LAPP INPUTS FOR 6×6×6 ANALYSIS

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LAPP-DP activities

Scintillation light simulation:

- Light maps generation for 666 and 311
- Studies of the impact of light absorption and light diffusion in LAr

→ Anne Chappuis PhD thesis (2018) on this topic

Scintillation light analysis:

- With the 3×1×1 detector -> Paper in preparation
- Study of scintillation light production, propagation and collection in LAr
- Study of the electroluminescence light (with lem field, e^- drift velocity)

Charge reconstruction & simulation:

- Developed the 3×1×1 (seems to be still working for np02)
- Noise filtering code, hit finder optimization, 2D track finder algorithm [currently used for the online reconstruction with QScan]
- Electric Field map updates, QScan developments to include non-homogeneous gain in simulation (I think it wasn't committed though)

Charge analysis:

- Purity and Effective gain measurements [311 technical paper]

Our main interests for np02 analysis

At the charge level, we are interested in understanding the drift field distortions
- due to the short circuit (not really planned though !)
- due to the space charge effect

In order to do so, we plan to :
- exploit 3D track topology (bending, end points, ...)
- use light S1 information to retrieve track t_0 to compare with reconstructed track arrival time
- In principle, S2 could be useful as well, but can get complicated due to the large amount of tracks
- use CRT information which should give the "true" track path

Ideally, our final goal is to be able to build a space-charge model for the dual phase technology, and to quantify the impact of this effect for the DUNE FD module performances.

At the light level, we have always been interested in the measurement of the Rayleigh scattering length, but our to-do list is already very long (no short term significant contribution expected)

Analysis to-do list

We (not just LAPP) need to work on:

at data level

- Hit finding ← We are working on it now
- Track finding, shower recognition, 3D merging
- Purity measurement and correction
- Effective gain measurement
- Charge & Light & CRT matching
- Light and CRT reconstruction
- Monitor our data ← We are working on it now

at simulation level

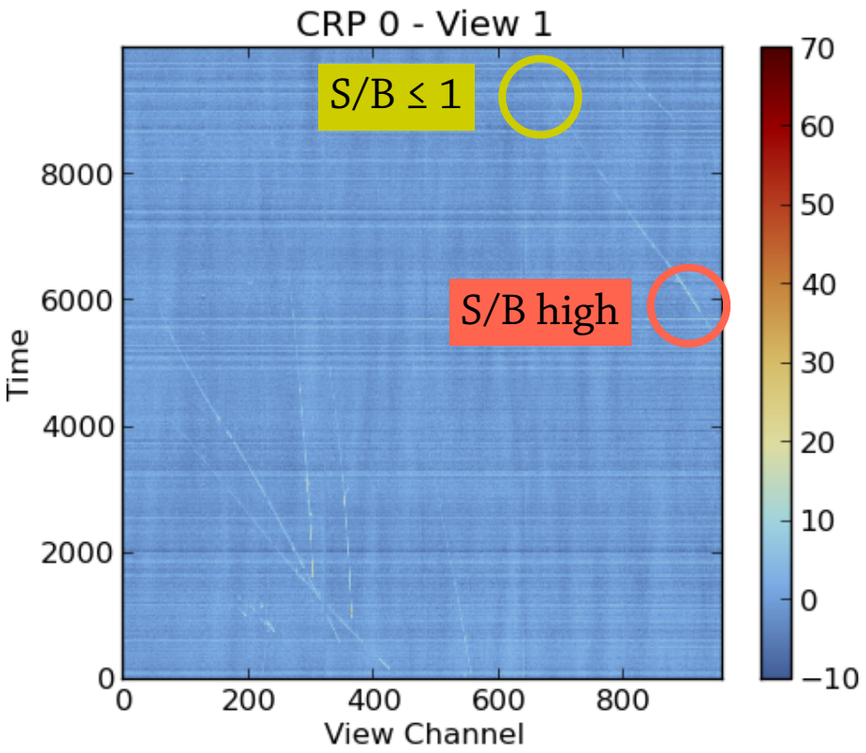
- Build new electric field maps taking the short into account ← Will work on it soon
- Study the effect of LEM inactive area on track reconstruction efficiency
- Study the short drift field distortion on track reconstruction
- Update light maps with new PMT position and PEN / TPB configurations (+PMT acceptance updates and S2 generation studies)

Long way to go before starting a SCE analysis …

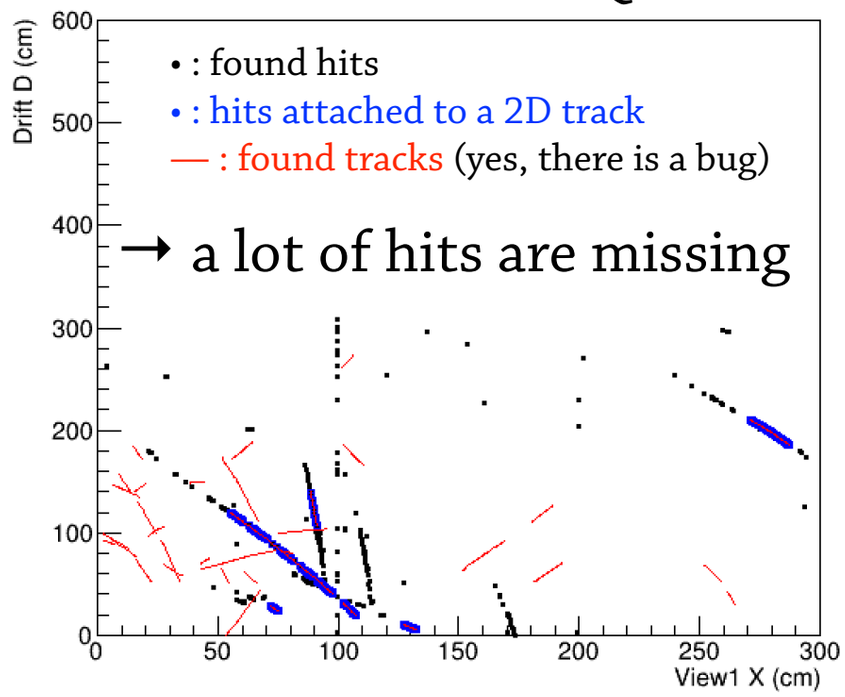
Improved Hit finding / Noise filtering

For the data taken so far, we should really consider noise filtering

run 1323/10_a/1(1081)

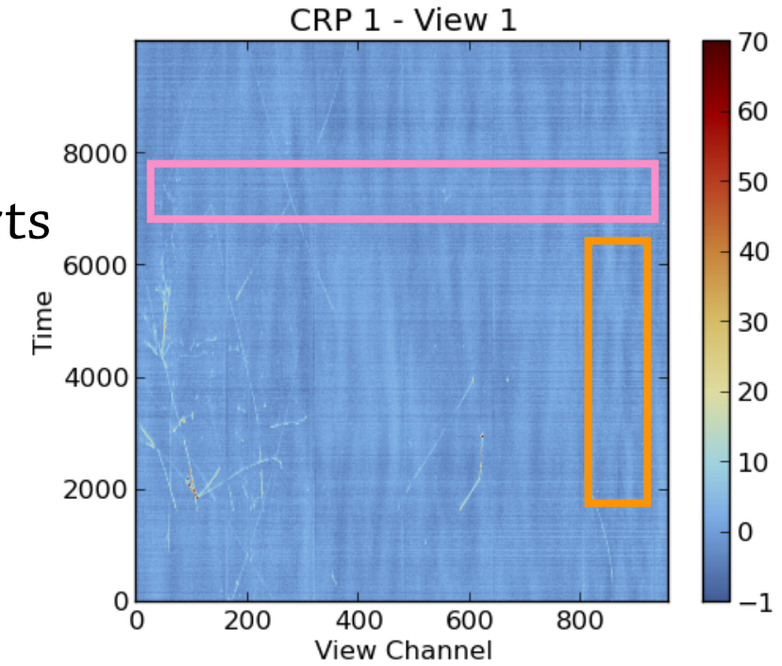


reconstruction in QScan :



The noise filtering as it is implemented now consists of 3 parts (originally for the 311):

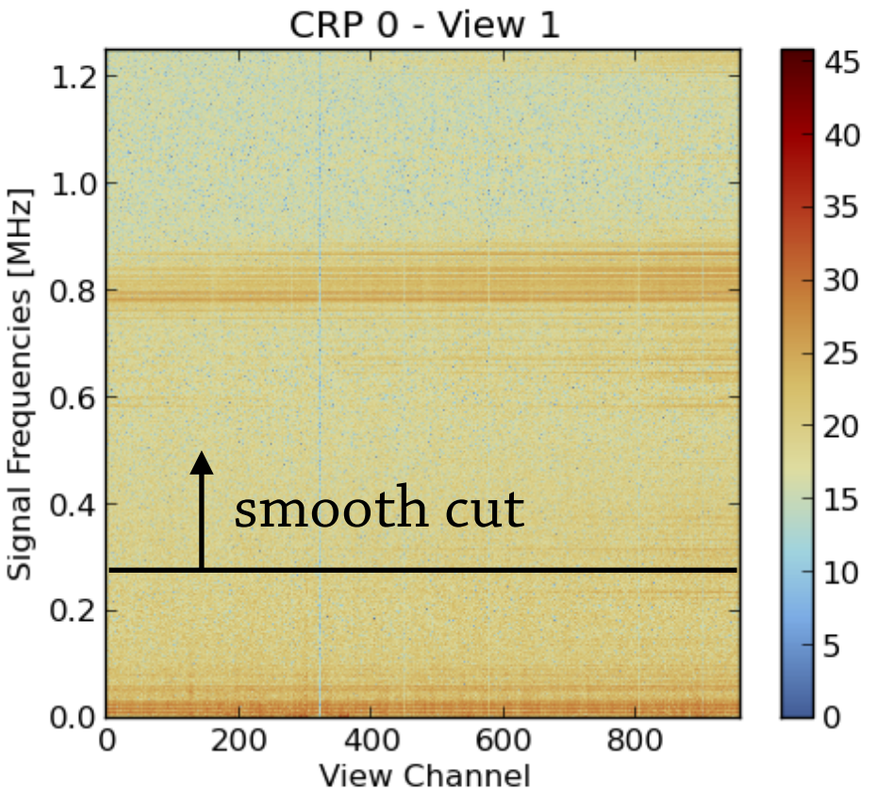
- FFT low pass
- Coherent filter
- Pedestal flattening



Unfortunately, these algorithms are not designed to run on such large dataset.
In Qscan it takes about ~15 mn per event to run the 3 codes

→ Optimization will take forever

Noise filtering : FFT

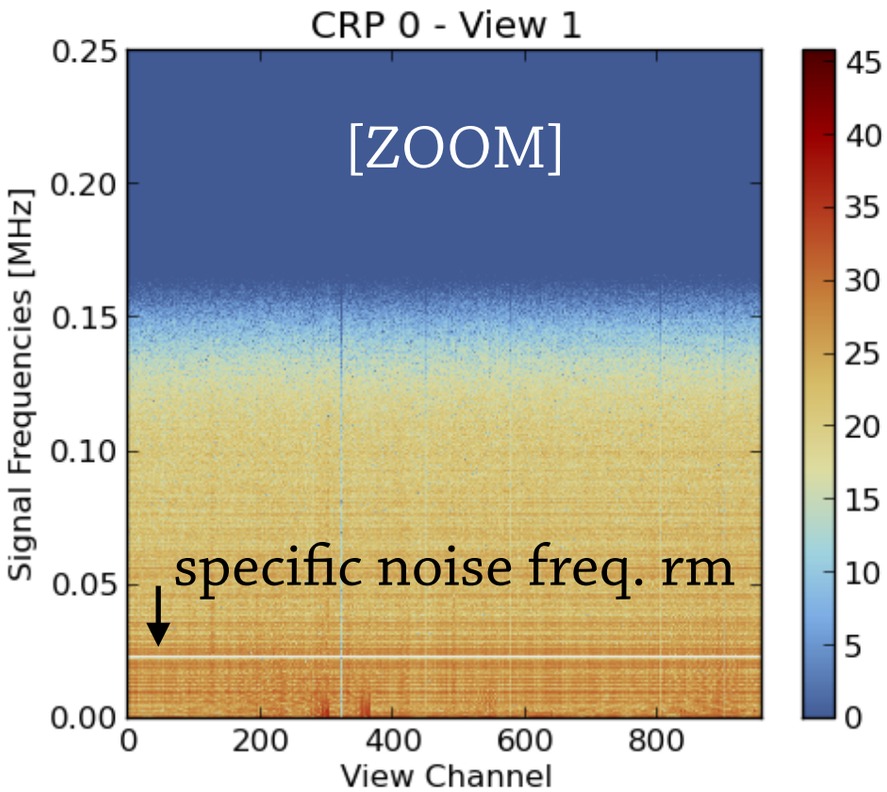


In order to speed up the running time, we have developed a python-based script to study and remove the noise

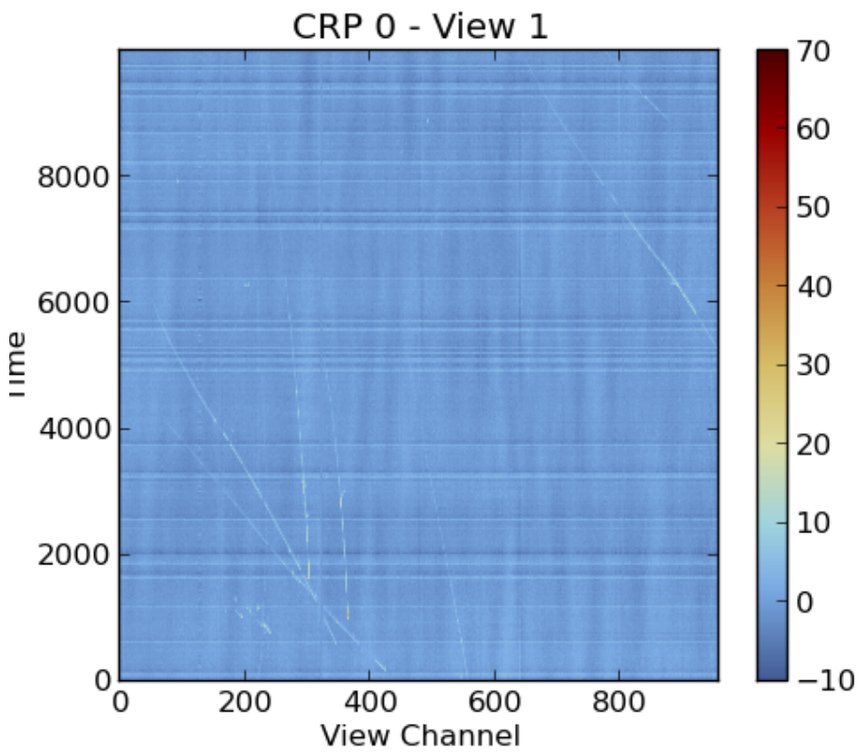
→ optimized parameters to be later passed to QScan / LArSoft

First noise filter is low pass FFT cut

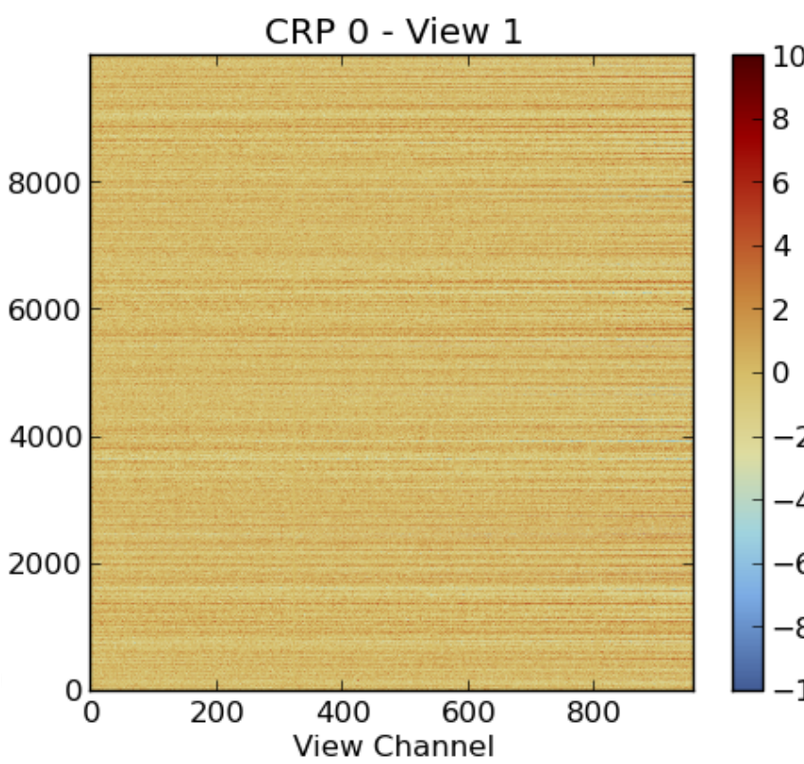
→ Can we efficiently remove the noise just with FFT ?



FFT filtered event



Noise removed



Noise filtering : Coherent noise

Second filter is the coherent noise

-in group of 320 channels in all CRP/view (-> at chimney level ?)

- for CRP 0/view 0 [in chimney 5] in groups of 64 channels (-> at card level ?)

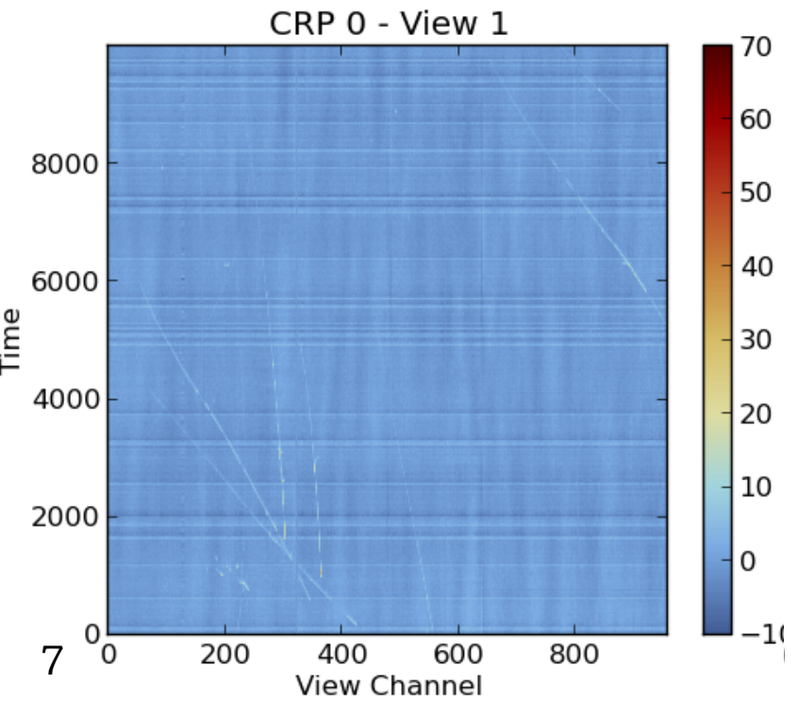
Filtering approach :

In groups of N channels, compute the mean noise at a certain time, and then subtract it.

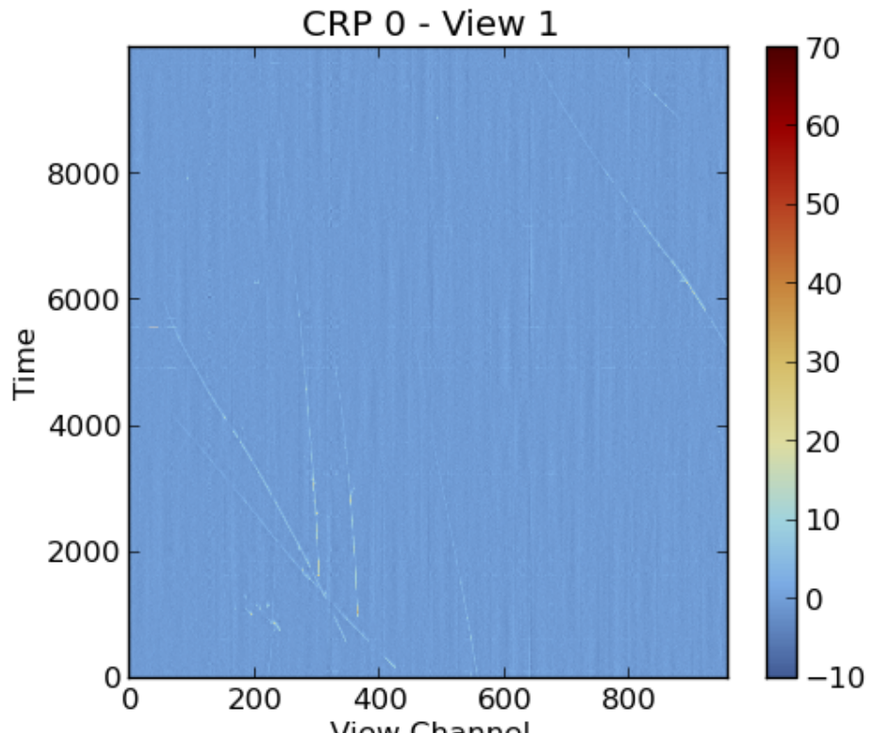
Main challenges are:

- define what's noise and what's signal
- the computational time (-> 2×2×(960/N)×10000 loops to do)
- this part is quite long in QScan

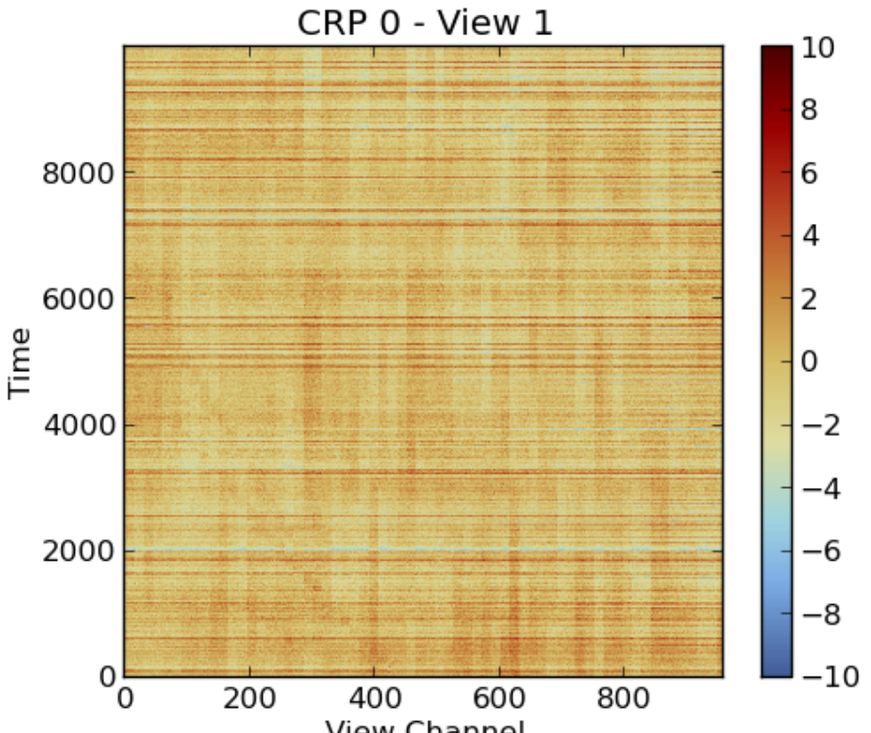
FFT filtered



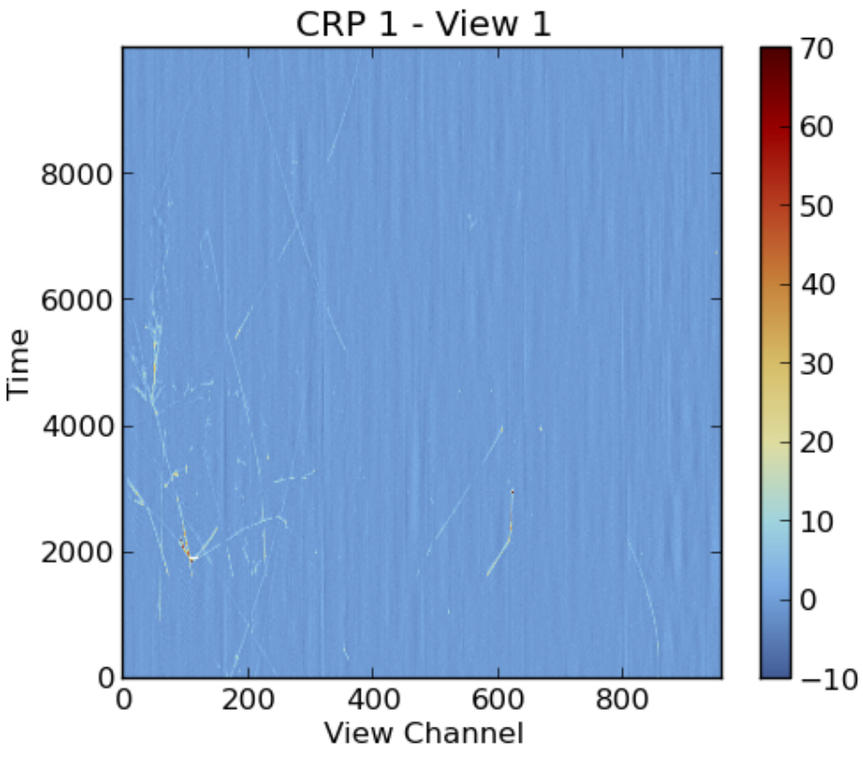
coherent filter



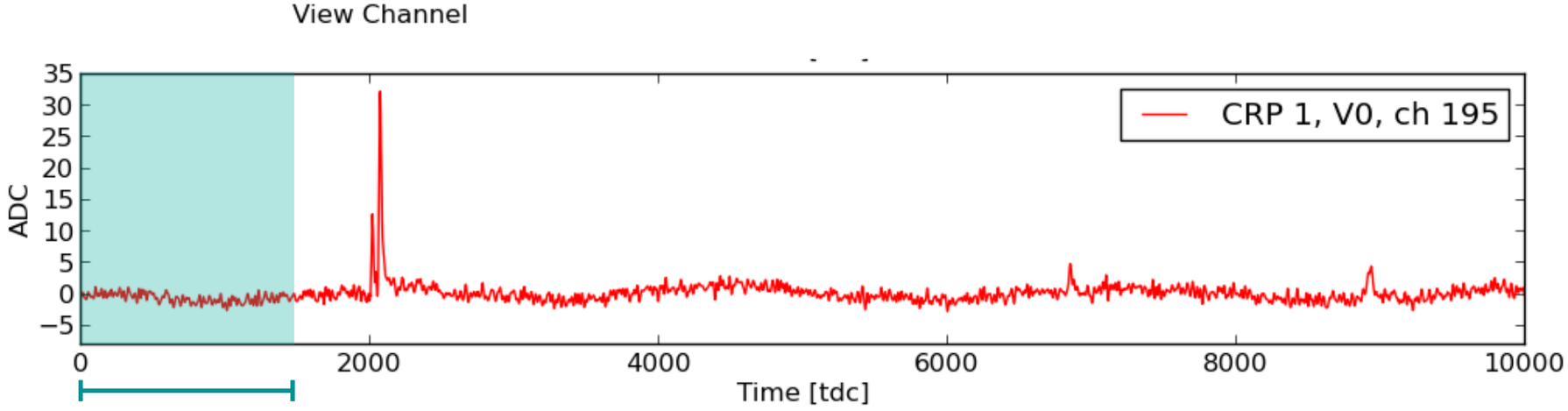
all noise removed



Noise filtering : Pedestal noise (microphonic?)



- This noise is more important on CRP 1
- It seems to consist of different waves and be time & space dependent
- Origin not clear ; under investigation
- Already seen and removed in the 311



time window of 311 [1667 bins]

In the 311, we were only seeing part of the wave -> the baseline was fitted with a 3rd order polynomial and subtracted

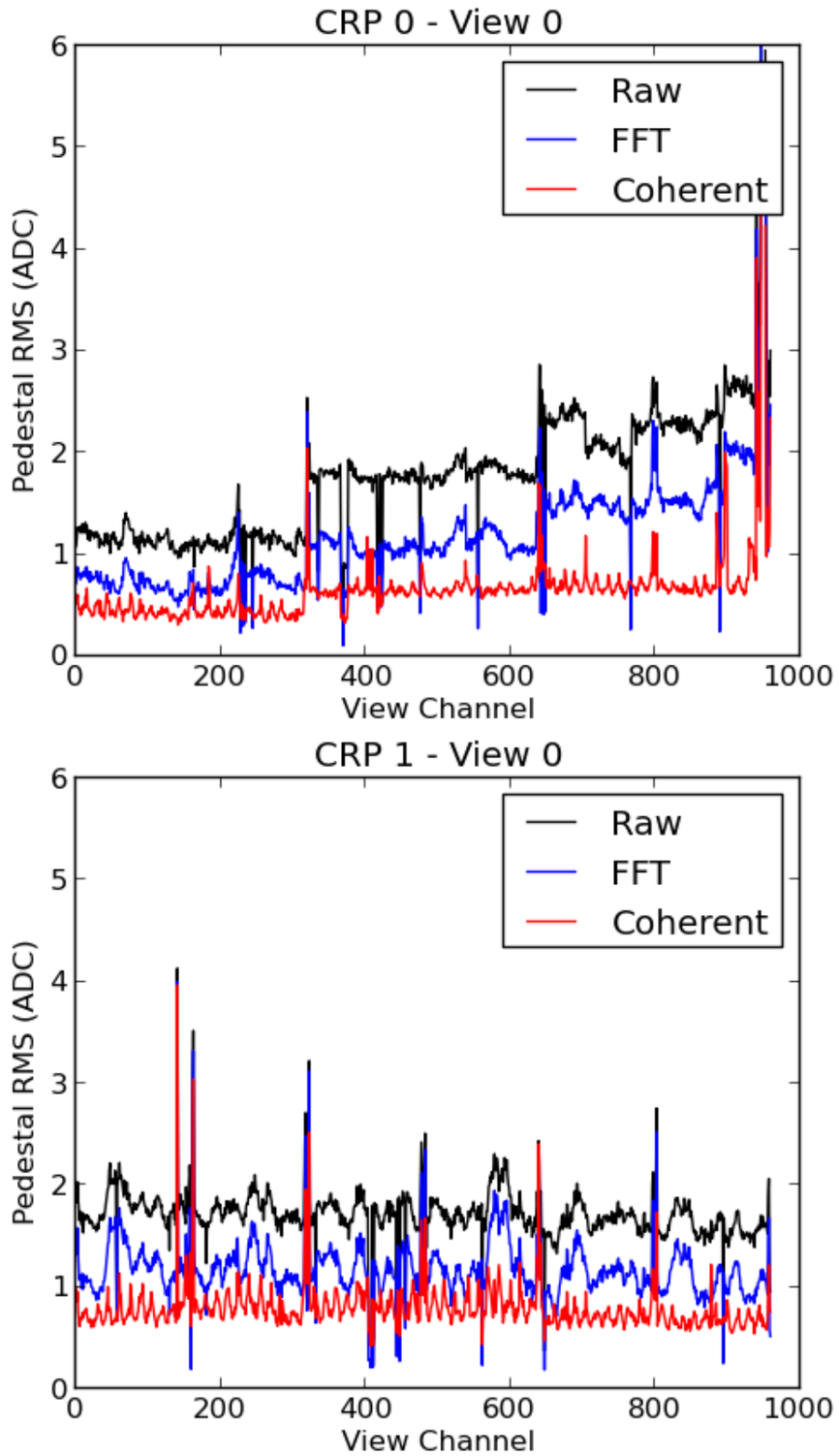
↳ Do not work on the 666 data !

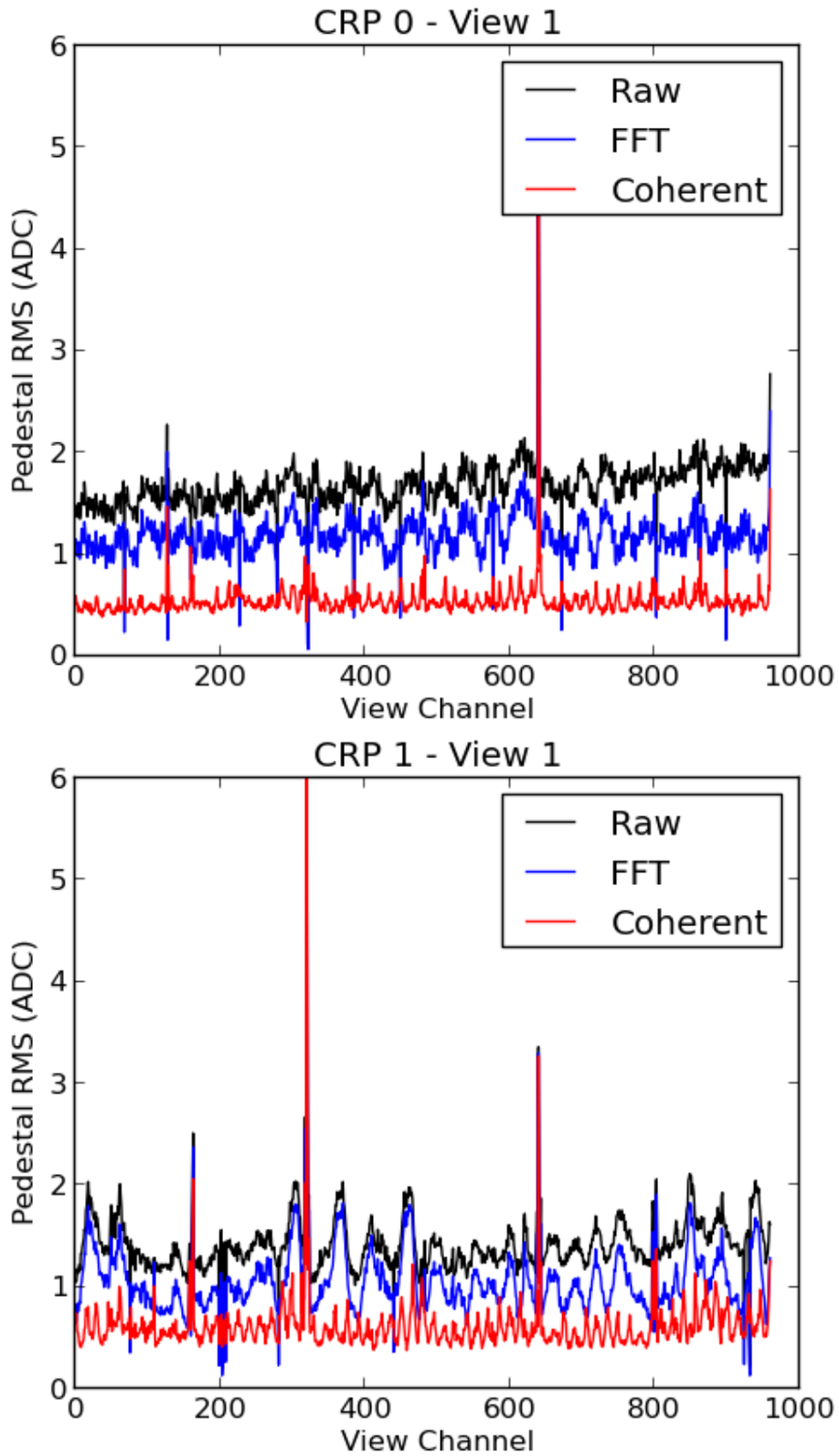
We're trying to fit the baseline with cosines to extract some specific frequencies to be FFT filtered

Noise filtering : Pedestal RMS

run 1323/10_a/1(1081)

For that specific event :





Charge Run Monitoring

Many runs already taken with various conditions.

→ Worked on building a set of scripts to summarize everything needed

1. List of all charge runs (pedestals, cosmics, test) with nb of subruns and missing files (if any)
2. More detailed infos for cosmic runs (+nb of events, timestamps, …)
3. Extract Slow Control informations and store it (voltages, Ar temperature, LM, pressure, …)

NB : A similar list already available :
example here :
`/eos/experiment/neutplatform/protodune/rawdata/np02/run_060220.list`

and similar code to retrieve slow control infos here :
https://wiki.dunescience.org/wiki/DP_slowcontrol

→ It would be to merge these efforts to have a more complete runs informations

Charge Run Monitoring & Summarizing

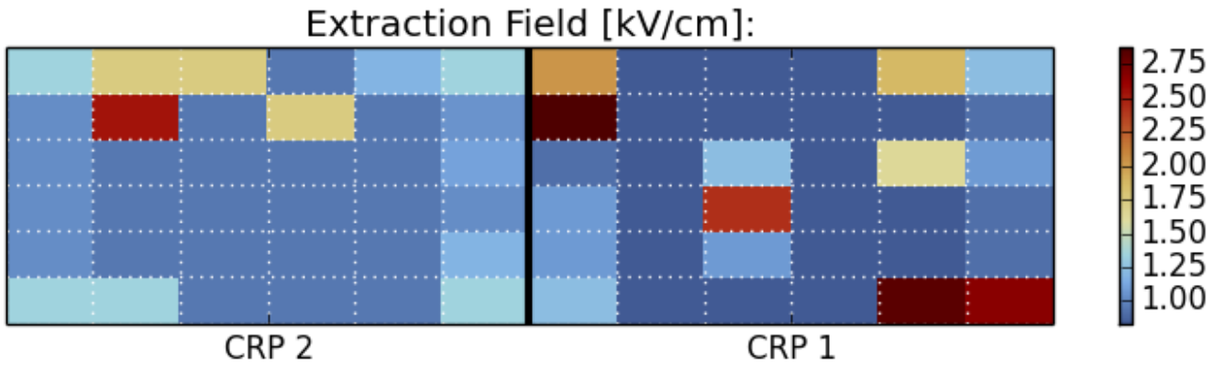
4. (Bonus) Make a summary plot

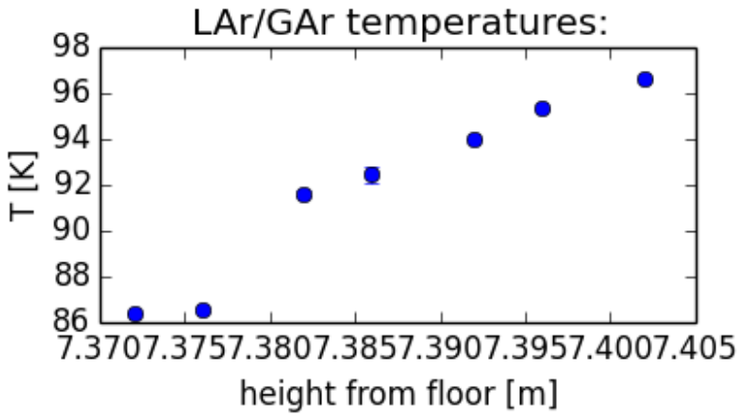
Run: 1415

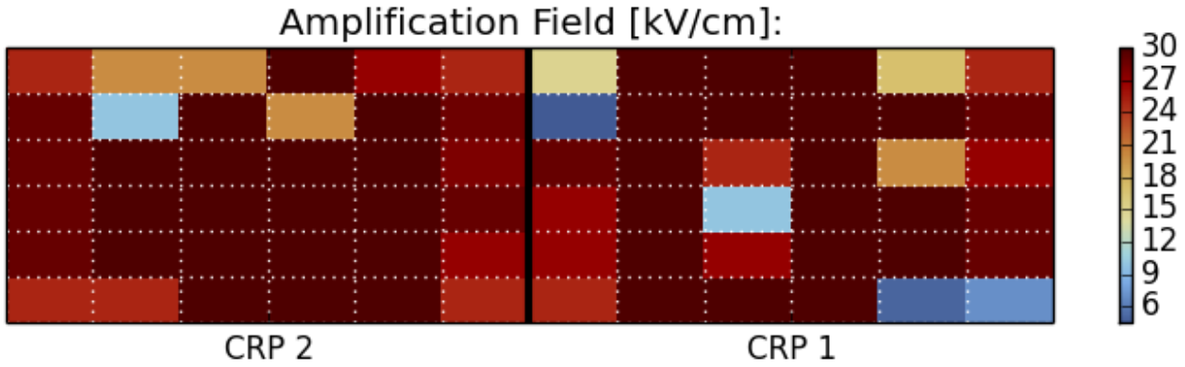
Events: 4824

From: 14-01-2020 18:35:04

To: 14-01-2020 18:43:06







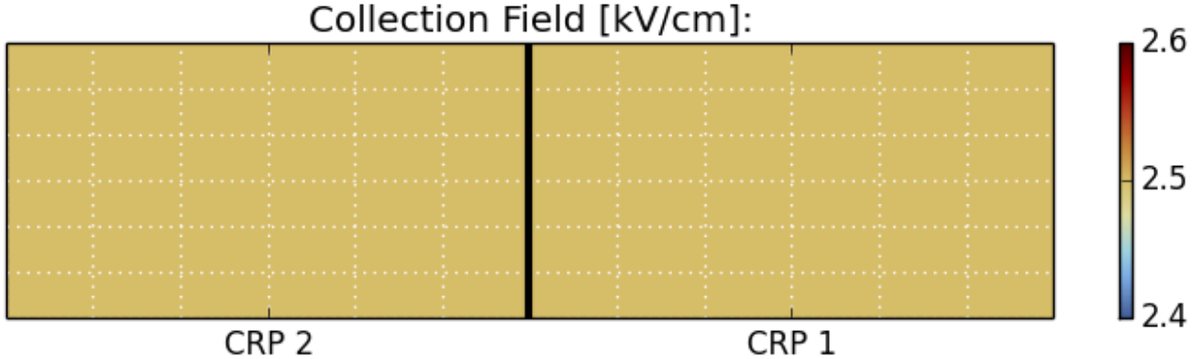
grid voltage [kV]:

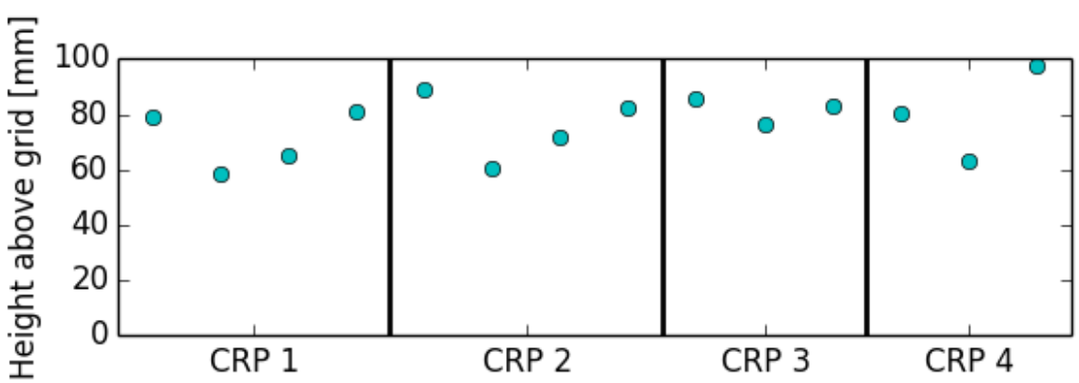
Pressure : 1050 mbar

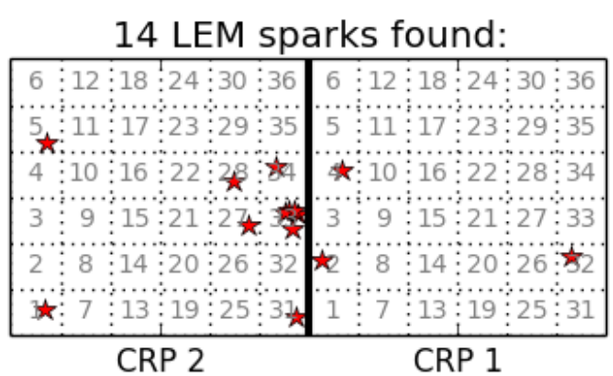
$V_{cath} = 50.02 \pm 0.83$ kV

$V_{ffs} = 4.59 \pm 0.13$ kV

crp 2	crp 1
4.69	4.55
crp 3	**crp 4**
5.00	4.50







Charge Run Monitoring & Summarizing

NB: assumes a nominal Lar height above grid

4. (Bonus) Make a summary plot

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Events: 4824

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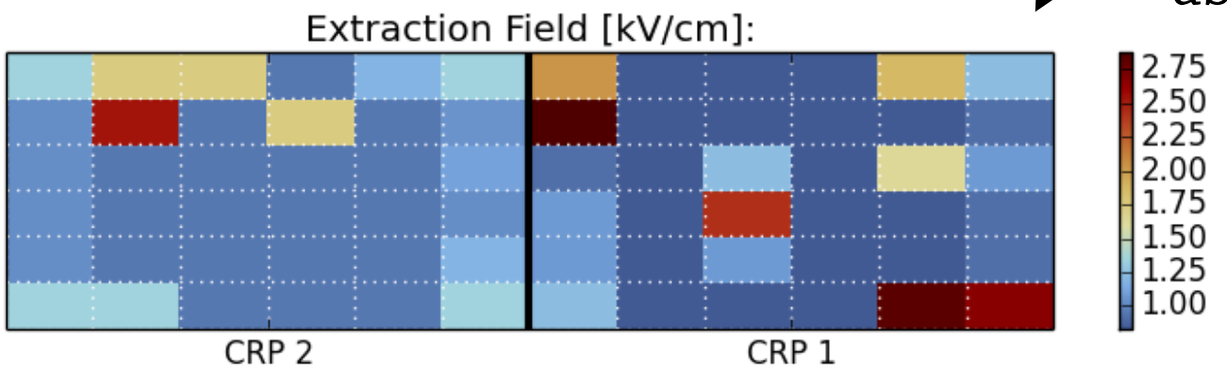
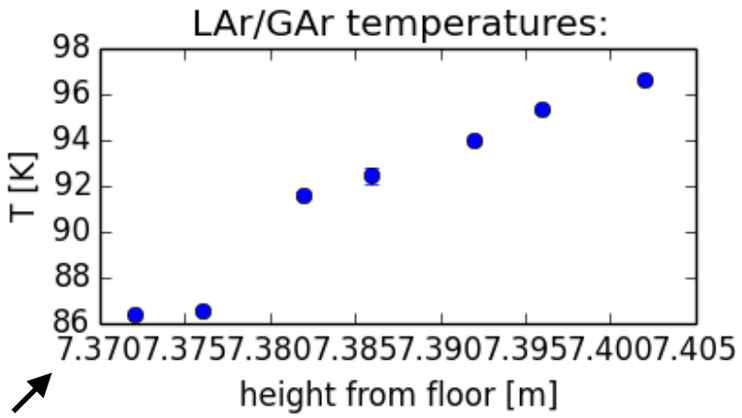
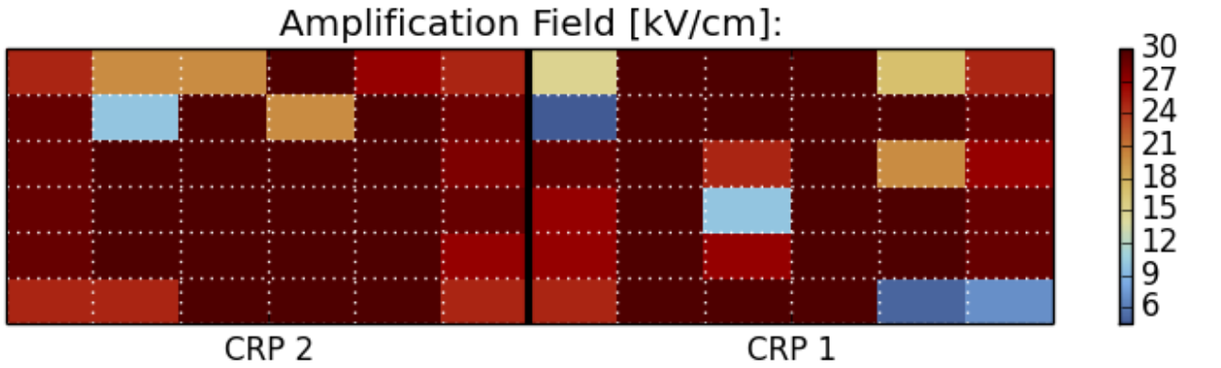
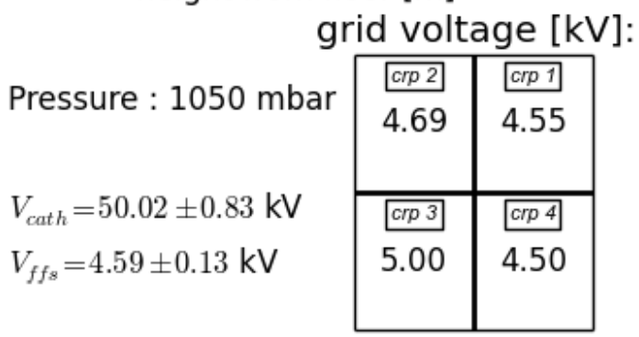
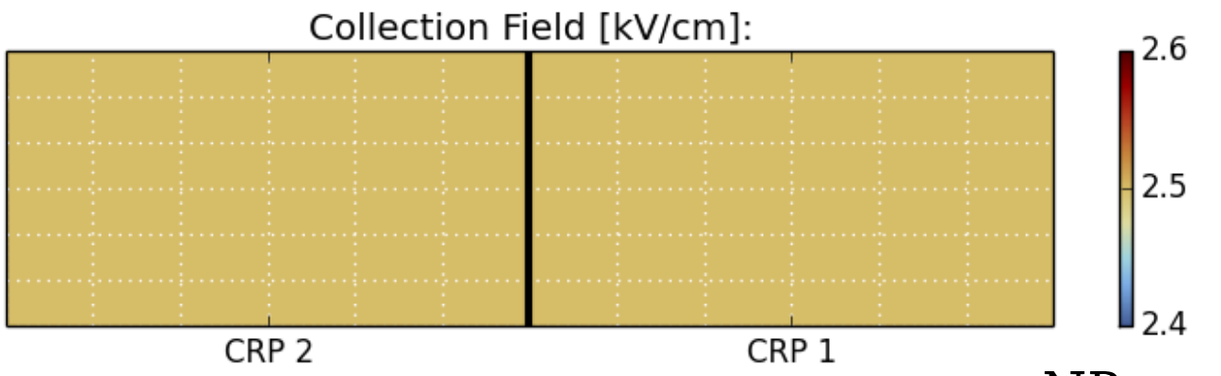


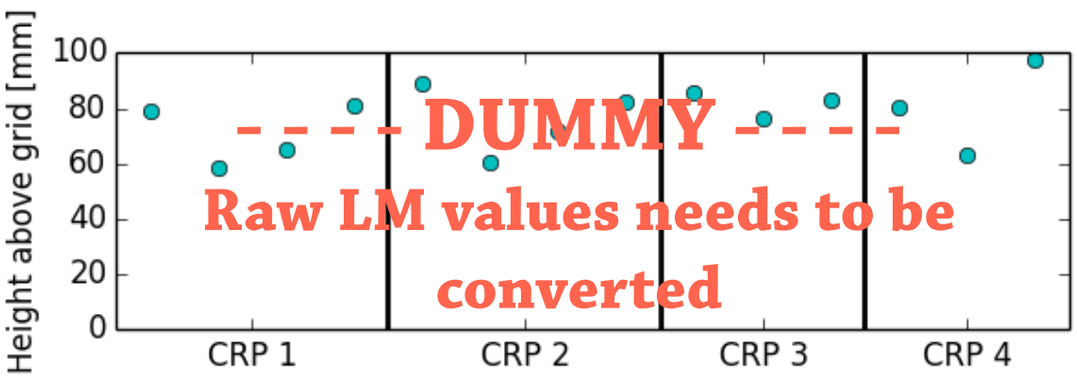


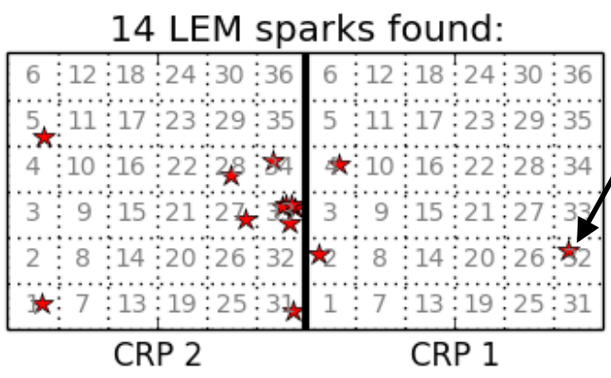


NB: working on a way to change to 'height above liquid'









NB: spark hunter code under test and spark location within a LEM is set randomly!