Beam Spreading System Employing the Double-scattering Method for Proton-therapy Experiments at CYRIC

著者	Terakawa A., Ishizaki A., Totsuka Y., Honda T., Miyashita T., Matsuyama S., Yamazaki H., Ishii K., Okamura H., Baba M., Itoh M., Orihara H.
journal or publication title	CYRIC annual report
volume	2004
page range	21-23
year	2004
URL	http://hdl.handle.net/10097/50269

II. 4. Beam Spreading System Employing the Double-scattering Method for Proton-therapy Experiments at CYRIC

Terakawa A., Ishizaki A., Totsuka Y., Honda T., Miyashita T., Matsuyama S., Yamazaki H., Ishii K., Okamura H., Baba M.*, Itoh M.* , and Orihara H.***

Department of Quantum Science and Energy Engineering, Tohoku University
**Cyclotron and Radioisotope Center, Tohoku University*
***Department of Physics, Tohoku Institute of Technology*

The charged-particle beam has the characteristic advantage of depth dose distribution for radiation cancer therapy. We are planning to develop the advanced particle irradiation system and study superior therapeutic effects of proton therapy using small animals. Last year, the beam spreading system providing a broad beam with flat beam intensity was built to develop the devices, such as energy filters, dose and beam profile monitors, for the irradiation system. In this report the design of the beam spreading system and the result of the beam spreading experiments are described.

The setup of the beam spreading system based on the double scattering method[1)] is shown in Fig. 1. The first and second scatterers were designed from the multiple-scattering theory for a 80-MeV pencil beam so that the flat beam-intensity field 60 mm in diameter could be obtained at the target located at a distance of 1700 mm from the first scatterer. The first scatterer is a 0.3 mm thick lead foil, while the second scatterer located at a distance of 350 mm from the first scatterer is a dual-ring disk which consists of a 0.5mm thick lead inner disk 17 mm in diameter and an 1.6 mm thick aluminum outer disk 120 mm in diameter. The present system has been installed at the end of the 52-beam line in the target room 5.

The beam spreading experiment with the present system was performed using a 76 MeV-proton beam from the AVF cyclotron at CYRIC. The proton energy was estimated from the range in water. The two-dimensional beam fluence at the target position was measured with an Imaging Plate (IP)[2)]. Because of wide dynamic range for dose measurements the IP is a useful dose censer for charge particle beams as well[3)]. The IP was irradiated for a few seconds with the proton beam whose intensity was decreased up to the order of 10 pA using the beam attenuator installed in the beam injection line of the cyclotron. The observed fluence distribution shown in Fig. 2 indicates that a flat fluence field about 60 mm in diameter is obtained. The flatness of the field (the difference between the maximum and minimum intensities of the flat field) is less than 7 %.

The experimental result allows us to use the proton beam from the present system as a therapeutic beam for proton therapy experiments. If the beam energy and profile of the pencil beam from the cyclotron can be optimized, the flatness would be improved.

References

1) Dual-ring double scattering system at Proton Medical Research Center, Tsukuba University, http://www.pmrc.tsukuba.ac.jp/.
2) Fuji Photo film CO., LTD., http://www.fujifilm.co.jp/bio/si_imgplate/imgplate.html
3) Ohuchi H., Yamadera T., Baba M., Radiat. Port. Dosim. **107** (2003) 239.

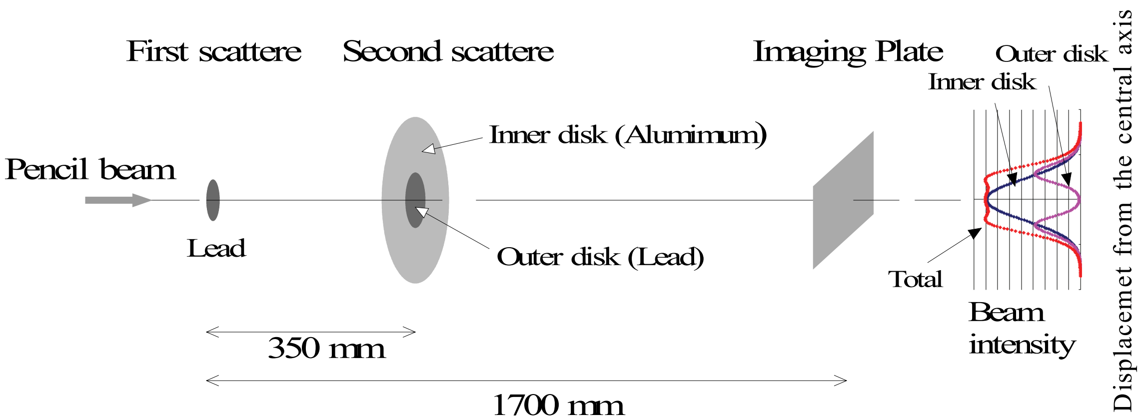

Figure 1. Schematic layout of the beam spreading system based on the double scattering method.

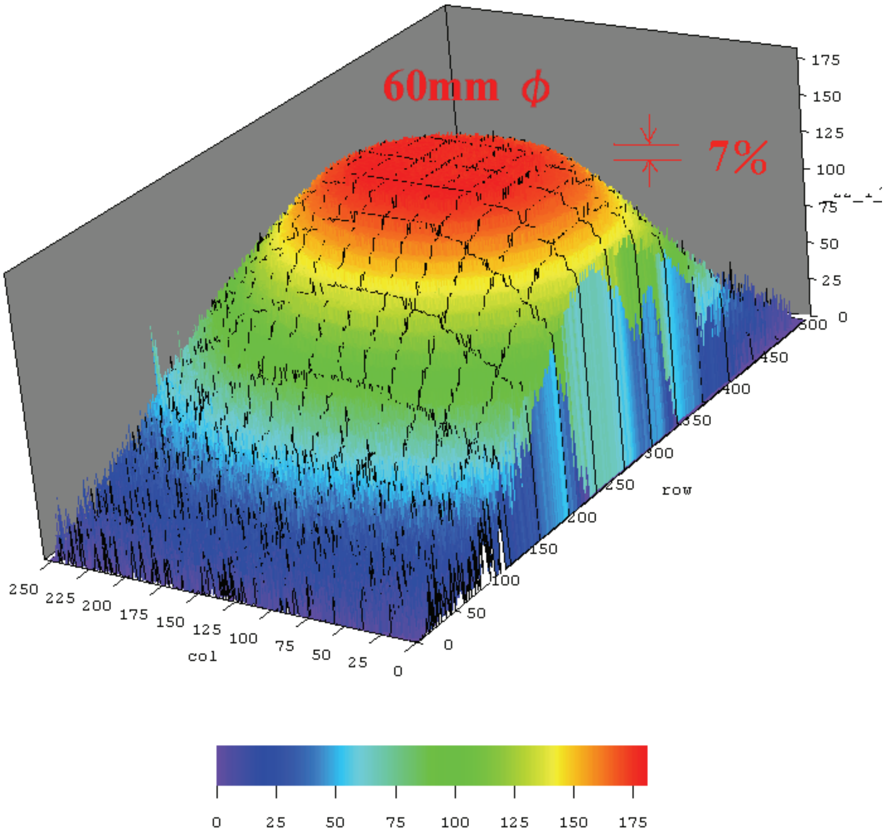

Figure 2. Measured fluence distribution of the proton beam from the beam spreading system.