



MICE Hall Model Status and Plans

Abridged version of a presentation given to ISIS on
28/03/2013

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Introduction



At Ken's request this is an abridged version of the presentation that I gave to ISIS on 28th March 2013. The full version that was given to ISIS is available online at:

http://www.hep.shef.ac.uk/research/mice/opera_models/presentations/

Basically the differences between these presentations are:

I've removed a lot of the introductory material – I'm assuming you're now familiar with the modelling work.

I've removed the plots at roof level.

I've replaced some other plots with more recent ones for consistency – the results haven't changed though.

For information all of the plots shown today and many, many others are available online:

http://www.hep.shef.ac.uk/research/mice/opera_models/autogen_plots.html



Introduction



There is a big caveat that must be borne in mind throughout the presentation...

The Hall model has yet to be benchmarked. We are in the process of negotiating to have the model independently benchmarked by 'Vector Fields'. This benchmarking process should help us to understand the limitations of our model, find out if there are any major faults in the model and suggest ways in which it can be improved.

Until we have the results of this benchmarking all results shown in this presentation must be considered both provisional and unverified, consider them as a guide based upon the current status of our models.



The 5 Gauss Limit



At what point do we become concerned about the level of field observed?

Of course the answer to this is location dependent but in general if the magnetic field strength B_{mod} is below 5 gauss (0.5 mT) in air, then unless we have specific reason to be concerned, we worry slightly less. This is a limit self-imposed by RAL & CERN by “Best Practise”, due to the possibility that members of the public with Pace-Makers might be present in the ISIS & MICE Control Rooms.

One of the most common sensitive components are relays which start to become affected from $\sim >13$ gauss* but of course there are other possibilities – hall probes, crts.

**Magnetic compatibility of standard components for electrical installations tests on programmable logical controllers and other electronic devices.- J. Hourtoule *, D. van Houtte, P. Fejoz, P. Hertout - November 2005, Pages 179–183 - Proceedings of the 23rd Symposium of Fusion Technology — SOFT 23*

Clearly the level of field that will cause a problem is application/area specific and each location needs to be considered individually.



List of ISIS concerns



David Findlay circulated a list on the 27th March of items that ISIS are concerned about.

Areas to consider for magnetic fields and people? MICE Local Control Room, ISIS Main Control Room (MCR), area outside MICE Hall main door, the new toilets beyond the MCR, offices and labs. near the MCR, the newly shielded EHT area, the linac, and anyone on the roofs of R5.2 and nearby roofs, ...

ISIS equipment possibly affected by magnetic fields? ISIS linac, equipment in the newly shielded EHT area, ISIS equipment in the MICE Hall (*e.g.* the DSA PPS interlocks, and the HEDS beam chopper driver), the linac air conditioning plant up on the roof of the MICE Hall, other ISIS equipment in the MICE Hall which we've forgotten about but which helps to keep ISIS going, ...

I'm not going to address all of these today, but I have taken this list on board. It's my suggestion that this list needs to be considered in a report rather than in a presentation? – but we do need to benchmark the model first .

There is also the question of whether we need to add additional steel to the model to be able to answer these questions?



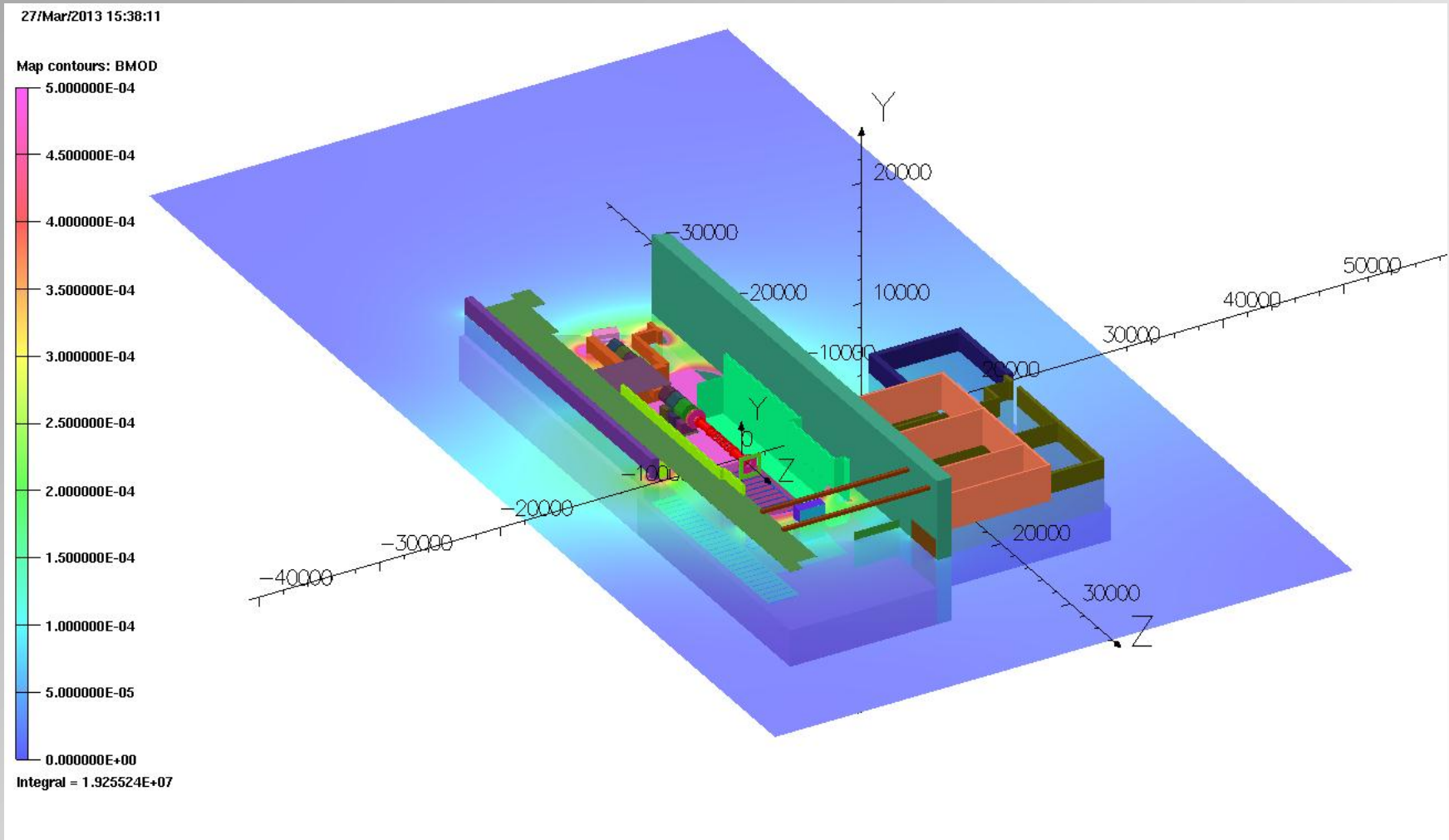
List of ISIS concerns



What I had planned to look at today are a few overview plots of the Hall and the surrounding area and the ISIS control rooms as these have been discussed previously.

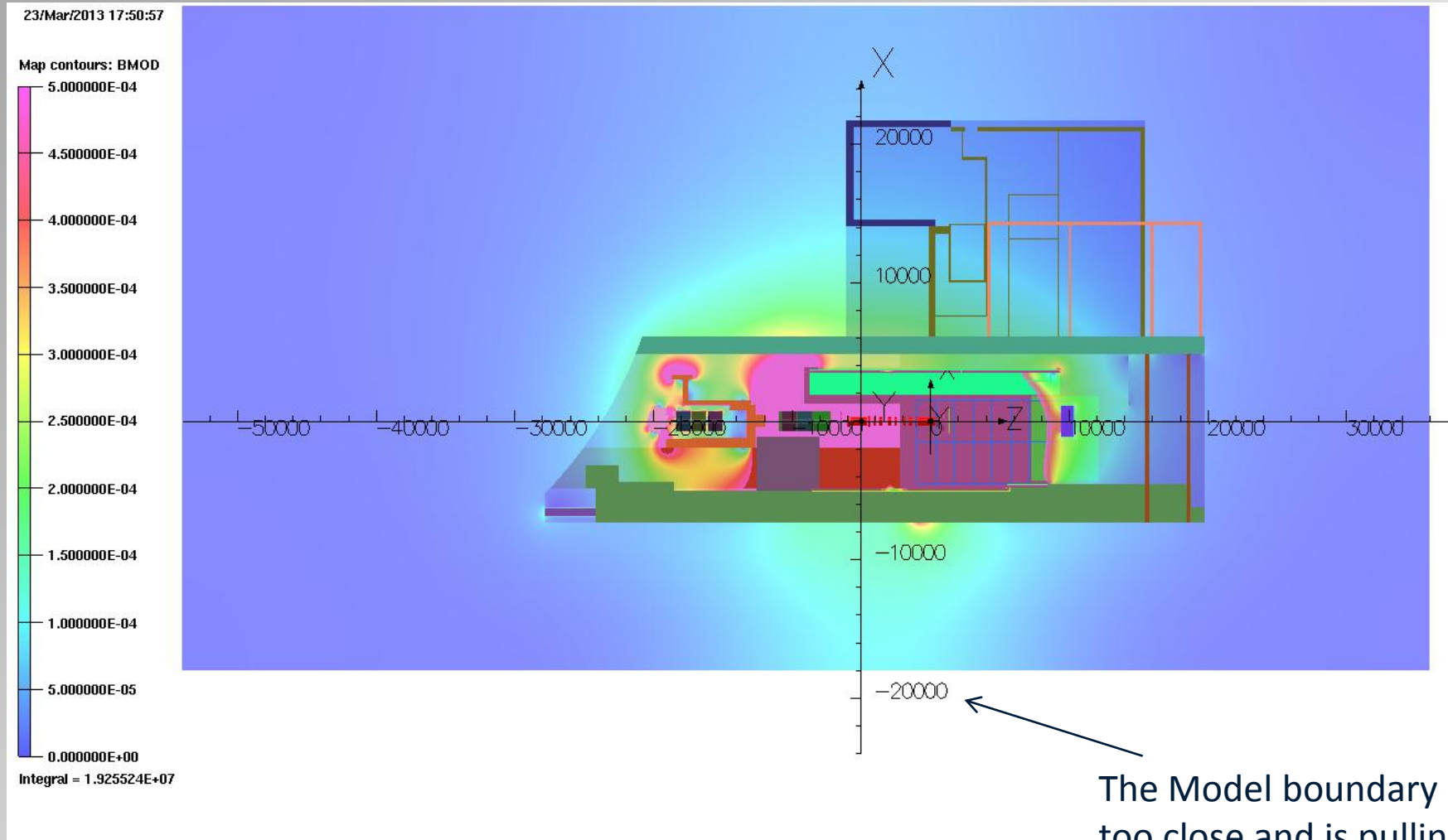
We produce a lot of information that is available on line including a significant number of auto-generated images of each model, you can view these at your leisure but bear in mind the current model caveats.

http://www.hep.shef.ac.uk/research/mice/opera_models/

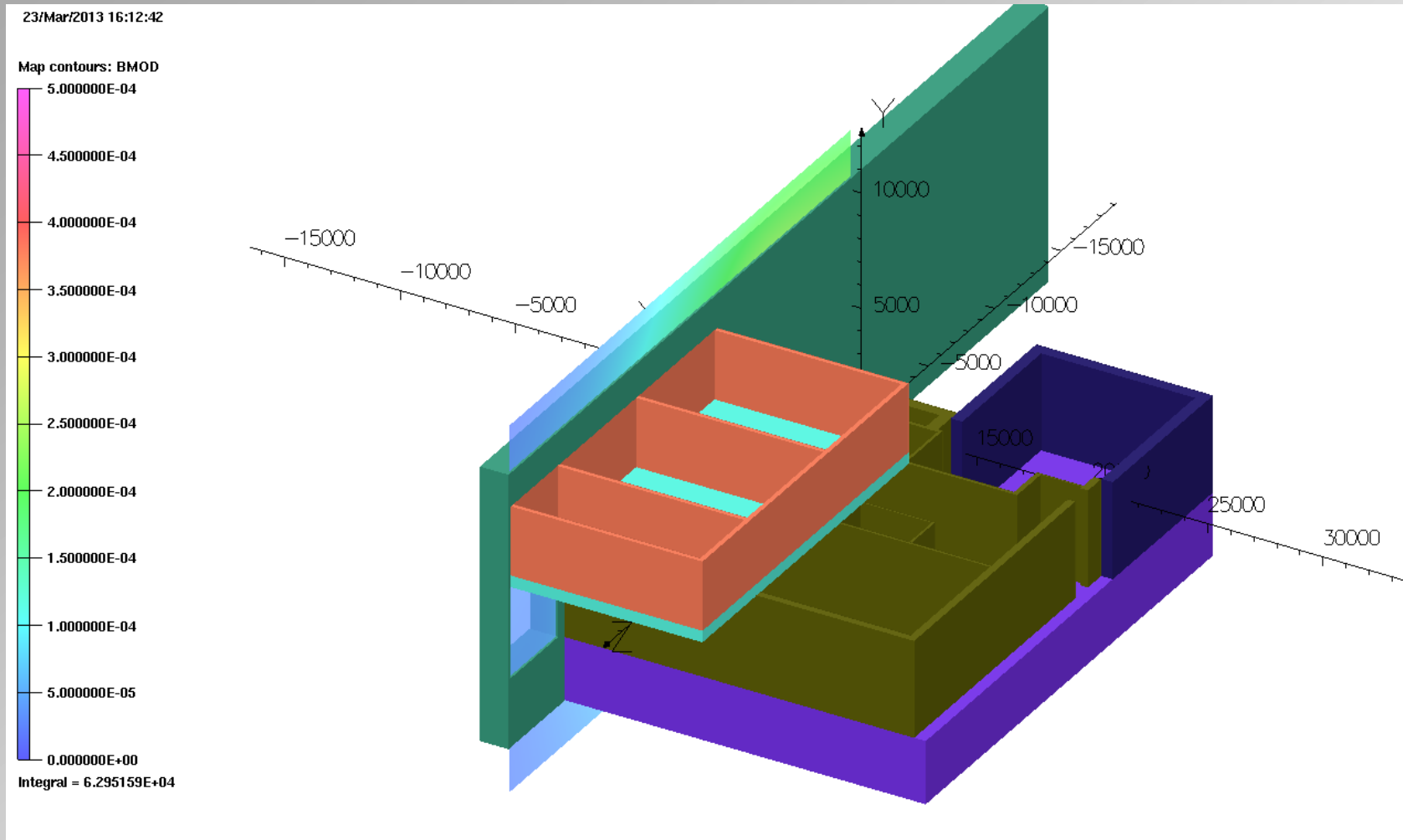


Preliminary Results Hall Overview

Step IV Solenoid 240 MeV/c

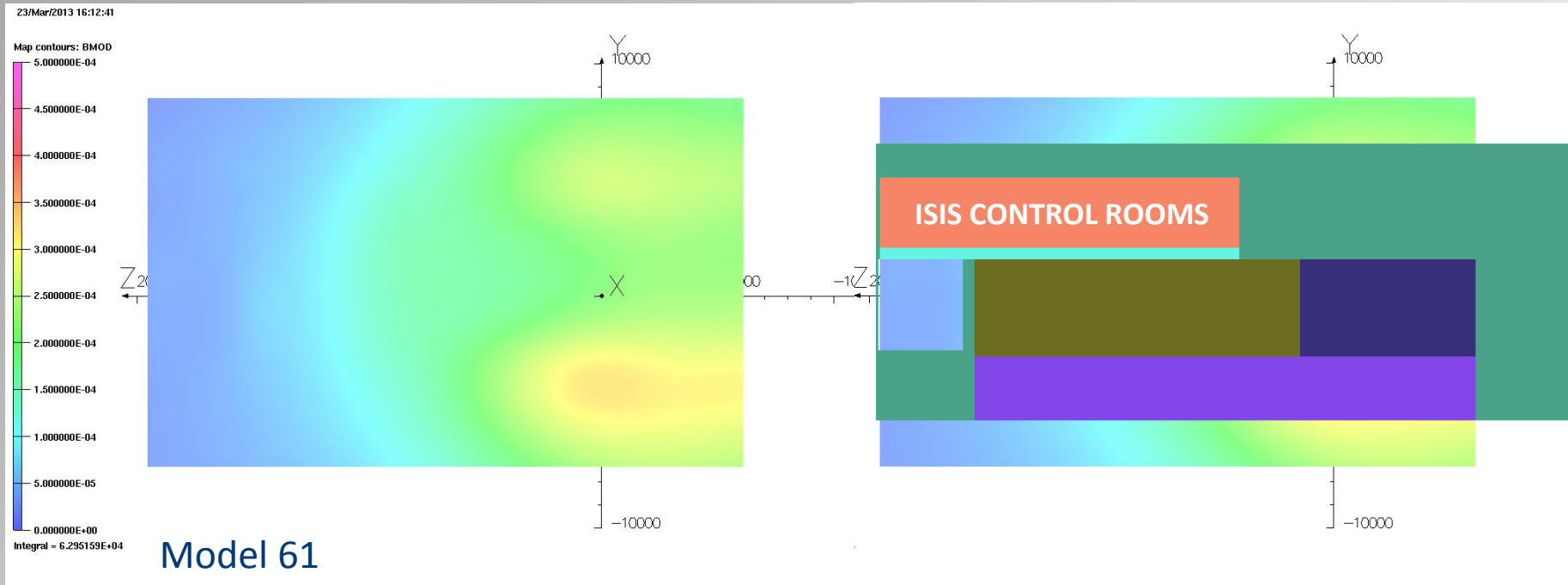


Model 61 - Step IV Solenoid 240MeV/c .
5 Gauss Scale. Bmod. Beam Height (y=0)



Model 61. x=6000 mm. 3D view to gain perspective on the plot plane

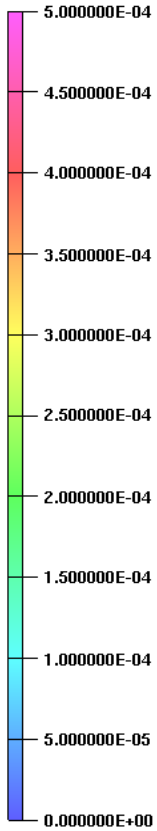
LHS is the same plot as RHS but with structures superimposed



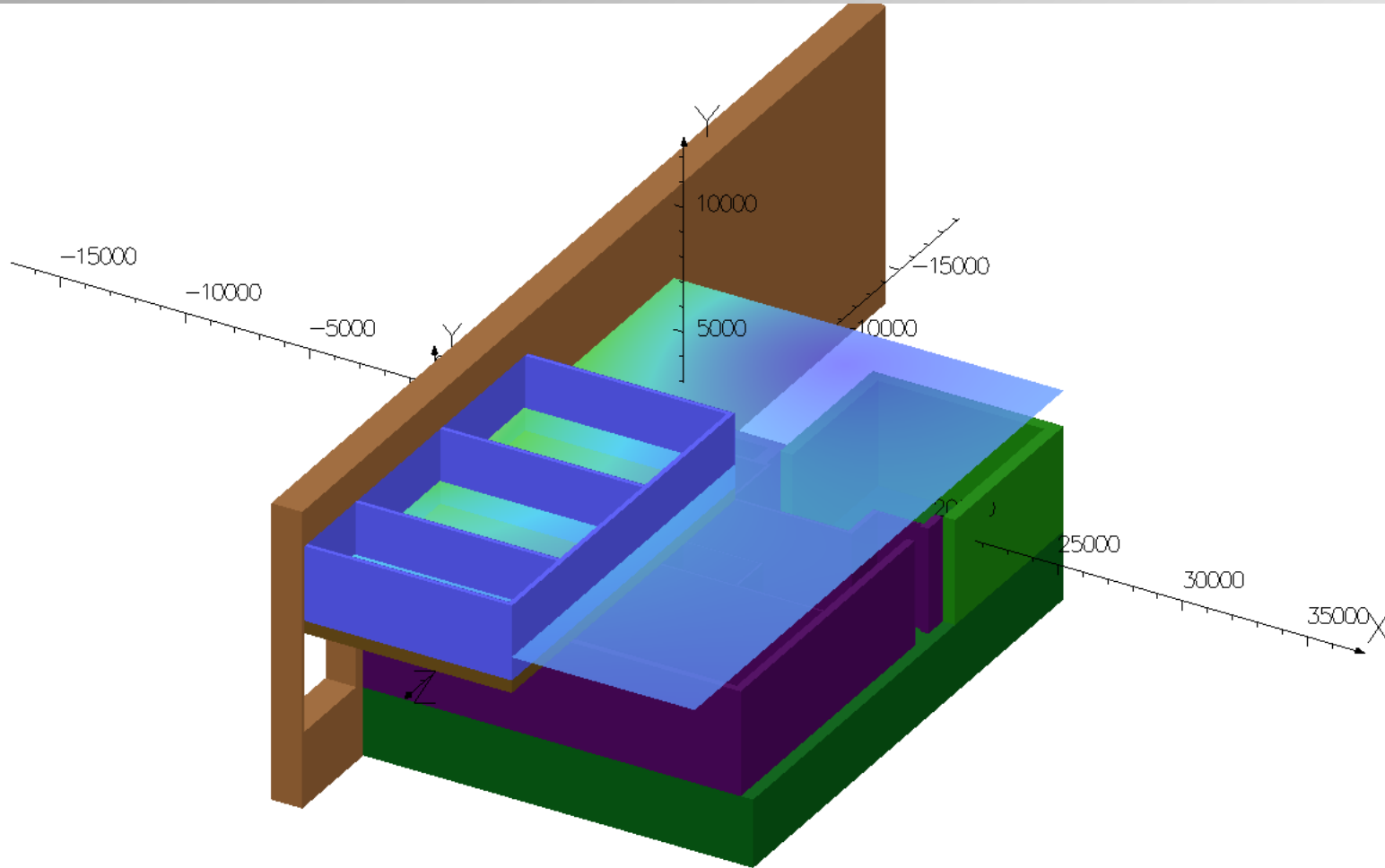
(Apologies – a bug in the auto-generator meant that the scale appeared behind the plot.)
5 gauss scale. Bmod. x=6000

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Map contours: BMOD



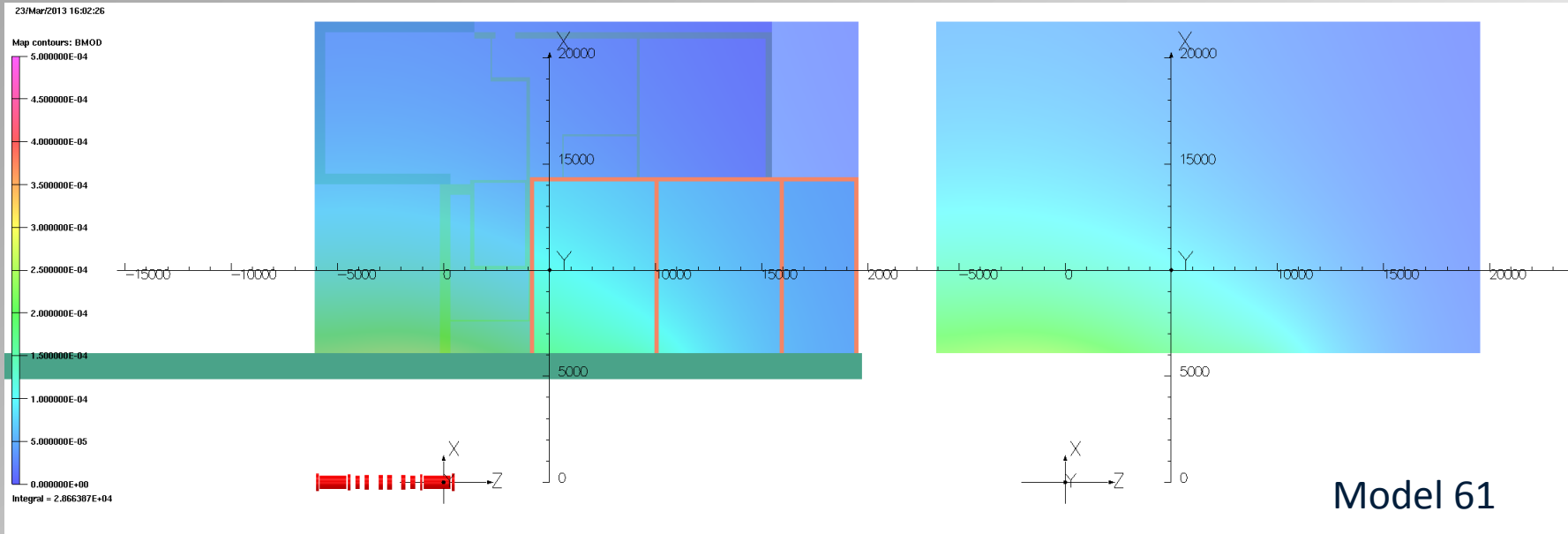
Integral = 2.606917E+04



Model 61. $y=3000$ (3m above beam height)

3D view to gain perspective on the plot plane

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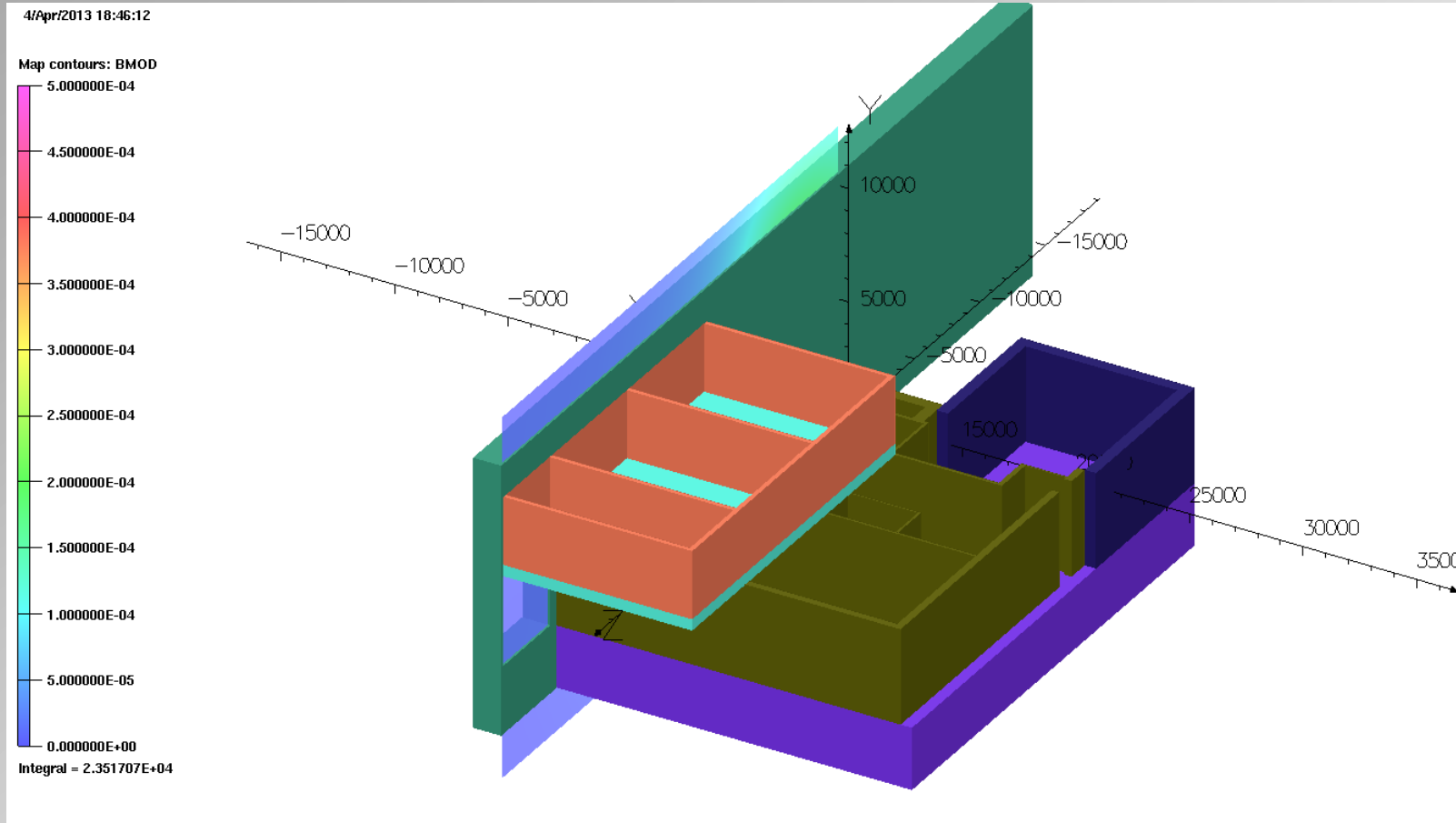


I'm continuing to show plots with both structures turned 'on' and 'off' because when the structures are turned 'on' the transparency of the plot can affect the apparent colouration of it .

5 gauss scale Bmod. $y=3000$

Preliminary Results

Step IV- Flip

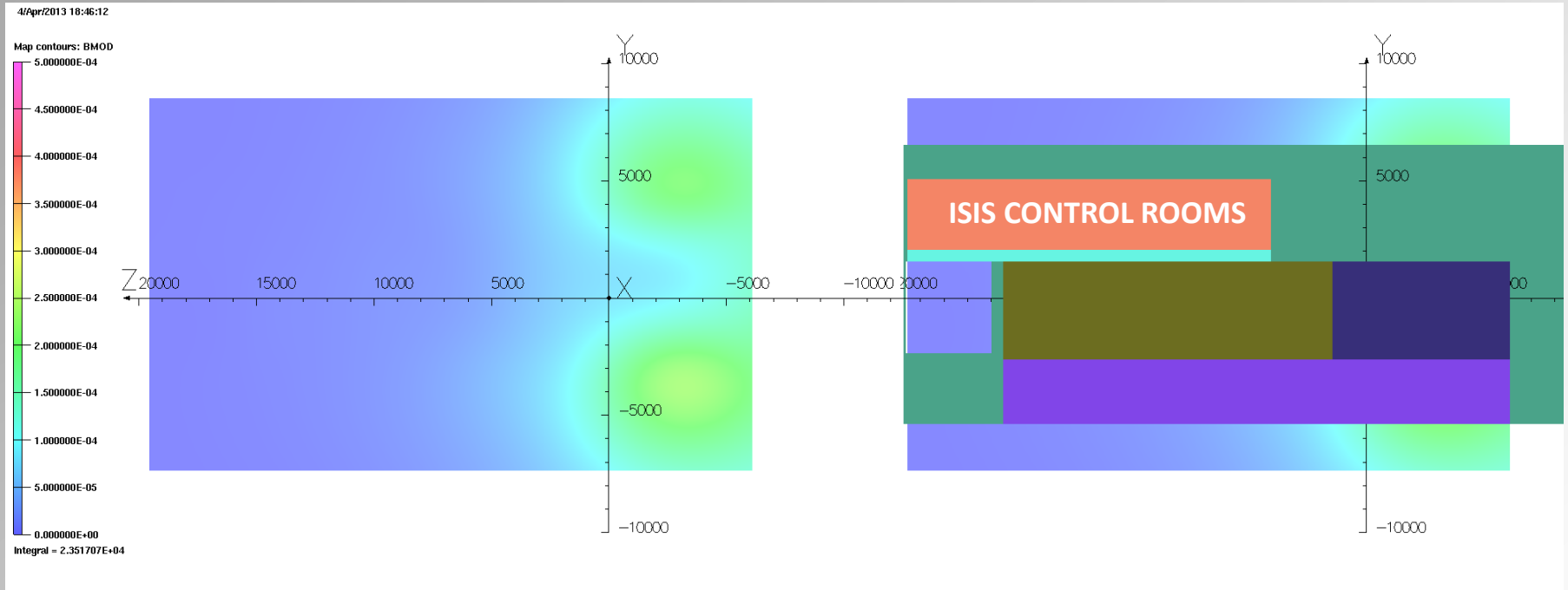


Model 64. $x=6000$.

3D view to gain perspective on the plot plane.

Preliminary Results

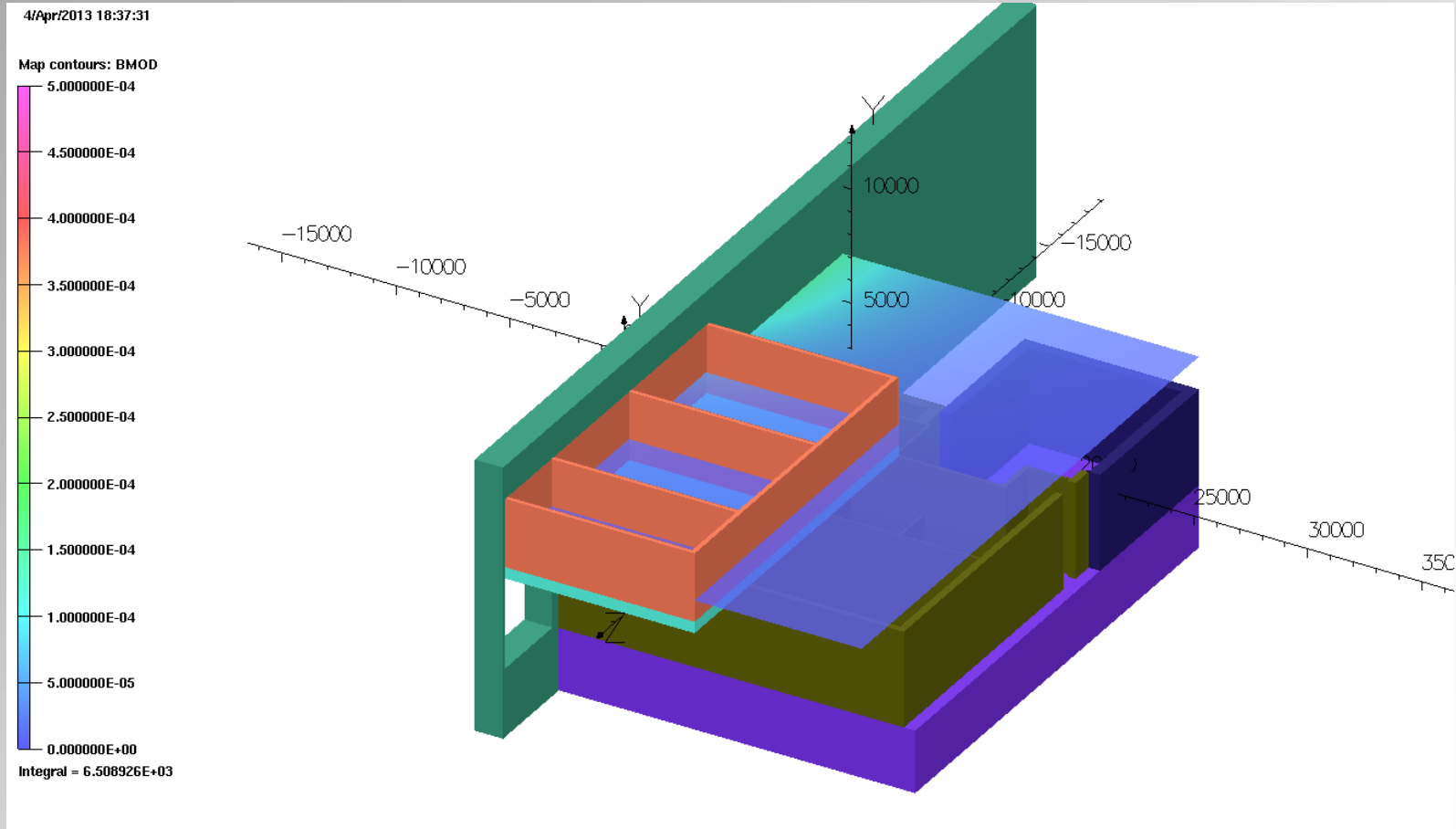
Step IV - Flip



Model 64 – Step IV Flip 240 MeV/c.
Bmod. 5 gauss scale. x=6000

Preliminary Results

Step IV- Flip



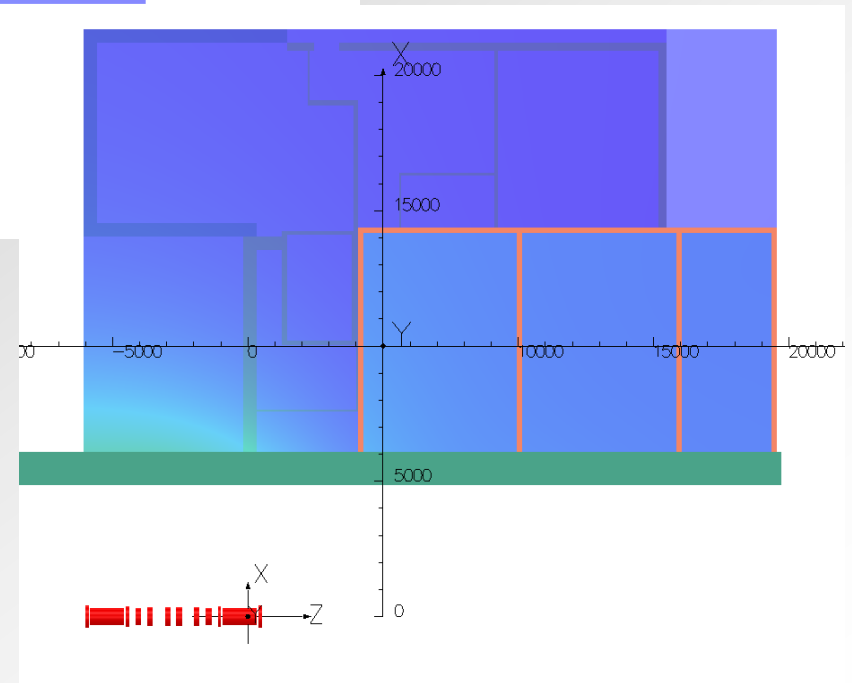
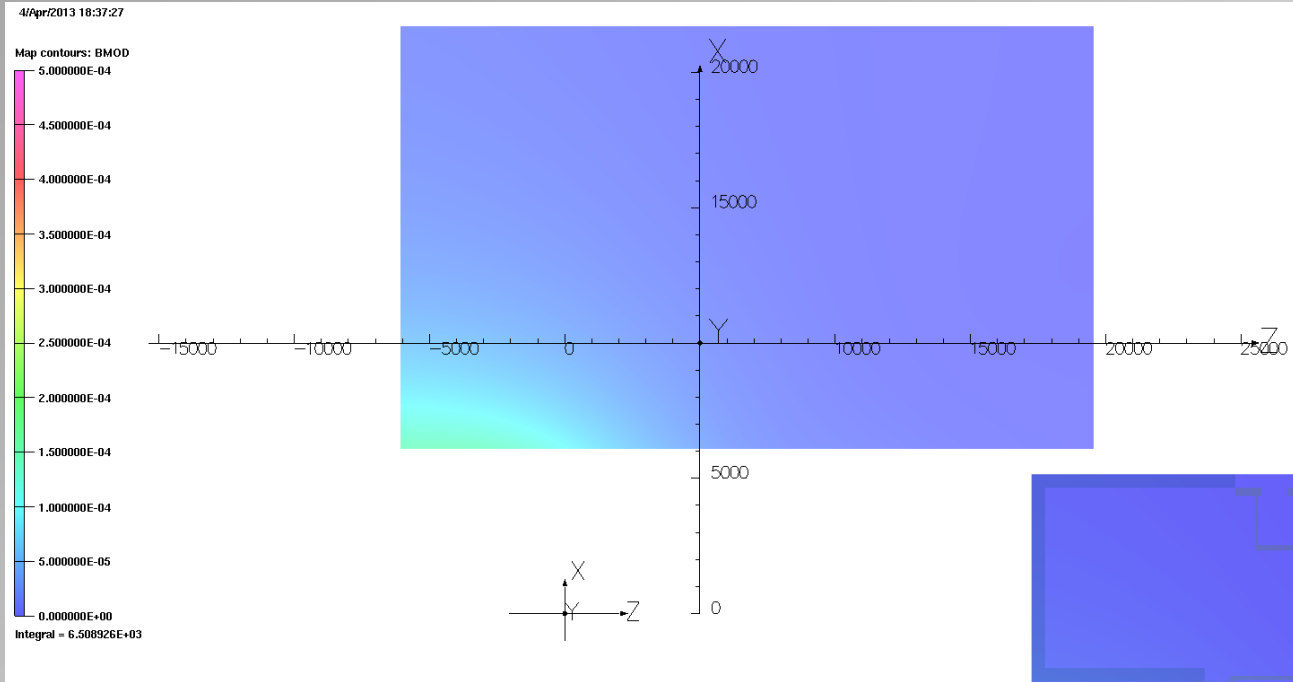
Model 64. y=3000 mm

3D view to gain perspective on the plot plane

28/03/2013

Preliminary Results

Step IV - Flip



Model 64 – Step IV Flip 240 MeV/c.
Bmod. 5 gauss scale. $\gamma=3000$



Step IV



I haven't done an extensive search through the control room volumes but from these plots it is indicative that the field levels within these volumes peak at a few gauss (~ 3 max) but are for the most part in the region of 0.5-2 gauss. These values compare favourably with values earlier models produced by Mike Courthold and reported in the document titled MICE Shielding Issues presented to the ISIS safety review on 20th July, 2011

The equivalent vector plots are also available online.

Clearly the field levels are worse for solenoid mode than flip mode.

They field levels may go a little higher if the planes were taken at the floor level in the Control Rooms as they would be slightly closer to our beam line – this needs checking at some point but I wouldn't expect a huge change.



Conclusions



We have a hall model that is producing field plots that we feel are believable but we also understand that the model needs benchmarking to give us the confidence to progress using these models. We are currently pursuing this with Vector Fields.

For Step IV:

It looks like there is very little intrusion of anything above 5 gauss outside the MICE Hall – occasional spots from what I can see but it needs a more thorough examination after the model boundary has been moved outwards & VF checks.

Solenoid Mode looks worse than Flip mode; that is reasonable as one would expect some field cancellation with Flip mode.

For the ISIS control rooms the model currently predicts a field of a few gauss at most, typically 1-2 gauss with peaks of ~3 gauss in very localised volumes.

We have taken your list of 'locations of concern' on-board and will give our consideration to the field strength in these areas in due course.