DAQ system and online analysis

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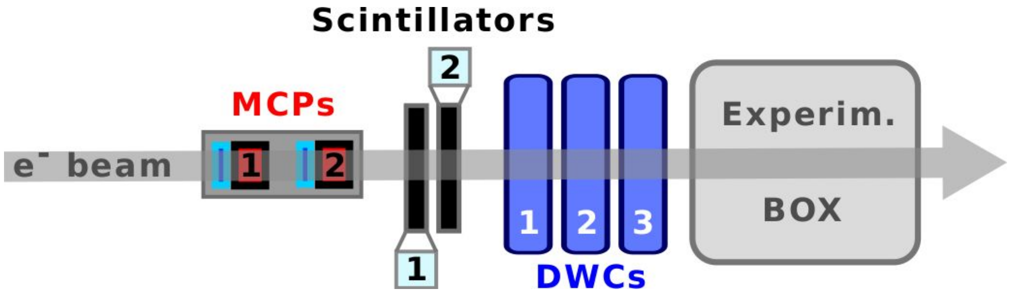
DAQ is composed by:

- Particles detectors: Triggering, Time reference generation, Tracking, [module].
- Hardware: Experimental box (patch panel, top and lateral access, rotational stages, remote attenuators), HV controller (CAEN SY5527), VME and NIM crates (signal discrimination and trigger, software trigger for calibration, busy distribution, ADC/Digitizer/TDC readout ..).
- Synchronous software: run GUI (Iouri GUI), TB GUI.

Online analysis [asynchronous]:

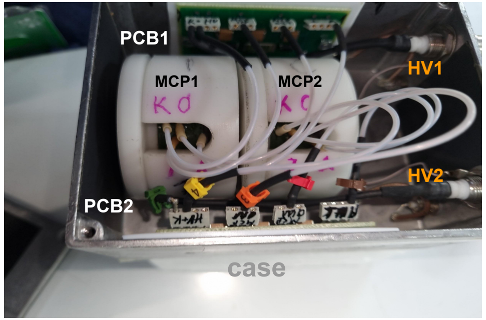
- Parse configuration file.
- Reading output files of the synchronous DAQ.
- If the digitizer V1742 is in use: calibrate the signal using the custom calibration.
- Multithreading computation of quantities like pulse amplitude, integral and CFD timestamps.
- One powerful pc will always sit in the test beam control room, to provide fast support to the data taking (link to how to is provided).

Particle detectors:

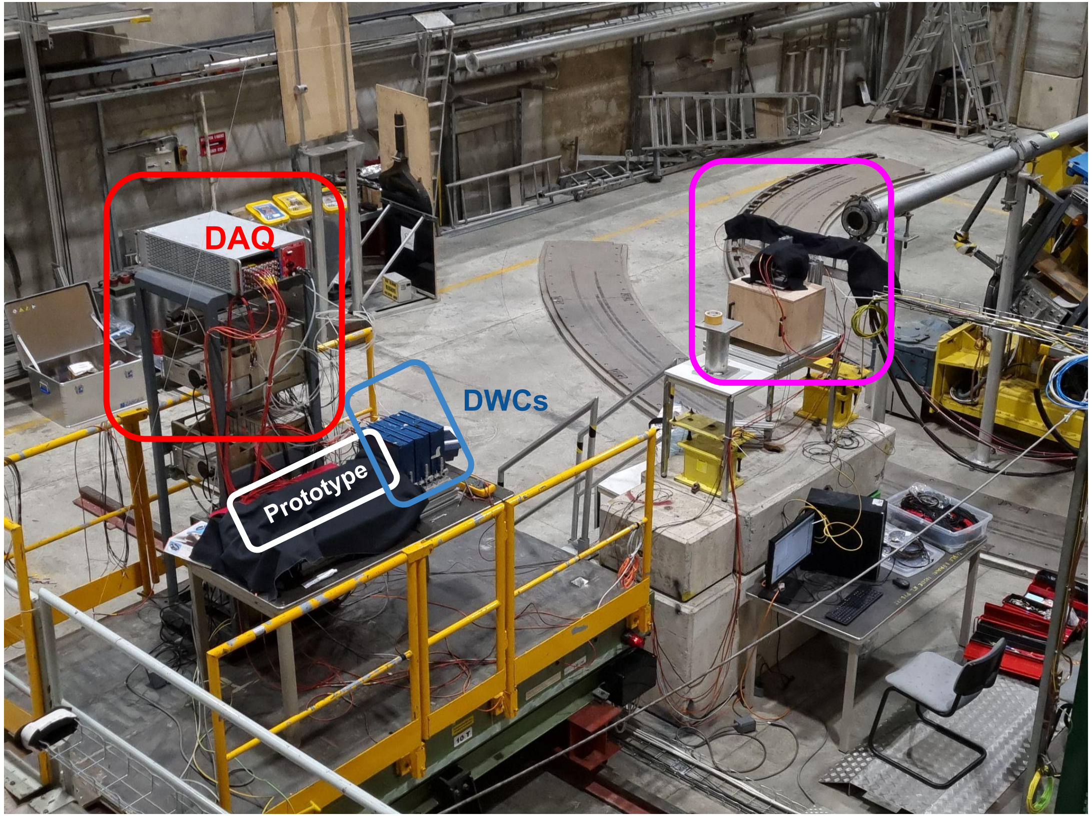


- 2 x MCP PMT for time reference, ~ 14 ps average time resolution.
- 2 x (Scintillator + PMT) used for trigger (discriminated and in coincidence).
- 3 x DWC for tracking and shower/multiple hits rejection.
- Light tight experimental box with the module inside.

MCPs box

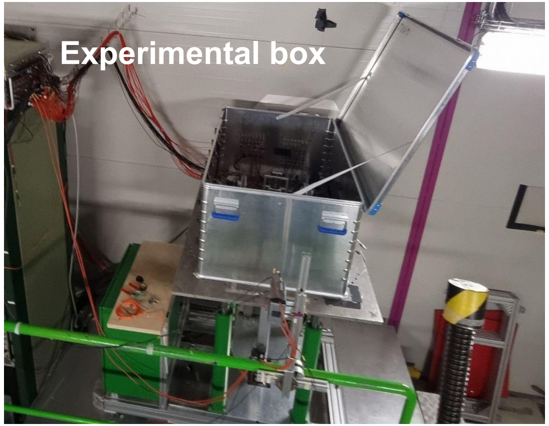


Particle detectors: SPS configuration



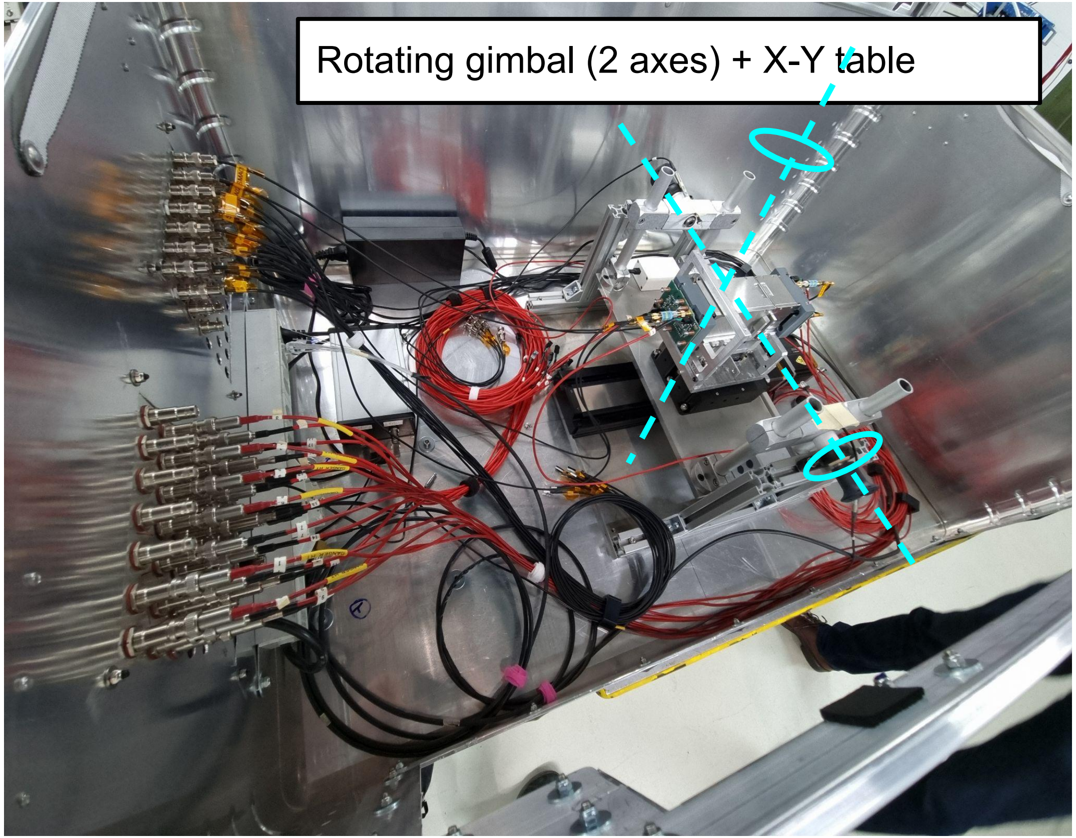
Scint (trigger)
+ MCPs

Hardware: **around the module**



The box is an alu Zarges modified with:

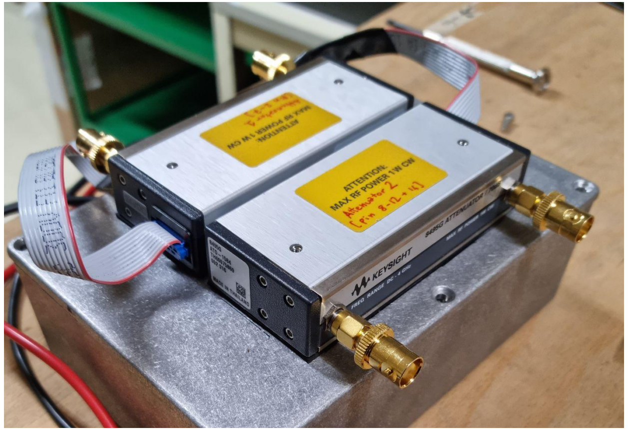
- patch panels (signal, HV, USB, Power), lateral access
- rotational stages
- remote attenuators

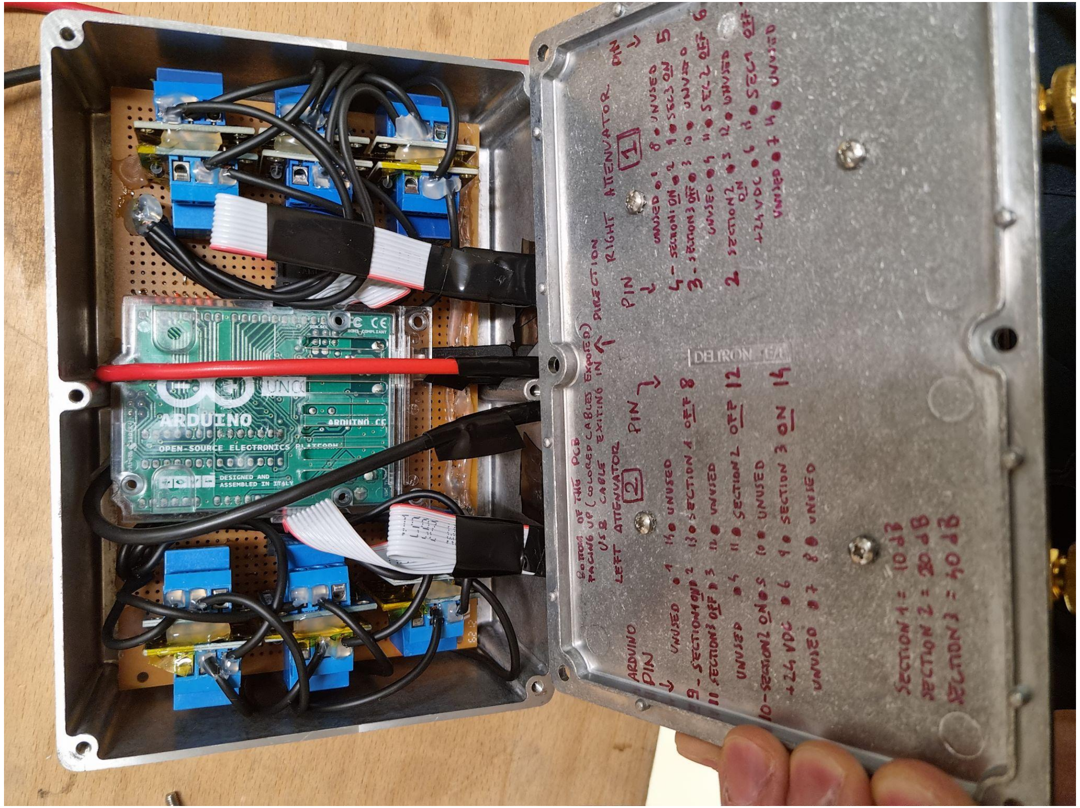


Remote attenuators:

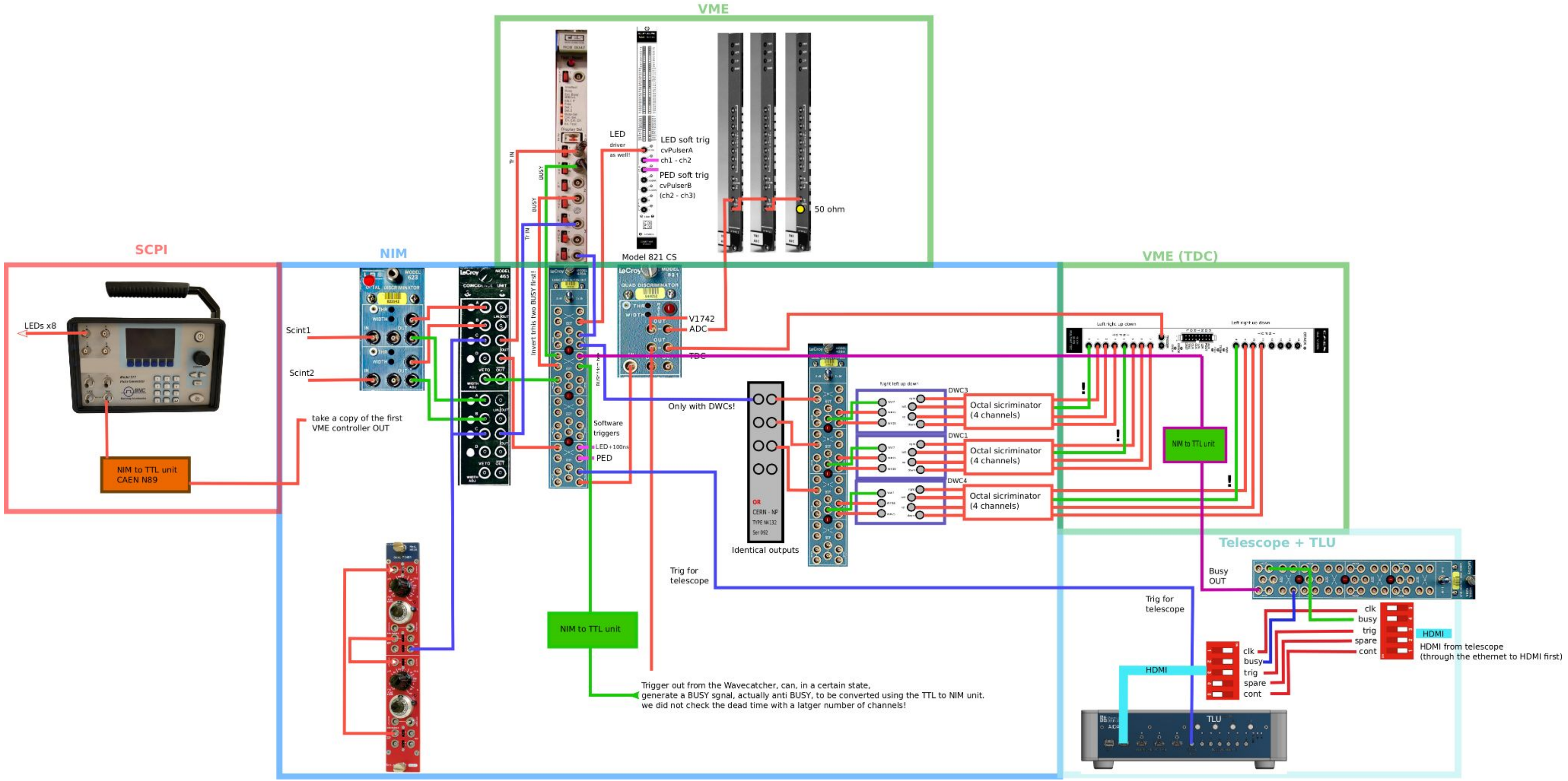
Arduino based, python controlled

- Toggle between any combination of the following attenuations:
- 0 dB, 10 dB, 20 dB, 40 dB.
- Required 24 volt
- USB connection





Hardware: NIM, VME, external device (telescope + TLU, SCPI)



Link to the schematics and description

Hardware: Digitizer calibration

- The CAEN v1742 digitizer is a VME board with 32 channels based on the DRS4 chip
  - Maximum sampling rate is 5 GS/s, i.e. ~200 ps per cell on average, with 1024 cells per channels (full acquisition window of 204.8 ns)
- The board comes precalibrated from the factory, but the default calibration is crappy
  - Need to perform a thorough calibration offline to achieve ultimate performances of the DRS4 ASIC
- Two types of calibration
  - Calibration of voltage offsets for each cell
  - Calibration of time width of each cell
- The calibration has to be done cell by cell, which means 1024x32 sets of calibration constrants if one wants to calibrate it all

Courtesy of the Bologna group

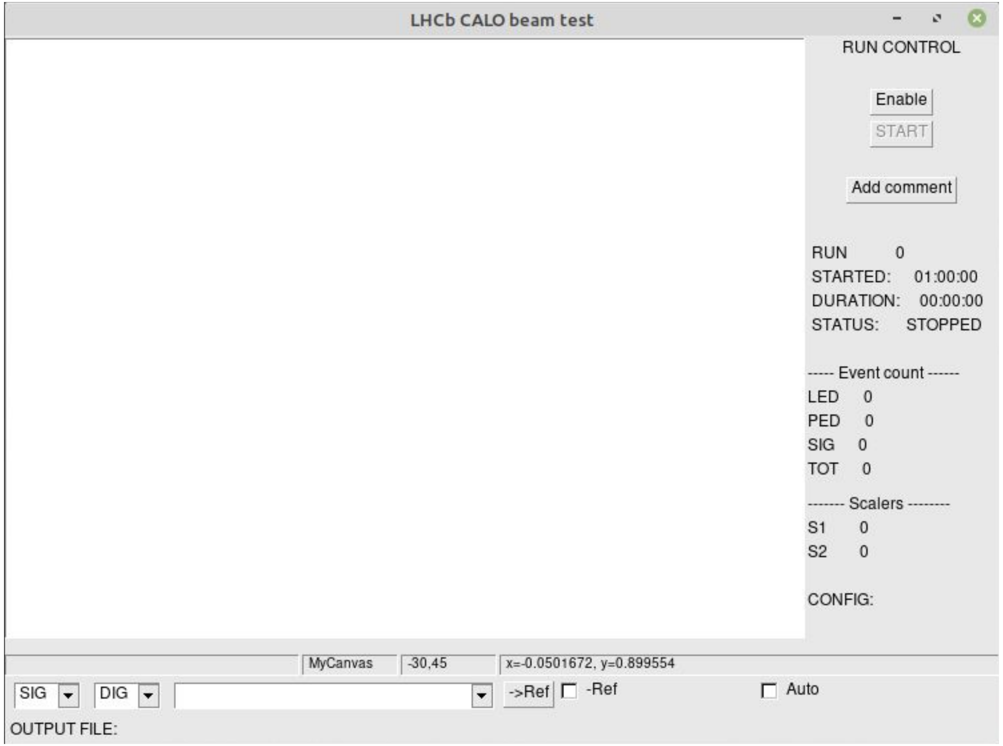
Link to the calibration procedure

Optional digitization provided by the Wavecatcher (samlong chip)

Hardware: possible improvements

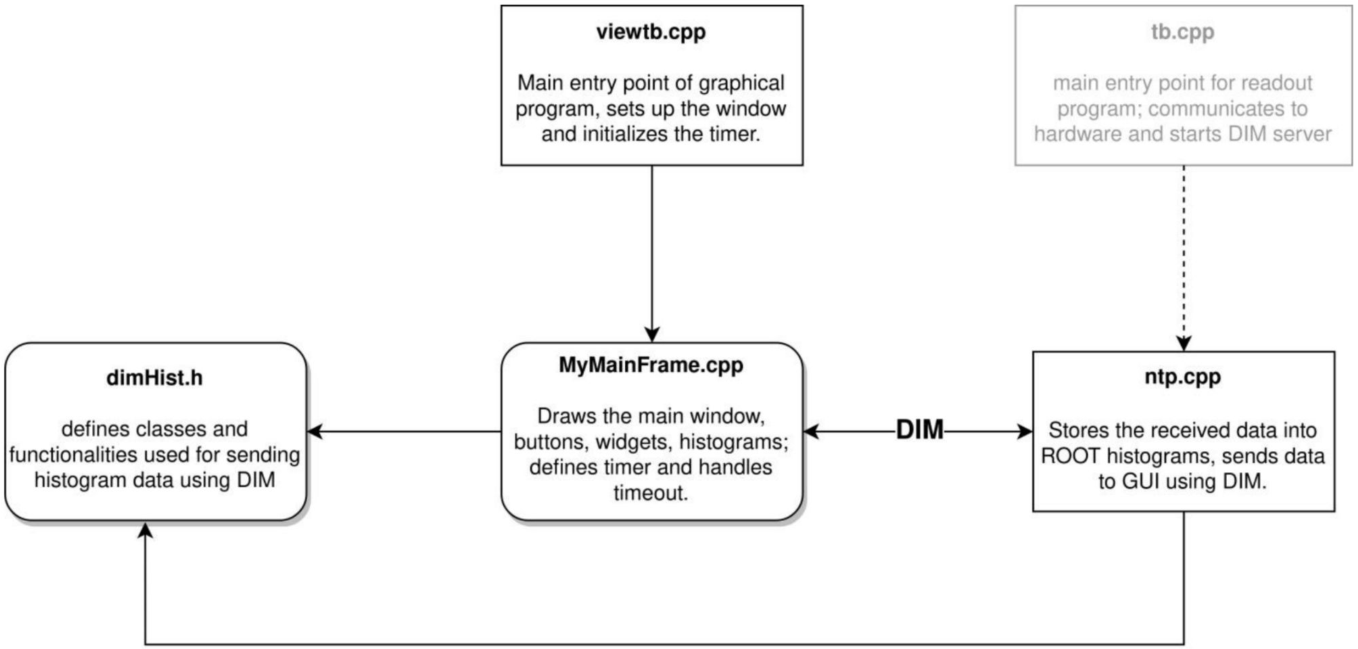
- Larger MCP planes -> increase useful area for time resolution measurements
- Smaller scintillating counters (trigger) -> same dimension of the MCP
- Tracking system -> no conflict with the ATLAS group activities (presentation from Ettore)
- Amplifier for low energies.
- Remote delay line selector

Synchronous software: run GUI



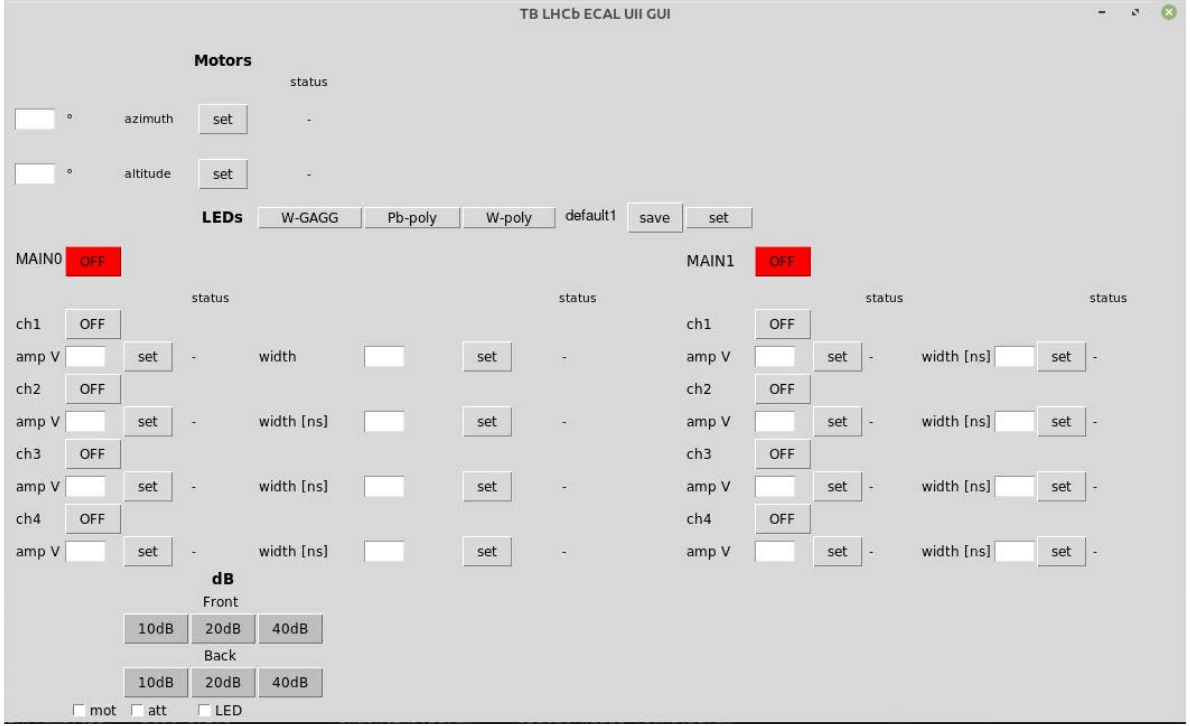
- Control of data acquisition from ADC, TDC, Digitizer
- Live data control of several quantities of each device (waves, amplitude spectrum, beam position, etc.)
- Run information: number of signal received, signal lost, calibration signal etc.
- Device setting through configurations file (HV, Digitizer sampling frequency and trigger configuration, output file naming etc.)

Synchronous software: run GUI (viewtb) + control code documentation



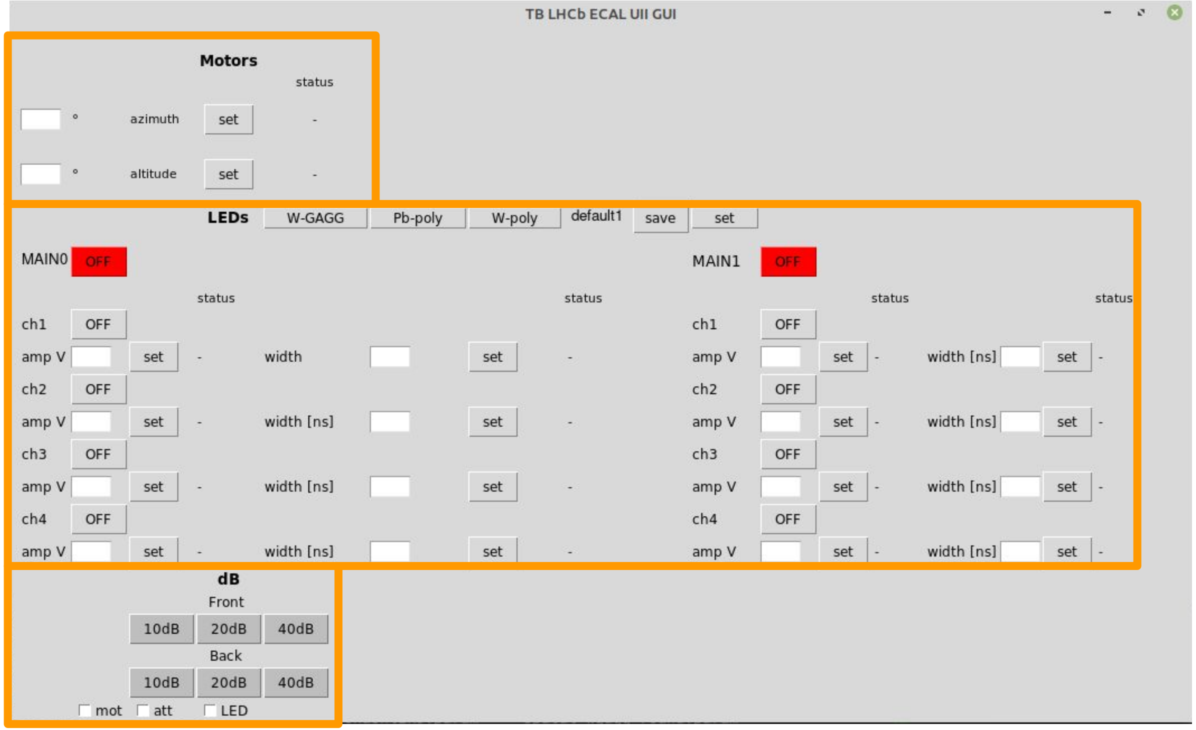
[Gitlab repo with the code]

Synchronous software: TB GUI



- Motors control (0.1 deg, 50 kg of max load)
- Driver remote control for LED calibration (amplitude up to 40 V and pulse width down to 10 ns)
- Remote control for attenuators (2 channels, 4 GHz, 0-70 dB with 10 dB step)
- Twiki with installation procedure

Synchronous software: TB GUI



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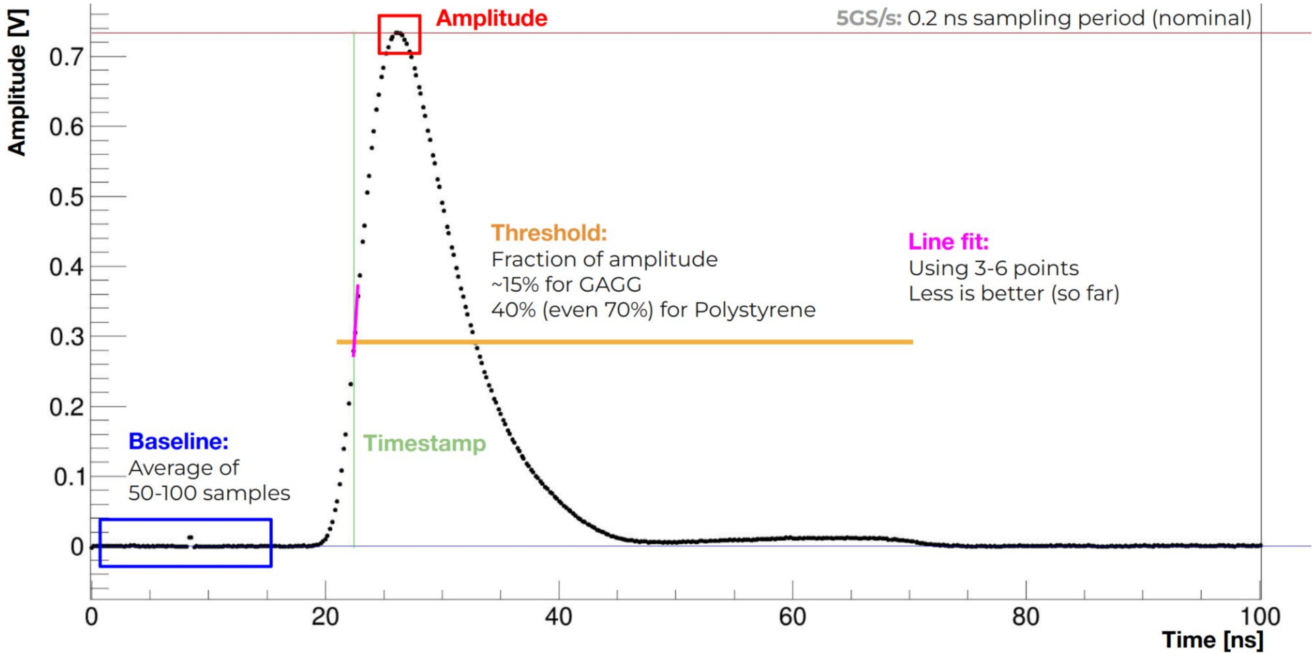
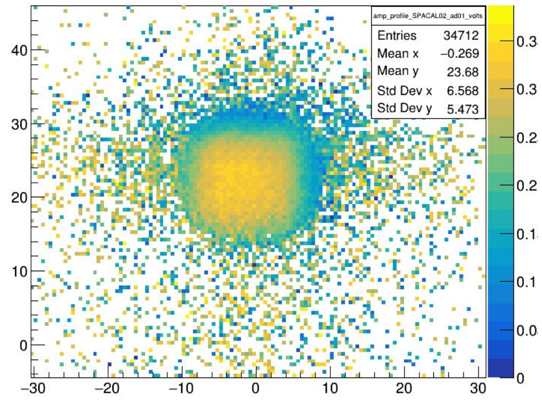
Online analysis (GitLab):



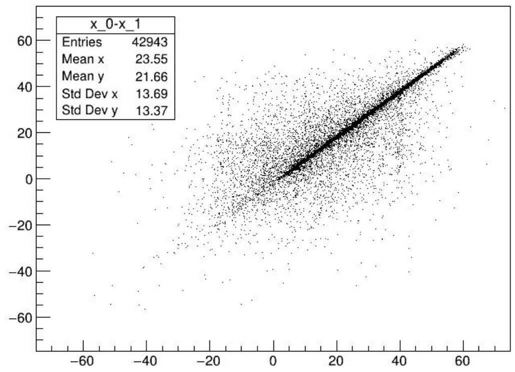
Different methods other than CFD..?

Online analysis:

Alignment



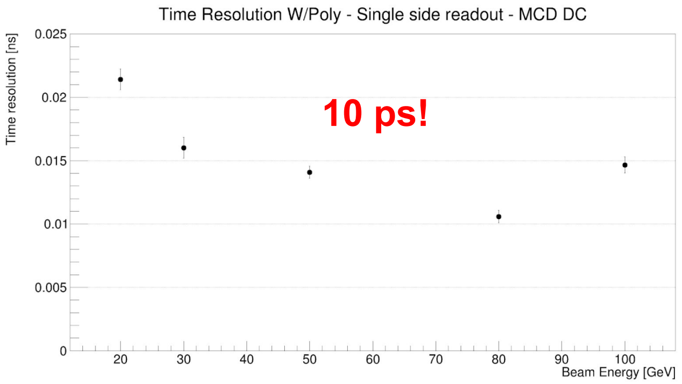
Cleaning the data



Very complete and versatile tool. Some online analysis examples:

- MCP amplitude vs x-y coordinate (alignment) and time resolution
- Amplitude vs x-y -> module alignment
- X1 vs x2 coordinate for shower and multiple hit rejection in the DWCs
- Module time resolution.
- Integrated charge (if not using ADC).
- All the information regarding the run collected starting from 2020 are listed in this gigantic logbook: giga_logbook

Results



Conclusions:

- Powerful tools are now available to anybody who would want to participate to the test beam shifts and/or to test new ideas.
- Some improvements will be implemented, but the system is mainly shifter safe and efficient.
- Online analysis can be performed by shifters using the powerful tool provided.