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MAGIC: a SiPM Readout ASIC for Monolithic PET Detectors

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Abstract

We present the design of the first prototype of MAGIC (Multichannel Analog Gamma-ray detection Integrated Circuit), an ASIC developed for the readout of Silicon Photo-Multipliers (SiPMs) coupled with monolithic scintillators. The circuit is designed in standard CMOS 110 nm technology and it is optimized for Time-of-Flight Positron Emission Tomography (TOF-PET). The input stage is a current conveyor (CC) based on positive feedback to handle large SiPM capacitance. This stage buffers the input current to the energy path, consisting of a Gated Integrator (GI), Baseline Holder (BLH), multiplexer, buffer, and single-ended to differential operational amplifier; and to the timing path, including a Schmitt Trigger, an OR gate, delay line, differential AND, and LVDS driver. To meet the application requirements, the ASIC offers a large dynamic range of ≃ 60 dB, capability to read large input currents close to 30 mA, an intrinsic jitter of ≃ 20 ps FWHM, and on-chip digital logic for event discrimination. Photon-by-photon event validation is performed on-chip by means of an innovative network applying a threshold on the sum of the SiPM currents, a proxy for the photon energy.

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