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Development of large-area LGADs for Space Application

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Recently, Low Gain Avalanche Detectors (LGADs) has emerged as a technological solution for precise timing measurements in the tens of ps range. They have led to a range of developments in High Energy Physics and other applications. In space application, the timing of particles is one of the crucial observable that has a direct implication on particle identification. However, to distinguish particles with similar mass an absolute timing resolution is required in the order of O (10 ps). In space the rate of particles is not as high as HEP and power consumption is an issue, ultimately reducing the number of channels. The typical size of silicon sensor for strip geometry in space application is 100 μm pitch and 50-60 cm long resulting in a channel area of about 1 cm2 whereas, the typical LGAD channel size is O (1 mm2
). This work was motivated by
the requirement of a O (1 cm2
) sized LGAD detector. In this work, we investigated the jitter of the sensor as a function of different sensor thickness and gain values. In addition, we measured some big area sensors using the transient current technique (TCT) to study the signal shape and gain uniformity. We discuss the measurements performed with pad sensors of dimensions 5 mm × 5 mm (with and without gain), and strip sensors with pitch 192 μm and 3.5 cm long stips. These pad sensors with gain layer, are the biggest single channel LGADs ever fabricated in Fondazione Bruno Kessler (FBK) with standard LGAD technology. After successful measurements with TCT, we discuss the gain, gain uniformity, signal shape, signal propagation, and issues that need to be addressed while making large-area sensors.

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