

# Optical systems

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## 1 Bistable ring laser

A ring laser consists of a ring interferometer formed by three or more mirrors and a laser medium inside the cavity. In two-mode ring lasers, the light can travel in a clockwise or counterclockwise direction. Bistability with respect to the direction has been discussed in large detail—see, for example, Man-*el*, Roy, and Singh . Random switching of the beam intensities, initiated by spontaneous emission in the laser medium and fluctuations in the pump mechanism, indicates bistable operation of the ring laser.[1]

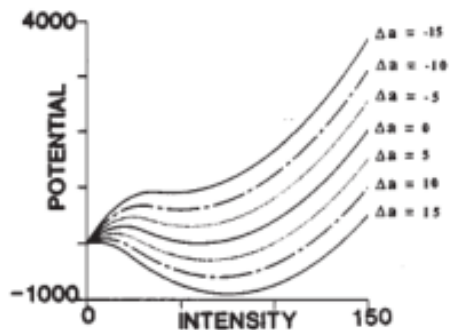


Figure 1: Bistable ring laser

## 2 Lasers with saturable absorbers

A laser with a saturable absorber is a quantum device consisting of a laser cavity where an amplifying as well as an absorbing medium are placed.[2]

### 3 Model for absorptive optical bistability

Consider a ring interferometer with a passive medium placed in it. Light is coupled into the interferometer through a semipermeable mirror and, likewise, light is transmitted at another mirror. Measuring the intensity of the transmitted wave against the intensity of the incident wave, one finds an S-shaped curve.[3]

$$X(t) = -H(t) \sum_{n=1}^{\infty} g_n l_n \exp(-l_n t)$$

$$x' = x - x^3 + u(t) + A_0 \cos(st)$$

### References

- [1] M. V. Buensalido, M. J. De Vera, and J. A. Tiongson. A descriptive study on the safety and efficacy of mesenchymal stem cell therapy for parkinson's disease: A case series. *Cytotherapy*, 18(6):S111–S111, 2016.
- [2] Jingyuan Li, Craig E. Landry, and Land Economics. Flood risk, local hazard mitigation, and the community rating system of the national flood insurance program. *Land Economics*, 94(2):175–198, 2018.
- [3] Hao Zhang, Jianyi Liang, Ye Liu, Hang Wang, and Liqing Zhang. An iterative method for classifying stroke subjects' motor imagery eeg data in the bci-fes rehabilitation training system. 215:363–373, 2014.