Generation of high-contrast few-cycle pulses via nonlinear ellipse rotation in a differentially pumped hollow-fiber

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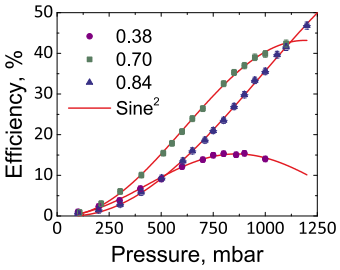
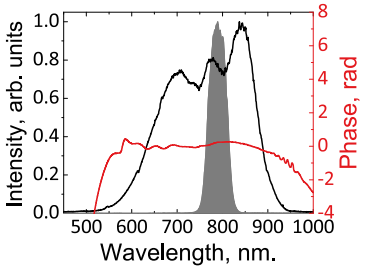
Cross-polarized wave generation (XPW) is currently the most widespread technique for contrast enhancement of ultra-high intensity lasers [1]. But when XPW is driven at high intensity to achieve high efficiency, nonlinear spatial effects can degrade the output beam profile and in time the XPW crystal itself. Devoid of such shortcomings, nonlinear ellipse rotation (NER) in a gas-filled hollow fiber provides higher efficiency and more robust beam parameters [2, 3].

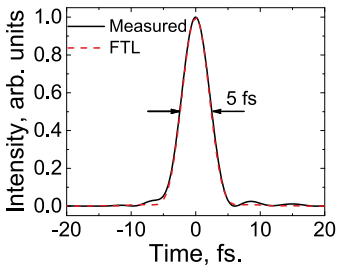
We performed NER experiments by seeding 30 fs, 300 μJ pulses at 1 kHz into an Ar-filled 46 cm-long, 250 μm-bore stretched flexible hollow fiber operated in pressure gradient mode, placed between two $\lambda/4$ wave plates and a polarizer-analyzer pair with an extinction ratio $> 10^3$. The temporally filtered pulses were re-compressed in a chirped mirror compressor. At optimum gas pressure, the initial laser pulses could be broadened to $\approx$ 200 nm FWHM and compressed down to sub-5fs duration with a record-high 46.8% conversion efficiency (see figures below). This could possibly be an elegant all-in-one method for generating high-contrast, high-energy few-cycle pulses from FCPA laser systems [4].



(a) Efficiency curves



(b) Spectral domain



(c) Time domain

References

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