

PD-HD Coldbox data: Noise Study

Wenqiang Gu, Jay Hyun Jo

March 28, 2024
Wire-Cell Meeting

Introduction

- PD-HD Wire-Cell Noise Filtering (NF) has not been fully checked
- first look at PD-HD cold box data
 - workflow
 - check NF performance in general
 - check various sub-components within NF chain
- coldbox data run: 16751 (**noise run**)
 - data *not* taken with LAr temperature
 - APA3; gain 14mC/fc; shaping time 2us
 - spreadsheet of NP04 coldbox run info can be found [here](#)

Noise Filtering

- **single**

- baseline subtraction
- ~~RC undershoot correction~~
- adaptive baseline correction

- **grouped**

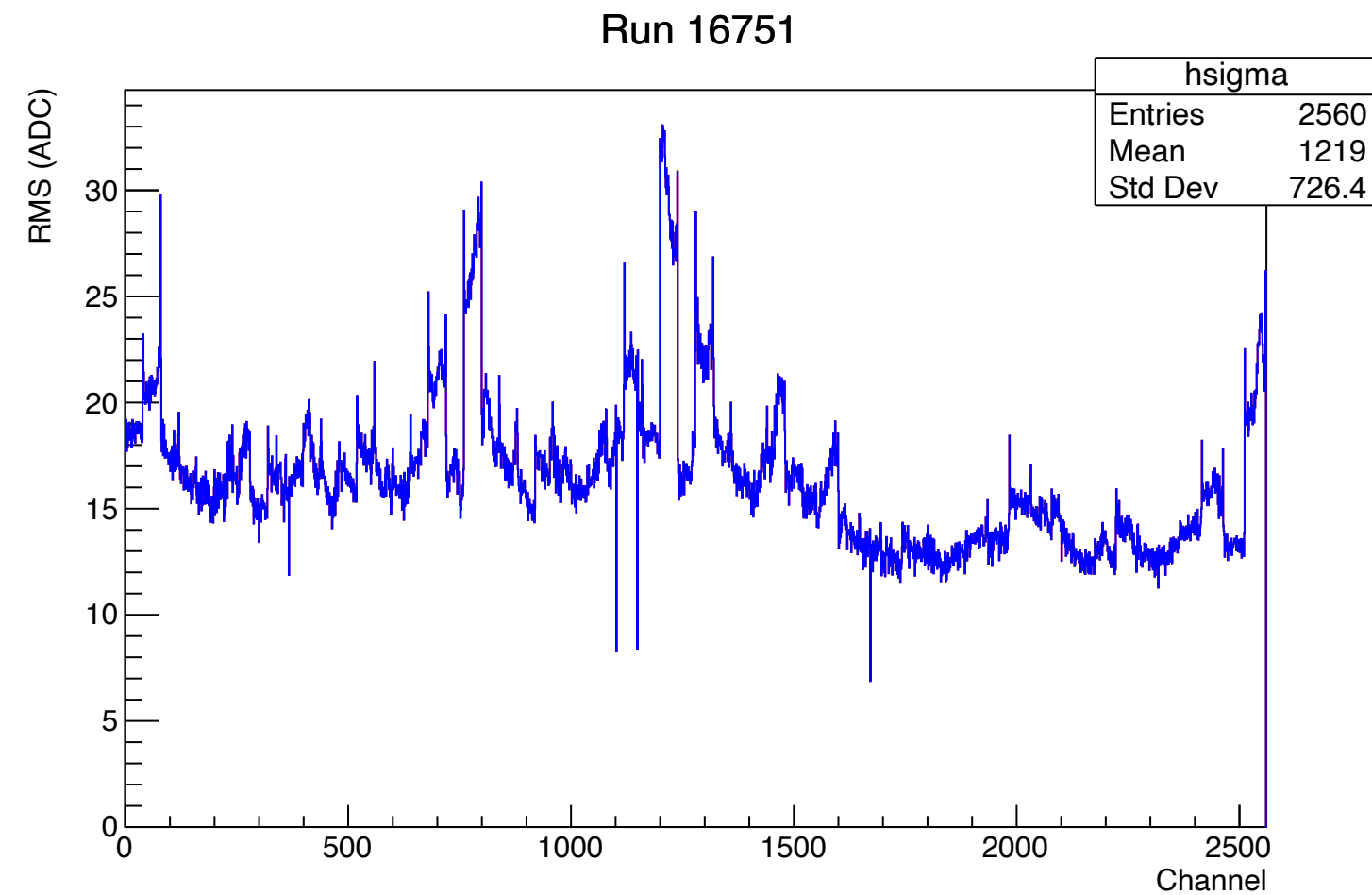
- coherent noise removal

- we have separate WC NF code for PD-HD: `wire-cell-toolkit/sigproc/src/ProtoduneHD.cxx`

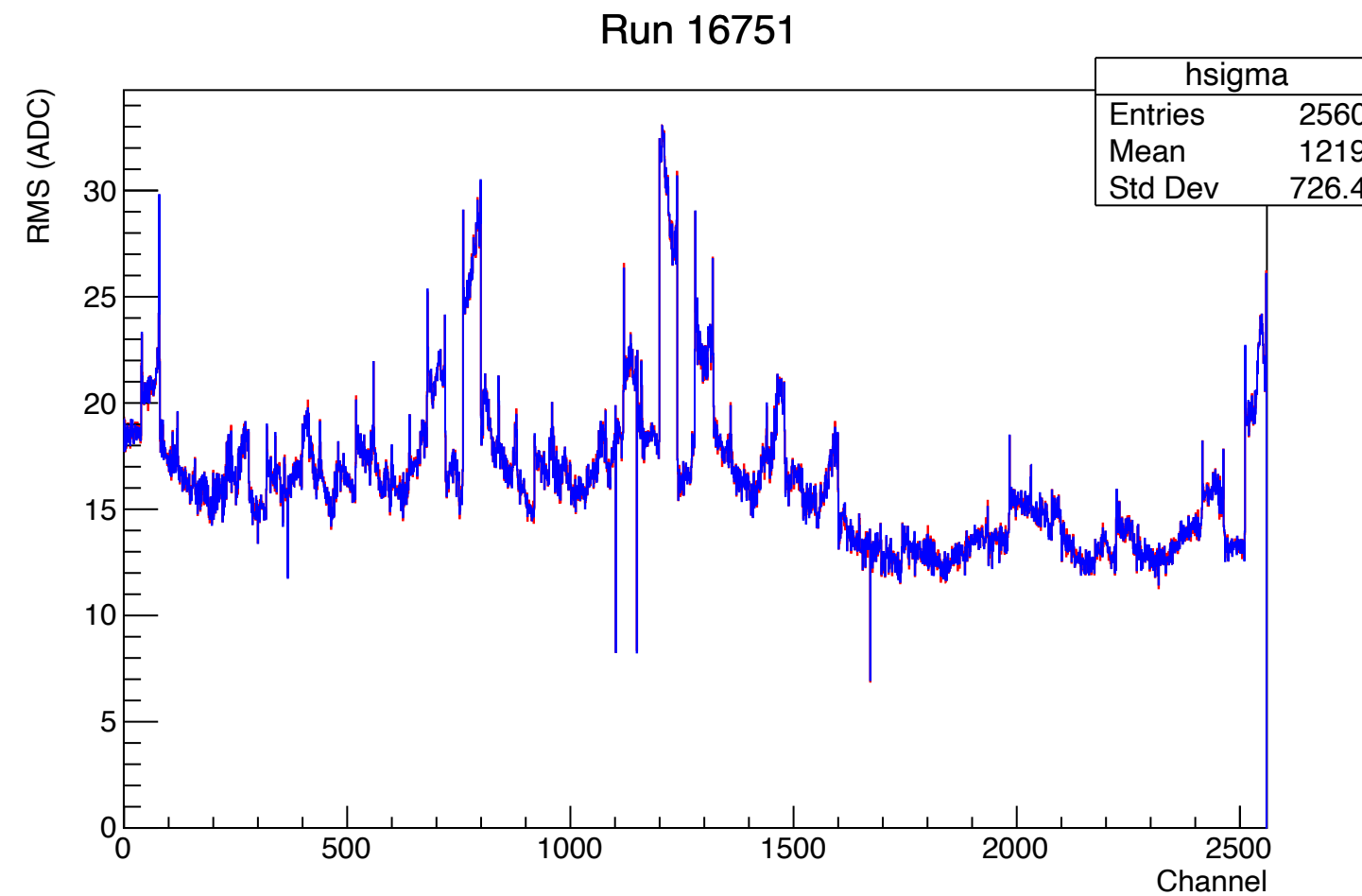
- replacing DuneCrx.cxx
- no RC undershoot correction

RMS check

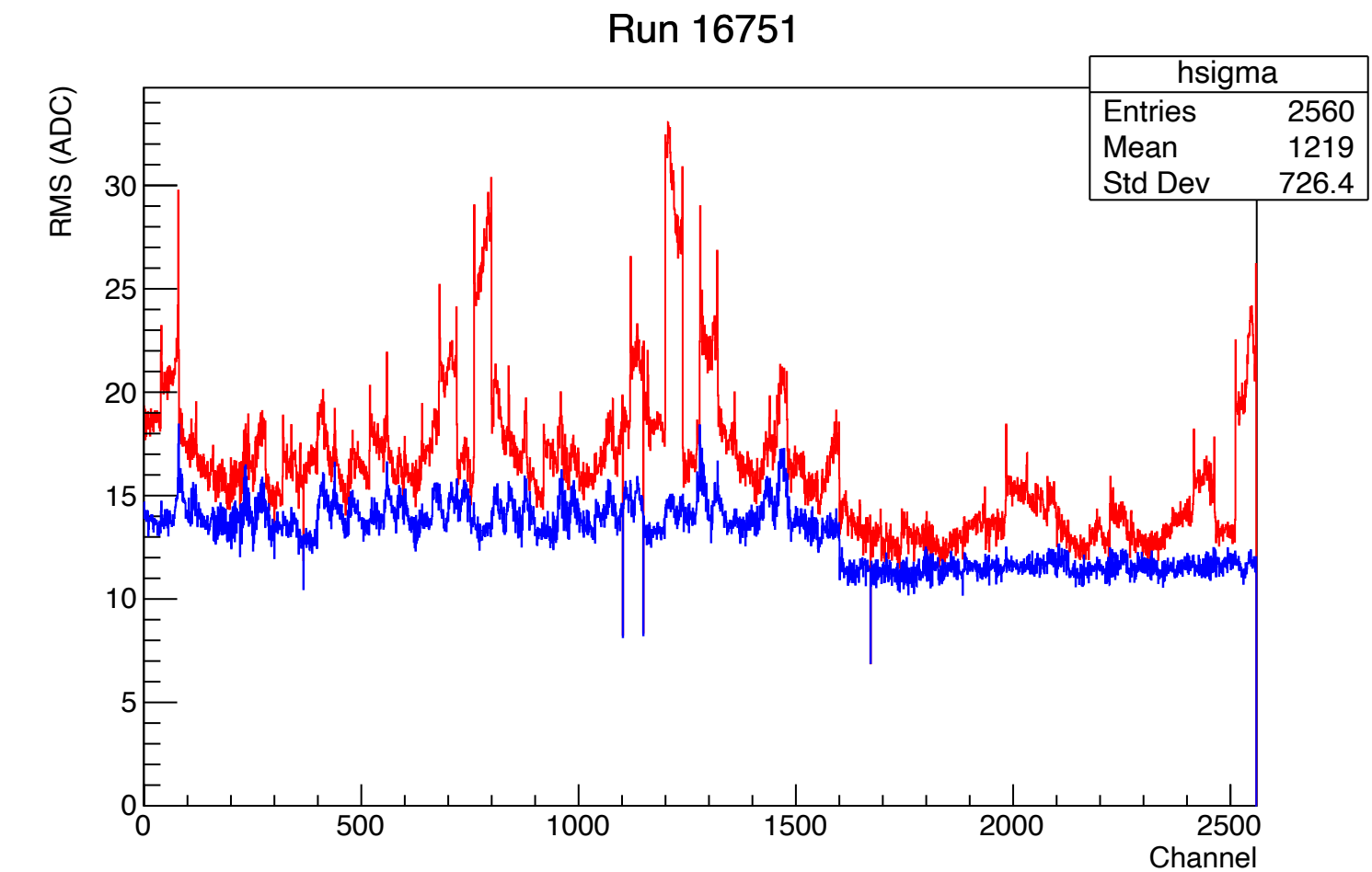
no NF



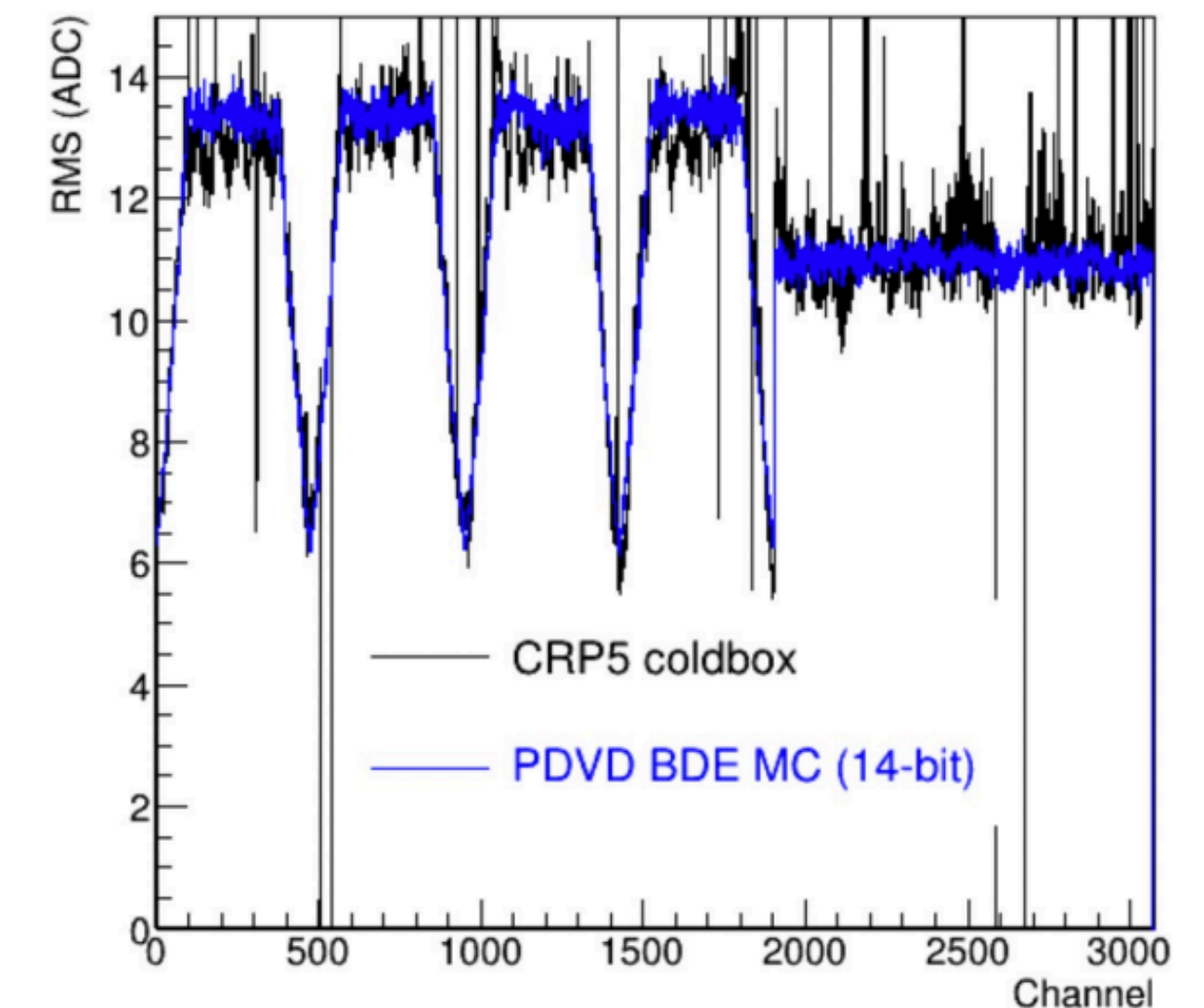
single NF only



single+grouped NF



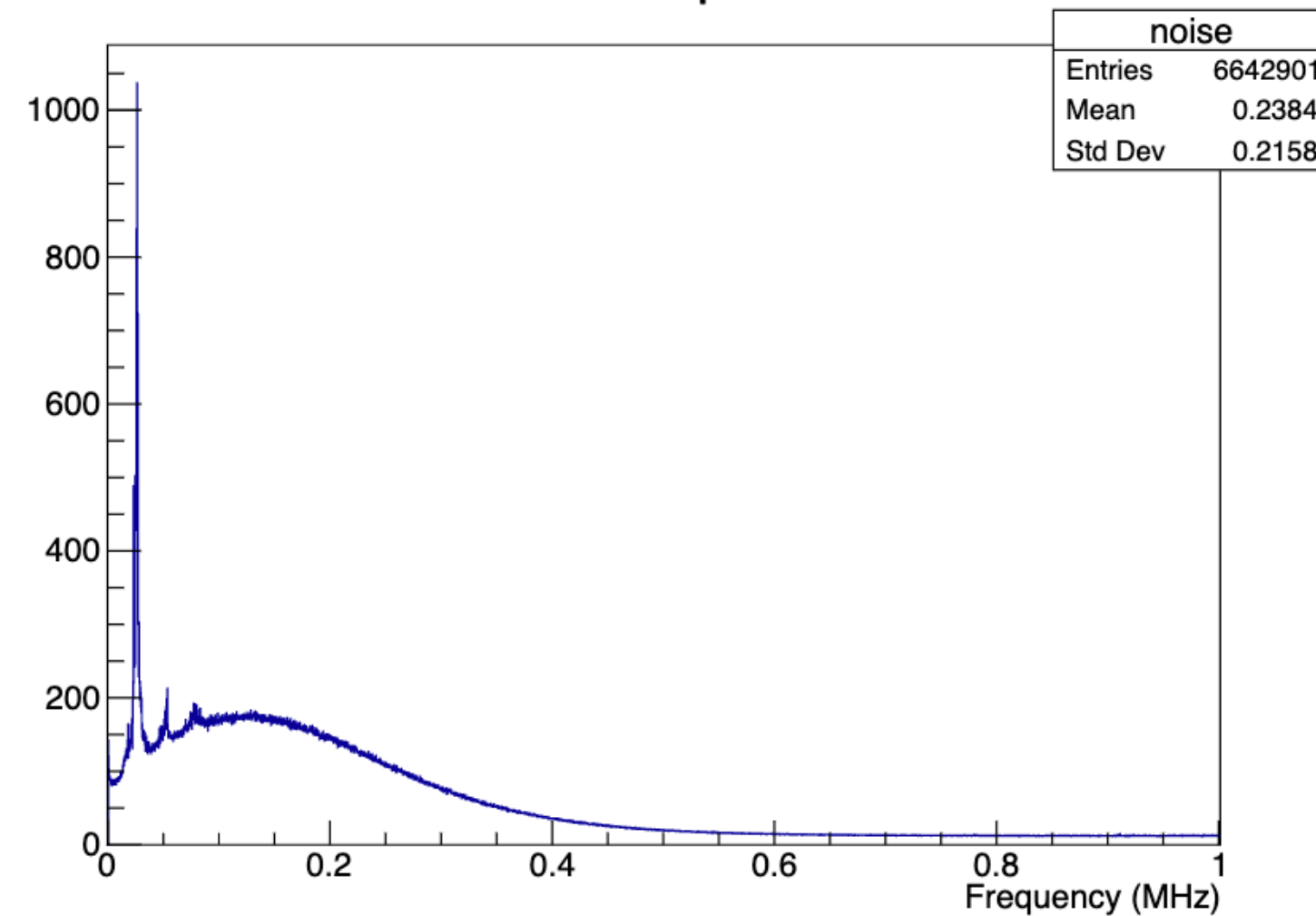
- single-only NF does make a difference
- together with grouped, NF performs well
- comparing to PD-VD, noise level is looks reasonable



Frequency spectrum

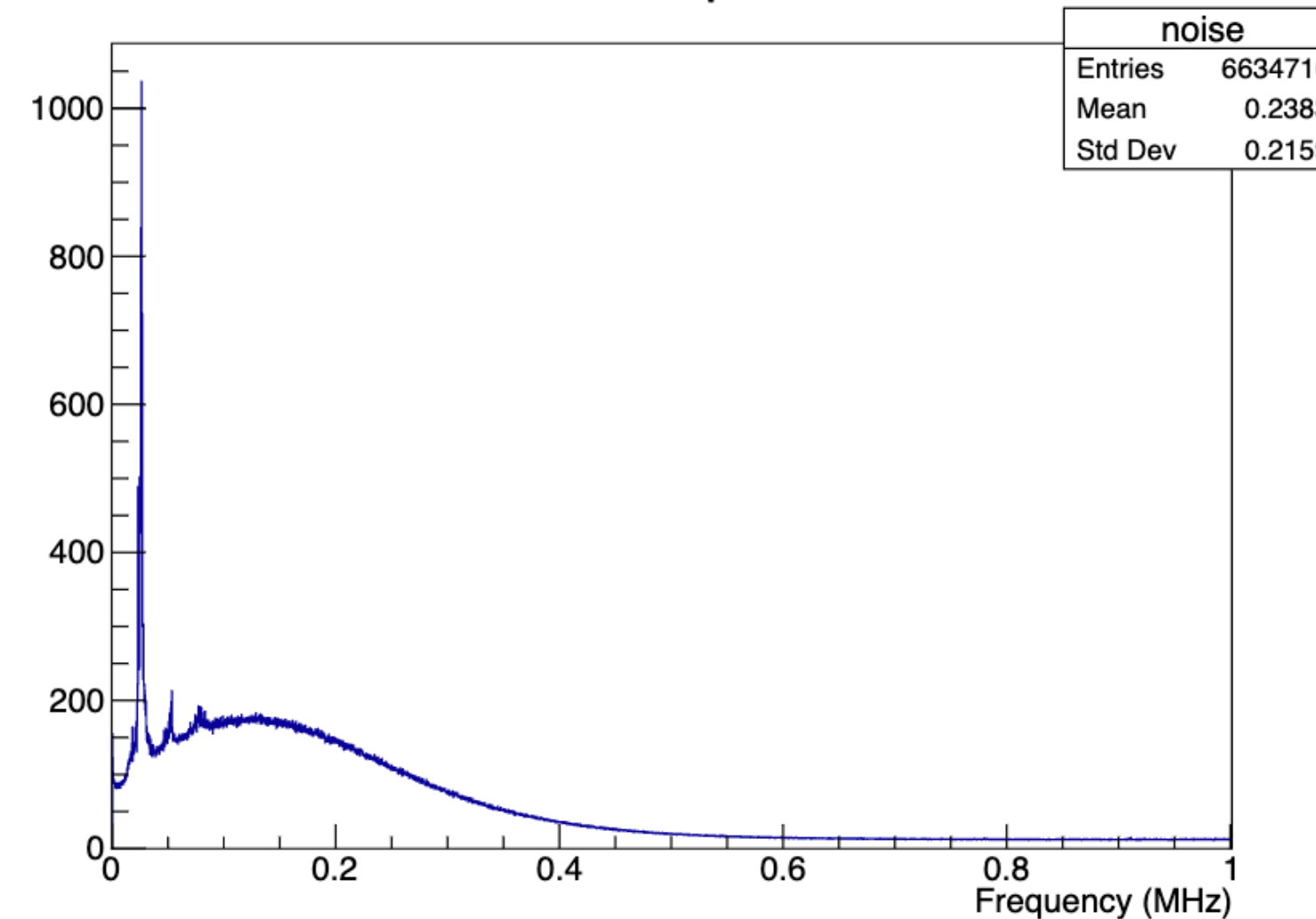
no NF

Noise w plane



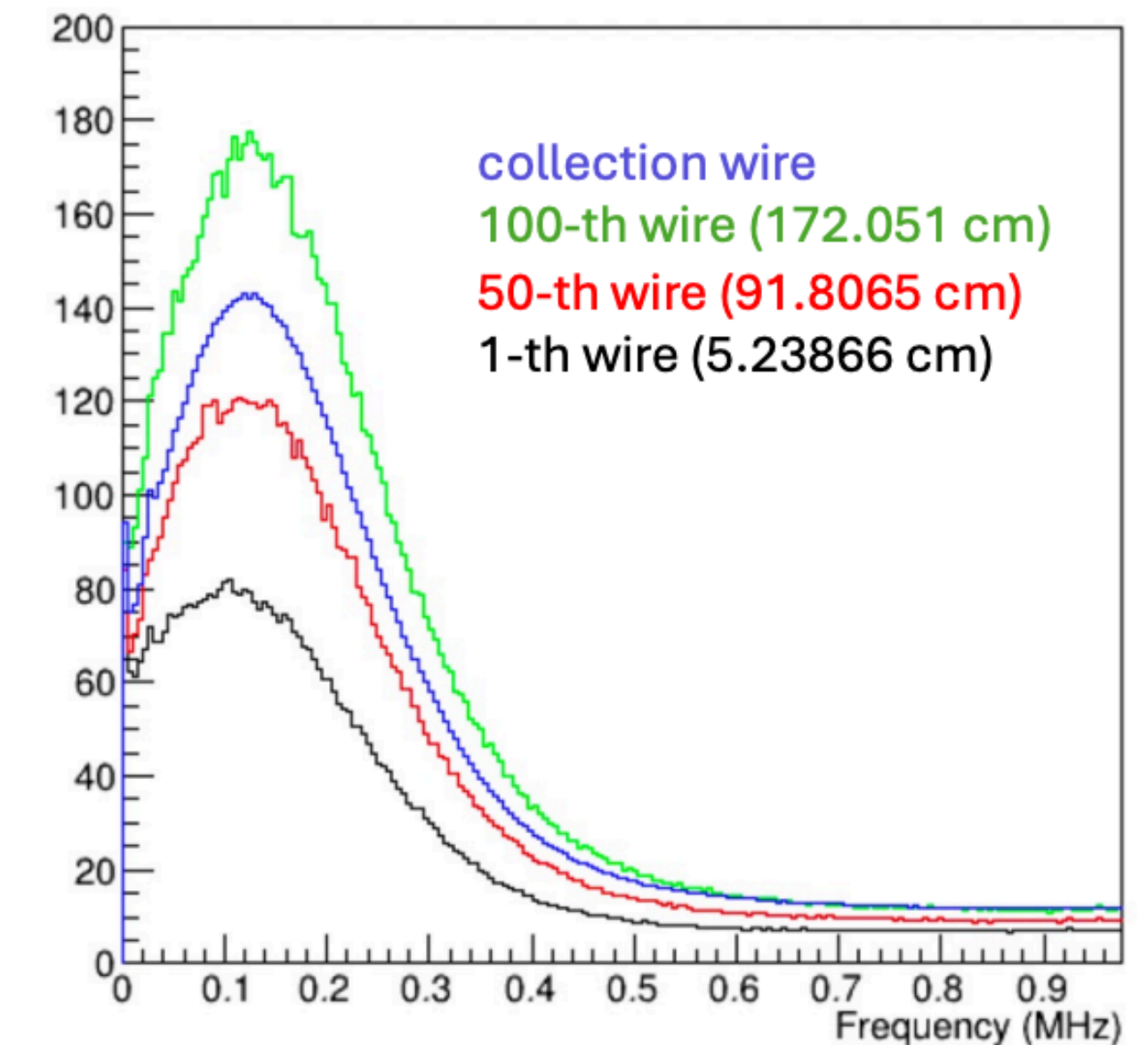
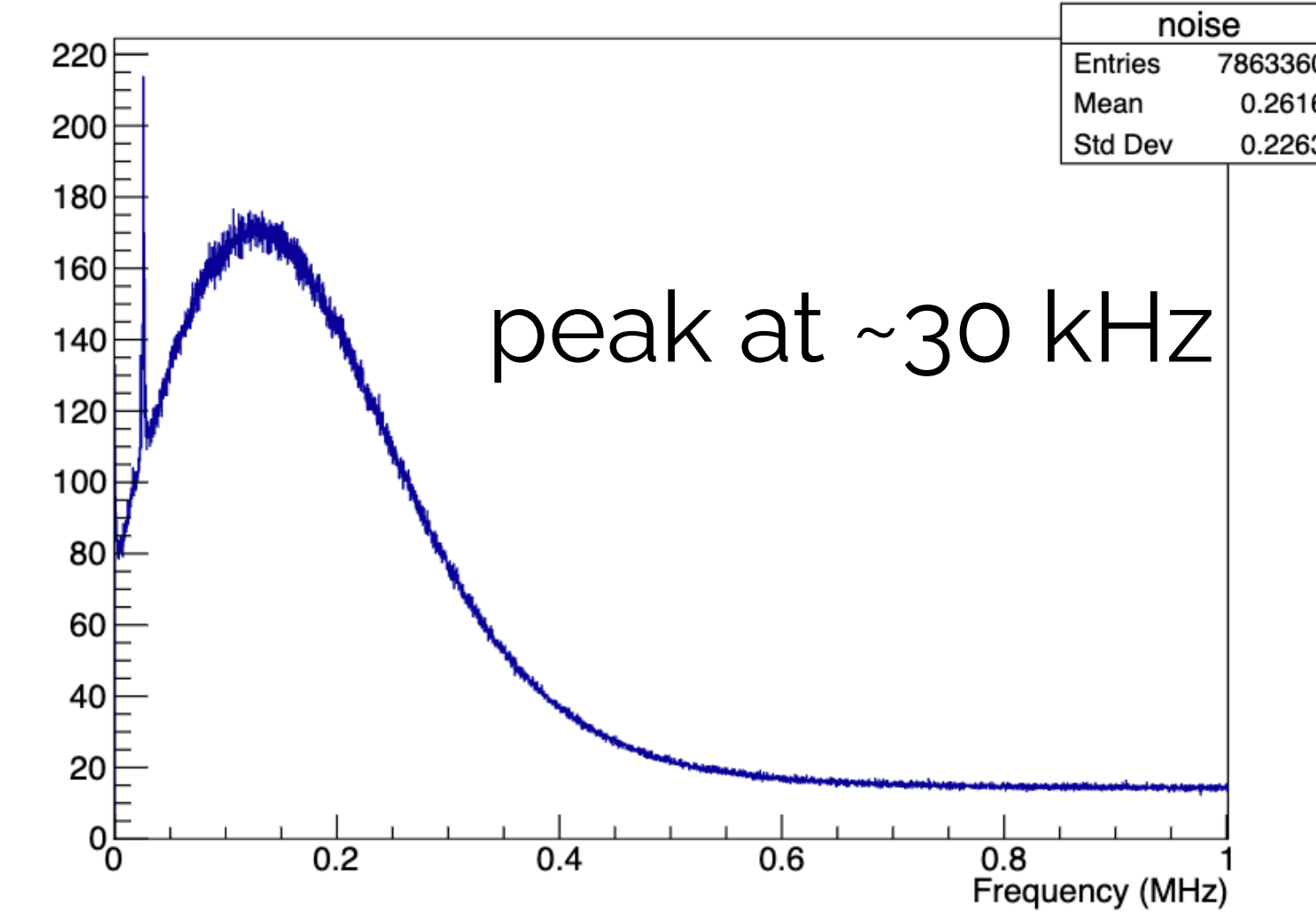
single NF only

Noise w plane



single+grouped NF

Noise w plane

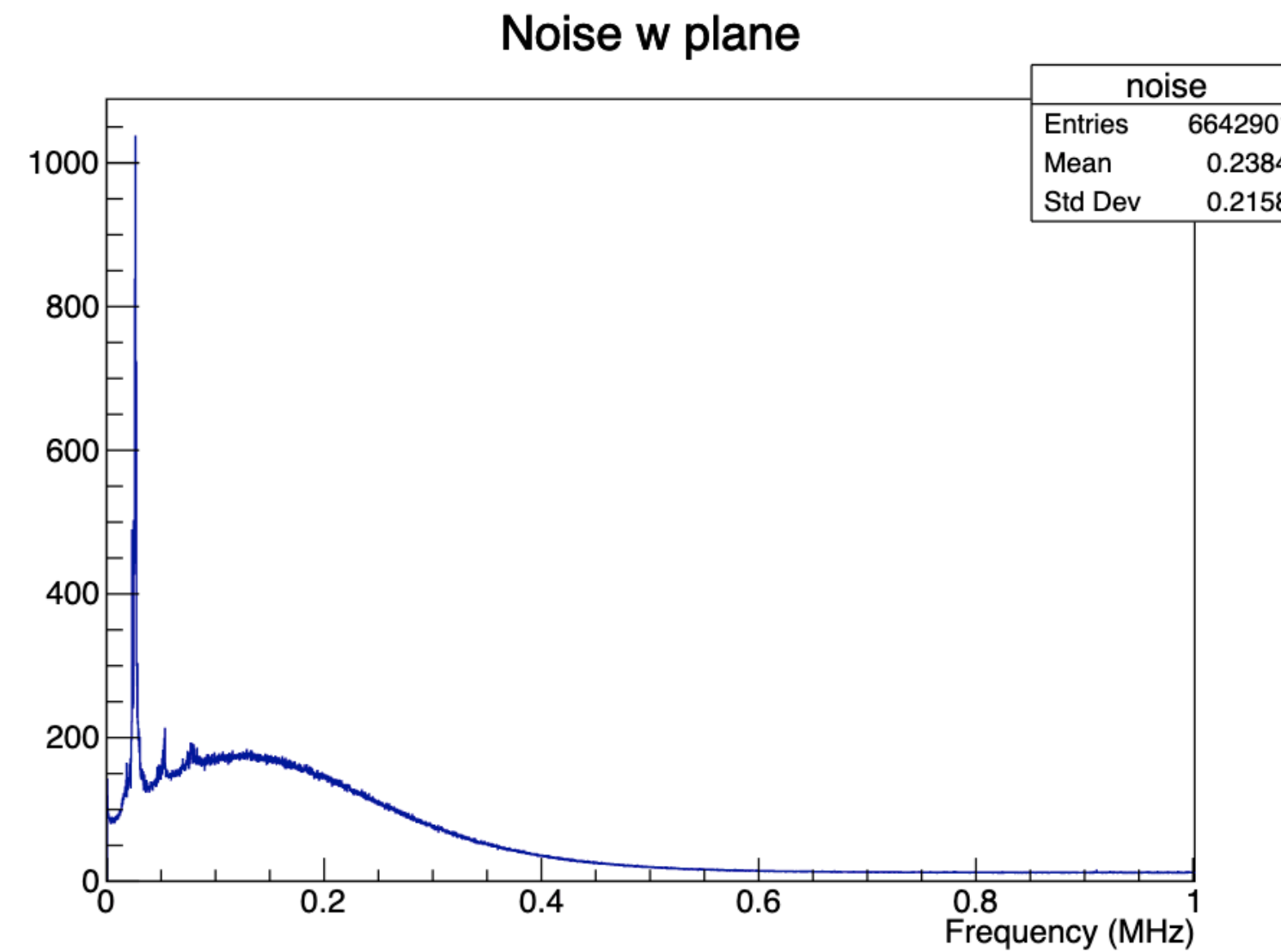


- single-only NF does make a difference
- together with grouped, NF performs well
- comparing to PD-VD, noise level is looks reasonable

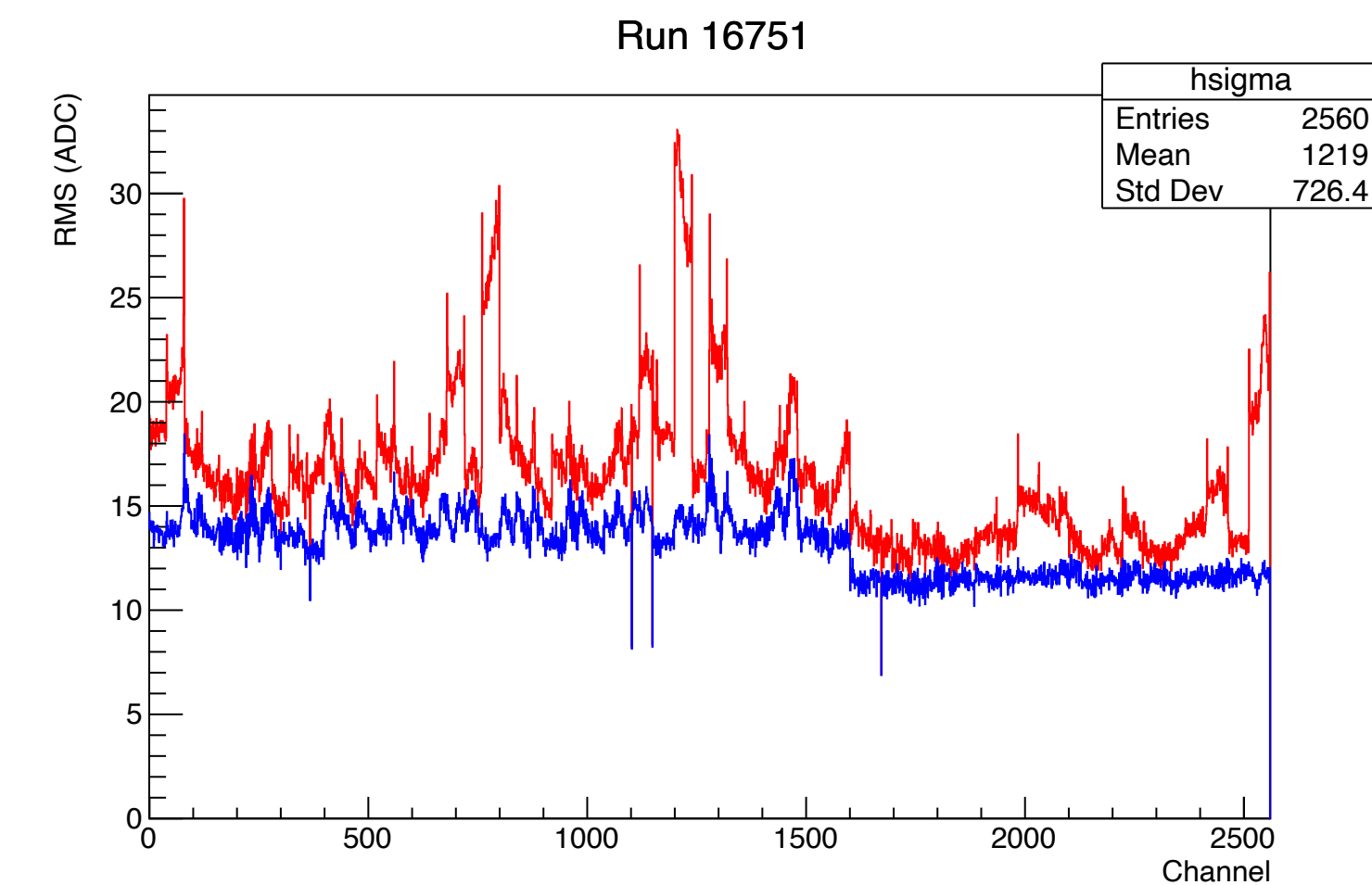
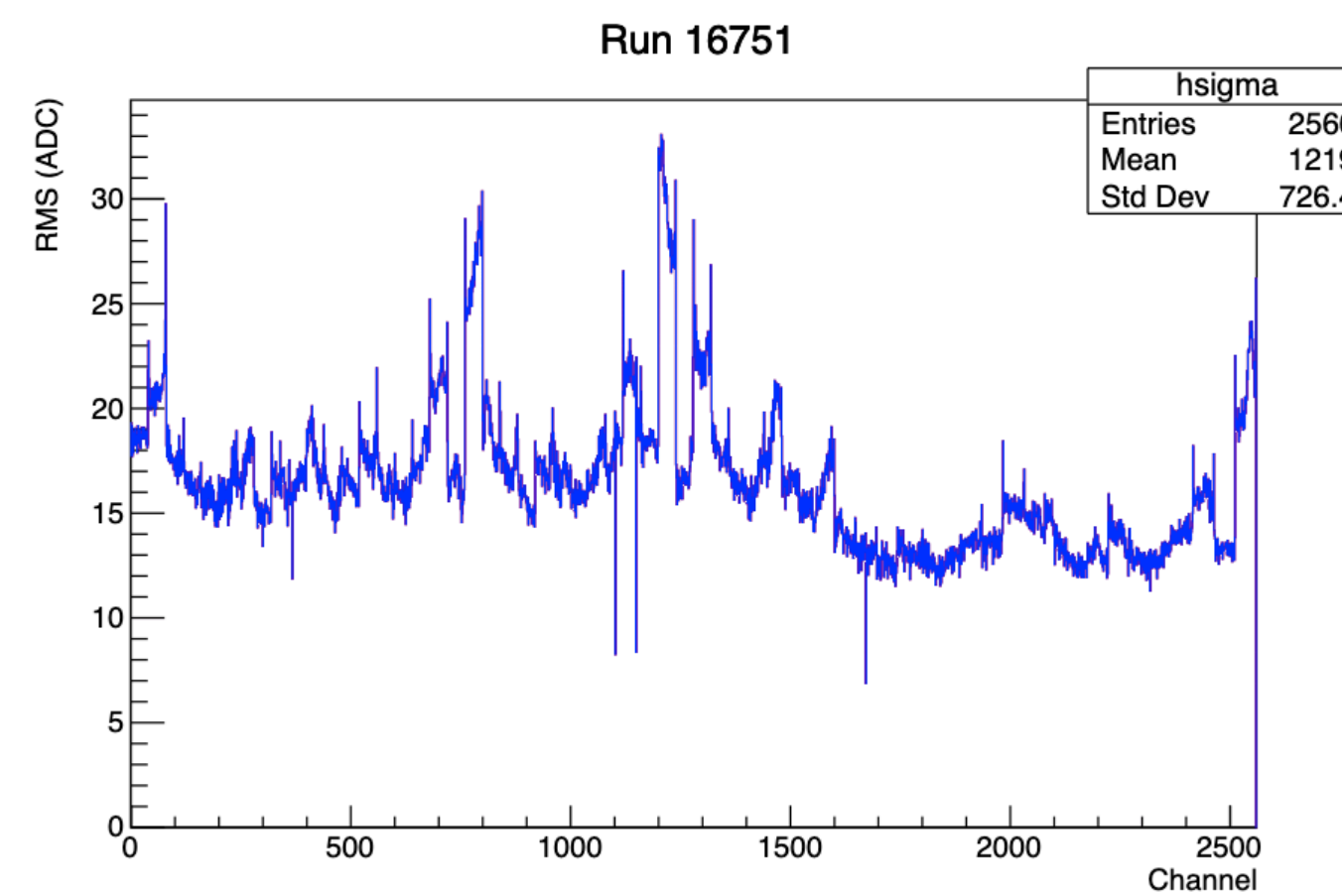
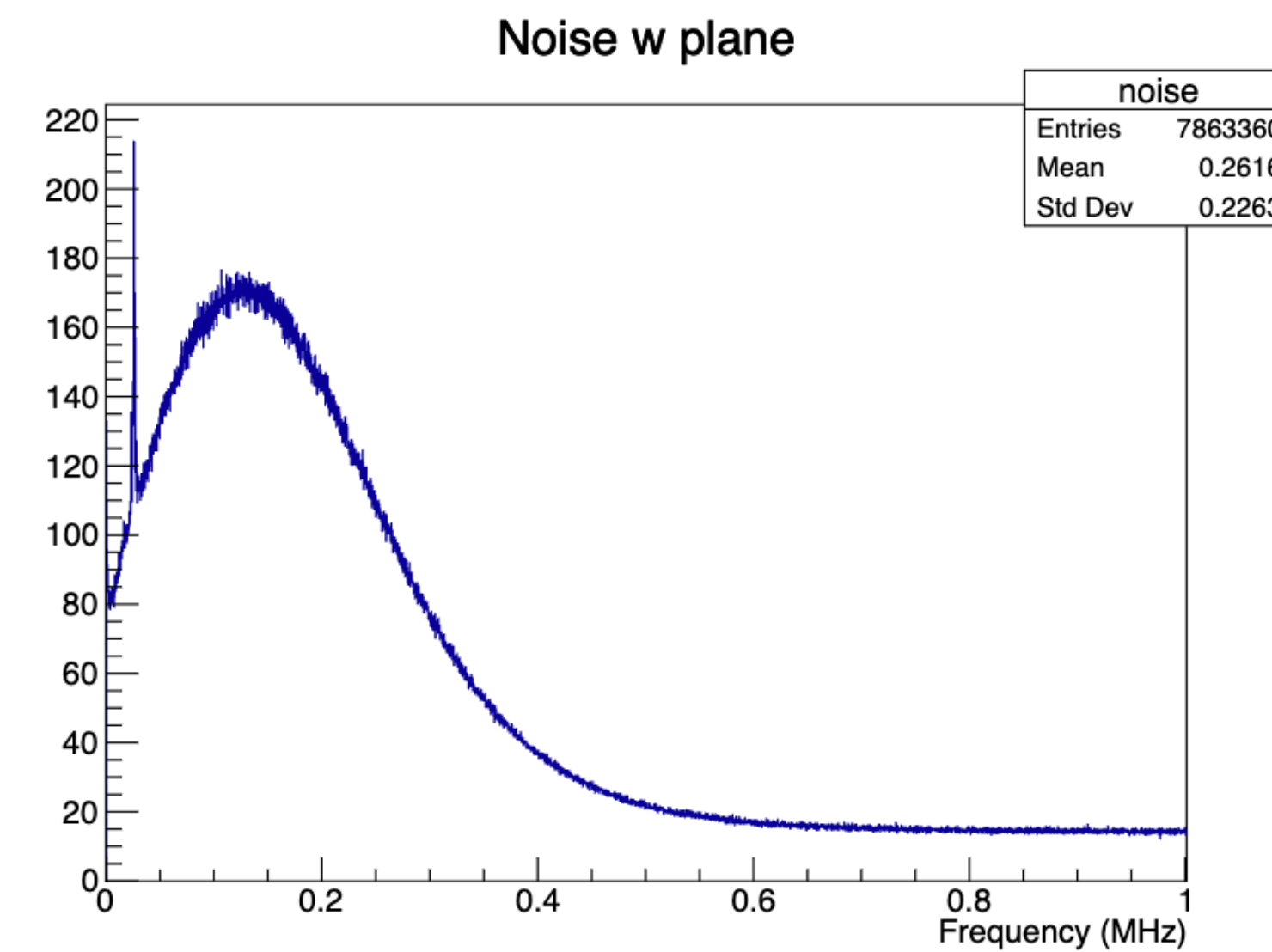
single & grouped

- grouped (CNR) only works together with single NF?

grouped NF only

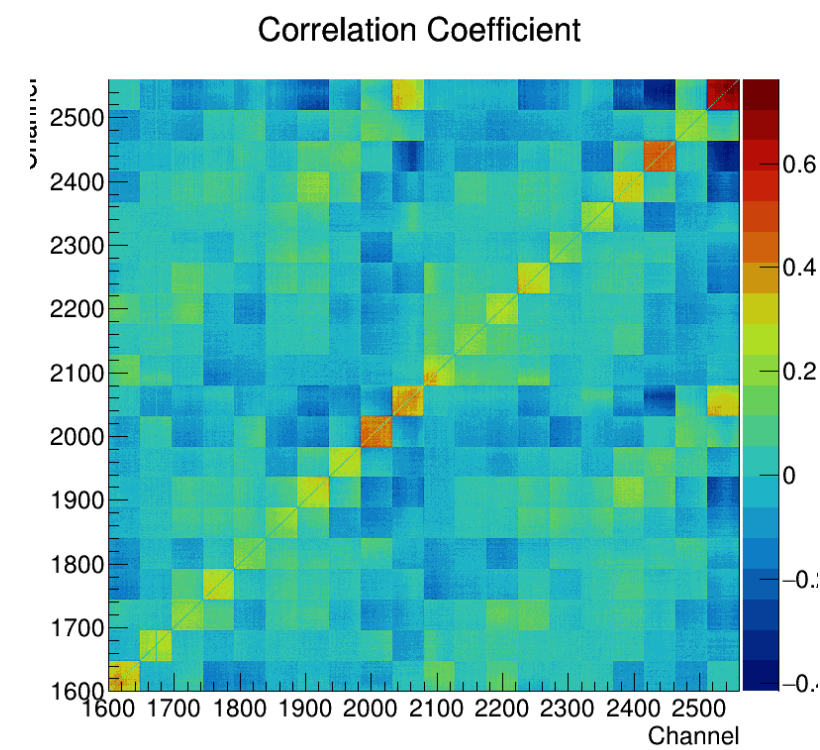
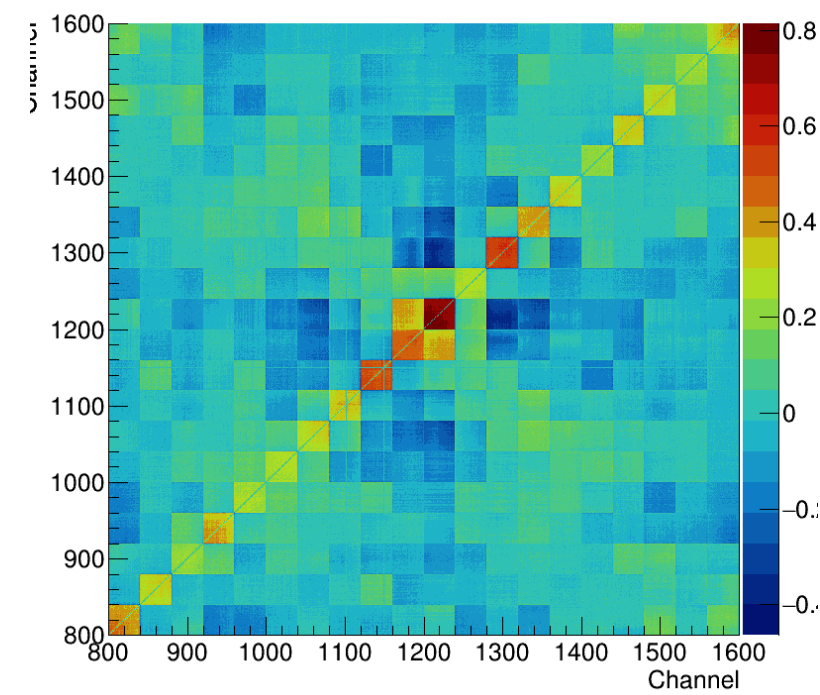
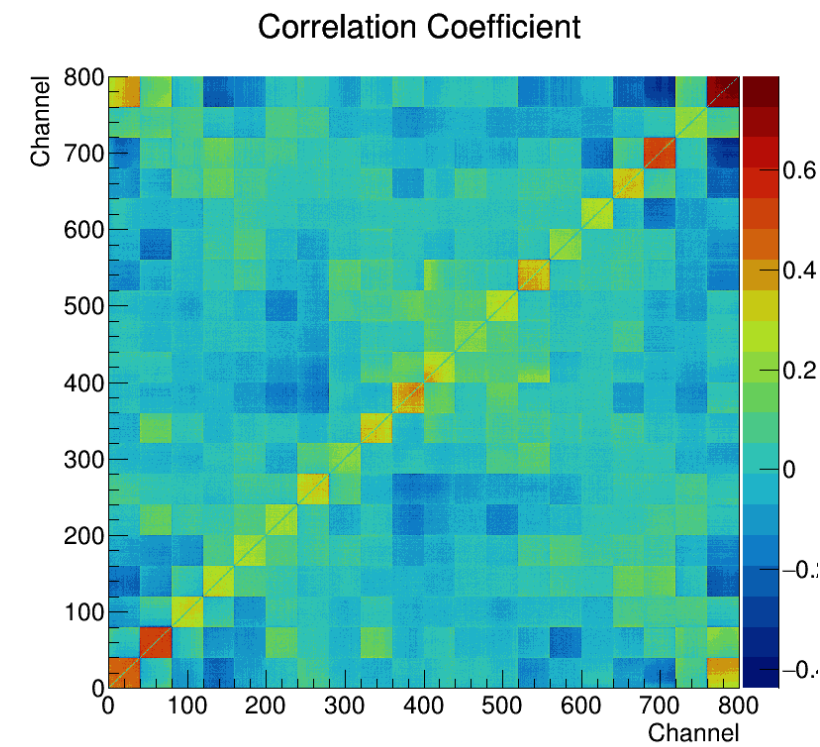


single+grouped NF

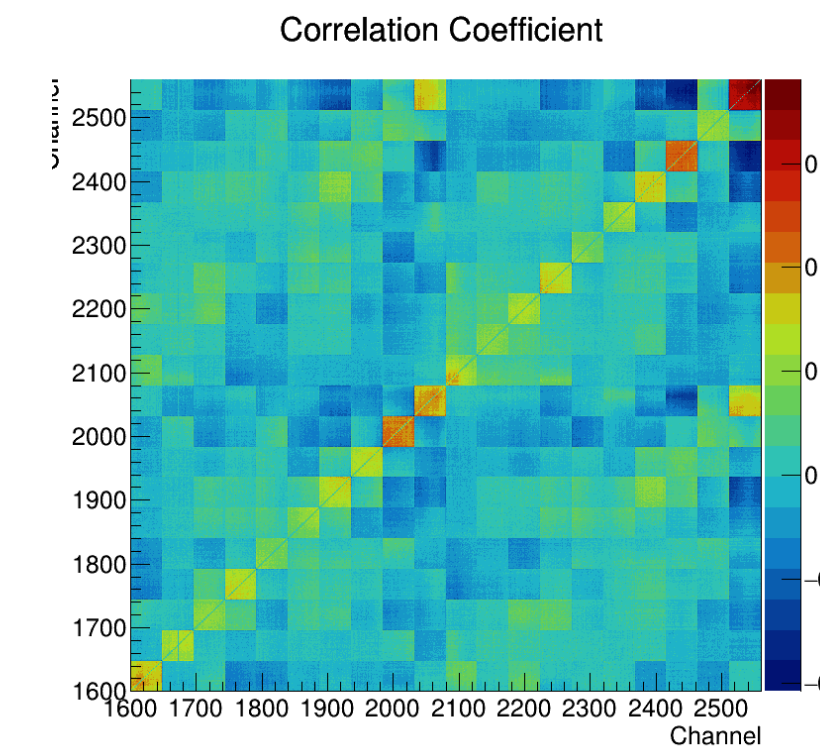
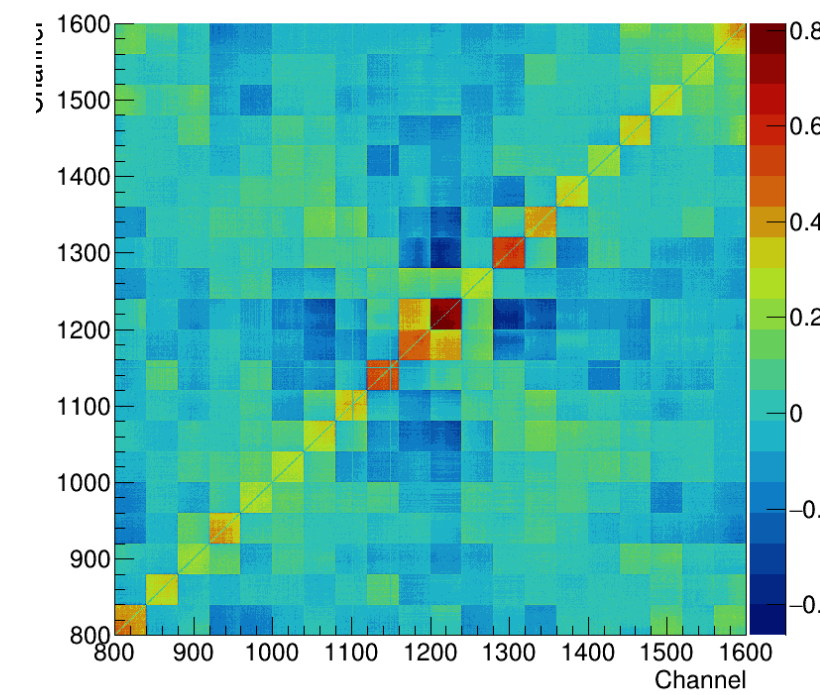
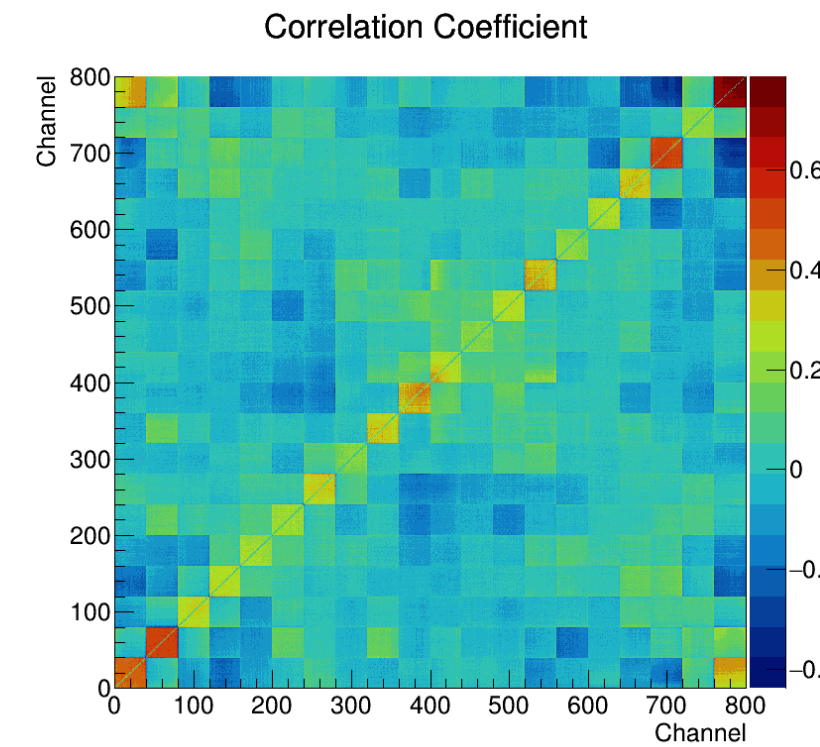


Ch-to-Ch correlation

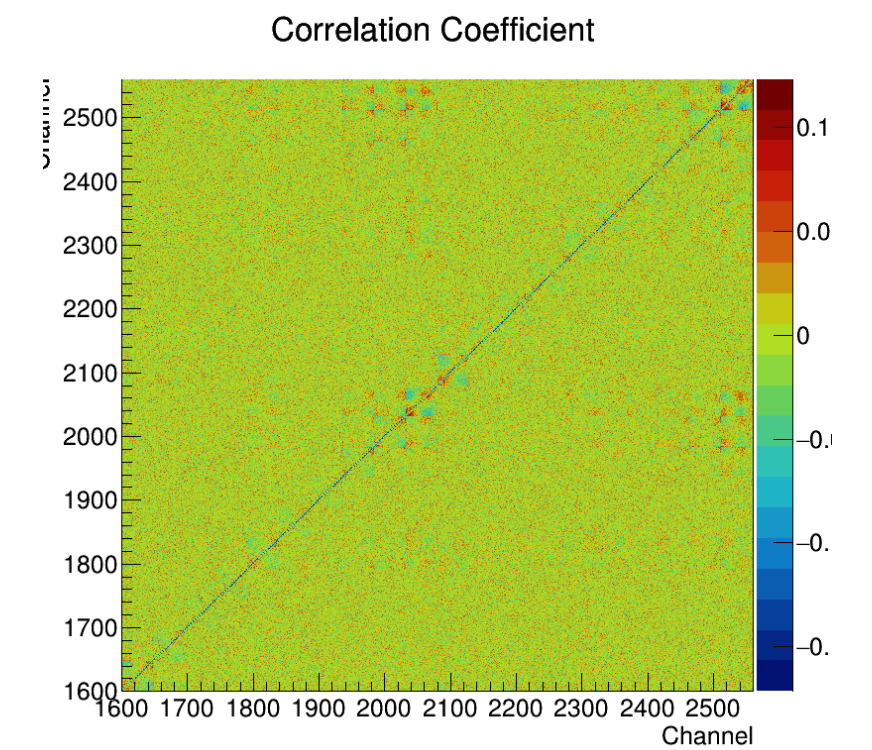
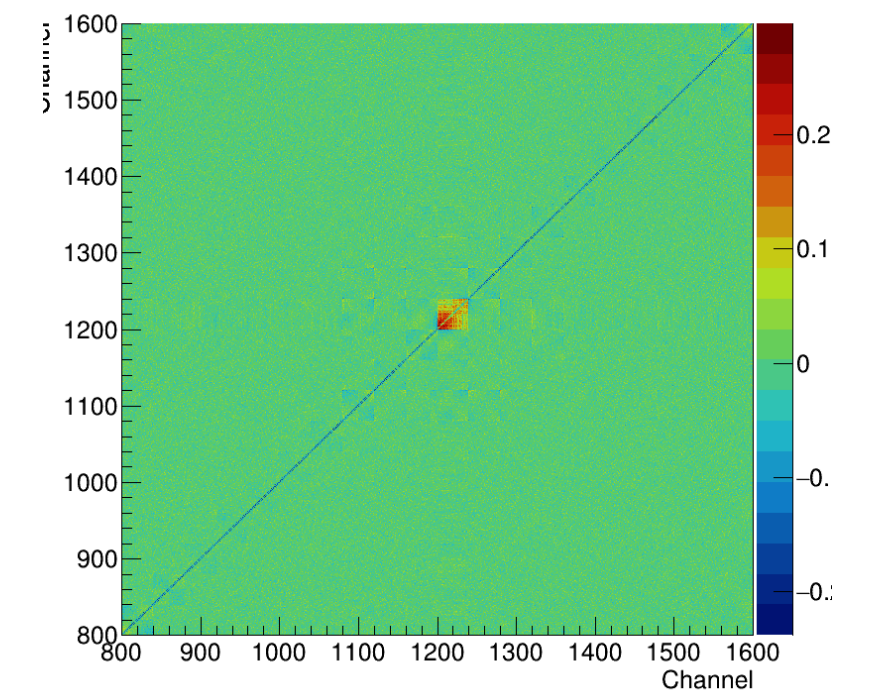
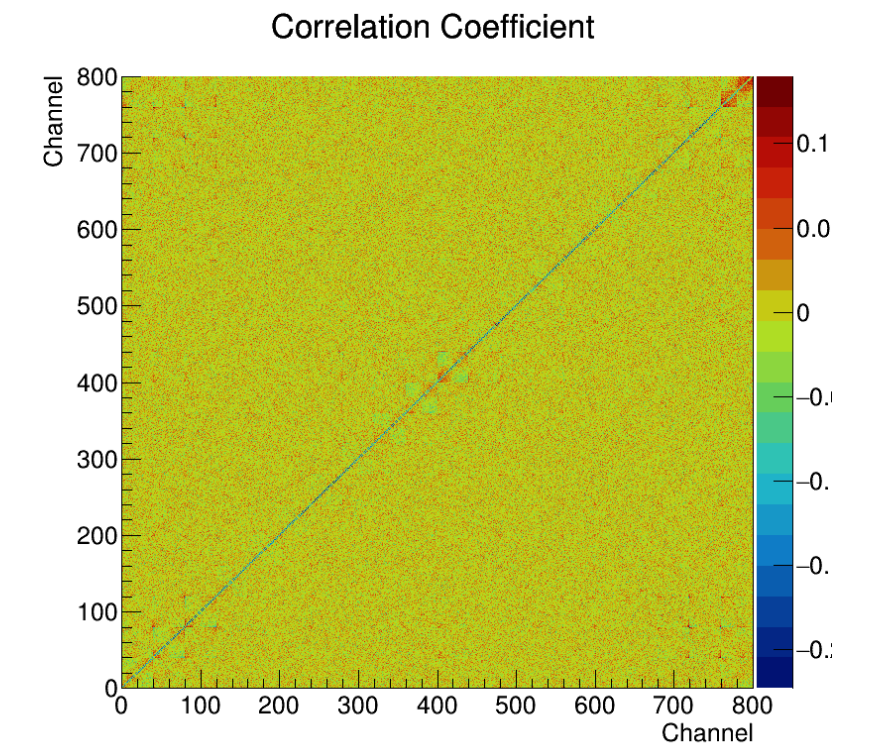
no NF



single NF only

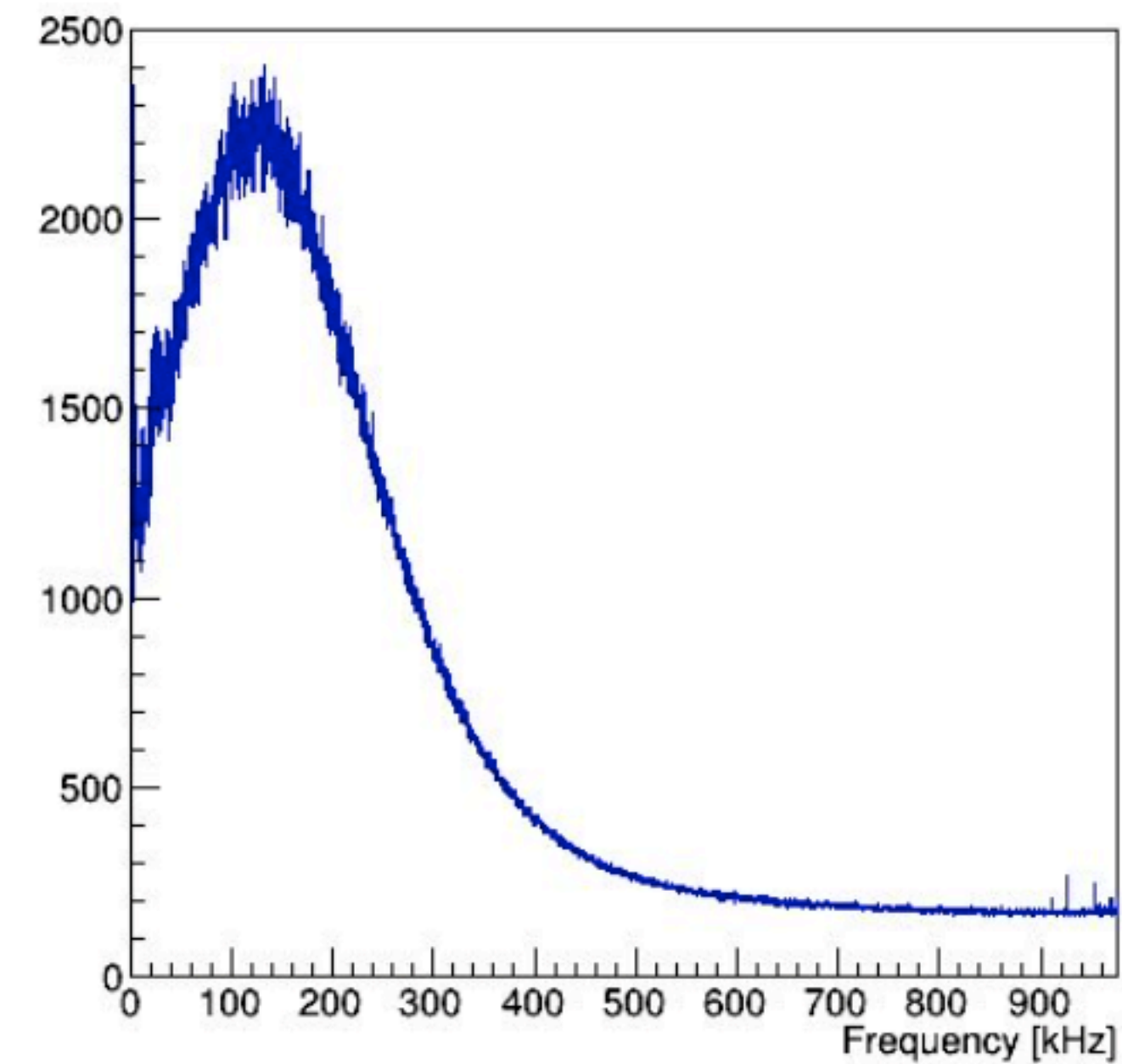
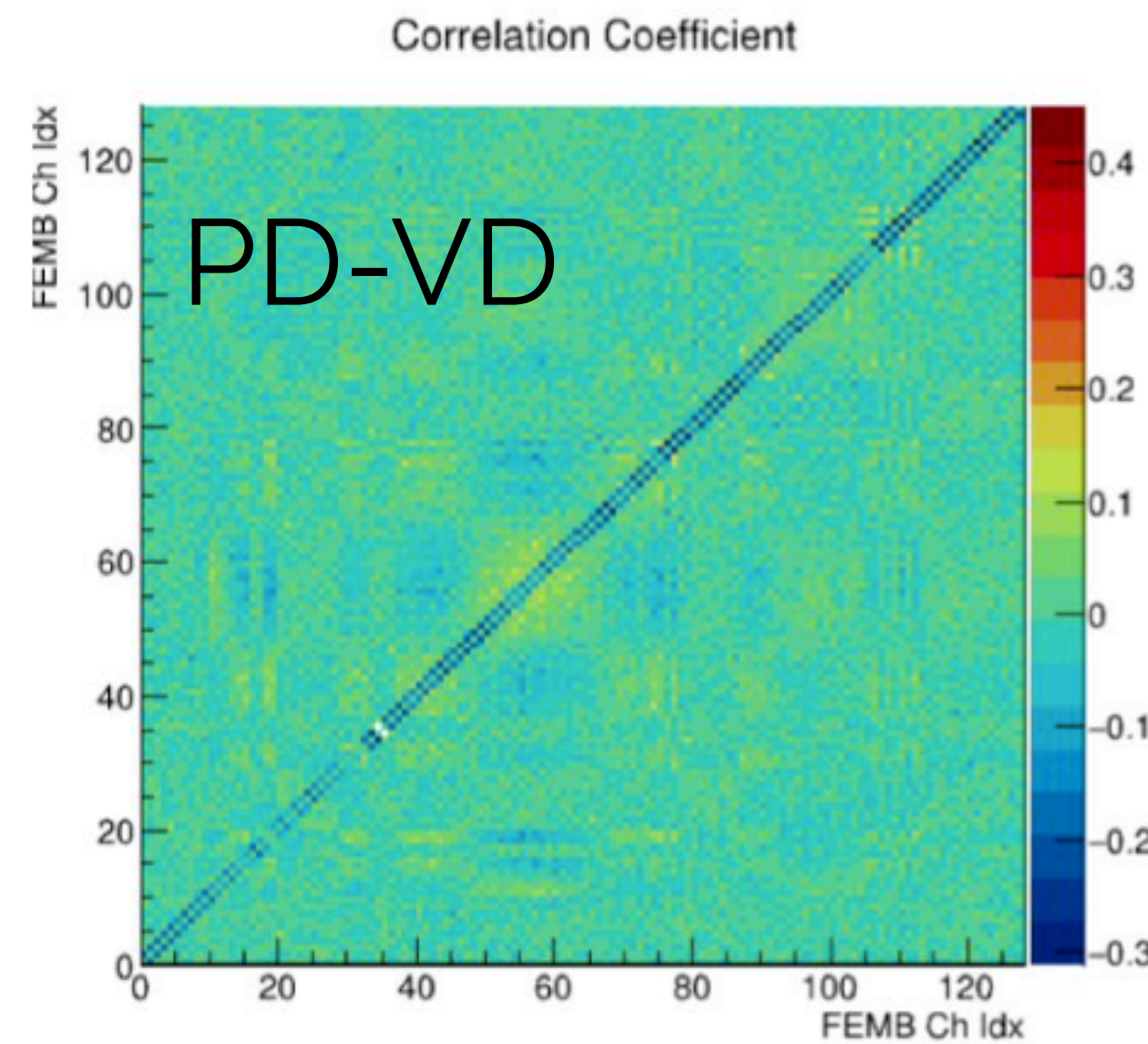
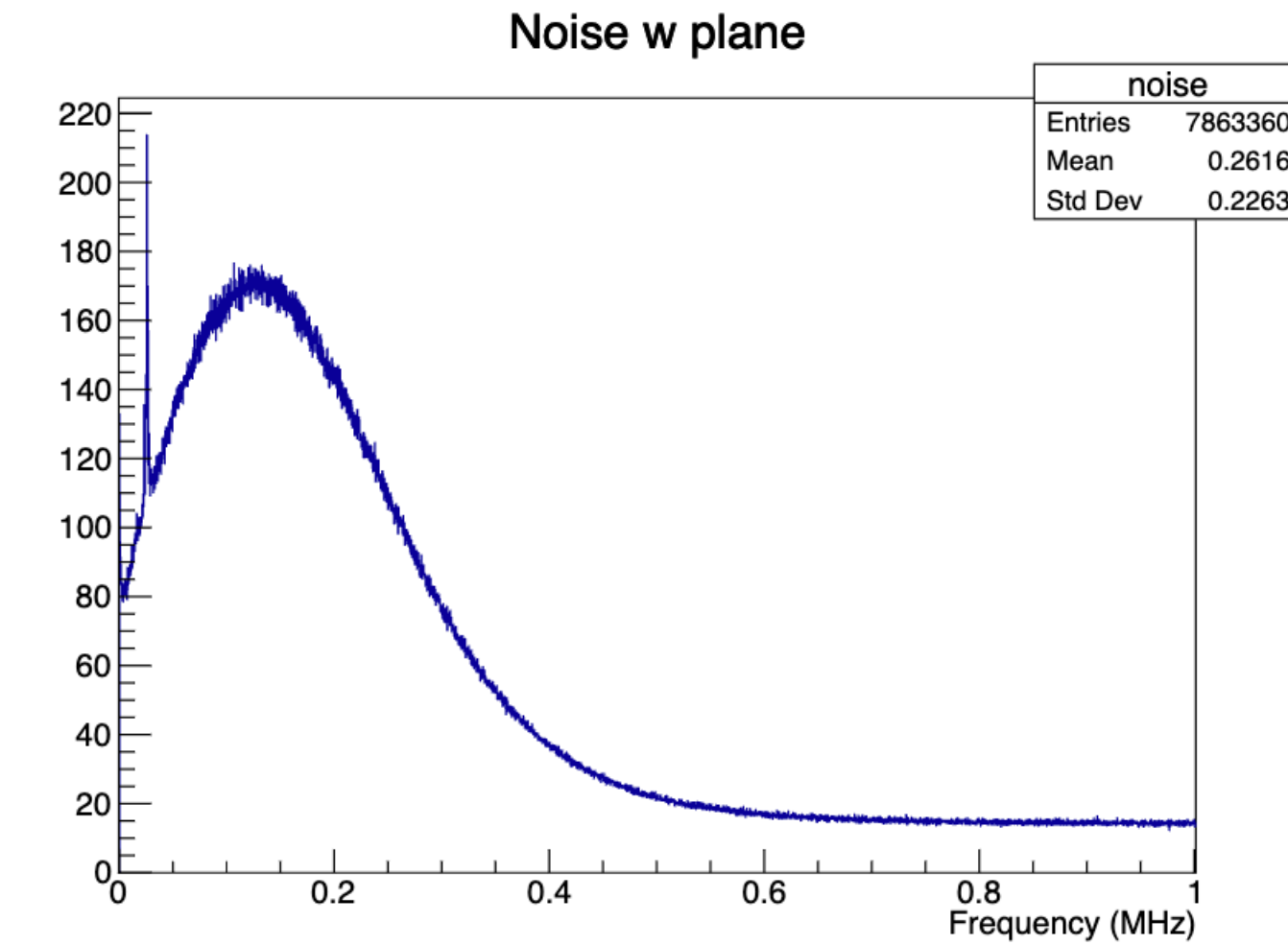
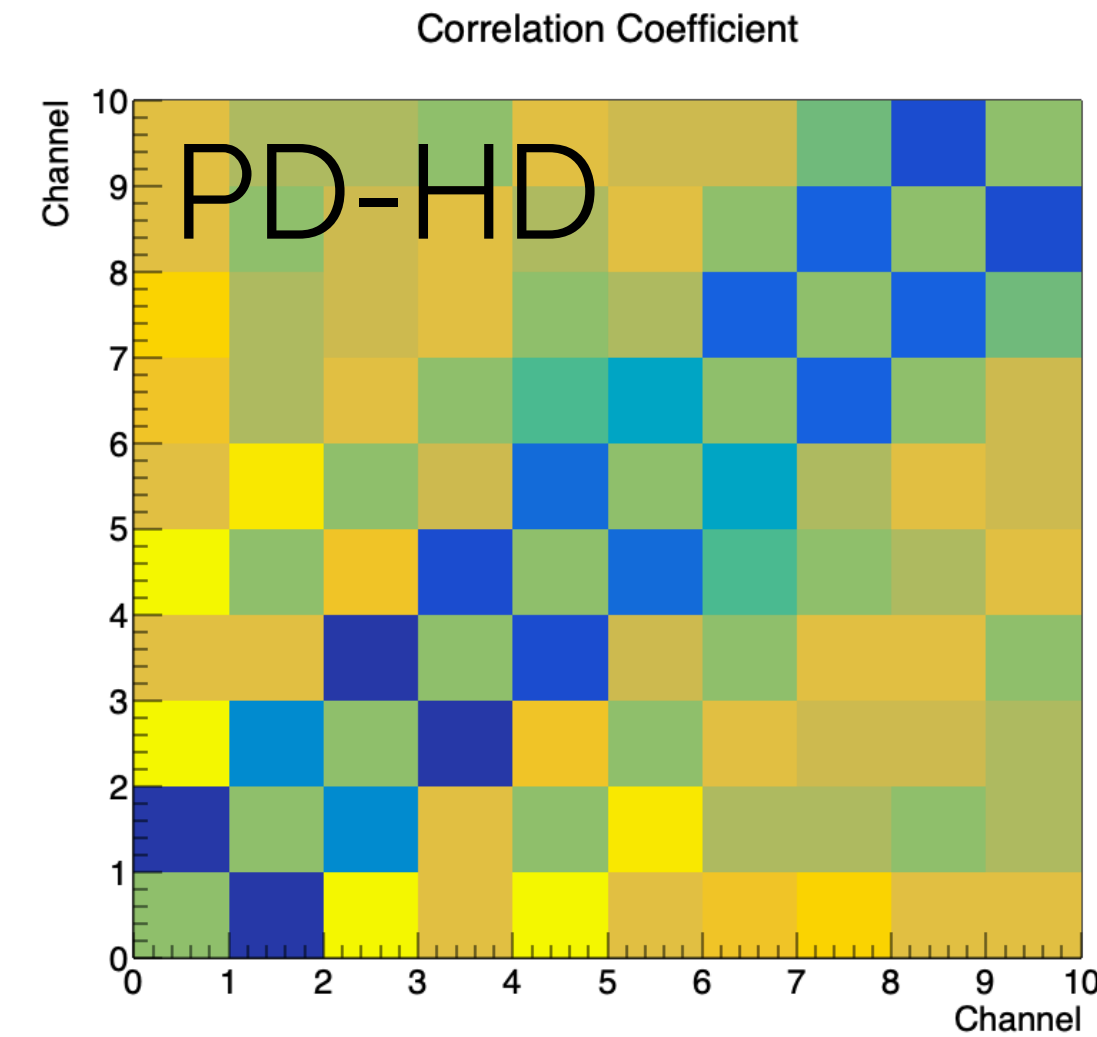


single+group NF

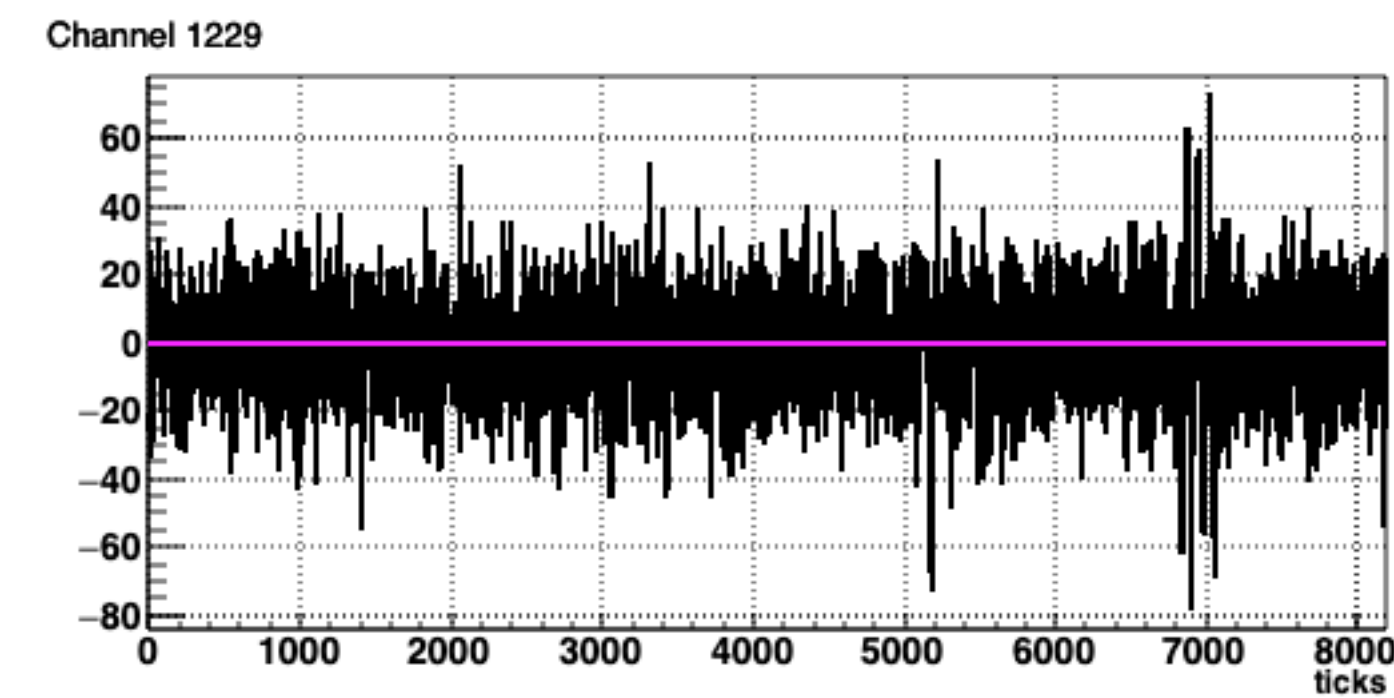
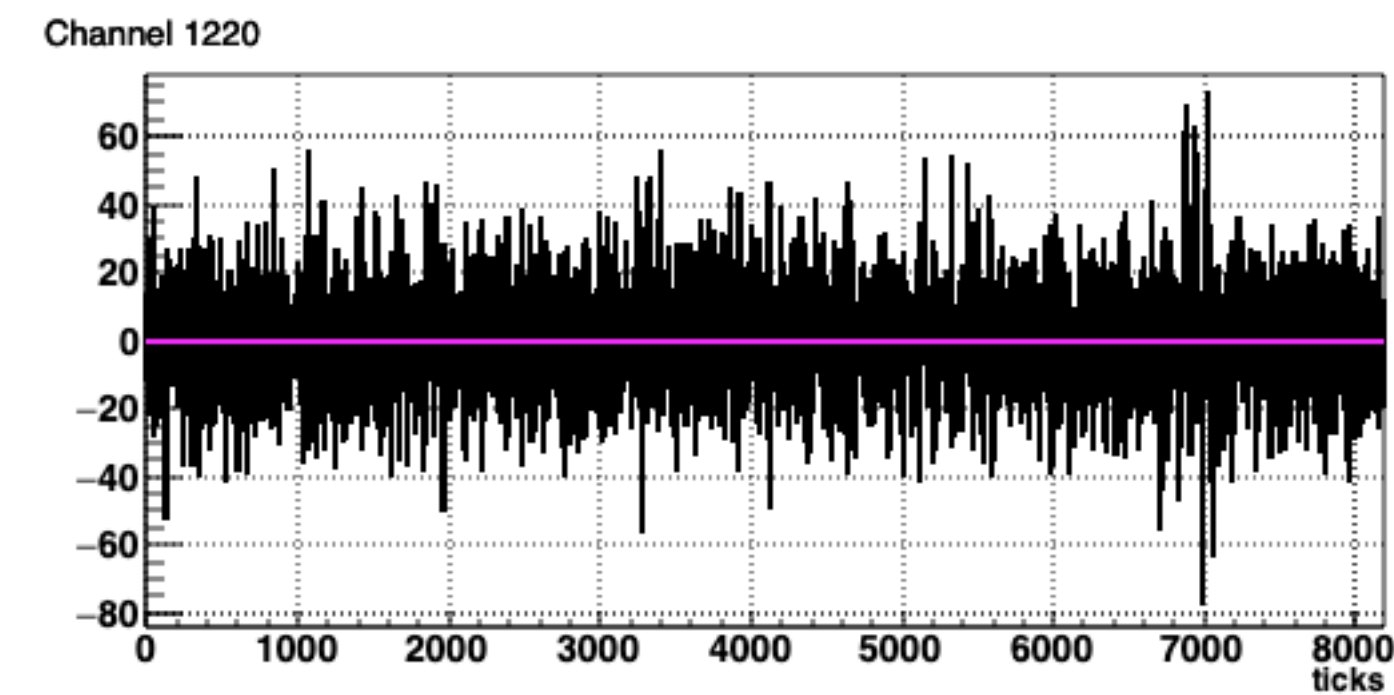
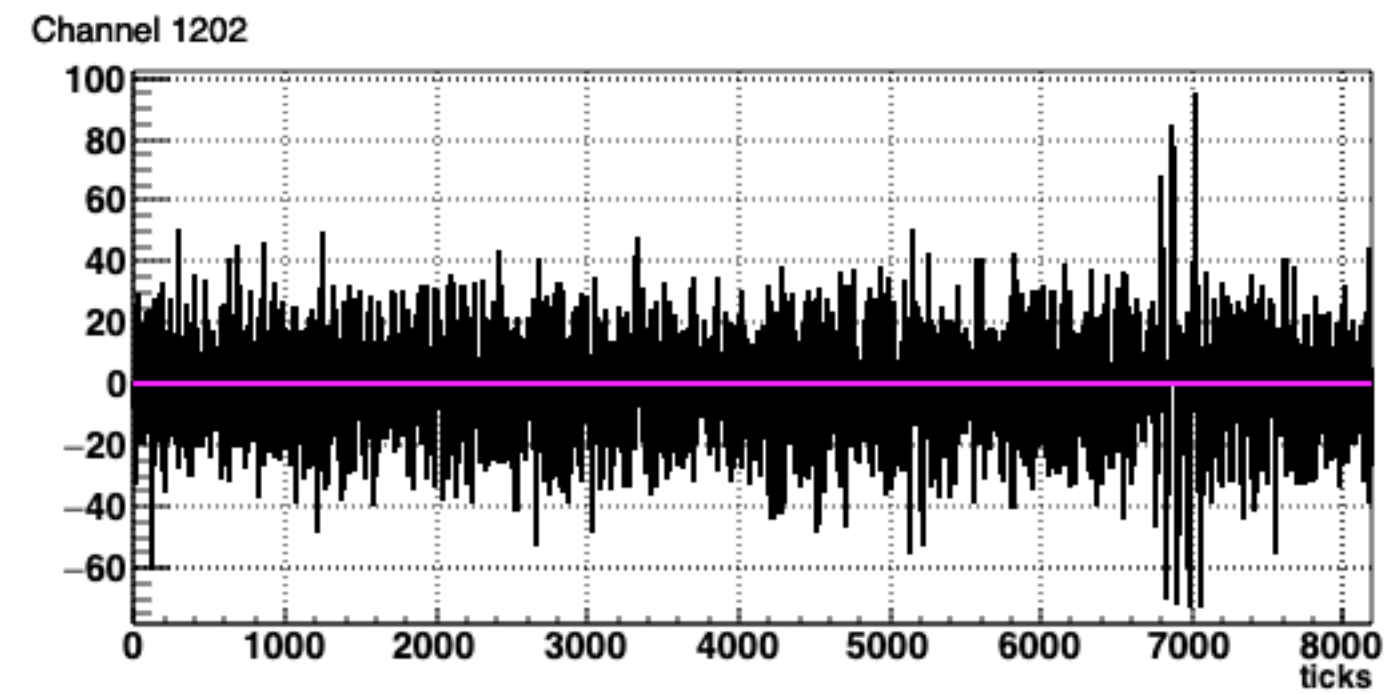


Ch-to-Ch correlation

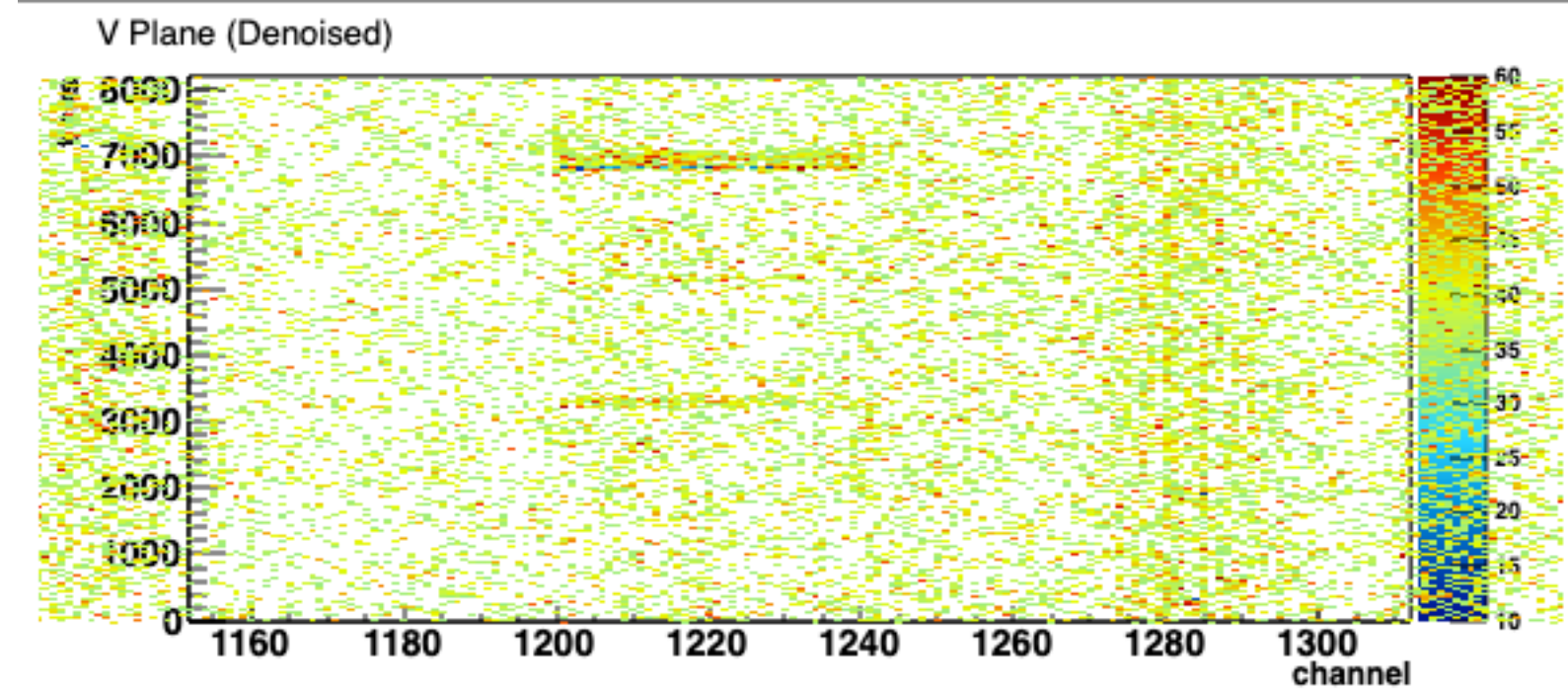
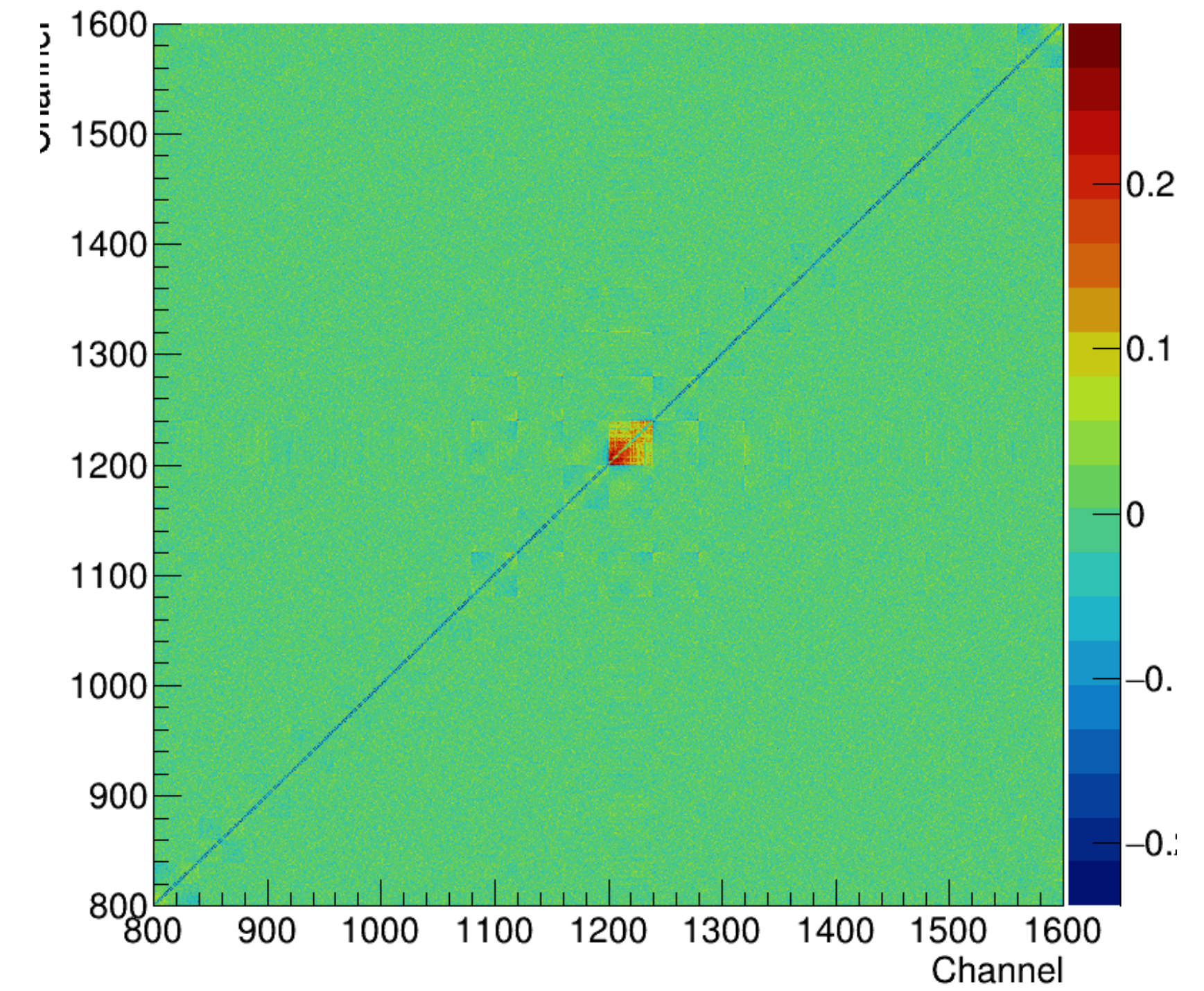
- after all NF
- anti-correlation in neighboring bins?
- similar behavior in PD-VD



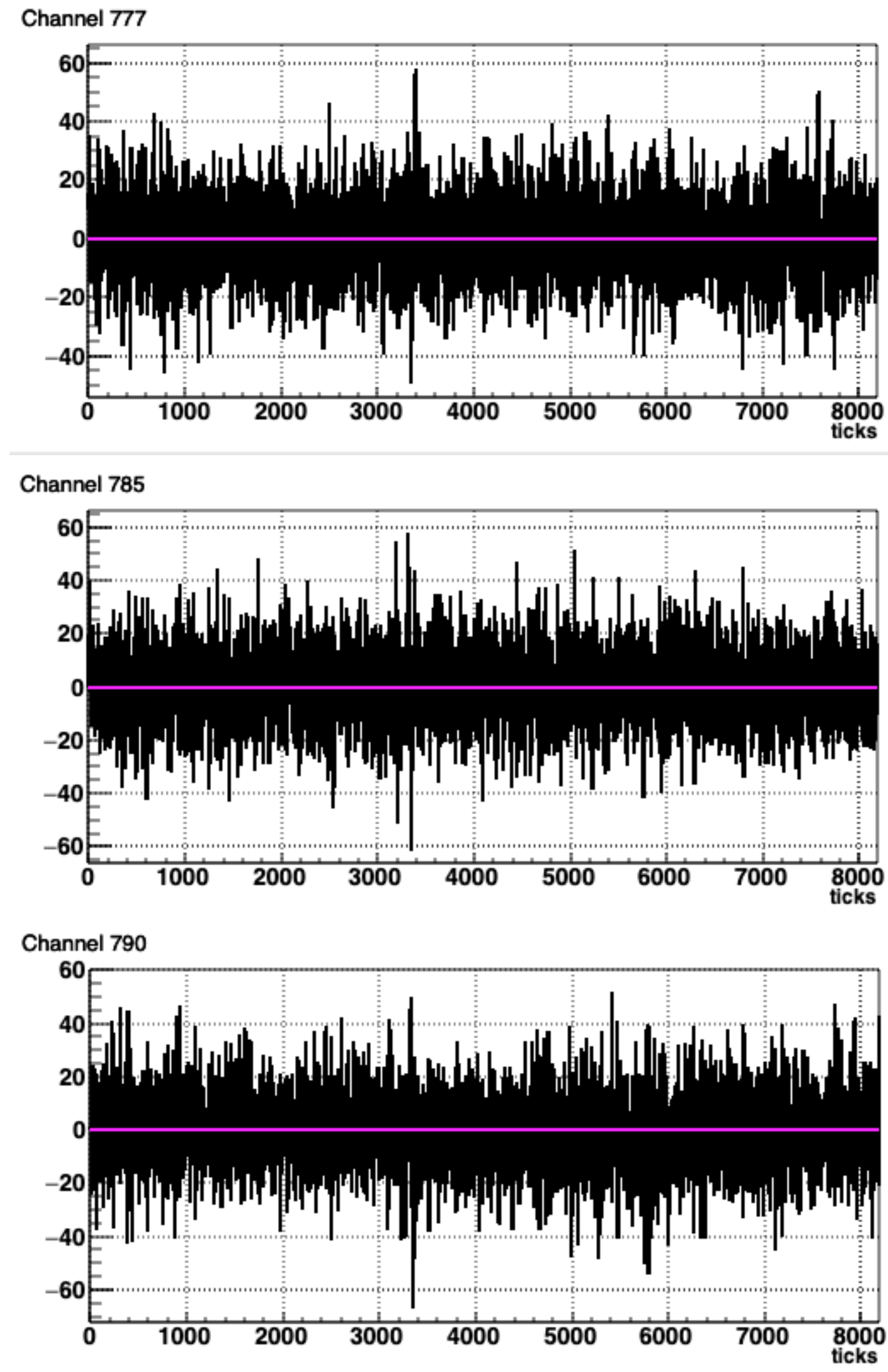
remaining noise



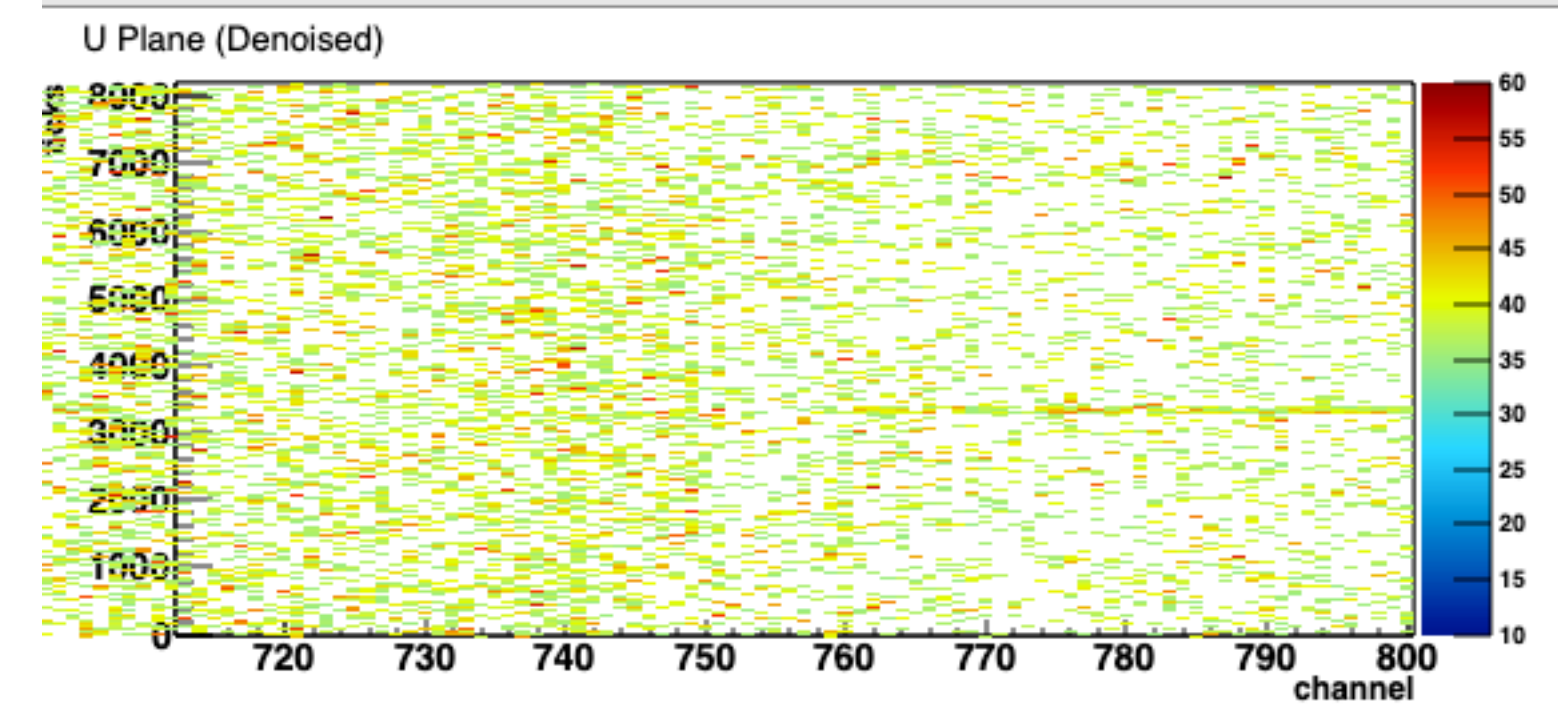
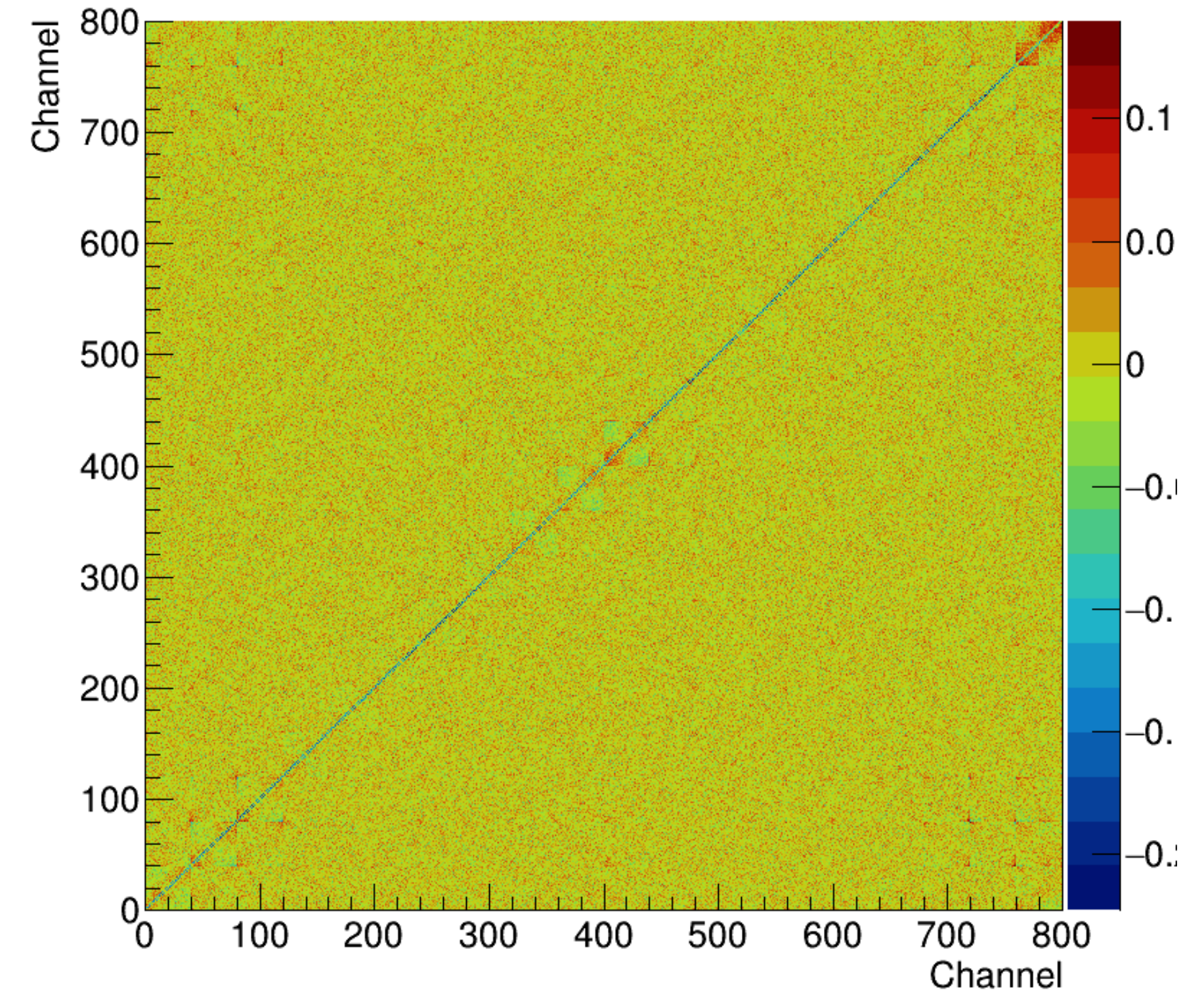
Correlation Coefficient



remaining noise



Correlation Coefficient

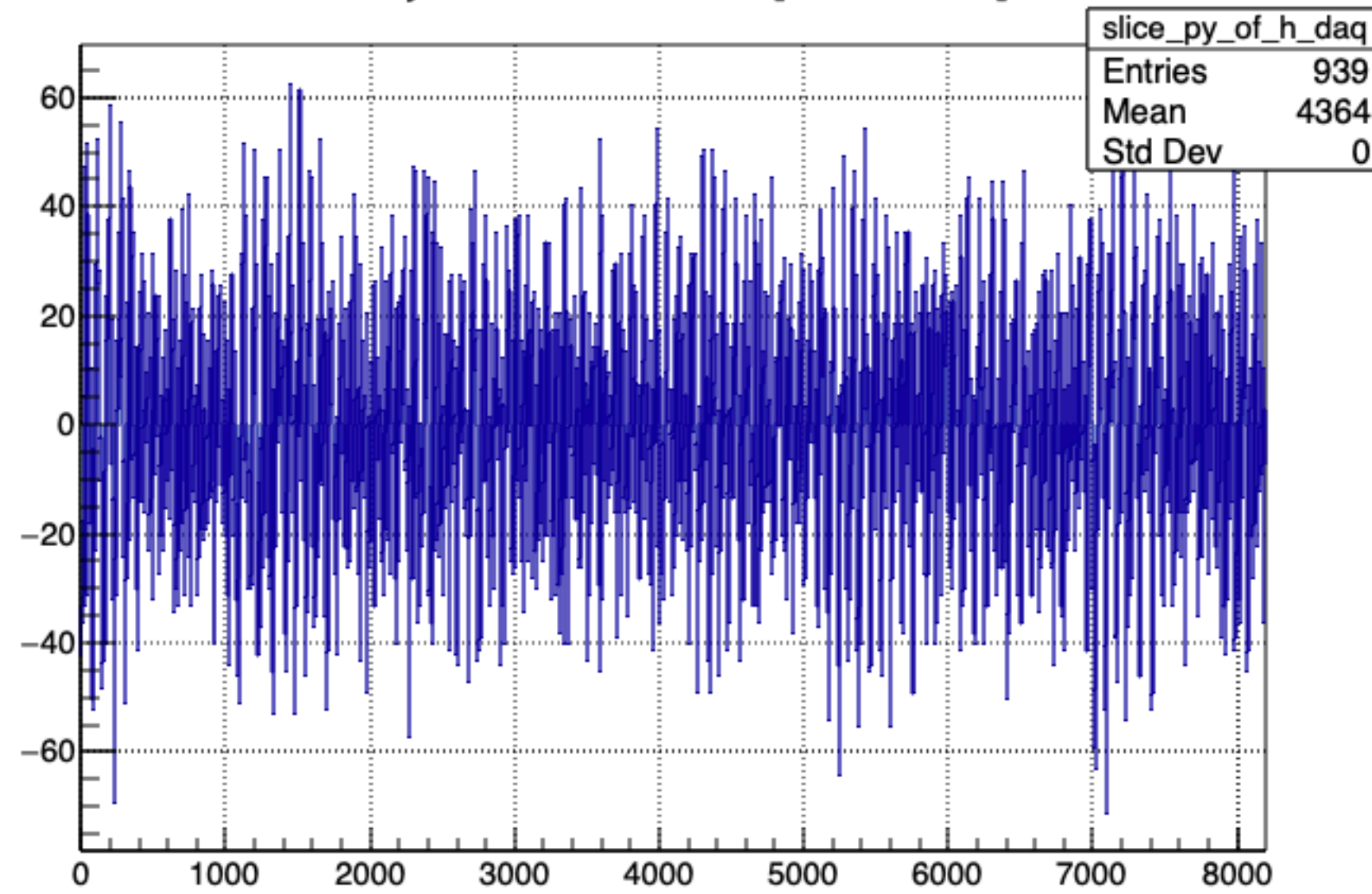


Observations so far

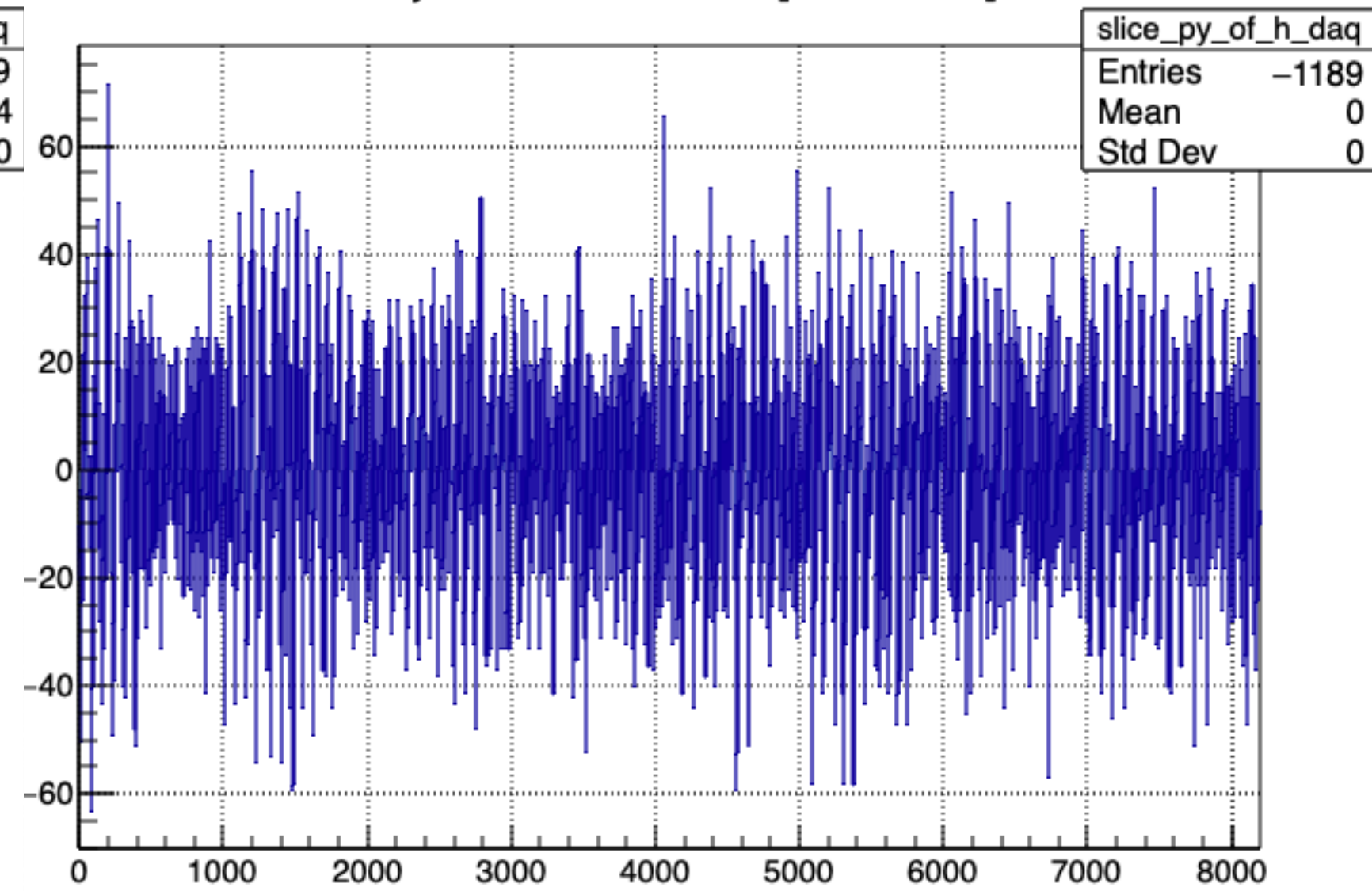
- all in all, Wire-Cell NF works quite well with PD-HD with minor tweaks
- few things to note
 - CNR only works together with single NF(in particular with baseline subtraction)
 - no microphonic noise observed so far
 - CNR works well, except it leaves with anti-correlation between adjacent channels

h_daq, ch 0/1/2

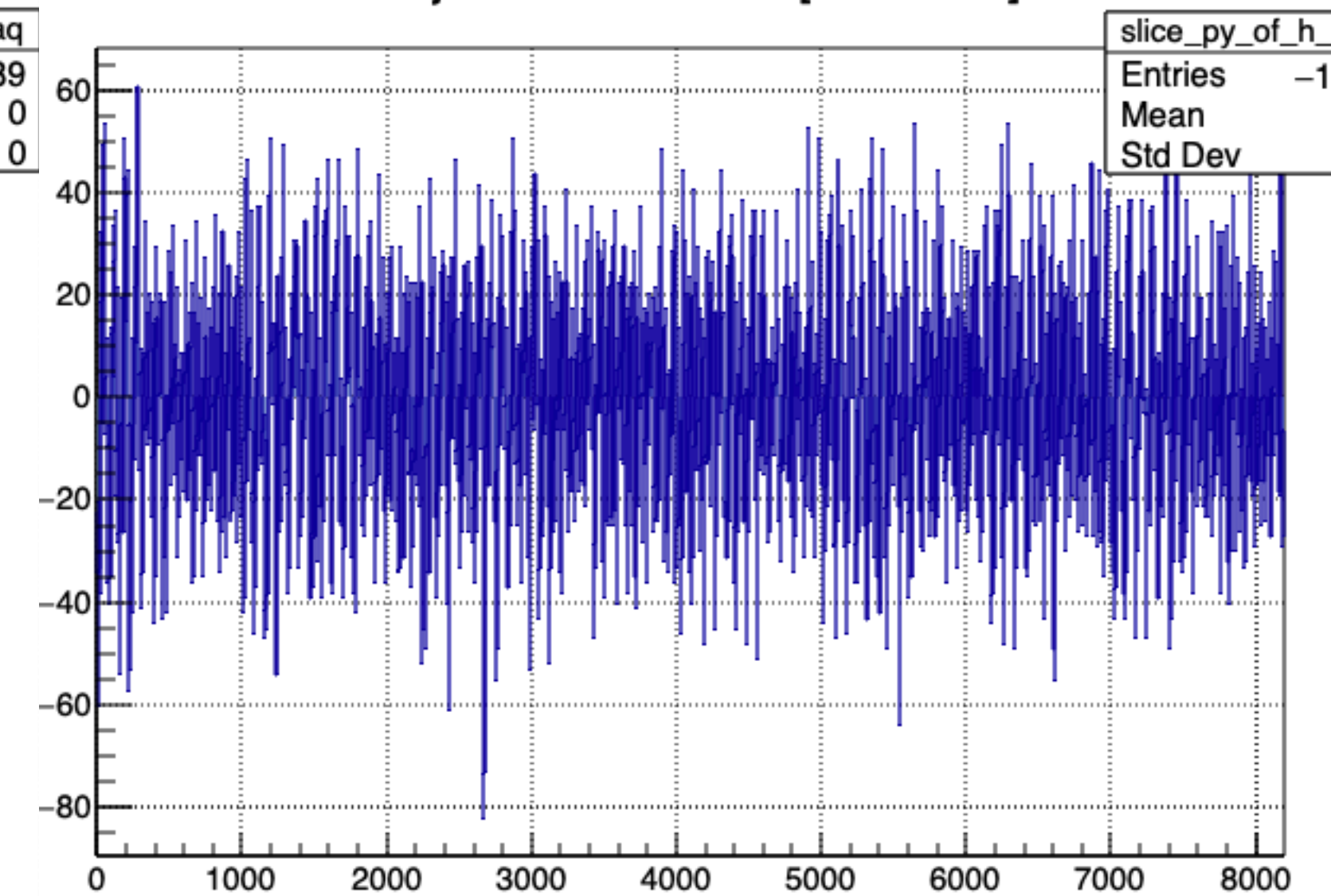
ProjectionY of binx=1 [x=-0.5..0.5]



ProjectionY of binx=2 [x=0.5..1.5]

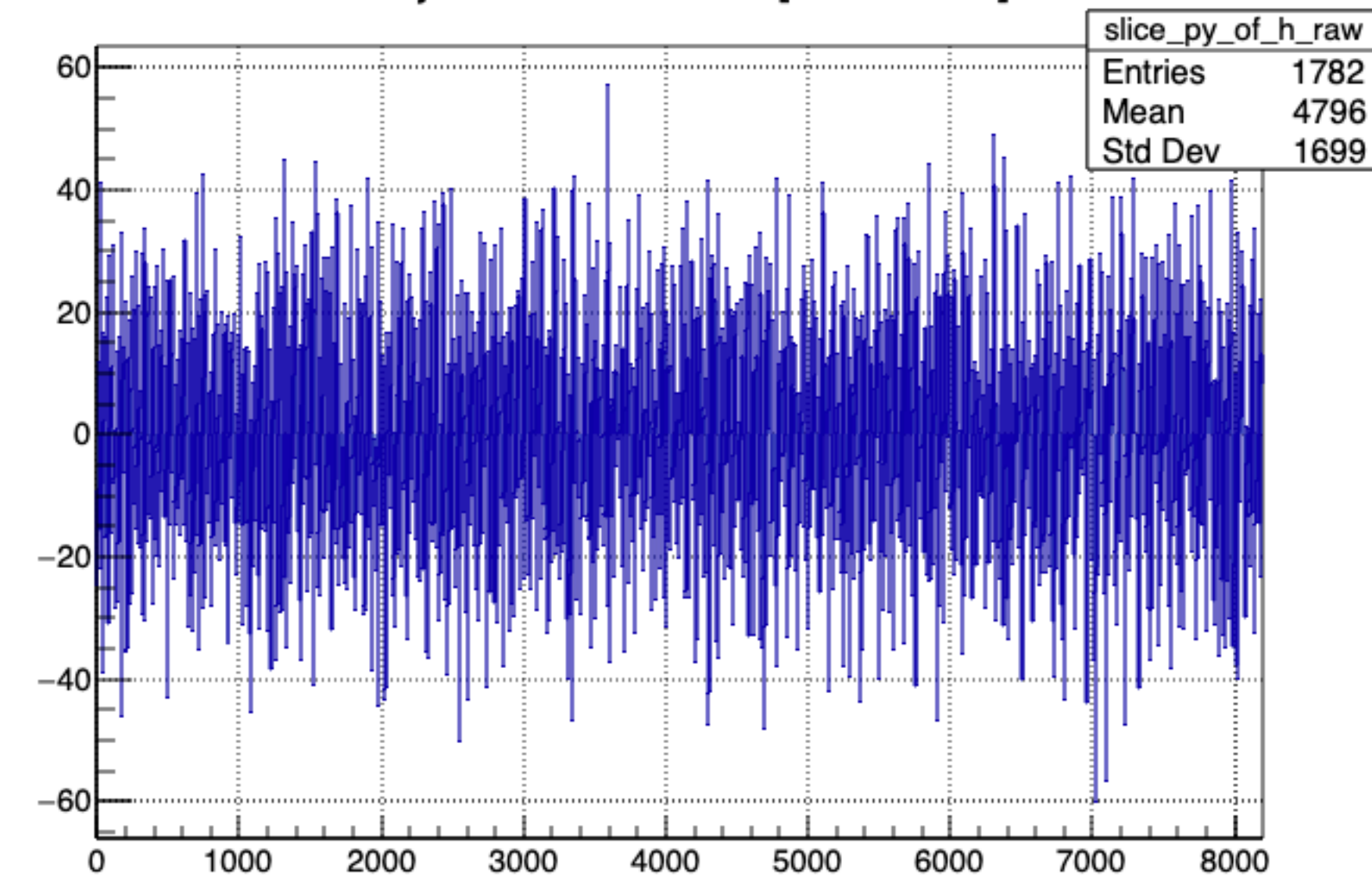


ProjectionY of binx=3 [x=1.5..2.5]

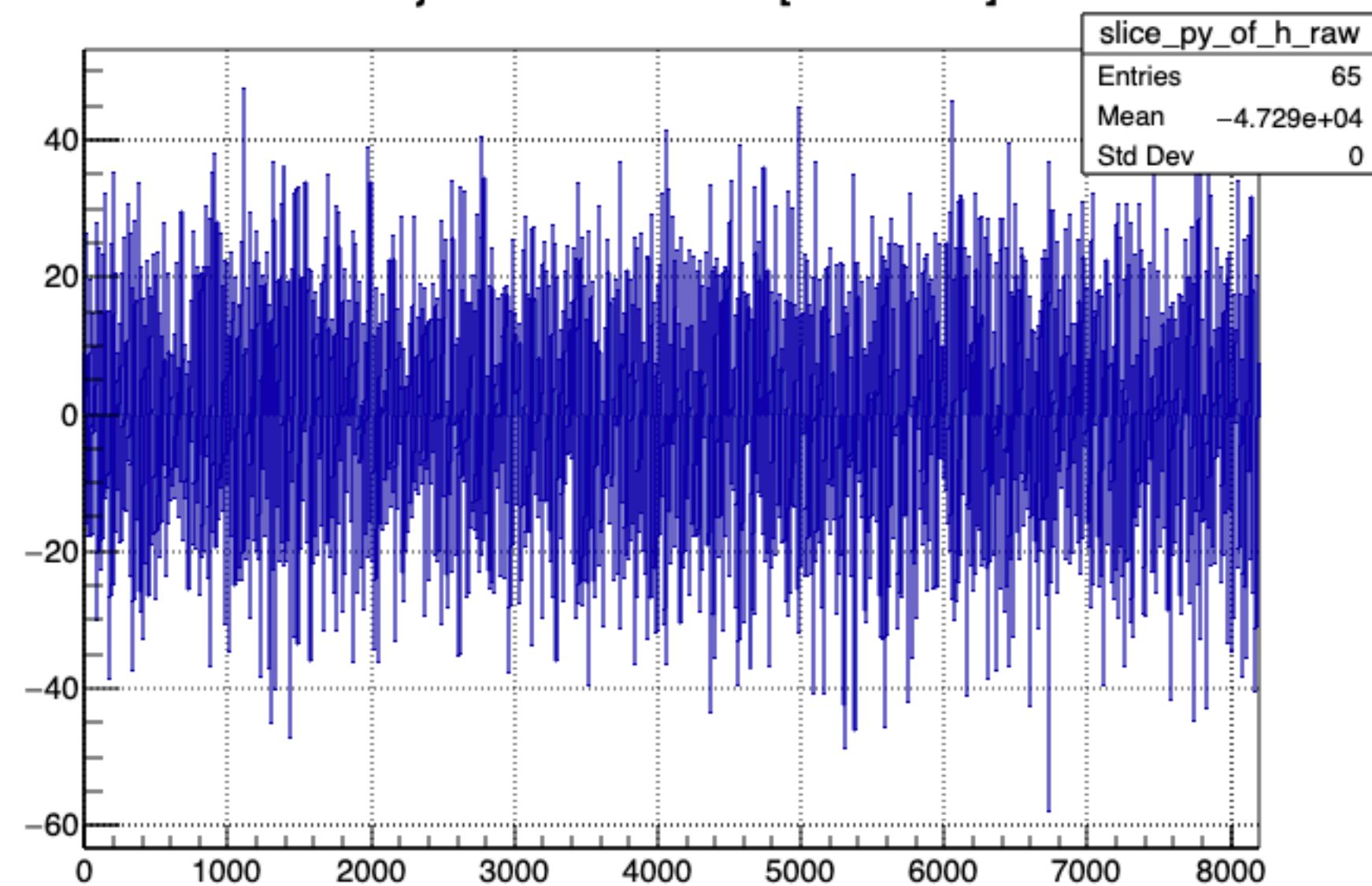


h_raw, ch 0/1/2

ProjectionY of binx=1 [x=-0.5..0.5]



ProjectionY of binx=2 [x=0.5..1.5]



ProjectionY of binx=3 [x=1.5..2.5]

