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Impact of high deposited energy on Single Event Burnout in LGADs

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Low Gain Avalanche Diodes(LGADs) are prime candidates for high resolution timing applications in High Energy Physics, Nuclear science, and other fields. Over the course of their lifetime, these sensors are required to withstand enormous amounts of radiation (> 10^{15} neq/cm^2) while maintaining acceptable performances at hadron colliders. Particles interacting with highly biased sensors can produce irreversible damages known as Single Event Burnouts (SEBs).

Recent studies conducted using high energy protons or pions, i.e. minimum ionizing particles (MIPs), found that LGAD sensors operated below a certain threshold voltage greatly minimized the risk of permanent damage. Thus, the current expectation is that SEB events might be more likely when a particle deposits a high amount of energy in the interaction with silicon. Protons and ions in the O(10 - 100) MeV energy range deposit a high amount of energy in silicon in their interaction, increasing the probability of SEBs with respect to a MIP produced at higher energy accelerators under the same experimental conditions.

We exposed a variety of LGADs and AC-LGADs, pre-irradiated at the Rhode Island Nuclear Science Center up to 1.5 x 10^{15} neq/cm^2, to a high intensity beam of both 28 MeV protons and 330 MeV Gold ions produced at the BNL Tandem Van de Graaff accelerator. Results from this study allow us to strengthen our understanding of SEB and permanent radiation damages and parametrize the SEB mortality threshold in interactions with high deposited energy.

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