Pulse broadening and compression at 515 nm in a multi-pass cell

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Spectral broadening and compression is a powerful technique to generate short pulses around 1 μm [1,2]. Extending this approach to different wavelengths would be highly beneficial. For instance, increasing demand for coherent and ultrafast laser sources in the 250–530 nm (UV to visible) spectral range is rising for industrial and scientific applications [3]. In this work, we propose shortening the pulses directly in green to not compromise the frequency doubling efficiency. We use a traditional BBO crystal for efficient second-harmonic generation at a moderate (>250 fs) pulse duration, from 1030 nm to 515 nm, followed by a spectral broadening and compression scheme in a Herriot-type cell (HC), using a bulk material as the nonlinear medium.

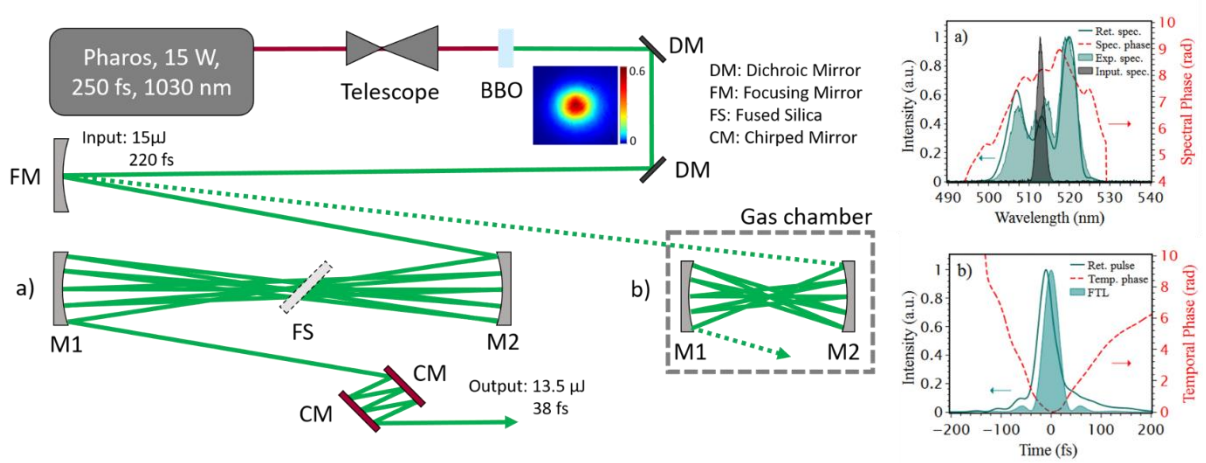

Fig. 1 Left: Experimental setup for pulse broadening and compression in the 515 nm spectral region. The 1030 nm IR-beams originated from a commercial laser (Light Conversion PHAROS) are frequency-doubled in a BBO crystal and subsequently the 220 fs pulses are broadened in a) a fused silica plate or b) in a pressurized environment containing different gases. Right: a) measured (shaded area) and FROG-retrieved (solid line) output spectrum and spectral phase (dashed line) for the solid-state broadening scheme at input energy of 15 μJ. b) FROG-retrieved temporal profile (solid line), temporal phase profile (dashed line), and FTL reference (shaded area). The measured duration was 38 fs with an FTL of 35 fs.

The driver laser (Light Conversion PHAROS) delivers 15 W average power at 1 μm, emitting 250 fs pulses with a pulse energy of up to 200 μJ at a repetition rate of up to 1.0 MHz. After the conversion stage, the pulses are spectrally broadened and compressed in a multi-pass cell yielding sub-40 fs pulses with over 20 nm bandwidth around 515 nm. The efficiency of spectral broadening and compression exceeds 90 %. These results represent the first implementation of a multi-pass spectral broadening and compression in the green spectral regions and pave the way for similar experiments in UV.

References

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