

Chapter 5 Conclusion

We figure out the dynamic behavior of the Nd:YVO₄ laser system with large spot size around degenerate configuration both experimentally and numerically.

We found that the laser output would become unstable for high pump power, and the dynamic behavior at different pump power shows chaos, pulsation, quasi-periodic etc. We show the bifurcation diagram of this system, and analyze the chaotic signal to make sure the signal be chaos.

We found the second threshold depends on the cavity configuration and the pump spot size. The second threshold shows V-shaped curve on spot size. When we decrease the spot size or increase the reflectivity of the output coupler, the depth of V-shaped would increase.

Besides, we observe the low frequency fluctuation and found changes when the cavity length is tuned and is equivalent to the transverse mode beating. So we know that the instability is induced by the transverse mode competition.

Finally, we observe the dependence of output power on the cavity length and obtain chaotic region. We found there is a power bump when we tuning cavity length across the degenerate configuration and show that the chaotic regions are symmetric to the degenerate configuration but with a little shift due to the thermal effect.

Reference

- [1] E. Seigman, *Laser* (Mill Valley, CA, 1986) p.747
- [2] M. Shin and P. W. Milonni, *Opt. Commun.* 49,155 (1984)
- [3] L. A. Melnikov, S. A. Tatarkova, and G. N. Tatarkov, , *J. Opt. Soc. Am. B* **7**, 1286–1292 (1990).
- [4] A. E. Siegman, *Lasers* (Mill Valley, CA, 1986), p. 761.
- [5] F. Hollinger and Chr. Jung, *J. Opt. Soc. Am. B* **2**, 218 (1985).
- [6] R. Hauck, F. Hollinger, and H. Weber, *Opt. Commun.* **47**, 141 (1983).
- [7] F. Hollinger, Chr. Jung, and H. Weber, *Opt. Commun.* **75**, 84 (1990).
- [8] M. E. Innocenzi, H.T. Yura, C.L. Fincher, and R. A. Field, *Appl. Phys. Lett.* 56, 1831 (1990)
- [9] Y. J. Cheng, P. L. Mussche, and A. E. Siegman, , *IEEE J. Quantum Electron.* **31**, 391(1995).
- [10] M. Moller, L. M. Hoffer, G. L. Lippi, T. Ackemann, A. Gahl, and W. Lange, *J. Mod. Opt.* **45**, 1913 (1998).
- [11] K. Otsuka, J. Y. Ko, H. Makino, T Ohtomo and A. Okamoto, *J. Opt. B:Quantum Semiclass. Opt.* 5, R137 (2003)
- [12] G. Martel , C. Ozkul and F. Sanchez, *Opt. Commun.* 185 419 (2000).
- [13] C.H. Chen, M. D. Wei and W. F. Hsieh, *J. Opt. Soc. Am. B* 18 (2001) 8