Septum Calculations

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PREX/CREX collaboration meeting

Outline

- Manitoba work
- Shield through septum
- Field between HRS resistive quads
- Conclusions
- Off-topic: 12 GeV beam parameters table working group

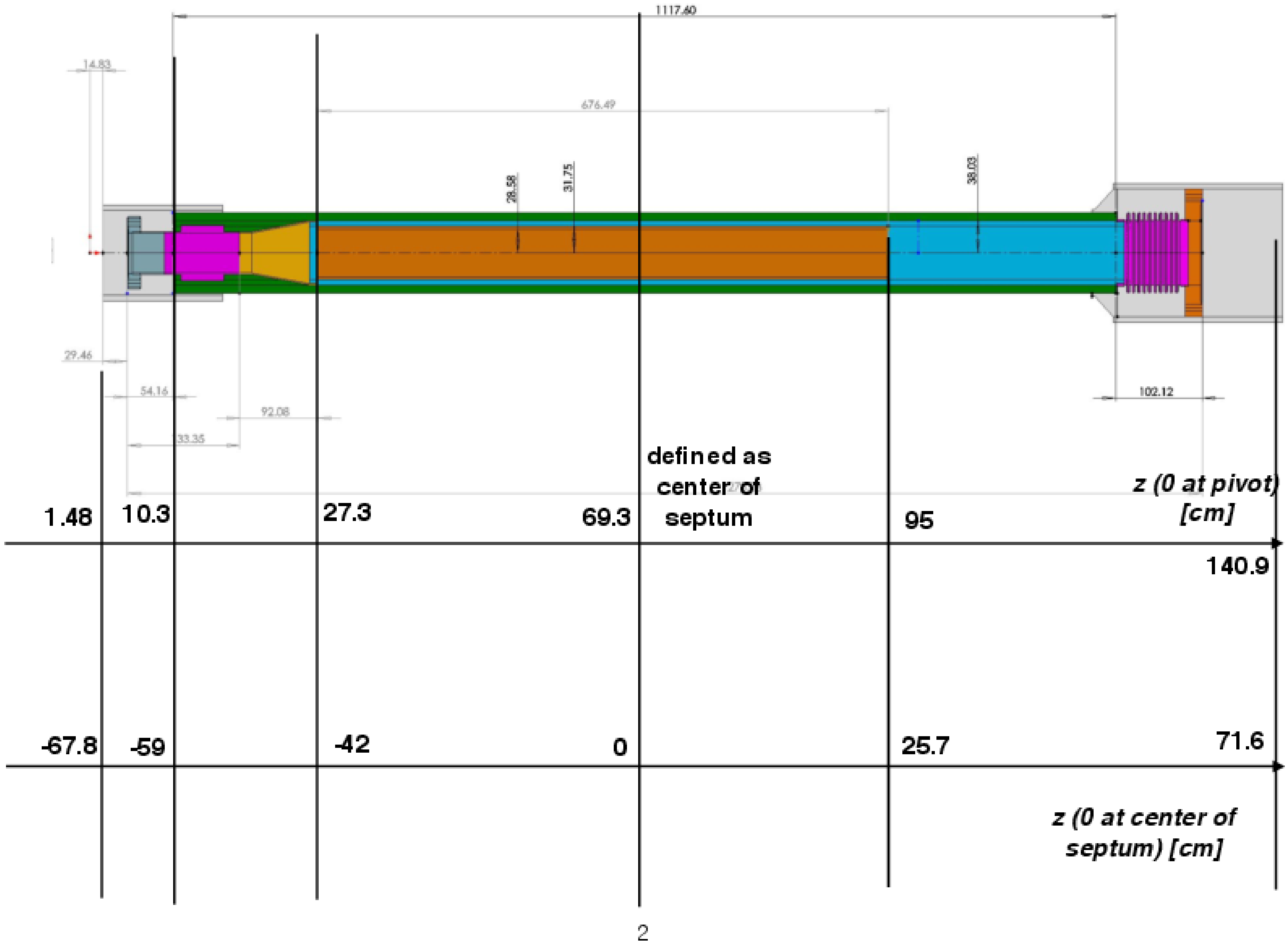
Manitoba

- original quad model provided to Juliette Mammei and Iris Halilovic by Bogdan Wojtsekhowski
- Juliette and Iris created a model with the septum and two quads pointed at the advanced target location
- I got the files from Iris 19 May 2017 and began work

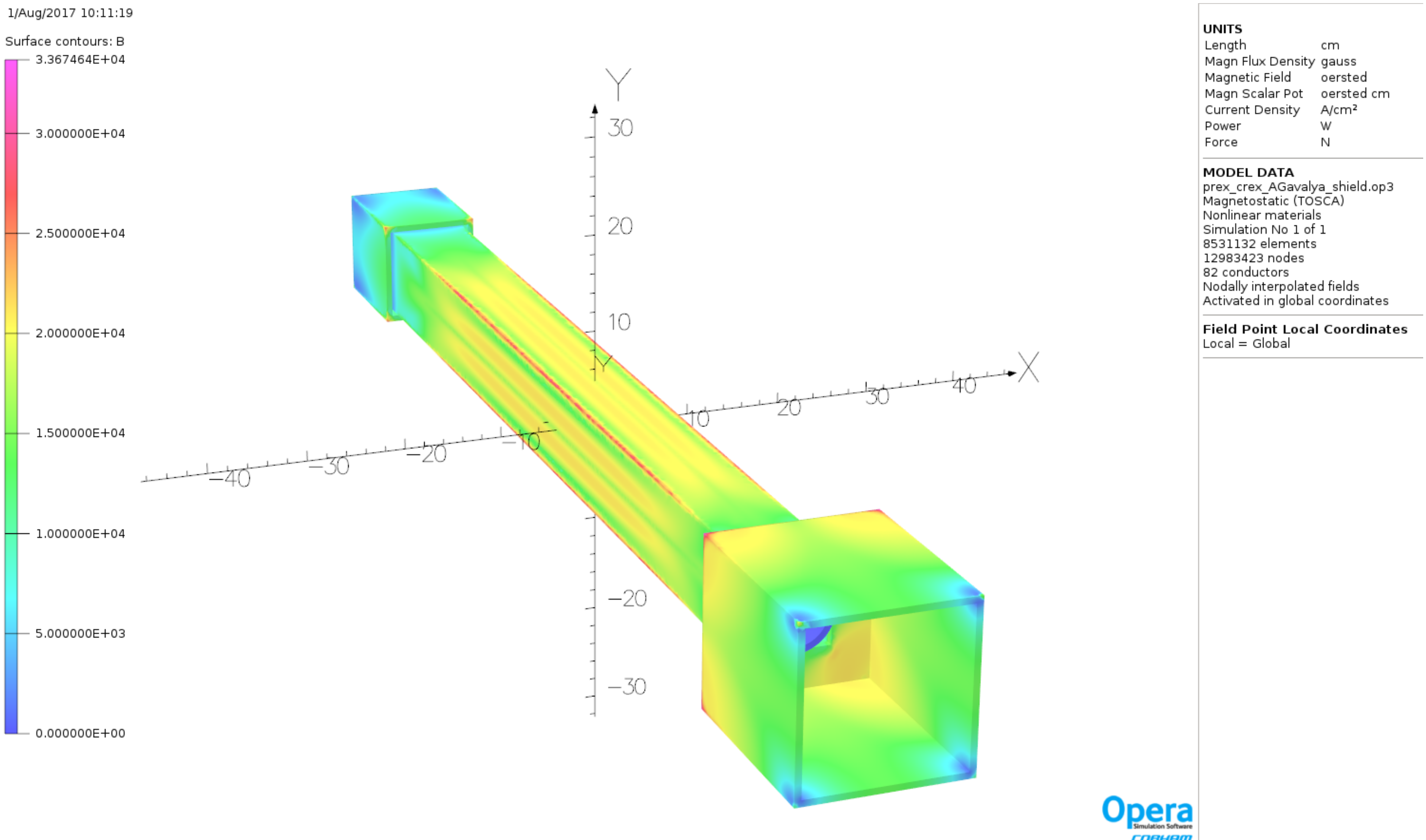
Beam magnetic shield through septum

- Original shield was OK for PREX but not for CREX
- Shield thickness needed to be increased on sides, from 4 mm to 7 mm, per my models
- In late July Ciprian Gal provided me with drawings of modified septum shield design by Alan Gavalya
- I incorporated this into my model and ran it
- Field maps through beam pipe were provided to Ciprian and Seamus for simulation

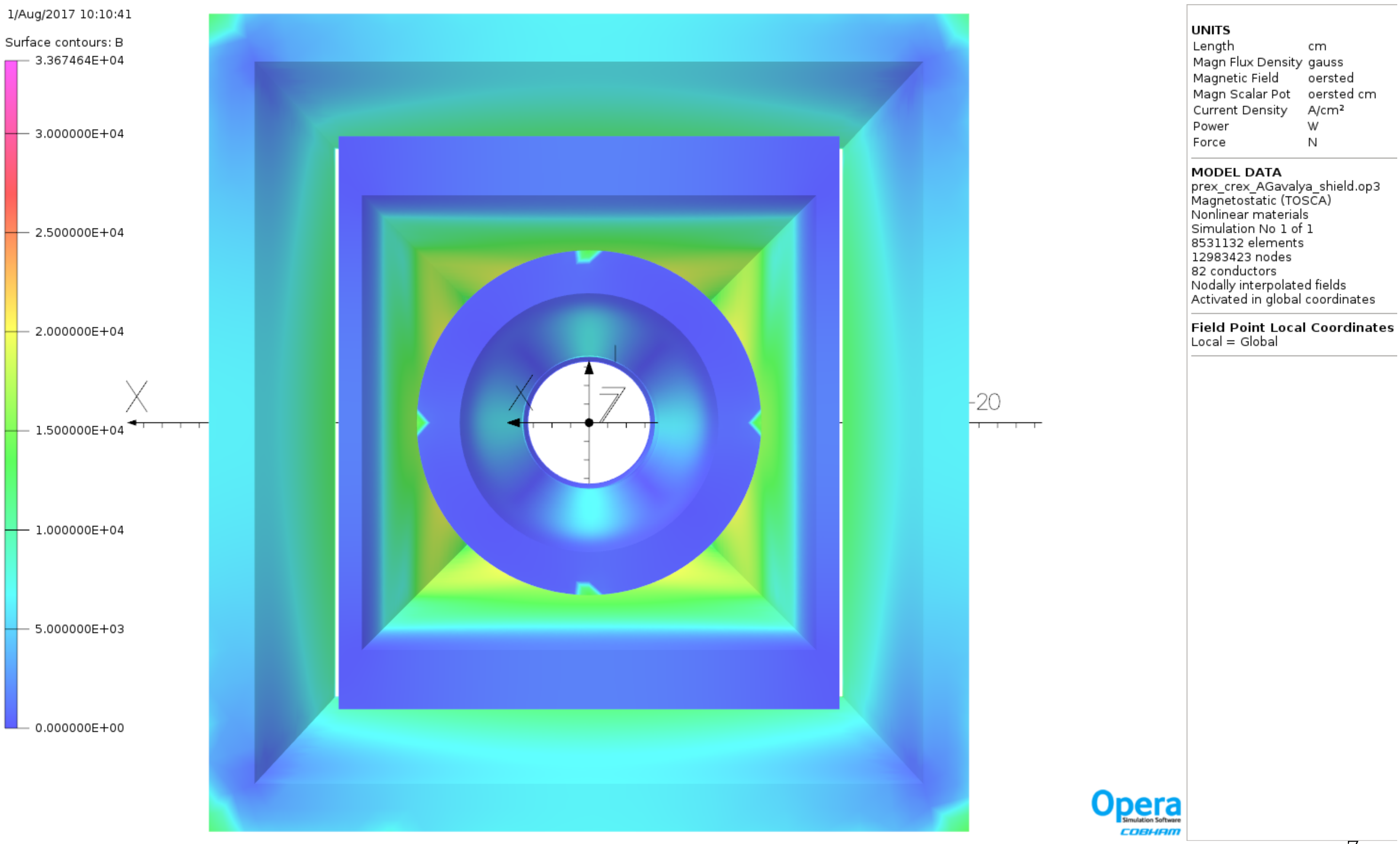
Gavalya shield



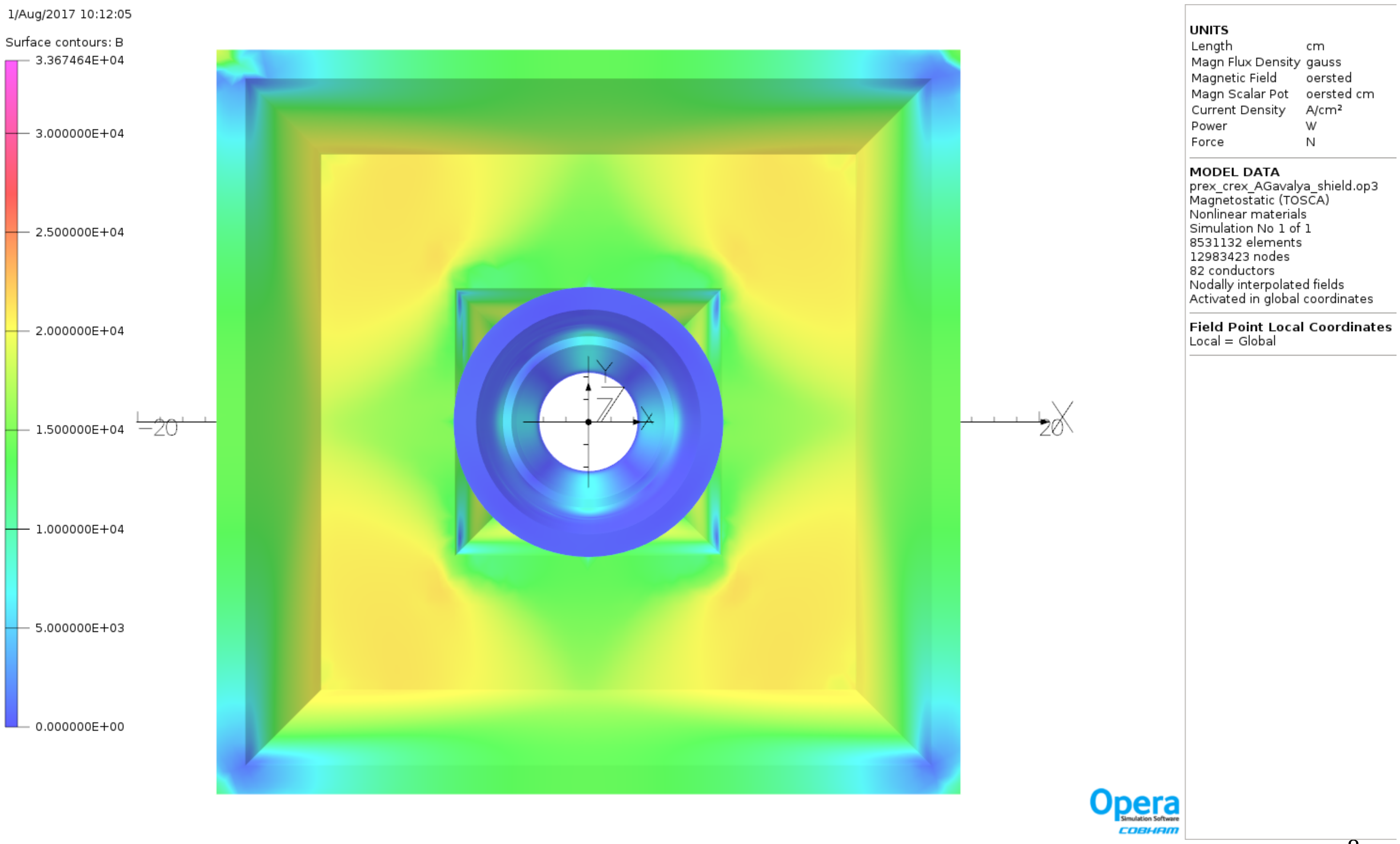
Model images 1



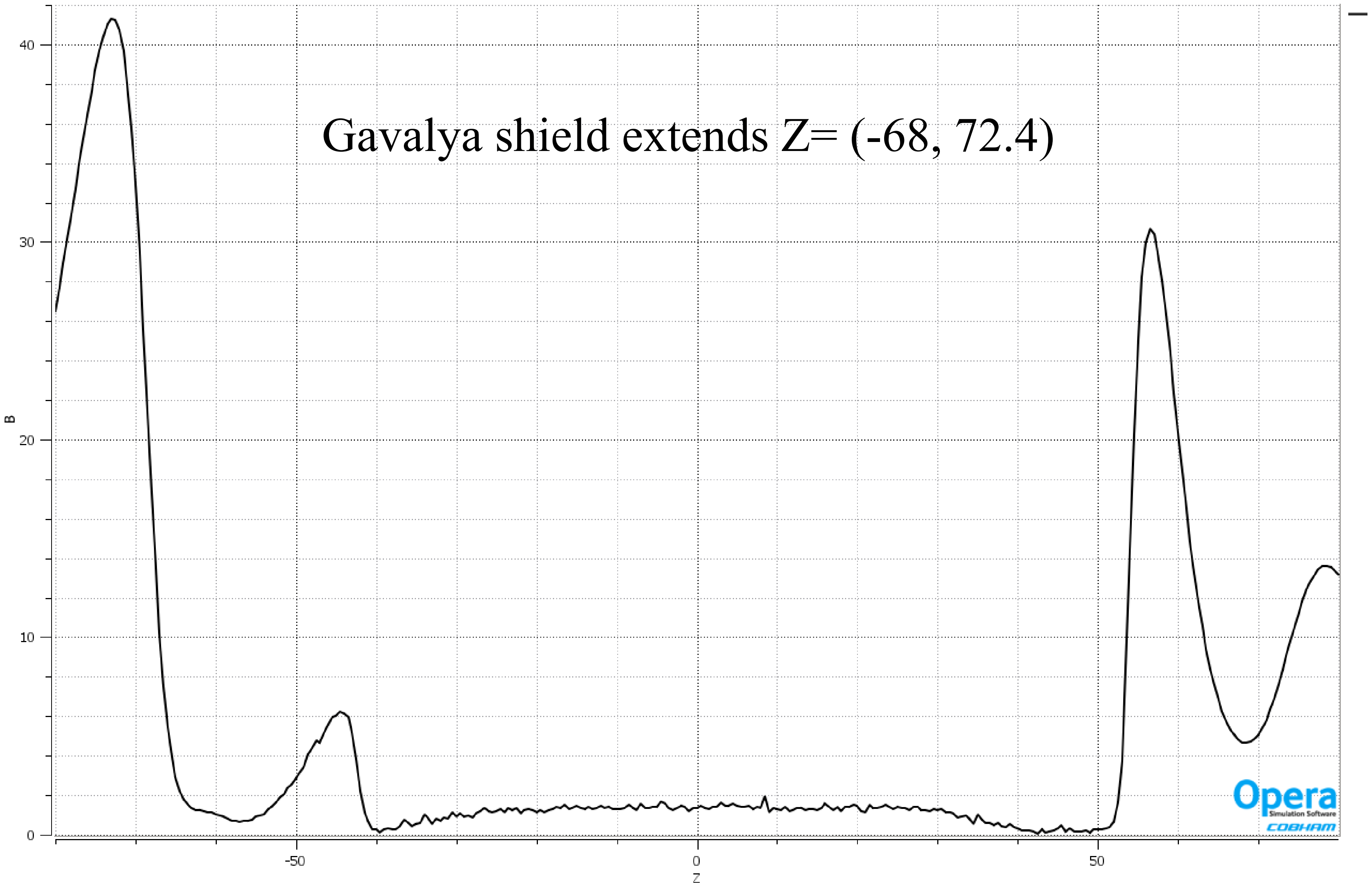
Model image 2 - from Z negative end



Model image 3 - from Z positive end



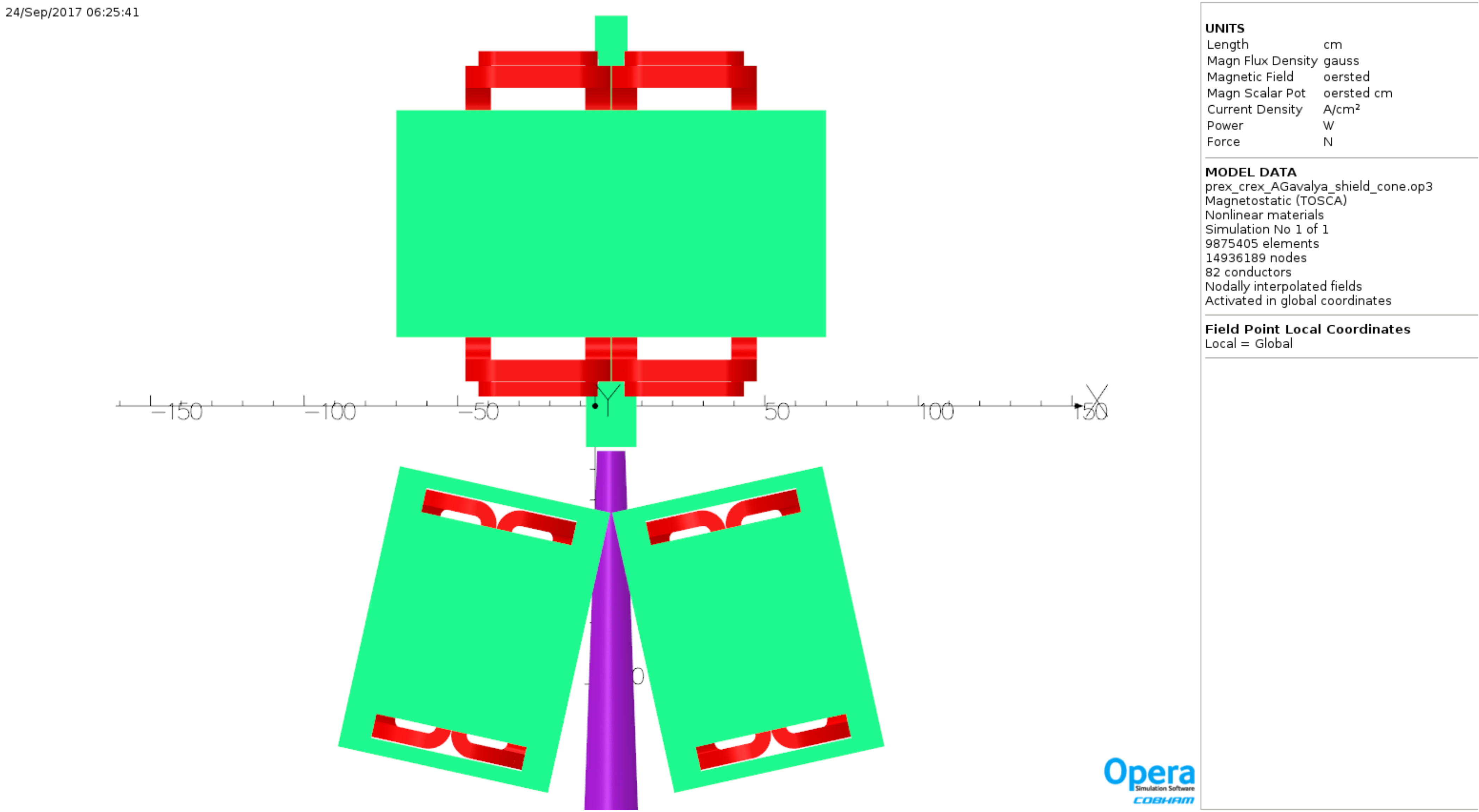
|B| along z at (1.414, 1.414)



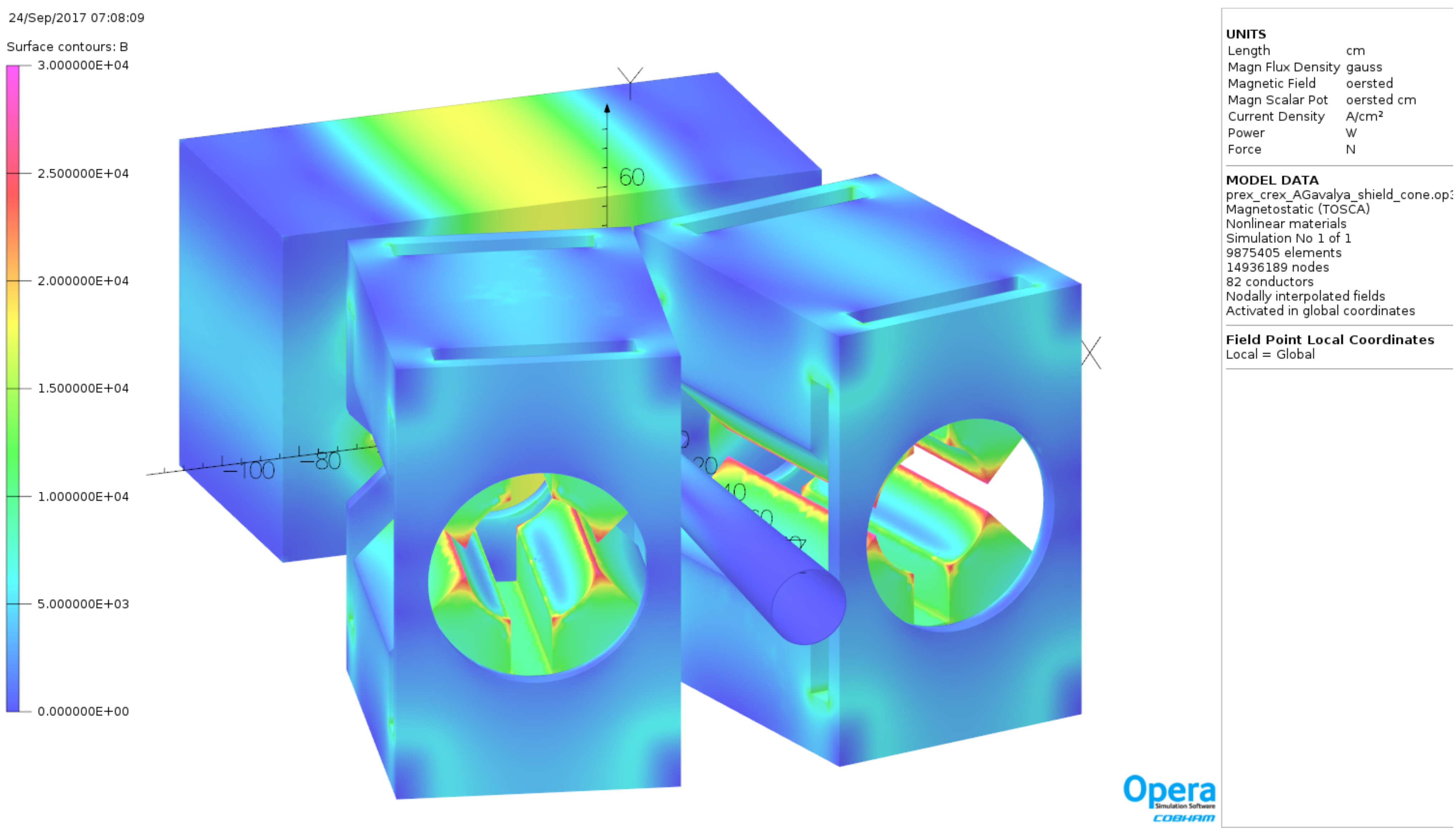
HRS quads

- stray field from HRS quads also impinge on the unscattered beam path
- this resulted in an unplanned excursion exploring the new resistive quads in some depth, summarized in JLAB-TN-17-032 "Post-target fields in Hall A".
- Evaluation of stray fields in the beam line to the dump with one quad off, e.g. due to power supply problem, showed that incorporating a magnetic shield into the standard Hall A beam line is highly desirable.
- I recommend replacing the stepped aluminum beam pipe between the quads with a round conical carbon steel shield, ~3 mm thick, to route the stray fields around the beam line. If fabrication costs are too high, a truncated pyramid with square cross-section and perhaps angle iron stiffeners against atmospheric pressure. I fear that a duplicate of the stepped aluminum pipe in carbon steel will be fabricated instead, increasing activation issues.

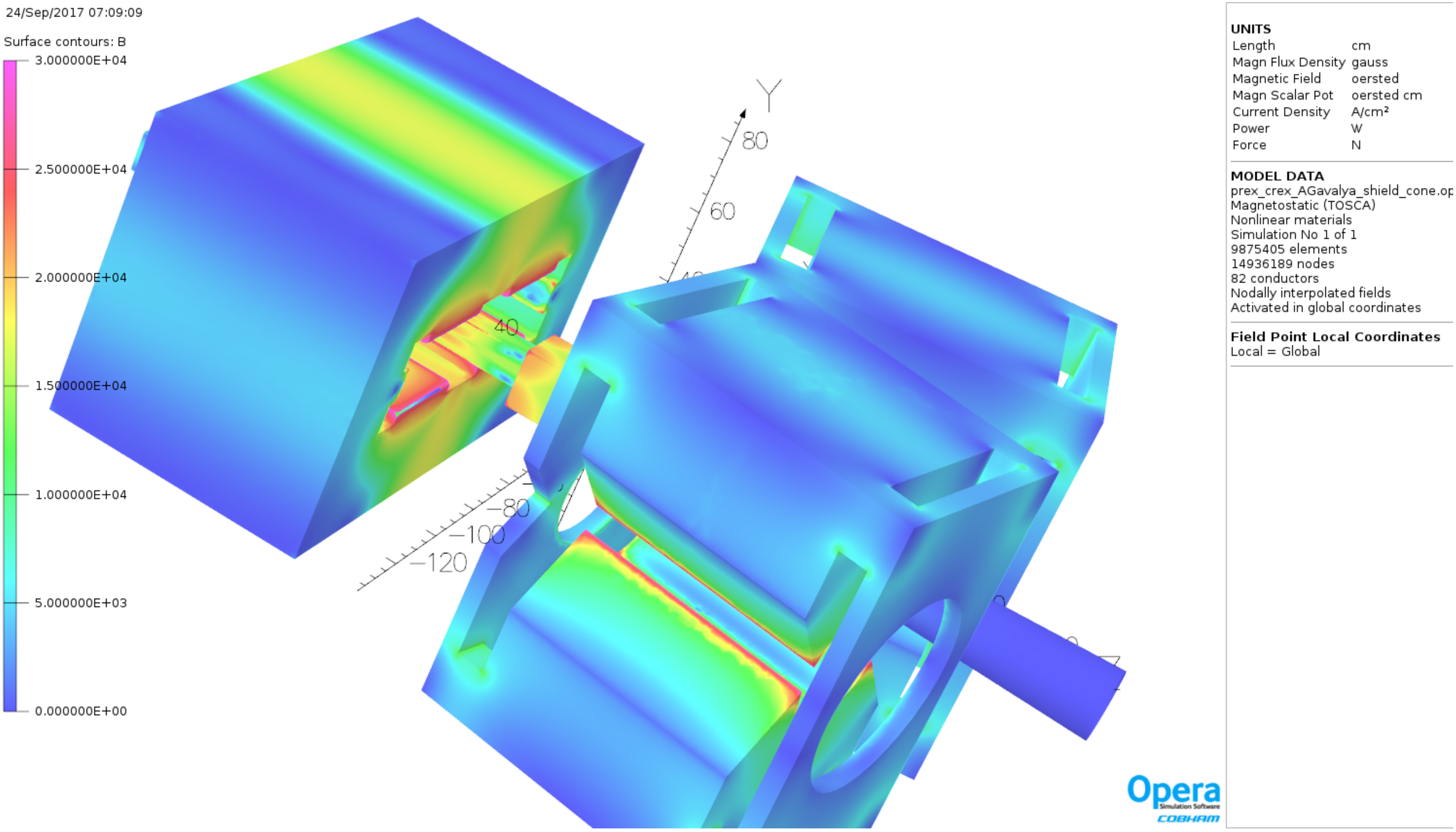
Model image 4 with cone in purple



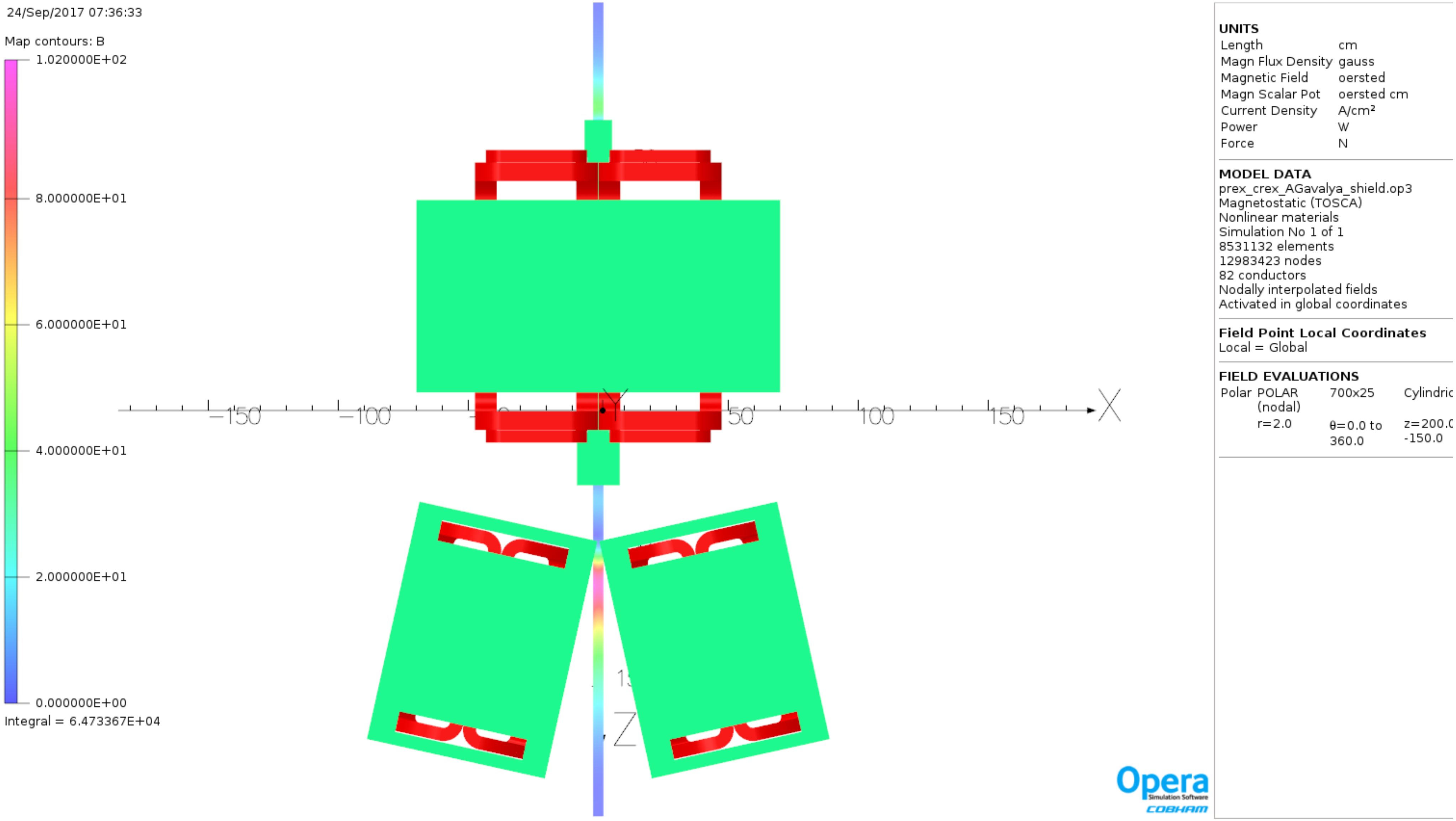
Model image 5 - |B| on surface



Model image 6 - |B| on surface

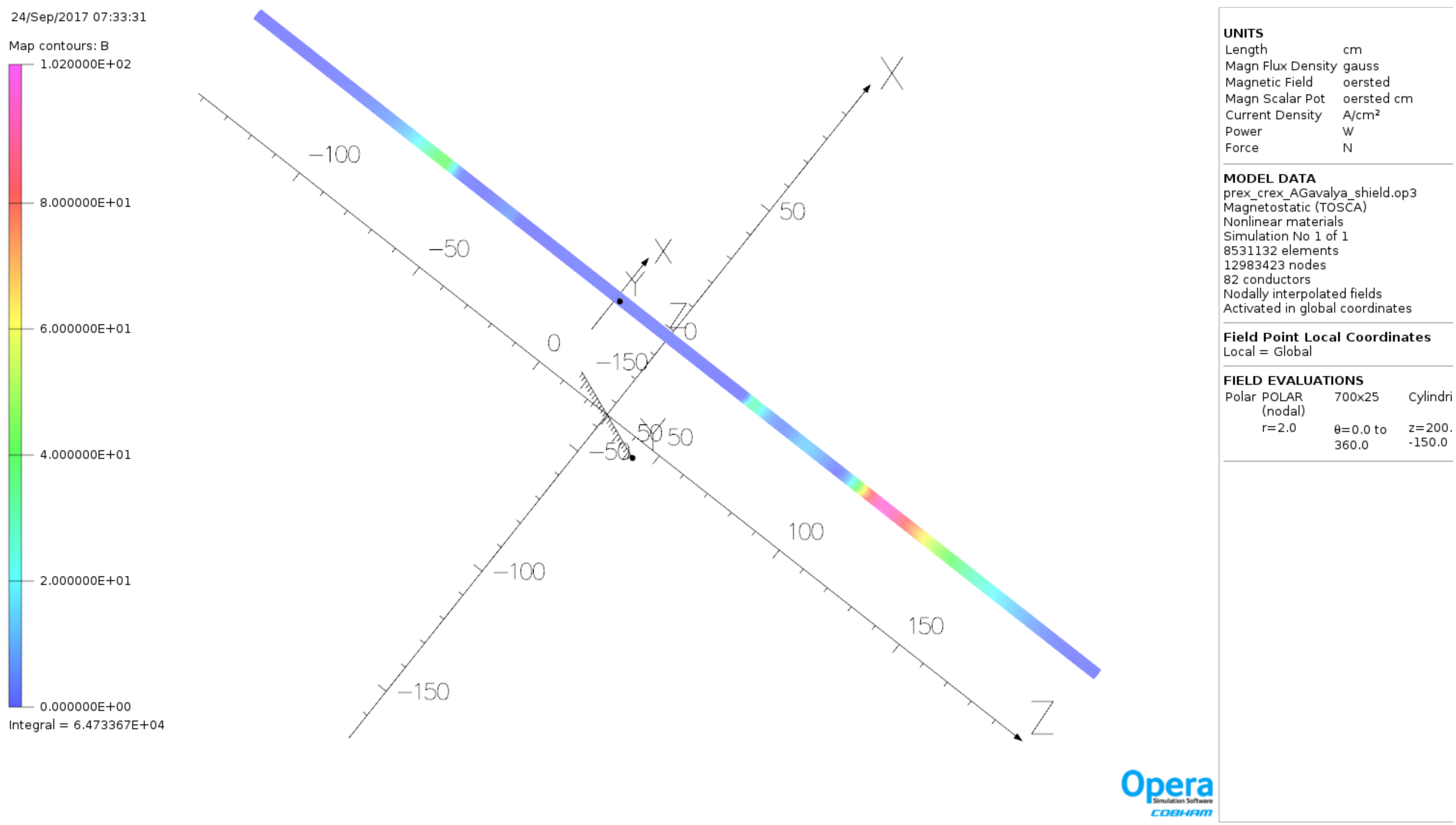


Model image 7 - |B| on beam to dump, no cone



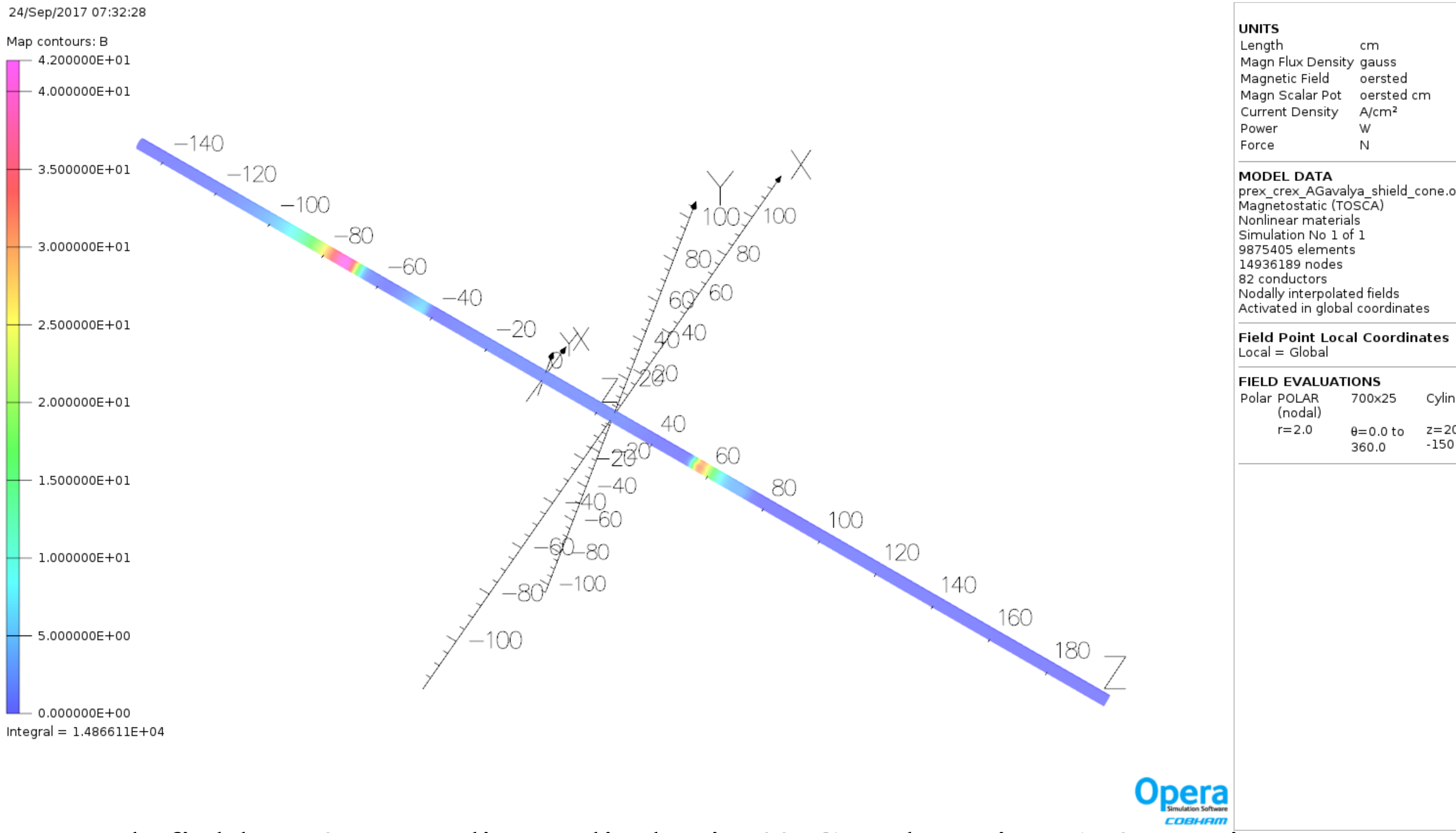
Peak field on 2 cm radius cylinder is 102 G

Model image 8 - |B| on beam to dump, no cone



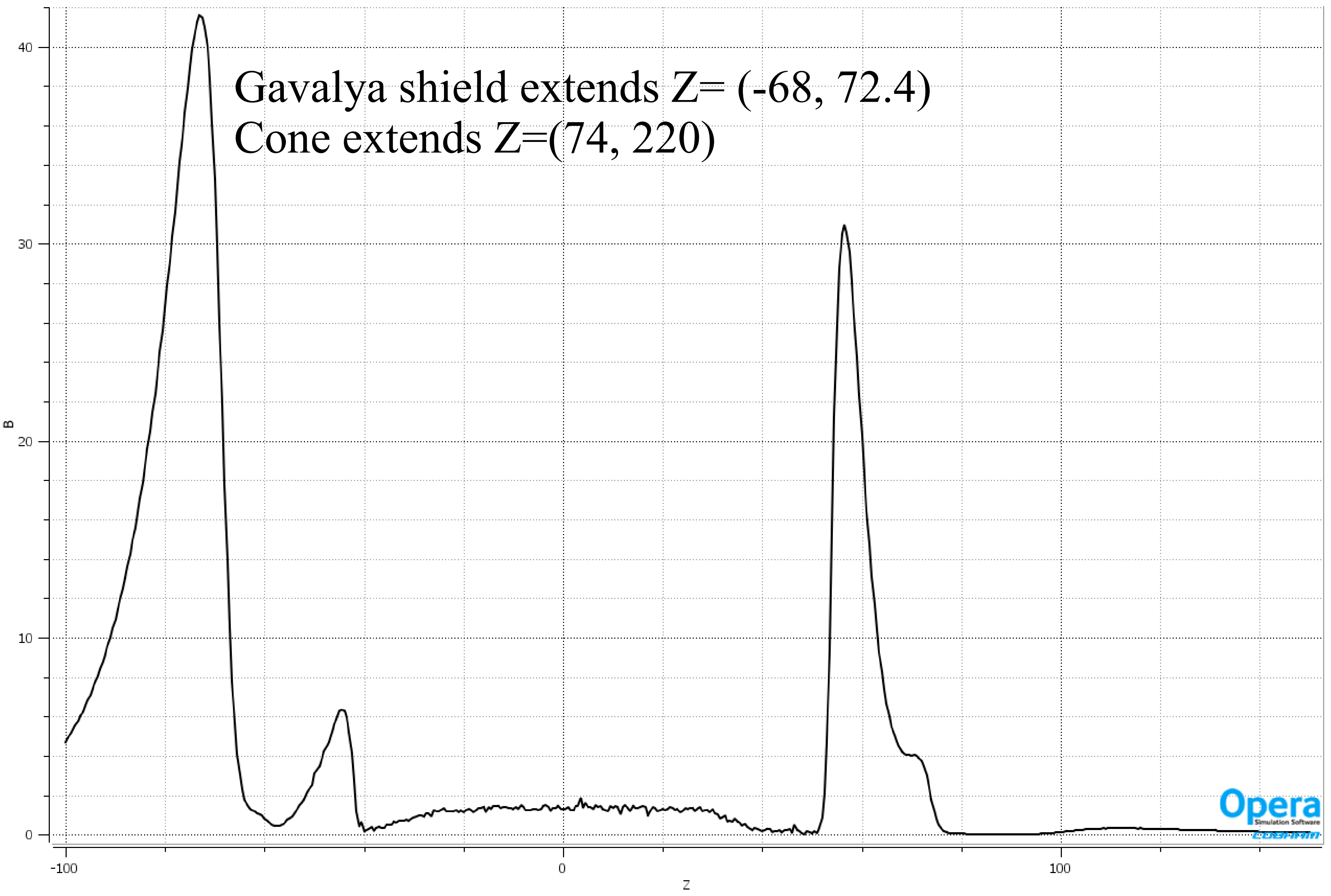
Peak field on 2 cm radius cylinder is 102 G

Model image 9 - |B| on beam to dump, cone



Peak field on 2 cm radius cylinder is 42 G. There is a 1.6 cm air gap between septum and cone shields which may be unnecessary.

|B| along z at (1.414, 1.414) with cone



Conclusions

- Gavalya septum shield is overkill and will suffice
- A conical carbon steel shield 2.5-3 mm thick will shield beam to dump from HRS quad stray field in symmetric or asymmetric HRS positions and is recommended for all Hall A experiments.
- Mechanical design of shield should take into account cost and activation by scattered particles.
- Field maps with 5 mm, 10 mm or greater spacing through septum and quads can be generated on request.

HRS quad shield options

- N. Wilson asserts Hampton Sheet Metal can provide a conical shield. Weld tube stubs and CF flanges on each end and install. Aluminum CF flanges with stainless steel knife edges are available commercially for mating tubes.
- W. Seay found a steel casting vendor for SoLID who can handle much larger sections. Cast it in a unit with tube stubs and braze to CF flanges. Minimum material for activation. No welds to worry about.
- A truncated pyramid: trapezoidal sides, square plates with tube stubs at each end, perhaps with 1/2" angle to stiffen sides, is a more massive option with a lot more weld length and more mass than first two options.
- A duplicate in carbon steel of the stepped aluminum pipe now installed will likely cost more and mass far more, so more material to activate. ALARA
- Replace the plastic water cooling lines to the quads with copper or stainless.

Acknowledgment

Seamus Riordian reviewed earlier drafts of this presentation and made suggestions which significantly improved it.

12 GeV Beam Parameters Table

Arne recently asked a group to create a table which reflects the beam parameters which can be achieved and verified without any special effort. Parity experiments require special effort. Parameters requested must still be verifiable by someone and possible to manipulate. The APELs (Roblin, Tiefenback, Benesch, Satogata) are to represent the Halls's interest. Suleiman represents the gun group, Gubeli diagnostics. Bogacz chairs it. I have uploaded the two attachments Arne provided to docdb. Table due to Physics March 31, 2018. First meeting 1430 Tuesday, October 3 in MCC conference room. Please provide me with input re Hall C and parity requirements.