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Dynamics studies for advanced-compact and high repetition rate C-band injector for PWFA

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C-band technology holds the potential to generate a high-energy, high-brightness electron beam by elevating the peak field of both the cathode and cavity within the machine. This proposed injector offers a promising avenue for achieving kHz operation. The conceptualization of this injector draws inspiration from the EuPRAXIA@SPARC_LAB S-band injector, wherein the gun is replaced with a 2.6-cell C-band RF gun. The entire beamline is proportionally scaled, reducing lengths by a factor of 2 while doubling electric and magnetic fields. Operating with brief RF pulses, the 2.6-cell C-band RF gun mitigates breakdown rates and power dissipation. By capitalizing on higher peak fields and applying established scaling laws to reduce laser spot size and duration, it becomes feasible to minimize both cathode and space charge emittance. A Ka-band HHC after the RF gun stabilizes the beam by pre-correcting its longitudinal phase space, flattening the charge distribution, and optimizing parameters at the photoinjector exit. The design of a C-band injector is within the framework of the EuPRAXIA@SPARC_LAB design study, aiming to produce high-quality beams for PWFA applications.

Footnotes

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