Progress report on ILD detector magnet

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Summary

Introduction

1. Version ILD-V2 Saclay for the magnet configuration
   1.1 Main parameters
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   2.1 Anti-DID coil design

Present conclusions

Summary

Introduction

Introduction

- New parameters used for ILD V2 detector magnet:

  . after Cambridge, Chicago and Catherine parameter list

  . homogeneous field in the TPC volume:

$$\Delta l\,(R) = \int_{0}^{z_{max}} (B_r\,(R) / B_z\,(R)\,dz \leq 10\text{ mm}$$

within the TPC volume:

$z_{max} = 2.25$ m
$R_{max} = 1.8$ m

- Same design for the coil as before
  . 5 modules (correction current in each module at extremity)
  . 4 layers per module (correction current in the 3 inner layers of the modules at extremity

Summary

1. Version ILD-V2 Saclay for the magnet configuration
   1.1 Main parameters

Version ILD-V2 Saclay

New parameters used for ILD-V2 detector magnet

. B_0 = 4 T nominal, 3.5 T operation

. R_{int} coil = 3 590 mm

. R_{ext} coil = 3 940 mm

. L coil = 3 672 * 2 mm

Stray field (@ 3.5 T)

. $B_{ext} \leq$ 200 G @ z=10 m from I.P.

. $B_{ext} \leq$ 200 G @ at (Rout + 1.5 - 2 m) in the radial direction

Yoke (barrel + end-caps)

. dimensions and constitution as in Catherine's table

. no endcap gap filling factor

Version ILD-V2 Saclay: field homogeneity

As previously described, the field homogeneity is ajusted with:

- a FSP (Field Shaping Plate)
- and correction currents in some places of the coil (3 inner layers of the two modules at extremities).

Summary

1.2 Main outputs

ILD-V2: main outputs

Electrical parameters (4 T)

I_{nom} (kA)	15.9	
Eng. J (A/mm²)	9.6	(for I_{nom})
ΔI_{cor} (kA)	18.1	(3 layers * 2 modules)
Stored energy (GJ)	2.0	
W_s density (kJ/kg)	12.2	

Integral homogeneity in TPC volume (mm)

≤ 9

Yoke dimensions

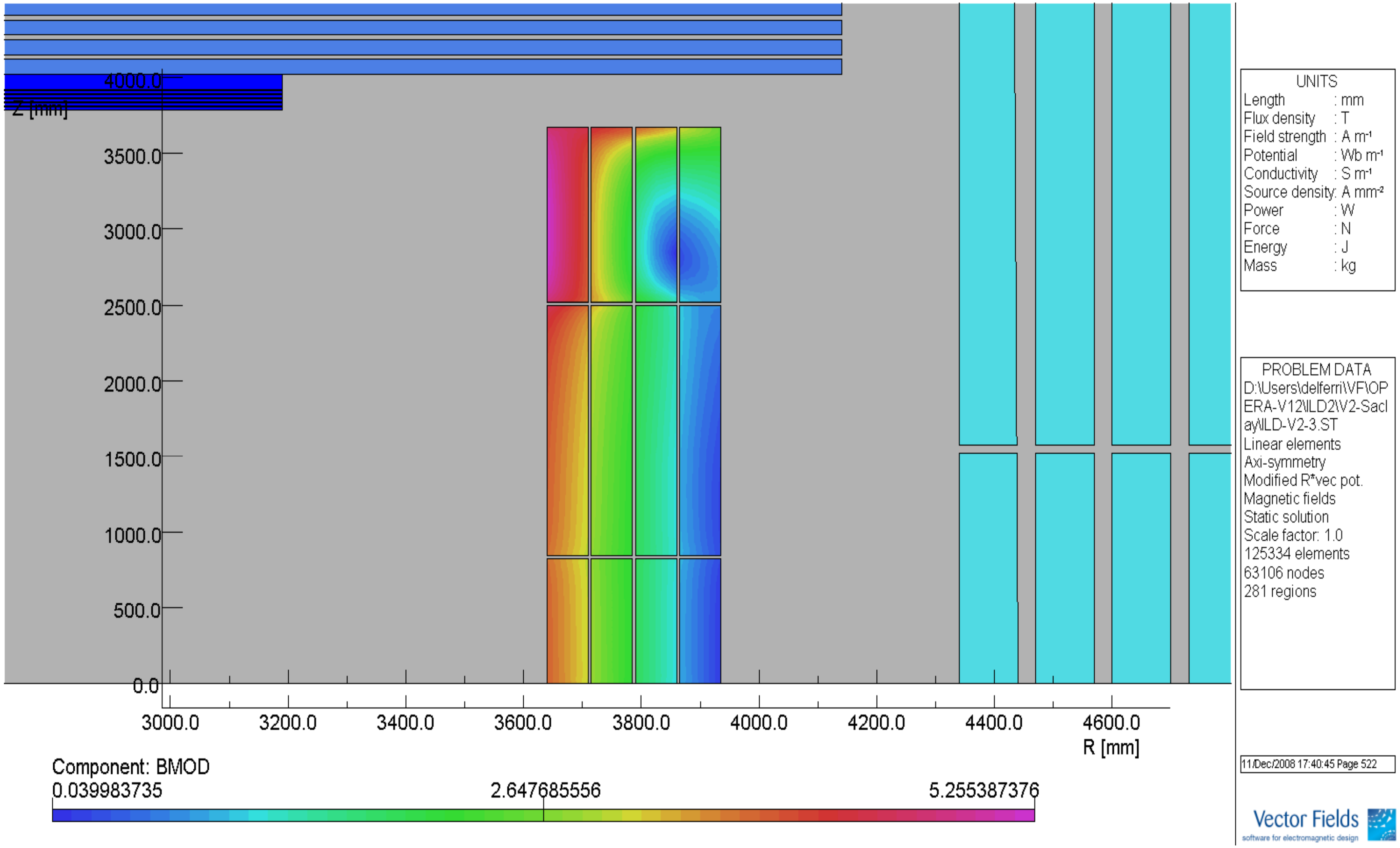
R_{out} barel yoke (mm)	7 110
Z_{out} endcap yoke (mm)	7 190

Stray field (@ 3.5 T)

B_{ext} = 110 G @ z=10 m from I.P.

B_{ext} = 220 G @ at R_{out} + 2 m in the radial direction

Field on conductors @ 4 T

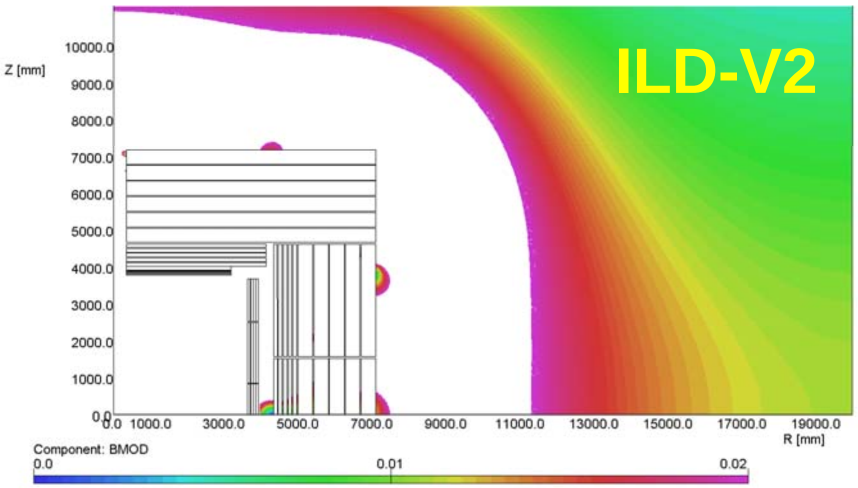


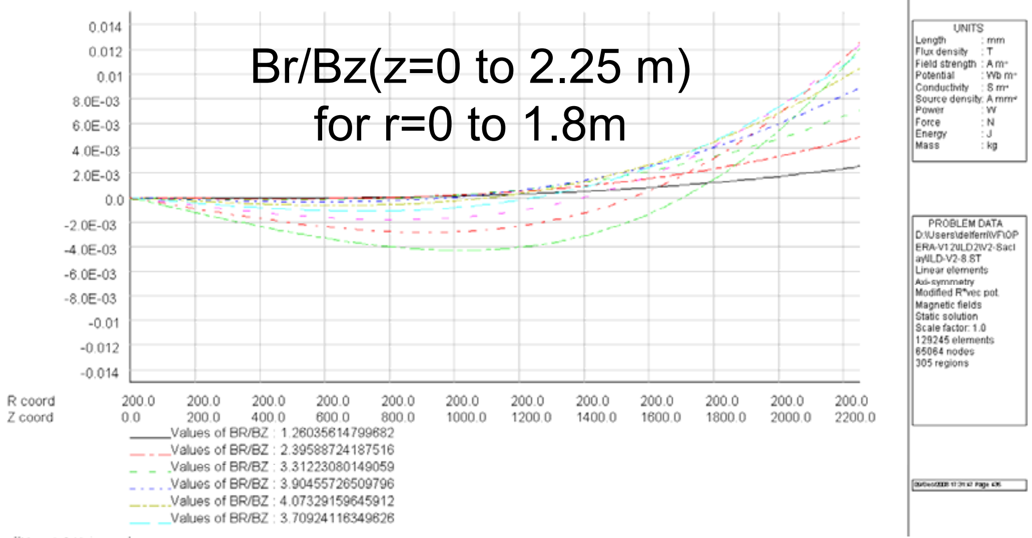
ILD-V2 SACLAY configuration @ 4 Tesla

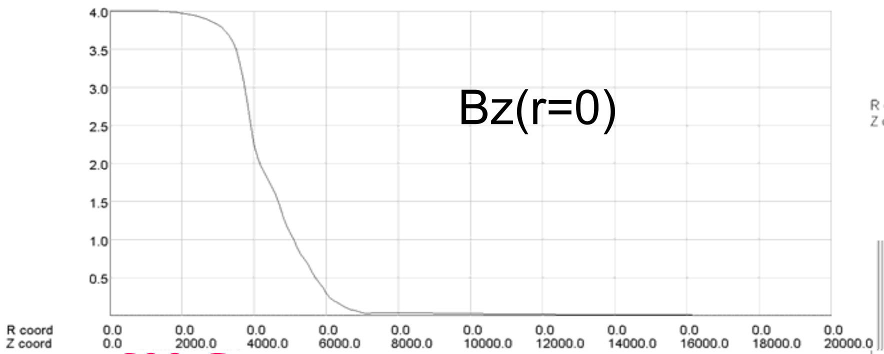
Iron : up to R=7.110m (2.76m thick), up to Z=+/-7.190m (3.27m thick)

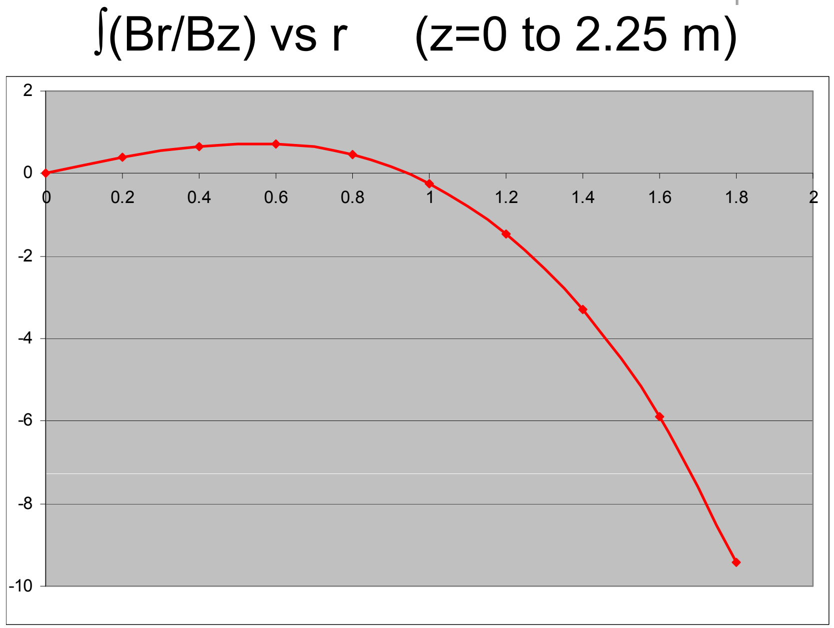
+ 100 mm FSP (Field Shaping Plate)

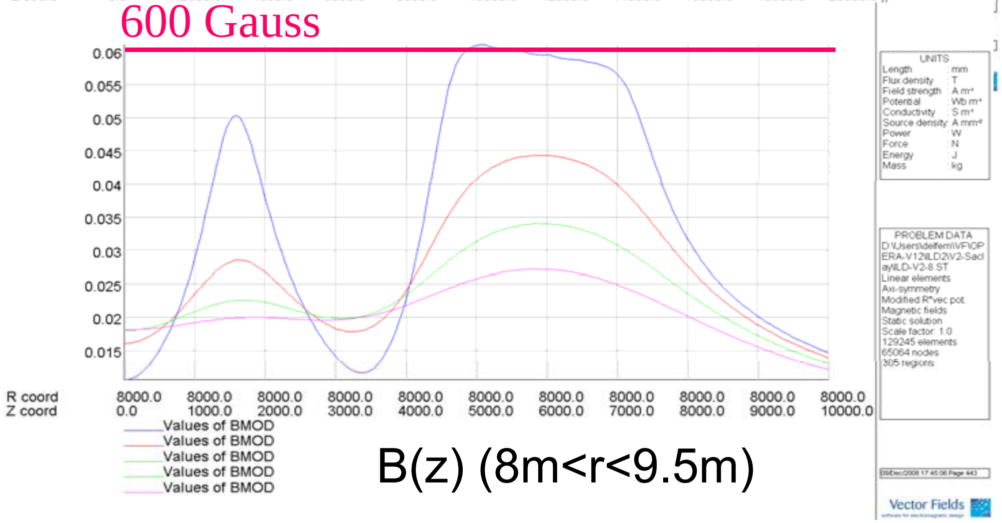
Coil : 4 layers ,7.35 m length subdivided in 5 parts

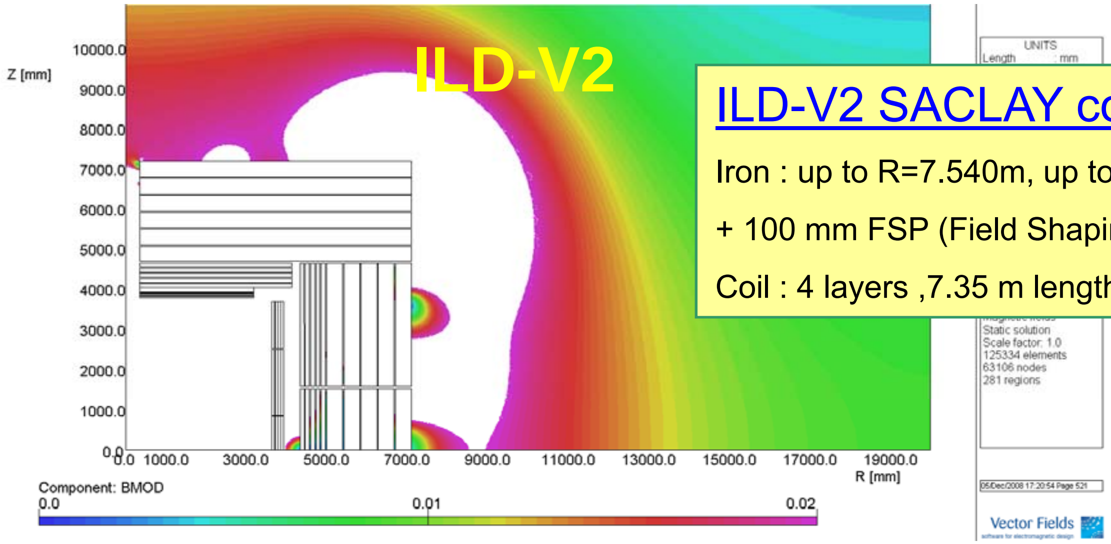










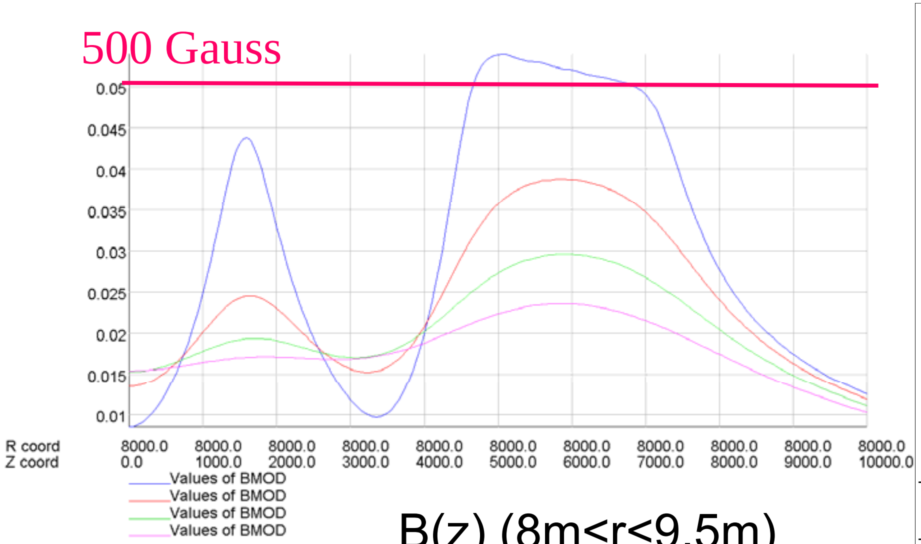


ILD-V2 SACLAY configuration @ 3.5 Tesla

Iron : up to R=7.540m, up to Z=+/-7.192m (~3m thickness)

+ 100 mm FSP (Field Shaping Plate)

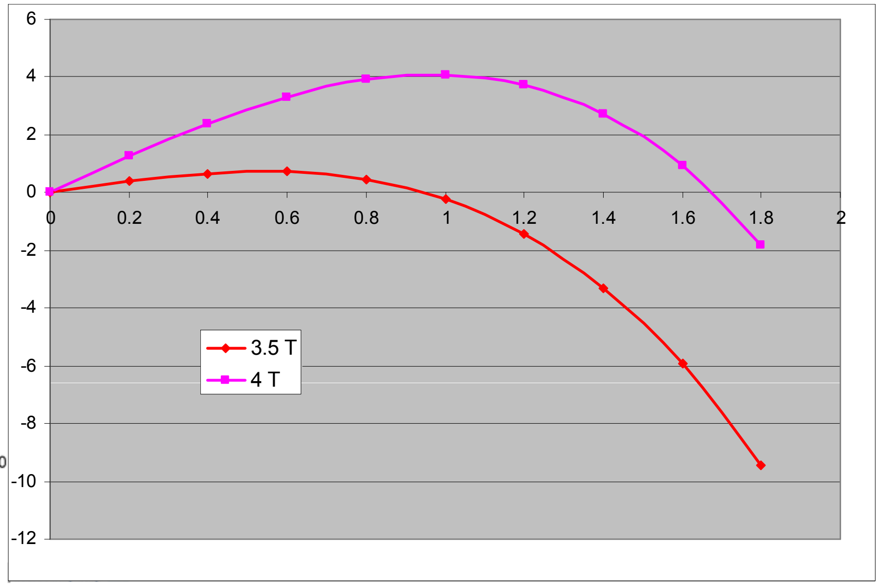
Coil : 4 layers ,7.35 m length subdivided in 5 parts



B(z) (8m<r<9.5m)

∫(Br/Bz) vs r

(z=0 to 2.25 m)



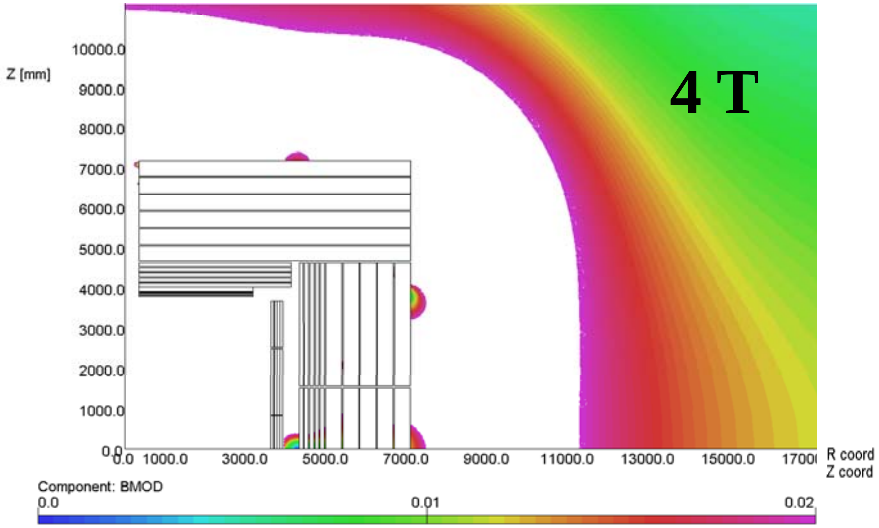
Stray field for ILD-V2 (3.5 T)

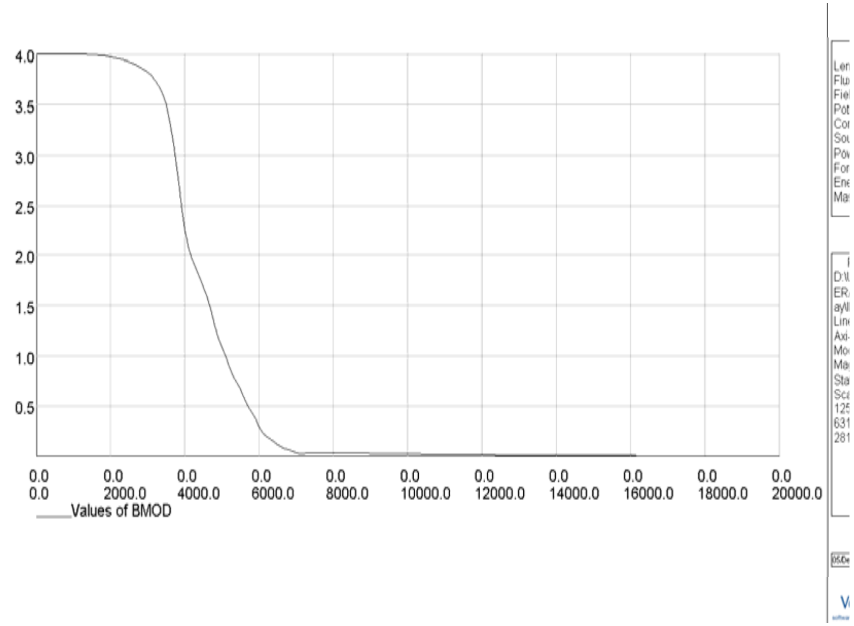
R (m)	Z (m)	B_{stray} (G)
0	10	150
9.5	5	230
9.5	0	150

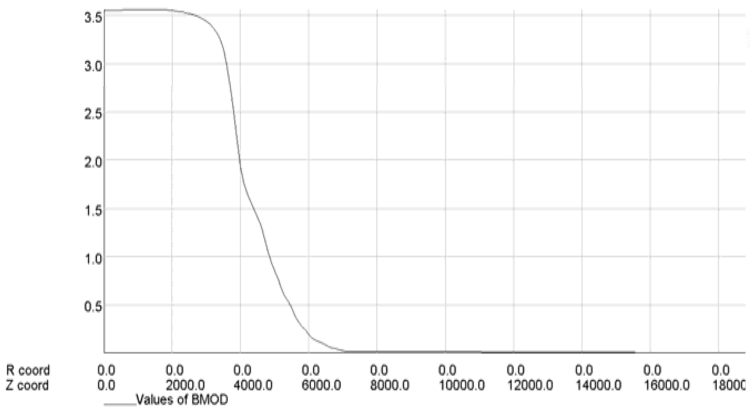
. Even if stray field has been calculated for 4T, results are given for the operation field of 3.5 T

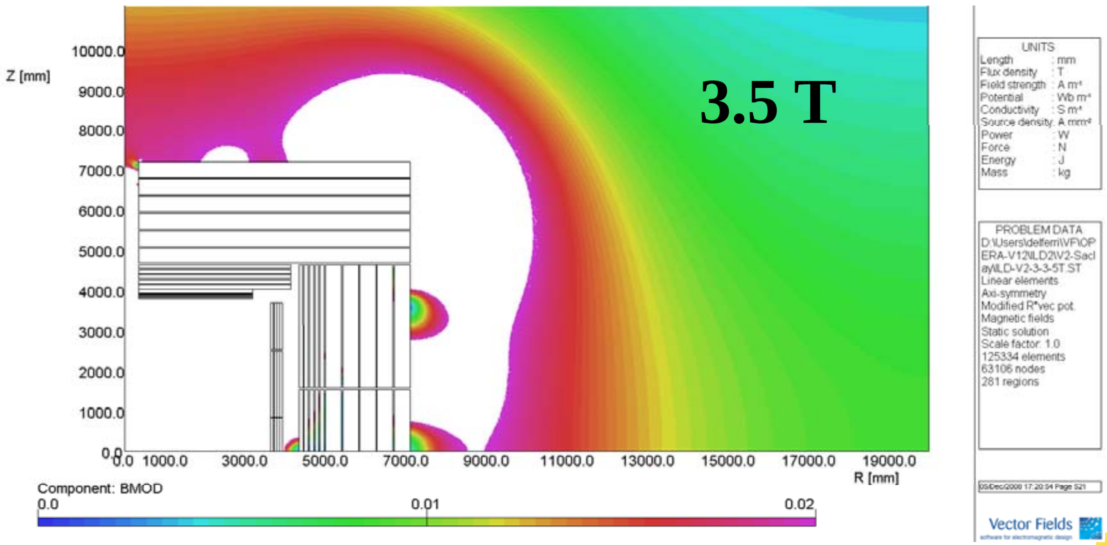
. Strong influence of the radial gaps in the barrel yoke: increasing the yoke thickness in the R direction does not help too much because of these gaps

Stray Field at 4 T and 3.5 T: 200 Gauss limit





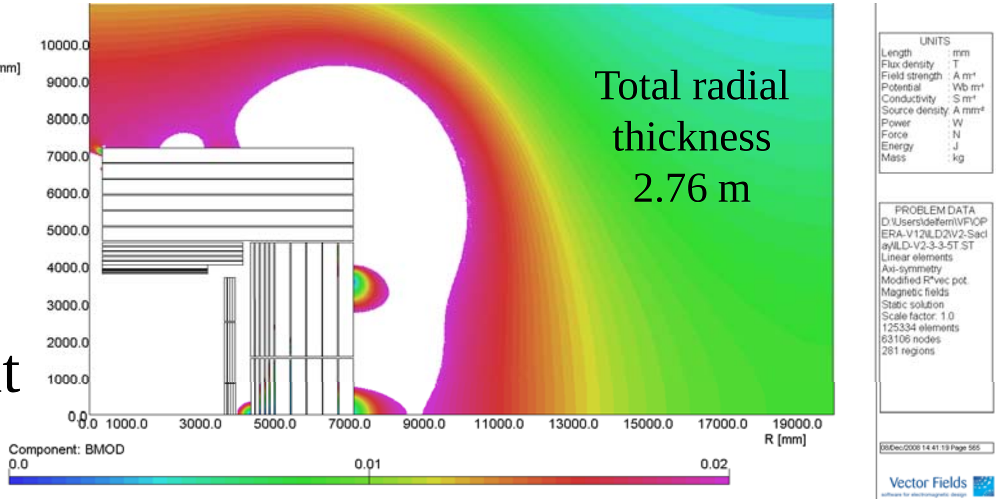


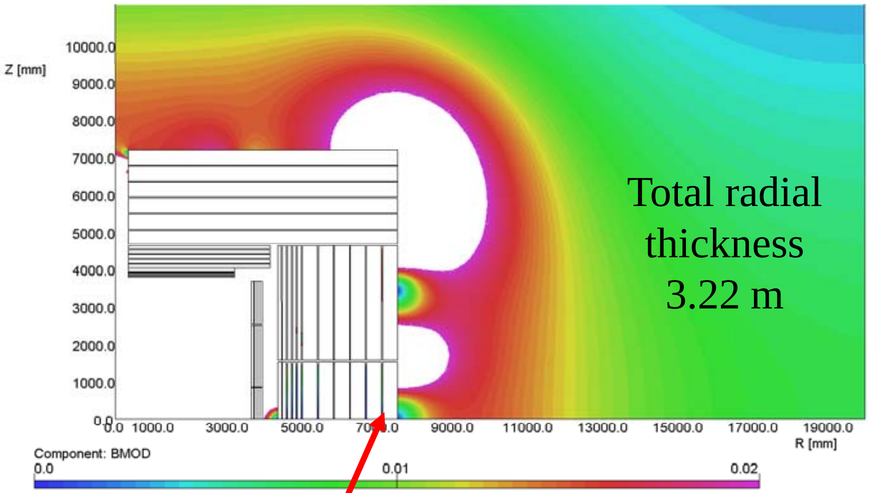


Stray Field vs Barrel Yoke thickness @ 3.5 T

ILD V2

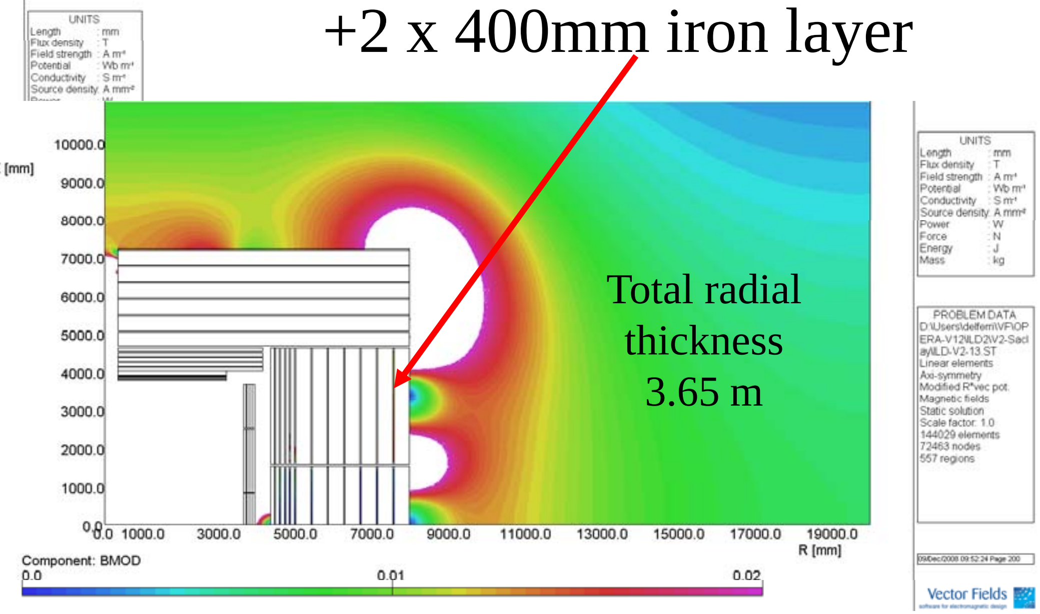
200 Gauss limit



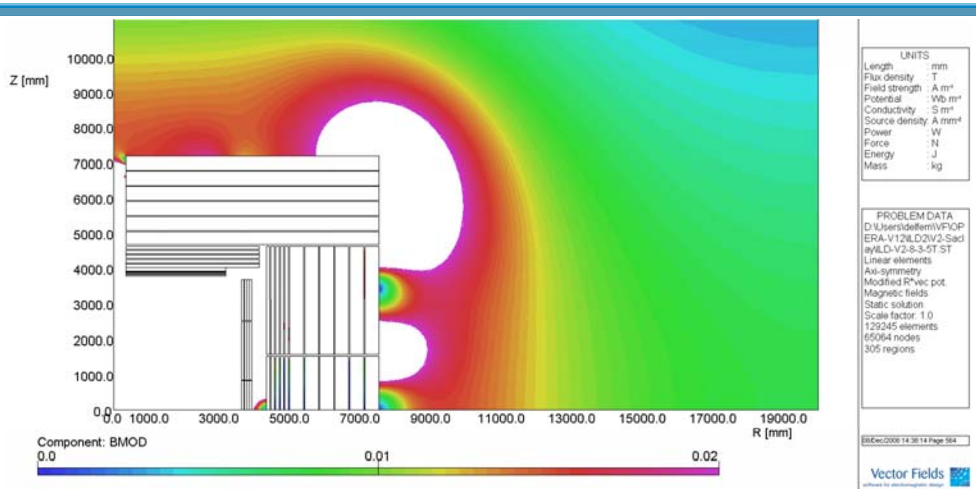


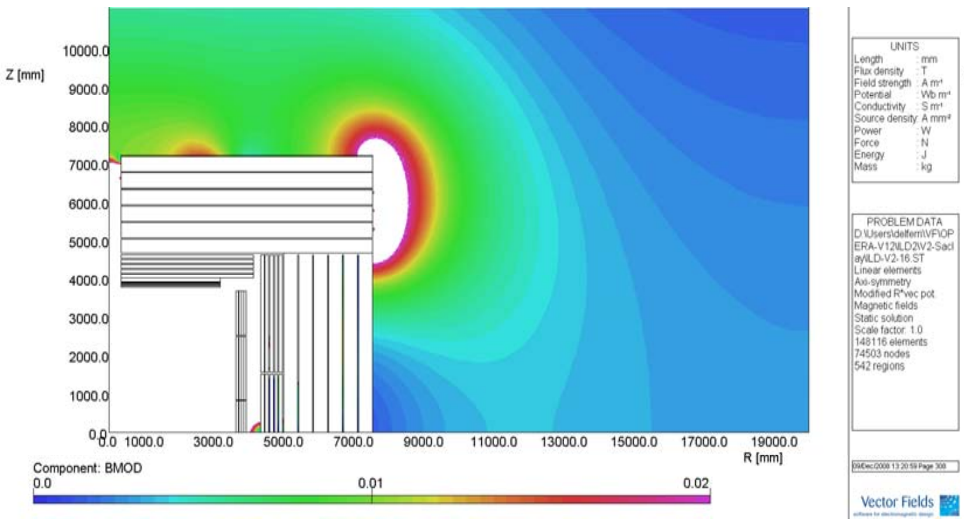
+1 x 400mm iron layer

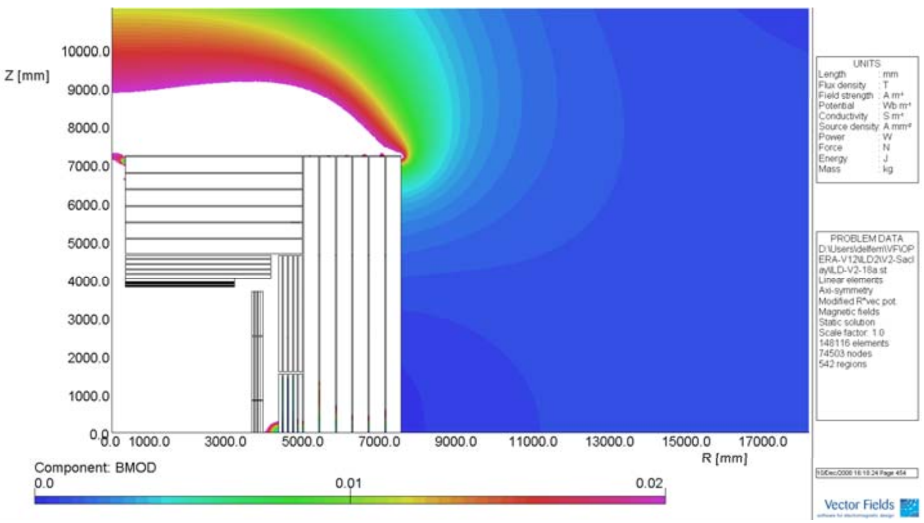
+2 x 400mm iron layer



Influence of gaps on the stray field (ILD V2 iron up to R=7.54 m)







No gaps in the barrel

Barrel up to Z=7.2 m

Summary

2. Some other points
   2.1 Anti-DID coil design

Anti-DID coil design

Brett Parker has agreed to contribute to the anti-DID coil design:

. in a first step, he will provide a coil pattern compatible with the new solenoid coil geometry to first order

. next step will be the conceptual coil design (forces, peak field, stored energy…)

. then, semi-realistic engineering (conductor, winding technique, support and cooling of the coil…).

We are in touch together, and he told me that he will start this work this week

Summary

Present conclusions

Present conclusions

- New magnetic calculations have been done with the LoI parameters. Solutions which meet the specifications have be found

- Point which still needs some study is the yoke design, in relation with the acceptable stray field: minimum dimension of gaps in the yoke, partial filling of the gaps…?

- Conceptual design of the anti-DID is going to restart, with the new detectotr magnet configuration.