FOCAL-SPOT ZOOMING USING RADIAL DIFFUSION AND DISPERSION

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Focal-spot zooming strategies are being investigated to reduce the energy loss caused by cross-beam energy transfer [1] in laser-fusion targets. A radially varying diffuser, referred to as a zooming phase plate (ZPP), is being developed to implement two-state zooming on OMEGA. The ZPP consists of two concentric phase patterns that generate different focal spot sizes and profiles. A reduced-aperture beam propagating through the center of the ZPP will produce a larger spot for picket pulses, while a beam propagating through the outer annular region of the ZPP will produce a smaller spot for the main pulse. The feature size is smaller in the central region to achieve insensitivity to laser beam phase errors. Larger speckles exist because of a shift of the power spectral density toward lower spatial frequencies and may require enhanced beam smoothing to limit speckle imprint on target.

An alternative zooming strategy that uses the full-beam aperture for both the picket and main pulses potentially reduces speckle imprint during the picket pulses while providing sufficient energy for the main pulse. The Graxicon, a novel dispersive optic that consists of both refractive and grating axicons, is being developed at LLE where technological advancements are being pursued in surface generation, polymer synthesis, and optical replication. In this scheme, the central wavelengths of the picket and main beams are shifted by an amount that, together with the dispersive Graxicon, yields the required change is focal spot size on target. Distributed phase plates (DPP's) are commensurately designed to produce the optimum focal spot size and profile for both pulses. This full-aperture, zooming scheme produces a radially varying power spectrum and a time-dependent profile that must be judiciously chosen to achieve improved target performance. Various configurations of radially dispersive optics and time-dependent beam spectra provide new opportunities to explore alternative combinations of focal-spot zooming and laser beam smoothing using optimized DPP's.

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