

# First results of the PM Calorimeter November 2015 BFT test

Padme meeting LNF 14/1/2016

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PM Calo runs : 304 (150 MeV), 305 (297 MeV), 302 (431 MeV)  
3\*3 cm crystals (same as old BTF test)

Always used positive signal - pedestal subtracted  
Normalized at 1 V  
9 read detectors + trigger signal

# First results of the PM Calorimeter November 2015 BFT test

Successfully used old run analysis program with new Padme event class prototyping by E. Leonardi.

Changes easy to implement.

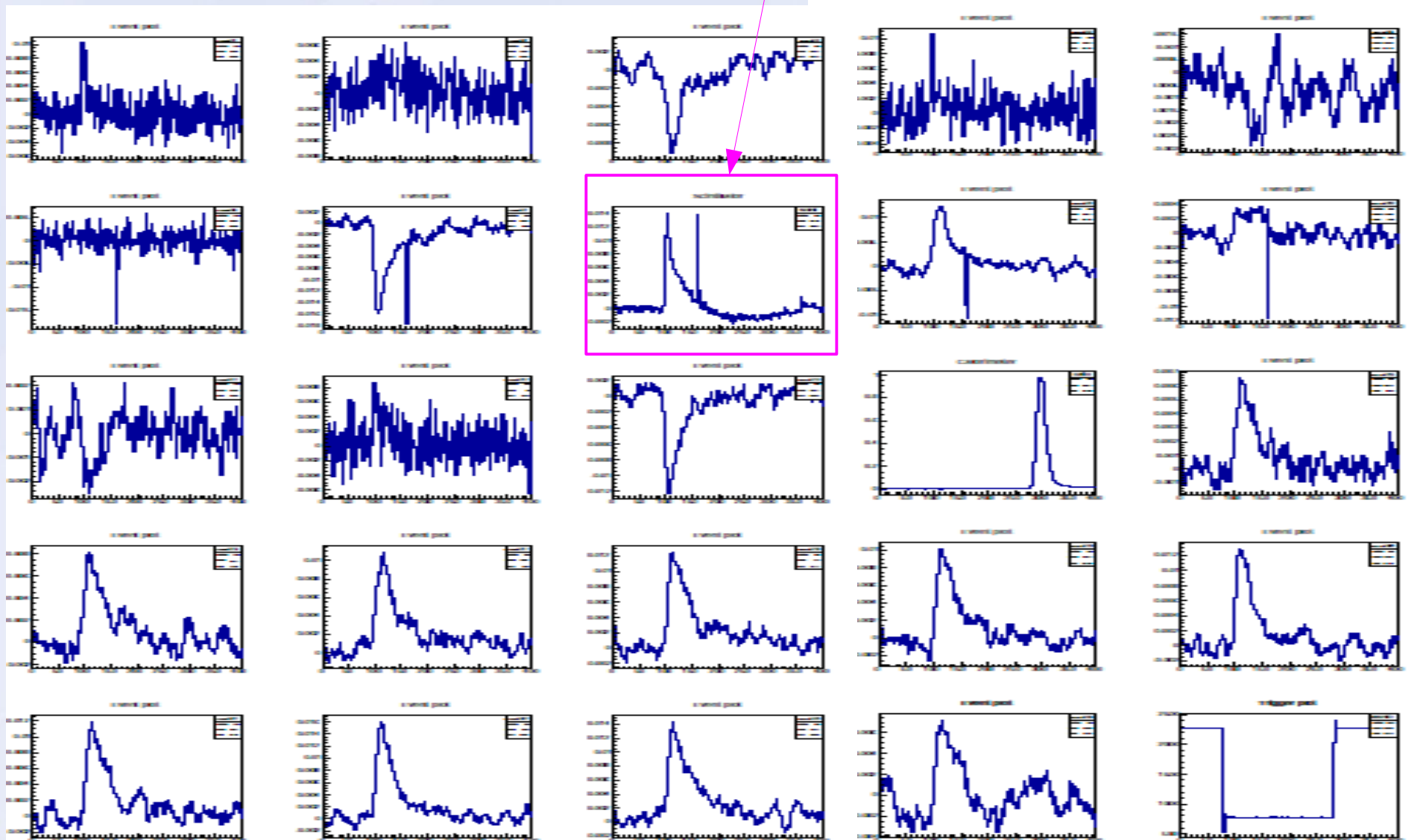
Analysis started on 3-4 files/run only (not yet on Padmesrv1 – done on proprietary machines, thanks to Emanuele).

In other talk results also for APD calorimeter.

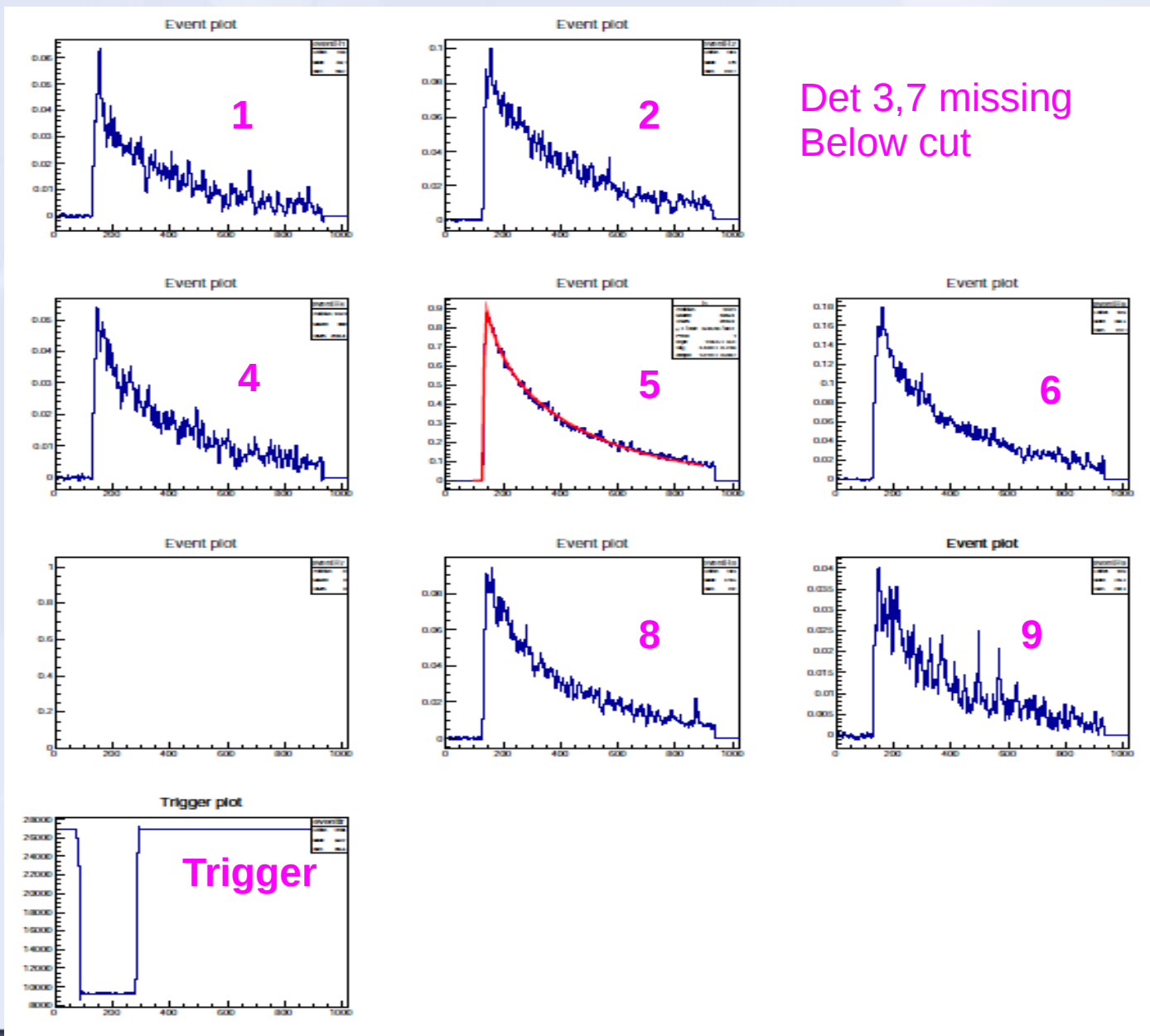
Started also analysis on diamond detector data and scintillator for timing – no results to show yet.

# Run 90 – Diamond detector in

Just to show 1 event of run 90 – **scintillator finger** working quite well



# PM Calo Event – run 302



# Signal fit detector 5 unsaturated

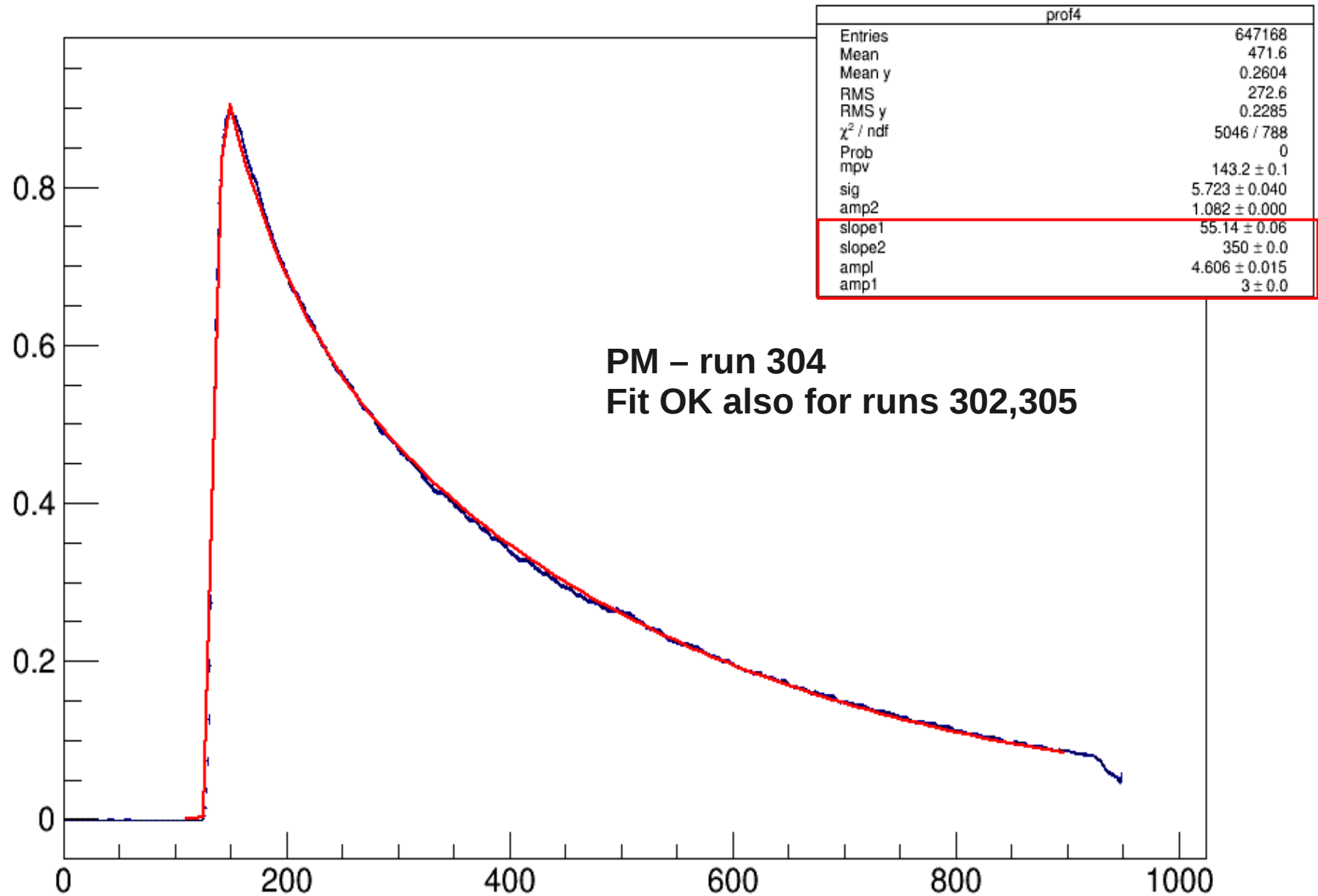
Profile plot fit of detector 5  
(center crystal - 5 point smoothing) :

Signal rise :  $A_{\text{landau}} * \text{Landau}(\text{mpv}, \text{sigma})$   
Until Landau mpv

Signal descent - After Landau mpv :  
 $A_1 * \exp(-t/\tau_1) + A_2 * \exp(-t/\tau_2)$   
("fast" component + one with  $\sim$  BGO decay time)

**7 free parameters in fit**

# Signal fit detector 5 unsaturated



# Fit detector 5 unsaturated

Only 3 free parameter fit :  $A_2$ , mpv, sigma

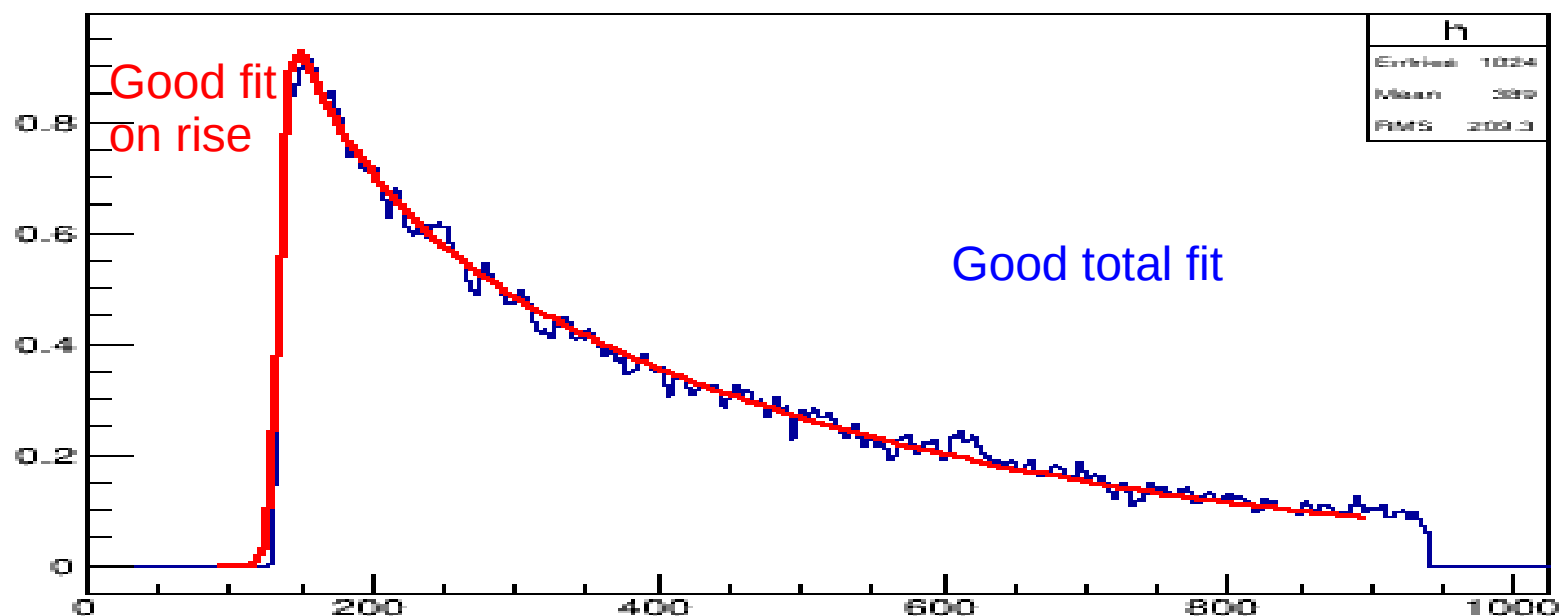
Fit made on range (100:900 nsec) of signal

Amplitudes fixed as proportionals to  $A_2$  (free in fit)

$$A_{\text{landau}} = 4.26 \cdot A_2 \quad ; \quad A_1 = 2.772 \cdot A_2$$

Fixed  $\tau_1 = 55.14$  nsec ,  $\tau_2 = 350$  nsec (expected 300 nsec x BGO)

Event plot

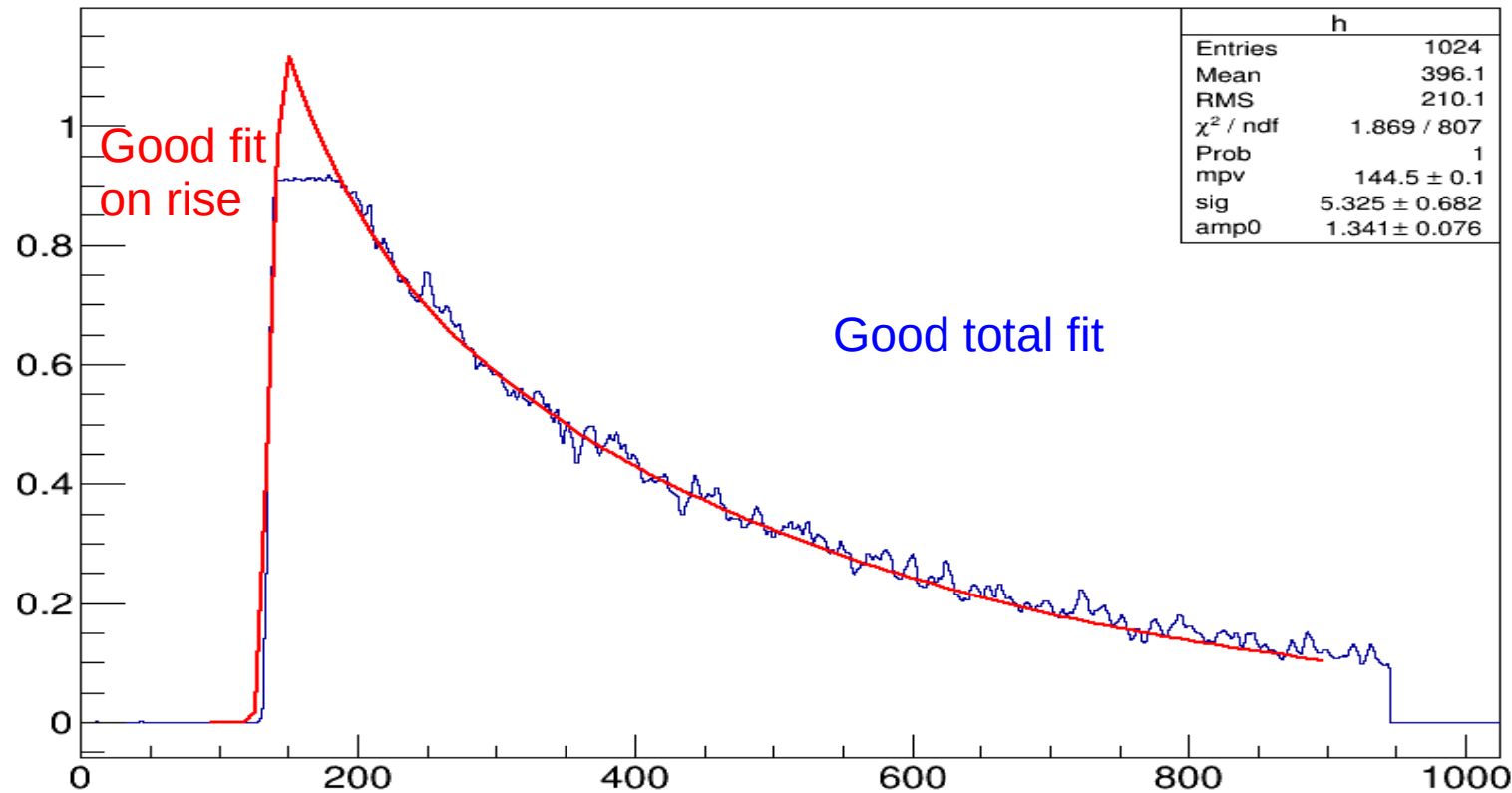


# Fit detector 5 saturated

Only 3 free parameter fit :  $A_2$ , mpv, sigma

Used same fixed and proportional values as unsaturated fit.  
On saturated events fit made **only on unsaturated range**  
(signal < 0.93 V) **and then we may show on all range**

Event plot



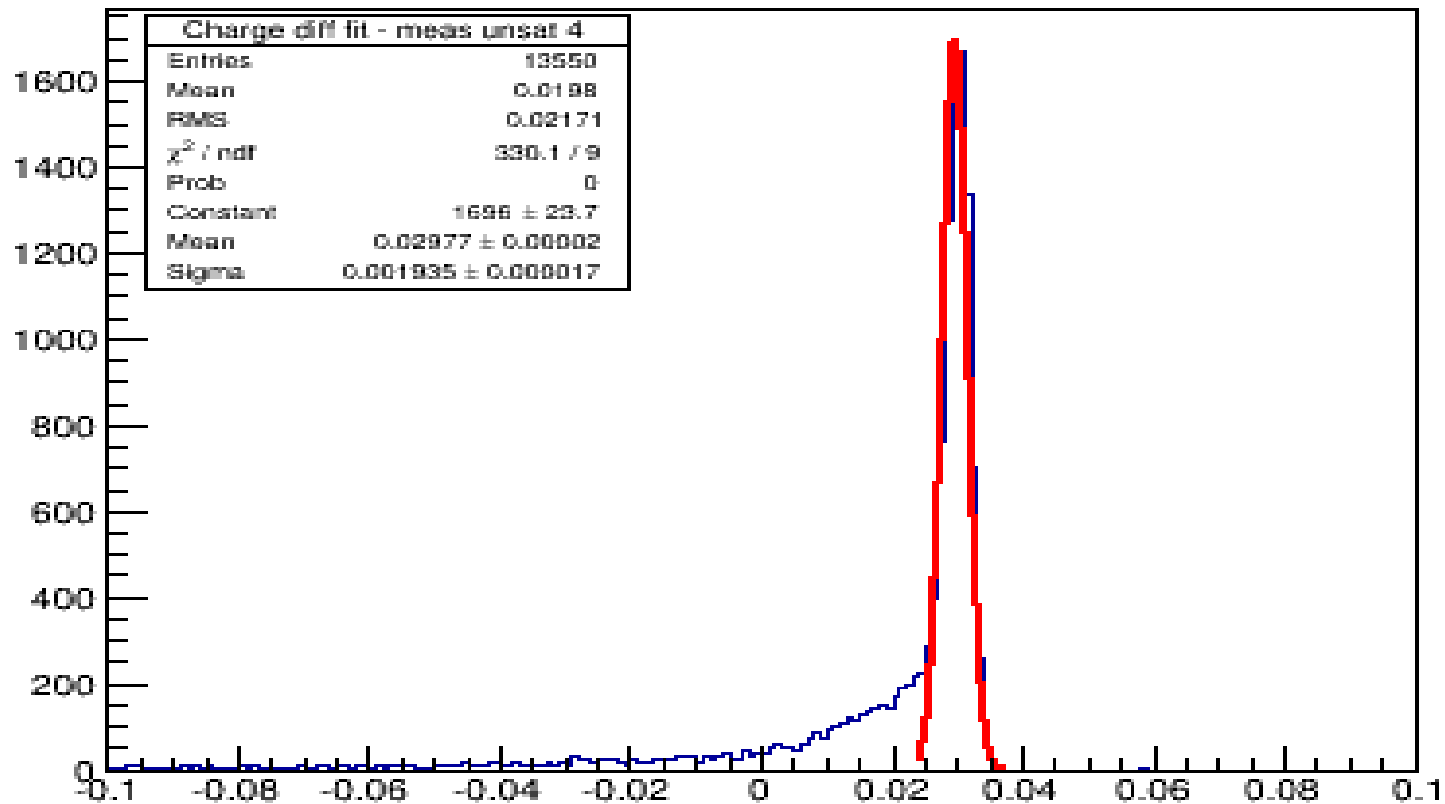


# Q fit - meas difference

Percentage difference fitted -measured charge (signal)  
on unsaturated events – center detector  
Similar for all runs

Fitted mean :  $+2.98 \pm 0.002 \%$

Charge diff fit - meas unsat 4



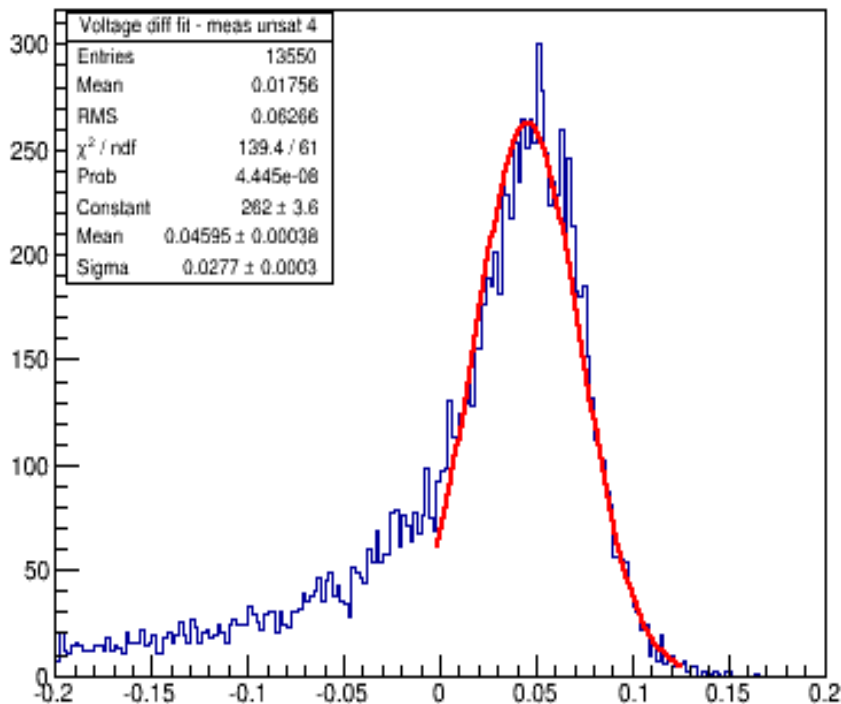
# Vmax fit - meas difference

Percentage difference fitted -measured Vmax (signal)  
on unsaturated events – center detector  
Similar for all runs

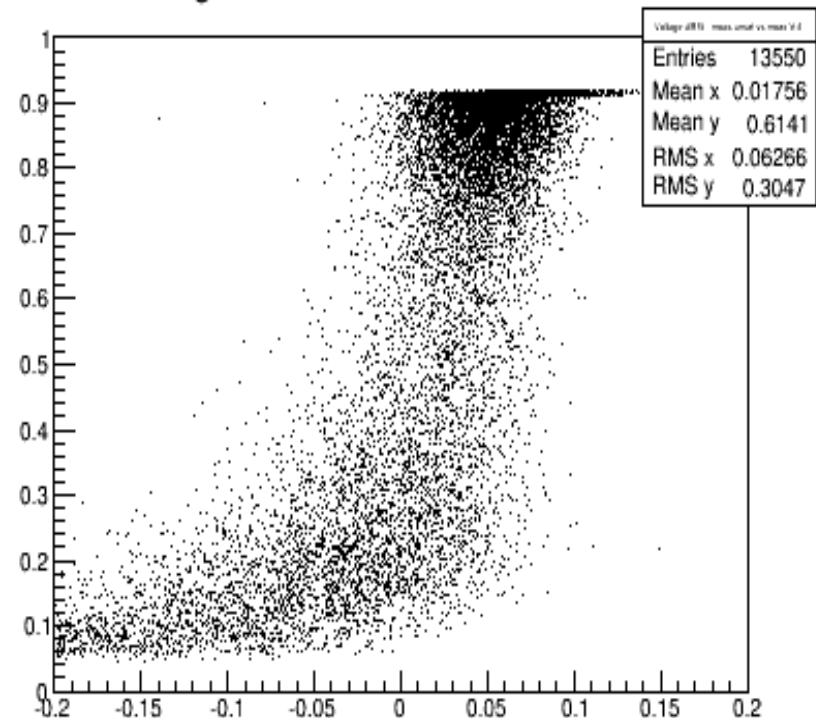
Fitted mean :  $+4.60 \pm 0.04 \%$

Peak mostly at highest values – to be used for correction ?

Voltage diff fit - meas unsat 4

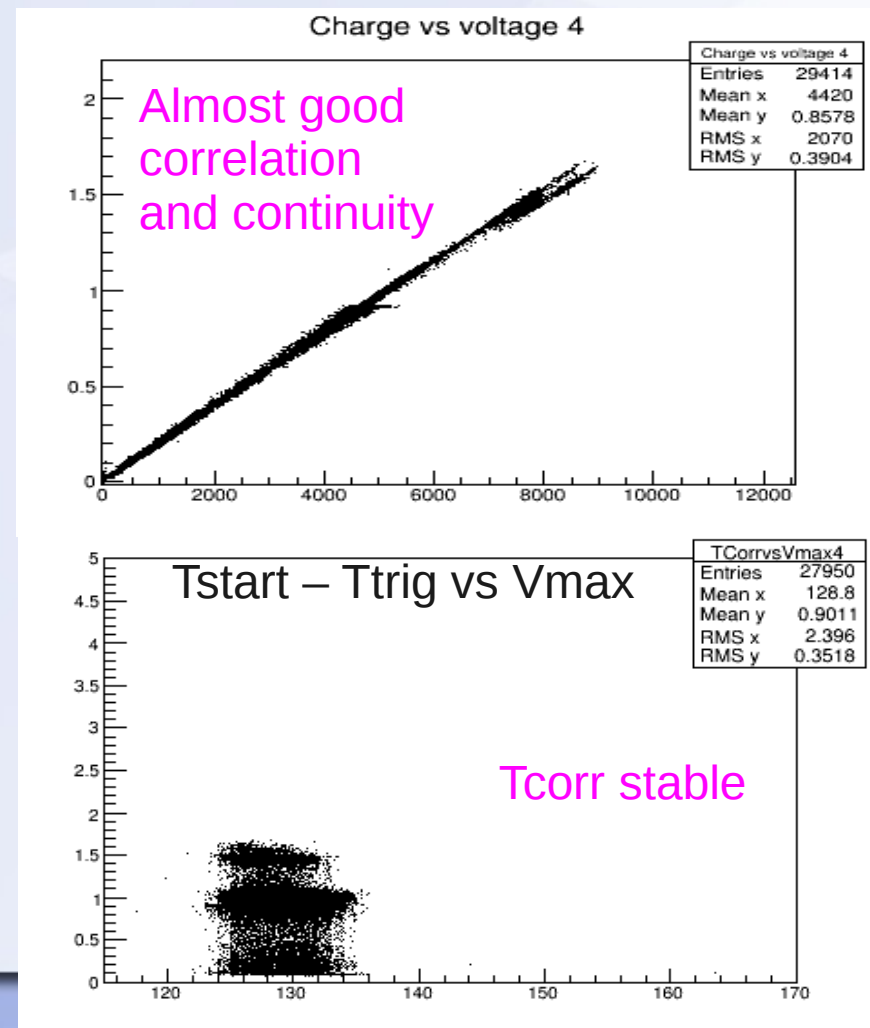
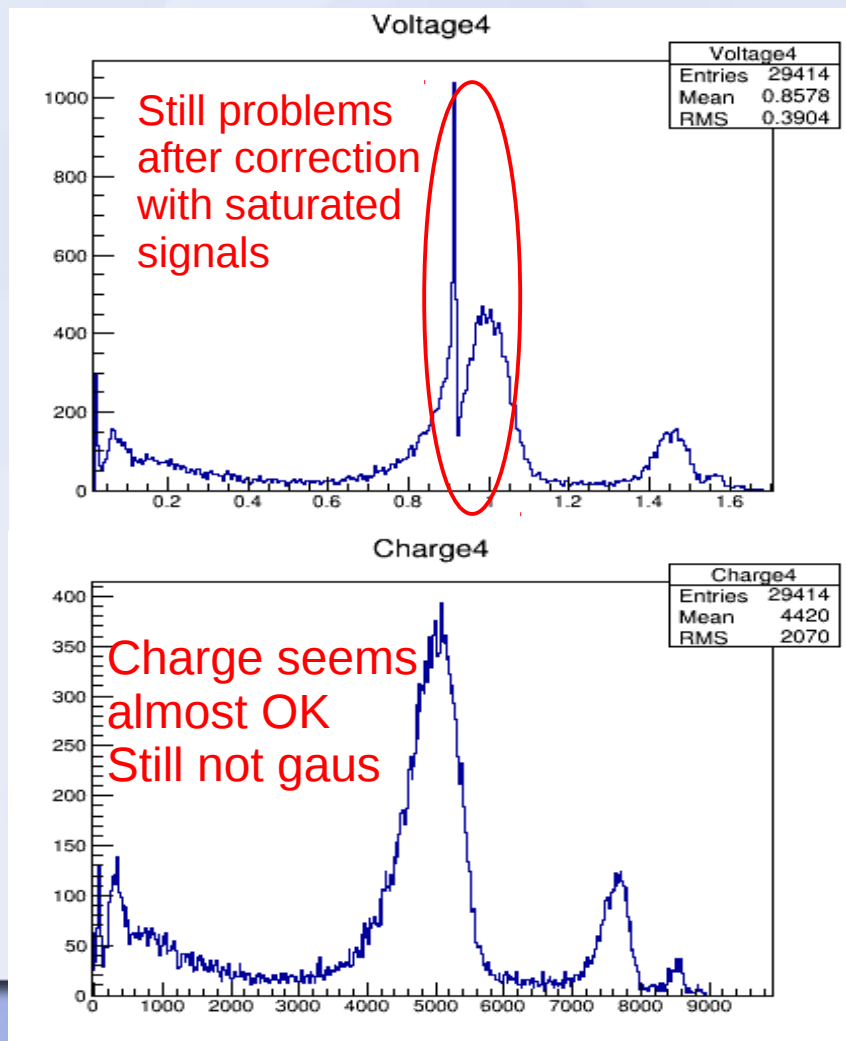


Voltage diff fit - meas unsat vs meas V 4



# Results detector 5 – run 302

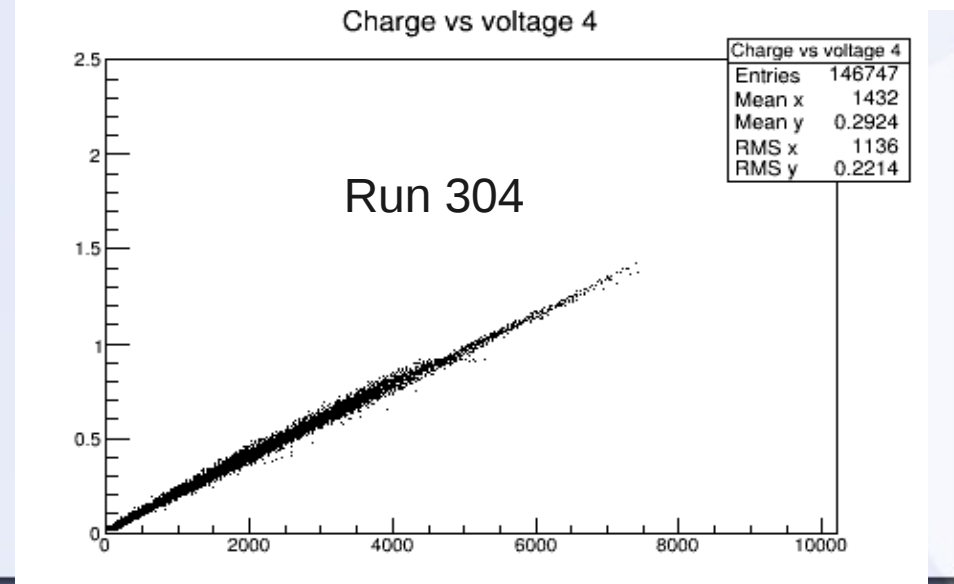
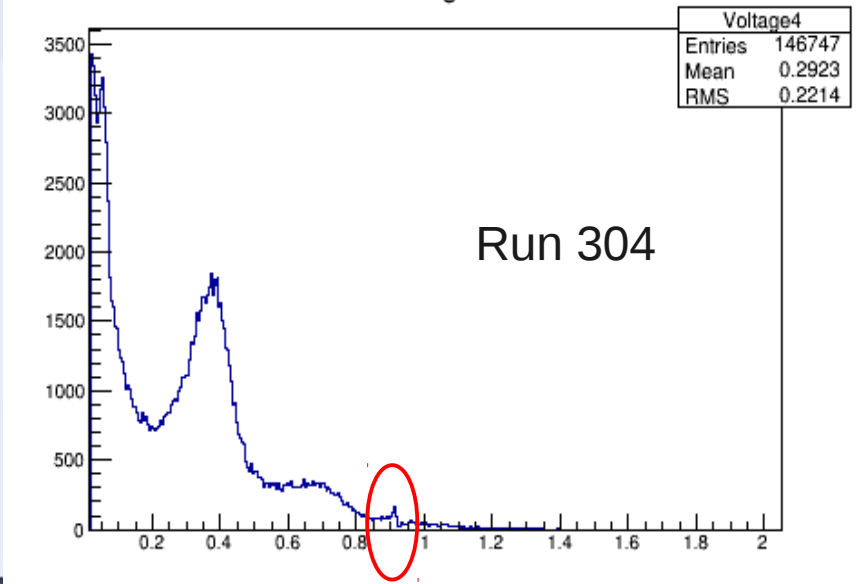
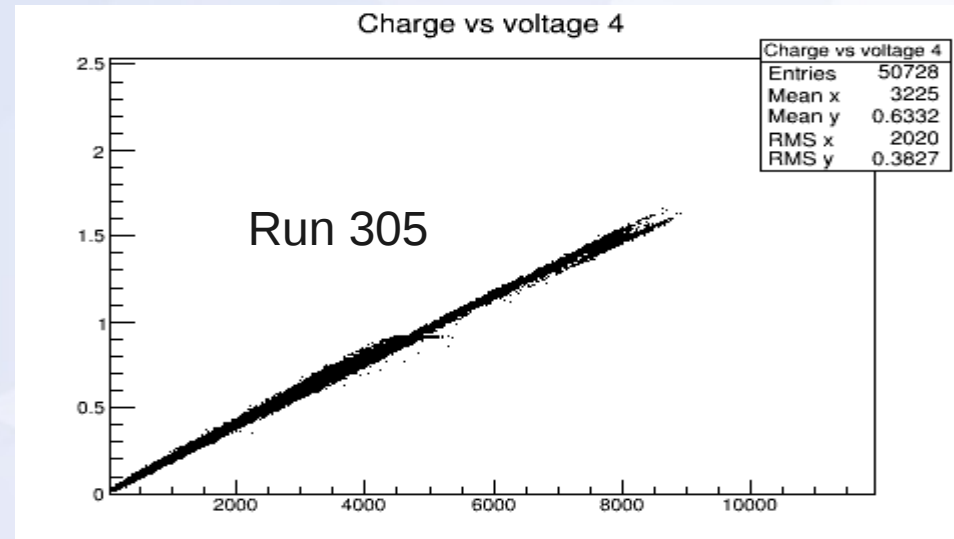
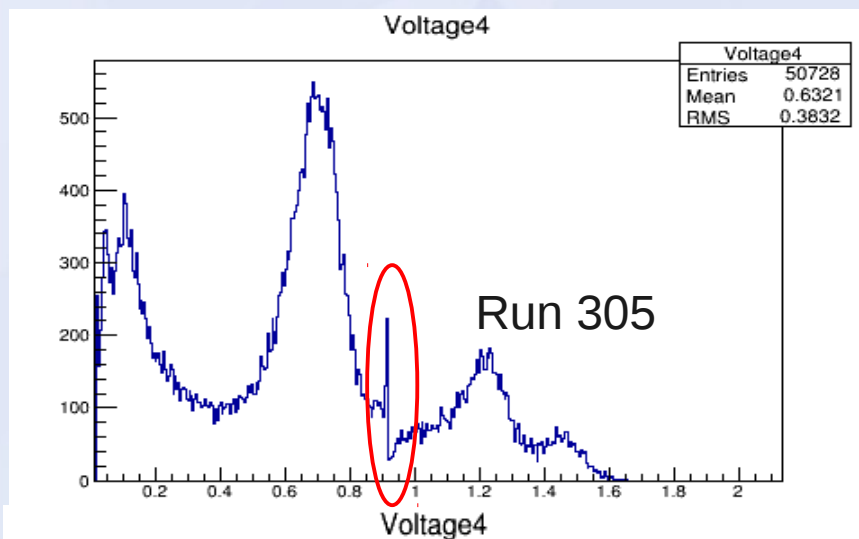
Results on detector 5 (signal center) show still some problems with continuity of signal in Vmax with saturated events – also after correction. After corrections of Q and Vmax we see a good correlation and continuity among them (signal unsaturated, fit saturated – after corrections) Also  $T_{corr} = T_{start} - T_{trig}$  from signal is stable on all Vmax range.



# Results detector 5

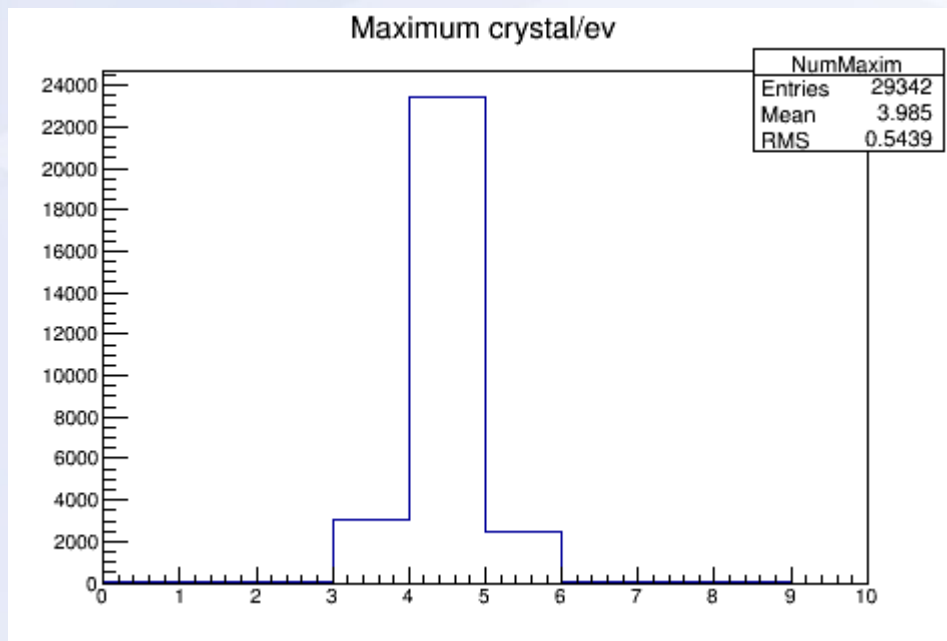
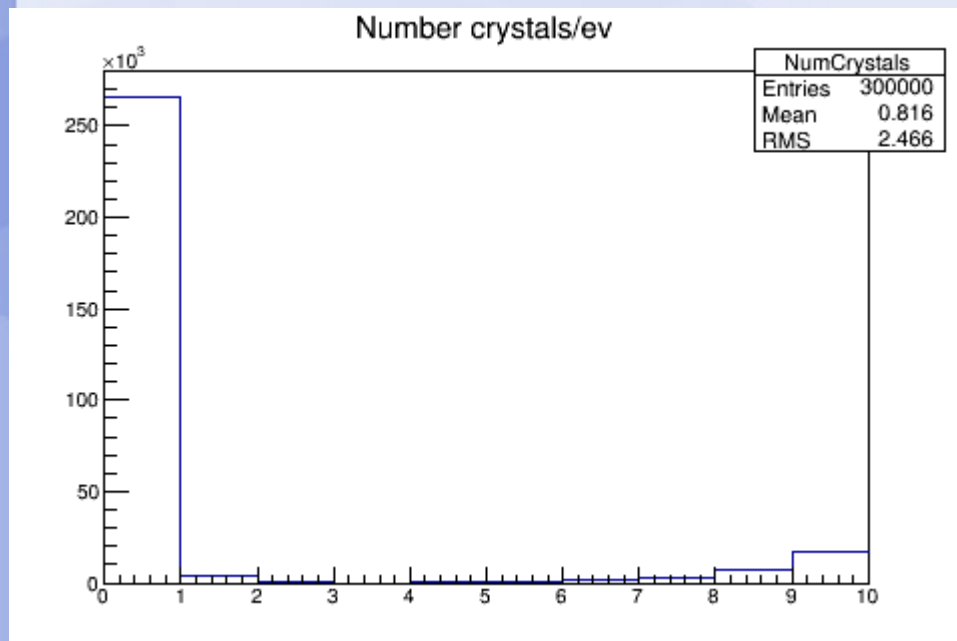
## runs 303,305

Vmax saturation problem less in lower energy runs, but still there



# Results – run 302

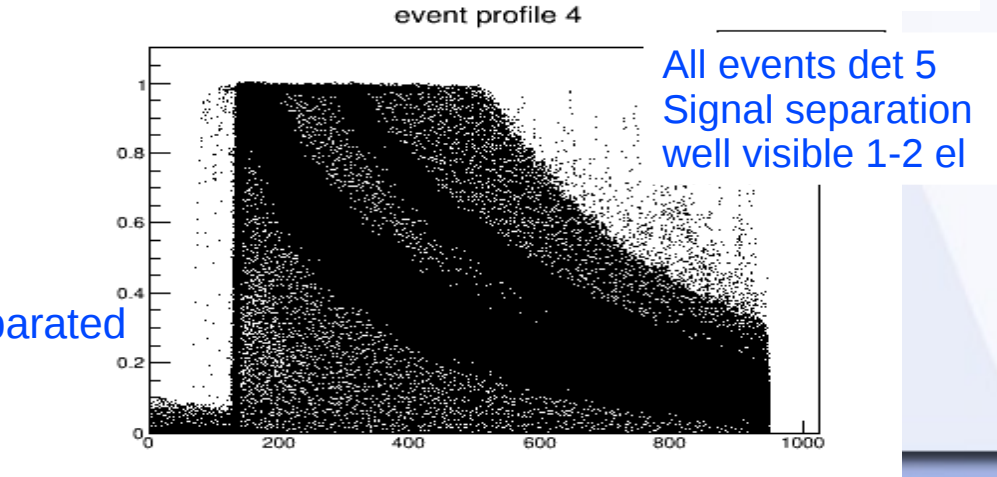
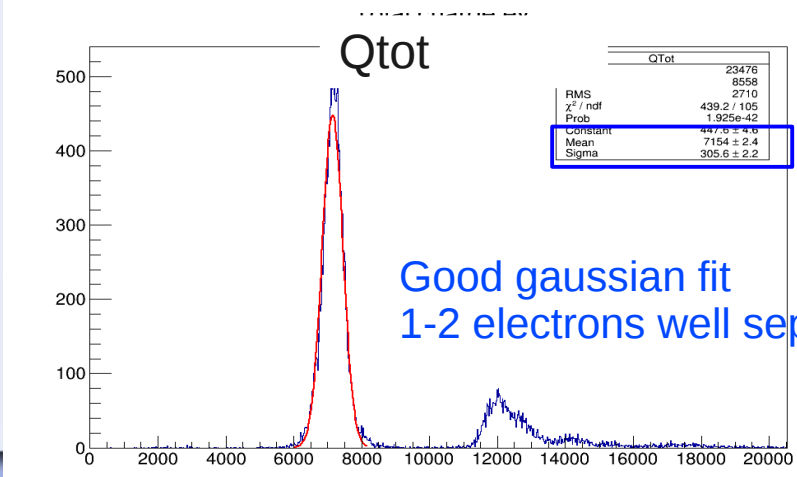
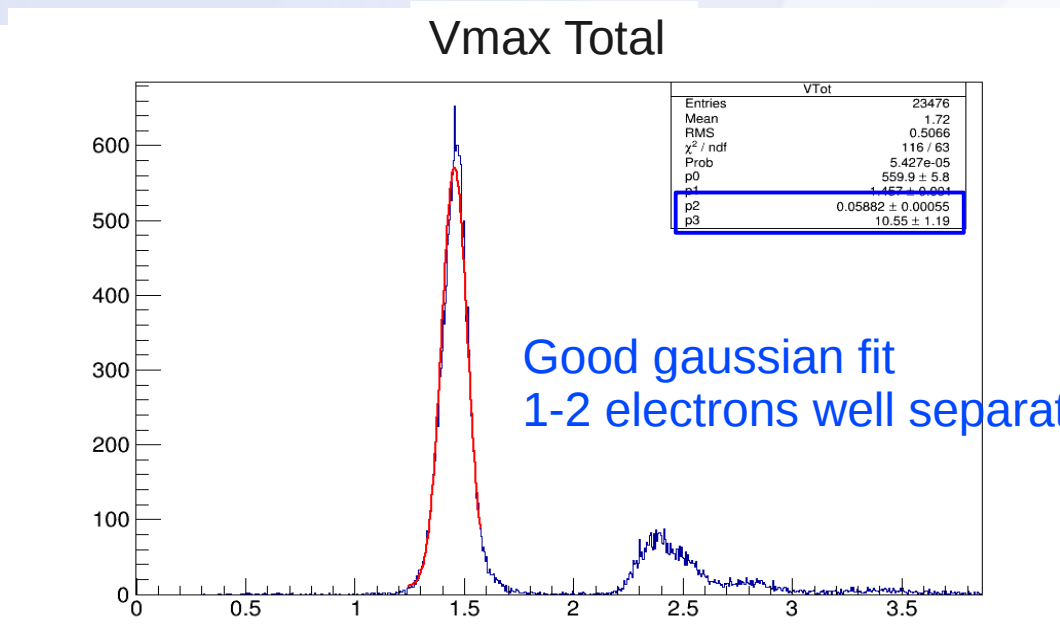
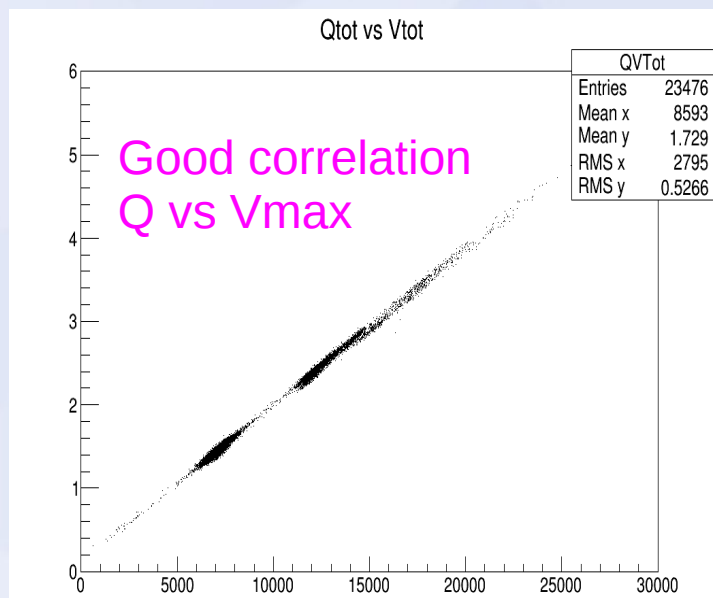
For the analysis on the whole calo we cut at Ncrystals > 1 and we use only events where the maximum is on detector 5 (central)



# Run 302 - Sum all detectors

We use corrected Vmax and total integrated charge (Tstart ÷ 900) summed on all detectors over Vmax > 0.02 V

Cuts : > 1 crys/ev ; max on crystal 5 ; Vmax(5) > 0.05 V

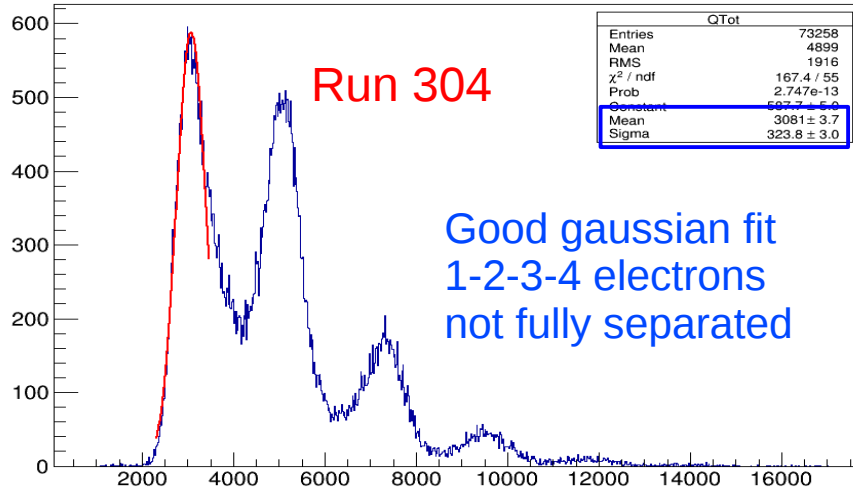


# Runs 304,305

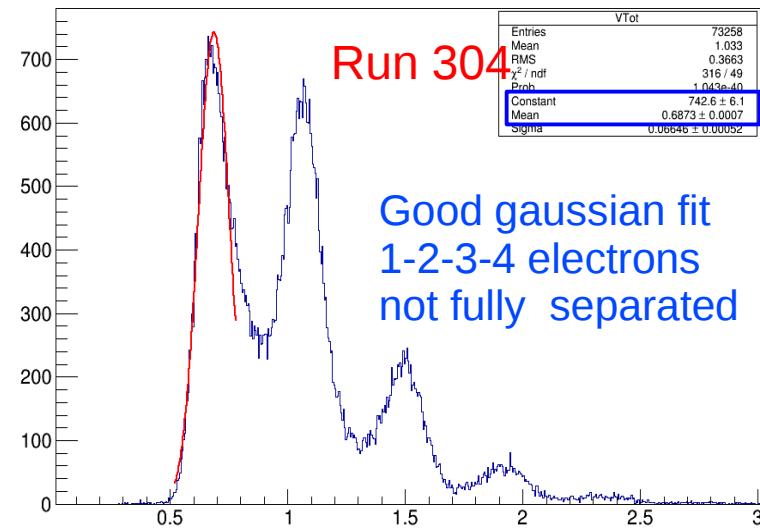
## Sum all detectors

Same cuts as run 302 used

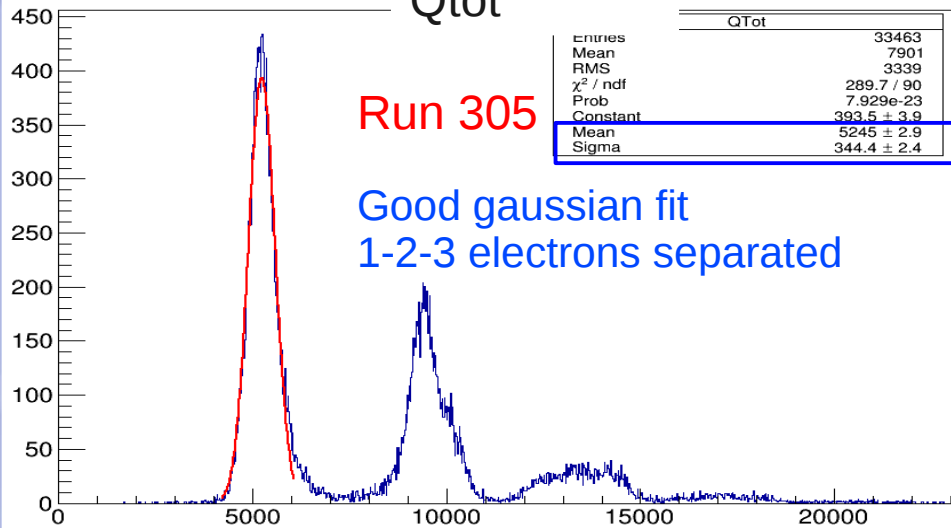
Qtot



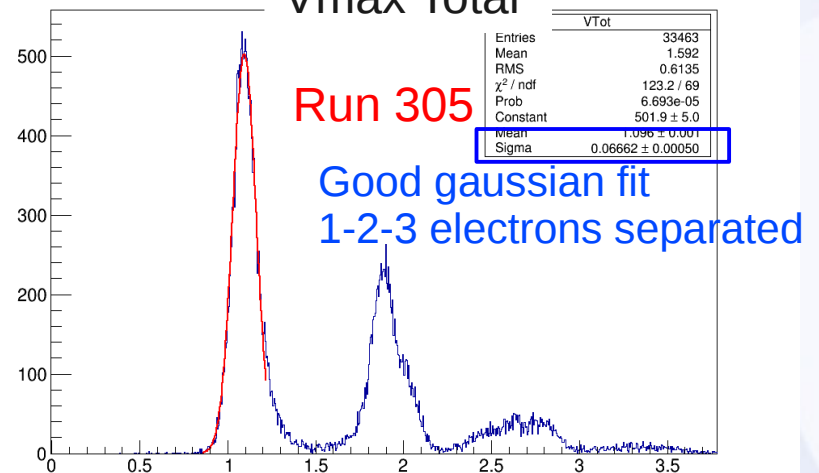
Vmax Total



Qtot

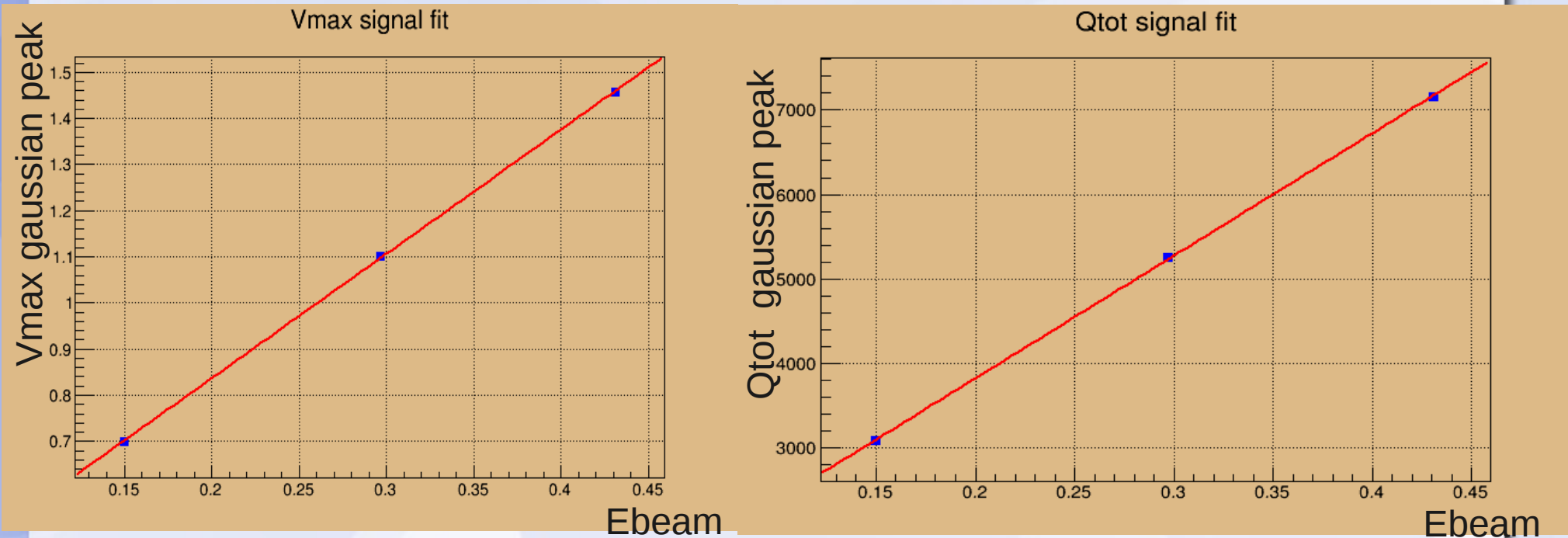


Vmax Total



# Linearity

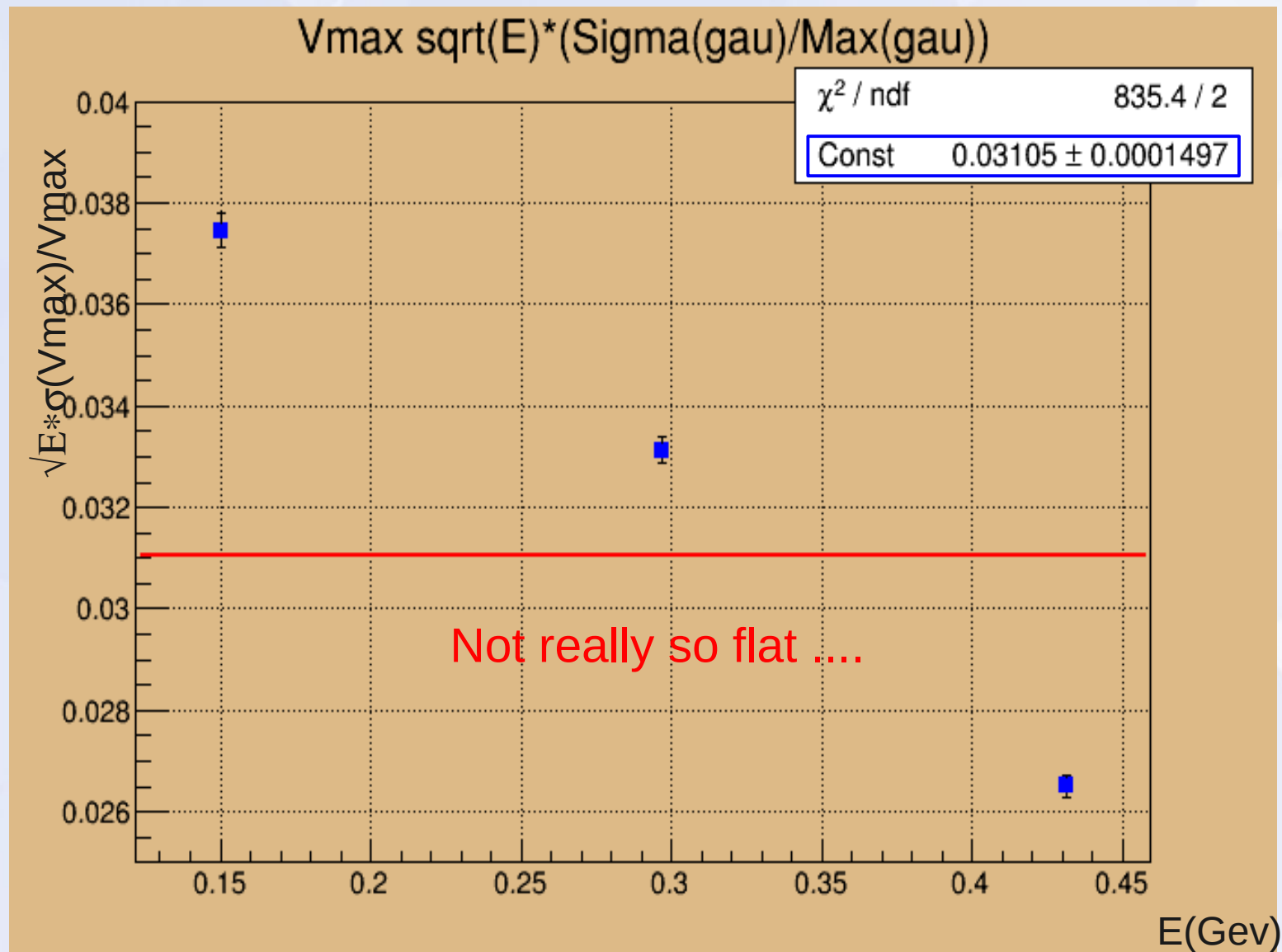
We have a very good energy linearity both for Vmax and Qtot on all energy range explored





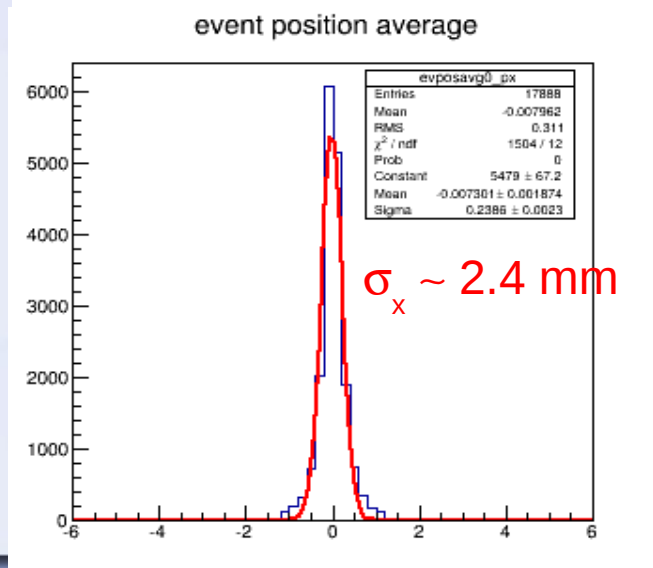
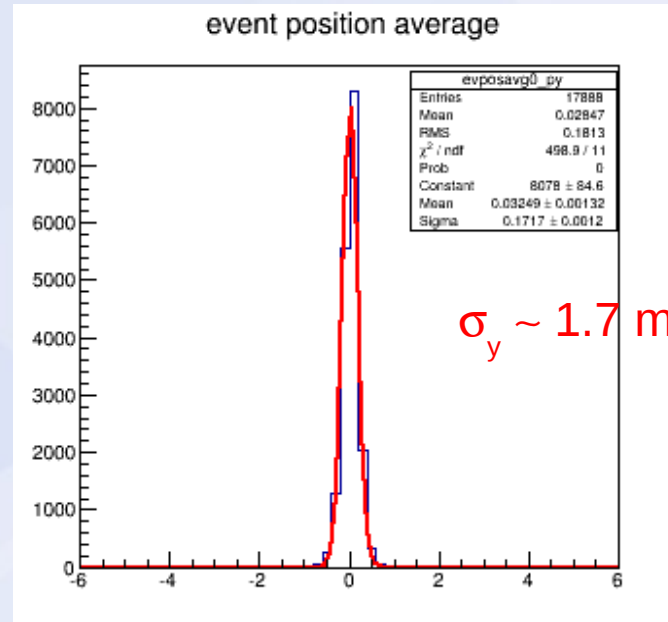
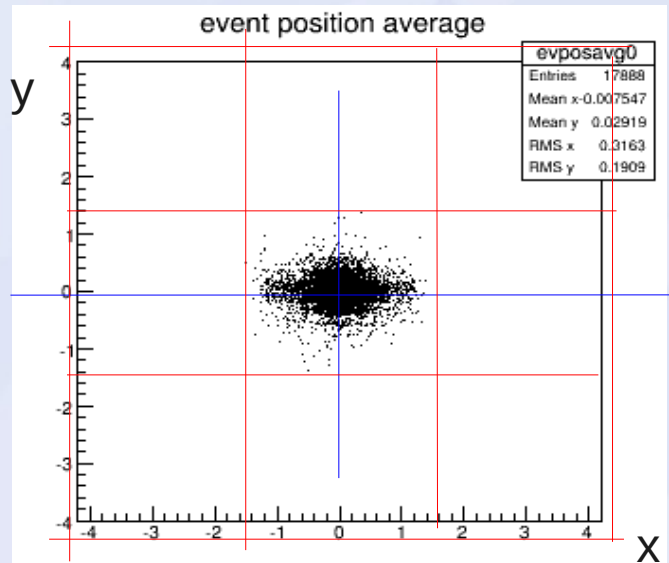
# Resolution - Vmax

$\sigma(E)/E \sim (3.11 \pm 0.01)\% / \sqrt{E}$  - But we may still improve



# Run 302 - Position Resolution

We take the position using the energy-weighted avg (using Vmax) of each crystal center for each detector signal **only for events with Vtot max under the first peak.**  
**Position distributions are quite gaussian**

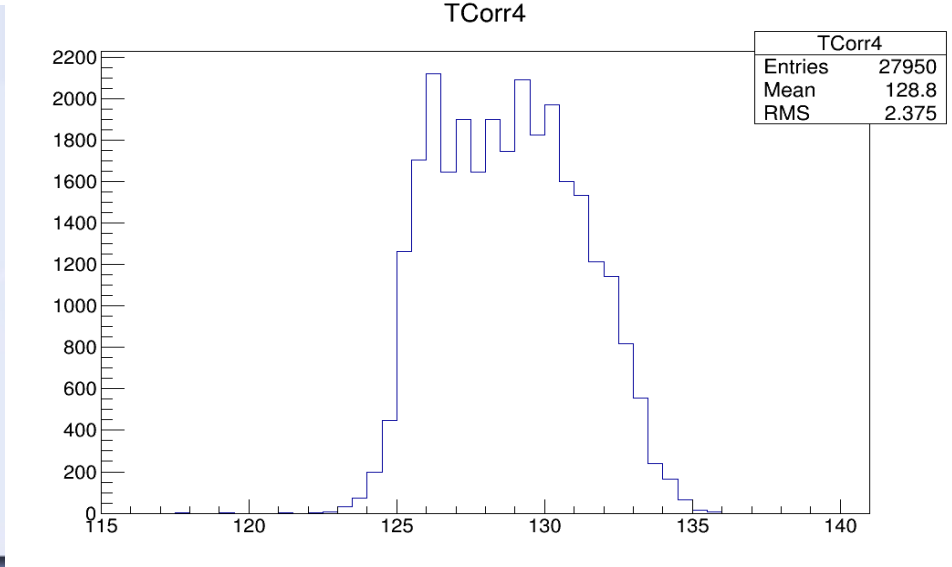
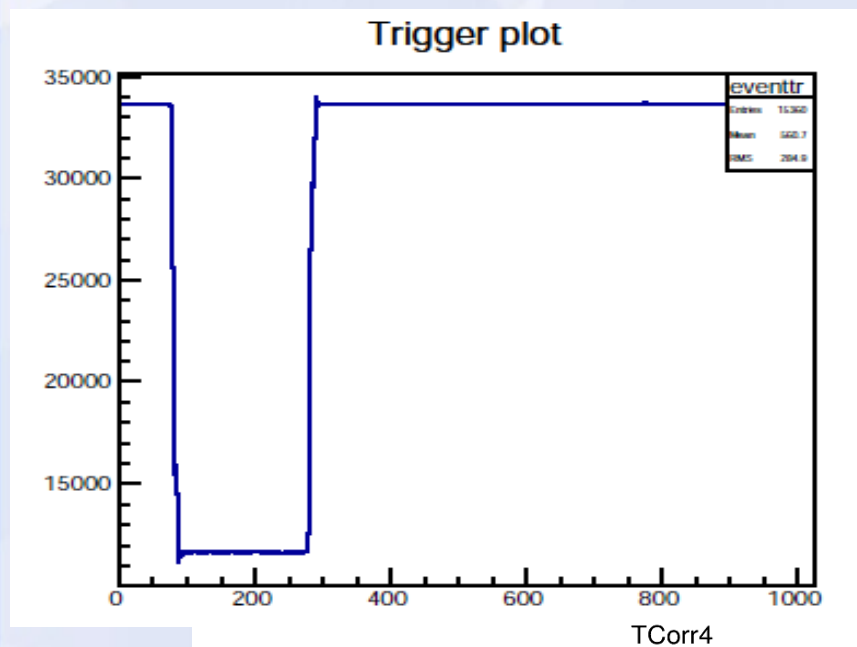


Center of crystal 5 is (0,0)  
Crystals boundaries are shown in red

Position resolution O(2 mm) for both x and y  
Similar resolutions for other runs as well

# Time resolution

Improved BTF trigger signal shape , but still unstable  
We have still a  $\sim 10$  nsec flat width of Tstart trigger ??



Corrected start time - Ttrig of signal (all dets) bad resolution depends from Tstart\_trig

# Time resolution

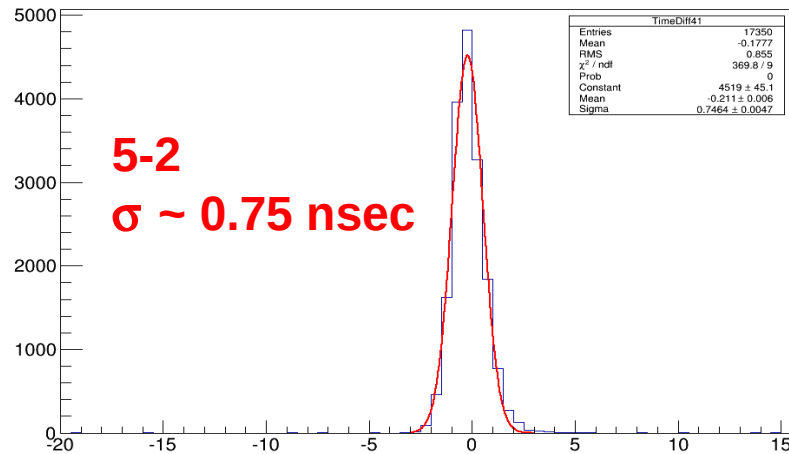
Analyzed 4 main crystals : 5 (central) and neighbours : 2,4,6

Difference  $T_{start\_x} - T_{start\_5}$  (6 points linear fit at thresh)

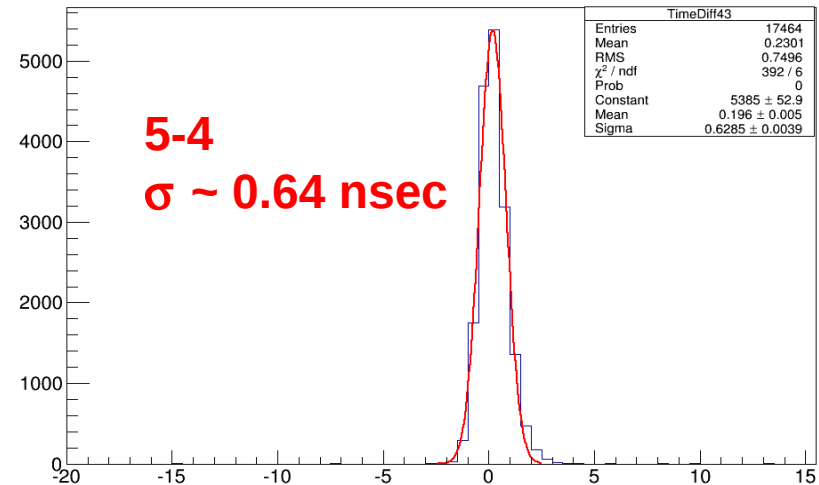
Cuts : each detector  $> 0.020$  V

Results shown for run 302 but similar also in other runs

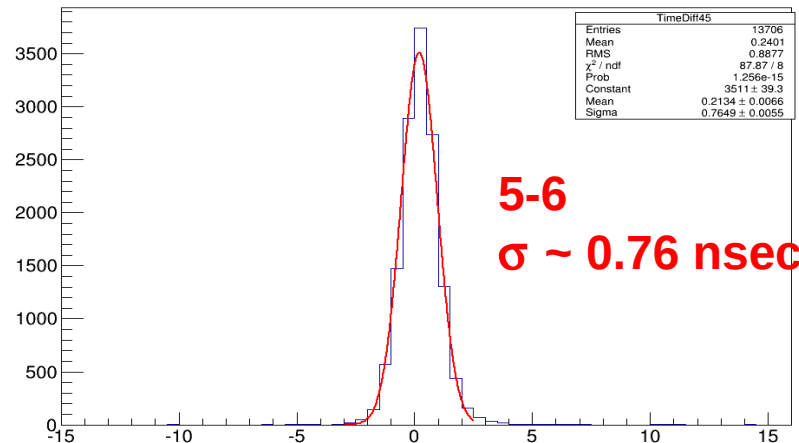
Timecorr diff 4-1



Timecorr diff 4-3



Timecorr diff 4-5

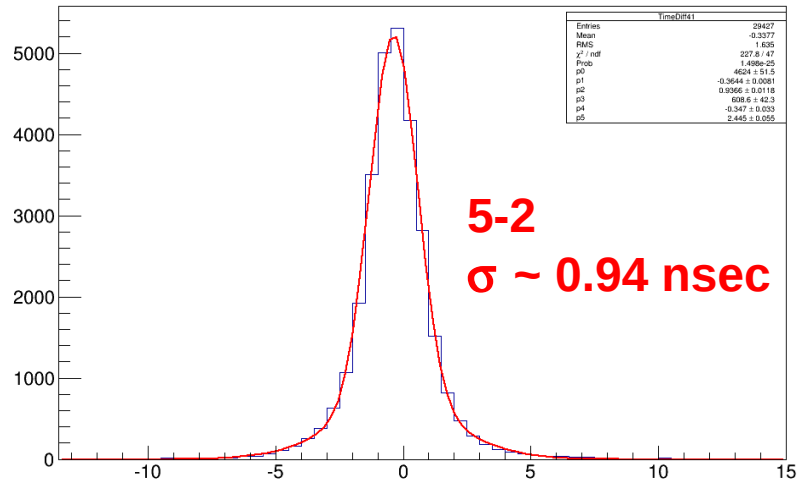


Tstart difference between detector has a time resolution  $< 1$  nsec

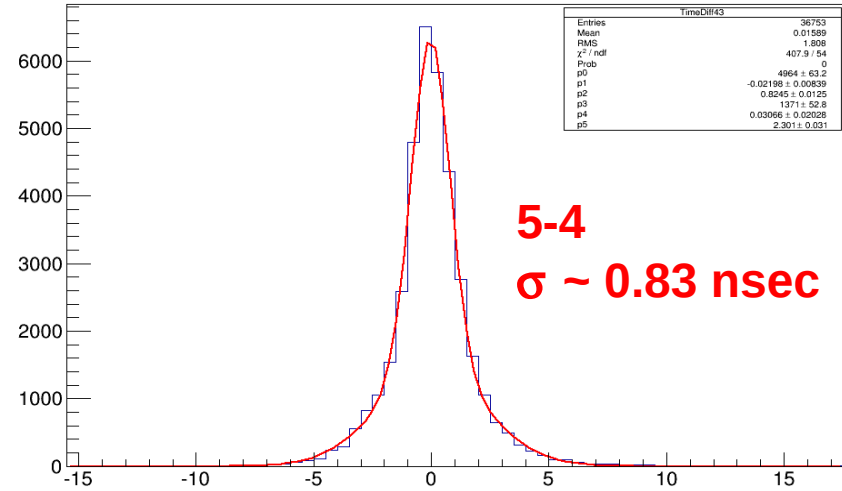
# Time resolution

Run 304 (150 MeV) - Same cuts as run 302 used

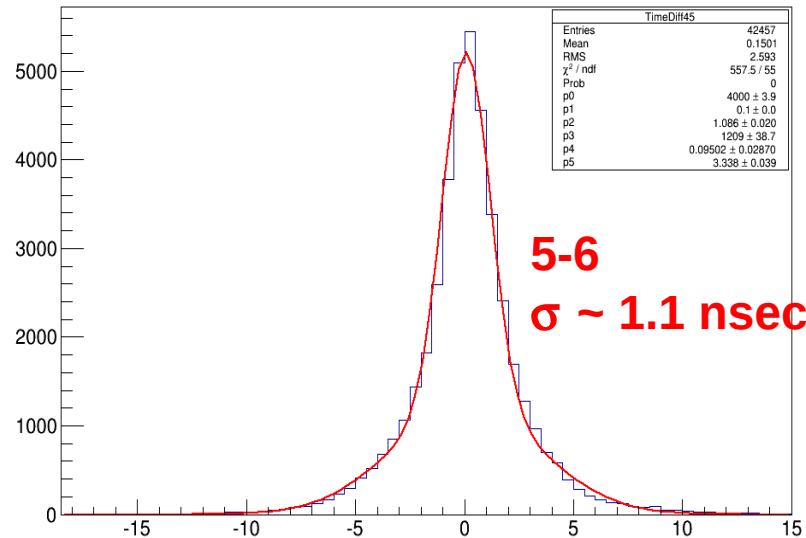
Timecorr diff 4-1



Timecorr diff 4-3



Timecorr diff 4-5



Also at lower energy  
Tstart difference between  
detector has a time resolution  
 $\leq 1 \text{ nsec}$