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Trigger-Less Readout System With Pulse Pile-Up Recovery for the PANDA Electromagnetic Calorimeter

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The PANDA collaboration at FAIR, Germany, will investigate yet undiscovered charm-meson states and glueballs in antiproton annihilations to study QCD phenomena in the non-perturbative regime. A multi-purpose detector for tracking, calorimetry and particle identification is presently being developed to run at high luminosities providing annihilation rates up to 20 MHz. The PANDA electromagnetic calorimeter (EMC) is composed of PbWO4 (PWO) crystals which are cooled to -25 °C and coupled to large-area avalanche photodiodes or vacuum photo-triodes /-tetrodes. Individual crystals will be exposed to single-detector hit rates up to 500 kHz causing a pileup probability up to 15%. The photo-sensor signals are continuously digitized by Sampling ADCs (SADCs) and analyzed on-line in FPGAs to detect hits and extract energy and time information. The on-line digitizer algorithm was designed , optimized and implemented in VHDL for a Xilinx FPGA. In order to gain flexibility and selectivity at high data rates, the PANDA collaboration develops the trigger-less readout system: all detector channels are self triggering entities and able to detect and pre-process signals and to transmit only the physically relevant information, sorted according to precise time-stamps. We present test results for the prototype of a trigger-less readout chain of the PANDA EMC including as key ingredient the synchronous optical link connection for clock signals and time-synchronization commands.

Optional extended abstract

additional information and references:
In comparison with the conventional charge-integrating readout the digital readout improves the energy resolution in particular at low photon energies and simultaneously provides a time resolution below 1 ns in a wide dynamic range [5]. Applying precise timing algorithms and signal filtering, the energy and time stamp of pile-up pulses can be recovered with high accuracy up to time differences equal to the pulse rise-time in a wide range of signal-amplitude ratios, reducing the remaining pileup probability from 15% to 1.5%.

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for the collaboration

on behalf of the PANDA Collaboration

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