

3D silicon sensor optimisation for high resolution time measurements

Looking forward to future High Luminosity LHC experiments, efforts to develop new tracking detectors are increasing. A common approach to improve track reconstruction efficiency in high pile-up conditions is to add time measurement per pixel with resolution smaller than 50 ps. Different sensor technologies are under development in order to achieve those performances, like low gain avalanche diodes and 3D sensors. 3D sensors are characterized by very fast charge collection times, but present some critical issues in timing due to their electrode configurations. The presence of zero electric field volumes inside the electrodes themselves and low electric field regions between same sign electrodes causes that the 3D sensor technology presents potentially a large time walk contribution which negatively affects time resolution. In order to reduce drastically this error, a detailed study based mostly on simulation has been done with main focus on the exploration for a timing optimised 3D sensor electrode configuration. To have a more detailed view of the timing performances, sensor operation was also simulated, using TCAD and other simulation tools developed specific for this application, and the results analysed. In this presentation a detailed overview of the modeling and simulation activity as well as their results, including also future steps will be presented. The output of this studies defines the optimal sensor layout for timing applications.

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