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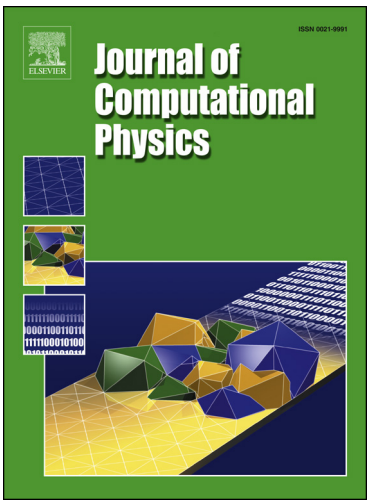

Boundary conditions for arbitrarily shaped and tightly focused laser pulses in electromagnetic codes

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Boundary conditions for arbitrarily shaped and tightly focused laser pulses in electromagnetic codes

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Abstract

Investigation of laser matter interaction with electromagnetic codes requires to implement sources for the electromagnetic fields. A way to do so is to prescribe the fields at the numerical box boundaries in order to achieve the desired fields inside the numerical box. Here we show that the often used paraxial approximation can lead to unexpected field profiles with strong impact on the laser matter interaction results. We propose an efficient numerical algorithm to compute the required laser boundary conditions consistent with the Maxwell's equations for arbitrarily shaped, tightly focused laser pulses.

Keywords: electromagnetic codes; Maxwell solver; particle-in-cell (PIC) codes; tight focusing; vector beams

1. Introduction

Electromagnetic codes are useful tools to study various problems in microwave engineering, plasma physics, optics and other branches of natural science. Such codes solve Maxwell's equations coupled to constitutive equations describing the matter within a numerical box. In studies of laser matter interaction, external electromagnetic waves (the "laser") have to enter the computational domain in order to interact with the matter. In the case of particle-in-cell (PIC) codes like CALDER [1], PICLS [2] or OCEAN [3], it is common practice

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