Coincidence calibration histograms in $\overline{\text{Off}}\underline{\text{line}}$

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- ▶ Implementation of new Classes:
  - ▶ CDAS-DAQ (Compiled, not run tested)
  - ▶ CDAS-User (From ASCII files to sd and ad root files.)

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  - ▶ ADST/RecEvent/src/Traces.cc
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  - ▶ ADST/EventBrowser/src/EventBrowserSignals.h
  - ▶ Framework/SEvent/PMTRecData.h
  - ▶ Framework/SEvent/PMTCalibData.h
  - ▶ EventIO/CDAS/CDASToOfflineEventConverter.cc
  - ▶ Modules/General/RecDataWriterNG/SD2ADST.cc
  - ▶ Modules/SdReconstruction/SdTraceCalibratorOG/SdTraceCalibrator.cc
  - ▶ Modules/SdReconstruction/SdHistogramFitterKG/SdHistogramFitterKG.cc

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- ▶ Coincidence histograms able to be include into ad, sd and ADST root files.

Implementation tested with two set of data:

- ▶ 1st data set: February 2nd, 9th and 10th, 2022.
- ▶ 2nd data set: July from 24th to 31st, 2022.

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- ▶ 1st data set: February 2nd, 9th and 10th, 2022.
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With these data:

- ▶ A fitting algorithm to find the CQ^{pk}/CI^{pk} value was implemented
- ▶ Reconstruction of events using a Q^{VEM}, calculated from CQ^{pk}, was performed.

Results: EventBrowser visualization
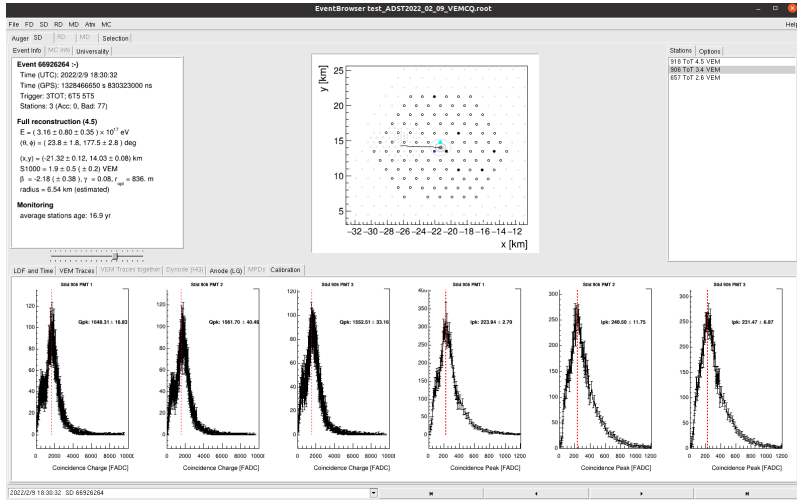
The symmetry and presence of a "single" peak are used to design the fitting algorithm.

Algorithm for fitting 2nd order polynomial to coincidence histograms

As a first approach, two parameter to study:

- The χ^2/Ndof
- The error of the peak obtained from the fit; named as ErrIpk, for pulse height histograms and ErrQpk, for charge histograms.

The algorithm was temporally implemented in the SdHistogramFitterKGB.cc module:

- Find the bin with the maximum of counts (binMax)
- From binMax, fit a second order polynomial from binMax - n to binMax + n.
- Check for the distribution of χ^2 , error of fit as a function of the number of degree of freedom.

```
for ( int nFADC =8; nFADC <100; nFADC +=4 ) {
  [...]
  MakeQuadraticFitter ( coinciPeakHisto , binMax - nFADC , binMax + nFADC ). GetFitData ( qf );
  [...]
}
```

Results: Setting the range for height pulse histograms
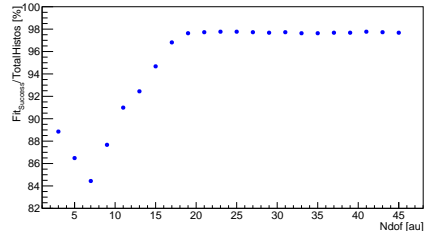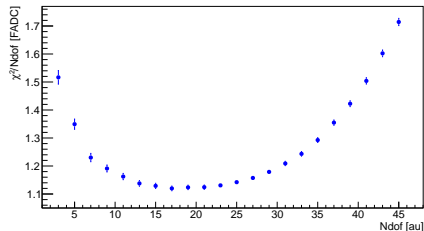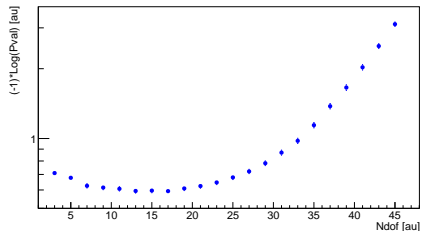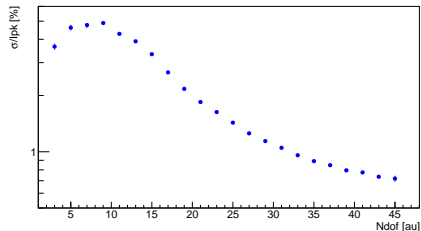
Results obtained with 1st data set.
From 19 to 35 Ndof, the fit that agrees with: $\sigma/\mathrm{lpk} < 5\,\%$, and $\chi^2/\mathrm{Ndof} < 2.0$ is the one from which the $\mathrm{CI}^{\mathrm{pk}}$ is set.

Setting the range for charge histograms
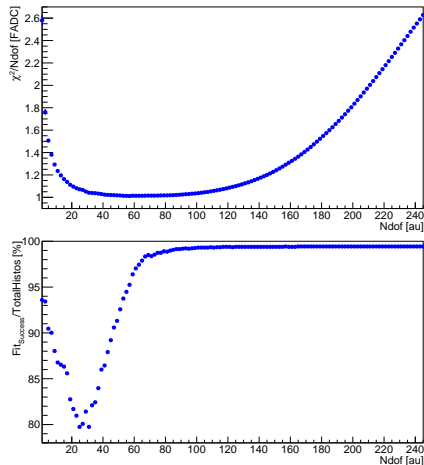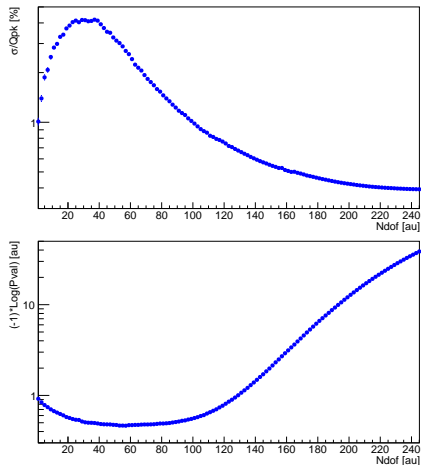
Results obtained with 2nd data set.
From 71 to 121 Ndof, the fit that agrees with: $\sigma/\text{Qpk} < 5\,\%$, and $\chi^2/\text{Ndof} < 2.0$ is the one from which the CQ^{pk} is set.

Validating with Katarina's results (1st data set)

Offline:
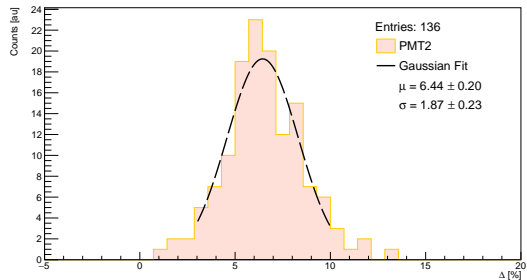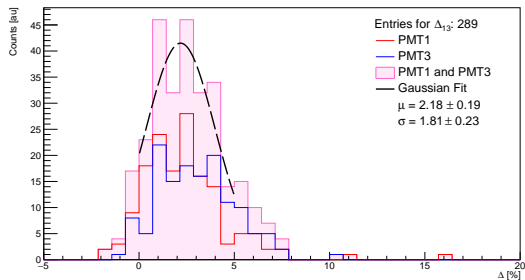
Katarina (Applying a cut for histograms with v/h<0.8)
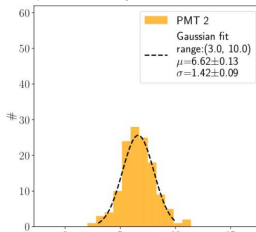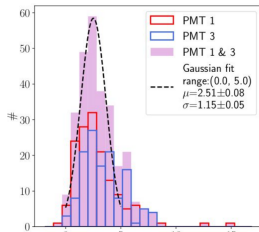
Validating with Katarina's results (1st data set), one by one

O̅ff̲line̲:
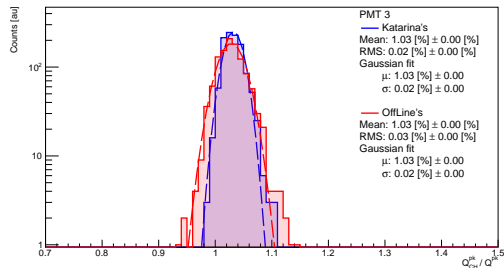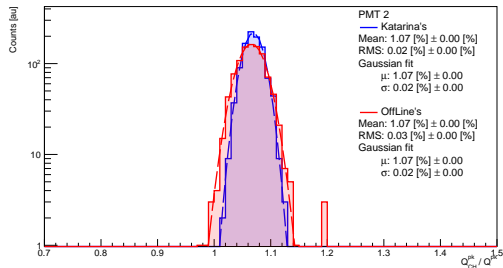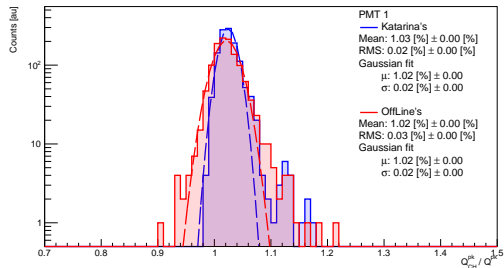
Calculating Δ for 1st and 2nd data set
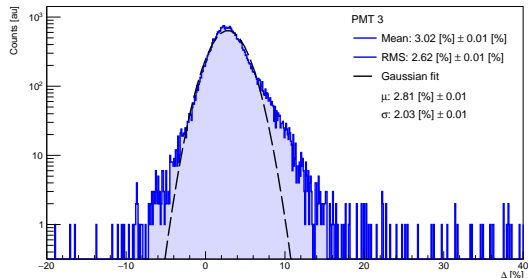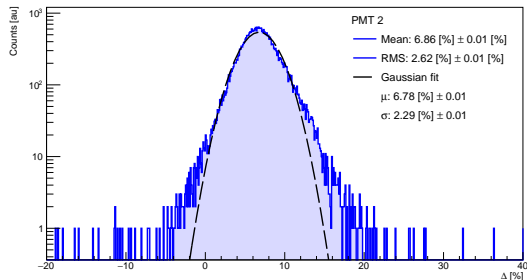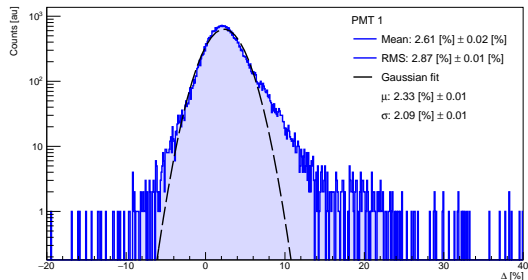
These conversion values are included into: SdHistogramFitterKG.xml.in as variables named *cchargeDeltaFactorPMT{1,2,3}*, respectively.

This mean, now it is possible to choose between using Q^{pk} or CQ^{pk} for VEM calibration: SdTraceCalibrator.xml.in (*useVEMfromCoinci*)

Results for reconstruction (using 1st and 2nd data set)

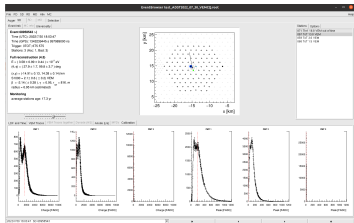Relative magnitude of signals per PMT (Only events with signal in the three PMTs)
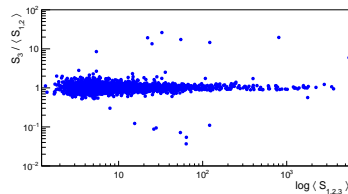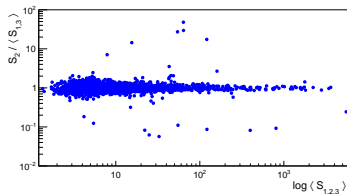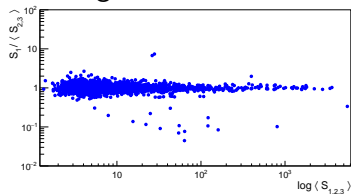
Using Q^{pk}
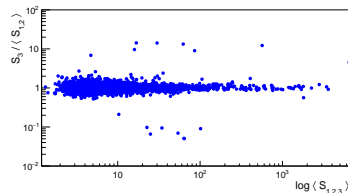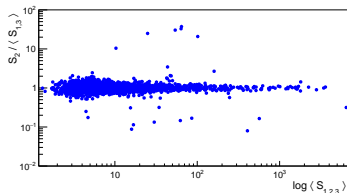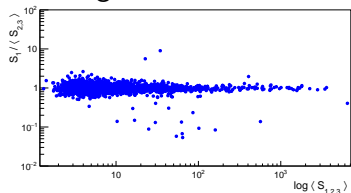
Using CQ^{pk}
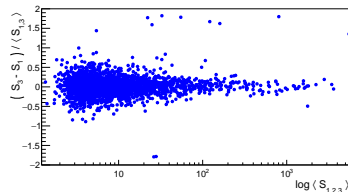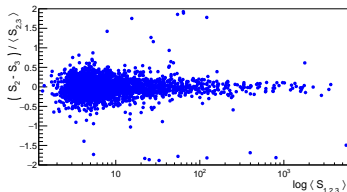
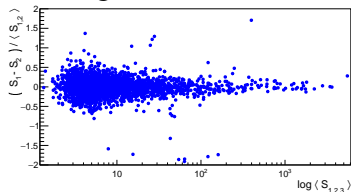# Outlier: event 68958543
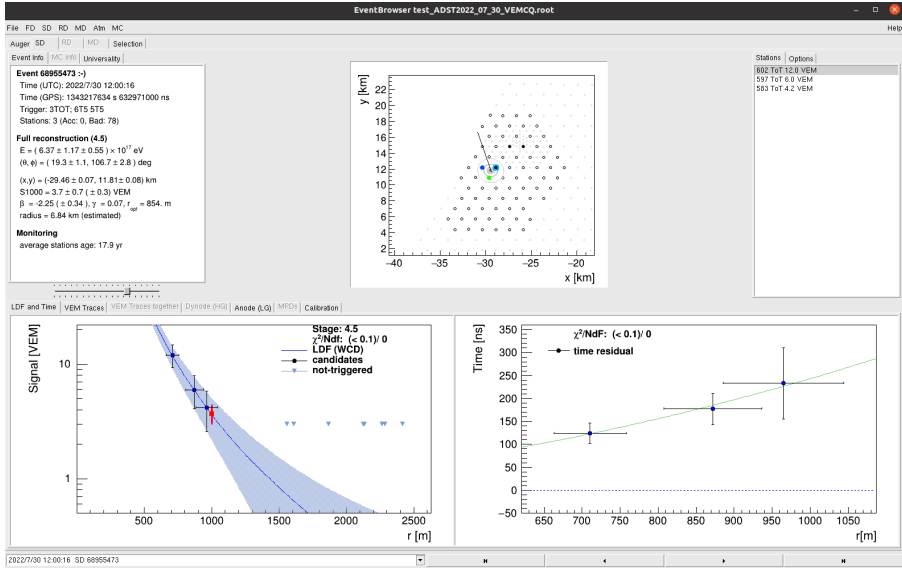
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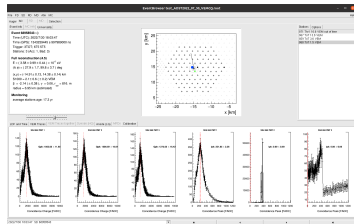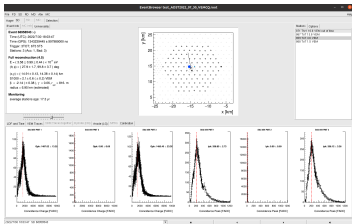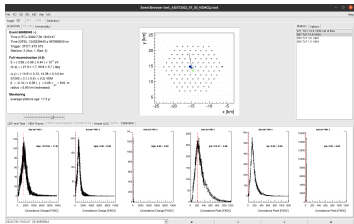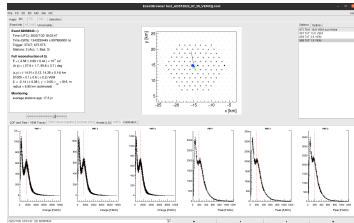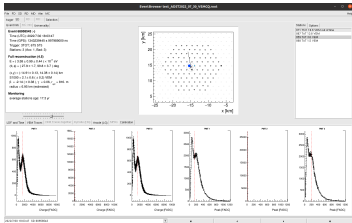
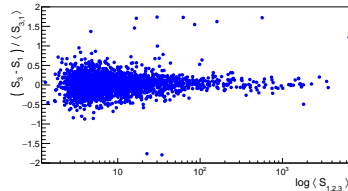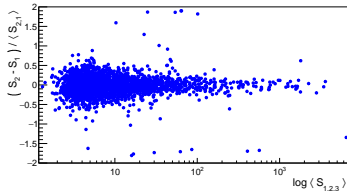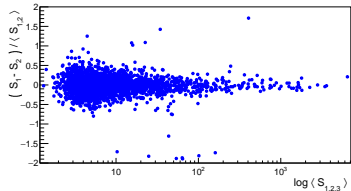# Results for reconstruction (using 1st and 2nd data set)

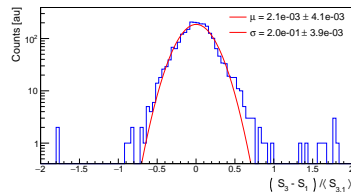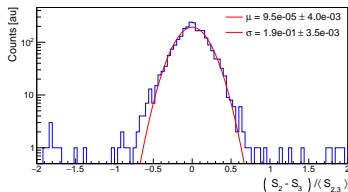Asymmetry of signals in the station (Only events with signal in the three PMTs)

Results for reconstruction (using 1st and 2nd data set)

Distribution of the asymmetry of signals in the station (Only events with signal in the three PMTs)
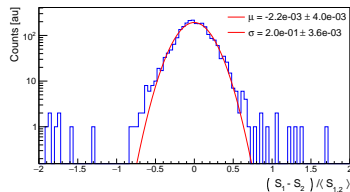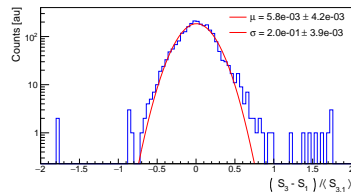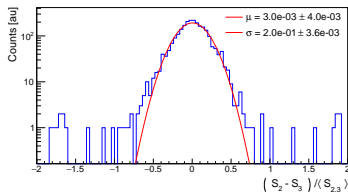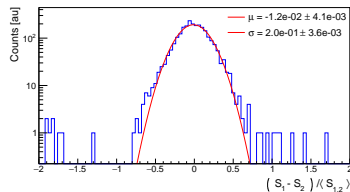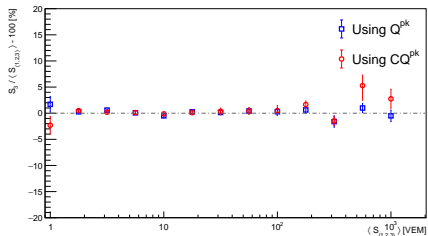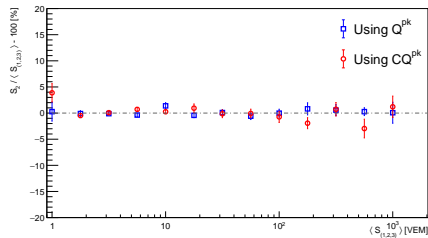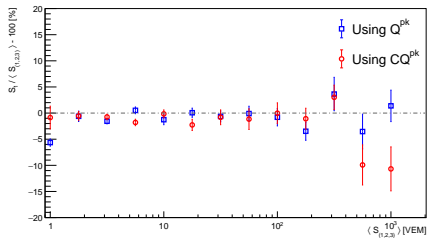
Using Q^{pk}

Using CQ^{pk}

Results for reconstruction (using 1st and 2nd data set)

Signal in a single PMT (Only events with signal in the three PMTs)

An extra check needed to be sure about these differences

Remarks

- ▶ Coincidence histograms able to be include into ad, sd and ADST root files.
- ▶ EventBrowser allows to see the coincidence histograms.
- ▶ A fitting algorithm for coincidence histogram implemented and tested by using 1st data set.
- ▶ This fitting algorithm was validated by comparison with an independent method, i.e. Katarina's algorithms using python/scipy libraries.
- ▶ Δ values obtained with this $\overline{\text{Off}}\underline{\text{line}}$ implementation agree with Katarina's results.
- ▶ An extra check is needed to be sure about the possible improvement in signals using coincidence histograms.