

BBCal analysis

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Abstract

1 Analyzing data file

1. Connect to tedbbdaq as user: daq pwd: D4q!23
2. cd Analysis/BBCal
3. source setup.csh
4. cd replay
5. analyzer
 - .L replay.C+
 - replay_bbcosmics(runnumber,-1)
 - .q
6. This produces a root file, bbcal_runnumber.root in rootfiles subdirectory

2 Analyzing root file

Root file has the following leaves in the tree ("T"). The shower leaves are arrays of 189 members with $\text{index}=(\text{nr}-1)*7+(\text{nc}-1)$ where nr is row number 1-27 and nc is column 1-7 and $\text{index} = 0-188$. The preshower leaves are of 54 members with $\text{index}=(\text{nr}-1)+(\text{nc}-1)*27$ where nr is row number 1-27 and nc is column 1-2 and $\text{index} = 0-53$. For purposes of analyzing cosmic data, the following leaves are relevant:

1. bb.sh.a (189 member array of shower raw ADC)
2. bb.sh.a.p (189 member array of shower raw ADC - pedestal)
3. bb.ps.a (54 member array of preshower raw ADC)
4. bb.ps.a.p (54 member array of preshower raw ADC - pedestal)

3 To create histograms and event display

3.1 Create Shower histograms

1. cd Macros; root -l
2. .x Shower_macros/make_hist_shower.C("bbcal_nrun",nrun,*show_track*) where nrun is the integer run number of the analyzed data. *show_track* is a flag for showing the event display which by default is kFALSE.
3. This macro creates a root file: hist/bbcal_nrun_shower_hist.root
4. Histograms in the root file with histogram for each block that is identified by row (nr=1-27) and column (nc=1-7):
 - (a) h_shADC_rownr_colnc histogram of raw ADC (bb.sh.a) spectra
 - (b) h_shADC_pedsub_rownr_colnc histogram of pedestal subtracted ADC (bb.sh.a_p) spectra
 - (c) h_shADC_pedsub_cut_rownr_colnc histogram of pedestal subtracted ADC (bb.sh.a_p) spectra with cut that any block in row 27 and any block in row 1 had a pedestal subtracted ADC value greater than 20 channels and that block had pedestal subtracted ADC value greater than 25 channels.

3.2 Create PreShower histograms

For the preshower histograms Col 1 is also labeled "L" and Col 2 is also labeled "R".

1. cd Macros; root -l
2. .x PreShower_macros/make_hist_shower.C("bbcal_nrun",nrun,*show_track*) where nrun is the integer run number of the analyzed data. *show_track* is a flag for showing the event display which by default is kFALSE.
3. This macro creates a root file: hist/bbcal_nrun_preshower_hist.root
4. Histograms in the root file with histogram for each block that is identified by row (nr=1-27) and column (nc="L" or "R"):
 - (a) h_psADC_ncnr histogram of raw ADC (bb.ps.a) spectra
 - (b) h_psADC_pedsub_ncnr histogram of pedestal subtracted ADC (bb.ps.a-p) spectra
 - (c) h_psADC_pedsub_cut_ncnr histogram of pedestal subtracted ADC (bb.ps.a_p) spectra with cut that Col 1 in Row 2 and Row 26 or Col 2 in Row 2 and Row 26 had a pedestal subtracted ADC value greater than 100 channels and that block had pedestal subtracted ADC value greater than 20 channels.

4 To plot pedestals and create pedestals for the BBCal database

4.1 Shower pedestals

1. in the Macros subdirectory
2. `root -l`
3. `.x Shower_macros/plot_ped.C("bbcal_nrun")`
4. Plots `h_shADC_rownr_colnc` histograms for 7 blocks for each row in one canvas. Saves all the plots in pdf file: `plots/bbcal_nrun_ped.pdf`
5. Fits the pedestal for each histogram with a gaussian.
6. Makes two 2D histograms of `nrow` versus `ncol` with each having the weight filled by the mean or sigma of the pedestal gaussian fit
7. Makes a 1D histogram of all the pedestal means.
8. Saves these plots in pdf file: `plots/bbcal_nrun_ped_2d.pdf`
9. The pedestal means are printed to the terminal in a format that can be included in the `db_bb.sh.dat` file

4.2 PreShower pedestals

1. in the Macros subdirectory
2. `root -l`
3. `.x PreShower_macros/plot_ped.C("bbcal_nrun")`
4. Plots `h_psADC_ncnr` histograms for "L" and "R" block for each row in one canvas. Saves all the plots in pdf file: `plots/bbcal_nrun_ps_ped.pdf`
5. Fits the pedestal for each histogram with a gaussian.
6. Makes two 2D histograms of `nrow` versus `ncol` with each having the weight filled by the mean or sigma of the pedestal gaussian fit
7. Makes a 1D histogram of all the pedestal means.
8. Saves these plots in pdf file: `plots/bbcal_nrun_ps_ped_2d.pdf`
9. The pedestal means are printed to the terminal in a format that can be included in the `db_bb.ps.dat` file

5 Plotting pedestal subtracted ADC spectra

5.1 Shower

1. in the Macros subdirectory: root -l
2. `.x Shower_macros/plot_pedsub.C("bbcal_nrun")`
3. Plots `h_shADC_pedsub_rownr_colnc` histograms for 7 blocks for each row in one canvas. Saves all the plots in pdf file: `plots/bbcal_nrun_pedsub.pdf`

5.2 PreShower

1. in the Macros subdirectory: root -l
2. `.x PreShower_macros/plot_pedsub.C("bbcal_nrun")`
3. Plots `h_psADC_pedsub_ncnr` histograms for 2 blocks for each row in one canvas. Saves all the plots in pdf file: `plots/bbcal_nrun_ps_pedsub.pdf`

6 Plotting pedestal subtracted ADC spectra with event selection

6.1 Shower

1. in the Macros subdirectory
2. root -l
3. `.x Shower_macros/plot_pedsub_select_event.C("bbcal_nrun",nrun,check_all)`.
`check_all` is a `Bool_t` and by default `check_all = kFALSE`.
4. Plots each block's ADC spectra and fits a gaussian to each spectra. First tries to automatically do fit.
 - (a) Finds the bin center, `BINC`, with the maximum counts. If bin center < 40 , then finds bin center in range 40 and above.
 - (b) Fits region between $0.7*BINC$ and $1.3*BINC$
5. If `check_all = kTRUE` or fit peak < 100 or error on the fit peak > 10 then enters a while loop:
 - (a) ask: "enter icheck value (=1 set new fit parameters, =0 fit OK)". Enter 0 and leave while loop and go to next block fit .
 - (b) if Enter 1 then ask: "enter starting values for peak counts mean sigma". Enter values separated by space.
 - (c) Fits ADC spectra with new starting values with fitting region between $0.6*mean$ to $1.4*mean$.

- (d) plots the new fit and goes repeats the while loop.
- 6. Plots `h_shADC_pedsb_cut_rownr_colnc` histograms with fit for 7 blocks for each row in one canvas. Saves all the plots in pdf file: `plots/bbcal_nrun_select_event.pdf`
- 7. Plots four 2d histograms of the row versus column weighted by integral, mean, peak channel and sigma. Plots 1d histogram of mean versus block number. Saves plots in `plots/bbcal_nrun_select_event_2d.pdf`
- 8. Saves the mean and mean error in file `Output/run_nr_peak.txt` for use later.

6.2 PreShower

1. In the Macros subdirectory: `root -l`
2. `.x PreShower_macros/plot_pedsb_select_event.C("bbcal_nrun",nrun).`
3. Plots each block's ADC spectra and fits a gaussian to each spectra. Automatically does a fit.
 - (a) Finds the bin center, BINC, with the maximum counts and RMS of the histogram.
 - (b) Fits region between BINC-RMS and BINC+RMS
4. Plots `h_shADC_pedsb_cut_rownr_colnc` histograms with fit for 7 rows in one canvas. Saves all the plots in pdf file: `plots/bbcal_nrun_ps_select_event.pdf`
5. Plots four 2d histograms of the row versus column weighted by integral, mean, peak channel and sigma. Plots 1d histogram of mean versus block number. Saves plots in `plots/bbcal_nrun_ps_select_event_2d.pdf`
6. Saves the mean and mean error in file `Output/run_nr_ps_peak.txt` for use later.

7 Creating new HV file with constant HV shift

The subdirectory `hv_set` is symbolically linked to `/home/daq/slowc/BBCAL/hv_set`. For each run with run number = `nr`, one should save the HV into a file with name `run_it nr_hv.set` using the "Save HV" in the HV GUI.

7.1 Shower

1. The code `Shower_macros/HV_Peak.C` is library of modules. In root load library : `.L Shower_macros/HV_Peak.C+`
2. In root: `UpdateHV(nrun,HV_shift)` where `nrun` is the run number and `HV_shift` is the desired shift in HV. To set the abs(HV) to larger (smaller) value then set positive (negative) `HV_shift`.

- (a) Calls module SetHVMap() which creates a mapping between the HV slot and channel and the block row and column. This is based on the current documented HV mapping, so if that changes this module needs to be updated. The code assumes that there are two crates and 16 slots. For each crate, slot and channel it sets the block number initially to -1 for all HV channels. Then it sets the Shower block number (0-188) for each HV channel that is used by the Shower.
 - (b) Sets the HV output file to hv_set/run_it nr_hv_newset.set
 - (c) Loops through two crates and sixteen slots. If slot is not present in the read-in map, then sets all HV for that slot to zero. If the channel is not a shower block, then it writes the read-in HV. If the channel is a shower block, then it writes the read-in HV $-HV_shift$, since the read-in HV is a negative number.
3. The new HV set file can be loaded to the HV crates through the HV GUI and a new run started.

7.2 PreShower

1. The code PreShower_macros/PreShower_HV_Peak.C is library of modules. In root load library : .L PreShower_macros/PreShower_HV_Peak.C+
2. In root: UpdateHV($nrun, HV_shift$) where nrun is the run number and HV_shift is the desired shift in HV. To set the abs(HV) to larger (smaller) value then set positive (negative) HV_shift.
 - (a) Calls module SetHVMap() which creates a mapping between the HV slot and channel and the block row and column. This is based on the current documented HV mapping, so if that changes this module needs to be updated. The code assumes that there are two crates and 16 slots. For each crate, slot and channel it sets the block number initially to -1 for all HV channels. Then it sets the PreShower block number (0-53) for each HV channel that is used by the PreShower.
 - (b) Sets the HV output file to hv_set/run_it nr_hv_newset.set
 - (c) Loops through two crates and sixteen slots. If slot is not present in the read-in map, then sets all HV for that slot to zero. If the channel is not a preshower block, then it writes the read-in HV. If the channel is a preshower block, then it writes the read-in HV $-HV_shift$, since the read-in HV is a negative number.
3. The new HV set file can be loaded to the HV crates through the HV GUI and a new run started.

8 Comparing ADC spectra for multiple runs

8.1 Shower

1. For each run, create histograms and execute Shower_macros/plot_pedsub_select_event.C
2. In root ,load library : .L Shower_macros/HV_Peak.C+
3. For each run : AddRun(*nrun*)
4. CompHistRuns() will plot the ADC pedestal subtracted for the selected events for each run overlayed.
5. Each row has a separate canvas and hit any key to advance to the next canvas.
6. all plots are saved in plots/hv_peaks_*nrf*-*nrl*.pdf where *nrf* is the first run used in AddRun and *nrl* is the last.

8.2 PreShower

1. For each run, create histograms and execute PreShower_macros/plot_pedsub_select_event.C
2. In root ,load library : .L PreShower_macros/PreShower_HV_Peak.C+
3. For each run : AddRun(*nrun*)
4. CompHistRuns() will plot the ADC pedestal subtracted for the selected events for each run overlayed.
5. Each row has a separate canvas and hit any key to advance to the next canvas.
6. all plots are saved in plots/hv_peaks_ps_*nrf*-*nrl*.pdf where *nrf* is the first run used in AddRun and *nrl* is the last.

9 Determining alpha from multiple runs

9.1 Shower

1. For each run, create histograms and execute Shower_macros/plot_pedsub_select_event.C
2. In root ,load library : .L Shower_macros/HV_Peak.C+
3. For each run : AddRun(*nrun*)
4. FitRuns(*Set_Peak*) where *Set_peak* is the desired peak position. Default is 200 channel.
 - (a) Plots the fitted peak mean with error versus HV for each column overlayed on one plot for a row.

- (b) Each row has a separate canvas and hit any key to advance to the next canvas.
 - (c) all plots are saved in plots/hv_fit_nrf_nrl.pdf.
 - (d) For each column is fitted with $\log(HV) = a + \alpha * \log(peak)$.
 - (e) Determines new HV to set the peak at the desired Set_Peak location.
 - (f) At the end, a 2d histogram of row versus column weighted by alpha is plotted and saved as plots/alpha_2d_nrf_nrl.pdf . Hit any key to advance to the next canvas.
5. WriteHV() will write the updated shower HVs to file hv_set/hv_update_sh_nrf_nrl.set . HV channels which are not for the shower will have their original HV values written to the file. The file can be uploaded to the HV crates through the HV GUI.

9.2 PreShower

1. For each run, create histograms and execute PreShower_macros/plot_pedsub_select_event.C
2. In root ,load library : .L PreShower_macros/PreShower_HV_Peak.C+
3. For each run : AddRun(*nrun*)
4. FitRuns(*Set_Peak*) where Set_peak is the desired peak position. Default is 200 channel.
 - (a) Plots the fitted peak mean with error versus HV for each column overlaid on one plot for a row.
 - (b) Each row has a separate canvas and hit any key to advance to the next canvas.
 - (c) all plots are saved in plots/hv_fit_ps_nrf_nrl.pdf.
 - (d) For each column is fitted with $\log(HV) = a + \alpha * \log(peak)$.
 - (e) Determines new HV to set the peak at the desired Set_Peak location.
 - (f) At the end, two 2d histogram of row versus column weighted by alpha and HV needed to reached the Set_Peak is plotted and saved as plots/hv_alpha_ps_nrf_nrl.pdf . Hit any key to advance to the next canvas.
5. WriteHV() will write the updated preshower HVs to file hv_set/hv_update_ps_nrf_nrl.set . HV channels which are not for the preshower will have their original HV values written to the file. The file can be uploaded to the HV crates through the HV GUI.