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Performance of 55 micron pitch TI-LGADs on Timepix4

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In recent years, development of pixel detectors has evolved from only improving the spatial resolution to also improving the temporal resolution. The ultimate goal is to develop a 4 Dimensional tracking (4D tracking) system capable of combining micrometer spatial resolution with a time resolution in the order of tens of picoseconds.

Low-Gain-Avalanche-Detectors (LGADs) provide a promising avenue for detectors with excellent time resolution due to their intrinsic gain.
However, typical LGADs are limited in their spatial resolution due to the large Junction Termination Extension (JTE) which provide no gain. This results in large millimeter sized pads to ensure sufficient ratio of gain to no-gain regions.
Modifications to the process such as Trench-Isolated-LGADs (TI-LGADs) that forego these JTE allow for small pixel structures similar to those found in typical planar sensors.

Many TI-LGADs were tested using external amplifiers and oscilloscopes as readouts in order to determine their performance. Such operation is not suitable for implementation in large scale detector systems and requires more investigation into a fully hybridized system using a dedicated ASIC.

The Nikhef Detector R&D group has connected variants of TI-LGAD produced by FBK for RD50 with 55×55 pixels and a 55 micron pitch to a Timepix4 readout ASIC to investigate the performance of a fully hybridized system using TI-LGADs as sensors.

In this contribution we will present recent results of multiple TI-LGADs on Timepix4 assemblies showing, intrinsic gain, and achieved time resolution as a function of, but not limited to, intrapixel position and angular dependence. Results have been obtained using a picosecond laser, as well as high energy beam particles within the Timepix4 beam telescope.

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