Laser Spectroscopy on Rubidium – Instruction Notes

Keywords: absorbtion sppectroscopy, saturated absorbtion spectroscopy, frequency modulation spectroscopy, semiconductor laser, rubidium atom, hyperfine splitting

I. GOALS OF THE EXPERIMENT

The goal of this practical experiment is to gain insights into experimental atomic physics and laser techniques using laser spectroscopy.

To these aims, a tunable diode laser with an external resonator in Littrow configuration is set into operation. The D2 hyperfine splitting line of a rubidium gas at 780. 027 nm is measured with a diode laser. Firstly, an absorption spectrum is recorded in which the hyperfine structure is not resolved due to the Doppler broadening of the individual transitions in the thermal rubidium gas at 300K. After a change in the experimental setup, saturation spectroscopy can be used to resolve the hyperfine structure of the D2 line. Finally, the D2 line is measured using frequency modulation spectroscopy as well.

II. LEARNING CONTENT

- diode laser
- absorption spectroscopy
- saturated absorption spectroscopy
- hyperfine structure the absorption spectrum of rubidium
- Lamb – dip and crossover peak
- frequency modulation spectroscopy

III. PROCEDURE

The measurements will be performed with a laser emitting at 780 nm with an output power of 20 mW, therefore the wearing of laser googles is mandatory. The laser is put into operation and switched off at the end of the test day only by the advisor. The optics should not be touched directly, but if it does happen, it is advisable to take no individual cleaning attempts but to inform the advisor.

FIRST LAB SESSION

- set up the diode laser
- Doppler – limited absorbtion spectroscopy of rubidium

SECOND LAB SESSION

- saturated absorption spectroscopy: the improved spectral resolution should enable precise recording oft he lamb-dip and crossover resonances oft he hyperfine structure of rubidium spectrum

- frequency modulation spectroscopy on rubidium

IV. REFERENCES:

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