Shaper-assisted Ultrafast Waveform Characterizations

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Ultrashort pulse shaper [1] is traditionally used in controlling optical waveform in the picosecond-to-femtosecond regime. Its application to waveform characterizations has received increasing attention since recently [2-5] because of the advantages of integration of pulse manipulation and measurement, elimination of reference beam and additional dispersion, directly measuring the pulse at the point of experiment, and unprecedented measurement sensitivity [5]. In fact, the great potential of shaper-assisted measurement schemes is still not fully recognized. As the pulse bandwidth approaches the octave spanning regime, dispersion and imperfect response of optical elements could seriously restrict the measurement accuracy. For optical arbitrary waveform (OAW) with 100% duty cycle, delay-scanning is no longer available and the few functional measurement schemes become fairly complicated. Vectorial ultrafast waveforms are useful in nano-photonics and plasmonics with strong polarization-dependence. However, it remains challenging to accurately measure these delicate 4D fields.

In this talk, I will review what we have achieved in measuring ultraweak 400 fs pulses with 5.2 aJ (40 photons) per shot (Fig. 1) [5] and OAW from an 18 GHz frequency comb (Fig. 2) [6] by using scalar pulse shapers (both at 1.5 μm wavelength). Experimental investigations on <7 fs Ti:Sapphire laser pulse at 0.8 μm and OAW from a 20 GHz frequency comb at 1.5 μm by using a polarization line-by-line shaper [7] will also be presented.

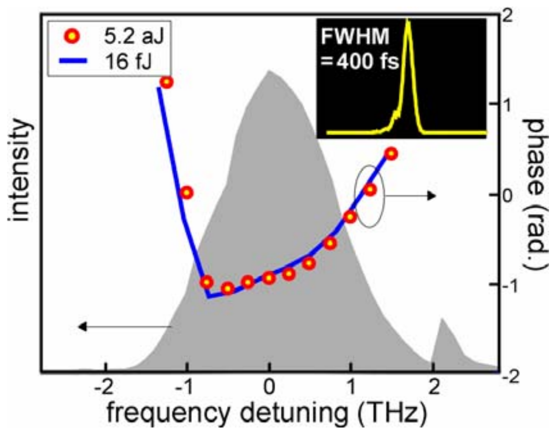

Figure 1. Power spectrum (shaded), spectral phases measured at pulse energies of 16 fJ (solid) and 5.2 aJ (circles), respectively.

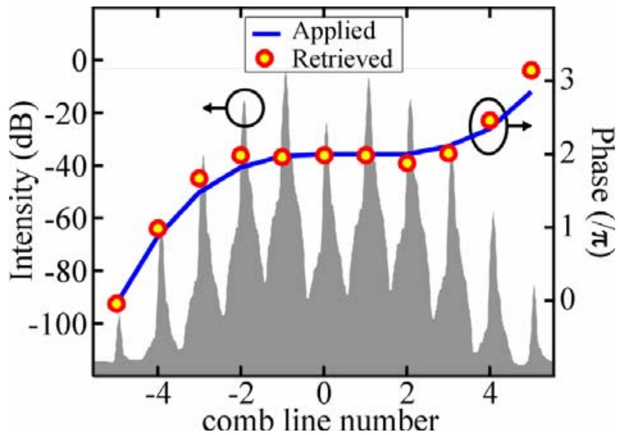

Figure 2. Power spectrum (shaded), spectral phases applied by the pulse shaper (solid) and measured by non-iterative PROOF method (circles), respectively.

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