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Laser Pulse Tailoring for HOFI Waveguide Generation

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Extended depth of focus optics or *axioptics* are becoming increasingly important for many areas of high-power laser-matter interactions. Rather than focusing light to a single longitudinal point, like a parabolic mirror, these optics focus light to a line segment along the optical axis, allowing for the generation of extended regions of high laser intensity. Optics for generating such intensity structures include the axicon, the axilens, and the more recently proposed axiparabola.

Axioptics are routinely used to form optical waveguides in laser-plasma accelerators, in order to prevent diffraction of the drive laser and boost the electron beam energy to the multi-GeV level. They have also been proposed as a key optical element in the application of flying focus techniques to mitigate dephasing in laser-plasma accelerators. Efficient tailoring of the longitudinal intensity profile can be challenging, with the achievable peak intensity being reduced by deleterious effects such as chromaticity in diffractive optics or by misalignment in complex off-axis solutions.

Here we present theory and simulations detailing an alternative approach to the generation of foci with an extended region of high intensity for HOFI plasma channel formation and present recent experimental results employing custom optical elements that demonstrate this approach in the laboratory.

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