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Investigating the effect of processing and isolation layout design parameters of IP region with 2 p-stops and bias ring on charge collection and hole amplification in IP region: Case studies on Type 10 from Ti-LGAD batch (W11) and UFSD 4.0 (W18)

Thursday 22 June 2023 09:00 (20 minutes)

In this presentation, we show the results from the comparative analysis of the charge distribution along the x-axes, measured in two segmented UFSD prototypes after their interpad regions were illuminated by fs-laser of different intensities. The segmented UFSDs are originating from two different batch productions. The two spikes recorded at the edge of p-stops in IP region, in Type 10 UFSD from the TI-LGAD batch, are compared to the charge distribution measured in the IP region of the UFSD 4.0 prototype. The UFSD 4.0 represents the latest and final CMS and ATLAS LGAD production. The interpad distance (IPD) in the reference Type 10 sensor from the TI-LGAD batch, as reported by vendor FBK, is 49 microns, while the nominal IPD in UFSD 4.0 Type 10 sensor is 61 microns. Those tested samples differ also in the length of the distance between the p-stop and the JTE; they also differ in the width of the p-stops, width of JTE, and in the distance between the p-stops. Additionally, those two samples differ in other processing parameters, some of which are publicly known, while others have not been yet disclosed publicly by the FBK. Notably, both samples exhibit a similar X-profile with a well-defined position of the bias ring. However, while the spikes observed in the proximity of p-stops are significantly amplified in the case of the Type 10 LGAD sensors from the TI-LGAD batch, in the UFSD 4.0 Type 10 sensors the spikes are absent, except when enhanced laser power is used.

The results show the strong dependence of the electric field strength, in the IP region, on the geometry of the p-stops and their position in regard to the position of JTE. Also, the results show the strong correlation between the reduction of interpad distance and the increase in the el field strength at the edge of the p-stops, enabling the impact ionization and charge multiplication even in IP with no-gain layer, when critical value for strength of el field is achieved.

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