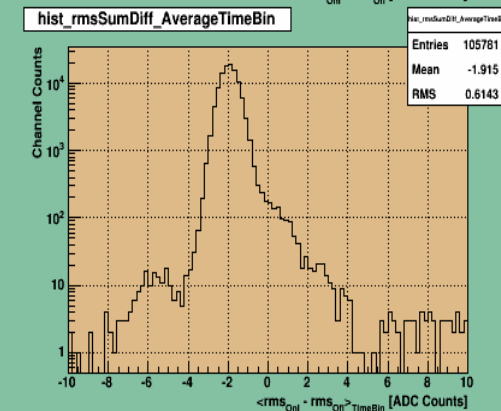
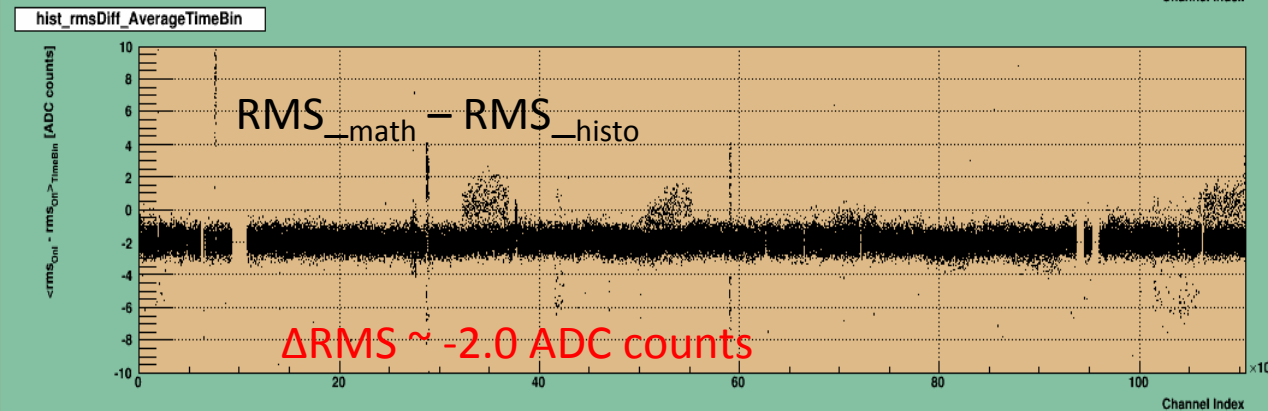
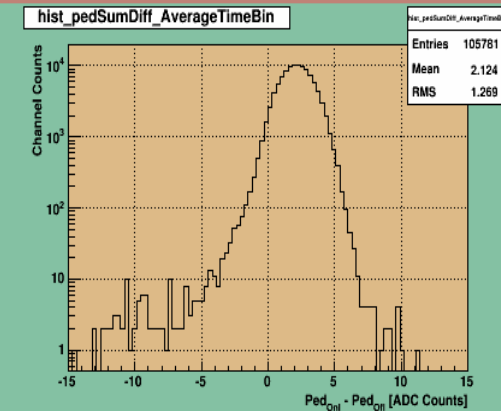
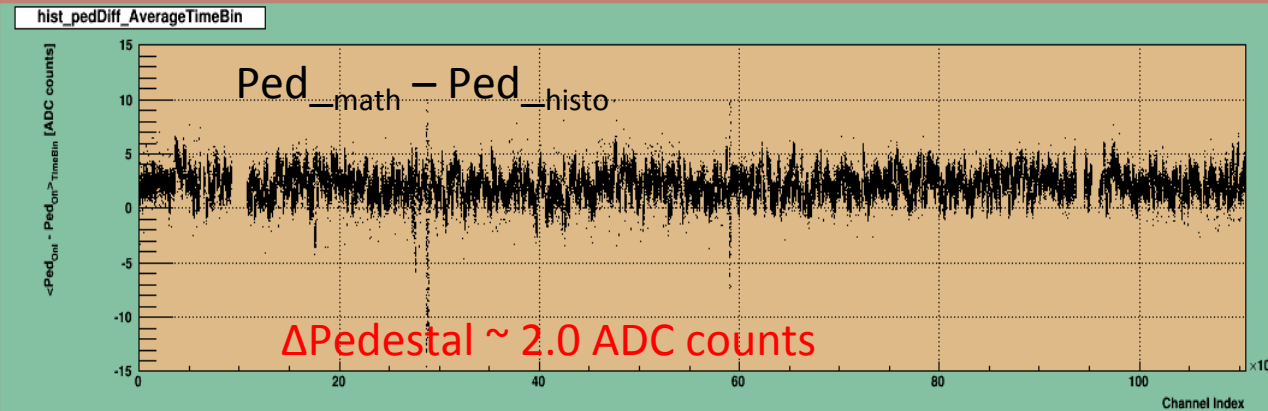

ZS vs Non-ZS data Check

Yaping Wang (UIC)

Pedestal/RMS comparison between online and offline

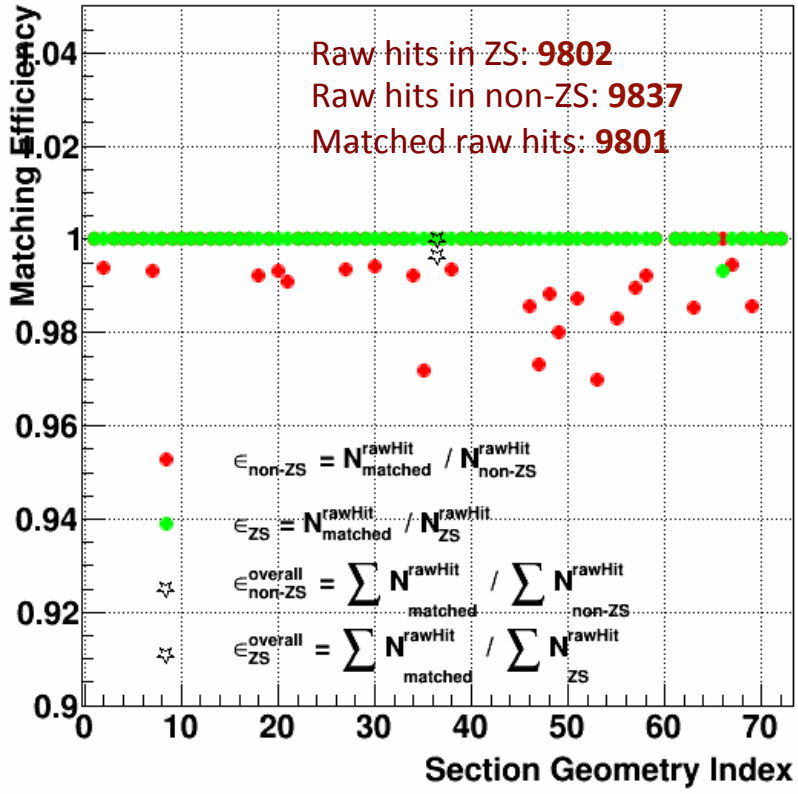
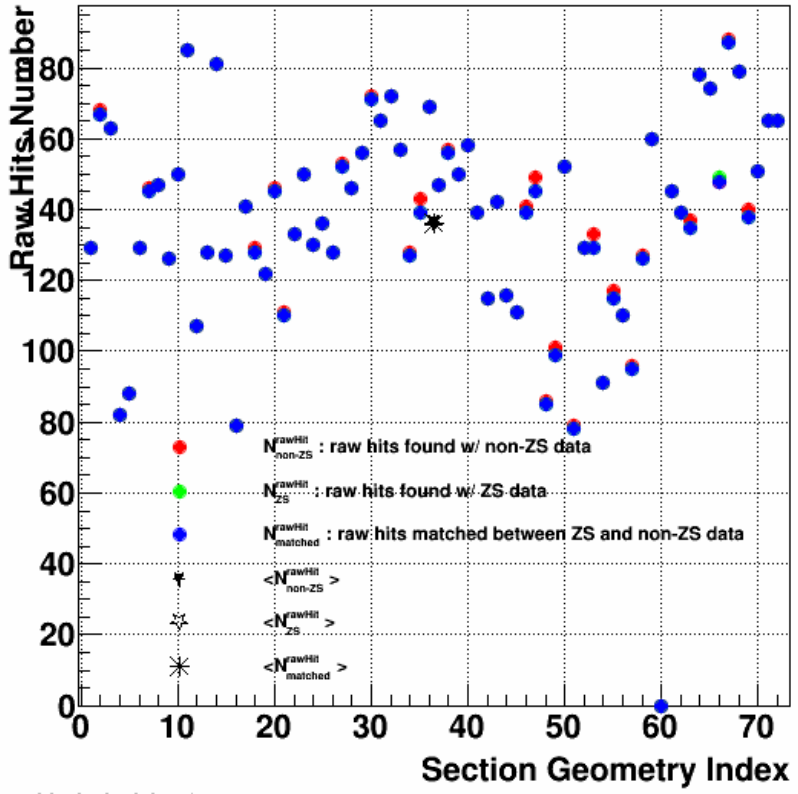
Pedestal/RMS comparison between online math calculation method (Tonko, pedestal run #15039124) and offline histogram calculation method (Yaping, physics run #15039169)



- The comparison shows a clear difference ~ -2.0 ADC counts on RMS noise. The bigger RMS with histogram method could cause loss of raw hits with small ADC counts.
- The two methods show difference on pedestal ~ 2.0 ADC counts (fluctuations channel by channel due to different data sample?).

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% .

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): StlStCalibrationMaker

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

```
int code = k1stNumTimeBins * 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:

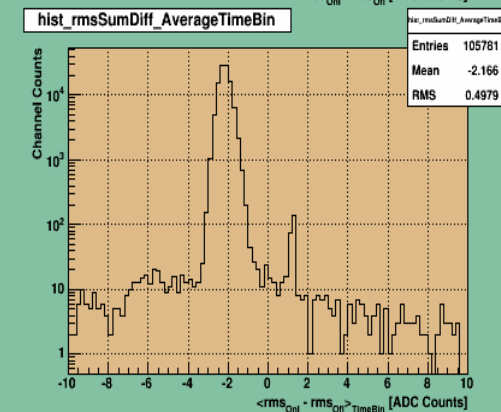
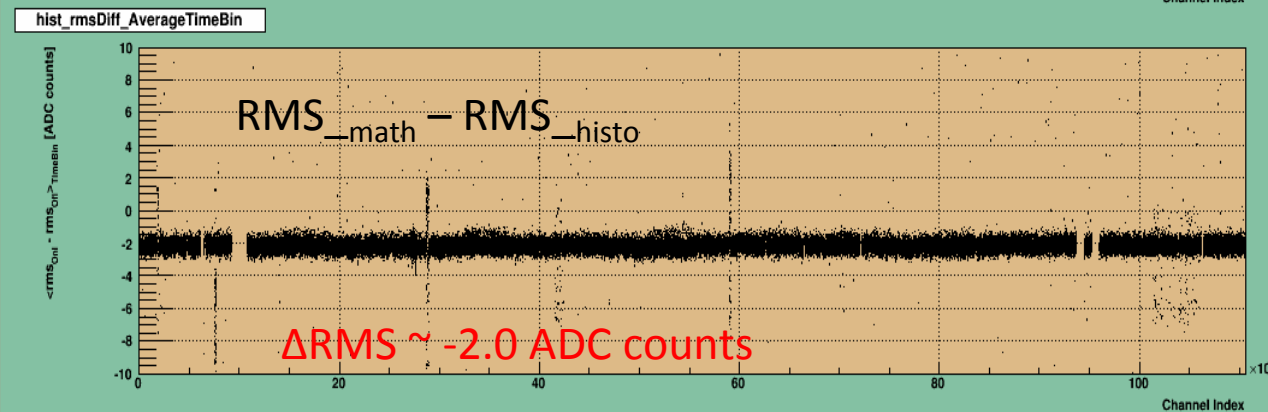
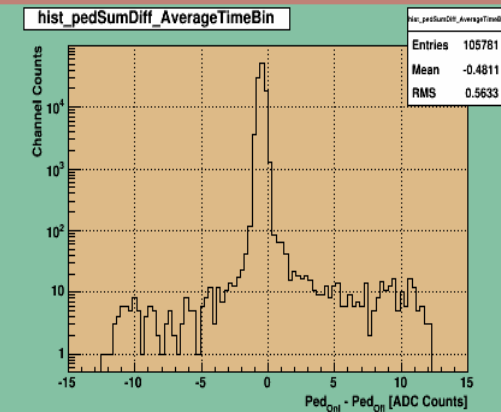
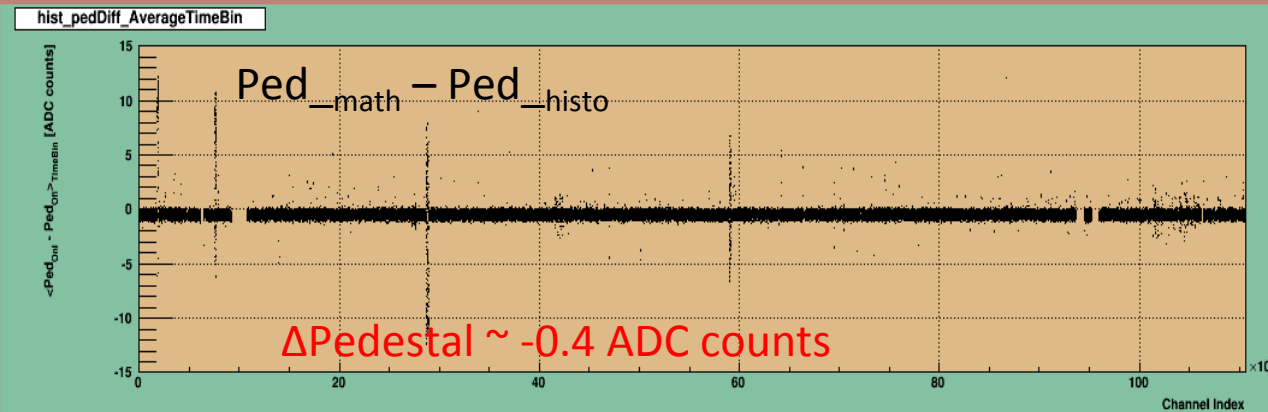
```
averagePed += pedestal[TB]/numTimeBins;  
averageRms += rms[TB]/numTimeBins;
```

5. Do pedestal subtraction:

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

Pedestal/RMS comparison (#15040023)

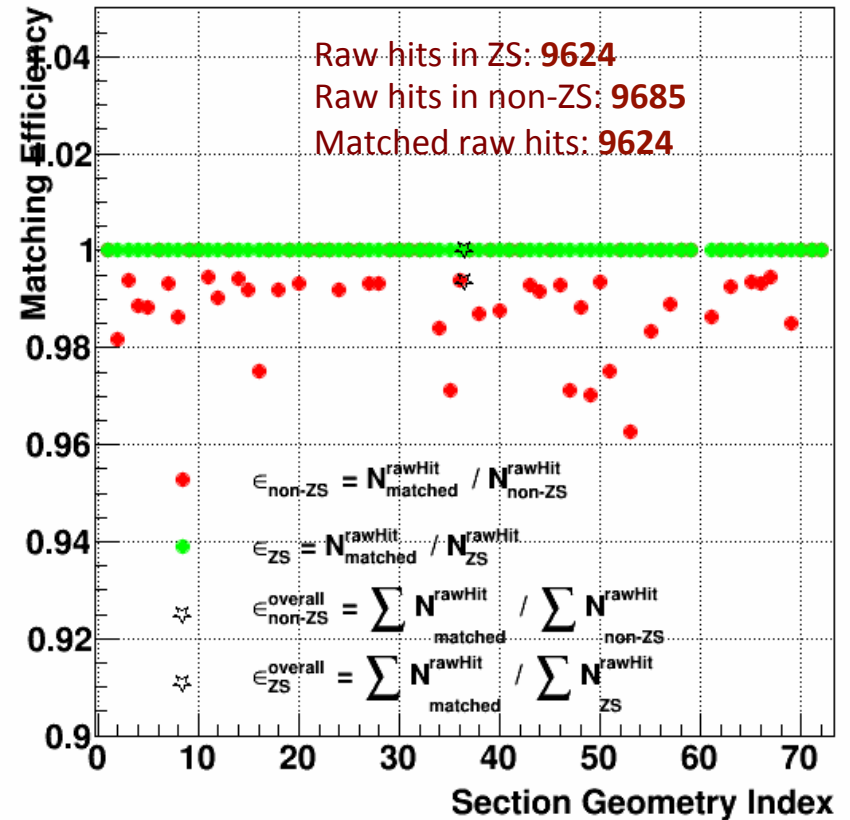
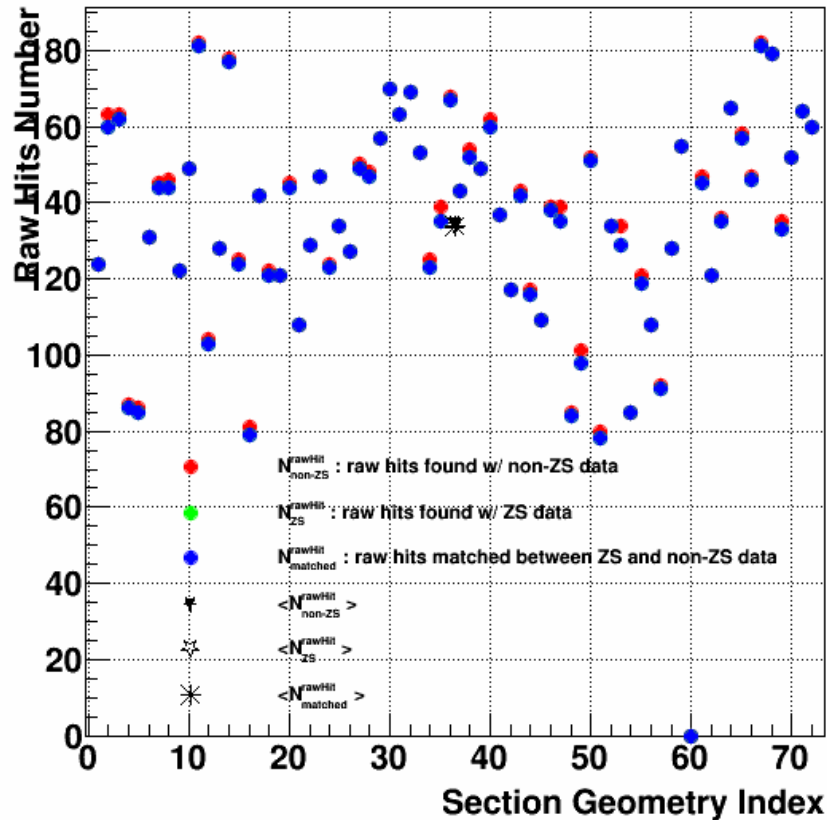
Implemented the math calculation method into the offline calibration maker, and then compare the pedestal/rms values channel by channel between math and histogram methods.



- The two calculation methods show a clear difference \sim -2.0 ADC counts on RMS noise. The bigger RMS with histogram method could cause loss of raw hits with small ADC counts.
- The two methods show a minor difference on pedestal (stable due to same data sample?).

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

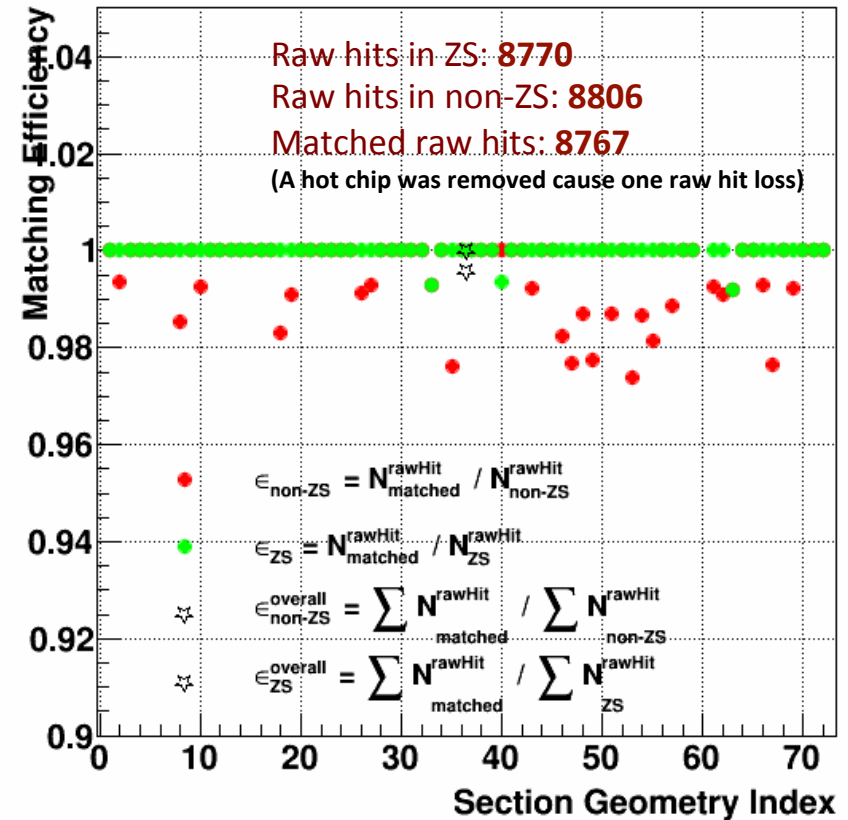
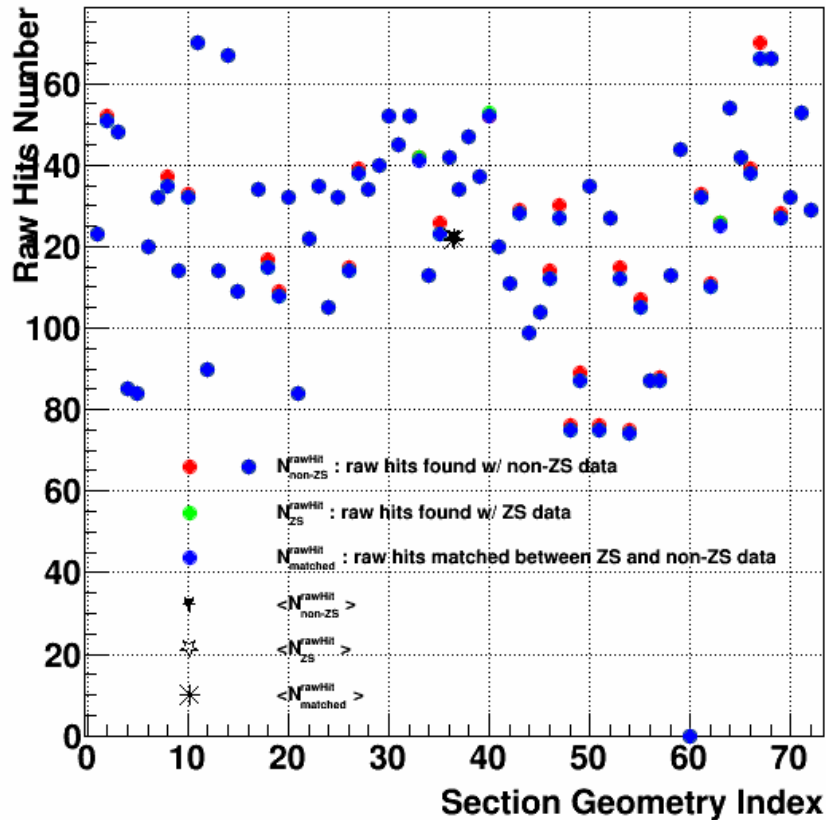
Populate the pedestal/rms values calculated with math method to the local istPedNoise Db table, and then compare the found raw hits number in ZS and non-ZS data.



- 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.



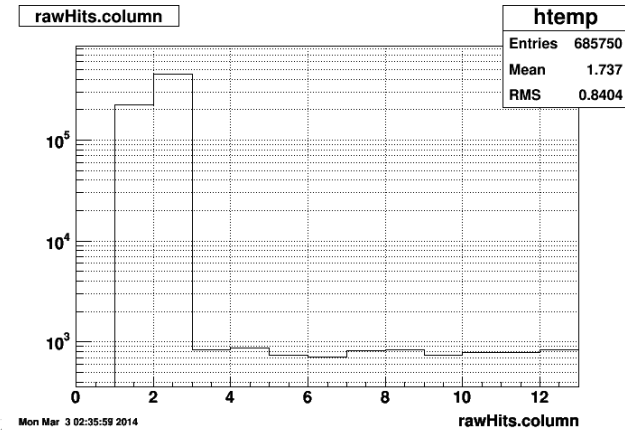
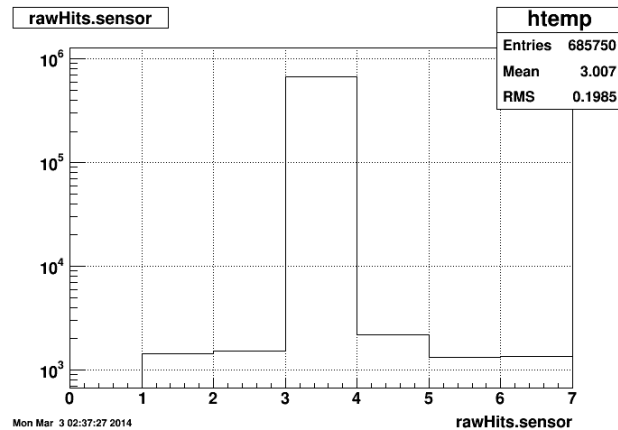
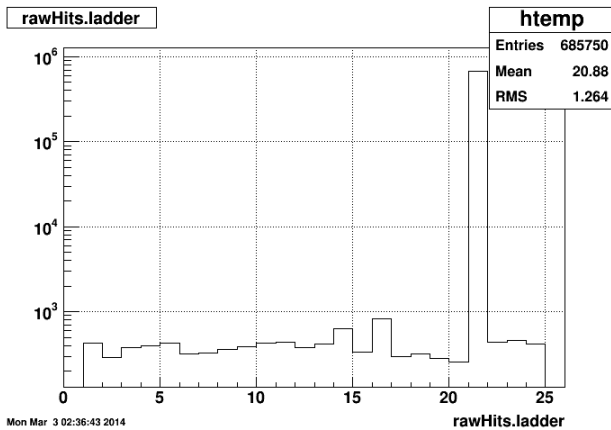
- All raw hits in ZS data are founded in non-ZS data (except for 3 sections, 1 raw hit missing each).
- Number of raw hits found in non-ZS data is a bit bigger than the number found in ZS data, the overall matching efficiency is around 99.6% .

Issue for histogram calculation method (#15040023)

A hot chip (ladder 21, sensor 3, column 1-2) was found in non-ZS data when I use the pedestal/RMS Db table calculated with histogram method.

But it seems:

- 1) the hot channels in this chip have been detected in ZS data;
- 2) The hot channels in this chip can be detected using the pedestal/RMS Db table calculated with math method (there is ~ 2.0 ADC counts difference on RMS between math and histogram methods).



Conclusion

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 ~ 2 ADCs shift seems to be disappeared when using the same data sample (physics run #15040023, see slide 5).

Request to output/store non-ZS data for pedestal run!

3. The above RMS ~ 2.0 ADCs shift is caused by the calculation method (also exists while using the same data sample as shown in slide 5). This shift will cause loss of raw hits with small ADC counts when we use the Ped/RMS Db table calculated with histogram method.

As expected the raw hits number (9685) found with math method is bigger than the number (8806) found with histogram method shown in slides 6 and 7.

The math calculation method seems to be a better way to describe channel's pedestal/rms.

4. Most important thing is that **the online ZS works good and the matching efficiency can be up to 99.5%.**
