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4-Dimensional Particle Tracking with Ultra-fast Silicon Detectors

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Measurement of charged particle trajectories is ubiquitous in applications of physics to a wide variety of areas and is essential for making measurements in high energy particle physics experiments. Silicon sensors are good for measurement of charged particles due to their resistance to radiation, high spatial granularity across large array areas, as well as their ability to collect data at very high rates. By adding an additional doping layer of p+ material (Boron or Gallium) close to the n-p junction in an n-in-p sensor, we create a new type of sensor with a large electric field and high doping concentration near the junction. This new type of thin sensor is a Low Gain Avalanche Detector (LGAD), which is capable of measuring tens-of-picosecond pulses at a rate of 500 MHz and achieving millimeter position resolution from low-energy x-ray, photon, and ⍰-particle sources. This improved fast timing resolution is necessary for LHC particle tracking to determine particle arrival times. Arrays of these LGADs allow for coverage of large detection areas. In addition, a novel type of AC coupled LGAD (AC-LGAD) is characterized by unsegmented sheets of the p-multiplication layer, the n-implant and a coupling oxide with a segmented metal contact on top. Continuous collection electrodes read out by segmented contacts allow for excellent position resolution. AC-LGAD will allow improved simultaneous measurements of deposited energy, position, and time.

Session

Works in Progress (15+5 min)

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