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Invited Talk: Silicon Sensors for Trackers at High-Luminosity Environment - RD50 Collaboration Status Report

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Position sensitive silicon detectors are largely employed in the tracking systems of High Energy Physics experiments due to their outstanding performance. They are currently installed in the vertex and tracking part of the ALICE, ATLAS, CMS and LHCb experiments at LHC, the world's largest particle physics accelerator at Centre for European Nuclear Research (CERN), Geneva.

An upgrade of LHC accelerator is already planned, namely the high luminosity (HL) phase of the LHC (HL-LHC foreseen for 2023). This will enable the use of maximal physics potential of the machine. At the high integrated luminosity of 3000 fb^{-1} the tracking system at HL-LHC will face more intense radiation environment than the present system was designed for. This requires the upgrade of the all-silicon central trackers that will be equipped with higher granularity as well as radiation hard sensors, which can withstand higher radiation levels and higher occupancies also in the innermost layers closest to the interaction point. In order to address the problems caused by intense radiation environment, extensive measurements and simulations studies requirements have been initiated within the RD50 Collaboration, with an open cooperation across experimental boundaries, for investigating different designs and materials options for silicon sensors with sufficient radiation tolerance. Research topics include studies of sensors with n-electrode readout (mainly sensors with p-bulk), which offer the advantage of collecting electrons instead of holes resulting in an improvement of radiation tolerance. Also a further enhancement of performance is investigated in thinned bulk sensors (reduced trapping probability) and in active edge technology (maximized sensitive area). Another line of activity is the development of advanced sensor types like 3D detectors and Low Gain Amplification Detectors (LGAD) designed for the extreme radiation environment at the inner layers. TCAD simulations of silicon strip sensors have expanded to cover both bulk and surface properties after irradiation at HL-LHC levels, producing results that are converging with measurements.

Summary

Our results from both measurements and simulations of several detector technologies and silicon materials at radiation levels expected for HL-LHC will be presented. Based on our results, latest developments in finding the most suitable silicon detectors to be used for LHC detector upgrades will be reported.

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