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Basic principles in conventional and laser driven therapy accelerators

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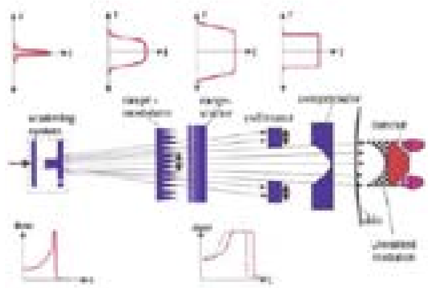
Radiation beams used in therapy for a malignant tumor treatment located in a patient's body, should meet two conditions: 1. to have sufficient energy to penetrate to the depth of the tumor; and 2. the radiation intensity after equalization on the radiation field at the entrance to the tumor to provide the energy absorbed per unit mass of 2 Gy per session. The paper presents the principles of electromagnetic acceleration of leptons and hadrons used in radiotherapy. Particle beams are provided by conventional accelerators based on the principle of electromagnetic acceleration in the field of radiofrequency, non-resonant (betatron and betatron linear), resonant with cavities (microtron, isochronous cyclotron, synchro-cyclotron and synchrotron) and resonant with waveguides (linac). Conventional accelerators based on radiofrequency technology have the deficiency of a relatively low acceleration gradient which leads to a small ratio between the length of the acceleration space and the length of the trajectory traveled by the beam. In order to increase this ratio and to reduce the weight of the accelerator, the superconducting magnets technology was used. Acceleration principles for new models of accelerators are presented: Fixed field alternating gradient accelerator (FFAG) - a combination of cyclotron and synchrotron, dielectric wall accelerator (DWA), which is the type of conventional induction accelerator and dielectric laser accelerator (DLA) - which instead of radiofrequency waves it uses a laser beam to generate electric fields for accelerating in the dielectric structure. The disadvantage of RF waves about acceleration gradient is removed by using the relativistic mode when laser provide a peak amplitude of the transverse electric field of a linear polarized laser pulse greater with about four orders of magnitude. The principles of laser acceleration of electrons, gases and plasmas and the principles of acceleration TNSA and RPA for hadrons are presented.



Recent Publications

1. Scarisoreanu A, Scarlat F, Stancu E, Badita E, Dumitrascu M, Vancea C and R Popa (2017) Absorbed dose to water and air kerma results for measurements carried out in an oncology radiotherapy laboratory. Romanian Reports in Physics 69(1):605.
2. Badita E, Vancea C, Calina I, Stroe D, Dumitrache M, Stancu E and Scarlat F (2017) Long term stability of the performance of a clinical linear accelerator and z-score assessement for absorbed dose to water quantity, Romanian Reports in Physics 69(1):606.

3. Scarlat F, Verga N, Scarisoreanu A, Badita E, Demeter M, Stancu E, Vancea C and Scarlat Fl (2016) Absorbed dose determination in conventional and laser-driven hadron clinical beams using electrical charge measurements. Romanian Reports in Physics 68(1):210-219.
4. Badita E, Vancea C, Stancu E, Scarlat F, Calina I and Scarisoreanu A (2016) Study on the development of a new single mode optic fiber radiation dosimeter for electron beams. Romanian Reports in Physics 68(2):604-614.

Biography

Florea Scarlat has completed his Graduation as a Physicist Engineer from the Faculty of Electronics and Telecommunications at the Polytechnic University of Bucharest, Romania. Later on he obtained his PhD in Nuclear Techniques at the Institute of Atomic Physics of the State Committee for Nuclear Energy with subjects “Contributions to the development of the magnetic induction electron circular accelerator for radiotherapy use”. He was the Scientific Director at the Institute of Physics and Nuclear Engineering Bucharest, Magurele and Director of the Romanian-English joint venture GEC Romanian Nuclear Limited, Leicester, England. Then he was a fulltime Professor of Physics at Valahia State University of Targoviste. He was elected Member of the New York Academy of Sciences and Corresponding Member of the Romanian-American Academy. Currently, he is a Consultant Manager at STARDOOR Laboratory at the National Institute for Lasers, Plasma and Radiation Physics, Magurele.

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