Contribution ID: **2** Type: **not specified**

AC-LGAD novel geometries exploration by etching of metal on the surface AC-coupled pads

Tuesday 22 June 2021 15:45 (20 minutes)

Low Gain Avalanche Detectors (LGADs) are thin silicon detectors with moderate internal signal amplification. LGADs can provide time resolution of few 10's of pico-seconds for minimum ionizing particles. In addition, the fast rise time and short full charge collection time (as low as 1 ns) of LGADs are suitable for high repetition rate measurements in photon science and other fields. However the current major limiting factor in granularity is due to structures preventing breakdown caused by high electric fields in near-by segmented implants. As a result, the granularity of LGAD sensors is currently limited to the mm scale.
In this contribution, we present measurements on AC-LGADs (also named Resistive Silicon Detectors RSD), a version of LGAD which has shown to provide spatial resolution on the few 10's of micrometer scale with a sparse readout. This is achieved by an un-segmented (p-type) gain layer and (n-type) N-layer, and a di-electric layer separating the metal readout pads. The high spatial precision is achieved by using the information from multiple pads.
The sensors were produced by FBK (Italy) with square pad of several pitch and pad size, the production is called FBK RSD1. To study and optimize alternative pad configuration the metal layer of the pads was etched to create new geometries such as circles, crosses and micro-strips. The pad metal surface was etched at BNL (US) with laser lithography. Additionally results with AC-LGADs produced at BNL with geometries of pads, strips and hexagons will be shown.
The alternative geometries have been studied using a focused IR-Laser scans directed both at the read-out side on the front and the bias side on the back of the sensor. The etching process and preliminary measurements with the laser will be presented. For the BNL hexagonal and strip sensors a position reconstruction method based on the AC-LGAD master formula will be shown.

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Session Classification: LGAD - Low Gain Avalanche Detectors