# Low-noise parametric amplification of an ANDi fiber supercontinuum to the W-level at 40 MHz

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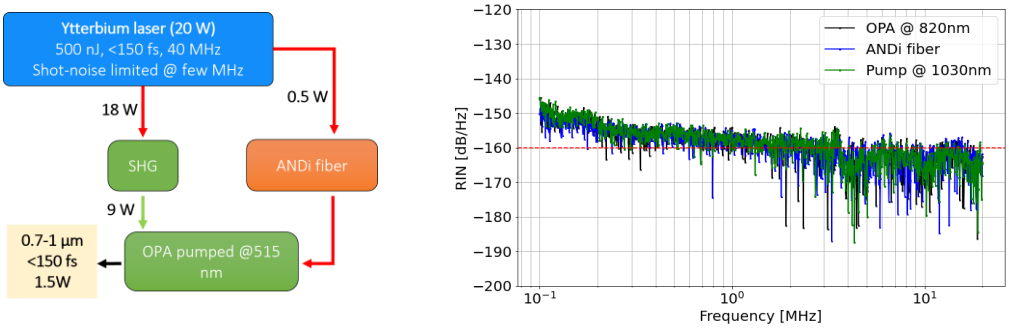
**Abstract:** We study the optical parametric amplification of a supercontinuum generated in an all normal dispersion (ANDi) photonic fiber at 40 MHz. Up to 1.5 W of near-infrared (780-950 nm) is generated in a single-pass optical parametric amplifier (OPA) pumped at 515 nm. We find shot-noise-limited relative intensity noise (RIN) at >1 MHz frequencies (-160 dB/Hz for an average photocurrent of 1.6 mA) when both the ANDi fiber and the OPA are driven by a Kerr-lens mode-locked Ytterbium laser. This approach represents a low-noise alternative to optical parametric oscillators.

In Stimulated Raman Scattering (SRS) imaging [1] signal appears as a weak modulation [1] and low noise source is essential to optimize the signal-to-noise ratio[2]. Starting from a 40-MHz Kerr-lens mode-locked Ytterbium laser (Flint, Light Conversion, sub-150 fs, 20 W) we generate a supercontinuum in an ANDi [3] fiber and seed a tunable OPA pumped at 515 nm (cf Figure 1.a). The OPA delivers up to 1.5 W of output average power (37 nJ/pulse) from 780 nm to 1000 nm. Once the polarization instabilities are minimized in the ANDi fiber [4], a stable amplification regime is achieved. The noise figure was characterized by a RIN measurement, defined as the power spectral density over the total electric power at the output of an InGaAs fast photodiode.




(a) (b)

Figure 1 : (a) OPA diagram, (b) Relative intensity noise (RIN) over [100k-20M] Hz, for the pump at 1030nm (green), 8 cm of ANDi fiber (blue) and the OPA at 820 nm (back) for an average current of 1.6 mA (shot noise in red dotted line).

Figure 1.b shows that the RIN of the fiber output follows that of the pump laser and reaches the shot-noise floor at -160dB /Hz near ~3 MHz. We also demonstrate that despite the spectral selectivity (~10-80 nm) and high gain of the OPA stage (>200) the amplified signal at ~820 nm is also shot-noise limited above a few MHz. This work is supported by European Union through the European Regional Development Fund (ERDF) forming part of the Programme Opérationnel FEDER-FSE Provence Alpes Côte d'Azur 2014-2020.

## References

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