SoLID magnet modeling

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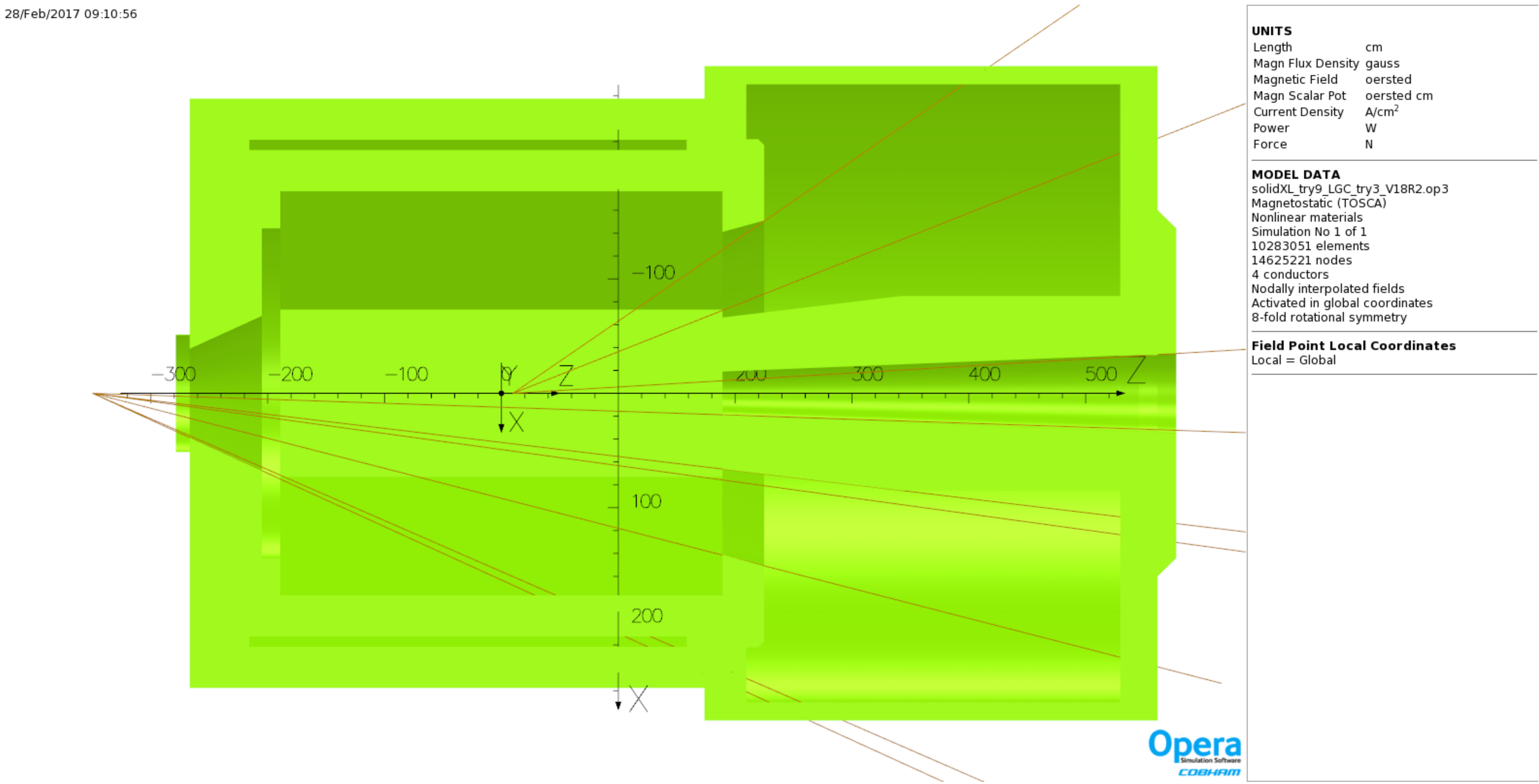
Outline

- Model variations examined
- Trade-offs noted as a result
- Plots comparing long, larger aperture, less steel model with long, smaller aperture, more steel model
- Plots showing a "less steel" model with notch for LGC
- Questions for collaboration
- For many more details, see three documents linked at https://solid.jlab.org/cgi-bin/private/ShowDocument?docid=2 and the later ones I've added to the docdb.

Model variations examined

- SIDIS acceptance angles 2, 7 vs 8 (endcap cone), 14.7, 24 vs 25 (entrance plug)
- Endcap internal cylinder 85 cm R or 90 cm R
- PVDIS acceptance angles 3.5, 22, 35 degrees
- Endcap length 261 cm vs 304.8 cm
- All models have 14” downstream coil collar, minimum per W. Seay
- 15.24 cm (6”) vs 16 cm (6.3”) endcap walls
- Upstream plug either solid or made of twenty 3 cm steel, 1 cm air groupings.

Largest acceptance model

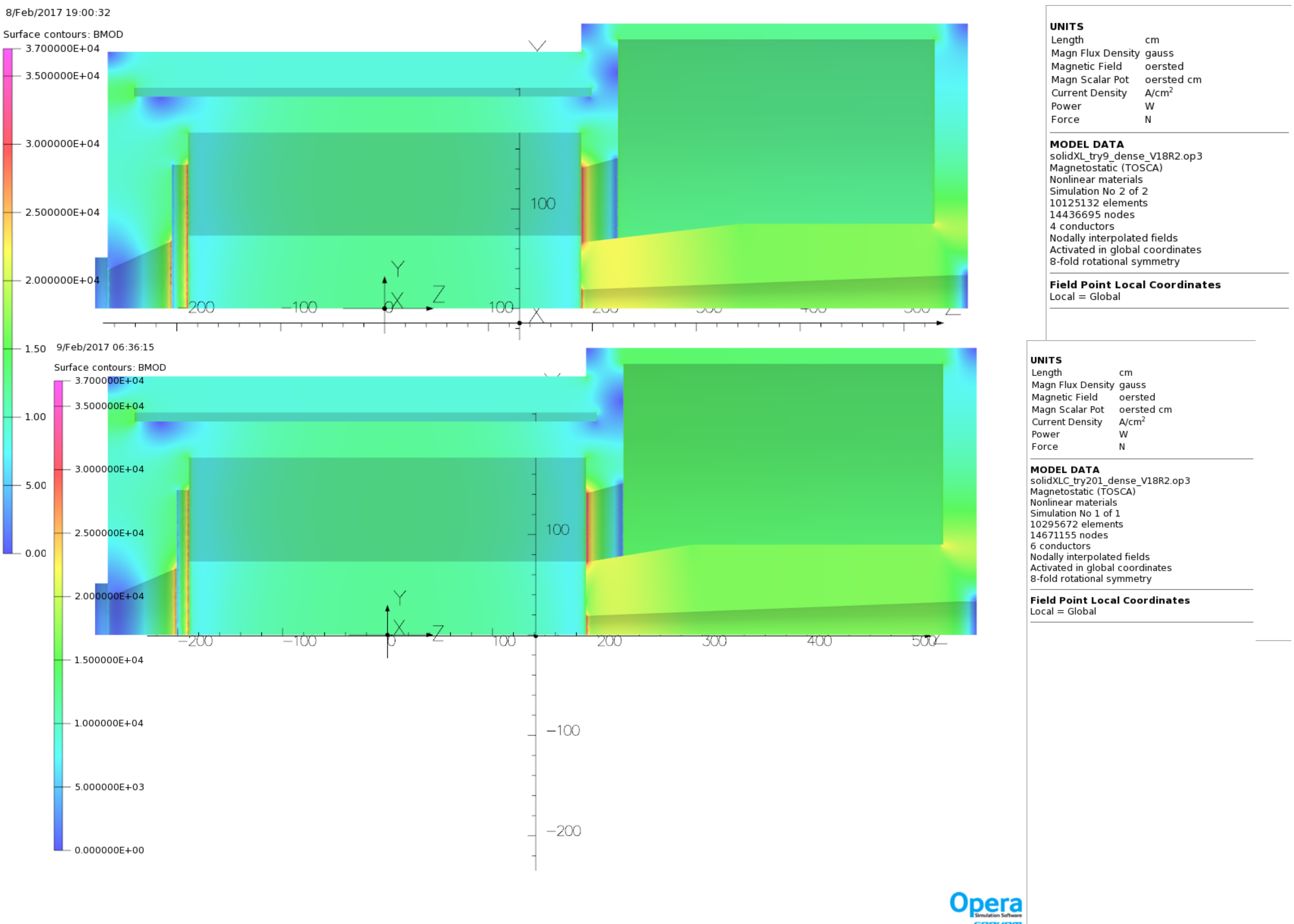


All angle options shown

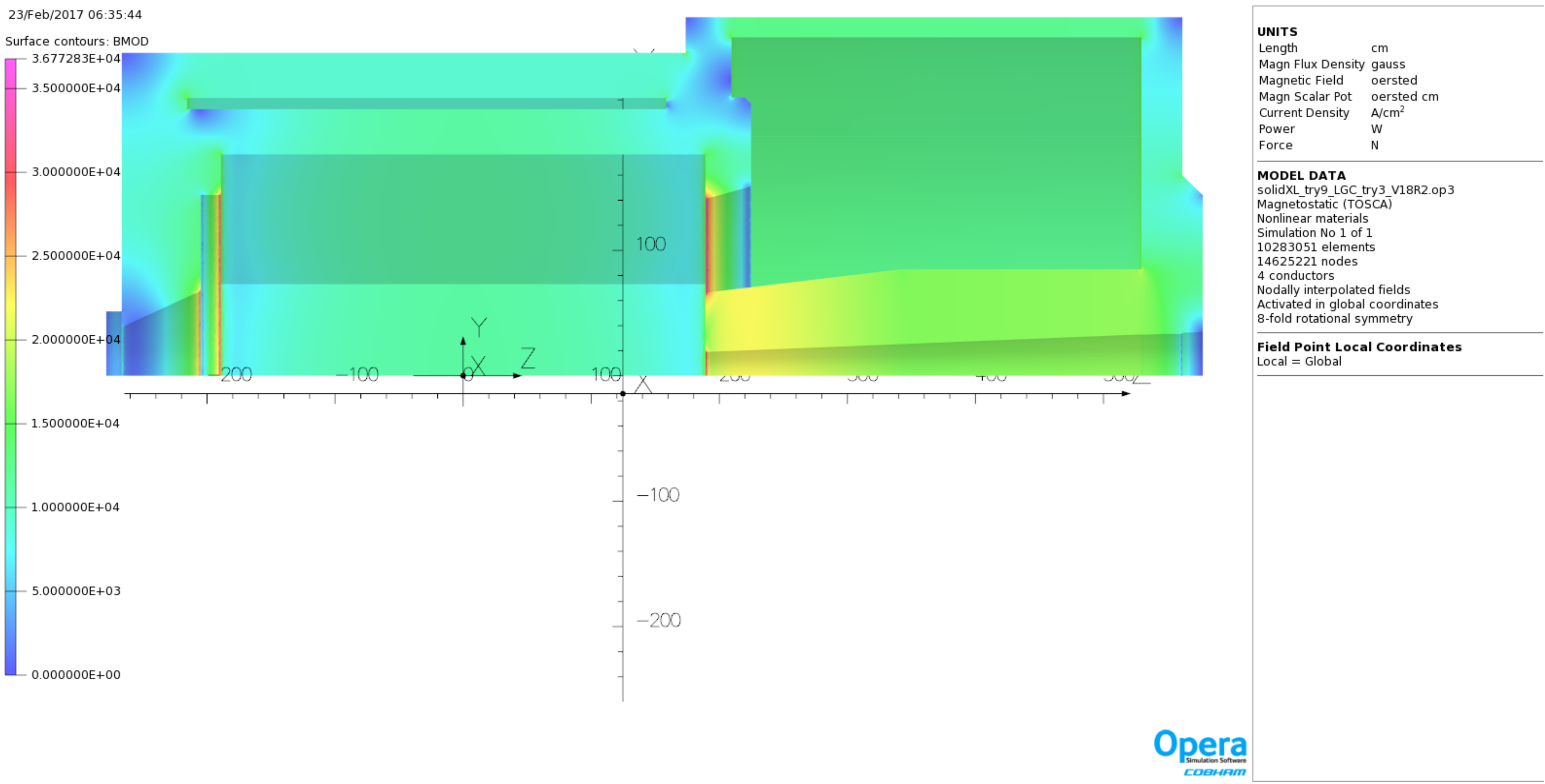
Trade-offs noted

- 24 vs 25 degree input angle has modest affect on stray field excursion achievable over 60 cm He3 target, 1.91 G vs 2.16 G
- 85 cm R change to 90 cm R of inner endcap feature requires ~ 4 cm increase in thickness of upstream plug (24 degrees). He3 stray field excursion 1.63 G and correction coil solenoid amp-turns -27% from 9.72 kAT above.
- 90 cm R inner cylinder also reduces field within endcap but not enough to eliminate need for PMT shields.
- Service turrett cut-out produces transverse torques < 100 kN-cm in models with varying mesh choices. Eight radial supports at 5 kgf each so capacity at least a factor of four above requirement.
- Adjusting upstream plug thickness at mm level allows longitudinal force on coil to be set to 1% of available longitudinal load capacity.

Bmod for less (top) and more steel cases

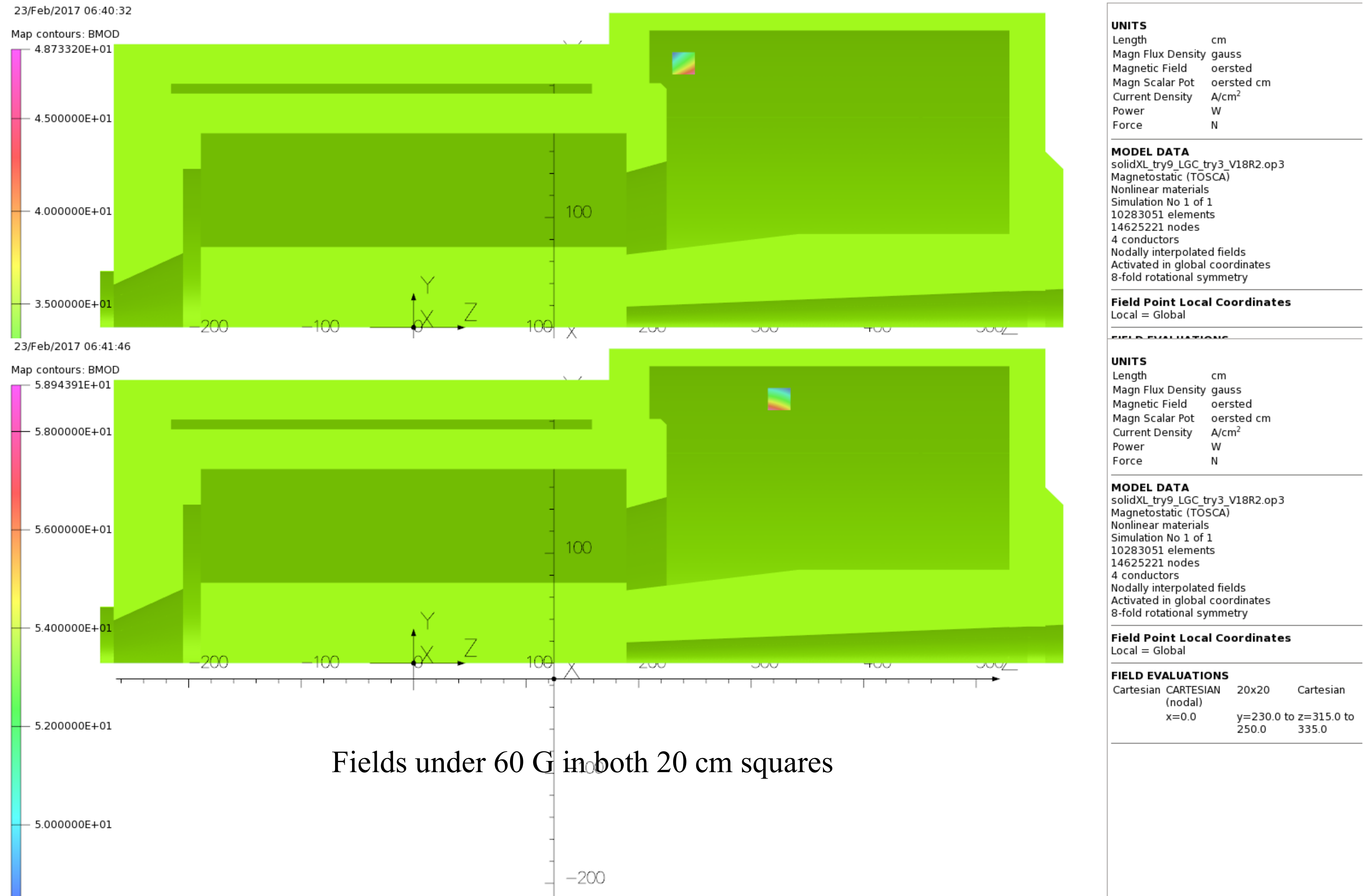


Bmod for model with LGC notch



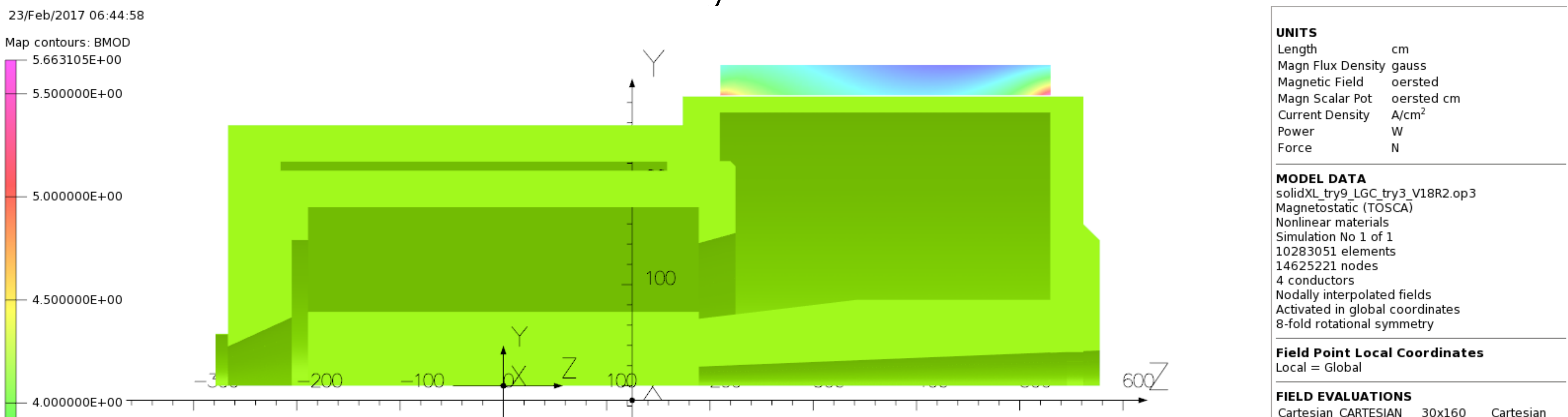
"less steel" model: larger acceptances, 85 cm downstream radius steel, notch Z=[209.55, 224.79] R=[222,270]

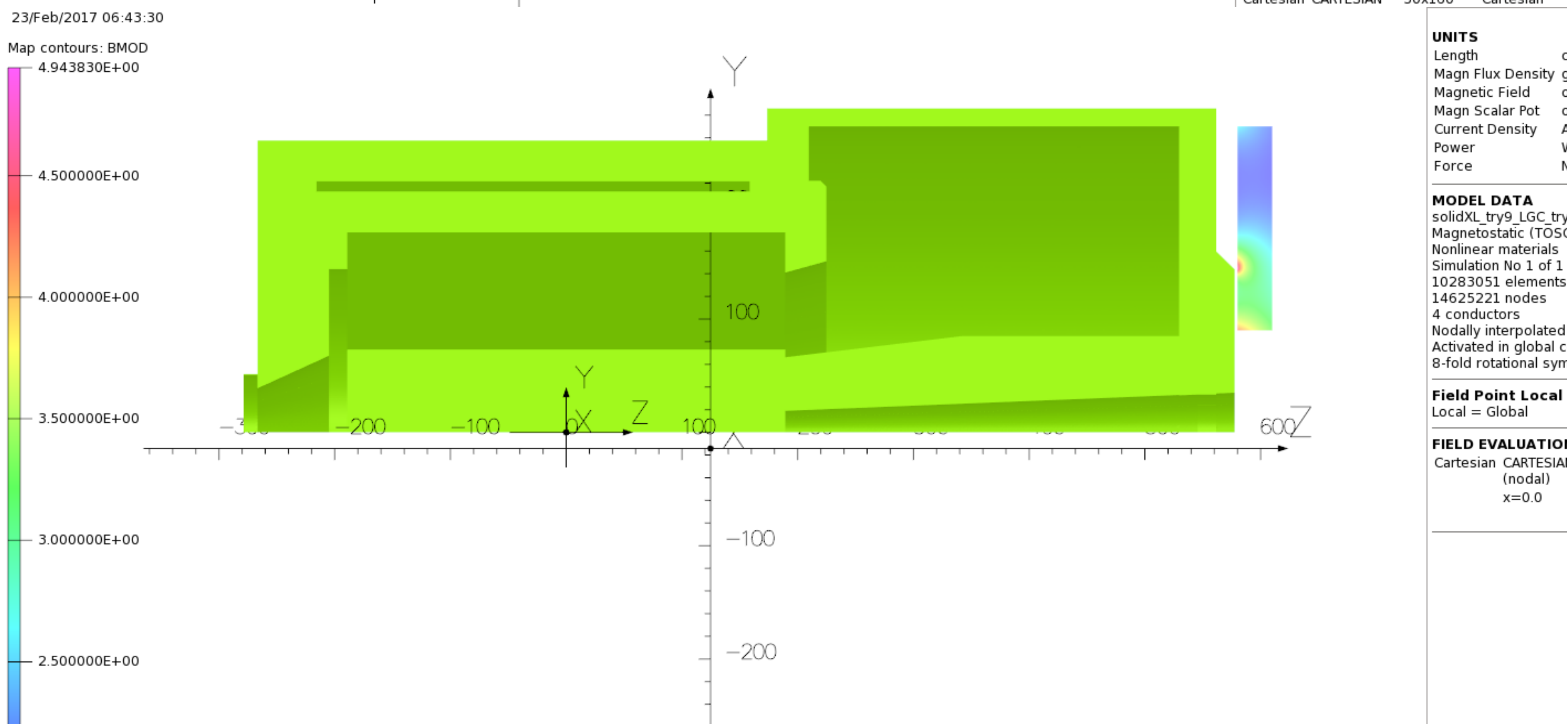
LGC, HGC PMT locations



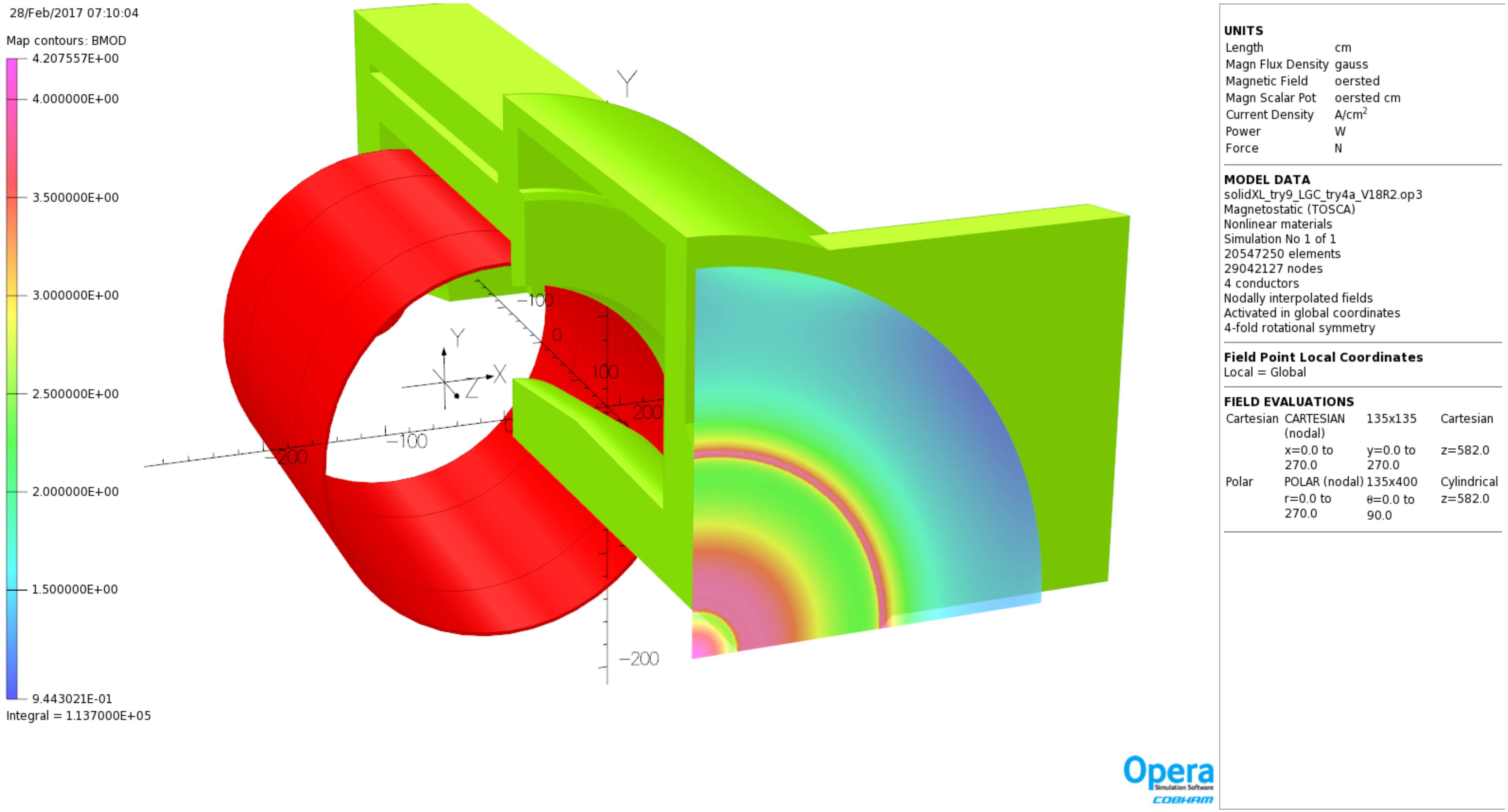
Fields under 60 G in both 20 cm squares

External stray fields under 6 G



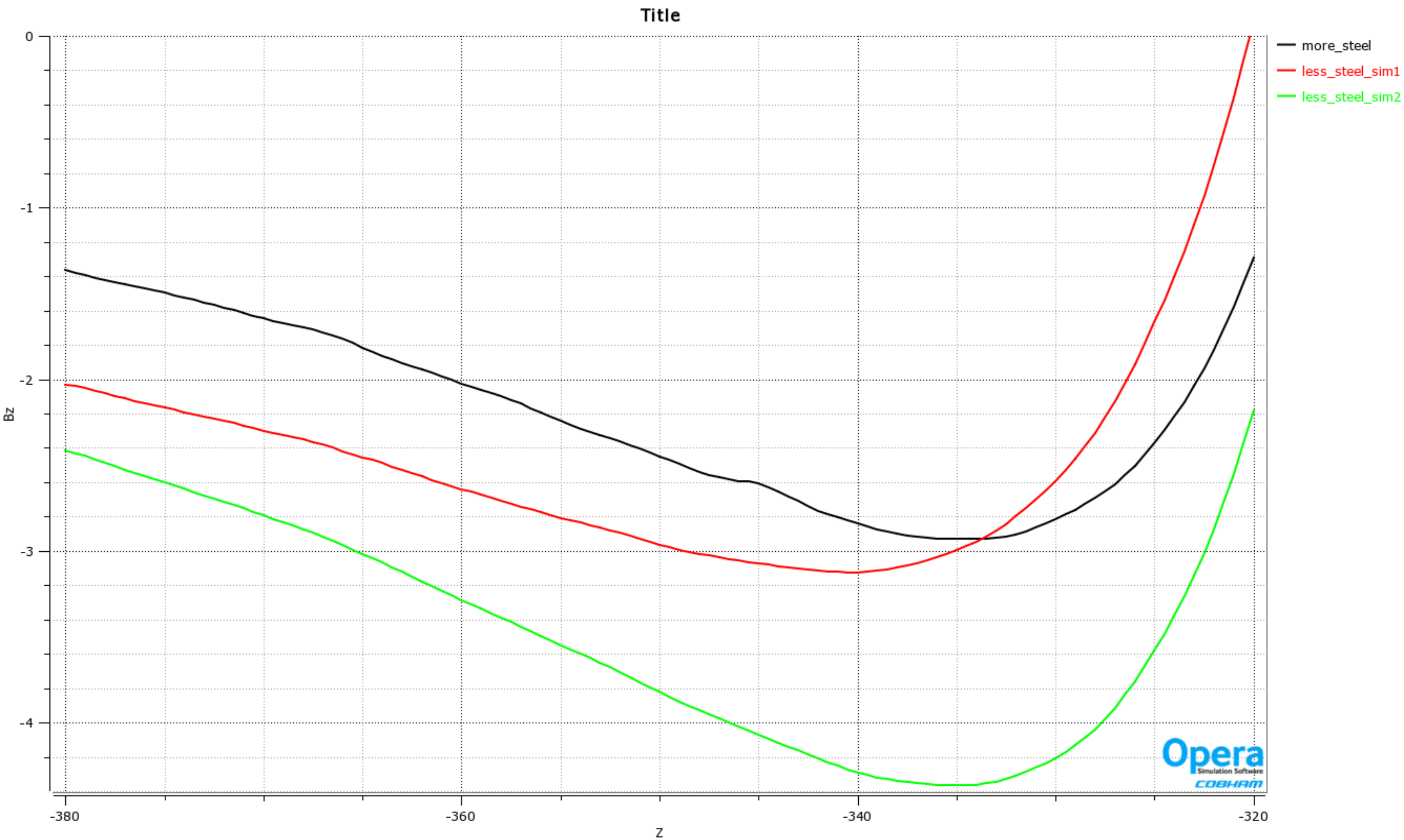


If ECAL wants yet lower fields behind endcap



Use three of 14" outer muon plates for back wall of endcap. 4.2G max
Only 15% reduction from 32 cm (12.6") back wall, but they are free.

Field in vicinity of He3 target



Black line: more steel case with 87.5 A/cm^2 in 9 cm square correction solenoid
Green line: less steel case with 120 A/cm^2. Red line: less steel with 115 A/cm^2
Lines may be shifted on vertical (Bz) axis by use of Bz Helmholtz pair of target

Questions for collaboration

- how long should endcap be, including contingency for detector changes?
- what should OD of endcap central cylinder be? Range 85-90 cm. Max that detector mounts allow under 90?
- what size radial holes are needed at what endcap R, Z locations for cables?
- how much will 2 G excursion in Bz over 60 cm He3 target affect it?
- reuse outer muon steel for back of endcap or save it for muon detectors?