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80 fs Pulses from a Stretched-Pulse Yb^{3+}:Silica Fibre Laser

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Abstract

We report the first demonstration of ultrashort pulse generation in a Ytterbium:silica fibre laser. The self-starting, stretched-pulse laser system produces 100 pJ, transform-limited, 80 fs pulses and represents a key step in the development of an all-solid-state, Yb^{3+}-based, high power amplified system.

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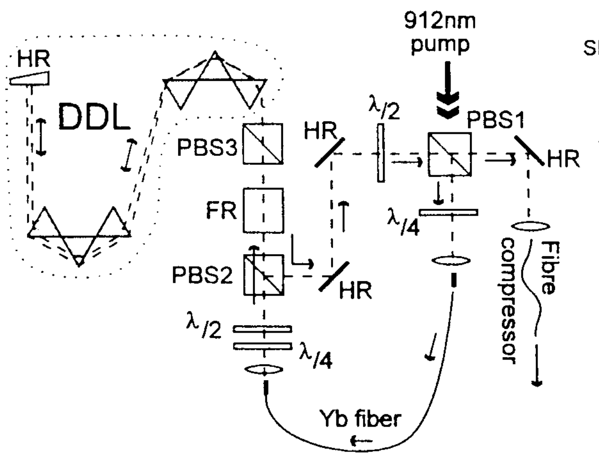
Ytterbium doped silica with its broad gain bandwidth, large saturation fluence (38 Jcm^{-2}) and high optical power conversion efficiency [1] represents a very attractive medium for both the generation and amplification of extremely intense, ultrashort optical pulses[2]. An entirely high power diode-pumped chirped pulse amplification system based on Yb^{3+} :silica seems feasible, offering a very compact, robust, and reliable design. In this paper we present the first experimental results on short pulse generation using Yb^{3+} :silica fibre, thus demonstrating a key first step towards such a high power diode-pumped system.

A passively modelocked cavity using a unidirectional polarisation switch and based on the stretched pulse laser concept [3], incorporating an anomalously dispersive delay line (DDL) to offset the fibre dispersion, was constructed (see Fig. 1). Robust, self starting, fundamental (50 MHz) mode-locking was readily obtained in the wavelength range 1020-1060 nm for a launched pump power of 300mW provided that the intracavity waveplates and the DDL was appropriately set. The pulses were found to be linearly chirped (~1.0 ps) at the system output (PBS1), but could be compressed down to clean 100 pJ, 80 fs pulses (see Fig. 2) in a short section of normally dispersive single-mode fibre. Increased pulse energies (~1 nJ) and shorter pulse durations (~30 fs) should be achievable in the near future.



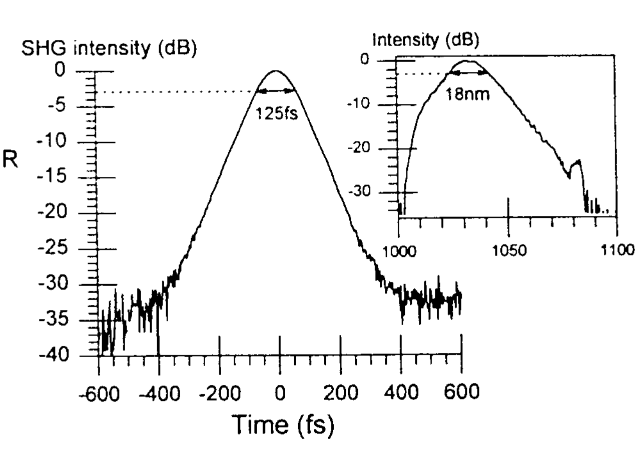


Fig 1: Stretched pulse laser configuration. PBS=Polarizing beam splitter. FR=Faraday rotator. DDL=Dispersive Delay Line.

Fig 2: Background-free autocorrelation function and spectrum of 80 fs (assuming $sech^2$ pulse shape) pulses at the compression fibre output ($\Delta\nu\ \Delta T$=0.41).

[1] H. Pask et al. IEEE J. of Select Topics in Quantum Electron. 1, 2 (1995).
[2] D. Strickland and G. Morou: Opt Commun. 56, 219 (1985).
[3] K. Tamura, E.I. Ippen, H.A. Haus, L.E. Nelson: Opt. Lett. 18, 1080 (1993).