6. Conclusion

We have theoretically and experimentally compared performance of linear standing-wave cavity and ring cavity for external cavity frequency doubling at the wavelength from 795 nm to 397.5 nm. The two cavity structure show obvious differences of the thermal effect in nonlinear crystal, cavity sensitivity, and maximum output power for same waist radius, linear loss and crystal length. In the case of SWC, due to double-pass beam propagation in the PPKTP crystal, its thermal effect is more severe than that in RC. Induced from the severe thermal effect, for the same variation of input power, the variation of thermal focus length located in the SWC is shorter than that of in RC. The SWC sensitivity is influenced by both the severe thermal effect and the characteristics of the cavity itself. In the RC, we obtain maximum output power of 408 mW, which is far higher than that of in SWC (only 138 mW). The phenomenon is explained as non-optimal phase-matching induced from the temperature gradient, non-optimal mode-matching induced from the thermal lens, and non-optimal resonant locking induced from the thermal effect meanwhile induced bistability. In the SWC, the power fluctuation is still a bit larger than that of in RC, which may be due either to cavity sensitivity or to fluctuation of the relative phase between forward- and backward directions of temperature change.

By using RC as the external resonator, we obtain maximal output power of 408 mW at 397.5 nm, with a beam quality factor of less than 1.43. The laser beam with good beam quality and enough output power can meet the requirements for pumping an OPO, which will promote the improvement of squeezed vacuum source at 795 nm resonant on Rubidium D1 line. We believe the output power can increase further with the enlargement of waist radius, which can meet the requirement for pumping more OPO and obtaining entanglement beams.

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