

Realistic noise simulation in LArSoft

Andrea Scarpelli (CNRS/APC)

Outline

- 3x1x1 noise patterns
- Simulation strategy
- Results

Summary of the model

FFT MODEL CREATION

- FFT based on 3x1x1 729-0 noise run (the pedestal reference for this summer data)
- Time window is 1667.
- **FFT just 1024. Choose not to 0 pad to 2048 nor mirroring**
- Resolution **~2.4 kHz**
- **FFT spectrum is the average over all the channels and all the events. No normalization**

NOISE SIMULATION

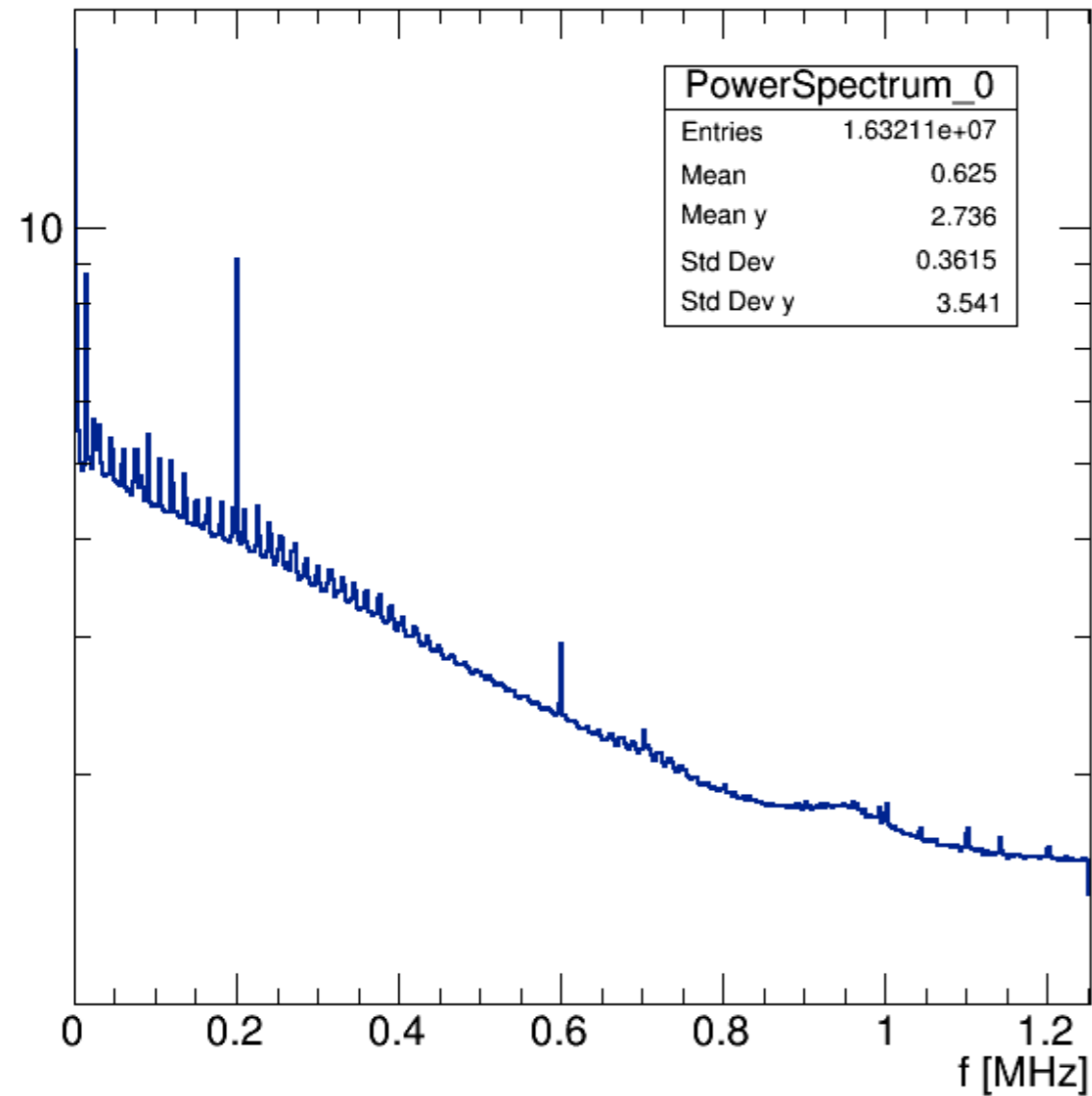
- Model is imported in LArSoft from the TProfile histogram where was it made
- Amplitudes get a realistic Gaussian randomization ~ 0.02
- Phase get randomized with flat distribution from 0 to 2π
- InFFT is done on the number of point of the Input FFT regardless the detector time window
 - **Added a self-made normalization at $0.5 \cdot \sqrt{1024}$. It was the only one giving meaningful results and a noise rms compatible with the real noise**

FINAL MANIPULATION

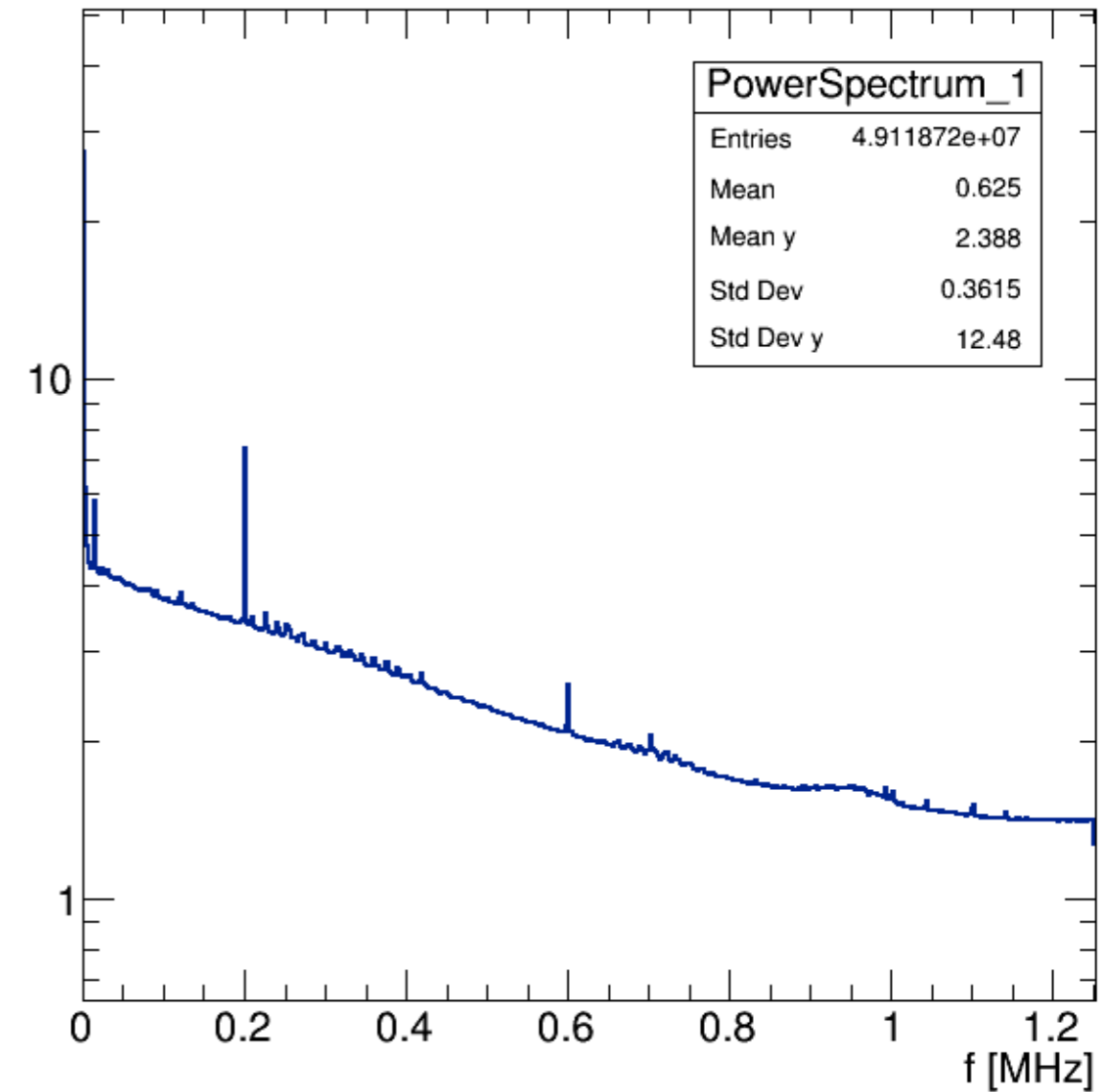
- The so generated 1024 long time signal is now expanded to match the detector time window using the mirroring (see more in specific slide)

3x1x1 model

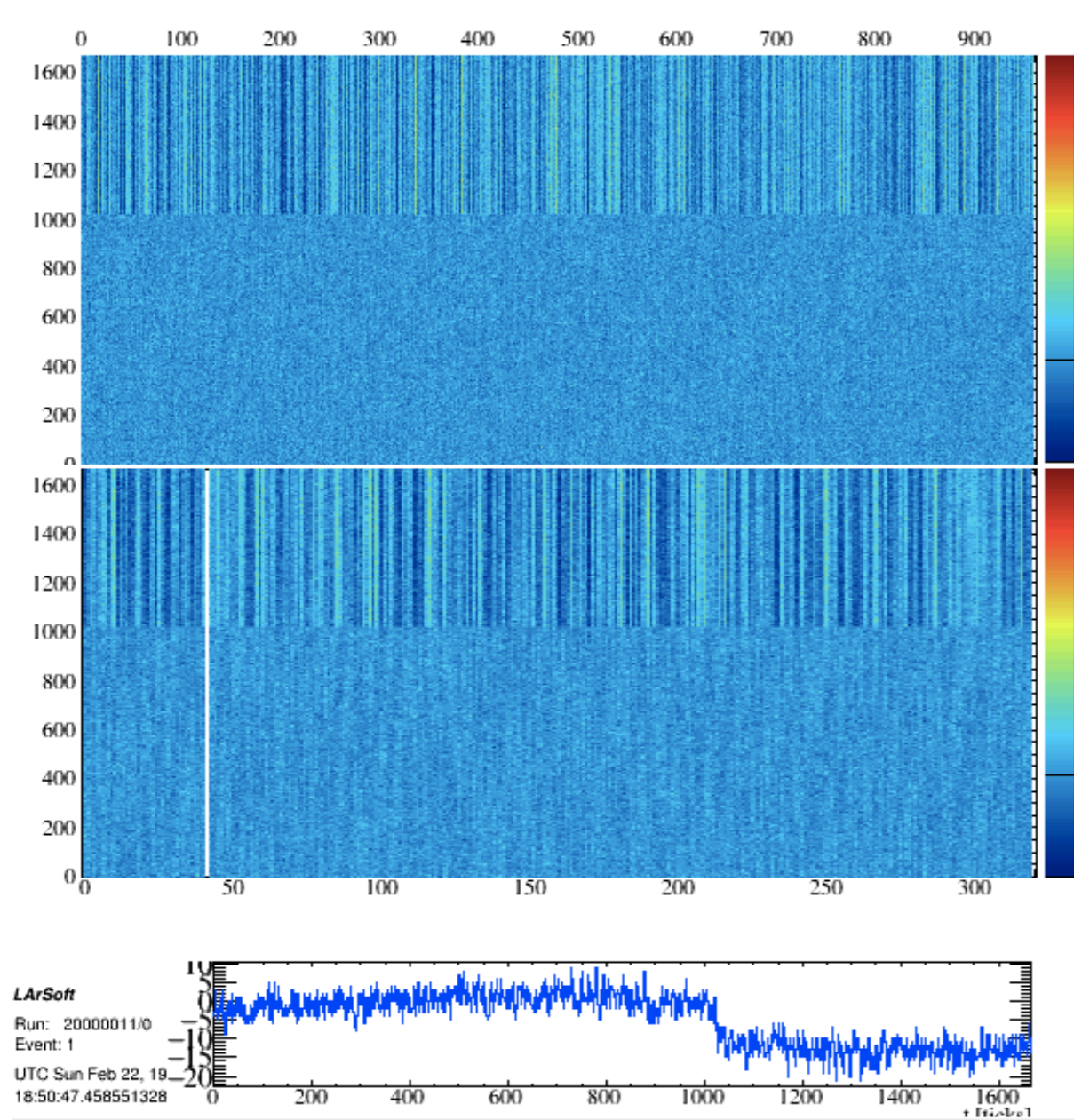
View 0



View 1



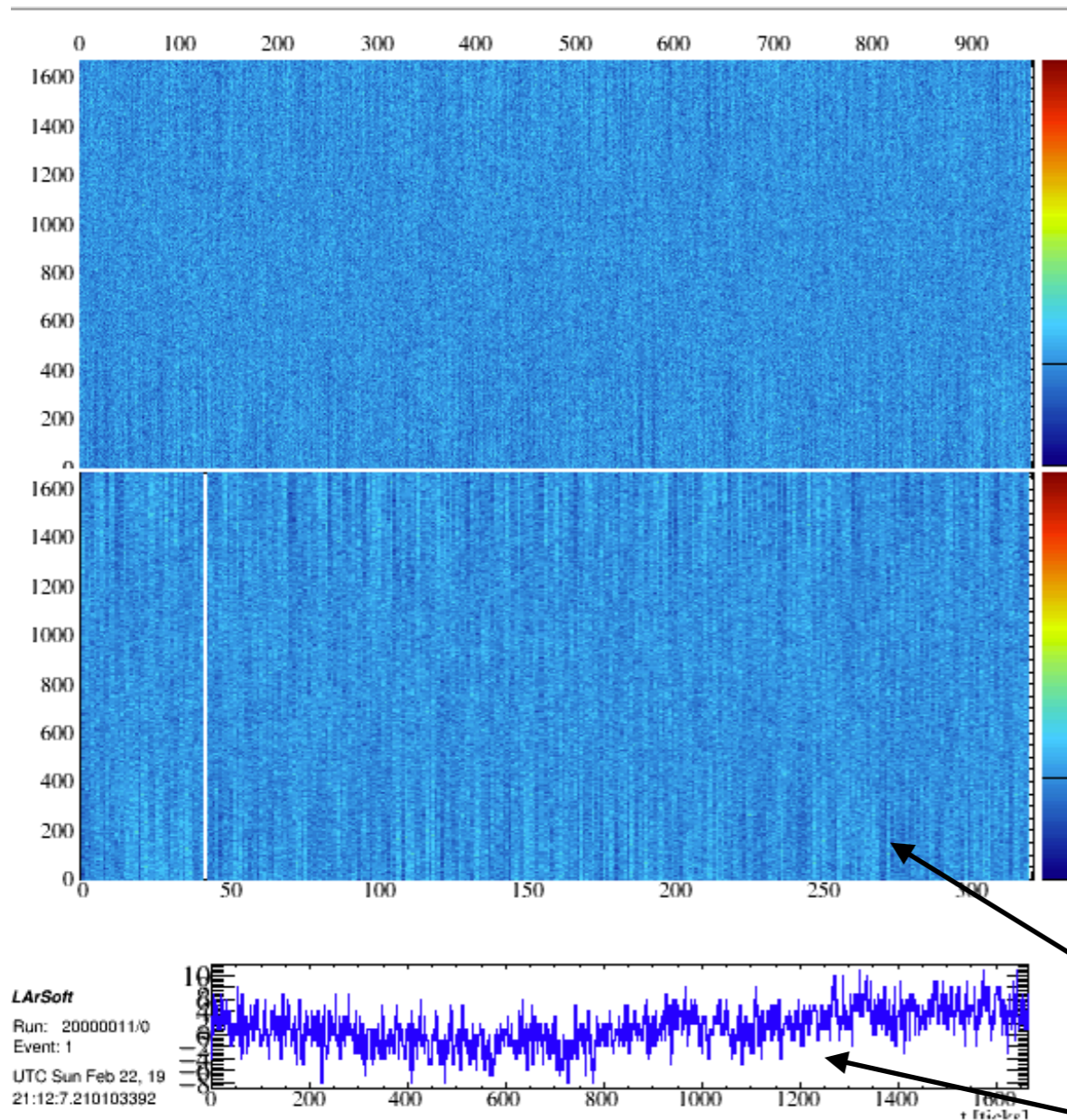
Mirroring (1)



MIRRORING (done following Robert's code)

- Get the last value of the original time signal (the 1024th in our case) and multiply by two:
 $\text{shift} = 2 * \text{signal}[1024]$
- $\text{signal}[1025] = -\text{signal}[1024] + \text{shift}$
- Iterate until the full time window of the detector is fulfilled
- Produce artifact

Mirroring (2)



MIRRORING Strategy to avoid artifacts

- shift is done using the rms in the last 200 ticks:
 $\text{shift} = 2 * \text{rms}(\text{signal}[824-1024])$
- This don't change: $\text{signal}[1025] = -\text{signal}[1024] + \text{shift}$
- Iterate for the full time window
- Artifacts are still present, but less evident
- To make them even less evident disappear:
reverse the time array in some randomly
selected channels.

Slow oscillating component fairly similar to the one in data appears,

There is an even slower one, that we can't probably resolve. **Simulate?**

TODO and possible improvements

EXPORT ON DUNE

- Getting some weird segmentation fault. Hadn't time to debug yet.

CREATE A PARAMETRIZED MODEL

- Artifact from noise can be avoided creating a simple parametrization of the spectrum. Specific frequencies can be added from a more careful noise study.
- This would solve mirroring artifacts (plus is in analogy on what done from uBoone on ProtoDUNE)