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Spatio-temporal dynamics of charge transport in LGAD probed with focused ion beams

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Here we present new insights into the effects of LGAD gain suppression obtained using Ion Beam Induced Charge (IBIC) technique with the ion microprobe setup at the Ruđer Bošković Institute. This experimental setup allows us to investigate properties of the signal induced by single ions in the MeV energy range, and thus probe charge transport in the detector at spatial and temporal scales relevant to understanding the underlying charge carrier dynamics. These unique capabilities were exploited in this study: The density of injected charge carriers was varied by using different ion species, energies, and angles of incidence with respect to the electric field direction, and the influence on signal gain was compared for different cases. The microscopic mechanism of gain suppression was explained within the framework of the drift-diffusion model of charge carrier transport, and the results were supported by simulations using the KDetSim code. The crucial influence of ionization density on the charge multiplication processes is discussed. Furthermore, ion- TCT analysis provided us with additional information on the electric field screening in the device during charge collection after high density ionization events.
Finally, a few selected studies of semiconductor detector probing using ion microprobe at RBI are presented to demonstrate additional setup capabilities that could be of potential benefit to the community.

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