

Pulse digitization using template fitting

$$t' = \frac{2}{\pi} \tan^{-1} \left(\frac{S_m - S_{m-1}}{S_m - S_{m+1}} \right) \quad (1)$$

$$t(\tau) = (5.88 \text{ ns}) \frac{\int_0^\tau p(\tau') d\tau'}{\int_0^{5.88 \text{ ns}} p(\tau') d\tau'} \quad (2)$$

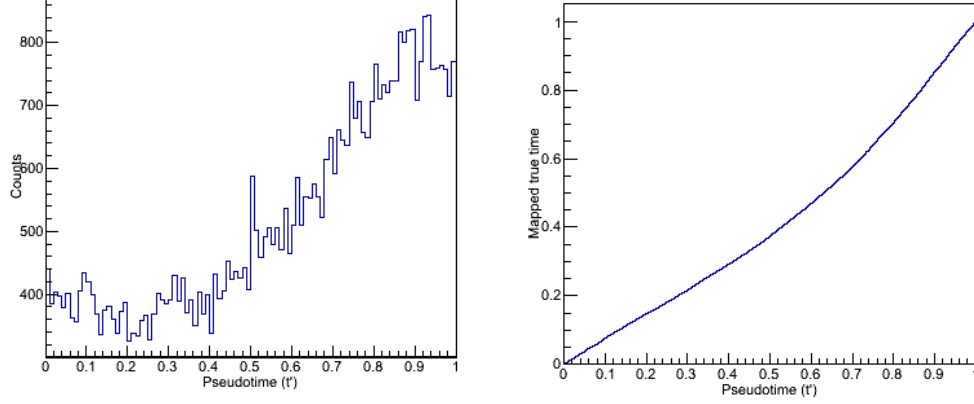


Figure 1: Pseudotime t' distribution of channel 1 for gamma rays (left) and true time mapped from normalized running integral of pseudotimes (right)

Template design procedure

The normalization was also done by subtracting the pedestal. An illustration of a neutron template and gamma template for channel 1 is shown in figure ??.

Should I show a figure of all 8 ndets for neutron and gamma templates?

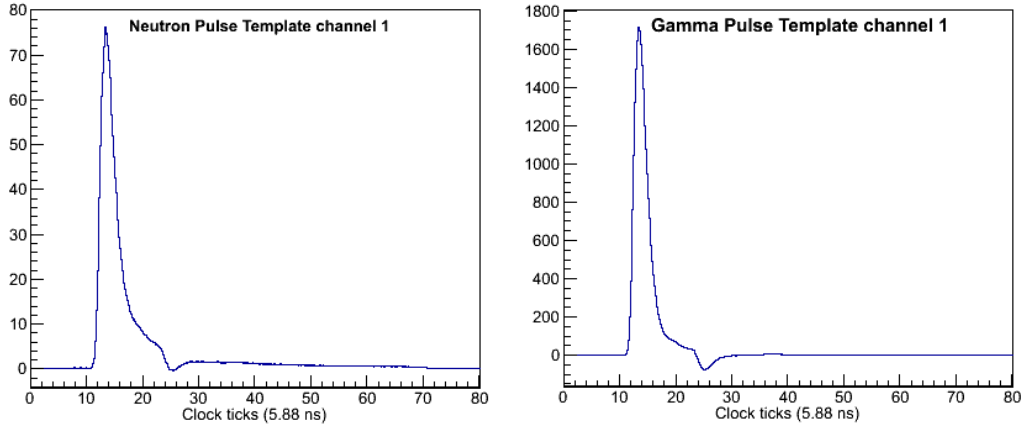


Figure 2: Template channel 1 for neutrons (left) and Template channel 1 for gamma rays (right)

Energy Dependence of templates

- 2000 - 3500 channels corresponding to low energy

- 3500 - 5500 channels corresponding to intermediate energy
- 5500 - 7000 channels corresponding to high energy

Figure ?? shows the template of the three energy ranges stated above for neutrons and gammas respectively.

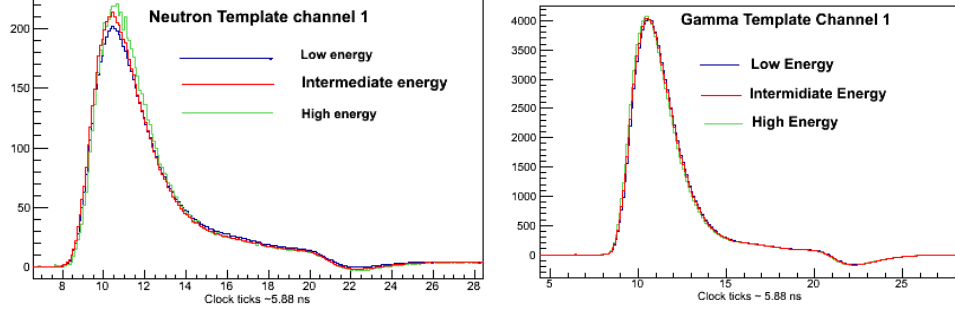


Figure 3: Three energy dependent neutron templates(left) and gamma templates (right).

Minimization

$$D = \sum_{i \in \text{samples}} [S_i - P - A f_i(t)]^2 \quad (3)$$

Fit Parameters: The time t_j , pedestal subtracted area A_j and pedestal P of the pulse were used as independent fit parameters to

The figure ?? shows a neutron pulse (by neutorn pulse, I mean a pulse tagged as a neutron from our previous analysis to

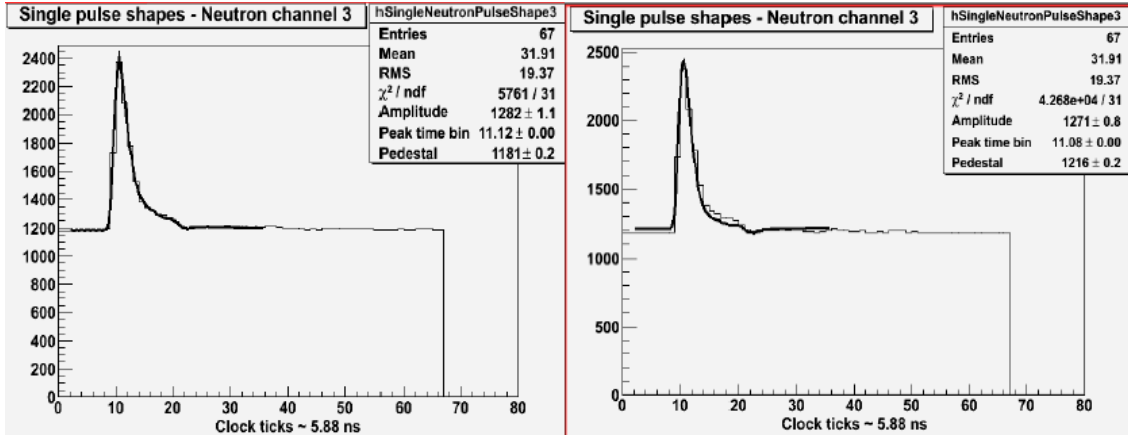


Figure 4: A neutron pulse first fitted with a neutron template(left) and then a gamma template (right), using root fit.

$$\frac{\partial D}{\partial P} = -2[S - P - \sum_{j \in \text{pulses}} A_j f_j(t_j)] = 0 \quad (4)$$

$$\frac{\partial D}{\partial A_j} = -2f_j(t_j)[S - P - \sum_{j \in \text{pulses}} A_j f_j(t_j)] = 0 \quad (5)$$

Fit Function/Template: No analytical fit function was used. Instead bin content read from a root histogram i.e. the average template $f_j(t_j)$ was used for fitting individual pulses. Some properties of the fit function are listed below:

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Figure ?? shows the fit using Brent method on a neutron pulses fitted with neutron and gamma ray templates.

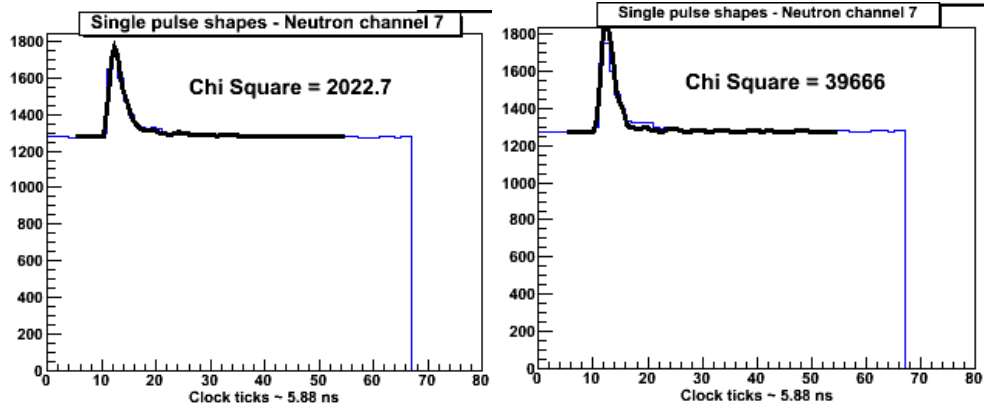


Figure 5: A neutron pulse first fitted with a neutron template(left) and then a gamma template (right), using Brent's minimization.

The plots shown in figure ?? illustrates the comparison of t_j, A_j and P

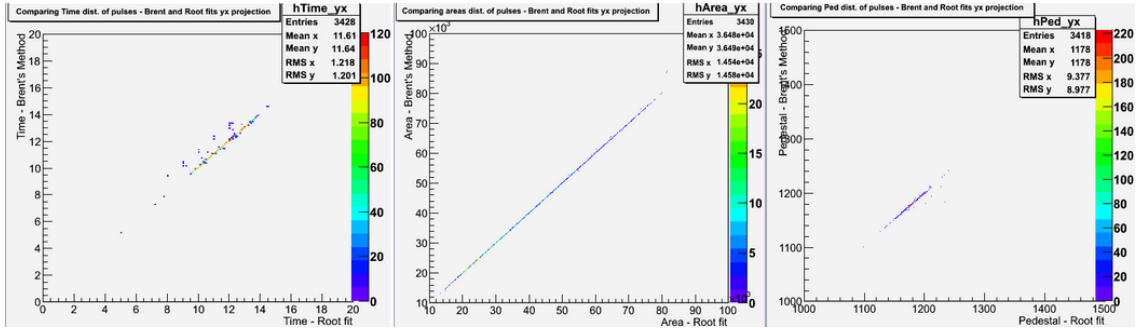


Figure 6: Comparison of fit parameters

Chi Square distribution using Brent's algorithm

Correlation between bins

Figure ?? takes a large scale into account to get an idea of the big picture of the distribution of residues. The plots in figure ?? revealed that the gamma rays displayed a much less

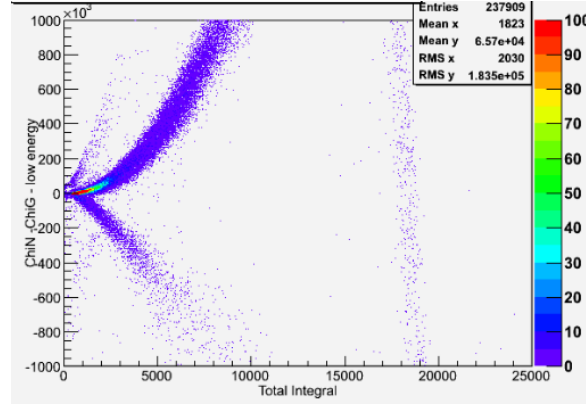


Figure 7: Plot of chi squared difference between neutron and gamma templates with pulse energy(total area)

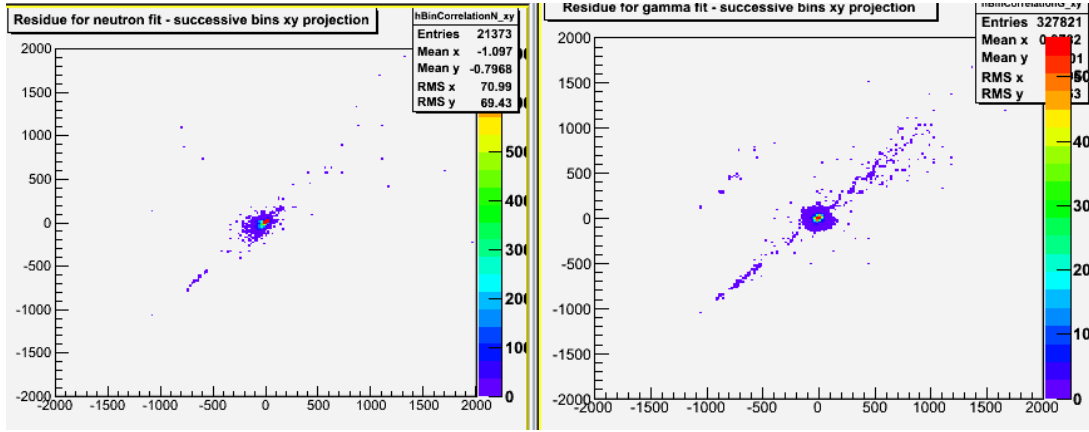


Figure 8: Residues of fitted function and pulses for consecutive bins for neutrons(left) and Gamma rays(right)

- Noise that had no real pulse
- Pulses sitting on islands that were less than the fit range
- Pileup pulses - i.e two pulse on an island which were reasonably far apart and so could be handled
- two pulse on an island which were reasonably far apart and so could be handled

Residue VS. Bin for all Neutron channels. Range 5 to 55

Residue VS. Bin for all Gamma rays all channels. Range 5 to 55

Plan to add: Study of correlation b/w bins. PSD with chisq diff and tail total. FOM of each and compare

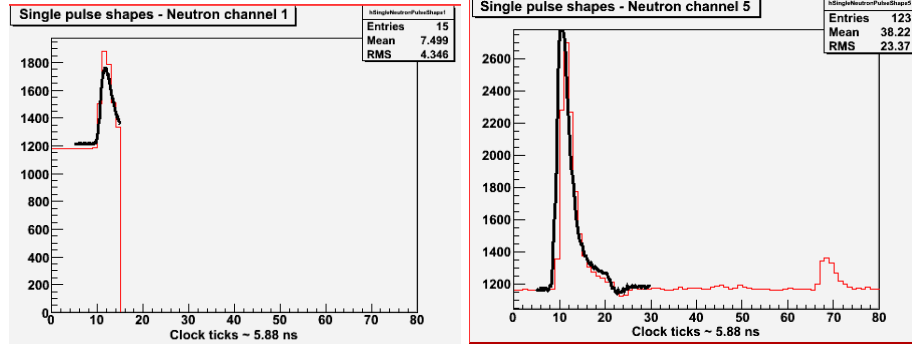


Figure 9: Pulses with island size less than the fit range

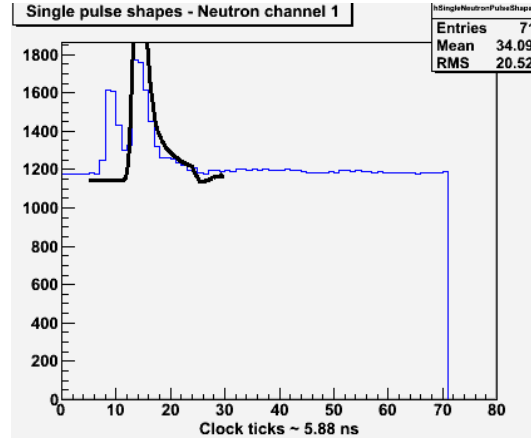


Figure 10: Extremely close double pulses on an island

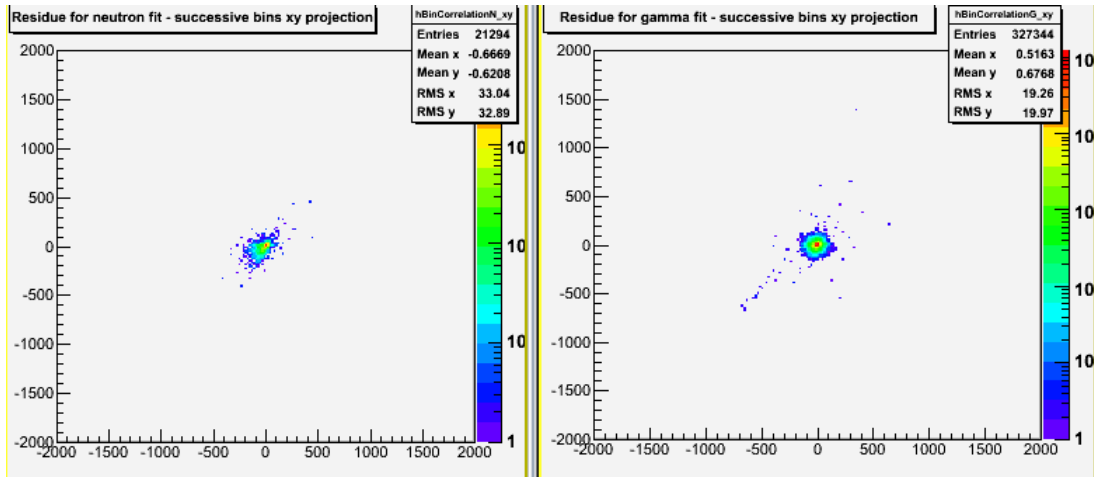


Figure 11: Residues of fitted function and pulses for n th and $(n+1)$ th bin for neutrons(left) and Gamma rays(right) - Improved version

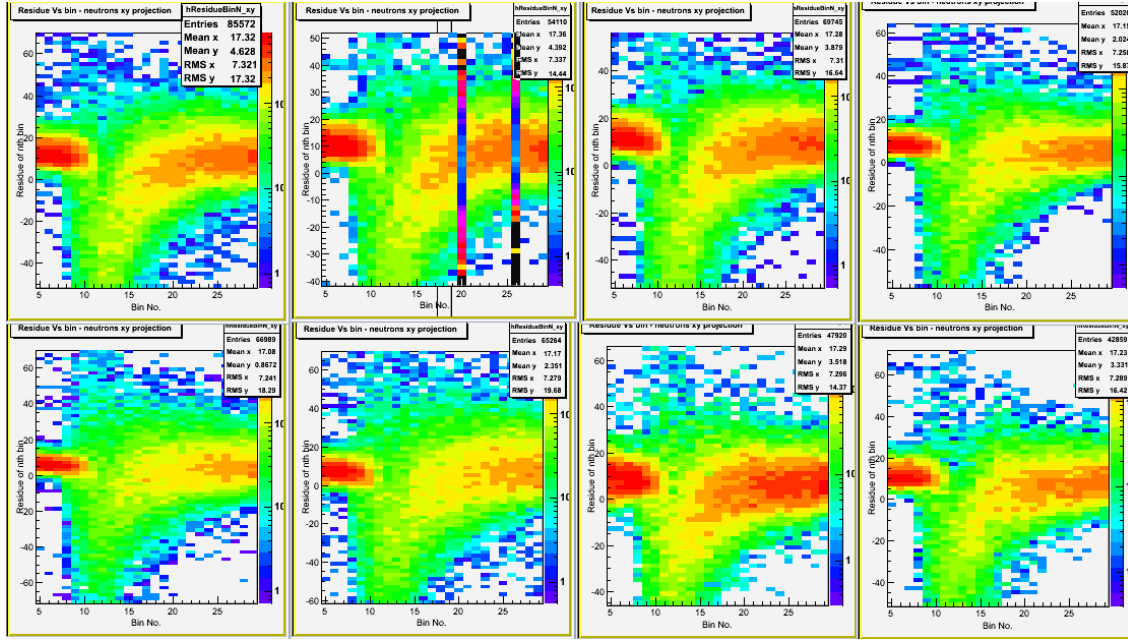


Figure 12: Residues of each bin in fit range 5 to 30 - neutrons - all detectors

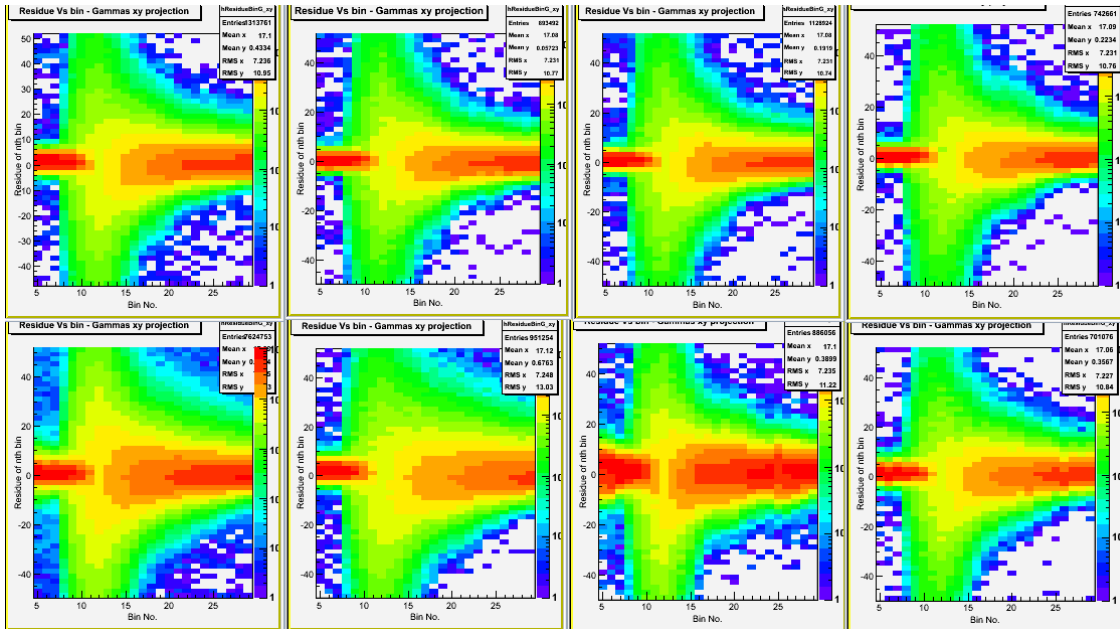


Figure 13: Residues of each bin in fit range 5 to 30 - Gamma rays - all detectors

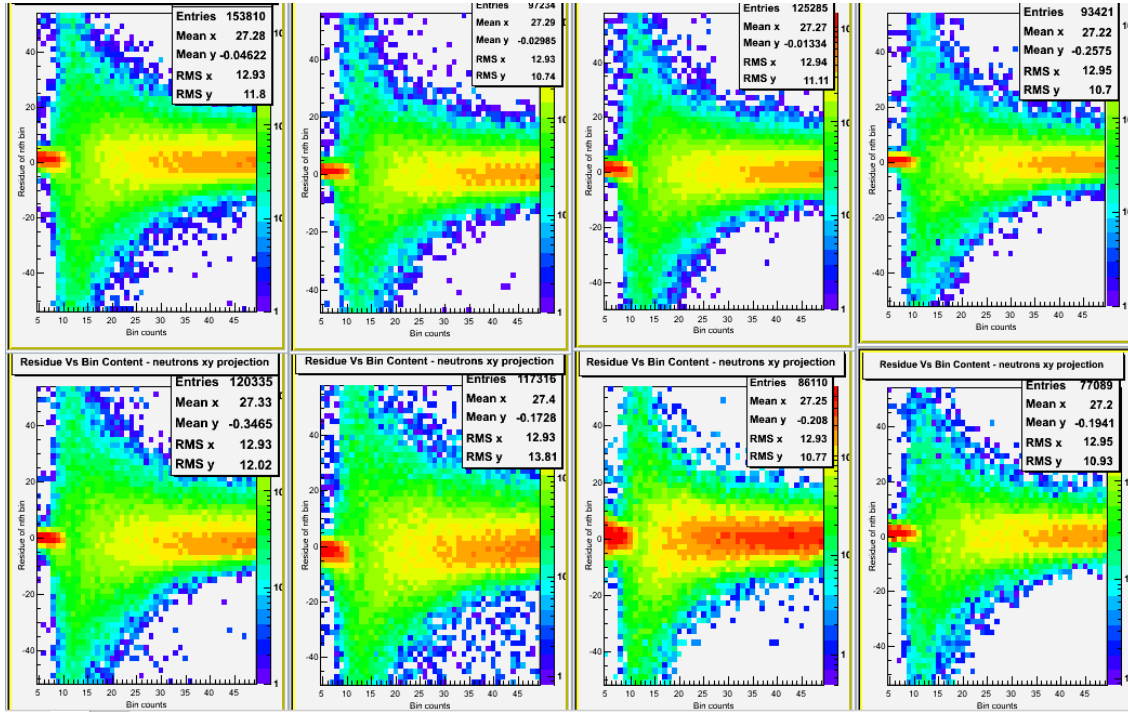


Figure 14: Residues of each bin in fit range 5 to 55 - neutrons - all detectors

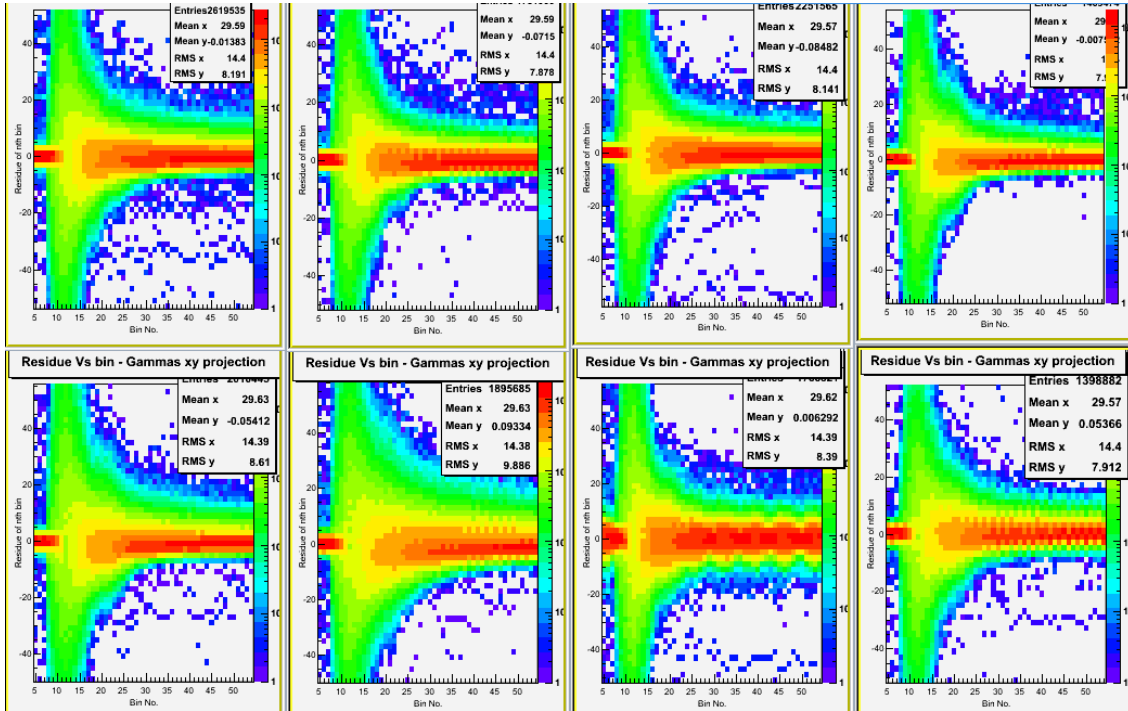


Figure 15: Residues of each bin in fit range 5 to 55 - Gamma rays - all detectors