

# Performances and noise dynamics of a normal dispersion fiber optical parametric chirped pulse oscillator

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**Abstract:** We report on the performances of a fiber optical parametric chirped pulse oscillator (FOPCPO) in the normal dispersion regime. The FOPCPO generates pulses up to 500 nJ at 1 MHz repetition rate. Idler pulses can be dechirped down to 500 fs. Studies on relative intensity noise (RIN) have been performed through RF measurements and dispersive Fourier transform (DFT), highlighting the potential of these systems for nonlinear spectroscopy or microscopy.

Recent developments in FOPCPAs and FOPCPOs have shown their potential for energy scaling [1,2]. In particular, pumping in the normal dispersion regime allows these systems to match the requirements for Stimulated Raman Spectroscopy (SRS) and microscopy [3], thus paving the way to all-fiber systems for non-laboratory applications. Although FOPCPAs are a more convenient way to access exotic wavelengths, they exhibit a lack of tunability. Furthermore, in order to enhance the spectroscopic measurements, the parametric source should exhibit the lowest RIN possible, which seems incompatible with FOPCPAs due to the presence of two noise sources, and the absence of a feedback loop. In this work, we demonstrate the ability of FOPCPOs over FOPCPAs to produce low noise and tunable pulses. The experimental setup is depicted in figure 1a). The 8 cm long nonlinear fiber (Photonics Bretagne SUP-5-125, ZDW: 1055 nm, MFD: 5  $\mu$ m) is pumped by a FCPA producing 500 ps (200 fs transform limited) 1036 nm pulses with energies up to 10  $\mu$ J at 1 MHz. The signal resonant cavity is closed with a 200 m spool of LMA endlessly singlemode fiber (ESM10-PM, Photonics Bretagne). An optical delay line is used to adjust the length of the cavity to match the pump repetition rate, as well as to tune the output of the FOPCPO through dispersive filtering. The signal pulses can be tuned in a 75 nm band around 820 nm, while the idler pulses can be tuned in a 180 nm band around 1380 nm. The idler pulses are compressed down to 500 fs with a 1200 grooves/mm Treacy compressor. The maximum energies are 500 nJ (resp. 300 nJ) for the 820 nm (1380 nm) band. The FOPCPO exhibits low RIN (< -125 dBc/Hz), while an equivalent CW-seeded FOPCPA exhibits a higher RIN, which depends on the seeding power. More details on the noise performances and dynamics of the sources from DFT measurements will be discussed during the conference, focusing especially on the impact of the feedback ratio or the seeding power.

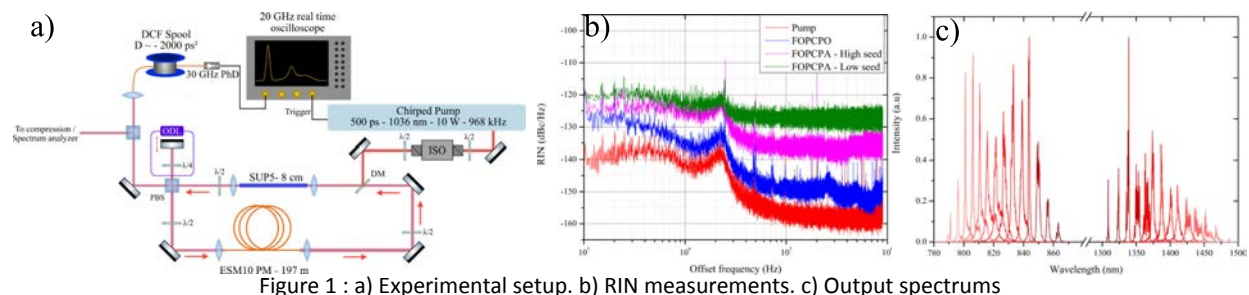


Figure 1 : a) Experimental setup. b) RIN measurements. c) Output spectrums

## References

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