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Design of high brightness Plasma Wakefield Acceleration experiment at SPARC LAB test facility with the 3D particle-in-cell ALaDyn

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We present a numerical investigation of a Plasma Wakefield Acceleration scenario in the weakly non-linear regime relevant to the campaign at the SPARC LAB test facility. The investigation considers a two bunches configuration: a charged driver that induces the wakefield, followed by a less charged bunch (trailing bunch) that is accelerated; bunches are generated and pre-accelerated up to 100 MeV by a high brightness photo-injector. Our numerical investigation focuses on specific parameters that are of interest for the beam-driven experiments ongoing at SPARC LAB. The numerical simulations are conducted with the state-of-the-art 3D particle-in-cell code ALaDyn. For the specific case of PWFA experiments at SPARC LAB, we have identified a setup in the weakly non-linear regime capable to preserve witness quality over the propagated distance. Starting from this case scenario we modify a few parameters in order to evaluate the working point robustness: identify and measure the possible causes of witness quality degradation.

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