Status of Design of PEFP Beam Lines

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1. Introduction

PEFP(Proton Engineering Frontier Project) is developing a high current 100MeV proton linear accelerator. 20MeV and 100MeV proton beam lines are also under development for beam applications.

10 beam lines will be developed to support various purposes. Two kind of proton beam energy will be transported to 2 beamlines for industrial applications and 3 beamlines for various researches. The characteristic design scheme of PEFP beam lines is the application of a programmable AC magnet. Beam distribution to 3 research beam lines will be conducted sequentially to increase the operation efficiency by using it. To provide flexibility of the irradiation conditions, each beam line is designed to have specific beam parameters. The development of beamline components, including magnets, is conducted in parallel. The details will be reported.

2. Requirements for Target Room

From surveys for proton beams demanded from many application fields, we had selected the common requirements for many applications and have summarized requirements for 10 beam lines of 100MeV and 20MeV. Table 1 and 2 shows summarized requirements for each target room.

Two fixed beam lines will be used for the radio isotope production and the power semiconductor production. To provide flexibilities of irradiation conditions for users from many application fields, we designed beam lines with wide or focused, external or in-vacuum, and horizontal or vertical beams[1].

Table 1: 100MeV target room requirements

Target Room	Application Field	Rep. Rate (Hz)	Max. Avg. I(mA)	Irradi. Cond.	Max. Dia. (mm)
TR101	Isotope	60	0.6	Hor. Vac.	100
TR102	Medical(Proton Therapy Reseach)	7.5	0.01	Hor. Atm.	300
TR103	Materials/Energies and Environment	15	0.3	Hor. Atm.	300
TR104	Basic science(Physics, Chemistry), Aerospace	7.5	0.01	Hor. Atm.+Vac	100
TR105	Neutron Source/Irrdiation Trial	60	1.6	Ver. Atm.+Vac	100

Table 2: 20MeV target room requirements

Target Room	Application Field	Rep. Rate (Hz)	Max. Avg. I(mA)	Irradi. Cond.	Max. Dia. (mm)
TR21	Semiconductor	60	0.6	Hor. Atm.	300
TR22	Biotech/Medical	15	0.06	Hor. Atm.	300
TR23	Materials/Energies and Environment	30	0.6	Hor. Atm.	300
TR24	Basic science(Physics, Chemistry)	15	0.06	Hor. Atm.+ Vac.	100
TR25	Isotope	60	1.2	Hor. Vac.	100

3. Development of Components

On the basis of the beam optics calculation, we estimated the required magnets[2]. Among these magnets, quadrupole magnets, AC magnets and some dipole magnets were already manufactured and under the performance tests.

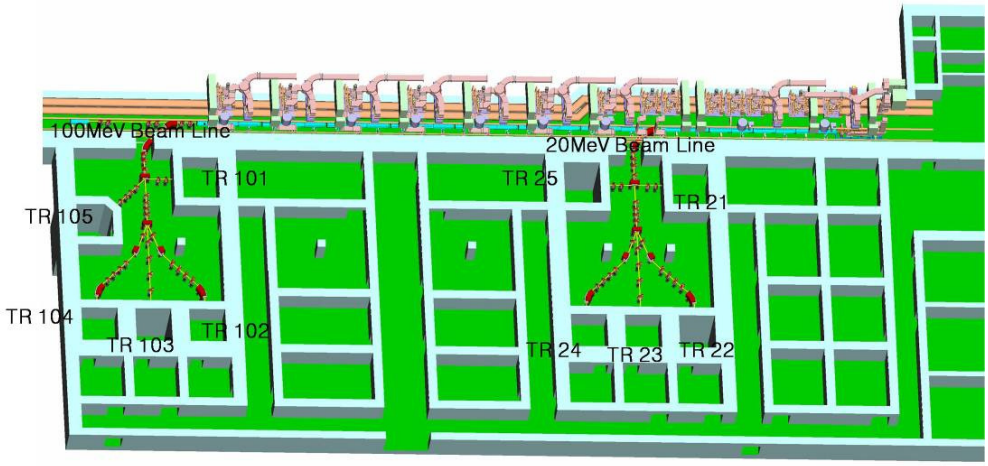

Figure 1: Layout of PEFP user facility

For the AC magnets, programmable current power supply and vacuum chamber are under development. And we have been cooperated with IHEP(Institute of High Energy Physics Chinese Academy of Sciences) in design and fabrication of beam line magnets.

A distinctive feature of the beam lines is external beam. To extract the high current and large beam, we developed aluminium-beryllium alloy window with high mechanical strength at high temperature, low-Z for low beam loss, and good radiation resistivity. We also will adopt a fast closing gate valve system to protect main facilities from the accident cause by the failure of the beam window.

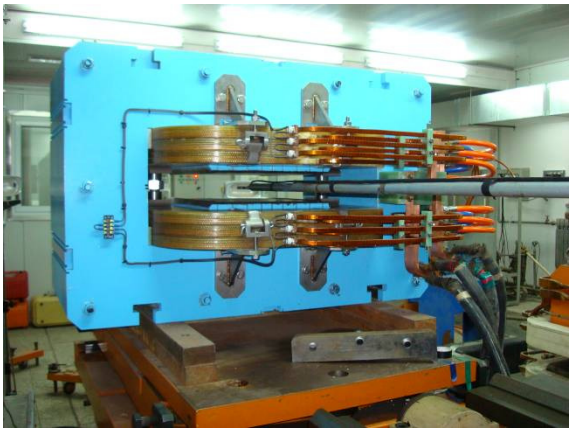

Figure 2: AC magnet for beam distribution

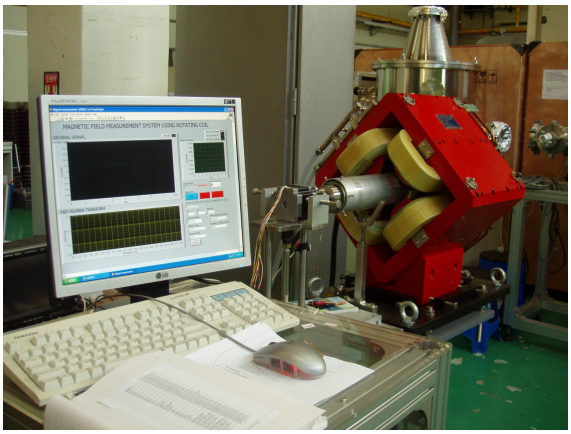

Figure 3: Performance tests of quadrupole magnets

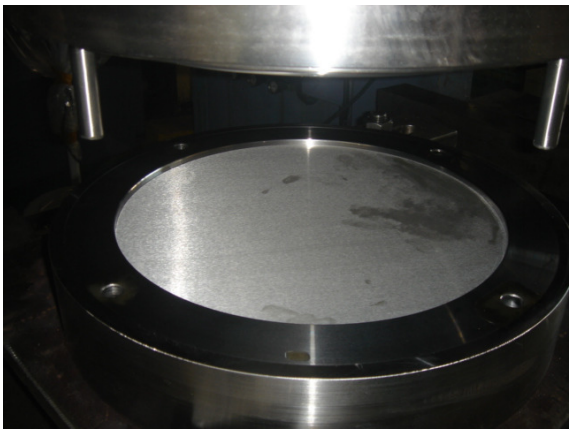

Figure 4: Large beam window for the external beam

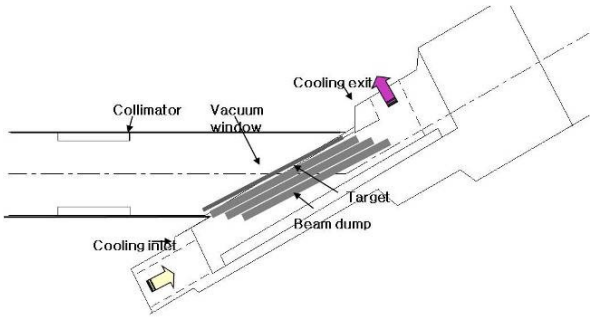

Figure 5: Targetry for the isotope production

4. Summary

The 100MeV linear accelerator is being developed for the 20MeV and 100MeV user facilities of Proton Engineering Frontier Project (PEFP). 10 beam lines have been designed reflecting the various views of beam users. And the conceptual design of 10 target rooms including RI production facility is on-going. The R&D for beam line components, such as programmable current power supply, is also in progress. We will ground break in this July. The operation of this facility will start in 2011.

Acknowlegment

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REFERENCES

[1] In-Seok Hong, et al., “Conceptual Design of the PEFP Beam Line”, EPAC’08, Genoa, Italy, 2008
[2] J. H. Jang, et al., “Beam optics of the PEFP Modified Beam Lines”, EPAC’08, Genoa, Italy, 2008