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Quasi-remote Pulse Compression and Generation of Radiation and Particle Beams[1] RICHARD F. HUBBARD, ANTONIO TING, JOSEPH R. PENANO, BAHMAN HAFIZI, DANIEL F. GORDON, PHILLIP SPRANGLE, Plasma Physics Division, Naval Research Laboratory, ARIE ZIGLER, Icarus Reearch, Inc., Bethesda, MD — Using chirped pulse amplification (CPA), laser pulses are routinely compressed to pulse lengths below 50 femtoseconds and focused to spot sizes of a few microns. These intense pulses may be focused onto a solid, gas, or plasma converter to produce penetrating electromagnetic radiation (e.g., x-rays, terahertz) or energetic particles. However, nonlinear effects and plasma generation place severe restrictions on the intensity of the pulse that can be propagated through the air to a distant target or object. This paper describes a quasi-remote laser pulse compression architecture in which the pulse compression apparatus, focusing system, and radiation or particle beam converter are placed at a substantial distance from the rest of the CPA system. By propagating a radially-expanded, chirped/stretched pulse through the air at a sufficiently low intensity, the stretched pulse can be compressed and focused onto the converter while keeping the largest and most expensive components of the CPA system far from the object to be irradiated. Analytical and simulation models are used to determine how axial compression and focused spot size degrade as the standoff distance to the compressor/focusing/converter assembly is increased. The implications of these results for proof-of-concept experiments and various potential applications will be discussed.

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