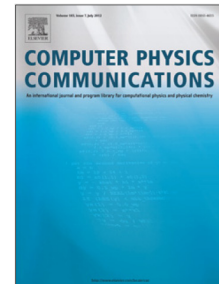


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# A hybrid model of laser energy deposition for multi-dimensional simulations of plasmas and metals

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## Abstract

The hybrid model of laser energy deposition is a combination of the geometrical-optics ray-tracing method with the one-dimensional (1D) solution of the Helmholtz wave equation in regions where the geometrical optics becomes inapplicable. We propose an improved version of this model, where a new physically consistent criterion for transition to the 1D wave optics is derived, and a special rescaling procedure of the wave-optics deposition profile is introduced. The model is intended for applications in large-scale two- and three-dimensional hydrodynamic codes. Comparison with exact 1D solutions demonstrates that it can fairly accurately reproduce the absorption fraction in both the  $s$ - and  $p$ -polarizations on arbitrarily steep density gradients, provided that a sufficiently accurate algorithm for gradient evaluation is used. The accuracy of the model becomes questionable for long laser pulses simulated on too fine grids, where the hydrodynamic self-focusing instability strongly manifests itself.

*Keywords:* Laser absorption, laser plasmas, ray tracing

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## 1. Introduction

An important ingredient in any large-scale hydrodynamic code, aimed at simulations of laser plasmas, must be a model for propagation and absorption

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