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TCAD simulation of 4H silicon carbide LGADs

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Silicon carbide (SiC) has several advantageous material properties, making it an appealing detector material: its high charge carrier saturation velocity and breakdown voltage allow for an intrinsically higher time resolution than for silicon (Si). The larger bandgap suppresses dark current, even for highly irradiated material, reducing power consumption and thus omitting the need for cooling.
However, current limitations in the manufacturing of epitaxial layers of sufficiently high resistivity and thickness, as well as its large ionization energy compared to Si, mitigate the number of generated charge carriers and therefore reduce the signal output. The realization of a 4H-SiC low gain avalanche diode (LGAD), utilizing a controlled charge multiplication, could overcome this drawback while simultaneously boosting time resolution.

This talk presents our progress in simulating and designing such 4H-SiC LGADs. It will review SYNOPSYS-TCAD simulations of simplified LGAD structures to benchmark and characterize crucial design parameters and impact ionization models. In addition, a simplified analytical model to expedite the search for viable designs will be introduced.
New Alpha and UV-TCT measurements of neutron-irradiated planar 4H-SiC diodes that indicate signal-enhancing properties when operated in forward bias will be shown and possible origins of this behavior will be discussed.
Finally, a status report of the previously presented 4H-SiC wafer run in collaboration with CNM will be given.

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