











efficiency (>94%) within its spectrum bandwidth and sharp cut-offs on both longer and shorter wavelengths. Thus the overall efficiency was gradually reduced with increased average output power due to spectrum broadening. An output power of up to 36 W was obtained after compressor with input power of 78 W. Spectra after compressor at various amplified power levels are shown in Fig. 8(b). An autocorrelation trace is shown in Fig. 10(a). Assuming a  $\text{sech}^2$  pulse intensity profile, the compressed pulse had a pulse duration of 790 fs at the maximum output power level. The signal to noise ratio of output pulses was always greater than 20 dB (which was limited by the oscilloscope and detectors) in this experiment. Figure 10(b) shows the output pulse train at the maximum output power level. The background signal in the output pulse train was intentionally checked, and no CW component was observed.

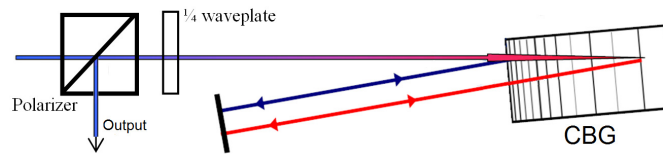


Fig. 9. Schematic diagram of a double pass CBG pulse compressor

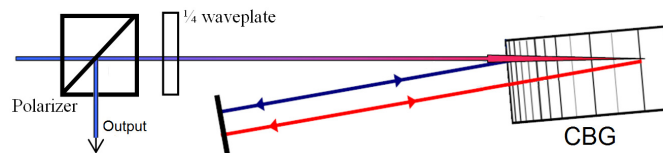


Fig. 10. (a) Autocorrelation trace of compressed pulse with amplified power of 78W (36W after pulse compressor); (b) Output pulse train with amplified power of 78W.

## 5. Conclusions

In conclusion, we demonstrated the highest power (78 W before pulse compressor) mode locked fiber laser at the central wavelength of 2011 nm. The laser consisted of femtosecond seed oscillator, two stage pre-amplifiers and a high energy amplifier. The femtosecond pulse train of 2  $\mu\text{m}$  wavelength was generated from a near-zero dispersion fiber oscillator with a repetition rate of 30.84 MHz. Pulses were stretched by a fiber stretcher to 273 ps. The amplifiers boost the power to 78 W. After pulse compression, an average power of 36W and a compressed pulse width of 790 fs were obtained. Further scaling of power and pulse energy is ongoing in PolarOnyx.

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