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Development and test of a TDC and amplifier circuit for a multi-channel positron detector.

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In a continuous beam muon facility positrons are detected by relatively large plastic scintillators without position sensitivity. An idea has been proposed to make these positron detectors multi-channel and able to track the positron trajectories. This will ultimately enable 2-dimensional magnetic imaging of the sample with the μSR technique. To attain this "muon microscope"idea, large numbers of independent photosensors with high-timing resolution will be necessary.

Our group at KEK has developed an amplifier-shaper-discriminator (ASD) circuit named FGATI with 16 channels per chip and a high-resolution time to digital converter, called HR-TDC with a timing resolution on the order of picoseconds. Silicon photomultipliers (SiPMs) from Hamamatsu (MPPC) are employed to give electric pulses for the optical input [1-2]. We have been testing this new set-up at TRIUMF with a pulsed laser to understand the efficiency, transient response, timing resolution, and the data acquisition to a computer. We are now successfully detecting the rising and falling edge timing as well as the time-over-threshold (TOT) of the laser pulses.

The tested circuit will be a basis for the light detection and time recording from scintillation fiber arrays to be used for the multi-channel positron detectors. Multiple layers of such detectors will establish tracking the positron trajectory and aid with the development of the "muon microscope".

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Reference
1 K.M. Kojima et al, JPS Conf. Proc., 21, 011062 1-6, (2018).
2 K.M. Kojima et al, J. Phys: Conf. Ser., 551, 012063, (2014).

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