

Ultra-short electron bunches by Velocity Bunching as required for plasma wave acceleration

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The generation of ultra-short bunches is nowadays a critical requirement for plasma wave accelerators, on which many laboratories world-wide are investigating or close to start with experimental activities. This requirement is true for both, external injection into Laser Wake Field Accelerators, where injected beams need lengths close or shorter than 10 fs, or Plasma Wake Field Accelerations (PWFA), where the wake field intensity scales like the driver bunch charge over the square of the rms bunch length (Q_b/σ_z^2).

This work presents beam dynamics simulations, which show how to use the Velocity Bunching (VB) technique to obtain such ultra-short bunches. The VB is applied with a proper control of the bunch density versus the energy gain, which permits to control the transverse normalized emittance as well as the correlated longitudinal energy spread, using small bunch charges (1-10 pc). Our optimization is carried out taking the SPARC's Linac layout, which has been designed to maximize the VB performances.

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