DISSERTATION

Cool Science

ausgeführt am Atominstitut

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durch

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"The Setesh guard's nose drips."
Teal'c

Abstract

Short and sweet...

Zusammenfassung

Kurz und bündig...

Contents

1. Chapter 1

List of class options:

********** General settings **********

1. 'a4paper' or 'a5paper'
2. '11pt', '12pt'(default) or '10pt' however font size 10pt is NOT recommended
3. 'print': Use 'print' for print version with appropriate margins and page layout. Leaving the options field blank will activate Online version.
4. 'signed': Use 'signed' to add section on titlepage to be signed by the superviser. Works only with the print option!
5. 'declaration': adds a page with an declaration after the titlepage, to be signed by the author Works only with the print option!
6. 'final': option some packages might need for the finalized document
7. 'place': insert place and date on the title page
8. 'index': For index at the end of the thesis
9. 'abstract': To generate only the title page and abstract page with dissertation title and name for submission somewhere
10. 'chapter': This option enables only the specified chapter and its references Useful for review and corrections.
11. 'titlepage2': This option loads the alternative titlepage titlepage_alternative instead of titlepage_official. This intended to have two designs available and quickly switch between them.

********** Draftmode settings **********

12. 'draftclassic': For draft mode without loading any images (same as draft in scrbook) and notes
13. 'draft': Special draft mode with line numbers, images, and water mark with timestamp and custom text. Position of the text can also be modified.

14. ‘nolinenumbers‘: disable line numbers in draft mode !!!When toggled auxiliary files must be deleted.

15. ‘todonotesoff‘: manualy disable todonotes (has to be loaded after draft options) Add notes with follwing commands in the draft mode:

```
\mynote{text} -> green note on the side pointing to the location
\sidenote{text} -> blue note on the side
\needref{text} -> blue note on the side pointing to the location
\urgentnote{text} -> red note on the side pointing to the location
\inlinenote{text} -> orange inline note
\missingfigure[figwidth=length]{text} -> dummy picture
```

In the index section a list of todonotes is printed. !!!You must not use underscore in the missingfigure argument. !!!Line numbers and todo notes are not really compatible.

16. ’bibdebug’: debug mode for BibLaTeX

********** Custom Page Margins **********

17. ‘custommargin‘: Use ‘custommargin’ in options to activate custom page margins, which can be defined in the preamble.tex. Custom margin will override print/online margin setup.

********** Choosing the Fonts in Class Options **********

18. ‘times’ : Times font with math support

19. ‘fourier’: Utopia Font with Fourier Math font (Font has to be installed) It’s a free font.

20. ‘customfont’: Use ‘customfont’ option in the document class and load the package in the preamble.tex

    default or leave empty: ‘Latin Modern’ font will be loaded.

********** Bibliography settings **********

21. ‘biblatex‘: use the package BibLaTex instead of natbib packages

22. ‘bibsections‘: list references by parts/chapters/sections (settings in header)

23. ‘bibtex‘: use BibTeX as backend for BibLaTeX to sort references from .bib file (by default Biber is used)

24. ‘bibtex8‘: use BibTeX8 (UTF-8 support) as backend for BibLaTeX to sort references from .bib file (by default Biber is used)

********** Choosing the Bibliography style **********

25. ‘authoryear’: For author-year citation eg., Krishna (2013)
26. ‘numbered’: (Default Option) For numbered and sorted citation e.g., [1,5,2]
27. ‘custombib’: Define your own bibliography style in the ‘preamble.tex’ file.

    `\RequirePackage}[square, sort, numbers, authoryear]{natbib}`

    . This can be also used to load biblatex instead of natbib

The equation from [1, 2] and [3]

$$\langle n \rangle_{\mathrm{BE}} = \frac{1}{\mathrm{e}^{\beta(\epsilon-\mu)} - 1}, \tag{1.1}$$

was inserted with by using the short-cut cmd + n, which gives a labelled "eqn" environment.

2. Chapter 2

Here some Pgf exemplary plots.

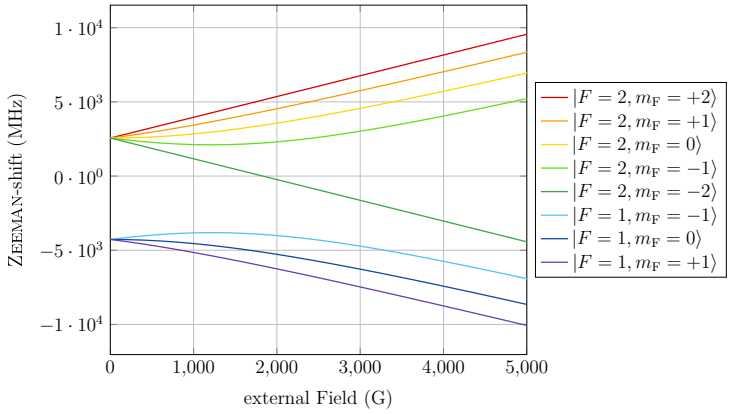

Figure 2.1.: ZEEMAN splitting of the ^{87}Rb ground state $5^2S_{1/2}$.

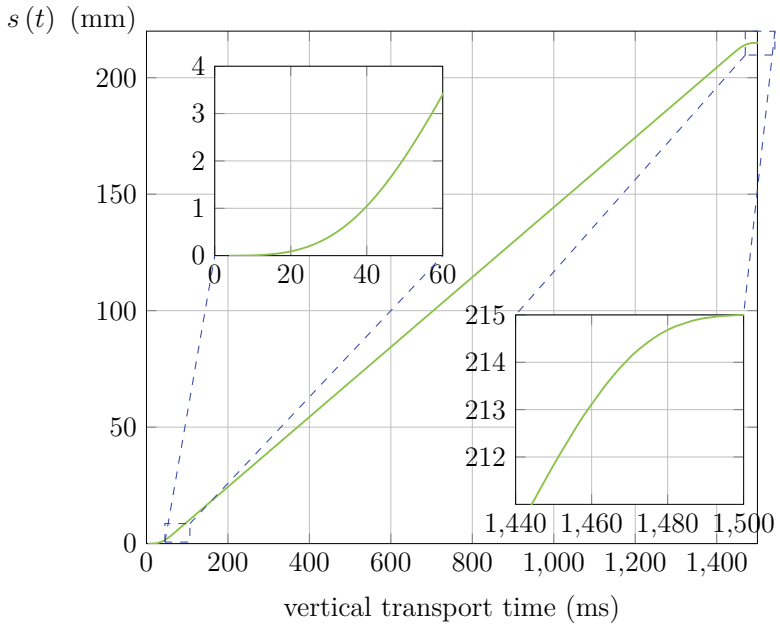

Figure 2.2.: pgf plot with zoom

3. Chapter 3

This chapter contains a few Tikz sketches and diagrams as a inspiration and guide line to create your own Tikz figures.

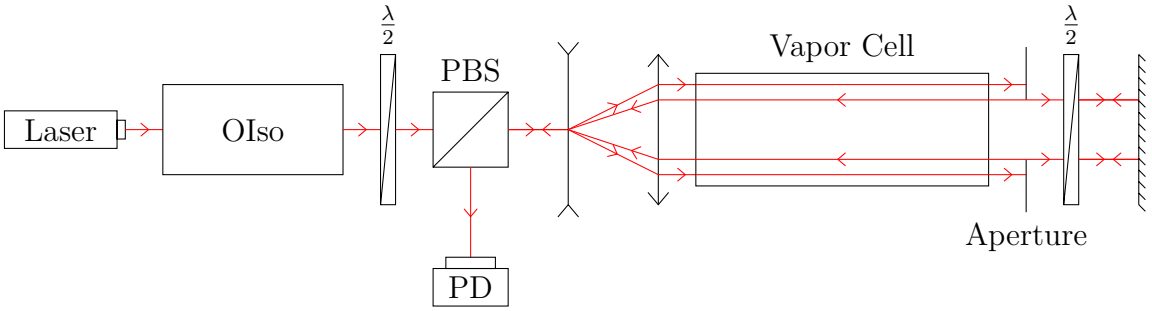

Figure 3.1.: optical setup for a DOPPLER free spectroscopy

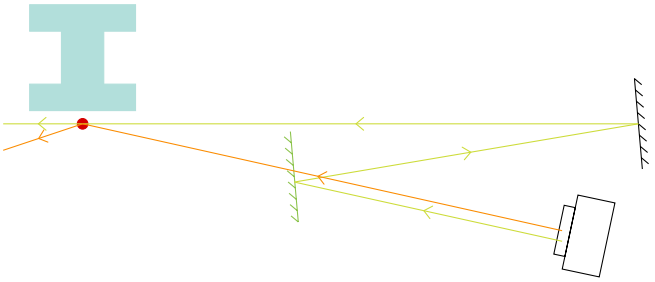

Figure 3.2.: optics sketch 1

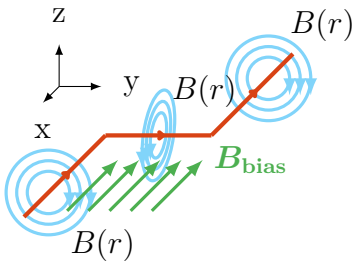

Figure 3.3.: Trapping atoms with wires.

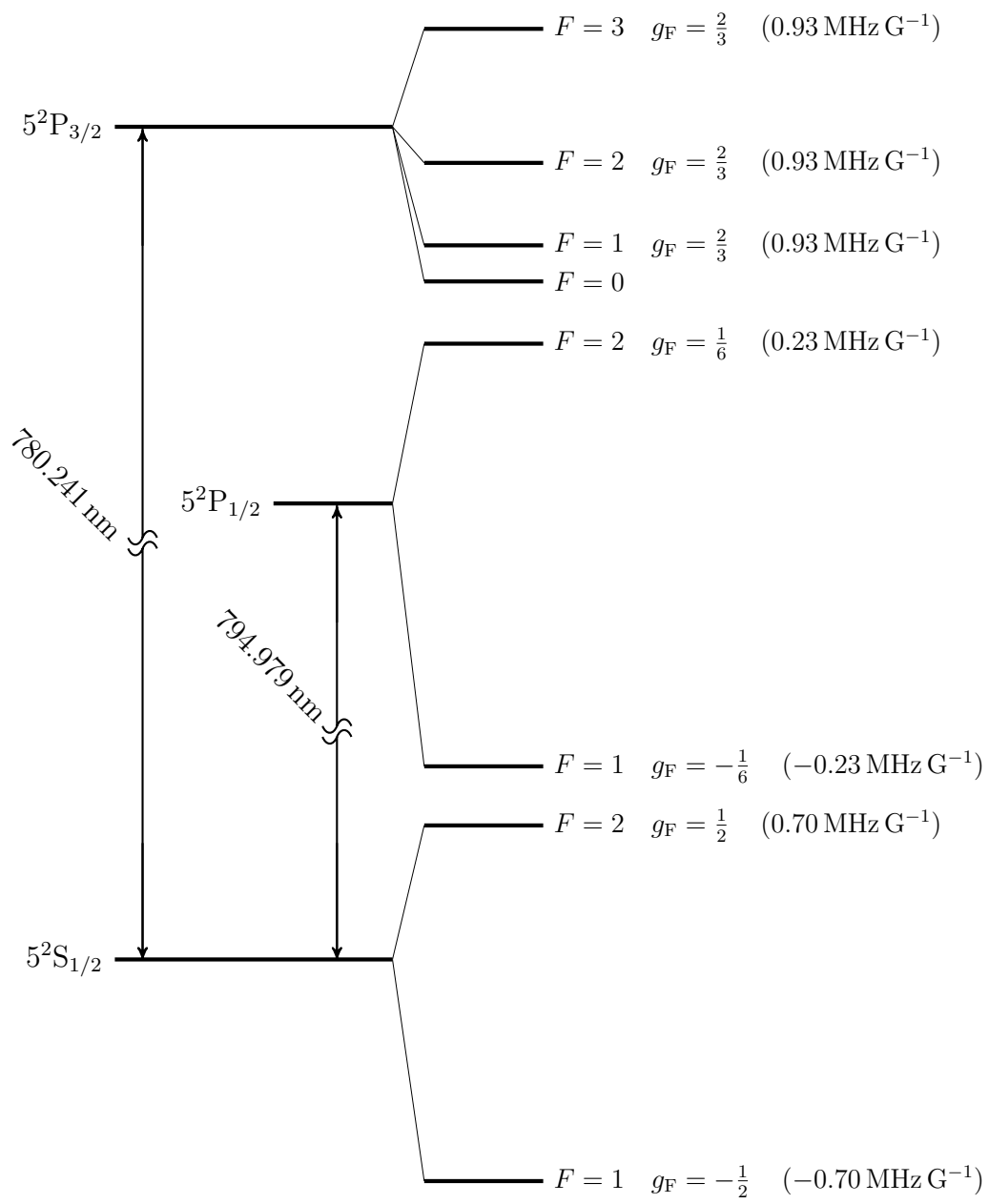

Figure 3.4.: ^{87}Rb hyperfine structure of the D1 and D2 line

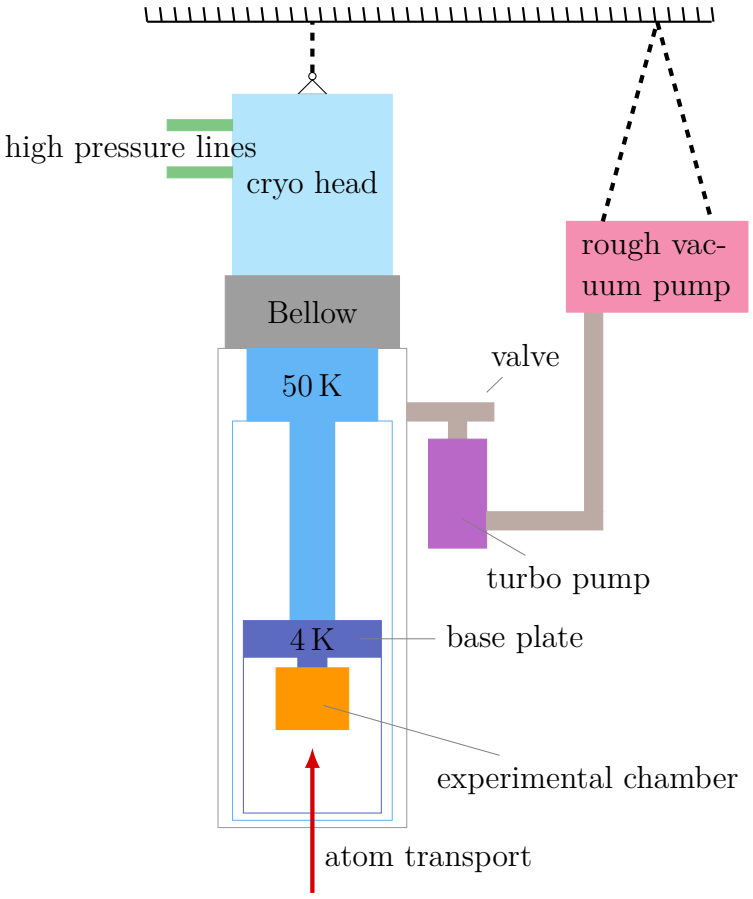

Figure 3.5.: Overview sketch of the cryogenic setup

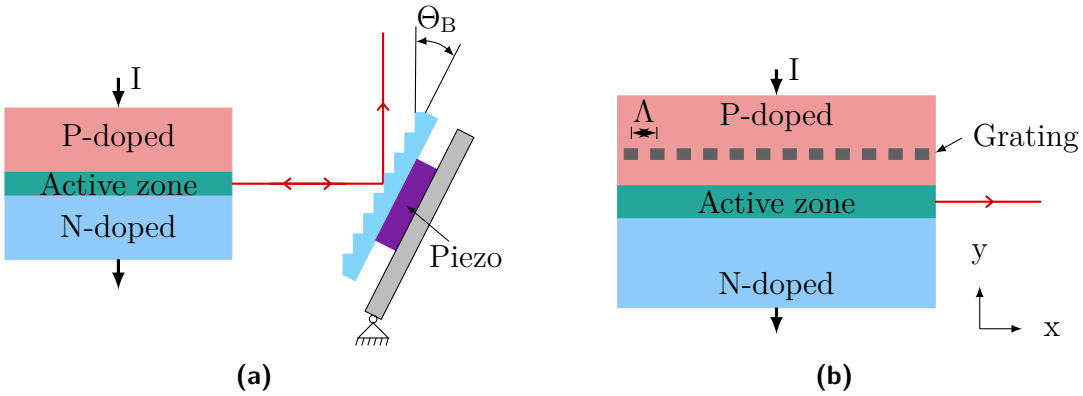

Figure 3.6.: semiconductor laser types: (a) ECDL; (b) DFB.

4. Cicero Word Generator

This chapter describes the installation and initial setup of Cicero Word Generator[4] on a PC running Windows 10 with analog and digital cards from National Instruments (NI). The code is freely available on Github[5]. This chapter contains only differences, problems, and possible solutions encountered when Cicero was installed for the PC 'Fritz Fantom' which will be used for the QuaK experiment. It is therefore advised to use the technical and user manual in conjunction. The titles in this chapter and font style with `Courier` and **Boldface** was mirrored to fit the manual.

4.1. Installation of National Instruments drivers

Before setting up the Cicero Word Generator, it is necessary to install the newest .NET Framework from Microsoft. For the first installation of NI drivers, NI-DAQmx (version 9.3), NI-VISA (newest version), and NI-4888.2 (newest version) should be downloaded from the National Instruments website. When installing the NI drivers it is possible to get an 'Runtime Error!'. In this case it is necessary to set the Regional format settings of Windows 10 to 'English (United States)'.

4.2. Installation of National Instruments Cards

After installation of the necessary drivers, the physical cards can be inserted into the PCIe slots on the motherboard. On 'Fritz Fantom' the digital card (NI PCIe-6537B) was installed in PCIe bus 3 while the analog cards (NI PCIe-6738) were installed in PCIe bus 4 and 5.

4.3. Configuring Atticus

After installation of the NI cards, Atticus should be launched for the first time and closed without changing any settings. After this, the NI-DAQmx drivers should be

updated to the newest version. If version 9.3 was not used when launching Atticus in this step, it could result in an error. After this, "Configuring Atticus" on the user manual can be followed. The **Server Name** was set to 'Fritz_Phantom'. **Dev1** to **Dev3** were set in the same ascending order as the physical installation on the motherboard.

change server i lab? Fantom, r Phantom

4.3.1. Configure hardware timing / synchronization

For synchronization, a **Shared Sample Clock** was used with **Dev1** being the master card. The settings are summarized in table 4.1 and table 4.2. For **Dev3** 'SampleClockExternalSource' should be set to '/Dev3/RTSI7'. The 'SampleClockRate' is set to 350 kHz since this is the fastest rate with all 32 analog channels active. It is possible to raise this to 1 MHz by only using 8 channels (1 channel per bank).

Table 4.1.: Settings for **Dev1**.

Setting	Value
MasterTimebaseSource	
MySampleClockSource	DerivedFromMaster
SampleClockRate	350000
UsingVariabletimebase	False
SoftTriggerLast	True
StartTriggerType	SoftwareTrigger

Table 4.2.: Settings for **Dev2**.

Setting	Value
MasterTimebaseSource	
MySampleClockSource	External
SampleClockExternalSource	/Dev2/RTSI7
SampleClockRate	350000
UsingVariabletimebase	False
SoftTriggerLast	False
StartTriggerType	SoftwareTrigger

4.4. Configuration and Basic Usage of Cicero

After setting up the Atticus server, Cicero can be configured. In step 3.c. it is necessary to write the full IP address and not 'localhost'.

Appendix

A. Appendix A

A.1. Source Code

Here is some source code added with the lstlisting package. With

```
$£\vdots£$
```

you can insert vertical dots to truncate code.

```
/*+++++++++++++++++++++++++++++++++++++
+                 Awesome source code                 +
+                    TU Wien 2018                     +
+                   Thomas Weigner                    +
+              weigner.thomas@gmail.com               +
+                      main.cpp                       +
+                      vers  3.4.1                    +
+++++++++++++++++++++++++++++++++++++*/

#include <header.h>
//---main program
int  main(){
//---declare stuff and initialize  things
  ⋮
//------generating polynom for vertical transport
Poly polArray[5];            //Creating a polynom object array with the default constructor
double vMax = 2.0;           //maximal velocity
  ⋮
```

A.2. Matlab2Tikz

Matlab to Tikz a is a very power full script to translate a Matlab figure into Tikz and Pgf code. After creating a file containing the code with this Matlab script one can do

fine adjustments directly in the code. If you are not already using it you should go and check it out.

Todo list

List of Figures

List of Tables

Acknowledgements

Thanks to ...

References

[1] Albert Einstein. "Quantentheorie des einatomigen idealen Gases (zweite Abhandlung)". In: *Sitzungsberichte der Preussischen Akademie der Wissenschaften* 1 (1924), pp. 261–267.

[2] Albert Einstein. "Quantentheorie des einatomigen idealen Gases (erste Abhandlung)". In: *Sitzungsberichte der Preussischen Akademie der Wissenschaften* 2 (1925), pp. 245–257.

[3] Louis V. de Broglie. "The wave nature of the electron". In: *Nobel lectures, Physics 1922-1941* (1929), pp. 244–256.

[4] Aviv Keshet and Wolfgang Ketterle. "A Distributed, GUI-based, Computer Control System for Atomic Physics Experiments". In: *Review of Scientific Instruments* 84.1 (2013), p. 015105.

[5] Aviv Keshet. *The Cicero Word Generator*. URL: https://github.com/akeshet/Cicero-Word-Generator (visited on 02/20/2020).