

Projective Hybrid Tracker Studies

Nick Lukow

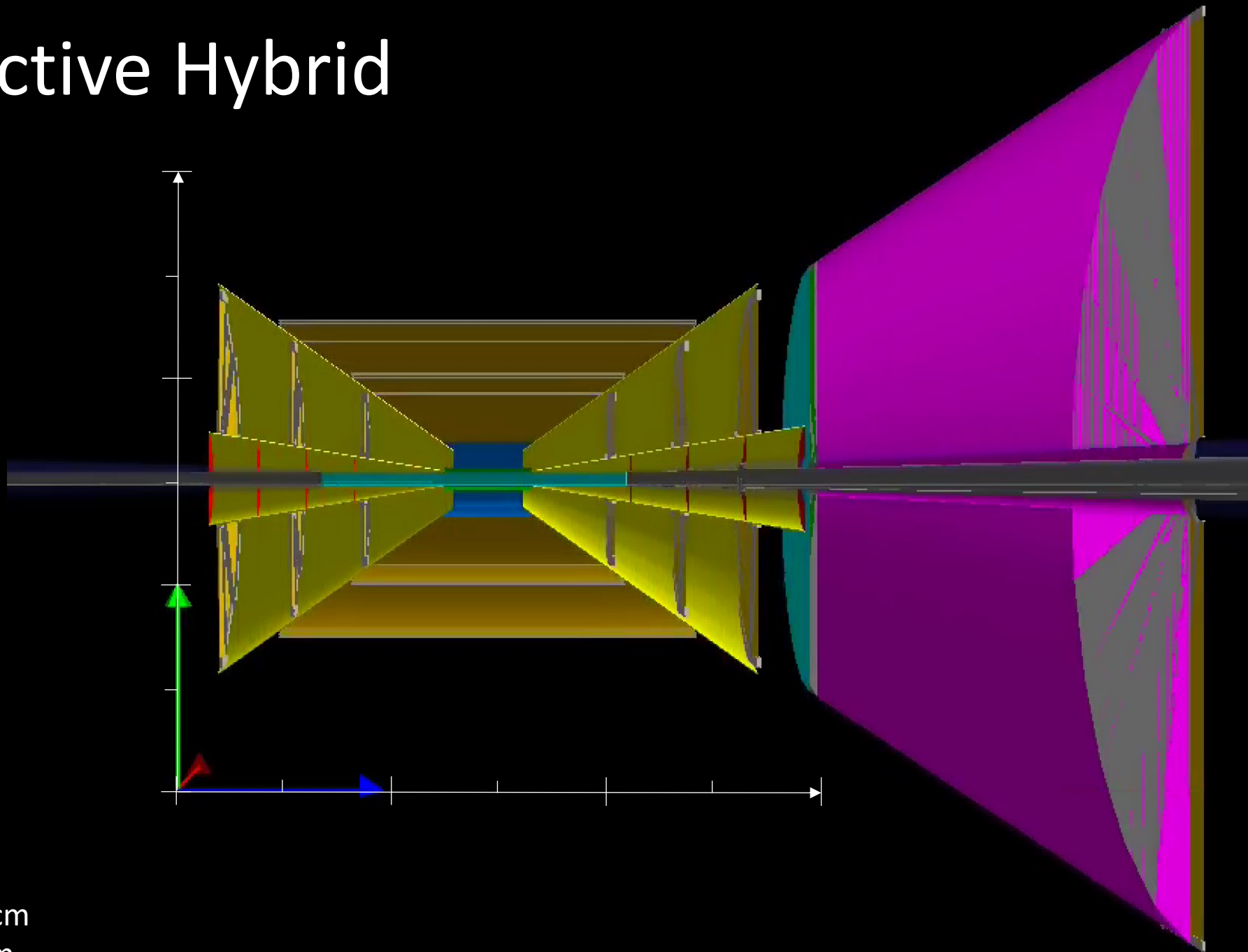
ATHENA Tracking WG

September 7, 2021

Overview

- Various Studies:
 - Momentum Resolution as function of GEM starting z position
 - Resolutions as function of GEM final Z position (if mRICH moved)
 - Optimization of GEM disks for mRICH at largest possible z position
 - Resolutions for different barrel Micro-Megas configurations

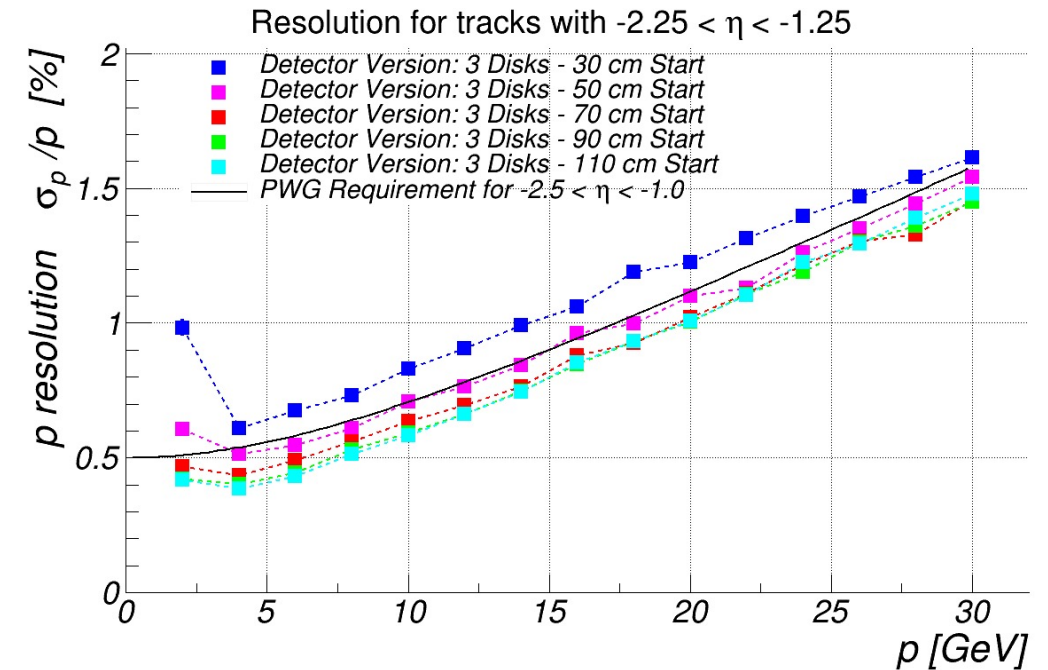
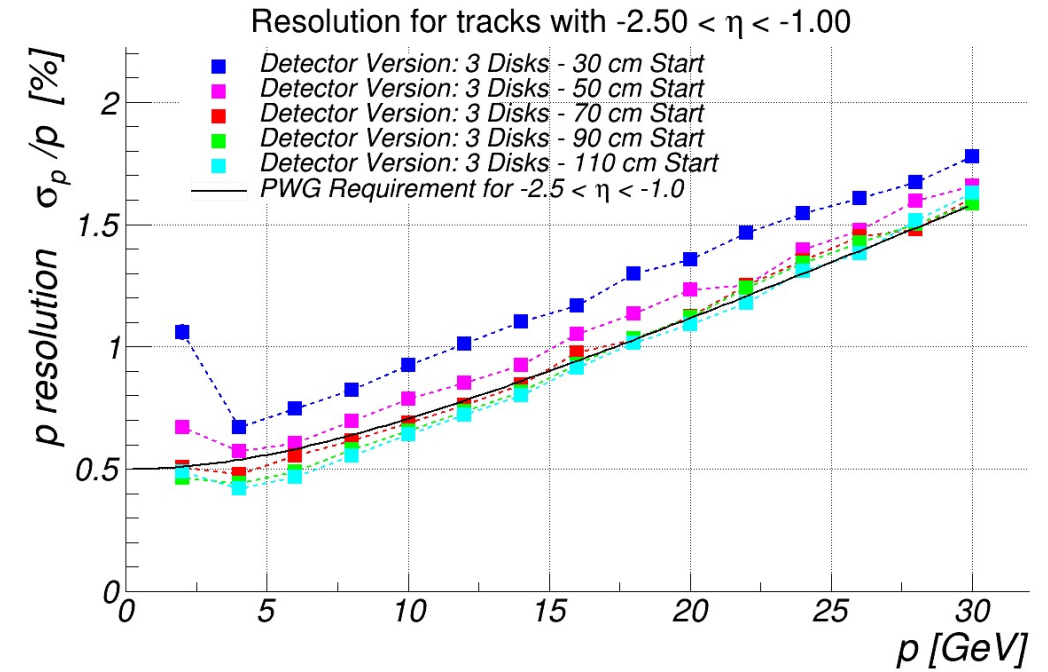
Projective Hybrid

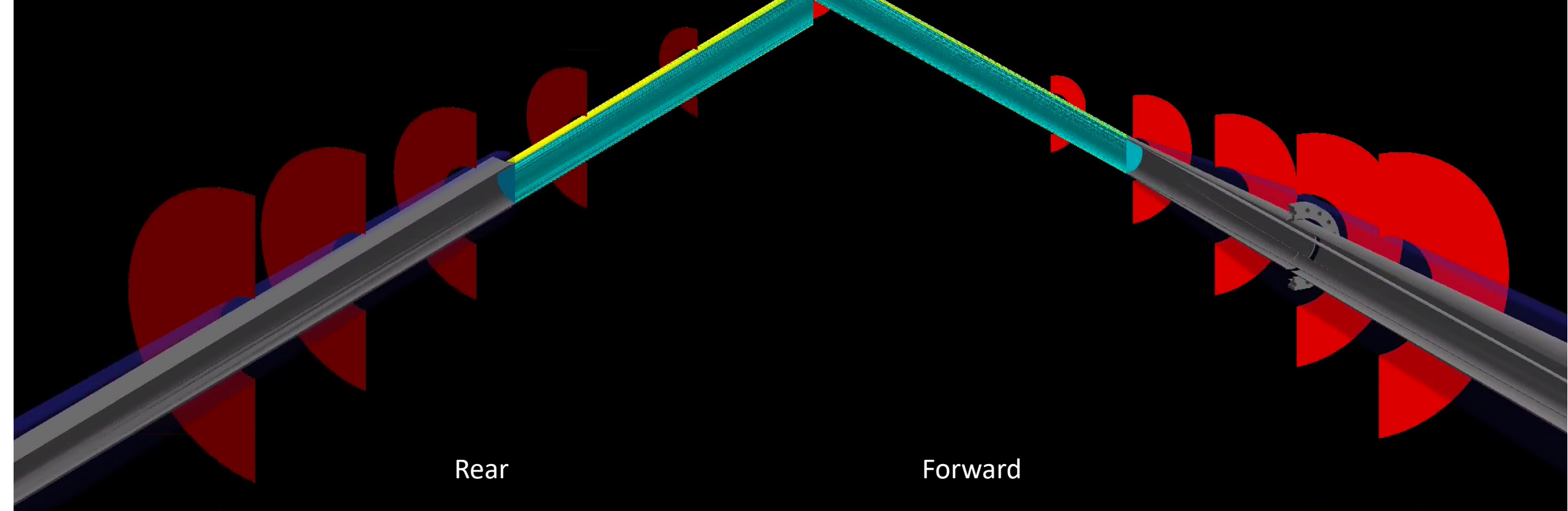


Major tick: 100cm
Minor tick: 50cm

Keeping 3 GEM Disks equally spaced covering up to -135 cm in z. Moving the starting z position further from the IP improves resolution

- Top plot shows full -2.5 to -1.0 eta range
- Bottom plot shows range only in active area



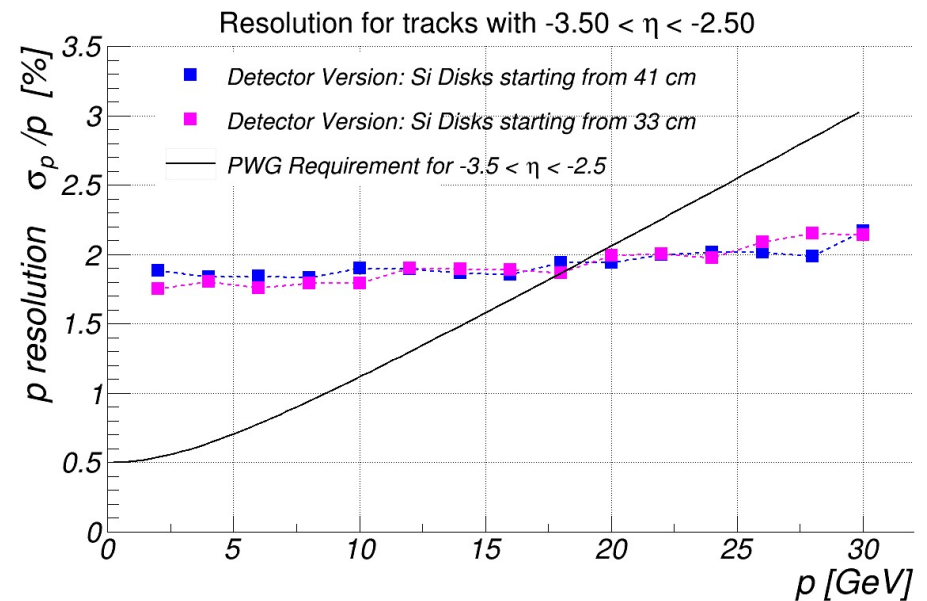


Silicon disks have been repositioned:

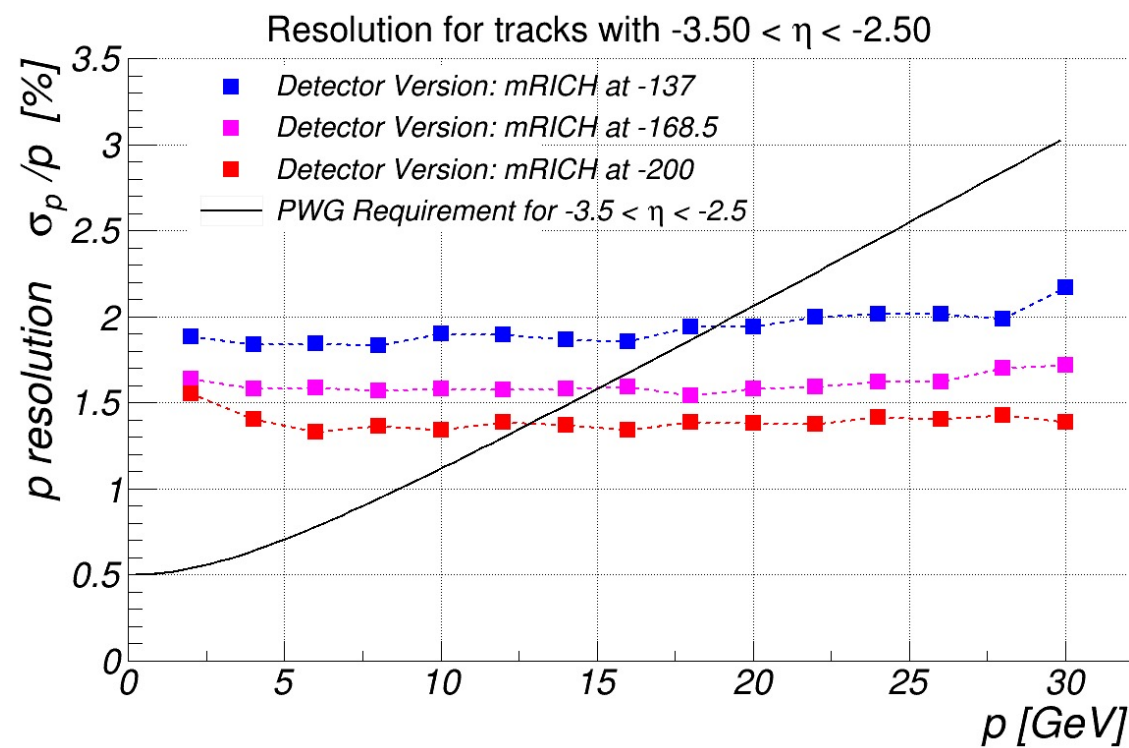
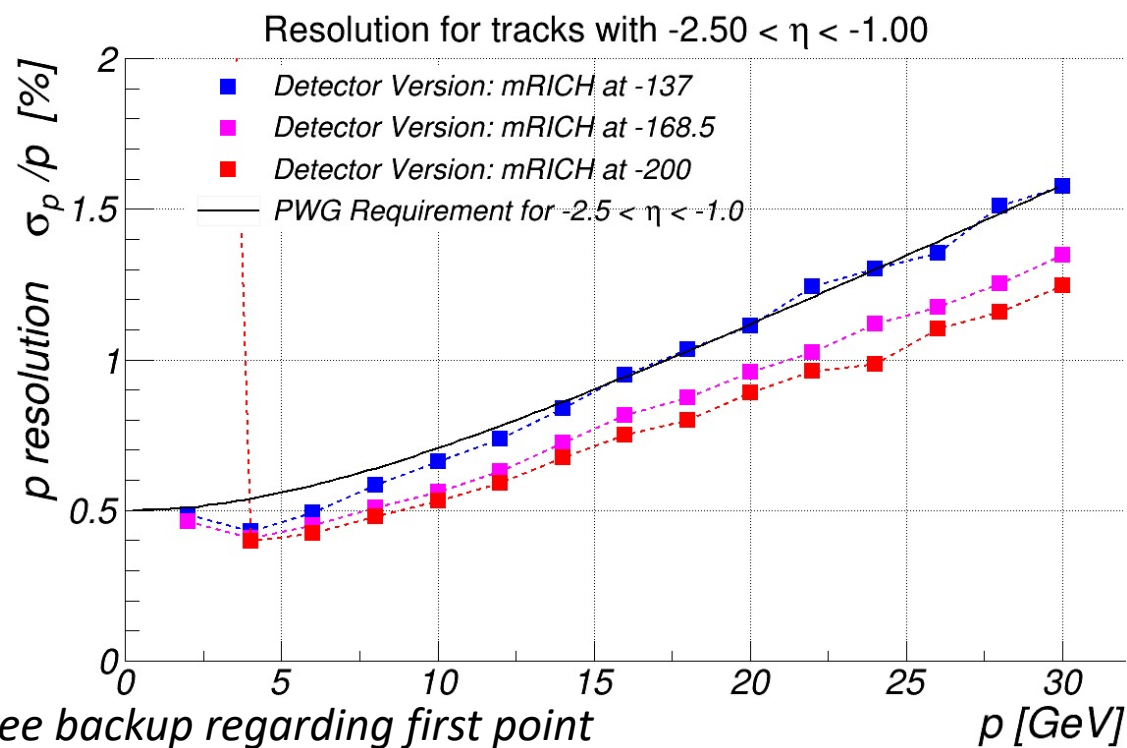
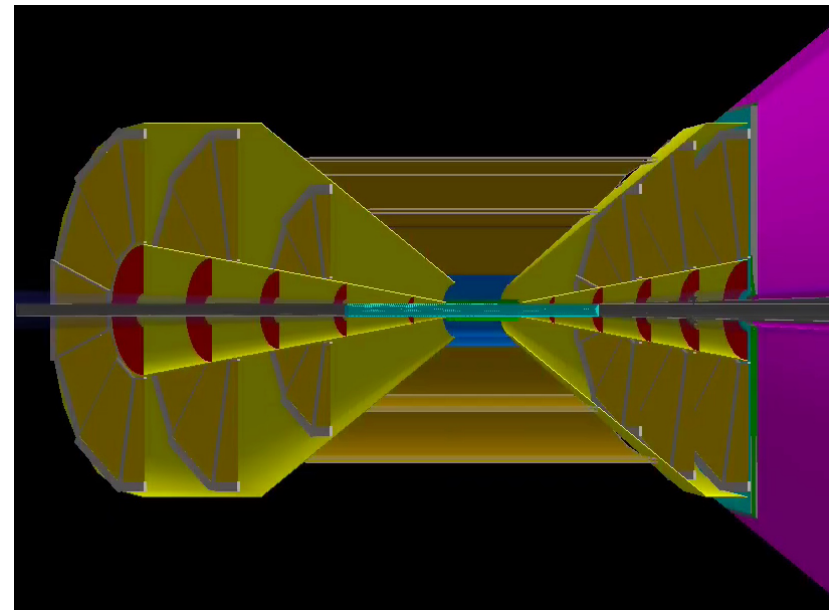
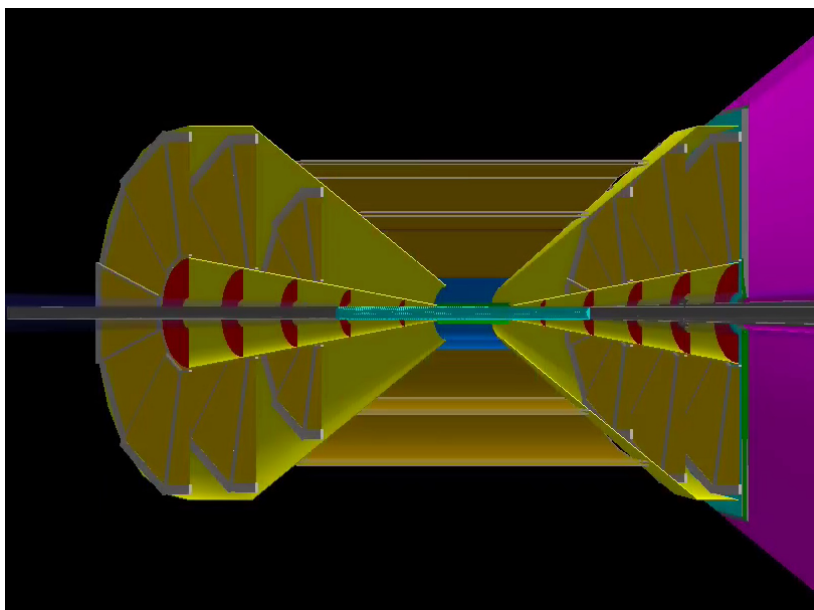
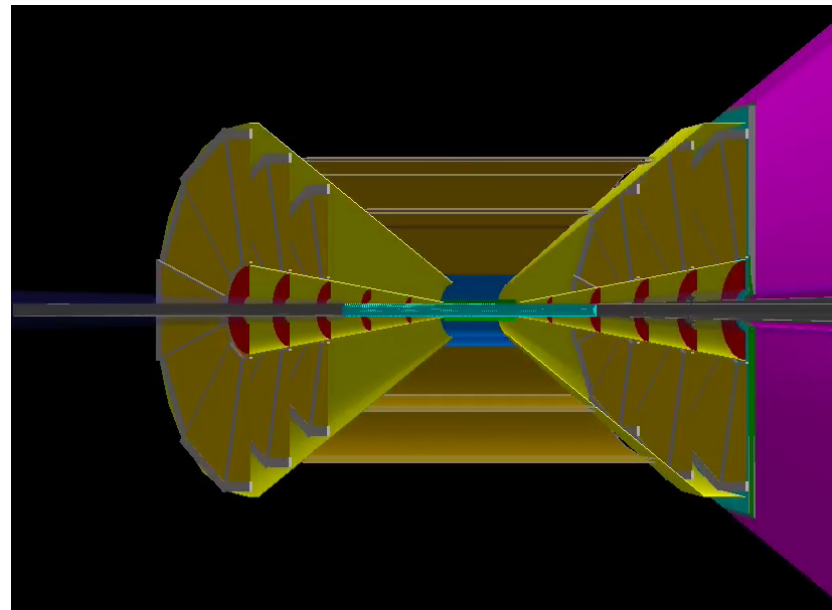
- starting position is further in z
- ending position is limited by PID (+153cm/-135cm)
- equally spaced relative to disks on same side

Change in z positions has very little effect on resolution

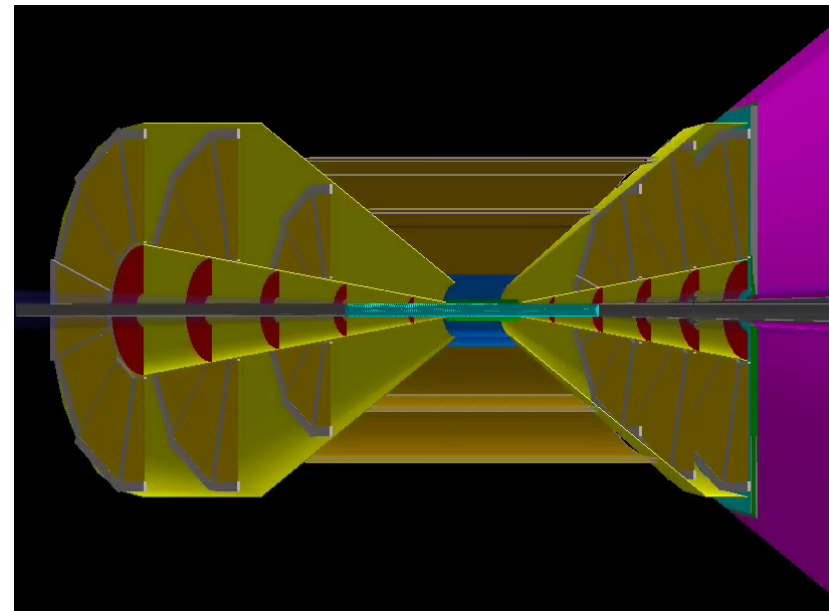
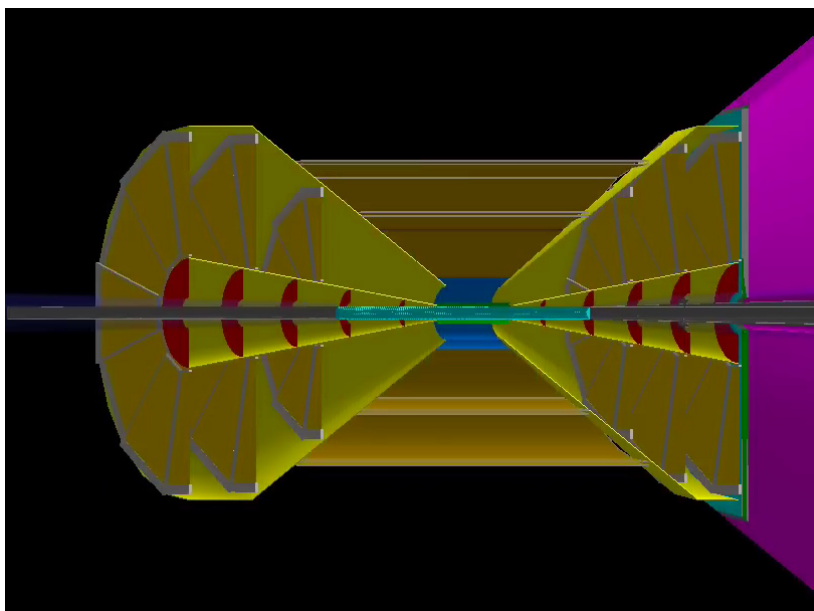
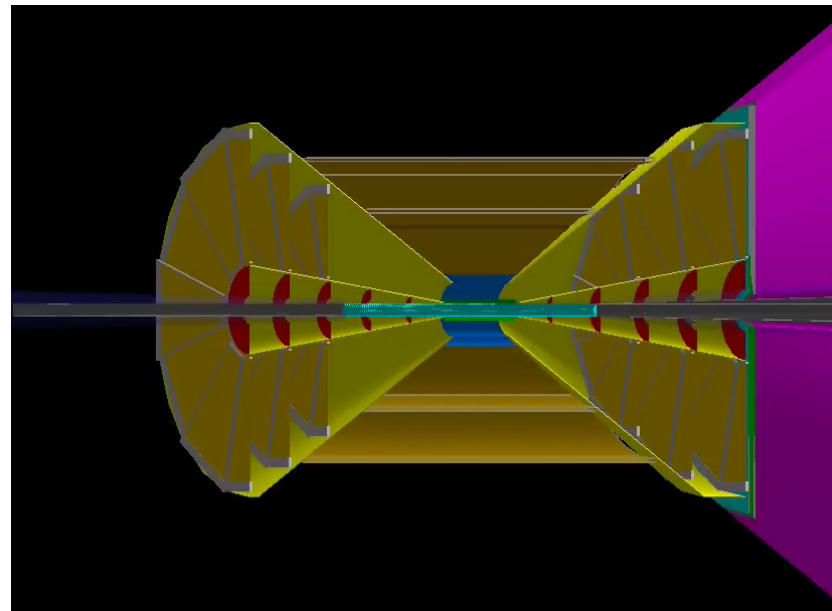
Changed inner radii to minimum allowed by beampipe for new z positions
 No longer symmetric



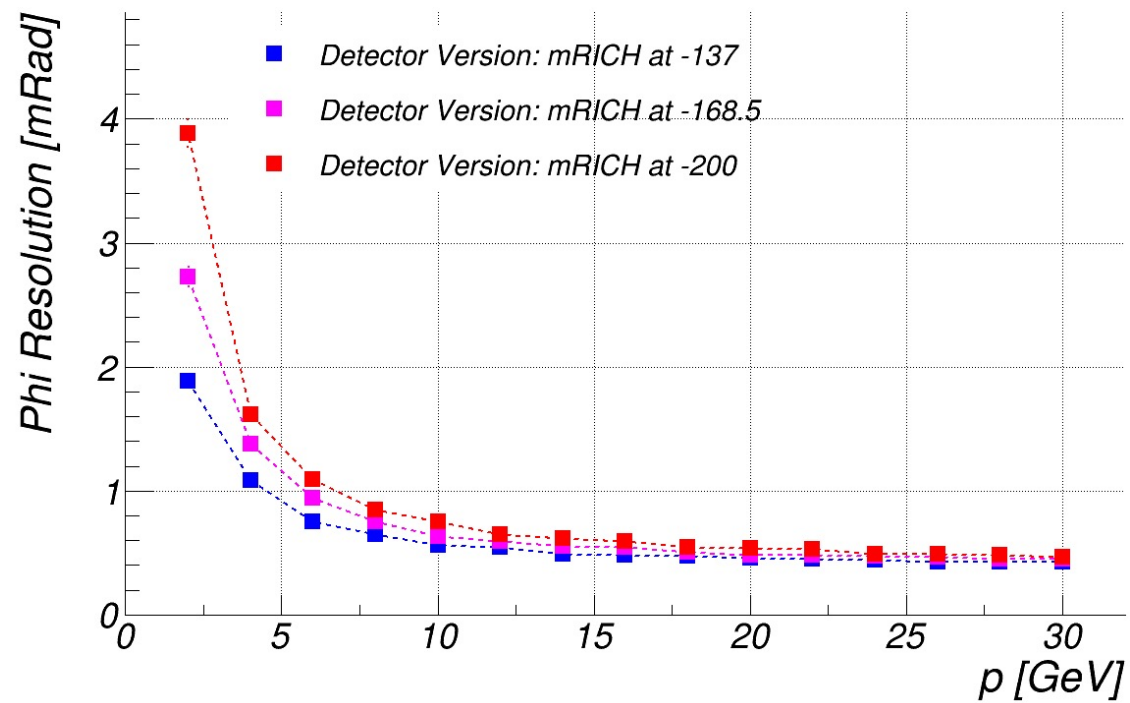
Momentum Resolution



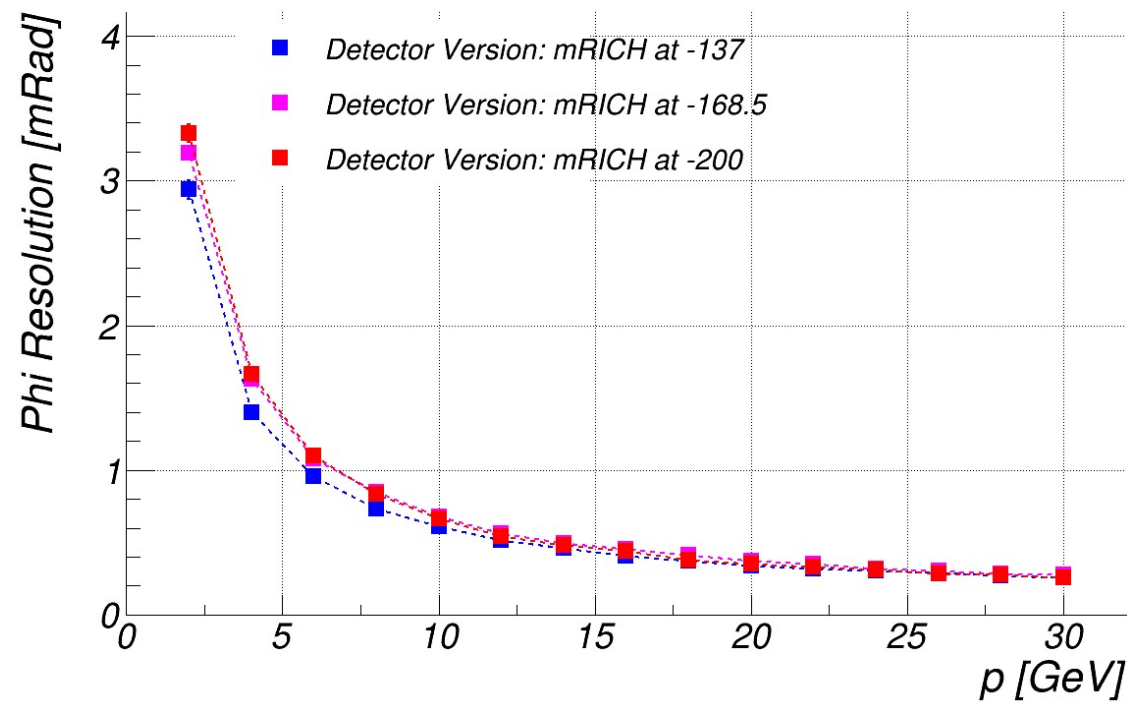
Phi Resolution



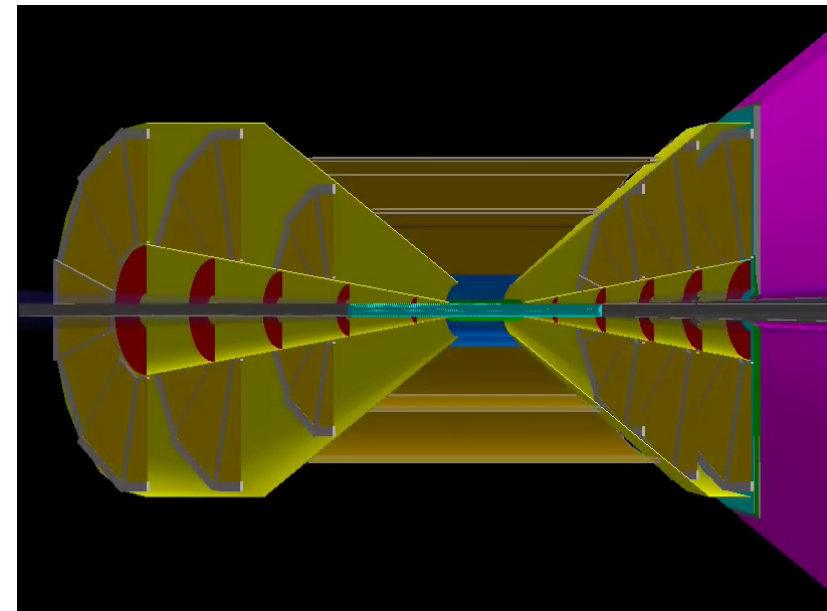
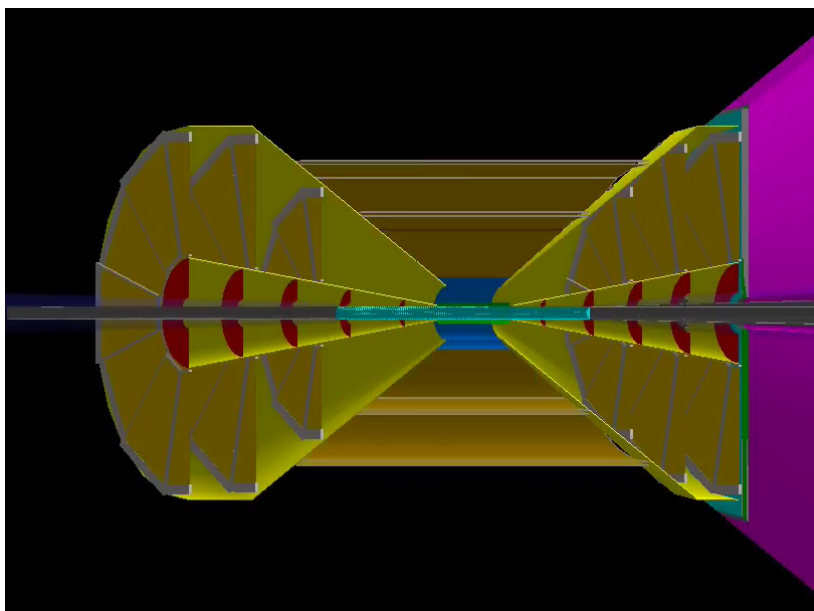
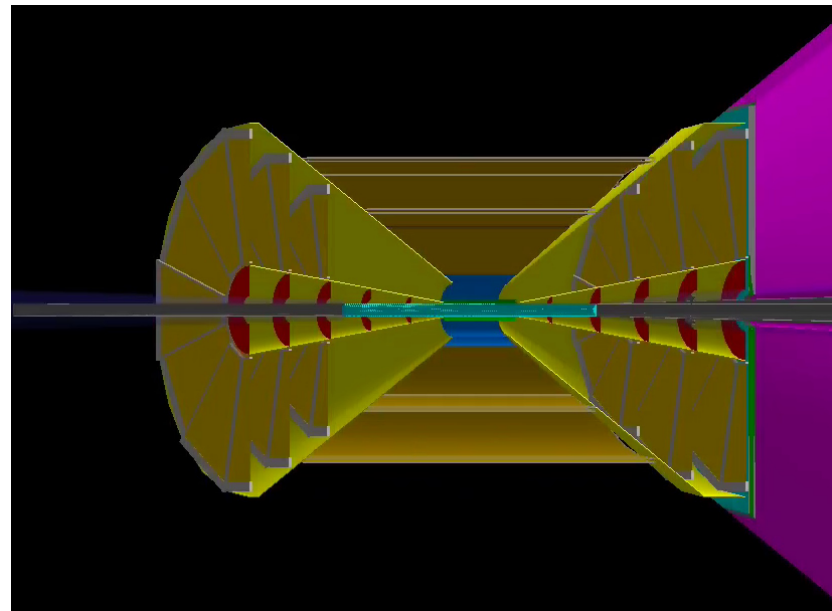
Phi Resolution for mRICH Entrance for tracks with $-2.50 < \eta < -1.00$



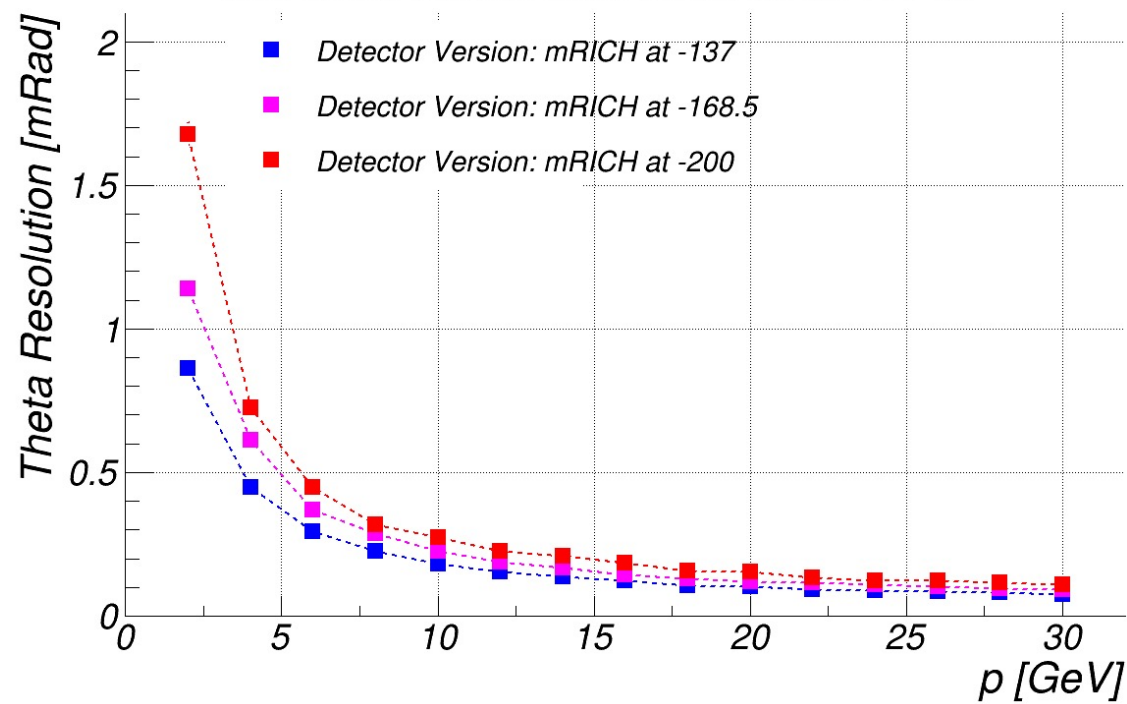
Phi Resolution for mRICH Entrance for tracks with $-3.50 < \eta < -2.50$



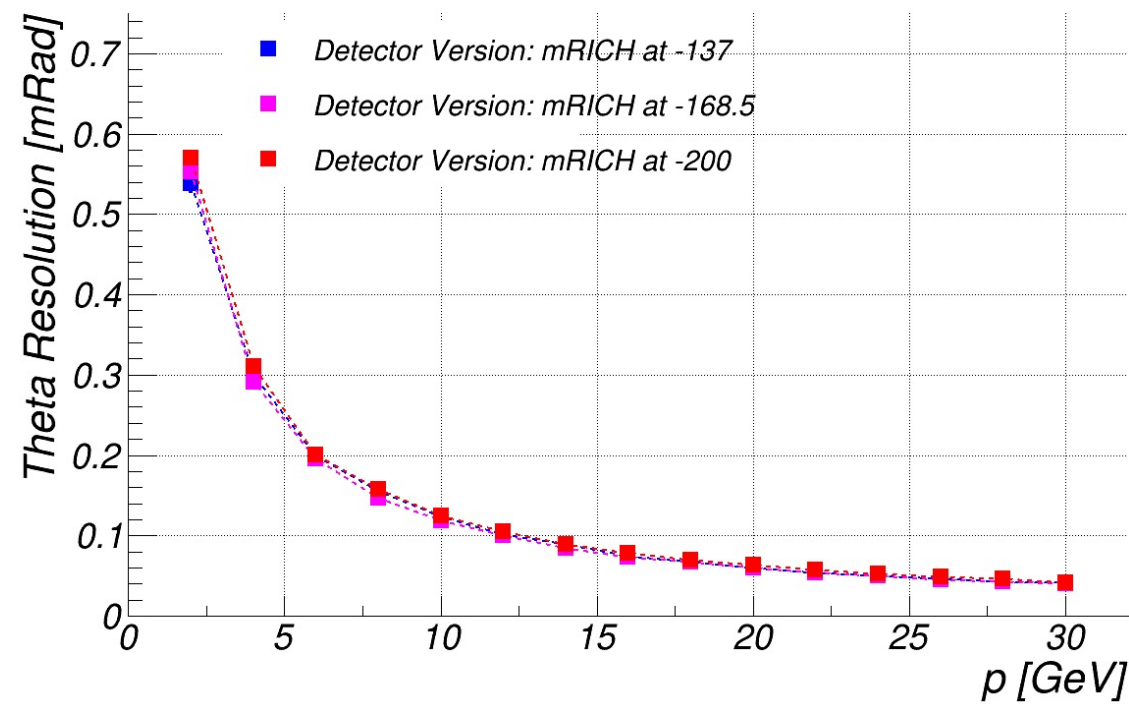
Theta Resolution



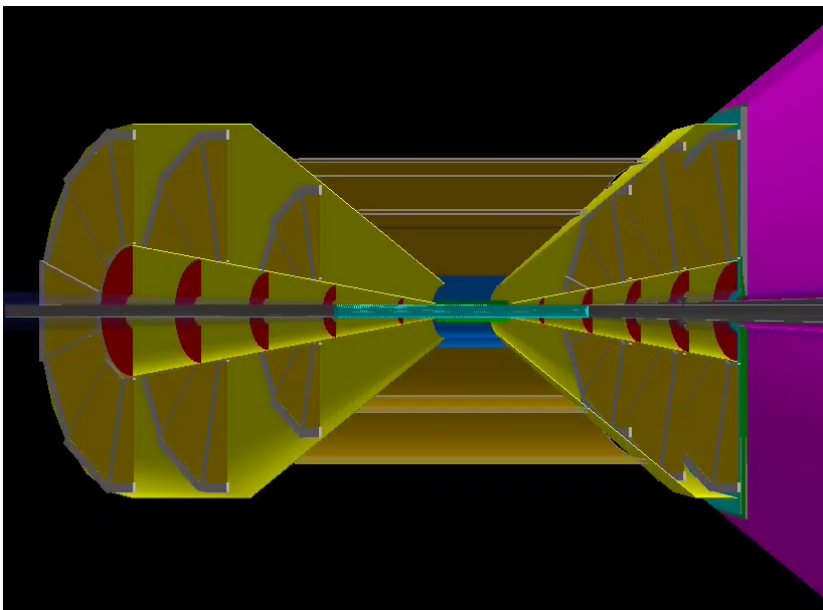
Theta Resolution for mRICH Entrance for tracks with $-2.50 < \eta < -1.00$



Theta Resolution for mRICH Entrance for tracks with $-3.50 < \eta < -2.50$



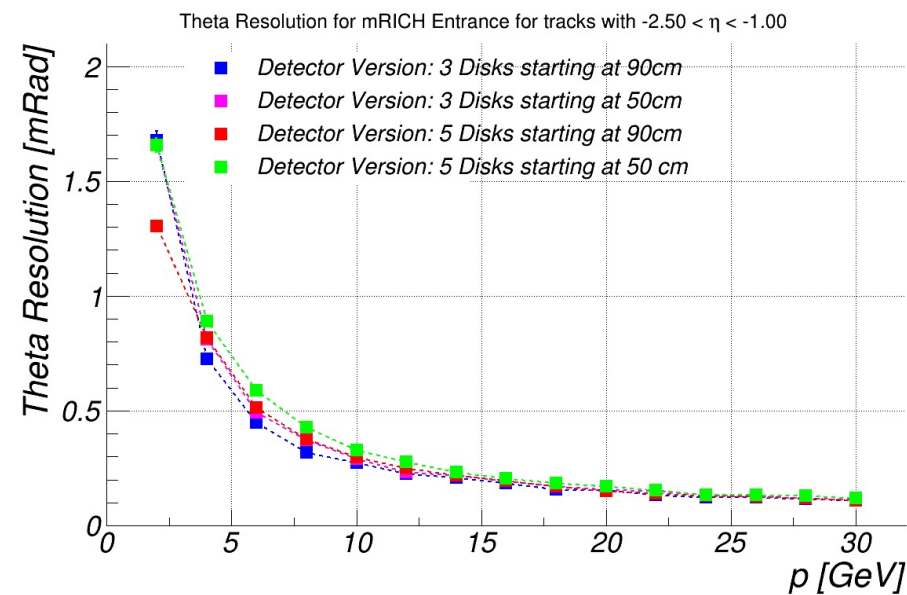
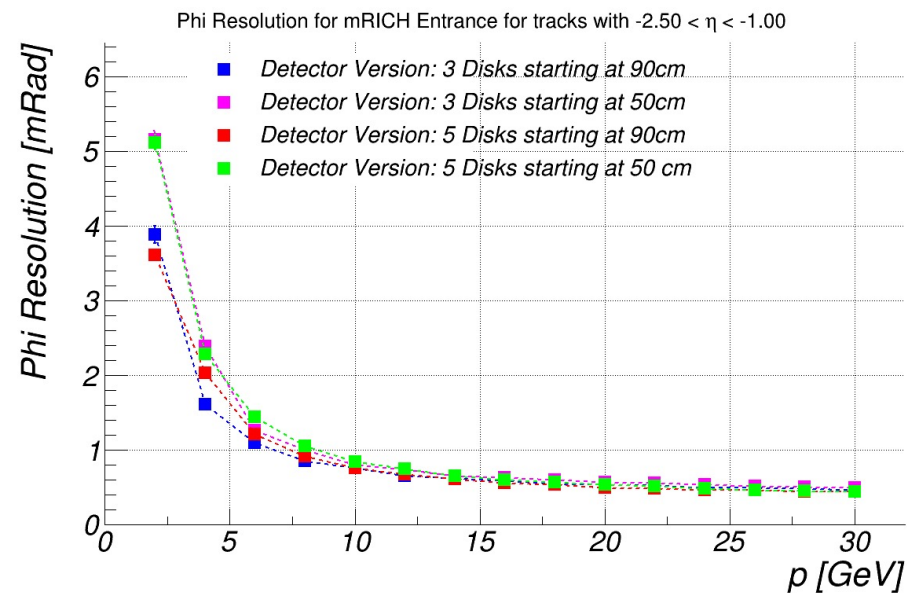
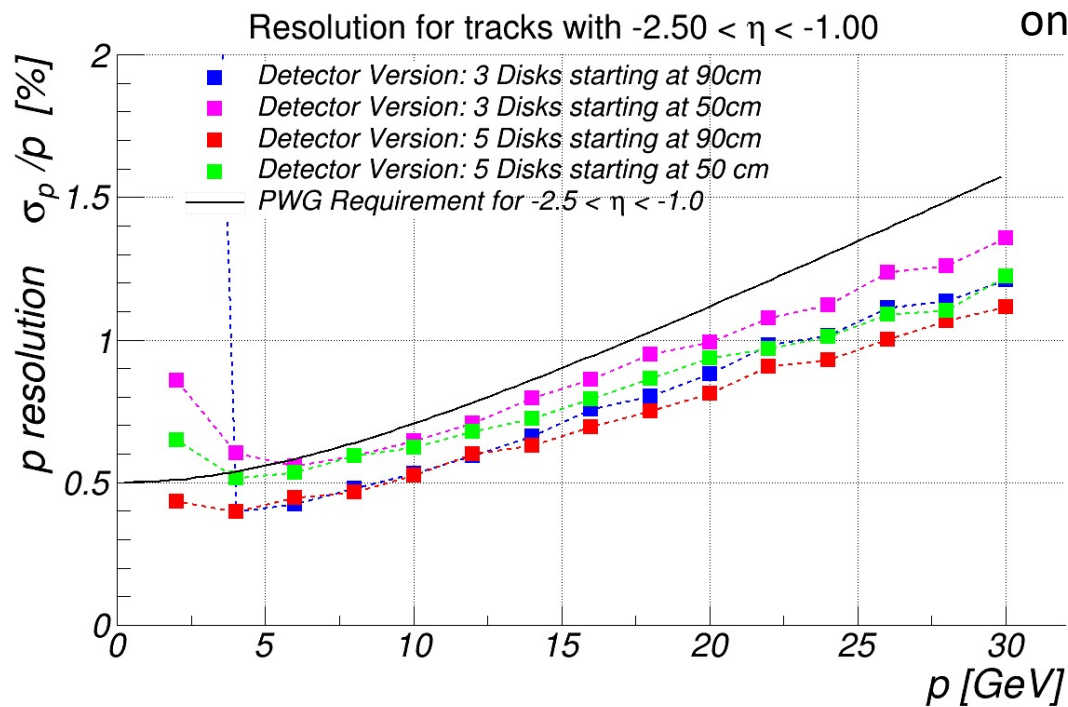
First Pass at Optimization



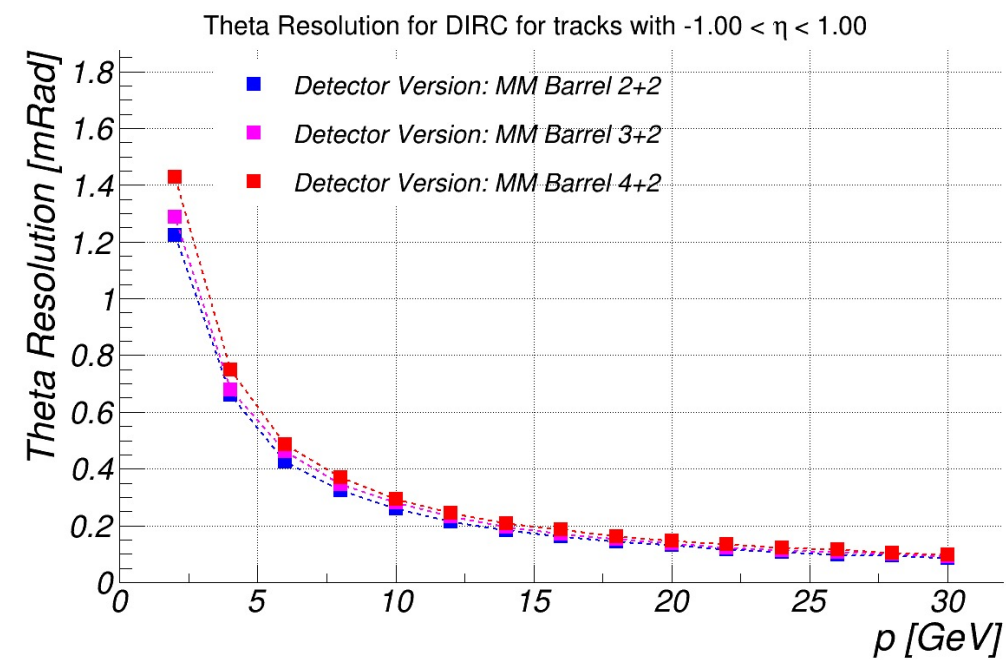
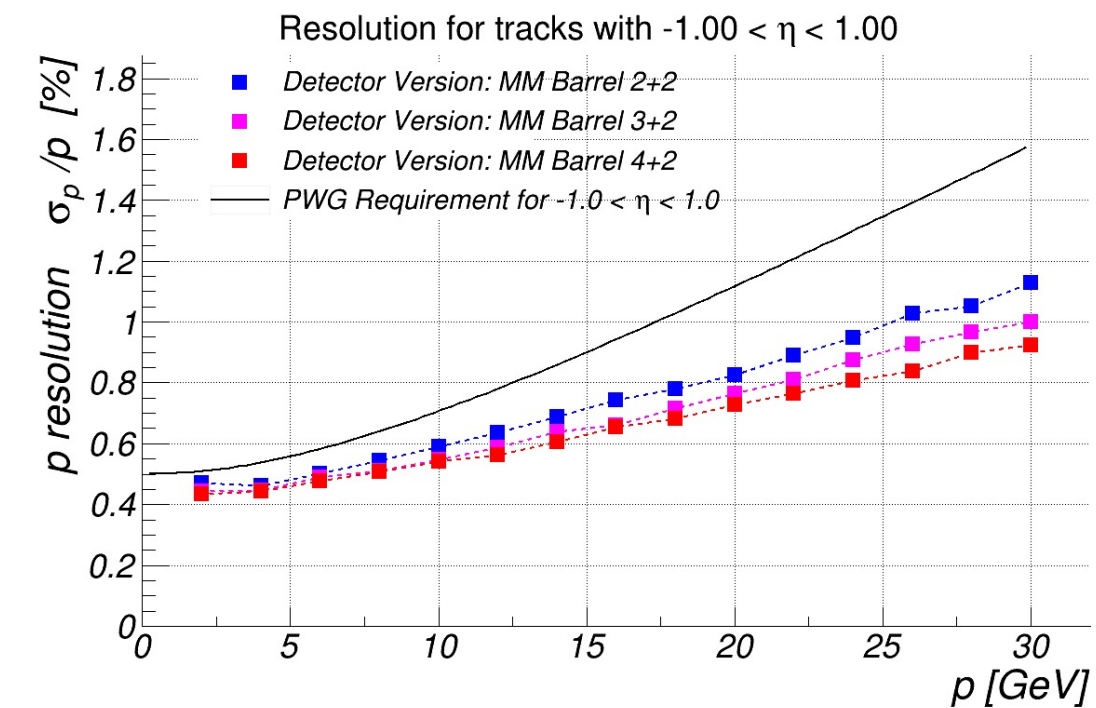
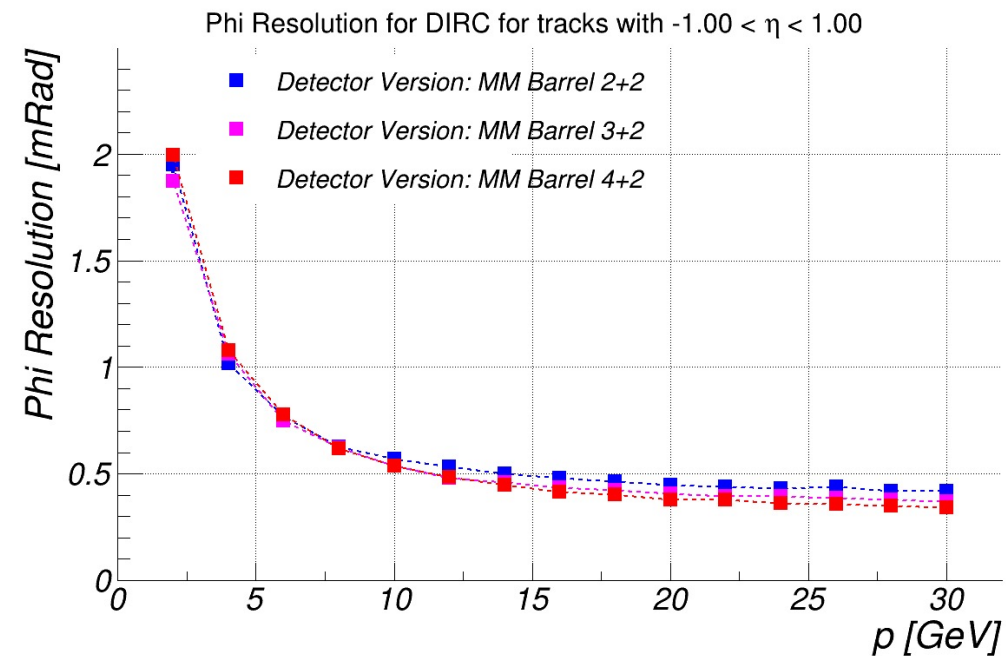
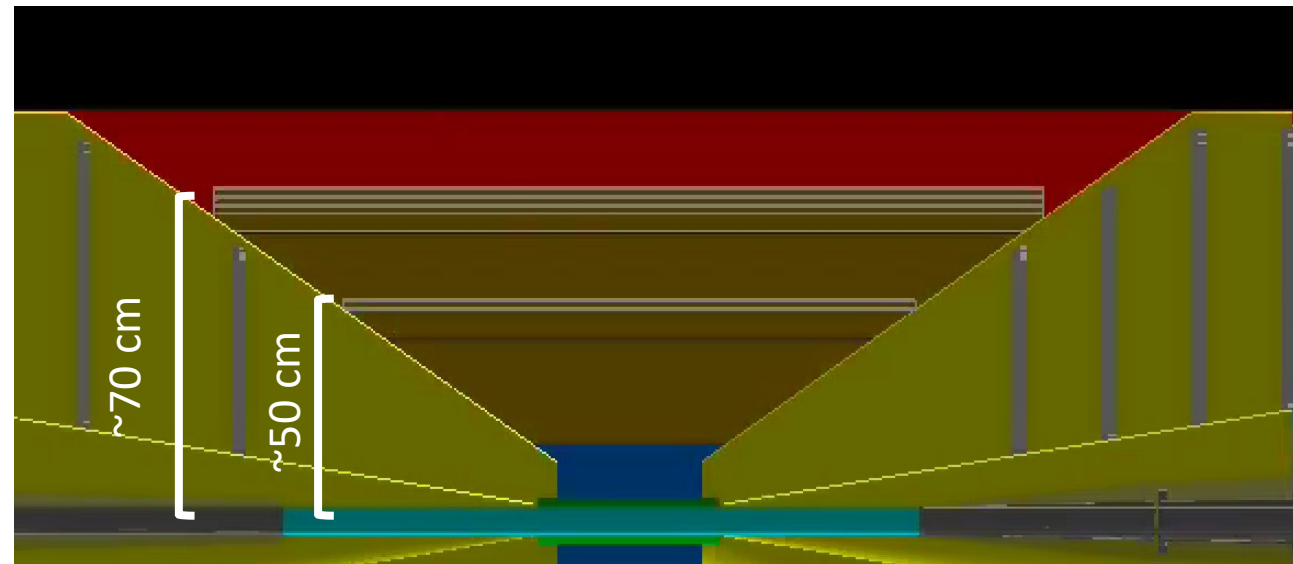
Keeping the mRICH at -200cm, changing GEM configuration

Adding GEM disks improves momentum resolution at low momenta and high momenta. Comparable angular resolutions with some tradeoffs at low and moderate momenta.

Starting GEM disks earlier only hurts resolutions



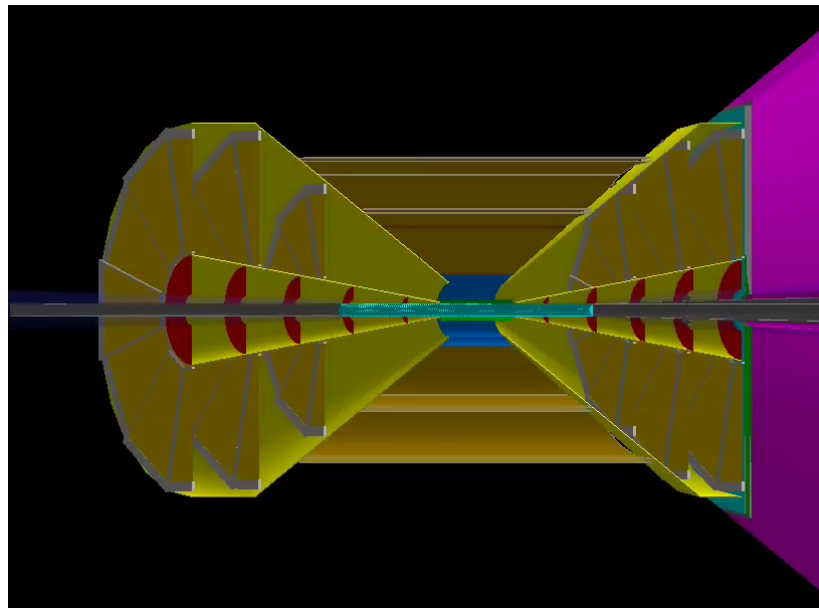
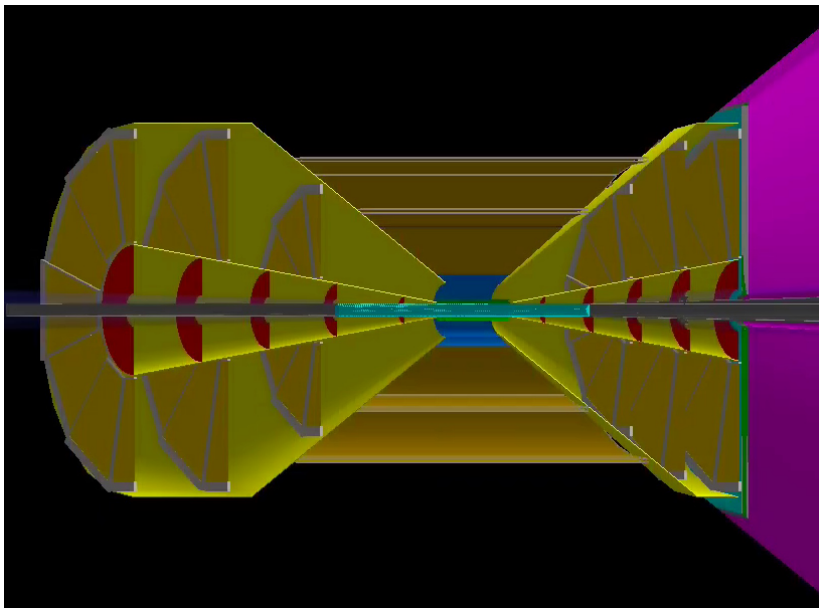
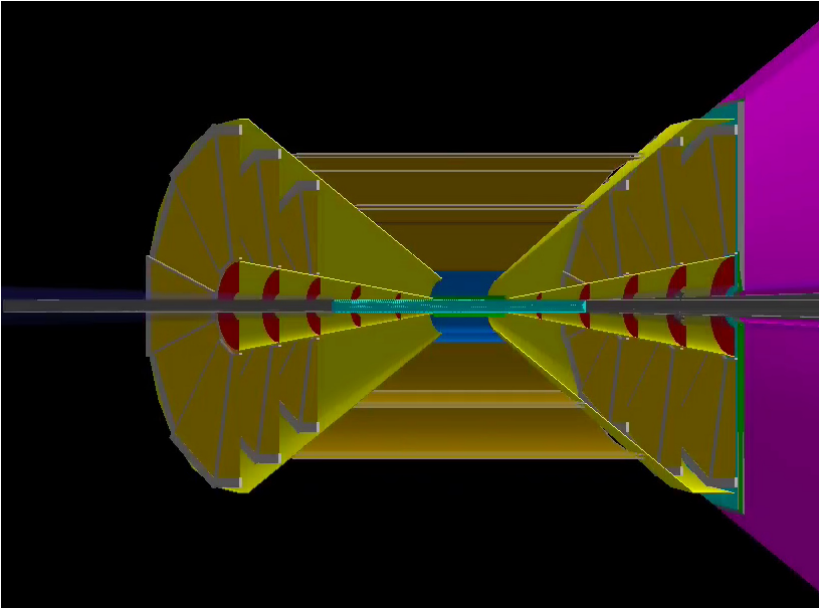
MM Barrel Layers Study



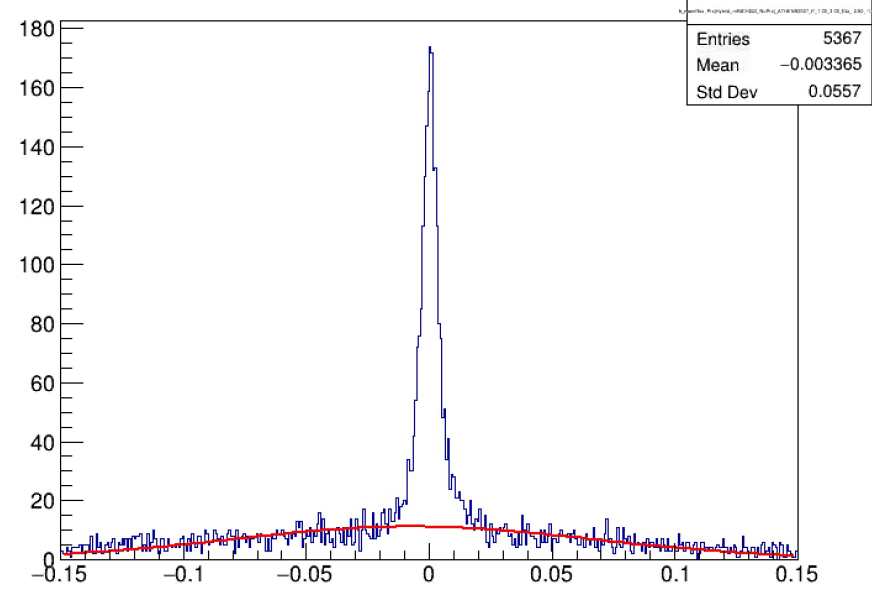
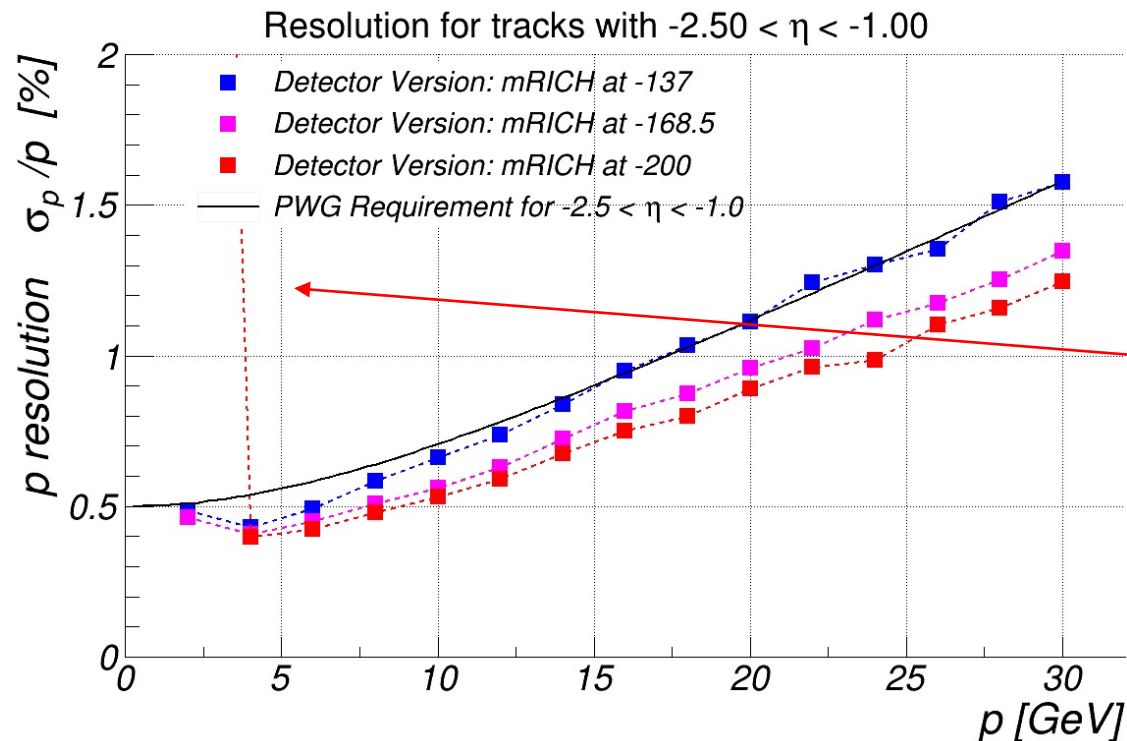
Summary

- MM barrel can meet requirements with only 2 outer and 2 middle layers
- Moving the mRICH location further away from the IP and expanding the z range covered by the trackers improves momentum resolution, but harms the phi resolution
- With expanded z coverage, adding more GEM disks can improve resolution

BACKUP



dp/p for $1.00 < p < 3.00$ and $-2.50 < \eta < -1.00$ - Detector: mRICH at -200 Field Map: ATHENA

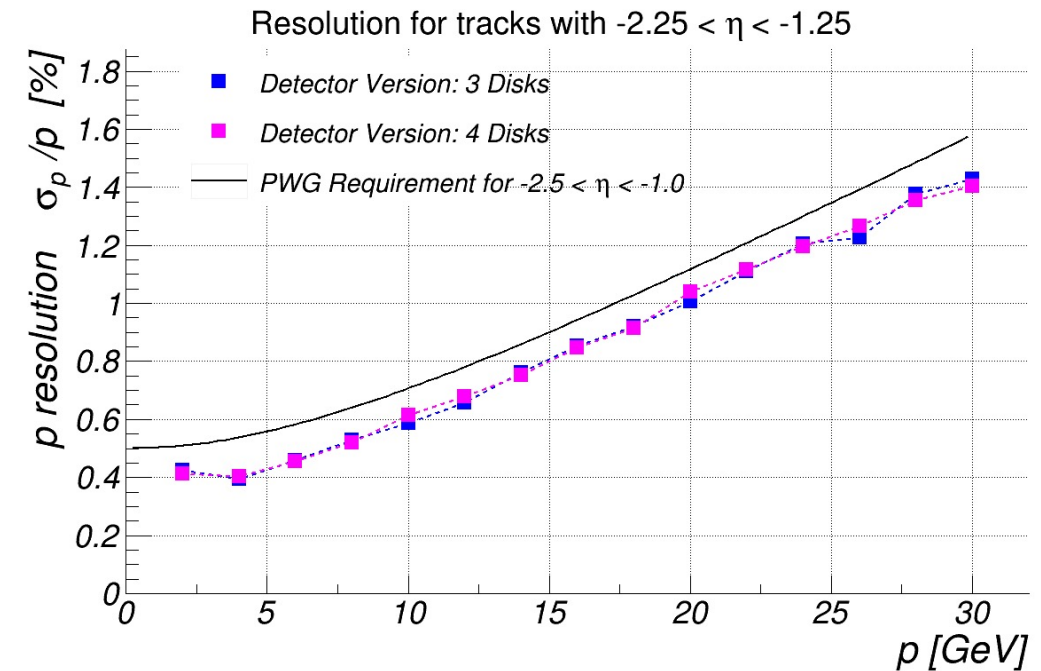
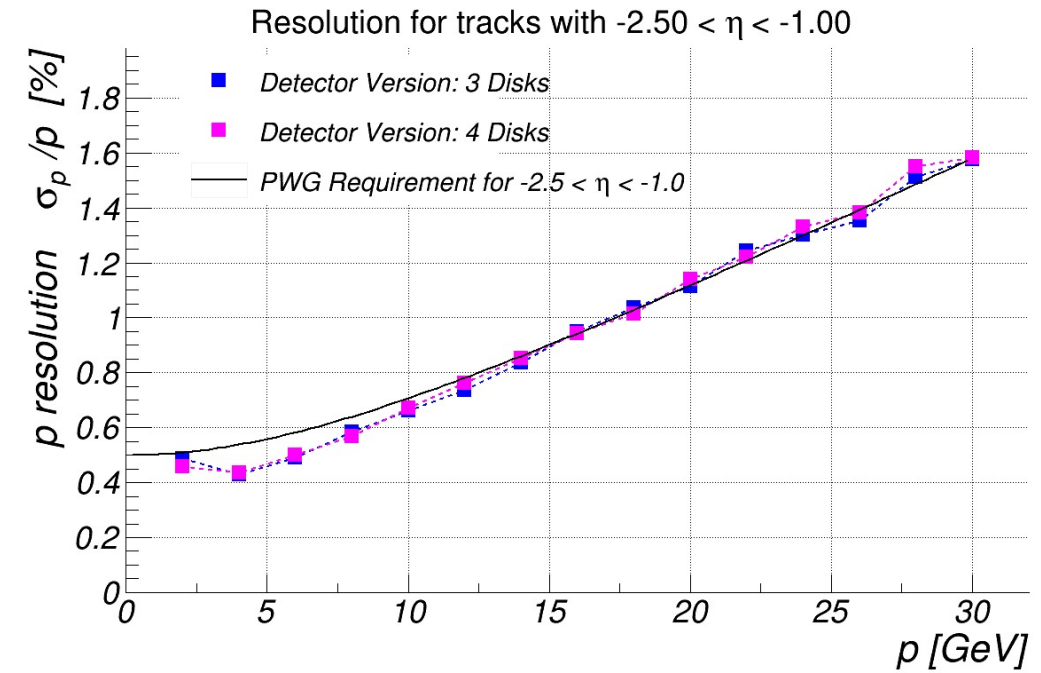


With such a large spacing, it may be necessary to add more GEMs, and perhaps closer for low momentum tracks

With same z coverage (-50 to -135 cm), adding additional GEM layers does not improve the resolution.

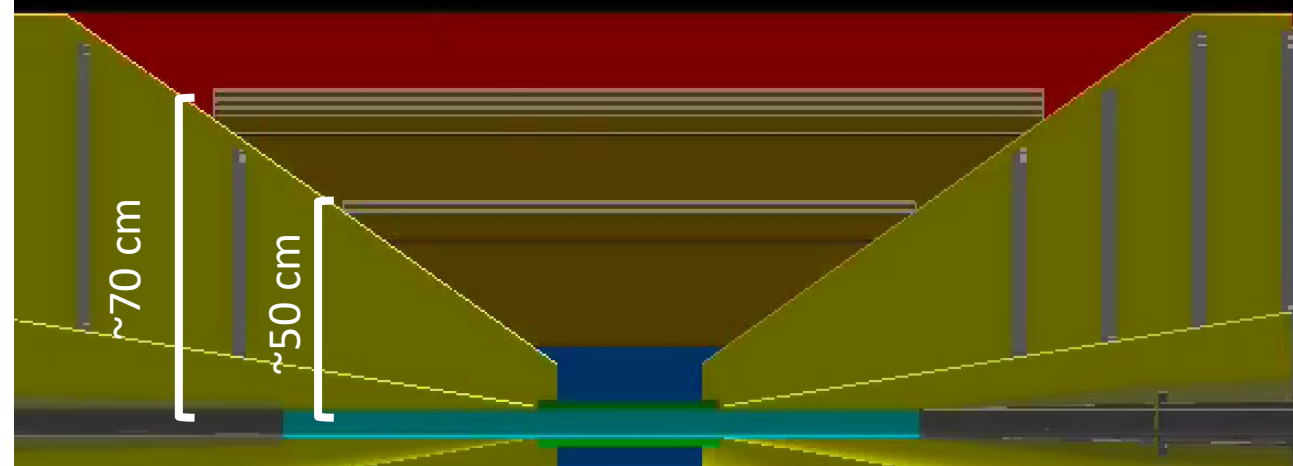
- Top plot shows full -2.5 to -1.0 eta range
- Bottom plot shows range only in active area

When expanding the z coverage, additional disks do become helpful, as seen in earlier slides

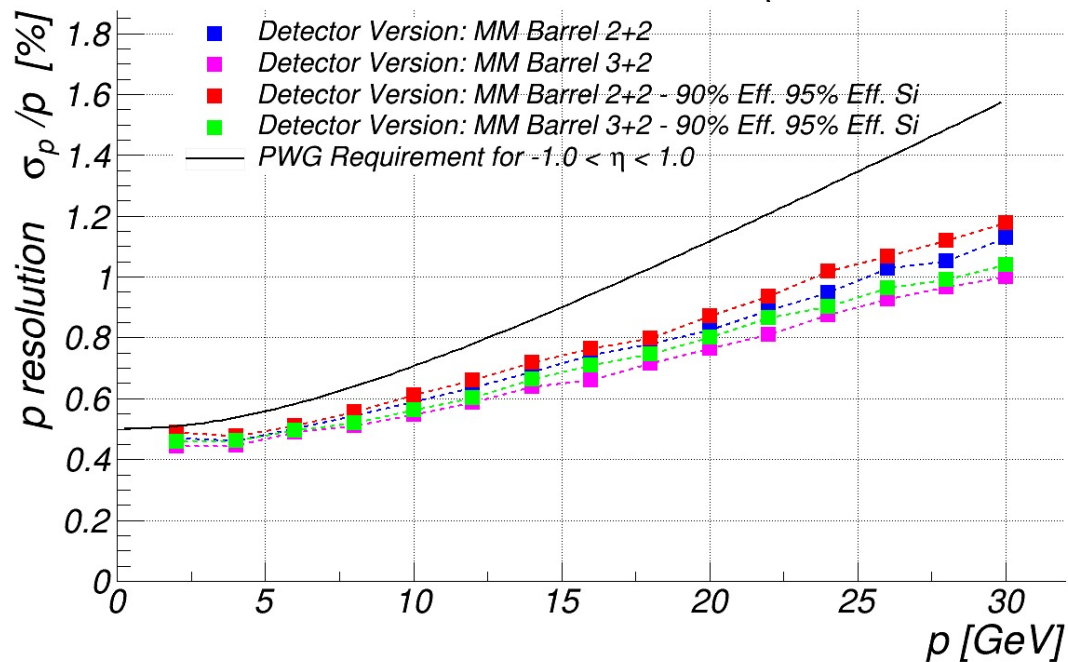


MM Barrel Layers + Efficiency Study

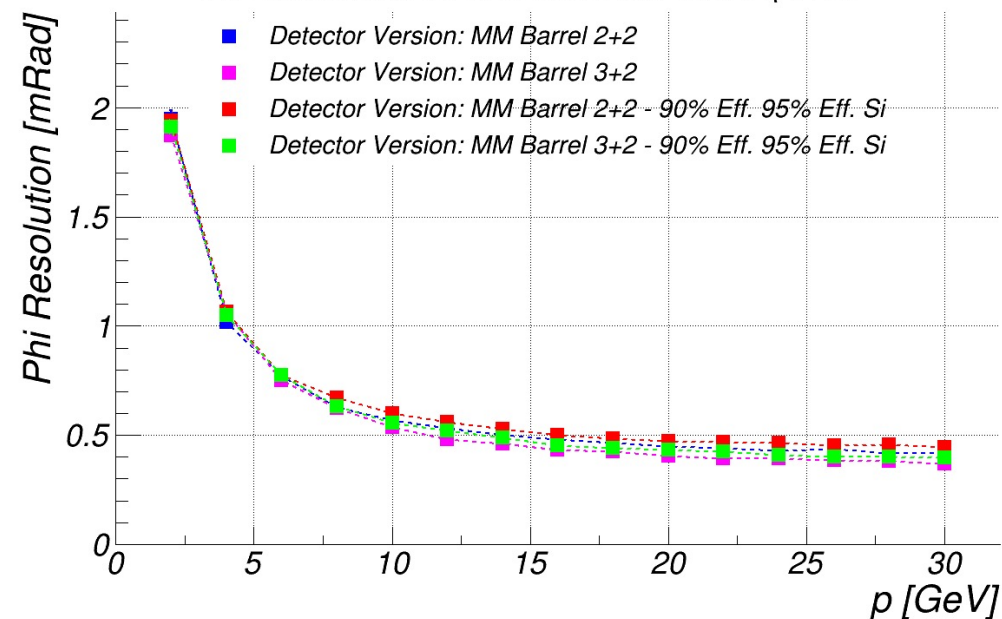
MM layers have efficiency of 90%, Si layers have eff. of 95%



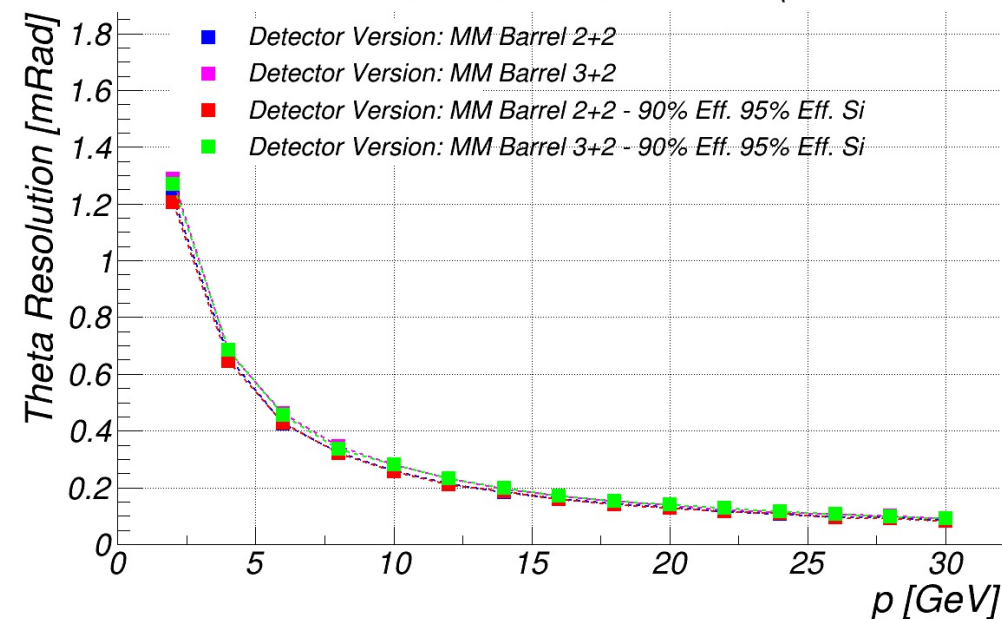
Resolution for tracks with $-1.00 < \eta < 1.00$



Phi Resolution for DIRC for tracks with $-1.00 < \eta < 1.00$



Theta Resolution for DIRC for tracks with $-1.00 < \eta < 1.00$



MM Barrel Layers + Efficiency Study

Only the MM layers have efficiency < 1.0 (90%)

