

# CygnosDAQ report

Oct. 29th, 2020

# Outline

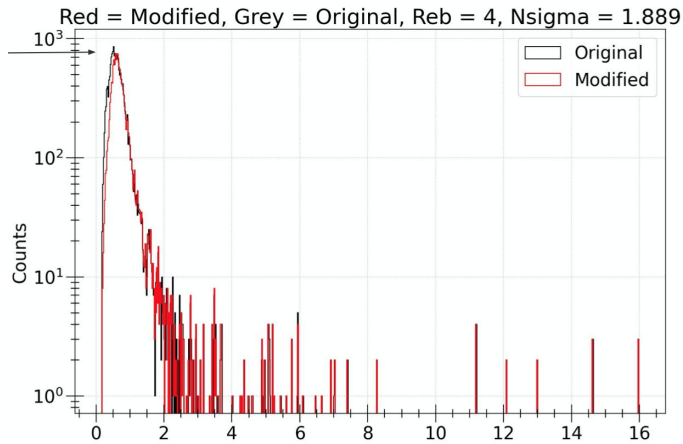
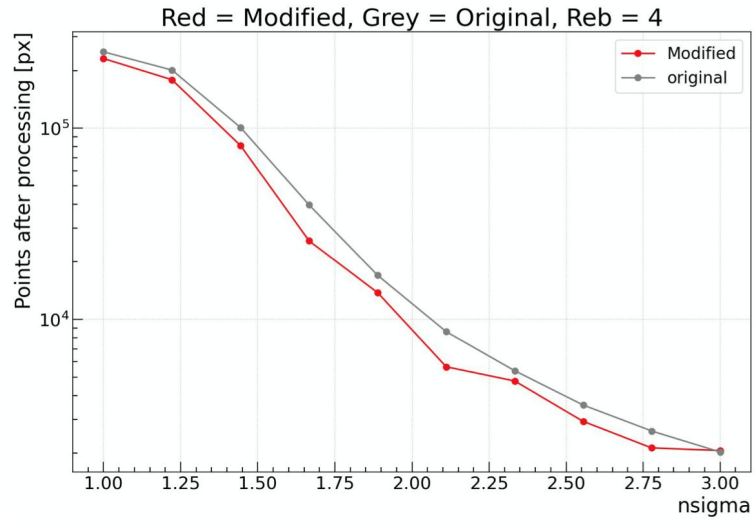
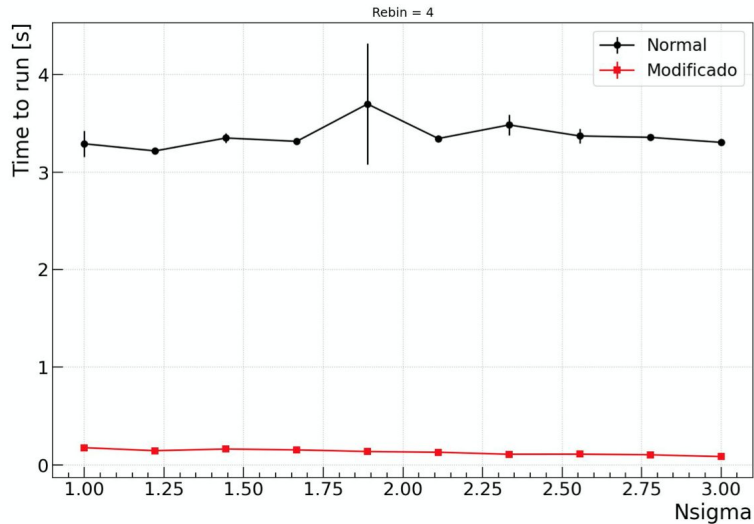
- Reimagining the noise reduction algorithm [Amaro Lopes]
- Photomultiplier DAQ development [Herman Lima]
- Storage survey [Herman Lima]

All the details available on the DAQ meeting agenda [here](#)

New mailing list for the daq: [cygno-daq@list.infn.it](mailto:cygno-daq@list.infn.it)

# Noise reduction algorithm

- We've found that the noise reduction algorithm was the bottleneck for full resolution images (45~60s in google colab);
  - This part is important because it reduces the number of elements to be sent to the clustering algorithm;
- The original process is done through a recursive removal of noise pixels, being necessary to sweep every pixel while removing noise.
- A similar process could be done with a convolution of the whole image with a unit kernel of size 3.



- In order to help, a kernel-based filter was designed, with similar response and smaller processing time.

- Survey and selection of technologies/devices: ADC, FPGA,  $\mu$ C. **DONE**
- Drawing electrical schematics: analog input circuit, ADC connections, microcontroller circuit. **DONE**
- Survey of other FPGA due to software licence issue (Quartus Prime). New FPGA family selected: **Cyclone V**. **DONE**
- Second ADC option selected due to transceiver speed limitation in Cyclone V.
- Drawing electrical schematics: FPGA circuit. **DOING**
- Possible design change: ~~4 input channels instead of 8 because of routing restrictions with new ADC.~~ → **8 channels is possible (bigger FPGA package)**
- **Defining and drawing ADC to FPGA data buses (16 x 4 LVDS channels).** **DOING**
- **Learning how to use the ARM processor in the FPGA to implement the Ethernet and USB module interfaces. No need of the PIC controller.** **DOING**

- Requirements:
  - Number of cameras: 18
  - Event rate: 1~10 Hz
  - Image resolution:  $2304 \times 2304 \times 16 \text{ bits} \approx 10 \text{ MB}$
- The following calculations do not take into account any technique to reduce the raw images size, like:
- The calculations consider the minimum rate of events (1Hz).
- Daily storage required:  $10\text{MB} \times 18 \times 86400\text{s} \approx 16\text{TB} / \text{day}$
- Annual storage required:  $16\text{TB} \times 365 \approx \mathbf{5840\text{TB} / \text{year}}$