

“Design of ScECAL in ILD”

1st / February. 2012 CALICE-ASIA

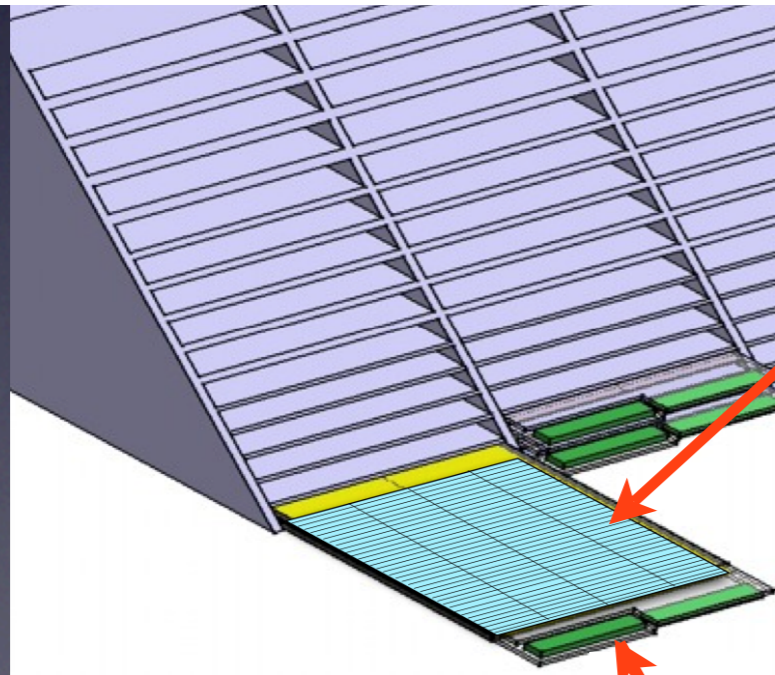
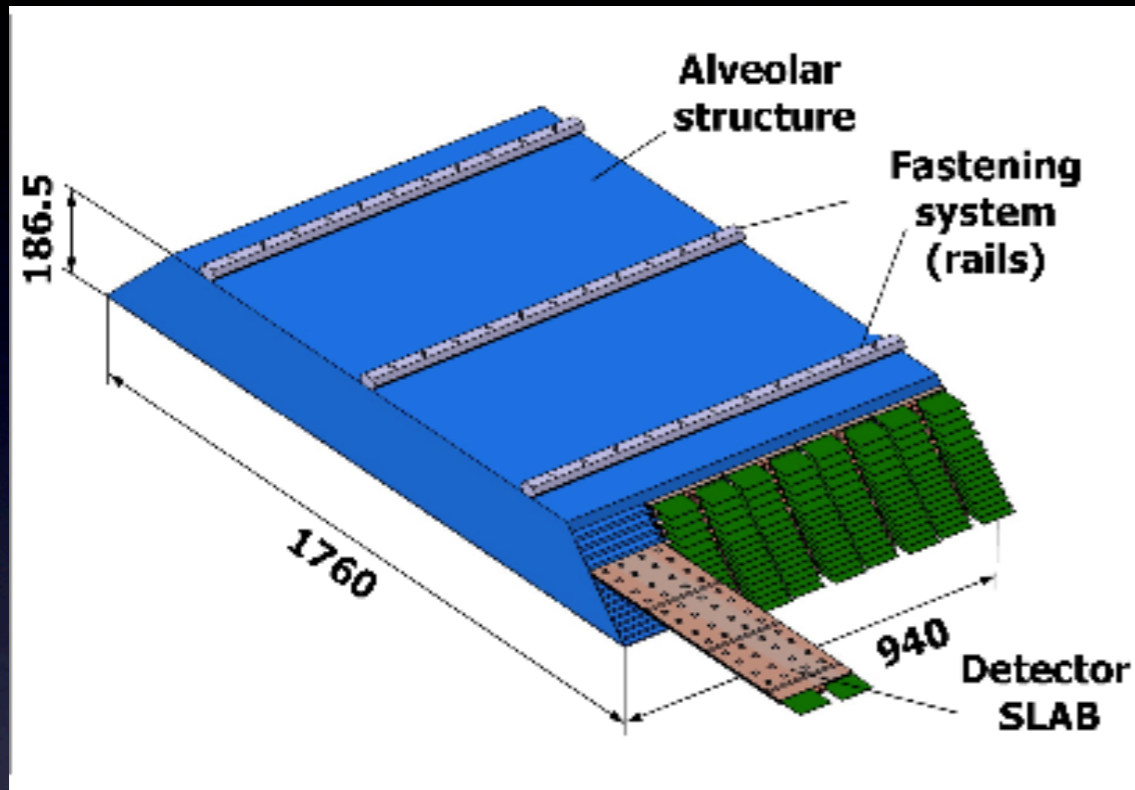
Shinshu university K.Kotera

Basic design

- Follow the SiECAL, Alveolar structure,
- ~ 2 mm thick plastic scintillator enveloped in reflector film,
 - Current technology
 - 1.9 mm is minimum thickness including forming sheets due to the SMD-MPPC
 - Future technology
 - 1.4 mm is minimum thickness
- 3 mm thick tungsten absorbers,
- PCB:
 - Current technology: 1.4 mm
 - Future technology: 0.8 mm
- Cooling copper and shielding sheet: 0.5 mm
- Carbon fiber 0.15 mm x ?
- Total Module thickness should be 185 mm

Over view

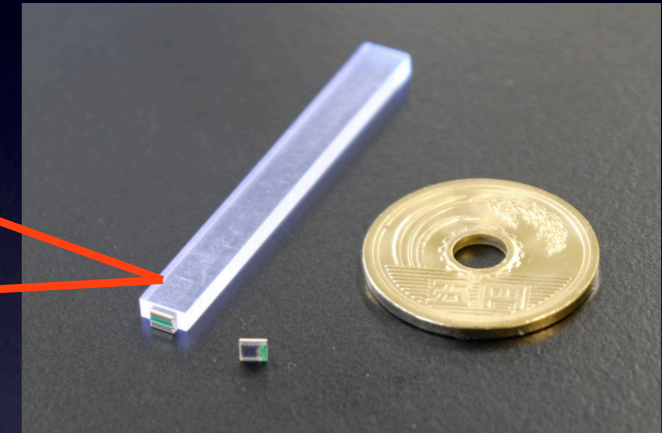
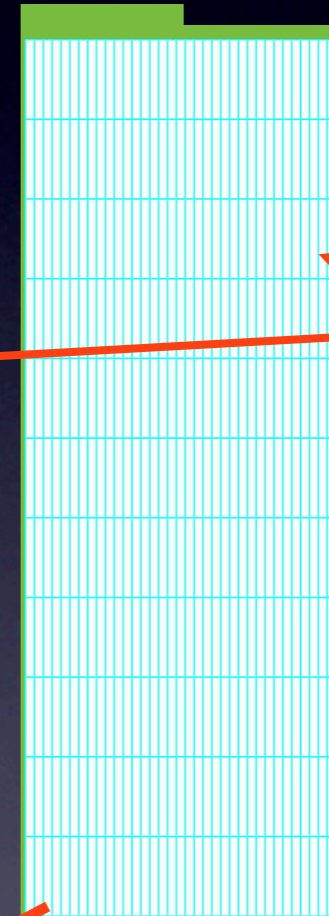
Following SiWECAL structure



fine in x

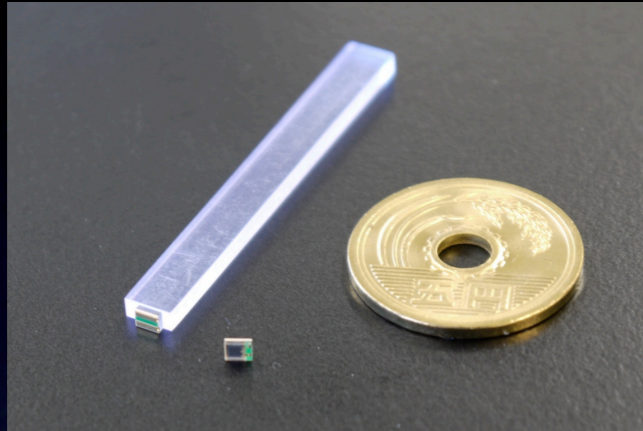


fine in z

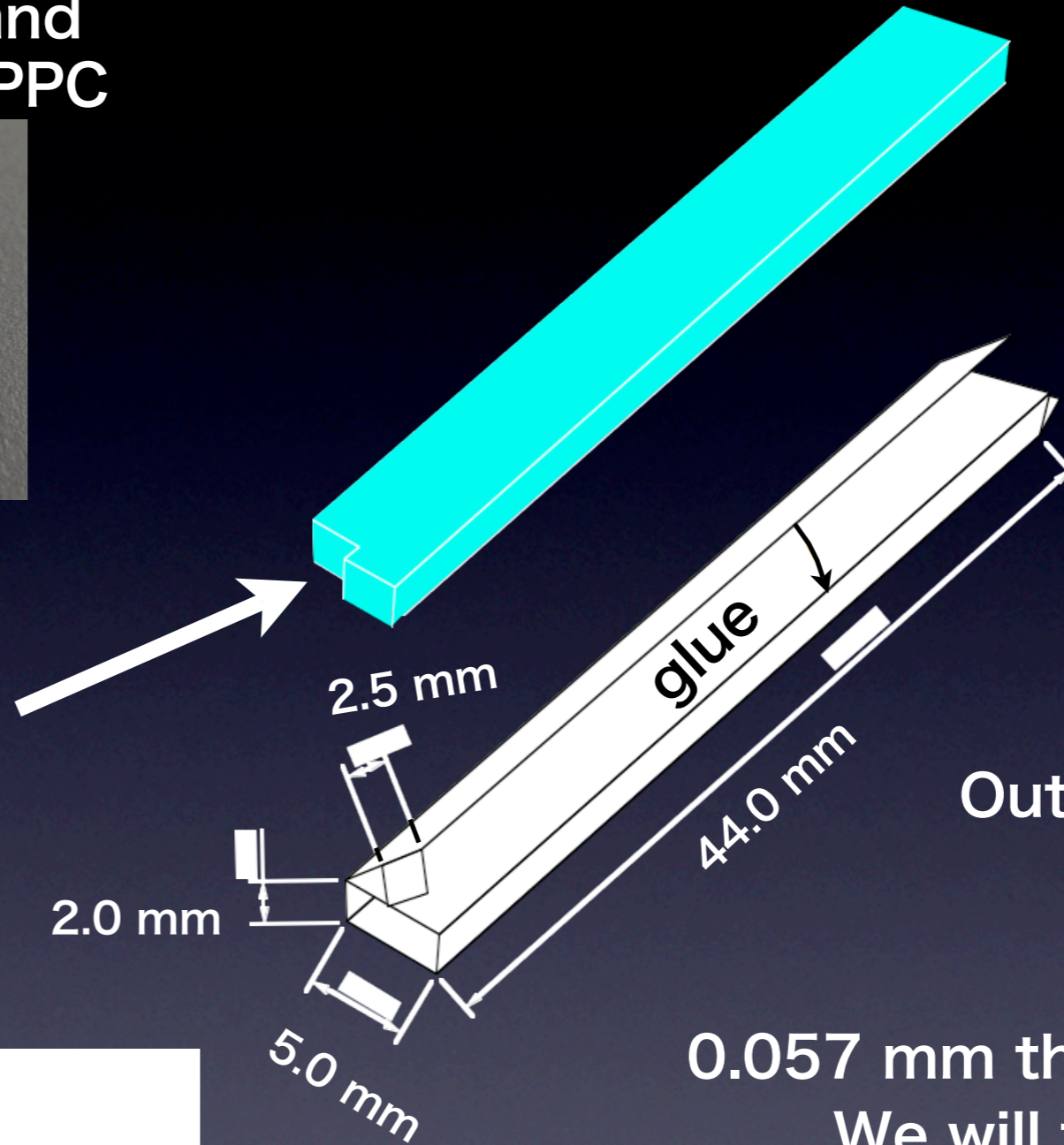


Scintillator-MPPC unit on PCB

Scintillator strip and Surface Mount MPPC



Backside of MPPC

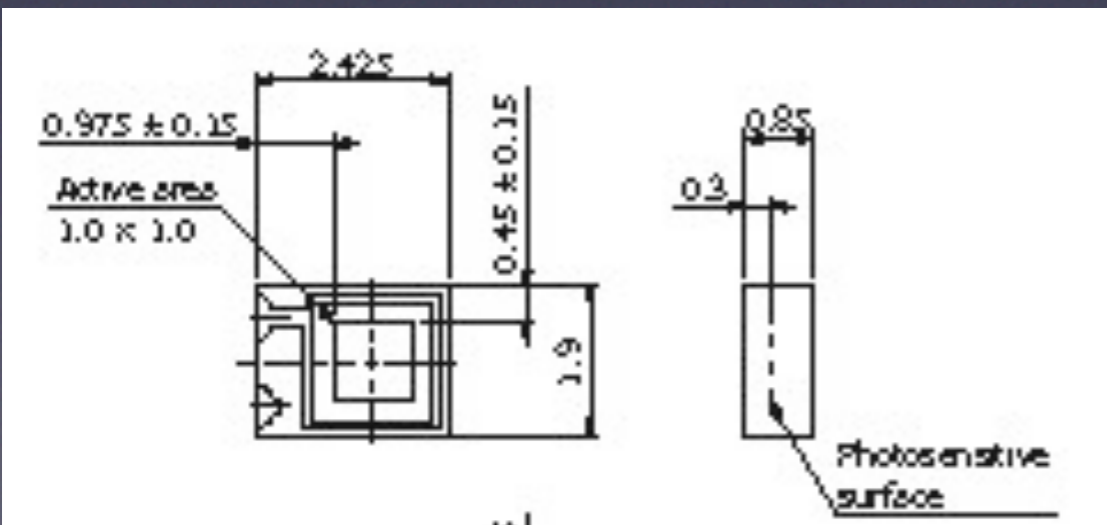


Out side scales

0.057 mm thick reflector
We will find thinner film

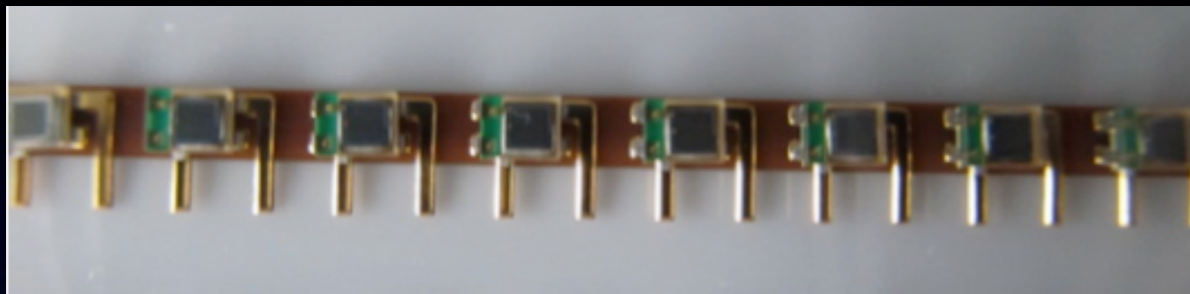
Hamamatsu developing more small package now

→ discussion with an engineer



Stacked channels

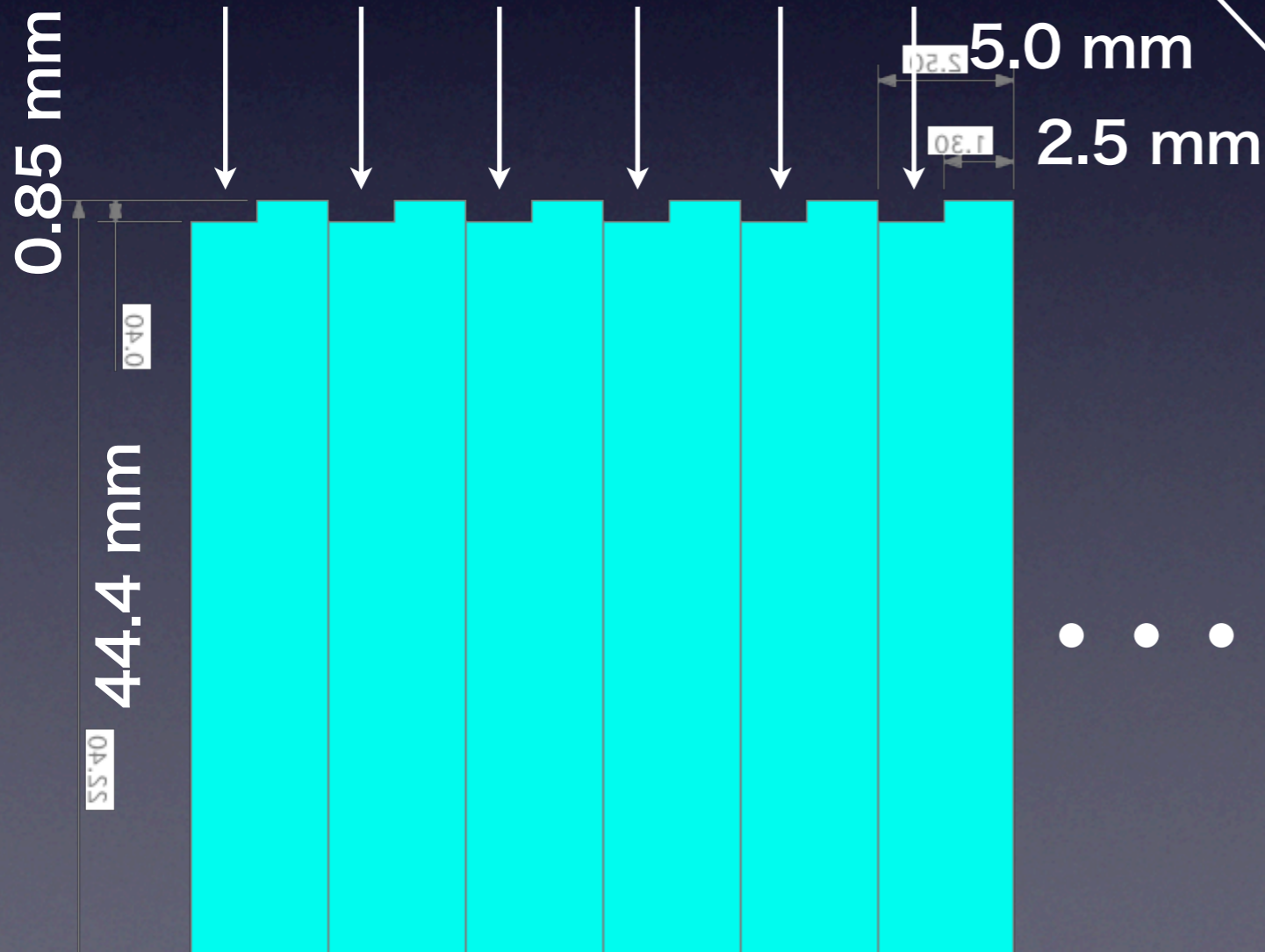
36 MPPCs soldered on electrodes
on a polyimide ribbon



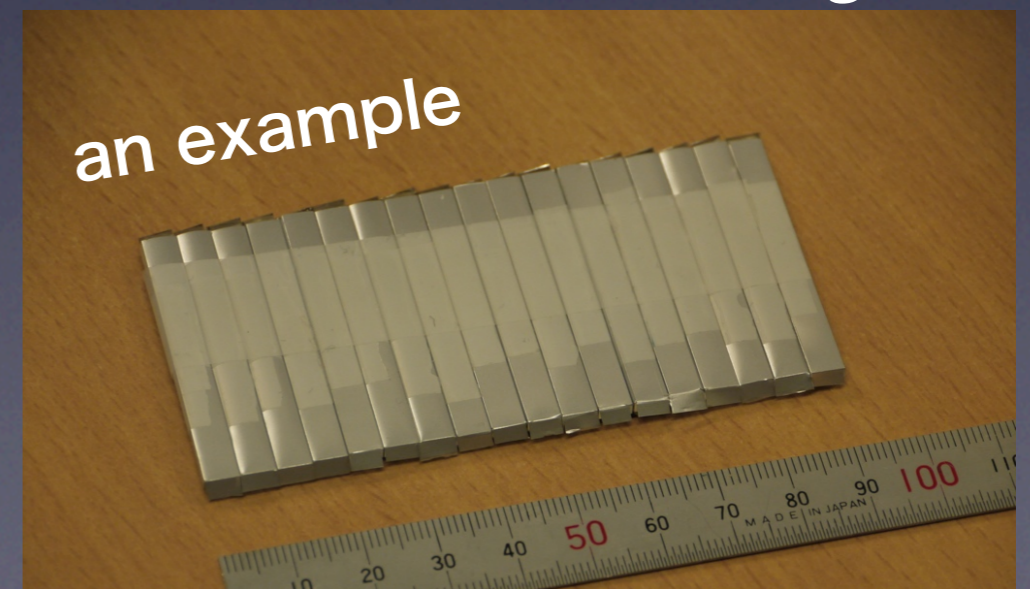
Thickness of ribbon: 0.06 mm

Thickness of electrode: 0.5 mm

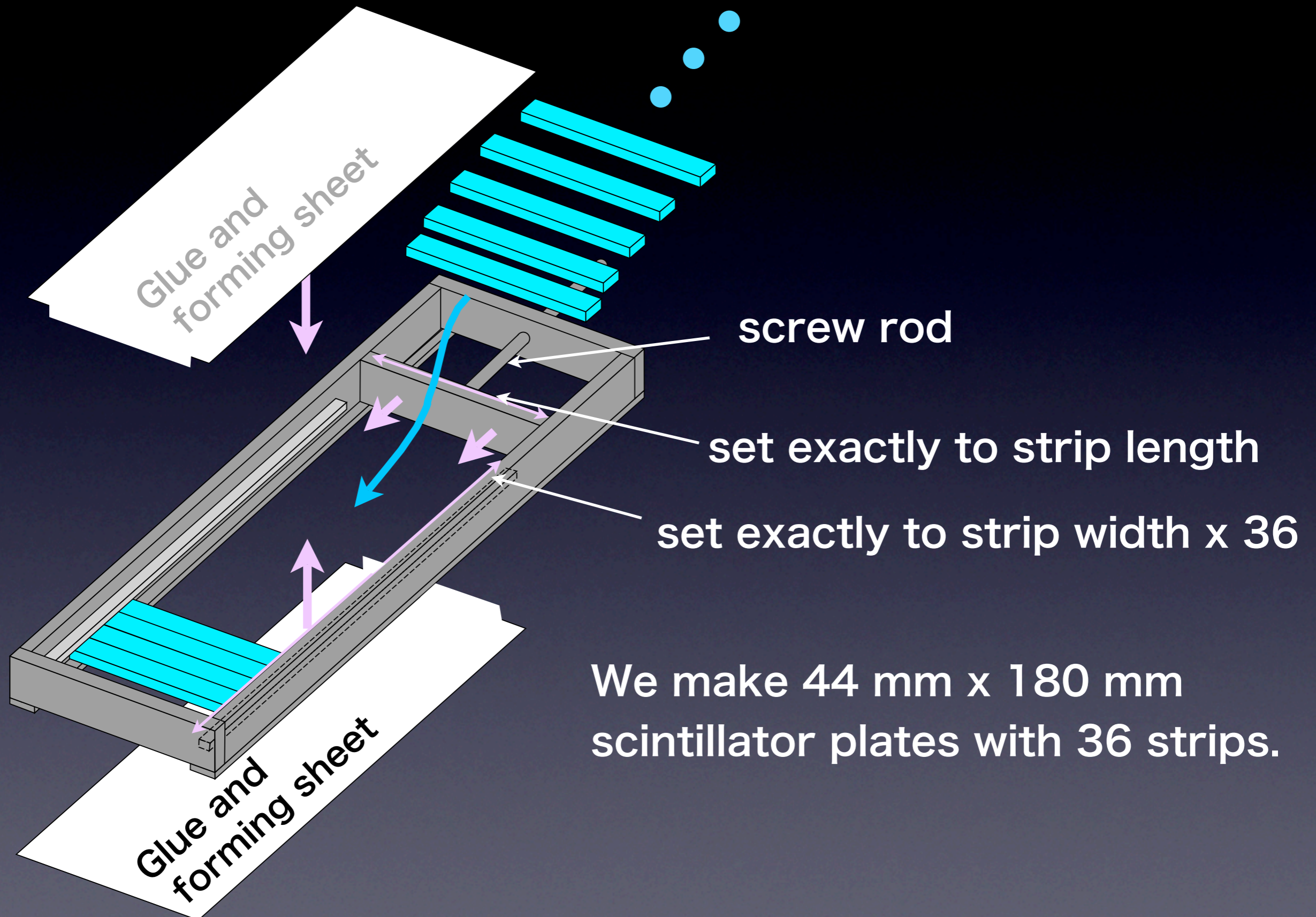
Thickness of MPPC: 0.85 mm



18 scintillator strips enveloped in
reflector film stacked together



How to make them be rigid together



In alveolar/ without Carbon fiber

Tungsten absorber:
3.00 mm

Scinti. Form plate
inc. glue: 0.05 mm

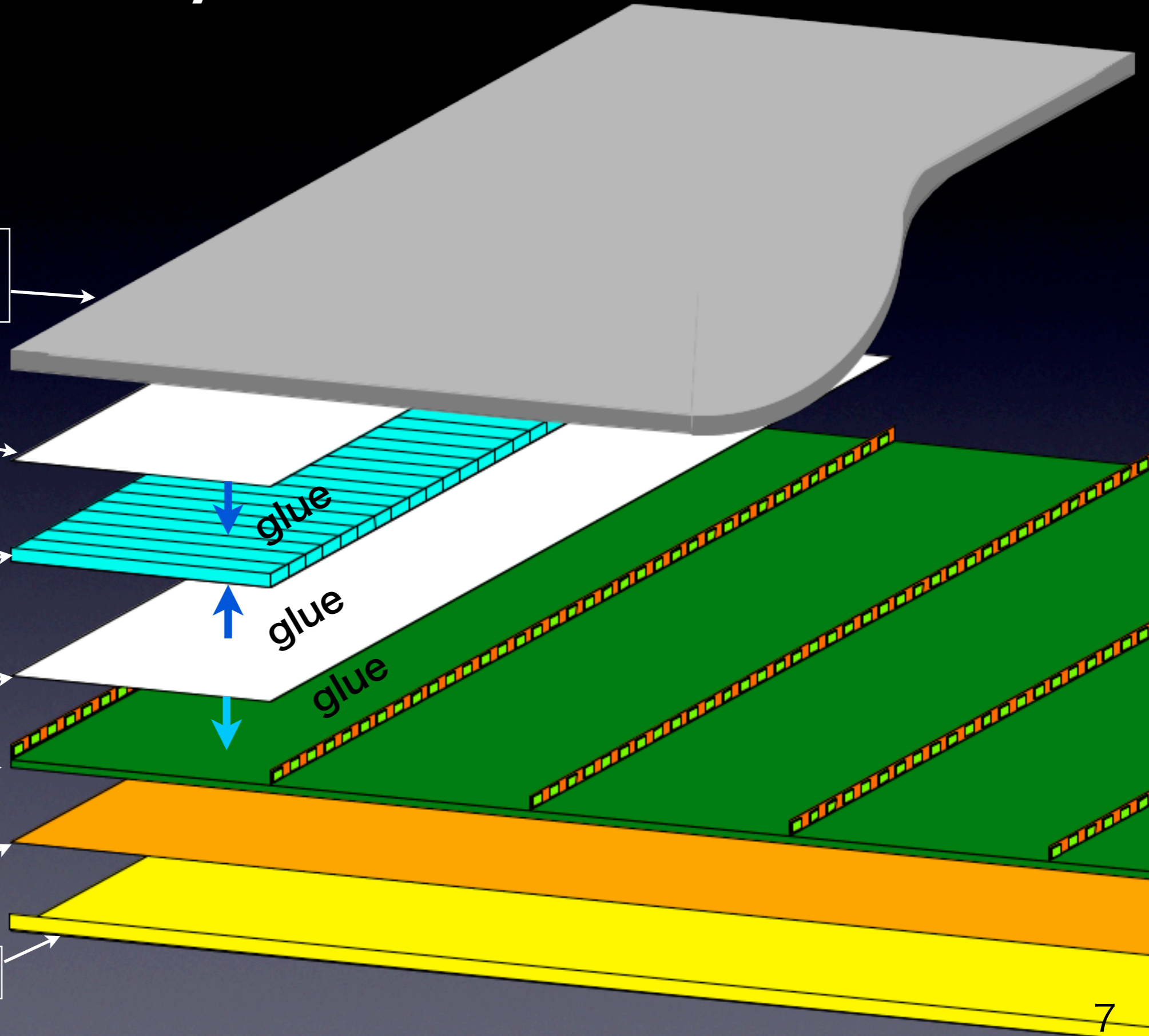
Scinti. inc.
reflector 1.80 mm

Scinti. Form plate
inc. glue: 0.05 mm

PCB: 0.80 mm

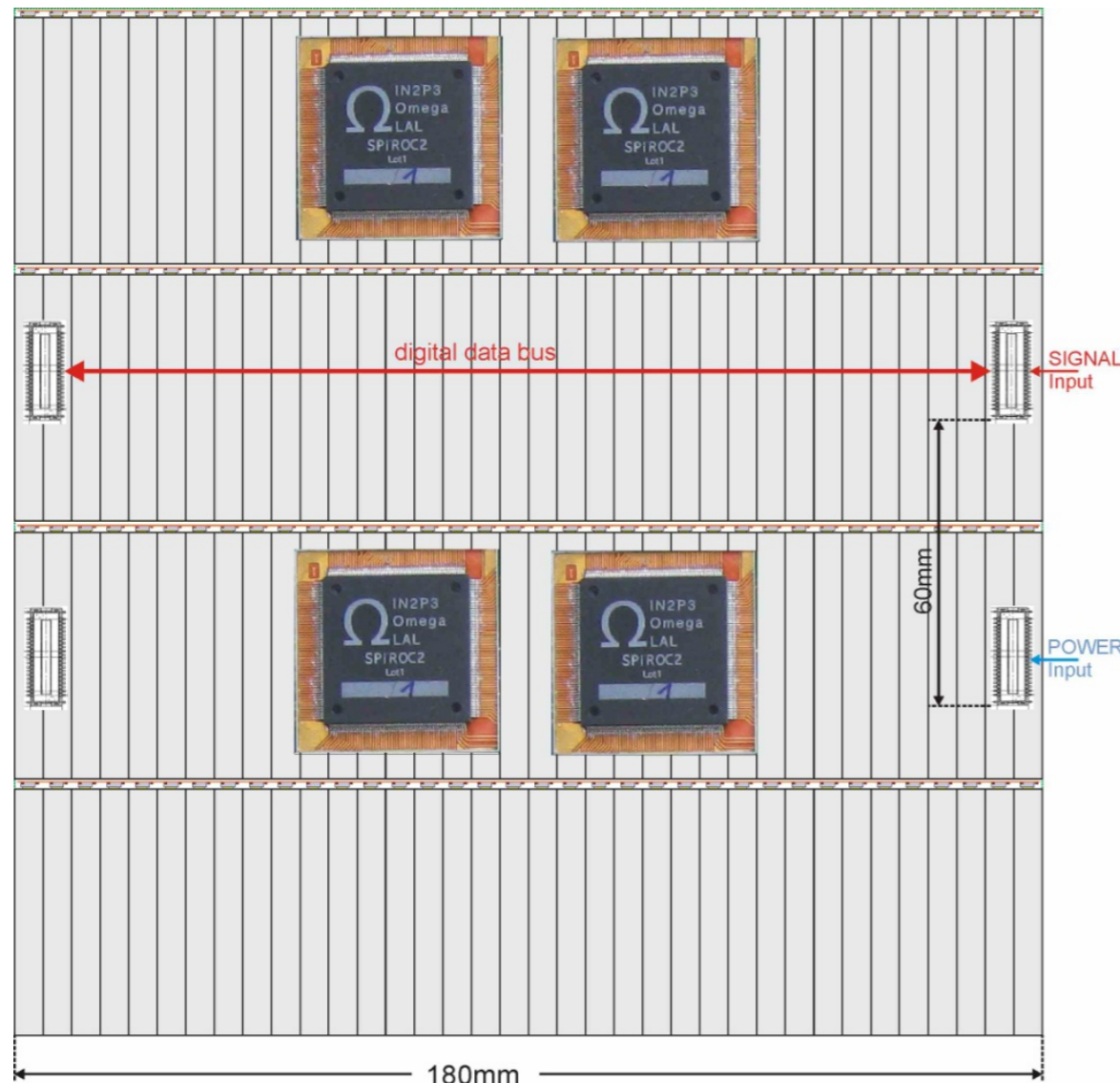
Copper radiator:
0.40 mm

Shielding: 0.10 mm



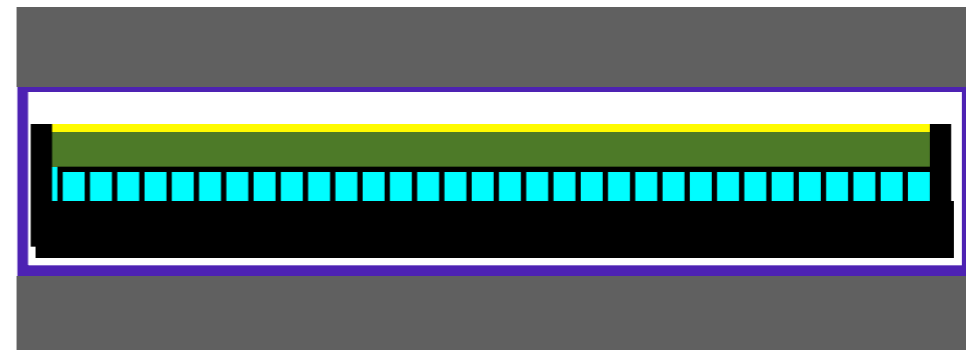
For Mechanical prototype

Using HBU technic for AHCAL,
Mathias (DESY) is developing also
ScECA PCB (EBU)

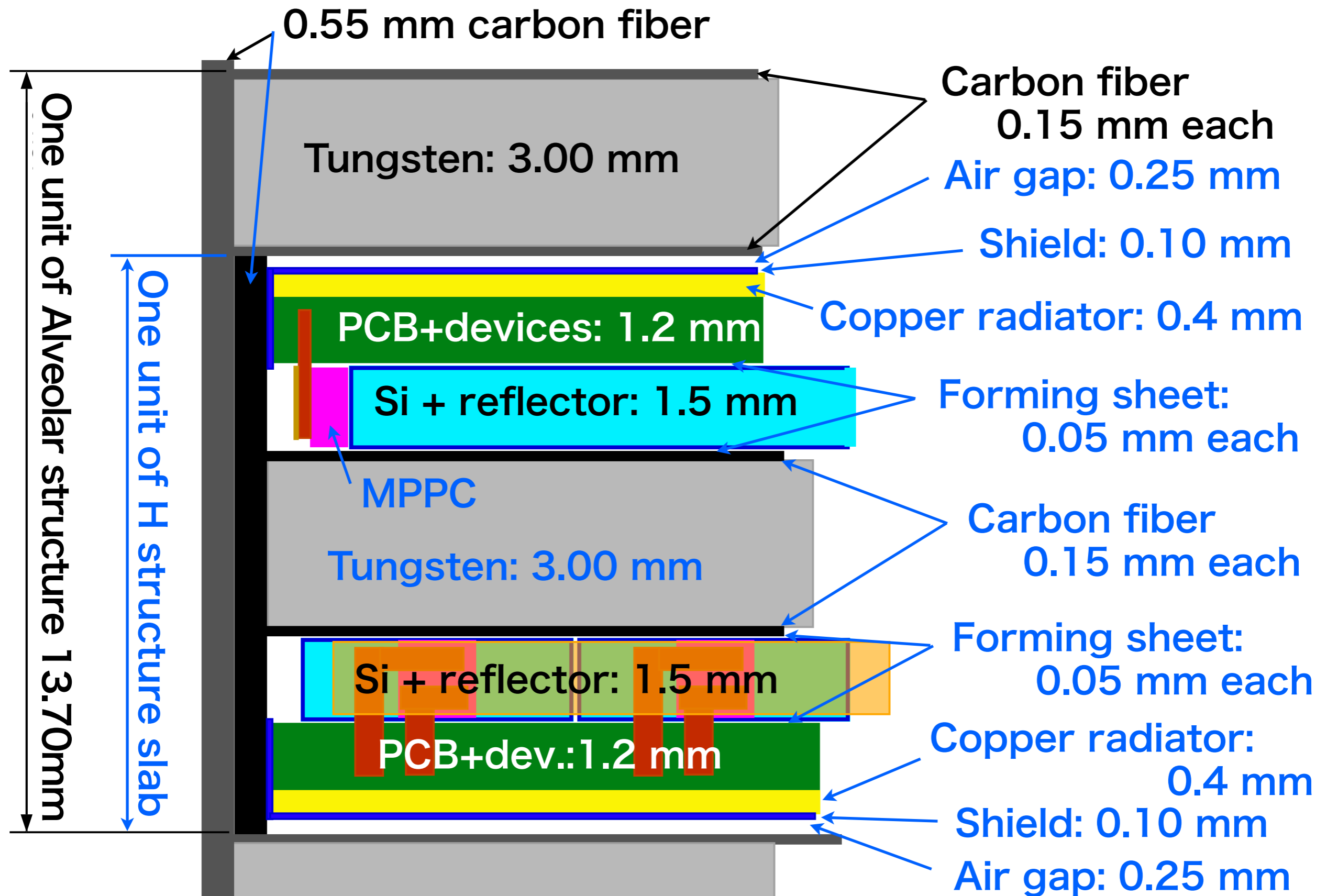


- Using SPIROCII
- 1.8 mm thickness

We will use U structure
instead of H structure for
the mechanical prototype

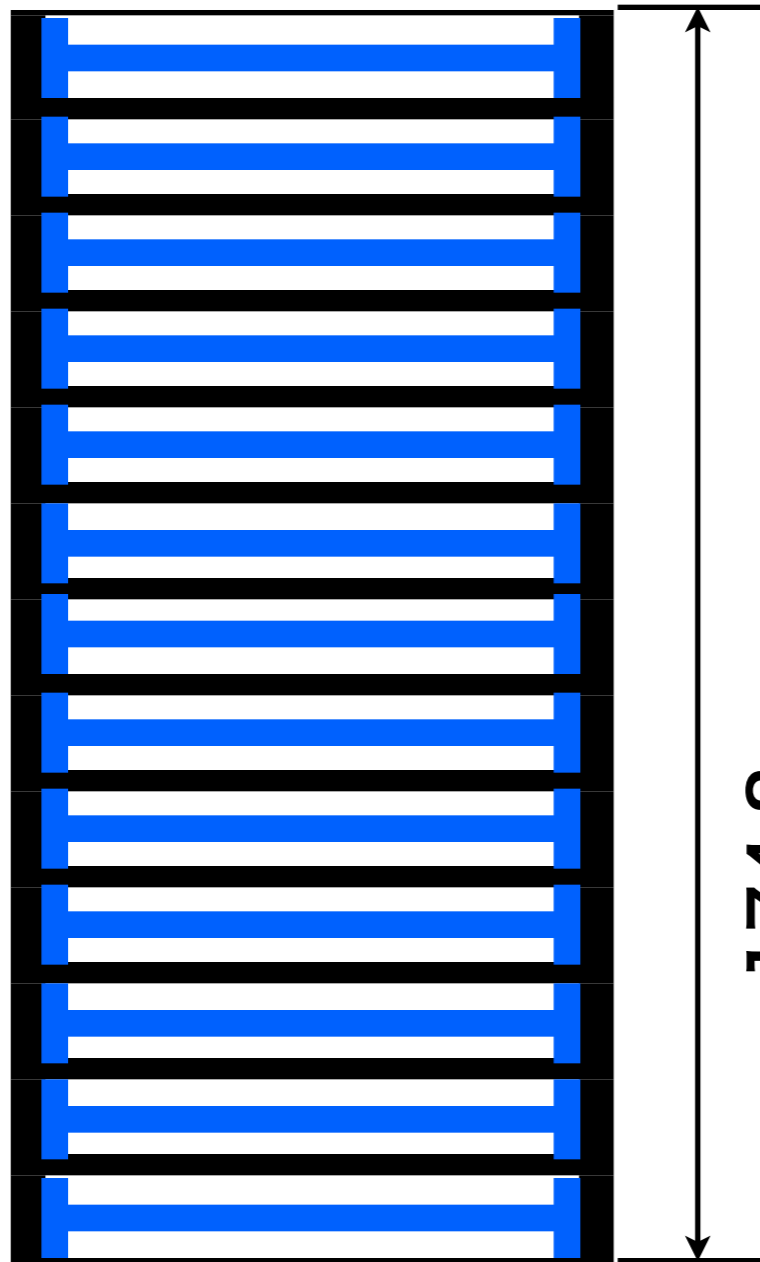


One unit of alveolar (a pair of Sc)



Module thickness and Gap

9.3 mm support

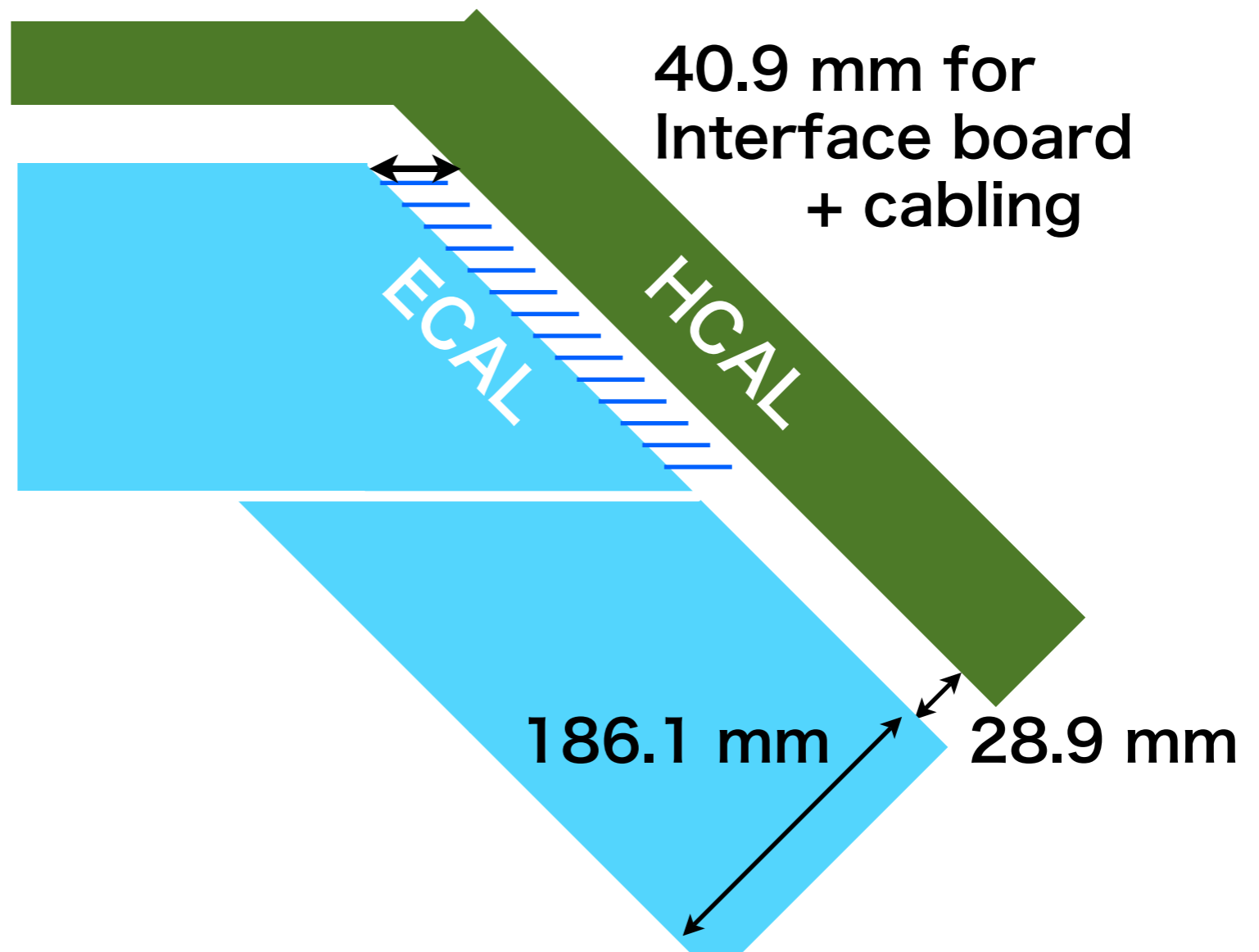


174.8 mm



2.0 mm front face

- 13 alveolars, 25 tungsten layers
- 21.5 X_0
- Total 186.1 mm Module thickness allows 28.9 mm between HCAL inner most surface



40.9 mm for
Interface board
+ cabling

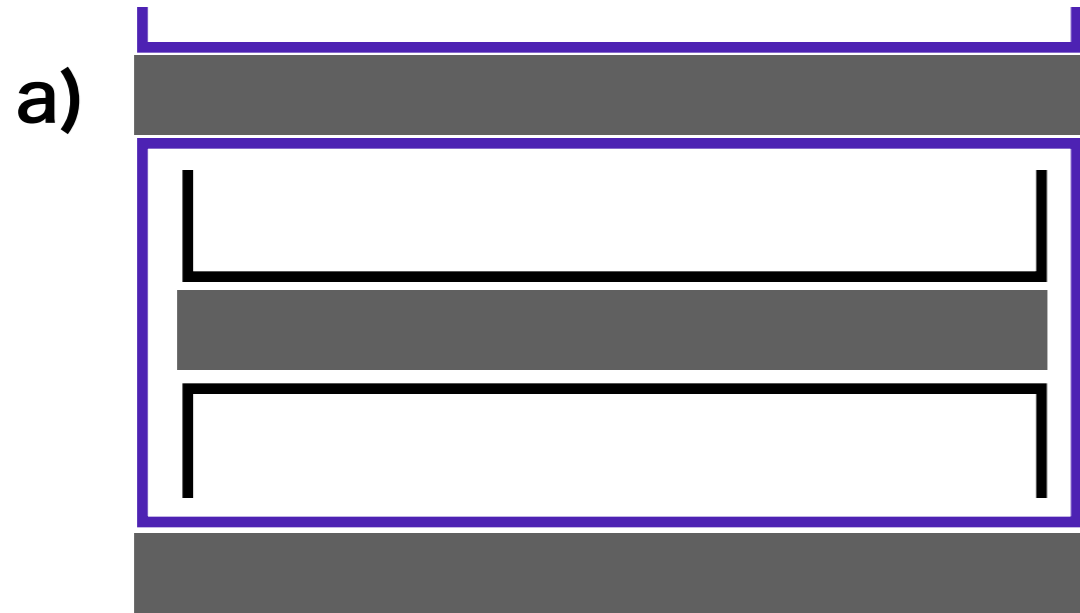
ECAL

HCAL

186.1 mm

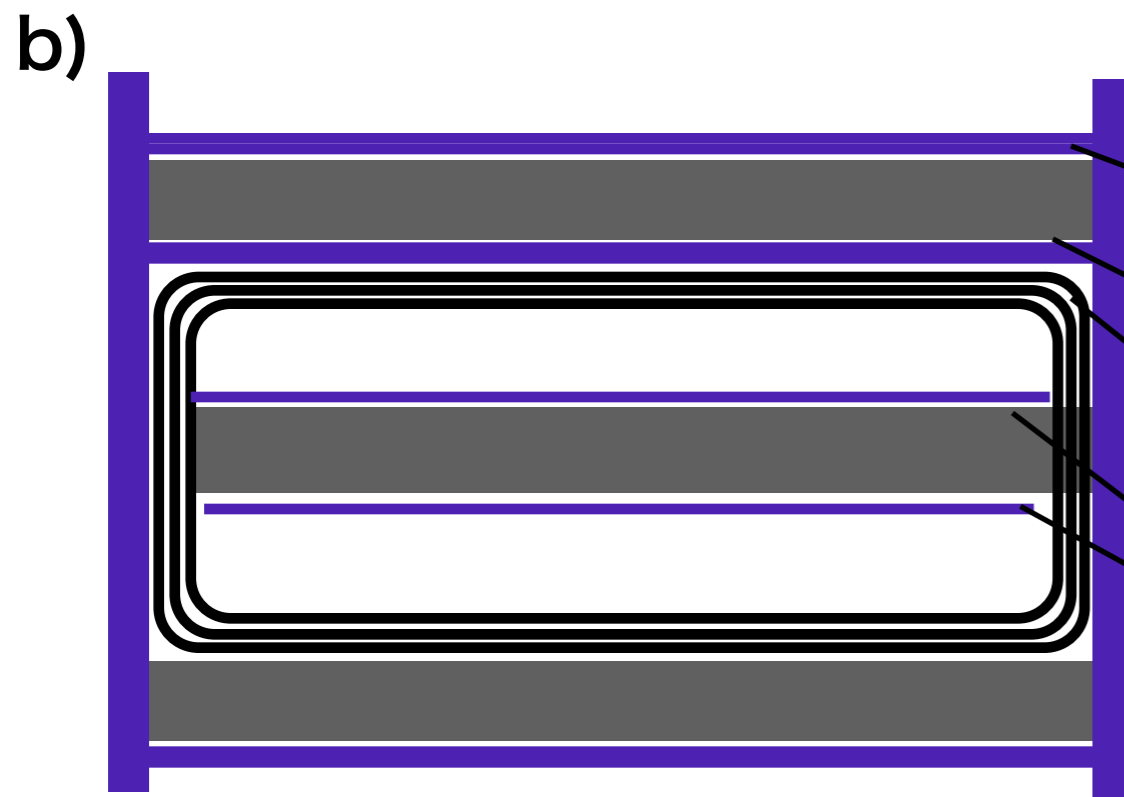
28.9 mm

Carbon fiber thickness



a) not practical design... too thin

b) EUDET mechanical prototype design (one unit is 0.25 mm)



Future design, one unit 0.15 mm

0.15 (or 0.25) mm x 2

0.15 (or 0.25) mm x 2

0.15 (or 0.25) mm x 3

0.15 (or 0.25) mm x 1

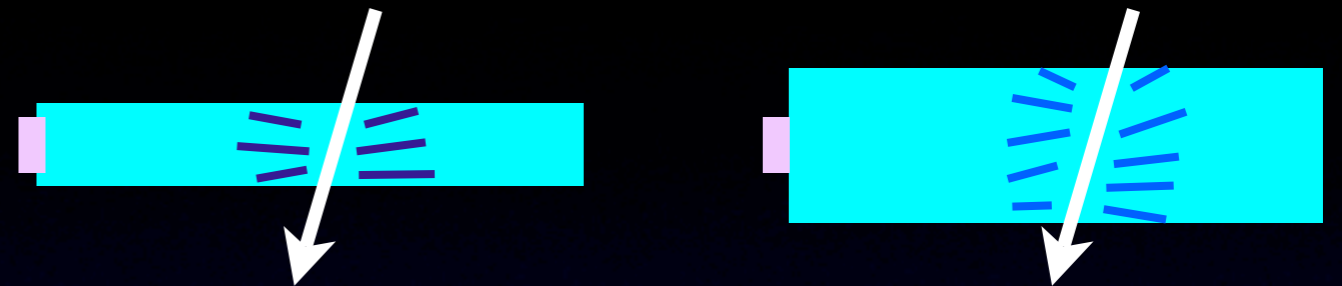
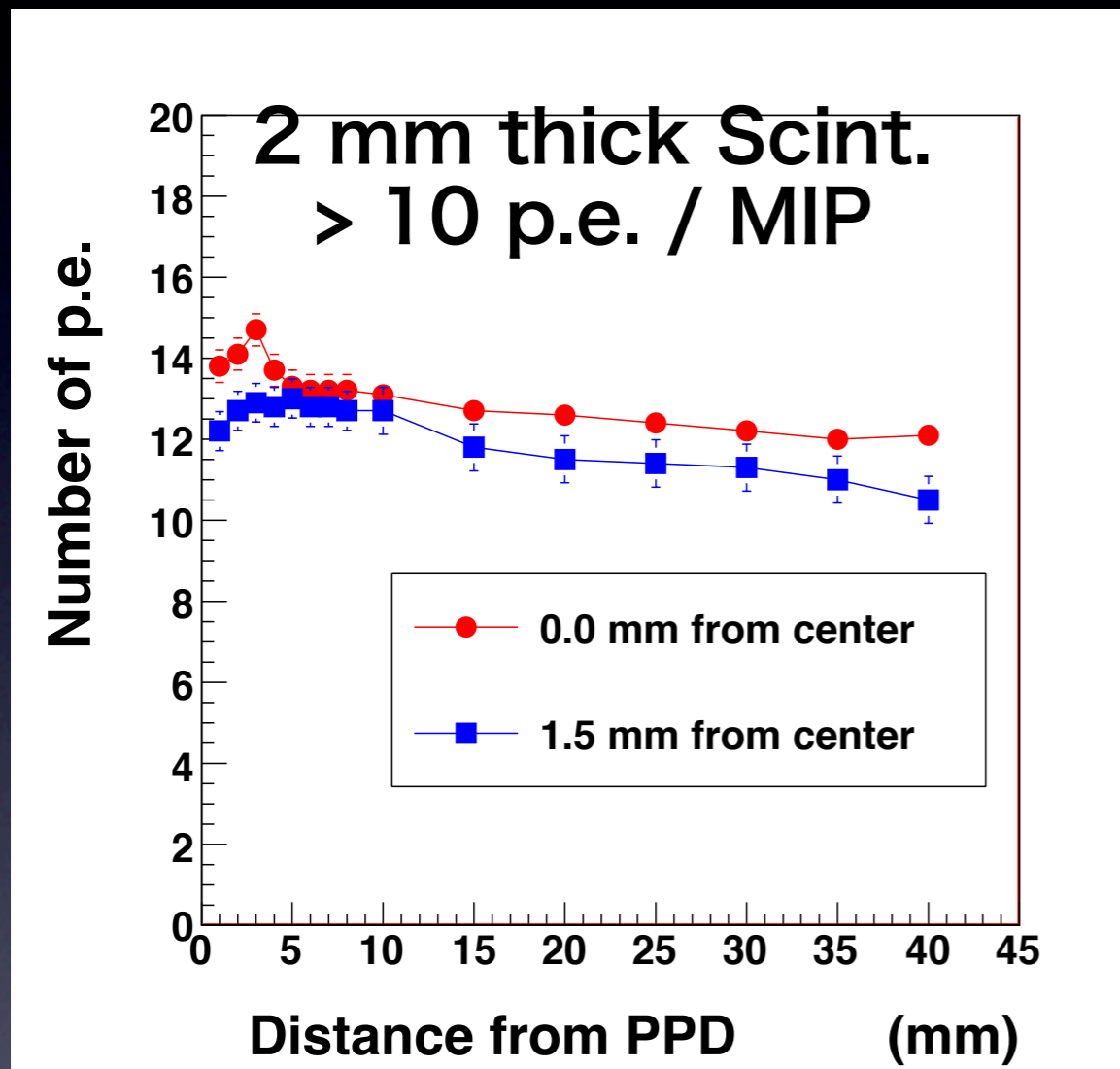
ScEcal Thickness Calculation

Thickness (mm)

				Default (Mokka) SiECAL				ScECAL 25 W, PCB: 0.8 mm				SeECAL 23 W, PCB: 1.2 mm			
The number of alveolar:				15				13				12			
		X0/Unit	Dens.												
				#	Unit	Total	#X0	#	Unit	Total	#X0	#	Unit	Total	#X0
for Alveolar structure	Front surface (G10)			1	2.00	2.00		1	2.00	2.00		1	2.00	2.00	
	Tungsten absorber (structure-1)	6.76	19.3	10	2.10	21.00	6.00	12	3.00	36.00	10.28	11	3.00	33.00	9.42
	Tungsten absorber (structure-2)	6.76	19.3	4	4.20	16.80	4.80								
	Support (G10)			1	9.30	9.30		1	9.30	9.30		1	9.30	9.30	
	Carbon fiber frame layer			56	0.15	8.40		48	0.15	7.20		44	0.15	6.60	
for H structure	Tungsten absorber(in alveolar-1)	6.76	19.3	10	2.10	21.00	6.00	13	3.00	39.00	11.13	12	3.00	36.00	10.28
	Tungsten absorber(in alveolar-2)	6.76	19.3	5	4.20	21.00	6.00								
	Carbon fiber frame layer			120	0.15	18.00		104	0.15	15.60		96	0.15	14.40	
	glue gap			30	0.10	3.00									
	Scintillator forming film + glue							52	0.05	2.60		48	0.05	2.40	
	Silicon Sensor	21.82	2.329	30	0.50	15.00	0.16								
	Scintillator + reflector	43.79	1.06					26	1.30	33.80	0.08	24	1.50	36.00	0.09
	ground			30	0.10	3.00		26	0.00	0.00		24	0.00	0.00	
	PCB			30	0.80	24.00		26	0.80	20.80		24	1.20	28.80	
	Copper radiator			30	0.40	12.00		26	0.40	10.40		24	0.40	9.60	
	Shielding film			30	0.10	3.00		26	0.10	2.60		24	0.10	2.40	
Alveolar air gap			30	0.25	7.50		26	0.25	6.50		24	0.25	6.00		
Module Total thickness						185.00				185.80				186.50	
Total number of tungsten absorber 1				20				25				23			
Total number of tungsten absorber 2				9											
ECAL-HCAL gap						30.00				29.20				28.50	
ECAL inner surface – HCAL inner surface						215				215.00				215.00	
Total number of X0							22.94				21.495				✓19.79

Scintillator thickness

Position dependence of #p.e.



Scintillation is proportional to thickness of scintillator



but acceptance is proportional to the ratio MPPC height/scinti. height(thickness)

We expect that also 1.3 mm thick scintillator can make enough photon yield.

→ we will make confirmation in the near future.

Summary

- ScECAL construction was discussed.
- Current available layer structures are:

in 185 mm	# W layers	# X0	PCB thick	Scinti. thick
A	25	21.5	0.80 mm	1.3 mm
B	23	19.8	1.2 mm	1.5 mm

- Many knowledge are from SiECAL study. thanks!
- We need to clarify the following:
 - is PCB 0.8 thickness OK? (EBU thickness ~1.8mm. Thanks mathius)
 - is 40 mm space for DAQ interface OK?
 - is performance OK with 3 mm x 23 W layers, 19.8 X₀? We will test make simulation
 - does 1.3 mm thick scintillator have enough photon yields? we will show it
 - What design of structure support by using carbon fiber can we choose?

Back up

ScEcal Thickness Calculation

Thickness (mm)

				Default (Mokka) SiECAL				ScECAL 25 W, PCB: 1.2 mm				SeECAL 25 W, PCB:1.4 mm			
	The number of alveolar:			15				13				13			
		X0/Unit	Dens.												
				#	Unit	Total	#X0	#	Unit	Total	#X0	#	Unit	Total	#X0
for Alveolar structure	Front surface (G10)			1	2.00	2.00		1	2.00	2.00		1	2.00	2.00	
	Tungsten absorber (structure-1)	6.76	19.3	10	2.10	21.00	6.00	12	3.00	36.00	10.28	12	3.00	36.00	10.28
	Tungsten absorber (structure-2)	6.76	19.3	4	4.20	16.80	4.80								
	Support (G10)			1	9.30	9.30		1	9.30	9.30		1	9.30	9.30	
	Carbon fiber frame layer			56	0.15	8.40		24	0.15	3.60		24	0.15	3.60	
for H structure	Tungsten absorber(in alveolar-1)	6.76	19.3	10	2.10	21.00	6.00	13	3.00	39.00	11.13	13	3.00	39.00	11.13
	Tungsten absorber(in alveolar-2)	6.76	19.3	5	4.20	21.00	6.00								
	Carbon fiber frame layer			120	0.15	18.00		26	0.15	3.90		26	0.15	3.90	
	glue gap			30	0.10	3.00									
	Scintillator forming film + glue							52	0.05	2.60		52	0.05	2.60	
	Silicon Sensor	21.82	2.329	30	0.50	15.00	0.16								
	Scintillator + reflector	43.79	1.06					26	1.50	39.00	0.09	26	1.30	33.80	0.08
	ground			30	0.10	3.00		26	0.00	0.00		26	0.00	0.00	
	PCB			30	0.80	24.00		26	1.20	31.20		26	1.40	36.40	
	Copper radiator			30	0.40	12.00		26	0.40	10.40		26	0.40	10.40	
	Shielding film			30	0.10	3.00		26	0.10	2.60		26	0.10	2.60	
Alveolar air gap			30	0.25	7.50		26	0.25	6.50		26	0.25	6.50		
Module Total thickness						185.00				186.10				186.10	
Total number of tungsten absorber 1				20				25				25			
Total number of tungsten absorber 2				9											
ECAL-HCAL gap						30.00				28.90				28.90	
ECAL inner surface - HCAL inner surface						215				215.00				215.00	
Total number of X0							22.94				21.507				21.49