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A 64-channel ASIC for full waveform sampling with 200 MS/s for space-based cosmic-particles applications

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This paper discusses the development of a 64-channel ASIC designed in a commercial 65nm CMOS technology to readout a camera plane composed of Silicon Photo-Multipliers (SiPMs). The purpose of the readout chain is the detection of Extensive Air Showers (EASs) by focusing the Cherenkov radiation which signal is produced by Ultra-High Energy Cosmic Rays (UHECRs) and Cosmic Neutrinos (CNs) interactions in the atmosphere. Each ASIC generates a hitmap sent to an FPGA to analyze the pixel proximity. The stored data can only be digitally converted on-chip if it is validated through this external checker. A single ASIC is formed by channels where 256 cells are connected to the output of the front-end electronics to obtain a full waveform sampling. An analog memory, a 12-bits Wilkinson Analog-to-Digital Converter (ADC) and latches are placed into the cell unit to which a 200 MHz clock is distributed. To derandomize the input signal, the array of cells is partitioned into segments of 32 cells each. The readout is realized using a serializer operating at 400 MHz in Double Data Rate (DDR). The ASIC is developed in the framework of the Extreme Universe Space Observatory - Super Pressure Balloon 2 (EUSO-SPB2) mission, but it is also suitable for several other applications due to its configurability such as the partitioning and the resolution in the range of 8-12 bits. In this way, the chip can save power and conversion time, depending on the requirements of the experiment.

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