



LHCb Upgrade Fibre Tracker Module design concept

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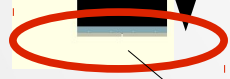
Fibre Tracker Layout

1 module

0.529 m wide



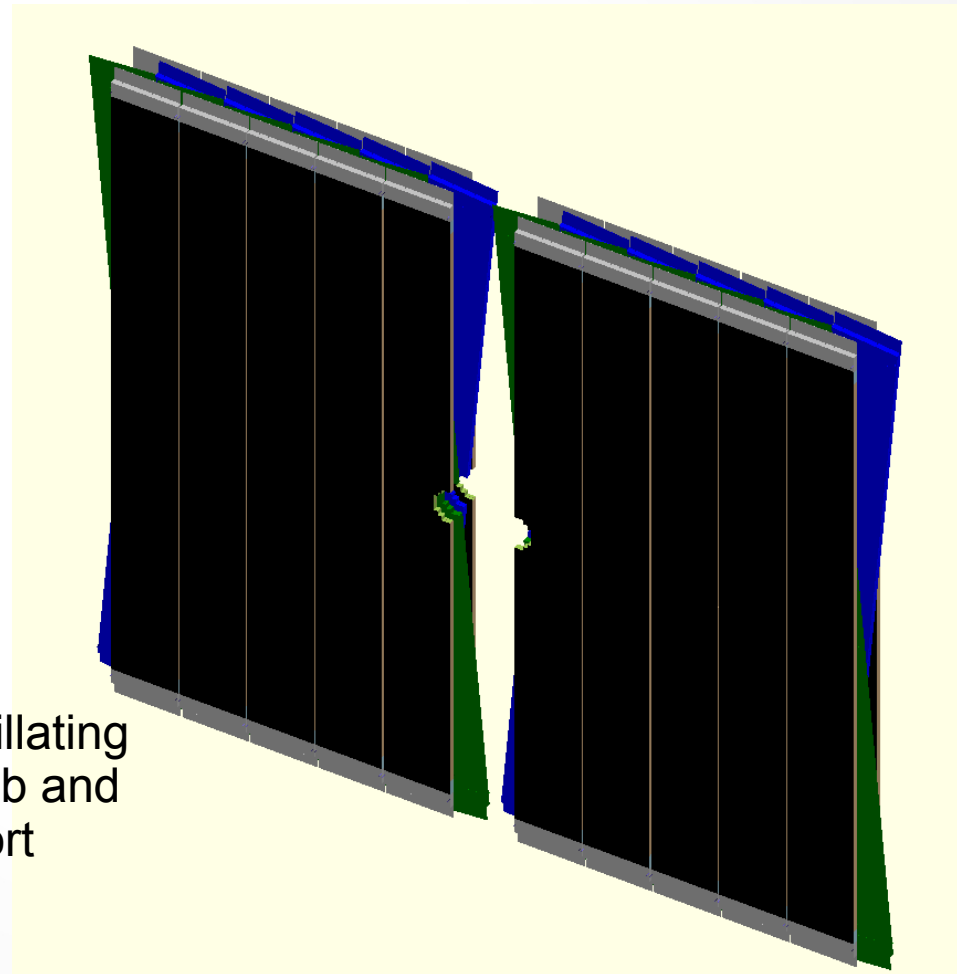
5 m long



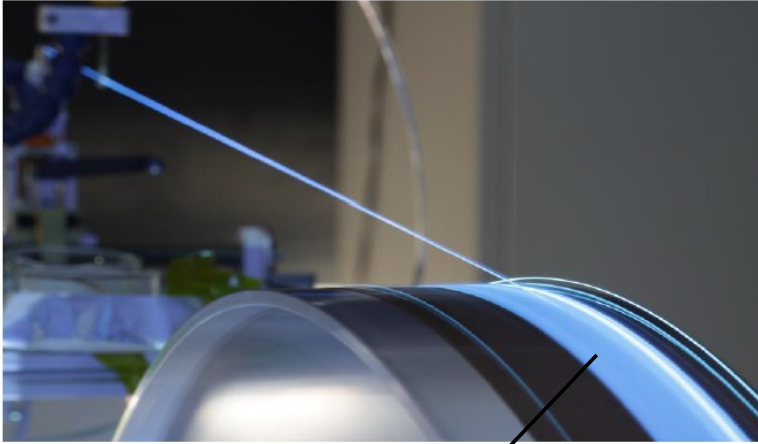
CF "Panel" = scintillating fibres + honeycomb and carbon fibre support

"Endcap" = cooling / readout / electronics box

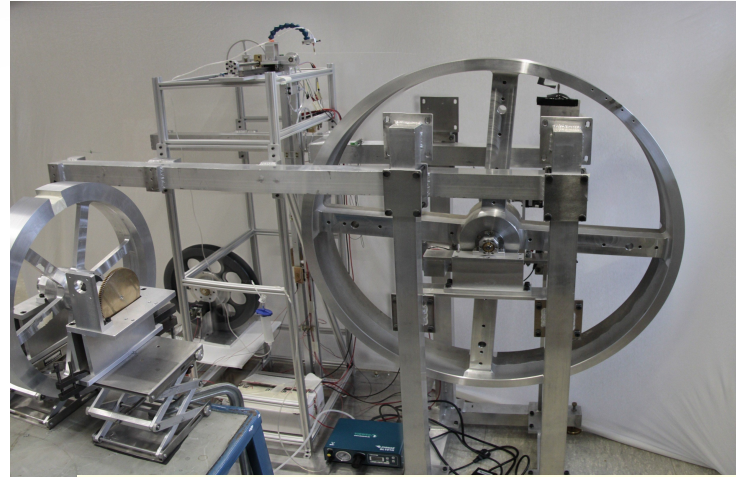
1 station = 4 layers of 10 + 2 modules each



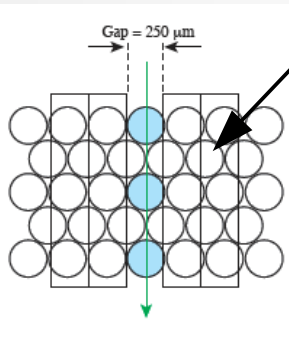
Fibre Winding and Mats



1. Winding



4. Layer



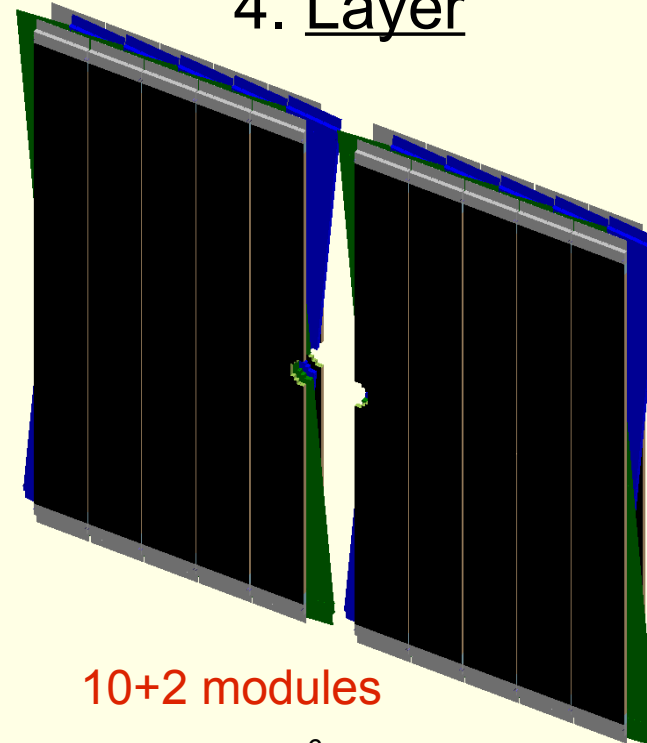
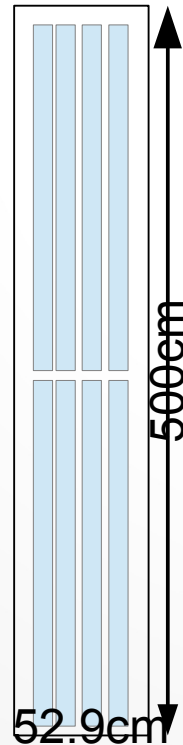
13.2cm

250cm

8 mats

6.6 km of fibre

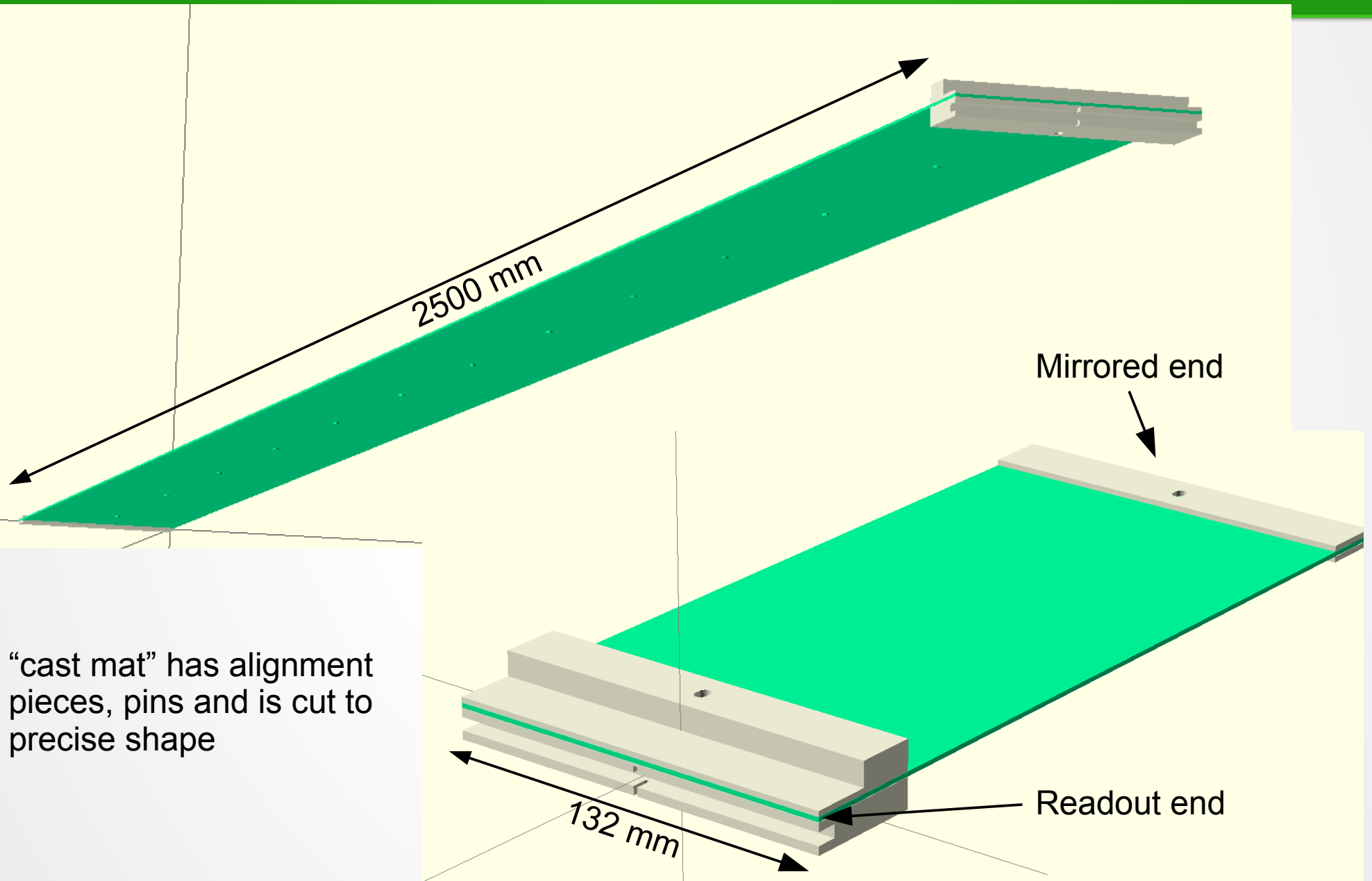
3. Module



10+2 modules

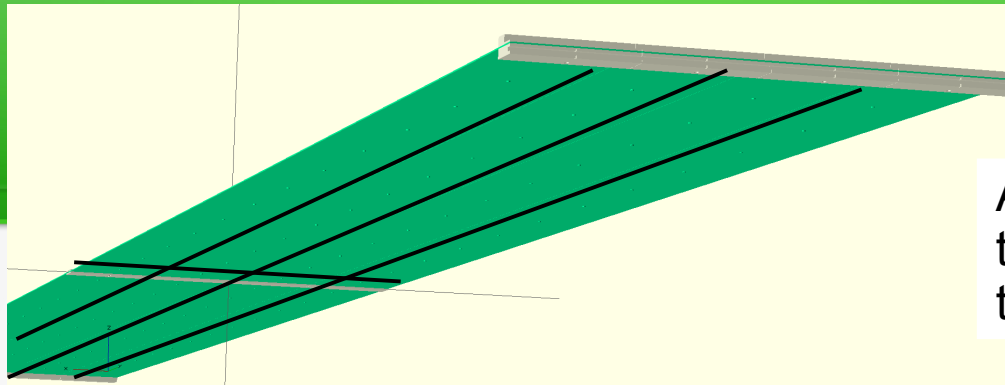
$\sim 8-10 \times 10^6$ m of good fibre for 3 layers

Fibre Mats



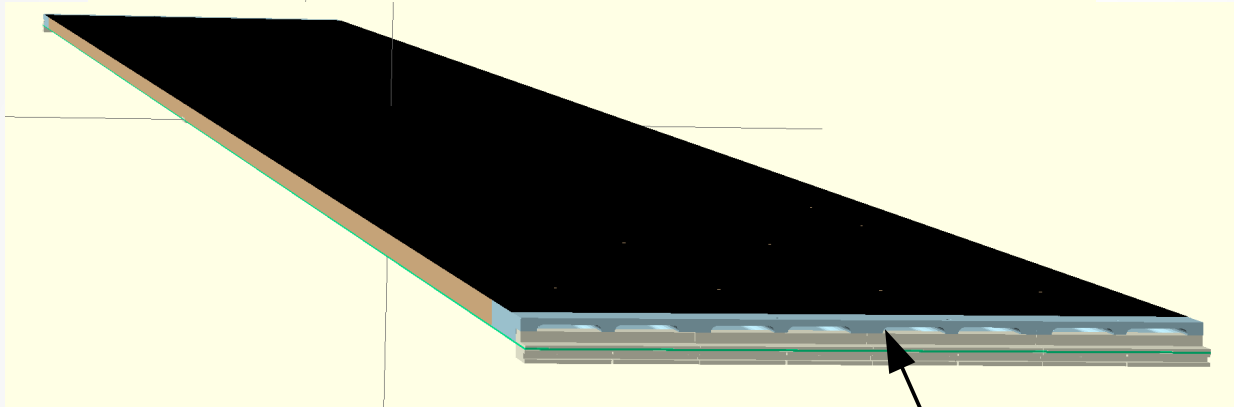
“cast mat” has alignment pieces, pins and is cut to precise shape

1.



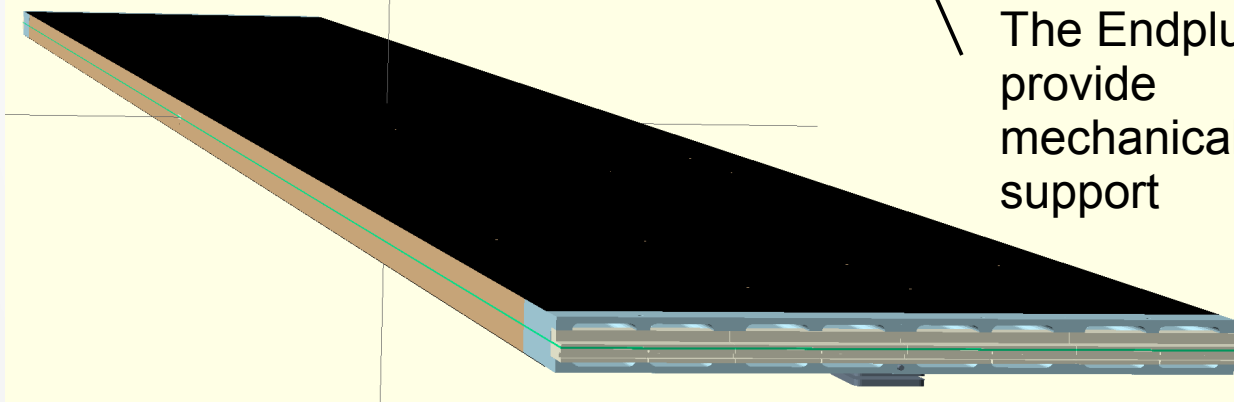
Align 8 mats on a template / vacuum table

2.



Align and bond one side of the Honeycomb/CF panel and "Endplug"

3.



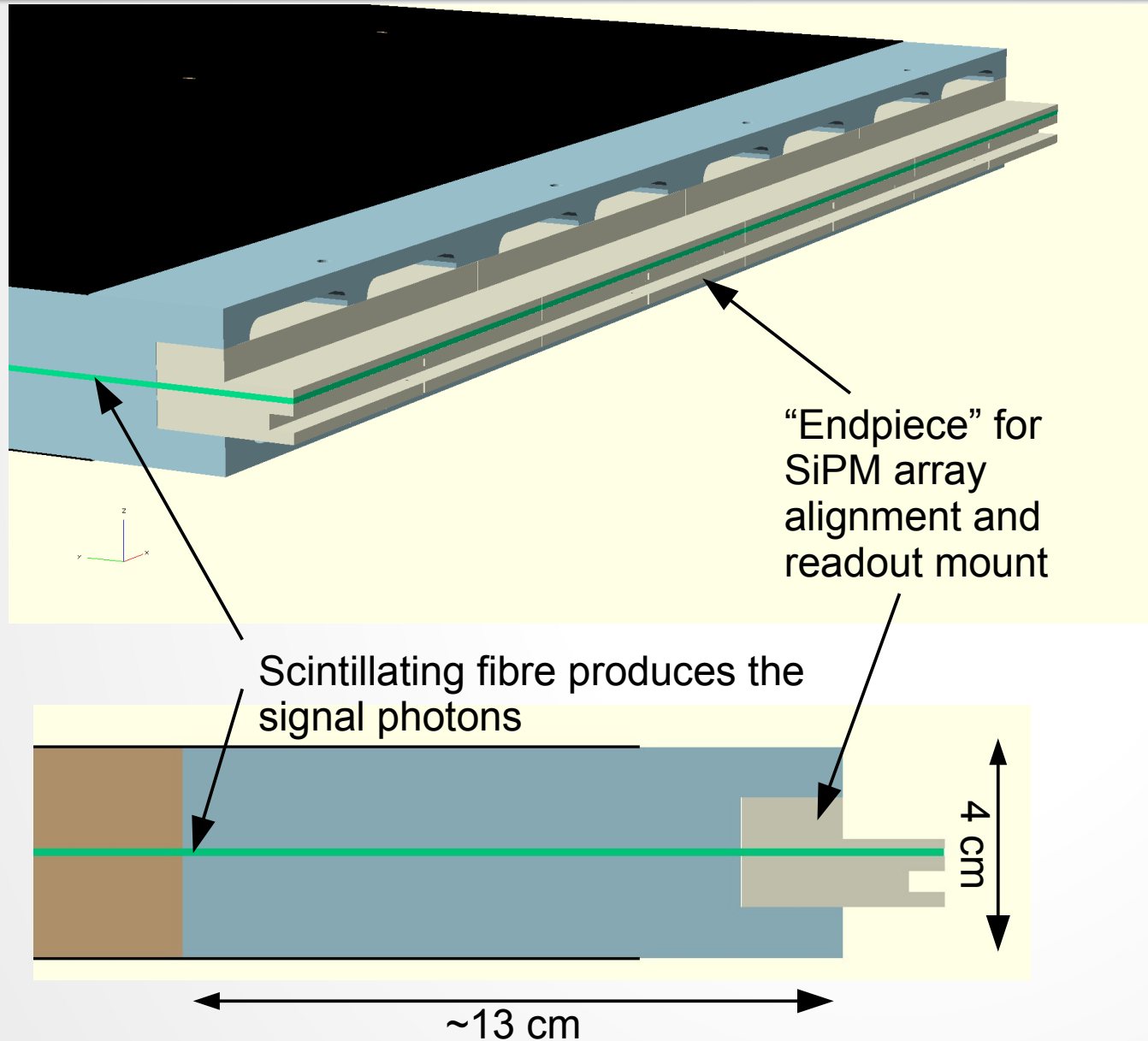
The Endplug will provide mechanical support

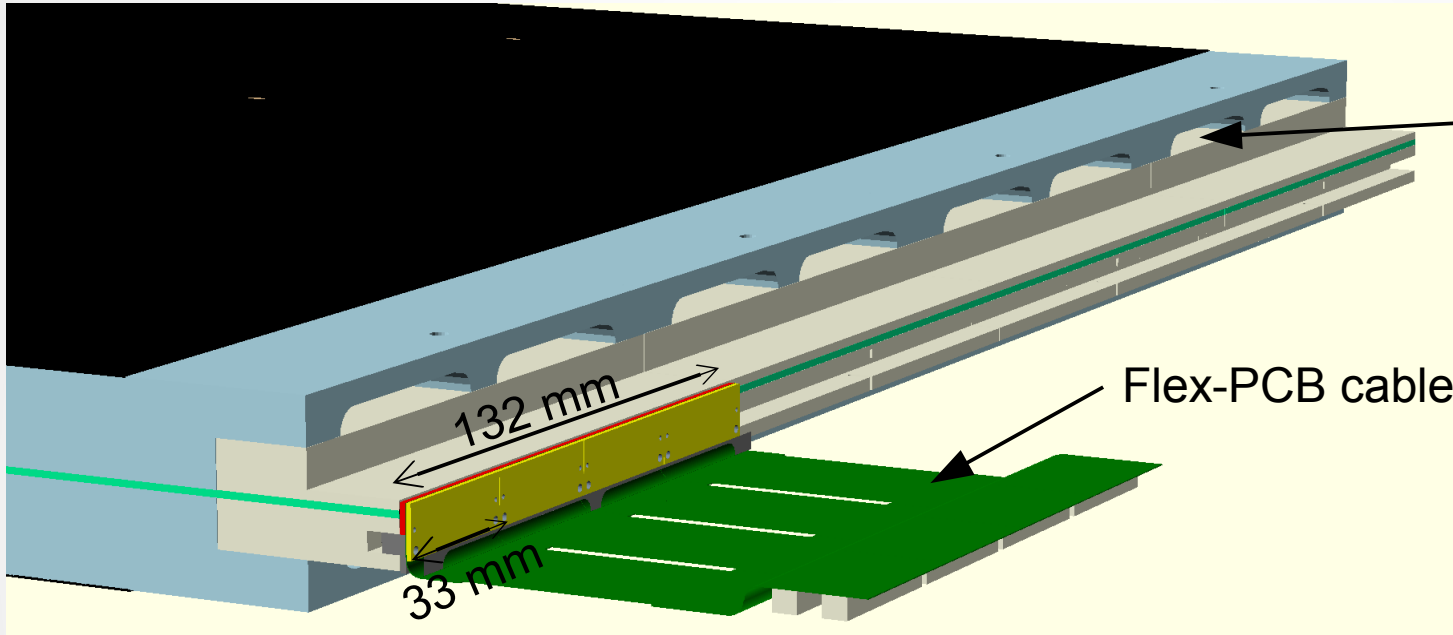
Flip and repeat

4.

Sides will be taped to ensure light tightness, and likely wrapped in Tedlar or other foil to ensure dry and dark environment within the panel.

The Endcap Region

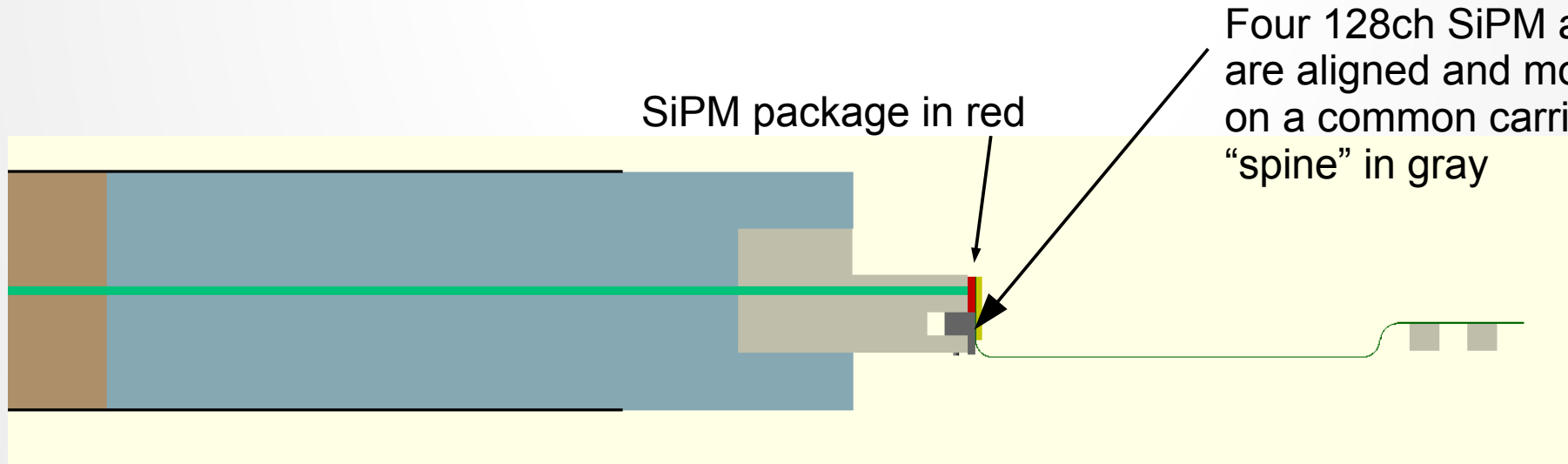




Pockets in the endplug for material removal and thermal barrier

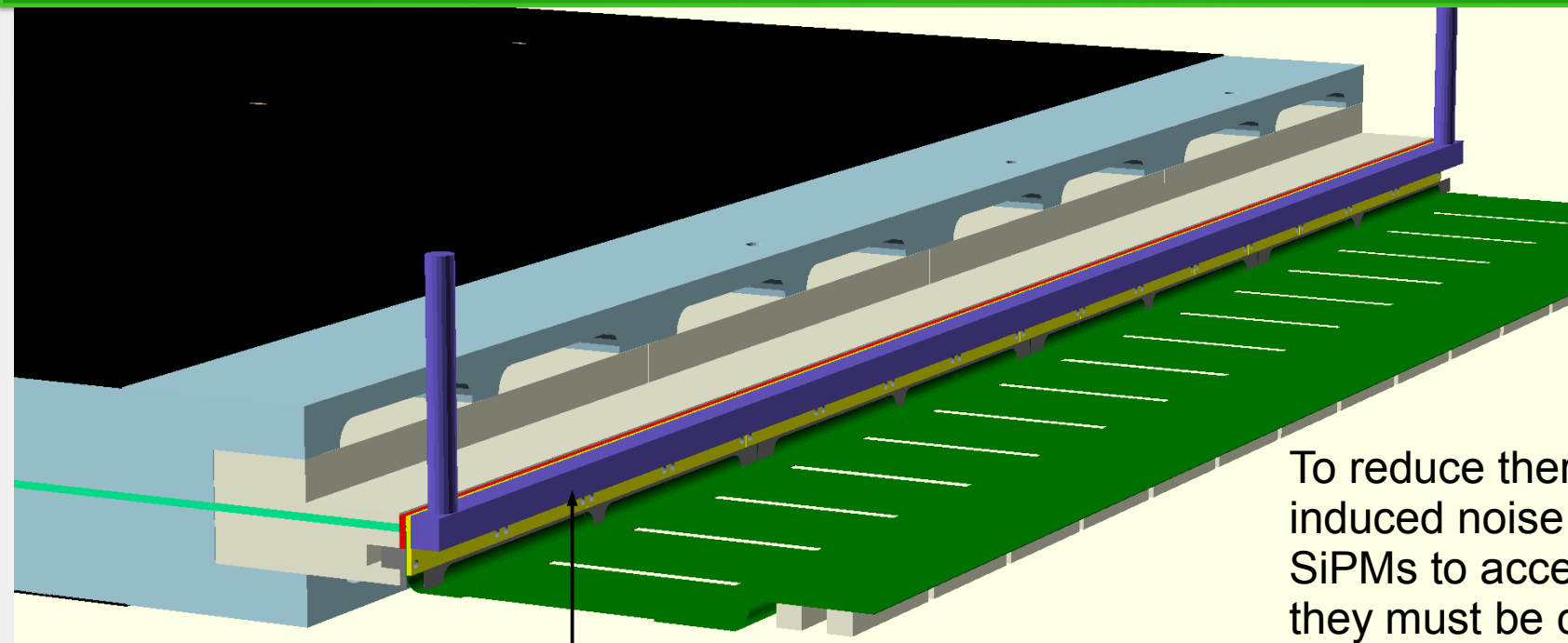
Flex-PCB cable

132 mm
33 mm



SiPM package in red

Four 128ch SiPM arrays are aligned and mounted on a common carrier "spine" in gray



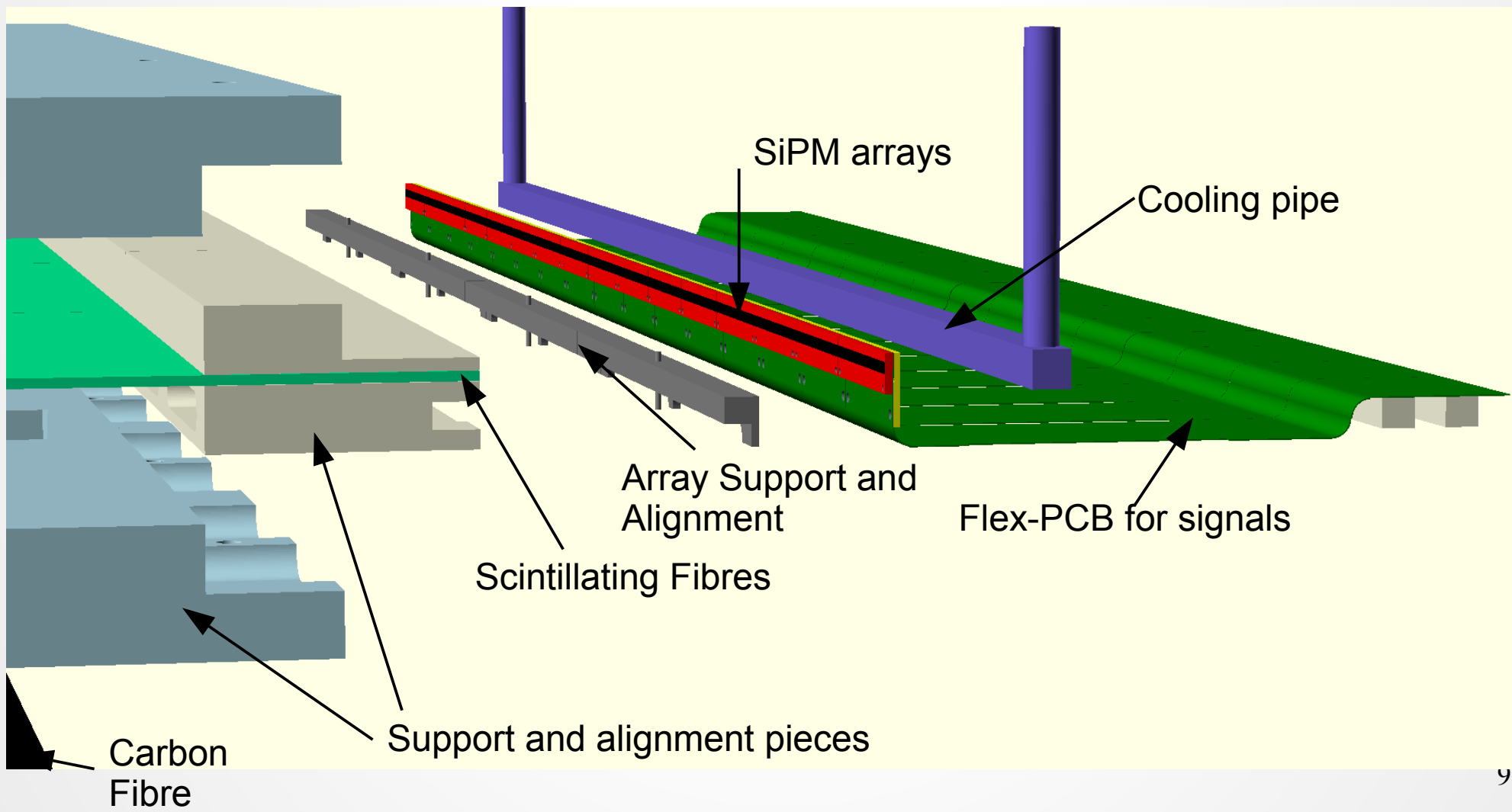
To reduce thermal and radiation induced noise signals in the SiPMs to acceptable levels, they must be cooled below -40 Celcius

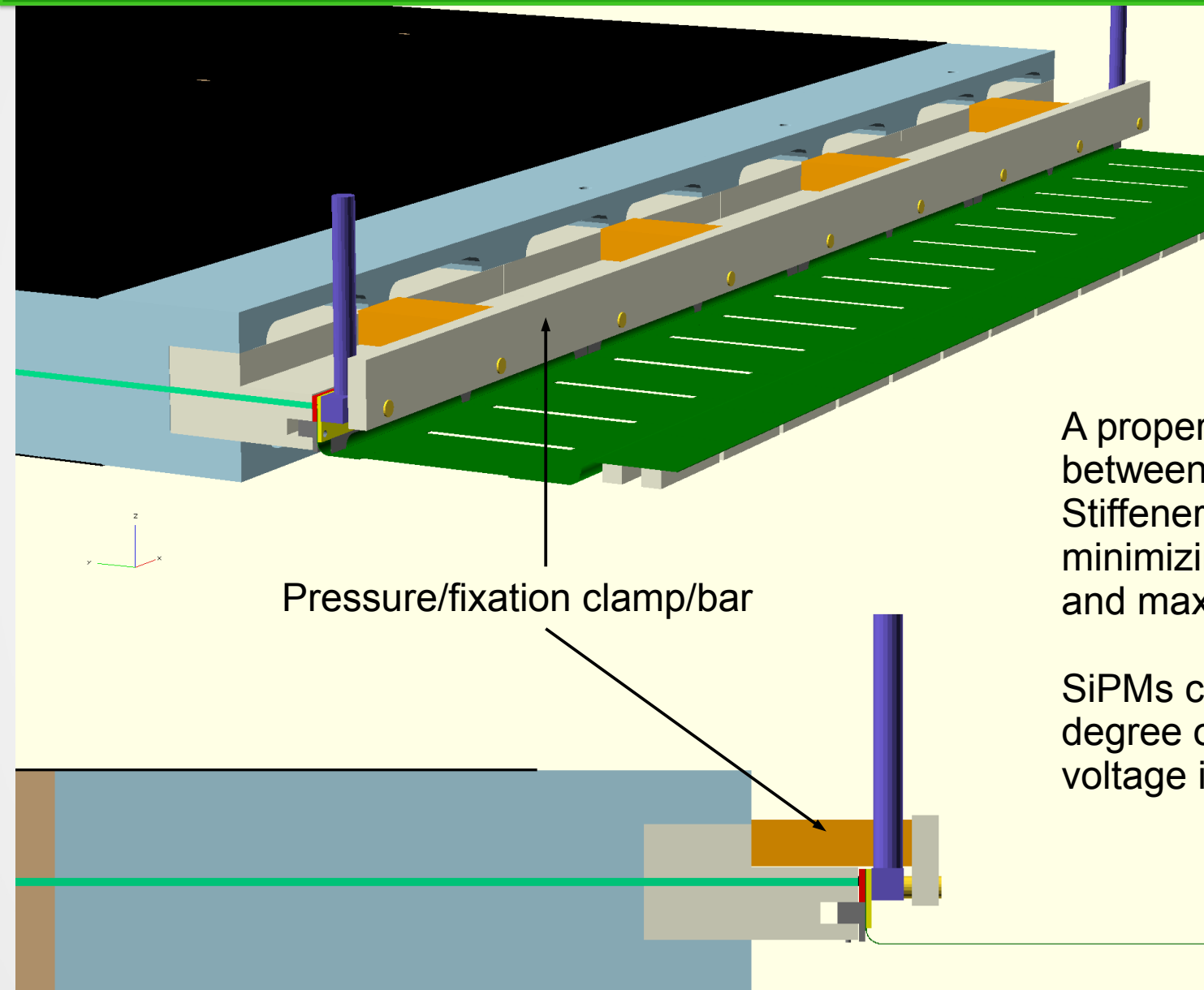
Cooling pipe

No fixed solution to what the cooling will be.... but it needs to be scalable to cover 150m of SiPMs

"stiffener" in yellow

SiPM package in red

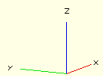
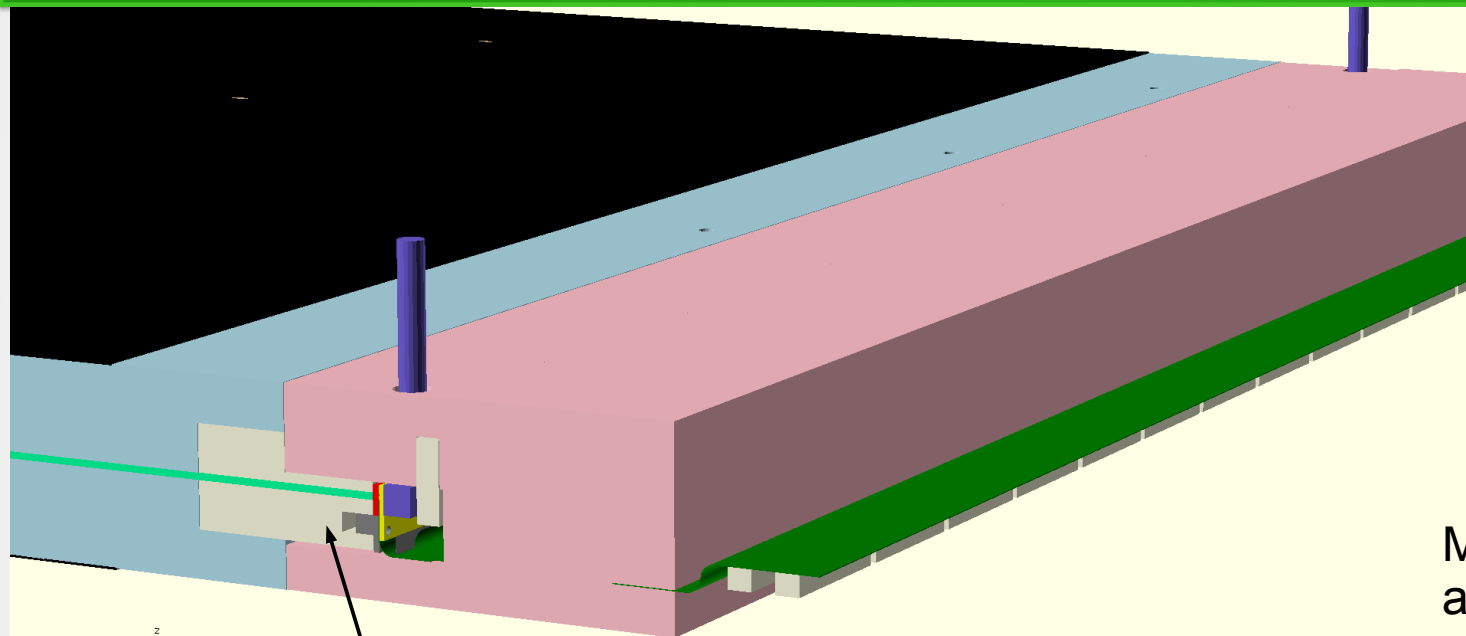




Pressure/fixation clamp/bar

A proper thermal contact between the cold pipe and the Stiffener is very important for minimizing thermal gradients and maximizing transfer

SiPMs can only tolerate <1 degree of ΔT (breakdown voltage is T dependant)



No room for insulation on the end!

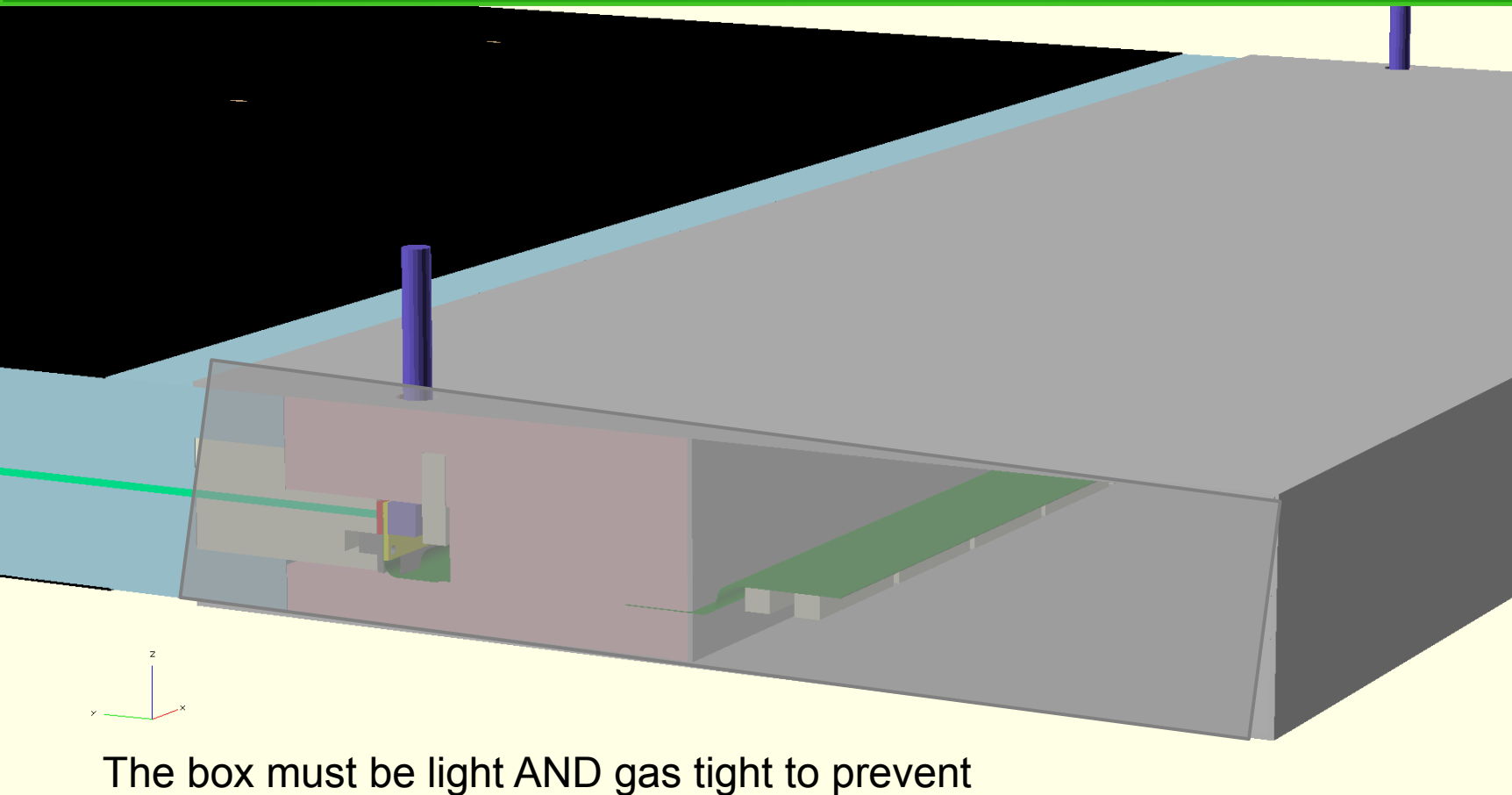
Minimizing the heat load and preventing condensation and frost on the outer surfaces is very important.

Must be $>15\text{C}$

-40C

Warm front-end electronics go here.

Must be $>15\text{C}$



The box must be light AND gas tight to prevent condensation/frost and stray light to the SiPMs

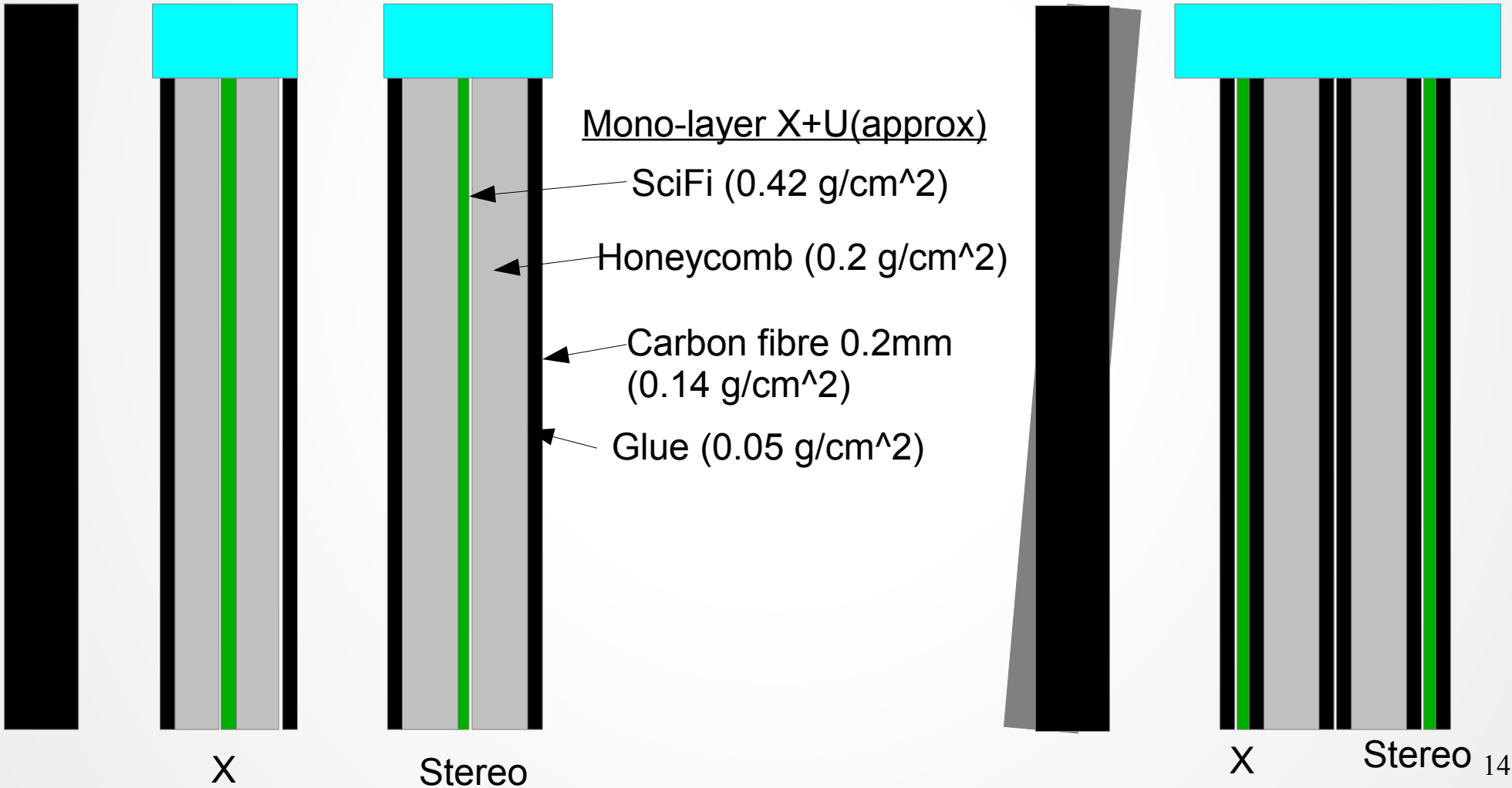
Will need to be flushed with dry nitrogen

The End.

• Mono-layer

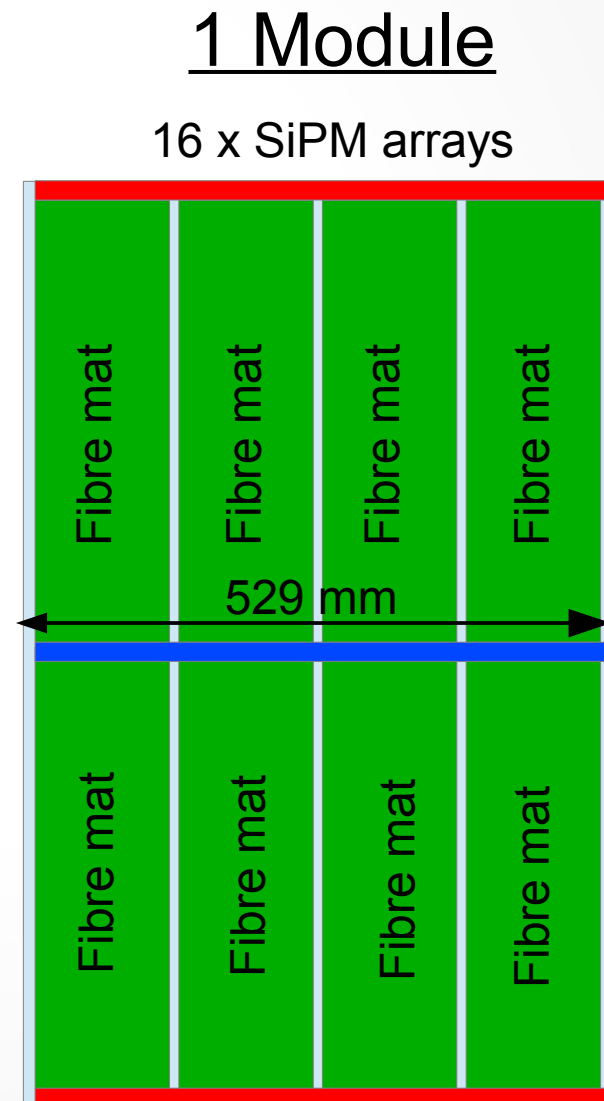
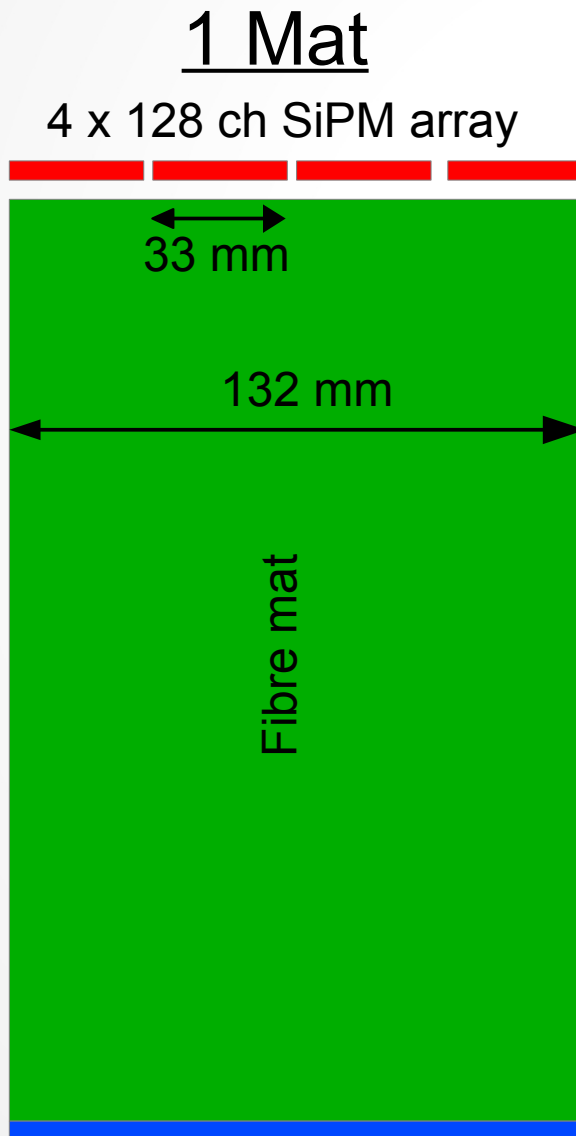
or

Bi-Layer



Backup

- Segmentation



Backup

- Beam pipe cutout

