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ToF-Wall Activity Report

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Overview

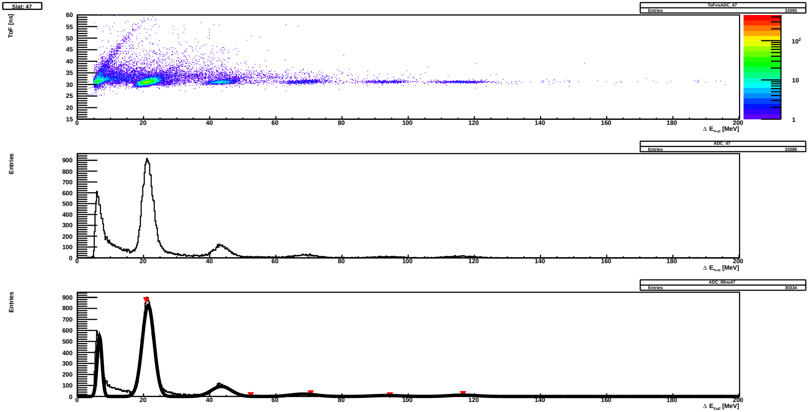
1. Z id Performance on MC
2. Z id Efficiency and Contamination
3. Calibration Stability
4. Next Steps

Peak identification on MC hits

The same approach used for Z id on production data has been followed

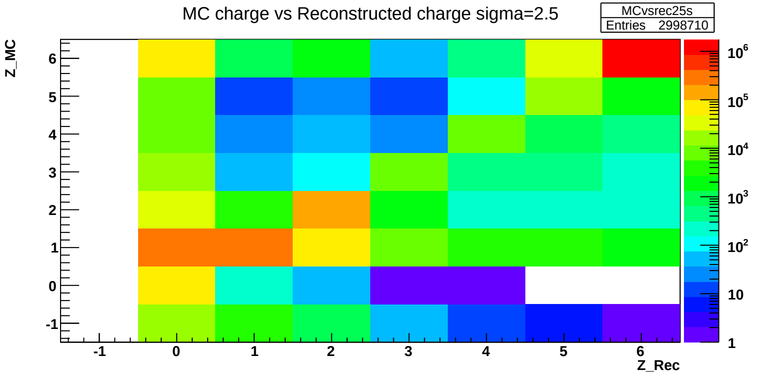
- *ToF* vs E_{loss} plots have been considered
- a *ToF* cut ($\pm 3\,\mathrm{ns}$) has been applied to isolate main spots
- a projection on the energy axis has been produced for each slat
- peaks have been identified on the energy axis
  - for each peak mean position and σ have been recorded
- when the released energy is within $n\sigma$ from a peak,
  the reconstructed Z is assigned accordingly
- a cut at $\pm 2.5\sigma$ has been choosen for a good reconstructed statistics of Carbons

Peak identification on slat 47



Comparison of MC vs Reconstructed Charge at Present

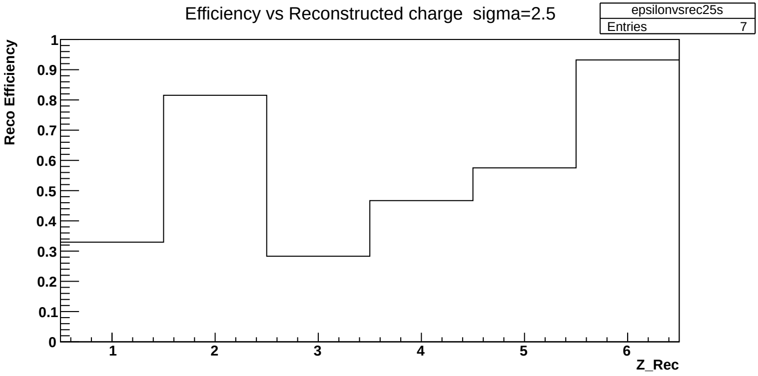
- a diagonal distribution is expected for perfect id
- not diagonal elements show misidentified charges, e.g. element (2,6)
- Note: logarithmic color scale!



Efficiency

$$\epsilon(Z_{Rec}) = \frac{N(Z_{Rec} = Z_{MC})}{N'(Z_{MC})}$$

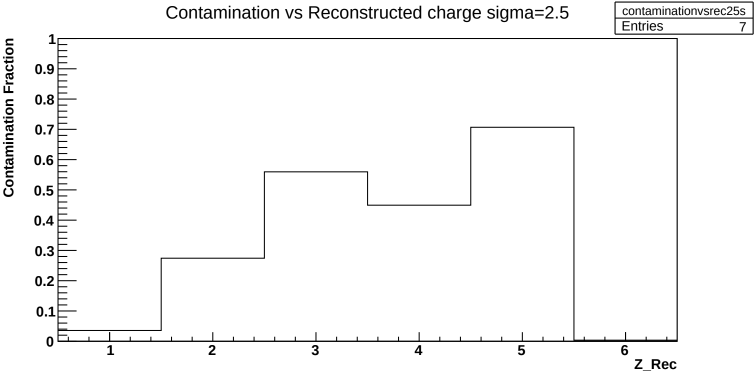
- $N(Z_{Rec} = Z_{MC})$: times the reconstructed and MC charges coincide
- $N'(Z_{MC})$: times a given Z occurs in MC (assumed as true Z)



Contamination

$$\kappa(Z_{Rec}) = \frac{M(Z_{Rec} \neq Z_{MC})}{M'(Z_{Rec})}$$

- $M(Z_{Rec} \neq Z_{MC})$: times the reconstructed and MC charges differ
- $M'(Z_{Rec})$: times a given Z is reconstructed



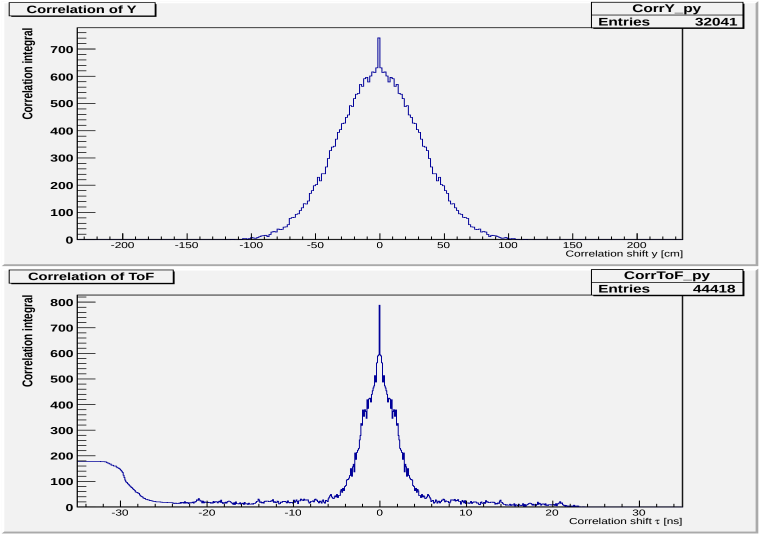
Calibration Stability - Correlation Method

- a correlation method has been applied to evaluate the calibration stability over time (runs)
- run distribution patterns have been compared with a reference distribution (merge of runs 260-264)
- the rerference group has been choosen as close as possible to calibration sweepruns
- the correlation function between the run and the reference distribution, $A(X)$ and $B(X)$ respectively, has been evaluated

$$R(\xi) = \int A(X - \xi)B(X)dX$$

- the peak position indicates the calibration drift - peak position @ zero means no drift

- run 400, slat 40 - Y and ToF correlation plots

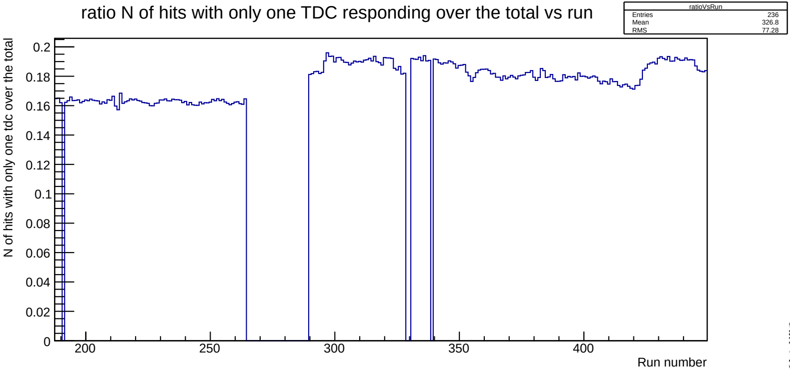


Work in progress

- for Eloss the method must be modified
  - Eloss is non linear with respect to calibration parameters
    - pedestals can be compared first and
    - then scaling correlation must be evaluated (a different correlation function is needed)

Under-threshold hits

- several hits (mostly protons) release under-threshold energies
- only 1 TDC channel fires in the slat
- the plot shows the fraction of statistics that is lost for a missing TDC



Single Channel Issue

In order to recover some lost statistics it is necessary:

- exploit redundancy in TDC and ADC readings
  - info for hits missing one reading can be completed
  - single channel TDC calibration can be retrieved from Y and ToF calibration parameters (Δ_t,Δ_b)
  - single channel ADC calibration is needed
    - the sweeprun vertical coordinate is provided by wedge bar position
    - wedge bar is centered on the slat height (just checked)
    - wedge bar height is 7 cm
      calibration beam position uncertainty is ± 3.5 cm
    - Y can be better estimated by cross-checking with Vertex data (need for HIReco)
- any re-calibration should consider the position of MUSIC dead material for side and central slats

Single channel ADC calibration

$$ADC'_t = \epsilon_t E_0 e^{-\alpha[Ls-Y]}$$
$$ADC'_b = \epsilon_b E_0 e^{-\alpha[L(1-s)+Y]}$$

$$E_0 = \sqrt{\epsilon_t * \epsilon_b * e^{-\alpha * L}} * \sqrt{ADC'_t * ADC'_b} = K * \sqrt{ADC'_t * ADC'_b}$$

$$Y = \frac{1}{2\alpha} \log\left(\frac{ADC_t}{ADC_b}\frac{\epsilon_b}{\epsilon_t}\right) - \frac{L}{2}(1-2s)$$

- ϵ_t and ϵ_b are PMT gain factors, α is the attenuation coefficient along the slat, L is the slat length, $s \in (0,1)$ is the length fraction indicating where the beam impings (Ls is the distance from the top PMT, $L(1-s)$ from the bottom one)

Single channel ADC calibration

- E_0, Y are known in sweepruns: 2 equations, 3 unknowns (ϵ_t, ϵ_b, α)
- WANTED α: two different coordinates Y and Y' must be selected to provide another equation
    - larger $\Delta_Y = Y - Y'$ lead to lower uncertainty propagation to calibration parameters
    - the beam spot spread is less than 1.5 cm in sweepruns!
    - alternate take: assume α is the same in all slats, separate two hit distributions, for Y and Y' respectively, on one slat in production runs and build two equations

Front and Rear Hit Clustering

- gather data from FRONT and REAR walls related to a unique track
- a cluster can be built on the basis of suitable criteria
  - X (slat), Y, ToF and Eloss compatibility
    - tilted tracks on right side slats lead to higher shift in slat number between front and rear walls
    - analogous reasoning holds for Y coordinate - higher Y implies higher vertical shift
    - REAR-panel ADC measurements have to be handled appropriately (e.g. $\approx 116\,\mathrm{MeV}$ loss on front-wall for Carbon)
  - issue: no direct track coming from target through ALaDiN acceptance flange reaches the first 33 slats

THE END

Thanks for your attention