Abstract

Since its discovery, the Zeeman effect has played a large role in the field of atomic physics and magnetometry, which is the study of the intensity of magnetic field across space and time. There have been several calculations to include the relativistic corrections [**2007Drake-Wu**, **Drake-Yan**], field inhomogeneities, and quadratic effects in hydrogenic systems [**Fontanari_Sadovskií_2015**]. However, little is known about its behavior in multi-electron atoms such as ^{3}He, which is of key interest in magnetometry and the muon magnetic moment anomaly (μ_g−2), for which there is a 5.0 σ discrepancy [**aguillard2023measurement**] with the standard model prediction.

Using perturbation theory, I have calculated analytic corrections to the Zeeman effect, including nonlinearities, for ^{3}He$^+$. These calculations will be validated via the Dalgarno interchange theorem, and expanded to second order. The one electron perturbation of the nuclear charge gives the leading coefficient for the two electron case, giving us an analytic expression for the first quadratic Zeeman term in ^{3}He. This work will be used in experimental research involving the construction of an absolute magnetometer based on ^{3}He nuclear magnetic resonance at the University of Michigan [**Farooq_Chupp_Grange_Tewsley-Booth_Flay_Kawall_Sachdeva_Winter_2020**] in conjunction with Klaus Blaum's Max Plank Heidelberg group on a self-calibrated measurement of the helion magnetic moment.

Keywords: keywords

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Study programme:	Atomic Physics
Institution:	Department of Physics, Faculty of Science, University of Windsor
Year:	2025
Pages:	100

Acknowledgements

Here I thank everyone who helped me while I was working on my thesis.

Contents

Preface

Here I explain my contribution to the thesis and how it came to be.

Olomouc
April 2019

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Chapter 1

Introduction

This is an intro.[**Smith2017**] It may cite some references.[**Migdall2013Book**, **Straka2014**, **Straka2018Apr**, **Straka20**] Reference **Straka2019Thesis** is the original thesis typeset using the first version of this template.

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Methods of Solving the Perturbation Equation

Appendix B

Vita Auctoris