



Contribution ID: 160

Type: Poster

TOFPETv2: a high-performance circuit for PET Time-of-Flight

Tuesday, 26 May 2015 15:25 (0 minutes)

We present a readout and digitization ASIC for radiation detectors using modern Silicon Photomultipliers [1]. The circuit is designed in standard CMOS 110 nm technology, has 64 independent channels and is optimized for time-of-flight measurement in Positron Emission Tomography (TOF-PET). The input amplifier is a low impedance current mirror based on a regulated common-gate topology. The chip has quad buffered analogue interpolation TDCs and charge integration ADCs, in each channel. The signal amplitude can also be derived from the measurement of time-over-threshold. The circuit has linear response in the range 0-1500 pC. Simulation results show that for an impulse charge of 200 (550) fC the circuit has 25 (30) dB SNR, 93 (39) ps r.m.s. time resolution, and 5 (8) mW power consumption. The maximum event rate is 600 kHz per channel, with up to 2 MHz dark counts rejection.

[1] T. Nagano, N. Hosokawa, A. Ishida, R. Tsuchiya, K. Sato, and K. Yamamoto, "Timing resolution dependence on MPPC geometry and performance," in Proc. Conf. Rec. IEEE Nuclear Science Symp., Seoul, Korea, Oct./Nov. 2013, pp. 1-5, paper NPO1-89.

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Session Classification: Applications - Poster Session

Track Classification: S4 - Applications