



# F44 Zeeman Spectroscopy

## Short Report

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The Zeeman effect is an atomic physics phenomenon that describes how spectral lines of an element are split when the magnetic moment of the atom is coupled to an external magnetic field. The aim of this experiment was to observe the normal Zeeman effect in cadmium and then to investigate the splitting of the spectral lines as a function of the magnetic field strength. In a second part of the experiment we determine the wavelength of the red cadmium line by using a Czerny Turner spectrometer. In our measurement we determined the wavelength  $\lambda_{Cd} = (643.8 \pm 2.9) \text{ nm}$ . In addition, the bohr magneton  $\mu_B$  could be calculated from both test parts, for which we obtained  $\mu_B = (10.3 \pm 0.5) \times 10^{-24} \text{ J/T}$ .

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## 1. Introduction

The zeeman effect was studied first in 1896 by the Dutch physicist Peter Zeeman when he observed the widening of the yellow D-lines of burning sodium between strong magnets. Later he found out that the widening of the lines was actually a division in up to 15 components.

The spectral lines of an element arise when an electron emits a photon at the transition between different energy levels, which wavelength depends on the energy difference of the energy levels.

If a strong external magnetic field is applied, individual energy levels are changed by coupling the magnetic moment of the electron with the external magnetic field, which leads to a splitting of the spectral lines. A distinction is made between the normal Zeeman effect observed in the experiment and the anomalous zeeman effect. These differ in the total spin  $\vec{S}$  of the electron, which is  $\vec{S} = 0$  at the normal Zeeman effect and  $\vec{S} \neq 0$  at the anomalous zeeman effect.

## 2. Theoretical Basics

## 3. Measurements Log and Evaluation

## 4. Discussion

## References

- [1] Wolfgang Demtröder. *Experimentalphysik 3. Atome, Moleküle und Festkörper*. ger. 5. Aufl. 2016. Springer-Lehrbuch. Berlin, Heidelberg: Springer Spektrum, 2016, Online-Ressource (XXI, 588 S. 740 Abb. in Farbe, online resource). ISBN: 978-3-662-49094-5. DOI: [10.1007/978-3-662-49094-5](https://doi.org/10.1007/978-3-662-49094-5). URL: <http://dx.doi.org/10.1007/978-3-662-49094-5>.