# Update on Momentum Units for Realistic Seeding

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Units Change for the Realistic Seeder

Inspired by the work Beatrice and Barak have done on the units error in the deposited energy threshold. When fitting the tracks, resolution issues were noticed when using real seeds. Rey and Barak then found a problem with the units for the q/p variable in the seeder output.
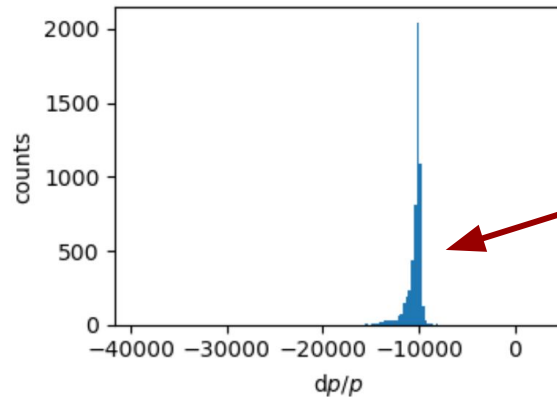
For BField == 1.7 T, we see that the momentum resolution is not centered at zero!
:(

Figuring Out the Units

Pt is calculated by equating lorentz and centripetal forces.

$$m\frac{v^2}{R} = q_e\,(v \times B) \longrightarrow \boxed{p[GeV/c] = 0.3 * R[m] * B[T]}$$

This is where pt is calculated in EICRecon - two bugs here!

```
97    float pt = 0.3 * R * (m_cfg.m_bFieldInZ * 1000) / 100.;
```

Overcompensating for a factor of 1000 and 0.3 (already included in acts)

constexpr double `Acts::UnitConstants::T` = 0.000299792458

R is expected in cm (but acts default is mm)

constexpr double `Acts::UnitConstants::mm` = 1.0

$$\frac{0.3}{1000} = T \longrightarrow \frac{0.3}{1000} * \frac{1}{1000} = kT$$

So this pt definition is currently taking in R[cm] and B[kT]

constexpr double `Acts::UnitConstants::GeV` = 1.0

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Momentum Resolution Result

After changing only the bFieldInZ parameter from 1.7 to 0.0017 (corresponding to kT), I found the following for the momentum resolution.

```
            -Ptracking:CentralTrackSeedingResults:bFieldInZ=0.0017*Acts::Uni
tConstants::T \
```
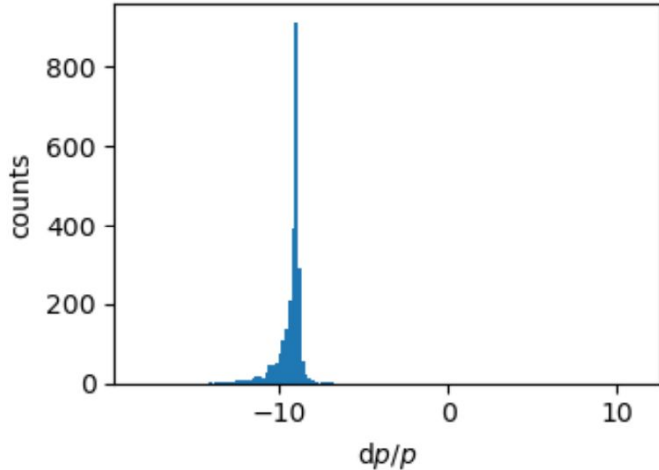

- We see we are still a factor of 10 off from zero. If we divide by 10, our momentum resolution is forced to center at zero.
- Verifies that the pt calculation is taking in R[cm] instead of R[mm]

Summary

- Discovered two bugs in the pt calculation
- Barak and Rey plan to make a branch in EICRecon to fix the two bugs discussed.
- My study on variation of parameters for seeding was affected by the bug. Need to rerun the study to obtain the find the best parameters after the fixed branch is created. I hope to share this with you all next week!

backup

Github link to where pt is calculated

https://github.com/eic/EICrecon/blob/main/src/algorithms/tracking/TrackSeeding.cc#L97

efficiency set to 1 if > 1 seeds reconstructed

Legend:
- file 0 - sigmaScattering 5 bpt0017
- file 1 - sigmaScattering 5 nochange
- file 2 - sigmaScattering 6 bpt0017
- file 3 - sigmaScattering 6 nochange
- file 4 - sigmaScattering 7 bpt0017
- file 5 - sigmaScattering 7 nochange

x-axis: η
y-axis: efficiency

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