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Neutron Pulse Shape Discrimination

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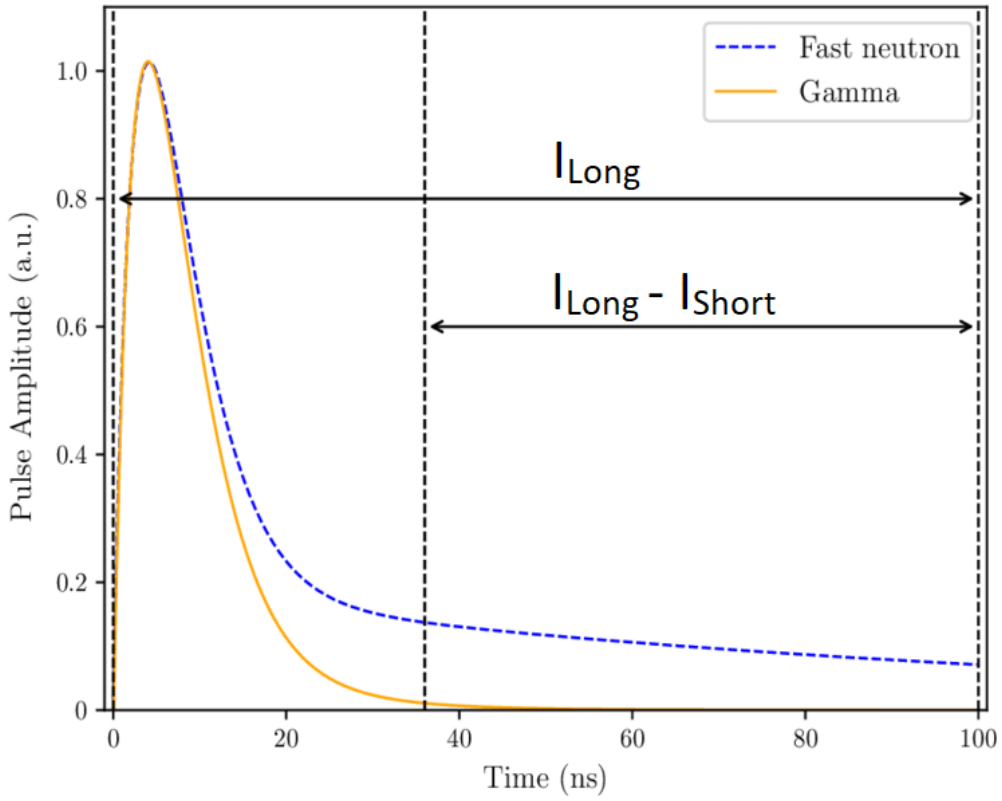
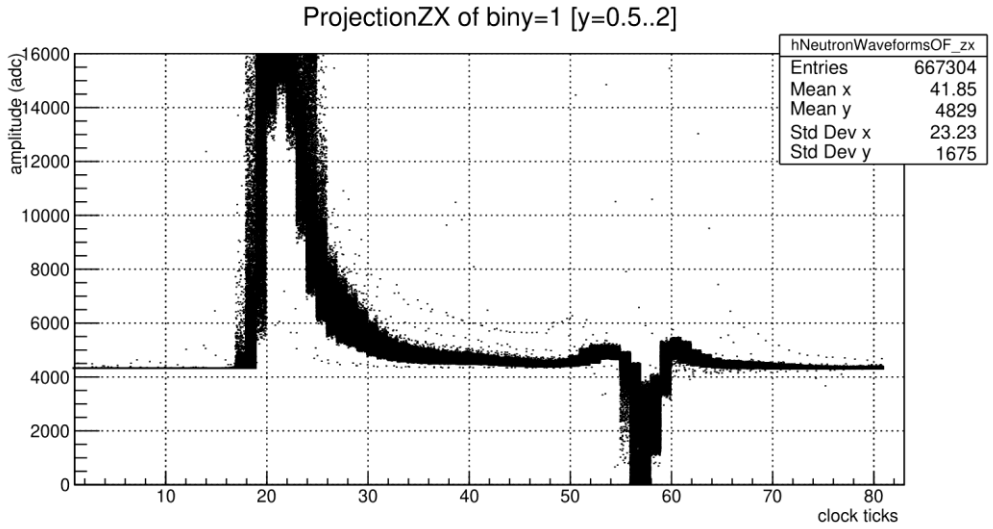
Difference between gamma and neutron pulses

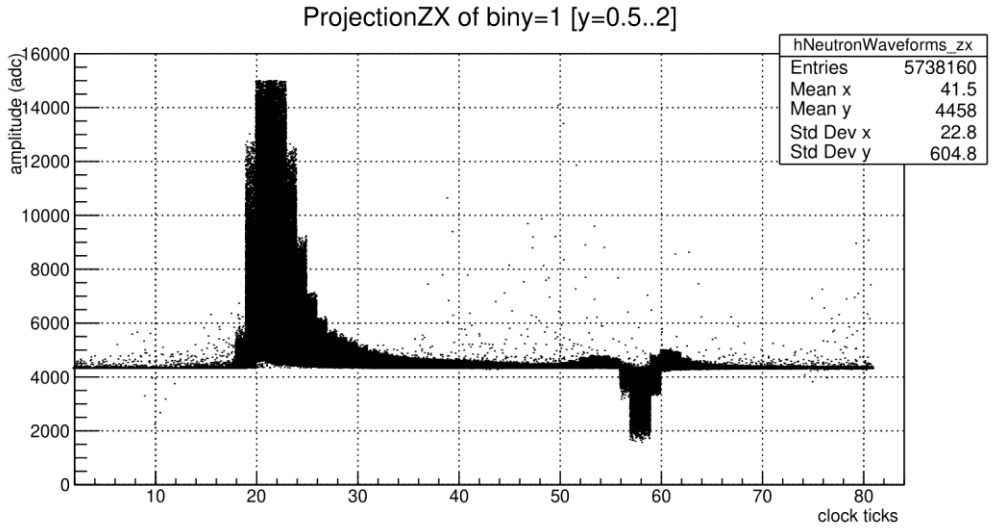
- Both transfer energy to electrons
- Neutrons are heavier → longer pulse tails
- Compare main peak region and tail region



First attempt

- Only consider non-overflow events (cutoff currently at 15000)
- Get baseline by averaging first 10 clock ticks
- Short integral: integrate between maximum/2 times
- Long integral: integrate between maximum/10 times

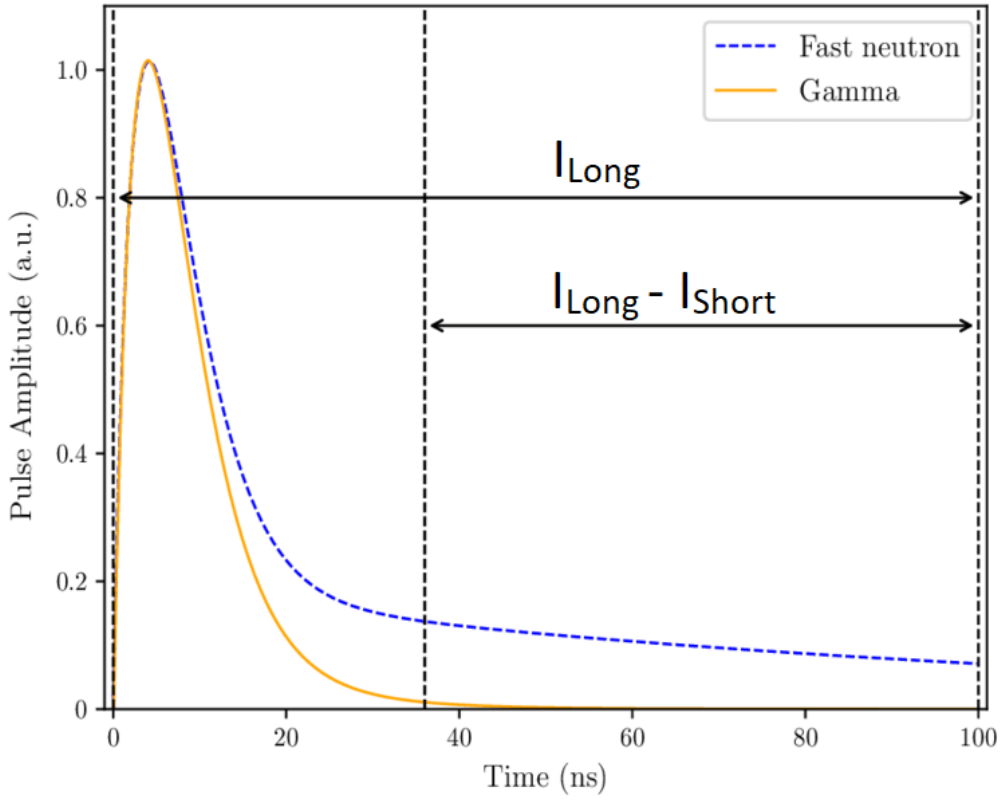




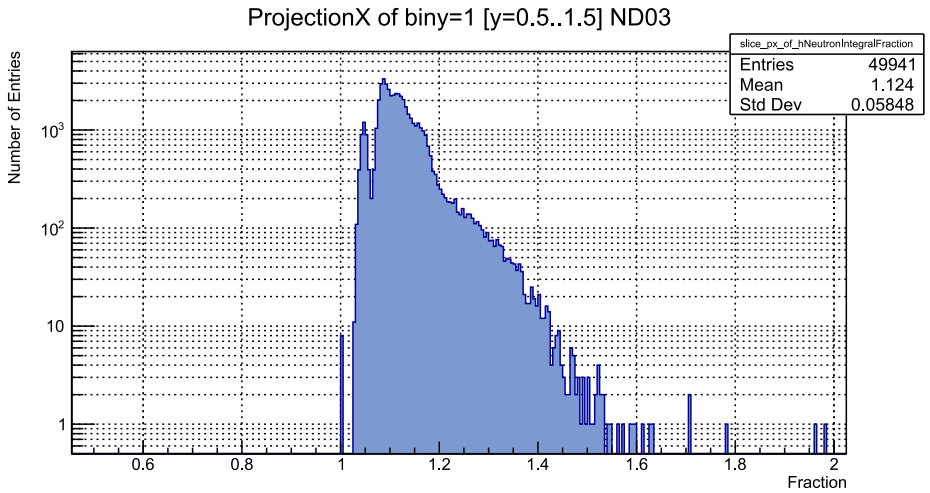
Types of discrimination

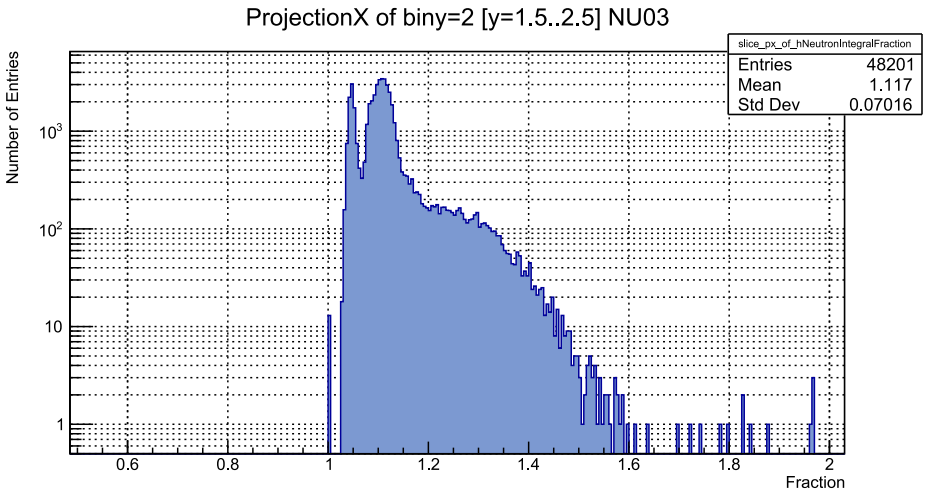
- Fraction
  - $PSD = \frac{Long\ integral}{Short\ integral}$
  - $1 < PSD < \infty$
  - Will vary more with energy

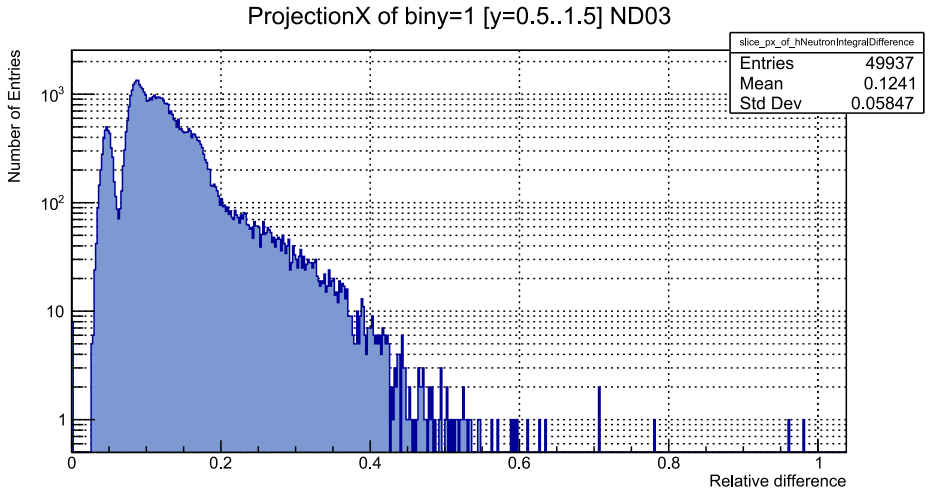
- Relative difference
  - $PSD = \frac{Long\ integral - Short\ integral}{Long\ integral}$
  - $0 < PSD < 1$

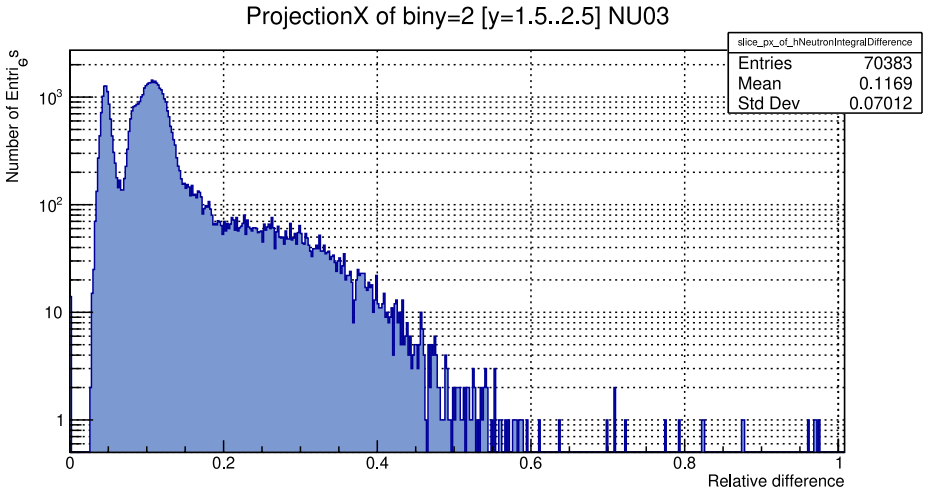


Long/short integral differences





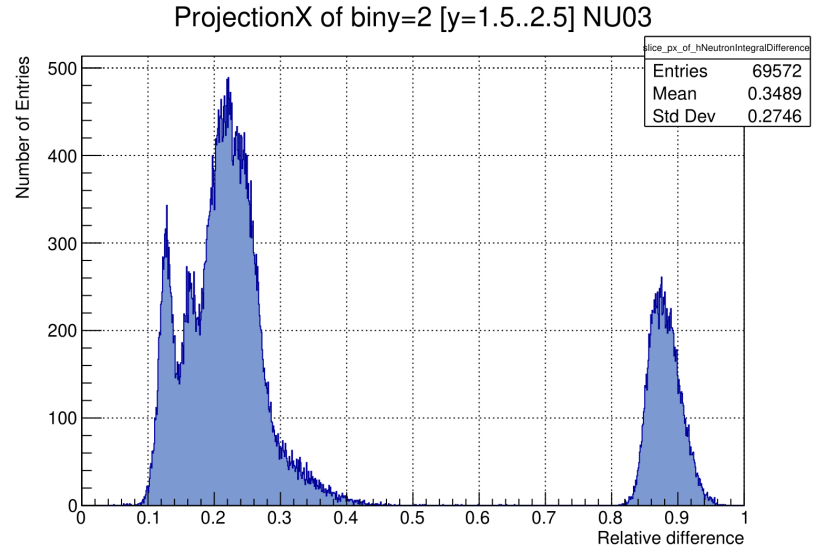


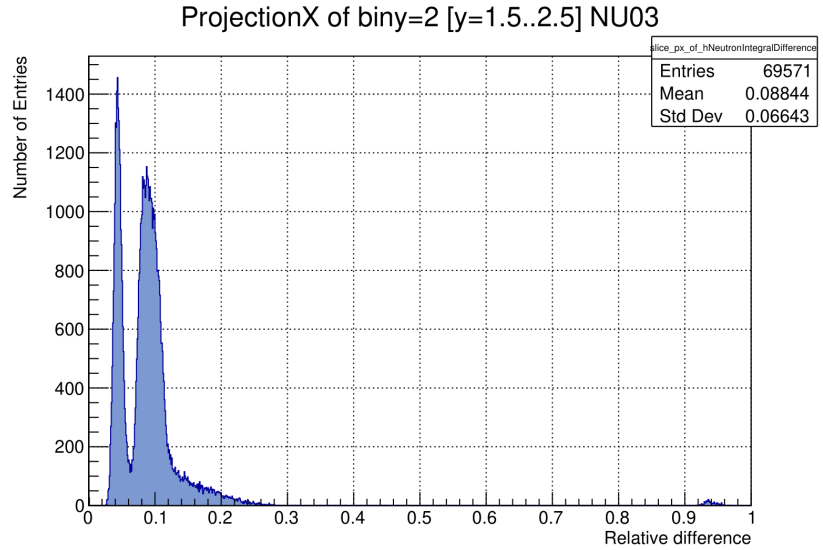


Second attempt

- Integrals start from maximum/10
- Long integral: integrate up to maximum/10 right of peak
- Short integral: integrate up to maximum/n right of peak
- Investigated n = 2, 3, 4, 5

- Problem: Photon-neutron ratio changes with n???

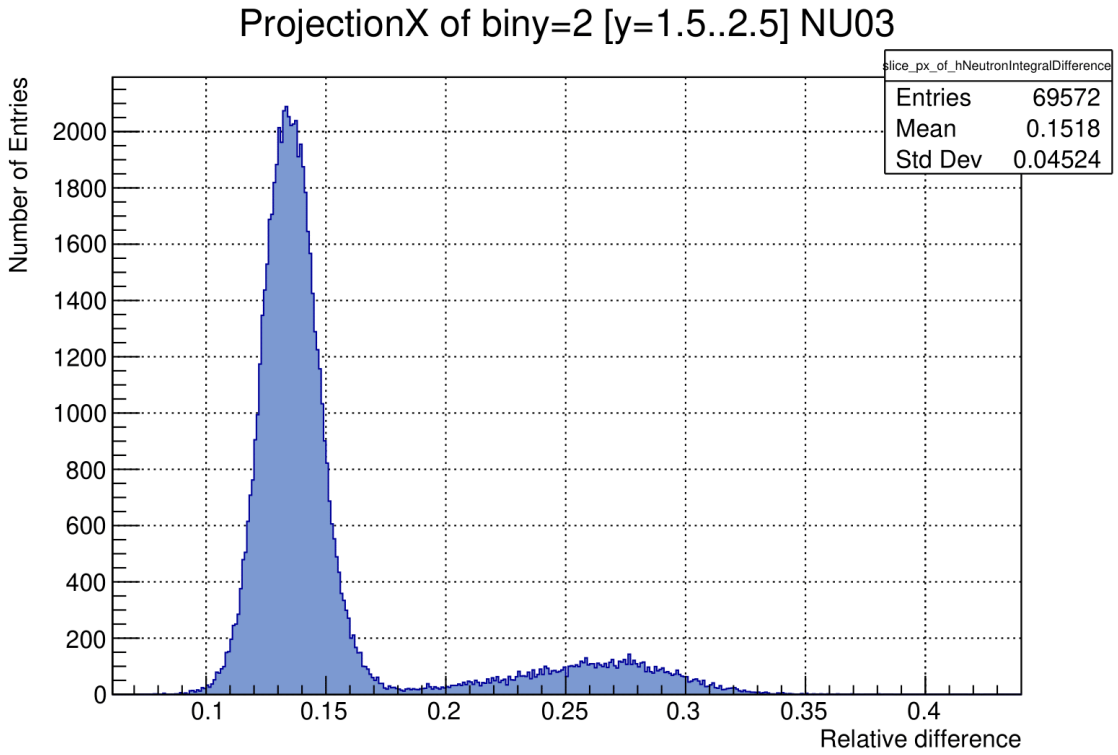




Third attempt

- Fixed time interval
- Integral start: Clock tick 10
- Long integral end: Clock tick 50
- Short integral end: Find optimal

- Seemingly no changing photon-neutron ratio



What's next?

- What is the part below the baseline?
- Figure out what is present in this run (run number 27000)
- Check more time intervals
- Fit with several Gaussians/Crystal ball functions to figure out probability of being a neutron
- Energy slices
  - Change in distinguishability
  - Change in best parameters
- Perform for different runs

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