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Open boundary conditions for the time-averaged ponderomotive approximation in Particle-In-Cell codes

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Fully kinetic Particle-In-Cell simulations of laser wakefield accelerators (LWFA) demand heavy computational resources mainly because of the wide range of time and space scales they have to cover: from the short laser cycle to the long plasma target.
The time-averaged ponderomotive approximation (TPA), also called the laser envelope model, is a very efficient way of reducing this disparity and thus the cost of LWFA simulations.

Over the last few years, this model has been improved and tailored for various LWFA schemes. The numerical dispersion of the highly parallelizable envelope equation solver has been improved, the model has been implemented in Cartesian and cylindrical geometries, and its capability of simulating tunnel ionization for LWFA has been demonstrated.

This presentation reviews the capabilities of the envelope model as they were implemented in the PIC code Smilei and reports, for the first time, the implementation of open boundary conditions for TPA in the form of Perfectly Matched Layers for the full wave equation for the laser complex envelope. This is a critical step towards the application of TPA to the accurate simulation of LWFA.

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