

TPC Electronics / Cooling

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2013.12.18 ILC Tokusui MTG @ KEK

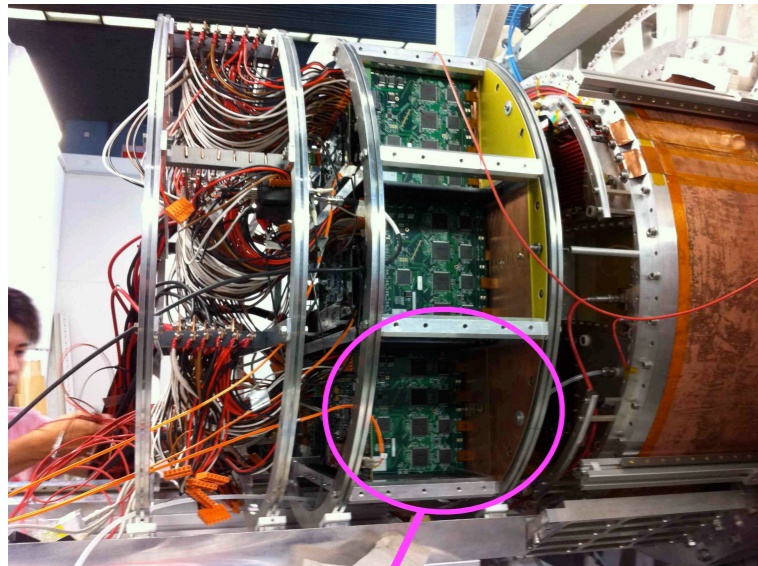
Outline

- LCTPC Electronics for pad readout
- Readout electronics based on SALTRO16 chips and its cooling
- CO₂ cooling system and test
- Summary

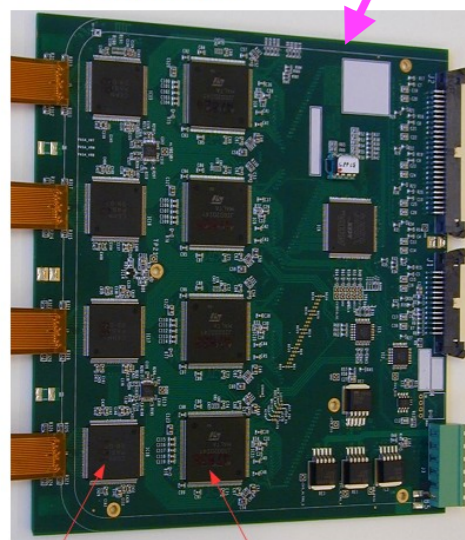
Introduction:

LCTPC Electronics Development for Pad Readout

Large Prototype
test so far

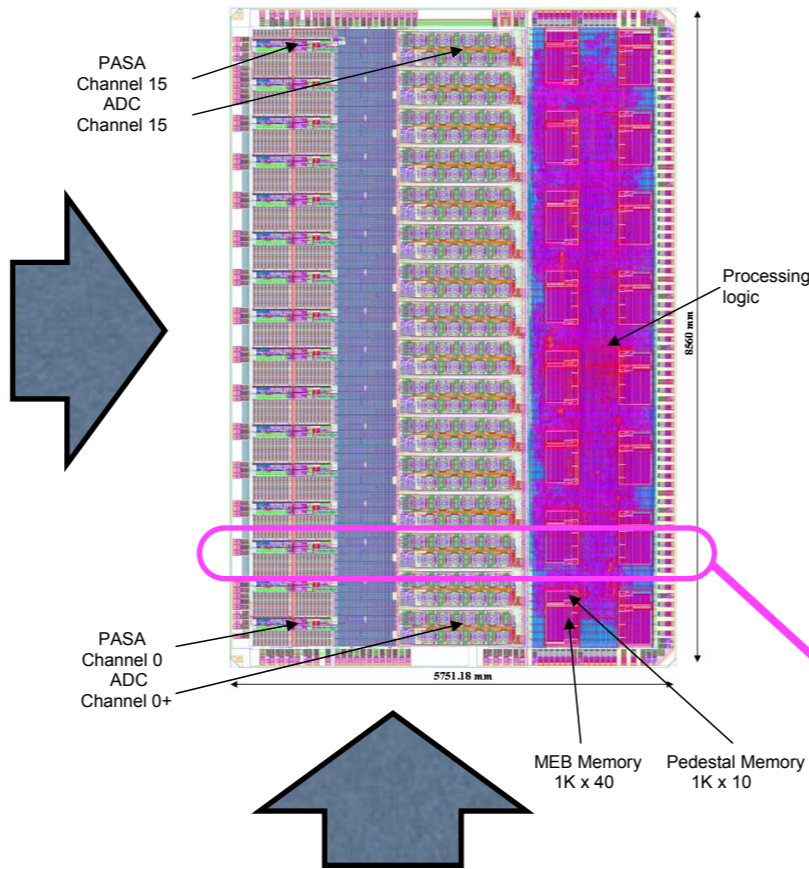


Front End Card

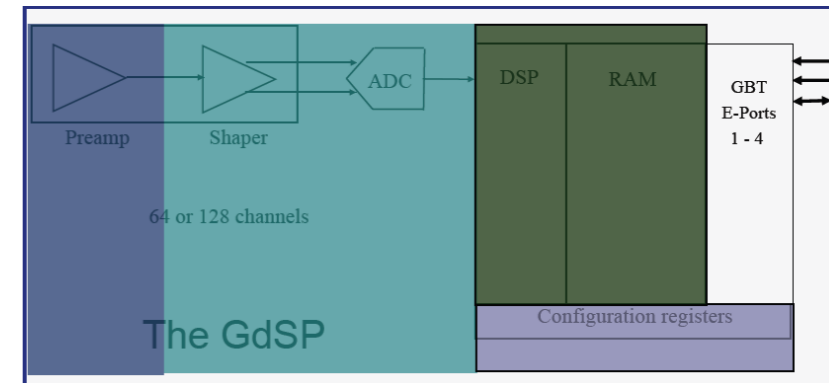


PCA16
(programmable) ALTRO

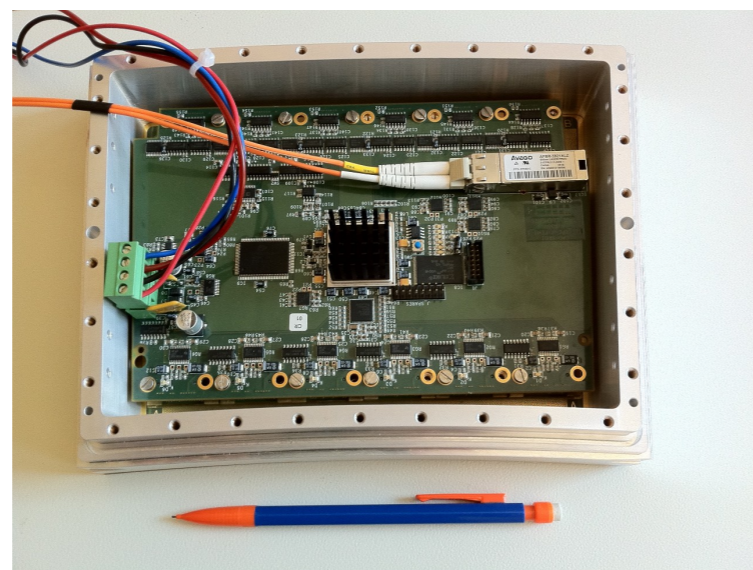
Next step
S-ALTRO16 (fabricated)



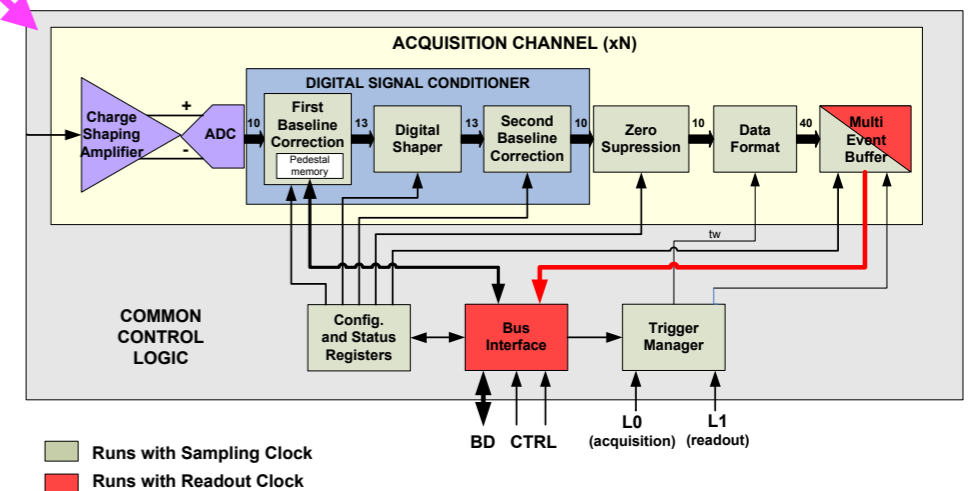
Future
GdSP (design in progress)



- 64 or 128 channels in a chip.
- Low power consumption (7-8mW/ch).



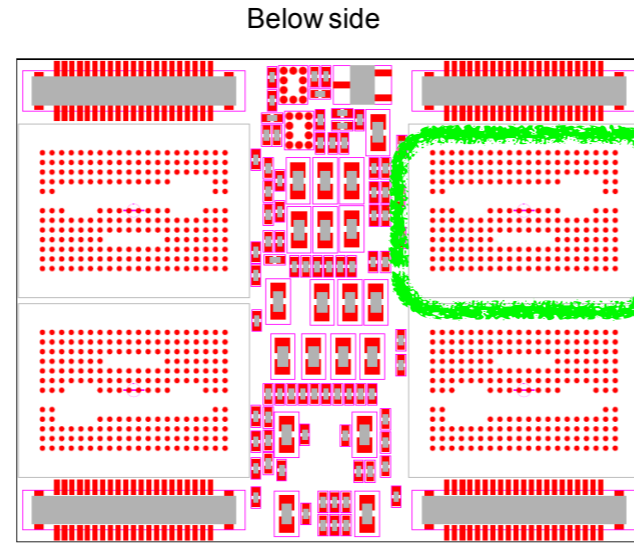
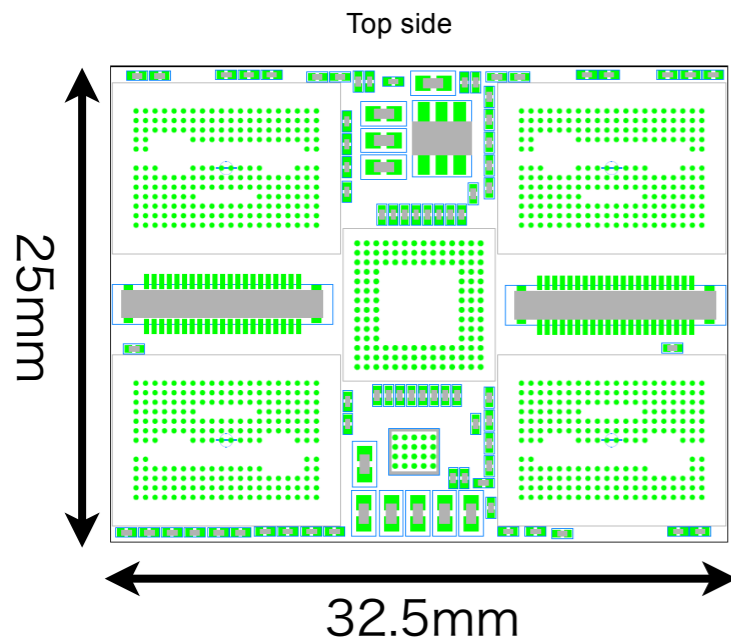
MicroMegas module
with AFTER-based electronics



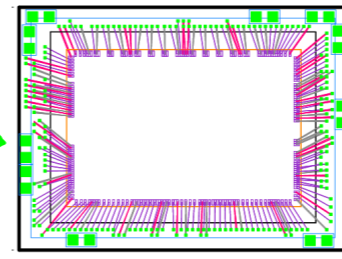
- 16 channels in a chip.
- About 40mW per channel @ 20MS/s.

Readout electronics based on S-ALTR016 chips

8 S-ALTR016 chips on a MCM (multi-chip module)

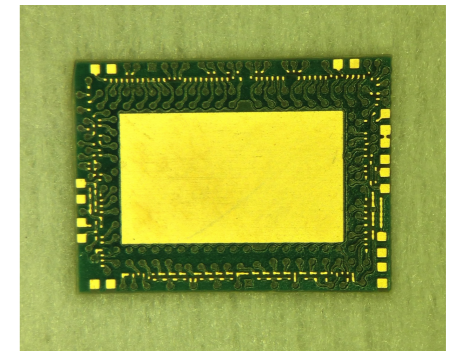


carrier board

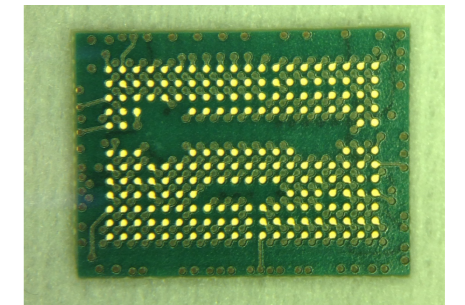


8.9mm

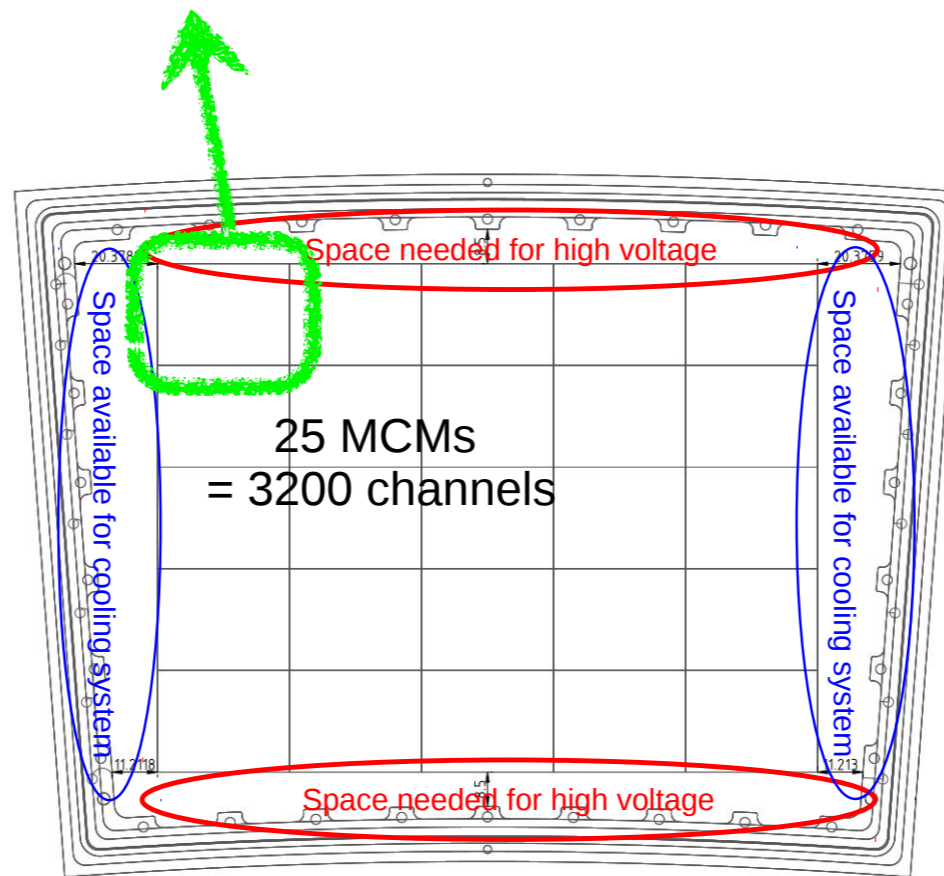
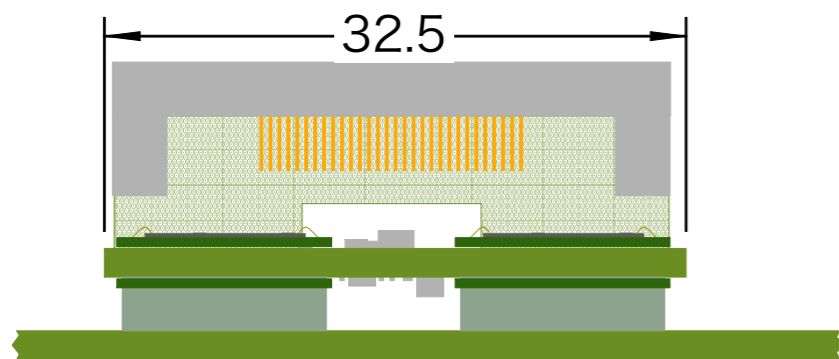
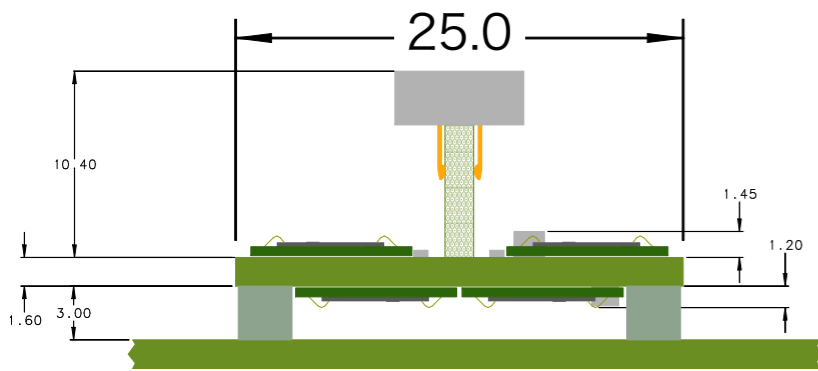
12mm



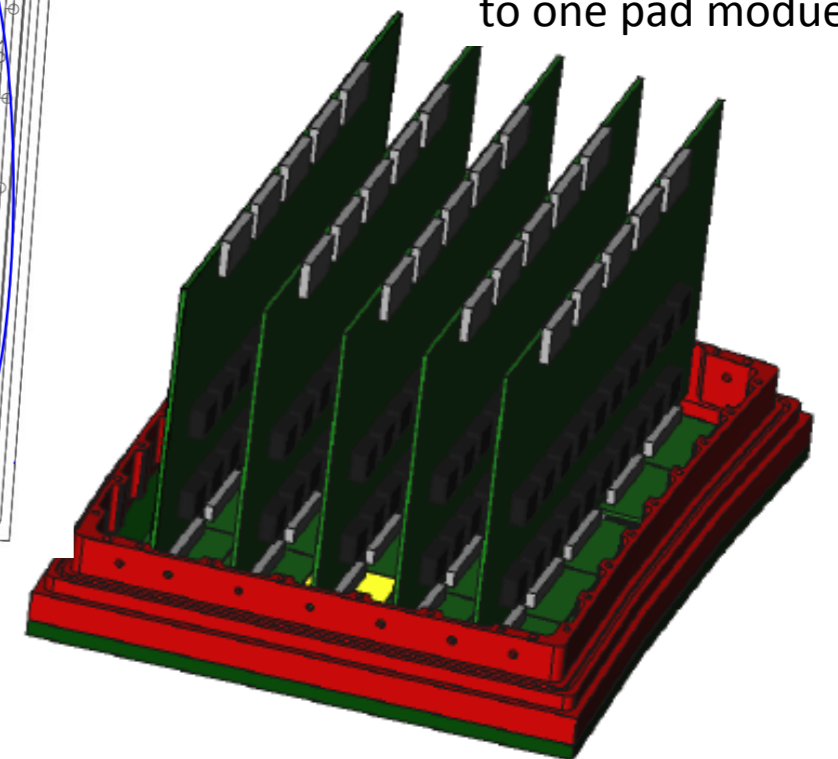
chip side



BGA side



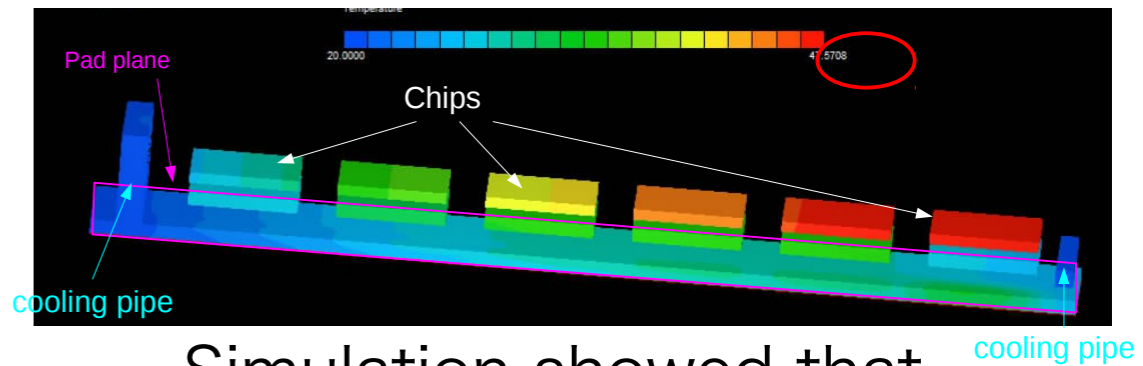
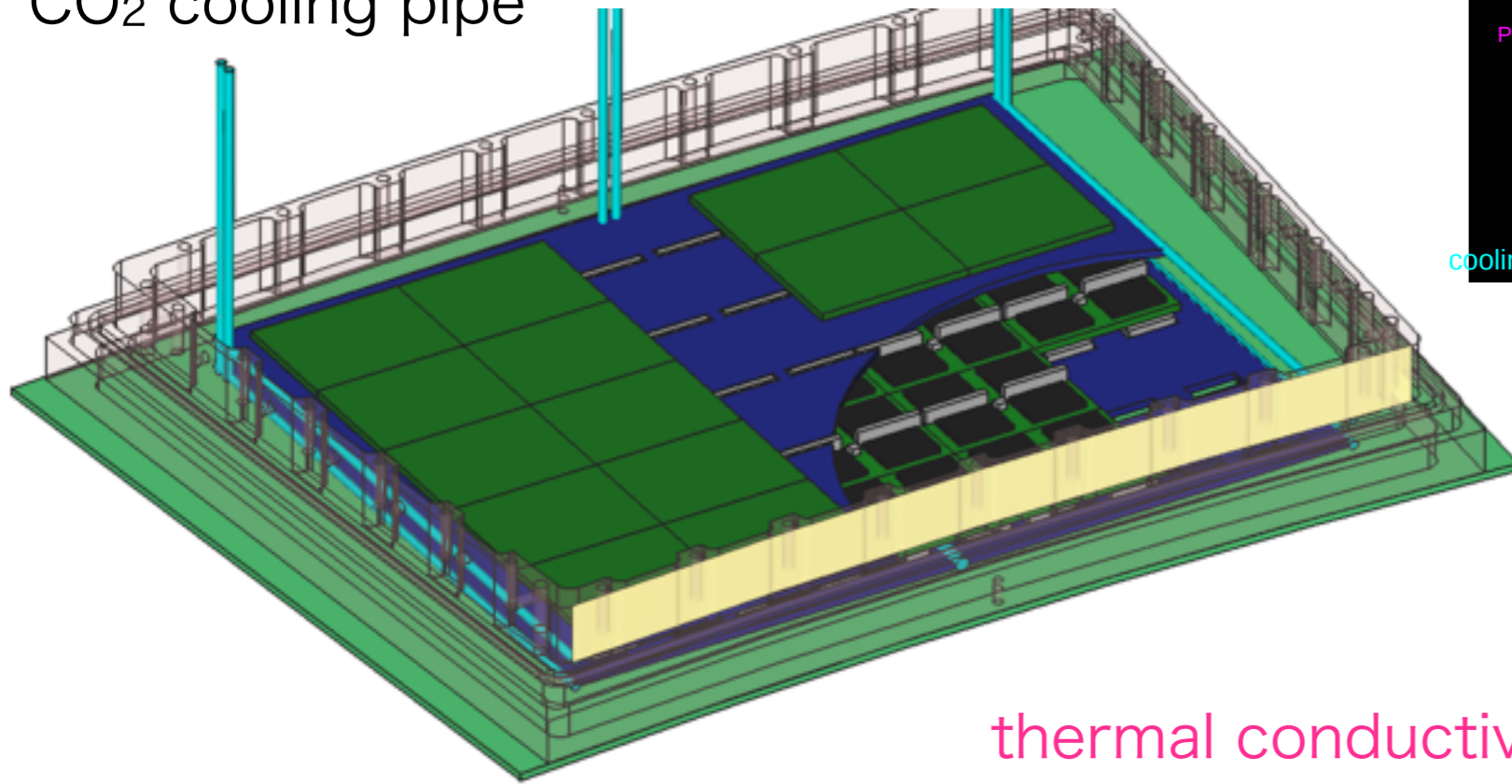
LV-boards attached to one pad module



Developed by Lund Univ.

Proposed Cooling for S-ALTR016-based electronics

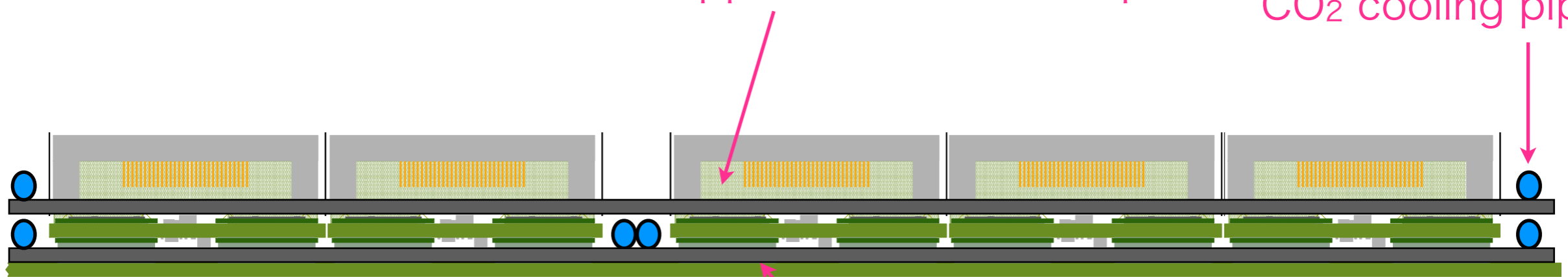
CO₂ cooling pipe



Simulation showed that Middle pipe is necessary

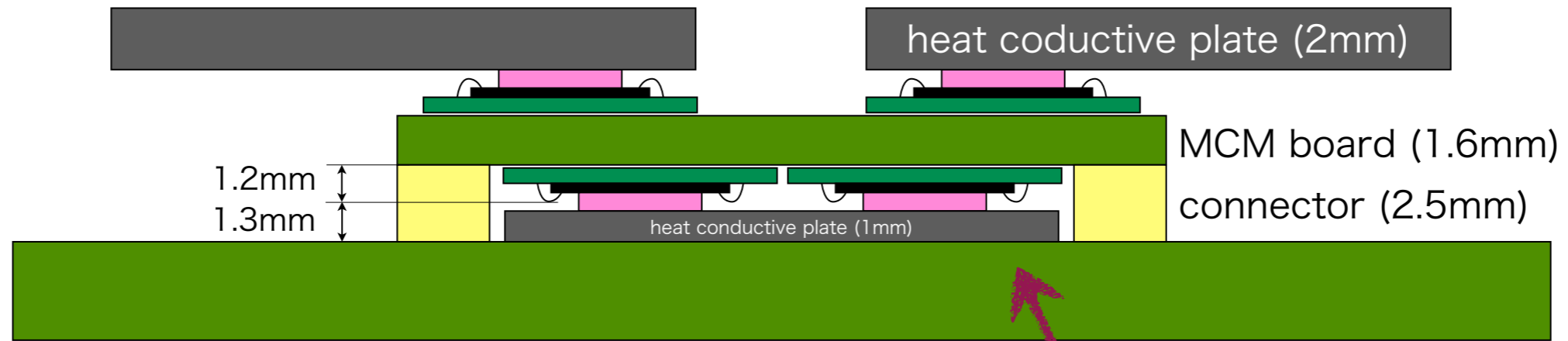
thermal conductive plate for upper S-ALTR016 chips

CO₂ cooling pipe



thermal conductive plate for lower S-ALTR016 chips and to keep pad-plane temperature

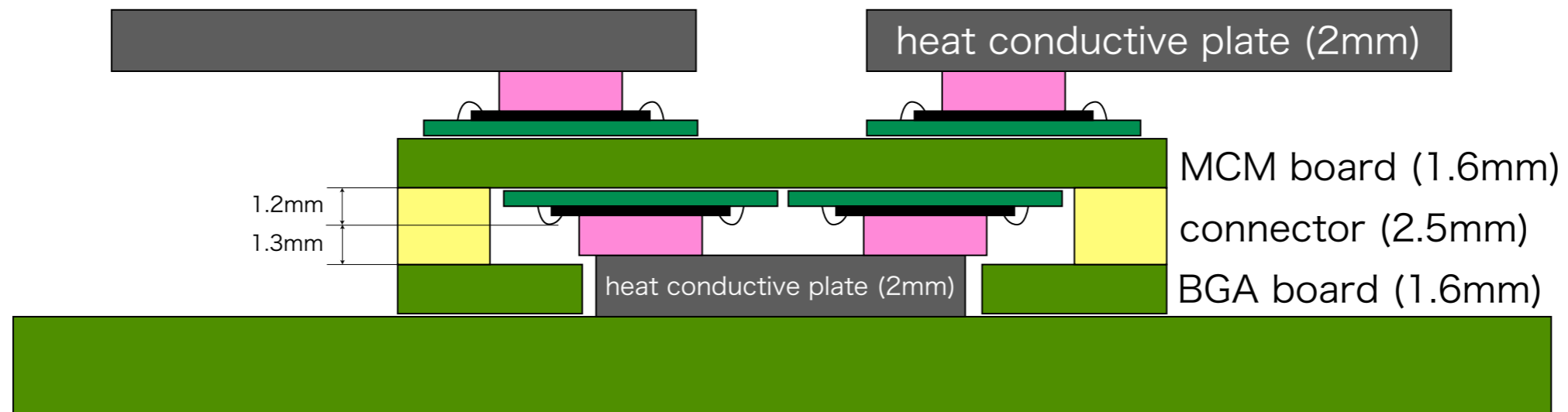
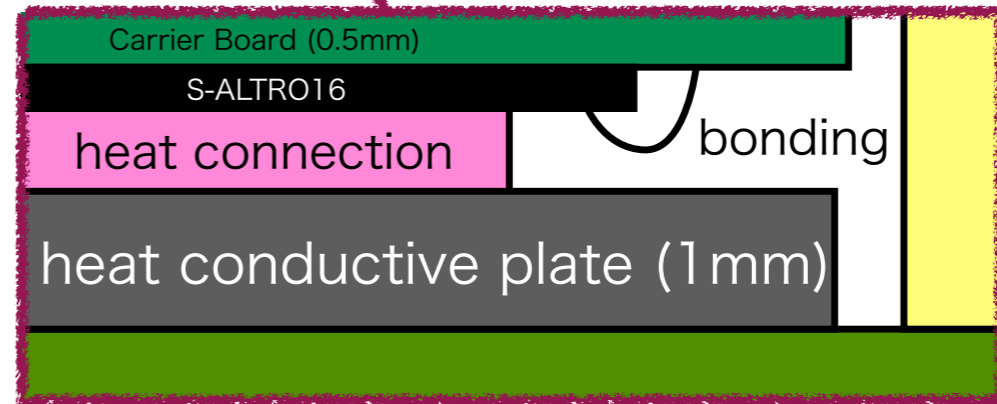
The limited space btw. MCM bd. and pad plane



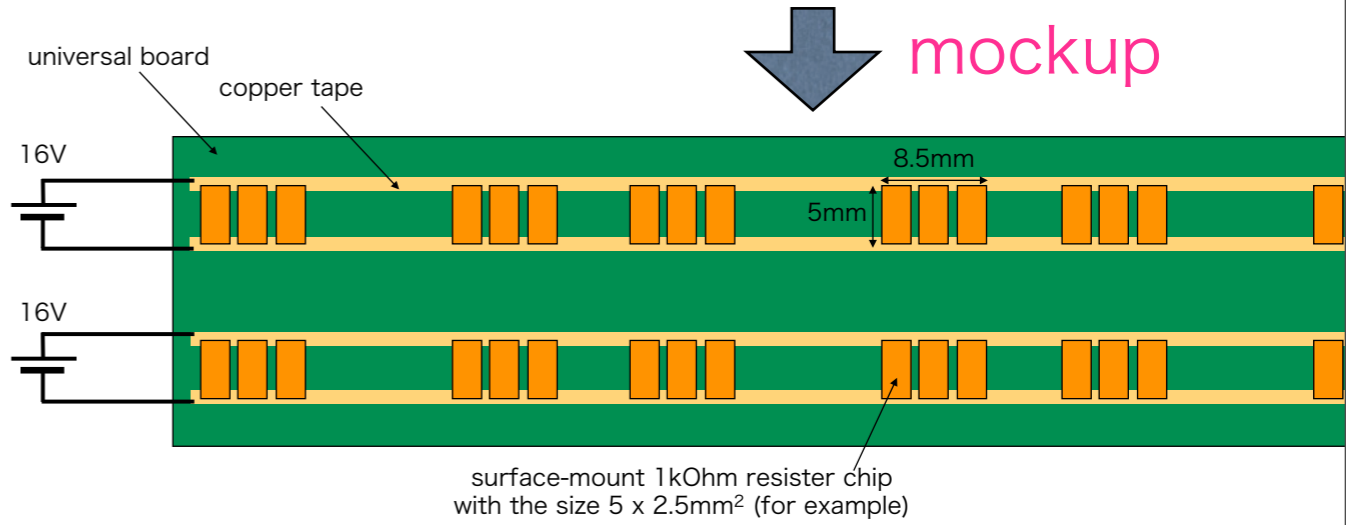
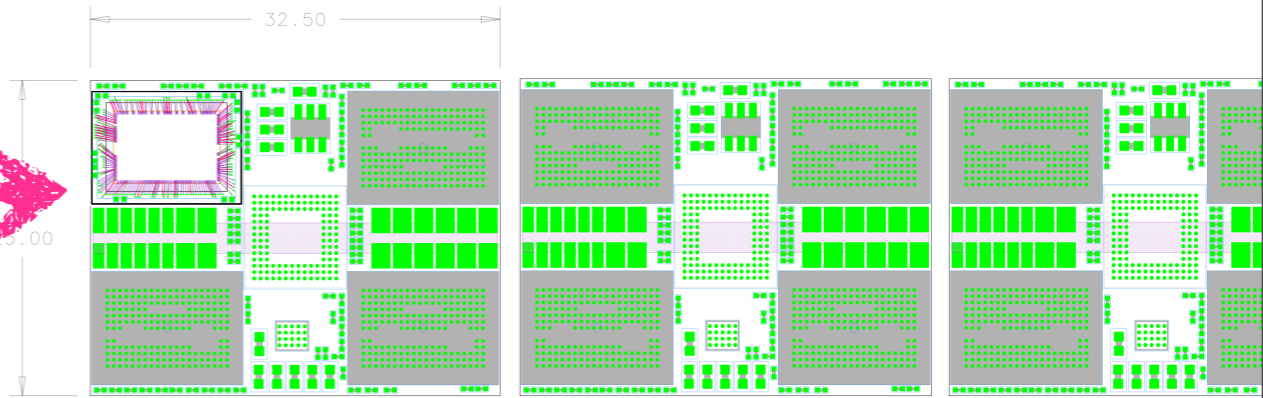
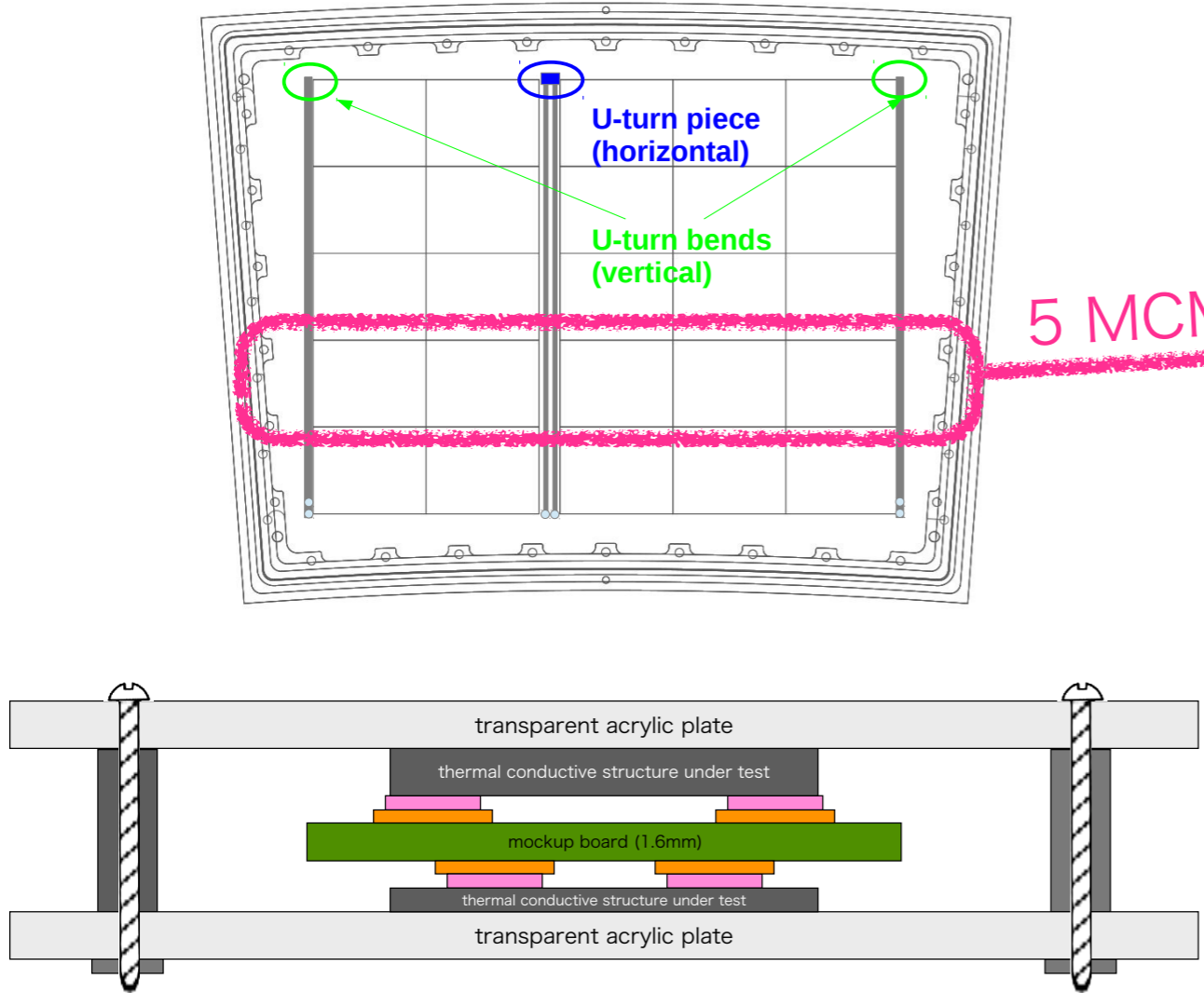
Maximum thickness is only 1mm for heat conductive device between MCM and pad plane board



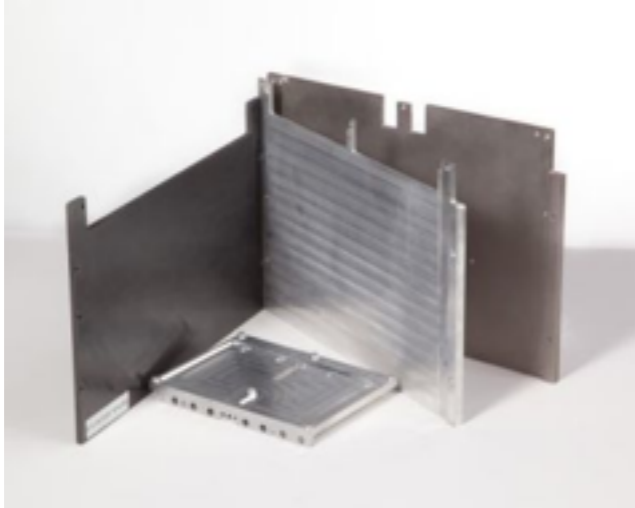
To keep thicker space by additional BGA could be another solution



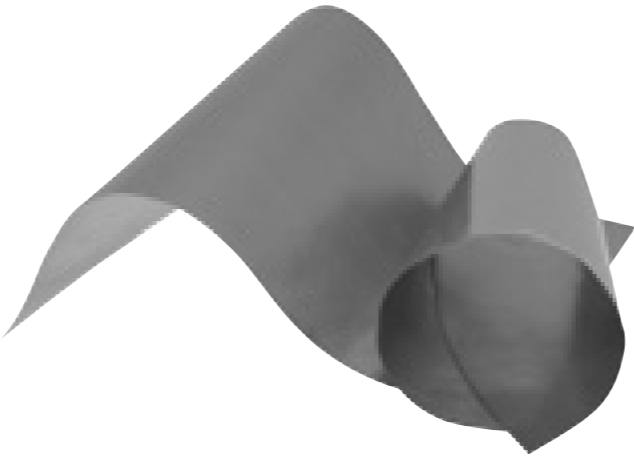
Mockup Test Plan



Combination of various thermal conductor/insulator will be tried



TPG plate (by Momentive)
~1500W/m · K
sandwiched by Al plate



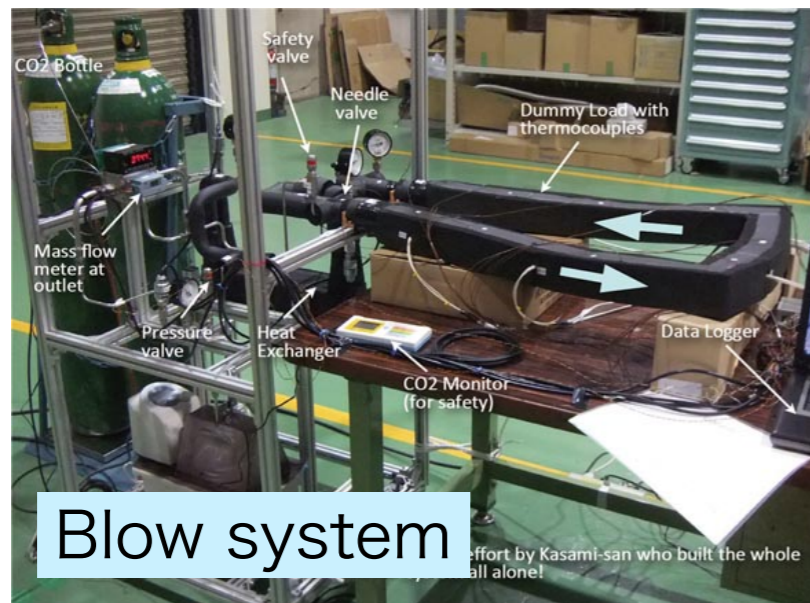
PGS graphite sheet
(by Panasonic)
~1500W/m · K



heat insulating sheet
(by Polymatech)
~0.02W/m · K

2-Phase CO₂ Cooling systems

KEK CO₂ group for
Belle II VTX, ILC VTX, ILC TPC

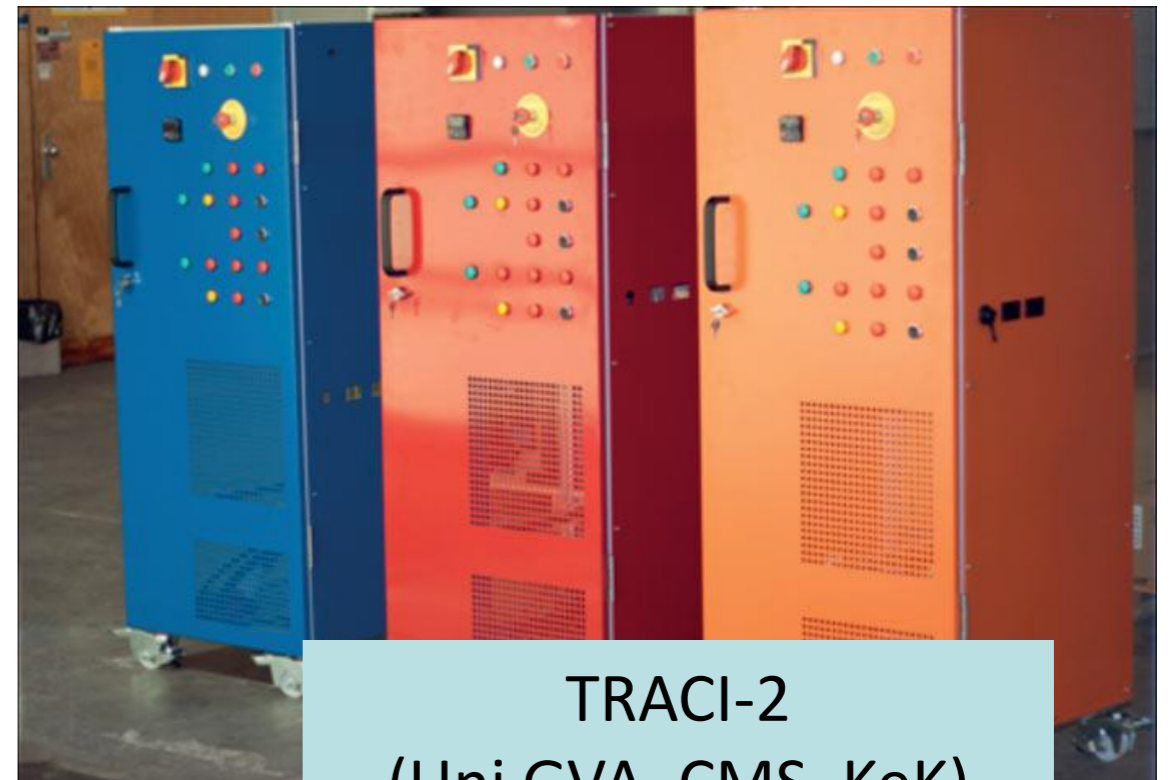


Blow system



Circulating system

KEK-TRACI2 for LCTPC
by Bart Verlaat @ NIKHEF



TRACI-2
(Uni GVA, CMS, KeK)

- **Portable** laboratory cooling unit
- Cooling power <100W – 250 W>
- Temperature range <-40°C;+20°C>
- **Turn key**
- Very simple to operate "**fridge like**"

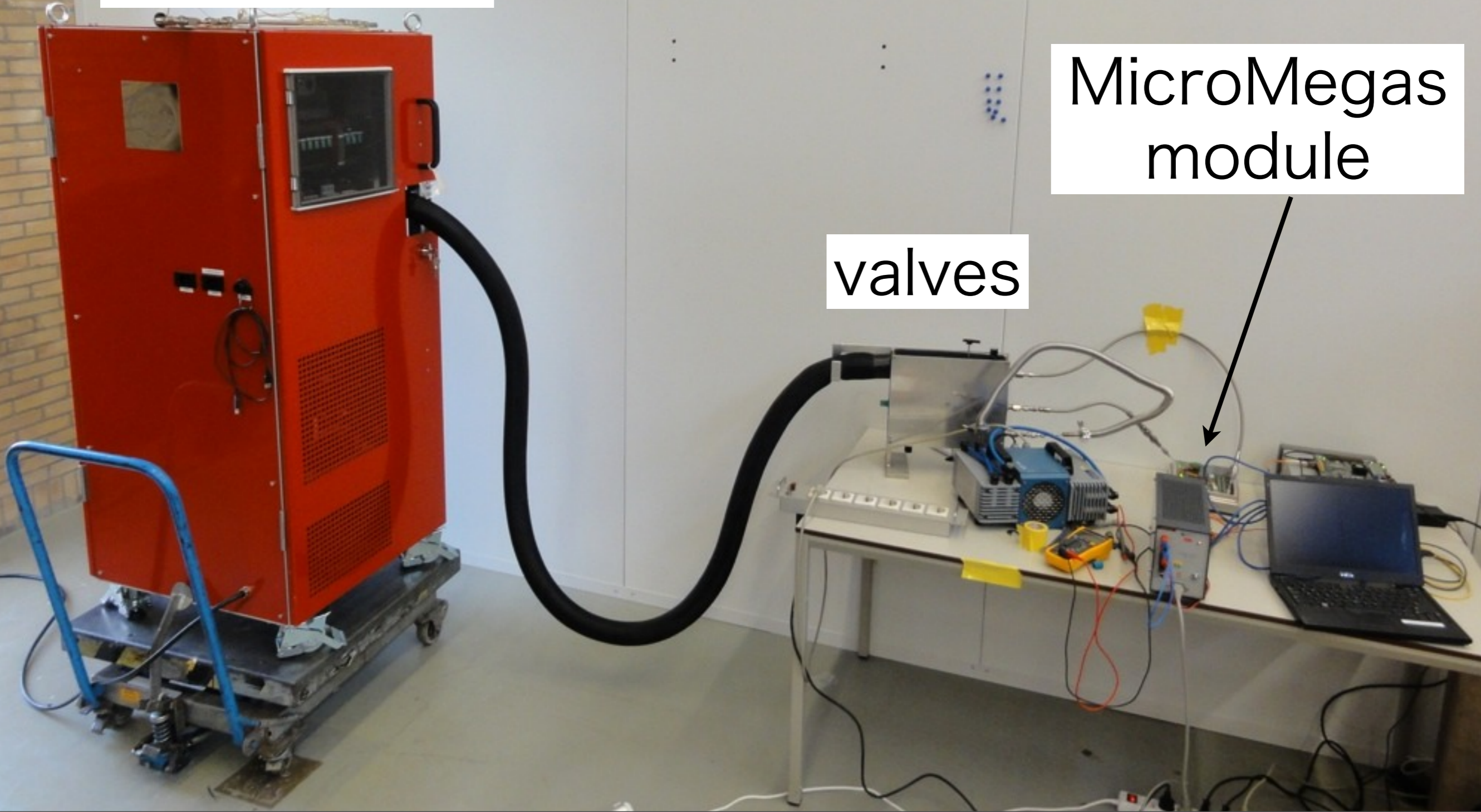
KEK-TRACI2 is now ready at NIKHEF
→ brought to DESY in Jan/2014

First CO₂ test with a LCTPC module
(MicroMegas module)
at NIKHEF (2-4/Dec/2013)

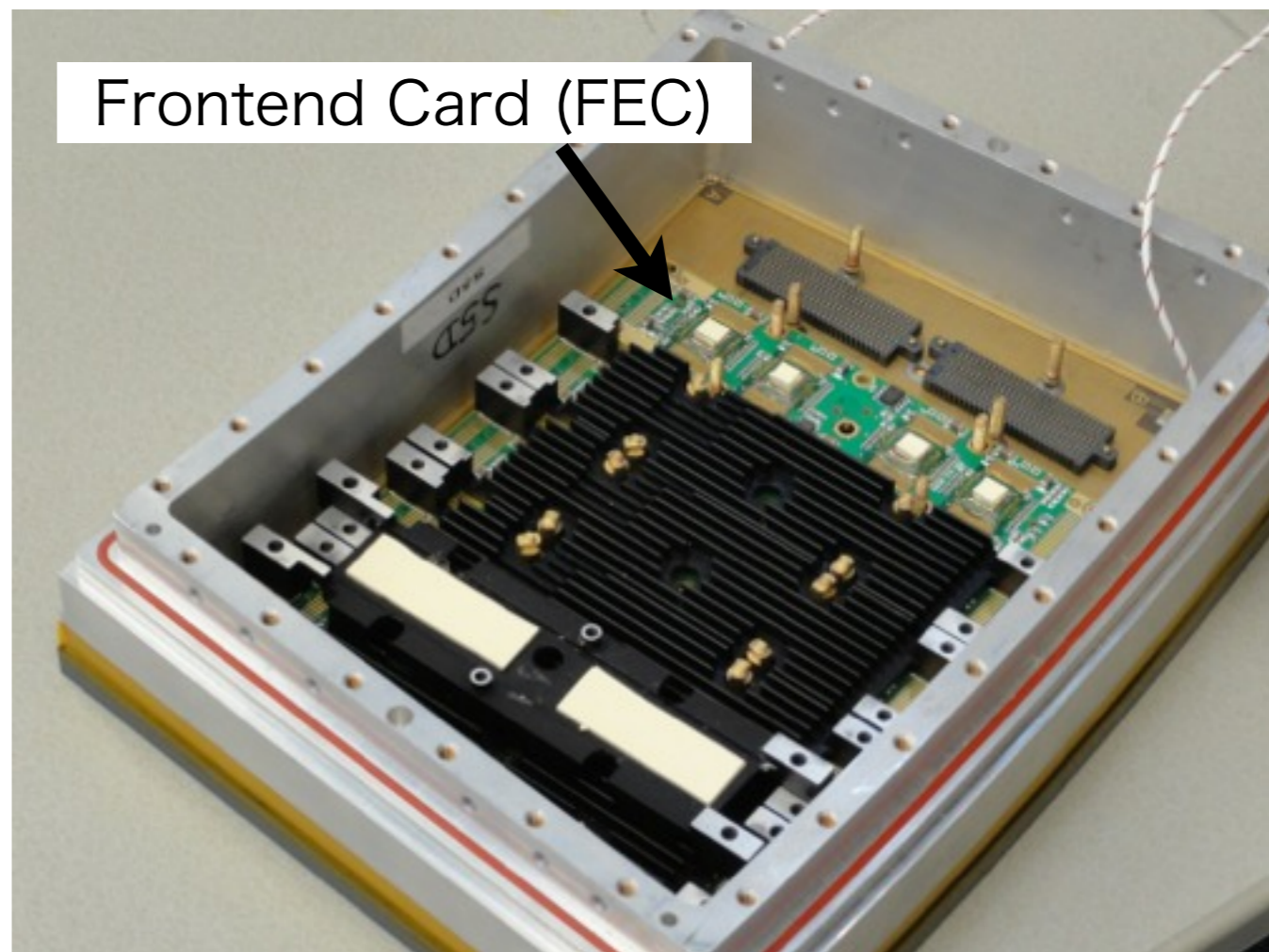
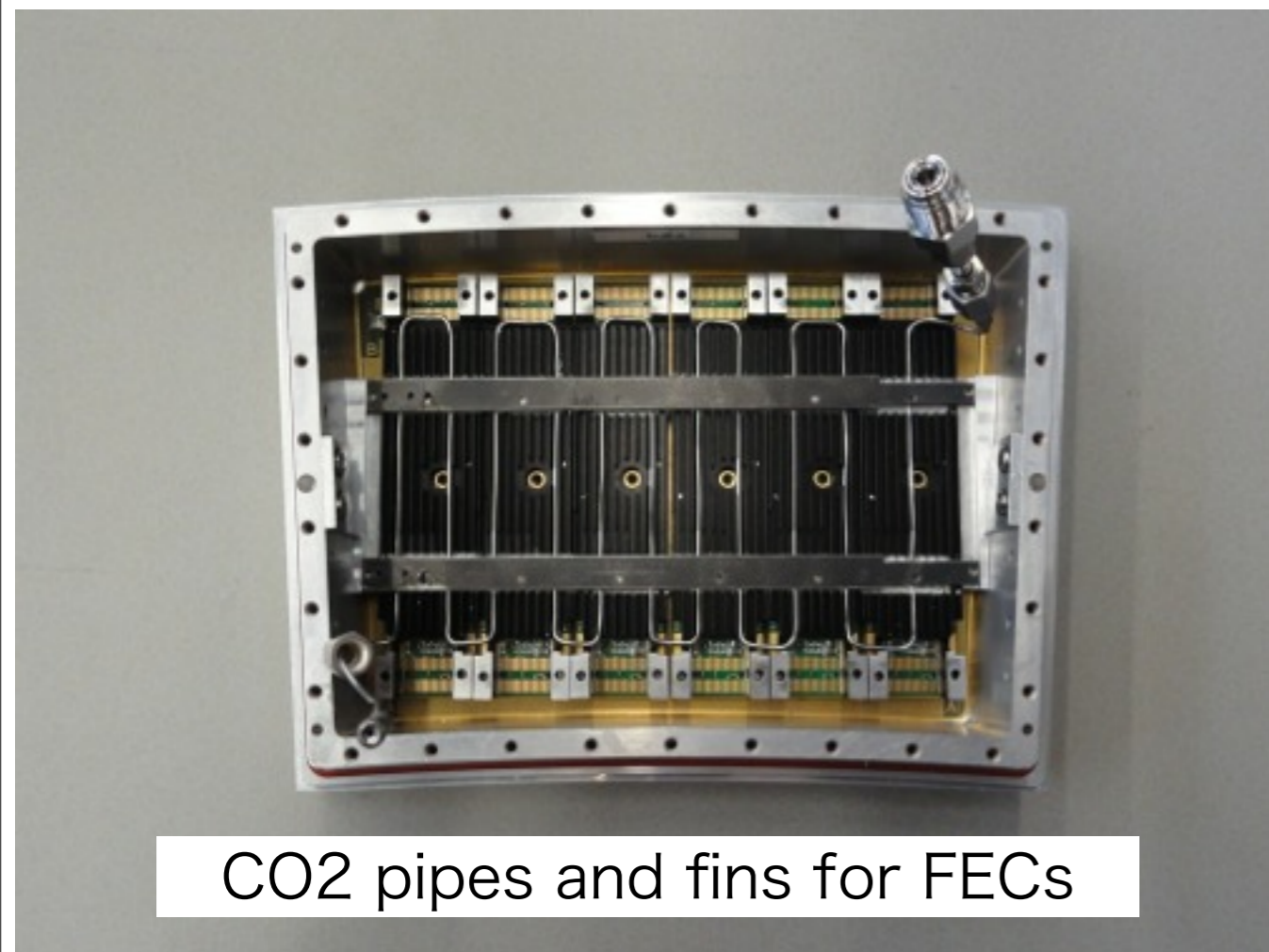
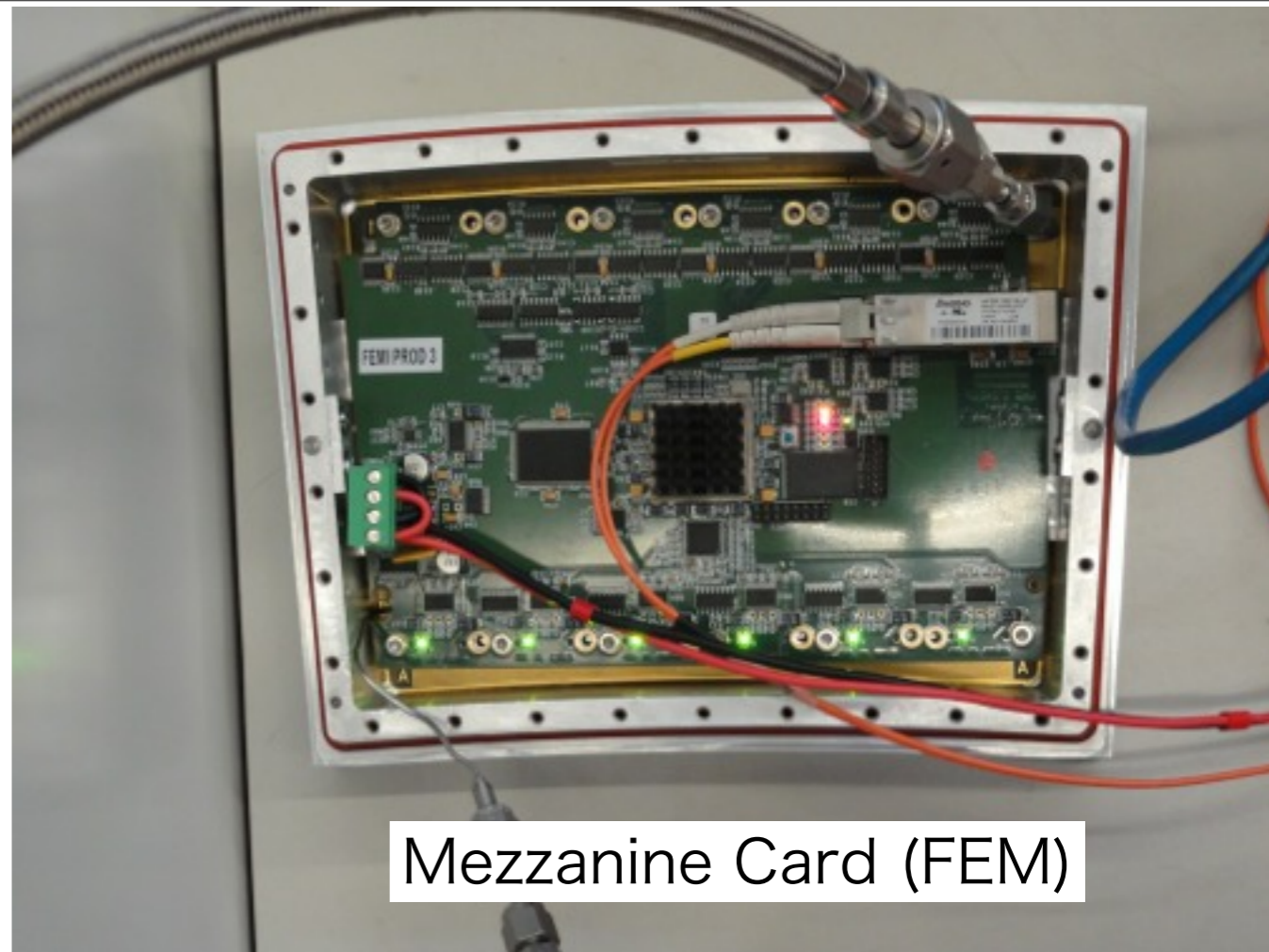
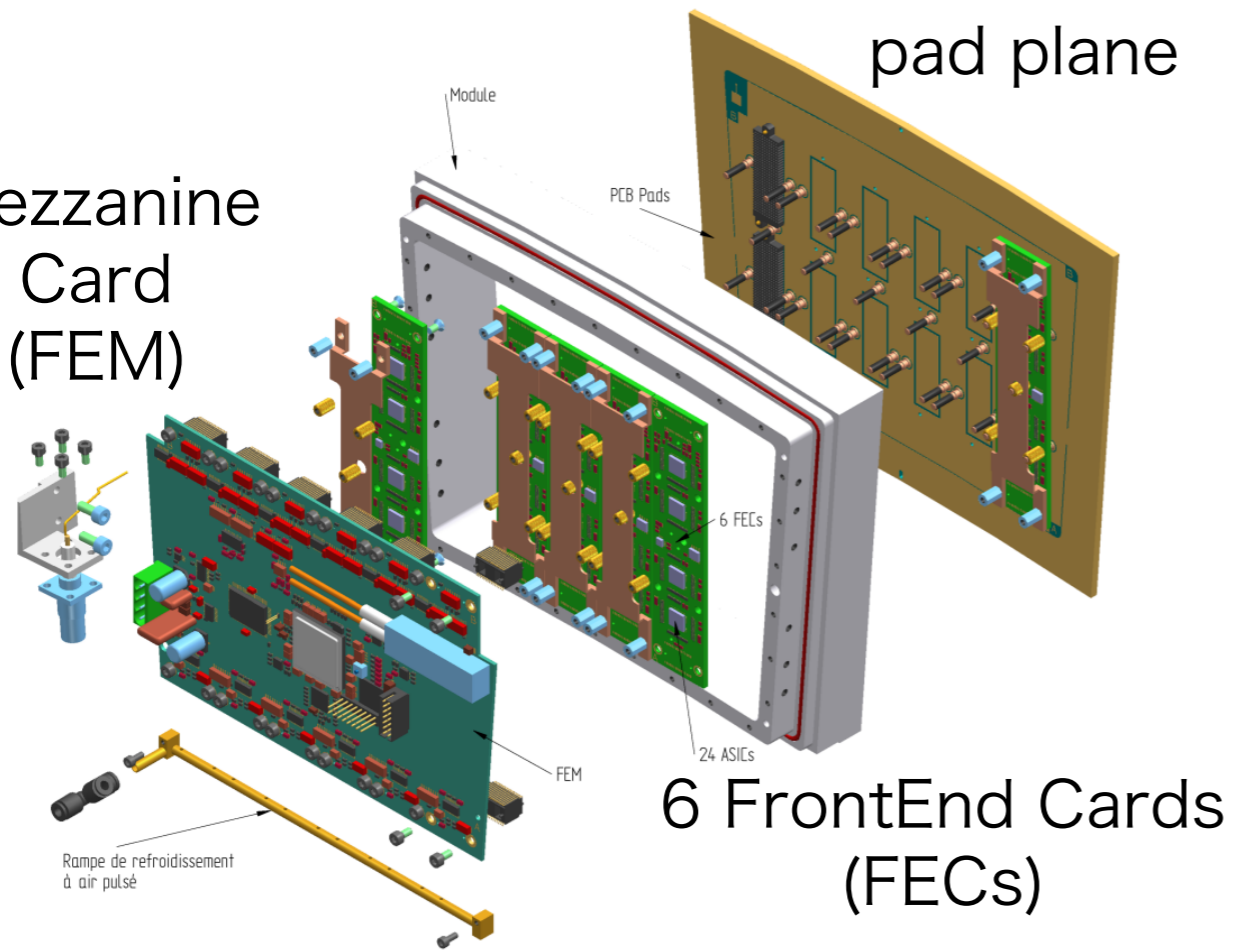
KEK-TRACI2

MicroMegas
module

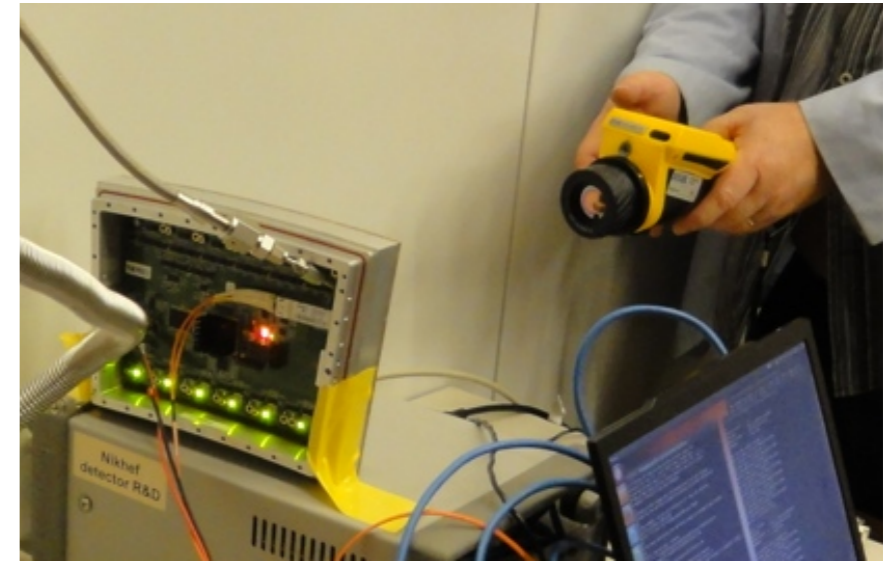
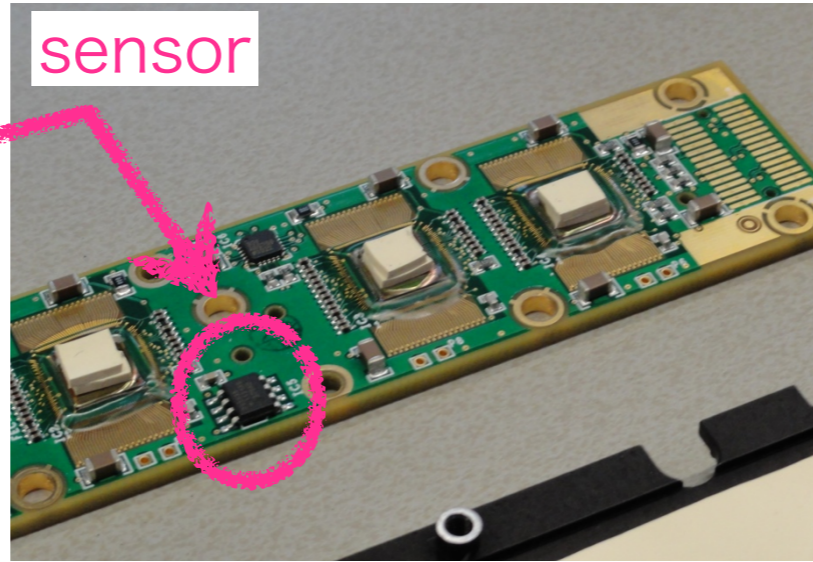
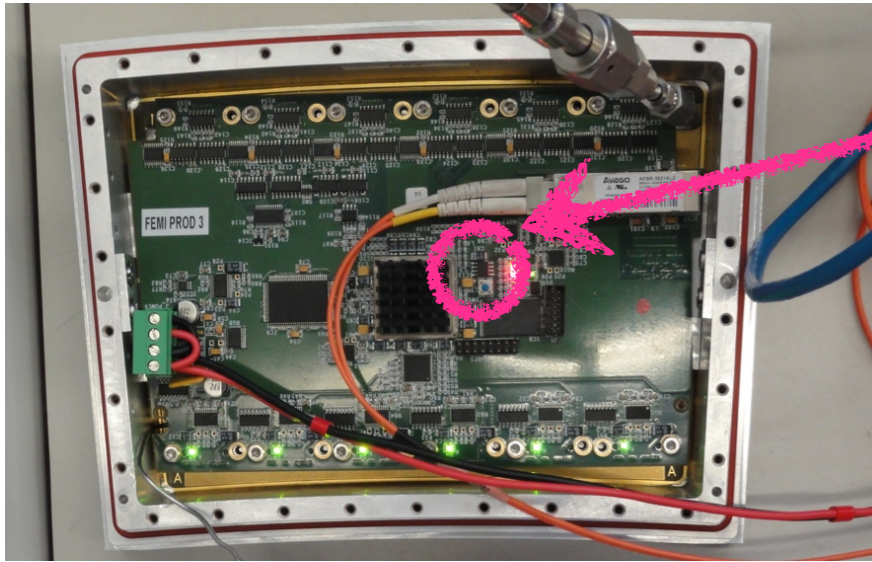
valves



Mezzanine Card (FEM)



Temperature with CO₂ Cooling



	FEM [°C]	FECs [°C]	pad plane [°C]
no cooling	~55	~65	-
air cooling	-	~55	-
CO ₂ cooling*	37	32	30

*) 10°C and 45.1 bar at outlet, 55.2 bar at inlet, P(diff) = 10.2 bar,
Flow rate is 2.0g/sec. P(module total) = 40W.

- Heat contact will be improved for the next beam test in Feb/2014.
- The KEK-Traci2 cooling system will be moved from NIKHEF to DESY in Jan/2014.

Summary

- Development of S-ALTRO-16 based electronics is ongoing
- Structure of the cooling device is an issue and a mockup test will be done soon.
- First CO₂ cooling of LCTPC module was performed with MicroMegaspas module. Asian GEM module will follow!