3. RESEARCH SUPPORT ACTIVITIES

3.1 HIGH VACUUM LABORATORY

A. Kothari, P. Barua and D.K. Avasthi

A General purpose testing chamber was commissioned in vacuum lab for regular leak testing and gauge testing work. A UHV system with RGA facility was also commissioned for testing new gauges and for testing reconditioned Ion pumps. Centralized purchasing of essential vacuum components from local and import was carried out to maintain essential components in stock. Contaminated penning gauges are cleaned and tested regularly to maintain stock of gauges in working condition, for emergency replacement.

A target ladder controller and chamber light controller for AMS experimental facility was designed, fabricated and installed. Besides a local controller unit, a control unit for remote operations has been installed in control room.

A vacuum interlock system was designed fabricated and installed in the portable turbo pumping system.

Regular support to pelletron group in maintenance activity is being provided.

3.1.1 General Purpose Testing Chamber

A new general purpose testing chamber was designed, fabricated and commissioned in vacuum lab. It has a turbo based pumping system and pirani - penning

Fig. 1 : General Purpose Testing Chamber

gauge combination to cover vacuum range from atmosphere to high vacuum. It is also mounted with two capacitance gauges which cover vacuum up to low 10^{-05} Torr. It can be used for leak testing of various components and calibration of pirani gauges.

3.1.2 Modification in Ultra High Vacuum Setup

Old UHV setup in vacuum lab was restructured and modified to meet our requirements.

- to remove vacuum leak in the system.
- to provide for initial pumping of the test section.
- to provide additional ports for mounting vacuum gauges.
- to achieve vacuum in low 10^{-10} Torr range.
- to test the gauges and Ion Pumps after cleaning.

In order to meet our objectives the whole setup was restructured. It was divided into two sections connected through manual isolation valve. One section contains Ion pump, Getter pump, UHV baking lamp and UHV gauge and is never exposed to atmosphere. So it maintains a vacuum better than 5 x 10^{-10} Torr and the pumps are always in vacuum. The other section called test section is equipped with UHV gauge, RGA, two fine control gas flow valves, a six inch CF test port for mounting Ion pump and a Turbo based pumping system. This section is vented as and when loading different pumps or items to be tested and it can be pumped down fast with the turbo pumping system. The

Fig. 2 : UHV test set up

Turbo pump and the test section have an isolation valve in between. When the test section vacuum improves to UHV range the turbo pump can be isolated from the system. The two fine controlled gas dosing valves can be used for introducing test gas at desired vacuum and its composition can be checked with RGA analysis. It can be used for calibrating the vacuum readings of Ion pumps, for calibrating cold cathode gauges in a clean UHV environment and to provide RGA facility for doing RGA related studies like studying outgassing characteristics of various materials, impurities in gases, etc.

3.1.3 Phase-II Beamline Installation

Atomic Physics beamline (+ 10 degree) in phase - II beamhall was installed with all the beamline components. All the components were accurately aligned and leak tested after installation.

3.1.4 Beam Line Maintenance

Beamline valve of GDA, BLV L6-2 bellow had a through leak. The leak was rectified by valve seat adjustment. Complete overhauling of the Getter pump of 04 area (GP 04), GDA beamline (GP L6-1), Zero degree beamline (GP 05 -1) and Superbuncher exit (GP 06 -1) was done and cartridges were replaced.

3.1.5 Installation Activities

Repositioning of Phase Detector in Vault (04 area) : The installation position of the phase detector in vault was after BPM, Faraday cup and Slits, as shown in figure 1. There was considerable beam loss through slits. So for improving the working of Phase detector, phase detector was removed and installed between Offset Faraday cup and BPM. For this, Offset Faraday cup was shifted towards Sweeper and the connecting Drift tube modified accordingly. The Phase detector and Offset faraday cup were realigned accurately.

Installations in Zero degree Beam line: The Diagnostic box in 05 area, just before Superbuncher, was removed and a new NEC Faraday Cup was installed. The turbo based pumping setup was removed and an additional Ion pump (IP 05 -2) was installed to take care of the huge load in the beamline.

All the components in the area between Quadrupole and Superbuncher were removed from the line and a theodolite was setup taking the reference from Analyzer magnet, BPM 04 area and Switching Magnet. All the components were then installed in the beamline, and BPM and Faraday cup were perfectly aligned.

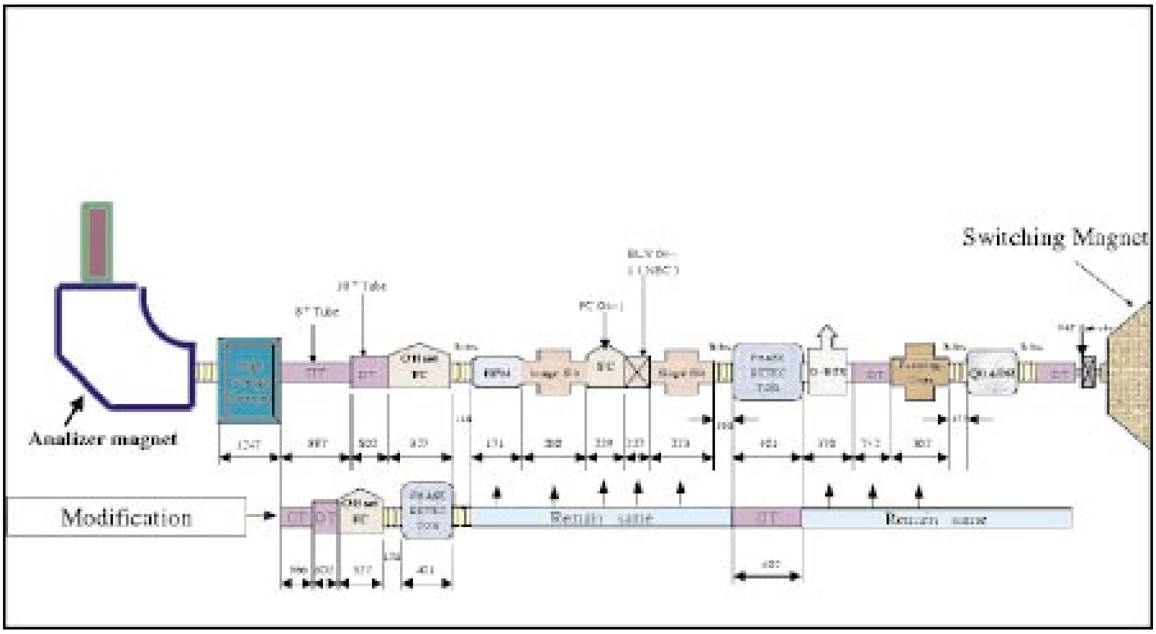


Fig. 3 : Modification in Vault

Multiple drift tube joints in the 06 area, Superbuncher - LINAC I, were removed by replacing it with a single drift tube.

Installation of Gas Cell / Target Ladder in AMS Experimental Facility: A new gas cell was installed in the facility. A new Target ladder was also installed and aligned with the beam axis. BPM L 2-2 was also cross checked for alignment.

3.1.6 Double Slit Controller

A controller for double slit which is being used for controlling the beam in Y-Y and X-X direction was designed and fabricated. This controller consists of four identical stepper motor controllers to control the four channels of the slit. That means +X, -X, +Y, and -Y channel of the Slit can be controlled, one at a time, individually. LED indication for In and Out limits of the slit is provided on the controller. It can be remote controlled through CAMAC.

3.1.7 Pneumatic Valve Controller

Pneumatic valve controller was designed and fabricated for controlling the PSTV Pneumatic Valve. By using this Controller the Pneumatic valve can be opened or closed. The valve can be operated by local as well as remote control from the control room. The controller is fully interlocked with the interlocking inputs from the external devices. And also it is providing the interlocking outputs to the external devices like Faraday cup controller and CAMAC. Fifteen controllers have been fabricated for installation at different locations.

3.2 MAINTENANCE OF MAGNETS AND POWER SUPPLIES

S.K. Suman, Rajesh Kumar, A.J. Malayadri and A. Mandal

The Beam transport group has been performing the regular maintenance of all magnets, magnet power supplies, their CAMAC modules and the other supporting BTS instruments to carry out the primary responsibility to maximize uptime of beam transport system for operation of pelletron. Following major jobs were done for beam transport system maintenance.

3.2.1 Routine maintenance

Routine maintenance of all magnets and their power supplies are done twice in a year to keep the uptime of Beam Transport System maximum. Following tasks have been carried out in the maintenance:

- Thorough observation of the power supplies.
- Testing of stability of bending magnet power supplies and rectification of problems, if any.
- Observation and rectification of output ripples in magnet power supplies.
- Calibration and testing of interlocks and read backs.
- Dust cleaning of electronic cards of all magnet power supplies.
- Checking of all transistor bank heat sinks and rectifier heat sinks for corrosion effect in the power supplies.
- Checking of connections for control signals in power supplies.
- Temperature monitoring of all magnets at full load current, cleaning of blocked coils with sulphamic acid solution to remove scaling.
- Changing damaged hose pipes.
- Checking input and output power connections for loose contacts.

3.2.2 Breakdown maintenance

A very low failure rate occurred which were rectified and repaired on spot.

3.2.3 Major maintenance and repairing jobs done during this year

- CAMAC based controller for X-scanning in beam scanner power supply was repaired. Module was generating a spike in "power off" control section which was treated as an OFF command for power supply. Due to this power supply was going off in the remote mode.

- Read back problems in the switchgear were rectified. Beam line selection for powering the magnets was right but more than one read backs were showing in the control room. A few pins of 50Pin D-connector in the interconnecting cable between controller (placed in control room) and switch gear control assembly were found to be shorting each other. Due to this, false read back was shown in the control room.

- Repaired MQX_LX power supply. All series pass power transistors at the output power stage were damaged (faulty) due to improper load of quadrupole in AMS Beam line. A doublet quadrupole was installed this year in AMS line. Load resistance of single quad is half in comparison to other beam line quadrupoles. So continuous power dissipation across the transistor bank was twice the normal dissipation capacity. Due to this, transistors were heating and it finally burnt. To solve this problem a dummy load has been connected in series with each coils of each quadrupole in AMS line to match the output impedance of the power supply.

- Vario-transformer of Analysing Magnet power supply was repaired. Current collecting plates in the secondary side had burnt and Carbon & Oxide layer had deposited on the current collector bars. This happened due to occurrence of alignment error on the sliding mechanism, since this power supply has been running for more than ten years. Spares for sliding assembly were fabricated and replaced in vario-transformer. All mechanical parts were cleaned and proper alignment was done during scheduled maintenance period.

- Coils of Quadrupoles for GPSC, GDA, Mat. Sc and HIRA beam lines were cleaned by sulphamic acid and high pressure water. Water cooled magnets are used in our system. It is found that flow rate of water through coils of the magnets gets reduced slowly with time due to scaling inside the coils. This causes heating of the coils at higher current.

- A few cards which failed in the power supplies operation were replaced by the spares to minimize the breakdown time and later on, these cards were repaired in lab.

- Quadrupole and Steerer Magnets in the AMS beamline were installed and tested.

3.3 DETECTOR DEVELOPMENT LABORATORY

P. Sugathan, A. Jhingan and T. Varughese.

Detector Laboratory provides support to users in various detector setup and experimental facilities. New detectors are developed and tested for experiments. This year a gas ionization chamber and two large area position sensitive multi wire proportional counters were fabricated. Support & training were provided to various experimental groups, research students and trainee scientists.

3.3.1 Multiwire Proportional Counters

A. Jhingan, P. Sugathan, T. Varughese and E.T. Subramaniam

Last year, one of the large area MWPC (8” x 4”) was damaged during a vacuum accident in general purpose scattering chamber (GPSC). Out of the five wire frames used inside the detector, one got damaged. Also the entrance mylar foil was punctured. The detector was repaired and tested successfully. Also another MWPC with same specification was fabricated. Both the detectors were using standard alpha source (241Am) and in beam experiments using Pelletron beam in GPSC. Count rates up to 10k were observed in the in beam test. Figure below shows a typical spectrum taken using alpha source and a mask in front of the detector. The mask consists of 1 mm diameter holes at 5mm

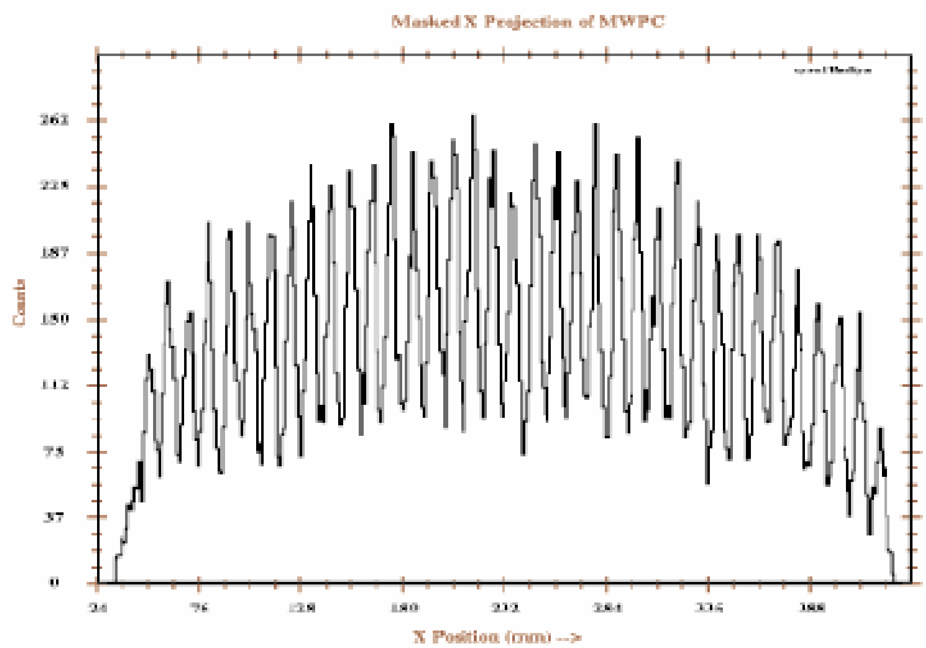


Fig. 1: The X -position spectrum taken using alpha source and a mask in front of the MWPC detector is shown. The mask consists of 1 mm diameter holes at 5 mm separation.

separation. Detector efficiency was also tested with alpha source using a silicon detector behind the MWPC. At low pressure (2 torr) operation with the optimum voltage settings of anode and cathode, efficiency of the MWPC was better than 95%. At slightly higher pressure (4 Torr) the efficiency was close to 100%. Performance of the MWPC with 4 electrode and 5 electrode geometry was also tested. It was found that rise times of anode pulse were better in case of 4 electrode geometry. Observed rise times were about 15-20 ns. The detectors will be used in GPSC for HI induced fission dynamics studies in coincidence with fission neutrons.

3.3.2 Diamond Detector

A. Jhingan, P. Sugathan and A. Roy

To explore the possibility of using fast timing detectors in ion beam applications, a CVD diamond detector was tested for charged particle response using ^{241}Am source. CVD detectors are used as fast timing detectors and are less prone to radiation damage. Using a home made fast timing preamplifier, the rise time observed with the detector was 1-2 ns. The CVD diamond detector was gifted to detector laboratory by Dr. E. Berdermann, GSI, Germany.

3.3.3 CsI based Detectors

P. Sugathan and A. Jhingan

As an alternative to silicon based light charged particle (LCP) detector which are rather expensive and prone to radiation damage, we are planning to make use of CsI based charged particle detector setup. A CsI detector (50 x 50 x 10mm^3) coupled to silicon photo diode (Hamamatsu) was procured and tested using radioactive sources. Developments are on for customized electronics circuits for pulse shape discrimination (PSD) based charged particle identification. The detectors are likely to be used for light charged particle identification in GPSC and HIRA experiments.

3.3.4 Electronics Development

A. Jhingan, E.T. Subramaniam and P. Sugathan

To make readout of the pulse formed in various detectors, different kinds of preamplifier circuits are tried. A new charge sensitive preamp has been designed and fabricated. Salient feature of the preamplifier is its fast timing output with gain of 200 mV/ pC. Rise time of better than 10 ns was observed with a 100 mm^2 partially depleted 300 micron thick Canberra silicon detector. More improvements in the design will be made in near future. A high gain charge sensitive preamplifier was designed for detecting weak or minimum ionizing radiations in silicon detectors such as low energy electrons, X-rays and photons. A preamplifier with a gain of 3 V/pC was designed and tested. Noise problems were observed with very low capacitance detectors which are being rectified.

3.3.5 Special Purpose Detectors

An annular gas proportional counter is being designed for charged particle detection in coincidence with gamma rays. Preliminary designing of a prototype detector has been done and the fabrication of the detector will be carried out soon. The detector is likely to be used inside the target chamber at the entrance of recoil separator (HIRA or HYRA) and GDA at forward or backward angles.

3.3.6 Fission Fragment detector array.

A. Jhingan, P. Sugathan and B.P. Ajithkumar.

A new fission fragment detector telescope array has been designed which will have segmented ionization chamber with a transverse electric field working as DE detector and an array of Solar cells (10mm X 10mm) as E detector. The gas ionization chamber will give differential energy loss for particle identification. The detector chamber has been designed in the shape of an arc which will cover one quadrant from 170° to 90° in the lab frame. Solar cells will be placed at an angular separation of 10° and each Solar cell will provide an angular coverage of ±2°-3°. Attempts are on to develop dedicated readout for the detector which can be placed inside vacuum to avoid loss of signals in the cables.

3.3.7 Position sensitive X-ray gas detector

A. Jhingan, C.P. Safvan and P. Sugathan

Development of a position sensitive gas detector for detecting X-rays was initiated. In this respect a Cathode strip chamber has been designed and fabricated. It has an active area of 5 X 1 cm^2. The detector has a two electrode geometry having a wire frame acting as anode and a cathode which is segmented into 10 strips of width 5mm each. A custom made readout system is currently under development. The detector will be tested soon.

3.3.8 Study of breakdown characteristic of gases used in detectors

J. Gehlot, T. Varughese and P. Sugathan

A setup was made to study the breakdown characteristics of different gases used in multi wire proportional counters. The setup consists of two parallel plate electrodes mounted inside a vacuum chamber. The electrode is made of aluminum disk with cylindrical shape. The cathode plate is attached to the chamber flange while the anode plate is attached to linear motion feed through. The distance between the electrodes can be varied precisely from 200 micron to 10 mm. High voltage is applied to the anode through SHV connector mounted on the flange. A gas pressure control unit supplies and regulates the flow of gas through the setup. The chamber was filled with different gases like iso-butane, helium, and air. The breakdown voltage for each gas was measured as a function of voltage versus pressure at different inter-electrode spaces to get the Paschen curve. The observed minimum of the Paschen curve corresponds to 364 Volts for air, 458V for iso-butane and 176V for helium gases.

3.3.9 Radioactivity Measurement of ^{60}Co using Sum-Peak Technique

Dinesh Negi, Golda K.S., P. Sugathan and R.K. Bhowmik

Standard radioactive source like ^{60}Co is routinely used for efficiency and energy calibration measurements in gamma ray spectroscopy experiments. The source strength is required to be known. Using coincidence summing technique, we have measured the absolute decay rate of the ^{60}Co source. Sum-peak method is a commonly used method for the standardization of radionuclide such as ^{60}Co and ^{94}Nb which emits two photons with no direct transitions to ground state. ^{60}Co is a radioactive source, emitting two gamma rays almost at the same time. Sum peak in ^{60}Co spectrum indicates that two gamma ray photons interact with the detector and deposit their energy within a time that is short compared with the response time of the detector or the resolving time of the electronics. In the energy spectrum of ^{60}Co, one can see two peaks corresponding to photo peaks 1173 and 1332 KeV energies as well as a peak corresponding to the summed peak of these energies at 2505 KeV.

Sum peak of the ^{60}Co provides a method for calculating its strength. In this method the intensity of the two photo peaks (N1,N2) and the coincident sum peak(N12) are measured. This measurement is repeated by varying the source to detector distance. To improve the accuracy of the measurement the dead time of the detecting system is also determined. For measuring dead time of the system, we employed the two source method in which the dead time of the detecting system is measured at different count rate by artificially changing the count rate of the system. We obtained a value of 38.4μs within the accuracy of 3.6%. After applying dead time correction, we get source strength from N = N1* N2/N12. The activity of the ^{60}Co source is measured to be 7.875 x 10^3 ± 88.7 disintegrations/second.

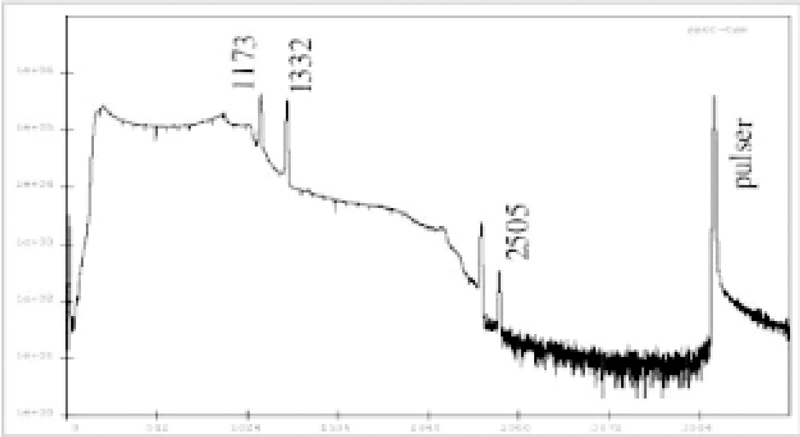


Fig. 2 : The typical ^{60}Co spectrum from our setup using a single HPGe detector.

3.3.10 Experiments with Gas Filled Separator: A simulation study using LISE++

P. Sugathan

To study the feasibility of doing experiments in mass region A ~ 200 using gas filled separator, a theoretical simulation has been done to find out the evaporation residue collection efficiencies and position spectra for the gas filled separator of HYRA. The current version of the program LISE++ has been used for this study. LISE++ is being widely used by many laboratories for the simulation of fragment separators to produce Radioactive Ion beams. The program includes substantial amount of physics dealing with reaction cross sections, energy losses in materials, ionic charge state distributions, reaction kinematics, nuclear database properties, ion optics calculations, acceptance effects and gives first order results for simulation of particles through separators. The recent version of the program includes ion optical blocks for gas filled dipoles and fusion evaporation reaction kinematics.

The first order transfer matrix for the Ion optical components was extracted using the code TRANSPORT and this was incorporated into LISE++ optical blocks. By optimizing the ion optical parameters for different optical blocks the calculations are preformed with He gas filled in the separator at 1 Torr. The detection system consists of one MWPC followed by 12cm x 4cm silicon strip detector. A drift distance of 40 cm is given between the detectors. Detected parameters include TOF between the two detectors, position information and Energy from strip detector. The parameters are varied to find out the optimum gas pressure and the transmission and intensity of residues at the focal plane.

The simulation result was used to plot the spatial and angular distribution of the residues at different points along the separator. The following figure shows the results of the distribution for residues after the first dipole.

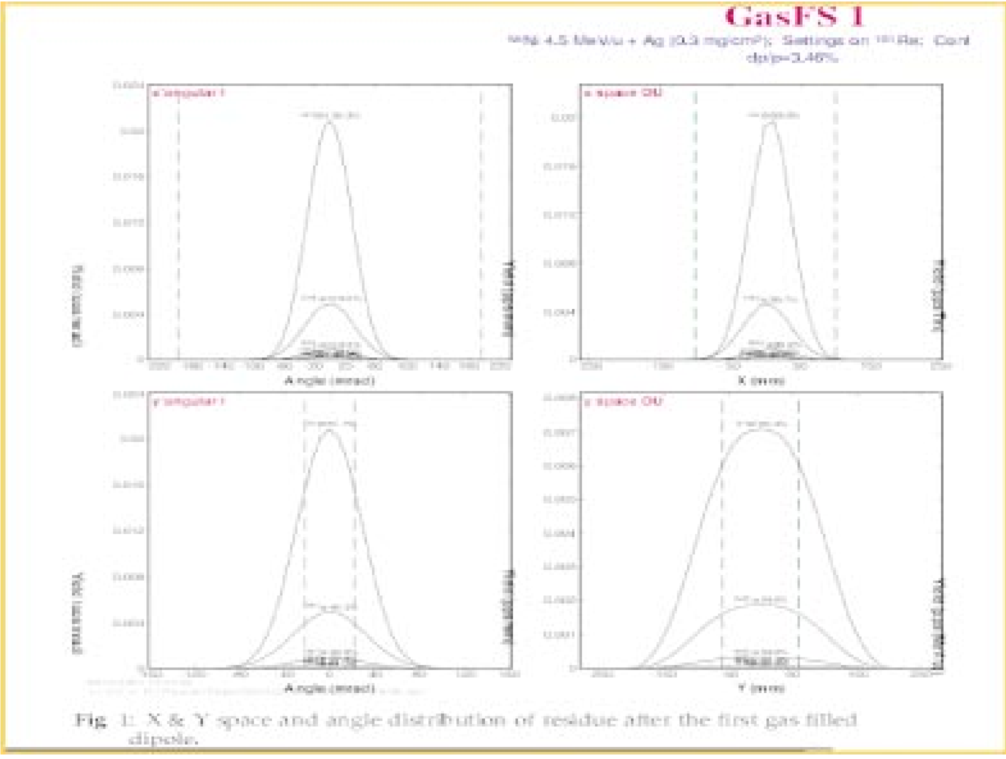


Fig. 3: The angular and spatial distribution after the first section of the gas filled dipole.

3.4 TARGET DEVELOPMENT LABORATORY

D. Kabiraj, Abhilash S.R. and D.K. Avasthi

Target Development Laboratory at NSC provides facilities to the users for the preparation of targets used for the experiments with NSC Pelletron. Several targets have been prepared in the last year for the studies in Nuclear Physics, Atomic Physics, Materials Science and Bio Science. The following gives an account of the attempts made by various techniques for the preparation of targets. There were 131 and 51 evaporations attempted in HV and UHV evaporator respectively. More than 25 foils were prepared using rolling technique. In addition to this, 600 carbon stripper foils of less than 5 mg/cm^2 thick were also prepared for NSC Pelletron. The target preparation facility has been used by 75 different users during this year.

Using the new evaporator, several composite films have been prepared by co-sputtering using the wide beam ion gun. There were 38 attempts made to prepare films by co-sputtering of SiO_2 and various elements like Ag, Cu, Si, Ge and that of ZnO and Ni. The objective is to prepare thin films with metal clusters embedded in transparent dielectric material. The optical absorption due to the surface plasmon resonance (SPR) from these metal clusters has been studied using optical absorption spectroscopy. Figure 1 shows the surface plasmon resonance absorption peak for Cu, in Cu and SiO_2 co-sputtered thin film. It has been estimated by Rutherford Back Scattering (RBS) spectroscopy (fig. 3) that the film is 280nm thick and composed of uniformly distributed 6.0 atomic % Cu. The evolution of the SPR peak with annealing is due to the change of Cu cluster size. Figure 2 shows absorption due to SPR of Ag clusters formed in the as deposited Ag-SiO_2 co-sputtered film. The film is 100nm thick and contains uniformly distributed 3 atomic % Ag, as shown in figure 3.

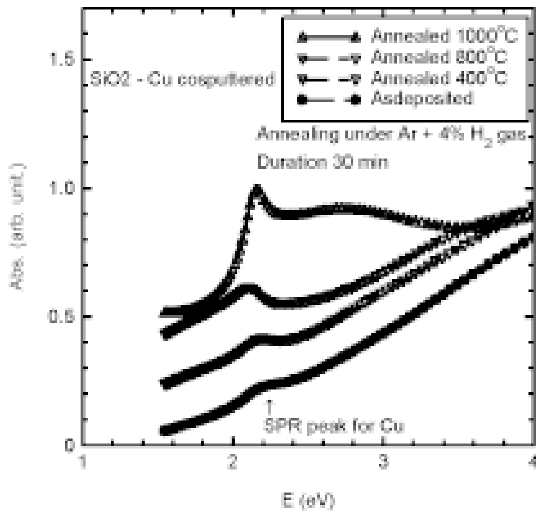


Fig. 1

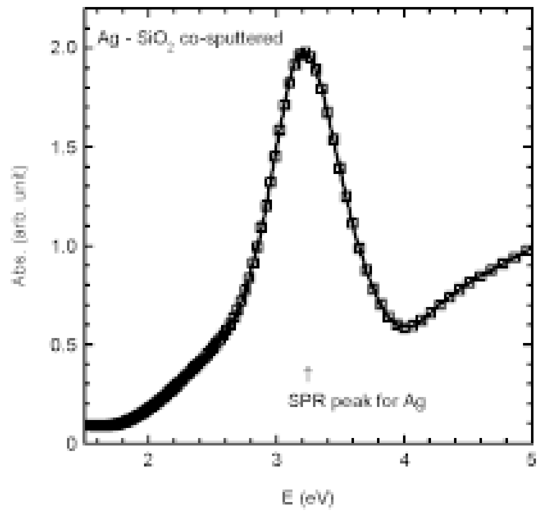


Fig. 2

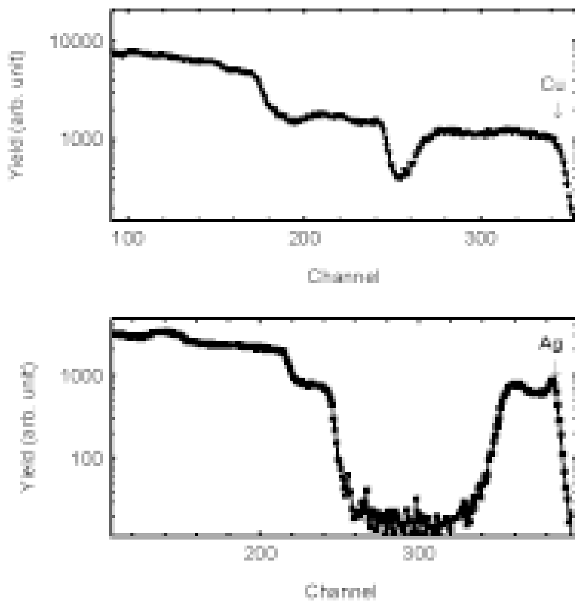


Fig. 3

3.5 RF & ELECTRONICS LABORATORY

B.K. Sahu, K. Singh, R. Shanthi, Ashutosh Pandey, A. Gupta, K. Rani, M. Jain, R.N. Dutt, V.V. Satyanarayan, S. Venkataramanan, A.Sarkar and B.P. Ajithkumar

3.5.1 General Purpose Controller box

We have been using CAMAC for all our control applications and develop all the required modules in-house but not the Crates. The standard CAMAC Crates are expensive, heavy and consumes a lot of power that is a concern when used inside high voltage platforms. A functional substitute was made by packaging 64 ADCs, 28 DACs, 32 relay contacts & 32 contact inputs, along with an onboard computer running Linux, inside a 19" rack mount box. The power consumption is around 20 Watts and the outside connection through a single ethernet/fiber optic link. The system is software compatible with the existing hardware used in the Pelletron. It is currently being used for controlling the ECR ion source.

3.5.2 LN2 filling system with embedded controller

An automated LN2 filling system for the Clover detectors of INGA was developed using an embedded PC running Linux. The circuit can handle 32 relays and 32 temperature sensors. The software design is similar to that of NSC accelerator control system. On powering the PC, it downloads the Linux Kernel from a central server and starts a small server program that monitors the LN2 filling system in a closed loop. The server also listens over the network for client connections and carries out the commands like read the sensor, open/close a valve etc. The client program provides the user interface and can be run from anywhere on the network. It displays the temperatures and allows the user to control any valve. The auto fill routine is triggered at scheduled intervals and it fills all the detectors properly by monitoring the temperature.

3.5.3 Radio Frequency Circuits for LINAC

The RF electronics required for eight LINAC resonators and the super buncher was completed and tested with ion beam. Electronics for 24 resonators are kept ready. Eight channel Slow Tuner electronics module was designed, fabricated and deployed. Slow Tuner mechanical assembly also was completed and tested.

A 97 MHz, 400 Watts power amplifier prototype was made and the production job for ten units was given to BEL, Bangalore. Six numbers of 250Watt units were made in-house to meet the test schedules. In-house fabrication of 20 units of 400W amplifier is progressing.

3.5.4 RF Sputtering and Plasma Enhanced Chemical Vapour Deposition, PECVD

Efforts were made to convert the BHEL solar cell plant at Gurgaon from 13.56 MHz to 100 MHz on their request. A feasibility study was done by creating plasma on the 3' x 1' electrodes by designing new matching networks. Seven to Eight times more deposition rates were observed but the plasma was not uniform and project is continuing. With demonstration of initial prototype units and trial runs we have signed an MOU with BHEL to design and develop high power broad band RF power Amplifier (50 to 150 MHz), of 300 Watts and Matching Network.

The know-how of the 500 W, 13.56 RF sputtering system has been transferred to one more firm, M/s Vacuum Equipments, New Delhi. Training was given to them.

3.5.5 Implementation of High Density Clover Electronics Module for INGA

The Module consists of various daughter cards like

Shaping Amplifier
Timing Filter amplifier & CF Discriminators
Anti-Coincidence Logic unit assembled on a Mother board.

These daughter cards are implemented using state of the art surface mount devices. Two Prototype units were tested with INGA at NSC for 6 months successfully and the same were mass produced at NSC. So far 16 Modules have been assembled and are being used with INGA at VECC, Kolkata.

The technology to assemble these Modules was transferred to SINP, Kolkata.

Other electronics circuits developed and implemented are the following:

ACS Preamplifier: It is a wide band voltage amplifier along with buffer circuit in order to preserve the timing information from ACS Photomultiplier tubes of INGA. Ten such 5-channel modules have been produced and some are used with INGA at VECC, Kolkata.

Charge Sensitive Preamplifier based on design knowledge acquired in high quality preamplifiers for HpGe detectors, and a general purpose preamplifier with both high quality Energy & fast TIME outputs for Silicon Surface Barrier detector have been developed, tested and implemented.

In order to fulfill further in house requirements, we have developed the following daughter cards of Time to Amplitude Converter (TAC). A prototype of high Density TAC for GDA is being tested. It is designed for time difference of 200 ns (range) between

START and STOP input signals. The output pulse amplitude varies from 0 to 5V in proportion with the above time difference. In case of over range, an over range reset signal is generated to terminate the conversion cycle.

TFA & Constant Fraction Discriminator (TFA + CFD): This high density circuit over comes the pitfalls in already developed TFA + CFD cards for INGA, with features such as AUTO WALK, offset free TFA and remotely controllable ‘Dead Time’ and ‘ Width’ settings.

The design and implementation of a double width High density Clover Electronics Module for INGA which would replace 2 NIM bins of electronics, allied cables and connectors are being carried out. A patent application has been filed with TIFAC, DST for patenting under Indian Patent law.

3.6 ELECTRICAL GROUP ACTIVITIES

U.G. Naik, Raj Kumar

Electrical group has succeeded in keeping its installation uptime to nearly 100% with proper and timely maintenance schedules and monitoring arrangements. This group also has successfully completed the projects and works planned or approved for the year.

Maintenance:

3.6.1 Stabilised Power arrangement

We maintained 1 MVA and 500 kVA stabiliser catering to major loads such as A/C plant-II and Helium Compressors and the clean power to NSC pelletron cum experimental areas with 100% uptime without a single break in the supply. This year no breakdown or repairs on either of the servos happened.

3.6.2 UPS Systems

This year NSC has procured and installed about 50 kVA, 3 phase, UPS dedicated to feeding motor loads and some computer controls for High Current Injector systems. NSC has a previous base of about 20 UPS ratings from 2-10kVA. Most of the UPS are on AMC and during the present year all UPS were very healthy and had 100% uptime. Routine maintenance was carried out by the manufacturers’ authorised service centre and the faulty batteries were replaced. Not even a single occasion of UPS failure was observed.

3.6.3 Power Factor Compensation

Electrical group is very happy to quote that year after year we are maintaining a power factor almost near to unity and this year is no exception. This has been clearly visible in the energy audit report from external energy auditors. Our system power factor without correction is about 0.85 and by raising it to near unity we save around Rs. 45 lakhs a year from energy billing.

3.6.4 Communication equipments

Electrical group maintains the Hand held radio stations (Walkie-talkie) and base station. Till now we have 14 nos. of hand held stations and one base station. The system is working fine. The license is periodically validated from the Ministry of telecommunications.

3.6.5 Maintenance of Phase-I & II Electrical Installations

The electrical Group is proud to declare here that during this year we did not have even a single breakdown, hence keeping the uptime at 100%. By doing these maintenances, timely and efficiently this group has maintained the system in a very healthy and efficient manner and this has reduced the down time. A few major yearly maintenance activities carried out are listed as below.

- Dehydration of Tr. Oil was carried out of transformer for 3X 500 kVA and 2X1MVA
- Oil Circuit Breaker servicing - 7 nos.
- Air Circuit Breaker servicing - 20 nos.
- Calibration and setting of Over Current and Earth fault relay - 48 elements.
- Periodic maintenance of LT panels, Distribution boards and other accessories, Lighting, Fixtures, lighting and power circuits.
- Servicing of DG sets 60 kVA X 2nos, 2 X 320 kVA, 1 X 100 kVA-twice a year.
- Maintenance of the street lighting.
- Testing and treating of earth pits- 80 nos.

3.6.6 Energy Saving

Energy savings measures taken earlier continued in the areas where we had installed the energy saving time switches. CPWD has agreed and installed energy efficient lighting in the newly constructed blocks as per our request.

Project Works

3.6.7 Installation for Beam Hall-II

The year has seen a lot of activities in beam hall-II. The cable trays for Power, Signal and control cables are installed from vault to beam hall for all the beam line equipments and for the experimental areas. Cable trays are also laid for taking cables from Electronics areas to the control room. Power distribution panels for the HYRA facility are ordered and will be done before 31st March 2005. Temporary power of 250kVA is arranged in the HYRA area so that the planned facility testing in July-Dec 2005 can be carried out.

HYRA power requirements are frozen at around 540 kVA and further requirements of High Current ECR source facility is around 440 kVA. These two will need a separate 1 MVA dedicated Transformer and work in this direction is in progress.

3.6.8 Phase-II Part-II Installations

Electrical group has been working in close co-ordination with the CPWD to make sure that the requirements as per the user input and as per the standards are followed in the project by CPWD. 1000kVA Transformer, associated bus trunking, LT panel, distribution boards, HT and LT XLPE cables, cable trays are supplied and installed. Concealed conduiting is done for the wiring. Wiring for services such as LAN, Paging and telephone is in progress. Fire alarm panel is installed in the Guest house and other works such as pumps and down comers, hose reel, engine driven pump room and works associated with fire are in progress.

3.7 COMPUTER AND COMMUNICATIONS

S. Mookerjee, S. Bhatnagar and E.T Subramaniyam

The focus of the group this year was on the consolidation of the central networking and computing infrastructure, incremental expansion of desktop computing, and introduction of systems to streamline the acquisition and maintenance of computing resources. This year saw the phasing out of the last of the proprietary 64-bit RISC platforms from the server pool, to be replaced by commodity Intel servers running Linux and public domain software. The mail and internet access systems were enhanced, and the computing cluster upgraded. Besides this, group members were involved in development of data acquisition and detector electronics hardware and software, software development for the administration, and numerical simulations of swift ion beams in materials.

3.7.1 Internet and mail

The Centre's Internet link through Spectranet was upgraded to 512 kbps on a 1:4 contention ratio, from the earlier 256 kbps (1:4). The 64 kbps radio link through Ernet was also upgraded to 512 kbps (1:3). This saw a major improvement in Internet access speeds for all users.

The Silicon Graphics server running the nsc.ernet.in system (proxy, web, mail and firewall services) was replaced by two Xeon-based Linux servers, one running the proxy and web services and the other running the mail server. This finally establishes an all-Linux server pool, which has enabled the Centre to improve reliability and cut costs and manpower even with the manifold increase in the number of servers, desktops and users.

Transparent ftp access from the Centre's LAN, ssh access from the outside world, anti-spam and anti-virus filters on the mail server, and web-based access to user configuration are some features of the new setup. The qmail scanner anti virus (clamuko) quarantines about 175 messages a day at a speed of maximum of about 0.5 second per message. The SpamAssassin is used to carry out heuristic tests on mail headers and body text to identify "SPAM". The Spam Assassin tags all the incoming messages e.g X-Spam-Status: Yes, hits=17.9 required=5.0 , thus substantially reducing the SPAM mails after suitable filter on the client side. A web-based e-mail package (Squirrel Mail) is included which includes built-in pure PHP support for the IMAP and SMTP protocols, and all pages render in pure HTML 4.0 (with no JavaScript required) for maximum compatibility across browsers. The squirrel web mail has facilitated the remote users not on the LAN by giving a web based access to our mail server.

To meet enhanced reliability and manageability requirements, now that the number of network nodes in the Centre has crossed 300, four of the existing switches were replaced by 48-port managed switches. The experience with managed switches has been satisfactory, and all switches would be upgraded in the next year.

The increasingly pervasive use of the internet for a wide variety of tasks, including internet banking, online purchases and quotations, and access to the Centre's internal databases for accounts, purchase and personnel records, also mean that security is a critical concern. The problem is exacerbated by the increasing number of spams, viruses and worms, attempts to hack into servers, and other malicious activities. A policy encompassing both hardware and software tools to enhance security, both on the local network and for access to the internet, is being put into place at the Centre. Managed switches, internet access only through dual-homed servers with filtering firewalls, caching and proxying servers for web access and file transfers, anti-spam and anti-virus filters on the servers, secure shell logins, comprehensive coverage of desktop Windows systems with anti-virus software, and restricted access to critical servers are components of the security strategy. It is recognized that the key to a successful policy lies in balancing security considerations with the kind of ease of use and transparent access required by research and academic institutions like ours.

Detailed plans were also made to extend the network to new buildings expected to come up next year, and to complete the expansion in the most seamless manner possible.

3.7.2 Central computing facility

The Linux cluster for parallel computing was overhauled and expanded this year, to a configuration of eight dual-Xeon systems with hyperthreading-capable CPUs. The system is now being used for simulations in molecular modeling, materials science with ion beams, and nuclear physics.

A move towards a networked printing solution for the Centre's printing requirements was started last year, and eight duplex high-capacity laser printers were added to the printer pool in the academic net.

3.7.3 Desktop computing and local networks

Thirty desktop PCs were added to meet various requirements, pushing the total number of PCs in the Centre to more than 250.

3.8 AIR CONDITIONING, WATER SYSTEM AND COOLING EQUIPMENTS

P. Gupta, A.J. Malyadri and Bishamber Kumar

3.8.1 Central AC Plant

NSC's Central Air Conditioning/Low temperature Cooling System of Phase-1 consisting of 400 TR Central AC plant, performed with 100% uptime. Proper maintenance ensured that the safety record of the plant was maintained at 100% and the power consumption kept at optimum levels. The reciprocating compressors (1,3&4) have logged in approximately 78,000 hours each and the new compressor (Comp#2) has run for 2500 hours. Other rotary equipment have logged in about 1,21,000 **c**ontinuous run hours. The yearly maintenance costs have been maintained at approximately 2.6% of the installed project cost. The equipment being into their sixteenth year of sustained operations has far outlived their economic lives. In the current year, plenty of repair activities were carried out. This was essential to reset the reliability of the equipment. Considering the age of the equipment, a replacement policy has been taken up in the Xth plan period, based on the real time health of the individual equipment. Two nos. of AHU's (AHU#4&7) and two nos. of Cooling Towers (CT#1&2) are being replaced by new ones.

The Phase-II, Central AC Plant with a Centrifugal Chiller and with its installed capacity of 250 TR performed to an uptime of 87.5%. The plant was under breakdown for one and a half months as the thrust bearings of Centrifugal Chiller failed. A complete compressor teardown had to be carried out to replace the thrust bearings. However, Phase-II activities were not hampered for want of the above machine as we were able to take phase-II loads on Phase-1 AC Plant. The plant catered to the cryogenic activities and was used extensively for picking up the Phase-I heat loads. This affected a huge energy saving.

The highlight of the operation and maintenance of the above systems was the in-house responsibility and supervision provided to the contracts, thereby affecting substantial savings in the price paid for the operation and maintenance contracts.

3.8.2 Water Systems

NSC's centralized water system of phase-I, feeding low temperature cooling water of a total heat removal capacity of 115 TR, potable water supply and the gardening water supply performed to an operational uptime of 100%. This was possible due to the stringent maintenance practices that were followed over the years. The mechanical systems have already overshot 72,000 hours beyond their expected life span. A strict monitoring on the water quality ensured that the flow paths are in healthy condition. Numerous replacement works were carried out.

NSC's centralized water system of phase-II, feeding low temperature cooling water of a total heat removal capacity of 80 TR, Liquid Helium Cooling water of approx. 350 TR, potable water supply performed to an operational uptime of 100%. This was possible due to the stringent maintenance practices that were followed over the years. A strict monitoring on the water quality ensured that the flow paths are in healthy condition. Numerous replacement works were carried out.

3.8.3 Cooling Equipments

Availability of these equipments was recorded at around 95%. 28 Nos. of Geysers have been installed in new Guest house. New equipments were added to cater to additional requirements. Several replacements are being done in a phased manner.

3.8.4 New Construction

Planning for the Phase II, Part -II works in association with CPWD was completed. Execution is in progress with expected commissioning in April 2005.

3.9 MECHANICAL WORKSHOP

Rewa Ram, S.K. Saini, R. Ahuja, S. Sunder Rao and Jimson Zacharias.

The Mechanical Workshop is serving as an in house machining and welding facility for the 15 UD Pelletron Accelerator, supporting various laboratories and a large number of user community. Workshop has been involved in developmental activities of new systems as well as large scale production of beam line components right from the inception of NSC. This year like earlier time most of the beam line components used for the new beam lines were fabricated in the NSC workshop. Workshop continues to assist all the in house fabrication activities of LINAC, RFQ, HCI and Cryogenic component developments.

The major facilities of the workshop are the Machine-shop, Welding-shop and the state of art Electron Beam Welding (EBW) machine facility.

The Machine-shop is equipped with a CNC lathe, three conventional lathes, two milling machines and radial drilling machine. Most of these machines are of HMT make, fitted with DRO's for achieving higher accuracy and better productivity. Apart from these we have cylindrical grinder, tool and cutter grinder, horizontal and vertical band saw machines, sand blasting machine etc for the general requirement. We also have the CAD facility, SolidWorks for the design and the drafting purposes.

Welding-shop is having many high quality TIG welding facilities. Some of the TIG machines can give pulsed arc for the thin section welding. Air plasma cutter with a capacity to cut up to 40mm thickness of stainless steel is used extensively. Aluminum welding and Oxy- acetylene cutting and brazing set ups are also available. This year we added a new micro-plasma machine from Air Liqiude France for very thin section welding.

The new workshop building will be ready by April 2005 and the machines can be relocated accorrdingly. Some new machines like a lathe and a milling machine will be installed in the new workshop building. A five axis Vertical Machining Centre, CNC based, is also planned for the new workshop facility. The purchase process for this machine is in the final stages.

The Electron Beam Welding facility is fully operational. So far we have completed the fabrication of three Niobium resonators and slow tuners using this facility. Also we have repaired nine cavities using the EBW machine facility. During these periods the machine has performed extremely well and satisfied our requirements. We are in the process of making fifteen new resonators within a span of two years.

All the machines, mentioned above, are working in good condition, because of timely maintenance and careful handling. Apart from the people engaged in the workshop, other academic personnel and students are also capable of handling the machines.

NSC workshop is providing apprentice training for the ITI passed students in both welding shop as well as in machine shop. Basic workshop training is provided for the scientist trainees and Ph.D. Students enrolled in NSC.

Workshop activities

Always efforts have been made for the procurement of equipments, tools and consumables for the smooth functioning of the workshop as well as the user requirements. A good inventory of the materials and tools procured is maintained for this purpose. These are often used mainly for the upcoming facilities like Phase II Accelerator (LINAC), RFQ, HCI, Low Energy Ion Beam Facility (LEIBF), and Ion Source Test Bench etc. Workshop always gives top priority to the urgent jobs coming from users and Pelletron laboratory for the successful completion of the experiment.

Workshop is associated with most of the labs for the design, fabrication and installation of the experimental set ups. All the five people associated with this group are fully conversant with machining as well as welding techniques. Knowledge of CAD and CNC systems were found to be very useful for the development of sophisticated set ups. Most of the beam line hardware including high vacuum chambers is being fabricated in the workshop. Apprentices enrolled in the workshop, enhanced the work output from the workshop considerably. Workshop personnel take both theory classes and practical works for the apprentices engaged with NSC.

Apart from the large number of emergency and short jobs, the following are the list of main jobs and projects undertaken by the workshop group. The details about these can be obtained from the respective group activities.

- Design and fabrication of Parallel plate avalanche detector and electron beam Faraday cup set up for the atomic physics experiments.
- AMS detector mounts, and two foil experiment set up at LIBR.
- Design and fabrication of Sollar slit detector assembly.
- Electro static analyser drift tube set up
- Gas jet target set up
- LN2 valve assembly mount.
- Beam line stands, Vacuum flanges, beam tubes, vacuum bellow and accessories.
- Various types of heat sinks for magnets, and power supplies.
- Vacuum chamber and its stand for the LEIBF line, soft landing setup.
- RF power cable cooling lines for the LINAC systems.

- Materials science new XRD chamber and its stand.
- Universal coupling for the LINAC RF power supply line.
- Steerer magnets
- A high vacuum chamber for AMS line.
- Target ladders and beam line components for the AMS line.
- High vacuum chamber for the material science line.
- Heat sinks for the cryogenic laboratory.
- Zero length adaptors of various sizes.
- RF power supply heat sinks.
- Gas cell absorber setup
- Beta spectrometer setup
- Liquid droplet source experimental set up for the LEIBF line.
- General purpose radiation chamber for materials science laboratory.
- Chamber for ECR plasma based deposition.
- Decelerating lens set up
- Triplet quadrupole
- Cryo valve development
- LN2 cooled target ladder for the materials science experiments.
- General purpose testing chamber for the vacuum chamber for the vacuum lab.
- Design and development of RFQ.
- Bellow development for the quarter wave resonator
- Machining of various parts of the resonators.
- Design and development of the various welding fixtures for the resonator fabrication.
- Machining for the repair of several components for the resonator.
- Design and drafting for a high vacuum spherical chamber
- Development of an aluminium heat sink for RF power supply for the resonator controllers.

3.10. HEALTH PHYSICS

S.P. Lochab and R.G. Sonkawade

Health physics personnel are involved in the field of radiation safety, radiation shielding and research and development. As radiation physics has emerged over the years as a separate discipline of research and development activities, increasing use of particle accelerators of various types have opened up new avenues for research in this field.

Currently health physics group is actively involved with different universities on various aspects of radiation research. A few of the aspects of health physics group activities are listed here.

A good setup for the environmental radiation monitoring and research is setup at health physics which includes the low background counting system, monitoring of radon, thoron facility, characterization of the Thermo luminescent material and conducting polymers. Total six universities are utilizing the off-line facilities available in this laboratory. There are another two universities which are linked with the Pelletron accelerator facility for the thermo luminescence material development, characterization. Two universities are involved in the characterization of conducting polymers and its possible aspects of charged particle, neutron & electron dosimetry.

3.10.1 Development and study of new TLD phosphors

Mixed sulphates $CaBa(SO_4)_2$: Eu, nano particles of MgB_4O_7 : Dy, $K_2Ca_2(SO_4)_3$: Eu, $LiNaSO_4$: Eu were prepared and studied for their TL properties. Five different types of TLD-materials i.e. $CaSO_4$: Dy, LiF : Mg,Cu,P (TLD-700H), $K_2Ca_2(SO_4)_3$: Eu, $LiNaSO_4$: Eu and MgB_4O_7 : Dy were exposed to Li (24MeV and 48MeV) ions in the fluence range of $5 \times 10^9 - 1 \times 10^{12}$ and thermo luminescence were recorded by taking 2mg of the samples each time. It was observed that there was growth of some extra TL peaks at lower temperatures. This might have occurred due to the implantation of some of the ions in host materials. Also the same samples exposed to gamma rays did not show such a glow peak.

(i) Thermoluminescence Study of Mixed Phosphor $CaBa(SO_4)_2$: Eu as a TL Material for Radiation Dosimetry.

S.P. Lochab[1], Numan Salah[2], P D Sahare[2], R S Chauhan[3]

[1]Nuclear Science Centre, New Delhi-110067
[2]Department of Physics & Astrophysics, University of Delhi, Delhi-110007
[3]Department of Physics, R.B.S. College, Dr. B.R. Ambedkar Univ., Agra-282002

$CaBa(SO_4)_2$:Eu samples are prepared in different ratio of $CaSO_4$ and $BaSO_4$ where Eu_2O_3 ratio is kept constant in all the samples. The microcrystalline powers of these samples are studies for their TL properties. The sensitivity of these samples varies with the variation in the ratio of $CaSO_4$ and $BaSO_4$. The sensitivity of samples is compared with $CaSO_4$:Dy, commercially availably TL material. All the samples are having single prominent peak. The glow peak shifts at different temperature with change in $CaSO_4$ and $BaSO_4$ ratio. The sensitivity of these samples also varies with dose. The dose response in case of Ca:Ba = 0.05:1.95, 0.2:1.8, and 0.3:1.7 is found similar. But Ca:Ba = 0.05:1.95 ratio is found to be most sensitive among all other samples and over all fading in this sample is less than 5% in first 30 days. More than 25% fading in 30 days is observed in case of Ca:Ba=1.5:0.5 and 1.9:0.1. For higher dose dosimetry CaBa = 0.05:1.95 is found more suitable, as it has less fading and linearity response above 100 rads.

(ii) TL response of LiF:Mg,Cu,P to 24 MeV of $^7Li^{2+}$ ions

Numan Salah[1*], S.P. Lochab[2], P.D. Sahare[1], S. Somdrendro Singh[1], Vinod Mune[1]

[1]Dept.of Physics and Astrophysics, University of Delhi, Delhi 110007
[2]Nuclear Science Centre, New Delhi 110 067

The effect of $^7Li^{2+}$ ion beams (24 MeV) for various fluences (in the range $5x10^9$-$1x10^{12}$ ions/cm^2) on LiF: Mg,Cu,P (TLD-700H) was studied using the thermoluminescence (TL) technique. TL response for all the glow peaks has been analyzed. It has been observed that the dosimetric peak (481 K) saturates around the fluence $5x10^{11}$ions/cm^2, while the TL fluence response of the peak at 524 K increases till the maximum fluence $1x10^{12}$ ions/cm^2. This has been attributed to the probability of $^7Li^{2+}$ ion implantation. The shift of all the peaks towards the lower temperature side was observed, comparing with those due to γ-ray of Co^{60}. The efficiency of LiF: Mg,Cu,P to $^7Li^{2+}$ (24 MeV) ion beam has been measured relative to γ-ray of Co^{60} and found to be 0.0053. The supralinearity and sublinearity has been discussed in the frame of track interaction model (TIM).

(iii) Effect of ^7Li (24 AND 48 MeV) Ion Beam Irradiation on $K_2Ca_2(SO_4)_3$:Eu TLD Phosphor: Studied by Thermoluminescence technique

P.D. Sahare[1@], Numan Salah[1], S.P. Lochab[2], Tanuja Mohanty[2], D. Kanjilal[2]

[1]Department of Physics and Astrophysics, University of Delhi, Delhi 110 007
[2]Nuclear Science Centre (NSC), New Delhi 110 067

Highly sensitive $K_2Ca_2(SO_4)_3$:Eu TLD phosphor was irradiated at room temperature by ^7Li ion beams of 24 and 48 MeV for different ion fluence in the range 10^9 - 10^{12} ions/cm^2 using a NEC 16 MV Tandem Van de Graff type Electrostatic Pelletron Accelerator at Nuclear Science Centre. The samples from the same batch were also irradiated to γ-rays from Cs^{137} source for comparative studies and also to determine relative thermo luminescence (TL) efficiencies to ion beams. Glow curves of the ion beam irradiated samples mainly consists of two prominent peaks at around 392 and 411 K while the γ-rays irradiated samples show only one peak at around 411 K. The appearance of the new peak (392 K peak) may be attributed to the trapping centers due to ^{7}Li ions that might have been implanted during irradiation and act as a source for these traps. This was confirmed from the glow curve structure of Eu, Li ion co-doped samples. The same glow curve structure and trapping parameters were obtained on ã-rays irradiation.

3.10.2 Radiation Survey of PKDELIS ECR Ion Source

S.P. Lochab, G. Rodrigues, P. Kumar, P.S. Lakshmi and D. Kanjilal

PKDELIS ECR ion source is a multiply charged high current source used for injecting (accelerating) beam into LINAC. It operates at 14.5 and 18 GHz. The maximum RF power is 1.7 kWatt. Two HTS (High Temperature Superconducting) coils can be energized up to a maximum current of 181 Amp and 145 Amp on injection and extraction side respectively.

Radiation survey of this unit was done at different parameters on the higher side. The radiation survey was started with Thyac III (Victoreen, USA) survey meter and UMo LB 123 (BERTHOLD Technology) radiation survey meter. Later on when the radiation level increased we added Teletector survey meter (it can read from a distance of 20 feet).

Locations taken for measurements:

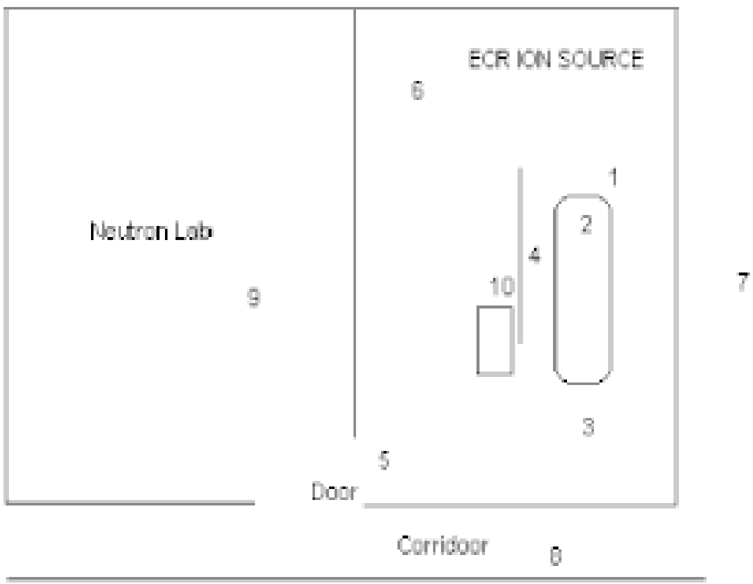


Table: Radiation survey (Average values in mR/h)

Machine output/ Location for reading	P = 20 watt CS = 90/ 60 amp	P = 100 watt CS = 90/ 60 amp	P = 200 watt CS = 90/ 60 amp	P = 500 watt CS = 90/ 60 amp	P = 20 watt CS = 150/ 100 amp	P = 100 watt CS = 130/ 100 amp	P = 200 watt CS = 130/ 100 amp	P = 500 watt CS = 130/ 100 amp
1	0.7	13	30	100	150	1500	2000	5000
2	1.8	30	200	250	600	2000	3000	7000
3	50	180	320	1500	700	800	1000	1000
4	0.4	6	25	40	60	400	600	800
5	0.03	0.06	0.15	0.2	0.3	0.5	1	3
6	0.02	0.07	0.1	0.15	1.5	4	7	12
7	0.02	0.05	0.05	0.05	0.2	0.3	0.5	0.6
8	0.02	0.02	0.08	0.05	0.05	0.04	0.4	0.5
9	0.02	0.05	0.05	0.6	0.2	0.6	1	1.2
10	0.05	0.05	0.1	0.2	1	4	6	7.5

P = Power, CS = Coil Supply

The above radiation survey data showed the level of radiation is increased with increase in microwave power (wattage) as well as coil supply (amp). This room needs certain modifications like shielding the machine or addition of extra wall thickness. The shielding work has been initiated already after radiation survey.

3.10.3 Low background counting system

R.G. Sonkawade

The low background system is used for the analysis of radionuclide's in the soil samples received from the high background radiation areas. This setup is used for the determination of the radionuclide formed in the accelerator components due to the continuous bombardment of the primary and secondary radiations.

The activity concentration of the natural radio-nuclides namely U-238, Th-232 and K-40 is measured for the soil samples, Rock samples and the granite samples received from different regions of India. The samples were crushed into fine powder for a sieve size of 150micron, dried for 24 hours at a temperature of 107^{o}C and sealed for a four week period to attain the radio-activity equilibrium among radon (Rn-222), thoron (Rn220) and their short lived daughter products.

The activity concentrations of the different samples were converted to the dose for the assessment of the radiation equivalent dose (nGy). To assess the radiation hazard, the UNSCEAR (1988) has given the dose conversion factors for converting the activity concentrations of ^{238}U, ^{232}Th and ^{40}K into doses (nGyh^{-1}per Bqkg^{-1}) as 0.427, 0.662 and 0.043 respectively. Using these factors, the total absorbed gamma dose rate in air at 1 m above the ground level is calculated as

$$D = (0.427\ C_U + 0.662\ C_{Th} + 0.043\ C_K) nGyh^{-1}$$

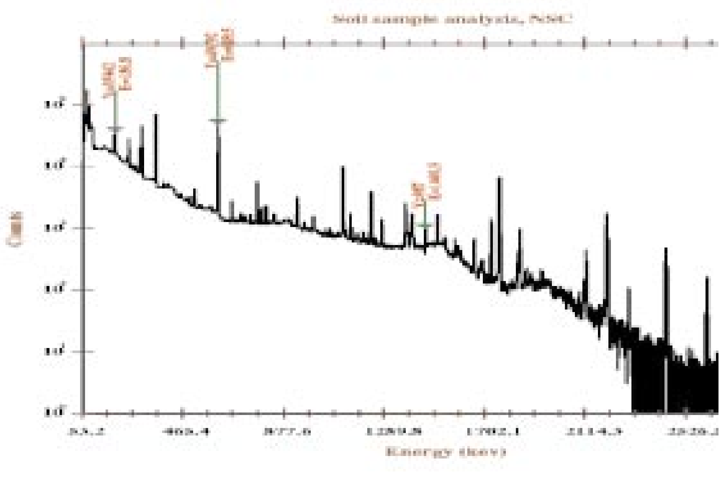
where C_U, C_{Th} and C_K are the activity concentrations (Bqkg^{-1}) of Uranium, thorium and potassium respectively. Annual estimated average effective dose equivalent received by a member is calculated using a conversion factor of 0.7 SvGy^{-1}, used to convert the absorbed rate to human effective dose equivalent with an outdoor occupancy of 20% (UNSCEAR, 1988). The graph of the sample analyzed at NSC is shown in fig.1. The activity concentrations of the sample are shown in Table1. The radiation absorbed dose and dose equivalents are given in Table 2.

Table 1 : Activity Concentration:

Sample	Activity Concentration (Bq/Kg)		
	U-238	**Th-232**	**K-40**
U01 (Jadugoda)	7074.8±7.15	—	532.6±7.15
G01 (Granite)	731±6.5	66.56±2.6	1009±8.3

Table 2 : Radiation absorbed dose and dose equivalents for all the samples

Sample	**Absorbed Dose (nGyh^{-1})**	**Dose Equivalent/Year**
U01(Jadugoda)	3043.8	3.73mSv
G01(Granite)	399.584	490.049microSv



REFERENCE

[1] UNSCEAR, United Nations Scientific Committee of the Effect of Atomic Radiation, 1988. Sources, Effects and Risks of Ionizing Radiations. United Nations. New York

3.10.4 Radon monitoring to locate the structural weak zones with helium

R.G. Sonkawade[2] and R.C. Ramola[1]

[1]H. N. B. Garhwal University, Tehri Garhwal, India
[2]Nuclear Science Centre, New Delhi

High heat flow and weak structural fractures in the geothermal areas allow easy passage for release of subsurface gases to the atmosphere. Particularly radon and helium are constantly transported from the earth's interior and vented out through exhalation points in permeable fault zones. Radon monitoring has been taken up to locate the structural weak zones with helium. The high values of radon in the thermal spring represent the presence of the radioactive minerals and the weak structural zones. Radon and helium are constantly transported from earth's interior and vented out through permeable fault zones. The radon level in the water sample of Sohana thermal spring was 70KBq/m^3 which is seven times higher than the prescribed limit (4K-40KBq/m^3, UNSCEAR 1993). The Helium level found is ~7000pp. Radon is generated in the geothermal areas due to the presence of radioactive uranium and thorium in the path of the thermal water. The purpose of this study is to attempt to establish radon as a tracer for helium exploration, earthquake precursor, to locate structurally weak zones and to find out the radon concentration for health risk analysis.

REFERENCE

[1] UNSCEAR, United Nations Scientific Committee of the Effect of Atomic Radiation, 1993 .Sources and Effects of Ionizing Radiations. United Nations. New York

3.10.5 Radiation Dosimetry around the Pelletron accelerator at NSC:

R.G. Sonkawade and S.P. Lochab

Extensive work has been done around the accelerator facility at NSC to measure the total radiation dose coming from the radon, their progeny and the neutron and gamma. The secondary radiations gamma and neutron generated from the ion beams of accelerator were measured by using thermo luminescence and CR-39 dosimeters. The gamma, neutron, radon, thoron and progeny radiation levels in the accelerator facility have been converted to effective dose by taking into account the radiation quality factor for different energy and the set formulae. The most dominant neutron energy in the 15UD accelerator facility at NSC is ~2-5 MeV for light ion (Li, C, O) beams around the vault and experimental chamber as estimated from fusion evaporation code PACE. For gamma the dominant energy is likely to be a few hundred KeV. The average radiation levels found around the facility for Li, C, O are around 0.20 to 8 mrem/hr of neutron and 0.11 mrem/hr to 1.5 mrem/hr for gamma. The neutron radiation levels found during the proton run varied from 1.2 to 800 mrem/hr. The gamma radiation level varied from 0.25 to 2.5 mrem/hr depending upon the location of measurement, tuning of the beam, energy, charge state and beam current. In case of 80 MeV Si having beam current of ~10 nAmp, the radiation level for gamma is 1.5 to 3.0 mrem/hr and for neutron is 3.0 to 4.5 mrem/hr. For Cu beam the radiation dose rate for gamma is from 0.075 to 0.20mrem/hr and neutron radiation level is from 0.19 to 0.37mrem. For 150 MeV Ni with beam current 150 nAmp, the radiation level for gamma is 0.06 to 0.18 mrem/hr and for neutron is 0.5 to 1 mrem/hr.

Airborne radioactivity is produced directly in the air from photonuclear reactions leading to formation of radioactive ^{15}O ($T_{1/2}$ =2min), ^{13}N ($T_{1/2}$=10min) and in some cases ^{16}N ($T_{1/2}$=7sec) during the light ion runs. Radioactive particulates such as O^{15}, N^{13}, N^{16} which are produced during the use of light ion beam, have been filtered out on an Whatsman filter paper with the help of high power air sucking pumps. It is usually best to sample the air that the worker breathes, measure it and estimate the internal dose. Special method is adapted during the light ion (especially proton) beam. The radioactive particulates are measured using the setup of contamination monitor for alpha-beta and beta-gamma contamination. It has been observed that the contamination levels of these products are within permissible limits. Due to the acceleration of light ion most of the time the residual radioactivity in the accelerator facility was found near the Analyzing Magnet, single slit, BPM-5, FC-04-1, beginning of switching magnet bellows, at the target and the ladder etc. Radiation dosimetry has been done using the Solid State Nuclear Track detectors (SSNTD). The etching parameters and the SSNTD for various kind of radiation are different. The tracks obtained by radiations are converted into the effective dose by taking account of occupancy factor and time parameters. The secondary radiation levels of neutron (0.25-0.91mSv for a period of 3 months) and gamma are within the permissible limits of 20 mSv/yr. The effective dose due to radon and thoron was found to be 0.3mSv and 0.15 mSv respectively. The values are well within the permissible level of dose due to natural radon and thoron which are 1.43mSv for radiation workers and 1.10mSv for general public.

3.11 CIVIL WORKS

M.K. Gupta and Avinash Gupta

Civil section is associated with the following activities:

(a) Major Projects

(b) Minor Projects

(c) Minor Works

(d) Maintenance Works

(e) External Cleaning of the Campus

(f) Liaison with various outside and Govt. agencies for statutory approvals and civic problems

Important Civil Activities during 2004-05

Following important Civil works were undertaken during the year 2004-05 in addition to routine civil maintenance and minor works:

(a) Construction of Guest House building under Phase II - Part II Project

(b) Construction of Material Science Lab. and Modular Lab. II under Phase II - Part II

(c) Construction of Utility Building III under Phase II - Part II

(d) Epoxy painting on wall and floor of Beam Hall II vault including Heavy concrete blocks kept there

(e) Polishing of wooden doors and painting of aluminium doors in Lab. Building

(f) Procurement of Haematite aggregates (Heavy density aggregates) and construction of heavy concrete wall in Beam Hall II

(g) External painting of Lab. Building

(h) Waterproofing of corridor portion of Beam Hall I roof

(i) Providing and fixing vinyl flooring in Guest house flats

(j) Construction of heavy concrete triangular concrete blocks in Beam Hall II

(k) External painting of Phase I housing and Hostel complex

3.12 SF6 GAS STORAGE & GAS HANDLING SYSTEM, COMPRESSED AIR SYSTEM , MECHANICAL PUMPS AND MATERIAL HANDLING EQUIPMENTS

K.K. Soni and Bishamber Kumar

i) SF6 Storage and Gas handling: 37 Tons of SF_6 Gas is stored in 5 nos. of 150

M^3 each pressure Vessels. With routine checks and timely maintenance, SF_6 system has been performing well and gas leakage through system is minimum. Further with operational skill, SF_6 quality has been maintained with Dew point better than - 65 degree Centigrade.

Necessary inspection and test of all the pressure vessels have been done as per norms of The Chief Controller of Explosives, Govt. of India.. Thorough inspection and testing (as per SMPV rules) of Relief Valves installed on storage tanks are also carried out to ensure the soundness of the pressure vessels and subsequently the storage license is sent for renewal from the chief controller of explosives of India.

ii) Compressed Air System: Compressed air plant (Ph-I & PH-II) consisting of reciprocating compressors (2 nos.), screw compressor, air dryer & filters with capacity of 3000 lpm @ 9.00 kg/cm^2 have been maintaining uninterrupted air supply to tower, Beam Hall-I, Beam Hall-II building, round the clock. Pneumatic connections have been extended to all the laboratories. Further to ensure dew point of the air, the compressed air is passed through two number refrigerated type air dryers of 4300 lpm capacity. Ultra high filters (boro silicate based) are provided in different location of the compressed air to provide clean air, free from dust and oil particles. Reciprocating compressors are more power consuming and also source of excess oil contamination in the compressed air. Therefore 2 nos. reciprocating compressors are replaced by one Screw Air Compressor of 2208 lpm capacity.

iii) Industrial Gases: Various industrial gases required in different labs have been made available from time to time. Special gases like Iso Butane and mixture gases are also procured for labs.

iv) Elevator: Elevator has been running smoothly and monthly preventive maintenance of the same is carried out to minimise the operational break down.

v) Material Handling System: Maintenance/servicing of all E.O.T cranes and electric hoists for Ph-I & Ph-II is being carried out periodically and the same have been working smoothly. Operational guidance for handling of scientific equipment / setup from one place to other is given whenever required. Two more cranes of 2 Ton capacity are installed in EBWM room and Material Storage area. All the cranes are put on remote control operation for safe handling.

vi) Fire Extinguishers: Annual refilling and periodic maintenance of all the fire extinguishers have been carried out. New fire extinguishers have been installed in newly constructed BH II store area. Some more signals including the “Escape route” in emergency is added in the building with GLOW LIGHT which shines even in darkness.

3.13 DATA SUPPORT LABORATORY

V.V.V. Satyanarayana, R. Ruby Santhi, P. Sugathan

Apart from providing regular user support to users, this year the Data Support Laboratory developed a few Electronic Modules, Serviced & maintained Radiation Monitors, and procured data acquisition Electronic Modules, connectors, cables etc.

3.13.1 Fabrication of Multi Channel Analyzers for Control room, Target & LEIBF laboratory

Multi Channel Analyzer with 12-bit Analog to Digital Converter with PC parallel port interfacing is made for Control room, target lab and LEIBF labs. This module includes a 12bit Analog to Digital Converter along with a peak detecting circuit at the input. The input range is up to 5 volts, unipolar signal.

3.13.2 Development of FPGA based Histogram generator CAMAC module

This is a single width CAMAC module. The logic part of the circuit is integrated into a single XC4010 Xilinx integrated chip using VHDL design. This module is a replacement of the existing TTL version histogram module. This module contains 8K, 24-bit memory and it communicates through the interface card sitting in the ISA slot of the Data Acquisition computer.

3.13.3 Development of FPGA based Histogram generator with ADC

FPGA based Histogram generator along with Peak sensing circuit and Analog to Digital Converter is wired on a single board with an interface to the PC using ISA bus. The peak sensing circuit detects the height of the input and is given to an analog to digital converter based on the integrated chip AD676 from Analog Devices . A threshold comparator sitting at the input initiates the conversion process and after the conversion complete data will be given to the histogram generator.

3.13.4 Servicing and Maintenance

A few numbers of neutron and gamma radiation monitors installed at different locations of the accelerator and beam lines were serviced and repaired. The problem causing malfunctioning of these radiation sensors was identified as the failure of ICs and associated circuitry. The other items serviced include Pre-amplifiers and Current Integrators.

Data Support Lab has acquired the following Electronic modules for data acquisition resource pool

1. LA303 Lecroy make 200MHz Oscilloscopes - 2nos.
2. 449-2 EG & G Ortec Log/Linear Rate meter - 1no.
3. VT120A EG & G Ortec Fast Pre-amplifier - 2nos.
4. 556 EG & G Ortec Time to Amplitude Converter - 1no.
5. GG8020 EG & G Ortec Octal GDG - 1no.
6. 935 EG & G Ortec Quad 200MHz CFD - 2nos.
7. 556 EG & G Ortec High Voltage power supply - 2nos.
8. 567 EG & G Ortec TAC/SCA - 2nos.
9. BNC and LEMO Connectors.