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Exploring the capability of different 3D-trench electrode sensors for 4D tracking

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Future colliders will produce unrivaled levels of luminosity, generating extreme radiation fluences. These environments call for sensors capable of 4D tracking while withstanding extreme radiation damages. 3D-trench electrode sensors developed under the TimeSPOT project show outstanding timing resolution even after fluences up to $\sim 10^{17}$ 1-Mev $n_{eq}cm^{-2}$. However, the not yet mature fabrication technology limits the yield of large-area sensors. To address this issue in view of sensor layout design, a variant has been proposed that introduces a gap in the continuous p^{+} electrodes. New batch of sensors containing both the standard and dashed sensors have been fabricated at FBK, with preliminary on-wafer electrical test results exhibiting high breakdown voltages and low leakage currents for the majority of sensors. Moreover, the yield of large sensors for the new variant is higher than that of the standard design, proving the effectiveness of the concept. Functional tests and dedicated irradiation campaigns are scheduled to assess the timing performance of these sensors. In the meantime, it is imperative to evaluate the performance of these sensors for future upgrades by utilizing available simulation platforms.
Monte Carlo simulations within the framework of Allpix^2 are performed to examine the charge collection efficiency and timing resolution before and after radiation damage. Results show that both designs have high charge collection efficiency even after server bulk damage. Dashed 3D-trench electrode sensors achieve a timing resolution of 10.29 ps before irradiation. Further simulations confirm that the dashed sensors exhibit performance comparable to the standard sensors after fluences up to 2×10^{16} 1-Mev $n_{eq}cm^{-2}$. Though the timing performance slight degrades after bulk damage, it can be recovered by increasing the reverse bias.

Will the talk be given in person or remotely?

In person

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