1. ACCELERATOR

1.1 OPERATIONAL SUMMARY

S. Chopra

The accelerator operation in this year had been smooth and there were no major breakdowns in the accelerator. The operational summary of the accelerator is as follows for the period 01-04- 2003 To 31-03-2004.

Total No. of Chain Hours	=	6350 Hours.
Actually Used	=	3194 Hours.
Machine breakdown	=	354 Hours.
Accelerator Conditioning	=	2188 Hours.
Beam Change Time	=	6 Hours.
Facility Testing	=	608 Hours.

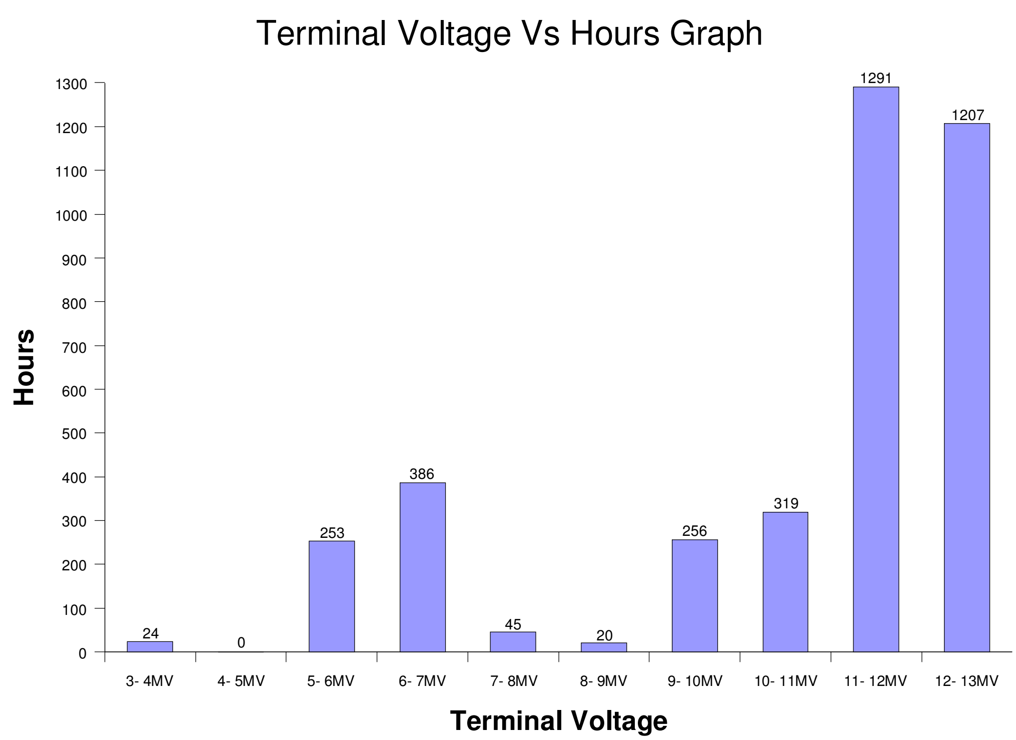

Fig.1:Terminal Voltage vs Hour curve

During the above mentioned period a total number of 475 shifts were used for experiments. Out of these 475 shifts, 76 shifts were used for facility testing and rest were used for user experiments. The machine uptime for this period is 94.42% and the beam utilization is 59.87%. 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 13.5 MV.

The total duration of beam run for the mentioned period is 3802 hrs. Duration of run time in percentage for different ions is shown in Fig. 2.

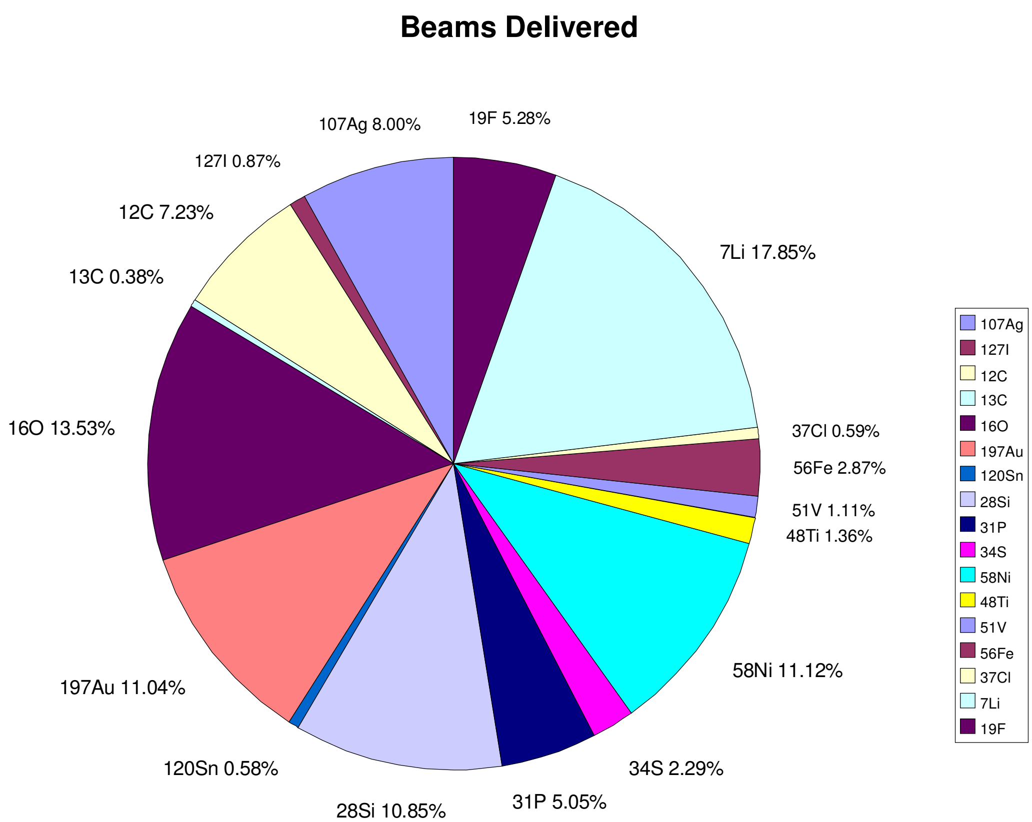

Fig. 2: Run time for different Ions (2003-04)

1.2 MAINTENANCE AND DEVELOPMENT ACTIVITIES

S Chopra, R Joshi, S Gargari, M Sota, V P Patel, S Ojha, K Devarani, J Prasad, R Kumar, M P Singh, N S Panwar, S Mohan, Suraj Kumar, P Barua, A Kothari, B Kumar and R P Sharma

There were four tank opening maintenances, out of which, two were scheduled and the other two were unscheduled maintenances. The scheduled maintenances were for routine activities like checking of resistor network inside tank, HV breakdown test of CSP gaps, foil stripper change etc. The unscheduled maintenances were exclusively for repairing breakdowns. The major activities, in these four tank openings, were related to accelerator modifications and breakdown maintenances.

Major maintenance jobs

The major maintenance jobs carried out are listed below :

1. In one scheduled maintenance, it was observed that the condition of all four column support posts in unit #10 was bad. The ceramic of 2^{nd} gap of all the support posts got severely cracked and were not able to hold required voltage. The column support post P1, of this unit broke into two pieces from 2^{nd} gap. Therefore, all four damaged column support posts were replaced by new ones.

2. During conditioning, the terminal voltage was not going beyond 10.6 MV. Lots of glitches were observed in high energy (HE) as well as low energy (LE) sections. It was decided to short the problematic units and run the machine. During shorting in LE section, the drive got stuck and did not work. The tank had to be opened for unscheduled maintenance. After opening the tank, one nylon rod was found in bent condition, like a bow, in Unit #1. This was caused due to dryness on rod surface and which was not pushing through smoothly. This damaged rod and the corresponding rod guide were changed and a thin layer of oil was applied on rod surface to solve the problem.

3. Another major breakdown was in charging system #1. The terminal was getting restricted to around 10 MV. The problem was looked into and lots of sparks were found all along chain #1. The tank had to be opened for unscheduled maintenance. The charging system was thoroughly checked and it was observed that the lever, in the see saw arrangement of chain #1, was not moving smoothly. There was some friction between the lever and fulcrum as there was no clearance between them. This caused instability in chain positioning, hence chain was striking against idler wheel and was producing lots of idler dust. This idler dust got deposited on chain pellets and resulted in chain sparking. The see saw mechanism was taken out and machined to get some clearance between lever and fulcrum and was installed back. The driving pulley of charging chain and charging chain #1 was properly aligned. One pellet of charging chain #1 was also cut to reduce the slackness in chain. All the damaged idler wheels were changed and aligned properly. The chain motor #1 was put ON and the movement of chain was observed closely. Chain #1 was running smoothly without any wobbling and none of the idler wheels was touching the chain at the time of movement of chain, and no idler dust, was coming out.

4. During the operation of accelerator, sometimes it was seen that gas stripper at terminal gets open, Faraday cup at terminal, foil stripper at HEDS and corona probe move of its own with tank spark. The cause for this was thoroughly investigated in one of the scheduled maintenances and it was found that the problem was in the spark protection modules. The spark protection modules were not able to take care of the

voltage spike due to tank high voltage spark. This spike got propagated through spark protection circuit and caused this erratic operation. All the spark protection modules, corresponding to terminal gas stripper, terminal Faraday cup, foil stripper at HEDS and corona probe, were replaced. The terminal faraday cup was also kept in open position permanently. This solved the problem of erratic operation of devices.

5. A few other important maintenance work was done. These were the repair of through leak of terminal lower valve, replacement of lower pendulum valve by NEC repaired valve. During operation, ion pump (IP T2-1) got damaged and it had been replaced by a recycled ion pump. A leak of order of 10^{-6} T was developed in faraday cup (FC 01-1). This cup was leaking in the out condition. The leak was detected in the bellow, and the head assembly of this faraday cup was changed to solve the problem.

Modification work

Earlier in 03 area, faraday cup (FC 03-1), fast acting valve (BLV 03-2) and beam profile monitor (BPM #4) were installed in such a way that FC 03-1 was followed by BLV 03-2 and then by BPM #4. If the beam is stopped in FC 03-1 the profile of beam cannot be monitored in BPM #4. To have an effective use of BPM #4, it was decided to change the positions of these components. Therefore, the positions of these components were rearranged, so that BPM #4 is now followed by FC 03-1 and then by BLV 03-2.

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 had to be opened for maintenance work after this. The major breakdown and maintenance performed are listed below:

Maintenance work

1. General Purpose Tube (GP tube) breakdown maintenance

After one year of MC - SNICS source operation, it was found that GP tube could not hold more than 190 kV as compared to normal voltage of 250 kV. To investigate the problem, all the GP tube resistors were removed and the resistance of each GP tube gap was measured. All the gaps of first GP tube were showing resistance in the range of Mega ohms whereas all other four GP tube gaps were showing infinity resistance. The problem was perhaps due to Cs deposition. To remove the deposited Cs from the ceramic surface, the tubes were baked for 7 days at a temperature of around 140°C. This improved the G.P. Tubes condition and it could hold 280kV after conditioning.

2. Ionizer Replacement work

The source was opened for maintenance. This was the 1st MC-SNICS source opening since its installation. The ionizer got broken during sand blasting. It was replaced with a new one.

3. Einzel lens cleaning work

Once during operation there was accidental over supply of cesium due to malfunctioning of control system. After this accident it was observed that the focus was following the extractor voltage. Without applying any voltage to focus, the focus was taking half of the extractor voltage. The cause for this was investigated and found that all the gaps of einzel lens were almost shorted. So the lens assembly was taken out from the high voltage deck for maintenance. Cesium deposition was found on the inner surface of einzel lens. The lens was dipped in alcohol for 24 hours and then it was baked for another 24 hours. The resistance was measured again and it was showing few hundred Gega Ohm. It has been installed again and beam has been developed successfully.

Development work

1. Installation of reverse movement mechanism for 40 MC-SNICS:

MC -SNICS was originally installed with unidirectional rotational mechanism for cathode wheel. To have quick cathode change, bidirectional rotational mechanism is essential. Hence it was decided to modify the system for bidirectional rotational mechanism and the required components, like advancing index cylinder, mounting roller actuator and tension spring for reverse rotational (anticlockwise) mechanism was procured. All these components were installed and new air line was laid for reverse rotation of wheel. Now MC - SNICS source cathode wheel can be rotated in both the directions which saves cathode change time substantially.

2. Ion Source Test Bench facility

The ion source test bench facility has been set up for carrying out research and developments in ion sources. At present this test bench is completely operational and various tests related to beam currents are being performed. In future for SNICS source, studies of gas cathodes, efficient production of negative ions, mixed cathodes and their relative yield in negative ion currents will be performed. Studies of ion sources other than SNICS source like Duoplasmatron source, alphatross may also be carried out.

1.4 BEAM PULSING SYSTEM

R Joshi, S Ojha and A Sarkar

Operation

Pulsed beam was delivered to user for a total number of 593 hours, out of which 134 hours were used for LINAC testing and remaining 459 hours were used by other users. ^{28}Si pulsed beam was used for LINAC testing and the pulsed beam used by other users are ^{7}Li, ^{12}C, ^{16}O, ^{19}F, ^{28}Si and ^{31}P. For all these pulsing run, 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.

Problems encountered and their remedy

A few problems like drift in centroid and time width of bunched beam were encountered. The control electronics of multi harmonic buncher was modified as some drift was also observed in control system. The main reason, for the problem of drift in centroid and time resolution, was instability in some of the power supplies, associated with steerer and chopper offset, in pre acceleration section. These faulty power supplies were replaced by new power supplies, after their stability test. In one of the occasion the problem in drift was due to broken foil stripper in high energy dead section. This foil stripper was replaced by an absolutely blank position. These actions solved the problem of drift satisfactorily.

1.5 ACCELERATOR MASS SPECTROMETRY (AMS)

Pankaj Kumar, J. Pattnaik[1], K. Devarani, S. Gargari, S. Chopra, T.K. Nandi, A. Mandal and S.K. Datta

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Work on the development of Accelerator Mass Spectrometry has continued this year as before and some of the details of the progress made are reported below. Most important among these are installation of the reverse motion mechanism in the Multi-cathode SNICS, Beam Optics calculation for the new AMS line, installation of the AMS beam line, with Wien filter and Quadrupole doublet, and putting the beam through the new line.

a. Completion of Beam Line for AMS

Pankaj Kumar, J.Pattnaik, K.Devarani, P.Barua, A.Kothari, S.Gargari, S.Chopra, A.Mandal, B.Kumar and S.K. Datta

The beam line for atomic physics, situated in Light Ion Beam Room (LIBR) is now dedicated for AMS usage. Beam Optics calculation was done with the code GIOS to find the best position for the installation of a Quadrupole doublet and the Wien filter in the line. The old position of the steerer was changed and it is now put after the Quadrupole. A second BPM is also incorporated, after the switching magnet at the position of the first beam waist which also serves as the object point for the Wien filter, Quadrupole combination. A distance of about 5.5 meters is allowed from the Wien filter to the final detector system for best separation of the unwanted components for Be and Chlorine work. The Beam Optics Calculation is shown in Fig.1 This work was completed in two phases i.e. in two Pelletron maintenance periods. In the first the Wien filter and an additional BPM after the switching magnet was put, and in the second the Quadrupole doublet was put after some changes in the relative positioning of the components. A Wien filter stand was fabricated and the Wien filter was put on it in the vault area. Stands and Chamber for the quadrupole magnet were designed and fabricated. Power connection and water connection for the quadrupole have been installed. A diagram of the new beam line is shown in Fig. 2. The multi anode detector, the intermediate chamber for solid state telescope and the insertable Faraday cup chamber is also installed. A single slit system is procured and will be put in the beam line in front of the multi-anode detector in the next maintenance period.

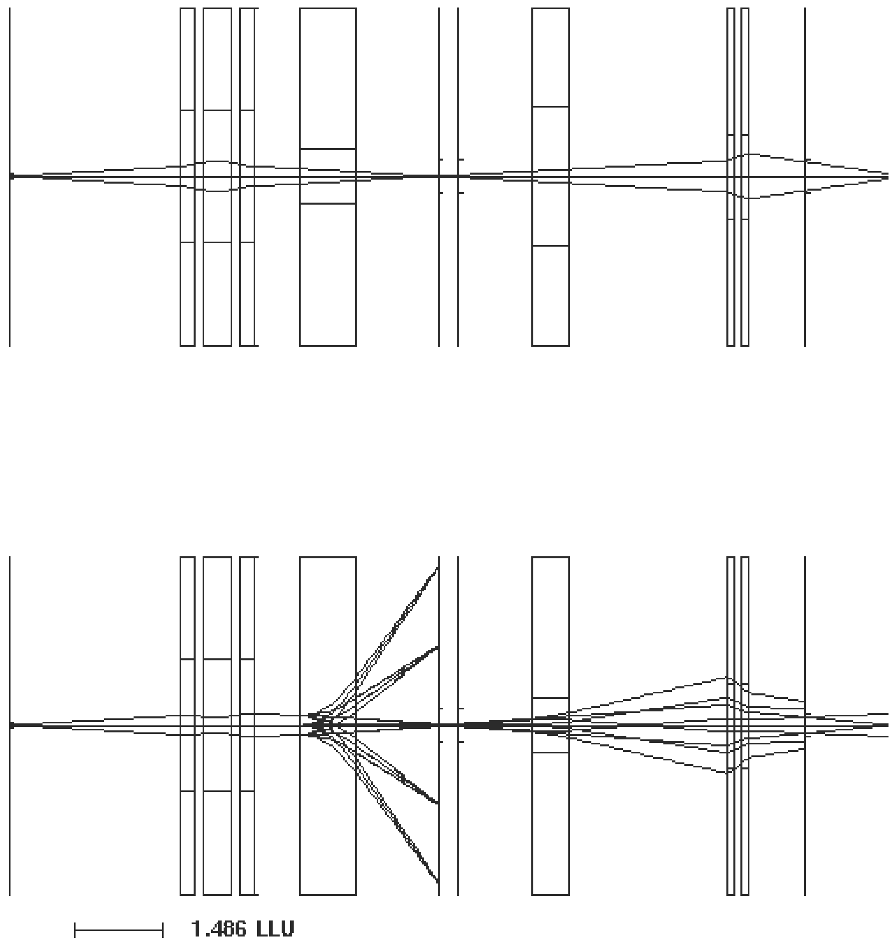

Fig. 1 Beam Optics Calculation with GIOS for AMS beam line. Top part is the Y plane, the bottom part is the x-plane. Major elements shown are the Magnetic quadrupole triplet in vault, Switching magnet, Wien Filter and Quadrupole Doublet, in addition to some apertures. The calculation is for 48MeV, 10Be 3+ charge state with mass deviation of 10% and energy deviation of 10%. (i.e. 3 masses and 3 energies)

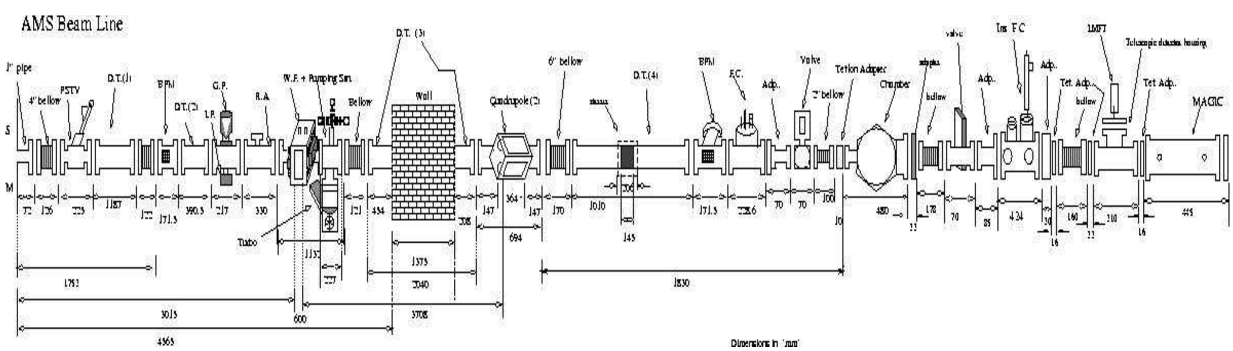

Fig.2 New AMS beam line, with all componenets marked

b. Local Controller for Wien Filter Electrical Power Supply and CAMAC control for Magnet and Electrical power supply

Suraj Kumar, S.K. Suman and Rajesh Kumar

The +/- 50 kV power supply (Model PS/MK50P01.5-22, PS/MK50N01.5-22, Glassman High Voltage Inc) obtained from DanFysik, needed a local controller box. This was designed. The two deflecting plates on which electrical potentials are applied, can be operated in a tracking mode (i.e. If 5kV is applied on the positive plate, -5kV is automatically provided in the other plate). Independent voltage operation mode is also provided. The voltage, as well as the current can be read on a digital panel meter locally. The Magnet power supply and the Electrical Power supply are also interfaced through CAMAC, using DAC, ADC, Input Gate and Output Registers, to the Pelletron control program. Read back signals are also provided. The Wien filter is fully operable now from control room.

c. Testing of Beam Line for AMS

Pankaj Kumar, J.Pattnaik, K.S. Golda, K.Devarani, S.Gargari, S.Chopra, T.K. Nandi, A.Mandal and S.K. Datta

The beam line was tested with a ^{12}C beam of 72 MeV and later verified with ^{28}Si beam of 70MeV. The Wien filter assembly needs an additional turbo pumping station, which was installed, to maintain a line vacuum in the neighbourhood of 5×10^{-8}torr. A 2mm beam spot could be obtained on the quartz near the end of beam line. Beam could also be read on the locally designed insertable Faraday cup, which compared well with the reading on NEC Faraday cup. The quadrupoles are needing fairly high power between 30% to 40% for the above mentioned beams. Some amount of misalignment is present as it requires high values of steerers for getting the beam in the centre of the quartz. This will be corrected in the next maintenance period. The Wien filter was also checked and found that deflections could be produced by the applied electric field and then cancelled by the applied magnetic field. The measured values of E and B fields were in conformity with calculated values for the given beam species and energy. This establishes its function as a velocity selector. Actual effectiveness of the Wien filter as a remover of the unwanted species would be tested in forthcoming AMS runs.

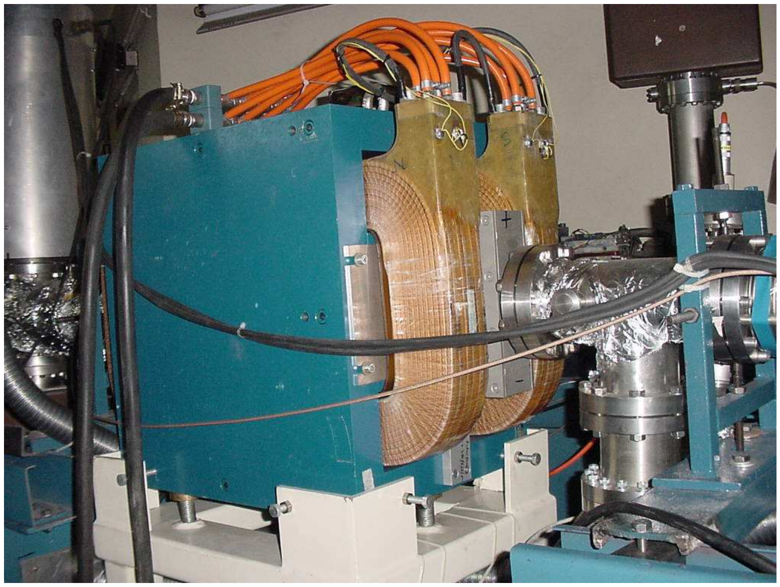

Fig.3. Wien filter assembly installed in beam line.