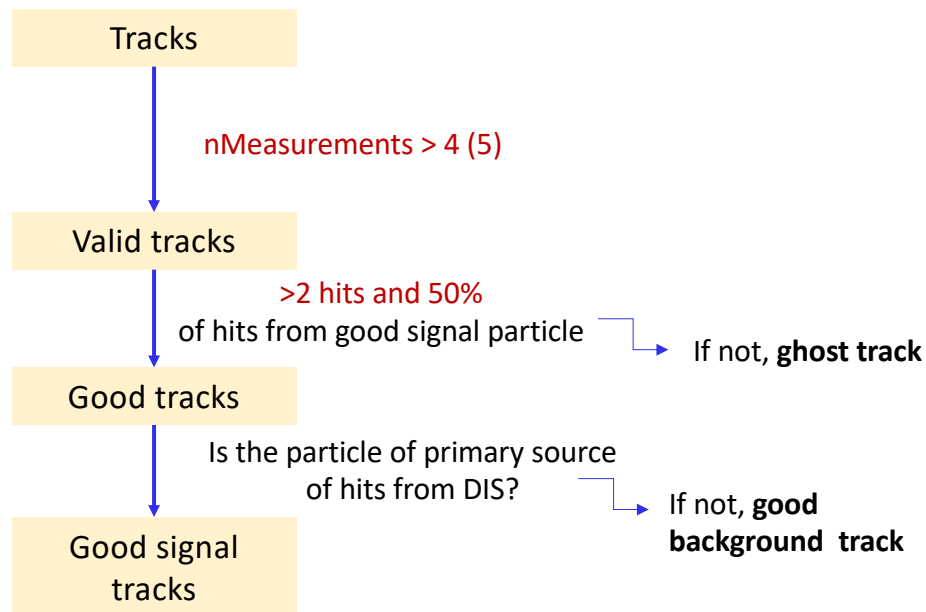
Study Definitions: Cuts



Truth info from MC



Reconstructed Tracks



Tracking efficiency: (Good signal particles w/ good track) / (Good signal particles)

Tracking purity: (Good signal tracks) / (Good tracks)

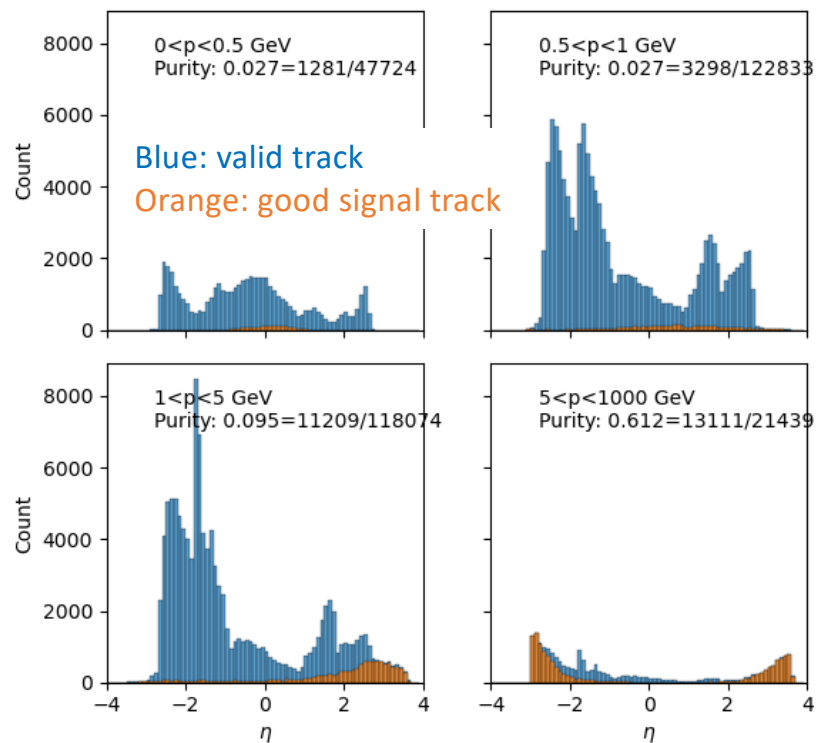
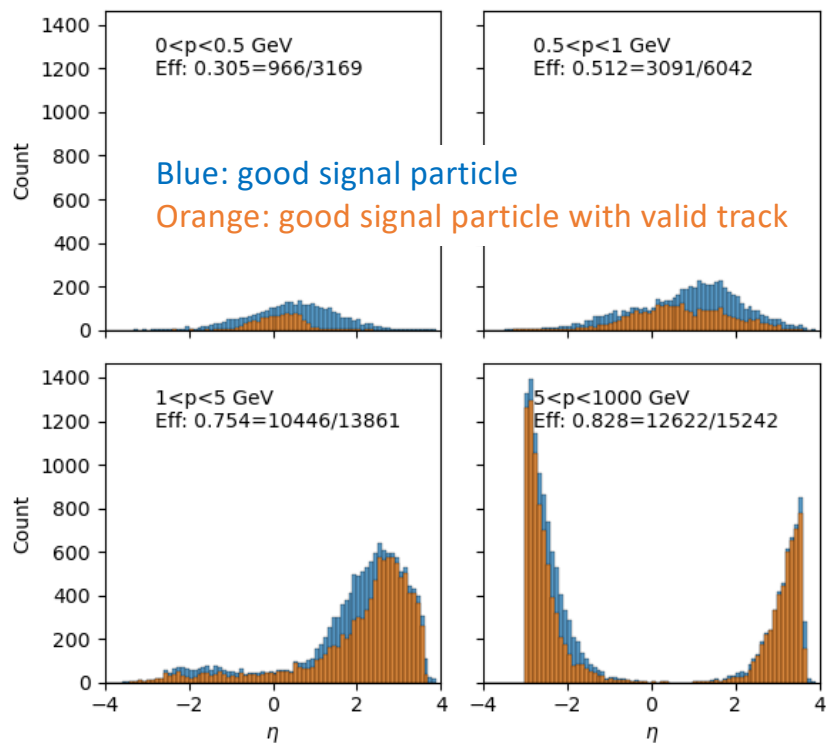
MPGD fraction: (Good signal particles w/good track + MPGD hit) / (Good signal particles w/ good track)

Efficiency and Purity: 150 μ m MPGD Resolution – 4 Hits



Efficiency (4 hits) | 10x275, 150 μ m | total=0.708 (27125/38314)

Purity (4 hits) | 10x275, 150 μ m | total=0.093 (28899/310070)



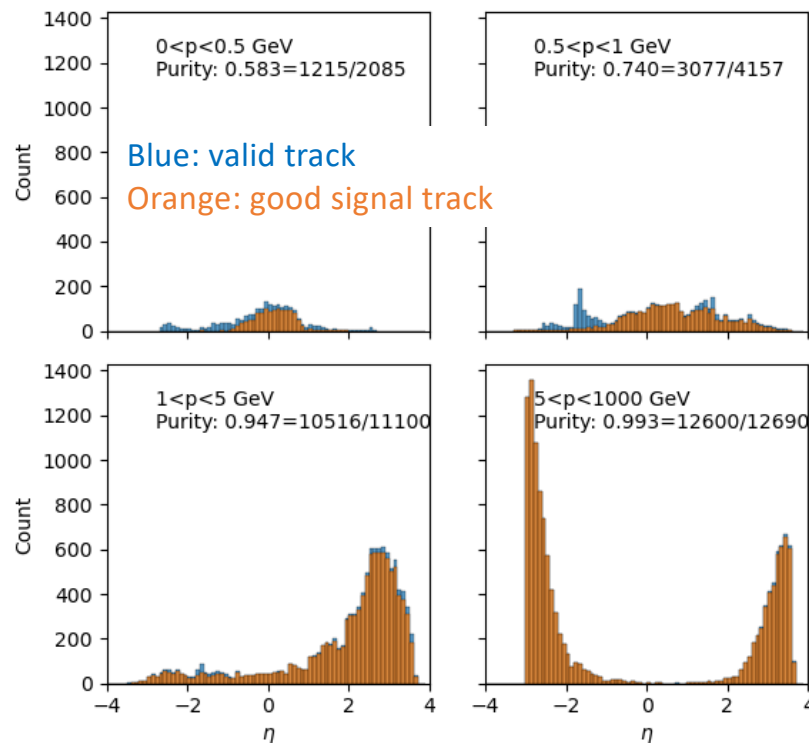
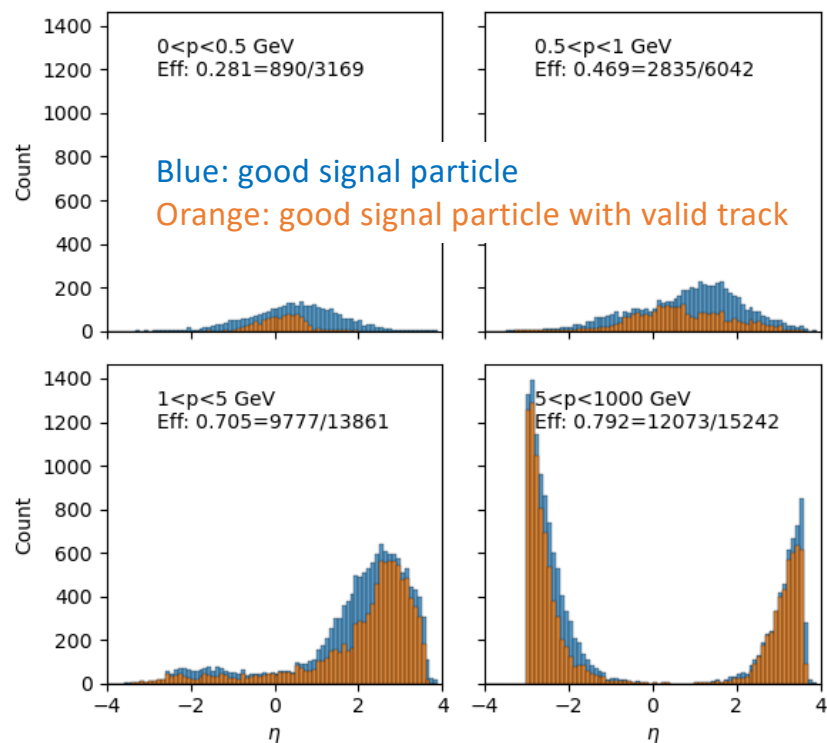
➤ Requiring 4 hits or more on a track yields poor purity

Efficiency and Purity: 150 μ m MPGD Resolution – 5 Hits



Efficiency (5 hits) | 10x275, 150 μ m | total=0.668 (25575/38314)

Purity (5 hits) | 10x275, 150 μ m | total=0.913 (27408/30032)



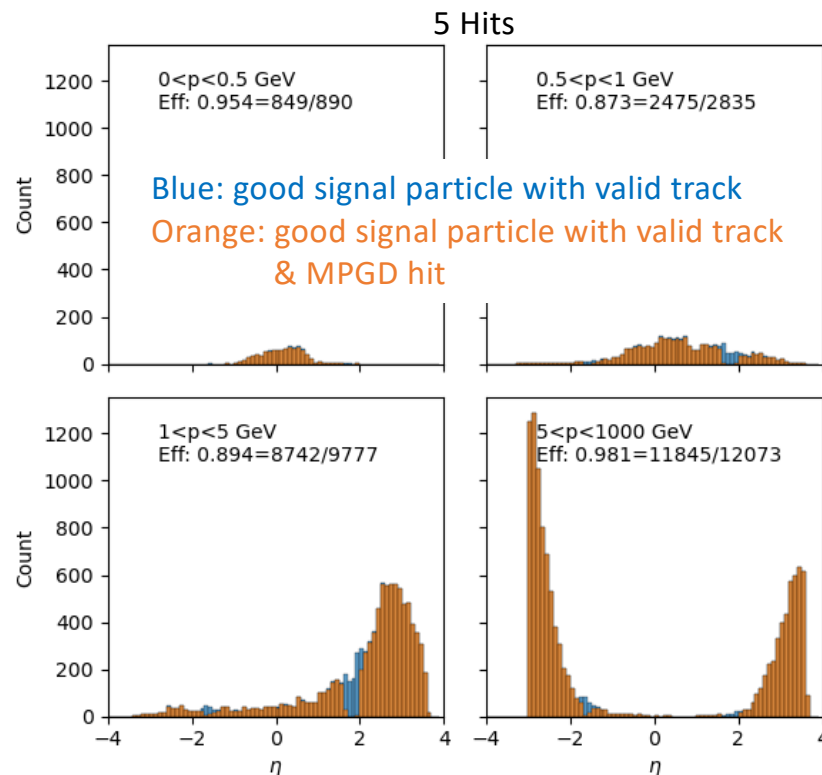
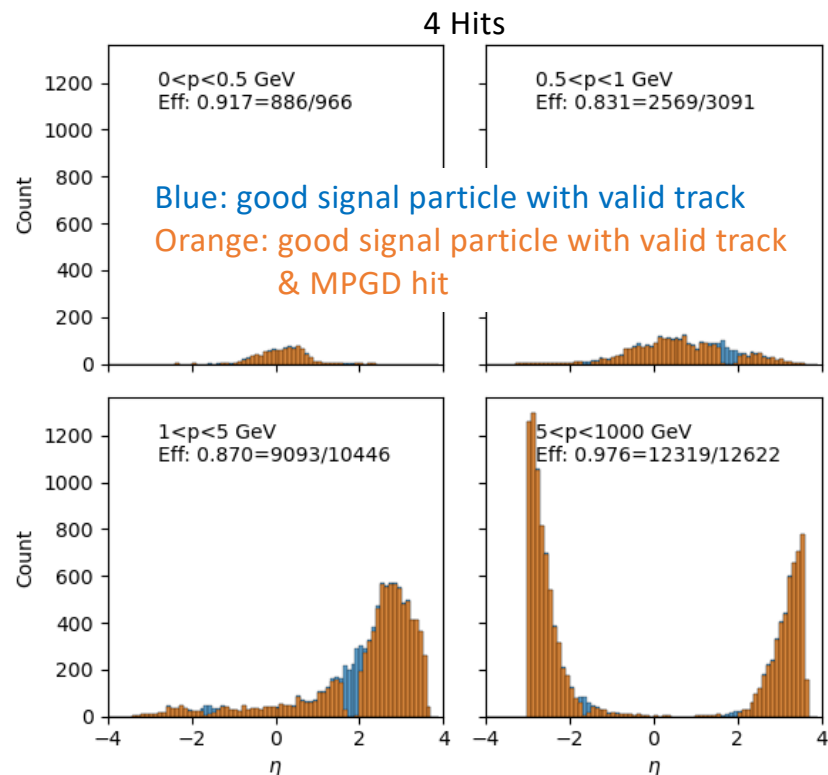
➤ Requiring 5 or more hits on a track leads to much improved purity

MPGD Fraction: 150 μ m MPGD Resolution



MPGD Efficiency (4 hits) | 10x275, 150um | total=0.917 (24867/27125)

MPGD Efficiency (5 hits) | 10x275, 150um | total=0.935 (23911/25575)

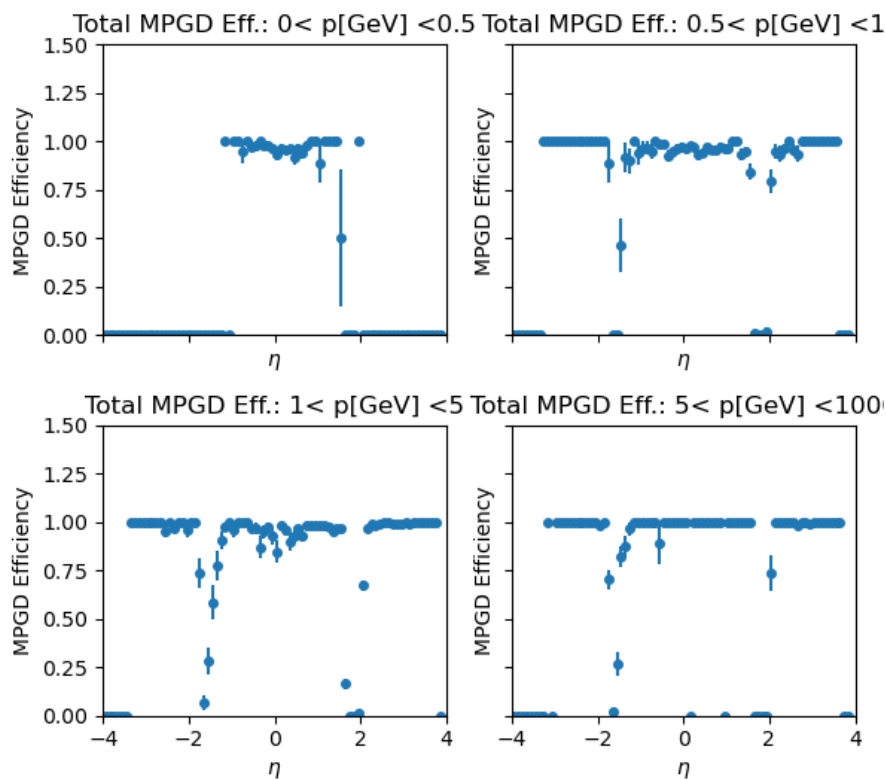


➤ More than 90% of total valid tracks contain at least 1 MPGD hit

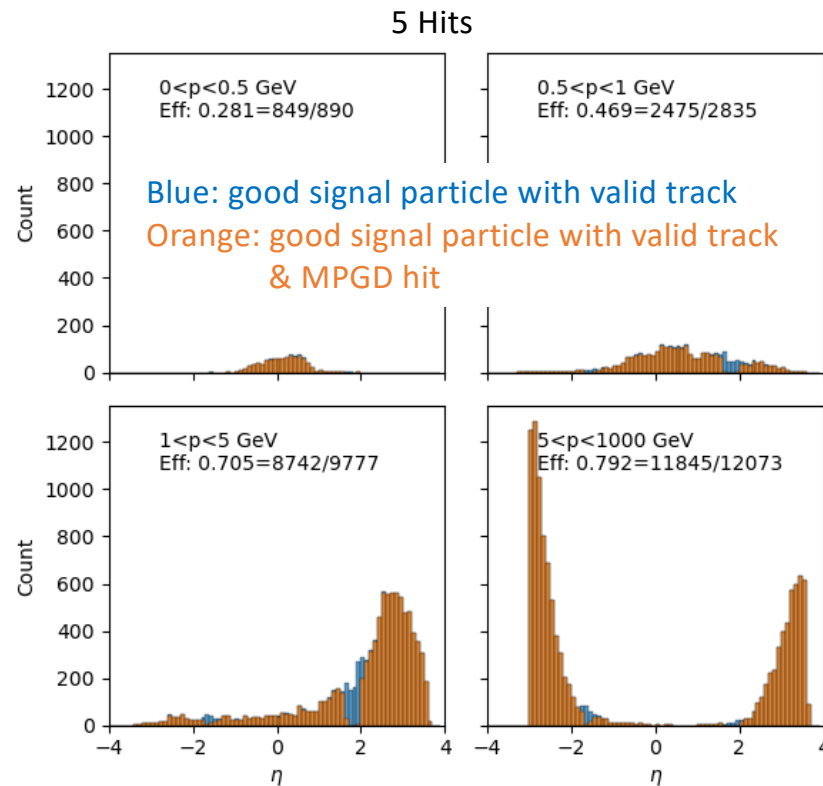
MPGD Fraction: 150 μ m MPGD Resolution



MPGD Efficiency vs η (5 hits) | 10x275, 150 μ m



MPGD Efficiency (5 hits) | 10x275, 150 μ m | total=0.935 (23911/25575)



➤ More than 90% of total valid tracks contain at least 1 MPGD hit

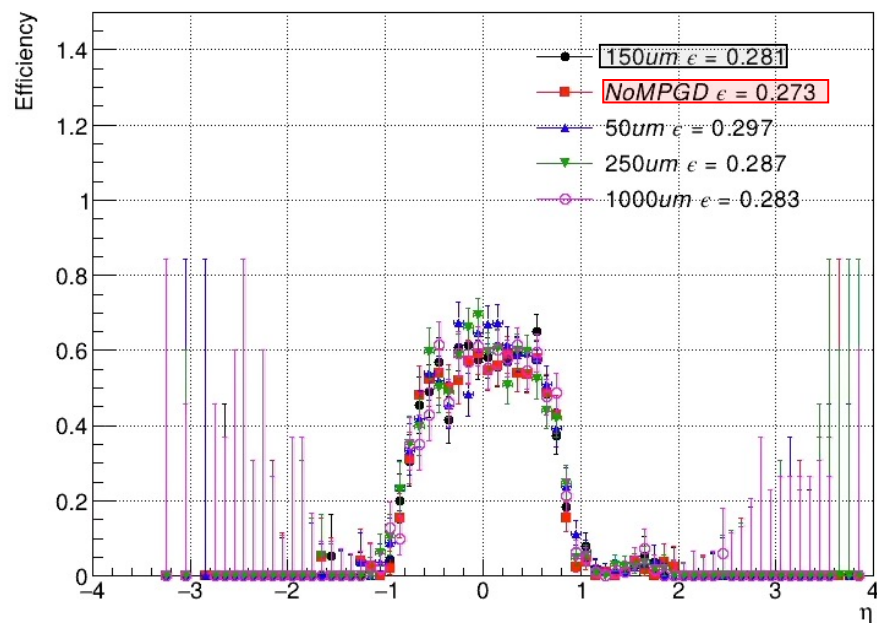
MPGD Resolution Impact: Efficiency (5 Hits)



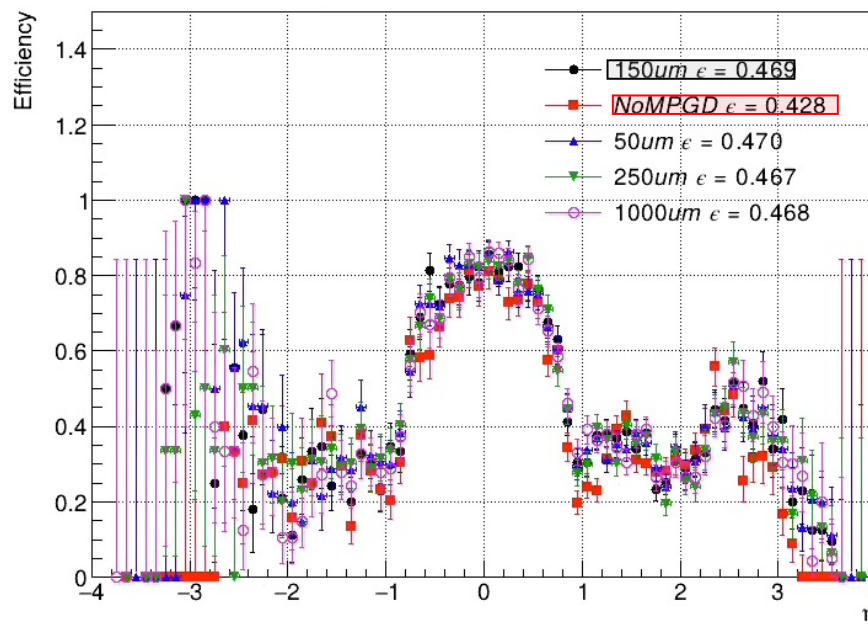
- Compare performance with MPGD resolutions of: 50 μm , 150 μm , 250 μm , and MPGD hits removed from reconstruction (NoMPGD)

➤ Slight efficiency improvement at lower momenta ($p \leq 1 \text{ GeV}$)

Tracking efficiency (0.0-0.5 GeV)



Tracking efficiency (0.5-1.0 GeV)

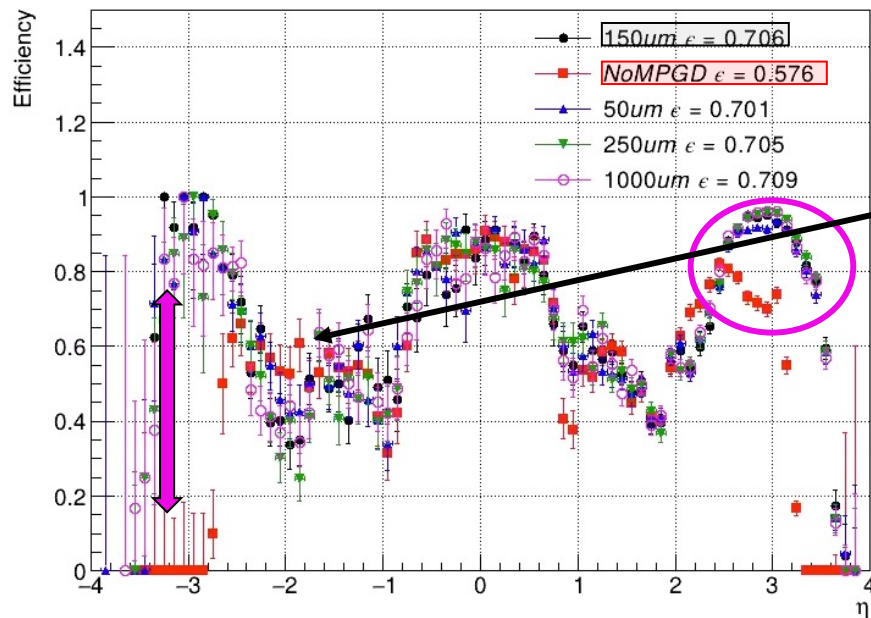


MPGD Resolution Impact: Efficiency (5 Hits)

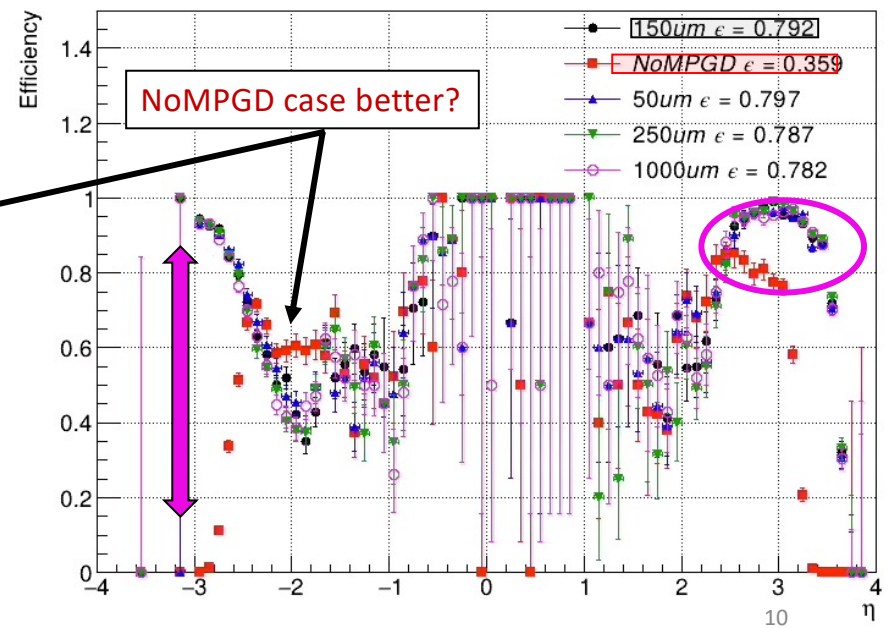


- Larger efficiency improvement at larger momenta ($p \geq 1$ GeV)
- Clear MPGD impact in large $|\eta|$ region

Tracking efficiency (1.0-5.0 GeV)



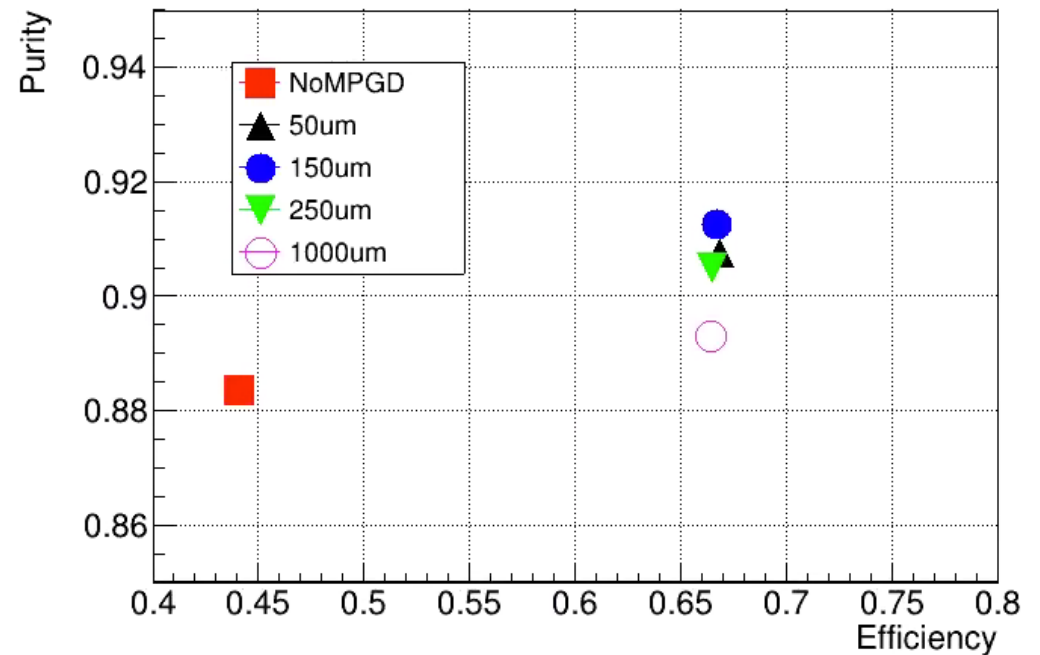
Tracking efficiency (5.0-100.0 GeV)



MPGD Resolution Impact: Summary (5 Hits)



- MPGDs show a clear impact on tracking performance
- Tracking performance shows minimal sensitivity to MPGD spatial resolution
 - At 1mm spatial resolution there is a slight degradation in the purity



- At least 5 hits on a track are required to obtain a reasonable purity (~90%)
 - Requiring at least 4 hits drops the purity to ~10%
 - Going from 4 to 5 hits has a smaller effect on the efficiency (~67% to ~71%)
- Impact of MPGDs on Tracking efficiency and purity were assessed with background embedded environment
 - Clear improvement seen when MPGDs are included in the track reconstruction
 - More than 90% of valid reconstructed tracks contain at least 1 MPGD hit.
 - Will be important when timing information is included in reconstruction
 - Tracking performance is fairly consistent across MPGD spatial resolutions ranging from 50 μ m to 250 μ m