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Silicon Electron Multiplier (SiEM)

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Silicon sensors for the future generation of collider physics experiments will require high performances on spatial ($< 10\,\mu m$) and time resolution ($20-50\,ps$) with a radiation tolerance up to fluences of $10^{17}\,n_{eq}/cm^2$. To meet these challenges, an innovative silicon sensor architecture is proposed, achieving internal gain without relying on doping, the Silicon Electron Multiplier (SiEM). The SiEM consist of a set of metallic electrodes buried within the silicon substrate which create a high electric field region close to the readout electrode. Such a geometry results in charge multiplication. Extensive studies of the SiEM behaviour through TCAD simulations demonstrating a gain in excess of a factor 10 are presented. The impact of the multiplication electrode geometry and biasing scheme on the gain and breakdown behaviour of the device is also discussed. Through transient simulations, the time structure and formation of the signal is presented for the various cases. Finally, possible fabrication processes are presented with a highlight on very first studies done with the Metal Assisted Chemical Etching technique.

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