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Investigation of signal characteristics and charge sharing in AC-LGADs with laser and test beam measurements

AC-LGADs, also referred to as resistive silicon detectors, are a recent development of low-gain avalanche detectors (LGADs), based on a sensor design where the multiplication layer and n+ contact are continuous, and only the metal layer is patterned. This simplifies sensor fabrication and reduces the dead area on the detector, improving the hit efficiency while retaining the excellent fast timing capabilities of LGAD technology. In AC-LGADs, the signal is capacitively coupled from the continuous, resistive n+ layer over a dielectric to the metal electrodes. Therefore, the spatial resolution is not only influenced by the electrode pitch, but also the relative size of the metal electrodes. Signal propagation between the metallized areas and charge sharing between electrodes plays a larger role in these detectors than in conventional silicon sensors read out in DC mode.
AC-LGADs from various manufacturers were studied with capacitance-voltage measurements, infrared laser scans and in beam tests. Methods to distinguish between (desired) signal charge sharing, cross-talk and pick-up from other channels, as well as electronic and signal-related noise, are presented. Furthermore, the impact of metal electrode size and pitch, n+ layer resistivity, and applied bias voltage on the detector response and signal characteristics is shown.

Primary experiment

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