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3D bridge microdosimeter: Charge collection study and application to RBE studies in ^{12}C radiation therapy

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3D bridge microdosimeter: Charge collection study and application to RBE studies in ^{12}C radiation therapy

Abstract

Radiotherapy using heavy ion beam such as Carbon-ion has the advantage for the treatment of deep-seated tumour over conventional radiotherapy with X-rays due to an enhanced dose deposition in the Bragg peak (BP) at the end of the ion range. The highest dose can be deposited in the tumour with much lower doses to the surrounding healthy tissue. The Relative Biological Effectiveness (RBE) of a carbon-ion radiotherapy beam greatly depends on a depth of the target volume in the body and the nuclear fragmentation process that increases close to the BP or spread out BP (SOBP) as well as neutrons. It is important to understand the RBE of the heavy ions in hadron therapy applications in order to deliver correct dose. Microdosimetry is extremely useful technique, used for RBE study in unknown mixed radiation fields typical of hadron therapy. Conventional detectors for microdosimetry consist of tissue equivalent proportional counters (TEPC) which have advantages of a spherical sensitive volume and tissue equivalency through use of a tissue equivalent gas. However, TEPC has several limitations such as high voltage operation, large size of assembly, which reduces spatial resolution and introduces wall effects, and an inability to simulate multiple cells. A new silicon microdosimeter with 3D sensitive volumes (SVs) has been proposed to overcome the shortcomings of the conventional TEPC. The new microdosimeter is called "bridge" microdosimeter as it has thin Si bridges between the SVs to support the Al tracks over the SVs. The charge collection study of the new device and its application for RBE determination in ^{12}C radiation therapy at the Heavy Ion Medical Accelerator in Chiba (HIMAC), Japan is presented. This work presented the first RBE10 derivation in a ^{12}C ion therapeutic beam using a high spatial resolution silicon microdosimeter and demonstrated a simple and fast method for Quality Assurance in charge particle therapy.

Keywords

application, rbe, studies, sup, 12, c, collection, radiation, study, therapy, charge, microdosimeter, bridge, 3d

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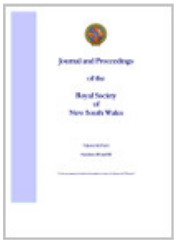

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