

established researchers. Overall, it is an interesting and important book on a topic central to nuclear and hadronic physics.

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Beam-Wave Interaction in Periodic and Quasi-Periodic Structures

Levi Schächter

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Today's accelerator physicist or engineer needs a kit packed with a variety of intellectual tools to successfully ply the craft. Certainly among the most important of these tools is a more-than-superficial understanding of the interaction of charged particles with the electromagnetic fields in or near metallic and dielectric structures. This knowledge is fundamental in designing the high-power radio-frequency sources needed to drive storage ring cavities and linac structures and in understanding the dynamics of particle acceleration in these cavities and structures.

Beam-Wave Interaction in Periodic and Quasi-Periodic Structures by Levi Schächter is directed primarily toward providing the conceptual and mathematical tools needed for research in the first of these areas, namely high-power microwave source design. Although a variety of rf devices are treated at varying levels of detail, the emphasis is on high-voltage, high-power traveling-wave amplifiers and oscillators, where relativistic effects are important. (All the expressions in the book explicitly take relativity into account.) The author has selected a limited number of devices for detailed treatment so as to have, in the author's words, "a coherent and thorough presentation of the beam-wave interaction in a few modern devices with most, if not all, the mathematical details associated with the models which explain their operation."

Not surprisingly given the title, the core of the book deals with the beam-wave interaction in periodic and quasi-periodic structures. The stage is set by a useful chapter on wave propagation in closed periodic structures (for example, a disk-loaded waveguide) and on the surface of open structures (such as a corrugated rod). Two examples of quasiperiodic structures are treated: a finite length of axially symmetric periodic structure with input and output radial waveguides and a set of coupled

pillbox cavities (not necessarily identical) terminating in an output radial waveguide. Such structures, driven by a density-modulated beam, also serve as output structures for the current generation of high-power (50 to 75 MW) X-band klystrons designed to drive a linear collider.

Almost all of the structures treated are axially symmetric; in addition a strong, longitudinal magnetic field is assumed, so that the particle motion is confined to the longitudinal dimension. With these simplifying assumptions, the author is able to develop analytic expressions for the beam-wave dynamics in the linear regime, where beam density variations are small. In the nonlinear regime needed to describe a source operating at high output efficiency, the author changes to an approach in which the beam is modeled by tracking the energy and position of a collection of macroparticles. The next step (which the author does not take) would be to introduce a self-consistent two-dimensional macroparticle simulation in which transverse particle motion with realistic focusing fields is allowed. This is the way that high-power, high-efficiency microwave power sources are actually modeled. Unfortunately, work on a 2D generalization was completed only after publication of the book.

The book also contains a useful introductory chapter on elementary electromagnetic phenomena and sections on classical dynamics and relativity. These sections are slanted toward the specific material covered later in the book. A chapter on free-electron lasers follows the core material on the beam-wave interaction. This is a logical extension since, as the author points out, there is a "full equivalence between a free-electron laser and a traveling-wave amplifier."

A final comment on content: The first and the last chapters in the book bear little relation to the core content. The first chapter, which presents a brief overview of microwave power sources, is in fact too brief to be of much use to the intended reader (an advanced graduate student or someone beginning research in the design of high power microwave sources). The same can be said for a concluding chapter covering linear accelerator concepts and advanced accelerator concepts, such as wakefield accelerations. In both chapters, brevity leads in places to confusion; an example is the treatment of beam loading in a linac structure.

Although it does not interfere with the technical content, irritating evidence of editorial carelessness (missing articles, improper punctuation) appears at least once per page. Following

a current trend in technical book publication, the author was asked to supply a complete electronic file of the manuscript in final form. Apparently the budget for producing highly technical books—books that are directed toward a limited market—is so tight that it doesn't allow for any professional editorial support from the publisher. Authors whose first language is not English can suffer in particular.

Despite these minor faults, I can recommend this book to the advanced student who wants an authoritative, in-depth treatment of the material described by the title. The excellent chapter on free-electron lasers is a bonus.

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Supersymmetry in Disorder and Chaos

Konstantin Efetov

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The quantum statistical properties of systems that are random, or disordered, have been the subject of considerable attention in areas of physics ranging from nuclear to condensed matter. The recent recognition that phenomena associated with mechanisms of quantum coherence in disordered conductors are manifest in quantum chaotic structures has renewed interest in this area. Among the different approaches that have been applied to the study of coherence phenomena, perhaps the most successful has been a field-theoretic approach, which has come to be known in the literature as the "supersymmetry method." The main aim of Konstantin Efetov's *Supersymmetry in Disorder and Chaos* is to provide a substantial introduction to this general technique in the arena of mesoscopic quantum physics.

Indeed, given the importance that this method has assumed in recent years, a reference text on the subject seems long overdue. Moreover, as the principal architect of the supersymmetry method, the author seems uniquely qualified to write on the subject. However, although the text provides a sound introduction to the general method, it perhaps fails to convey fully the depth and significance of this area of research as well as the breadth of potential applications in more general areas of physics.

The nonlinear σ -model of spectral statistics has assumed a central role in the theory of disordered conductors