Installation of 3-MV Tandem Accelerator at KOMAC

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1. Introduction

A 3-MV tandem accelerator was installed at Seoul National University (SNU) in 1998, and has been successfully operated until 2016[1,2]. High Voltage Engineering Europa, B.V. in Netherlands manufactured this system. It was usually used for the radiocarbon dating. In addition, other analyses such Be AMS, and external PIXE were performed. However, by an accident in 2016, it stopped working. Therefore, this machine was moved to KOMAC in Gyeongju in 2017, and is in re-installation at KOMAC[3]. In this report, the status of re-installation and the plan is presented.

2. Installation Status and Plans

The 3-MV tandem accelerator consists of a variety of components including ion sources, injection magnets, analysis magnets, vacuum systems and power systems in addition to the main accelerator. Especially this device has functional separation between the ^{14}C analysis and the multi-purpose line. Firstly, ^{14}C analysis line will be completed and then the multi-purpose line will be done later. In this section, the progress of installation by each components is shown, and the future plans for unfinished parts are presented.

Fig. 1. 3-MV tandem accelerator at KOMAC.

2.1 Control System

The system is controlled almost entirely by the computer system, including system on/off, power supply control, measurement data acquisition, etc. Most of control systems are nearly in normal operation. The communications between each part of the accelerator system and computer control system are connected with optical cables, and some of them requires repairs because some fiber connections are bad. The control system is very old-fashioned. The operating system of the control computer is Microsoft Windows 3.1. Therefore, it is difficult to obtain appropriate replacement parts. In the near future, the control unit needs to be upgraded to the latest computer system.

2.2 Vacuum System

The vacuum system consists of seven turbo molecular pumps (TMPs) that maintain high vacuum and low vacuum pumps that hold the fore vacuum of each TMP. Five of the seven TMPs are used in the ^{14}C analysis line, and they are in normal operation. One of them did not work and was replaced with a new one. The vacuum of the multi-purpose line will be operated later. The vacuum level is maintained at 10^{-7} mbar. It is rather high, but a level in which an accelerator system can be operated and the vacuum will be further tightened through a leak test later.

2.3 Magnet System

The magnetic field system of ^{14}C analysis beam line consists of two electro-magnet sets. One set is composed of four 45˚ electro-magnets, and it injects low energy beam to the accelerator. The other set is composed of 110˚ electro-magnet and 90˚ electro-magnet, which are used for ion beam mass analysis. The high current power supplies for operating these electro-magnets work well.

The magnetic field system for multi-purpose line is not tested yet. It will be done after the ^{14}C line is completed.

2.4 Ion Sources

Three ion sources are installed in this accelerator system. One is a multi-cathode source of negative ions by cesium sputtering (MC-SNICS). The others are a SNICS and a Duoplasmatron. MC-SNICS is for ^{14}C analysis and is cleaned and re-assembled firstly. Cesium is refilled for MC-SNICS. The power systems for MC-SNICS are checked and confirmed that they are operating well.

The SNICS and the Duoplasmatron are used for multi-purpose system and will be tested later.

2.5 3-MV Cockcroft-Walton Tandem Accelerator

The main accelerator is a tandem accelerator, in which it is grounded at both ends and high voltage is applied at the center terminal. Since the accelerator applies a high voltage in a Cockcroft-Walton type, an RF power supply is used to generate the high voltage.

Firstly, the terminal systems is tested. The stripper gas control is calibrated and the terminal pumping operation is checked.

The insulation gas (SF_6) pressure tank is assembled tightly and SF_6 is injected into the tank up to 2.5 bar pressure for low voltage (~ 10^5 V) test. For full range voltage (2 – 3 MV), pressure should be up to 8 bar.

RF power supply does not work because of the high voltage breakdown accident at SNU. The IC's in the voltage regulator part are nearly broken. The power supply is in the repair.

Most parts of the accelerator system operate almost normally. However, high voltage applying power supply is still under repair. When the high voltage operation is completed, the facility will be inspected and registered as an authorized device.

3. Conclusions

The installation of the 3-MV tandem accelerator at KOMAC is in smooth progress. Repairing a high voltage power supply may takes some time, but after successful completion of the high voltage test, the facility can be inspected.

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