

Timing performance of small cell 3D silicon detectors

Tuesday 26 February 2019 09:00 (20 minutes)

A silicon 3D detector with a single cell of 50x50 μm^2 was produced and evaluated for timing applications. The measurements of time resolution were performed for ^{90}Sr electrons with dedicated electronics used also for determining time resolution of Low Gain Avalanche Detectors (LGADs). The measurements were compared to those with LGADs and also simulations. The studies showed that the dominant contribution to the timing resolution comes from the time walk originating from different induced current shapes for hits over the cell area. This contribution decreases with higher bias voltages, lower temperatures and smaller cell sizes. It is around 30 ps for a 3D detector of 50x50 μm^2 cell at 150 V and -20C, which is comparable to the time walk due to Landau fluctuations in LGADs. It even improves for inclined tracks and larger pads composed of multiple cells. A good agreement between measurements and simulations was obtained, thus validating the simulation results.

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Session Classification: Session 4: Technologies and Applications (1)

Track Classification: 3D Sensors