FEASIBILITY OF 50-MEV PROTONS FOR RADIOTHERAPY

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Abstract

The test experiments to study the applicability of 50-MeV proton beam to radiotheraph have been performed. The experimental arrangement and the dosimetry are described in this contribution.

Introduction

Proton beam is considered to be more advantageous than γ-rays or neutrons for use in radiotherapy because of it's sharp Bragg peak, relatively high LET, low back-ground dose and the easiness of beam controle or handling.

Therefore, the test of the applicability of protons to radiotherapy has been undertaken by using INS FM Cyclotron since 1976.

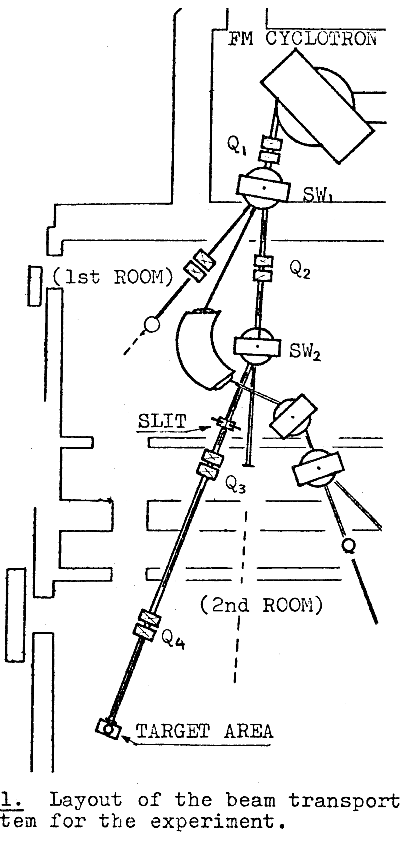

Fig. 1. Layout of the beam transport system for the experiment.

Experiments and Results

The 52-MeV proton beam from FM Cyclotron is transported to the second measuring room as shown in Fig. 1. The beam is defined by the slit in the first measuring room, and then focussed onto the irradiated target position by two sets of quadrupole magnetic lenses. Thus, the beam size and shape with good uniformity is easily adjustable according to the irradiating condition under the reduced back-ground doses.

The beam is extracted away through a 30 μm thick stainless window.

The beam current was monitored by detecting the particles scattered from the stainless foil with a NaI(Tl) scintillation counter, which counts had been calibrated by the beam current measured by Faraday cup.

A 7 X 3 cm^2 rectangular beam shape was obtained with good uniformity for use in mice radiation, which was checked photometrically by X-ray films. The dose distribution (Bragg curve) of the beam in the dummy patient was measured with TLD lods which had been calibrated individually with ^{60}Co γ-ray. The obtained Bragg curve for the paraffin as a dummy target is shown in Fig. 2.

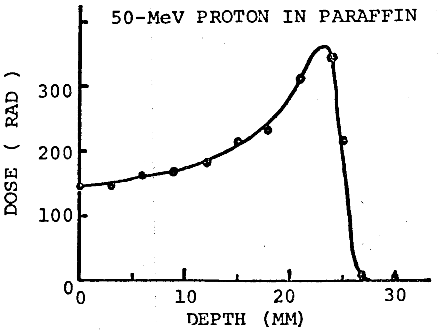

Fig. 2. Depth dose distribution of a broad 50 MeV proton beam.

In order to measure the spatial radiation dose inside and arround the target, TLD lods, a BF_3 neutron Rem-counter and a 3" X 3" NaI(Tl) scintillation counter for γ-ray spectra are used. In this case a 25 X 25 X 25 cm^3 water box was used as a dummy patient. Figs. 3 and 4 show the dose distribution inside and outside the water box, respectively, measured by TLD for 3 micro-Coulomb beam. Neutron dose is also shown in Fig. 4 for 1 nA proton beam. These spatial doses are low enough for a supposed therapy patient.

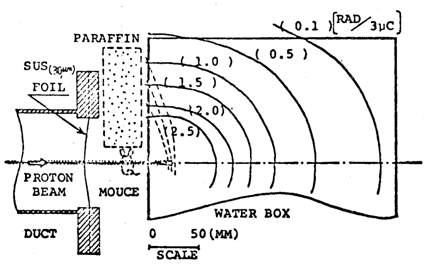

Fig. 3. Radiation dose distribution in a phantom patient (water box) obtained by TLD chips. Dotted lines show radiation without paraffin shield which prevented not to income scattered protons from stainless foil.

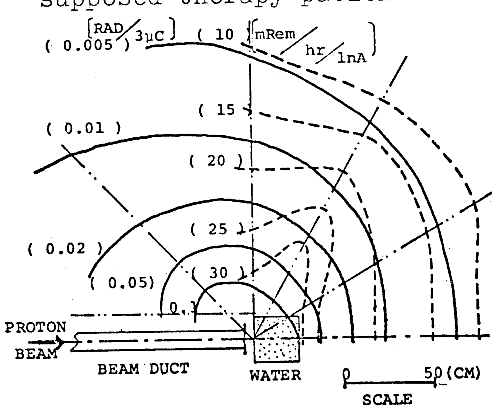

Fig. 4. Spatial dose distribution arround a phantom patient (water box). Solid and dotted lines are measured by TLD and neutron counter, respectively.

The design of the modified experimental techniques for use in supposed radiotherapy in near future is also discussed.