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First results from the Timepix4 Telescope

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A beam telescope based on the recently developed Timepix4 ASIC was built in order to perform tests of synchronous multiple-detector readout and track reconstruction with fast timing capability. The Timepix4 is a readout ASIC for hybrid pixel detectors that is designed to record both the time of arrival (ToA) and the time over threshold (ToT) for each discriminated signal. It has a 448 × 512 pixel matrix with square pixels at a 55 µm pitch. The ToA is digitised by a TDC with time bins of 195 ps. The ToT is proportional to the charge collected by the silicon sensor, and is used to achieve sub-pixel spatial resolution. The ToT is also used to correct for timewalk and thereby improve the ToA resolution. The telescope consists of eight planes with n-on-p silicon sensors. Four of these planes are instrumented with 300 µm thick planar sensors, and they are tilted with respect to the be incidence to provide high quality spatial measurements. The other four planes have 100 µm thick sensors to achieve a better time response. Each detector assembly (sensor + Timepix4 ASIC) is cooled by circulating chilled glycol through a 3D-printed titanium block that is directly attached to the carrier PCB. The cooling block has a circular cut-out to minimise the amount of material traversed by incident particles. The assemblies are readout by SPIDR4 systems. Scintillators and micro-channel plate (MCP) detectors provide precise time-reference signals that are recorded by the PicoTDC chip which has time bins of 3 ps. The time references are used to characterise and calibrate the time measurements of the telescope. First tracks were reconstructed using information from all eight planes, which allows for the assessment of temporal resolution using high energy particles.

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