

Some Information about CFEB Performance

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1 Results

We have attempted to provide some modest new information on the performance of the CSC CFEBs in CRAFT. The CSC community could elect to include these results in the *CSC Performance Paper*. The main questions would appear to be:

- What is the noise level?
- What is the fraction of noisy channels?
- How many dead CFEBs are there?

We have tried to provide some answers in the following paragraphs.

A skimmed set of CRAFT data was used for this analysis, spanning a few runs in the latter part of the run. The total number of events is 90,000. The analysis was done with code `CheckBadChannels` which has been written to find easily bad CFEBs and HV segments.

The first two time bins in a strip signal are reserved for an estimate of the *base line* and should be free of signal. Prior to the beginning of CRAFT, the CSC commissioning group adjusted the overall timing of the CSCs to ensure that this rule is observed, in response to early checks with `CSCValidation`. This means that the difference in the ADC values recorded for the first two time bins, $Q_1 - Q_0$, should be zero, aside from any random fluctuations due to electronics noise. (Slow components in the noise on a channel will not be efficiently detected this way.) In order to be very sure that no signal contributed to Q_1 and Q_0 , we skipped strips which had a sum of charges above base line of 13 ADC counts or more.

We take the rms of the distribution of $\Delta_{01} \equiv Q_1 - Q_0$ to be our measure of noise. Call this quantity σ_{01} . We obtained σ_{01} for all CFEBs in the system. Fig. 1 shows the distribution of all σ_{01} values.

The typical values are about 3 or slightly larger; there is little spread indicating excellent uniformity. There are absolutely no large values, indicating no oscillating or otherwise “hot” channels at all. Another view of the uniformity of the noise level (as defined here) is given in Fig. 2, a “box plot” showing σ_{01} for all working CFEBs in ME+2/2. There is very little variation – chamber 21 tends to have slightly larger values for σ_{01} – this is true in CRAFT09 as well. Chamber 18 was not working.

Two peaks can be discerned in Fig. 1, corresponding to smaller and larger chambers. We produce some examples distributions for Δ_{01} showing how the rms is larger for larger chambers – see Fig. 3.

apparently dead chambers

ME+1/1/23
 ME+1/2/23
 ME+1/3/15
 ME+1/3/16
 ME+1/3/28
 ME+2/2/18
 ME-1/1/2
 ME-1/1/4
 ME-2/2/5
 ME-3/2/24
 ME-4/1/15

Table 1: List of apparently dead chambers (delivered no strip digis) for a subset of CRAFT runs. In addition, ME-3/2/19 displayed anomalous behavior.

There are 74 CFEBs giving no signal (they are entered at $\sigma_{01} = -1$ in this histogram), but many of these come from chambers that were turned off. A list of information for all 2268 CFEBs allowed us to separate dead chambers (Table 1) from dead CFEBs (Table 2). There is also one CFEB (ME+1/2/15 #3) which gives $\sigma_{01} \equiv 0$, which we count as a dead CFEB, though it is not obvious what is wrong in this case. We count 22 apparently dead CFEBs, amounting to a fraction of 0.97%. This number is representative; the actual number of dead CFEBs fluctuated somewhat through the CRAFT data taking period.

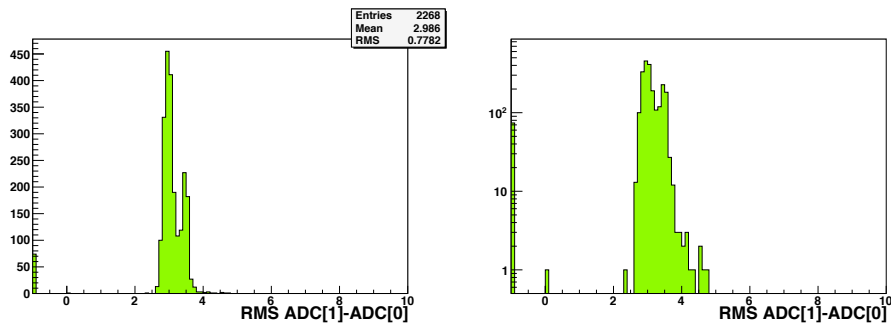


Figure 1: Distribution of all σ_{01} values, on a linear scale (left) and a log scale (right)

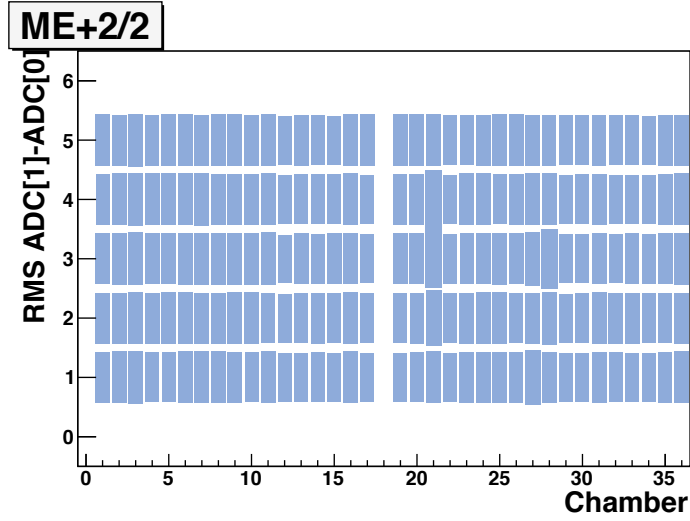


Figure 2: Summary of σ_{01} values for CFEBs in ME+2/2. Chamber 21 tends to have slightly larger values, and chamber 18 was not functioning.

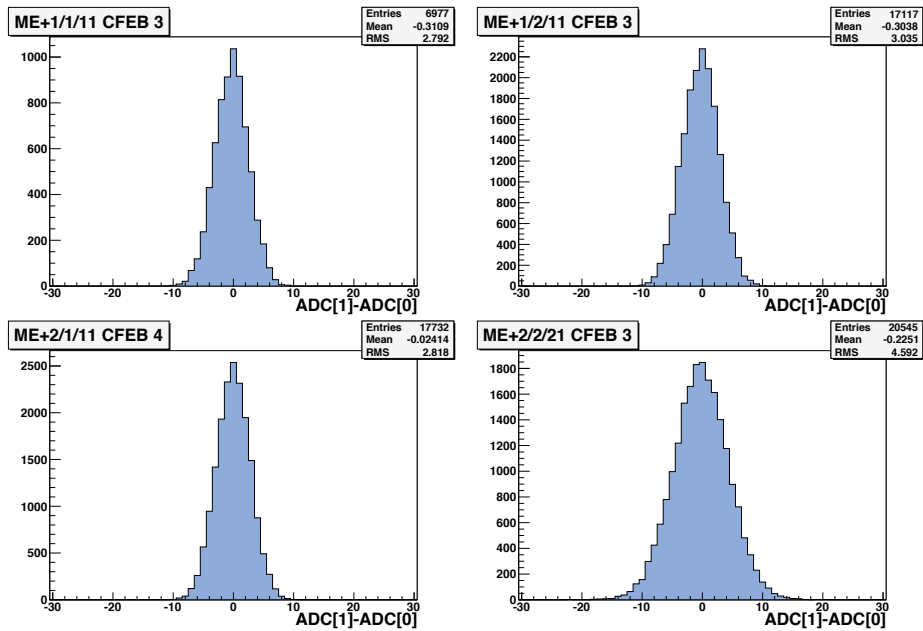


Figure 3: Four examples of Δ_{01} distributions.

apparently dead CFEBs

ME+1/1/26 #5
ME+3/1/4 #5
ME+3/2/23 #5
ME+3/2/34 #2
ME+4/1/3 #4
ME+4/1/14 #1
ME-1/1/11 #2
ME-1/1/16 #5
ME-1/1/23 #4
ME-1/1/30 #1
ME-1/1/35 #1
ME-1/2/4 #3
ME-1/2/20 #5
ME-1/3/29 #1
ME-2/2/3 #3
ME-3/1/13 #3
ME-3/1/15 #2
ME-3/2/5 #1
ME-3/2/22 #3
ME-3/2/25 #5
ME-4/1/9 #3

Table 2: List of apparently dead CFEBs (delivered no strip digis) for a subset of CRAFT runs. The CFEBs corresponding to the dead chambers in Table 1 are not included.