Construction and Experimental Plan of Daejeon Ion Accelerator Complex

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1. Introduction

A heavy ion beam facility, which is based on the transferred heavy ion accelerator TRIAC (Tokai Radioactive Isotope Accelerator Complex) [1] from KEK of Japan, is being constructed at KAERI with a new name DIAC (Daejeon Ion Accelerator Complex). The assembly of the main beam line of the facility, which is composed of an ECR ion source [2], a RFQ and IH linear accelerators [1], has been finished, and the important characteristics of the accelerator has been measured successfully. Radiation shielding is necessary to start beam tuning and beam acceleration. Also three target rooms are being designed to use the heavy ion beam in the various R&Ds [3]. The present status and future plan of the heavy ion beam facility will be discussed in this present.

2. Designed DIAC Heavy Ion Beam Facility

The designed beam line of the DIAC heavy ion beam facility is shown in Fig. 1. The final beam line will be completed by adding a new ECR ion source and three target rooms for different application in the transferred TRIAC linear accelerator system.

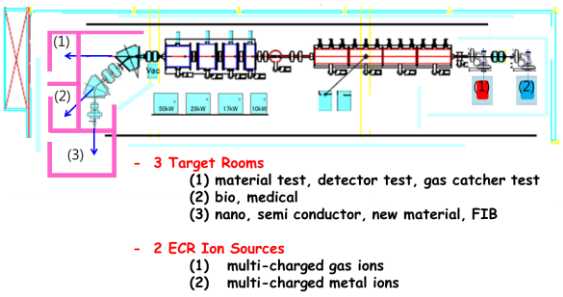

Fig. 1. A designed DIAC beam line as a heavy ion beam facility.

2.1 ECR Ion Sources

Two ECR ion sources, one is transferred from Japan and the other is developed at KAERI, will be installed at DIAC as shown in Fig 1. The 18 GHz ECR ion source [2], which had been developed as a charge breeder in Japan, will be used to produce metal ion beams. Some modification is necessary for this ion source by adding metal oven and cooling system in the future. The 14.5GHz ECR ions source [4], which had been developed at KAERI for highly charged carbon beam extraction, will be used to produce gas ion beams. Some modifications will be made for the Einzel lens and beam transport components in the future.

2.2 RFQ and Linac

Two linac system as summarized in Table 1, RFQ as a post accelerator and IH linac as a main accelerator, accelerate all of the highly charged heavy ions, which is produced by ECR ion source, up to 1 MeV/nucleon.

Table 1. Main parameters of the DIAC Linac

• Split-coaxial RFQ(SCRFQ) linac	
Very compact (diameter = 0.9 m)	
Frequency	25.96 MHz
Input energy	2.1 keV/u
Output energy	178 keV/u
Transmission	> 90 %
Vane length	8.585m
• Inter-digital H (IH) linac	
4 cavity tanks, 3 magnetic-quadrupole triplets	
Frequency	51.92 MHz
Input energy	178 keV/u
Output energy	**0.14~1.09 MeV/u**
Total length	5.6 m

A transport system between the RFQ and IH linac comprises a rebuncher and two sets of quadrupole doublet. The rebuncher is a 25.96 MHz double coaxial quarter wave resonator with six gaps. The beam currents of heavy ion beams are limited by linac operation condition of q/A>1/9 and charge breeding capacity of the ECR ion sources.

2.3 Target System

The different characteristics of DIAC heavy ion beam compared with that of other internal heavy ion beam facility could be defined as follows:

- Beam energy is not high enough to make nuclear reaction.
- But heavy ion beam power is high enough to make radiation damage effects in a short time.
- Any heavy ions could be accelerated.

To give the opportunities to the internal researchers in using heavy ion beams as much as possible, three target rooms as shown in Fig. 1 are designed. The simulation experiments on radiation damage of the reactor materials for Gen IV and fusion reactors and

fission fragments' activities in fuel rods will be the main mission the zero degree target room. A vertical irradiation port will be installed in the 45 degree target room for the bio and cell unit experiments. Pure and highly focused heavy ion beam will be made at the 90 degree target room to make nano related R&Ds including challengeable topics.

3. Construction Status and Future Plan

3.1 Construction Status

The construction was actually started from the disassembly of TRIAC system at Japan and transferred into Korea as parts itself. Now assembly of the main beam line of the DIAC is completed including power distribution and coolant circulation system as shown in Fig. 2. The important characteristics of accelerator system such as tightness of the beam line vacuum, healthiness of the cooling channels, and RF characteristics of the RF cavities have been checked, and at this moment basic maintenance of the system is being made.

Fig. 2. Layout of the assembled main beam line of DIAC.

3.2 Future Plan

Even though DIAC beam doesn't make nuclear reactions, it produces X-rays mainly by Bremstruhlung. And ECR ion sources are another X-ray source. At this moment X-ray shielding for DIAC system is the most urgent work in order to start beam tuning. If proper support be started form this year, the construction will be finished with the following time schedule.

2015	radiation shielding
2016	allowance and start beam tuning
2017	complete zero degree target room
2018	complete 45 & 90 degree target room

4. Summary

A heavy ion beam facility is being constructed at KAERI to open the opportunities to the internal researchers on materials, bio, nano and others topics. We will try the facility be open to other researchers with a stable beam in a nearest future.

REFERENCES

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