DE LA RECHERCHE À L'INDUSTRIE

MPGD Tracker for EIC

Simulation progress at CEA-Saclay

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EIC YR – Tracking WG

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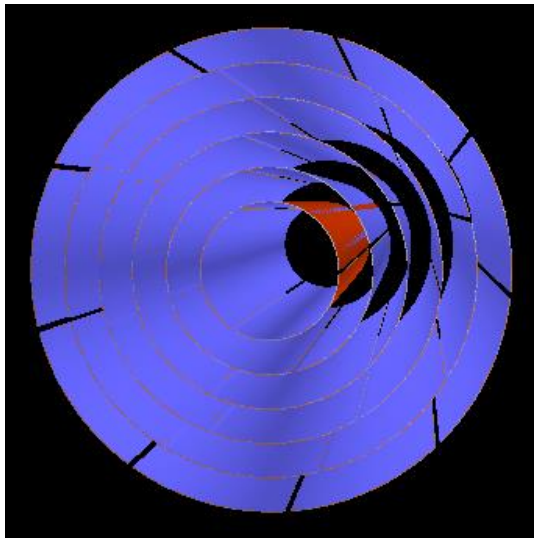
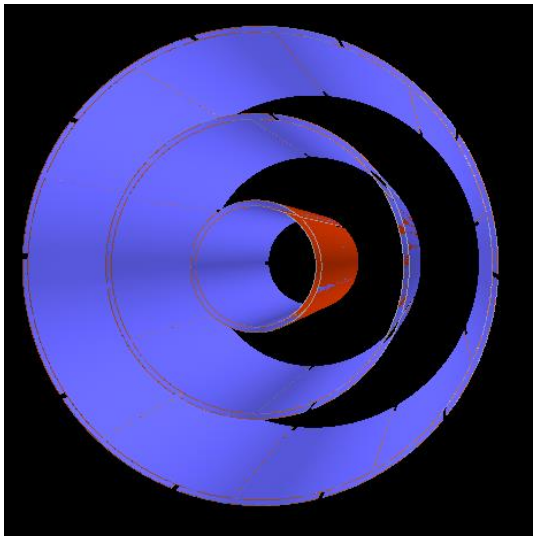
Geometry update

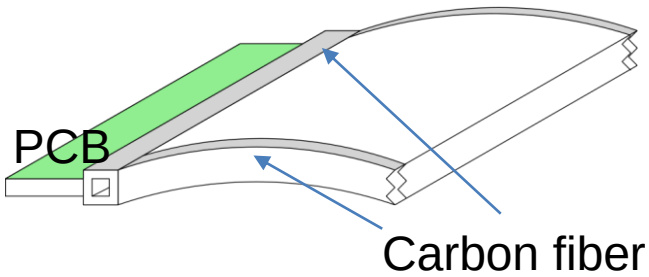
- Simulation based on Fun4All+ePhenix
  - But we remove all components but the 3-layer SVTX and the TPC
  - Replace the TPC with our MPGD tracker
- The tracker geometry is improved to be more realistic
  - Add the carbon fiber around the MPGD tracker (3mm)
  - Add the PCB board for readout of the strips in one direction, width of the PCB ~ 2cm
  - Each side has a 2mm dead zone on the MPGD



6 equidistant layers

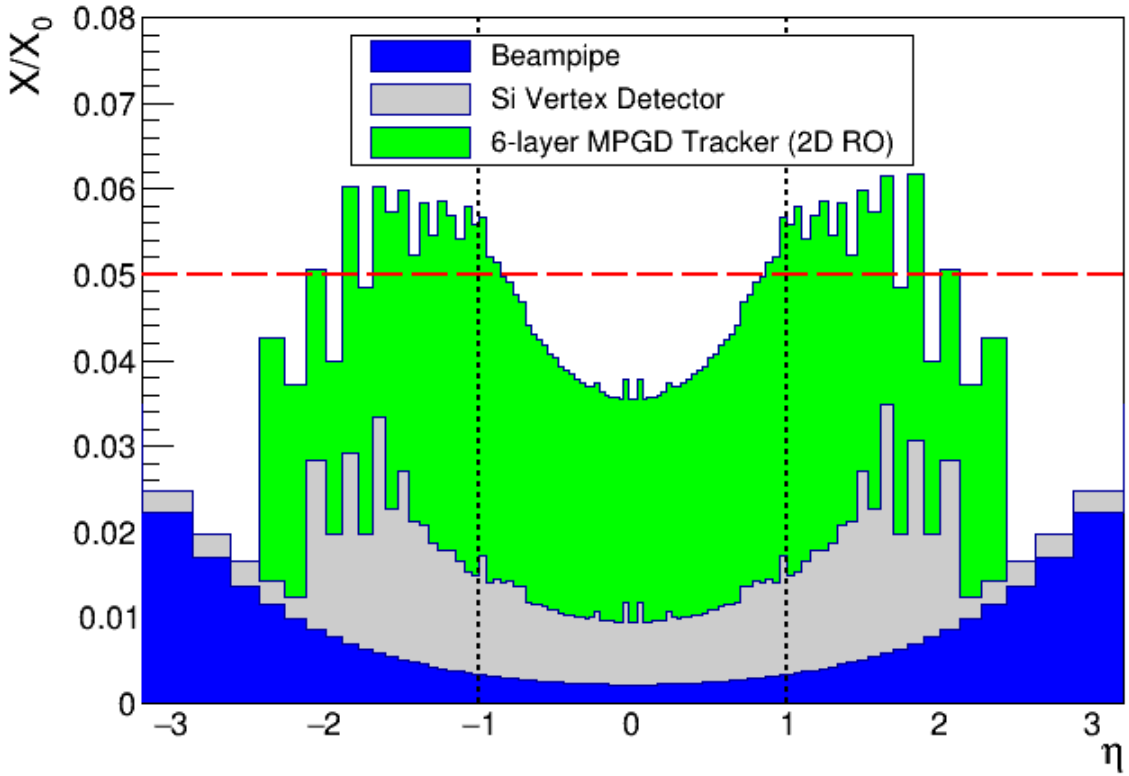


6 layers arranged as 3×2



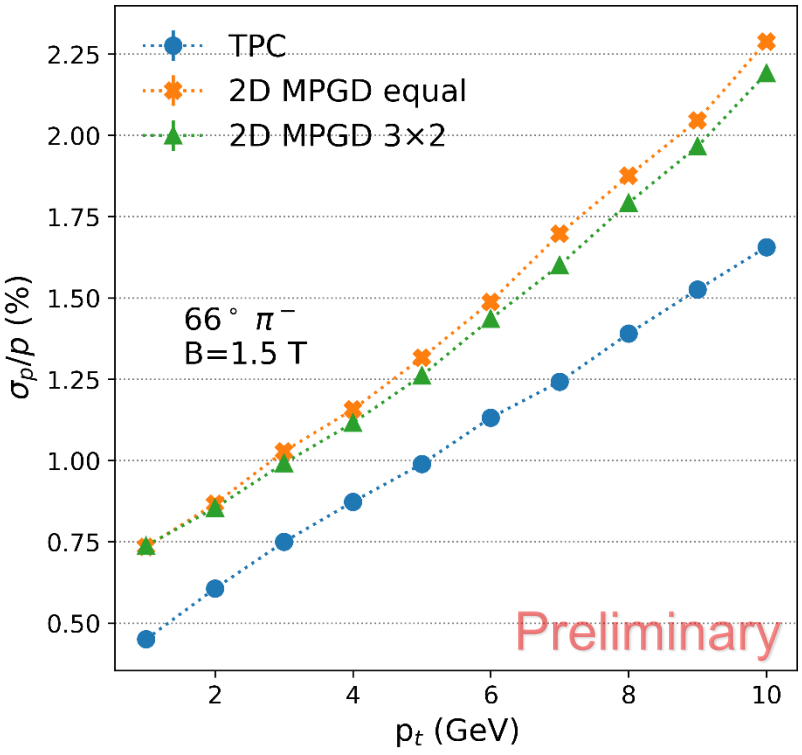
Material scan

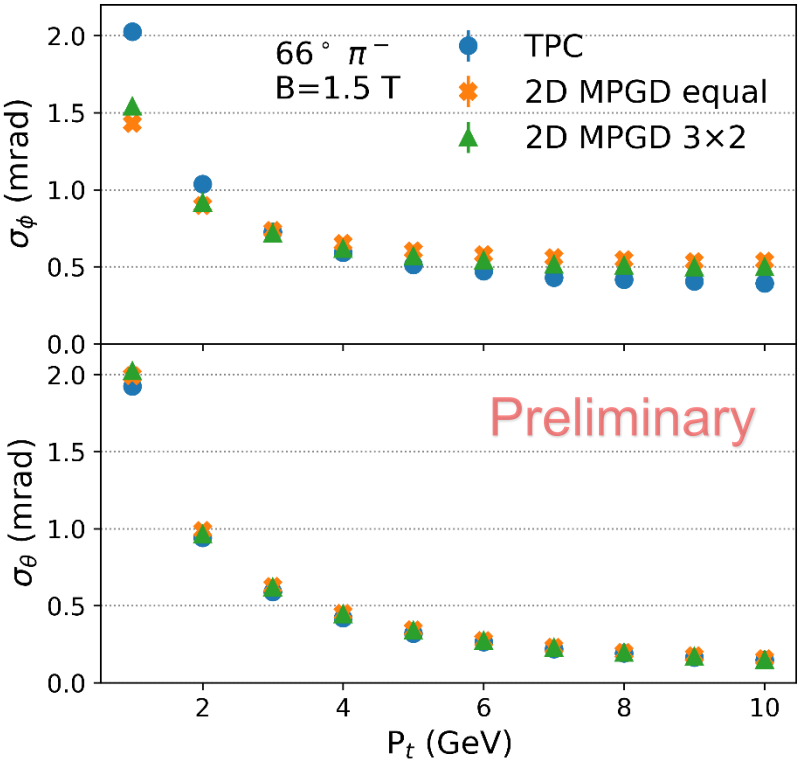
- A new material scan is performed
- Resulting material budget is still acceptable



Tracking performance

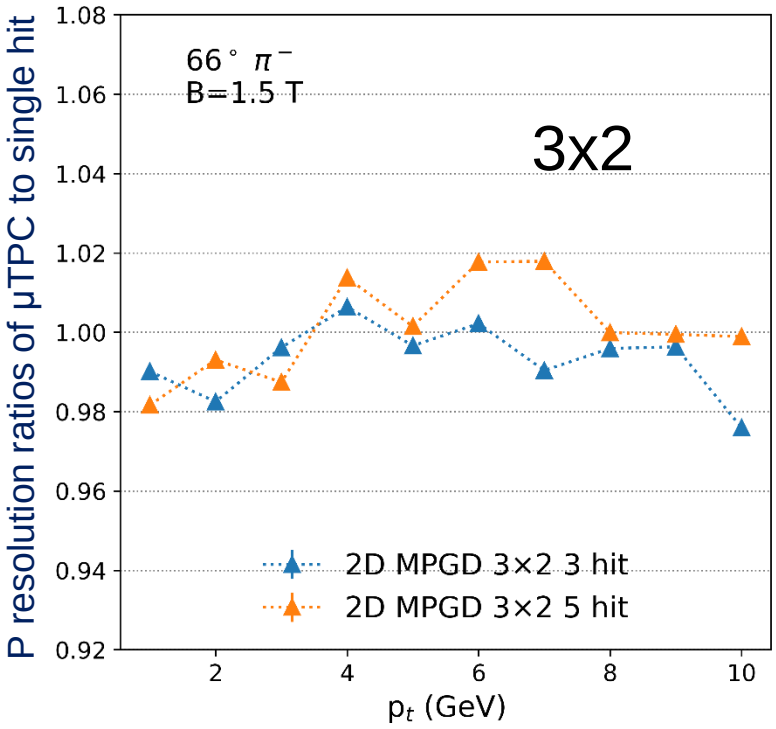
- Compare momentum/angular resolutions at DIRC (r=81.5cm) of different configurations
  - Each point contains 10k π^- from (0,0,0) and with a constant θ=66°
  - Track reconstruction includes SVTX measurements: σ(R/Rφ/Z)=5μm
  - For TPC: σ(Rφ)=200μm, σ(Z)=500μm
  - For MPGD: σ(Rφ)=150μm, σ(Z)=150μm

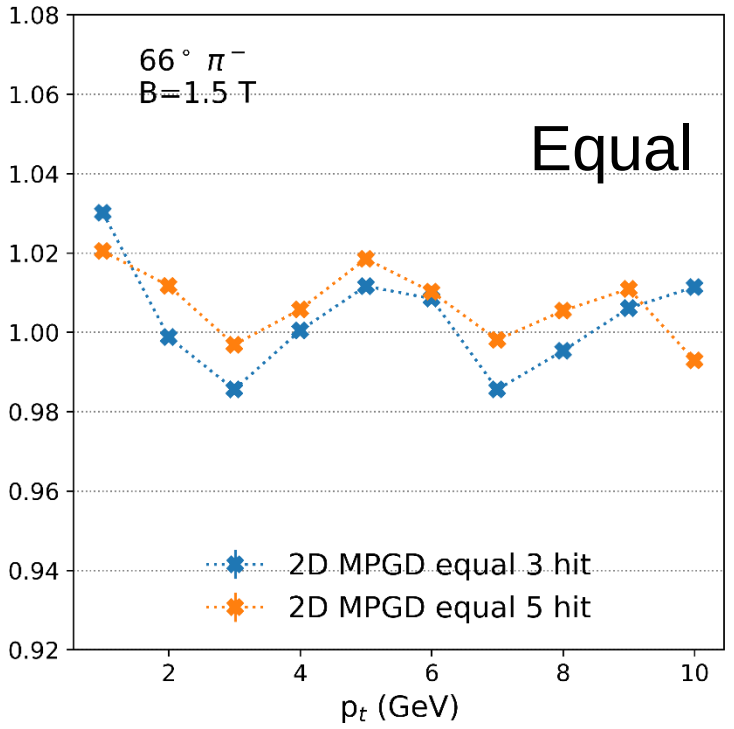




Performance with µTPC

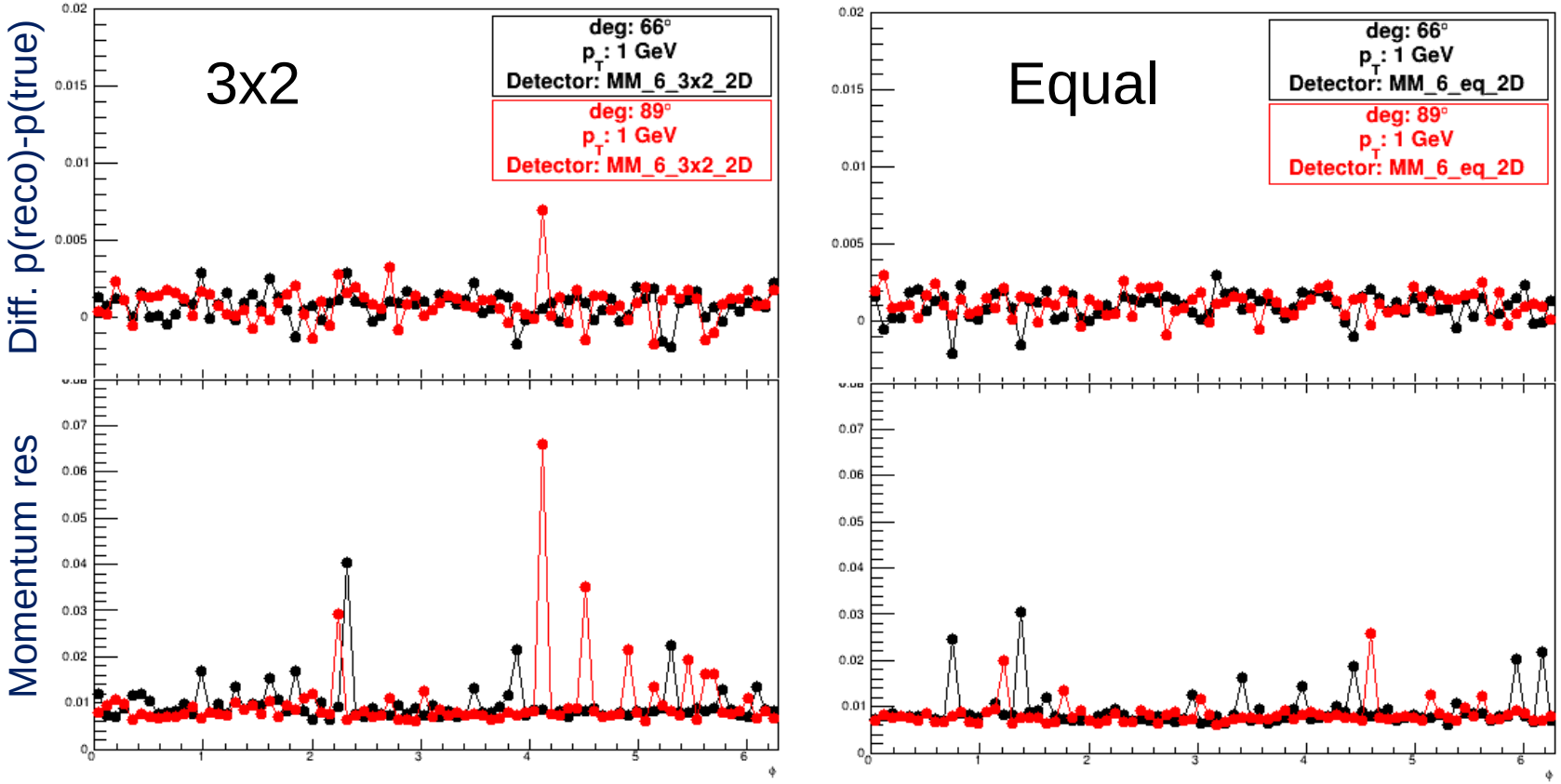
- By adding more active layers in the simulation, more hits are registered, thus we can mimic the µTPC mode
- The thickness of the active gas volume however remains the same, i.e. 3mm
  - ➢ Given the thinness of the gas volume, µTPC gives the same performance
- Next step: get some guideline from our Micromegas experts, and try with a thicker gas volume, e.g. 5mm or 1cm





Φ-dependency of the tracking performance

- MPGD tracker consists of tiles, which result in a change of materials along the Φ-direction
- Potentially this can lead to a Φ-dependency of the tracking performance
  - Already mitigated by rotating each layer by 15°
  - No visible Φ-dependency for both tracker configurations

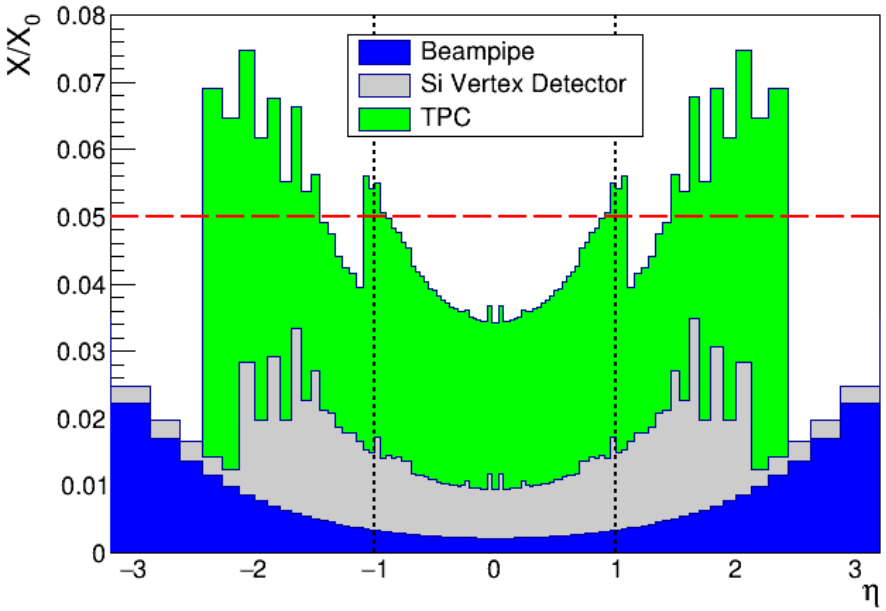


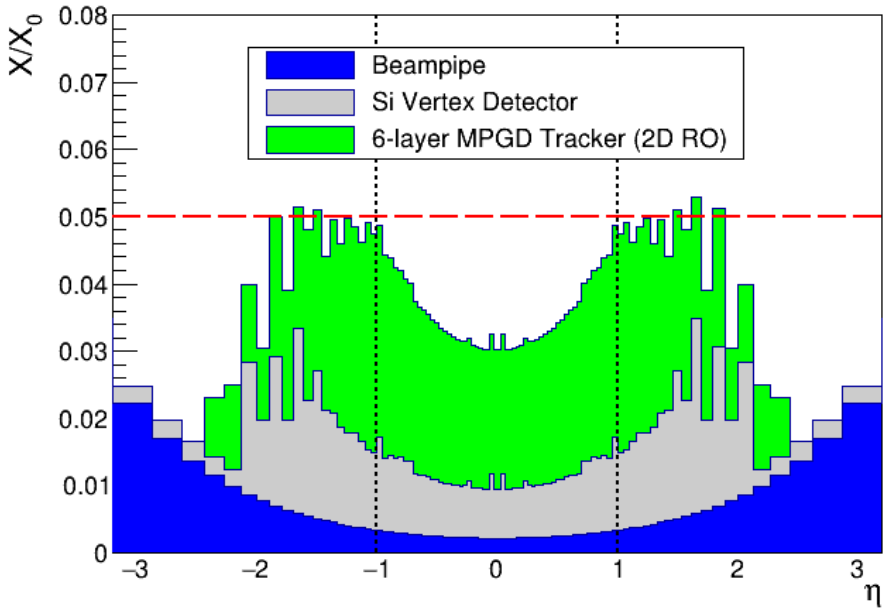
Summary

- The MPGD tracker simulation has been improved
  - More realistic geometry
  - Material budget increased but still <5%
  - The added materials do not degrade significantly the tracking performance
- A primitive simulation of μTPC mode
  - Does not bring significant improvement of the tracking, because the gas volume is thin
- A scan over Φ to check if the tracking performance sensitive to Φ
  - No visible Φ-dependency is found
- Next steps: focus on the μTPC simulation

BACKUP

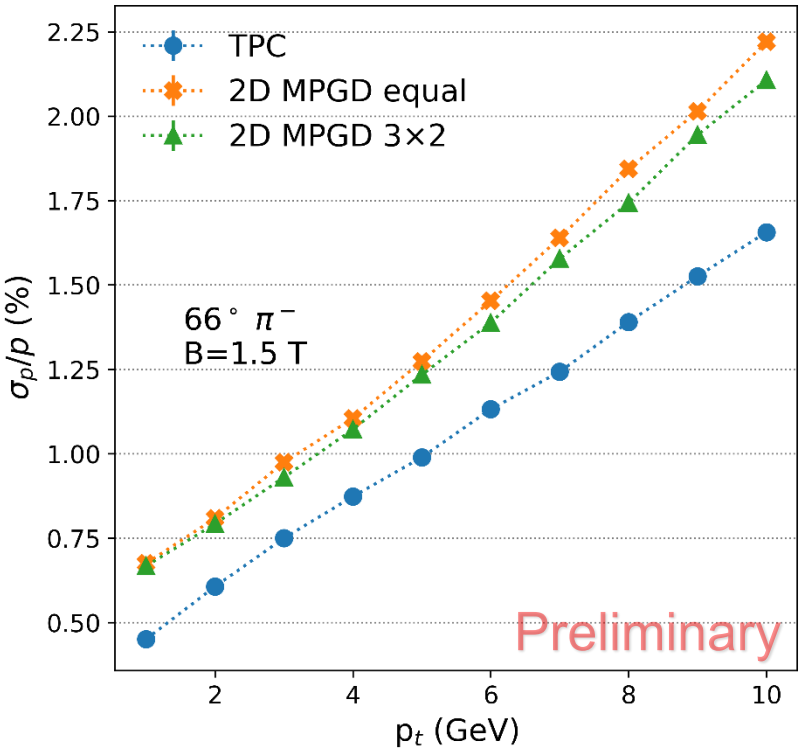
Material scan of the TPC and MPGD without dead material

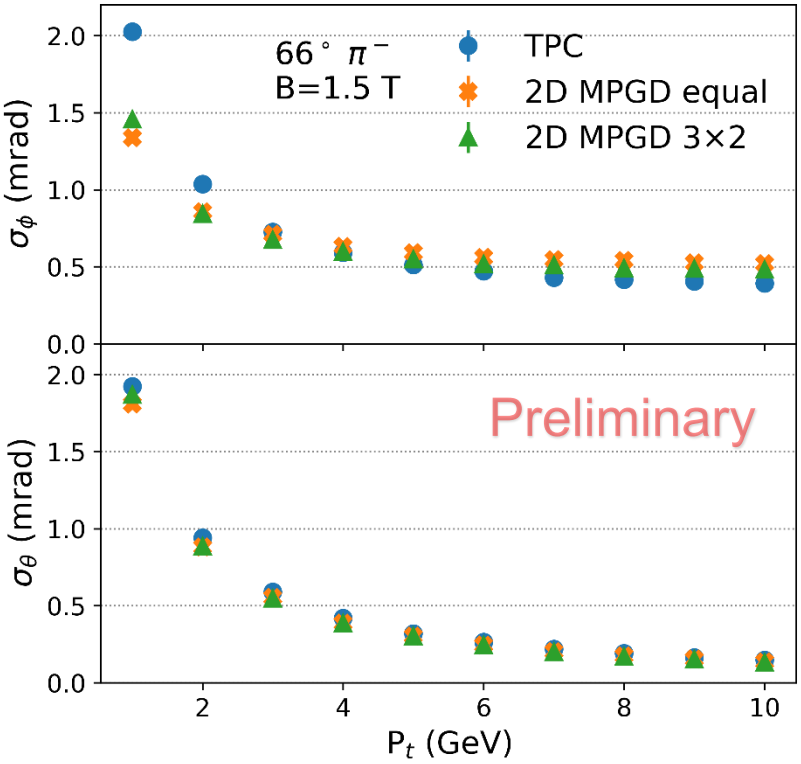




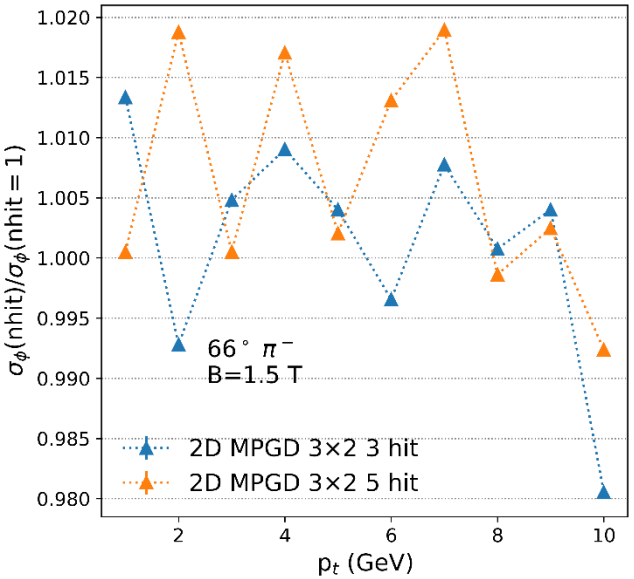
MPGD tracker simulation and performance study

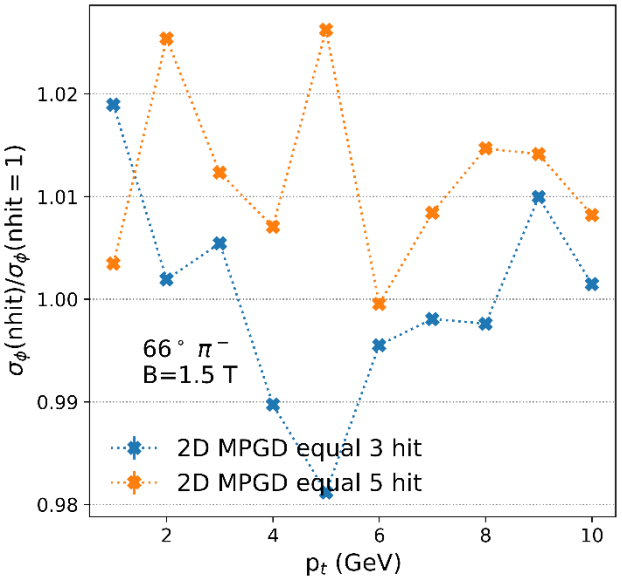
- Compare momentum/angular resolutions at DIRC (r=81.5cm) of different configs
  - Each point contains 10k π^- shot from (0,0,0) and with a constant θ=43°
  - Track reconstruction includes SVTX measurements: σ(R/φ/Z)=5μm
  - For TPC: σ(φ)=200μm, σ(Z)=500μm
  - For MPGD: σ(φ)=150μm, σ(Z)=150μm
- Vigorous R&D ongoing at CEA Saclay to verify a potential improvement of the performance with micro-TPC mode

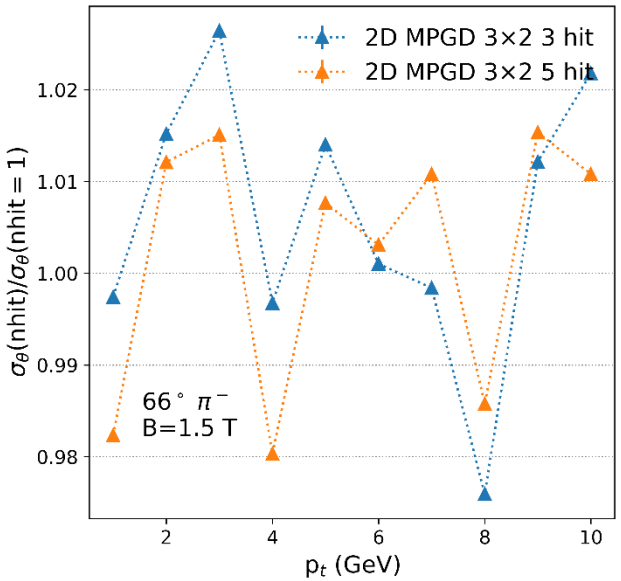


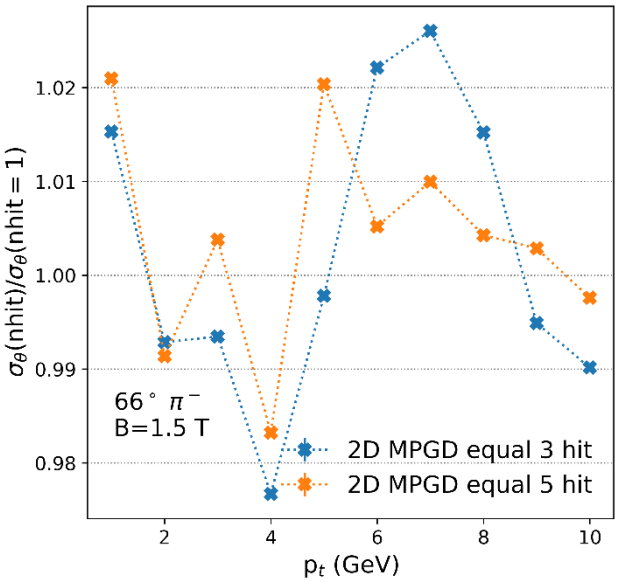


Performance with µTPC – angular resolution

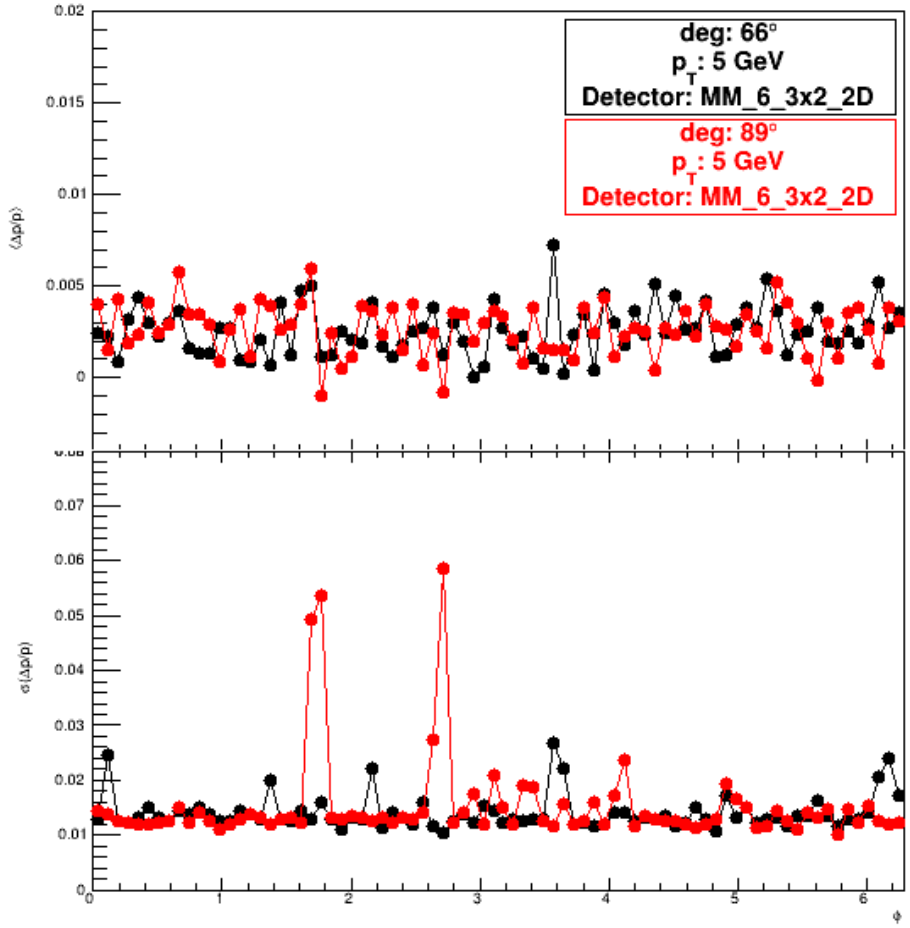


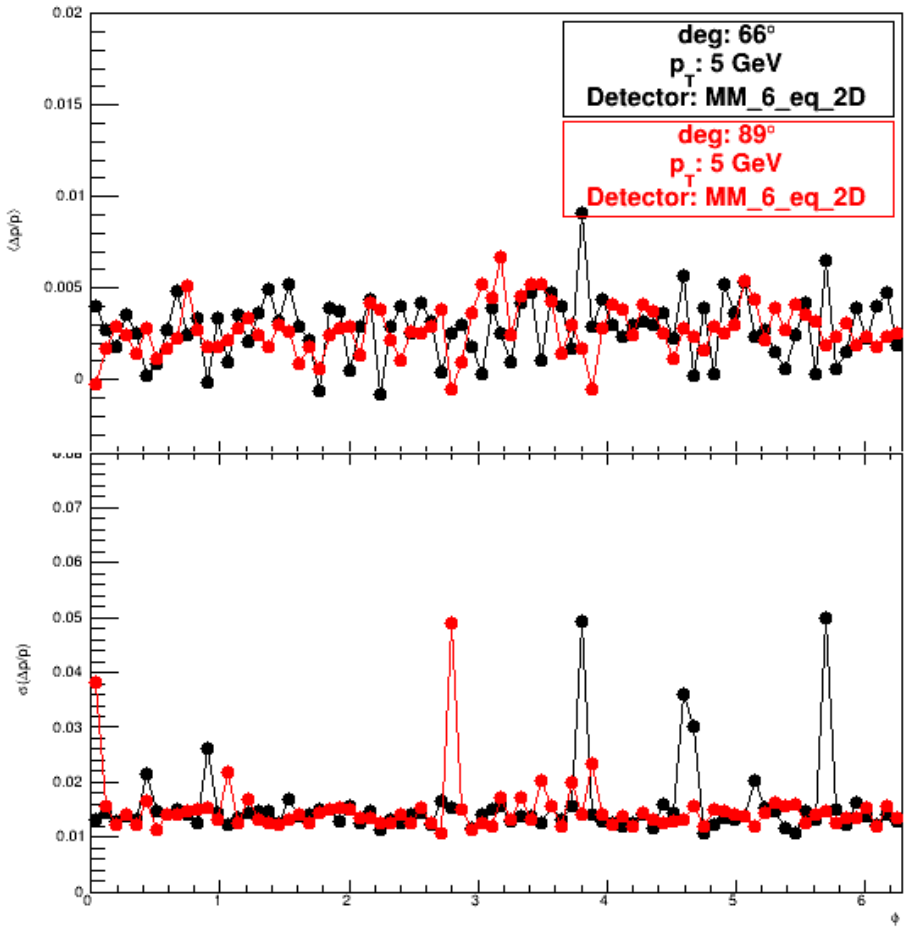






Φ-dependency of the tracking performance





Φ-dependency of the tracking performance

Central Tracking Work

- Simulations were performed in EICRoot.
  - 1000 pions were thrown at $\eta = \{0, 1, 3\}$ and $p = \{1, 10, 25, 50\}\ GeV$
  - This was done for magnetic fields of {1.0, 1.5, 2.0, 2.5, 3.0} Tesla
  - The tracks were reconstructed, and the reconstructed momentum was compared to the actual momentum of the generated track.
  - Distributions of $\frac{(p_{Reconstructed} - p_{Monte\ Carlo})}{p_{Monte\ Carlo}}$ are made, and the standard deviation is taken as the momentum resolution.

25 GeV Pions at eta ~0