

Peculiarity behaviour of the Inter-pad region in Double Trenched LGAD: Insights from RD50 and AIDAInnova Production Runs

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In our presentation, we delve into the investigation of the inter-pad (IP) region within double trench isolated LGADs (2Tr TI-LGADs), focusing on double-trenched PINs from both the RD50 and AIDAInnova production runs. Our previous research revealed that exceptionally large signals, with prolonged duration, manifest in the IP region alongside the standard IP signals recorded in conventional LGADs with 2JETS and 2 p-stops. We have identified a correlation between strong signals and ghost signals persisting in the IP region even when the laser is deactivated. Recently, we replicated a study using double-trenched PINs (without gain layer in pads) and observed no ghost signals. However, under specific laser power and bias threshold conditions, we recorded remarkably high signals with prolonged duration, akin to observations in double-trenched LGADs where ghost signals were present. This prompted us to conduct a systematic study to explore the relationship between laser threshold and bias, aiming to establish the threshold for charge accumulation between trenches that trigger the ghosts. We discovered that the laser power needed to replicate a strong signal akin to one observed in LGADs (with ghosts in the IP region) was significantly higher in the PIN sample from AIDAInnova than in the PIN sample from the RD50 Common project production; this difference was significantly higher at higher bias. Additionally, we conducted an identical study on double-trenched LGADs from AIDAInnova, where the gain layer is carbon-enriched, and the guard ring is differently designed compared to double-trenched LGADs from the RD50 common run. The measured bias threshold at which ghost signals are triggered in the IP region of the device from AIDAInnova was significantly lower than in the sample from the RD50 Common project. These peculiarities motivated us to undertake comprehensive studies to elucidate the observed differences among sensors. In this presentation, we will provide a concise overview of the main finding and offer an interpretation.

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