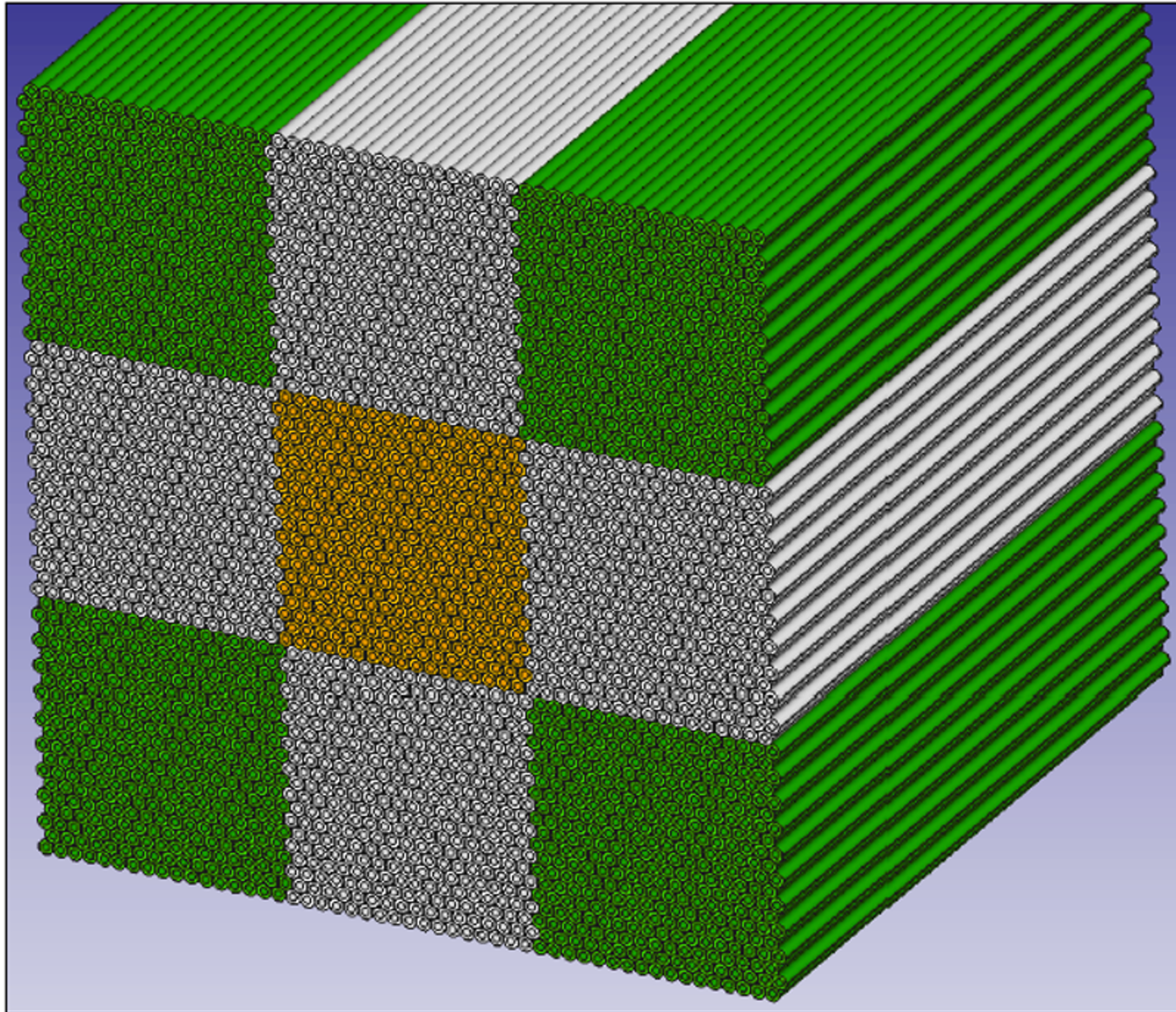


Dual Readout calorimeter

- Present status
- HiDRa Call in CSNV
- Scientific program 2021
- Financial request 2021

Recap “EM-scale” module



10x10 cm² divided in 9 towers, 1m long
16x20 capillary each (160 C + 160 S)

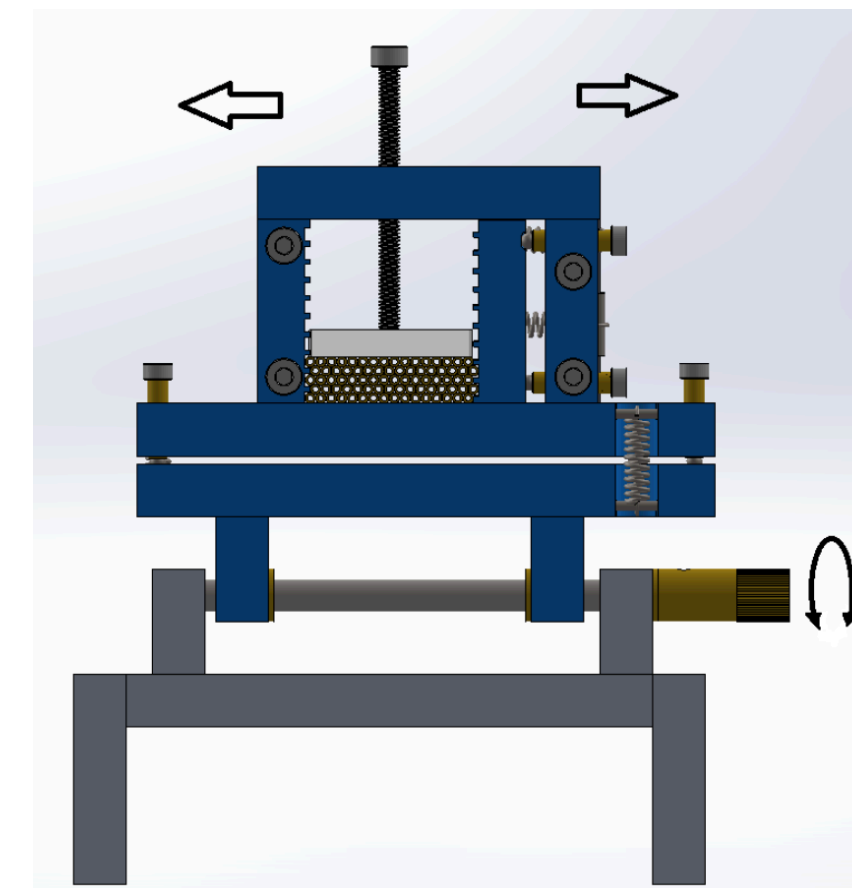
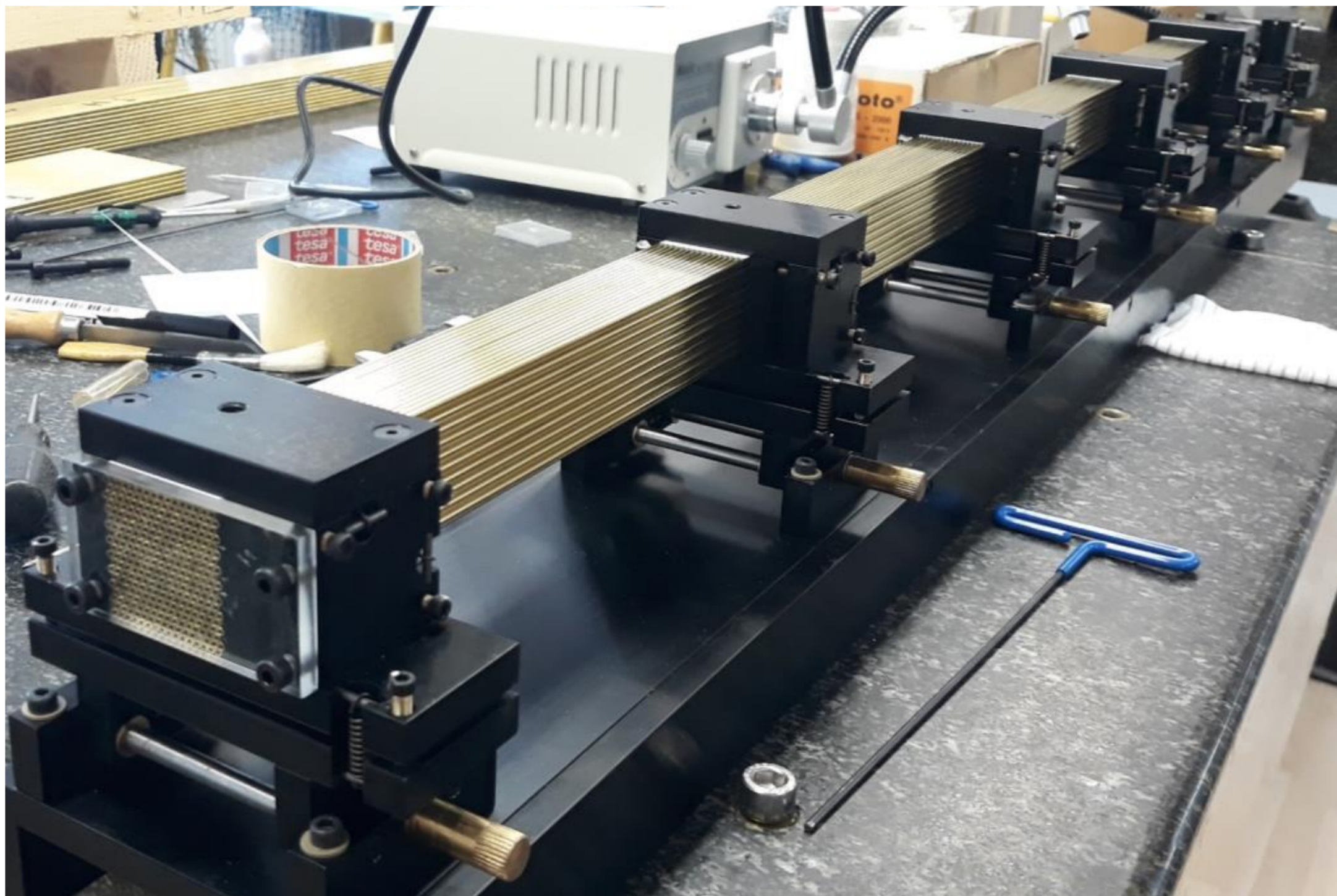
Capillary:

2mm outer diameter, 1 mm inner diameter

Material: brass CuZn37

Readout:

- 1 central tower readout by SiPMs (320 SiPM)
- 8 surrounding towers readout by PMTs (2 PMTs per tower - à la RD52)



6 adjustable stations for packing capillaries to correct position. Alignment of stations through micrometric screws

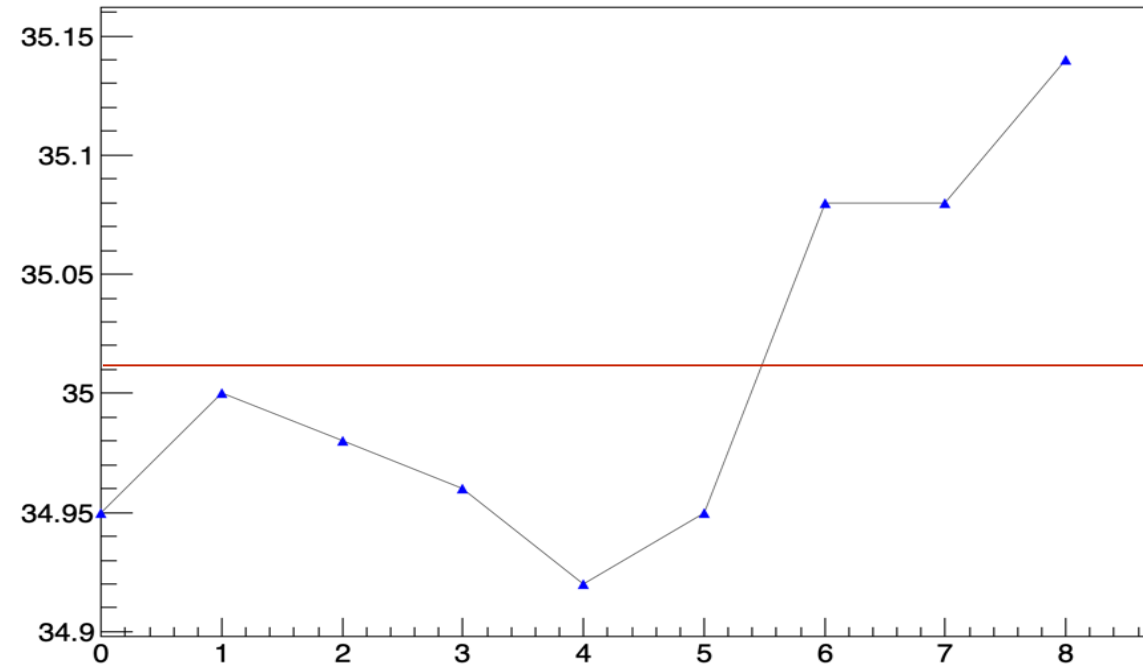
9 towers delivered to Pavia beginning of August

Towers qualifications

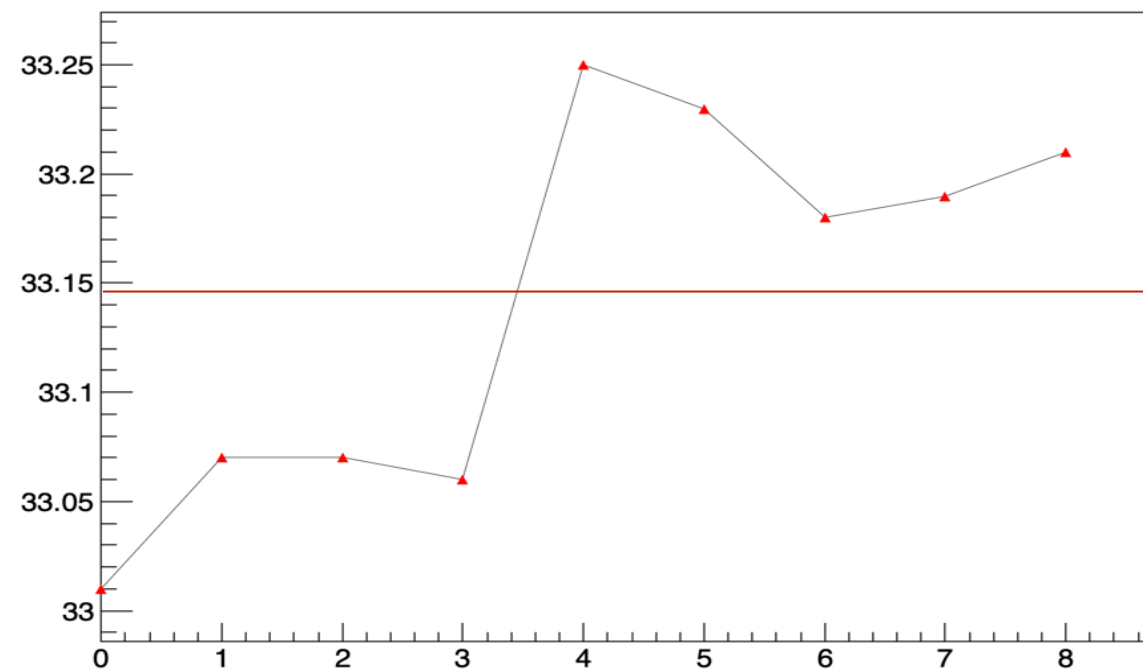
Thickness (in mm)		
Module	Mean	RMS
M0	34.95	0.05
M1	35.00	0.05
M2	34.98	0.04
M3	34.96	0.04
M4	34.92	0.05
M5	34.95	0.05
M6	35.08	0.04
M7	35.08	0.03
M8	35.14	0.05



Graph



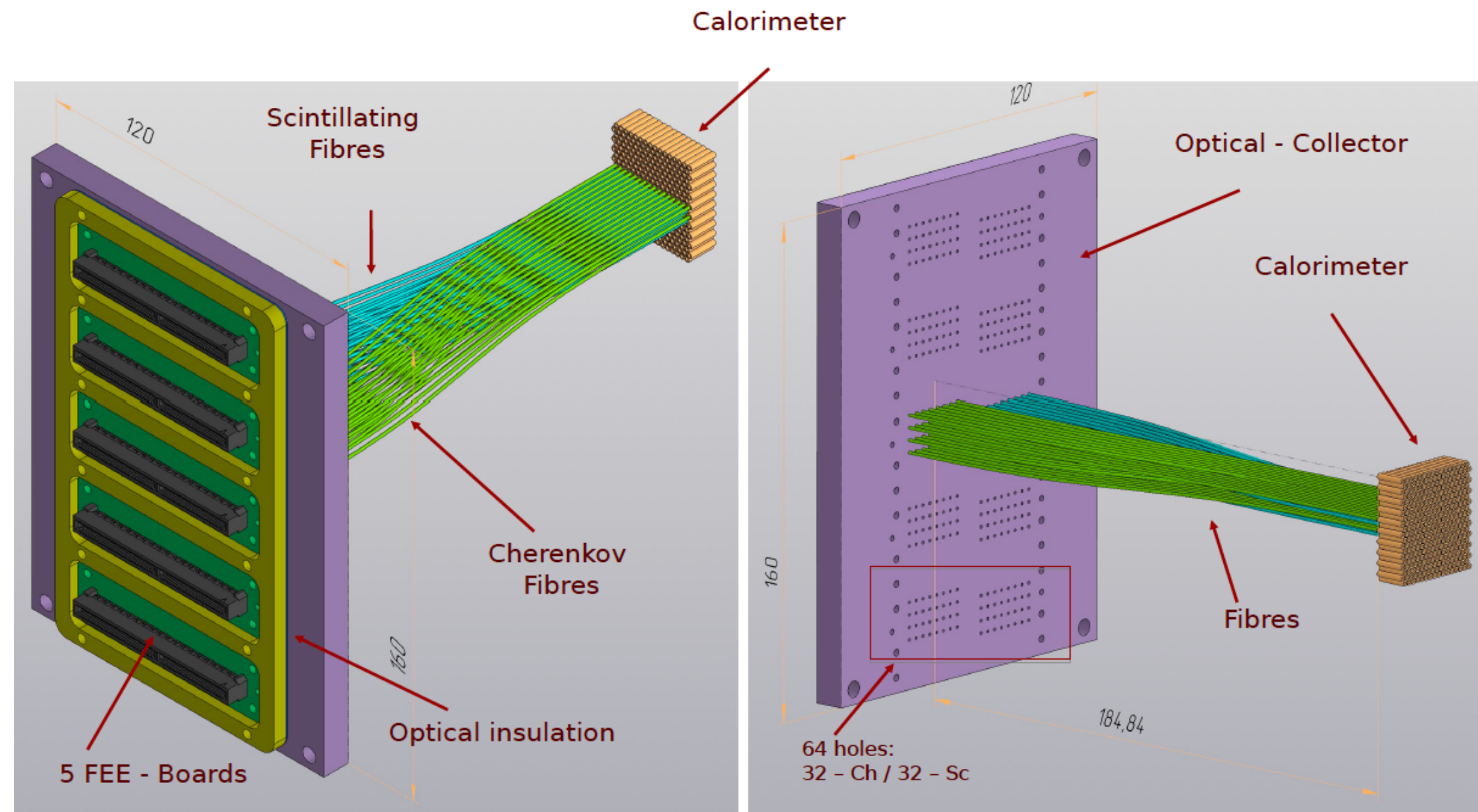
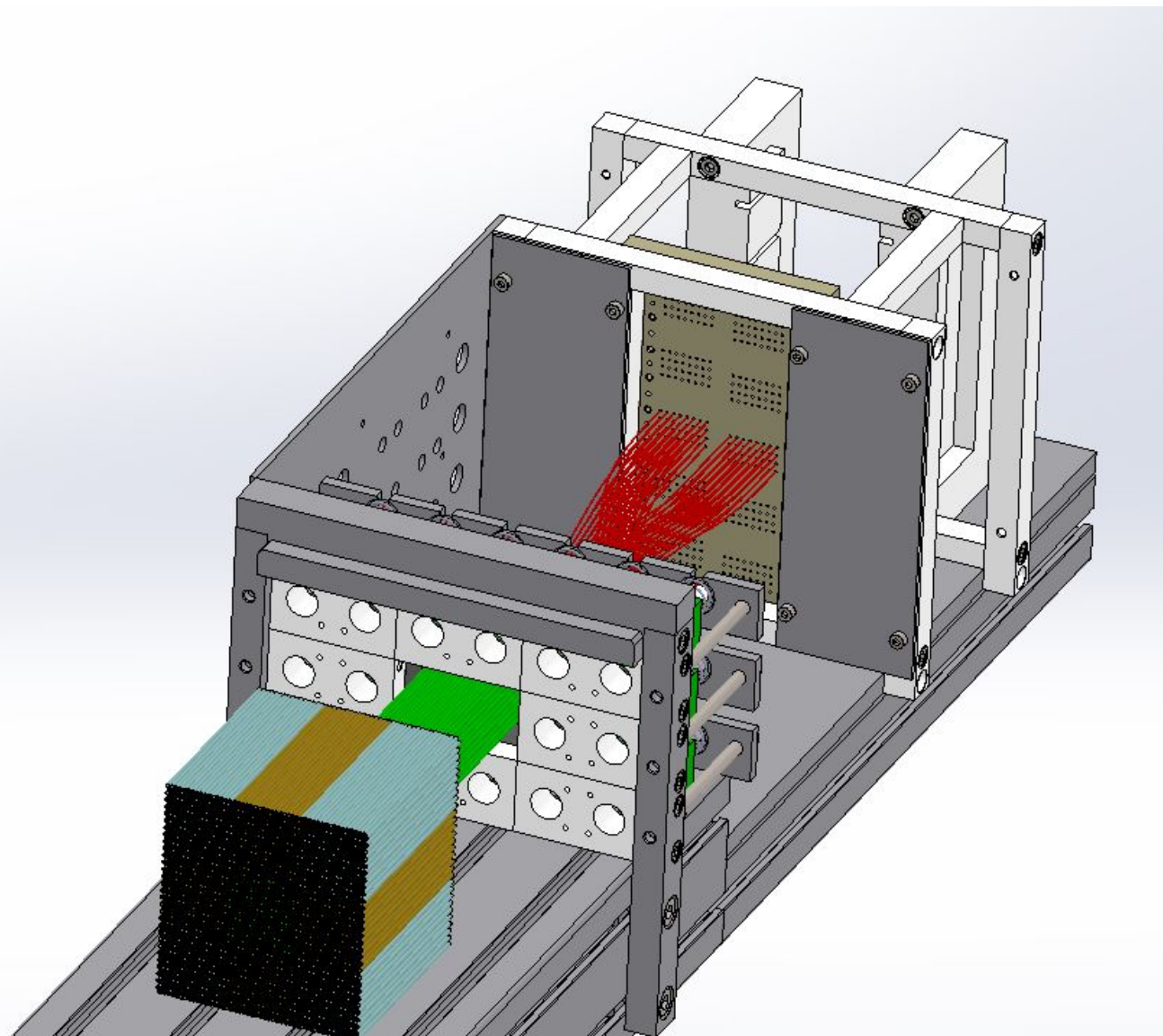
Graph



Width (in mm)		
Module	Mean	RMS
M0	33.01	0.03
M1	33.07	0.02
M2	33.07	0.04
M3	33.06	0.02
M4	33.25	0.05
M5	33.23	0.10
M6	33.18	0.04
M7	33.19	0.04
M8	33.21	0.05

Measurements performed in Pavia with a high-precision Linear Height Each module measured in 36 points

SiPM Readout



FEE-boards

Boards equipped with all components are ready and will be delivered to Como in the next days for the final qualification.

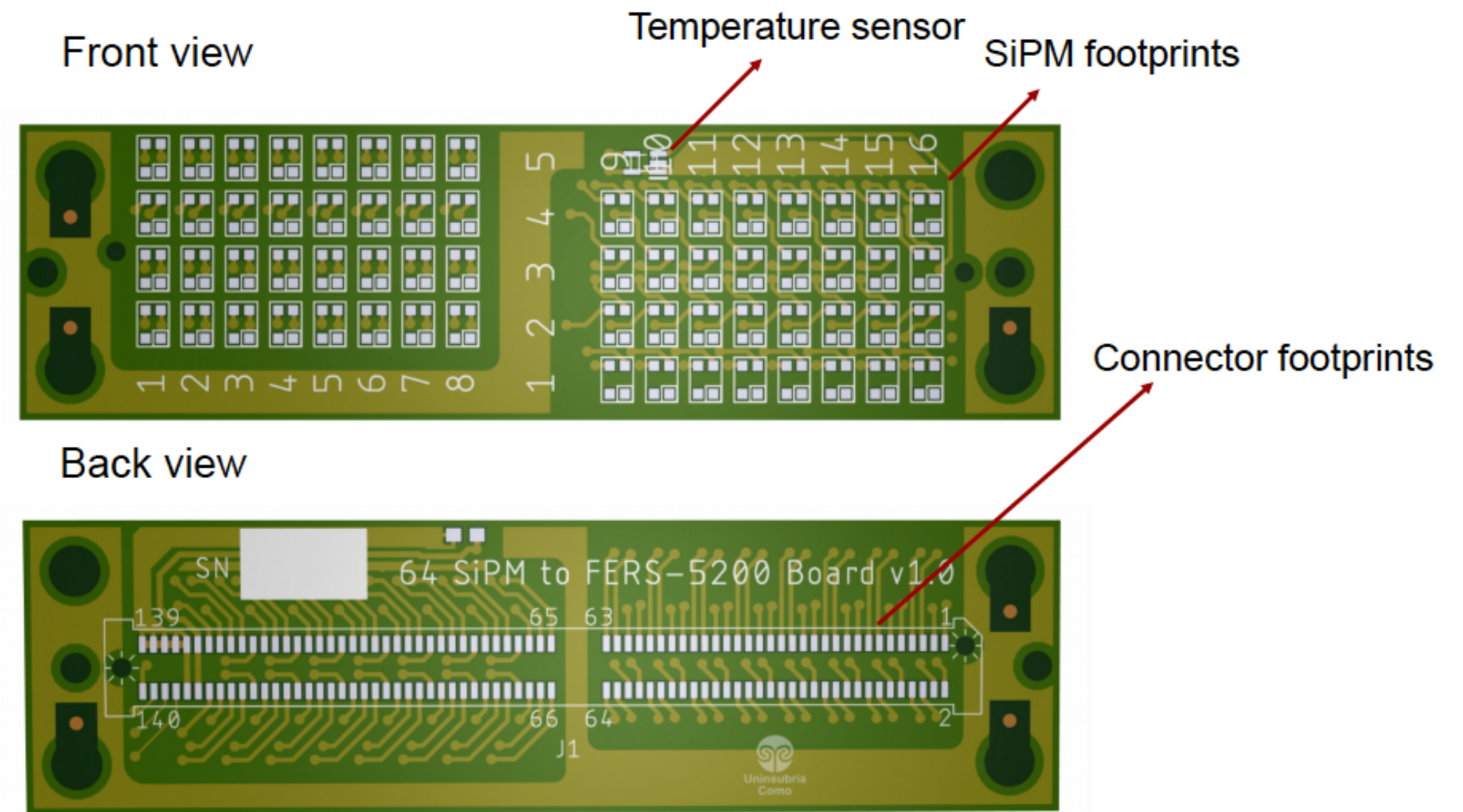
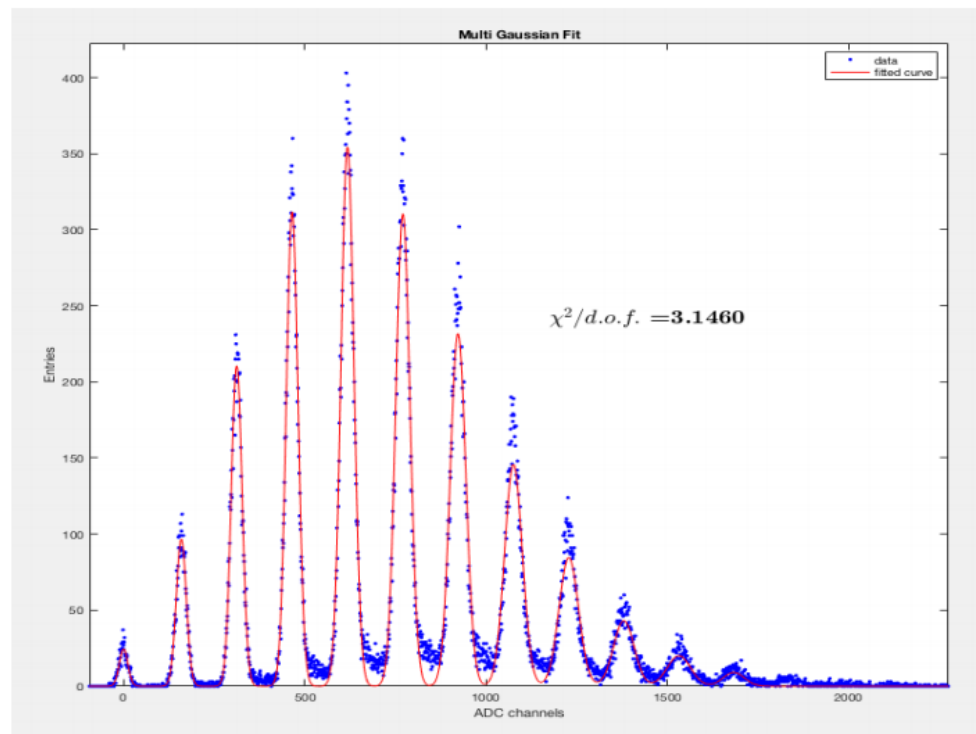
Sensor: **S14160-1315PS**

Cell size = $15\mu\text{m}$

Vbias = 42 ($\approx 4\text{ V}$ over breakdown)

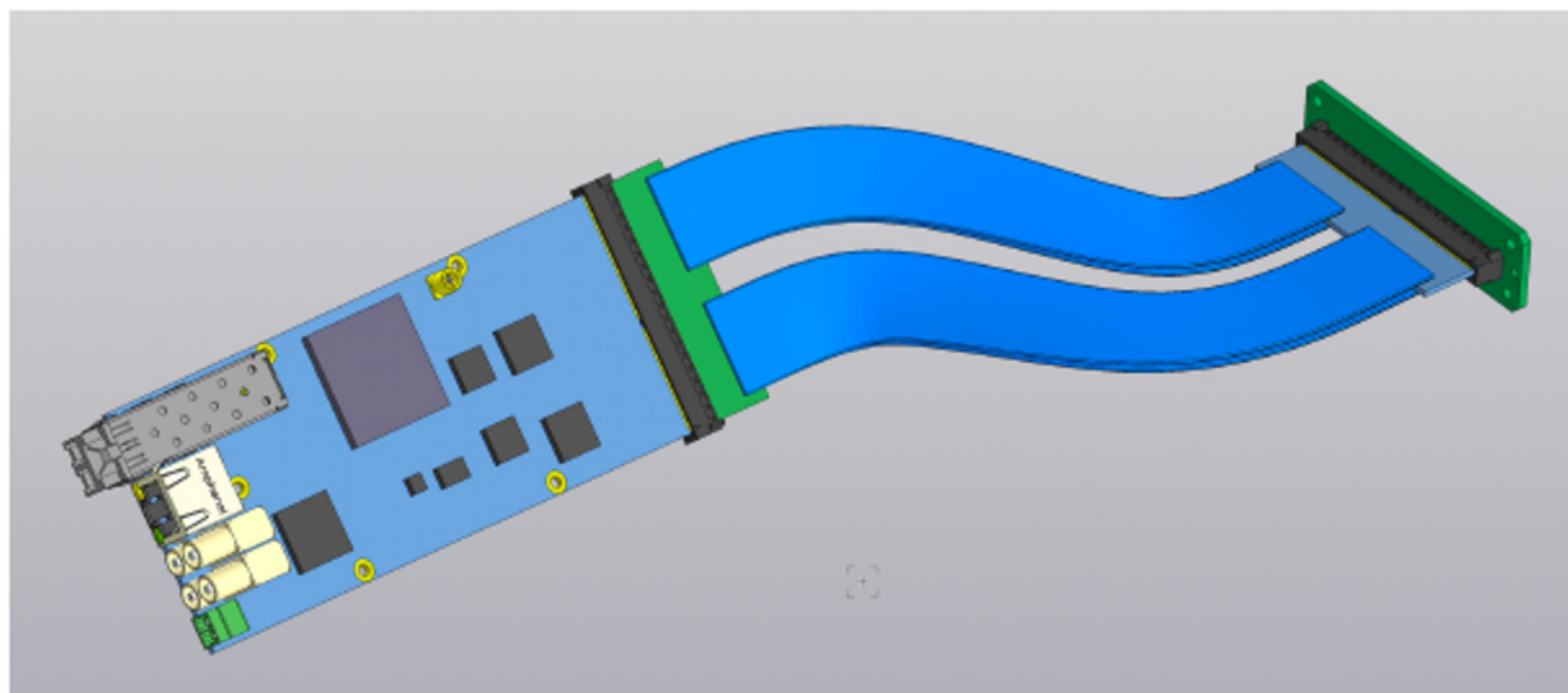
Signal amplification: 40dB

Measured Xtalk = 2%

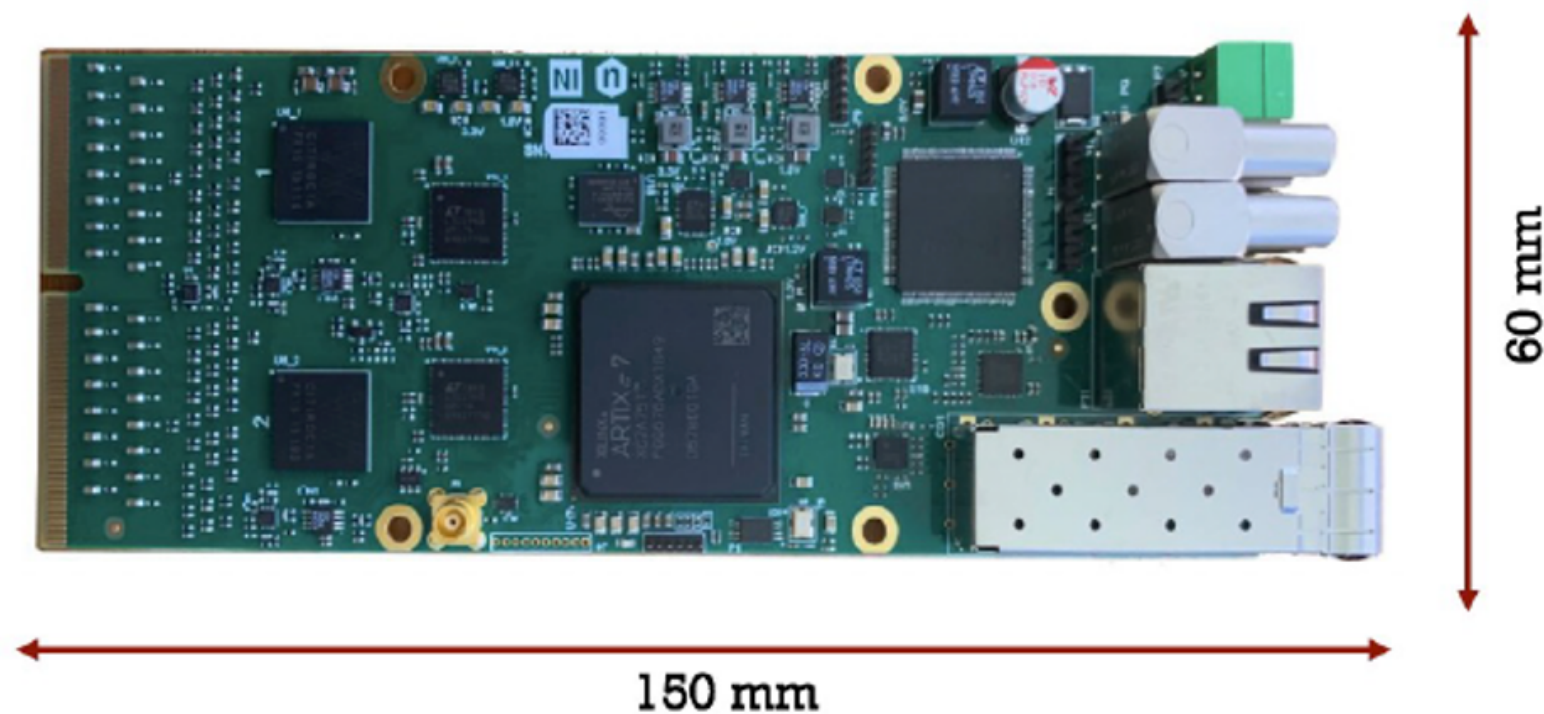


FERS

Delivery was delayed due to COVID crisis. Expected delivery at the beginning of November



FERS: A5202



Test beam @ DESY

- ◆ End of June: input request for rescheduling TB periods
- ◆ We proposed to move to beginning 2021 (February or beginning March)
- ◆ New call last week - deadline Oct. 7th
 - ◆ US group interested to join with xtal calo
- ◆ Survey of the TB area this year is under organization

HiDRa call

- ◆ Detailed presentation of the call proposal at the last CSNI meeting
https://agenda.infn.it/event/23272/contributions/117592/attachments/73912/93777/CSNI_DR_Bob.2020.07.10.pdf
- ◆ The project was evaluated in a very good way from both the panel and the committee. Large number of calls was presented this year (including thematic ones)
- ◆ Committee encouraged us to continue and resubmit the call in 2021
- ◆ Current plans for project development:
 - ◆ Requests in CSNI on both mechanical and readout of the detector (see later)
 - ◆ Strengthening international collaboration, in particular synergy with the Korean, Sussex and RBI groups

Scientific Program: mechanical development

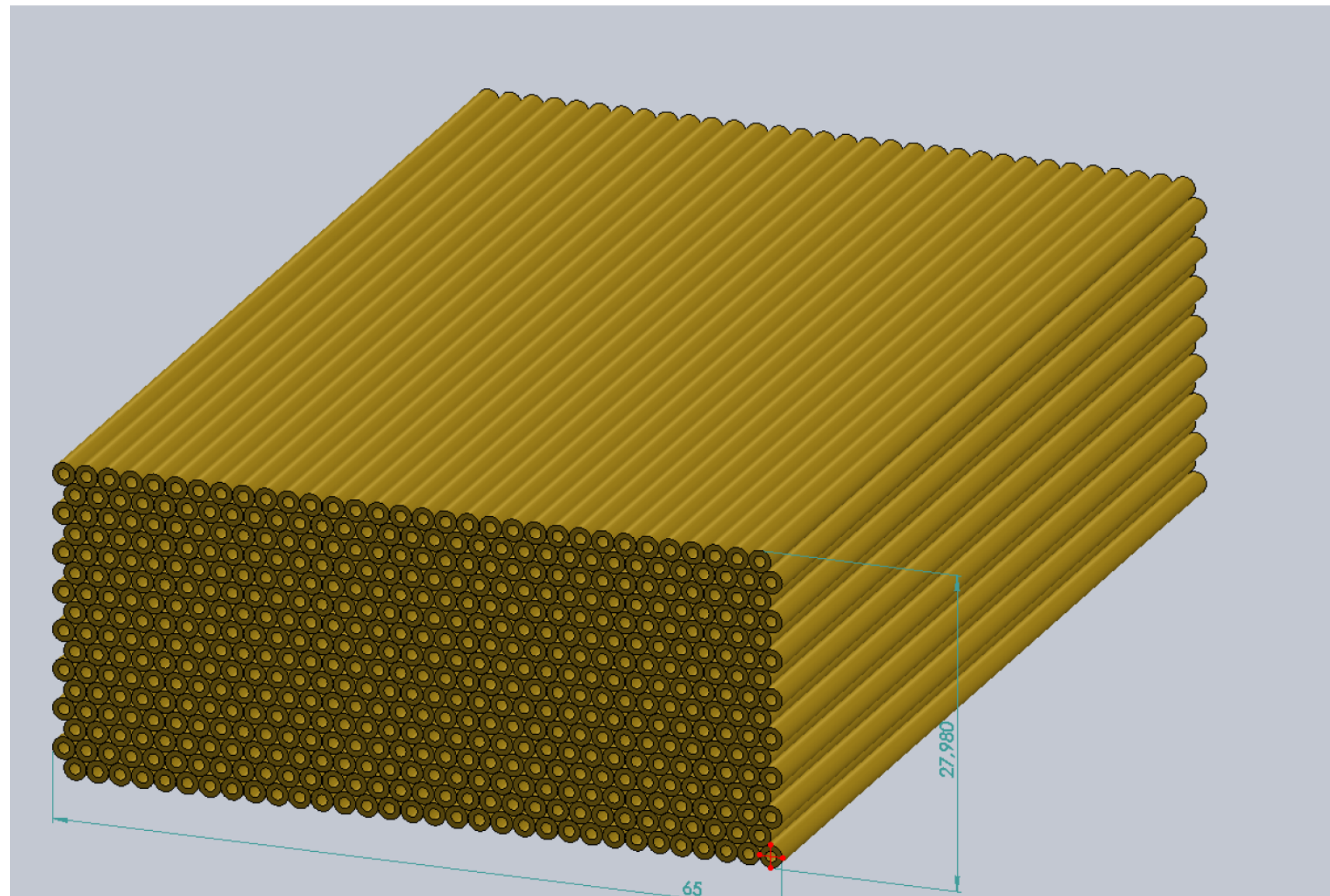
Improve and define baseline options for the construction of a capillary-tube calorimeter

- ◆ **TUBE (PV, RBI):**
 - ◆ Absorber material choice, optimal tolerances
 - ◆ Quality on larger production sets, comparison of different producers

- ◆ **FIBERS (PI, SUSSEX):**
 - ◆ Test of different producers to find optimal characteristics for DR calorimeter
 - ◆ Qualification of fibers: definition of procedure and setup

- ◆ **CALORIMETER ASSEMBLY (PV, PI, RBI):**
 - ◆ Definition of optimal dimensions for coupling to readout
 - ◆ Definition of assembly procedure and tools
 - ◆ Automatization of some assembly procedures (e.g. gluing)
 - ◆ QAQC procedure and criteria

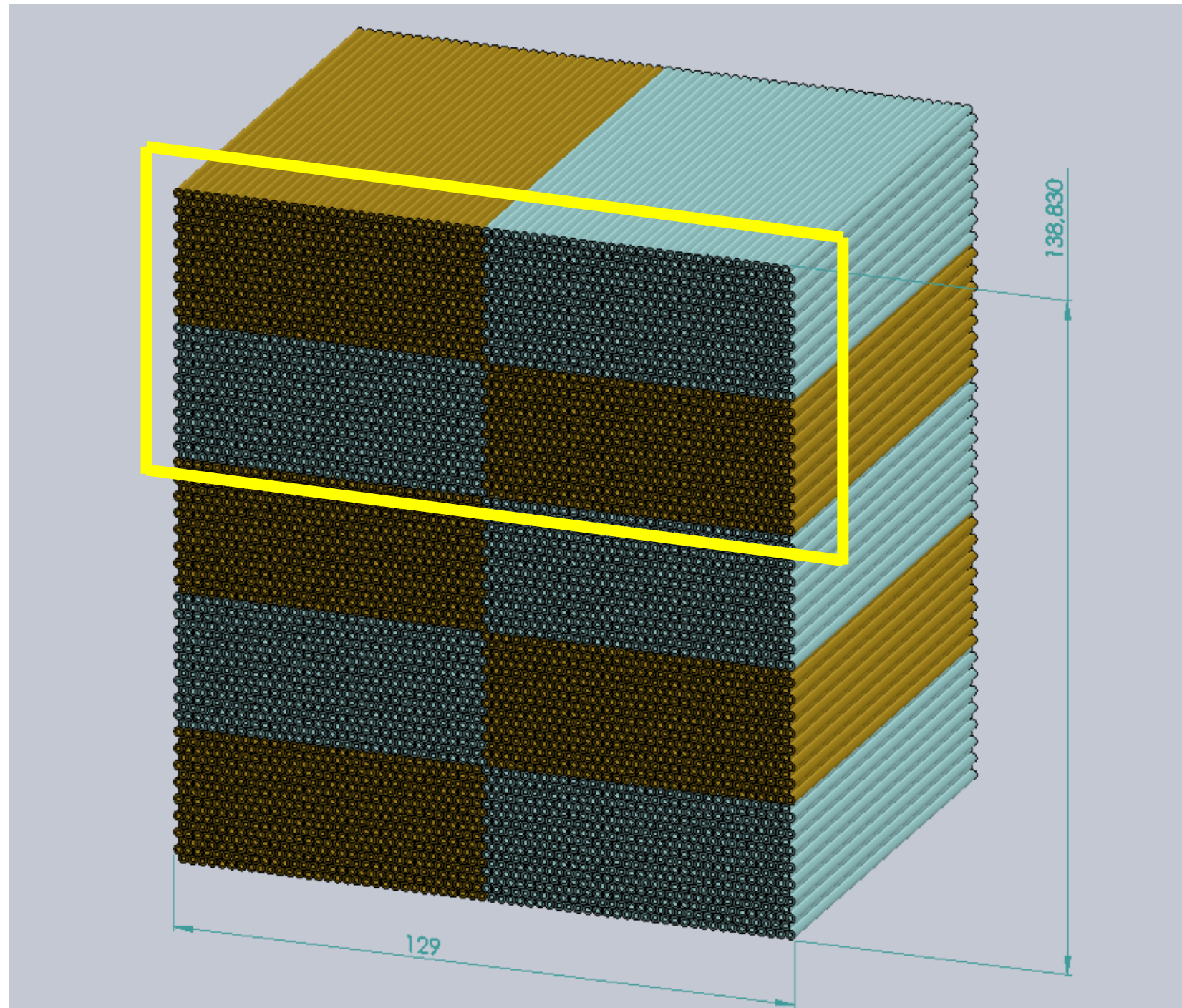
- ◆ **FIBER INSERTION IN THE TUBE AND COUPLING TO SENSORS (PV,PI, Como)**
 - ◆ Fiber in Metal Tube products already on the market: are they suitable?
 - ◆ PMTs for external ring in large size calorimeter: choice and test



I MINIMODULE:

32 x 16 channel (512 ch)

New dimensions of minimodule
come from preliminary study
done for HiDRA



Construction of a few MINIMODULE to study:

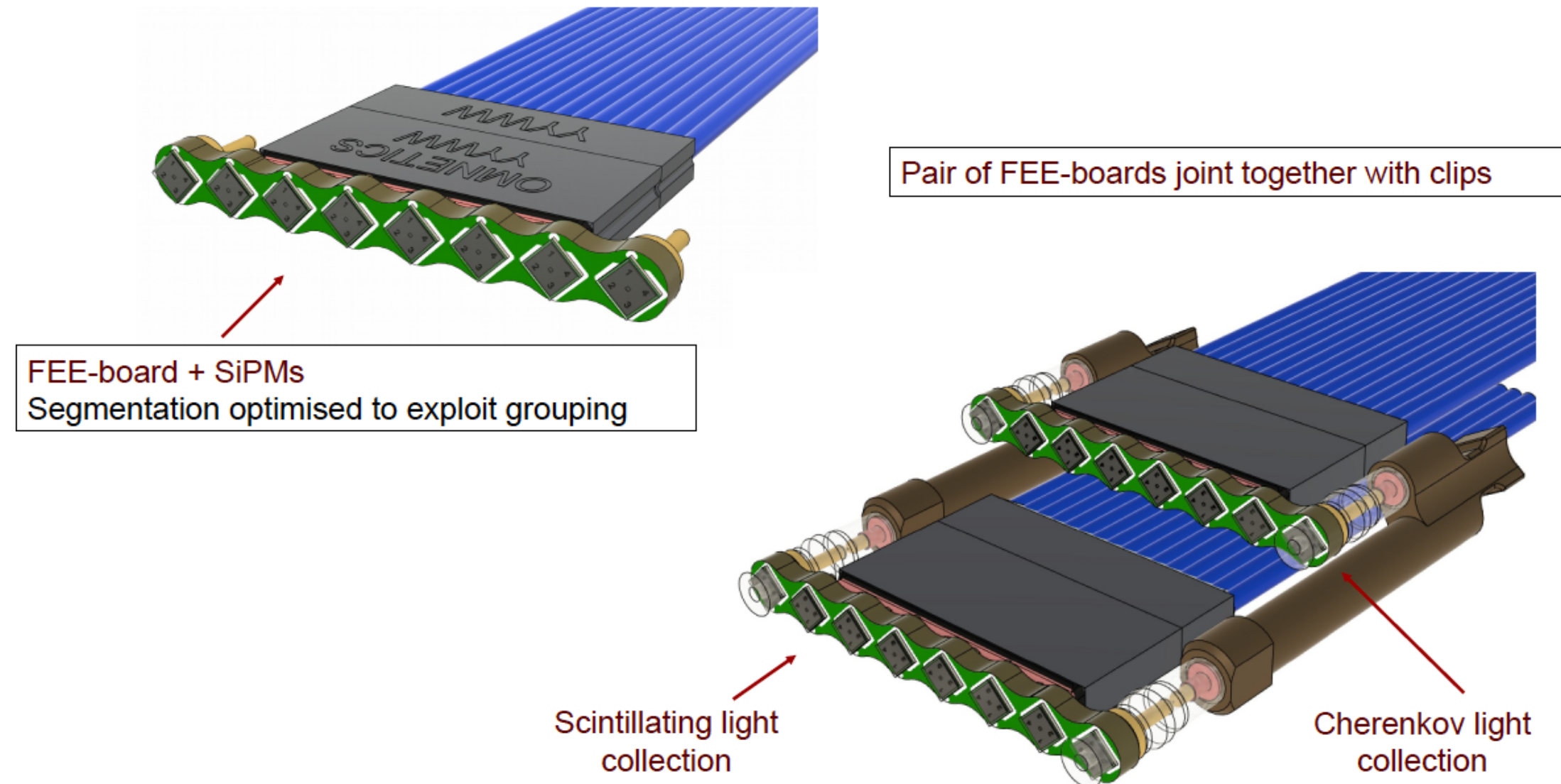
- Assembly procedure
- Reproducibility of assembled modules
- Mechanical supports

At least 4 MINIMODULES are needed
(HiDRA design: 10 minimodule = 1 module)

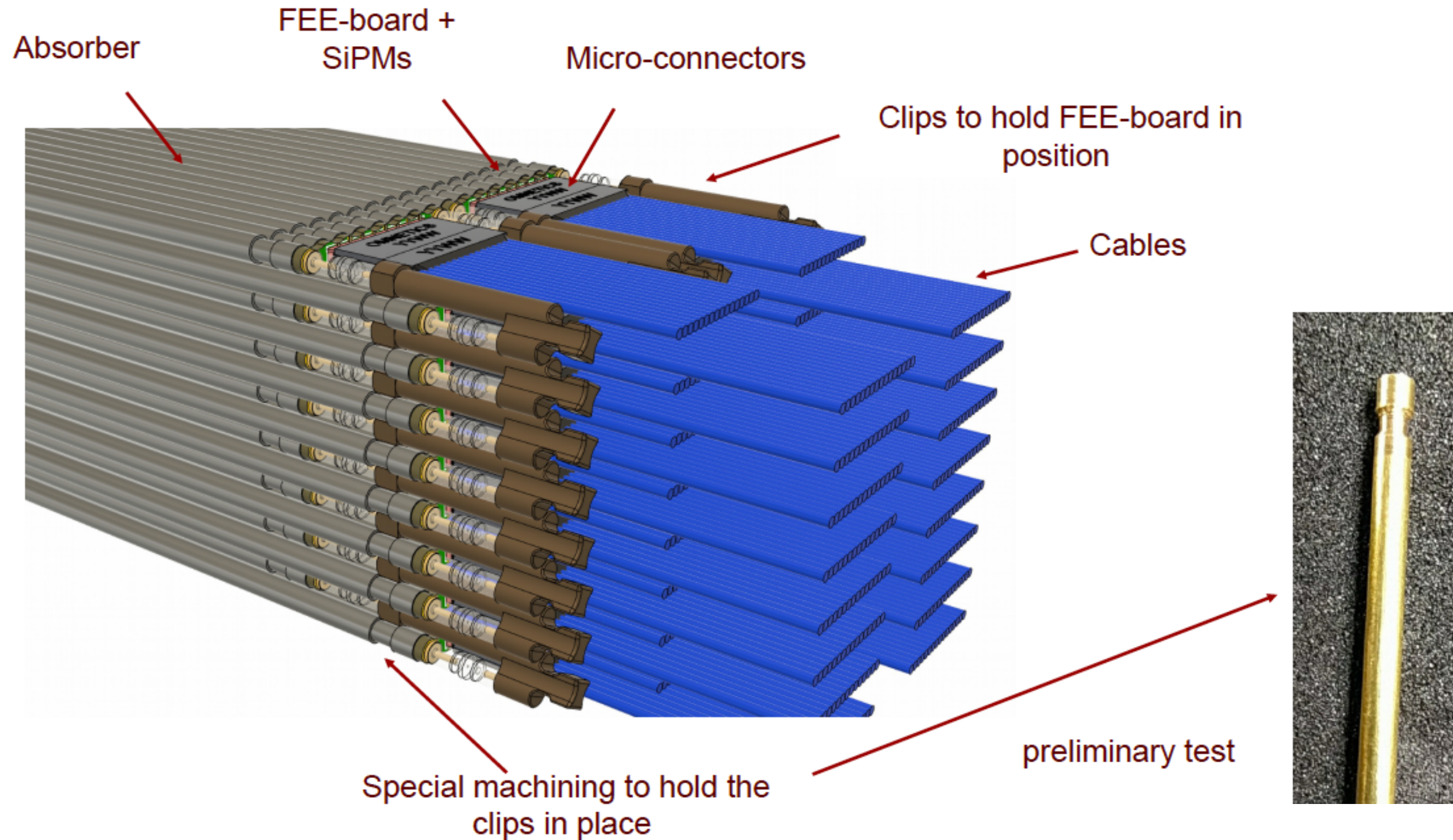
+ Material to assess material choice and baseline choice
(cost equivalent to 1 MINIMODULE)

Scientific Program: FEE-board

- ◆ Mini FEE Boards (8 ch) equipped with SiPMs and micro connectors.
- ◆ Costs are dominated by PCB printing area
- ◆ Qualification of single signals and signal grouping
- ◆ Qualification of power supply for SiPM
- ◆ After preliminary studies, signal characterization with ASIC under evaluation



New concept for a true scalable module



Scientific Program: ASIC evaluation

Evaluation of an ASIC with digitizer and feature extraction capability, produced by Nalu

- ◆ CAEN is planning to implement it on FERS platform.
- ◆ If available in 2021, we plan to verify that its characteristics are consistent with our needs.
 - ◆ Studies from electrical point of view
 - ◆ Test readout SiPM of choice (small area with large dynRange)
 - ◆ Use with multiple SiPMs arrays.
- ◆ Interest of Catania and Bologna groups to collaborate on these activities to spread knowledge and support work load.
- ◆ We propose to put the request sj at ASIC availability

Financial request

Descrizione	Richiesta	Sede	Capitolo	Tag
acquisto capillari	5	Pavia	Consumo	3
Colla	0,5	Pavia	Consumo	3
sistema di costruzione meccanico	15	Pavia	Consumo	3
sistema di test meccanica	2	Pavia	Inventario	3
fibre scintillanti	12	Pisa	Consumo	3
fibre chiare	1,5	Pisa	Consumo	3
componenti per sistema di test fibre	5	Pisa	Consumo	3
fotomoltiplicatori	5	Pisa	Inventario	3
SiPM	3	Como (MI)	Consumo	3
produzione mini-FEB	7	Como (MI)	Consumo	3
micro cavi coassiali	3	Como (MI)	Consumo	3
board di qualifica ASIC SiREAD	6	Como (MI)	Inventario	1
board di qualifica ASIC SiREAD	6	Bologna	Inventario	1
metabolismo di laboratorio	2	Catania	Consumo	3
Sum	73			

Travel request:

TB@DESY (tag = 3)

- BO (3k€) + CT (2 K€) + Como(MI) (6.5k€) + PV (6+3 k€)

Digitiser Evaluation (SiRead) (travels to Como) (tag = 1)

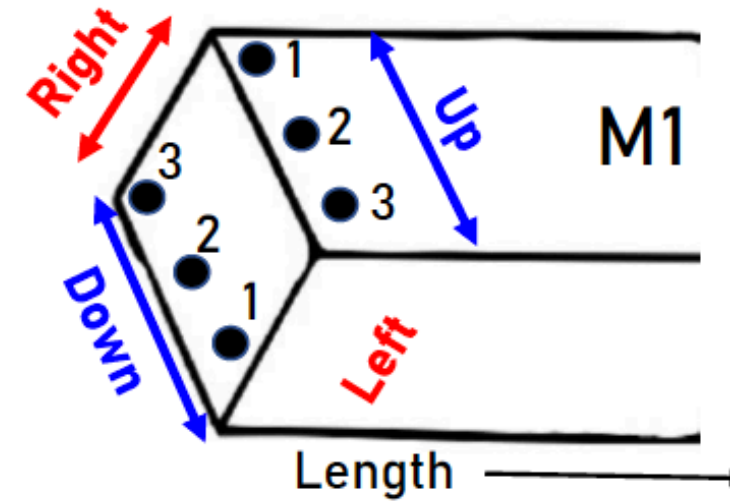
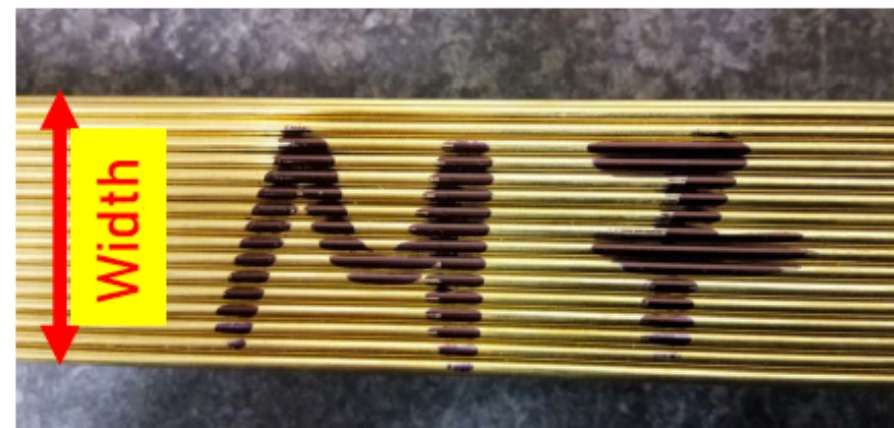
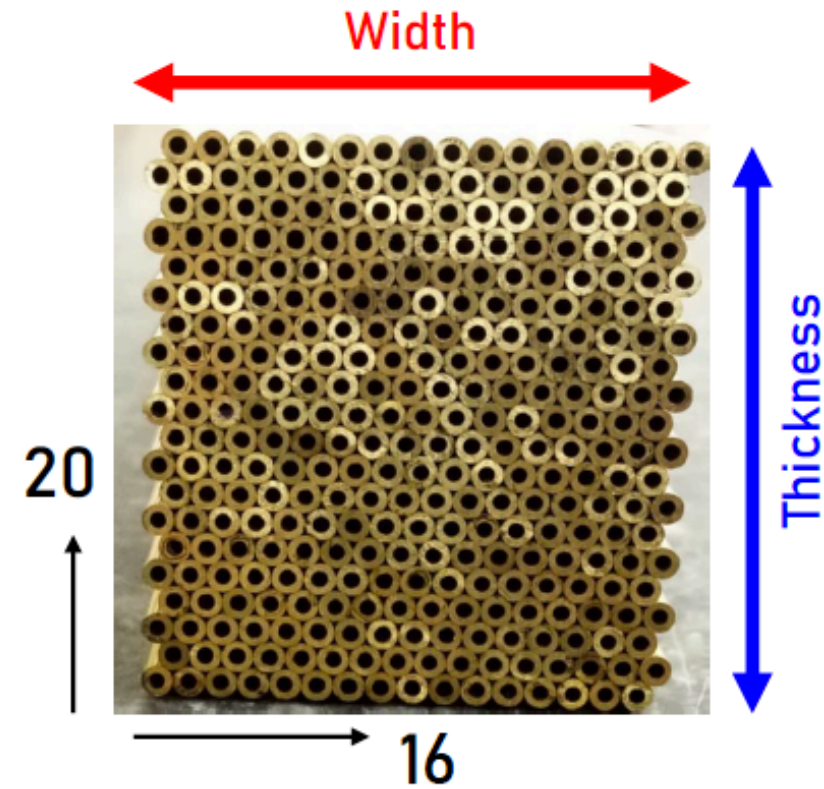
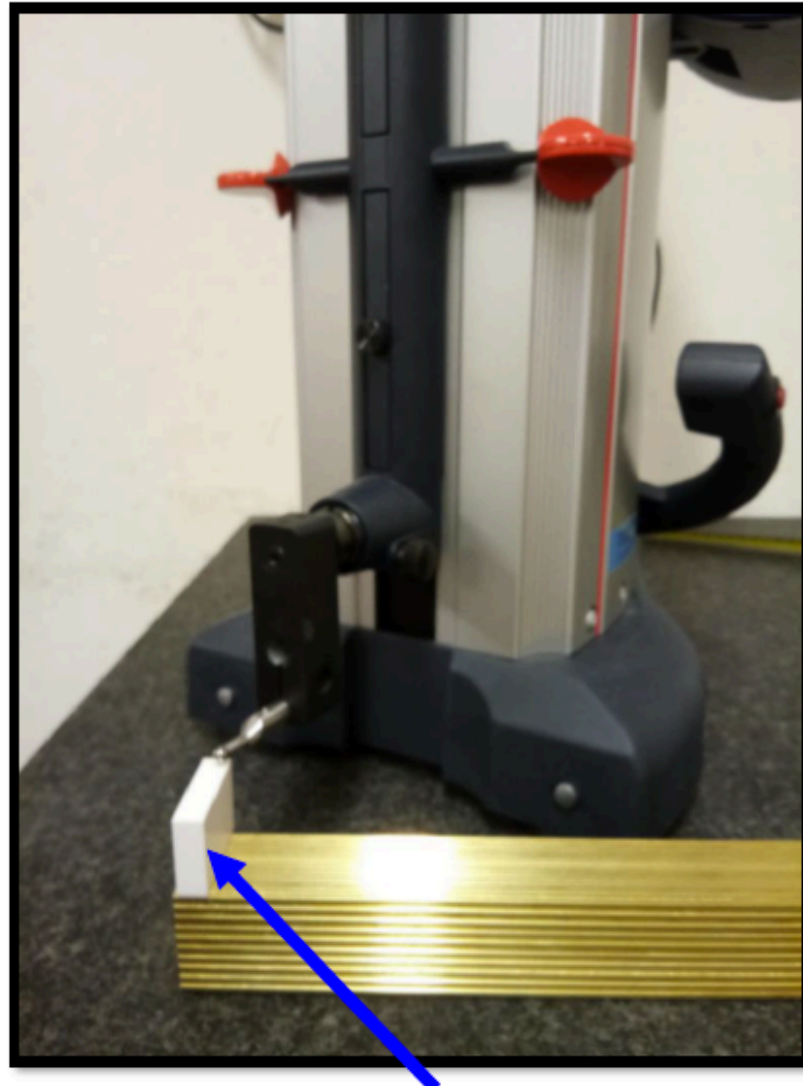
- BO (1 K€) + CT (2k€)

Contact with companies (tag = 3)

- PV (2k€)

Back up slides

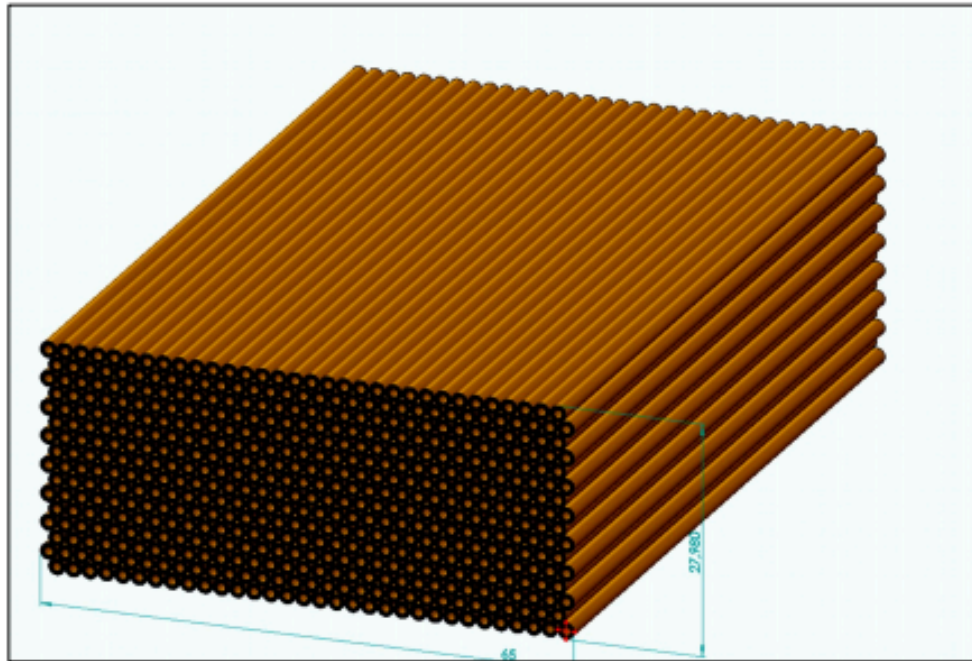
Module Measurements



- Module names: M0, M1, ..., M8
- Central module: M0
- Thickness_Coordinate1 = $(Up1 + Down3)/2$
- Width_Coordinate1 = $(Left1 + Right3)/2$

- Central module: 15 measurements
- Other modules: 12 measurements

HiDRa: detector design



1 Mini-Module (MM):

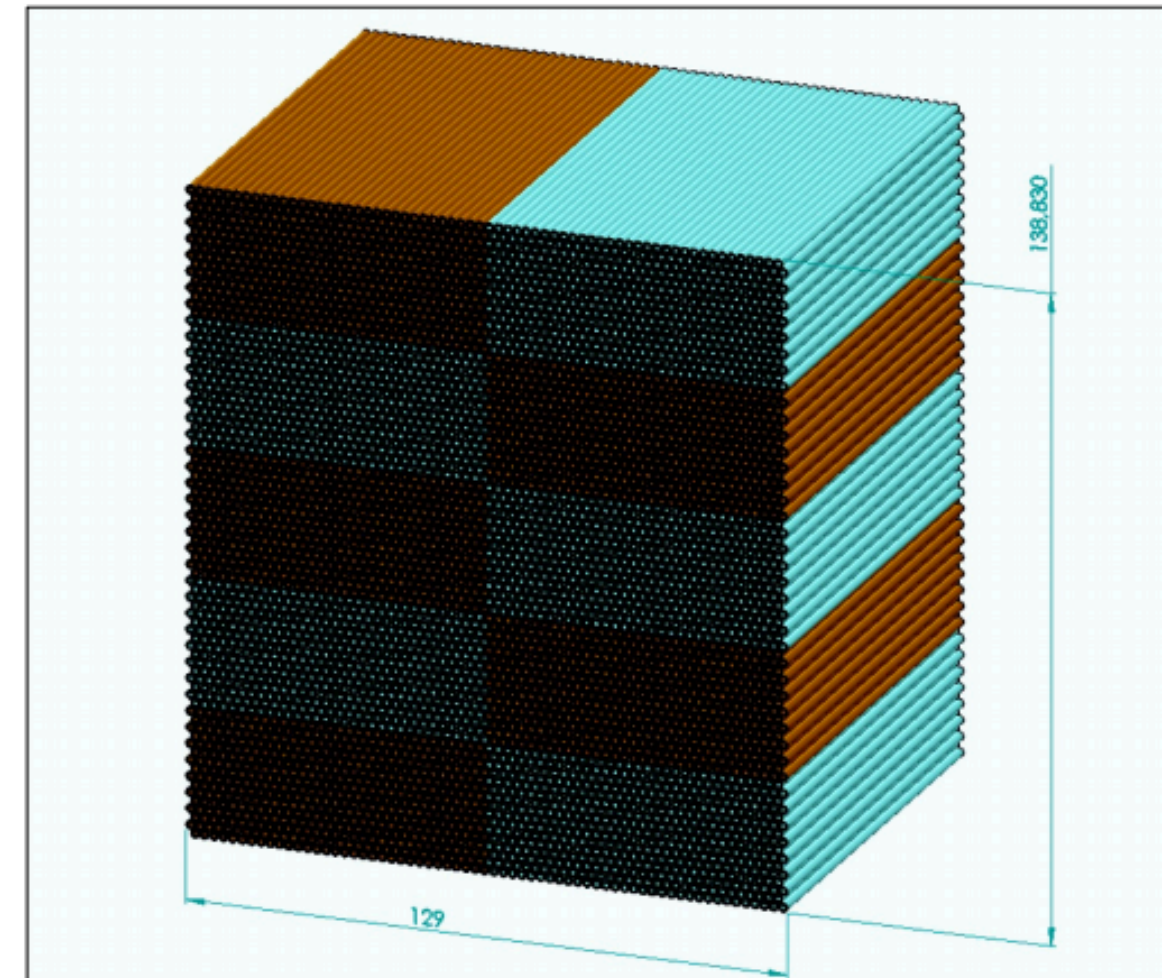
32 × 16 channel (512 ch)

1 Module:

2 × 5 MMs

→ 10 FEE boards
(8-channel grouping)

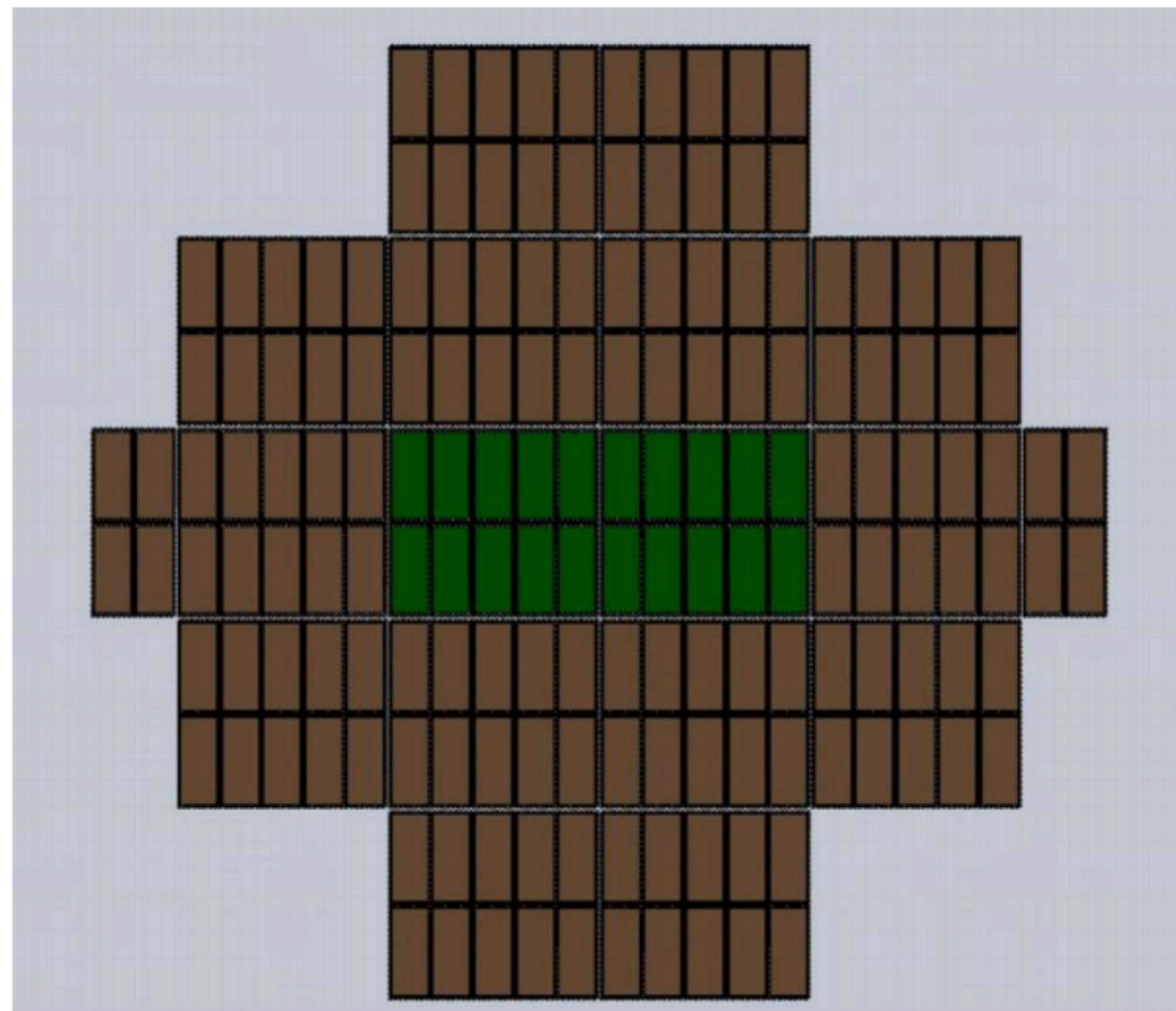
~ 13 × 13 × 200 cm³



HiDRa: Hadronic-scale module

17 modules:

- 2 central ones with SiPMs
 - ~ 10 k SiPMs
 - ~ 20 FEE boards
- all others with PMTs
 - ~ 150 PMTs



d-SiPMs: small 64-channel demonstrator
~ 1 × 1 × 100 cm³