Babar to SuperB
IFR Upgrade

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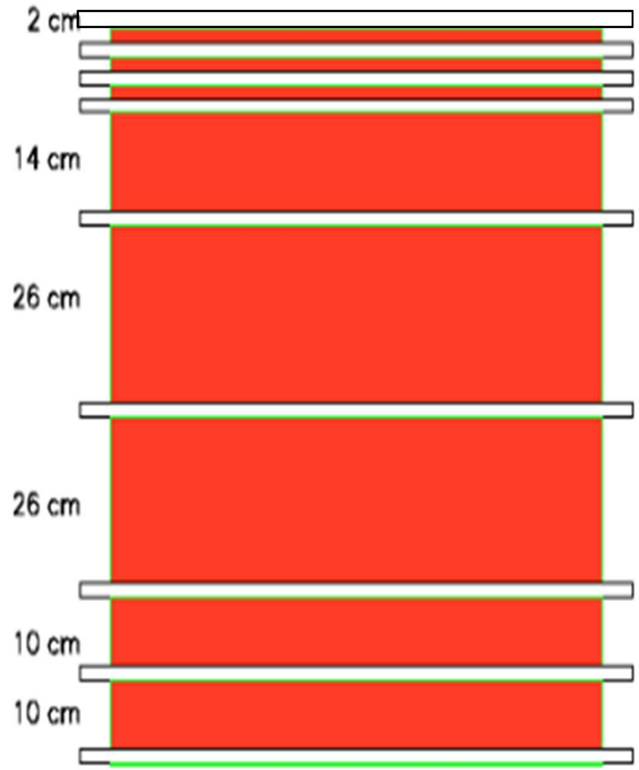
SuperB IFR
Baseline Flux Return detector geometry

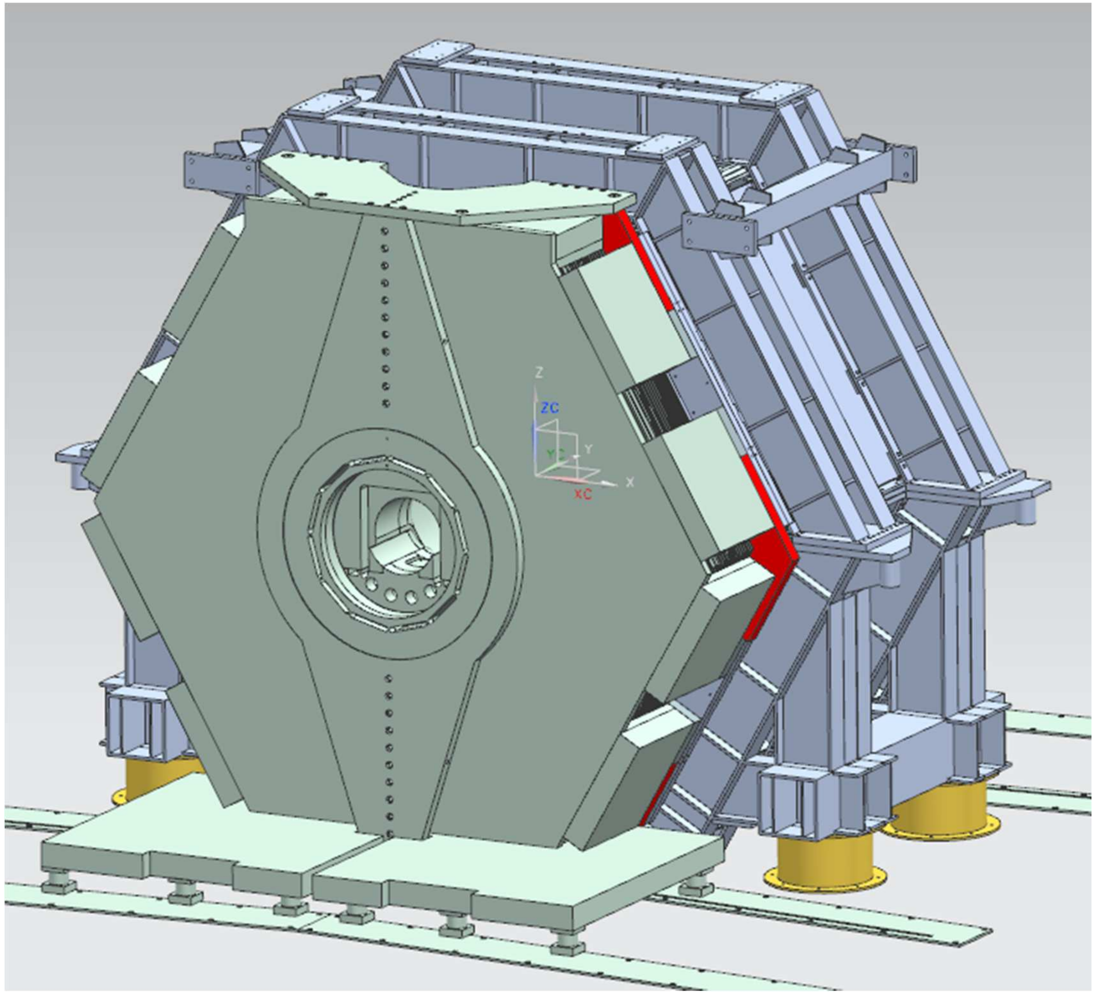
SuperB main specifications:

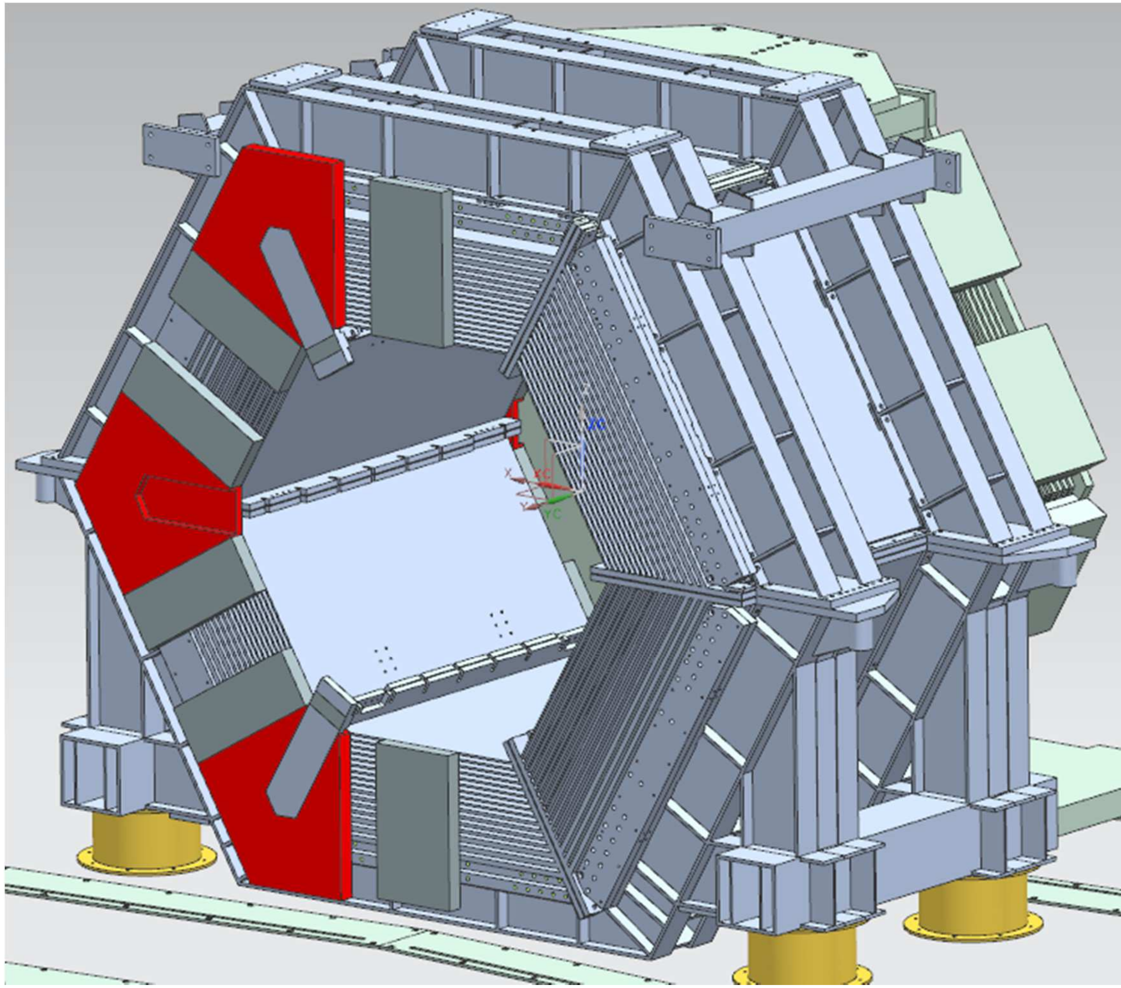
- Overall IFR design thickness: 920 mm
  (vs Babar: 650mm barrel/ 600mm endcaps)
- Number of detectors layers: 8 or 9
  (vs Babar: 17 gaps)
- one scintillator layer at inner radius wrt iron
  (not foreseen in Babar)
- one scintillator layer at outer radius wrt iron
  (not foreseen in Babar)
- 6 or 7 scintillator layer inside gaps
  vs Babar: 17 detector layers

I.P.



SuperB IFR
Baseline Flux Return detector geometry



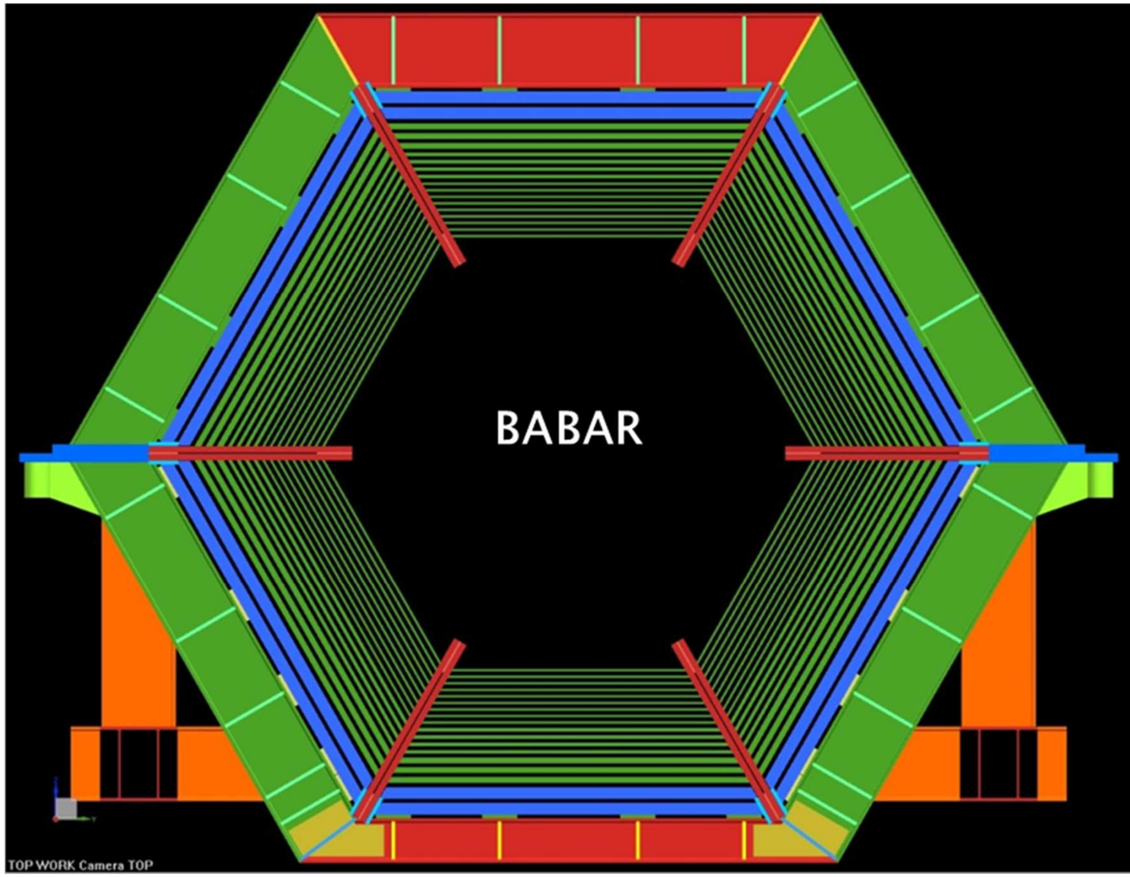


SuperB IFR
Baseline Flux Return detector geometry

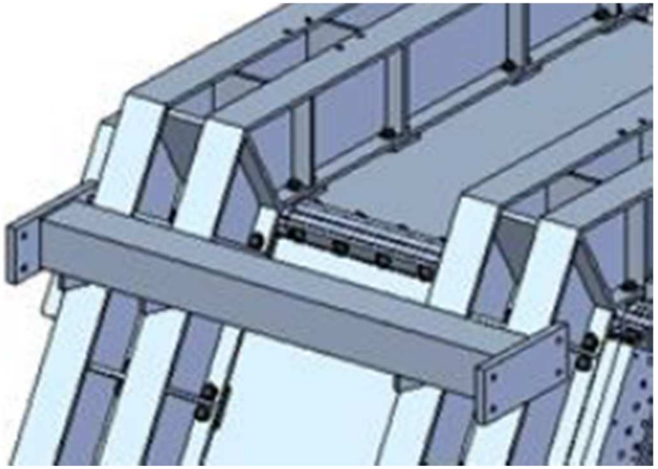
Babar IFR can be fully reused if:
IFR Absorber can be increased, best if to 920 mm
Can lodge scintillator boxes of 25 mm of thickness

Reusing the Babar IFR means:

- About 800t of iron available
- Minimal requirement in terms of design
- Requires modifications due to last scintillator layer
- Requires modification due to increase of weight
- Requires filling of gaps with metal plates
- About 95t of brass plates available for gaps filling
- Could requires parts replacing
- Shipping management and costs



SuperB IFR
Possible options to upgrade Babar IFR



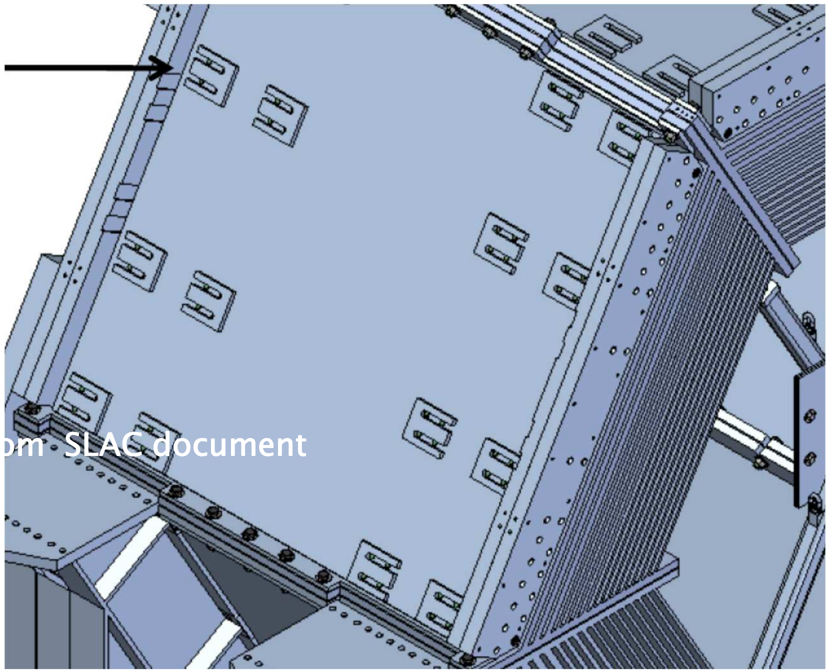
Upgrade options for Barrel (doors upgrade simpler)

a) Fill unused gaps with plates 22mm thick (as done in Babar)
b) Fill gaps with thicker plates
c) Add steel slabs «outside» (at outer radius wrt Babar iron)
d) Replace inner wedges of Babar IFR

Common to all options

To leave a gap for scintillators outside the barrel :
- reduce screws connecting wedges to cradle/arches
- modify outer wedges and cradle/arches accordingly

IFR weight increasing + connections reduction:
- Reduce number & reinforce connections (screws)
- Reinforce cradle and arcs in the screws region



SuperB IFR
Gaps filling: plates material

Material	Density t/m^3	Interaction Length cm	I.L. x Density g/cm^2	Cost (approx.) €/t	110523 LME quotation Cash b. k$/t
Steel (magnetic)	7.8	16.8 cm	132.1	1.5	0.55
S-steel aisi 304L Low permeability	8	16.8 cm (esteem)	134 (esteem)	4	
Copper	8.9	15.3	137.3		8.8
Zinc	7.1	19.4	138.5		2.1
Lead	11.3	17.6	199.6		2.4
Brass (e.g.30% Zn)	8.4-8.7	16.5 (esteem)	138.5(esteem)	8.3	
Tungsten	19.3	10	192	40 – 50?	

Source (for pure metals): http://pdg.lbl.gov/2010/AtomicNuclearProperties/

Source for quotations: LME. Source for cost: suppliers

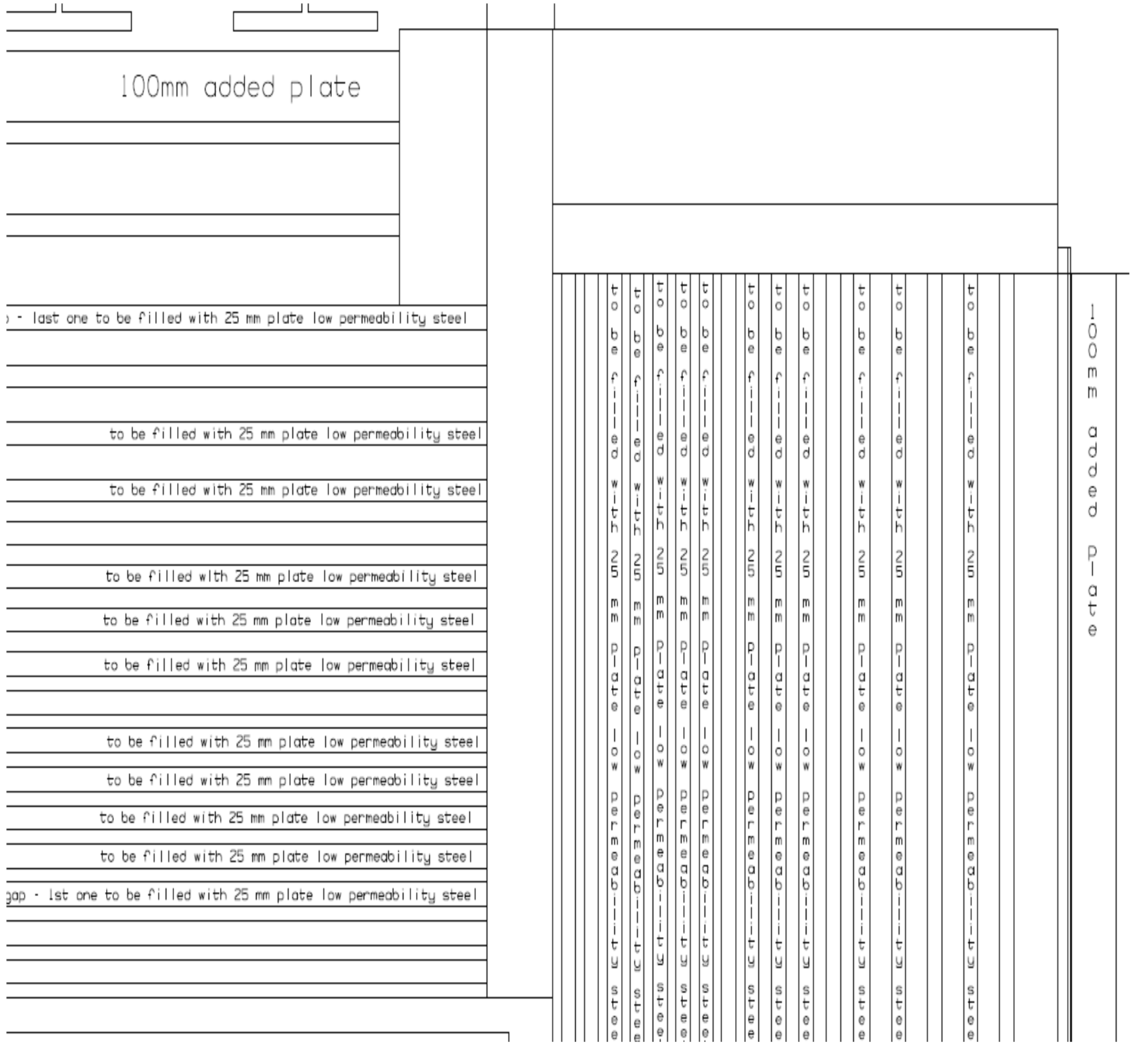
SuperB IFR
Gaps filling: plates material vs magnetic prop.

Possible configurations foreseen for magnetic field simulation

1) Babar + «amagnetic» filling
(brass or Ssteel = Babar)

2) Babar + mixed filling
Brass of Babar upgrade in the inner gaps
Steel filling in the outer gaps

3) Babar + magnetic steel filling
of 11 gaps (as worst case comparison)



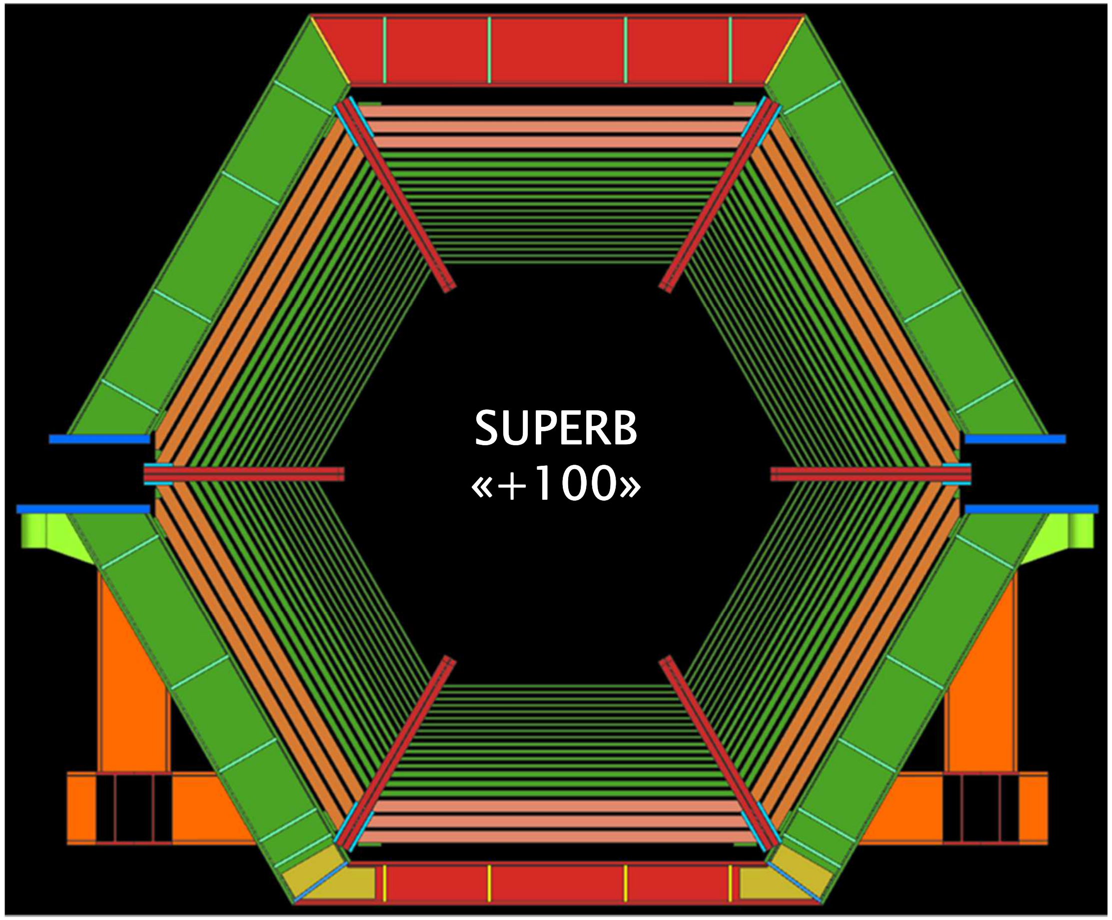
SuperB IFR
c) Adding steel plates outside

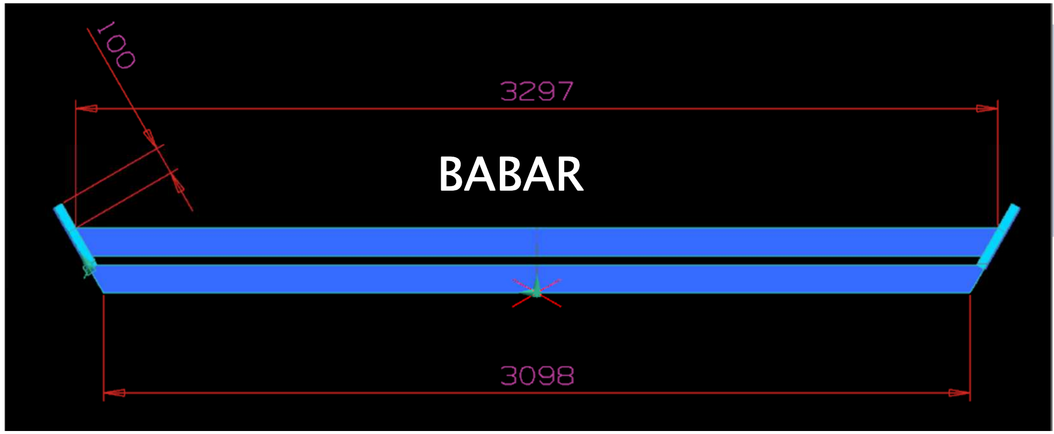
Add 100mm thick plates «on top» the outer wedges, in order to reach required IFR thickness

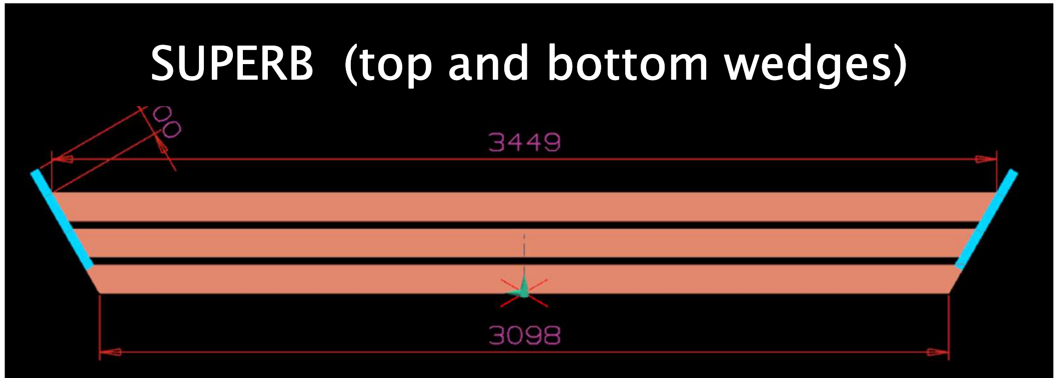
Require to deeply modify all the main parts (inner and outer wedges, cradle, arcs)

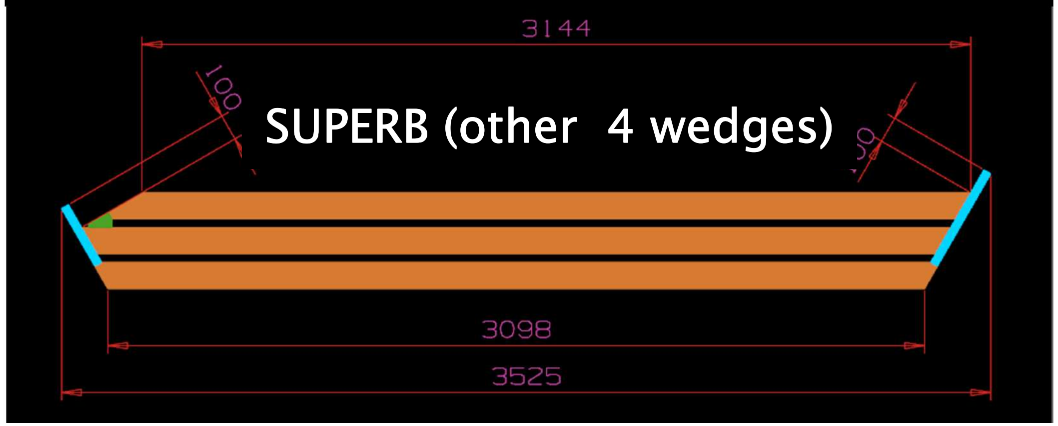
Requires either additional filling of 2 gaps wrt Babar (8 gaps x 22 mm each) or to increase thickness of the additional slabs to 140 mm.

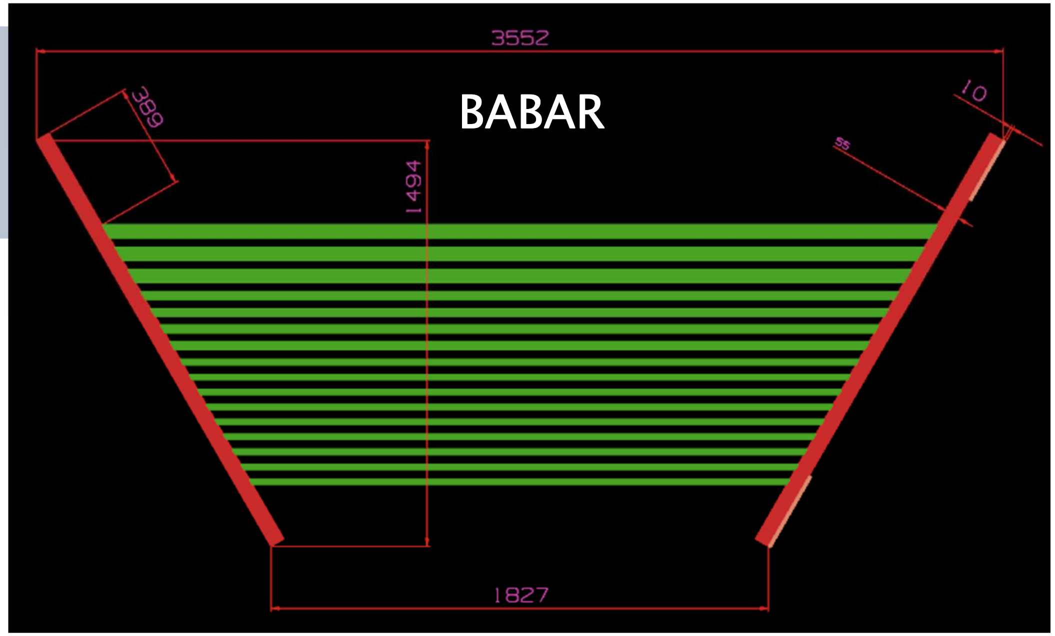
Thicker slabs imply more difficult integration, may require replacing of cradle / arcs and larger dead space of last scint. layers

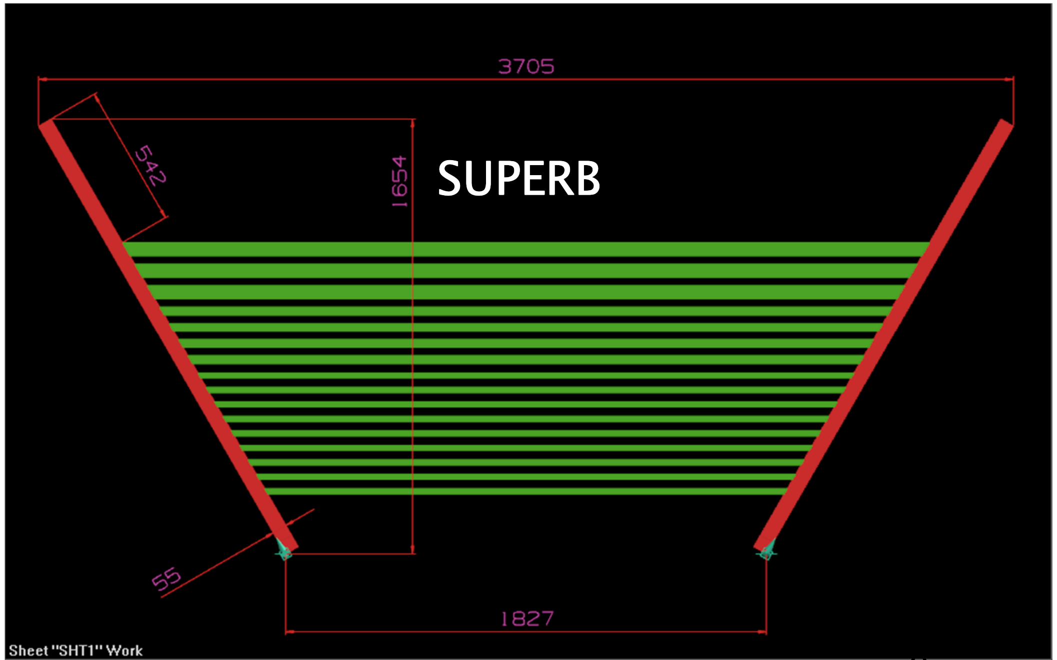


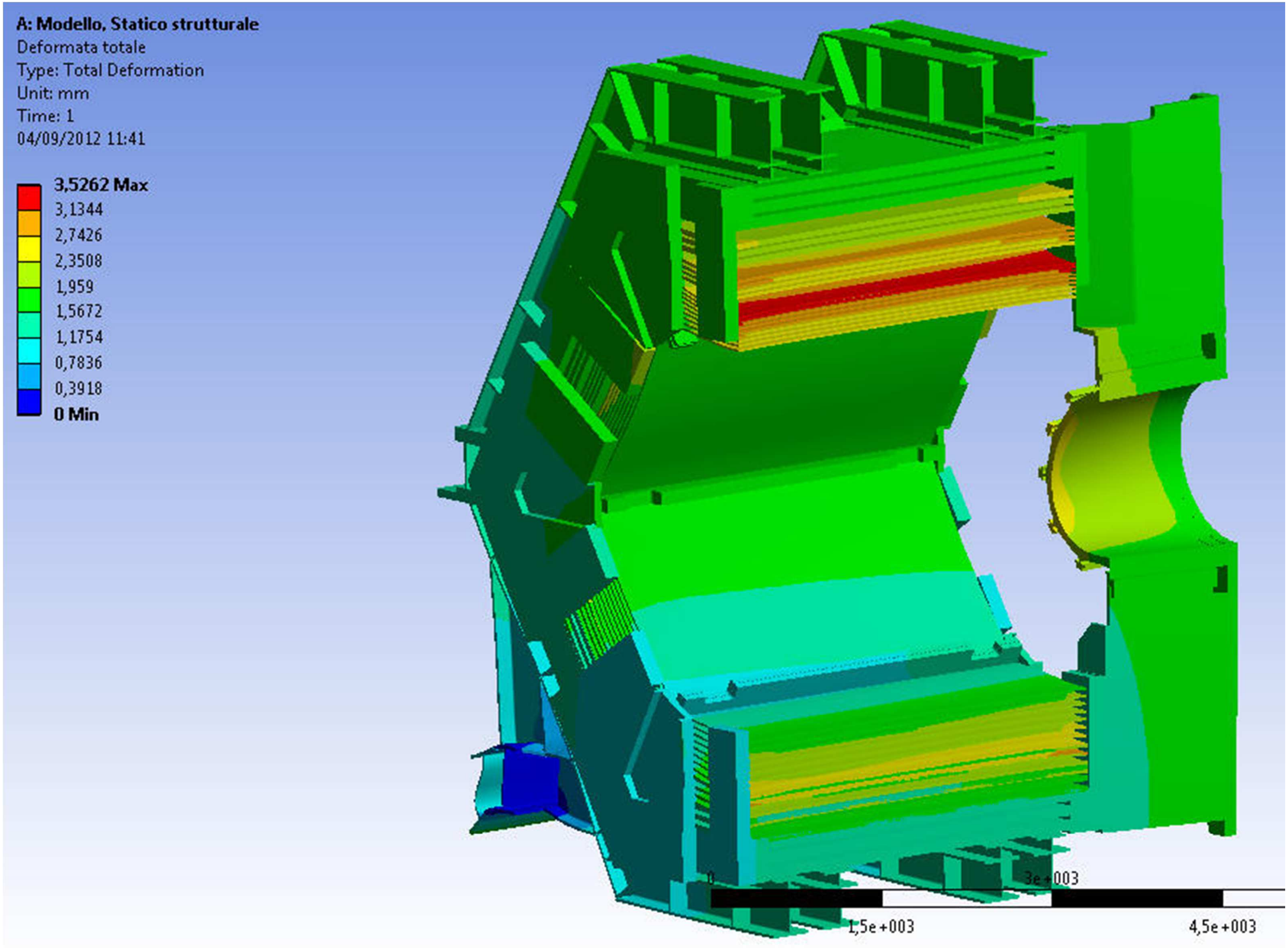

BABAR
100
3297
3098


SUPERB (top and bottom wedges)
100
3449
3098


SUPERB (other 4 wedges)
3144
100
3098
3525


BABAR
3552
389
1494
10
1827


SUPERB
3705
542
1654
55
1827
Sheet "SHT1" Work


A: Modello, Statico strutturale
Deformata totale
Type: Total Deformation
Unit: mm
Time: 1
04/09/2012 11:41
3,5262 Max
3,1344
2,7426
2,3508
1,959
1,5672
1,1754
0,7836
0,3918
0 Min
0
3e+003
1,5e+003
4,5e+003

Options	Max thickness	To do (design and workshop)	PROs	CONs
Babar IFR filled as possible with 22mm thick plates	870/892 mm with 9 or 8 scintillators layers	Modify carpentry to create a gap between wedges and cradle/arcs	Full recycling, with as less as possible modifications	Low thickness Labour intensive Cost vs thickness if brass is needed Filling with steel/Ssteel to be investigated
Babar IFR filling with thicker (25-27 mm) plates	882/ 907 mm with 9 or 8 scintillators layers Up to 917 with 27 mm plates	Modify carpentry to create a gap between wedges and cradle/arcs	Full recycling Could reach 920 mm	Maybe not possible, require intensive measurements campaign Could imply large deformation on top and bott. wedges May not reach design thickness on top and bott. Wedges Labour intensive Filling with steel/Ssteel to be investigated
Babar IFR modified adding slabs outside	920 mm and more	Modify carpentry to create a gap between wedges and cradle/arcs	Cheaper way to reach 920 mm	Require to deeply modify all barrel parts plus plates filling. Possible loosing of barrel geometric precision, may require adjustment. Outer scintillators layer with large dead space.
Replace inner wedges	920 mm and more	Modify carpentry to create a gap between wedges and cradle/arcs	Clean, reliable solution	Cost Big order: burocracy, long timing

IFR
Costs esteem

Cost esteem based on preliminary offers:

- Steel plates for filling 1.5 k€/t + cutting etc
- Stainless steel plates for filling, low permeability: 5 k€/t
- Brass plates for filling 8.5 k€/t
- New carpentries: 3.5 k€/t

- Other possible candidates like Zn, Pb neglected, no evident advantages

- Shipping SLAC – Italy
  Preliminary esteem: 0.8 k€/t for pieces exceeding container dimensions

SuperB IFR
Shipping quotation

Got new quotation for main IFR parts: 540cbm/696 mtons

Pos	items	dims each	Tons/each	descr.
1	6	360x380x160 cm	40	wedge
2	2	940x390x350 cm	26	cradle
3	6	350x370x40 cm	18	plate
4	8	600x350x70	37	door

Pos 3-4 stackable only among them (3/3 - 4/4) and max up to 2 tiers
Menlo Park / Palm Beach CA / Savona / Rome

€ 540.000
VAT and Duties not included

Means 0,8 k€/t.
Baseline cost for 40' high cube container: 9000€/pc = >300 €/t

IFR
Costs esteem (barrel only)

	max equivalent thickness [mm]	new carpentry to buy [tons]	new layers of plates wrt Babar	new plates to insert [mm of thickness]	Filled layers Overall	Filling Metal	Density	Cost/t	Additional weigth [t] of filling wrt Babar	Overall weigth [t] barrel nut only	Costs [k€]							Missing thickness [mm]
											Transport	plates proc.	plates insert.	New carpent	Carpentr. modifications	Overall	Cost/Dmm (thick-785) [k€/mm]	
a1) Babar with modified cradle/arcs 2 wedges connection, 22 mm plates filled	872	0	4	**89**	**10**	**steel**	**7,8**	**1,5**	**39,0**	399,0	230	58	50	0	120	**458**	**5,3**	**48**
						S-steel	**8,0**	**4,0**	**40,0**	400,0	230	160	50	0	120	**560**	**6,4**	**48**
						Brass	**8,4**	**8,3**	**42,0**	402,0	230	348	50	0	120	**748**	**8,6**	**48**
a2) Babar with modified cradle/arcs 2 wedges connection, 22 mm plates filled	894	0	5	**111**	**11**	**steel**	**7,8**	**1,5**	**48,7**	408,7	230	73	50	0	120	**473**	**4,3**	**26**
						S-steel	**8,0**	**4,0**	**50,0**	410,0	230	200	50	0	120	**600**	**5,5**	**26**
						Brass	**8,4**	**8,3**	**52,4**	412,4	230	435	50	0	120	**835**	**7,6**	**26**
b) thicker(25 mm) plates filling	925	0	all	**275**	**11**	**steel**	**7,8**	**1,5**	**120,7**	480,7	230	181	50	0	120	**581**	**4,1**	-5
						S-steel	**8,0**	**4,0**	**123,8**	483,8	230	495	50	0	120	**895**	**6,4**	-5
c1) Add 100 mm outward	928	60	2	44	8	**S-steel**	7,8	3,5	**19,5**	439,5	230	78	36	210	210	**764**	**5,4**	-8
c2) Add 140 mm outward	923	85	0	0	6		7,8	3,5	**0,0**	445,0	230	0	27	298	210	**765**	**5,5**	-3
d) Replace inner wedges	920,0	360	0	0	0		7,8	3,5	**0,0**	480,0	80	0	0	1260	120	**1460**	**10,8**	0
e) Replace all barrel	920,0	540	0	0	0		7,8	3,5	**0,0**	480,0	0	0	0	1890	0	**1890**	**14,0**	0

Cost esteem vs Metals (LME) quotations

Steel Billet cash buyer

Copper cash buyer

Variation of LME quotation affects about 50% of semifinished cost

(2009-2011: steel semifinished +70%, brass +20%) source: http://www.lme.com/

IFR
Conclusions

- Modify the connections between cradle/arcs and the wedges and reinforce cradle and arcs seems feasible, it requires more accurate FEA simulations.

- If overall thickness barrel thickness of 882 – 907 mm (9 – 8 scintillators) can be fine =>
  filling as Babar with brass plus 4 – 5 additional gaps filled with steel/s-steel.

- Fill with “thicker” plates e.g. 27 mm is cost efficient and could reach the 920 mm.
  Requires extensive measures with proper gauges.

- Brass expensive, will use S-steel or magnetic steel according to field simulations

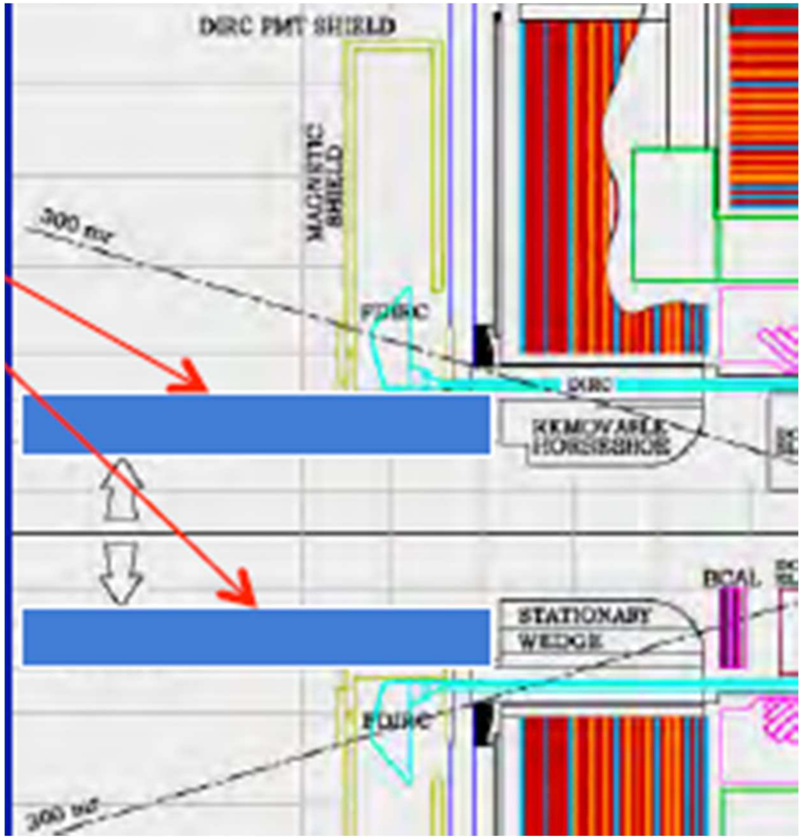
- Adding plates at outer diameter could be cost effective but requires extensive modifications to all main barrel parts, cost for adjustments may grow.

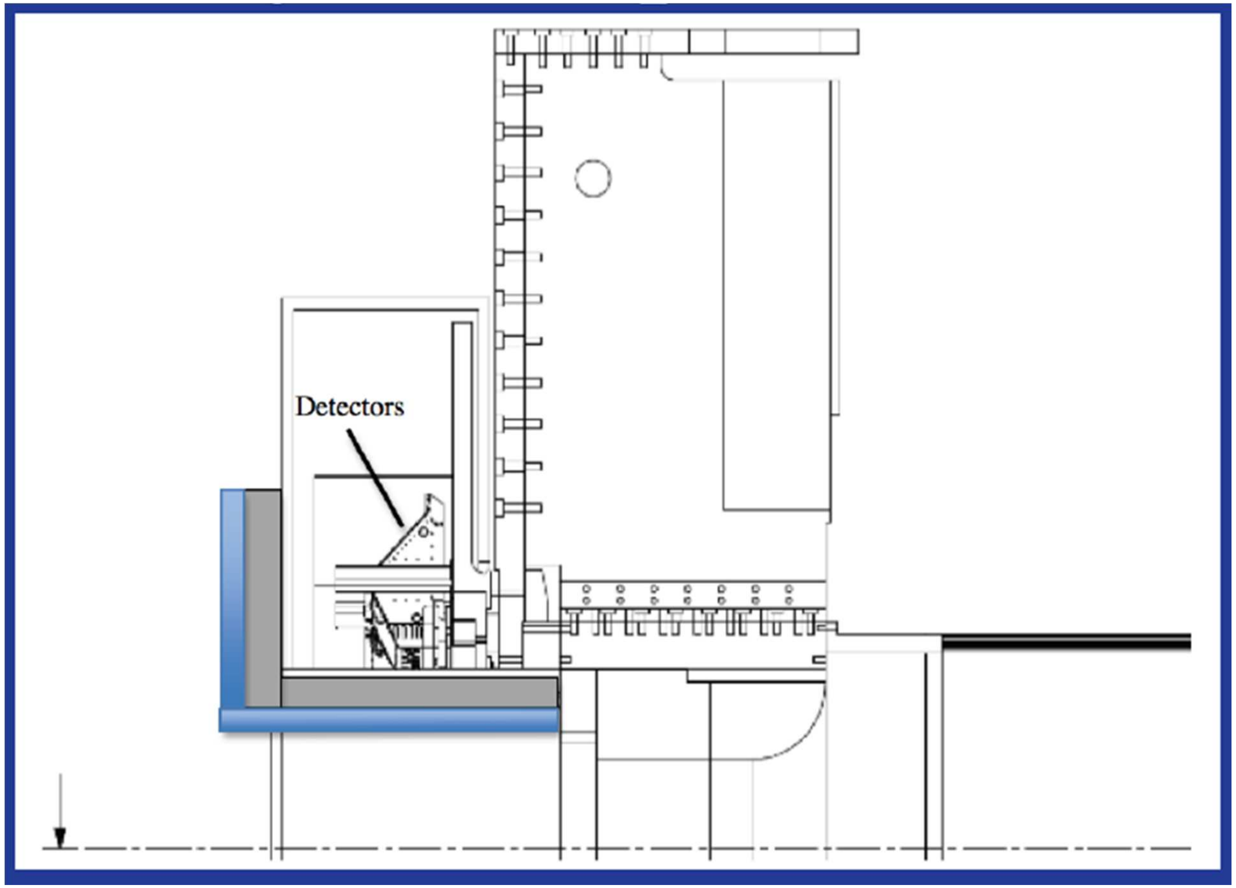
- Replacing of Babar wedges with new ones is more expensive but it is a reliable solution.

- The cost of candidate solutions (b: thicker plates gaps filling) is about 1.5 M€.
- Filling with magnetic steel could save up to 300 k€

SuperB IFR
DIRC shielding requests

- 50 mm steel (magnetic shield)
- 100 mm lead
- 100 mm Borated HDPE





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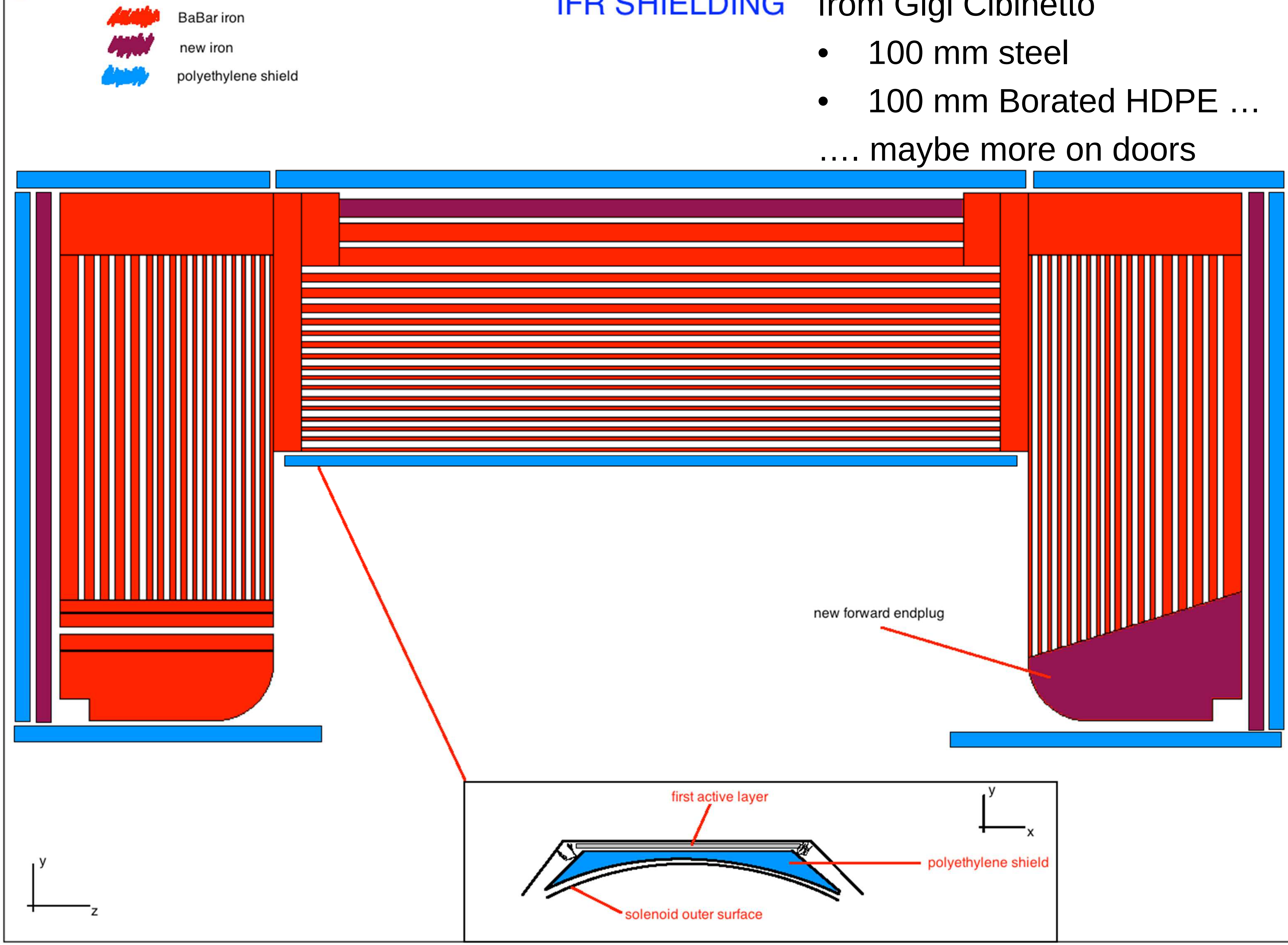
IFR SHIELDING

from Gigi Cibinetto

- 100 mm steel
- 100 mm Borated HDPE …

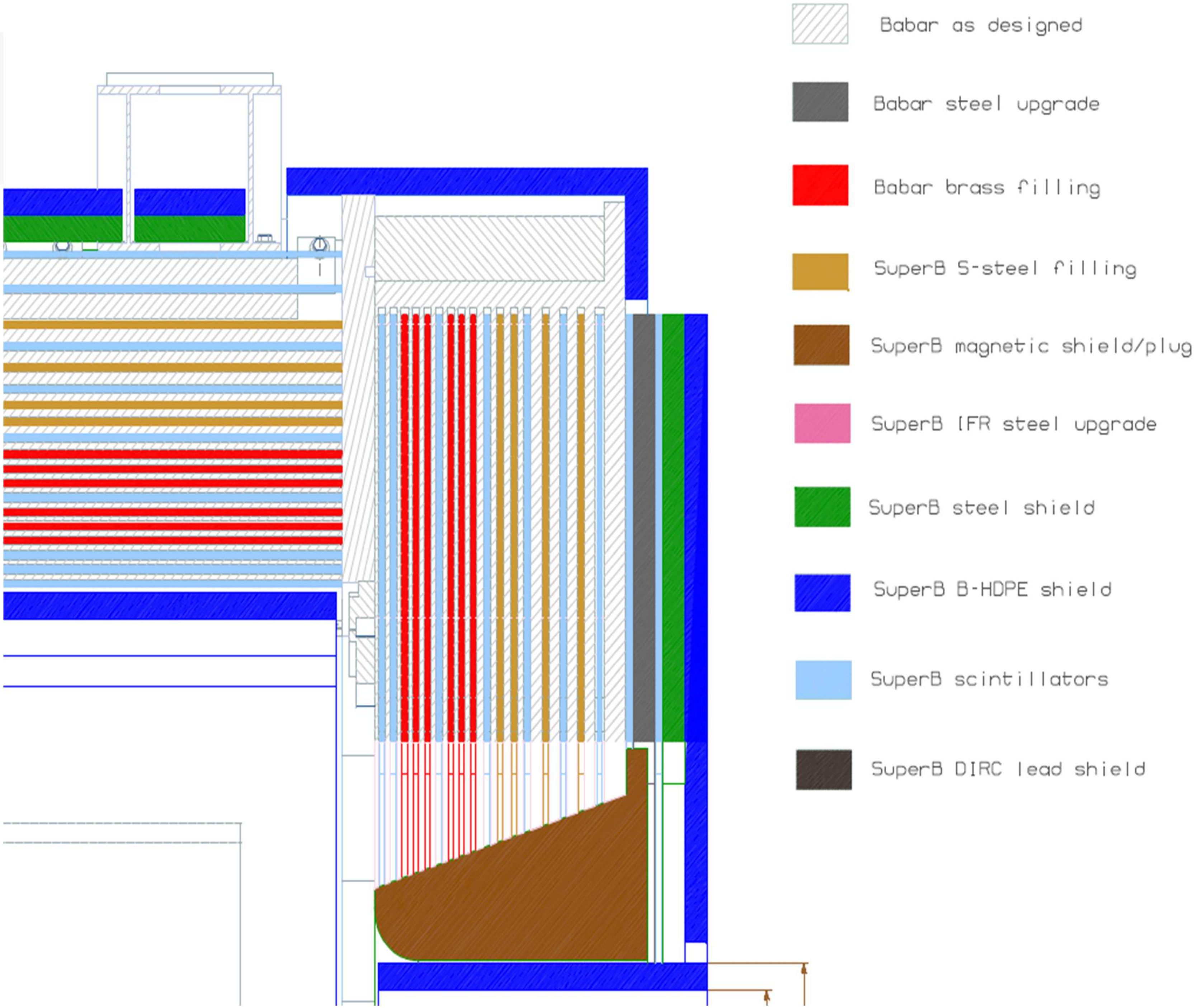
…. maybe more on doors

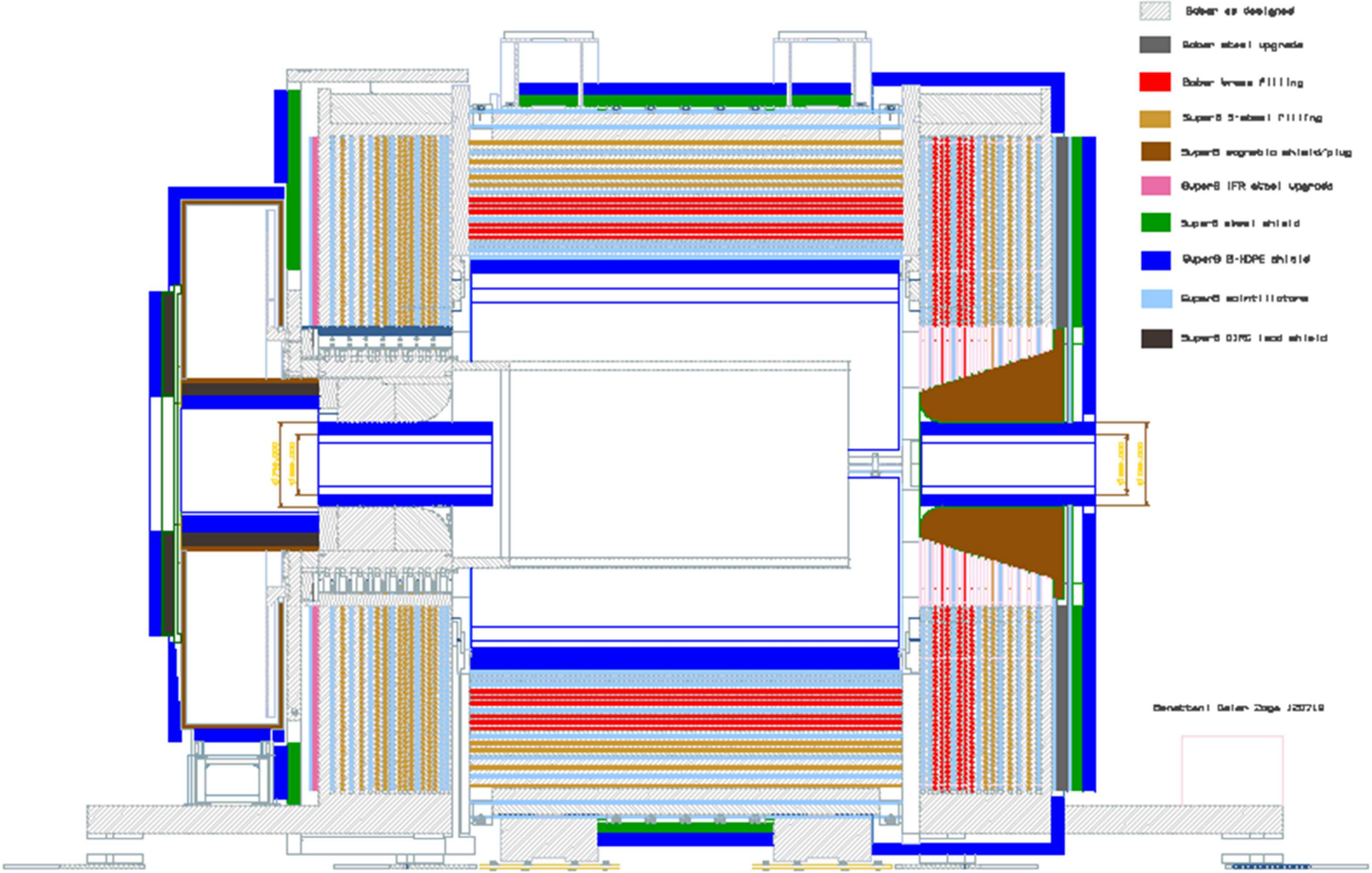


scintillator and HDPE layers at inner radius

(facing coil tank)

HDPE layer inside plug and horseshoe





Babar as designed
Babar steel upgrade
Babar brass filling
SuperB S-steel filling
SuperB magnetic shield/plug
SuperB IFR steel upgrade
SuperB steel shield
SuperB B-HDPE shield
SuperB scintillators
SuperB DIRC lead shield

SuperB IFR
Some data about IFR upgrade + shield

Wedges + doors

- ~ 1000 t , > 50% larger than Babar «as designed» (650t)
- ~ 350 t due to upgrade + shielding
- ~ 50% of weight increasing being due to Fe shielding, 10 cm thick

Lead

- > 10 m^2 , 10 cm thick
- 12 – 13 t

Borated HDPE

- 250 – 300 m^2, 10cm thick
- 25 – 30 t

No space for 10 cm HDPE between beam pipe and magnet plugs

Poor hermeticity of shielding vs cryo plants, services, cradle/arc, platforms ….

Shielding presumable cost > 0.5 M$

SuperB IFR
SuperB Shield

- As much as possible, shield at the source:
- some cover of the beamline at least as far as the final dipoles
- May be simpler than a full enclosure.
- Shield locally to the item affected