Description of Macros in the Calibration Folder

University of Glasgow: R. Montgomery (Rachel.Montgomery@glasgow.ac.uk), D. Hamilton, R. Marinaro, G. Penman

Last updated: 28/08/2021

Getting the scripts from GitHub

The analysis macros can be found online in the repository at:
https://github.com/rachel-m/HodoSW.git
To clone it and navigate to the right directory:

- git clone https://github.com/rachel-m/HodoSW.git
- cd cal
- ls to see the macros

These macros will work wither with or without raw TDC hit data. At the moment they are set up only to analyse "good" bar hits.

Pedestal Fitting

Macro: GetPed.C.

Input data file: replayed output from SBS-offline.

Purpose: plots adc spectrum for each channel. Fits the pedestal region of each spectrum with a Gaussian to find the position for each channel. Output can be used to allow for pedestal correction to be made in SBS-offline. Since the MIP Landau peak is very separated from the pedestal in hodoscope cosmic data, setting the pedestal correction value to the pedestal peak position is not ideal for all subsequent purposes. One can therefore enter a desired *Cut* value when calling the function. The pedestal cut location is calculated to be = (pedestal mean + Cut*pedestal sigma). If one wants the pedestal correction to occur at the mean of the pedestal peak directly however, set this cut value to 0. Currently it uses the raw ADC output from SBS-offline, ie not any branch which is converted to e.g. energy or that has pedestal correction applied already. You can select which replayed branches you want to use near to the top of the macro.

Variables to check/be aware of:

- Paths. The location of the input SBS-offline replayed files is defined as REPLAYED_DIR and should be updated accordingly, otherwise it will not find the correct input file. The output location is defined as ANALYSED_DIR and it should be updated accordingly.

Output:

- Pedestal correction values in a text file, in a format compatible with the bb.hodoadc.adc.pedestal table entry in the db_bb.hodoadc.dat database so that it can be copied and pasted to the correct file. The text file name will have format PedFits_inputfilename.txt.
- Root file with all fitted histograms so that fits can be checked. The root file name will have format PedFits_inputfilename.root. Open the file in root and look through the histograms with a TBrowser.

Executing the file:

- analyzer

- .L GetPed.C+
- GetPed(filename, nevents, GaussSigma, FitRange, Cut, HistRange)
- Filename is the input file name without the .root suffix and without the path, e.g. "bbhodo_307_1000"
- nevents is the number of events you want to run, where the default -1 = all
- GaussSigma is the initial guess for the sigma widths of the pedestals, to be used as an initial parameter in the Gaussian fits. The default is 7 ADC bins.
- FitRange is the range of the Gaussian fit, it is calculated as a multiple of GaussSigma, eg initial guess at pedestal position +- FitRange*GaussSigma. Default value is 3.
- Cut is how many sigma above the pedestal mean you wish to use for the pedestal correction position for subsequent input to SBS-Offline for pedestal corrections.
- HistRange is the upper ADC bin value to use for plotting the spectra. Default calue is 300 adc bins.

ADC Landau Fitting
Macro: GetLandau.C.
Input data file: replayed output from SBS-offline.
Purpose: Plots adc spectrum for each channel on a log scale. Fits the cosmic MIP region of each spectrum with a Landau to find the Landau peak position (MPV, most probable value) for each channel. Uses the pedestal corrected output from SBS-offline and uses the raw ADC values, ie not converted to energy. Please note GetPed should already have been used to set the pedestal correction in the database file for each channel and SBS-offline should have already been re-run with the correct pedestal correction values in the adc database file to create the pedestal corrected outputs. One should still use the FitStart and FitStop parameters when calling the function to eliminate any pedestal remnant from the fit to the full adc spectrum and start the fit in the minimum of the valley between the pedestal and MIP peak.
Variables to check/be aware of:
- Paths. The location of the input SBS-offline replayed files is defined as REPLAYED_DIR and should be updated accordingly, otherwise it will not find the correct input file. The output location is defined as ANALYSED_DIR and it should be updated accordingly.
Output:
- Landau fit results are output to a text file. The filename has the format LandauFits_inputfilename.txt. The text file could be read in to a future macro to eg plot MPV values against HV for each channel, to calibrate the gain curve for each PMT. Each line of the text file reads: (Bar) (Left PMT MPV) (Left PMT MPV error) (Right PMT MPV) (Right PMT MPV error).
- Root file with all fitted histograms so that fits can be checked. The root file name will have format LandauFits_inputfilename.root. Open the file in root and look through the histograms with a TBrowser. There are also graphs plotting fit parameter results versus pmt for the left and right pmts, as well as equivalent histograms showing fit results across pmts.
Executing the file:
- analyzer

- .L GetLandau.C+
- GetLandau(filename, nevents, FitStart, FitStop, Width, HistRange)
- Filename is the input file name without the .root suffix and without the path, e.g. "bbhodo_307_1000."
- nevents is the number of events you want to run, where the default -1 = all
- FitStart is the starting value for the fit range – set this to the rough valley position of the ADC spectra before the start of the Landau peak (a rough value is ok since all PMTs are gain matched and pedestal corrected). The default value is 150 ADC bins.
- FitStop is the upper range of the fit range. Default value is 1000 ADC bins.
- Width is the initial guess at the width of the Landau fits. The default value is 40 ADC bins.

Tot versus ADC Fitting

Macro: FitTOT.C.

Input data file: replayed output from SBS-offline.

Purpose: plots TOT against ADC for each PMT. Fits a function to calibrate the TOT behaviour (currently of form a(b-c/x) which was found from literature review and a TORCH LHCb study using the NINO and HPTDC readout). Since a 2D fit is desired for TOT versus ADC fits, the FitSlicesY method in ROOT is employed to obtain more reliable fits when looping over several PMTs in one go. The macro can also be run without fitting, by setting a flag when calling the function. The macro outputs a root file with the graphs and if the fits were made a text file with the fit parameters for each channel is also written.

Variables to check/be aware of:
- Paths. The location of the input SBS-offline replayed files is defined as REPLAYED_DIR and should be updated accordingly, otherwise it will not find the correct input file. The output location is defined as ANALYSED_DIR and it should be updated accordingly.
- If the fit is having troubles, the TOTStatCut parameter on line 217 is a good starting point to change. It defines how many bins in the y-slice are required for the slice to be included in the fit. Beyond that, if there are still difficulties, the fit starting parameters and range can be modified in the lines subsequent to this.

Output:
- Fit results and errors are output to a text file. The filename has the format TOTFits_inputfilename.txt.
- Root file with all fitted histograms and all raw TOT versus ADC plots. If the fits were not performed only the raw distributions will be recorded. The root file name will have format TOTFits_inputfilename.root. Open the file in root and look through the histograms with a TBrowser.

Executing the file:
- analyzer
- .L FitTOT.C+
- FitTOT(filename, nevents, DoFitTOT)
- Filename is the input file name without the .root suffix and without the path, e.g. "bbhodo_307_1000."

- nevents is the number of events you want to run, where the default -1 = all
- DoFitTOT is the flag to tell the macro if you want to fit the TOT vs ADC distributions. Set this to 1 if you want to do the fits.

Leading Edge Time versus TOT Fitting

Macro: FitTimeWalk.C.

Input data file: replayed output from SBS-offline.

Purpose: plots leading edge (LE) time against TOT for each PMT. Fits a straight line function to calibrate the time walk behaviour. Since a 2D fit is desired for LE versus TOT fits, the FitSlicesY method in ROOT is employed to obtain more reliable fits when looping over several PMTs in one go. The macro can also be run without fitting, by setting a flag when calling the function. The macro outputs a root file with the graphs and if the fits were made a text file with the fit parameters for each channel is also written, in a format that should be easy to copy into the TDC database file for SBS offline. If this macro is being used during commissioning runs with the ADC connected, one can also demand a cut on having good ADC hits to clean up the spectra and check the integrity of the 2D distributions. This flag is set when calling the function. The ADC branch used from SBS offline will be the non pedestal corrected, raw ADC values.

Variables to check/be aware of:
- Paths. The location of the input SBS-offline replayed files is defined as REPLAYED_DIR and should be updated accordingly, otherwise it will not find the correct input file. The output location is defined as ANALYSED_DIR and it should be updated accordingly.
- If one wants to cut on good ADC hits, the ADC hit cut value is global for all channels and defined on line 21.
- If the fit is having troubles, the StatCut parameter on line 225 is a good starting point to change. It defines how many bins in the y-slice are required for the slice to be included in the fit. Beyond that, if there are still difficulties, the fit starting parameters and range can be modified in the lines subsequent to this.
-

Output:
- Fit results and errors are output to a text file. The filename has the format LEFits_inputfilename.txt.
- Root file with all fitted histograms and all raw LE versus TOT plots. If the fits were not performed only the raw distributions will be recorded. The root file name will have format LEFits_inputfilename.root. Open the file in root and look through the histograms with a TBrowser. If ADC good hit cuts were demanded, the ADC raw histograms will also be recorded.

Executing the file:
- analyzer
- .L FitTimeWalk.C+
- FitTimeWalk(filename, nevents, DoFit, CutADC, Fitmin, Fitmax)
- Filename is the input file name without the .root suffix and without the path, e.g. "bbhodo_307_1000."
- nevents is the number of events you want to run, where the default -1 = all

- DoFit is the flag to tell the macro if you want to fit the LE versus TOT distributions. Set this to 1 if you want to do the fits.
- CutADC is the flag to tell the macro if you wish to cut on good ADC hits or not. Set this to 1 if you wish to cut on ADC.
- Fitmin and Fitmax should normally be entered as 999.0. This will force the macro to automatically find the best start and stop positions for the linear fit. You can change these numbers to define the start and stop of the straight line fit yourself, but it is only recommended as a last resort.