QUASI-REMOTE LASER PULSE COMPRESSION AND APPLICATIONS *

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Chirped pulse amplification (CPA) is a widely used technique for producing extremely short laser pulses. In particular, Ti:sapphire laser pulses are routinely compressed to pulse lengths below 50 femtoseconds (fsec) and in vacuum can be focused to intensities as high as 10^{21} W/cm^2. These intense pulses can be used for a variety of potential applications, mostly involving the conversion of the laser pulse energy to electromagnetic radiation at a different wavelength or to energetic particles which can then be used to probe a target. Nonlinear effects and plasma generation place severe restrictions on the intensity of the pulse that can be propagated to a distant target or device in air. However, if the pulse compression apparatus, focusing system, and radiation or particle beam converter are placed close to the target or sample, it may be possible to propagate a radially-expanded, chirped/stretched pulse through the air at a sufficiently low intensity to avoid plasma generation and nonlinear effects. This pulse can be compressed and focused onto the converter while keeping the largest and most expensive components of the CPA system far from the target. The dominant source of pulse degradation in most cases will come from atmospheric turbulence. This paper describes analytical and simulation calculations that estimate how much the stretched pulse degrades as it propagates through a turbulent atmosphere, and the effect of this degradation on axial compression and focused spot size as the standoff distance to the compressor/focusing/converter assembly is increased. The implications of these results for various potential applications will be discussed.

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