

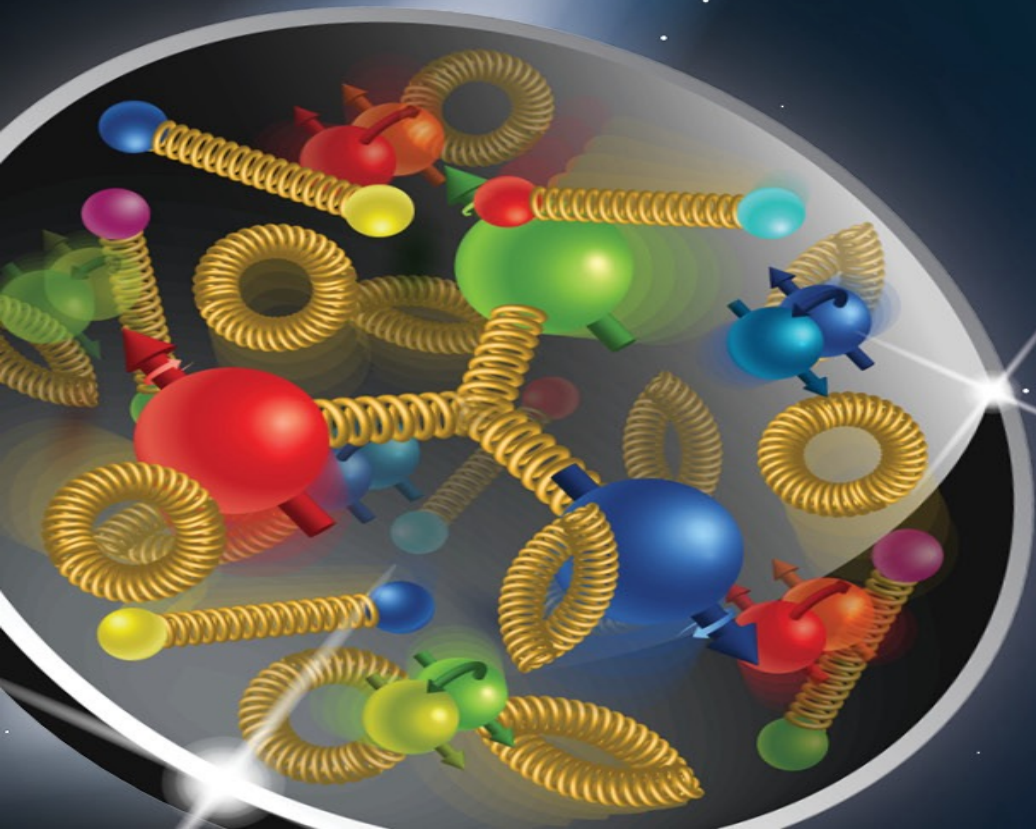
Tracking Performance in the B0 with Field Map

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EIC IR Meeting (edited)

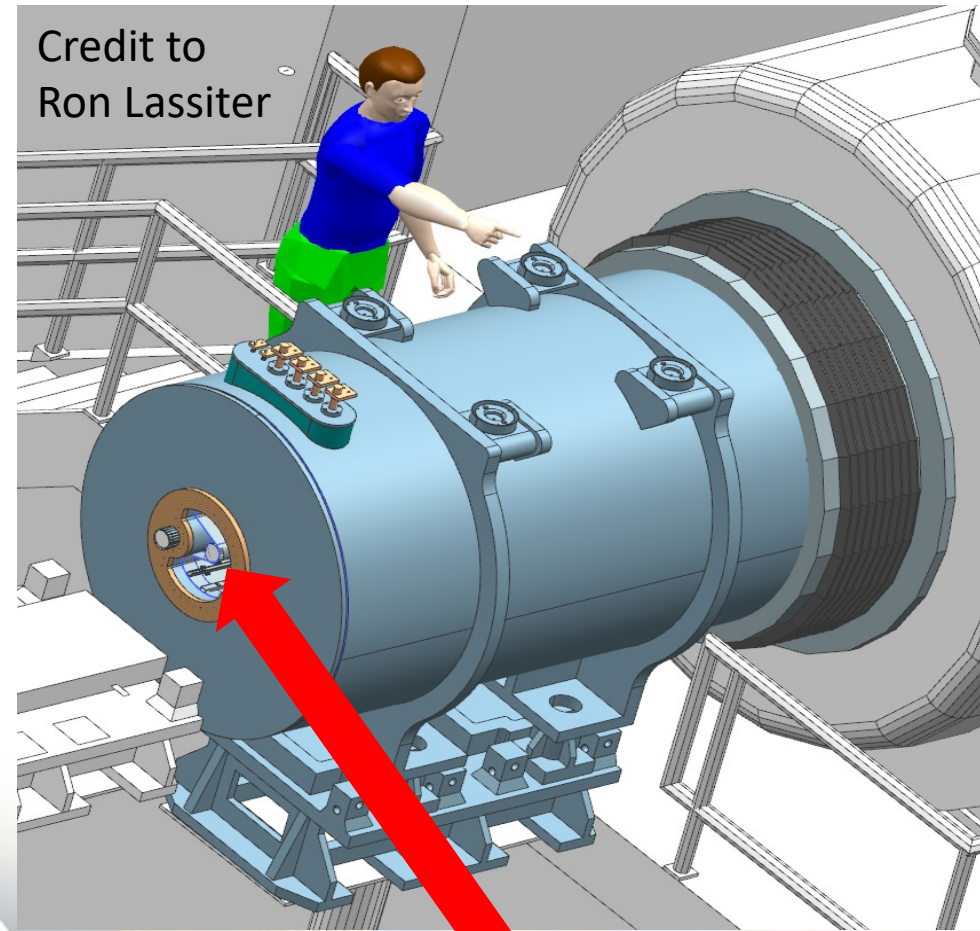
December 1st, 2023

Shown @ FF meeting Dec. 5th, 2023

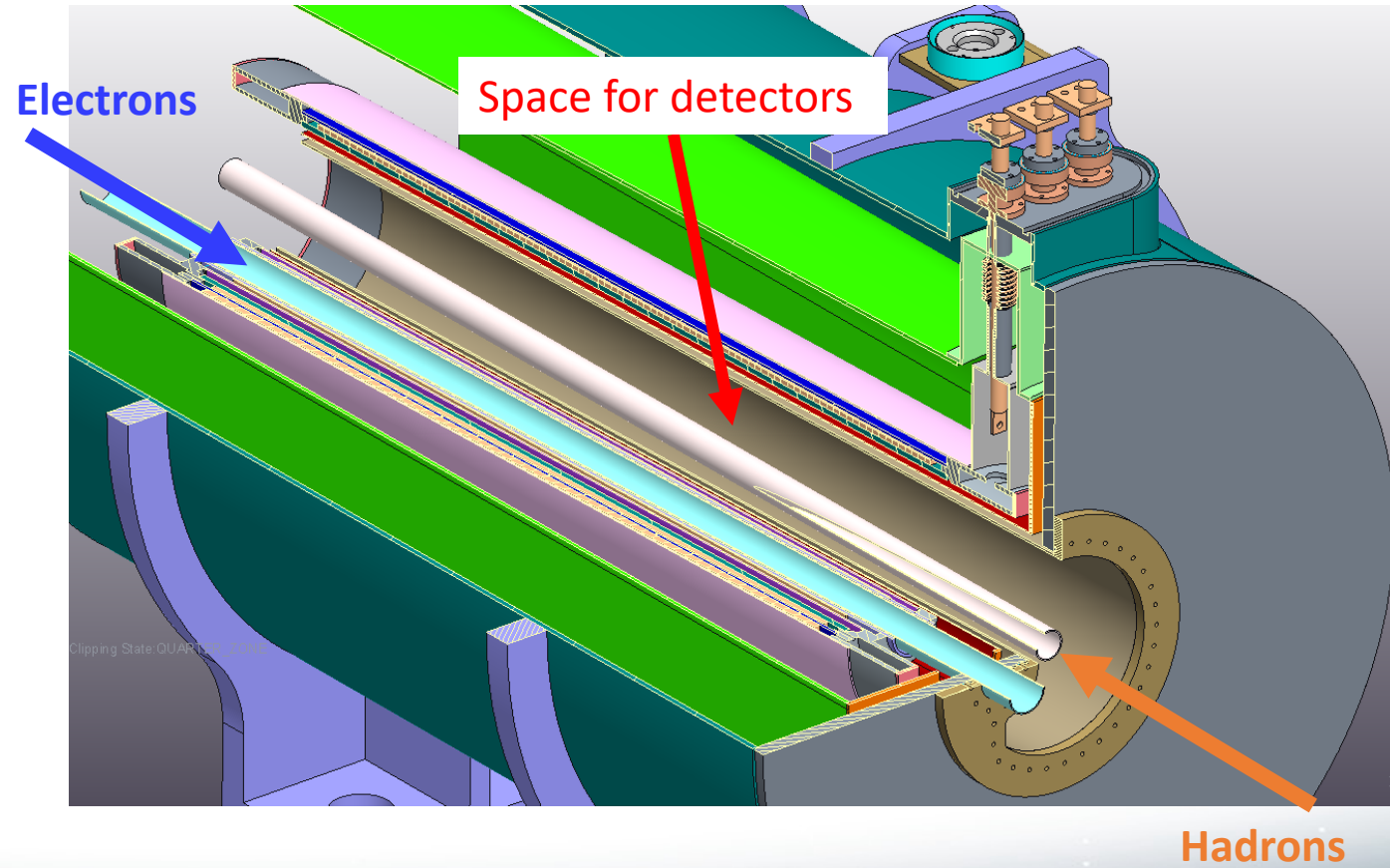


B0 Detectors

- Detector subsystem embedded in an accelerator magnet.



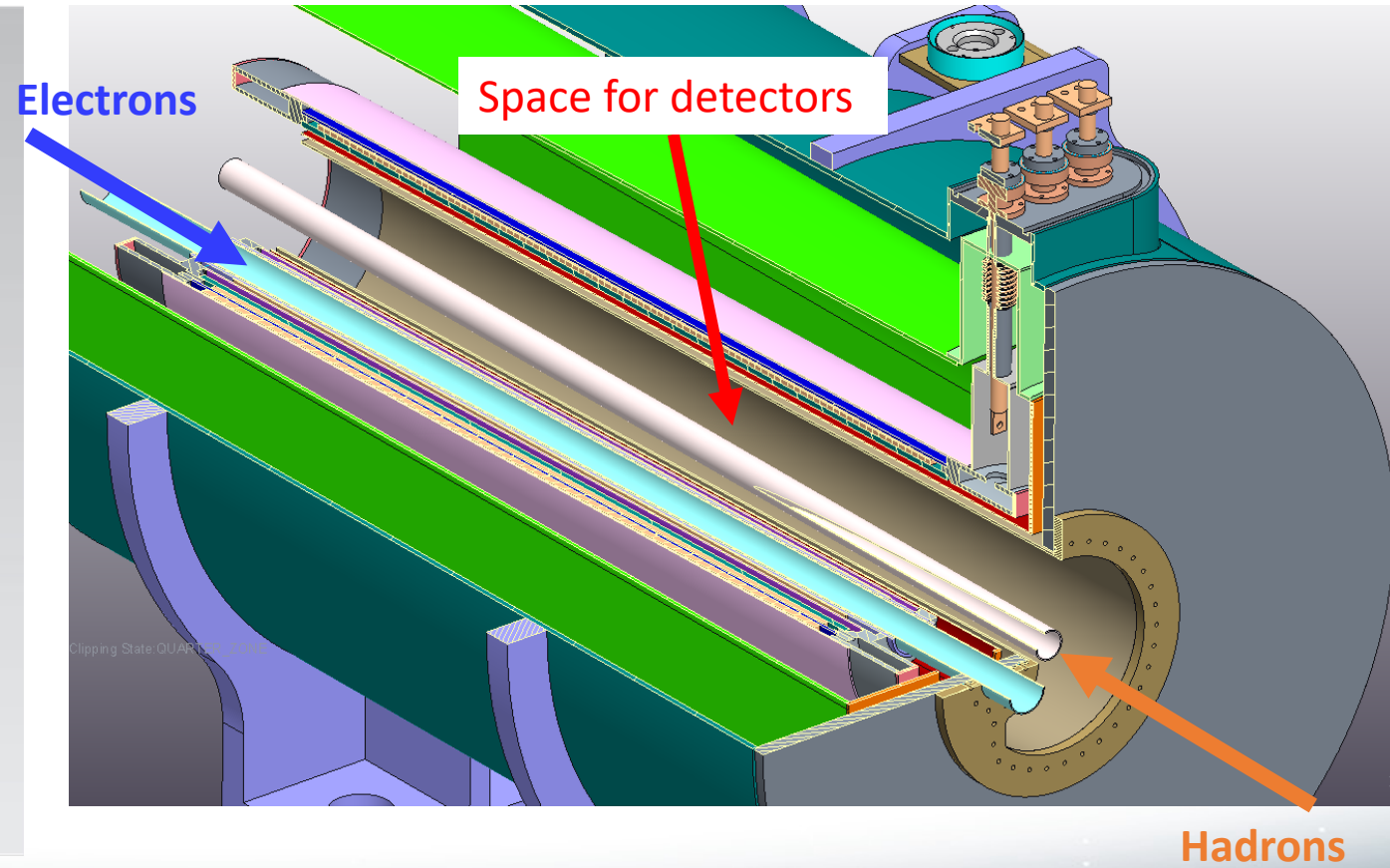
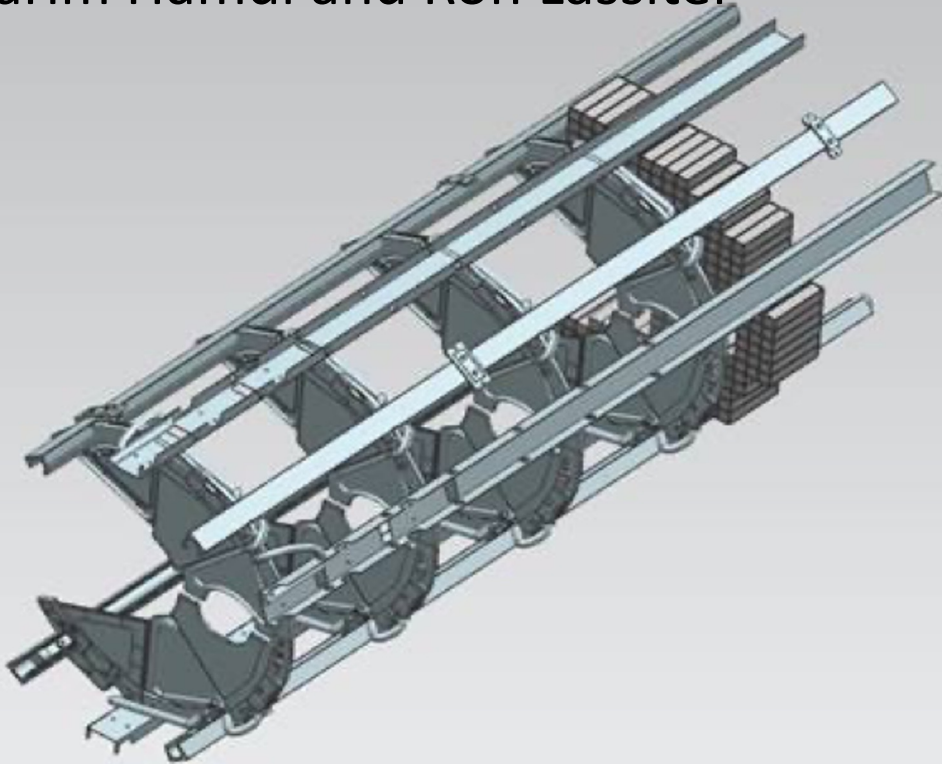
This is the opening where the detector planes will be inserted



B0 Detectors

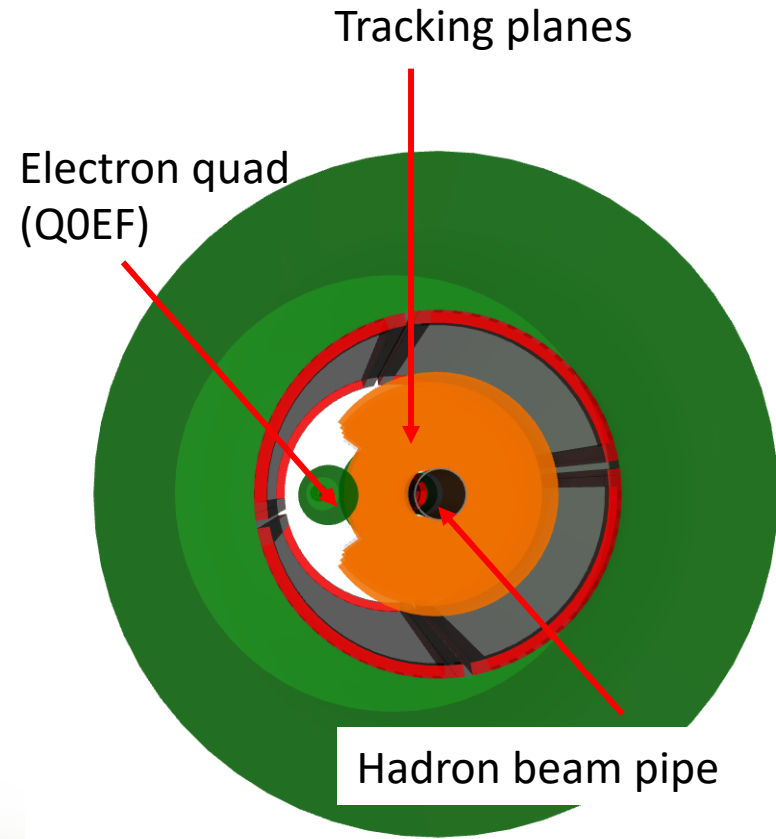
- Detector subsystem embedded in an accelerator magnet.

Karim Hamdi and Ron Lassiter

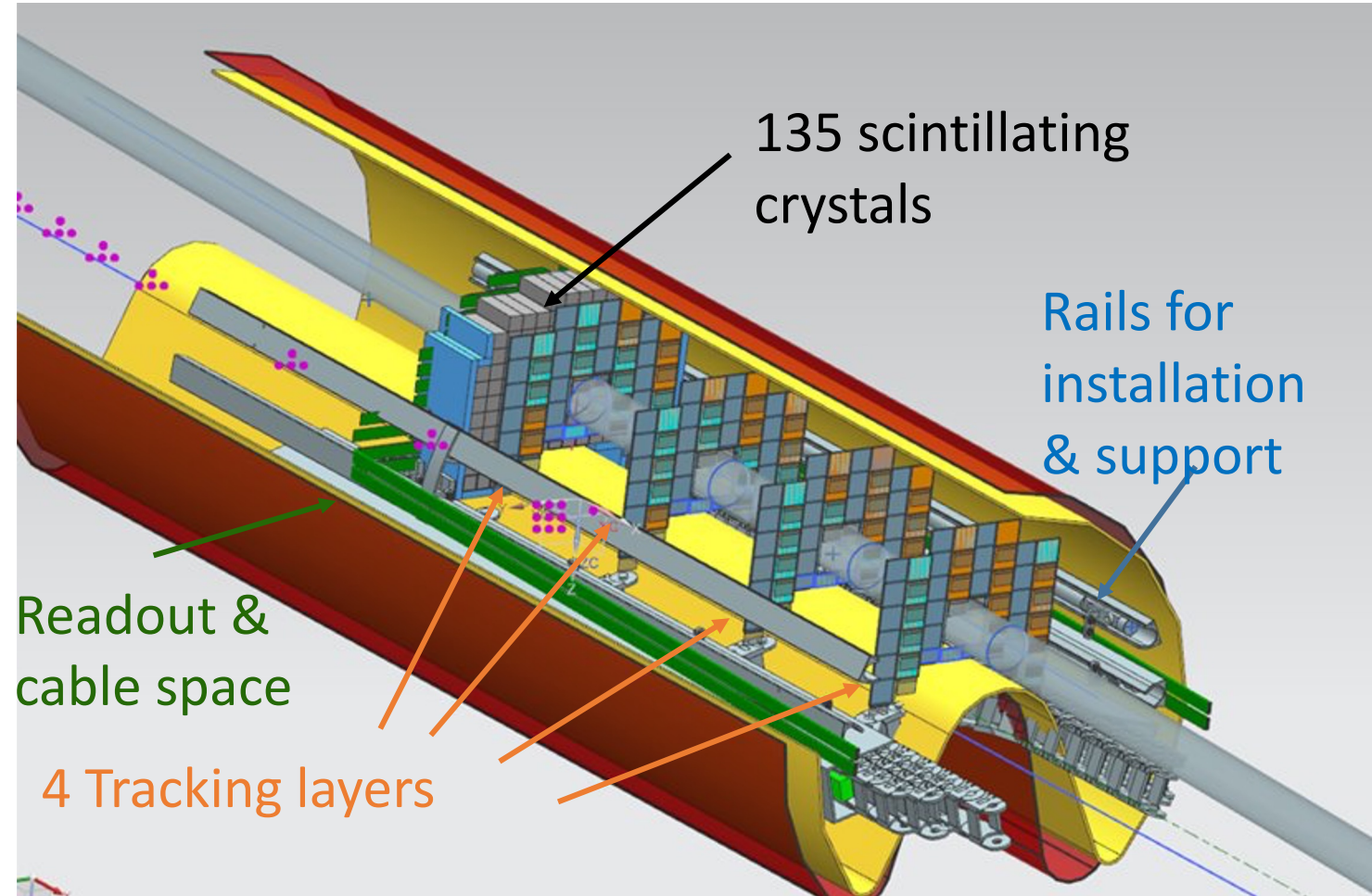


B0 Tracking and EMCAL Detectors

CAD Look credit: Jonathan Smith

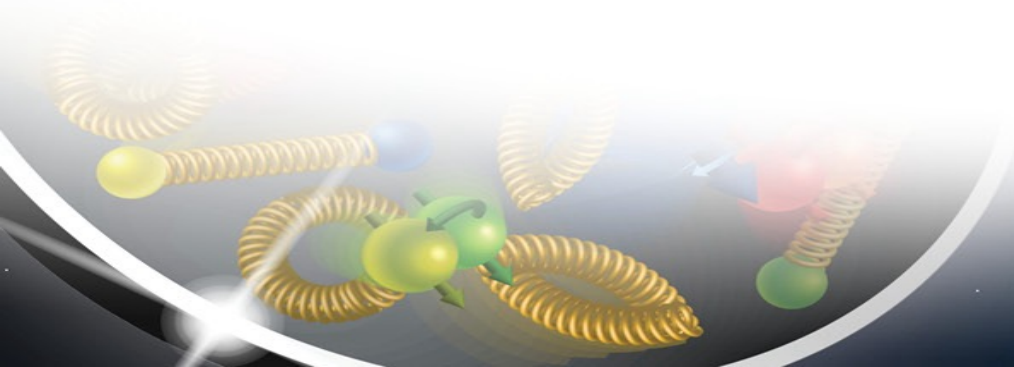


ePIC DD4HEP Simulation

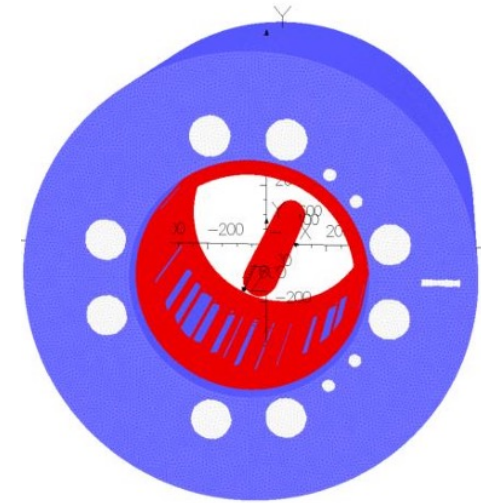
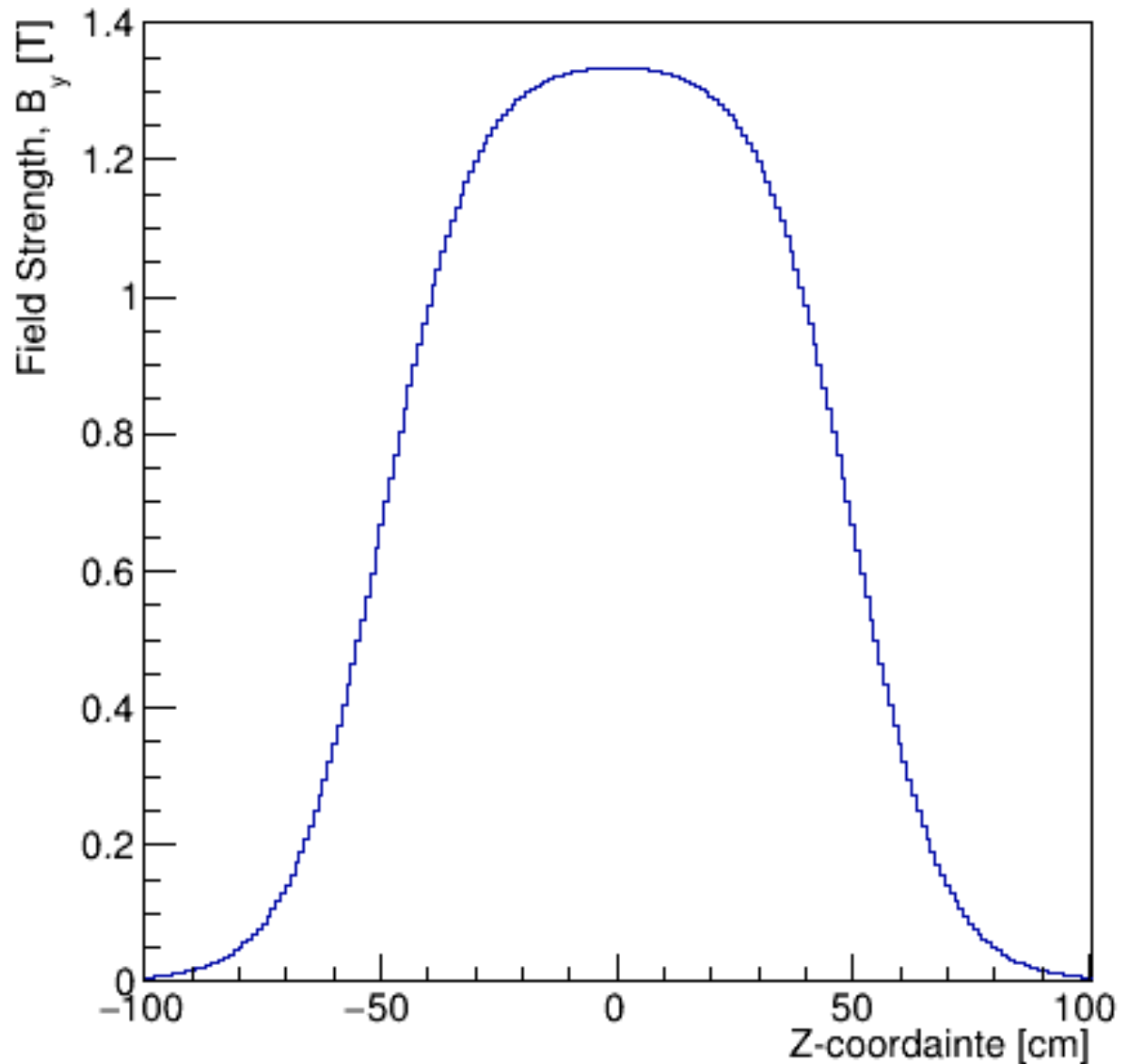


B0 Field Map

- Information pulled from here:
 - [https://wiki.bnl.gov/EPIC/images/e/ef/12212022 - Set up to do 3D field map.pdf](https://wiki.bnl.gov/EPIC/images/e/ef/12212022_Set_up_to_do_3D_field_map.pdf)
 - [https://wiki.bnl.gov/EPIC/images/1/1b/B0 field map 23dec2022.txt.zip](https://wiki.bnl.gov/EPIC/images/1/1b/B0_field_map_23dec2022.txt.zip)
- Map given in 1cm steps → lots of information for the detector simulations, reduced to 10cm steps in z for processing.
 - ✓ Field lines then rotated and translated to correct simulation coordinate system.
 - ✓ Field values checked at various locations to ensure correct usage.



B0 Field Map



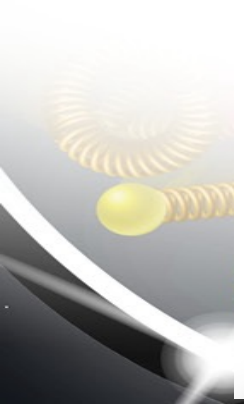
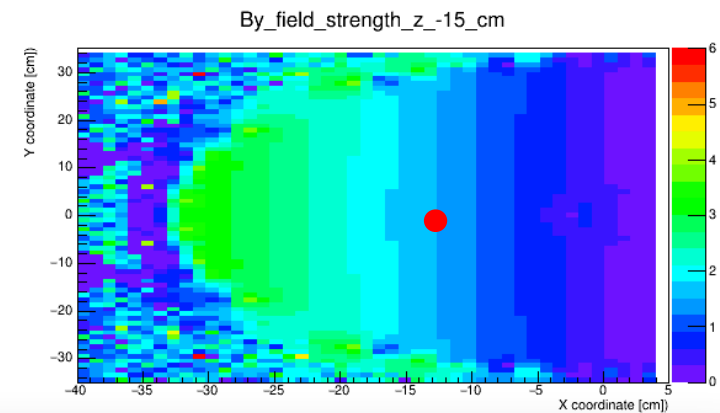
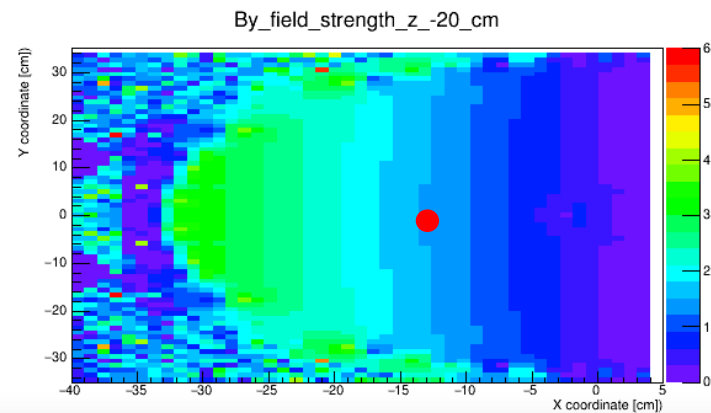
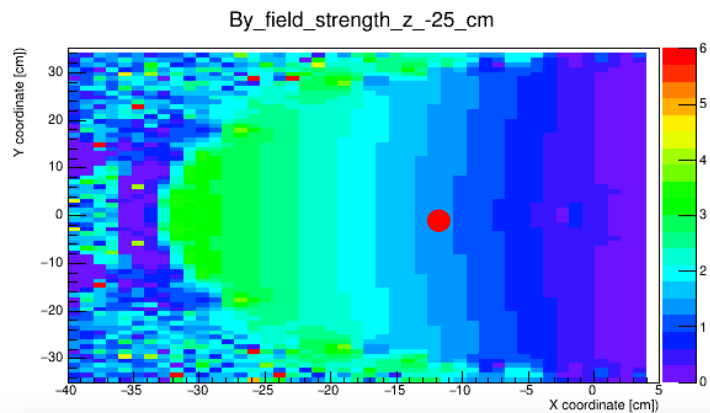
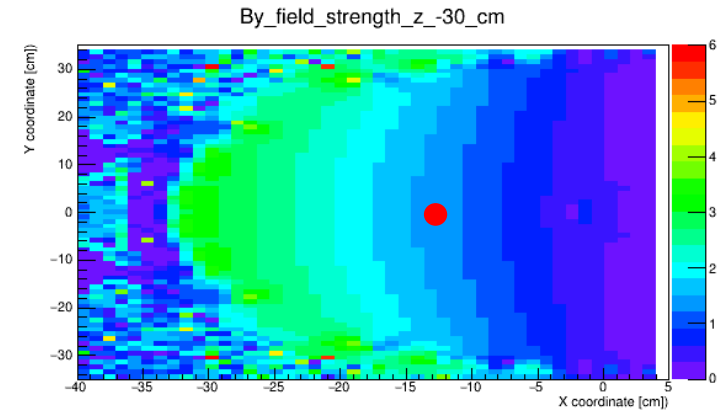
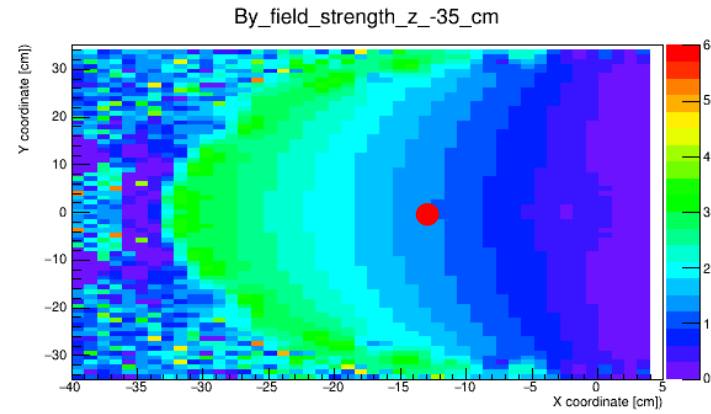
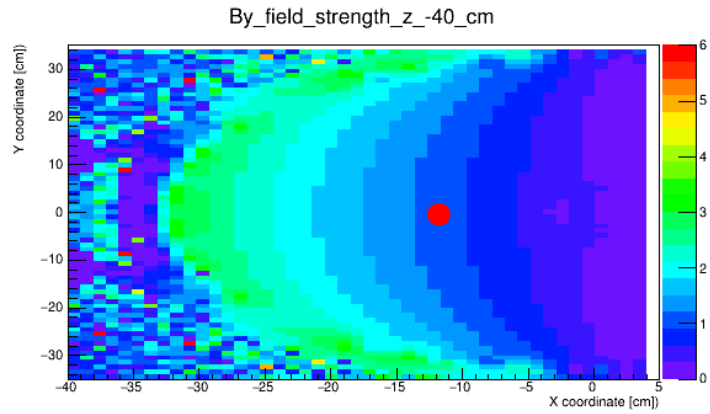
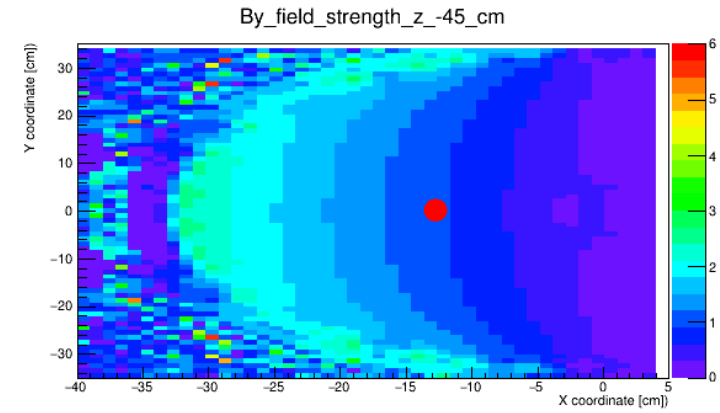
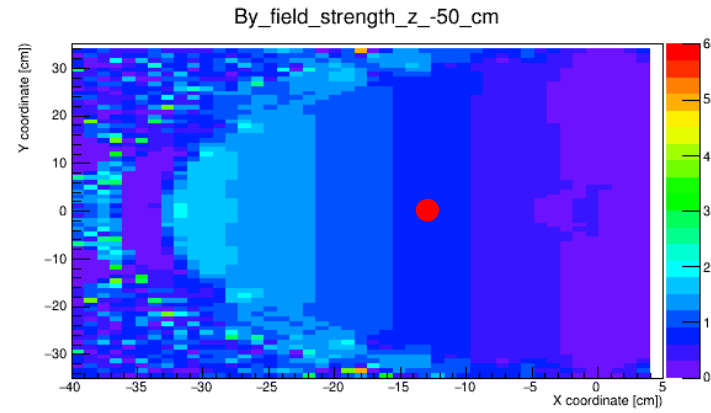
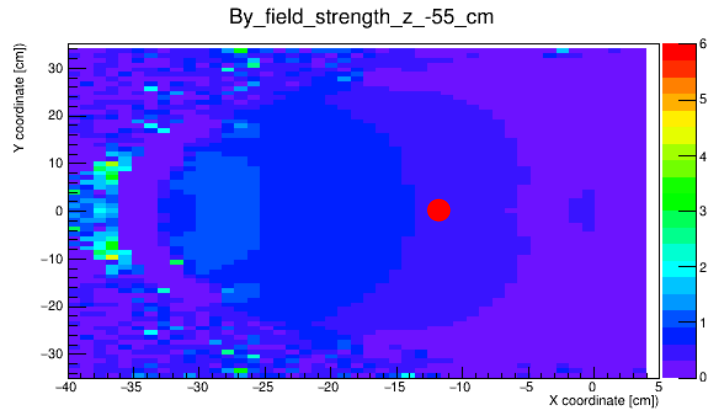
e-beam @ +34 mm and hadrons @ -126 mm
(neglecting 25 mrad angle) in this model

Z=0 is center of the magnet @ 6.4m

- X = -126 mm, y = 0 mm (before rotation and shift to fit along beamline).
 - By field strength along the hadron beam.
 - Gaussian field shape!

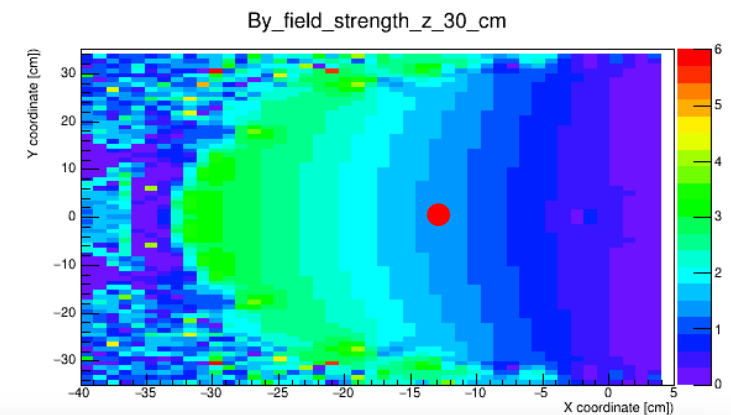
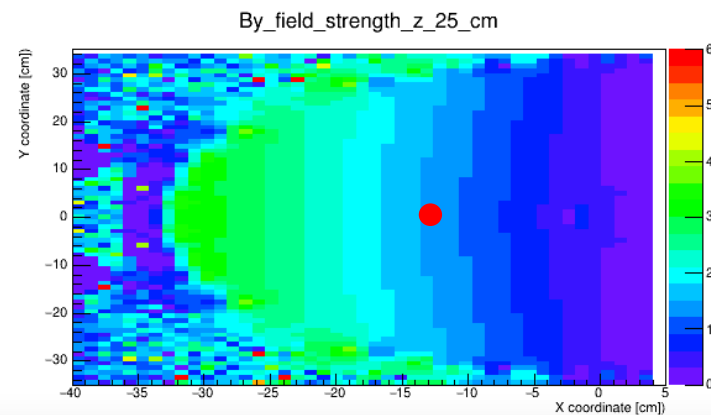
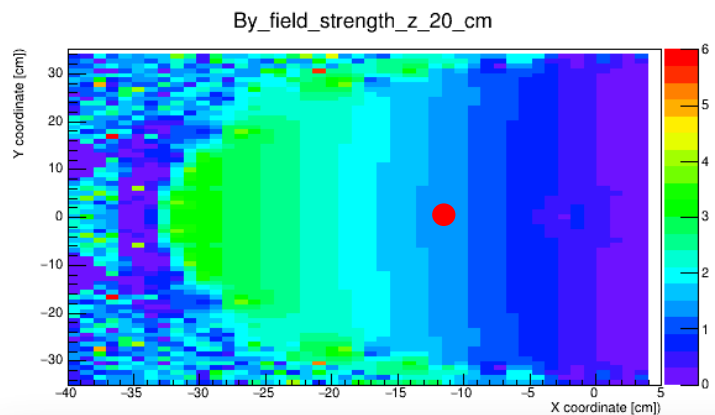
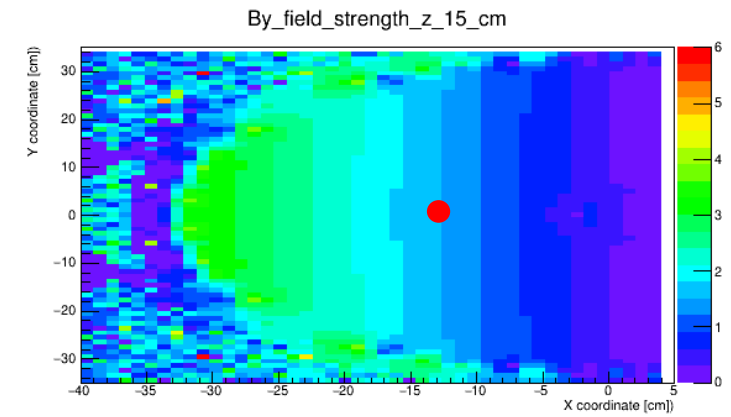
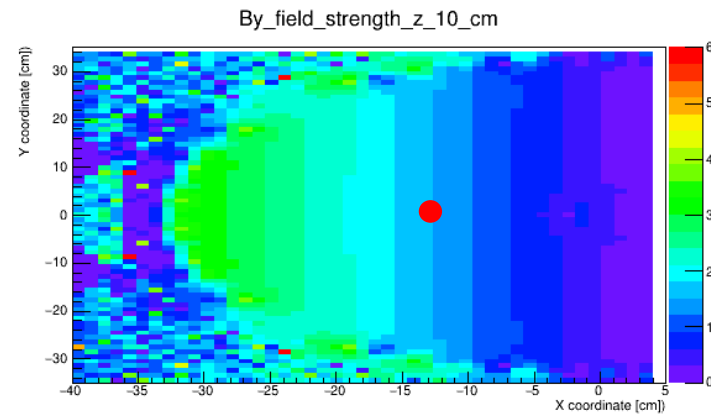
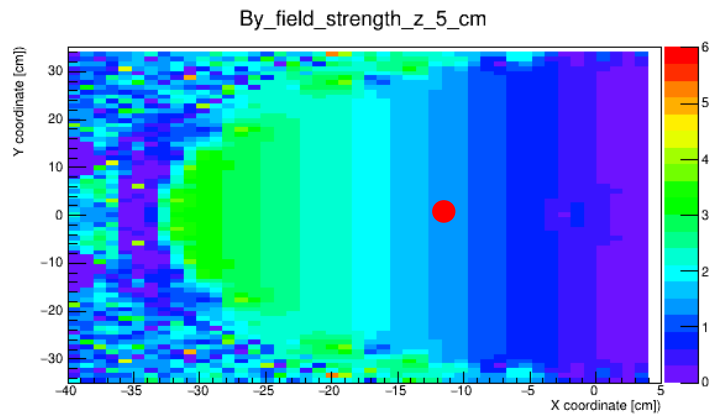
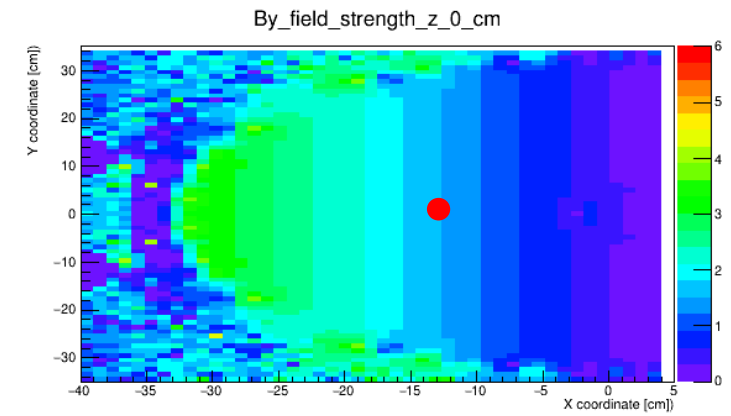
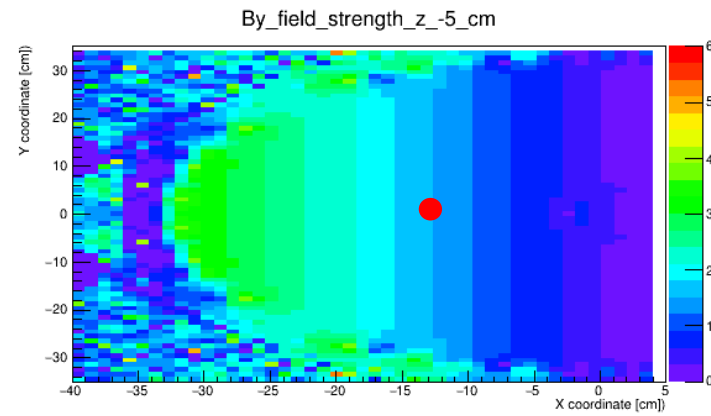
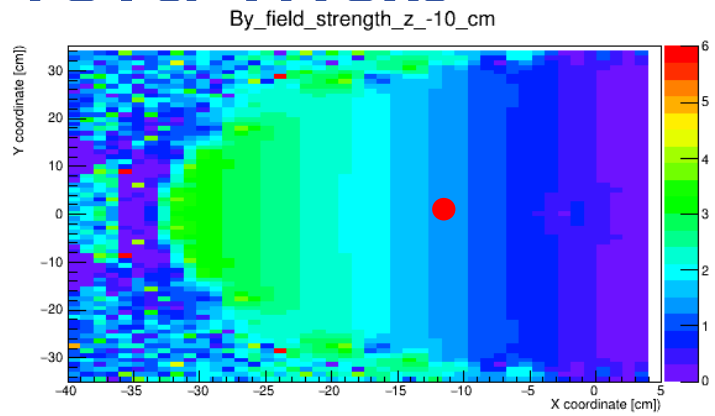
B0 Field Map

Left to right, top to bottom – increasing Z (IP to center of magnet)



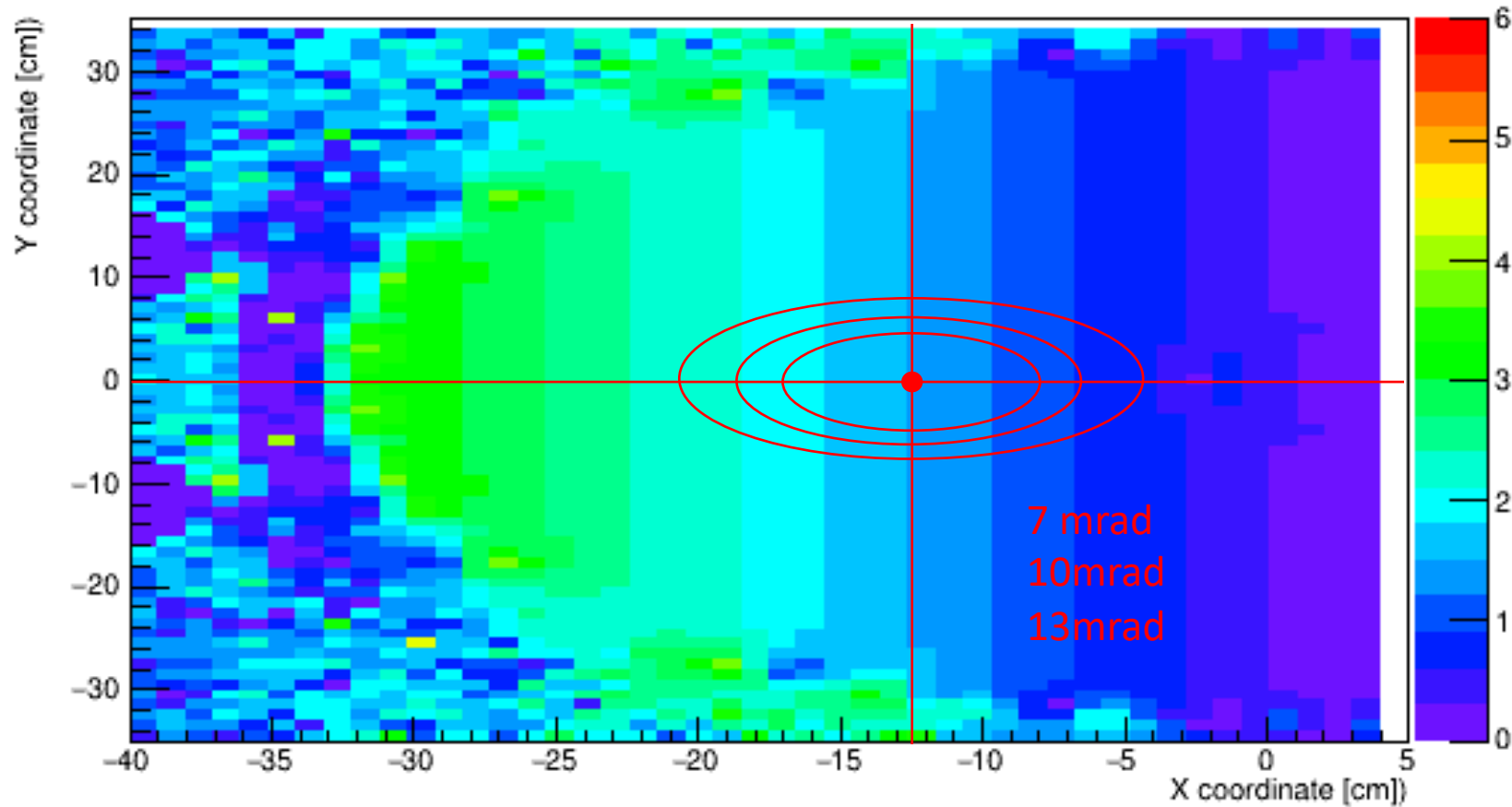
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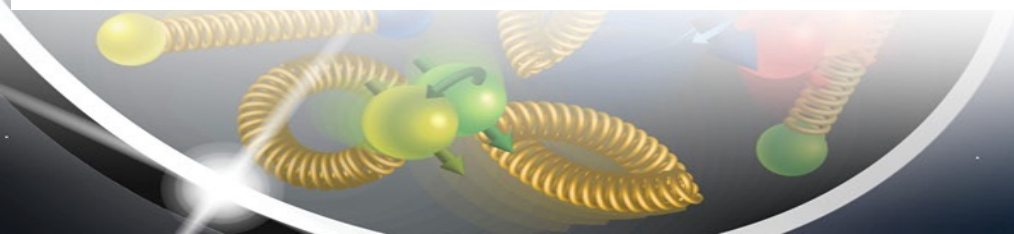


B0 Field Map

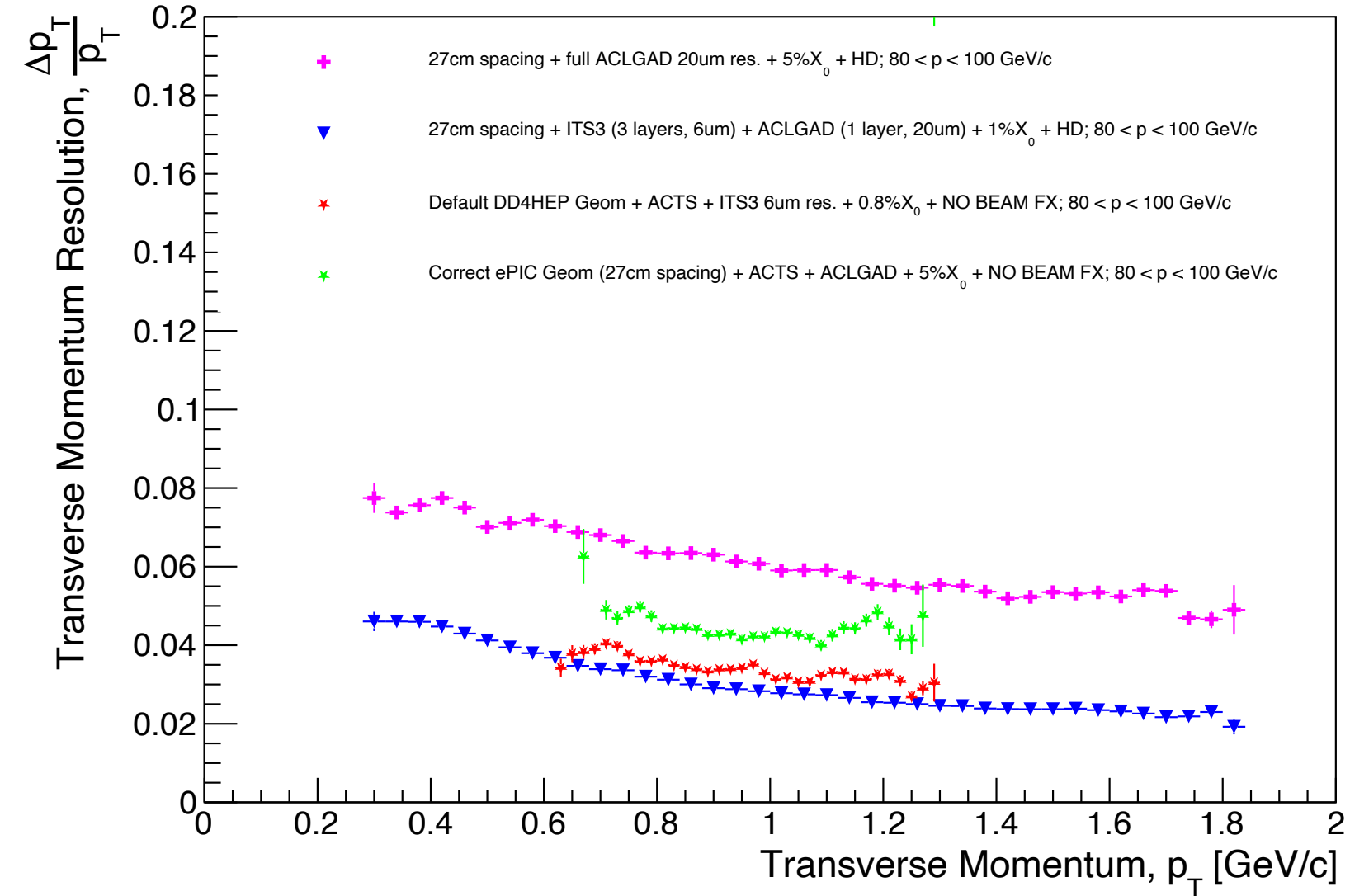
By_field_strength_z_0_cm Center of magnet



- Field seen by protons is pT/angle dependent – will add an additional smearing dependence on position within the magnetic field.

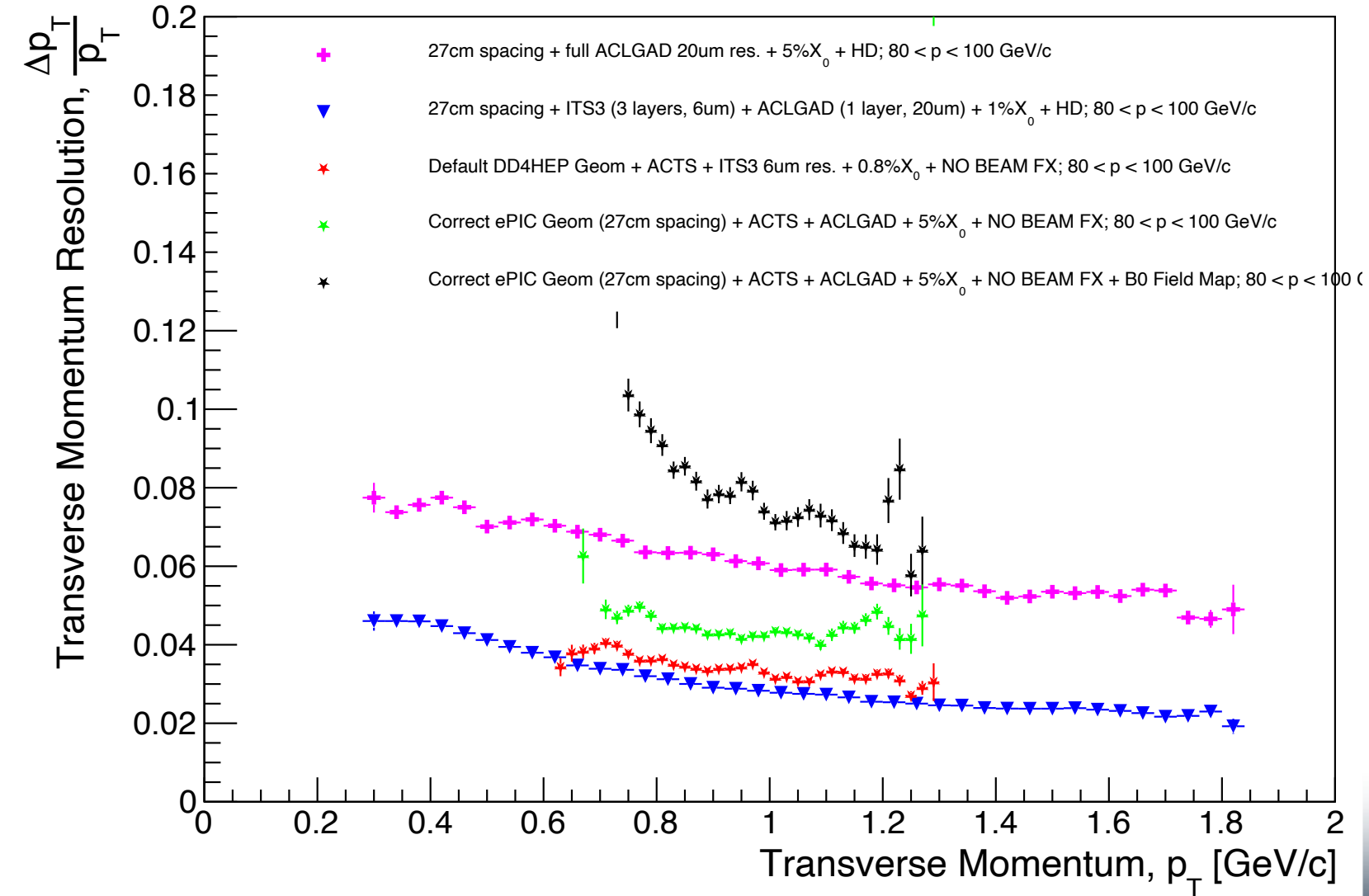


B0 Tracking - Performance



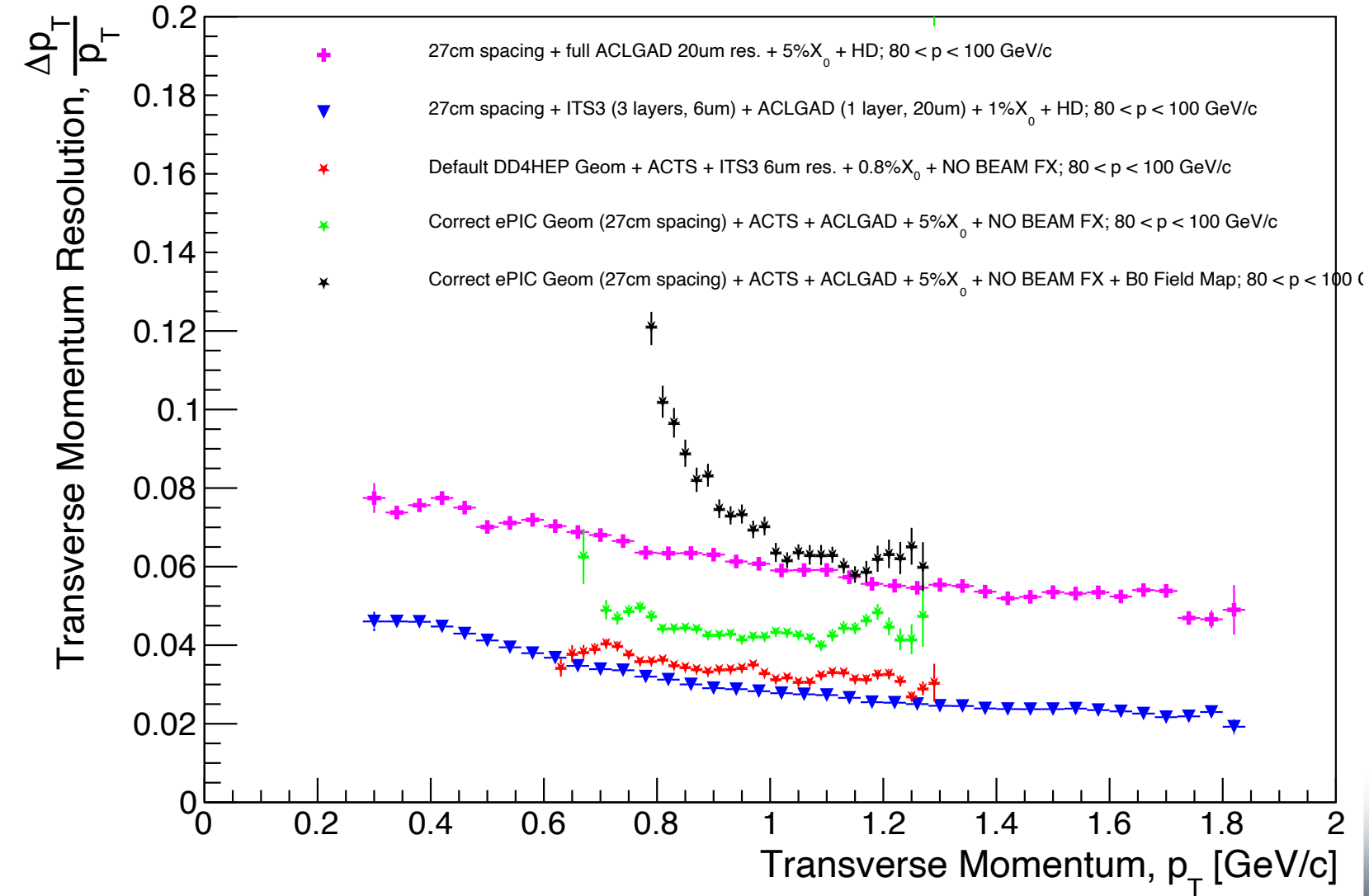
- All of these assume constant dipole + quadrupole field through entire 1.2m long magnet volume.
- **Green/Red** assume 6 to 13 mrad cone of 80 to 100 GeV protons.
 - Aiming at ~symmetric portion of acceptance, conservative case for the tracking performance (100 GeV protons are very rigid)

B0 Tracking - Performance



- Black: field map with nominal geometry (plane separation and central location).
- Assume 6 to 13 mrad cone of 80 to 100 GeV protons.

B0 Tracking - Performance



- Black: tracker shifted away from IP by 10cm.
- Assume 6 to 13 mrad cone of 80 to 100 GeV protons.

Conclusion

- Issues getting field map into simulations now solved.
 - Non-trivial, but things make sense now.
- Tracking performance appears to be okay.
 - Field strength depends on pT – adds extra smearing at lower pT.
 - Only showing performance for 80 to 100 GeV protons, performance \sim x1.5-2 better for lower energy protons from 41 GeV beams (where B0 is most-important).
- Room for detector folks to optimize layout of tracking layers (spacing, central location).
- Work to be done on ACTS tracking software for usage with field maps (likely some optimization can be achieved).

