

Tracking - First findings obtained with the data of the simulation campaign

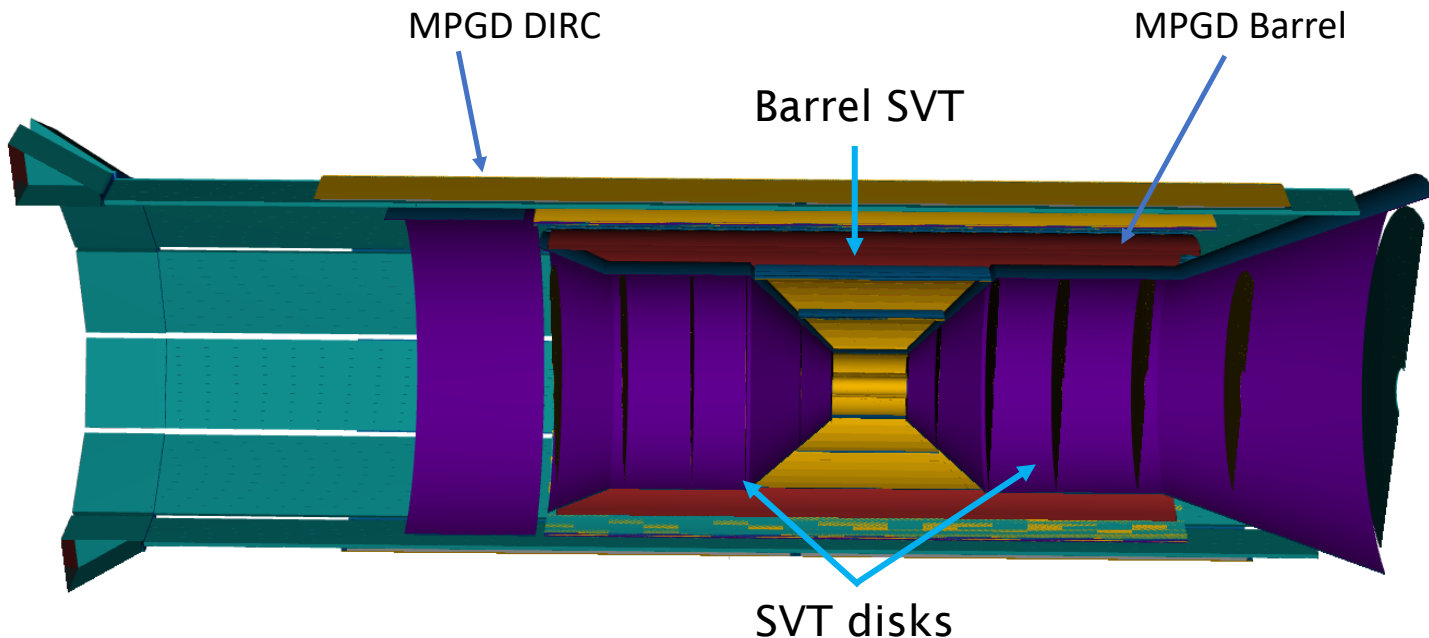
F. Bossù, L. Gonella, K. Gnanvo, X. Li

ePIC GD&I meeting

21 November 2022

ePIC Tracking Configuration for Nov 22 sim

- Two configurations: Arches and Bryce Canyon.
- The **SVT is the same** in both configurations.
 - Consists of barrel layers, disks in forward and backward region.
- Two configurations of MPDG barrel layers.
 - Arches: one MPGD layer after outermost silicon layer, before TOF (**MPGD barrel**).
 - Bryce Canyon: MPGD barrel + MPDG layer right before DIRC (**MPGD DIRC**).

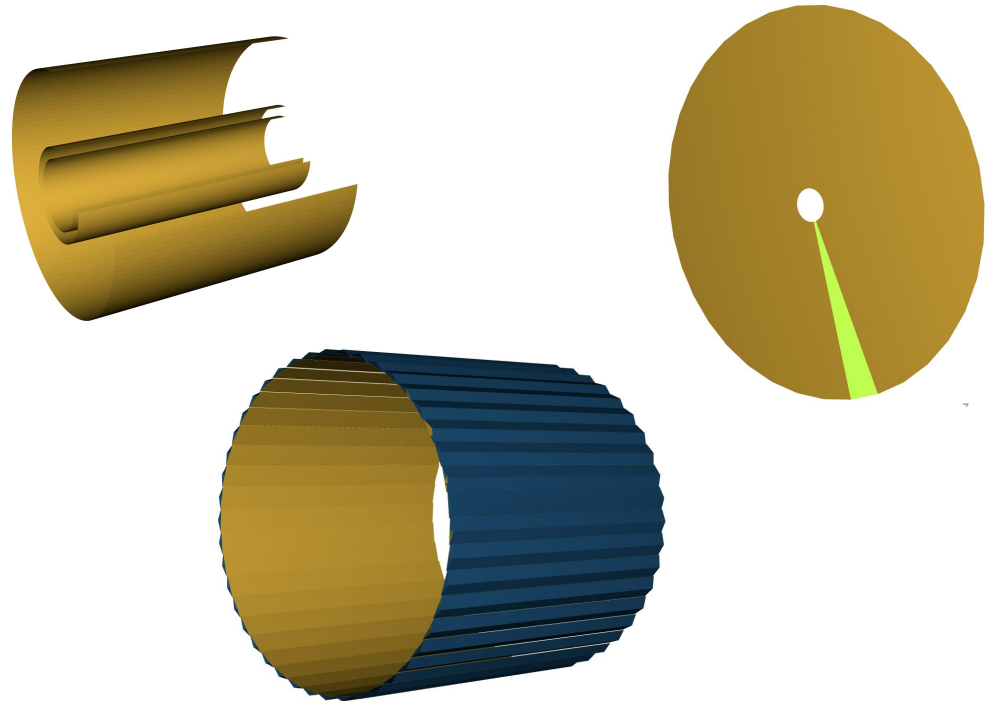


SVT

- The ePIC SVT layout developed for the Nov 2022 simulation campaign has 5 barrel layers and 5 disks per side.
- Asymmetric disk layout
 - Reduced envelop in the BWD direction according to space available in case of (current design of) pMRICH.

BARREL	r [mm]	l [mm]	X/X0 %
Layer 0	36	270	0.05
Layer 1	48	270	0.05
Layer 2	120	270	0.05
Layer 3	270	540	0.25
Layer 4	420	840	0.55

DISKS	+z [mm]	-z [mm]	X/X0 %
Disk 1	250	-250	0.24
Disk 2	450	-450	0.24
Disk 3	700	-650	0.24
Disk 4	1000	-900	0.24
Disk 5	1350	-1150	0.24



Implementation details in Shujie's talk at <https://indico.bnl.gov/event/17394/>

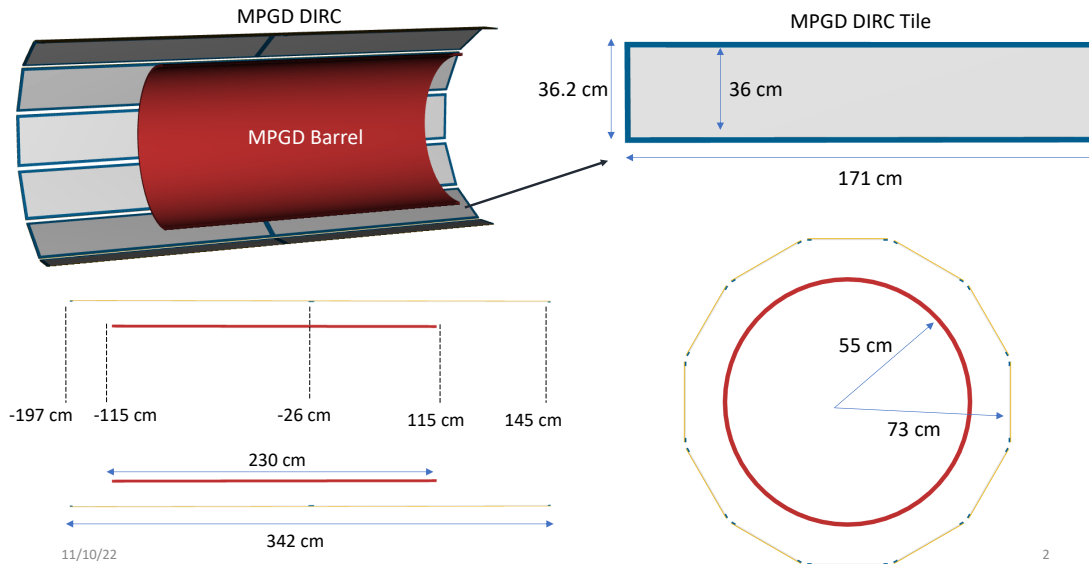
MPGD

- MPGD Barrel

- $R=55\text{cm}$, $L=230\text{cm}$, $\sim 0.5\% X/X_0$
- Resolution $150\mu\text{m}$
- Contributes to track reconstruction

- MPGD DIRC

- $R=73\text{cm}$ $L=342\text{cm}$, $\sim 2\% X/X_0$
- $z_{\text{min}}=-197\text{cm}$, $z_{\text{max}}=145\text{cm}$
- Resolution $150\mu\text{m}$
- No Contribution to track reconstruction



Implementation details in Matt's talk at <https://indico.bnl.gov/event/17349/>

Initial issue with eicrecon - Solved

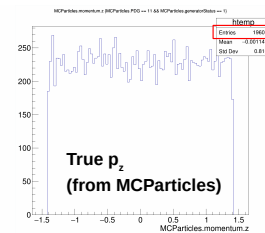
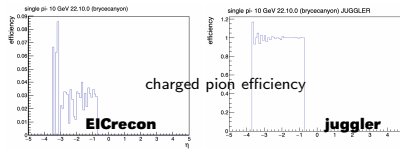
- Initial issue with track reconstruction in single particle eicrecon outputs.
- MPGD hits missing → now solved
 - See more at <https://indico.bnl.gov/event/17349/> (Nicholas, Stephen)

EPIC EXPERIMENT 22.10/11 Simulation Campaign Output Status

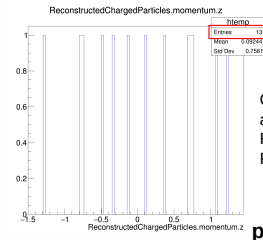


- Two outputs available for single particle productions (juggler and eicrecon)
- Files can be found on S3 (eicrecon / EPIC / RECD / 22.10.0)
 - <https://dtn01.sdcc.bnl.gov:9001/buckets/eicrecon> via eicS3read (user+pw)
- Some issues observed:
 - ▶ **Missing fraction of MPGD hits** due to ddsim minimum energy cut of 1keV on all detectors
 - no fix available yet
 - ▶ **Nearly no tracks available in eicrecon output** (e.g. 350 tracks in 150k events)
 - juggler output unaffected (see plots)
 - tracking factory failed due to SurfaceErrors in ACTS and was then excluded from further event processing
 - Problem described e.g. in [EiCrecon #306](#)
 - **Fix available now and merged, see EiCrecon #326**
 - ▶ **Missing ReconstructedParticles branch in DIS outputs** (22.11 campaign)
 - to be fixed after SimQA meeting today

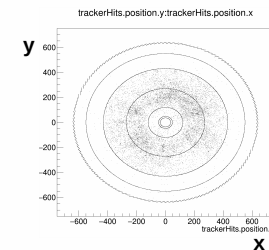
Single particle eicrecon outputs not usable for tracking studies at the moment. Use juggler output until new eicrecon outputs are available.



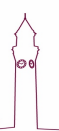
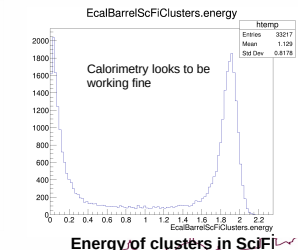
File contained ~20k generated electrons



Only 13 events available in ReconstructedChargedParticles (for this file)



Hits look reasonable → problem probably occurs when converting hits into a reconstructed track



Initial issue with B-field map - Solved

- Initial issue with magnetic field map reported by Rey at <https://indico.bnl.gov/event/17349/>
- Corrected field map for new magnet (MARCO) now available.

Old map
v.6.4.1.1.2,
2022/10/05

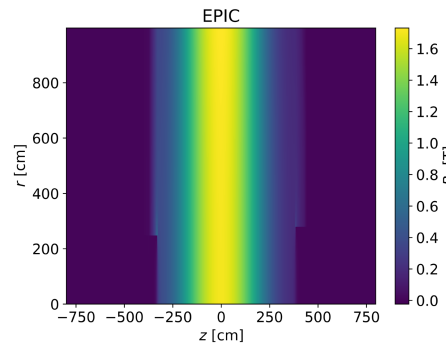
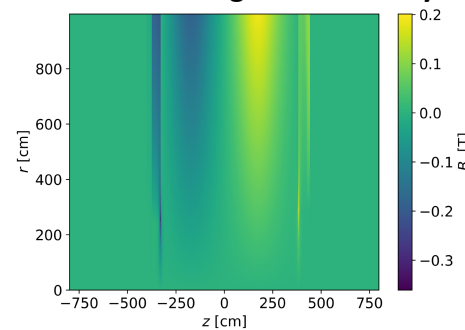
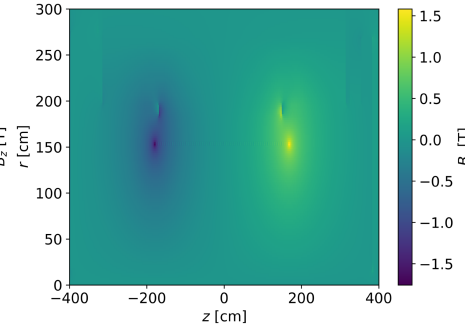
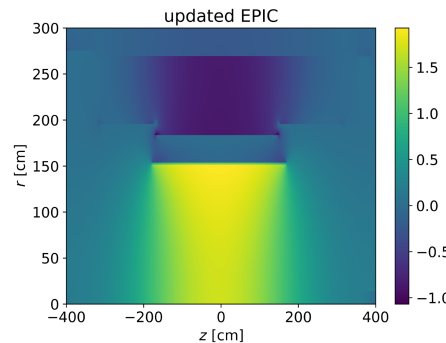


Figure credit: Rey



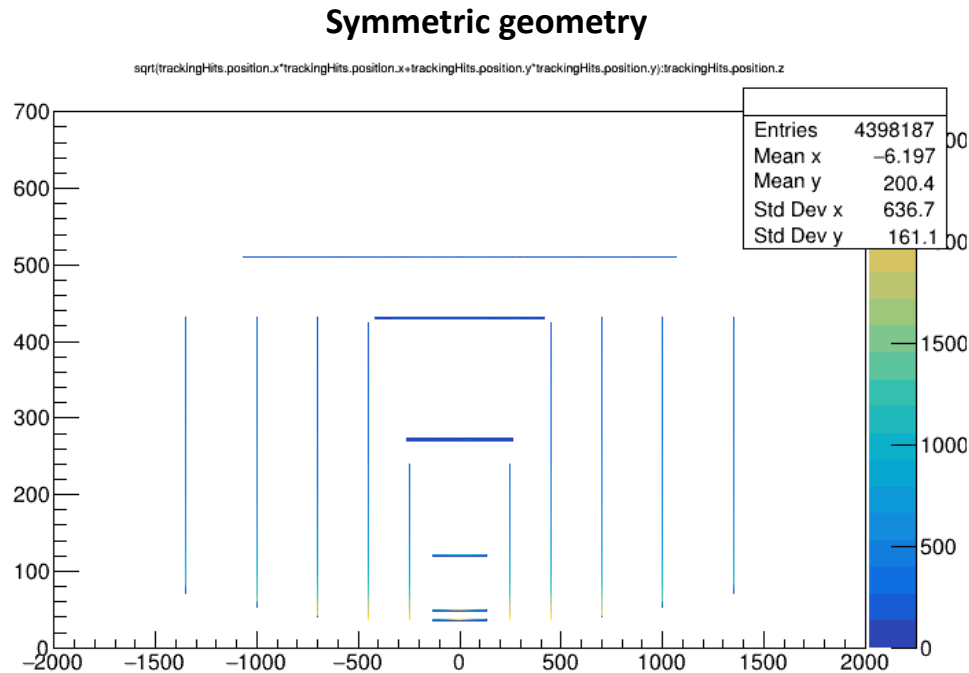
Corrected map
v.6.4.1.1.3,
2022/11/14



- Effect on tracking performance studied by Wenqing, full report at: <https://indico.bnl.gov/event/17600/>

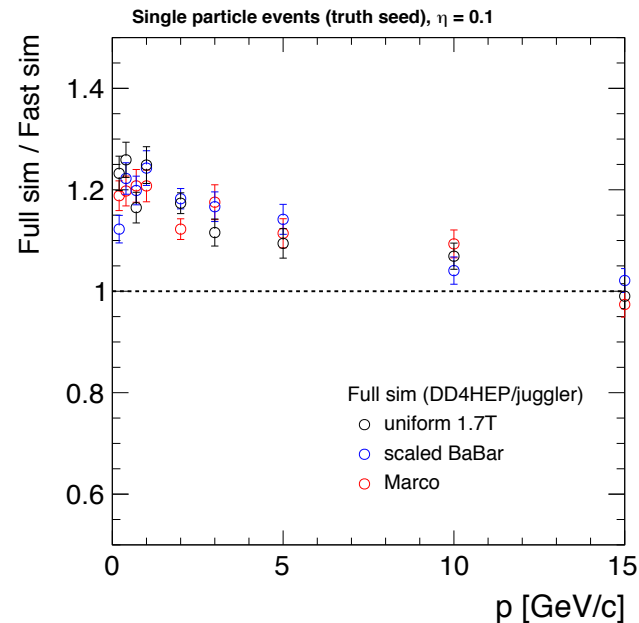
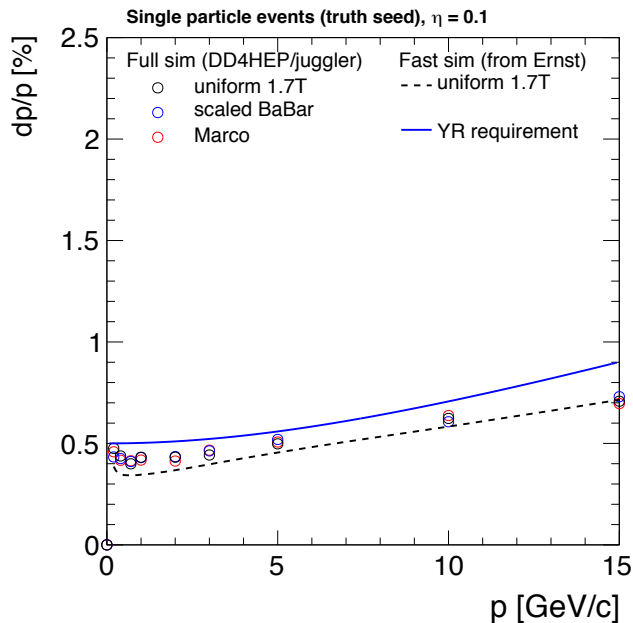
Effect of the different B field maps

- Effect on tracking performance studied by Wenqing, full report at: <https://indico.bnl.gov/event/17600/>
- Note that these studies have been done on a different configuration than the one from the Nov 2022 camping, still valid to quantify effect of B-field.
 - Barrel MPGD: $r = 51\text{ cm}$.
 - Endcap silicon: $z = 25, 45, 70, 100, 135\text{ cm}$ – symmetric configuration.



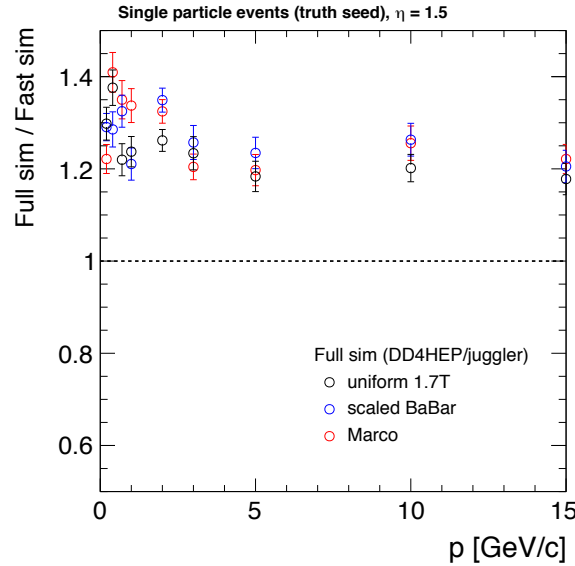
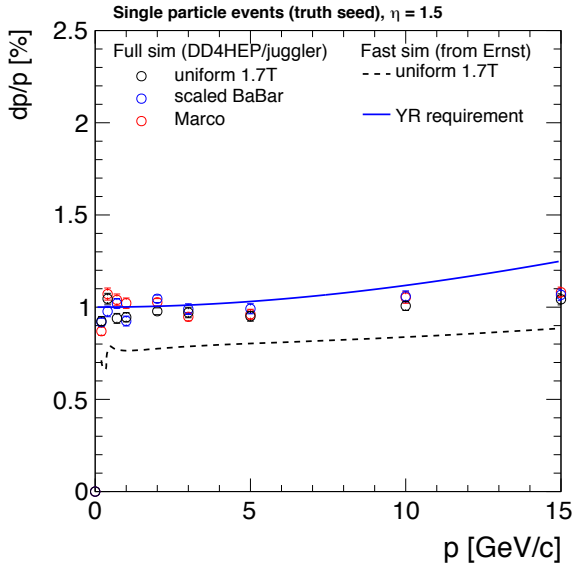
Effect of the different B field maps

- Same geometry with different B field settings
 - **New MARCO field map (1.7T), Scaled BaBar field map (by 1.7T/1.5T), Uniform 1.7T field**
- Difference between full and fast simulation due to material difference
 - No support cylinder in the fast simulation + more material per disk (including air) in the full simulation

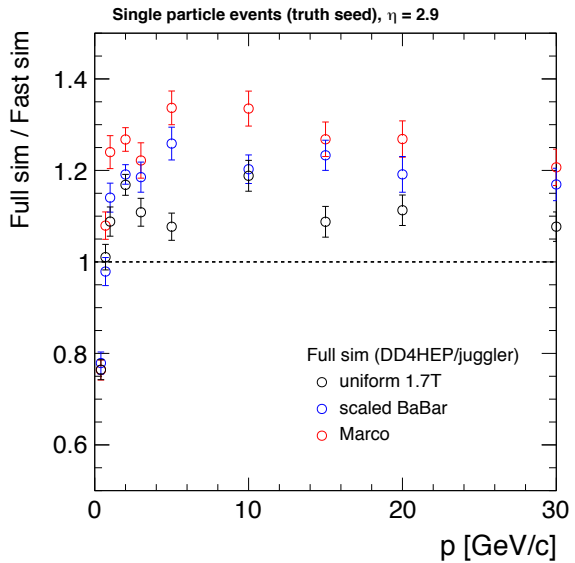
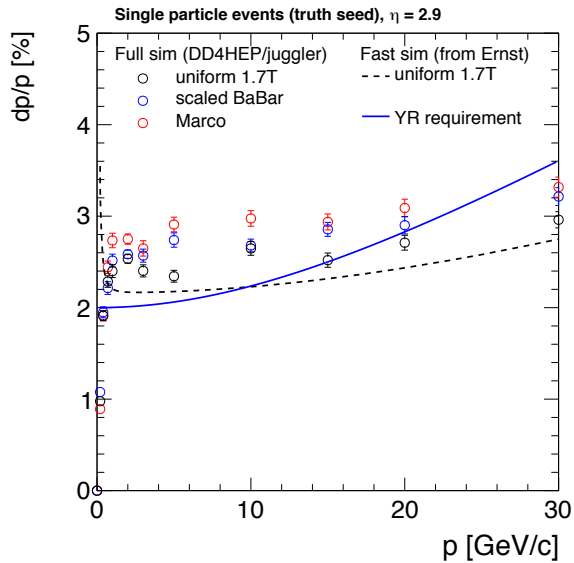


**Similar
performance
from different
B field settings**

Effect of the different B field maps



Slightly better performance with uniform field

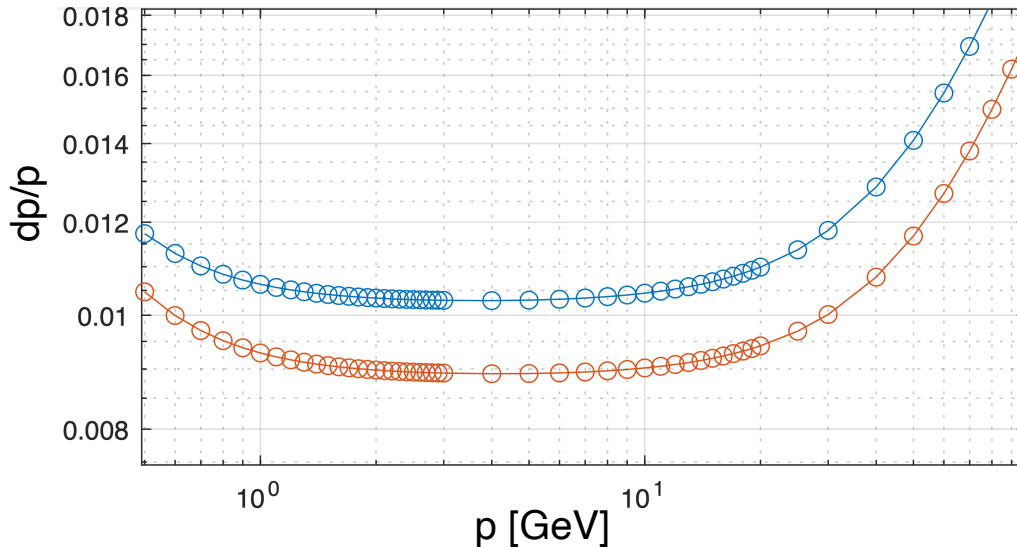
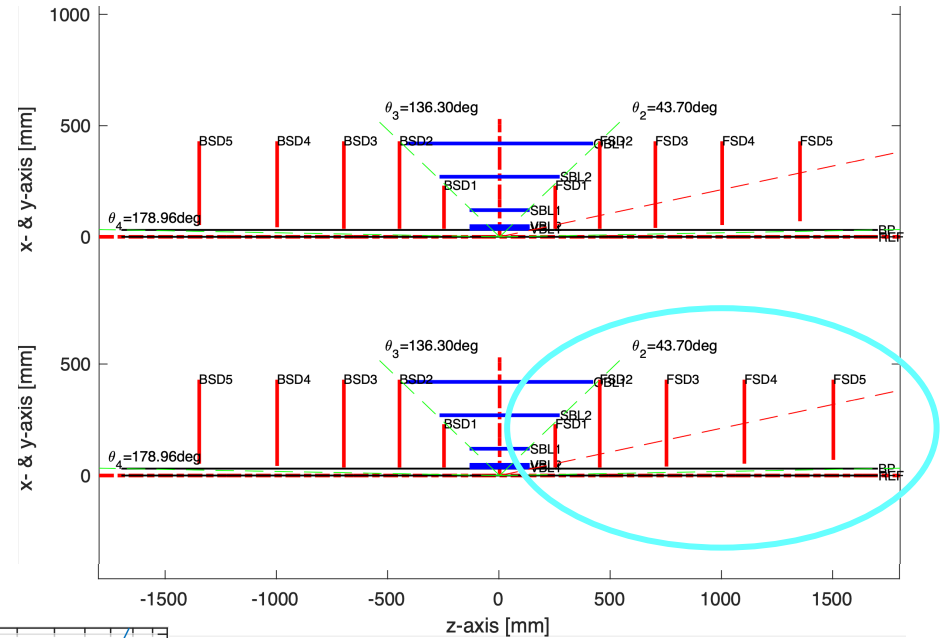


dp/p: Uniform < Scaled BaBar < Marco

10-20% worse performance from the new MARCO field map comparing to the uniform field map at forward rapidity

Considerations to recover YR performance over a wider η range

- Extending the lever-arm within the envelope tends to improve performance,
- Illustrated here,
 - $z_{3-5} = 75, 110, 150$ cm versus
 - $z_{3-5} = 70, 100, 135$ cm
- Considering to (also) extend the outer radius to meet the shallow cone.



- Illustration for constant $B = 1.7$ T for $\eta = 2.25$ from fast simulations,
- Lever arm **125** vs **110** cm (vertex layers are outside of acceptance).

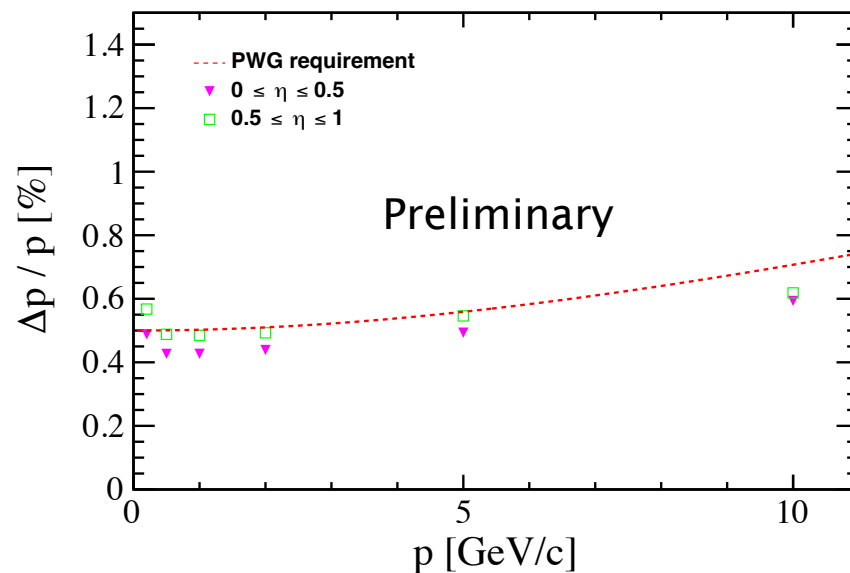
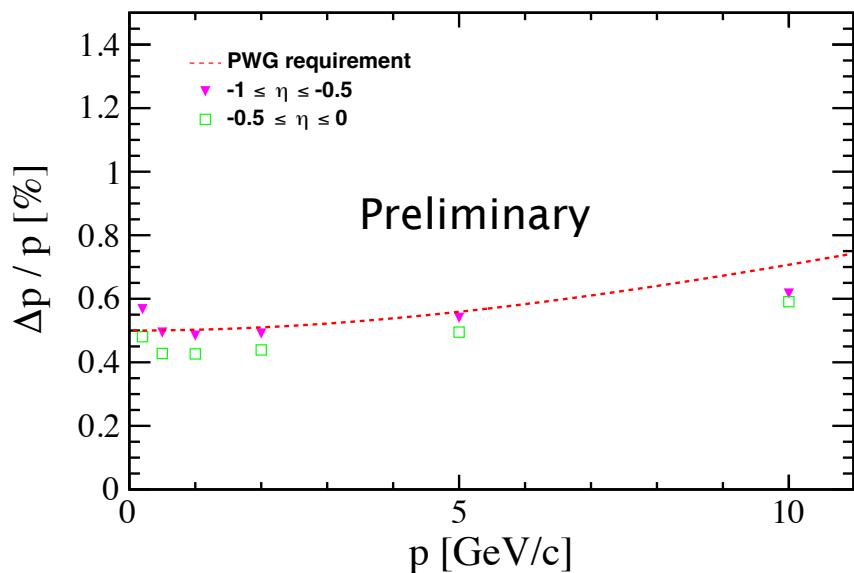
Slide by Ernst

Data from simulation campaign

- Latest single particles data available at [S3/eicctest/EPIC/RECO/22.11.2](#) with **corrected ePIC 1.7T B-field map**.
- Initially data looked anomalous.
- The magnetic field wasn't downloaded correctly for those files meaning that there was no magnetic field present during reconstruction.
- The issue appears to have been fixed over the weekend, new files available that look correct.

Preliminary plots

- **Preliminary** momentum resolution plots for the central region of the **bryce canyon configuration** made using the single particle files available at S3/eictest/EPIC/RECO/22.11.2/epic_brycecanyon/SINGLE /pi-
 - Preliminary as they became available one hour ago and have not been discussed at the Tracking WG yet.
 - Performance in agreement with previous results from fast simulations, Fun4All, and ePIC software.



Plots by Stephen

Conclusion

- ePIC tracking detectors implemented in DD4Hep and validated by Shujie (silicon), Matt (MPGD).
- Initial issues with eicrecon and B-field map solved.
- Study of different B-field configurations points to 10-20% worse dp/p with correct B-field map → increase of lever arm in forward and backward direction will need to be explored.
- Single particle files with updated B-field map available for ePIC tracking performance studies.
 - Initially no magnetic field present during particle propagation.
 - Corrected files became available during the weekend.
- Preliminary results on dp/p vs p as expected; more plots on tracking performance expected at the next tracking WG meeting (Thursday 1 Dec).