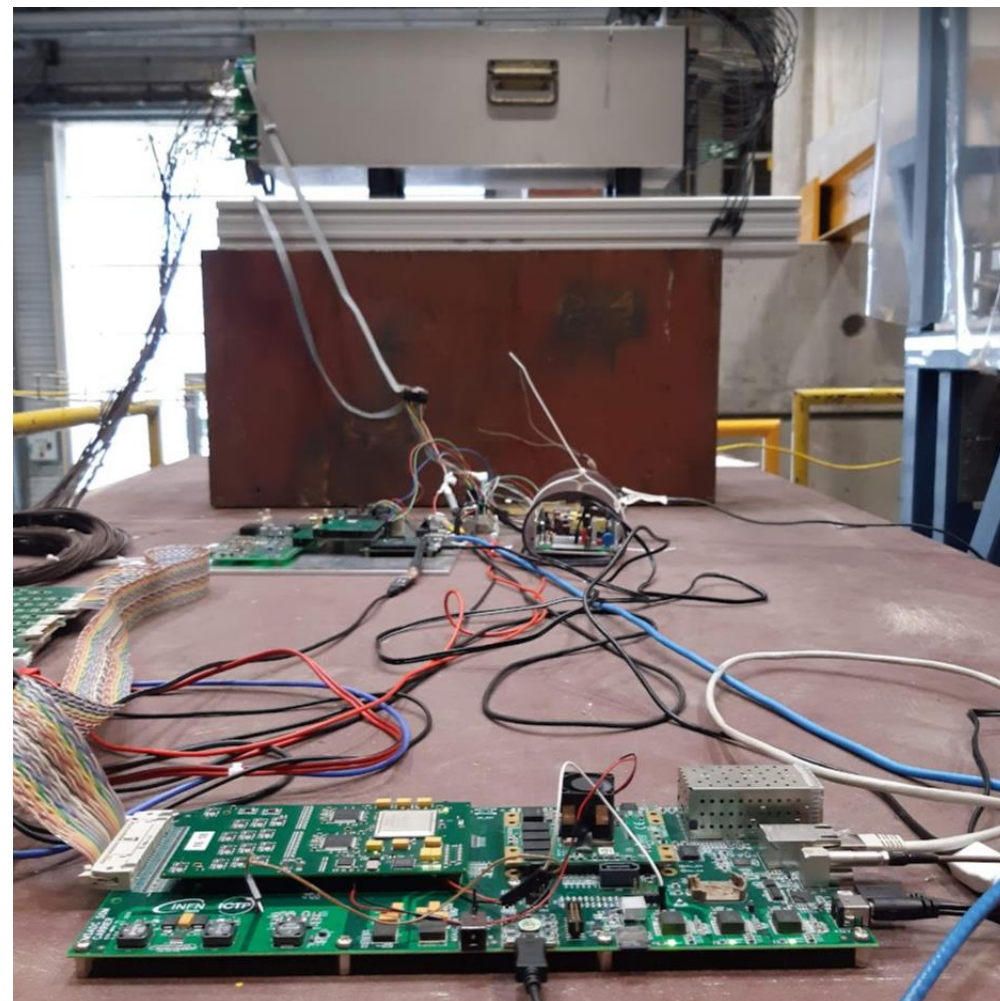


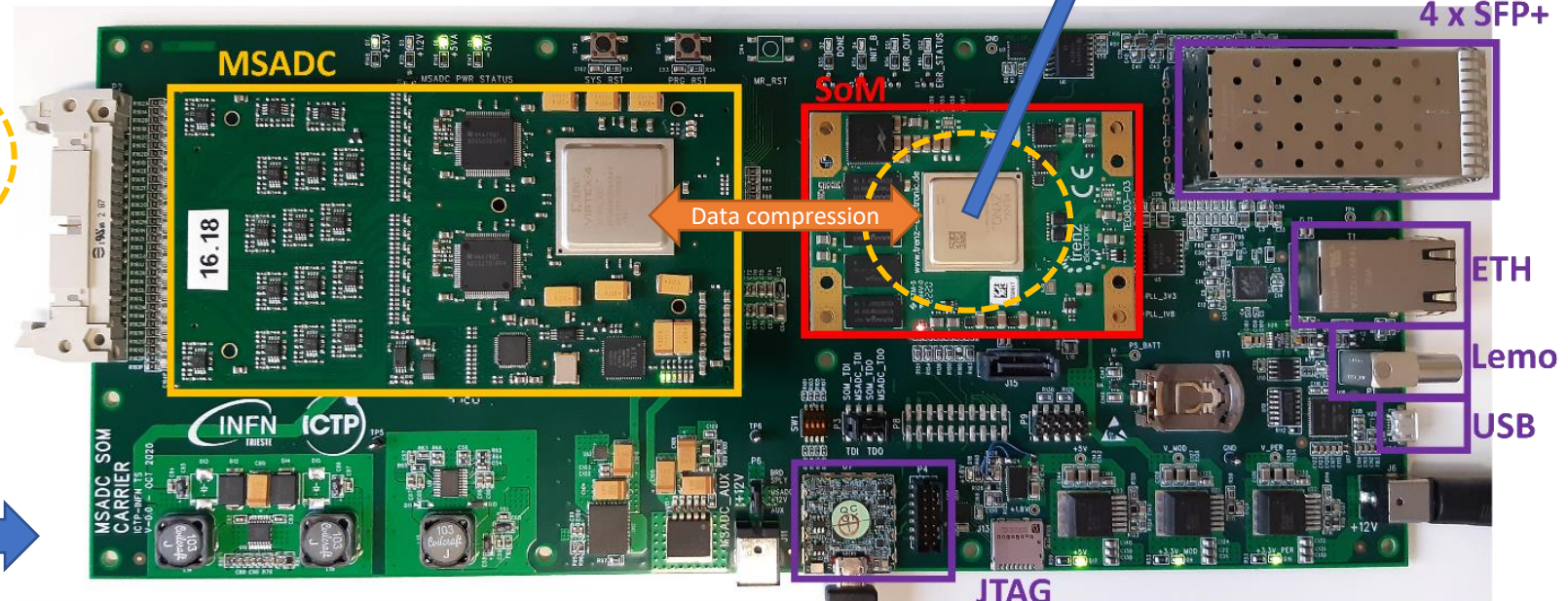
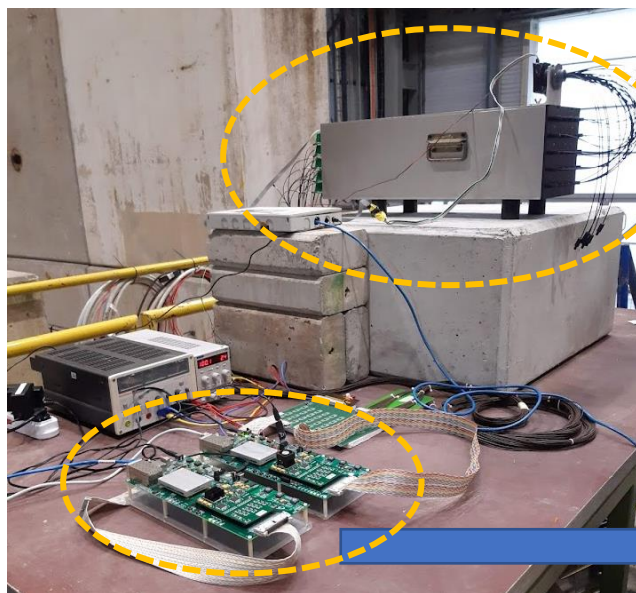
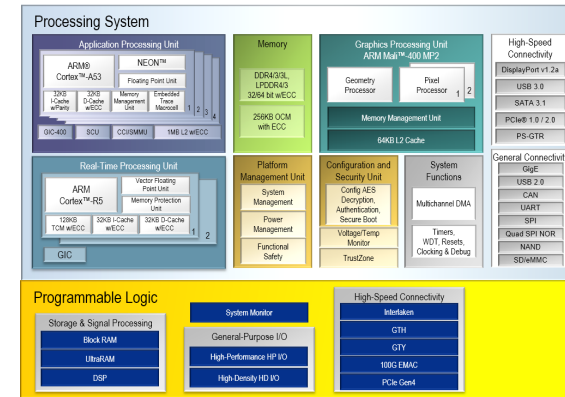
ECAL-2 Free Running DAQ

Global architecture, digital design,
embedded programming, and data analysis

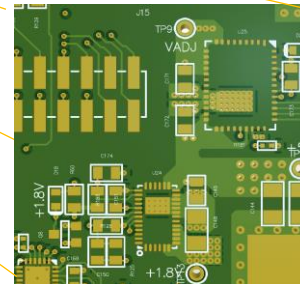
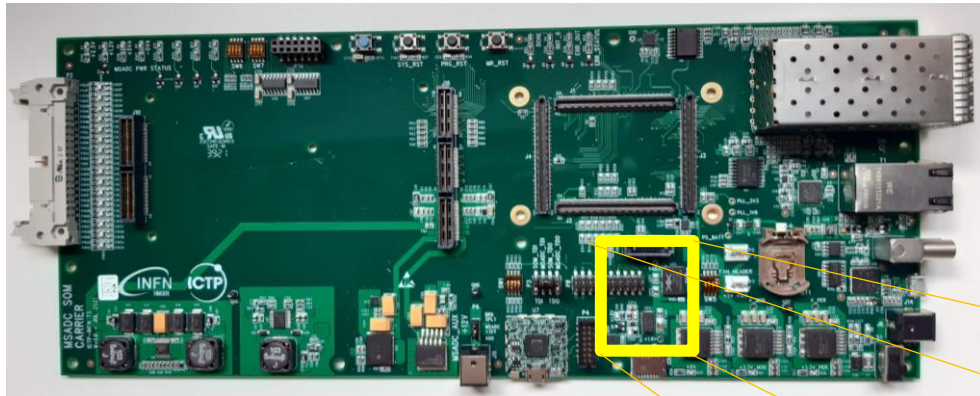
B. Valinoti, M.L. Crespo, A. Cicuttin, R. Molina, I. Morales, L. Garcia, S. Levorato,...



ECAL-2 MSADC SoM Carrier



MSADC SoM Carrier V1_1 (small redesign)



- Production 20 units
- **Approx. for mid Dec'22**
- Issues to find some components
- Redesign of power system 1.8V and Vaux, approx. 2-3 days



- Xilinx Zynq UltraScale+ XCZU9EG-1FFVC900E
- 2520 DSP block
- 32.1 Mb BRAM (embedded)
- 4GB DDR4 SDRAM (external)
- **No stock, probable delivery date: Middle 2023**

Current version is controlled using command line prompt script running on Python.

- Currently we are experiment with Quasar OPC running in the ARM microprocessor.



```
mlabadm@hp6g4-mlab-5: ~/my_gits/infnpamp/SDK/udma_pamp/src
File Edit View Search Terminal Help
Board communication
=====
close_server connect disconnect log udma x_change_cb

Comblock Read
=====
x_read_fifo x_read_mem x_read_ram x_read_reg

Comblock Write
=====
x_ecal_ramp_all x_ecal_set_all x_write_fifo x_write_ram
x_ecal_ramp_ch x_ecal_set_ch x_write_mem x_write_reg

pAmp Control
=====
adc500_cfg HVadj_set imon_read pas_set vadj_set
hv_pwrdown HVadj_set_ramp pAmp_init set_dec_n vmon_read

Uncategorized
=====
alias exit history py run_pyscript set shortcuts
edit help macro quit run_script shell

RVI CLI >: |
```

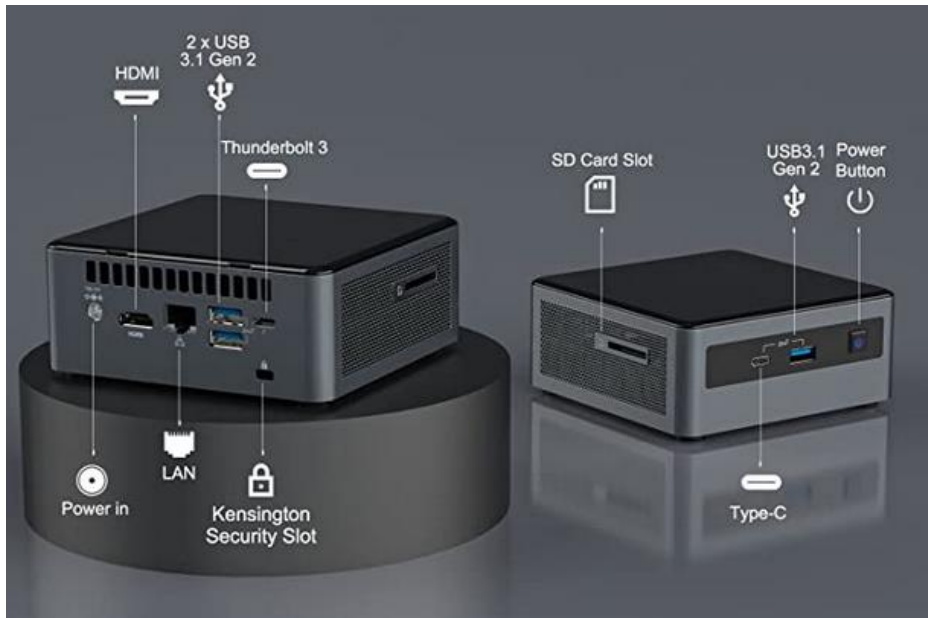
Network hardware

Order already placed, some components arrived to CERN













- 1 x FHD MTP®-24 Cassette, 24 Fibers OM4 Multimode, Type AF, MTP® to 24 x LC Duplex (Aqua), 0.35dB max
- 1 x FHD MTP®-24 Cassette, 24 Fibers OM4 Multimode, Type A, MTP® to 12 x LC Duplex (Aqua), 0.35dB max
- 10 x Cisco SFP-10G-SR Compatible 10GBASE-SR SFP+ 850nm 300m DOM Duplex LC MMF Optical Transceiver Module
- 10 x 20m (66ft) LC UPC to LC UPC Duplex OM4 Multimode PVC (OFNR) 2.0mm Fiber Optic Patch Cable
- 10 x 3m (10ft) LC UPC to LC UPC Duplex OM4 Multimode PVC (OFNR) 2.0mm Fiber Optic Patch Cable

PC – two units for interface, control and programming



NUC-Slim 8th Gen/8GB/240SS -- 514 euro

- Core™ i5, 8GB RAM, 240GB SSD
- Front 2 x USB 3.1 Gen2, Rear 2 x USB 3.1 Gen2
- 1000 Mbps Ethernet port
- 1 x HDMI
- CERN provided: not clear when available --> EDH Dec 2022

Buy	SCEM Code	Unit	Unit Price	Stock	Expected Delivery	Direct Delivery	DESIGNATION - DESCRIPTION	Data sheet - URL
	80.01.01.025.4	PC	718.0	0 	14.12.2022	>=5 	HP Elite 800 G9 Desktop Mini, i5, 16GB RAM, 512GB SSD, GbE RJ45 Port, 120W Power Adapter	Lire la fiche technique
	80.01.01.026.3	PC	551.0 	0 	10.02.2023	>=5 	HP-EliteDesk 800 G8 Tower i5/8GB/256 SSD	Read technical sheet
	80.01.01.029.0	PC	514.0	0 	02.12.2022	>=5 	NUC-Slim 8th Gen/8GB/240SS	Read technical sheet
							SCEM to order a standard desktop HP 800 G8 Mini with options available here	

100V Power source – W Ethernet interface

Thurlby Thandar Instruments PLH-P 250

Actual size

Better Energy Efficiency

- High accuracy four digit meters have a fixed resolution for consistent readings at-a-glance.
- View and adjust setting limits at any time.
- S-Lock** digitally locks voltage and current settings at the touch of a button.
- True analog controls make adjustment quick and simple.
- V-Span** enables the full 300° rotation of the voltage control to cover any voltage range.
- Safety binding post terminals can accept fixed-shroud 4mm plugs** as well as normal plugs, bare wires, and fork connectors.
- Low current range gives 0.01mA meter resolution and finer low current setting.
- Meter averaging reduces the jitter from rapidly varying load currents.
- DC output switch enables voltage and current to be set up before connecting the load.
- Voltage sensing can be changed between local and remote at the flick of a switch.

OPTIONAL - Option (G)

OUT LAN

CV Remote Local

CC Remote Local

RS232

USB

IEEE-488

CAUTION: TO PREVENT ELECTRIC SHOCK, DISCONNECT AC LINE BEFORE REMOVING LID. REFER TO MANUAL

RATED VOLTAGE:
230V SETTING: 230VAC, ~ 50/60Hz
115V SETTING: 115VAC, ~ 50/60Hz
THIS INSTRUMENT IS SET FOR **230V**

REFER TO MANUAL TO CHANGE

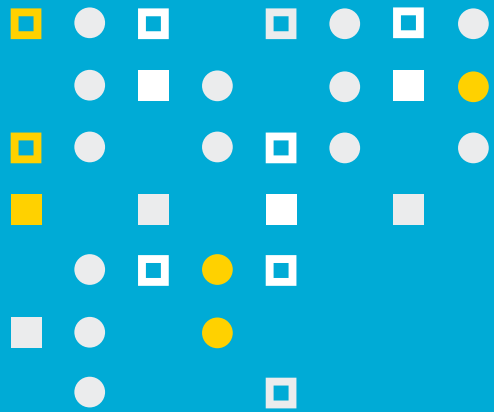
POWER: 280VA MAX
FUSE: 250V HRC(5 x 20mm)
115V SETTING: 3.15A(T)
230V SETTING: 1.6A(T)
USE ONLY FUSE OF CORRECT TYPE AND RATING

WARNING: THIS APPARATUS MUST BE EARTHED

WARNING: EARTH BOND POINT DO NOT TAMPER

□ SUMMARY

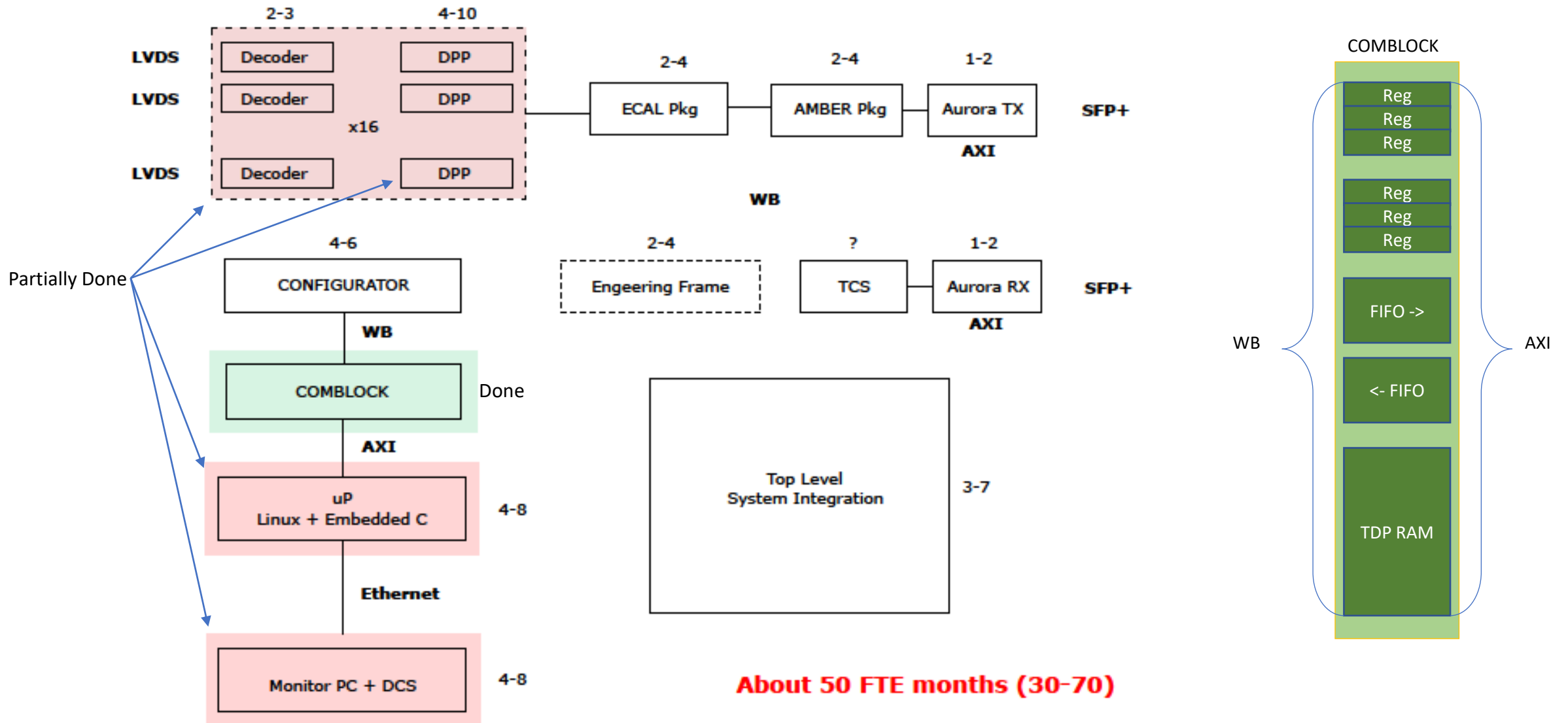
Hardware Status



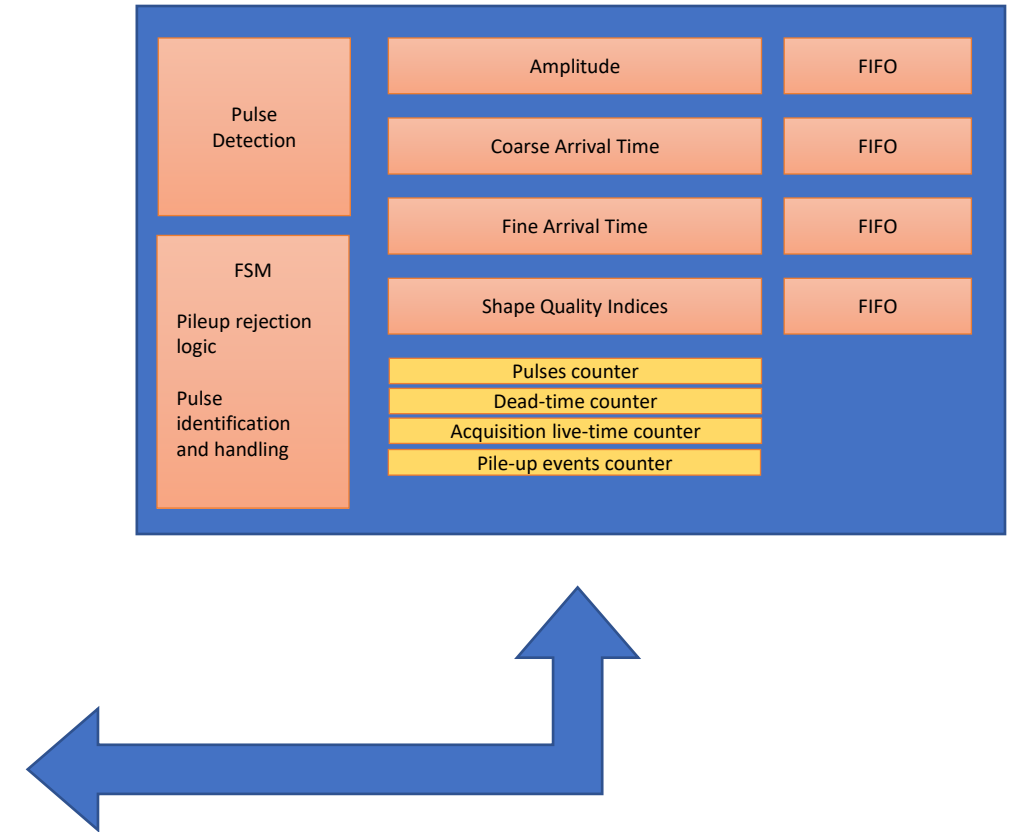
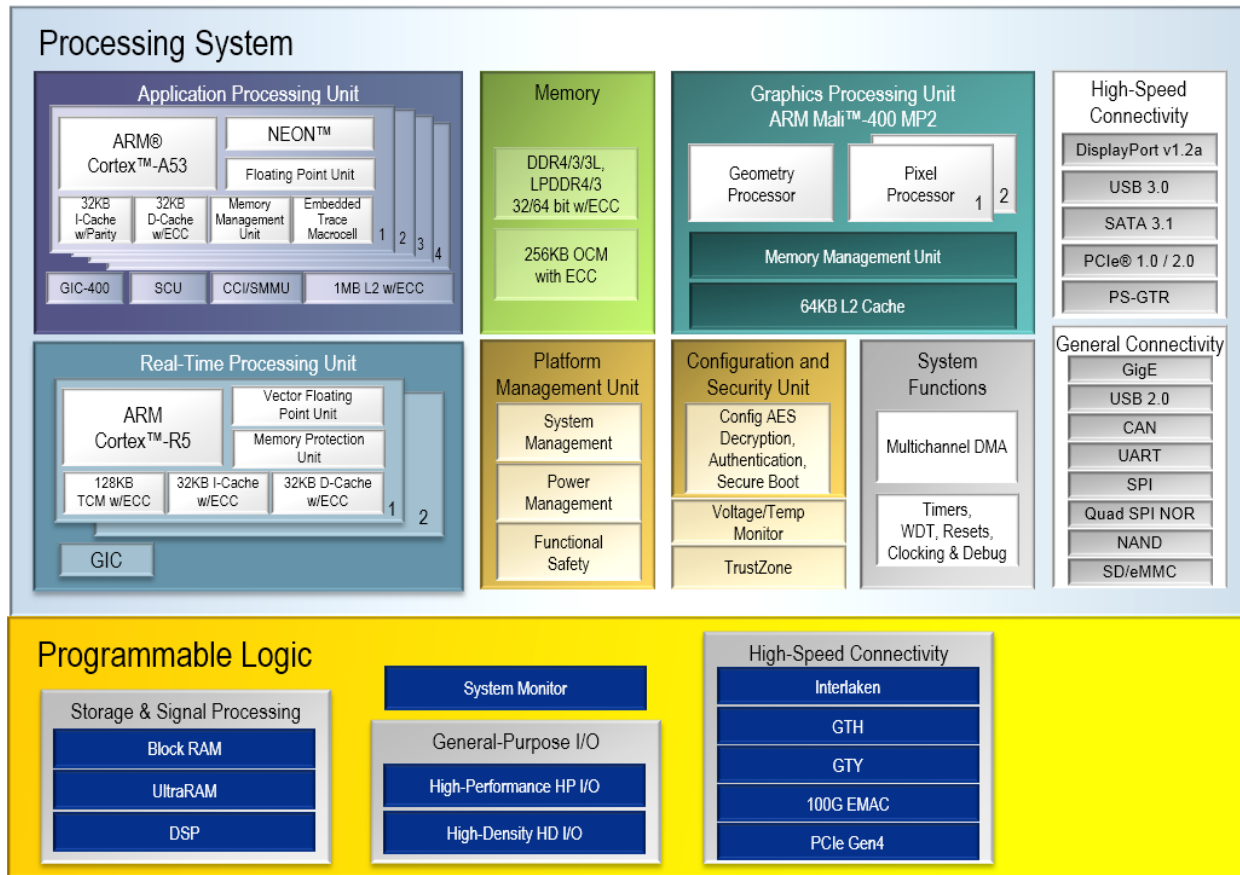
- Carriers production
 - 3 units V0_0 (Oct-Dec 2020)
 - 3 units V1_0 (July-Dec 2021)
 - 20 Carrier V1_1: **Requesting quotation these days**
- System on Modules (Xilinx Zynq Ultrascale+)
 - 5 acquired and using
 - **20 expected by Middle 2023** (about 52 weeks from order)
- MSADC cards: from current ECAL2 front-end electronics
- HV Control board: Fully implemented and working. Production of new control boards batch
- PC for interface, control and programming: **Two to be ordered**
- Network hardware: **Order already placed, some components arrived to CERN**

Firmware Development

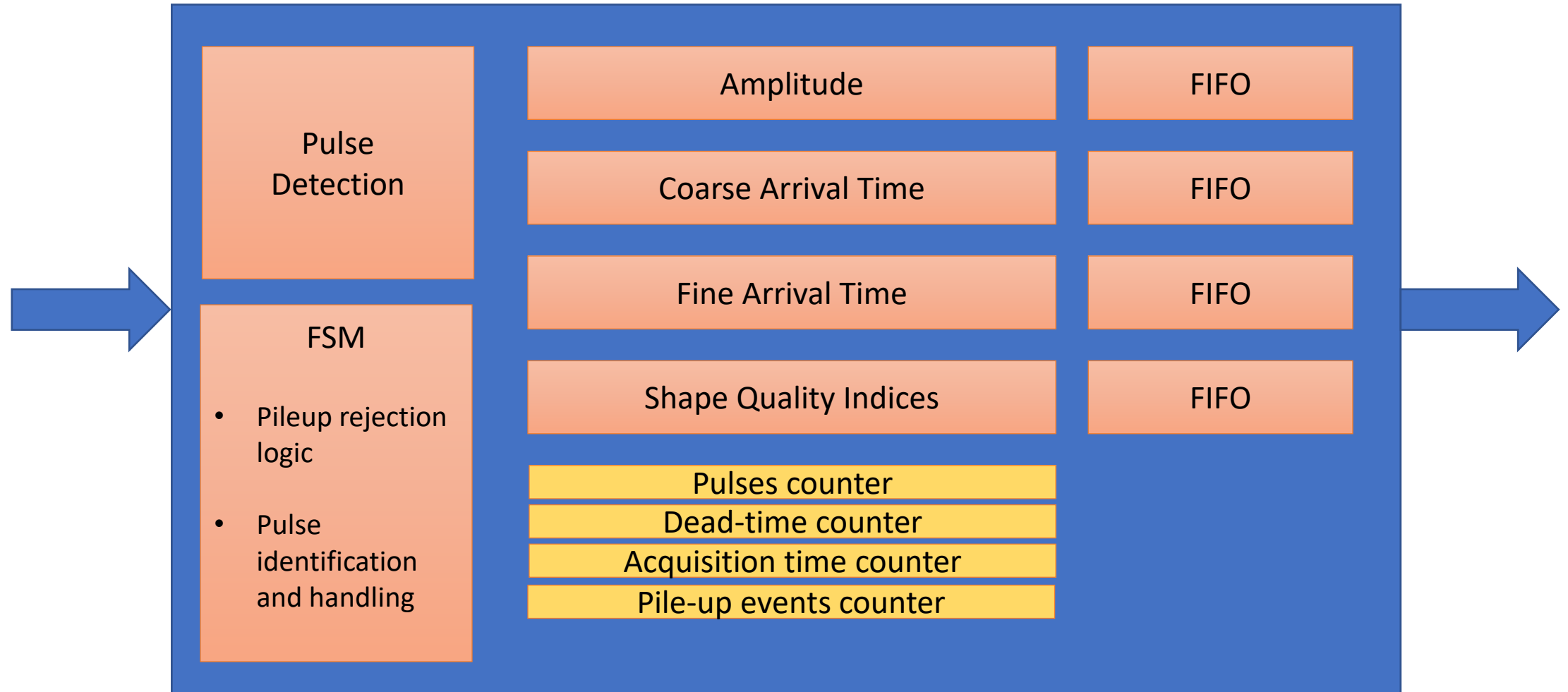
Global Design Architecture Main functional blocks and their estimated development times (range in FTE months)



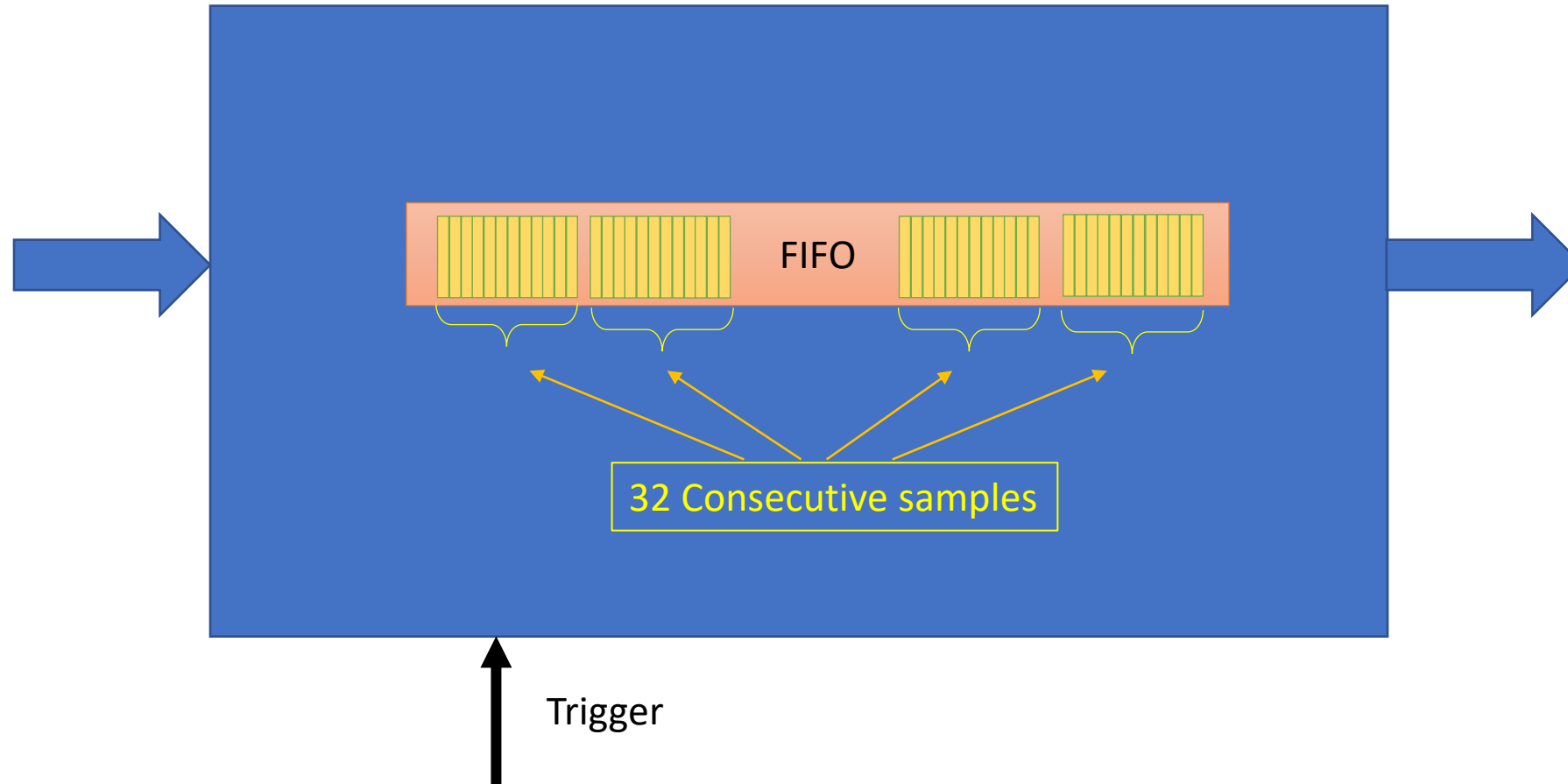
Firmware Development: The Digital Pulse Processor (DPP)



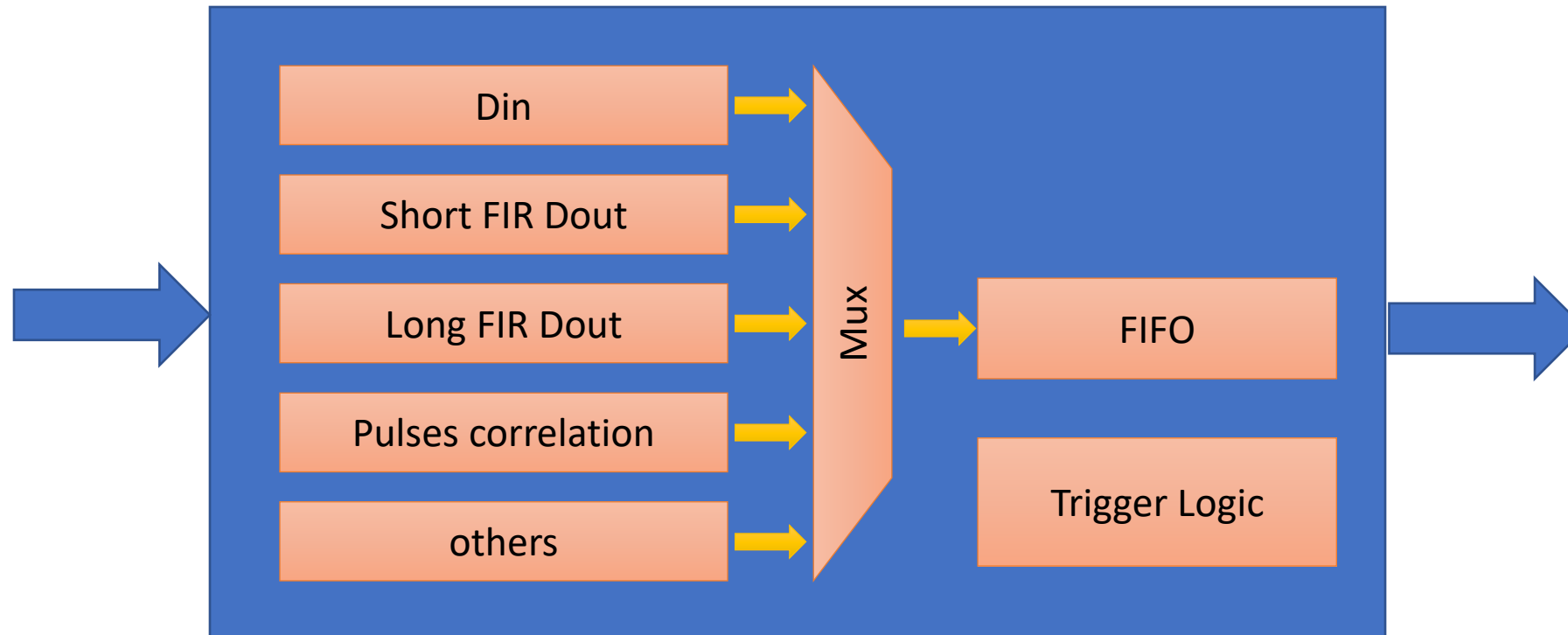
DPP: Possible features extraction in free running working mode



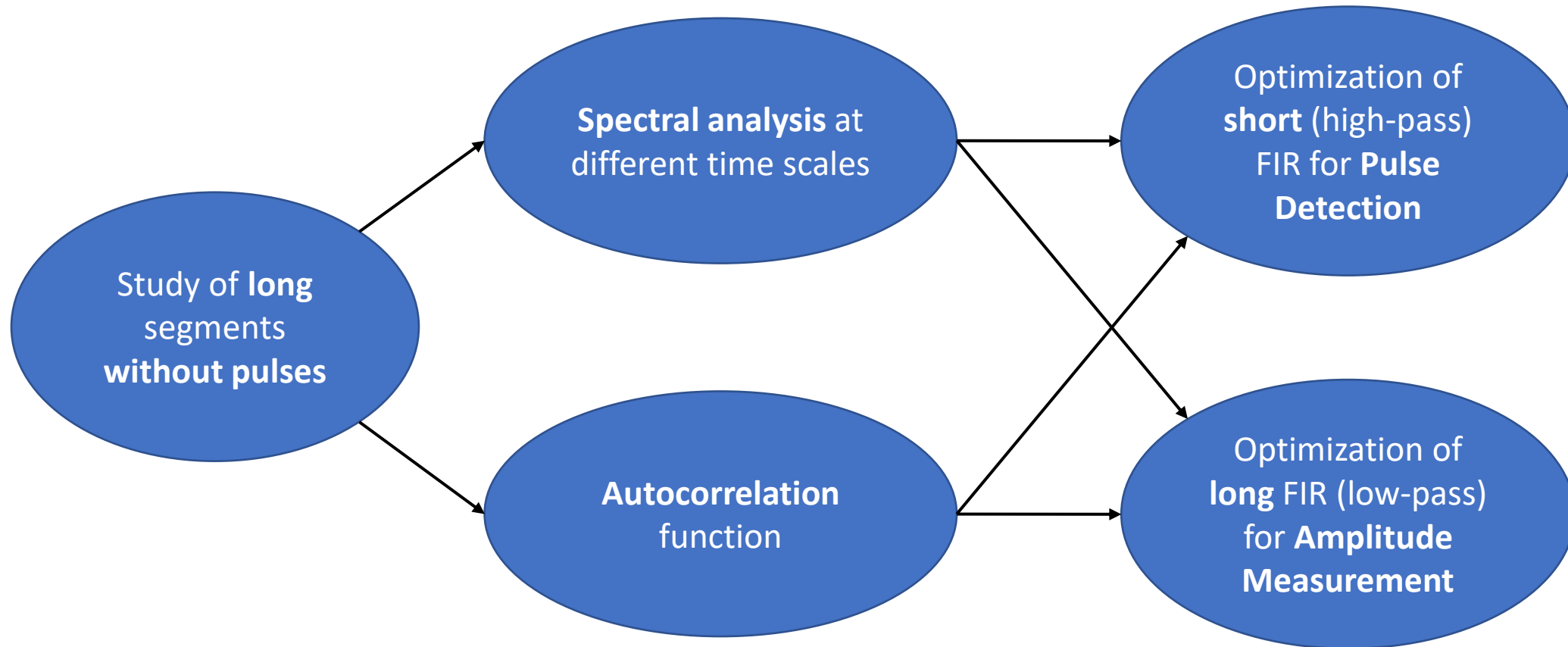
DPP: Legacy (present) working mode



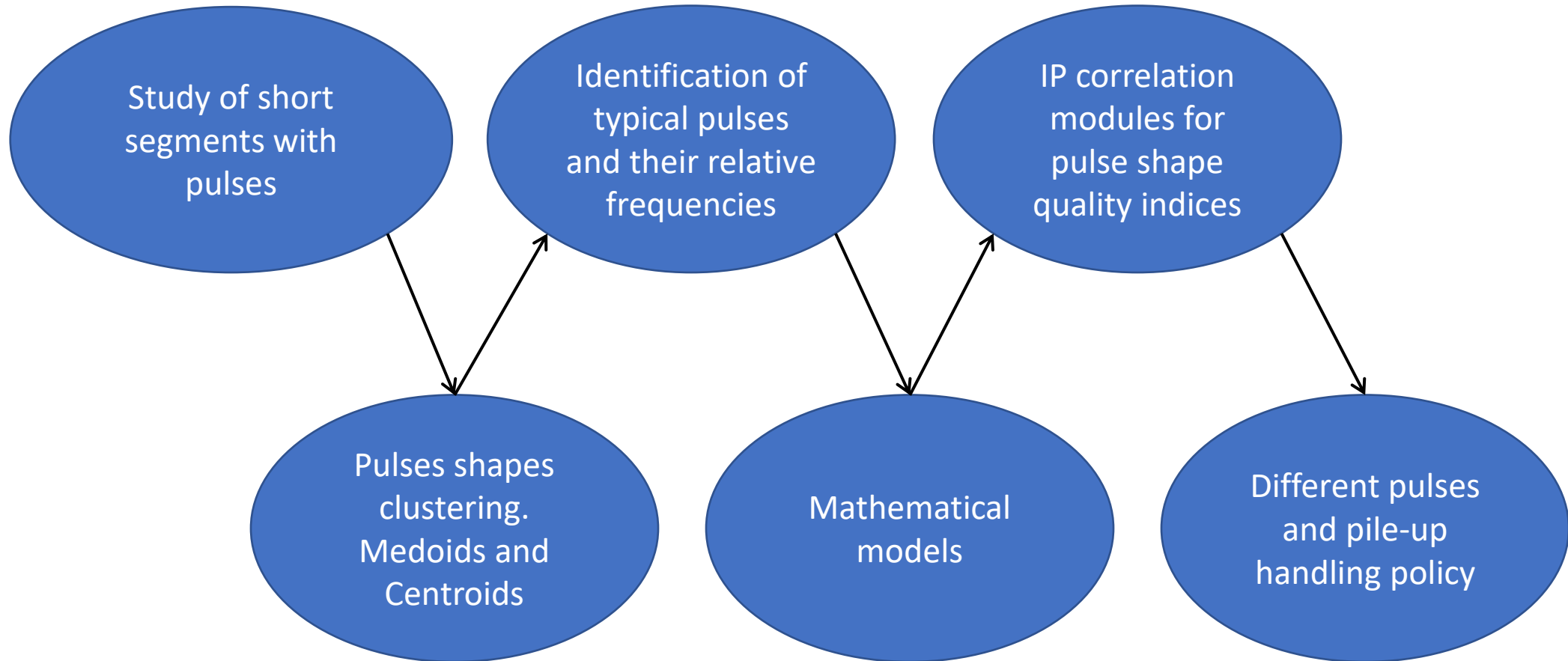
DPP: Digital oscilloscope (debugging) working mode



ECAL-2 Data Analysis I: Noise study



ECAL-2 Data Analysis II: Signals study



ECAL-2 Data Analysis III: New research lines



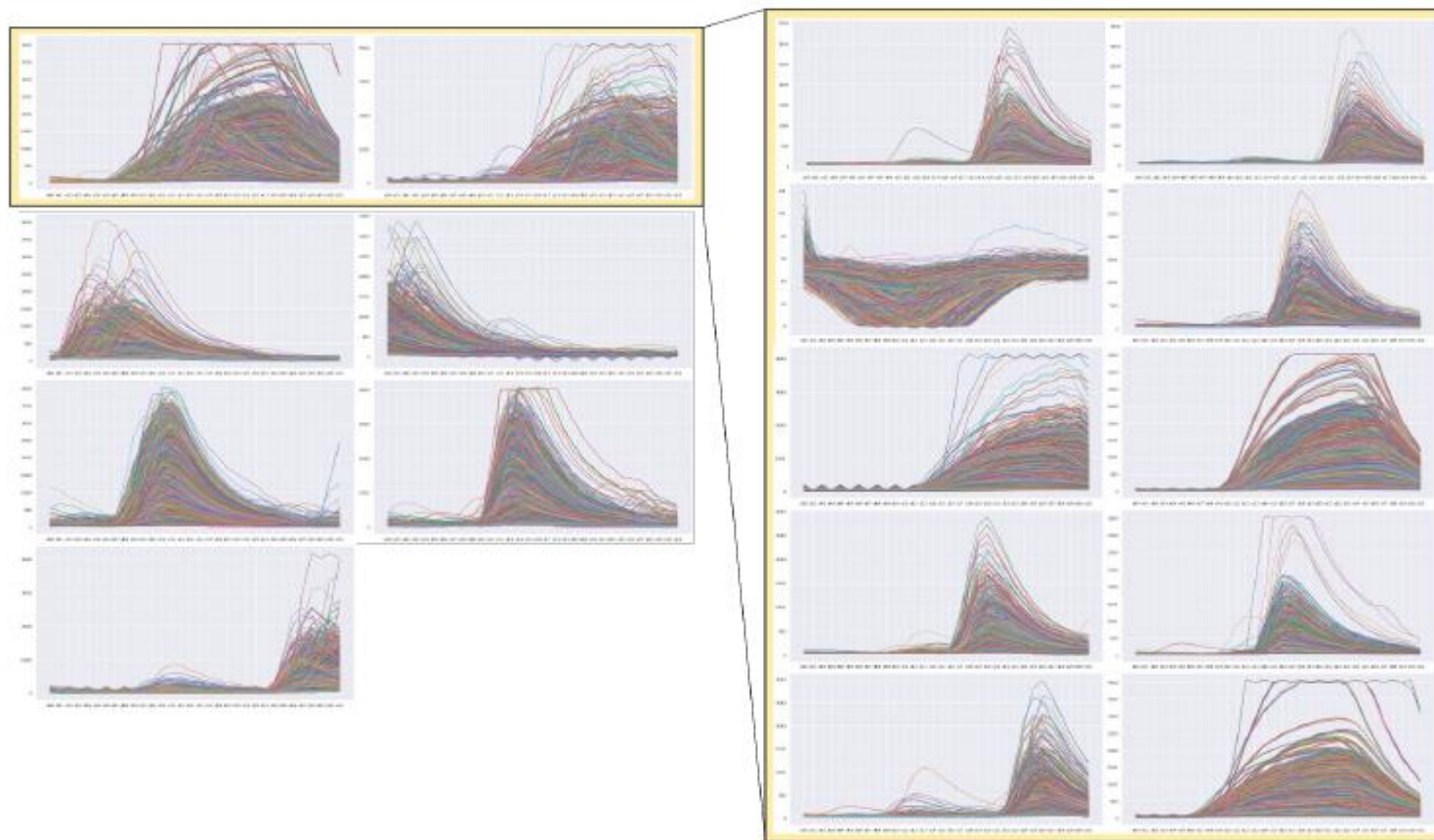
Machine Learning and ECAL2

Romina Molina

Trieste - Italy
1.04.2022

Centroid-based clustering

Offline algorithmic pulse classification

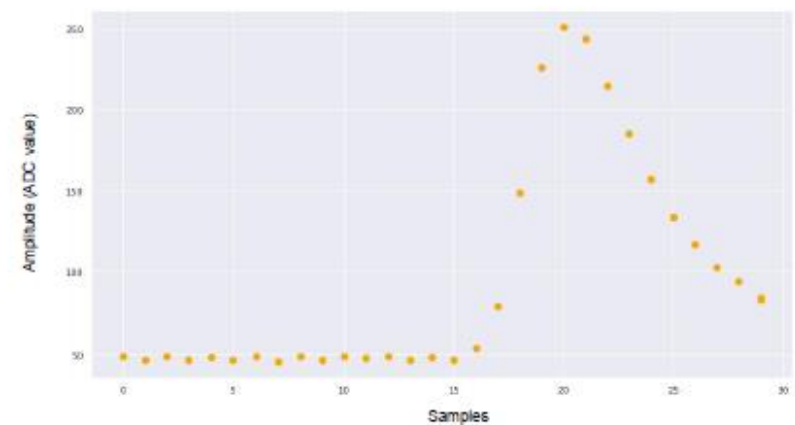
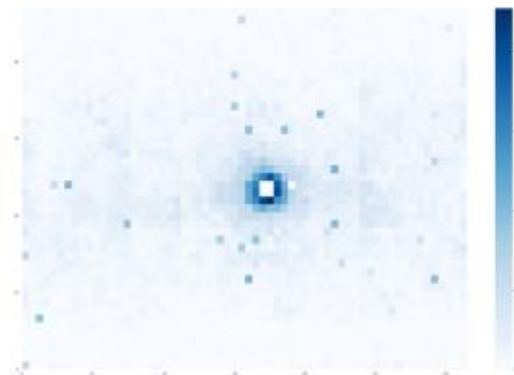
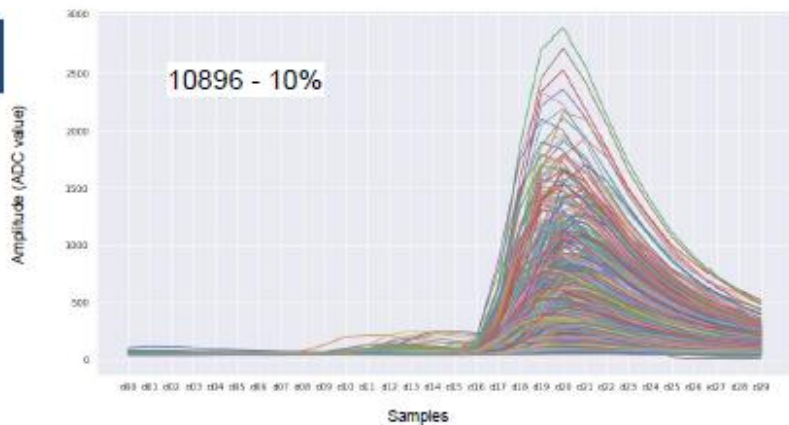


Centroid-based clustering

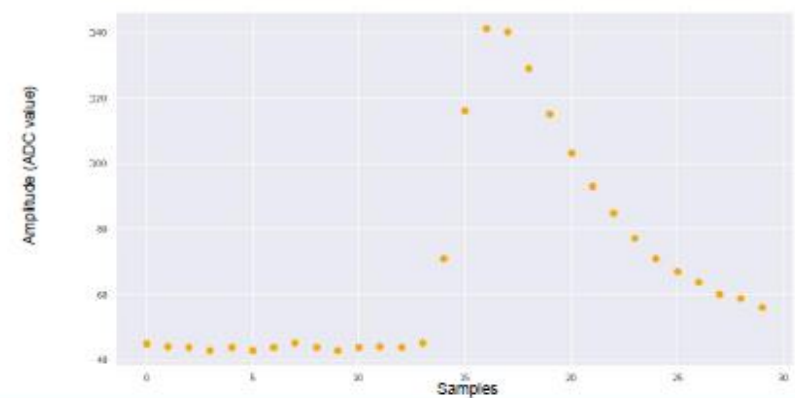
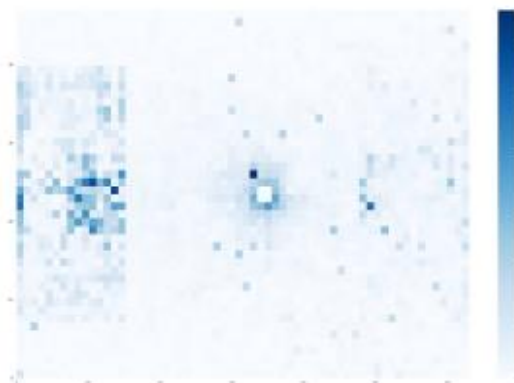
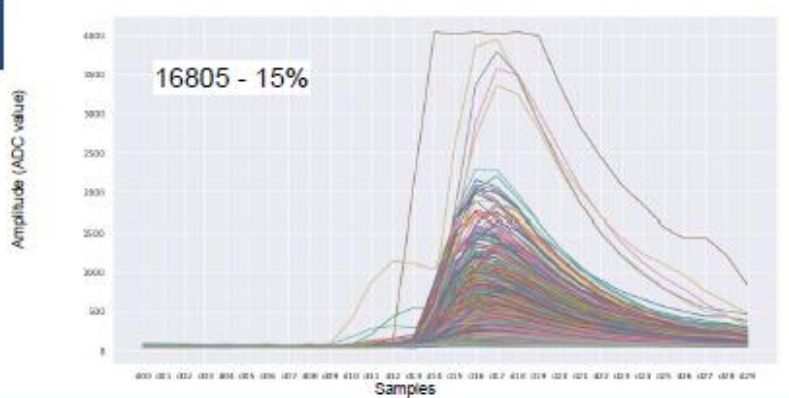
Results - Second Iteration with 135129 signals

Possible debugging/diagnostic based on pulse shapes

C6



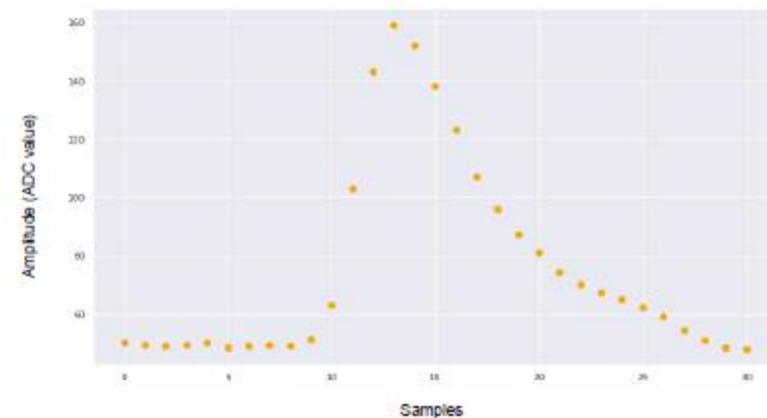
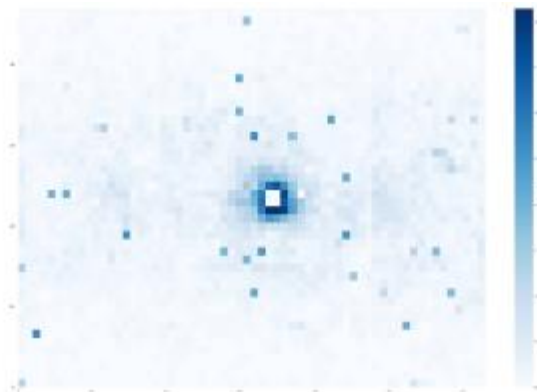
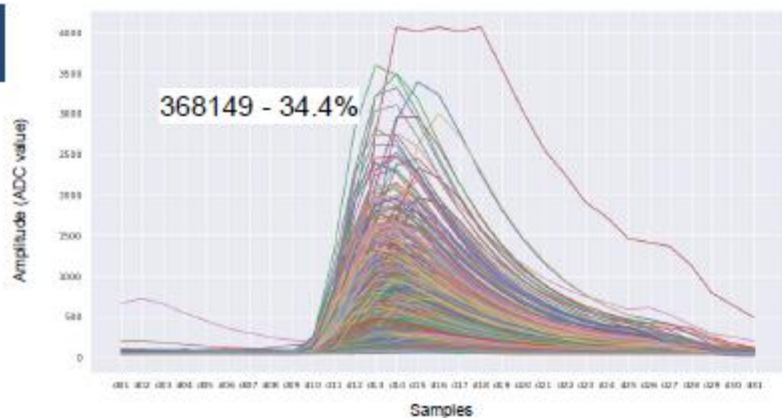
C7



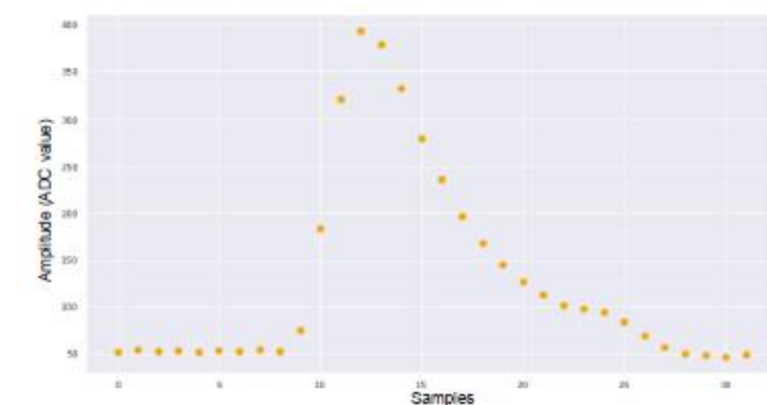
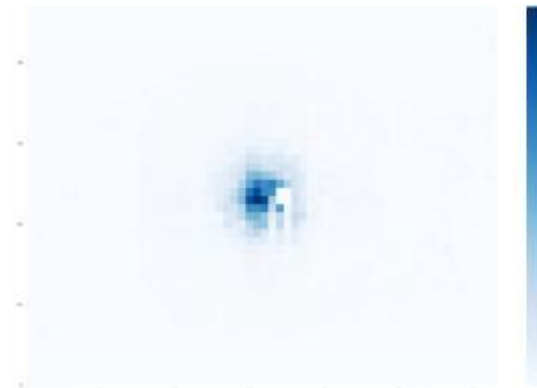
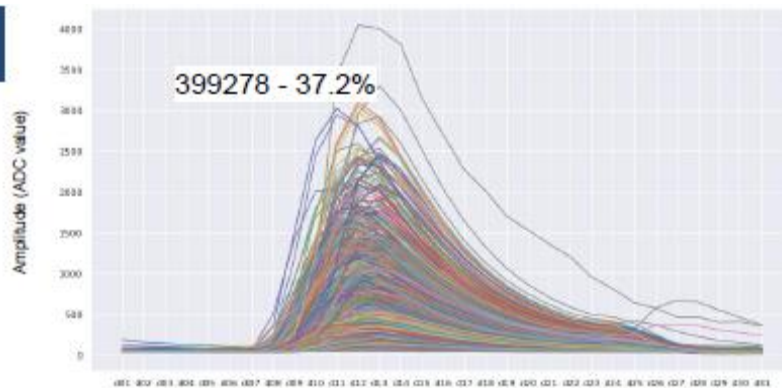
Centroid-based clustering

Results - First Iteration with 1072747 signals

C1



C2



Possible pulse shape based
particle discrimination?