NONLINEAR PULSE SHAPING FOR COHERENT RAMAN MICROSCOPY

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Nonlinear photonic-crystal fibers (PCF) are efficient frequency converters, most dramatically demonstrated in supercontinuum generation. Nonlinear pulse shaping is a new and more deterministic approach to frequency conversion and consists in amplitude and phase shaping the laser pulse prior to launching it into a highly nonlinear PCF with the aim of generating light only in a certain frequency range. This can be done by shaping the laser pulse into a train of weak pulses, each optimized to form a fundamental soliton in the PCF. In the PCF, each soliton redshifts by $\Delta \nu$ (which is dependent on the initial peak power $P$) and slows down due to fibre dispersion. Coherent anti-Stokes Raman spectroscopy (CARS) has been demonstrated using red-shifting soliton as a Stokes beam [1], nevertheless the output extracted power has been limited due to the inherent low power carried by a single soliton.

In this work we use nonlinear pulse shaping to increase the spectral brightness of red shifting soliton to perform coherent Raman spectroscopy and microscopy. Both CARS and stimulated Raman scattering (SRS) are investigated and demonstrated in test samples. Using nonlinear pulse shaping it is also possible to perform spectral compression to generate narrow band spectral line suitable for coherent Raman [2]. This is the goal of this presentation to show the assets of nonlinear pulse shaping as an alternative powerful technique to generate a variety of output frequency shaped light pulses suitable for coherent Raman imaging.

Figure: Principle of a nonlinear pulse shaper. A 4f pulse shaper and a highly nonlinear fiber generate a variety of controllable output light pulses suitable for coherent Raman spectroscopy and microscopy.

References