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HELIOS-CR – A 1-D radiation-magnetohydrodynamics code with inline atomic kinetics modeling

J.J. MacFarlane, I.E. Golovkin and P.R. Woodruff

Prism Computational Sciences, 455 Science Drive, Suite 140, Madison, WI 53711, USA

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Abstract

HELIOS-CR is a user-oriented 1D radiation-magnetohydrodynamics code to simulate the dynamic evolution of laser-produced plasmas and z-pinch plasmas. It includes an in-line collisional-radiative (CR) model for computing non-LTE atomic level populations at each time step of the hydrodynamics simulation. HELIOS-CR has been designed for ease of use, and is well-suited for experimentalists, as well as graduate and undergraduate student researchers. The energy equations employed include models for laser energy deposition, radiation from external sources, and high-current discharges. Radiative transport can be calculated using either a multi-frequency flux-limited diffusion model, or a multi-frequency, multi-angle short characteristics model. HELIOS-CR supports the use of SESAME equation of state (EOS) tables, PROPACEOS EOS/multi-group opacity data tables, and non-LTE plasma properties computed using the inline CR modeling. Time-, space-, and frequency-dependent results from HELIOS-CR calculations are readily displayed with the HydroPLOT graphics tool. In addition, the results of HELIOS simulations can be post-processed using the SPECT3D Imaging and Spectral Analysis Suite to generate images and spectra that can be directly compared with experimental measurements. The HELIOS-CR package runs on Windows, Linux, and Mac OSX platforms, and includes online documentation. We will discuss the major features of HELIOS-CR, and present example results from simulations.

Keywords: Hydrodynamics; Radiation transport; Atomic kinetics; Laser-produced plasmas; Z-pinch plasmas; High energy density physics

Corresponding author.

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