Long-distance propagation of fs-TW pulses in air

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High power ultrashort laser pulses propagating in transparent media undergo nonlinear propagation. Nonlinear self-action leads to strong evolutions of the spatial (self focusing, self guiding, self-reflection), spectral (four wave mixing, self phase modulation) as well as temporal (self-steepening, pulse splitting) characteristics of the pulse. The chirped pulse amplification technique permits to produce ultrafast laser pulses and to reach intensities sufficient to observe highly nonlinear propagation even in only slightly nonlinear media such as atmospheric pressure gases.

In this respect, applications such as Lidar remote sensing require knowledge about the propagation of high-power laser pulses over long distances in the atmosphere. Space constraints limit the length scale of laboratory experiments, while present propagation models are limited to short distances due to unreasonable calculation times.

Here we present results about long-path propagation in the atmosphere over a kilometer range, obtained with our new "Teramobile" mobile TW-fs laser system. Particular interest has been dedicated to filamentation, white-light generation, pointing stability, as well as corrections for the dispersion of the atmospheric air.

Atmospheric applications such as Lidar or lightning triggering will also be discussed.