

# Sector 17 (Run 15750) Odd Single Pixel Gap Behavior

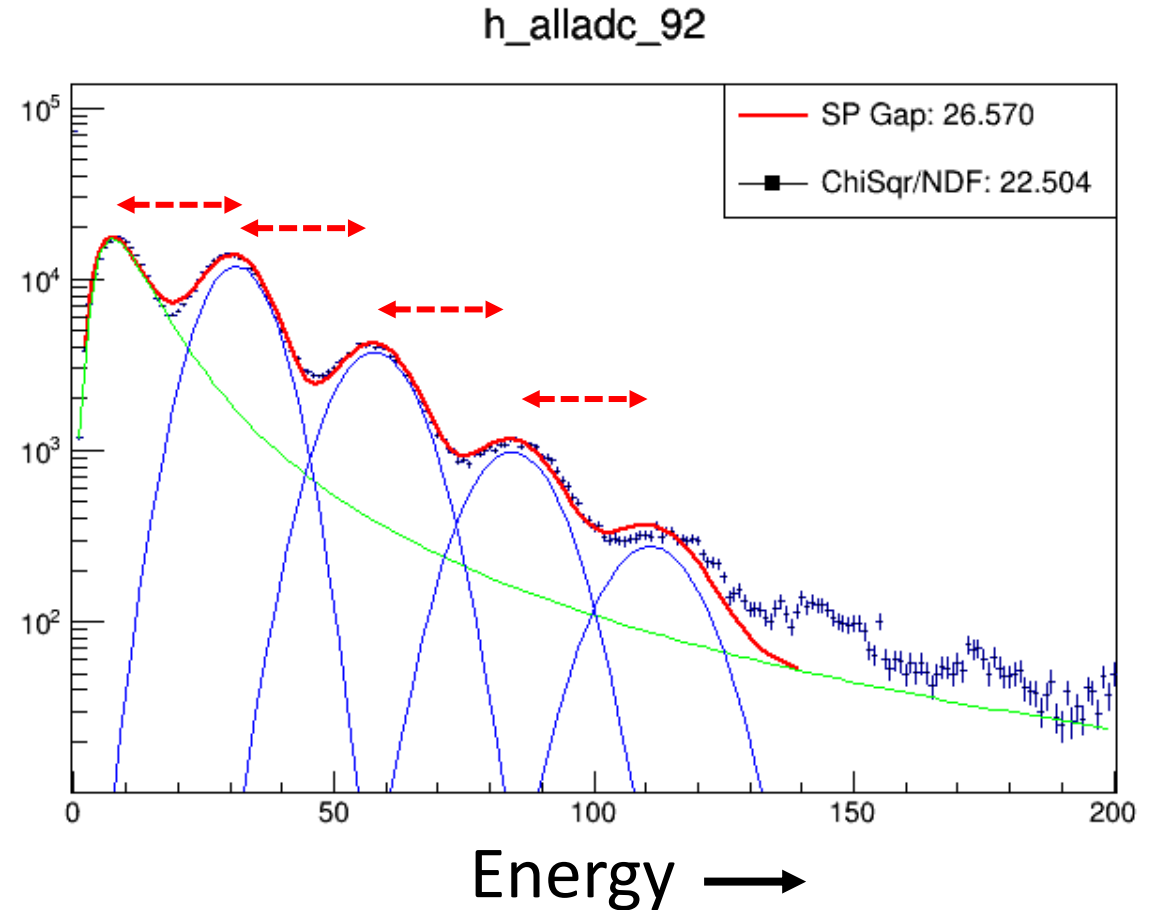
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10/4/2021

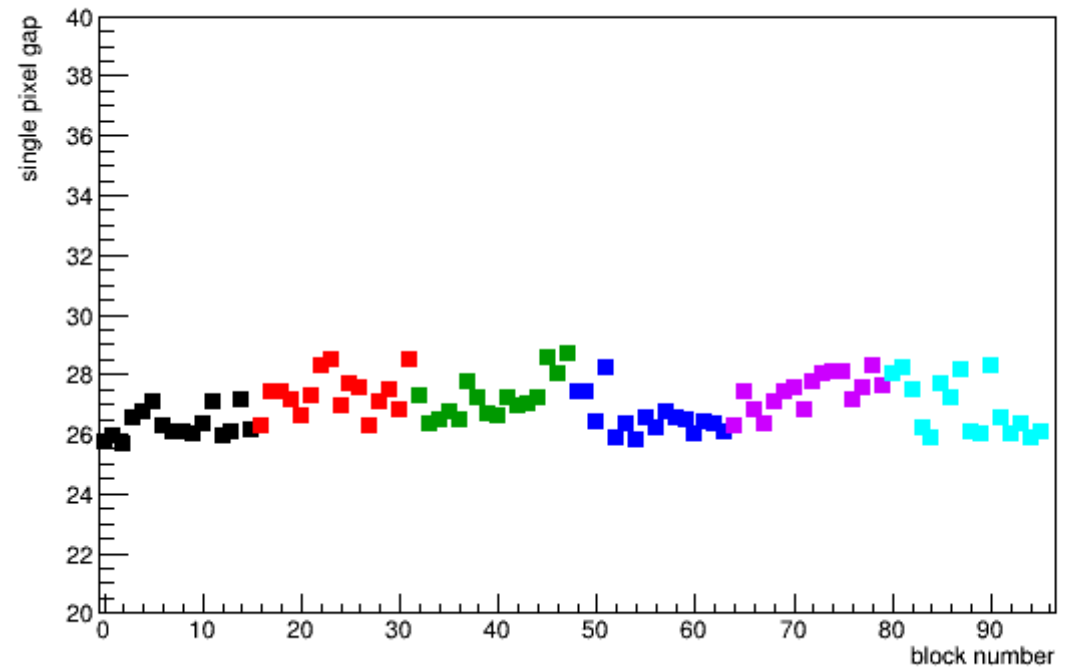
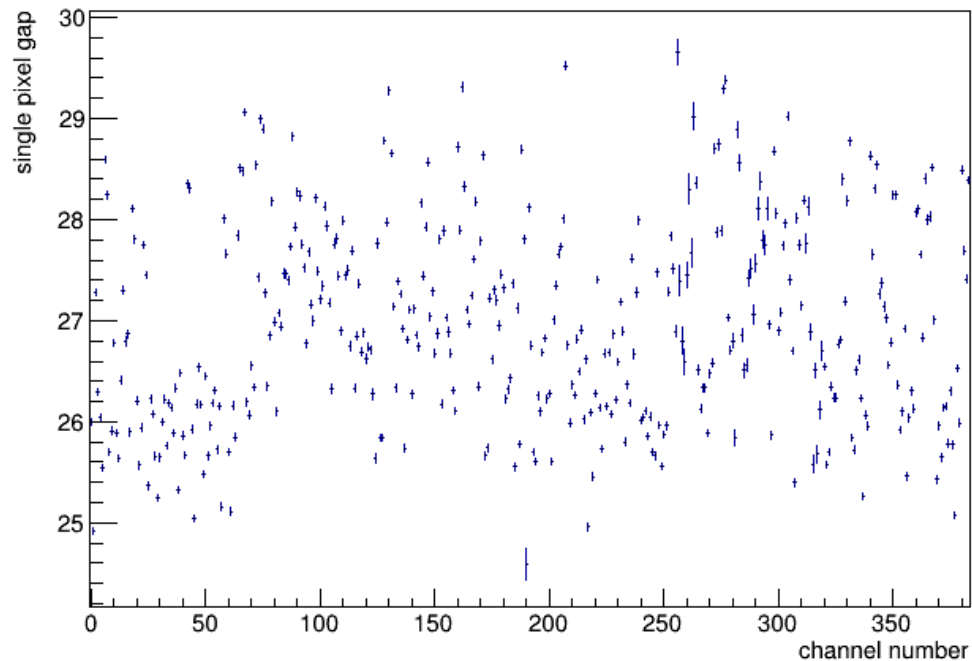
# What is the Single Pixel Gap?

- First peak (green) is a landau distribution and is treated as background noise
- Other peaks (blue) are gaussian
- Overall fit (red) is sum of all distributions
- Single pixel gap is spacing between individual distribution peaks



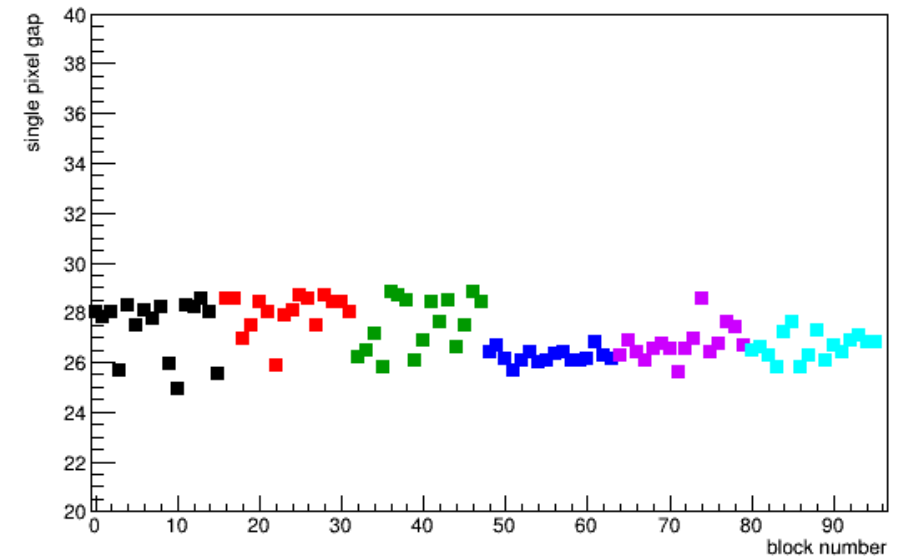
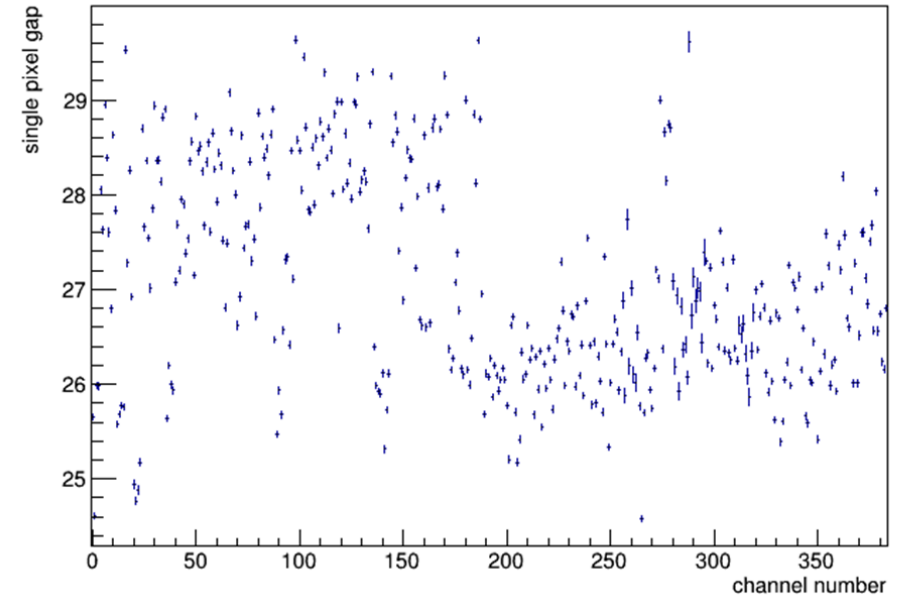
# Typical Sector (Sector 18, Run 15885, 8/18/2021)

- Single pixel gaps are *rather* uniformly distributed throughout all channels and IBs



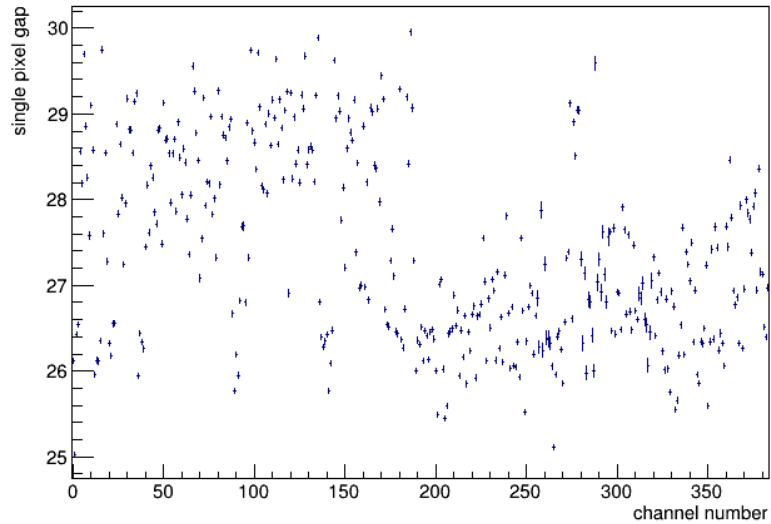
# This Run (Sector 17, Run 15750, 8/13/2021)

- We see two “bands” which are clearly separated at the boundary between IBs 2 and 3
- IBs 0-2 centered  $\approx 28$  (mean gap 27.652)
- IBs 3-5 centered  $\approx 26$  (mean gap 26.528)

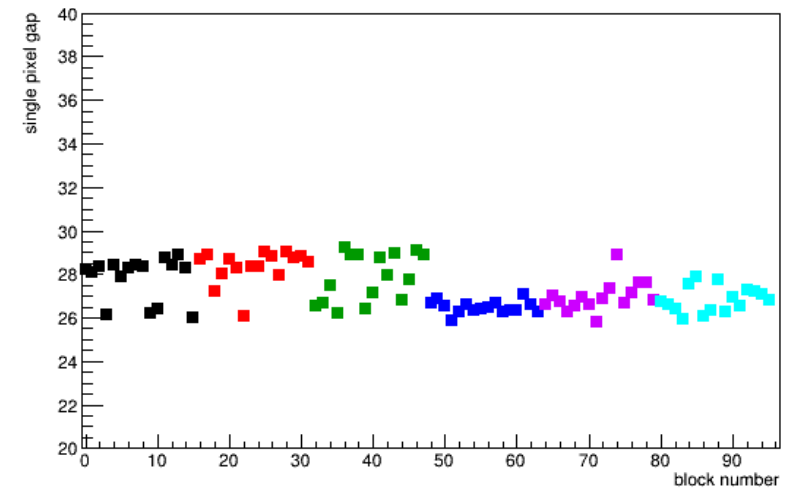
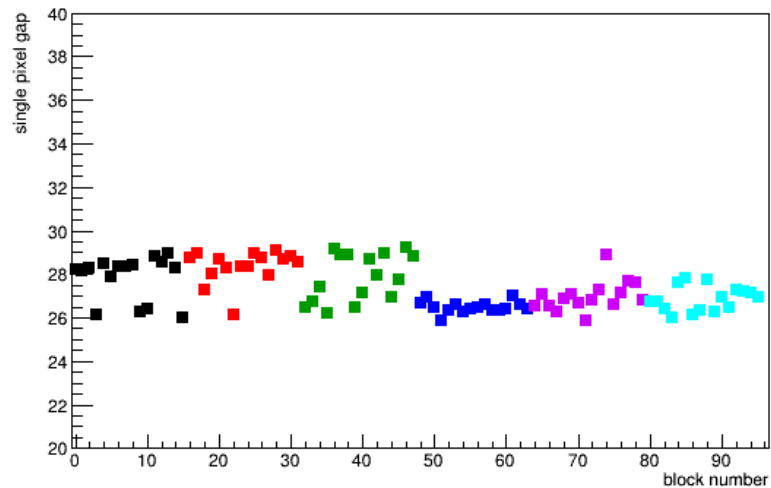
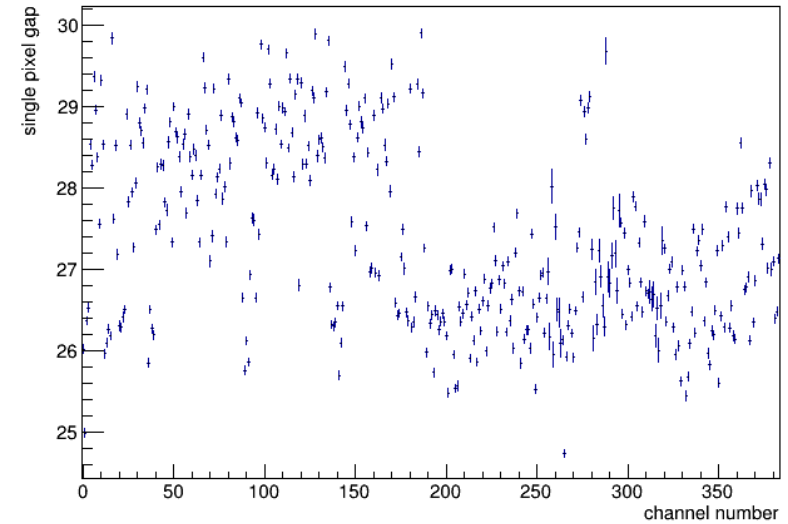


# Earlier Sector 17 Runs Look The Same

Run 13166 (5/9/2021)

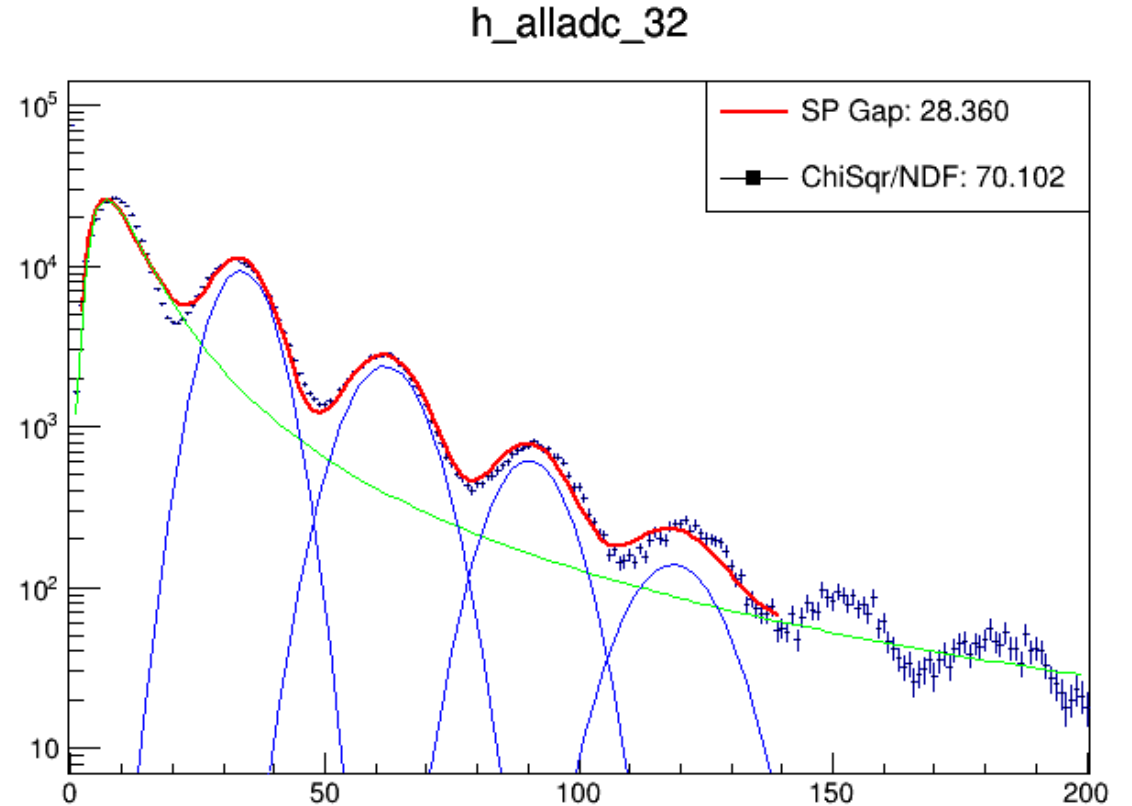


Run 13167 (5/10/2021)



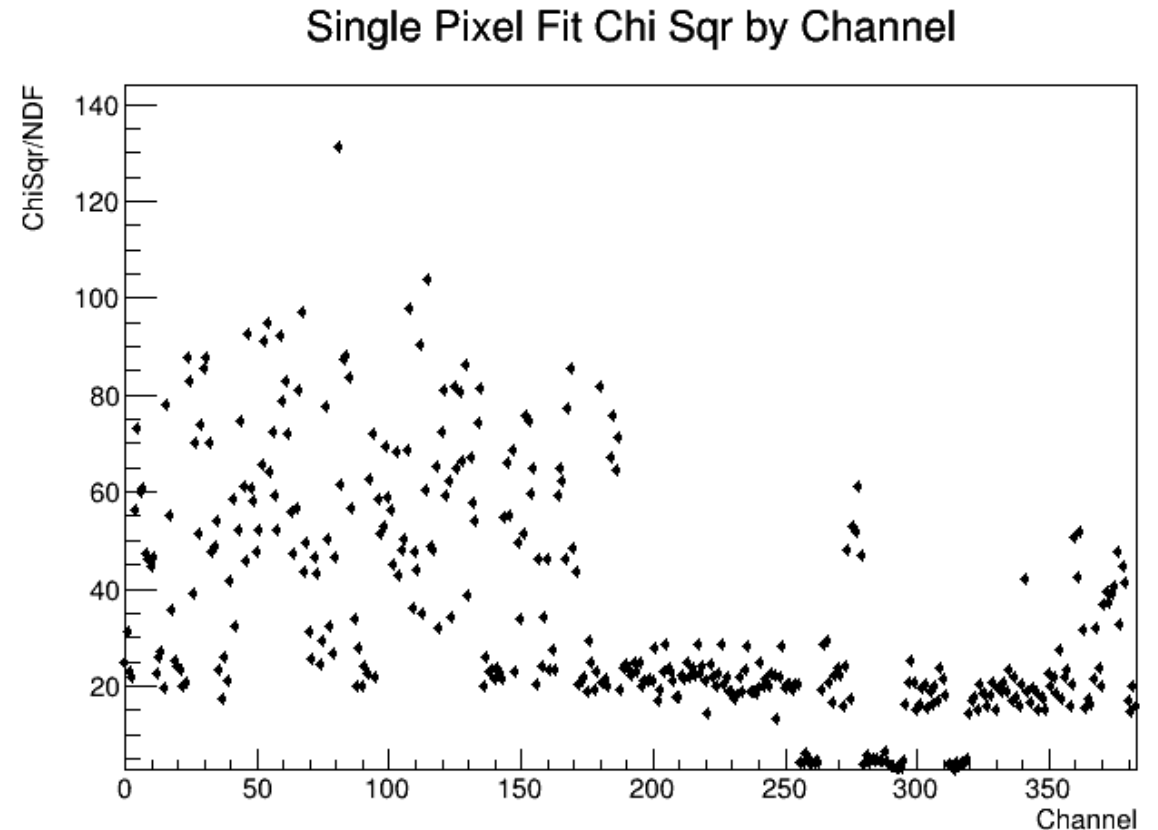
# Is it the data or the fit?

- Are single pixel gap differences in data or just an artifact of the fit?
- Could the gaps be made uniform across IBs by improving the fitting algorithm?



# Chi Squared “Goodness of Fit”

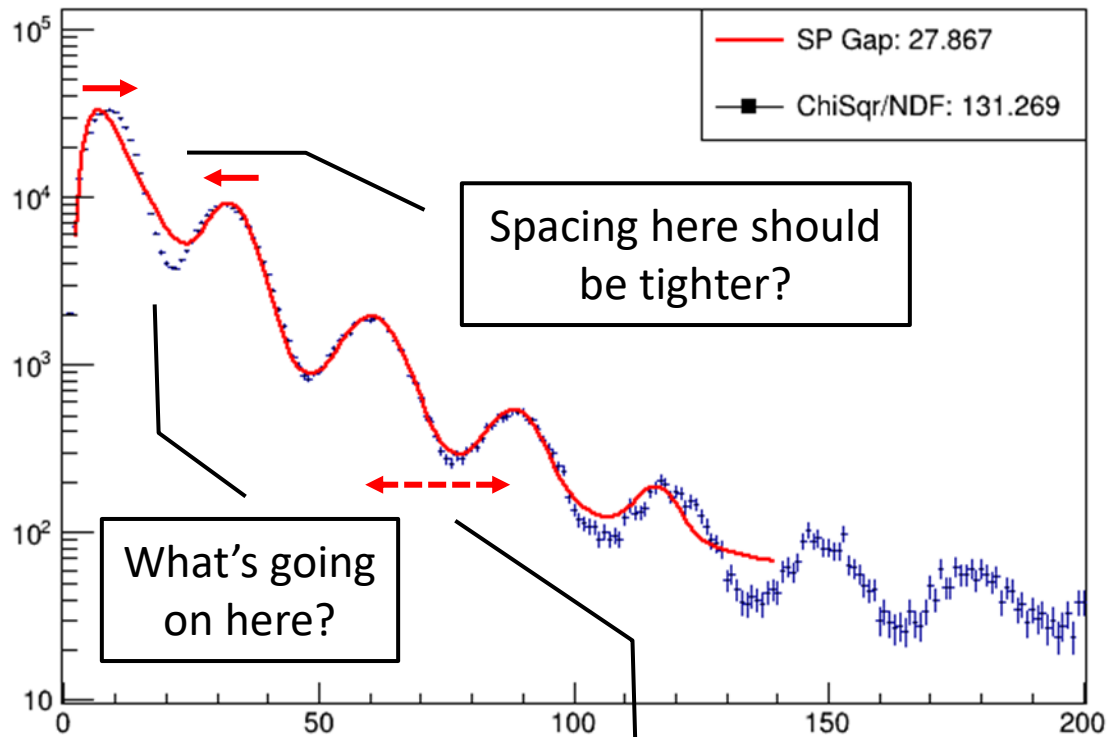
- *All plots are Sector 17, Run 15750 (8/13/2021) from now on*
- We see a similar pattern in the chi squared of fits...
- IBs 0-2 have “worse fits” and larger spacing (single pixel gap) (avg  $\chi^2$ : 50.57)
- IBs 3-5 have “better fits” and tighter spacing (avg  $\chi^2$ : 20.03)



# Comparing Good and Bad Fits

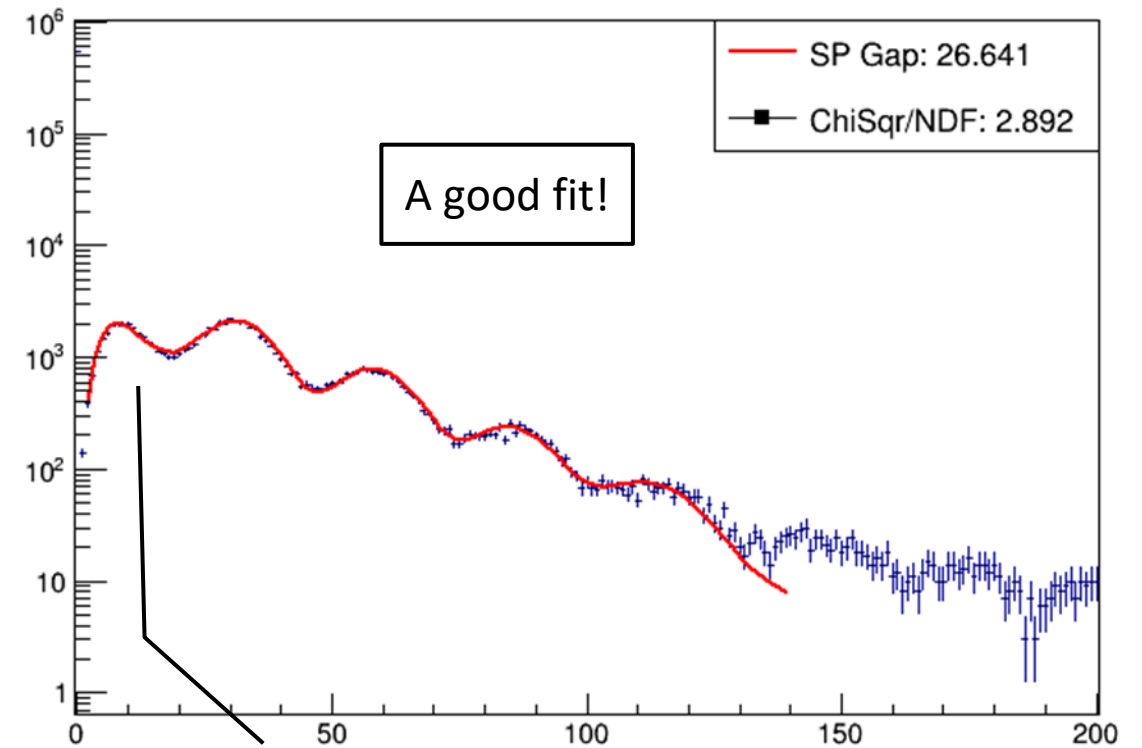
## Worst Fit (Channel 81)

h\_alladc\_81



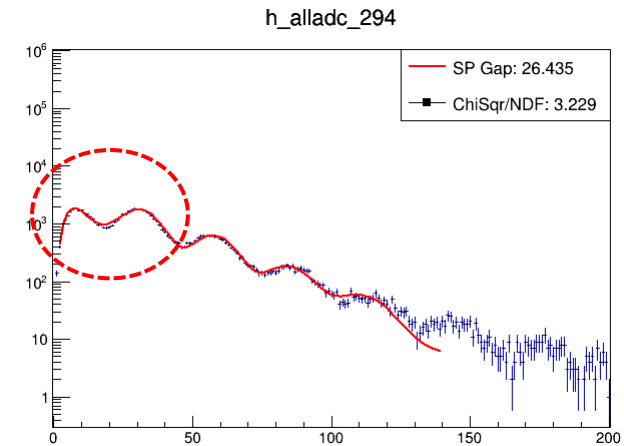
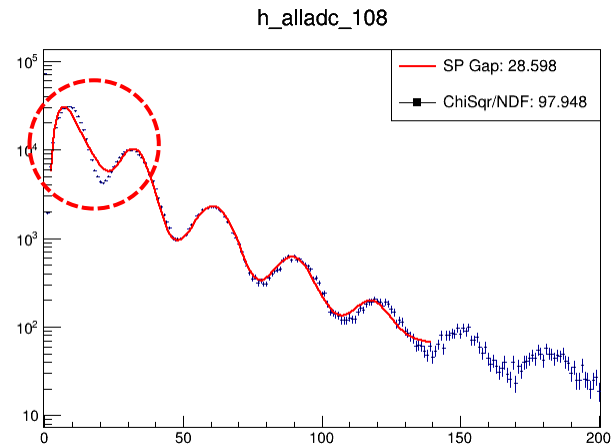
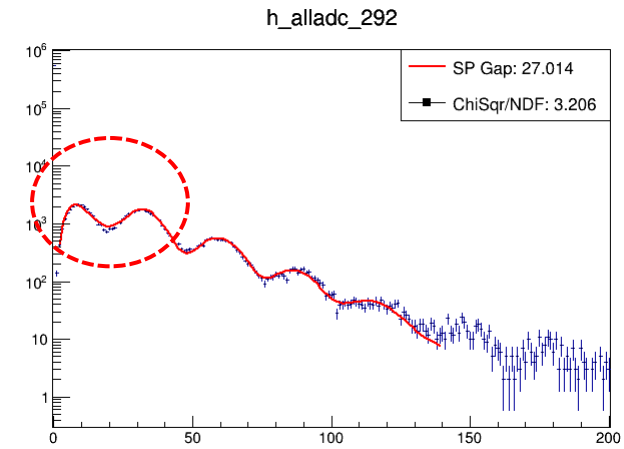
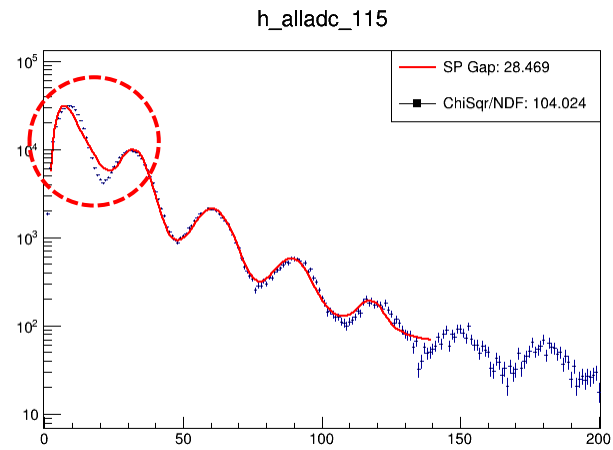
## Best Fit (Channel 314)

h\_alladc\_314

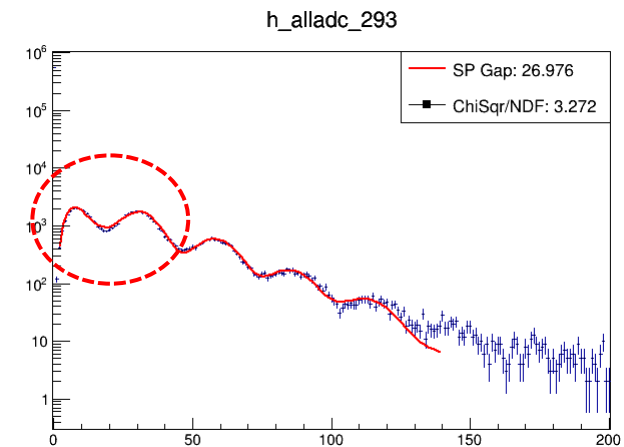
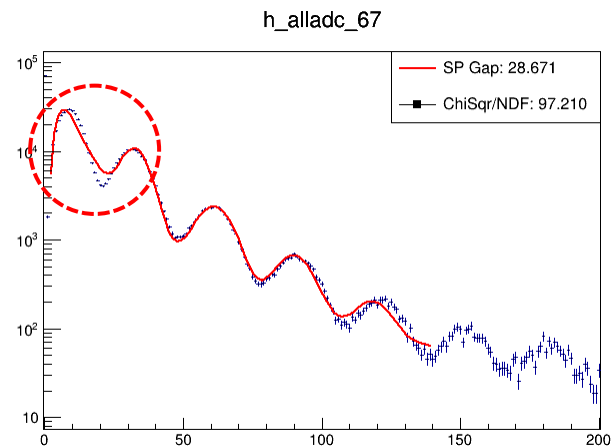




3 next worst fits look the same



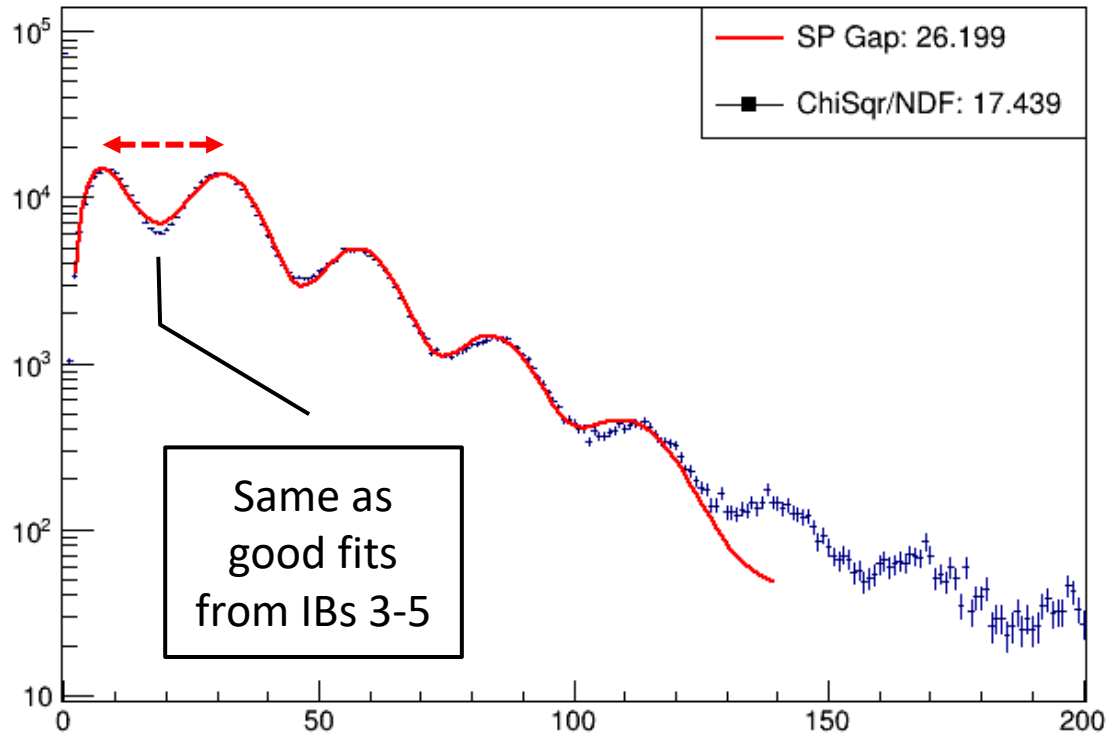
3 next best fits look the same



# Counterexamples?

## Best Fit in IBs 0-2 (Channel 37)

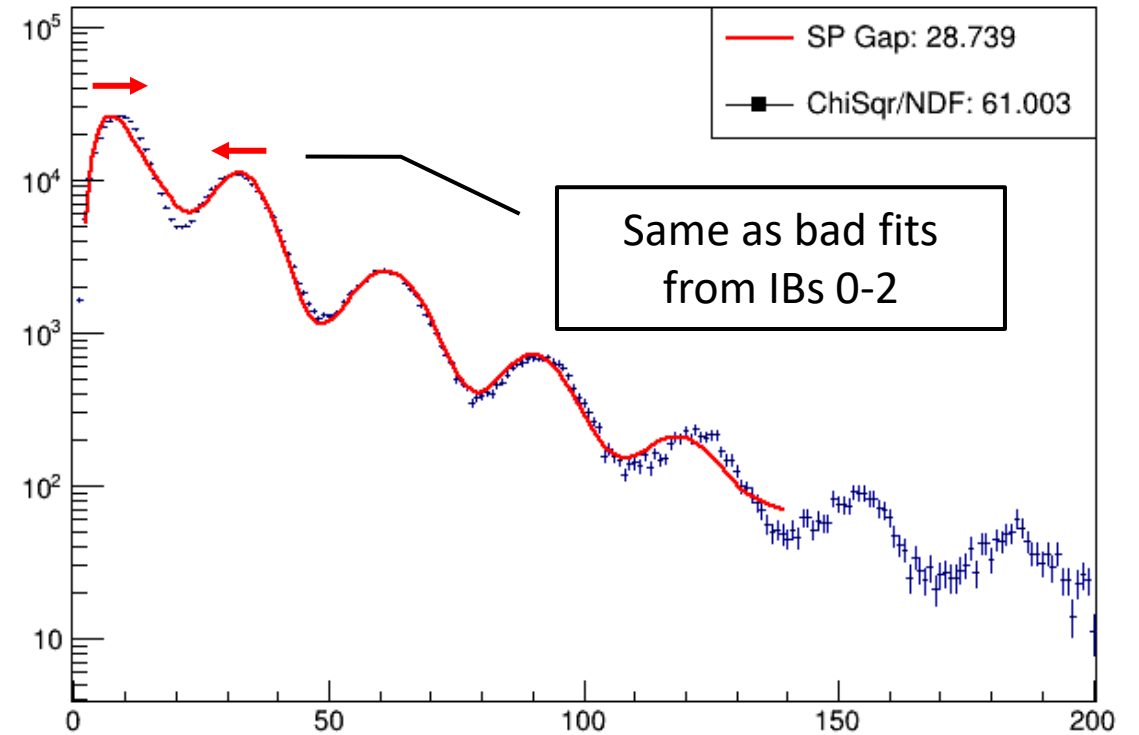
h\_alladc\_37



10/4/2021

## Worst Fit in IBs 3-5 (Channel 278)

h\_alladc\_278



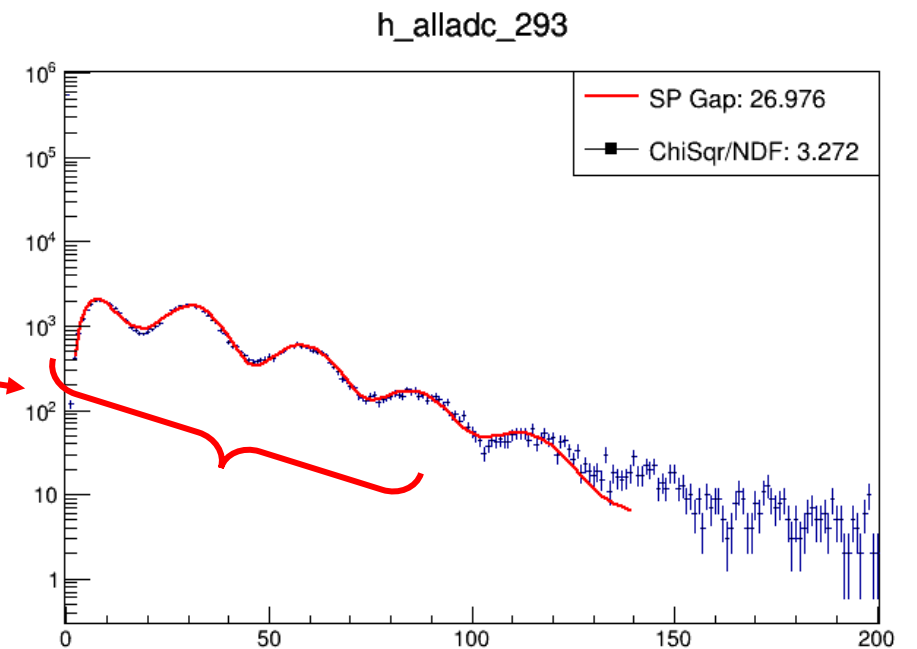
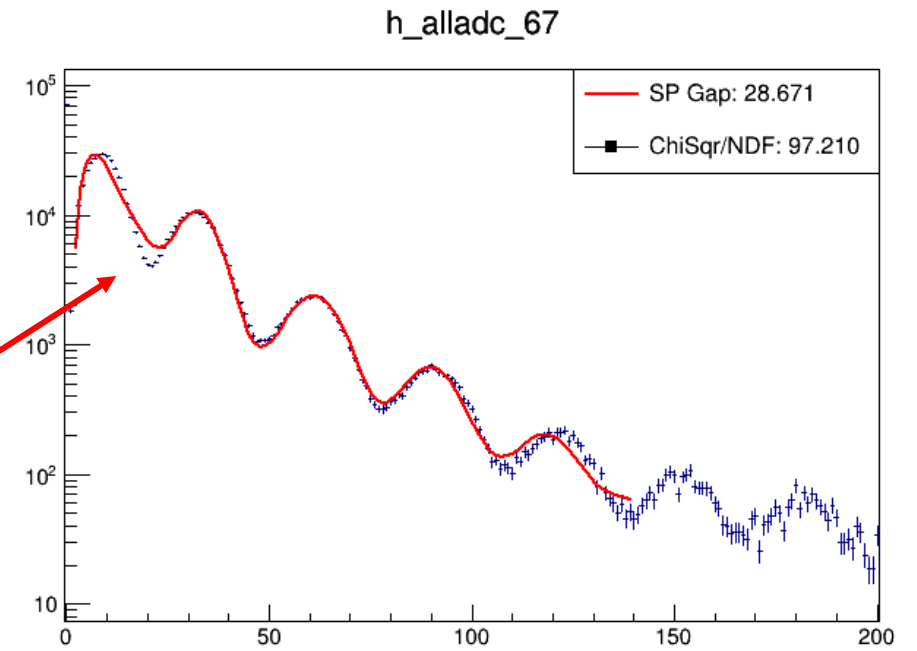
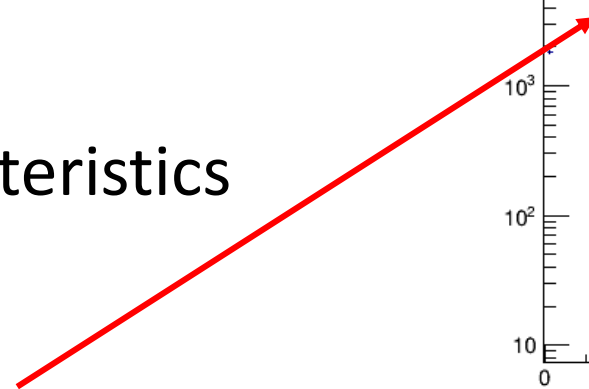
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# Findings

- So...we see a mix of behaviors in all IBs
- Yet this still confirms general relation that a better fit gives a lower single pixel gap and a worse fit gives a larger gap
- Bad fits usually struggle between the first two peaks when the first peak is noticeably higher than the second...
- ...and when first and second peaks are about the same height, fits seem to be much better

# Findings

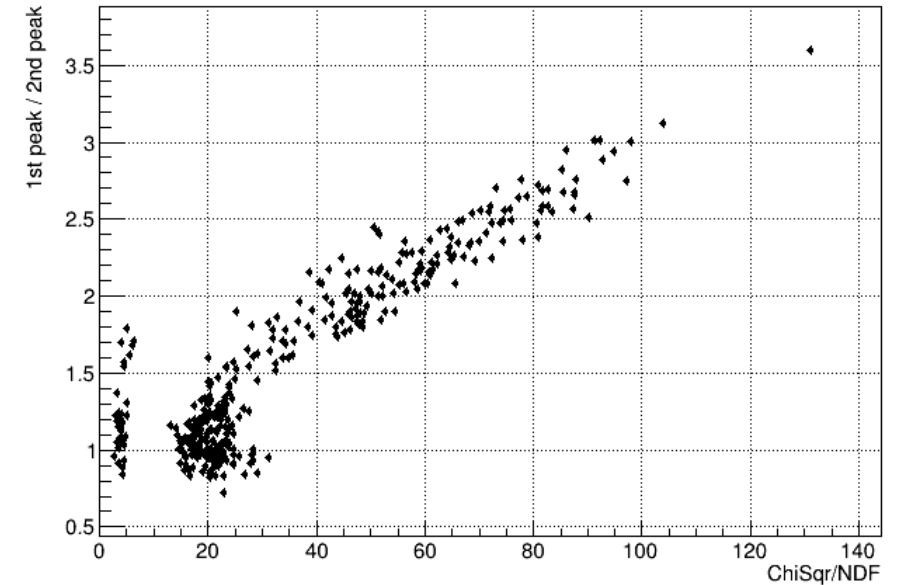
- We observe different characteristics in IBs 0-2 than in IBs 3-5
- IBs 0-2
  - 1<sup>st</sup> peak largest, fit struggles between 1<sup>st</sup> and 2<sup>nd</sup> peaks
- IBs 3-5
  - 1<sup>st</sup> and 2<sup>nd</sup> peaks about the same, fit consistently good across first 3-4 peaks
- Why? For this sector only? Across multiple tests?



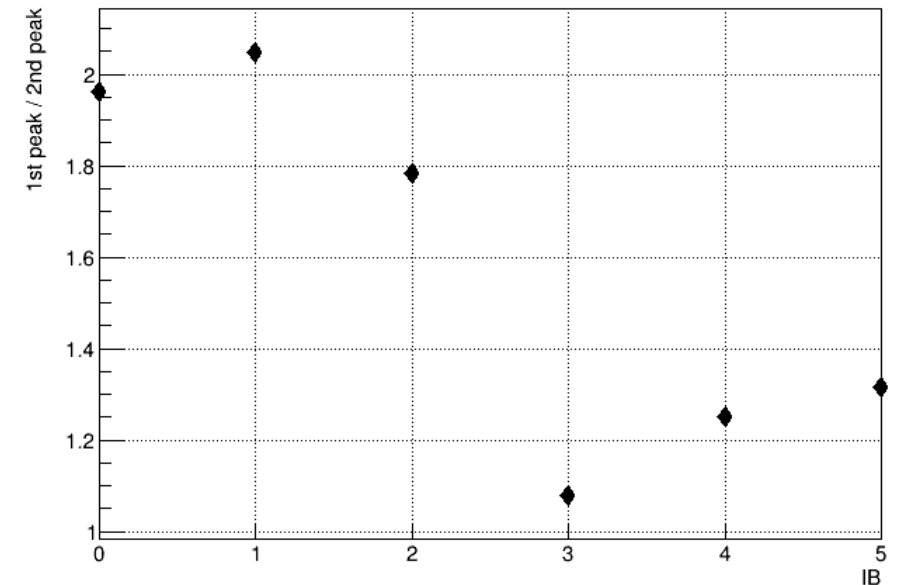
# Why are the fits worse?

- Fit struggles between first and second peaks when first peak (landau) is much higher than the second
- Indicates that there is more background noise in these channels
- Single pixel gaps are different because IBs 0-2 are more “noisy” than IBs 3-5?

Peak Height Ratio by Chi Sqr



Peak Height Ratio by IB



# Conclusion/Outstanding Questions

- Do the fits accurately represent single pixels gaps of *data*?
- Could the fitting algorithm be improved to handle noisy data?
- Do we see this clear separation of single pixel gaps by IB in other sectors?
- Code, plots, and csv of statistics by channel on GitHub:  
[https://github.com/masonrh2/sphenix\\_cosmics/tree/master/pixel\\_gap\\_output\\_00015750](https://github.com/masonrh2/sphenix_cosmics/tree/master/pixel_gap_output_00015750)