TRENDS IN MÖSSBAUER SPECTROSCOPY

Title Applications of the Mössbauer Effect in Chemistry and Solid-State Physics

Publisher International Atomic Energy Agency, Vienna, 1966

Pages 267

Price $6.00

Reviewer Morton Kaplan

The recently discovered Mössbauer effect is an example of a phenomenon which has found application in many diverse fields of research. To assess the current status of development, the International Atomic Energy Agency convened a panel on April 26-30, 1965, to review the situation and discuss possible directions for future work, particularly in the areas of chemistry and solid-state physics. This book is presented as the report of the panel, and consists of the collection of papers given by participants at the Vienna meeting.

The program is divided into several sections, dealing with theory, apparatus and techniques, structural investigations, etc. In practice, the contents of individual papers frequently overlap these areas somewhat, which seems to be more or less true of most conferences. Each paper is an independent contribution, unified unto itself, which makes it possible for the reader to pick and choose according to his interests. However, this has the consequence of a certain amount of repetitiveness for one reading the whole book.

Most of the material presented in the book is not new, and can be found as published articles in various journals. The virtue of the book is that it presents, in one place, a representative view of work being done in the field, and there are adequate references given to enable the reader to follow a particular line of interest. There is apparently some confusion as to the intended audience, since rather elementary concepts are frequently spelled out in detail, whereas more advanced ideas appear with relatively little elaboration. For an individual active in the field, the book is a worthwhile addition to his collection, even though he will have seen some of the material in other places. Of particular value to this reviewer were the excellent discussions of surface phenomena and scattering experiments in the papers by Frauenfelder and collaborators. To the uninitiated, the book may serve as a useful source of ideas, but some readers will probably want to have prior acquaintance with one or more of the standard review articles on the Mössbauer effect.

Morton Kaplan is Assistant Professor of Chemistry at Yale University. He received AB and SM degrees at the University of Chicago, and a PhD from MIT. He spent several postdoctoral years at the Lawrence Radiation Laboratory in Berkeley, and then joined the Yale faculty. His research interests are in the mechanisms of nuclear reactions and in Mössbauer studies of magnetism and chemical bonding. He is currently an Alfred P. Sloan Research Fellow.

TIMELY AND STIMULATING

Title Containing the Arms Race—Some Specific Proposals

Author Jeremy J. Stone

Publisher The M. I. T. Press, 1966

Pages xvi + 252

Price $6.95

Reviewer W. A. Higinbotham

Thanks to the efforts of ANS members and to generous public support, nuclear power has come of age and nuclear power plants are spreading around the world. As a source of cheap and clean power they should materially improve man's lot. But at the same time they will put large amounts of plutonium into the hands of many independent and sometimes belligerent nations. Already, the vast nuclear military forces of the major powers present a grave danger to society. The uncontrolled spread of nuclear plants will create many additional problems. Currently, a treaty to prevent further proliferation of nuclear weapons is under active consideration. Hopefully, this will soon come into effect. But this, like the partial nuclear test ban, will have little effect in slowing the arms race unless other arms control measures are soon adopted and the difficult process of creating an international security structure is begun.

Containing The Arms Race—Some Specific Proposals is a descriptive title. Author Stone elects to discuss a few modest steps which appear to be negotiable at the present time, which might serve to decrease the rate of nuclear weapons development, and which might lead to more substantial arms-control agreements. Specifically, the measures are: a freeze on anti-ballistic missile systems, bomber disarmament, a reduction in long-range missiles, and a freeze on procurement of strategic weapons. These are all topics which have been seriously proposed for discussion in the 18-nation disarmament committee.

The analysis of the ABM freeze is especially timely, since that subject will be sharply debated this year. There is considerable evidence that the Soviet Union is presently installing ballistic missile defenses on a substantial scale. Many US arms-controllers fear that an ABM race will initiate a new round of research and procurement which will leave the world even less secure than it is now. Soviet arms controllers, on the other hand, argue that defensive measures are consistent with stability and disarmament; and one gets the impression that the Russians will not agree to stop.

As Dr. Stone points out, the United States may respond by building an ABM system, accompanied by an extensive civil defense program, or it may simply improve the quantity and quality of its strategic weapons. Either way, it is costly and the world as a whole is probably less secure.

It is impossible to summarize the ABM discussion in a brief review. The treatment of this topic and of the other proposals, too, is thorough and logical, analyzing the "security" and the practical political factors with great care. One does not need to have access to classified information to become an expert on arms control. Dr. Stone dug the necessary factual information out of newspapers, magazines, and the *Congressional Record*. One *does* have to apply imagination and analysis and political intuition. This is a timely and stimulating book on a most vital topic.

W. A. Higinbotham is head of the Instrumentation Division at Brookhaven National Laboratory. He has been active in the Federation of American Scientists for many years and served as Chairman of that organization in 1946, 1952, and 1965. His undergraduate work was done at Williams College (AB, 1932), from which he was granted an honorary DSc in 1963.

AN ILLUMINATING DISCUSSION !

Title Radiative Contributions to Energy and Momentum Transport in a Gas

Author D. H. Sampson

Publisher John Wiley & Sons, Inc., 1965

Pages 178

Price $8.50

Reviewer Baxter H. Armstrong

This monograph might more appriately be called "Mathematics of Radiative Contributions to Energy and Momentum Transport in a Gas," or "Formal Theory of . . . ," as it is not the practical treatise the preface might be taken to indicate. Fortunately, there are a number of significant formulas and discussions not to be found (or at least difficult to find) elsewhere. It is disappointing, however, that the reader has to slog through so much poor composition and grammar to find them. Also, the text does not appear to have been proofread with much care; for example, the title to Chapter 7 alone contains two misspelled words. (At least, the typographical errors appear to occur mostly in the text, rather than in the equations.) A particularly annoying peculiarity appears systematically in the format of the equations: the exponential function of an argument x, $\exp(x)$, is often disengaged from its argument with the exp on one line and the argument (sometimes even without parentheses!) on the next line. This seems surprising for an experienced publisher.

The author's prepossession with formality occasionally obscures the more important physical concepts by diverting attention to unnecessary details. There is also a certain inconsistency in his presentation: in the preface he states his purpose, "to ... provide a tract which ... will be of use ... (in) radiative transport problems involving almost any conditions of gas density and temperature." However, he fails to separate important effects into their respective domains of importance. For example, Chapter 8, "Applications of Surface Concepts," begins with time-retardation ($t \rightarrow t - r/c$, where t is time, r is distance, and c is the velocity of light) being included. But at temperatures for which (it seems to me) this could possibly be of importance, there could be no surfaces or walls of any kind—as the author himself indicates on page 3 of the Introduction. In fact, it would have been most interesting if the author had indicated somewhere in the book the practical significance, if any, of the time retardation effect, and of the effects he considers of solving the transport equation in a noninertial frame. This significance is not at all obvious in a field where the calculated and/or measured quantities (emissivities, etc.) rarely are determined to an accuracy of better than 50%—particularly at temperatures above a few thousand degrees. Without such indication, these aspects would appear to remain as superfluous pedantic exercises. A few numbers would go a long way in adding some physical intuition and insight into the presentation. Although somewhat more obvious, the practical significance of Lorentz transformations and availability of final states (both of which the author treats in considerable detail) to problems in radiative transfer, is not satisfactorily indicated. This would have been a valuable service, as these topics are not covered (in this context) in any other book I know of, and yet are certainly important under the proper circumstances.

It doesn't require many of the above-listed shortcomings to make a book appear to be merely an attempt to demonstrate the author's erudition, rather than to educate the ignorant. I am sure this was not this author's motive, but a somewhat better organization of the material and attention to physical reality would prevent the suspicion from arising. In the author's favor, it should be pointed out that he has had the courage to write on a difficult subject about which little has been written. Very few books deal meaningfully with laboratory or terrestrial applications of radiative transfer, and a brief glance at the principal contenders shows Mr. Sampson's tract not to suffer at all by the comparison. In view of this, some more detailed comments are perhaps in order, which will provide the interested prospect with a more definite idea of what the book is about.

In Chapter 1, the author writes down the general Boltzmann transport equation for the distribution function, defines its constituent terms, and the various transport properties (mass, momentum, energy) that can be obtained from this equation or from this distribution function, once it is known. He concludes the chapter with a brief discussion of electron degeneracy. This particular discussion is necessary, but is the same as given in many books. It ends with the usual statement for the condition of nondegeneracy:

$$e^{\eta_e} = (N_e/2)[(h^2/2\pi m_e kT)^{3/2}] \ll 1.$$

This affords an illustration of my earlier remarks. It is often possible to rephrase an old, but essential argument to convey a little more physical insight. This could be done here by noting that $(h^2/2\pi mkT)^{1/2} \equiv \lambda_T$ is the thermal de Broglie wavelength, and that this condition, requiring that $e^{\eta_e} = \frac{1}{2}N_e\,\lambda_T{}^3 \ll 1$ is tantamount to the requirement that there be very few particles in a "thermal de Broglie cube." This condition is usually met in gases, and this type of description would render more perspicuous the