# PPLN based Picosecond Parametric Generation Driven by an All-Fibre Erbium Doped Amplifier System

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Presented is a compact periodically poled lithium niobate based picosecond optical parametric generator, pumped by a truly all-fibre chirped pulsed amplification system. This source's high powers and frequency doubling allowed efficient energy conversion, (43%).

# PPLN based picosecond Parametric Generator driven by an all-fibre erbium doped fibre amplifier system

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The combination of periodically poled lithium niobate (PPLN) and diode-pumped, high-power fibre lasers allows the development of a wide range of compact, versatile, all-solid state parametric devices. For example, we have recently demonstrated a Q-switched erbium fibre laser pumped, widely-tuneable (1-5μm) nanosecond optical parametric oscillator (OPO) with a 10μJ threshold . A femtosecond optical parametric generator OPG has also been demonstrated using a frequency doubled, erbium fibre amplifier based Chirped Pulse Amplification (CPA) system pump source [1]. Thresholds as low as ~50nJ were demonstrated (600fs pulses at 780nm). In order to obtain such pulse energies these authors needed to employ a bulk diffraction grating pair as the pulse re-compressor within the CPA system. Use of a conventional fibre grating pulse recompressor was not possible due to the onset of nonlinearities within such structures at the powers levels required. Bulk grating compressors makes the system both complex and bulky and therefore far less attractive from a practical perspective. In this paper we report the development of a compact, picosecond OPG pumped by truly all-fibre CPA system.

The system is shown in Figure 1. The main point of novelty in this scheme is the use of large mode area (LMA), single mode fibre components in the CPA system and in particular the use of a LMA-fibre grating pulse recompressor. The fibre Mode Field Diameter (MFD) of these components was ~23μm compared to conventional fibre grating and amplifier fibre MFDs of ~8μm. These novel components gave us a factor of ~10 increase in terms of peak power in the recompressed pulse relative to conventional fibre CPA systems, and before nonlinear effects dominate. Using such an approach we have achieved powers of 450 kW for 4 ps pulses, a record energy (~1.5μJ) for an all fibre system [2], which allows direct fibre pumping of an OPG.

An 18.7μm period PPLN grating was used to frequency double the 20 KHz, 450 kW 4ps pulses to a wavelength of ~767nm and the resulting pulses used to pump the OPG. The OPG PPLN crystal had gratings of 18.7μm and 18.3μm. and could be temperature tuned to provide output in the ranges 1.2-1.34μm and 1.32-1.42μm respectively. A typical OPG characteristic is shown in Figure 2. The OPG threshold was ~50nJ for both gratings. Signal energy conversion efficiencies of 27% were obtained, corresponding to total energy conversion efficiencies of ~43%. The output pulse width was measured to be 3ps.

We believe these results to be significant in that they provide yet further evidence of the potential, and practicality, of fibre pumped parametric devices based on PPLN.

Figure 1 Schematic of laser and experiment

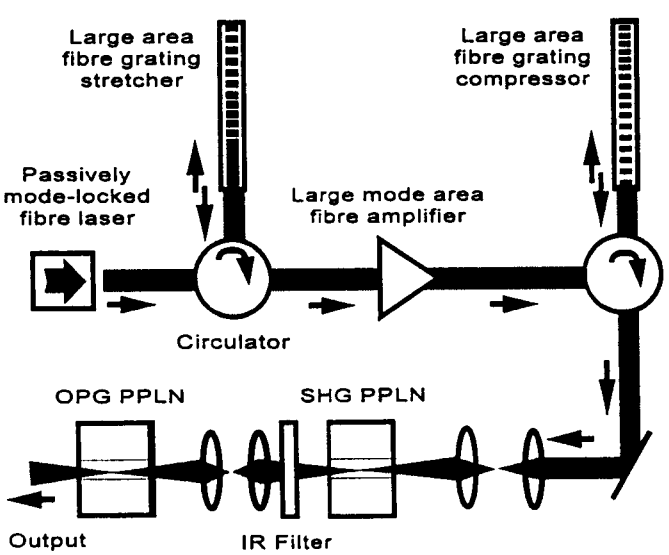
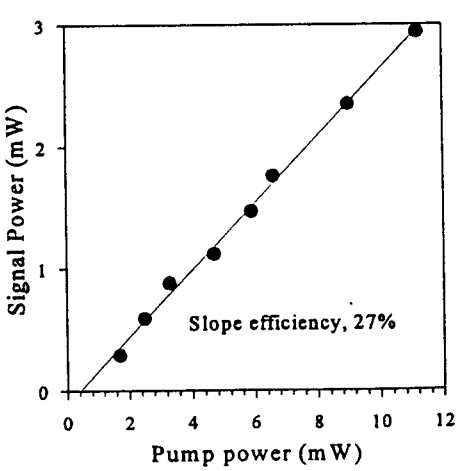



Figure 2 OPG characteristic

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