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Optimization of the PERLE injector using a multi-objective genetic algorithm

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The PERLE (Powerful Energy Recovery Linac for Experiments) project requires an injector capable of delivering a beam current of 20 mA at a total beam energy of 7 MeV with 500 pC bunches. These requirements present challenges for achieving the high quality beam required for the main ERL loop. At low energy and high bunch charge, the electron bunches will predominantly experience emittance growth due to the space charge effects. The compensation of this emittance growth will be performed with the traditional method of two solenoids a single bunching cavity and a linac to reach the intended injection energy. Additionally, the control of longitudinal and transverse bunch size must be performed to meet the requirements at the end of the injector. For stable operation of PERLE a rms bunch length of < 3 mm is required, with transverse emittances < 6 mm·mrad and acceptable transverse size. Presented here is the re-optimization of the injector settings used during commissioning for two alternative DC photoguns. It is found that the former cathode does not perform to the standard of previous optimizations. However, a newly procured cathode when optimized can meet the requirements for PERLE.

Footnotes

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