REFINEMENT AND DOSE EVALUATION OF 52-MeV PROTON IRRADIATION COURSE FOR BIOLOGICAL AND MEDICAL STUDY

Yoshitomo Uwamino,*[1] Takashi Makamura,*[2] To-oru Ohkubo,*[2]
Akira Ito,*[3] Shinobu Ohtsu*[3] and Takuro Arimoto*[4]

*[1] National Institute of Radiological Sciences
*[2] Institute for Nuclear Study, University of Tokyo
*[3] Institute of Medical Sciences, University of Tokyo
*[4] School of Medicine, Hokkaido University

INTRODUCTION

Proton irradiation effect on organism has been studied by Hasegawa, et al[1] at the FM cyclotron of Institute for Nuclear Study. But the 52-MeV proton beam from the FM cyclotron was not stable enough, then the dose distribution could not be accurately evaluated. We aimed at improvement of the beam course to get good beam stability and accurate dose distribution.

INSTALLATION

An outline of the beam course is shown in Fig.1. 52-MeV protons were extracted into atmosphere through the stainless steel window 8m away from the deflector after they passed through slits and 0.2-mm-thick stainless steel beam scatterer. The extracted beam was shaped in a form of 3cm by 3cm by lower slits. Beam current was monitored by a parallel plate ionization chamber, and beam profile was monitored by a rotating multi-wire ionization chamber, and its data of drifted charges were projected into 2-dimensional beam current distribution by a micro-computer. The beam current was absolutely measured by a Faraday cup which was evacuated up to 10^{-5} torr. When a flat depth-dose distribution was needed, a range modulator was placed.

Absorbed dose was measured by a parallel-plate tissue-equivalent(PPTE) chamber which had been calibrated by a 60-Co standard field at Institute of Medical Sciences. Effective volume and diameter of the PPTE chamber were 0.430cm^3 and 10.5mm respectively, and the high voltage electrode was made of 1-mm-thick TE plastic.

RESULTS AND DISCUSSION

Uniformity of the beam profile was improved by the scatterer, but the beam did not have clear square form as shown in Fig.2. The correspondence between the currents of the beam monitoring chamber and the Faraday cup was quite good over two dicade variance of beam current. The depth-dose distribution(Bragg curve), shown in Fig.3, measured by the PPTE chamber was stable and well reproducible during four days machine time, and its peak-to-plateau ratio was 4.9. The absorbed doses, at the plateau, measured by the PPTE chamber and the Faraday cup agreed each other within 7.5% error. The depth-dose curve modulated by the range modulator is shown in Fig.4. The dotted line was calculated by synthesising the Bragg curve with the data of modulator thickness, and the solid line was also calculated by including the effect of multiple scattering in the modulator placed 26cm away from the measuring point. This effect was found to be noticeable, from that the solid line agrees well with the measurement.

REFERENCE

[1]T.Hasegawa,et al, Proceeding of the 2nd Symposium on Accelerator Science and Technology, p241-242(1978)

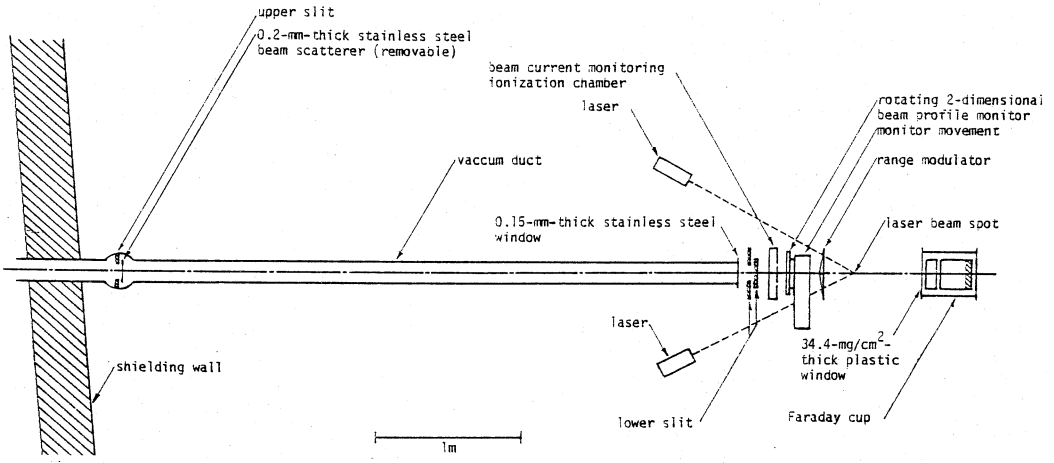

Fig.1 Outline of beam course.

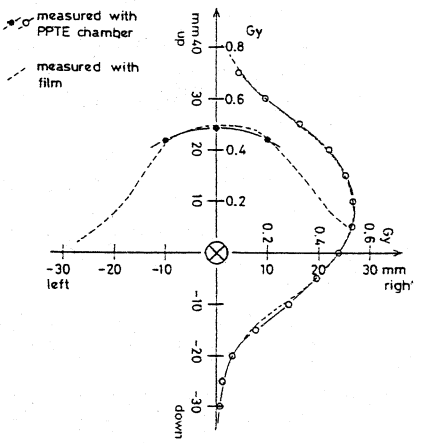

Fig.2 Beam profile at irradiation point.

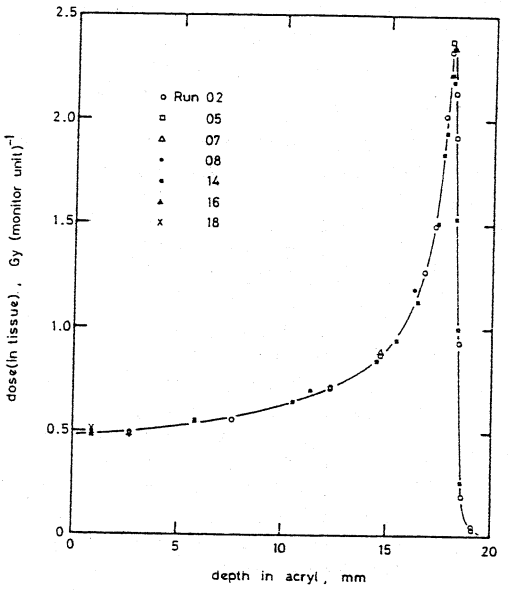

Fig.3 Depth-dose curve in acryl.

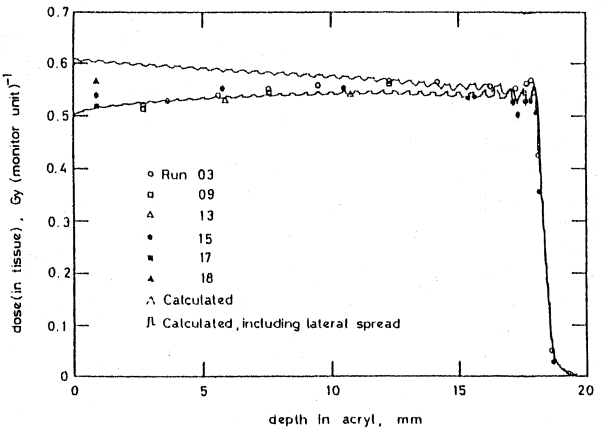

Fig.4 Modulated depth-dose curve in acryl.