

Stability Test of ProtoDUNE ARAPUCA PDS channels  
Performed with PDS Calibration System

Zelimir Djurcic

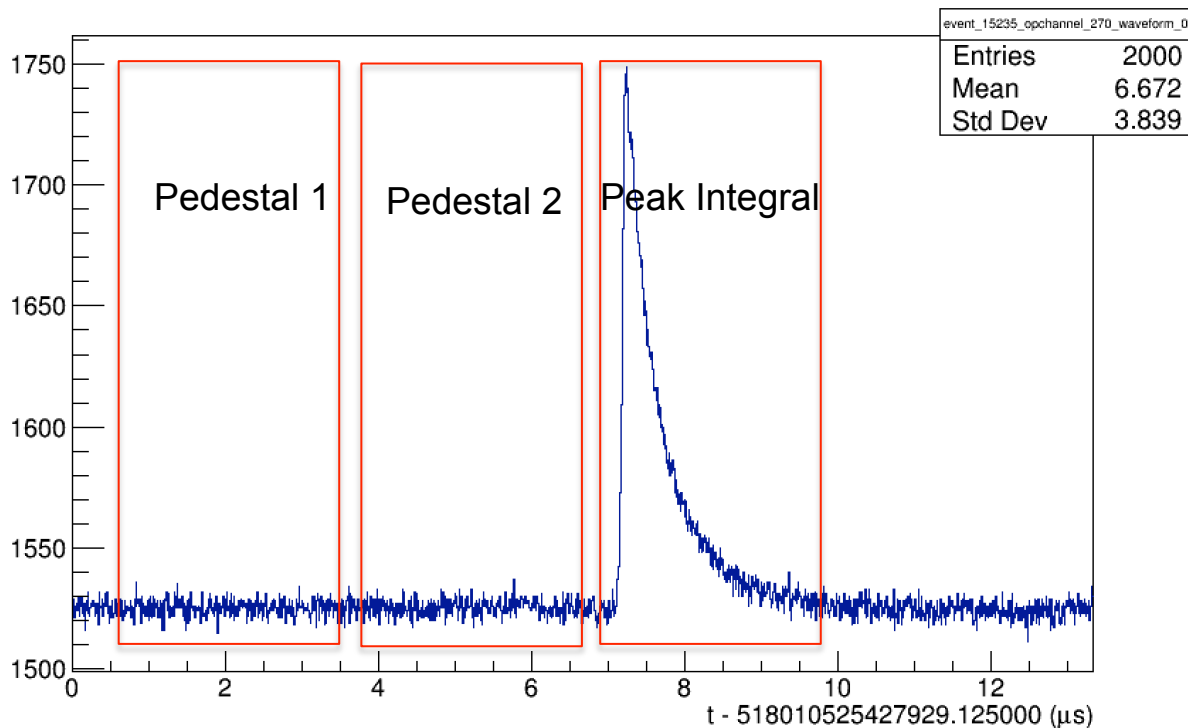
Argonne National Laboratory

## Stability Test Results

- Recent “stability” analysis of PDS calibration data performed by Chris, Dante, Niccolo
  - See for example talks presented here  
<https://indico.fnal.gov/event/20968/>
- These stability results showed the following
  - the amount of detected light consistently went down on the beam drift side as a function of time (over past six months or so)
  - the amount of detected light stayed stable on the non-beam side
- In the following slides we show an explanation for the observed effects

# Stability Test Info

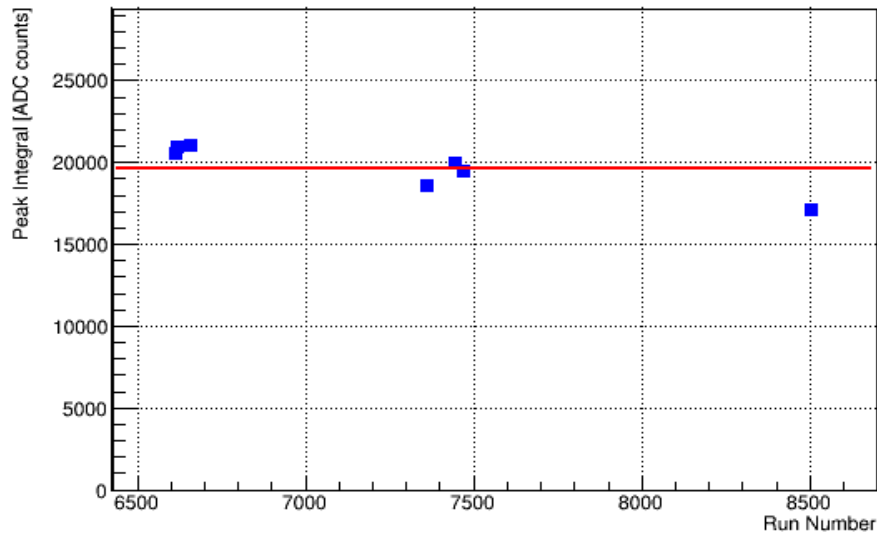
- Used DCM Runs:
  - Jan/Feb: 6015 (double pulses), 6620 (single pulses), 6659 (single pulses)
  - Mar/Apr: 7363, 7445, 7473 (all single pulse runs)
  - June 25: 8507
  - Pulse amplitude: UV LED bias = 30V -> “0x00040FFF” for all runs
  - Pulse width: 30 ns -> “0x9” for all runs
- Integrate the waveform peak area for each channel



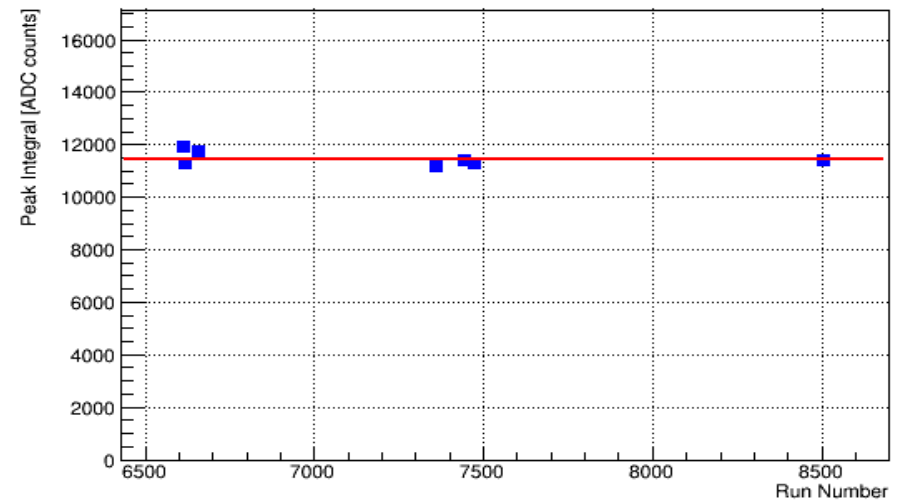
# Stability Test Results

- Make the following plot for each channel, fit the line and check the spread

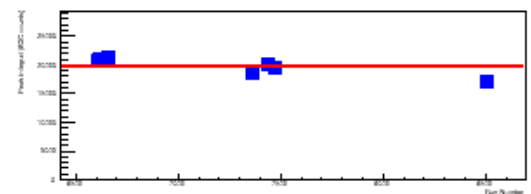
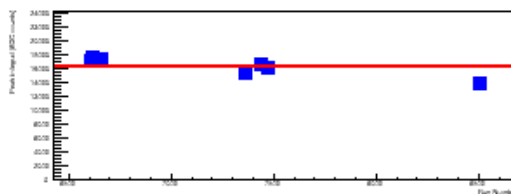
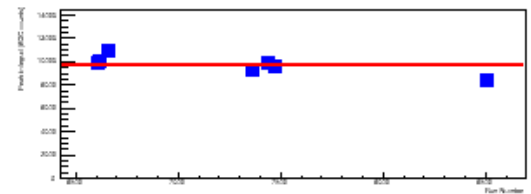
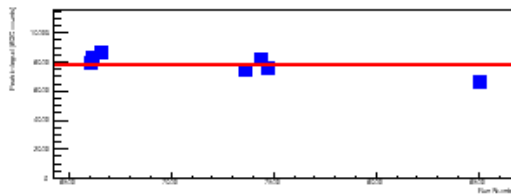
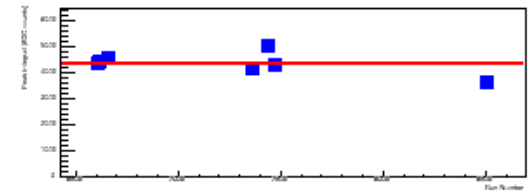
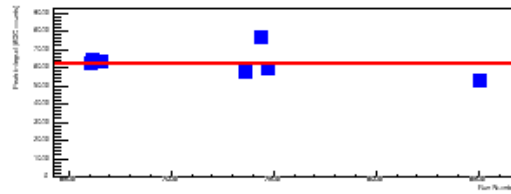
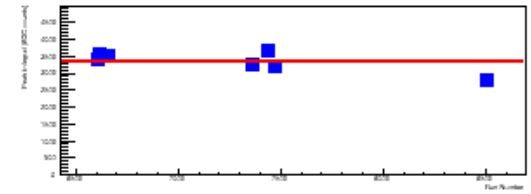
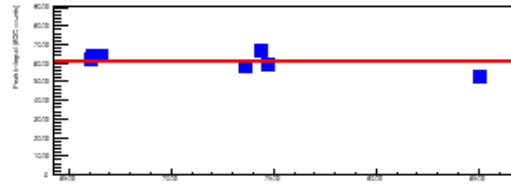
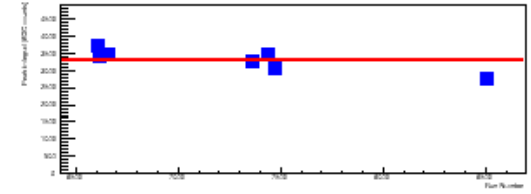
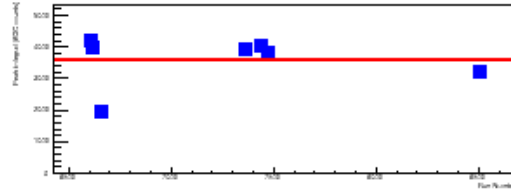
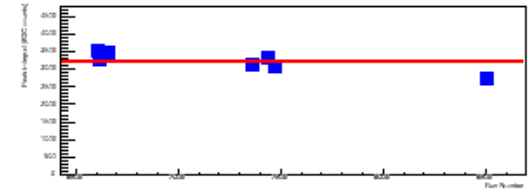
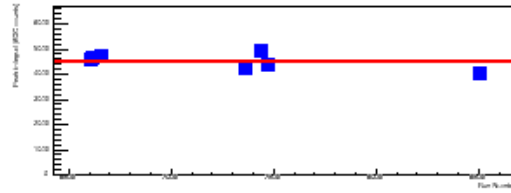
-example: ARAPUCA 1 channel 143



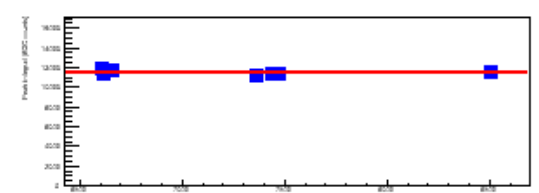
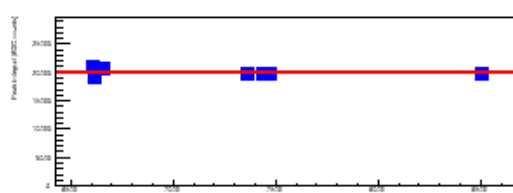
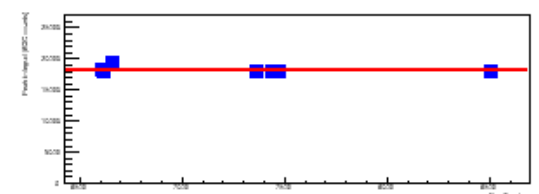
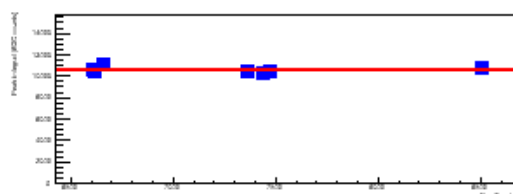
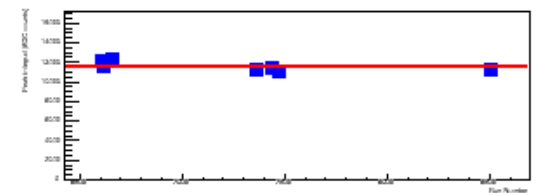
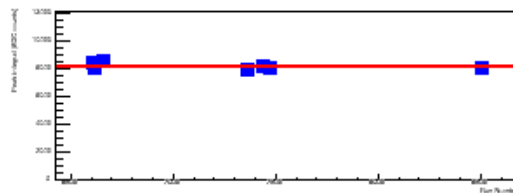
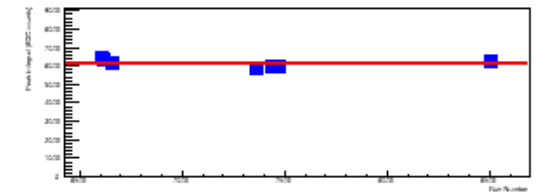
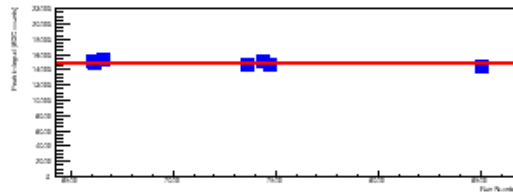
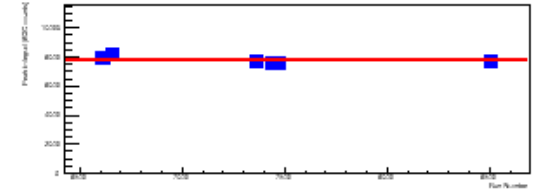
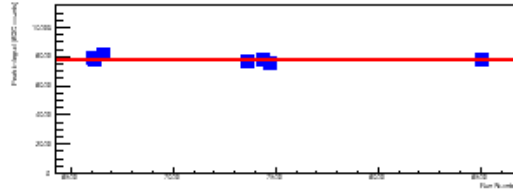
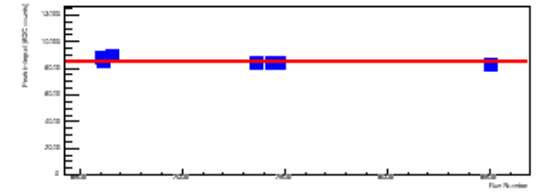
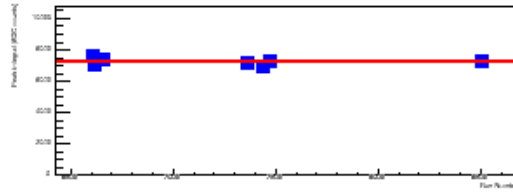
-example: ARAPUCA 2 channel 275



# ARAPUCA 1 (ch 132-143)

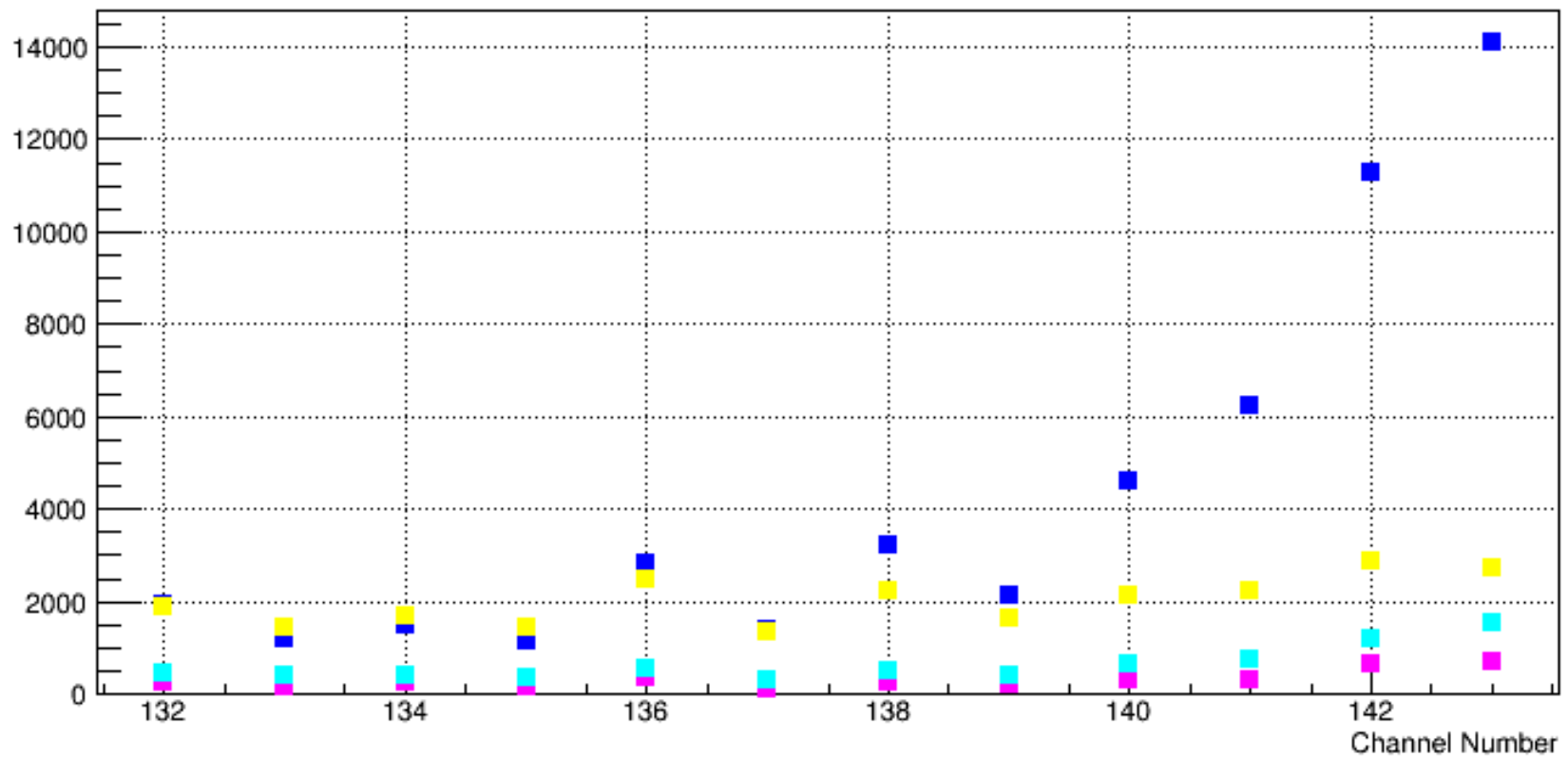


# ARAPUCA 2 (ch 262-275)



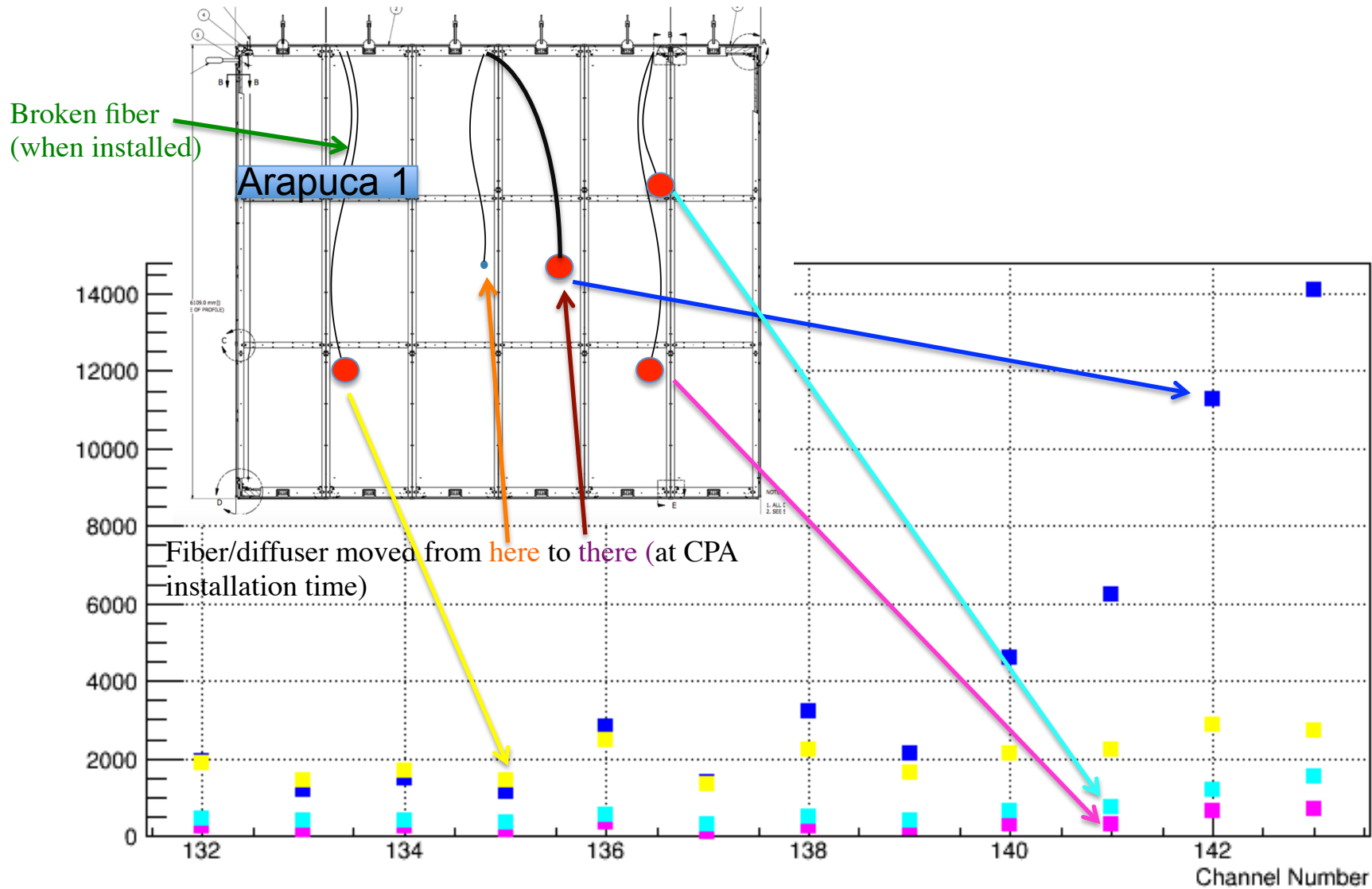
# Single DCM Channel Run Results

- ARAPUCA 1 (ch 132-143)



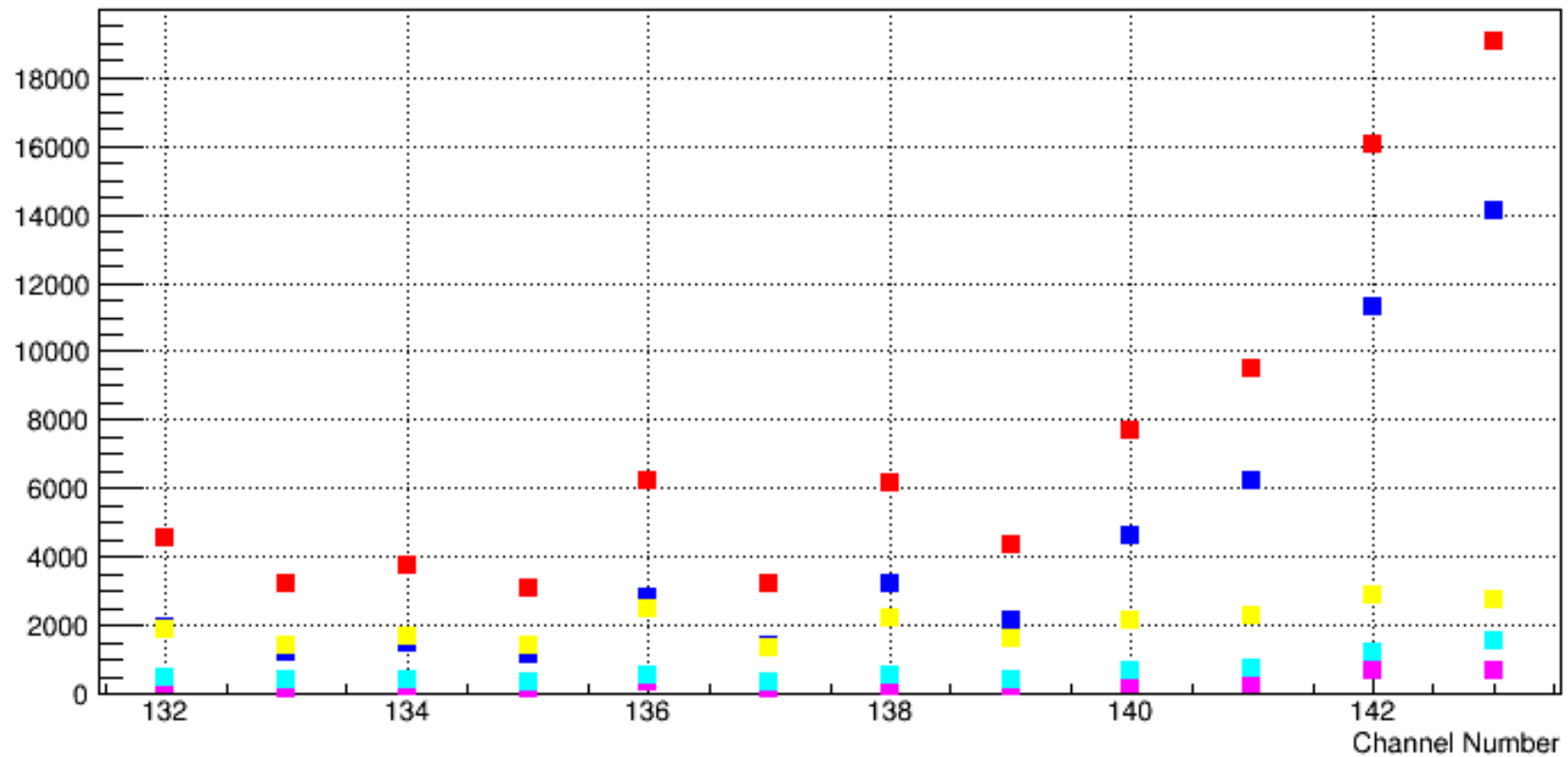
# Single DCM Channel Run Results

- ARAPUCA 1 (ch 132-143)



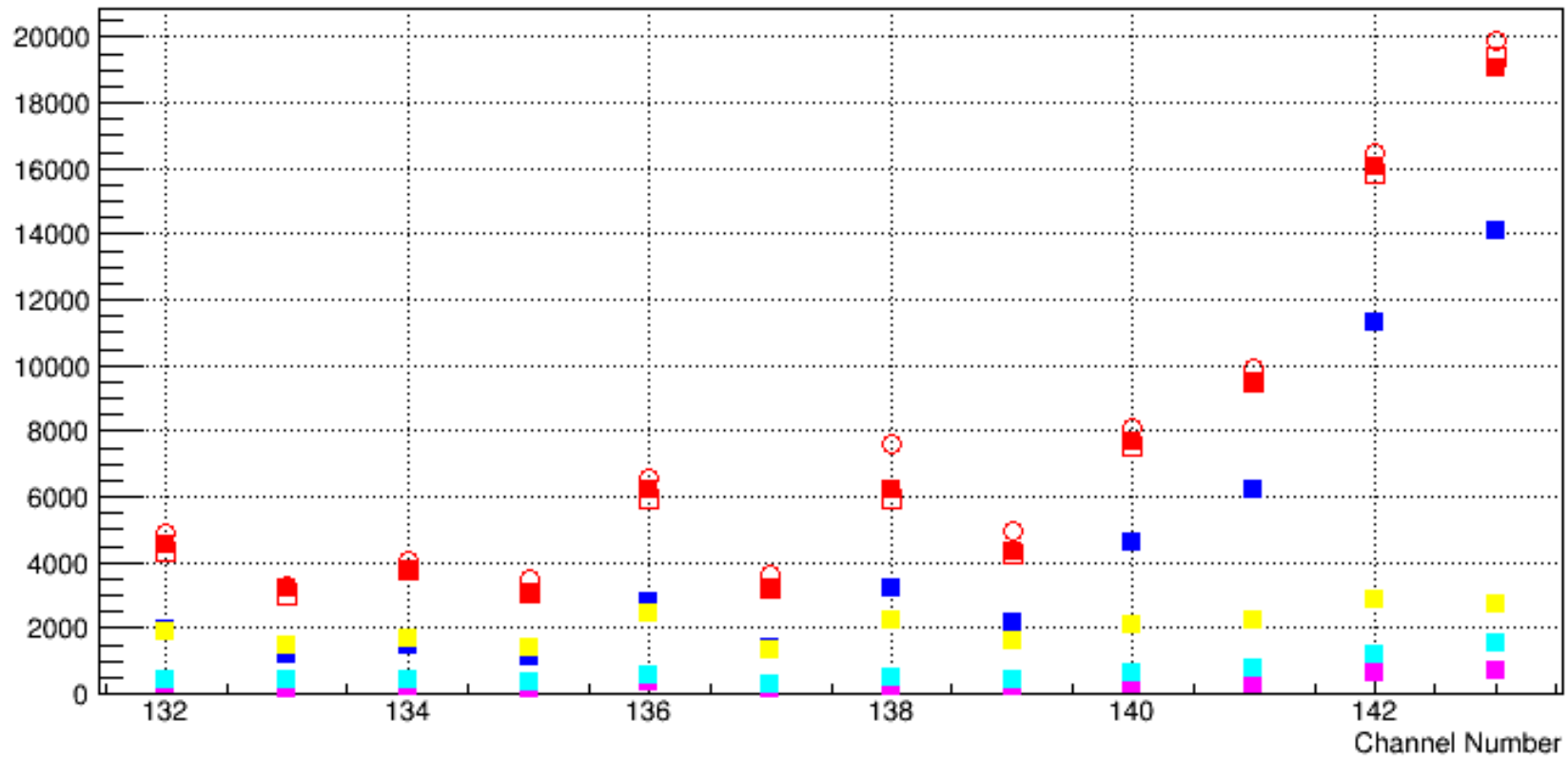


# Numerical Sum of Single DCM Channel Runs

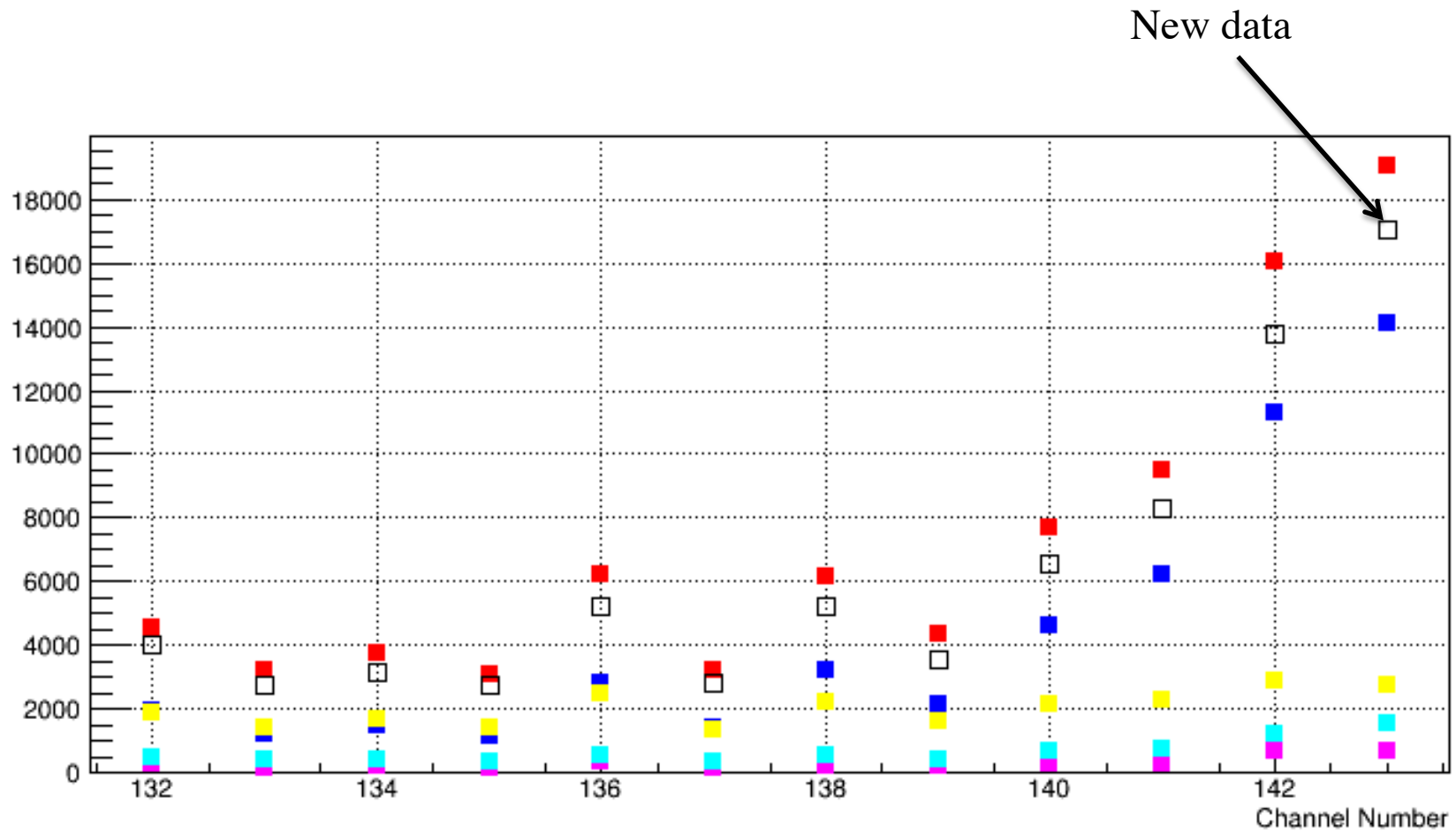


## Test of Numerical Sum of Single DCM Channel Runs

-Sum of 4 single channel (ie single diffusers) DCM runs compared to two available “all” diffuser runs

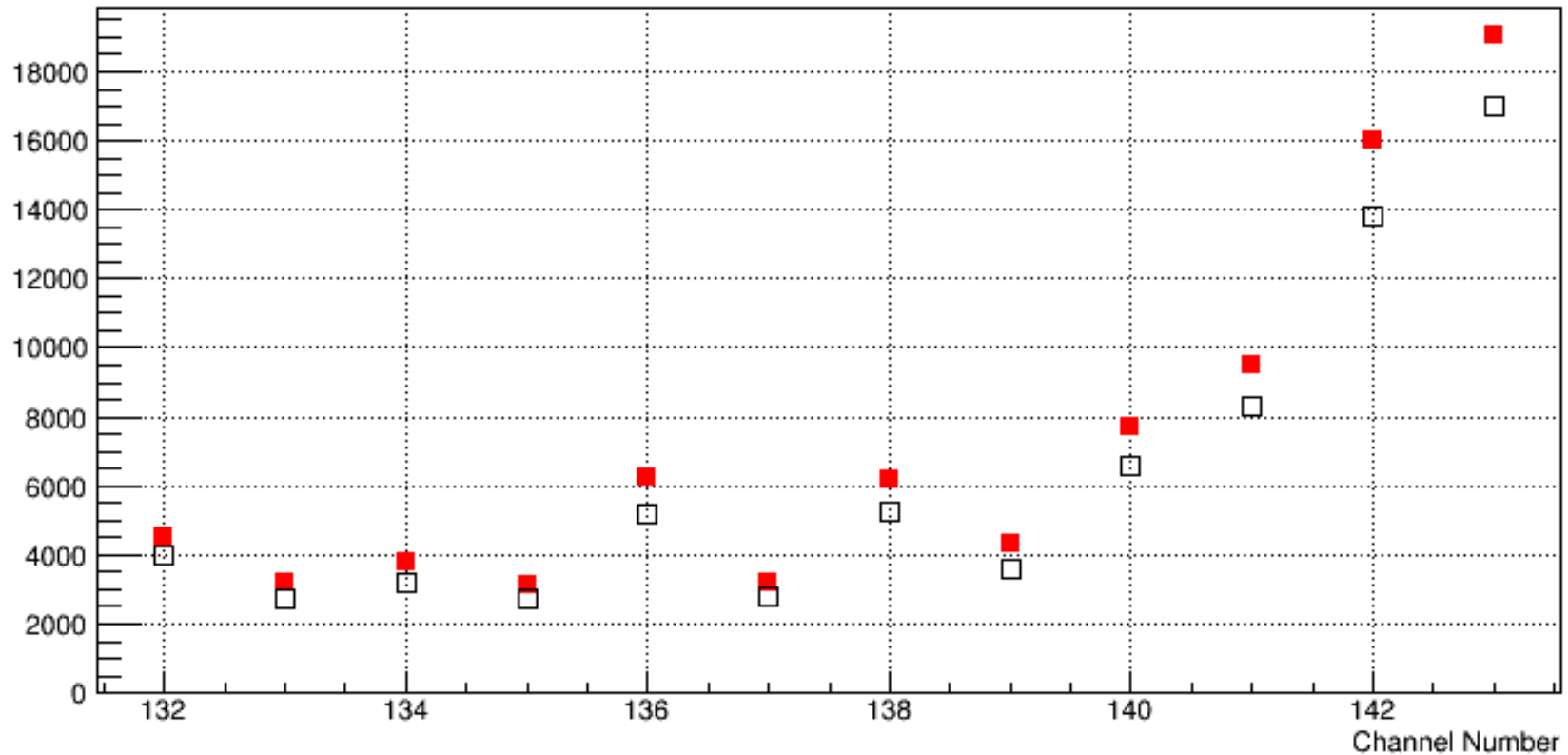


# Old data (red) vs New data (black)



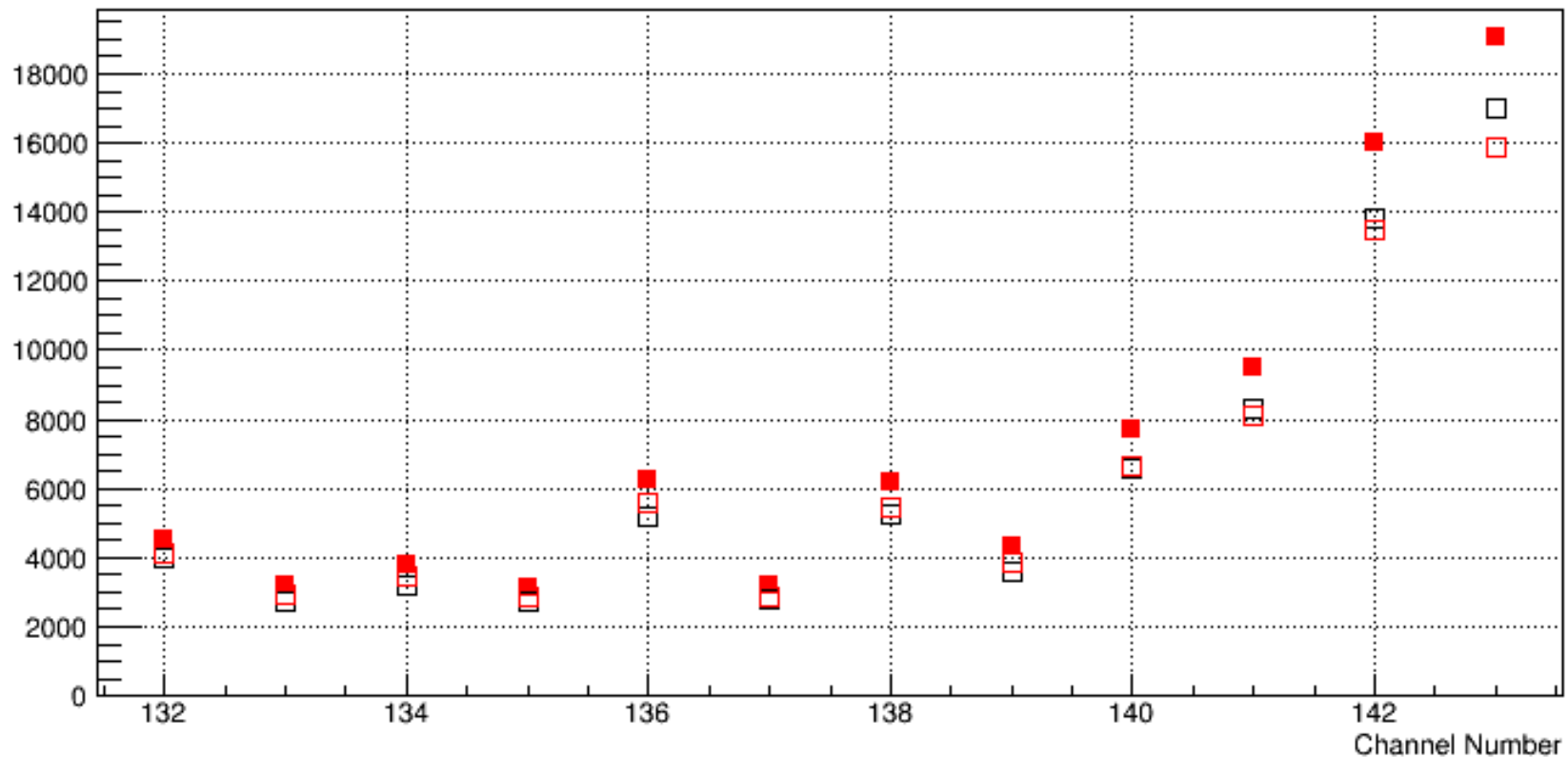
## Old data (red) vs New data (black)

- Same as previous page



## Matching Old data (red) vs New data (black)

- Scale **blue** data-ONLY down by 22.5%  
(blue dots on previous slides = CENTRAL DIFFUSER only)  
=> MAKING NEW DATA MATCHING THE OLD DATA



⇒ Provides a strong evidence that the “CENTER” calibration channel’s light yield has been decreasing

## Summary

- Recent “stability” analysis of PDS calibration data performed by Chris, Dante, Niccolo
  - See for example talks presented here  
<https://indico.fnal.gov/event/20968/>
- These stability results showed the following
  - the amount of detected light consistently went down on the beam drift (aka “rack”) side as a function of time (over past six months or so)
  - the amount of detected light stayed stable on the non-beam (aka “DAQ”) side
- We provided a strong evidence that the “CENTER” calibration channel’s light yield has been decreasing, to explain the PDS collection stability (as decreasing) on tack side
- These finding are suggesting that the DCM calibration runs are valuable tool to monitor the light yield stability but on rack side the analysis has to use individual calibration channels (aka “single diffusers”) other than the “CENTER” channel