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Designing Flying Focus Optics with Adjoint Optimization

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The development of plasma channels is of great interest for many applications, including Laser Wakefield Acceleration (LWFA). However, the creation of meter-scale plasma channels that allow precise spatial and temporal control remains a complex challenge. Designing a plasma channel involves determining an optical phase that can generate the required intensity profile at the focus. In this presentation, we explore the use of advanced computational techniques, specifically the adjoint optimization algorithm, to fine-tune the phase of a focusing optic. Known for its efficiency and accuracy, the adjoint optimization algorithm iteratively adjusts parameters to minimize a cost function. This process effectively shapes the target pulse along the axis by optimizing the curvature of a reflective mirror. To demonstrate this, we examine how the adjoint algorithm optimally reduces the focal spot size of a mirror which has a predetermined solution, i.e., a parabolic surface. We will delve into these findings in detail, highlighting the potential of adjoint optimization in optical design for creating plasma channels suitable for LWFA applications.

Working group

WG1 : Laser-driven plasma wakefield acceleration

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