Contribution ID: **141** Type: **Poster**

Response of iLGAD sensors to single X-ray photons absorbed within and close to the gain layer

Wednesday 3 July 2024 14:22 (1 minute)

Inverse Low Gain Avalanche Diode (iLGAD) sensors featuring a thin entrance window exhibit promising characteristics, including a quantum efficiency exceeding 60% and single-photon detection capability for soft X-rays down to 390 eV, accompanied by a reasonable signal-to-noise ratio. First experiments employing hybrid pixel detectors in conjunction with the developed iLGADs have yielded encouraging results.

Recent investigations into LGAD sensors for particle physics applications have revealed a phenomenon termed gain suppression, wherein a reduction in gain occurs when measuring Minimum Ionizing Particles (MIPs) with higher charges. Given the different absorption mechanisms between X-rays and MIPs, comprehending this phenomenon and its implications for X-ray applications is imperative.

This study delves into the electric field, charge multiplication behavior, and charge collection mechanisms within iLGADs for X-rays, utilizing TCAD simulations. We simulate the response of iLGAD sensors to single X-ray photons, considering variations in photon absorption depth within the sensor (in particular inside and close to the gain layer), photon energies, and initial charge densities etc. The observed outcomes will be presented, and the implications for photon science applications utilizing iLGADs will be discussed.

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Session Classification: Poster Session