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Multistage impact ionization in Si detectors in situ irradiated at 1.9 K

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Multistage impact ionization in Si detectors observed in the unique conditions of the in situ irradiation with 23 GeV proton beam fragmented into 400 ms spills and $T = 1.9$ K was analyzed using the current pulse responses of detectors irradiated to medium fluences. Within the range $5 \times 10^{13} - 2.7 \times 10^{14}$ p/cm², the responses demonstrated two-stage and three-stage processes of charge collection, respectively, with sequential charge multiplication in the regions of high electric fields near both contacts. Data treatment allowed extracting the full set of carrier transport parameters, internal charge gain up to 3.7 and a significant rise in the hole trapping probability at 1.9 K in comparison with its value at $T = -10^\circ\text{C}$.

Primary authors: Mrs SHEPELEV, Artem (Ioffe Institute); Dr EREMIN, Vladimir (Ioffe Institute); VERBITSKAYA, Elena (Ioffe Institute (RU))

Presenter: Mrs SHEPELEV, Artem (Ioffe Institute)

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