

The AHCAL barrel in ILD

Design Status Report

CALICE Collaboration Meeting
@CERN 19.-21.05.2011

AHCAL barrel data set 2 for the mechanical design

the second loop through the

“*Workflow to design a HCAL barrel absorber structure for the ILD*”
based on *ILC Document , D00000000913605,A,1,1*

1. AHCAL barrel absorber material

- stainless steel 1.4401 or 1.44355

2. AHCAL barrel dimensions

- min. inner radius : 2058 mm
 - absorber thickness : 20 mm
 - absorber plate thickness : 19 mm
 - sensitive layer cover thickness : 2 x 0,5 mm
 - max. number of sensitive layers : 48 layers
 - sensitive layer gap thickness : 6,5 mm
 - air gap : 1 mm
 - plate pitch : 26,5 mm
 - max. number of absorber plates : 49 plates
- max. outer radius : 3396 mm (coil inner radius: 3440mm)
- length of one half module: 2420 mm (z=0 to z=2420)
 - length of the absorber structure: 2340 mm (z=0 to z=2340)
 - length of the sensitive layer: 2310 mm (z=15 to z=2325)
 - length of the frontend electronics: 95 mm (z=2325 to z=2340)

3. AHCAL barrel shape

- octagonal inner shape, nearly circular outer shape
- 2 sub-modules per octagon module
- 8 modules x 2 sub-modules = 16 sub-modules per half barrel
- 2 x 16 sub-modules = 32 modules for total AHCAL barrel
 - between each sub-modules pointing cracks 2 x 5 mm (side plate) = 10 mm
 - between half barrel pointing crack 2 x 15 mm (back plate) = 30 mm

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4. AHCAL sensitive layer

30 x 30 x 3 mm³ scintillator tiles read out by SiPMs

- thickness
 - 3 mm scintillator tiles
 - 2 mm integrated readout electronic on top of the tiles
 - 0,5 mm for reflection and isolation foils
 - 2 x 0,5 mm for housing
 - 6,5 mm total thickness for the sensitive layer
- length
 - 30 mm / tile x 12 tiles = 360 mm / HBU (HCAL Base Unit)
 - 360 mm / HBU x 6 = 2160 mm
 - 30 mm / tile x 5 tiles = 150 mm -> sHBU (short HCAL Base Unit)
 - 6 HBU + 1 sHBU = 2310 mm
- width
 - 30 mm / tile x 12 tiles = 360 mm / HBU
 - 5 smaller versions has to fill the width without too big air gaps
 - *update is in progress*

5. AHCAL support

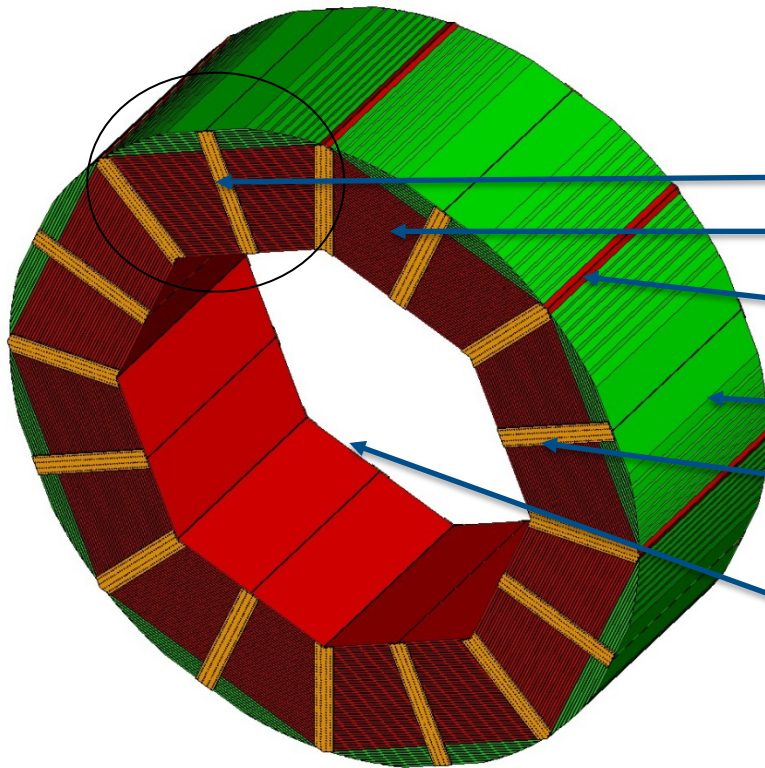
- each AHCAL half barrel has 4 feet's (two, left and right) right
 - 2 support rails fixed left and right to the coil cryostat under 22,5° to the horizontal
 - due to increase of the AHCAL absorber structure the total weight for 1 AHCAL half barrel = 330 t
 - total load to the coil cryostat AHCAL barrel 2 x 330 t + ECAL barrel 75 t = 735 t -> ~92 t/foot

6. AHCAL front end

- each half barrel 8 AHCAL half barrel supply channels els
 - 1 channel (2 sub modules) : 200mm x 80mm = 16000mm² (8000mm²/sub module)
 - cooling : 2 tubes for 1 module 2 x 2500mm² + distribution 2000mm² = 7000 mm² (3500mm²/sub module)
 - cabling: power 48 x 100mm² + signal 48 x 18mm² = 5664mm²/sub module
 - area needed for 1 sub module : *9164mm²*
- length of the frontend electronics: 95 mm (z=2325 to z=2340)2340)
 - front end electronic depth : *100 mm*

AHCAL barrel absorber structure

mechanical design overview (set 2)

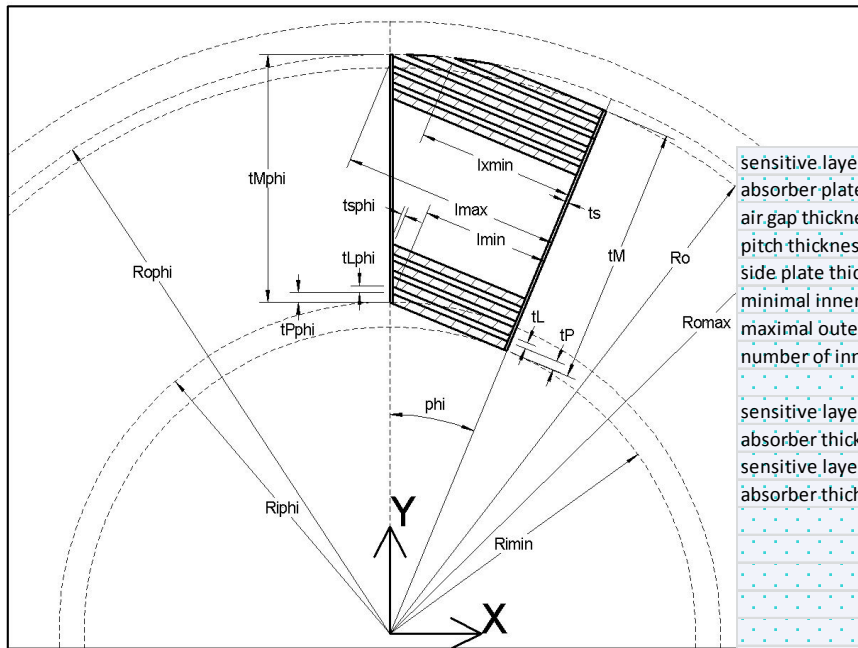


■ AHCAL half barrel absorber structure

- 8 module per half barrel
- 2 sub-module per module
 - with 40 layers -> 5,171 l
- 2 side plates per sub-module
 - thickness: 5 mm
- 16 backpacks
 - with 8 layers -> total 5,73 B l
- 32 connector plates on front and backside
 - thickness: 15 mm
 - width 200 mm
- 16 back plates to fill the gap between half barrels
 - thickness: 15 mm

Geometrical data

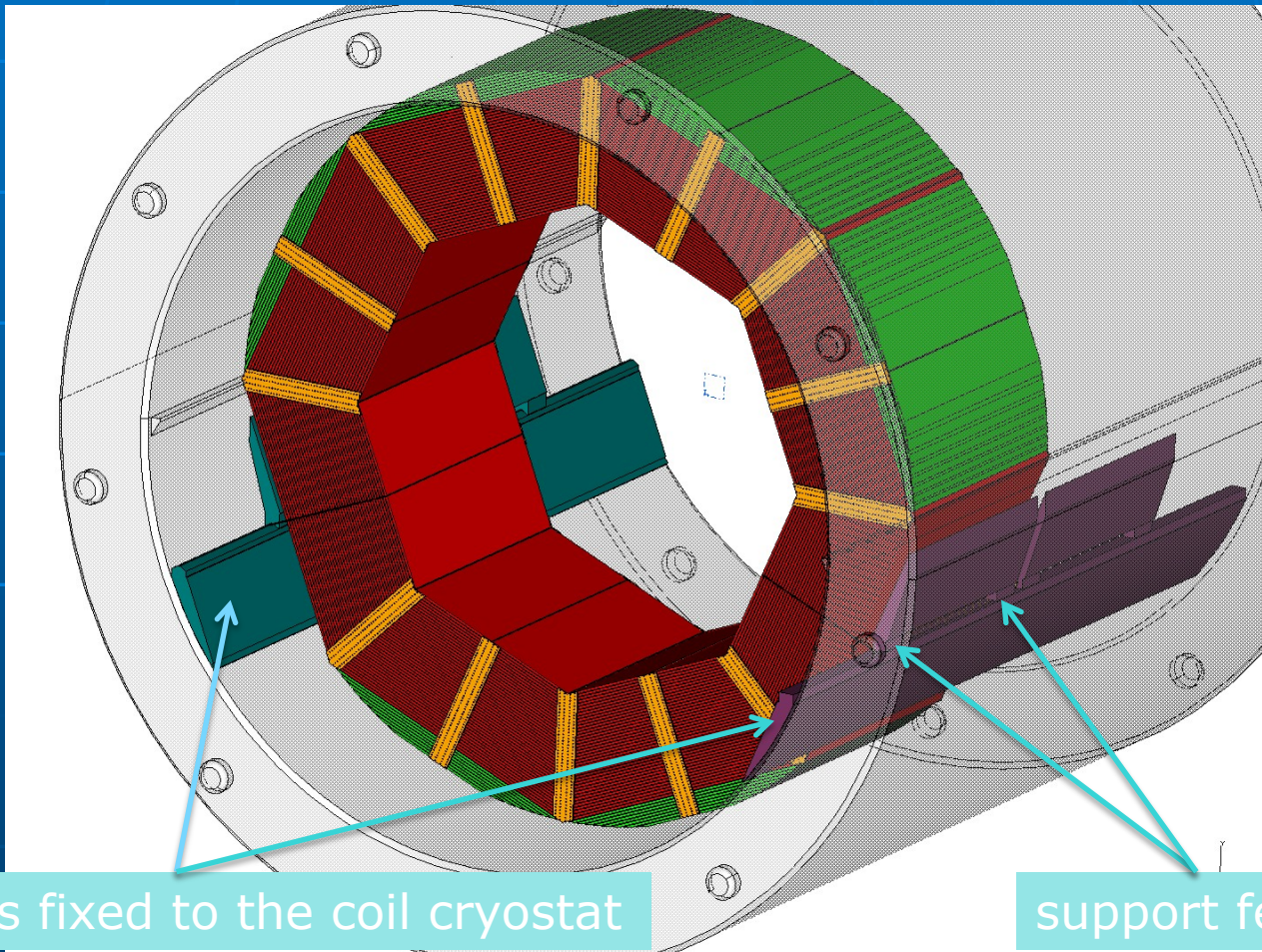
for the AHCAL barrel absorber structure (set 2)



sensitive layer thickness	tL	6,50	mm	tLphi	7,04	mm
absorber plate thickness	tP	19,00	mm	tPphi	20,57	mm
air gap thickness	tg	1,00	mm	tgphi	1,08	mm
pitch thickness	tpitch	26,50	mm	tpitchphi	28,68	mm
side plate thickness	ts	5,00	mm	tsphi	5,41	mm
minimal inner radius	Ri min	2058,00	mm	Phi	22,50	°
maximal outer radius	Ro max	3380,00	mm	Riphi	2227,56	mm
number of inner corners	n corner	8,00		tMphi*	1152,44	mm
				nphi*	39,46	
sensitive layer housing thickness	th	1,00	mm	nphi	40,00	
absorber thickness rectangular	t	960,00		tMphi	1167,90	mm
sensitive layer housing thickness	thphi	1,08		Rophi	3395,46	mm
absorber thickness angular	tphi	865,91		tM*	1322,00	mm
				n*	49,17	
				n	48,00	
				tM	1291,00	mm
				Ro	3349,00	mm
absorber material		Fe				
	Z	26,00		absorption factor rec.	n ₁	5,73
	A	55,85		absorption factor phi.	n _{1 + phi}	5,17
	l ₁	131,90	g/cm ²			
	X ₀	1,76	cm	n theoretisch	t/X ₀	54,55
	r	7,87	g/cm ²	n theoretisch phi	tphi/X ₀	49,20
	n ₁	5,30				

AHCAL barrel support structure

mechanical design overview (set 2)

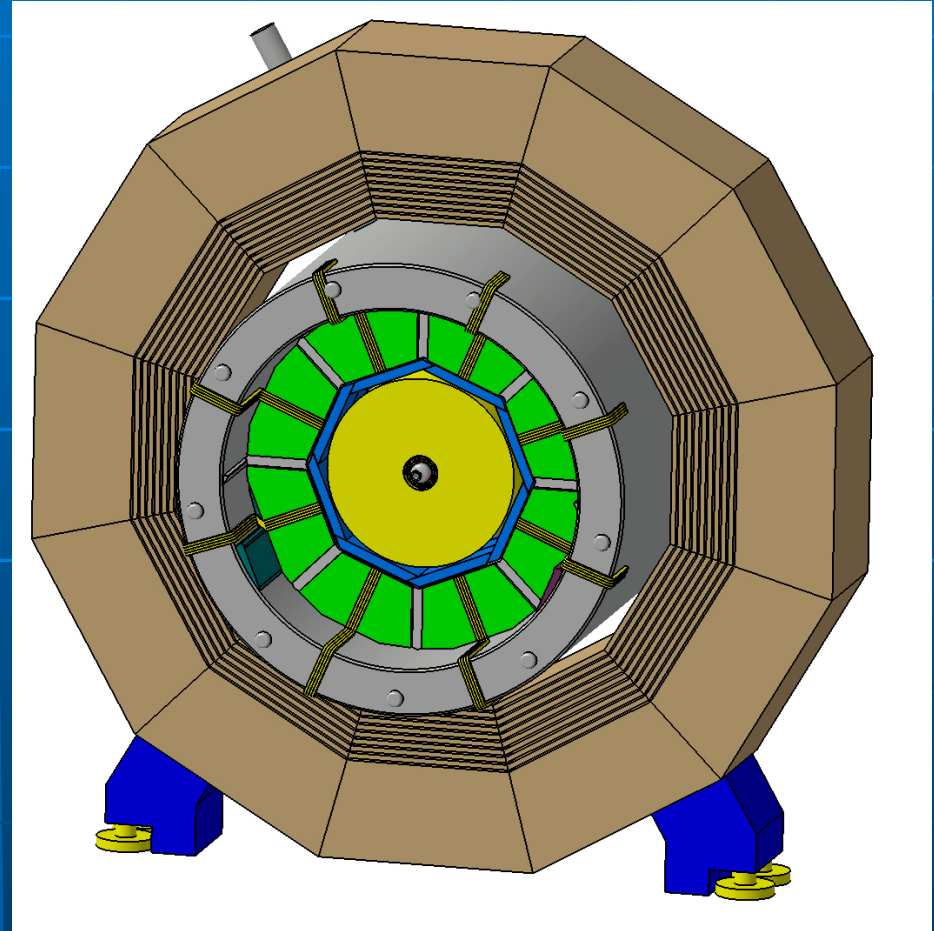


support rails fixed to the coil cryostat

support feet

With ECAL

- By M.Joré, LAL



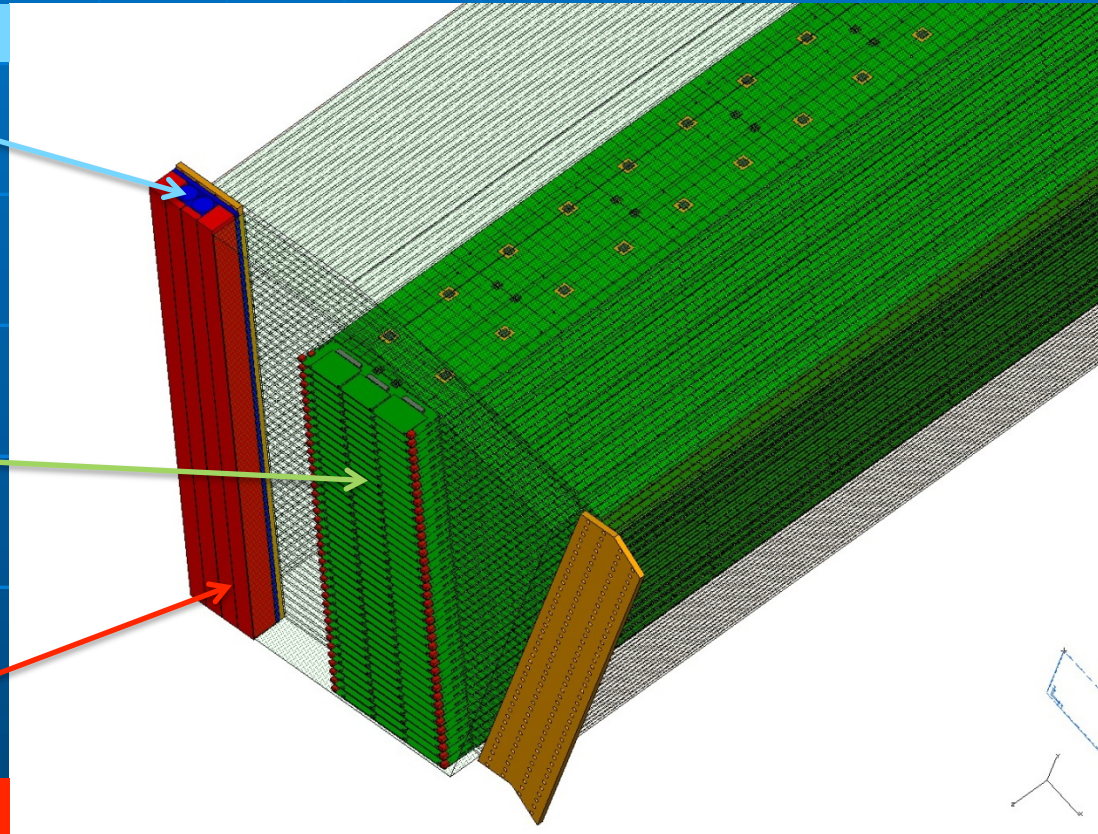
AHCAL barrel front end

sub module with 40 layers HBU 360 tower

blue->cooling for 2 sub modules

front end electronic

red-> cabling for 2 sub modules



conclusions

- the update of the AHCAL placeholder is done and transmitted
- the ILD placeholder model has to be updated
- the update of the detail AHCAL absorber model has started
- the detail design of the supply system will start soon
- the sensitive layer layout has to be workout
- the mokka model has to be checked and updated