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Bruno P. Chaves[1], Van Thuy Hoang[1], Vincent Couderc[1], Brent E. Little[2], Sai T. Chu[3], David J. Moss[4], Roberto Morandotti[5], Benjamin Wetzel[1]

1. *XLIM Research Institute, CNRS UMR 7252, Université de Limoges, Limoges 87060, France*
2. *QXP Technologies Inc., Xi'an, China*
3. *Department of Physics, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong, China*
4. *Optical Sciences Centre, Swinburne University of Technology, Hawthorn, VIC 3122, Australia*
5. *Institut National de la Recherche Scientifique - Centre Énergie Matériaux Télécommunications, Varennes J3X 1S2, Canada*

Optical wave-packet control and optimization is highly sought-after in numerous demanding applications. Recent advances have shown the potential of programable photonic integrated chips (PICs) [1] for enabling new optical functionalities. For instance, programmable delay lines (PDL) can be used for autonomous picosecond pulse shaping [2] as well as supercontinuum (SC) spectral shaping [3]. Recent work also demonstrated the potential of such approaches for gaining access to advanced spectro-temporal control [4] which would directly benefit applications such as nonlinear imaging and multiphoton microscopy [5]. Here, we demonstrate the spectro-temporal characterization and adaptive adjustment of broadband supercontinua (SC). The experimental setup shown in Fig. 1(a) comprises a femtosecond laser at 1550 nm, injected into an on-chip PDL [2-4] and used to generate a train of femtosecond pulses with a tunable pattern. This train of pulses is then amplified and sent into a highly nonlinear fiber (HNLF) to experience nonlinear spectral broadening. The broadband output SC spectrum is finally characterized via an X-FROG [6] setup that mixes the SC with an asynchronous femtosecond laser source (at 1040 nm) resulting in a sum-frequency generation (SFG) signal measured with a fast spectrometer. Here, the two lasers exhibit different yet stable repetition rates (i.e. locked but asynchronous), such that there is a constant frequency detuning yielding a fast scanning effect for the acquisition of the X-FROG spectrograms.

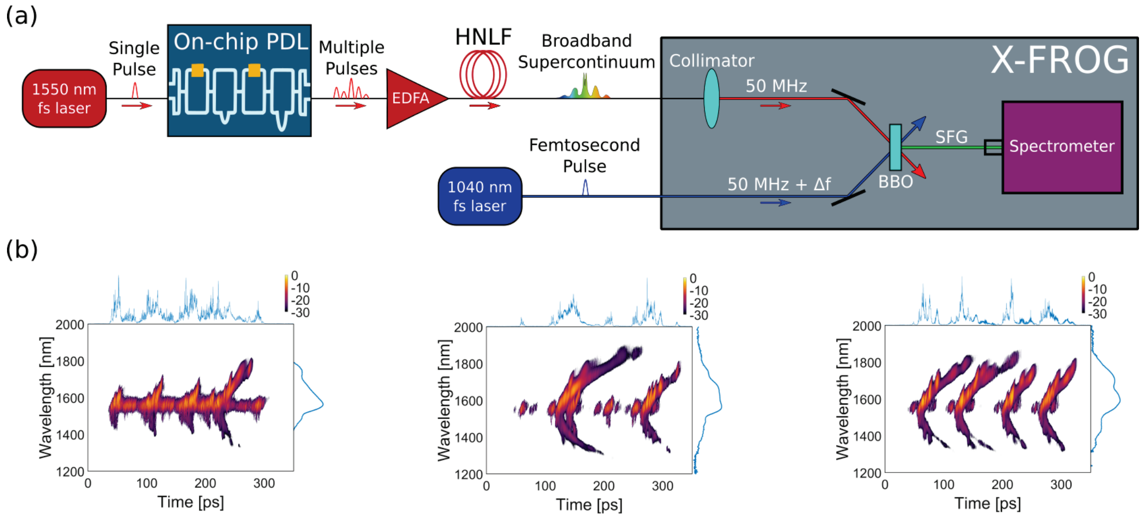

Fig. 1 (a) Experimental setup. (b) Experimental spectrograms showing spectro-temporally reconfigurable SC.

In Fig. 1(b), we show three experimental spectrograms obtained using our setup. In this case, the frequency detuning was 5 mHz, corresponding to an acquisition time of 200 s and a temporal resolution of 26 fs. We demonstrate that such nonlinear optical sampling can be performed with picosecond resolution, at a refresh rate compatible with machine-learning optimization techniques (by a tradeoff between acquisition speed and resolution, obtained by adjusting the laser detuning). The control of nonlinear broadening mechanisms can then be tailored in an efficient manner by adjusting the input pulse patterns ("on-the-fly" and without deconvolution of the spectrogram). Altogether, our approach opens up the way for flexible spectro-temporal control of light.

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