UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

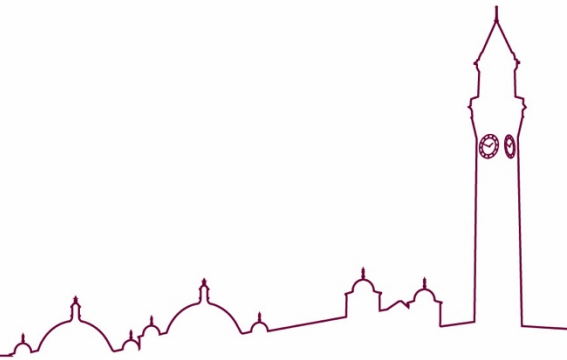
Update on simulations from the University of Birmingham

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

25th of May 2021

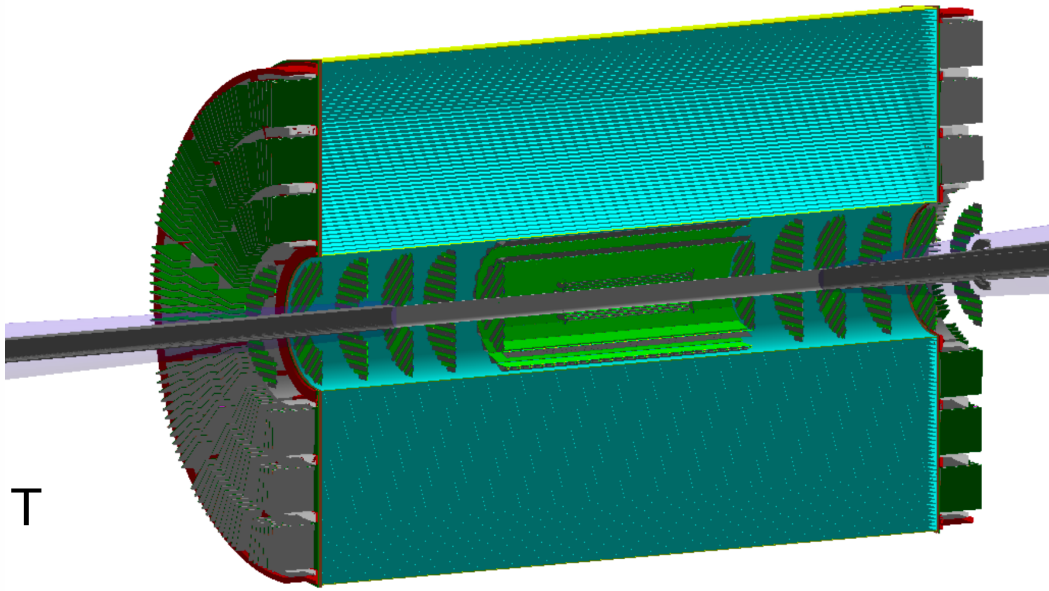
Overview

- 1st created analysis code to analyse Fun4All output and benchmarked against results of YR Hybrid Concept
- 2nd updated the field map from uniform to 3T solenoid field map (2021-4-30 Bmap)
- 3rd Implemented a Si+TPC hybrid configuration using simplified geometry implementation from Rey Cruz-Torres



YR Hybrid Baseline – Benchmarking against existing results*

- Studies performed with positive pions
  - **$0 \leq p_T \leq 30$ GeV/c**
- Pseudorapidity intervals of:
  - **$-1.0 \leq \eta \leq 1.0$**
  - **$1.0 \leq \eta \leq 2.5$**
  - **$2.5 \leq \eta \leq 3.5$**
- Uniform Fields of 1.5 T and 3.0 T



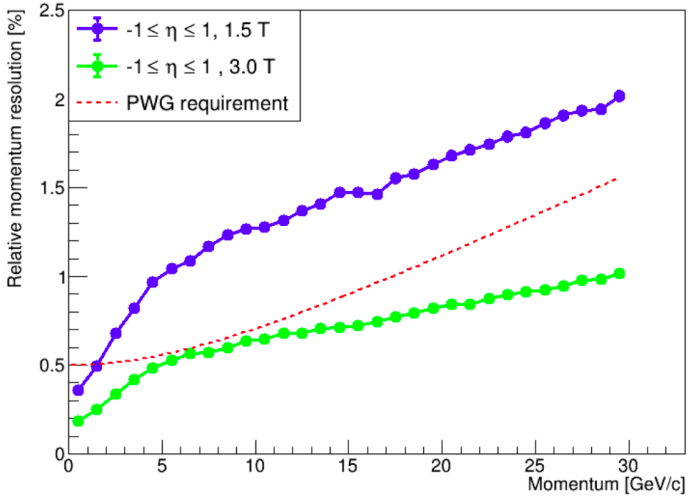
$$\frac{\sigma_p}{p} = A \cdot p \oplus B$$

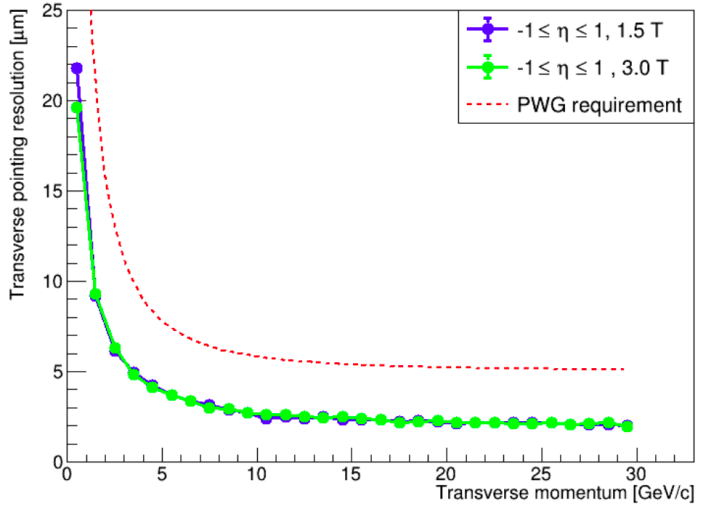
$$\frac{\sigma_{xy}}{p_T} = \frac{A}{p_T} \oplus B$$

* See slides from H. Wennlöf
https://indico.bnl.gov/event/7919/

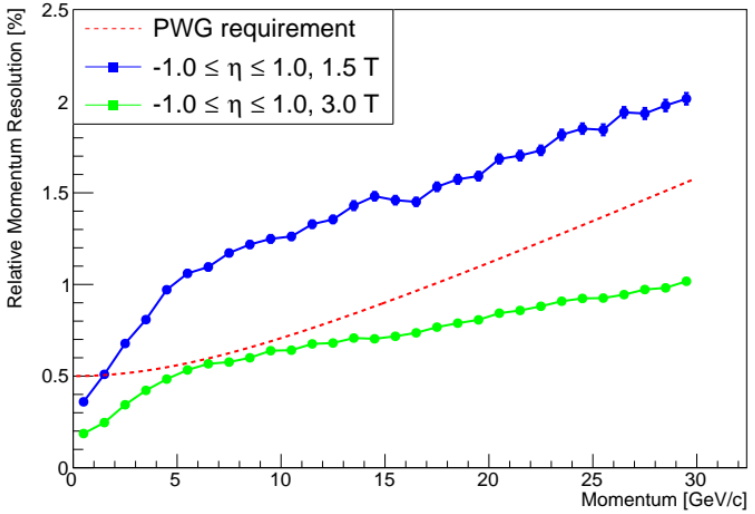
-1.0 ≤ η ≤ 1.0

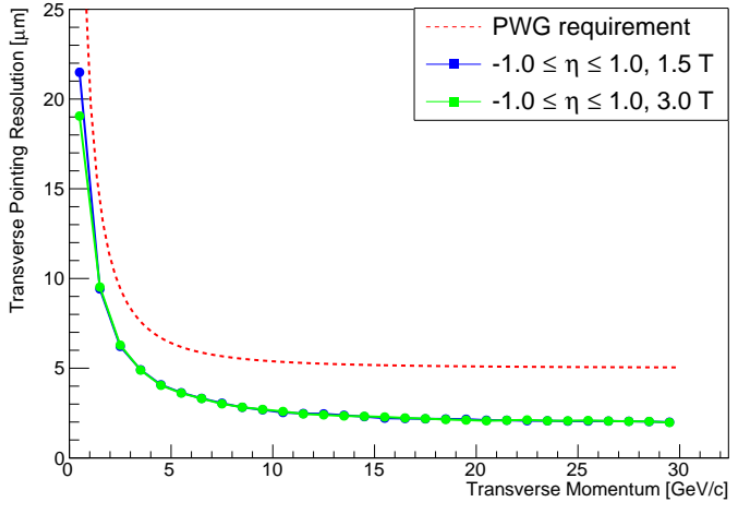
H. Wennlöf (Nov 2020)





S. Maple (May 2021)

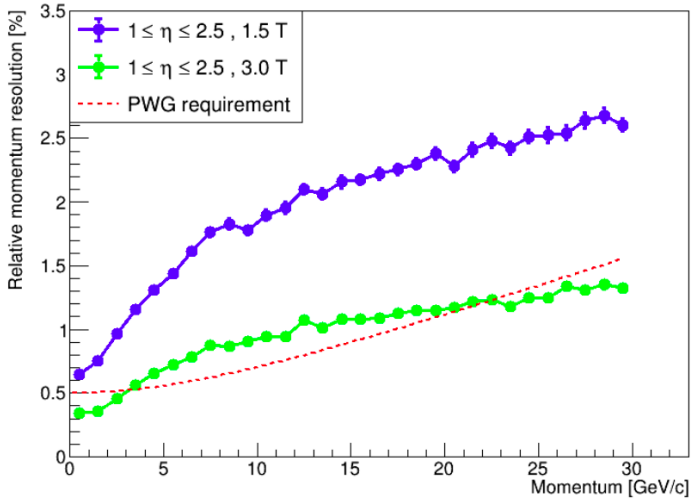


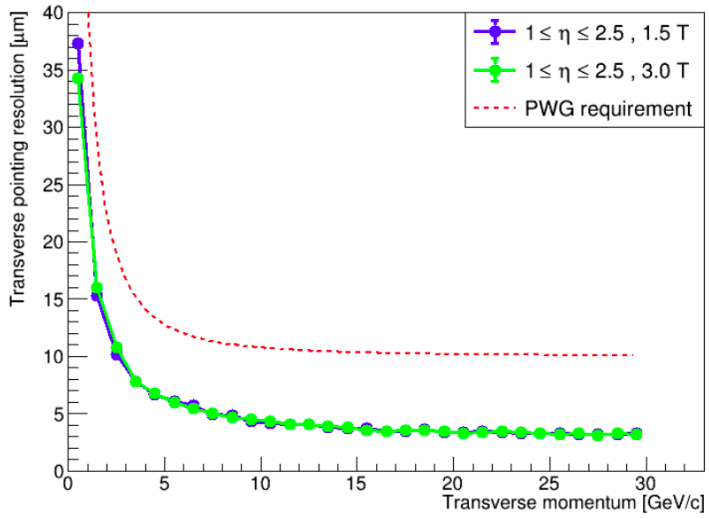


$1.0 \leq \eta \leq 2.5$

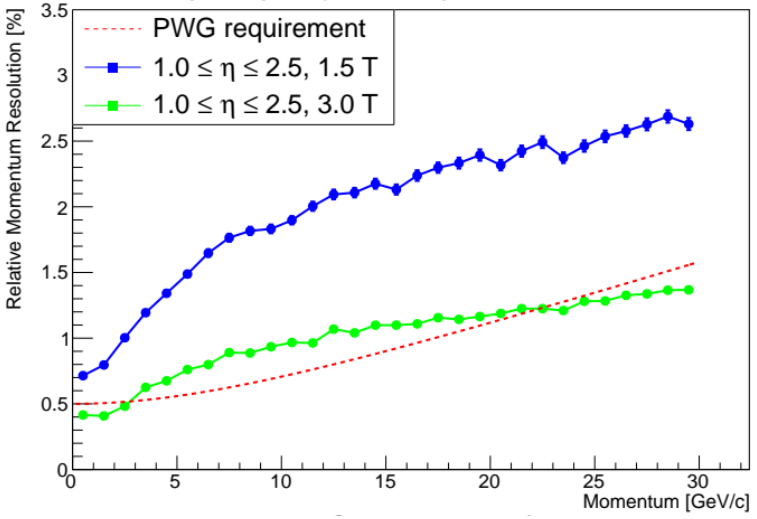
Note that the requirements from the physics working groups have changed since the Nov 2020 plots were made

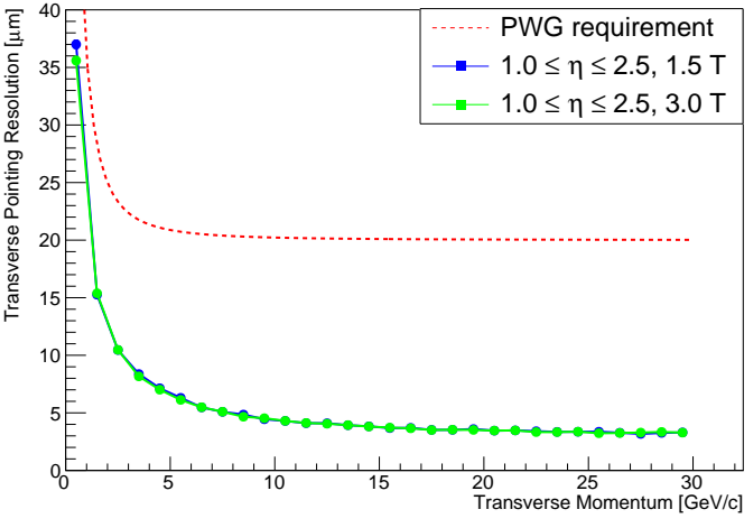
H. Wennlöf (Nov 2020)





S. Maple (May 2021)

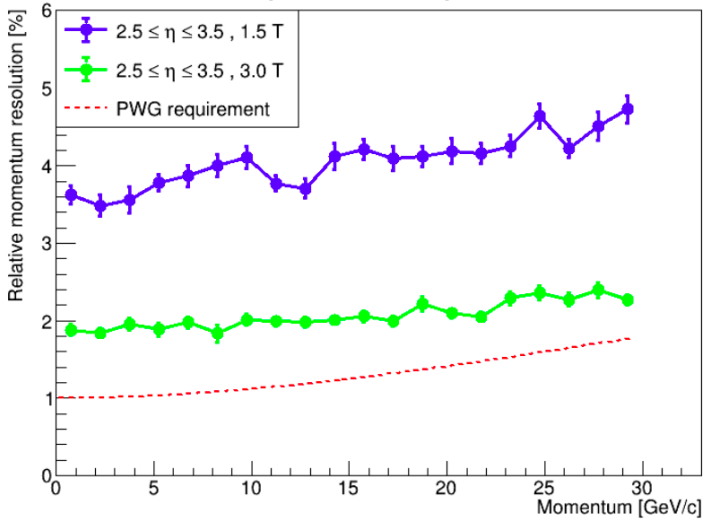


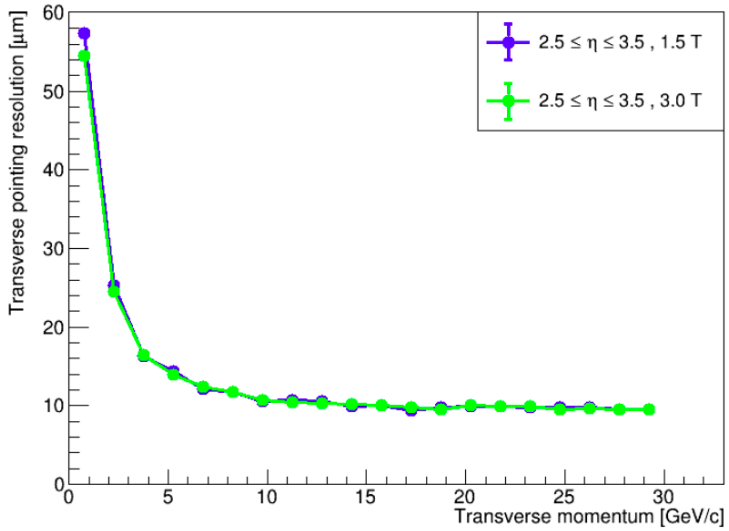


$2.5 \leq \eta \leq 3.5$

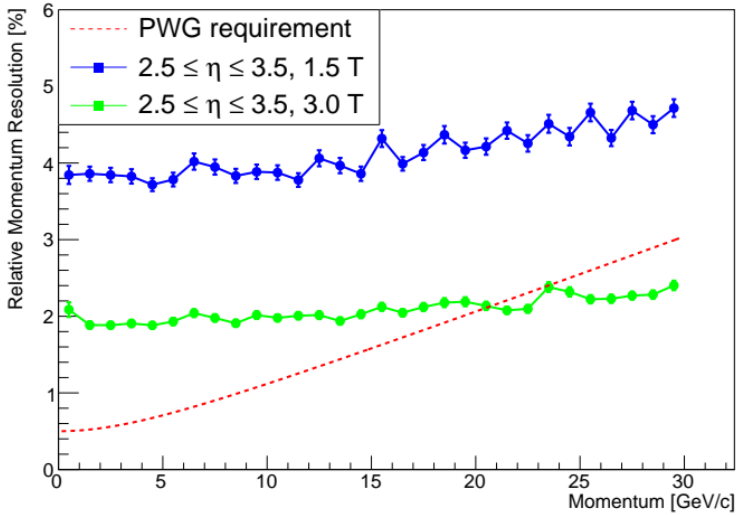
Note that the requirements from the physics working groups have changed since the Nov 2020 plots were made

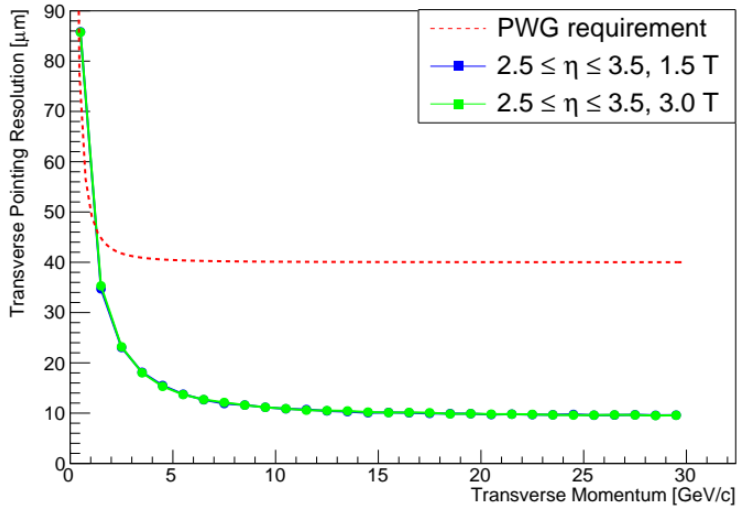
H. Wennlöf (Nov 2020)



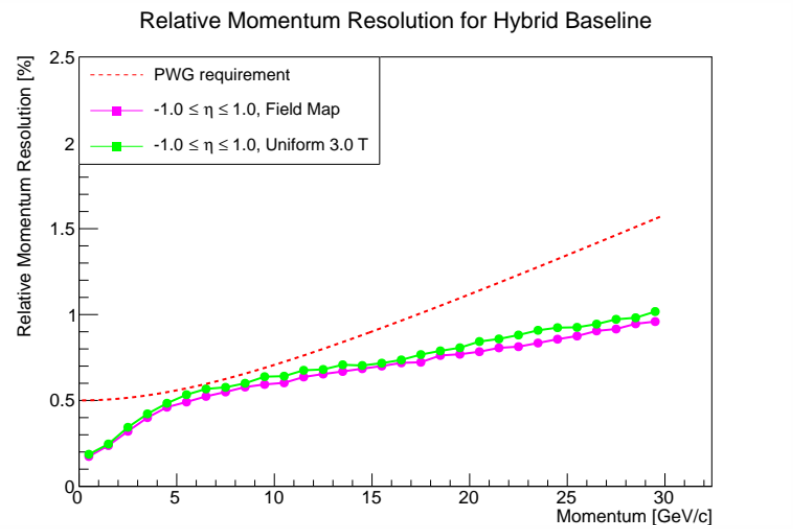


S. Maple (May 2021)

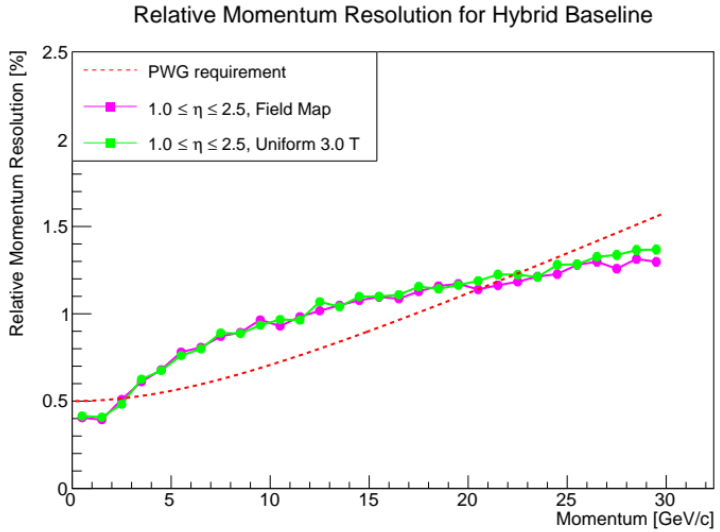


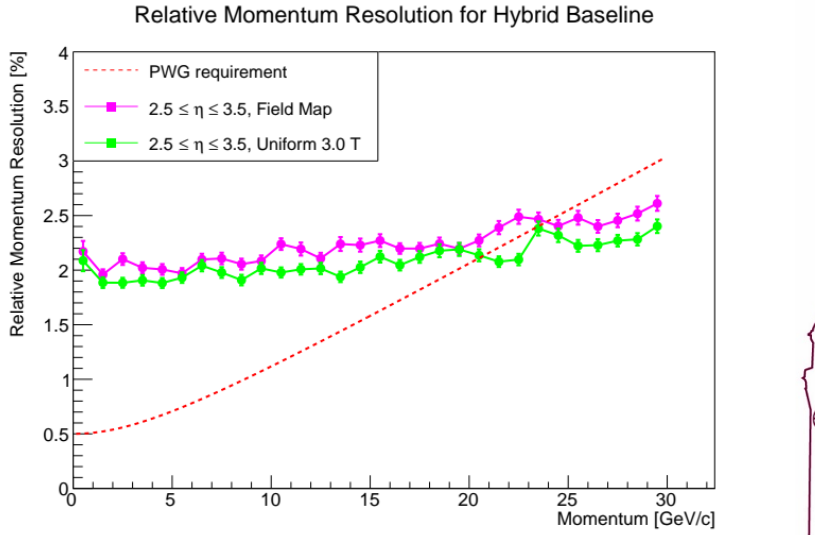


Updated Field Maps

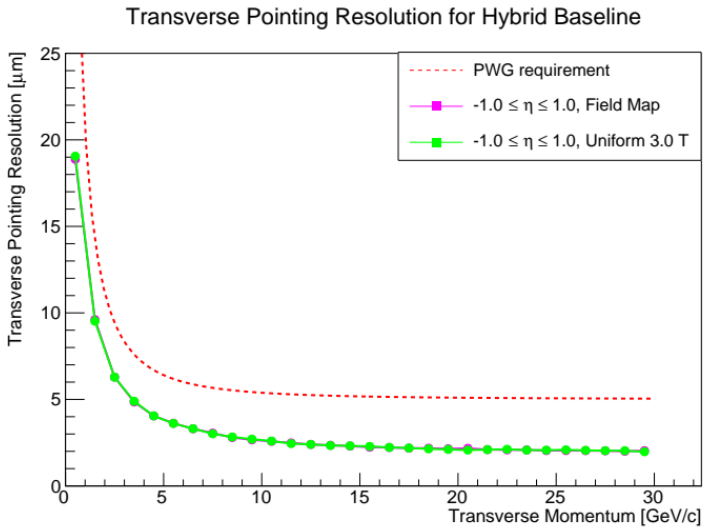


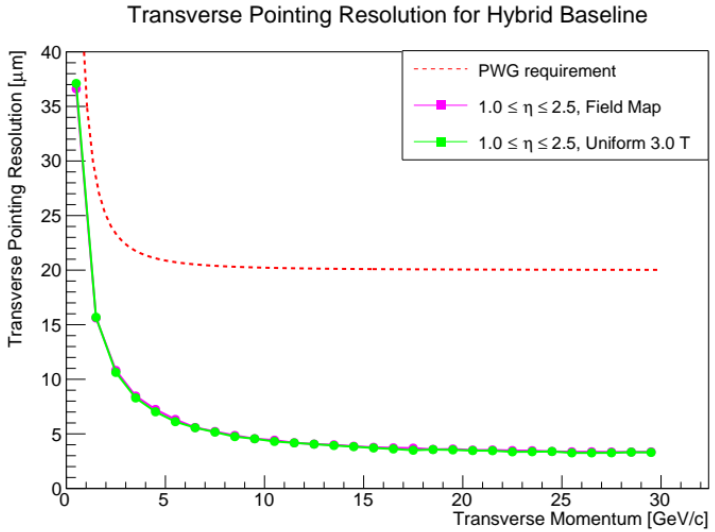
- "Field Maps circulated for EIC Solenoid (3T maximum field)
- Benchmarked against 3.0 T Uniform field used in YR Hybrid studies



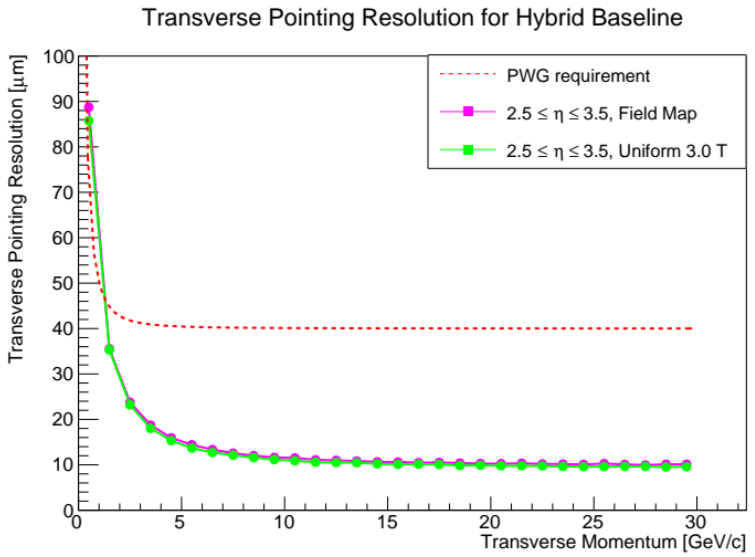


Updated Field Maps



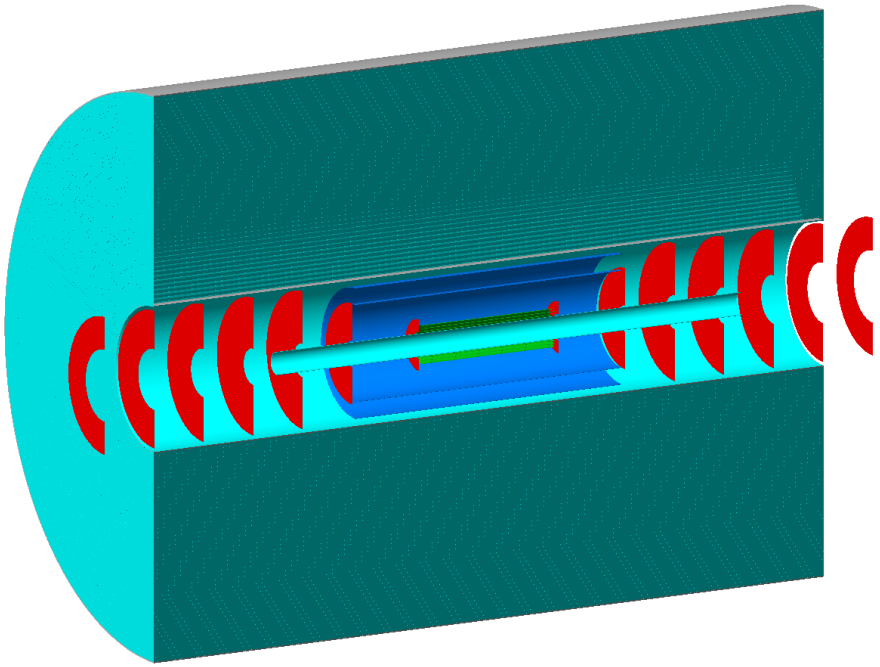


- Field Maps circulated for EIC Solenoid (3T maximum field)
- Benchmarked against 3.0 T Uniform field used in YR Hybrid studies



Simplified Silicon Hybrid Implementation

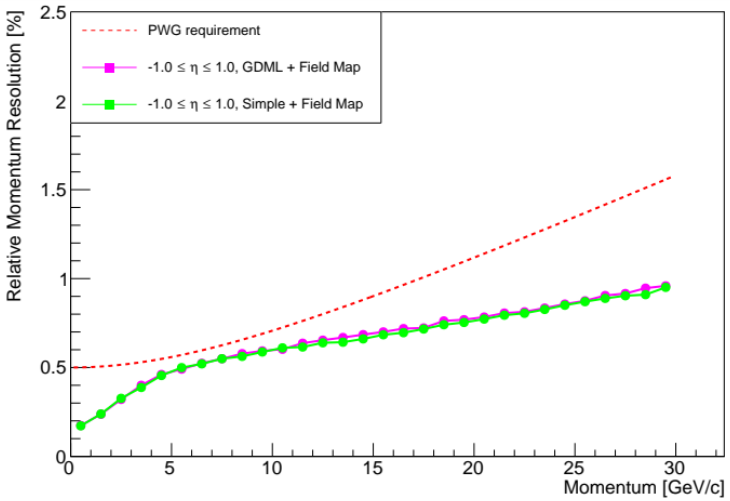
- Studies performed with positive pions
  - **$0 \leq p_T \leq 30$ GeV/c**
- Pseudorapidity intervals of:
  - **$-1.0 \leq \eta \leq 1.0$**
  - **$1.0 \leq \eta \leq 2.5$**
  - **$2.5 \leq \eta \leq 3.5$**
- 3T solenoid field map used
- X/X0 = 0.05%, 0.55%, and 0.24% in vertexing layers, barrel layers, and disks respectively
- Benchmarked against YR Hybrid baseline setup



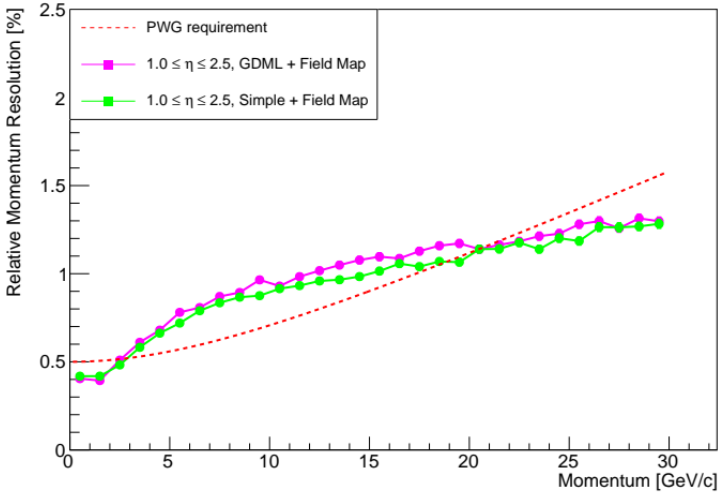
*Note that TPC endcaps were not included in these simulations

Relative Momentum resolution

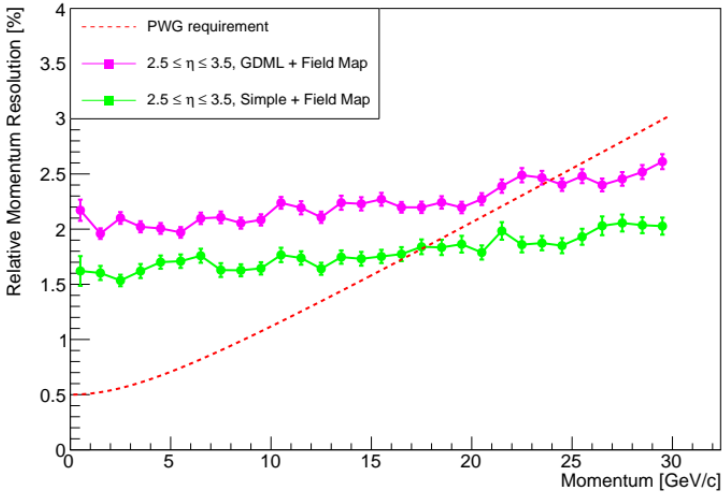
-1.0 ≤ η ≤ 1.0



1.0 ≤ η ≤ 2.5



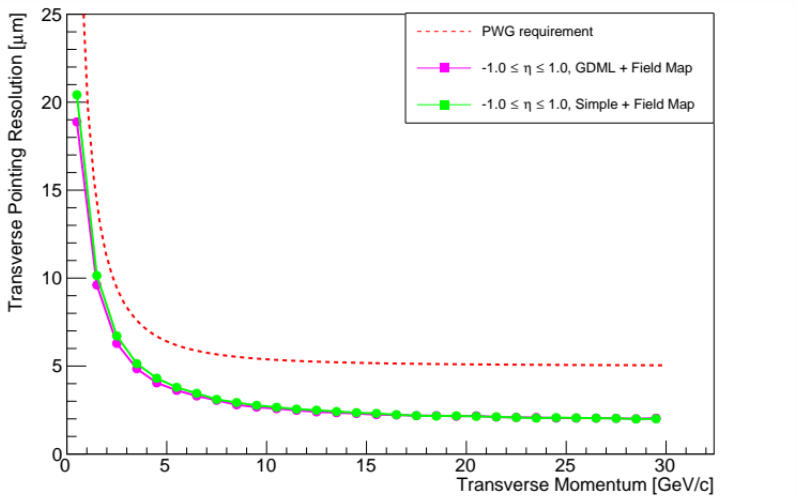
2.5 ≤ η ≤ 3.5



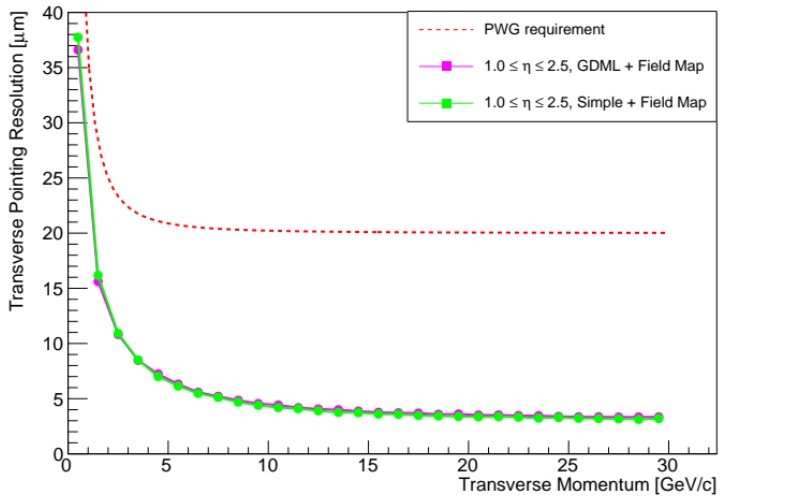
Some discrepancy found in the forward region
→ possibly because edges of disks are rounded rather than being squared off as in the stave based model

Transverse Pointing resolution

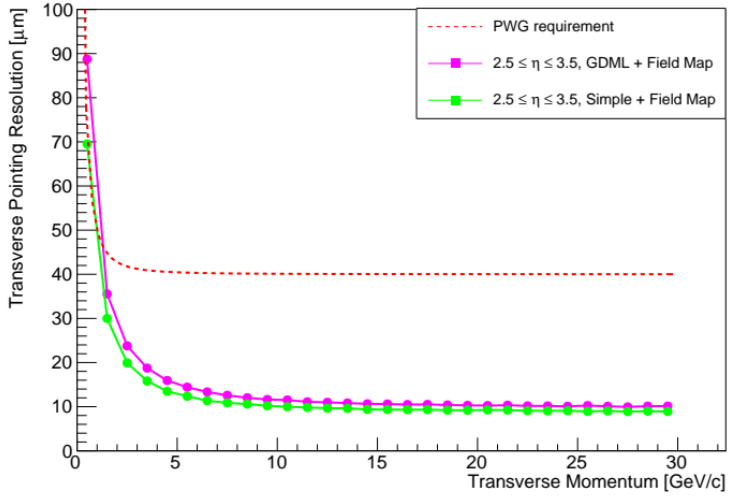
-1.0 ≤ η ≤ 1.0



1.0 ≤ η ≤ 2.5



2.5 ≤ η ≤ 3.5



Summary and Next Steps

- Analysis method produces results consistent with those from YR
- 3T Solenoid field map implemented and benchmarked against Uniform 3T field → similar results
- Simplified geometry implemented and produces results matching YR Hybrid configuration in all but highest pseudorapidity region

  - Discrepancies to be investigated further (Run again with TPC endcaps, plot resolutions as a function of pseudorapidity, material scan)

- Next step is to switch out the TPC for MPGD and GEM in the barrel and endcaps respectively (geometry implementation from Matt, Nick, Athira, Merrick)

UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

Backup Slides

Resolution Requirements

Tracking requirements from PWGs						
			Momentum res.	Material budget	Minimum pT	Transverse pointing res.
η						
-3.5 to -3.0	Central Detector	Backward Detector	σp/p ~ 0.1%×p ⊕ 0.5%	~5% X0 or less	100-150 MeV/c	
-3.0 to -2.5					100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 40 μm
-2.5 to -2.0			σp/p ~ 0.05%×p ⊕ 0.5%		100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 20 μm
-2.0 to -1.5					100-150 MeV/c	
-1.5 to -1.0					100-150 MeV/c	
-1.0 to -0.5		Barrel	σp/p ~ 0.05%×p ⊕ 0.5%		100-150 MeV/c	dca(xy) ~ 20/pT μm ⊕ 5 μm
-0.5 to 0						
0 to 0.5						
0.5 to 1.0						
1.0 to 1.5		Forward Detector	σp/p ~ 0.05%×p ⊕ 1%		100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 20 μm
1.5 to 2.0					100-150 MeV/c	
2.0 to 2.5					100-150 MeV/c	
2.5 to 3.0			σp/p ~ 0.1%×p ⊕ 2%		100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 40 μm
3.0 to 3.5					100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 60 μm