SBS GEM Crosstalk Analysis

SBS Software/Analysis Meeting

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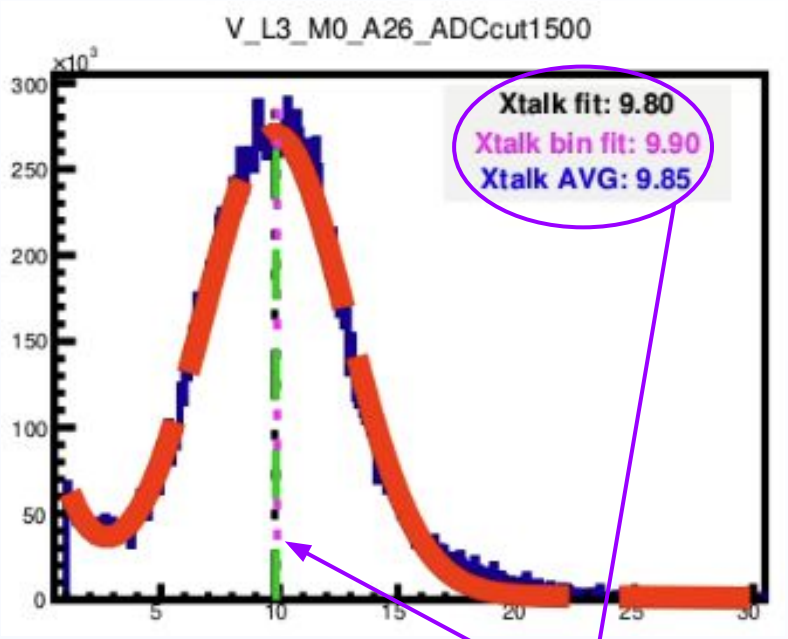
Crosstalk Analysis Terms & Approach

- **Digital Crosstalk** on APV25 (multiplexer) channels (*channel-space vs strip-space*)
- ***Ratio of Neighboring Channels***
  - **"The Ratio"** is calculated by dividing the ADCs of neighboring channels
  - **The larger ADC is always divided by the smaller ADC**
  - **Calculation is skipped if either ADC is 0.**
  - A threshold (ADC cut) can be applied to the numerator (larger ADC) to expose "dominant" ratios
  - Ratio is calculated using all channels on a single APV

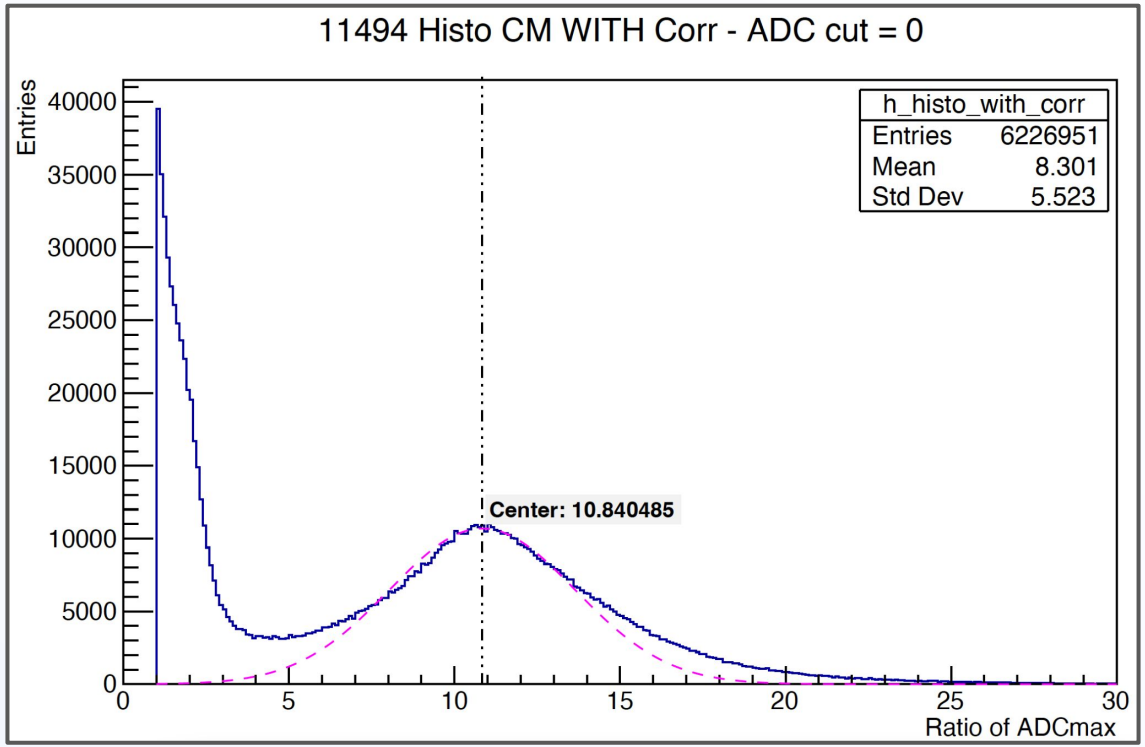


Determining APV Ratio

- Histogram for **Ratio of All Neighboring Channels** on a single APV for a single run.
- The bump near the center of the plot is the crosstalk → crosstalk ratio for APV25 is typically ~10

- Run: 11494
- Single APV on one GEM
- Fit “ratio bump”
- Find center of bump

From graph:
Ratio = 10.84



Determining APV Ratio

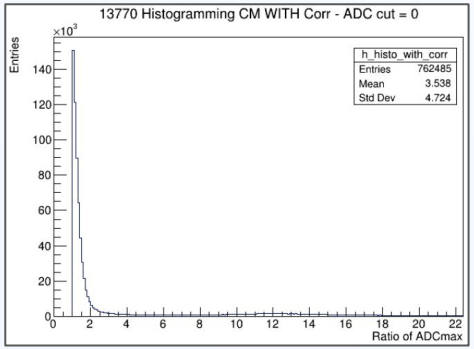
Taking a higher occupancy run:

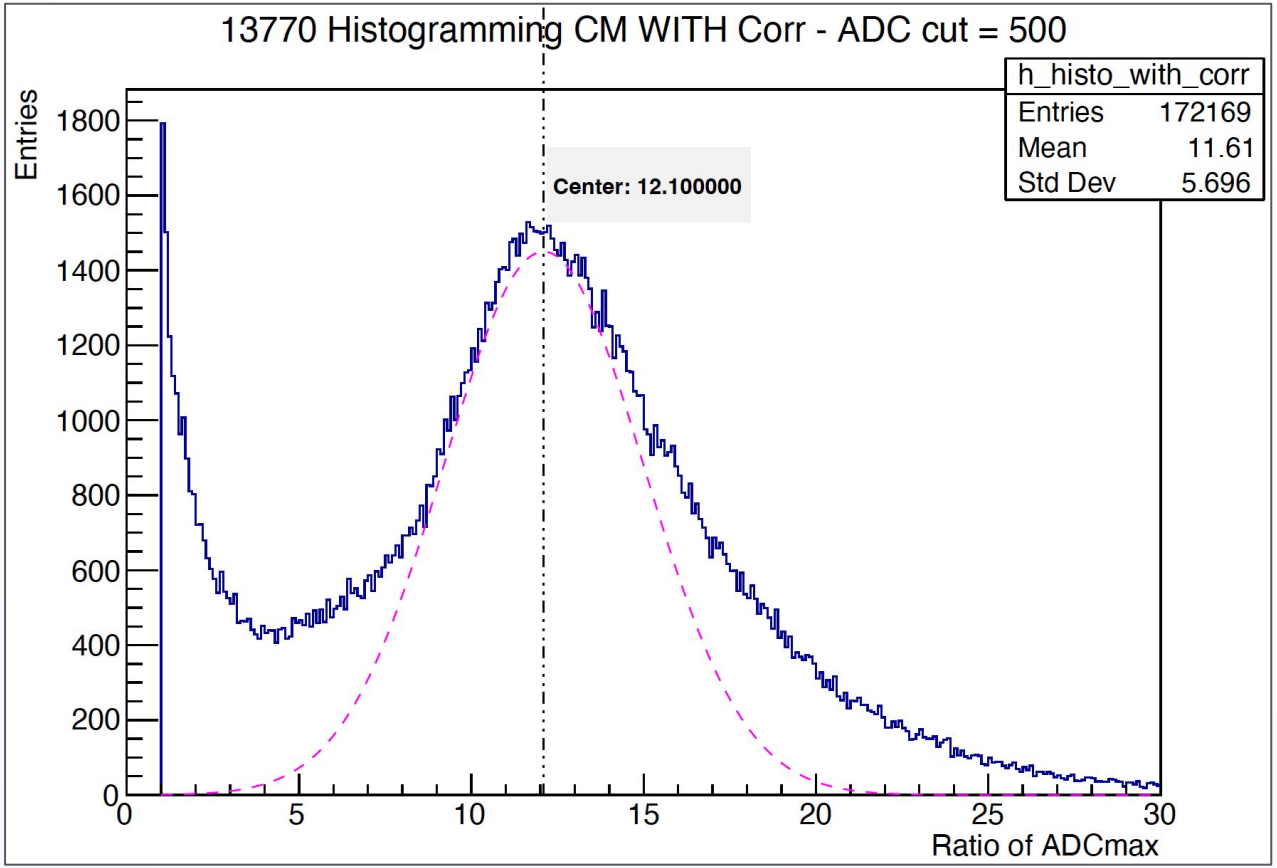
- Run: 13770
- Beam current: 12 uA
- Single APV on one GEM
  - Front UV GEM
  - APV 9
- Fit “ratio bump”
- Find center of bump

From graph:

Ratio = 12.1

“Correction Ratio”

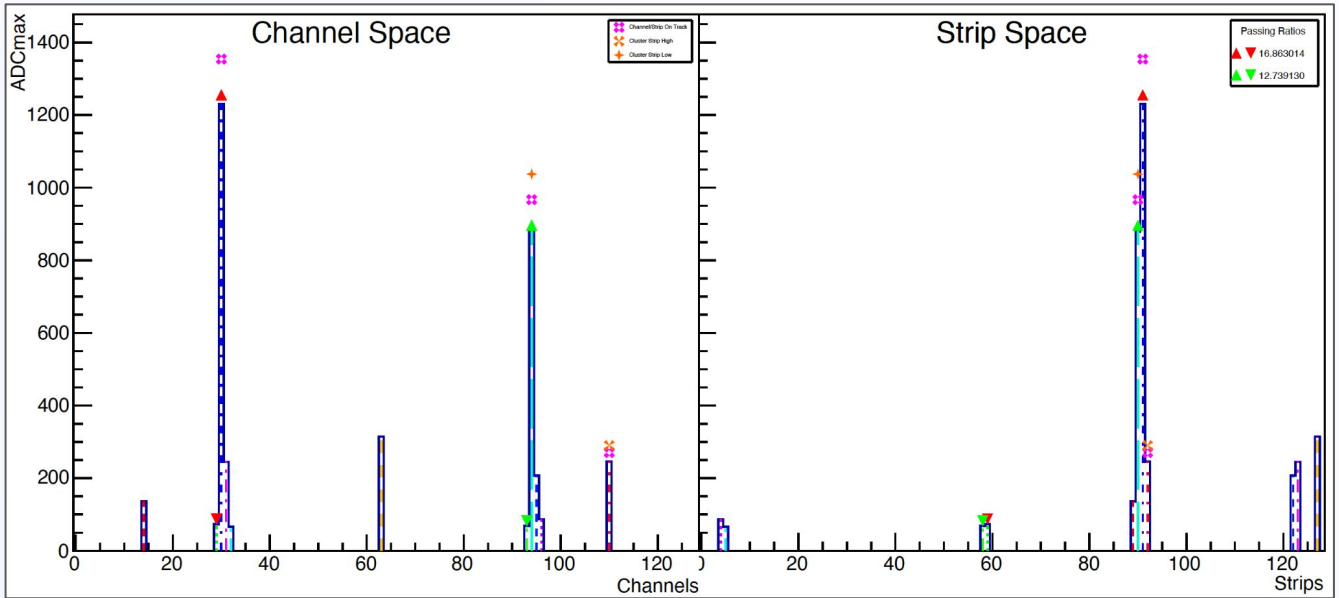




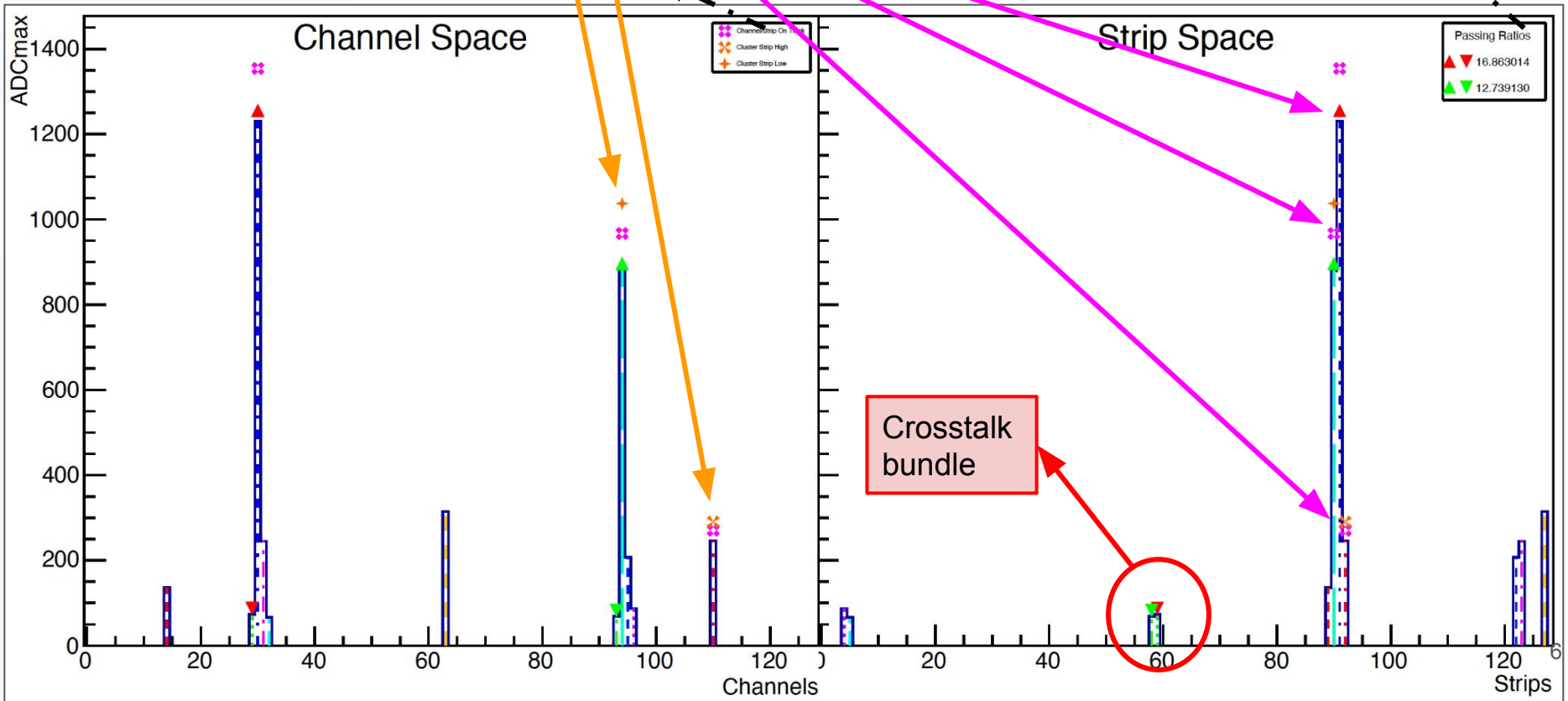
Current Analysis Approach

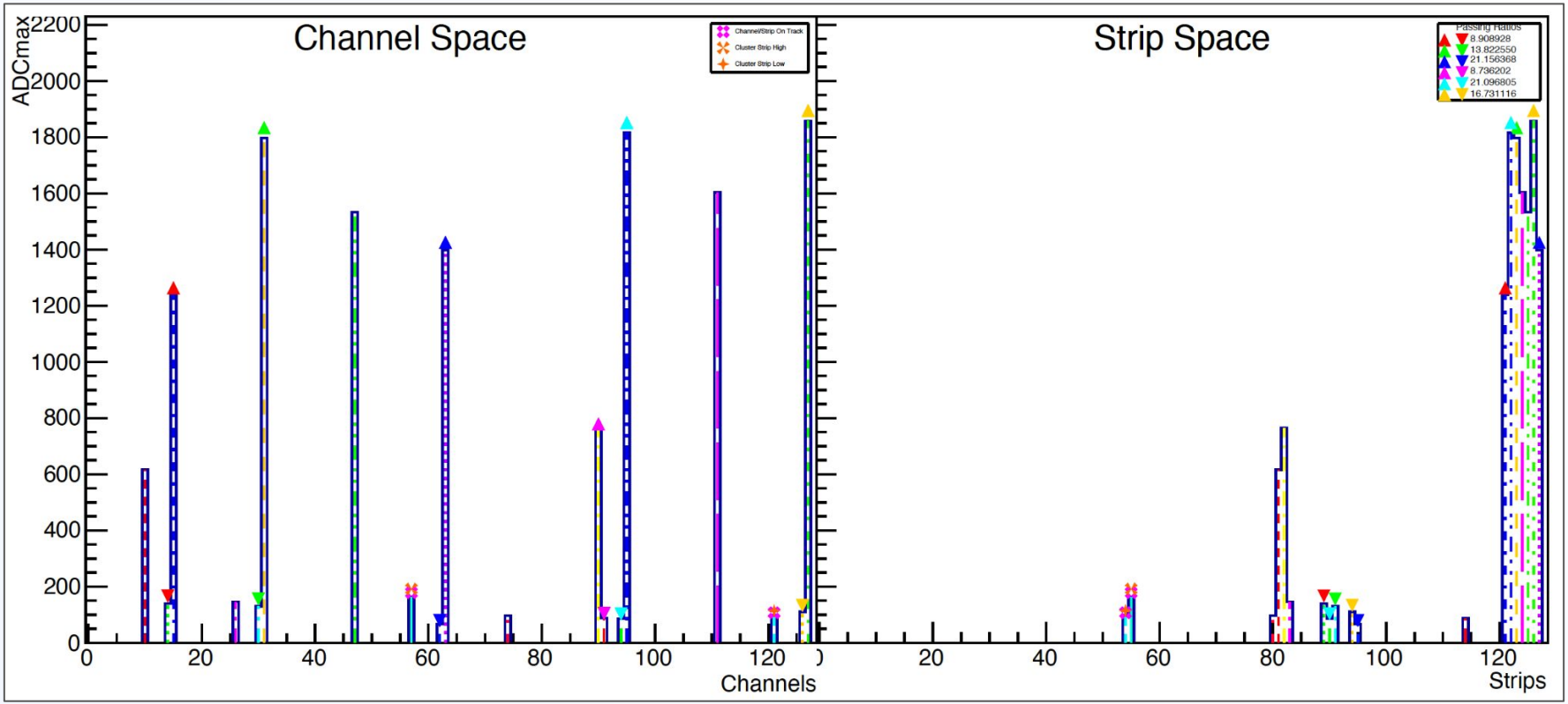
Event viewer to inspect single events

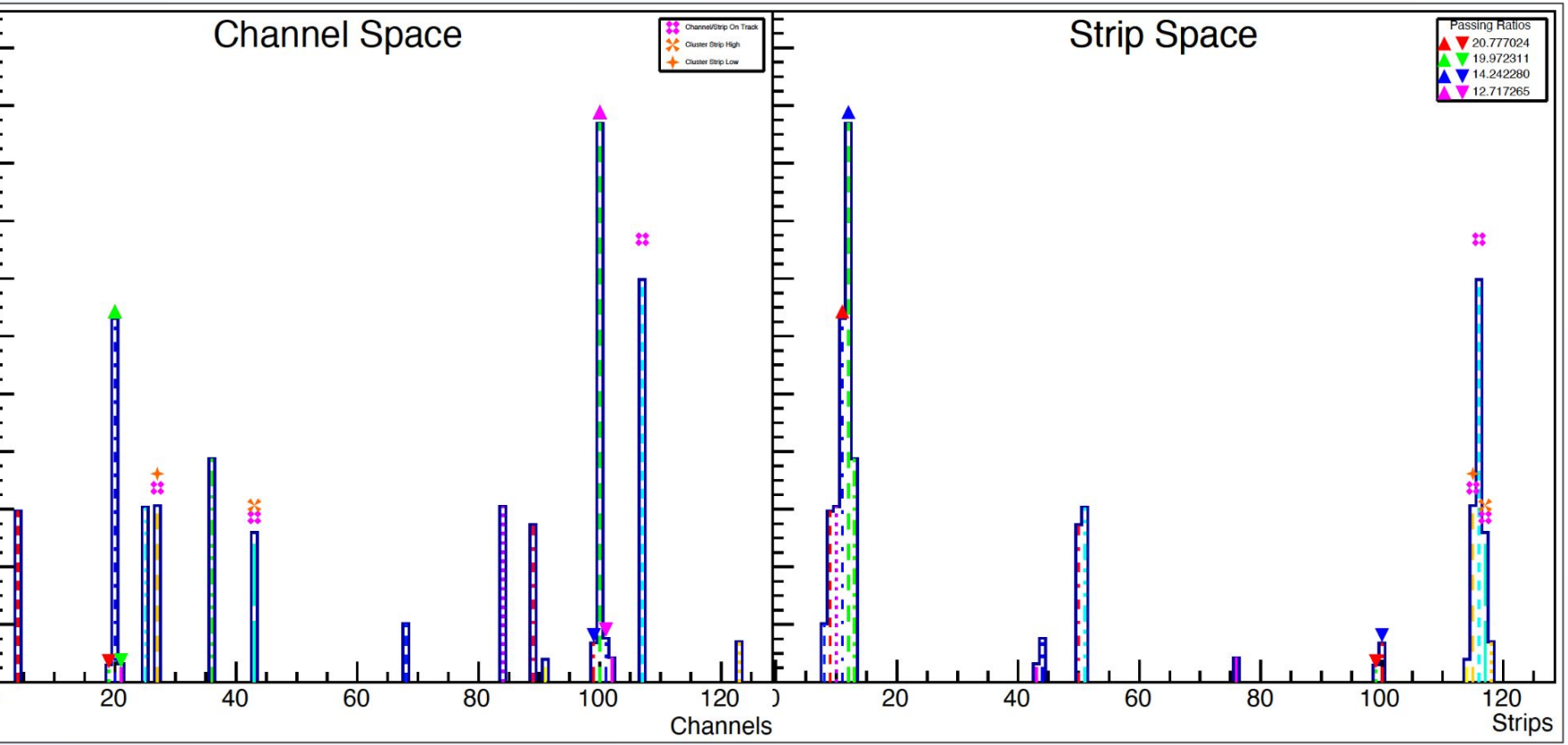
- Shows hit/event in Strip Space (right) and Channel Space (left)
- Hits/events shown meet some basic criteria:
  - Includes only neighbor channel ratios greater than some threshold
  - Smaller channels (denominator) contributing to the ratio map “bundles” to strip space (min. bundle size = 2 strips)
- Marks numerator/denominator strips/channels with Up/Down Triangles, respectively
- Indicates if event contains “On Track” strip/channel (and determined clusters ( )



Ratio Event Viewer

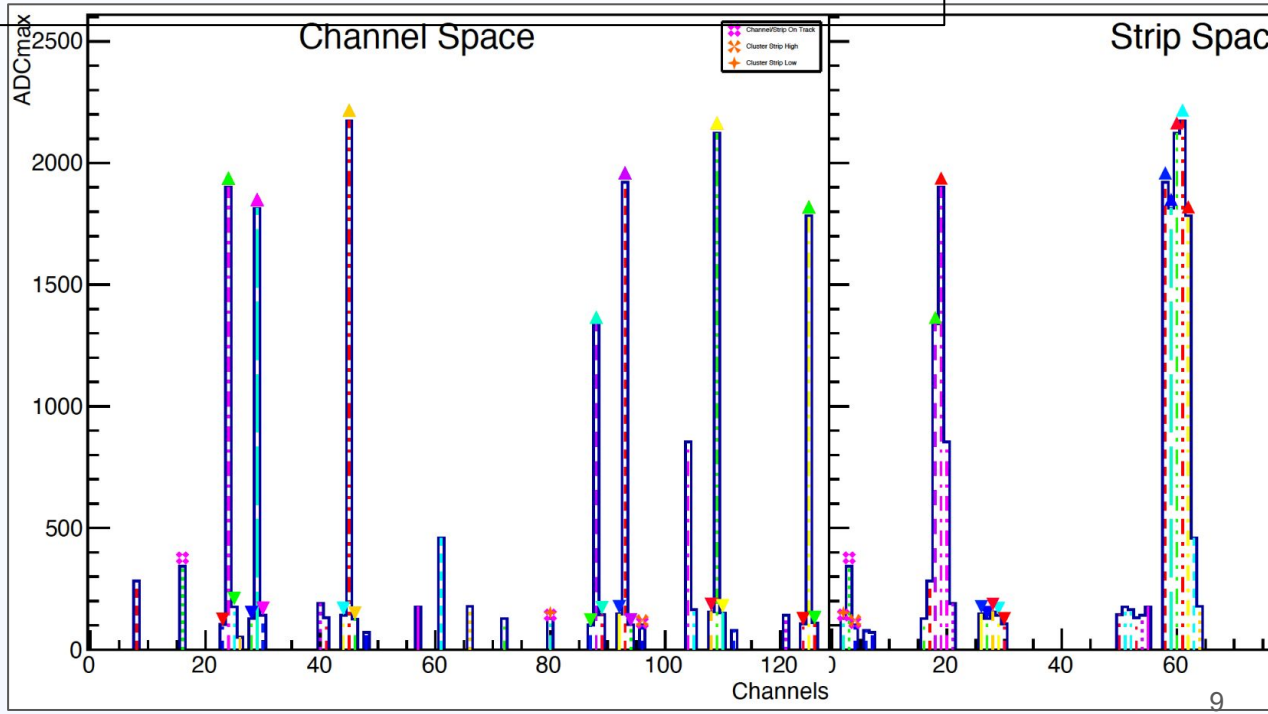



Channel Space
Strip Space
ADCmax
Channels
Strips
Channel/Strip On Track
Cluster Strip High
Cluster Strip Low
Passing Ratios
8.908928
13.822550
21.156368
8.736202
21.096805
16.731116


Channel Space
Channel/Strip On Track
Cluster Strip High
Cluster Strip Low
20
40
60
80
100
120
Channels
Strip Space
Passing Ratios
20.777024
19.972311
14.242280
12.717265
20
40
60
80
100
120
Strips

Findings From Viewer Events

- Crosstalk bundles are typically NOT “On Track” or “In Cluster”
- This is an empirical and should be tabulated
- Consider the case that a real hit/signal/cluster is part of a denominator bundle → We don’t want to lose that signal



Crosstalk Corrections

Proposed correction approach:

- For the APV we determine the Ratio (Correction Ratio) → Here we have **12.1**
- We determine a Ratio Threshold → **8**.
- Event is flagged if it contains *neighbor channel ratio greater than threshold*.
- **Smaller channel ADC is corrected:**
  - Subtract “ADC correction” from Smaller Channel’s ADC:

$$\text{ADC correction} = \frac{\text{Larger Channel ADC}}{\text{Correction Ratio}}$$

  - If:

(Smaller Channel ADC) - (ADC correction) < 0

  - Then:

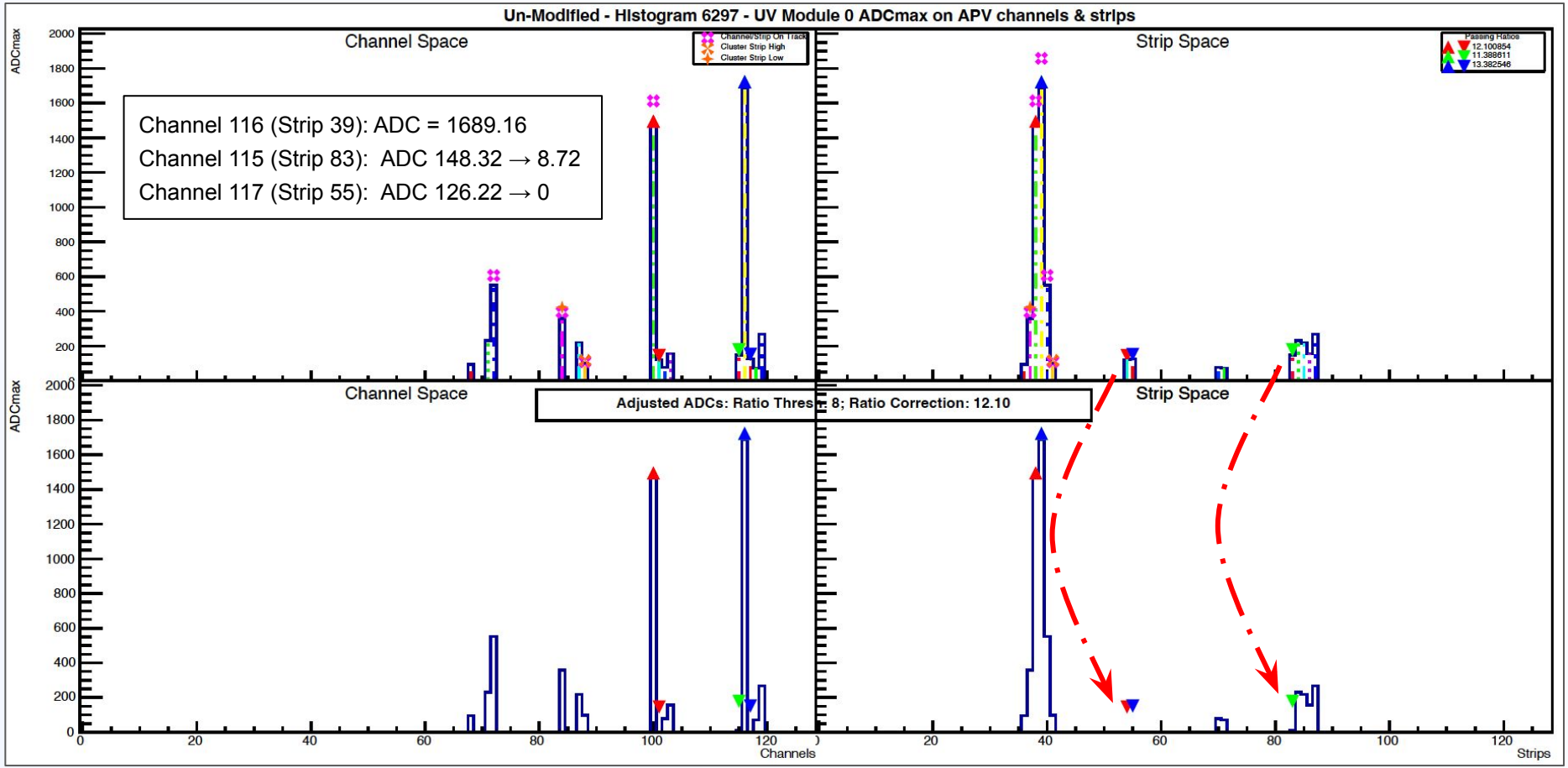
Set Smaller Channel ADC to 0

  - Else:

Smaller Channel ADC = (Smaller Channel ADC) - (ADC correction)

- Run: 13770
- Ratio Thresh = 8
- Corr. Ratio = 12.1

Handling Crosstalk Channels/Bundles



Crosstalk Corrections

- We have for this run, **Correction Ratio = 12.1**
- **Ratio Threshold = 8**
- *"Passing"* events/channels → (Ratio between neighbor channels > ratio threshold)
  - Channel 116: On Track & ADC = 1689.16
  - Channel 115: ADC = 148.32 → Ratio = 11.389
    - Larger ADC divided by Ratio Threshold:
      - 1689.16/12.1 = **139.6**
      - Corrected ADC on Channel 148 = 148.32 - 139.6 = **8.72**

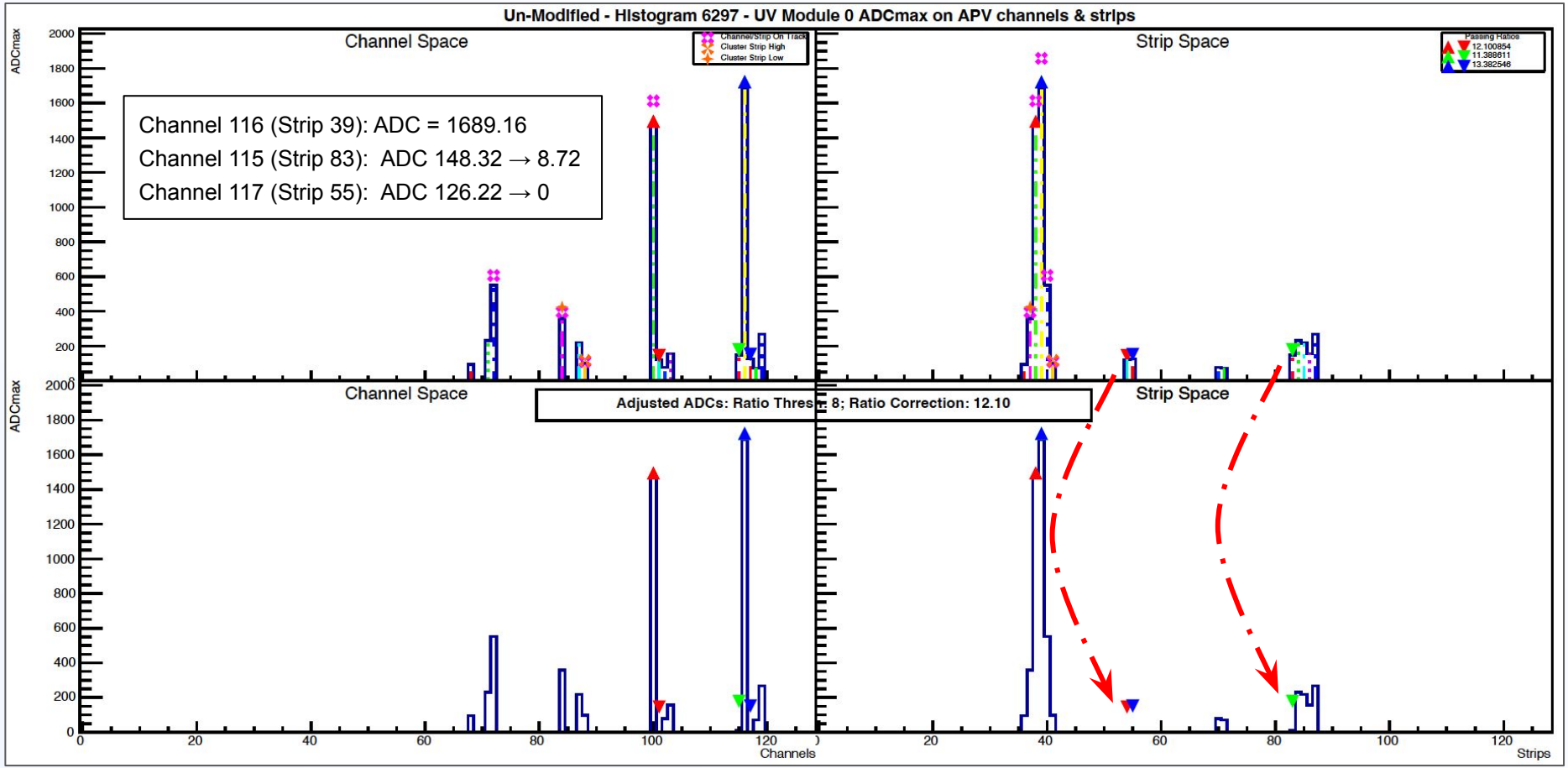
  - Channel 116: On Track & ADC = 1689.16
  - Channel 117: ADC = 126.22 → Ratio = 13.383
    - Corrected ADC on Channel 117 = 126.22 - 139.6 = -13.38
    - **Less than zero so, set ADC to 0.**

Summary for "Passing" ratio event/channels:

- Channel 115: ADC 148.32 → 8.72
- Channel 117: ADC 126.22 → 0

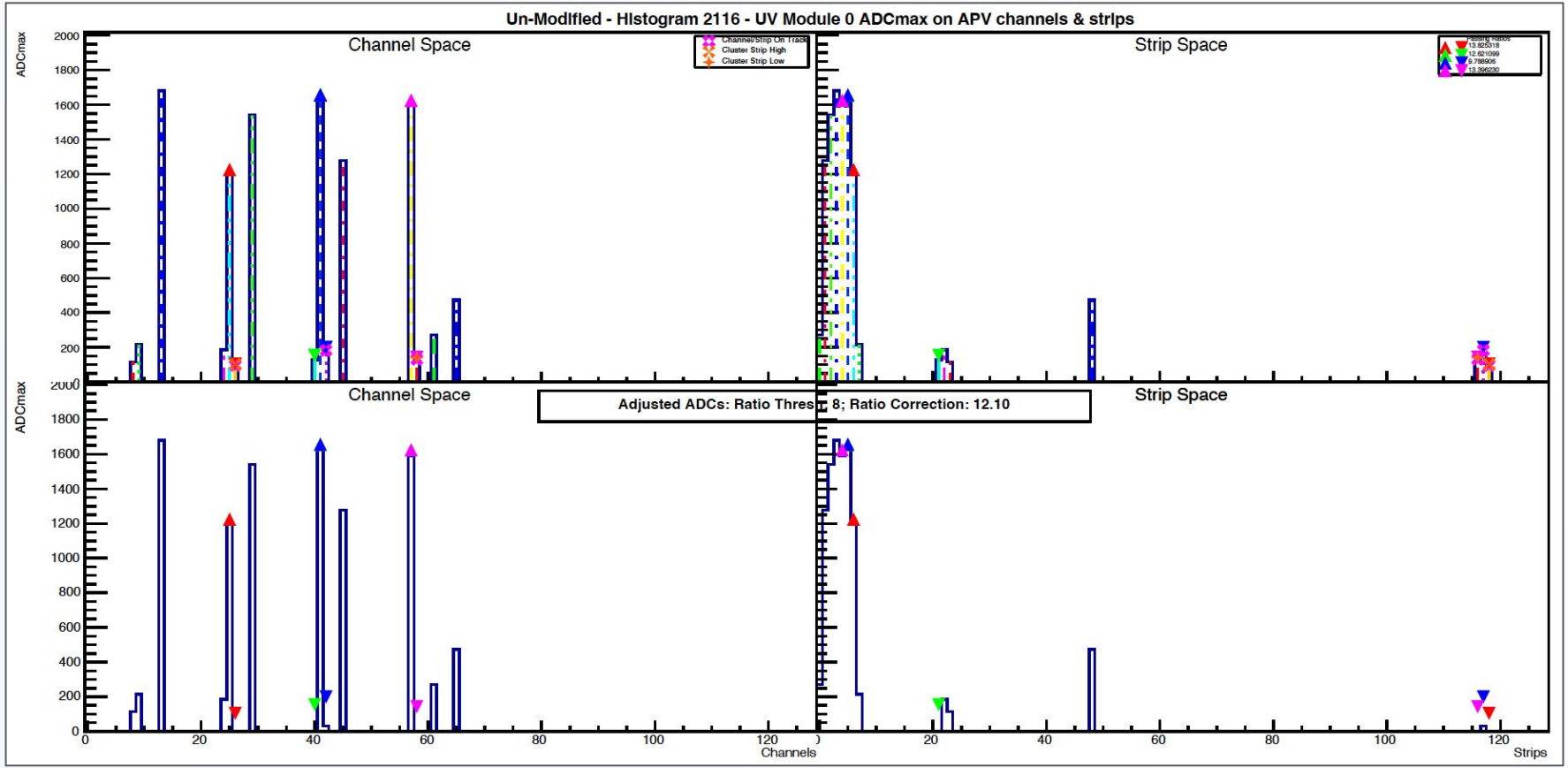
- Run: 13770
- Ratio Thresh = 8
- Corr. Ratio = 12.1

Handling Crosstalk Channels/Bundles



Another Correction Example

- Run: 13770
- Ratio Thresh = 8
- Corr. Ratio = 12.1



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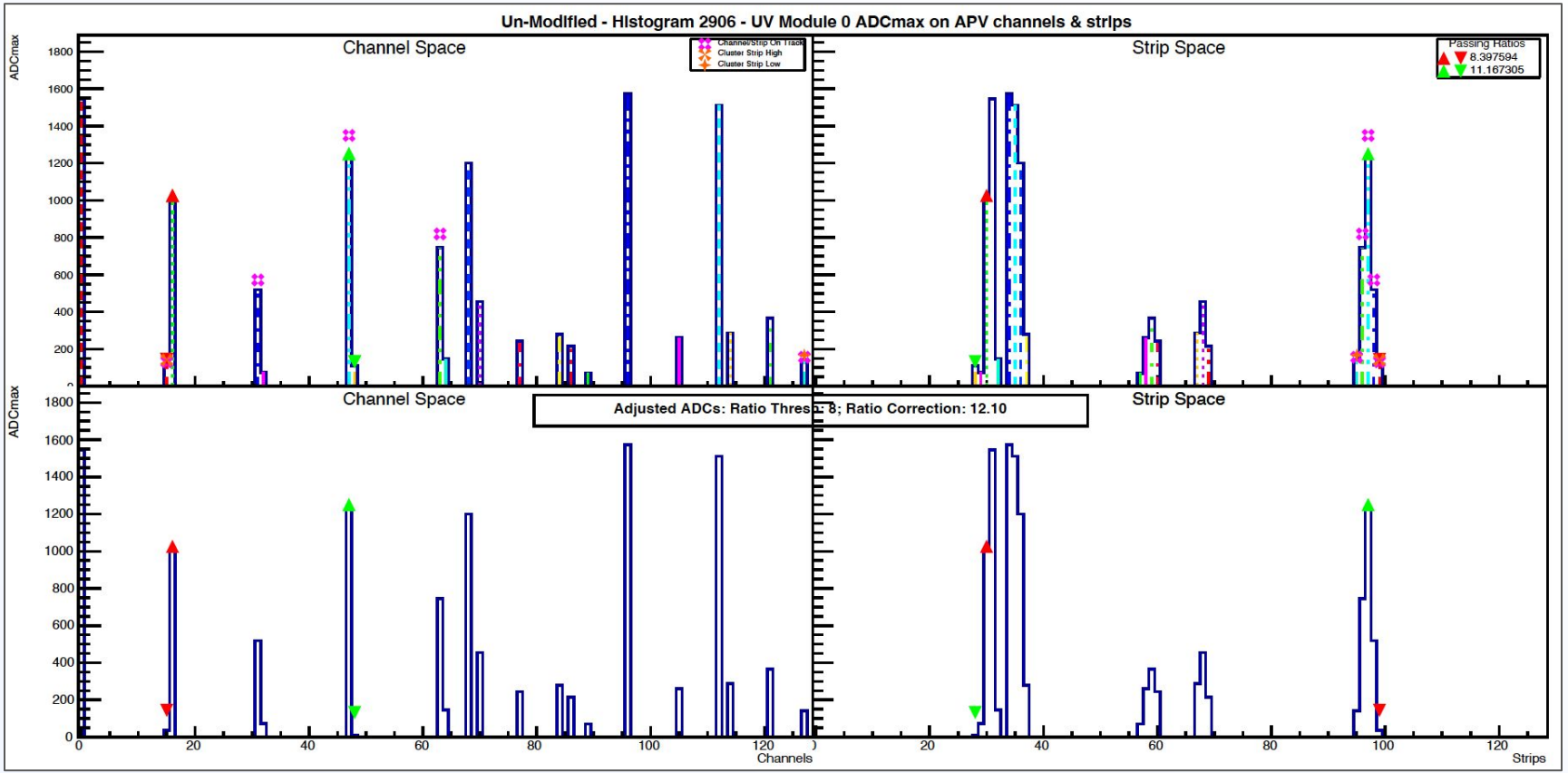

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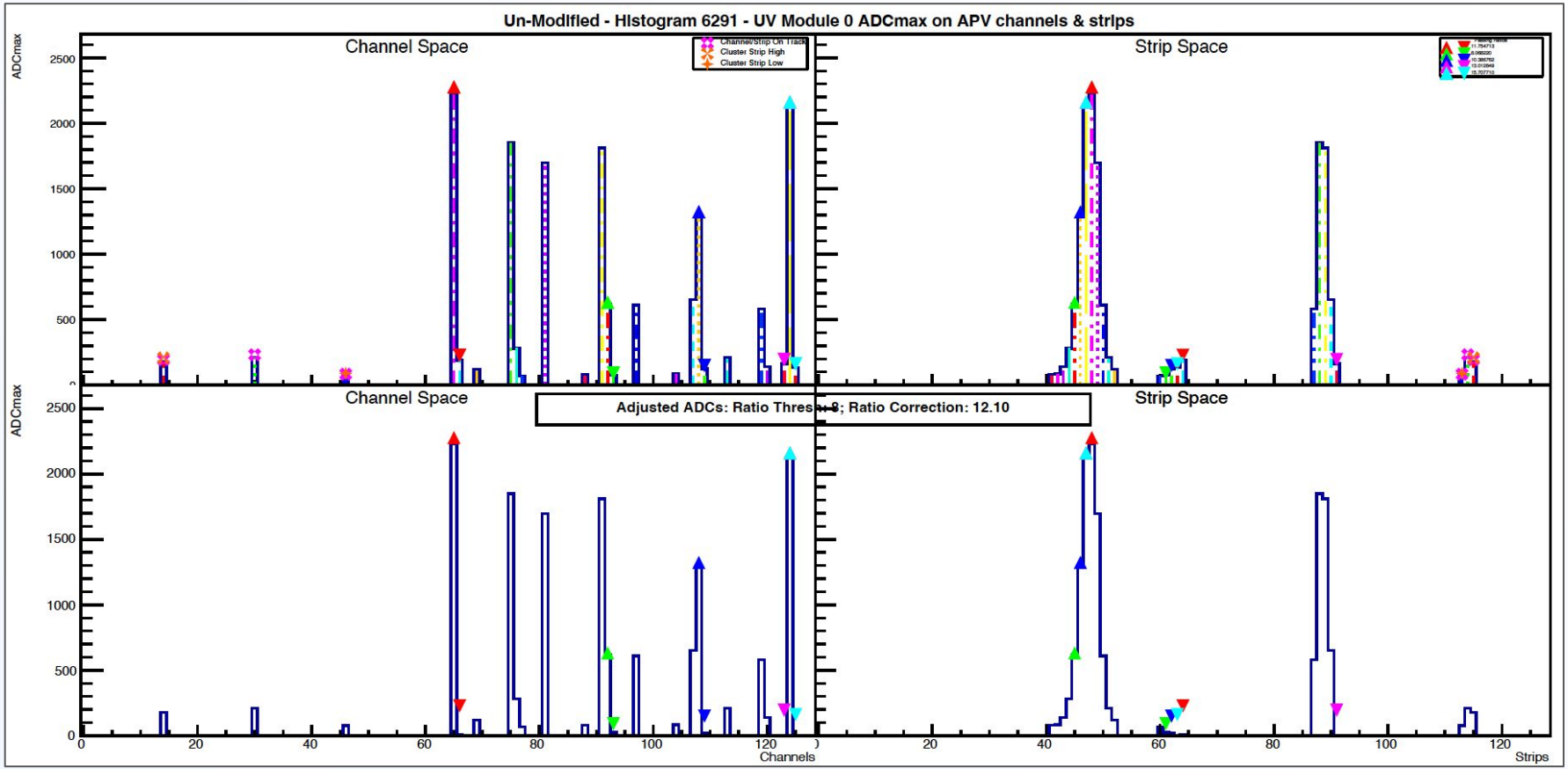

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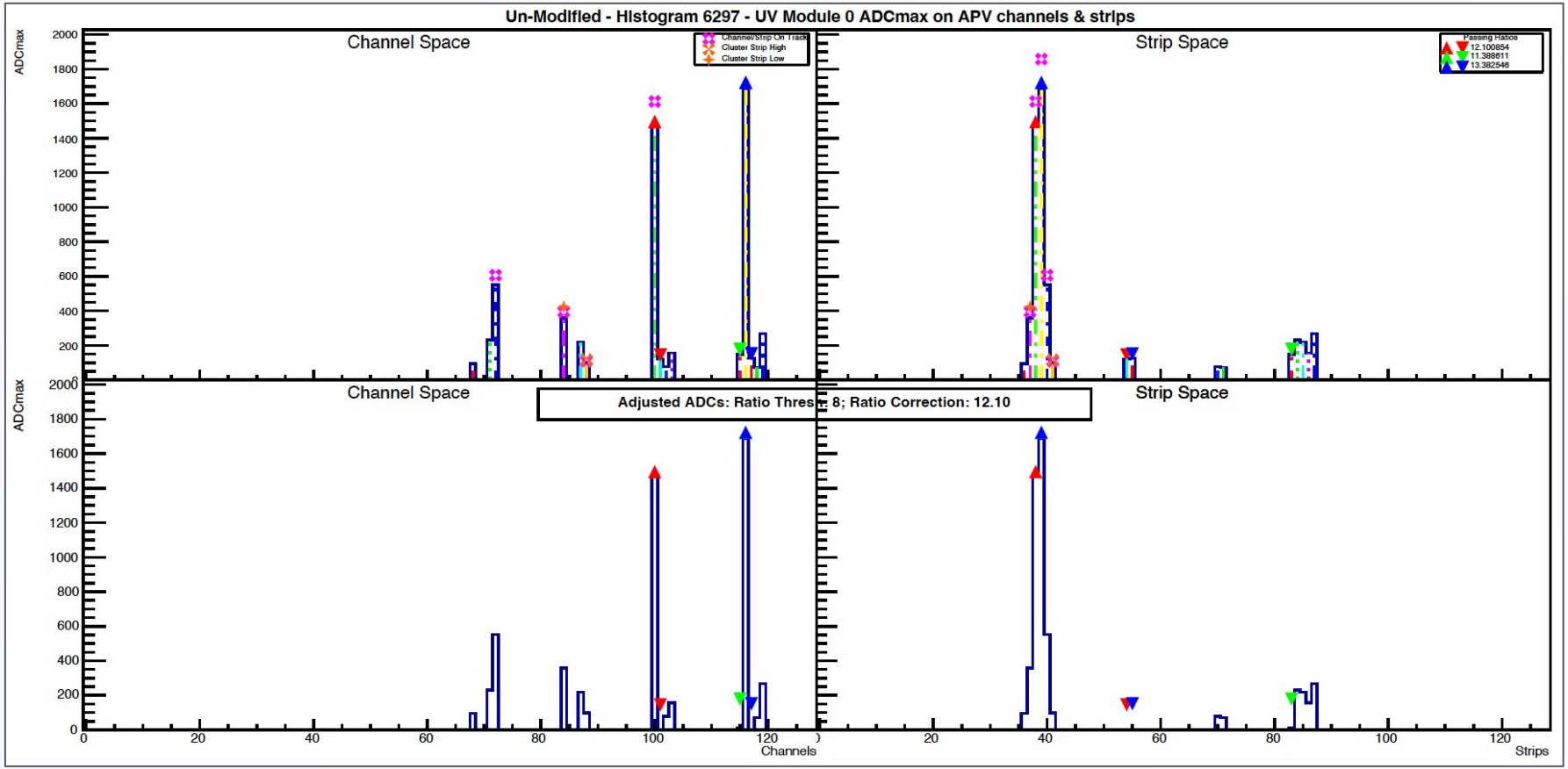
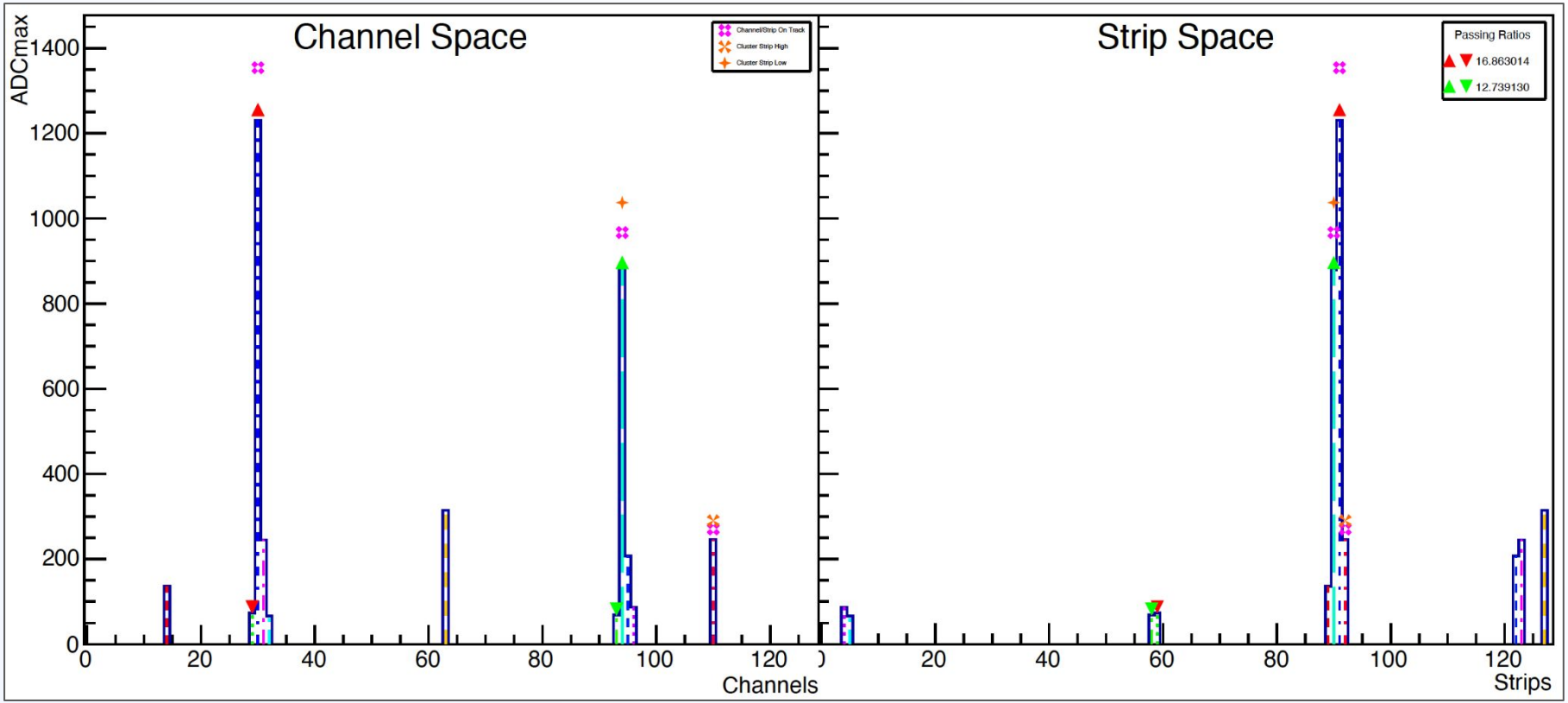
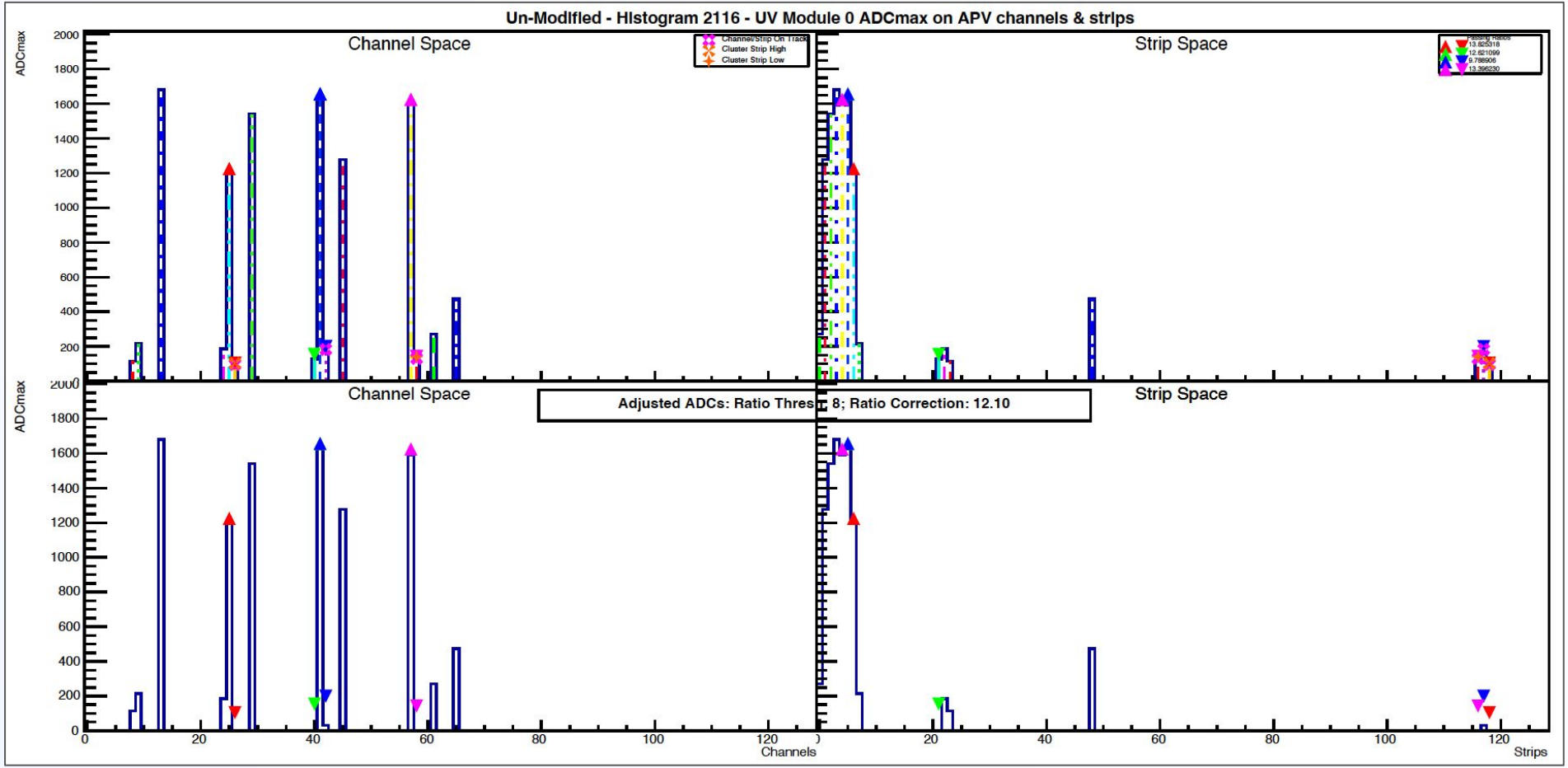
- Ratio Thresh = 8
- Corr. Ratio = 12.1




Channel Space
Channel/Strip On Track
Cluster Strip High
Cluster Strip Low
ADCmax
0
200
400
600
800
1000
1200
1400
0
20
40
60
80
100
120
Channels
Strip Space
Passing Ratios
16.863014
12.739130
20
40
60
80
100
120
Strips


Un-Modified - Histogram 2116 - UV Module 0 ADCmax on APV channels & strips
Channel Space
Strip Space
Channel Space
Strip Space
Adjusted ADCs: Ratio Thres
8; Ratio Correction: 12.10
ADCmax
ADCmax
Channels
Strips