

ProtoDUNE noise simulation

DUNE DRA

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Introduction

The protoDUNE detector is being commissioned

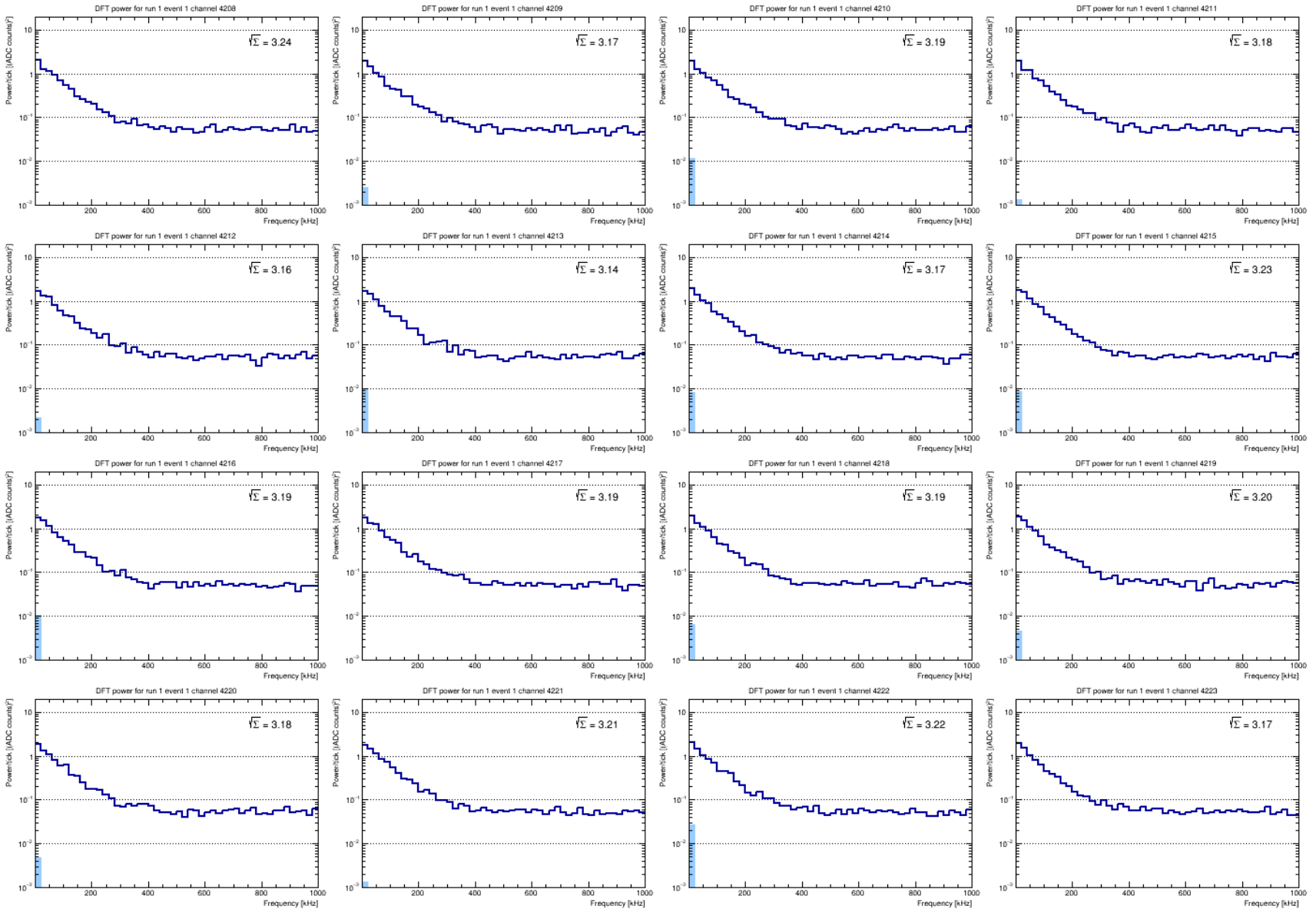
- Filling with LAr this month
 - Close to full by now
- Data taken sporadically as detector cools
 - List of runs I have studied is at [https://wiki.dunescience.org/wiki/ProtoDUNE_commissioning_runs_\(dla\)](https://wiki.dunescience.org/wiki/ProtoDUNE_commissioning_runs_(dla))
 - DQM plots (Channel-tick, metric vs. channel) for many runs at <http://home.fnal.gov/~dladams/protodune/dqm/index.html>
 - DFT of noise for one run is at <http://home.fnal.gov/~dladams/protodune/dftplots/run003775/tps0/plots.html>

I tried to tune simulation noise to match that in data

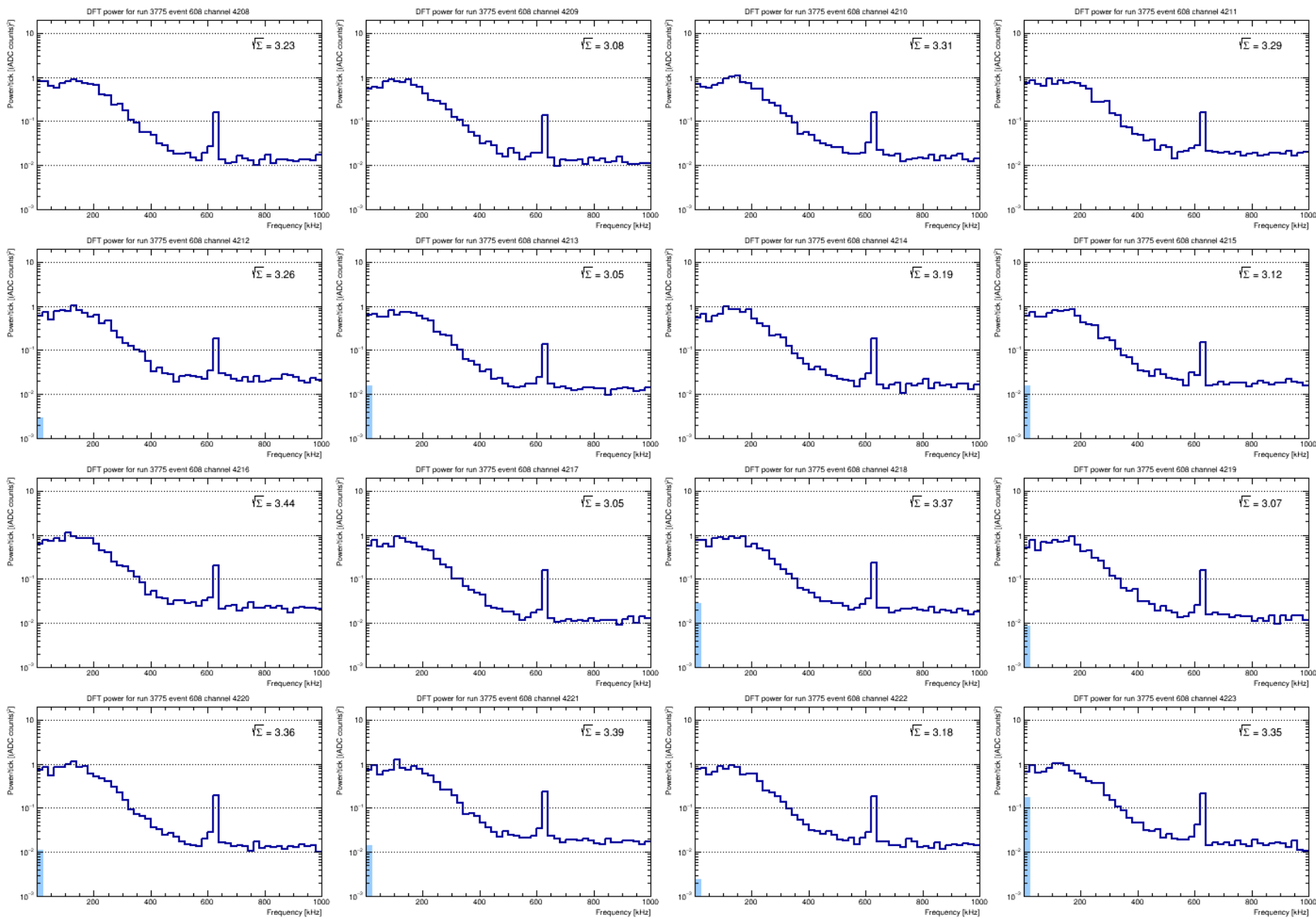
- See task <https://cdcv.s.fnal.gov/redmine/issues/20621>
- Data DFT flattens out at low frequency
 - I modified ExponentialNoiseService to provide option for such behavior
 - But kept the old behavior for existing configurations
 - I adjusted params to match the data—see following plots
 - New fcl is pdsp_chnoiseAug2018 in detsimmodules.fcl

DFT spectra

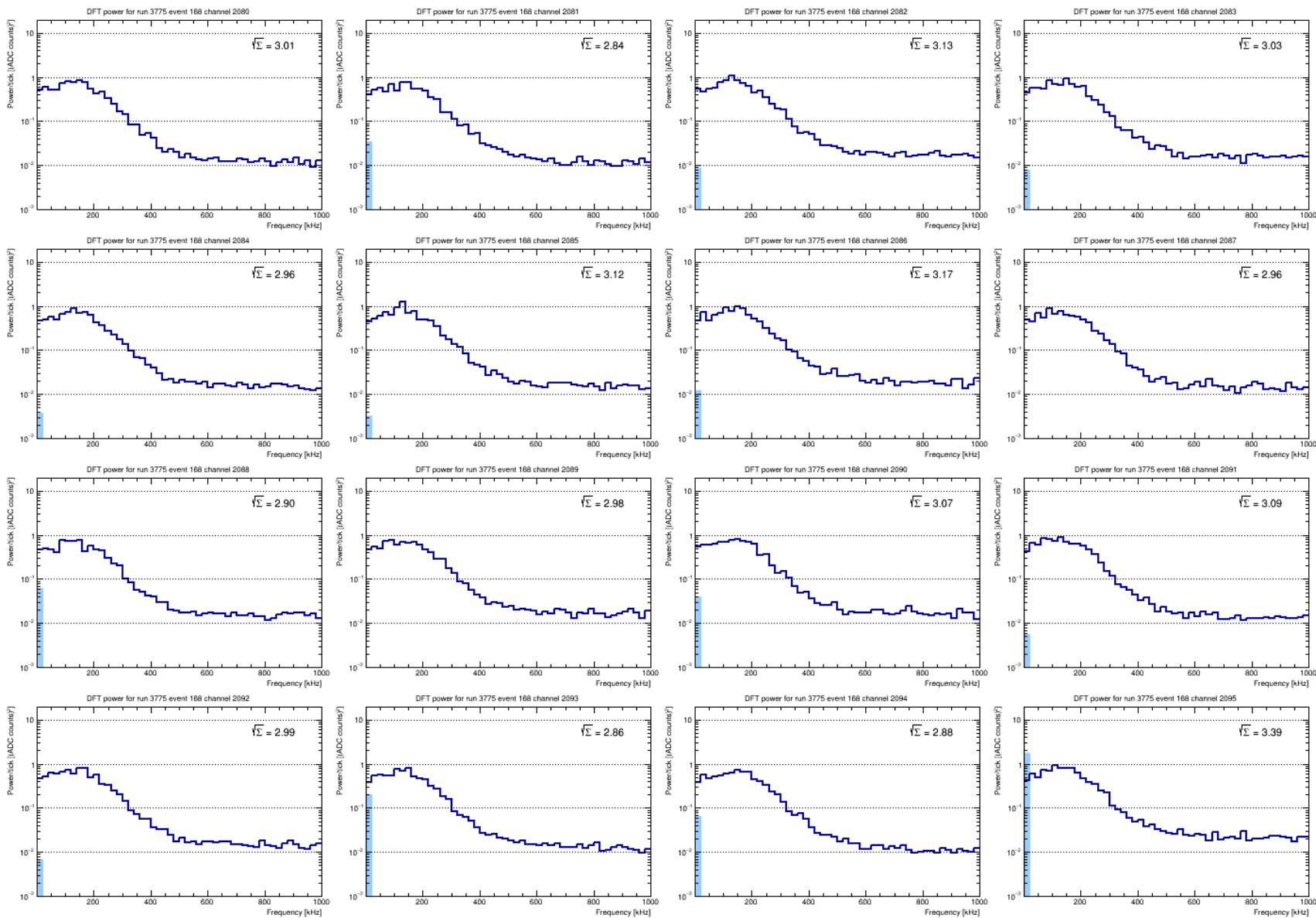
Collection DFT: current simulation



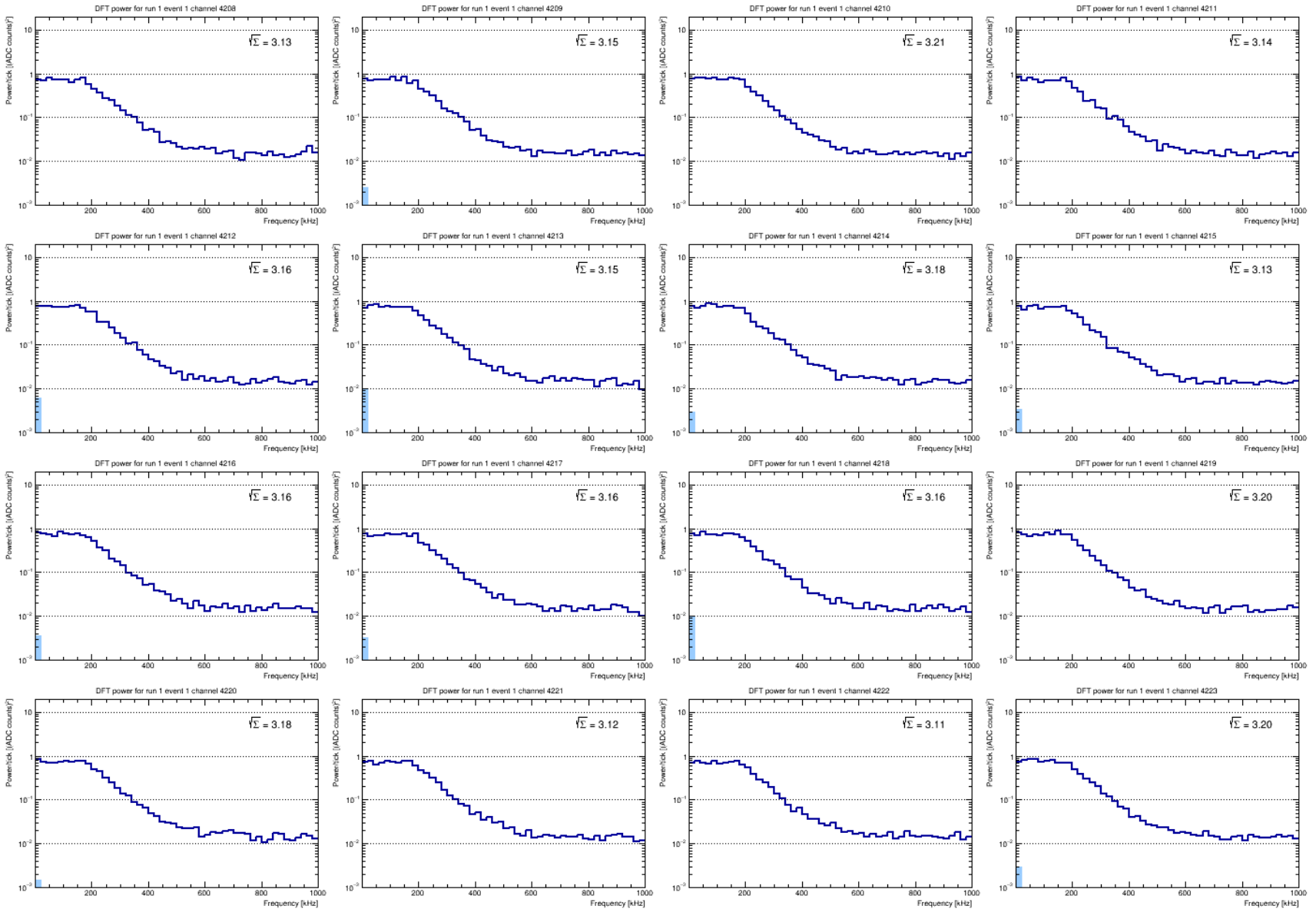
Collection DFT: data (with spike)



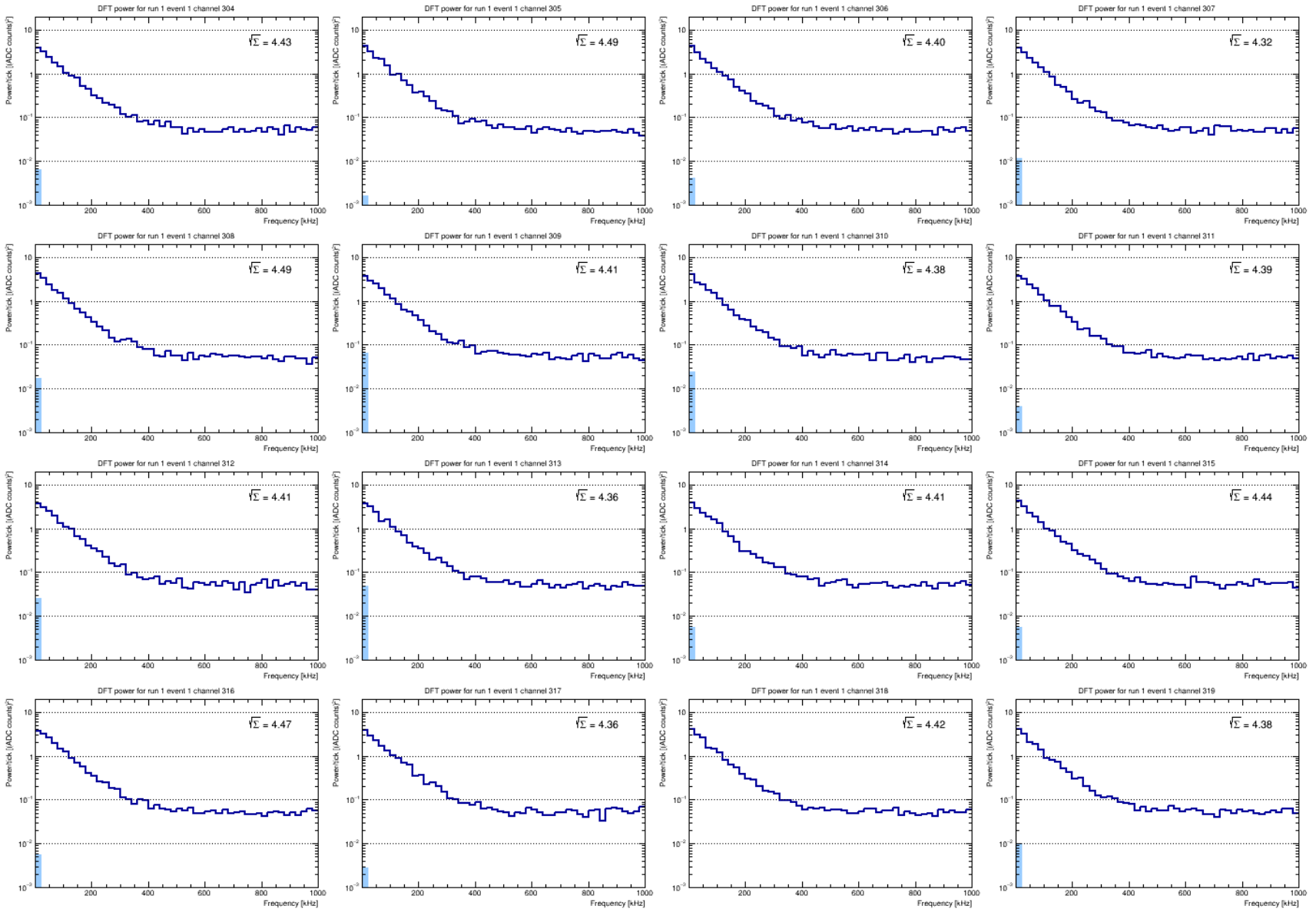
Collection DFT: data (no spike)



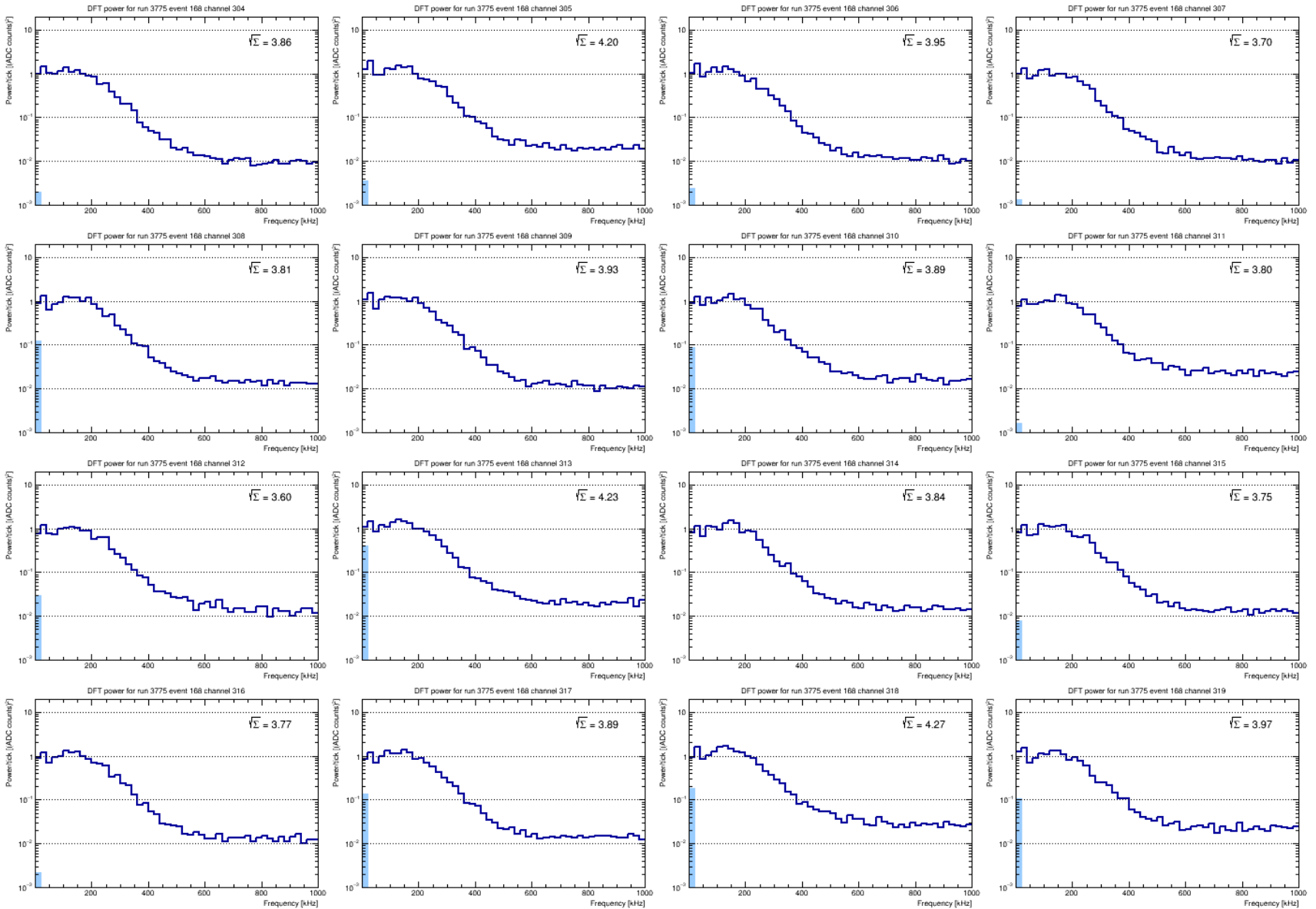
Collection DFT: new simulation



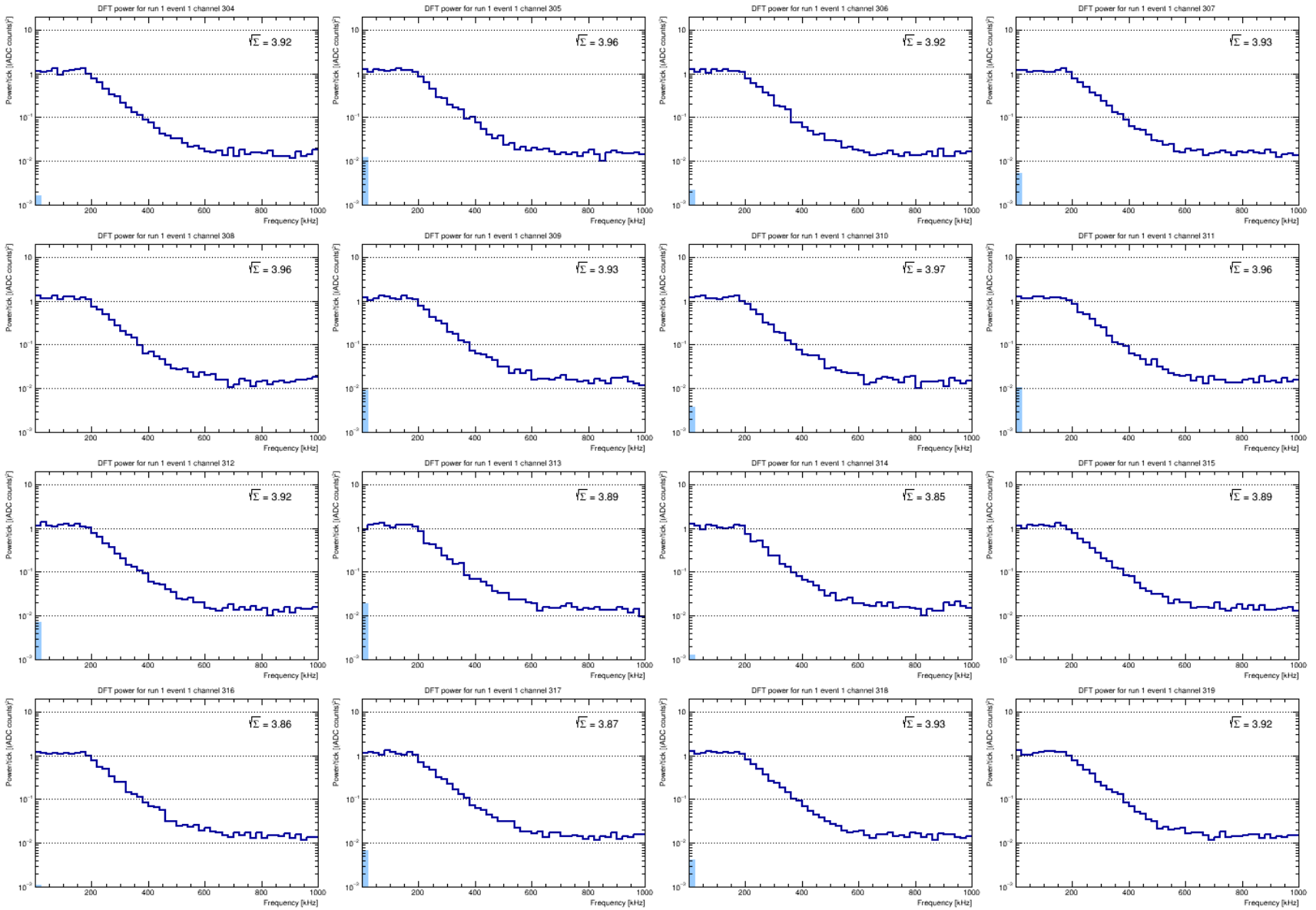
Induction DFT: current simulation



Induction DFT: commissioning data



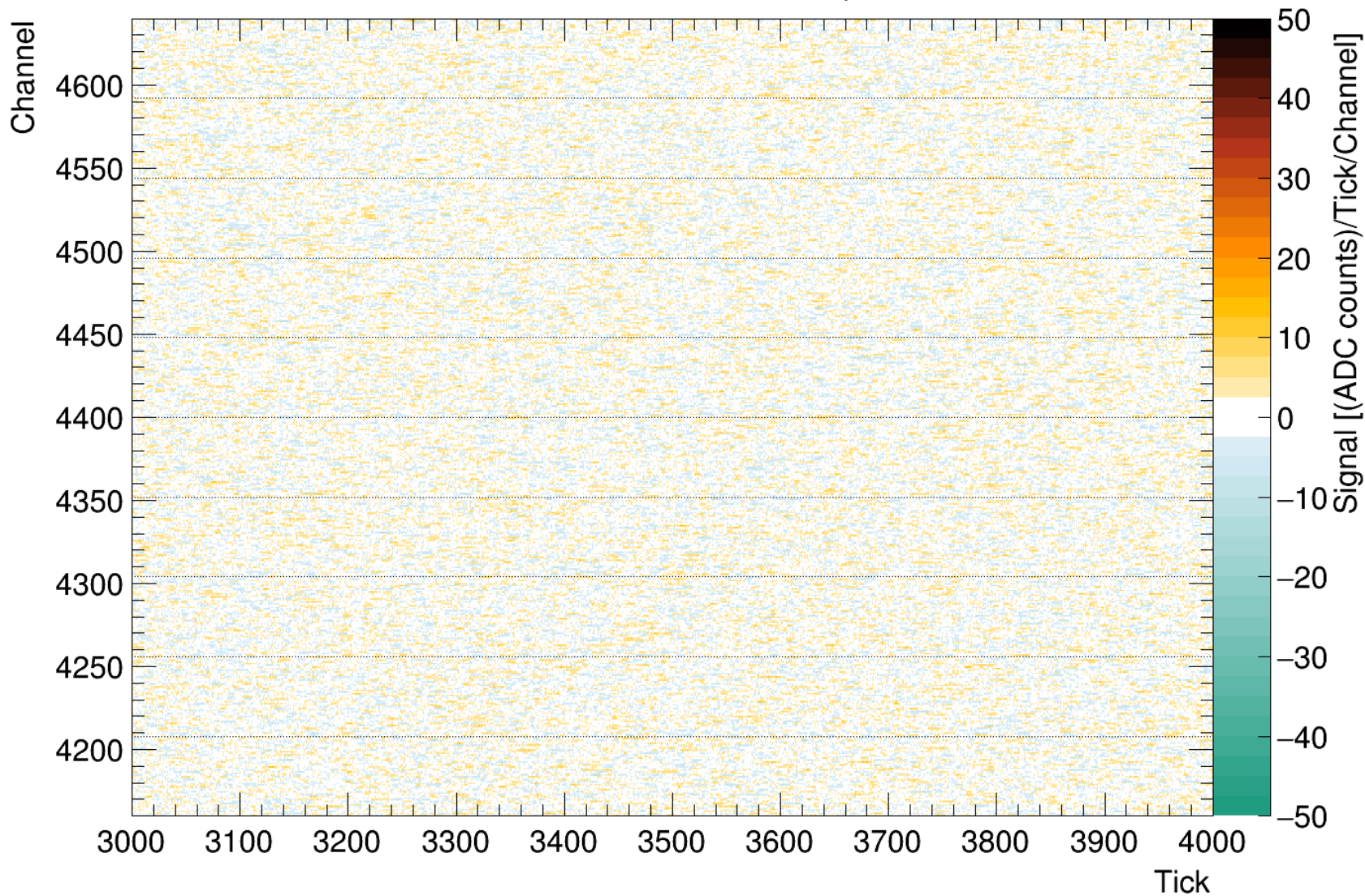
Induction DFT: new simulation



Channel vs. tick displays

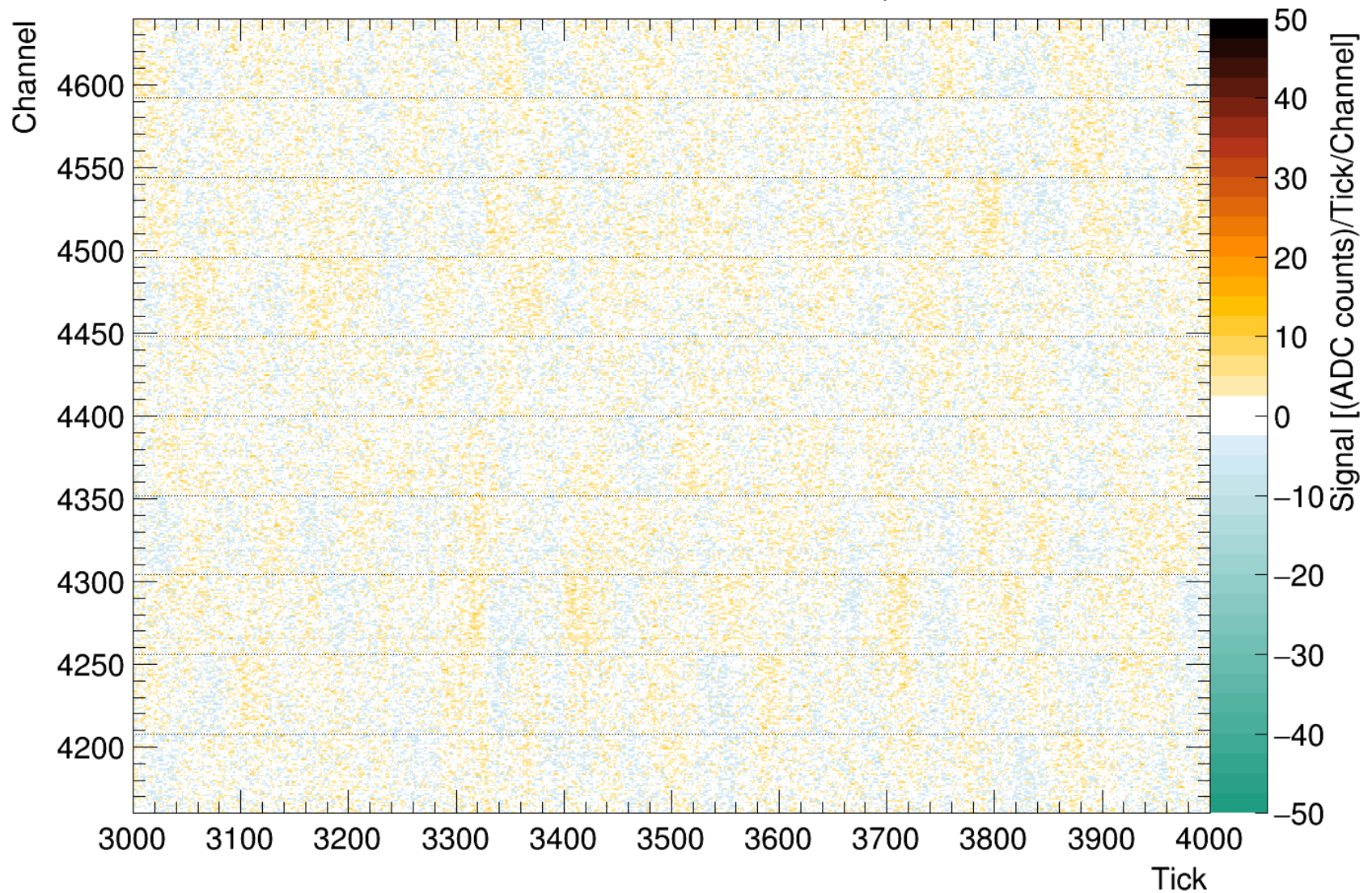
Collection channel vs. tick: old simulation

Raw ADC for run 1 event 1 TPC plane 1z



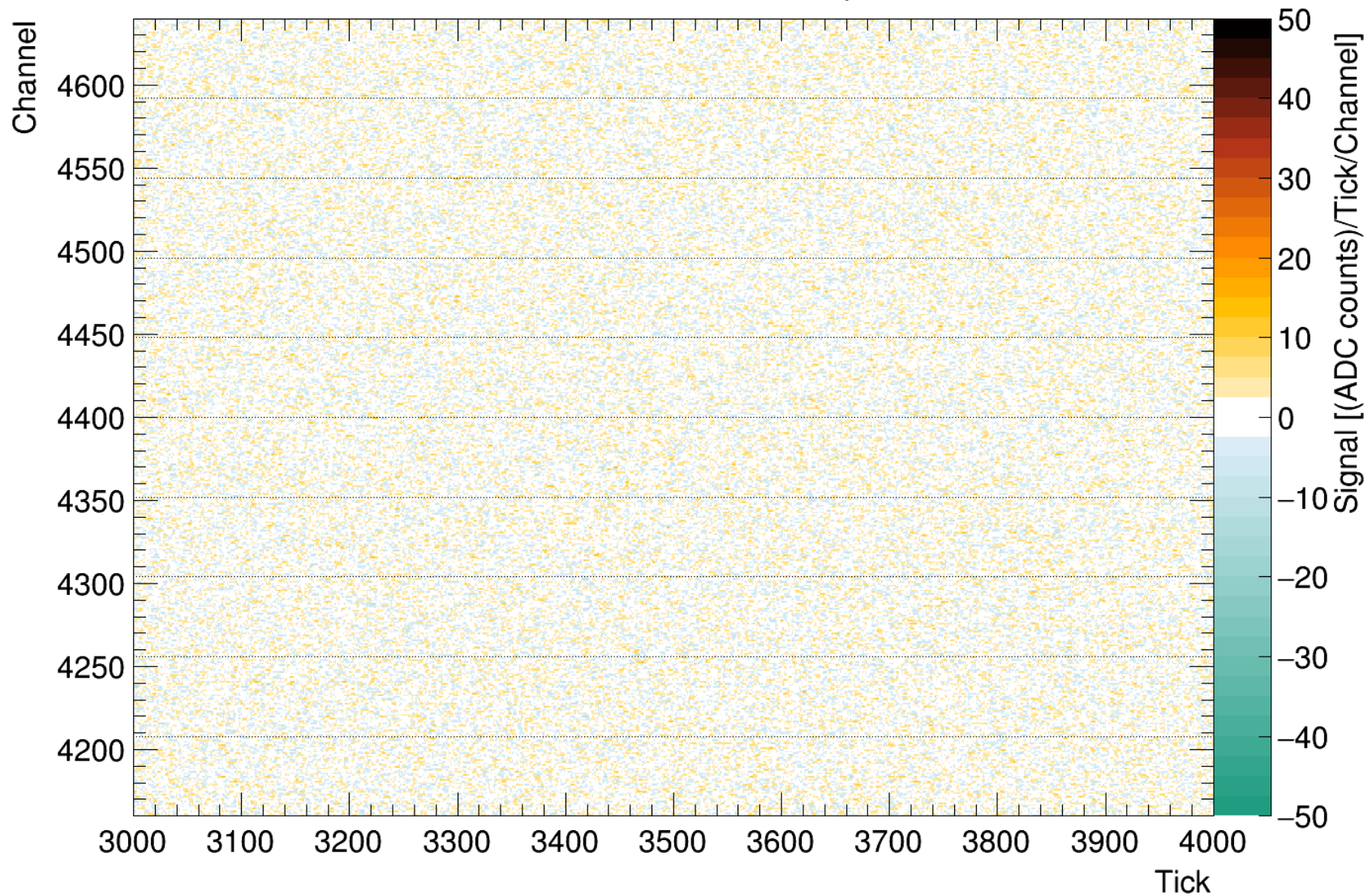
Collection channel vs. tick: data

Raw ADC for run 3775 event 608 TPC plane 1z



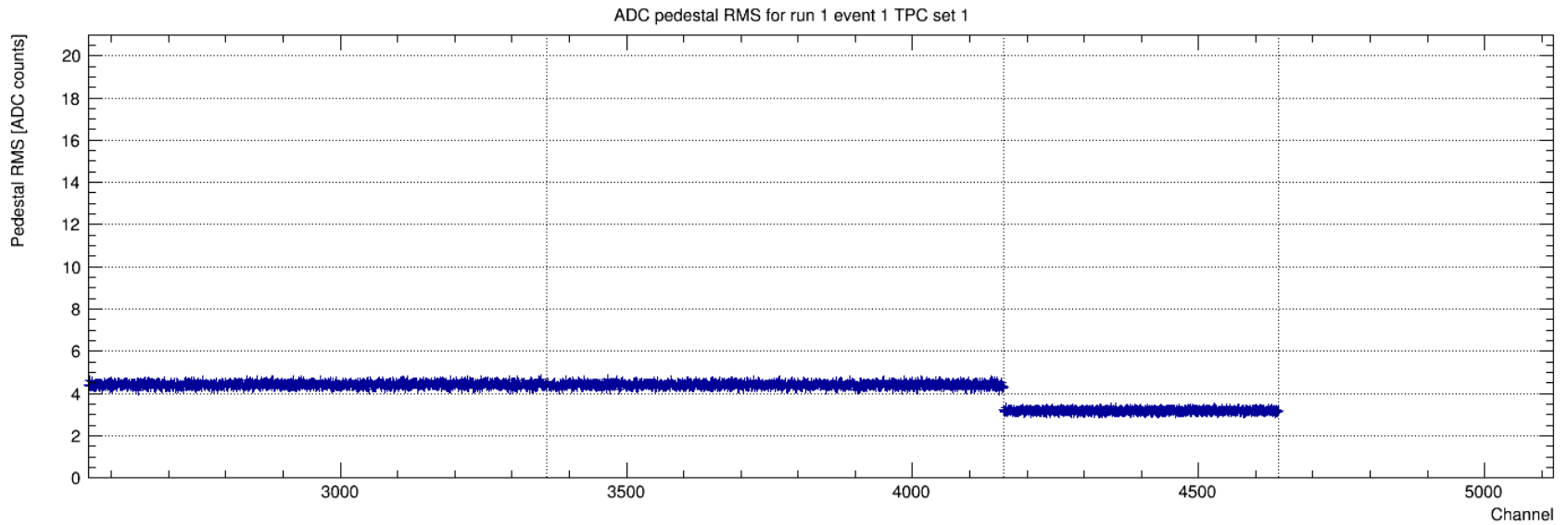
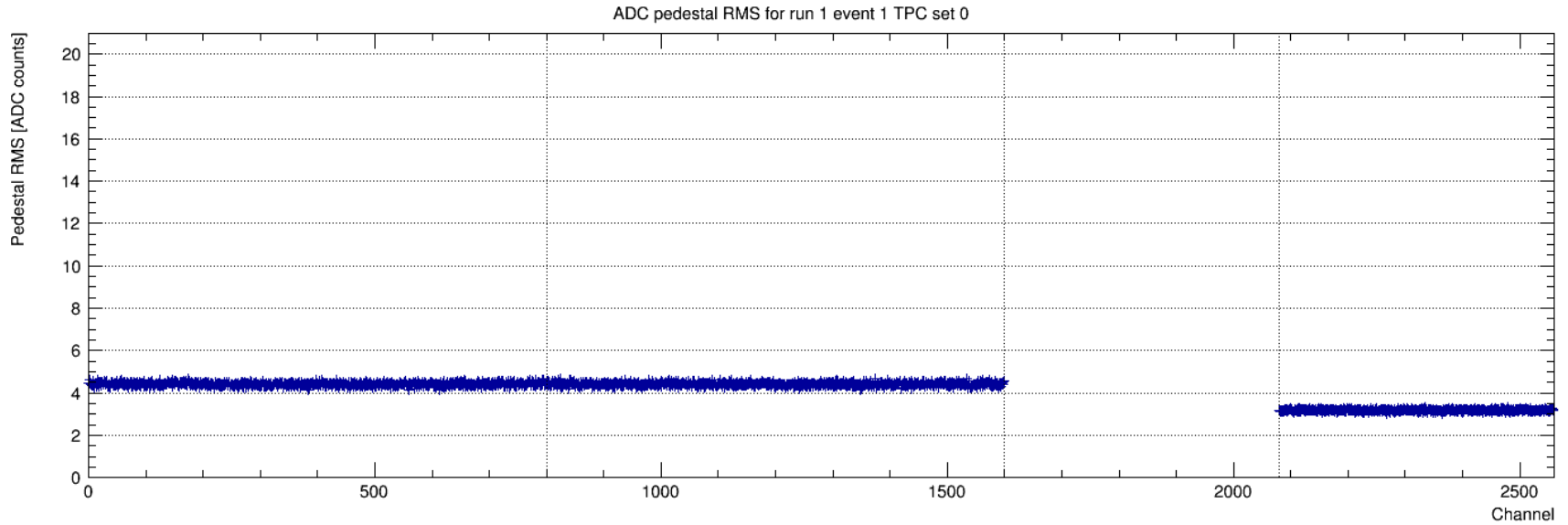
Collection channel vs. tick: new simulation

Raw ADC for run 1 event 1 TPC plane 1z

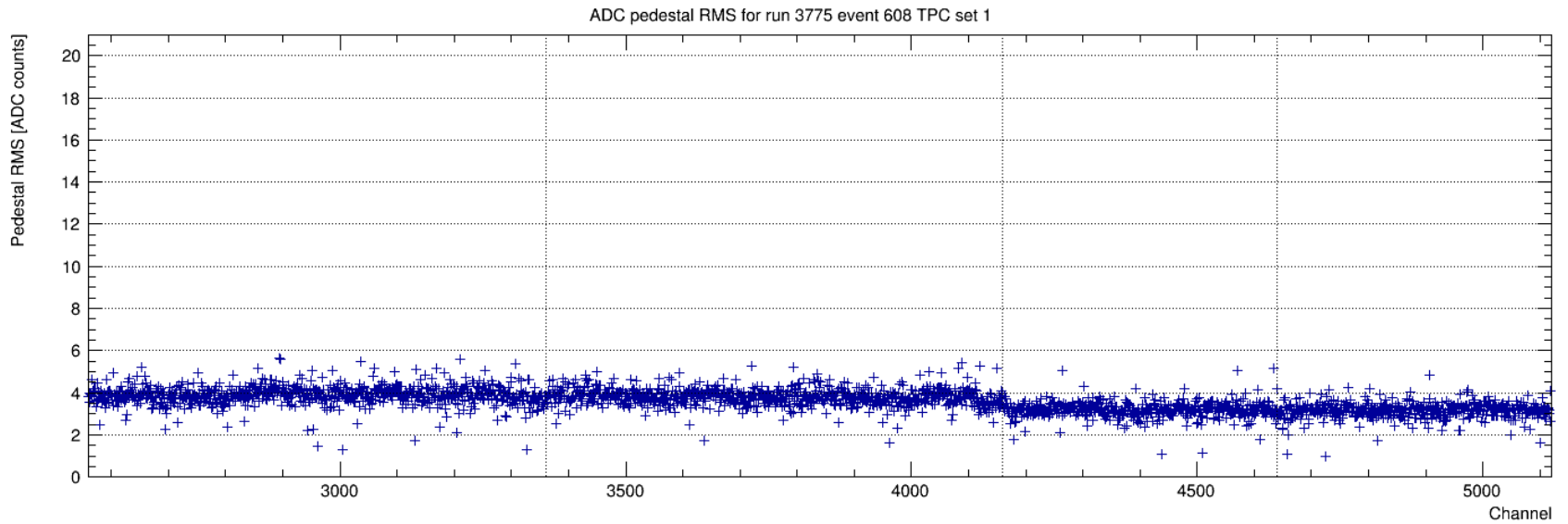
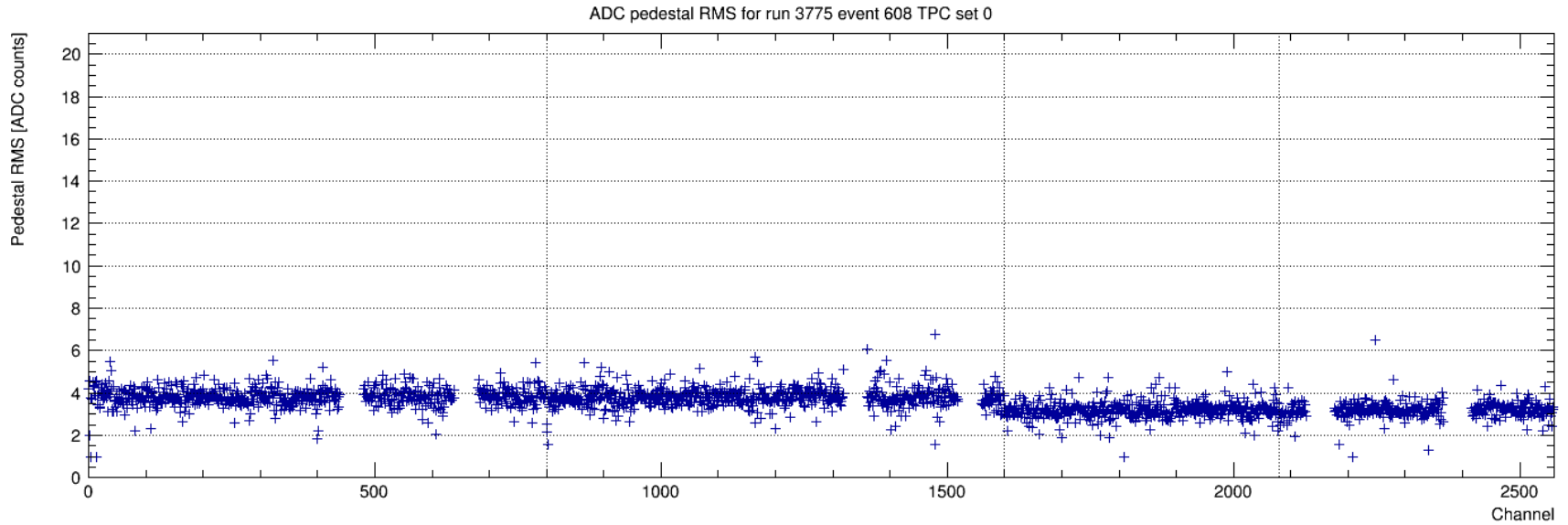


Noise level

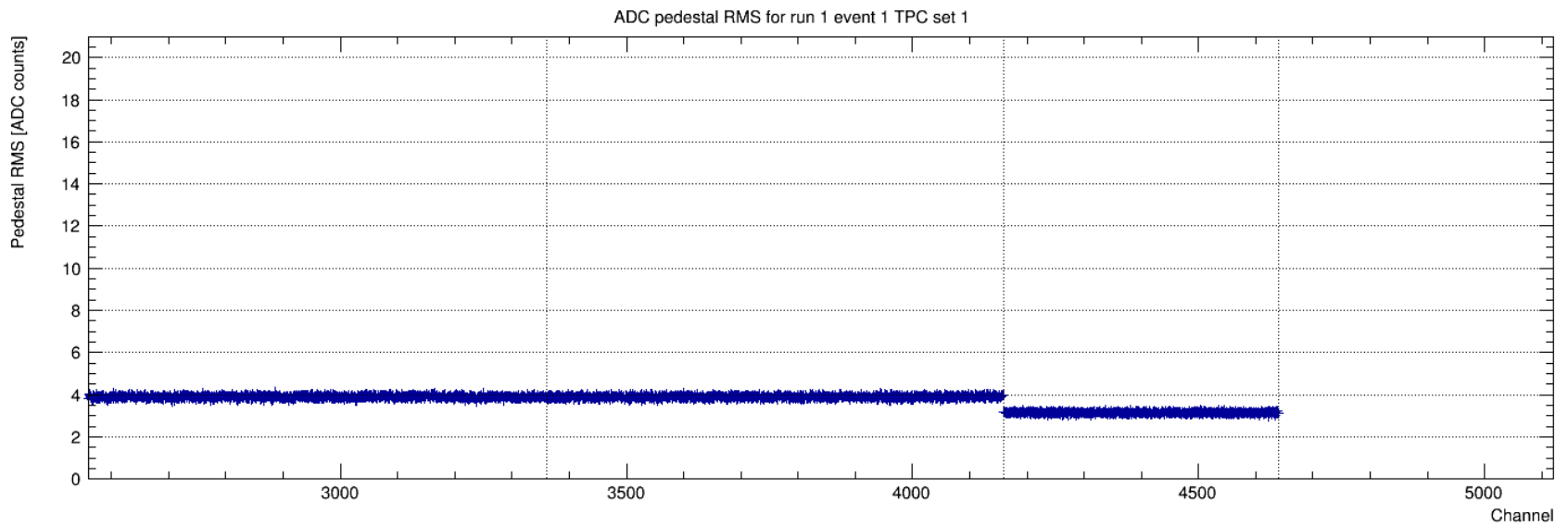
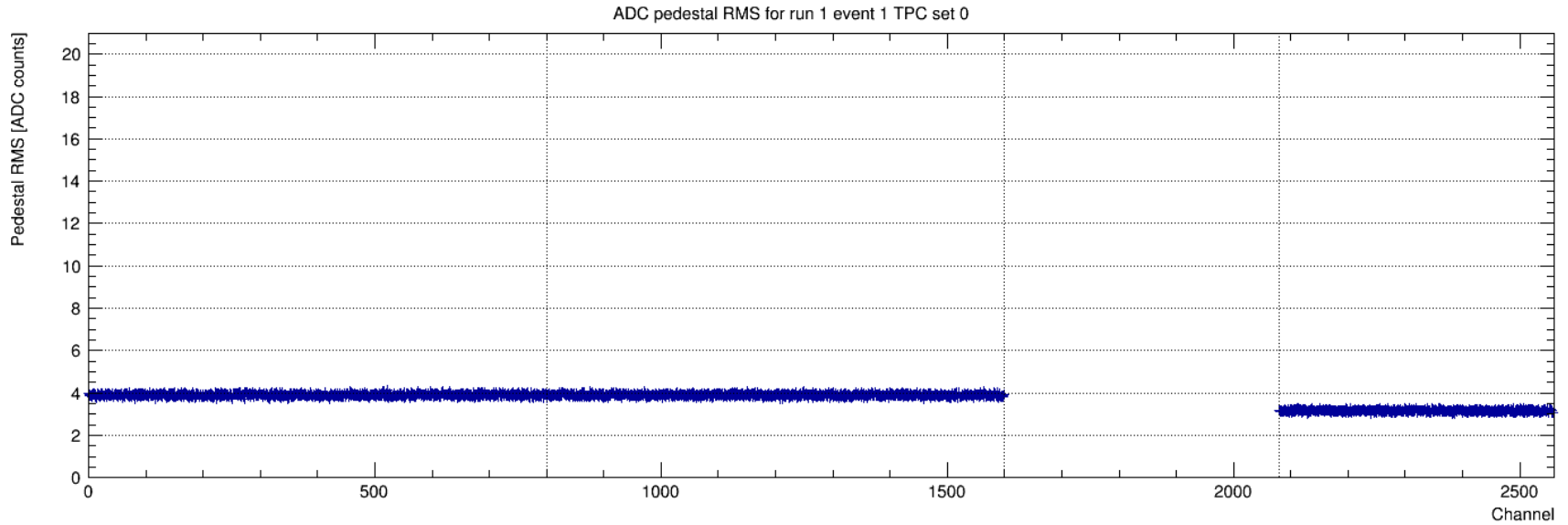
Noise level: old simulation



Noise level: data



Noise level: new simulation



Comments/conclusions

Noise simulation tuned to match data

- Total noise level reduced by 10% for induction
- DFT shape improved
- Differences remain
 - Data has more channel-to-channel scatter
 - Plus spikes in some detector regions
 - Data show significant correlation between neighboring channels
 - Data appears to have more tick-to-tick correlation

Modifications are in dunetpc

- Change to ExponentialNoiseService
- Prolog pdsp_chnoiseAug2018 in detsimmodues_dune.fcl
- Should we make this the default for protoDUNE simulation?