ILD Magnet Activities

ILC Mini-Workshop,
KEK

Feb. 2018

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HELMHOLTZ ASSOCIATION

DESY

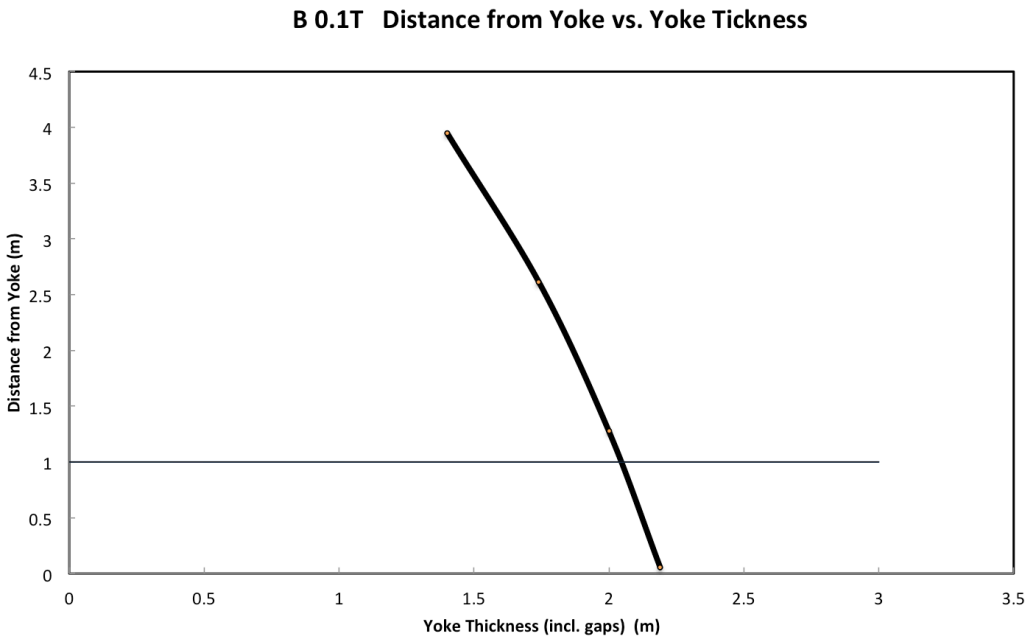
Reduced Yoke – Shielding Wall

Stray field considerations

- 5mT limit at 15m in order not to disturb SiD in park position
  - Access to detector for installation and maintenance
- ILD in beam position
  - Data taking
  - Detector should be accessible, no installation work, only non-magnetic tools
  - Acceptable B field

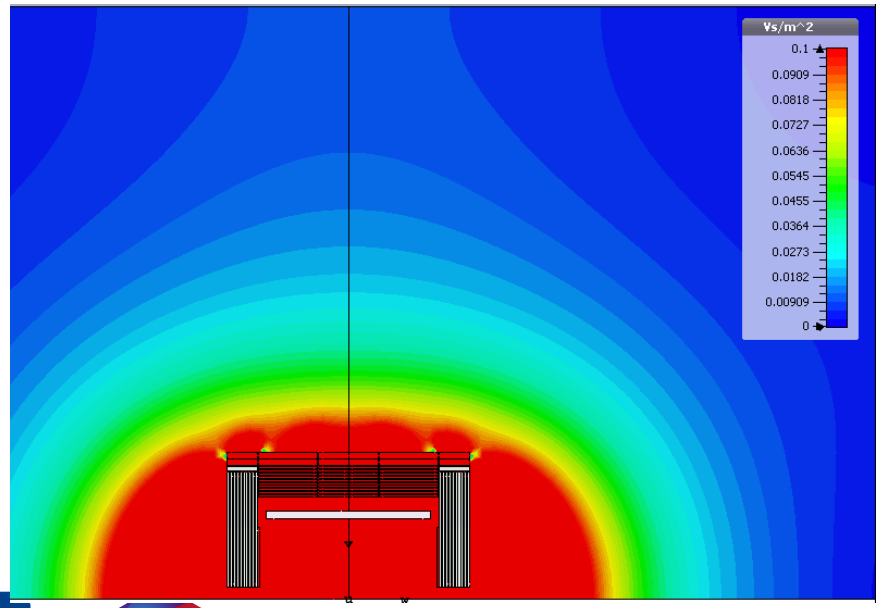
    < 200mT: human safety, CERN regulation for full working day (8h/d)
    < 100mT: operation of magnetically sensitive equipment
- Reduce size of yoke: 100mT at 1m distance from yoke
  - Have to check radiation shielding
  - May have to add concrete shielding, cheaper than iron
- Use shielding wall to reduce field at SiD
  - Could be part of radiation shielding during accelerator commissioning

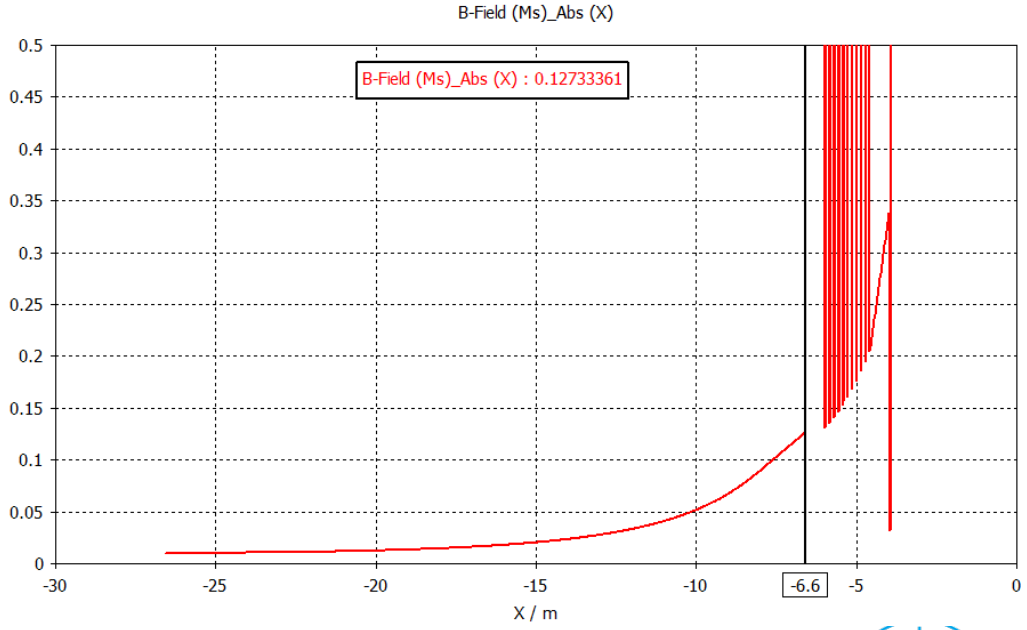
Reducing Yoke Thickness



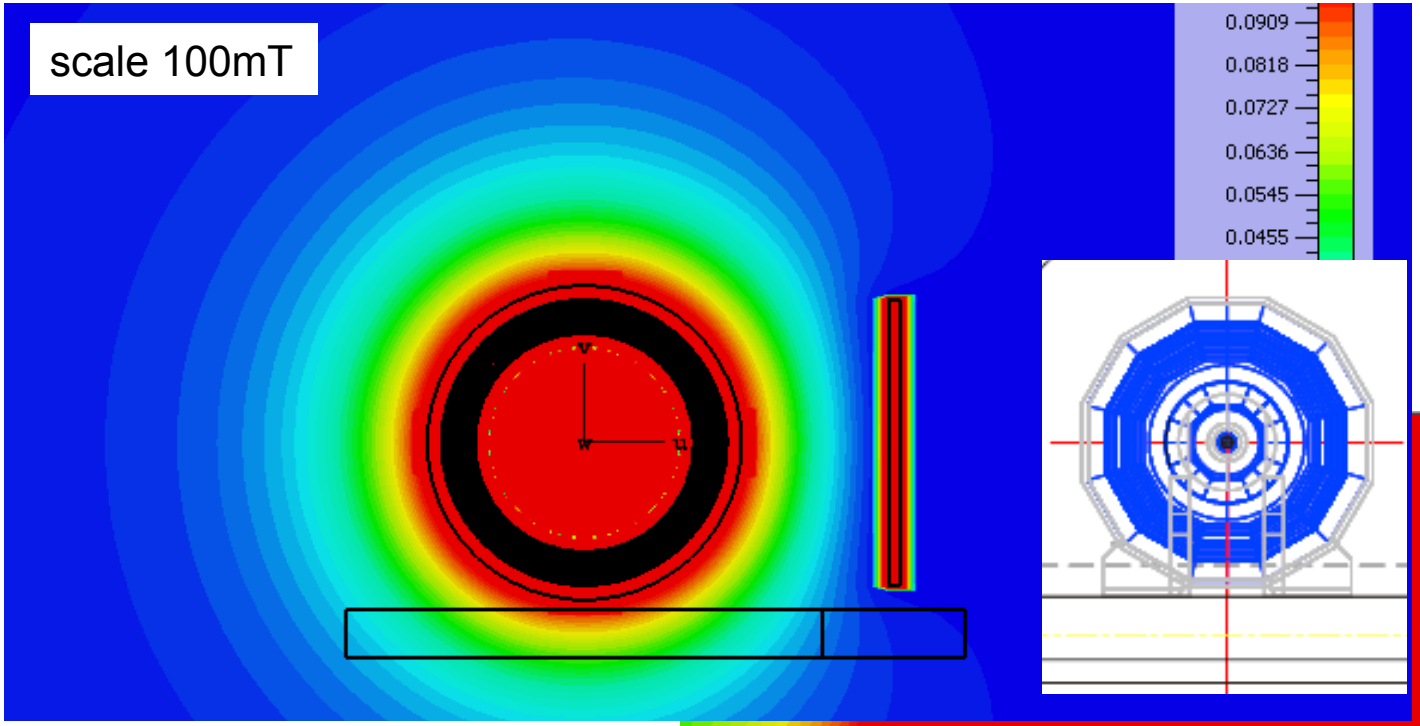
Yoke size and thickness reduced

- B 0.1mT at 1m from yoke for
  - R_{out} = 6.6m (instead of 7.76m)
  - iron thickness 2.04m including gaps





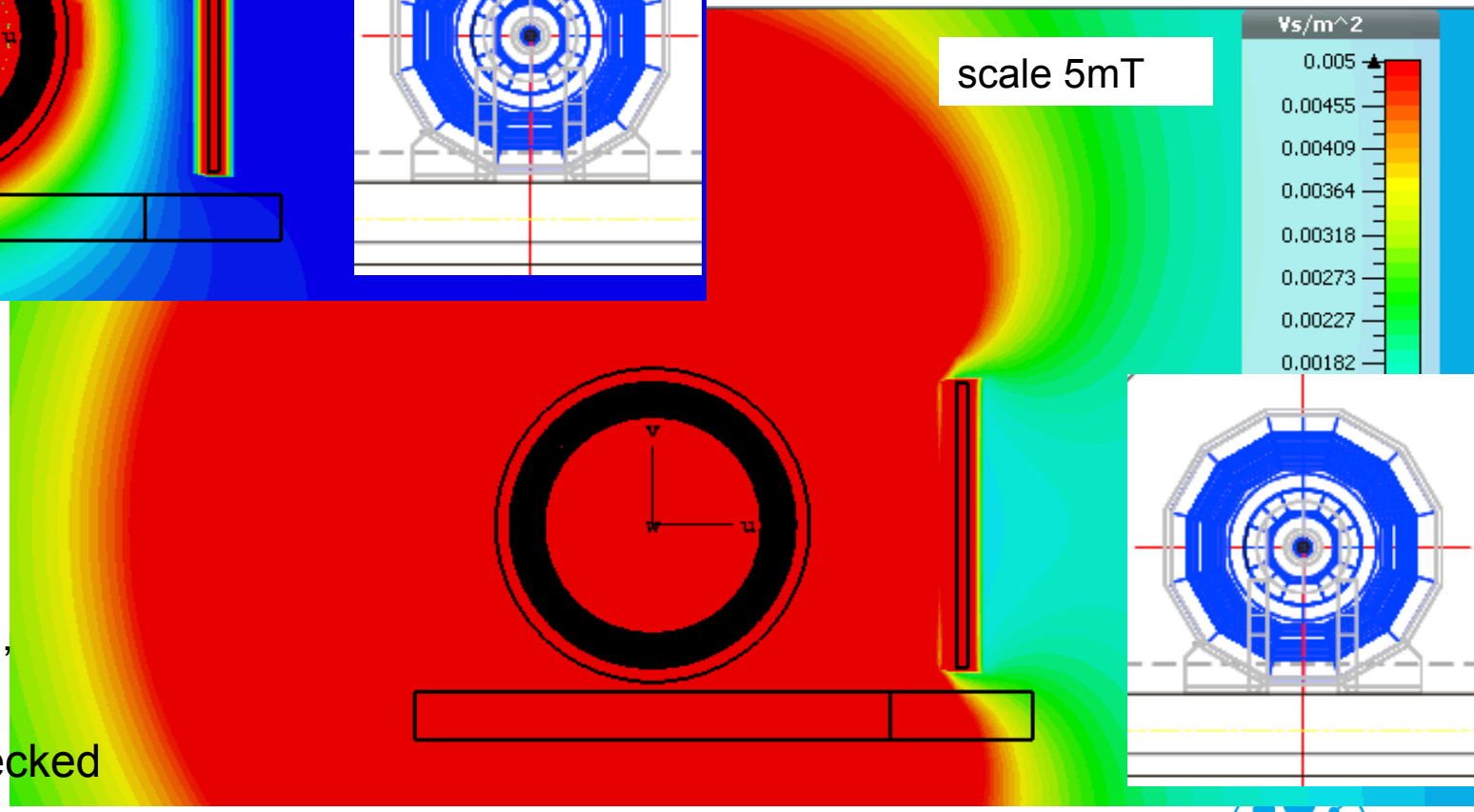
Reduced Yoke – Shielding Wall



Preliminary, hexahedral mesh

Movable iron shielding wall

- 13m from beam line
- 25 (20)m x 12m x 0.5m



ILD in beam position

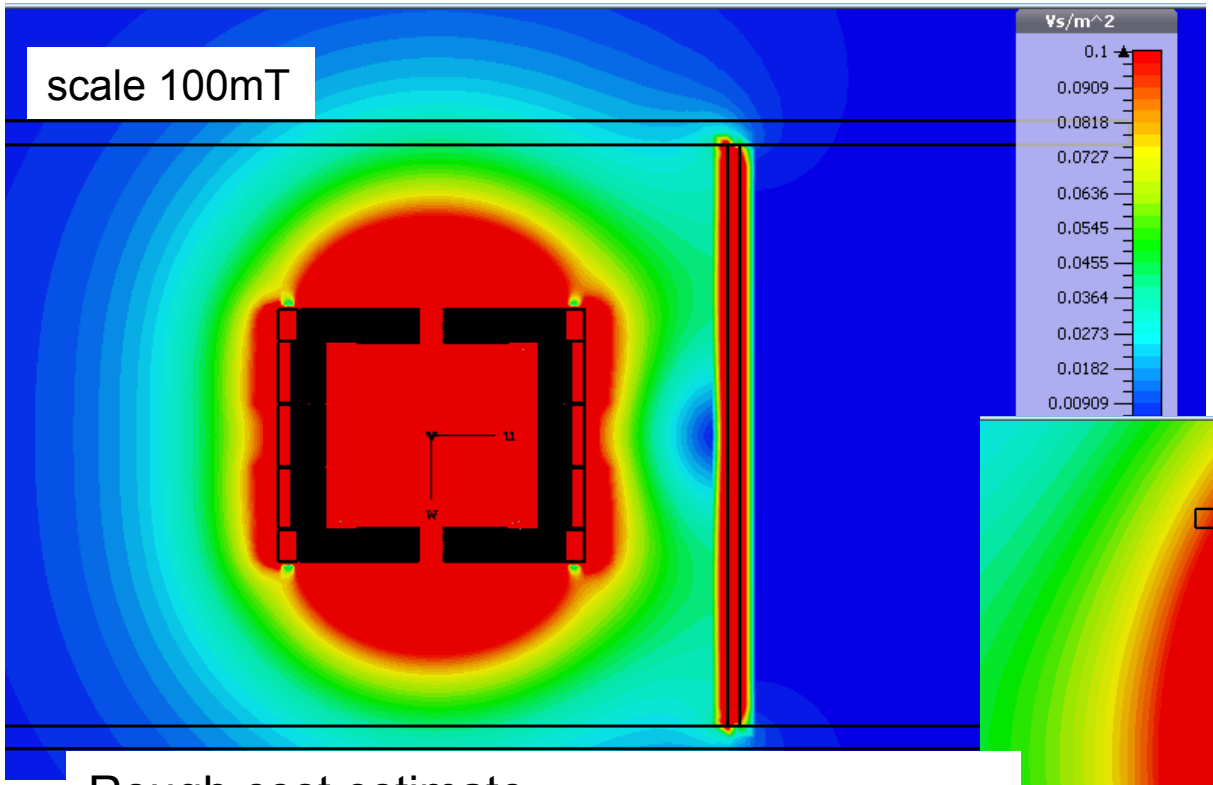
- Hall accessible with non magnetic tools

SiD in off beam position

- Unlimited access (installation, maintenance)

Radiation shielding to be checked

Reduced Yoke – Shielding Wall



Preliminary, hexahedral mesh
(confirmed with tetrahedr. mesh)

Movable iron shielding wall

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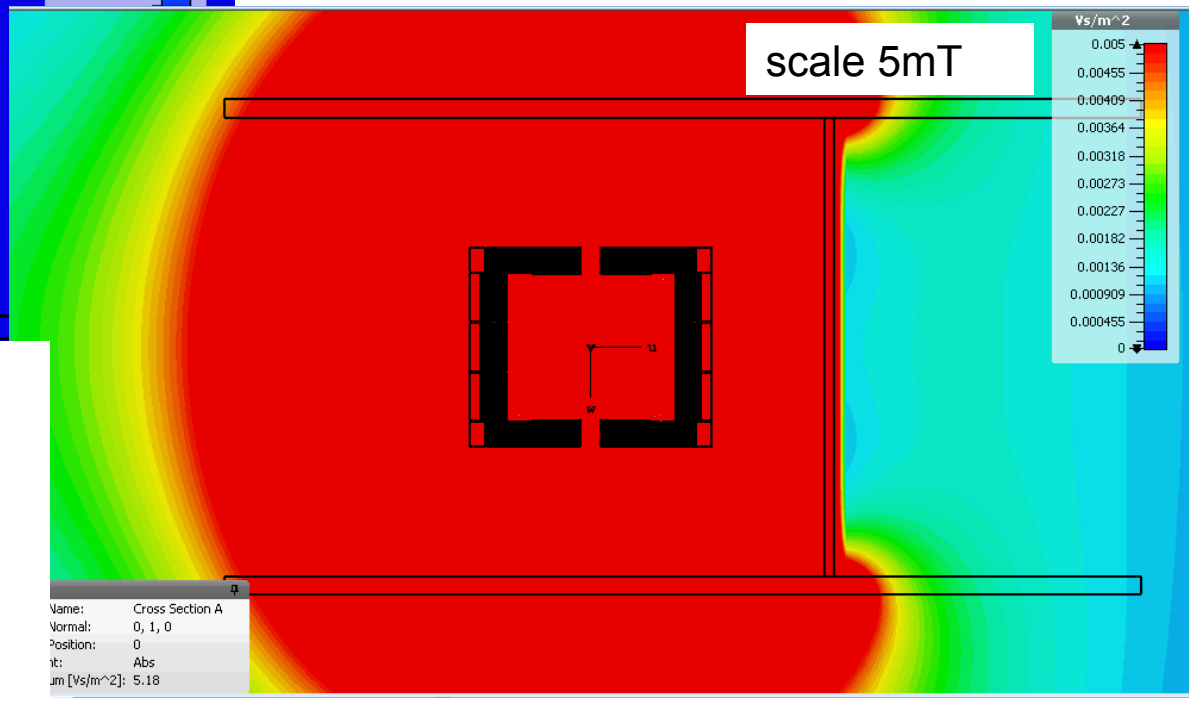


Rough cost estimate

- Yoke 37 instead of 81MILCU
- Shielding wall O(7MILUC), assuming same unit cost as for yoke (Should be cheaper, but need moving platform)
- Could reduce hall height by approx. 1m
- May need some concrete shielding

(Restared shielding simulations (Sanami)

Asymmetry in outer field
-> small asymmetry in central field

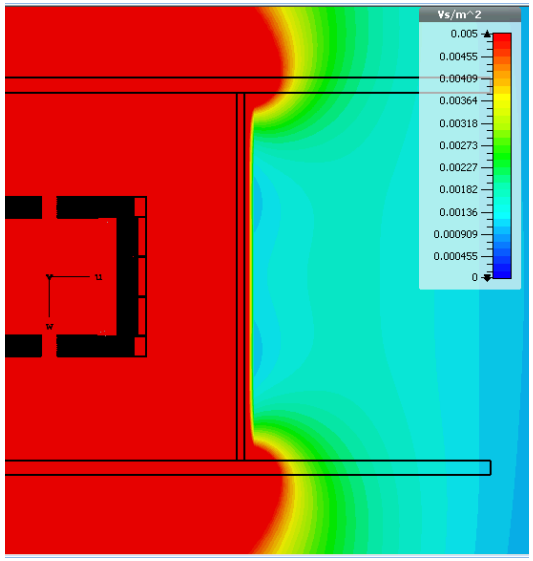
Reduced Yoke – Shielding Wall

Experience with CST Studio calculations

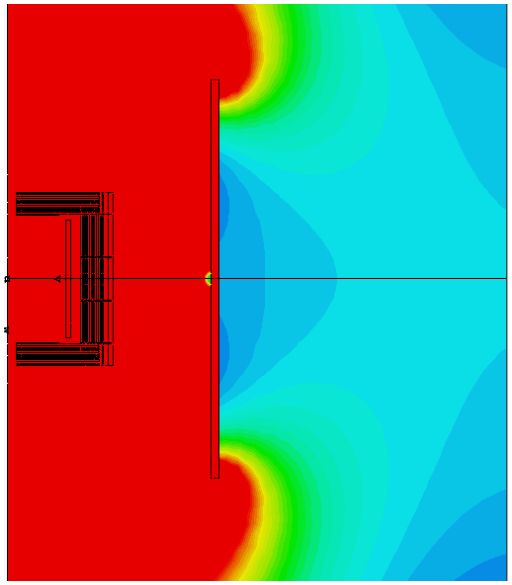
- Hexahedral mesh:
  - Yoke gaps not meshed properly, stray field usually too small
- Tetrahedral mesh
  - Good meshing, stray fields higher, in agreement with other codes
- Previous calculations
  - First, hexahedral mesh (faster)
  - Tetra mesh for final results
- Reduced yoke with shielding wall
  - Hex mesh results
  - Problems running 3D tetra mesh
  - Compare with 2D tetra mesh
  - Similar results

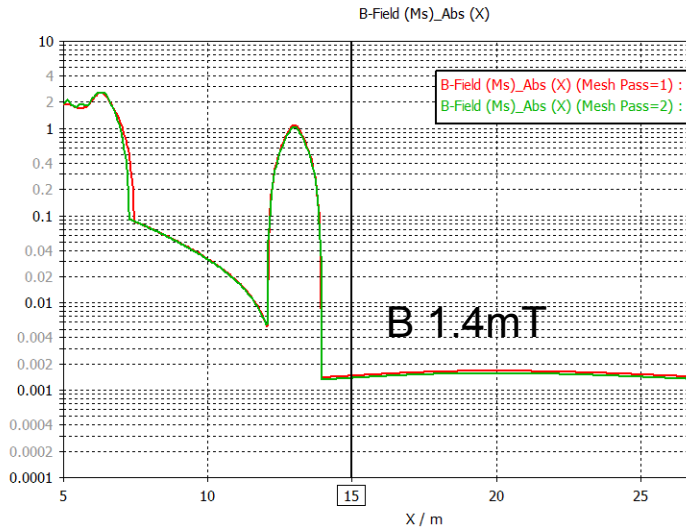
both 5mT scale

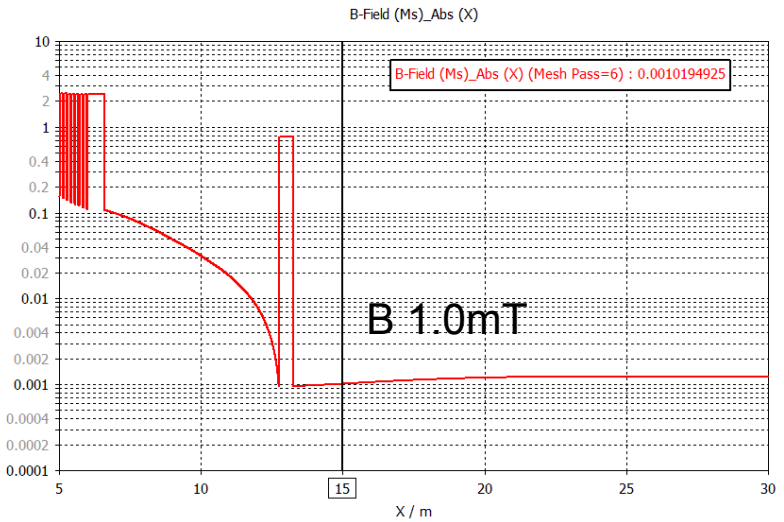
Hexahedral mesh



2D tetrahedral mesh





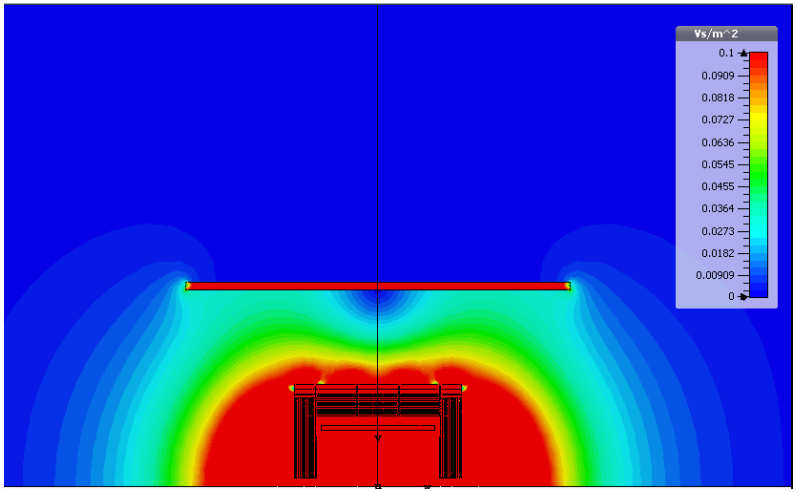


Shielding Wall

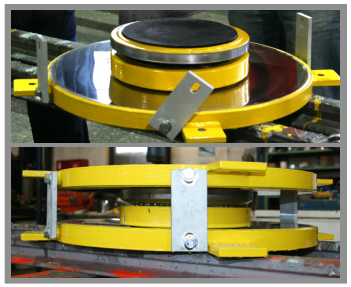
- Magnetic forces
  - Max. stress 0.02N/mm^2
  - Force on complete wall ca. 4MN = 400t (prel., to be checked)
- Wall design details talk by R.Stromhagen
  - Iron blocks 5 x 0.5 x 1m, weight 20t (transport no problem)
  - I beam supports (500mm) on both sides
  - Base has to be enlarged to prevent tipping
  - Platform increase width from 3 to 5m

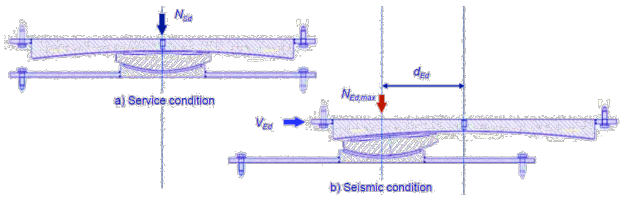
Earth quake protection options

- Supports with dampers on walls of experimental hall ?
- Ground isolation using friction pendulum isolators with dampers, CLIC study by F.Duarte Ramos
- Ground isolation using perma glide, R.Stromhagen
- … need experts



Field at y = 0
Slightly lower for y < 0 and y > 0



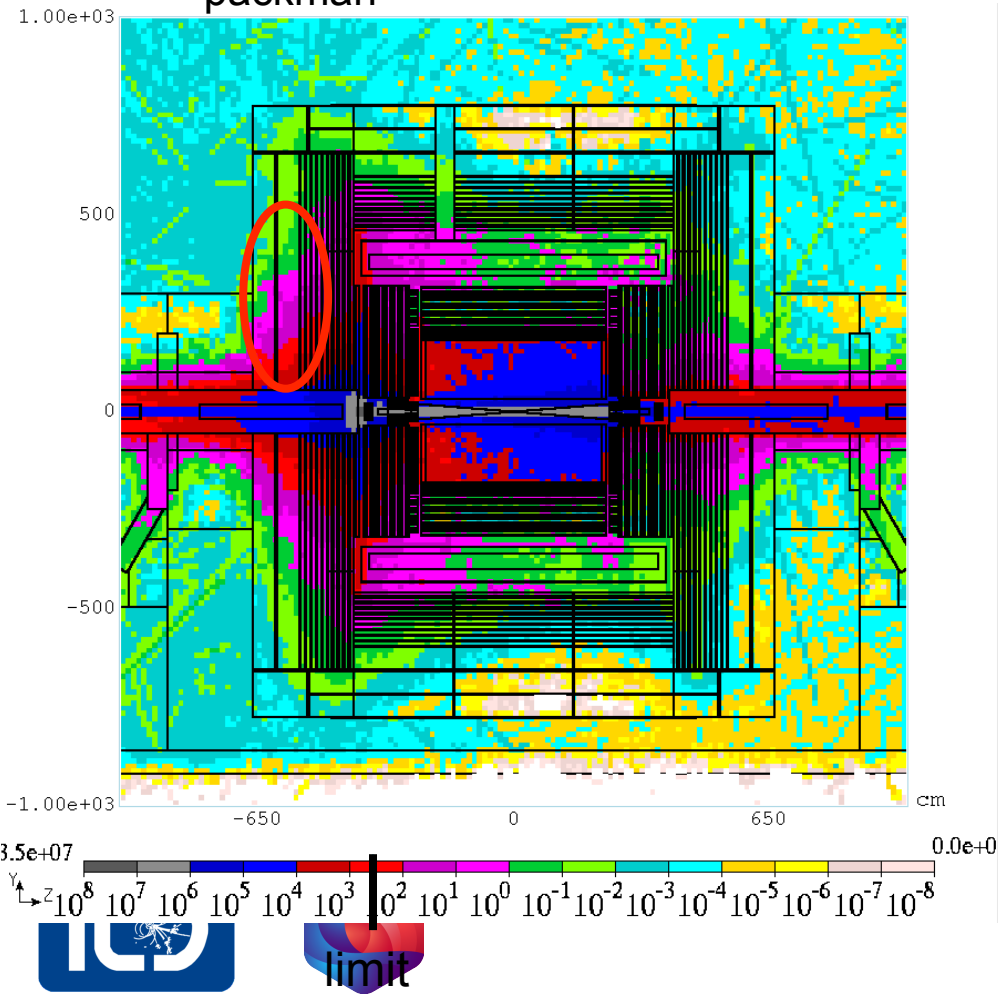


Reduced Yoke – Radiation Shielding

Radiation dose estimates, T. Sanami et al. 2009

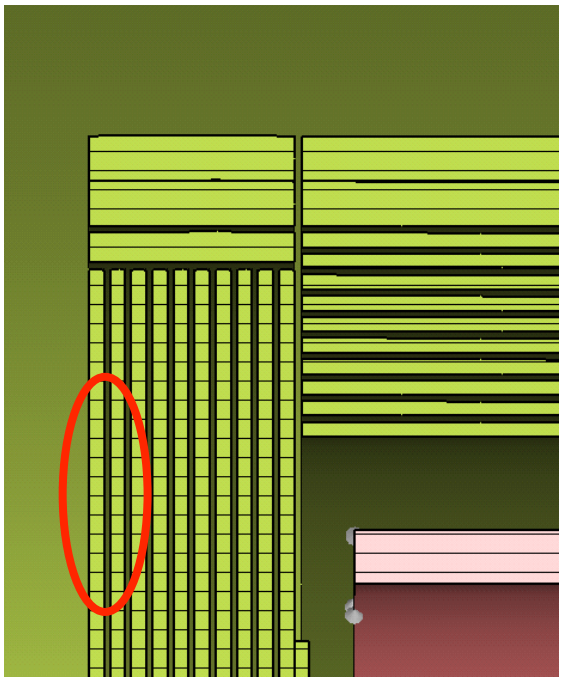
Old end-cap design

- Fulfills requirements
- weak spot: transition between EC and packman



Reduced yoke may need some modification

- thicker EC plates or additional shielding

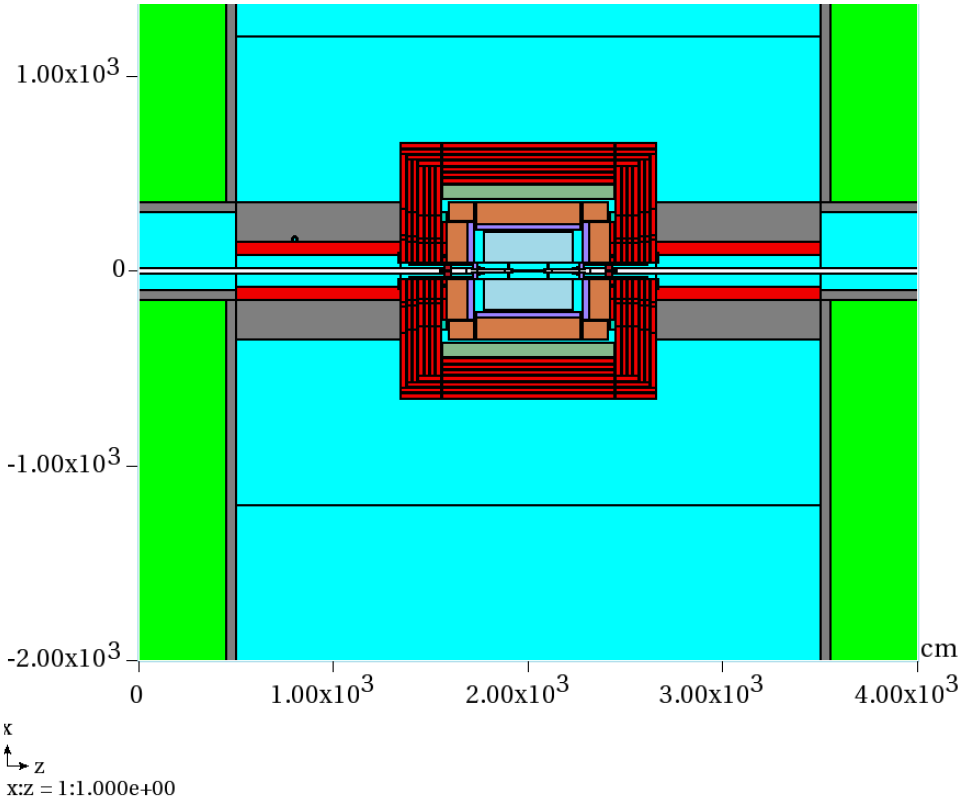


Radiation Shielding

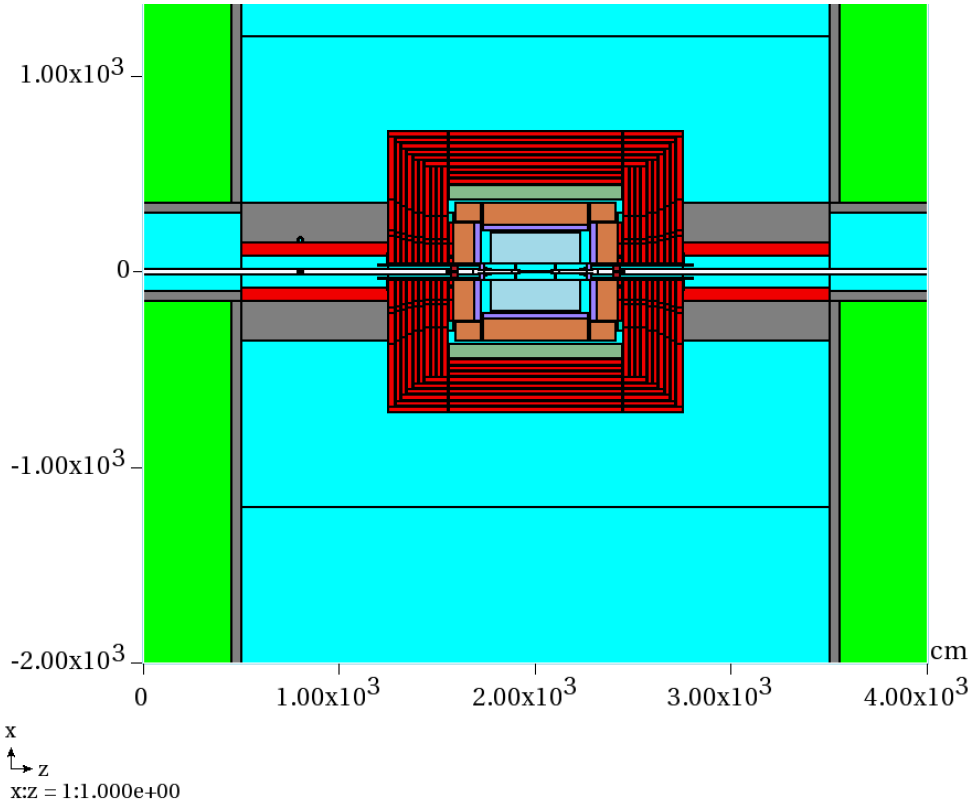
Recently, re-activated shielding calculations, T. Sanami

GLD detector

reduced size



full size



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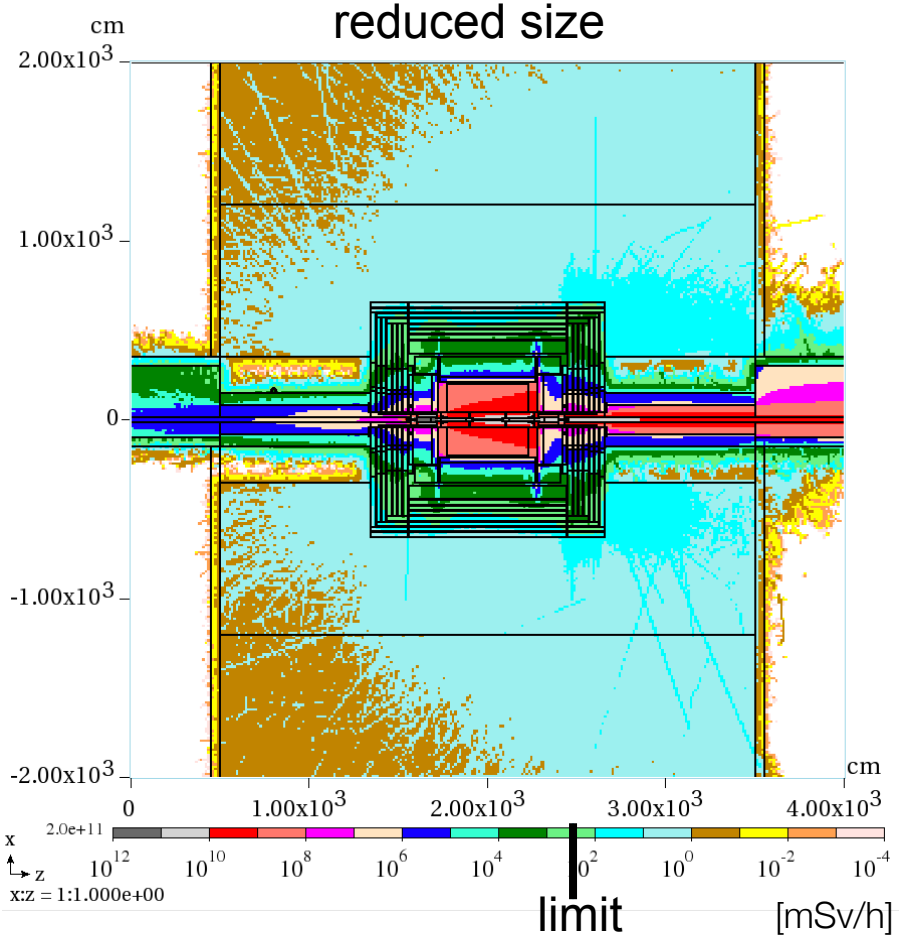

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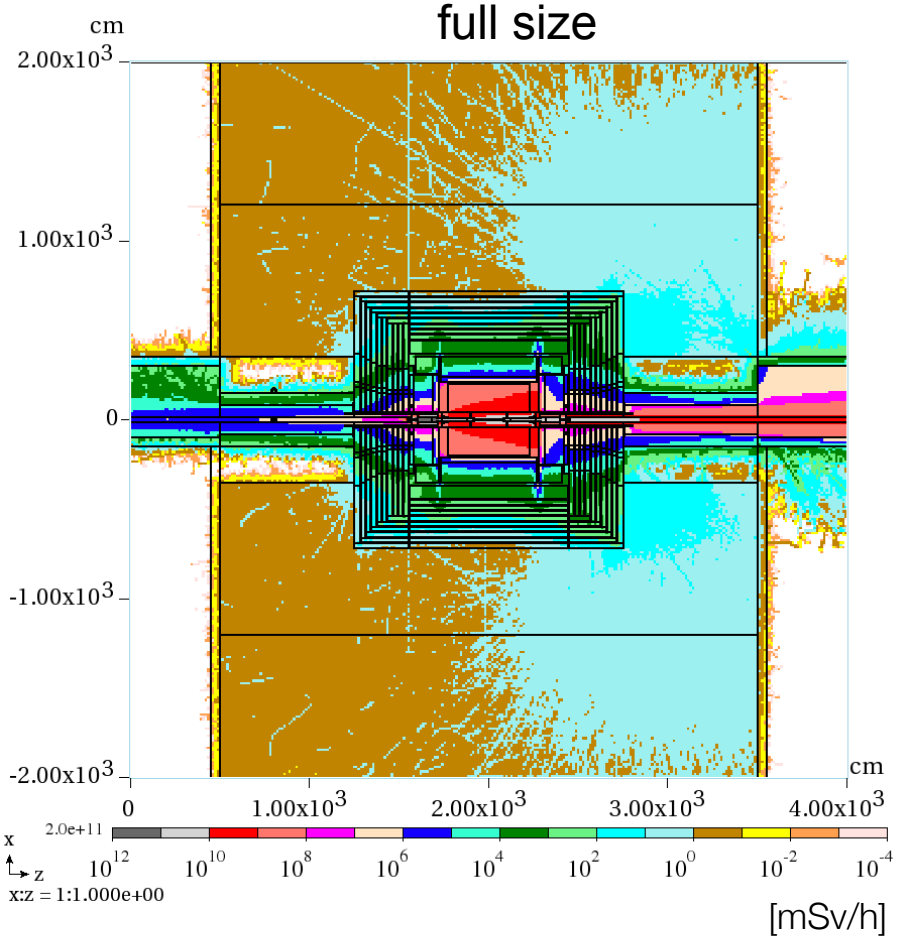

EC iron thickness in reduced GLD still 2.0m,
instead of 1.0m for reduced ILD

Conclusions

Reduced yoke with shielding platform looks quite attractive

- Significant cost saving
- Have to check radiation shielding
  - Recent progress (T. Sanami)
- Mechanical design in progress
- Have to study earth quake protection

Experts welcome