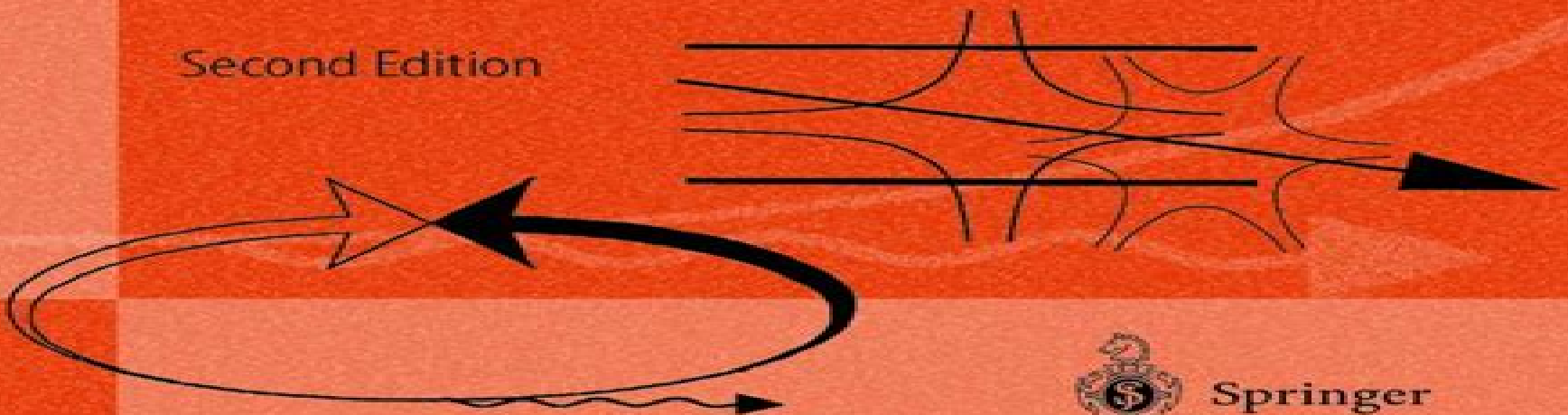


H. Wiedemann

# Particle Accelerator Physics I

Basic Principles  
and Linear Beam Dynamics

Second Edition



Springer

# Particle Accelerator Physics Basic Principles And Linear Beam Dynamics

**Helmut Wiedemann**



## **Particle Accelerator Physics Basic Principles And Linear Beam Dynamics:**

**Particle Accelerator Physics** Helmut Wiedemann, 2003 This two volume book serves as a thorough introduction to the field of high energy particle accelerator physics and beam dynamics Volume 1 provides a general understanding of the field and a firm basis for the study of the more elaborate topic mainly nonlinear and higher order beam dynamics which is the subject of Volume 2

*Particle Accelerator Physics I* Helmut Wiedemann, 1999-03-12 In this second edition of Particle Accelerator Physics Vol 1 is mainly a reprint of the first edition without significant changes in content The bibliography has been updated to include more recent progress in the field of particle accelerators With the help of many observant readers a number of misprints and errors could be eliminated The author would like to express his sincere appreciation to all those who have pointed out such shortcomings and wel comes such information and any other relevant information in the future The author would also like to express his special thanks to the editor Dr Helmut Lotsch and his staff for editorial as well as technical advice and support which contributed greatly to the broad acceptance of this text and made a second edition of both volumes necessary Palo Alto California Helmut Wiedemann November 1998 VII Preface to the First Edition The purpose of this textbook is to provide a comprehensive introduction into the physics of particle accelerators and particle beam dynamics Parti cle accelerators have become important research tools in high energy physics as well as sources of incoherent and coherent radiation from the far infra red to hard x rays for basic and applied research During years of teaching accelerator physics it became clear that the single most annoying obstacle to get introduced into the field is the absence of a suitable textbook

**Particle Accelerator Physics** Helmut Wiedemann, 2013-11-11 Particle Accelerator Physics is designed to serve as an introduction to the field of high energy particle accelerator physics and particle beam dynamics It covers the dynamics of relativistic particle beams basics of particle guidance and focusing lattice design characteristics of beam transport systems and circular accelerators Particle beam optics is treated in the linear approximation including sextupoles to correct for chromatic aberrations Perturbations to linear beam dynamics are analyzed in detail and correction measures are discussed Basic lattice design features and building blocks leading to the design of more complicated beam transport systems and circular accelerators are studied Characteristics of synchrotron radiation and quantum effects due to the statistical emission of photons on particle trajectories are derived and applied to determine particle beam parameters The discussions specifically concentrate on relativistic particle beams and the physics of beam optics in beam transport systems and circular accelerators such as synchrotrons and storage rings This book is aimed at students and scientists who are interested in an introduction to particle beam optics and accelerator physics It provides a general understanding of particle beam physics and forms a broad basis for further more detailed studies of nonlinear beam dynamics and associated accelerator physics problems to be discussed in a subsequent volume

*Particle Accelerator Physics II* Helmut Wiedemann, 2012-12-06 This text is a continuation of the first volume of Particle Accelerator Physics on Basic Principles and

Linear Beam Dynamics While the first volume was written as an introductory overview into beam dynamics it does not include more detailed discussion of nonlinear and higher order beam dynamics or the full theory of synchrotron radiation from relativistic electron beams Both issues are however of fundamental importance for the design of modern particle accelerators In this volume beam dynamics is formulated within the realm of Hamiltonian dynamics leading to the description of multiparticle beam dynamics with the Vlasov equation and including statistical processes with the Fokker-Planck equation Higher order perturbations and aberrations are discussed in detail including Hamiltonian resonance theory and higher order beam dynamics The discussion of linear beam dynamics in Vol I is completed here with the derivation of the general equation of motion including kinematic terms and coupled motion To build on the theory of longitudinal motion in Vol I the interaction of a particle beam with the rf system including beam loading higher order phase focusing and the combination of acceleration and transverse focusing is discussed The emission of synchrotron radiation greatly affects the beam quality of electron or positron beams and we therefore derive the detailed theory of synchrotron radiation including spatial and spectral distribution as well as properties of polarization *Particle Accelerator Physics II* H.

Wiedemann, 2012-12-06 *Particle Accelerator Physics II* continues the discussion of particle accelerator physics beyond the introductory *Particle Accelerator Physics I* Aimed at students and scientists who plan to work or are working in the field of accelerator physics Basic principles of beam dynamics already discussed in Vol I are expanded into the nonlinear regime in order to tackle fundamental problems encountered in present day accelerator design and development Nonlinear dynamics is discussed both for the transverse phase space to determine chromatic and geometric aberrations which limit the dynamic aperture as well as for the longitudinal phase space in connection with phase focusing at very small values of the momentum compaction Effects derived theoretically are compared with observations made at existing accelerators **Particle**

**Accelerator Physics** Helmut Wiedemann, 2015-07-24 This book by Helmut Wiedemann is a well established classic text providing an in depth and comprehensive introduction to the field of high energy particle acceleration and beam dynamics The present 4th edition has been significantly revised updated and expanded The newly conceived Part I is an elementary introduction to the subject matter for undergraduate students Part II gathers the basic tools in preparation of a more advanced treatment summarizing the essentials of electrostatics and electrodynamics as well as of particle dynamics in electromagnetic fields Part III is an extensive primer in beam dynamics followed in Part IV by an introduction and description of the main beam parameters and including a new chapter on beam emittance and lattice design Part V is devoted to the treatment of perturbations in beam dynamics Part VI then discusses the details of charged particle acceleration Parts VII and VIII introduce the more advanced topics of coupled beam dynamics and describe very intense beams a number of additional beam instabilities are introduced and reviewed in this new edition Part IX is an exhaustive treatment of radiation from accelerated charges and introduces important sources of coherent radiation such as synchrotrons and free electron lasers

The appendices at the end of the book gather useful mathematical and physical formulae parameters and units Solutions to many end of chapter problems are given This textbook is suitable for an intensive two semester course starting at the senior undergraduate level

**Particle Accelerator Physics** Helmut Wiedemann,2013-11-27 This two volume book serves as a thorough introduction to the field of high energy particle accelerator physics and beam dynamics Volume 1 provides a general understanding of the field and a firm basis for the study of the more elaborate topic mainly nonlinear and higher order beam dynamics which is the subject of Volume 2 *Particle Accelerator Physics I* Helmut Wiedemann,

**Beam-Wave Interaction in Periodic and Quasi-Periodic Structures** Levi Schächter,2013-03-09 During the past seven years I have been involved in the investigation of high power microwave sources for accelerator and radar applications As for many others before me the starting point of this book was a collection of notes on theoretical topics out of the material I had been working on The notes were the core of a course for graduate students at Cornell University When I started to prepare these notes it seemed a fairly straight forward and not very time consuming task since I had most of the material well organized Today three years after the preparation of the first notes I can only wonder how naive this thought was Most of my work was oriented towards analytic and quasi analytic techniques for the investigation of the interaction of an electron beam with electromagnetic waves These topics are presented in Chaps 4 and 6 However for a systematic elaboration of these topics it was necessary to provide some general background therefore parts of what are today Chaps 2 3 and 5 were prepared Related topics of acceleration concepts were also prepared to some extent but I ran out of time and the material Chap 8 was not delivered In the meantime various sections of this book were taught at the Technion Israel Institute of Technology and Ben Gurion University In the last version I included a discussion on free electron lasers Chap 7 **Beam**

**Dynamics In High Energy Particle Accelerators** Andrzej Wolski,2014-01-21 Particle accelerators are essential tools for scientific research in fields as diverse as high energy physics materials science and structural biology They are also widely used in industry and medicine Producing the optimum design and achieving the best performance for an accelerator depends on a detailed understanding of many often complex and sometimes subtle effects that determine the properties and behavior of the particle beam **Beam Dynamics in High Energy Particle Accelerators** provides an introduction to the concepts underlying accelerator beam line design and analysis taking an approach that emphasizes the elegance of the subject and leads into the development of a range of powerful techniques for understanding and modeling charged particle beams

**Particle Accelerator Physics II** H. Wiedemann,1999 Particle Accelerator Physics II continues the discussion of particle accelerator physics beyond the introductory Particle Accelerator Physics I Aimed at students and scientists who plan to work or are working in the field of accelerator physics Basic principles of beam dynamics already discussed in Vol I are expanded into the nonlinear regime in order to tackle fundamental problems encountered in present day accelerator design and development Nonlinear dynamics is discussed both for the transverse phase space to determine chromatic and geometric

aberrations which limit the dynamic aperture as well as for the longitudinal phase space in connection with phase focusing at very small values of the momentum compaction Effects derived theoretically are compared with observations made at existing accelerators

**Physics of Particle Accelerators** Melvin Month, Margaret Dienes, 1989 Particle accelerator physicists nuclear and particle physicists [CERN Courier](#) ,2011 *Proceedings of the 1999 Particle Accelerator Conference* ,1999

**CAS, CERN Accelerator School** Stuart Turner, 1998 *EPAC96, Fifth European Particle Accelerator Conference* S. Myers, 1996 Discusses various invited papers including accelerators and storage rings beam dynamics and electro magnetic fields and subsystems technology and components This volume also includes poster presentations of high energy hadron accelerators and colliders *Saw-tooth Instability Studies at the Stanford Linear Collider Dampening Rings* Boris V. Podobedov, 1999

**Il Nuovo cimento della Società italiana di fisica** ,1997 [CERN.](#) ,2009 **Nuovo Cimento** ,1997

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