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Beam Commissioning of Injector for IFMIF/EVEDA Prototype Accelerator
IFMIF/EVEDA原型加速器用入射器のビーム試験

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The prototype accelerator is being carried out for an engineering validation of the International Fusion Materials Irradiation Facility (IFMIF) as accelerator-driven-type neutron source for developing fusion reactor materials. This is a deuteron linear accelerator consisting of an injector, an RFQ, a superconducting RF linac, RF power systems, a beam dump and beam transport lines. The specification of the target is to produce a CW deuteron beam with the beam energy and current of 9 MeV/ 125 mA. From the spring of 2014, full installation of the injector was started at Rokkasho site and the injector beam test has been just began from November 2014 in order to obtain better beam qualities for successful injection and acceleration of the following accelerators such as RFQ.

1. Introduction

The international fusion material irradiation facility (IFMIF) which is an accelerator-driven-type neutron source has the neutron-irradiation strength and irradiation volume which carry out an equivalent to the fusion reactor [1, 2]. Although ITER aims at establishment of the burning plasma, demonstration of a longer-duration plasma and reactor engineering technology, neutron irradiation strength realizable by ITER is only several percent or less of a DEMO reactor target to the first wall and a blanket structural material. Therefore, heavy neutron irradiation data is indispensable for the development of the first wall and blanket structural-material by IFMIF. The activity for the engineering validation and engineering design prior to construction of IFMIF is the IFMIF/EVEDA project. This is carried out as one of the project of broader approach (BA) activities developed by a Japan-Europe international collaboration. The development of a prototype particle accelerator is carried out in Rokkasho Fusion Institute (International Fusion Energy Research Center, IFERC) of Japan Atomic Energy Agency (JAEA). This prototype particle accelerator is called

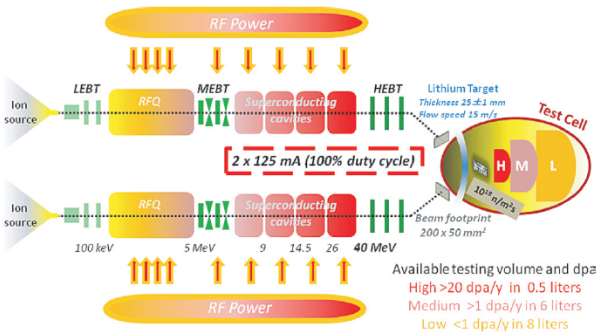

Figure 1. Schematic of IFMIF.

Table 1. Main parameters of LIPAc compared to IFMIF.

Primary parameters	LIPAc	IFMIF	Units
Number of Linacs	1	2	—
Duty factor	CW	CW	—
Ion type	D^+	D^+	—
Beam intensity on target	125	2 × 125	mA
Beam kinetic energy on target	9	40	MeV
Beam power on target	1.125	2 × 5	MW
RF	175	175	MHz
Target material	Cu	Li	—
Total length	34.0	84.7	m
Injector length	5.0	5.0	m
RFQ length	9.8	9.8	m
MEBT length	2.3	2.3	m
SRF Linac length	4.6	22.4	m
Number of cryomodules	1	2 × 4	—
HEBT total length	9.6	45.0	m

LIPAc (Linear IFMIF Prototype Accelerator), it is a deuteron linear accelerator consisting of an injector, an RFQ, a superconducting RF linac (SRF), RF power systems, a beam dump and beam transport lines (LEBT, MEBT, HEBT) mainly. The performance of the beam is 9 MeV/ 125 mA CW in deuteron beam. The injector has been already tested in 100 keV/140 mA proton and the deuteron beam at the CEA Saclay in 2012 [3,4,5]. This injector system was taken apart and moved to Rokkasho site of Aomori prefecture after the completion of the beam commission in CEA Saclay. Within a couple of years, RFQ from INFN in Italy, SRF from CEA Saclay and other components (RF power sources, MEBT, HEBT, BD) from CTEMAT

will be delivered to Rokkasho site and assembled.

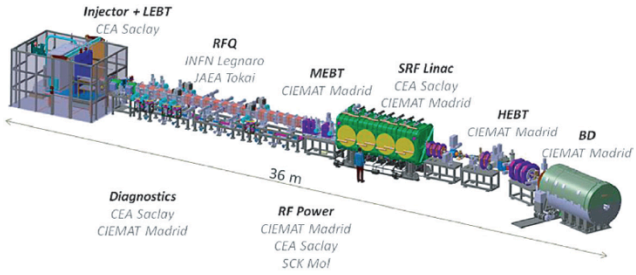

Fig. 2 Layout of the LIPAc with indication of the different labolatory contributions.

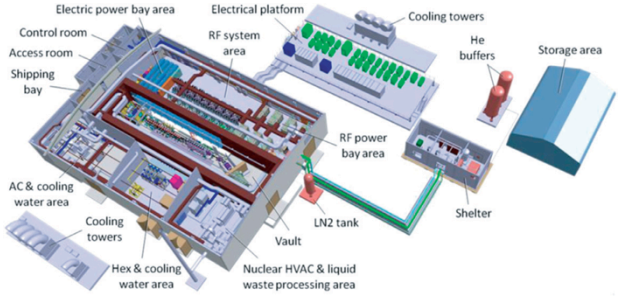

Fig. 3 3D view of the LIPAc facility.

2. Beam Commissioning of Injector

In Rokkasho site, full installation and assembly of the injector were started from March 2014. Deliverables from EU are not only injector main unit. A cooling skid and electrical distributed boards were also imported from EU and installed. After the completion of the installation, the check-out of the injector components have been just carried out in this October. In the check-out phase, total number of 10 researchers / engineers came to Rokkasho site from CEA for check-out work and JAEA and IFMIF project team did the collaborative work with CEA. At first, proton beam commissioning has been just started in this November.

Fig. 3 HV Deck, ECR source, accelerator column, LEBT and diagnostics.

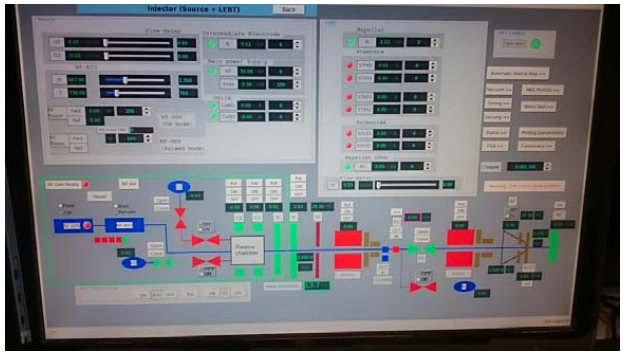

Fig. 5 GUI of the injector operation.

3. Future Schedule

After the completion of the proton beam commissioning, the deuteron beam commissioning will be started. In this time, facility inspection for the set of radiation controlled area based on “Law Concerning Prevention from Radiation Hazards due to Radio-Isotopes, etc” will be done. After that, we will fully make an injector beam commissioning for the reliable prediction of beam injection quality into the RFQ for beam dynamics and the predicted beam injection quality for the RFQ requirements.

References

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