# BOOK REVIEWS

Selection of books for review is based on the editors' opinions regarding possible reader interest and on the availability of the book to the editors. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

*Title* Neutron Cross Sections and Technology, Vols. I and II

*Subtitle:* Proceedings of Conference

*Editor* D. T. Goldman

*Publisher* National Bureau of Standards, Washington, DC

*Pages* xvii + 640C

*Price* $10.50 per set of 2 volumes, from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402

*Reviewer* T. A. Eastwood

These two volumes constitute the proceedings of a *Second Conference on Neutron Cross Sections and Technology* held in Washington, DC in March, 1968. The conference followed the pattern set by a similar conference held in the same place two years earlier and was designed to bring together, for the exchange of status and progress reports on topics of mutual interest, the three groups chiefly concerned with neutron cross sections: the experimentalists who produce nuclear data; data compilers and evaluators; and those who use the data in fields of basic or applied science. It is to the credit of the organizing committee and the Editor of the proceedings that representative contributions from these three groups were presented at the conference and that all the conference papers, exceeding 120 in number, are assembled in these volumes.

The papers fall under the following general headings: experimental neutron cross-section measurements; standards; theoretical interpretation of cross-section results; data storage, retrieval, and evaluation; the relationship between differential data and integral experiments; and the need for nuclear data in reactor physics applications, shielding technology, and astrophysical calculations. The majority of the papers are rather short and formed the basis of 10 to 15 min oral presentations but in addition there are review papers on each topic that were invited by the conference organizers. Discussions of the presented papers are not recorded but comments about the state of this area of science and technology from a number of experts, expressed during a panel discussion at the conference, appear at the end of the proceedings.

There seems to be a growing interest among scientists in the uses to which their knowledge is put. These proceedings can therefore be expected to have a general appeal to experimentalists and theoretists, including those whose preoccupation is the basic nuclear phenomena, for the users of the data have taken pains to show where the data are being used, what the accuracy of the measurements means in terms of reactor performance or cost, and what additional data are required. Detailed interests will not be as well served and only a few of the papers in these proceedings can be considered complete in the sense of journal papers or papers to some of the more specialized conferences. However, a great many new data are presented, particularly in the resonance and fast-neutron regions, and new developments in rapidly expanding areas are well covered. Subthreshold fission is an example of such an area and the resonance grouping structure shown in the cross section of $^{240}$Pu between 0.2 and 8 keV reported by Migneco and Theobald from the EURATOM Laboratories at Geel will be of interest to many. A more elaborate account than has appeared elsewhere, of Griffin's theory accounting for the mass distribution and other aspects of low-energy fission, will also appeal to the nuclear physicist.

Evaluators will have frequent recourse to the proceedings not only for the overview they give of activities in the field but also for new information to be digested and for the light they shed on standards, accuracy of measurements, and the resolution of discrepancies. They will appreciate having new information as early as possible even though it may be preliminary; nevertheless, many will wish that more detailed information was available. Poenitz's results from Argonne on the $^{235}$U fission cross section in the keV energy range, for example, attracted a good deal of attention, for they have obvious practical implications and disagree with earlier measurements. The details of the measurements in the proceedings are rather sparse and preliminary in some respects so that a full consideration of their significance will have to await further developments. The review papers on standards, flux measurements, neutron yields, and related topics will be appreciated by evaluators for the assessments they contain of our current position in these areas.

Reactor designers, although a section of the triptych in the minds of the conference organizers, will have less frequent reference to the proceedings for they look primarily

to the data centers for information. Nevertheless, the proceedings will be of interest to those concerned about the general state of the foundations on which they are building.

In summary, these proceedings will be of general background interest to all those active in the measurement, intepretation, collation, and application of neutron data. Experimenters and evaluators will make reference to the details, especially in those areas that are changing rapidly.

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*Title* Principles of Particle Accelerators

*Authors* Enrico Persico, Ezio Ferrari, and Sergio E. Segre

*Publishers* W. A. Benjamin, Inc.

*Pages* x + 301

*Cost* $17.75

*Reviewer* Ernest D. Courant

This book presents the principles of design and operation of the various types of particle accelerators – electrostatic accelerators, linear accelerators, betatron, synchrotron, cyclotron, microtron, FFAG, and storage rings. The emphasis is on the properties of the particle orbits; in addition, there are brief discussions of the practical engineering problems involved in building the various devices.

The book is intended for readers with a rather modest level of mathematical sophistication – corresponding to the first two years of college. Accordingly, the use of Hamiltonian and Lagrangian methods in orbit analysis is avoided, and there are short summaries of relativistic dynamics, elements of matrix algebra, and waveguide theory.

Following a descriptive introductory chapter, there are chapters on electrostatic accelerators, dynamics of a particle in an electromagnetic field, the betatron, and the synchrotron. In these chapters these respective accelerators are described, and the equations and properties of betatron and phase oscillations are derived.

In keeping with the reader's assumed lack of mathematical background, these derivations are carried out without the use of Hamiltonian formalisms. But even so, the derivations of the equations of betatron and phase oscillations given here are unduly formalistic. The equations are derived here, not by directly considering the forces on a particle in electric field $E$ and magnetic field $B$, but rather by immediately introducing the vector potential, and then deriving relations concerning the canonical angular momentum. In addition the notation is confusing: the prime is used for partial differentiation with respect to $r$, while conventional notation is used for other partial derivatives; $P_r$, $P_\theta$, and $P_z$ are components of the kinetic momentum $P$, while $p$ (no subscript) is the canonical angular momentum. Thus we see equations such as

$$\dot{P}_\theta = q\left[-\frac{\partial A}{\partial t} - u_z\frac{\partial A}{\partial z} - u_r\left(A' + \frac{A}{r}\right)\right] - P_r\dot{\theta}$$

The result is that in following the derivations, the reader loses sight of the physical meanings of the various terms, without, on the other hand, being able to appreciate the simplicity and elegance of the Hamiltonian method (which is in fact, being used implicitly).

The next chapter introduces and uses the matrix formalism to treat betatron oscillations in alternating-gradient (and also weak-focusing racetrack and zero-gradient) synchrotrons. Then there is a chapter on the standard cyclotron, synchrocyclotron, and microtron, one on linear accelerators (a concise self-contained contribution by M. Puglisi), a final chapter on FFAG accelerators, separated orbit cyclotrons, and colliding beams, and an appendix on quadrupoles and beam transport.

Even though the book is primarily devoted to orbit theory, the theory is not carried very far beyond the derivations of the fundamental equations of motion and of AG orbit stability criteria. The concepts of emittance and admittance are not treated at all (except in connection with beam transport in the appendix); field errors, coupling, and resonances are only touched upon very briefly, as are space-charge and high-intensity phenomena. Furthermore, in many cases where a topic is mentioned but not treated in detail, no reference is given. For example, in Chap. 2 we find a formula for the equivalent index of refraction in an electrostatic lens, but no derivation, no reference, and no formula for the focal length.

The descriptive material includes discussions of ion sources, vacuum problems, magnets, and radiofrequency systems. But the section on ion sources omits all mention of the duoplasmatron, which has in the last few years become, by far, the most widely used type of source for proton accelerators.

The book was published in 1968, and the Preface is dated February 1968. But tables of parameters of accelerators are as of 1965; thus the Serpukhov and SLAC machines are listed as "under construction" and the 200 to 300 GeV machines now under way in the US and Europe are not mentioned at all.

To summarize: The descriptive material in the book is readable and informative, but there are significant omissions. The theory is unnecessarily formal without making use of advanced methods; it does not go very far beyond the most fundamental topics.

*Dr. Courant obtained his PhD from Rochester in 1943 and has specialized in orbit theory of particle accelerators for the past 20 years. He was one of the originators of the principle of alternating-gradient focusing. A member of the staff of Brookhaven National Laboratory since 1948, he has also been on the faculty of the State University of New York at Stony Brook since 1967.*

*Title* Reflections on Big Science

*Author* Alvin M. Weinberg

*Publisher* The MIT Press

*Pages* 182

*Price* $1.95

*Reviewer* Eugene P. Wigner

The writer of this book is the director of Oak Ridge National Laboratory and he remarks, in the Preface, that he had heard, from Dr. Piore, vice-president in charge of research of IBM, that "the first job of a laboratory director is to assure continuing and ample support for the institution he directs." It is probable that this duty is much on the mind of the writer; when one reads the book, it becomes equally evident that he considers it also his job to render his institution useful to the society which supports it and to the government which created it. This reviewer had read most of Dr. Weinberg's articles on which the various parts of this book are based, but his enchantment with the sincerity and thoughtfulness of the writer was renewed when reading the present *Reflections*. As laboratory director and frequent advisor of the government, Weinberg seems to have considered it to be one of his prime obligations to think and to understand the role of science in our society, both as a goal and as a means toward ends. This book is a compendium of his views, presented in a somewhat casual style but clearly—clearly not only as far as his conclusions but also, as far as his assumptions are concerned.

Producing the daily bread will require a steadily decreasing fraction of the effort of our society. As a result, we can hope to pursue higher aims to an increasing extent, and one of these higher aims—for most of us the aim which is closest to our heart—is the increase of the total knowledge and "understanding" of the physical world around us and of of a single scientist, or of a small group of scientists. He has a much more cautious attitude toward the support of "big science" which requires the organized effort of hundreds of scientists and expenditures in the range of hundreds of millions of dollars.

Weinberg claims quite generally that, although the quality of a scientific accomplishment can be judged competently only by the scientists working in the field of that accomplishment, the value of the endeavor must be judged from the outside. He introduces two criteria to base a valuation upon: the interaction of the endeavor with neighboring fields, and the general usefulness of the results for the other goals of society. He considers the funds spent on high energy physics, and the number of scientists engaged therein, to be excessive because this field has so far produced few results of great significance for *other parts of science*. He is happy to praise high-energy physics as "in a sense the most fascinating branch of physics." Nevertheless, he questions whether "the agony (of the late Dr. Oppenheimer and of his followers for the understanding of high energy phenomena) needs to be relieved as quickly as possible." He questions the magnitude of the effort going into space exploration with even greater decisiveness (p. 81).

Weinberg does not wish to apply his criteria of scientific worth to little science. He realizes that the criteria are not sharp and that they are relevant only if the effort demanded is of such magnitude that its wholehearted pursuit interferes with other goals of science and society. For this reason, he has no intention to interfere with the choice of the research subjects of the faculties of our colleges and universities. He does wish, though—and it is difficult to differ with him in this regard—that the members of these faculties take their teaching more seriously and that their attention be given, not only to those students whom they expect to be their future colleagues, but also to those who will enter neighboring or even more remote fields. It is difficult not to be reminded of the forces within us. There are many beautifully phrased passages in the book which extol this aim, even though the author admits, with characteristic objectivity, that "society does not *a priori* owe the scientist, even the good scientist, support any more than it owes support to the artist, or the writer, or to the musician" (p. 72). He is, nevertheless, wholeheartedly in favor of the support of "little science"—that is, scientific endeavor that does not require much more than the time and interest Einstein's praise of the more pedestrian functions of the scientist which make it unnecessary for him to "lay a golden egg every day."

The preceding discussion of Weinberg's book perhaps overemphasizes one subject with which the book deals: the relation between little and big science, and the role and support of the latter. This subject is probably the one to which the author devoted most thought and attention; it is far from the only subject illuminated in the book. It contains important observations also on the preservation of scientific information, its communication, the role of the national laboratories, the role of pure science in these laboratories, the future prominence of biology, and many others. This reviewer is convinced that the reader will find in *Reflections on Big Science* stimulating ideas on all these subjects.

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