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Few cycle pulse characterization using different variants of Dispersion Scan technique

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Being correlative to the generation of femtosecond pulses, their characterization is equally vital for the ultrafast community. Three decades of restless endeavor in this direction has been resulted in development of couple of pulse characterization techniques such as FROG and SPIDER. These techniques and dozens of their variants are capable of characterizing pulses from few femtosecond to tens of picoseconds in different spectral regions.
However, due to the octave-spanning spectrum and increased sensitivity of few cycle pulses on material dispersion, space time couplings, etc., their characterization are still very challenging. Here robustness and simplicity of a measurement arrangement becomes a paramount factor.

One of the simplest pulse characterization methods developed so far is the d-scan technique, first demonstrated by Miranda and co-workers [1]. This makes it a well-suited candidate for characterization of few-cycle pulses. In d-scan an increasing amount of dispersion is introduced to the test pulse and consequently its spectrally resolved nonlinear response, most of the cases second harmonic generation (SHG), is recorded by a detector. Despite of its simplicity, the original SHG d-scan might suffer from limited phase-matching bandwidth and also detection of the nonlinear signal in difficult spectral regions.

Recently, we have introduced a new version of d-scan employing cross-polarized wave (XPW) generation as nonlinearity that is free of such limitations [2]. This is because XPW nonlinearity is a degenerate four-wave mixing process and therefore there is no spectral shift between the original pulse and the generated signal resulting in complete phase matching of the full spectrum. Furthermore, XPW can take place in materials such as BaF_2 having a broad spectral transmission window from 0.14 to 14 µm.

Here, we will overview the different aspects of XPW d-scan technique and compare its performance with SHG d-scan for measuring 1.5-cycle NIR pulses.

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2. A. Tajalli, B. Chanteau, M. Kretschmar, H. G. Kurz, D. Zuber, M. Kovačev, U. Morgner, and T. Nagy, "Few-cycle optical pulse characterization via cross-polarized wave generation dispersion scan technique," Opt. Lett. **41**, 2016, pp. 5246-5249.