1. Identify Bad Channels
2. Timing Correction (Si, CsI)

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Data

Run_0265.dat.24-07-18_20h22m45s

This run is gas-in run and contains 11 datafiles in total

Collected in 24/07/2018

1. Identify Bad Channels

1.1 Identify bad channels, Si

1.2 Identify bad channels, CsI

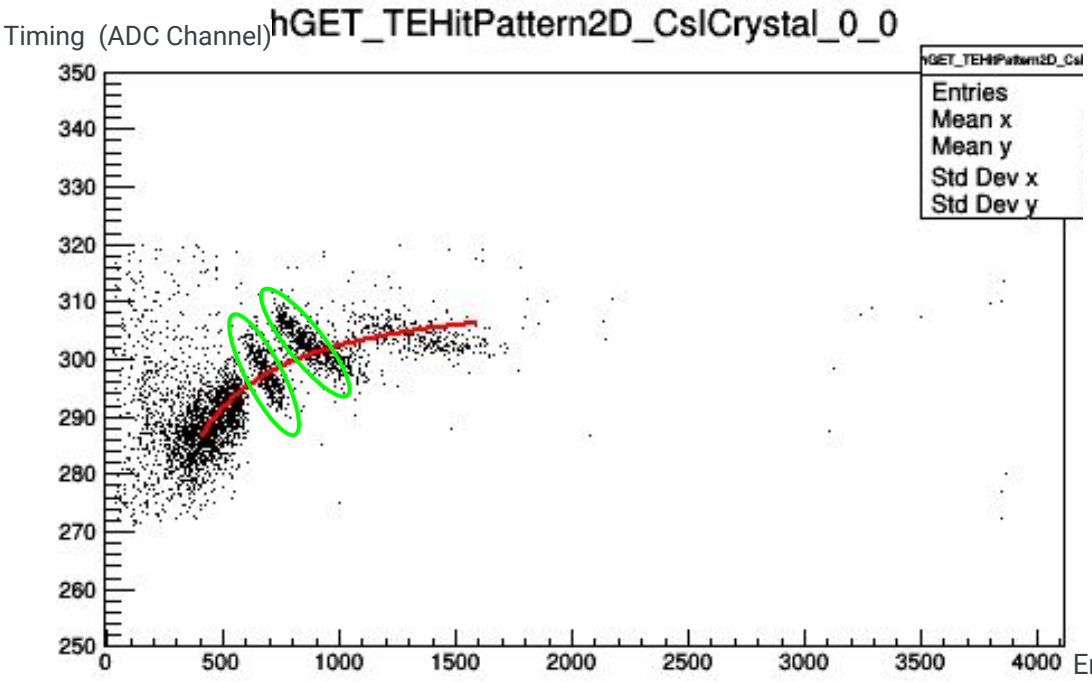
See 1st meeting 2019

2. Timing Correction

2.1 Timing Correction, Si (see 1st meeting 2019)

2.2 Timing Correction, CsI

Time vs Energy (CsI_0_0 only)



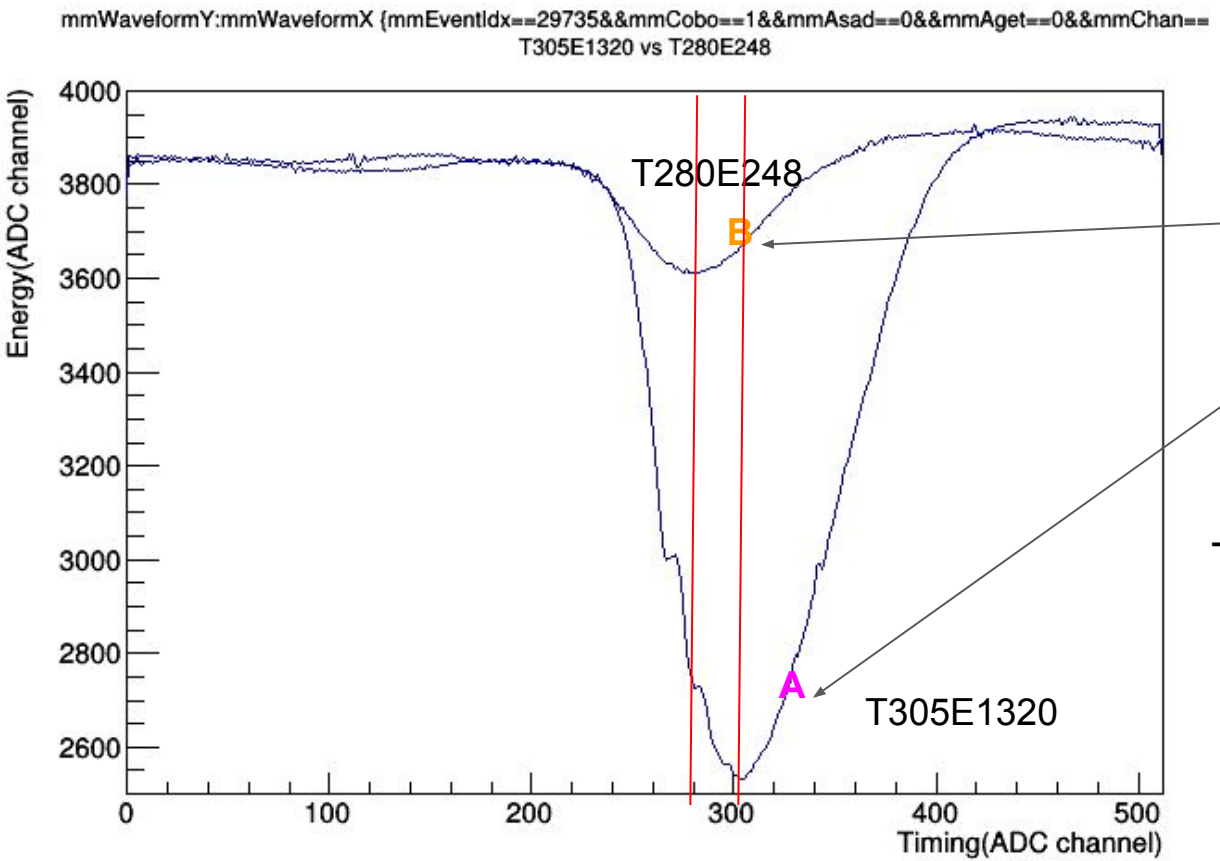
Two primary observations:

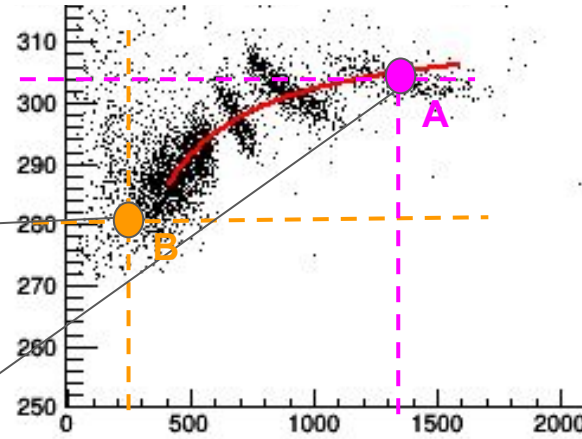
1) **Time measurement is energy dependent:**
   a) **T_corr = T_obs - C0 - C1/E**
   b) **T_corr = T_obs - 313.0 - 10619.3/E**
2) **Regions in green which have an anti-correlation**

Will comment on both

Global Tendency

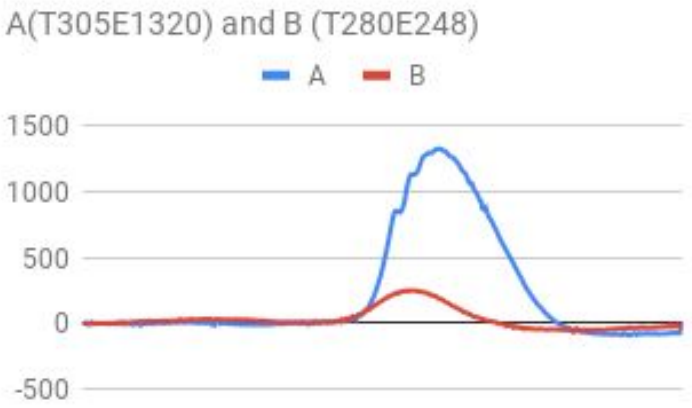
clearly showing that timing depends on energy (energy ↑, timing ↑, red line)



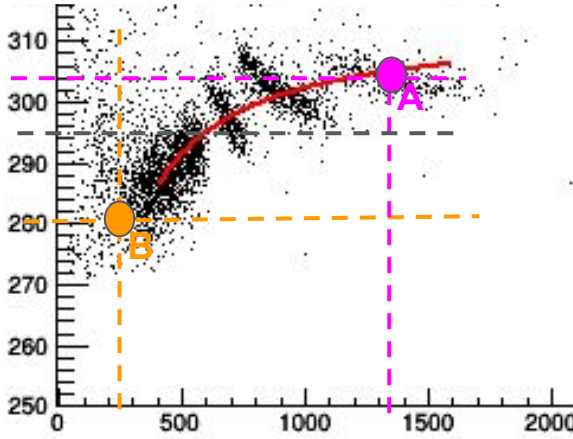


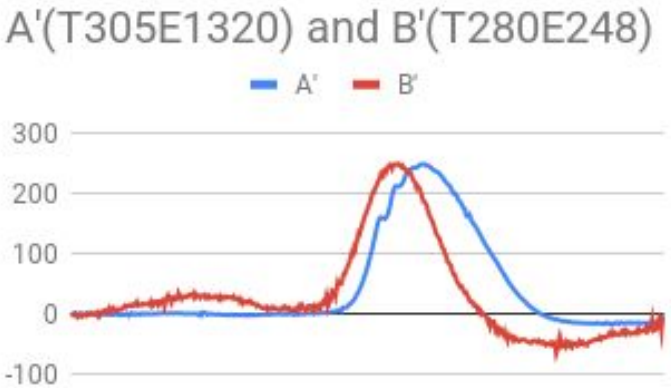
T280E248 vs T305E1320

T305E1320 vs T280E248 After Normalization



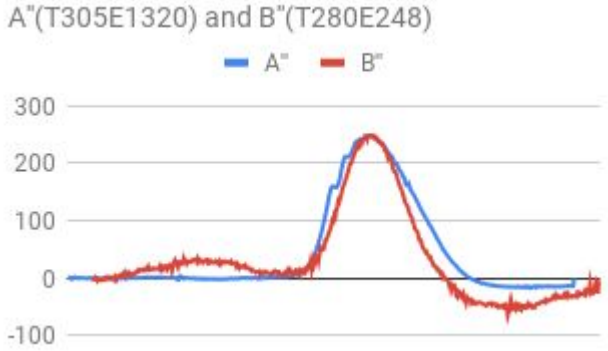
1





2

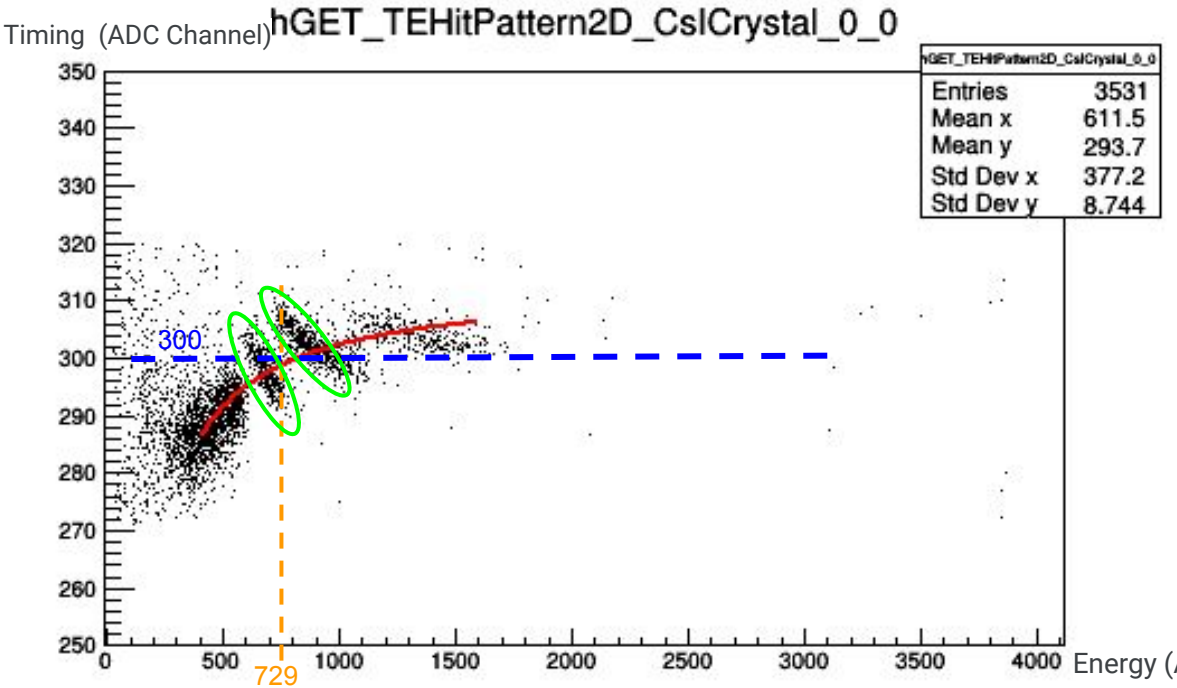
3



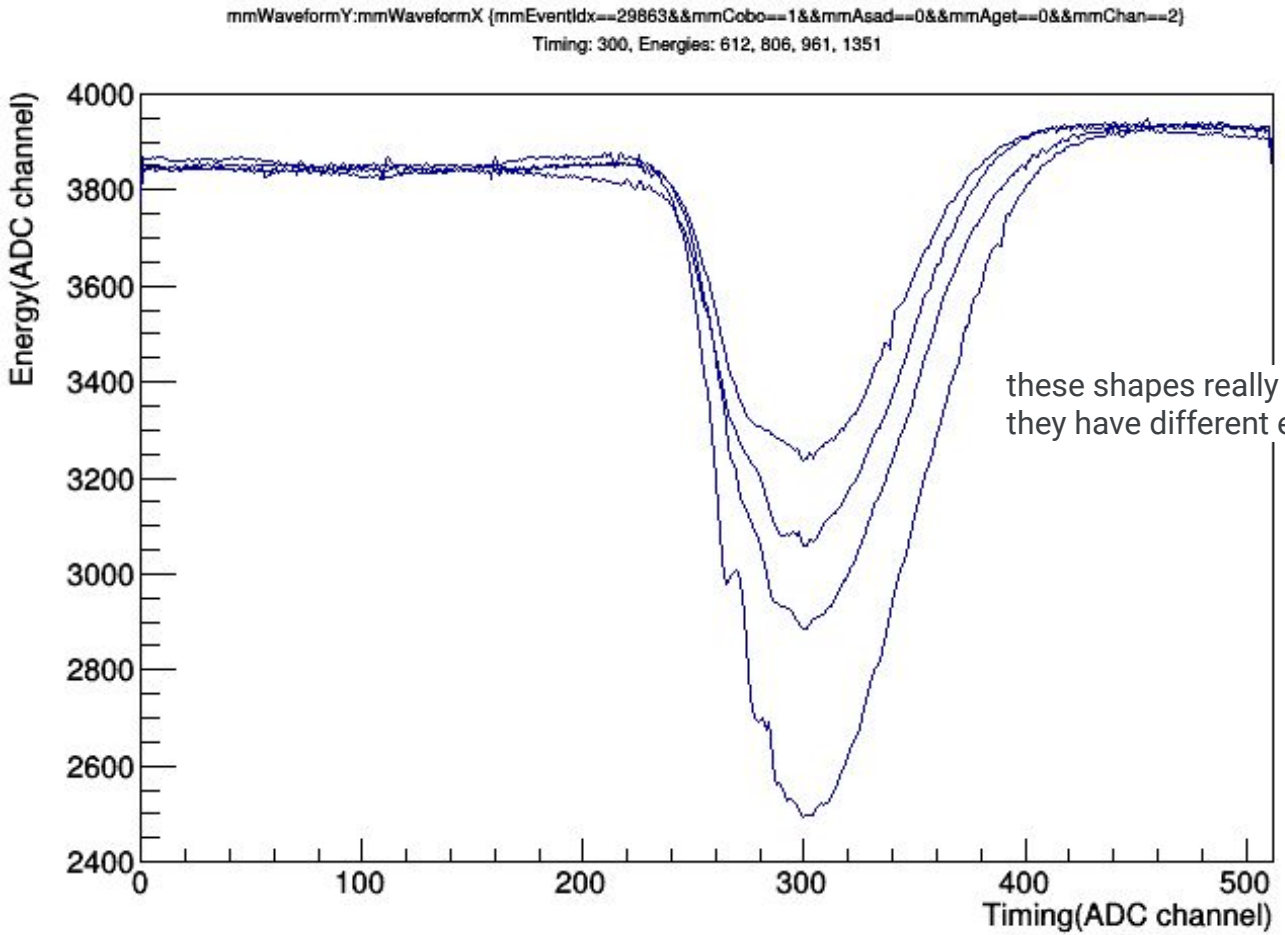
Regional Structure, WHY?

Timing's dependence on energy opposite to global one (energy ↑, timing ↓, green circle)

Consider two quick comparisons of event waveforms:
1) the same observed time, but very different energy
2) the same energy, but different time

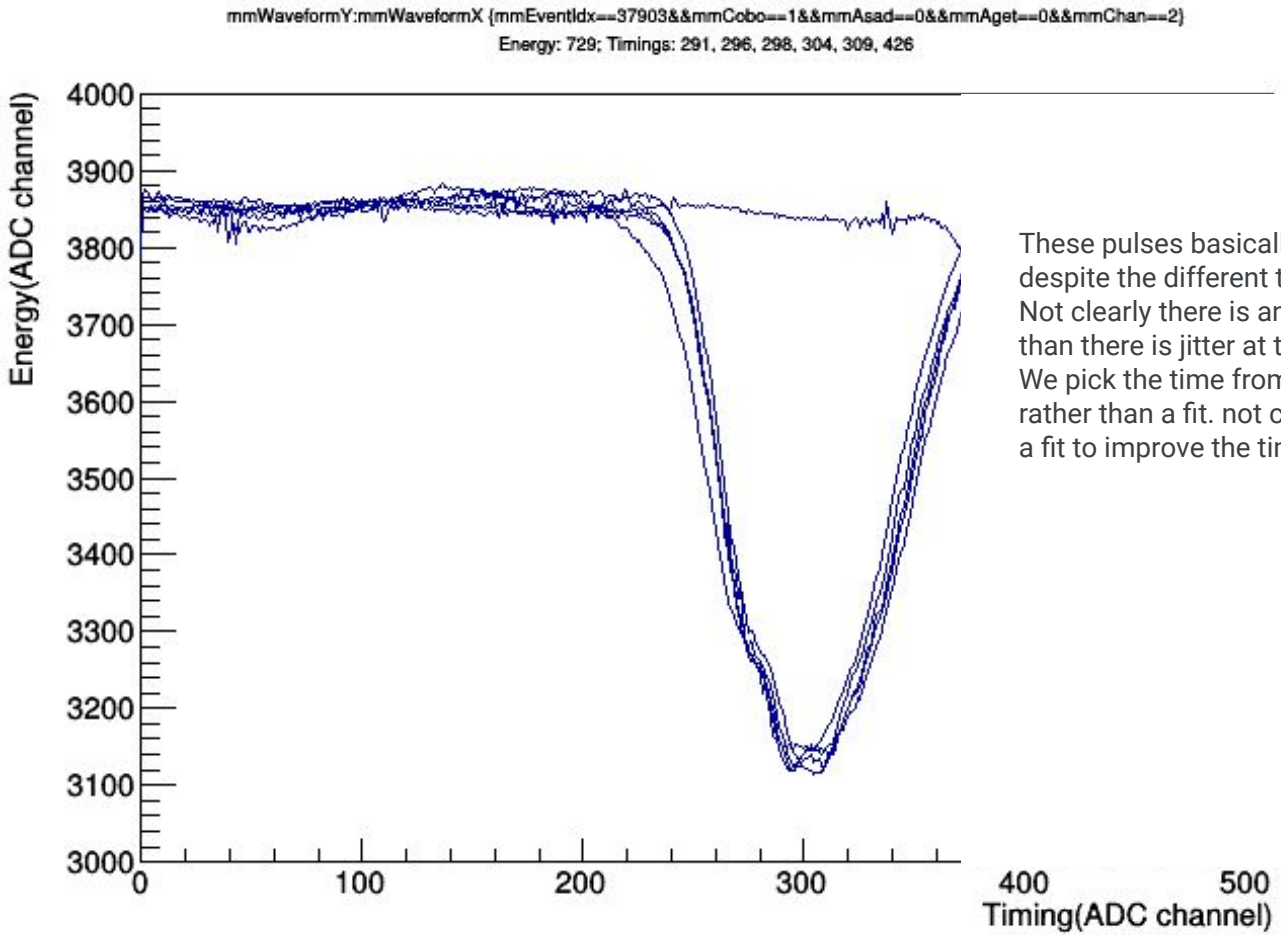


Same Time(300), but different Energies(612, 806, 961, 1351)



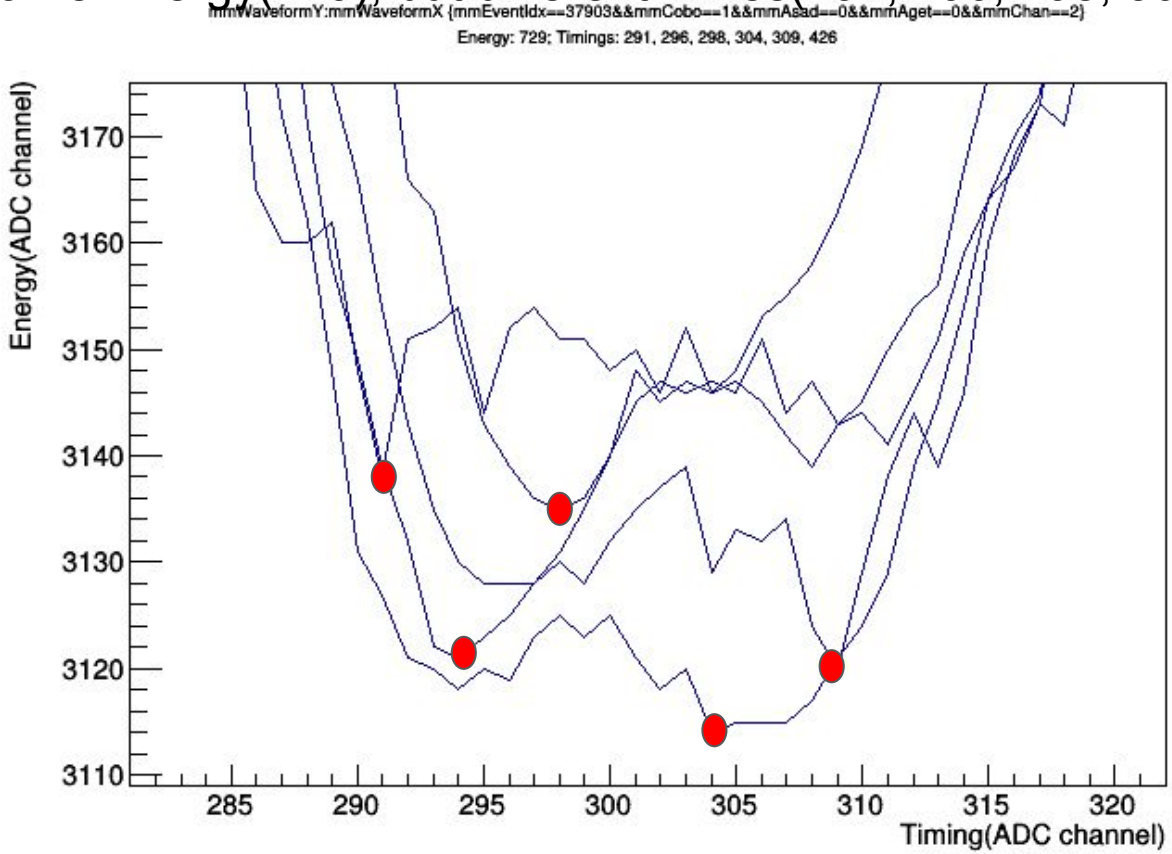
these shapes really are similar even though they have different energies.

Same Energy(729), but different Times(291, 296, 298, 304, 309)

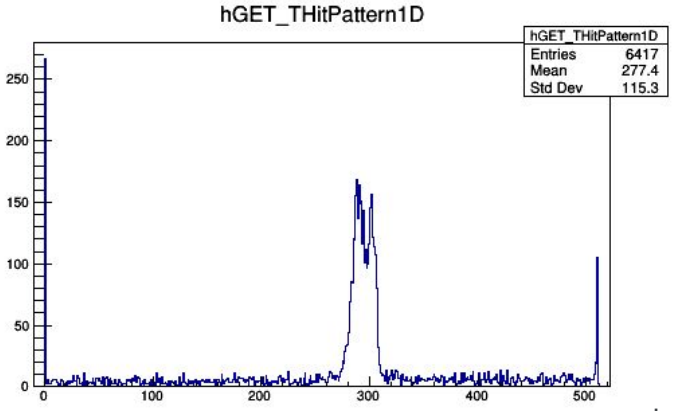


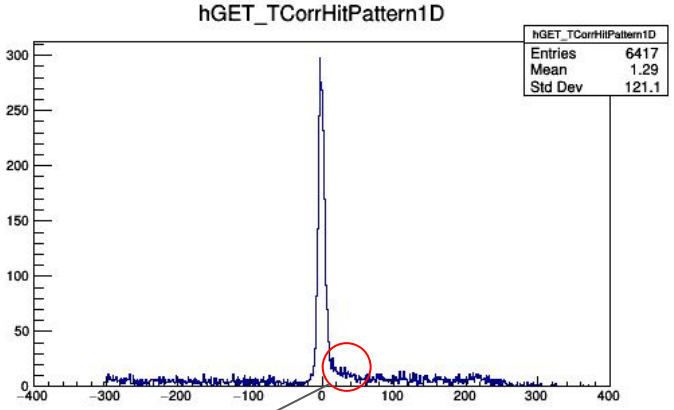
These pulses basically all look the same despite the different times.
Not clearly there is anything to to learn other than there is jitter at the bottom of the pulse.
We pick the time from the actual minimum, rather than a fit. not clear it is worth moving to a fit to improve the timing measurement.

Zoom in to the minimum
Same Energy(729), but different Times(291, 296, 298, 304, 309)

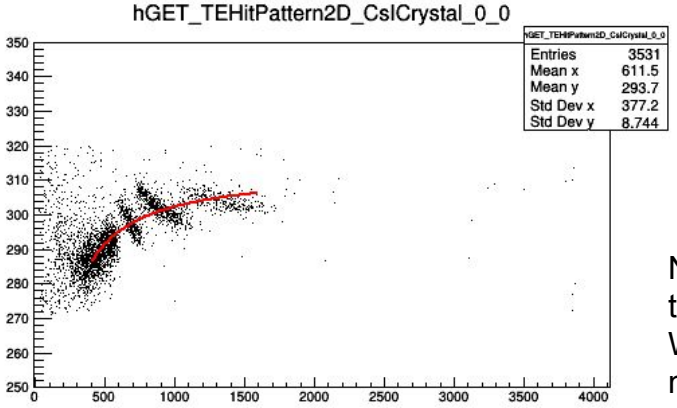


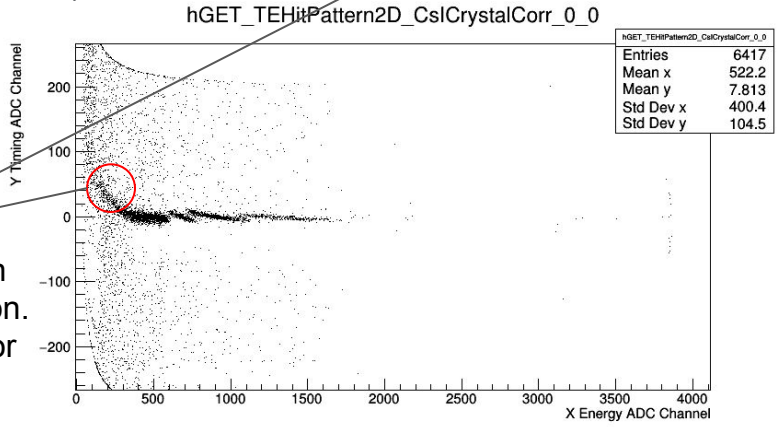
Timing of CsI_0_0, before and after correction





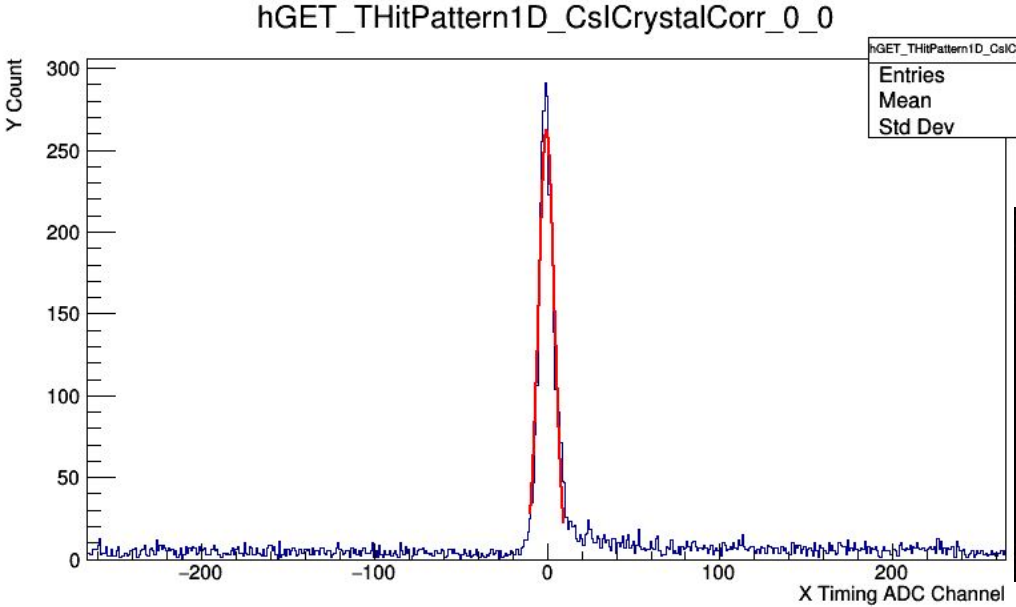
t_corr = t_obs - 313.0 - 10619.3/E





Not well corrected on the low energy portion. Won't bother fixing for now.

Timing of CsI_0_0 after calibration with fitting results



CsI0_0	mean	m_error	sigma	s_error	unit
	-0.25	0.09	4.55	0.09	ADC channel
	-10.00	3.60	182.00	3.60	ns

```
root [2] TF1 *f1 = new TF1("f1","gaus",-10,10)
(TF1 *) 0x475f840
root [3] hGET_THitPattern1D_CsICrystalCorr_0_0->Fit("f1","R")
 FCN=80.2786 FROM MIGRAD    STATUS=CONVERGED      64 CALLS
                EDM=8.31869e-10    STRATEGY= 1      ERRO
  EXT PARAMETER                                   STEP
  NO.   NAME      VALUE            ERROR          SIZE      D
   1  Constant     2.61795e+02   6.62031e+00   2.13169e-02
   2  Mean        -2.55338e-01   9.47894e-02   3.97344e-04
   3  Sigma        4.54909e+00   8.99940e-02   2.12984e-05
(TFitResultPtr) <nullptr TFitResult>
```

1. The Gaussian fitting result does not perfectly match the peak, might be caused by the a little wider fitting range which involves some part of the asymmetric background.
2. The asymmetric background is caused by the fitting range in the TvsE plot
3. Won't bother refitting to get a better resolution measurement.

T_Corr Fitting Results of **ALL** CsI Crystals

Crystal	Peak	P_Err	Mean	M_Err	Sigma	S_Err
W0C0	261.80	6.62	-0.255	0.095	4.549	0.090
W0C1	259.44	6.58	-0.590	0.088	4.337	0.081
W0C2	240.02	6.40	-0.572	0.094	4.483	0.093
W0C3	186.41	5.67	-0.886	0.105	4.352	0.101
W0C4	323.84	7.39	-0.596	0.082	4.439	0.077
W0C5	282.26	6.24	1.588	0.114	5.164	0.099
W0C6	305.10	7.23	-0.186	0.086	4.469	0.082
W0C7	299.09	6.69	0.704	0.100	4.891	0.089
W0C8	248.99	6.67	-0.505	0.089	4.154	0.082

W1C0	291.09	6.39	0.032	0.107	5.605	0.115
W1C1 dead	0.00	0.00	0.000	0.000	0.000	0.000
W1C2	362.17	7.23	-0.229	0.095	5.569	0.105
W1C3	216.61	5.59	-0.151	0.119	5.406	0.125
W1C4	391.87	7.46	-0.370	0.089	5.485	0.095
W1C5	306.95	6.41	0.416	0.116	6.062	0.131
W1C6	279.81	6.34	-0.598	0.102	5.295	0.105
W1C7	288.81	6.29	0.693	0.113	5.682	0.118
W1C8	125.60	4.35	-0.831	0.159	5.505	0.181

W2C0 dead	0.00	0.00	0.000	0.000	0.000	0.000
W2C1	239.31	6.51	-0.924	0.091	4.216	0.085
W2C2	327.28	6.95	0.151	0.091	4.904	0.083
W2C3	200.88	5.86	-1.021	0.100	4.279	0.093
W2C4	295.36	6.78	-0.406	0.092	4.903	0.093
W2C5	161.32	4.92	-0.893	0.135	5.288	0.145
W2C6	279.02	6.76	-0.592	0.087	4.408	0.080
W2C7	193.13	5.25	0.386	0.117	4.963	0.107
W2C8 dead	0.00	0.00	0.000	0.000	0.000	0.000

W3C0	165.69	4.82	-0.412	0.135	5.386	0.138
W3C1	363.39	7.51	-0.149	0.081	4.707	0.076
W3C2	252.54	5.86	0.454	0.113	5.265	0.103
W3C3	356.48	7.49	-0.397	0.082	4.647	0.076
W3C4	478.83	8.57	-0.351	0.072	4.899	0.071
W3C5	391.07	7.65	0.074	0.080	4.802	0.074
W3C6 dead	0.00	0.00	0.000	0.000	0.000	0.000
W3C7	258.43	6.37	-0.335	0.096	4.694	0.091
W3C8	271.23	6.19	0.176	0.100	5.045	0.093

dead channels

compared to other values in the same wall, these values are a little larger

Conclusion

1. We observed a real timing dependence as a function of energy from small to large energies, but there are variations due to jitter/timing measurement procedure that probably don't matter.

2. We have calibrated the system.
    1. There are improvements that could be made to the individual event timing, and to the calibration of the low energy events, but we will leave them for now and move on.
    2. Resolution looks to be about ~180ns, and not vary much between channels

3. Ready to start correlating hits to find particles in all three detectors next

Appendix: jitter in the waveforms