Azimuthal Gaps

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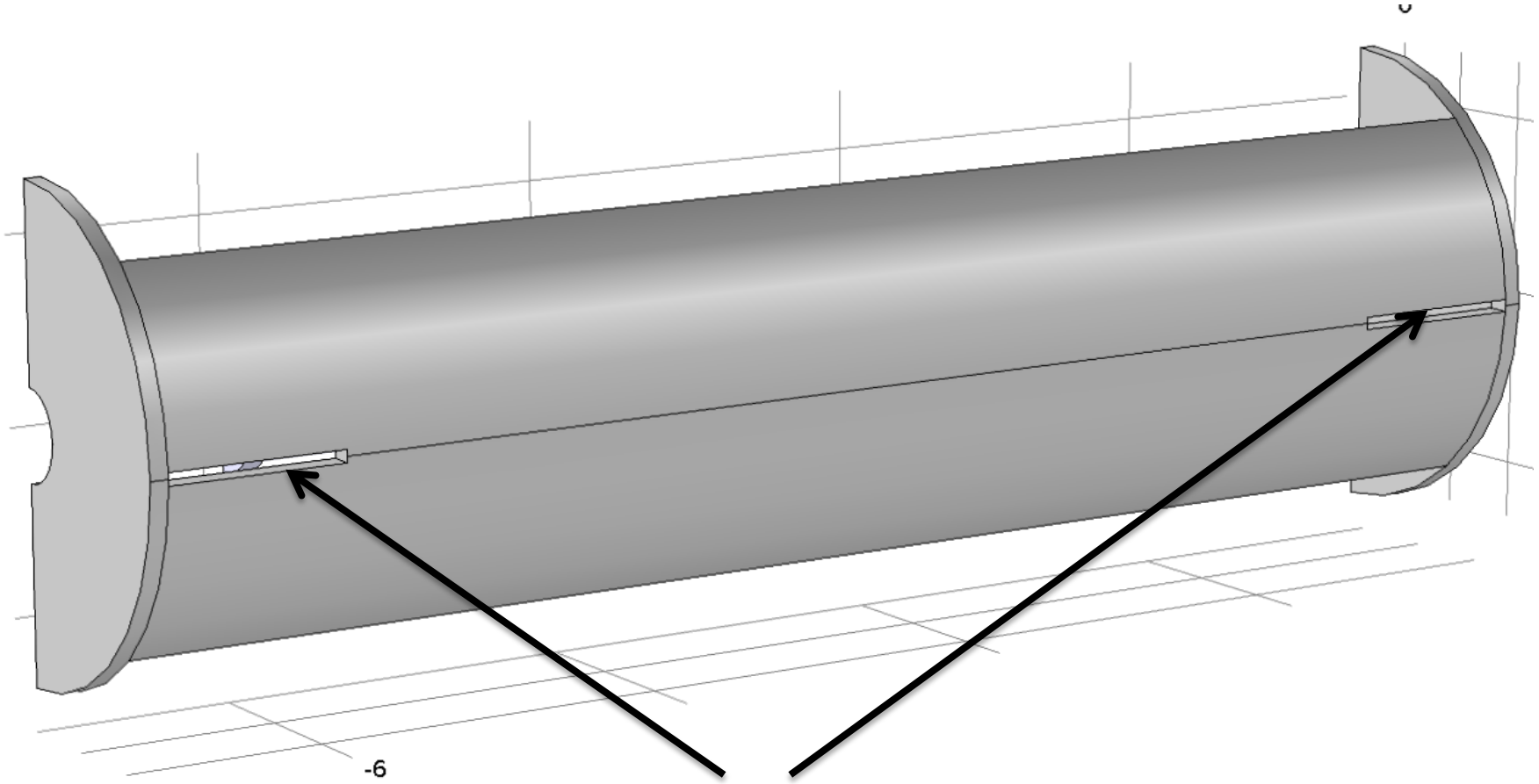
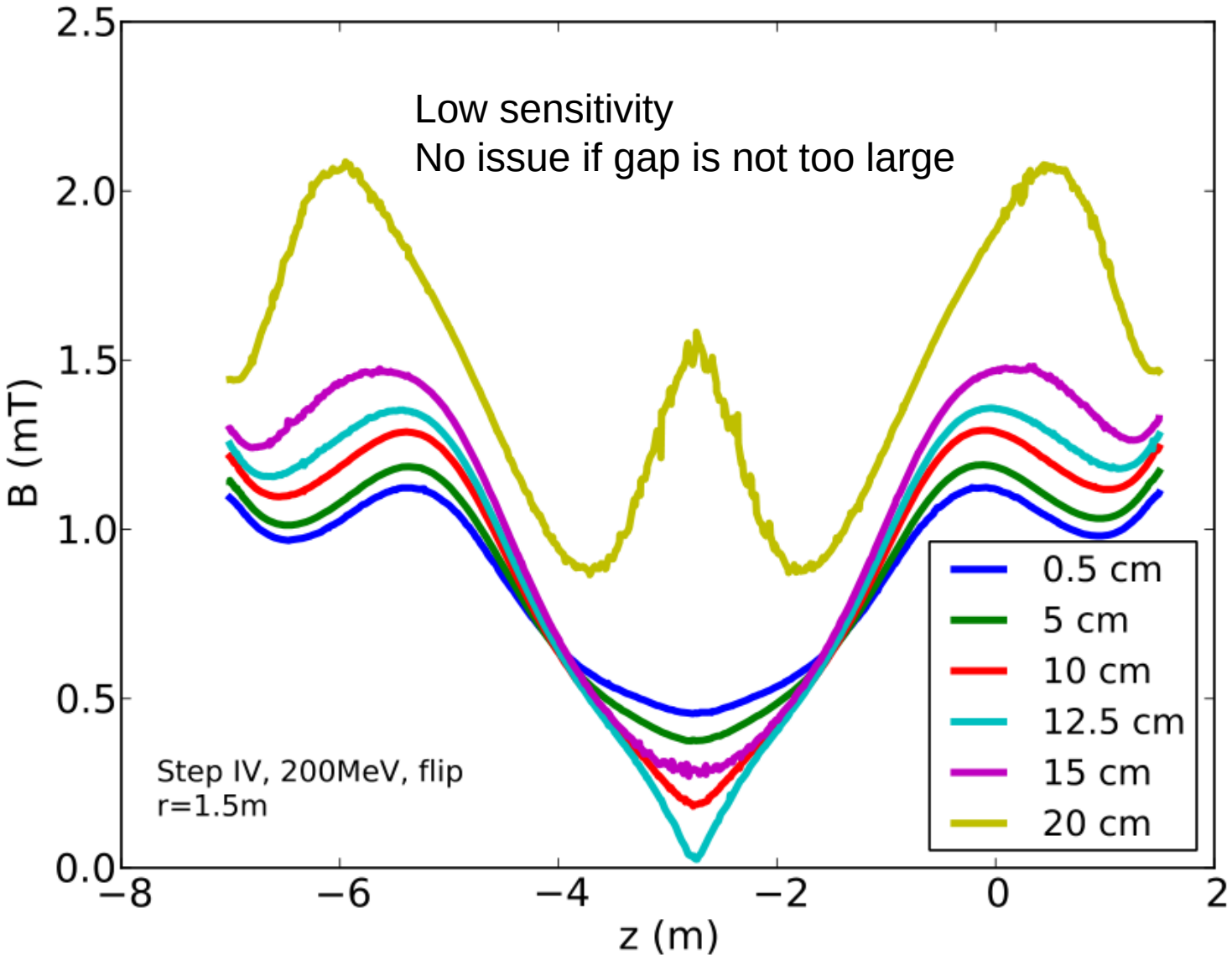
Longitudinal Gaps/Slots



Gaps: 1 m long, 10 cm wide

Longitudinal Gaps



MICE Shielding

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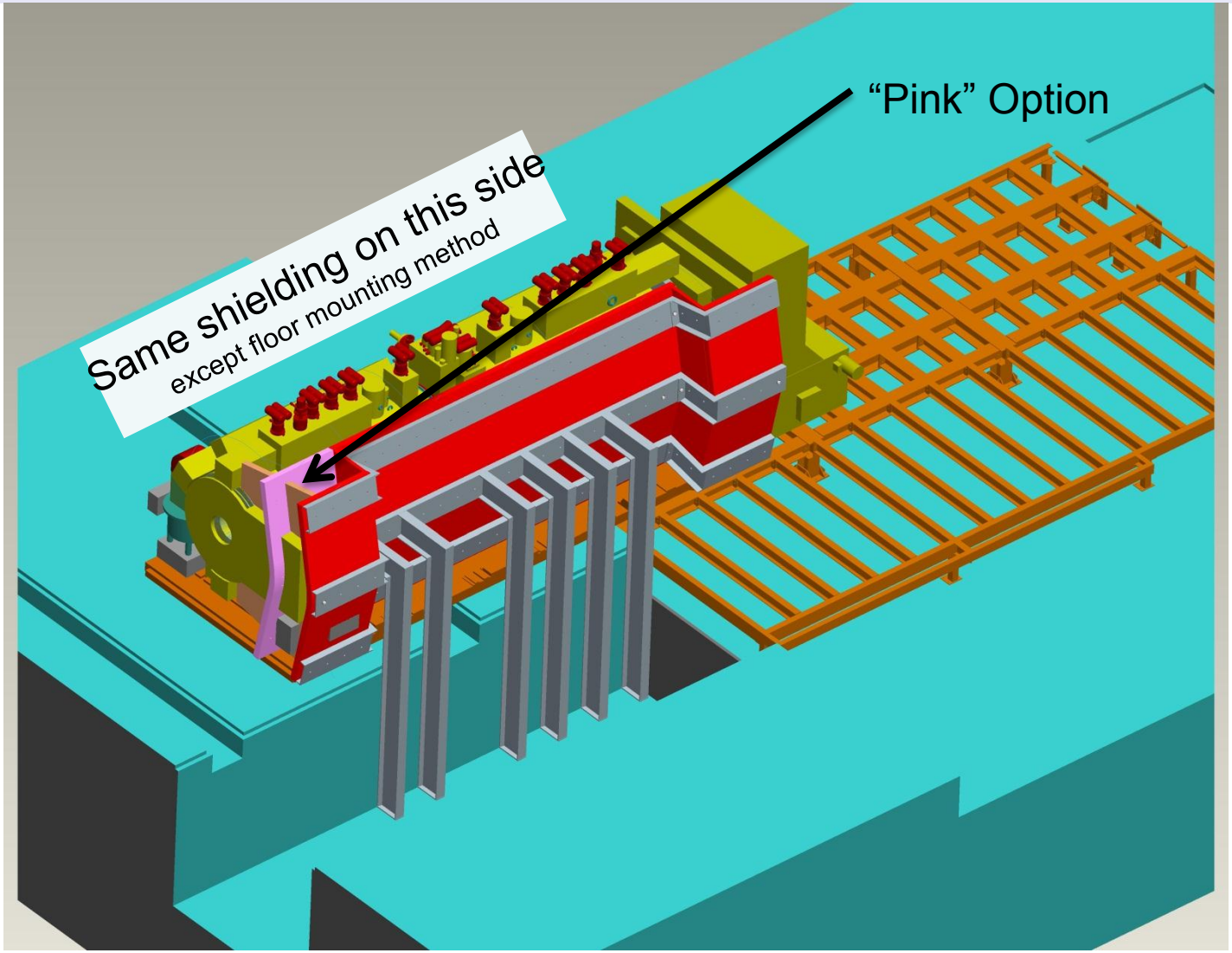
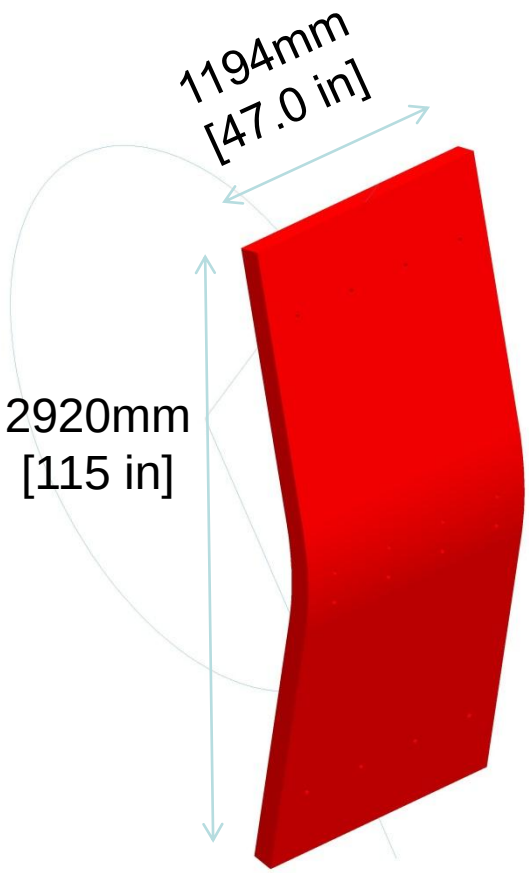
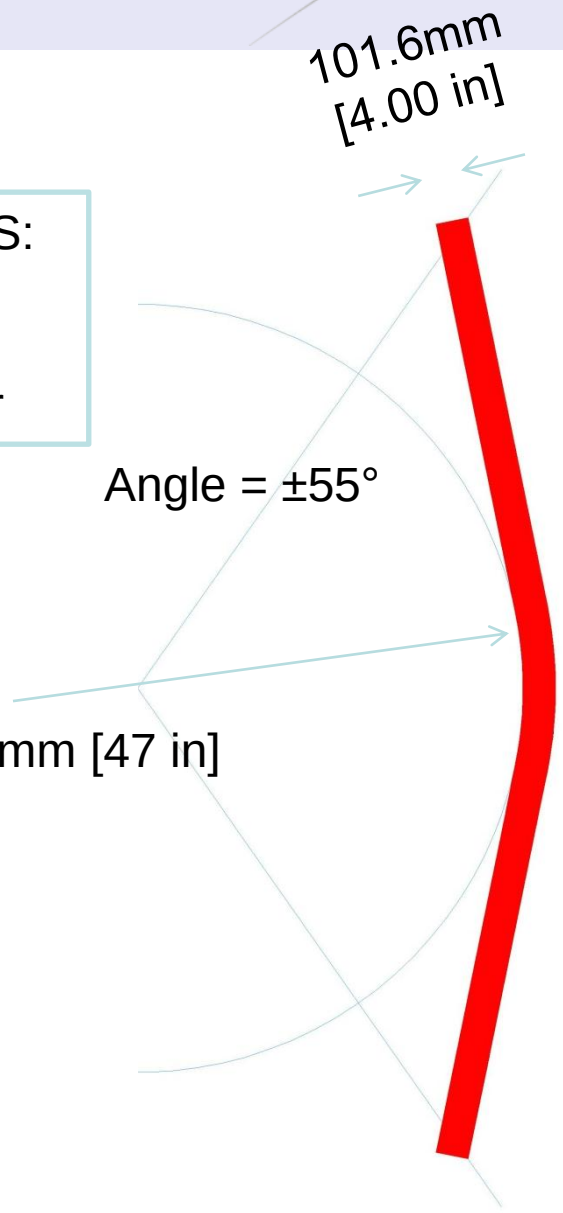


Courtesy of Steve Plate, BNL

Shield Section

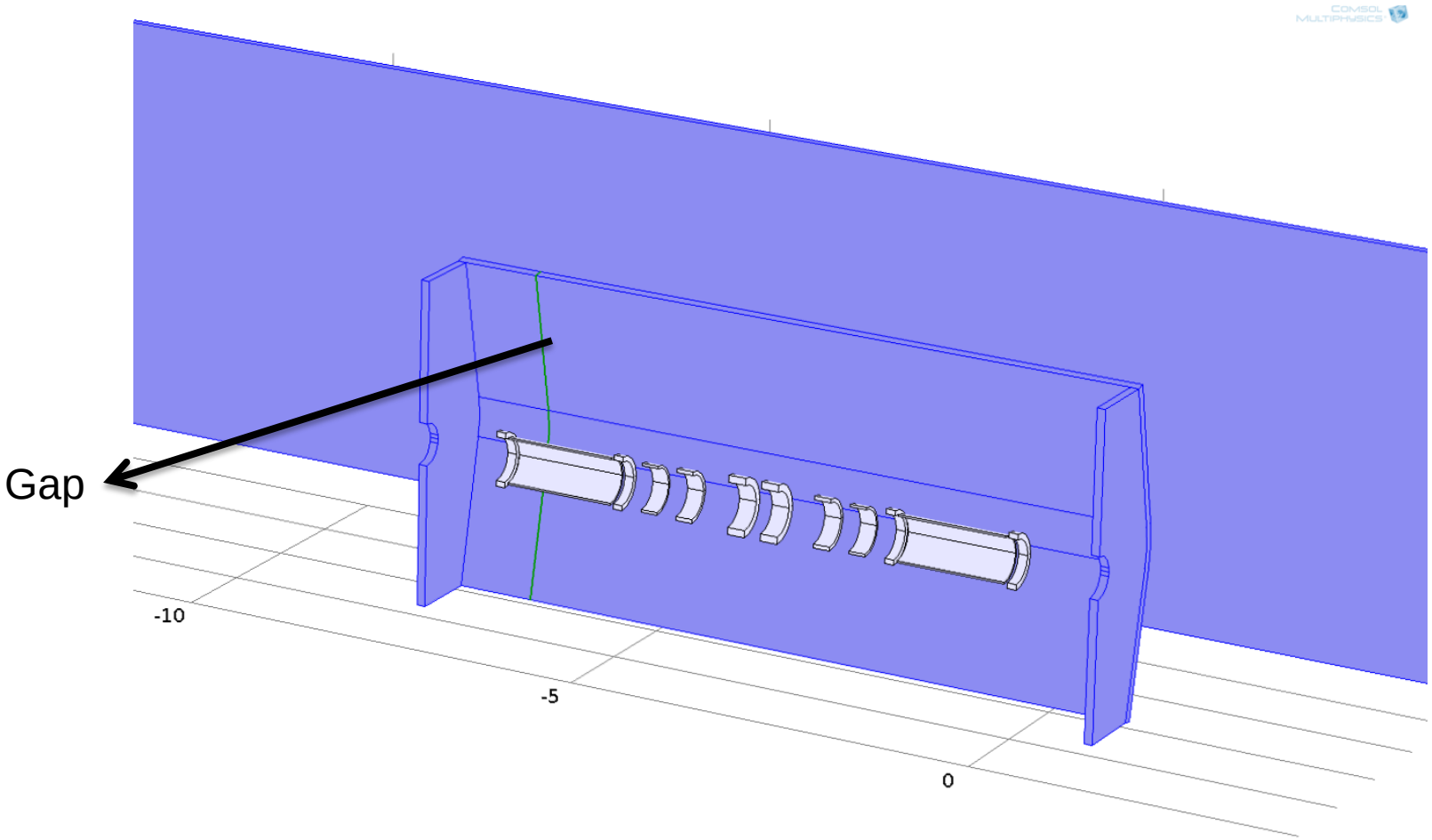


REQUIREMENTS:
- Concentricity
- Symmetry
- Extend to floor



Courtesy of Steve Plate, BNL

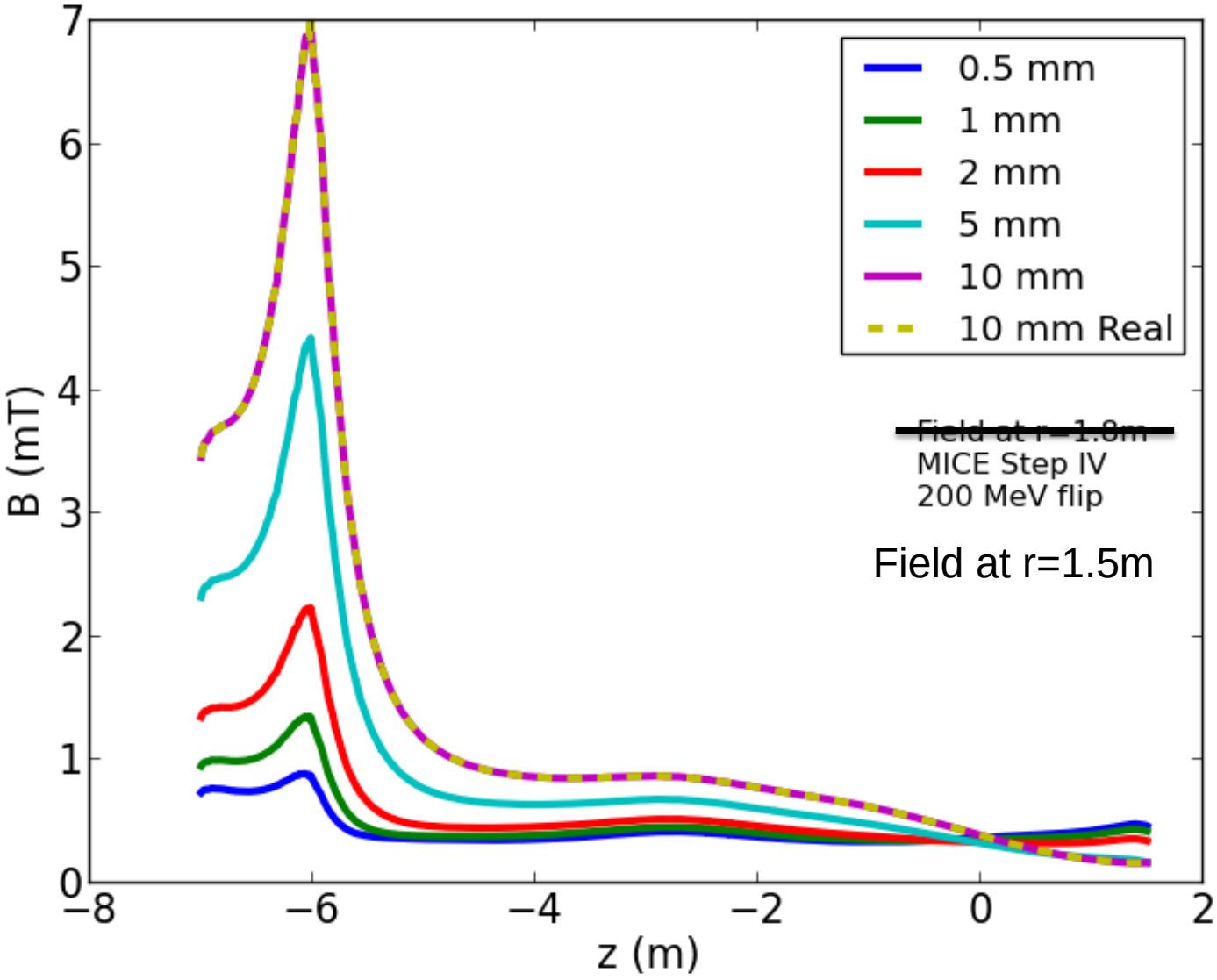
Joints



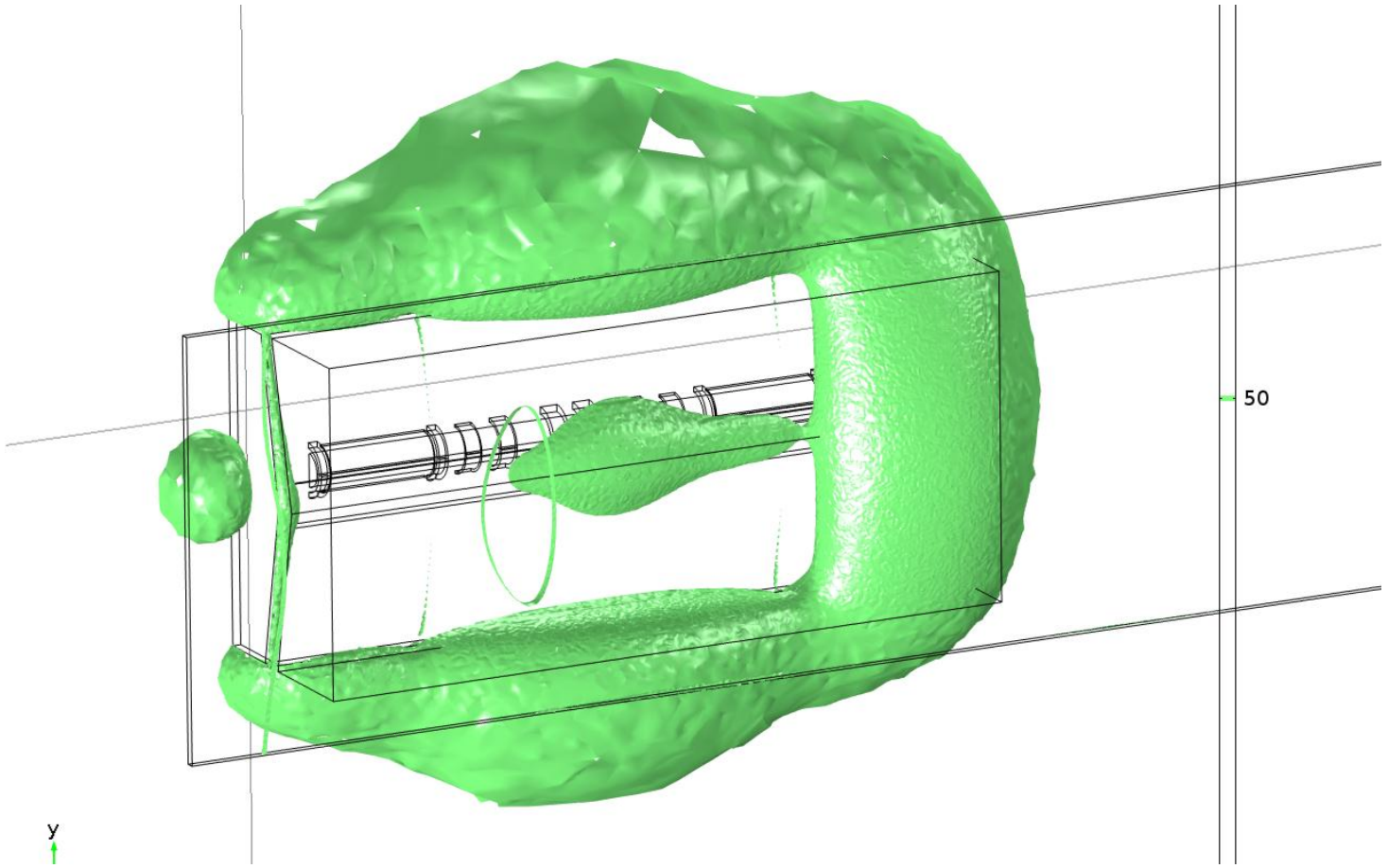
Modelled using
thin permeability gap BC:

$$\mathbf{n} \times (\mathbf{H}_1 - \mathbf{H}_2) = \nabla_t \times \frac{d}{\mu_0 \mu_r} \nabla_t \times \mathbf{A}$$

Results

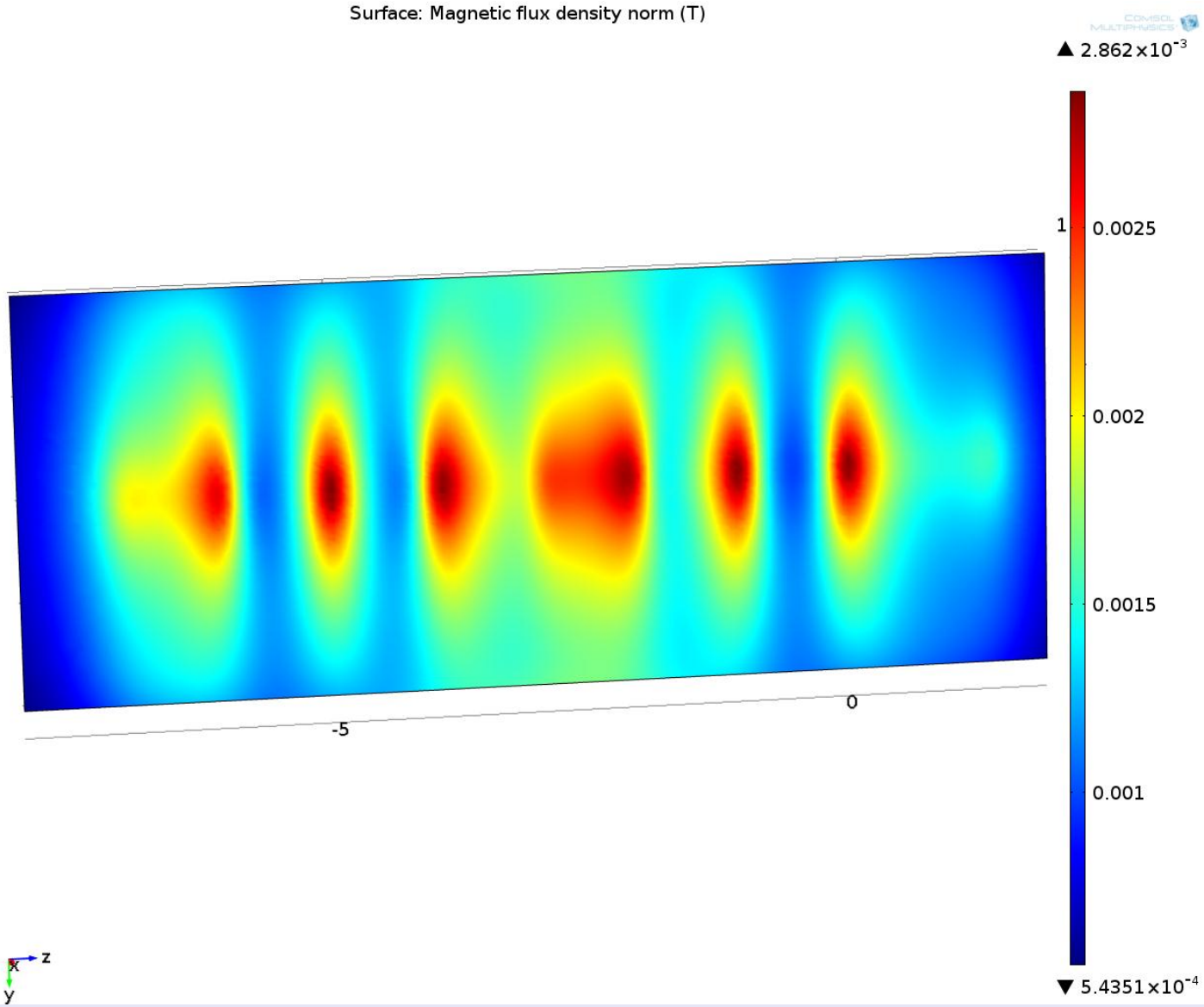

0.5 mm
1 mm
2 mm
5 mm
10 mm
10 mm Real
Field at r=1.8m
MICE Step IV
200 MeV flip
Field at r=1.5m
B (mT)
z (m)
0
1
2
3
4
5
6
7
−8
−6
−4
−2
0
2

Iso-Surface 5 Gauss

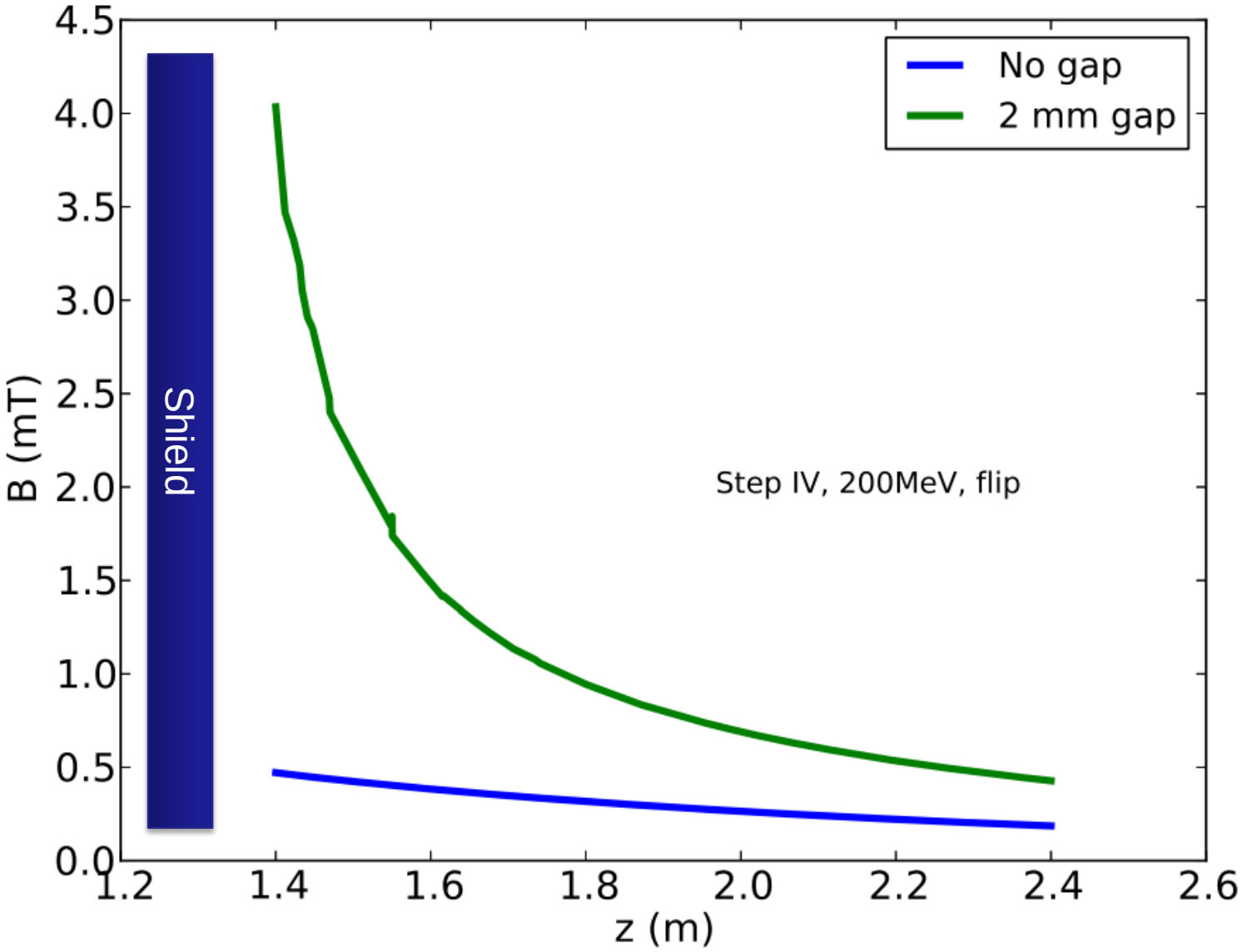


2 mm Gap

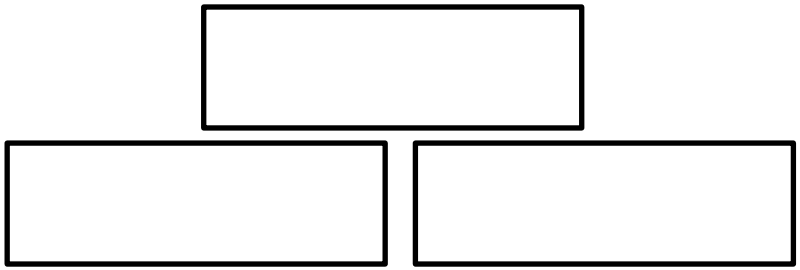
Multiple Gaps



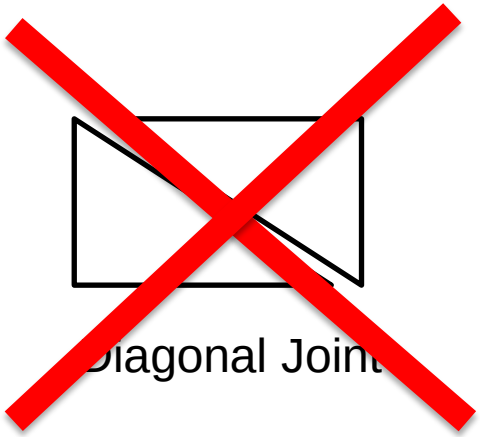
Field in Horizontal Direction



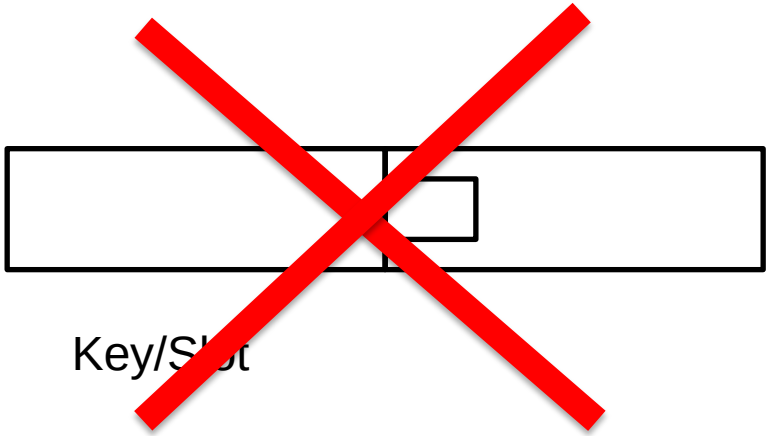
Solutions?



Doubling up



Diagonal Joint



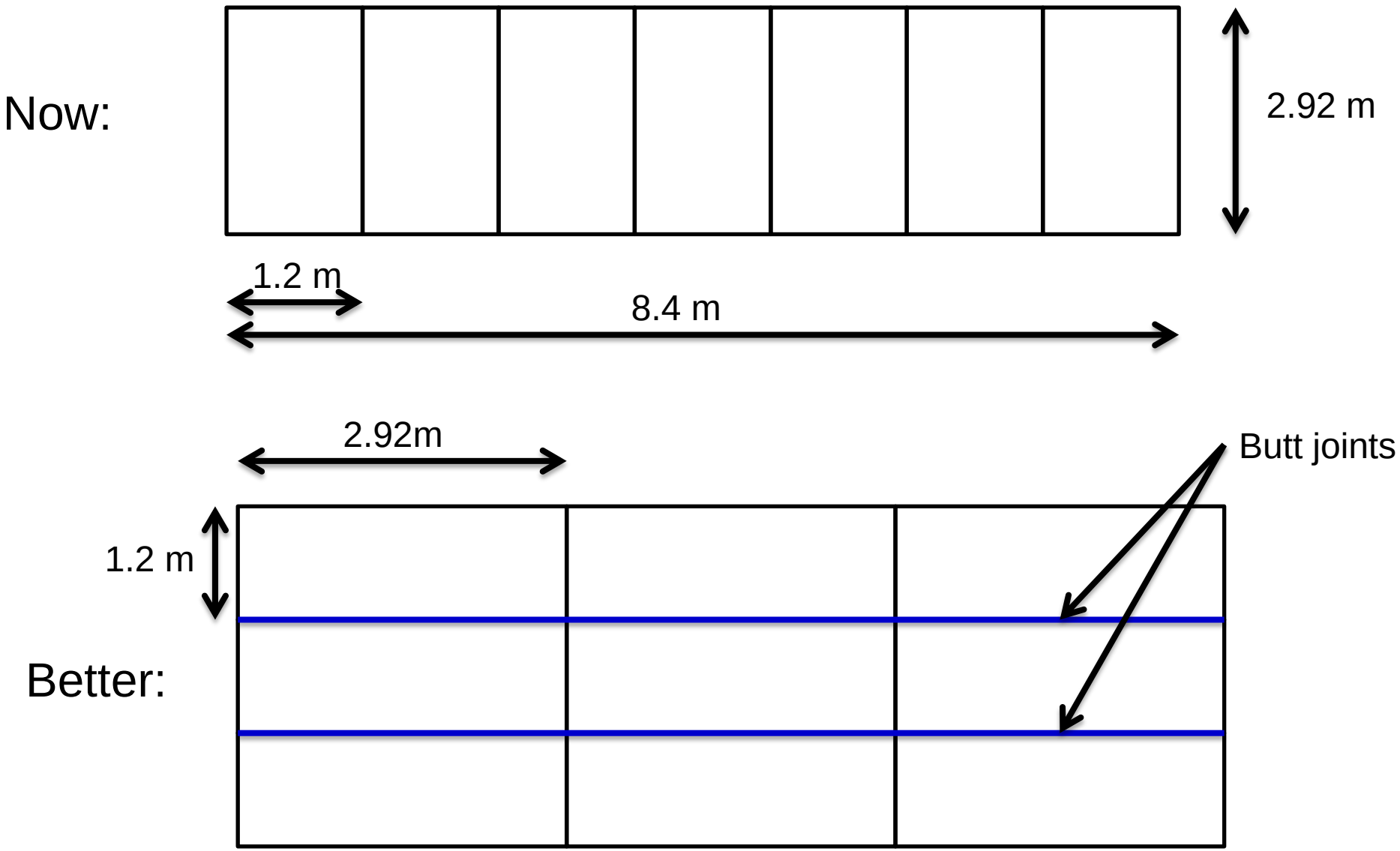
Key/Slot

Butt joint

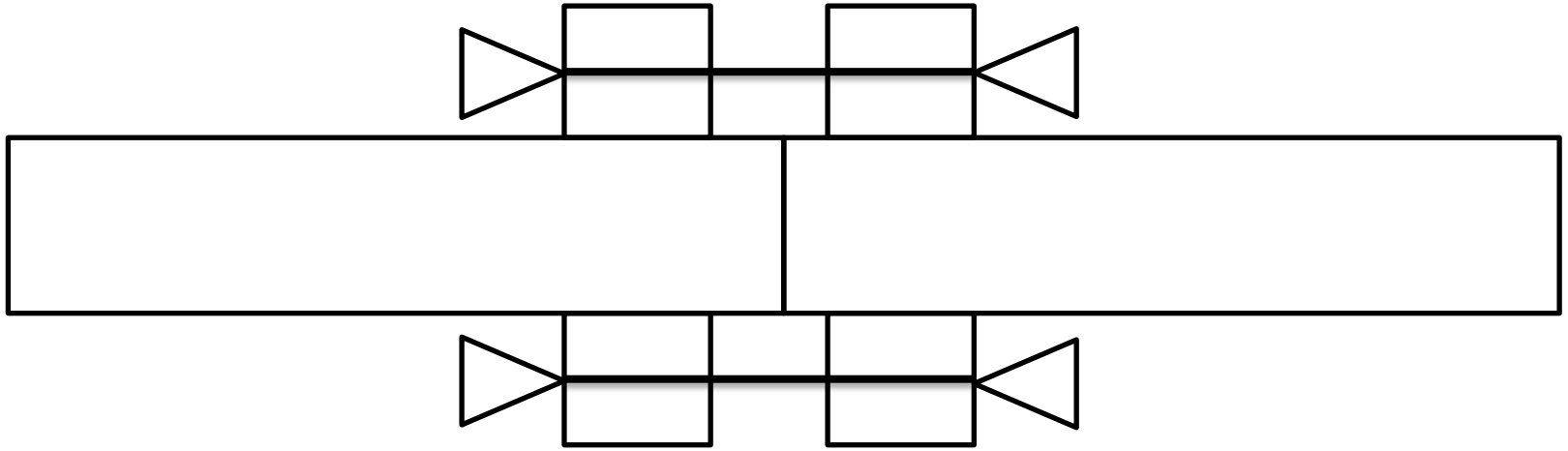
Options

- Live with situation
  - Improvements should be possible by minimizing azimuthal gaps
- Butt joints + pressure
  - Tightening bolts
  - Tolerances?
- Doubling up joints
  - Space?

Avoiding Azimuthal Joints

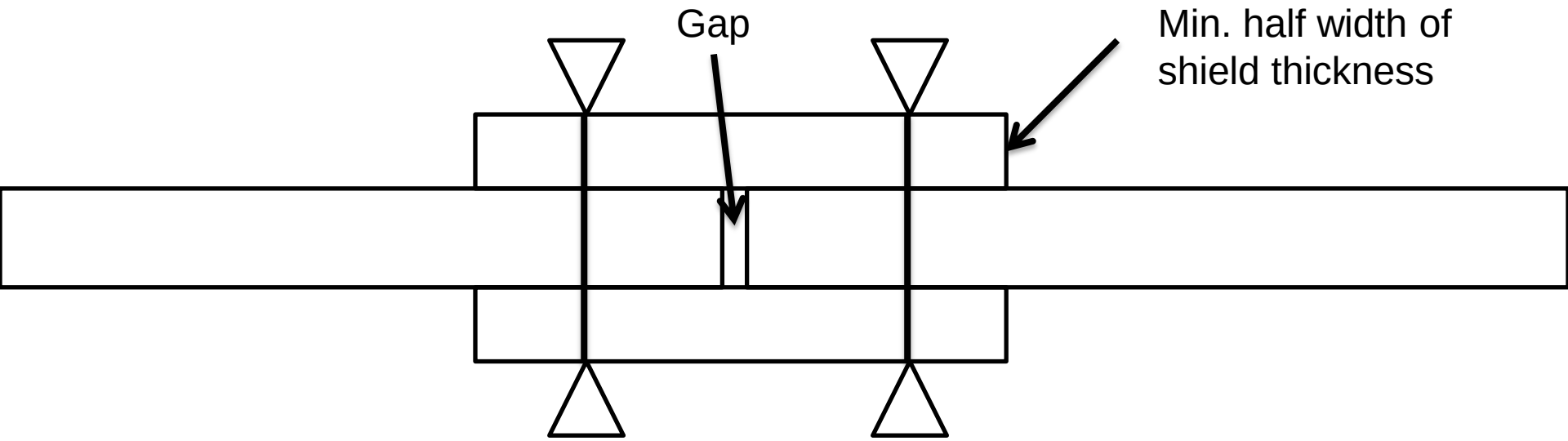


Butt Joints



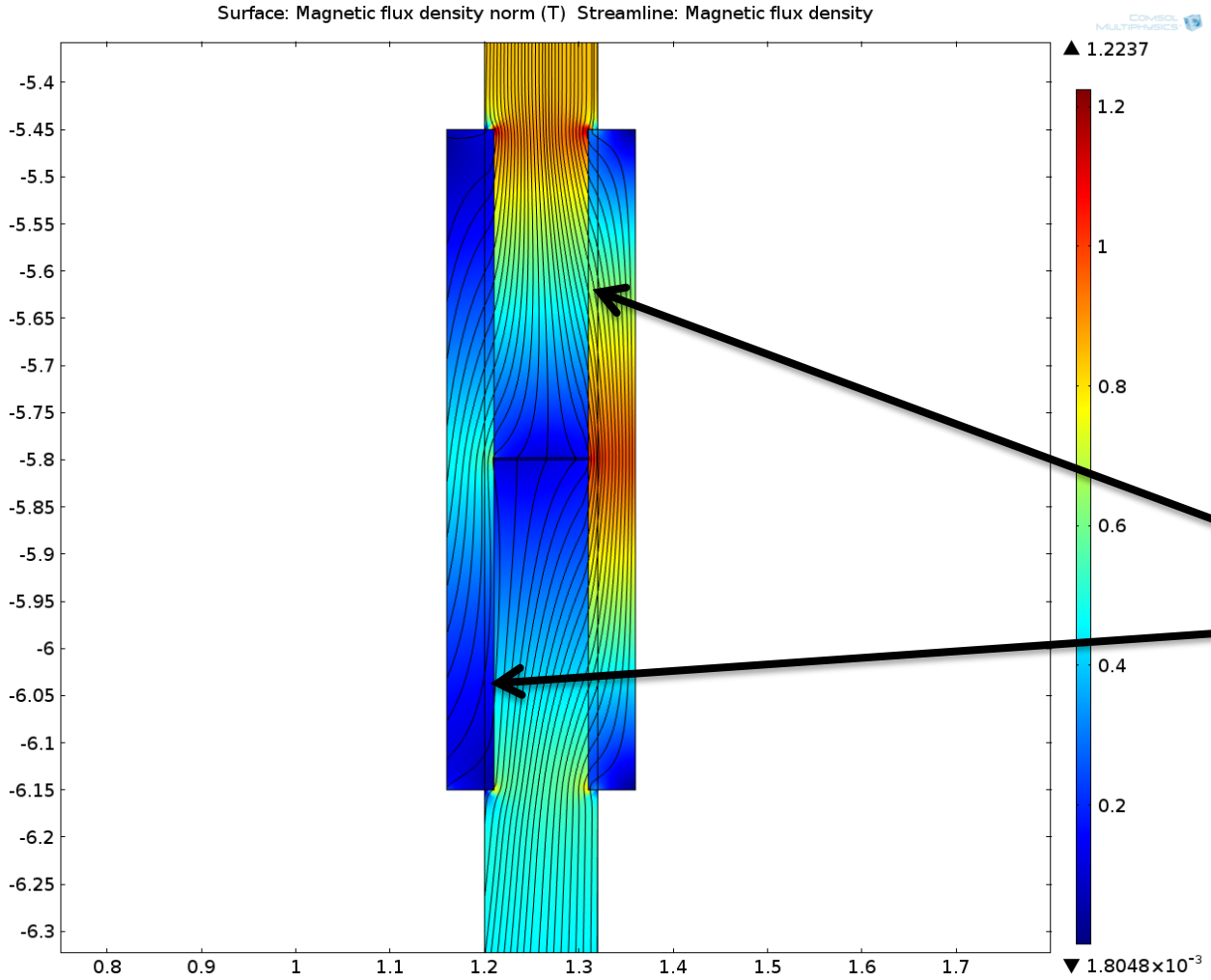
- Minimize width of gap – requires machining
- make connection to push pieces together
- Potential issues:
    - tolerances (faces need to be parallel over long distance)
    - 1/100 degree deviation: 1 mm off

Doubling Up



- Connection piece: min. half thickness of shield thickness
  - Or different material
- Need to cover large area, not just gap
  - How much will depend on gap between connection piece and shield
  - Need to create low magnetic reluctance connection

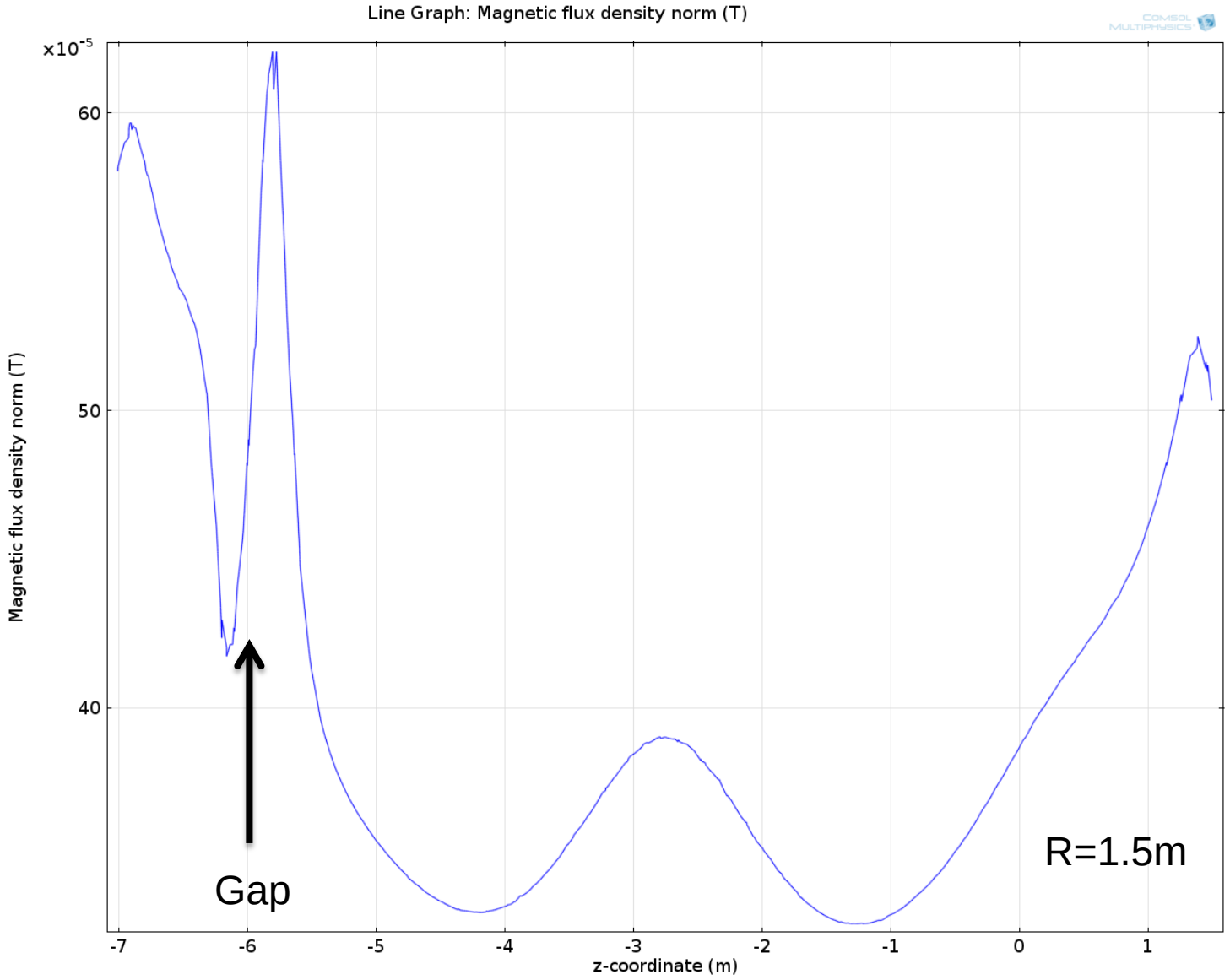
2D Axis-Symmetric Study



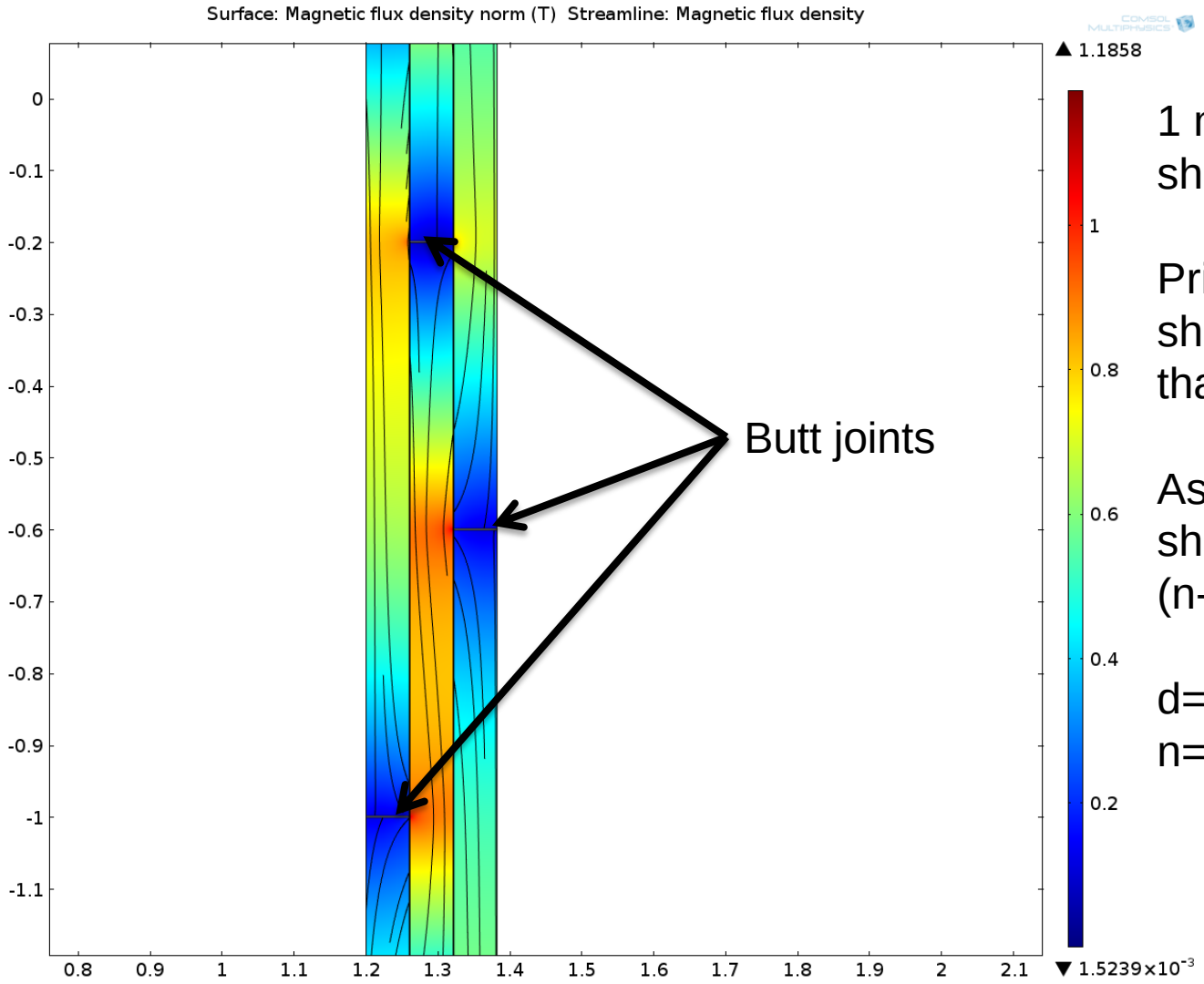
Simulation assumes
1 mm gap between
Connection plate
And disc

1 mm Gap

Field 3D Model



Variant: Nesting Multiple Shields



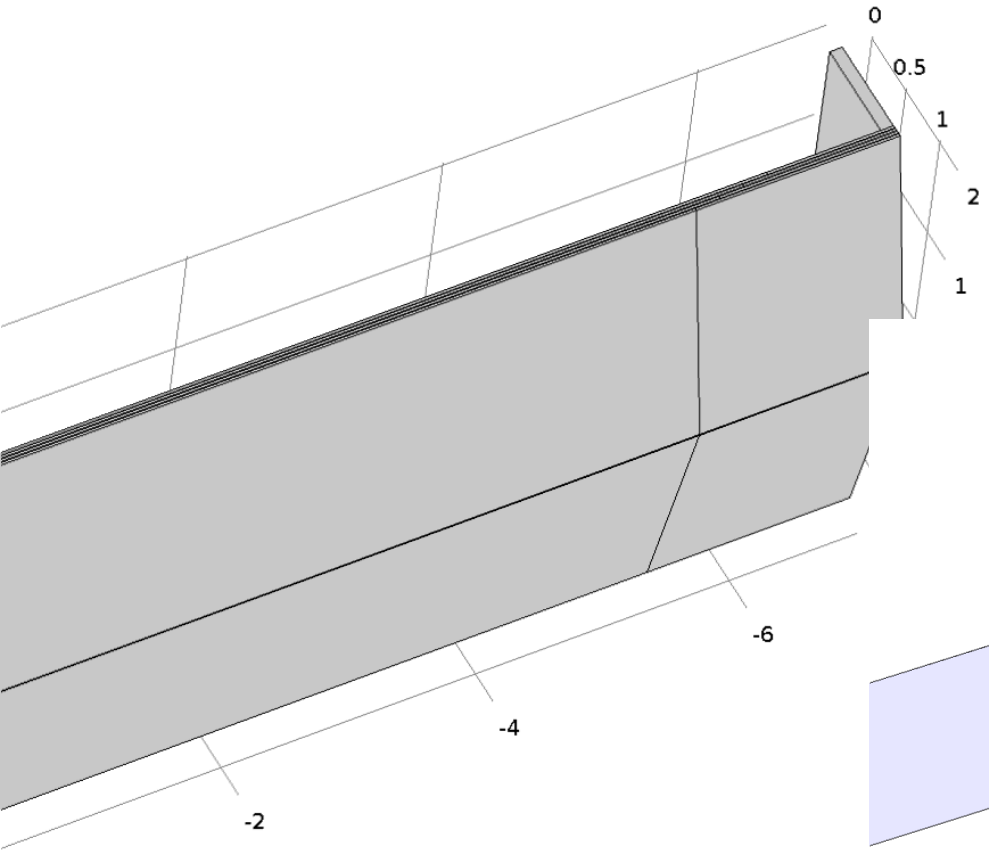
1 mm gap between shields in radial direction

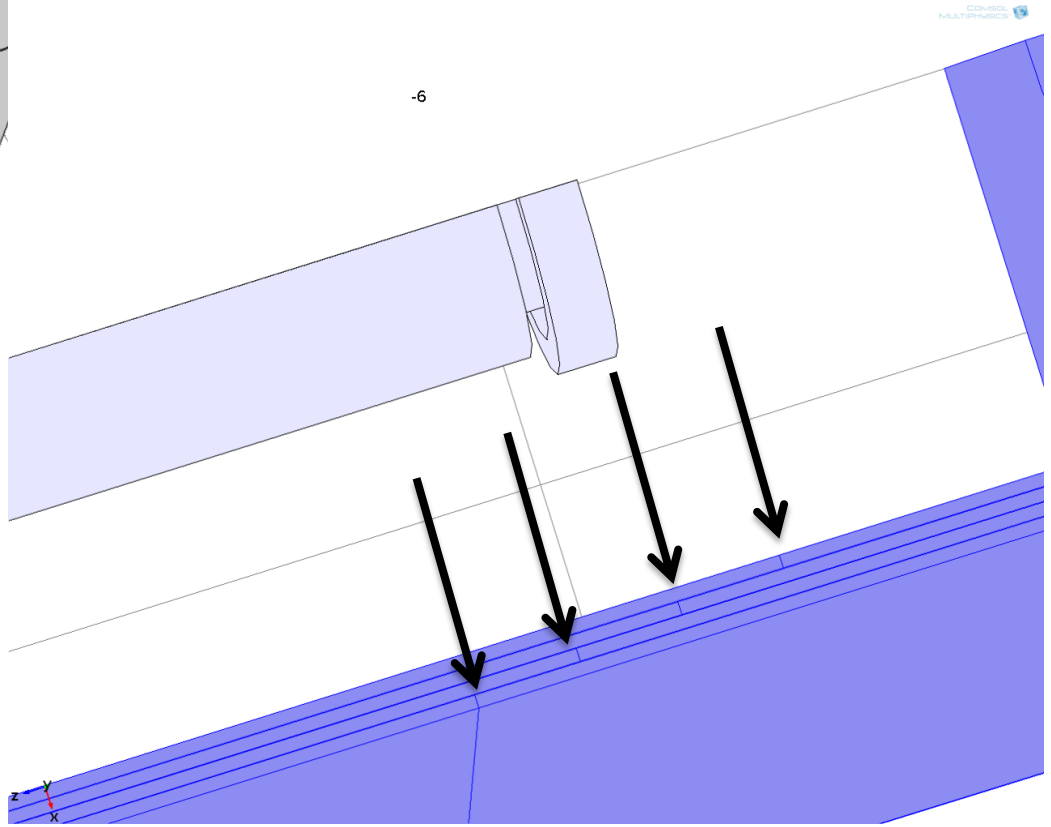
Principle: shift shields longitudinally so that two gaps never line up

As efficient as monolithic shield with thickness (n-1)*d

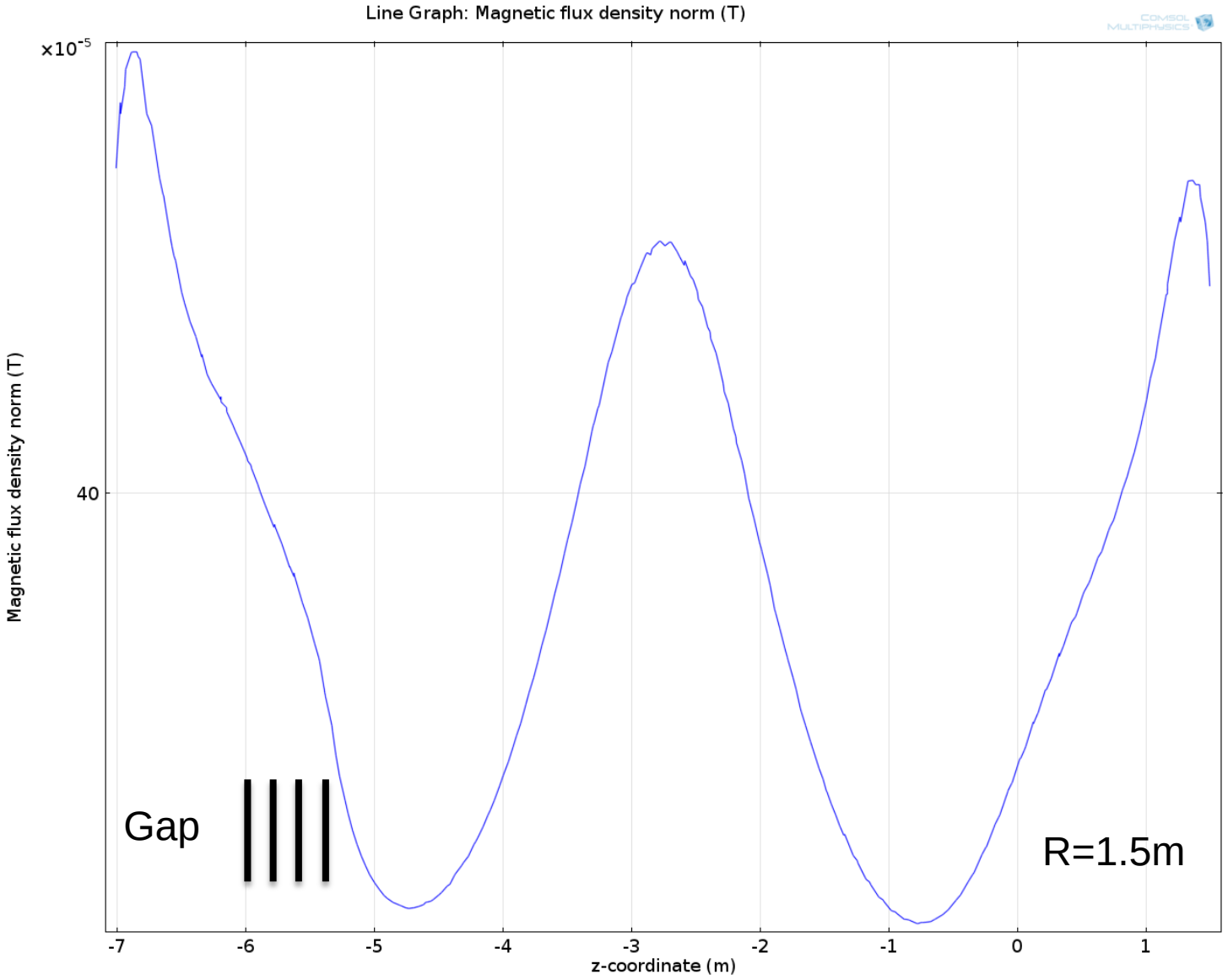
d=indiv. shield thickness
n=Number of shields

Multiple Shields





Multiple Shields - Field



(Short) Discussion

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- Butt joints
  - Looks tricky to me to get the tolerances at the faces right
- Doubling up at joint
  - Probably also the most space consuming solution
  - We can decide to go for a better material to make the joint, e.g. FeCo (B>2T); connection pieces could be thinner
- Nesting Multiple Shields
  - Looks elegant, but maybe costly?
- Waiting for engineering feedback