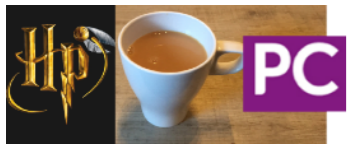


# Image Processing

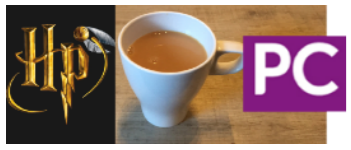
*#TeamCCD*



# Contents



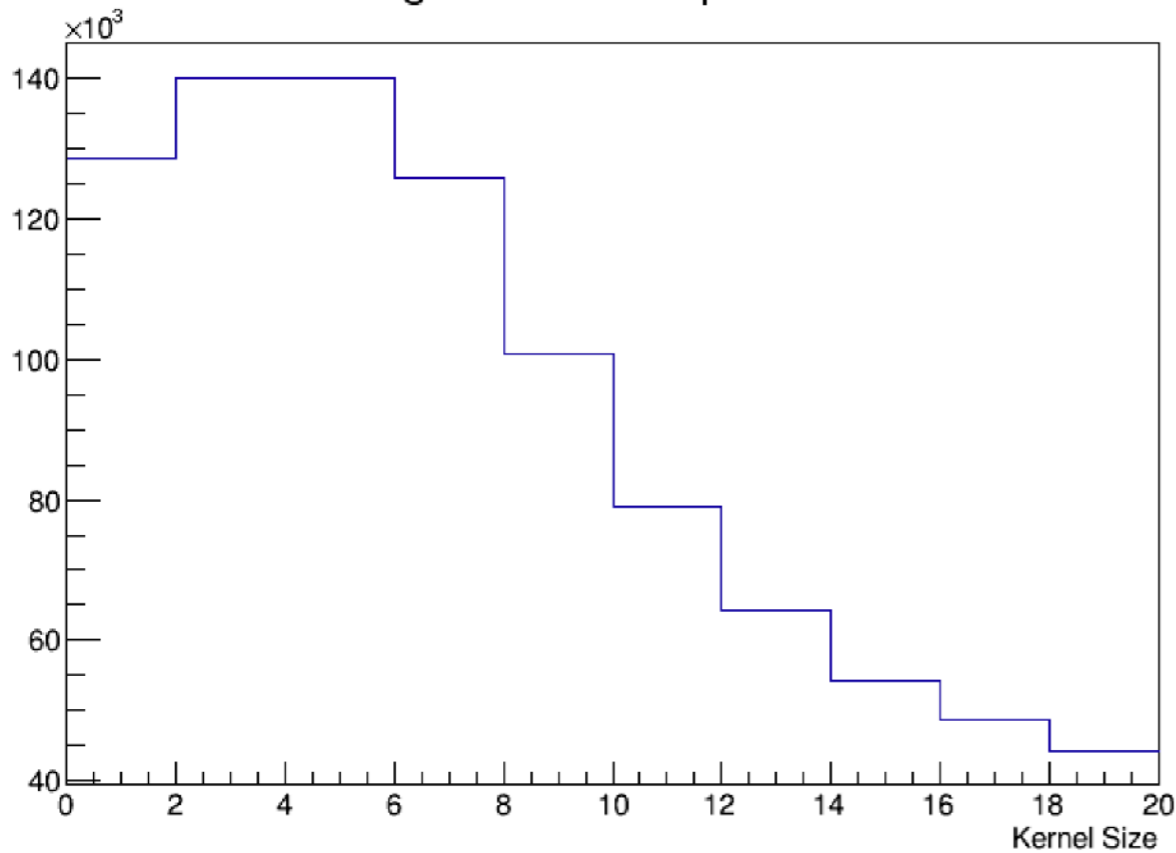
- Gaussian Blurring
- Neighbour Clustering
- Time Series Analysis
- Bias Subtraction
- Next Steps



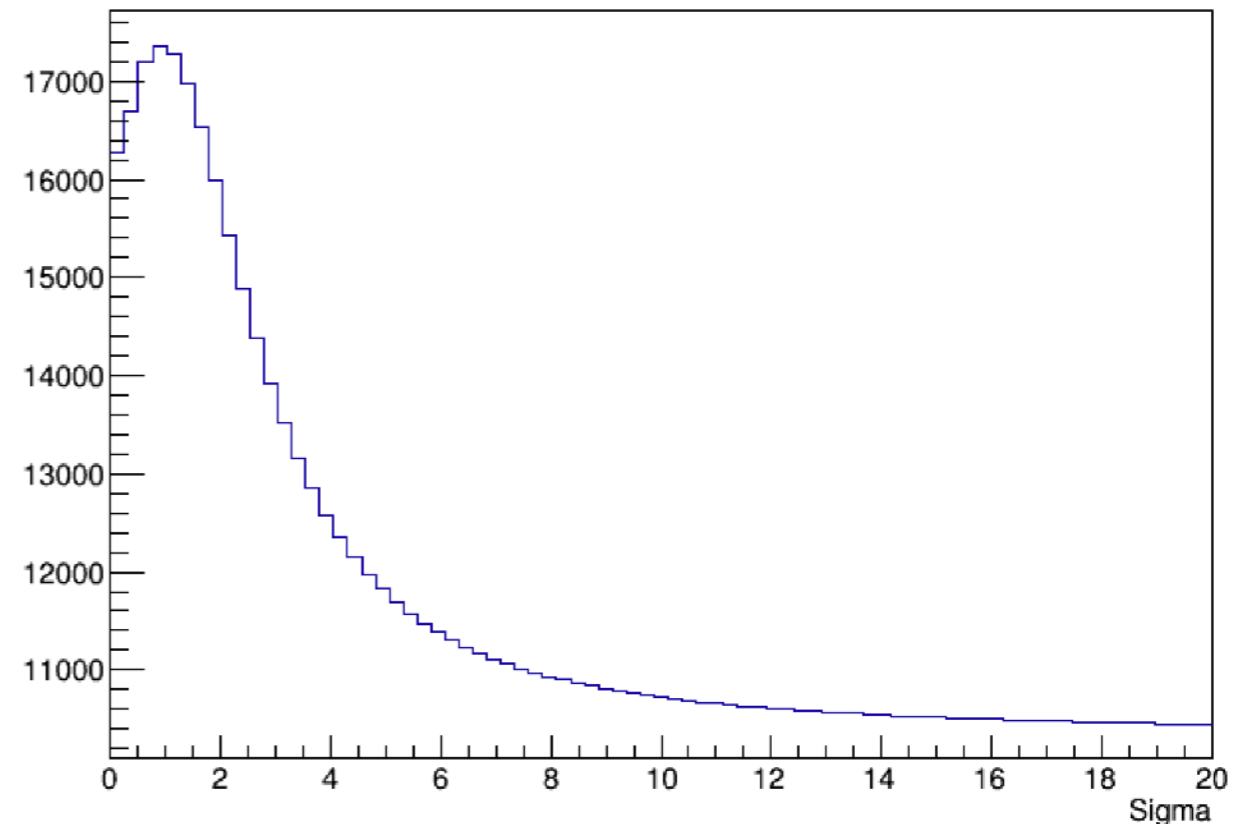
# Gaussian Blurring

- Following up on requested plots from Gaussian Scan
- Peak is kernel size 3 or 5 (has to be odd), sigma 1.0
- All images from scan [here](#) (rebinned 2x2 to make pdf not 200Mb)

Integral Around Gap in Track



Integral Around Gap in Track

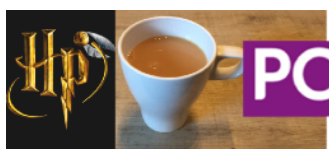




# Neighbour Clustering



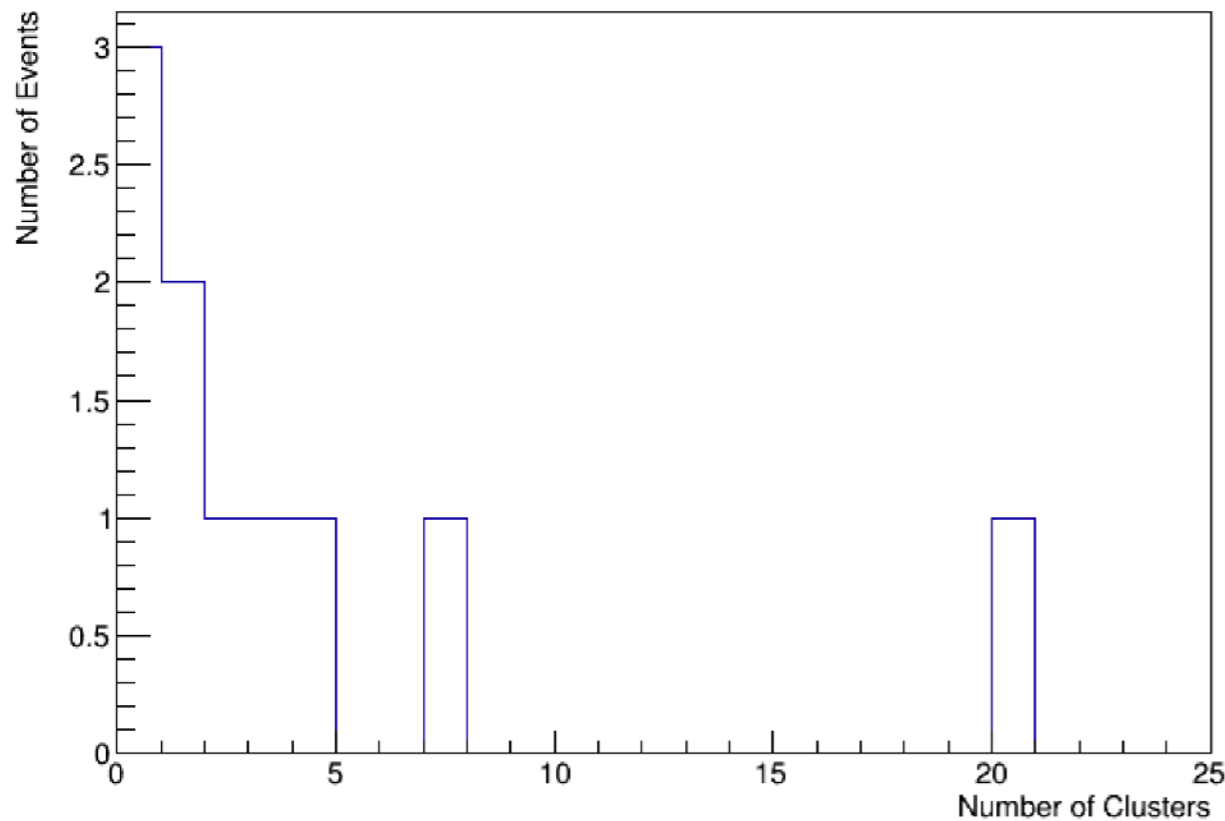
- Look for all pixels above a threshold
  - For the highest, search for other pixels above threshold in neighbourhood and add to cluster
  - Look for pixels above threshold (not already in a cluster) in neighbourhood of next pixel in cluster (This threshold currently same as initial pixel threshold. Need to make this a separate parameter)
- Repeat for next highest pixel not already in a cluster
- ADU threshold, minimum spacing between pixels in same cluster, and minimum cluster size all set in config
- Haven't yet implemented cut on aspect ratio



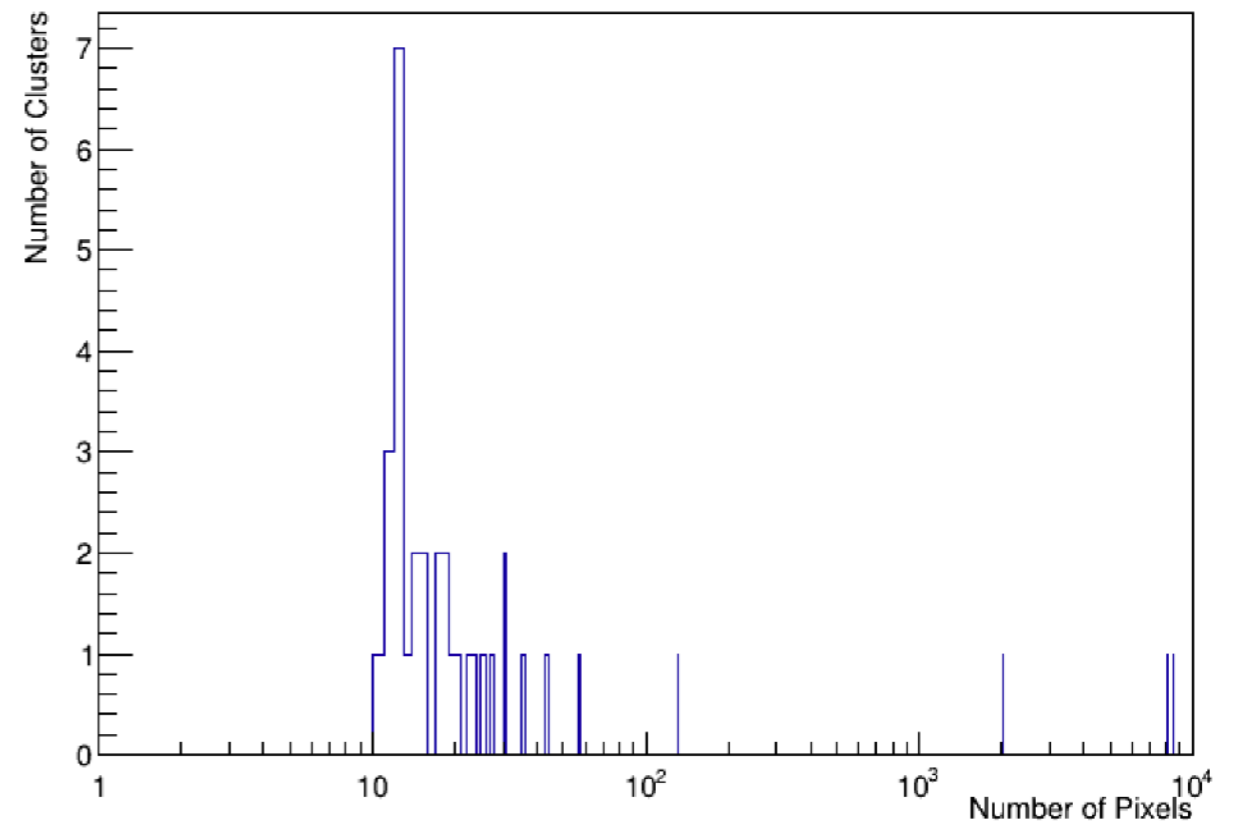
# Neighbour Clustering

- Process is quite slow, only run it over 10 events so far for testing
- Analysis processor makes plots below. These are for min cluster size 10, ADU threshold 100, max spacing 10 pixels, but these values will need some tuning
- Low stats but seems to be doing what it's supposed to

Number of Clusters per Event



Number of Pixels per Cluster





# Time Series Clustering



- Compare image with previous image for same CCD
- For each pixel, check if it has increased by a threshold amount (set in config)
  - If it has keep the pixel value
  - Else set it to 0 ADU
- Processor and app written
- I've just been saving TH2s in the main processor for tests rather than having a separate analysis processor

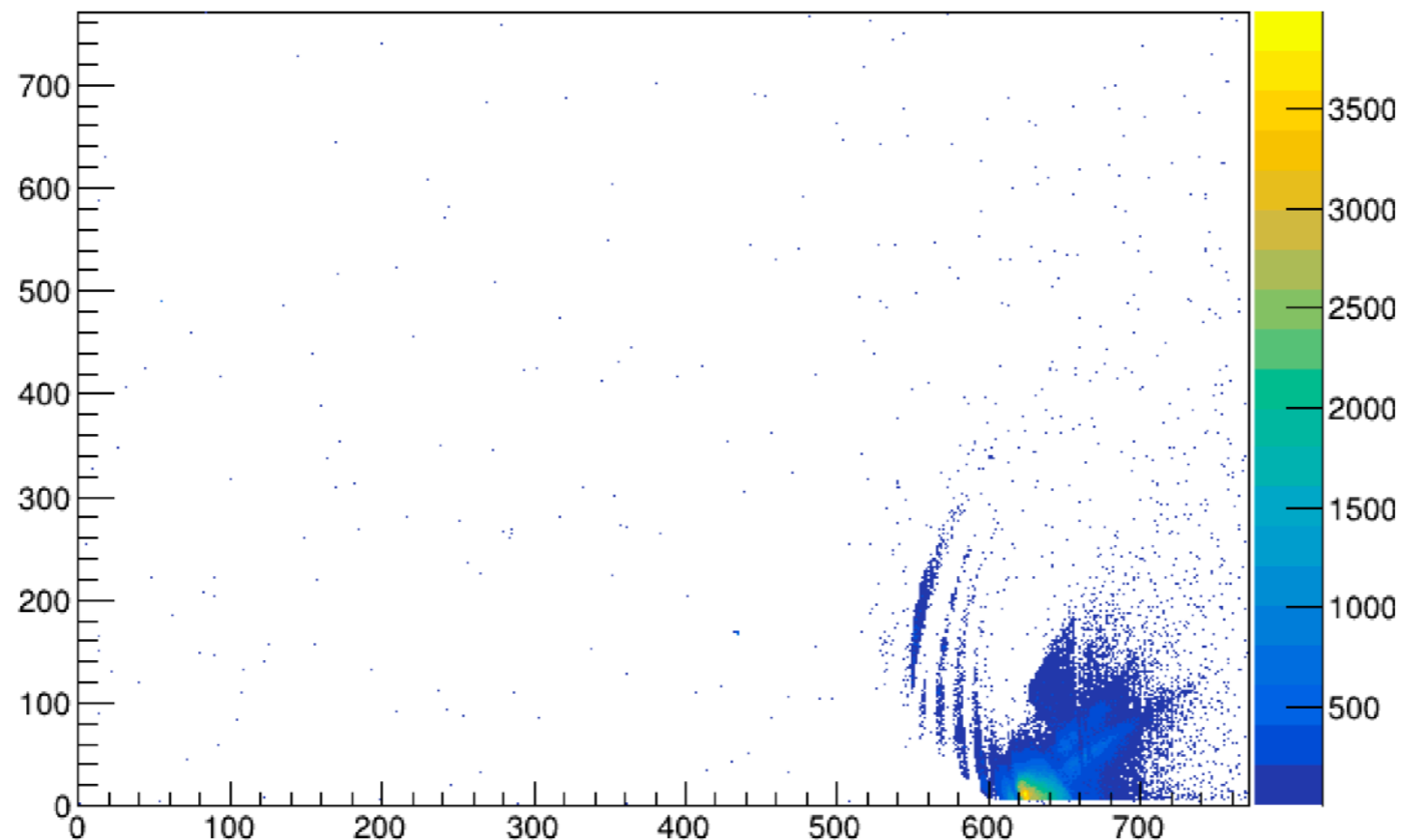


# Time Series Clustering



- This plot for ADU change threshold 100, and requiring an increase
- Again, we'll want to tune this parameter for running on all runs
- Ideally spark would have been found by spark killer, but shows this processor working as we'd want

hTime\_run1238082\_cam0\_eve1



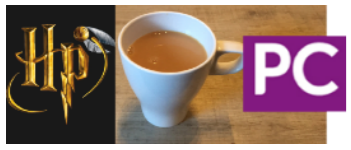


# Time Series Clustering



- Need to update how we deal with the first event in run
- At the moment we compare to final bias frame
  - But physics frames are bias subtracted so have average ADU much lower than final bias frame
  - Will subtract average bias from final bias for this algorithm, but hasn't been done yet

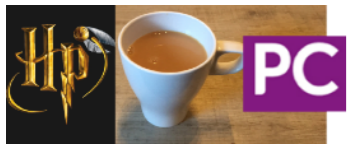




# Bias Subtraction



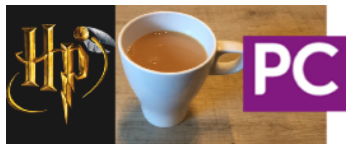
- Zack found spark killed files which indicated all bias frames had been used in the averaging for subtraction
- We'd previously agreed not to include the first bias frame
- In the code, all frames are being used. We're not sure when rejecting the first bias got lost
- Now have committed fix, and run over all the good runs.  
Currently copying this over to linapp



# Next Steps



- Aspect Ratio cut in Neighbour Clustering
- Separate ADU threshold for neighbour pixels
- Use bias subtracted final bias for first exposure in Time Series Analysis
- Tune configurable parameters in these processes
- Strip out waveform data, and objects from previous processes eg. In Gaussian blurred file, don't need to keep the physics\_ccd
- Run over all good runs?



# Backups