Advances In Medical Linear Accelerator Technology

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Inside the linear accelerator - The Linear Accelerator (LINAC) (2/5)

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Medical physics Shielding Design for Linear Accelerators NCRP151

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1952: Henry Kaplan and Edward Ginzton begin building a medical linear accelerator. 1956: The first medical linear accelerator in the Western Hemisphere is installed at Stanford Hospital in San Francisco. 1959: Stanford medical school and hospital move to the Palo Alto campus, bringing the medical linear accelerator. 1962: Kaplan and Saul Rosenberg begin trials using the linear accelerator with chemotherapy to treat Hodgkin's disease, an approach that dramatically improves patient survival ...

advances in medical linear accelerator technology - Ampi ...

Advances In Medical Linear Accelerator Technology Author: dc-75c7d428c907.tecadmin.net-2020-10-19T00:00:00+00:01 Subject: Advances In Medical Linear Accelerator Technology Keywords: advances, in, medical, linear, accelerator, technology Created Date: 10/19/2020 8:21:29 PM

Advances In Medical Linear Accelerator Technology

Abstract. The microwave-powered electron linear accelerator, or linac, is becoming the dominant radiotherapy treatment unit. Several technical advances, combined with attention to how patients are most effectively set up and treated, have led to continuing improvements in linac radiotherapy. This review describes: improvements in accelerator structures, widely variable energy linacs, microtrons, beam transport systems, and treatment head design.

Advances in linear accelerator design for radiotherapy ...

During the 1950s and 1960s, Varian Associates invented or commercialized many technologies, including X-ray tubes and linear accelerators. In the late 1960s, the company developed the medical linear accelerator for radiation therapy. Ultimately, linear accelerators displaced cobalt as the radiation therapy method of choice.

Advances in Radiotherapy | CANCERactive

An RF linear accelerator (LINAC) for applications in the medical field is a device that uses electromagnetic waves, in the microwave range, to accelerate charged particles such as electrons. Some medical and industrial applications employ the resulting accelerated high-energy particle beams.

Low-level RF control of a klystron for medical linear ...

A medical linear accelerator (LINAC) customizes high energy x-rays or electrons to conform to a tumor's shape and destroy cancer cells while sparing surrounding normal tissue. It features several built-in safety measures to ensure that it will deliver the dose as prescribed and is routinely checked by a medical physicist to ensure it is working properly.

LINAC (Linear Accelerator)

The possibility of photonuclear production of Cu and Mo medical radioisotopes using linear electron accelerators was investigated. The 100 Mo(γ,n) 99 Mo reaction was considered as a case study for photoneutron production. Monte-Carlo simulations were performed and the 99 Mo activity was predicted to be about 7 MBq/(g ⋆ kW ⋆ h). Irradiating 1 g target for 10 using 10 kW electron LINAC would result in 700 MBq.

Production of medical radioisotopes with linear accelerators

A new development in the design of particle accelerators is the plasma wakefield accelerator, using a beam or a laser. The laser wakefield plasma accelerator (LWPA), combined with electrons or protons, can increase the effectiveness of radiation on tumors and reduce side effects. Plasma Therapy

The Medical Applications of Particle Accelerators

A linear particle accelerator is a type of particle accelerator that accelerates charged subatomic particles or ions to a high speed by subjecting them to a series of oscillating electric potentials along a linear beamline. The principles for such machines were proposed by Gustav Ising in 1924, while the first machine that worked was constructed by Rolf Widerøe in 1928 at the RWTH Aachen University. Linacs have many applications: they generate X-rays and high energy electrons for medicinal ...

Linear particle accelerator - Wikipedia

Modern radiotherapy achieved its successes as a result of the advances that were introduced during the past few years in the linear accelerator technology and computerization, making the dose delivery extremely sophisticated and heavily dependent on skills of the radiotherapy team consisting of radiation oncologist, medical physicist, radiation dosimetrist, and treatment technologist.

Particle Accelerators in Medicine | Radiology Key

The medical linear accelerator equipment segment is growing due to the growing incidence of cancers globally, coupled with the increasing demand for digitally advanced radiotherapy devices. The use of innovative oncology informatics platforms has led to rapid progress in radiation treatment planning, thereby saving time and cost.

Medical Linear Accelerators Market - Global Outlook and ...

A device that accelerates radioactive particles and beams to body regions affected by malignancy, while minimising damage to normal tissue. Linear accelerators use electrodes and gaps arranged in a straight line, proportioned so when electrical potentials are varied with the proper amplitude and frequency, particles passing through the waveguide receive successive increments of energy, and are therefore accelerated; the device delivers therapeutic radiation in the range of 4 to 25 million ...

Linear accelerator | definition of linear accelerator by ...

ver the past 40 years, technical advances in imaging, particularly the use of medical linear accelerators, have revolutionized cancer treat-ments. Cancer patients are the winners here, with sub-millimeter accuracy due, in part, to accurate localization of the cancerous tumors, and the sparing of healthy tissue surrounding the treatment site.

Imaging Innovations Lead to Advances in Radiation Therapy

The microwave-powered electron linear accelerator, or linac, is becoming the dominant radiotherapy treatment unit. Several technical advances, combined with attention to how patients are most effectively...

Advances in linear accelerator design for radiotherapy ...

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Advances In Medical Linear Accelerator Technology

linear accelerator designs for s ecurity and non-destructive testing applications. NEW X-BAND DEVELOPMENTS Portability of X-Band Linacs The X-band accelerators operate at three times higher frequency compared to the similar S-band linacs and the accelerator cell cross section area is approximately 10

Modern medical imaging and radiation therapy technologies are so complex and computer driven that it is difficult for physicians and technologists to know exactly what is happening at the point-of-care. Medical physicists responsible for filling this gap in knowledge must stay abreast of the latest advances at the intersection of medical imaging and radiation therapy. This book provides medical physicists and radiation oncologists current and relevant information on Adaptive Radiation Therapy (ART), a state-of-the-art approach that uses a feedback process to account for patient-specific anatomic and/or biological changes, thus delivering highly individualized radiation therapy for cancer patients. The book should also benefit medical dosimetrists and radiation therapists. Adaptive Radiation Therapy describes technological and methodological advances in the field of ART, as well as initial clinical experiences using ART for selected anatomic sites. Divided into three sections (radiobiological basis, current technologies, and clinical applications), the book covers: Morphological and biological biomarkers for patient-specific planning Design and optimization of treatment plans Delivery of IMRT and IGRT intervention methodologies of ART Management of intrafraction variations, particularly with respiratory motion Quality assurance needed to ensure the safe delivery of ART ART applications in several common cancer types / anatomic sites The technology and methodology for ART have advanced significantly in the last few years and accumulated clinical data have demonstrated the need for ART in clinical settings, assisted by the wide application of intensity modulated radiation therapy (IMRT) and image-guided radiation therapy (IGRT). This book shows the real potential for supplying every patient with individualized radiation therapy that is maximally accurate and precise.

Organized to serve as a ready reference, this book covers the design & principles of operation of microwave electron linear accelerators for the radiation treatment of cancer. Designed for use by persons without extensive knowledge & experience of accelerator technology, the book assumes a knowledge of elementary physics & mathematics & places its emphasis on how accelerators actually function & how they are used in cancer treatment. Coverage includes the history of development & application, general theory of acceleration, accelerator systems, radiation beam systems & associated equipment, performance characteristics, testing & use. The major modules of a representative medical accelerator are described, including principles of operation & how these models function collectively to produce electron & X-ray beams for radiotherapy.

Appraising cancer as a major medical market in the 2010s, Wall Street investors placed their bets on single-technology treatment facilities costing $100-$300 million each. Critics inside medicine called the widely-publicized proton-center boom "crazy medicine and unsustainable public policy." There was no valid evidence, they claimed, that proton beams were more effective than less costly alternatives. But developers expected insurance to cover their centers' staggeringly high costs and debts. Was speculation like this new to health care? Cancer, Radiation Therapy, and the Market shows how the radiation therapy specialty in the United States (later called radiation oncology) coevolved with its device industry throughout the twentieth-century. Academic engineers and physicians acquired financing to develop increasingly powerful radiation devices, initiated companies to manufacture the devices competitively, and designed hospital and freestanding procedure units to utilize them. In the process, they incorporated market strategies into medical organization and practice. Although palliative benefits and striking tumor reductions fueled hopes of curing cancer, scientific research all too often found serious patient harm and disappointing beneficial impact on cancer survival. This thoroughly documented and provocative inquiry concludes that public health policy needs to re-evaluate market-driven high-tech medicine and build evidence-based health care systems.

Linear Accelerators for Radiation Therapy, Second Edition focuses on the fundamentals of accelerator systems, explaining the underlying physics and the different features of these systems. This edition includes expanded sections on the treatment head, on x-ray production via multileaf and dynamic collimation for the production of wedged and other i

By the mid-1950s, a linear accelerator suitable for treating deep-seated tumors was built in the Stanford Microwave Laboratory and installed at Stanford Hospital. It served as a prototype for commercial units that were built later. Since that time, medical linear accelerators gained in popularity as major radiation therapy devices, but few basic training materials on their operation had been produced for use by medical professionals. C.J. Karzmark, a radiological physicist at Stanford University, was involved with medical linacs since their development, and he agreed to collaborate with Robert Morton of the Center for Devices and Radiological Health (formerly the Bureau of Radiological Health), U.S. Food and Drug Administration, in writing the first edition of this primer.

This book serves as a practical guide for the use of carbon ions in cancer radiotherapy. On the basis of clinical experience with more than 7,000 patients with various types of tumors treated over a period of nearly 20 years at the National Institute of Radiological Sciences, step-by-step procedures and technological development of this modality are highlighted. The book is divided into two sections, the first covering the underlying principles of physics and biology, and the second section is a systematic review by tumor site, concentrating on the role of therapeutic techniques and the pitfalls in treatment planning. Readers will learn of the superior outcomes obtained with carbon-ion therapy for various types of tumors in terms of local control and toxicities. It is essential to understand that the carbon-ion beam is like a two-edged sword: unless it is used properly, it can increase the risk of severe injury to critical organs. In early series of dose-escalation studies, some patients experienced serious adverse effects such as skin ulcers, pneumonitis, intestinal ulcers, and bone necrosis, for which salvage surgery or hospitalization was required. To preclude such detrimental results, the adequacy of therapeutic techniques and dose fractionations was carefully examined in each case. In this way, significant improvements in treatment results have been achieved and major toxicities are no longer observed. With that knowledge, experts in relevant fields expand upon techniques for treatment delivery at each anatomical site, covering indications and optimal treatment planning. With its practical focus, this book will benefit radiation oncologists, medical physicists, medical dosimetrists, radiation therapists, and senior nurses whose work involves radiation therapy, as well as medical oncologists and others who are interested in radiation therapy.

This unique resource offers you a clear overview of medical and industrial accelerators. Using minimal mathematics, this book focuses on offering thorough explanations of basic concepts surrounding the operation of accelerators. You find well illustrated discussions designed to help you use accelerator-based systems in a safer, more productive, and more reliable manner. This practical book details the manufacturing process for producing accelerators for medical and industrial applications. You become knowledgeable about the commonly encountered real-world manufacturing issues and potential sources of defects which help you avoid costly production problems. From principles of operation and the role of accelerators in cancer radiation therapy, to manufacturing techniques and future trends in accelerator design and applications, this easy-to-comprehend volume quickly brings you up-to-speed with the critical concepts you need to understand for your work in the field.

This book concisely reviews important advances in radiation oncology, providing practicing radiation oncologists with a fundamental understanding of each topic and an appreciation of its significance for the future of radiation oncology. It explores in detail the impact of newer imaging modalities, such as multiparametric magnetic resonance imaging (MRI) and positron emission tomography (PET) using fluorodeoxyglucose (FDG) and other novel agents, which deliver improved visualization of the physiologic and phenotypic features of a given cancer, helping oncologists to provide more targeted radiotherapy and assess the response. Due consideration is also given to how advanced technologies for radiation therapy delivery have created new treatment options for patients with localized and metastatic disease, highlighting the increasingly important role of image-guided radiotherapy in treating systemic and oligometastatic disease. Further topics include the potential value of radiotherapy in enhancing immunotherapy thanks to the broader immune-stimulatory effects, how cancer stem cells and the tumor microenvironment influence response, and the application of mathematical and systems biology methods to radiotherapy.

Linear particle accelerators (linacs) are essential for future discovery machines as well as many advanced medical and industrial applications. A linac is formed from a set of cascaded RF cavities (cells). For a typical electron linac, such as the SLAC linear accelerator, RF power is fed to the linac from one point and flows to adjacent cells through the beam tunnel. Consequently, the linac design process requires careful consideration of the coupling between adjacent cells. This limits the ability of the designer to optimize the cell shape for high RF-to-beam efficiency and/or craft the field on the surface for high-gradient operation. We introduce a novel particle accelerator technology that utilizes a periodic feeding network to feed every accelerating cell independently. This eliminates the need for the coupling between cells, giving considerable optimization flexibility for the shape of the accelerator cells. This dissertation discusses the concept behind this topology and presents how such a concept is developed and implemented through a set of key research milestones. The theory of the distributed-coupling linac is presented alongside the associated optimization techniques that take full benefit of the resultant design flexibility. Compared to a conventional linac, our designed and tested structures provide approximately double the shunt impedance. A novel manufacturing technique is enabled by observing that both the cells and the feeding network have planes with no currents passing through them. This allowed the manufacturing of the structure from two blocks. From an economical point of view, this reduces the part count by about two orders of magnitude in comparison to traditional ways of building the structures from half-cell cups. Additionally, this method allows us to assemble the structure without the necessary brazing steps typically needed for traditional linacs. Hence, the copper or doped-copper material hardness properties can be maintained, further enhancing the ability of the surface to resist damage due to cyclic fatigue. Cryogenic operation of normal-conducting linacs substantially reduces their surface resistance and hence improves RF-to-beam efficiency. The reduced losses also reduce the transient temperature rise on the surface, which is the root cause of the surface cyclic fatigue that leads to surface distortions and consequently breakdown events. That cyclic fatigue is further reduced because the copper yield strength is increased at lower temperatures. In this work, we present the first demonstration of high-gradient acceleration of an electron-beam at a cryogenic temperature of 77 K. Experimental operation of the distributed-coupling structure at 77 K resulted in a reduction in the breakdown rates by two orders of magnitude. Furthermore, the concept of distributed-coupling is extended to superconducting accelerators. Compared to conventional designs, the provided optimization flexibility of the distributed-coupling topology leads to optimized geometries with a reduced surface magnetic field and RF power loss. This reduction should allow for high-gradient operation and reduced system cost. We present our initial attempts to build and test a superconducting distributed-coupling linac. Finally, the concept of distributed-coupling is extended to utilize two accelerating modes that operate simultaneously in the same linac. Dual-mode acceleration enhances the shunt impedance while allowing the structure to operate at much higher gradients. The latter advantage is due to the fact that a given point on the cavity surface does not experience the sum of the peak fields from the two modes at the same time. An extra degree of freedom is obtained by not requiring the operating frequencies to be harmonically related; it is sufficient to have a common sub-harmonic. The value of this sub-harmonic determines the distance between the bunches that can be accelerated. The proposed dual-mode architecture prevents the leakage of the high-frequency mode through the coupling ports of the low-frequency mode by introducing a choke feature in the low-frequency port. Moreover, this architecture preserves the structure symmetry and allows for manufacturing the structure from quadrant copper blocks.

Comprehensive Biomedical Physics is a new reference work that provides the first point of entry to the literature for all scientists interested in biomedical physics. It is of particularly use for graduate and postgraduate students in the areas of medical biophysics. This Work is indispensable to all serious readers in this interdisciplinary area where physics is applied in medicine and biology. Written by leading scientists who have evaluated and summarized the most important methods, principles, technologies and data within the field, Comprehensive Biomedical Physics is a vital addition to the reference libraries of those working within the areas of medical imaging, radiation sources, detectors, biology, safety and therapy, physiology, and pharmacology as well as in the treatment of different clinical conditions and bioinformatics. This Work will be valuable to students working in all aspect of medical biophysics, including medical imaging and biomedical radiation science and therapy, physiology, pharmacology and treatment of clinical conditions and bioinformatics. The most comprehensive work on biomedical physics ever published Covers one of the fastest growing areas in the physical sciences, including interdisciplinary areas ranging from advanced nuclear physics and quantum mechanics through mathematics to molecular biology and medicine Contains 1800 illustrations, all in full color