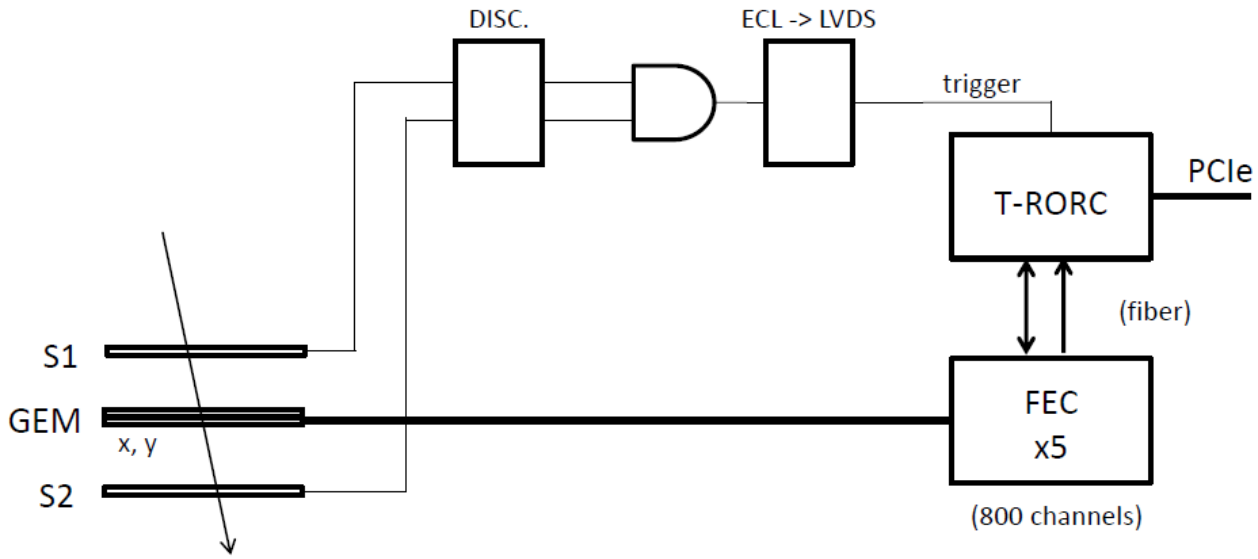
Streaming DAQ (updated 4/21/20)

- Finished most single chip measurements (linearity, time resolution, x-talk, etc.)
- Assembled complete readout system with GEM; cables + GEM inside Faraday cage to suppress noise
- Use Direct ADC Serialization (DAS) mode to take a pedestal run
- Create pedestal file consisting of Pedestal and $\sigma_{Pedestal}$ for all 760 channels
- Create threshold file: **Threshold(chan) = Pedestal(chan) + 3*$\sigma_{Pedestal}$(chan)**
- Modify SAMPA initialization software to read in threshold file and set thresholds for all channels
- Take cosmic ray run in DSP mode (zero suppression)

Cosmic Ray Test Setup



S1, S2 – plastic scintillators

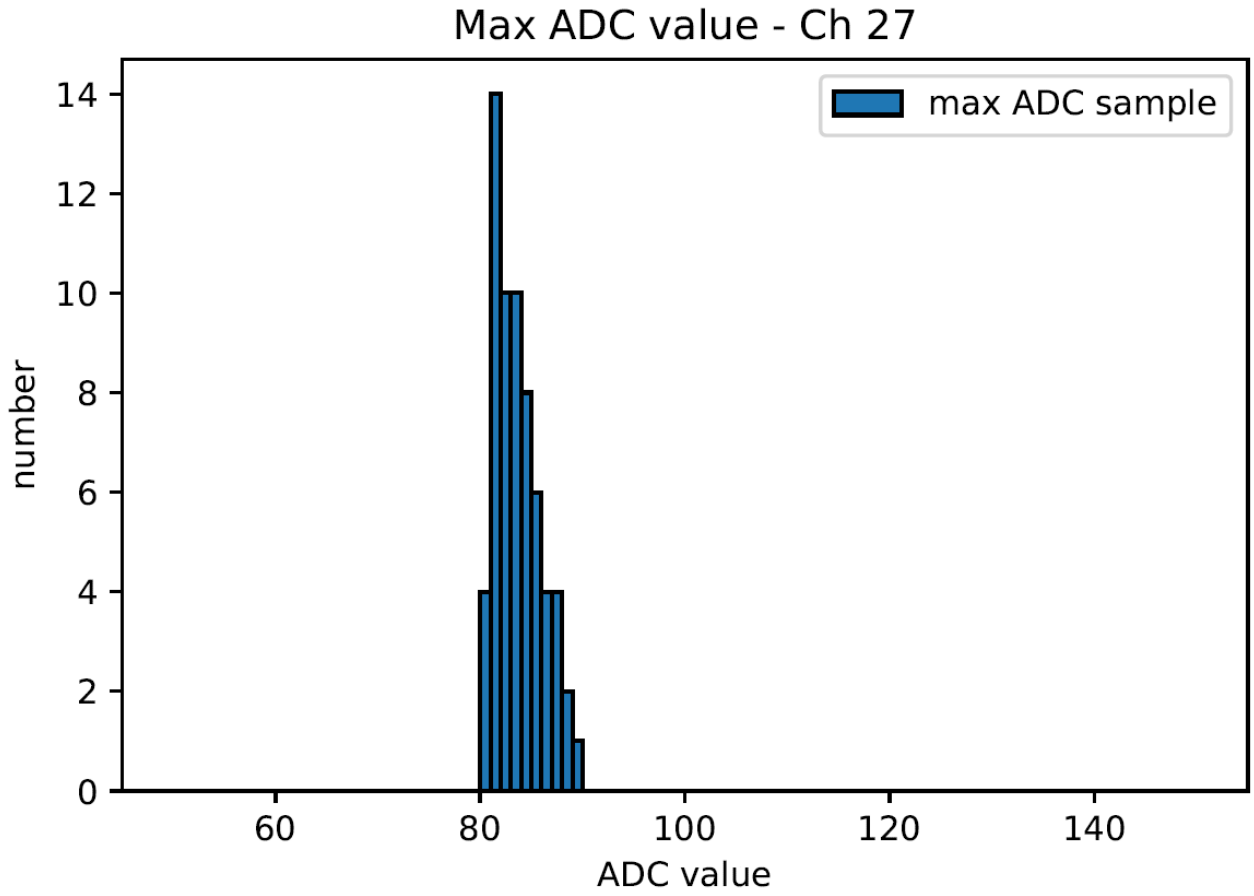
GEM – 1x, 1y plane (384 channels each)

T-RORC – ALICE/ATLAS Read Out Receiver Card with GBT serialization protocol

FEC – ALICE Front End Card (JLAB version) – 5 SAMPA chips (160 channels)

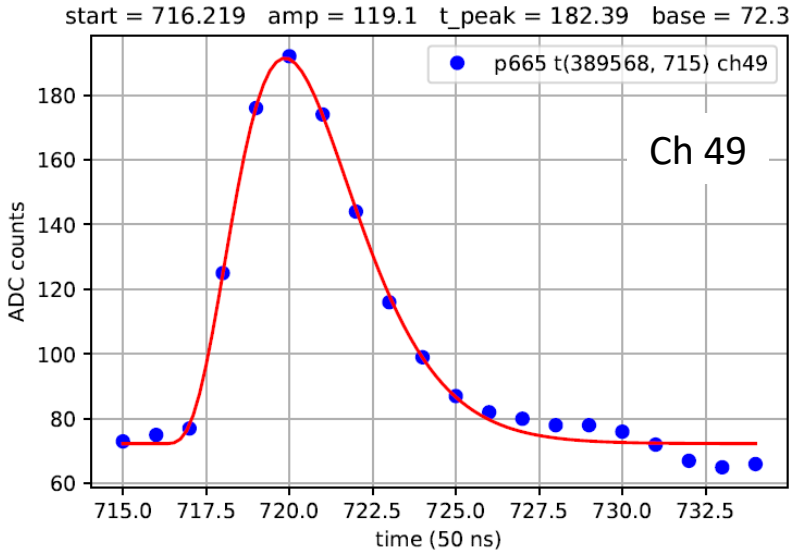
We do not trigger the SAMPA chips. Data is continuously streaming from the FECs to the T-RORC. Receipt of a trigger causes a programmable window of streamed data to be captured by the T-RORC. This data is transmitted to the PC memory and written to disk.

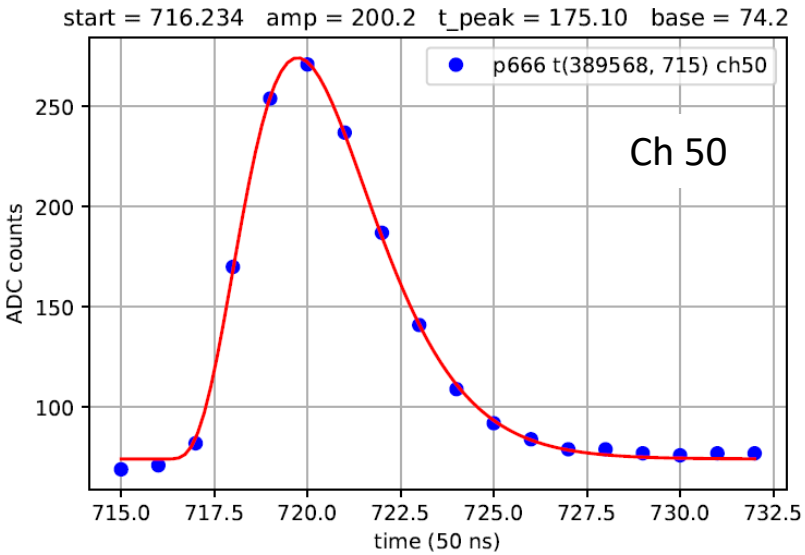
- Most pulses are small amplitude noise pulses. We use these to verify that the thresholds have been programmed correctly for all channels.

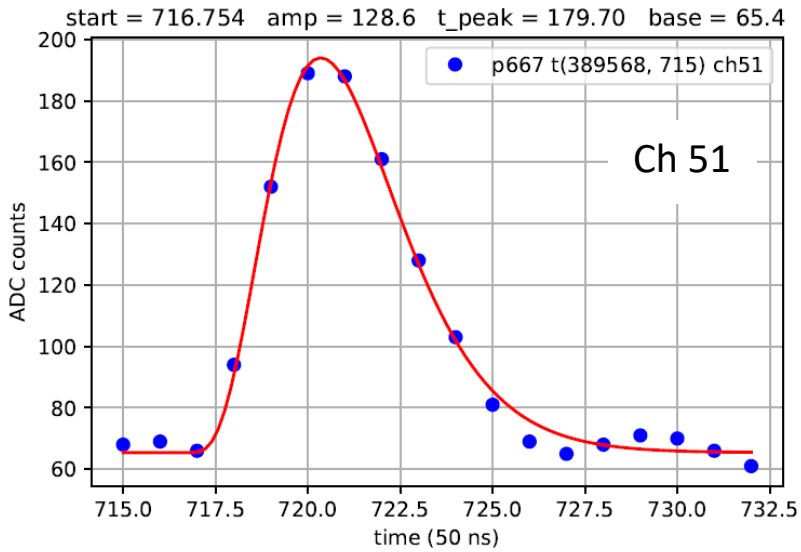


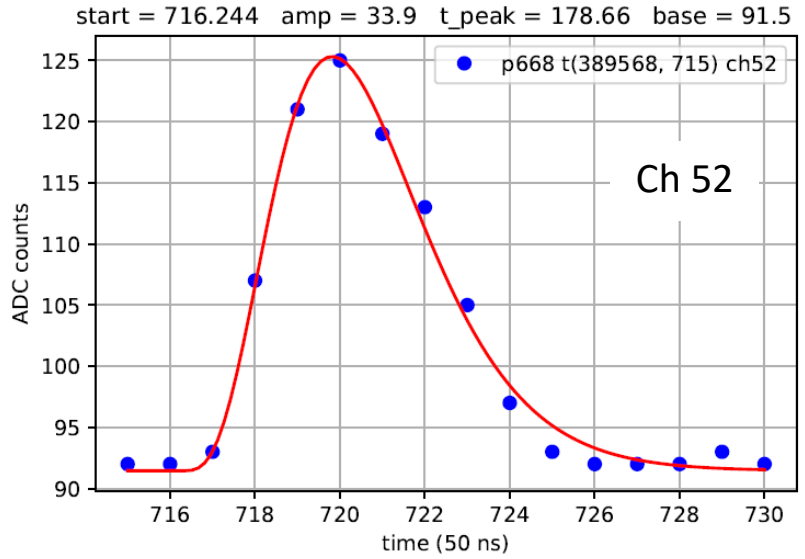
pedestal = 71.48 σ = 2.80 threshold = pedestal + 3*σ = 80

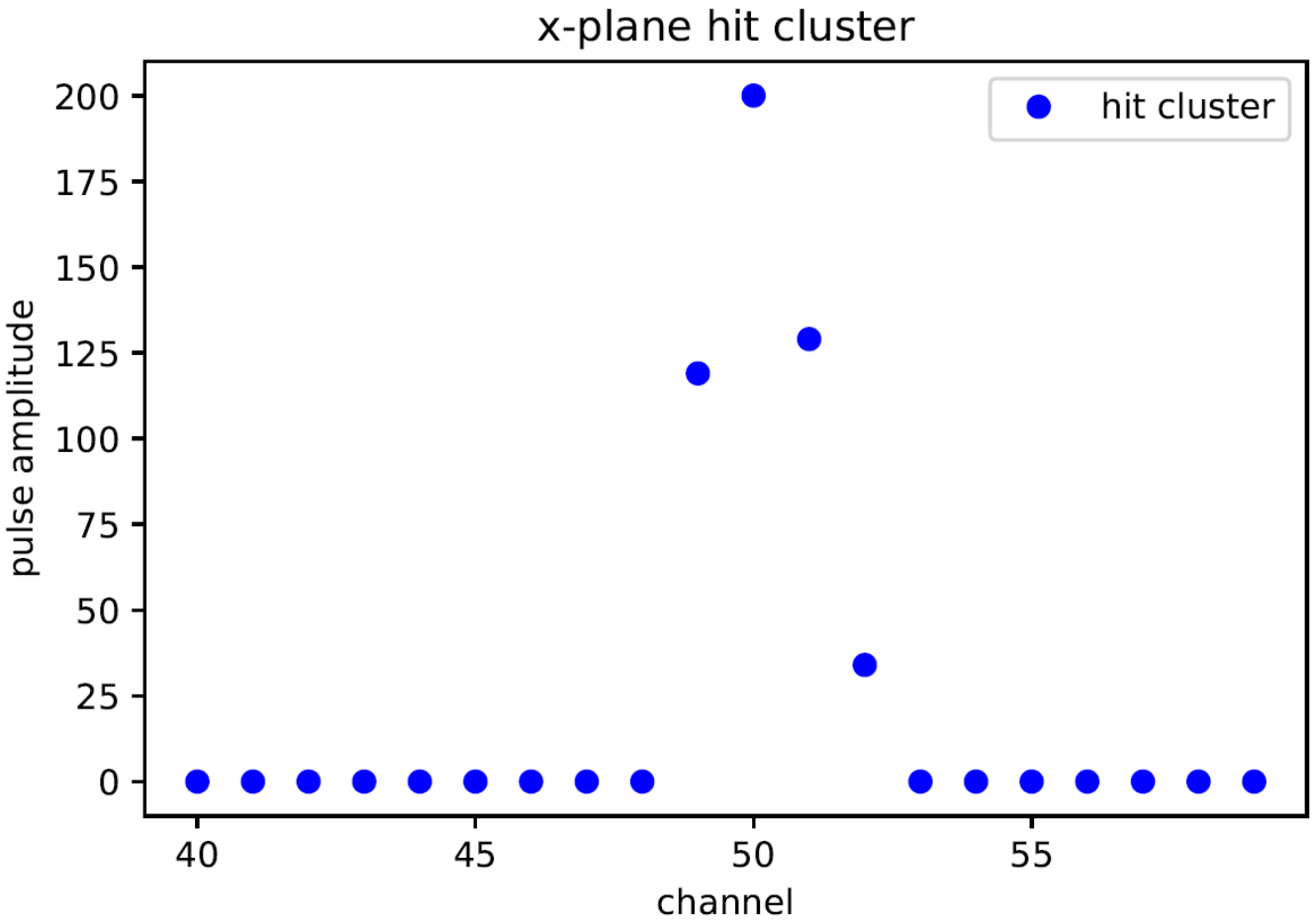
Cosmic ray candidate – cluster of adjacent channel hits with close times



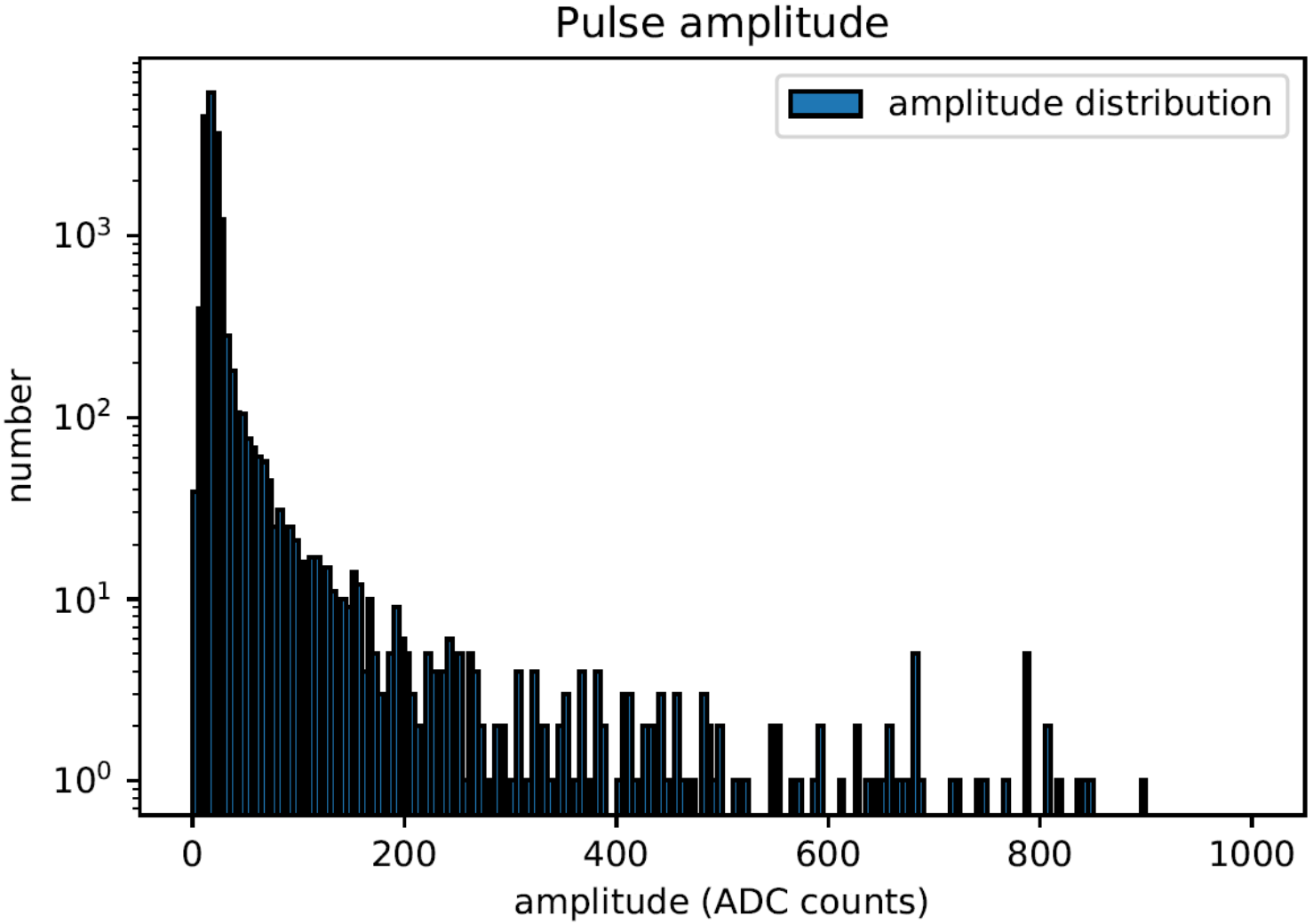


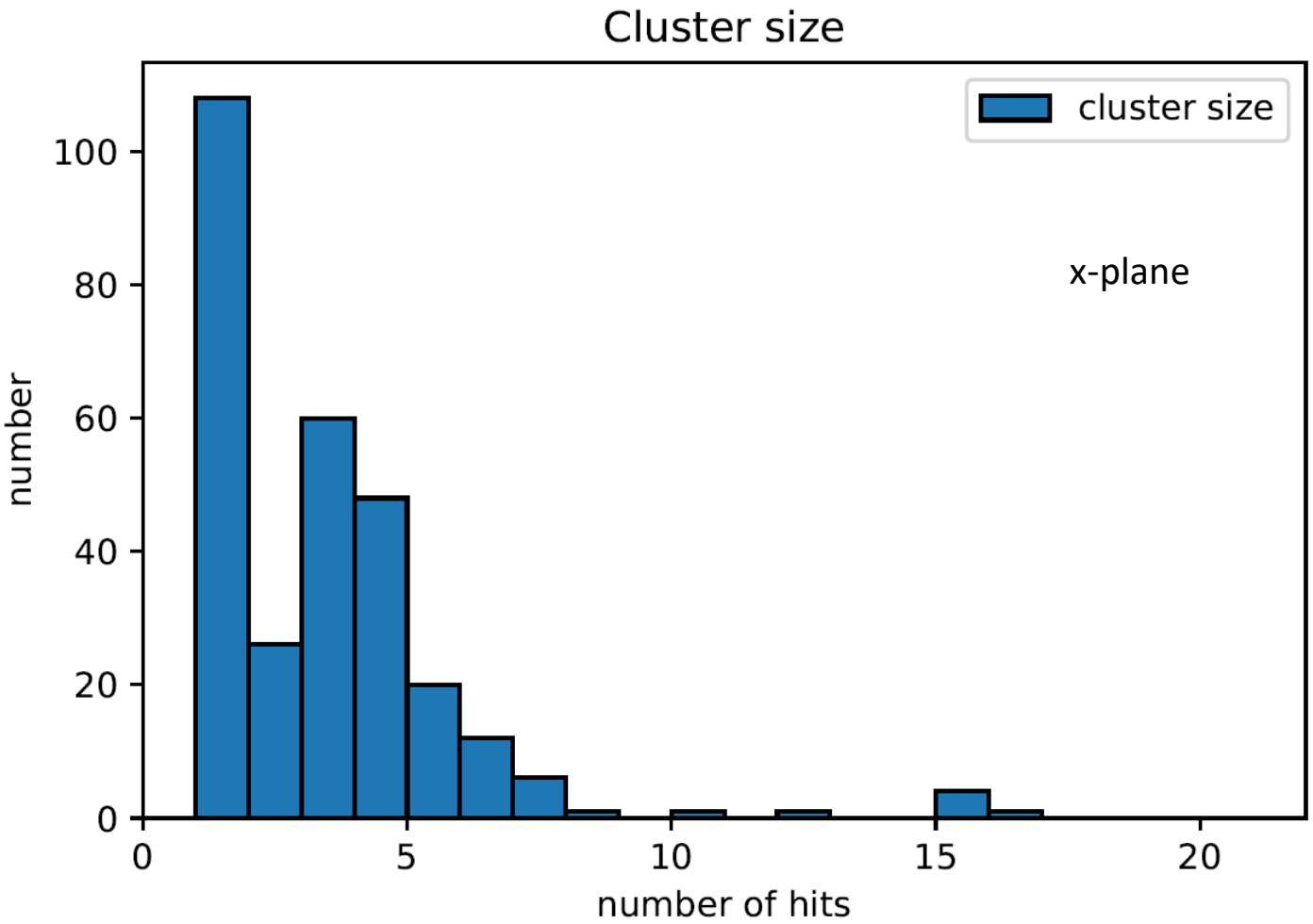


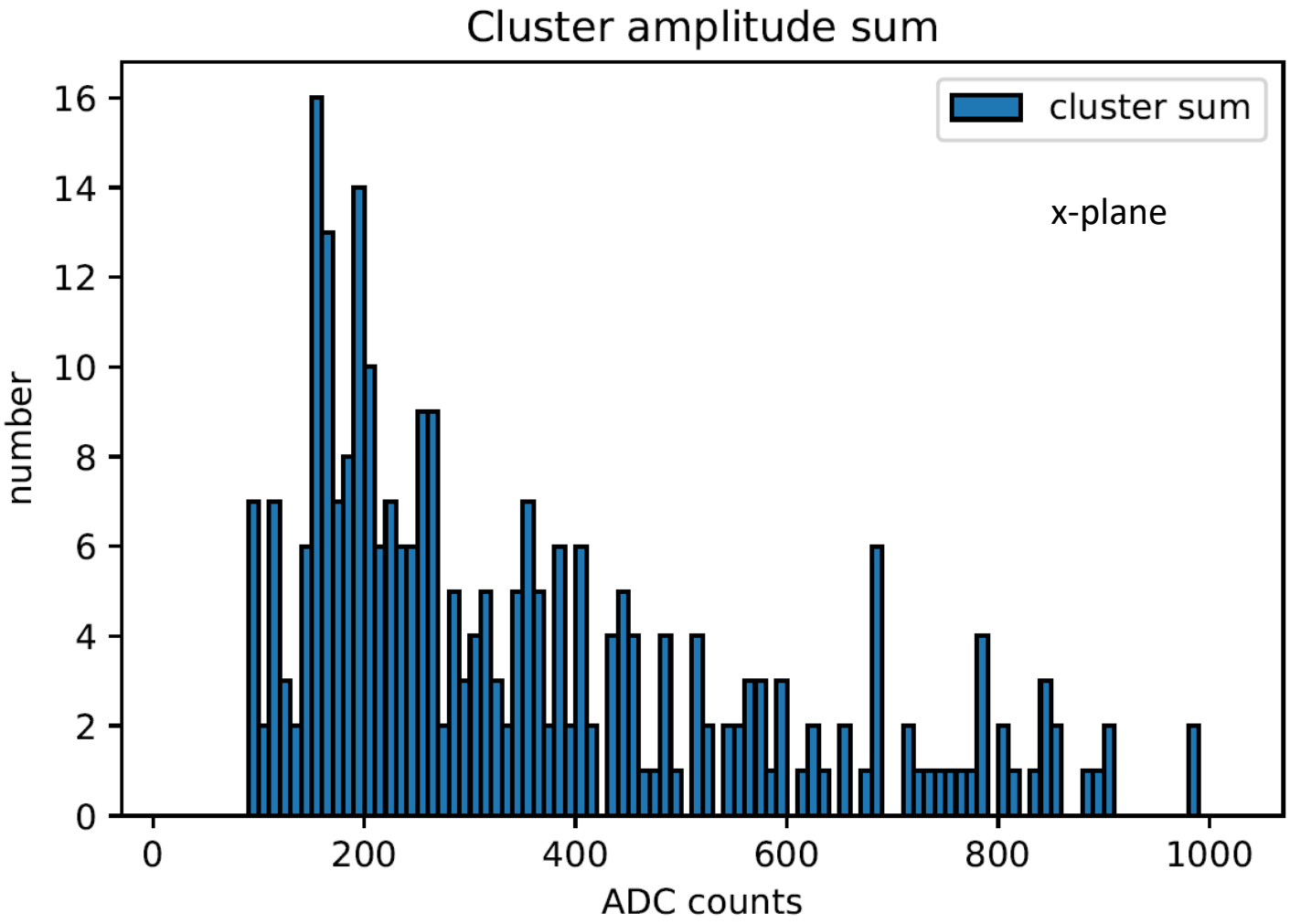




Pulse amplitude sum = 482 (48 fC)


Pulse amplitude
amplitude distribution
number
10^3
10^2
10^1
10^0
0
200
400
600
800
1000
amplitude (ADC counts)


Cluster size
cluster size
x-plane
number
number of hits
0
20
40
60
80
100
0
5
10
15
20


Cluster amplitude sum
cluster sum
x-plane
number
ADC counts
0
2
4
6
8
10
12
14
16
0
200
400
600
800
1000

- Developed and coded algorithm for cluster finding in x & y planes. (All data analysis done in Python.)

- Check if distribution of amplitude sums for minimum ionizing cosmic rays is consistent with gain of GEM + SAMPA, and energy loss fluctuations in a thin absorber (Landau distribution)

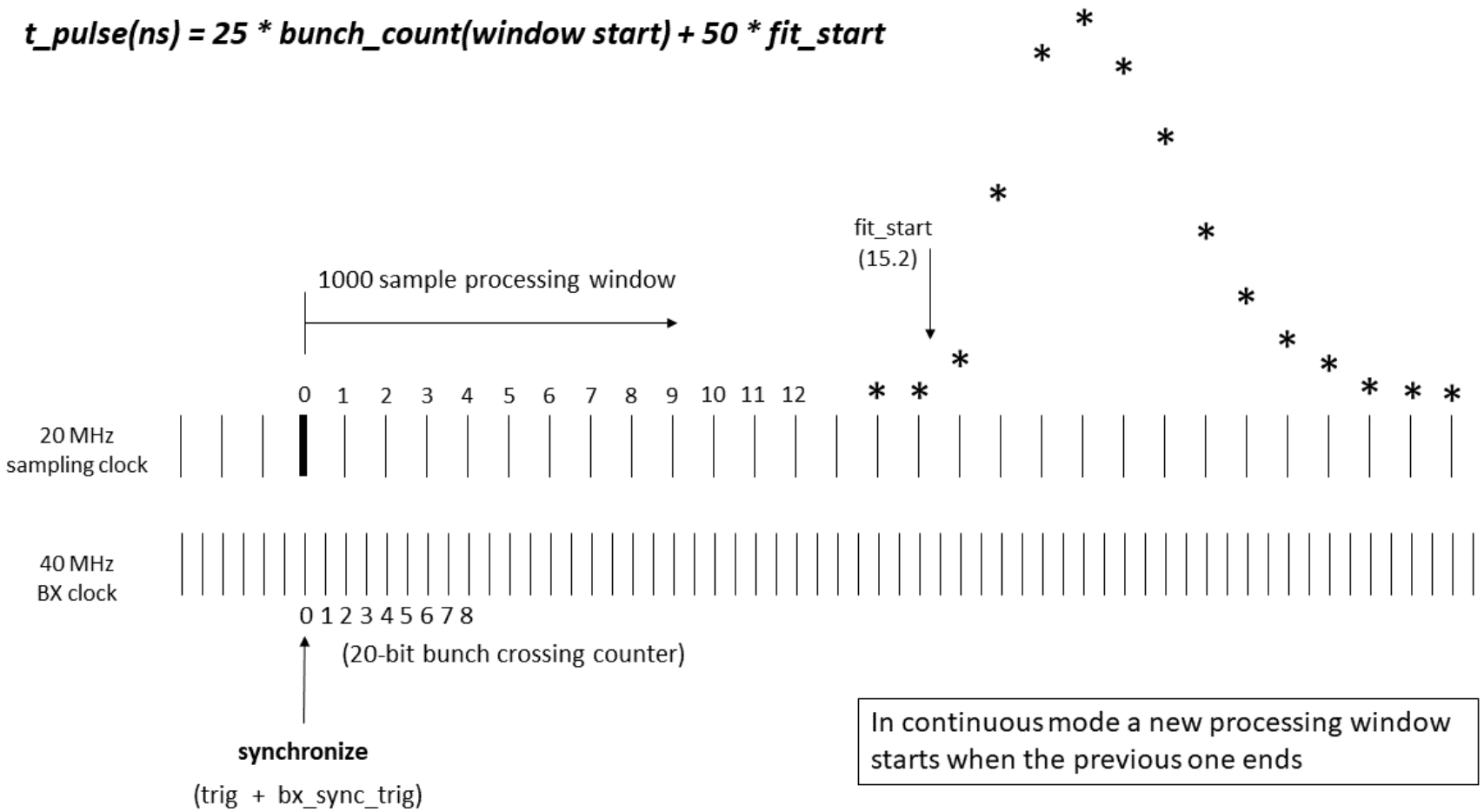
- **x-plane cluster** should have a corresponding **y-plane cluster** with **close time**

- Working on automating matching of x and y clusters (see **NOTE** below)

- Compare cluster amplitude sum of x and y clusters from same particle. (Are they approximately equal?)

- Study timing resolution from matched x and y clusters

t_pulse(ns) = 25 * bunch_count(window start) + 50 * fit_start



NOTE: Discovered that the cosmic ray run was made without properly synchronizing the 5 front end cards. Synchronization aligns the SAMPA processing windows and initializes the data packet time stamps to zero. (Currently trying to extract the relative time offsets from the data.)