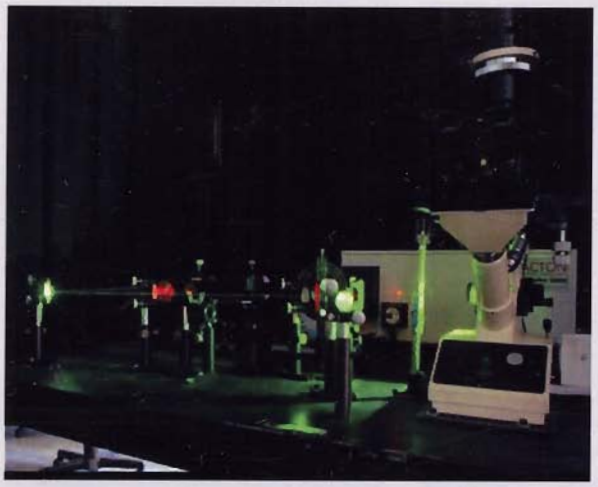

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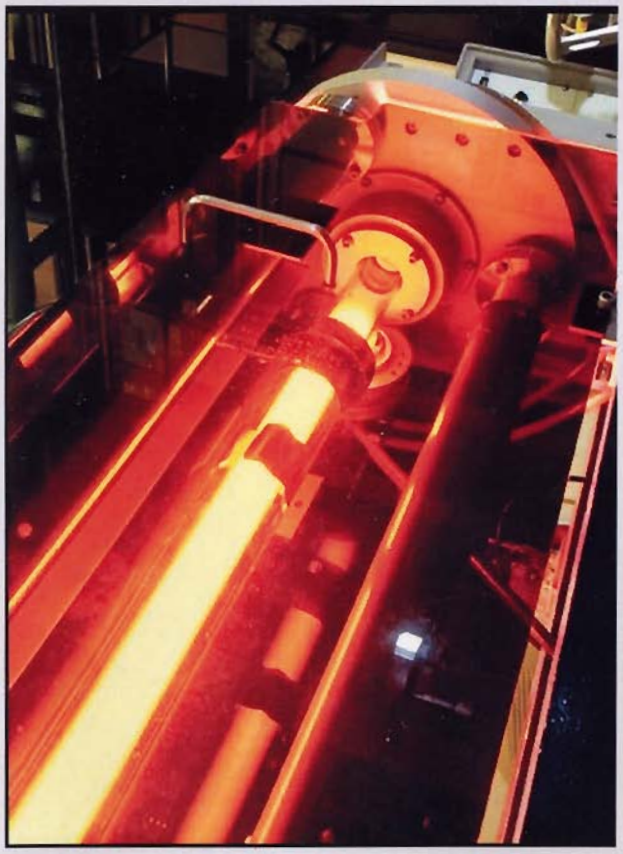

Pedestal Suppression in a Short-pulse Fiber-laser Output by Soliton Self-frequency Shift in a Photonic-crystal Fiber

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Discrimination of an ultrashort light pulse against an extended low-power pedestal is one of the key operations on a short-pulse laser output often needed for a clean, physically unambiguous high-intensity-laser--matter interaction experiment and for high-quality optical signal transmission. Fiber-format pedestal suppression is of special value for rapidly growing fiber-laser technologies. Nonlinear Kerr-effect-induced polarization phenomena offer an elegant solution to the problem of pedestal suppression in the fiber format [1]. However, for femtosecond fiber sources, pedestal suppression without a substantial temporal broadening of the main peak is often necessary for high-field physics and optical information technologies. Here, we show that soliton self-frequency shift [2, 3] of ultrashort light pulses in a highly nonlinear photonic-crystal fiber (PCF) [4, 5] allows a high-peak-power femtosecond pulse to be discriminated from a picosecond pedestal in the output of a positive-dispersion Yb fiber laser [6]. The central, most intense part of the laser pulse tends to evolve toward a soliton, experiencing a continuous red shift due to the Raman effect, which both spectrally and temporally isolates the soliton from the nonsolitonic, rapidly dispersing part of the field. As a result of this solitonic dynamics, high-contrast, pedestal-free 80-fs pulses with a milliwatt-range average power and kilowatt-level peak power have been generated at the output of an Yb-fiber-laser--PCF-discriminator system.

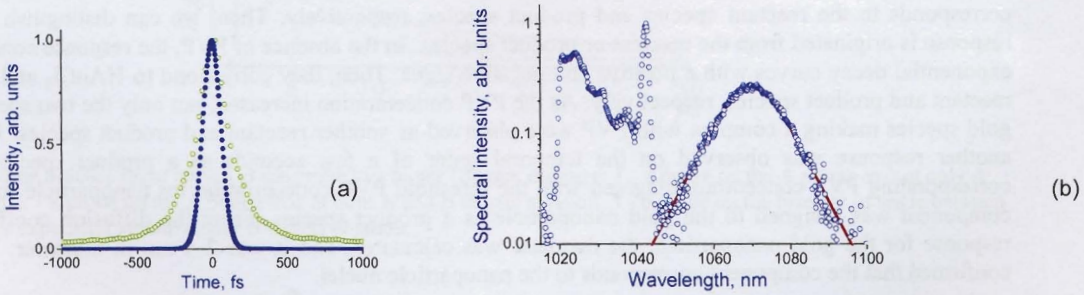

Fig. 1. (a) The autocorrelation of the compressed Yb-fiber-laser output (open circles) and PCF output (filled circle); (b) the spectrum of precompressed Yb-fiber-laser pulses transmitted through a 160-cm-long piece of PCF (open circles) and a hyperbolic-secant fit of the red-shifted solitonic feature (solid line).

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