UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

Tracking Performance Studies

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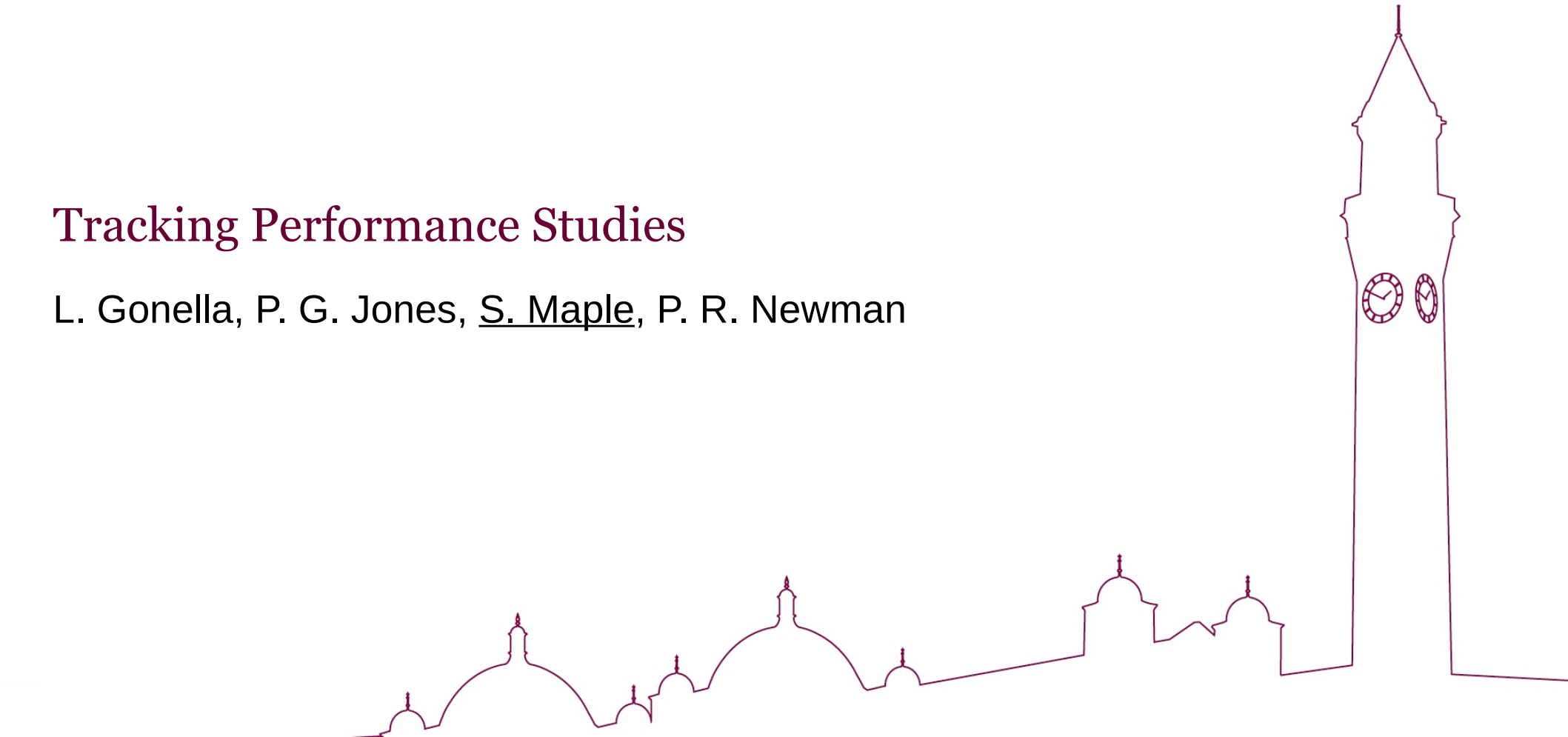
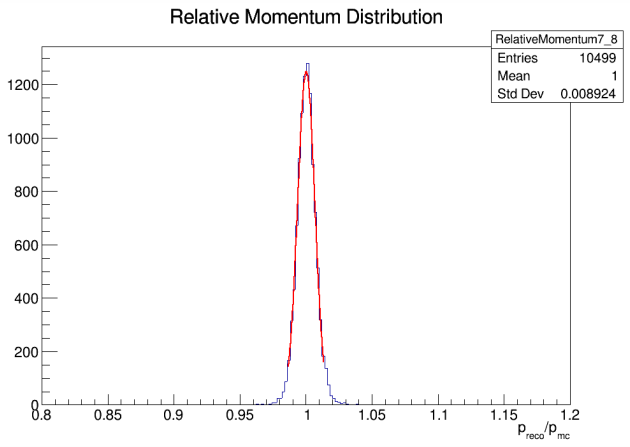
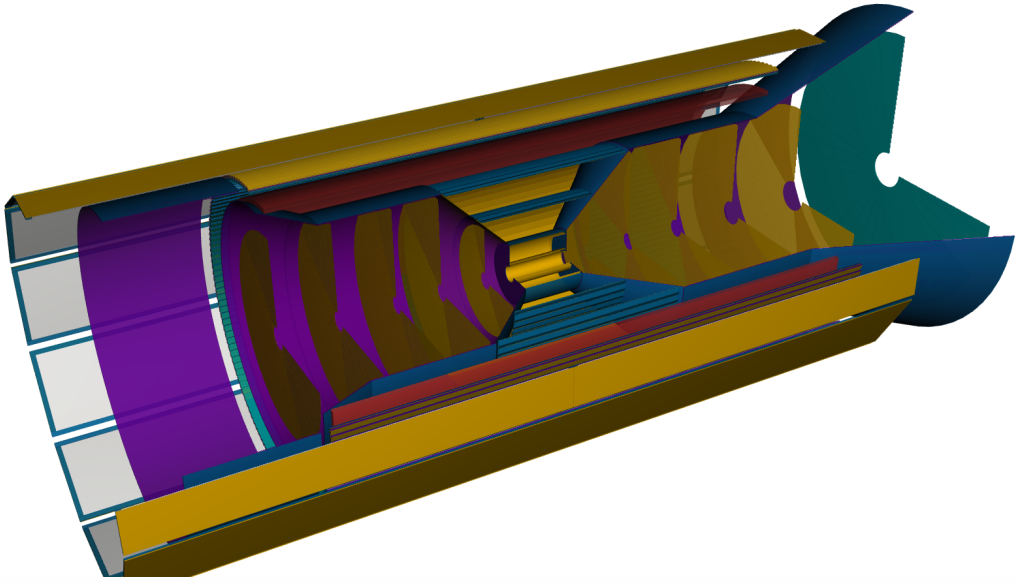


Simulations in EPIC software

- Generate pions uniformly in p_T and η
  - $0 < p_T < 15$ GeV
  - $-4 < \eta < 4$
- Pass through latest ePIC tracking geometry with DD4sim
- Reconstruct pion tracks with most recent version of EICrecon

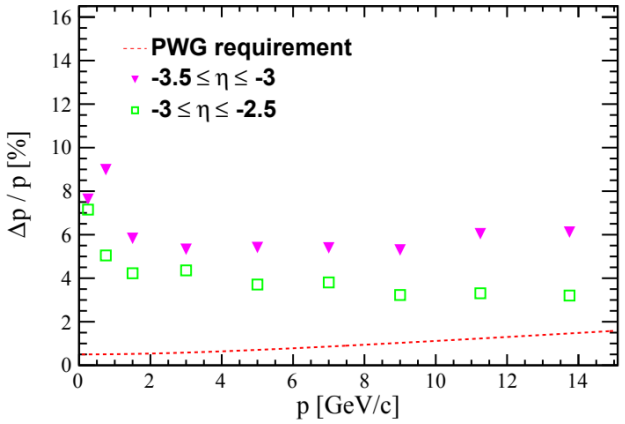


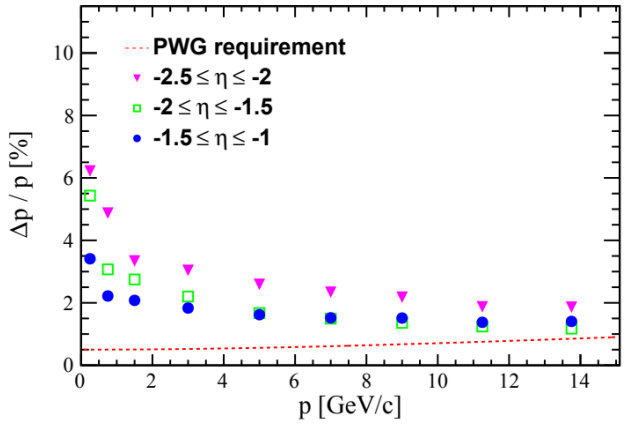
- Reconstructed events binned in η and p_T, fitted in 2σ range around peak and resolution extracted

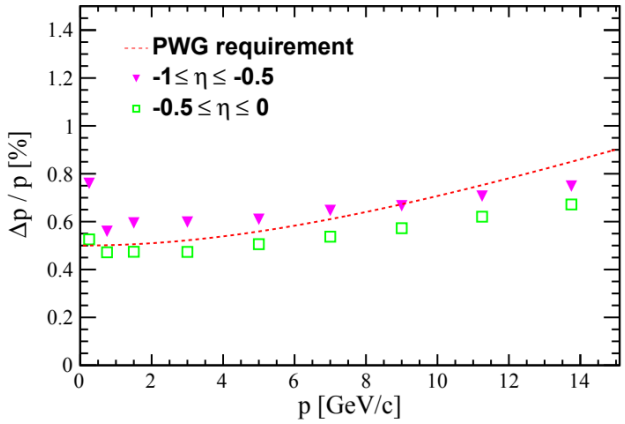


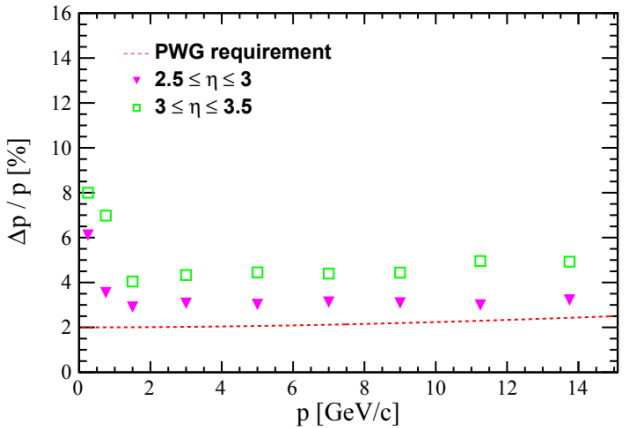
Updated performance: Momentum resolution

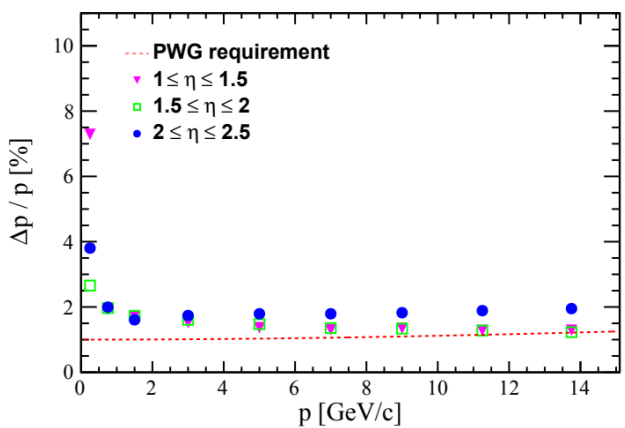
- Smeared truth seeding → restores rise at low p

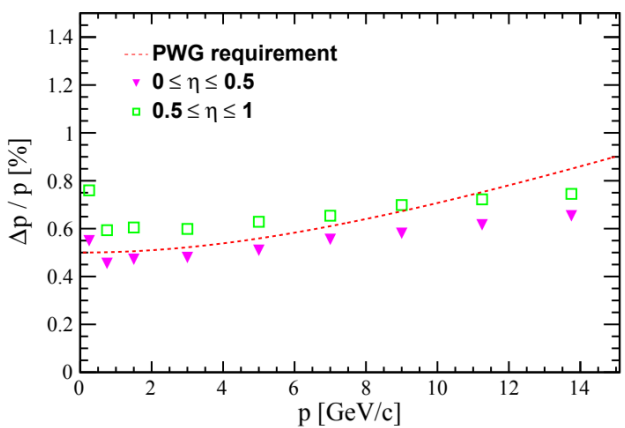






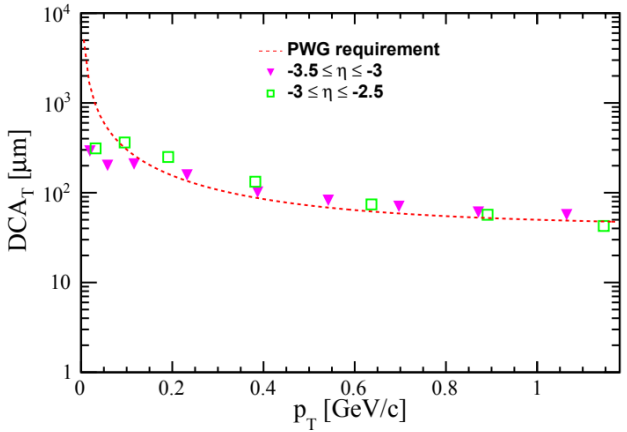


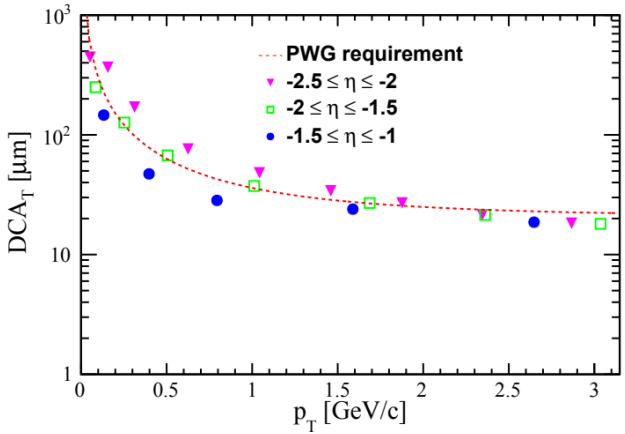


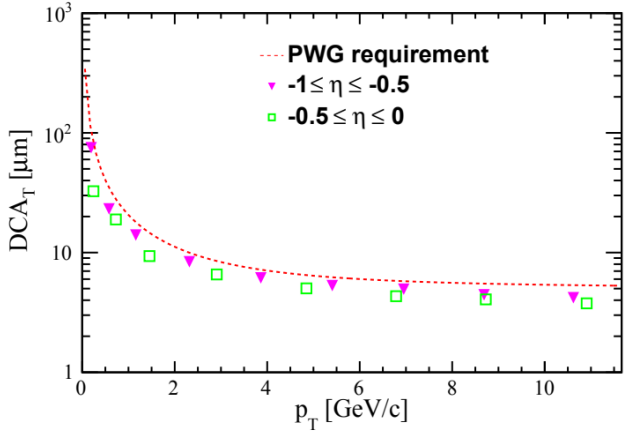


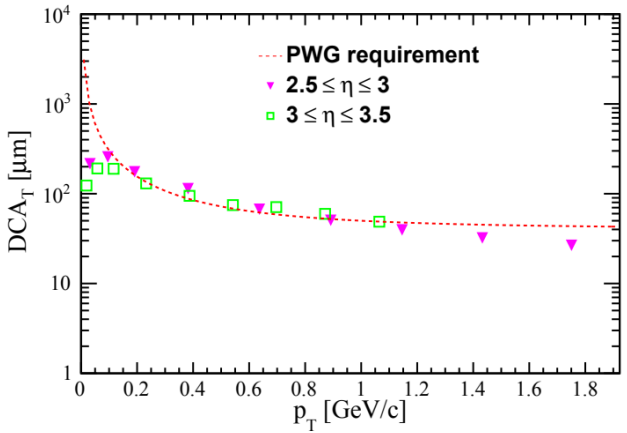
Updated performance: Transverse Pointing resolution

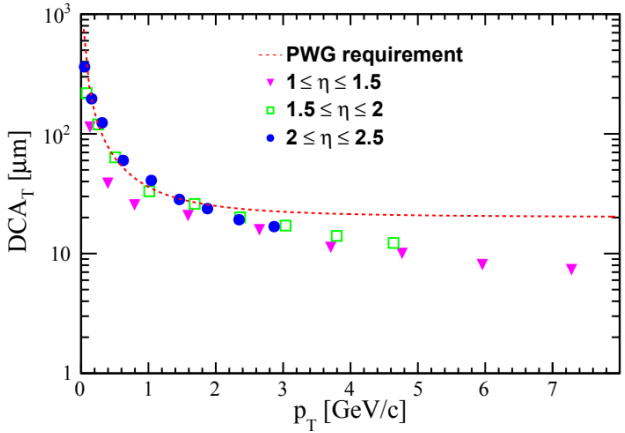
- DCA resolution comparable to requirement, as before

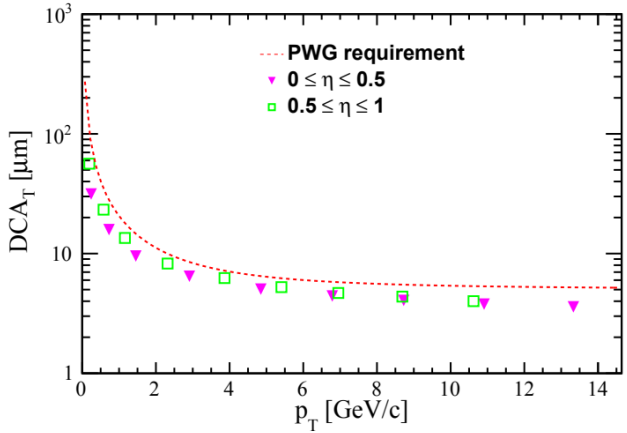






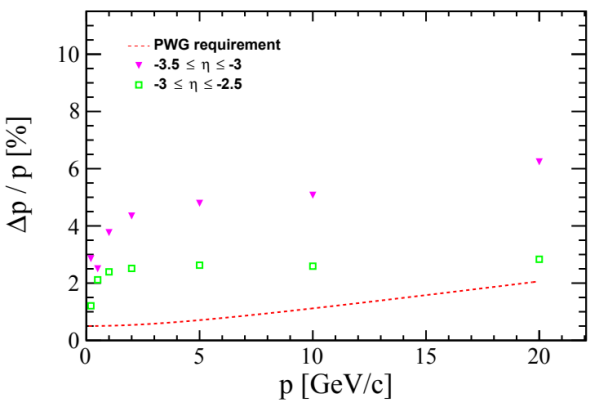


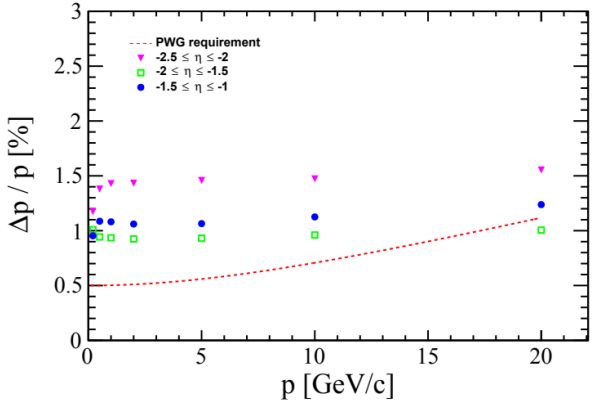


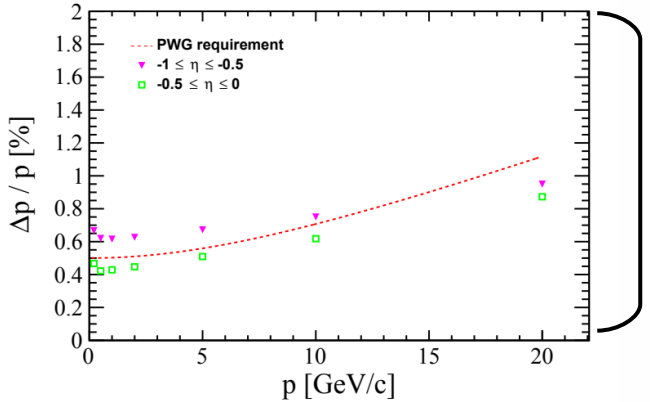


“Old” vs New

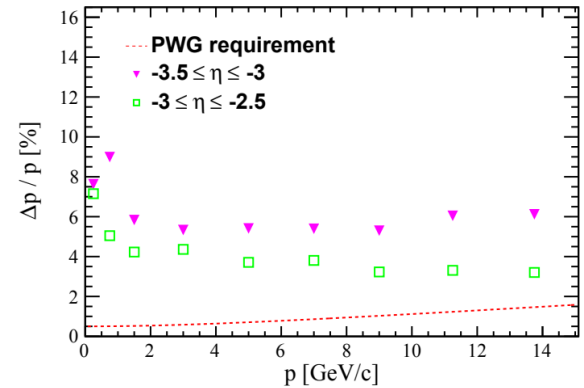
- Compare performance from December simulation campaign to that of most up to date geometry

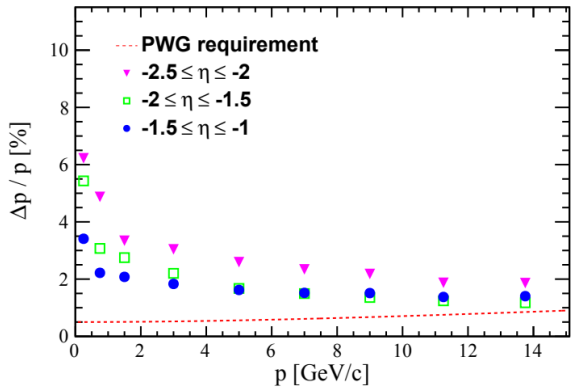


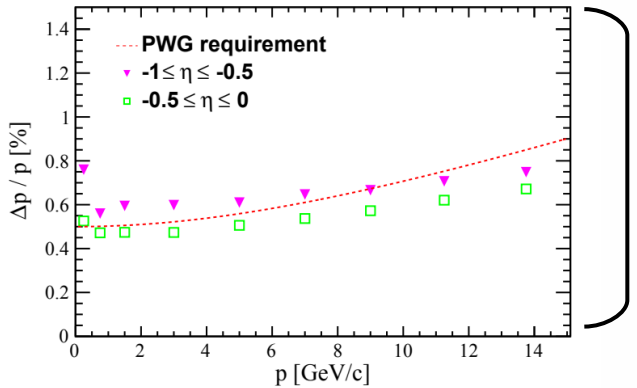




Old







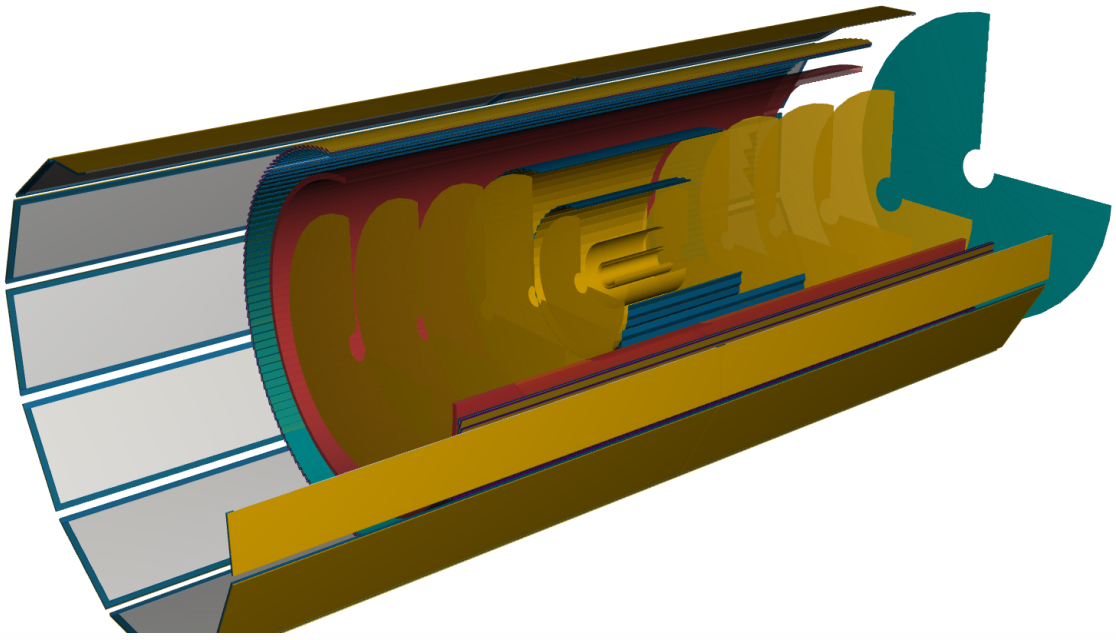
New

- Differences:
  - Truth seeding → Smeared truth seeding
  - No ToF in reconstruction → ToF hits used for reconstruction

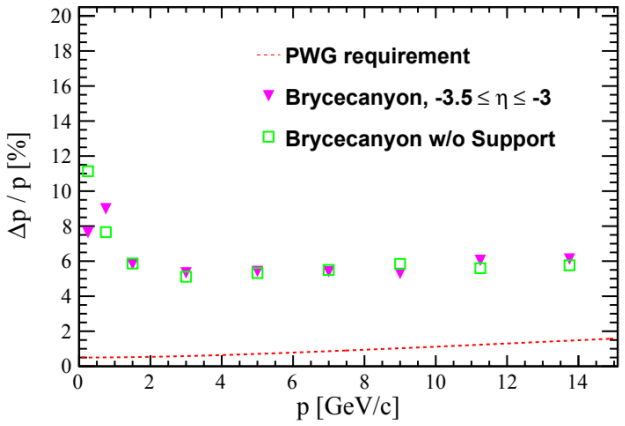
Performance degraded at |η|>1 → effect of different seeding?

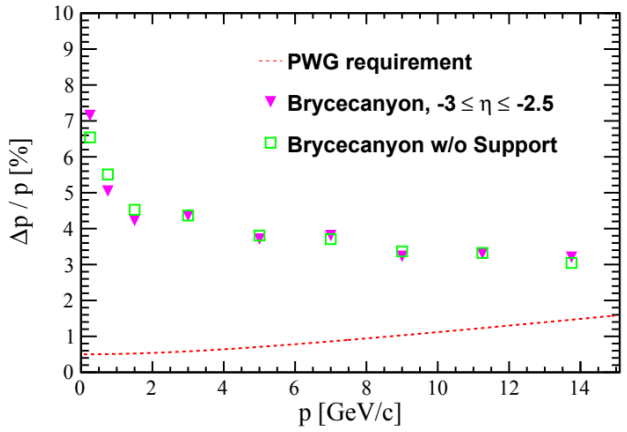
Effect of Support Cone material

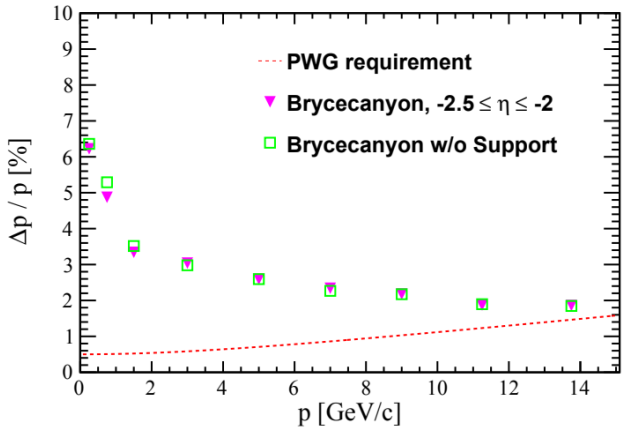
- Is this rise at low p explained multiple scattering in material?
  - Simulation and reconstruction repeated with no support structure present

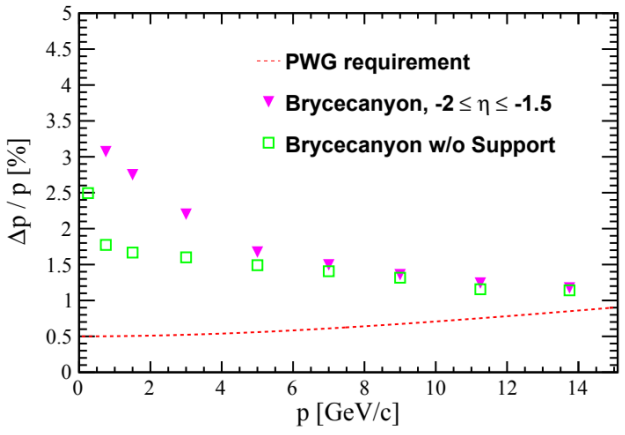


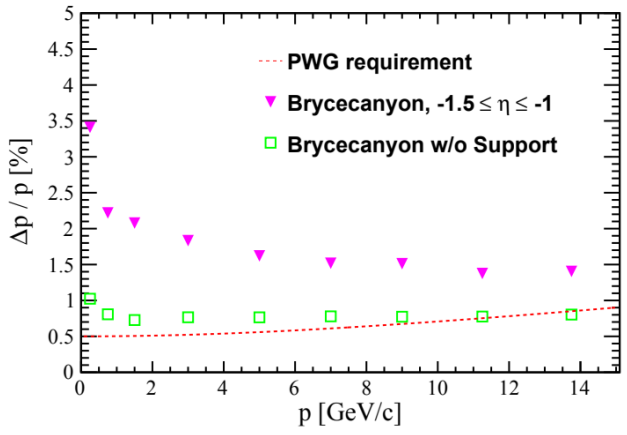
Effect of Support cone material





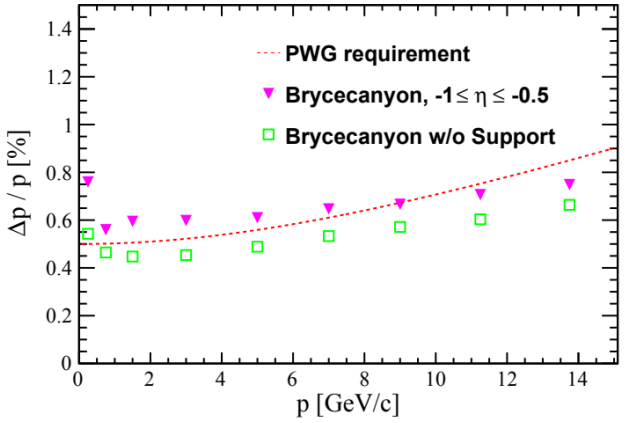


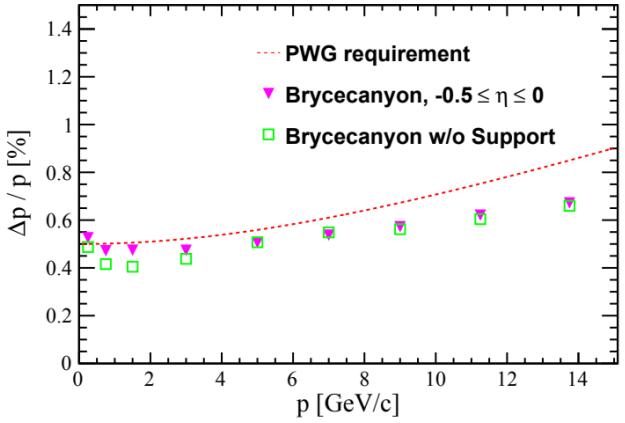


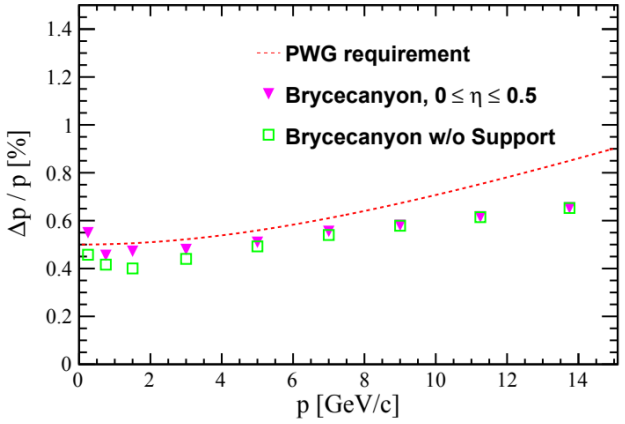


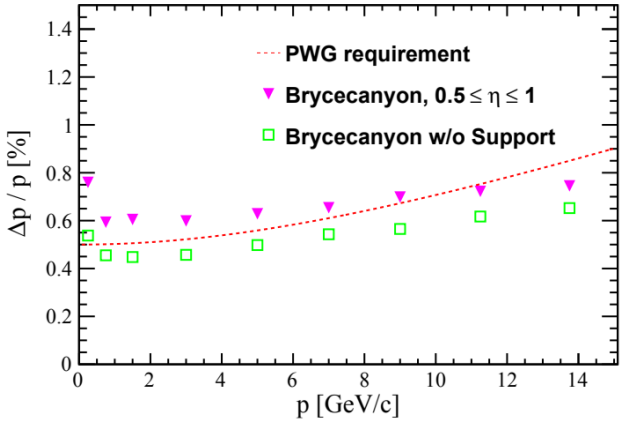
- Support material has significant impact on momentum resolution at |η| < 2
  - **Rise as p → 0 less prominent with reduced material (but still present)**

Effect of Support cone material



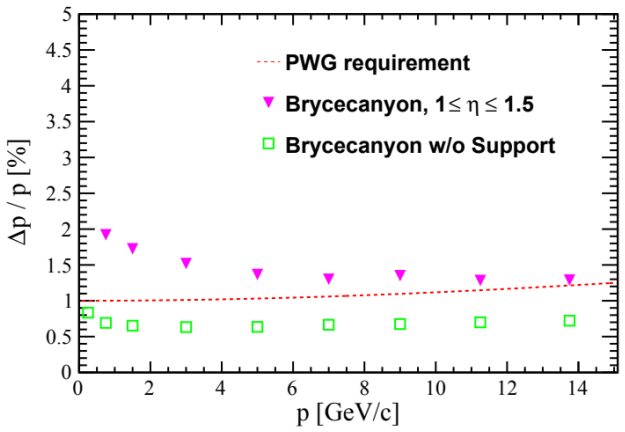


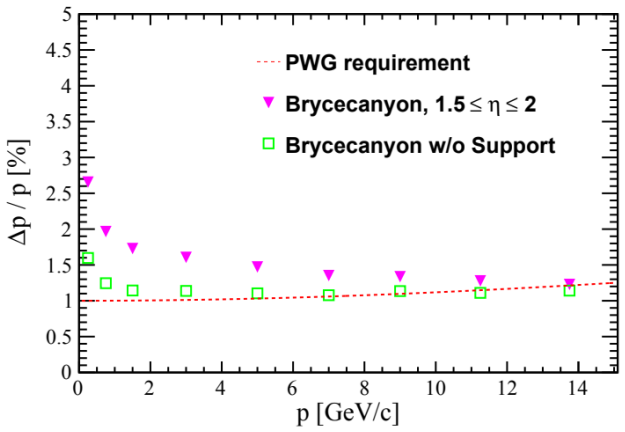


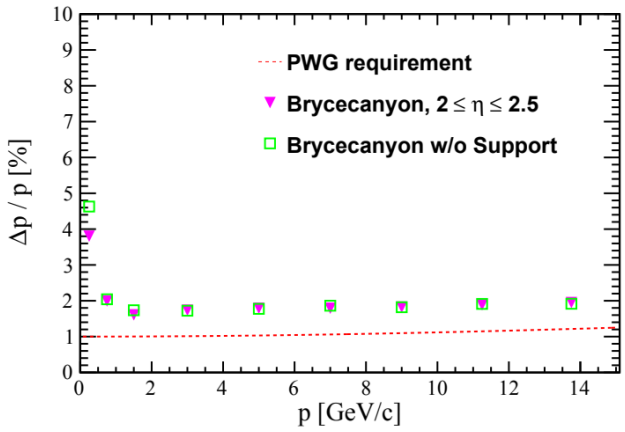


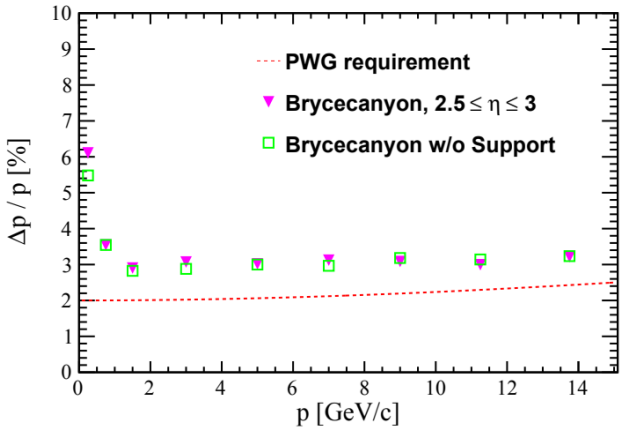
- For |η|<0.5 only see degradation for lower p → much lower material here
- Support cone starts at |η|~0.9 so see some impact on 0.5<|η|<1 region

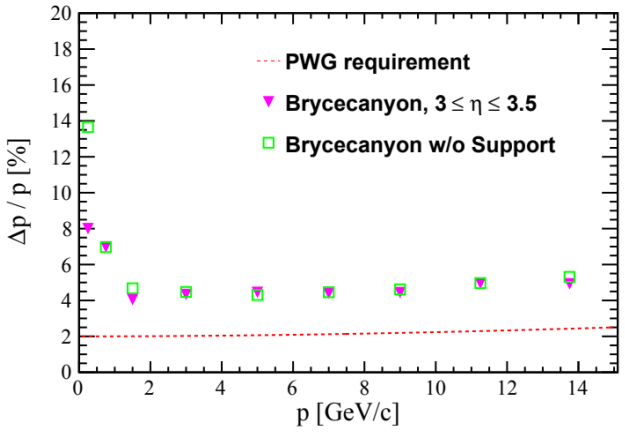
Effect of Support cone material







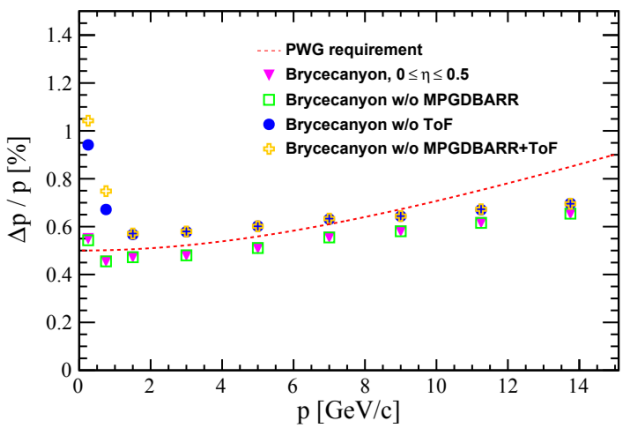


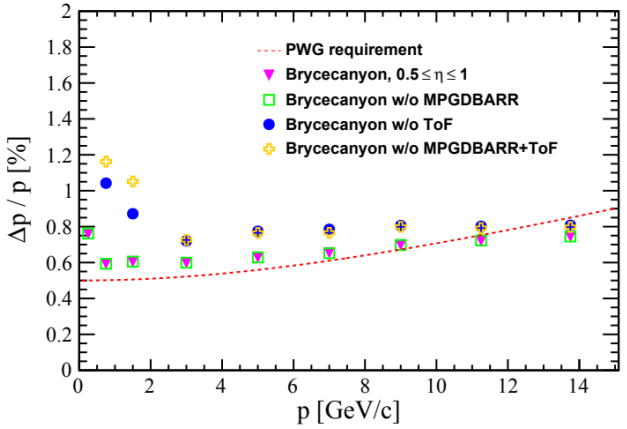


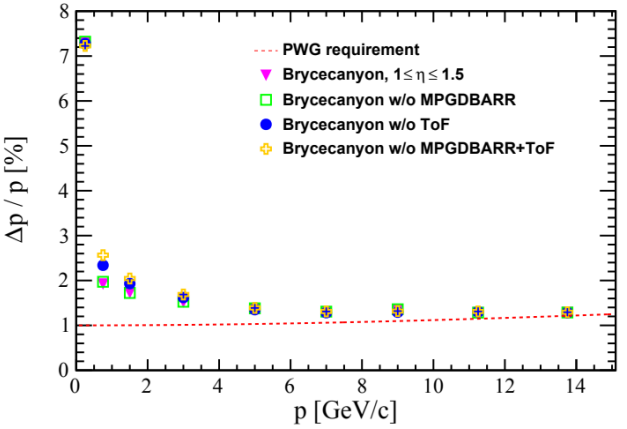
- Rise at low p less prominent in forward direction → extra lever arm in disks helping to counteract?

$$\left(\frac{\sigma_{p_T}}{p_T}\right)_{\mathrm{MS}} = \frac{1}{|q|B}\frac{13.6\,\mathrm{MeV}\,c^{-1}}{\beta}\sqrt{\frac{C_N}{X_0 L}}.$$

Effect of ToF and MPGD on momentum resolution







Both MPGD + ToF alive

ToF alive MPGD dead

MPGD Alive ToF dead

MPGD dead ToF dead (Si only)

- 2 Bands appear → ToF and no ToF
  → We have seen this in Fun4All studies: consistent behaviour in EPIC-Software
- |η| > 1.5 not shown (no difference in performance)

Summary

- Simulations performed using EPIC software to evaluate performance with an up-to-date simulation and reconstruction
  - Some loss in performance compared to December simulation campaign → Attribute this to change in seeding
- Verify that rise at low p is expected by simulating with reduced material (no services)
- Confirm impact of ToF and MPGD layers on momentum resolution in EPIC software are consistent with trends seen in Fun4All studies