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INCREASING IRRADIATION UNIFORMITY AT INDUSTRIAL ELECTRON ACCELERATORS

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These days radiation treatment of objects and materials has been increasingly used in various areas of the national economy. For a number of categories of objects narrow radiation dose ranges are prescribed. Exceeding the upper limits of this range has a negative effect on physical and chemical properties of the object. Going beyond the lower limits does not reach the desired treatment objective. Therefore, it's important to ensure the best possible dose distribution homogeneity over the entire volume of the object. An increase in the uniformity of irradiation is achieved by placing aluminium plates between electron accelerator exit window and the irradiated object [1]. The presence of the plates modifies the electron beam spectrum by blurring the peak of the initial electron spectrum towards lower values. Thus, the dose in the surface layers increases, resulting in a greater irradiation uniformity. But at the same time the limiting size of objects that can be treated decreases.
In this work we propose a method of increasing irradiation uniformity based on placing a combination of aluminum modifier plates of different thicknesses at the electrons beam way during radiation treatment. Methods like this are used in proton radiation therapy to form a modified Bragg peak of a given thickness at a given depth [2]. The key task is to determine absorbed dose distributions weights in such a way that the superposition of dose distributions is as close as possible to the desired form. In other words, Σ*(j=1)^M*⊠*(*Σ(i=1)^N⊠⊠ω_i D(x_j,d_i) ⊠-D ^(x_j))^2 ⟶Min, where D(x_j,d_i) - is the absorbed dose generated at point of x_j depth when using a d_i thickness modifier, ω_i - weight coefficients, of the dose distributions in the presence of the plate d_i , D ^(x_j) - the desired dose at point xj . The summation is performed on i from 1 to N, where N is the number of different thickness modifiers and on j from 1 to M, where M is the number of points at which the absorbed dose is determined.
In this work, the absorbed dose distributions over the depth of cubic water phantoms with a depth up to 155 mm during one-sided irradiation with monoenergetic electrons with energies 1 - 10 MeV were obtained by computer simulation using the Geant4 toolkit. Aluminum plates with the thickness of 0 - 6 mm were placed in the beam path.
Based on the results of the work for each phantom, weighting coefficients were selected by using the non-negative least squares method [3] to obtain combinations of dose distributions that provide maximum possible radiation treatment homogeneity.
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The speaker is a student or young scientist

Yes

Section

1. Nuclear technology and methods in medicine, radioecology

Primary authors: ZOLOTOV, Sergey (Faculty of Physics M.V.Lomonosov Moscow State University); Dr BLIZNYUK, Ulyana (Faculty of Physics, Moscow State University, Moscow); Prof. CHERNYAEV, Alexander (1 Faculty of Physics, Moscow State University); Mr KRUSANOV, Grigorii (Burnasyan Federal Medical Biophysical Center, Federal Medical Biological Agency); Mr STUDENIKIN, Felix (Faculty of Physics, Moscow State University)

Presenter: ZOLOTOV, Sergey (Faculty of Physics M.V.Lomonosov Moscow State University)

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