

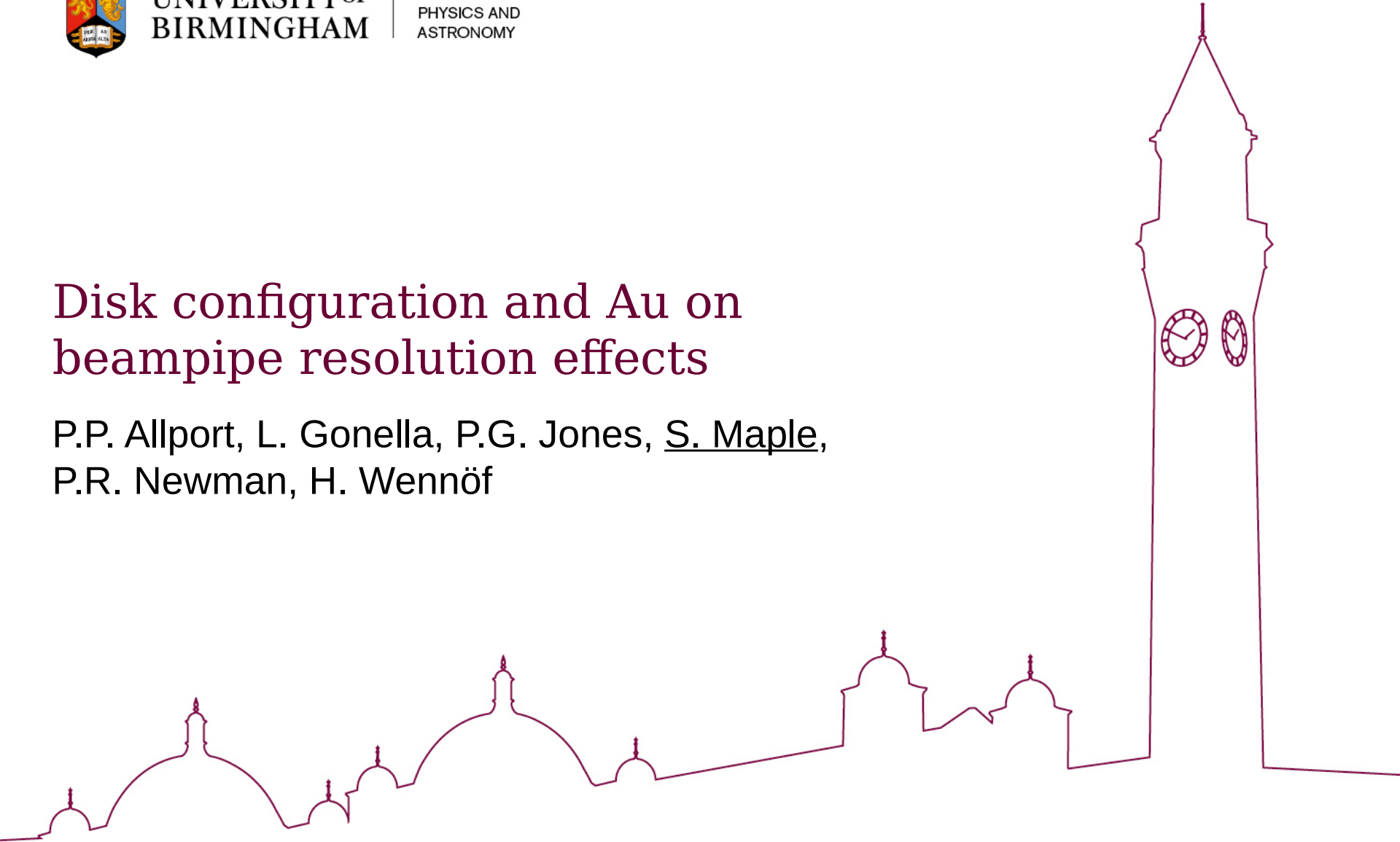


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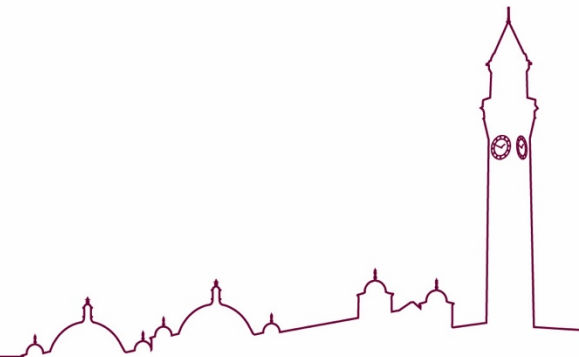
Disk configuration and Au on beampipe resolution effects

P.P. Allport, L. Gonella, P.G. Jones, S. Maple,
P.R. Newman, H. Wennöf



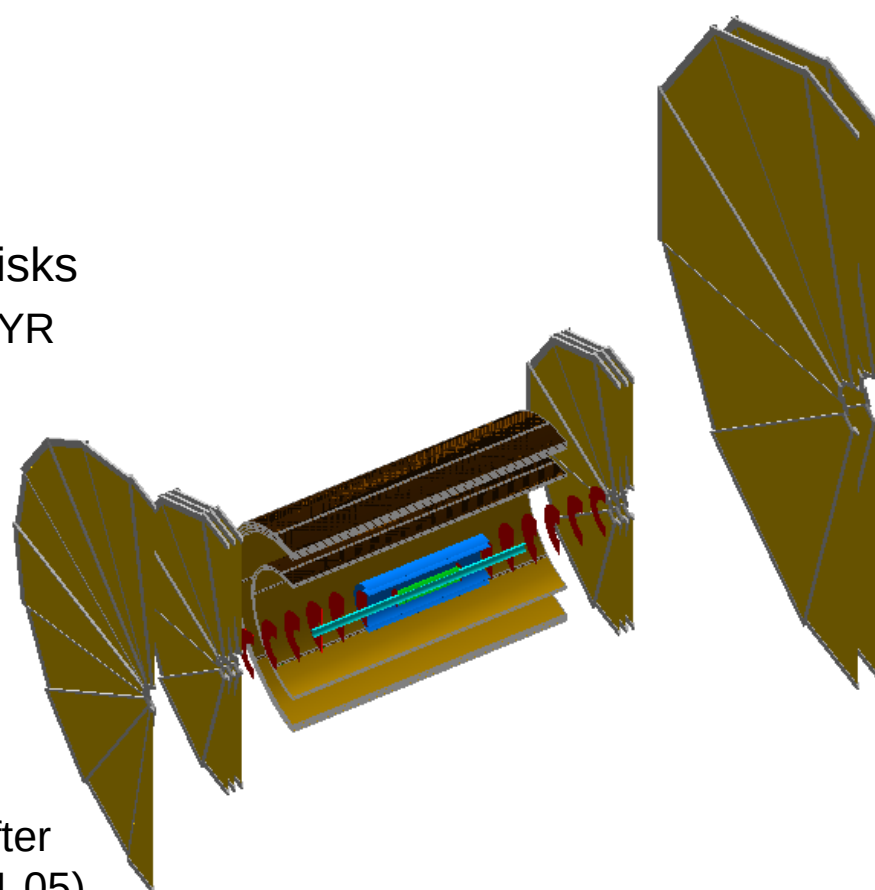
Overview

- Testing disk configurations
 - Simulated particles in pseudorapidity range $-3.5 < \eta < 3.5$, generated with transverse momentum range $0 < p_T < 30 \text{ GeV}/c$
 - Used π^- for $\eta > -1$ and e^- for $\eta < -1$
 - Compared YR 7 disk configuration to two different 5 disk configurations for Simplified Hybrid implementation with barrel MicroMegas and GEM endcaps → Produced benchmark plots
- Added $2\mu\text{m}$ and $10\mu\text{m}$ Au to beampipe
 - Produced benchmark plots
 - Performed Material Scans



Configuration

- Simple Silicon Inner barrel layers and disks
 - Barrel layers as described in table 11.12 of YR
 - Disk configurations shown on next slide
- Barrel MPGD Tracker
 - 2 Middle + 4 Outer layers
 - $R = \{47.7, 49.6, 71.9, 73.8, 75.6, 77.5\}$ cm
 - Layers span $-1 < \eta < 1$
 - Resolution = $150\mu\text{m} \times 150\mu\text{m}$
- GEM Disks
 - 3 Disks either side of tracker and 2 Disks after RICH on hadron going side (covering $|\eta| > 1.05$)
 - 1 Disk before the ECAL on electron going side (covering $|\eta| > 1$)
 - See Nick's talk here for more details
<https://indico.bnl.gov/event/12013/>



MPGD + GEM code from N. Lukow github

https://github.com/NicholasLukow/ATHENA_Tracking_GEM

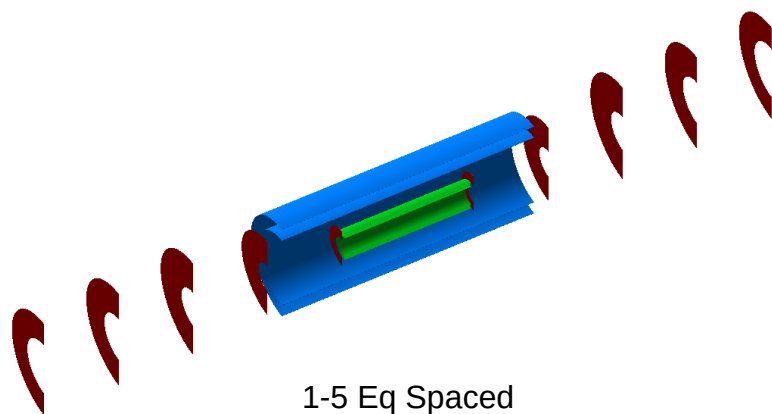
Disks Configuration

- 3 Designs
 - YR Baseline (top)
 - 5 Disks (Disks 1-5 Equally spaced) (middle)
 - 5 Disks (Disks 2-5 Equally spaced) (bottom)

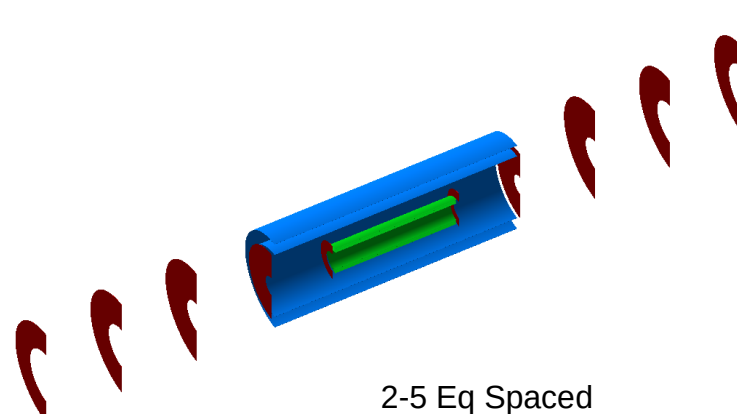
Disk	z position (mm)	Inner radius (mm)	Outer radius (mm)
Disk 1	220	36.4	71.3
Disk 2	430	36.4	139.4
Disk 3	586	36.4	190.0
Disk 4	742	49.9	190.0
Disk 5	898	66.7	190.0
Disk 6	1054	83.5	190.0
Disk 7	1210	99.3	190.0

Disk	z position (mm)	Inner radius (mm)	Outer radius (mm)
Disk 1	220	36.4	71.3
Disk 2	468	52.1	151.6
Disk 3	715	67.9	190.0
Disk 4	963	83.6	190.0
Disk 5	1210	99.3	190.0

Disk	z position (mm)	Inner radius (mm)	Outer radius (mm)
Disk 1	220	36.4	71.3
Disk 2	430	36.4	139.4
Disk 3	690	57.4	190.0
Disk 4	950	78.3	190.0
Disk 5	1210	99.3	190.0



1-5 Eq Spaced

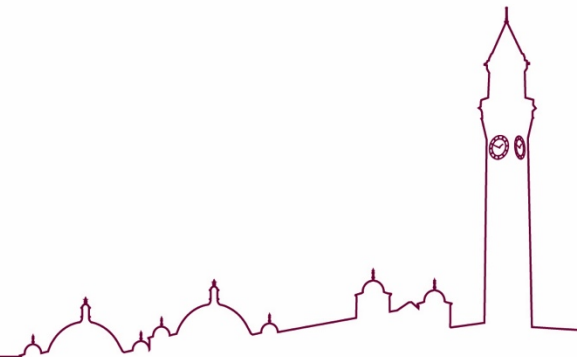


2-5 Eq Spaced

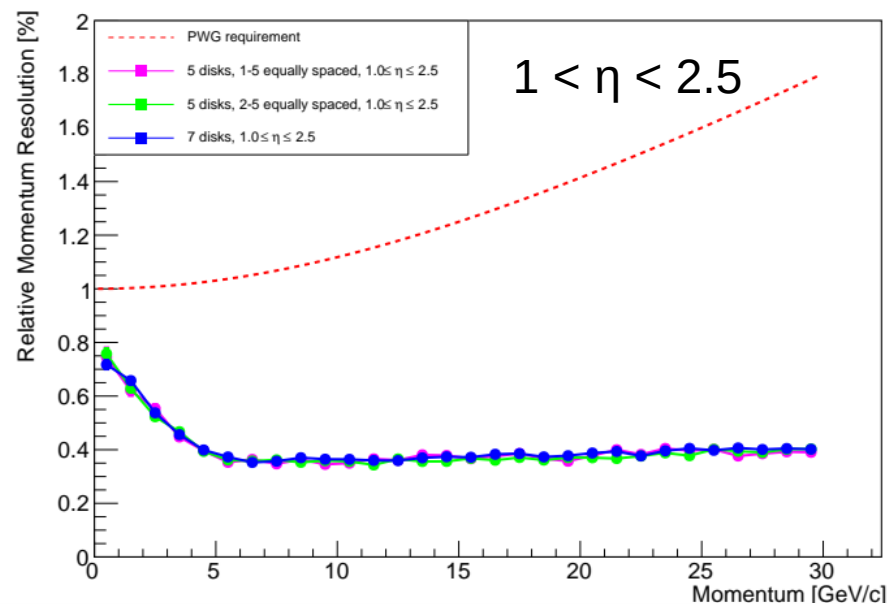
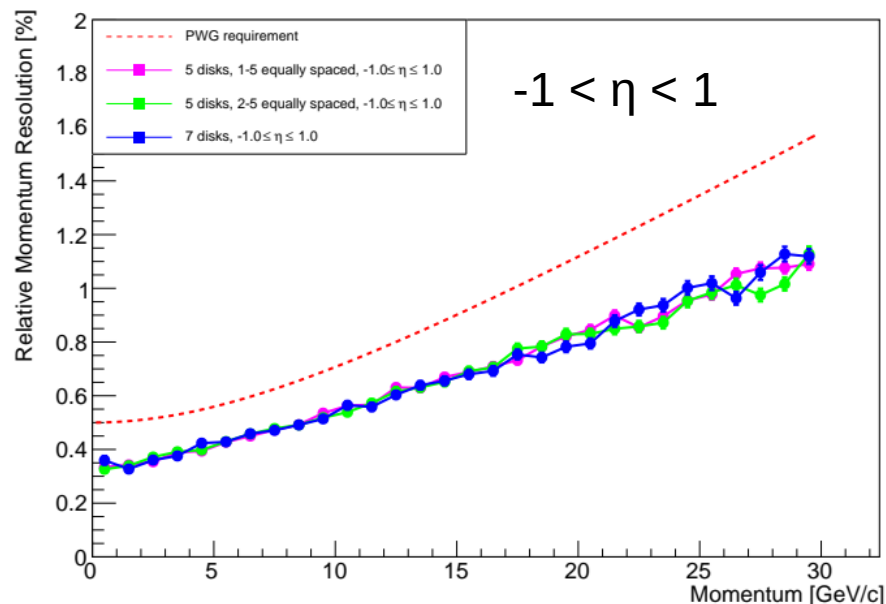
Inner radii adjusted to allow for beampipe

Simulation

- Simulated particles uniformly in p_T range $0 < p_T < 30 \text{ GeV}/c$
 - $-3.5 < \eta < -2.5$: 1.5M electrons
 - $-2.5 < \eta < -1$: 1M electrons
 - $-1 < \eta < 1$: 300k negative pions
 - $1 < \eta < 2.5$: 1M negative pions
 - $2.5 < \eta < 3.5$: 1.5M negative pions
- 2021-05-28 B Field Map used

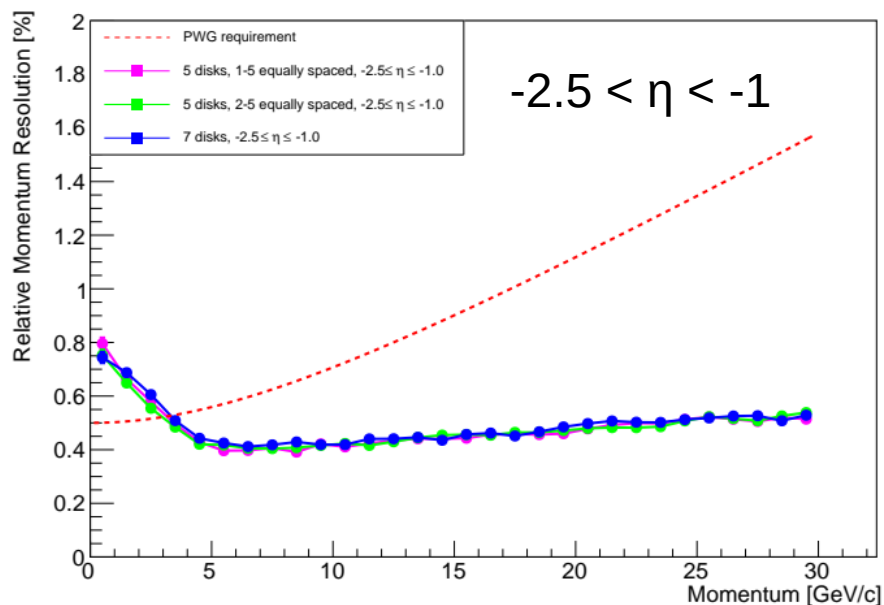


Disks Comparison: dp/p



3 Designs

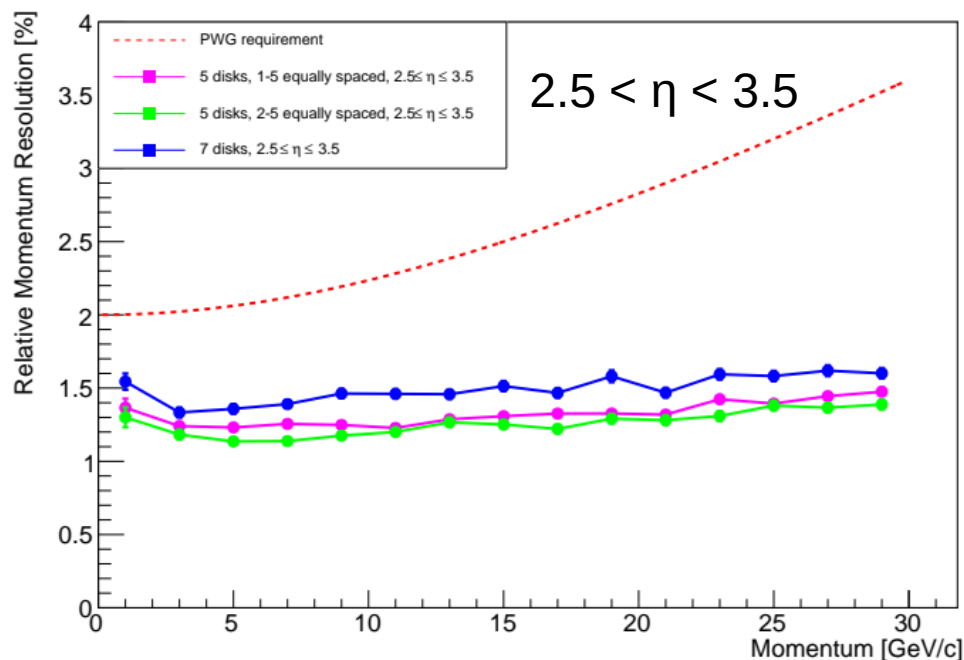
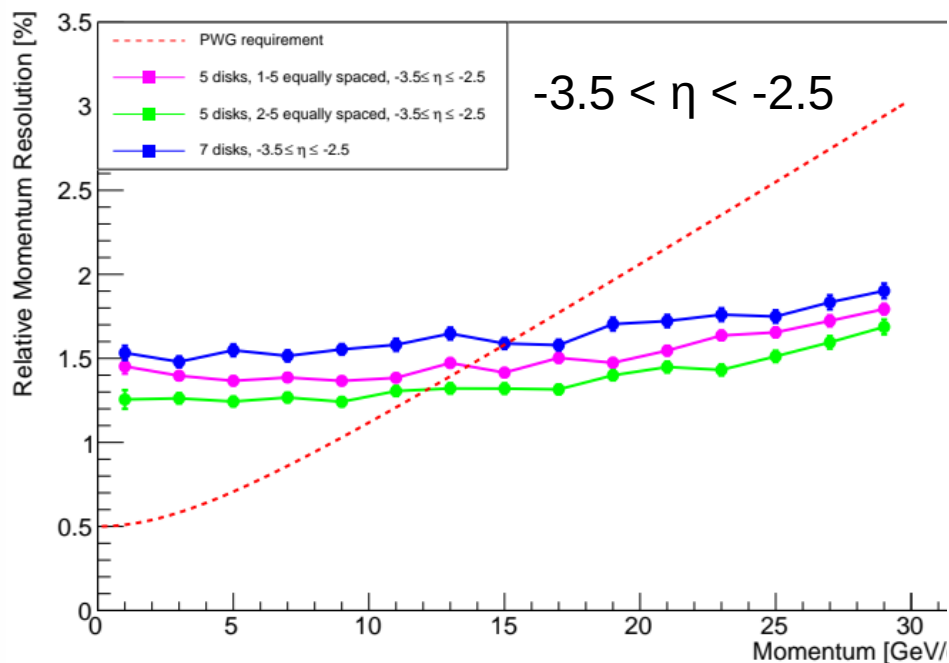
- YR Baseline
- 5 Disks (Disks 1-5 Equally spaced)
- 5 Disks (Disks 2-5 Equally spaced)



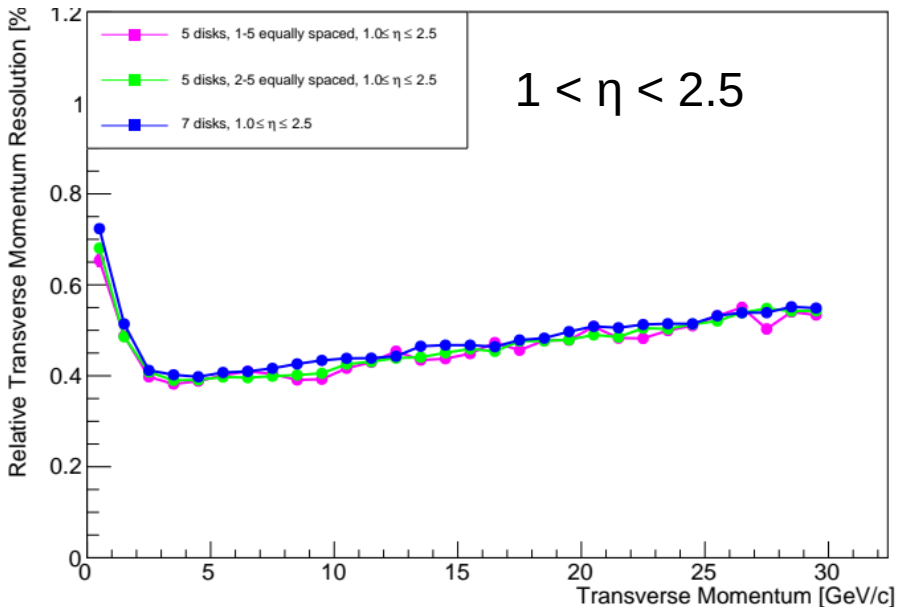
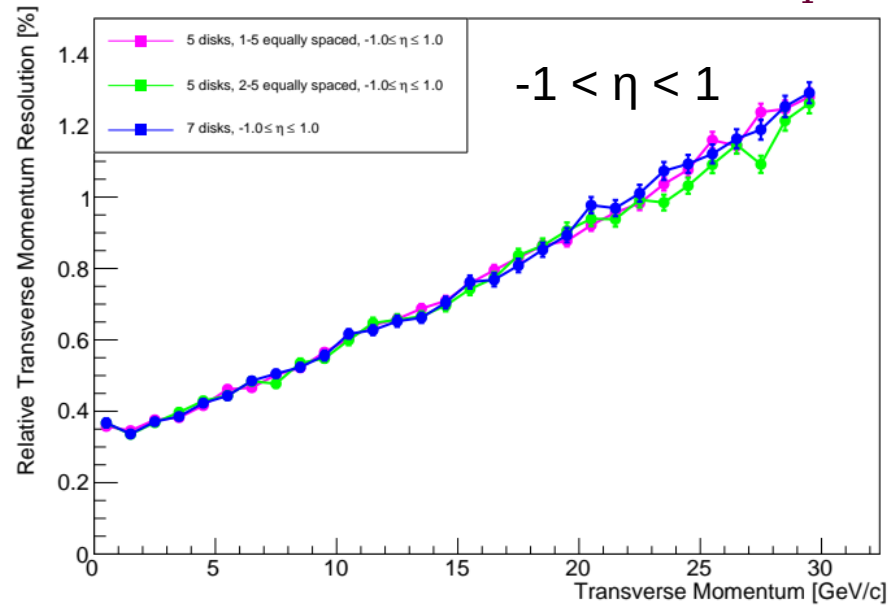
Disks Comparison: dp/p

3 Designs

- YR Baseline
- 5 Disks (Disks 1-5 Equally spaced)
- 5 Disks (Disks 2-5 Equally spaced)

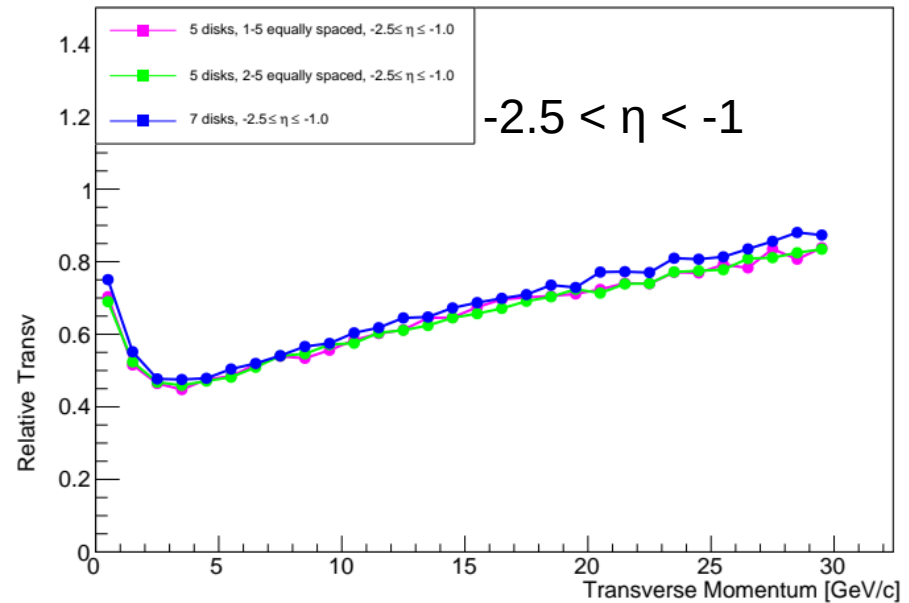


Disks Comparison: dp_T/p_T



3 Designs

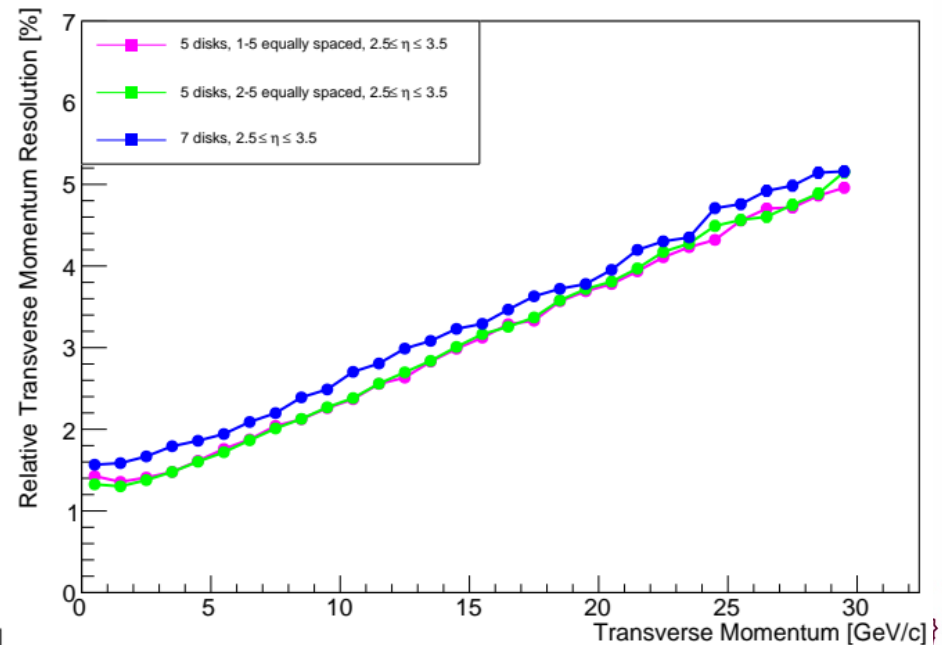
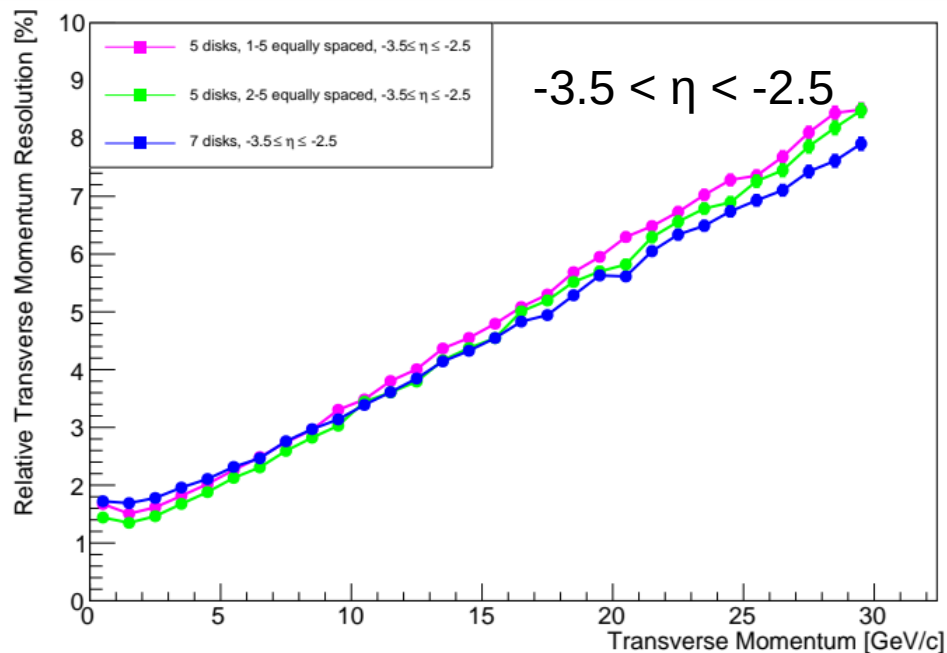
- YR Baseline
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- 5 Disks (Disks 2-5 Equally spaced)



Disks Comparison: dp_T/p_T

■ 3 Designs

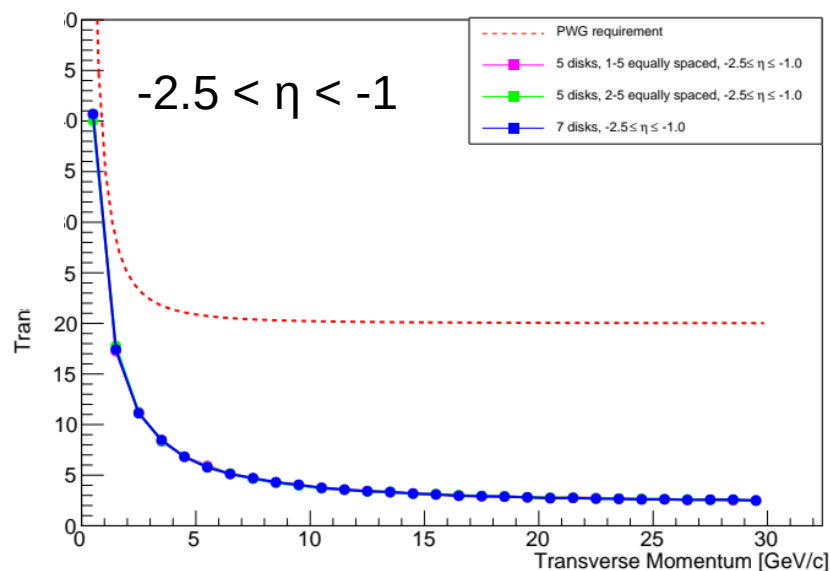
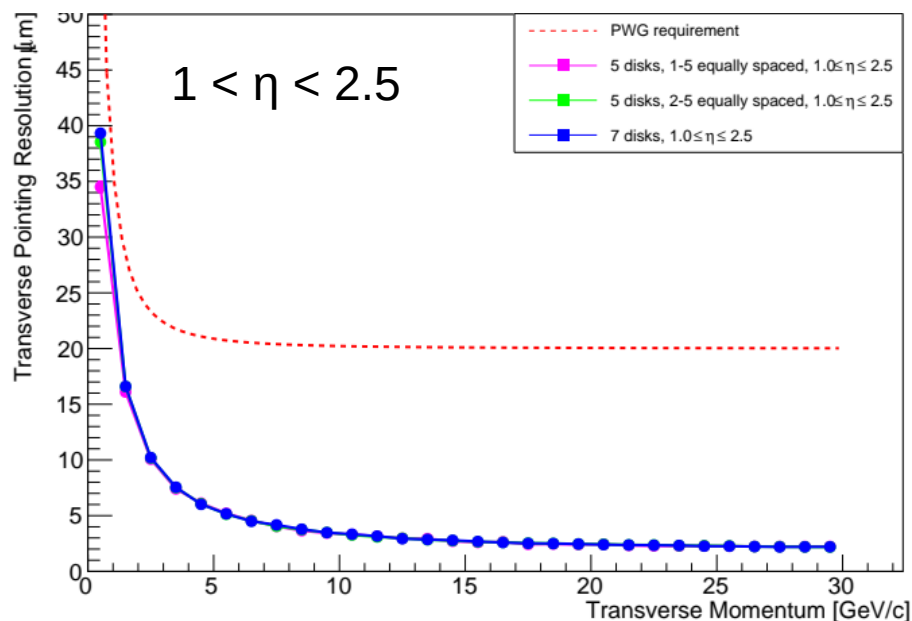
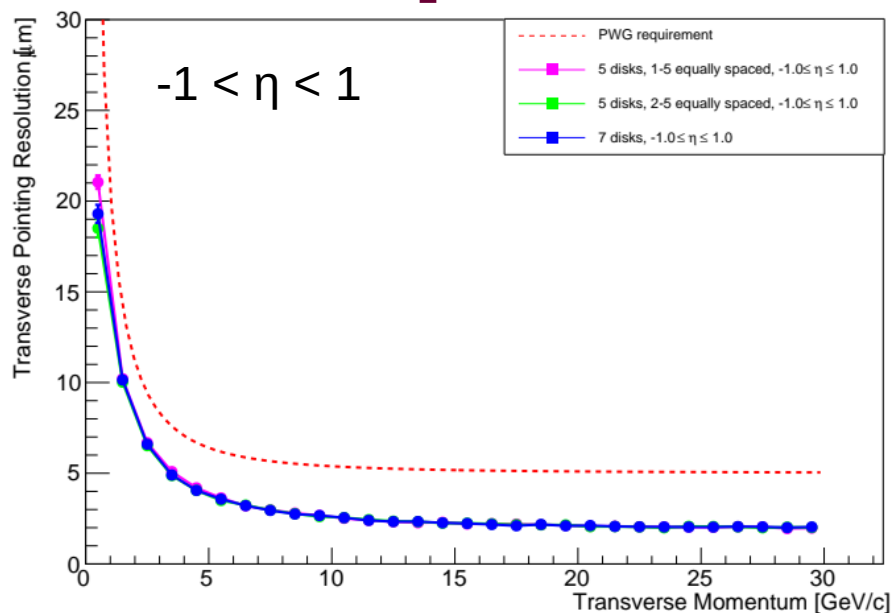
- YR Baseline
- 5 Disks (Disks 1-5 Equally spaced)
- 5 Disks (Disks 2-5 Equally spaced)



Disks Comparison: Transverse Pointing resolution

3 Designs

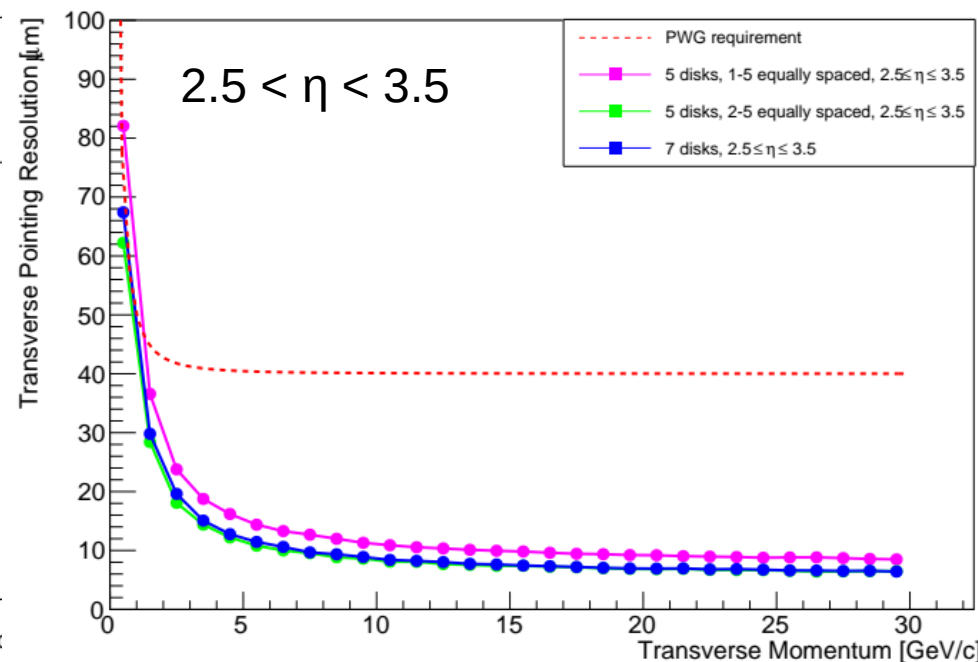
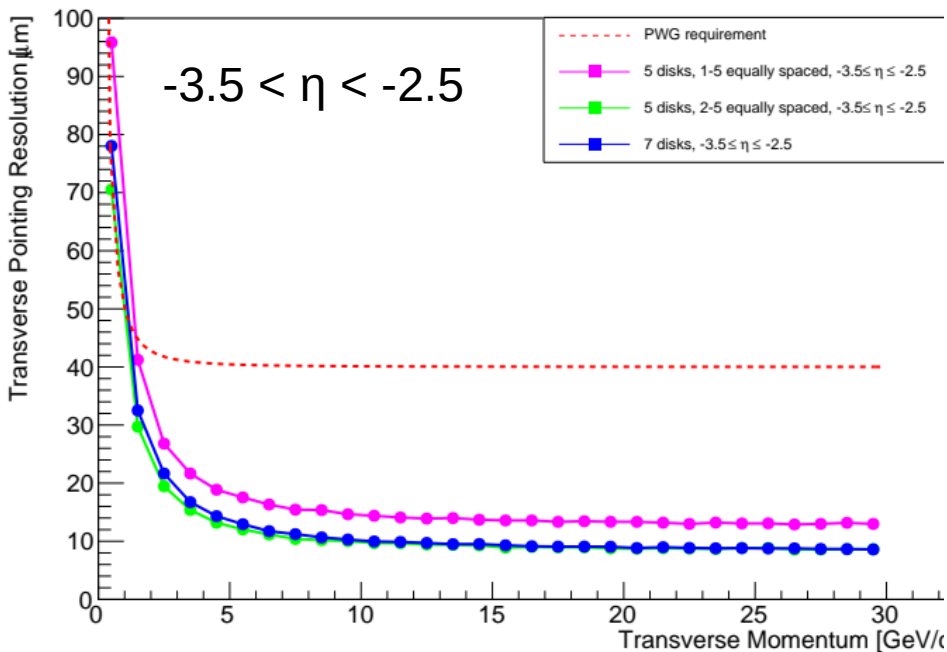
- YR Baseline
- 5 Disks (Disks 1-5 Equally spaced)
- 5 Disks (Disks 2-5 Equally spaced)



Disks Comparison: Transverse Pointing resolution

3 Designs

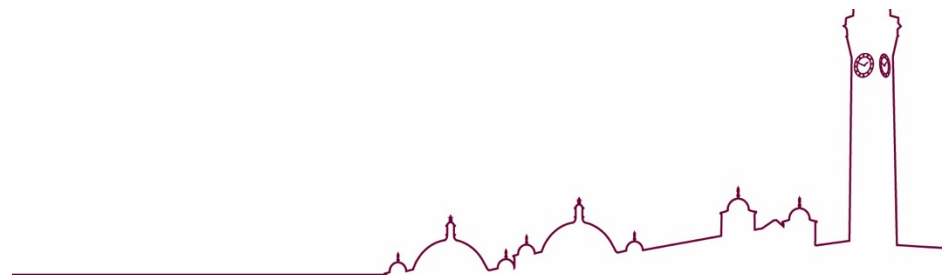
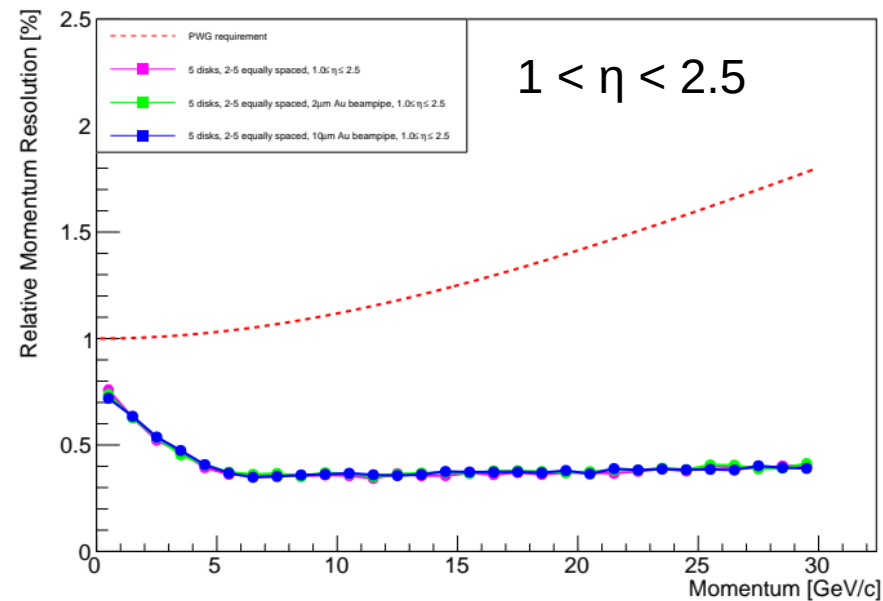
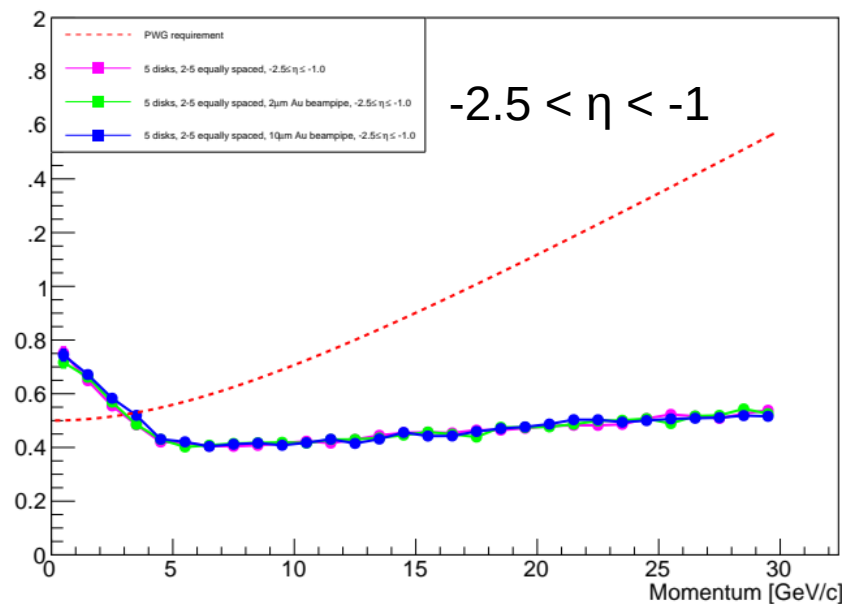
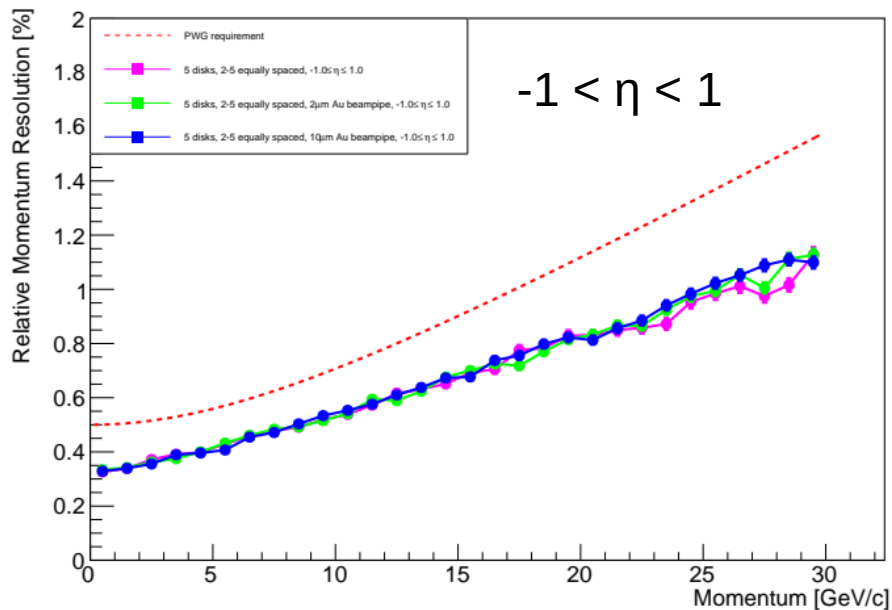
- YR Baseline
- 5 Disks (Disks 1-5 Equally spaced)
- 5 Disks (Disks 2-5 Equally spaced)



Beampipe Comparison: dp/p

5 Disks, 2-5 evenly spaced

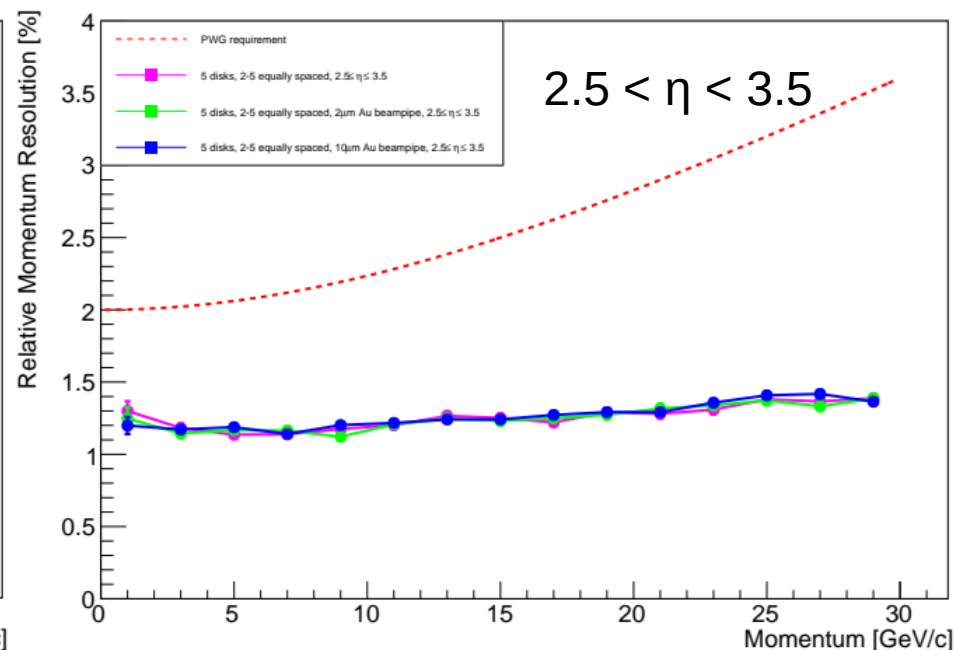
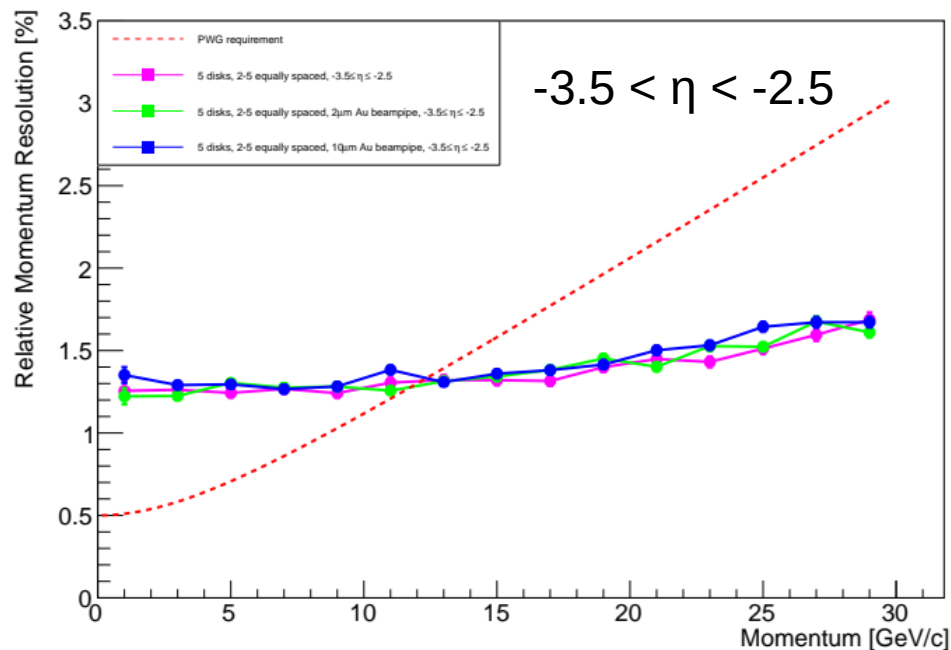
- 10 μ m Gold Coating
- 2 μ m Gold Coating
- Beryllium only



Beampipe Comparison: dp/p

5 Disks, 2-5 evenly spaced

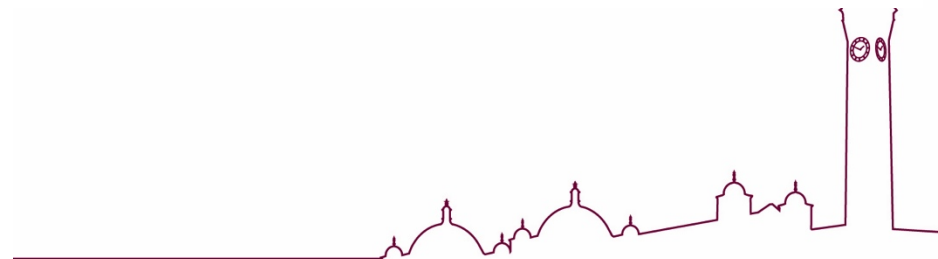
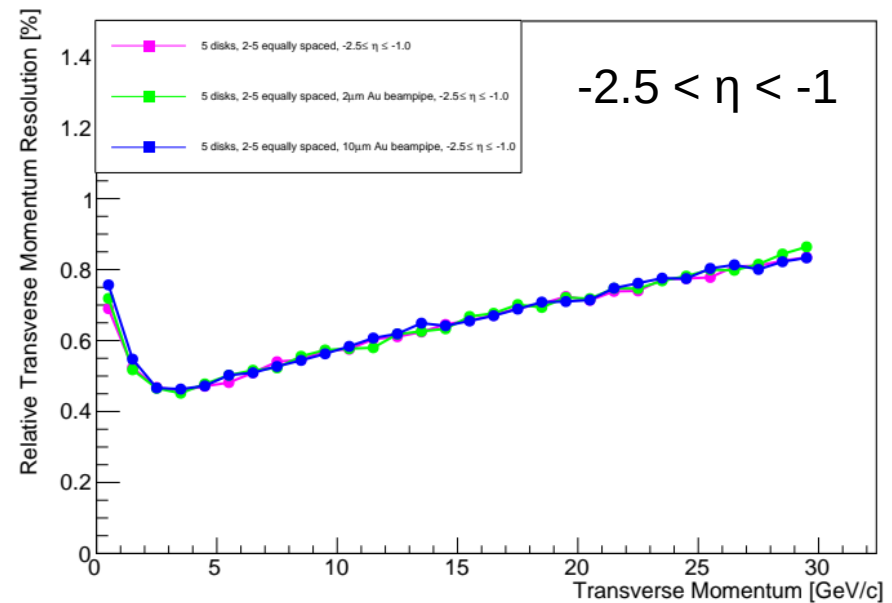
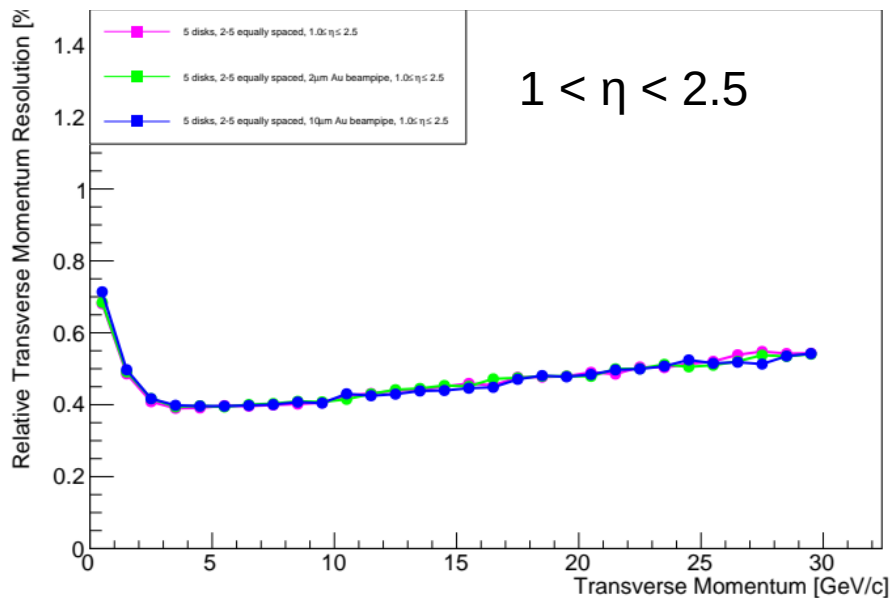
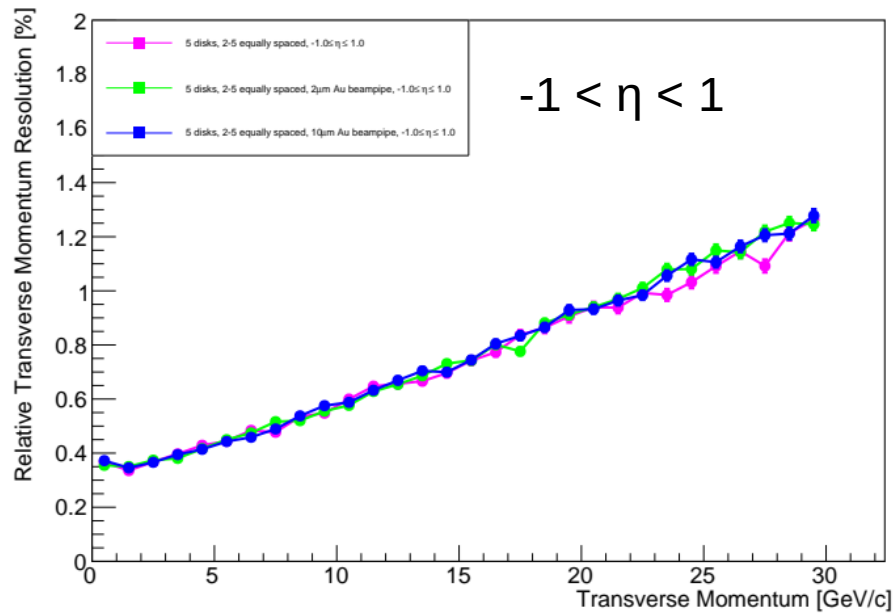
- 10 μ m Gold Coating
- 2 μ m Gold Coating
- Beryllium only



Beampipe Comparison: dp_T/p_T

5 Disks, 2-5 evenly spaced

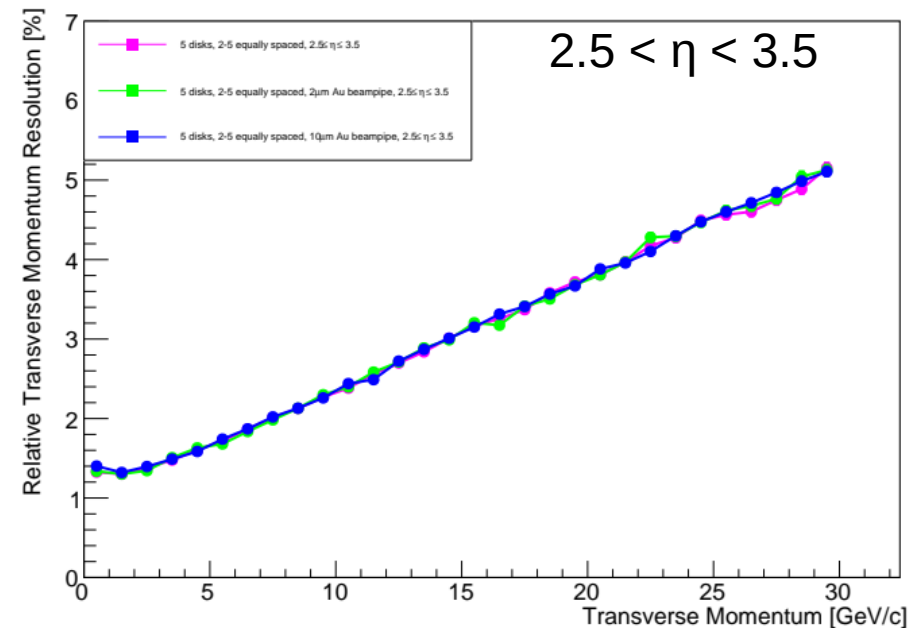
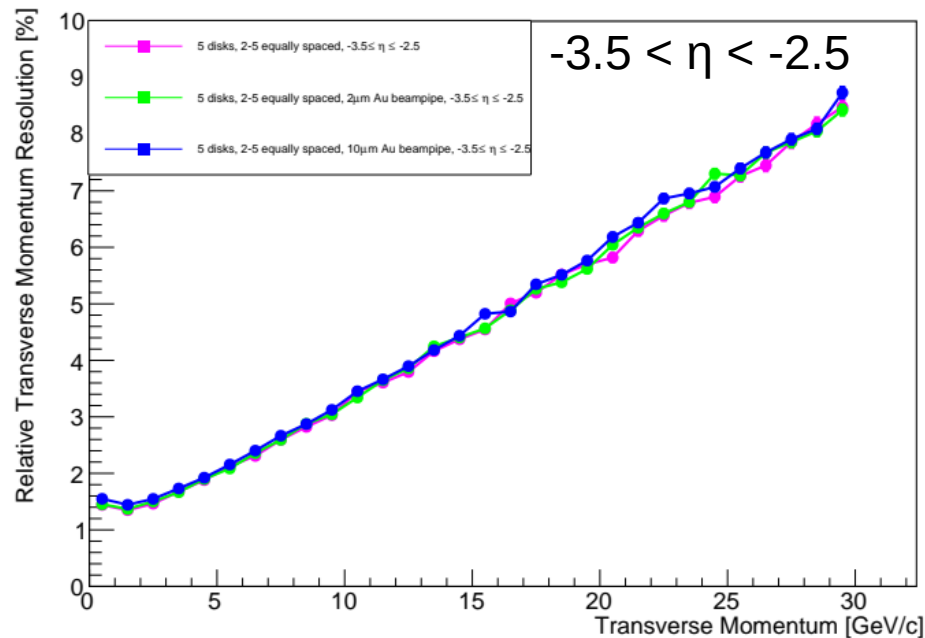
- 10 μ m Gold Coating
- 2 μ m Gold Coating
- Beryllium only



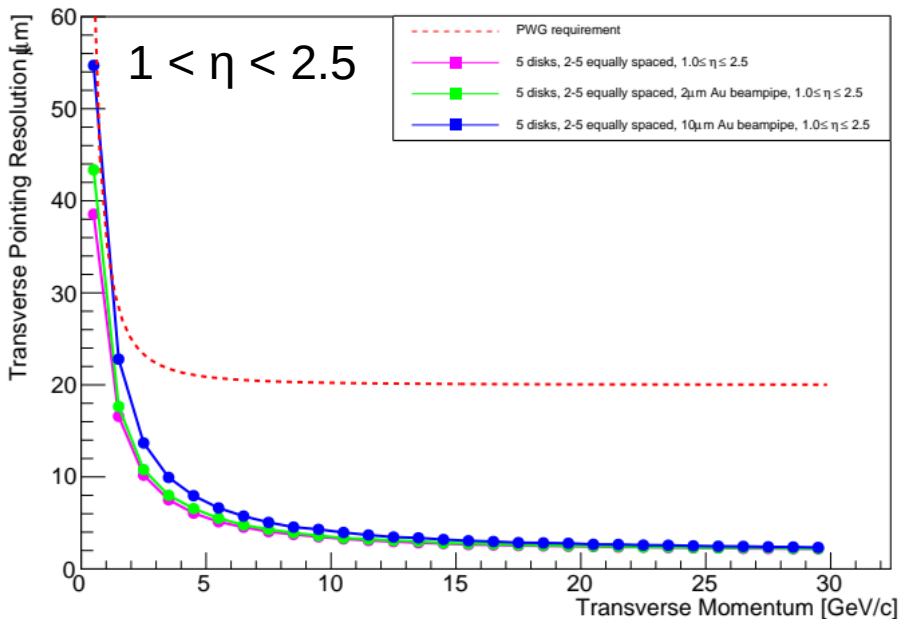
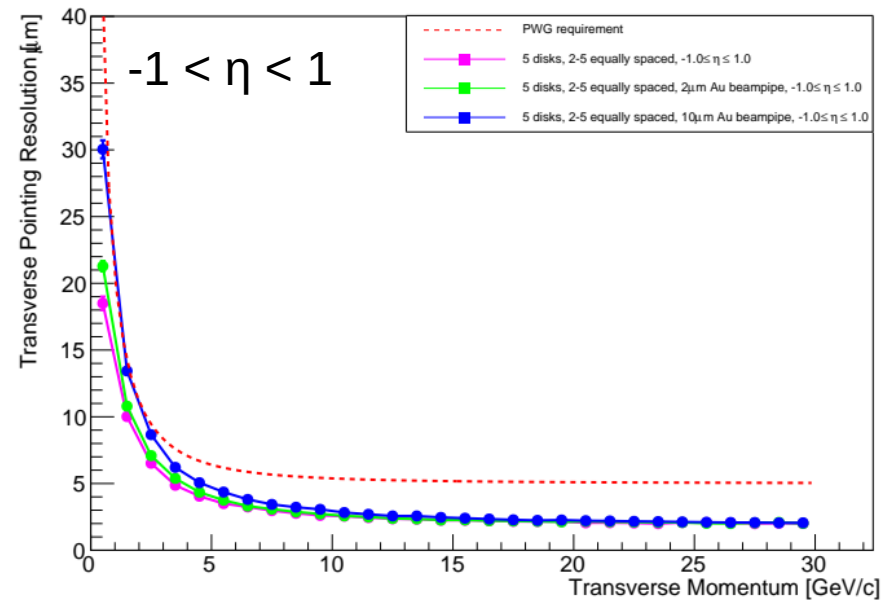
Beampipe Comparison: dp_T/p_T

■ 5 Disks, 2-5 evenly spaced

- 10 μ m Gold Coating
- 2 μ m Gold Coating
- Beryllium only

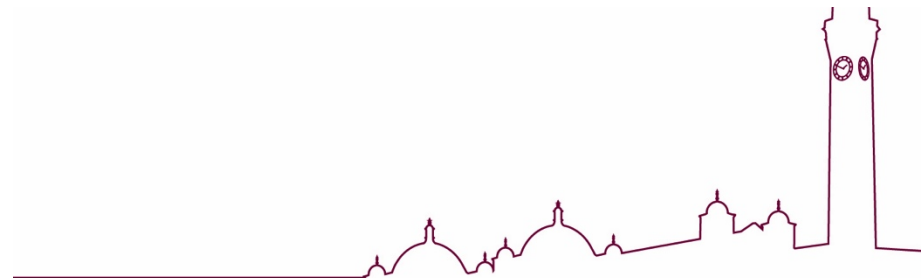
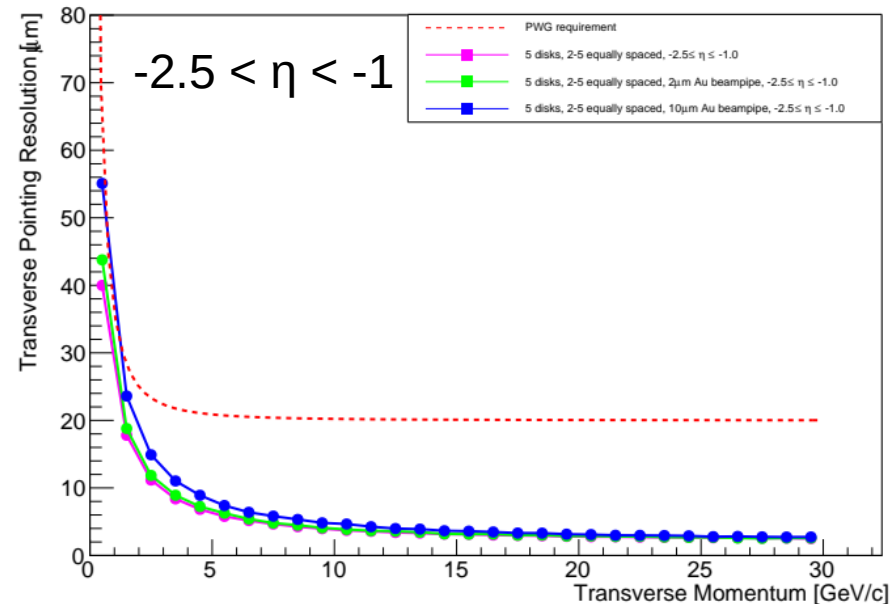


Beampipe Comparison: Transverse Pointing resolution



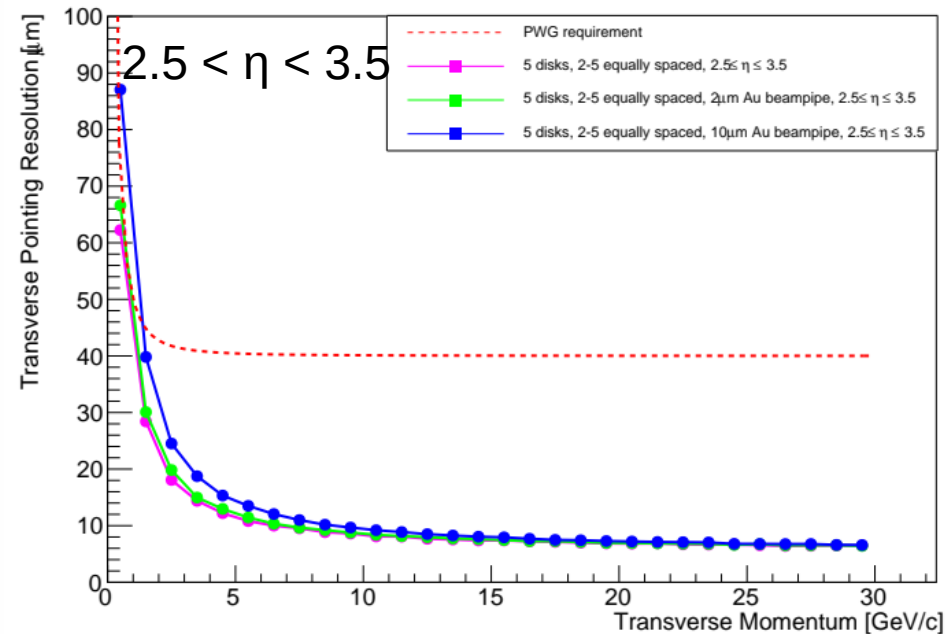
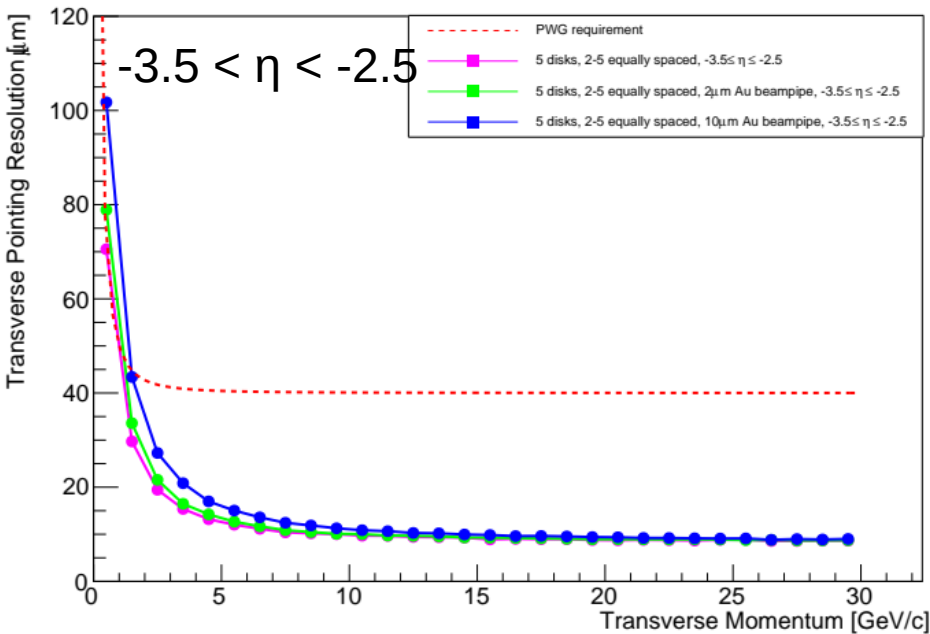
5 Disks, 2-5 evenly spaced

- 10 μm Gold Coating
- 2 μm Gold Coating
- Beryllium only

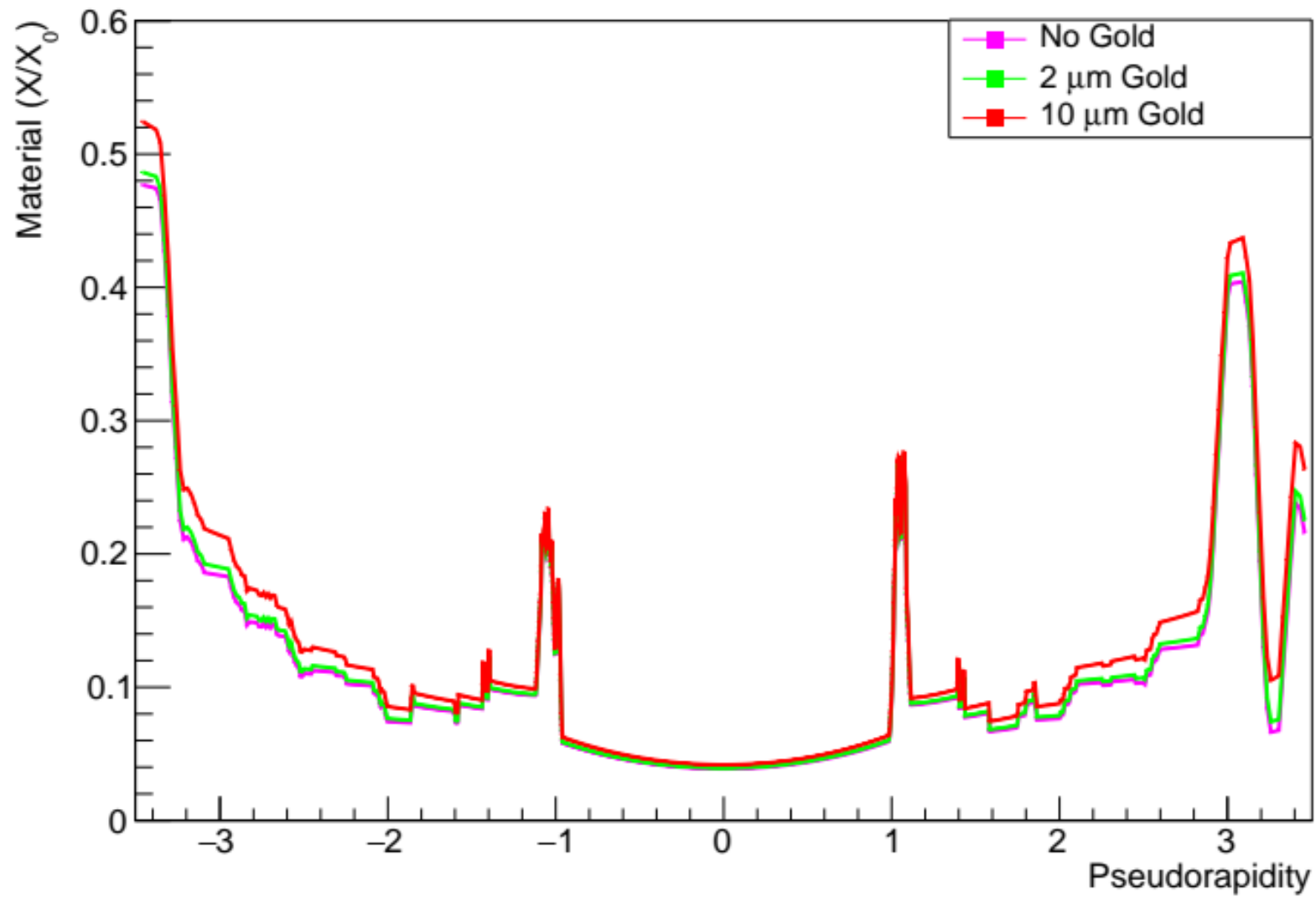


Beampipe Comparison: Transverse Pointing resolution

- 5 Disks, 2-5 evenly spaced
 - 10 μm Gold Coating
 - 2 μm Gold Coating
 - Beryllium only



Material Scan



Summary

- Benchmarked 3 different disk configurations
 - Disk 2-5 equally spaced configuration performed well and was used for further studies
- Added Au coating to beampipe and looked at effects
 - No difference observed in relative momentum and transverse momentum resolution → look into this further (plots vs η)
 - Gold coating deteriorates transverse pointing resolution at low $p_T \rightarrow 2\mu\text{m}$ coating is comparable to no coating, $10\mu\text{m}$ coating is noticeably worse

Next Steps

- Update configuration to reflect changes in MM and GEM
- Angular resolution studies at mid-point of PID

