MICE Shielding

Holger Witte
Brookhaven National Laboratory
Advanced Accelerator Group

MICE Global Shielding

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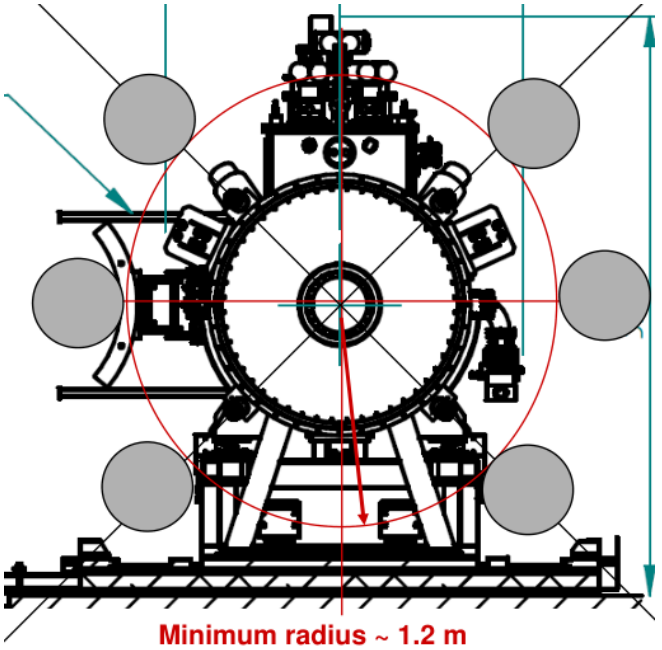
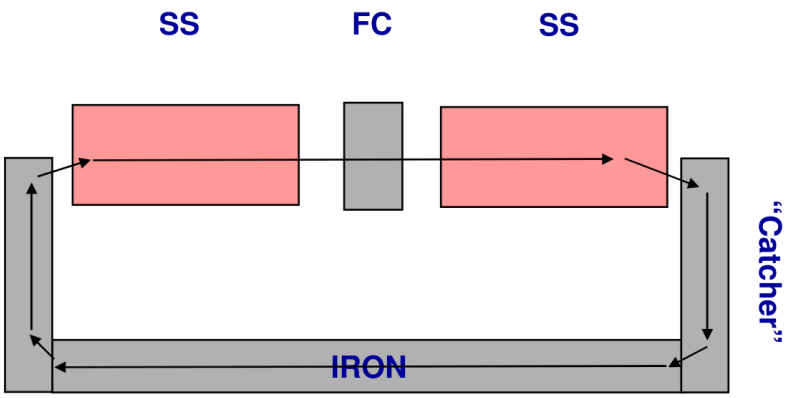
- Aim: identify global solution
  - one iron shield which makes shielding of individual components unnecessary
  - Initially only for Stage IV, but should also work for Stage VI (or upgradable)
- Magnetically ideal solution: encase MICE in cylinder
  - everything else is worse, but by how much?
- What has been done so far?
  - initial studies studying effectiveness of different shielding approaches (multiple bars, flux catchers, cylinders, …)
  - effect of shielding on field of MICE
  - studies do not include any other equipment in MICE hall

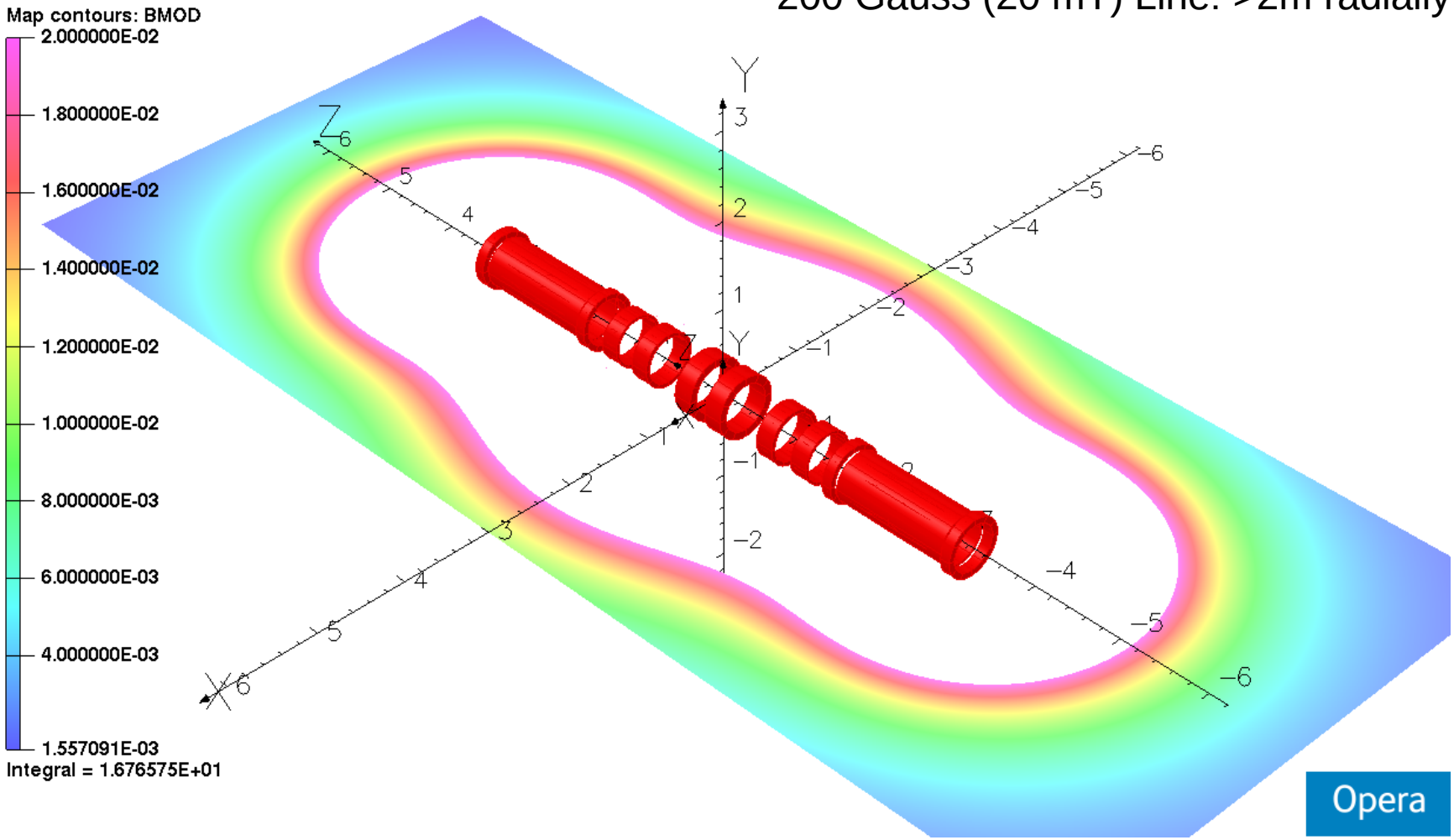
Things which don't work

- Approximate tube by multiple iron bars (4/6/8/…)
  - poor shielding performance (~2)
  - reason: large gaps between bars allows flux to escape
  - gets slightly better with increase in diameter and number of bars
- Flux catchers / end caps (in combination with bars)
  - catch only (some) flux from spectrometer





Initial Fields



Simulation: Stage IV, 200 MeV flip, no iron

Initial Fields

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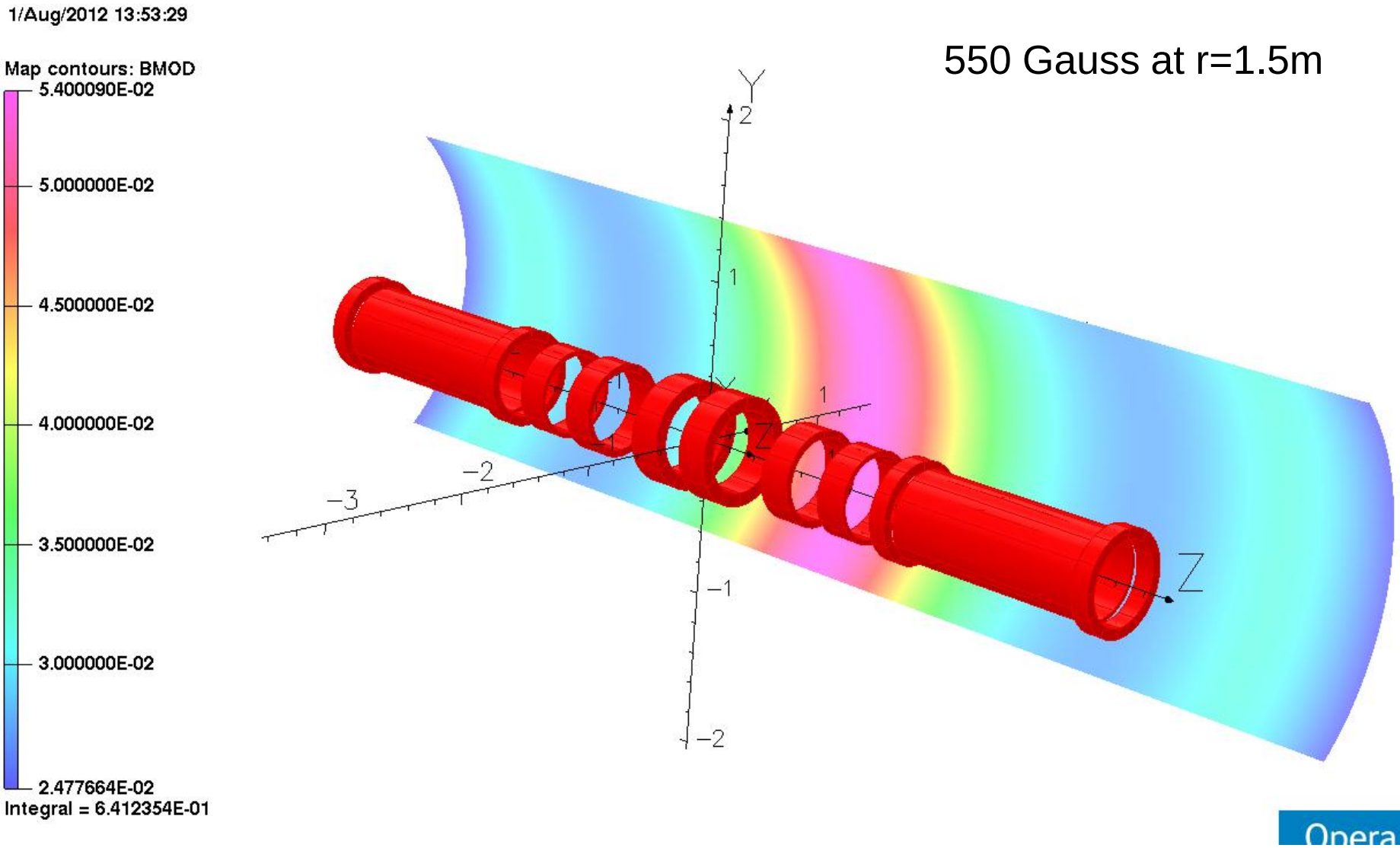
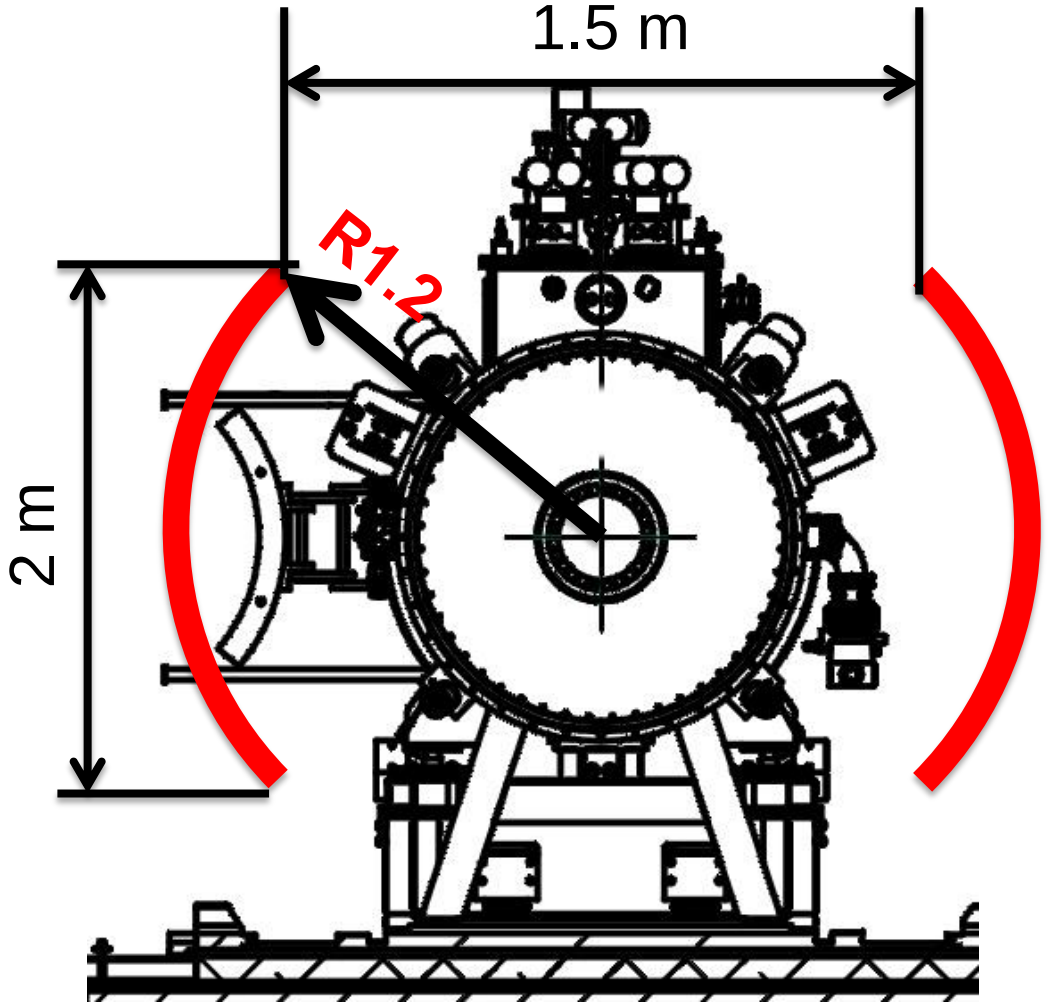
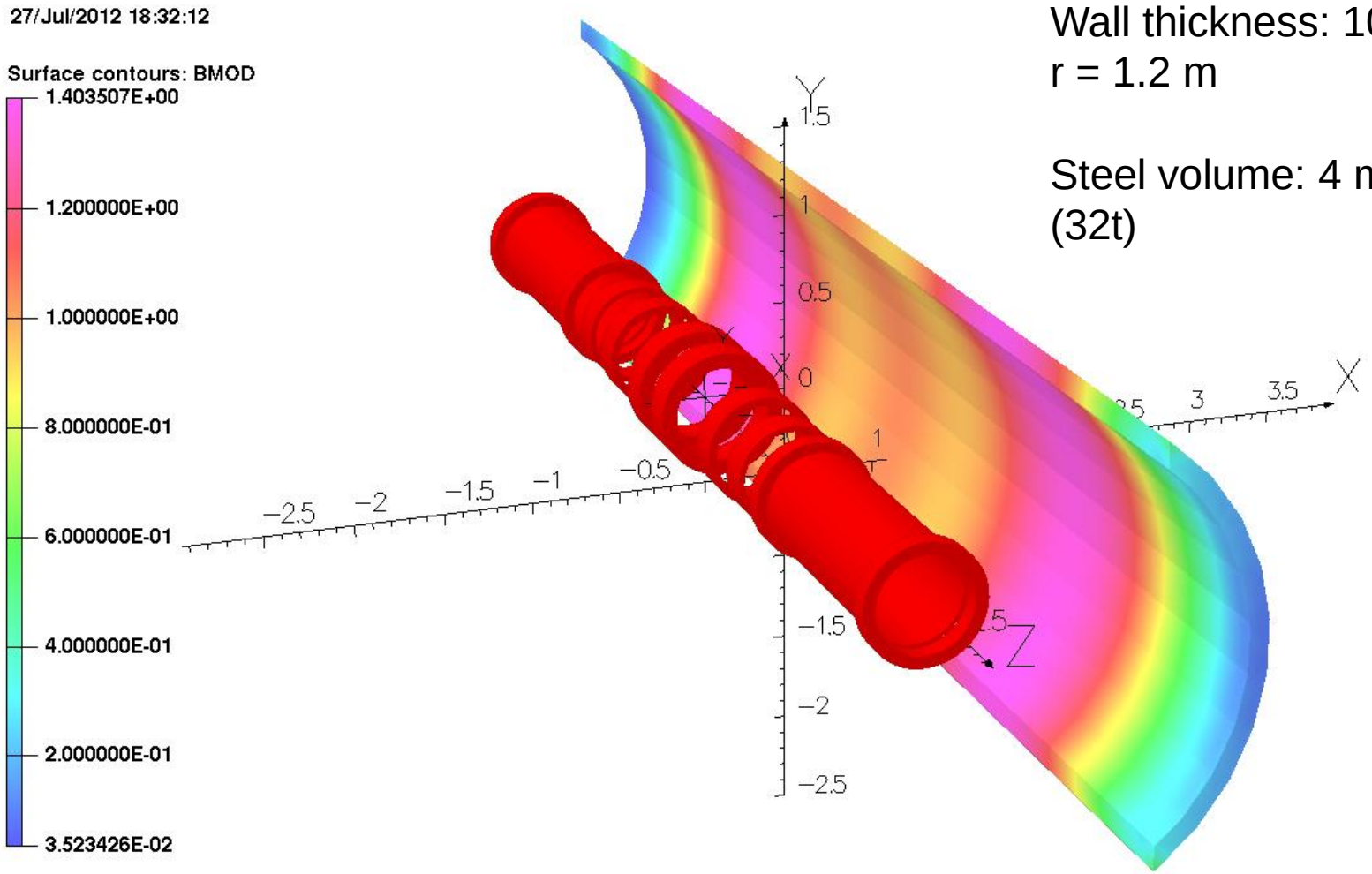


Quarter Tubes

- (Note: not to scale)
- To get good shielding horizontally: need continuous steel in azimuthal direction
- Top and bottom: shielding not absolutely necessary
  - breaks symmetry, will come back to this later
- Tube of radius 1.2 m
  - wall thickness 10 cm
  - hor. cut-out of 1.5 m



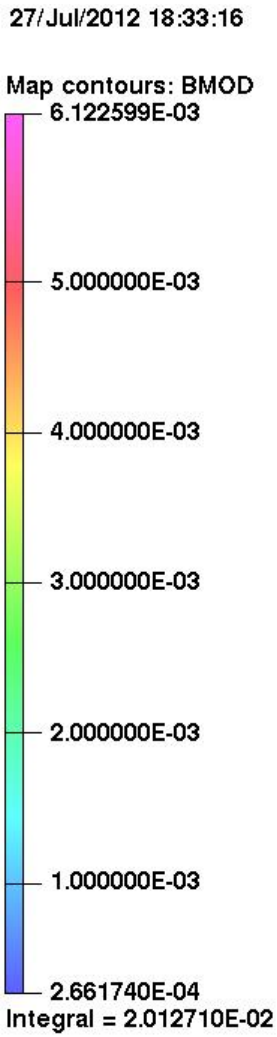
Magnetization

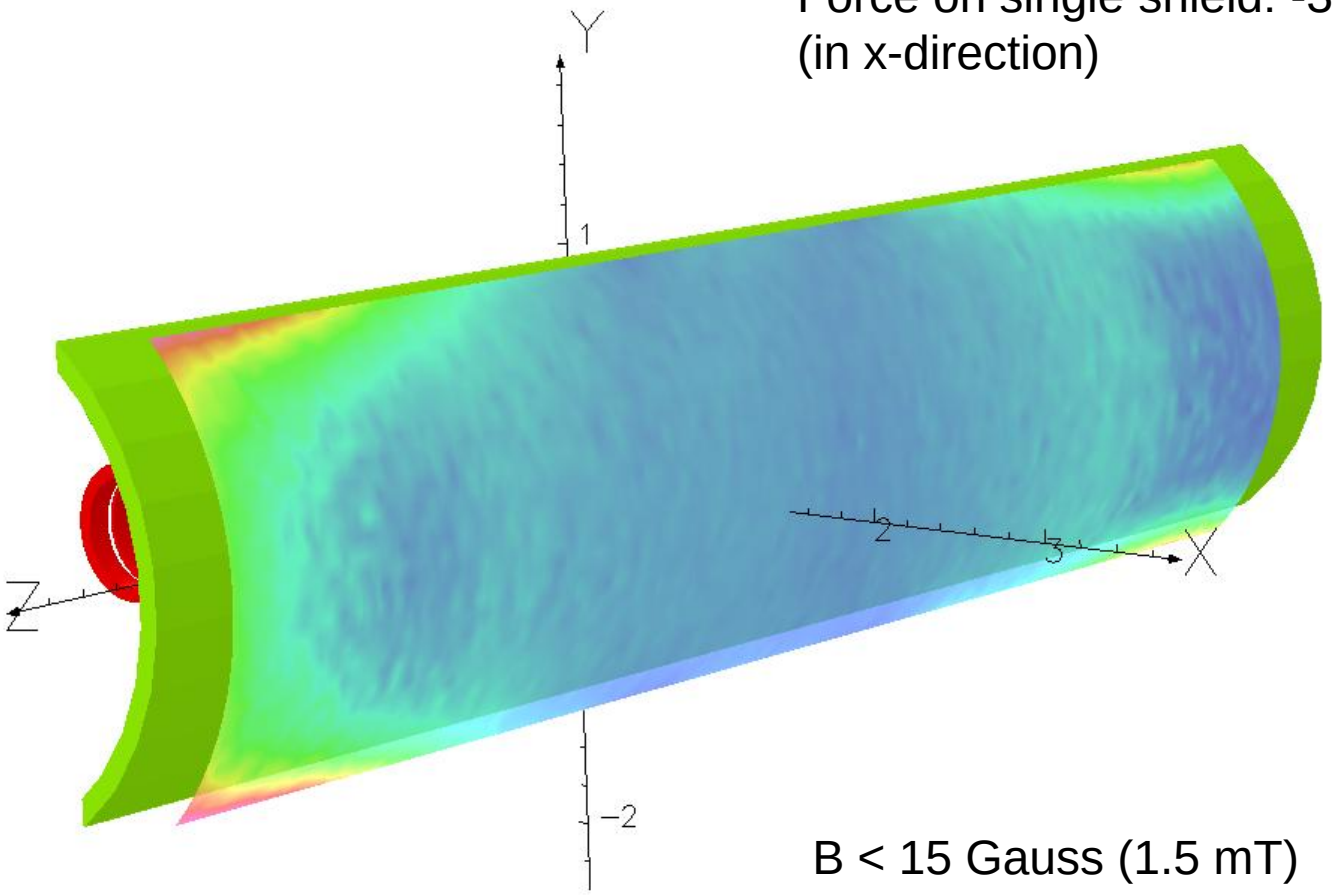


Wall thickness: 10 cm
r = 1.2 m

Steel volume: 4 m^3 (32t)

Step IV, 240 MeV, Flip



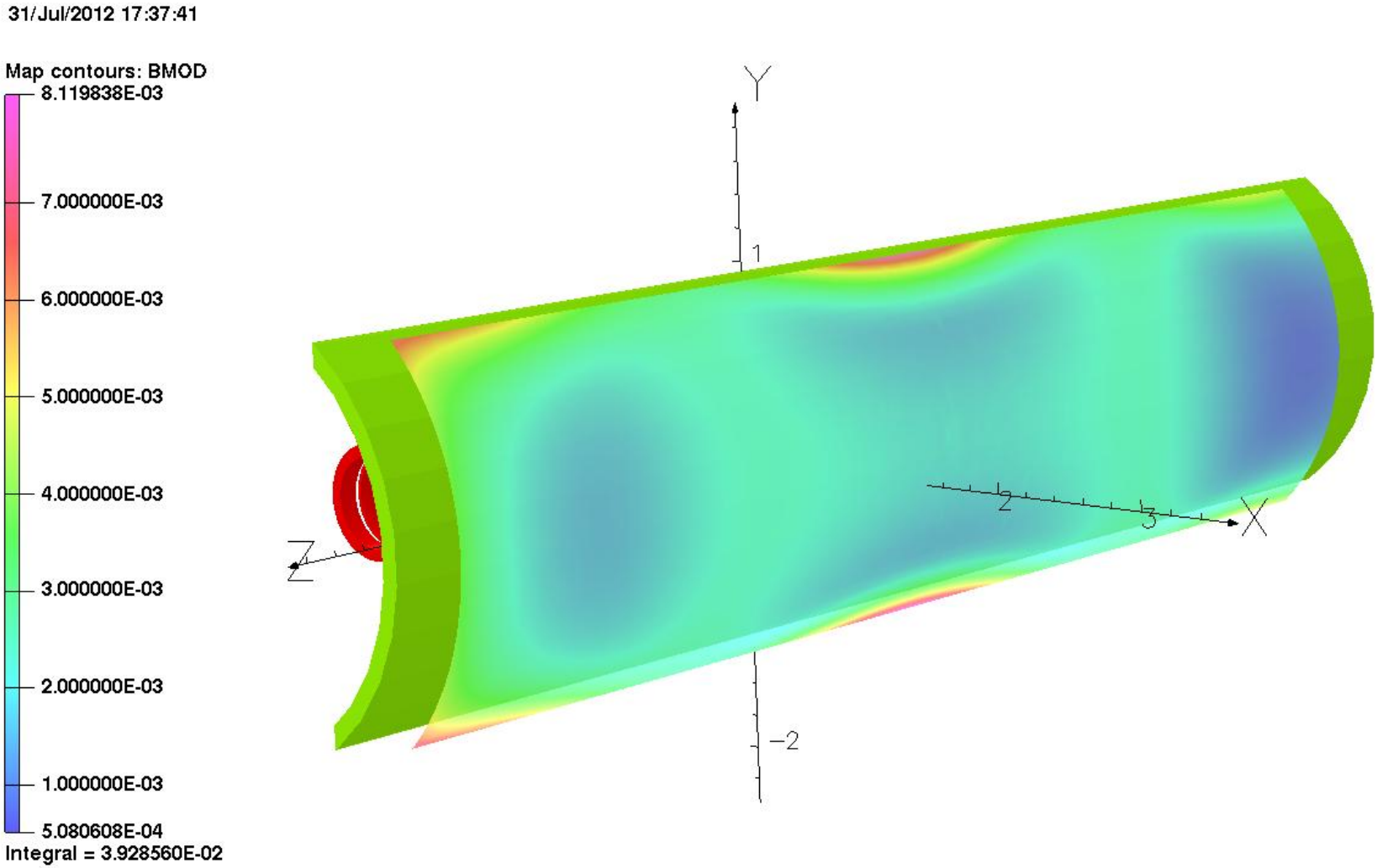


Force on single shield: -36 kN (in x-direction)

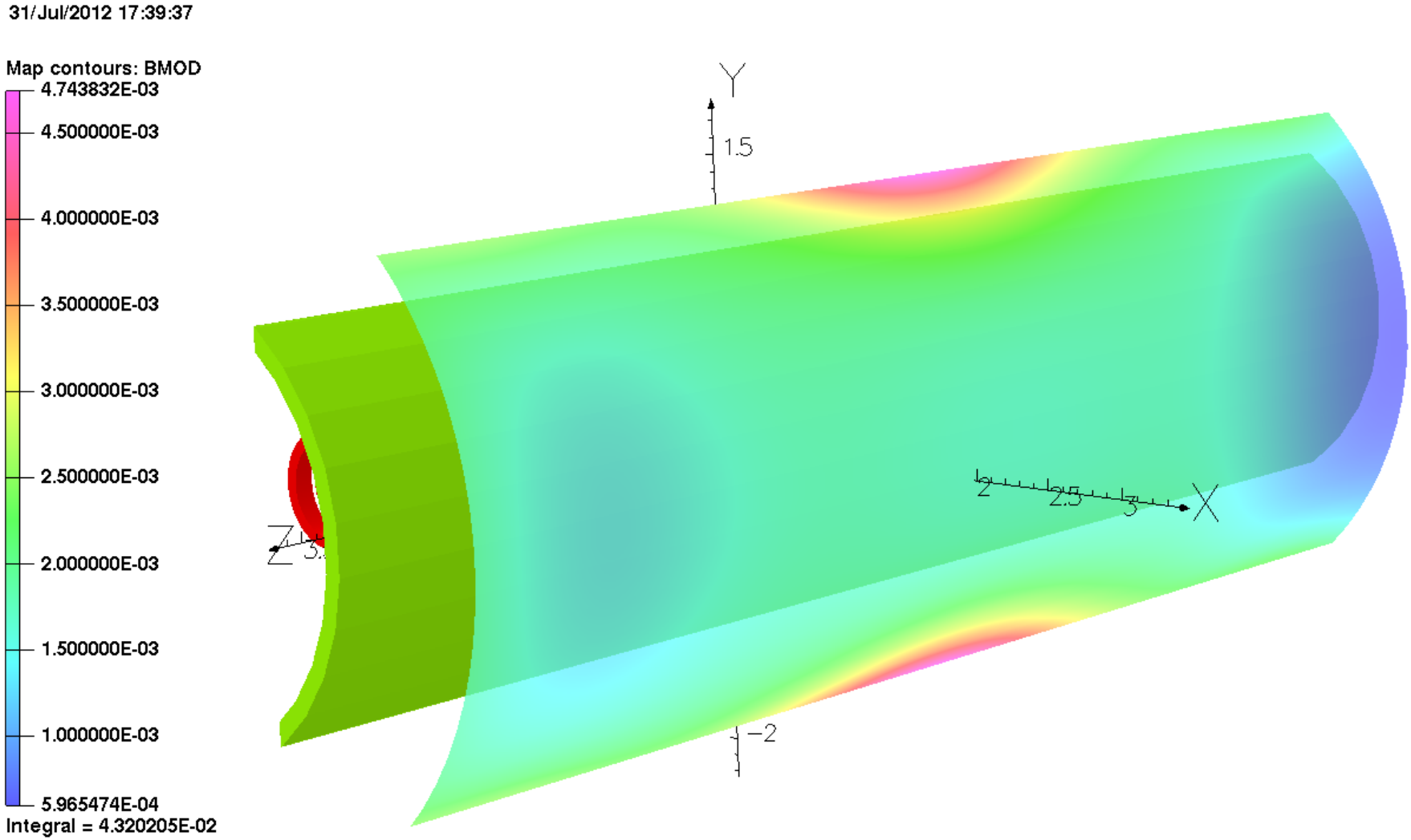
B < 15 Gauss (1.5 mT)

240 MeV/c

Development of Fringe Field



Development of Fringe Field



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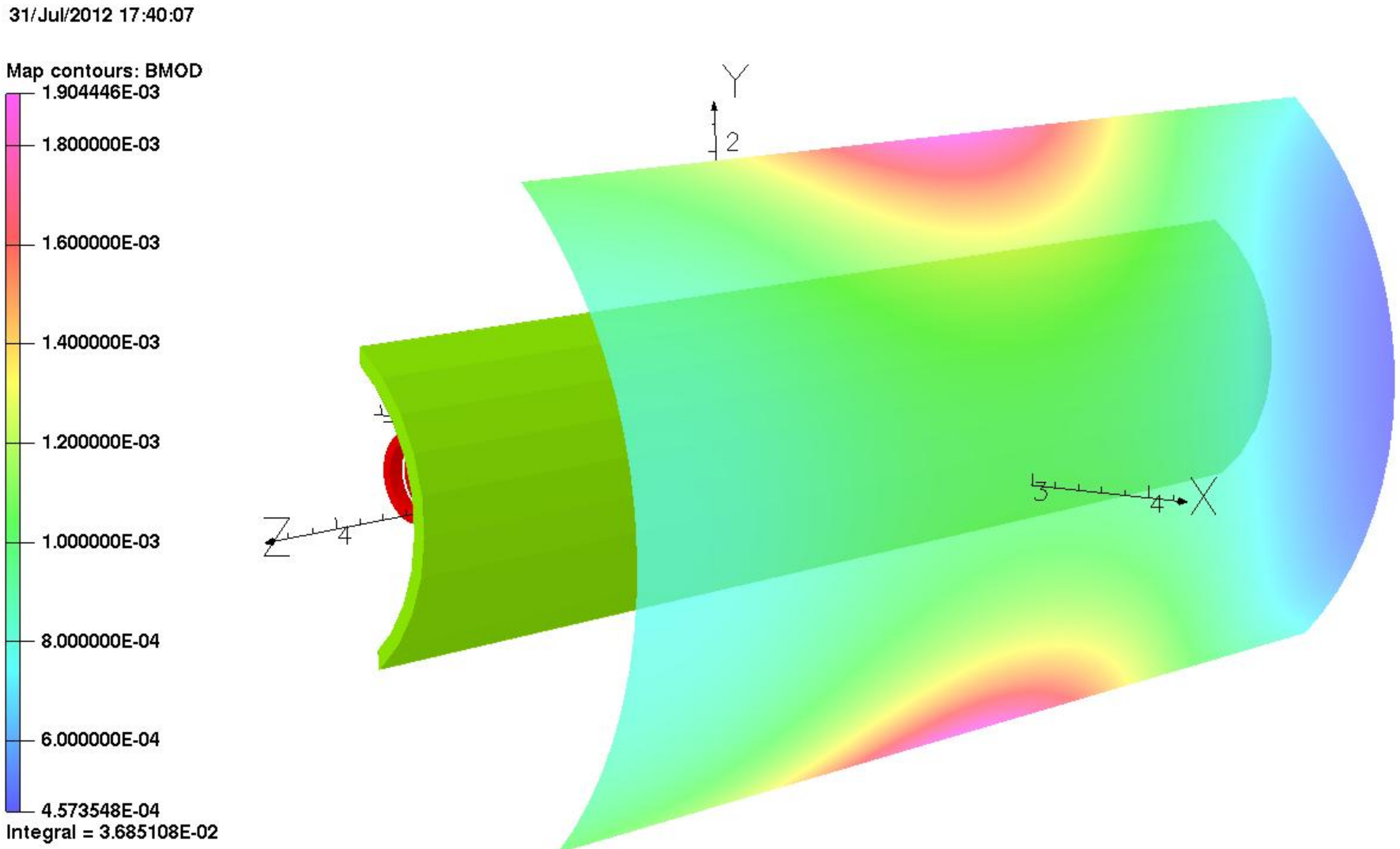

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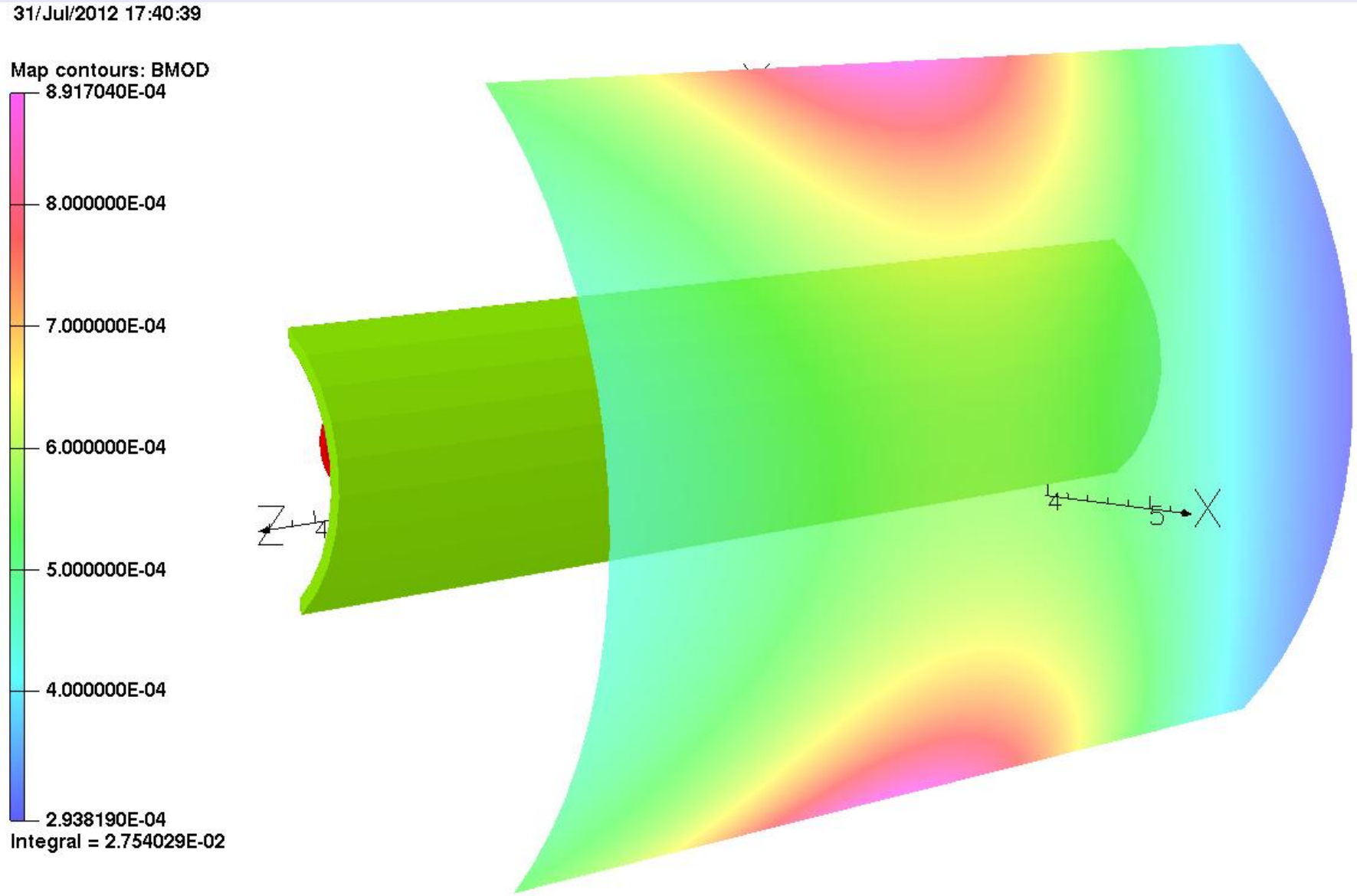
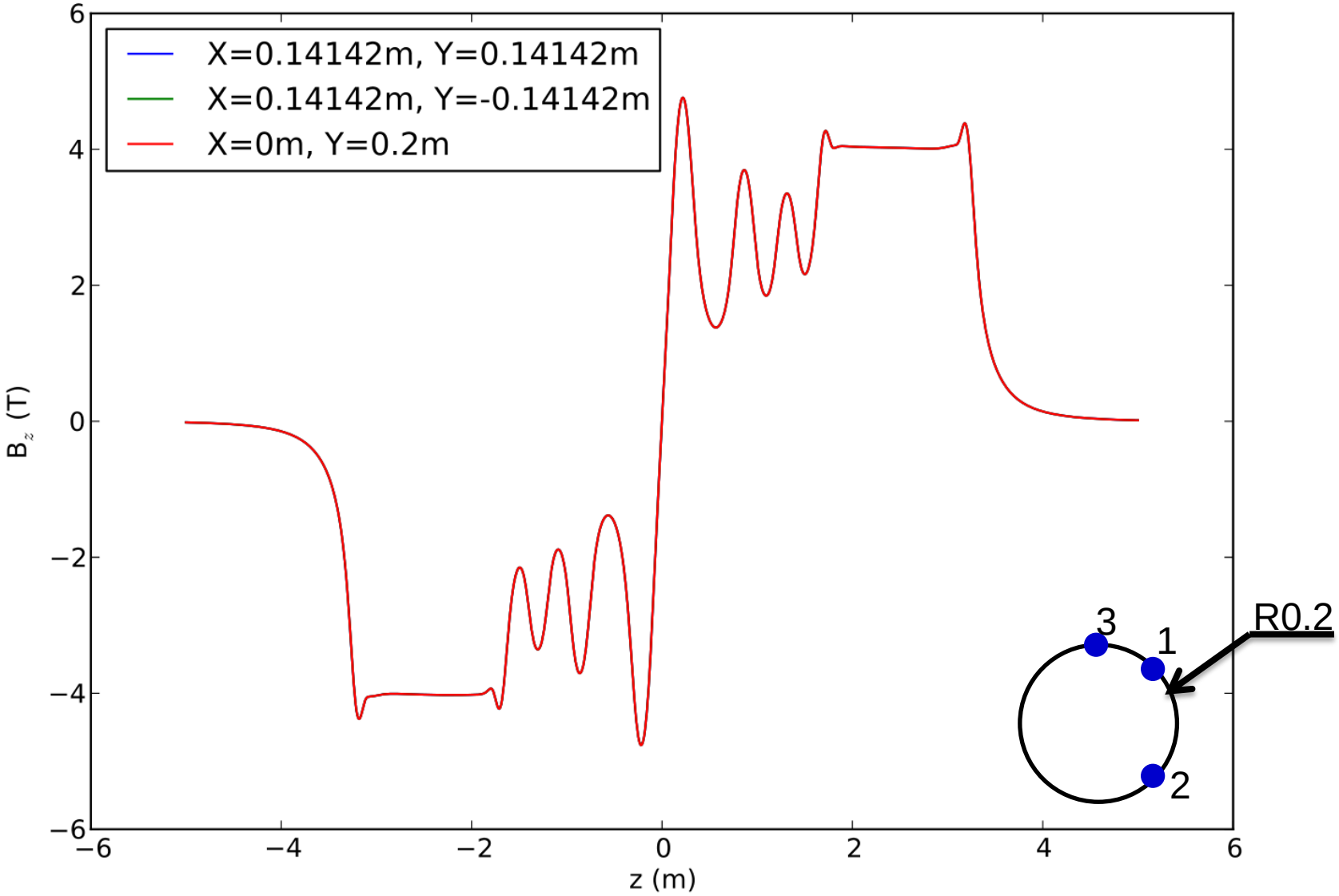


Effect on Field in Channel



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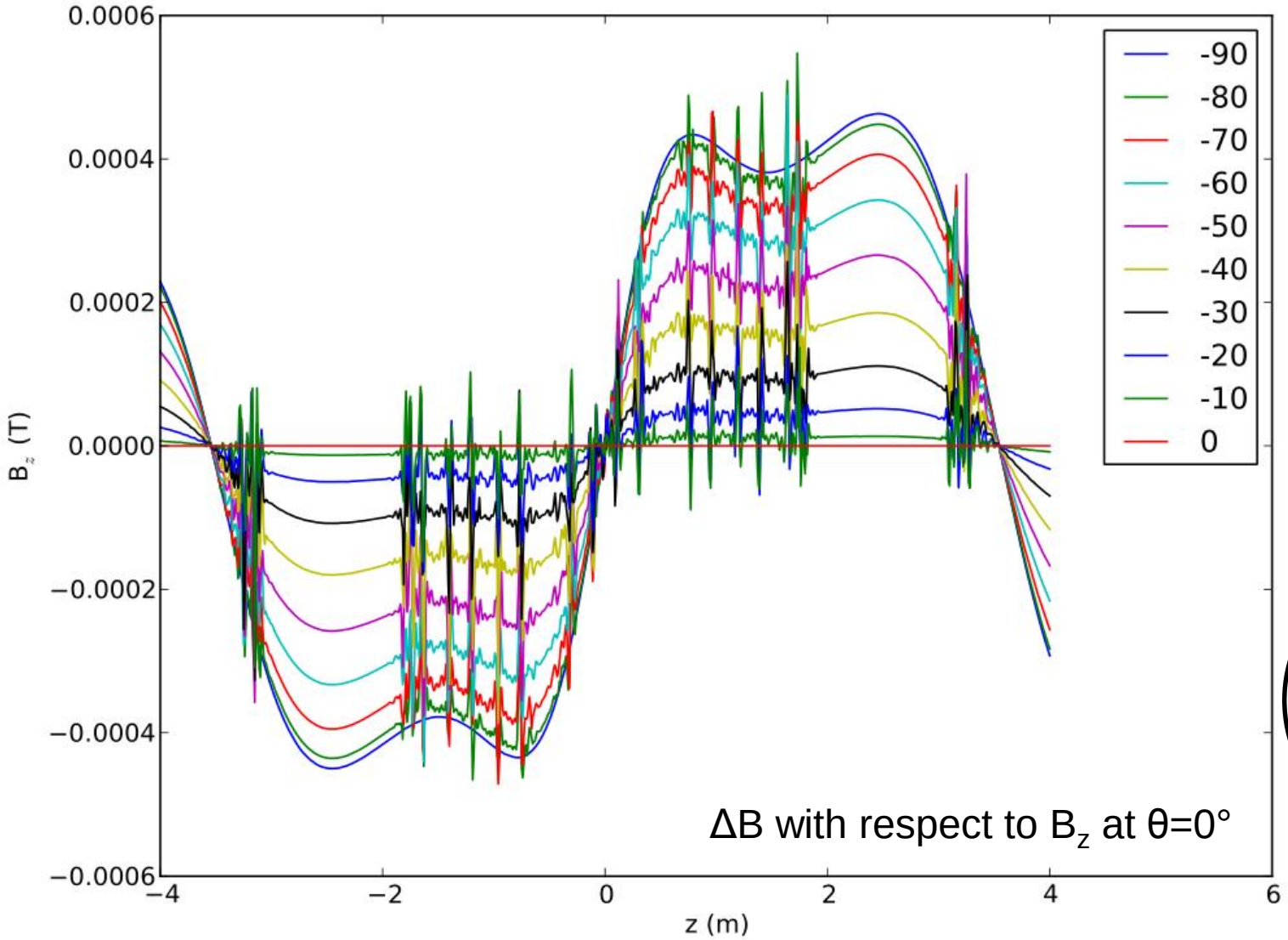
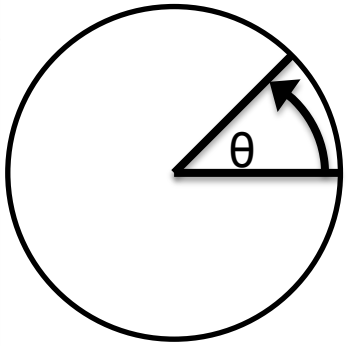
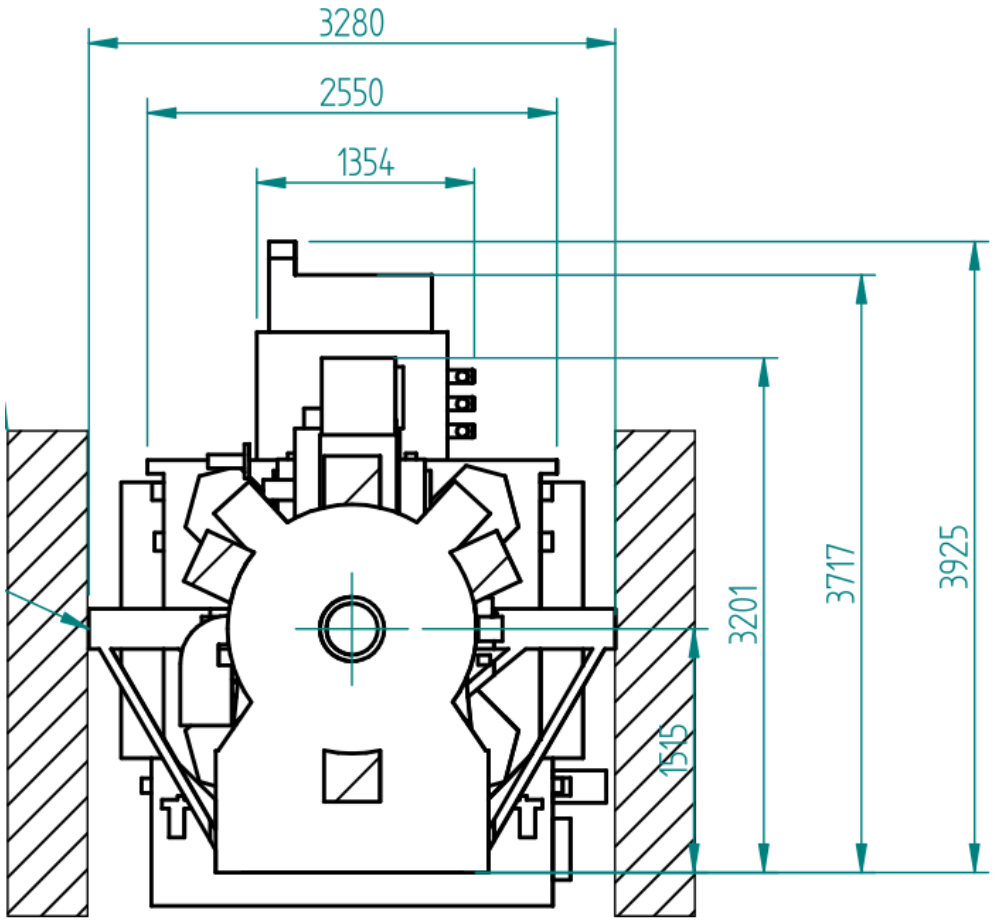


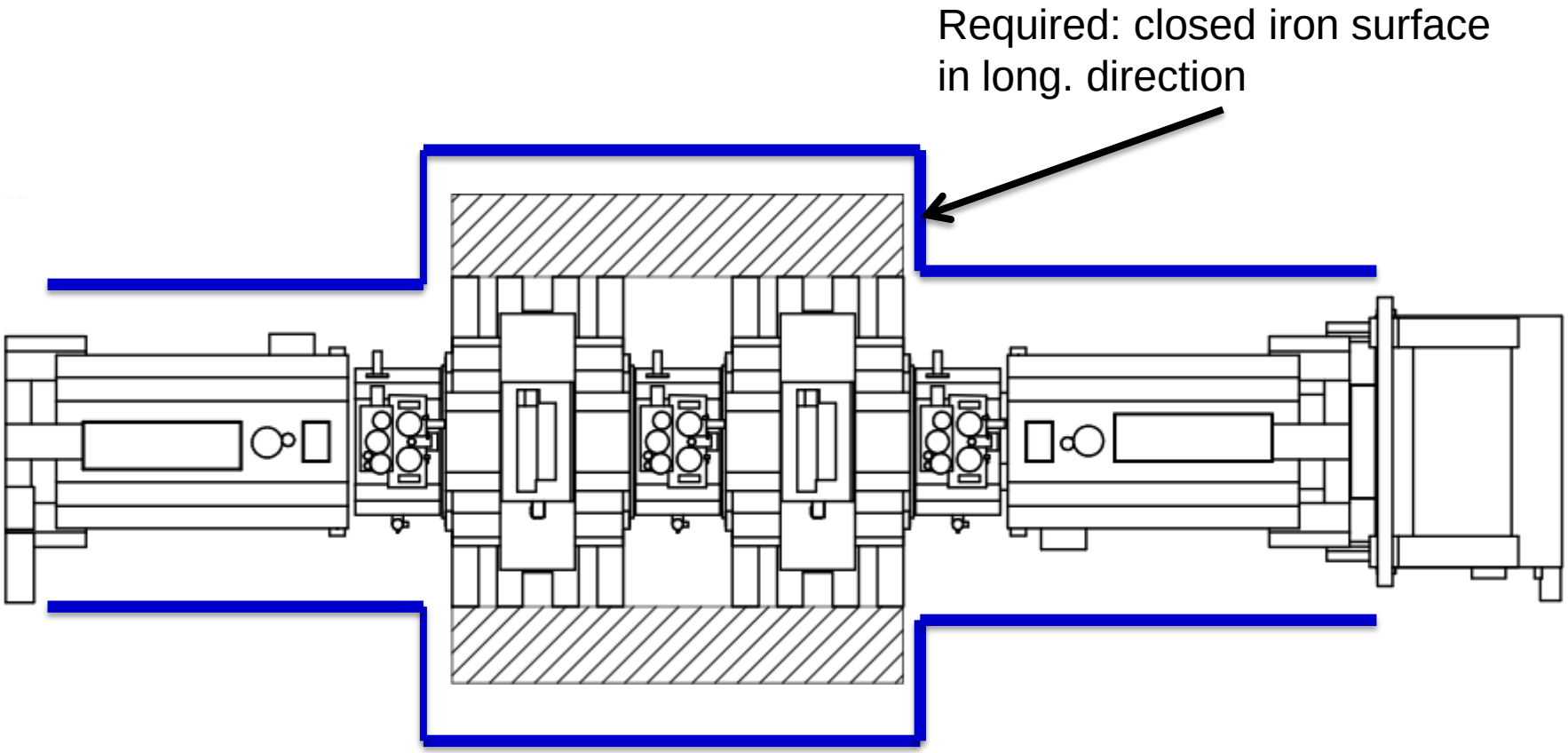


Options for Extension MICE Stage VI

- MICE stage VI: significantly larger in diameter
  - Coupling coils
  - RF waveguides
- Adaption of scheme possible?
- Ideally:
  - single scheme for both scenarios
  - Or: possibility of modification



MICE Stage VI – Option 1



MICE Stage VI – Option 1

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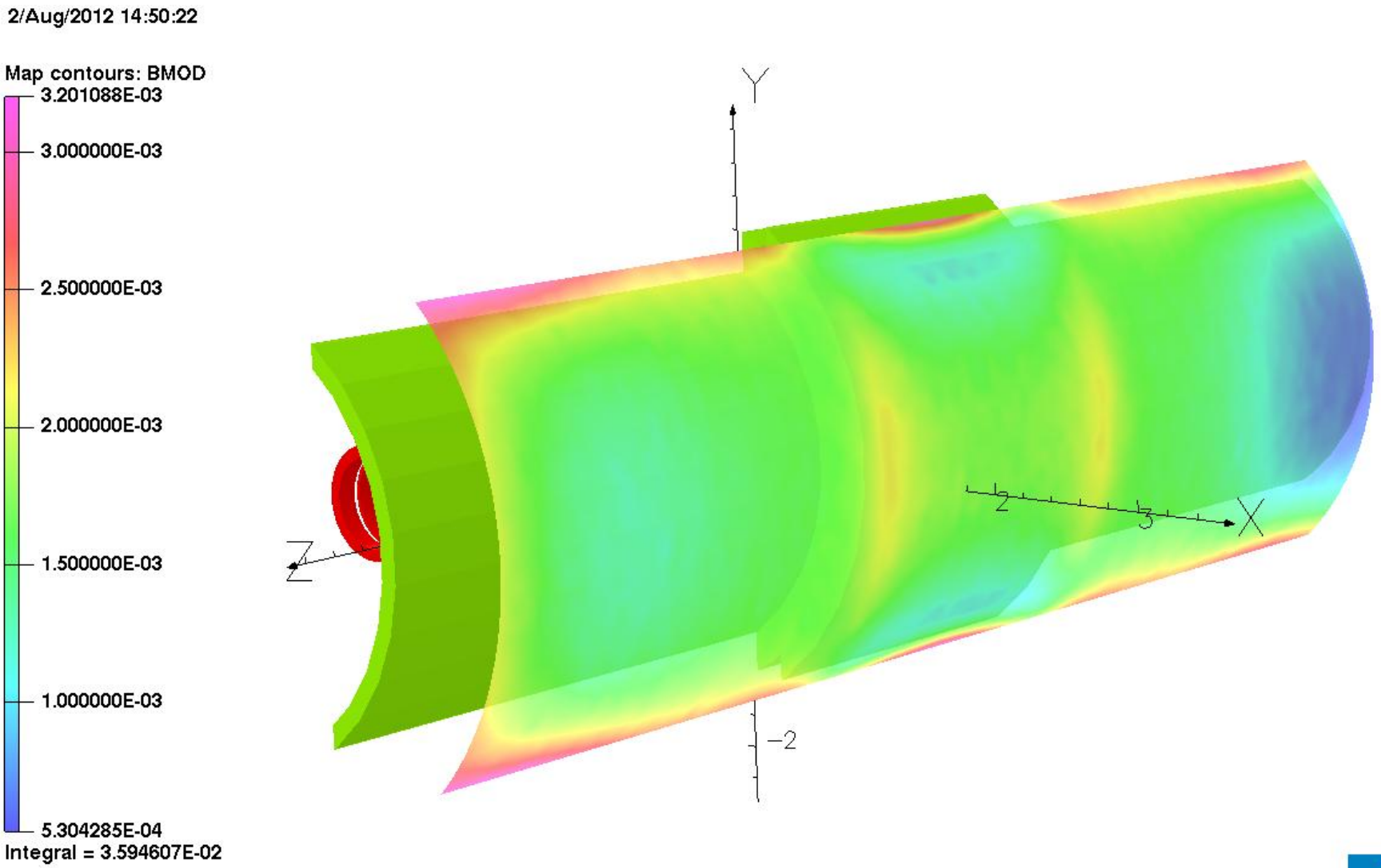

r=1.5m

MICE Stage VI – Option 2

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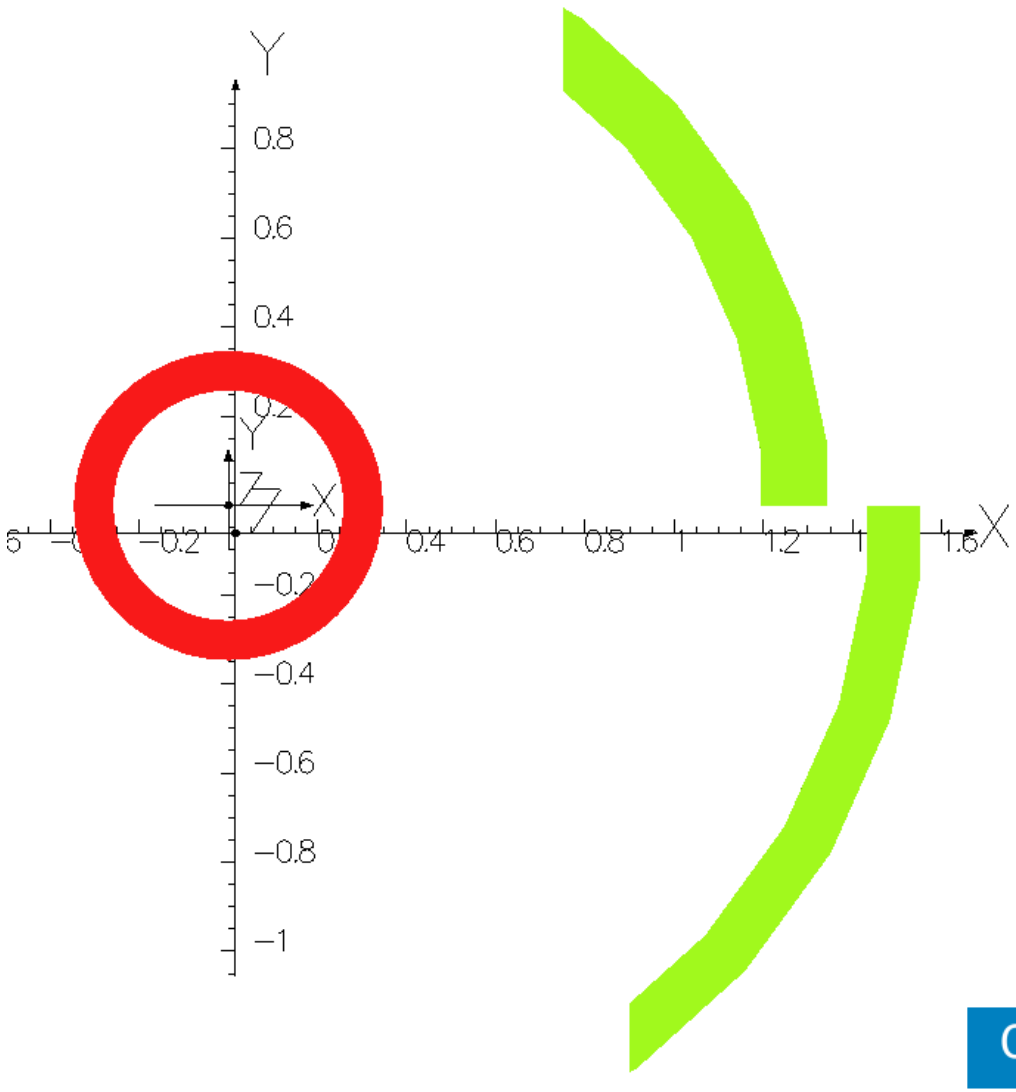
- Gap in radial direction
  - still continuous flux return path in longitudinal direction
- Nesting of tubes of different diameter
  - azimuthal angles must match
  - overlap seems not necessary
- Allows feed-in/out of tracker wiring?



MICE Stage VI – Option 2

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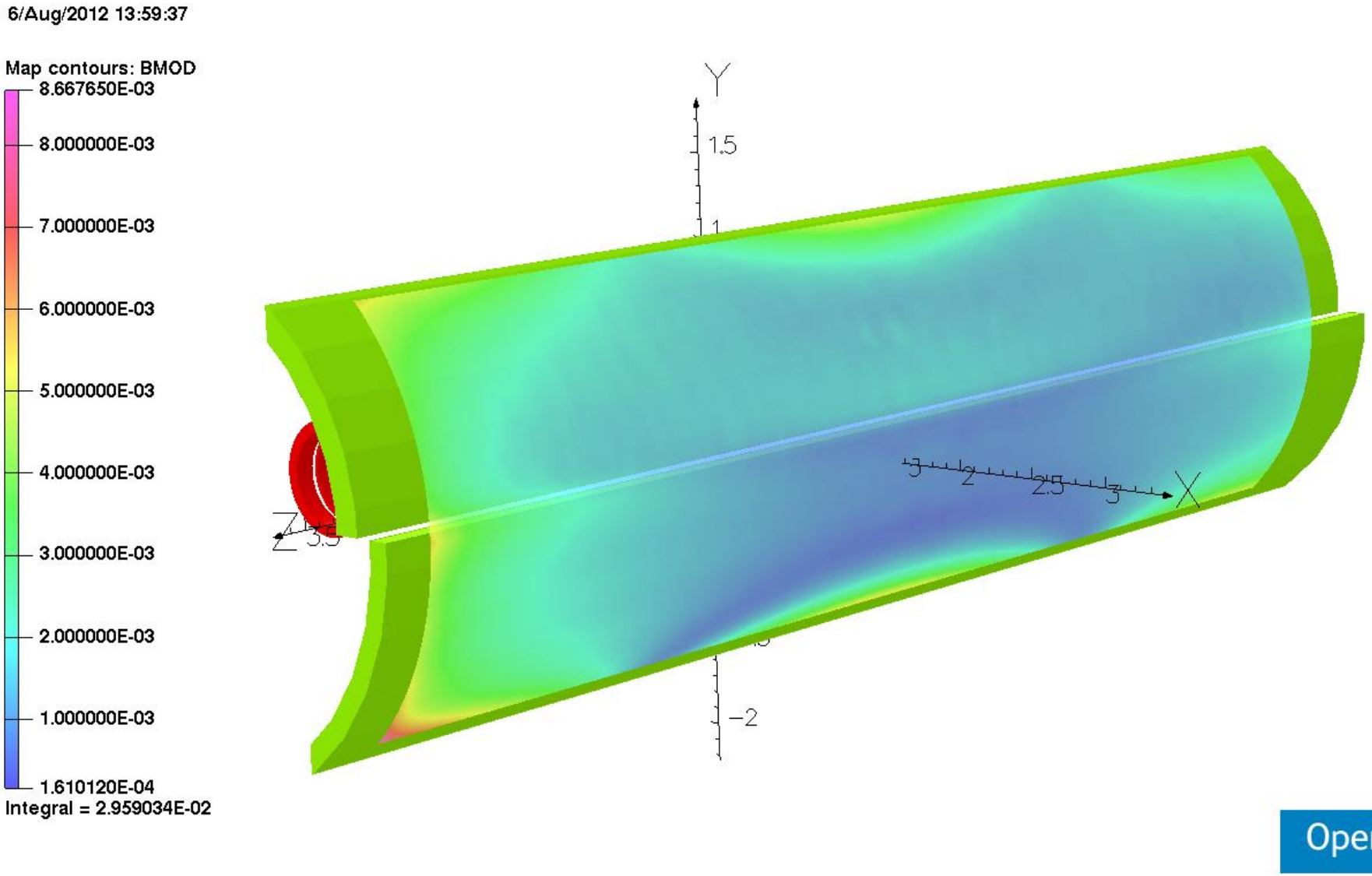

Conclusion

- Things which don't work:
  - several iron bars around MICE
  - flux catchers
- Quarter tubes covering ±50° looks promising
  - for all cases of Stage IV, not only 200 MeV flip mode
  - B less than 15 Gauss (shielding factor 30)
  - forces manageable?
  - effect on central field small (small enough?)
- Stage VI: options for possible modification of scheme
  - provide continuous longitudinal flux path
  - cover all azimuthal angles (jumps in radial direction seem ok)