VE438: Advanced Lasers and Optics Laboratory

Laboratory manual
Lab 4: Optical Communication[1]

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[1]Edited based on the material and feedback from course instructor and previous TAs: Feng Yaming, Cao Jianjun and Shang Ce. Last Updated by Qin Tian(May 30, 2019)

1 Suggested Reading Assignment

Fundamentals of Photonics (Saleh & Teich) Ch 16, 17, 22

2 Pre-lab Questions

1. Compare the principles of a semiconductor laser diode and a semiconductor photodetector.
2. What are "rise time" and "fall time" of a diode? How do they affect the bandwidth of information transmission?
3. "Free space communication" makes use of a laser beam in free space instead of an optical fiber, what are the problems and how can we solve them?

3 Procedure

NOTICE:

- Pay attention to all lab safety instructions. Lasers used in the lab might hurt your eyes if you look into the beam directly.
- Equipment used in optics experiments such as mirrors and prisms are very fragile thus special operating rules need to be followed. Your grade for in-lab operation will be deducted for improper operations.
- Make sure the checklist below is clear before leaving the lab:
  - ☐ The experimental setup has been shown to the TA;
  - ☐ The data sheet has been checked and signed by the TA;
  - ☐ The equipment has been restored;
- TA will give a question to one of the group members to check your understanding on lab content. Grade for in-lab operation and the question will be shared among the whole group.

1. Mount a semiconductor laser diode, and connect it with a function generator, with square function, 20Hz, 3.5Vpp, and 1.75V bias. Make sure the voltage arange is from 0V - 3.5V to protect the diode;
2. Set an objective lens to a spatial filter, mount the filter, and couple the light into a multi-mode fiber;
3. Use a photon diode to receive the optical signal, connect the photon diode to a oscilloscope, trigger the signal and observe;
4. Change the frequency of the square function and observe the rise time and the fall time;
5. Use a triangle function to determine the threshold of a semiconductor laser diode. (Hint: try setting lower bias around 3V and observe the signal shape)

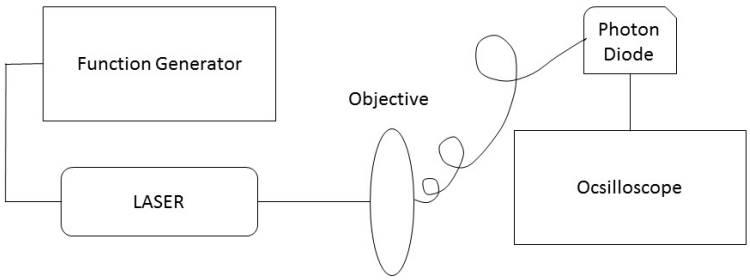

Figure 1. The experiment schematic

4 Post-lab Questions

1. What are the limiting factors in order to transmit information faster in your experiment both at the transmitting end and the receiving end?
2. What is the shape of the oscillation observed from your oscilloscope in your experiment, and why is it happening?
3. Supposing one is attempting to transmit two signals at the same time using a green laser and a red laser, how could he/she separate them out at the receiving end?