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Compensated LGAD –An innovative pathway towards the extreme fluences

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Future high-energy and high-intensity colliders will require precise particle tracking in space and time up to very high fluences, above 10^{17} 1 MeV equivalent n/cm^2. To design future tracker detectors that can operate in such extreme radiation conditions, radiation-tolerant sensors with 4D tracking capabilities must be manufactured.

We will present a pioneering silicon sensor concept that profits from the saturation of the radiation effects observed at high fluences. It uses thin substrates, intrinsically less affected by irradiation, and internal multiplication of the signal up to the target fluences.

This breakthrough is possible thanks to a new concept of the implant responsible for signal multiplication in Low-Gain Avalanche Diodes (LGADs) obtained through the compensation of p- and n-type dopants. This strategy is more resilient to radiation, as both acceptor and donor atoms will undergo deactivation with irradiation, but if accurately engineered, their difference will remain constant. Therefore, the compensated LGADs will empower the 4D tracking ability up to extreme fluences.

The first batch of compensated LGADs was released by FBK at the end of 2022. Sensor characterisation and signal analysis before and after irradiation will be presented. Possible improvements to the present design will be introduced. The path to extend the validity of the present models to very high fluences will be discussed.

Primary experiment

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