Contribution ID: **54** Type: **contributed talk**

Silicon Sensors for Extreme Fluences

Tuesday, 18 February 2020 18:00 (20 minutes)

Present silicon sensor technology allows to efficiently operate sensors up to 10^{16} n_{eq}/cm^2. However, several future applications, such as tracking detectors in high-luminosity and high-energy particle physics experiments, monitors for particle therapy and nuclear fusion reactors, envisage the use of silicon sensors in environments with fluences exceeding 10^{17} n_{eq}/cm^2.

To overcome the present limit, we propose a design of silicon sensors which extends the range of operation by more than one order of magnitude, up to fluences of $5{\cdot}10^{17}$ n_{eq}/cm^2. The idea behind this radiation tolerance exploits the saturation of radiation damage effects, observed above $5{\cdot}10^{15}$ n_{eq}/cm^2, in combination with two developments in sensor technology: (i) the use of thin sensors (20-30 μm), intrinsically less affected by radiation than thicker sensors, and (ii) the presence of internal signal multiplication (gain of 5-10), to compensate for the low signals generated in thin active volumes.

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Session Classification: Radiation and High Fluence

Track Classification: hybrid sensors (3D, LGAD)