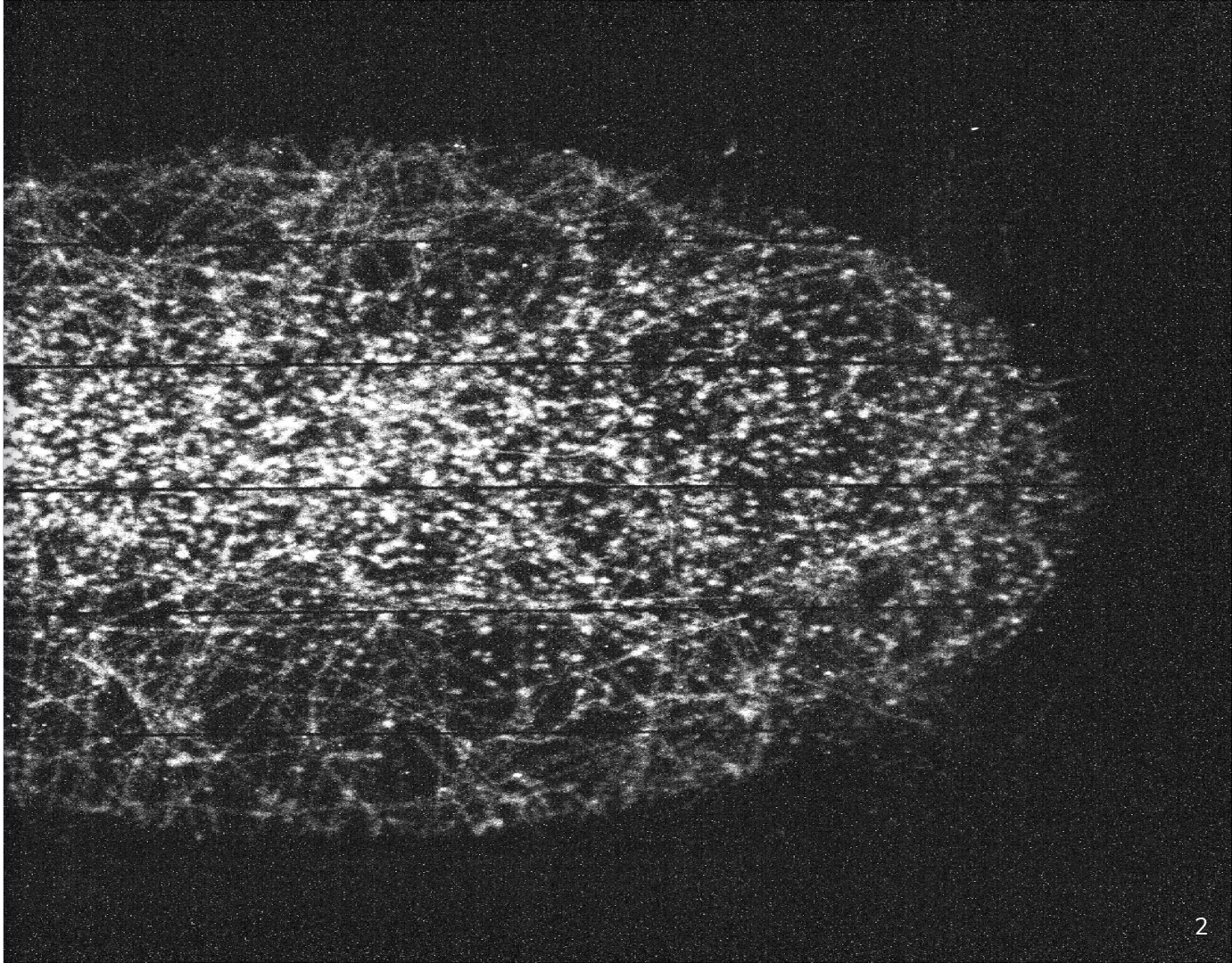
Mini-Tutorial about the reconstruction algorithm

1.

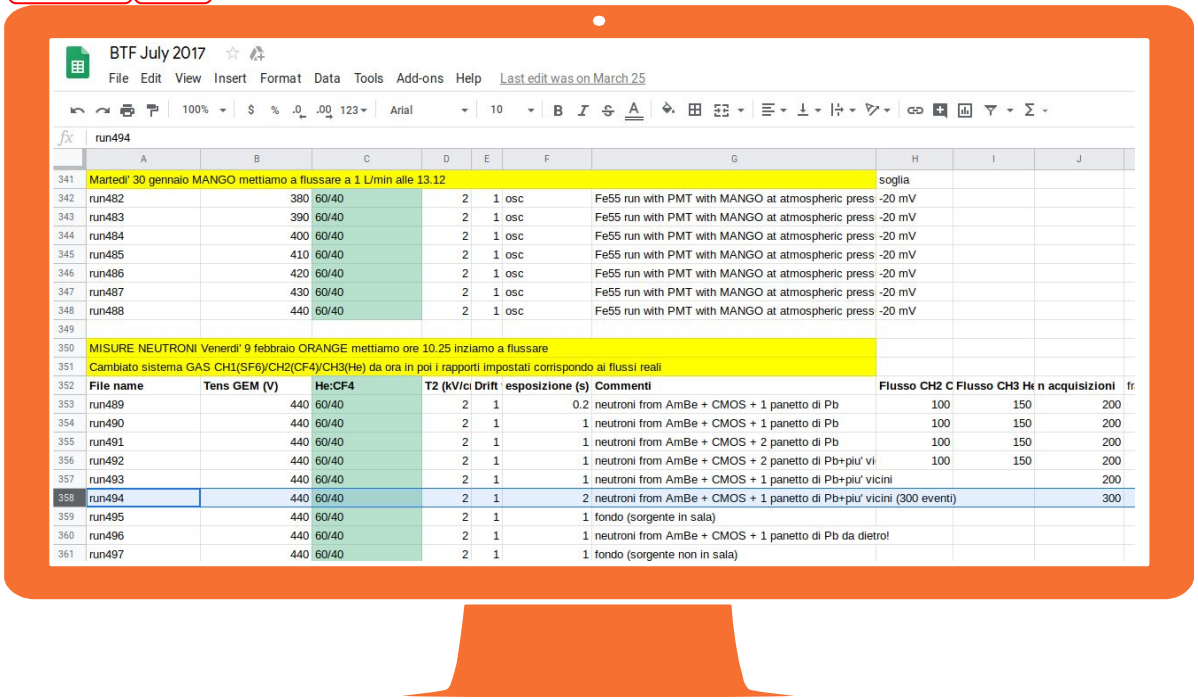
DATA



How to access the data

In this link there is a ‘tutorial’ on how to access the data, but it is almost enough to have the link above and understand some key parameters:

https://swift.cloud.infn.it:8080/v1/AUTH_1e60fe39fba04701aa5ffc0b97871ed8/Cygnus/Data/LTD/Data_Camera/ROOT/histograms_Run01300.root



	A	B	C	D	E	F	G	H	I	J
341	Martedi' 30 gennaio MANGO mettiamo a flussare a 1 L/min alle 13.12							soglia		
342	run482	380	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
343	run483	390	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
344	run484	400	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
345	run485	410	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
346	run486	420	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
347	run487	430	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
348	run488	440	60/40	2	1	osc	Fe55 run with PMT with MANGO at atmospheric press	-20 mV		
349										
350	MISURE NEUTRONI Venerdi' 9 febbraio ORANGE mettiamo ore 10.25 inziamo a flussare									
351	Cambiato sistema GAS CH1(SF6)/CH2(CF4)/CH3(He) da ora in poi i rapporti impostati corrispondo ai flussi reali									
352	**File name**	**Tens GEM (V)**	**He:CF4**	**T2 (kV/c**	**Drift**	**esposizione (s)**	**Commenti**	**Flusso CH2 C**	**Flusso CH3 He**	**n acquisizioni**
353	run489	440	60/40	2	1	0.2	neutroni from AmBe + CMOS + 1 panetto di Pb	100	150	200
354	run490	440	60/40	2	1	1	neutroni from AmBe + CMOS + 1 panetto di Pb	100	150	200
355	run491	440	60/40	2	1	1	neutroni from AmBe + CMOS + 2 panetto di Pb	100	150	200
356	run492	440	60/40	2	1	1	neutroni from AmBe + CMOS + 2 panetto di Pb+piu' vi	100	150	200
357	run493	440	60/40	2	1	1	neutroni from AmBe + CMOS + 1 panetto di Pb+piu' vicini			200
358	run494	440	60/40	2	1	2	neutroni from AmBe + CMOS + 1 panetto di Pb+piu' vicini (300 eventi)			300
359	run495	440	60/40	2	1	1	fondo (sorgente in sala)			
360	run496	440	60/40	2	1	1	neutroni from AmBe + CMOS + 1 panetto di Pb da dietro!			
361	run497	440	60/40	2	1	1	fondo (sorgente non in sala)			

Data Format

The algorithm works with .ROOT files, but some of our old data were in .h5.

Git repository where you can find instructions about how to convert .H5 to .ROOT

Name of the image

Format of the variable

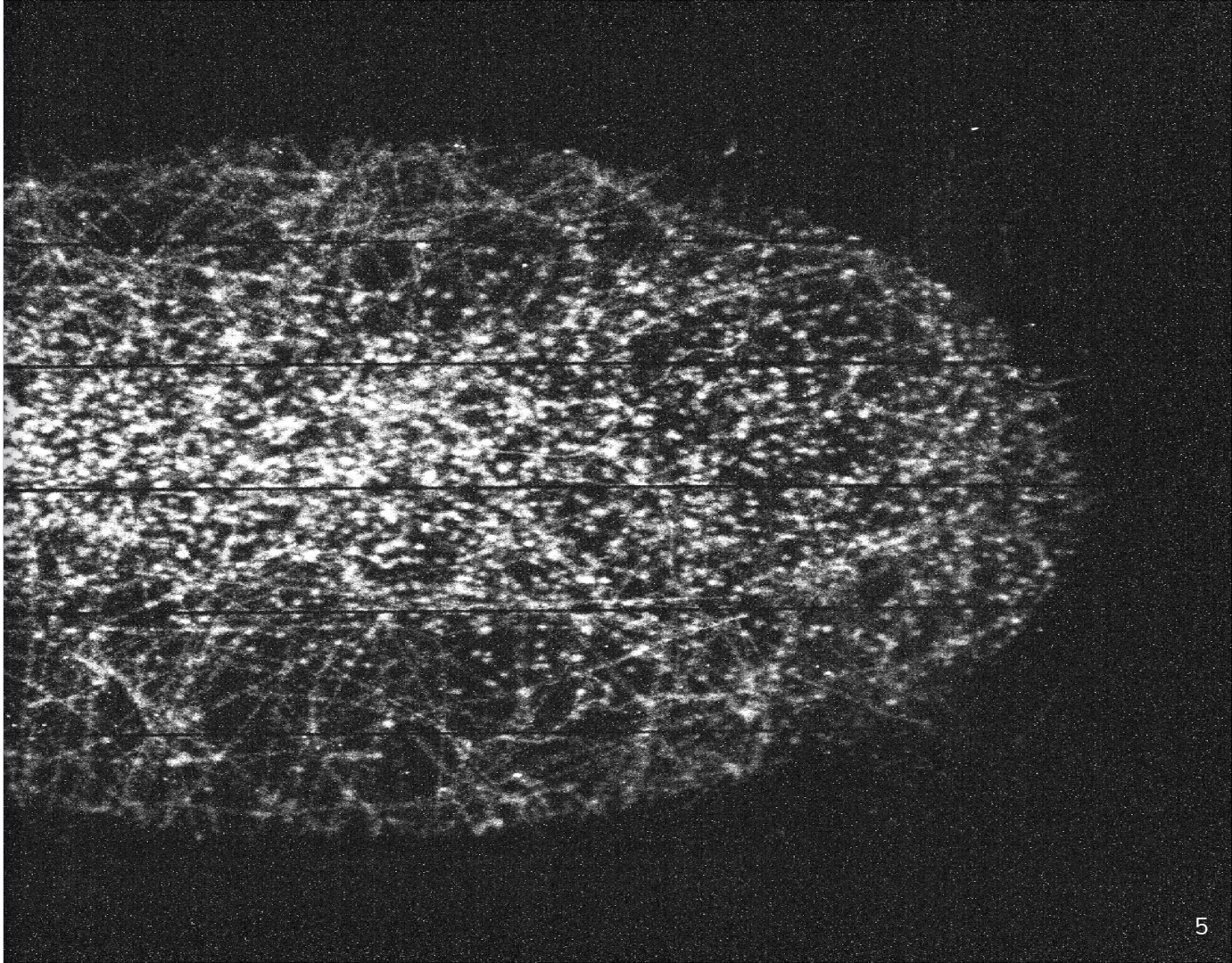
Name of the PMT waveform

Time stamp of the acquisition

```
igorabritta@c-3po:~/Documents/cygno/analysis$ root -l histograms_Run01754.root
root [0]
Attaching file histograms_Run01754.root as _file0...
(TFile *) 0x555a338e4100
root [1] .ls
TFile**         histograms_Run01754.root
 TFile*         histograms_Run01754.root
  KEY: TH2F     pic_run01754_ev0;1      Camera, timestamp 1572880704
  KEY: TGraph   wfm_run01754_ev0;1      PMT, timestamp 1572880704
  KEY: TH2F     pic_run01754_ev1;1      Camera, timestamp 1572880706
  KEY: TGraph   wfm_run01754_ev1;1      PMT, timestamp 1572880706
  KEY: TH2F     pic_run01754_ev2;1      Camera, timestamp 1572880707
  KEY: TGraph   wfm_run01754_ev2;1      PMT, timestamp 1572880707
  KEY: TH2F     pic_run01754_ev3;1      Camera, timestamp 1572880708
  KEY: TGraph   wfm_run01754_ev3;1      PMT, timestamp 1572880708
  KEY: TH2F     pic_run01754_ev4;1      Camera, timestamp 1572880708
  KEY: TGraph   wfm_run01754_ev4;1      PMT, timestamp 1572880708
  KEY: TH2F     pic_run01754_ev5;1      Camera, timestamp 1572880708
  KEY: TGraph   wfm_run01754_ev5;1      PMT, timestamp 1572880708
  KEY: TH2F     pic_run01754_ev6;1      Camera, timestamp 1572880710
  KEY: TGraph   wfm_run01754_ev6;1      PMT, timestamp 1572880710
  KEY: TH2F     pic_run01754_ev7;1      Camera, timestamp 1572880710
  KEY: TGraph   wfm_run01754_ev7;1      PMT, timestamp 1572880710
```

2.

RECONSTRUCTION ALGORITHM



Reconstruction Algorithm

How to run

Running the analysis code: (https://github.com/CYGNUS-RD/analysis)

```
python3 reconstruction.py configFile.txt --pdir plots --max-entries X -jX
```

- configFile.txt is the configuration file with all the settings.
- pdir is the directory where the plots will be saved.
- max-entries is the number of images you want to analyse.
- j is the number of cores you want to use.

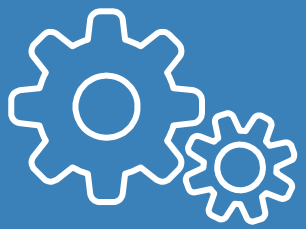
Reconstruction Algorithm

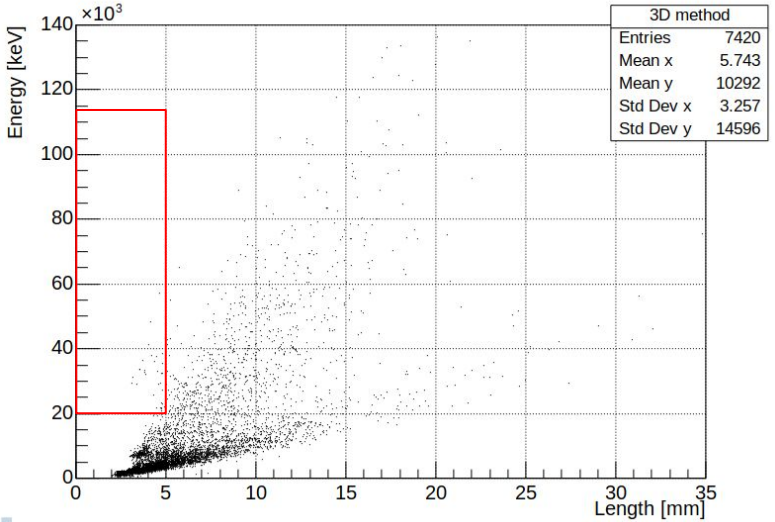
ConfigFile

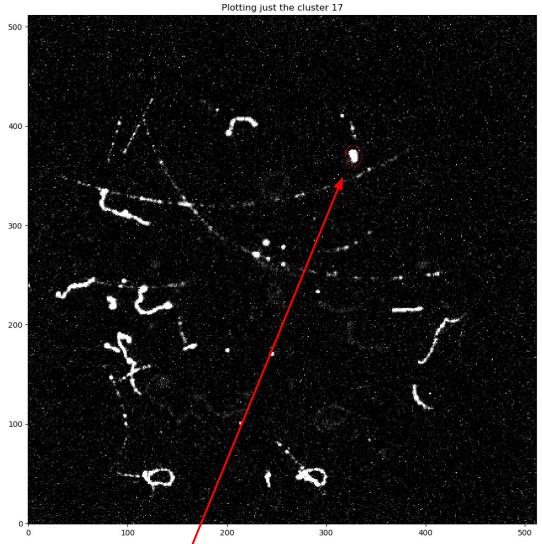
```
{
# DEBUG plots
'debug_mode'          : 0,
'ev'                  : 9,
'nclu'                : -1,        # -1
# Plots that will be made if debug_mode = 1
'flag_full_image'     : 1,
'flag_rebin_image'    : 1,
'flag_edges_image'    : 1,
'flag_first_it'       : 1,
'flag_second_it'      : 1,
'flag_third_it'       : 1,
'flag_stats'          : 1,
'flag_all_it'         : 1,
'flag_plot_noise'     : 1,

# Parameters of the plots
'cmapcolor'           : 'gray',
'figsizeY'            : 12,
'figsizeX'            : 12,

# Setting environments parameters

'numPedEvents'        : -1,
'pedExclRegion'       : None,
'rebin'               : 4,
'nsigma'              : 1.5,
'cimax'               : 200,                    # Upper threshold
'pedexposure'         : 40,
'justPedestal'        : False,
'dir'                 : '',
'run'                 : '01750',                # uses always 5 characters
'daq'                 : 'midas',                # DAQ type (btf/h5/midas)
'type'                : 'neutrons',             # events type (beam/cosmics/neutrons)

'excImages'           : [0,1,2,3,4,5],#[41, 42, 82, 83, 92, 93, 94, 95],                    # To exlude some images of the analysis.
Always exclude the first 5 which are messy
'min_neighbors_average' : 3.5,     # cut on the minimum average energy around a pixel (remove isolated macro-pixels)

# Setting i2DBSCAN parameters

'iterative'           : 4,
'tip'                 : '3D',
'vector_eps'          : [1,   2.5,  5.8,  4], #[ 1,   2,  3.2,  5], # [ 3,    6.5,  7,  7.5], # [2.26, 3, 3.5, 4],
'vector_min_samples'  : [1, 104, 30, 20], #[5, 100, 40, 50] , # [30,  1180,  360, 80],  # [30,  55,  28, 13],
'cuts'                : [375, 100]
}
```

Reconstruction Algorithm

Debug_mode








```
root [2] Events->Scan("run:event:track_nclu:track_length*55E-3:track_integral*0.75","track_integral*0
.75>20000 & track_length*55E-3<5")
************************************************************************************
*    Row   * Instance *       run *     event * track_ncl * track_len * track_int *
************************************************************************************
*      4 *        6 *       494 *         6 *        17 * 4.8893549 * 27757.148 *
*     14 *        2 *       494 *        16 *         0 * 4.0427966 * 48761.736 *
*     19 *        9 *       494 *        21 *         0 * 3.8139196 * 32487.052 *
*     22 *        4 *       494 *        24 *         1 * 4.9362495 * 43711.327 *
*     25 *        6 *       494 *        27 *         1 * 3.4109720 * 28846.183 *
*     33 *        8 *       494 *        35 *        12 * 4.5680405 * 21985.170 *
*     34 *        6 *       494 *        36 *         0 * 4.8952463 * 39074.504 *
*     48 *        5 *       494 *        52 *         8 * 4.3210306 * 25252.456 *
*     49 *        3 *       494 *        53 *         3 * 4.9364249 * 42969.975 *
*     49 *        4 *       494 *        53 *         1 * 4.3500047 * 37232.024 *
*     51 *       16 *       494 *        55 *        16 * 4.4667538 * 21501.802 *
*     52 *        8 *       494 *        56 *         8 * 4.7843172 * 22894.365 *
*     54 *        5 *       494 *        58 *         0 * 4.4088862 * 37230.246 *
*     57 *        4 *       494 *        61 *         2 * 4.7996802 * 32456.346 *
*     62 *        3 *       494 *        66 *         0 * 4.1378918 * 41015.452 *
*     62 *        7 *       494 *        66 *         1 * 4.5467575 * 32602.816 *
*     63 *        1 *       494 *        67 *         1 * 4.7175780 * 57349.359 *
*     69 *        5 *       494 *        73 *         0 * 3.5430604 * 34033.148 *
*     69 *        6 *       494 *        73 *         1 * 3.7676955 * 33045.644 *
*     73 *        7 *       494 *        77 *         0 * 3.2543413 * 31000.183 *
*     75 *        8 *       494 *        79 *         9 * 4.6355996 * 21137.579 *
*     79 *        4 *       494 *        85 *         0 * 3.6963212 * 35750.797 *
*     82 *        7 *       494 *        88 *         7 * 4.7110064 * 22321.372 *
*     83 *        6 *       494 *        89 *         1 * 3.0887208 * 28921.207 *
*     87 *        4 *       494 *        97 *         3 * 4.8508697 * 23288.512 *
```