Step by step TWIM Calibration

6. April 2022

0.1 Overview

For this calibration I used the data of Experiment S455 in March 2021, Run 273, subruns 1-48.

1. Alignment of the energy per Anode for each Section
2. Alignment of the energy per Section
3. Drift time Calibration

Info: I always count from 0 to 15.

0.2 Alignment of the energy per Anode for each Section

For the Energy, you should first align all the gain per anode by plotting for each section:
Eraw[anode i] vs Eraw[anode ref].
anode ref = the 5th anode
I plot these 2D histos only for events where the 16 anodes per section have seen an ion. (no specific tpat selection needed).

0.2.1 Computing

First run the program "small_script_hist.C" for all subruns. Then use "hadd" to add up the .root files. The combined .root file can then be used for the scrip called "retrieve_fits_hist.C ". This one makes nice canvases for the plots anode[i] vs anode_ref and stores the fit parameters under parameters_twim_anodes.csv.
In this directory you find the parameters_twim_anodes.csv I retrieved from this first calibration step. The offset (=gain) should be near to 1.

Design of parameters_twim_anodes.csv

It stores section(s), anodenr(i),slope,offset
$E\_sum\_ref * slope[i][s] + offset[i][s]$
To calibrate you have to do it the other way round:
$E\_cal\_anode[i][s] = E\_anode[i][s]/slope[i][s] - offset[i][s]/slope[i][s]$

0.3 Alignment of the energy per Section

- you should select event where the ions loss their energy in one section only
- then you should select a limited range in ToF (100 ps range)
- then you should calculate for each section Esum[s], the sum of the 16 anodes (using $E\_cal\_anode[i][s]$ from the previous step).
- you should see a small shift between the four sections
- correct from this shift by pol1
- as result you get: $Eal\_step2final[s][a] = OffsetPerSection[s] + GainPerSection[s] * E\_cal\_anode[i][s]$

0.3.1 Computing

Run the macro "twim_sum_energy.C" using all subruns as input parameter. As output you get a .root file with 1D histos with the summed TWIM energy for each section. Use this output .root file as input file for the macro "e_sum_cal.C".This uses TSpectra etc. to (linearly) calibrate the E_sum energy for all sections. The according fit parameters are stored in the parameter file "sum_anodes_parameters.csv".
Now you can use the macro "twim_final_cal.C" (as input parameter the name of the subruns). This macro uses both parameter files "parameters_twim_anodes.csv (anode fit) and "sum_anodes_parameters.csv"(summed energy fit). Now E_sum is calibrated.

0.4 Drift time Calibration

After this calibration you can extract the angle before GLAD from TWIM Music. From the signal of Music we do not get directly position information, but timing. Using the information from MW1 and MW2 the position on each anode can be extrapolated (2X and 2Y positions are needed in MW1 and MW2. For the precise reconstruction see macro rift_analysis_tref.C and mw_position.C):
Xal = FF_slope * anode_pos +FF_offset
This has to be done for each fission fragment (FF).
For this calibration only selected FF combinations are used (no tpat selection:

- subcase 2X2Y-D: one left down and one right down
- subcase 2X2Y-U: one left up and one right up
- subsubcase 2X2Y-LD-RU: one left down and one right up
- subsubcase 2X2Y-LU-RD: one left up and one right down
- subsubcase 2X2Y-L: one left down and one left up
- subsubcase 2X2Y-R: one right down and one right up

Important to mention, I only select events where each anode has exactly one value assigned, not more. All sections have a reference anode. The time for the anode is calculated:
t_drift[s][a] = time[s][a] - time_ref[s]
Plotting Xal versus drift time, the drift velocity on each anode can be extracted.
From this you retrieve Xcal for each anode of each section:
Xcal[s][a] = X_OffsetPerAnodePerSection[s][a] + DV_PerAnodePerSection[s][a]*DTraw[s][a] (where DV_PerAnodePerSectio
is the drift velocity)

0.4.1 δx correction

As next step the calibrated positions from all 16 anodes (Xcal[s][a]) for one section can be fitted for each event. For the fit I used anode 1-10 (see figure 1).
From this linear fit you get Xfit[s][a].
Then you plot DeltaX[s][a] = Xfit[s][a]-Xcal[s][a] versus Xcal[s][a].
Here you will see that it is not flat. This is normal because there are non-linearity due the cathode effect and attachment. I fit this using a TSpline. From this fit we can flaten the DeltaX vs Xcal plot and deduce the position resolution.

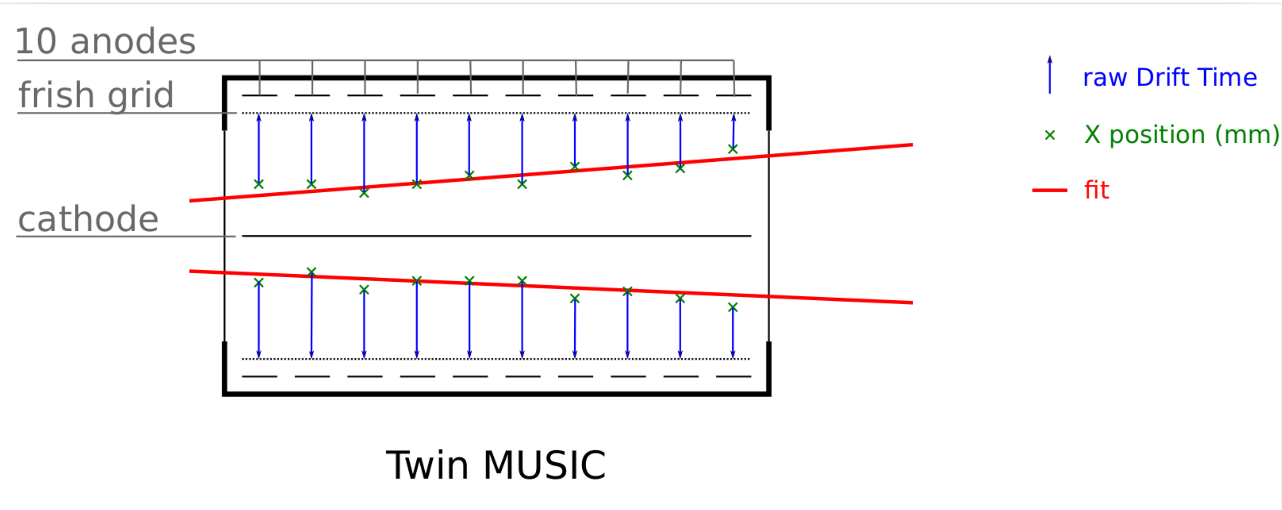

Abbildung 1: Calibrated positions (green) vs. fit (red). The fit is done using anode 1-10.