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Characterization of meter-scale Bessel beams for plasma formation in a plasma wakefield accelerator

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A large challenge with plasma wakefield acceleration (PWFA) lies in creation of a uniform-density plasma with profile and length that properly match the electron beam. Using a laser-ionized plasma source provides control in creating an appropriate plasma density ramp. Additionally, using a laser ionized plasma instead of ionization from the electron beam, allows for the accelerator to run at a higher repetition rate. At the Facility for Advanced Accelerator Experimental Tests (FACET-II), located at SLAC National Accelerator Laboratory, we ionize hydrogen gas with a 10 TW ultrashort laser pulse that passes through an axicon lens, imparting a conical phase on the pulse that produces a focal spot with an intensity distribution described by a two-dimensional Bessel function. This presentation will provide an overview of the diagnostic tests used to characterize and optimize the focal spot along the meter-long focus. In particular, we observe how wavefront aberrations in the laser pulse impact the plasma formation. Furthermore, I will discuss measurements of the nonlinear plasma defocusing effect that broadens the laser focus within the plasma.

Footnotes

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