

Channel classification instruction v5

Cheng-Wei Shih, Chia-Ming Kuo

National Central University, Taiwan

2021/7/15



New feature

- New plot in “summary_plot_time.pdf”
- Entry & gaussian_width of each channel are stored in root file.

Procedures

- Create a folder, make sure it has
 - run.sh
 - summary_plot.c
 - calibration_ana_code_multi.c
 - check_chip_prototypeMaximam_new.c
 - All “.dat” files (not .root file), 10 runs is enough.

Example

```
[5202011@chip01 INTT_multi_run_v2_test3]$ ls
NCU_fphx_raw_module_268_20210610-1132_0.dat  NCU_fphx_raw_module_268_20210610-1209_0.dat  NCU_fphx_raw_module_268_20210610-1246_0.dat
NCU_fphx_raw_module_268_20210610-1137_0.dat  NCU_fphx_raw_module_268_20210610-1215_0.dat  calibration_ana_code_multi.c
NCU_fphx_raw_module_268_20210610-1143_0.dat  NCU_fphx_raw_module_268_20210610-1220_0.dat  check_chip_prototypeMaximam_new.c
NCU_fphx_raw_module_268_20210610-1148_0.dat  NCU_fphx_raw_module_268_20210610-1225_0.dat  run.sh
NCU_fphx_raw_module_268_20210610-1153_0.dat  NCU_fphx_raw_module_268_20210610-1231_0.dat  summary_plot.c
NCU_fphx_raw_module_268_20210610-1159_0.dat  NCU_fphx_raw_module_268_20210610-1236_0.dat
NCU_fphx_raw_module_268_20210610-1204_0.dat  NCU_fphx_raw_module_268_20210610-1241_0.dat
[5202011@chip01 INTT_multi_run_v2_test3]$
```

Root version : 6.01

Procedures

- Before run the code, please modify “run.sh”

Number of root files

```
folder_direction="/home/5202011/INTT_cal/INTT_cal_test/INTT_multi_run_v2_test"
number_of_file=15
merge_file_name="aaa_test_summary"
module_ID=2

rm multi_run_status.txt
rm $merge_file_name.root
echo 1
sleep 15

ls *.dat > dat_file.txt
sleep 15

let number_for_final=number_of_file-1

for seed in $(seq 0 $number_for_final)
do
    cp check_chip_prototypeMaximam_new.c check_chip_prototypeMaximam_new_copy.c
    sed -i "s/data_index/${seed}/g" check_chip_prototypeMaximam_new_copy.c
    root -l -b -q check_chip_prototypeMaximam_new_copy.c\($module_ID\)
    rm check_chip_prototypeMaximam_new_copy.c
    sleep 15
done

ls *.root > total_file.txt
sleep 15

for seed in $(seq 0 $number_for_final)
do
    cp calibration_ana_code_multi.c calibration_ana_code_multi_copy.c
    sed -i "s/data_index/${seed}/g" calibration_ana_code_multi_copy.c
    root -l -b -q calibration_ana_code_multi_copy.c\($folder_direction\,$module_ID,true,false,0,true,false,false,true\)
    rm calibration_ana_code_multi_copy.c
    sleep 15
done

sleep 15
hadd $merge_file_name.root */*_summary.root

sleep 15
root -l -b -q summary_plot.c\($number_of_file,\"$folder_direction\", \"$merge_file_name\")
```

Folder direction

Name of final merged root file

Module ID

Variables descriptions are in next slide

← Merge all output files

Procedures

```
#Variable of calibration_ana_code_multi.c :  
#Variable 1 : TString, folder direction  
#Variable 2 : int, port_ID,  
#Variable 3 : bool, output the adc-ampl plot for each channel (should be true)  
#Variable 4 : bool, original unbond channel check (should be false)  
#Variable 5 : int, overall ampl noise level check (0 can be good)  
#Variable 6 : bool, output offset ampl distribution plot for each channel (should be true)  
#Variable 7 : bool, cout unbonded channel status @ without bias run. (should be false)  
#Variable 8 : bool, cout wider gaus width channel @ with bias run. (should be false)  
#Variable 9 : bool, output multi_run_status.txt (should be true)
```

Variable 3 & 6 : if “false” -> no plots created, can be faster

- After modification, please run “run.sh” → “. run.sh”
 - It takes ~ 15 mins to finish 20 root files.

Procedures

- Two files and a lot folders will be created after the run
 - Two files : `aaa_test_summary.root` & `multi_run_status.txt`
 - One “.root file” will be created in each folder of each run to record the status of the problematic channels.
- 3 final summary plots and un-functional channels status will be created and printed, examples are shown in next slide.
 - 3 final summary plots :
 - `Summary_noise.pdf`
 - `Summary_entry.pdf`
 - `Summary_plots_time.pdf`

Final overall results

Channels failed in noise criteria

```
Noise channel found, chip : 2   channel : 0   failed times : 13/20   ratio : 0.65
Noise channel found, chip : 7   channel : 12   failed times : 20/20   ratio : 1
Noise channel found, chip : 19  channel : 36   failed times : 20/20   ratio : 1
~~~~~
Noise channel, chip : 2 channel : 0
failed in file index : 2   file name : fphx_raw_20210428-1320_0.root, gaus width : 46.9425
failed in file index : 3   file name : fphx_raw_20210428-1321_0.root, gaus width : 78.376
failed in file index : 4   file name : fphx_raw_20210428-1322_0.root, gaus width : 4.47558
failed in file index : 5   file name : fphx_raw_20210428-1324_0.root, gaus width : 4.59855
failed in file index : 6   file name : fphx_raw_20210428-1331_0.root, gaus width : 75.7756
failed in file index : 7   file name : fphx_raw_20210428-1332_0.root, gaus width : 32.8639
failed in file index : 8   file name : fphx_raw_20210428-1333_0.root, gaus width : 38.3274
failed in file index : 11  file name : fphx_raw_20210428-1654_0.root, gaus width : 147.086
failed in file index : 12  file name : fphx_raw_20210428-1656_0.root, gaus width : 127.588
failed in file index : 14  file name : fphx_raw_20210428-1659_0.root, gaus width : 4.8683
failed in file index : 15  file name : fphx_raw_20210428-1700_0.root, gaus width : 4.15262
failed in file index : 17  file name : fphx_raw_20210428-1703_0.root, gaus width : 4.41939
failed in file index : 19  file name : fphx_raw_20210428-1706_0.root, gaus width : 33.9221
~~~~~
```

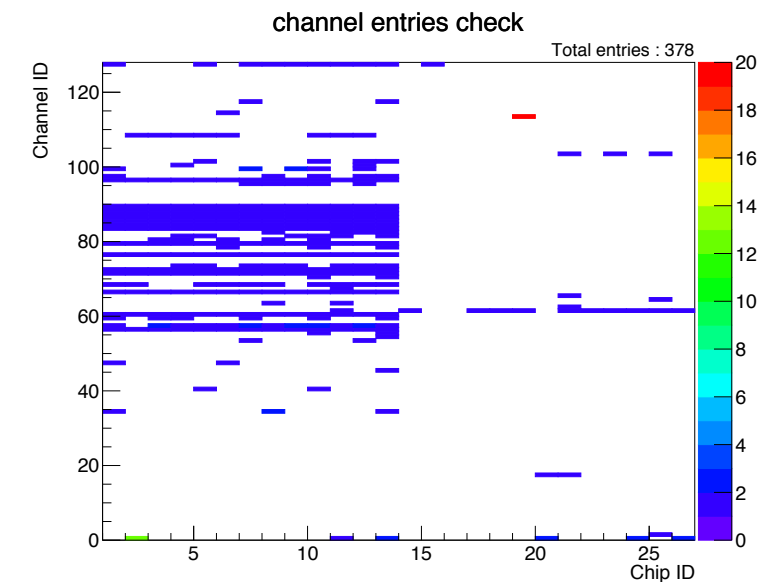
Channels failed in entry criteria

```
~~~~~
Weird entries found, chip : 2   channel : 0   failed times : 12/20   ratio : 0.6
Weird entries found, chip : 19  channel : 113 failed times : 20/20   ratio : 1
~~~~~
Bad entries channel, chip : 2 channel : 0
bad in file index : 2   file name : fphx_raw_20210428-1320_0.root, entries : 4410
bad in file index : 3   file name : fphx_raw_20210428-1321_0.root, entries : 5820
bad in file index : 5   file name : fphx_raw_20210428-1324_0.root, entries : 645
bad in file index : 6   file name : fphx_raw_20210428-1331_0.root, entries : 7557
bad in file index : 7   file name : fphx_raw_20210428-1332_0.root, entries : 2104
bad in file index : 8   file name : fphx_raw_20210428-1333_0.root, entries : 4062
bad in file index : 11  file name : fphx_raw_20210428-1654_0.root, entries : 20615
bad in file index : 12  file name : fphx_raw_20210428-1656_0.root, entries : 17784
bad in file index : 14  file name : fphx_raw_20210428-1659_0.root, entries : 569
bad in file index : 15  file name : fphx_raw_20210428-1700_0.root, entries : 422
bad in file index : 17  file name : fphx_raw_20210428-1703_0.root, entries : 467
bad in file index : 19  file name : fphx_raw_20210428-1706_0.root, entries : 2125
~~~~~
```

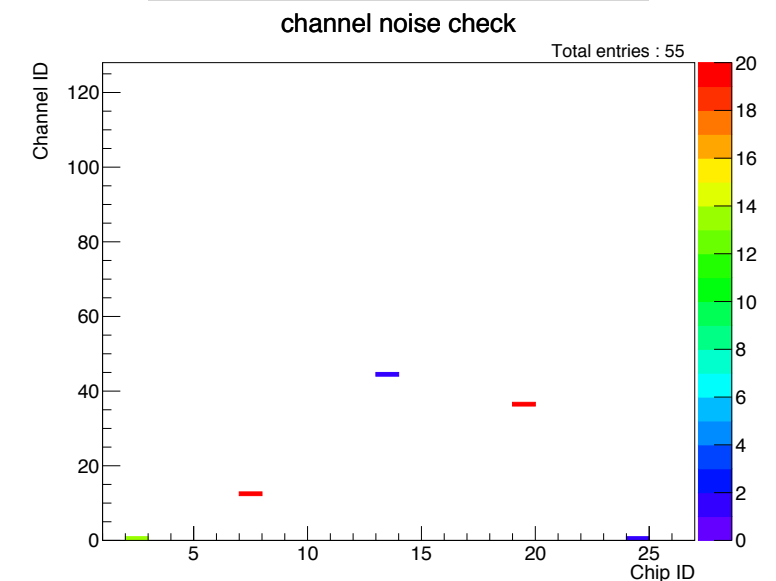
```
===== Final summary =====
# of noise channels : 3
# of bad entry chan : 2
# of double counting: 1

Total bad channels : 4
Overall good channel ratio : 3324 / 3328 = 99.880% Final result
===== Final summary =====
```

Summary_entry.pdf



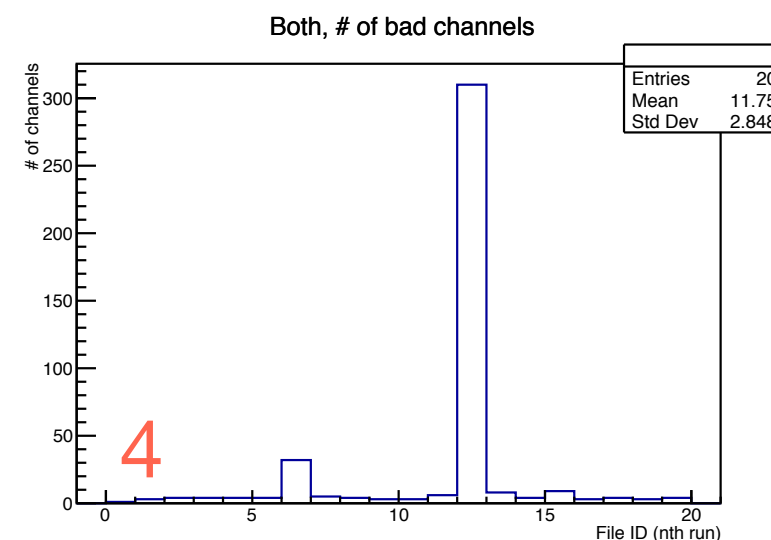
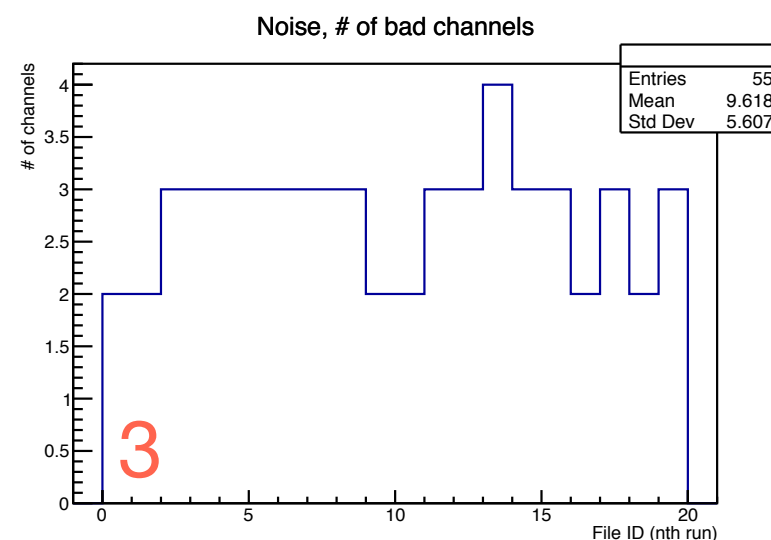
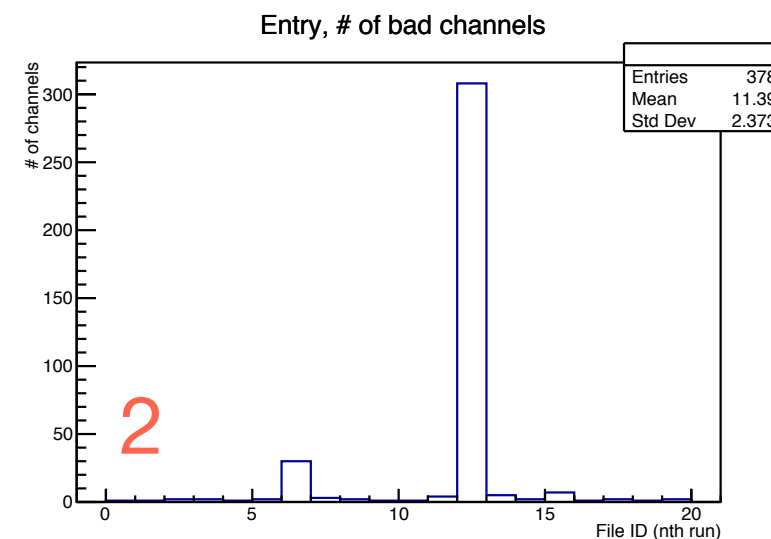
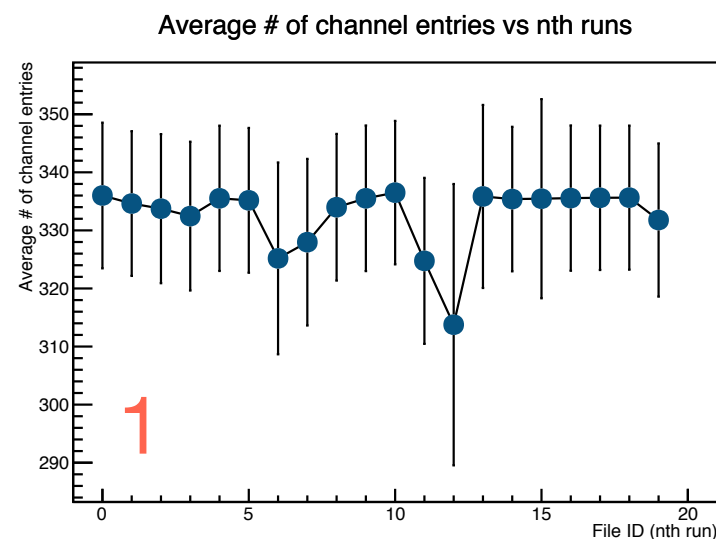
Summary_noise.pdf



Principle : the less entries in the plot, the better performance it is

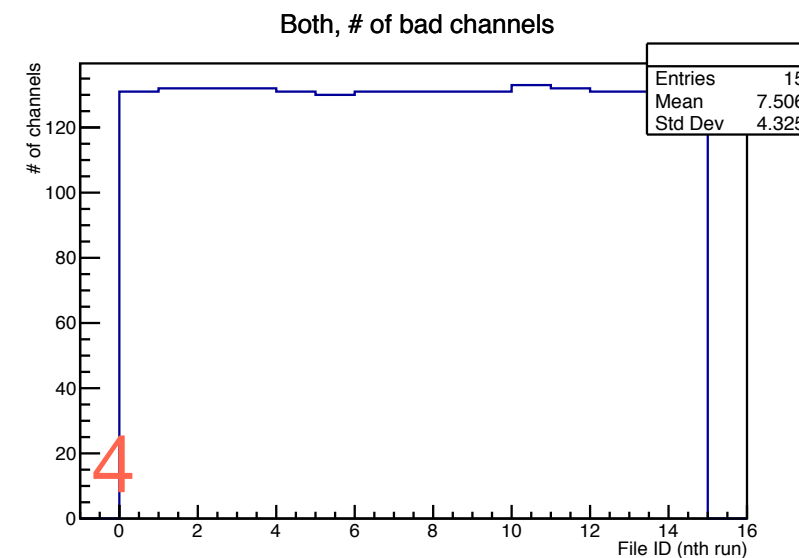
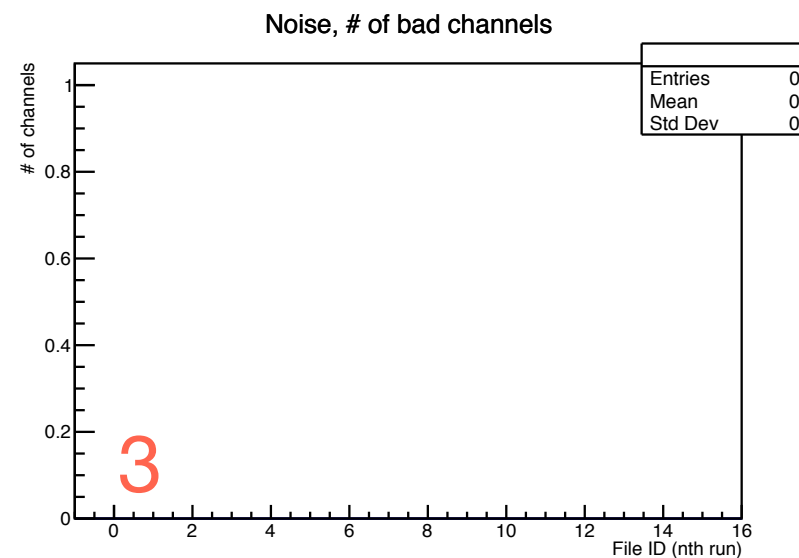
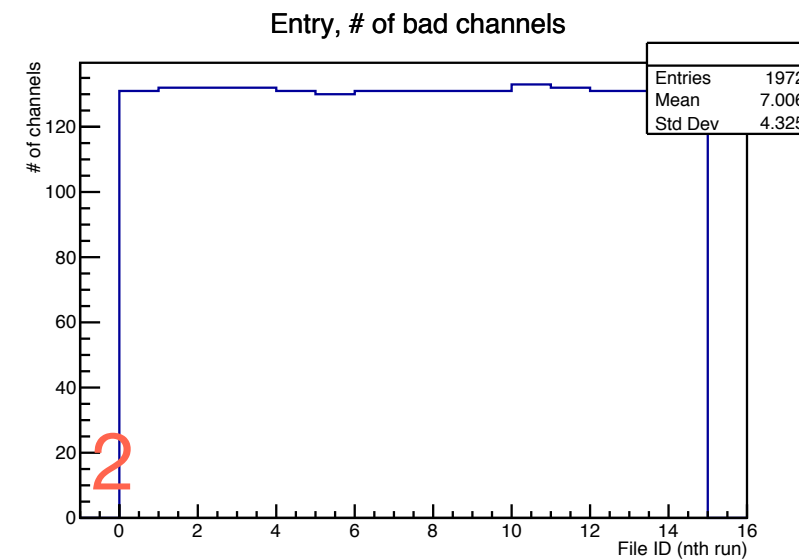
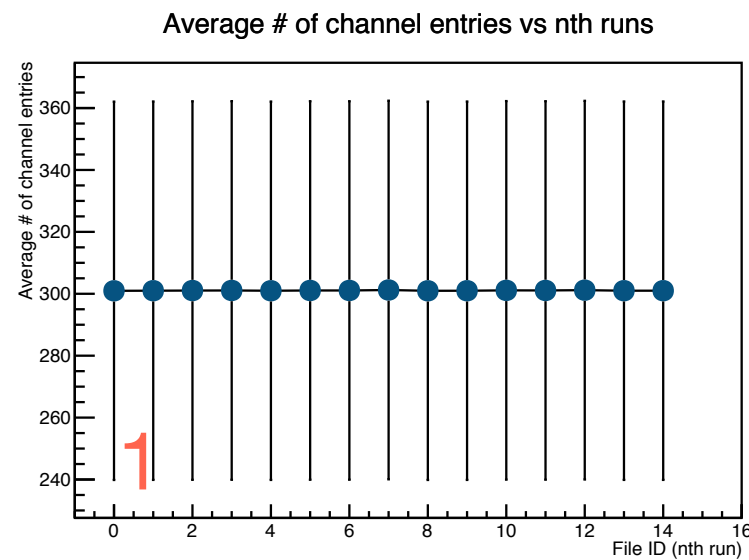
Final overall results : Summary_plots_time.pdf

- Summary_plots_time.pdf contents 4 plots
- Plot 1 : Average # of channel entries vs file ID
- Plot 2 : # of channels fail in **entry** criterion vs file ID.
- Plot 3 : # of channels fail in **noise** criterion vs file ID.
- Plot 4 : # of **bad** channels criterion vs file ID. (No double counting)



Final overall results : Summary_plots_time.pdf

- If the Testbench system is stable, the plot 1 should be a horizontal line.



Root file of introduction

- Each “.dat file” corresponds to one output root file.
- Example :
“NCU_fphx_raw_module_268_20210610-1246_0.dat”
corresponds to
“NCU_fphx_raw_module_268_20210610-1246_0.root_summary.root”
in folder
“folder_NCU_fphx_raw_module_268_20210610-1246_0.root”
- Tree “chan_gaus_width” : the gaus_width of each channel (entry : 3328)
- Tree “chan_entry” : # of events of each channel (entry : 3328)

source_id = file_id

Row	source_id	chip_id	chan_id	chan_entr
0	14	1	0	336
1	14	1	1	299
2	14	1	2	320

⋮

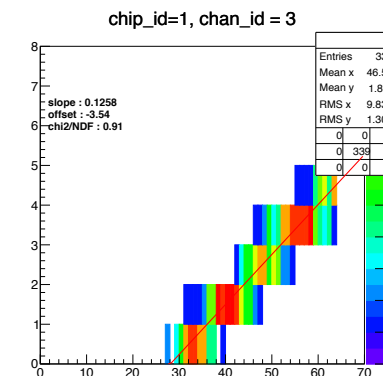
Criteria of bad channel

- # of input files > 10 files.
- Single channel is tested by 2 criteria :
 - Entry :
 - If channel with entry < 280 OR entry > 400.
 - If it happens more than 2 times in all calibration runs -> Bad.
 - Noise :
 - If channel with fit gaussian width > 4.
 - If it happens more than 2 times in all calibration runs -> Bad.
- If channel fails in both criteria, it is counted by 1 only.
 - No double counting.

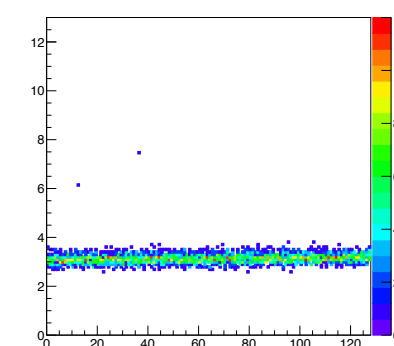
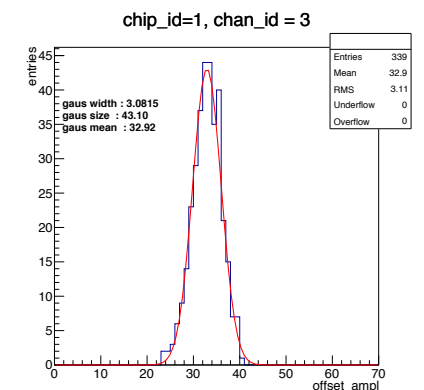
Plot descriptions

There are a lot of plots in each folder created by “. run.sh”. Here I introduce some plots I frequently check

- chipX_detail_ampladc.pdf
 - Ampl - ADC response for single channel
 - 128 pages for 128 channels
- chipX_detail_amploffset.pdf
 - Ampl width distribution after offset, single channel.
 - 128 pages for 128 channels
- ampl_adc_width_detial_TH2.pdf
 - Overall gaus width status of half-ladder.
 - Entries of plot : $128 \times 26 = 3328$



X axis : ampl,
Y axis : ADC

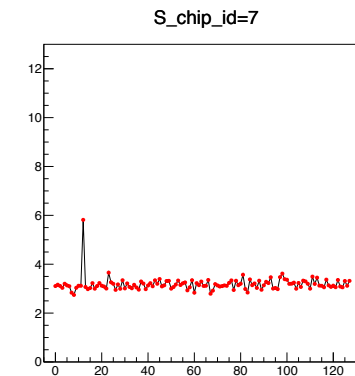


X axis : Channel,
Y axis : Gaussian width

Plot descriptions

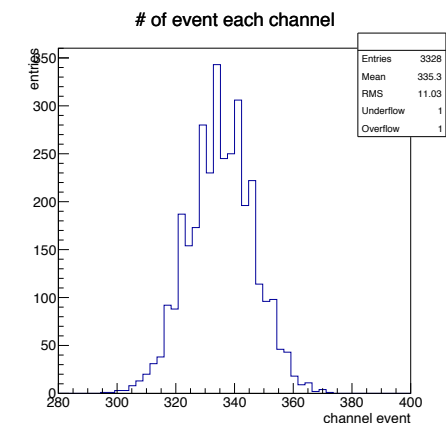
There are a lot of plots in each folder created by “. run.sh”. Here I introduce some plots I frequently check

- ampl_adc_width_detial.pdf
 - Overall gaus width status of each chip
 - 26 pages in total
- channel_entries.pdf
 - Distribution of # of events of each channel
 - Entries : $26 \times 128 = 3328$



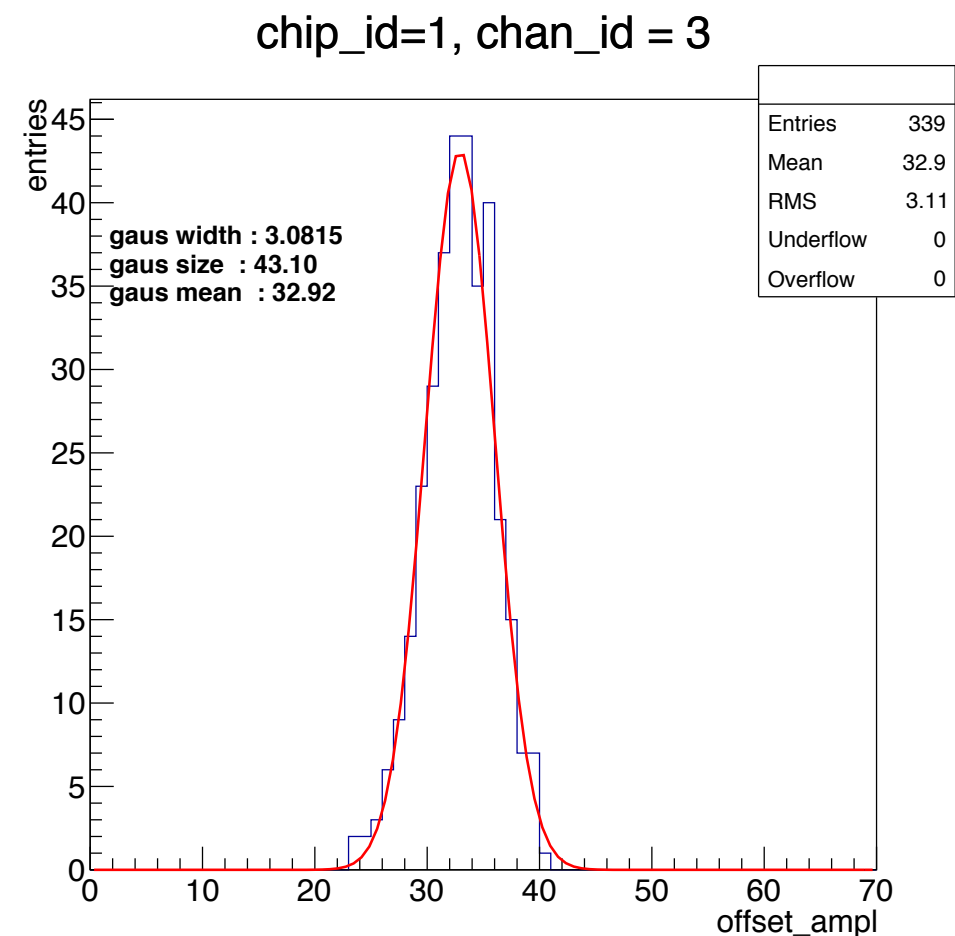
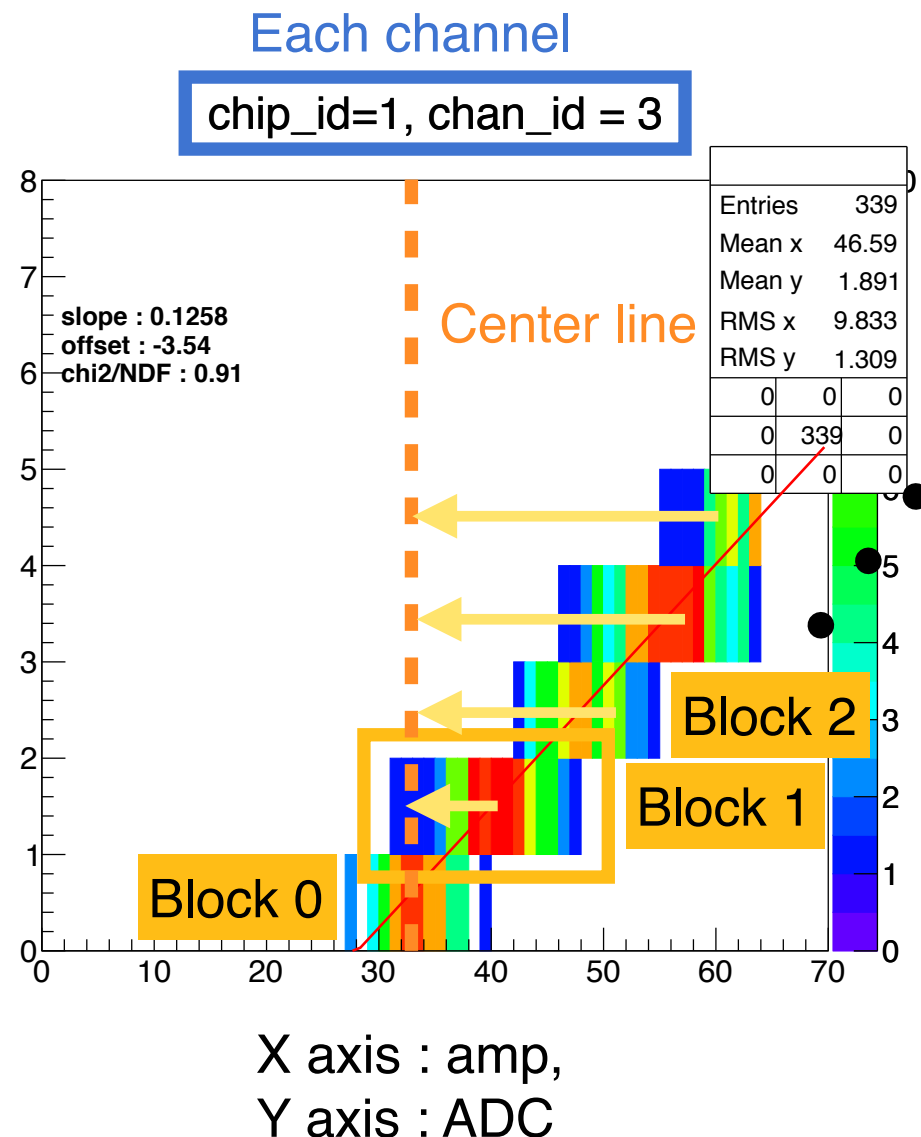
of data points : 128

X axis : Channel,
Y axis : Gaussian width



Algorithm introduction

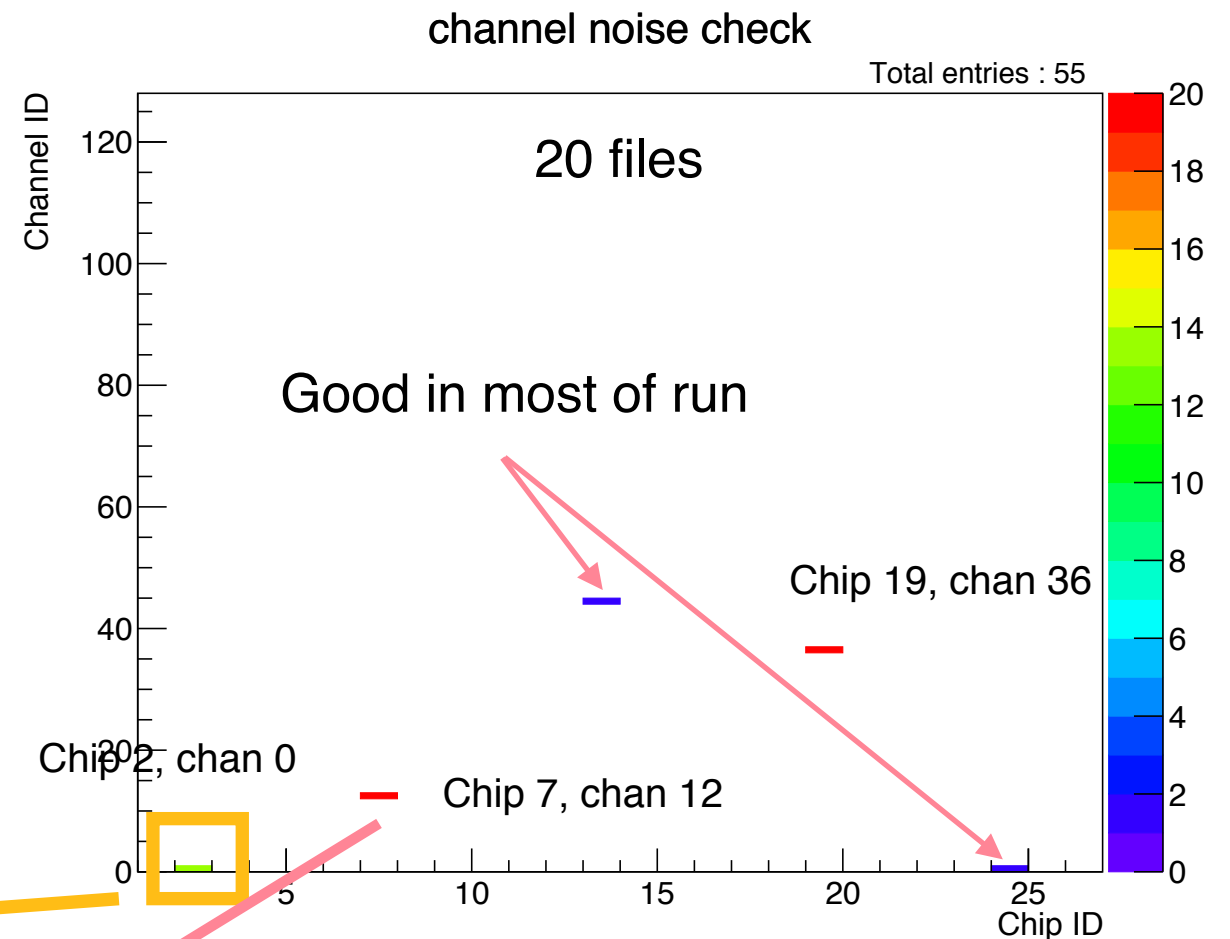
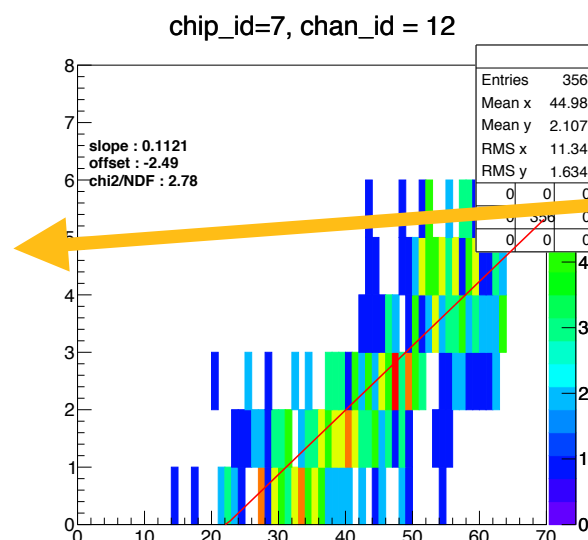
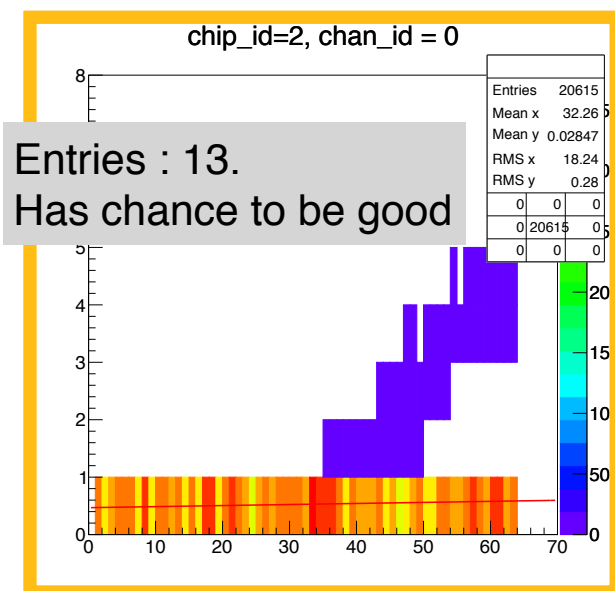
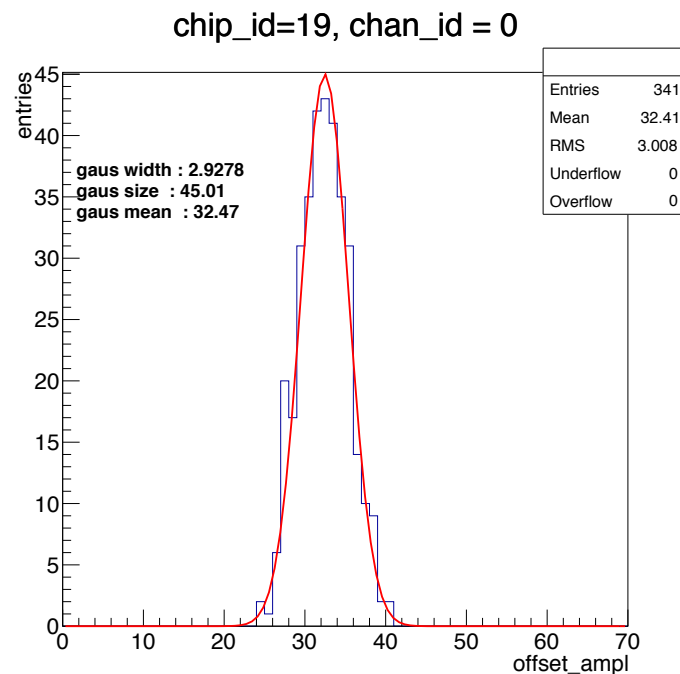
- For each channel of each chip :
 - Center line : mean of events in “Block 0” (ADC==0)
 - Center of the rest blocks are panned to center line.
 - Amount of movement : Mean of each block - center line
 - Each event is filled in TH1F, and fit with gaussian.



Algorithm introduction

- Update of my algorithm, 2 criteria : noise and entries

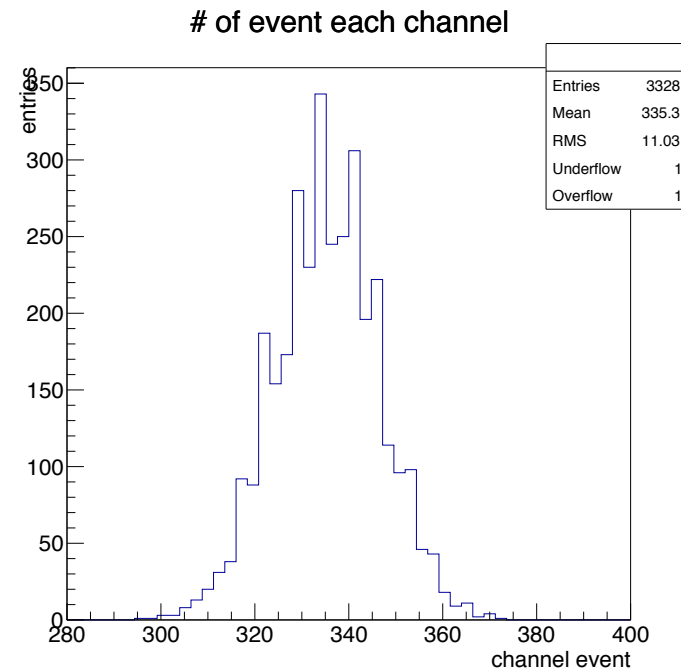
Gaus width > 4 will be shown in right plot



The less entries in plot, better performance it is.

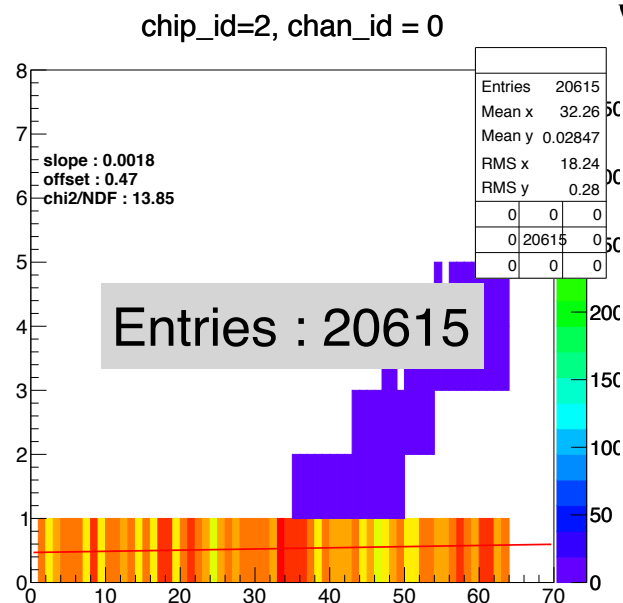
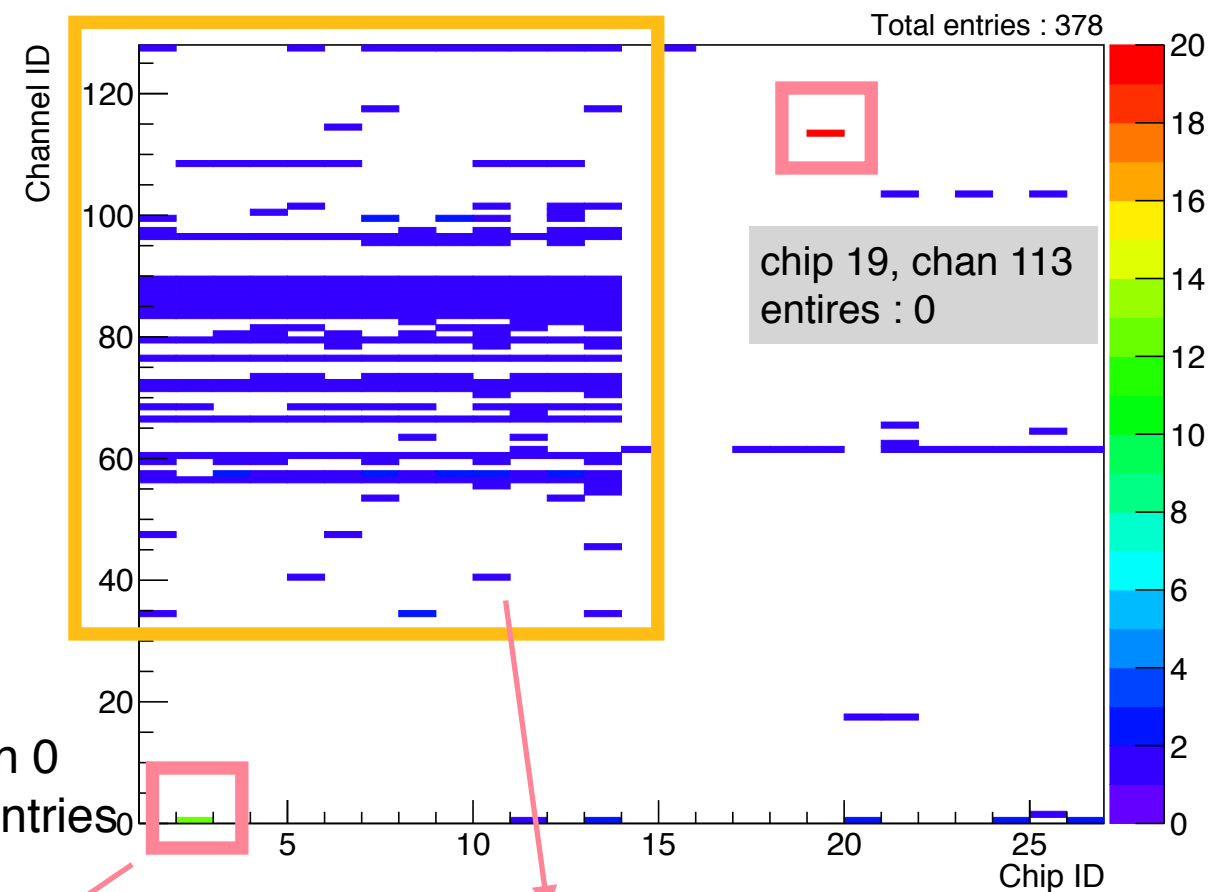
Algorithm introduction

of event of each channel ~ 330

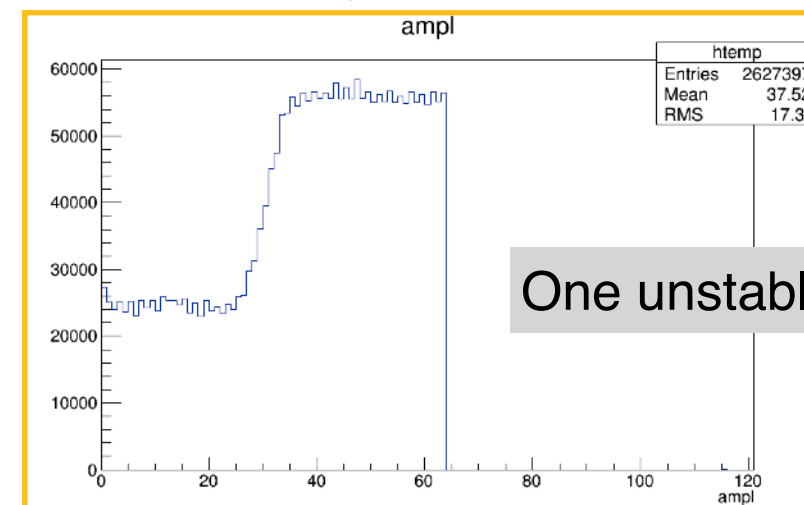


of event > 400 or < 280 will be filled in the plot

channel entries check



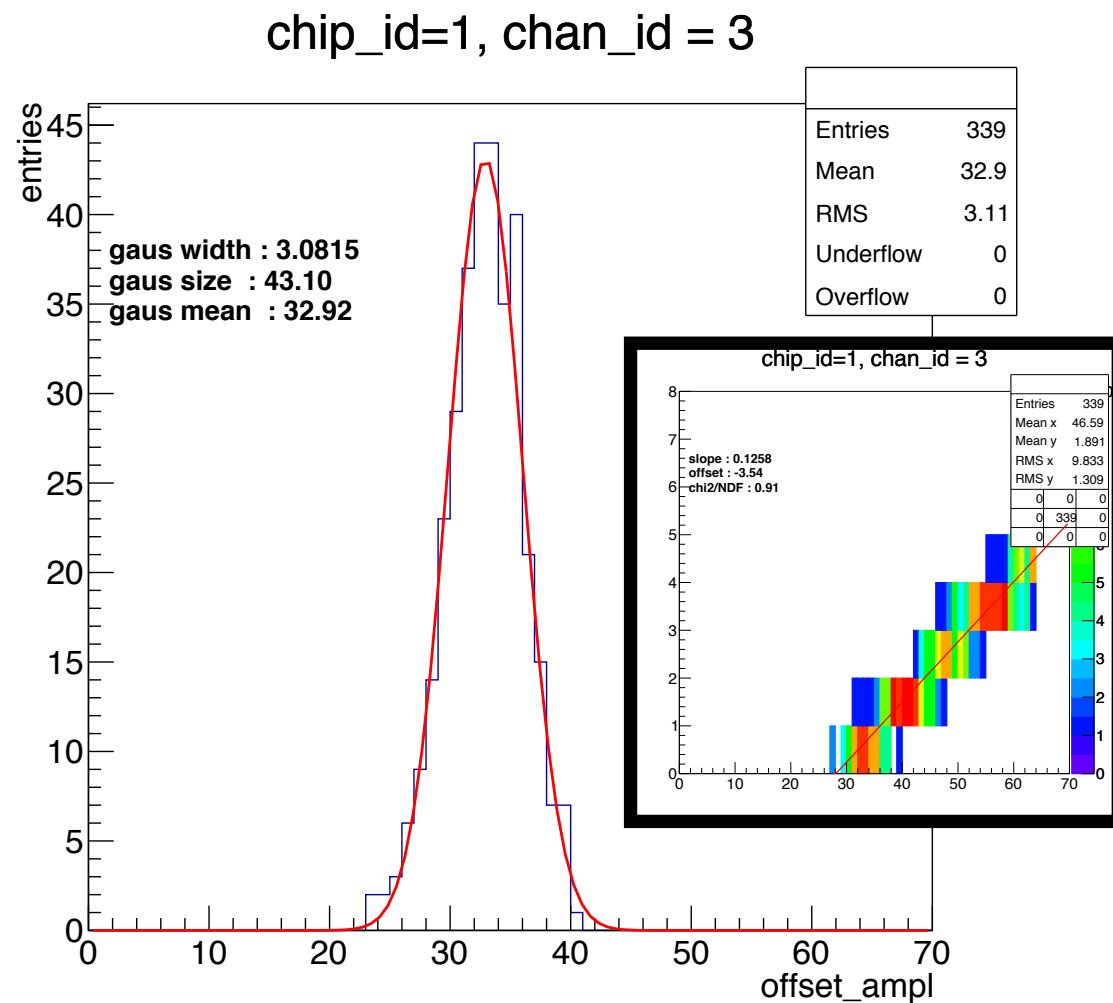
chip 2, chan 0
Very high entries



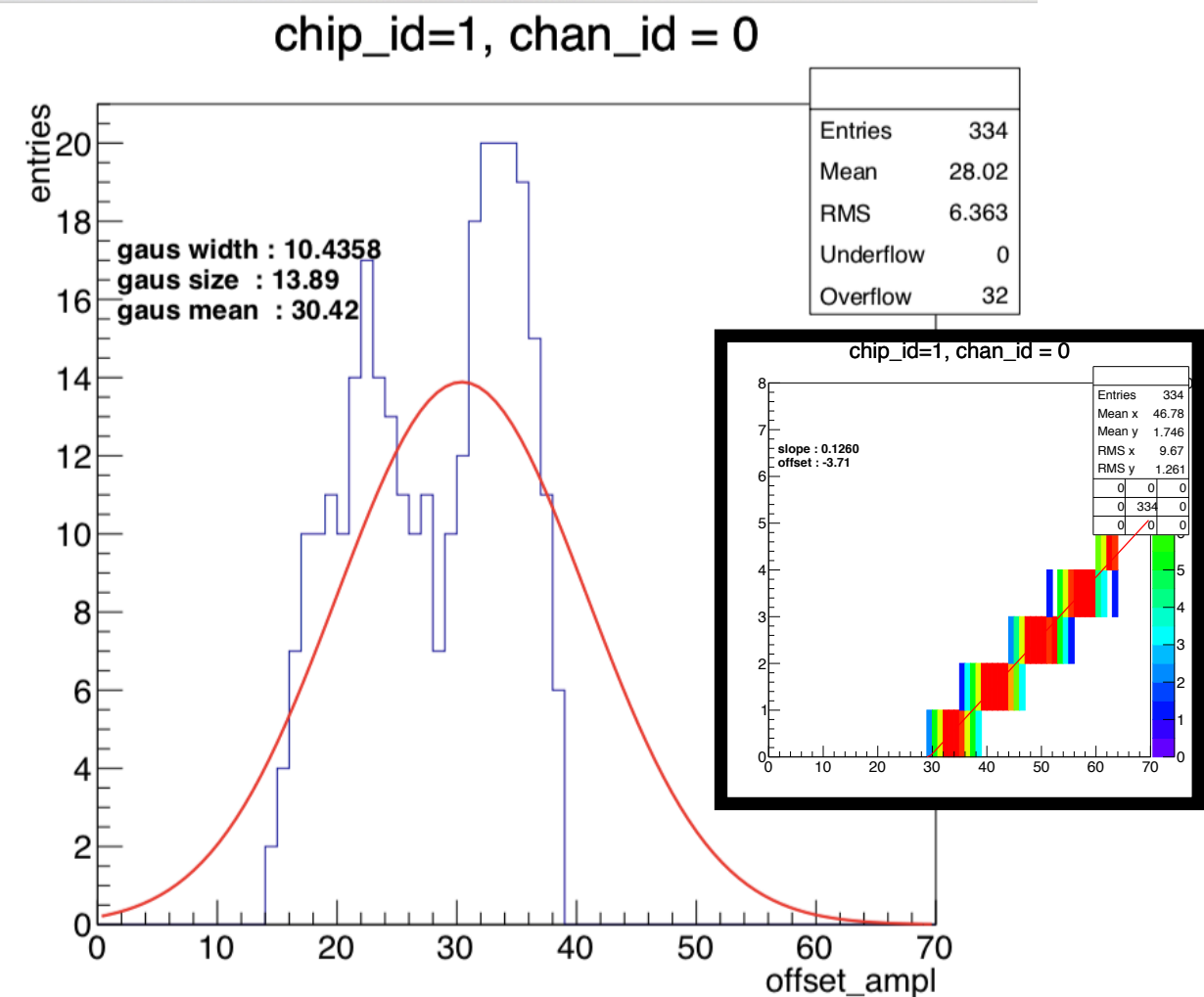
Back up

Attention !

- When you check “chipX_detail_amploffset.pdf”, if the distribution is not reasonable (For example : double or triple peaks, left plot). Please let me know.
- It is a bug, and has been solved already.



Correct one



Bug case,
The amtpl-adc distribution is good, but it
has a bug when filling the event in TH1F