



Fig. 9. The spectra (a), (c) and corresponding intensity autocorrelation traces (b), (d) of the mode-locking pulses at 1059.2 nm and 1082.2 nm. The experimental data and the sech^2 -shape fitting curves are described by the blue curve and the red curve, respectively.

To explain why the dual-wavelength synchronously mode-locking operation happened in our experiment, we assume that it is due to the alliance between the large gain cross sections at the two wavelength bands (1056 nm and 1081 nm) and an appropriate SESAM. Just as the situation in [19], the dual-color pulses turned out to be synchronous were mainly driven by the modulation of the SESAM. It is worth noticed that the repetition rate of beat pulses is not equal to 6.1 THz, the center frequency difference between the two wavelengths, but to be a fractional number of the frequency difference. And the shape of beat pulses is not completely cosine-like, which we contribute to the strong chirp features of the dual-color pulses and that the dual-color pulses are not completely overlapped in the time domain. According to the discussion in [38], the beat frequency does depend on not only the center frequency difference but also the time delay between the two pulses as well as the linear frequency chirp rate.

4. Conclusion

In conclusion, we have presented a dissipative soliton mode-locked Yb:YSO laser by using an all-normal-dispersion cavity. Strongly chirped pulses have been obtained with pulse duration of 9.3 ps at a repetition rate of 113.4 MHz. The central wavelength was 1082 nm with 3.1 nm FWHM bandwidth and the maximum output power was 144 mW. Furthermore, we have demonstrated what we believe the first dual-wavelength synchronously mode-locking operation at 1059.2 nm and 1082.2 nm from a Yb:YSO laser. It is proved that the two color pulses were synchronized and partially temporally overlapped in the cavity. The two synchronous pulses generated beat pulses train with 169 fs pulse width and a repetitive rate of 1.4 THz. We believe that it is a potential laser source to generate ultrashort THz-wave pulses.

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