Partial Return Yoke

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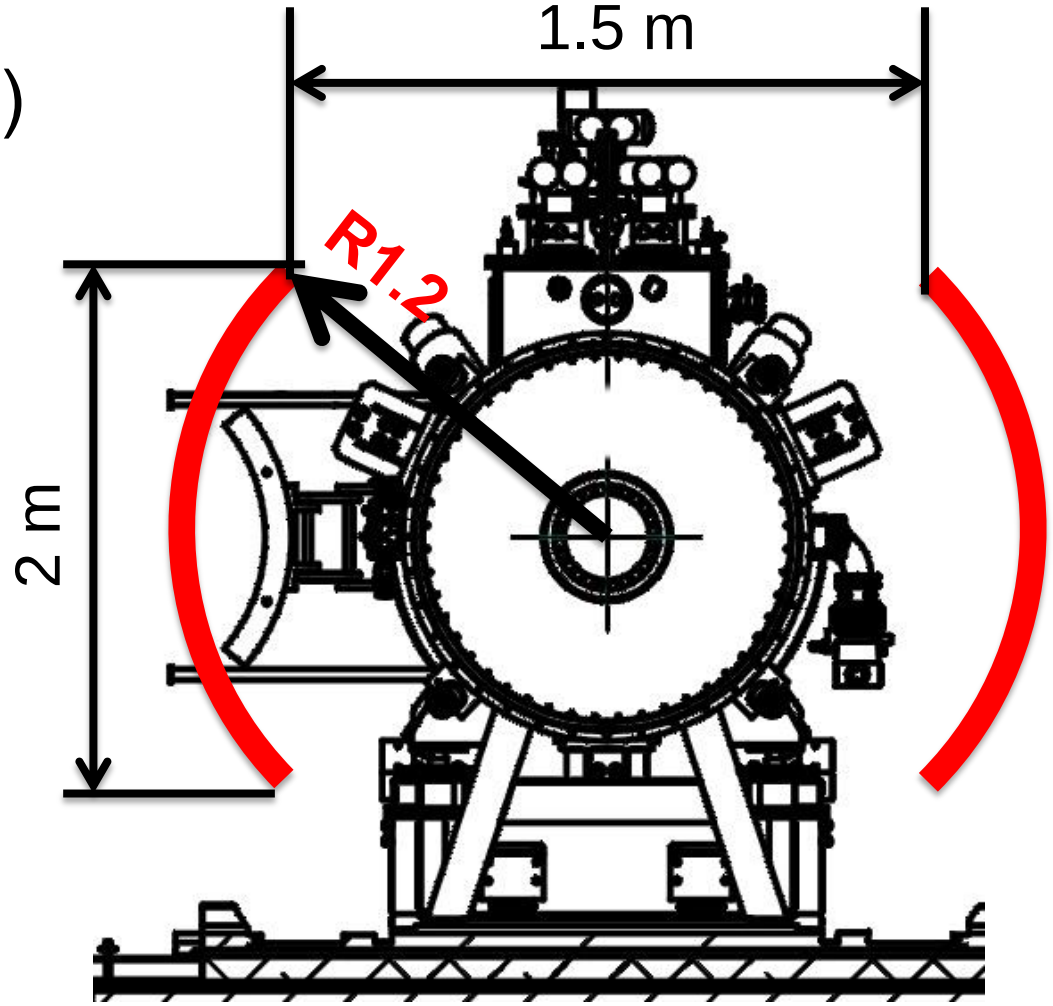
Outline

- Introduction and Concept
- Performance
- Engineering
- Extension to Step VI

Concept

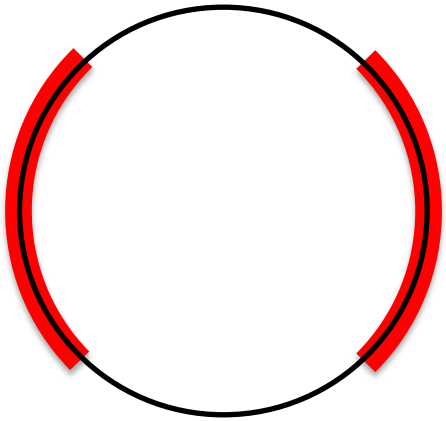
- Partial Return Yoke (a.k.a. “shield”, “yoke”)
- Concept presented at MICE CM 2012
- Initial Geometry
  - Tube of radius 1.2 m
  - wall thickness 10 cm
  - azimuthally -50..50°
  - weight: 30t



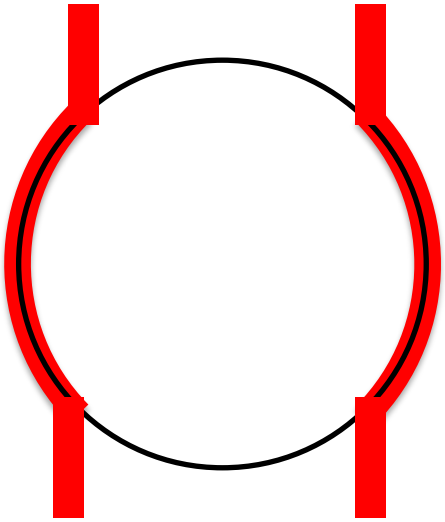
H Witte. Step IV & VI: Local Flux Return. MICE CM 34, October 2012.

(Note: not to scale)

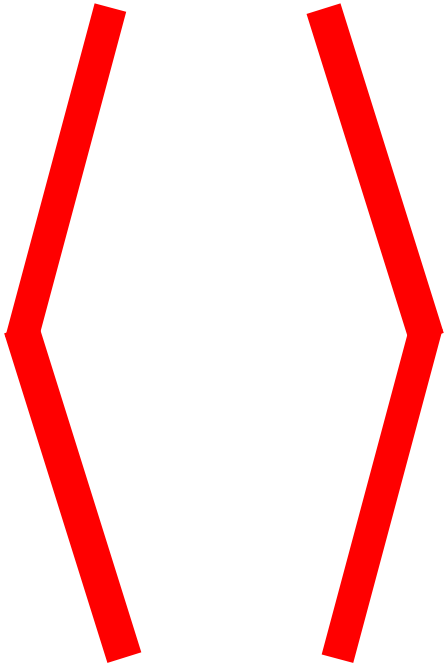
Geometric Variations



Initial Design



Vertical Extensions +
New Virostek Plates



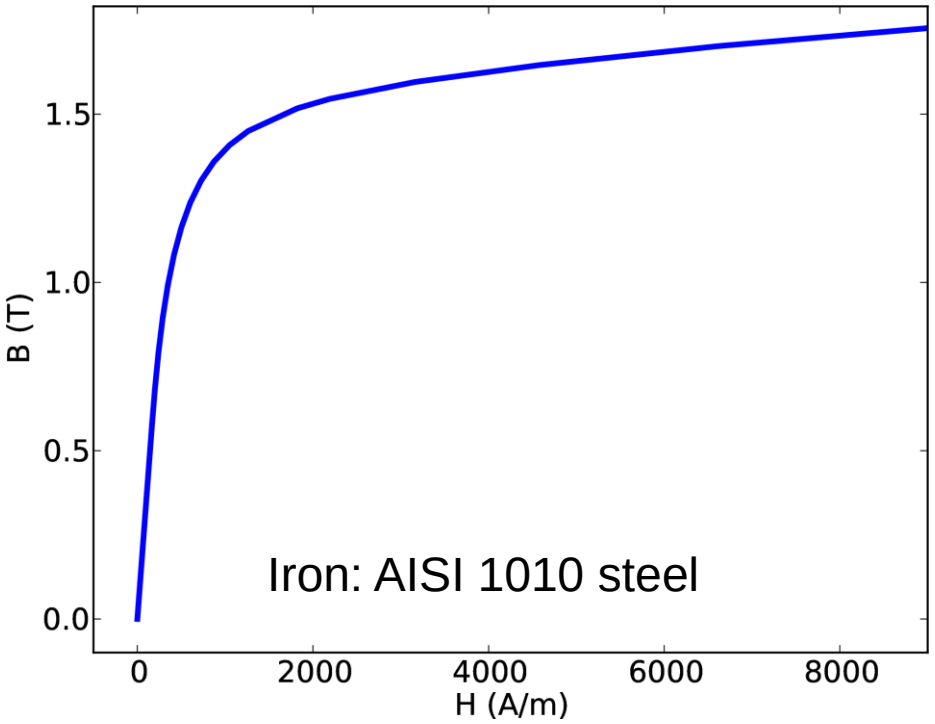
Present Design
Engineering driven

Simulation Details

- How certain are we of the results?
  - Simple concept
  - Key simulations done with two FEA codes
- Opera from VectorFields/Cobham
  - Solves for scalar potential

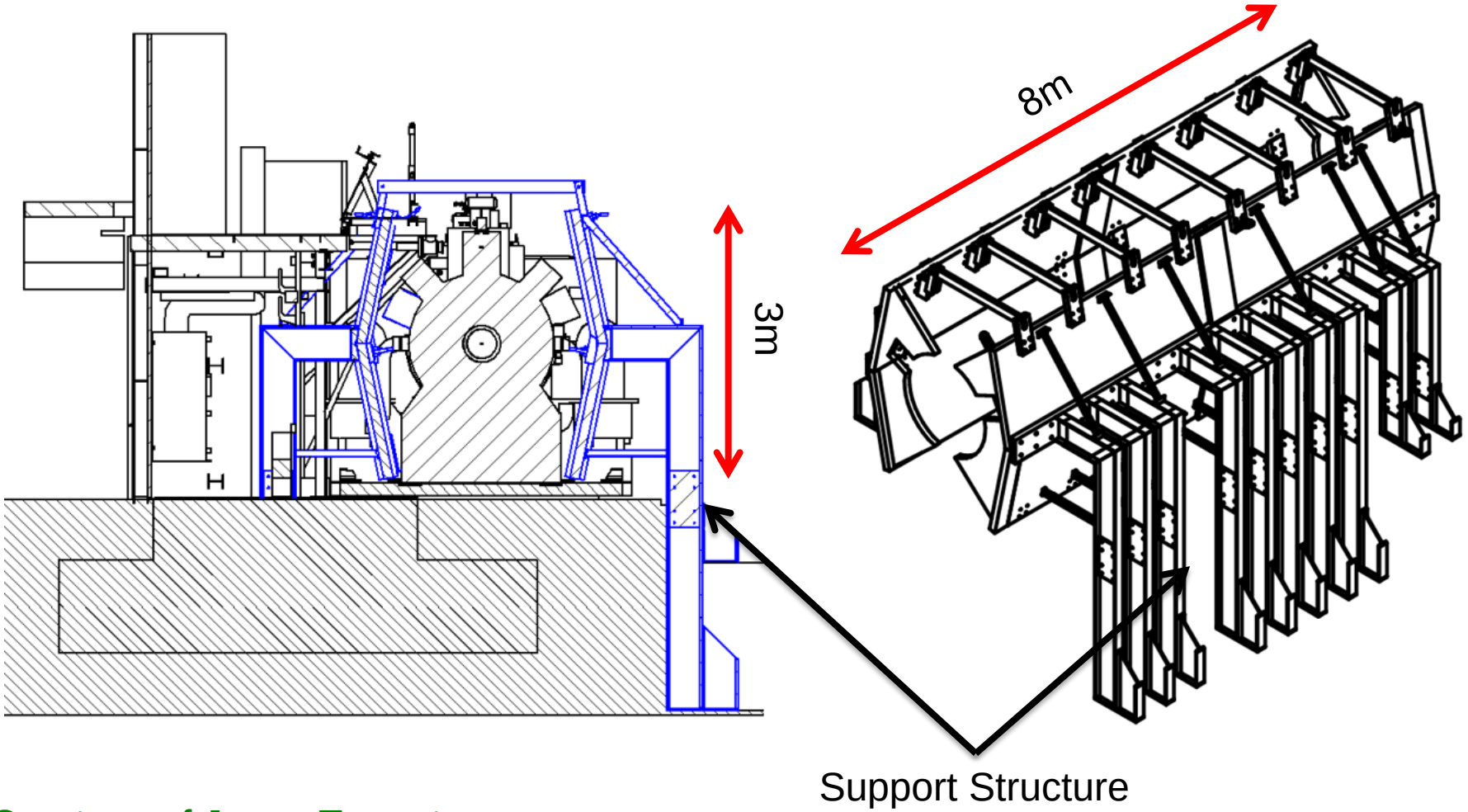
$$\nabla\mu\nabla\phi - \nabla\mu\left(\int_{\Omega_J}\frac{J\times R}{|R^3|}d\Omega_J\right) = 0$$

- Comsol Multiphysics
  - Solves for vector potential $\nabla\times(\mu^{-1}\nabla\times A) = J$



H Witte. Software Model Verification, 14 November 2012, Magnetic shielding meeting.

Partial Return Yoke



Courtesy of Jason Tarrant

Performance

Iso-Surface 0.5 mT

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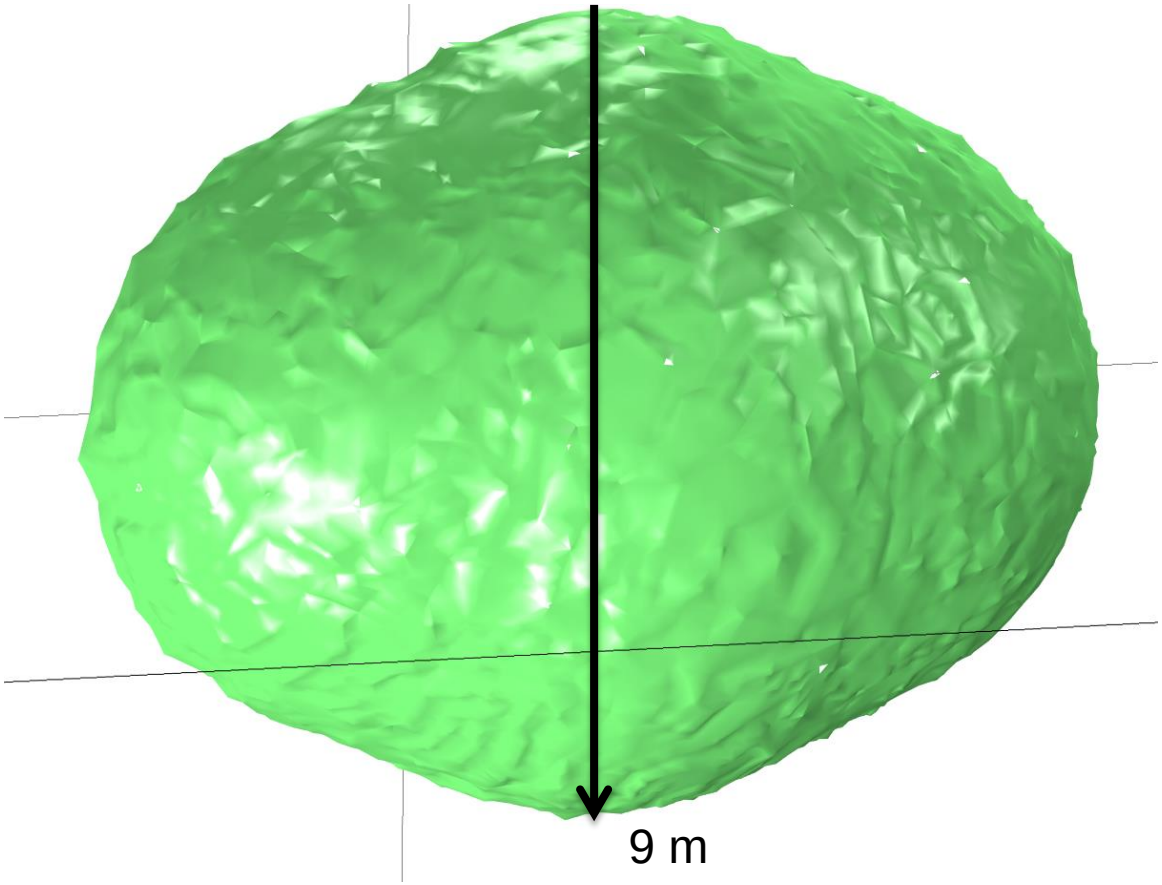
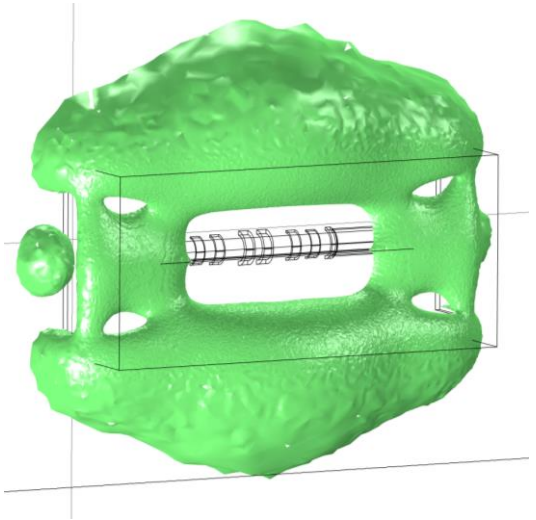
No Shield

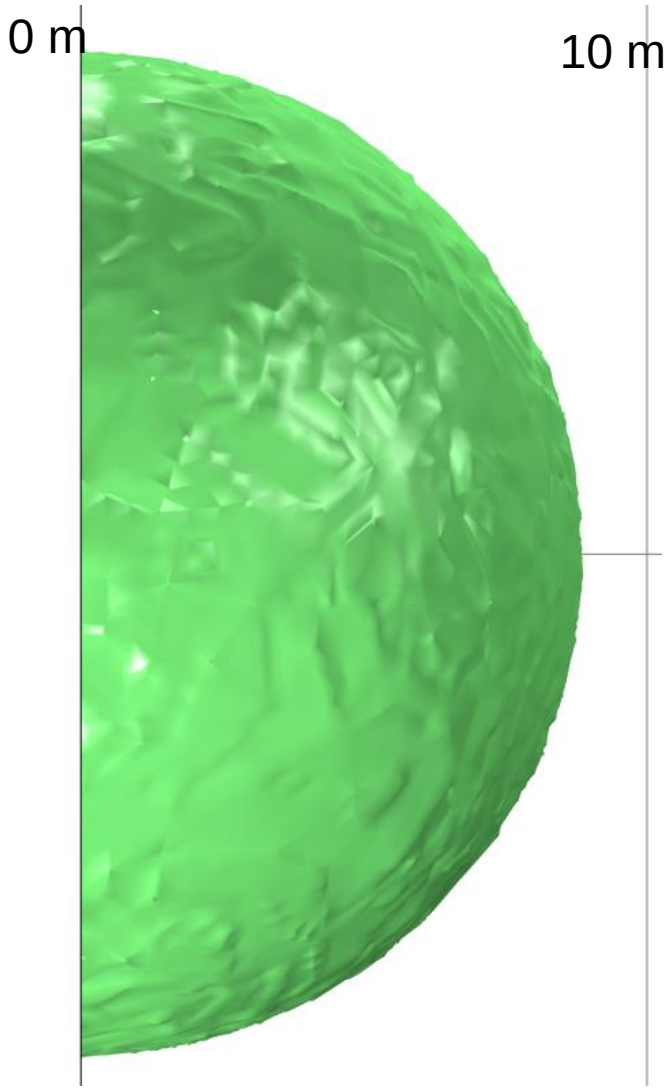


12 cm Shield



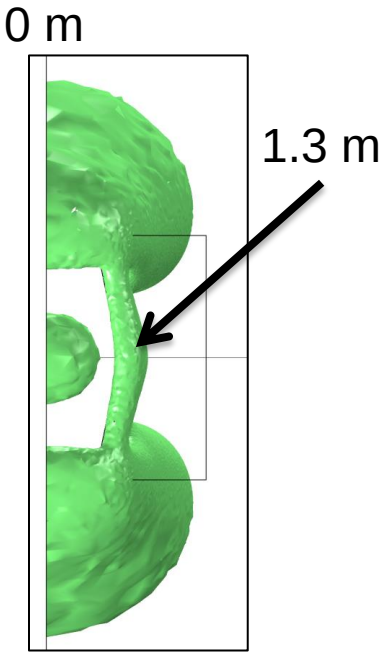
Step IV
200 MeV Flip

Frontal View – 240 MeV Solenoid



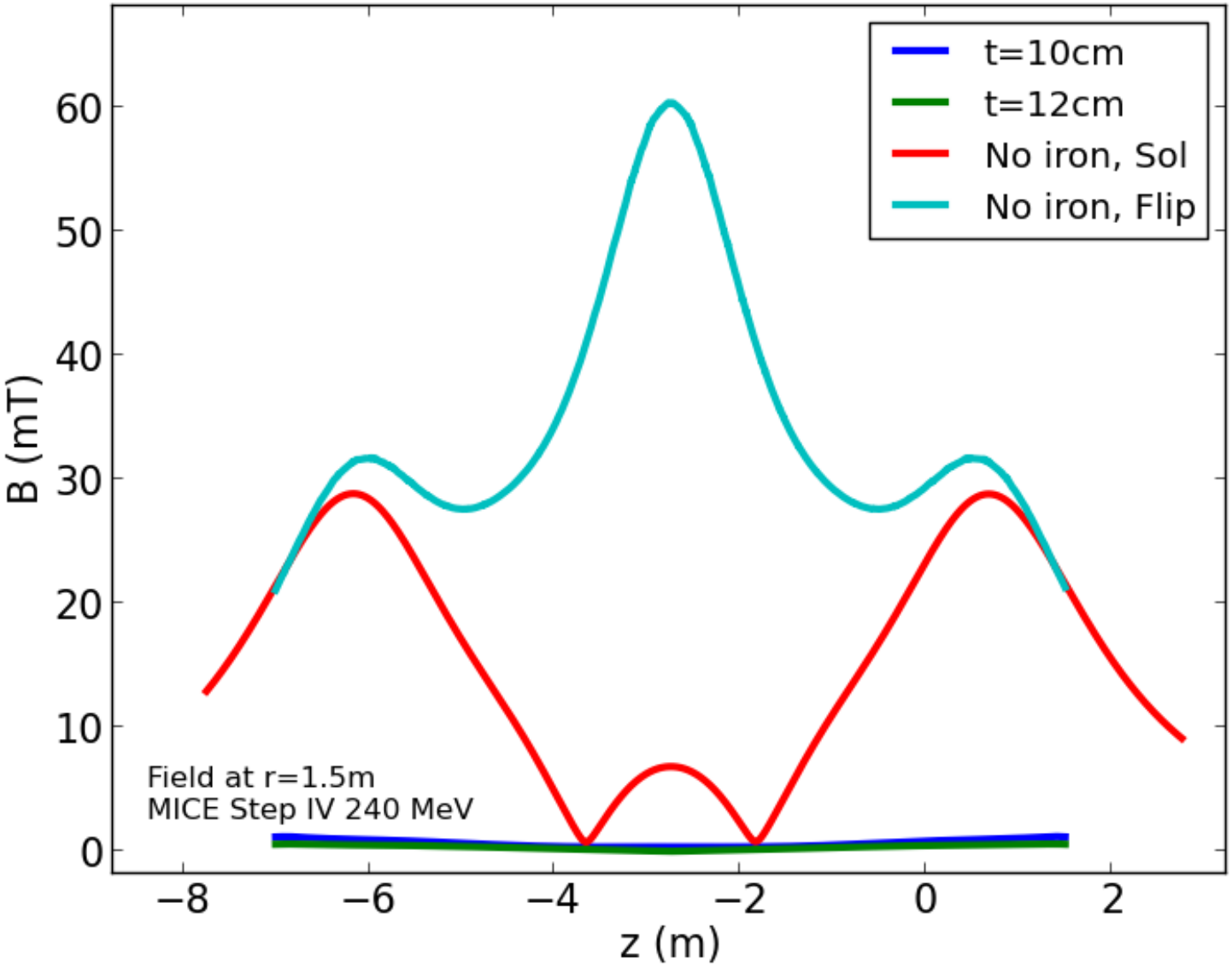
No Shield

All 5 Gauss



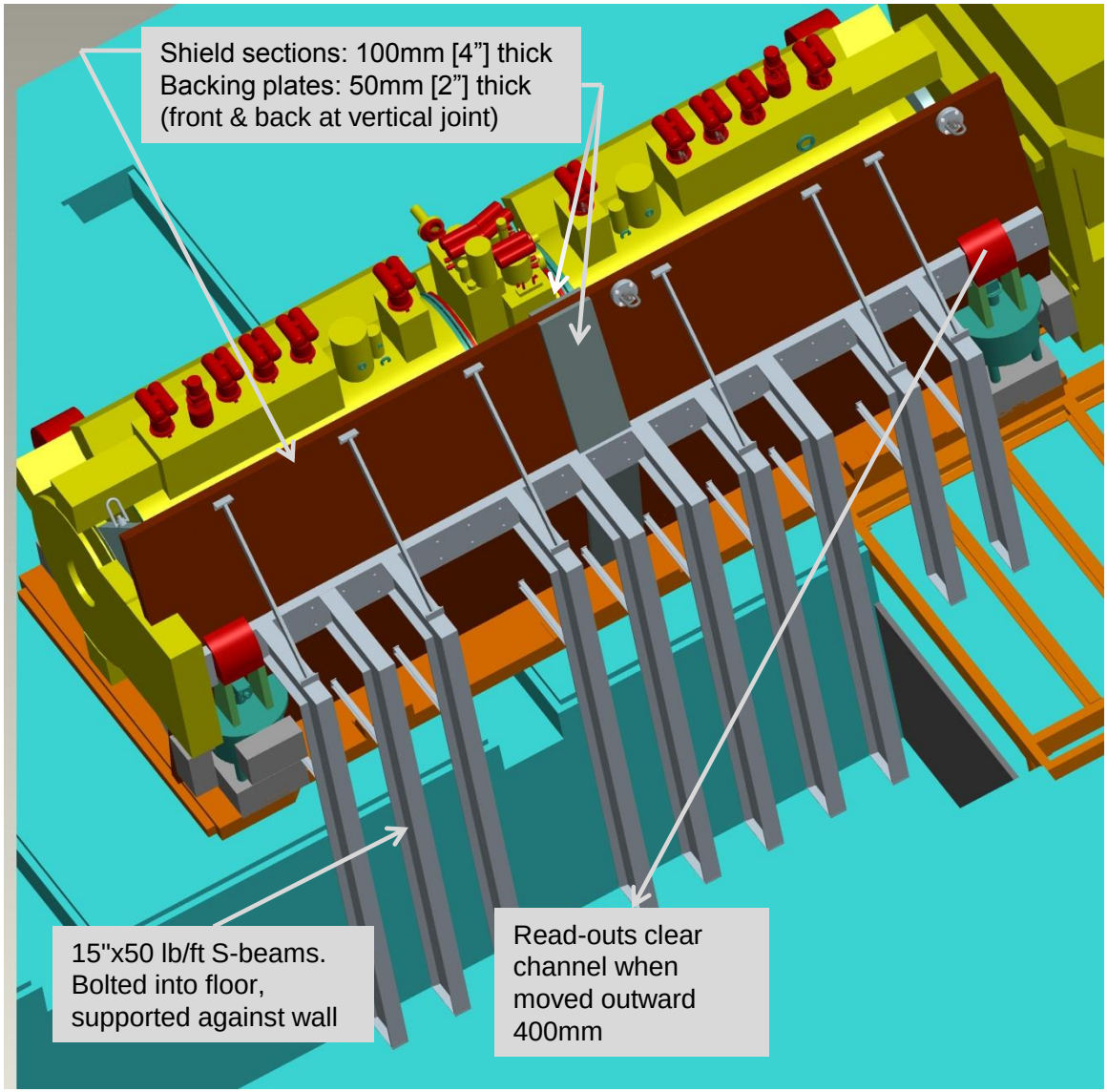
12 cm Shield

240 MeV Solenoid/Flip mode



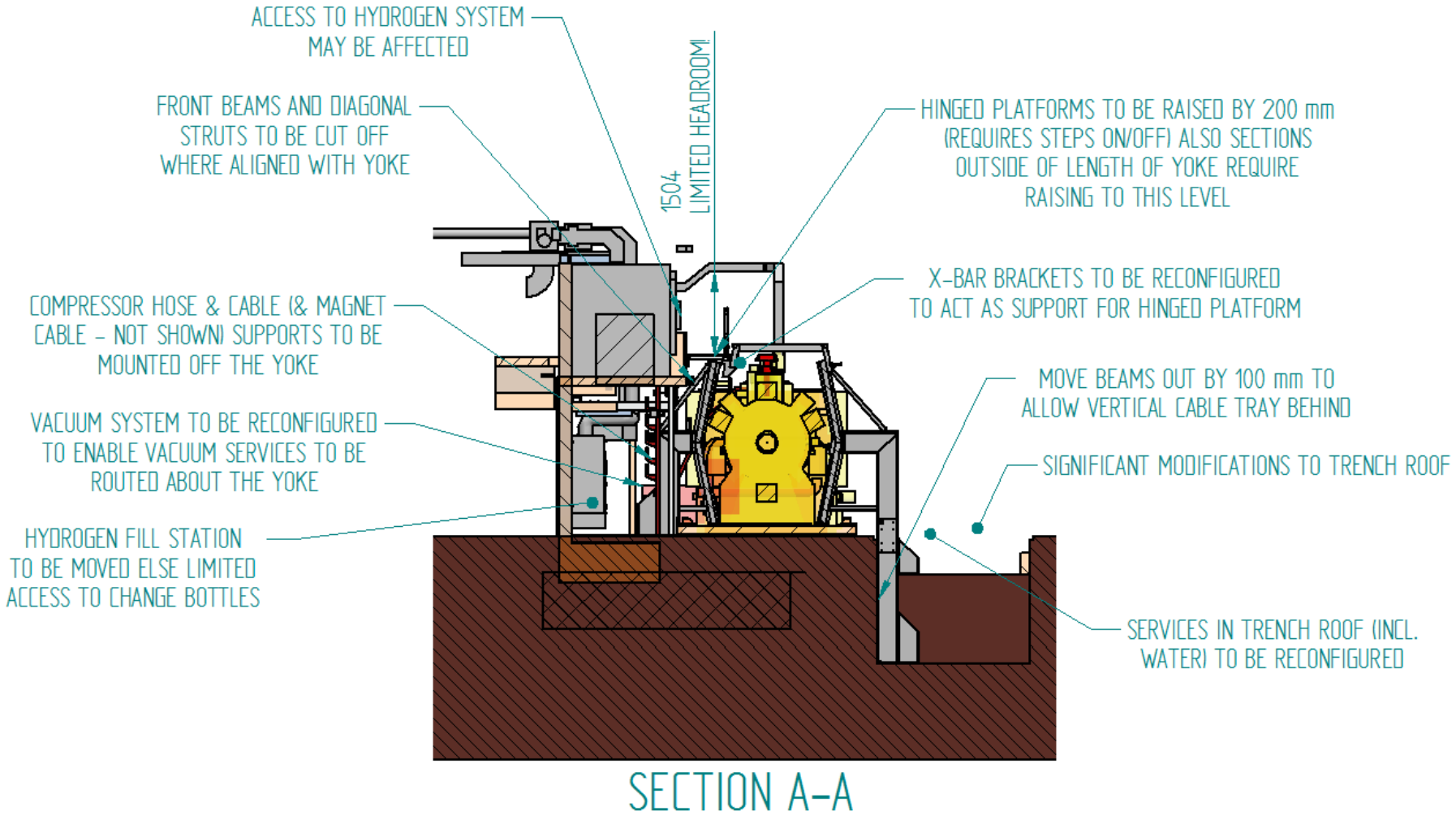
Engineering

Engineering



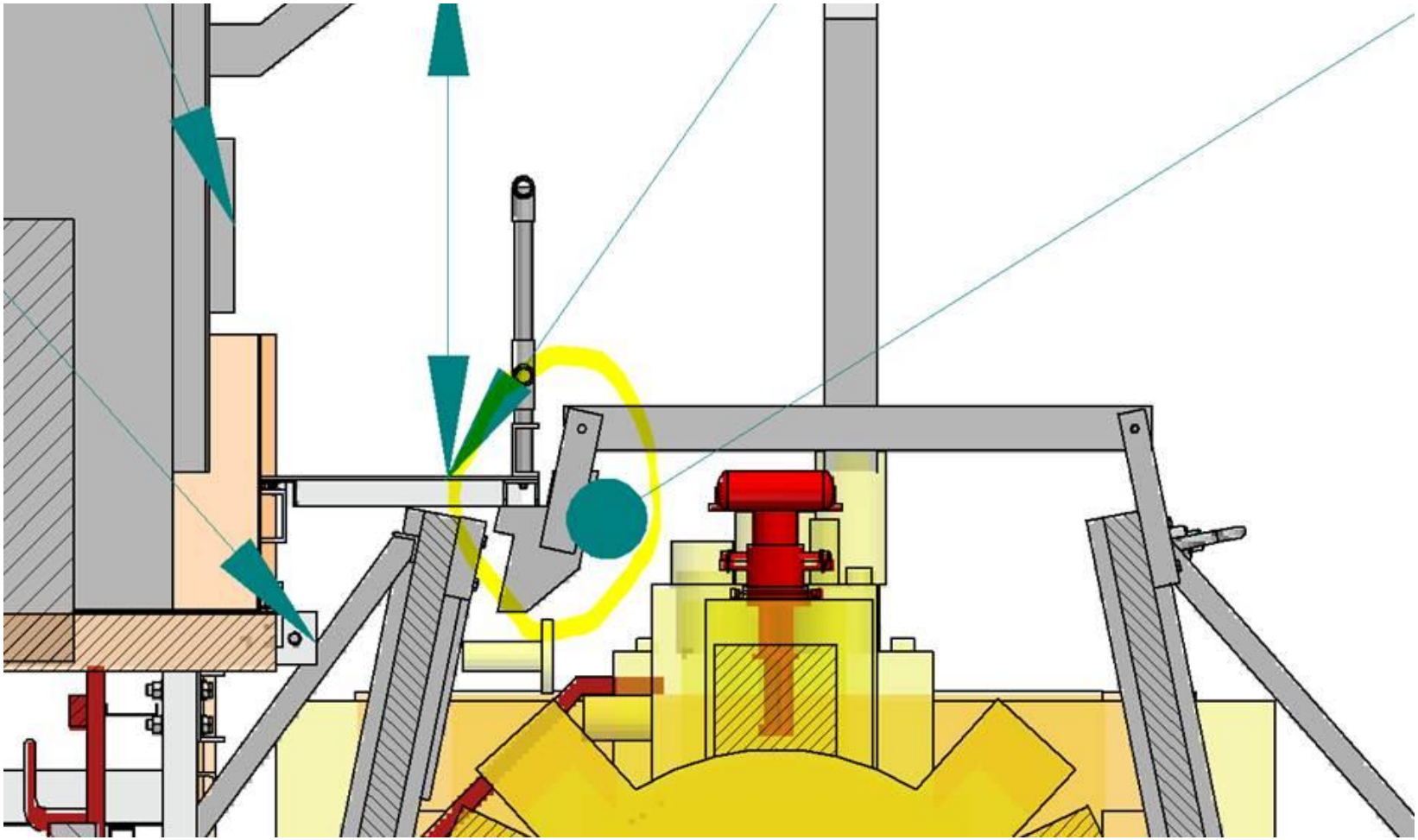
- BNL Engineering
  - Steve Plate
  - Mike Anerella
  - (lots of help from others: Jason Tarrant, Craig MacWaters, Tim Hayler, Geoff Barber)
- Preliminary Design Phase
  - (almost finished)
  - General concept (forces, tolerances, joining of pieces, …)
  - Costing
  - Time line
  - Assembly procedure
- Detailed Design Phase
  - Complete design
  - Fabrication drawings
  - Interferences

Interferences



Courtesy of Jason Tarrant, STFC

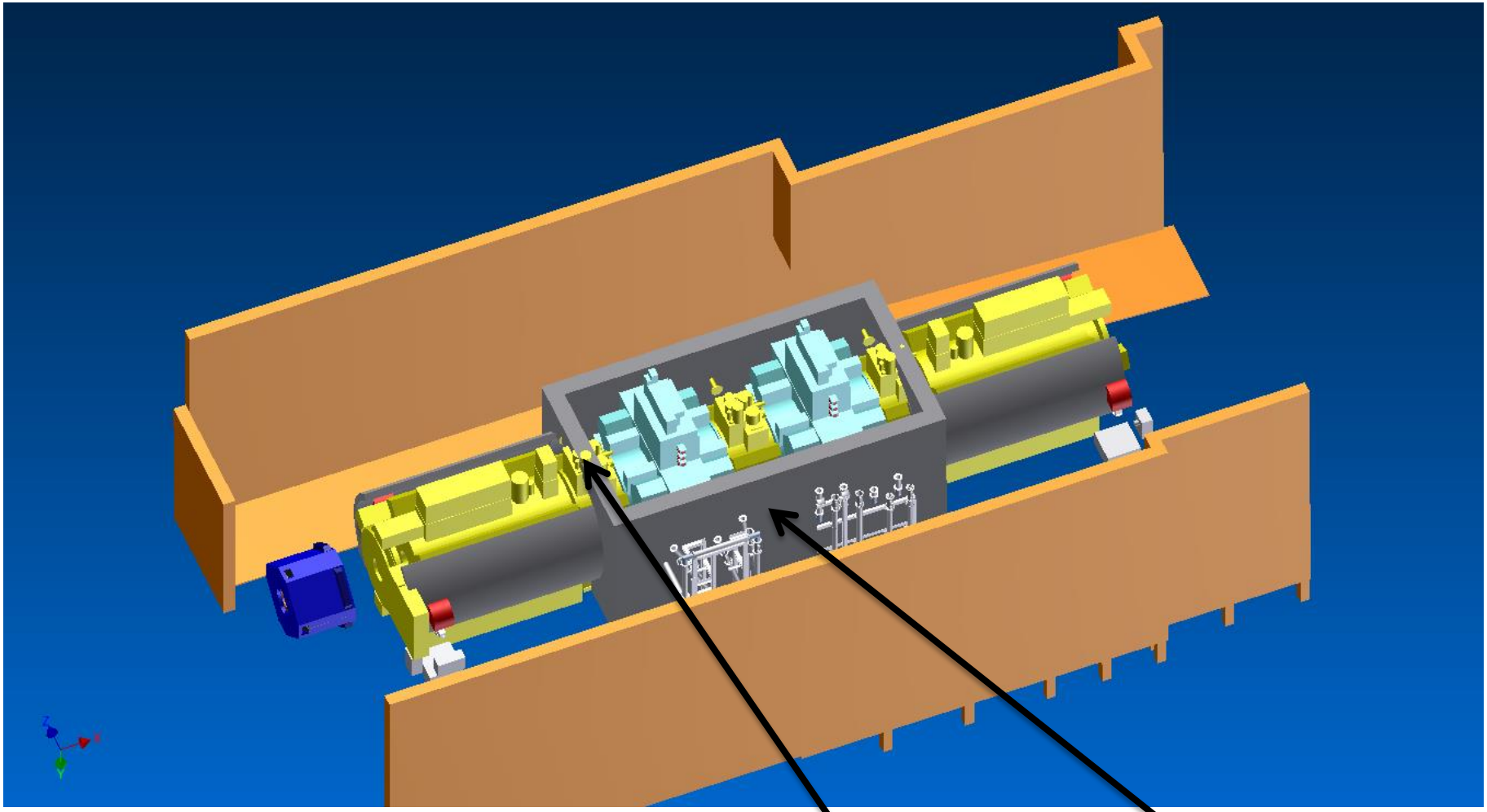
Engineering - Mezzanine



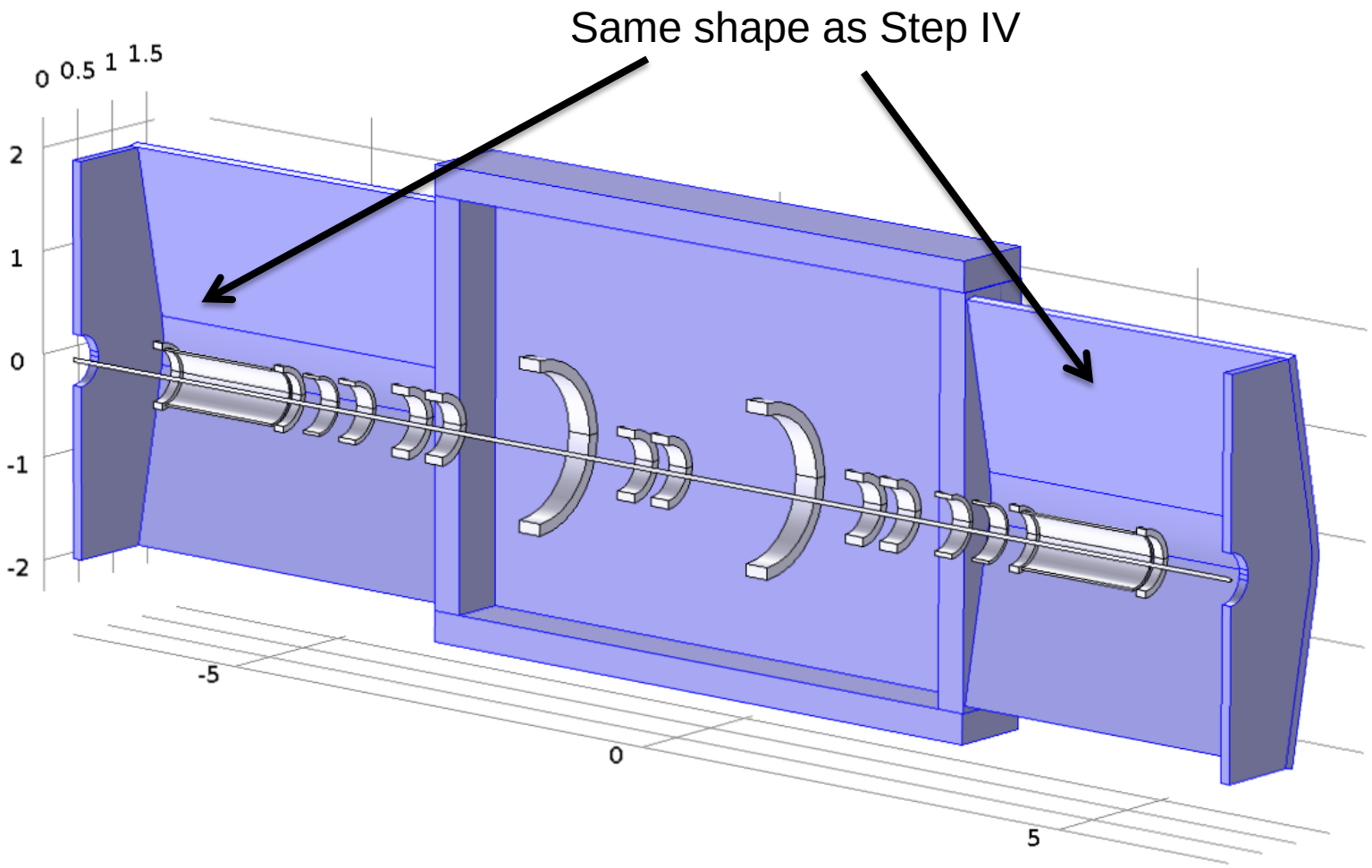
Courtesy of Jason Tarrant, STFC

Step VI

Step VI



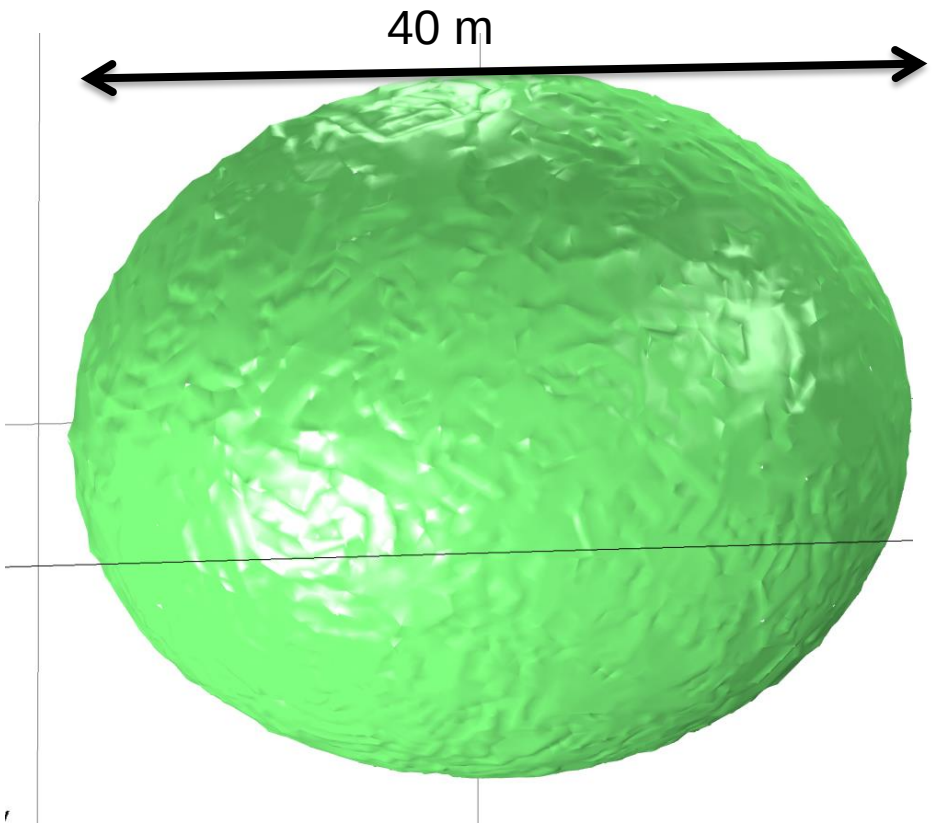
COMSOL Model



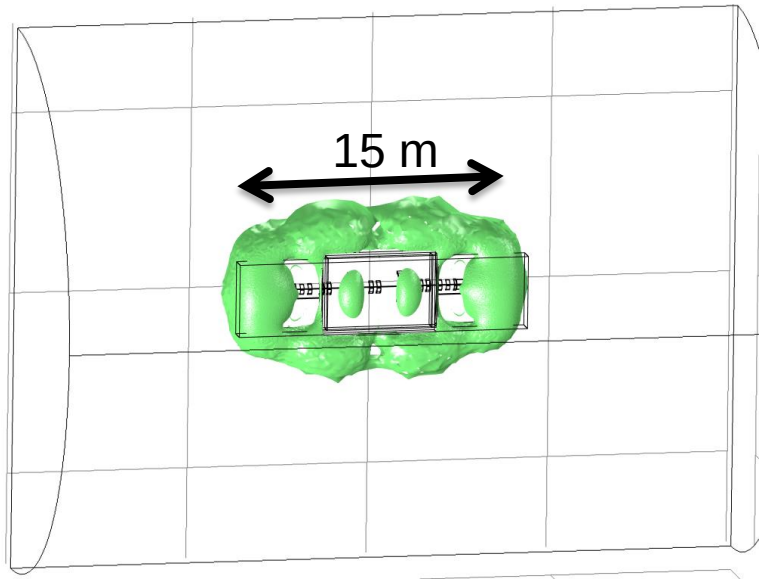
Based on Steve Plate's shield design

5 Gauss Surface

Step VI, 240 MeV Solenoid



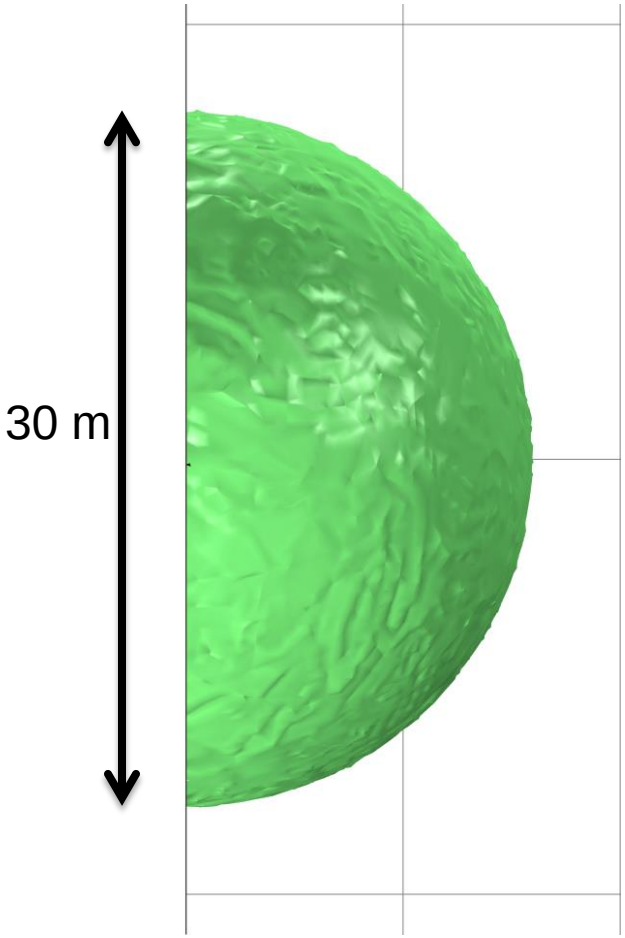
No Shield



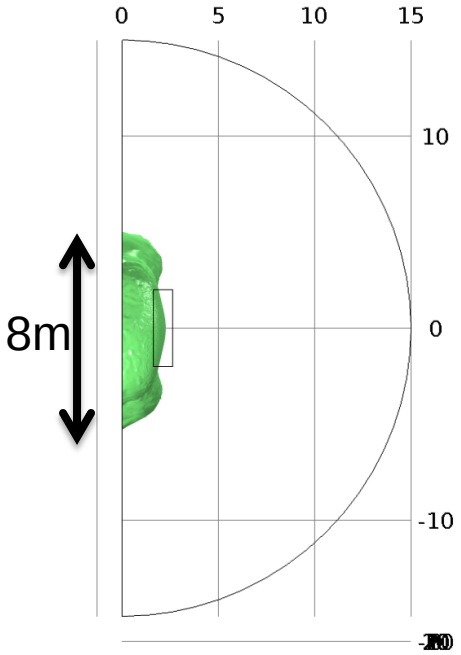
Shield

5 Gauss Surface

Step VI, 240 MeV Solenoid



No Shield



Shield

Conclusion

- Demonstrated shielding concept
  - Reduces stray field to 5—10 Gauss (10/12 cm)
    (No shield: 300—600 Gauss = factor 50+)
  - Also for Step VI
- Feasibility
  - Penetrations – tracker waveguides, vacuum, …
  - Connections for vertical gaps
- Effect on beam: no issue
- Engineering
  - ongoing