Ultrafast Waveforms Synthesis Using Coherent Raman Sidebands in a Reflection Scheme

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Coherent Raman sidebands generated from a Raman-active medium have the potential to serve as a source of single cycle pulses [1]. We propose a reflection scheme to synthesize ultrafast waveforms using the sidebands generated in a Raman-active crystal. We refocus the generated coherent Raman sidebands and the driving pulses back to the same crystal by using two spherical mirrors (Fig. 1). The nonlinear interactions between the sidebands and the driving pulses enable us to characterize the relative spectral phase among the sidebands. Furthermore, with the assistance of the micro-electro-mechanical systems (MEMS) deformable mirror, we demonstrate the capability of our setup to control the phase and thereby synthesize ultrafast waveforms.

Figure 1. Schematics of a pulse characterization setup. Left: Two spherical mirrors with 10 cm focal length re-focus the sidebands to the crystal. Deformable mirror (Boston Micromachines co.) is inserted into one of the beam path for fine phase adjustment. Right: Interferometric spectrogram for high order sidebands (AS3 to AS7) as function of the delay relative to the driving pulses.