Update Partial Return Yoke

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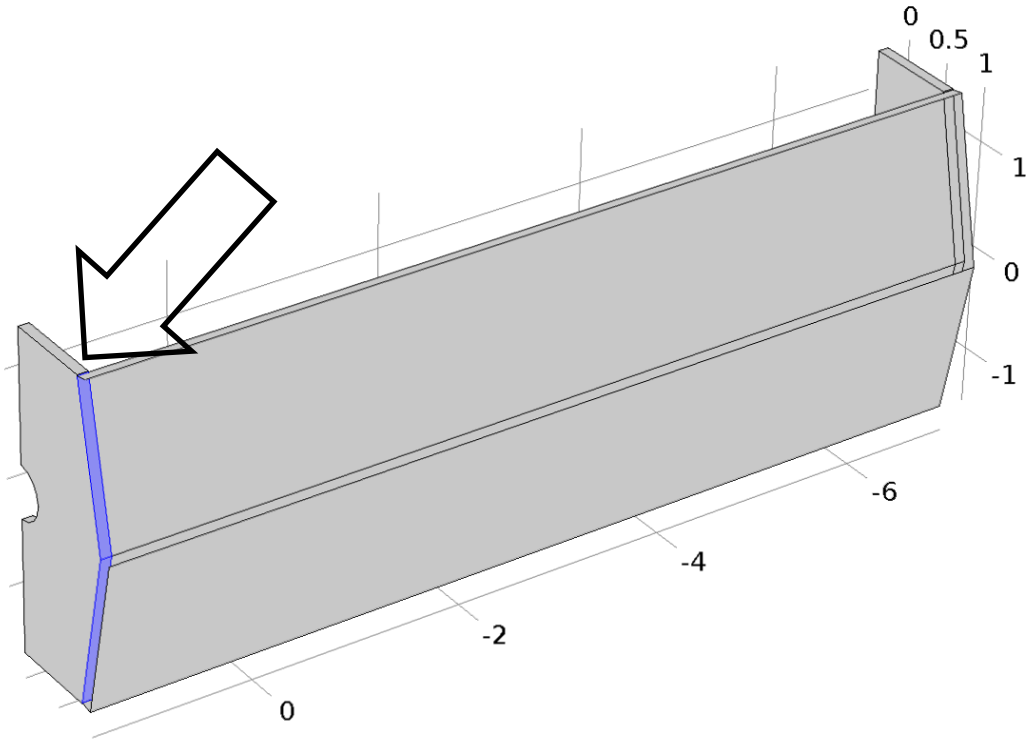
Overview

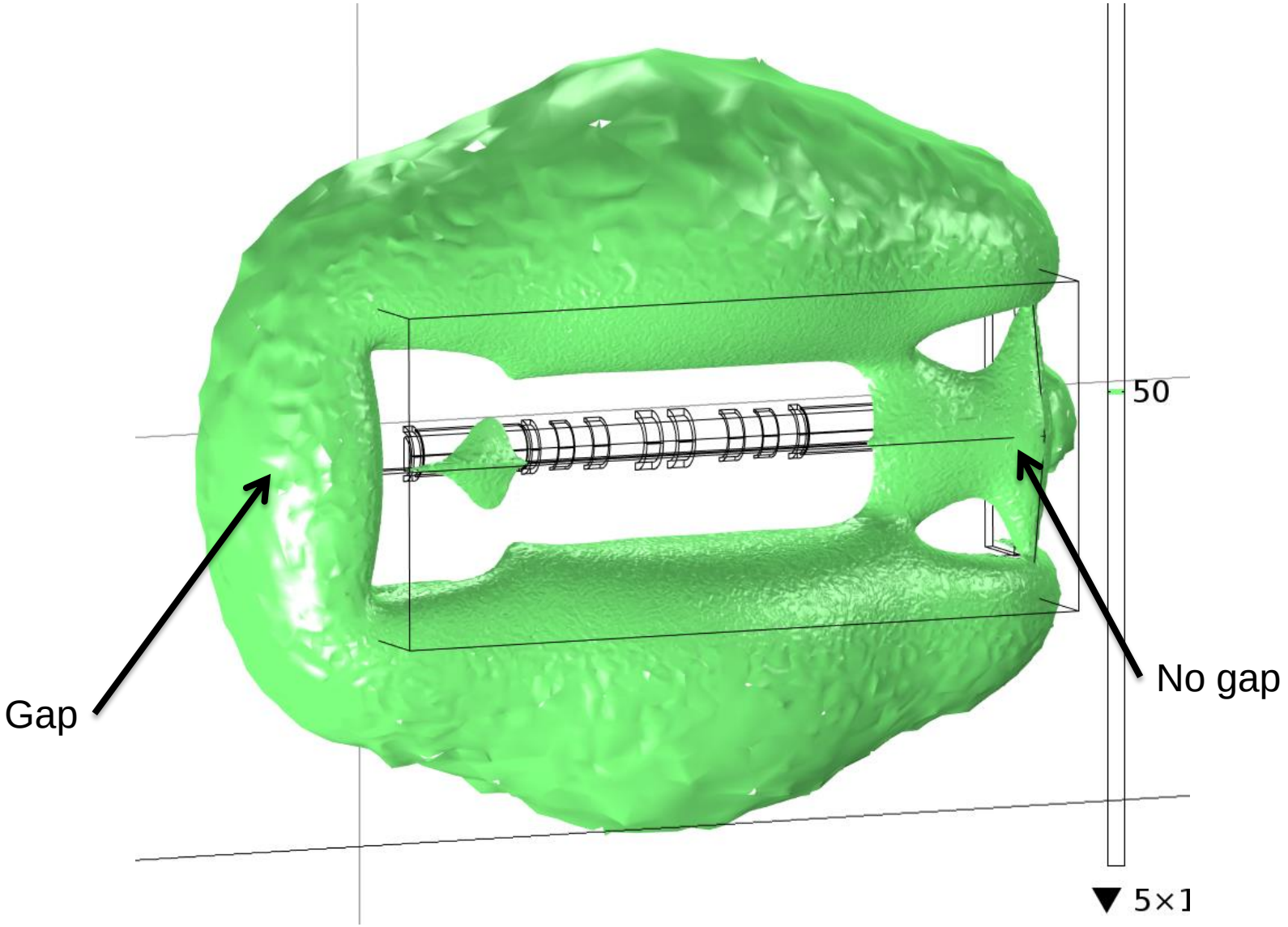
- Tolerance Virostek Plate / shield
- Shield thickness
- Materials

Tolerance PRY / Virostek Plate

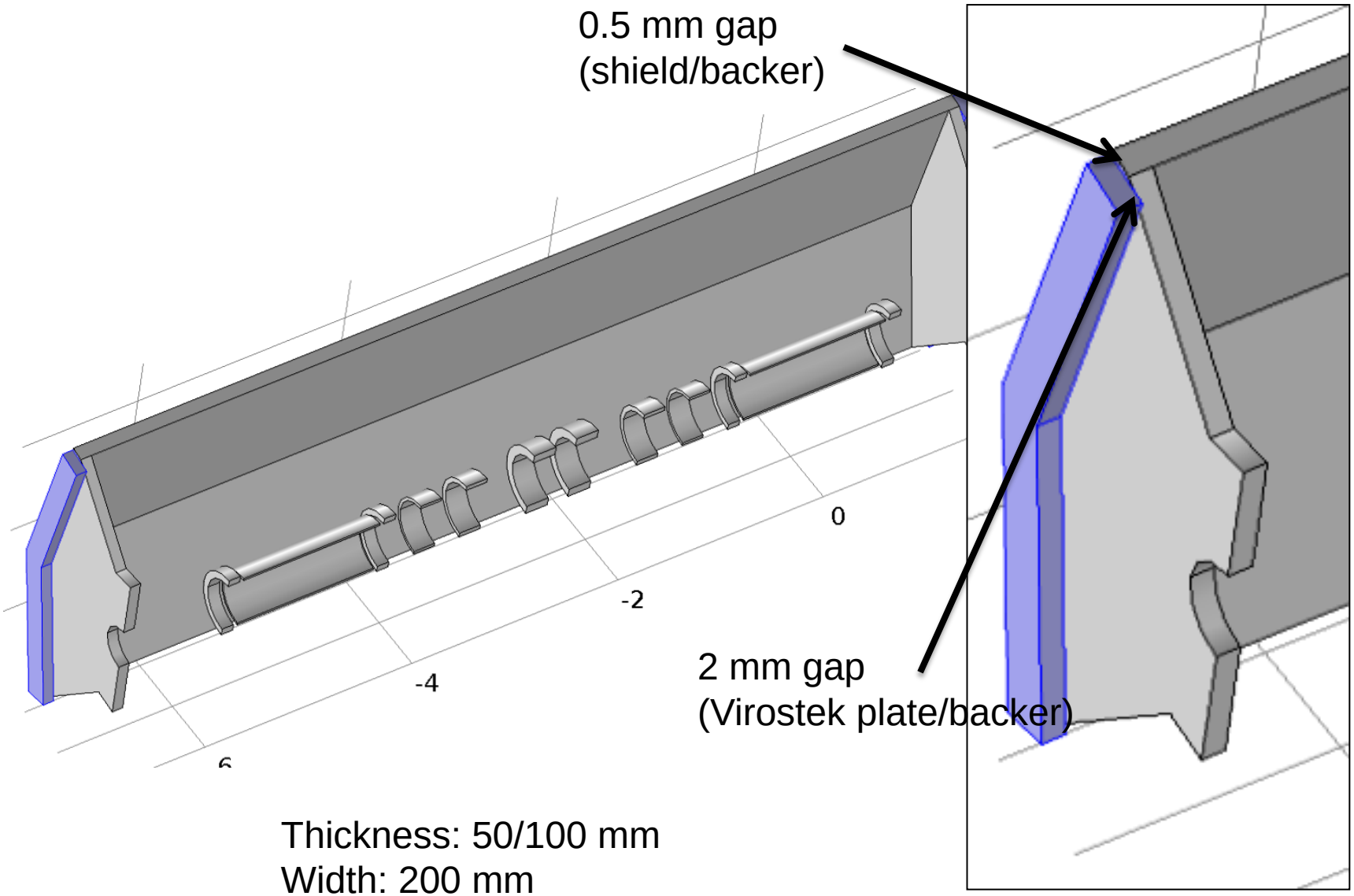
- Interface Virostek shield / Partial Return Yoke
  - Vertical gaps detrimental for performance
  - Separate parts: gap?
- Simulation
  - Assume 3 mm gap



5 Gauss Surface

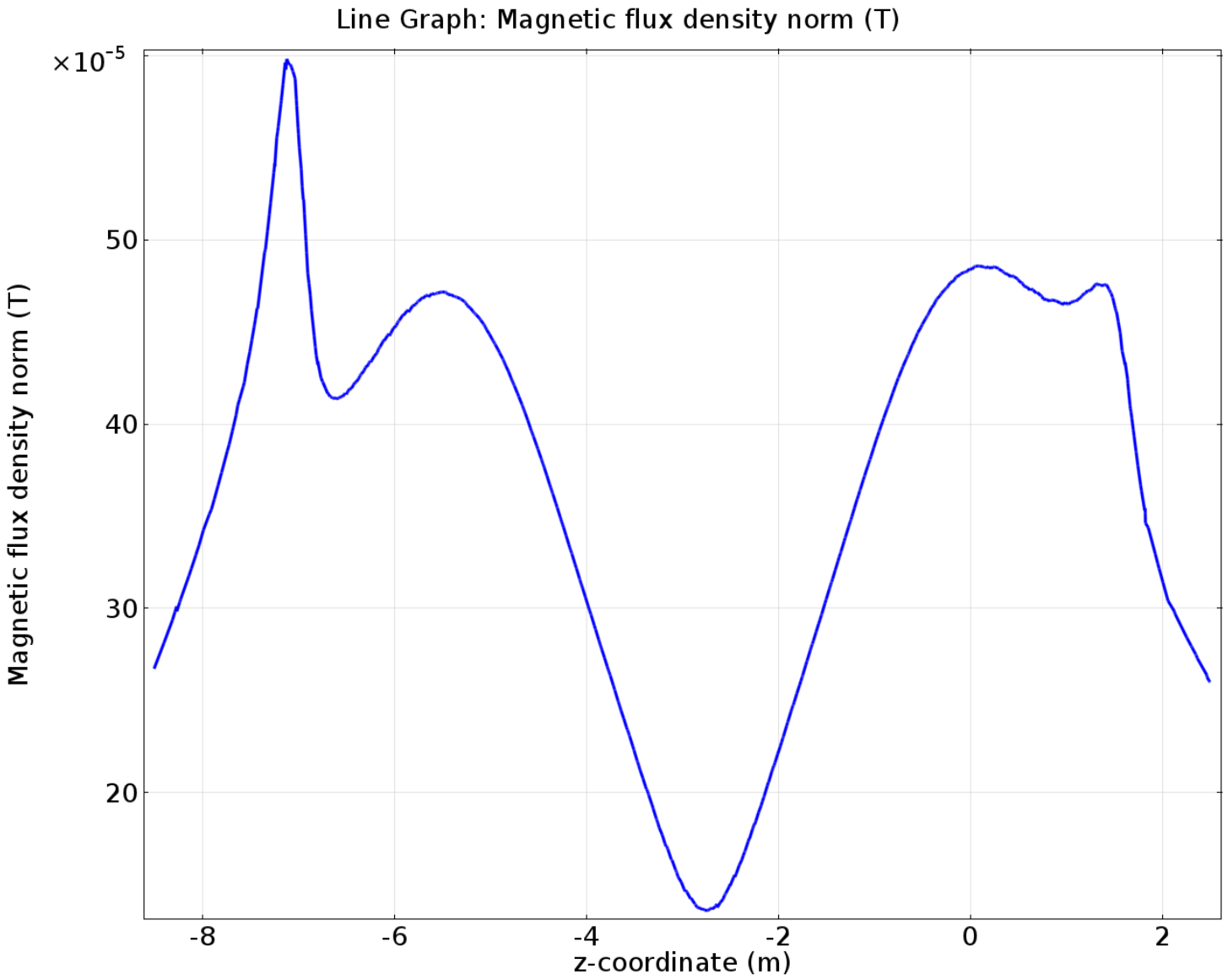


Connection



Thickness: 50/100 mm
Width: 200 mm

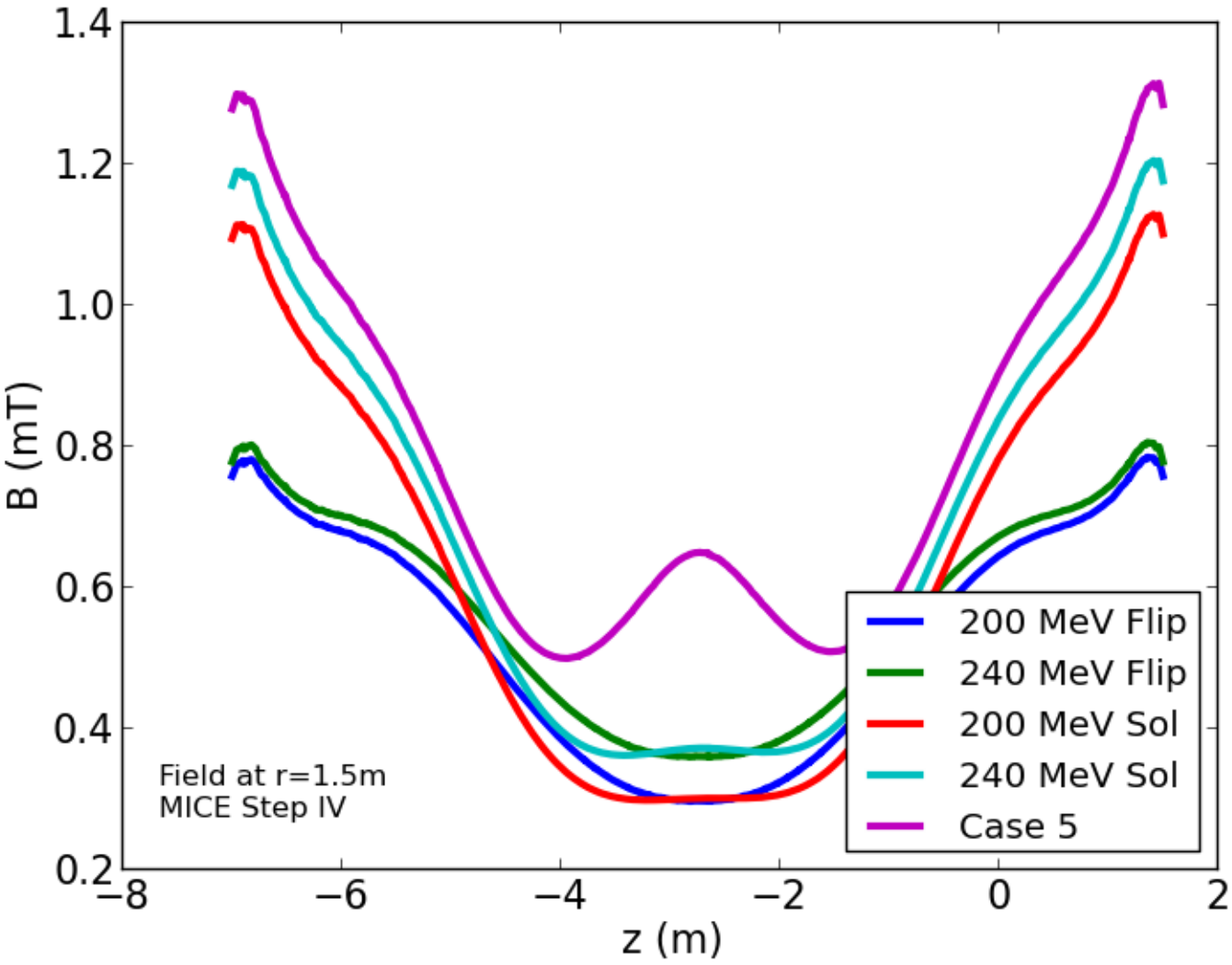
Field R=1.5m


Line Graph: Magnetic flux density norm (T)
×10^-5
50
40
30
20
Magnetic flux density norm (T)
-8
-6
-4
-2
0
2
z-coordinate (m)

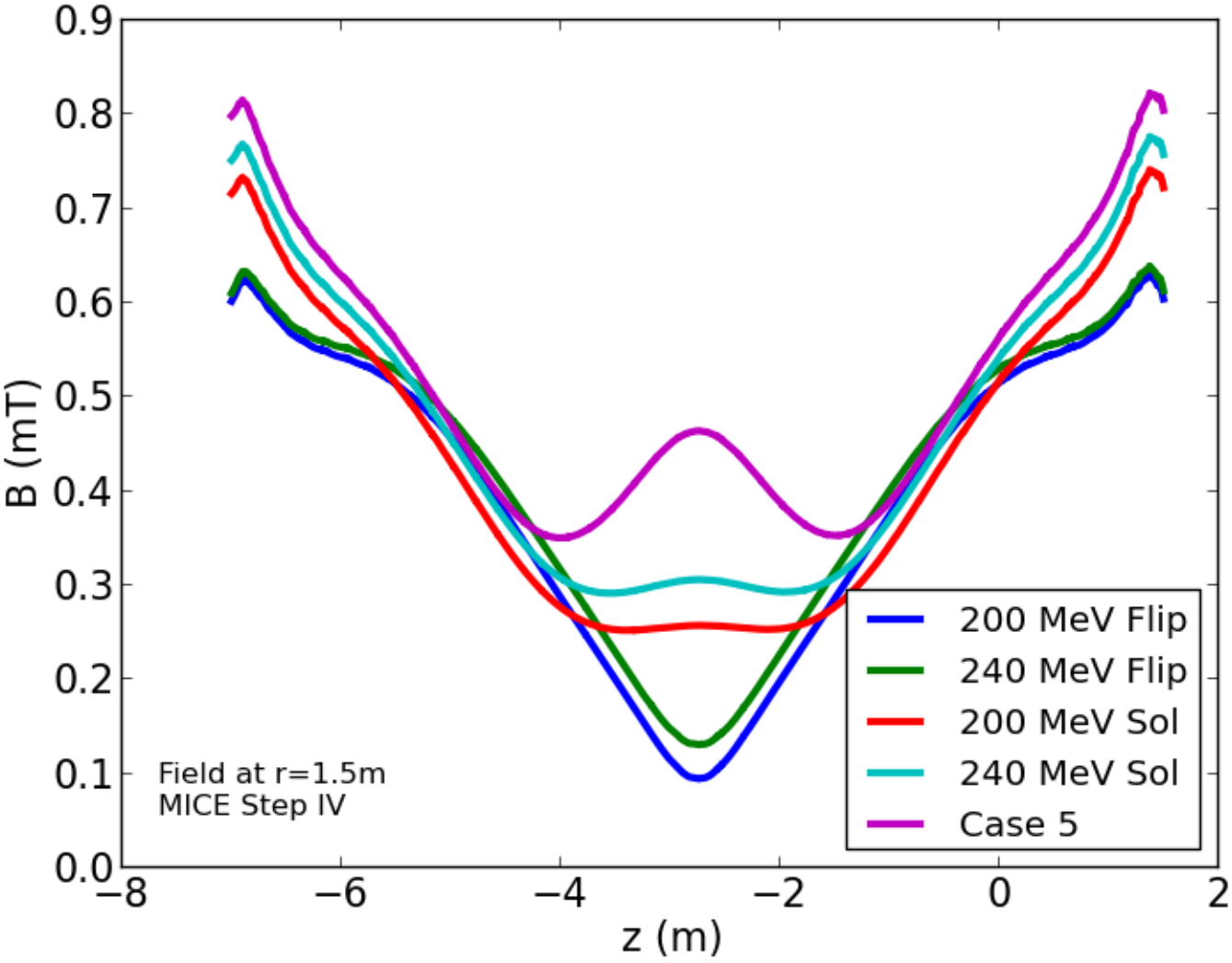
Shield Thickness

- Nominal case: 10 cm
  - Does it make sense to go to 12 cm?
- Pros
  - Better shielding efficiency: 12/7 Gauss
  - Margin: material properties, tolerances
- Cons
  - Cost
  - Dead weight increases → deflection
  - Space?
  - Procurement?

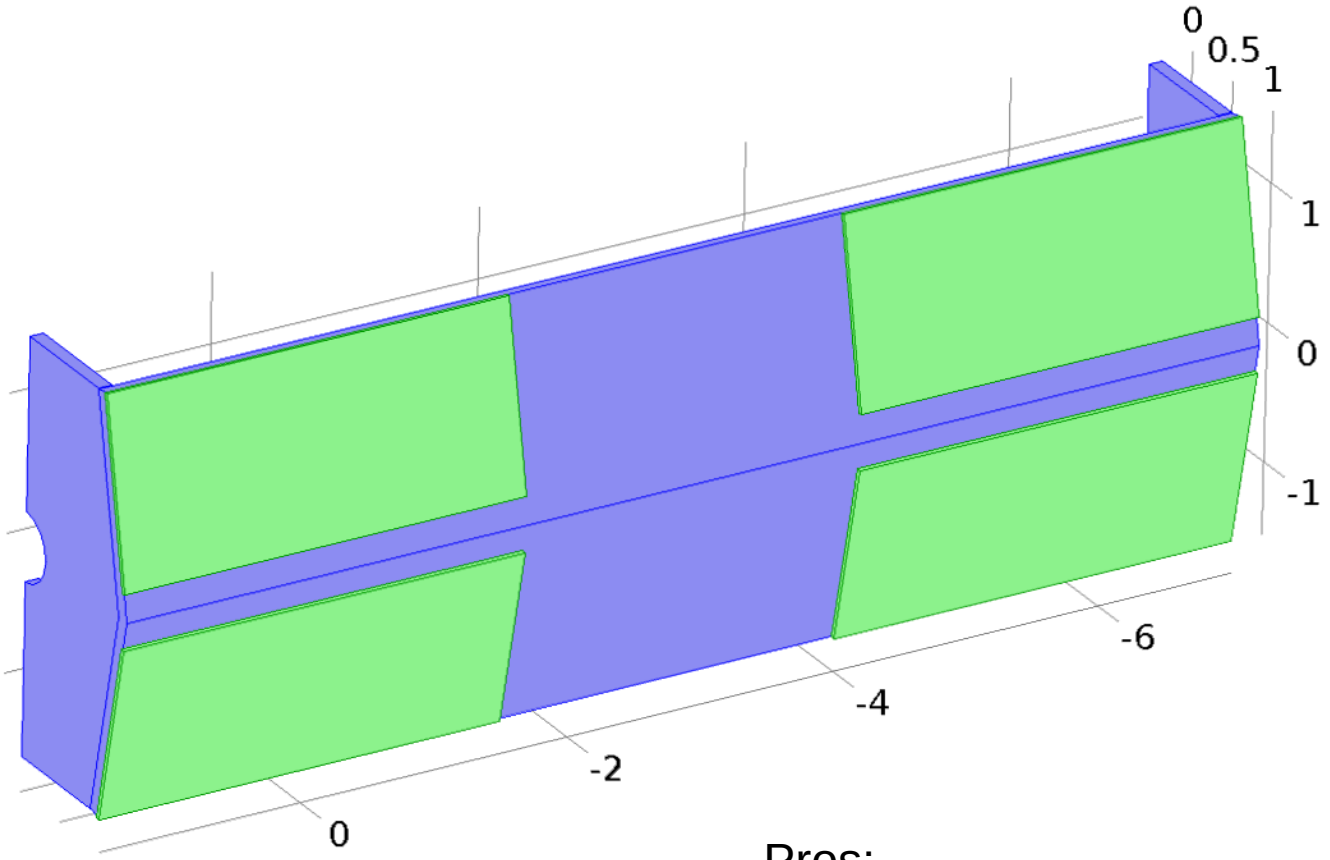
10 cm Shield


1.4
1.2
1.0
0.8
0.6
0.4
0.2
B (mT)
−8
−6
−4
−2
0
2
z (m)
Field at r=1.5m
MICE Step IV
200 MeV Flip
240 MeV Flip
200 MeV Sol
240 MeV Sol
Case 5

12 cm Shield


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
B (mT)
−8
−6
−4
−2
0
2
z (m)
Field at r=1.5m
MICE Step IV
200 MeV Flip
240 MeV Flip
200 MeV Sol
240 MeV Sol
Case 5

A Potential Option

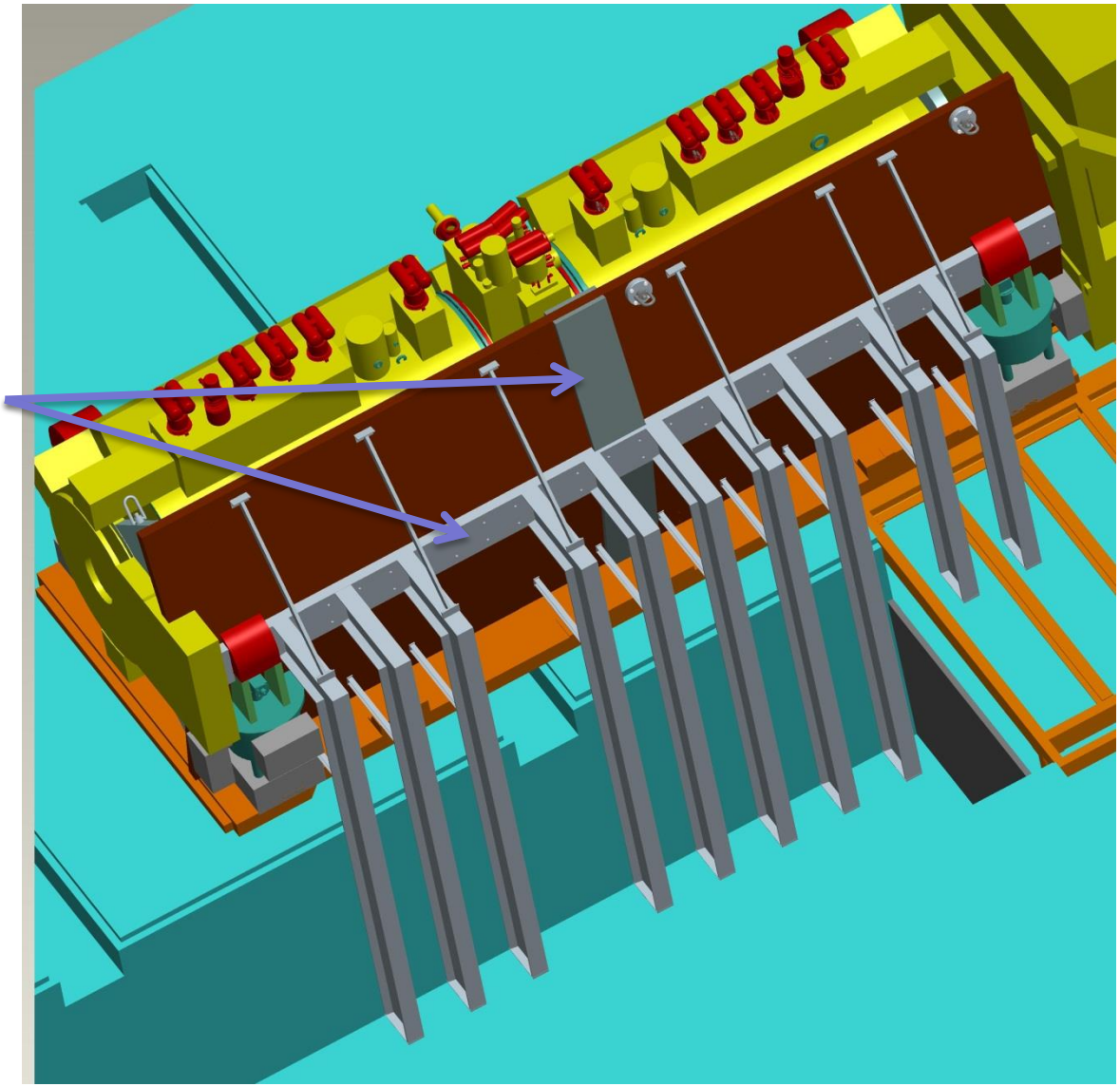


3 cm thick plates
Cover MICE Spectrometer Solenoid

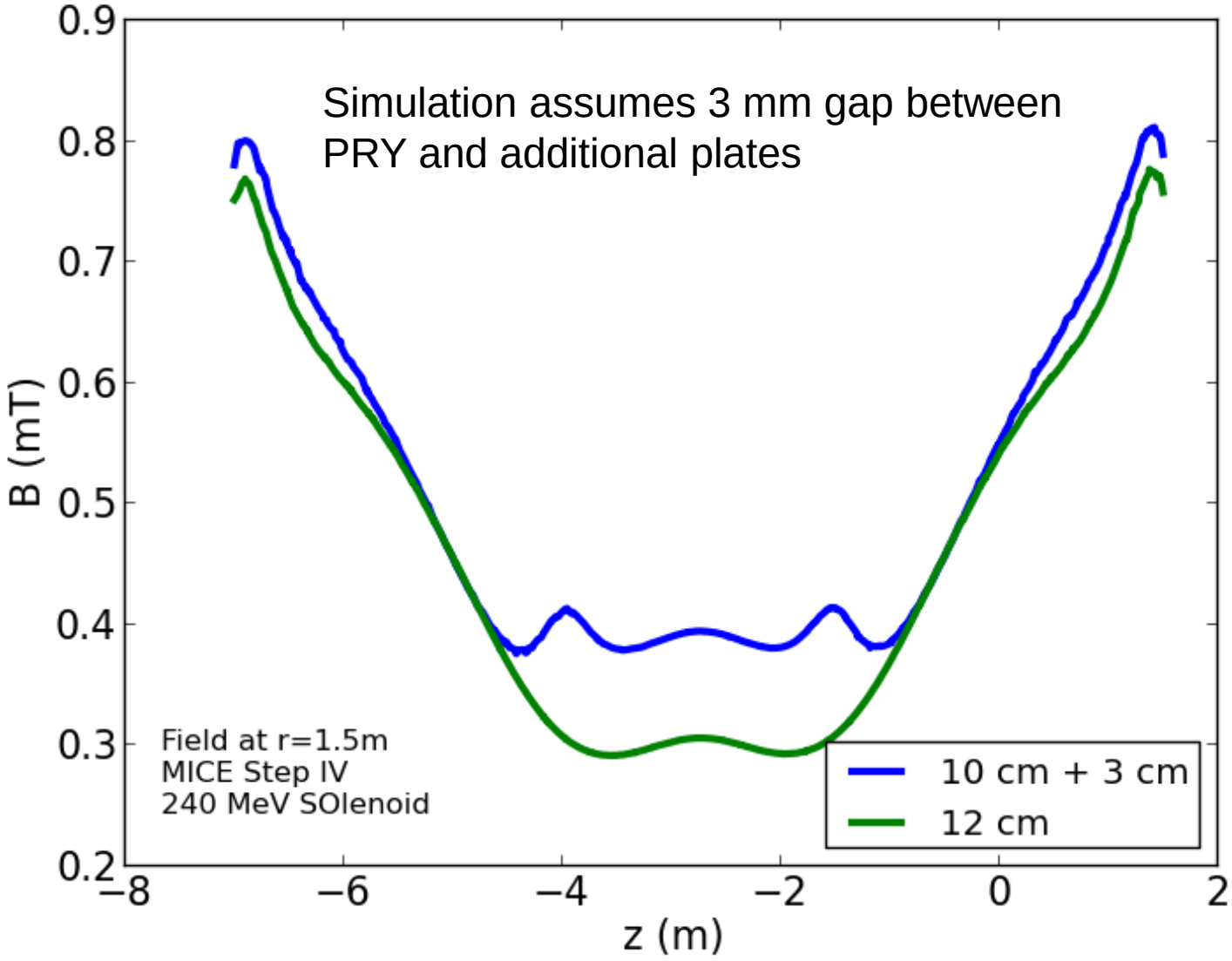
Pros:
- can be added later if necessary
- Procurement not an issue

Design

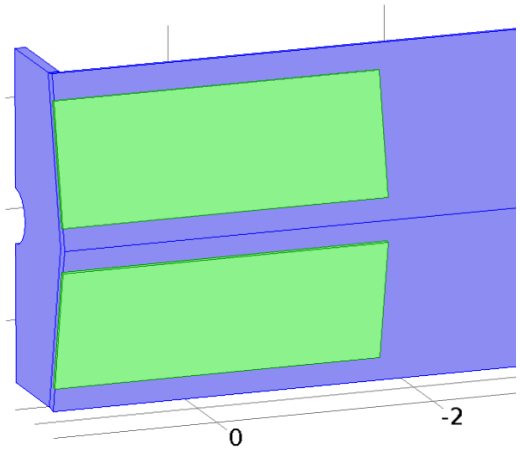
Structural parts do not interfere

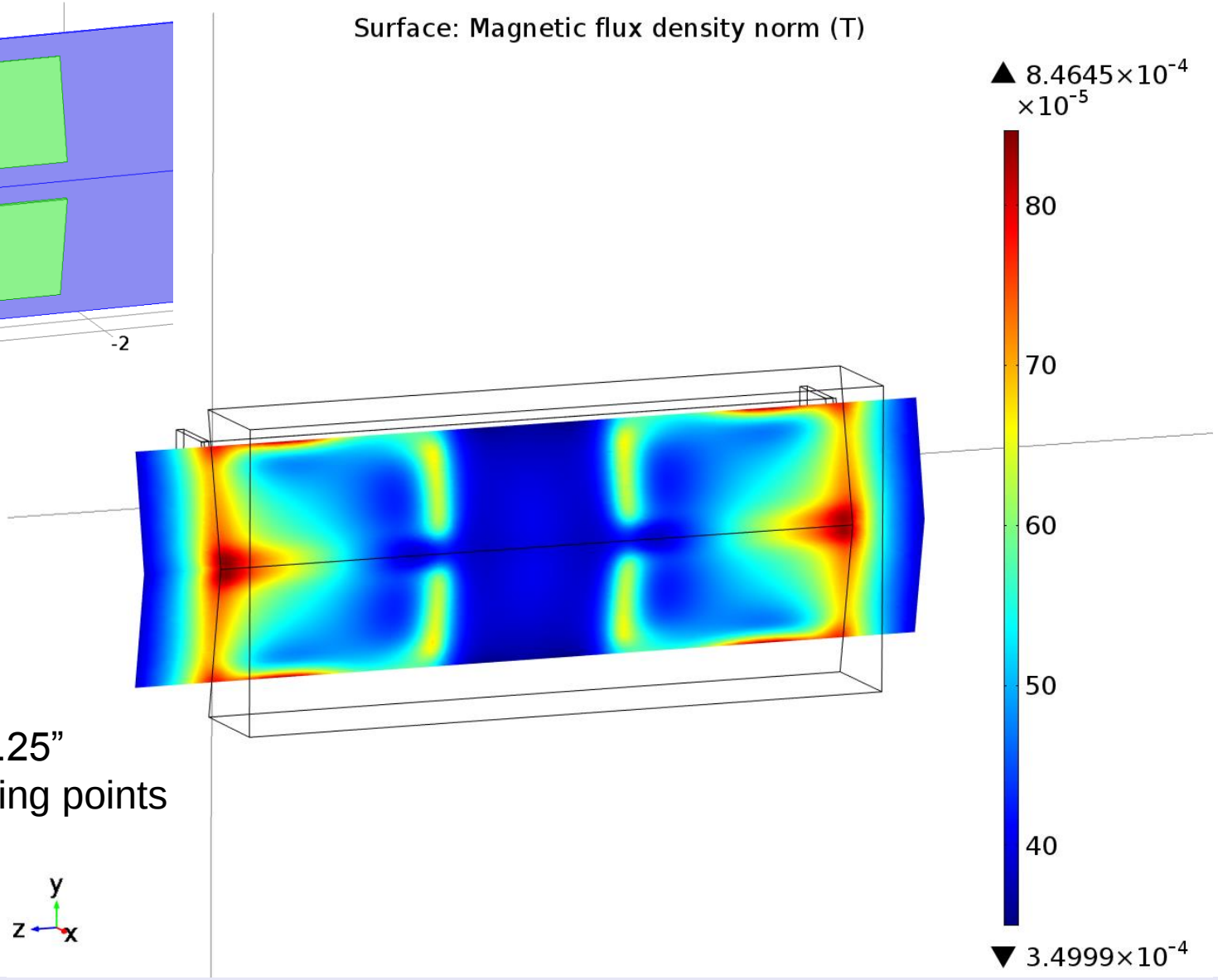


Performance



Reducing Height





Reduced by 9.25”
For top mounting points

Engineering

- Design based on AISI 1010 steel
  - BH data from Opera
- (Engineering design: A36)
- AISI 1010 (Matweb, hot rolled):
  - C: 0.080-0.13 %
  - Fe: 99.18-99.62 %
- Effect on magnetic properties?

Iron Alloys

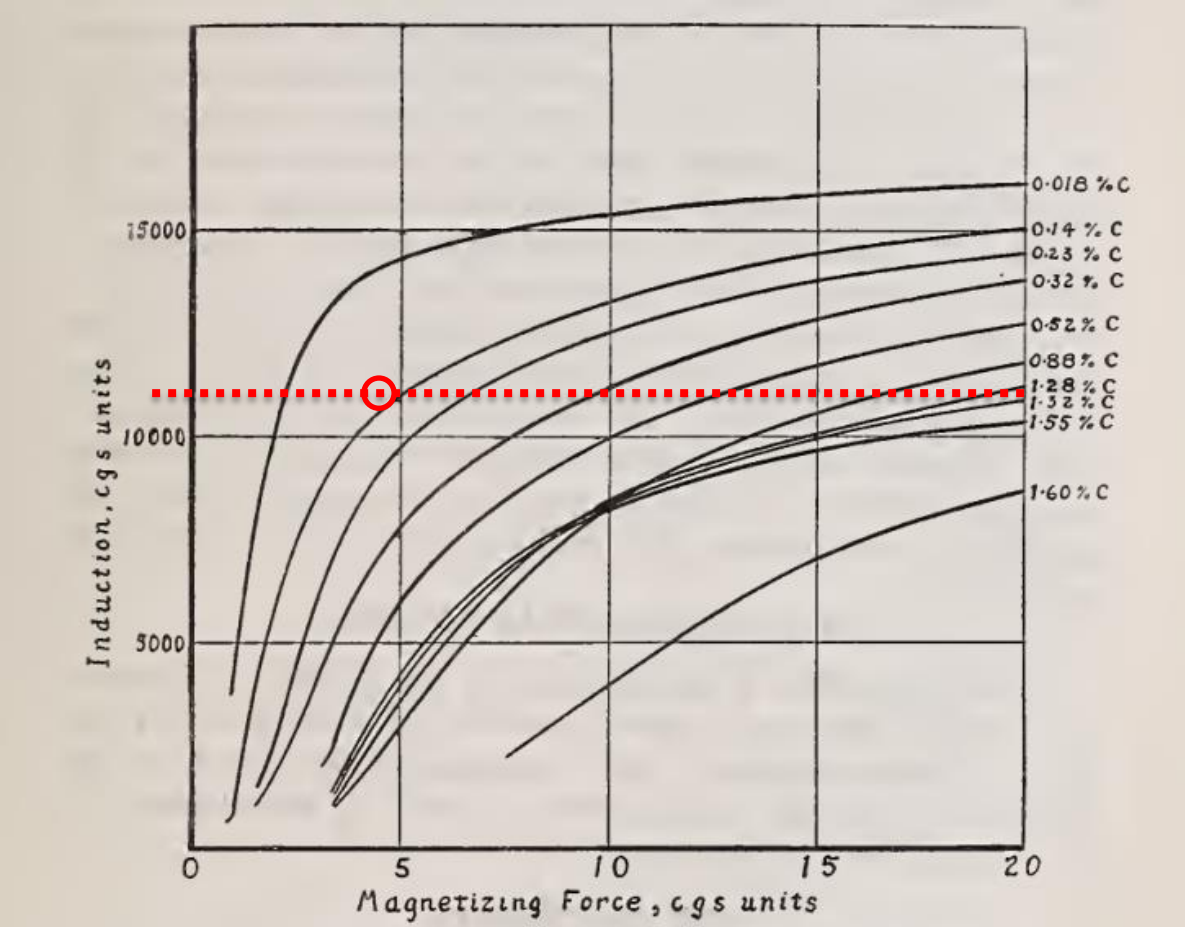
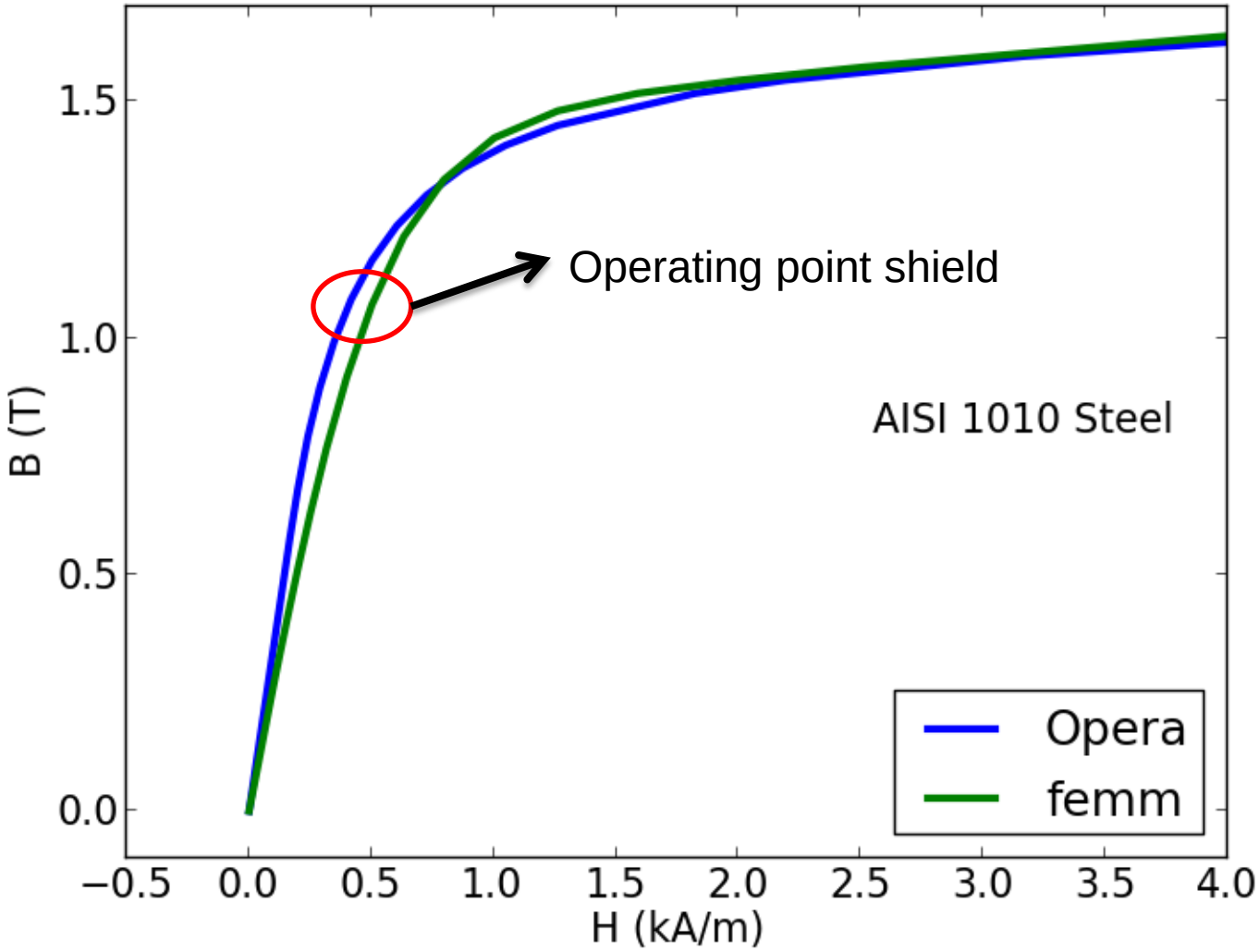


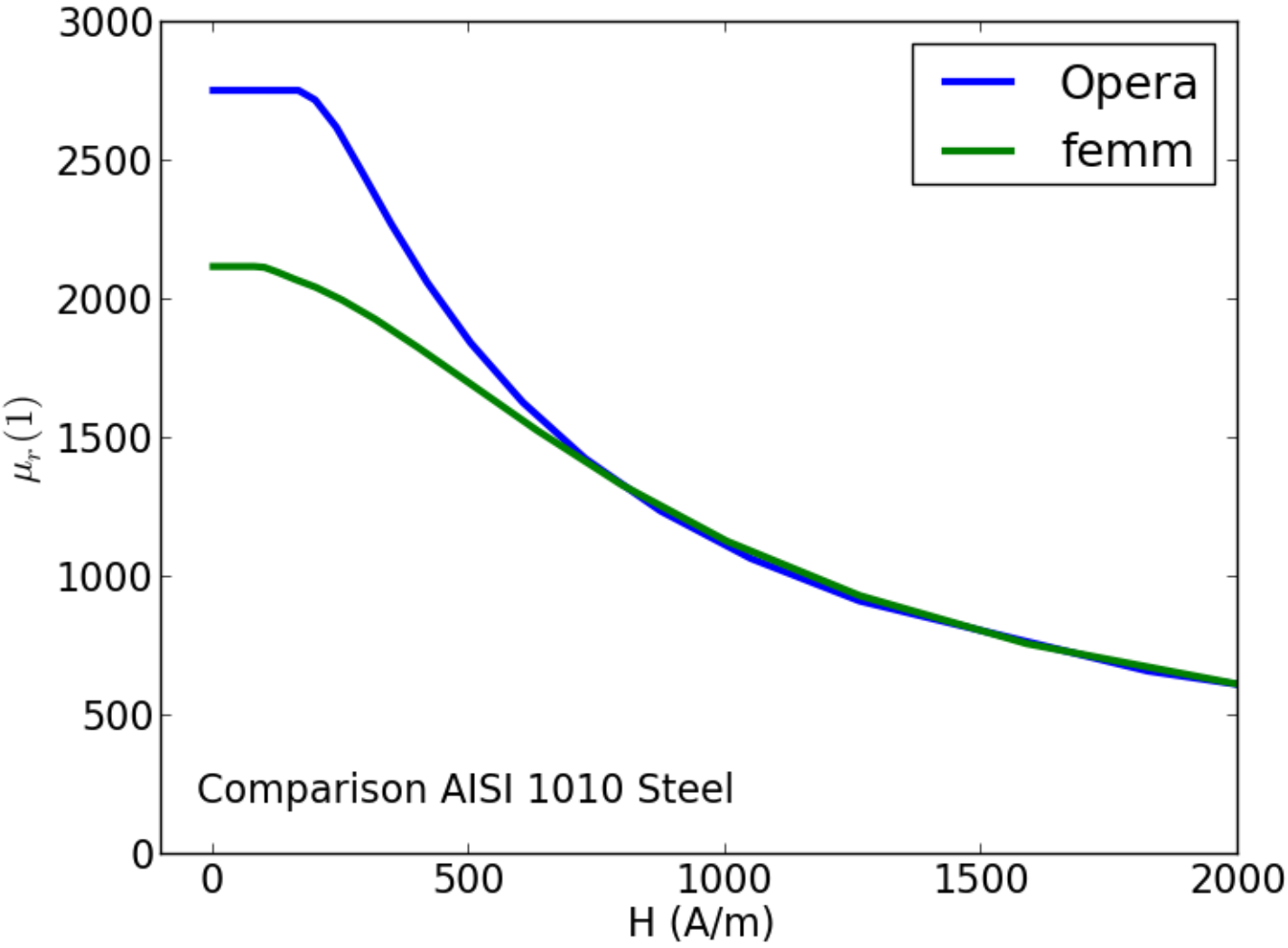
FIG. 10.—*Normal induction curves for specimens annealed in vacuo.*

W. L. Cheney: Preparation and Properties of Pure Iron Alloys. Scientific Papers of the Bureau of Standards. Washington, July 24, 1922.

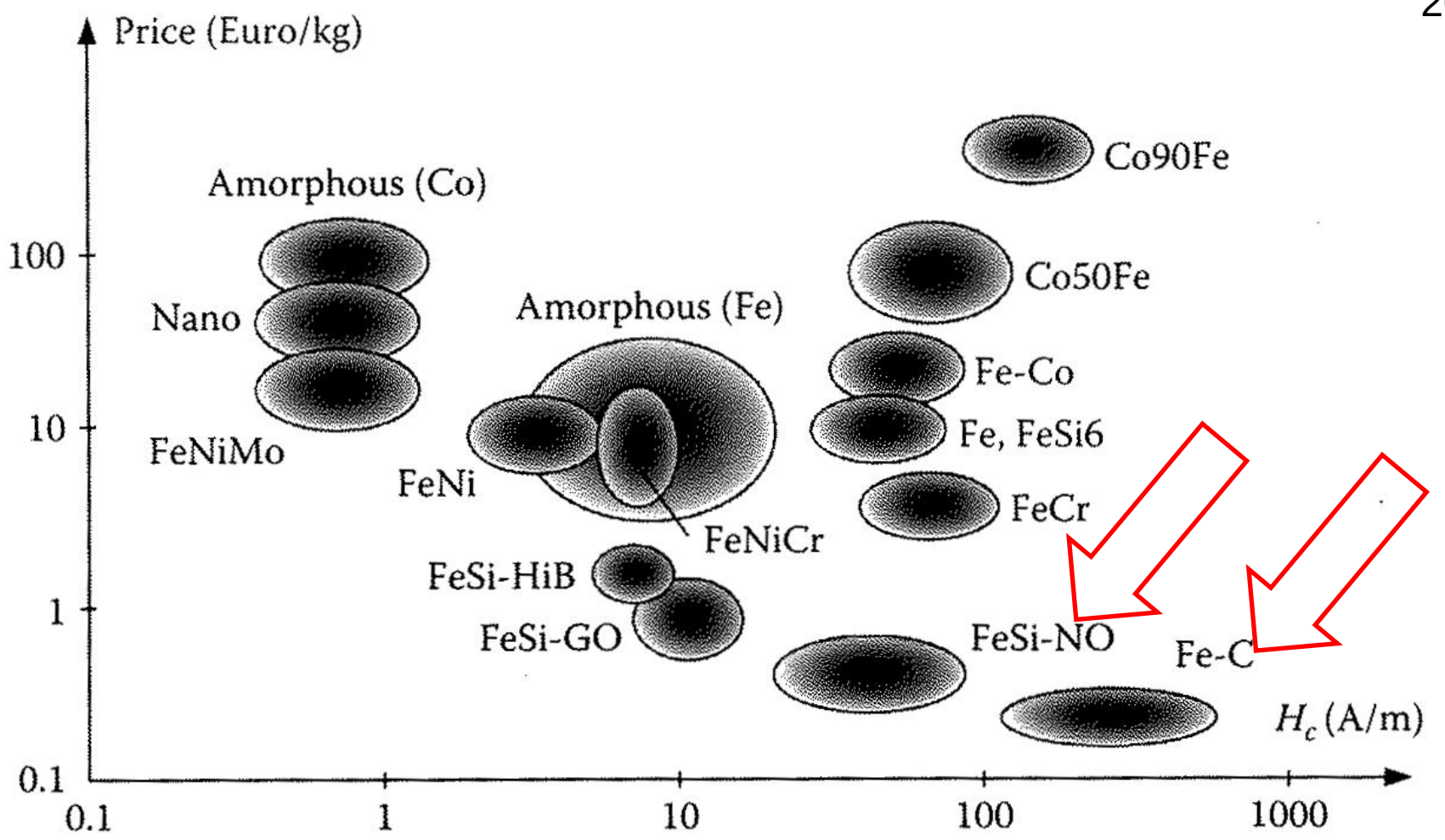
BH Curve AISI 1010



AISI 1010: μ_r

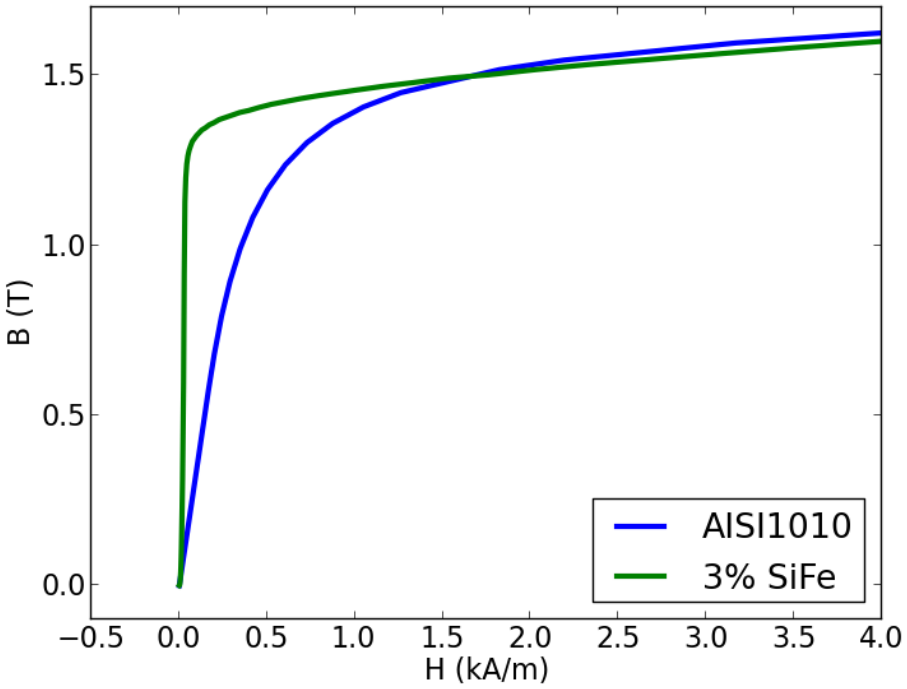


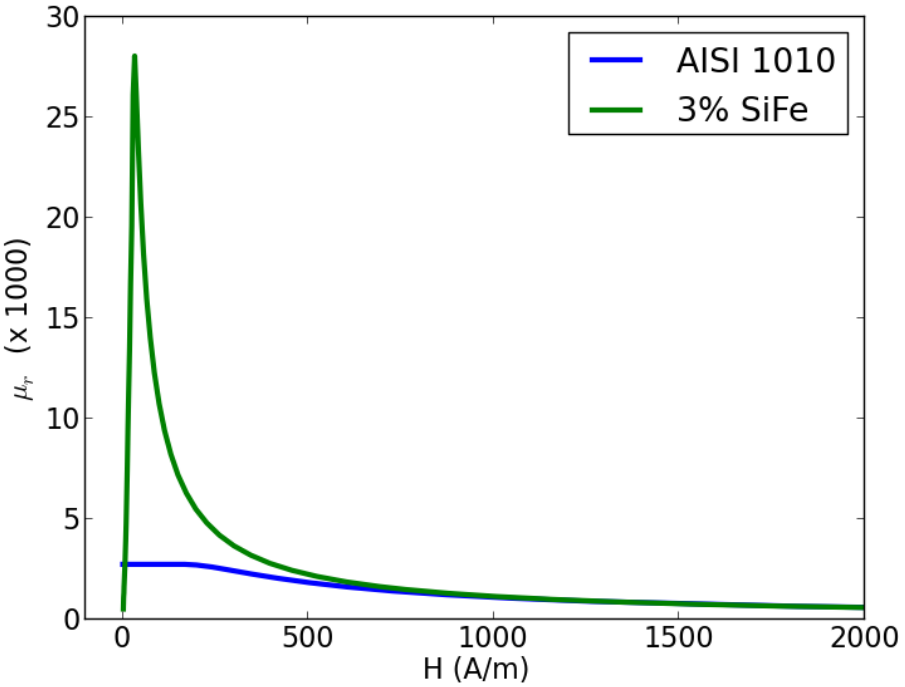
Materials



Handbook of Magnetic Measurements.

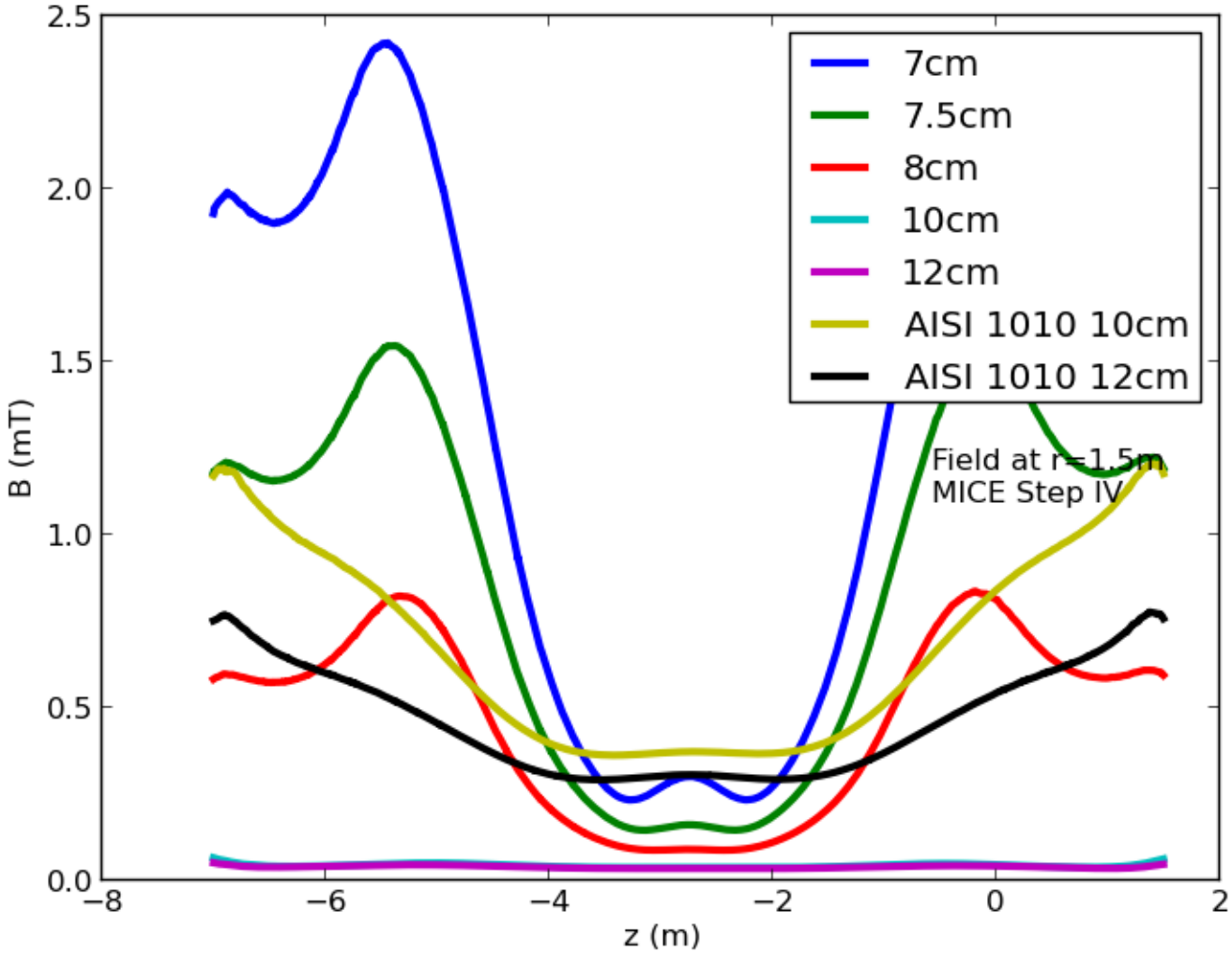
3% SiFe





- Better performance: higher μ_r (influences stray field behind shield)
- guaranteed properties

SiFe – Comparison



240 MeV Solenoid

Summary

- AISI 1010: magnetic properties?
  - AISI 1006?
  - Series of material tests
  - Increase margin (=thickness)
    - Option of ‘booster’ plates
- Alternatively: material with guaranteed magnetic properties
  - 3% SiFe: 8 cm can replace 12 cm AISI 1010 shield
  - Cost?
- Note on Partial Return Yoke
  - H. Witte and S. Plate, “Partial Return Yoke for MICE,” MAP-doc-4362, BNL-100819-2013-IR, 2013, pp. 1–39.