PELLETRON ION ACCELERATOR FACILITIES AT INTER UNIVERSITY ACCELERATOR CENTRE

S. Chopra, IUAC, New Delhi, India

Abstract

Inter University Accelerator Centre has two tandem ion accelerators, 15UD Pelletron and 5SDH-2 Pelletron, for use in different areas of research. Recently Accelerator Mass Spectrometry facility has also been added to to the existing experimental facilities of 15UD Pelletron. In these years many modifications and up gradations have been performed to 15UD Pelletron facility. A new MC-SNICS ion source has been procured to produce high currents for AMS program. Two foils stripper assemblies ,one each before and after analyzing magnet, have also been added for producing higher charge state beams for LINAC and for experiments requiring higher charge states of accelerated beams.

A new 1.7MV Pelletron facility has also been recently installed at IUAC and it is equipped with RBS and Channelling experimental facility. There are two beam lines installed in the system and five more beam lines can be added to the system.

A clean chemistry laboratory with all the modern facilities has also been developed at IUAC for the chemical processing of samples prior to the AMS measurements. The operational description of the Pelletron facilities, chemical processing of samples, methods of measurements and results of AMS measurements are being presented.

PELLETRON ACCELERATOR FACILITIES

Inter University Accelerator Centre has two tandem ion accelerators, 15UD Pelletron and 5SDH-2 Pelletron, for use in different areas of research. The 15 UD Pelletron has been in operation since 1990 and it has been operating successfully providing beams to more than 400 users from different global locations of India and abroad. The uptime of accelerator is more than 90% and beam time utilization factor is above 60%. The accelerator operation has recently been done with LINAC and 15UD Pelletron injected beams into LINAC.

The 15UD Pelletron during last nearly 25 years has served very well to all the researchers but several major maintenances had to be performed to keep the accelerator in best operational state. Many major modifications have also been performed to upgrade the capabilities of the accelerator. The major steps in the overall strategy of the operation and maintenance has helped us to reduce the number of tank openings of the accelerator.

The 15UD Pellertron was originally equipped with SNICS ion source but at present it is being operated with MC-SNICS ion source as MC-SNICS was added to the system to produce beams with higher currents and to deliver beams without delay to the users. The replacement of SNICS with MC-SNICS helped to improve beam time utilization factor of the accelerator. However , during these operational years we have noticed that this source has some operational limitations. It needs frequent maintenance due to constant high flow of cesium , floating cathode contact and shorting of cesium focus lens, einzel lens and general purpose accelerating (GP) tube. In order to avoid all of these operational problems , a new modified version of MC-SNICS ion source is being planned to be installed in near future. The modified MC-SNICS will help to further improve beam currents of the MC-SNICS and provide maintenance free operation of the ion source system. The modified MC-SNICS ion source has many features which MC-SNICS does not have. Few of the features are like the spherical ionizer focuses the cesium beam at the cathode target finely and 90-95% of the target material can be used to produce beam. The cesium diffuser diverts caesium only to the surface of the spherical ionizer. By doing this there are longer periods between each maintenance of the ion source.

Vacuum insulated cesium feed line allows normal operation of source with an oven temperature of 90^{o} C not as in the case of other oven at $130\ ^{o}$C. Also because of the lower oven temperature cesium doesn't migrate to the extractor lens and GP tube. The cathode contact is no longer done in the vacuum but is done externally which helps to eliminate most of the cathode sparking.

Till recently, home made foil by Evaporation Condensation (E-C) technique of 4 ug/sq.cm were used but recently we have started using laser plasma ablated(LPA) foils and these foils have improved the life of stripper foils. In past the stripper foils had to be replaced every six months but recently we opened tank after one year of operation due to other different reasons. The E-C foils have very short lifetime when irradiated with heavier beams like I, Ag, Au etc. LPA foils are known to exhibit longer lifetime against the radiation damage because its structure is composed of randomly oriented nano crystals . Lifetime of LPA foils are around 10 times more than E-C foils.

The performance of the new laser plasma ablated carbon foils versus old carbon foils are shown in fig.1.

Two foils stripper assemblies , one each before and after analyzing magnet, have also been added for producing higher charge state. These foil stripper assemblies have capacity of loading 50 foils of 5/8" diameter. After Analyzer Magnet, installation of the foil stripper is utilized by various experimental groups for:

Low Flux Irradiations, Charge state dependence studies, Isobar separation e.g In ^{10}Be measurements, ^{10}B is major source of contamination.

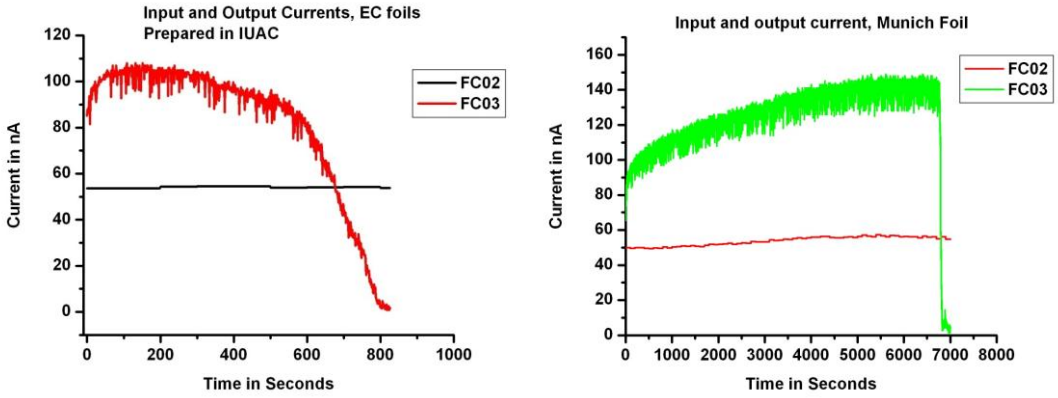

Figure 1: Performance of comparison of foils

Two controllers of similar design were developed and installed to control the operation of newly installed foil stripper assemblies. A position read back system was also designed by using a 3 digit BCD UP/DOWN counter with a DAC and these are being used for position read back of all the foil stripper assemblies in the system

A new SF_6 chiller has also been added to the system in place of a chiller which was being used inside accelerator tank to regulate the SF_6 temperature inside tank at around 25 ^{o} C. This new chiller is of shell and tube type. Chilled water is circulated in the tube which cools SF_6 gas present in the shell. The designed heat load for this chiller is 16,500 kcal/hr.

Although many new up gradations have been performed for 15UD Pelletron but many major maintenance activities have also been done. One of the charging chain has run for more than 1,25,000 hours now which is one of the world records but charging system had required major maintenances in the past. We have been continuously changing moving parts inside of the accelerator .Recently four more column support posts have also been changed which will help to improve overall voltage holding capacity of the accelerator.

Figure 2: 1.7MV Pelletron with RBS-Channelling facilities.

A new 1.7MV Pelletron facility has also been installed at IUAC. The new 1.7MV facility is a Pelletron based system manufactured by National Electrostaics Corp,USA and is equipped with RBS and Channelling experimental facility. The new facility has an alphatross ion source to produce alpha ion beams as well as proton beams. The 1.7 MV Pelletron facility can have one more negative ion source and can be used for other applications. The installation of this facility was completed recently and is open for users to perform RBS as well as channelling related experiments. There are two beam lines installed in this system and five more beam lines can be added to the system. The RBS system is supplied by Charles Evans and associates. Soon another low temperature RBS system will be installed in another beam line. Fig 2 shows the newly installed 1.7MV Pelletron with RBS facility.

Accelerator Mass Spectrometry facility was also added to existing 15UD Pelletron recently. The AMS facility has been added to the existing 15UD Pelletron ion accelerator after performing many up gradations to the accelerator. ^{10}Be and ^{26}Al measurements are being performed regularly for samples from different sources to study chronological events in various fields of earth sciences. Many modifications like addition of new ion source, a new re circulating gas stripping system in high voltage terminal, addition of Wien filter in AMS beam line and installation of offset faraday cup are few modifications and components installed in the system. A new clean room based chemistry laboratory for the processing of ^{10}Be and ^{26}Al samples has been developed. This laboratory is a completely metal free laboratory and is equipped with all the major equipments required to follow chemical processing steps.

The inter laboratory comparison have been performed for ^{10}Be samples as shown in Fig 3.The real sample inter laboratory measurements will also be performed. The ^{26}Al measurements are also being done and soon we shall be performing inter laboratory comparison studies for ^{26}Al samples also.

In brief all the facilities mentioned above are operating and performing satisfactorily. Many new plans

are being made with new 1.7MV Pelletron as well as AMS facility for the optimized usage of these facilities.

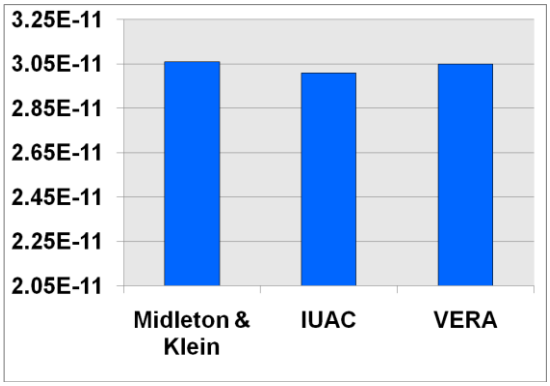

Figure 3: Comparison of the measurements for ^{10}Be standard in various laboratories.

Figure 4: Sample processing laboratory ^{10}Be,^{26}Al

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