

2019 SVT Offline Baseline Calibrations

Problem Statement

An effort has been underway for quite some time to determine the baseline calibrations for the SVT readout channels. The goal is to improve on the baselines which were determined during online calibration runs, if possible. Some runs were taken when the online calibrations might have become stale, some high-occupancy channels experience shifts in their baseline due to power-busing on the APV25 chip.

Previous Work

Cameron and Alic initiated this effort soon after the 2019 run with the following outline:

- Goal is to make offline baseline measurements for each channel for each run
- Fill 2D histograms with ADC values for each channel with SVTRawTrackerHits collection using HPSTR
- Y-Projection of each channel gives occupancy vs ADC value for channel
- Distribution composed of Gaussian signal (baseline) and Landau at some threshold (pileup from hits prior to current trigger)

See [this presentation](#) for details and results from run 10648.

Update

Since we may wish to incorporate some kind of baseline calibration/monitoring during the upcoming 2021 run, it was decided to investigate whether this could be done as part of the online Data Quality Management (DQM). This would involve filling the requisite histograms as part of the DQM stream and fitting the plots as part of the endOfData() method. Depending on the memory requirements, this could be accomplished as part of the normal DQM processing, or could be split off into a separate process.

Analysis Discussion

During the data-accumulation phase, a 2D histogram is created for each sensor. The x axis corresponds to the strip / readout channel number and the y axis contains the value of the first of the six APV25 readout channels. The split-strip thin sensors in layers one and two contain 512 strips, while the remaining sensors have 640 strips.

During the endOfData() phase, every y slice of each histogram is analyzed. If there are sufficient entries in the slice a peak-finding algorithm is run to identify the baseline peak. If the peak structure is well-behaved a Gaussian function is fit to the bins in the peak. If this algorithm fails, a second algorithm is run to handle special cases. The results are then plotted and the next slice / histogram is processed.

Status

A prototype Driver has been written, histograms have been created for all 295 "good" runs, and run 10648 has been processed in order to compare with the earlier analysis.

Results

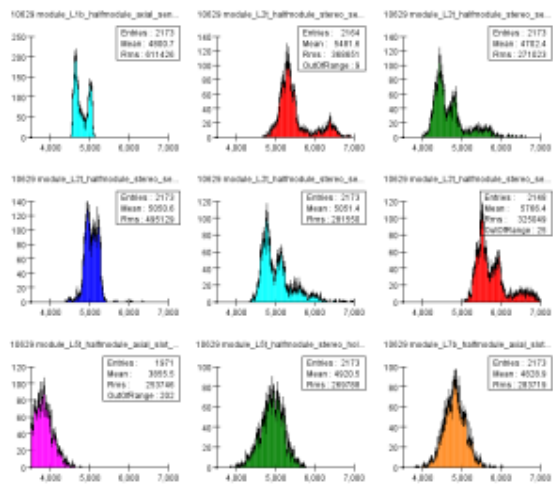
The output histograms with their fits can be found in [this pdf file](#). The plots fall into five categories:

- Slices which are successfully analyzed with the first algorithm are presented with the full spectrum in magenta, the bins identified as belonging to the peak in green and the gaussian fit in black.
- Slices which are successfully analyzed with the cleanup algorithm are presented with the full spectrum in orange, the bins identified as belonging to the peak in cyan and the gaussian fit in black.
- Slices for which no peak was identified, or for which the gaussian fit was not successful are shown in orange.
- Slices containing too few entries to analyze are shown in random colors.
- Slices with no entries correspond to dead channels.

The vast majority of the 20096 channels were successfully fit and the fits appear to capture the peak position of the baseline although, as Alic has shown, it's not always clear what the baseline position should be. Inspection of these plots by SVT experts is welcomed and feedback would be appreciated, especially for the channels for which no fit is currently done.

Online Baseline Run Analysis

Run 10629, the online SVT baseline calibration run taken before run 10648, was analyzed. Although most of the channels were successfully fit to a Gaussian to extract a mean and width, 127 slices out of 20096 total were not successfully fit (empty channels were not counted in this). These were primarily from Layer 2, top, stereo. Note that the channels from Layer 5, top, and Layer 7, bottom, were flagged because of their broad width. A sample of the various bad channels is shown below:



Future Work

- ☒ The online baseline runs will be processed to provide a double-check on the expected means and widths.
- ☐ The remaining 294 of the "good" runs from 2019 will be processed. It is to be expected that some further algorithm development will be needed to handle new edge cases or to tweak the few parameters in the current code.
- ☐ Once this has been accomplished and quality assurance metrics have been identified, the channel baselines (corresponding to the mean of the Gaussian fit) can be written out in such a manner that they can be uploaded to the database.