Ongoing activities

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LPNHE Neutrino Group Meeting
Wednesday April 20th

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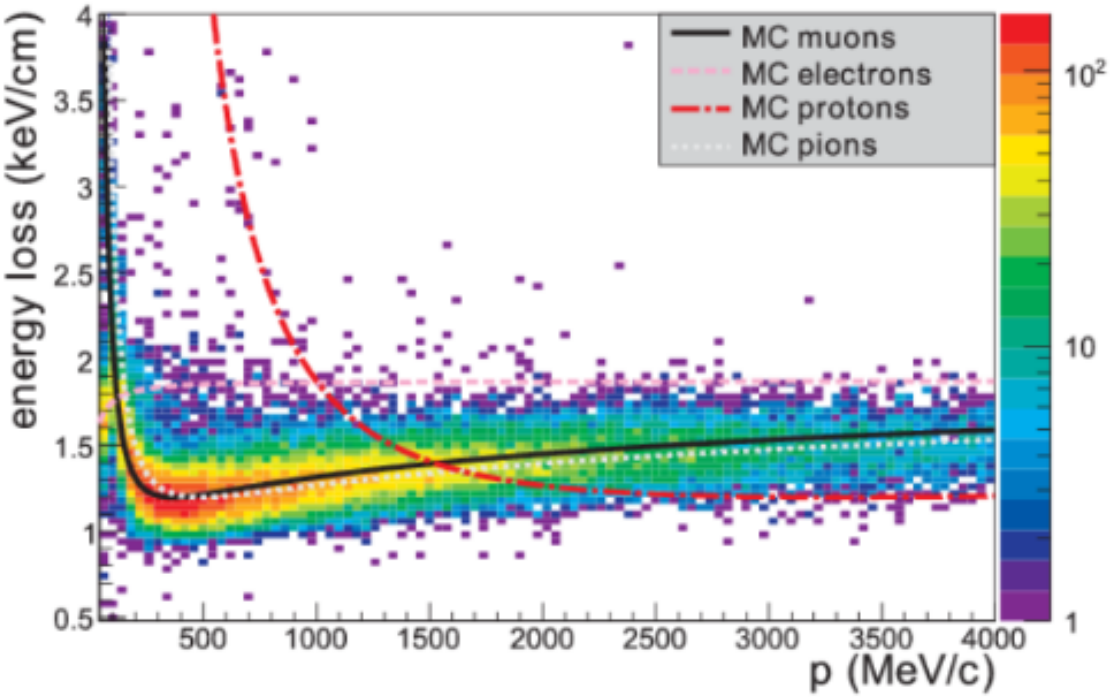
1. Study and implementation of ν_e sample in GUNDAM
2. FEC linearity tests

The ν_e selection

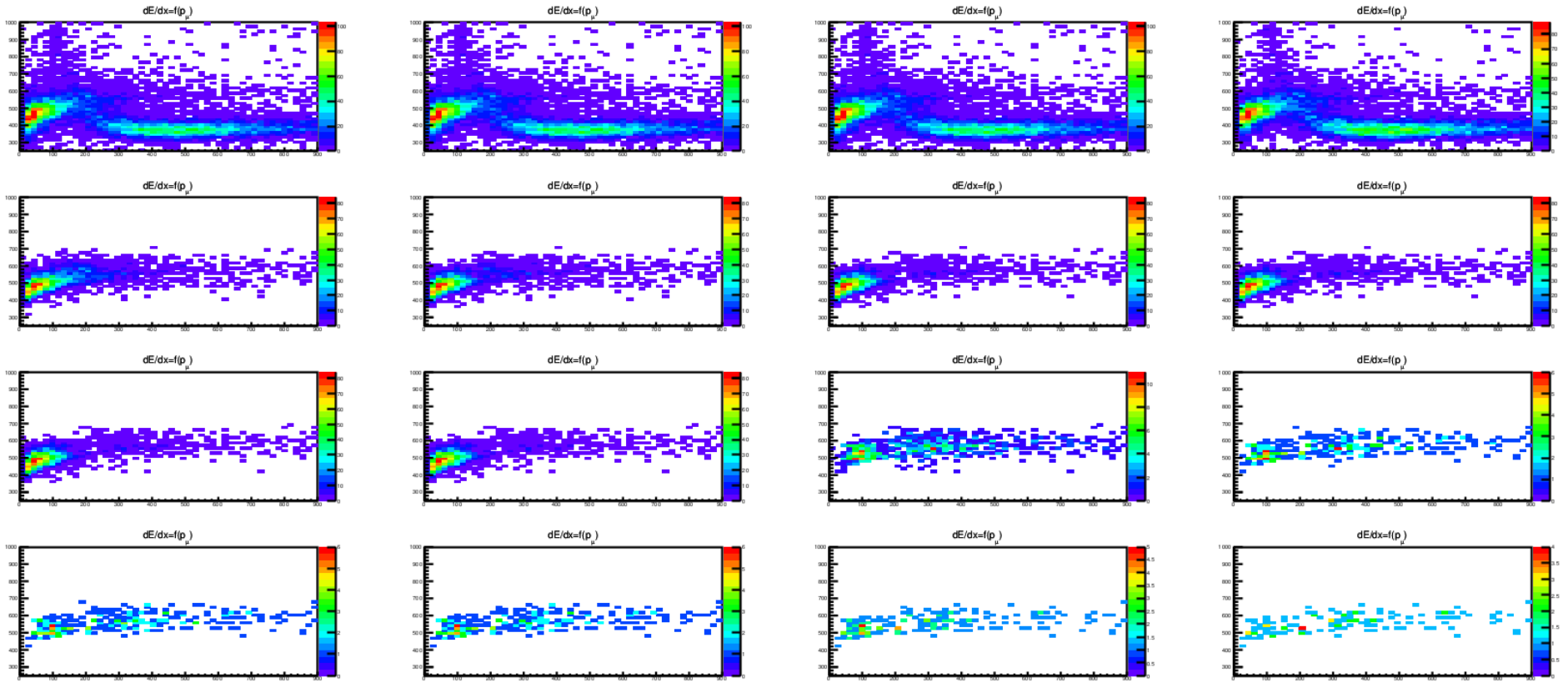


Particle identification thanks to TPCs

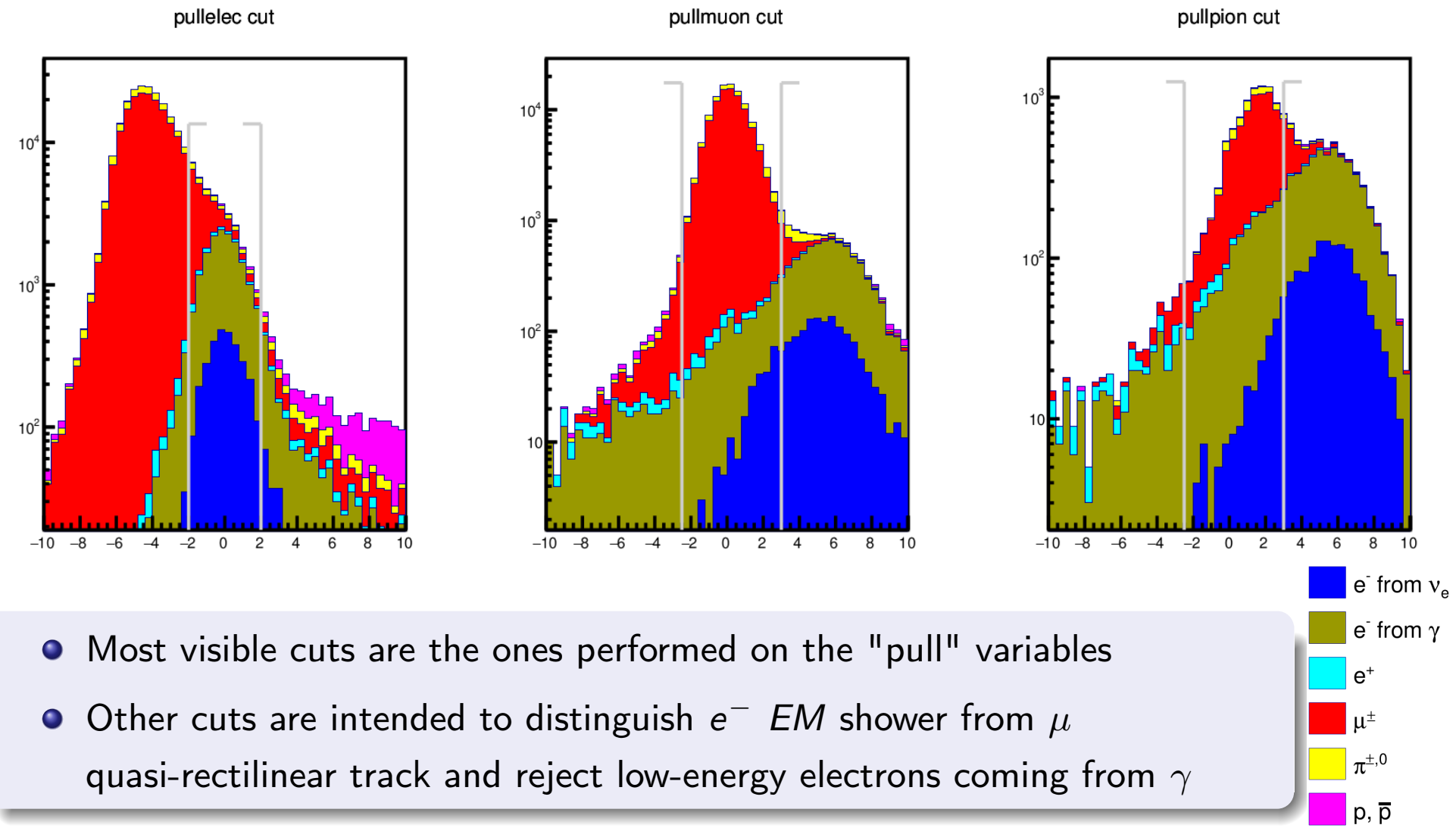
- TPCs give the informations dE/dx and p of the particles that are produced when a neutrino interacts
- The main goal in the ν_e selection is to keep only e^-, and more precisely the one that are coming from ν_e (as opposed to $\gamma \rightarrow e^+e^-$ ones)

The ν_e selection

- 17 levels of cuts are applied :

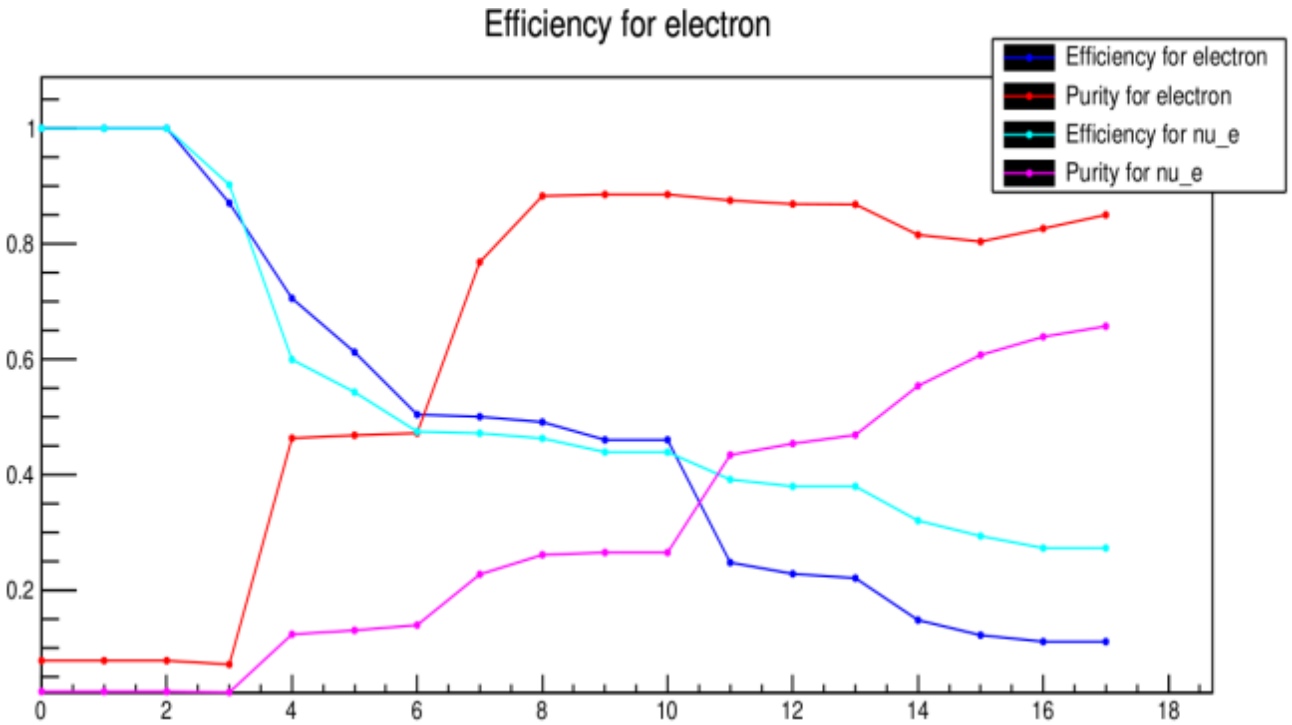


The ν_e selection



- Most visible cuts are the ones performed on the "pull" variables
- Other cuts are intended to distinguish e^- *EM* shower from μ quasi-rectilinear track and reject low-energy electrons coming from γ

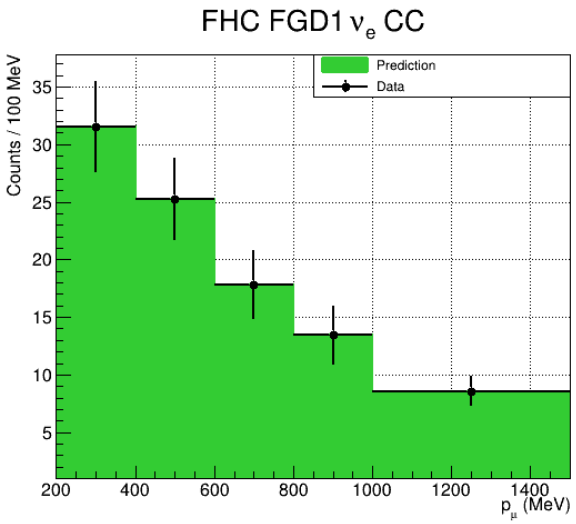
The ν_e selection

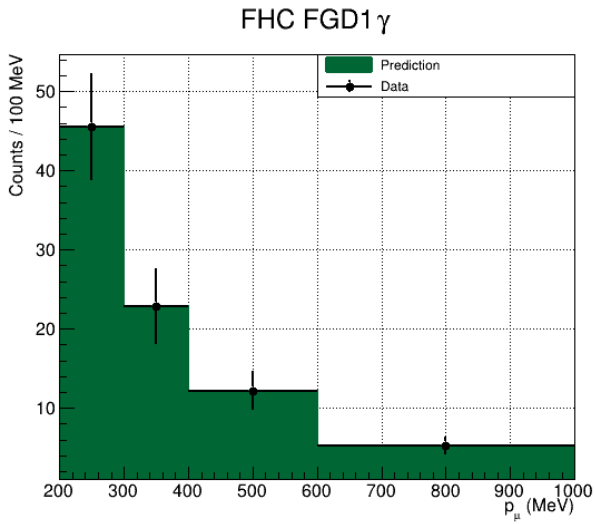


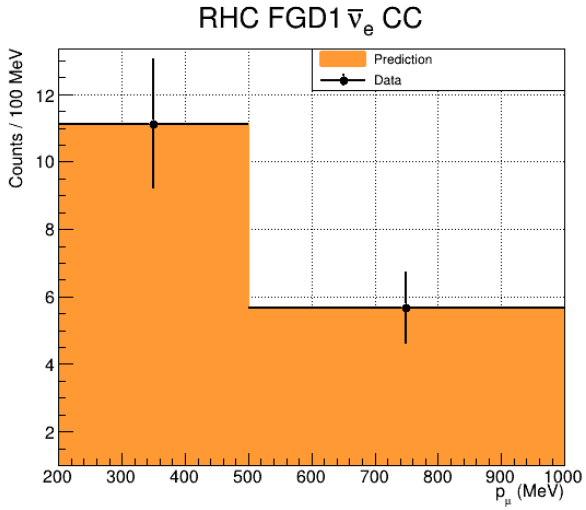
Results of ν_e selection

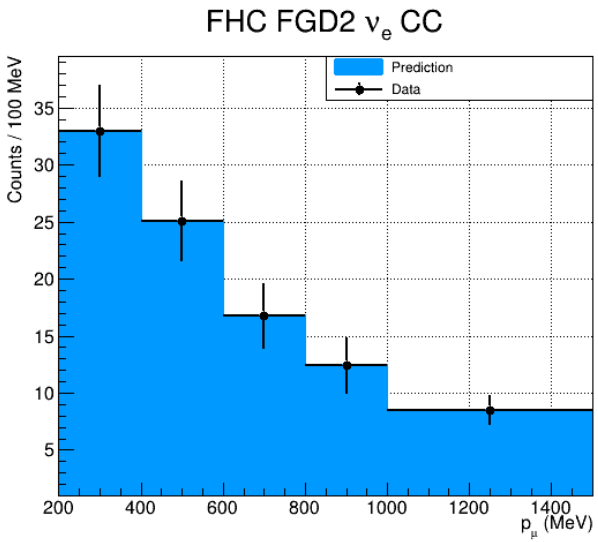
- Once all of the cuts were performed, the purity of the sample reaches $\approx 64.3\%$

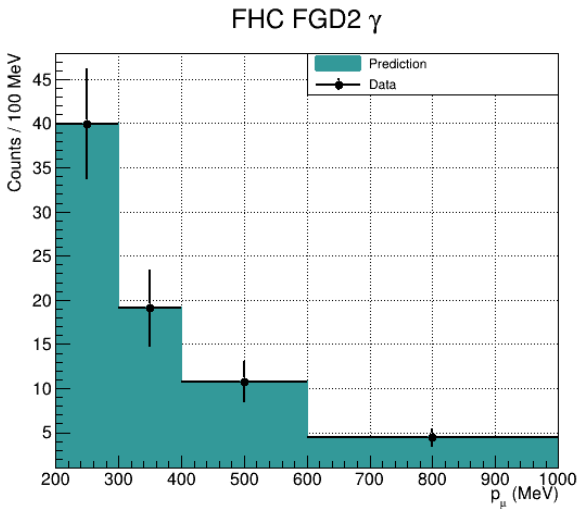
Implementation of ν_e, γ and $\overline{\nu}_e$ in GUNDAM

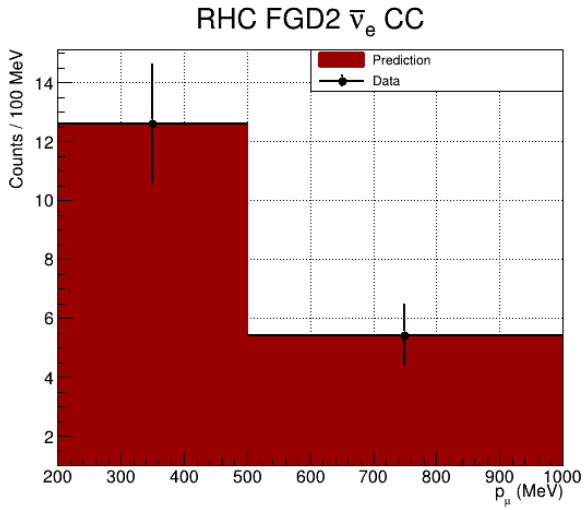




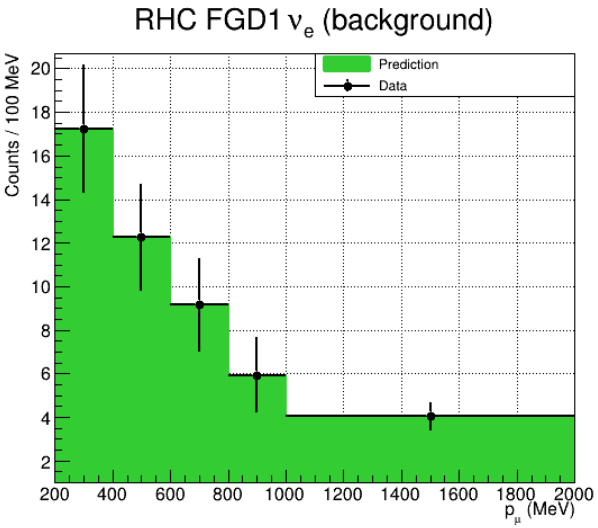


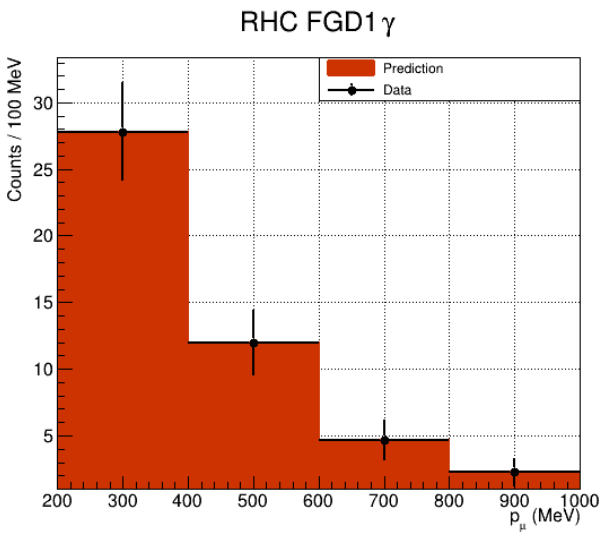


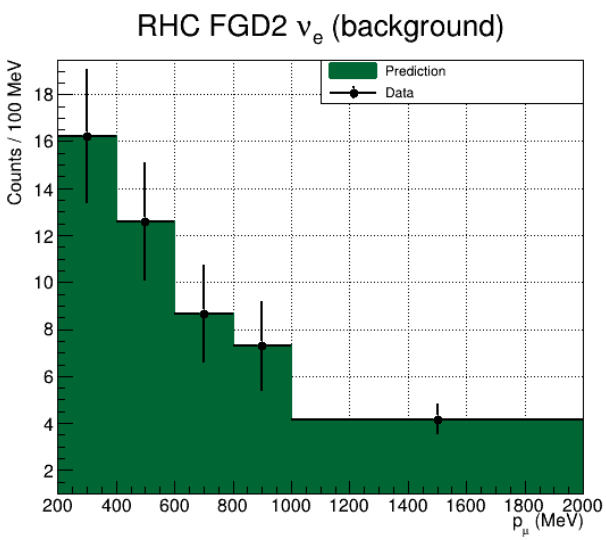


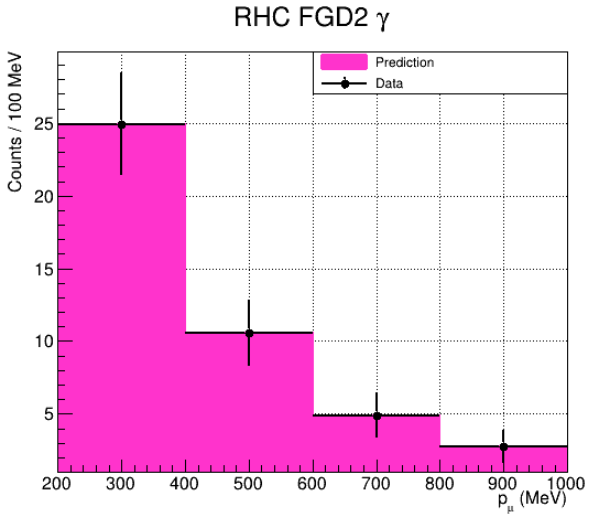


Implementation of ν_e, γ and $\overline{\nu}_e$ in GUNDAM

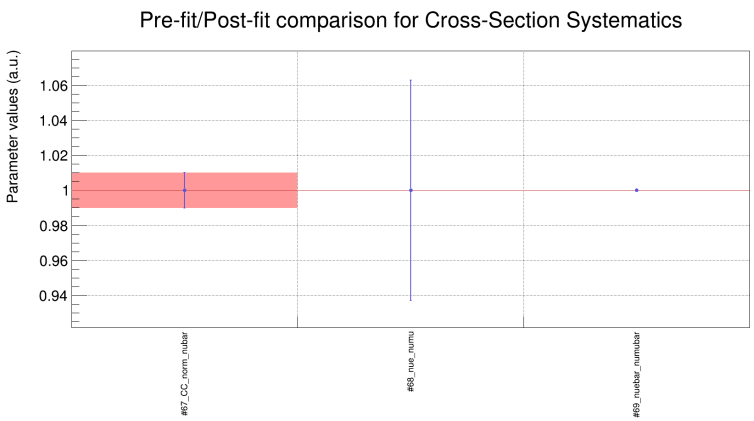






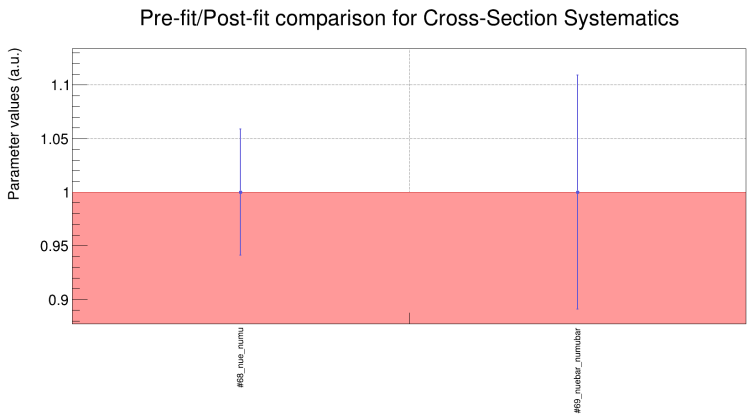


Implementation of ν_e, γ and $\overline{\nu}_e$ in GUNDAM



Results of the fit

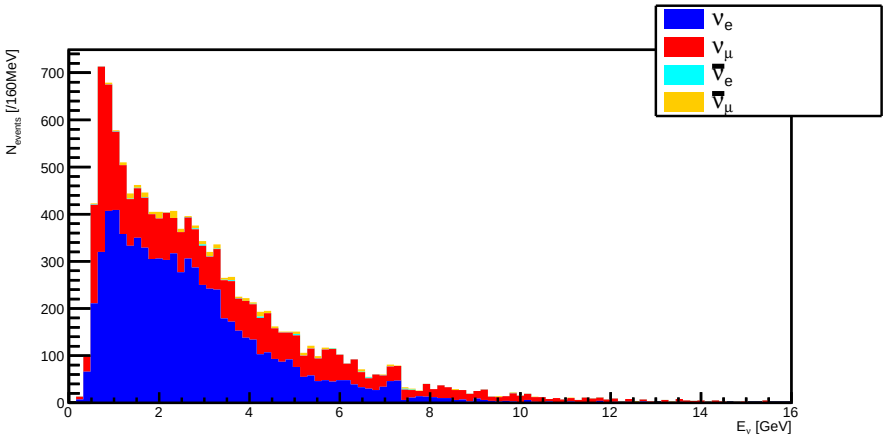
- First, All FHC data ν_e were added to the fit and nue_numu parameter was enabled
- Only flux and xsec parameters were enabled for this fit
- A $\approx$ 6% constraint on nue_numu parameter was obtained

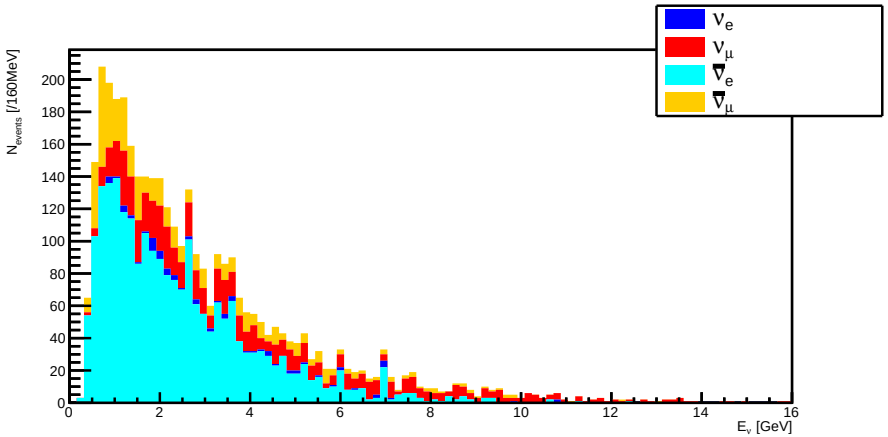


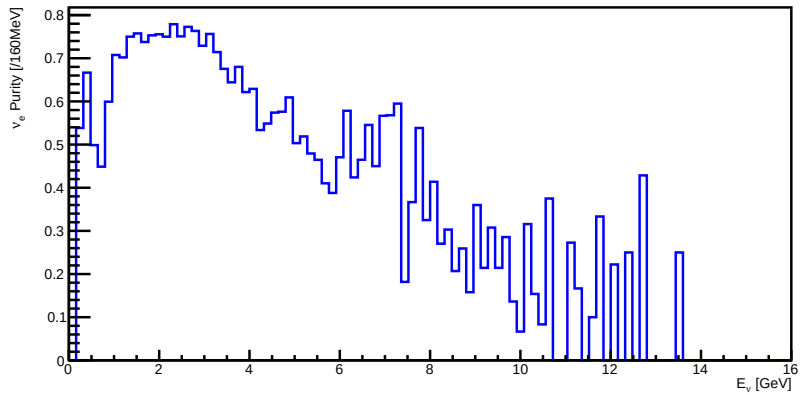
Adding γ, $\overline{\nu}_e$ and All RHC data

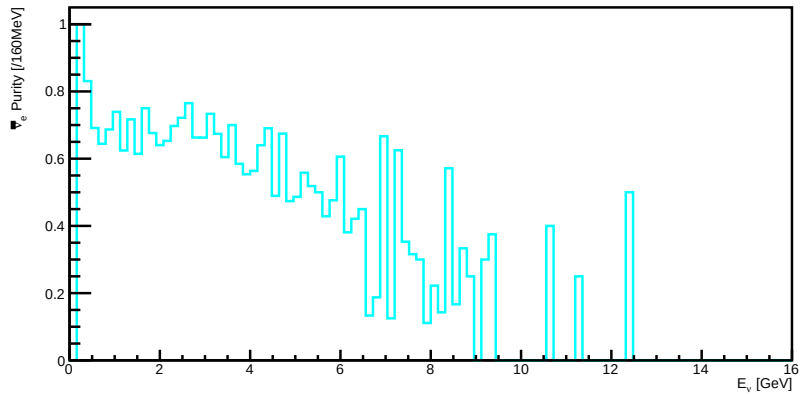
- Next idea was to add also γ and $\overline{\nu}_e$ samples in order to enable nuebar_numubar parameter ($\approx$ 11% constraint)

True energy of ν_e and $\overline{\nu}_e$ and creation of energy-depending nue_numu and nuebar_numubar fit parameters





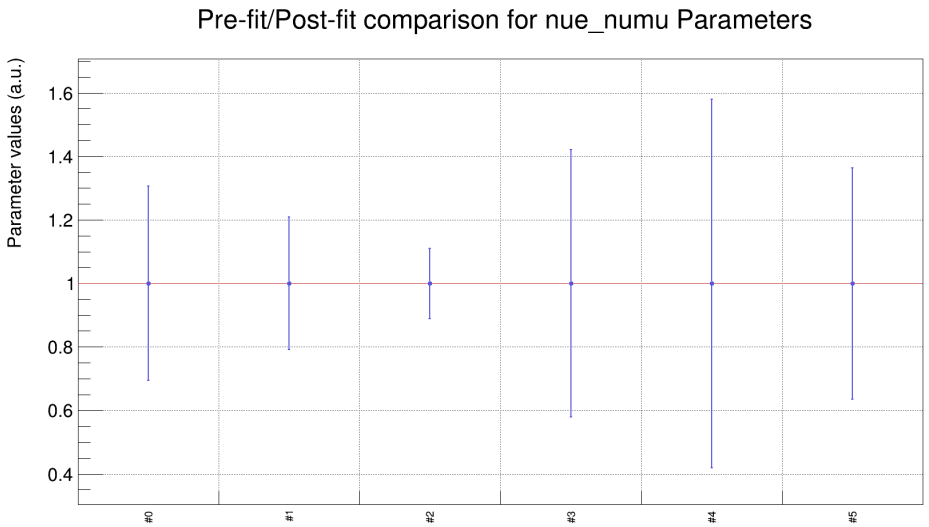


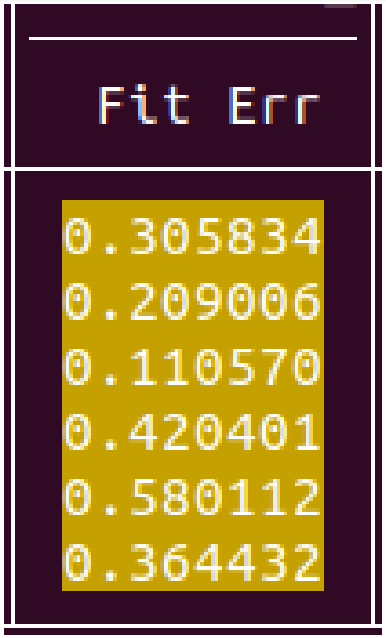


True energy of ν_e and $\overline{\nu}_e$ and creation of energy-depending nue_numu and nuebar_numubar fit parameters

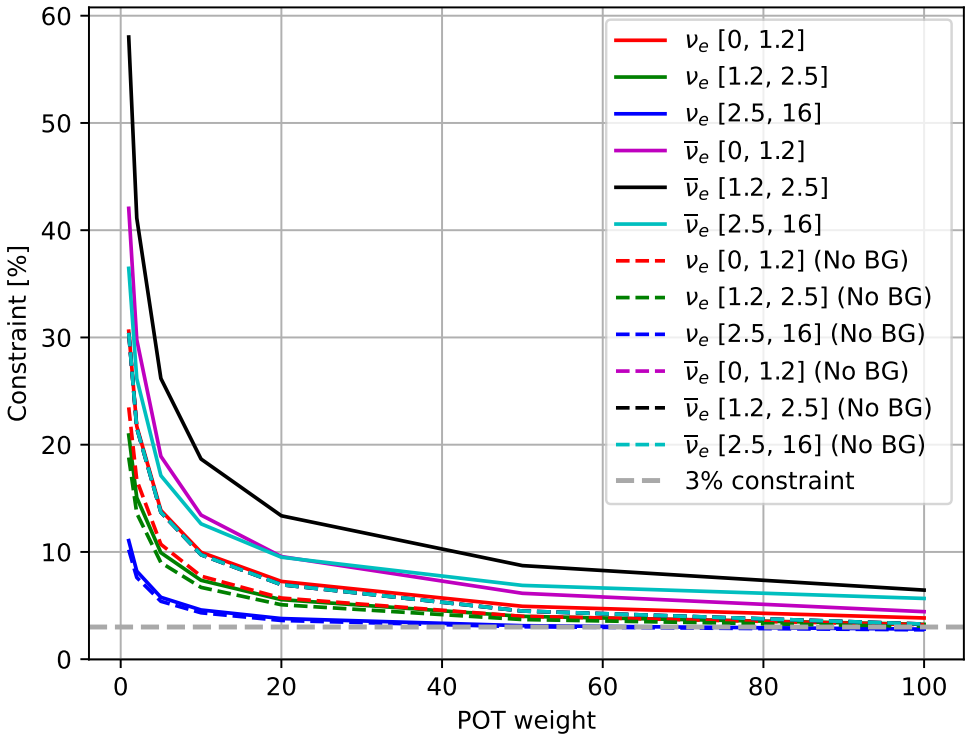
- Next idea is to separate each of nue_numu and nuebar_numubar fit parameters in three different ranges of energy :

Energy [GeV]	[0, 1.2]	[1.2, 2.5]	[2.5, 16]
nue_numu	#1	#2	#3
nuebar_numubar	#4	#5	#6





Increasing the POT and suppressing the background



Constraints [%] for nue_numu parameter with $E \in [0, 1.2]$ GeV :

POT	w BG	w/o BG
1	30.5834	23.4790
2	21.7207	16.6907
5	13.8825	10.7100
10	9.9697	7.7442
20	7.2522	5.7042
50	4.9331	3.9955
100	3.8422	3.2093

For next:

- Study the impact of the upgrade on the ν_e selection efficiency and take it into account in the fit

Table of Contents

1 Study and implementation of ν_e sample in GUNDAM

2 FEC linearity tests

Principle

- Electronic cards are intended to collect the signal coming from the TPCs
- The amplitude of the signal has to be proportional to the electric charge deposit
- Each electronic card or front-end electronic mezzanine (FEM) is connected to 2 front-end electronics cards (FEC)
- Electronic pulses are sent to FEM and one tests the linearity between signal amplitude and charge deposit

Tests at LPNHE

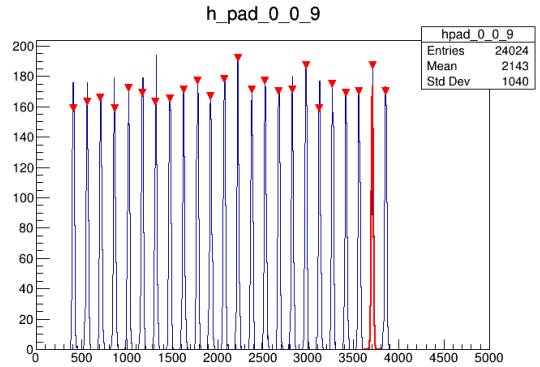
Before:

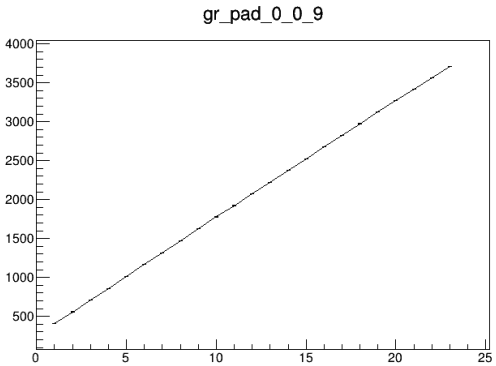
- At LPNHE, each FEM (or couple of FEC) is tested independently in a test bench
- These FEM can be separated into "pads" : 36 horizontally and 32 vertically
- A ".aqs" file is generated and then converted into ".root" file containing the signal amplitude information as a function of time

Tests at LPNHE

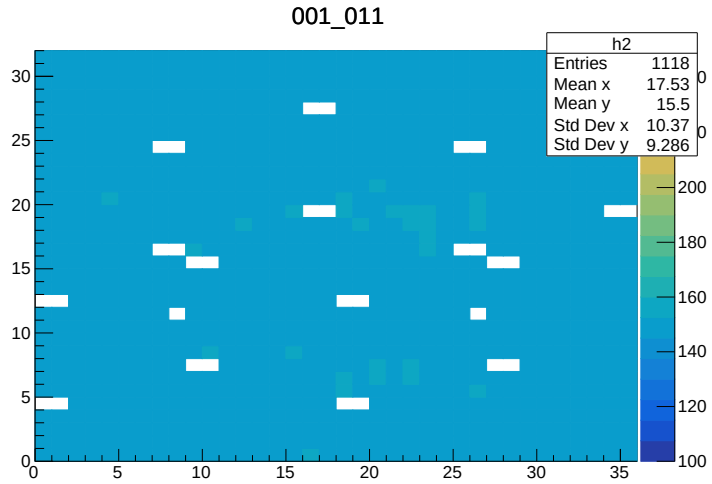
The analysis:

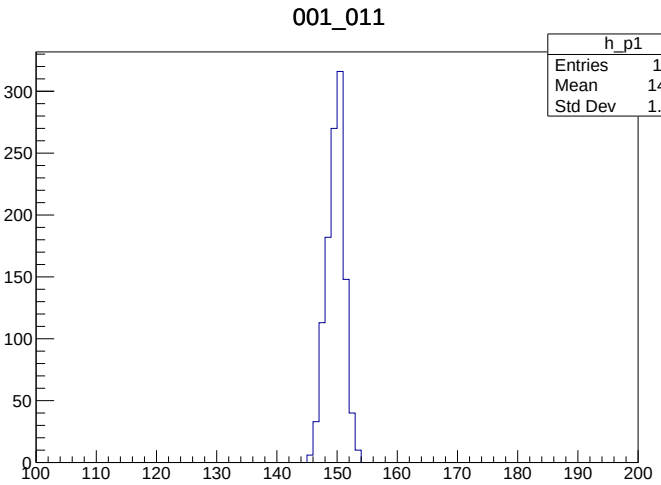
- A script is then used to find the maximum amplitude of signal for each (x, y) pad
- Another script is intended to find the peaks (electronic pulses) and to analyse their area (linked to charge deposit) thanks to a gaussian fit
- The charge deposit can then be plotted as a function of the number of electronic pulses
- An affine function is then plotted and the slope has to be near ≈ 150



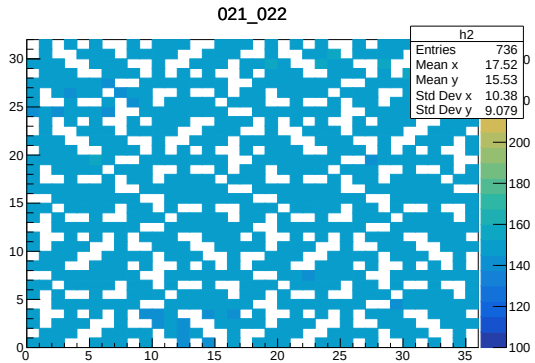


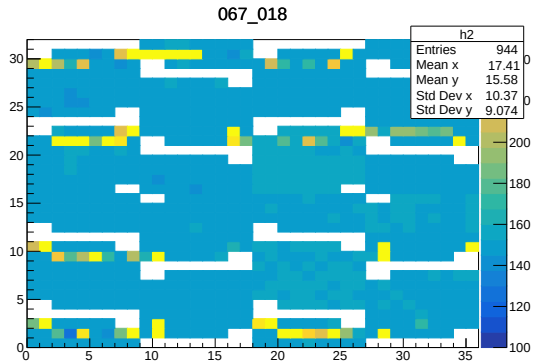
Tests at LPNHE



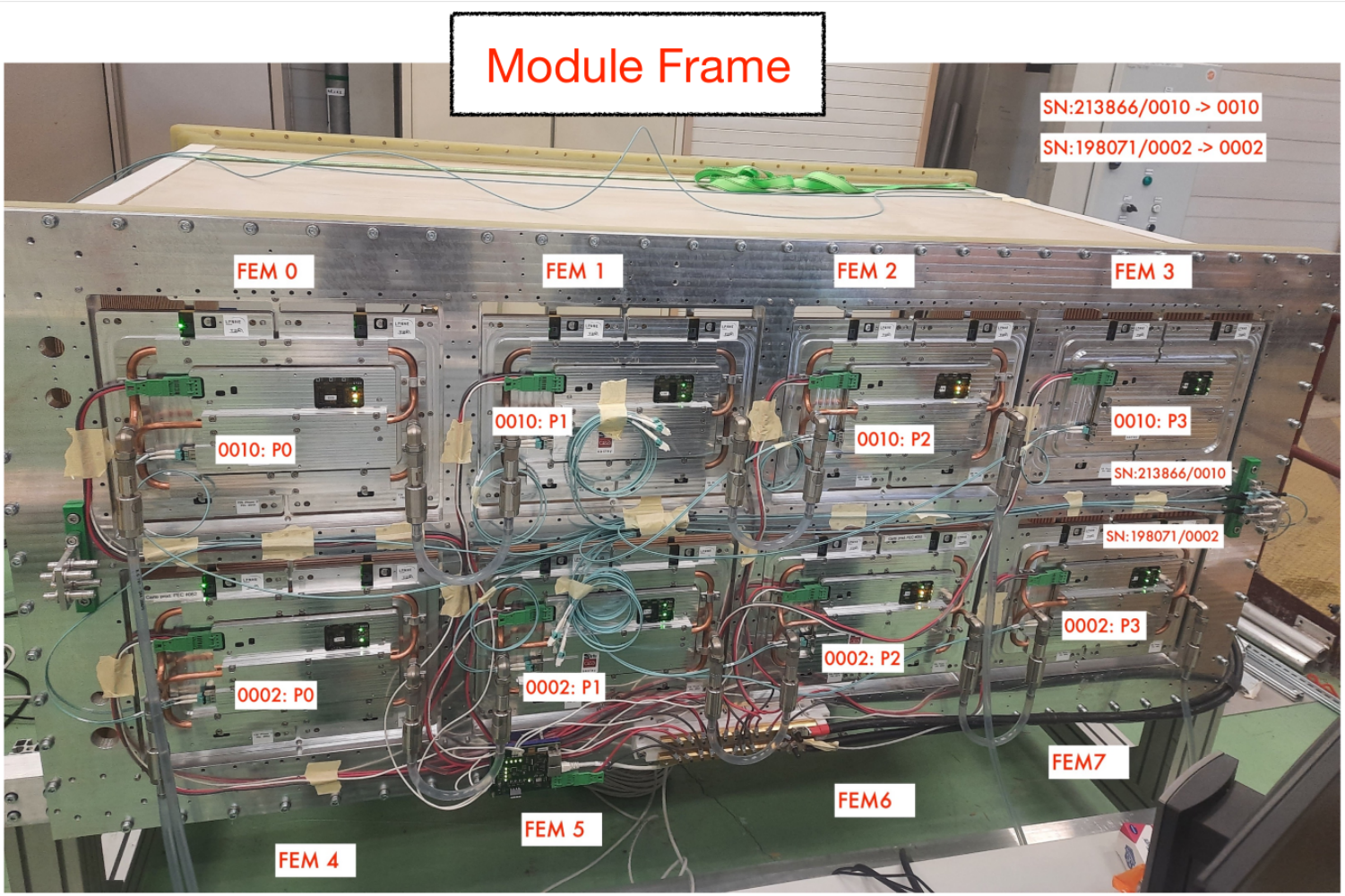


- Slope was plotted as a function of (x, y) coordinates and the mean value obtained is closed to the expected ≈ 150
- But some holes are visible, probably due to missing channels in the data file
- Anomalies observed for some cards such as 021_022 and especially 067_018





Tests at CERN



Tests at CERN

Process:

- A module frame is composed of 8 FEMs
- The procedure for the analysis is quite similar as before
- But need to adapt the script $(x, y) \rightarrow (card, chip, channel)$
- Since there are 8 cards, 16 chips and 72 channels, one needs to generate 9216 histograms
- The solution I chose is to generate a ".root" file containing the **maximum amplitude**, **card**, **chip**, **channel**, **N_peaks** and **slope** and **intercept** of the affine function

Tests at CERN

Conclusion:

- The curves obtained are all linear and their slope are equal to ≈ 150
- The only problem observed is some missing channels (0, 1, 2, 3, 4, 15, 28, 53 and 66)
- The later may be correlated to the holes observed in the tests performed at LPNHE, since the code for the DAQ is the same