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High-injection carrier dynamics generated by MeV ions and fs-laser, impacting the LGAD's limiting response: SEB and Gain suppression

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LGAD's failure due to Single Burnout Event and charge collection insufficiency (gain suppression) received a lot of attention recently,
Those radiation and high injection effects have some features in common, both deals with high density of generated charge but what distinguishes them seems to be the main triggering mechanism for another. While SEB induces a localized high-current state, gain suppression is charge cloud screening and gain polarization effect. While impact ionization by the holes seems to be suppressed during "gain suppression", their participation is crucial for self-sustaining of SEB.

SEB events have been investigated at ELI Beamlines in fs-laser tests, while the gain suppression presented here is investigated in IBIC tests at RBI and at ELI Beamlines. Through the use of different ion species at RBI and their respective energies, measurable charge signals give an insight into carrier transport properties in a wide range of detector depths. This also allows us to investigate the roles of two dominate phases of charge collection: the diffusion-dominated expansion phase of a charged cloud and the bipolar phase where the external field penetrates the clouds resulting in rapid charge injection into gain layer. The "transition" between those two phases can be seen as the "gain peak", more pronounced for more penetrating protons and carbons and at lower voltages. Gain suppression in SEB events was also investigated.

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