SiW-ECAL: preparation of the Test Beam 2020/03

Adrián Irles & Roman Poeschl (IJCLab CNRS/IN2P3)
on behalf of the SiW-ECAL team

Slides and material from A. Gallas, A. Thiebault, D. Breton, J. Maalmi, J. Jeglot, Vincent Boudry, R. P, A.I. and many more

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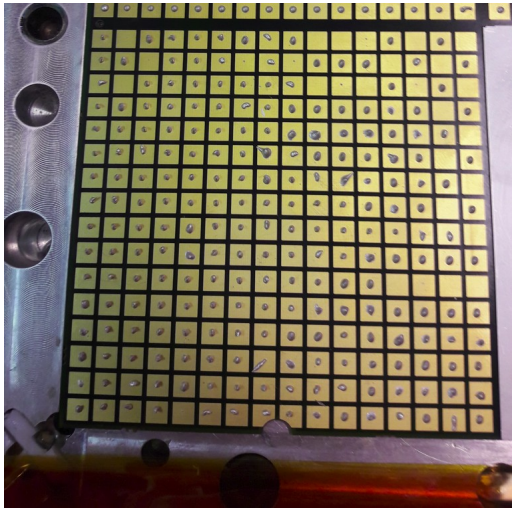
Outline

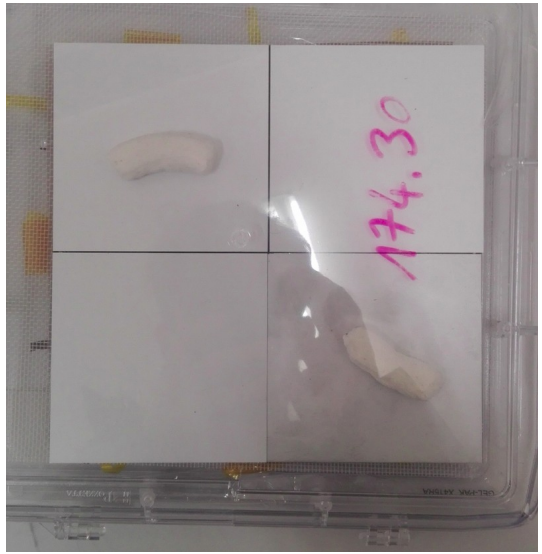
- New Modules equipped with the new compact DAQ
  - 2 x FEV12
  - 2 x FEV11_COB
- Adaptation of the FEV10/11 slabs to the new compact DAQ
- Adaptation of the FEV13 slabs to the new compact DAQ
- Cabling and mechanics
- Commissioning
- Beam Test 23/03 – 29/03 2020 at DESY
- Common beam test

2 x FEV12 (1 500 um wafer glued in 2019, 3 more in 2020)

Both equipped with 16 Skiroc2a

- Threshold issue during 2019 → **fixed** (the ASU was equipped with a resistor to fix a threshold of the sk2 not needed by SK2a)
- Some issues appeared during the 2020 gluing of the first FEV:
  - Different glue (different viscosity)
  - Connectors were in place → need of readaptation of the aspiration plate
  - New software for the robot → needed some tuning
  - Intrinsic difficulty of gluing wafers on a board with a wafer.
- Result:
  - Wafers slightly missaligned → the one near the connectors is 100-200um outside → need extra care for the connectivity.
  - One wafer with only 90% of cells connected.
- The **gluing of wafers in the second FEV12 was perfect** (learning curve!)
- **Both are operative (nice cosmics seen in all wafers)**



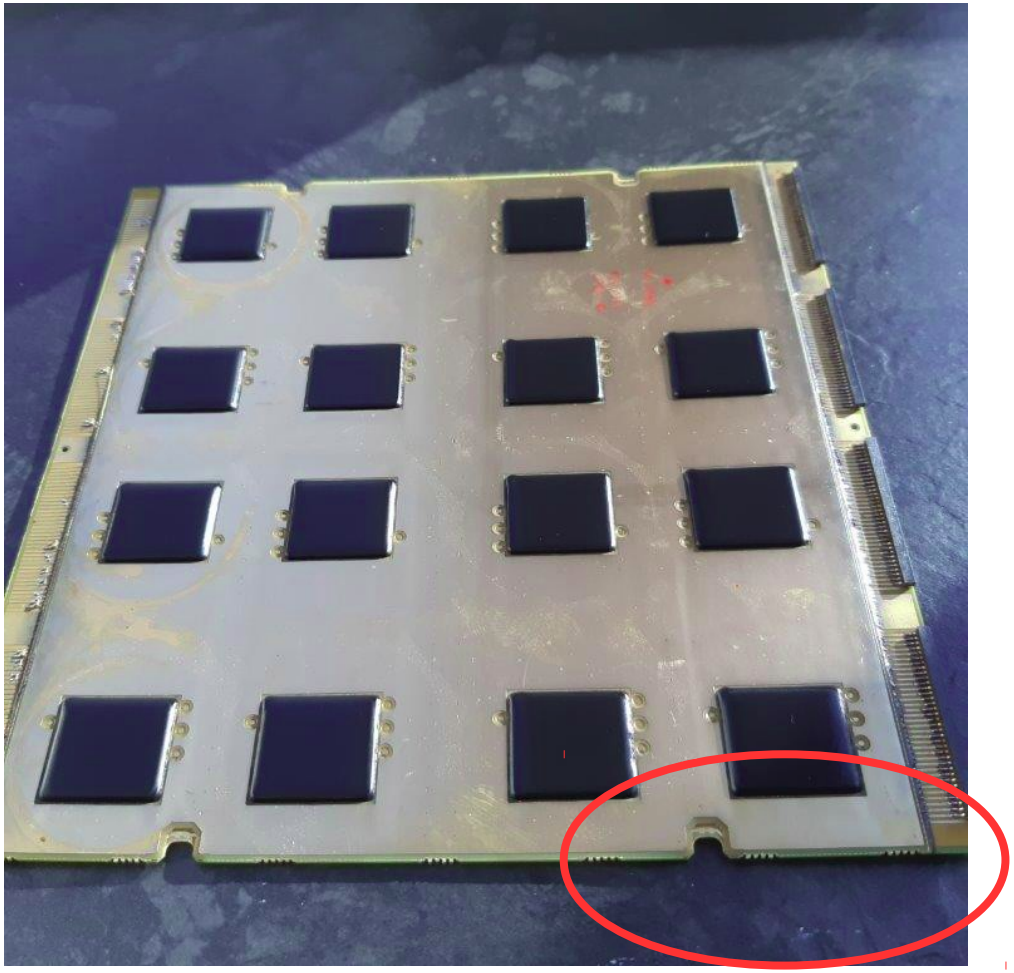


COB :-(

2 COBs with only on 500 um wafer each + 1 COB with only chips.

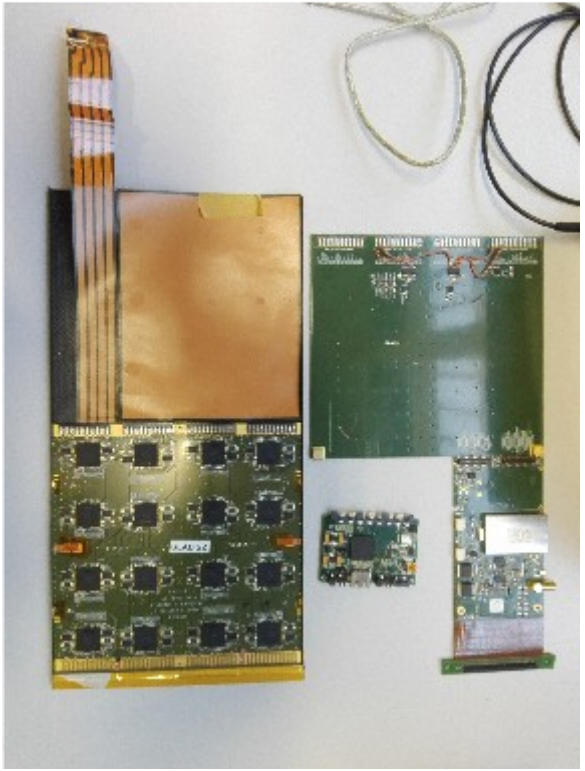
All equipped with Skiroc 2a.

- Very bad news!!
- Encapsulation with Globtopby Swiss company Hybrid lead to deformation of the COBs
- Most likely due to mechanicalstress during curing of Globtop
  - At 140 C for 6 hours !!
- Boards are operational but unreasonable/impossible to glue more wafers
- Boards are still useful for technical tests
- Have to study “cold” Encapsulation after beam test



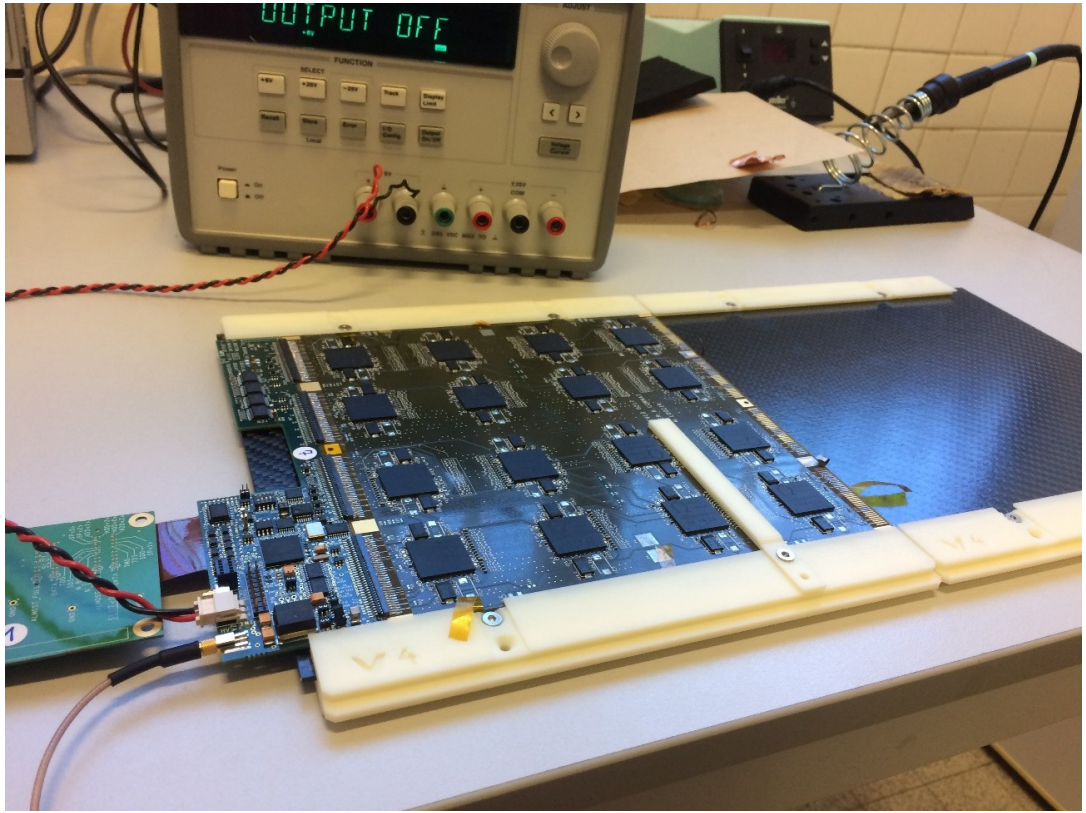
Adaptation of the “old modules” to the compact DAQ

- 10 short slabs based on FEV10/11 were produces
  - 7 of them tested in 2017
  - 6 of them operational in 2018
- Short slab description:
  - FEV +
  - + 16 CHIPs (all Skiroc 2)
  - + 4 wafers (all 320 um)
  - + SMBv4 (adaptor card) connected with thermically soldered kapton connectors
  - + a long HV kapton (glued to the wafer)
  - All embedded in a carbon frame
- Process of adaptation (phase 1):
  - Disconnect the SMBv4
  - Clean the pads + add new Gradcon connectors
  - Unglue the HV kapton.



Adaptation of the “old modules” to the compact DAQ

- Process of adaptation (phase 2):
  - Solder Gradconn/Antelect female connectors
  - Reconnect the HV kapton (short sheet designed for the compact DAQ) **
  - Mount them in a new carbon frame adapted to the compact DAQ mechanical structure (see later) → easy to dismount



** Currently only in 5 slabs, the rest of the kaptons are still making their way out of Italy (production country) !!

Result of the process

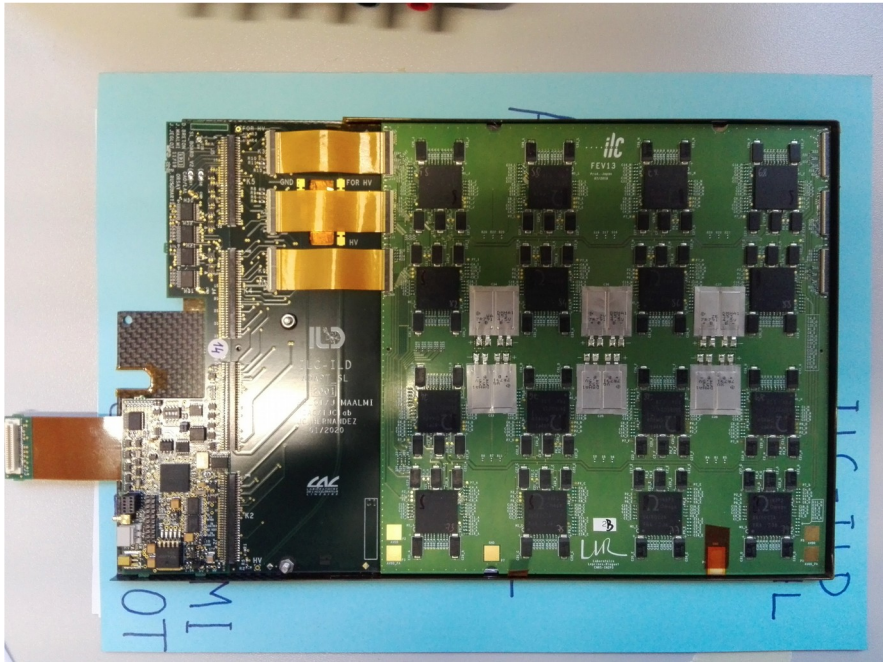
	type	SLAB	DESY 2017		CERN 2018		2020	
			Readiness	calibrated cells	Readiness	calibrated cells	Readiness	calibrated cells
1	FEV11	13		0%		0%		
2	FEV11	14		0%		0%		
3	FEV10	15		0%		0%		
4	FEV11	16		92%		?		
5	FEV11	17		93%		95%	travelling Japan – France	
6	FEV11	18		94%		?		
7	FEV11	19		93%		93%		
8	FEV11	20		94%		96%		
9	FEV11	21		54%		0%		
10	FEV11	22		84%		87%		
11	FEV10	23		0%		0%		

More details in the back-up slides

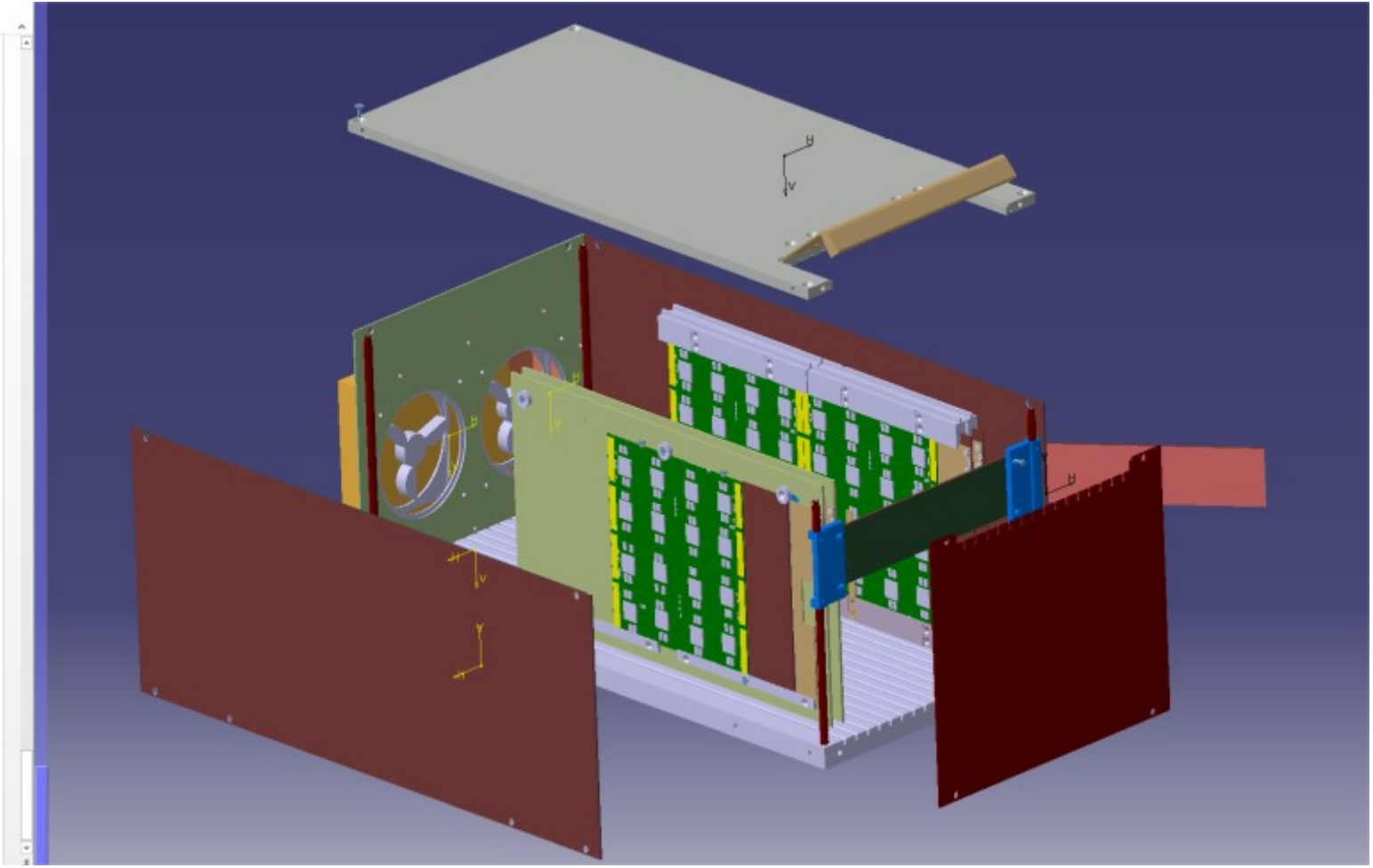
- 5 slabs recovered during the adaptation to the new compact DAQ.
  - Including the slab23 which was never connected to any adapter card.
- 2 slabs (16 and 18) have shown a reduction on the number of calibrated cells during 2018… is it the wafer partially disconnected from the ASU? (to be investigated)
- **11 FEV10/11 slabs in total → All with 4 wafers of 320um**

FEV 13 integration with th SLBoard system

- An Interface card has been designed and produced.
- FW and software modifications needed (different routing of signals)
  - The realisation of these modifications before the beam test depends on the availability of engineers (busy with several a bit more urgent matters!)



Design of the mechanical support



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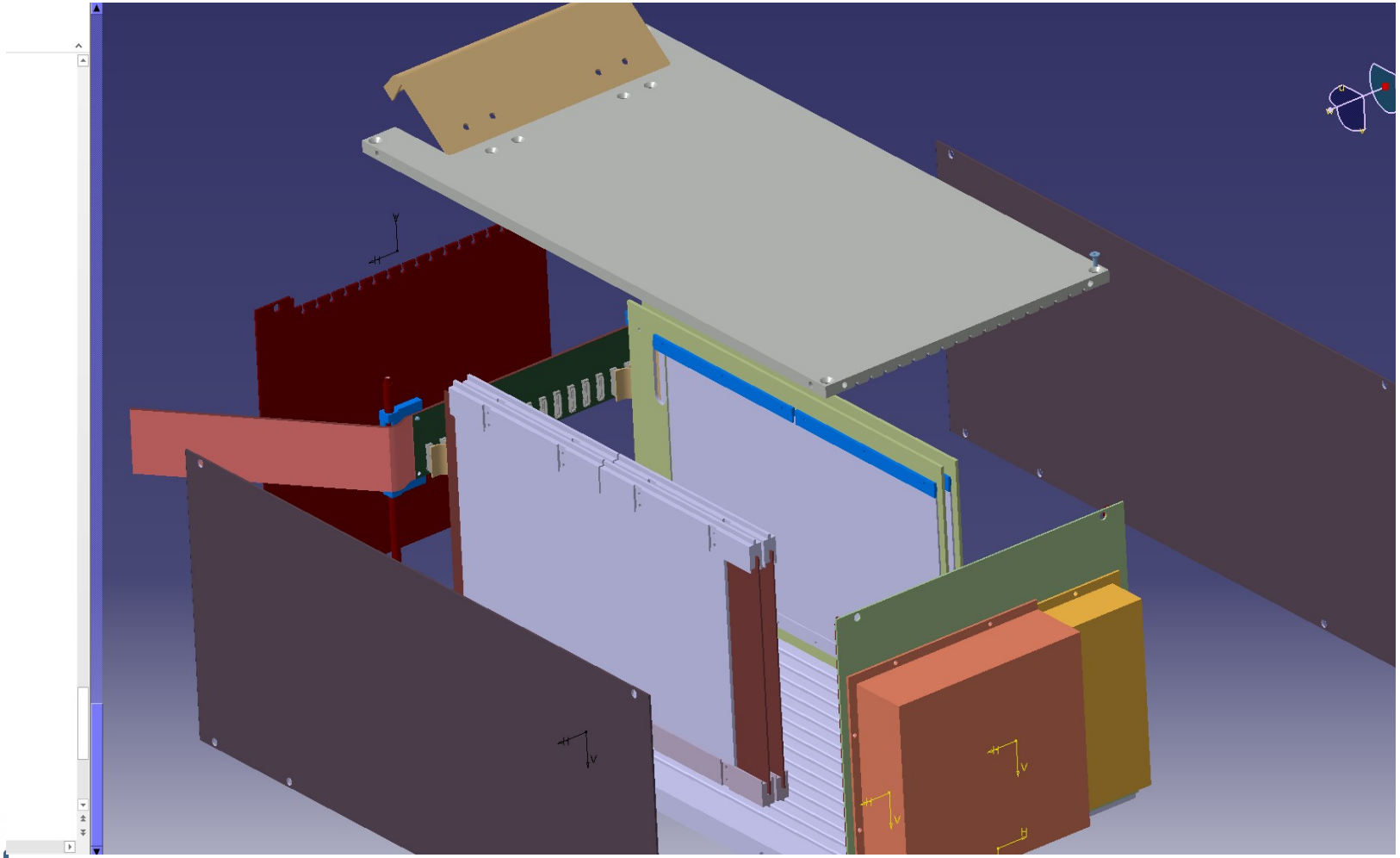
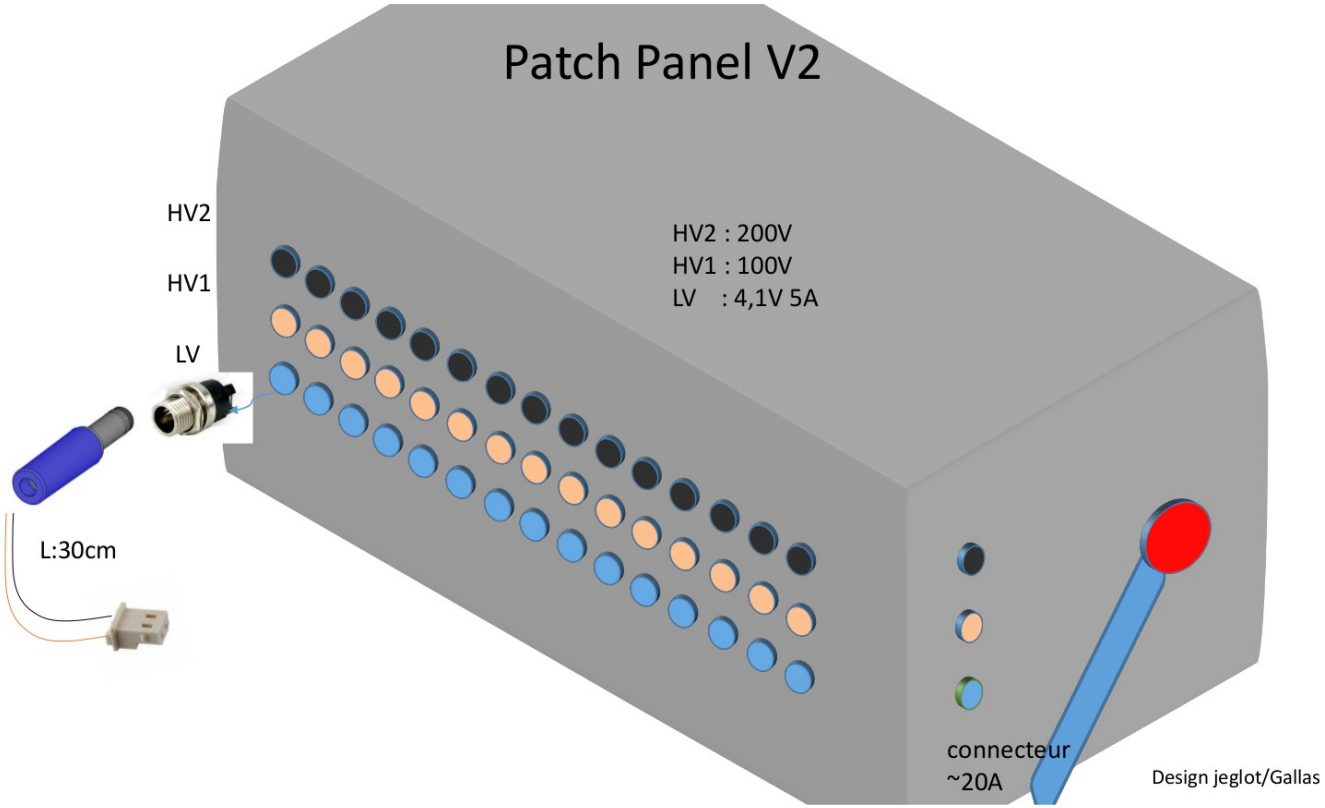


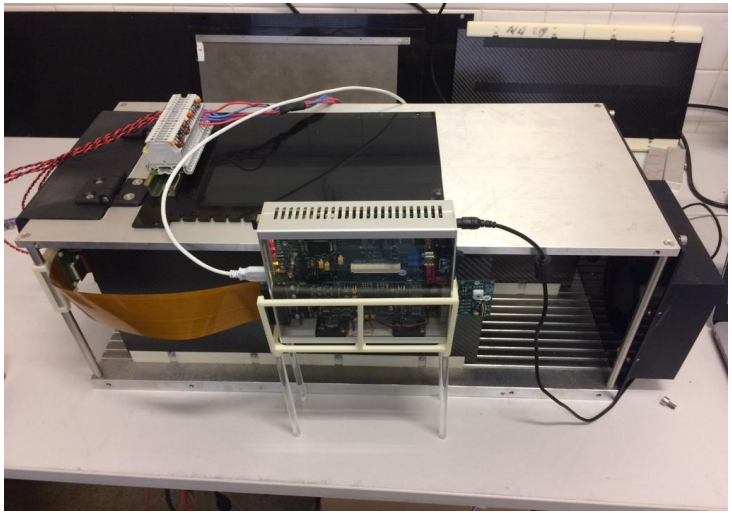
Design of the mechanical support: patch pannel

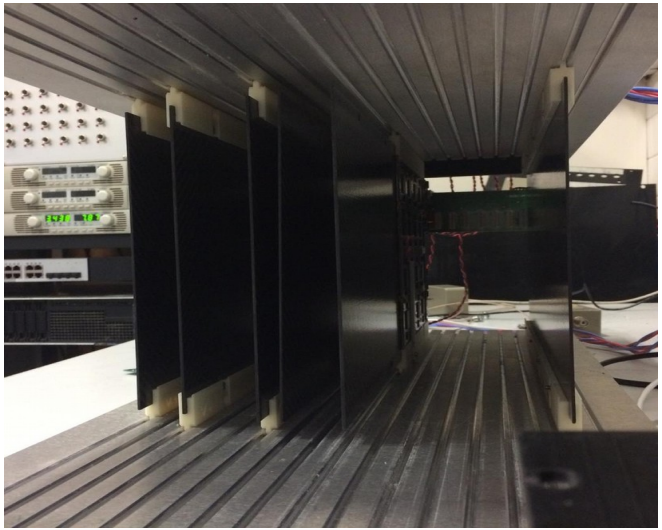


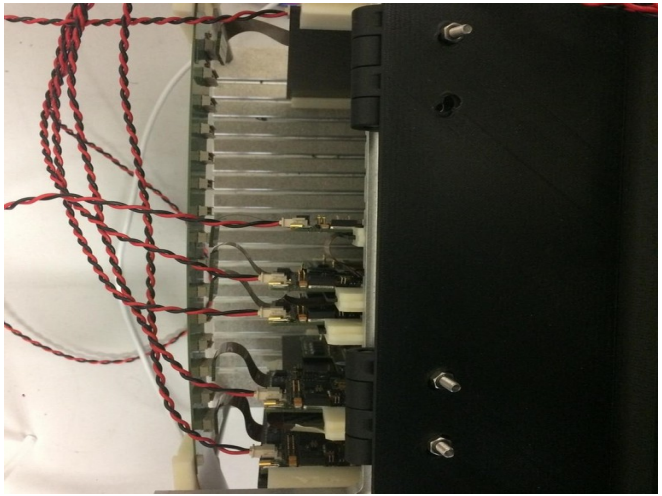
- Being cabled at the IJCLab (since 4th March)

Mechanics: realisation

- Up to 15 slabs with 2.1 mm tungsten.
  - + space for two more tungsten plates at the end/beginning.
- Patch pannel in the top.
- Support for the Core Module.
- Fan at the end for cooling of the electronics.
- Easy acces to the connectors

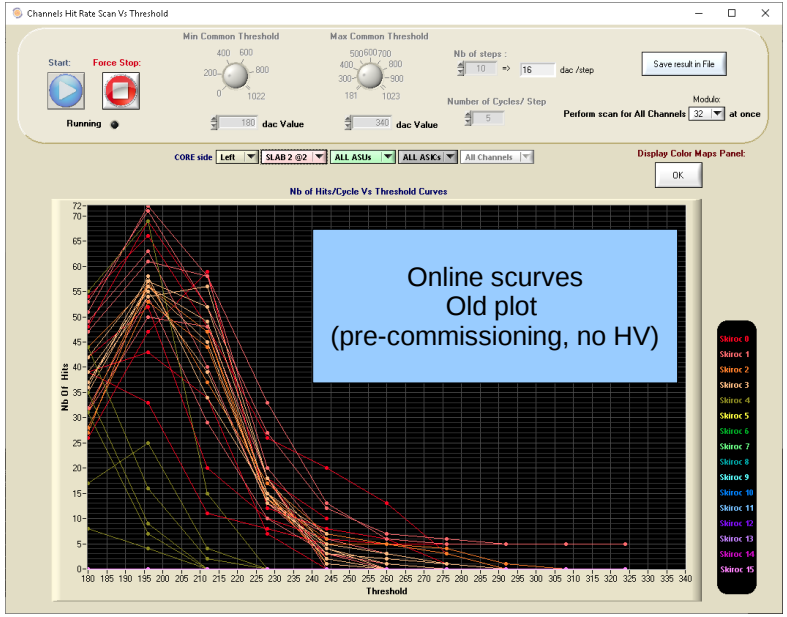




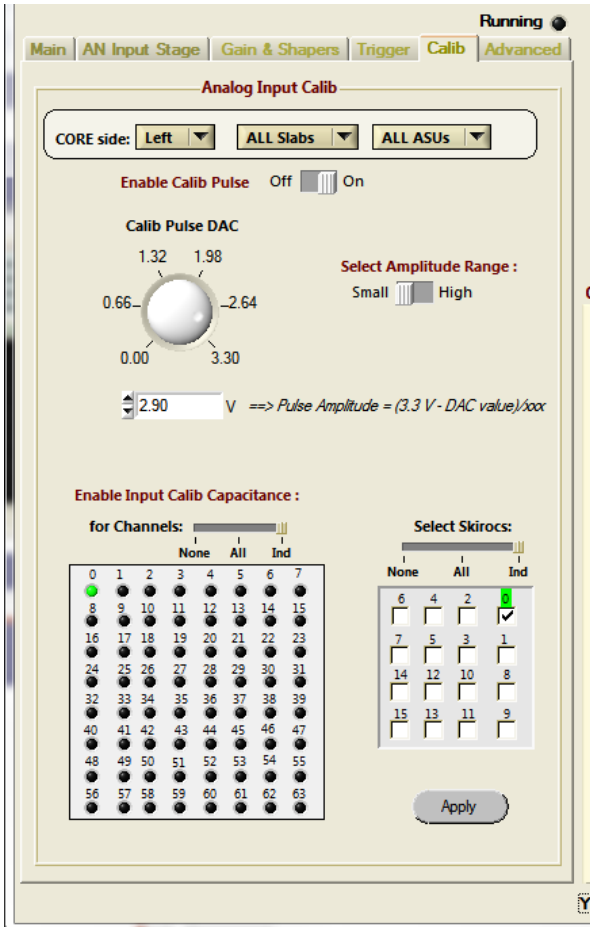


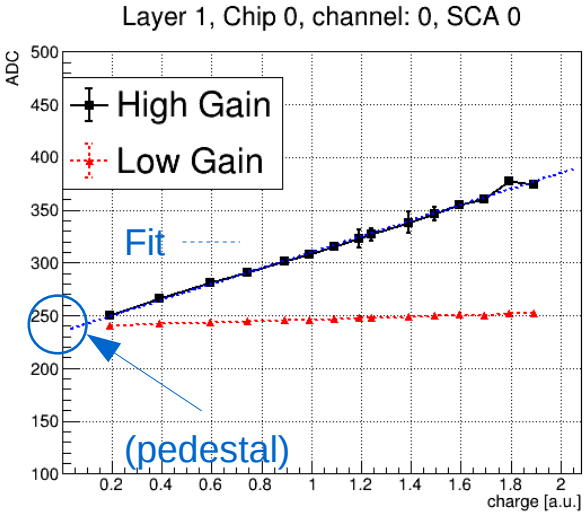
Commissioning

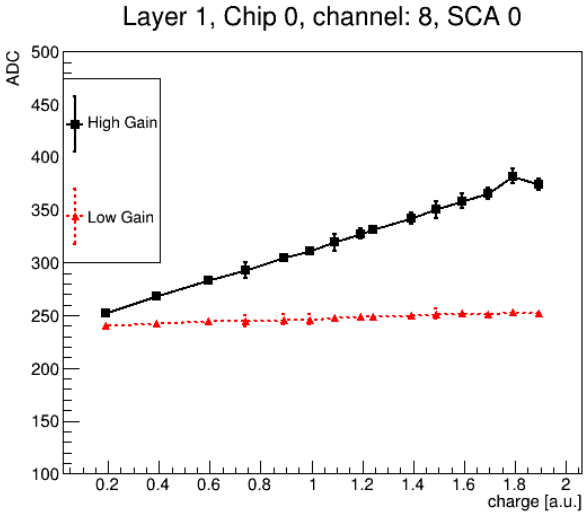
- Tools for debugging and commissioning:
- Automatic threshold scans performed with the DAQ
  - channel per channel or for several/all of them at the same time.
- Internal Calibration DAC integrated in the SLBoard
  - Allow for Hold scans and linearity checks
- Online monitoring tools
  - Charge (for all chips/channels/sca → easy masking procedure!)
  - BCID → coincidences searches
- Human readable configuration files



Commissioning: linearity

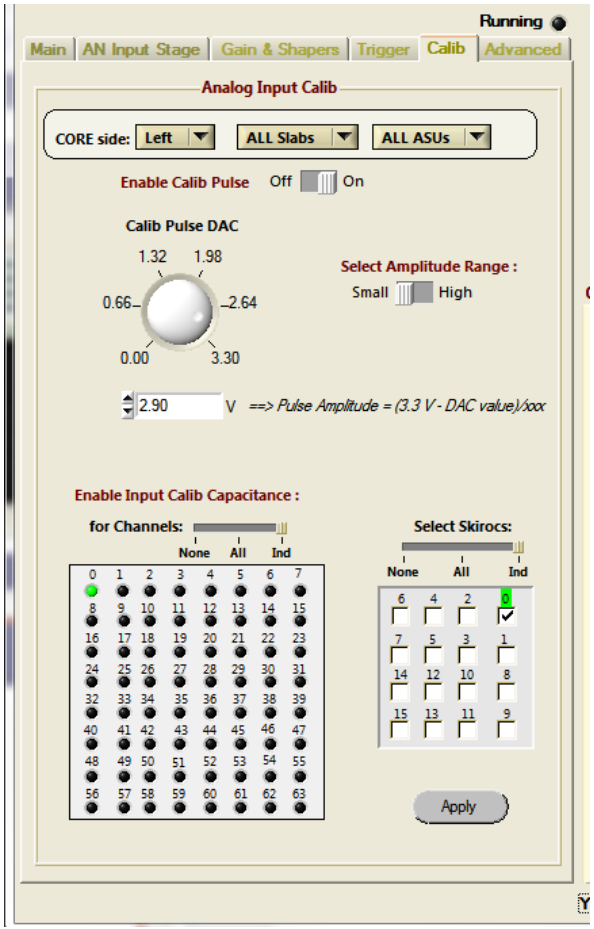


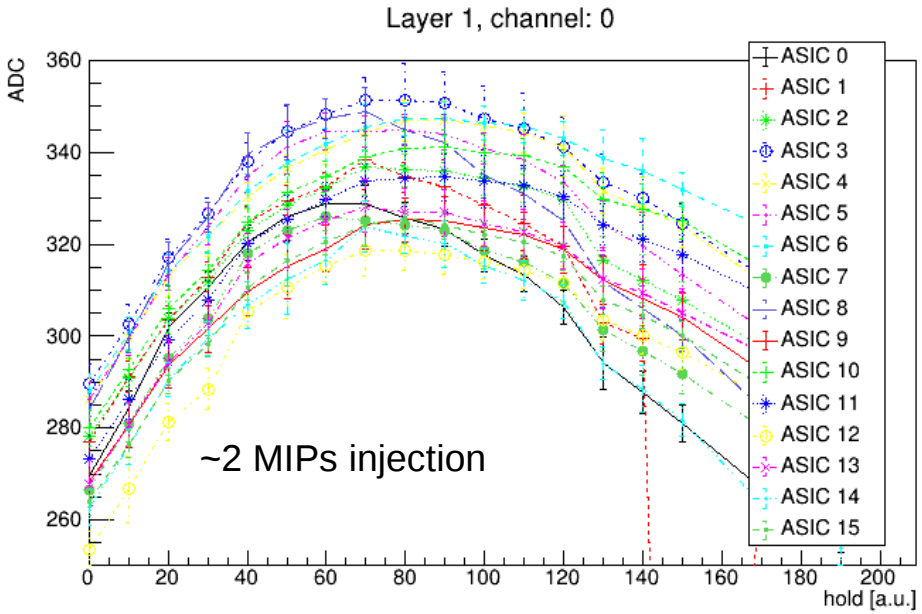




- Semiautomatic procedure to calibrate sca 0-3 for all channels of all 15 SLABS
  - Low gain and high gain
- Possibility to compare pedestal with fit method with pedestal obtained with “hit bit = 0”

Commissioning: linearity

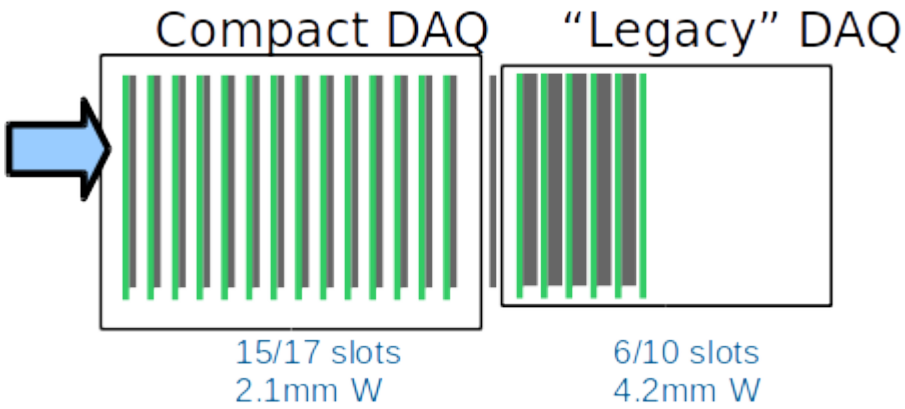




- Semiautomatic procedure to calibrate the hold of all chips

TB2020 at DESY TB24 (last week of March)

- 14-15 slabs integrated in the compact DAQ system.
- 4-6 FEV13 equipped with the legacy DAQ system at the back as a catch tailer
  - 4 FEV13 tested in 2018-19
  - 2 more in production



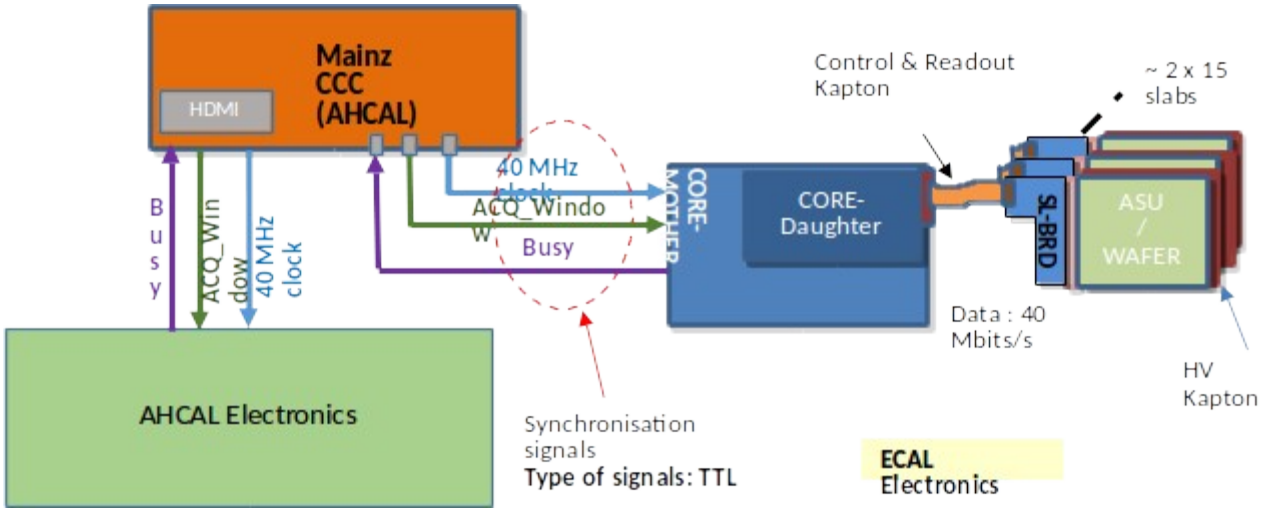
- A possible calorimeter layout

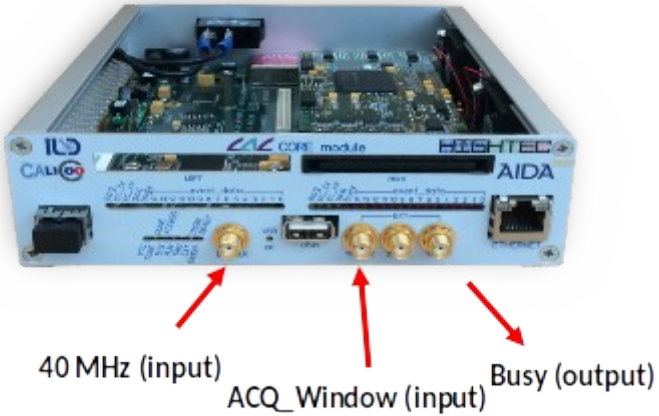
Layer number	Abs type bef.	mm	X0	X0 cumul.	Sh. Max /E	SLAB	REM :
1	0	0	0	0.0		COB (¼×500)	
2	1	2.1	0.6	0.6		FEV11/10 (320)	
3	1	2.1	0.6	1.2		FEV13 (650)	Early : Alignment
4	1	2.1	0.6	1.8		FEV11/10 (320)	
5	1	2.1	0.6	2.4		FEV11/10 (320)	
6	1	2.1	0.6	3.0		FEV12 (500)	
7	1	2.1	0.6	3.6		FEV11/10 (320)	
8	1	2.1	0.6	4.2	1 GeV	FEV11/10 (320)	
9	1	2.1	0.6	4.8		FEV12 (500)	500 µm @ core of shower
10	1	2.1	0.6	5.4	3 GeV	FEV11/10 (320)	
11	1	2.1	0.6	6.0	6 GeV	FEV11/10 (320)	
12	1	2.1	0.6	6.6		FEV11/10 (320)	
13	1	2.1	0.6	7.2		FEV11/10 (320)	
14	1	2.1	0.6	7.8		FEV11/10 (320)	
15	2	4.2	1.2	9.0		FEV11/10 (320)	
16	2	4.2	1.2	10.2		FEV13 (320)	Comparison FEV11/13
17	2	4.2	1.2	11.4		FEV13 (650)	
18	2	4.2	1.2	12.6		FEV13 (500)	
19	2	4.2	1.2	13.8		FEV13 (650)	
20	2	4.2	1.2	15.0		FEV13 (500)	
21	2	4.2	1.2	16.2		FEV13 (650)	
Type thickne	2.1 mm	0.6 X0					

- **Program:**
  - **DAQ tests**
  - **MIP calibration of all modules→ for future tests**
  - **Electromgnetic showers at different energies**

Common beam test

- The AHCAL has beam time just the week before in the same beam area.
- Tests of common DAQ are foreseen (from the 19th March)
- The CCC shares the clock and the start acq between both systems.
  - We will have a fixed time offset, to be determined during data taking
- Modifications in both systems are needed to accept/distribute busy signals → Ongoing activity (DESY/Prage/IJCLab)
- The EUDAQ implementation has been studied: it is feasible but will be postponed to after the beam test.





Summary

- We still have a couple of weeks of frenetic activities and then...
- **… let the fun begin !**

Back-up

FEV10/11 status

Historic (<2020)

- Slab 13 had problem with the adapter card (glue was spilled in it, affecting to the conductivity)
- Slab 14: Problem in the ASU (broken connexion between configuration lines)
- Slab 15: mistery! (it was operative during the first phase of the 2017 commissionig and then stopped… SMBv issue?)
- Slab 16 and 18 → we observed that some areas cannot be calibrated… deconnexion between wafer and ASU?
- Slab 21: unknown.
- Slab 23: it was never equipped with adapter card.

			DESY 2017		CERN 2018		2020	
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4	FEV11	16		92%		?		
5	FEV11	17		93%		95%	travelling Japan – France	
6	FEV11	18		94%		?		
7	FEV11	19		93%		93%		
8	FEV11	20		94%		96%		
9	FEV11	21		54%		0%		
10	FEV11	22		84%		87%		
11	FEV10	23		0%		0%		

SLAB 14: recovered for data taking

- Slab not tested at DESY 2017 due to a problem of the Signal/Slow Control Return lines that blocked the readout.
- First slab used to test the “disassembly procedure” (November 2019)
- Satisfactory DAQ tests done by bypassing 4 chips.
- Status: slab fully recovered and commissioned → similar performance than the other FEV11s had during 2017