books

Spectroscopy, laser physics and their interaction

Atomic and Laser Spectroscopy

A. Corney
763 pp. Oxford U.P., New York, 1977. $34.95

Reviewed by Richard D. Deslattes

Alan Corney has produced a study guide for his teaching of the "Final Honour School of Physics at Oxford" which appears effective and useful. The focus is on atomic spectroscopy, laser physics and how these areas interact with each other. The book appears suitable for self-study by graduate students as well as by those who have foregone the pleasures of this field until later years. It also appears to this reader to be a good text adjunct to a teaching enterprise in this area.

Corney begins with concise recapitulations of the foundations of this century's key concepts in atomic mechanics and with reviews of classical electrodynamics and of elementary and not-so-elementary quantum mechanics. Although one could have reservations about so lengthy a recapitulation, the effectiveness, accuracy and occasional insight save this from tedium. Corney has carefully selected and formulated a reasonable fraction of this review material in anticipation of the requirements of the second half of the book, where he brings lasers and laser spectroscopy to the fore.

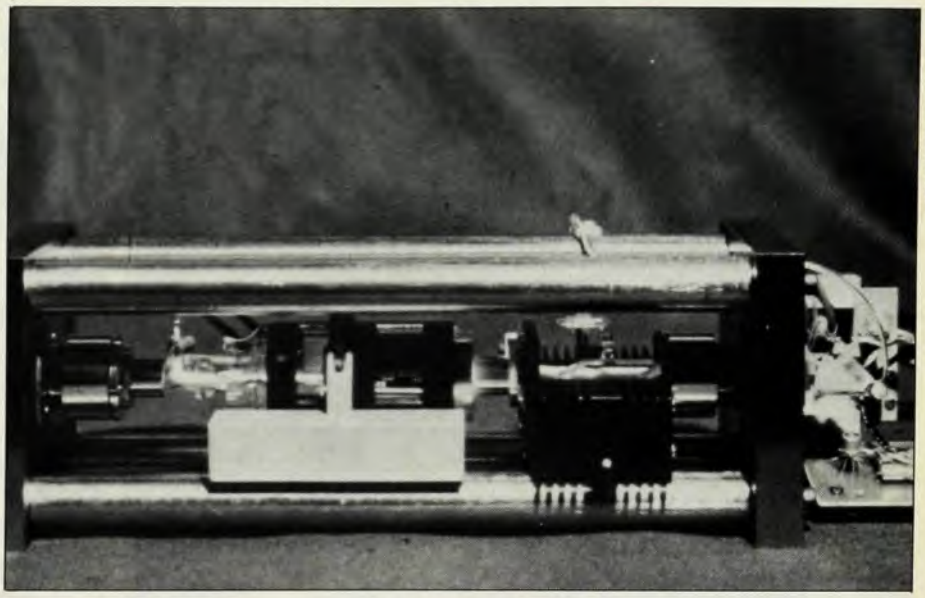
In the historical and conceptual review of laser physics and atomic spectroscopy I found general satisfaction. I believe that his path, as one can judge from his use of the literature, is well chosen. Corney guides the attentive reader toward the key literature, and good background references as well, providing a well-defined sense of what is to be expected there.

In one other way, namely that of timeliness, Corney's book has much to offer. Evidently, the use of photo-lithographic printing has permitted a rather short publication cycle. Thus one finds a publication dated 1977, with an author's preface dated July 1976, containing references published as late as the latter part of 1975. Among other things, this currency permits treatment not only of Doppler-free saturation spectroscopy in general but, most significantly, Doppler-free two-photon spectroscopy. The cutoff appears to be just between H(1s–2s) and the first demonstration of Ramsey fringes with lasers. This is a remarkable performance for a text-type publication. Lithographic reproduction of a text about at the level of typewriter composition found in *Physical Review* is not a particularly graceful example of the printer's art. On the other hand, the quality of reproduction is generally quite good and the benefits of evident timeliness, to this reader, outweigh the stylistic loss.

I found the text generally free of error but containing a number of points that may be taken as curious. On page 320 there is an initial description of optical resonators that can be read as excluding unstable ones. A masterful understatement occurs on page 372 where a minimal laser bandwidth estimate of about a millihertz precedes a statement that "In many lasers, this theoretical limit is never reached ...." The concept of "high-finesse" interferometry occurs on page 387 without, it appears, precedent or explication. Finally, a limiting performance of 2×10^{-8}/day (page 420) for passively stabilized lasers is probably overly pessimistic. On the other hand, most references of which I am cognizant were approximately cited and their context well summarized.

* * *

Richard D. Deslattes, of the National Bureau of Standards, has worked on stabilized lasers, their wavelength standardization and applications thereof to fundamental physical measurements.



RICHARD DESLATTES, NBS

Iodine-stabilized helium–neon lasers described in Alan Corney's *Atomic and Laser Spectroscopy*, reviewed on this page, have a frequency reproducibility of 1 part in 10^{10}. Thus they provide extremely useful secondary wavelength standards for work in the visible region of the spectrum.

Introduction to Plasma Physics, revised edition

B. M. Smirnov
174 pp. Mir, Moscow (US distributor: Imported, Chicago), 1977 (Russian edition, 1975). $3.25

The aim of this book is to provide "a concise yet general description of the physics of *weakly ionized* plasmas." Thus the generality of the title is somewhat misleading, since many topics dealing with highly ionized plasmas (of interest, for example, in controlled thermonuclear fusion research) are not em-

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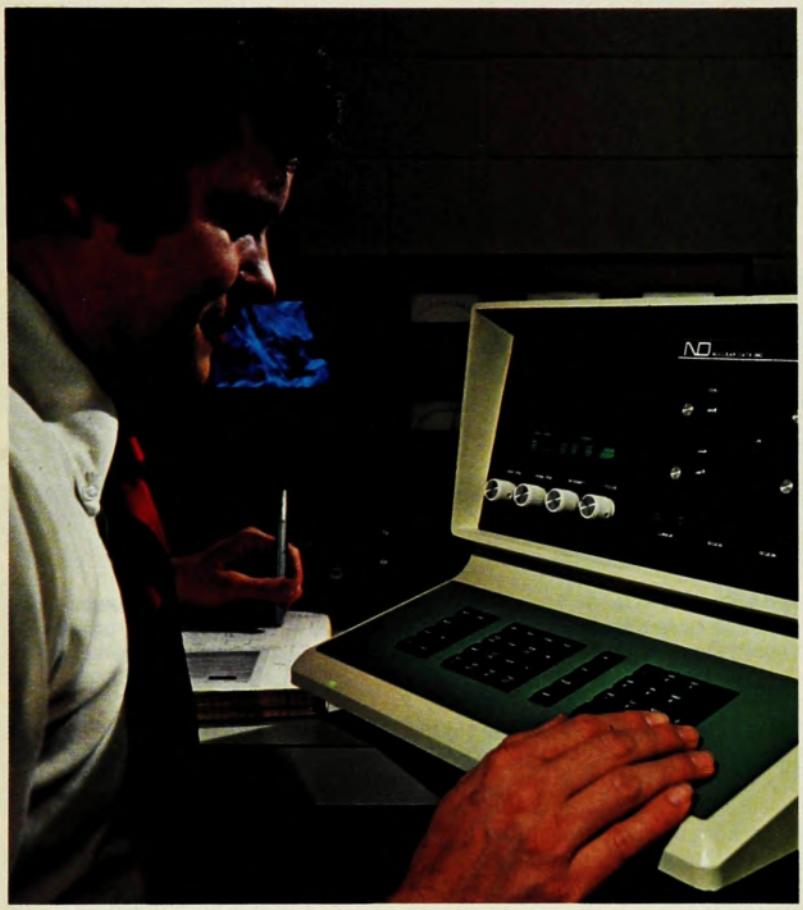

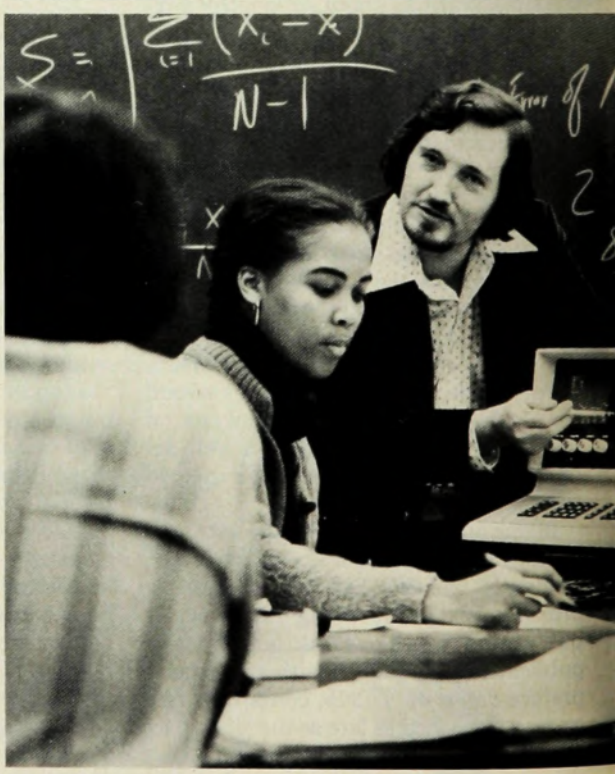

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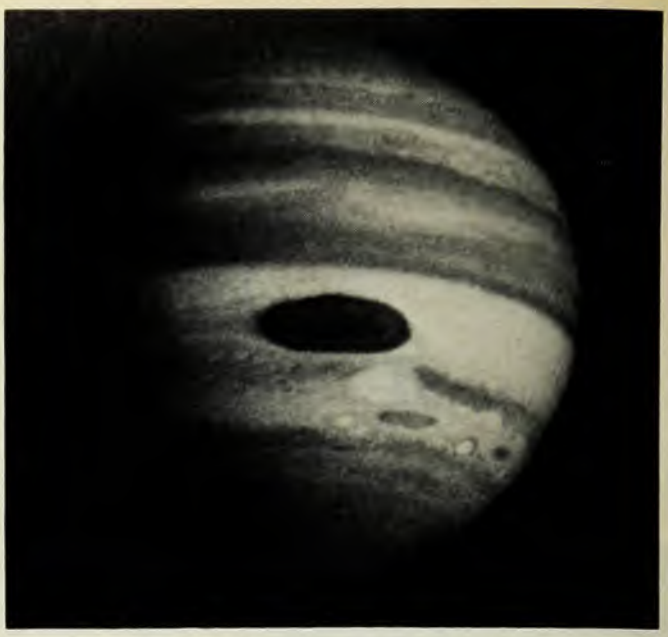

Planetary photography is featured in two recent government publications: Farouk El-Baz, *Astronaut Observations from the Apollo-Soyuz Mission* (Smithsonian Studies in Air and Space, No. 1) (Smithsonian Institution, Washington, D.C., 1977) and Richard O. Fimmel, William Swindell and Eric Burgess, *Pioneer Odyssey* (NASA SP-396) (USGPO, Washington, D.C., 1977). The latter volume is a revision of NASA SP-349 and includes data obtained not only from Pioneer 10, but also from Pioneer 11 as well. The photograph at left is a view looking southeastward at Egypt, Sinai, Saudi Arabia, the Red Sea and the Nile Valley. The Pioneer 11 photograph at right is of Jupiter with its Great Red Spot, taken at a distance of 1 100 000 kilometers. (Photographs courtesy of NASA)

phasized. On the other hand, topics such as charge exchange, ionization, recombination, excitation and atomic radiation receive proportionately more complete coverage than might be expected from a book with this title. The choice of topics reflects the interests of the author, Boris M. Smirnov, who has been teaching a course of lectures based on the subjects covered in this book at the Moscow Power-Engineering Institute. He is also editor-in-chief of the Soviet journal *Plasma Chemistry*. Some of the other topics treated include transport phenomena, kinetic theory, distribution functions, waves and the ionosphere.

The level of presentation is apparently meant to be suitable for a student who has had an introductory course in quantum mechanics as well as a basic course in electromagnetic theory and an acquaintance with fluid equations. Smirnov tries to use simple physical explanations with a minimum of mathematical analysis. While this is an admirable approach, it does not always work. Sometimes the "simple" treatment seems more difficult to follow than a presentation that used a little more mathematics would be.

Also, unfortunately, Smirnov makes a number of errors and unstated assumptions that would often cause difficulties for a student. For example, on page 92, equations (7.29) neglect inertia, equilibrium density gradients and time dependence, without so stating and without giving justification. Also, an elementary error in relating density perturbations to temperature and pressure perturbations appears on the same page. As another example, on page 39, Smirnov asserts without qualification that the main contribution to the average scattering cross section is from large-angle deflections. While this is true for charged-particle–neutral-particle collisions, it certainly does not apply to collisions between charged particles that interact via the long-range Coulomb potential.

This book is printed in the Soviet Union and is being imported for sale in the United States. The translation is adequate although some unimportant peculiarities of usage do occur. One attractive and notable feature of this book is its price, $3.25. The quality of the paper and binding is not as good as that of the outrageously priced technical books published in this country, but it is not bad either. One hopes that Mir Press will continue to make available such modestly priced translations of Soviet technical books.

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Introduction to the Strong Interactions

N. W. Dean
377 pp. Gordon and Breach, New York, 1976. $34.50

Writing a textbook on such a rapidly expanding field as particle physics is always a dangerous undertaking, since it is almost guaranteed that important new advances will be made by the time the text appears. In reviewing such a book one must be cognizant of this fact and sympathetic to the author, especially during a period such as the one we are now in. We have seen such an explosion of exciting experimental discoveries and theoretical ideas in the past few years that it would be impossible for any book to be up to date. Nevertheless this textbook by Nathan Dean has to be faulted for being especially antiquated. The subject matter treated is that of strong interactions, but the discussion is straight from the 1960's.

The restriction of material to strong interactions is justifiable; even if it does automatically exclude some of the most exciting recent developments (such as neutrino physics and unified theories of weak and electromagnetic interactions), it still leaves plenty of room for a pedagogically and thematically satisfying volume. One must insist, however, that a modern textbook at least make some introductory remarks about quantum chromodynamics, charm, and the parton model, topics that are nowhere mentioned in this book. The publisher must share part of the blame; although this text has a 1976 copyright, it seems to have taken a long time to appear and was actually written before the discovery of the J/ψ particles. The dated nature of the book extends beyond the lack of discussion of the "new" physics. Even in the area that the book is most at home, Regge theory and analyticity, it is at least seven years