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Programmable-trajectory ultrafast flying focus pulses

"Flying focus" techniques produce laser pulses with dynamic focal points that can travel distances much greater than a Rayleigh length. The implementation of these techniques in laser-based applications requires the design of optical configurations that can both extend the focal range and structure the radial group delay. This work describes a method for designing optical configurations that produce ultrashort flying focus pulses with arbitrary-trajectory focal points [1]. The method is illustrated by several examples that employ an axiparabola for extending the focal range and either a reflective echelon or a deformable mirror-spatial light modulator pair for structuring the radial group delay. The latter configuration enables rapid and automated exploration and optimization of flying foci, which could be ideal for experiments. This material is based upon work supported by the Department of Energy Office of Fusion Energy under Award Number DE-SC0021057 and by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0003856.

[1] M. V. Ambat, J. L. Shaw, J. J. Pigeon, K. G. Miller, T. T. Simpson, D. H. Froula, & J. P. Palastro, "Programmable-trajectory ultrafast flying focus pulses," Opt. Exp., **31**, 19 (2023).

Working group

WG1 : Laser-driven plasma wakefield acceleration

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