Contribution ID: **17** Type: **Poster**

Exploring the novel nLGAD concept

Wednesday, 22 May 2024 12:30 (1 minute)

Low Gain Avalanche Detectors (LGADs), implemented as ☒++–☒+–☒, show outstanding precision timing performance when detecting high-energy charged particles and will be used in the timing detectors for the upcoming High Luminosity LHC detector upgrades. However, due to the difference in multiplication mechanisms for holes and electrons, the detection performance for low penetrating particles (e.g low-energy protons or soft x-rays) is significantly reduced. A novel design of an LGAD detector, the nLGAD (☒++–☒+–☒), was designed and fabricated at CNM and first tested at the SSD laboratory at CERN.

Extensive studies were conducted to understand the performance of nLGAD detectors, using techniques such as the Two Photon Absorption –Transient Current Technique (TPA-TCT) to probe the nLGAD response with 3D resolution. Investigations also covered impact ionization and its temperature dependence, as well as gain reduction mechanisms. Gain response measurements were performed using laser light of different wavelengths. Another interesting aspect is the irradiation of nLGADs with different types of particles (neutrons and protons) to study basic material properties, for example whether donor removal occurres in the gain layer equivalent to acceptor removal in
high-energy physics LGADs.

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Session Classification: Poster Session & Lunch