

Development and Evaluation of an ultra-fast ASIC for future PET scanners using TOF-capable MPPC array detectors

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We developed a front-end ASIC for future PET scanners with time-of-flight (TOF) capability to be coupled with 4×4 Multi Pixel Photon Counter (MPPC) arrays.

The ASIC is designed based on the open-IP project proposed by JAXA and realized in TSMC 0.35 μm CMOS technology. The circuit comprises 16-channel, low impedance current conveyers to effectively acquire fast MPPC signals. For precise measurement of coincidence timing of 511 keV gamma-rays, the leading-edge method was used to discriminate the signal.

We first tested a time response of the ASIC by illuminating each channel of a MPPC array device of 3 × 3 mm² in size with a Pico-second Light Pulsar with light emission peak of 655 nm and pulse duration of 54 ps (FWHM). We obtained 105 ps (FWHM) on the average of each channel for the time jitter measurements. Moreover, we compensated for time lags of each channel with inner delay circuits and succeeded in suppressing about-700ps-lag to 15ps.

We will also report on the TOF measurements using back-to-back 511 keV signals, and suggest that the ASIC can be a promising device for future TOF-PET scanners based on the MPPC array.

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