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# ZS vs Non-ZS data Check

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# Pedestal/RMS calculation methods comparison

## Online math calculation method (pedestal run): fgt\_ped.C

### 1. Accumulate event by event for each channel each time bin:

```
p->ped[arm][apv][ch][tb] += (float) adc ;  
p->rms[arm][apv][ch][tb] += (float) (adc * adc) ;  
p->cou[arm][apv][ch][tb]++ ;
```

### 2. Calculate pedestal/rms for each channel each time bin:

```
pp = ped->ped[arm][apv][ch][t]/(double) ped->cou[arm][apv][ch][t];  
rr = ped->rms[arm][apv][ch][t]/(double) ped->cou[arm][apv][ch][t];  
rr = sqrt(rr - pp*pp) ;  
ped->ped[arm][apv][ch][t] = pp ;  
ped->rms[arm][apv][ch][t] = rr ;
```

### 3. Average pedestal/RMS over all time bins for each channel:

```
ped += p->ped[arm][apv][c][t] ;  
rms += p->rms[arm][apv][c][t] ;  
cou_tb++ ;  
ped /= cou_tb ;  
rms /= cou_tb ;
```

### 4. Threshold setting for each channel:

```
p->thr[arm][apv][c] = (u_short) (ped + rms * n_sigma + 0.5) ;
```

### 5. Do ZS for each channel each time bin (if any adc > p->thr):

```
*d16++ = (short)((float)f[i_save+i].adc - p_thr->ped[arm][apv]  
[ch][i] + 0.5);
```

3.0

## Offline histogram calculation method (non-ZS data of physics run): StIstCalibrationMaker

### 1. Fill histograms event by event for each channel each time bin:

```
int code = kIstNumTimeBins * eleclD + t;  
TH1F* histPed = mHistPedVec[ code ];  
histPed->Fill( (float)adc );
```

### 2. Exclude possible signal entries for each channel each time bin:

```
TH1F *histPed = *mHistPedVecIter;  
float meanPed = histPed->GetMean();  
float rmsPed = histPed->GetRMS();
```

```
histPed->GetXaxis()->SetRangeUser(meanPed-mPedCut*rmsPed,  
meanPed+mPedCut*rmsPed); // mPedCut = 3.0
```

### 3. Get Mean/RMS as pedestal/RMS for each channel each time bin:

```
meanPed = histPed->GetMean();  
rmsPed = histPed->GetRMS();
```

### 4. Average pedestal/RMS over all time bins for each channel:

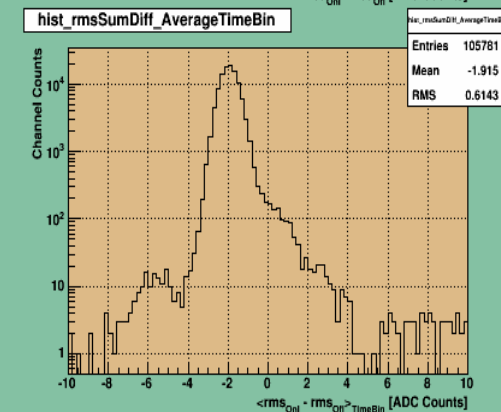
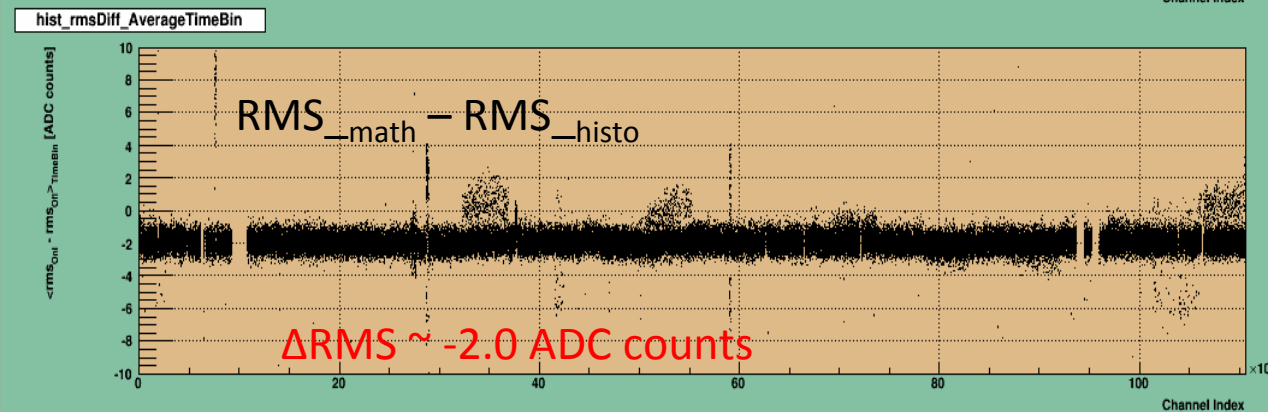
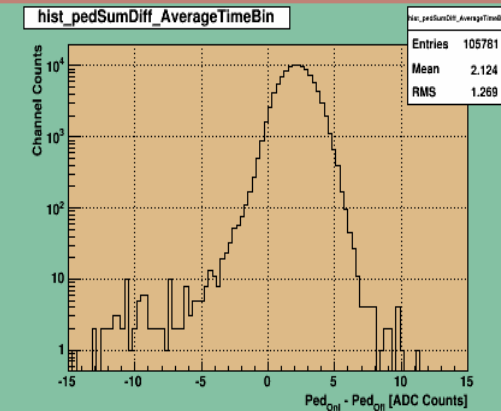
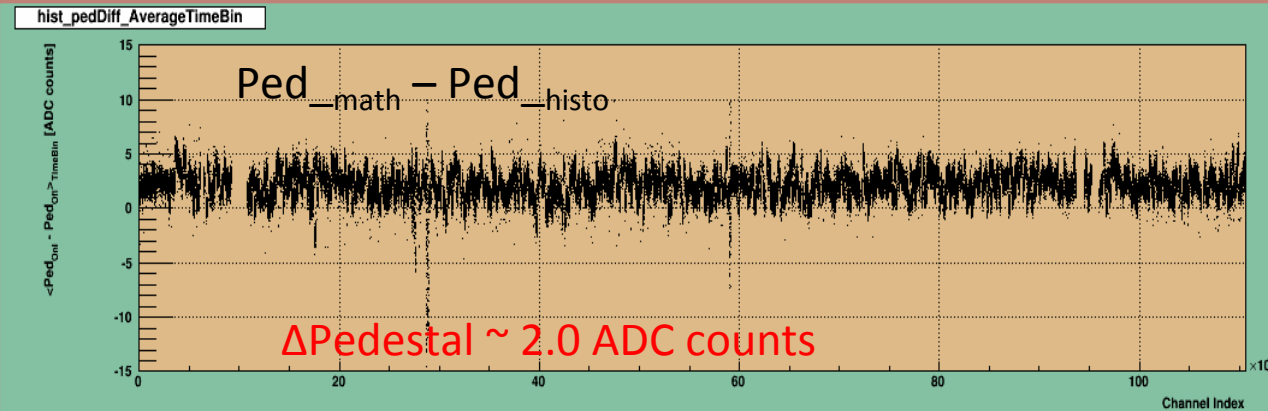
```
averagePed += pedestal[TB]/numTimeBins;  
averageRms += rms[TB]/numTimeBins;
```

### 5. Do pedestal subtraction:

```
signalCorrected[channel][timebin] =  
(float)signalUncorrected[channel][timebin] - mPedVec[eleclD];
```

# Pedestal/RMS comparison between online and offline

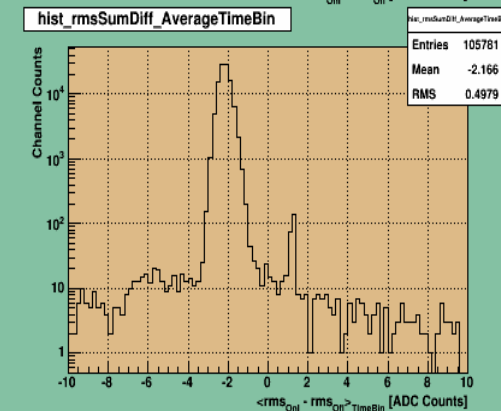
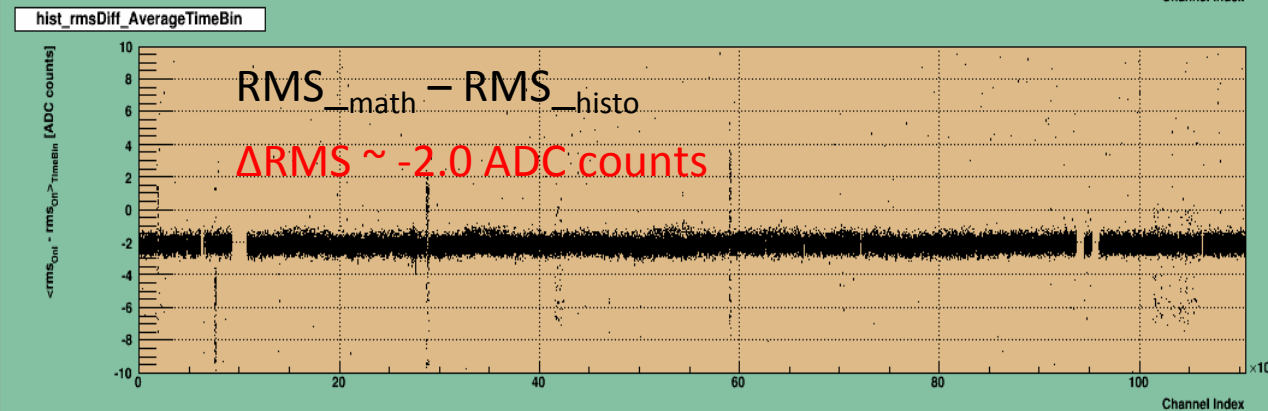
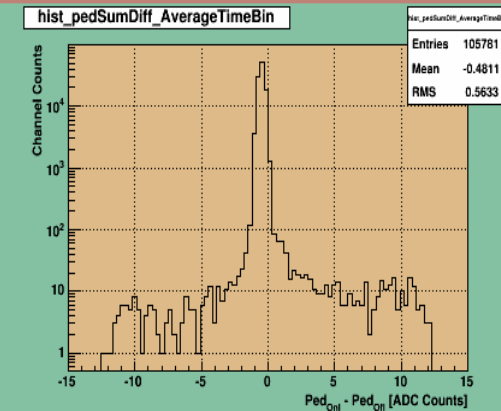
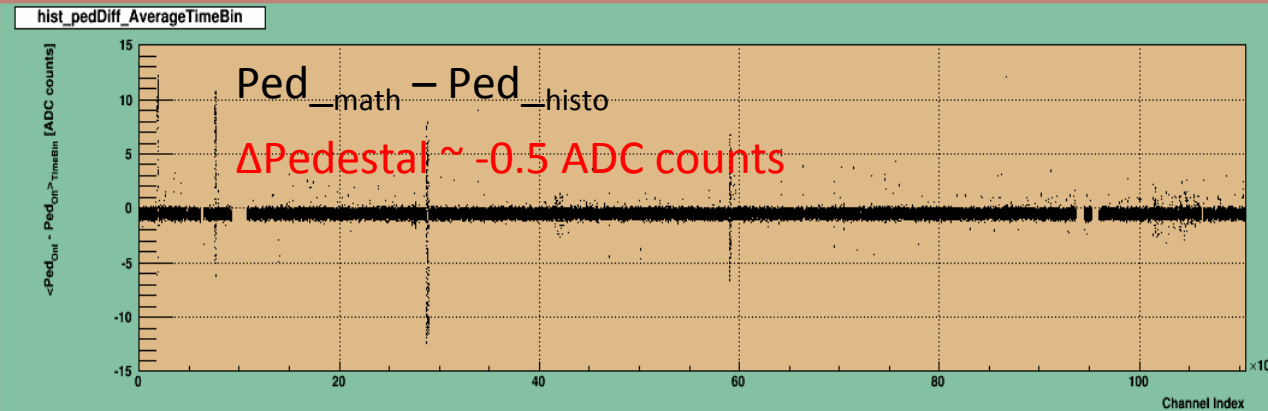
Pedestal/RMS comparison between online math calculation method (Tonko, pedestal run #15039124) and offline histogram calculation method (Yaping, physics run #15039169)



- The comparison shows a clear difference  $\sim$  -2.0 ADC counts on RMS noise.
- The comparison shows a difference on pedestal  $\sim$  2.0 ADC counts (fluctuations channel by channel due to different data sample?).

# Pedestal/RMS comparison – 1

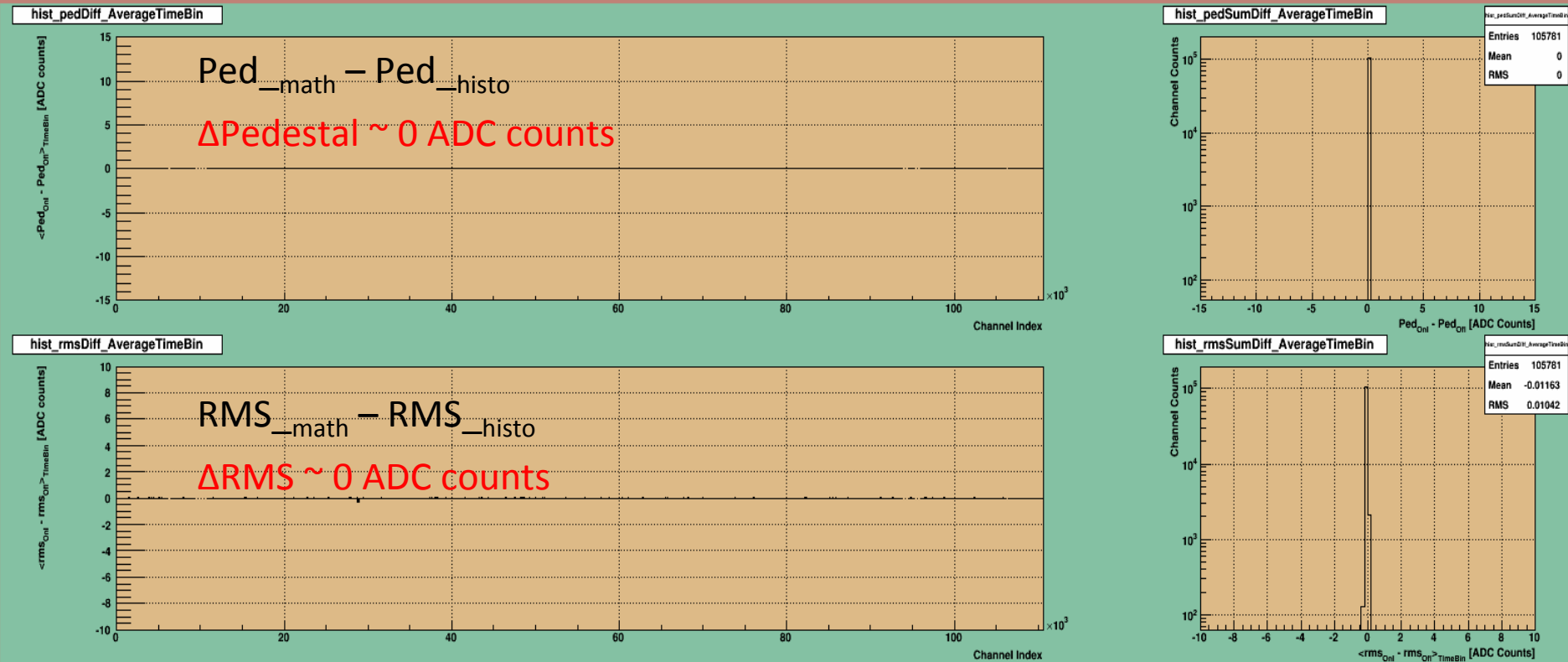
Implemented the math calculation method into the offline calibration maker, and compare the pedestal/rms values channel by channel between math and histogram methods for #15040023



- The comparison still shows a clear difference  $\sim$  -2.0 ADC counts on RMS noise.
  - The comparison shows a smaller difference on pedestal (stable due to same data sample?)
- In this comparison, the 3\*sigma cut was applied to exclude signal-event in histogram method

# Pedestal/RMS comparison – 2

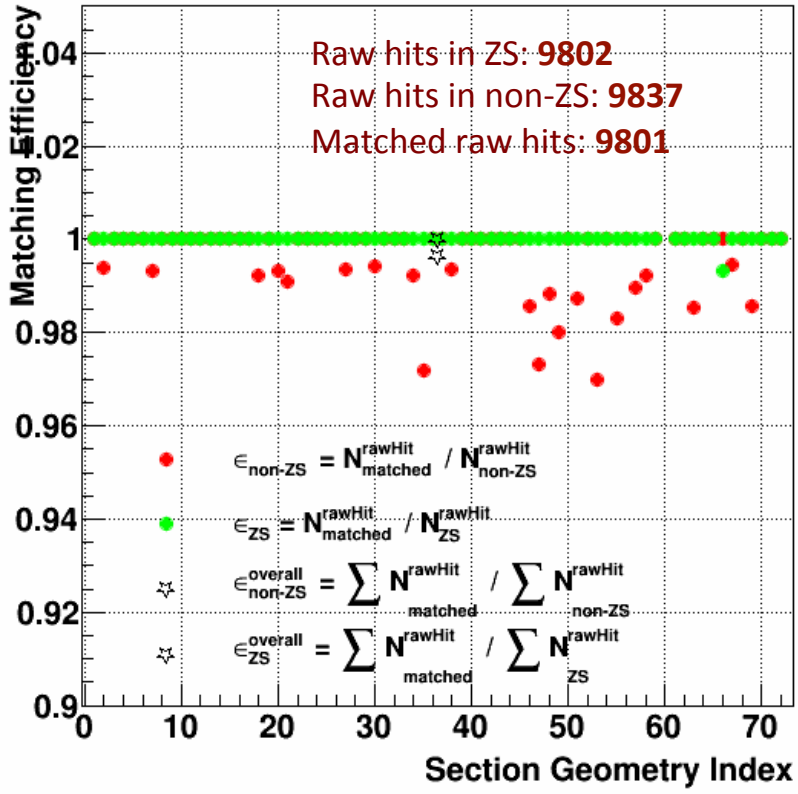
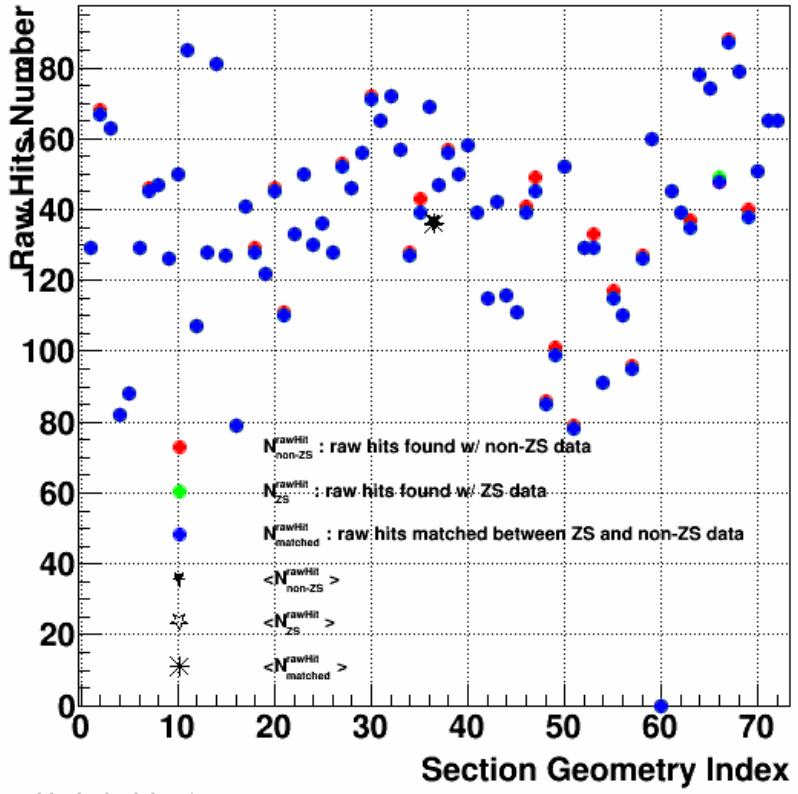
Implemented the math calculation method into the offline calibration maker, and compare the pedestal/rms values channel by channel between math and histogram methods for #15040023



- The comparison shows exact matches on pedestal and RMS noise between the two calculation method. The difference with the slide 4's comparison is that **the 3\*sigma pedestal cut was removed in histogram calculation method.**
- Updates were done for histogram method in StIstCalibration maker, and the issue fixed.

# Raw hits match comparison (#15040023)

**Quick check:** populate online (Tonko's) pedestal/rms values (pedestal run 15039169) to the local istPedNoise Db table for non-ZS data pedestal subtraction offline.

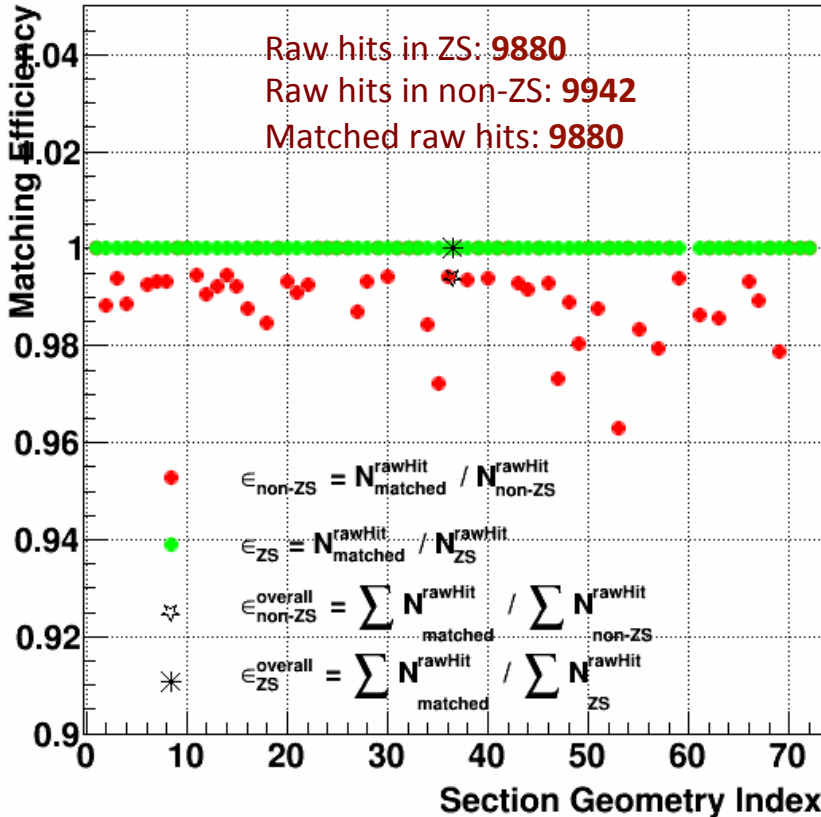
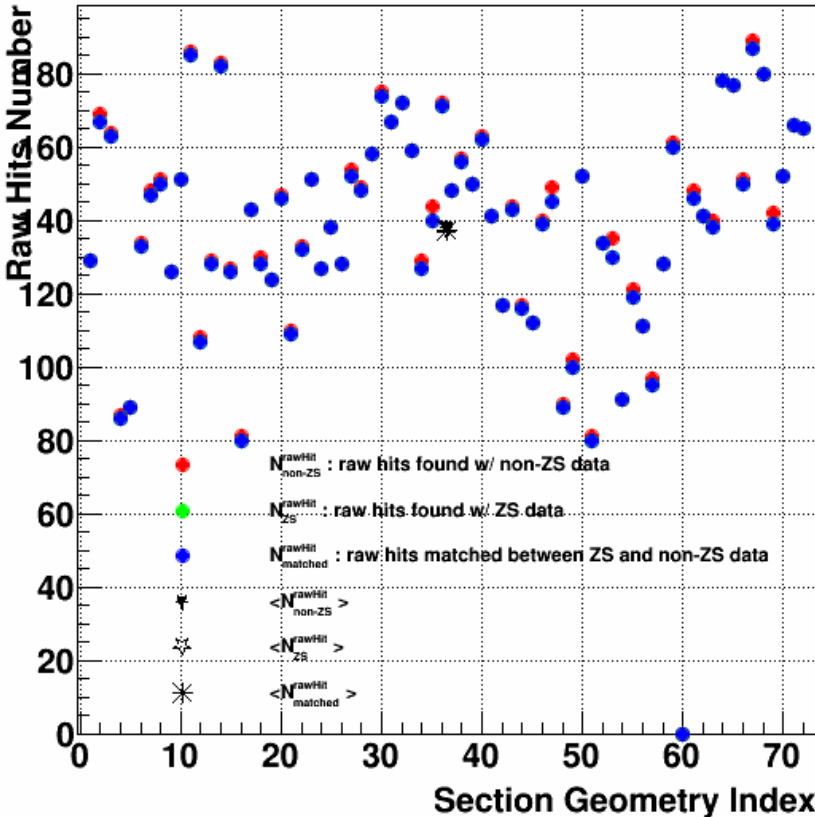


**AS expected:**

- All raw hits in ZS data are founded in non-ZS data (except for section 66, 1 raw hit missing).
- Number of raw hits found in non-ZS data is a bit bigger than the number found in ZS data, the overall matching efficiency is around 99.6% .

# ZS/non-ZS data comparison (#15040023) – math method

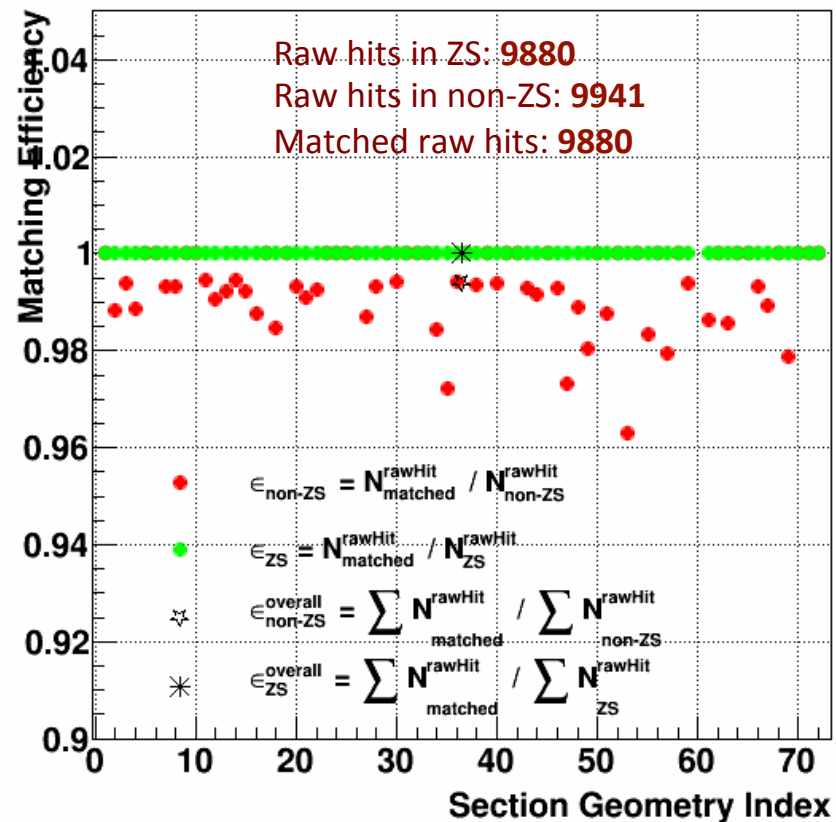
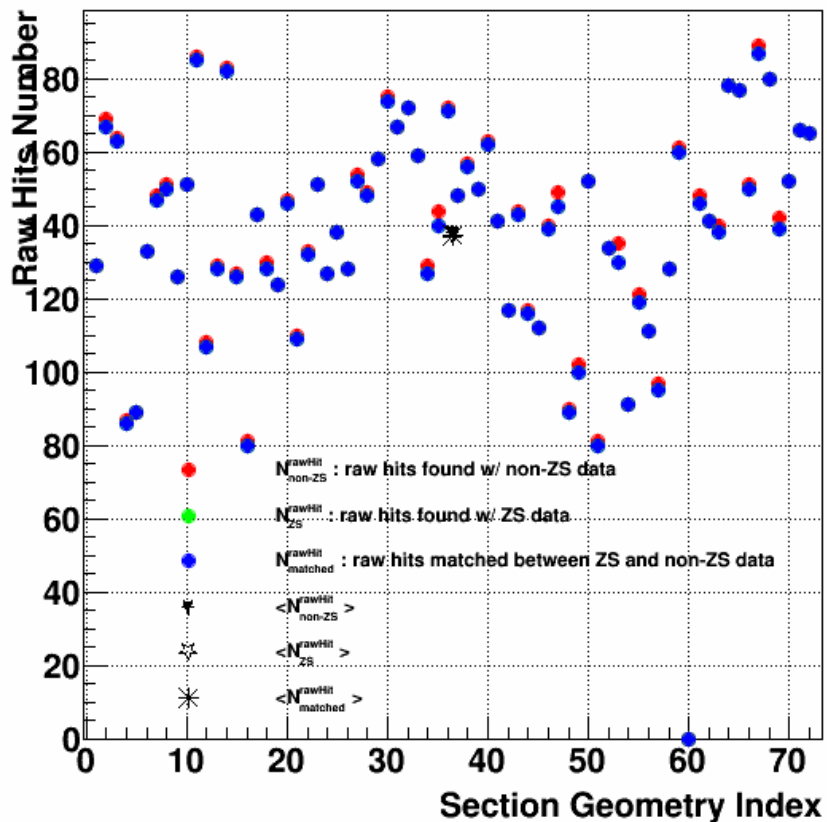
Populate the pedestal/rms values calculated with math method to the local istPedNoise Db table, and then compare the found raw hits number in ZS and non-ZS data.



- All raw hits in ZS data are founded in non-ZS data.
- Number of raw hits found in non-ZS data is a bit bigger than the number found in ZS data, the overall matching efficiency is around 99.4% .

# ZS/non-ZS data comparison (#15040023) – histogram method

Populate the pedestal/rms values calculated with histogram method to the istPedNoise Db table, and then compare the found raw hits number in ZS and non-ZS data.



- All raw hits in ZS data are founded in non-ZS data.
- Number of raw hits found in non-ZS data is a bit bigger than the number found in ZS data, the overall matching efficiency is around 99.4% .



# Conclusion

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Here try to give a conclusion on the IST ZS vs non-ZS data check:

1. There are differences on pedestal/RMS values between online (pedestal run #15039124) and offline (physics run #15039169) calculations (see slide 2):

$$\text{Ped}_{\text{online}} - \text{Ped}_{\text{offline}} \sim 2.0 \text{ ADC counts}, \text{RMS}_{\text{online}} - \text{RMS}_{\text{offline}} \sim -2.0 \text{ ADC counts}$$

2. The above pedestal shift become smaller,  $\sim 0.5$  ADC, when used the same data sample (slides 3 and 4). These differences will be zero when the  $3\sigma$  pedestal cut in histogram method is removed as shown in slide 4 and 5).

3. The above RMS  $\sim 2.0$  ADCs shift is caused by the  $3\sigma$  pedestal cut in histogram method. **This issue have been fixed in offline calibration maker.**

4. The raw hits numbers match between the math and histogram method.

**4. Request non-ZS data store/output in pedestal run for IST offline calibration.**

**5. The online ZS works good and the matching efficiency can be up to 99.4%.**

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