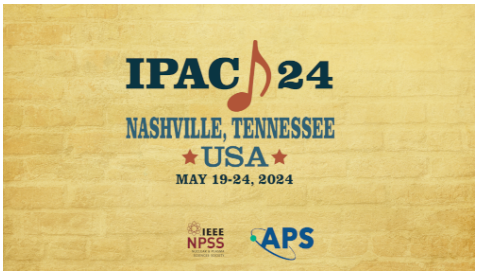


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# High gradient C-band photoinjector performance utilizing sacrificial charge to enhance brightness

*Monday 20 May 2024 16:00 (2 hours)*

We report simulation results showing the use of sacrificial bunch charge to achieve high brightness in photoinjector beamlines designed for Ultrafast Electron Diffraction (UED) and Inverse Compton Scattering (ICS). The beam undergoes nonlaminar focusing during which the tails dynamically linearize the core's transverse phase space. An aperture then removes the resulting diffuse tails, leaving a beam with high brightness. We employ this scheme in C-band photoinjector guns, whose high gradients are attractive for both low (UED) and high charge (ICS) applications. In our simulations we use a 1.6 cell gun with a peak field at the cathode of 240 MV/m. We start with negligible intrinsic emittance and use a multi-objective genetic algorithm to obtain a Pareto front minimizing bunch length and emittance. For ICS applications, we obtain an extremely small minimum emittance of 80 nm at a final charge of 250 pC per bunch and 1.44 ps rms bunch length. For a final bunch charge of 1e+5 electrons, typical for UED experiments, we obtain an emittance of 1.2 nm at an rms bunch length of 50 fs. Both results far exceed the brightness state of the art for these applications.

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