

VE438: ADVANCED LASERS AND OPTICS LABORATORY

LABORATORY MANUAL

LAB 6: ACOUSTIC-OPTIC MODULATOR¹

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¹Edited based on the material and feedback from course instructor and previous TAs: Feng Yaming, Cao Jianjun and Shang Ce. Last Updated by Yang Jianfan(June 27, 2019)

1 Suggested Reading Assignment

Fundamentals of Photonics (Saleh) Ch 20

2 Pre-lab Questions

1. Find out the relationship of the angle of incidence, frequency of acoustic wave and the wavelength of light in an Acoustic Optical Modulator(AOM). (Hint: the Bragg condition)
2. Consider the Doppler shift to an incident light in an AOM. Given the frequency of acoustic wave ω and the wavelength of incident light λ , calculate the frequency shift. What's the coherent length between the shifted light and the original light?

3 Procedure

NOTICE:

- Pay attention to all lab safety instructions. Lasers used in the lab may 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 experiment setup have been shown to the TA;
 - ☐ The data sheet has been checked and signed by the TA;
 - ☐ The equipment have been restored;
- TA will give a question to one of the group member to check your understanding on lab content. Grade for in-lab operation and the question will be shared among the whole group.

PART A: Raman-Nath Diffraction

1. Mount the Acoustic-optic Modulator on a post.
2. Fix that post on a 1D displacement actuator.
3. Set 24 V voltage for driving the AOM.
4. rotate the angle of the AOM to demonstrate the Raman-Nath diffraction.
5. Record the diffraction angle as many orders as you can observe.
6. Sketch the phase-matching diagram for the Raman-Nath diffraction.

PART B: Bragg Diffraction

1. Change the incident angle to demonstrate the efficient Bragg diffraction of +1 order.
2. Record the incident angle and the diffraction angle.
3. Repeat the above procedure for -1 order.
4. Sketch the phase-matching diagram for the Bragg diffraction of +1 order and -1 order.

PART C: Beating Between Modulated Light (for TA Demo only)

1. Build a M-Z interferometer.
2. Put one AOM in each arm of the optical path.
3. Set different values of the driving voltage of the AOM.
4. Collect the beating signal in a photo detector.
5. Observe the waveform on an oscilloscope.

4 Post-lab Questions

1. Estimate the velocity of acoustic wave in the crystal of AOM with the Bragg angle you measured. The laser wavelength is 632.8nm and the RF frequency of AOM is 100MHz.
2. Why do you see multiple light spots (> 3) in your experiment? Explain your observation with Raman-Nath Diffraction.