

# Magnetic Fields in and around ILD

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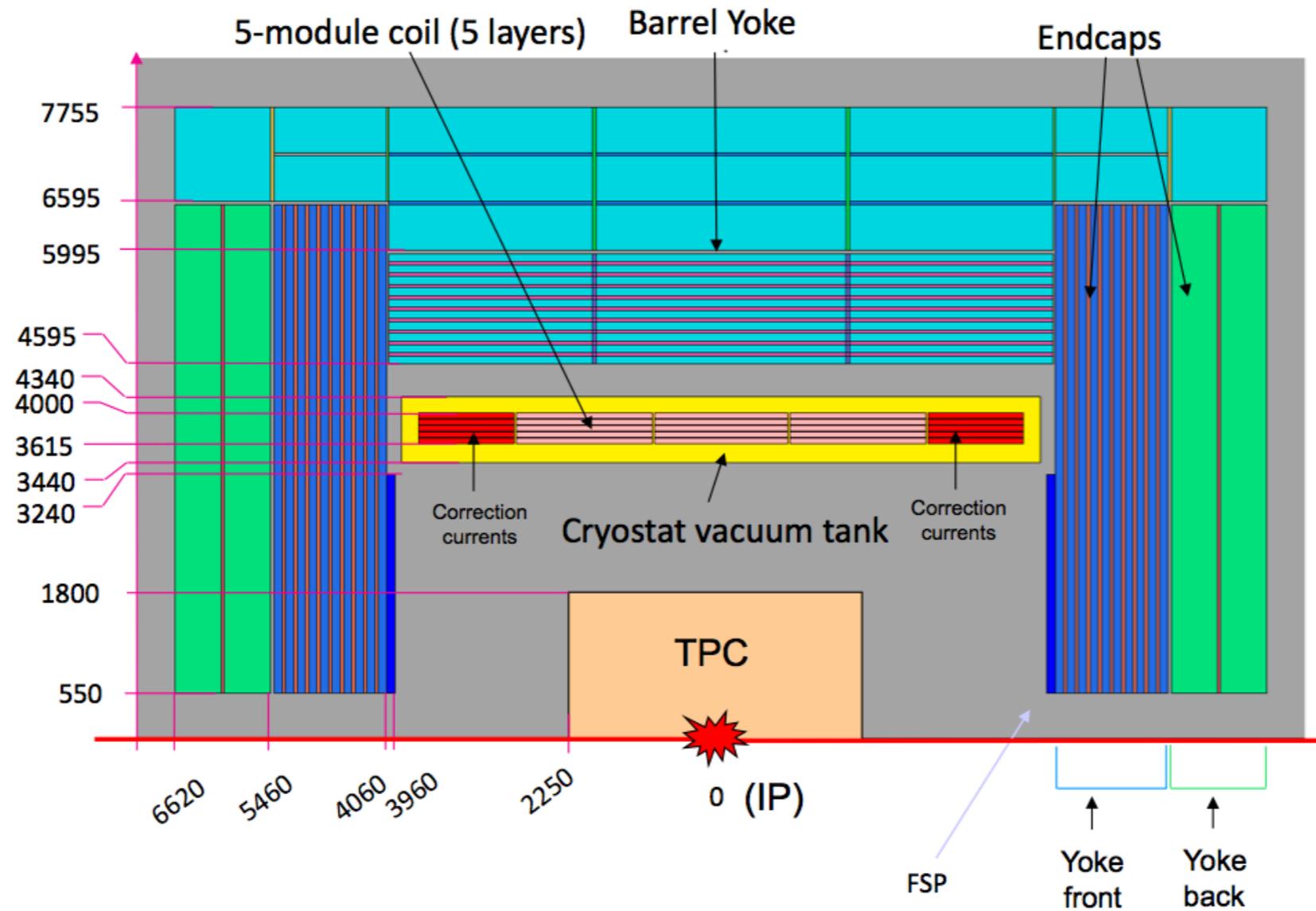
Karsten Buesser

ALCW15

24.04.2015

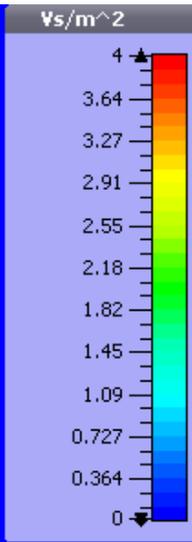
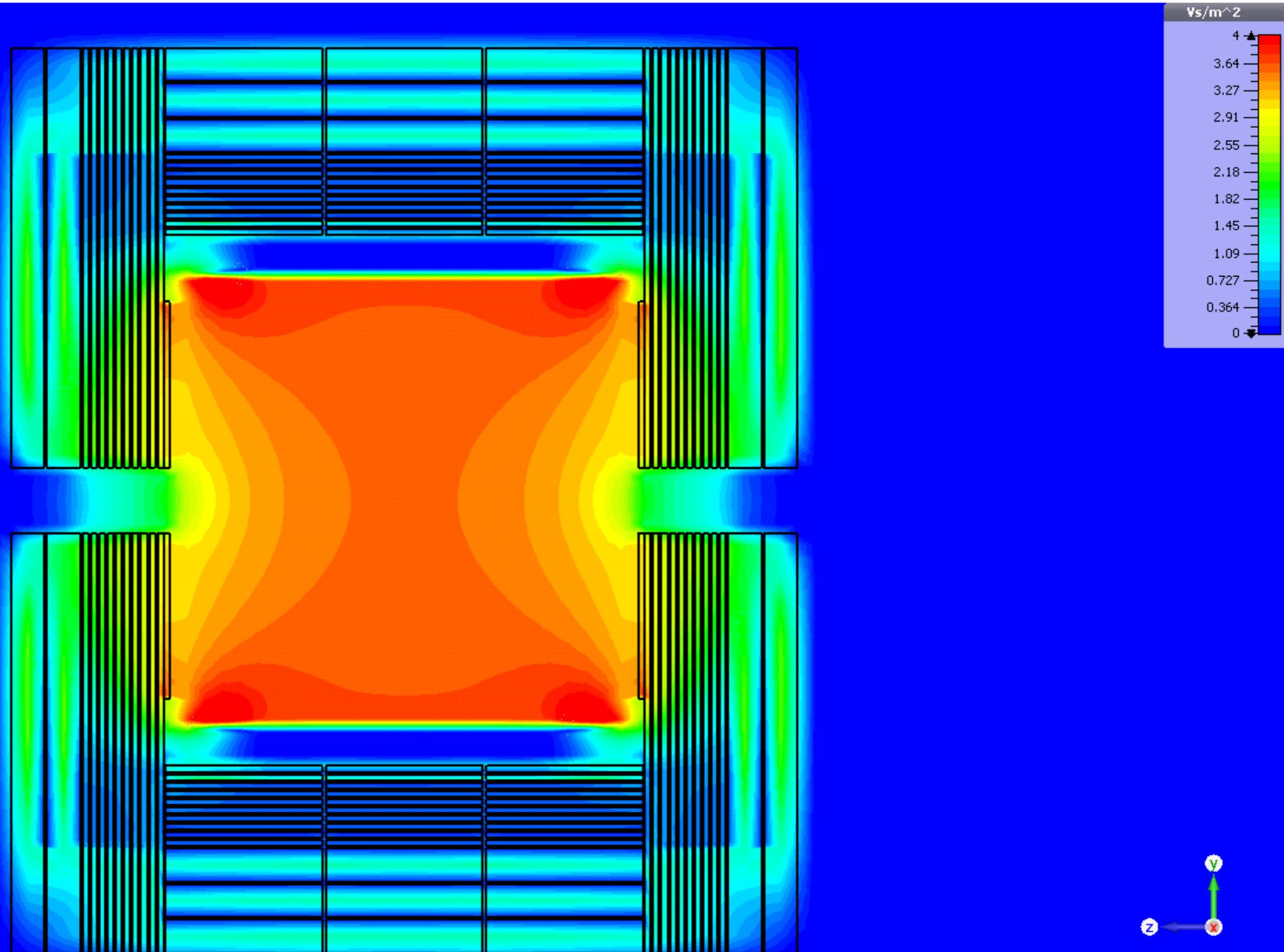


# ILD Solenoid Design - Lol

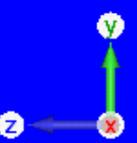


- 5 modules:
  - 3 solenoid coils modules
  - 2 solenoid correction coil modules

# ILD Field - Lol



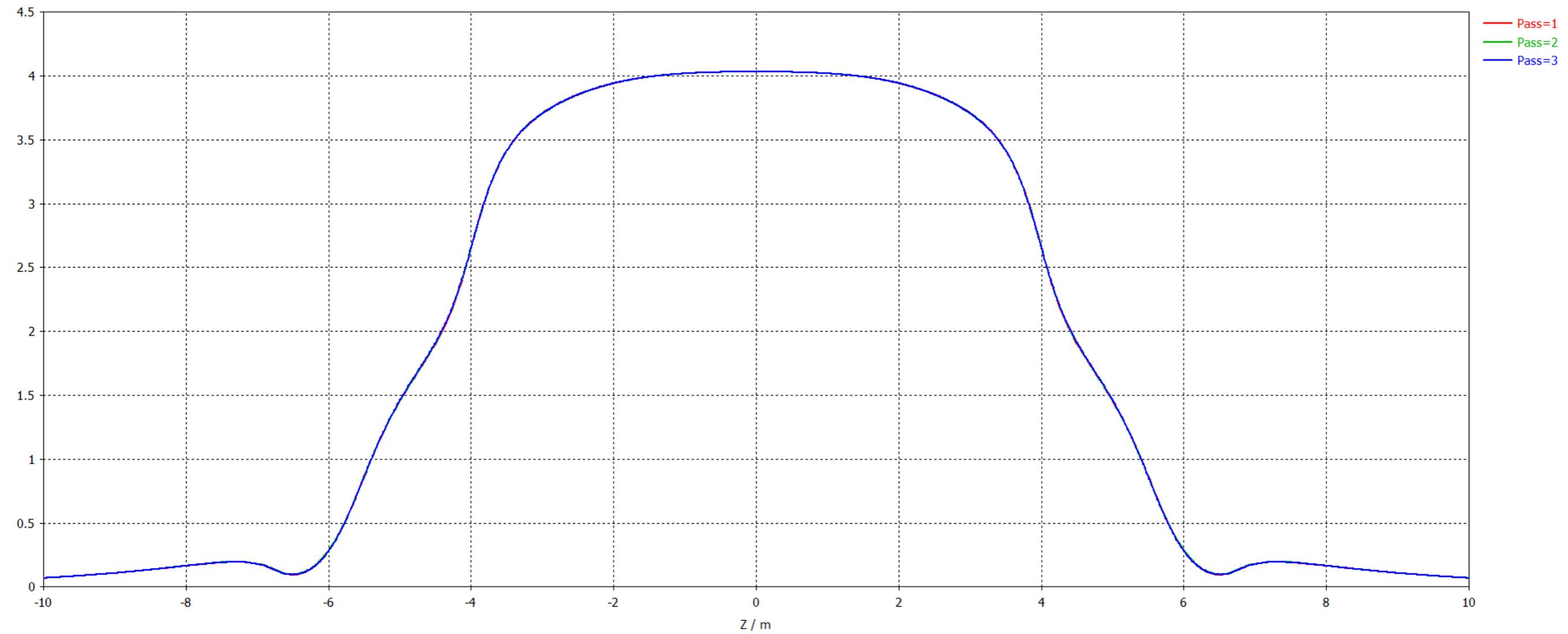
**B-Field**  
Cutplane name: Cross Section A  
Cutplane normal: 1, 0, 0  
Cutplane position: -3.638e-12  
Component: Abs  
2D Maximum [Vs/m<sup>2</sup>]: 4.659



# ILD Field - Lol

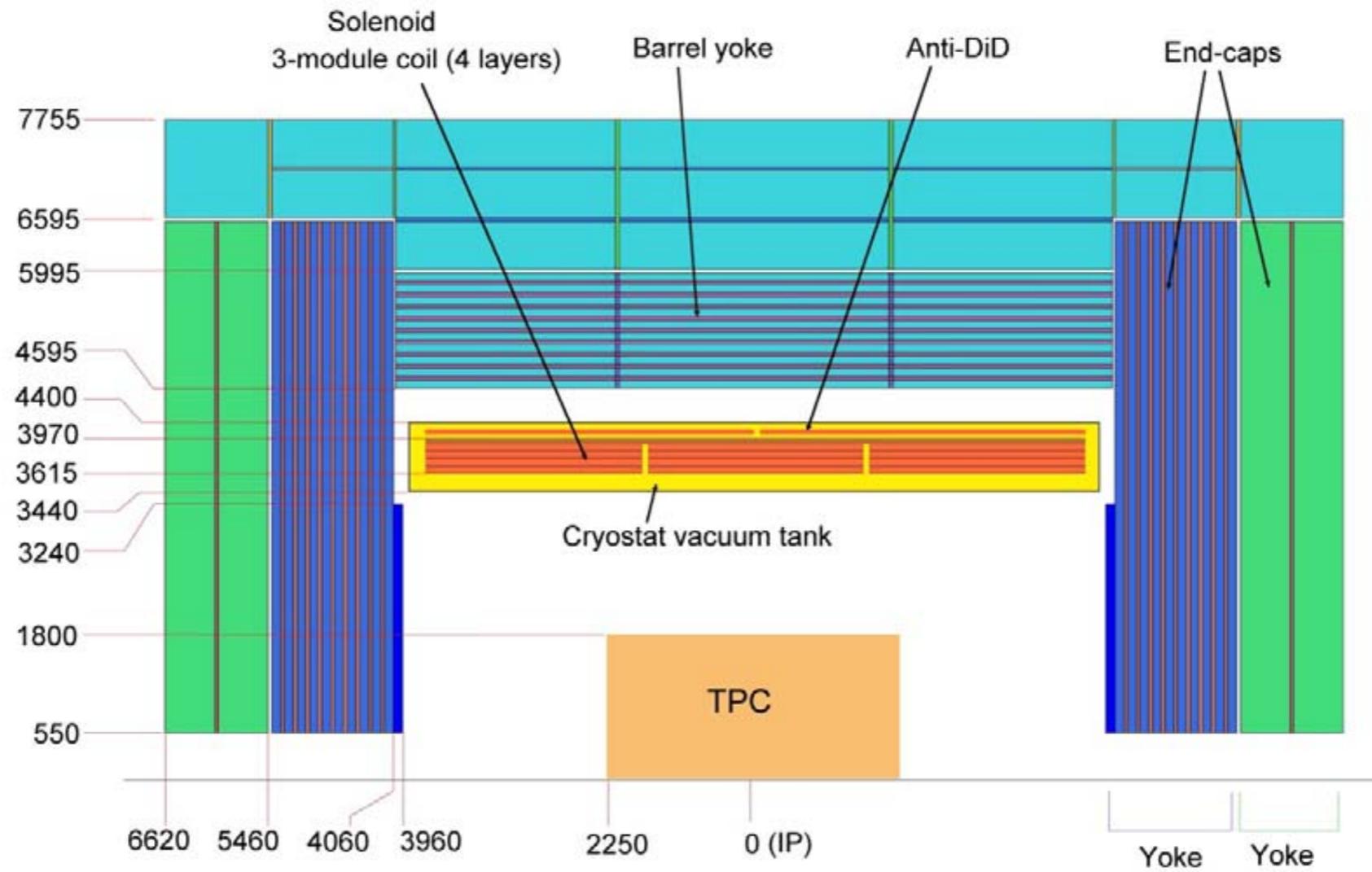


B-Field (Ms)\_Abs (Z)



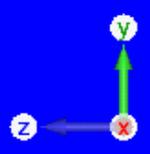
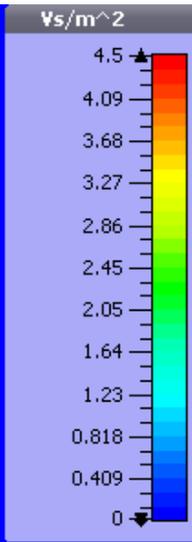
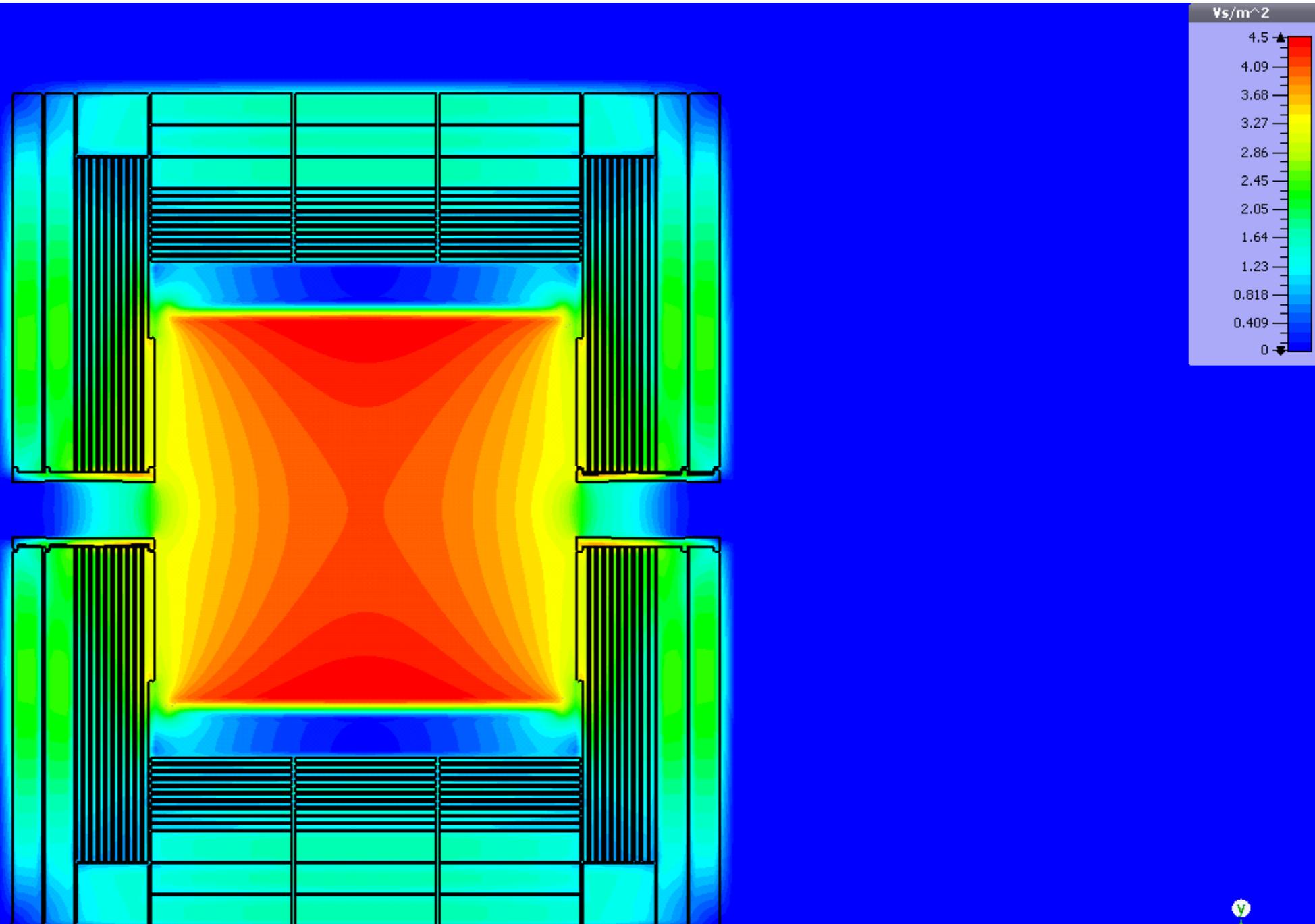
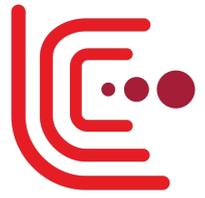


# ILD Magnet Design - DBD



- 3 modules of 4 layers, no correction coils (LC-DET-2012-081)
  - complicated to build, abandoned after discussions with tracking group
    - LC-DET-2011-002
    - reasoning: field inhomogeneities by DID are larger than by removing correction coils
    - rely on good field mapping
- 3.5 T nominal field, designed for 4 T

# ILD Field - DBD

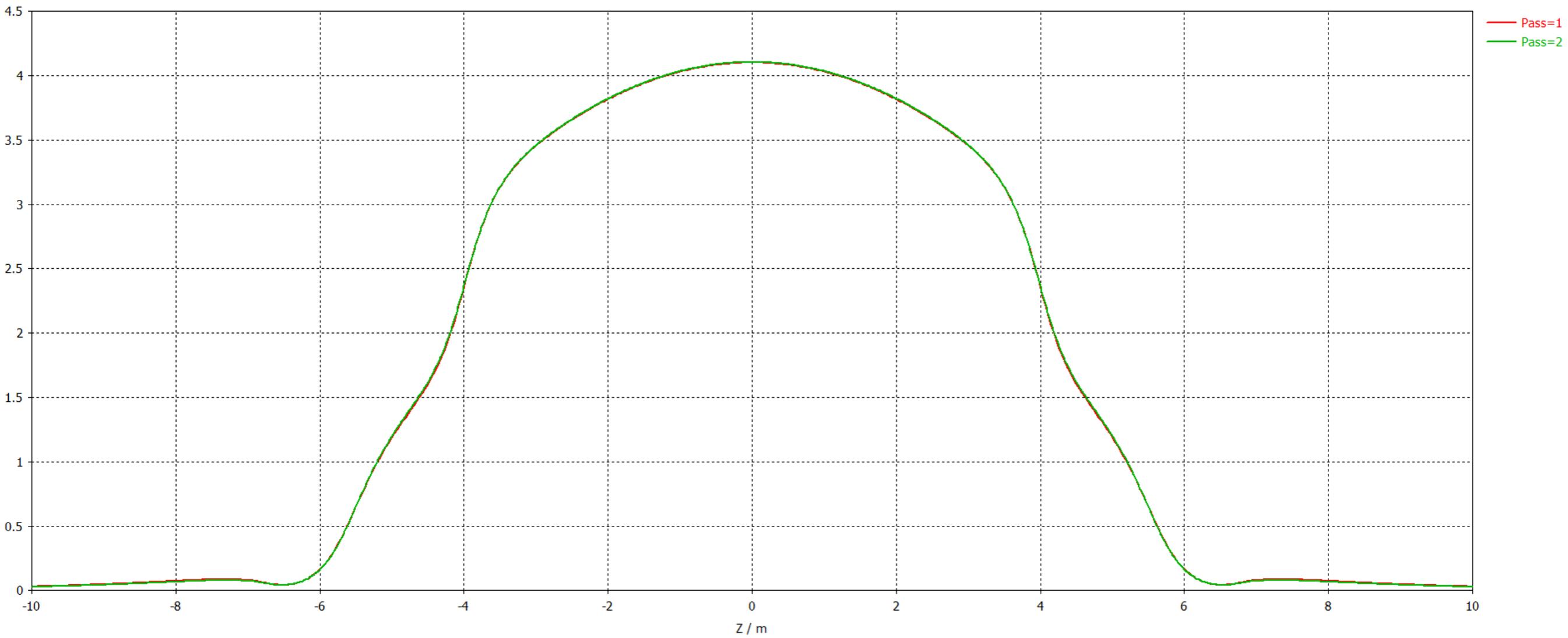


**B-Field**  
Cutplane name: Cross Section A  
Cutplane normal: 1, 0, 0  
Cutplane position: 0  
Component: Abs  
2D Maximum [Vs/m<sup>2</sup>]: 4.513

# ILD Field - DBD



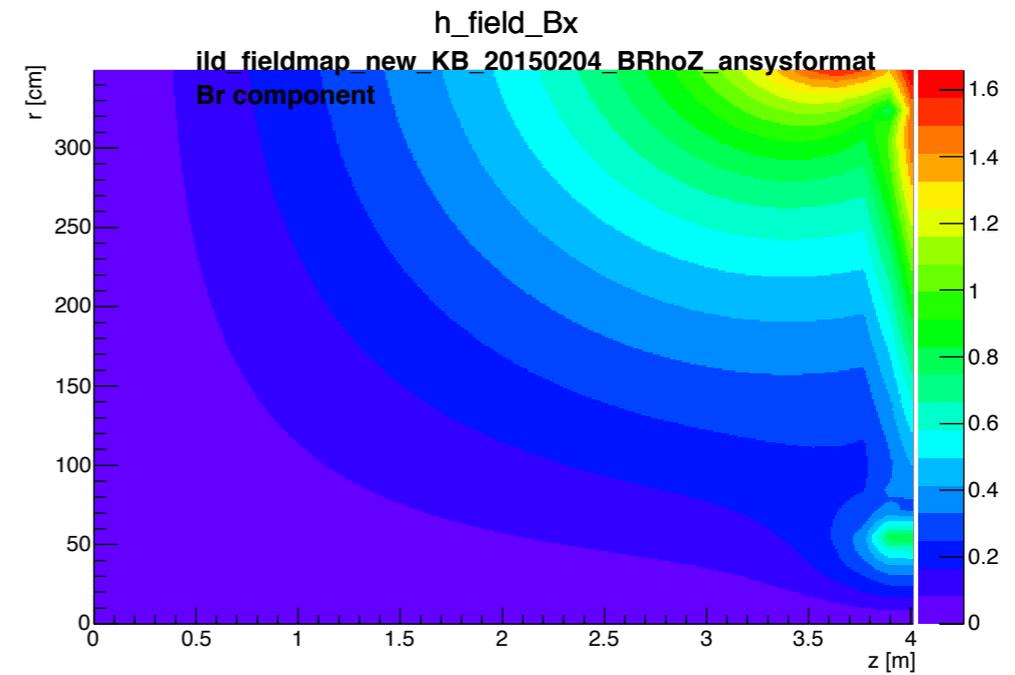
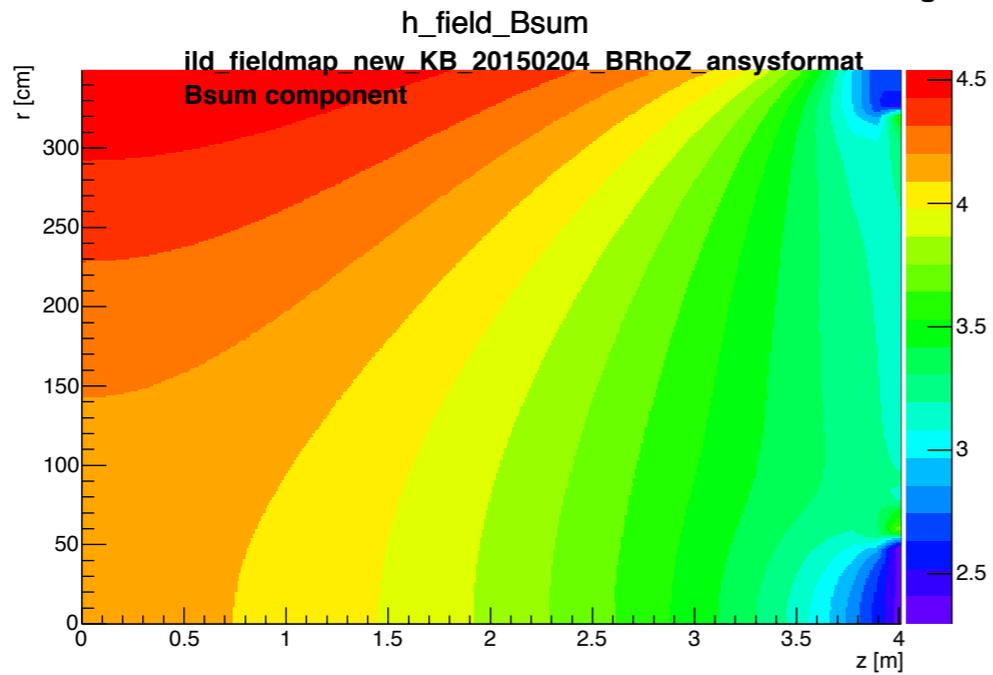
B-Field (Ms)\_Abs (Z)



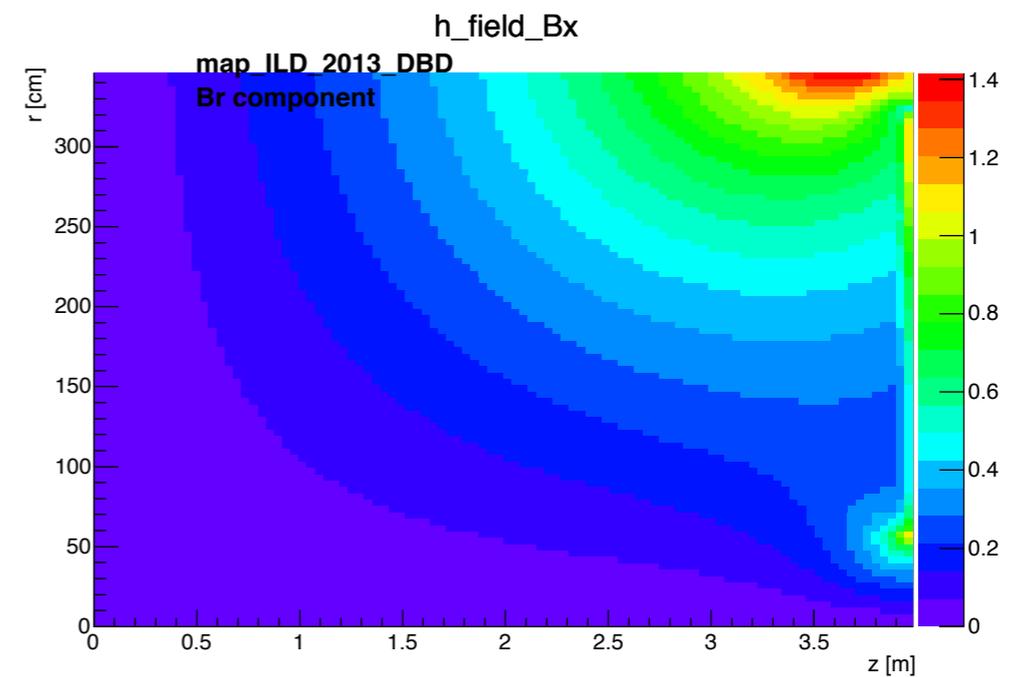
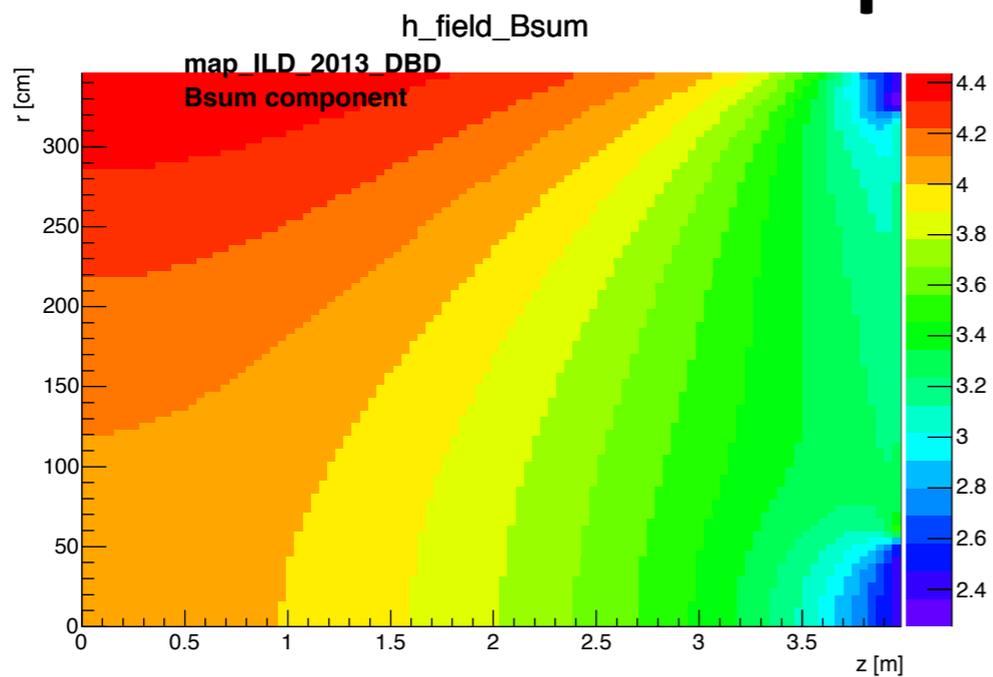
# Fieldmap Comparison CST/ANSYS



## Map from CST



## Map from ANSYS



# Anti-DID



- Detector Integrated Dipole
- Aligns integral magnetic field along outgoing beam (crossing angle)
- Mainly to reduce backgrounds on BeamCal
- Dipole windings around main solenoid
- this version is in the DBD:

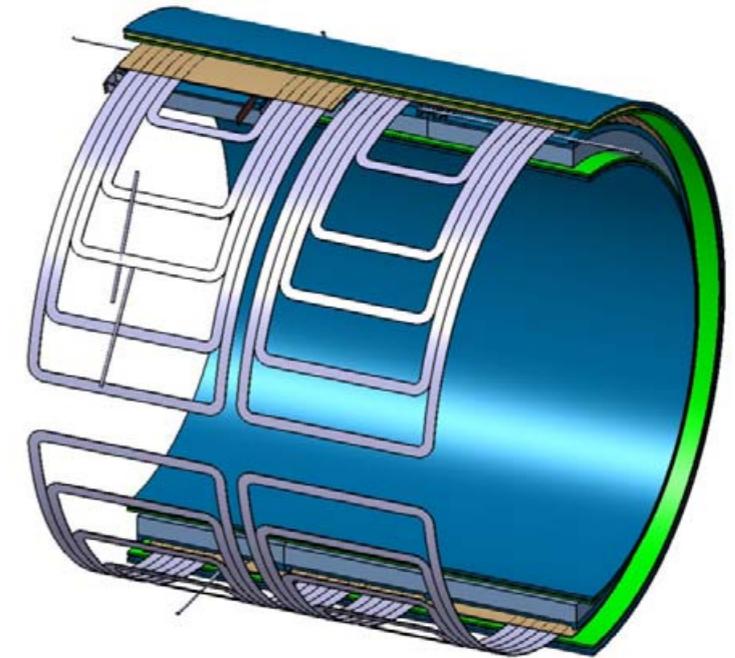
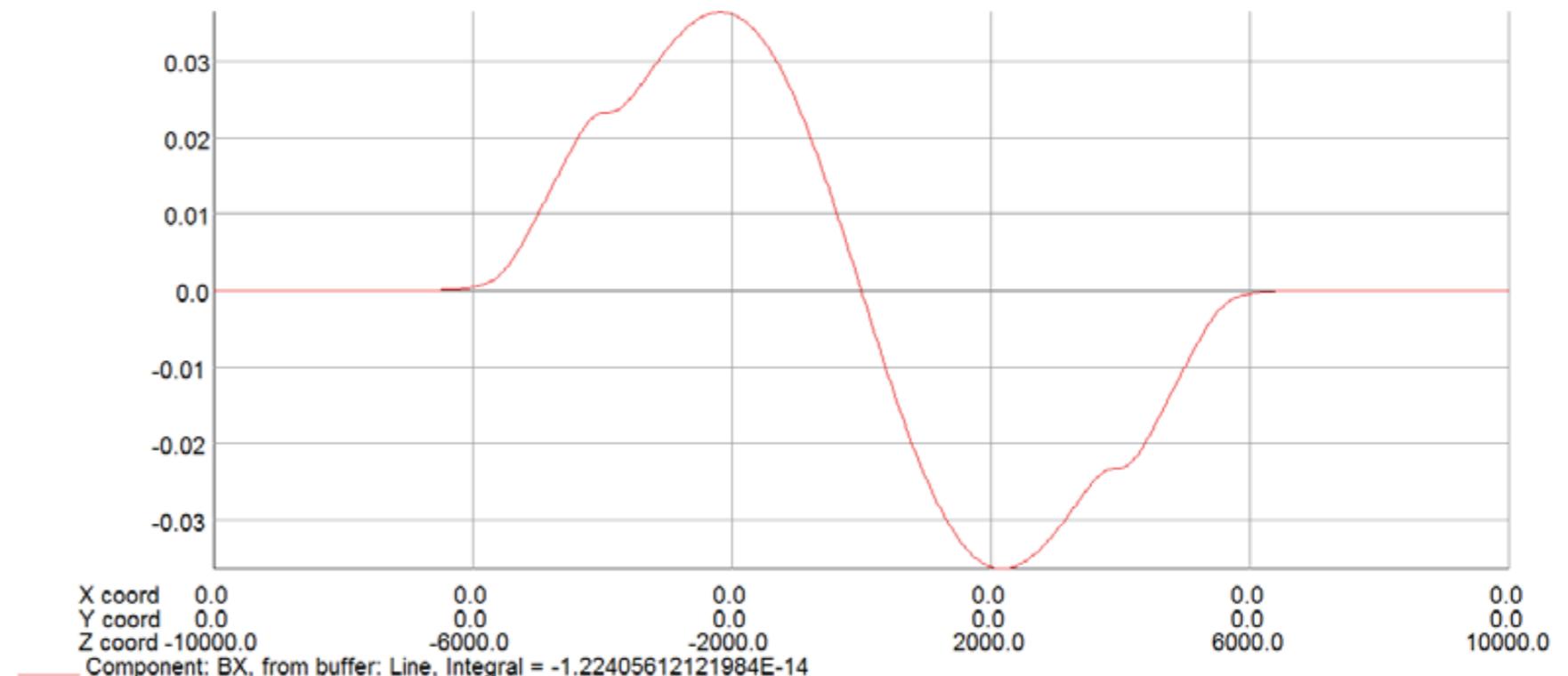


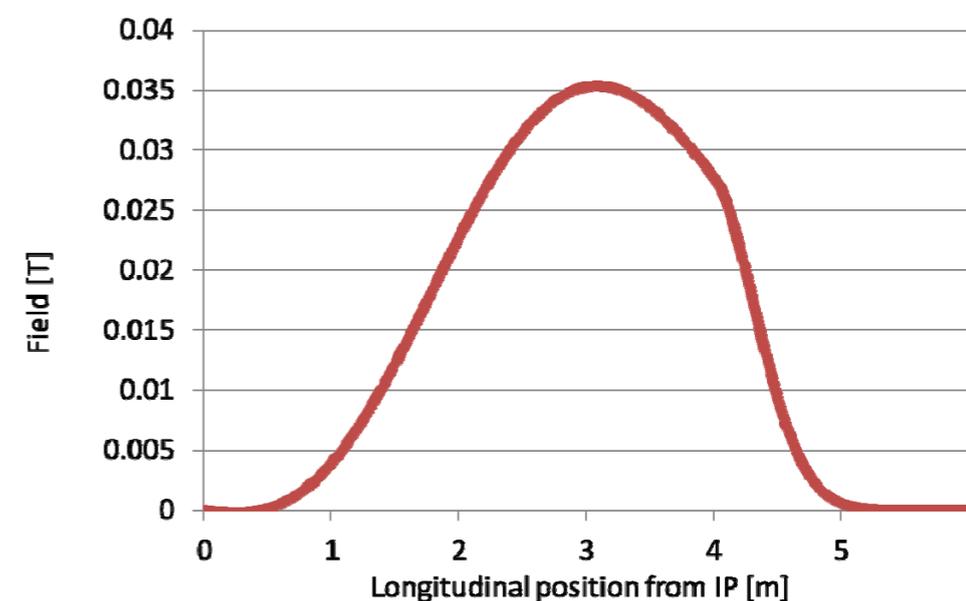
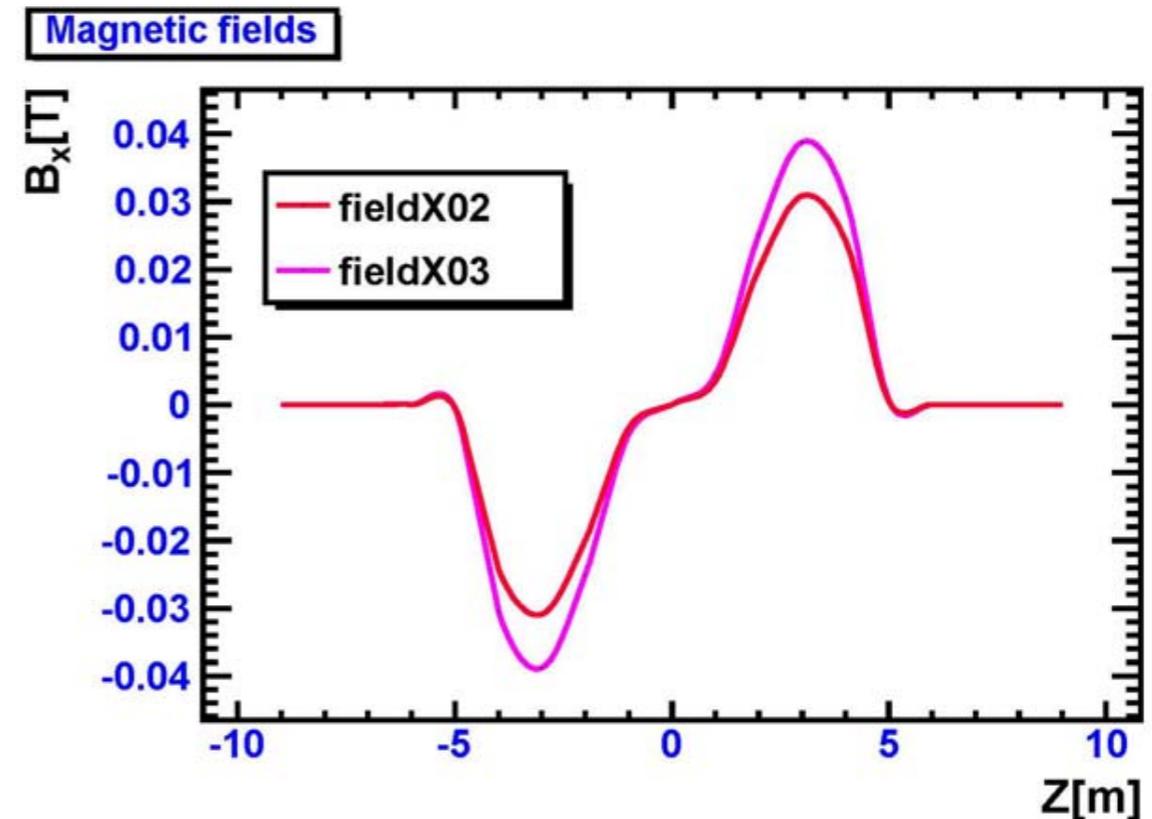
Figure 13: 3D view of the anti-DID (version 1).



# Anti-DID



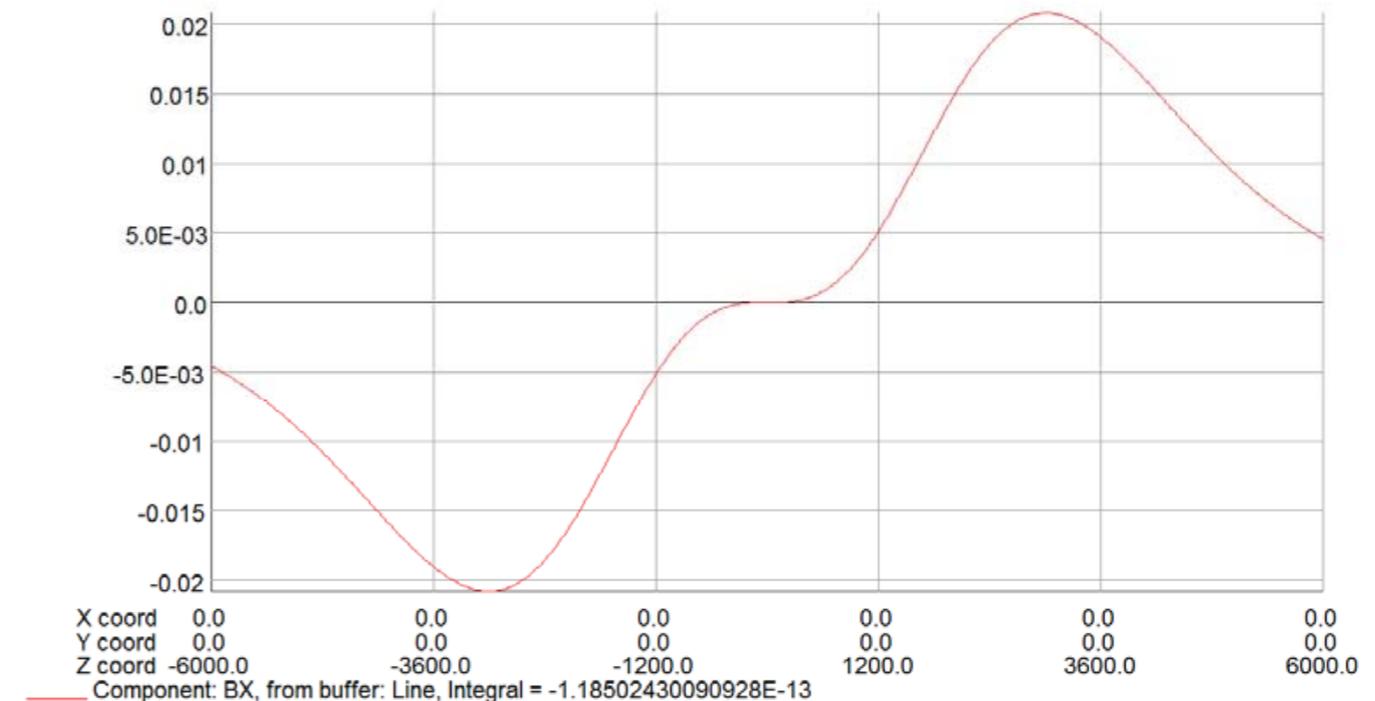
- Field versions used in full detector simulations are significantly different
  - typically hand-tuned to minimise background levels on BeamCal
- maximum field at  $\sim 3\text{m}$  from IP
- nearly flat-top zone at IP
- Designs have been used in studies of beam induced backgrounds:



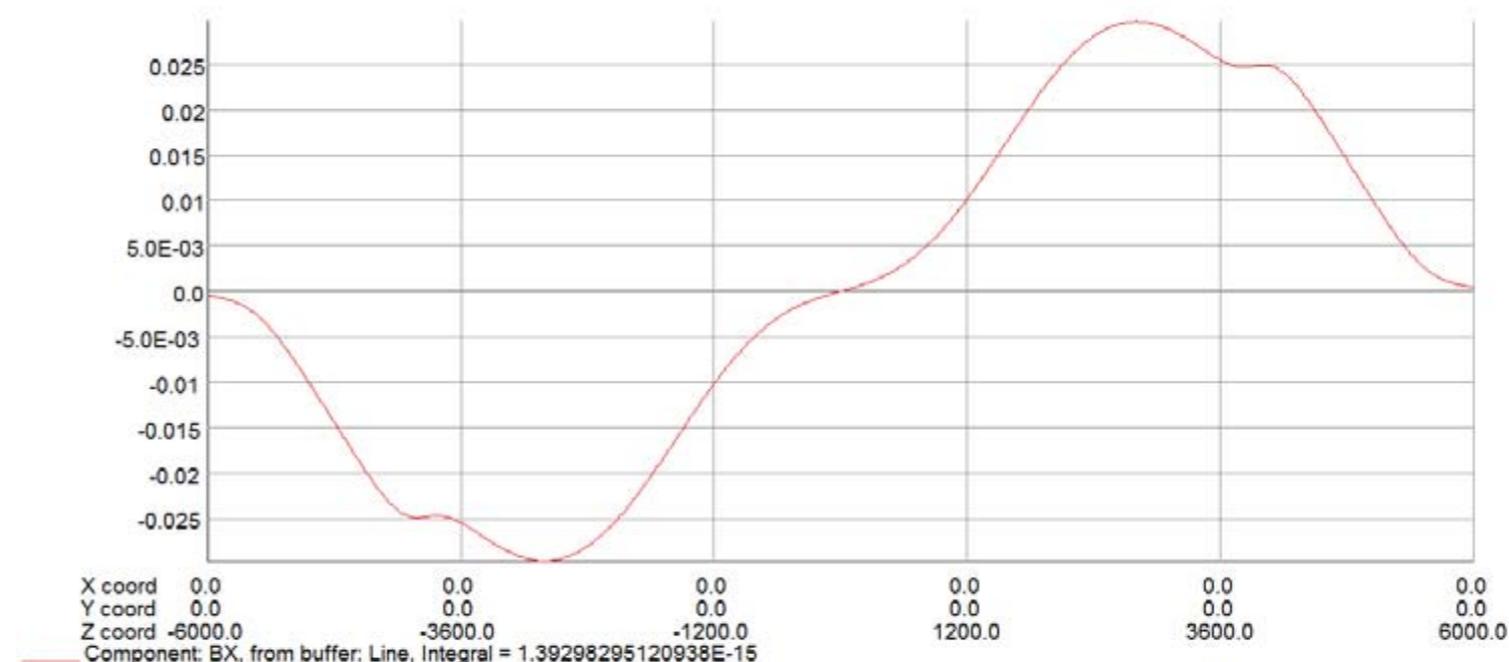


# Realistic Anti-DID

- Requirement: maximum field at 3m from IP and zero field up to 0.5m from IP (as in simulations)
- Technically extremely complicated
  - dipoles need to be split in two parts
  - much higher currents
- Realistic field with yoke and solenoid is far from perfect
- Need round of optimisation between simulation group and magnet experts on how the DID should look like
  - FYI: SiD considers to abandon DID as „it cannot be built“



Top: Anti-DID alone;  
bottom: Anti-DID, Solenoid within Yoke



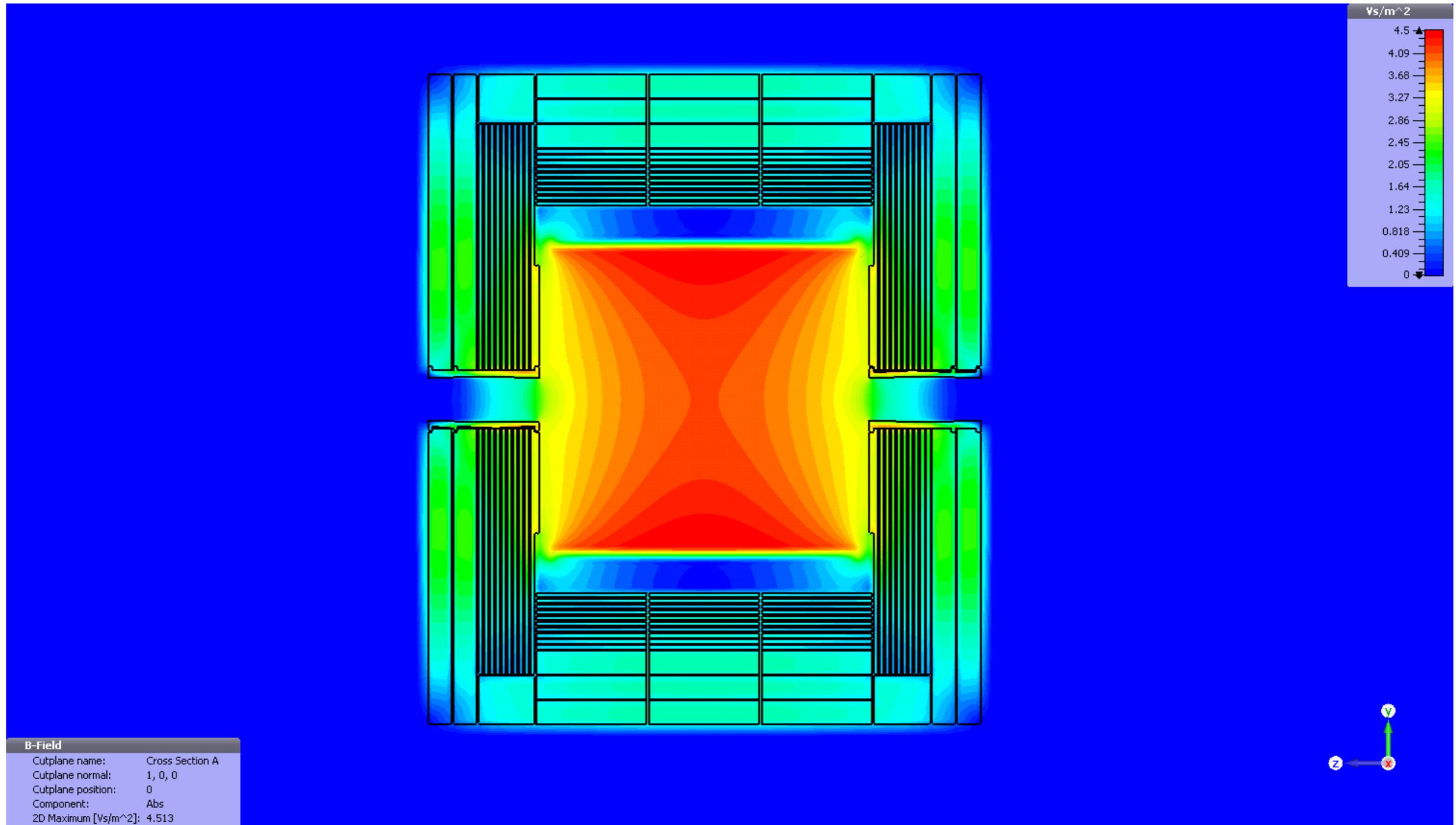


# Magnetic Stray Fields

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- In IR Interface Document (ILC-Note-2009-050):
  - limit of 50G in garage position of the non-operational detector
    - garage positions: 15 m from detector axis of operational detector
  - restrictions for areas closer to the operational magnet are not defined by MDI, but by each collaboration
    - typical human safety limit: 2 kG
- Discussed at SiD workshop in January:
  - how large are stray fields at the crane beams above the detectors?
  - any other sensitive areas in the halls?

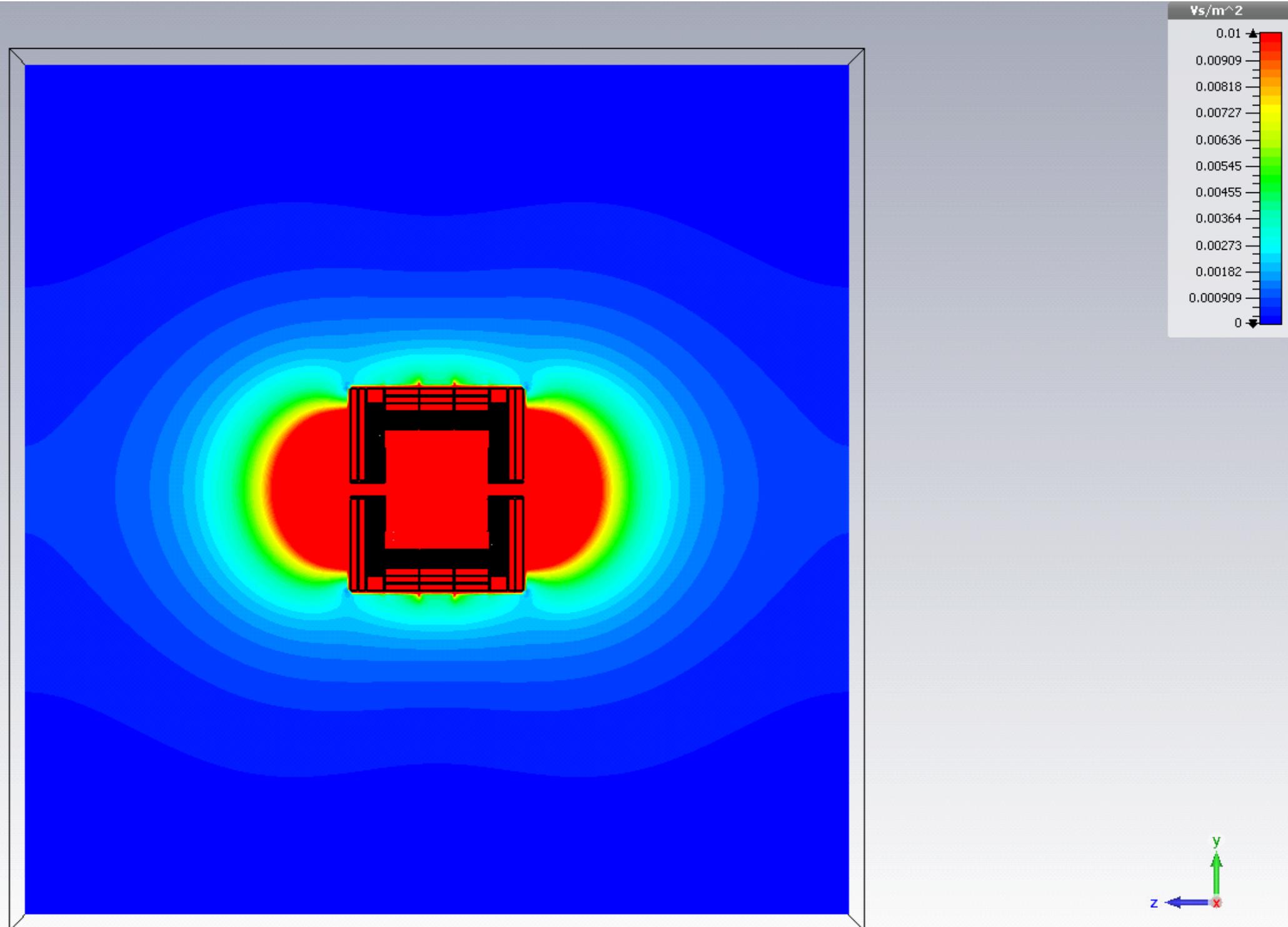
# ILD Magnetic Field



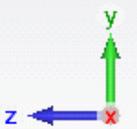
# ILD Stray Fields



- Scale (red) limited to 100 G



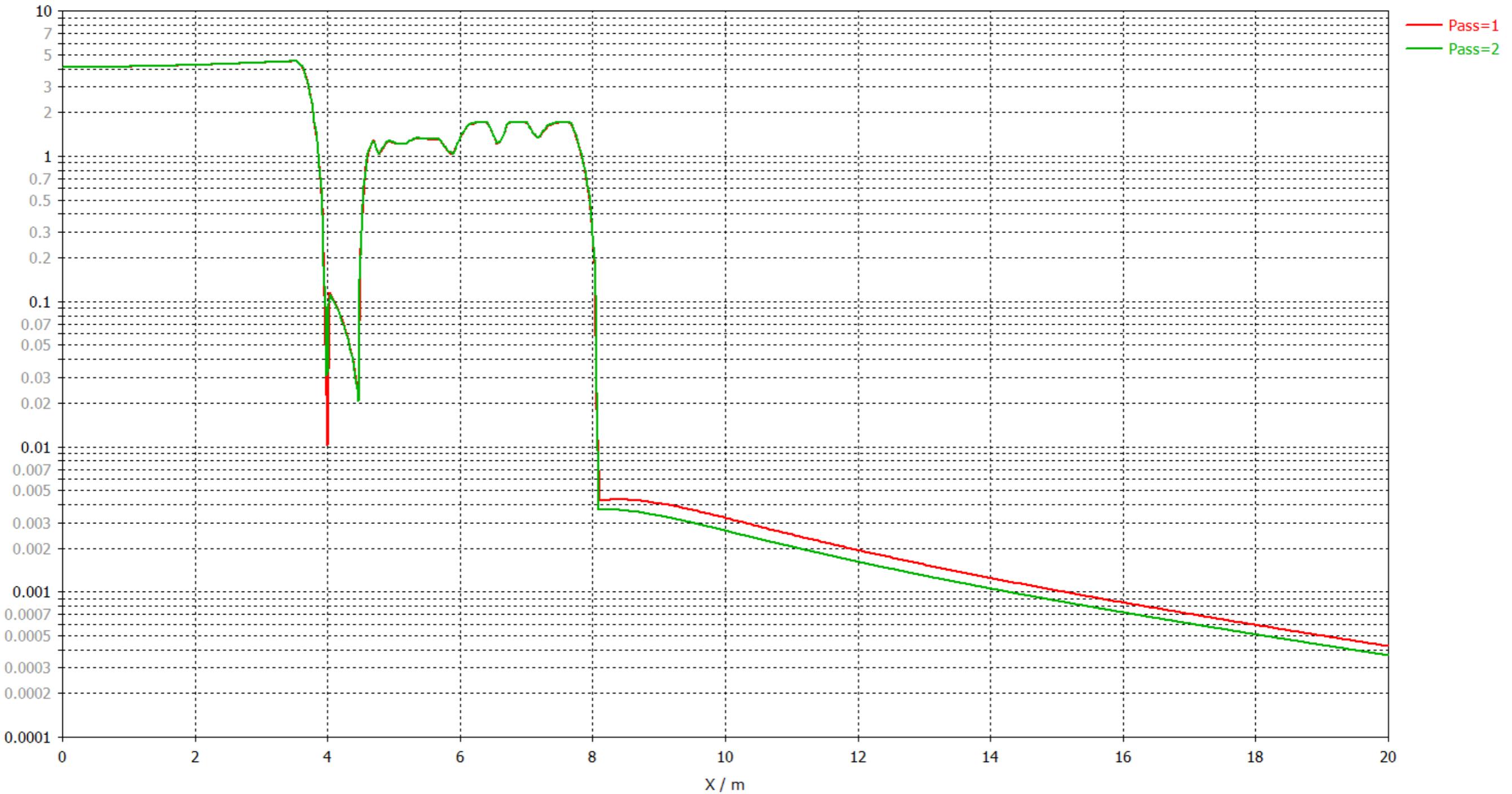
**B-Field**  
Cutplane name: Cross Section A  
Cutplane normal: 1, 0, 0  
Cutplane position: 0  
Component: Abs  
2D Maximum [Vs/m<sup>2</sup>]: 4.513



# ILD Field - outside



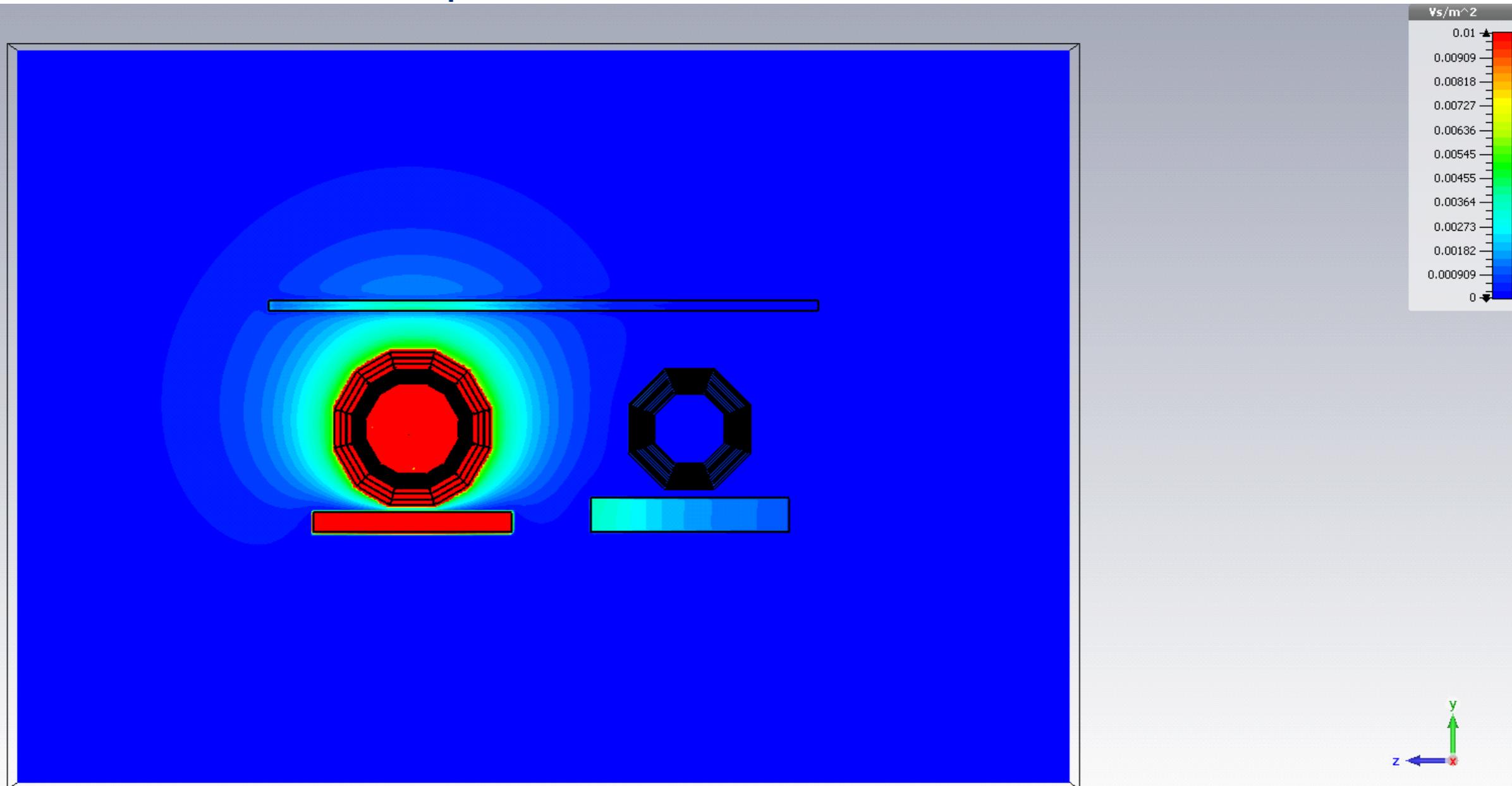
B-Field (Ms)\_Abs (X)



# ILD and SiD



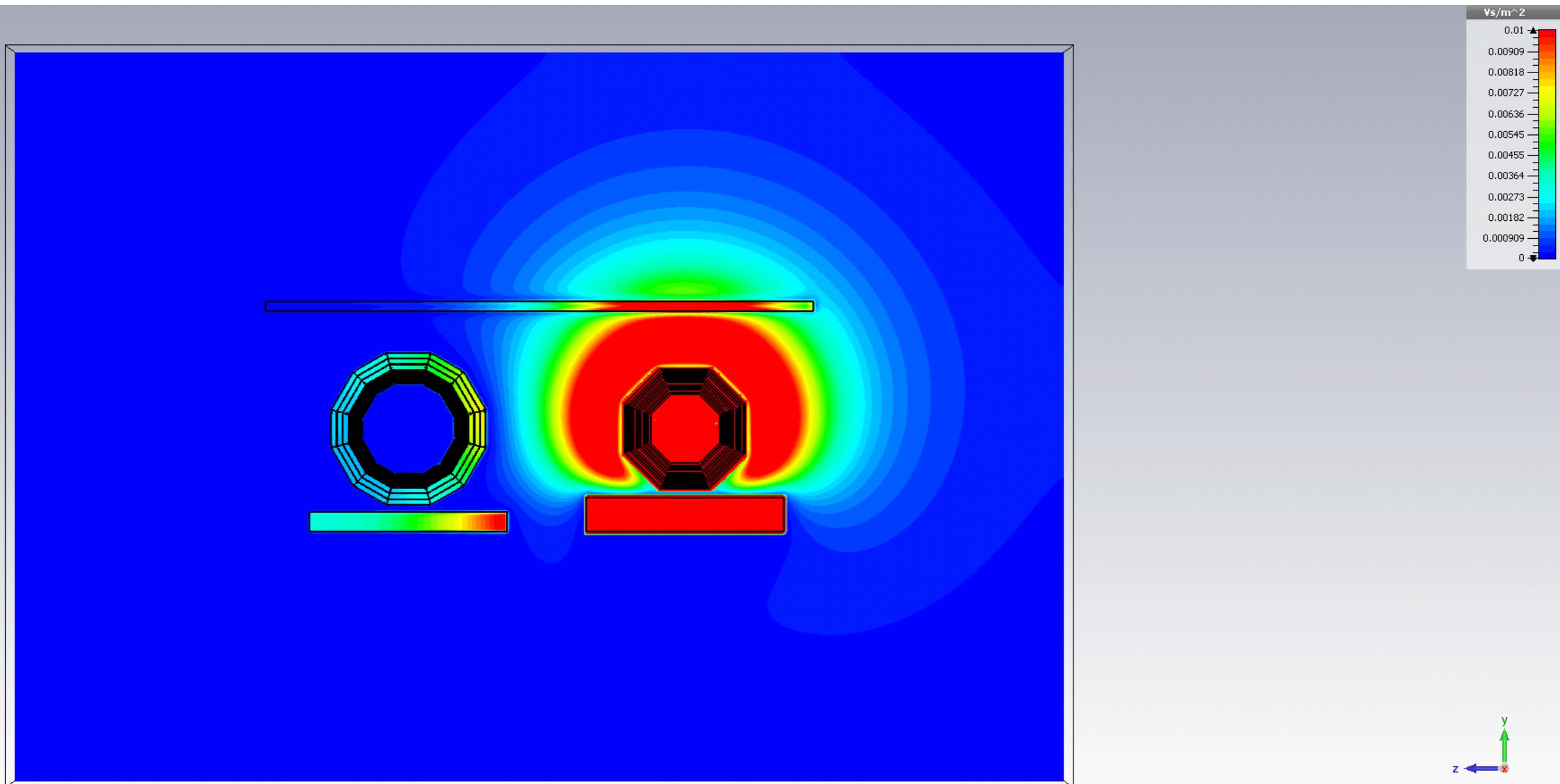
- ILD on, SiD off
  - crane beam and steel platform added



# ILD and SiD



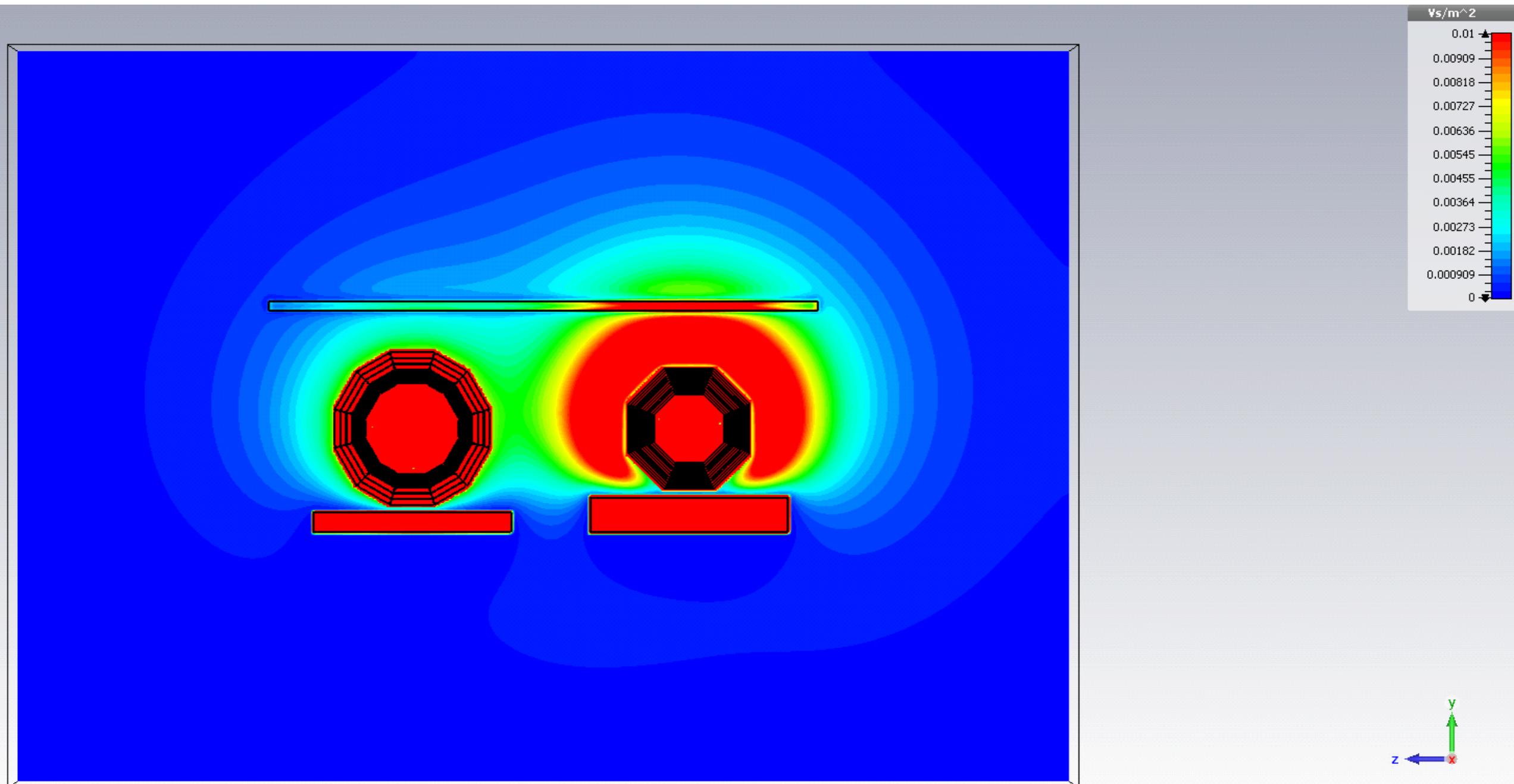
- ILD off, SiD on



# ILD and SiD



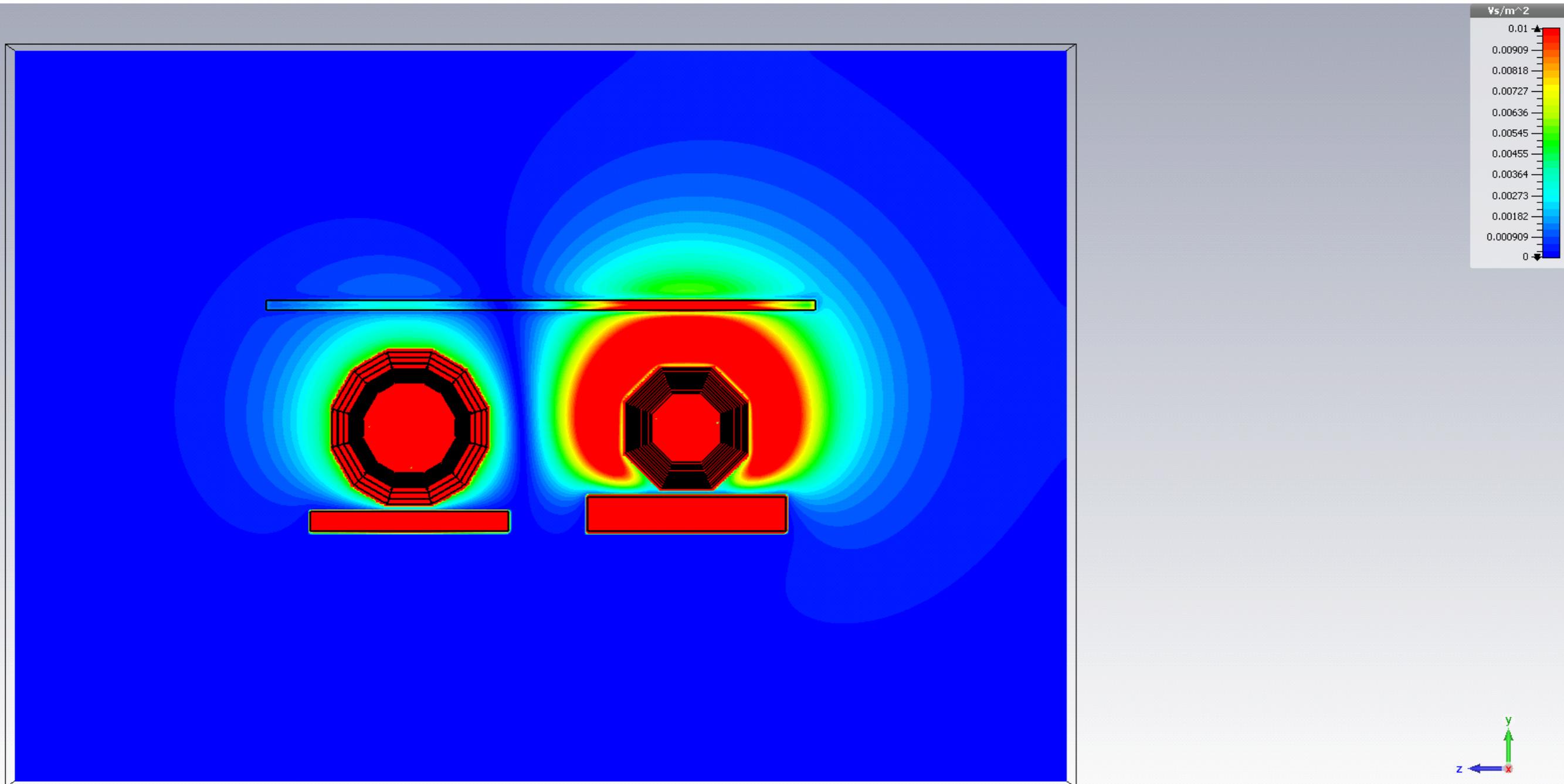
- ILD on, SiD on
  - stray fields in crane beam and platforms exceed 100G

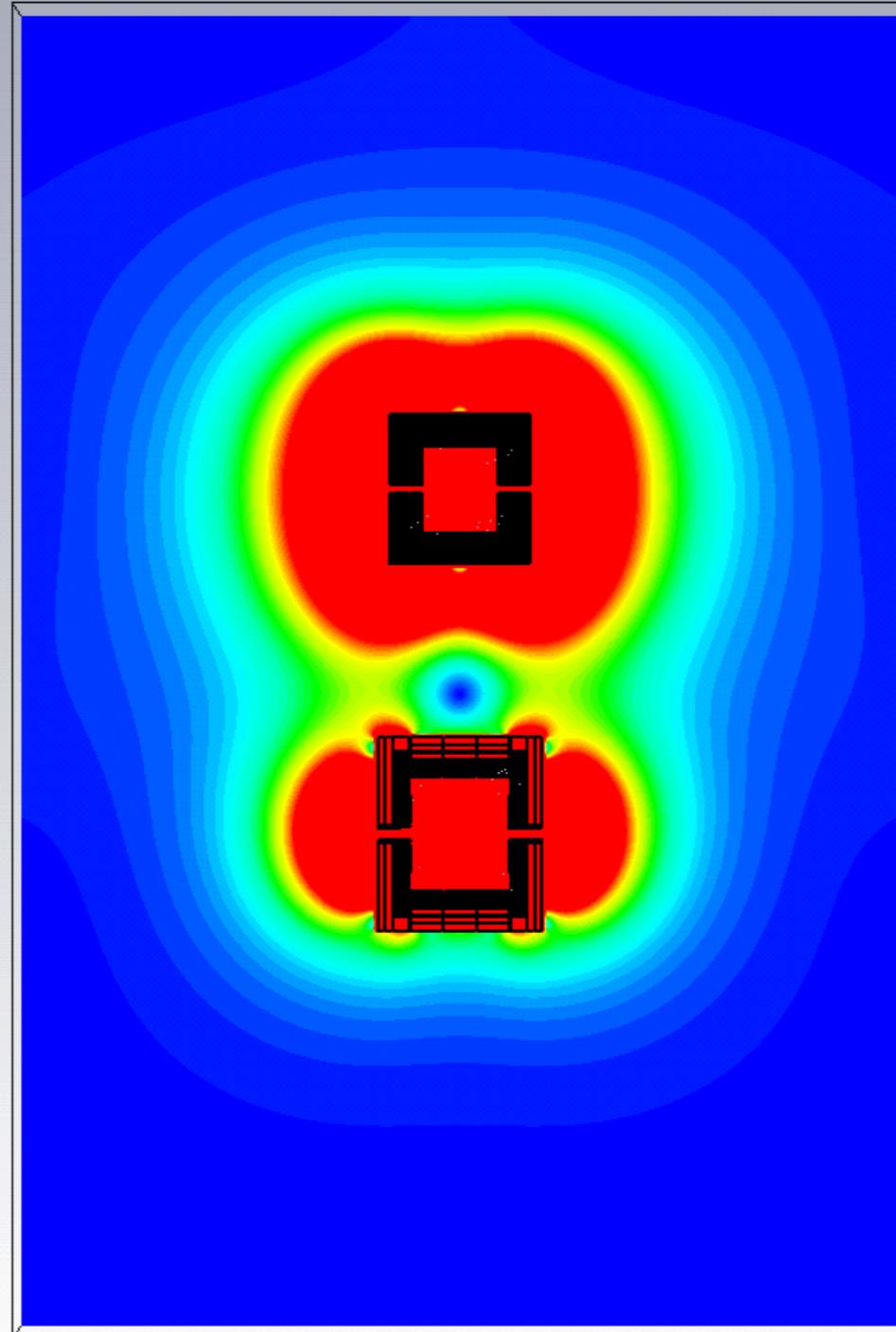


# ILD and SiD



- ILD on, SiD on
  - opposite polarities for the solenoids

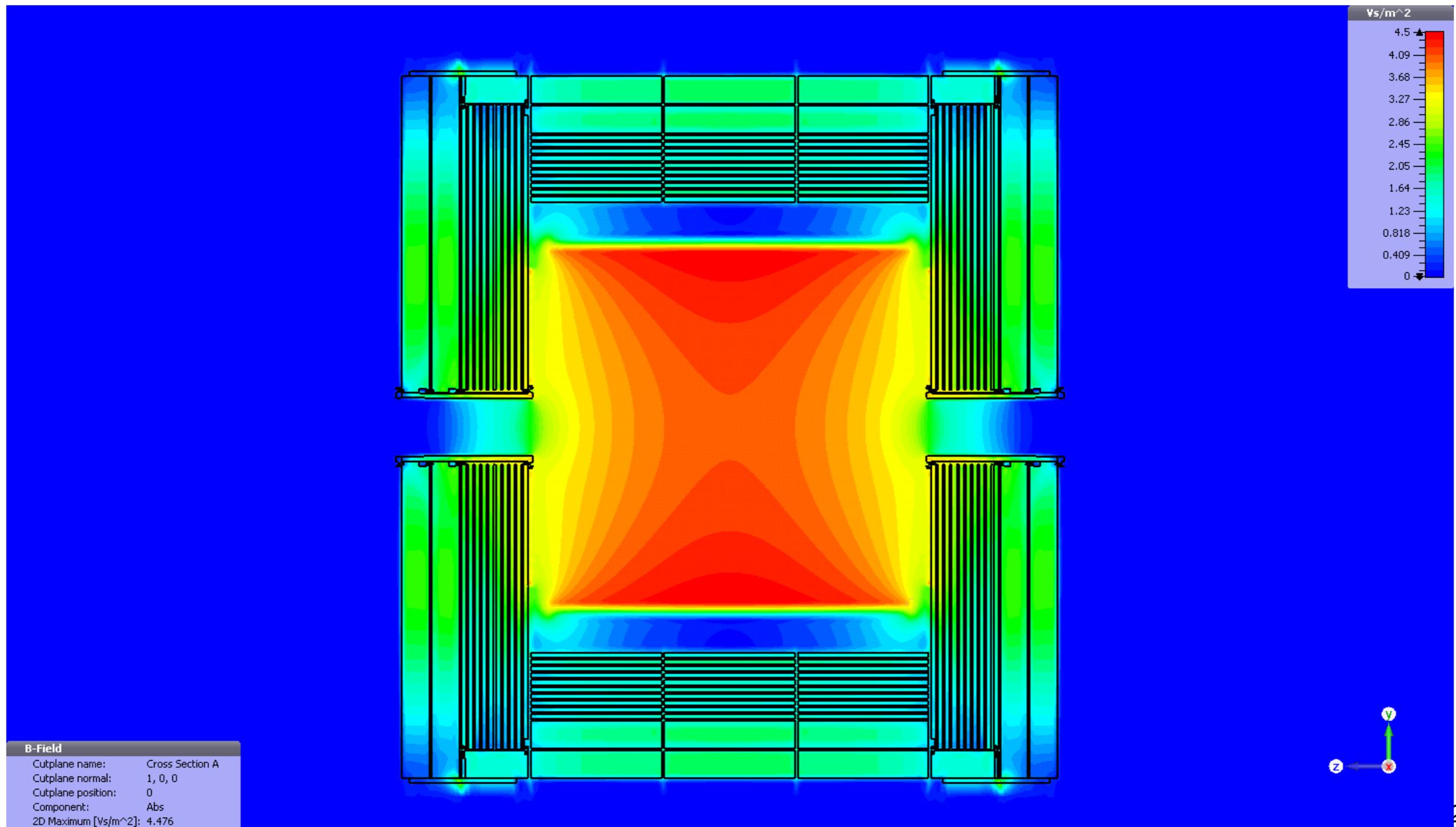




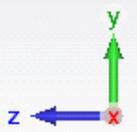
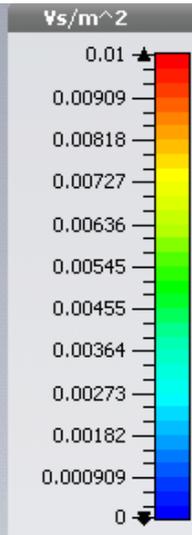
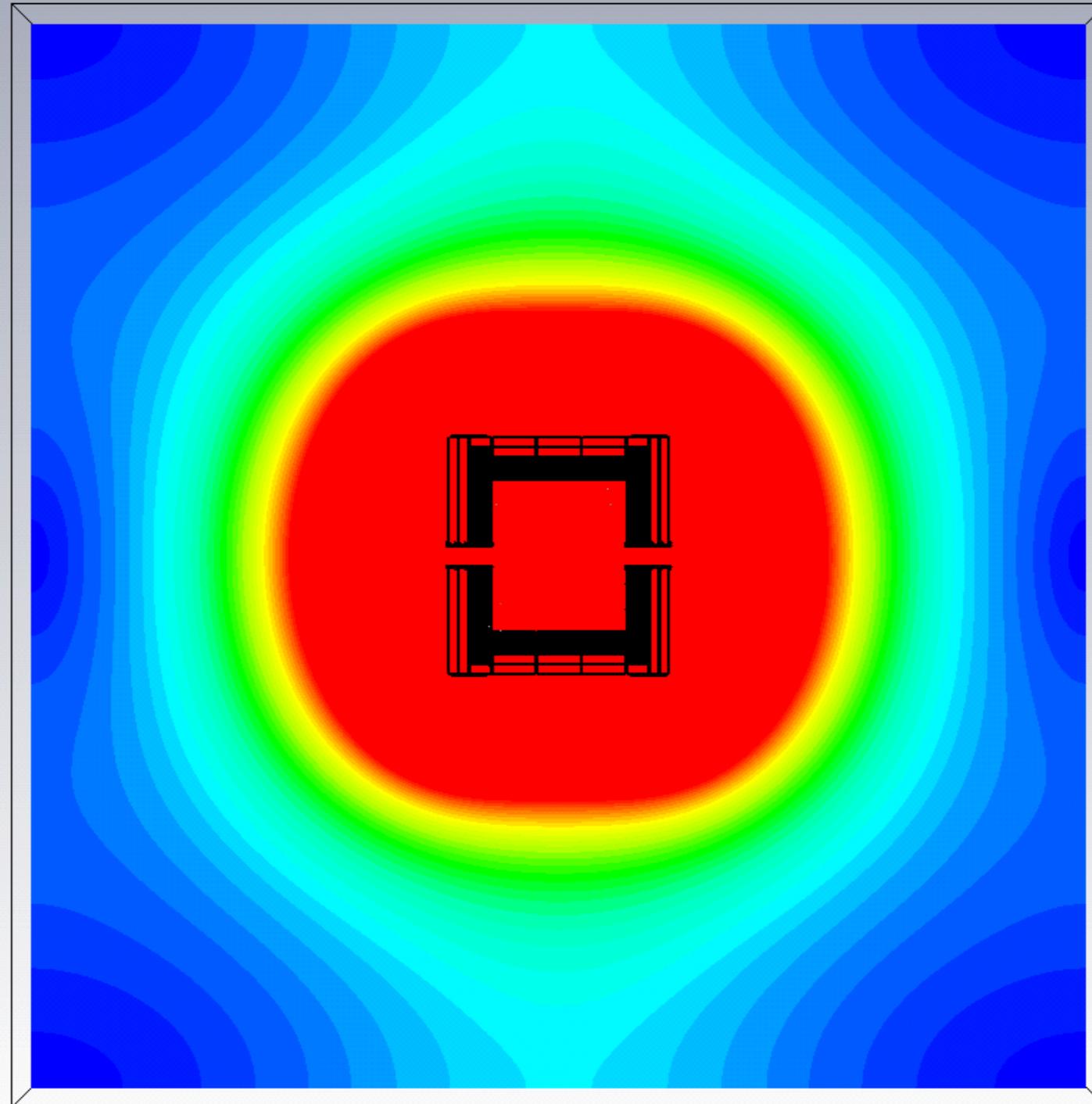


# Thinner ILD Yoke

- remove ~60cm of iron in barrel
  - save money, stray field similar as SiD



# Thinner ILD Yoke

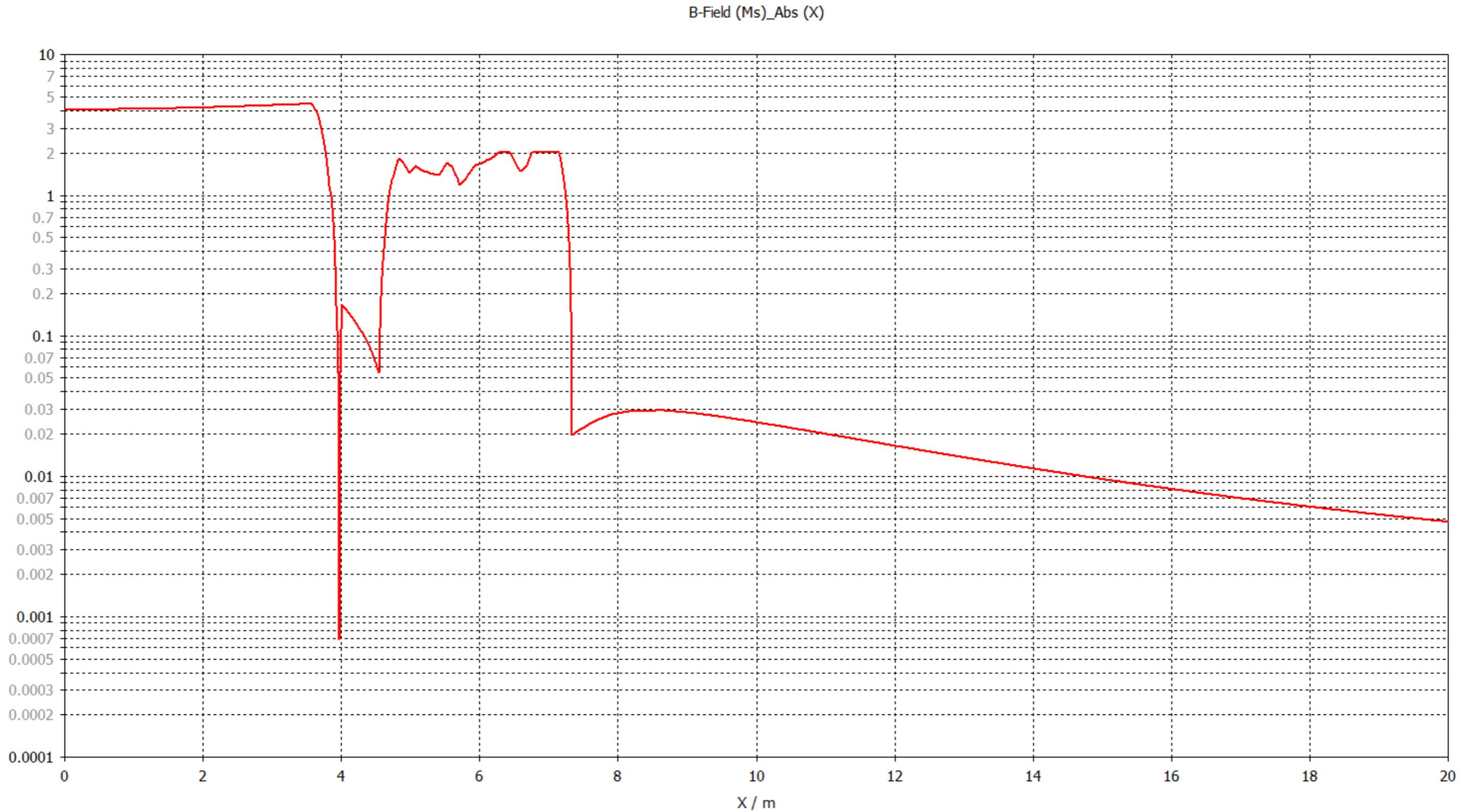


**B-Field**  
Cutplane name: Cross Section A  
Cutplane normal: 1, 0, 0  
Cutplane position: 0  
Component: Abs  
2D Maximum [Vs/m<sup>2</sup>]: 4.476

# Thinner ILD Yoke



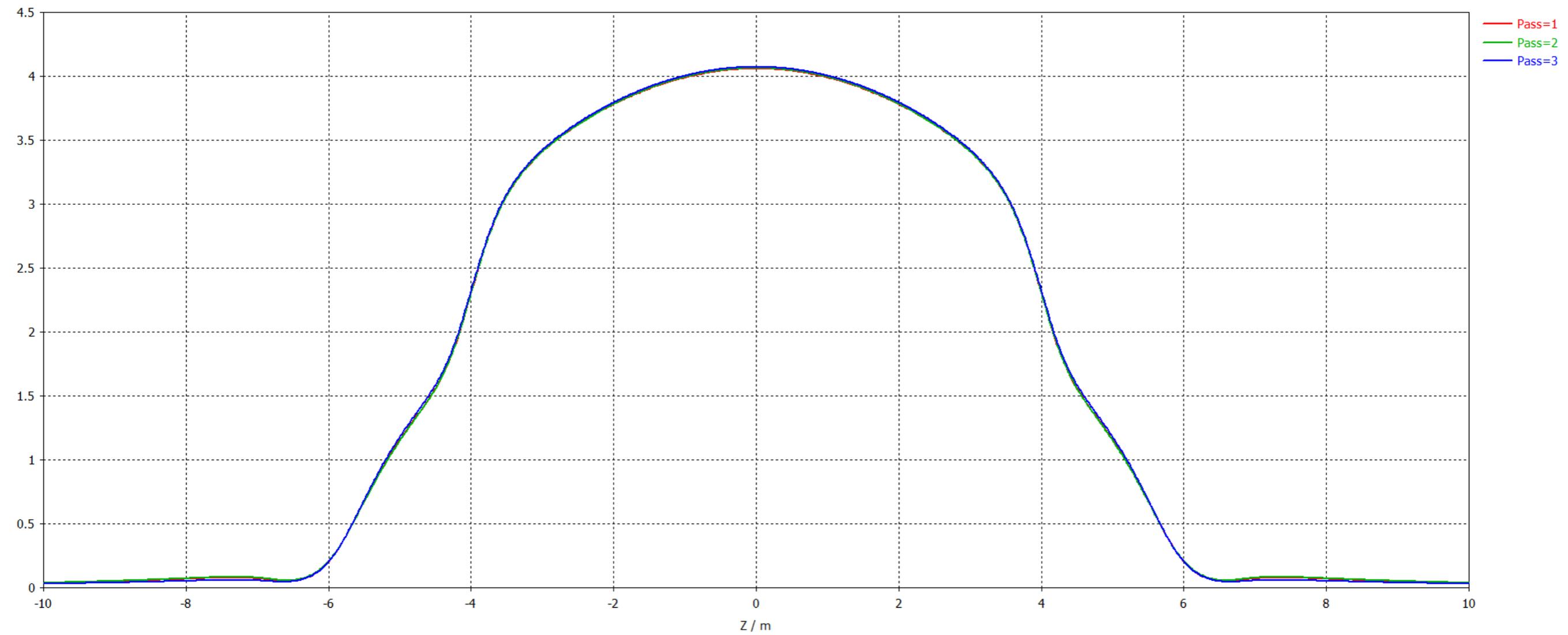
- 90G at 15m, 50G at ~19m



# ILD Field with Thin Yoke



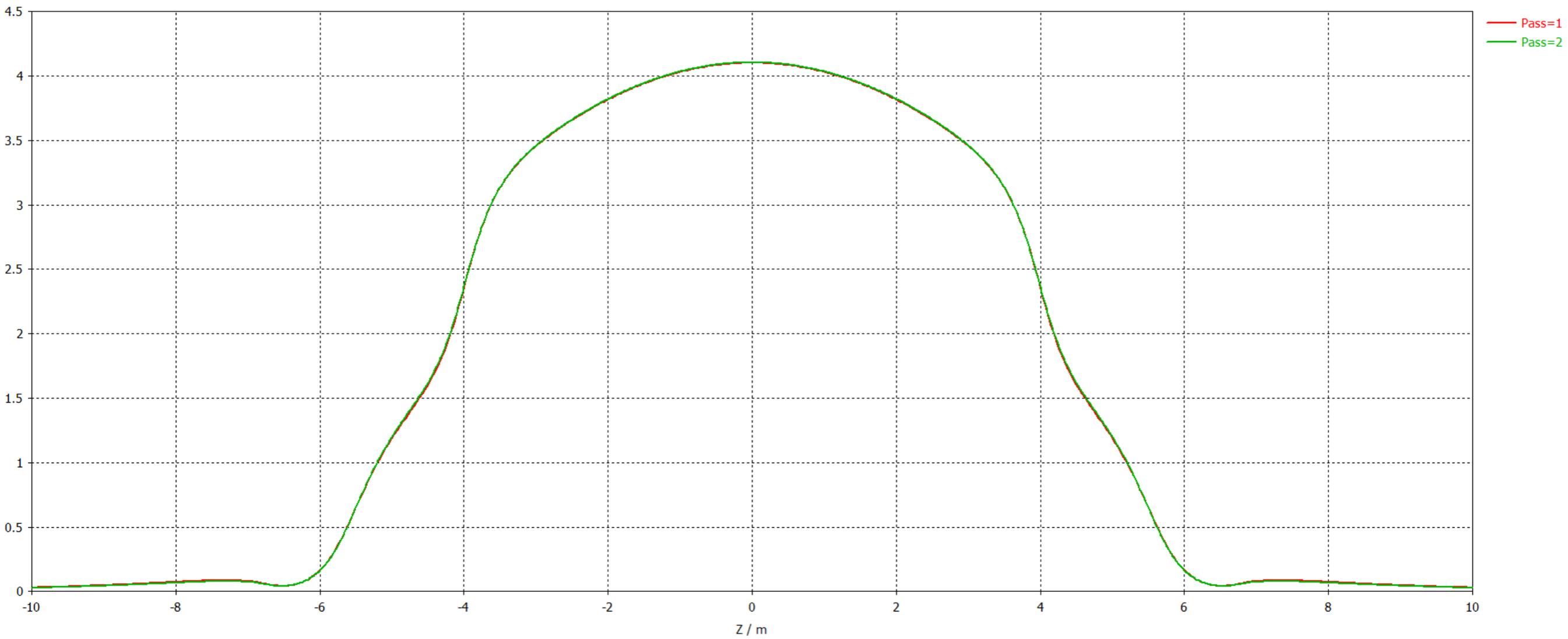
B-Field (Ms)\_Abs (Z)



# ILD Field - DBD



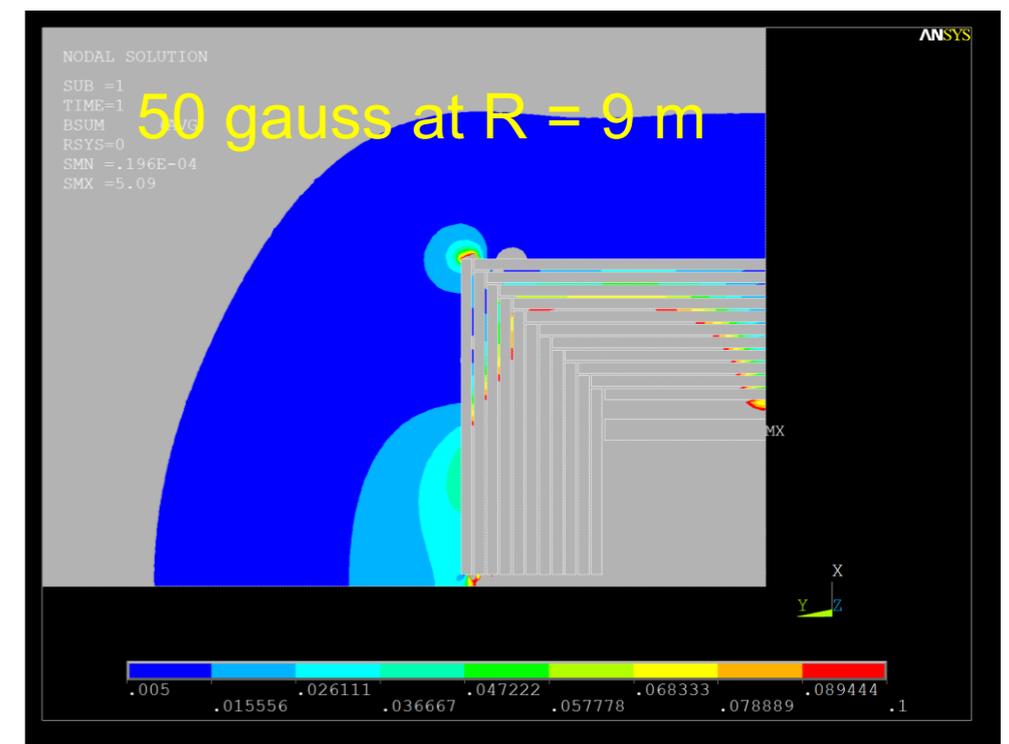
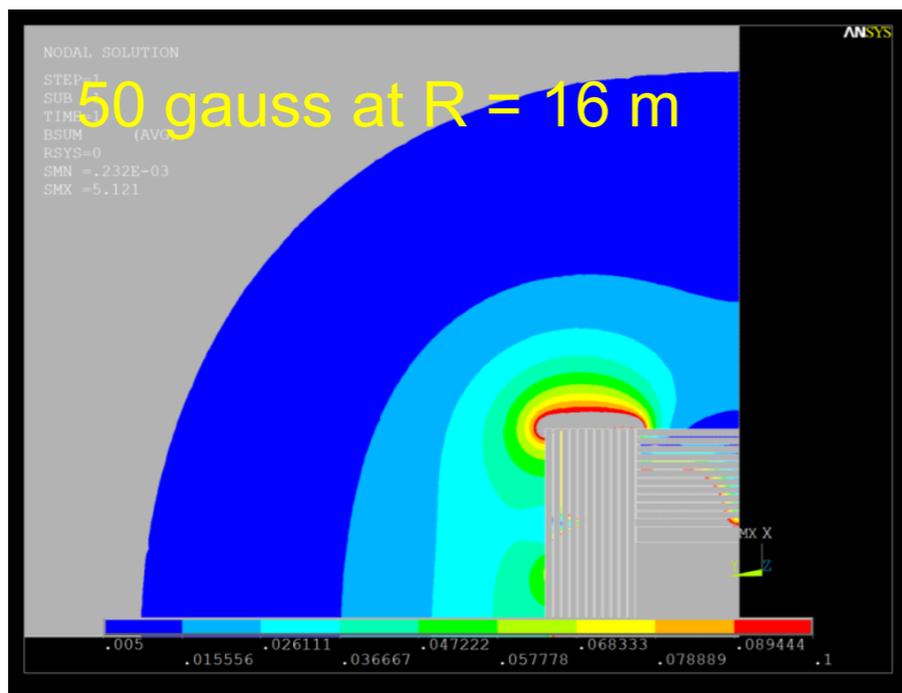
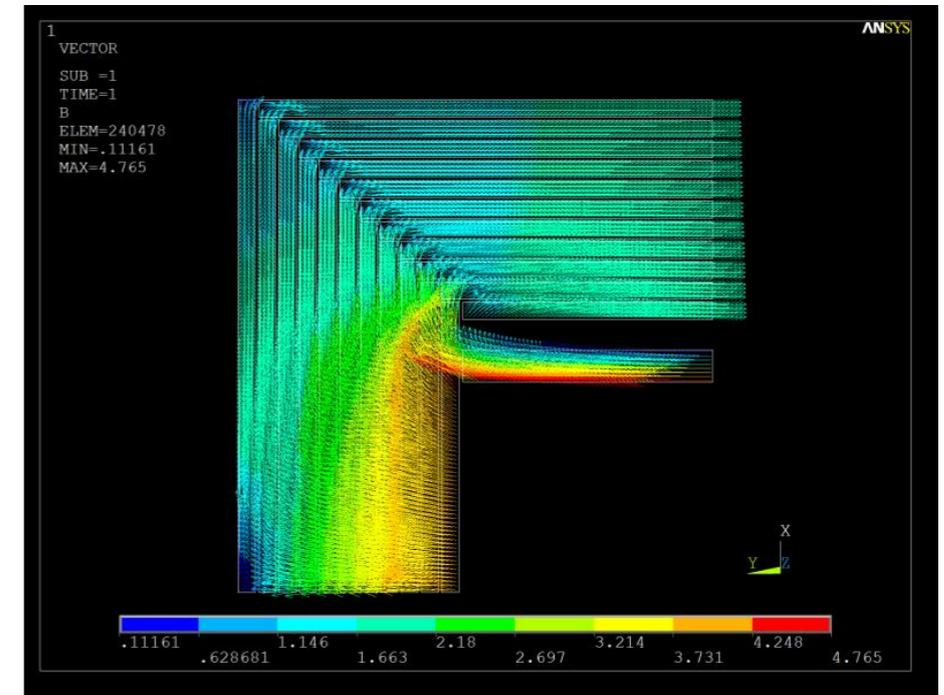
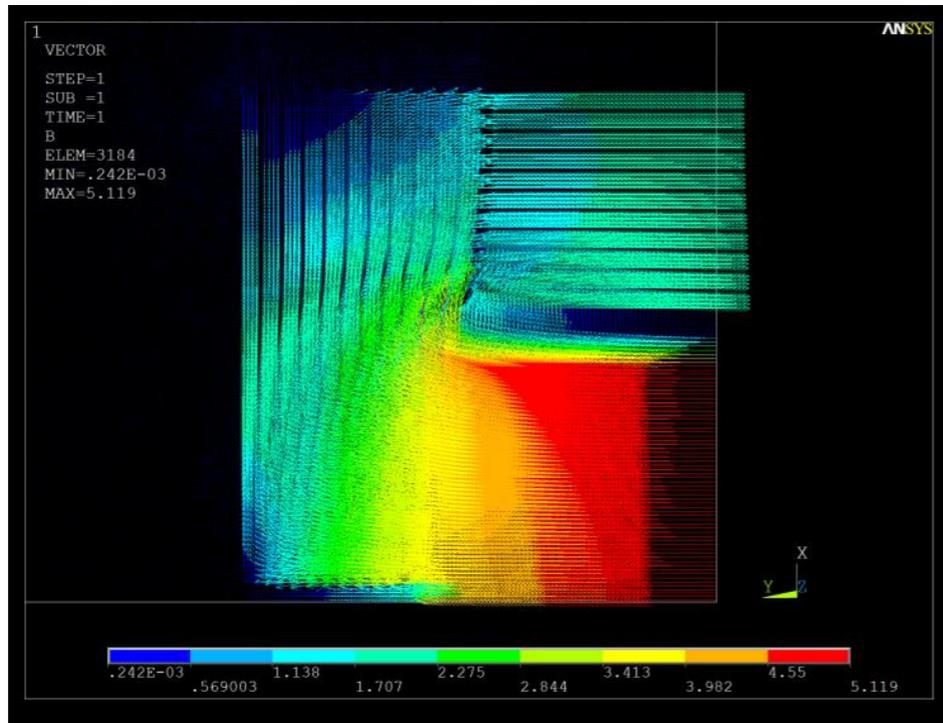
B-Field (Ms)\_Abs (Z)



# SiD Yoke Studies



- SiD has started to look into modified yoke design with reduced stray fields:





# Conclusion

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- Magnetic field in ILD has changed significantly between Lol and DBD
  - careful: old field maps partially still used in simulations
  - new field map on EDMS: D\*1096215,A,1,3
- Anti-DID is technically very difficult and needs careful optimisation
  - work for software and magnet group
  - tuning of Anti-DID vs technically achievable design
- Stray fields for ILD are low with existing thick barrel yoke
- Reducing barrel yoke by ~60cm increases stray fields to similar levels as SiD: 100G at 15m
  - saves iron, i.e. money
  - reduces ILD net height and reduces differences in platform heights for SiD and ILD
  - increases stray fields in the hall significantly, consequences for hall infrastructure and detector ancillaries (electronics etc.) not clear yet
  - maybe could look into modifications of barrel-endcap connection as SiD has just started to do