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P2.14: Timepix3 multi-layer detector setup for the measurement of anomalies in angular correlation of electrons and positrons internally produced in excited 8Be and 4He

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This contribution describes a new Timepix3 [1] multi-layer detector setup that is part of a spectrometer for the measurement of anomalies in angular correlation of electrons and positrons internally produced in excited 8Be and 4He [2].

Six detector layers are arranged hexagonally in the new design. There are some unique requirements that had to be addressed, including the capacity to operate in a vacuum, the accurate time synchronization of all detectors, and the small material budget behind detectors (due to the mitigation of influence on other detectors). The whole measurement chain consists of chipboard modules (fingers), the main board, and the readout system. Chipboard modules carry a Timepix3 chip with a silicon $500\mu\text{m}$ sensor and local power supplies providing excellent voltage stability. The Timepix3 assembly is glued to an aluminum block only by means of the inactive part of the ASIC chip (periphery part + pads extender) due to the demand for minimization of the material budget behind the sensor. Aside from that, specially thinned Timepix3 ASICs with a thickness of $200\mu\text{m}$ (instead of the typical $720\mu\text{m}$) are used.

Data from all six modules is concentrated on the main board, which ensures the main power voltage supply, fanout of control signals, and interconnectivity with the readout system via vacuum feed-through.

The modified Katherine readout for Timepix3 Generation 2 is used as a readout system [3]. This device's capabilities have previously been demonstrated in a number of projects, and it is based on a 1 G Ethernet and USB 3.0 interface.

Each chipboard module may give up to 20 Mhit/s. The maximum hit/data rate for the entire system is 120 Mhit/s, which corresponds with a raw data rate of about 6 Gbps (the PCI Express interface is considered for these maximal rates in future). The clock shift of each Timepix3 detector is measured to guarantee the accurate, consistent timing of the entire system.

In contribution, a demonstration of the whole setup, including sensor characterization and timing performance, will be shown.

[1] T. Poikela et al., 2014 JINST 9 C05013.

[2] Cortez, A. F. V., et al. "A spectrometer for the measurement of anomalies in the angular correlation of electron and positron internally produced in excited 8Be and 4He ." Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 1047 (2023): 167858.

[3] P. Burian et al., 2017 JINST 12 C11001.

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