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Arbitrarily non-paraxial electromagnetic wave-packets in particle-in-cell codes

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Current laser injection in particle in cell (PIC) codes is based on paraxial solutions to Maxwell's Equation. Up until now, there have been little to no problem in using these methods. However, as the use of ultra short or ultra tightly focused laser pulses gains popularity and applications, a new method needs to be developed to account for this extreme regimes while injecting electromagnetic pulses in PIC codes.

The aim of this project is the development of a novel injection method for electromagnetic fields in PIC codes which exactly satisfies Maxwell's Equations, allowing for the use of lasers with nearly arbitrary pulse shapes (limited only by the dispersion relation), paraxial or non-paraxial.

The generality of this algorithm is shown through examples of simulations with pulses with Lorentz boosts in arbitrary directions, λ^3 regime and spatiotemporal control of the pulse's profile.

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