

Sub-modelling –
Looking at the Sub-Station or the
Quads?

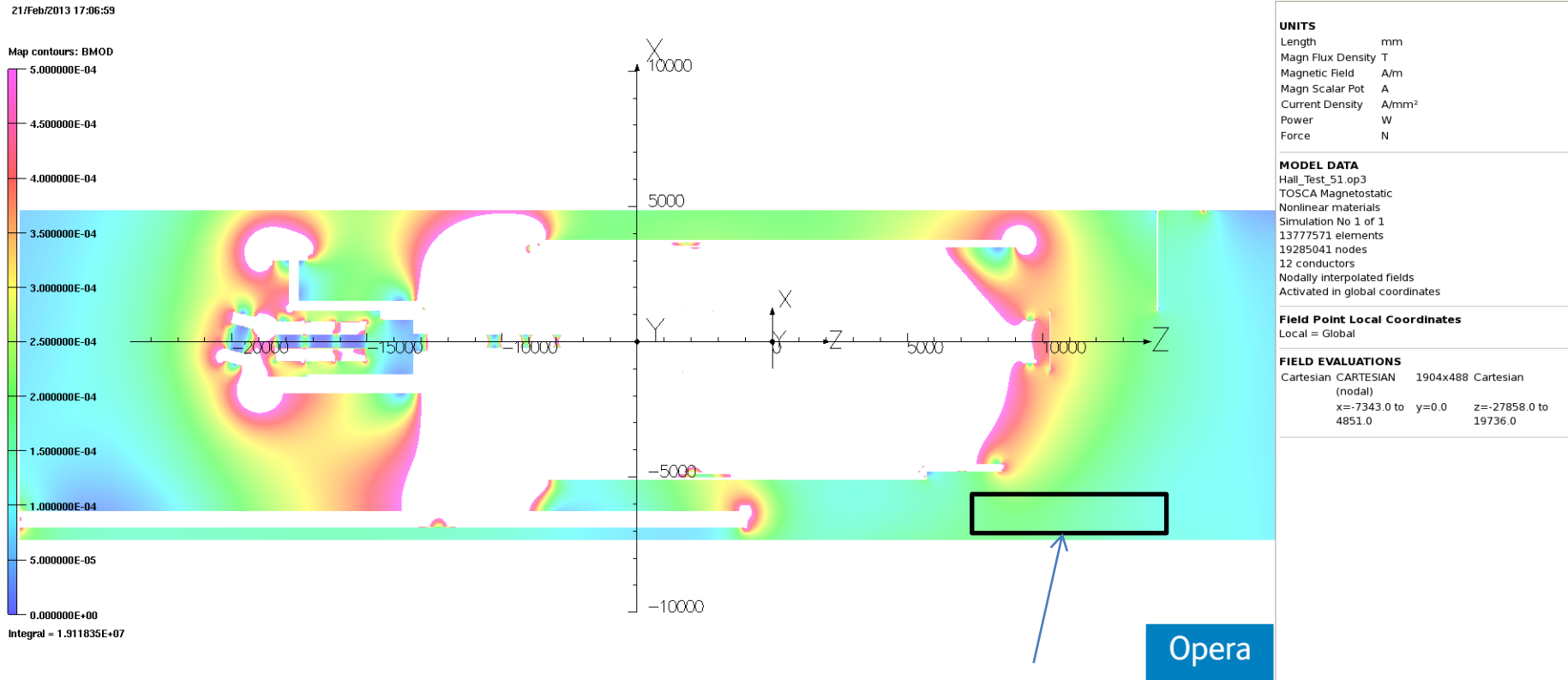
The following are slides I sent to Mike and Craig last week when I was exploring whether to look at the sub-station or the quads, I've since bolted a few more slides onto what I originally sent to these guys for today.

Before looking at these slides I should also add that I also drew up a more detailed consulting document for approaching VF with. Waiting for feedback and advice from Ken/Mike before we take this further.

Where does the Substation sit?



Plot taken from model 51 – Plot Auto-generator @ $y = 0$ Step IV 240 MeV/c - 0 to 5 gauss scale



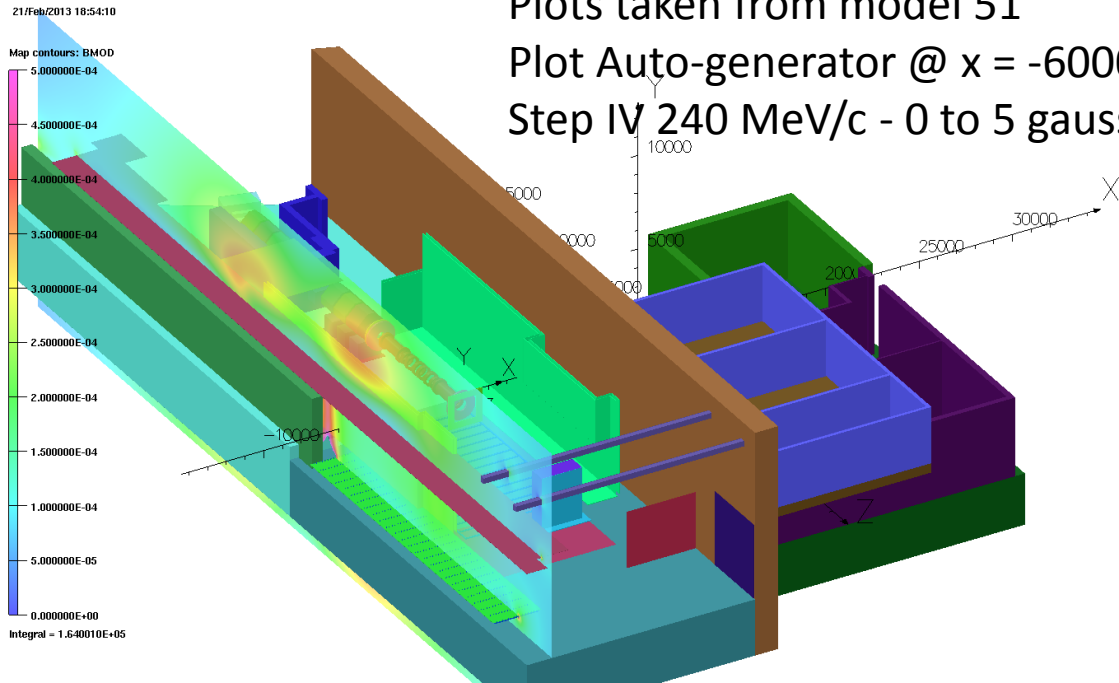
Sub station sits here
 (approximately)

Given our uncertainty in the model it looks like the substation sit in a few gauss for step IV? Is this foreseen as being a problem? Any information from manufacturer?

Plots taken from model 51

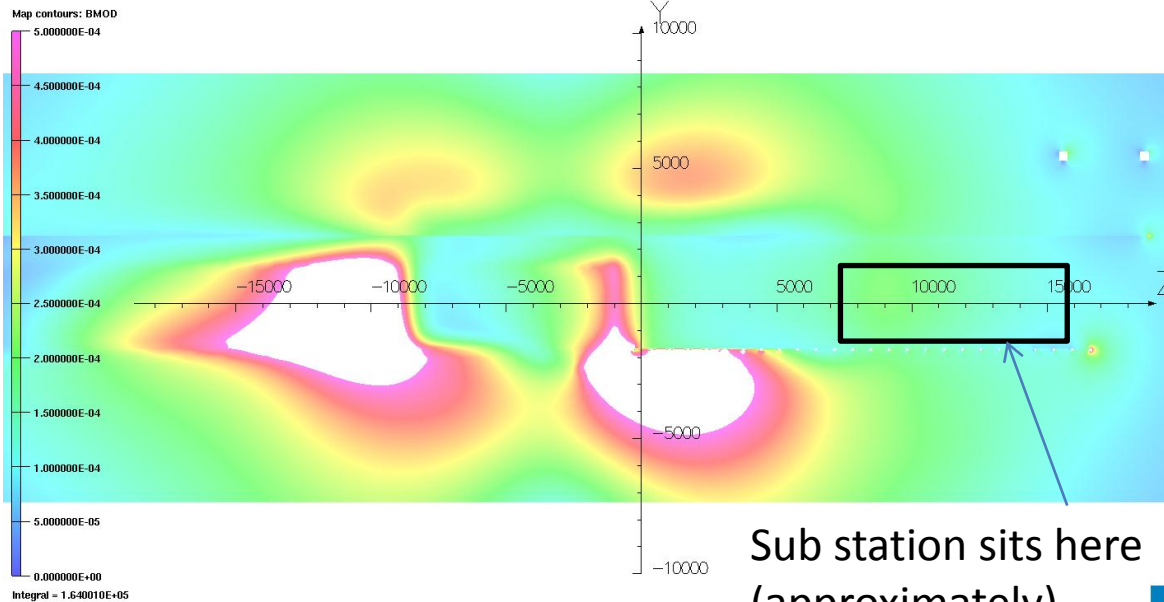
Plot Auto-generator @ x = -6000

Step IV 240 MeV/c - 0 to 5 gauss scale



UNITS		
Length	mm	
Magn Flux Density	T	
Magnetic Field	A/m	
Magn Scalar Pot	A	
Current Density	A/mm ²	
Power	W	
Force	N	
MODEL DATA		
Hall_Test_51.op3		
TOSCA Magnetostatic		
Nonlinear materials		
Simulation No 1 of 1		
13777571 elements		
19285041 nodes		
12 conductors		
Nodally interpolated fields		
Activated in global coordinates		
Field Point Local Coordinates		
Local = Global		
FIELD EVALUATIONS		
Cartesian	CARTESIAN	636x1904 Cartesian
(nodal)		
x=-6000.0	y=-7370.0 to	z=-27858.0 to
	8526.0	19736.0

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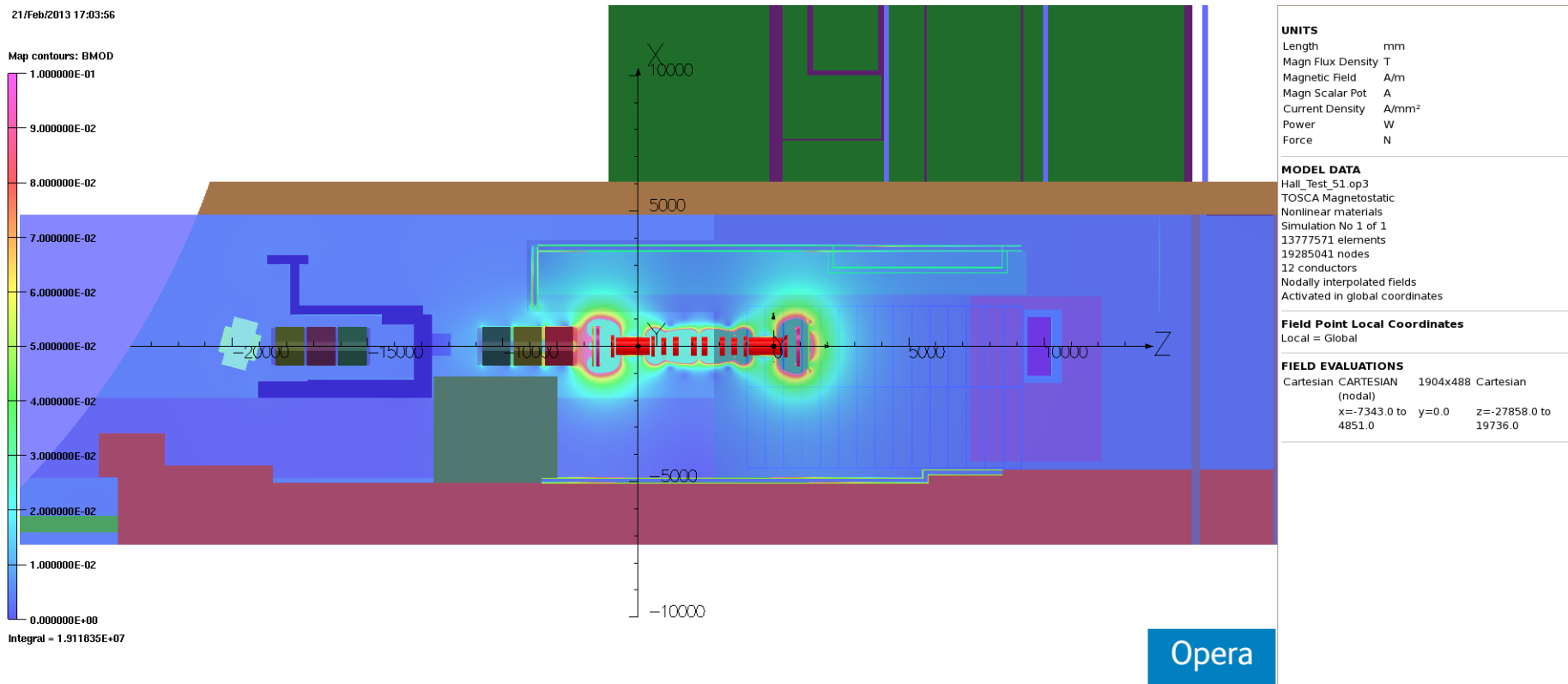


Sub station sits here
(approximately)

UNITS		
Length	mm	
Magn Flux Density	T	
Magnetic Field	A/m	
Magn Scalar Pot	A	
Current Density	A/mm ²	
Power	W	
Force	N	
MODEL DATA		
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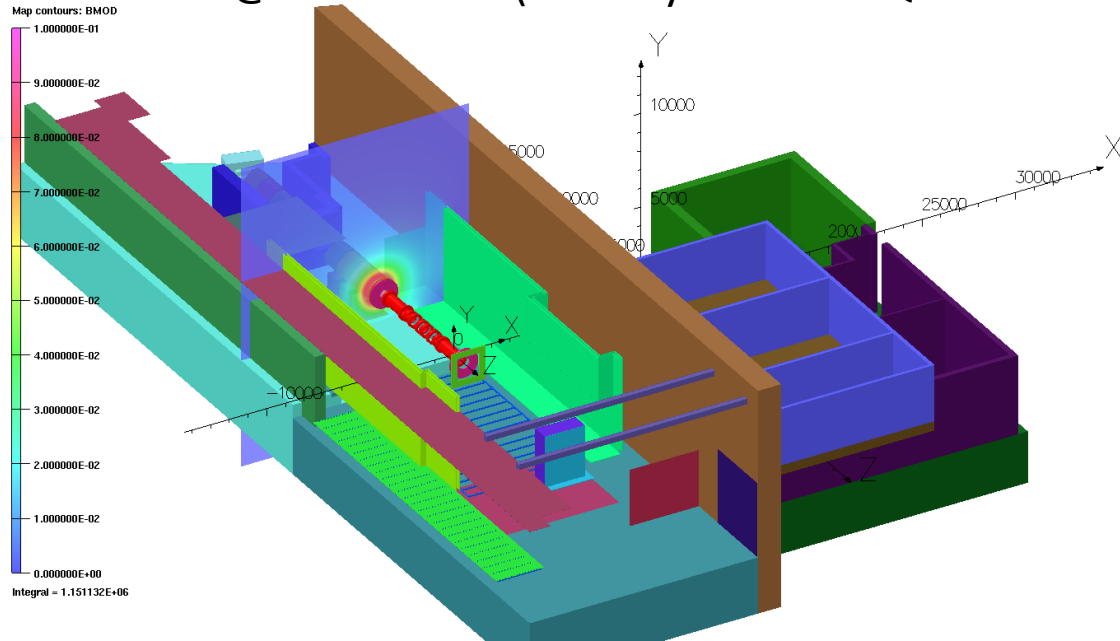
Apologies for poor plots – post processor currently tied up so re-using available plots from autogen...

Plot taken from model 51 – Plot Auto-generator @ $y = 0$
 Step IV 240 MeV/c - 0 to 1000 gauss scale



If model is to be believed then the Front Face of Q9 seems to be seeing about 0.1T in air.

@ z=7000mm (Halfway between Q9 and TOF plate)



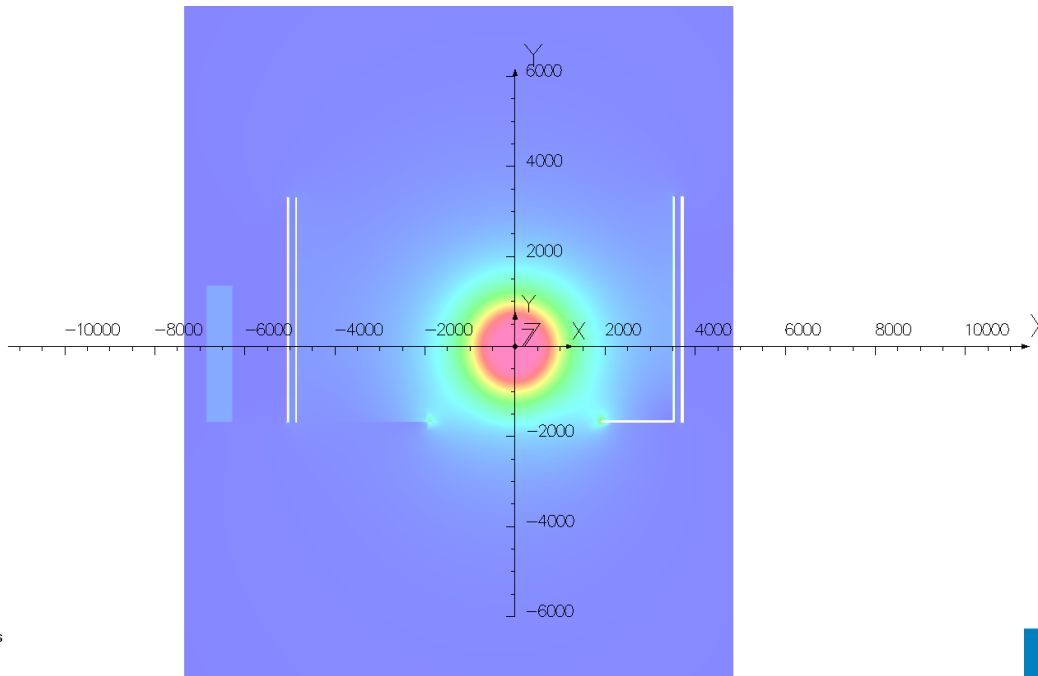
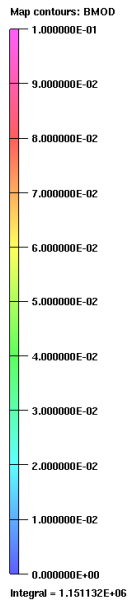
UNITS		
Length	mm	
Magn Flux Density	T	
Magnetic Field	A/m	
Magn Scalar Pot	A	
Current Density	A/mm ²	
Power	W	
Force	N	

MODEL DATA		
Hall_Test_51.op3		
TOSCA Magnetostatic		
Nonlinear materials		
Simulation No 1 of 1		
13777571 elements		
19285041 nodes		
12 conductors		
Nodally interpolated fields		
Activated in global coordinates		

Field Point Local Coordinates		
Local = Global		

FIELD EVALUATIONS			
Cartesian	CARTESIAN	488x636	Cartesian
	(nodal)		
	x=-7343.0 to	y=8526.0 to	z=-7000.0
	4851.0	-7370.0	

Opera



UNITS		
Length	mm	
Magn Flux Density	T	
Magnetic Field	A/m	
Magn Scalar Pot	A	
Current Density	A/mm ²	
Power	W	
Force	N	

MODEL DATA		
Hall_Test_51.op3		
TOSCA Magnetostatic		
Nonlinear materials		
Simulation No 1 of 1		
13777571 elements		
19285041 nodes		
12 conductors		
Nodally interpolated fields		
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Field Point Local Coordinates		
Local = Global		

FIELD EVALUATIONS			
Cartesian	CARTESIAN	488x636	Cartesian
	(nodal)		
	x=-7343.0 to	y=8526.0 to	z=-7000.0
	4851.0	-7370.0	

Opera

My gut feeling is that the Q9 needs looking at more urgently than the substation for Step IV.

Of course the sub-station should not be ignored. - I think we need more information about the sub-station from the manufacturers.

Also because the substation is missing from the model we have to acknowledge that there will be a multiplying effect of any field if we place steel in that region. This may take us up to a few 10's of gauss at the front panels? Are we concerned about this?

Of course if the model is also wrong by a factor of ~ 2 then we are starting to get into territory that should get us concerned – however I'm trying not to pre-empt this problem until we have had some further advice on the Hall model.

Quad Model

On the basis of this I decided to build a 'sub-model' or more accurately a 'reduced' model of the quads Q9-Q7. Part exercise to see how easy it is to build a reduced model out of existing hall model components.

The reduced model includes Solenoids, NSW, SSW, Q9-Q7 with bases and baseplates, Virostek plates and TOF shield.

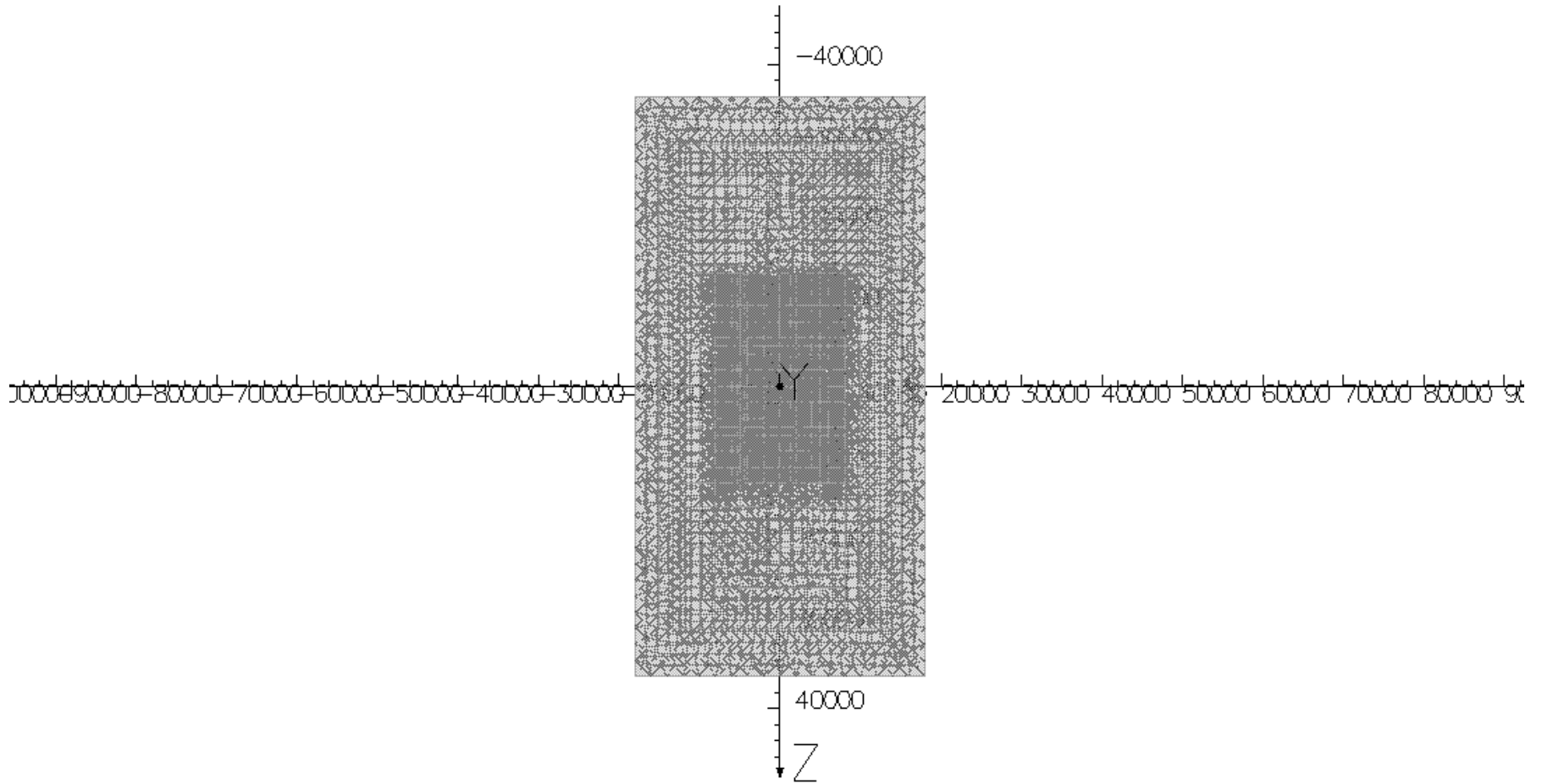
The work is still in progress – still tidying up the code a bit. This reduced model seems to solve in about 14 hours if run at the same meshing resolution as used in the Hall model.

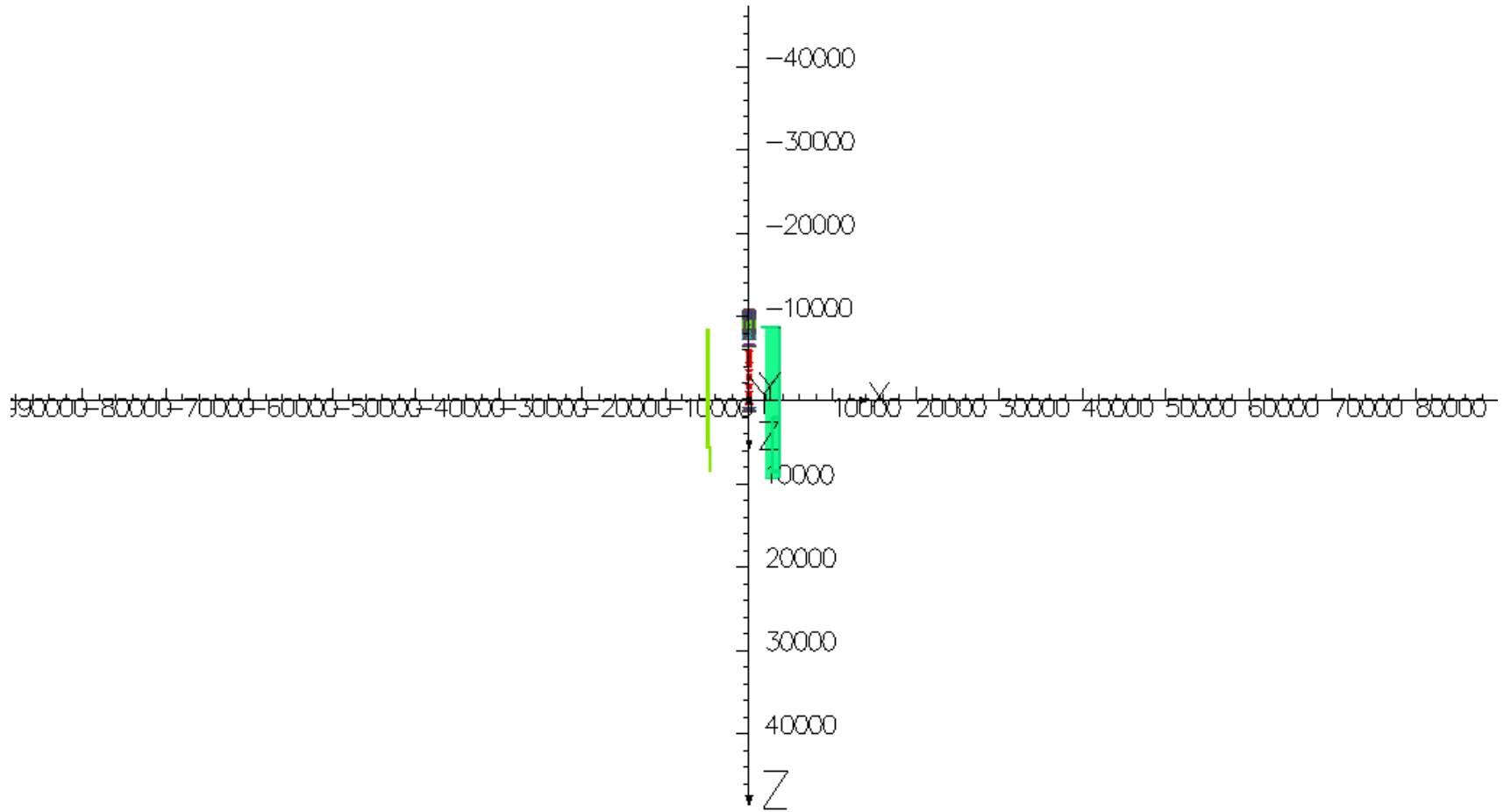
The plan is to first compare reduced model with hall model to ensure that they roughly agree around the quads for the same meshing resolution – I have still to do this.

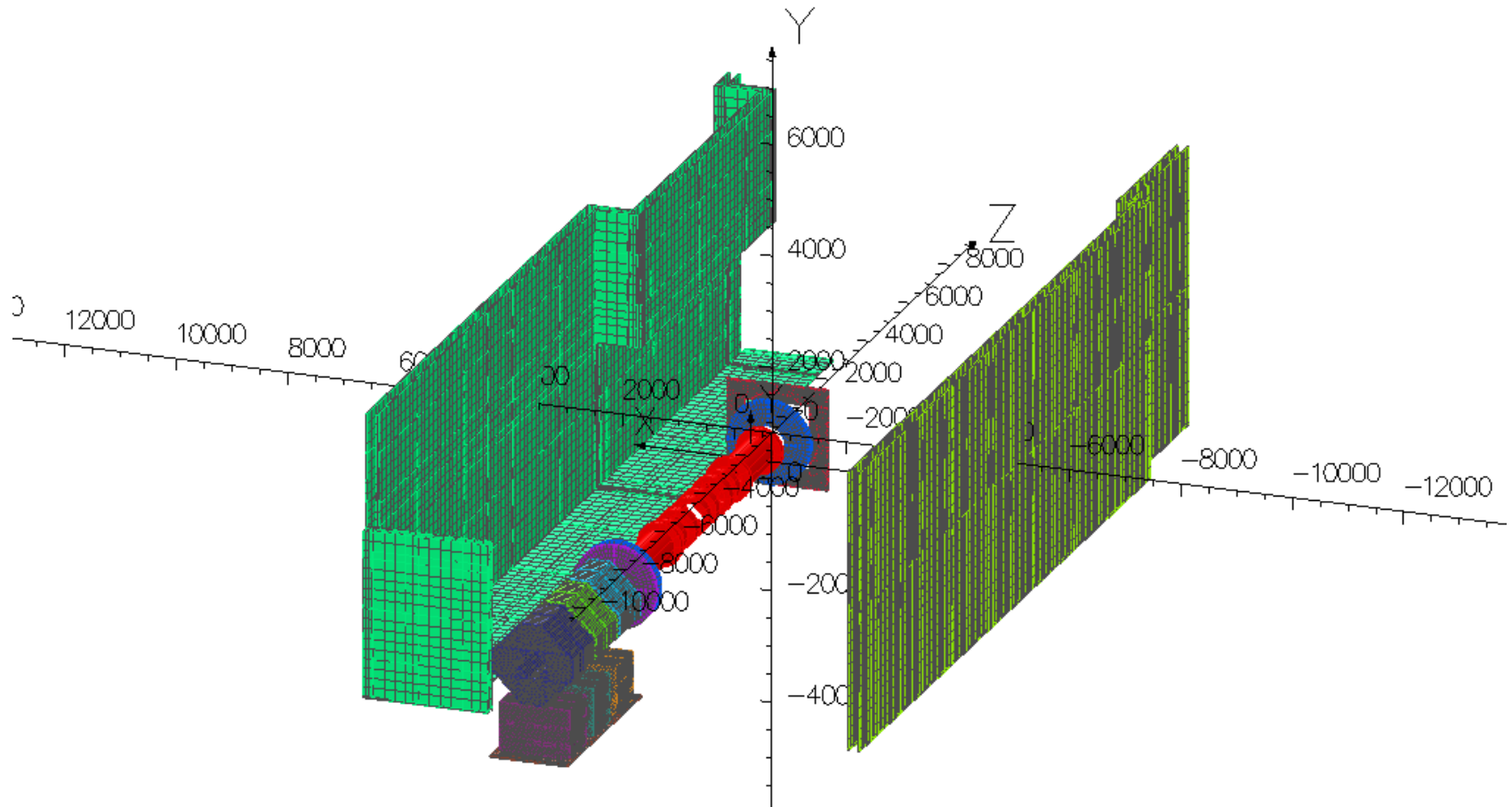
Run a model with improved meshing – do we see mesh convergence?

Then I'll take a much closer look at the quads and decide if this needs further work.

05/03/2013 Consider whether we need a better model of the Quads.







Vector Plot

This result is from the quick model I ran last night so there are some checks I haven't yet run – results are preliminary and very hot off the press. I haven't checked for mesh convergence in the new quad model (but we haven't done that yet for the hall model either!)

First thing I wanted to look at was the vector plots at low field. I changed the boundary conditions on this model as recommended by VF– recall last week all the plots with vectors pointing in the wrong direction at low field...

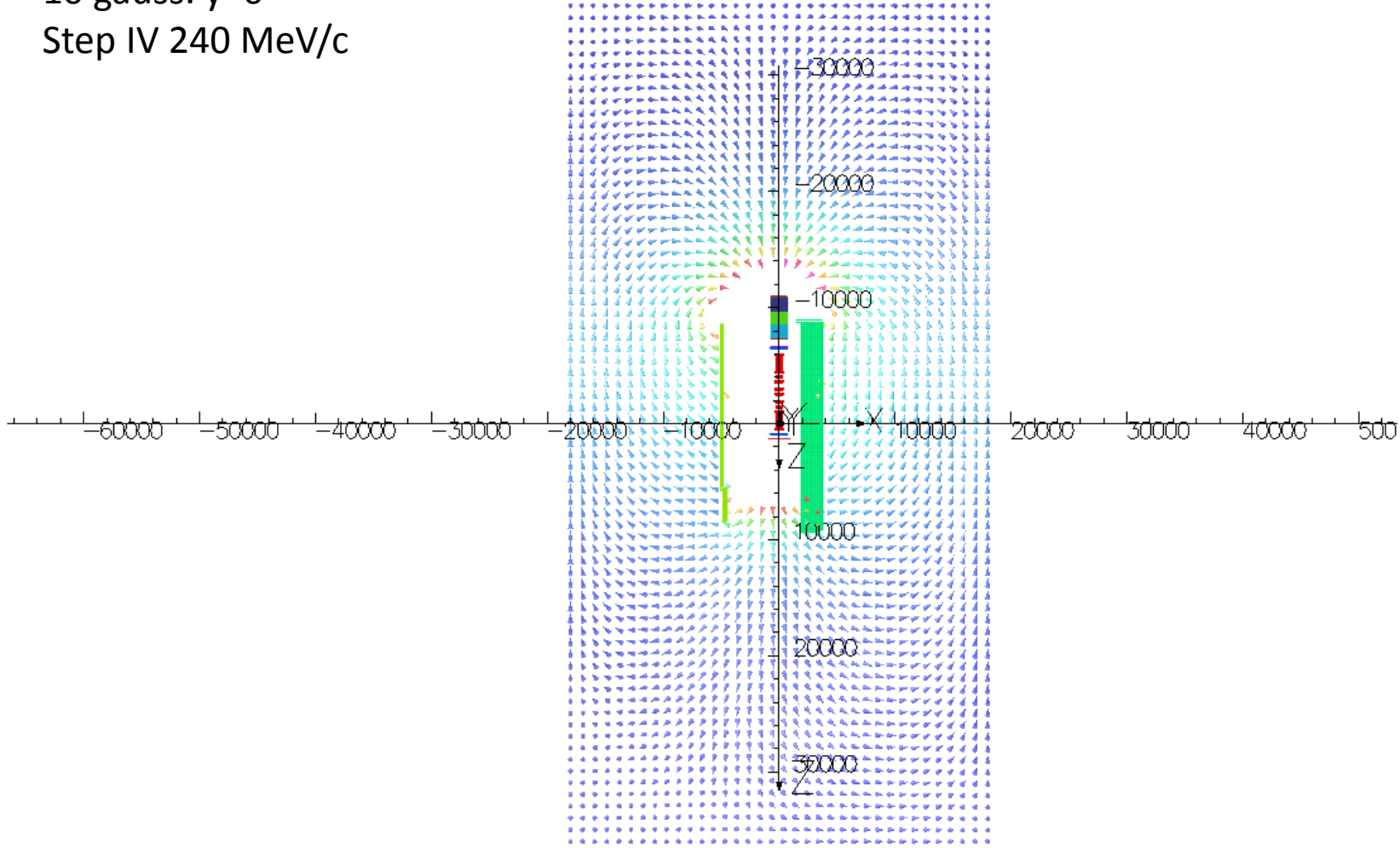
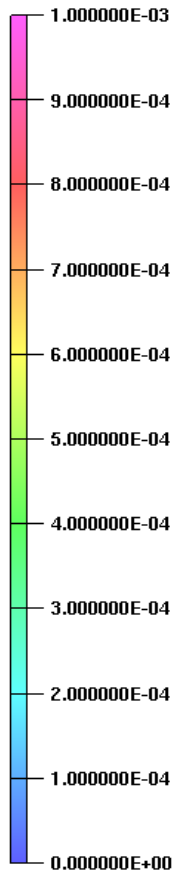
Result: These plots are much more believable. Of course the model is also much simpler so the jury is out as to whether it is the change to the boundary conditions or the simpler model that is responsible. Conclusion: Either way the implication is that Hall model 51 needs to be re-run with new boundary conditions as a comparison.

I have also started to look at whether I can see a field gradient across the quads – it doesn't look like I can see anything significant in this simple model but I need to look at these results in a bit more detail before presenting anything.

Quad model vector field at 10 gauss. $y=0$ Step IV 240 MeV/c

5/Mar/2013 11:32:48

Map vectors: B

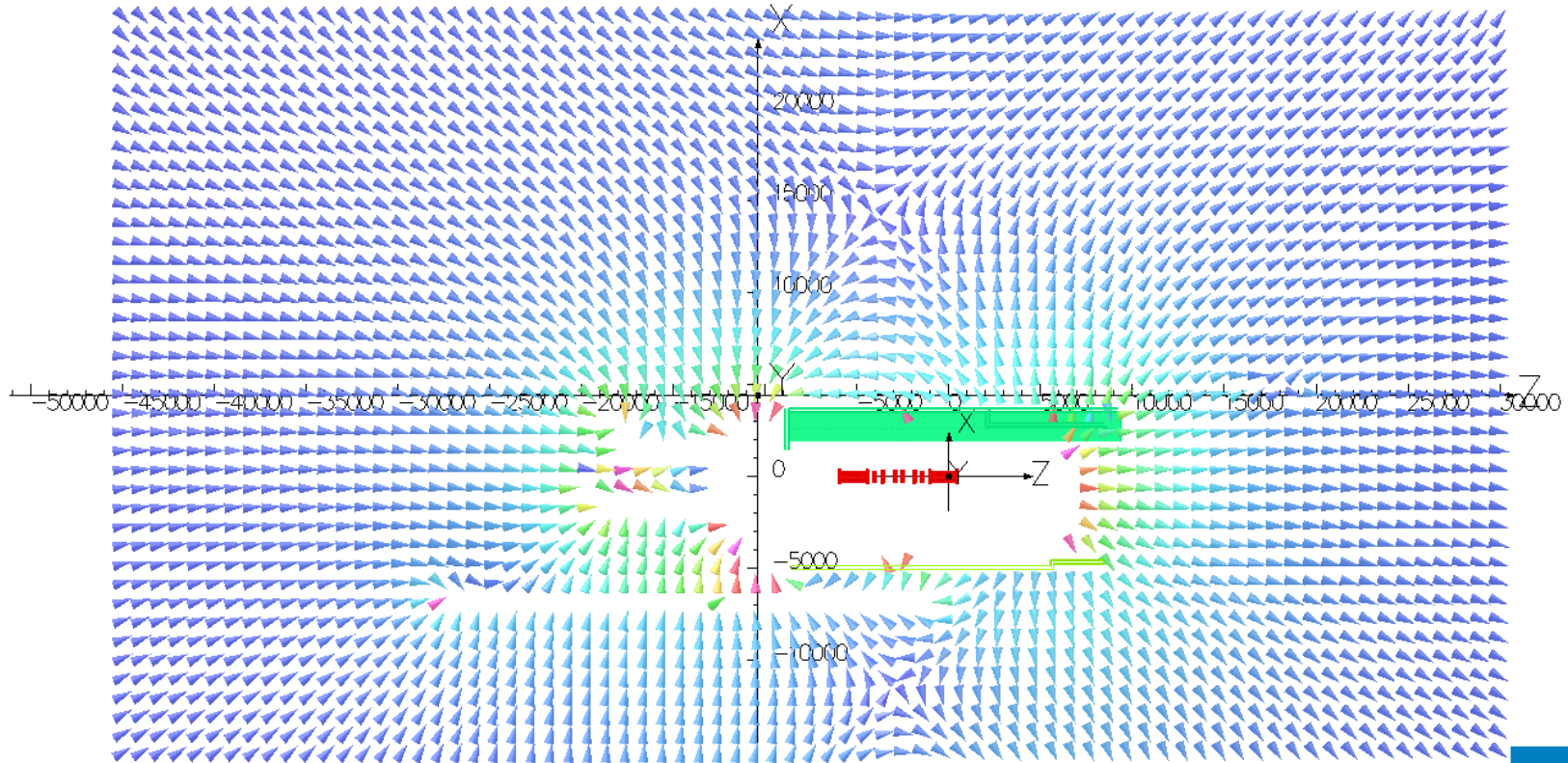
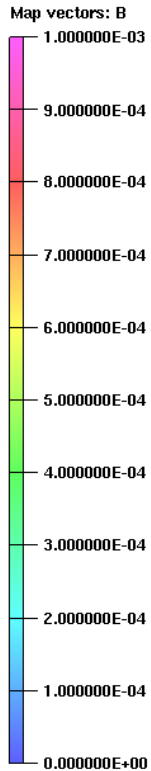


Boundary condition is set so that field is tangential to boundary - this forces vectors to be vertical in the corners – note that field at these points is below 1E-5T (0.1 gauss)

Compare with model 51 at same scale! –
Slide from presentation last Wed.

South

25/Feb/2013 16:14:25



North

Model 51 - Step IV 240Mev/c
No return yoke