1. ACCELERATOR

1.1 OPERATIONAL SUMMARY

S Chopra

Operation of Pelletron was quite satisfactory from 1st April 2009 to 31st March 2010. There was only one scheduled tank opening maintenance of Pelletron in this period. Apart from this maintenance, tank was opened for another 130 hours for maintenance, in the month of April 2009 as an overflow of March 2009 scheduled tank opening maintenance. Routine maintenances of MC-SNICS ion source and maintenance of Traveling Wave Deflector (TWD) were carried out during a short maintenance period from 5th to 8th October.

The accelerator was conditioned upto 14 MV. ^{24}Mg, 7^{+}, 10^{+}, 123 MeV beam was delivered to user at maximum terminal potential 13.15 MV and ^{11}B beam (36 MeV) at the minimum terminal potential of 7.18 MV. Out of total beam time of 4957 hours, 1284 hours of beam time was used by INGA users and 1081 hours were used for pulsed beam runs.

Statistical Summary

Breakup of chain hours

Total Chain Hours	=	7770 Hrs.
Beam utilization time	=	4957 Hrs.
Accelerator conditioning	=	1785 Hrs.
Time between experiments	=	729 Hrs.
Beam tuning time	=	247 Hrs.
Delay in experimental setup	=	52 Hrs.

The uptime of machine for this period was 99.21% and the beam utilization was 63.80%. Total power failure during mentioned period was ~111 hours.

Summary of other activities

Machine Breakdown time	=	61 Hrs.
Machine scheduled maintenance	=	846 Hrs.
Accelerator set up time after maintenance	=	54 Hrs.
Machine idle time	=	729 Hrs.

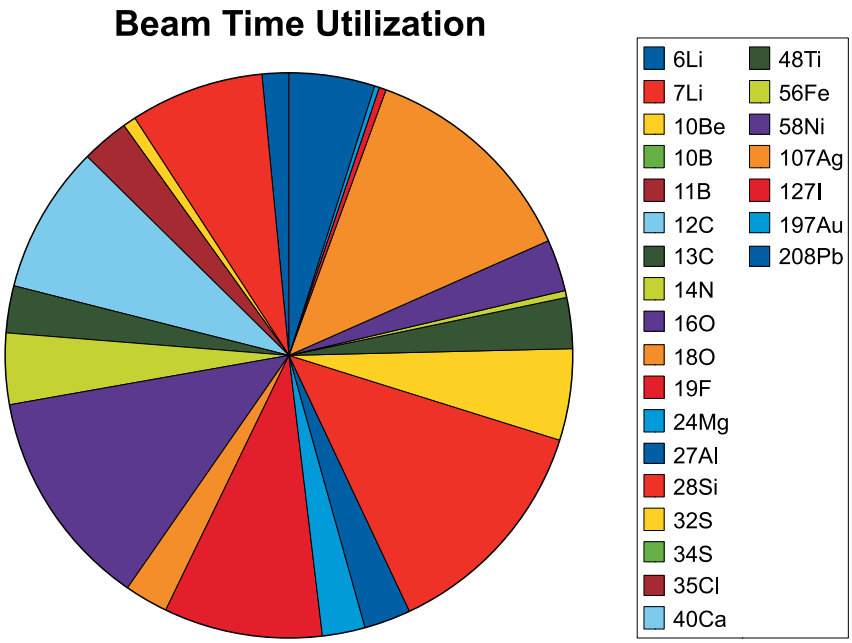

Fig. 1. Distribution of delivered beam species

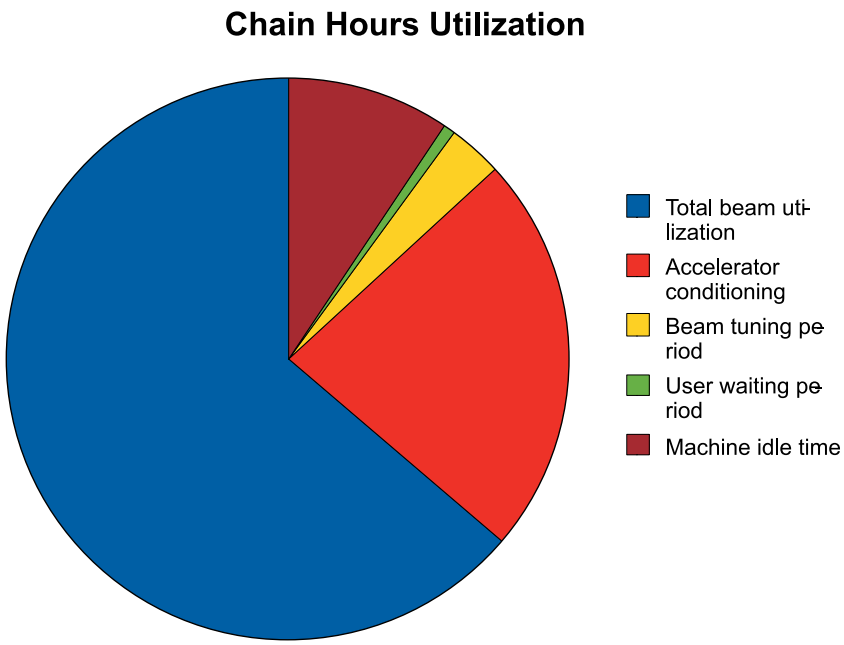

Fig. 2. Utilization hours

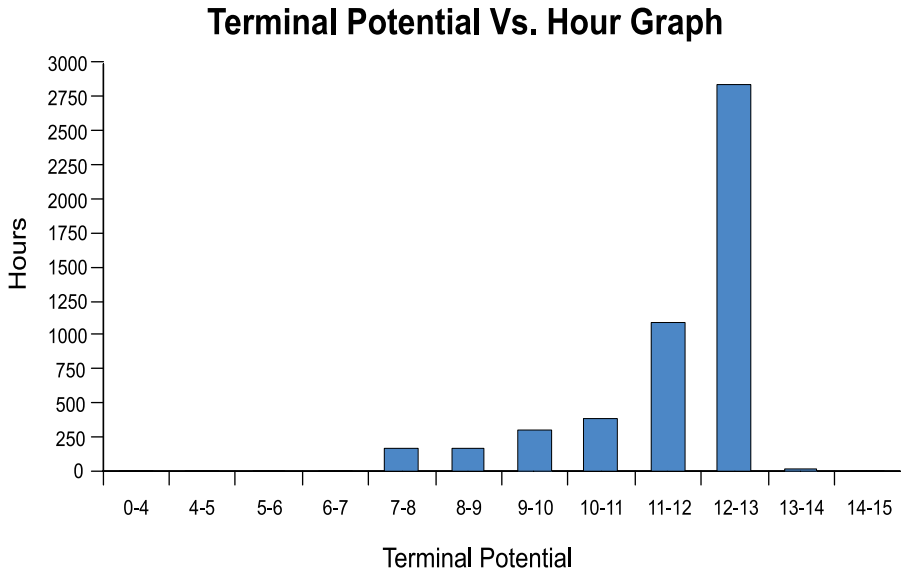

Fig. 3. Graph showing Terminal Voltage Vs Duration hours

1.2 MAINTENANCE AND DEVELOPMENT ACTIVITIES

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

Major maintenance activities

There was only one tank opening maintenance which was scheduled tank opening maintenance was from 19th November 2009 to 18th December 2009. Routine maintenance jobs like, terminal foil stripper loading, column support post and accelerating tube resistors maintenance, in tank ion pump maintenance and maintenance of rotating parts inside tank, were carried out. Apart from routine maintenance jobs, the major maintenance jobs carried out are listed below:

1. Corona probe maintenance

During routine operation, before scheduled maintenance, leakage of charge from terminal towards corona probe was noticed towards end of the cycle. Around 15 micro amps. of charge loss was noticed at ~165 mm of probe position. This loss was sustaining even if corona probe was not firing. This loss was reducing if the probe was taken away from terminal. New setting of probe position and CPS was done for terminal voltage stabilization. Over a period of time this leaking of charge first reduced and then disappeared. This problem

was investigated during maintenance and black dust was noticed on the probe. The probe was opened and cleaned thoroughly.

2. Maintenance of vacuum pump of gas handling system

A Kinney make vacuum pump is used during gas handling operation. Gasket of this vacuum pump got leaked towards the end of gas handling operation for opening the Accelerator tank. The pump was disassembled and the damaged housing gasket was replaced. A new plug was mounted on the exhaust pipe of vacuum pump for oil filling, as the old plug is now not in operation. The pump was tested and it worked satisfactorily.

3. Accelerator Column Units repairing

Spark marks around third electrode of column support post (CSP) in unit #27 were observed as resistor mounting brackets of this electrode came out from its mounting. Electrodes and resistors near to this area were along with the brackets and the bracket was mounted back. Also, maintenance was done in unit #12. The last CSP gap of this unit was shorted and the shorting was installed in post P2 and P3. The corona bracket of last electrode of post P2 came out from electrode as the mounting holes of electrode got damaged and it is beyond repair. A bracket was installed on last electrode of post P4 and the shorting was installed there in place of P2.

4. Cleaning of accelerating tube electrodes

Number of accelerating tube electrodes in entire machine were cleaned thoroughly with scotch brite and alcohol. All of these electrodes were dirty with lots of spark marks. This cleaning will improve the machine stability.

5. Maintenance of rotating parts inside accelerator

All the rotating parts inside tank were checked thoroughly for maintenance. In this maintenance, bearings of total number of nine separator boxes were replaced, six in low energy side and three in high energy side. Two of the separator boxes in low energy side were replaced by new boxes from NEC. All the motors inside tank were properly greased.

6. Stripper foil loading in terminal

In this maintenance, three different kinds of carbon stripper foils: IUAC foils, LPA (Laser Plasma Ablated) Munich foils and fullerene foils were loaded in the high voltage terminal. Fullerene foils are also developed in house. All of these foils are loaded with proper demarcation. The details of foils are mentioned below.

IUAC stripper foils	:	97 Nos.
LPA Munich foils	:	52 Nos.
IUAC made fullerene foils	:	18 Nos.

Fullerene foils are loaded for the first time to observe their performance in IUAC accelerator.

7. Maintenance of charging system

Both the charging systems were quite clean with very little idler dust. Black dust from terminal pulley in case of both the chains was also observed. Two idler wheel for charging system #1, one in up charge side and one in down charge side, were replaced by new idler wheel in unit #22. Two idler wheels of up charge side bracket in unit #27 for chain #2, were also replaced by new one. Position of all four newly installed idler wheels were aligned with respect to charging chains. Tightening of all nuts and bolts of both the charging system on terminal as well as motor side was assured. Both the charging systems ran for two overnights and their performances were satisfactory. Pulleys of both charging systems on terminal and motor side were oiled and full charging system was cleaned thoroughly.

1.3 ION SOURCE ACTIVITIES

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

The ion source operation was quite satisfactory from April 2009 to December 2009. The source was opened twice, in October 2009 and February 2010, for routine maintenance. The source was dismantled after removing it from beam line, and all of its parts were cleaned. After cleaning of all the parts, the source was assembled back, aligned and installed back. 5 gm. of fresh cesium was also loaded in cesium reservoir during October maintenance and einzel lens was replaced in February maintenance. Full cleaning of HV deck, GP tube cleaning and HV conditioning of GP tubes were also carried out up to ~300 kV. Apart from this cathode loading was also done as per requirement.

1.4 BEAM PULSING SYSTEM

R Joshi, S Ojha and A Sarkar

Operation

Different users utilized 135 shifts of pulsed beam runs, using multi harmonic buncher (MHB) along with low energy chopper and TWD. Out of these 135 shifts 67 shifts of pulsed

beam was delivered to users, after boosting beam energies using LINAC. Energies of ^{12}C, ^{16}O, ^{18}O, ^{19}F, ^{28}Si, ^{48}Ti and ^{107}Ag were boosted by using LINAC. ^{12}C, ^{19}F and ^{28}Si beams were bunched for different experiments for remaining 68 shifts of pulsed beam. 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. All the beam pulsing system worked satisfactorily for all experiments.

To deliver ^{7}Li pulsed beam, old pulsing system (LIB) was once again made operational, as MHB could not be used to get the optimum time resolution. Electronics and other parts were found to be working satisfactorily. But user settled with DC beam for his experiment, so the LIB was not used for experiment.

Maintenance

One of the switching banks of TWD was loading power supplies (+200Vdc and -200 Vdc). These power supplies play an important role for changing the repetition rate of chopped beam. Two switching channels of this faulty bank were repaired to solve the problem. Routine maintenance of chopper was also done.

1.5 DEVELOPMENT ACTIVITIES

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

Installation of new 50 position stripper foil assembly

A new 50 position foil stripper assembly is installed in post acceleration section before analyzer magnet in November 2009 tank opening maintenance period. The purpose of this is to provide higher charge states for LINAC run. Controller for this assembly was developed in house. This controller can control the operation of foils either locally or remotely. CAMAC crate stationed at position TWO (MSL 255) was modified for its operation. Total number of 30 foil strippers is loaded in this assembly. Charge state distribution by these foils is yet to be done.

1.6 ACCELERATOR MASS SPECTROMETRY (AMS)

Pankaj Kumar, Sunil Ojha, A. Jhingan, S. Gargari, R. Joshi and S.Chopra

The AMS facility for ^{10}Be and ^{26}Al measurements is in operation. A new clean chemistry laboratory has been developed and will be utilized to process standard and geological samples prior to the AMS measurements.

1.6.1 New additions in the system

Pankaj Kumar, S.Ojha, S.Gargari, R. Joshi and S.Chopra

The detection system at IUAC AMS facility consists of a multi-anode gas detector followed by a gas cell. Both require constant value of gas pressure to minimize the systematic error in any of the high precision AMS experiment. MKS Baratron make gas pressure controller system has been procured for this purpose. The system has been tested and will be installed soon.

For ^{10}Be AMS measurement, we follow simultaneous measurement method. In this method mass 26 ($^{10}Be^{16}O$ and $^{9}Be^{17}O$) is injected in the machine and after the analyzer magnet $^{17}O^{5+}$ (representative of ^{9}Be) is collected in an offset faraday cup while the ^{10}Be is recorded simultaneously in the gas detector placed in the AMS beam line. The natural abundance of ^{17}O is only 0.0375% and the current of $^{17}O^{5+}$ is about ~0.24nA/μA of $^{9}Be^{16}O^{-}$ for the best transmission values through the Accelerator. If for some of the samples the $^{9}Be^{16}O^{-}$ current from the ion source is low (100s of nA) then the current for $^{17}O^{5+}$ will be in the range of pA and such a low current is not easy to process with normal electronics set up due to the noise problem. We have procured a low noise current amplifier from Stanford Research Systems. This device can work in the region starting from pA to mA. The device has been tested and will be installed soon.

1.6.2 Development of Ultra-Clean Chemistry Laboratory

Pankaj Kumar, S.Ojha, S.Gargari , Rajan Joshi, and S.Chopra

A clean chemistry laboratory is an integral part of AMS. It is required to process the samples chemically in a clean environment before the AMS measurement. The basic requirement of clean room chemistry laboratory starts with a clean room. Clean room has a low level of environmental pollutants such as dust, airborne microbes, aerosol particles and chemical vapors. More accurately, a clean room has a controlled level of contamination that is specified by the number of particles per cubic feet at a specified particle size. The clean chemistry lab has been developed at IUAC (Fig. 2 in page 10) and many equipments like ultra-pure water plant, acid distillation unit and laminar flows have been installed in the clean chemistry laboratory. Initial chemical calibrations are being done before starting the routine processing of the samples. The main clean room is a 10000 class clean room with no outside metal exposure and is utilized for chemical processing of samples. Wooden work tables are used for putting laminar flows and other equipments. Laminar Flows are having 100 class air environments and will be utilized for doing the column chemistry, keeping drying station and acid distillation units.

1.6.3 ^{10}Be measurement from quartzite samples around the Main Central Thrust (MCT), Himalaya using AMS

Soumya Prakash Dhal[1], J.K. Pattnaik[1], Pankaj Kumar, S.Ojha, S. Gargari, R.Joshi, S.Chopra and S. Balakrishnan[1]

[1]Department of Earth Sciences, Pondicherry University, Puducherry

Quartzite samples were collected for cosmogenic ^{10}Be measurement from higher altitude area around Joshimath and Nandaprayag region across Main Central Thrust (MCT) of the Himalayas. The altitude of the sample location ranges from 1400 to 1700 m from the mean sea level. These samples were leached with 1% HF + 0.5% HNO_3 to remove feldspar and other minerals. Using anion and cation exchange column chromatography Be was separated from the quartz. The separated Be samples were precipitated as $Be(OH)_2$ by adding ammonia into the solution which were converted to BeO by step heating up to 900^{o}C for approximately 14 hours. These oxides along with Nb powder were loaded to the cathode tubes for AMS measurement.

As a first test three samples named as LOC1, LOC1(a) and LOC2 were analyzed repeatedly using Accelerator Mass Spectrometry for determining the ^{10}Be concentration. The chemical separation procedure of the above samples were carried out at ultraclean lab of National Facility for Isotope Geosciences, Department of Earth Sciences, Pondicherry University and the AMS experiment were carried out at Inter University Accelerator Center, New Delhi, India.

Taking ^{10}Be/^{9}Be ratio AMS experiment and ICP-AES determination of ^{9}Be concentration, the ^{10}Be concentrations in the samples were determined and given below.

Sl No.	Sample Name	Altitude (m)	Sp.Gravity(g/cc)	^{10}Be per gm sample(10^5)
1	*LOC 1*	*1700*	*2.5585*	*2.97±0.59*
2	*LOC1 (a)*	*1700*	*2.336*	*2.80±0.36*
3	*LOC2*	*1400*	*2.2413*	*3.71±0.56*

Higher value of error in the above measurement is due the poor statistics. The variation in the ^{10}Be concentration is mainly due to the altitude, orientation and geometry of the sample location.

1.6.4 Measurement of ^{10}Be conc. in sediment core samples from Uttarangudi site using AMS

Soumya Prakash Dhal[1], J.K. Pattnaik[1], Utpol K. Das[1], Pankaj Kumar, S.Ojha, S. Gargari, R. Joshi, S.Chopra, Pramod Singh[1] and S. Balakrishnan[1]

[1]Department of Earth Sciences, Pondicherry University, Puducherry

Sediment core samples collected from Uttarangudi site were taken for ^{10}Be measurement. After leaching with 8M HCl, samples were spiked by ^{9}Be carrier and Be was separated by anion and cation exchange column chromatography method. These samples were precipitated as hydroxide at 7.8 pH and converted to oxide (BeO) by step heating up to 900^{o} C. These Be oxides were used in the cathode tubes for AMS measurement after mixing with Nb powder.

Initially eight sediment samples were taken for ^{10}Be AMS analysis. Taking $^{10}Be/^{9}Be$ ratio from the AMS experiment and ICP-AES determination of ^{9}Be concentration, the ^{10}Be concentration of the samples were calculated and listed in the following table.

Sl No.	Sample Name	Depth (cm)	Density in g/cc	^{10}Be atom per gram of sample (in 10^{8})
1	*Surface UG*	*0*	*1.27*	*2.54±0.15*
2	*UG 0-4*	*2*	*1.06*	*3.42±0.24*
3	*UG 20-24*	*22*	*1.17*	*3.81±0.23*
4	*UG 40-50*	*45*	*1.15*	*4.62±0.23*
5	*UG 101*	*101*	*1.24*	*4.15±0.29*
6	*UG 218*	*218*	*1.29*	*4.05±0.24*
7	*UG 506*	*506*	*1.40*	*2.19±0.01*
8	*UG 1005*	*1005*	*1.12*	*1.99±0.12*

The specific gravity of these samples ranges from 1.06 g/cc to 1.40 g/cc and no. of ^{10}Be atoms/g sample ranges from 1.99×10^{8} to 4.6209×10^{8}. The variation of specific gravity and ^{10}Be conc. with depth are shown in figure below. These variations in the ^{10}Be concentration mainly due to change in ^{10}Be flux to the environment or differential sedimentation rate. This work is in progress; hence final conclusion for this variation cannot be drawn at this stage.

The chemical separation procedure of the above samples were carried out at National Facility for Isotope Geochemistry Laboratory, Department of Earth Sciences,

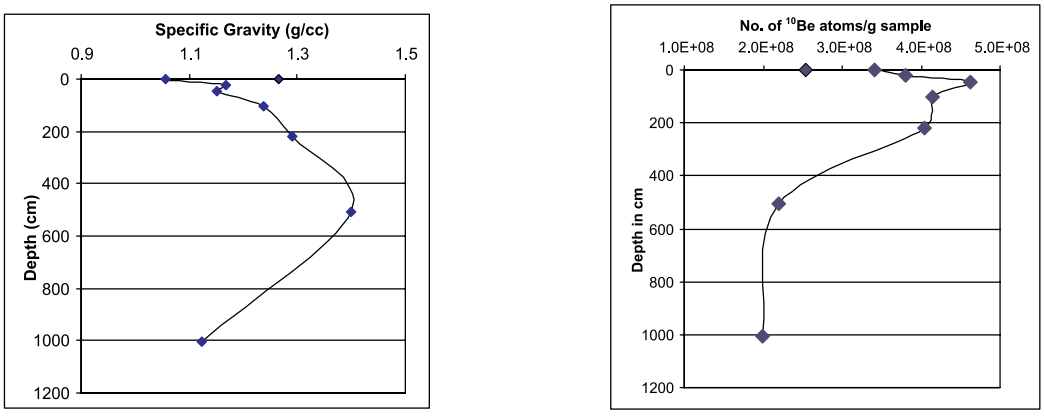

Fig. 1. Variation of specific gravity and ^{10}Be atoms/gm with the depth of sediment core

Pondicherry University and the AMS experiment were carried out at Inter University Accelerator Center, New Delhi, India.

Fig.2. AMS Ultra Clean Chemistry Laboratory