Numerical parametric optimization of an ultra-intense and ultra-short laser beam propagation on air

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The recent technological availability worldwide of ultra-intense and ultra-short laser system, thanks to the CPA (Chirped Pulse Amplification) technique, has contributed to a growing interest in the laser beam propagation on air, from the numerical and experimental point of view. The first theoretical studies on this subject had back to the ‘60s. The complexity of the process is high, due to the simultaneous presence of strongly nonlinear processes, such as the non linear Kerr effect and the gas ionization, which trigger the filamentation regime, the laser beam evolution over long distances, the energy deposition, the local heating and eventually the shock wave generation. The analytical and numerical modelling of all process has not yet been completed. However, a model which includes diffraction and to identify the main control parameters of propagation. Optimization of the spatial, temporal and spectral properties of the beam allows propagation above 2 km to be achieved using 10TW pulse beam. A set of parameters is therefore obtained to enable experimental studies of the given optimized configuration. An important application of the ultra-intense and ultrashort laser beams propagation on air is the LIDAR technique (Light Detection and Ranging), mainly used for environmental measurements, by detecting and analyzing the backscaterred signal from the atmosphere to the laser source.