VE438: Advanced Lasers and Optics Laboratory

Laboratory manual
Lab 5: Spectrometer[1]

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Summer 2019

[1]Edited 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 17, 2019)

1 Pre-lab Questions

1. Find a schematic for a commercial spectrometer and explain how it works.
2. How is the spreading angle of light related to the periodicity of grating?
3. In order to use grating for a spectrometer, which order of diffraction pattern should be used & why ? (Hint: compare first order mode and zero order mode).

2 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.

1. Collimate the white light with a convex lens and a single slit;
2. Shoot the collimated light on the CD-ROM. Adjust the angle of incidence until colourful diffraction pattern is observed;
3. Measure the angle of incidence and the diffraction angle of different orders;
4. Calculate the periodicity of grating on the CD.

3 Post-lab Questions

1. Estimate the period of grating on CD with your measurement in lab.
2. Explain zero-order diffraction and first-order diffraction for an optical grating. Given the CD in previous question, what's the zero-order and first order diffraction angle with 45 degree angle of incidence? Why first-order diffraction is used in spectrometer?
3. With the period of grating on your CD, how is the diffraction angle spreading for visible light (300nm-700nm) and for mid-IR (2μm-10μm)?