Fabrication of Faraday Cup Array for the Measurement of 2-Dimensional Proton Beam Profile

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1. Introduction

Beam diagnosis is very important for all kind of experiments and it must be reliable and rapidly applicable. Currently, many kinds of beam diagnostics methods are known. The simplest way is to use a Gafchromic film (Ashland Inc. KY, USA)[1]. It has an advantage of easy-to-use and possible to visually check, immediately; on the other hand, the measurement range is very limited. Another method is using the CCD camera-scintillator device such as p43 phosphor screen or chromox [2, 3].

A variety of faraday cup detectors have been recently introduced [4]. The faraday cup is one of the powerful and popular tools for the measurement of beam current. By using several faraday cups in array geometry, it is possible to observe current distribution. In this study, we developed an external faraday cup array for the measure the beam current and profile at a KOMAC (Korea Multi-purpose Accelerator Complex) beam utilization facility.

2. Methods and Results

2.1 Description of the developed faraday cup array

Faraday cup was designed for beam current measurements in air condition and determined that the faraday cup size and quantity are 5x5mm2, 10x10mm2 and 20x20mm2, respectively, considered the maximum beam size at the TR103 and TR23 in KOMAC. The number of channel in the faraday cup array was determined as a maximum of 100 channels considering the number of cable laying between the target room and the operation room. Faraday cup array consist of the three parts, main block, base plate, and faraday cup. The main block was designed to be inserted into the faraday cup and multi-hole was designed to measure 1- and 2-dimensional beam profile to suit the situation. Base plate was designed considering the structural support and main block insertion. Each faraday cup is electrically insulated using Teflon insulators. Aluminum was used as the base material of faraday cup and its thickness is 3mm or 40mm considering the 20, 100MeV proton beam energy, respectively. Figure 1 show that schematic drawing of faraday cup array. Figure 2 shows the Faraday cup fabricated for 100MeV.

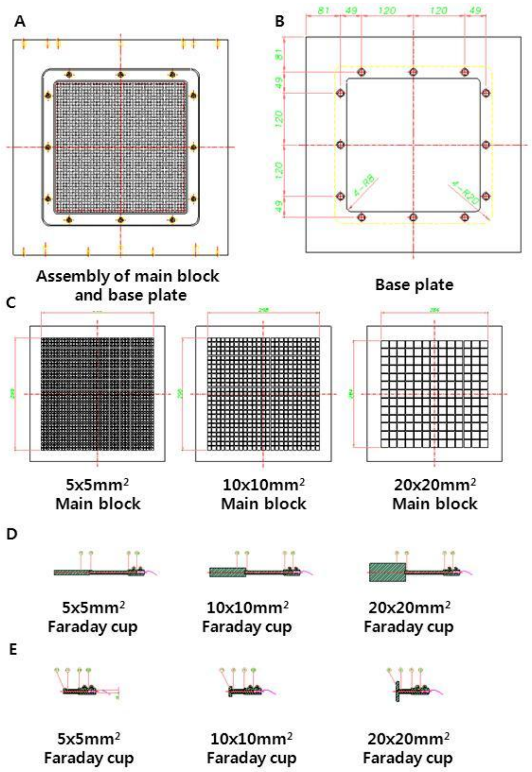

Fig. 1. Schematic drawing of faraday cup array A. assembly of main block and base plate, B. base plate, C. Main block, D. Faraday cup for 100 MeV proton beam, E. Faraday cup for 20 MeV proton beam.

2.2 Multi-channel charge integrator

Figure 3 shows a photograph of the multi-channel charge integrator and 2-D profile by using the multi-channel charge integrator. Charge integrator supports up to a maximum of 32 channels. Its specification is as follows: Data acquisition speed is 10k-1000k data per second per channel, saturation point is up to 10mA per channel. Due to these characteristics, it is suitable for measuring the high power and short pulse length proton beam produced by the 100-MeV proton accelerator at KOMAC.

According to the environment of the target room, change the position of charge integrator and wiring connection (fig. 4). Charge integrator is composed of a semiconductor element it can be damaged by radiation such as proton and neutron.

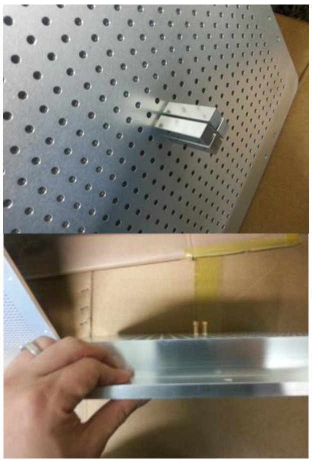

Fig. 2. The photograph of fabricated faraday cup array

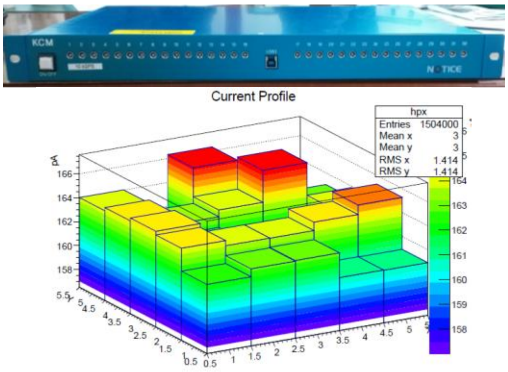

Fig. 3. 32-ch charge integrator (upper panel) and 2-D profile by measuring the charge integrator

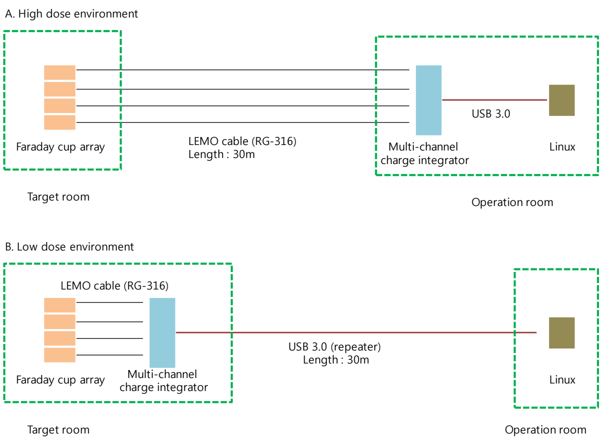

Fig. 4. The Schematic views of current measurement system depending on the target room environment. A. High dose environment, B. Low dose environment.

3. Conclusions

To measure the beam profile, before fabrication of faraday cup array, we use gafchromic film. By making the faraday cup array we were able to reduce the consumption of Gafchromic film and a more accurate diagnosis of the proton beam is possible. The use of faraday cup array, experiment using the proton beam is more reliable and confident.

ACKNOWLEDGMENTS

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