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Optimization of bunch charge distribution for space charge emittance growth compensation in the PERLE injector

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Low energy electron bunches experience emittance growth due to space charge. This effect can lead to large emittances which are unacceptable for a facility like PERLE at IJCLab. PERLE will be an ERL test facility circulating a high current electron beam. The traditional method to reduce emittance due to this effect is already planned for the PERLE injector, this has a limit of how small the emittance can be reduced to. This limit is defined by the quality of the bunch as it is upon production at the cathode. The transverse and longitudinal properties of the laser pulse incident on the cathode defines some characteristics of the bunch, to which the space charge effect is related. In addition, the complex evolution of the bunch along the injector could result in optimal laser parameters which are different from the simple flattop distribution currently simulated. Presented here are simulation-based studies of the bunch charge distribution at the cathode and its subsequent evolution along the injector. An optimization of the laser parameters which create the bunch is also performed. We find that there is an optimal bunch charge shape which corresponds to minimal emittance growth.

Footnotes

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