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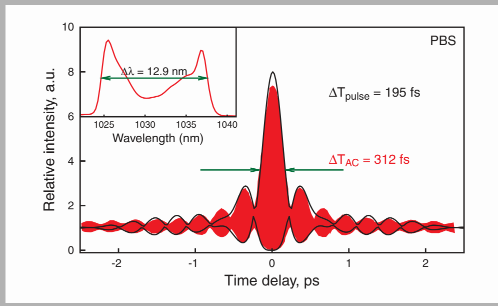
Abstract: Experimental results on an all-fiber, all-normal dispersion ytterbium ring laser are reported. It produces stable mode-locking of ∼ 10 ps pulses that can be externally compressed to as short as ∼ 200 fs.



Measured (red filled curves) and fitted (black lines) autocorrelation functions with the spectrum in the inset

All-fiber, all-normal dispersion ytterbium ring oscillator

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1. Introduction

Passively mode-locked fiber lasers have gained high interest because of their potentially compact, environmentally stable and alignment-free design. Although a wide variety of fiber optic components are now commercially available, they are not as reliable, and their parameters are rarely as easily controllable as that of bulk elements. This fact raises difficulties in the development of all-fiber oscillators. Much effort has been done to create all-fiber configurations [1–3], but at the ytterbium (Yb) wavelength solutions were only found lately.

Fiber lasers around 1 μm are usually constructed with some kind of intra-cavity dispersion compensation to overcome the normal dispersion provided by the silica fibers. Free space optics, such as gratings [4] and prisms [5] as well as photonic crystal fibers [6], higher-order mode fibers [7] or chirped fiber Bragg gratings [8] have been implemented as intra-cavity dispersion compensating elements. However, for the ease of construction and use it is desirable to design fiber oscillators without any dispersion compensation.

The pulse dynamics in all-normal dispersion fiber lasers are dominated by the interplay between gain, self-phase modulation, dispersion and filtering effects. Filtering with a 10 nm bandwidth spectral filter has lead to stable mode-locking of 3 nJ pulses dechirped to as short as 170 fs [9]. However, this setup employed free-space optics and such impressive results could not be reproduced by all-fiber configurations. Previous all-fiber Yb oscillators produced picosecond pulses owing to the strong spectral filtering [10], and in another approach ps pulses were generated by the pulse-shaping of the nonlinearity of a semiconductor saturable absorber mirror [11]. Lately an all-fiber similariton fiber laser was reported to produce 0.8 nJ pulses externally compressible to 627 fs [12]. This laser had a unidirectional cavity, utilizing a fiber coupled saturable Bragg

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