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Silicon Sensors for Extreme Fluences

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Present silicon sensor technology allows to efficiently operate sensors up to $10^{16} n_{eq}/\text{cm}^2$. 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 $10^{17} n_{eq}/\text{cm}^2$.

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 μ m), 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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