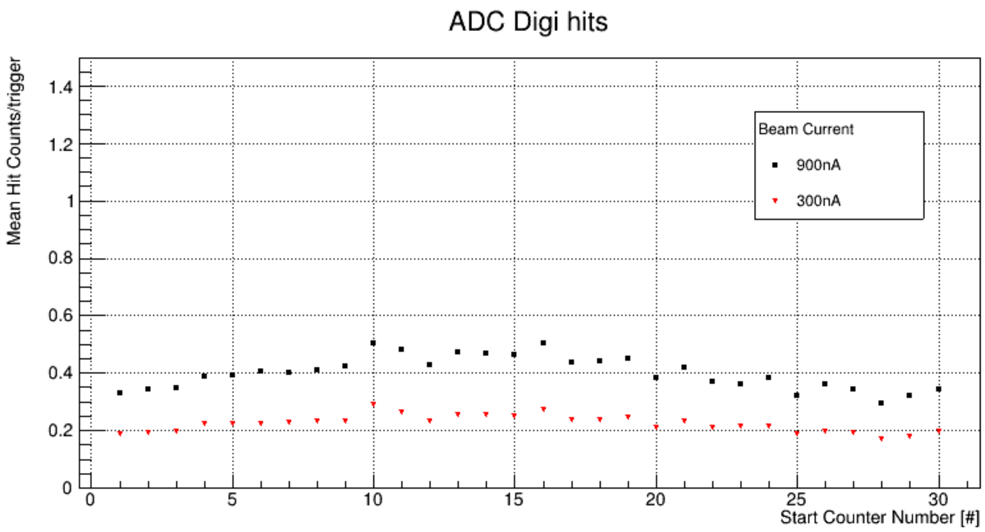
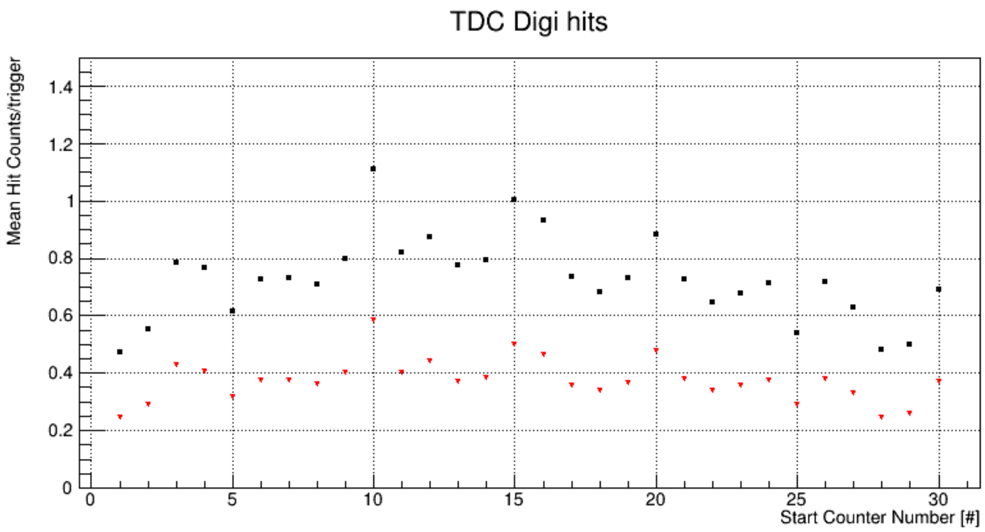
Start counter evaluation, comparing run 121039 data with run 120847 data.

Both these runs are taken in raw mode with the same configuration file and configration parameters.
in particular the following flash ADC parameters are the same in both runs
FADC250_W_WIDTH 80
FADC250_NSB 5
FADC250_NSA 20
FADC250_NPEAK 3
FADC250_READ_THR 120

Run 121039 was taken with 900nA e-beam current on diamond PERP, raw mode
Run 120847 was taken with 300nA e-beam current on diamond PARA, raw mode

The frist plot shows the relative rates in the ADC and TDC. The values are number of hits normalized to the physics triggers. The horizontal axis is the Start Counter counter number the vertical axis is the mean number of hits per trigger.





it is evident that the rates in the detector are higher for the 900nA beam which is expected. The threshold in the discriminator is set lower than in the flash ADC (w.r.t. base line) give by the fact that the rates are higher in the TDC than in the ADC. In some cases as high as 1 or more which means every trigger has a hit in that counter (10 and 15).

Next we look at the pulse peak amplitude distribution and the pedestal for both these runs. The following plot is representative of all paddle counters. The top plot shows the pedestal peak around 100 ADC counts with a tail towards higher value. This tail is most likely cause by the rather low readout threshold and would most likely be much less with a higher readout threshold. However, the higher beam current does affect the pedestal peak a little by

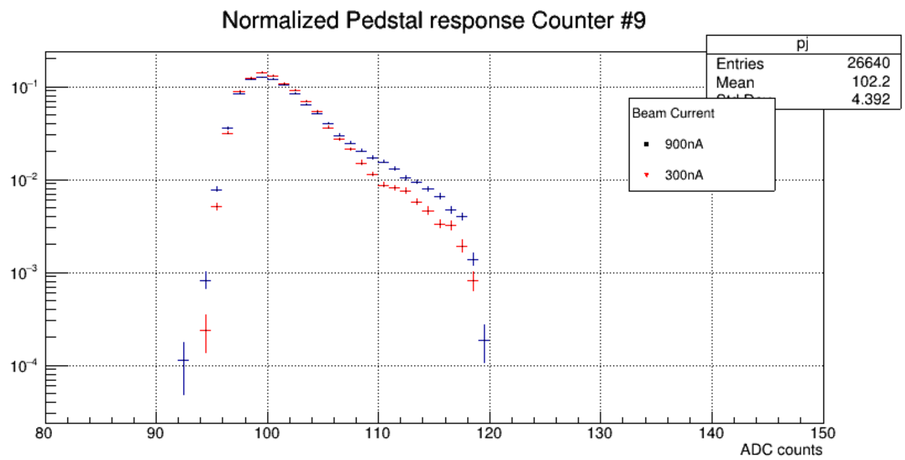
a) making the pedestal peak slightly wider

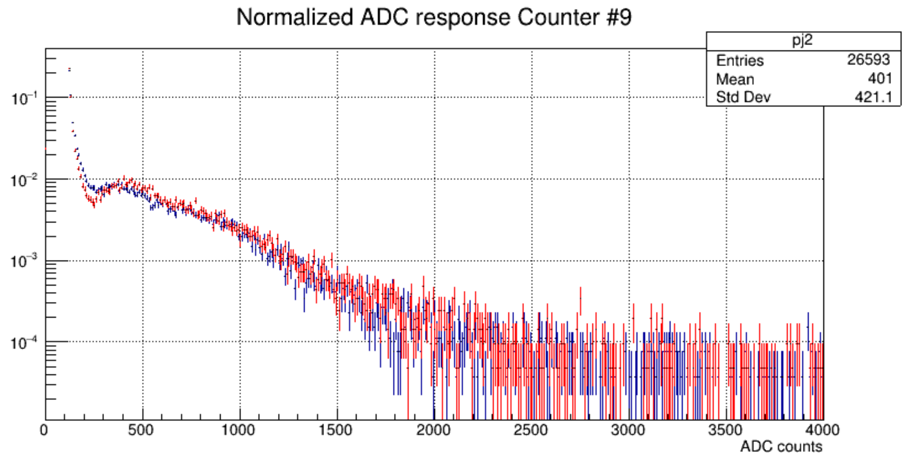
b) incrase the tail contrubtion to larger ADC values

The bottom plot shows the signal peak amplituded for all hits that were reported with a good pedestal. It is quite visibly different between nomial beam current and high beam current. At high beam current the amplituded seems to be slightly diminished or because of the enhanced tail of the pedestal the "gap" between pedestal and "landau peak" is more "filled". The separation between pedestal and signal is less prominent. This may also be an artefact of the the low readout threshold.

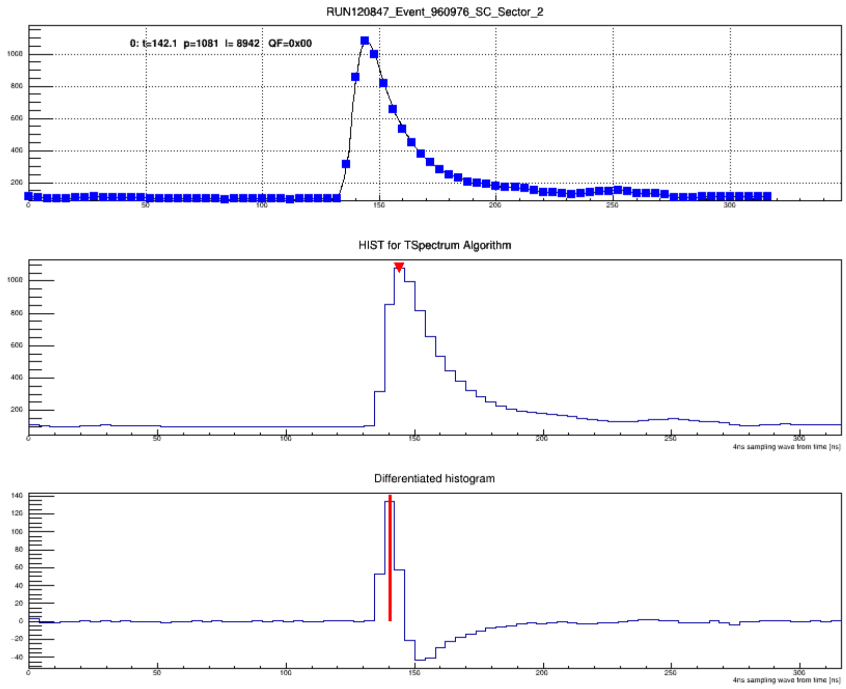
It will be useful to check if the readout threshold could be increased. This can be studied by looking at matched hits to tracks and plot the amplituded as a function of position along the paddle to test how high the threshold can be without impact on the efficiency.

Note, the histograms are normalized to the number of entries in the histogram to better compare the two run conditions. The pedestal width for the counters is between 2 and 2.5 ADC counts.

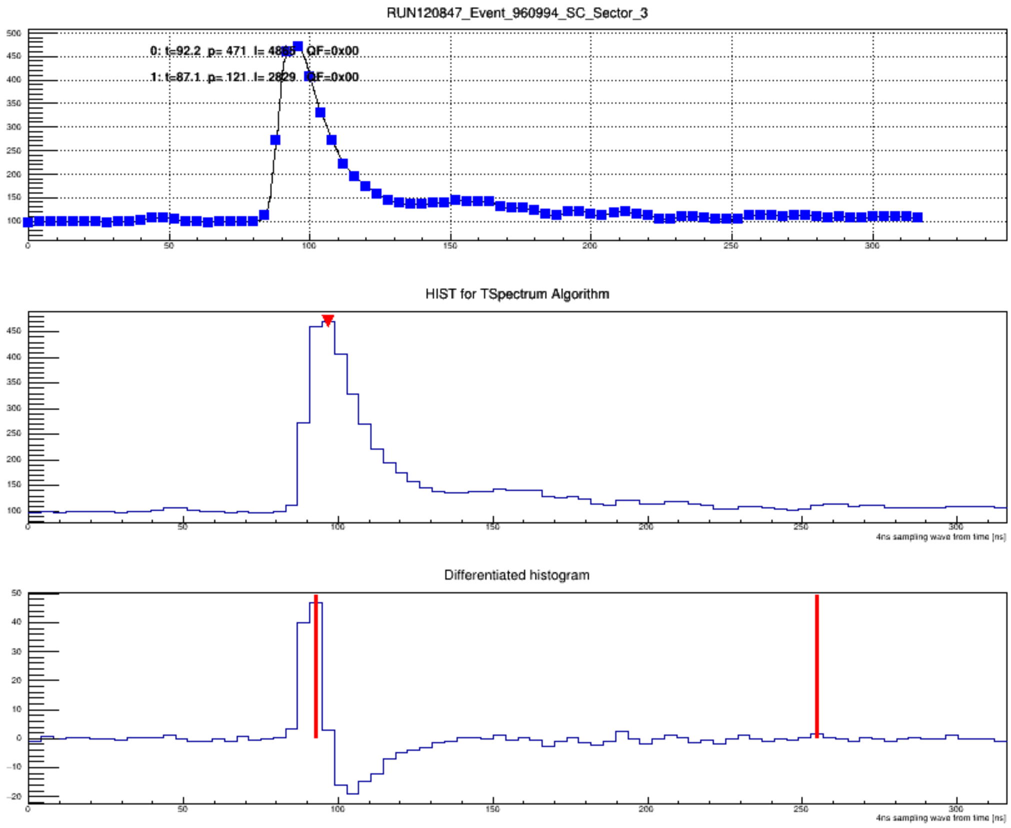




In the following we use the raw mode data to look more closely at the wave forms from the start counter paddles as well as the associated values reported by the FPGA algorithm.
The first wave form is an example of well defined pulse with a larger amplituded demonstrating the correct response of the algorithm running on the FPGA. The middle histogram is just the wave form subjected to the TSpectrum root class to find the peak location with that application. The bottom histogram is the differentiated wave form and used to identify peaks.

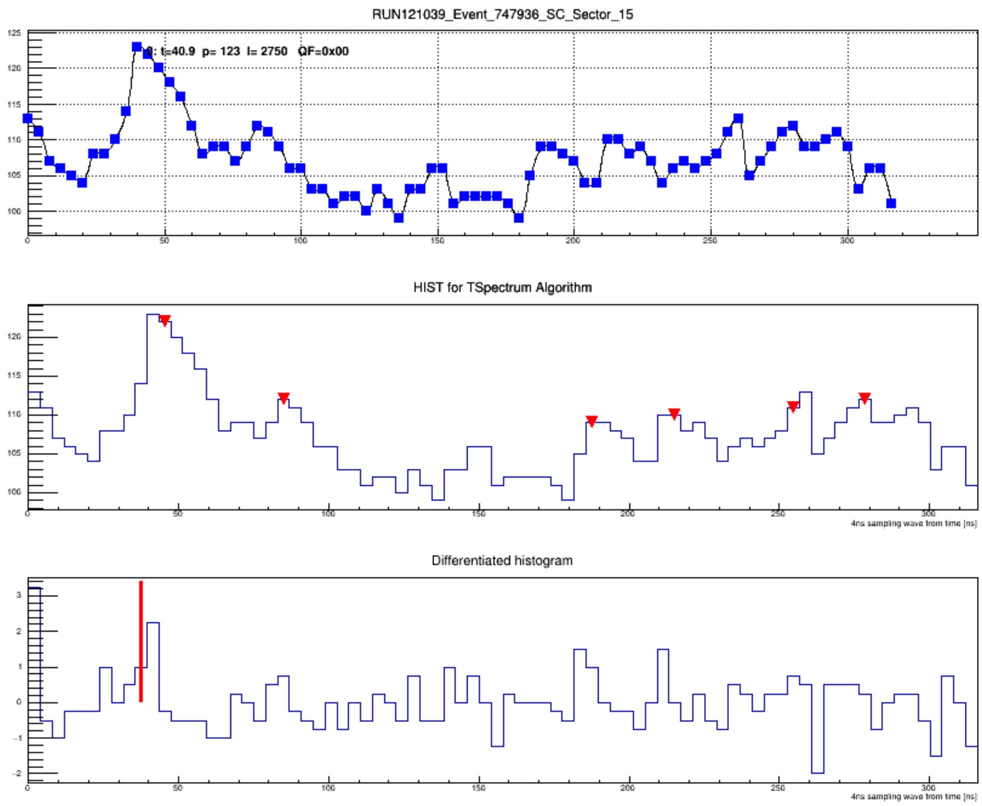


The second example of a wave from is to illustrate some problem with the algorithm running on the FPGA. In this case there is one nice pulse however the ADC reports two pulses a first one with the correct time and ampliutude but then a second with a time that is in fact earlier (by 5.1ns) with a much smaller pulse peak amplituded. This is also seen in other detectors but it seems to be more frequent in the start counter data. It may have something to do with the rather small readout threshold but at this point it has not been investigated what causes this error.



All the above wave forms are from run 120847, data taken with the nominal beam current on target. In the following we look at wave forms from run 121039 with a three times high beam current. Similar conclusions can be drawn here. However, it seems that the low readout threshold causes more wave forms with small signal amplitudes almost like noise.

In this first example the pulse is barely above threshold (p=123) and one sees a rather "noisy" wave form that is more irregular than what the width of the base line would suggeest. Note here that first four samples of this wave form are not even close to 100 (the base line) but the algorithm does not report this as a problem and the QF is zero. This is an example of what causes the pedstal tail.



Where the algorithm clearly has problems is detecting "pile-up". If a second pulse is too close to the first it will not be detected. The second pulse sits on the tail of the first and does not trigger another peak search in the algorithm.