

# Pulse Identification Method for Overlapped Pulses

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The KOTO experiment [1] is a rare kaon decay experiment at J-PARC in Ibaraki. The goal of KOTO experiment is to discover the  $K_L \rightarrow \pi^0 \nu \bar{\nu}$  decay, and measure its branching ratio. The standard model predicts its branching ratio to be  $2.4 \times 10^{-11}$  [2], while the current upper limit of the branching ratio is  $2.6 \times 10^{-8}$  (90%CL) [3]. KOTO is designed to improve the sensitivity by 3 orders of magnitude from the current upper limit. KOTO experiment took the first physics run in May 2013.

With the high intensity proton beam from J-PARC, the counting rate of detectors will become a few MHz. If two or more pulses arrive at detector within a short period of time, those pulses will merge into one pulse. In order to get energy and timing information of each pulse from such an overlapped waveform, we record waveform of each detector pulse with 125 MHz ADC. The inputs to the ADC chip are widened to be in gaussian-shape with the 10 pole Bessel filter in advance of the sampling to get enough data points with detector signals (Figure1). This technique also increases probability of overlapping. Overlapped waveform is observed even in KOTO physics run in 2013 (Figure 2) and pulse shape analysis is necessary for analysis. I developed a new method to identify pulses from overlapped waveform.

In this presentation, pulse identification method and its performance will be reported.

## References

- [1] J. Comfort et al, Proposal for  $K_L \rightarrow \pi^0 \nu \bar{\nu}$  Experiment at J-PARC. (2006).
- [2] J. Brod, M. Gorbahn and E. Stamou, Phys. Rev. D 83, 034030 (2011)
- [3] J. K. Ahn et al., Phys. Rev. D 81, 072004 (2010).

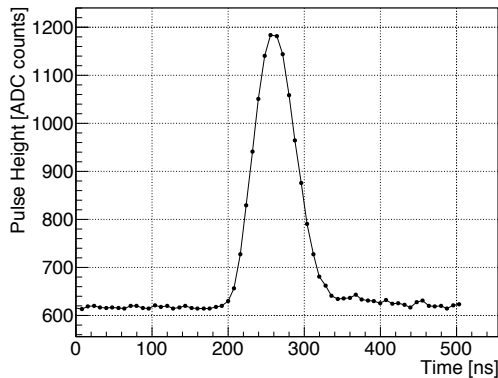


Figure.1: Recorded Waveform.

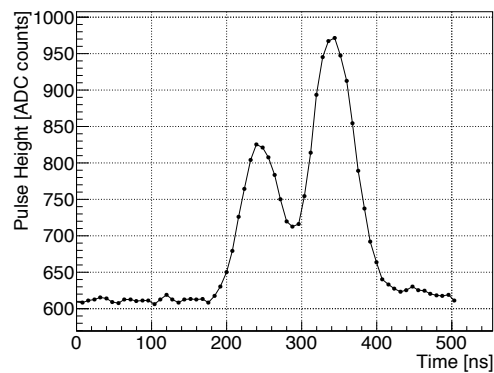


Figure.2: Overlapped Waveform.