Closed loop control of ultrashort laser pulses at the sample

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Nowadays, ultrafast laser oscillators generating bandwidth over 100 nm are commercially available. This bandwidth supports pulses shorter than 10 fs (Fig. 1). However, it is still relatively challenging to preserve pulse duration of 10 fs at a desired place in experiment. Our calculations show that generated pulse of 10 fs in duration will broaden to hundreds of fs after propagation through only couple of cm of glass. Significant amount of this pulse broadening is due to nonlinear chirp and requires an active feedback loop for pulse phase measurement and compensation. In our work we utilize the MIIPS method [1, 2] for phase measurement and commercially available Silhouette system from Coherent, for pulse shaping, feedback loop phase measurement and compensation [3].

One important application of ultrafast lasers is multiphoton microscopy. We will present how two-photon imaging improves when input transform limited laser pulses are shortened from 150 fs to 13 fs (Fig. 2). Some issues and limitations of broad bandwidth pulses will be discussed when a commercial microscope with high numerical aperture, water immersed microscope objectives are used.

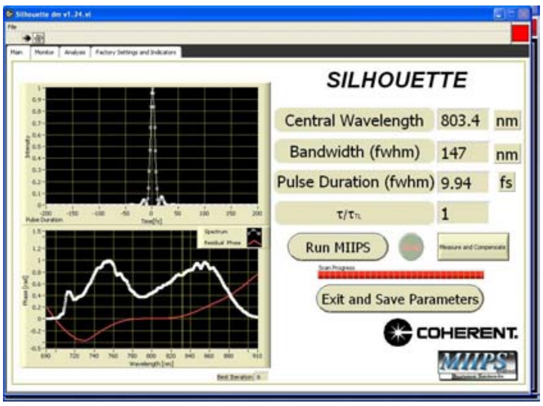

Fig. 1: 10 fs pulses generated from oscillator Micra and phase compensated at a sample by Silhouette.

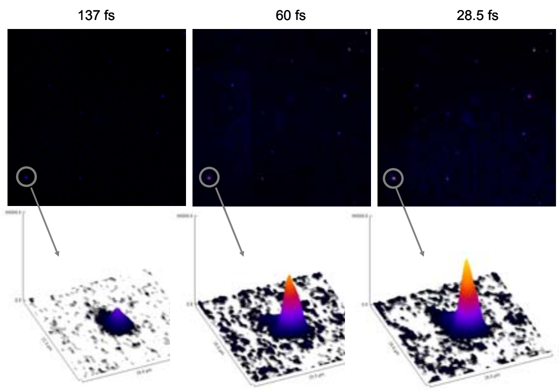

Fig. 2: Increase of fluorescence signal from a quantum dot material with shorter transform limited pulses

References:
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