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A Self-Consistent Model for Wakefield and Space Charge Calculations

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In the injector section of electron linacs, both internal space charge forces and wake field effects influence the beam dynamics. Full electromagnetic PIC codes solving for the full set of particle motion and Maxwell's equations require too high computational effort for practical applications.
On the other hand, conventional space charge solvers neglect transient EM waves, while wake field solvers can not account for internal particle dynamics. To fill this gap, we have developed a computational method to account for both effects self-consistently. It couples a space charge solver in the rest frame of the bunch with a wakefield solver by means of a scattered field formulation. The novelty of this approach is that it enables us to simulate the creation of wakefields throughout arbitrary emission and acceleration processes.
The method is used to simulate space charge and wake field effects in a traveling wave electron gun, providing detailed insights into the coupling of wake fields on bunches at low energies.
Specifically, uncorrelated energy spread and emittance are investigated which are of key interest for FEL operation.

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