

Status of the MSD

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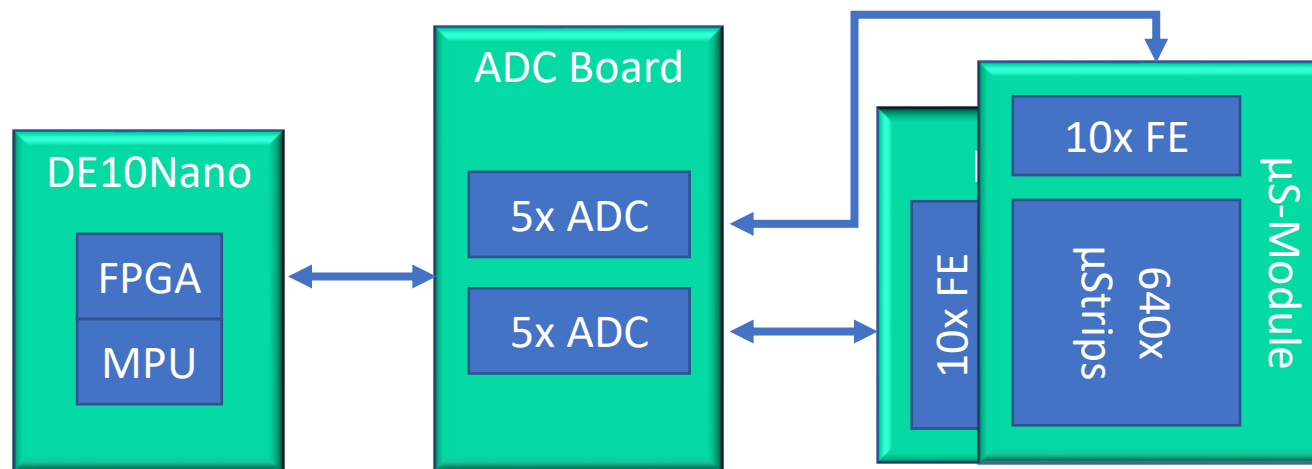
X FOOT Collaboration Meeting – 25-May-2021



1. Recap on the MSD architecture
2. Software and gateware status
3. Procurement and production status
 - Mechanical assemblies
 - Detector modules
 - DAQ modules (with a focus on the GSI test beam)
 - ADC boards + DE10Nano + MSD Patch Panel
 - μ S-Modules
4. μ S-Module characterizations



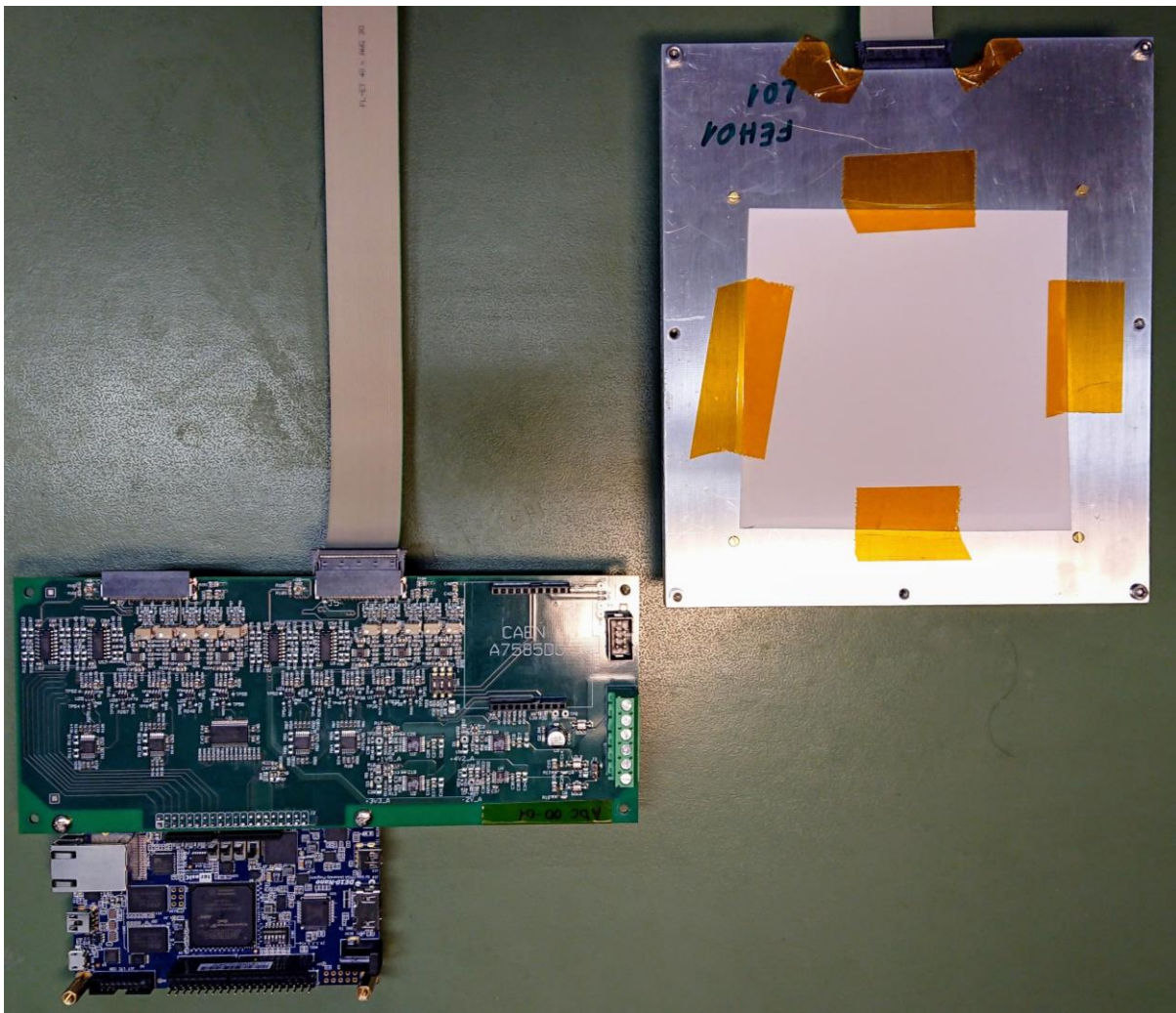
Single x-y plane MSD



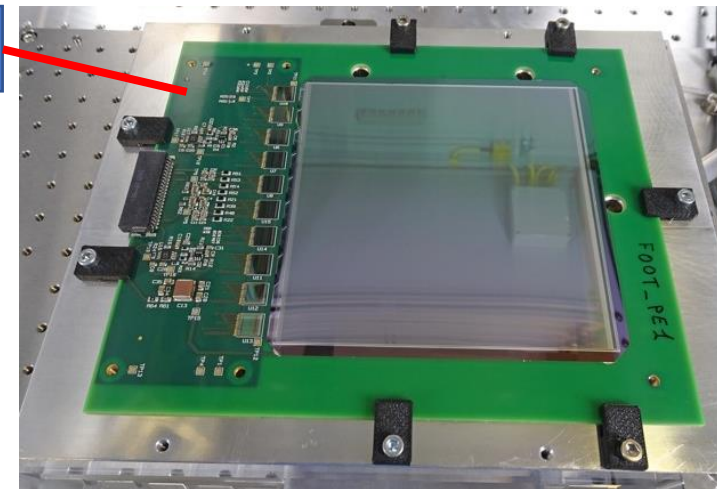
- 2x μS-Modules (1x x-y plane):
 - 1280 channels and 20x IDE1140 front-ends
 - Strip pitch: 50 μm
 - FE pitch: 150 μm
 - Detector Thickness: 150 μm
- 1x ADC Board: 2x 5x AD7276 ADCs
- 1x DE10Nano: data acquisition

Recap on the MSD Architecture

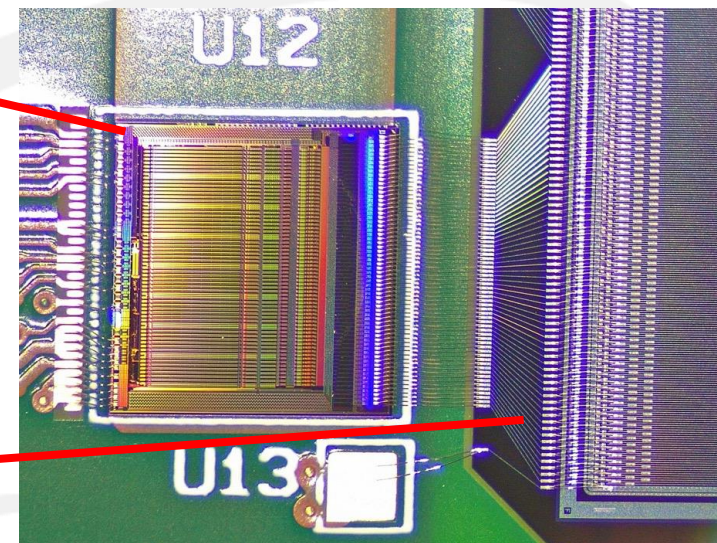
Single x-y plane MSD



Hybrid Board

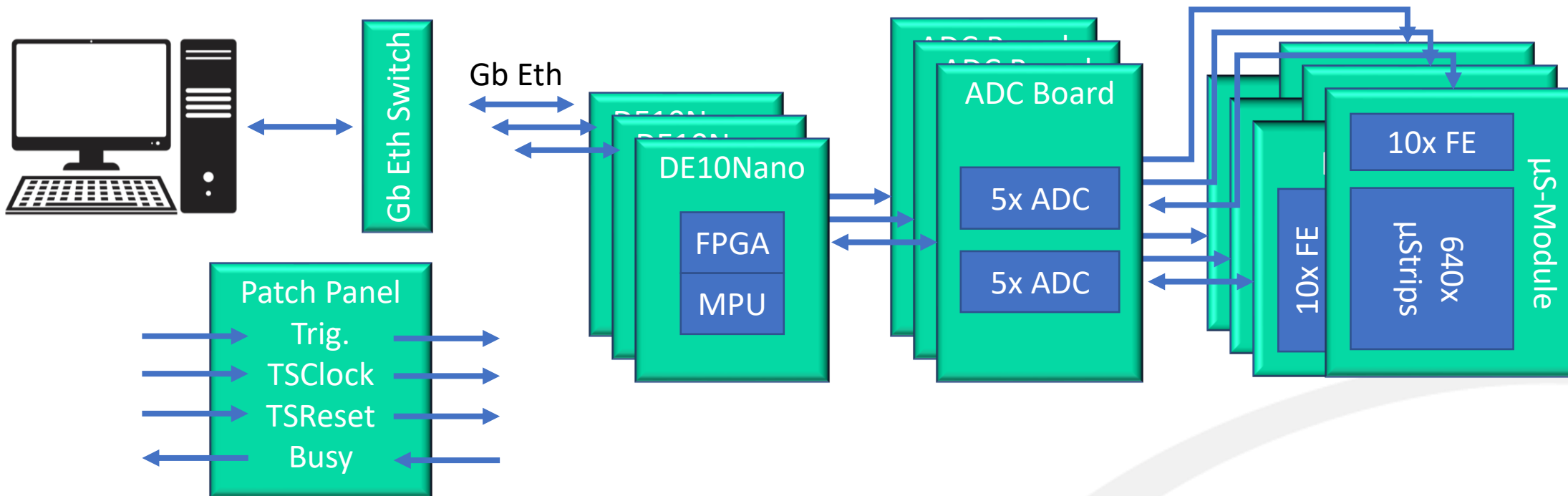


IDE1140 Front End



DET + Pitch Adapter

Triple x-y plane MSD



- 3x Single x-y plane MSD
 - Expandable with up to 3 Single x-y plane MSDs
- 1x MSD Patch Panel
 - Fan-out and conversion for Trigger, TSClock, TSReset, Busy
- 1x DAQ PC

Working standalone version of the DAQ PC software

- pg/standalone branch on the [Baltig repository](#) (forked from footpg1_0.2)
- Simultaneously acquire data from up to 6 ModuleDEMSED

DE10Nano HPS software at the last version

- Issues at auto-loading the FPGA gateway at boot time

DE10Nano FPGA gateway fully integrated with the BO's one

- Moving the project to Baltig and integrating it with [Hog](#) (HDL on Gitlab)
 - Add it to the foot group?
- No issues (so far)



Mechanical Assemblies

Consolidate the x-y plane assembly

- Prototype built, found a connectivity issue for the detector connectors
 - Found a fix that we will test in the next days

Building a complete Triple x-y plane MSD

- Based on commercial aluminum structural framing of Bosch Rexroth

Planning the grounding strategy of detector+DAQ

- No radiated emission/susceptibility
- Shielded connectors between μ S-Modules and ADC boards

ADC boards + DE10Nano + MSD Patch Panel

In-house

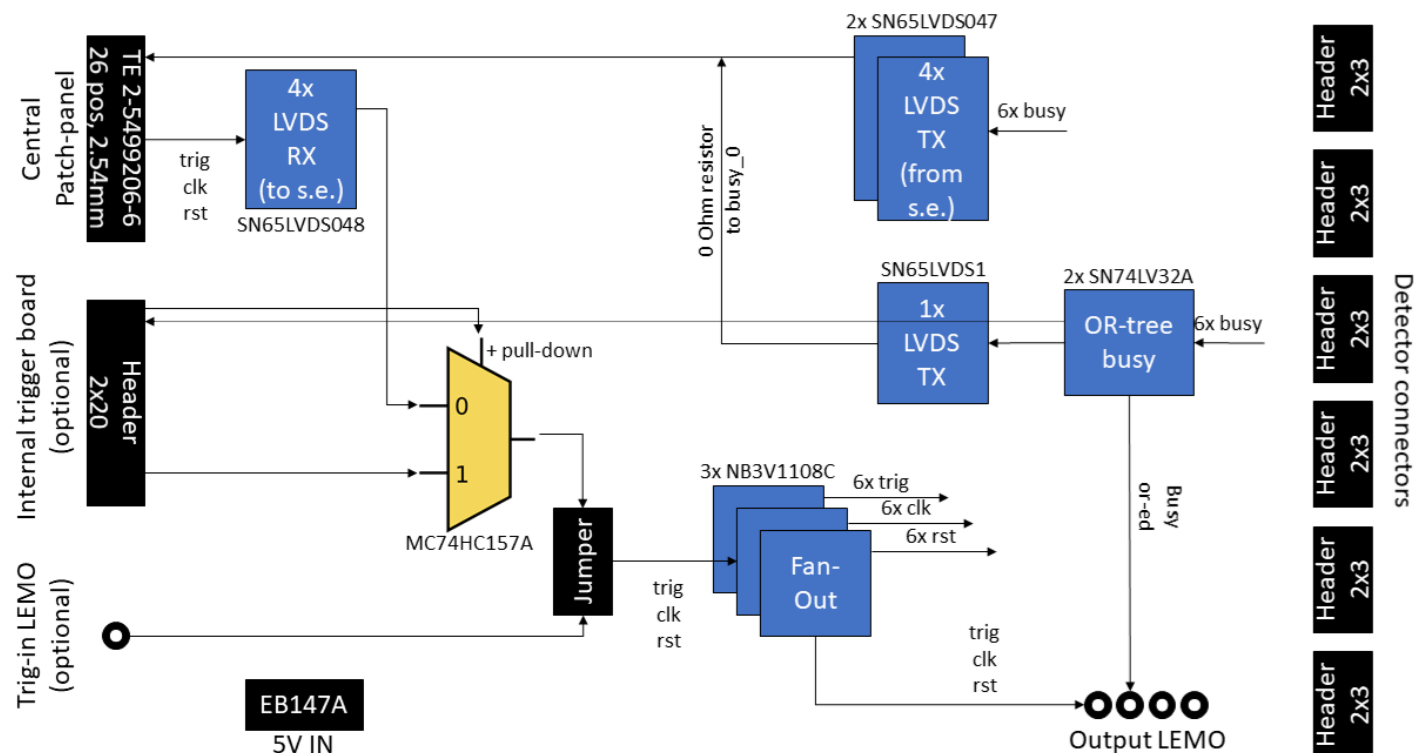
- 5x ADC boards
- 5x DE10Nano
- Internal Cables/Conn.

Ordered (ETA: Beginning June)

- 5x MSD Patch Panel
 - Only 1 needed
- 3x ADC boards
- 3x DE10Nano
- Missing Cables/Conn.

Goal:

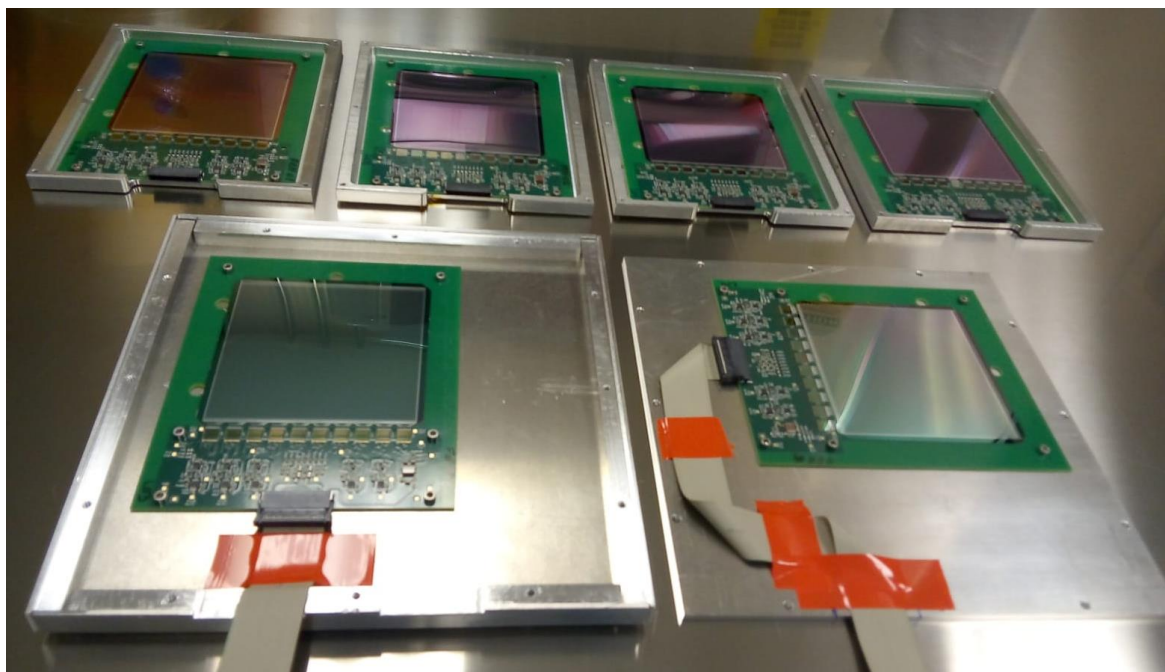
- have a complete triple x-y plane MSD plus spares



μS-Modules

In-house:

- 1x Prototype μS-Module
- 6x Standard μS-Modules (L01...L06)
- All tested and characterized with ^{90}Sr source

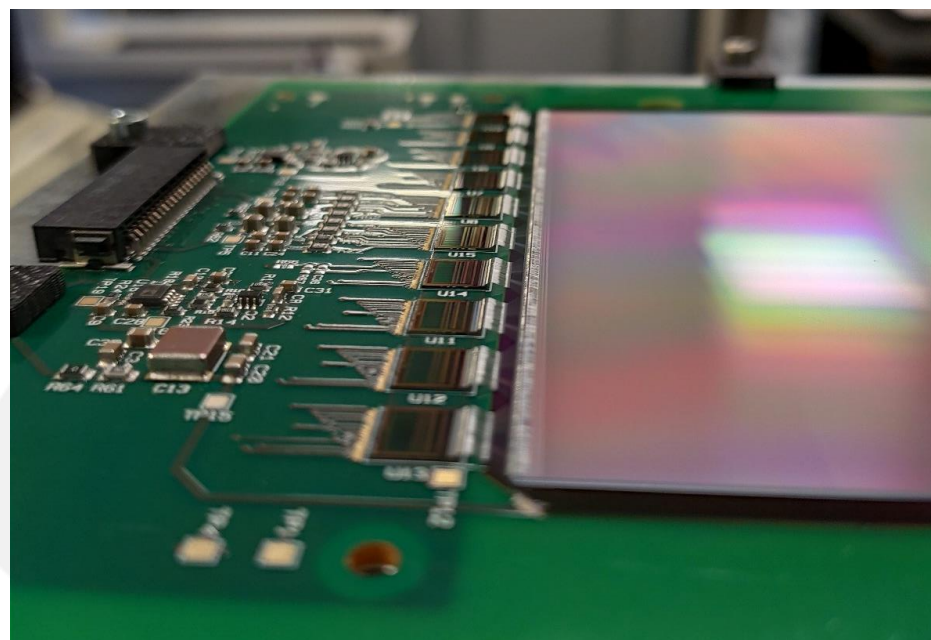


To-be produced:

- 3x μS-Modules

Goal

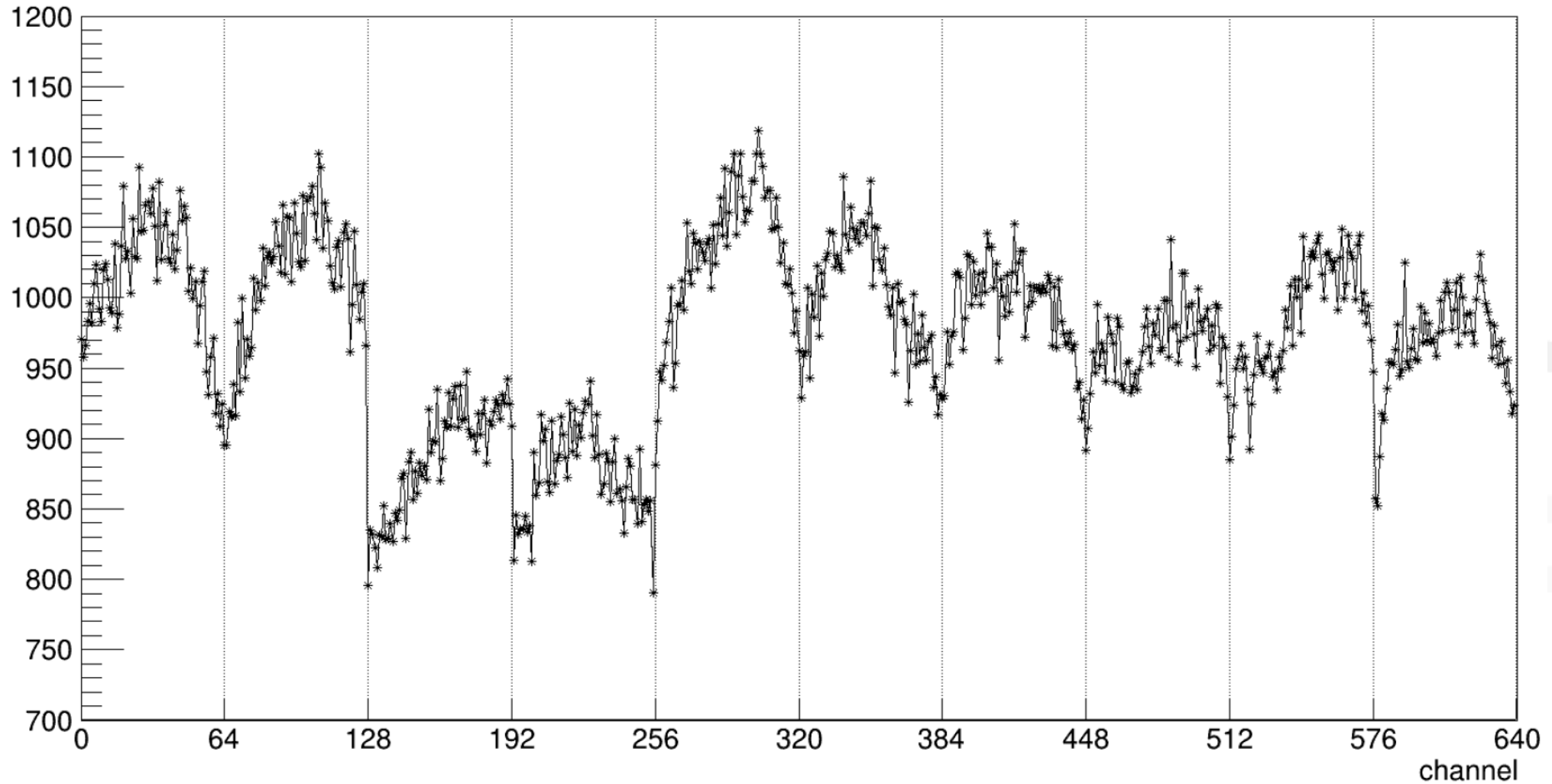
- Have three complete x-y planes with 50% spare



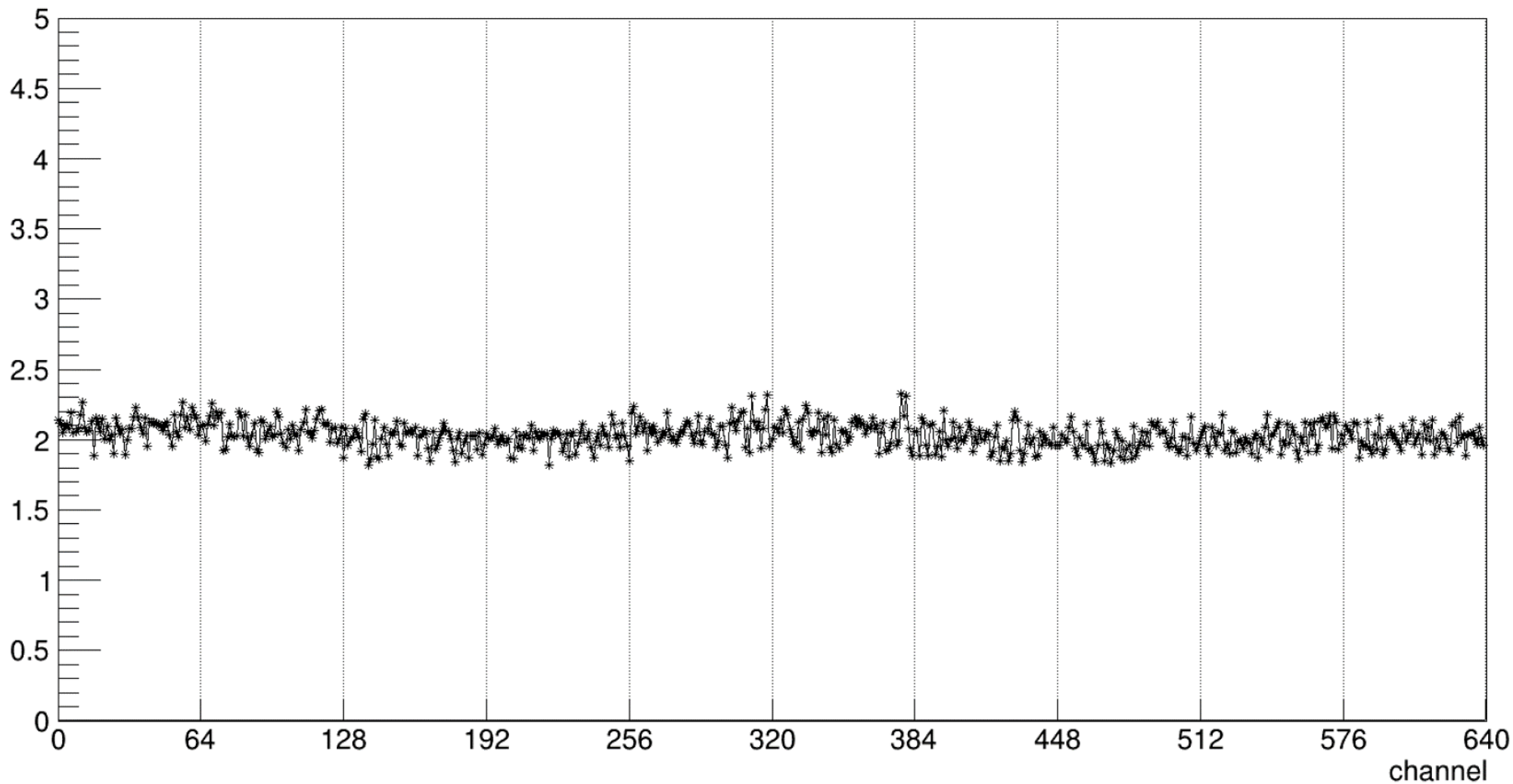
- Characterized each μS-Module with the same DE10Nano and ADC board
- For each μS-Module we performed
 - Calibrations (no rad sources, HV on)
 - Cosmic-ray acquisitions (no rad sources, HV on)
 - ⁹⁰Sr acquisitions (rad sources, HV on)
- Cosmic-ray acquisitions comparable to the prototype ones
 - Last FOOT meeting (G. Silvestre)
- Need to replace one ASIC in L02 and L05

DETECTOR	SIGNAL MPV	RECONSTRUCTED POSITION SIGMA	MEAN # CLUSTER PER EVENT	MEAN # STRIP PER CLUSTER
L01	17.6	3.9	1.0	1.7
L02	17.3	4.3	1.1	1.7
L03	17.2	4.8	1.1	1.8
L04	17.0	3.9	1.0	1.8
L05	17.4	4.4	1.1	1.7
L06	17.3	4.2	1.1	1.8

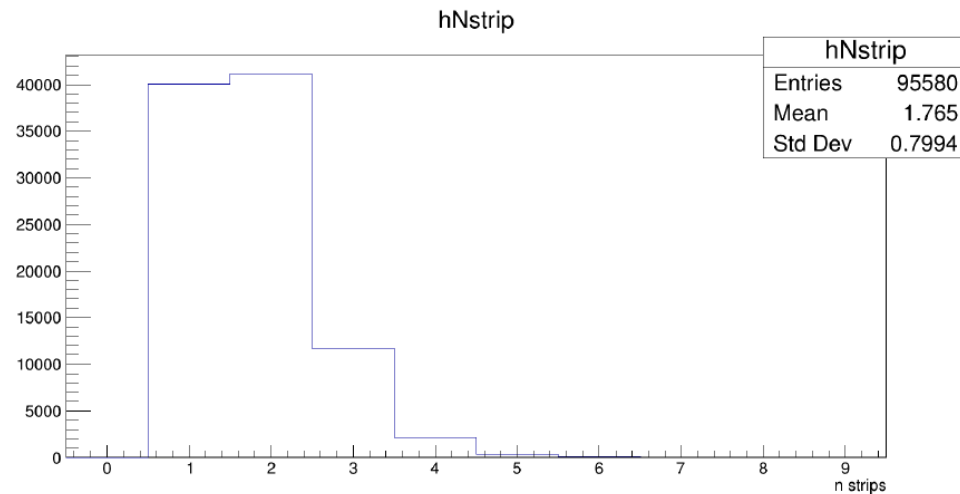
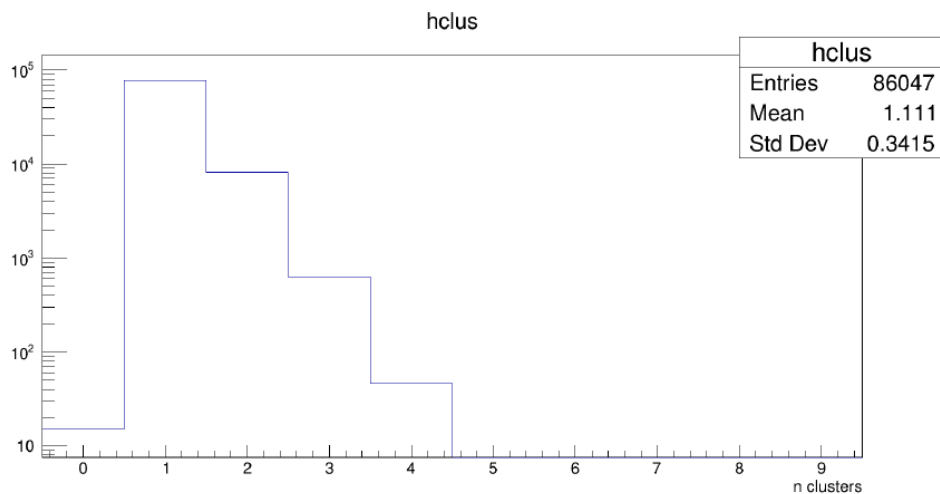
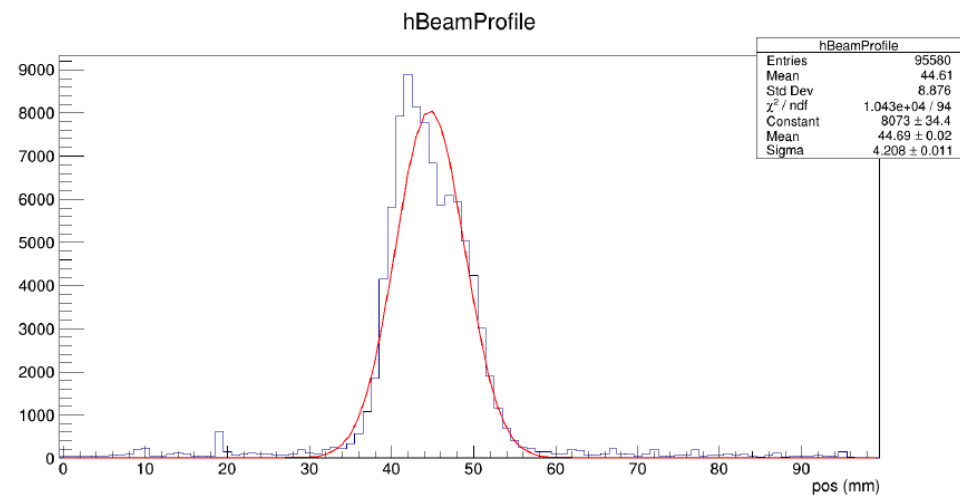
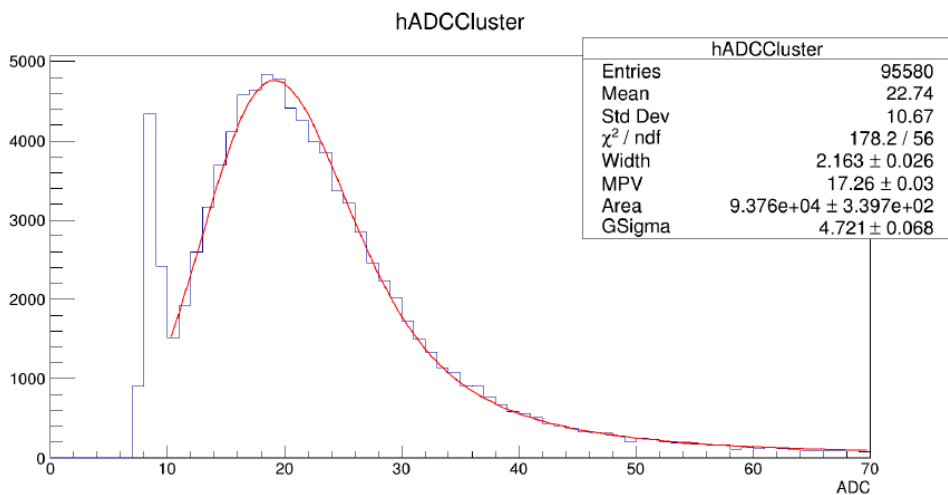
Calibrations: L06 Channels Pedestal



Calibrations: L06 Channels Noise (sigma)



^{90}Sr Acquisitions



- DAQ SW and GW are stable, with no major issues spotted
 - No issues in acquiring multiple sources
 - **5 kHz** maximum trigger rate, with **1 board**
- Characterization of single μ S-Modules shows consistent results
 - Only two minor issues with ASICs in two modules
- We built the first prototype of the detector mechanical assembly
 - To be tested at the Trento test-beam

- Procurement ongoing
 - 3 additional x-y planes
 - Readout boards
 - MSD Patch Panel
- We shall test the analysis software to be robust with multiple data sources
- Detector+DAQ to be immune to radiated and conducted noise (for the GSI, specifically)
 - Through proper shielding with assemblies
- Proton-beam tests in the near-future
 - Trento: 3-5 June 2021
 - GSI: mid-July 2021
- From these tests we expect
 - Final integration with the general DAQ
 - Hadron calibration of the MSD
 - Verification of the signal characteristics
 - Cluster signal
 - Cluster width
 - Efficiency

