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Multi-objective genetic optimization of high charge TopGun photoinjector

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The TopGun photoinjector is a 1.6-cell C-band gun developed by the University of California, Los Angeles team. Originally optimized for 100 pC operation, its low emittance design has been our starting point. However, the Los Alamos National Laboratory (LANL) needs to operate with a 250 pC bunch charge while maintaining an emittance below 100 nm. The initial optimization of the high charge TopGun-like photoinjector design, intended for construction at LANL, has been previously reported. That design had a single objective: achieving the lowest possible emittance, which was attained at significantly longer bunch length, thereby limiting improvements in beam brightness. Here, we present a multi-objective genetic optimization of the high charge TopGun-like photoinjector design to obtain a Pareto front minimizing bunch length and emittance. We have successfully reduced the bunch length from 8.18 ps to 5.67 ps while maintaining similar emittance values.

Footnotes

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