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Exploring the Intrinsic Time Resolution of the SiPM-on-Tile Technology

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The SiPM-on-Tile technology, where small plastic scintillator tiles are directly read out with SiPMs, has been developed for the CALICE Analog Hadron Calorimeter (AHCAL), and has been adopted for parts of the hadronic section of the CMS HGCAL. For future electron-positron colliders, a single cell time stamping on the sub-nanosecond level for energy deposits corresponding to single minimum-ionizing particles is desired to provide background rejection and to support pattern recognition and energy reconstruction with particle flow algorithms. To study the intrinsic time resolution achievable with this technology, detailed measurements have been performed in beam tests at DESY. For this program, a setup designed for maximum flexibility to minimize the time needed for access to the beam area and changes to the setup has been constructed. Four scintillator tiles are arranged as a “beam telescope”, allowing the investigation of various scintillator materials and tile geometries. This setup is integrated in an overall support structure and equipped with a compact system that provides SiPM, front-end amplifier power and signal routing. A precise digitizer reads out the full analog waveform to resolve the time structure of the detector response in an offline analysis. In this contribution, we will discuss details of the experimental setup and its calibration, and report on first analyses of the data taken at DESY in October 2021.

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