Book Review

Astronomical Spectroscopy — An Introduction to the Atomic and Molecular Physics of Astronomical Spectra by Jonathan Tennyson (World Scientific Publishing Company, Singapore, 2011)

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In astronomy, spectroscopy is the technique that often provides most insight into the physical make-up of an object. In his book, Prof. Jonathan Tennyson (University College London) sets out to connect observed spectral line features to the quantummechanical properties of atoms and molecules in the line-producing, radiating media. He covers the whole electromagnetic spectrum from γ -rays to radio waves. As expert in molecular spectroscopy, Tennyson puts emphasis on molecules, and the systematics in line spectra. In his foreword, he rightly stresses the role of molecules for spectra in the infrared and mm-range which are covered by (at the time of publication) upcoming observing facilities like Herschel, JWST, and ALMA. He leaves out aspects related to the modeling of spectra and the description of the instrumentation necessary for their observation. The book emerged from a lecture course for third year students. It assumes some familiarity with quantum mechanics on the level of the hydrogen atom, but not beyond. It starts out from the hydrogen atom to develop the concepts necessary to understand the spectra of complex, multi-electron systems. It applies the developed concepts to spectra observed in various astronomical environments before continuing with molecular structure and the hierarchy of molecular line spectra. Each chapter is finished by a number of problems with worked-out solutions which is helpful for lecturers using the book in their courses, or for self-study. Worked examples illustrate and clarify concepts. The second edition of *Astronomical Spectroscopy* is expanded by a chapter on effects of magnetic fields on atomic spectra, and the coverage of molecular spectroscopy is increased. The text is intelligibly written and compact. However, the compactness comes at the price that often facts are stated but details of the physical background are not provided, and the reader is referred to further reading. The text would have benefitted by giving more detail. In particular for students, extra information would have been helpful, even in cases where the more experienced reader sees the reason. Giving one example here, it is stated that “A molecule with N atoms has $3N - 5$ vibrational modes if it is linear, or has $3N - 6$ otherwise”, leaving it to the reader to see why this is. Many figures are scanned versions of original journal articles, and not always of satisfactory quality. Some typos and missing words are found in the second edition and interrupt the reading flow, an unnecessary short coming. Nevertheless, the book provides a very good introduction to the systematics in spectral line formation, spectroscopic notation and terminology — knowledge that is rarely conveyed in such an accessible form. It provides practical recipes to derive line properties from atomic and molecular characteristics that are relevant for the interpretation of

observed spectra. Practitioners of spectroscopy and students will find the book to be a valuable source of information.

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