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HKROC: a modern integrated front-end ASIC to readout photomultiplier tubes for Cherenkov-based experiments

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The HKROC ASIC was originally designed to readout the photomultiplier tubes for the Hyper-Kamiokande experiment. HKROC is an auto-triggered very versatile and innovative ASIC capable of readout a large number of channels while meeting very stringent requirements in terms of noise, time & charge resolution while sustaining very high hit-rate and low-power consumption.

Each HKROC channel features a low-noise preamplifier and shapers, a 10-bit successive approximation Analog-to-Digital Converter (SAR-ADC) for the charge measurement (up to 2500 pC) and a Time-to-Digital Converter (TDC) for the Time-of-Arrival (ToA) measurement with 25 ps binning. The key feature of HKROC is its “waveform digitization” capability: it dynamically opens acquisition windows for internal digitization. It enables new possibilities in terms of pulse-shape analysis and double pulse triggering with a low dead time (down to 10 ns), while preserving a very low power consumption compared to standard flash-ADC. Moreover, HKROC is equipped with an adaptive readout which allows to cope with very high rate events such as close supernovae (Betelgeuse...) for neutrino based experiment.

The presentation will describe the ASIC architecture and the experimental results of the second HKROC prototype received in December 2022.

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