

# Status of the ILD simulation models

Frank Gaede, DESY  
Software pre-meeting @ ILDMeeting  
Fukuoka, Japan, May 21, 2012

# new Mokka post-LOI ILD models:

- major rewrite of some sub detector drivers :
  - SIT, SET, ETD - FTD - Muon
  - increased level of detail and realism (incl. services)
- made existing drivers more realistic:
  - TPC, AHCAL, Ecal, FCal,...
- new drivers (technology options):
  - SDHCAL, SciEcal
  - added overall services and cables
- new models for DBD:

**ILD\_O1\_v03** "ILD simulation reference Model for DBD using Analog HCal"

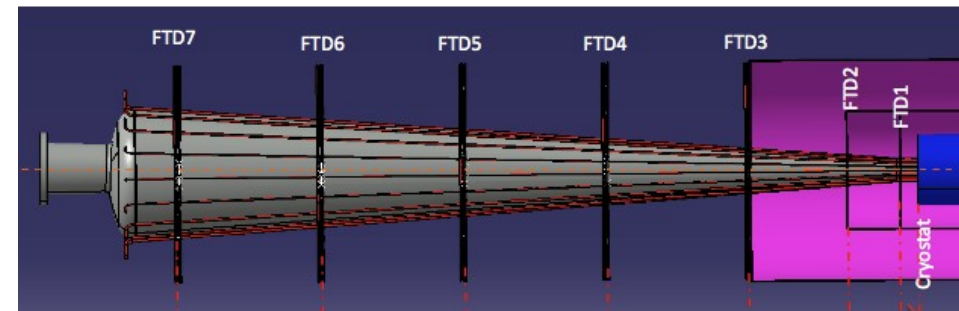
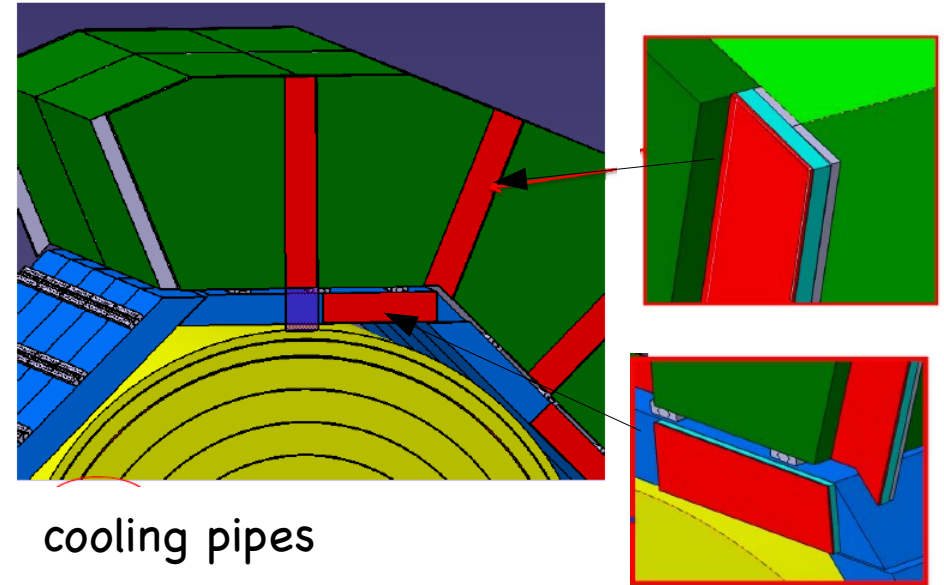
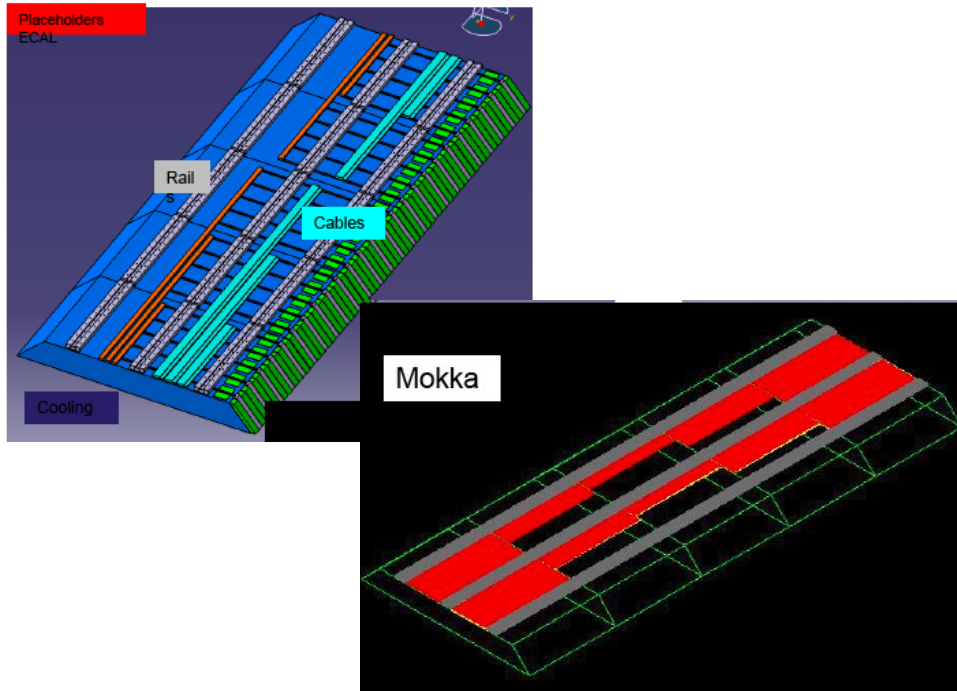
**ILD\_O2\_v03** "ILD simulation reference Model for DBD using SD HCal"

**ILD\_O3\_v03** "ILD simulation reference Model for DBD using SciW Ecal and Analog HCal"

- first part **ILD\_OX** - read "ILD - Option X", refers to the choice of sub-detector technology options of the model
- second part **\_vXX** refers to the software release version that describes this option for ILD

# increased realism in ILD\_OX models

- added cabling and services for TPC, ECal & Hcal ( C.Clerc, G.Musat )
- including inner detector services as defined by R&D groups



big step forward in increasing realism of ILD detector simulation !

power supply cables

# validation of Mokka ILD model(s)

- started validation process with volunteers nominated by the subdetector R&D groups, checking the Mokka drivers for:
  - overlaps, consistency w/ engineering model, hit production,..

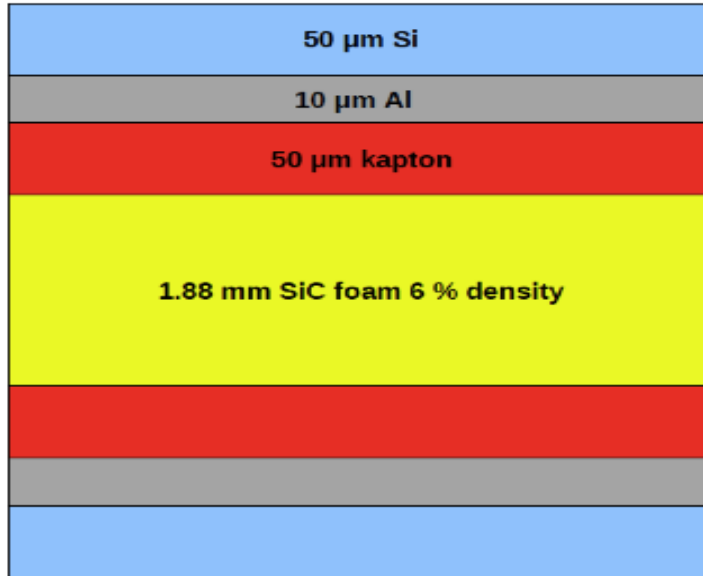
detector	person
VXD	G.Voutsinas
SIT/SET	K.Androsov
FTD	J.Duarte
TPC	S.Aplin
ECal	D.Jeans
AHCal	Sh.Lu
SDHcal	G.Grenier
FCal	A.Rosca, B.Pawlik
Muon	A.Saveliev

**start MC production, once all sub detectors are 'approved'**

overall overlap checking: Ch.Grefe

# VXD validation

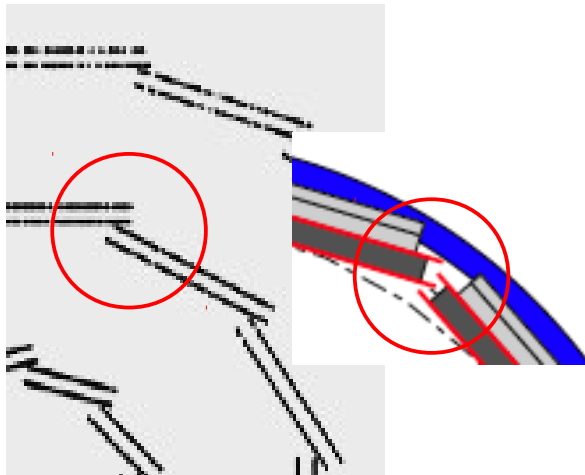
Y.Voutsinas



- 0.053 % x 2 +
- 0.011 % x 2 +
- 0.018 % x 2 +
  
- 0.130 % =

- 
- 0.294 %  $X_0$  per double layer

simplified in GEAR:  
0.2%  $X_0$  support  
+ 0.1%  $X_0$  sensitive  
= 0.3%  $X_0$  total



- inconsistency in geometry detected
- potential impact on track finding

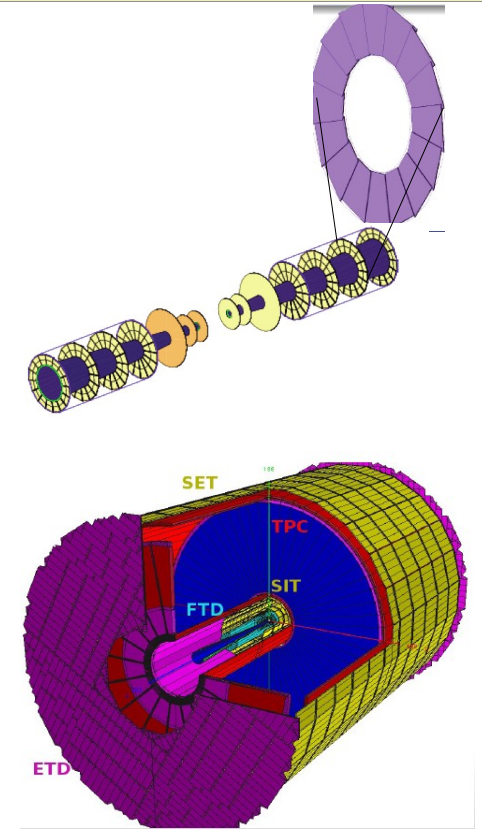
=> fixed by Yorgos  
=> VXD is validated

# SIT/SET & FTD

K. Androsov, J. Duarte

- very detailed new simulation models had been developed for SIT/SET as well as for the FTD (ETD is not in simulation models)
- these models did not quite reach the level of maturity one would need for the DBD mass production
- slightly simplified have been developed in parallel in order to proceed with new C++ tracking code
- these models have planar wafers, ~realistic support material and work with new tracking
- have now been validated by R&D groups

=>SIT/SET validated  
=> FTD validated



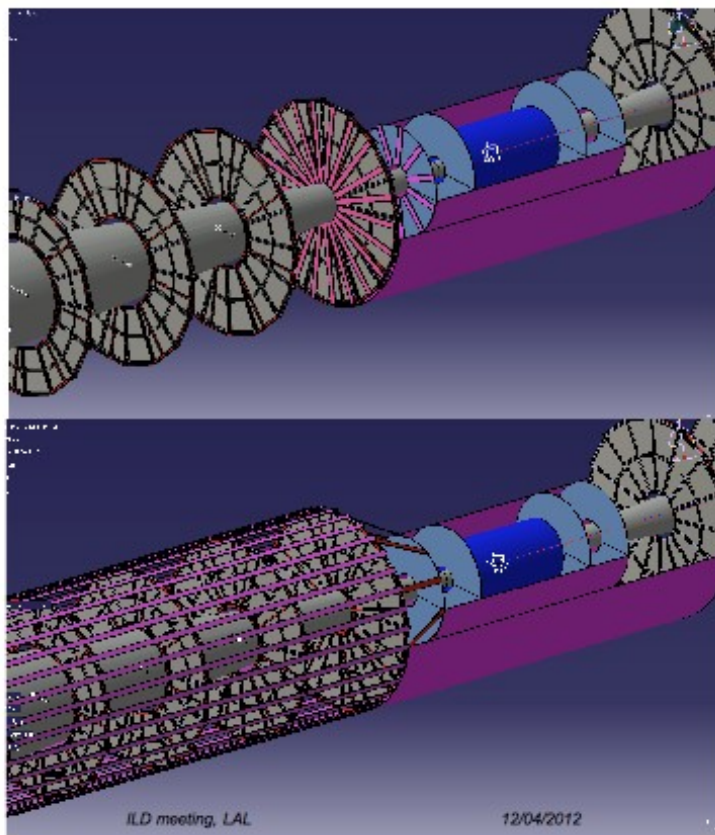


# routing of SIT/FTD cables

Frank Gaede, ILD Meeting, Kyushu U., May 21-25, 2012

SIT, two solutions

1. Along the beampipe : they have to run on backside of FTD2 and 3 , then :
  - huge amount of material around BP
  - Material in front of the other FTD
2. Run along the inner radius of TPC



- need to finalize the numbers as proposed by C.Clerc
- question of routing:
  - along beam pipe !?
  - cables going out to SIT/SET missing ?

ERC

C.Clerc

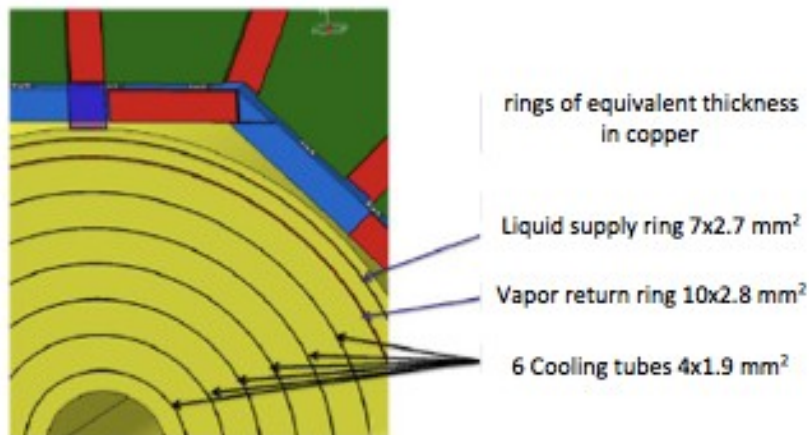
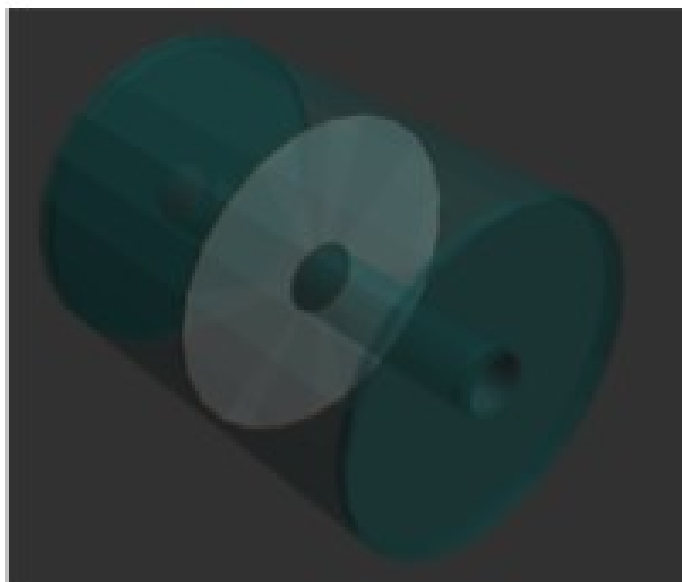
ILD meeting, LAL

12/04/2012

	Aluminum								
	position	FTD7	FTD6	FTD5	FTD4	FTD3	FTD 2	FTD 1	VTX
new values	eq Th of Al r	0,85	0,99	1,22	1,54	2,18	2,76	2,00	0,67
	X0% FCPPD	0,95%	1,11%	1,37%	1,73%	2,45%	3,10%	2,25%	0,75%
old values	eq Th of Al r	2,16	2,39	2,74	3,20	4,12	3,45	2,00	0,67
	X0% FCPPD	2,43%	2,68%	3,08%	3,60%	4,63%	3,87%	2,25%	0,75%

# TPC validation

S.Aplin

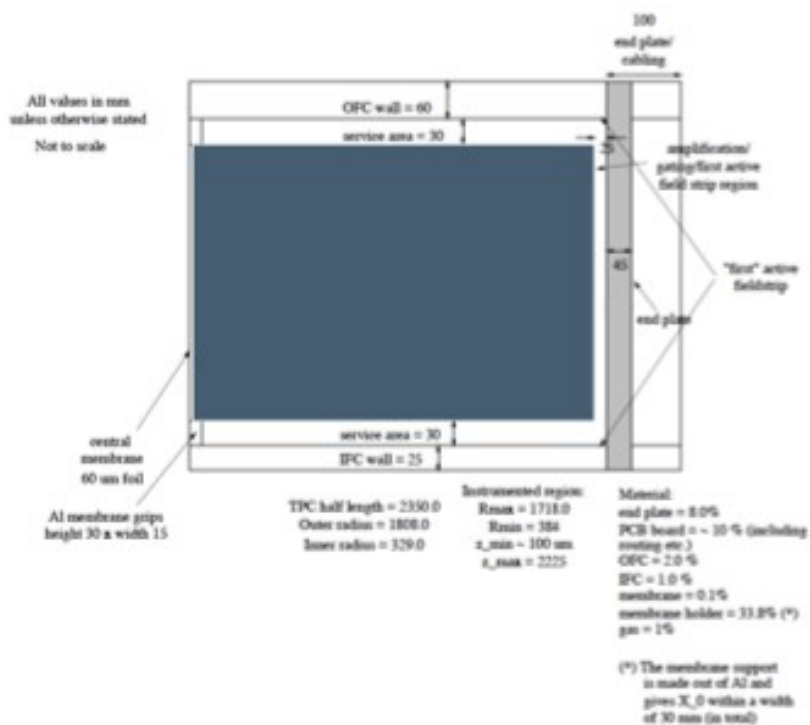


End-Plate modeled as discs of material representing components of the readout: GEM structure, Readout, and Support frame.

Cathode constructed from two thin discs, insulator and conductor, held by membrane grip.

Cooling modeled using rings attached to the outside of the end-plate.

Parameterised digitisation well established in the main reconstruction chain.



=> TPC is validated



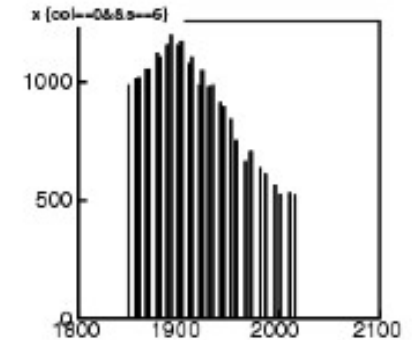
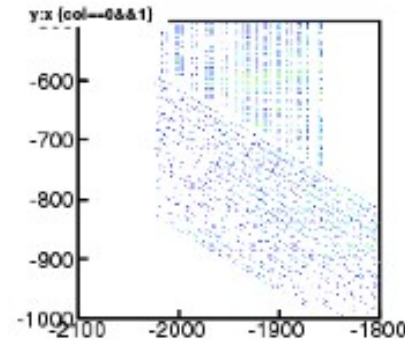
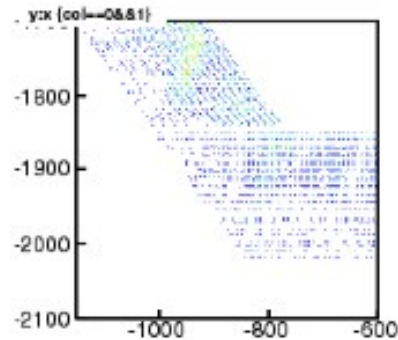
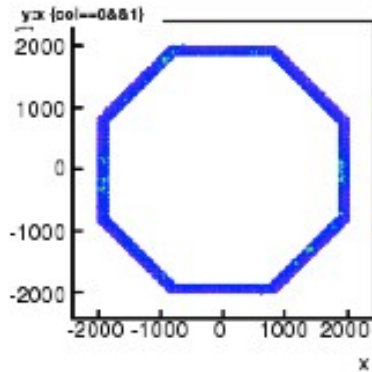
# SiW Ecal validation

D.Jeans

Engineering design dimensions:

Barrel: Rin=1843, Rout=2028, 1/2 length=2350

Endcap: Rin = 400 (square), Rout=2090 (octagon), Zin=2450, Zout=2635



Step	Leng	NextVolume
	0	WorldPhysical
	3	BarrelEcalModule
	2.45	FirstSlab
	0.25	PCBCuShield
pcb	1.3	FirstSlab
	0.1	WaferSi
si	0.5	Ground
	0.1	BarrelEcalModule
cf	0.15	RadiatorSlab
w	2.1	BarrelEcalModule
cf	0.15	Ground
	0.1	WaferSi
si	0.5	SecondSlab
	0.1	PCBCuShield
pcb	1.3	SecondSlab
	0.25	BarrelEcalModule
cf	0.75	RadiatorStruct
w	2.1	BarrelEcalModule
cf	0.75	FirstSlab
	0.25	PCBCuShield
pcb	1.3	FirstSlab
	0.1	WaferSi

## Conclusions

Hit positions consistent with engineering design

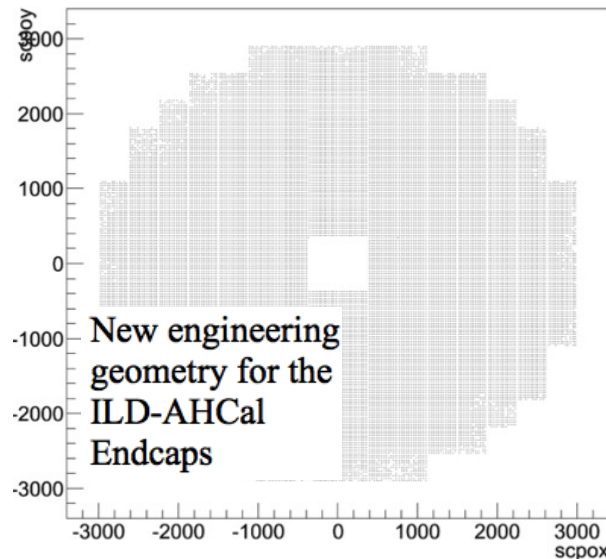
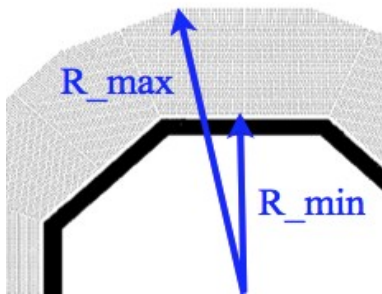
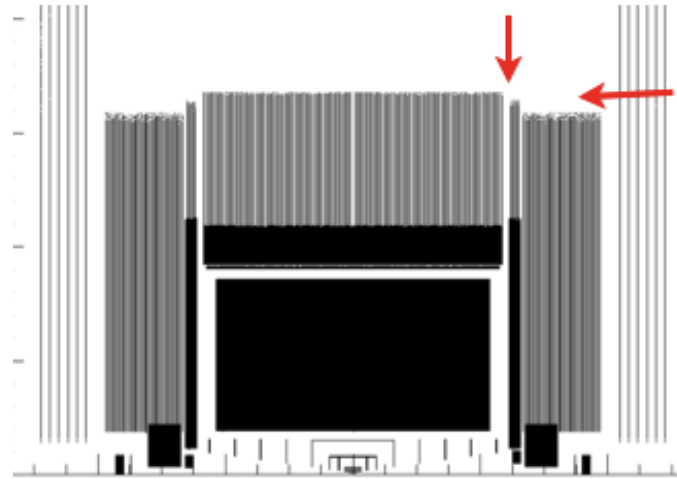
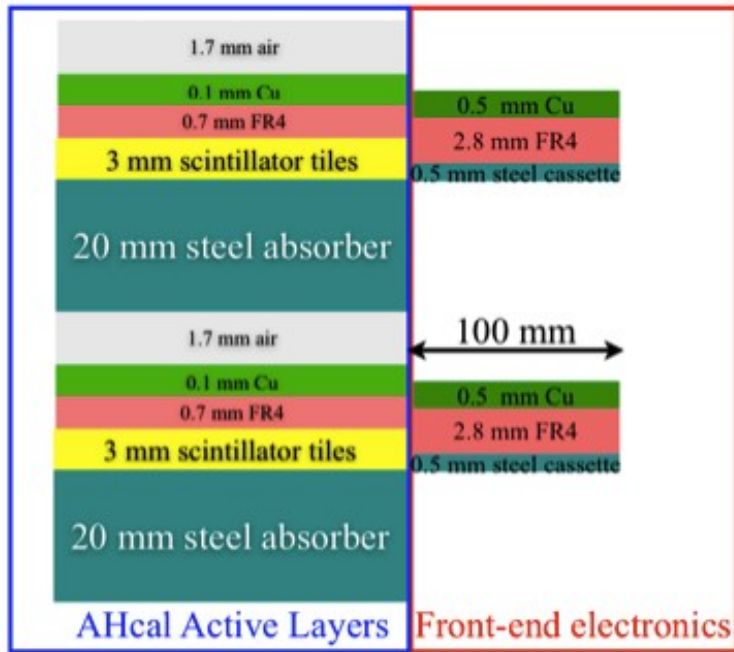
Decoded CellID behave as expected

No problems detected in ECAL structure (geantino)

**=> Ecal is validated !**

# AHcal validation

Sh.Lu



The Mokka drivers for the **Barrel** and the **Endcap** have been validated and synchronized with engineering design.

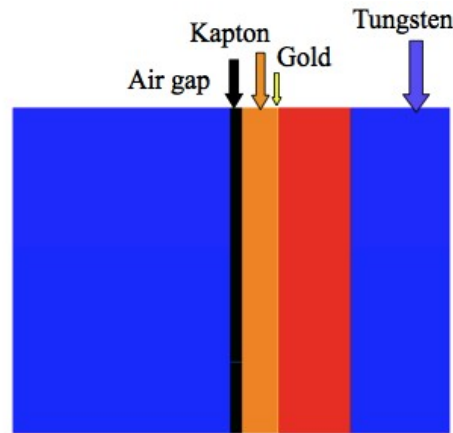
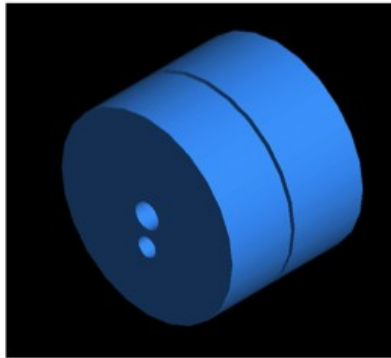
**EndcapRing** has been checked with engineering design too.

=> AHCal is validated

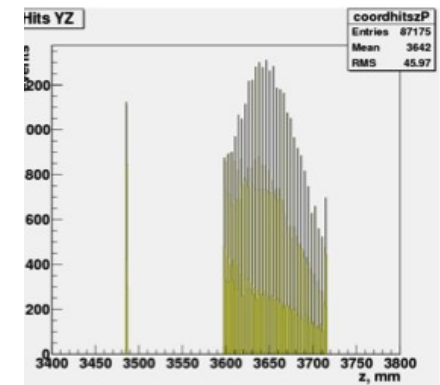
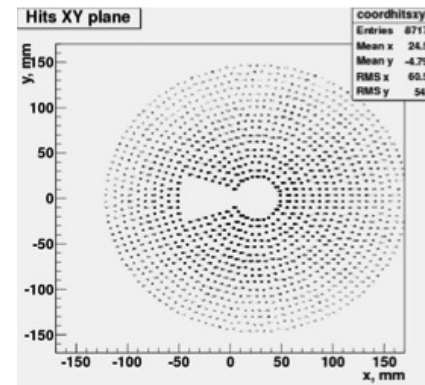
# Fcal validation

A.Rodca, B.Pawlik

## Simulation

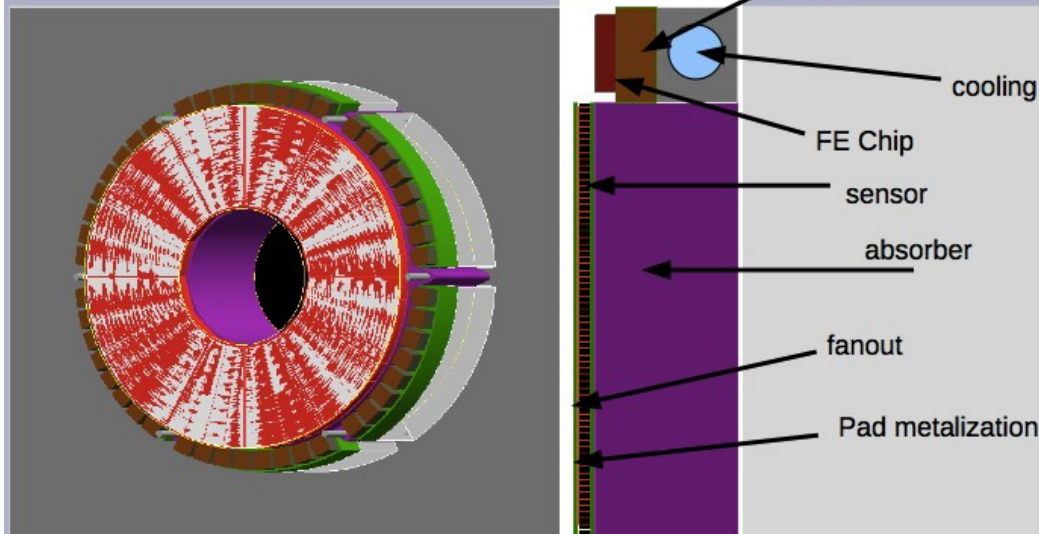


Geometry has been checked for overlaps  
– No overlap found.



$Z_{in} = 3450$  mm in the engineering design and  $\sim 3600$  mm in the simulation.

## Implemented Geometry (according to official RD)



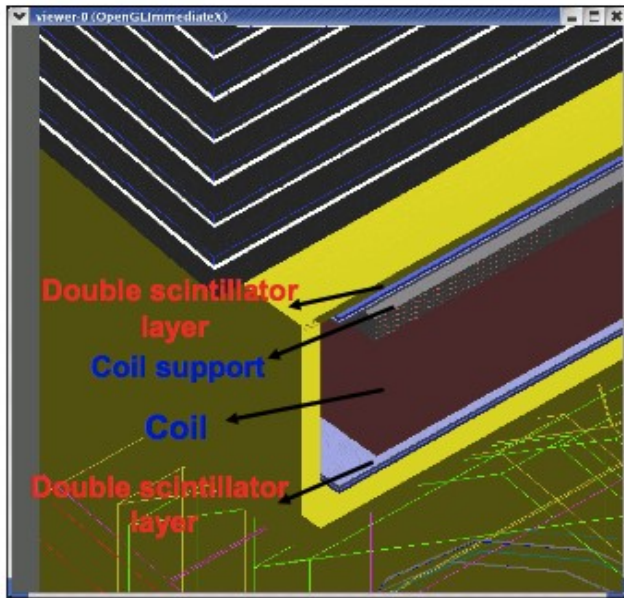
- different z-pos was just a proposal
- > decided to keep value in simulation eng. model

=> BCal validated  
=> LCal validated



# Muon validation

V.Saveliev



Cryostat: Detailed Geometry

- Instrumentation 2 Double Scintillator Layers → no baseline

Coil: Detailed Geometry,

- Coil Segmentation

→ remove from  
sim. model

Yoke: Detailed Geometry based on Mechanical Design

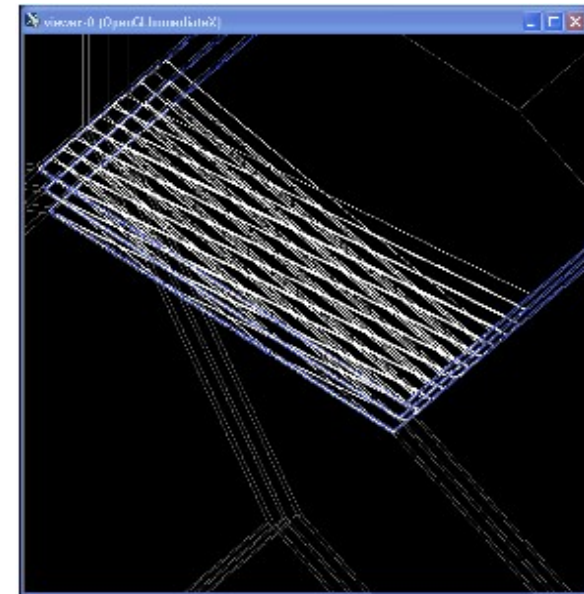
- Barrel:  $10 \times (100+40) + 3 \times (560 + 40)$  mm

- EndCup:  $10 \times (100+40) + 2 \times (560+40)$  mm

various readout options exist

- 3x3cm scint. tiles ← used in LOI & Pandora
- 3x3cm RPC ← implemented in ILD\_O1
- 3xLcm scint. strip stereo ← proposed

**⇒ need decision asap !!**



⇒ muon validation ongoing

# Overall Overlap checking

Ch.Grefe

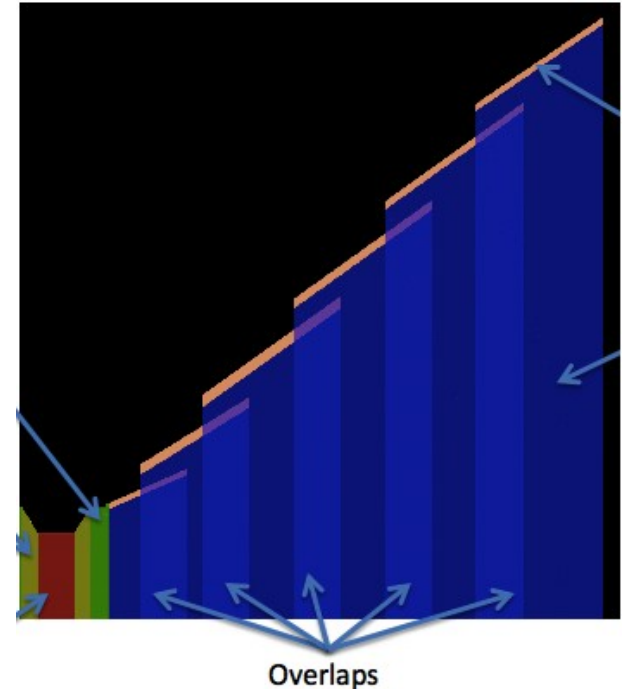
/geometry/test/recursive\_test

Gives detailed printout with coordinates of overlaps:

```
GeomTest Error: Overlapping daughter volumes
The volumes tube_IPOuterBulge[0] and tube_IPOuterBulge[0],
both daughters of volume WorldPhysical[0],
appear to overlap at the following point in global coordinates:
length (cm) ----- start position (cm) ----- end position (cm) -----
16.45          0          0          37.13          0          0          53.58
Which in the mother coordinate system is:
length (cm) ----- start position (cm) ----- end position (cm) -----
16.45          0          0          37.13          0          0          53.58
Which in the coordinate system of tube_IPOuterBulge[0] is:
length (cm) ----- start position (cm) ----- end position (cm) -----
16.45          0          0          -1.16          0          0          15.29
Which in the coordinate system of tube_IPOuterBulge[0] is:
length (cm) ----- start position (cm) ----- end position (cm) -----
16.45          0          0          -21.91          0          0          -5.46
```

Careful: can be false positives / false negatives  
Still the best starting point

- World volume too small – **fixed**
- SIT overlaps with FTD – **fixed**
- Overlapping sensors in SIT and SET – **fixed**
- Overlaps in FTD – **fixed**
- Insulators overlap in TPCCathode ( **fixed** )
- Overlaps in tube\_IPinnerTube ( **fixed** )
- Overlaps in tube\_IPOuterBulge ( **fixed** )
- YokeEndcap overlaps YokePlug – **fixed**
- Overlaps in HCalServices – **fixed**
- Chamber1 and Chamber2 overshoot YokeEndcap



=> ILD\_O1\_v03 should be free of overlaps

# validation of Mokka ILD model(s)

- started validation process with volunteers nominated by the subdetector R&D groups, checking the Mokka drivers for:
  - overlaps, consistency w/ engineering model, hit production,..

detector	person	status
VXD	G.Voutsinas	done
SIT/SET	K.Androsov	done
FTD	J.Duarte	done
TPC	S.Aplin	done
ECal	D.Jeans	done
AHCal	Sh.Lu	done
SDHcal	G.Grenier	to be done
FCal	A.Rosca, B.Pawlik	done
Muon	A.Saveliev	ongoing

start MC production w/  
ILD\_O1\_vxx a.s.a.p.  
- finalize muon readout  
- finalize SIT cabling  
- ... ?

overall overlap checking: Ch.Grefe



# Summary & Outlook

- ILD simulation models in Mokka have been made **more realistic** wrt. to the version that was used for the LOI:
  - added electronics, cabling and services
  - introduced wavers and support for Si-Tracking
- R&D groups have nominated people to **validate the corresponding drivers -> almost complete now**
- **now known (major) discrepancy known between the simulation and the engineering models**
- -> will start Monte Carlo production for DBD soon