3 Bunch Compression And Longitudinal Beam Dynamics 3 1

EPAC 90
A Fast Longitudinal Phase Space Tracking Code with Graphical User Interface
Advances of Accelerator Physics and Technologies
Introduction to Physical Principles, Experimental Results, Technological Challenges
Microbunching Instability Due to Bunch Compression
Electron-Photon Interaction in Dense Media
Proceedings of the Workshop on Applications of High Intensity Proton Accelerators
Handbook Of Accelerator Physics And Engineering (3rd Printing)
RF Superconductivity
Proceedings of the 25th International Free Electron Laser Conference and the 10th FEL Users Workshop, Tsukuba, Ibaraki, Japan, 8-12 September 2003
Proceedings of the 1981 Linear Accelerator Conference Held at Bishop's Lodge, Santa Fe, New Mexico, October 19-23, 1981
Accelerator Physics (Fourth Edition)
Coherent and Collective Interactions of Particles and Radiation Beams
Reviews Of Accelerator Science And Technology - Volume 9: Technology And Applications Of Advanced Accelerator Concepts
Fusion Energy Update
Fermilab, Chicago, 19-21 October 2009
Measurement and Control of Charged Particle Beams
Accelerator Physics
Geneva, Switzerland, July 7–11, 1980
Accelerator Physics
X-Ray Lasers 1996
11th International Conference on High-Energy Accelerators
Energy Research Abstracts
Self Focusing of Relativistic Electron Bunches in Plasma
Free Electron Lasers 2000
Nonlinear Dynamics And Collective Effects In Particle Beam Physics - Proceedings Of The International Committee On Future Accelerators Arcidosso Italy 2017
Proceedings
Studies of Proton Driven Plasma Wakefield Acceleration
Parameter Selection and Longitudinal Phase Space Simulation for a Single Stage X-Band FEL Driver at 250 MeV
Preliminary Study on Two Possible Bunch Compression Schemes at NLCTA.
Free Electron Lasers 2002
Peak Current Optimization for LCLS Bunch Compressor 2
LiTrack
Longitudinal Diagnostics for Short Electron Beam Bunches
Handbook of Accelerator Physics and Engineering
The Extraction of Transverse Beam Position from Beam-Excited Higher Order Modes
A Bunch Compression Method for Free Electron Lasers that Avoids Parasitic Compressions
Proceedings of the Tenth International Symposium on Applied Electromagnetic and Mechanics
2nd European Particle Accelerator Conference : Nice, June 12-16, 1990

SCHMIDT TYLER

EPAC 90 Springer Nature
A comprehensive survey of recent theoretical and experimental progress in the area of electron-photon interaction and dense media. A state-of-the-art discussion of radiation production, with descriptions of new ideas and technologies that enhance the production of X-rays in the form of channelling, transition and parametric X-ray production. Progress in electron beam physics to produce sub-picosecond electron bunches from low-energy linear accelerators make it possible to produce coherent, high brightness, submillimeter radiation and sub-picosecond X-ray pulses. Micro-undulators in the form of bent crystalline structures hold great promise as future X-ray sources.
A Fast Longitudinal Phase Space Tracking Code with Graphical User Interface World Scientific
Linac-based light sources and linear colliders typically apply longitudinal phase space manipulations in their design, including electron bunch compression and wakefield-induced energy spread control. Several computer codes handle such issues, but most also require detailed information on the transverse focusing lattice. In fact, in most linear accelerators, the transverse distributions do not significantly affect the longitudinal, and can be ignored initially. This allows the use of a fast 2D code to study longitudinal aspects without time-consuming considerations of the transverse focusing. LiTrack is based on a 15-year old code (same name) originally written by one of us (KB), which is now a Matlab [1] code with additional features, such as graphical user interface, prompt output plotting, and functional call within a script. This single-bunch tracking code includes RF acceleration, bunch compression to 3rd order, geometric and resistive short-range wakefields, aperture limits, synchrotron radiation, and flexible output plotting. The code was used to design both the

LCLS [2] and the SPPS [3] projects at SLAC and typically runs 105 particles in

Advances of Accelerator Physics and Technologies Springer Science & Business Media

An energetic charged particle beam introduced to an rf cavity excites a wakefield therein. This wakefield can be decomposed into a series of higher order modes and multipoles, which for sufficiently small beam offsets are dominated by the dipole component. This work focuses on using these dipole modes to detect the beam position in third harmonic superconducting S-band cavities for light source applications. A rigorous examination of several means of analysing the beam position based on signals radiated to higher order modes ports is presented. Experimental results indicate a position resolution, based on this technique, of 20 microns over a complete module of 4 cavities. Methods are also indicated for improving the resolution and for applying this method to other cavity configurations. This work is distinguished by its clarity and potential for application to several other international facilities. The material is presented in a didactic style and is recommended both for students new to the field, and for scientists well-versed in the field of rf diagnostics.

Introduction to Physical Principles, Experimental Results, Technological Challenges Gulf Professional Publishing

This book contains the Proceedings of the 24th International Free Electron Laser Conference and the 9th Free Electron Laser Users Workshop, which were held on September 9-13, 2002 at Argonne National Laboratory. Part I has been reprinted from Nucl. Instr. and Meth. A 507 (2003), Nos. 1-2.

Microbunching Instability Due to Bunch Compression John Wiley & Sons

This volume presents the non-linear theory of electrostatic focusing of an electron beam split into bunches under conditions when the plasma permittivity at the modulation frequency is negative and the effective Coulomb force acting on the electron bunches is reversed. Conditions for the spatial equilibrium between the bunch and plasma emission, as well as the dynamics of the formation of focussed bunches, are confirmed by solving (both analytically and numerically) the self-consistent set of equations.

Electron-Photon Interaction in Dense Media Microbunching Instability Due to Bunch CompressionMagnetic bunch compressors are designed to increase the peak current while maintaining the transverse and longitudinal emittances in order to drive a short-wavelength free electron laser (FEL). Recently, several linac-based FEL experiments observe self-developing micro-structures in the longitudinal phase space of electron bunches undergoing strong compression [1-3]. In the mean time, computer simulations of coherent synchrotron radiation (CSR) effects in bunch compressors illustrate that a CSR-driven microbunching instability may significantly amplify small longitudinal density and energy modulations and hence degrade the beam quality [4]. Various theoretical models have since been developed to describe this instability [5-8]. It is also pointed out that the microbunching instability may be driven strongly by the longitudinal space charge (LSC) field [9,10] and by the linac wakefield [11] in the accelerator, leading to a very large overall gain of a two-stage compression system such as found in the Linac Coherent Light Source (LCLS) [12]. This paper reviews theory and simulations of microbunching instability due to bunch compression, the proposed method to suppress its effects for short-wavelength FELs, and experimental characterizations of beam modulations in linear accelerators. A related topic of interests is microbunching instability in storage rings, which has been reported in the previous ICFA beam dynamics newsletter No. 35 (http://wwwbd. fnal.gov/icfabd/Newsletter35.pdf).Coherent and Collective Interactions of Particles and Radiation Beams

The main goal of the book is to provide a systematic and didactic approach to the physics and technology of free-electron lasers. Numerous figures are used for illustrating the underlying ideas and concepts and links to other fields of physics are provided. After an introduction to undulator radiation and the low-gain FEL, the one-dimensional theory of the high-gain FEL is developed in a systematic way. Particular emphasis is put on explaining and justifying the various assumptions and approximations that are needed to obtain the differential and integral equations governing the FEL dynamics. Analytical and numerical solutions are presented and important FEL parameters are defined, such as gain length, FEL bandwidth and saturation power. One of the most important features of a high-gain FEL, the formation of microbunches, is studied at length. The increase of gain length due to beam energy spread, space charge forces, and three-dimensional effects such as betatron oscillations and optical diffraction is analyzed. The mechanism of Self-Amplified Spontaneous Emission is described theoretically and illustrated with numerous experimental results. Various methods of FEL seeding by coherent external radiation are introduced, together with experimental results. The world’s first soft X-ray FEL, the user facility FLASH at DESY, is described in some detail to give an impression of the complexity of such an accelerator-based light source. The last chapter is devoted to the new hard X-ray FELs which generate extremely intense radiation in the Angstrøm regime. The appendices contain supplementary material and more involved calculations.

Proceedings of the Workshop on Applications of High Intensity Proton Accelerators IOS Press

This publication covers topics in the area of applied electromagnetics and mechanics. Since starting in Japan in 1988, the ISEM has become a well-known international forum on applied electromagnetics.

Handbook Of Accelerator Physics And Engineering (3rd Printing) World Scientific

This volume, consisting of articles written by experts with international repute and long experience, reviews the state of the art of accelerator physics and technologies and the use of accelerators in research, industry and medicine. It covers a wide range of topics, from basic problems concerning the performance of circular and linear accelerators to technical issues and related fields. Also discussed are recent achievements that are of particular interest (such as RF quadrupole acceleration, ion sources and storage rings) and new technologies (such as superconductivity for magnets and RF cavities). The book will interest not only researchers and engineers in the field of accelerator development but also users of accelerators in research and industry. Moreover, teachers giving courses on accelerators and their applications will profit by learning about the most recent achievements and future possibilities. Contents:Introduction:What Can We Learn from Experiments with Accelerators and Storage Rings (C Jarlskog)Circular Accelerators and Storage Rings:Beam Optics and Lattice Design (P J Bryant)Collective Phenomena and Instabilities (J Gareyte)The Relativistic Heavy Ion Collider, RHIC (H Foelsche et al.)Beauty- and Tau-Charm Factories (Y Baconnier)Linear Accelerators:General Aspects of Linear Accelerators (P Lapostolle)RF Quadrupoles as Accelerators (A Schempp)Accelerator Physics of the Stanford Linear Collider and SLC Accelerator Experiments Towards the Next Linear Collider (J T Seeman)The Road to TeV Electron-Positron Colliders (Y Kimura)New Methods and Technologies:Superconducting Magnets for Accelerators (G Brianti & T Tortschanoff)Superconducting Cavities for High Energy

Accelerators and Storage Rings (H Lengeler)Cooling of Particle Beams (D Möhl)Acceleration of Polarized Particles (J Buon)Ion Sources (H Haseroth & H Hora)A Good Idea at the Time (B W Montague)Geodesy for Particle Acceleratos (J Gervais & M Mayoud)Applications:Synchrotron Radiation Sources (S Tazzari)The Impact of Pulsed Spallation Neutron Sources on Condensed Matter Research (J L Finney)Inertial Fusion with Heavy Ions (I Hofmann)High Energy Accelerators in Medicine (P Mandrillon)Industrial Applications of Accelerators (K H W Bethge) Readership: High energy physicists, nuclear physicists and engineers. Reviews: "... essential reading for the accelerator specialist ... Bravo to the editor, Herwig Schopper, for making a success out of a timely compilation." CERN Courier

RF Superconductivity World Scientific

Edited by internationally recognized authorities in the field, this expanded edition of the bestselling Handbook first published in 1999 is aimed at the design and operation of modern accelerators including Linacs, Synchrotrons and Storage Rings. It is intended as a vade mecum for professional engineers and physicists engaged in these subjects. With a collection of 2200 equations, 345 illustrations and 185 tables, here one will find, in addition to the common formulae of previous compilations, hard to find, specialized formulae, recipes and material data pooled from the lifetime experience of many of the world's most able practitioners of the art and science of accelerators.The eight chapters include both theoretical and practical matters as well as an extensive glossary of accelerator types. Chapters on beam dynamics and electromagnetic and nuclear interactions deals with linear and nonlinear single particle and collective effects including spin motion, beam-environment, beam-beam and intrabeam interactions. The impedance concept and calculations are dealt with at length as are the instabilities associated with the various interactions mentioned. A chapter on operational considerations deals with orbit error assessment and correction. Chapters on mechanical and electrical considerations present material data and important aspects of component design including heat transfer and refrigeration. Hardware systems for particle sources, feedback systems, confinement and acceleration (both normal conducting and superconducting) receive detailed treatment in a subsystems chapter, beam measurement techniques and apparatus being treated therein as well. The closing chapter gives data and methods for radiation protection computations as well as much data on radiation damage to various materials and devices.A detailed index is provided together with reliable references to the literature where the most detailed information available on all subjects treated can be found.

Proceedings of the 25th International Free Electron Laser Conference and the 10th FEL Users Workshop, Tsukuba, Ibaraki, Japan, 8-12 September 2003 Springer Science & Business Media

The development of high energy accelerators began in 1911, when Rutherford discovered the atomic nuclei inside the atom. Since then, progress has been made in the following: (1) development of high voltage dc and rf accelerators, (2) achievement of high field magnets with excellent field quality, (3) discovery of transverse and longitudinal beam focusing principles, (4) invention of high power rf sources, (5) improvement of high vacuum technology, (6) attainment of high brightness (polarized/unpolarized) electron/ion sources, (7) advancement of beam dynamics and beam manipulation schemes, such as beam injection, accumulation, slow and fast extraction, beam damping and beam cooling, instability feedback, etc.The impacts of the accelerator development are evidenced by the many ground-breaking discoveries in particle and nuclear physics, atomic and molecular physics, condensed matter physics, biomedical physics, medicine, biology, and industrial processing.This book is intended to be used as a graduate or senior undergraduate textbook in accelerator physics and science. It can be used as preparatory course material for graduate accelerator physics students doing thesis research. The text covers historical accelerator development, transverse betatron motion, synchrotron motion, an introduction to linear accelerators, and synchrotron radiation phenomena in low emittance electron storage rings, introduction to special topics such as the free electron laser and the beam-beam interaction. Attention is paid to derivation of the action-angle variables of the phase space, because the transformation is important for understanding advanced topics such as the collective instability and nonlinear beam dynamics. Each section is followed by exercises, which are designed to reinforce the concept discussed and to solve a realistic accelerator design problem.

World Scientific

Hard x-ray Free electron lasers (FEL) are being built or proposed at many accelerator laboratories as it supports wide range of applications in many aspects. Most of the hard x-ray FEL design is similar with the SLAC Linac Coherent Light Source (LCLS), which features a two (or multiple) stage bunch compression. For the first stage of the bunch compression, usually the beam is accelerated in a lower-frequency RF section (such as S-band for LCLS), and then the longitudinal phase space is linearized by a higher-frequency RF section (harmonic RF, such as X-band for LCLS). In this paper, a compact hard x-ray FEL design is proposed, which is based on X-band RF acceleration and eliminating the need of a harmonic RF. The parameter selection and relation is discussed, and the longitudinal phase space simulation is presented. The FEL coherence condition of the electron beam in the undulators requires a large charge density, a small emittance and small energy spread. The RMS electron bunch length from the injector is in the ps scale, with a bunch charge in the range of hundreds pC to several nC, which means that the current is roughly 0.1 kA. According to the requirement from soft x-ray lasing and hard x-ray lasing, a peak current of 1 kA and 3 kA is needed respectively. Thus the bunch has to be compressed. Usually a two stage bunch compression or multipole stage bunch compression is adopted. The z-correlated energy chirp is normally established by letting the beam pass through a section of RF cavities, with a RF phase off crest. As stated above, S-band RF (3 GHz) acceleration could be applied in this section. Due to the nature of RF acceleration wave, the chirp on the bunch is not linear, but has the RF curvature on it. In order to linearize the energy chirp, a harmonic RF section with higher frequency is needed. For LCLS a short X-band RF section (12 GHz) is used which is a fourth order harmonic. The linearized bunch is then passing by a dispersive region, in which the particles with different energy have different path length. A four dipole chicane is the natural choice for the dispersive region. As the example illustrated in Figure 1, the head of the bunch has smaller energy, and gets a stronger bending kick from the dipole magnet, then has a longer path length in the dispersive region. Similarly, the tail of the bunch has larger energy and shorter path length in the dispersive region. At the exit of the dispersive region, the relative longitudinal position of the head and tail of the bunch both move to the center of the bunch, so the bunch length will be shorter.

Proceedings of the 1981 Linear Accelerator Conference Held at Bishop's Lodge, Santa Fe, New Mexico, October 19-23, 1981 Springer

This volume captures the contents of the talks given at the Workshop on Applications of High Intensity Proton Accelerators held at Fermilab Oct 19ndash;21, 2009. This workshop brought together experts from a variety of disciplines to explore new and

profound ways proton accelerators can be used in the future. The workshop explored uses of such a proton source for producing intense muon, kaon and neutrino beams as well as using the intense protons for new forms of nuclear reactors that go by the name Accelerator Driven Sub-critical systems that promise to increase our available nuclear fuel supply by orders of magnitude while at the same time solving the nuclear waste problem. Intense proton beams can also be used to produce short-lived nuclear isotopes that are important in the medical industry.
Accelerator Physics (Fourth Edition) Springer
Microbunching Instability Due to Bunch Compression
Coherent and Collective Interactions of Particles and Radiation Beams Atlantica Séguier Frontières
The Conference timetable had to be so arranged as to spread the main topics over several separate sessions. It was therefore decided to publish the material in these Proceedings under nine subject headings, irrespective of session. Within each chapter, which is preceded by a list of the sessions featuring the subject, all papers, invited and contributed, whether presented at the Conference or accepted for publication only, have been arranged in some lo gical order. The reports of the four Panel Discussions were edited or summarized by the respective Moderator in consultation with Panel Members. In one instance, shortened versions of the Introductory Papers precede the discussion. Where possible, verbatim accounts of the often lively exchanges have been retained. The customary catalogue of high-energy acceler ators has been published separately. The continuing world-wide activities in accelerator research, witl1 its ever larger pro jects, are reflected by the numerous contributions accepted for inclusion in these Proceedings, which have reached the limit of what a single volume can manageably contain, while making rapid publication even harder to achieve. All the more reason to extend the gratitude of all con cerned to those involved in the chain of production: - To the authors, for their prompt handing-in or timely posting of their papers. Thanks also to their secretaries who followed the guidelines for the presentation of camera-ready copy.
Reviews Of Accelerator Science And Technology - Volume 9: Technology And Applications Of Advanced Accelerator Concepts World Scientific
In this paper, two possible bunch compression configurations are proposed and evaluated by numerical simulation in the Next Linear Collider Test Accelerator (NLCTA) at SLAC. A bunch compression ratio up to 20 could be achieved under a perfect condition, without consideration for the timing jitter and other error sources. The NLCTA is a test accelerator built at SLAC, which is approximately 42 meters long and composed of X-band acceleration structures. The main aim of building NLCTA is to develop and demonstrate the X-band rf acceleration technologies for the next generation linear collider, with a relatively high acceleration gradient between 50 MV/m and 100 MV/m. The current operation configuration of NLCTA features a thermionic-cathode electron gun at its starting point which generates an electron beam with an energy of 5 MeV. This is followed by a roughly 1.5 meter long X-band acceleration structure which boosts the electron beam energy to 60 MeV. Then there is a four-dipole magnetic chicane which is 6 meters long and provides a first order longitudinal dispersion of R56 = -73mm. Next the electron beam passes by several matching quadrupoles and can be accelerated further to 120 MeV through another one-meter-long X-band acceleration structure. After that, there are three small chicanes downstream, with a total first order longitudinal dispersion of R56 = -10mm. A sketch of the main components of NLCTA is shown in Figure 1, where the total length of this accelerator is 45 meters. Free Electron Lasers (FELs), proposed by J. Madey and demonstrated for the first time at Stanford University in 1970s [2] [3], use the lasing of relativistic electron beam traveling through a magnetic undulator, which can reach high power and can be widely tunable in wavelength. Linac based FEL source can provide sufficient brightness, and a short X-ray wavelength down to angstrom scale, which promises in supporting wide range of research experiments. In order to have an electron beam lasing coherently in an undulator, one needs a very bright beam in all three dimensions. In other words, one needs an electron beam with very short bunch length (high intensity), very small transverse emittance and very small energy spread. Most FELs currently being operated, commissioned, constructed or proposed are based on RF acceleration in a frequency range from L-band (1 GHz) to C-band (6 GHz). As RF frequency goes higher, wake fields effects tend to be much stronger and jitter tolerances are tighter. To demonstrate that X-band acceleration structures can be applied in constructing an FEL, one could perform bunch compression experiments at NLCTA as a first step, and investigate tolerances on timing jitter, misalignments etc. Another important point is to evaluate the transverse emittance growth in this bunch compression process. In the following sections, two possible bunch compression schemes are proposed to be tested at NLCTA. Elegant [4] 3-D simulation is performed to evaluate these two schemes, with wake fields, space charge and coherent synchrotron radiation (CSR) effects included. One million macro particles are adopted in the numerical simulations. The simulation starts with an electron beam of 20 pC at a beam energy of 5 MeV. The initial RMS bunch length is taken as 0.5 ps at such a low bunch charge, and the RMS energy spread is 5 x 10−3. The normalized transverse emittance is 1 mm.mrad.
Fusion Energy Update IOS Press
This is the second book to RF Superconducting, written by one of the leading experts. The book provides fast and up-to-date access to the latest advances in the key technology for future accelerators. Experts as well as newcomers to the field will benefit from the discussion of progress in the basic science, technology as well as recent and forthcoming applications. Researchers in accelerator physics will also find much that is relevant to their discipline.
Fermilab, Chicago, 19-21 October 2009 World Scientific
This book contains the Proceedings of the 25th International Free Electron Laser Conference and the 10th Free Electron Laser Users Workshop, which were held on September 8-12, 2003 in Tsukuba, Ibaraki in Japan.
Measurement and Control of Charged Particle Beams CRC Press
Edited by internationally recognized authorities in the field, this handbook focuses on Linacs, Synchrotrons and Storage Rings and is intended as a vade mecum for professional engineers and physicists engaged in these subjects. Here one will find, in addition to the common formulae of previous compilations, hard to find specialized formulae, recipes and material data pooled from the lifetime experiences of many of the world's most able practitioners of the art and science of accelerator building and operation.
Accelerator Physics Nova Publishers
The high scienti?c interest in coherent X-ray light sources has stimulated world-wide e?orts in developing X-ray lasers. In this book a particularly promising approach is described, the free-electron laser (FEL), which is p- sued worldwide and holds the promise to deliver ultra-bright X-ray pulses of femtosecond duration. Other types of X-ray lasers are not discussed nor do we try a comparison of the relative virtues and drawbacks of di?erent concepts. The book has an introductory character and is written

in the style of a universitytextbookforthemanynewcomerstothe?eldoffree-electronlasers, graduate students as well as accelerator physicists, engineers and technicians; it is not intended to be a scienti?c monograph for the experts in the ?eld. Building on lectures by one of us (J. R.) at the CERN Accelerator School, and motivated by the positive response to a series of seminars on “FEL t- ory for pedestrians”, given by P. S. within the framework of the Academic Training Program at DESY, we have aimed at presenting the theory of the low-gainandthehigh-gainFELinaclearandconcisemathematicallanguage. Particular emphasis is put on explaining and justifying the assumptions and approximations that are needed to obtain the di?erential equations descr- ing the FEL dynamics. Although we have tried our best to be “simple”, the mathematical derivations are certainly not always as simple as one would like them to be. However, we are not aware of any easier approach to the FEL theory. Some of the more involved calculations are put into the appendices.

Geneva, Switzerland, July 7–11, 1980 World Scientific Publishing X-Ray Lasers 1996 provides not only an overview and progress report on this fast moving field, but also important reference material on which future work can be built. Topics covered include collisional x-ray lasers, table-top x-ray lasers, beam optics, x-ray optics, OFI and photo-pumped schemes, capillary schemes, international laser facilities, XUV nonlinear mixing, alternative soft x-ray sources, diagnostics, and applications. The volume is an essential addition to the libraries of researchers in the field.