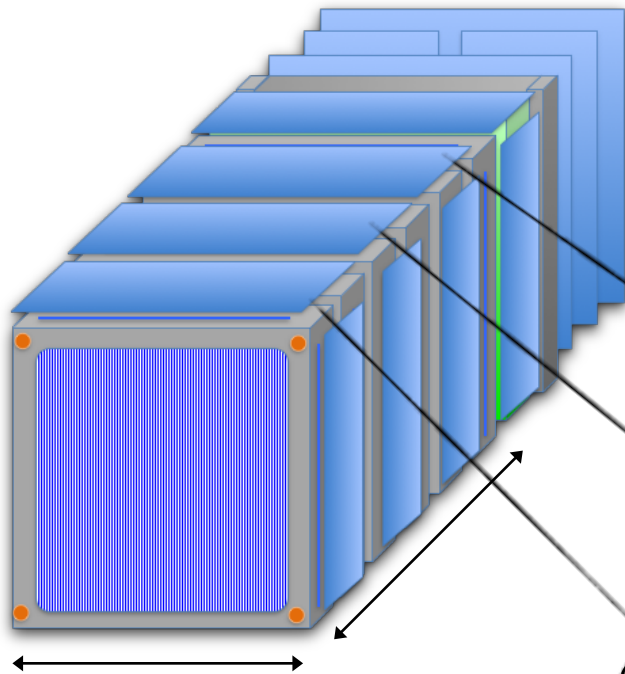
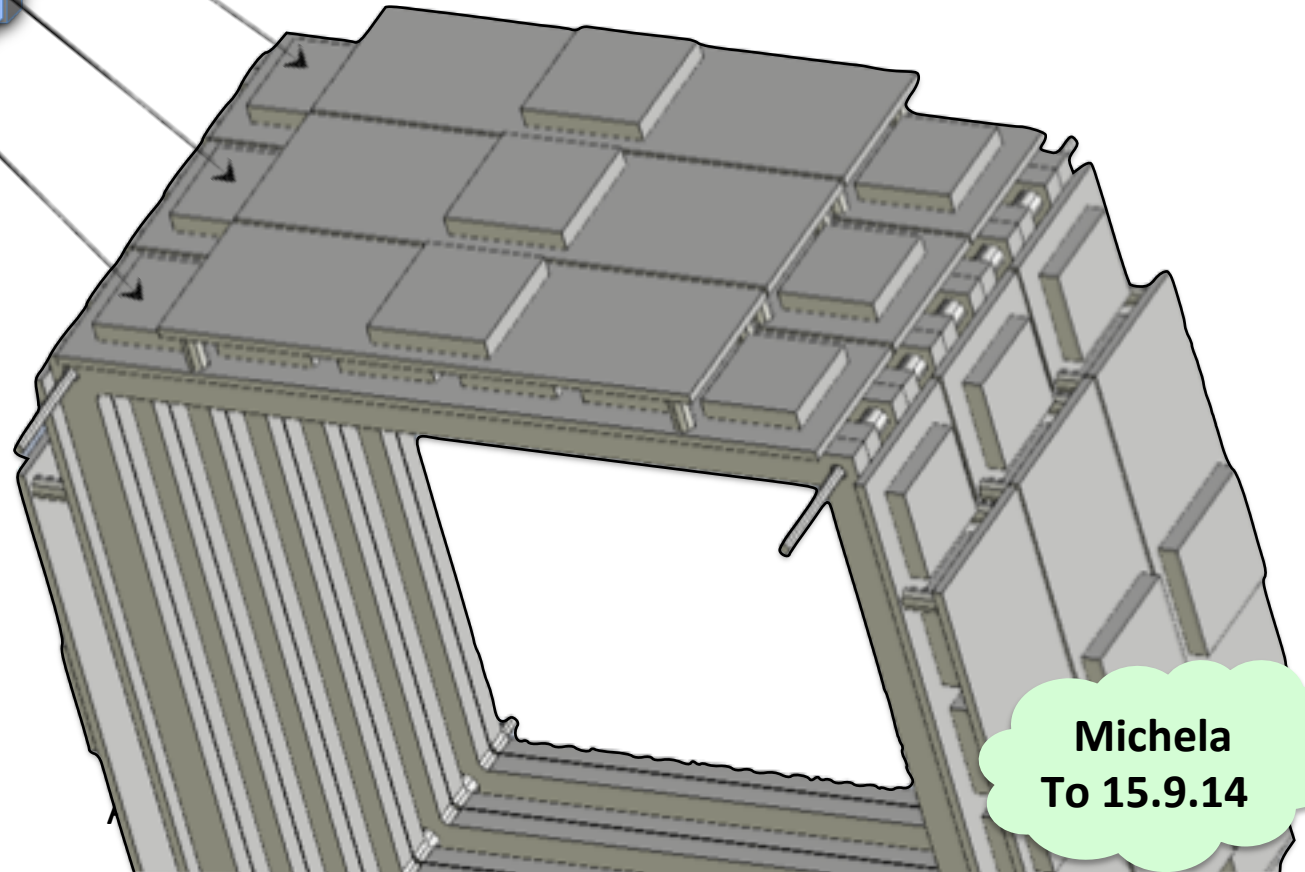


Dose Profiler status report (18 dec 2014)

DP: STRUTTURA MECCANICA del TRACKER



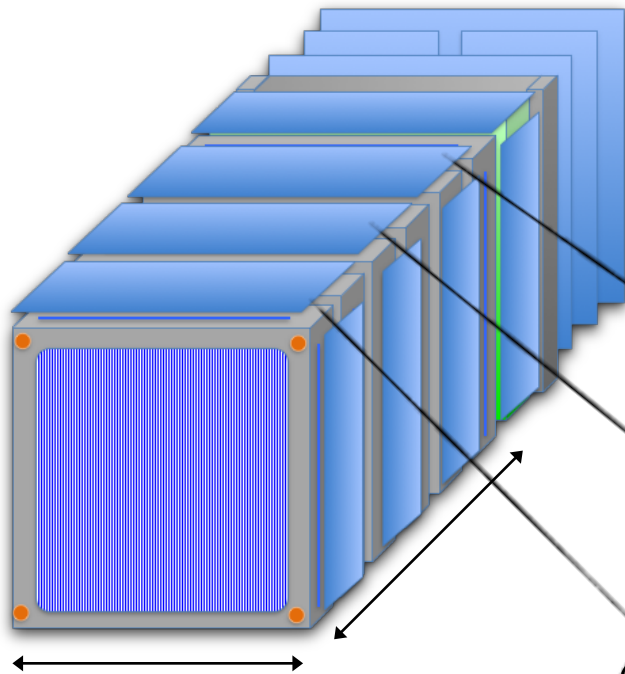
We start working on the mechanical structure of the DP; in particular we elaborate the integration of the plane tracker with the electronic boards (SiPM_fiber readout).



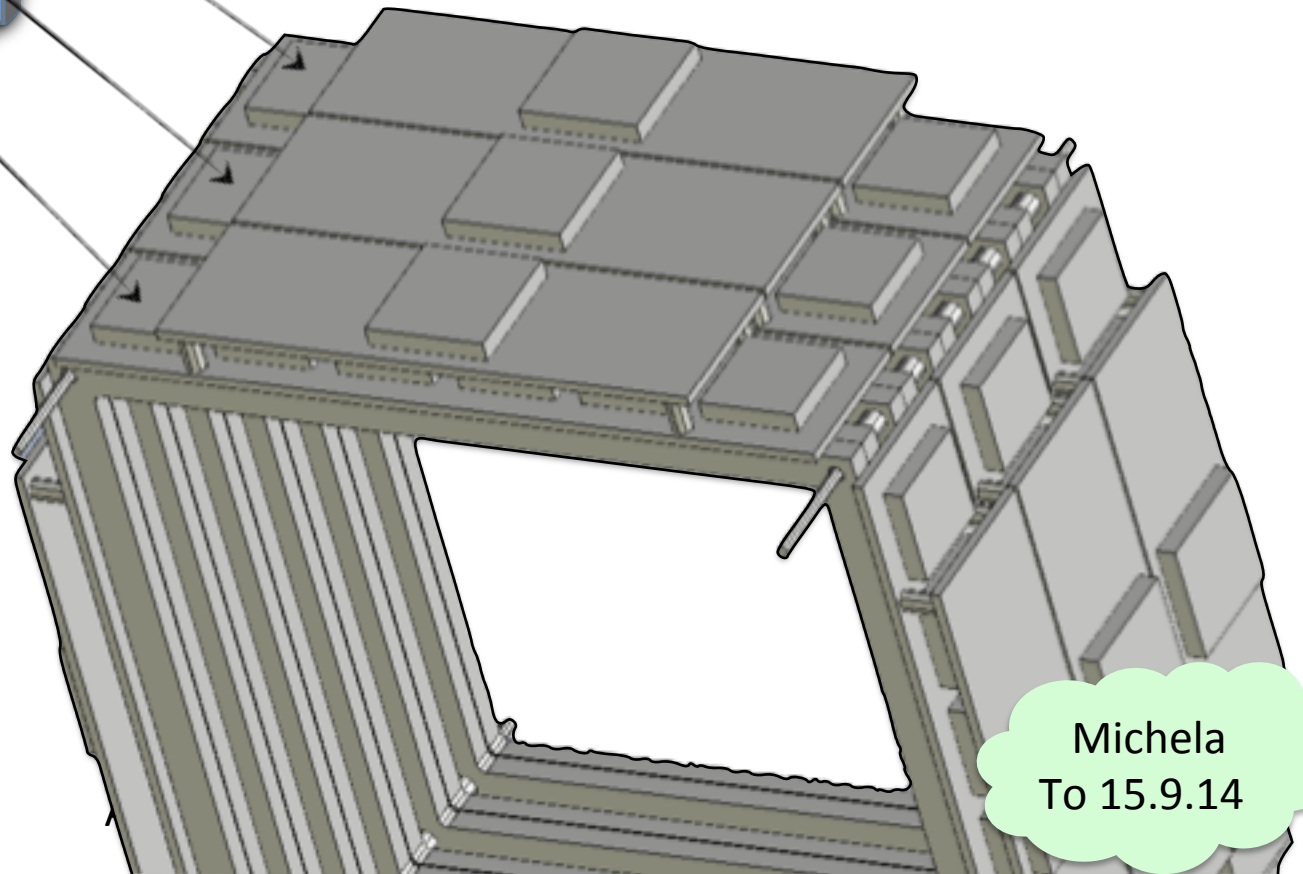
INSIDE - TORINO
15.9.2014

Michela
To 15.9.14

DP: STRUTTURA MECCANICA del TRACKER

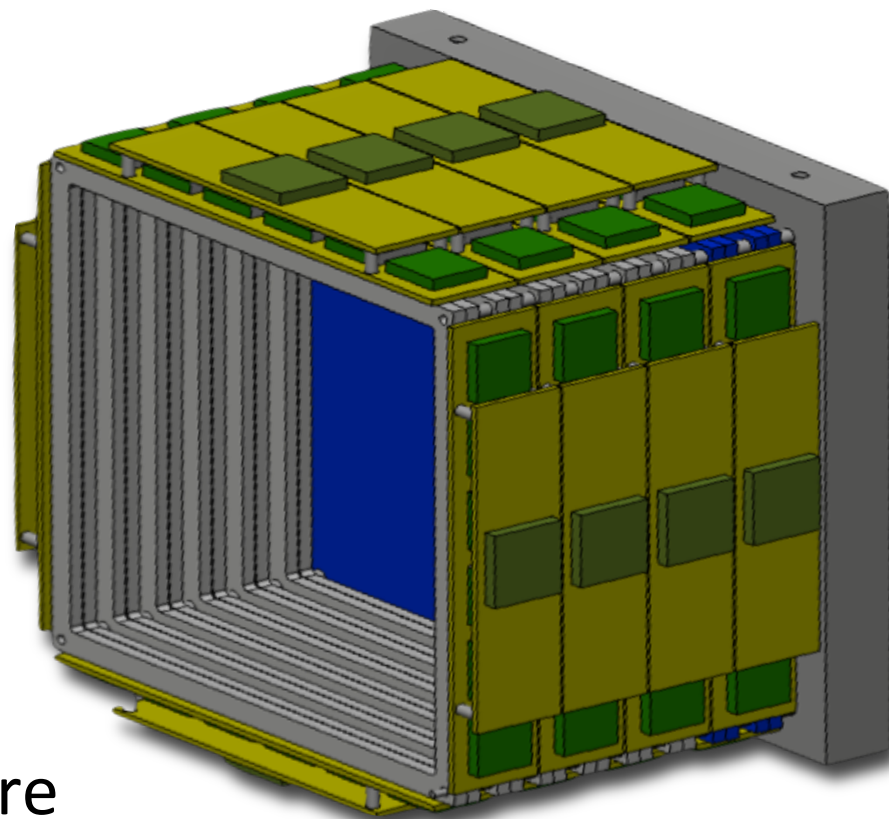
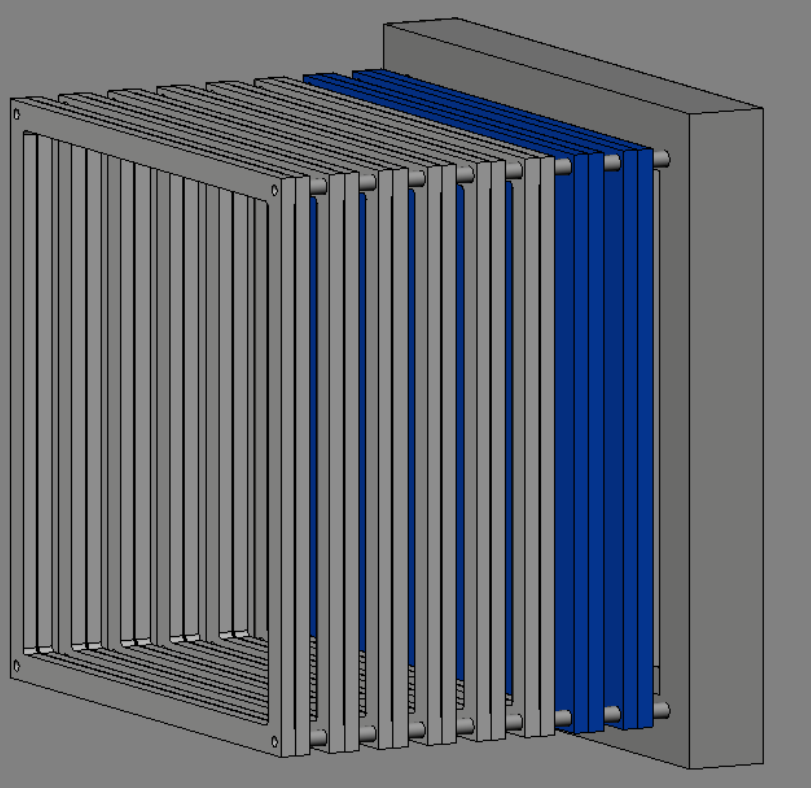


We start working on the **mechanical** structure of the DP; in particular we elaborate the **integration** of the plane tracker with the **electronic boards** (SiPM_ fiber readout).



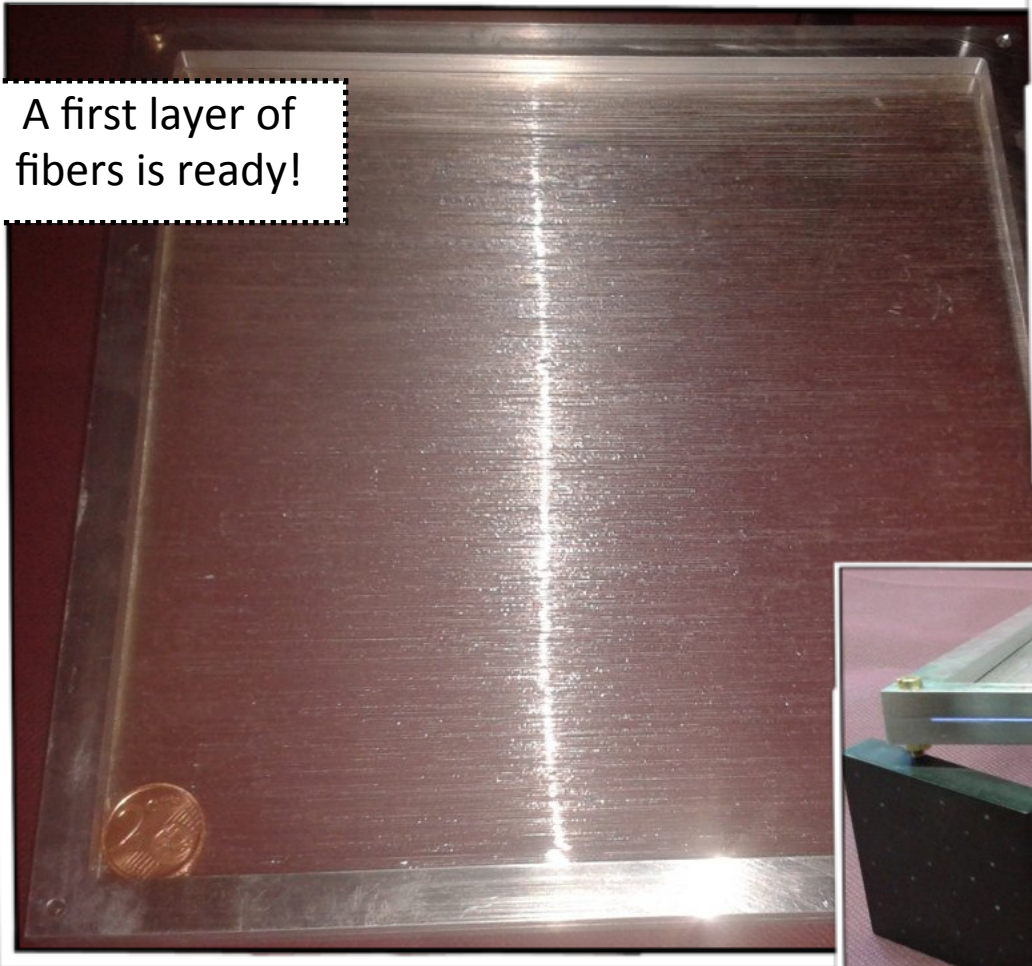
INSIDE - TORINO
15.9.2014

Michela
To 15.9.14

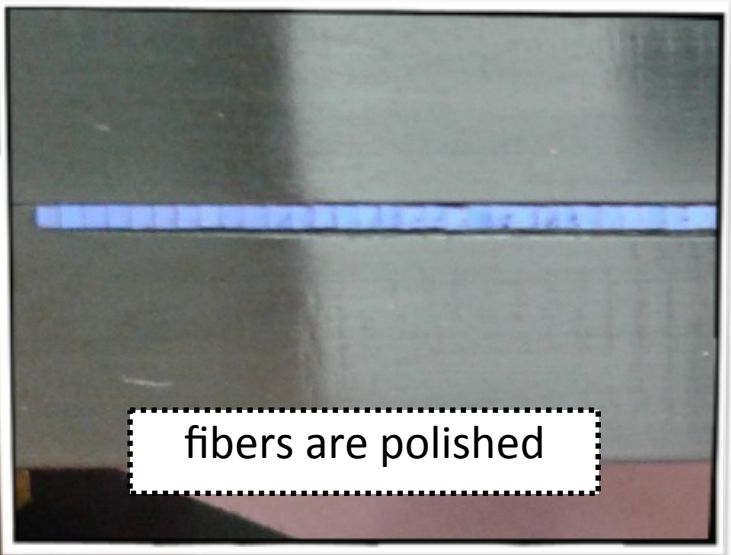


- 1) planes assembly procedure
- 2) cooling
- 3) printed circuit board fixation and fiber-SiPM alignment
- 4) electronics architecture
- 5) first studies of the calorimeter structure

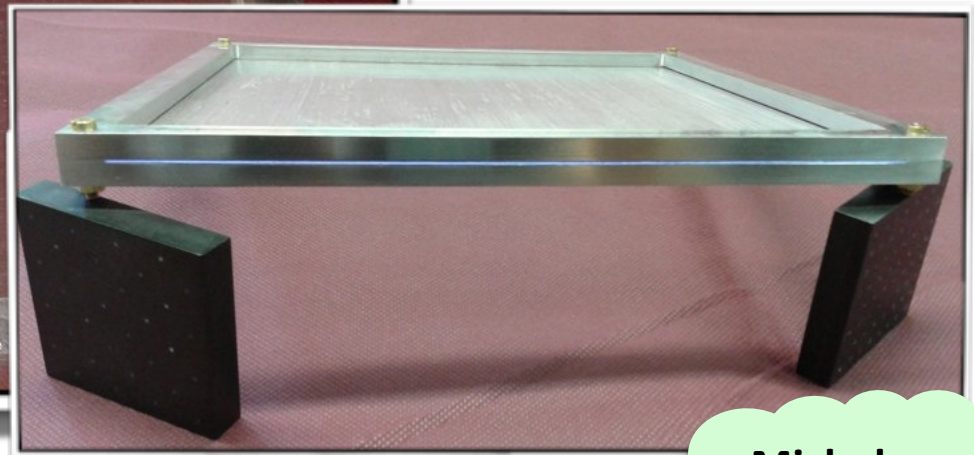
DP: STRUTTURA MECCANICA del TRACKER



A first layer of fibers is ready!



fibers are polished



Michela
To 15.9.14



The image shows a microscopic view of fiber optic bundles. A blue SiPM strip is overlaid on the fibers. A white text box in the center contains the text: "some dead space between fibers is unavoidable... fiber pitch doesn't match exactly SiPM pitch (as expected)".

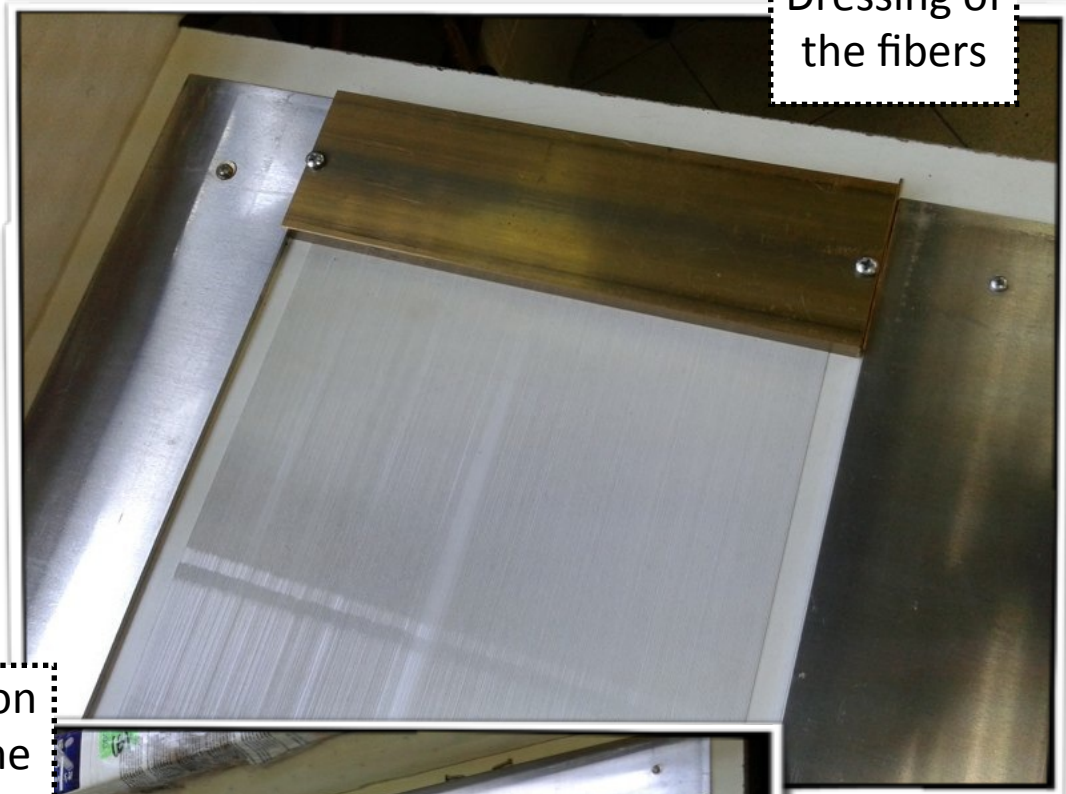
**some dead space between fibers is unavoidable...
fiber pitch doesn't match exactly SiPM pitch (as expected)**

STRUTTURA MECCANICA

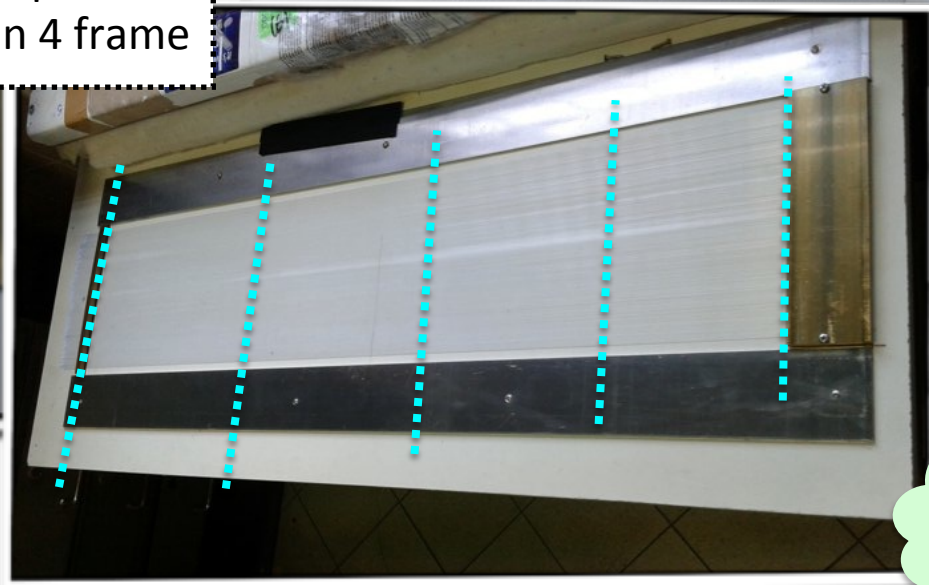
Dressing of the fibers



Dressing of the fibers



Separation in 4 frame



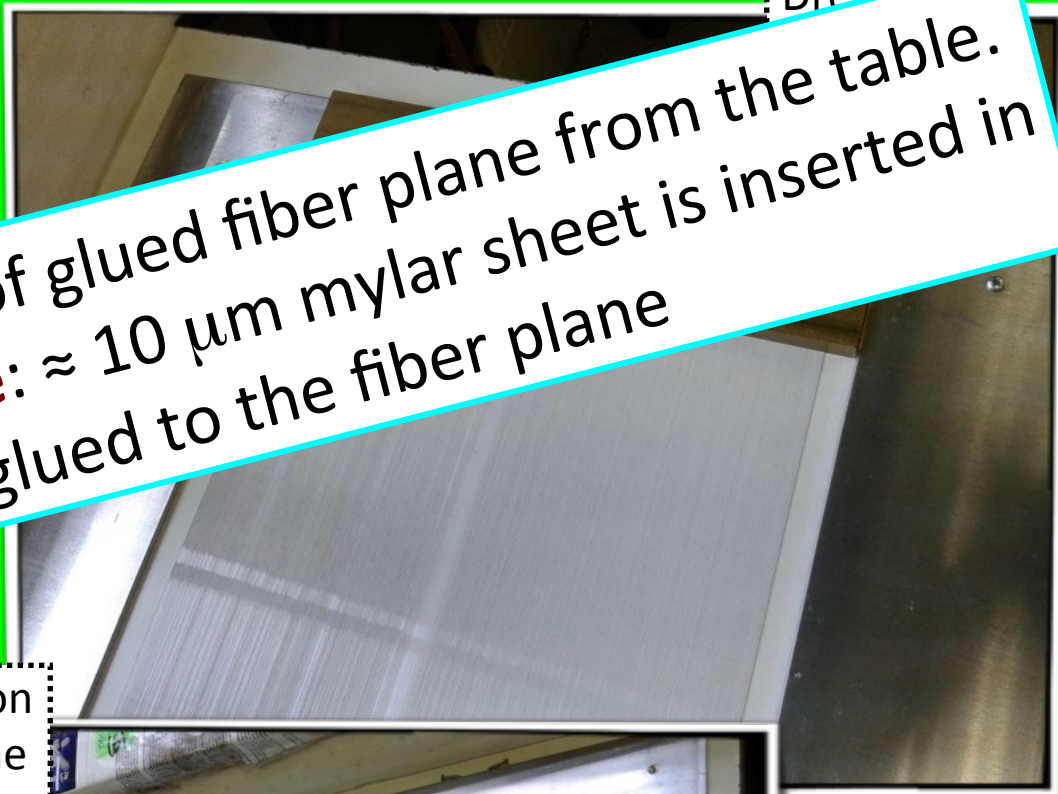
Michela
To 15.9.14

STRUTTURA MECCANICA

Dressing of the fibers

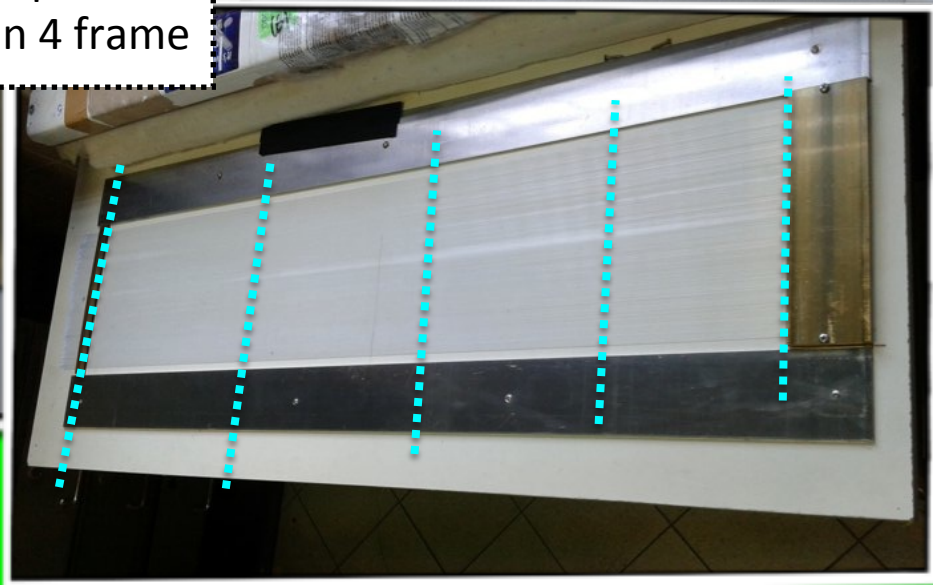


Dressi



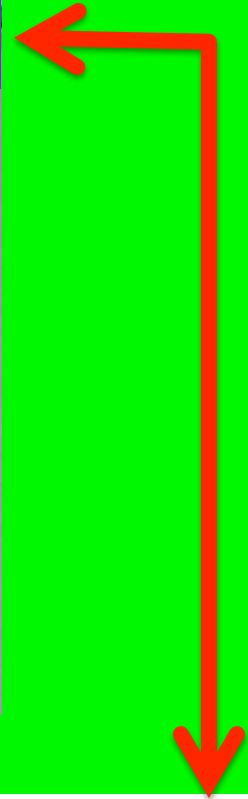
problematic detachment of glued fiber plane from the table.
New assembly procedure: $\approx 10 \mu\text{m}$ mylar sheet is inserted in between. It will remain glued to the fiber plane

Separation in 4 frame



after a long delay 9.7.2013 -> 12.12.2014

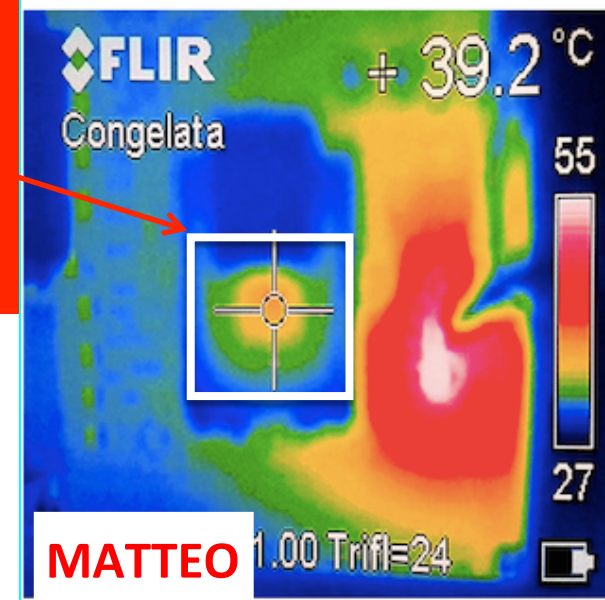
not visible fiber layer



Marco is producing the first 4 half planes with **multicladding** fibers (4,4 % -> 7,3 % light collection efficiency i.e. for a m.i.p. 14 -> 23 p.e./fiber)

BASIC32

39,2° in free air



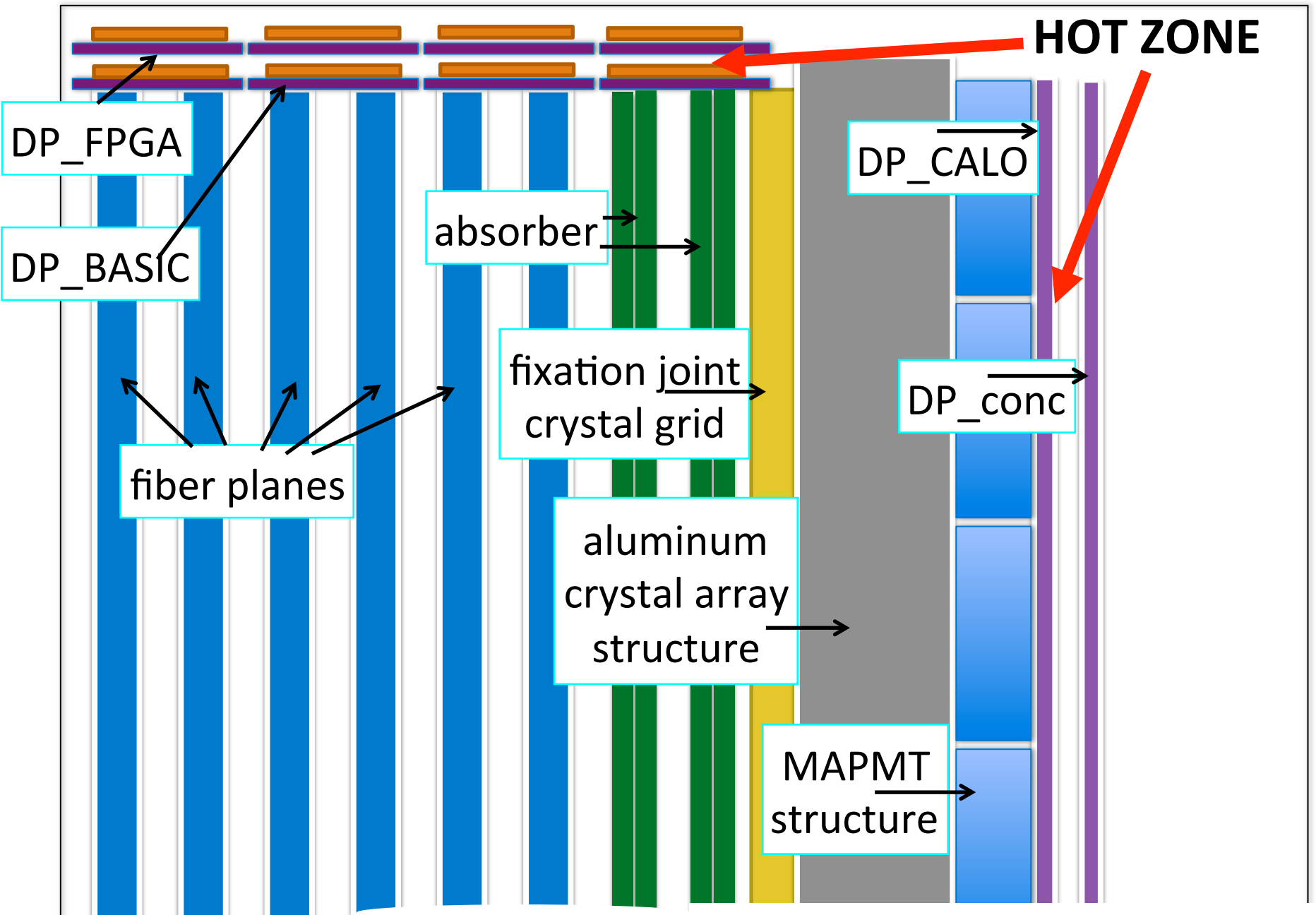
- the absorption was supposed to be 1 mA/channel
→ 0,1 watt/BASIC32

- static measure is 100 mA;

- dynamic measure is still missing: current could be as high as 150 mA
→ 0,5 W/BASIC32

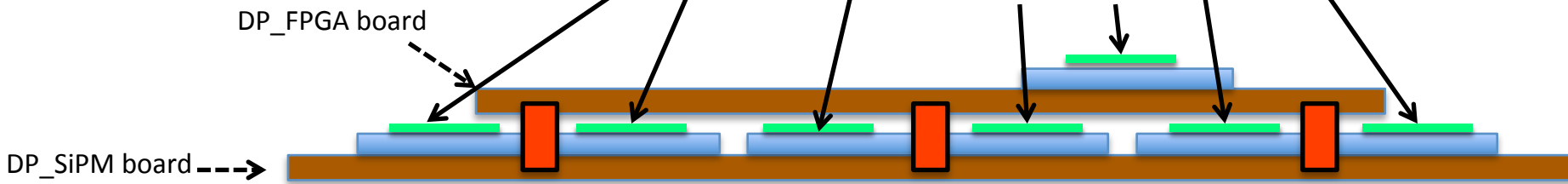
6x4x4=96 BASIC x 0,5 W = 50 W (+ 30W for FPGA + 50 W for calorimeter)

→ **cooling is an issue:** we must extract **150 W** from Dose Profiler

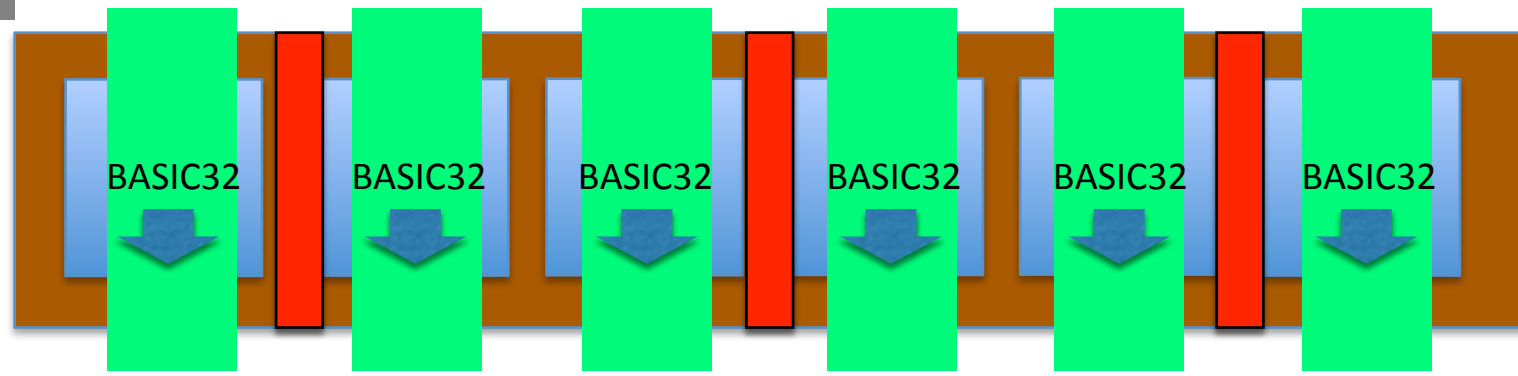
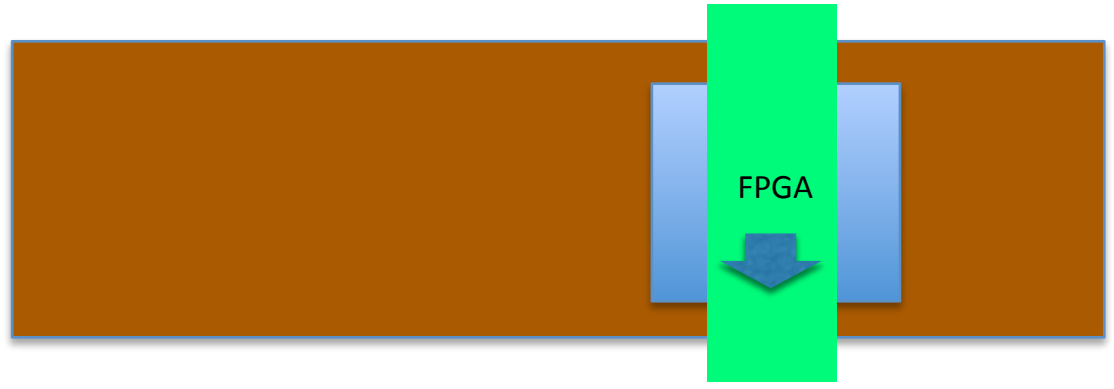
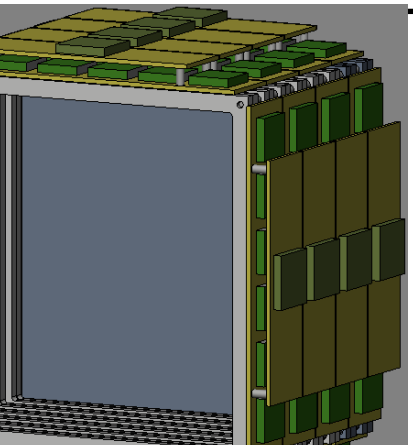


mechanical summary

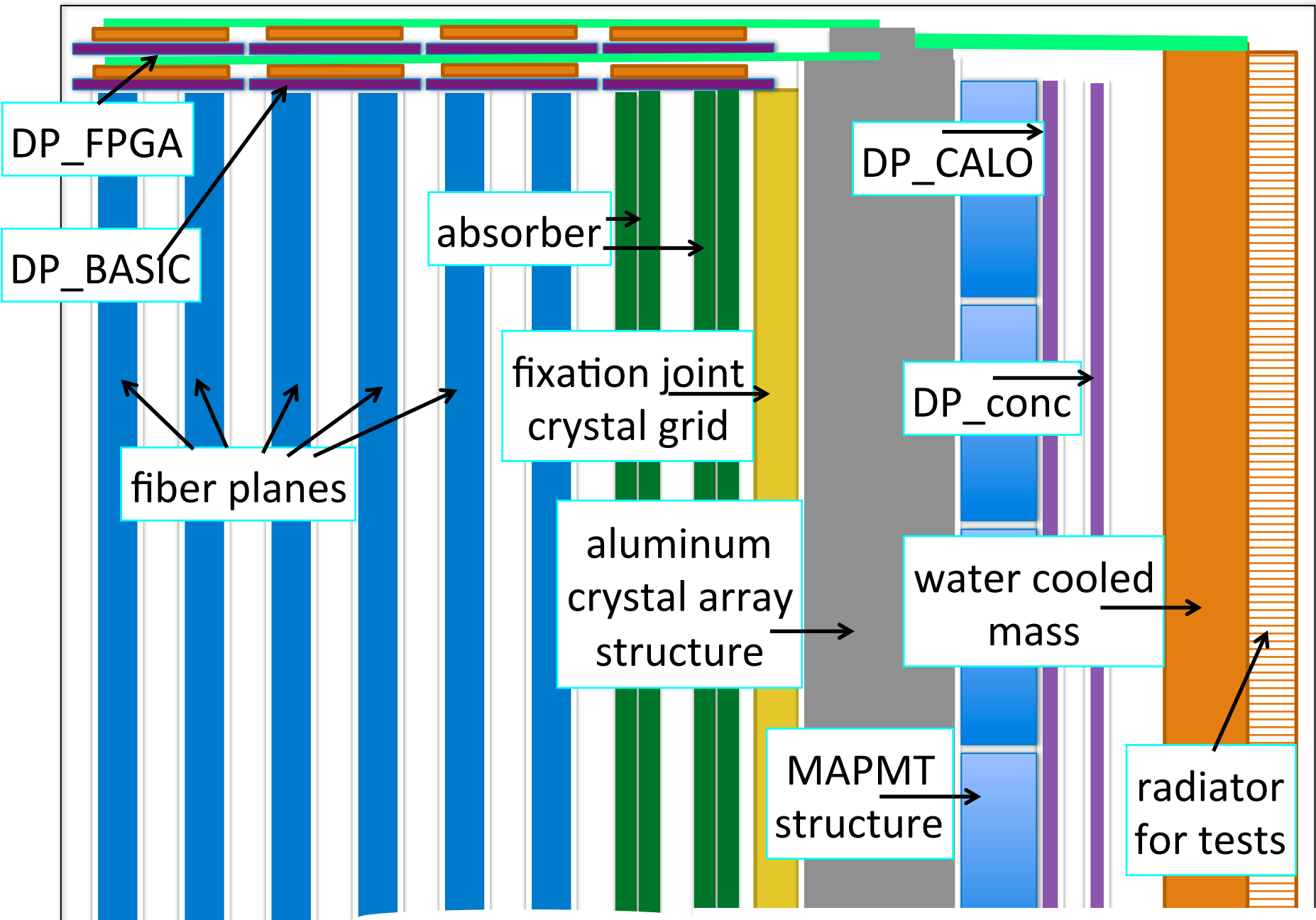
20 mm x 2 mm copper strips



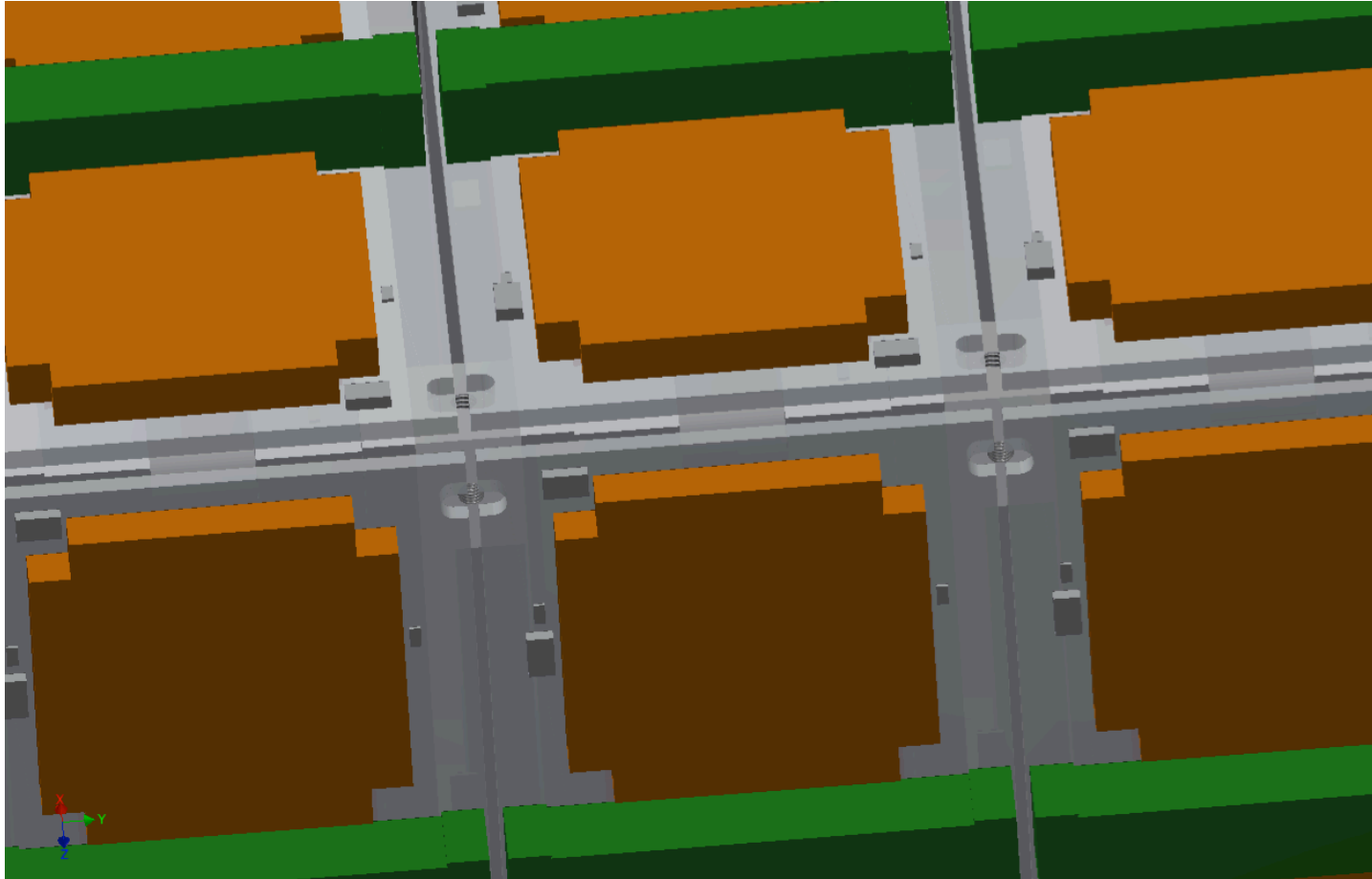
side view
top view



COOL MASS

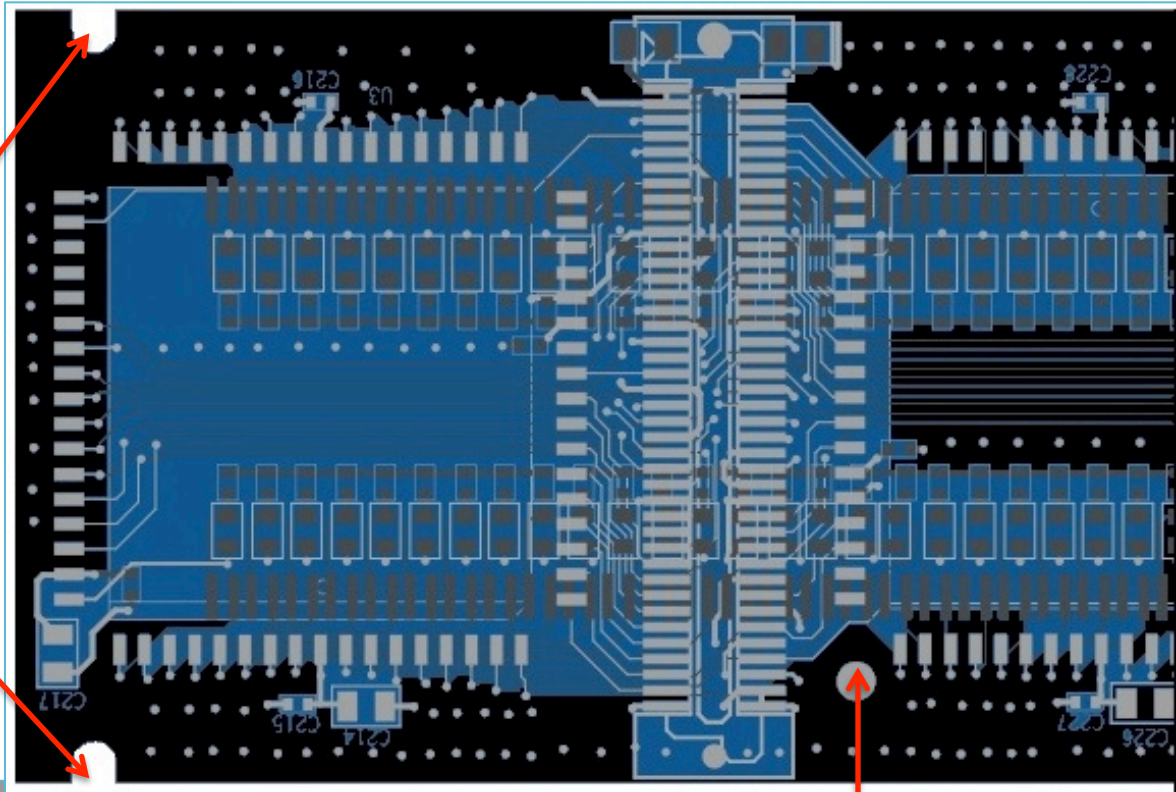


mechanical summary

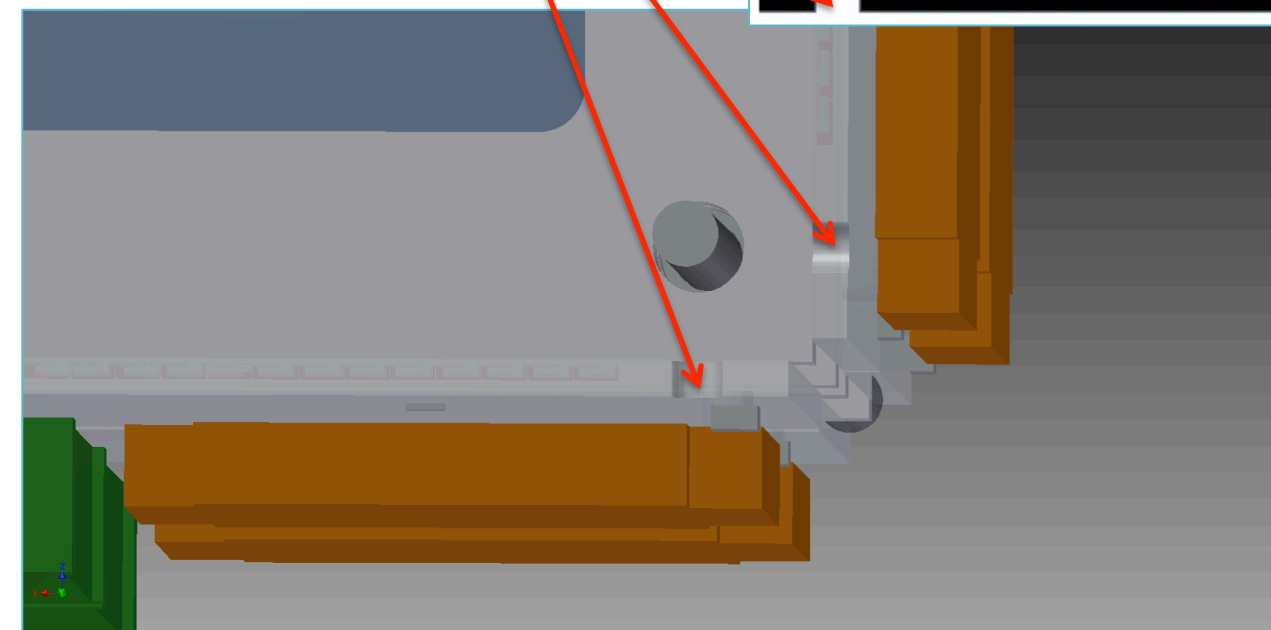


not a large space but DP is still in 28 cm x 28 cm:
kapton printed circuits to connect FPGA to concentrator

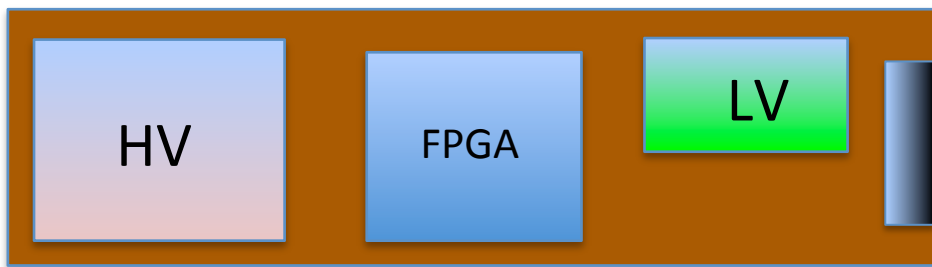
places for fixation screws



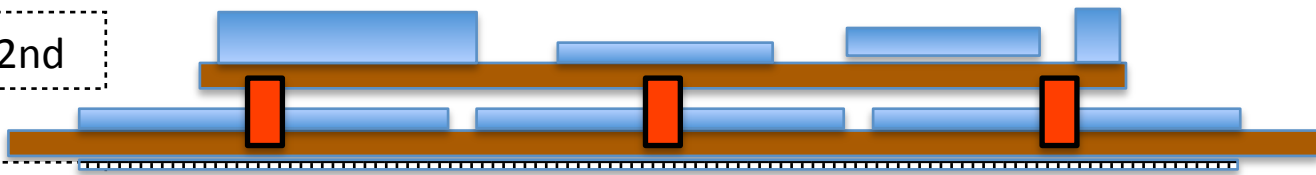
hole for alignment pin



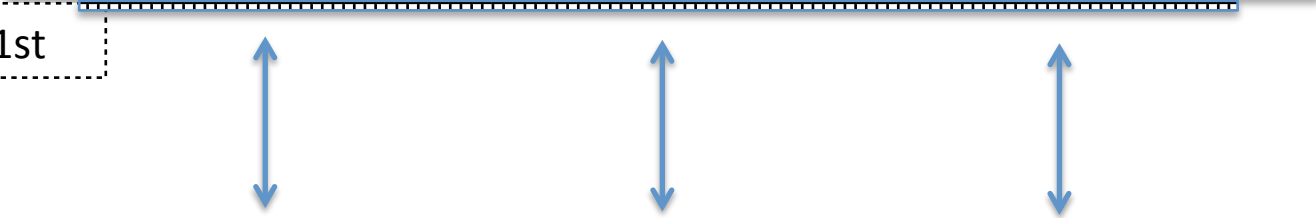
top view 2nd



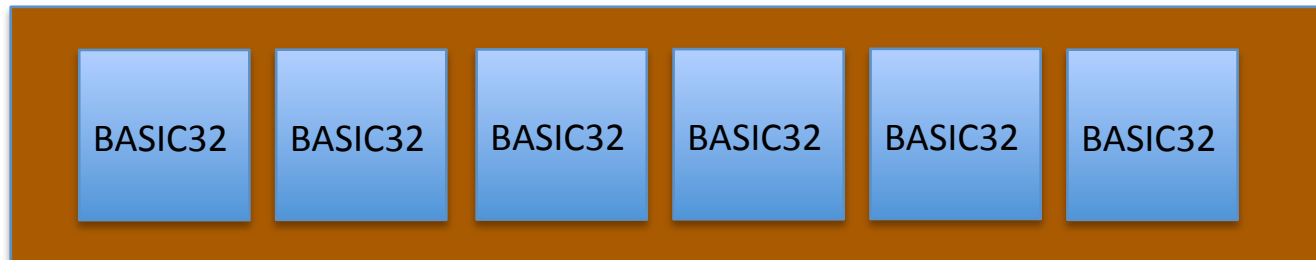
side view 2nd



side view 1st



top view 1st



96 SiPM

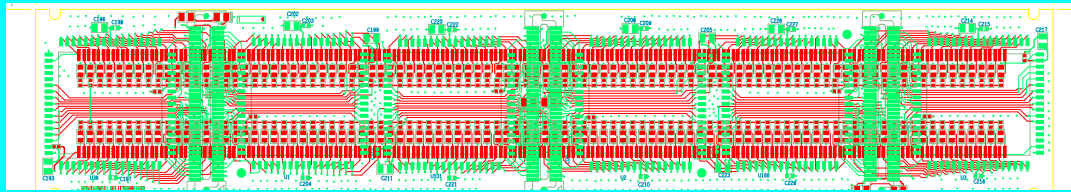


bottom view

96 SiPM



Michela
To 15.9.14

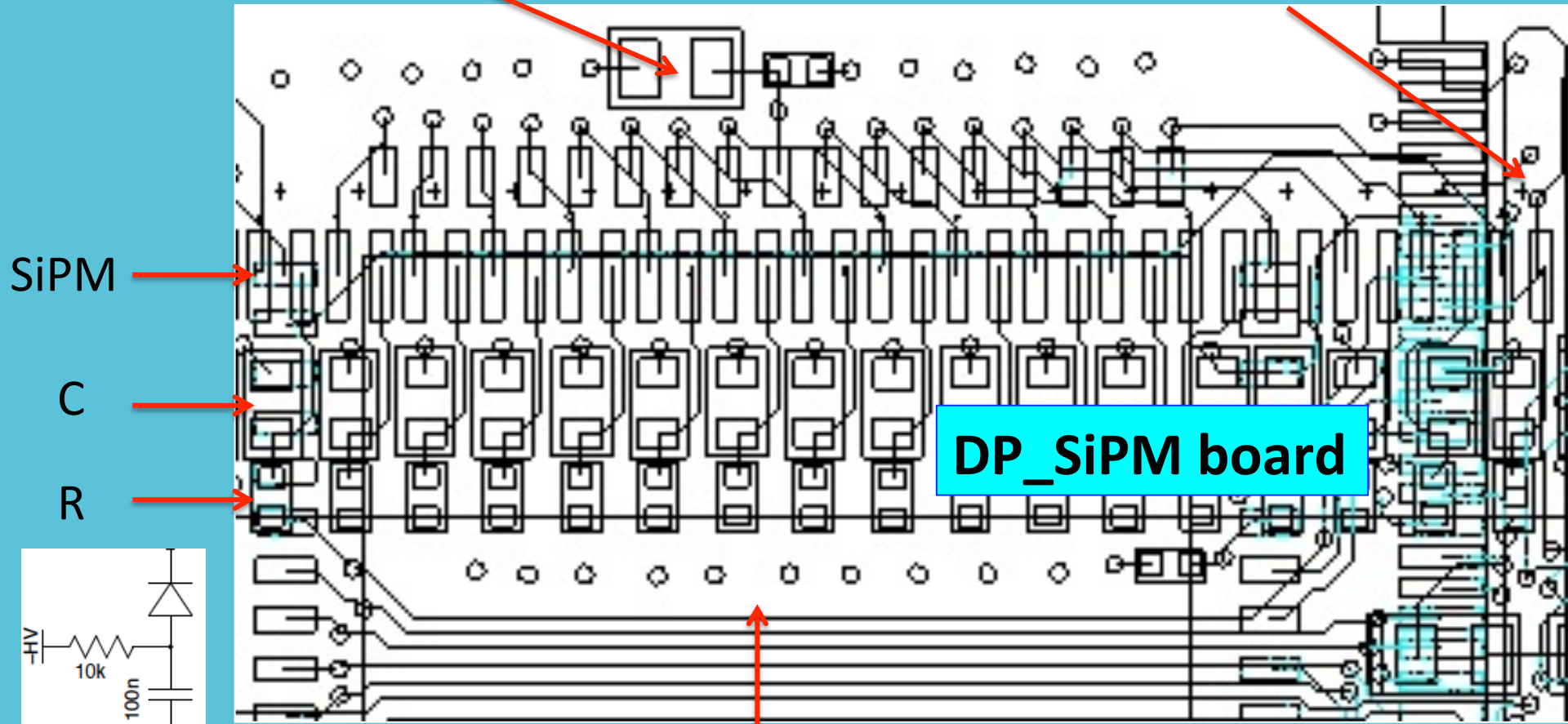


DP_SiPM board
with 6 BASIC32

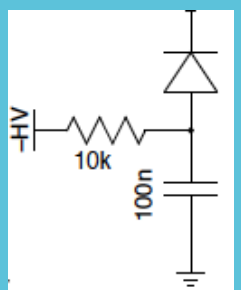
TODAY

LED for calibration/test

connector between
DP_SiPM and DP_FPGA

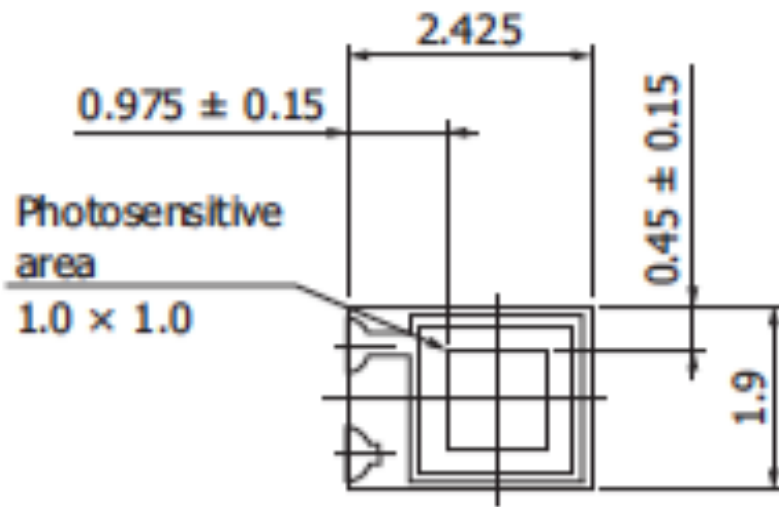


DP_SiPM board



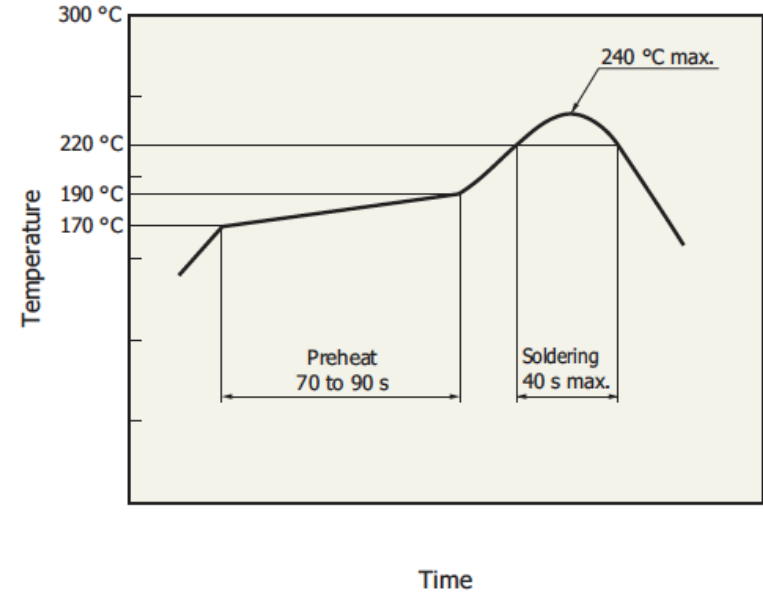
BASIC32

SiPM spacing could be an issue:
0,1 mm against 0,1 mm tolerance!!!
Hamamatsu guarantees but...
what will appen during soldering?



Tolerance unless otherwise noted: ±0.1

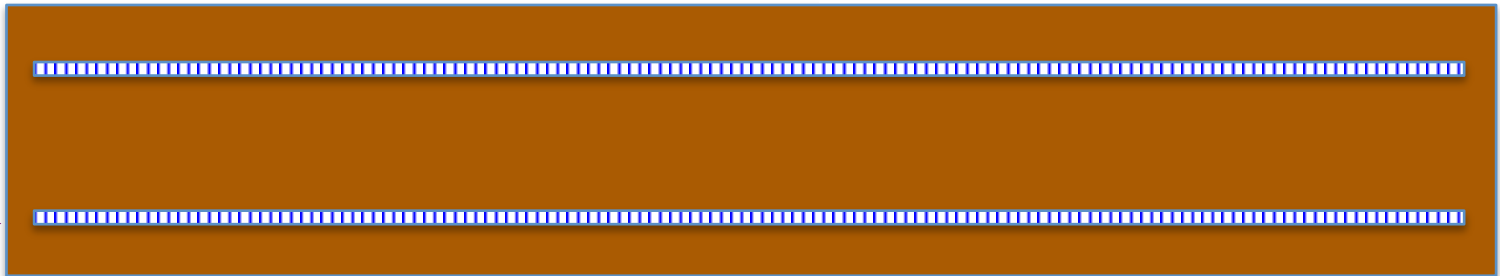
2 mm pitch
1,9 mm width



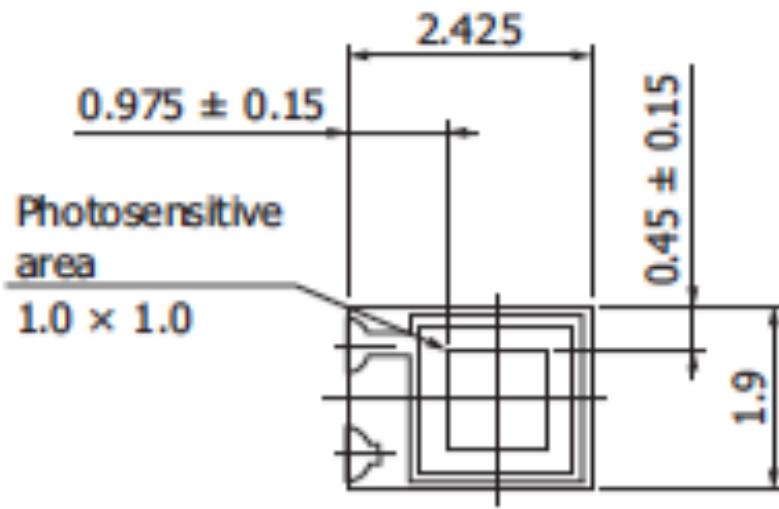
96 SiPM

bottom view

96 SiPM

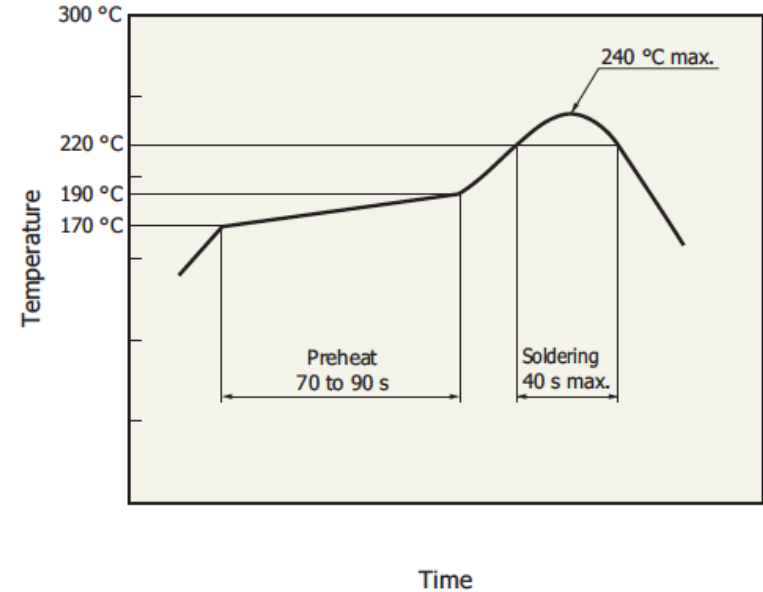


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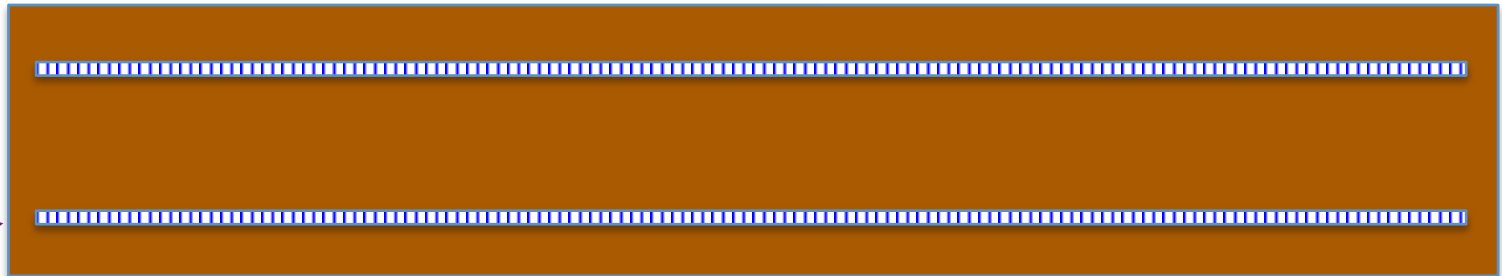
2 mm pitch
1,9 mm width



96 SiPM

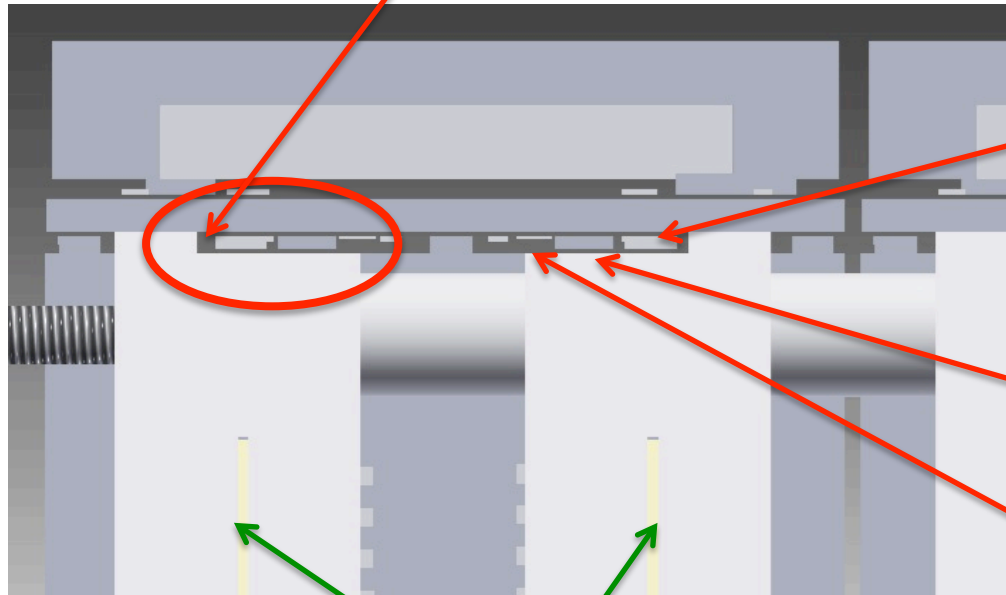
bottom view

96 SiPM



ARTEL will test dimensional problem using a few SiPM during soldering before first production start (extra SiPM delivered today)

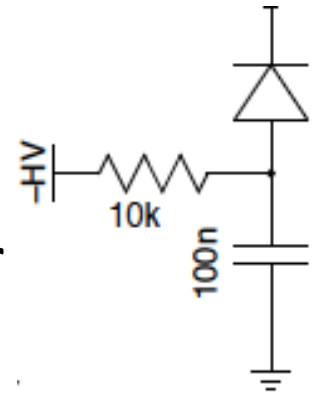
optical grease (EJ-550) resistivity? → **insulation test**



SiPM for vertical fibers

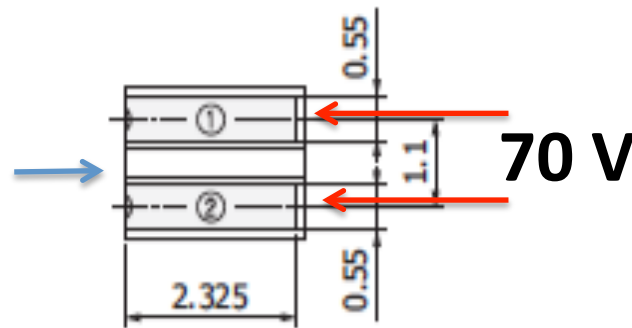
capacitor

resistor

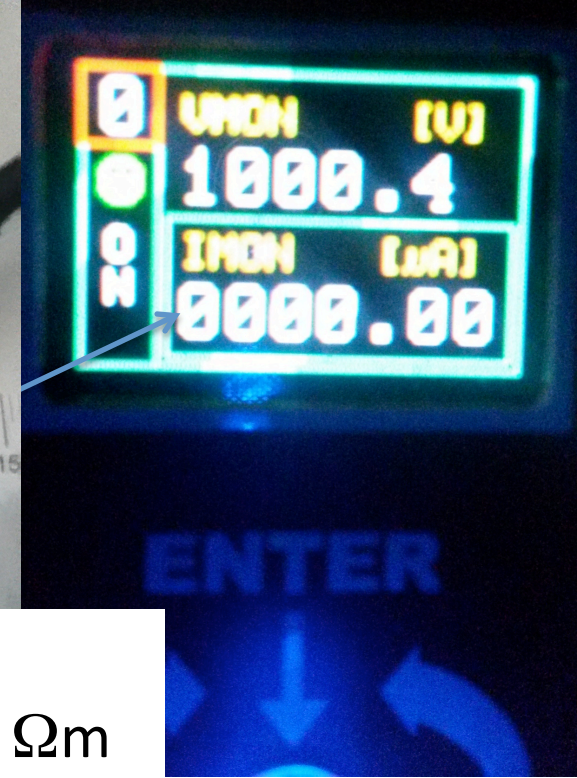
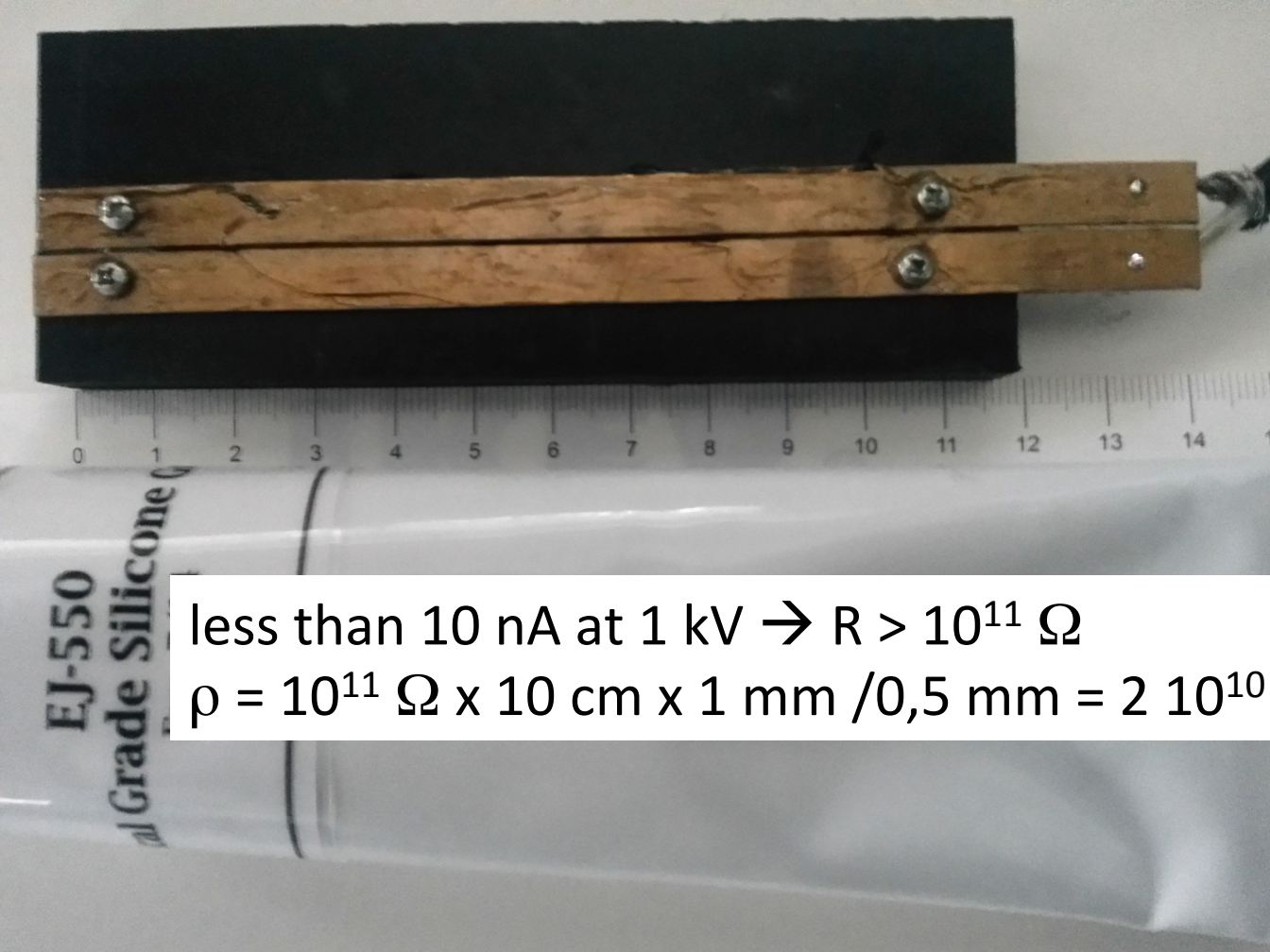


horizontal fibers

0,55 mm filled by grease

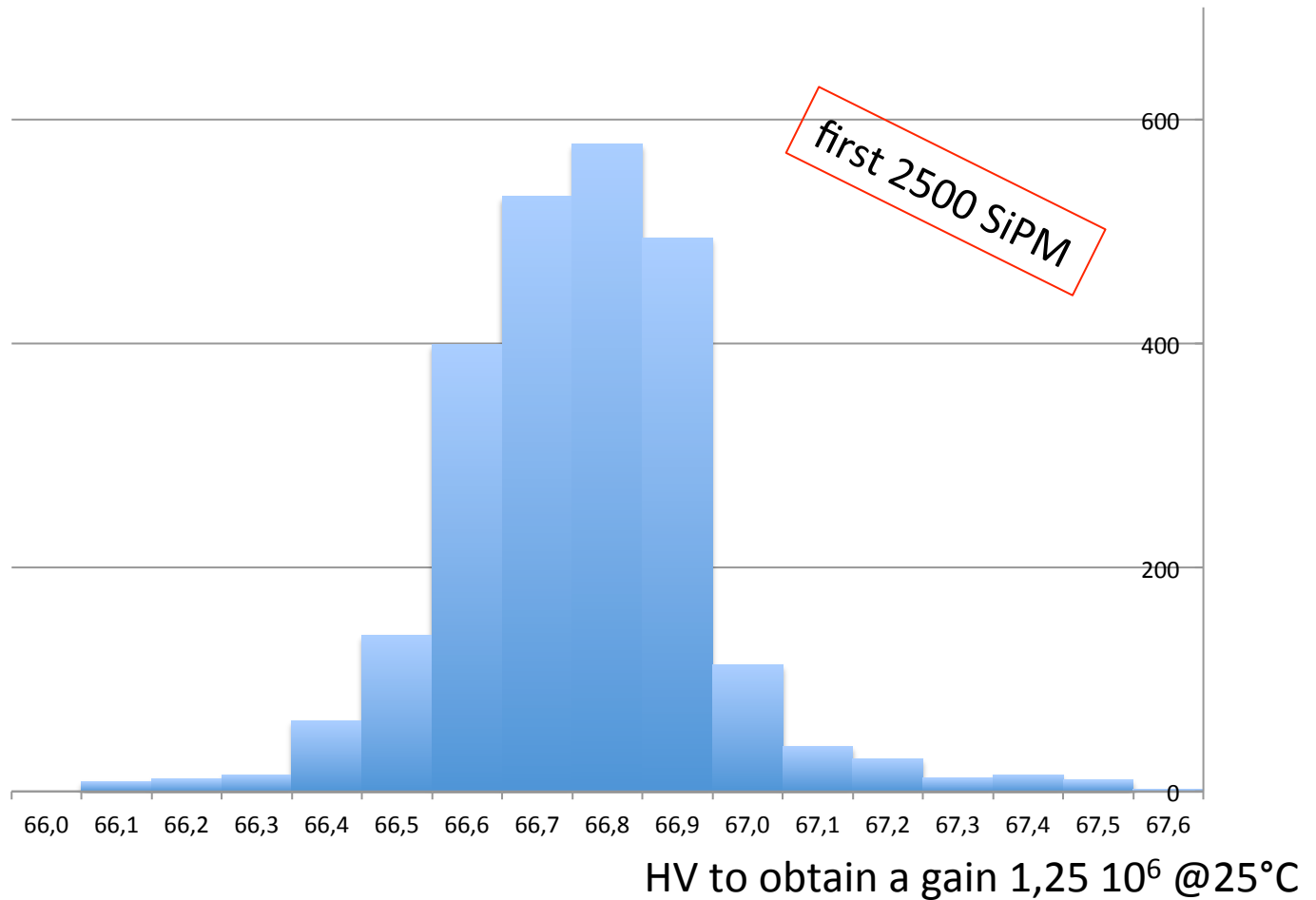
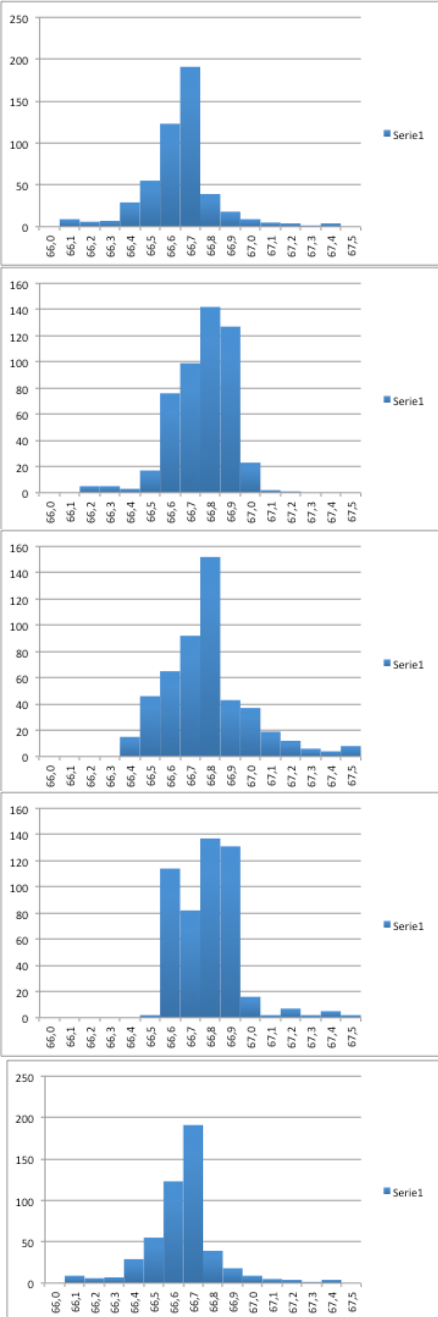


no reliable information from Eljen representative...



less than 10 nA at 1 kV $\rightarrow R > 10^{11} \Omega$
 $\rho = 10^{11} \Omega \times 10 \text{ cm} \times 1 \text{ mm} / 0,5 \text{ mm} = 2 \cdot 10^{10} \Omega\text{m}$

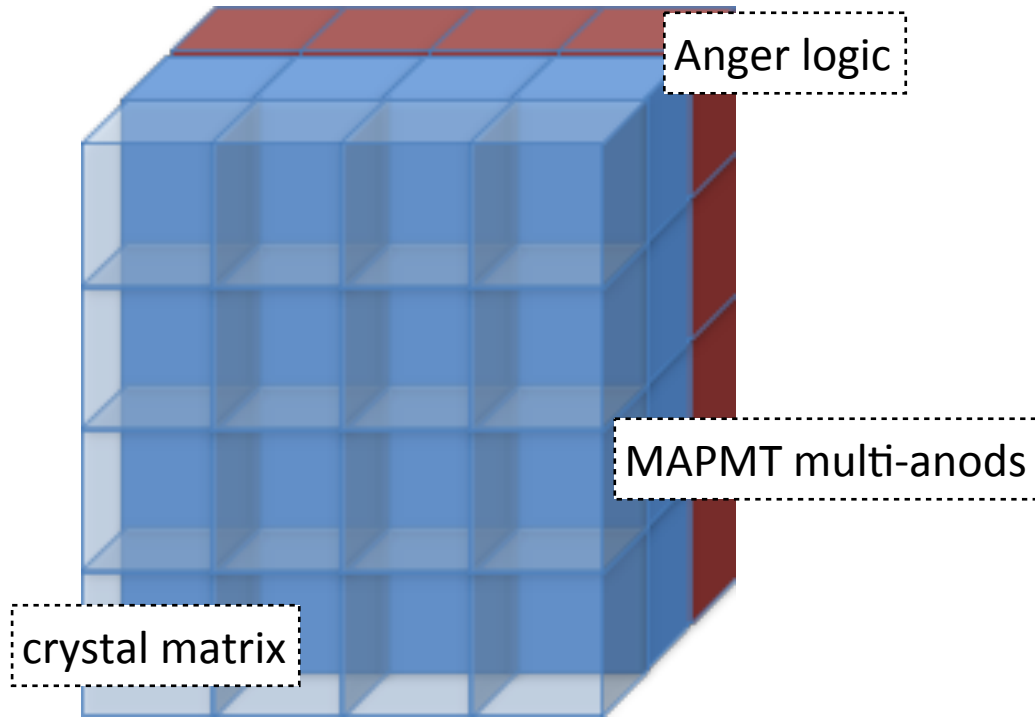
\rightarrow no problem with electrical insulation



1 V BASIC32 offset range

**we are preparing samples of 192 SiPM with similar HV
1° sample will be delivered to today (LNF→ARTEL)**

CALORIMETER readout



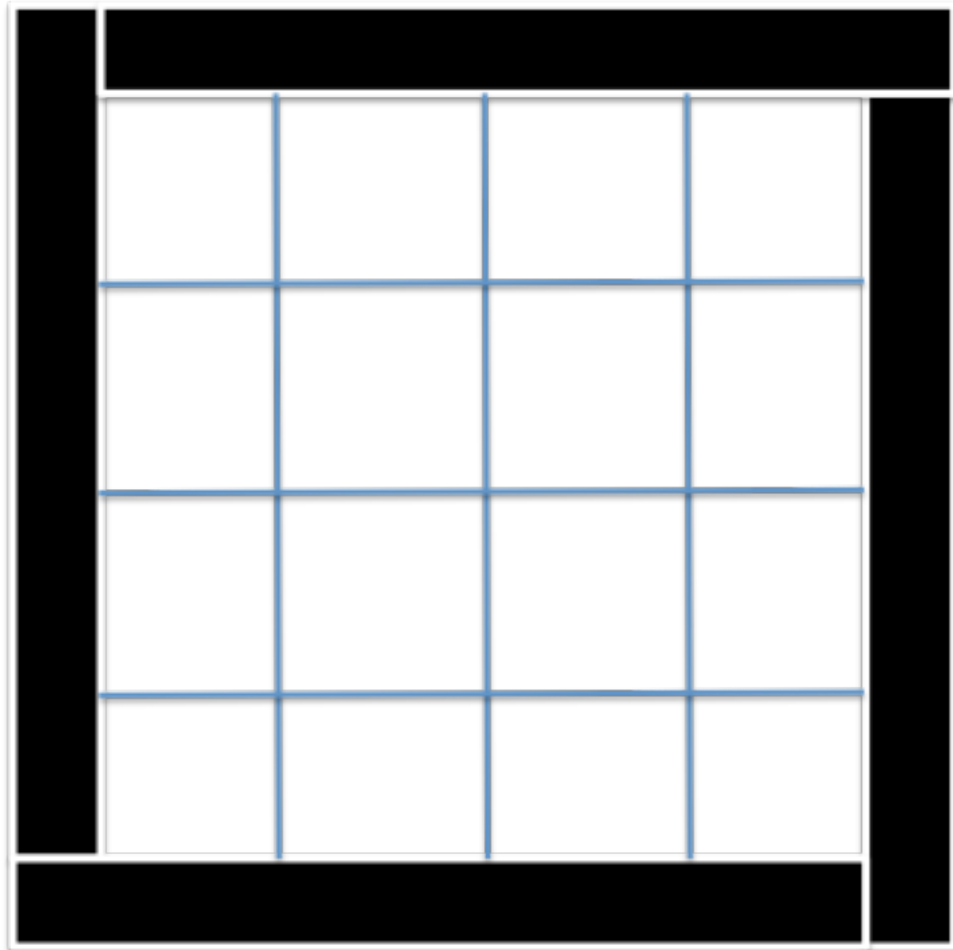
16 LFS matrices from
Hamamatsu
(ext: 52,7 x 23,7; 0,3 thick)
read by

16 MAPMT H8500
• already purchased
• partially tested

the Anger logic readout will be performed by BASIC32 (if there will be enough...):
we are waiting for the BASIC32 chip test (Matteo Cecchetti talk)

Michela
To 15.9.14

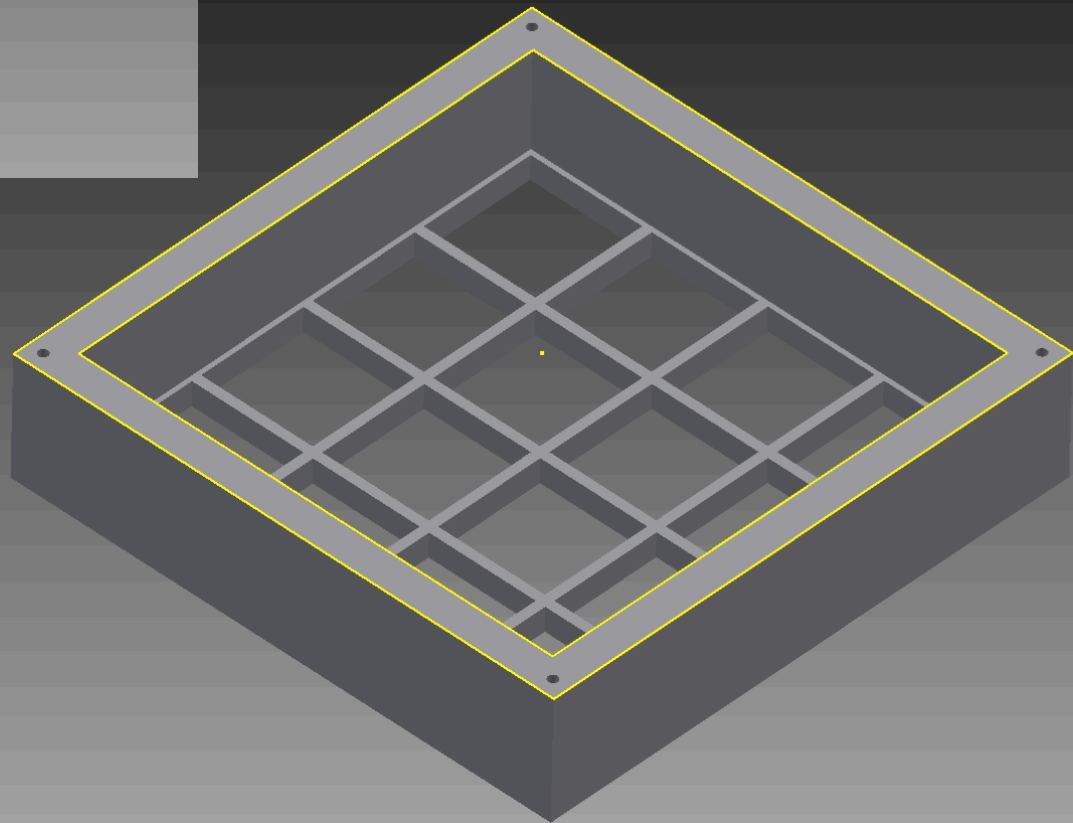
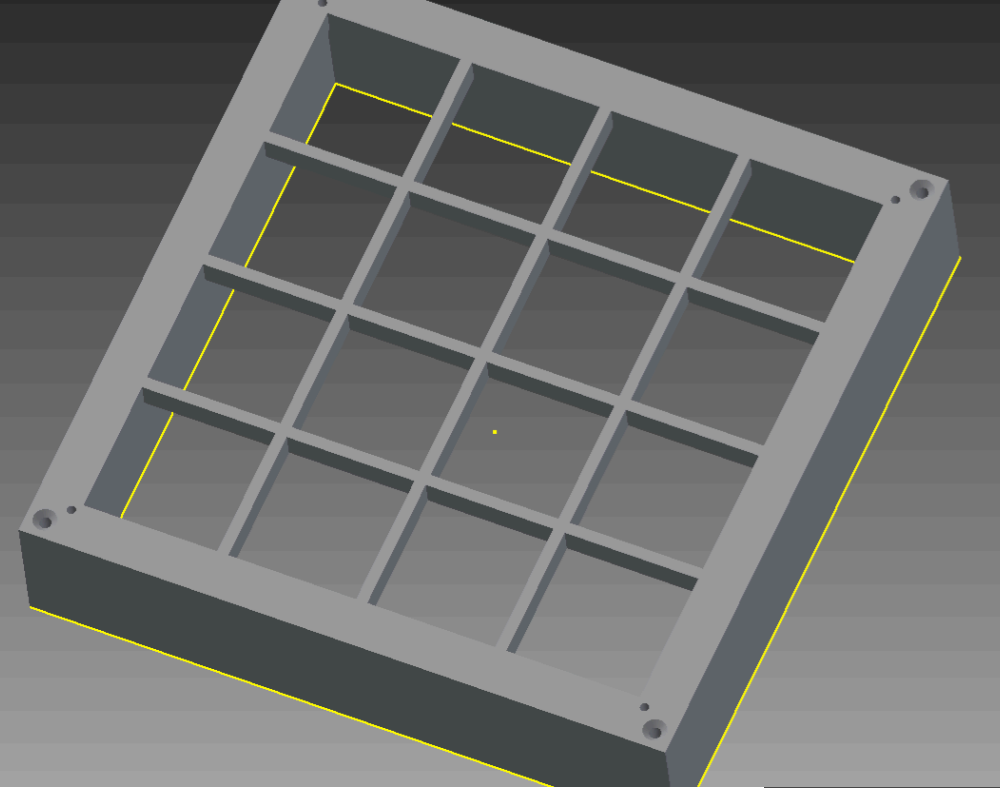
CALO MECHANICAL STRUCTURE:



INSIDE - TORINO
15.9.2014

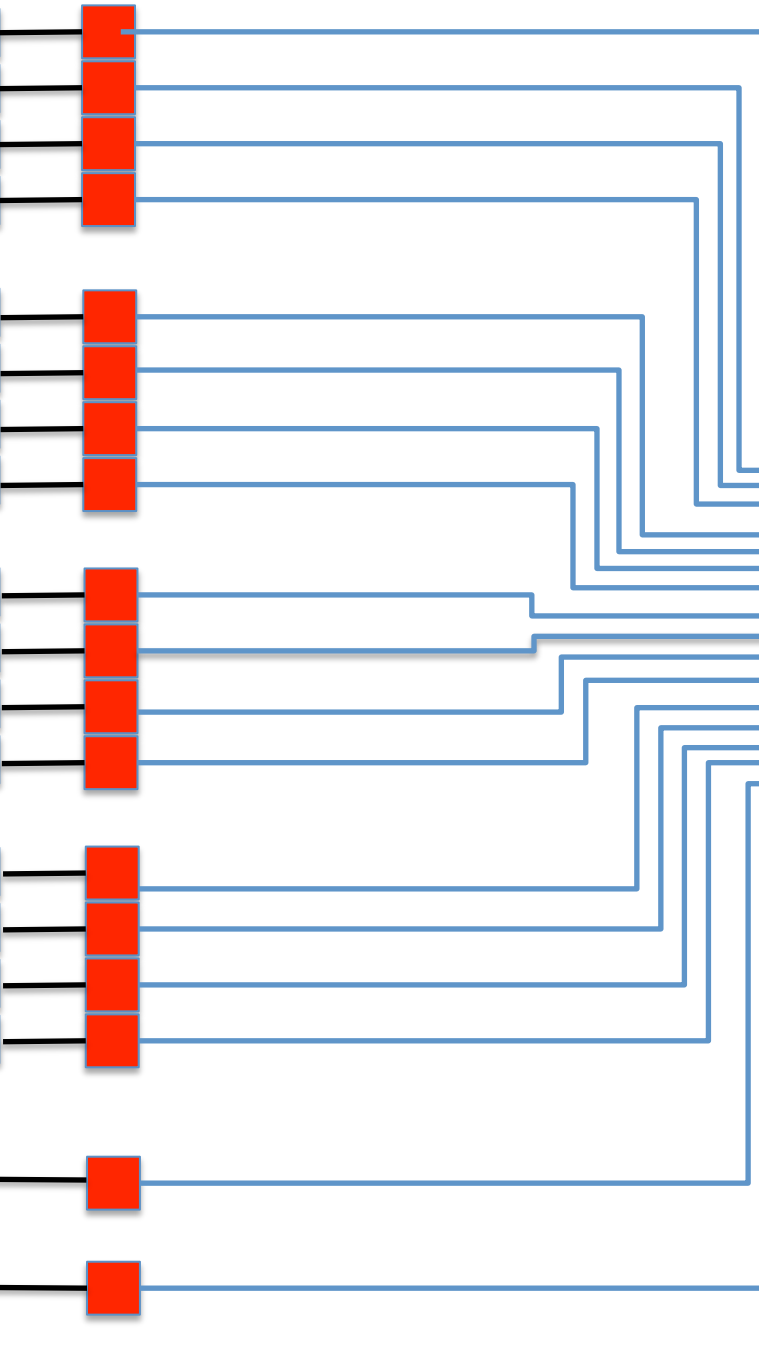
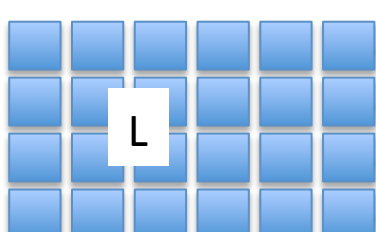
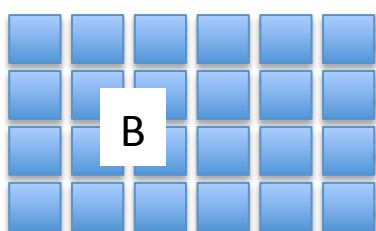
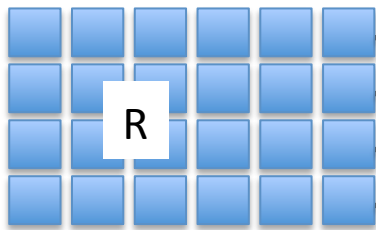
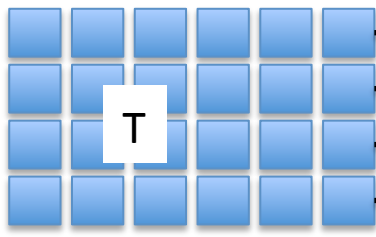
Adalberto e Michela - ROMA

Michela
To 15.9.14

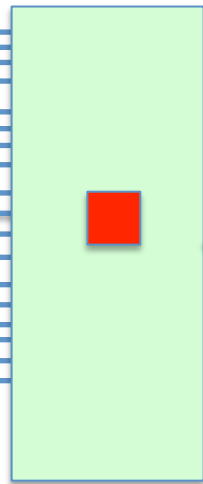


BASIC32

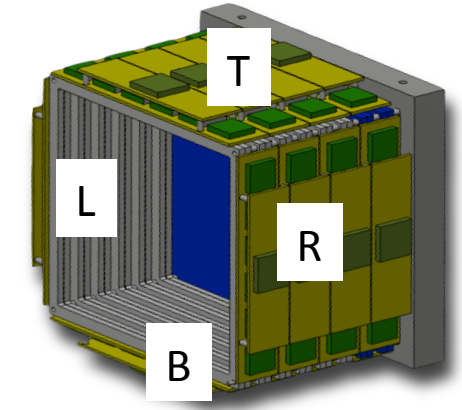
FPGA



concentrator

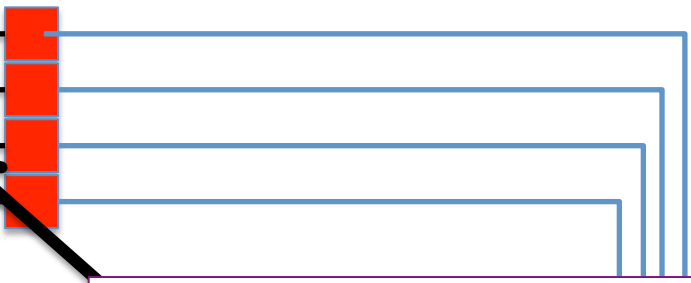
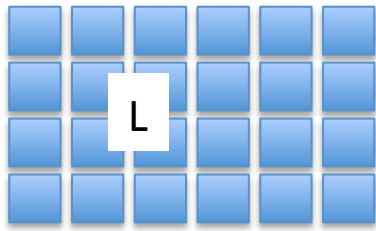
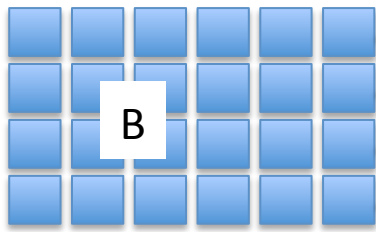
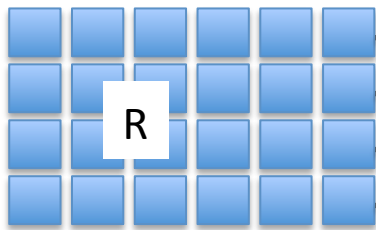
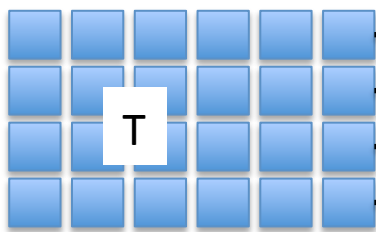
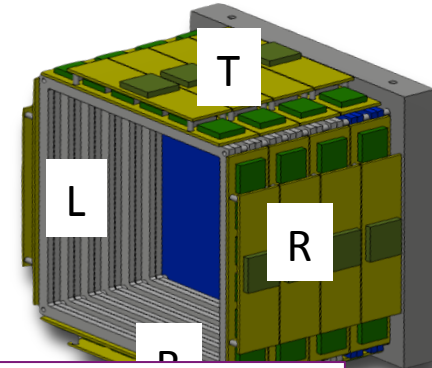


ethernet



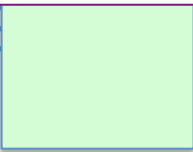
BASIC32

FPGA



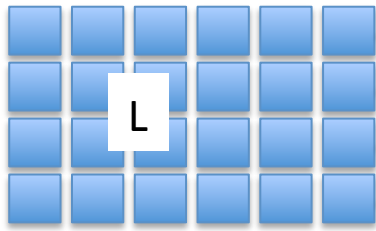
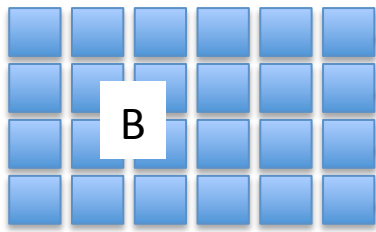
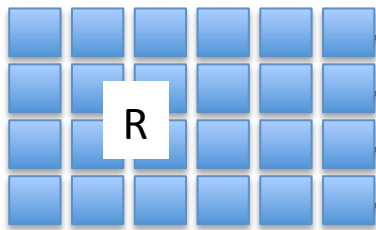
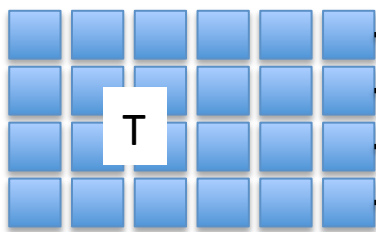
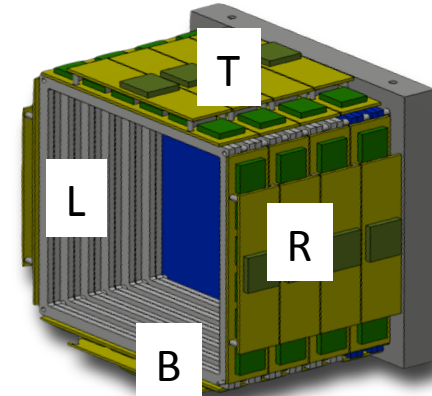
BASIC32
IN: configuration, readout TRG
OUT: OR for trigger, data, address

slow serial link: $20 \mu\text{s} @ 2 \text{ MHz} (< 20\text{MHz})$
DATA transfer in parallel from BASIC's to FPGA



BASIC32

FPGA

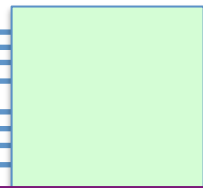
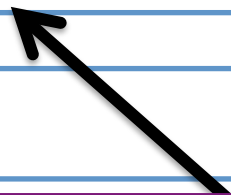


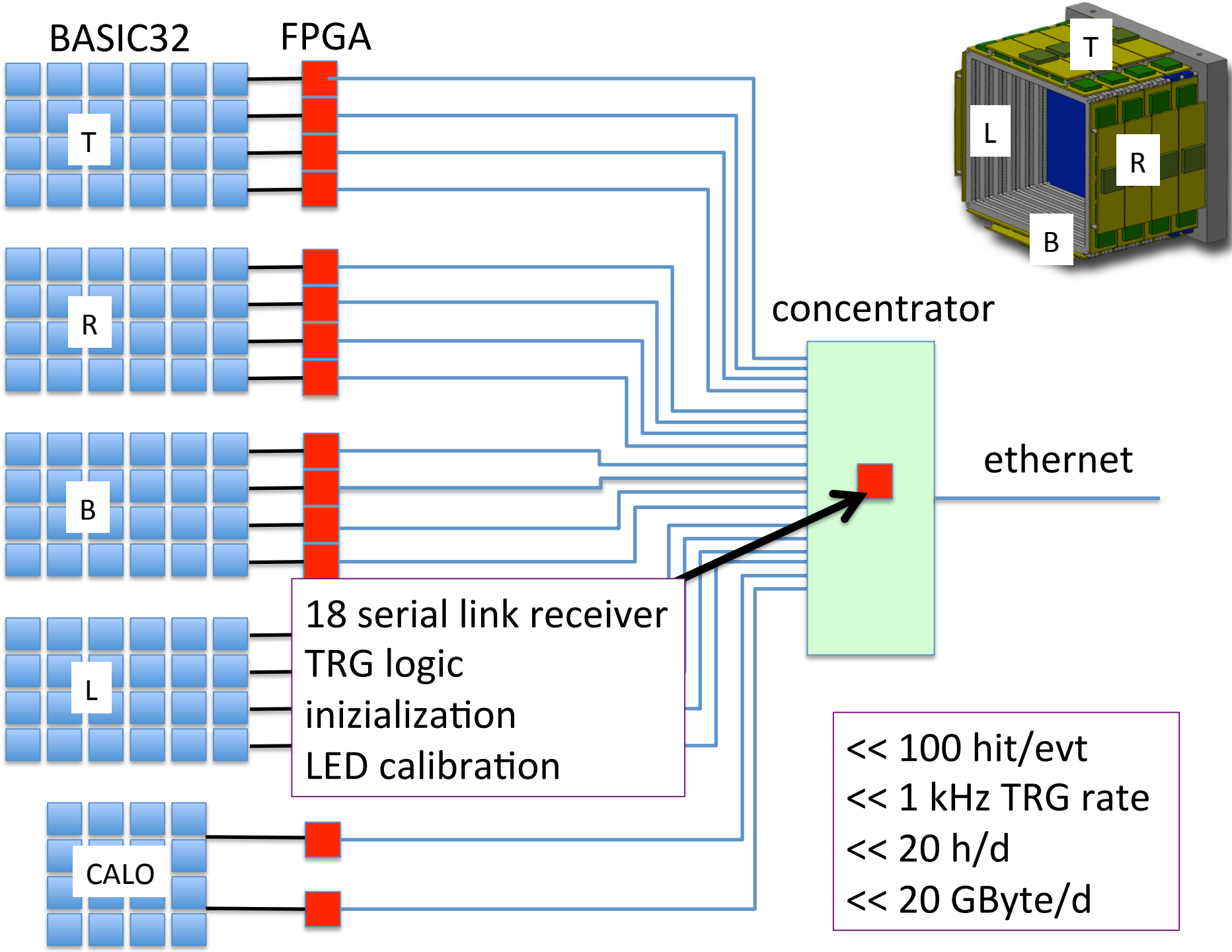
concentrator

ethernet

18 serial link
 if no zero-supp 6x32 word (data:8+addr:5) 2,5 kbit
 2 Gbit/s link is enough for 2,5 kbit/2 μ s

OR/TRG signal can be easily managed at 40 MHz
 (25 ns delay is not an issue): no more stringent time
 requirement from TRG (and LED pulsing)





Time Schedule

from MILANO
March 2014

2013

- profiler **layout optimization** with MC
- reconstruction algorithm development

2014

- fibers test
- electronics and DAQ design
- one plane module assembly => M.Magi

Milan is working to the test board
LNF start working effectively from June!

- other planes assembly and tests .. before Christmas!

up to now we are here!!

- stand alone mechanics
- electronics production
- calorimeter realization

2015

- profiler assembly (mechanics, electronics, DAQ & TRG)
- **integration HW & SW**
- global device test & characterization

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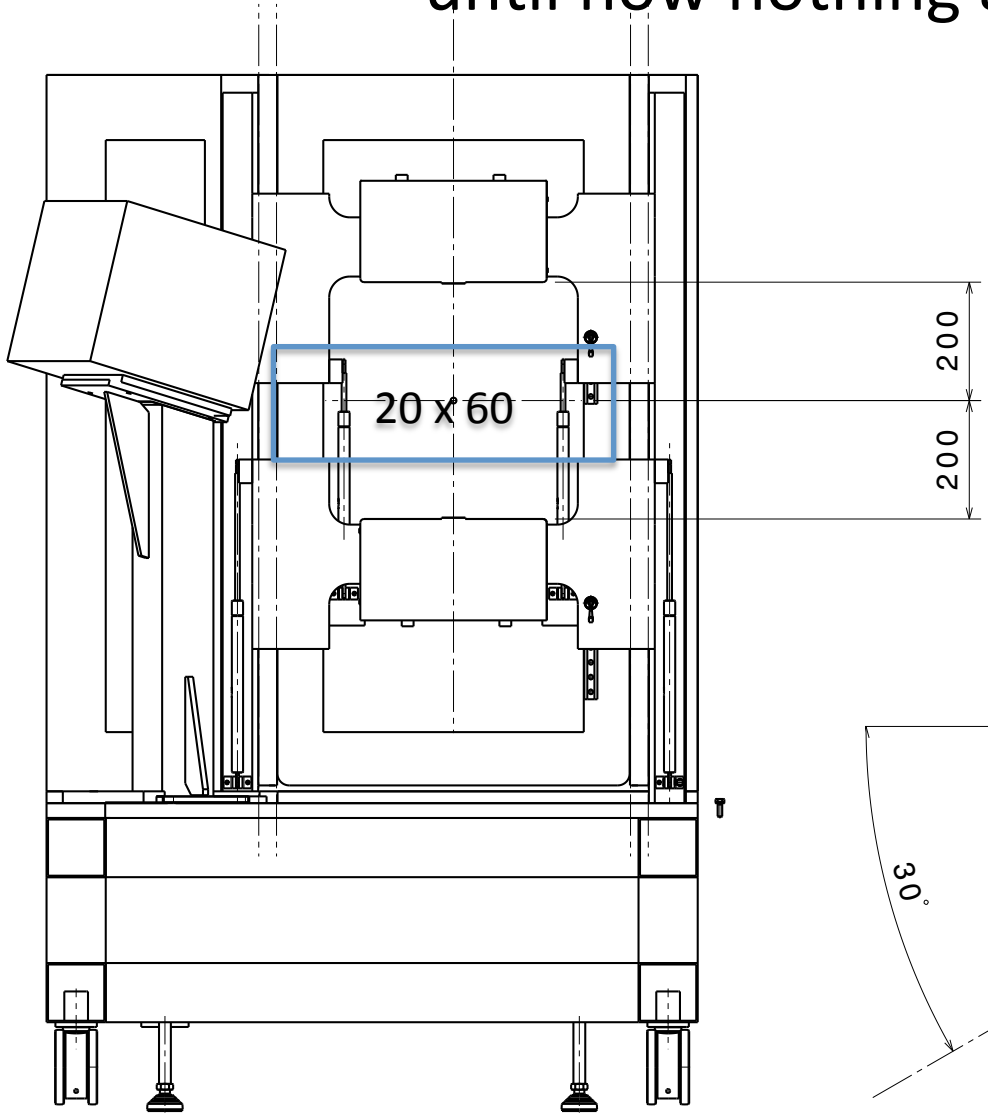
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2015

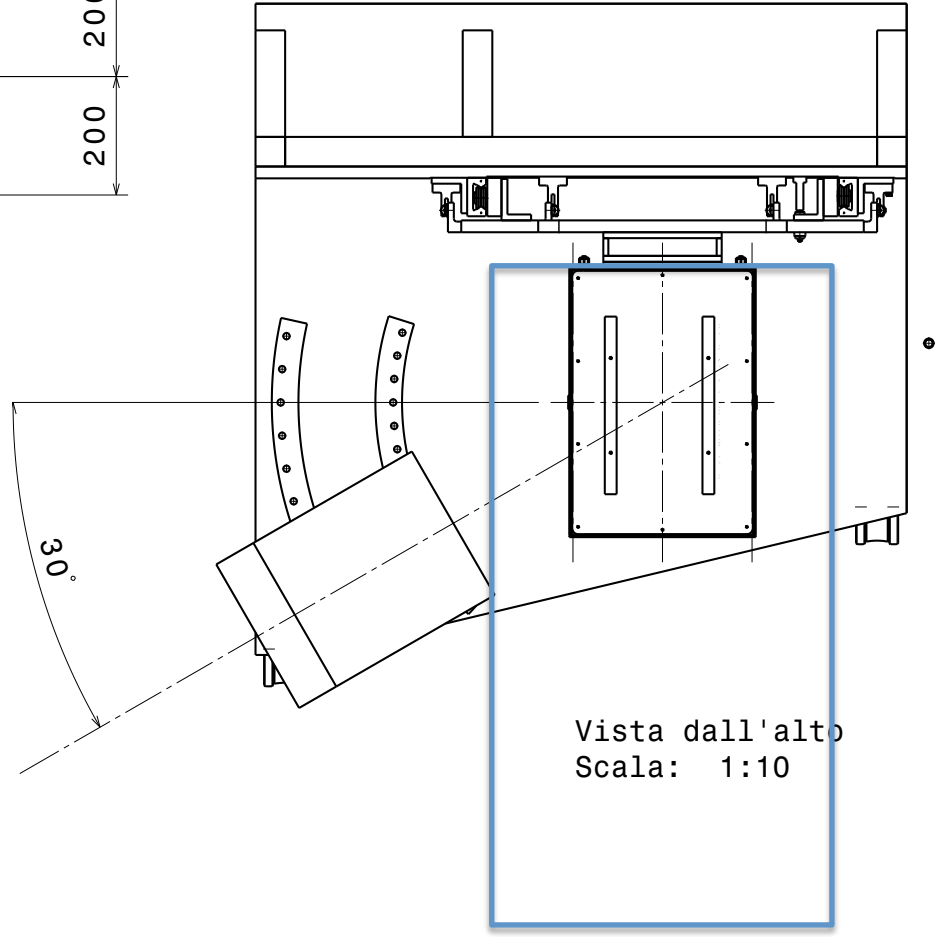
- profiler assembly (mechanics, electronics, DAQ & TRG)
- **integration HW & SW**
- global device test & characterization

18.12.2014: schedule confirmed!

until now nothing against 28 cm x 28 cm x 35 cm

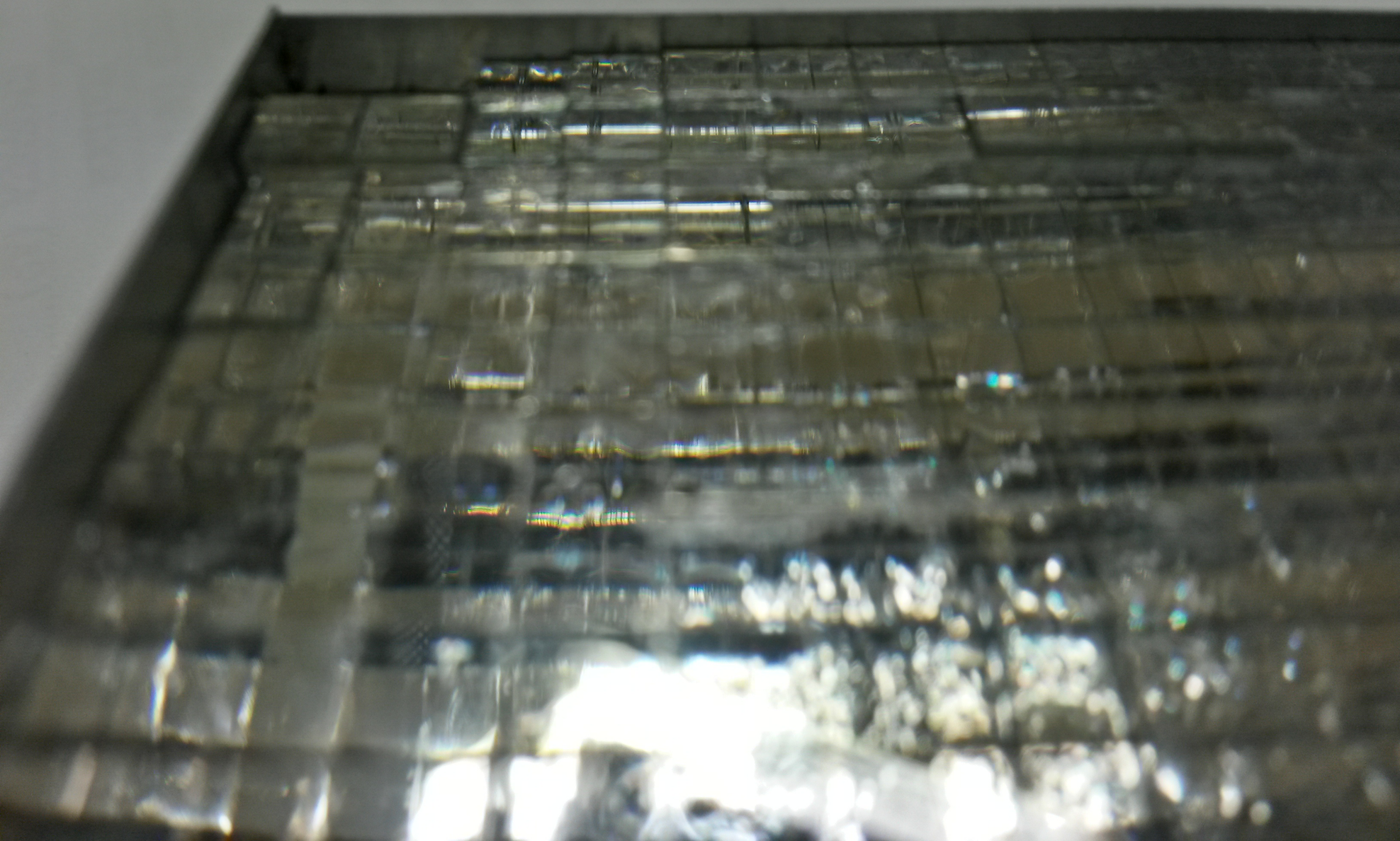


Vista frontale
Scala: 1:10

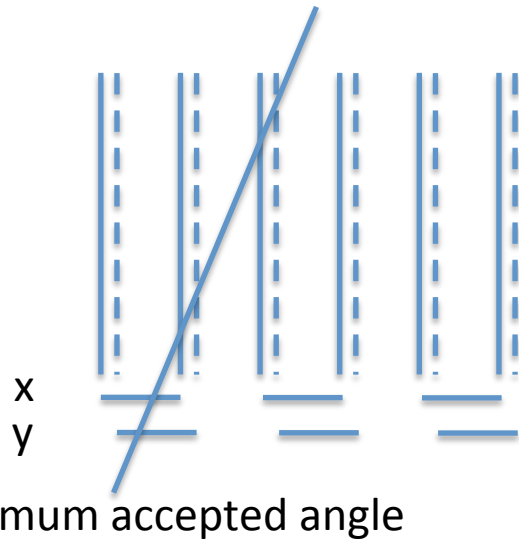


Vista dall'alto
Scala: 1:10

LFS matrix from Hamamatsu



TRG definition: a signal from at least 3 contiguous double layers



expected TRG rate < 100 Hz

if neutron induced event rate is higher, more layers, absorber and calorimeter could be required → configurable TRG logic (inside concentrator)

DAQ layout:

- front end board: 6 BASIC will be sequentilly read ($< 96 \times 2$ word in $< 6 \times 7 \mu\text{s}$) → > 25 kHz
- data from 16 FE board trasferred in parallel (time division?) to the concentrator

For each TRG we expect at maximum 2 particles: 24 coordinates in the tracker.

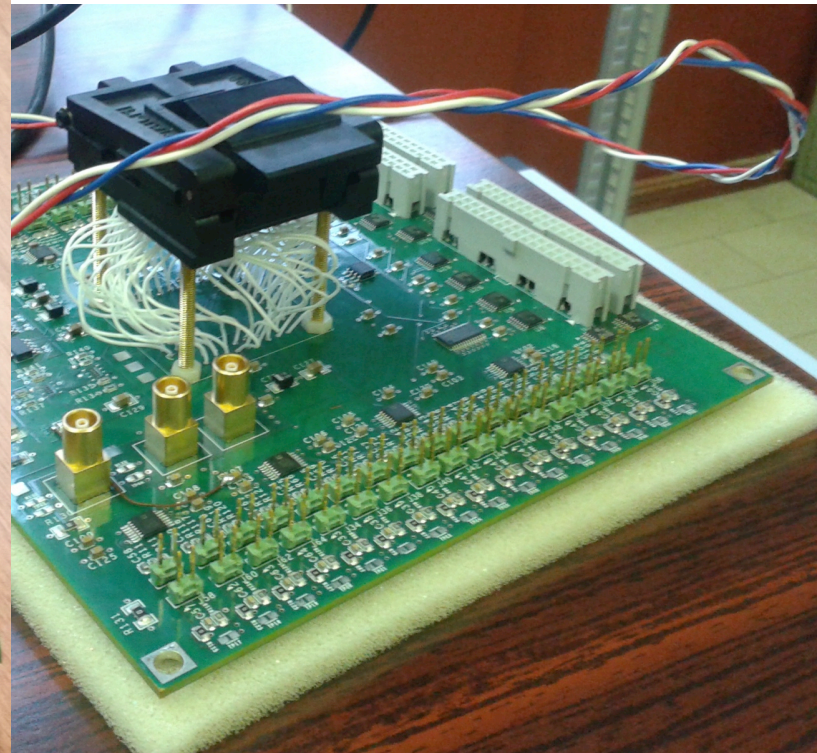
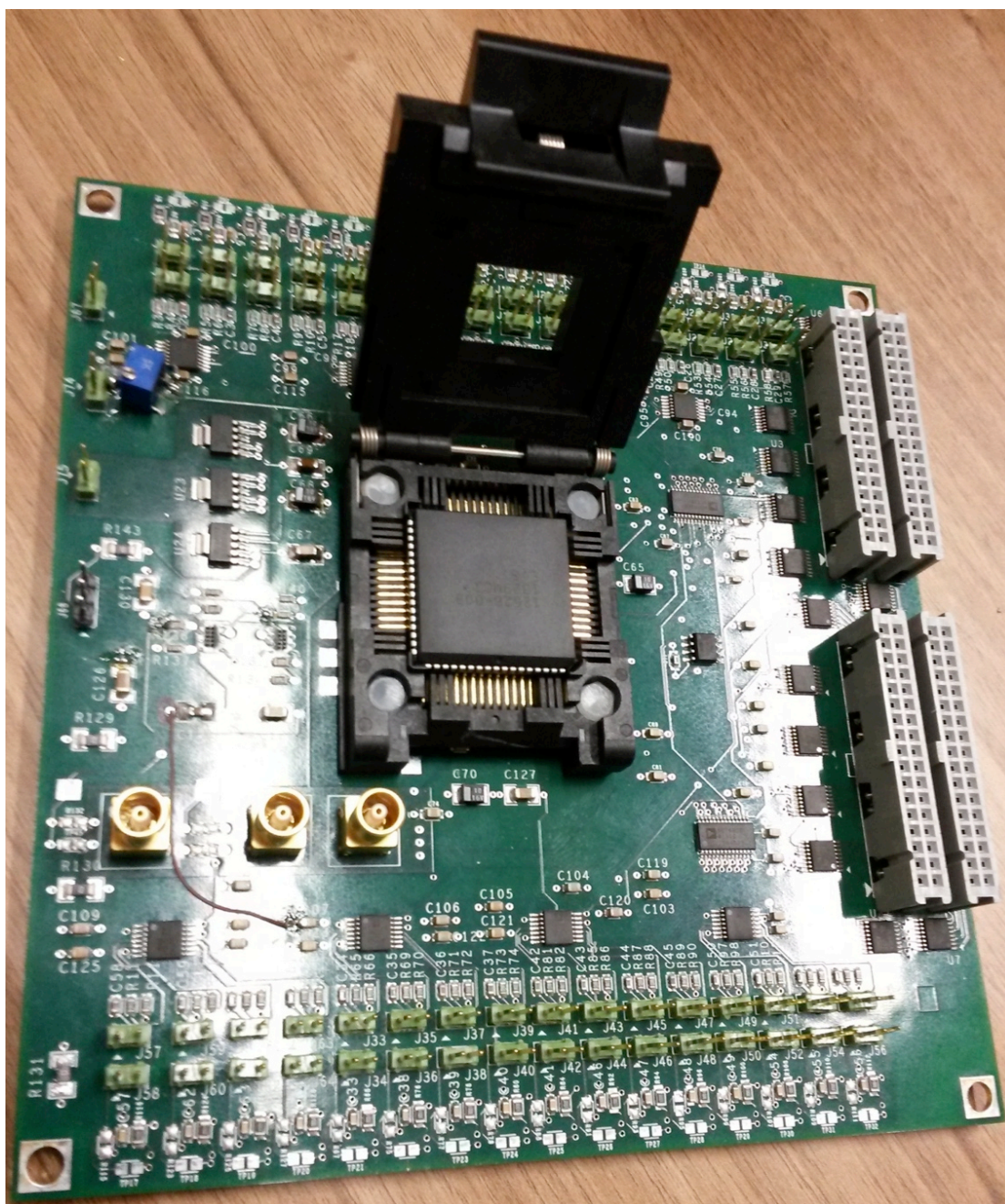
Assuming the cluster size (cross talk) of 3 mm, each coordinate generates $24 \times 3/0,5 \times 16$ bit < 300 byte

In the Calorimeter we expect at maximum 9 hit/(particle+noise) → $9 \times 4 \times 2$ byte= 72 byte

→ less than 400 bytes/TRG → **0,4 MB/s data acquisition rate in total** (@1 kHz TRG rate)

→ not an issue ... start of project: next weeks

Michela
To 15.9.14



1x1 mm

For a m.i.p.: 2MeV/cm (100keV/fiber) = 20000 ph/cm = 1000 ph/fiber

=> $1000 \times 4\% \times 35\% \sim 14\text{ p.e./fiber/m.i.p.}$

light will be shared by more fibers → thr 3-4 p.e.

- 20×20 pixel ($50\mu\text{m} \times 50\mu\text{m}$) => for one fiber 10×10 pixel for 7 m.i.p. 100 p.e. → non linearity if > 3,5 m.i.p.

192 mm

..fibres read out..