Conceptual design of multi-purposed horizontal and vertical target rooms for 100MeV proton beams of the PEFP

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1. Introduction

Proton Engineering Frontier Project (PEFP) has developed a 100-MeV linear accelerator which has 20-MeV and 100-MeV user facilities [1]. 5 beam lines for 100MeV target rooms for users have been designed to meet the requirements of the beam users[2]. To provide flexibilities of irradiation conditions for various fields, we designed beam lines with wide external or vacuum, and horizontal or vertical beams. Table 1 shows detail specifications of each target room. High current beamlime will be mainly used for RI production and spallation neutron experiments such as TR101 and 105. We have a plan to make 3 multi purposed target rooms such as TR102, 103, and 104 also. Maximum irradiation area is 300-mm in diameter and the maximum average current is 300-㎂ of the 3 target rooms.

Table 1 Specifications of 5 100MeV target rooms

No.	Rep. rate	Max. avg. beam current	Irradiation condition	Max. beam diameter
TR101	60Hz	0.6mA	Horizontal External	100mm
TR102	7.5Hz	10µ A	Vertical External	300mm
TR103	15Hz	0.3mA	Horizontal External	300mm
TR104	7.5Hz	10µ A	Horizontal External	300mm
TR105	60Hz	1.6mA	Vertical Vacuum	100mm

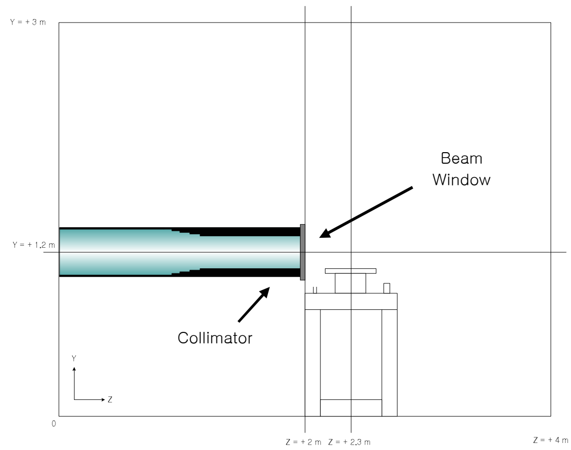

Figure 1 Horizontal target room for 100MeV proton beam

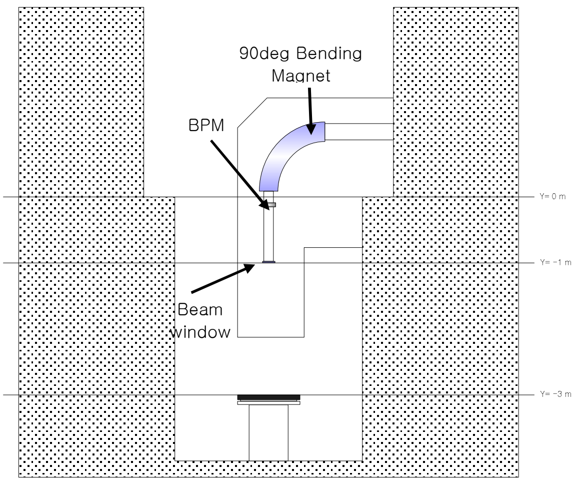

Figure 2 Vertical target room for 100MeV proton beam

2. Multi- purposed target rooms

2.1 Layout of the target room

Target room will be made for horizontal and vertical beam irradiation. Horizontal target room size is 4m x 4m with width and length. Beam pipe is located horizontally in the target room as shown in figure 1. Beam window is located in the center of the room. Tagret station will be closed to the window to reduce activation of beam to air.

Vertical target room is underground with 4meter as shown in figure 2. Using a 90 degree dipole magnet the proton beam can be delivered to vertical window. BPM will used to deliver the proton beam to center of the window. The distance between the window and the target station is around 1meter. This external proton beam from the window will be drifted scattered in the air.

2.2 Major components in the target room

Some windows have been considered to extract the proton beam from vacuum condition. We need thin large window with up to 300mm diameter to meet user requirement, we adopted the aluminum-beryllium alloy (AlBeMet) as the window material since it has sound mechanical properties at high temperature and good thermal characteristics. The structural issues were computed by using the finite element analysis procedure of the ANSYS code and experimentally confirmed sustainability after forming process and actual vacuum test. [3]

2.3 Beam scattering from the beam window

For our estimation to 100MeV proton beam drift in air, we use the Hilander fomular such as equation (1).

$$\vartheta = \frac{141}{p\beta c}\sqrt{\frac{z}{Lr}}\left(1+\frac{1}{9}\log_{10}\frac{z}{Lr}\right) \quad (1)$$

where

p: proton momentum [MeV/c]

βc: velocity of a proton

L_r: radiation length of material [g/cm^2]

We can get the 0.00689 and 0.0061 after window and 1meter drift in the air. Proton beam in the vacuum with 2cm of the size calculated from the beam optics will be spread out 3.84 centi-meter after window and 1meter drift in the air.

3. Conclusions

PEFP have a plan to construct multi purposed horizontal and vertical target room as user's facilities using 100MeV proton linac. We already designed conceptually optical magnetic elements to deliver the target rooms. Beam scattering calculation related to air drift was performed. PEFP will begin to construct accelerator tunnel and user's beam lines including the associated target rooms at Kyung-Ju in Korea in this year. These target rooms can supply the 100MeV proton beams for users after installing accelerator instruments at this facility.

Acknowledgment

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