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Magnetic Shielding Issues

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STFC - RAL

Overview

- Issues
- Items in harms way – Step IV
- Step IV mitigation plan
  - Racks
  - Compressors
- Current / Future work
  - Hall Field Analysis
  - Partial return yolk concept
- Step VI
- Conclusions

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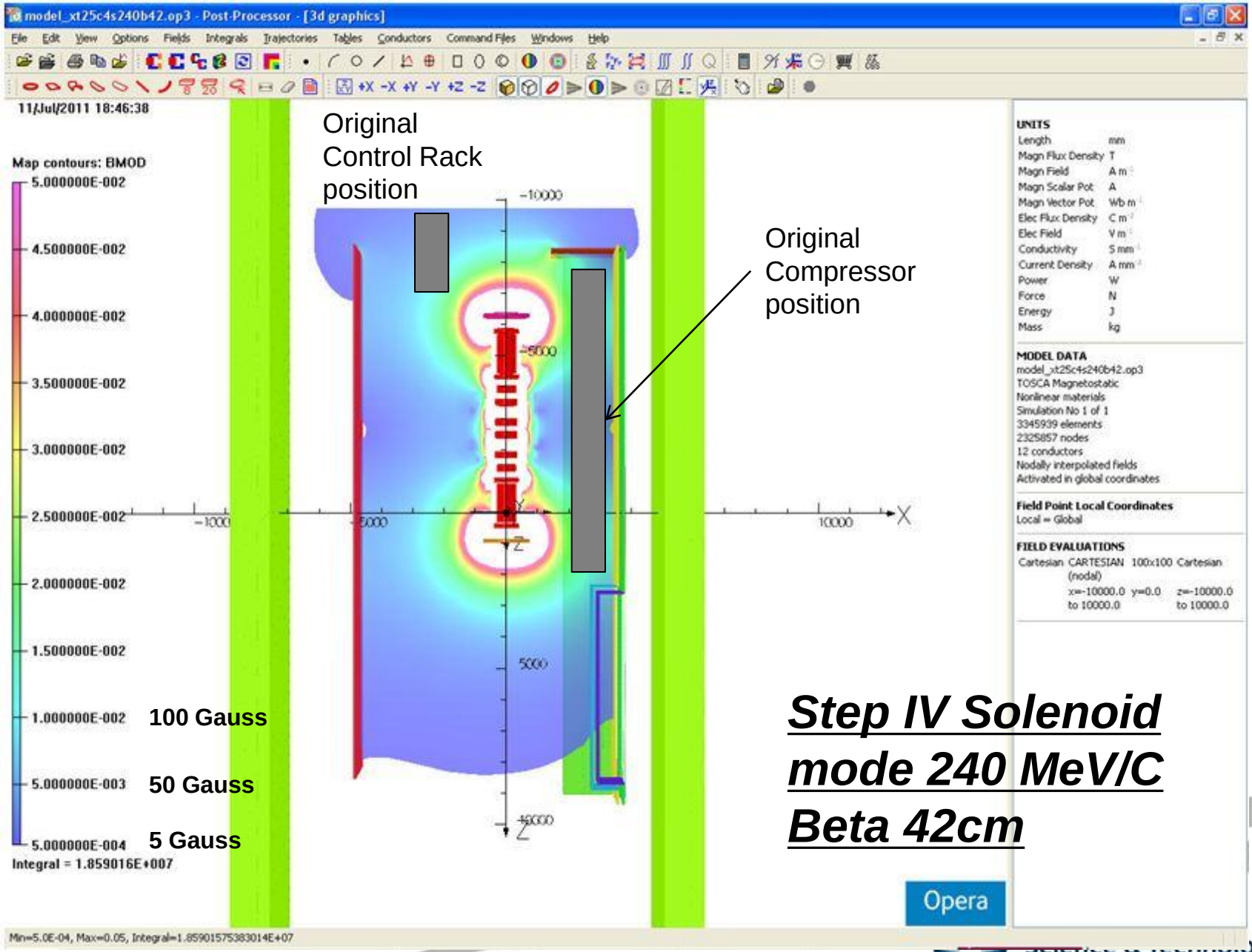
Issues

- Cooling channel initially designed without return yolks.
- Current North and South shielding walls designed to encapsulate the field with regard to the safety requirements.
- Safe levels outside the walls but high field within
- In air field, the original analysis, is not applicable for placing items. The field will focus where there are ferrous items.
- Sensitive equipment inside the shielding walls needs to be moved to lower field locations.



Step IV Solenoid mode 240 MeV/C Beta 42cm

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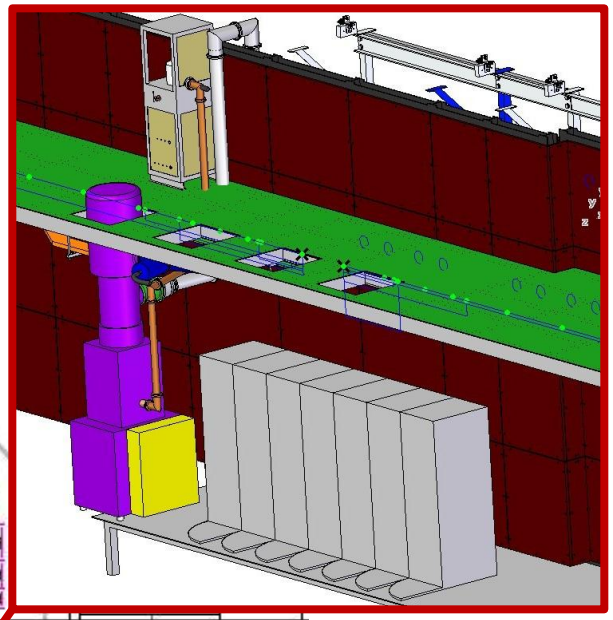
Items in harms way

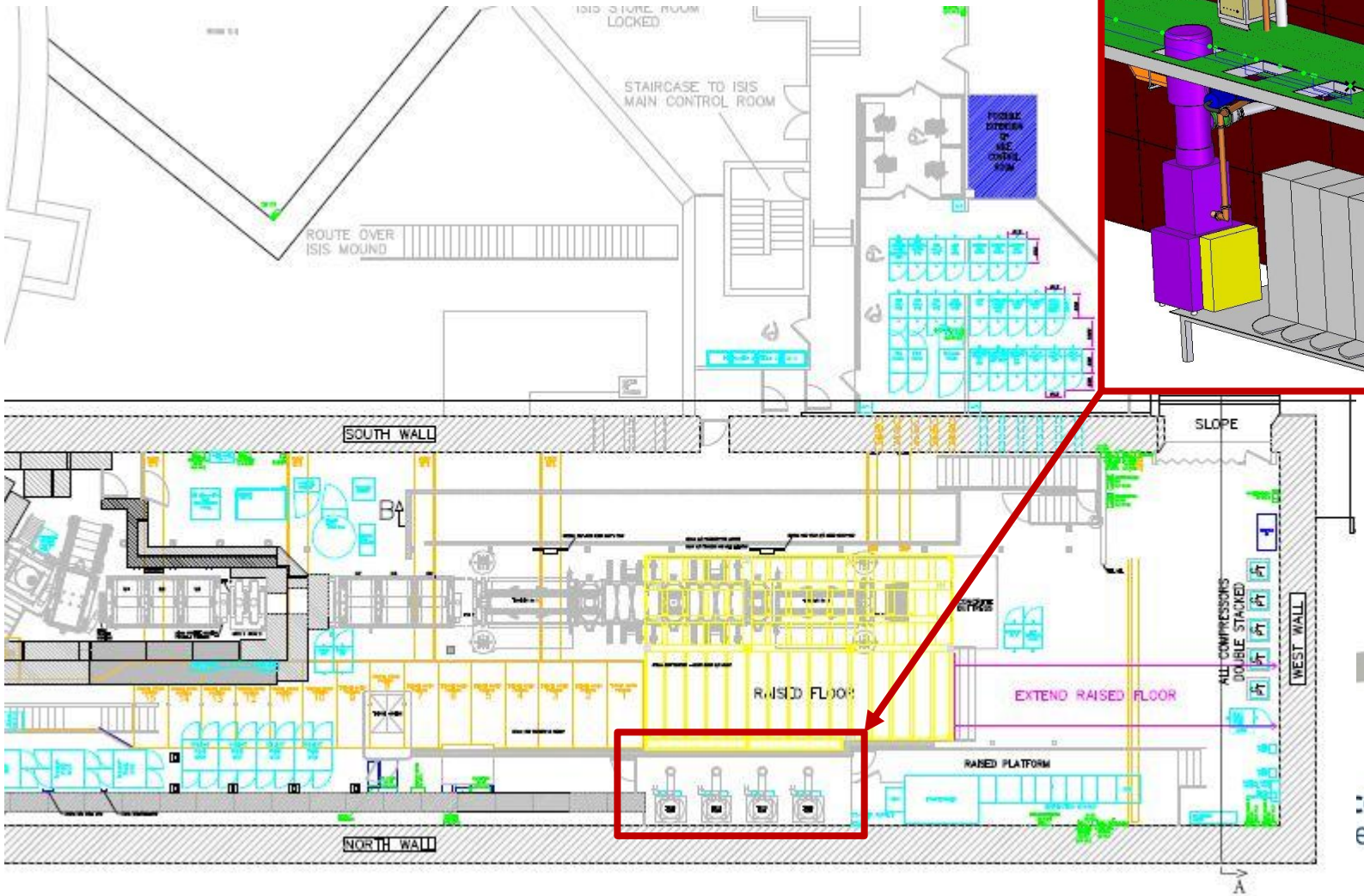
- Cryo cooler compressors.
- Power supplies, controls.
- PPS door interlocks
- Turbo pumps, primary pumps, Gate valves (limit switches)
- MCB’s, RCB’s, Relays
- ……..and the list goes on

Step IV - Racks

- Control and power supply racks for SS and FC to the RF area.
  - Behind shield wall and so out of large field.
  - Enough space for the 7 racks
  - Enough space to install the first of the four RF amplifiers
  - Power feed from the current RF boards
  - Cable routes under the false floor

Step IV - Racks





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Step IV - Compressors

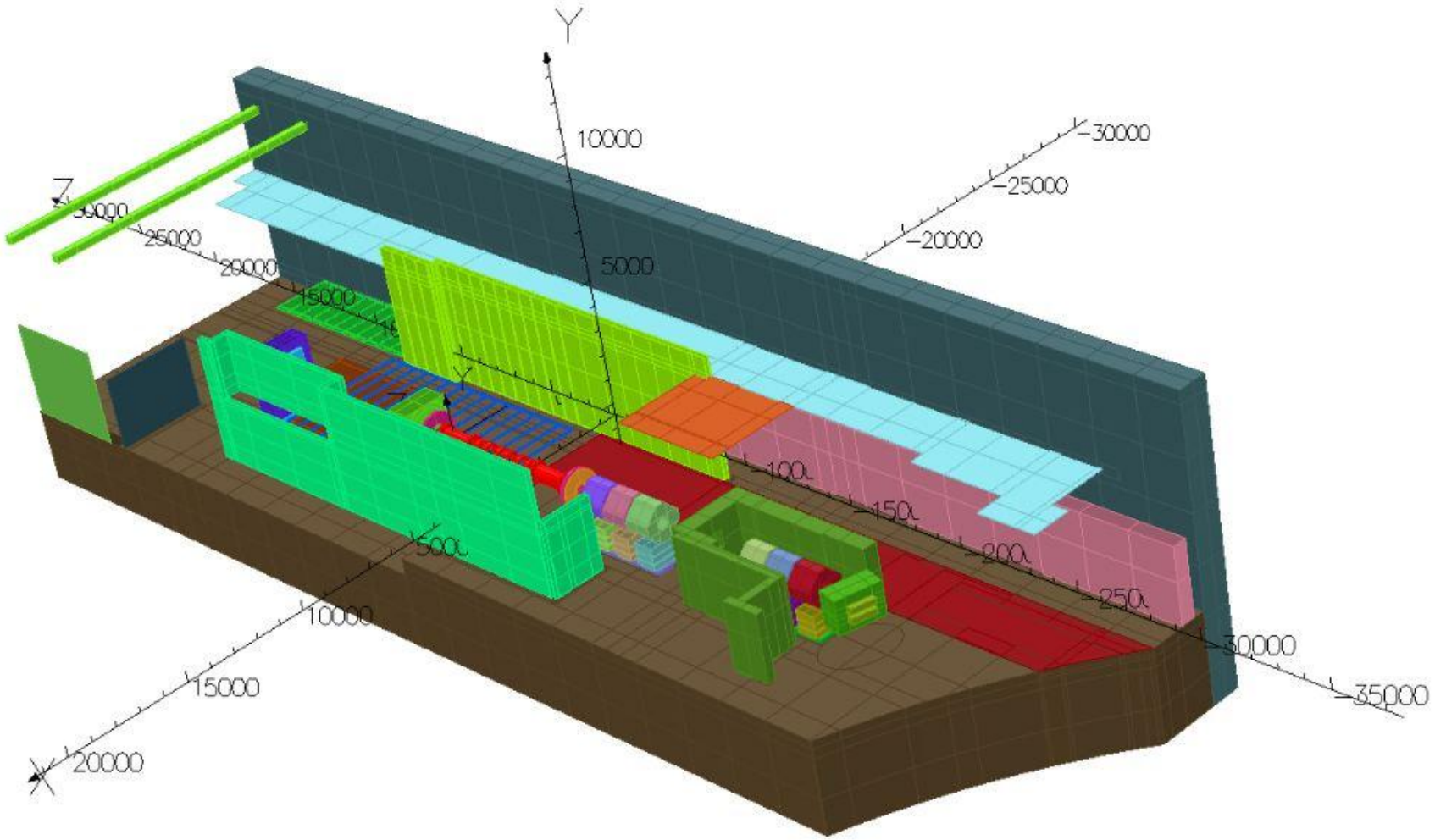
- Move to the West wall away from the South shield wall
  - 19 compressors, 13 two stage Cryomech, 2 single stage Cryomech and 4 single stage Sumitomo.
  - Very low field in air ~ 5 gauss
  - Enough space for the 19 compressors.
  - Long Helium lines will be required ~40m
  - Stairs will need to be moved through 90 degrees and a removable section design in.
  - Water supplies / pumps for the compressors will need to be moved from the trench and the current South wall installation.
  - Power supply for the compressors will need to be moved from the current South wall installation.

Step IV - Compressors

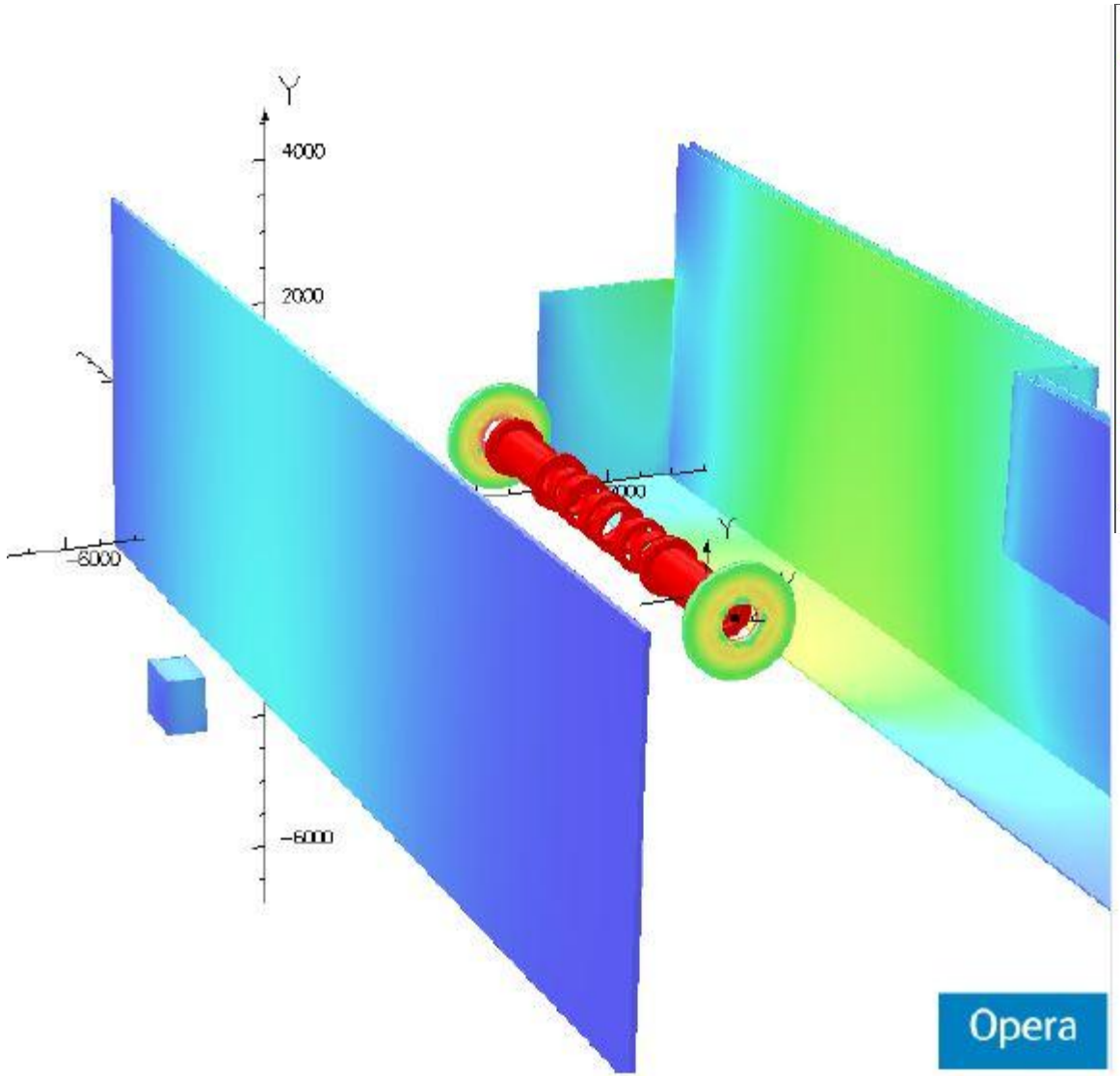
Current / Future work

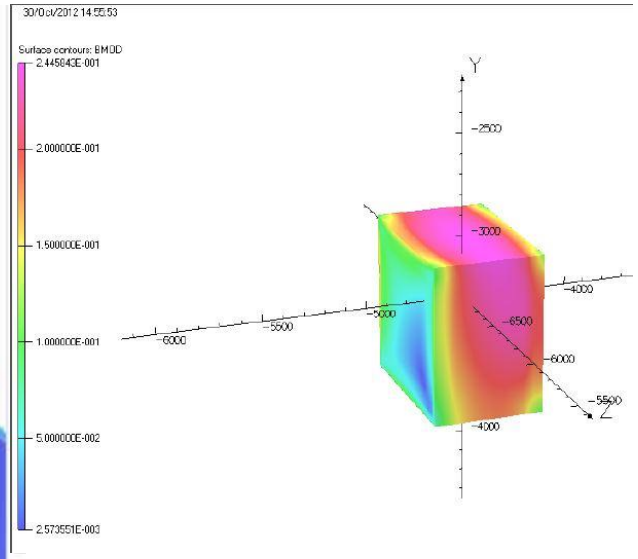
- Hall field analysis
  - Construction of a model containing as much ferrous equipment and structures as possible.
    - Quad magnets and stands
    - Decay Solenoid area shielding
    - North mezzanine structure
  - Size of model is a problem when solving for mesh and field analysis
    - Small objects cause the local mesh to be very fine extending solving time.
    - Limit in size of object that can be modelled.
  - The model is close to being in a state where numerical results can be taken from it. Further geometric and sanity checks to be carried out.
  - Investigation of Sub-modelling has taken an encouraging step forward.
    - Smaller model can be constructed with higher detail
    - Boundary conditions imposed onto the smaller model
    - Faster solving time
    - Smaller items / more detail can be analysed

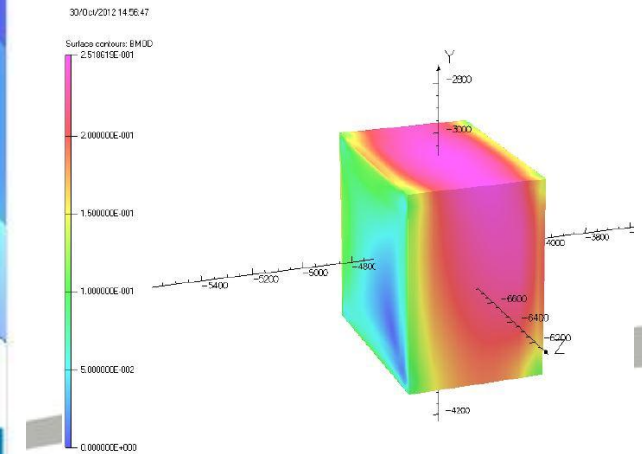
Current / Future work



Current / Future work







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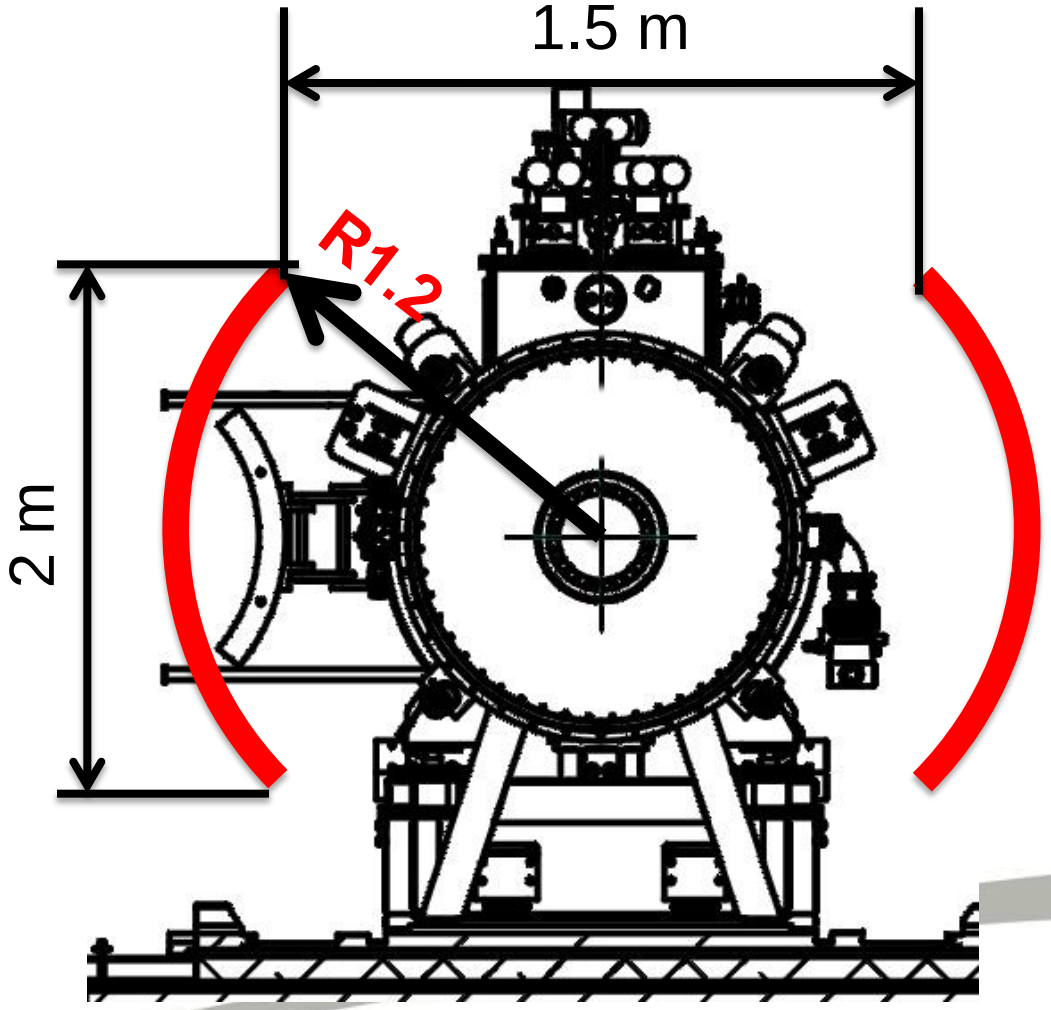
Current / Future Work

- To get good shielding horizontally: need continuous steel in azimuthal direction
- Geometry
  - Tube of radius 1.2 m
  - wall thickness 10 cm
  - azimuthally -50..50˚
  - weight: 30t



(Note: not to scale)

Slide from Holger Witte presentation at CM34

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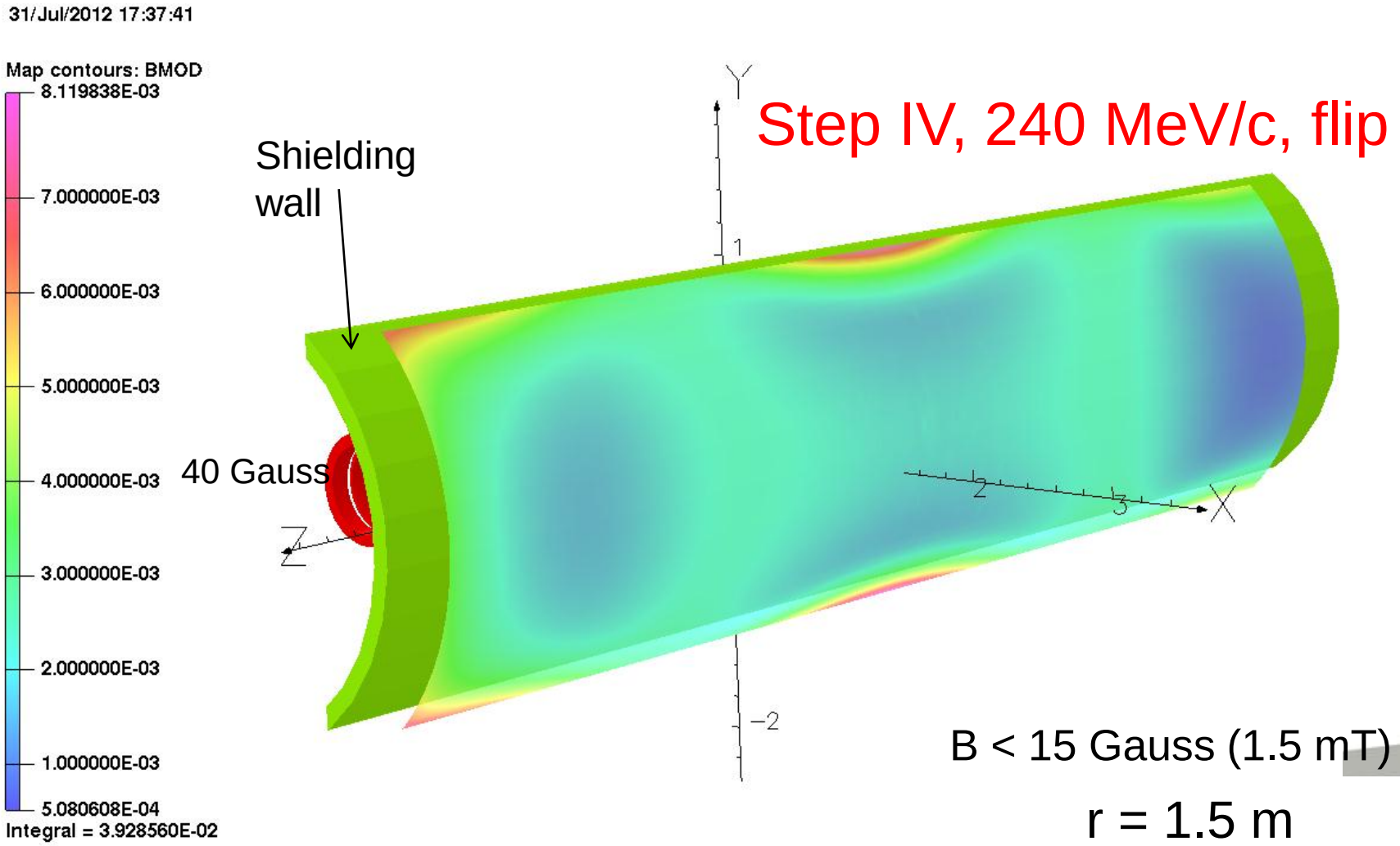
Shielding Efficiency



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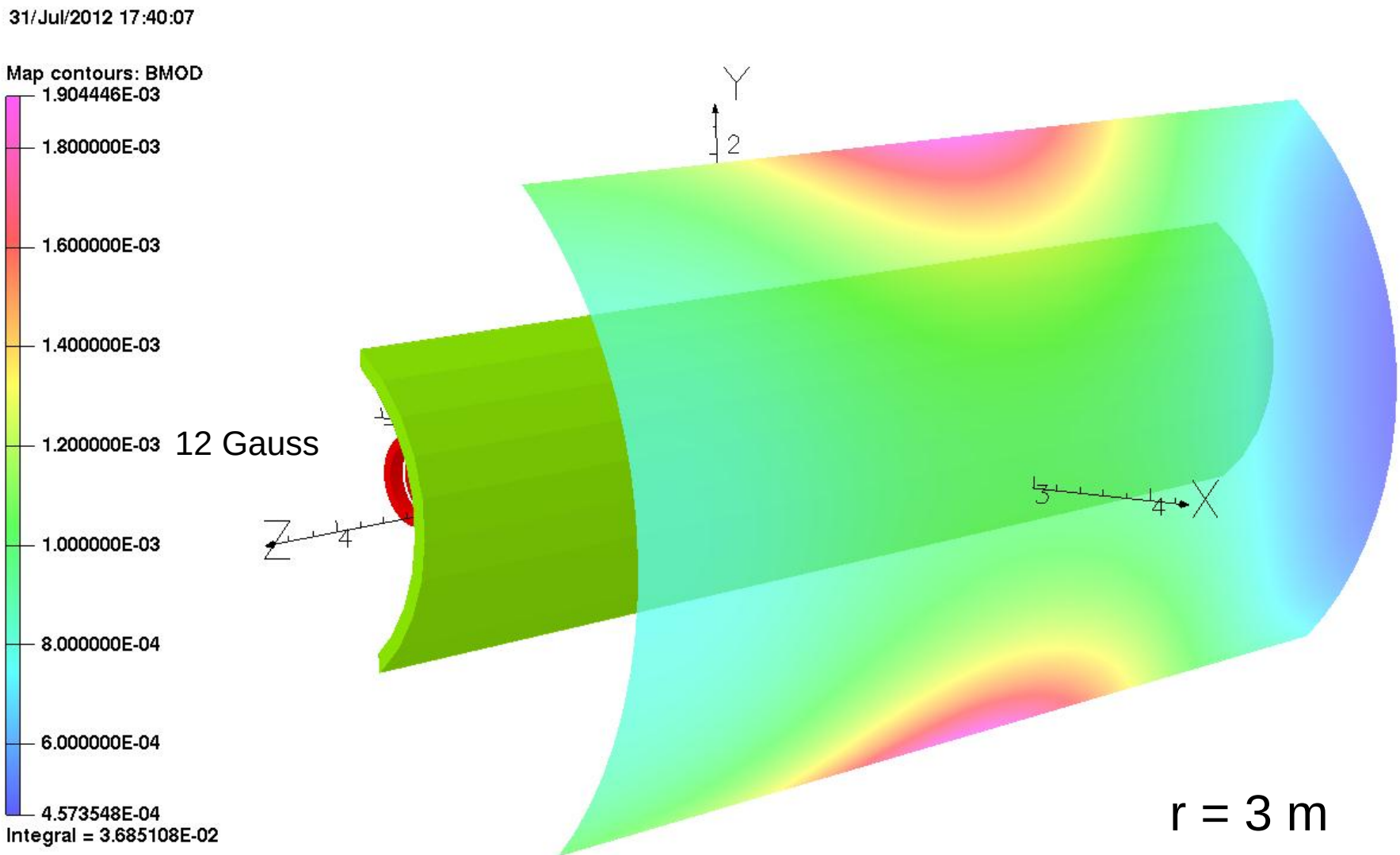
Development of Fringe Field



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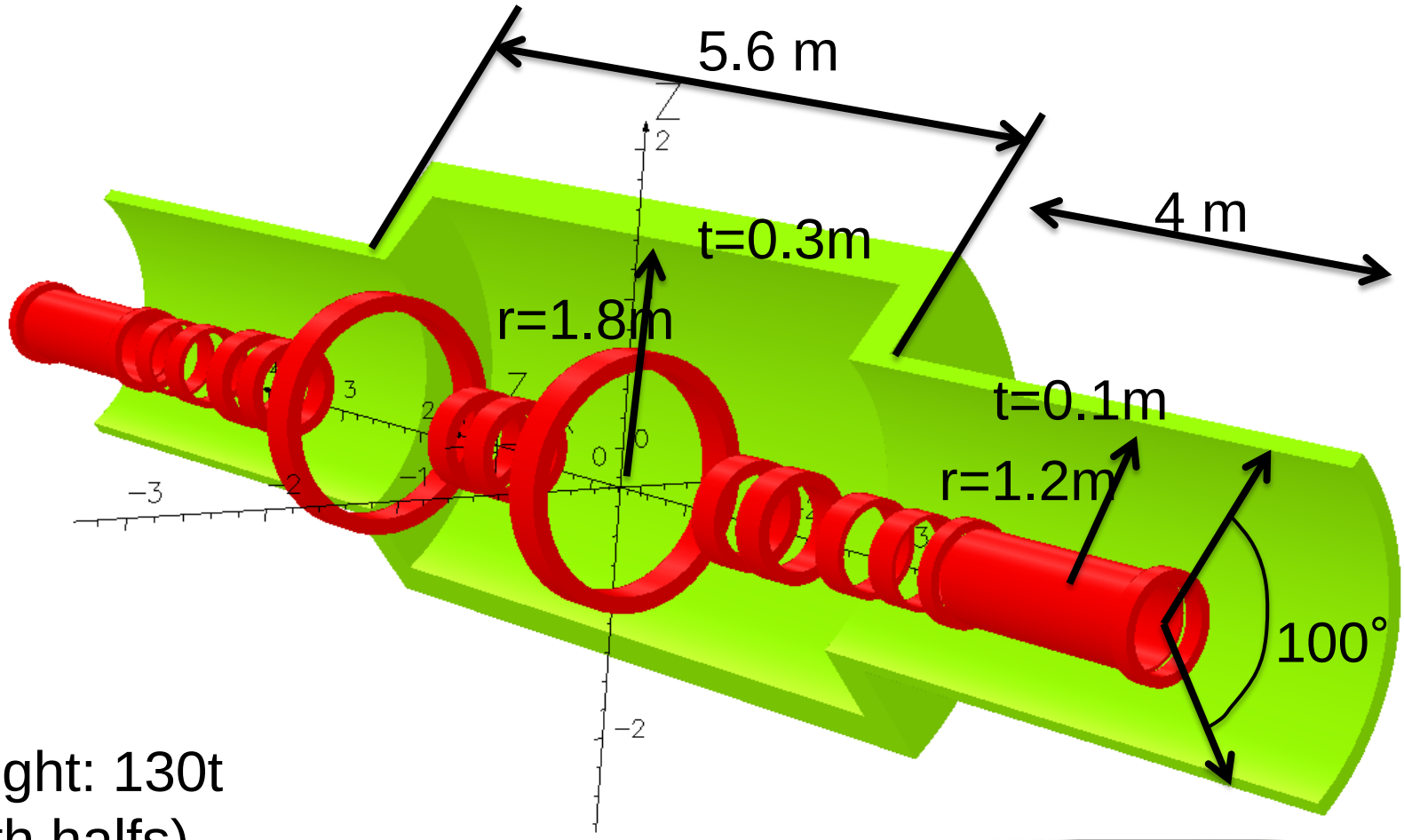
Step VI Geometry



Weight: 130t
(both halfs)

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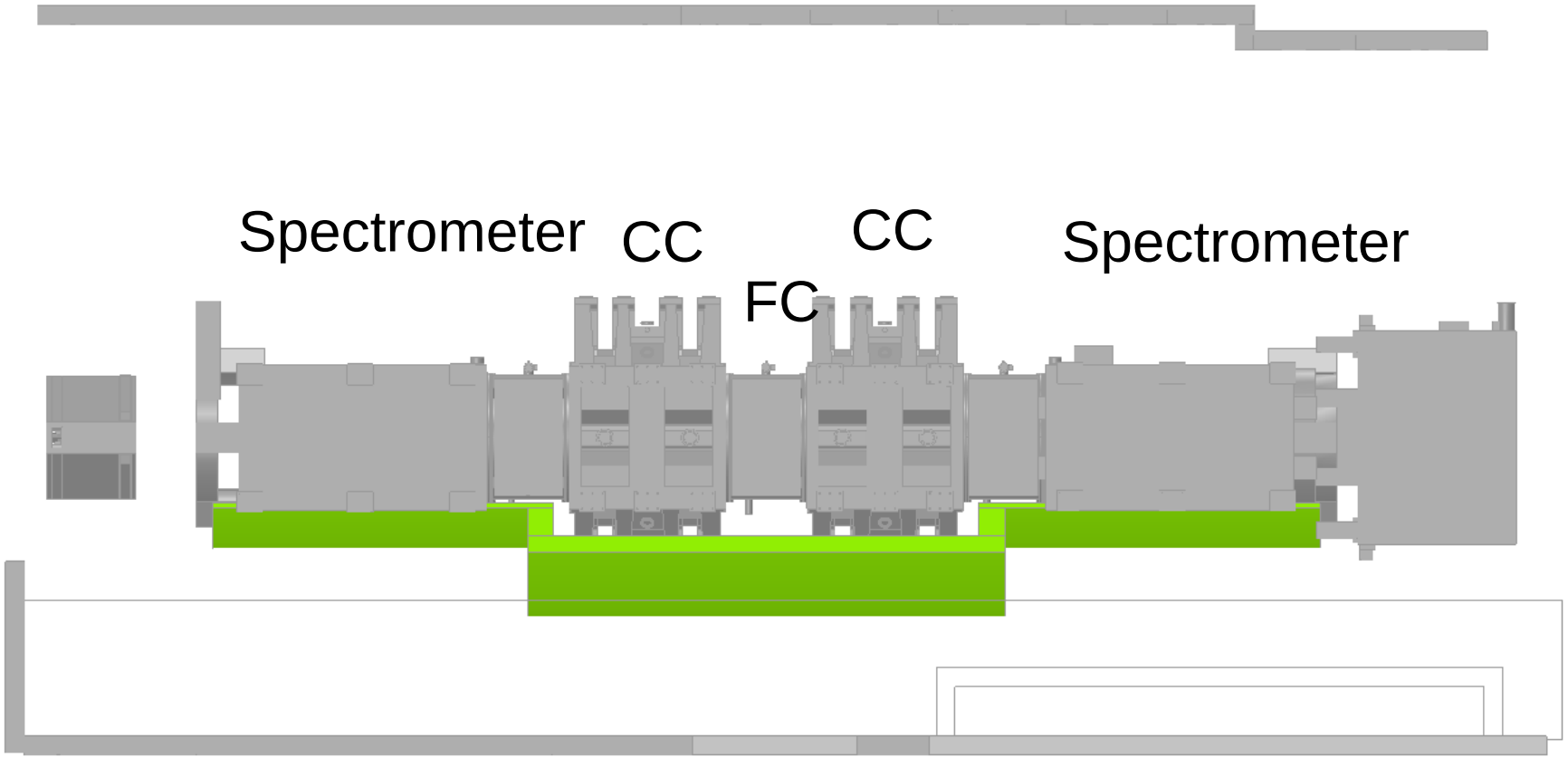
Step VI Geometry



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Partial return yolk conclusion

- Conceptual design of local flux return
  - reduces stray field in hall significantly (factor 30)
  - shield: about 30t of iron (130t for Step VI)
  - force on shield manageable
- Effect on beam – To be determined
- Effect on other iron structures in hall – To be determined
  - Q9, floor, walls
- Extension to Step VI possible
  - includes solution for natural breaks in shield for wire feed-in/out
- Engineering

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Step VI

- Power and control racks behind North wall will need to move to accommodate RF amplifiers.
- Discussion of possibility of using ISIS plant room as a rack room underway.
- Additional compressors installed to the West wall – structural aspects installed during Step IV mitigation.
- Partial return yolk concept applicable for next step.

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Conclusions

- Build of full analysis model to be completed and full checks carried out to ensure the model gives credible results.
- Further development of the sub-model analysis to give more detail in critical areas, eg, racks and compressors.
- Design / manufacture work for compressor location at the West end of the hall.
  - Routing of the He lines for cold heads
- Engineering investigation of the partial return yolk concept
  - Collaboration between RAL and BNL engineers
- Discussions for the ISIS plant room location for MICE rack room / extended control room.
- Testing of small equipment that cannot be realistically placed in the model.