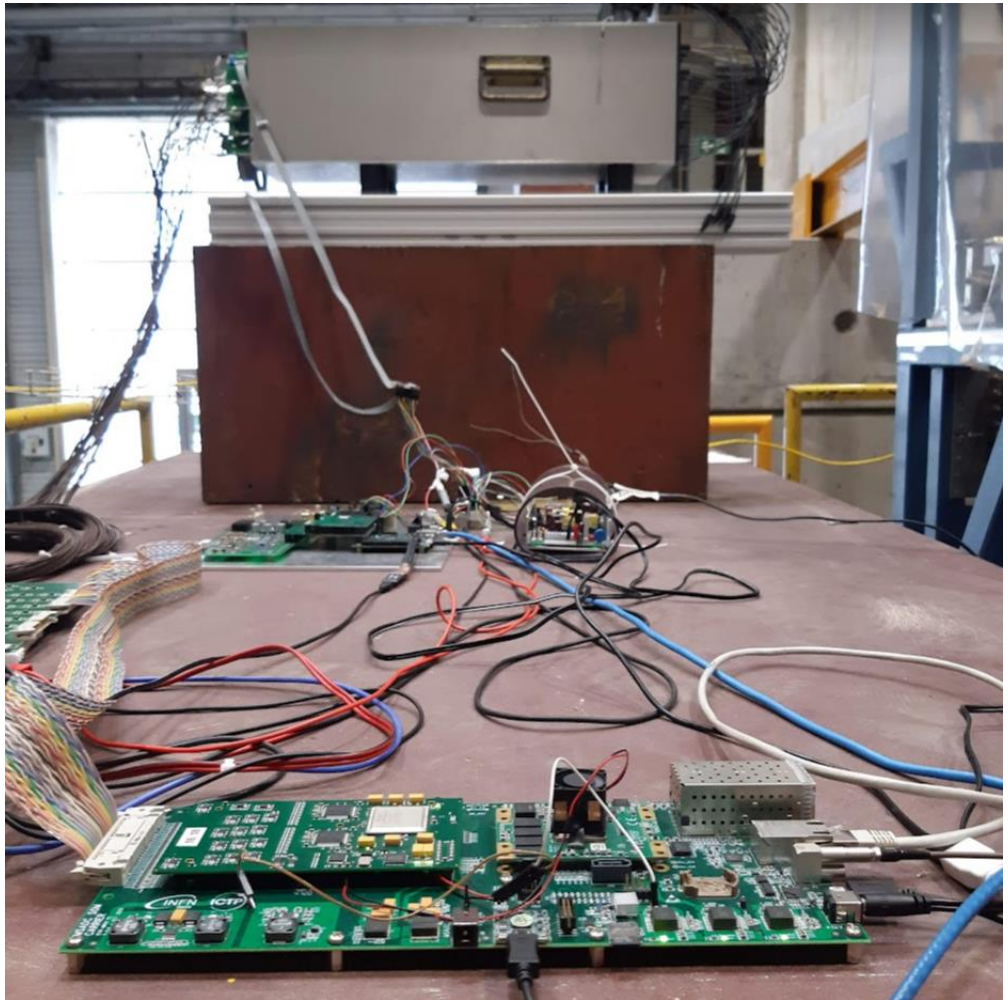
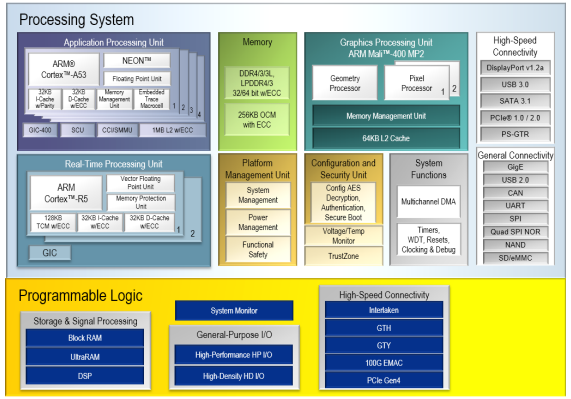
ECAL-2 Free Running DAQ

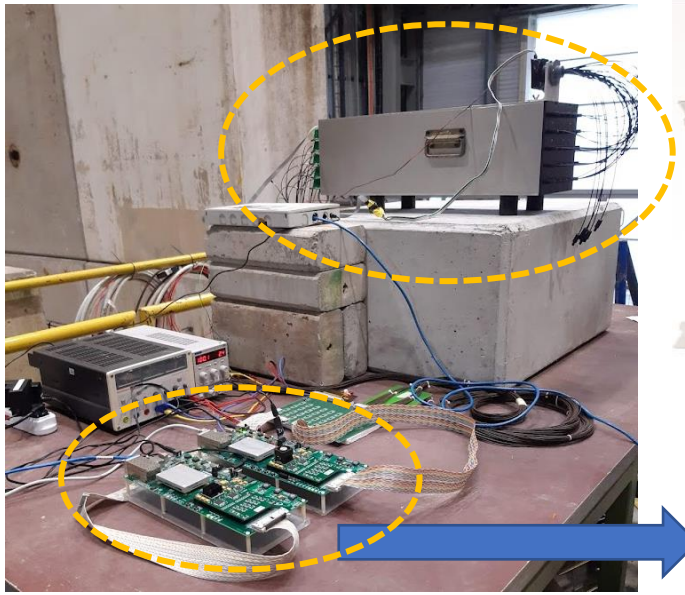
Global architecture, digital design,
embedded programming, and data analysis

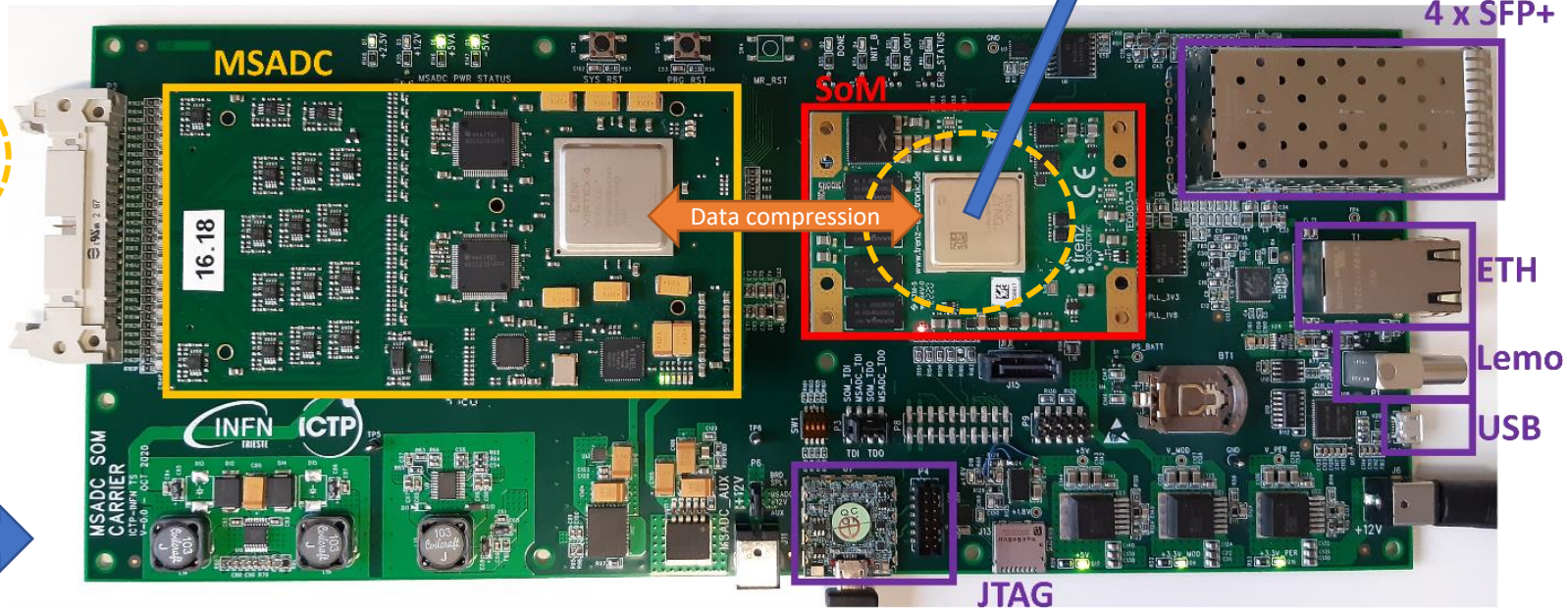
B. Valinoti, M.L. Crespo, A. Cicuttin, R. Molina, I. Morales, L. Garcia, S. Levorato,…



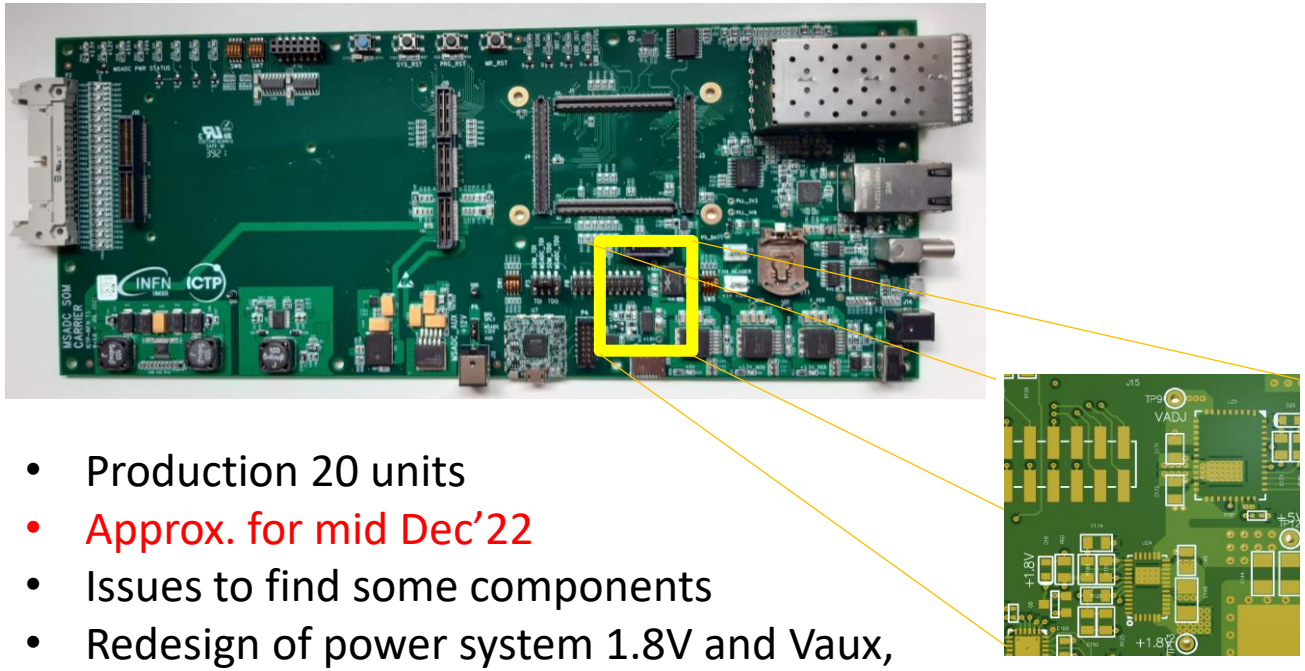
ECAL-2 MSADC SoM Carrier







MSADC SoM Carrier V1_1 (small redesign)



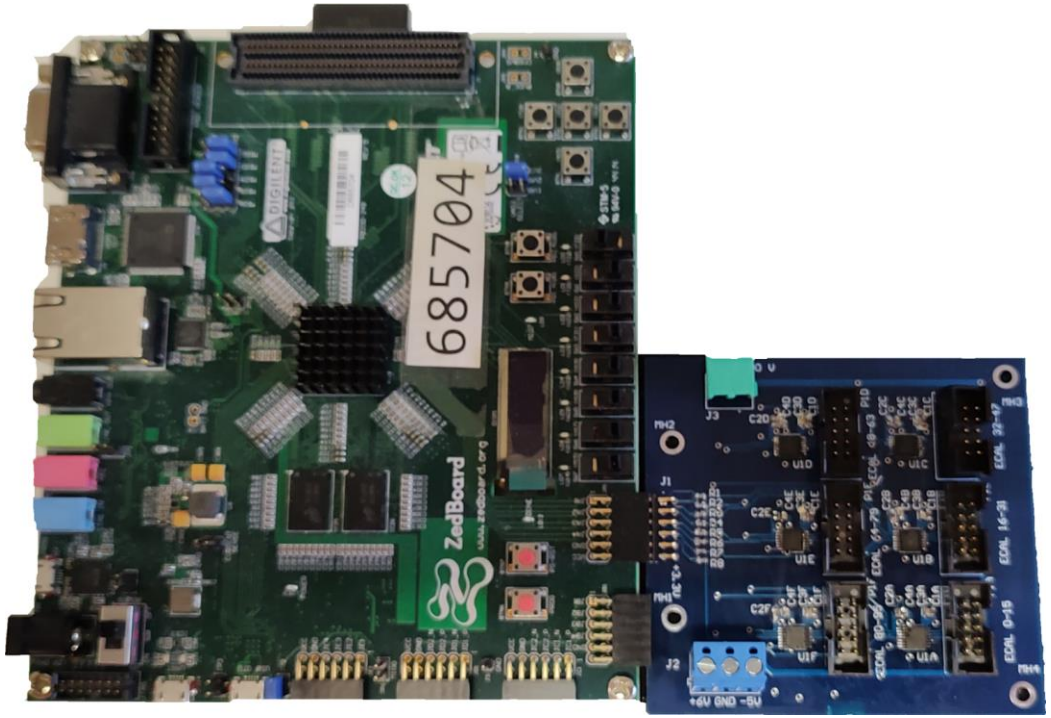
- Production 20 units
- Approx. for mid Dec'22
- Issues to find some components
- Redesign of power system 1.8V and Vaux, approx. 2-3 days

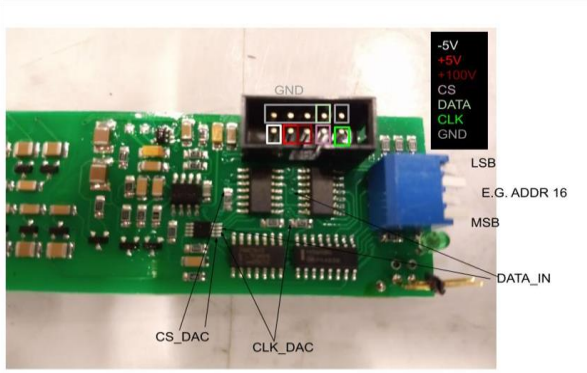
- Xilinx Zynq UltraScale+ XCZU9EG-1FFVC900E
- 2520 DSP block
- 32.1 Mb BRAM (embedded)
- 4GB DDR4 SDRAM (external)
- No stock, probable delivery date: Middle 2023

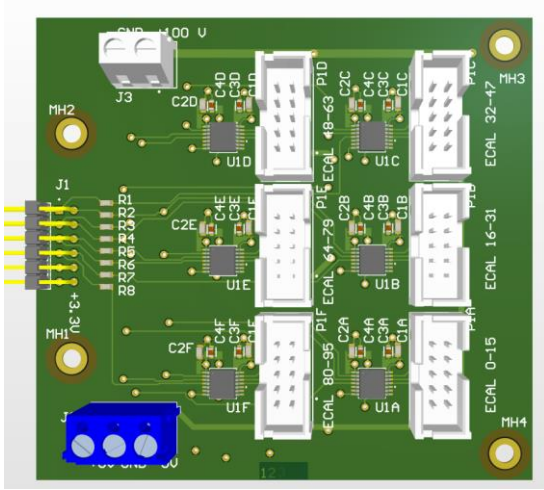
Control and distribution of the HV to polarize the ECAL2 PMTs.

ECALHV PCB prototype module was designed to handle the control and distribution of the HV to polarize the ECAL2 PMTs.

- Each module can control 96 Channels.
- Prototype implemented on a Zedboard Zynq xc7z020 and can handle 4 modules.

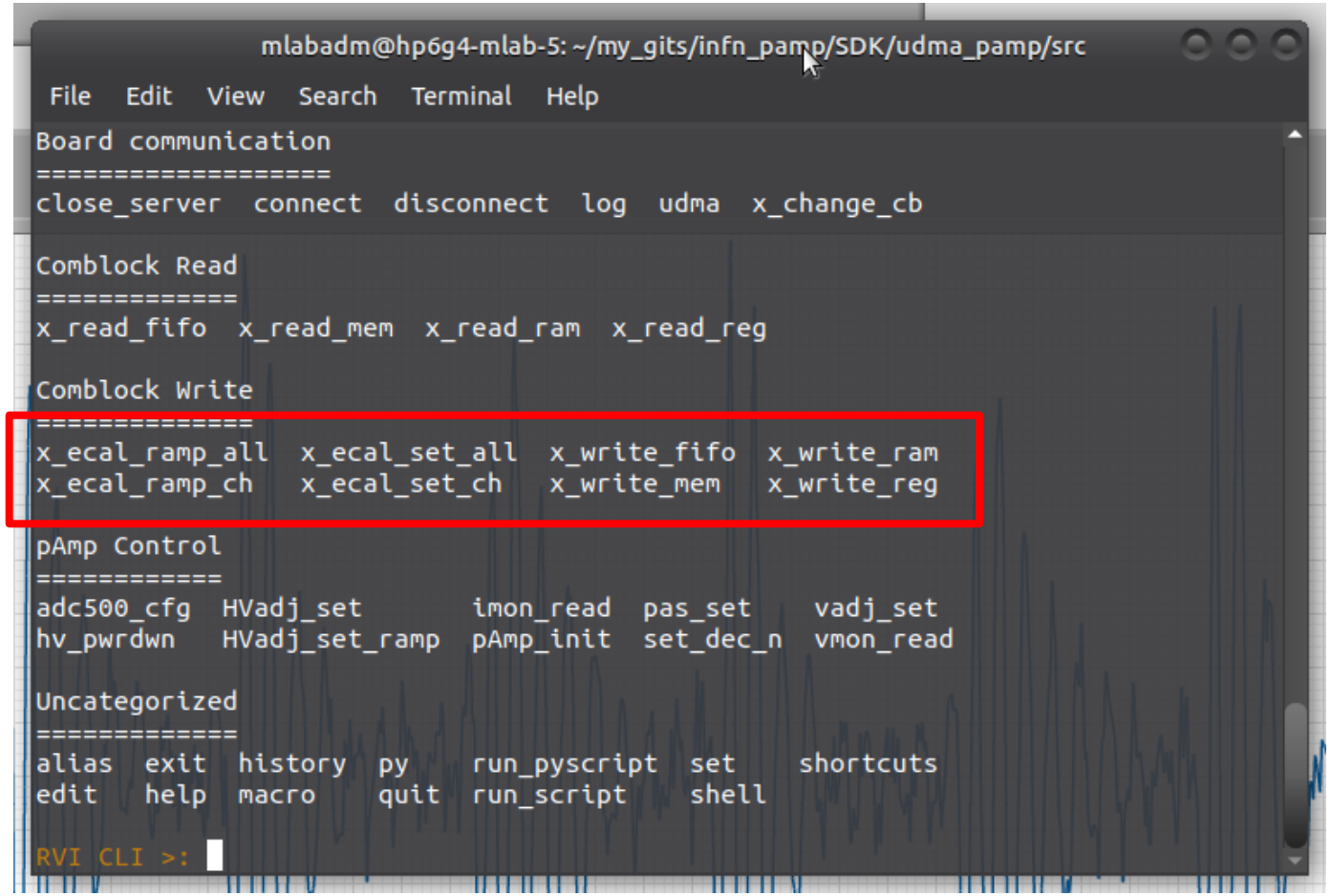






Current version is controlled using command line prompt script running on Python.

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

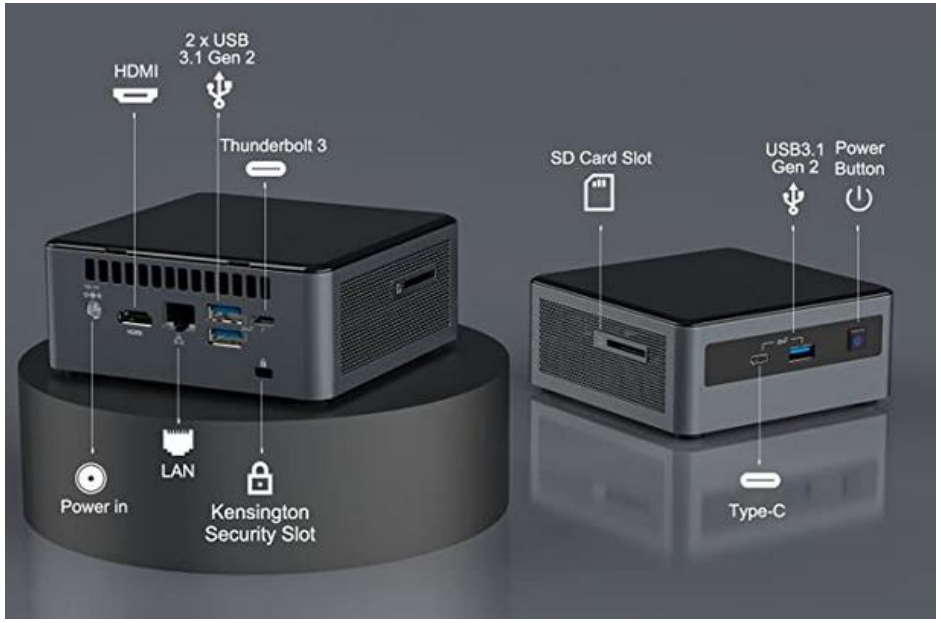


Network hardware

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



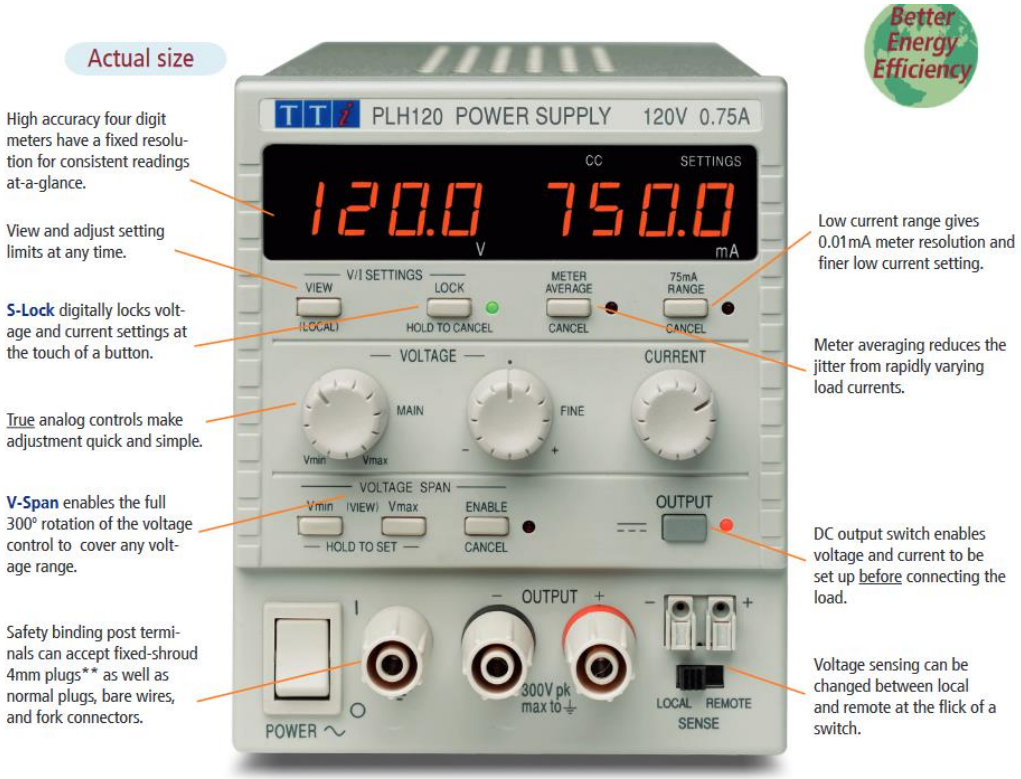
NUC-Slim 8th Gen/8GB/240SS -- 514 euro

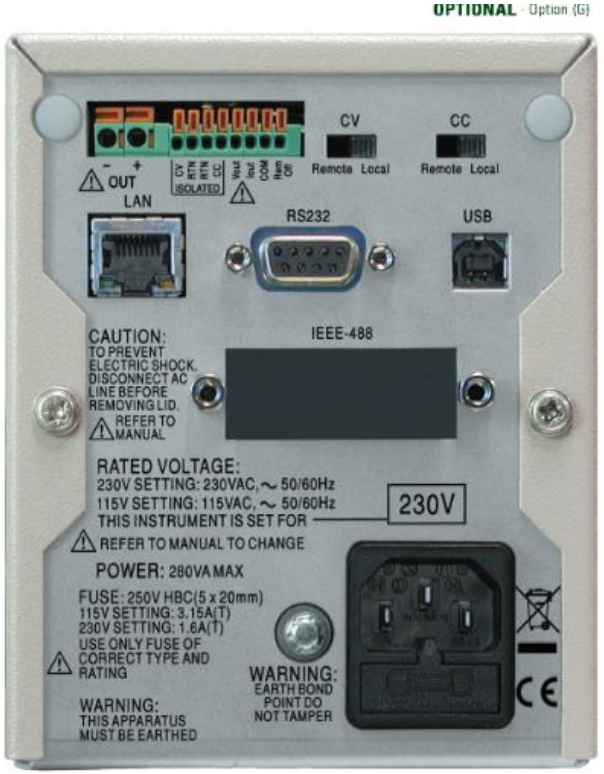
- Core™ i5, 8GB RAM, 240GB SSD
- Front 2 x USB 3.1 Gen2, Rear 2 x USB 3.1 Gen2
- 1000 Mbps Ethernet port
- 1 x HDMI
- CERN provided: not clear when available --> EDH Dec 2022

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

100V Power source – W Ethernet interface

Thurlby Thandar Instruments PLH-P 250





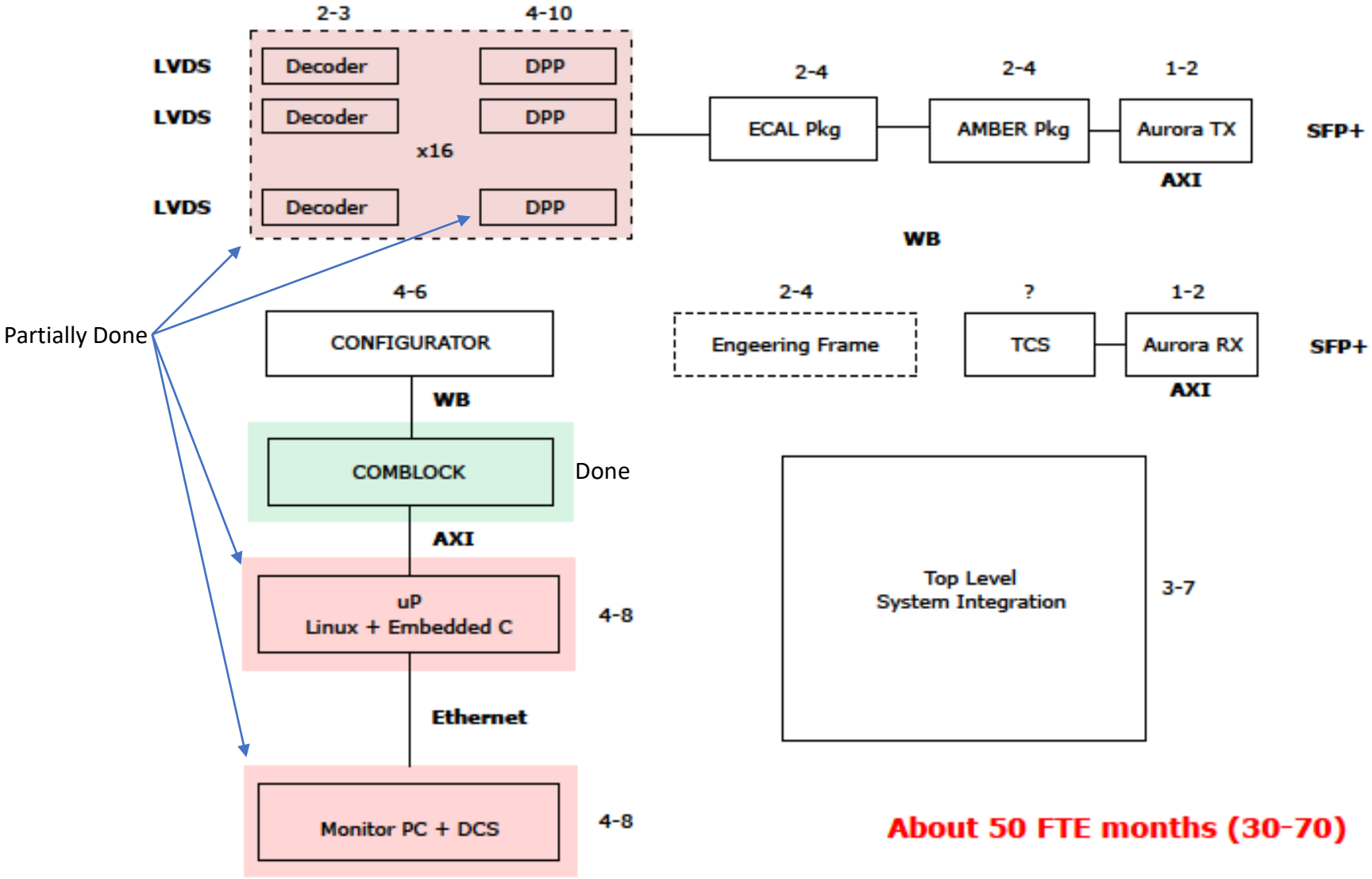
SUMMARY

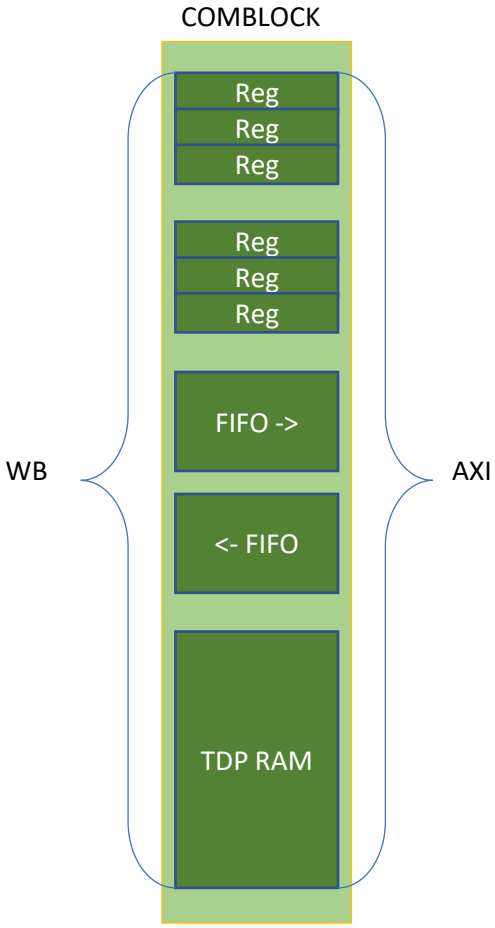
Hardware Status

- 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

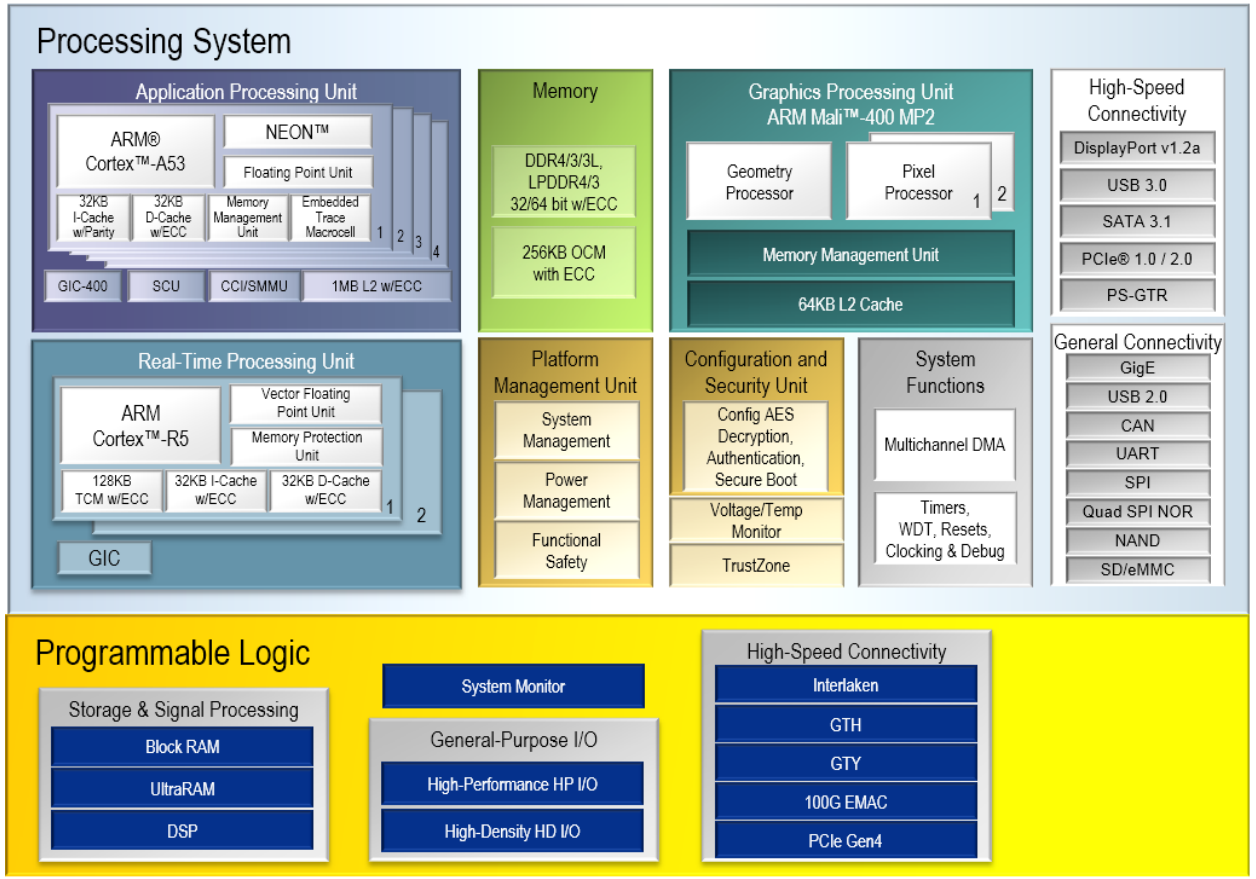
Firmware Development

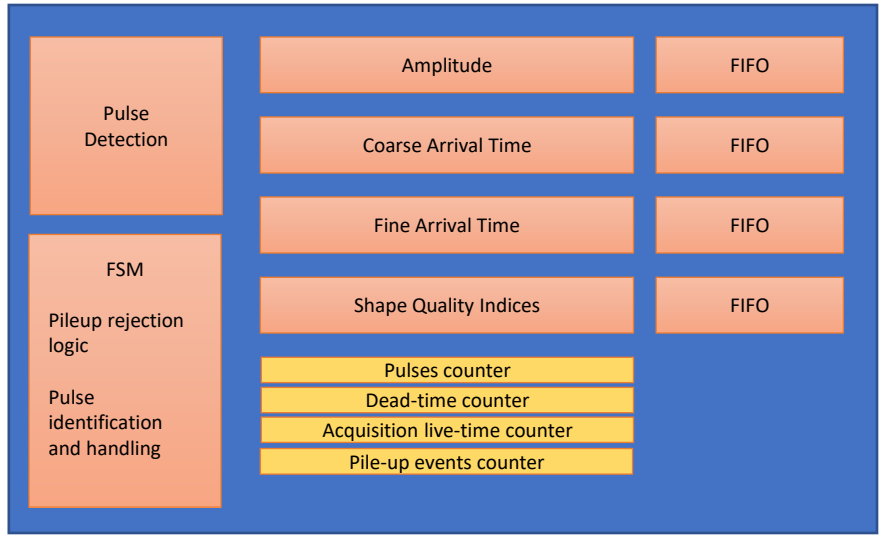
Global Design Architecture Main functional blocks and their estimated development times (range in FTE months)



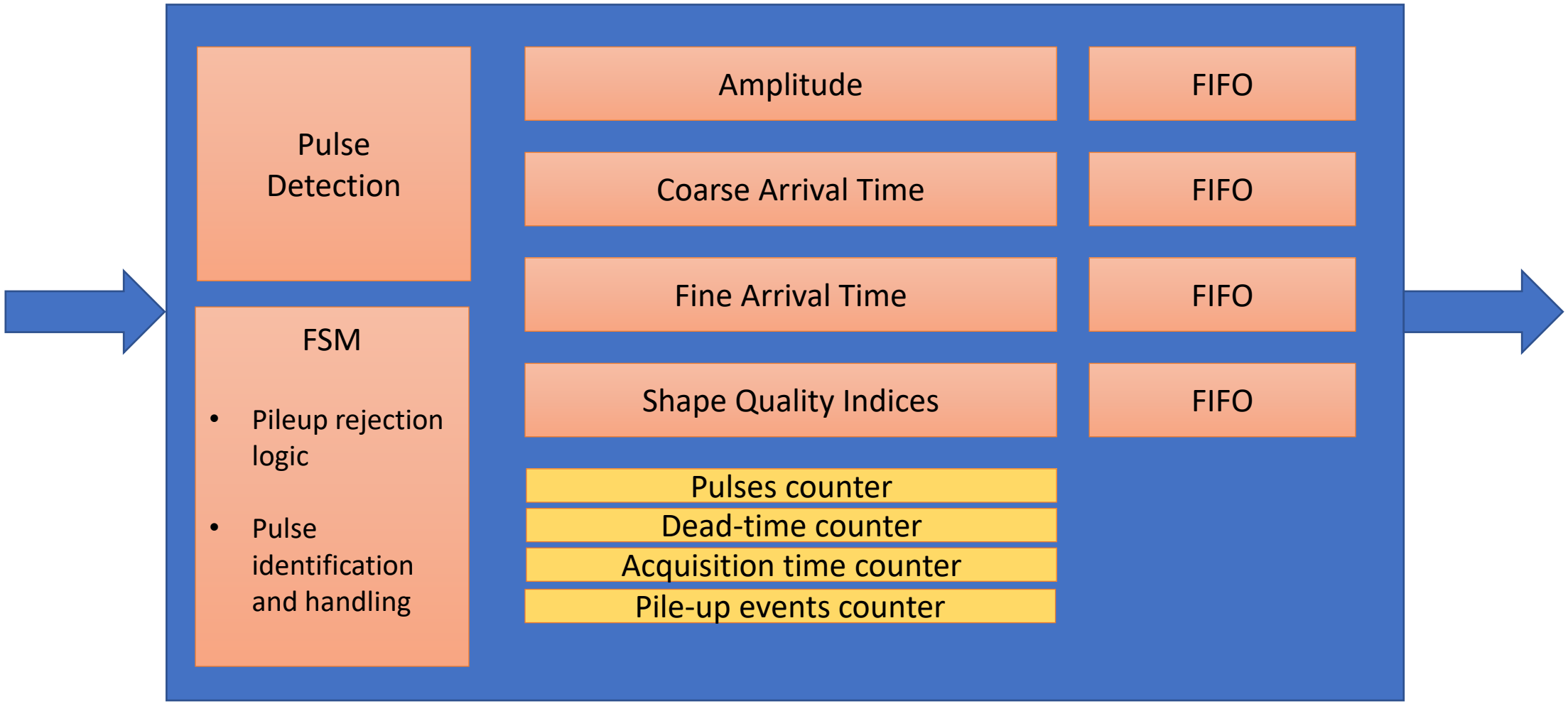


Firmware Development: The Digital Pulse Processor (DPP)

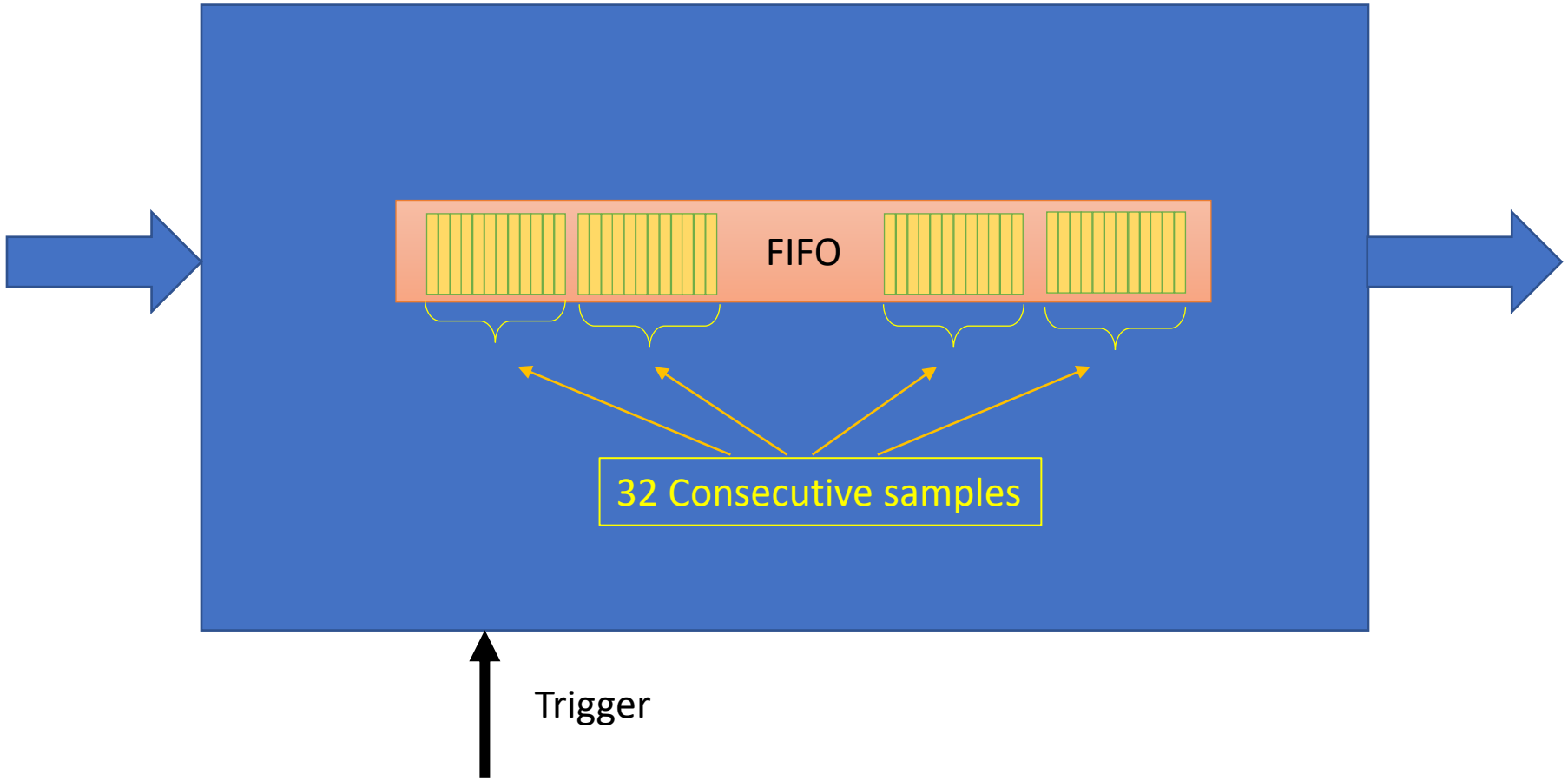




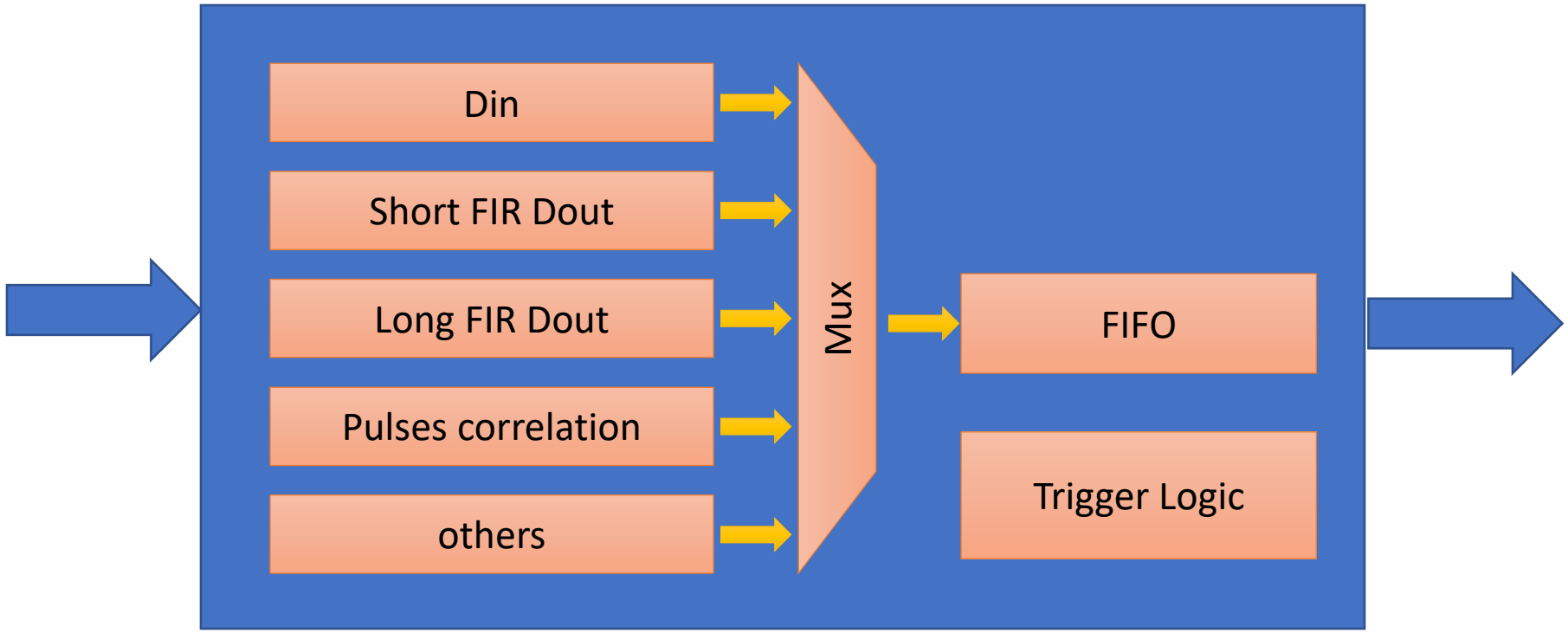
DPP: Possible features extraction in free running working mode



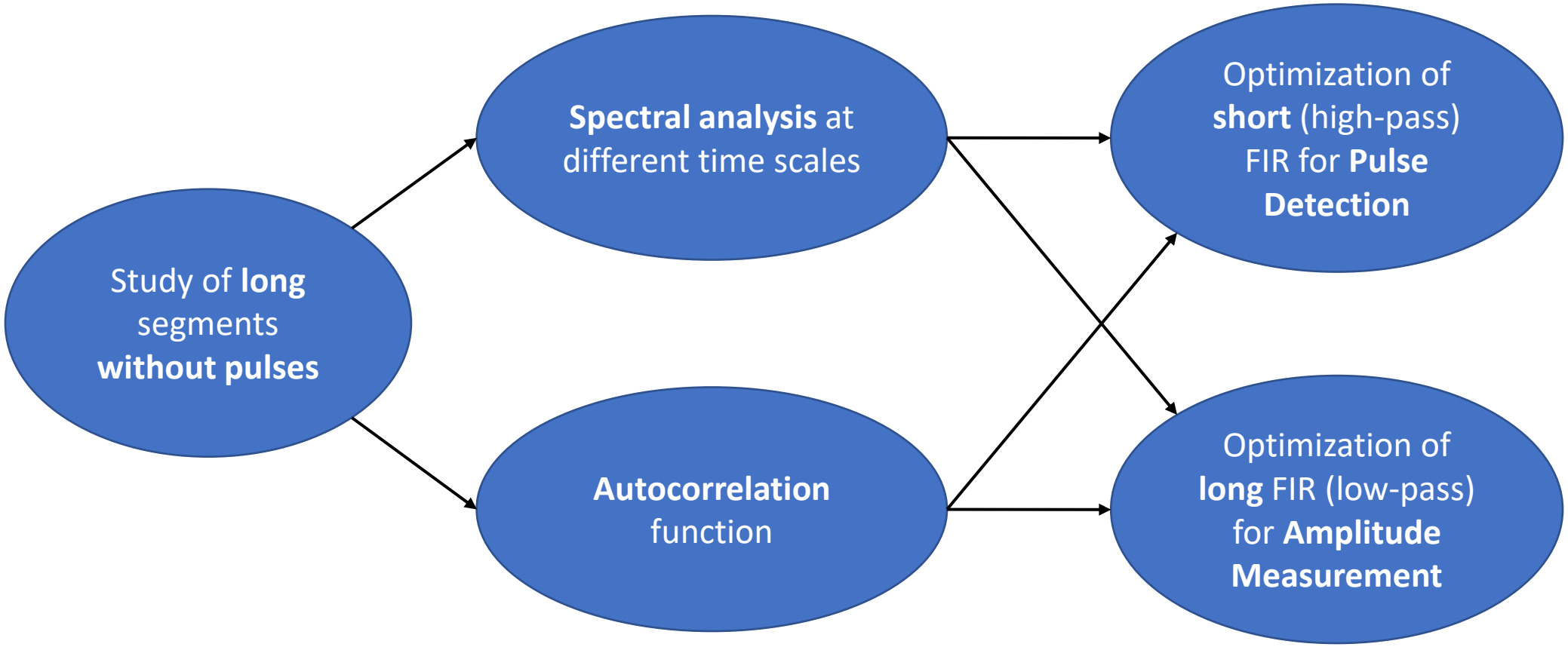
DPP: Legacy (present) working mode



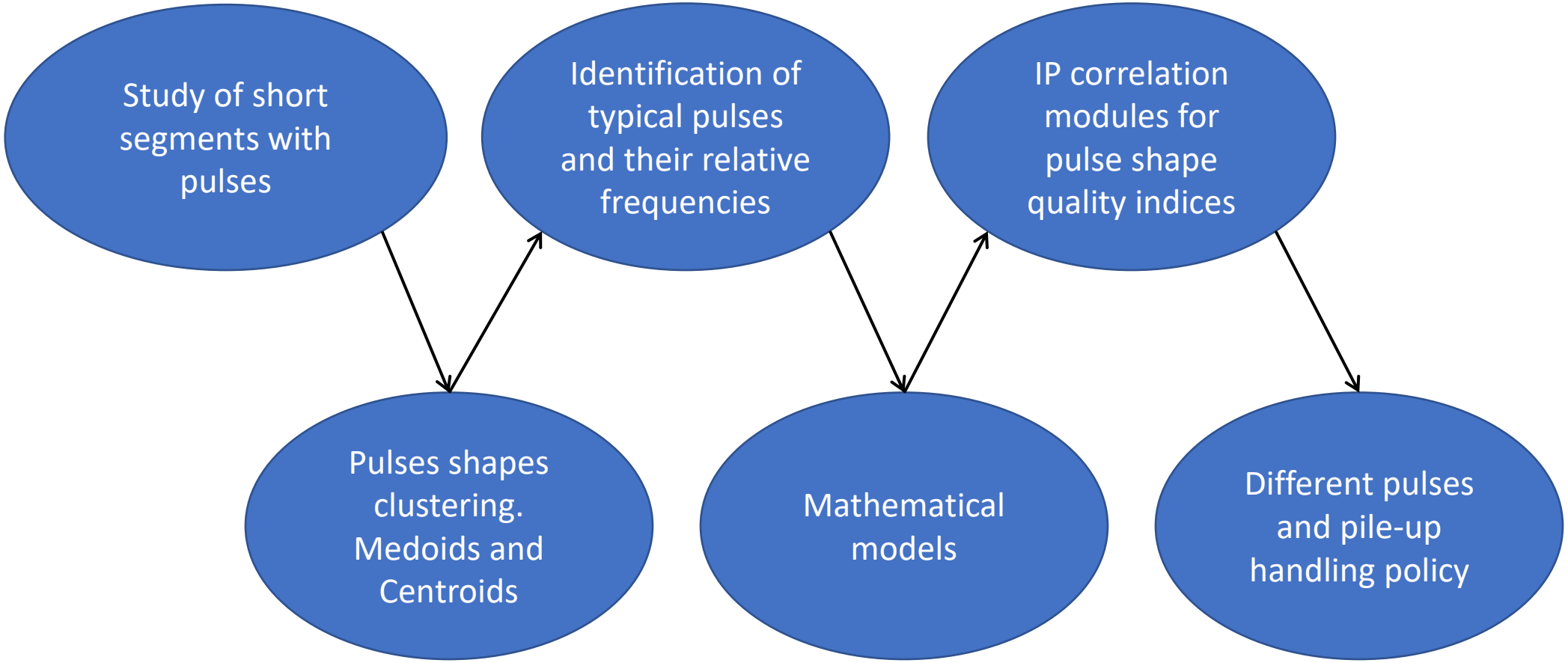
DPP: Digital oscilloscope (debugging) working mode



ECAL-2 Data Analysis I: Noise study



ECAL-2 Data Analysis II: Signals study



ECAL-2 Data Analysis III: New research lines

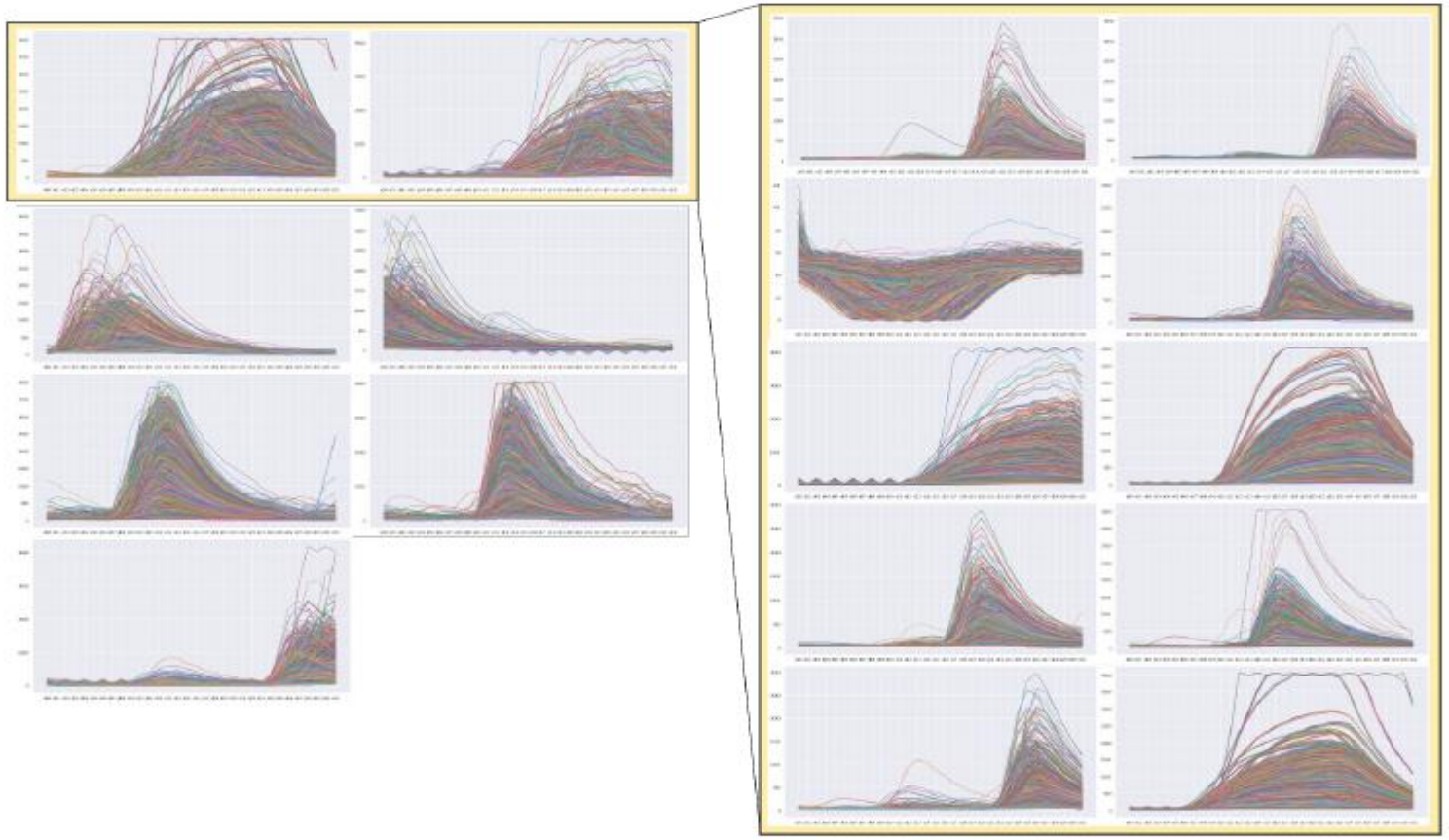
Machine Learning
and
ECAL2

Romina Molina

Trieste - Italy
1.04.2022

Centroid-based clustering

Offline algorithmic pulse classification

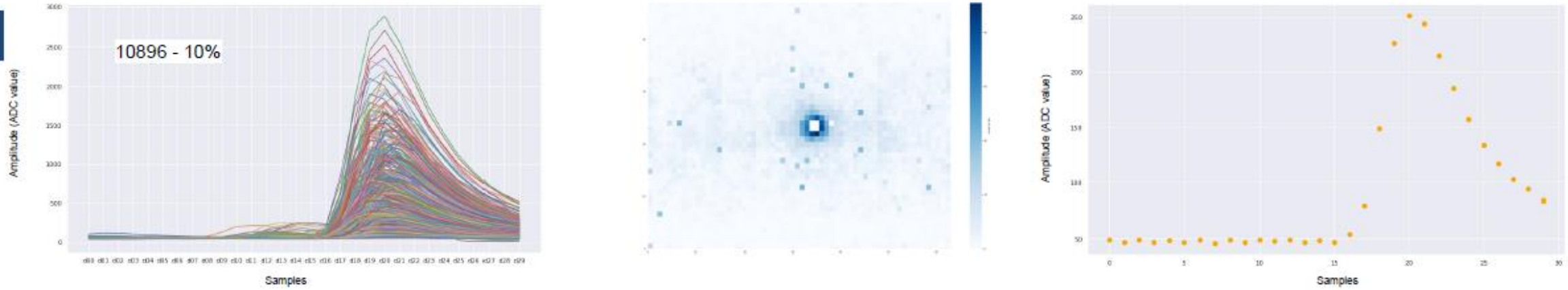


Centroid-based clustering

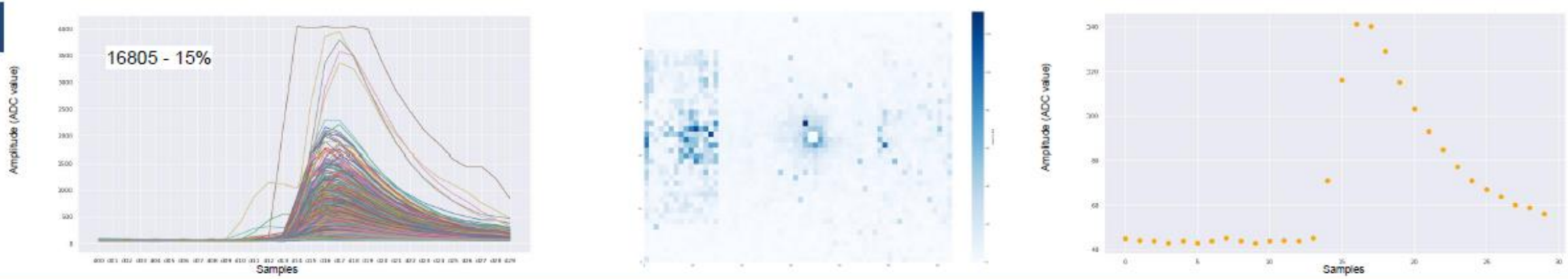
Results - Second Iteration with 135129 signals

Possible debugging/diagnostic based on pulse shapes

C6



C7

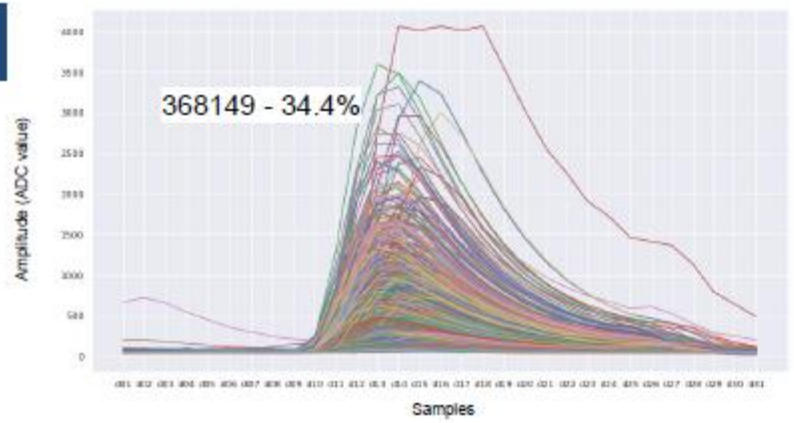


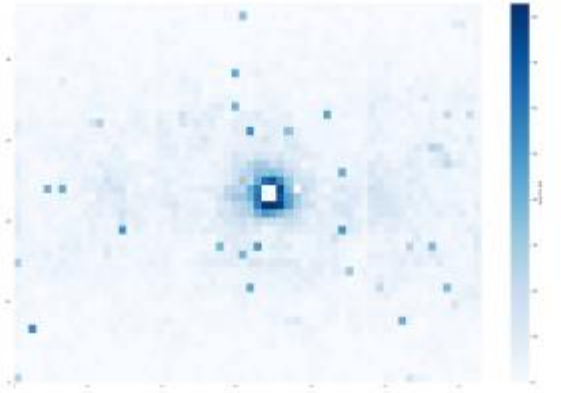
Centroid-based clustering

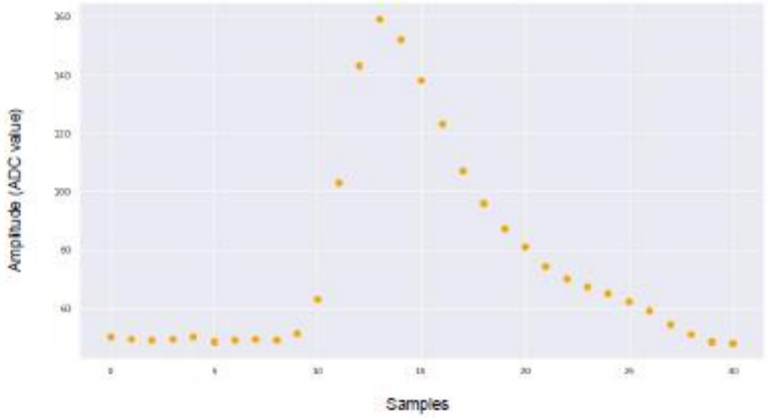
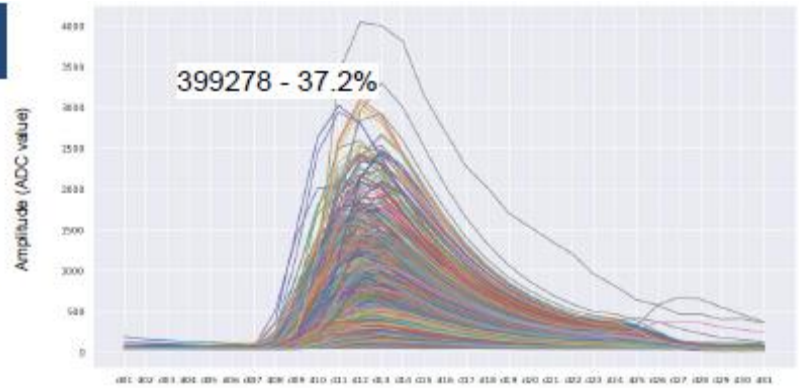
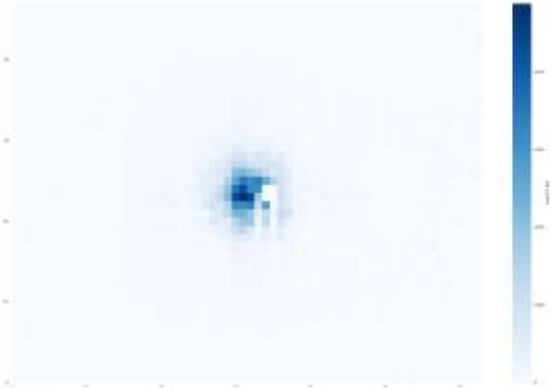
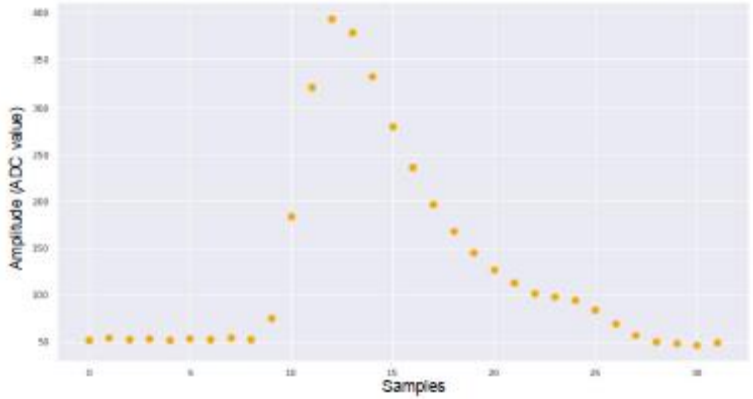
Results - First Iteration with 1072747 signals

Possible pulse shape based particle discrimination?

C1







C2