EICUG 2nd Detector Working Group meeting
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An EIC 2nd Detector, Magnet Concepts and Constraints

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Detector Concepts: Start with the Magnet

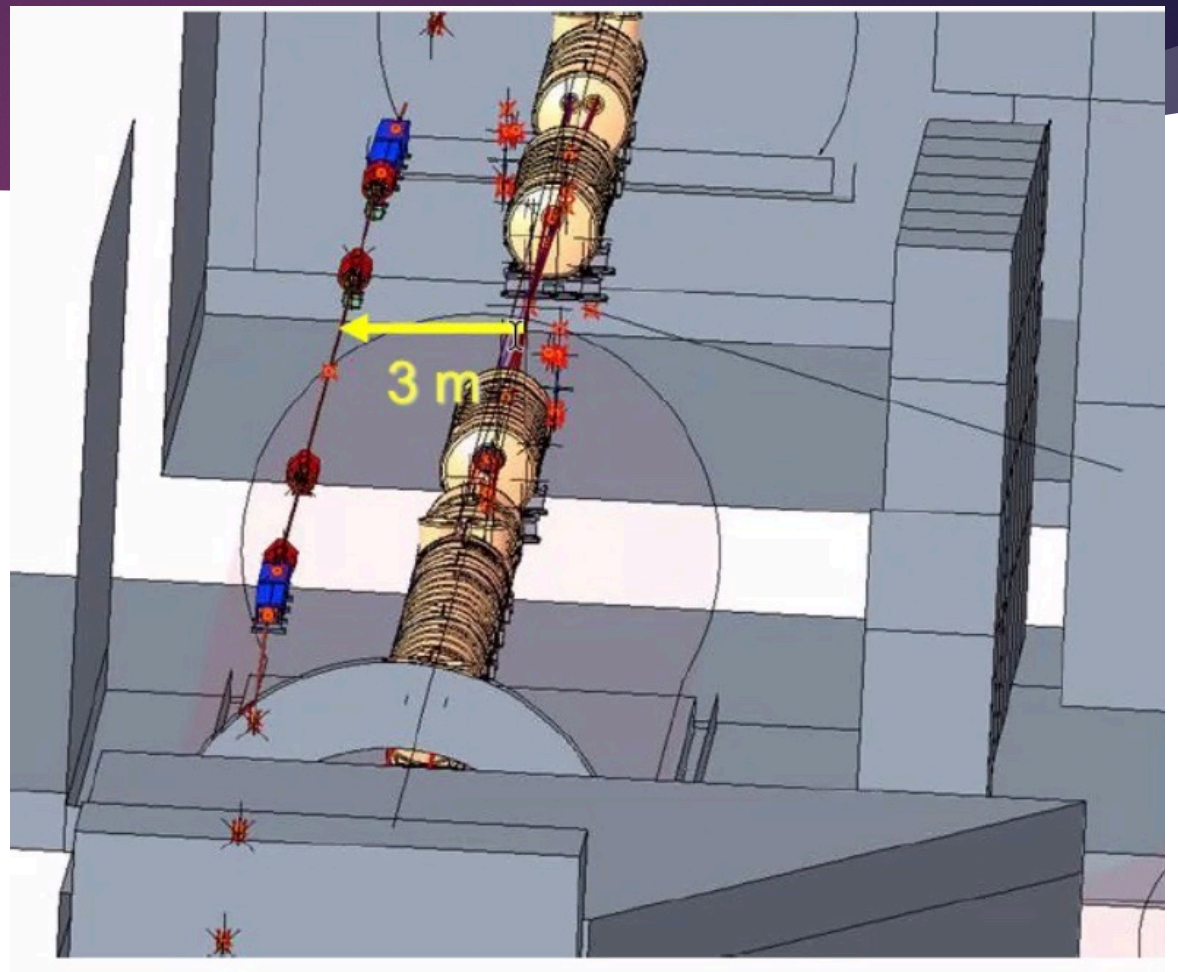
- Working Group Charge:
  - A General-Purpose Collider Detector
- Solenoid is still leading magnet contender
- Basic Decisions:
  - High Field (~3 Tesla) or Moderate Field (~1.7 Tesla)
  - Large bore (~3 m diam) or small bore (~2 m diam)
  - Length of Coil

Interaction Region 8

- Detector Space
  - ± 4.5 m Longitudinal
  - 3.0 m radial: constraint of Rapid Cycling Synchrotron (RCS)

IP-8 Detector Region

- Electron and Ion crossing beams at IP-8
- RCS 3 m transverse from IP
  - Field must be < 5 Gauss
- Longitudinal space for detector is ± 4.5 m



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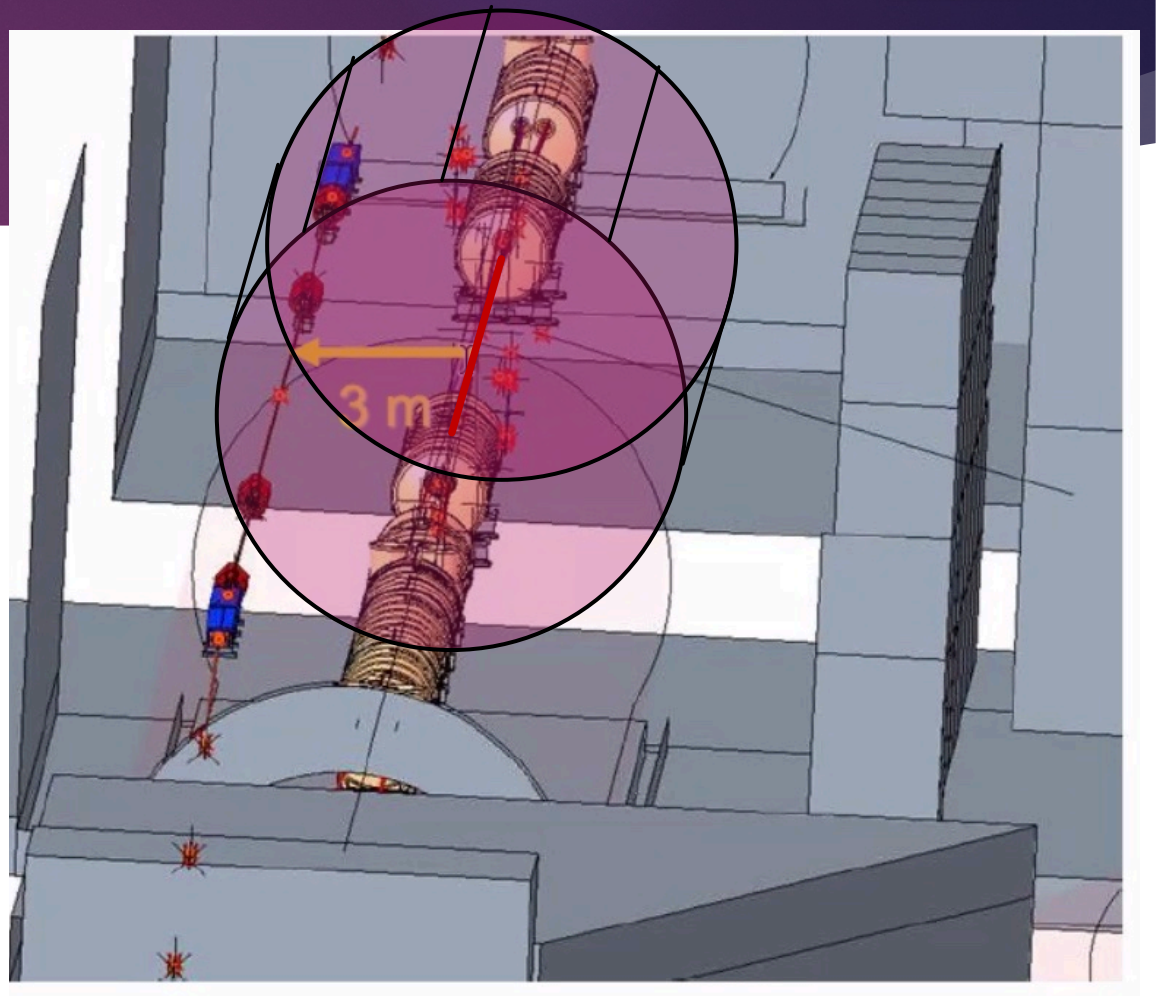


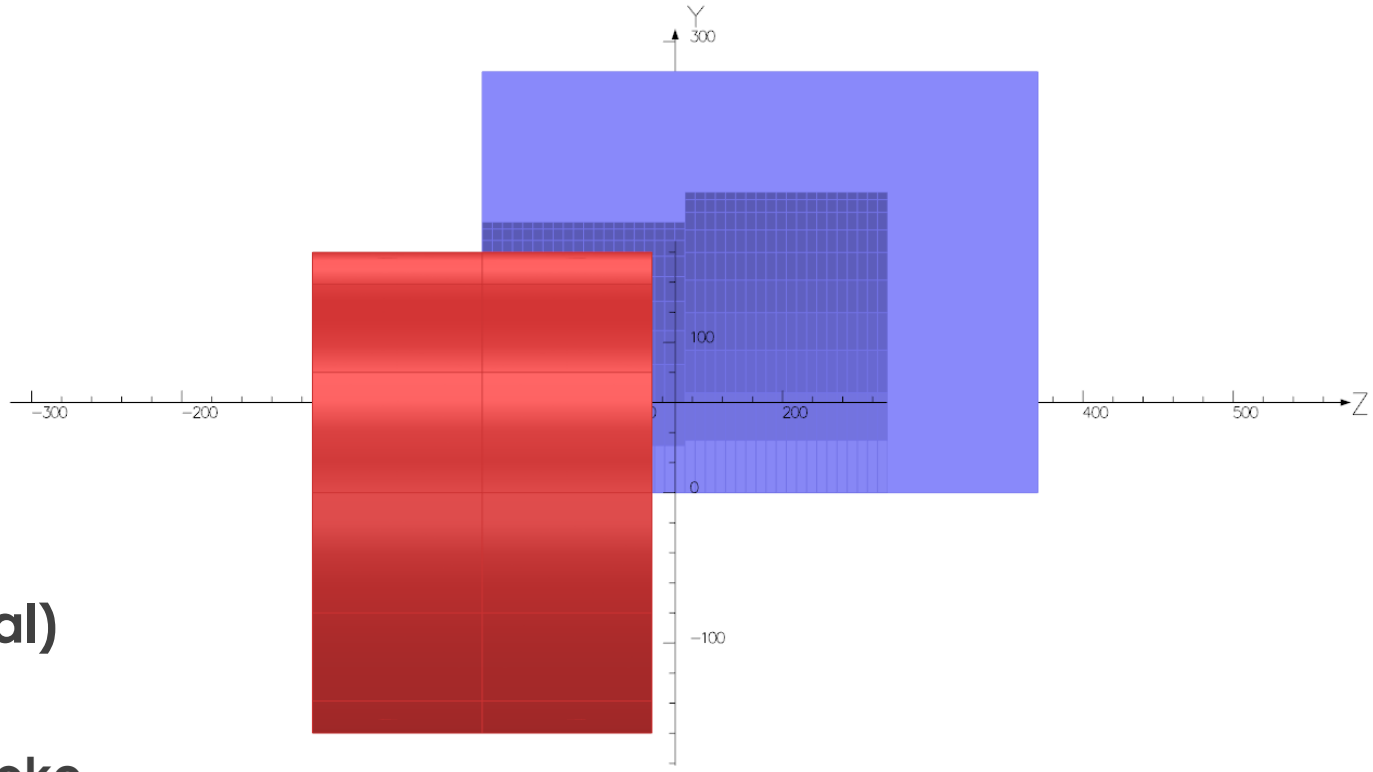
Three Magnet Concepts

- Large-Bore, High Field
- Large-Bore, Moderate Field
- Small-Bore, High Field

Each has consequences for the detector design

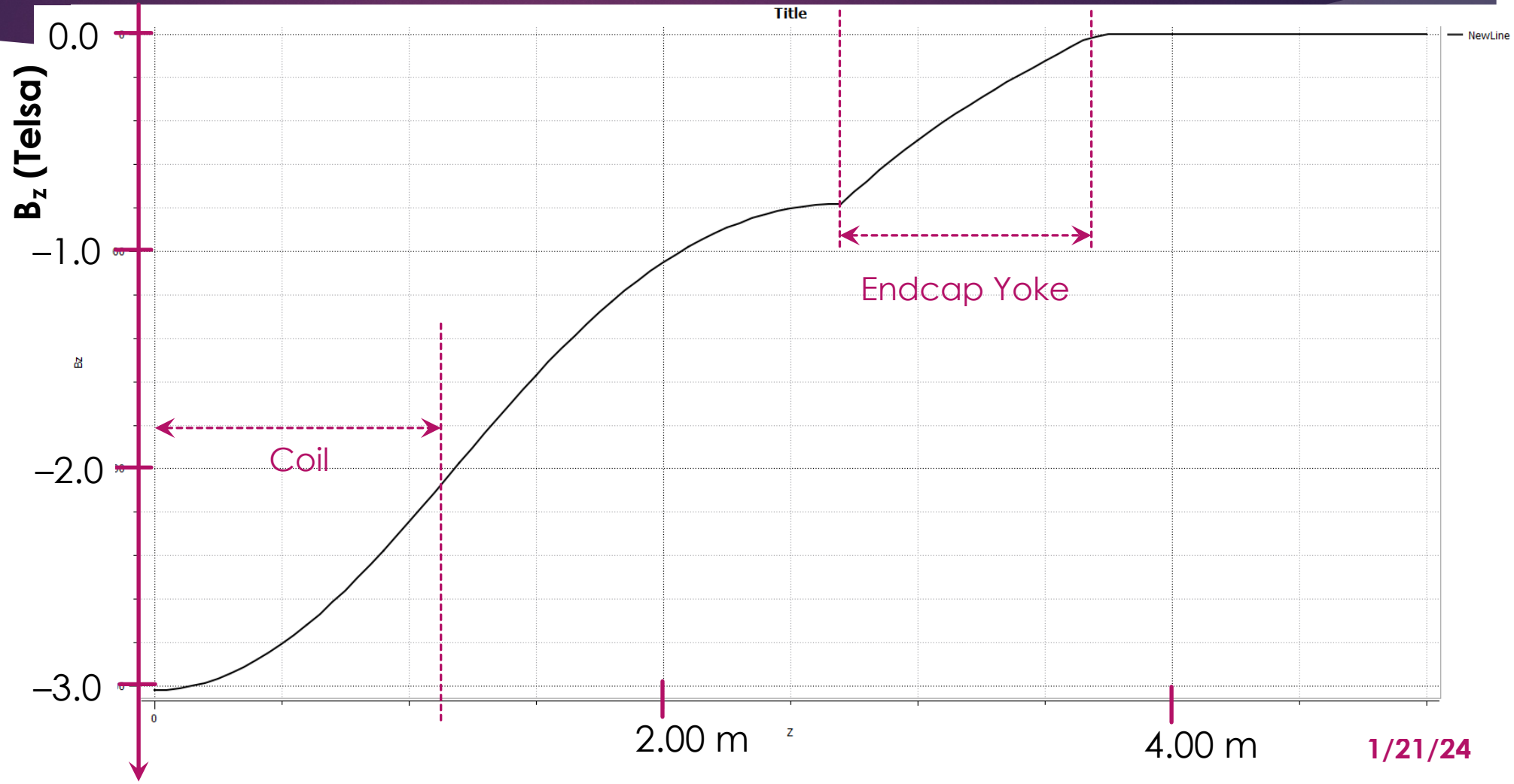
I. Large-Bore, High-Field

- Paul Brindza modification of "Marco" magnet of ePIC
- Coil Inner Radius 147 cm
- Coil Length ±113 cm
- Yoke length ± 370 cm
- Yoke Outer radius 280 cm
- **Central yoke must be 1 m (radial) 100% Fe to contain strong field**
  - **No Instrumentation possible in yoke barrel (~~muons~~, ~~HCal~~)**



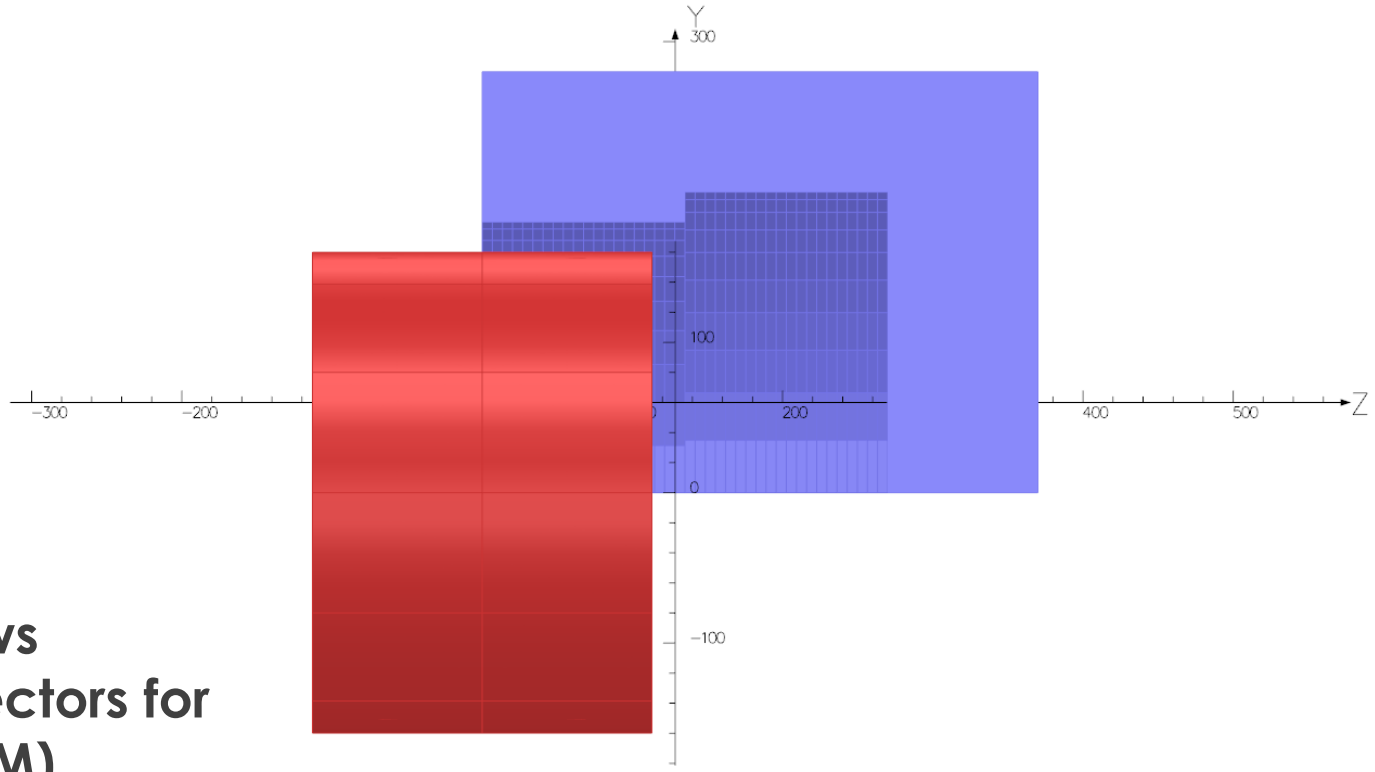
I. Large-Bore, High-Field

- Axial Field on axis



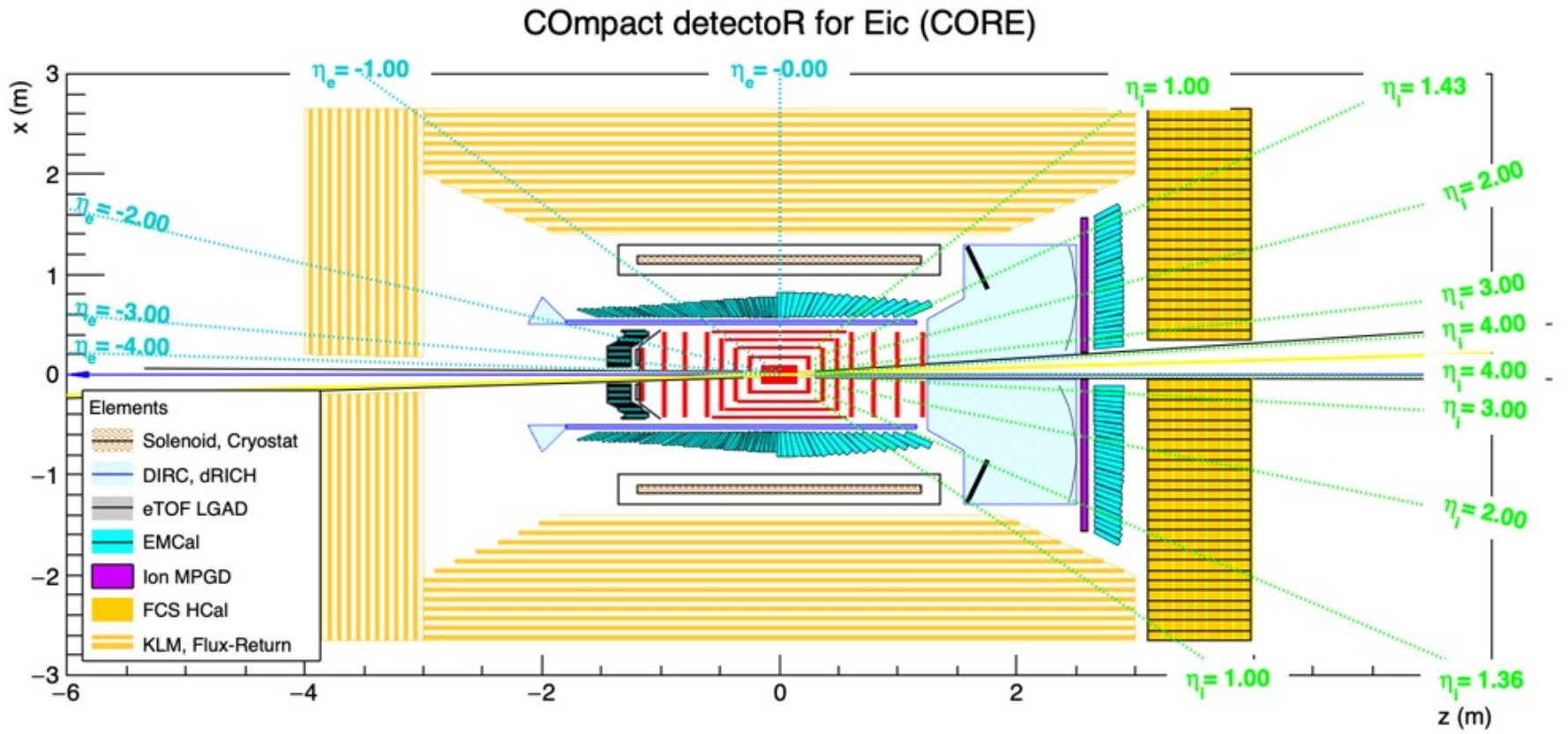
II. Large-Bore, Moderate-Field

- Same as previous
- Coil Inner Radius 147 cm
- Coil Length ±113 cm
- Yoke length ± 370 cm
- Yoke Outer radius 280 cm
- **Central Field of ~1.7 Tesla allows central yoke ~60%Fe 40% detectors for HCal or BELLE-II style Muon (KLM)**
  Entirely contained in 3 m radius to RCS



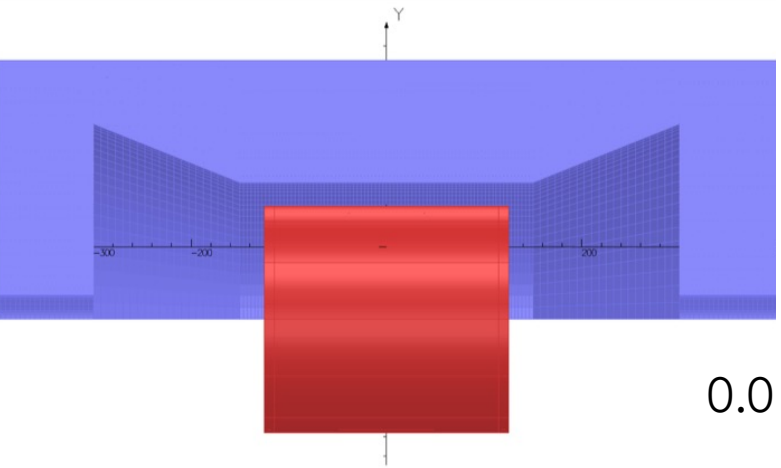
III. Small-Bore, High-Field

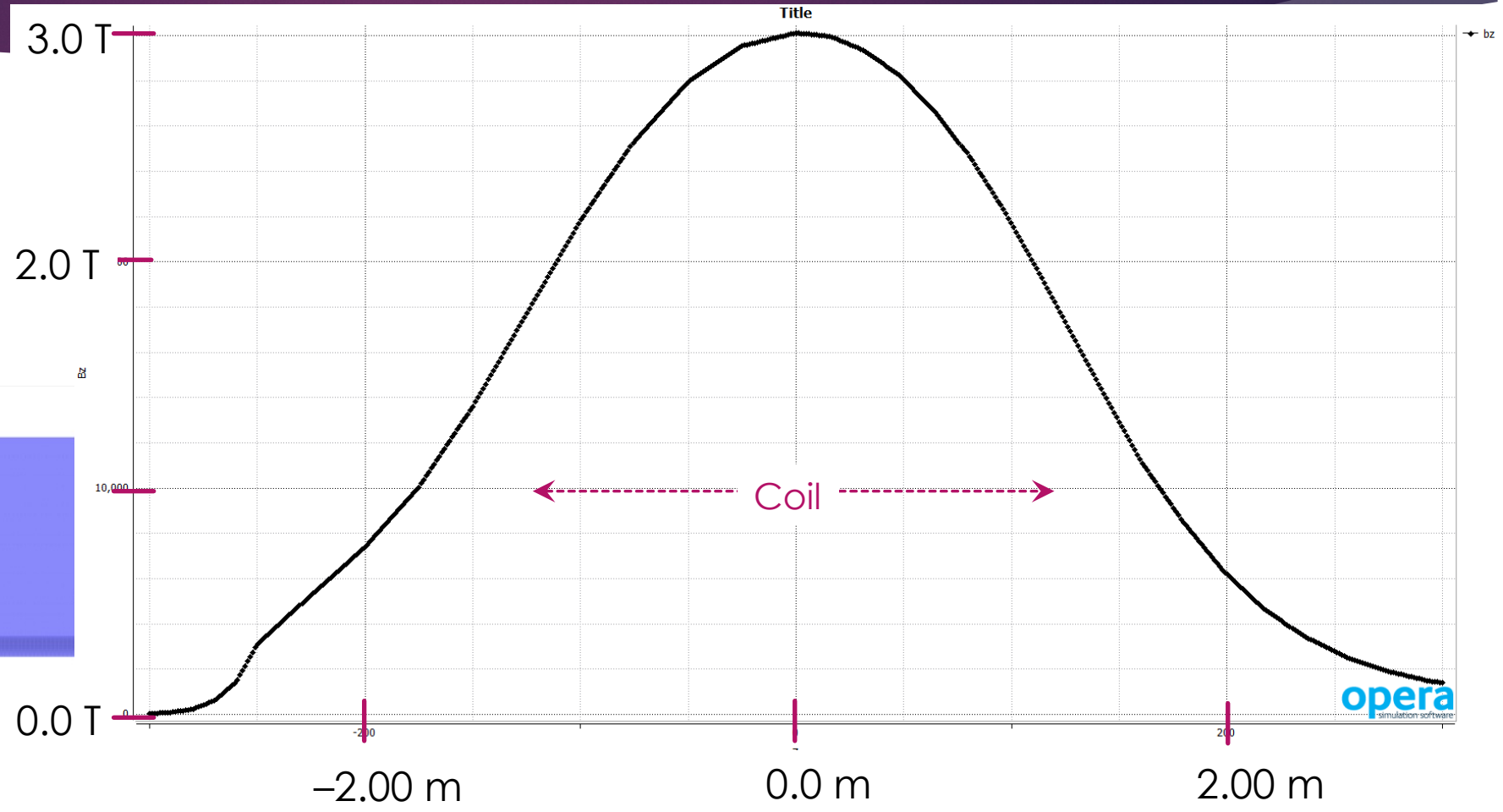
- CORE design (P.Brindza)
- Inner radius 100 cm, dimensions ~PANDA
- Yoke 60% Fe (by volume) compatible with ~3 T field and RCS
  - Symmetric yoke with asymmetric detector
- Scalable by ~120% and still consistent with IR-8, RCS and 3 Tesla constraints



CORE field, B_z on-axis

- Central Field 3 T





Discussion Points

- I suggest these three options are essentially the only currently viable magnet options
- Discussion should address the importance of different trade-offs
  - Large-Bore High-Field,
    - Improved tracking, space for multiple detector systems
    - No barrel calorimetry or muon ID outside coil
  - Large-Bore, Moderate-Field
    - very similar to ePIC in basic layout, Similar tracking performance to ePIC
    - options for Barrel-yoke instrumentation
  - Moderate-Bore, High-Field
    - Improved Tracking, Barrel-yoke instrumentation (e.g. KLM)
    - Geometry more constrained, CORE shows it is possible