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Title: Thermal lensing in Ti:Sa amplifiers – a browser-based GUI and future directions

Abstract

The laser pulse properties required for a future laser-driven collider are routinely demonstrated with Hz class Ti:Sa lasers; however, a four orders of magnitude increase in repetition rate will be necessary to meet collider luminosity specifications [1]. We model thermal effects in Ti:Sa amplifiers, including thermal effects at high repetition rate, using an operator splitting approach that divides each crystal and the laser pulse into slices [2]. Each laser slice is represented by a monochromatic 2D wavefront, with intrinsic bandwidth captured via overlapping slices. The 1D Frantz-Nodvik equation accurately captures amplification on a cell-by-cell basis within a 2D Cartesian mesh. Thermal lensing uses a near-axis expansion. Simulations show good agreement with experimental data, including the redshift during amplification. We will review the Sirepo-Silas app for executing these simulations in your browser [3]. Alternative simulation approaches will be reviewed, and future directions will be discussed.

[1] L. Kiani *et al*, “High average power ultrafast laser technologies for driving future advanced accelerators,” JINST **18**, T08006 (2023).

[2] D.L. Bruhwiler *et al*., “Thermal modeling and benchmarking of crystalline laser amplifiers,” in Proc. Int. Part. Accel. Conf., THPOTK062 (2022).

[3] The Sirepo-Silas app, https://www.sirepo.com/en/apps/lasers/