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T2Z1 CDMSliteR3 Template Generation

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Abstract

This work follows the same procedure as the previous work by Mark, for getting R2 templates. The templates are obtained from a 'test production' using R2 templates, that way the filter-related RRQs are obtained and used to align the pulses. The templates are the result of selecting some 'good events', and taking the shape of the 'mean' value from all of them.

I. Approach

- First the events are selected for different signal regions, and the pulses extracted. Then the pulses are aligned by their initial rise point using the Rise Time Fall Time Walk RQs (10% and 20% rise time levels) to compute the 0% risetime point, or where the pulse begins to rise. Next, the pulses are normalized, and their mean is computed. As shown in previous notes the starting time of the pulse can be calculted to be:

$$t0 = 2t0.10 - t0.20.$$

- Then the pulses are normalized, and an inital template is obtained. This serves to create a X^2 discriminator from the mean of each bin. The best 80% are accepted.
- The final selection is re-normalized, and new means are calculated for each bin, thus the finalized template is obtained.

II. Pulse Selection

The data (all bg data of April 2015) contains 3,454,183 events

The following cuts are applied to select the pulses:

- clitePT = PTNFamps(detnum,0) > -99999;
- cvolts = HVvolts == -75;
- clite = clitePT & cvolts;
- crdm = EventCategory(0) == 1;

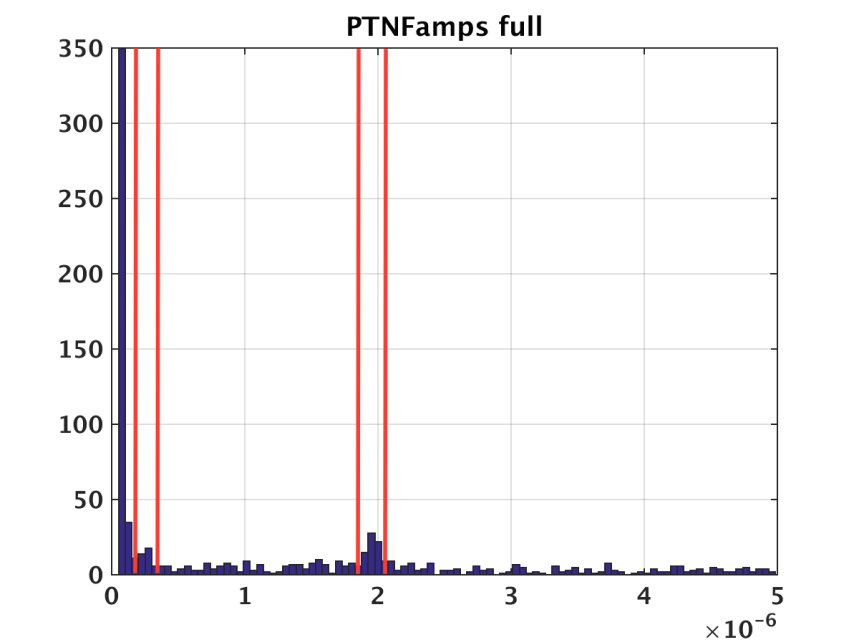
- cglitch_trig = ~((ntrigp(0)-ntrigq(0))>6)|((ntrigq(0)-ntrigp(0))>1);
- cglitch = cglitch_trig;
- cX2 = PTNFchisq(detnum,0) < 5000;
- ctime = BiasFlashTime(detnum,0)/secsPerMin > leakageTime;
- cE = inrange(PTNFamps(detnum,0),eLo,eHi); (2E-7,3E-7 for 1keV ; 1.8E-6,2.05E-6 for 10keV ; 2E-7,5E-6 for 'Full Range')
- cqin = QOOFvolts(detnum,0) < 2.95E-5;
- cEQ = QIOFvolts(detnum,0) > 1.132E-4;
- cc = clite & ~crdm & cglitch & cX2 & ctime & cE;

234 events are selected in the 'full range'
55 are selected applying cuts for the 10keV line
19 were selected for the 1keV line

Then the X^2 cut keeps the best 80%

PTNFamps is not showing easily the 1keV and 10keV peaks, but the boundaries are estimated from the following plots:

Full Scale



Zoomed

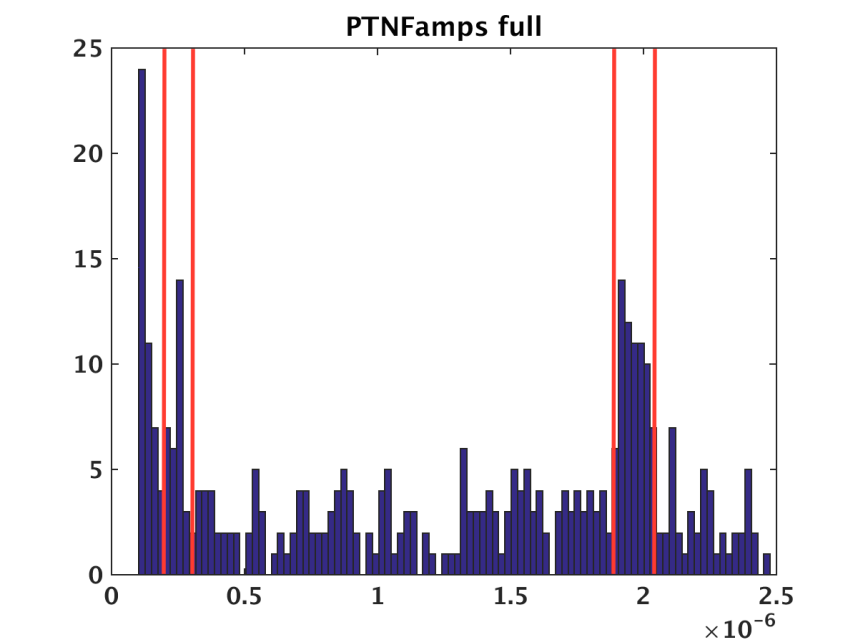


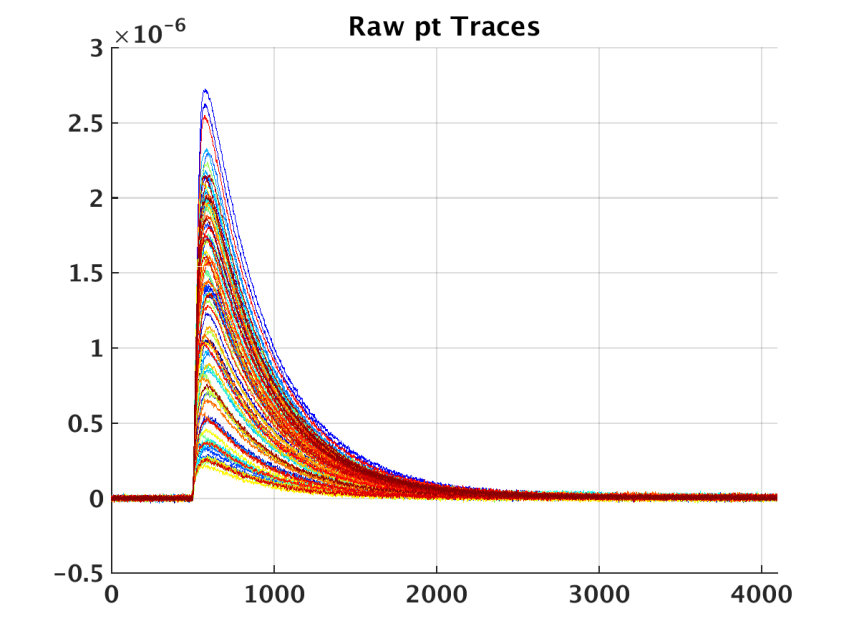
Fig 2.a PTNFamps Peaks

III. Raw Traces, Aligning, and Scaling

The raw traces are obtained, then aligned and normalized.

T2Z1 Traces					
Trace Conditions			Selected Events		
Raw	Aligned	Normalized and Aligned	Full Range	1keV	10keV

Full Scale



Zoomed

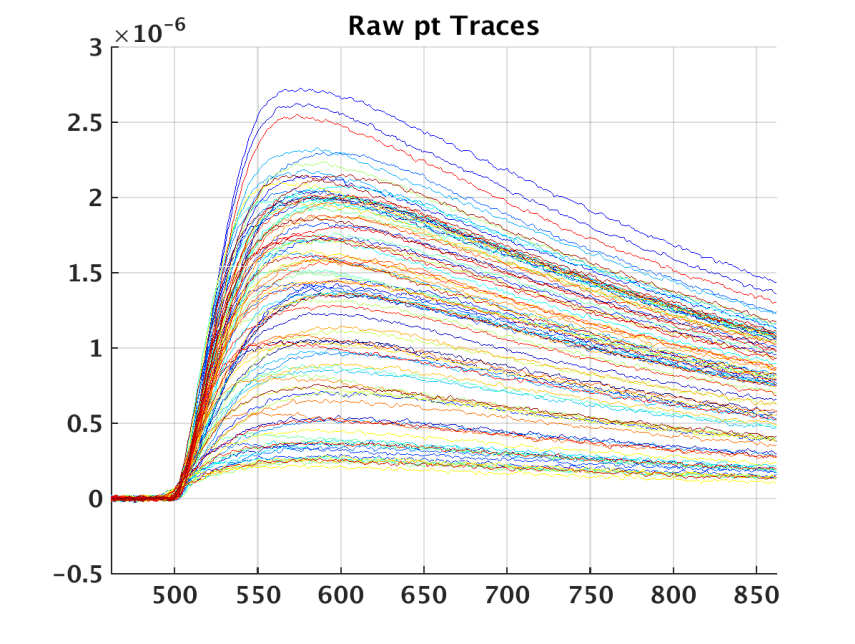


Fig 3.a Traces

The lower energy bins are clearly much noisier (see the 1keV sample). But even with so much noise, the pulses are appropriately scaled and aligned.
Now the X^2 is applied, discarding the worst 20% events.

X^2 Cut after Initial Average		
Selected Events		
Full Range	1keV	10keV

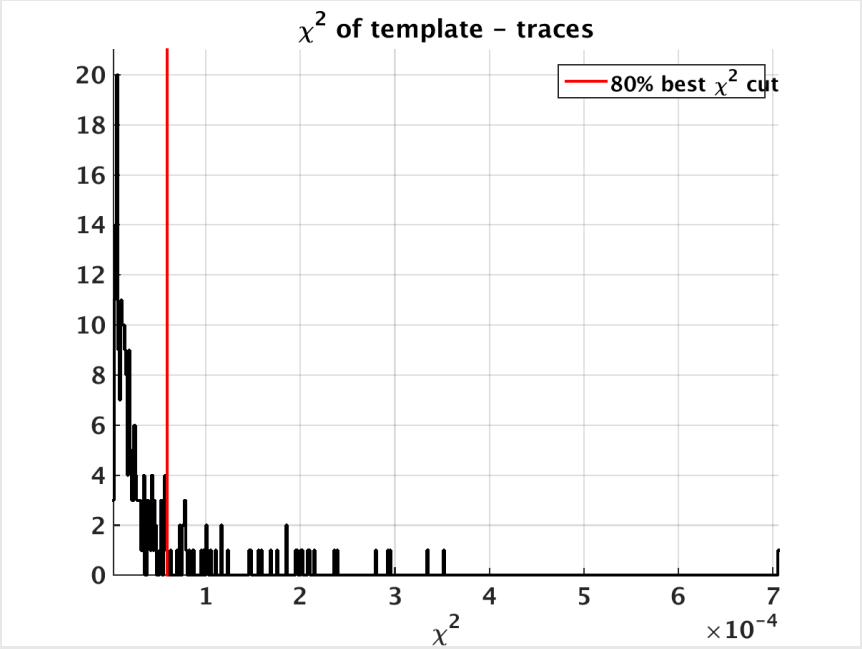


Fig 3.b X^2 selection

Finally, the pulses are re-scaled. It's noticeable that the noisier pulses were discarded, and that they all tend to have a similar shape.

Final Traces		
Selected Events		
Full Range	1keV	10keV

Full Scale	Zoomed

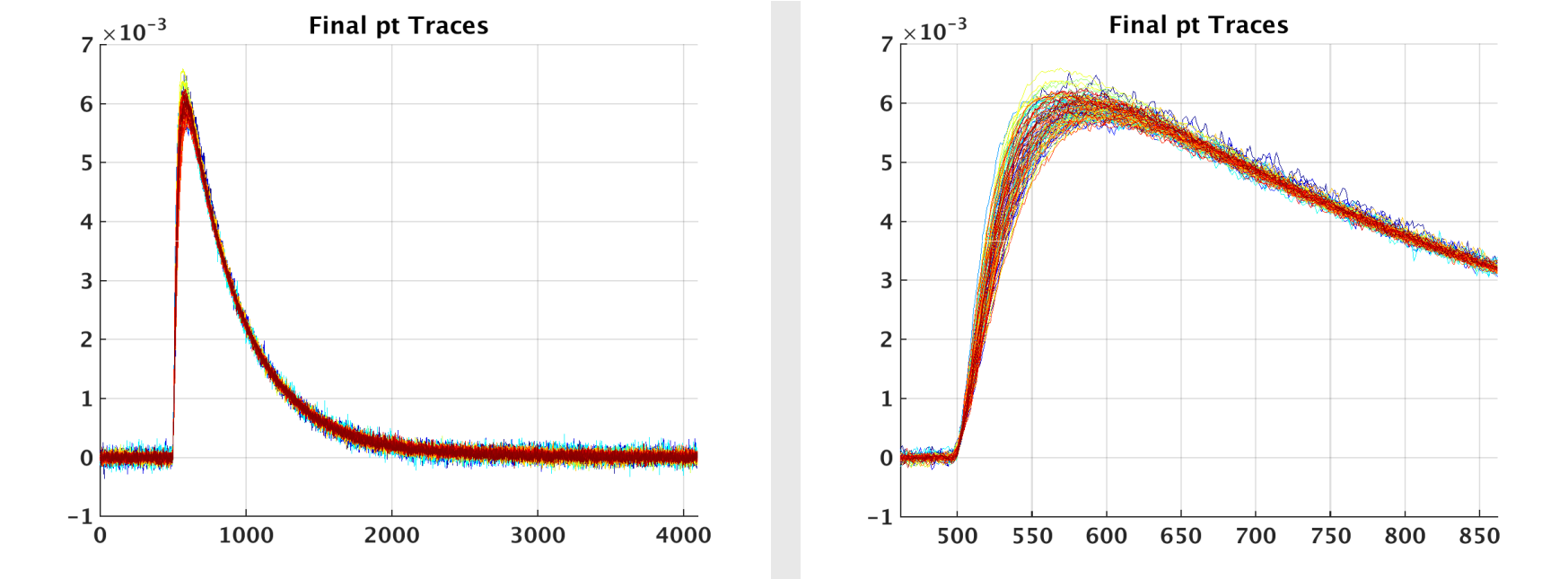


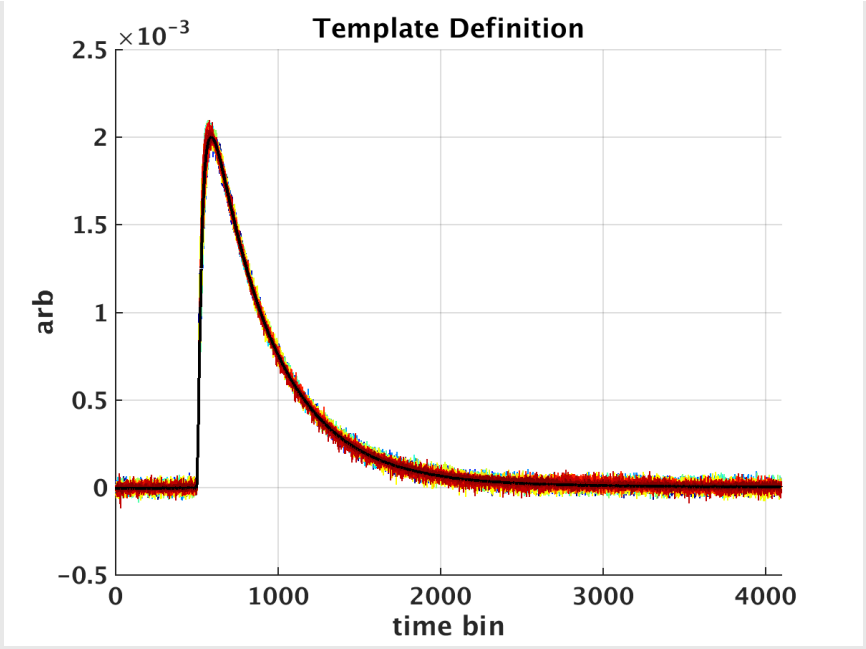
Fig 3.c Final Traces

IV. Templates

Finally the templates are created from the finalized traces, they are shown in black in Figure 4.a.

Final Templates		
Selected Events		
Full Range	1keV	10keV

Full Scale	Zoomed



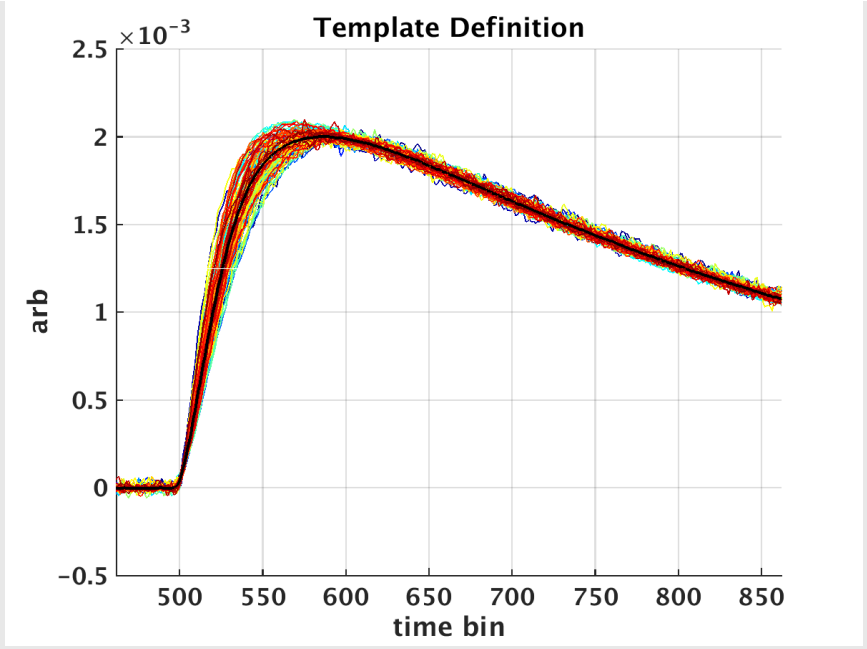
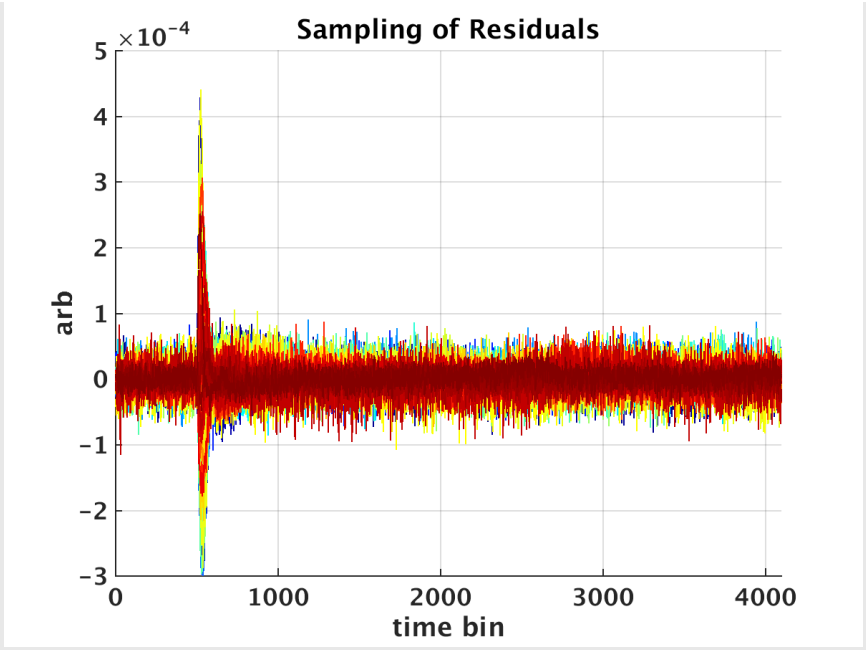


Fig 4.a Templates

The residuals between the pulses and the template, are shown in Figure 4.b. The differences seem to be due to the position dependance of the iZip, this difference treated as non-stationary noise and is used for the non-stationary optimal filter.

Residuals		
Selected Events		
Full Range	1keV	10keV

Full Scale	Zoomed



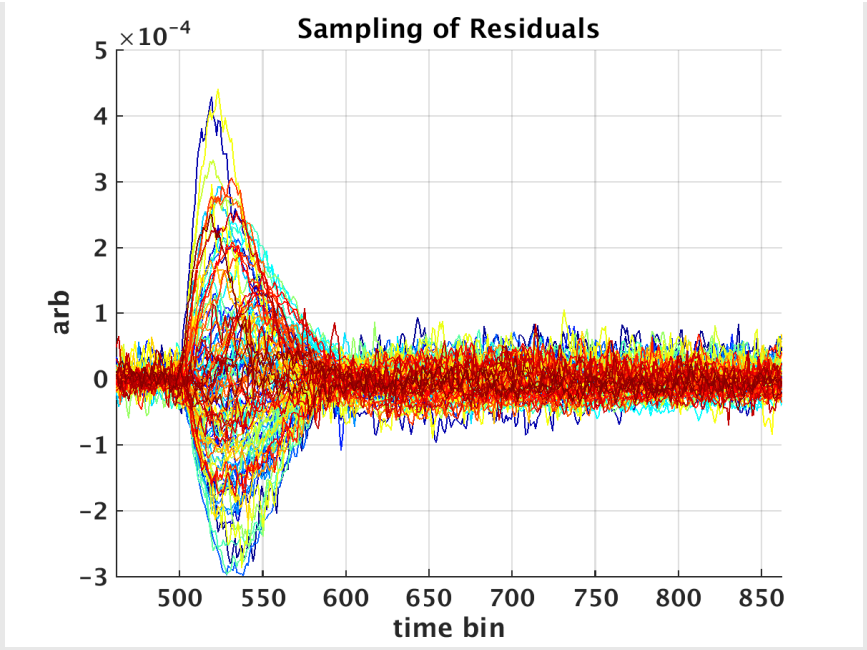


Fig 4.b Residuals

IV. Conclusions

- R3 templates have been generated
- Perhaps more events/traces should be included? (seems like that would require procsessing more data so maybe it's not ideal)
- Would it be useful to compare to other templates? (if so, references to those are needed...)
- Non-stationary OF information hasn't been obtained, but could be obtained with the PSD's of in the same series