

Stellar evolution and nucleosynthesis

An Introduction to Nuclear Astrophysics

J. Audouze, S. Vauclair

184 pp. Reidel, Hingham, Mass., 1979.
\$39.50 clothbound, \$19.95 paperbound.

Reviewed by David N. Schramm

Nuclear astrophysics stems from the interaction of nuclear physics and astronomy. It is the study of energy generation in stars and the origin of the chemical elements. The field dates in its complexity and maturity from the classic period of Margaret Burbidge, Geoffrey Burbidge, Willy Fowler and Fred Hoyle in the *Reviews of Modern Physics* in 1957. Up until now, the major textbook in the field has been *Principles of Stellar Evolution and Nucleosynthesis* written by Donald Clayton in 1968, just before the application of numerical solutions to reaction networks led to the study of nucleosynthesis under explosive conditions—a revolution in nuclear astrophysics. This new book, *An Introduction to Nuclear Astrophysics*, by Jean Audouze and Sylvie Vauclair, thus fills the tremendous need for a work of book length that is more modern than the 1968 textbook.

Audouze and Vauclair excellently summarize the current status of the field. The book is written at a level that would be quite suitable for use in a beginning graduate or upper division undergraduate course. The style is more the formal European style as opposed to the more free-flowing style that is now apparent among American textbooks. Audouze and Vauclair, both active French astrophysicists, have made numerous contributions to our understanding of nuclear astrophysics. Audouze in particular, is well known for his work on light element synthesis and on the chemical evolution of the galaxy, so it is understandable that these sections are extraordinarily well treated. However, the authors have also done quite an admirable job in treating the rest of the field: Big Bang nucleosynthesis, nuclear reaction rates, explosive nucleosynthesis and the synthesis of the heavy elements as well as the problems regarding the isotopic anomalies in the

early solar system and the use of radioactive decay for estimating the age of the universe.

Naturally, in any book written in a rapidly changing field, there is danger of recent developments being left out. For example, the discussion of the gravitational collapse of a massive star leading to a supernova explosion and a neutron star or black-hole remnant is somewhat dated. Considering the amount of research being done in this area, it would be difficult for a book to remain current for very long. A similar problem arises in any discussion of the Big Bang. Although the basic ideas of Big Bang nucleosynthesis are as valid now as they were when first presented by Jim Peebles, Bob Wagner, Willy Fowler and Fred Hoyle in the mid-1960's, there have been a number of new developments due to the increasing realization of the importance of elementary-particle physics in the early universe. But again, given the lead time involved in book publication, these are not serious flaws.

The point is that there finally is a recently written monograph on nuclear astrophysics that can be used as a reference and in courses at a level that even juniors and seniors with good physics backgrounds would be able to use.

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Lectures on the Electrical Properties of Materials (Second Edition)

L. Solymar, D. Walsh

415 pp. Oxford, New York, 1980 (first ed., 1970). \$36.50 hardbound \$17.95 paperbound

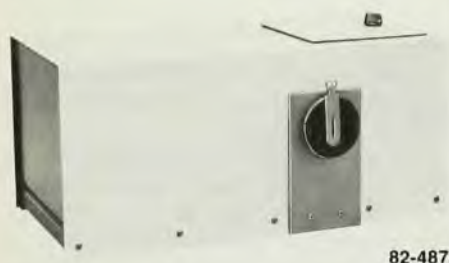
This is an introductory treatment of electrical properties of materials for engineers. It gives good coverage of metals and semiconductors, semiconductor devices, dielectrics, magnetics, masers and lasers and superconductivity. This second edition contains ex-

panded versions particularly of semiconductor devices, magnetics and masers and lasers.

An outstanding characteristic of the book is Solymar's and Walsh's obvious intention to bridge the "two worlds" and provide an informal, entertaining and often witty commentary in a historical, social and philosophical vein as well as of technical topics. After noting the effect on working hours caused by the development of semiconductor devices, the authors ask, "Will people know what to do with their leisure time? I hope so." These asides and the general conversational tone of much of the book contribute to its basic readability. The problem with this style, however, is that it must add considerably to the length (and cost) of the book and that it tends to lead the reader astray into thinking that he or she understands more than is really the case. The transition from these conversational episodes to the more technical aspects of the material is often fairly abrupt and may leave the student behind. A few time-dated remarks are also still present in the second edition; the most surprising of these is one that states "Engineers may be expected to reach for their slide rules at the slightest provocation but not to reach for the keyboard of a computer." (page 120)

The desire to present informal physical models is carried out somewhat unevenly in the text. For example, Solymar and Walsh just about dismiss the possibility of saying anything meaningful about the scattering relaxation time (page 161) except to cite typical temperature dependences, although it is fairly simple to provide a physical basis for these variations. On the other hand, they devote considerable attention to Feynman's coupled mode approach (pages 87-94) and to the Landau-Ginzburg theory of superconductivity (pages 366-373), both of which are almost certain to be virtually unintelligible to the student reader of this book. A number of particular problems that are conventionally worked out in more advanced texts are given as problems with hints (and an-

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swers supplied in an Appendix); one can hope that the teacher using this text will include these as illustrations in lecture rather than as homework assignments. Figures in the text tend to be abstract generalities rather than presentations of actual physical data on specific materials.

The material in the expanded chapters is particularly broad and helpful. In the semiconductor-device chapter the reader finds descriptions of the tunnel diode, varactor diodes, field-effect transistors, charge-coupled devices, the Gunn effect and microelectronic circuits. The authors also include examples of practical laser systems and of laser applications in that chapter. Magnetic bubbles are briefly treated in the magnetism chapter. On the other hand, optical properties are not explicitly discussed, and although these are sections on "Photo-diodes and lamps" and "Infrared detectors," neither luminescence nor fluorescence is mentioned in the Index. In addition, the only entries under "Optical" are optical fibers and "Optical Darwinism," the authors' term for mode competition in lasers. The authors label electrophotography "the Xerox process" and include it in the chapter on dielectrics.

Every author has his or her own way of treating a particular subject. This book presents a sprightly and readable version that is bound to be helpful to a variety of readers.

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Statistical Physics, Part 1 (Third Edition)

L. D. Landau, E. M. Lifshitz

578 pp. Pergamon, Elmsford, N. Y., 1980.
\$50.00 hardbound, \$20.00 paperbound

Since the English version of the book *Statistical Physics* by Lev. D. Landau and E. M. Lifshitz first appeared in 1959, it has become a modern classic in the field of statistical mechanics. It contains an especially clear and simple discussion of a variety of equilibrium phenomena including subjects not readily found in other texts. In particular, the discussion of equilibrium phase transitions is unexcelled anywhere for its depth and clarity. Much of the discussion on phase transitions is based on original work by Landau and the book as a whole reflects his deep insight into the workings of physical phenomena. This book has now been revised by E. M. Lifshitz and L. P. Pitaevskii, and the new Third Edition has been divided into two parts. Part I is an expanded version of the second edition but with the sections on quantum fluids removed. Part II, which has

yet to appear in English, will be devoted to quantum fluids and diagrammatic techniques.

In the Part I of the Third Edition, the chapters on thermodynamics, the Gibbs distribution, ideal and nonideal gases, solutions, chemical reactions fluctuations and surface phenomena remain almost unchanged from the previous edition. However, some reordering and rewriting has been done, and these chapters are more readable than before. The major changes occur in the chapters on condensed matter, symmetry of crystals and second-order phase transitions. The emphasis of the chapter on condensed matter has been changed from quantum liquids to solids and new sections on phonons and lattice vibrations have been added. The chapter on symmetry of crystals contains six new sections devoted primarily to symmetry properties of lattice vibrations and liquid crystals. The chapter on second-order phase transitions has seven new sections that deal with the effects of external fields at the critical point, the concept of critical indices and fluctuations at the critical point. The new sections in the Third Edition are written in the same clear style as older sections and serve to strengthen and modernize the book in some of the areas where it has become dated.

The format of the Third Edition, Part I, remains unchanged from that of older editions. It is a book devoted almost exclusively to equilibrium phenomena and contains no kinetic theory and little discussion of the microscopic foundations of thermodynamic phenomena. The book assumes that the reader is familiar with statistical concepts. One of the strengths of the book is a large number of worked problems. However, the book contains no unworked problems, which is a disadvantage if one wishes to use it as a text. Also, the material on basic thermodynamics is presented in a manner that requires a firm grounding in thermodynamics on the part of the reader. However, the Third Edition, Part I, as is true of the earlier editions, remains a delight to read and is a book that every student of statistical mechanics, young and old, should have on his bookshelf.

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Astronomy, Cosmology and Space Physics

Astrophysics from Spacelab (Papers presented at a meeting, Trieste, Italy, Fall 1976). P. L. Bernacca, R. Ruffini, eds. 670 pp. Reidel, Hingham, Mass., 1980. \$47.50