1. ACCELERATOR

1.1 OPERATIONAL SUMMARY

S Chopra

The accelerator operation in this year has been smooth with only major breakdowns of charging system. In addition to regular operation & maintenance of the accelerator, efforts were put to solve problem of charging system completely.

The operational summary of the accelerator is as follows for period 02-04-2004 to 02-04-2005.

Total No. of Chain Hours	=	6827 Hours
Actually Used	=	2932 Hours
Facility Testing	=	0692 Hours
Total utilization	=	3624 Hours
Machine breakdown	=	0232 Hours
Accelerator Conditioning	=	2902 Hours
Beam Change Time	=	0010 Hours

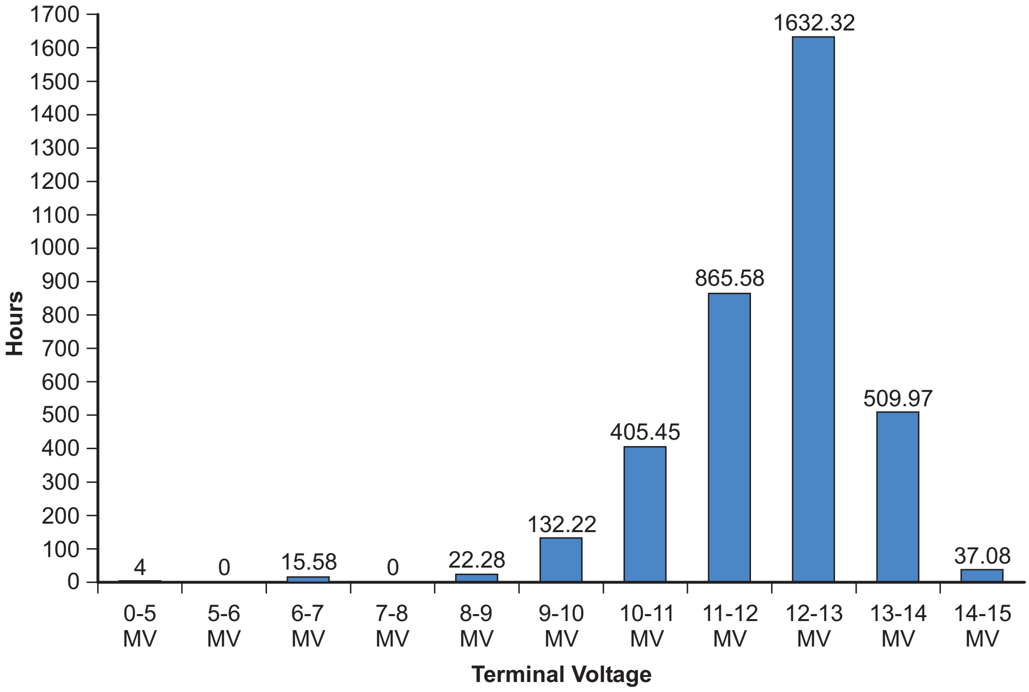

Fig. 1 : Terminal Voltage vs hours graph for the 15 UD Pelletron

During the above mentioned period, a total of 453 shifts were used for experiment. Out of these 453 shifts, 89 shifts were used for pulsed beam users which include LINAC testing also. The machine uptime for this period is 96.6% and the beam utilization is 53.08%. The voltage distribution of the Terminal Potential used for different experiments in the year is shown in Fig. 1. The maximum voltage achieved during conditioning in this year was 15.3 MV.

The total duration of beam run for mentioned period is 3624 hrs. Duration of run time in percentage for different ions is shown in Fig. 2.

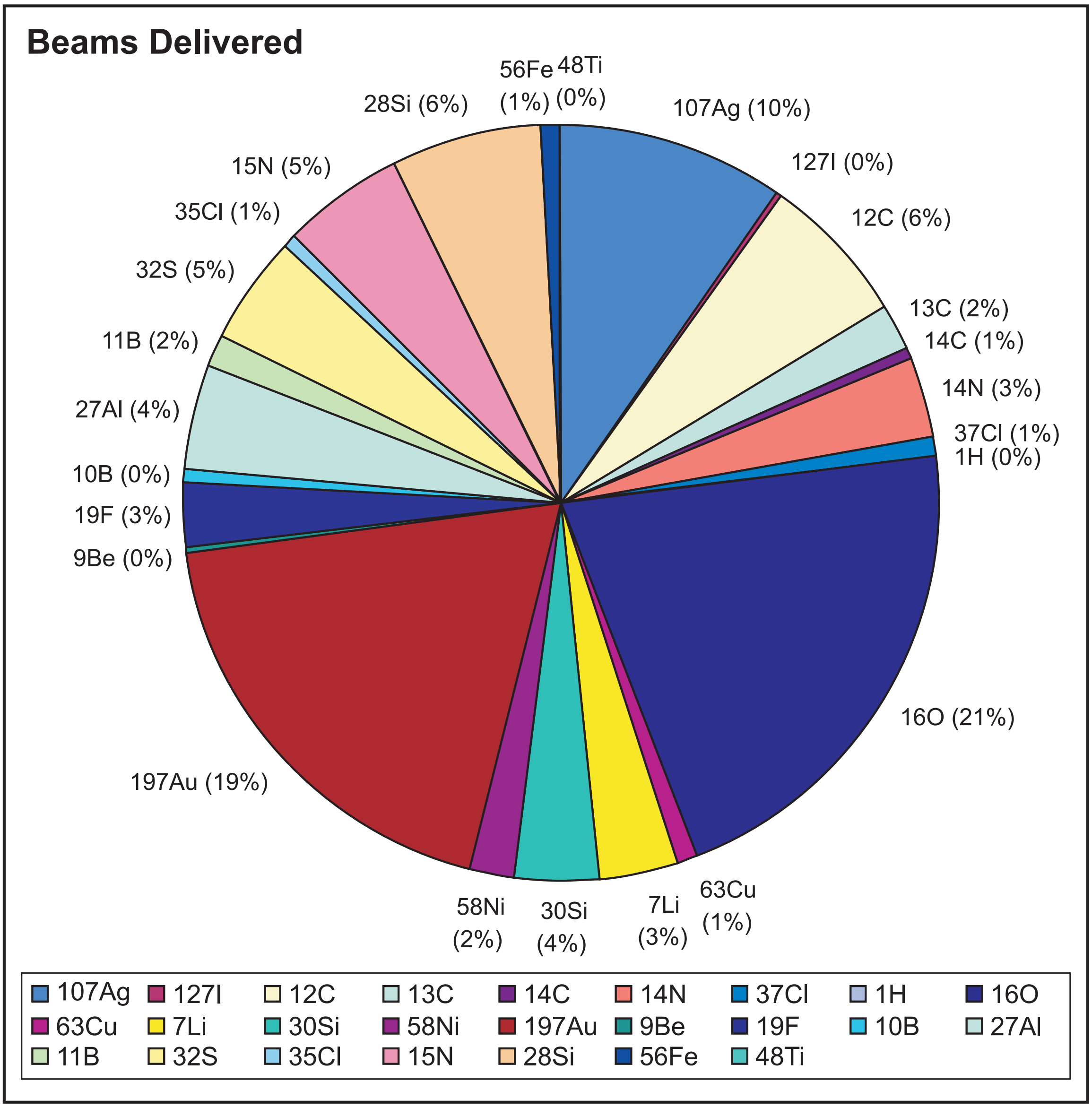

Fig. 2 : Run Time for different ions during 2004-05

1.2 MAINTENANCE AND DEVELOPMENT ACTIVITIES

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There was only one scheduled tank opening maintenance and this maintenance was taken up after a duration of seven months of operation. In this scheduled maintenance, routine maintenance like checking of resistor network inside tank, HV breakdown test of CSP gaps, foil stripper change etc. were carried out. Apart from these jobs a few major maintenance works were also performed.

Major maintenance jobs

The major maintenance jobs carried out are listed below:

1. Charging system maintenance

Although the terminal voltage went to 15.3 MV, but towards end of the cycle it was not going beyond 12 MV. The inside of the tank was looked at through view port. Lots of sparks were found across pellets of both the chains at higher terminal voltages and sparks were also noticed in unit #8. The unit #8 was shorted for smooth operation of machine. As nothing could be done to take care of sparking across pellets, it was decided to restrict the terminal to 12 MV and rectify this problem during tank opening maintenance. The scheduled tank opening maintenance started from 8^{th} January 2005. Lots of idler wheel dust was observed in both the charging systems. First of all, the charging chains were properly cleaned and the idler wheels of both charging system were readjusted. Both chains were run overnights and weekends. It was noticed that there was no idler dust in the chains but some fine pulley dust was generating from the terminal pulley of charging chain #2. This pulley was thoroughly cleaned and a thin layer of turbo pump oil was applied on the rim of this pulley. Chain #2 was put ON and it was observed that no pulley dust from terminal pulley was now getting generated. This indicates that the pulley dust was getting generated due to friction between chain and pulley rim. A thin layer of turbo pump oil was put on the rim of chain #1 also. Both the chains were kept ON overnight and neither idler wheel dust nor pulley dust was observed.

2. Rotating Shafts bearing maintenance

Another major maintenance work, carried out, was rotating shaft bearing maintenance. Total number of nine separator boxes, three in low energy side and six in high energy side, were opened for maintenance. Bearings of all these separator boxes were replaced as all of them were bad. In one separator box, rubber coupler was found to be cracked and was replaced by new one.

3. Unit repairing

As lots of bearings of rotating shaft were bad, this led to much vibration in the machine. Due to these vibrations a few equipotential rings came out from the column support posts and also lots of resistors got loosened. A few series connections fell on the castings. Each and every column support post and accelerating tube resistors were checked and tightened for better connection. All the series connections were put back.

4. Replacement of hoop screws

Lots of hoop screws were also changed. These hoop screws developed resistance between screw head and equipotential rings due to some deposition on the threads of hoop screws. The deposit material was analysed and found to be the byproducts of SF_6 gas.

1.3 ION SOURCE ACTIVITIES

S Gargari, K Devarani, M Sota, S Ojha, V Patel, J Prasad, R Kumar, M P Singh, N S Panwar, S Mohan, Suraj Kumar, R Joshi and S Chopra.

The ion source operation was smooth up to April, 2003 since its installation in July, 2002. The ion source operation had to be stopped for maintenance work after this period. The major breakdown and maintenance work performed are given below:

Maintenance work

1. General Purpose Tube (GP tube) conditioning

General purpose tubes (between the Deck and the beamline) were not holding potential more than 200 kV and beyond this voltage it was sparking. All five General purpose tubes were cleaned thoroughly with alcohol and then it was conditioned. During conditioning X-ray activity was monitored in area monitor. The radiation was going as high as 2.5 mR/hr. After proper conditioning, the General purpose tube is holding up to 300 kV.

2. MC-SNICS Ion source maintenance

The source was opened for maintenance. The source was totally disassembled. Each and every part of source was sand blasted and properly cleaned. After thorough cleaning work the source was reassembled back and aligned. The cesium focus lens was also replaced by new lens as this was not working effectively. The source was then connected to beam line. 5 grams of fresh cesium was also loaded in the cesium reservoir.

3. Einzel lens cleaning work

During regular operation of the source it was noticed that the focus electrode of the einzel lens was not holding potential. So the resistance of the ceramic surface was measured with the help of meggar and it was found that it got shorted from inside. To rectify the problem the lens assembly was removed from the high voltage deck. One spare einzel lens was in stock but this spare was of old version (SNICS-II). The first element of this spare lens is of a different configuration from that of the MC-SNICS einzel lens. The first element of lens of MC-SNICS was taken out and the first element assembly of the spare einzel lens was replaced by this element. In this way the SNICS-II spare einzel lens was modified. Then the modified lens was installed. It has been checked with the beam and it is working fine.

Ion Source Test Bench facility

A chamber is installed at the end of a test bench beam line and a quartz has been installed in this chamber. Beam was viewed on this quartz. It was found that the beam size as seen on the quartz was rather big beam covering the full quartz. Beam could not be focussed. To solve this problem, we are planning to install an electrostatic quadrupole in the line after injector magnet. A quadrupole was designed and its fabrication is under process. This quadrupole can be used in triplet as well as doublet configuration. Apart from this fabrication of an electrostatic steerer is also under process. There is plan to use this steerer as a scanner also. The design of scanner power supply controller is also done. A prototype of this controller is fabricated and tested.

1.4 BEAM PULSING SYSTEM

R Joshi, S Ojha and A Sarkar

Operation

Pulsed beam was delivered to user for a total number of 538 hours, out of which 74 hours were used for LINAC testing and remaining 464 hours were used by other users. ^{28}Si pulsed beam was used for LINAC testing and the pulsed beam used by other users are ^{16}O and ^{19}F. For all these pulsing runs, the multi harmonic buncher was used to bunch the different ion species. For LINAC testing high energy sweeper was used to sweep away the dark current whereas for remaining experiments, 4 MHz. chopper in pre acceleration section was used to eliminate the dark current as the repetition rate required by user was 250 ns. Traveling wave deflector (TWD) was also used, along with chopper and multi harmonic buncher, to get different repetition rates other than 250 ns. The beam pulsing system worked satisfactorily for all experiments.

1.5 ACCELERATOR MASS SPECTROMETRY (AMS)

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AMS facility development work has continued this year as before. Progress made in various developments is reported below. This year, we were able to detect ^{14}C from sample obtained from IOP and some progress was made in the Be -10 cathode preparation from standard solutions and towards 10Be detection. Some modifications were done in the beam line, which is fully dedicated to AMS now. AMS chamber, Detector and quartz put on a Ladder, Gas cell Absorber (for 10Be) and double slit in front of the chamber are among the new components added to the line. The Wien filter was fully tested and a remote controller for offset Faraday cup was designed.

1.5.1 Detection of ^{14}C from IOP sample

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We got a few ^{14}C samples from IOP, Bhubaneshwar for our system calibration. With these samples we were able to detect ^{14}C. In this experiment first ^{12}C was tuned from graphite sample up to FC- 02 (after injector magnet). ^{12}C current was 3µA. Then ^{13}C beam was tuned up to chamber and seen on quartz. Then accelerator parameters were scaled to mass 14 keeping $ME/z^2 = 36$ fixed. After this we switched to IOP sample and at TP = 8.22 MV and fixed $ME/z^2= 36$, beam was allowed to fall on E-dE telescopic detector. Two dimensional E-dE spectrum is shown in fig 1.

Li was present in sample as an impurity, which came at the time of cathode loading due to using same needle used earlier for Li sample loading.

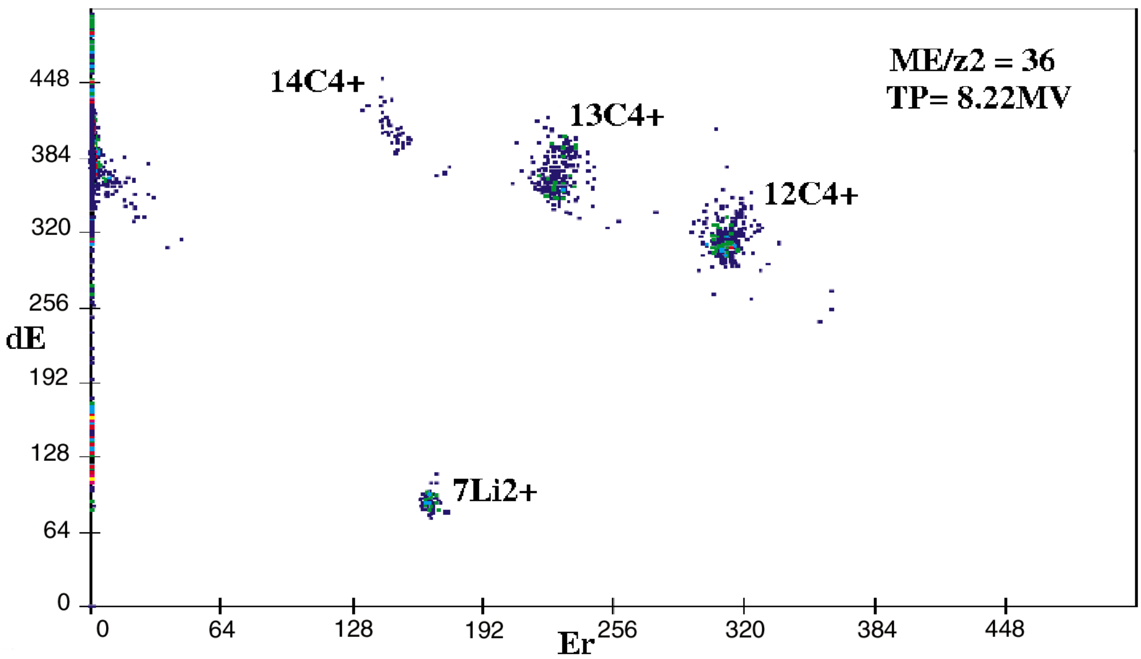

Fig. 1 : Two dimensional dE- E_{res} spectrum showing the presence of ^{14}C

1.5.2 Modification of Beam Line

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The beam line for the Atomic Physics Chamber was modified and made dedicated for AMS work. For this purpose we designed a new chamber (Fig.2). Chamber has one remote controlled Ladder, Insertable Faraday cup and Pumping system, camera for viewing and a lighting arrangement. Ladder is mounted on a 6'' motion (Linear Motion Feed thru) LMFT from chamber top, while Insertable Faraday cup is on another LMFT operated from the bottom of the chamber. On the ladder we have placed a Quartz, a Si Surface Barrier Detector and one E-DE telescopic Si Detector arrangement, of which any one can be used at a time. Insertable Faraday cup is installed in such a way that it comes in front of the ladder to collect the stable isotope beam as required in case of ^{36}Cl or ^{14}N measurement. Before the Chamber a double slit was installed to eliminate the unwanted ions deflected by the Wien filter. Double slit is installed at around 5 meter downstream of the Wien filter exit and can be opened from practically 0 mm to about 32 mm. After the Chamber the Multi Anode Gas Ionization Chamber (MAGIC) was installed.

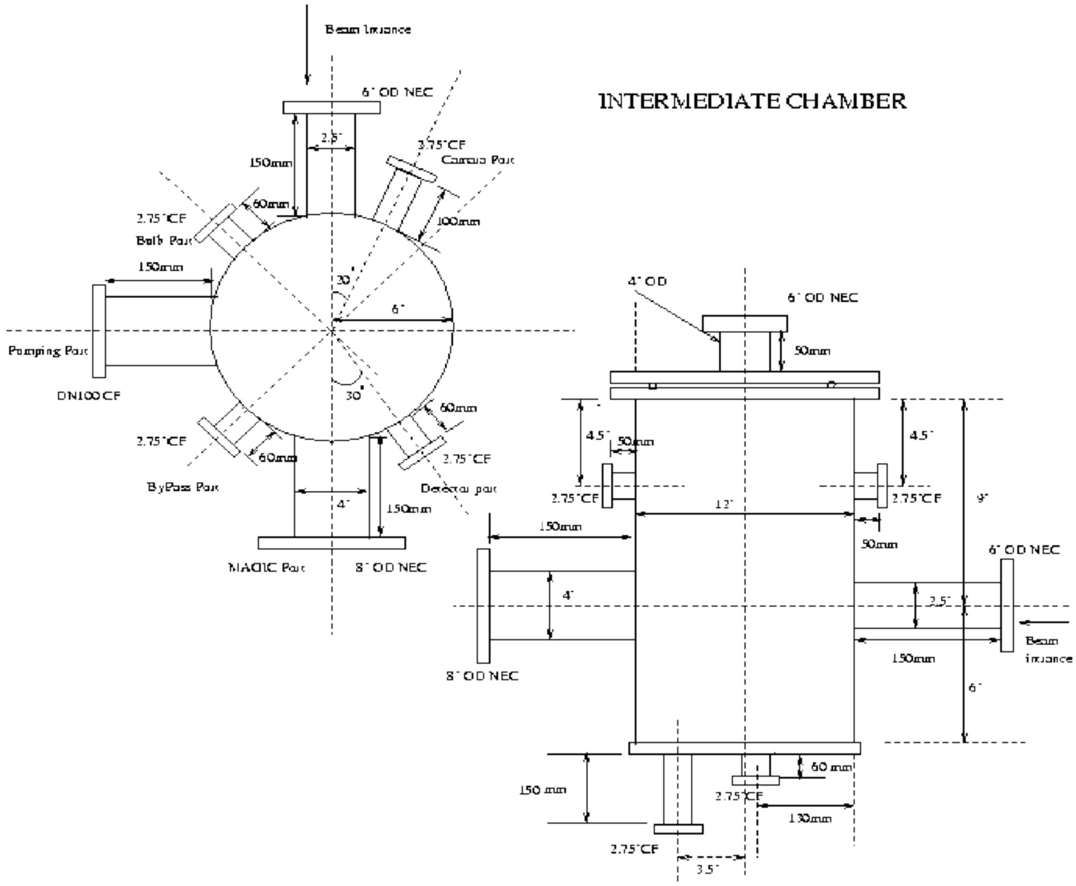

Fig. 2 : AMS Chamber

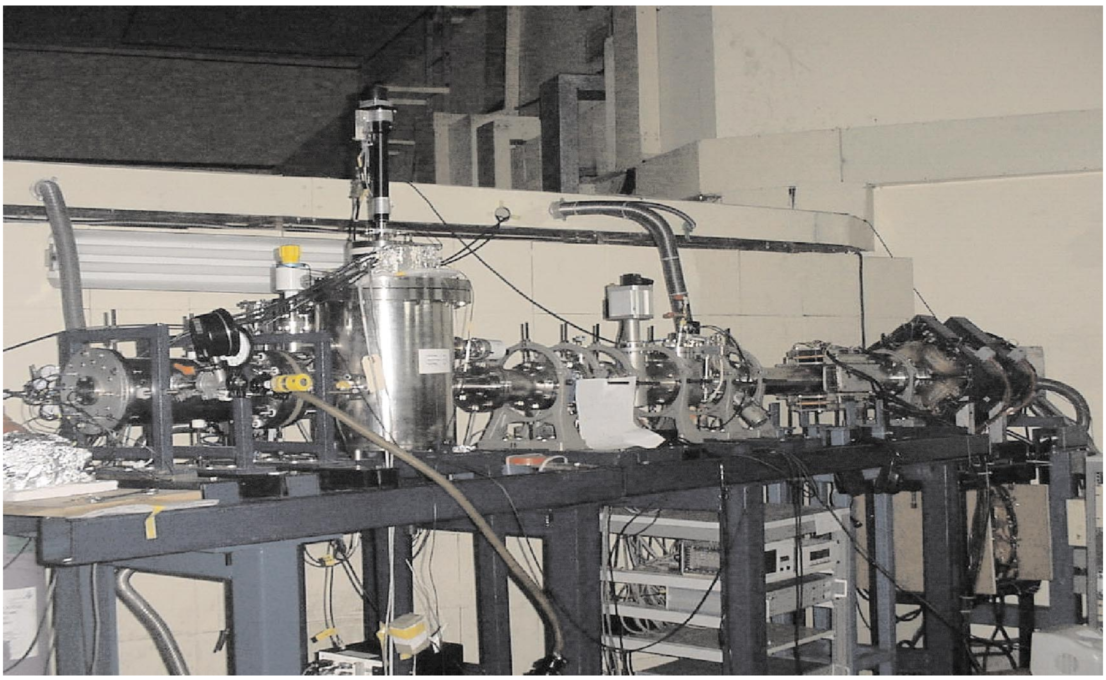

Fig. 3 : AMS Beam Line in Beam Hall 1

Subsequently a Gas Cell Absorber was also installed in the beam line. This is in between the chamber and MAGIC detector. The length of the cell is 350 mm. The window foils are of mylar of 6 micron thickness and the operating pressure will be in the neighborhood of 200-250 torr of Nitrogen gas. Gas Cell Absorber will be used for stopping B-10 (isobar of ^{10}Be) in the measurement of Be-10 of 40.7 MeV (3+ at 12 MV terminal potential)

1.5.3 Testing the effectiveness and calibration of Wien Filter

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We have now tested and calibrated the Wien filter. Testing was done using Carbon beam. Earlier it was possible to deflect away the ^{13}C present in injected mass 14 beam entering as ^{13}CH, while the ^{12}C beam from $^{12}CH_2$ were detected in the detector. The detector dimension was of 14 mm diameter and the detector was at a distance of 5.7 m from Wien Filter. Electric and Magnetic fields required were 6.25 x 10^5 volts/meter and 245 Gauss respectively. Later on it was checked whether the calculated values for the E and B fields for a given energy and mass and known dimensions of the detector matched the observed values of the fields. This was done using $^{16}O^{5+}$ sputtered beam tail present when mass 14 is selected in the injector magnet. Fig 4 (a),(b) shows the relevant spectra. $^{12}C^{3+}$ (Velocity = 20.8 x 10^6 m/s) peak is totally vanished (Fig. 4(b)). Since the velocities of $^{16}O^{5+}$ = 25.8 x 10^6 m/s and $^{13}C^{4+}$ = 25.5 x 10^6 m/s are nearly equal, so at the applied value of E = 6.53 x 10^5 V/m, B = 250 G, both these peaks were still falling on the detector of 12 mm diameter. It would be possible to get one of them off the detector at higher values of E and B or by restricting the slits to reduce the effective area of the detector. Applied magnetic and electric field values were matching with theoretical calculated values within a few percent.

1.5.4 Remote Controlling of Off-set Faraday Cup

Suraj Kumar, Pankaj Kumar, S Gargari, S Chopra and S K Datta

Off-Set Faraday cup is situated after analyzer magnet in the vault area. This will be used to collect $^{17}O^{5+}$ (representative of ^{9}Be) in the simultaneous measurement of Be-10. Off-set Faraday cup is installed with 4'' motion Linear Motion Feed Through (LMFT), operated by 10 RPM motor. For remote controlling of Off-Set Faraday cup one controller was made. This controller can control linear movement of Faraday cup remotely as well as locally in both up and down directions. The main controller is in the vault area with which the Faraday cup can be controlled locally and for remote controlling another controller

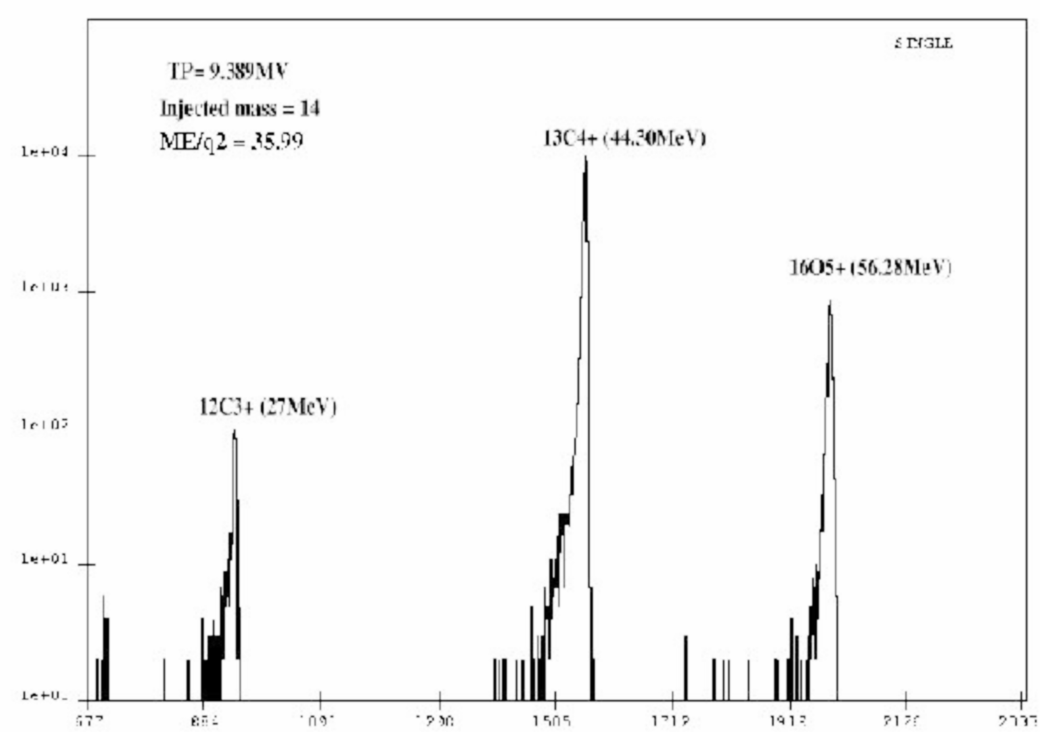

Fig. 4 (a) : Single detector spectrum when Wien Filter was off

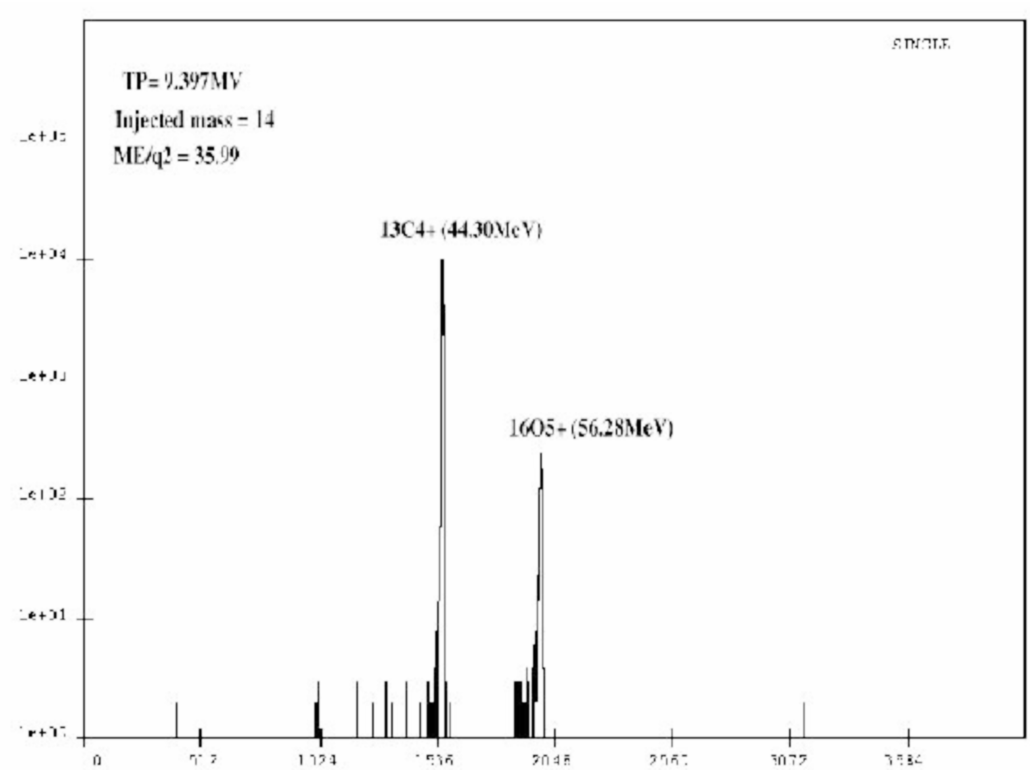

Fig. 4 (b) : Single detector spectrum when Wien Filter was on

is installed in control room. All required switches are provided on the controller panel.

1.5.5 BeO sample preparation from Be standard solution

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As part of Be-10 Detection Facility development, BeO samples were prepared from Be Standard solution, obtained from NIST, USA. For this, first Be solution (in HCl) was neutralized with ammonia and precipitated in $Be(OH)_2$ (Beryllium Hydroxide) form. After separation of ppt. by centrifuge process it was washed 2-3 times. Then solution was re-precipitated by HNO_3 in $Be(NO_3)_2$ form and on adding Na_2CO_3 it was converted in $BeCO_3$, which on heating up to 900ºC in an oven, yielded BeO. Finally Ag/ Nb powder was mixed to enhance thermal conductivity in the BeO powder and then this mixture was loaded in cathode capsules. These loaded samples are stored in vacuum environment. Some of these have been used to look for 10Be.