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Numerical Investigation of Bunch-Driven PWFA in Quasi-Nolinear Regime

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In the framework of Plasma Based Wakefield Acceleration (PBFA), a new
acceleration scheme has been proposed to combine high efficient blow-out
regimes, where the driving electron bunch forms a totally rarefied plasma channel, with the conditions assuring resonant excitation of a plasma waves at the linear frequency. This optimal configuration can be achieved by using a train of properly interlaced electron bunches carrying small charges but still having high number density and hence pulse strength nb/n0 > 1, as necessary to form a ”bubble”structure. Here we present a numerical investigation of this quasi-nonlinear configuration using the fully 3D ALaDyn
PIC code, as a preparatory work to design optimal conditions for the COMB experimental set-up at the SPARC-LAB laboratories. In particular we consider a bunch train containing three driving bunches with charges Qb=[10−50]pC and energy Eb=50−100MeV, followed by a smaller charge witness bunch. For plasma density n0=10^16cm−3, numerical accuracy is usually assured by a proper
resolution of the relevant skin depth
d_e≅47µm scale. Here the computation is more
demanding, since quasi-nonlinear regimes require a bunch transverse size
and beam channel radius rb « d_e

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