

# Data Analysis for MWPCs of J-PARC TREK-E36 Experiment

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# Contents

<b>1</b>	<b>Pedestal</b>	<b>4</b>
1.1	Pedestal Runs . . . . .	4
1.2	Comparison of Mean and $\sigma$ from Guassian Fits of ADC Spectra between Pedestal Runs	4
1.3	Pedestal Determination . . . . .	7
<b>2</b>	<b>Threshold</b>	<b>9</b>
2.1	Demonstration of Pedestal Subtration and $3\sigma$ Cut . . . . .	9
2.2	ADC-Channel vs. Strip-Channel before and after Pedestal Subtraction and $3\sigma$ Cut . .	10
2.3	Statistics of Hits and Multiplets by Event . . . . .	11
2.4	Statistics of Multiplets by Cluster . . . . .	16
2.5	Threshold Determination . . . . .	16

# List of Figures

1.1	Example of ADC Spectra for pedestal run 3094. . . . .	4
1.2	Example of normal ADC spectra and fits for pedestal runs. . . . .	5
1.3	Comparison of mean from fit vs. strip number between runs. . . . .	5
1.4	Comparison of sigma from fit vs. strip number between runs. . . . .	6
1.5	ADC spectra for unusual strips. . . . .	7
1.6	Pedestal vs. strip number. . . . .	8
2.1	Compariosn of ADC values before and after pedestal subtraction and $3\sigma$ cut. . . . .	9
2.2	ADC-channel vs. strip-channel for C2-4, X-Y direction of MWPCs and L-R of the detector system before pedestal subtraction and $3\sigma$ cut, separately. . . . .	10
2.3	ADC-channel vs. strip-channel for C2-4, X-Y direction of MWPCs and L-R of the detector system after pedestal subtraction and $3\sigma$ cut, separately. . . . .	11
2.4	Distribution of number of hits. . . . .	12
2.5	Distribution of multiplets. . . . .	13
2.6	Statistics of multiplets. . . . .	14
2.7	Occupation vs. threshold fore each event type up to $10\sigma$ . . . . .	15
2.8	Occupation vs. threshold fore each event type up to $50\sigma$ . . . . .	15

# List of Tables

# Chapter 1

## Pedestal

Strip transformation for C2X has been applied. In plugins, strip numbers for all MWPCs start from 0, rather than 1.

### 1.1 Pedestal Runs

There are 9 pedestal runs in the E36 experiment. Run numbers are 1723, 3094, 3157, 3397, 3399, 3779, 4142, 4272 and 4273. Among them, run 1723 and run 3094 are not applicable for pedestal determination. For run 1723, ADC readout for all strips of C2, strips 0 – 47 of C3XL and 0 – 47 of C3XR is 0. For run 3094, pedestal suppression was applied during data acquisition. An example is shown in Fig. 1.1 .

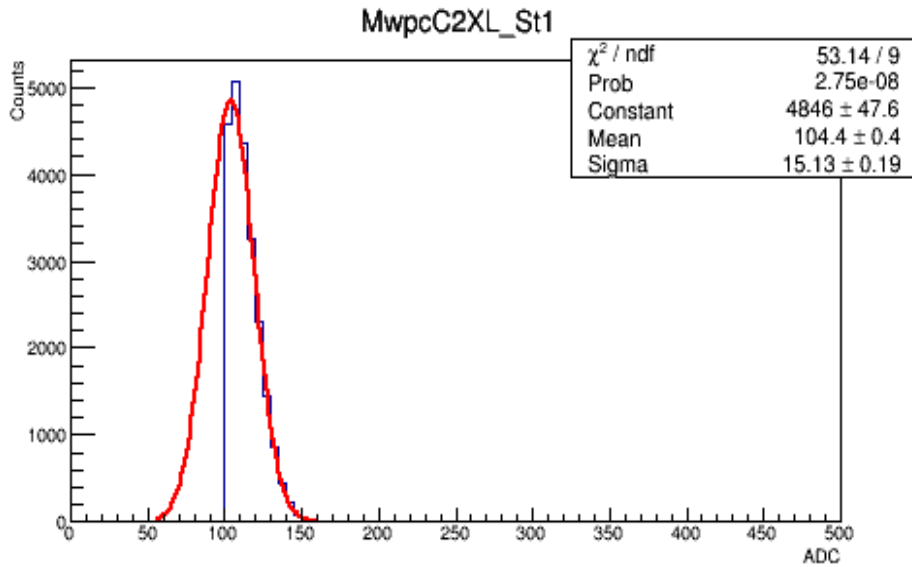


Figure 1.1: Example of ADC Spectra for pedestal run 3094.

### 1.2 Comparison of Mean and $\sigma$ from Guassian Fits of ADC Spectra between Pedestal Runs

The remaining 7 runs are taken for further analysis. Comparison of ADC spectra and gaussian fits between runs is show [here](#) strip by strip. Figure 1.2 show an example of ADC spectra of normal strips. Figure 1.3 shows comparison of mean from fit vs. strip number between runs. Figure 1.4 shows comparison of mean from fit vs. strip number between runs.

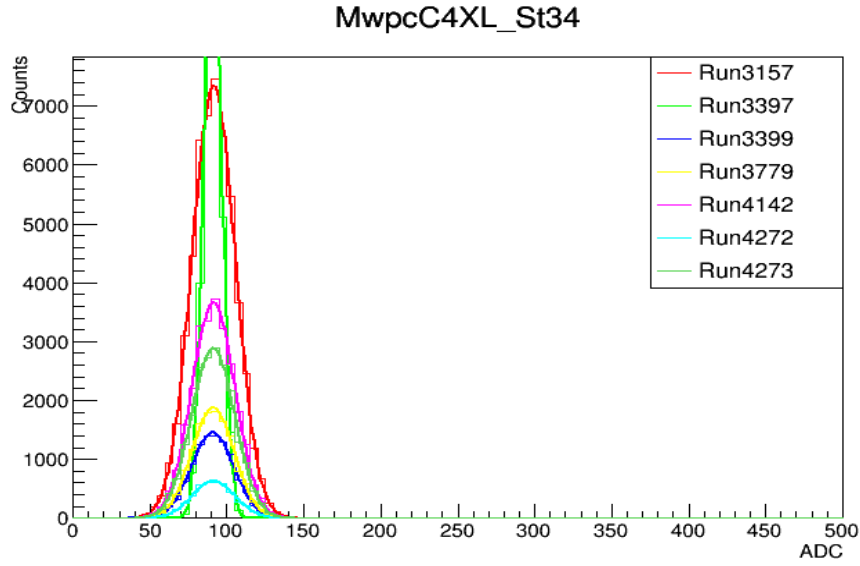


Figure 1.2: Example of normal ADC spectra and fits for pedestal runs.

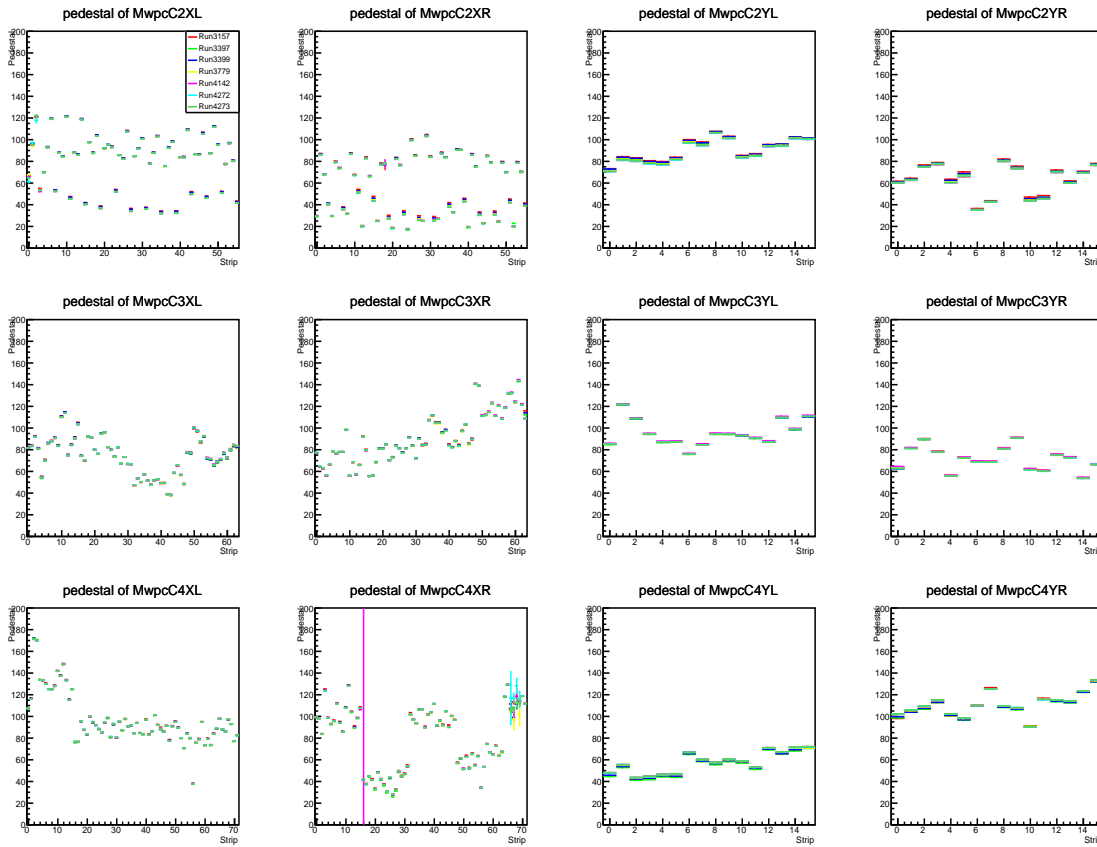


Figure 1.3: Comparison of mean from fit vs. strip number between runs.

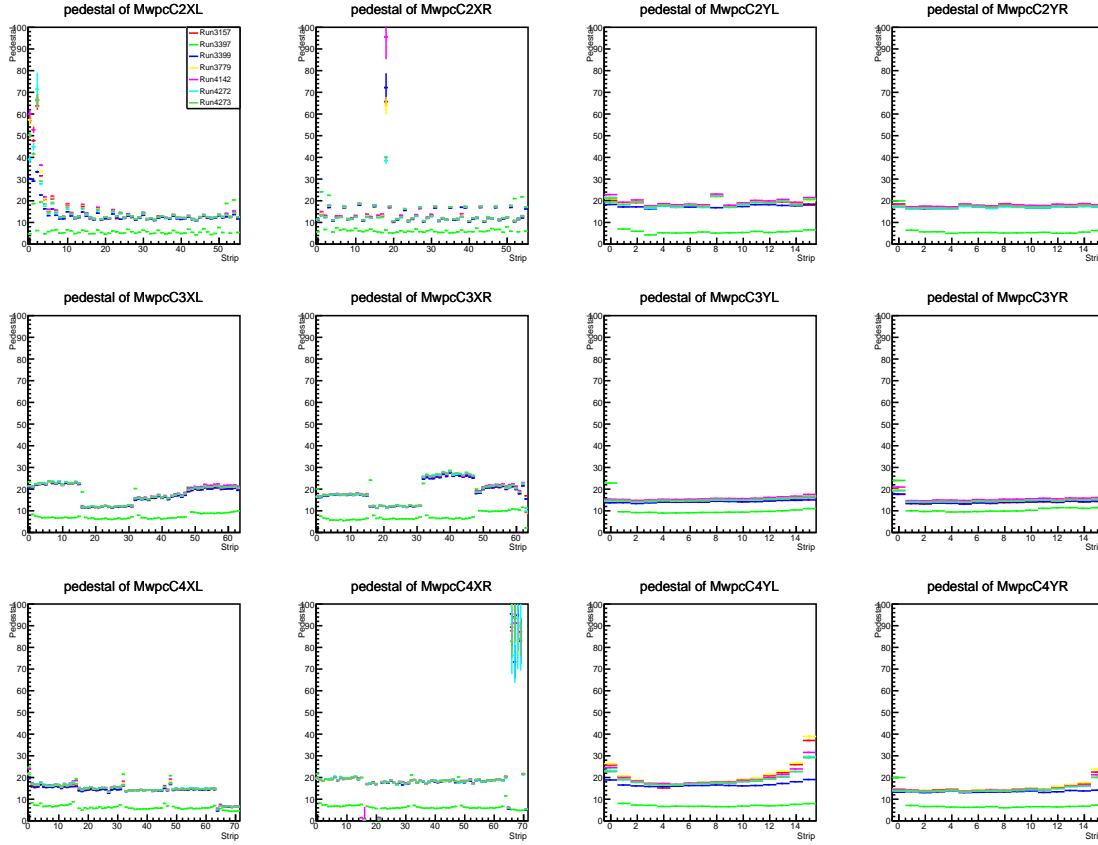


Figure 1.4: Comparison of sigma from fit vs. strip number between runs.

The comparisons suggest that

- Generally, mean values (pedestals) are consistent with each other between runs.
- Generally, sigma values are consistent with each other between runs except run 3397. Overall, sigma for run 3397 is smaller than other runs. Comparison between pedestal runs 3397 and 3399, which were taken at the same day, the difference of their run conditions is trigger, which is switched from "scalar" to "physics trigger". Additionally, degree of consistence for C2X is worse than C3X and C4X.
- ADC spectra for some strips are unusual. Here is the list of these strips: C2XL-St0, C2XL-St1, C2XL-St2, C2XL-St3, C2XR-St18, C3XR-St63, C4XR-St15, C4XR-St16, C4XR-St21, C4XR-St66, C4XR-St67, C4XR-St68, C4XR-St69 and C4YL-St15. Figure 1.5 shows their ADC spectra and fits.
  1. C4XR-16 and C4XR-21 are dead strips,
  2. For C2XL-St0, C2XL-St1, C2XL-St2, C2XL-St3, C2XR-St18, C4XR-St66, C4XR-St67, C4XR-St68, C4XR-St69 and C4YL-St15, their peak are much broader than normal strips of the same MWPC.
  3. For C3XR-St63, pedestal seems not to be consistent with each other.
  4. For C4XR-St15, ADC spectra of run4142 is unusual.

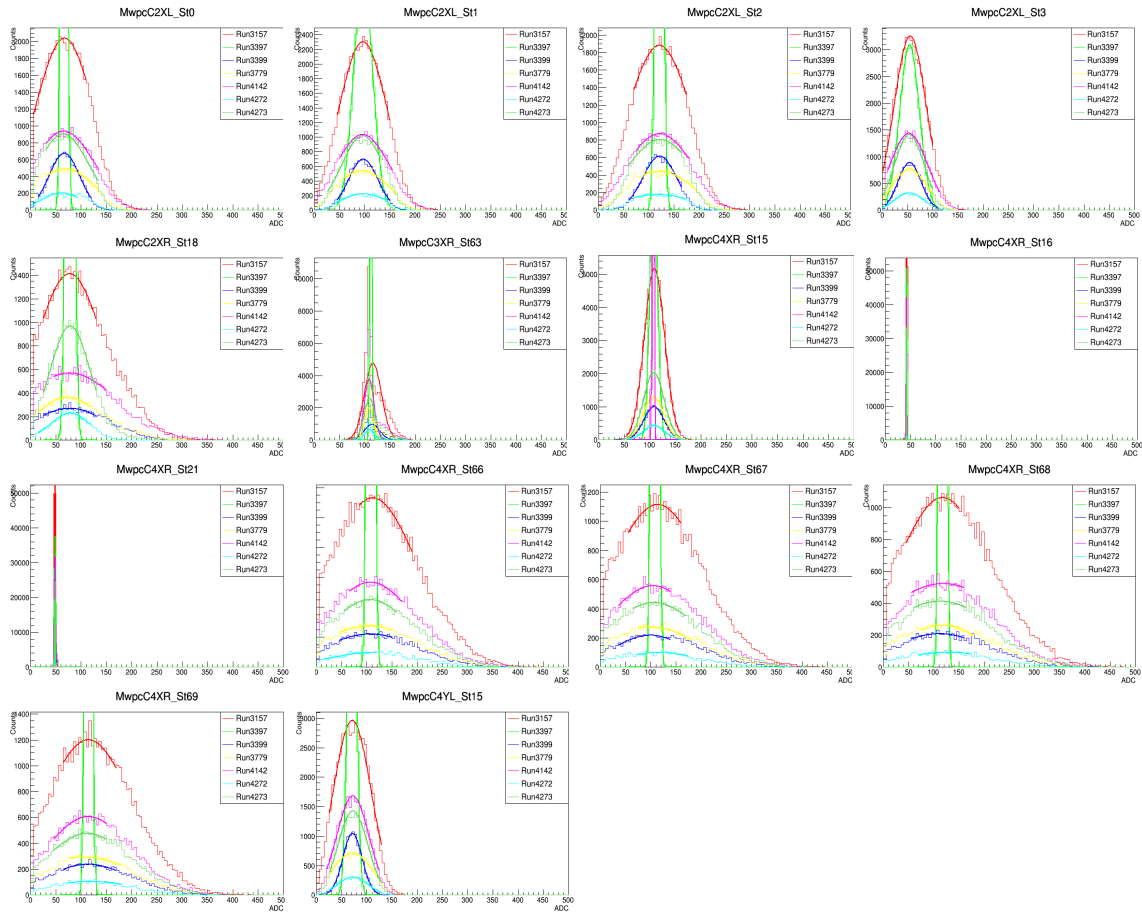


Figure 1.5: ADC spectra for unusual strips.

### 1.3 Pedestal Determination

Since run 3397 is unusual, other 6 runs are combined and used to determine final pedestals and their sigmas strip by strip. ADC spectra and fits for combination of 6 runs are shown [here](#). Figure 1.6 shows pedestal vs. strip number, and error bars denote sigma values.



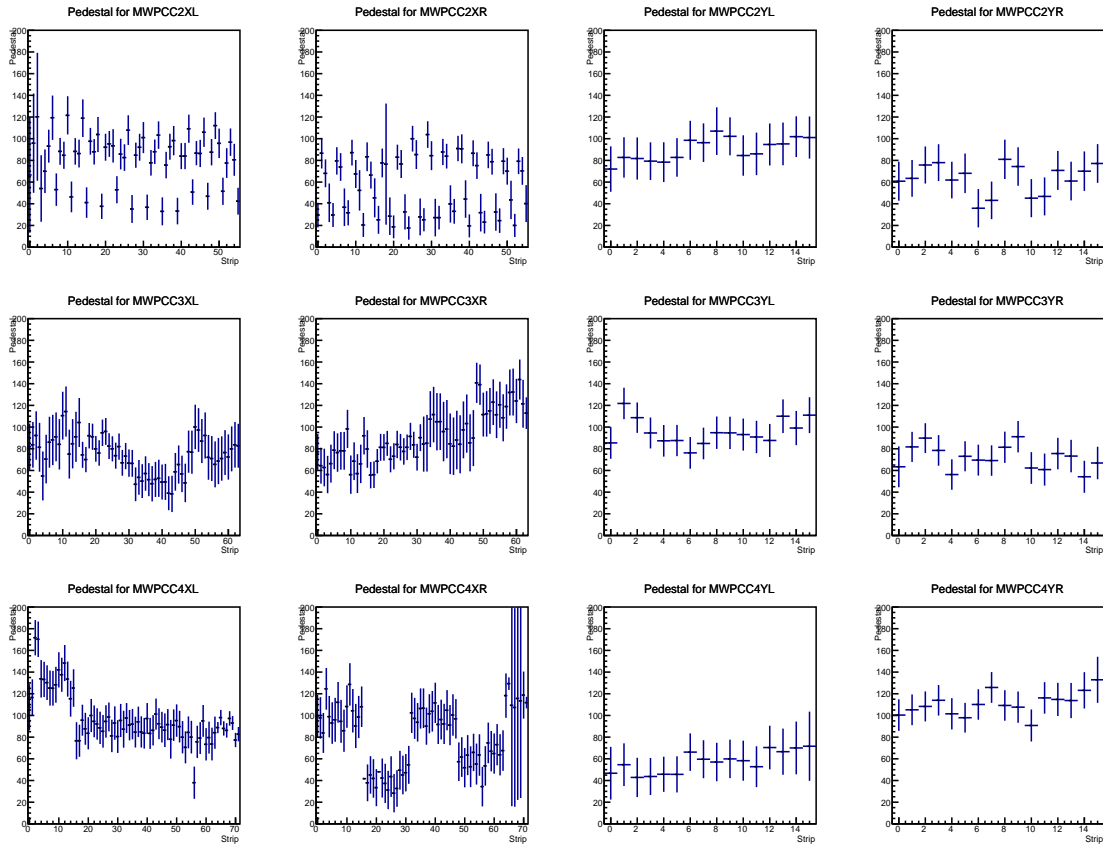


Figure 1.6: Pedestal vs. strip number. Error bars denote sigma values from fits.

# Chapter 2

## Threshold

Data from run 3994 is taken for the preliminary analysis. Strip transformation is applied for C2X.

### 2.1 Demonstration of Pedestal Subtraction and $3\sigma$ Cut

Pedestal suppression has been applied for physics runs during data acquisition. To get correct ADC value and cut off noise, pedestal subtraction and  $3\sigma$  cut are applied in our analysis. Compariosn of ADC values before and after pedestal subtraction and  $3\sigma$  cut are shown [here](#) event by event. Figure 2.1 show an example. Red lines denote that pedestal suppression was applied during data acquisition. Blue lines denote that pedestal subtraction was applied as well. Green lines denote that both pedestal subtraction and  $3\sigma$  cut was applied as well.

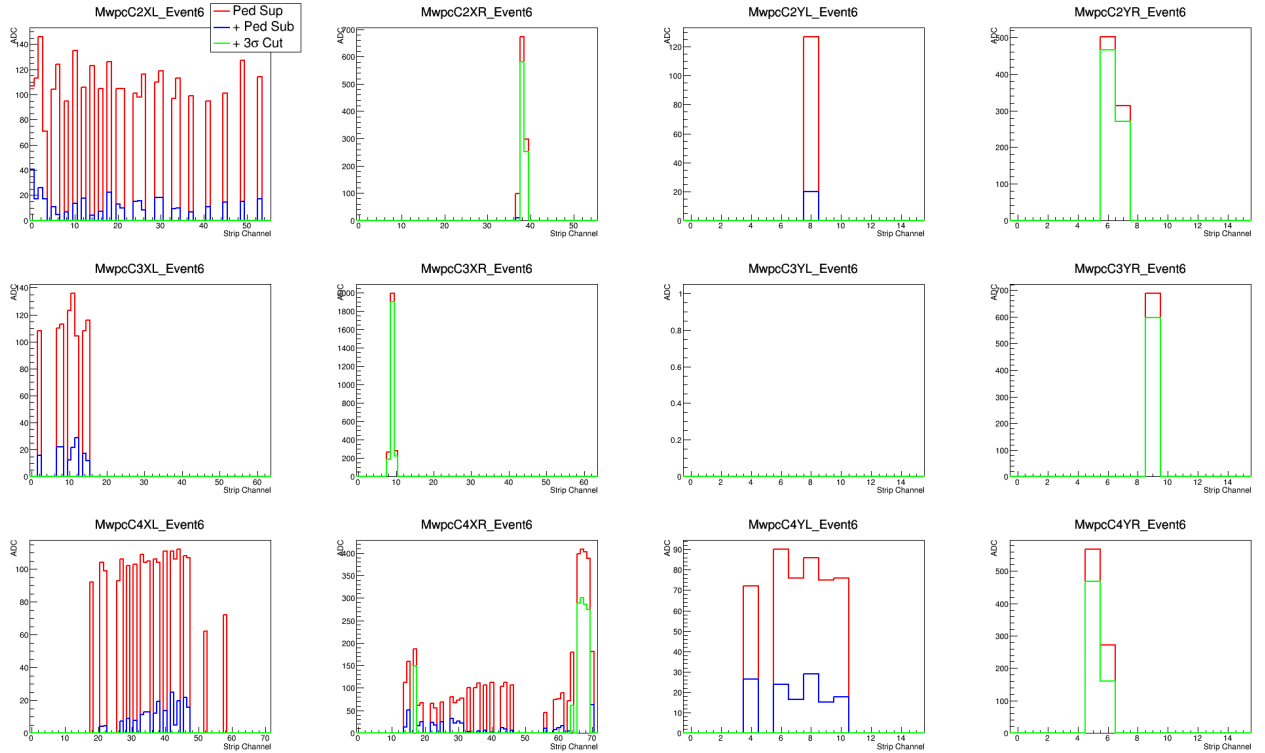


Figure 2.1: Compariosn of ADC values before and after pedestal subtraction and  $3\sigma$  cut. Red lines denote that only pedestal suppression was applied during data acquisition. Blue lines denote that pedestal subtraction was applied as well. Green lines denote that both pedestal subtraction and  $3\sigma$  cut was applied as well.

## 2.2 ADC-Channel vs. Strip-Channel before and after Pedestal Subtraction and $3\sigma$ Cut

Figures 2.2 and 2.2 shows ADC-Channel vs. Strip-Channel for C2-4, X-Y direction of MWPCs and L-R of the detector system before and after pedestal subtraction and  $3\sigma$  cut, separately. It suggests that:

- Generally, bumps appear at the center of plots except C3X.
- The distribution of C4XR shows two dead strip channels: 16 and 21 (starting from 0). That is consistent with results of pedestal runs.
- Unusually strips with much larger  $\sigma$  values located at the beginning of C2XL and at the end of C4XR are almost discarded by threshold cut.

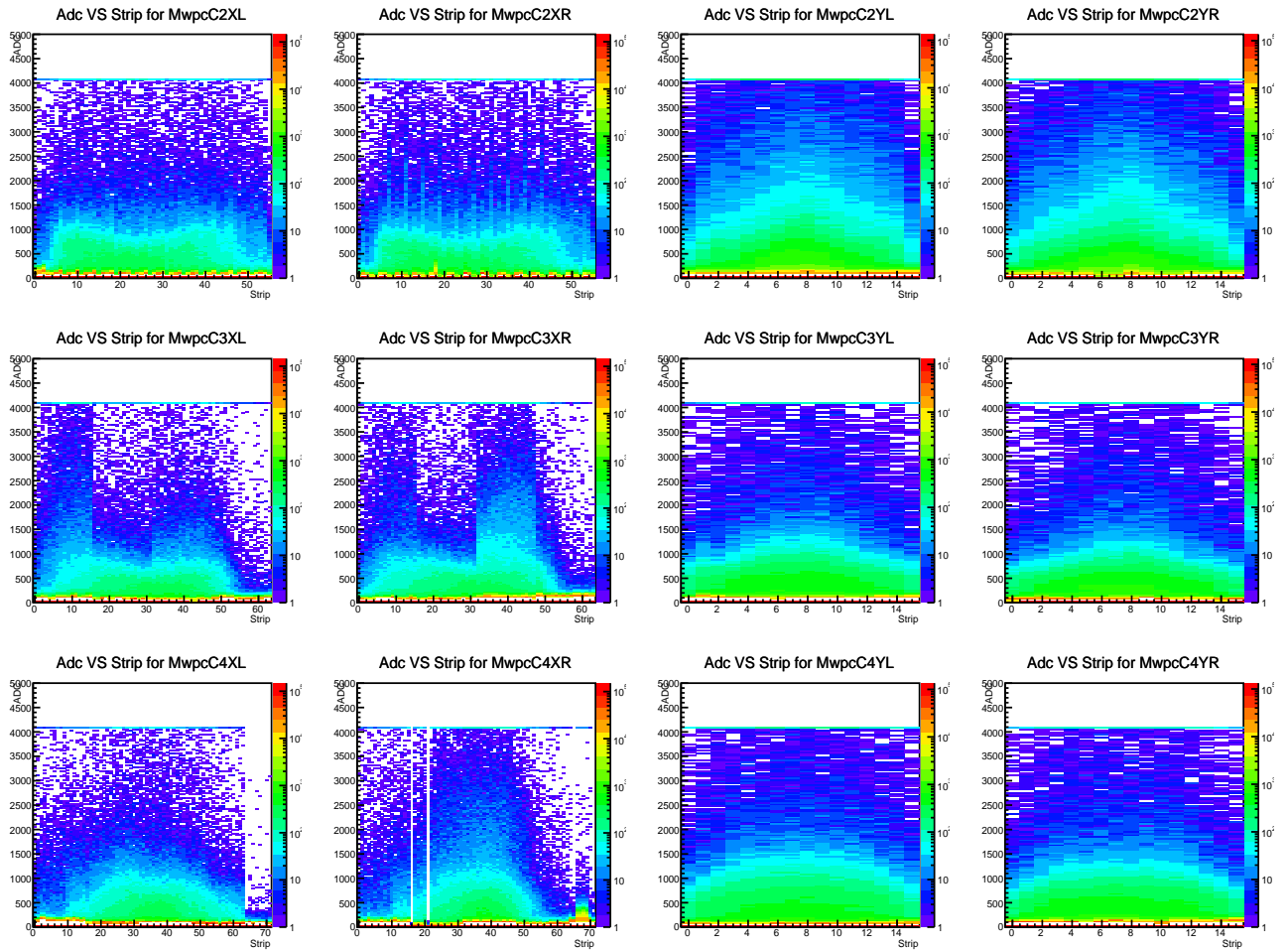


Figure 2.2: ADC-channel vs. strip-channel for C2-4, X-Y direction of MWPCs and L-R of the detector system before pedestal subtraction and  $3\sigma$  cut, separately. The first line is C2, the second line is C3, and the third line is for C4. The first two columns are for X (left and right, respectively), and the last two columns are for Y (left and right, respectively).

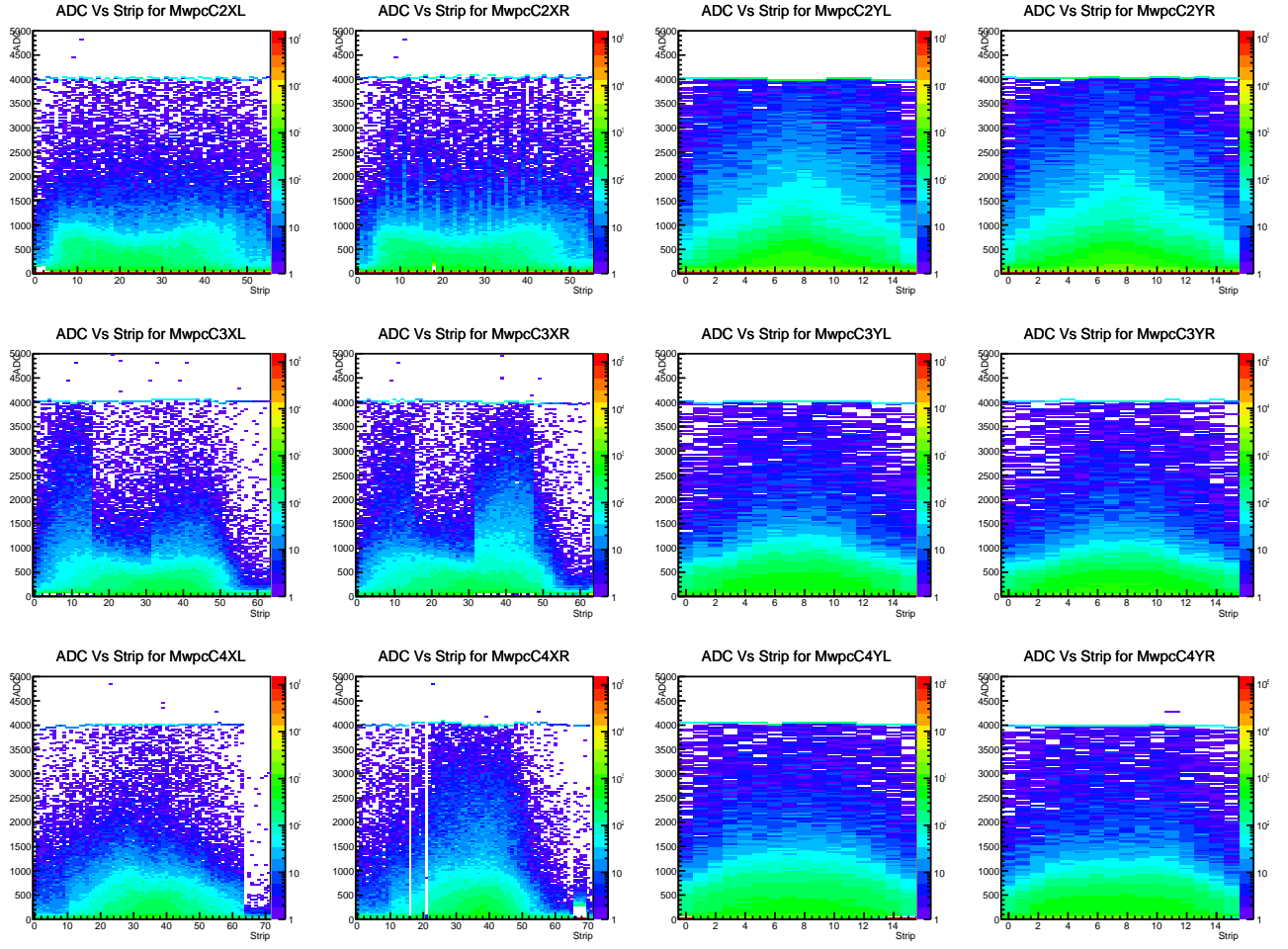


Figure 2.3: ADC-channel vs. strip-channel for C2-4, X-Y direction of MWPCs and L-R of the detector system after pedestal suppression and  $3\sigma$  cut, separately. The first line is C2, the second line is C3, and the third line is for C4. The first two columns are for X (left and right, respectively), and the last two columns are for Y (left and right, respectively).

## 2.3 Statistics of Hits and Multiplets by Event

Figure 2.4 shows distributions of number of hits after pedestal subtraction and  $3\sigma$  cut. It suggests that distributions are almost symmetry between Left and Right. Distributions of C3 and C4 are very close, but different from C2.

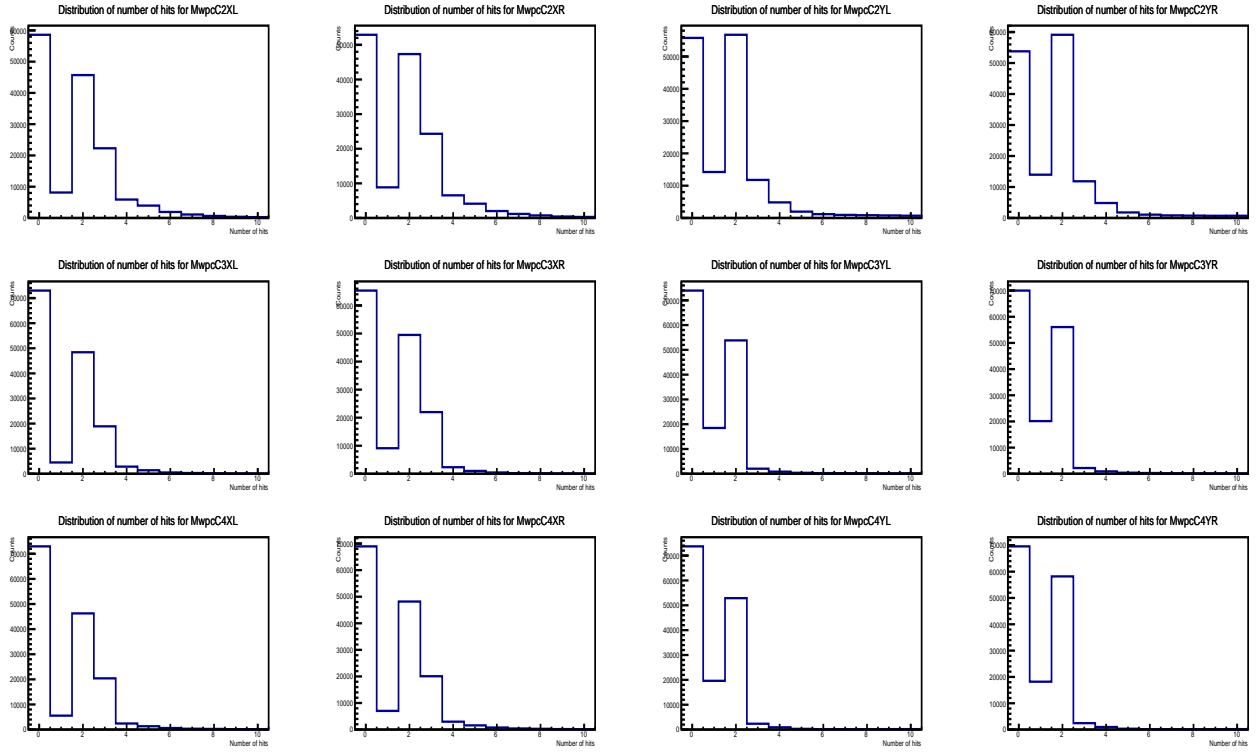


Figure 2.4: Distribution of number of hits.

For events with hit(s), Fig. 2.5 shows distribution of multiplets<sup>1</sup> after pedestal subtraction and  $3\sigma$  cut. Y-axis represents how many singlet, doublet or triplet (or more) for each event.

<sup>1</sup>Multiplets represent how many hits adjacent to a specific hit. Singlet: No adjacent hit; Doublet: One adjacent hit; Triplet: Two adjacent hits (or more).

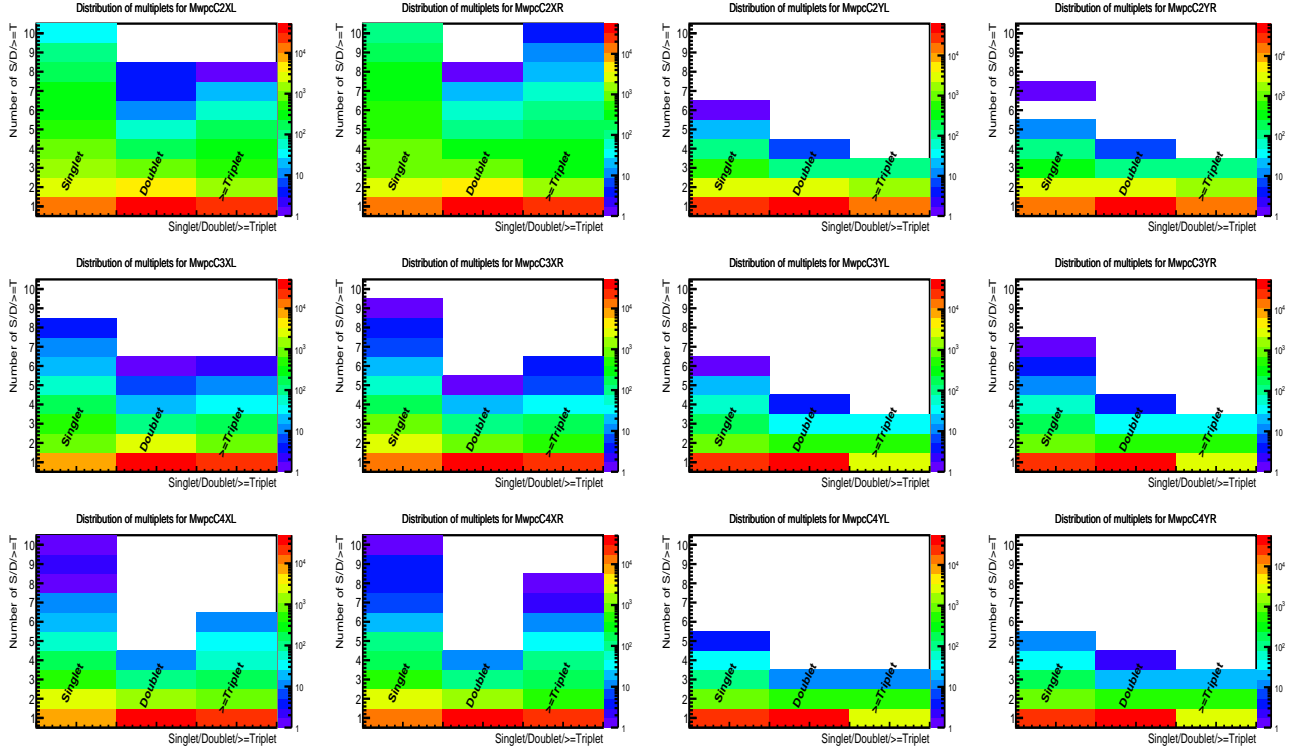


Figure 2.5: Distribution of multiplets.

Summarily, some events have no hits, some events have singlet, doublet, triplets, or combination of them. Therefore, events can be divided into 8 types: No hit, only singlet, only doublet, only triplet, with singlet and doublet, with singlet and triplet, with doublet and triplet, and with all of them. Figures 2.6 shows statistics of multiplets after pedestal subtraction and  $3\sigma$  cut.

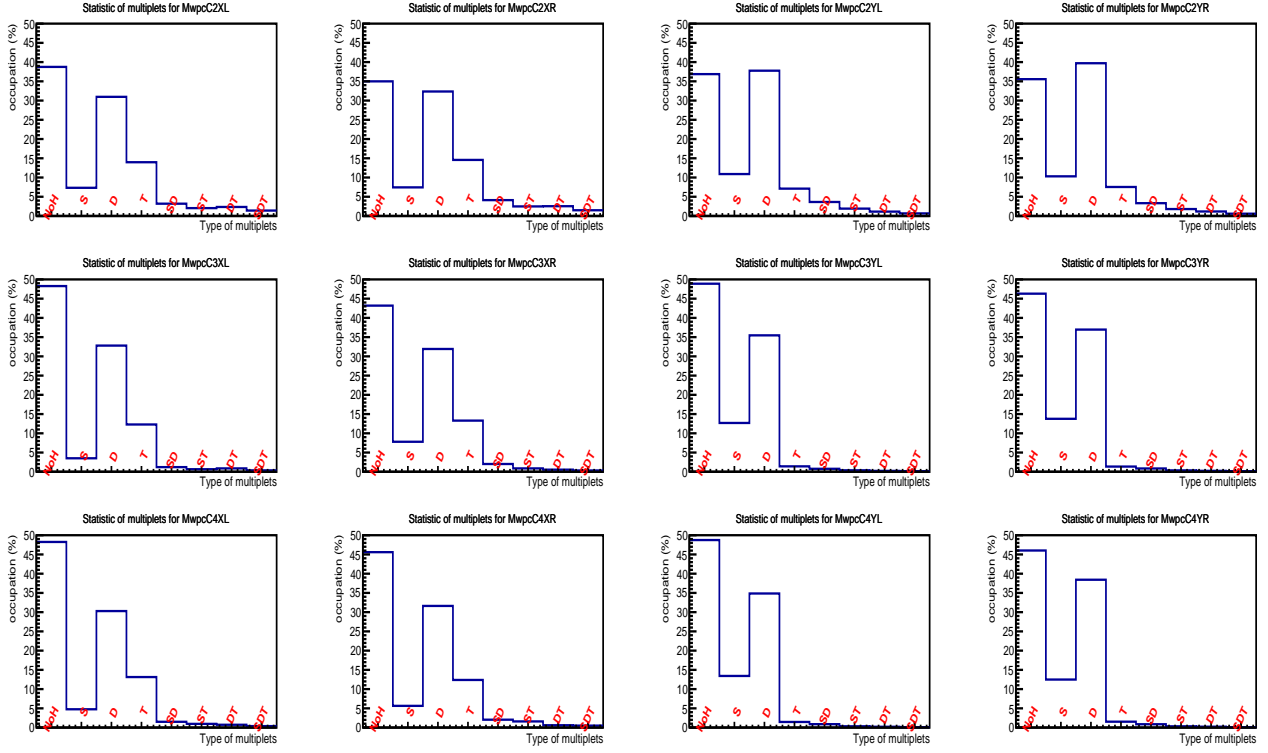
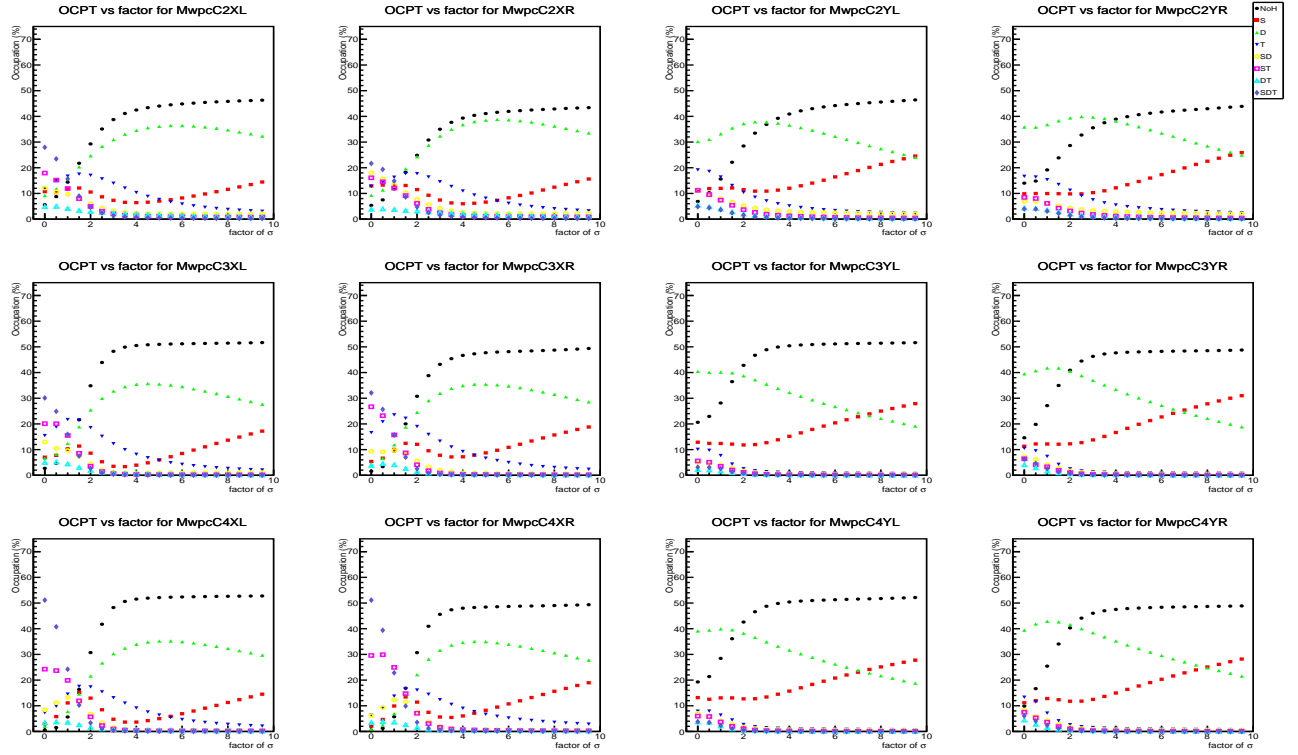
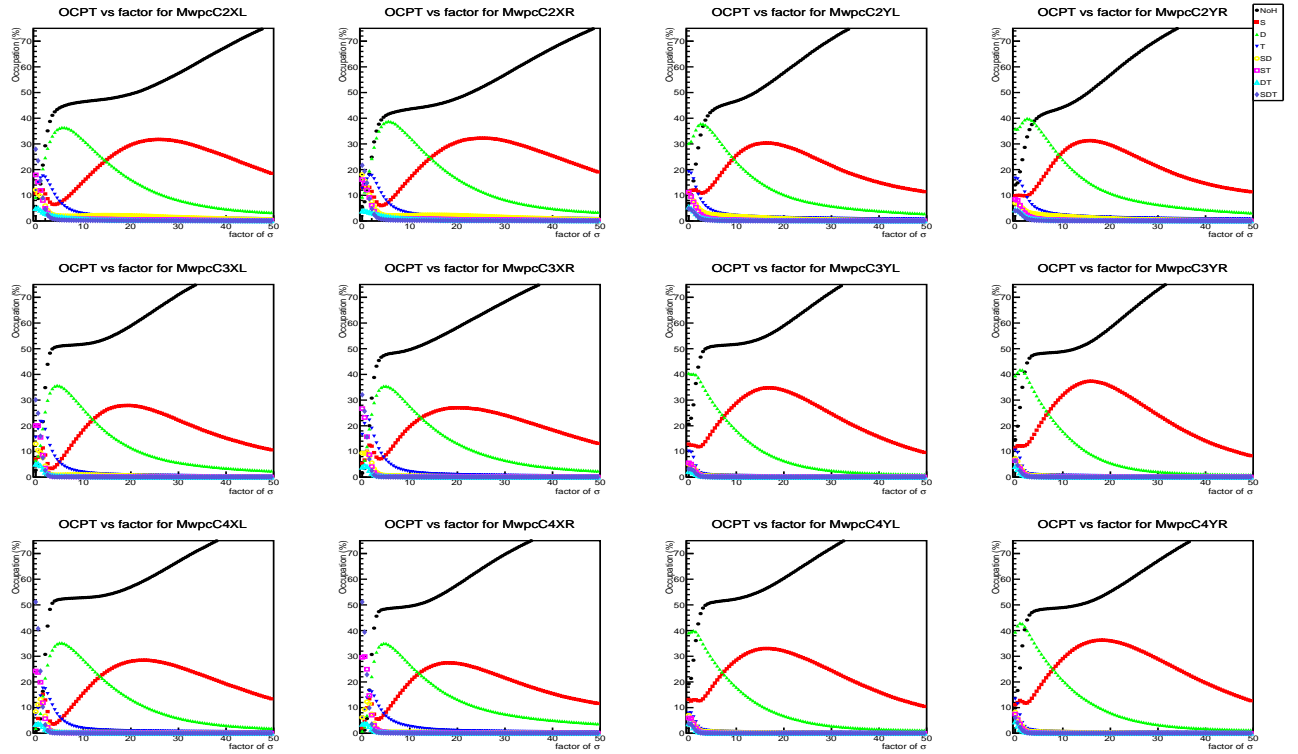


Figure 2.6: Statistics of multiplets.

Figures 2.7 and 2.8 show occupation vs. threshold for each event type up to  $10\sigma$  and  $50\sigma$ , separately. They suggest :

- Black curves show no-hit fraction which enters a plateau above  $3\sigma$  and stay almost flat up to  $10 - 20\sigma$ , and then shoots up. This indicates that good signals are really substantially larger than noise.
- Occupations of singlets (red curves) and doublets (green curves) are anticorrelated in the range of  $2 - 20\sigma$ . This range should be the region of good signals.
- Singlets have a clear minimum at  $2 - 4\sigma$ , while doublets and triplets (blue curves) have clear maximums or inflections at  $0 - 4\sigma$ .
- For SD, ST, DT and SDT, occupations generally decrease as thresholds increase.

Figure 2.7: Occupation vs. threshold fore each event type up to  $10\sigma$ .Figure 2.8: Occupation vs. threshold fore each event type up to  $50\sigma$ .



## **2.4 Statistics of Multiplets by Cluster**

## **2.5 Threshold Determination**