

Preface to the First Edition

This book follows closely a lecture course I gave entitled ‘Astronomical Spectroscopy’ to third-year undergraduate students at University College London between 1998 and 2003. The students who attended had done a prior introductory course on Quantum Mechanics which covered the hydrogen atom but no further atomic physics or spectroscopy. A similar level of prior knowledge is assumed in the current work.

In writing a book of this sort there are many people whose help has been essential for completion of the enterprise. First I must thank Bill Somerville who inaugurated the course Astronomical Spectroscopy and taught it for two years before me. He selflessly shared his lecture notes and other materials with me. I like to would thank Ceinwen Sanderson for turning my hand scrawled lecture notes into L^AT_EX, and my colleagues Tony Lynas-Gray, Bill Somerville, Peter Storey and Jeremy Yates for their extensive comments on the draft of the book. I owe a debt of gratitude to my graduate students Bob Barber and Natasha Doss who checked all the problems and found many errors. I thank all of them for the corrections: any errors that remain are all mine.

I must also thank the students who attended my Astronomical Spectroscopy course. It was great fun to teach, not least because the latest developments in astrophysics often fed straight into the lectures. Particular

thanks are due to the class of 2003 who made a number of helpful comments and suggestions on the contents of the book.

A book on spectroscopy thrives on good illustrations and I have shamelessly plundered the literature and other sources for spectra to illustrate this one. I must thank Xiaowei Liu for help with digitising many of the published spectra, and my student Iryna Rozum, my son Matthew and David Rage for their help with the other illustrations. Can I thank the journals and many authors who greeted my requests to reproduce their work with prompt enthusiasm, and especially those authors who adapted figures at my request. Each journal and author is individually acknowledged in the figure captions.

Finally I must give very warm acknowledgement to the many UCL astronomers past and present who have answered my many questions on astrophysics with a patience their frequent stupidity probably did not deserve. Particularly high on this list are Pete Storey and Mike Barlow but the rest of the varied lunch crew should not be forgotten. Without you my knowledge of things astronomical would be the same as it was the day I arrived at UCL — nothing.

Jonathan Tennyson
London

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In making a second edition I have taken the opportunity to add a chapter on the effects of magnetic fields on atomic spectra and to increase the coverage of molecular spectroscopy. The launch of high resolution infra red telescopes, recently Herschel and soon JWST, the development of extremely powerful ground-based long-wavelength telescopes such as ALMA, and the start of spectroscopic study of extra-solar planets have all acted to increase the astronomical importance of molecular spectroscopy. Indeed it is one of the joys of the study of astronomical spectroscopy that the constant discoveries drive the need for ever deeper understanding of the spectroscopy of atomic and molecular species which in turn enrich our appreciation of the Universe around us.

In preparing this second edition I would like to thank the many people who made very positive comments on the first edition and the (surprisingly) few who found errors in it. I am grateful to Bob Barber, Pete Storey, Michael Down, Stephen Harrison and Dermot Madden for their comments on the manuscript and, again, those astronomers who have allowed me to use their work to illustrate important points in spectroscopy.

Jonathan Tennyson
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Preface to the Third Edition

The third edition provides extensive updates and corrections to the previous additions. Many of these changes are due to Tony Lynas-Gray, Harold Heaton, Tom Meltzer and Tom Rivlin whose careful reading and detailed comments on both the second edition and drafts of this edition proved insightful and useful. I am very grateful to them as well as to Jonathan Rawlings, the current lecturer of the Astronomical Spectroscopy course at University College London, for his regular feedback. I also thank Sergey Yurchenko for help with the figures.

The increasing importance of the study of exoplanets means that molecular spectra are probed in dense environments. These environments are characterised by many collisions making the treatment of line-broadening of spectral transitions important both in models of exoplanet atmospheres and when interpreting their spectra. I have therefore added a chapter on line broadening. The physics involved in line broadening can be complicated and this chapter only gives a flavour of the processes involved plus some key formulae. There are whole text books on transition line shapes and the interested reader is referred to these.

Characterising exoplanets via their spectra is clearly a burgeoning field albeit one which is currently constrained by observational abilities. It is therefore a matter some frustration that JWST (mentioned above) remains

some time from launch. On a more positive note the European Space Agency (ESA) has recently selected Ariel, a space mission to characterise exoplanets via their spectra, and other exoplanet missions are also being actively proposed. Of these I have a particular interest in the Twinkle space mission. These missions, plus allied ground-based observations, have the ability to transform our understand of planets orbiting other stars.

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