

# **I dont know yet**



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This thesis is submitted for the degree of  
*Bachelor of Science*



## **Abstract**

This is where you write your abstract...



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# **Chapter 1**

## **Theory**

## 1.1 Rubidium

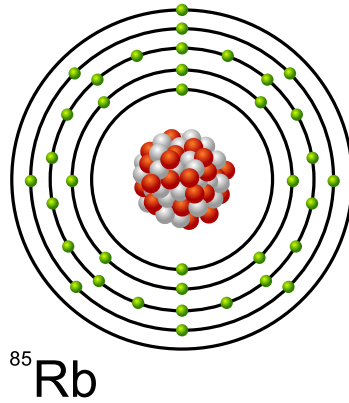


Fig. 1.1 Schematical representation of <sup>85</sup>Rb

Rubidium is a chemical element with symbol Rb and atomic number 37. It is a soft, silvery-white metallic element of the alkali metal group, with an atomic mass of 85.4678. Elemental rubidium is highly reactive, with properties similar to those of other alkali metals.

German chemists Robert Bunsen and Gustav Kirchhoff discovered rubidium in 1861 by the newly developed technique, flame spectroscopy. Because of the bright red lines in its emission spectrum, they chose a name derived from the Latin word rubidus, meaning “deep red”. [1]

Although rubidium is monoisotopic, rubidium in the Earth’s crust is composed of two isotopes: the stable <sup>85</sup>Rb and the radioactive <sup>87</sup>Rb. [2]

| Rubidium                |           |           |
|-------------------------|-----------|-----------|
| Isotope                 | 85        | 87        |
| Atomic mass             | 84.911794 | 86.909187 |
| in 10 <sup>-25</sup> kg | 1.40999   | 1.44316   |
| Abundance               | 72.17%    | 27.83%    |
| Spin I                  | 5/2       | 3/2       |

Table 1.1 Properties of rubidium isotopes

## 1.2 D2 line

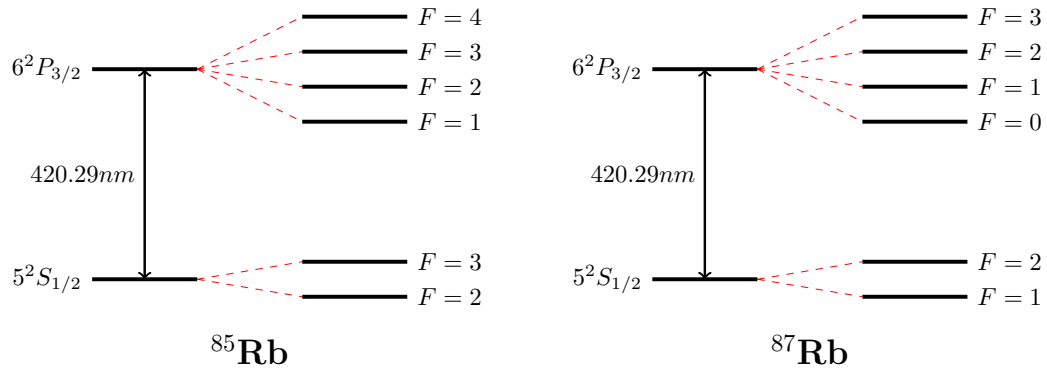


Fig. 1.2  $5^2S_{1/2} \rightarrow 6^2P_{3/2}$  transition of  $^{85}\text{Rb}$  and  $^{87}\text{Rb}$  with corresponding hyperfine structure

As we can see both isotopes have the same transition energy, but due to the different spin  $I$  (see table: 1.1) we get different energy levels for the groundstate [3]. This is the reason why we witness four doppler peaks in our spectrum.

**Caution:** Both figures below show the correct correlation between energy and isotopes. The explanation of this is that higher energy levels need lesser transition energy to reach the same excited state.

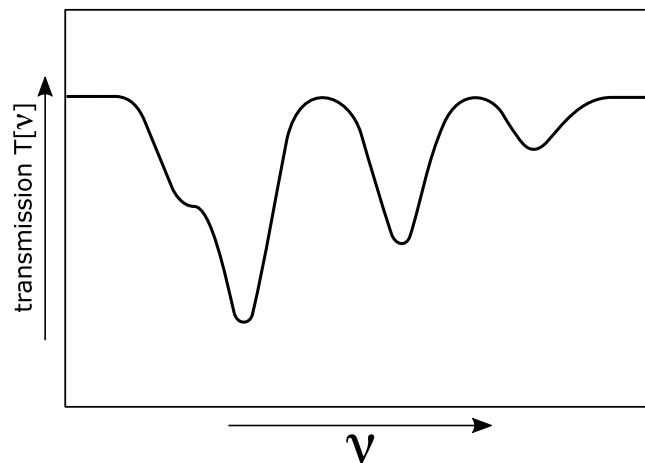


Fig. 1.3 Doppler spectrum of D2 line

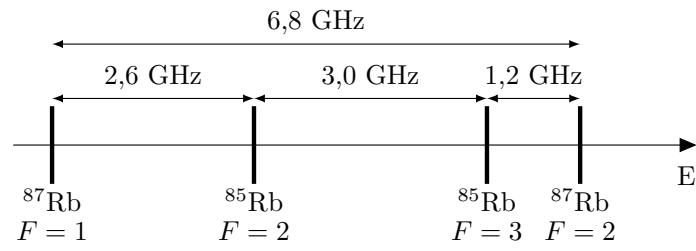


Fig. 1.4 Relative energy gaps of the groundstates between both isotopes

### 1.3 Two-level atom

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## **1.4 Laser absorbtion**

## 1.5 Doppler shifts



## **1.6 Behavior of absorption coefficient**

## **1.7 Non-linear differential equation**

# **Chapter 2**

## **Experiment**

### **2.1 Setup & Tools**

### **2.2 Laser diameter measurement**

### **2.3 Power / intensity measurement**

### **2.4 Doppler-free measurement**



# **Chapter 3**

## **Evaluation**

**3.1 Data processing**

**3.2 Temperature & saturation intensity**

**3.3 Comparison with theory**

**3.4 Compare Doppler-free measurement with theoretical values**



# References

- [1] G. Kirchhoff and R. Bunsen. Chemische Analyse durch Spectralbeobachtungen. *Annalen der Physik*, 189:337–381, 1861.
- [2] G. Audi, O. Bersillon, J. Blachot, and A. H. Wapstra. The NUBASE evaluation of nuclear and decay properties. *Nuclear Physics A*, 729:3–128, December 2003.
- [3] J. Reader A. Kramida, Yu. Ralchenko and NIST ASD Team (2015). NIST atomic spectra database (ver. 5.3). *National Institute of Standards and Technology*, 2015.





# **Appendix A**

## **Theory**



## **Appendix B**

### **Experiment**



# **Appendix C**

## **Evaluation**

