As of today most plausible design for the SiW-ECal

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Integration is a must, interfaces are a must, what about knowing what you interface?

Extracts from the SiW-Ecal Technical Design Document (Ecal design and fabrication process)
This has followed the modifications of the Ecal dimensions and the development of the “small” model with reduced radius.
The 26 layers model presented here can exist in a “small” version” but as well in a “large” version.
The following discussion is based on the 26 layers “small” version.

The development of the CMS HGCAL has impacted the ILD SiW-Ecal on three aspects:

- The price of 1 cm^2 of silicon for CMS is close to ½ the TDR price
- HGCAL will use 200mm wafers
- The question of timing.

The 200mm diameter ingots are sliced in wafers 725µm thick as a standard.
Using such a thickness improves the resolution and the signal over noise ratio.
(if we were to go to “scintillator thicknesses” (2 to 3 mm), the stochastic resolution would be 12 to 11%)

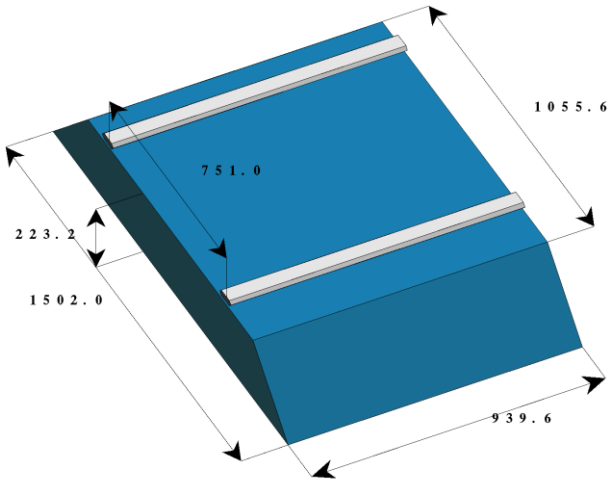
But we need slightly more space,
as the resolution improved we can slightly relax on the sampling.
The choice has been to go for 26 layers 18 thin and 8 thick,
on top of the space needed for the silicon matrices it provides also easier clearances.

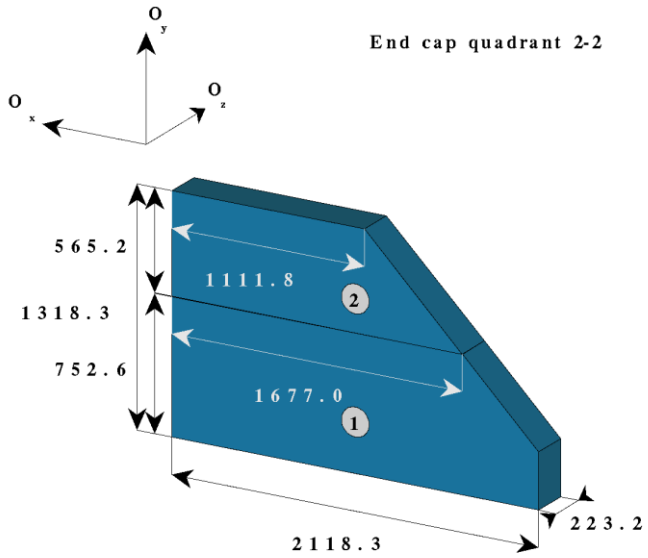
The envelopes defined for the model (here small) are kept.

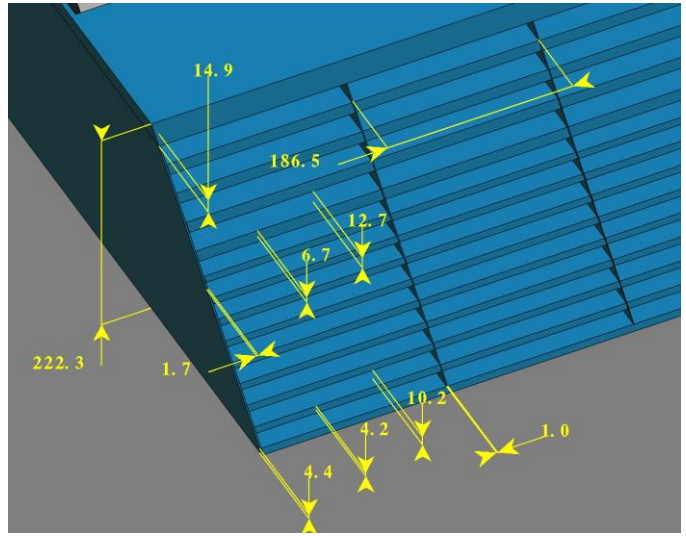
The barrel length is kept (large and small) which defines the number of modules (5) and the alveoli size (186.5mm)

For the end caps the outer radius is modified for the small, the alveoli width is kept and the module structure changes.

There are 2 modules instead of 3. It is still not clear which is 1 and which is 2.

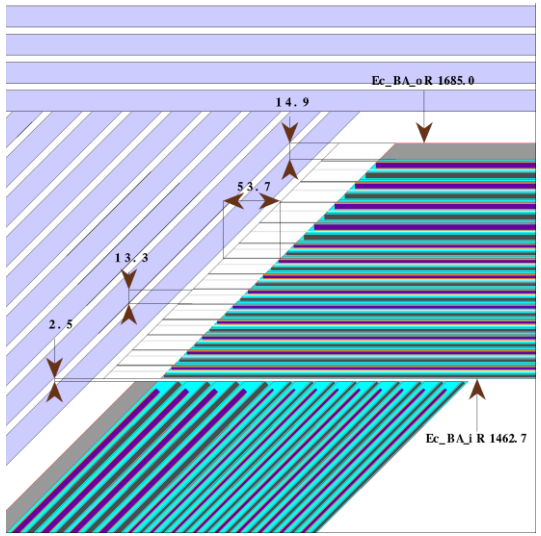




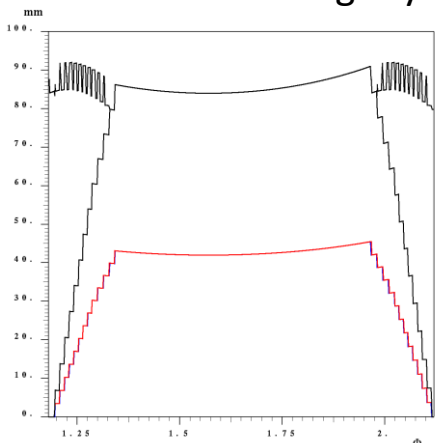


The sensitive layer depth structure and the slabs

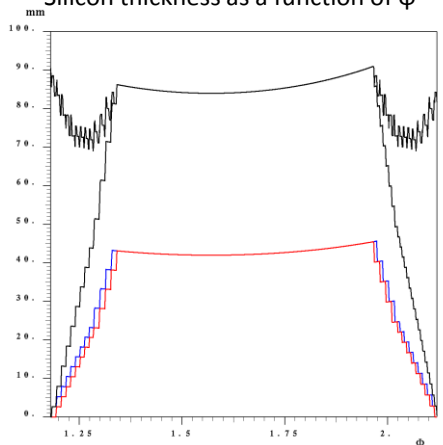
Going to 26 layers while keeping 24 X0's (?) means slightly thicker tungsten plates: 2.471 and 4.942mm. The chip and PCB thicknesses are slightly relaxed.



The electronics end of a stave

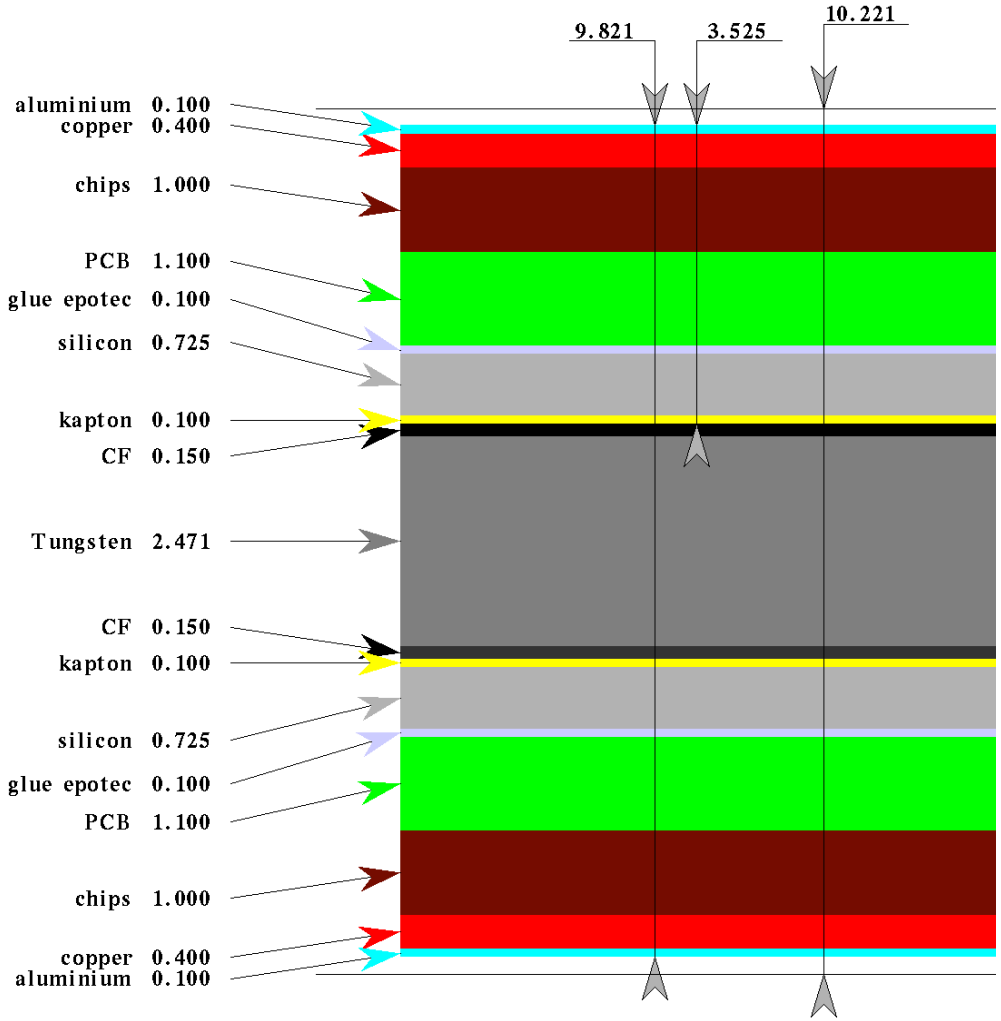


Silicon thickness as a function of ϕ

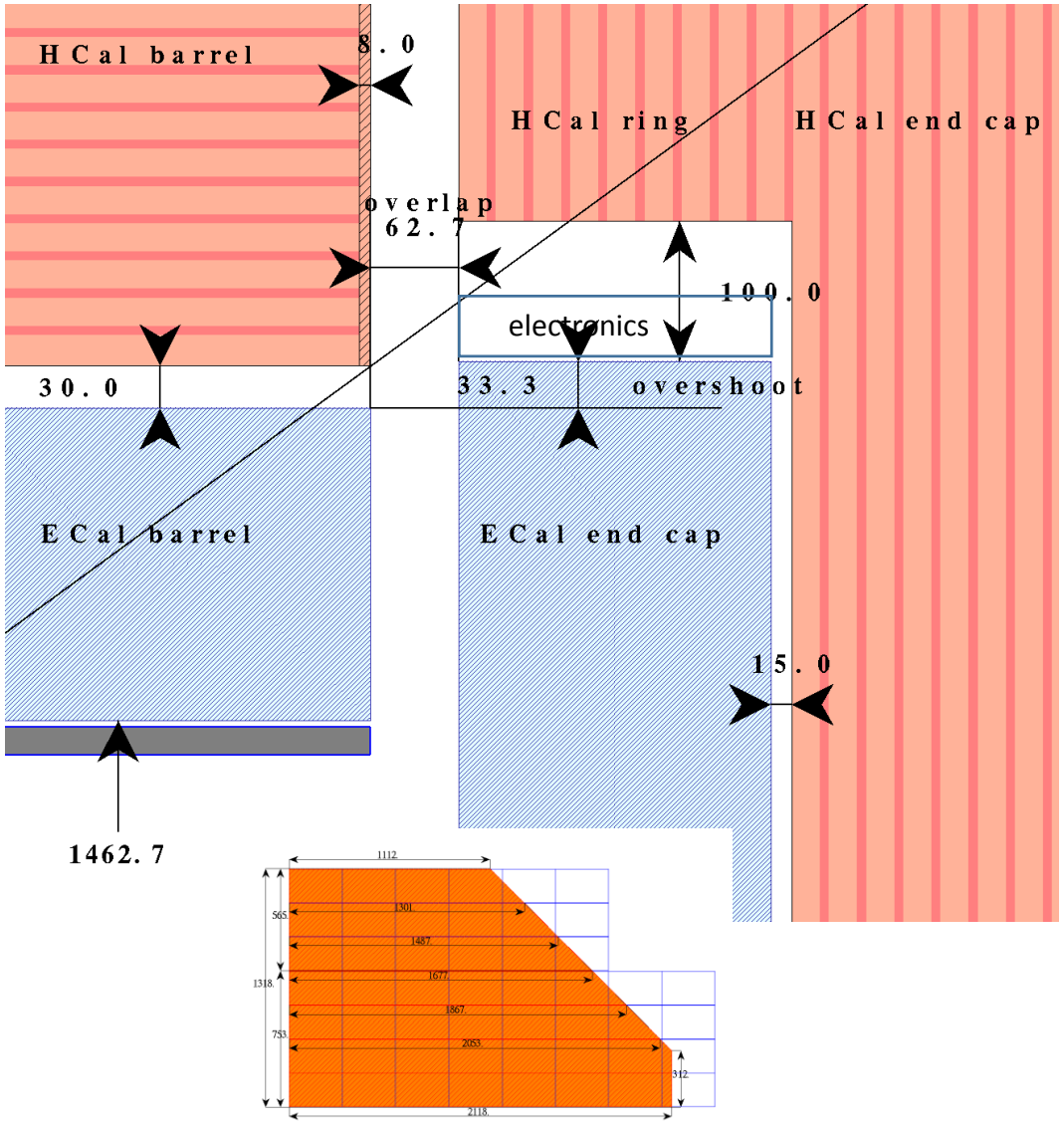


W thickness as a function of ϕ

Problems in ϕ



Thin slab structure



Problems in θ

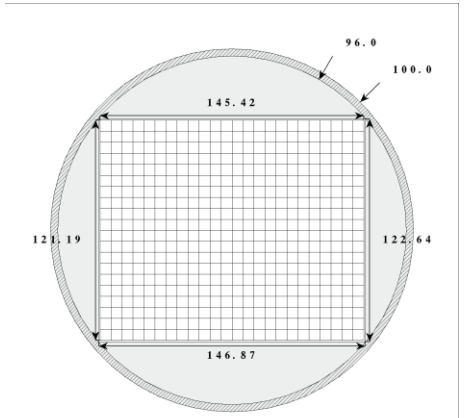
Notice that the end cap electronics detailed design is lacking

To cope with the increasing ECal thickness
while not moving the HCal
the TPC has been somewhat reduced in radius
(not the sensitive part though)
and the distance between barrel and end cap reduced from 100mm to 63. This improves the ECal connection. Around the Ecal end cap the 100mm are not empty but partly (in ϕ) full of electronics.

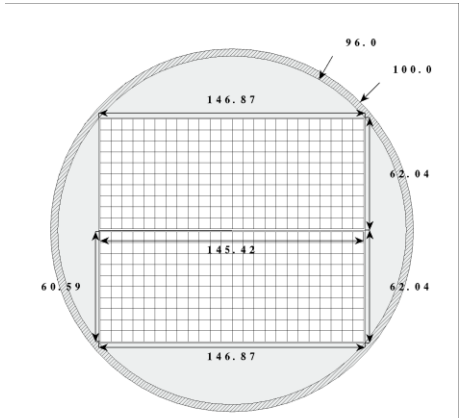
The questions linked to the services going out and the Ecal Hca interface will be covered by Roman.

Another question arises from the space between ECal and HCal in the end caps. The fastening of the ECal end cap and the insertion of the cooling needs 30mm rather than 15.

The width of an alveolus (186mm) cannot be filled by a sole matrix extracted from a 200mm wafer.

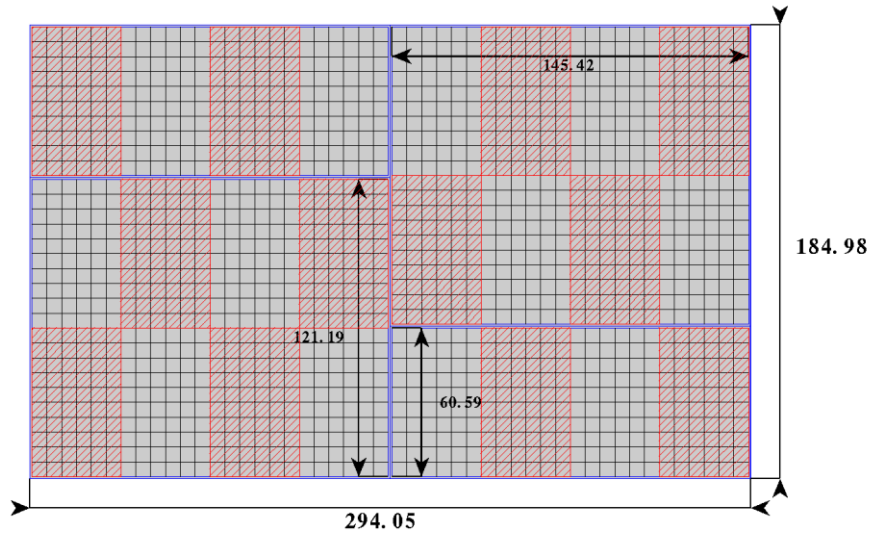


24 x 20 square pads



Note that a matrix as drawn here comes slightly too close to the ingot periphery.
A column of pads may be lost.

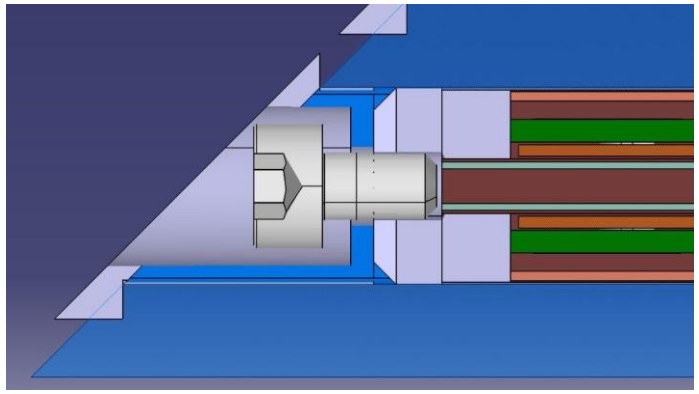
(Hamamatsu through Taikan)



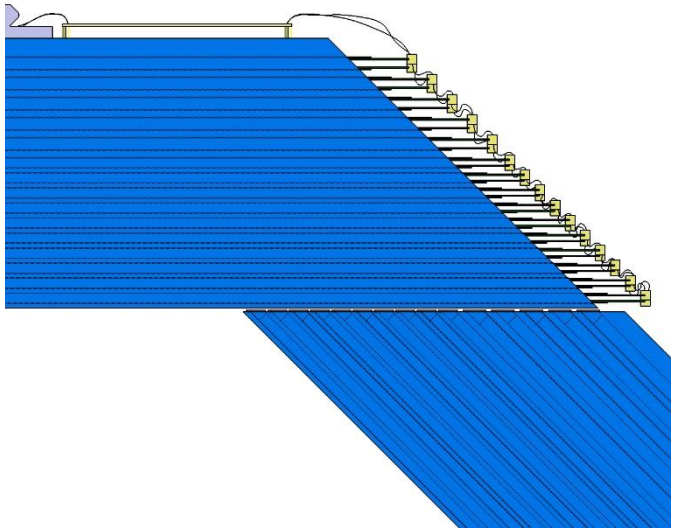
Tiling of an ASU with matrices
ASU or Active Sensor Unit is a piece of PCB covered on one side by matrices and on the other by FE chips.

The ASUs on the two faces of a slab are not symmetric and the inter-matrices dead zones do not coincide.
there are less borders between ASU's that for the 150mm case

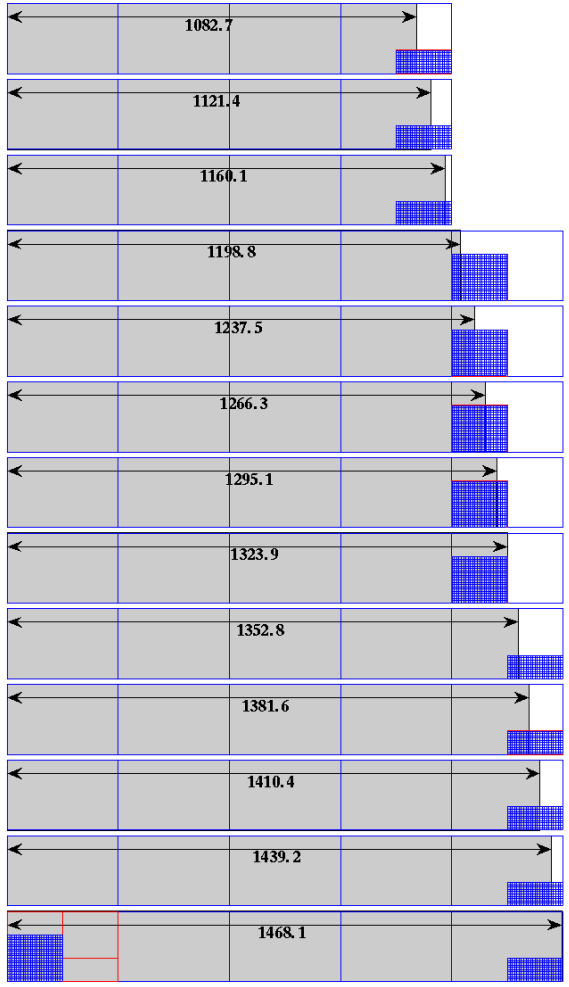
The 26 layer model has 13 different slabs inserted in the structure
In the barrel all the slabs in a column are different
but all the columns are identical.
In the end caps all the slabs from a column are identical but differ from one column to anoher
On one end a slab has a plug to fasten it inside an alveolus
On the other end is the electronics.



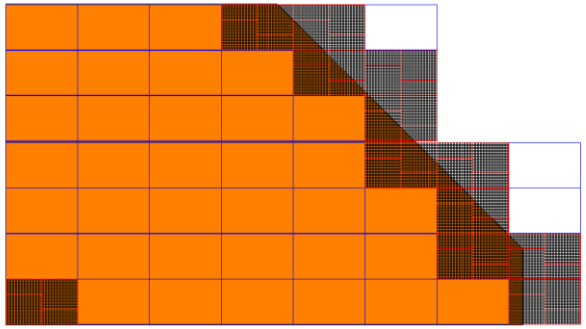
Plug possible design



Sketch of the end slab electronics

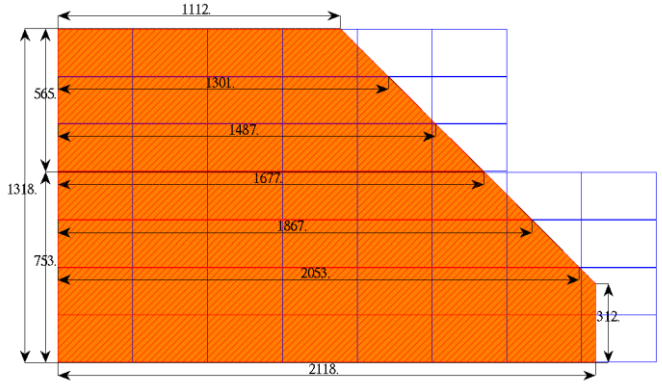


Barrel slabs ASUs tiling

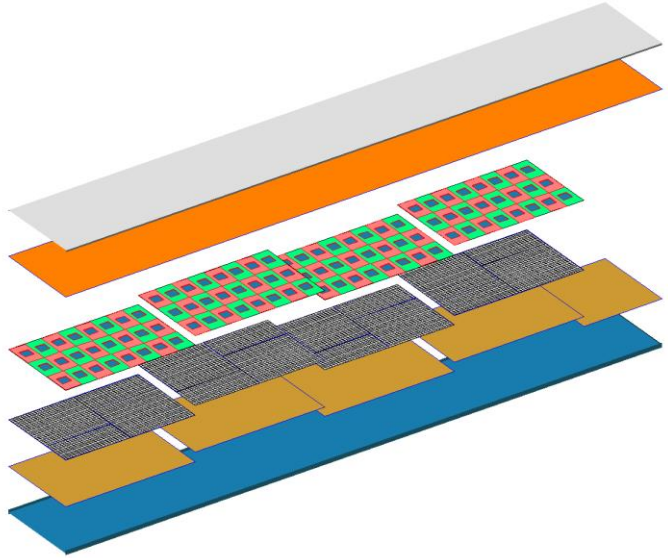


A slab is made of a tungsten core wrapped into CF (referred to as the H)
This core is surrounded by two sensitive layers built out of ASUs
which structure has been shown earlier

End cap slabs and ASUs tiling

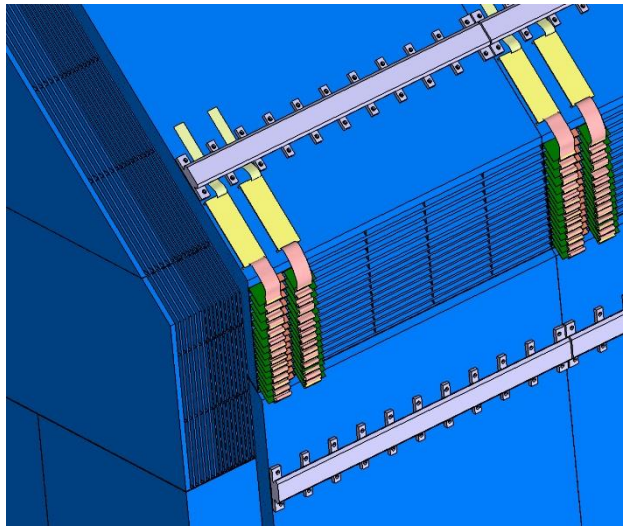


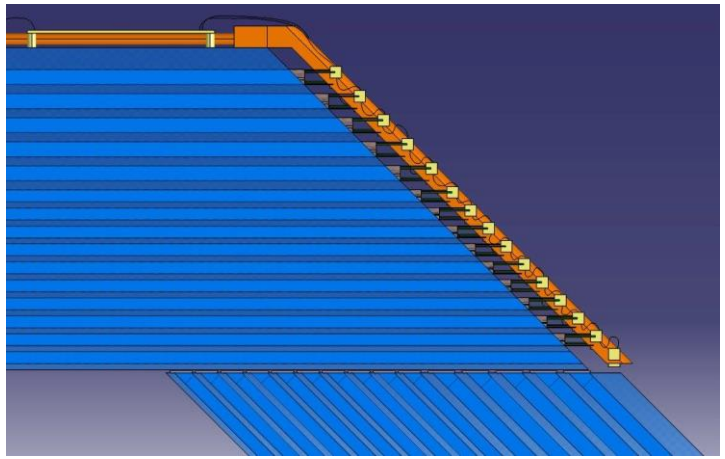
Al cover
Cooling copper
PCB's with chips
Diode matrices
HV kapton
H

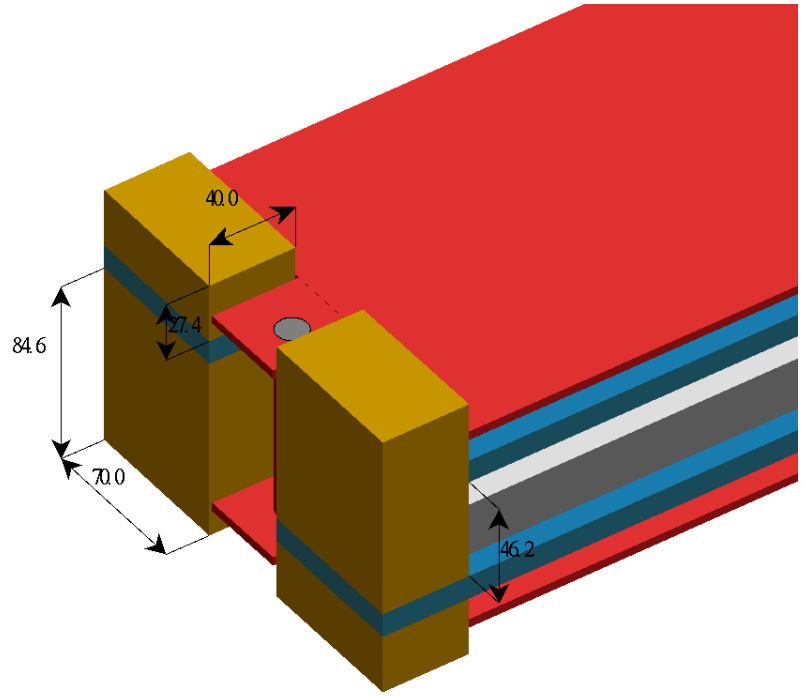


The slabs end electronics

and its connection to the world under development







The heights are multiplied by 10

For reason of safety the odd and even sensitive layers
the two faces of the slabs
are read independently one parity on the right side of the alveoli columns,
the other on the left side.
The signals from the front-end are serialised in the DIFs at the end of the slabs
and then all those from the same half-column in a DCC to be routed to a hub/patch-panel.
See RP.
The cooling for a column is installed in between and connected to the copper foil

Space available for the DIFs
in one scheme where they stay
just on half a column.

Just a reminder

Ecal /Hcal
The Ecal is fastened to the Hcal, end cap and barrel
through rails preinstalled on the Hcal
anticipating the Hcal deformation (to be known to adjust the dimensions)
Seemed statically OK for the clearances under consideration

Ecal /SET
To be looked at

Ecal / TPC patch-panels and suspension

Ecal / Various cables passing by

The End

for today

When could we have a blessing?