# 1. DIRECTOR'S REPORT:

This report covers the period from 1st April 2004 to 31 March 2005. Prof. V.N. Bhoraskar relinquished office of Director, towards the end of this period, on 28th February 2005. Prof. Ajay Gupta held charge for the last one month of this period.

Following the signing of the new MoU between UGC and DAE, the Inter-University Consortium got registered with the Registrar of Societies with the new name of UGC-DAE Consortium for Scientific Research on 7th July 2004. Under the new MoU, the scope of the activities of the Consortium will be widened to include collaboration with DAE institutions in other areas like biological sciences, chemistry, engineering sciences etc. Efforts are already being made to initiate activities in these fields.

It is our mandate to provide advanced and state of the art research facilities to the university scientists. Constant efforts are being made to enhance the research facilities through in-house development as well as through acquisition of state of the art equipments. It is envisaged that this will enhance the participation of the university researchers in the programs of the Consortium both in terms of quantity as well as quality.

It was decided to set-up advanced facilities for materials characterization at Indore under the Xth plan. A number of major facilities were acquired during the year 2004-05, which include a Transmission Electron Microscope with facility for EDAX, a micro-Raman spectrometer, high power laser for laser ablation facility. These facilities are in the process of getting installed. The Consortium is also participating in a national program of DST, New Delhi on setting up of advanced research facilities for the study of materials under extreme conditions of low temperatures and high magnetic fields. Under this program, two physical property measurement systems capable of going down to temperatures of 1K/0.3K and magnetic fields upto 14T were acquired. Various properties like resistivity, specific heat, magnetization can now be measured under extreme sample environment.

A number of new facilties have been established as a result of in-house efforts. This include facility for x-ray reflectivity and standing-wave analysis around a rotating anode generator, facility for Laue diffraction using a CCD detector, a temperature variation facility for dynamic light scattering, and installation of a 2kCi $^{60}$Co gamma irradiation source. Setting-up of the new beamline at Dhruva reactor is in progress. This year, the computer-controlled goniometer, developed at the University of Pune for the UGC-DAE CSR neutron beamline, was tested successfully. The Si focusing monochromator for neutron powder diffractometer was mounted on this goniometer and the assembly was tested for remote operation of X-Y motion, rotation, and tilt. This assembly was installed in the neutron beamline.

Organization of schools and workshops is one of the major activities of the Consortium, aimed at making university researchers aware of our activities and facilities accessible through the Consortium, and keeping them abreast with the latest developments in the

relevant research areas. Three such workshops were organized during the year 2004-05 in order to highlight the activities of the Indore, Kolkata and Mumbai centers.

Participation of University scientists in the activities of the consortium is constantly increasing. This year more than 200 scientists utilized the in-house facilities of the three centers. About 50 collaborative research schemes around the facilities of VECC, Kolkatta, IOP, Bhobaneshwar, IGCAR, Kalpakkam, and BARC, Mumbai were active during this year. These activities have resulted in publication of 66 research papers in international journals and 32 presentations in various conferences. In addition, in-house research activities of the consortium scientists resulted in publication of 58 papers in Journals and 32 presentations in conferences.

The Consortium for Scientific Research endeavours to improve the research activities in the University system in some selected spheres of science, which should encompass new areas under the new MoU between UGC and DAE. When existing wealth is distributed, there are losers and gainers. When new wealth is to be created, gains are not met at the cost of losses. Research, as an endeavour that creates new knowledge, simulates the creation of new wealth. The Consortium has a vision of catalyzing research activities in which all participants will gain through new ideas, with increased output of research of high quality.

**- P. Chaddah**

## 2. ABOUT UGC-DAE CSR:

### (a) Background Information:

UGC-DAE Consortium for Scientific Research (UGC-DAE CSR) formerly known as Inter-University Consortium for Department of Atomic Energy Facilities was established as an autonomous institution by the University Grants Commission, New Delhi in the year 1990 at Indore (M.P.). A Memorandum of Understanding which led to the establishment of the Inter University Consortium for Department of Atomic Energy Facilities was signed by Dr. M.R. Srinivasan, then Chairman, Atomic Energy Commission and Prof. Yash Pal, then Chairman, University Grants Commission on 5$^{th}$ July, 1989 at Vigyan Bhavan, New Delhi in the presence of Hon'ble Shri Shiv Shankar, the then Union Minister for Human Resource Development.

Initially, the Consortium was foster-mothered by the Devi Ahilya Vishwa Vidyalaya, Indore and all the activities of Consortium were carried out under the overall guidance of the Steering Committee chaired by Prof. Yash Pal, then Chairman, University Grants Commission, New Delhi.

In due course of time, the Consortium was registered as a society under the M.P. Societies Registrakaran Adhiniyam, 1973 on 31$^{st}$ July, 1990.

As per the MoU, the Department of Atomic Energy agreed therein to make its major facilities, mainly the Dhruva Reactor at Bhabha Atomic Research Centre (BARC), Mumbai; the Variable Energy Cyclotron Centre (VECC), Kolkata; and the Synchrotron Radiation Source at Centre for Advanced Technology (CAT), Indore, available to the university researches for research and developmental work.

Subsequently, the Consortium established its three Centres, one at Indore for utilization of the Synchrotron Radiation Source, CAT, Indore; one at Mumbai for the utilization of the Dhruva Reactor, BARC, Mumbai; and one at Kolkata Centre for utilization of the Variable Energy Cyclotron at VECC, Kolkata.

The objectives of the Consortium are to develop competence and promote teaching and research in the design, fabrication and utilization of frontline research facilities such as accelerators, lasers, nuclear reactors, synchrotron radiation source, etc. In addition, the emphasis is on the development of State-of-the-Art facilities for research in physical sciences as well as in other branches of Science and Technology. In order to provide low energy ion accelerator facilities to University researches, the accelerator facilities of Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam and of the Institute of Physics (IOP), Bhubaneshwar, were added recently as D.A.E. facilities. Along with the utilization of DAE facilities, the University researches are also provided the

available synthesis and characterization facilities of the respective centers of Consortium.

A revised MOU between UGC and DAE was signed by Prof. A.S. Nigavekar, Chairman, UGC and Dr. Anil Kakodkar, Chairman, AEC on 10th December, 2003 at UGC, New Delhi. As per the new MOU the name of the Consortium has been changed to UGC-DAE Consortium for Scientific Research. Under this MOU, the research facilities in the fields Physical Sciences, Chemical Sciences, Life Sciences and Engineering Sciences of the DAE Centres can be utilized by the researches from universities and institutions of higher learning.

**(b) Administration:**

The Consortium has a Director, who looks after the overall administration in addition to the scientific and academic programmes of the Consortium. The office of the Director and the Head Office of the Consortium are situated on the campus of Devi Ahilya Vishwavidyalaya, Indore. Each Centre is looked after by a Centre-Director. The other employees of the Consortium are scientists, engineers, technicians and administrative staff. All the employees of Consortium support the scientific and academic programmes as well as the Collaborative Research Schemes of the Consortium.

**(c) Academic Programmes:**

The Consortium is now recognized as one of the National Institutes working for the Univesity scientific community and for other scientific organizations.

A large number of characterization and synthesis facilities have been established at Indore. Some of the important facilities like (i) Electrical and Magnetic measurements upto Liquid Helium temperature (ii) UHV-Multi layer thin film deposition system, (iii) X-ray scattering and diffraction, (iv) X-ray reflectivity, (v) EXAFS, (vi) XPS, LEED, (vii) Auger and ESCA, (viii) Atomic Force Microscopy, (ix) Thermal and Mechanical properties, (x) Mossbauer spectrometer, (xi) SEM, (xii) SIMS, (xiii) different types of furnaces, etc., are unique in the Indore Centre.

In addition, the scientists of the Consortium in collaboration with universities and other national institutions have designed, fabricated and installed a Photoelectron Spectroscopy (~200 eV) Beam-line on INDUS-1 at CAT, Indore. This Beam-line is in operation for the last two years. University researchers and scientists of other national laboratories are using this Beamline. Improvements are made in this Beam Line from time to time, as and when required.

The neutron spectrometers of Dhruva Reactor, BARC are being used by the University researchers through the Mumbai Centre of the Consortium. A large number of University and College teachers are carrying out research work in

collaboration with the scientists of SSPD, BARC and UGC-DAE CSR-Mumbai Centre. The main emphasis of the research work is on the studies related to neutron diffraction, magnetic scattering, inelastic scattering and small angle neutron scattering.

The new neutron beamline which was designed and fabricated by the Scientists of UGC-DAE CSR, Mumbai Centre in collaboration with the Scientists of SSPD, BARC is now being installed and tested in the Dhruva Reactor Hall of BARC. This neutron Beamline is likely to become operational within a short period. In addition, the Mumbai Centre has the following characterization facilities: (i) static light scattering, (ii) AC susceptibility measurement, (iii) Dielectric Relaxation, (iv) Viscometer, (v) Rheometer, (vi) Arc Furnaces, (vii) sample preparation facilities.

The Variable Energy Cyclotron of VECC, Kolkata is being used by the University researchers through the Kolkata Centre, of the Consortium. In addition, the Universitysa researchers are also utilizing the other DAE facilities like (i) the Low Energy Ion Accelerator of IOP Bhubaneshwar, and (ii) the Particle Accelerator Facility of IGCAR, Kalpakkam, through the Kolkata Centre of the Consortium. Some of the important facilities available at the Kolkata Centre are (i) Positron Annihilation, (ii) Californium-Neutron Source, (iii) Gamma-ray Spectrometers, (iv) Alpha, Beta and Gamma-Ray Radiation Detectors with M.C.A., (v) Target Laboratory, (vi) Semiconductor Detector fabrication Laboratory, (v) Chemistry Laboratory, (vi) Radiation Biology Laboratory, (vii) Mossbauer Laboratory and (viii) Radio Isotope Laboratory. In addition, the Scientists of the Kolkata Centre have contributed in the installation of Indian National Gama detector Array and Clover Array Detector. This is a common facility and carried to different places like TIFR, NSC, and VECC for experimental work. A $^{60}$Co $\gamma$-ray source has been installed at the Kolkata Centre recently and is being used for research work.

The Consortium provides financial assistance to University teachers for carrying out collaborative research work using the DAE facilities as well as the in-house research facilities of the Consortium. In most of cases, travel support and local hospitality are provided to the teachers and students who are interested to visit any of the DAE Centres or Consortium Centres, in connection with the research work.

The Consortium also provide fellowships to a large number of research students working on the Collaborative Research programmes in various Universities as well as in the Centres of the Consortium. In general, a fairly good number of the University teachers, particularly in Physics, have been benefited by these Collaborative Research Schemes and a number of students have obtained Ph.D. degrees. Based on the work carried out by the University researchers, a large number of research papers have been published, and also presented in various conferences.

A number of workshops, seminars, training programmes, short-term courses, etc., are being organized by the Consortium from time to time at different universities and its three centers.

The Consortium has made a mark in the fields of (i) Neutron Scattering Studies, (ii) development of nuclear techniques and radiation detectors, (iii) UHV-multilayer thin films coatings, (iv) X-ray diffraction, (v) X-ray reflectivity, (vi) Physical properties measurements at low temperatures and high fields, (vi) thermal analysis, (vii) nuclear reaction analysis, (viii) nuclear reactions induced by low and heavy ions, (ix) Beam-line for the Synchrotron Radiation Source and its utilization, (x) Mossbauer Spectrometry, (xi) Atomic Force Microscopy, and (xii) Other characterization facilities.

A large number of University and college teachers as well as scientists from other national laboratories are using the facilities of Consortium and carrying out collaborative research work.

Under the Xth Five Year Plan, the consortium is in the process of establishing facilities for research work in the field of synthesis and characterization of nanostructured material at Indore.

Under revised MOU between University Grants Commission and Department of Atomic Energy, signed by Prof. A.S. Nigavekar, Chairman, UGC and Dr. Anil Kakodkar, Chairman, AEC on 10$^{th}$ December, 2003 at UGC, New Delhi, the research facilities in the field of physical sciences, chemical sciences, life sciences and engineering sciences will be made available to the researchers from the universities and other institutions. It is proposed to involve university faculty in the major research and development projects of the DAE Centres.

*Picture of the UGC-DAE CSR Neutron Beamline and Neutron Powder Diffractometer installed at Dhruva Reactor.*

Neutron Diffractometer is used for determining microscopic structure of materials. Unlike X-ray diffraction, neutron diffraction is used for locating light elements in presence of heavy one. Neighbouring elements in periodic table can also be distinguished. More importantly, neutron diffraction is a unique technique for investigating microscopic magnetic structure.

Gamma Irradiation Chamber commissioned at UGC-DAE CSR, Kolkata Centre.

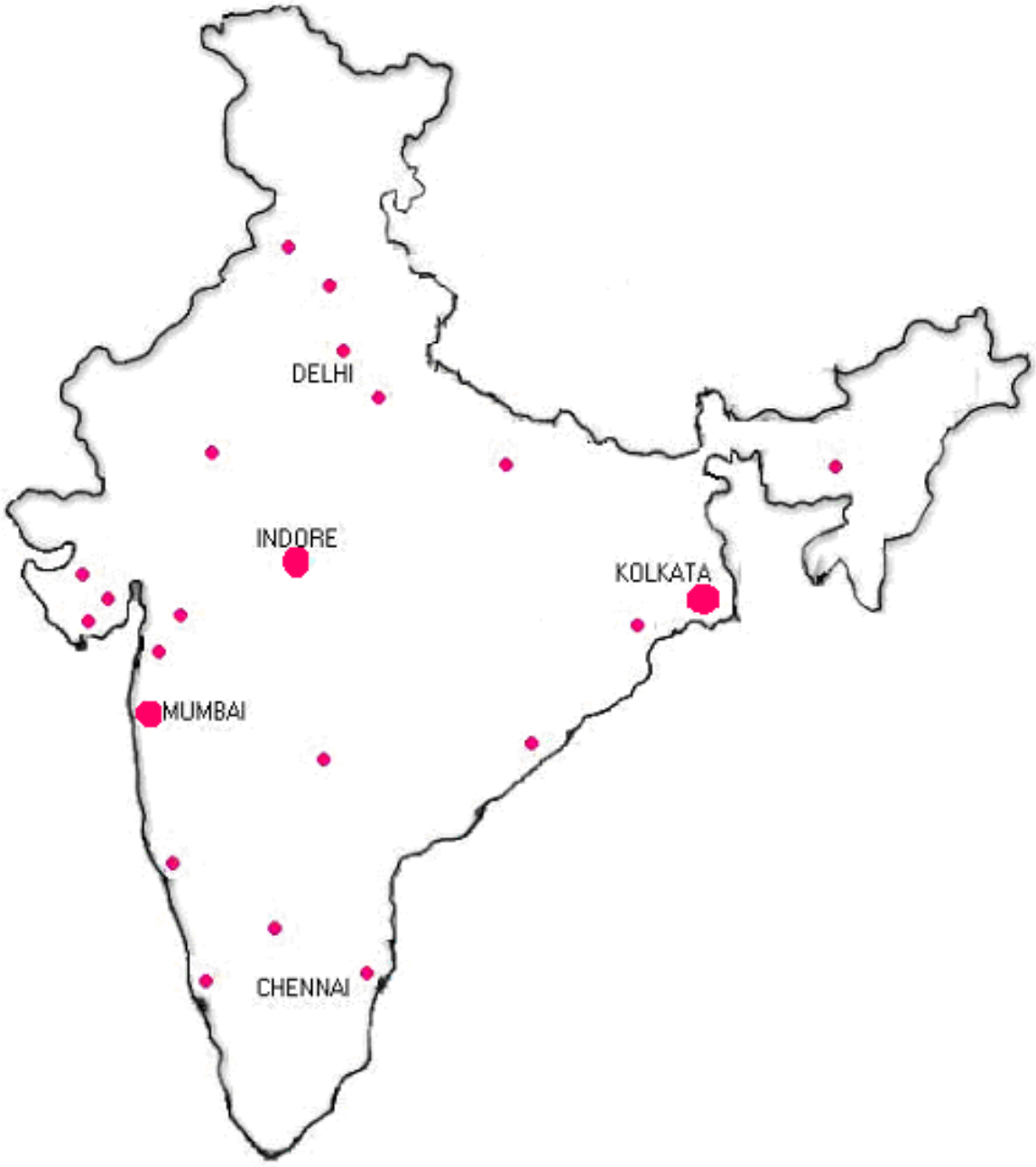
Energy Dispersive X-ray Fluorescence Set-up for Trace Element Studies at UGC-DAE CSR, Kolkata Centre.

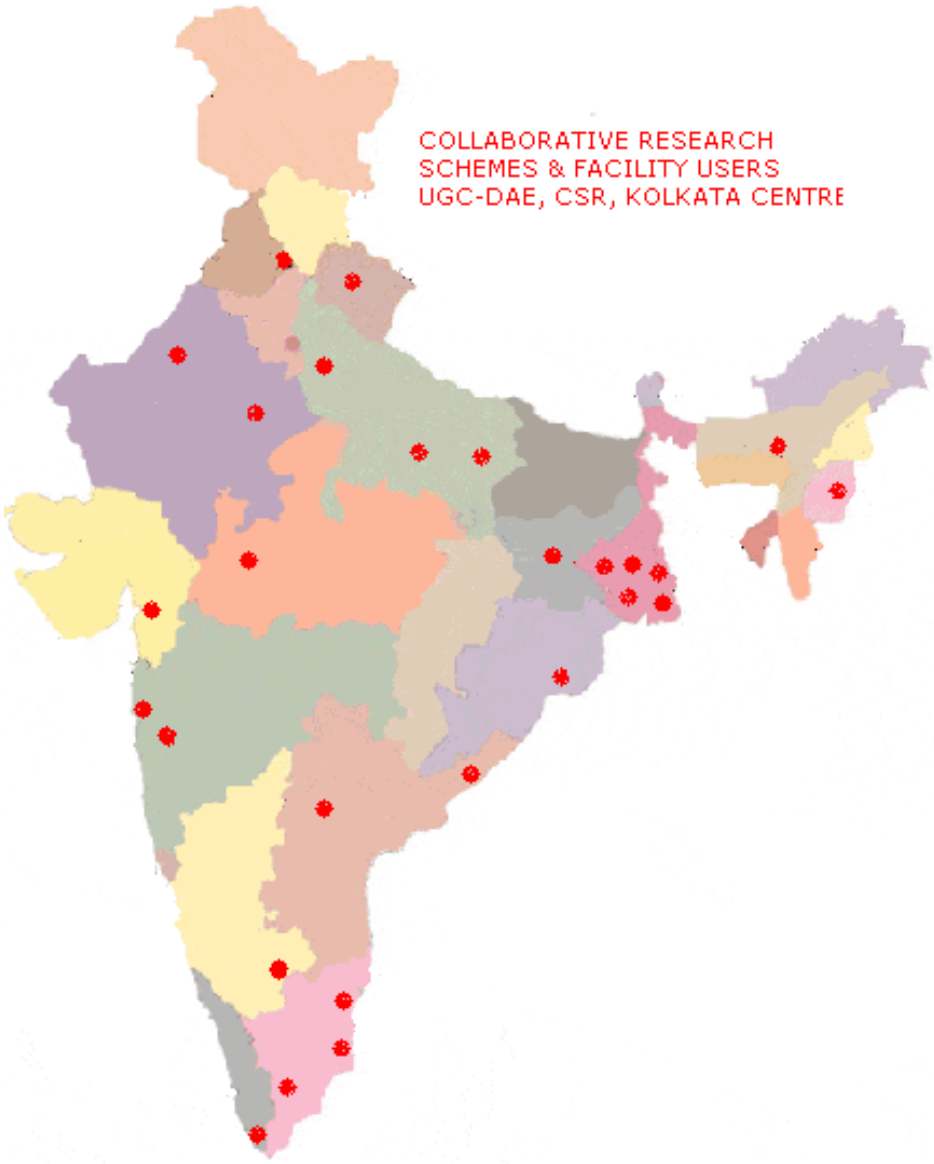
X-ray reflectivity and X-ray standing wave setup developed inhouse at CSR, Indore Centre.

# Distribution of Universities/Institutions' users for in-house facilities of CSR, Indore Centre


Universities/Colleges  Institutions

Distribution of Universities' users of DHRUVA reactor




COLLABORATIVE RESEARCH
SCHEMES & FACILITY USERS
UGC-DAE, CSR, KOLKATA CENTRE

# 3. COLLABORATIVE RESEARCH CARRIED OUT BY UNIVERSITY SCIENTISTS USING DAE FACILITIES:

## *3.1 Photoelectron spectroscopy beam line using INDUS-1, CAT, Indore*

### 3.1.1 Investigation of interface electronic structure in annealed Ti/Ni multilayer:

Synchrotron based PES study (core-level and valence band) carried out on [Ti(50Å)/Ni(50Å)]$X_{10}$ multilayer samples clearly shows the changes in electronic structure that has occurred due to annealing treatment at interfaces. At lower temperature of annealing it has been observed that Ni diffuses into Ti layers due to its faster mobility as compared to Ti atoms. However, for multilayer samples annealed at 300ºC and 400ºC, our measurements show clear evidence for Ti-Ni alloy phase formation at interface. The observed shifts in modified Auger parameters determined from recorded experimental data show positive value for Ti and negative for Ni. This provides clear evidence that direction of charge transfer from Ni to Ti atom during the formation of Ti-Ni alloy at the interface. By using a simple electrostatic model, the calculated charge on ionized atoms also indicates the similar trends for charge transfer deduced from Auger parameters and chemical shifts.

*( S. M. Chaudhari and collaborators)*

### 3.1.2 Determination of bandgap in Si/Ge multilayers using photoemission spectroscopy:

The valence band (VB) photoemission spectroscopy technique is most sensitive to changes in the local bonding. In addition to this, the surface sensitivity of this technique makes it suitable for the measurement of electronic properties in thin film nanostructures. This has been applied to Si/Ge multilayers for the determination of bandgap from the measured shift in valence band offset. The VB edges of bulk Si and Ge were taken as a reference point. Before extending to ML system, this procedure was adopted for single layers of Si and Ge, in order to check for the validity of the procedure. The bandgap values thus obtained are matching well with those obtained from standard absorption measurements.

*( S. M. Chaudhari and collaborators)*

### 3.1.3. PES study carried out on Ag and Au nanoparticles:

Photoelectron spectroscopic measurements carried out on Ag and Au nanoparticles prepared by chemical route show significant changes in recorded core levels as well as valence band spectra. The Ag-3d and Au-4f core levels are clearly observed to be shifted towards lower BE side as compared to their bulk BE values. Corresponding changes are also observed in the valence band edges. This work was carried out by Dr. Shailja Mahamuni Dept of Physics, University of Pune.

Similar kind of work was done by Dr M. Banerjee Dept. of Physics, DAVV Indore on $ZnFe_{1.5}Al_{0.5}O_4$, $Zn_{0.5}Cu_{0.5}Fe_2O_4$ and $ZnMnFe_2O_3$ nanoparticles.

*( S. M. Chaudhari and Shailaja Mahamuni, Pune)*

## *3.2 Activities with the Indian National Gamma Array on VECC:*

The *Indian National Gamma Array* (INGA) collaboration has been set up by the nuclear physics community of the country, belonging to the national institutes and the Universities some years ago with a view to realize a high efficiency and high resolving power γ-detector array, based on the latest state of the art technology in detector and pulse processing, for pursuing research of contemporary interest in the field of nuclear structure and dynamics studies under extreme conditions of temperature, spin and iso-spin. Presently VECC is hosting the INGA facility. UGC DAE CSR - KC has made a coordinated effort for the implementation of this multi-clover array and has ensured an active University participation in this significant development in Nuclear Physics scenario in the country.

The relatively higher beam energy, available from VEC, Kolkata, offers an opportunity to carry out a wide range of nuclear reaction and spectroscopic studies. A series of test experiments were carried out with a view to explore the relative contributions from the underlying reaction processes, such as, fusion-fission, deep inelastic & multi-nucleon transfer reactions and the prospects of spectroscopic studies of residual nuclei, produced by such reactions. Several discussions between the University users and the groups from UGC DAE CSR-KC, SINP, VECC and NSC were organized. This has resulted in the submission of about 20 beam-time requests from various users to the User Committee of VEC.

The Early Implementation of the INGA at VECC comprised of six Compton-Suppressed Clover detectors, pooled from the SINP (4) and UGC DAE CSR (2) groups. A compact uniformly thick aluminum chamber with conical entrance and exit ports has been used as the target chamber. At a short distance upstream of this chamber, a rigidly connected small chamber provides for the beam viewing and optimization using an electrically insulated collimator. In this configuration two detectors each were mounted at $90^0$, $40^0$ forward and $125^0$ backward with respect to the beam-direction. The target-to-detector distance was about 20 cm. The integrated electronics modules for clover detectors developed at NSC New Delhi, were used. A PC CAMAC-based multi-parameter system, ``LAMPS'' developed at BARC, Mumbai, was used for the data acquisition.

Out of approved experiments, using INGA array, six experiments have been carried out using $^{20}$Ne beam at 137 – 150 MeV since August 17$^{th}$ 2004. These experiments were chosen so as to cover a range of target nuclei between A = 40 – 170. Instead of normally used heavy metals as backing, light backing materials like pure aluminum or aluminized Mylar foils have been used with very satisfactory results in these experiments. The targets used were typically about 2 – 5 mg/cm$^2$ and typical beam currents used were 0.5 – 2 enA.

It is observed that there are no problems related to the background or to neutron related effects in the observed spectra. The timing and the turn selection of the cyclotron have been found to be quite good which is reflected in a very stable RF – γ time spectrum. Typical prompt γγ time resolution (FWHM) was of ~ 20 ns for the entire energy range and for all the detectors taken together. Out of the data sets accumulated, about 60-70% of the events corresponded to a two-fold coincidence in the clovers and about 8-9% of the events was triples.

The beam tuning was optimized where in it was ensured that the collimator current was almost zero while the beam-dump (few meters down-stream), indicated a maximum current of about 1-2 enA. During these initial experiments, a 15 mm size collimator was used. This procedure eliminated the need for beam viewing upstream, even after an energy change was made. During this beam cycle, there has been a minimal downtime due to machine related problems, in spite of the prevailing weather conditions, such as, the occasional thunderstorms and the associated power glitches.

The array would be upgraded shortly by adding four more Clovers in the available space. The multi-crate synchronization hardware would be incorporated to cope up the situation. It is proposed to incorporate, in a few experiments, two segmented LEPS detectors that would sit at the $90^0$ median plane positions. At a later date, a few suitable ancillary devices would be put for tagging of light charged particles and projectile-like fragments, for which necessary work is in progress. Experiments involving CRS projects of the UGC DAE CSR-KC carried out using the INGA at VECC are briefly described below:

### 3.2.1 Gamma ray spectroscopy of N ~ Z nuclei populated via deep inelastic collisions and fusion reaction of $^{20}$Ne + $^{40}$Ca system at 150 MeV

Deeply inelastic transfer reactions in heavy-ion collisions uniquely combines the two apparently opposite nuclear processes *viz* direct reactions and compound nucleus decay. Detailed cross-section measurements for such process have been the focus of several investigations. The cross sections for the $^{20}$Ne on $^{40}$Ca were measured by N V Sen et al., at 151MeV. The measurements indicated that the total cross section for deeply inelastic and quasi-elastic collisions is almost equal to the complete fusion cross section. Using this reaction it is possible to populate a few A ~ 50 nuclei such as $^{49,50,51}$Cr, $^{49}$V, to name a few. Some these nuclei are difficult to access via the conventional fusion reactions. Thus is it expected that the γ-ray spectroscopy following the $^{20}$Ne + $^{40}$Ca system at around 150 MeV, would help us undertake the investigation of these nuclei which earlier have been have been populated with extremely low cross-sections using the conventional fusion reactions.

The $^{20}$Ne beam was provided by the Variable Energy Cyclotron at Calcutta. In this experiment, we have used a ~5 mg/cm$^2$ thick $^{40}$Ca target. The target had a 15 m aluminized mylar backing. The de-exciting gamma rays were detected using the Indian National Gamma Array(INGA) then stationed at VECC, Kolkata. Transitions belonging to several A ~ 40-50 nuclei such as $^{49,50,51}$Cr have been identified. The analysis is in progress. *(Viswabharati University & UGC DAE CSR - KC)*

### 3.2.2 Gamma ray spectroscopy of neutron deficient $^{182}$Pt & $^{178}$Os nuclei

The Os nuclei, lying between the well-deformed rare earth and spherical lead isotopes, are believed to be soft to changes in deformation and could exhibit shape-coexistence. The neutron Fermi level in $^{178}$Os nucleus lies in the middle of the $i_{13/2}$ orbital. The yrast sequence and the band crossing behaviour of Osmium isotopes change with rotational frequency and the neutron number. Further, an unusual rotational band with spacing almost similar to a super-deformed band, was observed $^{178}$Os which has very large moment of inertia $J^2$, but connects to the normal yrast band. The $^{20}$Ne + $^{165}$Ho reaction at incident beam energy of 150 MeV was used to populate the high spin states in $^{178}$Os. The self-supporting $^{165}$Ho target had a thickness of about 4 mg/cm$^2$. The analysis of the data is in progress. *(Panjab University)*

### 3.2.3. Spectroscopy of A ~ 60 – 70 nuclei : from mid-shell to shell closure:

The $^{20}$Ne + $^{59}$Co reaction at E = 145 MeV was repeated in order to optimize the electronics and the data acquisition System. This experiment was carried out earlier during the previous test runs. The residual nuclei produced in this reaction span a variety of nuclei from mid-shell to shell closure and display a complicated interplay of single particle and collective degrees of freedom due to extra-core nucleons, spanning the *f-p* sub-shell space. Besides, the intruder high-j unique parity $g_{9/2}$ orbital plays an important role in high spin excitations and its coupling to the close lying $p_{3/2}$ orbital may produce octupole correlations. The $^{20}$Ne beam of 145 MeV incident energy was used to populate some of the nuclei of interest in the A = 60 – 70 region. The target was a self-supporting foil of thickness ~ 4mg/cm$^2$. At this energy domain, there is a competition between fusion-fission, deep inelastic and fusion-evaporation reactions. Therefore, de-excitations from both projectile-like as well as target-like residues, are expected to be observed besides those from fusion-evaporation residues.. The revision of the known level schemes is in progress. It is expected that the new information would add to our understanding of the nuclei in the *f-p* sub-shell. *(UGC DAE CSR- KC, VECC & University of Burdwan)*

### 3.2.4 In beam spectroscopy of $^{36}$Cl:

The γ decay of high spin states in $^{35,36,37}$Cl & $^{38,39}$Ar, $^{39,40}$K & $^{40,41}$Ca were investigated using $^{20}$Ne + $^{27}$Al reaction at an incident beam energy of 150MeV.

The $^{20}$Ne beam was provided by the VECC and the Early Implementation of INGA at VECC was used to detect the de-exciting gamma rays.

The preliminary analysis indicates several new transitions belonging to these nuclei. In addition to the earlier reported transitions several new transitions belonging to $^{36}$Cl nucleus have been identified and are being placed in the level scheme. The use of a Clover array would facilitate, polarization measurements which are crucial to make unambiguous spin parity assignments. It would be of interest to explore the underlying microscopic configurations in these difficult to access nuclei, following the development of the complete level scheme. *(Dr S Mukherjee, M S University of Baroda)*

## *3.3 Activities with the Indian National Gamma Array at NSC, New Delhi*

### 3.3.1 Polarization measurements in neutron rich N ~ 20 nuclei:

Heavy-ion induced transfer reactions have the potential to play a significant role in investigating the level structure of N~20 neutron-rich nuclei that are not easily accessible using fusion-evaporation reactions. Transfer reactions near the Coulomb barrier offer unique possibilities since the neutron-pickup and proton-stripping reactions will lead to neutron-rich projectile-like fragments. The structure of such neutron-rich nuclei in the A ~ 30-40 region is expected to reveal, even at low spins, several intriguing aspects such as deformation and shape co-existence.

In the first-ever measurements of its kind in the country, neutron-rich N ~ 20 nuclei, $^{36}$S and $^{33,34}$P, have been investigated using γ–ray spectroscopy following HI transfer reactions. The experiment was carried out at the 15UD Pelletron facility at the Nuclear Science Centre, New Delhi, employing the $^{34}$S + $^{115}$In reaction at an incident beam energy of 140 MeV. The isotopically-enriched $^{115}$In target was about 1.29 mg/cm$^2$ thick on a Au (7.14mg/cm$^2$-thick) backing. The de-exciting γ-rays were detected using the 8-clover INGA array then stationed at NSC

The polarization measurements which were possible due to the multi-clover array necessitated some changes in the previously reported yrast & near yrast sequences of $^{34}$P. The preliminary shell model calculations indicated the need to include $f_{7/2}$ orbital in the calculations to have an insight to the underlying microscopic configurations of these levels. *(UGC DAE CSR-KC & Burdwan University)*

### 3.3.2 High spin states in odd-odd nucleus $^{146}$Tb:

The odd-odd nucleus $^{146}$Tb has been populated via the $^{115}$In + $^{34}$S reaction at an incident beam energy of 140 MeV, at the 15 UD Pelletron facility at NSC, New Delhi. The de-exciting gamma rays were detected by the INGA array, then stationed at NSC. The INGA comprised of 8 clover detectors, at the time of the experiment.

Based on the observed γ–γ coincidences the level structure of $^{146}$Tb has been substantially extended up to J ~ 30 h and $E_x$ ~ 10 MeV.

The absence of any band-like structure is indicative of the persistence of single particle behaviour in this nucleus, up to the highest observed spin & excitation energy. The presence of high energy transitions and fragmentation of intensity into several cascades are indicative of excitation of nucleons across the shell gap.

The most interesting observation was the occurrence of a ΔJ=1 magnetic transition sequence at $E_x$ ~ 8 MeV and J ~ 24 h. This sequence resembles qualitatively a "shears" band reported in the neighbouring nuclei. *(UGC-DAE-CSR-KC & Burdwan University)*

### 3.3.3: Lifetime measurements of micro-second isomers using recoil isomer tagging:

The recoil-isomer tagging technique has been used to study the isomeric states of nuclei in the vicinity of the N = 50 shell closure. In recoil-isomer tagging, the isomeric levels are selected and separated from the beam-like particles, and evaporation residues by recoil-separator allowing its decay to be measured in a relatively low background environment at it's focal plane.

The flight path through the recoil-separator is typically of the order of a few micro-seconds. Thus this technique is limited to isomers having half-lives typically about 1 μs.

At the same time, an array of γ detectors are placed around the target position, to record the prompt γ decays. Thus this method uniquely allows the investigation of the correlation between the prompt decays feeding the isomer and the delayed events originating following the decay of the isomer.

Using the above mentioned technique the half lives of a few micro-second isomers in N=48 nuclei i.e. $^{88}$Zr & $^{90}$Mo have been investigated. The measured half-lives of the $8^+$ isomers in $^{88}$Zr and $^{90}$Mo are ~ 1.41$\mu$s and 1.17$\mu$s, respectively. Further, the half lives of the $11^-$ and $17/2^-$ isomeric levels in $^{90,91}$Nb also have been measured as ~ 0.47 $\mu$s and 3.25 $\mu$s respectively.

Using the prompt-delayed coincidences, yrast sequences above the 11- isomeric levels in $^{90}$Nb have been identified. The level scheme of $^{90}$Nb has now been extended up to J ~ 19h and Ex ~ 8 MeV.

From the measured lifetimes, the transition probabilities were calculated. It was observed that the effective charges derived from fitting the theoretical B(E2) values to the observed B(E2) are influenced by the excitation of a $g_{9/2}$ neutron across the N=50 shell closure. *(UGC-DAE-CSR-KC & Burdwan University)*

## *3.4 Collaborative research schemes on IOP, Bhubaneswar.*

### 3.4.1 Heavy metal genotoxicity and evaluation of antimutagenic diets

The CRS under Dr. Rudrama Devi of Osmania University, was completed. The student in this project submitted her thesis. The trace elemental profiling of the human blood samples of people exposed to leather industries showed presence of Cr, Fe, Zn, Br, Sr,S,Cl, K,Ca, Rb etc. Additionally the cytogenetic effects of Cr exposure in terms of chromosomal aberration of the exposed human population simulated in animal model has been studied. *(Osmania University and UGC DAE CSR - KC)*

### 3.4.2 Impact of waste metals from Tanneries in the East Calcutta wetland ecosystem

The PIXE data obtained was analysed. Data interpretation has been carried out and manuscript prepared for publication. Data of this investigation documented a unique

profile of heavy metal distribution in East Calcutta Wetland ecosystem following inputs from different industrial effluents including tanneries. PIXE analyses of various abiotic (bottom sediments and water) and biotic samples (three different fish species and water hyacinth) show significant variation in elemental distribution. It was observed that the concentrations of metals in bottom sediments collected from different sites were always higher than that of overlying water of the respective site. This is due to the constant sedimentation process occurring naturally throughout the year along the stretch of wastewater carrying canal, as well as the ponds of our interest. The accumulation of heavy metals in bottom sediments was closely correlated with the organic contents of the sediments as has been reported by earlier workers. It was noted that among the detected elements in abiotic samples, viz. bottom sediments and water, Ti, V, Rb, and Sr were only found in the bottom sediments and not detected in water samples of any site. Gradual amelioration of many metals like Ca, Cr, Cu, Mn, Zn was observed in the bottom sediments from the site I and site II to site IV. This reflects natural biological remediation processes taking place along the stretch of 40km from the source point of the effluent. The fish organs like gills, liver, muscle showed a general trend of larger concentration of elements in the gills than the other organs, which was expected since gills are directly exposed to the water. In facts according to reports, gills are the initial accumulation sites of heavy metals. It was also found that water hyacinth of the contaminated site accumulated higher amount of heavy metals such as Ca, Cr, Cu compared to that of the uncontaminated site. It was observed that this plant took up more chromium than vanadium, while none of them were present in the overlying water. However, higher availability of Cr in bottom sediment of the contaminated pond could be influencing the uptake by the plant. Similarly, though, concentration of Ca was observed to be higher in the overlying water of the uncontaminated pond, still higher concentration was found in the bottom sediment of contaminated pond. Thus, high uptake of Ca by water hyacinth of contaminated pond compared to the plant of the control counter part could possibly be influenced by the sediment concentration. It may also be due to availability of various other metals and inorganic components, which possibly influence rate of Ca uptake in the contaminated environment. Our data reflect inter-elemental interaction influencing the uptake rate of other element as has been documented by Tichy et al (1997) where presence of sulphur influences uptake of cadmium. Furthermore, we have carried out electron microscopic studies of fish exposed to the effluents in order to correlate the alteration of trace elements in the abiotic and biotic components and its effect on tissue ultrastructure of the affected biota *(WB Govt. College of Leather Technology, Maulana Azad College, Calcutta University and UGC DAE CSR-KC)*

### 3.4.3. **Estimation of trace elements in medicinal plants and human consumables of NE region and their biological significance**,

The potential of *Vinca rosea* (a herbal plant) as an anti cancer effect agent was studied. Mice subjected to carcinogenesis with diethylnitrosamine (DEN) a chemical carcinogen, was treated with extracts of *Vinca rosea* and effect on the elemental status studied. The PIXE data was analysed and data interpreted. DEN was found to cause alterations in the trace element profile not only in the liver as a whole but also in the intercellular parts. *Vinca rosea* was found affective in reversing the altered trace elemental status in whole liver and to some extent in the sub cellular levels. The differential alterations of some

elements like Br, Ca in the hepatic nuclei and mitochondria with respect to the whole tissue, warrants further study to understand the role of these organelles along with the elements in the development of malignancy. Results were complemented with biochemical study of markers for oxidative stress (lipid peroxidation, catalase), functional perspective(total protein) and antioxidant profile (glutathione content).

*(Govt. Ayurvedic College, Gauhati University and UGC DAE CSR-KC)*

## *3.5. Collaborative Research Schemes at Dhruva Reactor, BARC*

A number of neutron spectrometers at the Dhruva Reactor, built and operated by Solid State Physics Division, BARC, are available to university users under UGC-DAE CSR neutron scattering Collaborative Reseaarch Schemes. A list of ongoing projects is given in 11.4.

Some of the research problems studied under the Collaborative Research Scheme are described below in brief:

### 3.5.1 Study of Magnetic Fluids:

SANS measurements were carried out on seven samples of spinel ferrite / kerosene based ferrofluids. The size distribution of magnetic particles in above solutions was determined.

(*A. Krishnamurthy, Rajasthan University and V. K. Aswal, B.A.R.C.*)

The effect of magnetic field on SANS distributions from $H_2O$ based magnetic fluids was studied with and without addition of CTAB. It was seen that SANS distribution is independent of field at 330G, while small changes were seen at 980G. More experiments are being planned.

(*R. V. Upadhyay, Bhavnagar University and V. K. Aswal, B.A.R.C.*)

### 3.5.2 SANS from PLURONIC L64:

SANS measurements have been carried out on 2% solutions of L64 in presence of several different additives such as Urea (0,1,2, 3 and 4 M), SDS (2,4,10 and 20 mM), NaCl (0.0, 1.0 M) and Phenol (0.075, 1.0%). It is seen that micelle size is quite sensitive to the presence of above additives. Detailed analysis of data is in progress.

(*P. Bahadur, South Gujarat University and V. K. Aswal, BARC*).

### 3.5.3 Effect of addition of Block-Copolymers on size of Non-ionic Tween-80:

SANS experiments have been carried out micellar solutions of Tween-80 in presence of block copolymers such as $(EO)_{13}$ $(PO)_{30}(EO)_{13}$, $(EO)_{42}$ $(PO)_{46}$ $(EO)_{42}$ and $(EO)_{99}$ $(PO)_{65}$ $(EO)_{99}$ and polyethylene glycols such as PEG-400, PEG-6000 and PEG-15000. It is seen that sizes of Tween micelles are sensitive to above additives. Detailed analysis of data is in progress.

(*R. K. Mahajan, Guru Nanak Dev University, Amritsar and V. K. Aswal, BARC*).

### 3.5.4 Clouding in Ionic micelles:

Usually, clouding phenomenon is seen in non-ionic micellar solutions and not in ionic micellar solutions. Last year, it was reported that ionic surfactant tetra-n-butyl ammonium dodecyl sulphate (TBADS), infact, shows clouding. This year, SANS experiments were carried out in neighbourhood of cloud point to examine the morphology of micelles below and above the cloud point. The effect of addition of inorganic salts and quaternary bromides have also been examined. Data analysis is in progress. This work has been submitted for publication in Langmuir.

*(Kabir-ud-Din, Aligarh Muslim University and V. K. Aswal, BARC)*

### 3.5.5 Quasi-Elastic Neutron Scattering (QENS) from liquid crystals:

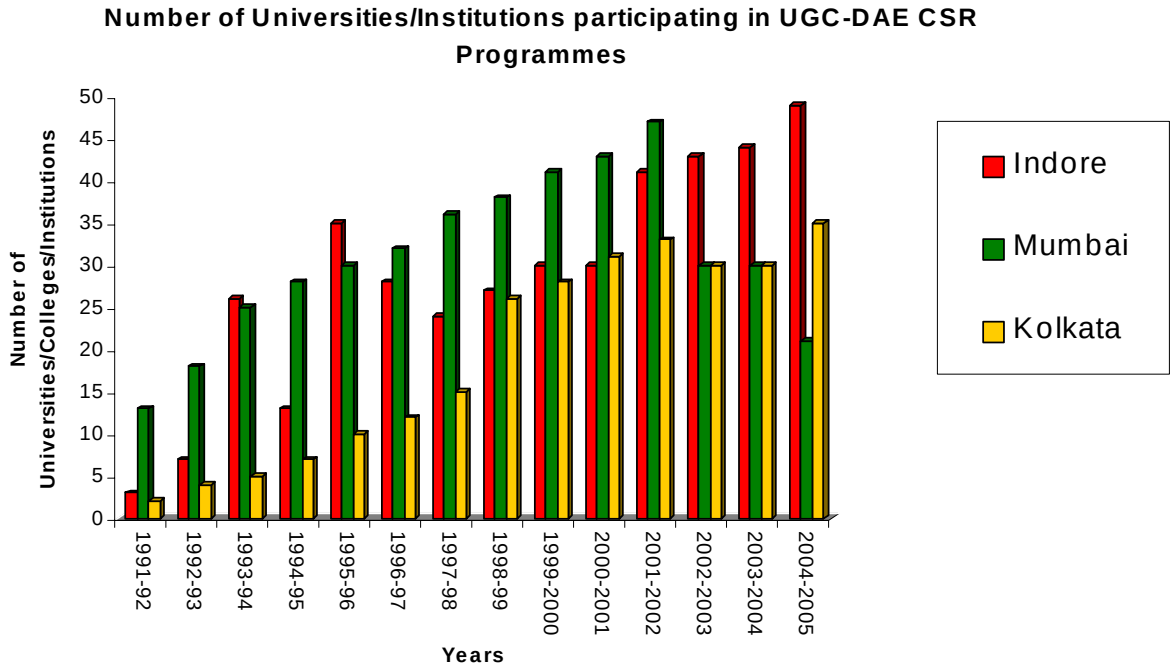
QENS experiments were carried out on crystal 4-n-octyloxy-4' cyanobiphenyl (8OCB). The interest in this compound is due to the one of the side chain being a polar group. The proton magnetic relaxometric studies in this compound yielded extensive information regarding dynamic process, such as nematic director fluctuations molecular self-diffusion and reorientations, in addition to the formation of cybotactic clusters and their critical divergence. The QENS studies in this compound are aimed at obtaining complementary information regarding faster dynamics. The EISF data show the presence of simultaneous reorientational motions of the chain around its axis and the core group around the molecular axis in its smectic and nematic phases. However, chain undergoes 2-fold jump rotation in smectic phase and uniaxial rotational diffusion in nematic phase and the core group follows uniaxial rotational diffusion in both the phases. Rotational diffusion constant for the core group is found to be higher in nematic phase than smectic phase. This work has been published in Chemical Physics Letters.

(*V. S. S. Sastry, Univ. of Hyderabad, and R. Mukhopadhyay, BARC*)

### 3.5.6 Structures of 1-propanol and 2-propanols in liquid state:

Neutron diffraction experiments have been carried out on deuterated samples of two isomers 1- and 2- of propanols in liquid state. Diffraction data were collected using upgraded detector set at high-Q diffractometer, Dhruva. It was seen that while 2-propanol data show a pre-diffraction peak in region of 0.7 – 0.9 A, no such peak is seen in 1-propanol. This shows that unlike 2-propanol, H-bonded chain molecular association is not present in 1-propanol. This work was presented at DAE Solid State Physics symposium at Amritsar.

(*R.N. Joardar, J. Univ., KolKata, and P.S.R. Krishna, BARC*)


Number of Universities/Institutions participating in UGC-DAE CSR Programmes
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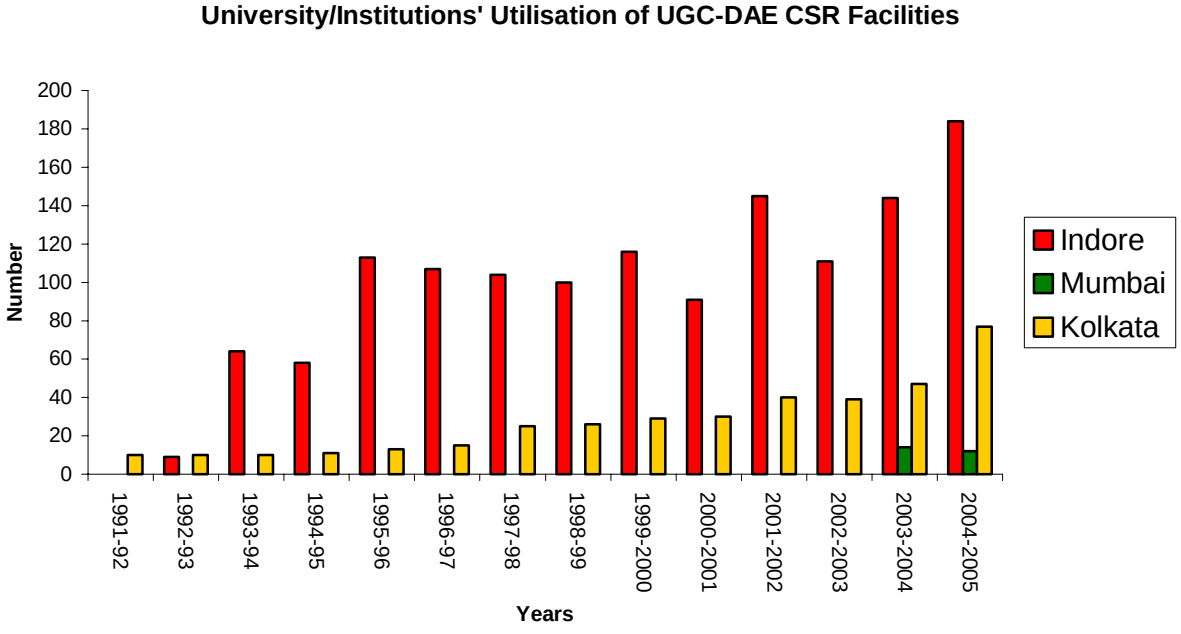
University/Institutions' Utilisation of UGC-DAE CSR Facilities
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Years
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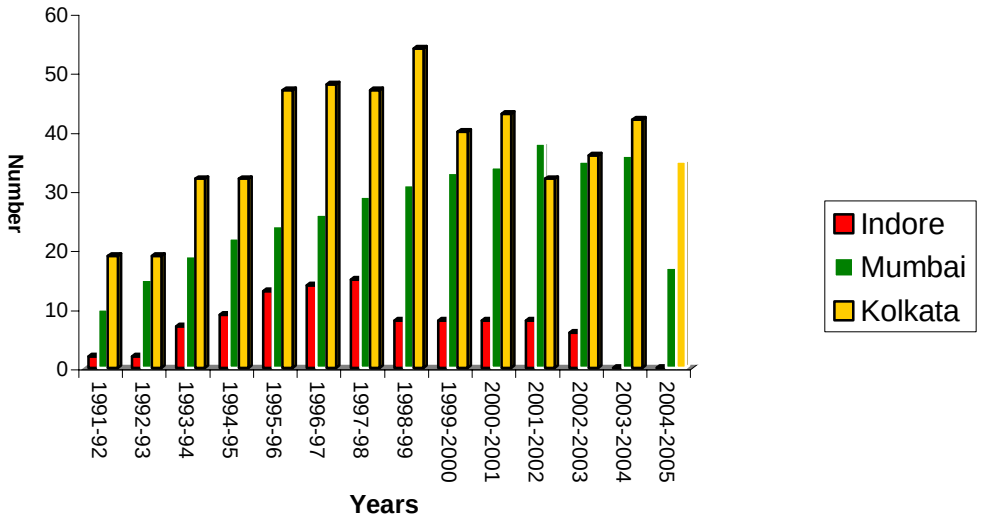
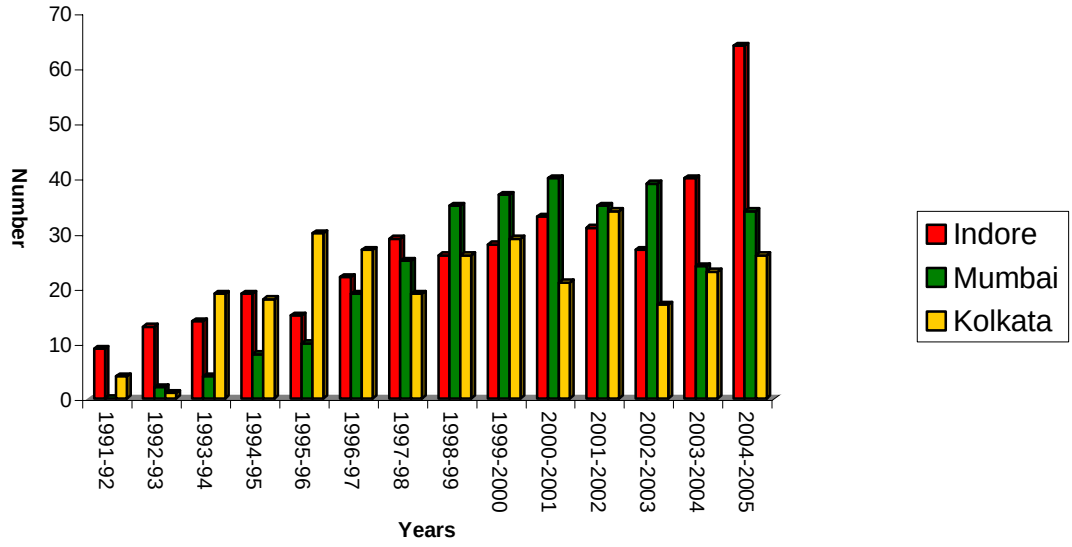
Kolkata

**Collaborative Research Schemes sponsored by UGC-DAE CSR**




**In-house and Collaborative Research Publications of UGC-DAE CSR**



# 4. RESEARCH ACTIVITIES:

## *4.1 Research Activity at Indore Centre*

### 4.1.1 Thin Films and Multilayers

**Effect of post deposition heat treatment on surface morphology of $MgB_2$ films**

At present it is commonly accepted that the thin film formation on conducting substrate is one of the keys to further development of advanced devices in the microelectronics and other applications. We have grown the $MgB_2$ films onto silver substrate by a electrochemical route from non aqueous bath. The deposition was carried out in potentiostatic mode at –1.75 V vs SCE using a Princeton Applied Research Versa-stat model 250/270 interfaced with a P-III PC. As electrodeposited clusters of $MgB_2$ in the form of films were post heat-treated at different temperatures from 100 °C to 500 °C for 90 min. in tube furnace. In the present investigation, surface morphological studies have been carried out using SEM (Scanning Electron Microscope) and AFM (Atomic Force Microscopic) technique of as grown $MgB_2$ clusters in the form of thin film and heat-treated at different temperatures. The SEM and AFM studies revealed that as the post deposition heat treatment temperature goes on increasing grain size becomes larger. It is seen that at the $MgB_2$ films post heat-treated at optimized temperature 300 °C for 90 min. show well developed crystal growth and uniform surface morphology was observed. The detailed effect of post deposition heat treatment on surface morphology of $MgB_2$ films has been discussed in the paper. *(D. M. Phase and.S.H.Pawar and his group from Department of Physics, Kolhapur University)*

**Study of ion beam induced mixing in nano-layered Si/C multilayer structure**

The effects of ion beam induced atomic mixing and subsequent thermal treatment in Si/C multilayer structures are investigated by use of the technique of grazing incidence X-ray diffraction (GIXRD) and Raman spectroscopy. The $[\mathrm{Si}\,(3.0\ \mathrm{nm})\,/\,\mathrm{C}\,(2.5\ \mathrm{nm})]_{\times 10}$/Si multilayer films were prepared by electron beam evaporation under ultra high vacuum (UHV) environment. The layer thicknesses were measured using *in-situ* quartz crystal oscillator. These multilayer films were subjected to 40 keV $Ar^+$ ion irradiation with fluences $5 \times 10^{16}$ (low fluence) and $1 \times 10^{17}$ ions / $cm^2$ (high fluence).The as-prepared and irradiated multilayer samples were annealed at 773 K for one hour. The GIXRD and Raman spectroscopy results reveal the formation of different phases of SiC in these multilayer structures. Deposition induced reactions at the nano-structured interface and subsequent room temperature Ar ion irradiation at low fluence result in formation of the hexagonal SiC phase. High fluence $Ar^+$ ion irradiation and subsequent annealing at 773 K for one hour leads to precipitation of the cubic-SiC phase. *(D. M. Phase)*

**Effect of chemical modification imparted to substrate on Magneto Optic Kerr Effect in Ni film on Si.**

The Magneto Optic Kerr Effect (MOKE) is widely used to study magnetic properties of thin films. It is known that surface/interface roughness of magnetic thin films and superlattices influences magnetic properties such as magnetic anisotropy, coercivity, magnetoresistance and magnetic domain structure. In addition to roughness, it is known that the preparation condition also determines the magnetic properties of the film. In the present paper we studied the effect of substrate cleaning solvent on magnetic properties of Ni films using MOKE technique. For that Si (100) single crystal is used as a substrate. Initially these substrate are cleaned using three different solvents viz. first set with acetone, second with ethanol and third with distilled water. Thus we prepared three sets of silicon substrate with different initial surface conditions though they are cut from same single crystal. A 200 Å Ni film is deposited on these three Si (100) substrate by electron beam evaporation technique under ultra high vacuum. The surface morphology and magnetic properties of the Ni film are measured by Atomic Force Microscopy (AFM) and MOKE technique respectively. All the three images from AFM measurements show island like structure with variation in vertical interface width and lateral correlation length. The MOKE measurements provided the in-plane azimuthal angular dependence of the hysteresis loops and change of loop shapes. Ni film on Si (cleaned with acetone or distilled water) shows magnetic uniaxial anisotropy. However in former case the difference in coercivity corresponding to soft and hard axis is maximum when compared with later case. Magnetic uniaxial anisotropy is not observed in Ni film on ethanol cleaned Si substrate. The results are discussed on the basis of the formation of interface bond configurations. *(D. M. Phase and V. R. Reddy)*

**Interfacial effects in MoZr multilayer structure**

Mo/Zr multilayers were prepared by electron gun evaporation system. These are immiscible systems and show novel conducting properties. Attempt has been made to mix the Mo-Zr layers to form an alloy system by ion beam bombardment carried out at IGCAR, Kalpakkam. The system has been studied by x-ray reflectivity in both specular and non-specular mode and x-ray diffraction. The results show that the system remains immiscible and the surface roughness of each layer is found correlated. The top Mo layer showed Iceland structure. One important conclusion drawn from these studies is that Zr gets oxidized during annealing which is underneath the top Mo layer that remains unchanged. The reflectivity increases on annealing and despite oxidation the multilayer structure is found stable. *(D. M. Phase and V. G. Sathe)*

**Pulsed laser deposition of $LaCaCoO_3$ films**

A number of thin films of $La_{0.7}Ca_{0.3}CoO_3$ were deposited at Department of Physics, Pune university using excimer laser. The films were deposited on LAO substrate at substrate temperatures of 500, 600, 650 and 700ºC in the oxygen atmosphere. These films were characterized by x-ray diffraction and it was found that films deposited at 650ºC were epitaxial in nature. *(V. G. Sathe and K. Adhi, Pune)*

**Study of Ordered vacancy compounds $(CuInSe_2)_n$**

Films of ordered vacancy compounds $(CuInSe_2)_n$ (OVC) for various n starting from n=4 were prepared by co-evaporation method. Electrical and photoconductivity studies

showed it to be an n-type semiconductor, which is highly photosensitive. Absorption curve for all the OVCs $_s$how three transitions in the fundamental absorption region - linked to three interband transitions from split levels of the valence band to conduction band. – corresponds to three optical band gaps. A detailed XPS studies were carried out on these samples. The shift in $In3d_{5/2}$ and $Cu2p_{3/2}$ peak positions to the higher energy side in In-rich compounds relative to Cu-rich compounds is observed and this suggest a stronger bonding between In-Se and Cu-Se by the introduction of vacancies and antisites in an ordered way. *(T. Shripathi, Reena Philip and Dr. Pradeep, CUSAT, Cochin.)*

**Depth profiling of marker layers using X-ray wave guides**

Using X-ray standing wave method, very accurate depth profiling of marker layer is demonstrated in planar x-ray waveguide structures. In x-ray waveguide structure, the depth resolution is significantly increased as compared to that conventional x-ray standing waves generated by total external reflection from a bottom layer of a high Z element. Waveguide with the structure [Float Glass/ Pt(70nm) / Si(16 nm)/ Ti(3nm) / Si(9nm) /Pt(2nm)] were deposited using Ion Beam Sputtering. In this structure two Pt layers form the walls of planer waveguide while the trilayer Si/Ti/Si forms the guiding layer. The 3nm thick Ti marker layer is intentionally kept asymmetrically inside the Si cavity, in order to achieve a higher sensitivity in determining its position. X-ray reflectivity and fluorescence measurements were done using a rotating anode laboratory source equipped with a Si (111) incident beam monochromator in order to select the $K_{\alpha 1}$ radiation of Cu. For the reflected x-rays were detected using a scintillation counter, while the fluorescence from the sample were measured using an Amptek XR100T PIN diode detector with an energy resolution of 250eV. From the simultaneous analyzed fitting of x-ray reflectivity and fluorescence data we could get the precision in the position of the marker layer with an accuracy of better than 0.2 nm. All the above measurements are carried out using our home made set-up.

*(A. Gupta & V.R.Reddy )*

**Tailoring of Magnetic anisotropy in FePt**

The equi-atomic FePt is known to have high perpendicular magnetic anisotropy values in the ordered phase. We have observed that the ordering temperature can be decreased starting from the multilayer structure of $[Fe(1.9nm)/Pt(2.5nm)]_{x10}$. As the interfacial energy plays a significant role in the multilayer structures, we have prepared Fe/Pt multilayers with different layer thickness and maintaining the total thickness constant. The thermal annealing of these films is in progress and we expect a further reduction in the ordering temperature. We have also started working on improving the hard magnetic properties of FePt system with the intergrain exchange coupling. For this we have prepared FePt with Ar and nitrogen as the sputtering gases. As a result of nitrogen sputtering gas, soft magnetic FeN phases are formed. It is observed that by annealing the samples at the same temperatures, the film with FeN phase forms the ordered FePt phase as compared to that of film without any nitrogen.

*(V.R.Reddy & A. Gupta)*

**Study of soft magnetic FeN films**

Iron Nitride exhibit excellent magnetic properties as high magnetic moment, low coercivity, high saturation magnetization as well as high corrosion resistance and high hardness over pure iron film. The main objective of this research work is to study the soft magnetic properties of the different phases of Iron Nitride in the wide composition range. The series of Iron Nitride films with different nitrogen concentration have been deposited by using reactive ion beam sputtering at room temperature as well as liquid nitrogen temperature. The magnetic properties of the sample are characterized by Mossbauer spectroscopy and Magneto Optic Kerr Effect, whereas its structural properties are studied by X-ray reflectivity and X-ray diffraction. The surface morphological changes are also studied by AFM measurement. In order to determine the nitrogen composition in the different samples of the series Rutherford back scattering technique is used. The resistivity of the samples is ensured by using four-probe technique to fulfill all the requirement of the material for being soft magnetic material. The thermal stability of the samples is studied by isochronal annealing of the iron nitride system. Other than this the samples are irradiate with high as well as low energy ions (in NSC Delhi and IGCAR Kalpakkam) at different doses to modify the characteristics of the samples.

*(A. Gupta)*

**Study of self-diffusion using Nuclear resonance reflectivity**

Study of atomic diffusion in amorphous, and nano-crystalline alloys is of great importance to understand the properties of the same. It is demonstrated for the first time that nuclear resonance reflectivity can be used to study self diffusion of Fe in specimens prepared in the form of isotropic multilayers. Diffusion lengths as small as 0.1 nm can be measured using this technique. Nuclear resonance reflectivity has been used to study the self diffusion of iron in isotopic multilayer FG (substrate)\[FeNZr(4nm)/$^{57}$FeNZr(3nm)]x20\FeNZr(4nm). The measurements were carried out using ID22N beamline of ESRF, Grenoble. The activation energy for self-diffusion of iron is found to be 0.8 ± 0.01eV while the pre-exponential factor is 3.54 x $10^{-13}$ $m^2/s$. The activation energy for self diffusion of iron in FeNZr nanocrysttaline alloys is found to be 0.8 eV which is substantially lower as compared to that of crystalline or amorphous alloys of similar compositions. This low activation energy can be attributed to higher concentration of grain boundary regions.

*(A. Gupta)*

**Effect of preparation condition on the soft magnetic properties of FeCuNbSiB thin films**

There has been a great interest in soft magnetic thin films for application in micromagnetic devices. Alloy composition around that of finemet alloy (FeCuNbSiB) are of particular interest since ribbons of this composition produced by rapid quenching exhibit excellent soft magnetic properties upon nanocrystallisation. We have studied the

effect of preparation condition on the structural and magnetic properties of the thin film $Fe_{72}Cu_1Nb_{4.5}Si_{13.5}B_9$. Amorphous films of composition ($Fe_{72}Cu_1Nb_{4.5}Si_{13.5}B_9$) have been prepared by ion beam sputtering of target consisting of amorphous ribbons of above composition. The energy of the sputtering ions affects the thermal stability of the film. Lower energy of sputtering ion result in a high thermal stability of amorphous phase. The as prepared films exhibit uniaxial anisotropy in the film plane, which may be attribute to the quenched -in stresses. The stresses do not get relieved up to the nanocrystallisation temperature. Thermal annealing behavior of coercivity is similar to that observed in earlier works. However it is observed that sharp increase in $H_c$ is not correlated with the amorphous to nanocrystallisation transformation. Rather it depends upon the size of the nanocrystals. This behavior can be understood in terms of the random anisotropy model for the nanocrystalline alloys.

*(A. Gupta)*

### 4.1.2 Nanomaterials

**Synthesis of metal oxide nanoparticles**

As a joint effort with the Chemistry Department of DAVV Indore, a program for chemical nanosynthesis of ZnO, $Mn_xO_y$, $SnO_2$, and TiO has been initiated, with a view to finally make their thin films via wet deposition, and thereupon prepare diluted magnetic semiconductors (DMS) by implanting transition metal ions. Success has been achieved in making powders, with average particle sizes as small as 2 nm to larger ones (30 nm), even as their size-dispersion and anisotropy etc await characterisation in near future. It was also possible to prepare the variably-valent compositions by selecting slightly different chemical processes and precursors. By using suitable templates, efforts are underway to prepare nanowires and porous Zeolite structures.

*(A. M. Awasthi)*

**Carbon nanotubes**

Nitrogen containing Carbon nanotubes: Nitrogen containing Carbon nanotubes were synthesized by varying ferrocine concentration. SEM of these grown nanotubes showed an increase in the length with increase in ferrocine concentration. TEM showed formation of a bamboo like structure. XPS studies carried out on these samples showed three different types of nitrogen and are responsible for formation of these bamboo like structures. The composition of these nanotubes also obtained from XPS results.

*(T. Shripathi and. O. N. Srivsatava, BHU, Varanasi)*

**Iron oxide nano wires**

Work on the aligned, Iron Oxide ($\alpha$-$Fe_2O_3$) nanowires has been initiated. The samples were synthesised from pure iron surface when heated to 550-650$^oC$ under controlled environment of oxidizing gases. Typically the dimensions are 10-50 nm wide and 10-25 μm in length. These have been characterized using SEM,.EDAX, ESCA, GIXRD and micro Raman measurements. The micro Raman studies showed that Raman peaks correspond to $\alpha$-$Fe_2O_3$ . A shift in the peak position towards the higher wave number is observed for nanowires as compared to the bulk $Fe_2O_3$. XPS studies also confirm $Fe_2O_3$ on the surface. *(T. Shripathi)*

### 4.1.3. Surface Physics, Exafs and Atomic Force Microscpy

**Electronic structure studies on ferromagnetic Huesler alloy like $Ni_{2+x}Mn_{1-x}Ga$**:

XPS and UPS studies have been performed on ferromagnetic Huesler alloy $Ni_{2-x}Mn_{1-x}Ga$ samples with different compositions. This system exhibits shape memory effect as well as ferromagnetism. The samples have been prepared by Arc furnace melting technique. The magnon and phonon contributions to resistivity, martensitic transtion temperatures and the crystal structures have been studied by resistivity, X-ray powder diffraction and differential scanning caloriemetry. The photoemission studies on these samples show systematic shanges in the valence band spectra as function of Ni content. FPLAPW band structure calculations on this system has also been performed. Magnetoresistance studies have been performed. *(S. R. Barman)*

**XPS and LEED studies on Mn/Al(111)**

XPS and LEED studies have been performed on Mn adlayers on Al(111) and interesting pseudomorphic growth has been obtained. The Mn 2p core level and valence band exhibit modifications in line shape and position as function of coverage. Experiments in BESSY, Berlin has also been perfromed and the data is being analysed at present *(S. R. Barman)*

**XPS and related measurements on AlPdMn**

Photoelectron diffraction measurements on AlPdMn quasicrystals has been performed in collaboration with the groups of K. Urban, Juelich, Germany; K. Horn, FHI, Berlin, Dr. E. Rotenberg, ALS, USA, M.A. Van Hove and C.S.Fadley, LBNL, USA. The results have been published recently. XPS work on laboratory as alos been done on different metallic layers on AlPdMn. *(S. R. Barman)*

**EXAFS, XPS studies on perovskite systems**

Mn K-edge and associated EXAFS were studied in LaSrMnO3 compounds for different Sr content. Interesting phase transitions were observed as a function of composition and these were used to interpret the X-ray spectroscopic data. *(Bindu and A. V. Pimpale)*
PrCaFeO3 compounds were prepared by combustion method and characterized by X-ray powder diffraction. Fe K-edge X-ray absorption spectroscopy and XPS of core levels of Fe, Pr and O were studied. *(S. K. Pandey and A. V. Pimpale)*

**Studies using AFM**

As in the previous years, the interaction with the users of different organisations has been very fruitful, about 175 samples were scanned for outside users spread over 23 groups and 114 samples for in-house researchers. Apart from this an extensive in-house programme in the area of bacteriology has yielded very interesting results through a collaborative programme carried out with Dr.Chitnis and Dr.Nanda from Choitram

Hospital, Indore. Extensive studies were carried out on the bio-film formation on various substrates of technological and implant interest. Part of this work coupled with the TSDC work on bio-electrets may form a core of the thesis work of Ms. Deepti Jain.

*(V.Ganesan)*

### 4.1.4 Study of magnetism and transport properties

**Manganite systems**

We have studied the consequence of progressive weakening of "charge ordered" state on the "finite size effect", antiferromagnetism and "Electronic Phase Sepation" (EPS) in the Al substituted $Pr_{0.5}Ca_{0.5}MnO_3$. It is found that neither the size of finite size clusters nor the antiferromagnetic transition temperature change significantly up on the dilution of the magnetic lattice by Al substitution in Mn site from 2.5% to 10% in this narrow bandwidth system. However, there is a significant reduction in EPS in this substitution range. These results indicate the formation of self organized structure in this series of samples that is driven by the EPS and stabilized by the quenched disorders. It also provides a basis for understanding large suppression of CE-phase by the disorder. We have shown earlier that, increase *in disorder increase the charge carrier mobility* resulting from the destabilization of the CE-phase which we put forward to be the reason for the decrease in the EPS.

The intermediate bandwidth system $Pr_{05}Sr_{0.5}MnO_3$ has two sharp magnetic transitions. The high temperature phase is ferromagnetic which transforms to antiferromagnetic phase accompanied by charge/orbital ordering at lower temperature. To dilute the magnetic lattice without changing the structure as well as any additional magnetic interaction, Ga is substituted at the Mn site. It is observed that, there is no appreciable change in the structure with up to 7.5% of Ga substitution which preferentially replace the $Mn^{3+}$ in the samples. The ferromagnetic transition temperatures decrease whereas the antiferromagnetic transition temperatures increase with the Ga substitution. The resitivity increase with the Ga substitution and the conduction in the paramagnetic region is found due to the adiabatic small polaron hopping.

The effect of non-stoichiomentry on structure, magnetism and transport properties in $La_{0.9}Sr_{0.1}MnO_{3+\delta}$ is being investigated in samples with $\delta$ = 0.008, 0.02 and 0.08. The structural analysis show that the samples with with $\delta$ = 0.008, 0.02 crystallize in orthorhombic symmetry whereas the sample with $\delta$ = 0.08 in rhombohedral symmetry. It is established that all the samples are ferromagnetic with transition temperatures ($T_C$) increasing with $\delta$. The resitivity of the samples increase with the decrease in $\delta$. The sample with $\delta$ = 0.08 shows metal to insulator transition around $T_C$ but the orthorhombic samples are semiconducting with change in slope around the respective $T_C$'s. It is observed that highly resistive sample with $\delta$ = 0.008 has broad hump in ac-susceptibility below $T_C$ followed by a sharp decrease in susceptibility at lower temperatures. This may be arising from the orbital ordering in this near stoichiometric sample.

*(A. Banerjee)*

## Intermetallic compounds

In continuation of earlier work on the system $CeCo_{2-x}Ru_xGe_2$ a detailed magnetoresistance, heat capacity studies on the system $CeCo_{2-x}Ru_xGe_2$ (x= 0, 0.5, 1.0, 1.5, 1.8, 2.0) and $LaCo_2Ge_2$ and $LaRu_2Ge_2$ have been completed. Besides these measurement magnetization measurement were also taken up and measurements on x=0.0 and 0.5 have been completed. These studies have shown that the ground state of the system changes from the magnetic to non magnetic ground state between the composition around x=1.0 to 1.5. The magnetoresistance result correlates well with high-pressure studies on $CeRu_2Ge_2$ reported in the literature. It shows that the effect of Co substitution is mainly a volume effect, as Co being smaller in ionic radii compared to Ru, results in a decrease in lattice volume with increasing Co concentration.

Based on these studies a magnetic phase diagram has been drawn for this system. With Co substitution the ferromagnetic ordering temperature found to decrease rapidly while the antiferromagnetic ordering temperature remains constant initially and then starts decreasing rapidly. This phase diagram is agreement with the earlier high-pressure studies qualitatively. However it was found that interatomic distance between Ce and Ru/Co ion dose not vary linearly for this system. The variation of transition temperature correlates well with the Ce-transition metal distance, which shows that f-d interactions are playing dominant role in determining the ground state of this system. This also explains the difference between the phase diagram of $CeRu_{2-x}Fe_xGe_2$ compared to our studies and high-pressure studies.

To fine-tune the transition from magnetic to non-magnetic ground state we have prepared the more composition with x= 0.3, 0.7, 1.1, 1.2, 1.3, 1.4, 1.6 by arc melting. Further studies are in progress to find out the quantum critical point, if any.

Besides these studies the $RPt_2$ system (R=Gd, Dy, Ho, Er and Y) were also studied to find out there usefulness for magnetocaloric applications. $DyPt_2$ system has been studies earlier where strong crystal electric field has been observed. The magnetoresistance and heat capacity studies on other compounds showed that magnetic ordering is complex in these systems. Therefore no peak or a broad and small peak was observed in heat capacity data which indicates that magnetocaloric effect is expected to be very small in these compounds.

*(R. Rawat)*

## Structural and transport studies of $CeRu_{2-x}Co_xGe_2$ (x=0.0-2.0)

The XRD data for all the compositions prepared was analysed by Rietveld refinement and exact structural parameters were obtained. The transport measurements like resistivity and magneto resistance has been carried out for the entire series of compounds. The magnetic behaviour of this system is correlated with the structural parameters. Based on these studies, a magnetic phase diagram has been proposed for this system. A transition from a magnetic to non-magnetic ground state has been observed with

increasing Co concentration. It is shown that the Ce-Ru/Co bond plays a critical role in driving the system from an RKKY dominated regime to a Kondo regime.

*(R. Rawat and V. G. Sathe)*

### 4.1.5 Studies on Kondo based insulator systems:

The studies on an interesting Kondo Insulator system CeNiSn has been investigated at some length. Extensive analysis of resistivity and TEP has been carried out on a set of samples with different doping levels, viz. La/Y at Ce site and Co/Cu at Ni site to understand the nature of coherence in these systems. Even though the destruction of coherence (Semi-conducting in this case) is seen upon doping at all levels, the behaviour of TEP is quite different. There is a large enhancement seen in TEP at low T (~20K) for La/Y/Co at low doping while Cu smears them out. The effects can be partly understood on the basis of survival of residual moments at the Ni site as predicted by band structure calculations. Cu doping drives the system to a heavy fermion state at low doping. A set of new samples with doping levels >10% and a few of non-stochiometric compositions have been prepared and characterised by resistivity and TEP. An estimate of effective mass of the carriers through measurements of $T^2$ coefficient 'A' from resistivity at mK ranges yields a reasonable estimate on par with the Kadowaki-Woods plot confirming the presence of heavy quasi particles.

Having studied the CeNiSn system to some length, the commonness of the coherence aspects prompted us to take up the problems related FeSi, to understand more about the TEP behaviour of these KI systems. Again Resistivity and TEP studies have been carried out on samples of $FeSi_{1-x}Ge_x$ [x=0.05,0.1,0.15,0.2,0.25,0.45,0.55] and $FeSi_{1-x}Al_x$ [0.0025,0.005,0.0075,0.01,0.10,0.25] prepared by argon arc melting followed by annealing. The M-I transition seen is thought to be an unconventional one due to the fact that the under lying system is not a simple but a correlated electron system. Added to that the evolution of quasi particle spectrum at relatively high temperatures around 200K makes it more attractive.

*(V. Ganesan)*

### 4.1.6 Glasses and Quasi Crystals

Analysis of our low temperature heat capacity measurements performed on several key compositions of bulk $Ge_xSe_{1-x}$ glasses showed remarkable agreement with the calculation of the same using the vibrational density of states (VDOS), obtained from the low temperature Raman data taken earlier on these glasses. Specifically, the hump seen in the measured $C_p/T^3$ at 5K is exactly reproduced from the calculations. Moreover, using a more accurate determination of the harmonic contribution, the excess $C_p$ (due to the localized excitations) has been found to exhibit several anomalies viz., the linear ($\sim T$) behaviour at 10K and at rather elevated 100K, together with both preceded by activation ($\sim e^{-\Delta/kT}$) dependences. An interpretation of these results in terms of two-level systems (TLS comprising of asymmetric double-well potentials, DWPs) can account for the observed behaviour, together with the identification of the atomic aggregates whose local dynamics (tunnelling and barrier-crossing) is responsible for these anomalies. The novel

observations/analysis is being consolidated as manifestation of the soft potential model (SPM) of floppy quasi-local dynamics in glasses.

*(A. M. Awasthi)*

The data analysis of magnetic and transport measurements carried out on $Al_{70-x}B_x$ $Pd_{20}Mn_{10}$ (x=0,0.5,1,2 & 4) has been done. The magnetic measurement shows that these alloys contain very dilute magnetic moments, which exist in a concentrated type Kondo alloys. The analysis shows a systematic in the rise of conductivity below conductivity minima and the minima temperature, with boron composition. A perfect scaling of all the conductivity data was also observed which indicates towards the presence of Kondo-type magnetic scattering present in these samples. The data has been analyzed in terms of weak-localization and temperature dependent magnetic scattering. Two research papers have been submitted for publications based on these results and analysis to J.NM-Cryst.Solids.

Low-temperature resistivity and magnetoresistance data carried out for stable icosahedral quasicrystals $Al_{65}Cu_{20+x}Ru_{15-x}$ (x= 1.5,1.0,0.5,0.0, &-0.5) has been analysed. The analysis of the magnetoresistance data shows an overwhelming presence of anti weak-localization effect. But the sample with x=-0.5 shows anomalous magnetoresistance and the anti weak-localization effect breaks down. The in-field $\sigma$-T between 5K-20K, for x= 1.0,0.5,0.0, &-0.5 samples, and between 1.4K-40K for x=1.5 sample, follow a power-law behaviour with an exponent of 0.5 and above ~30K the exponent ranges from 1.17 to 1.58. The observed power-laws basically characterize the presence of critical regime of the metal-insulator (MI) transition, dominated by electron-electron and electron-phonon inelastic scattering events respectively. In samples with x= 1.0,0.5,0.0, &-0.5 the in field $\sigma$-T has been found to follow $\ln\sigma$-vs-$T^{-1/4}$ below 5K, which indicates the presence of VRH. The observed transport features indicate the occurrence of proximity of metal-insulator transition in these $Al_{65}Cu_{20+x}Ru_{15-x}$ samples. A search papers have been published based on these results and analysis.

*(N. P. Lalla)*

Various perovskite based titnates like Sr-Ca-Ti-O, Ba-Sr-Ti-O, and Ba-Ti-Hf-O have been prepared. These have been structurally characterized by XRD and SEM/EDAX. The dielectric measurements on these samples have been done. Ba-Ti-Hf-O samples show systematic in the XRD results. With increasing Hf the average structure transforms to cubic from tetragonal. A cross over from classical to relaxor ferroelectric behavior has been observed with increasing Hf. .

*(N. P. Lalla)*

## *4.2 Research Activity at Kolkata centre*

### 4.2.1 Trace Elemental Studies using EDXRF

**Risk Assessment Of Heavy Metal Toxicity In Human From Aquatic And Stratospheric Sources And Its Impact On Gene Expression System**

Studies were carried out to investigate the heavy metal content in aquatic and stratospheric sources in Kolkata and its suburbs and its effect on exposed population like hawkers, traffic constables etc. The aerosol samples, water samples, blood samples etc were analysed by AAS specifically for Fe, Cu, Pb, Cr, Cd The work is still going on and the results are being interpreted by the group for preparation of manuscript. Experiments were carried out with the EDXRF for the study of trace elements in fruit fly or Drosophilia for Fe, Cu, Pb, Cr, Cd. This was done in continuation of the pollution studies to assess correlation of variability of gene expression of metabolic enzymes of the exposed population.

*(Calcutta University and UGC DAE CSR- KC)*

**EDXRF detection of Trace elements variation resulting from natural treatment of wastewater bodies at East Kolkata Wet Land**

Trace element variation from natural treatment of waste water bodies of East Kolkata Wetland were studied. The samples from the Raw Sewage Canal (RSW) and waste water fed fisheries were analysed. Elements like Na, Si, Al, K, Ca, V,Cr, Mn, Fe, Co, Ni, Cu, Zn, Pb, Ag, Bi were detected It was observed that concentration of most of the elements in RSC was higher than the same in drinking water. Maximum increase was seen in the level of Ca, which is much above the limits set by WHO and India counterpart. This could the effect of decalcification process operating in the tanneries. Although Ca level was very high in the RSC water, in bheri water the concentration was found to be much less indicating its removal by either precipitation or by uptake. Further work is being carried out.

*(West Bengal University of Technology and UGC DAE CSR- KC)*

**Trace Elements Analysis of water samples from lakes and tals of Uttaranchal**

Water samples from in and around Naini lake in Pant Nagar were analysed by the EDXRF to study effects of pollution. Several elements like Na, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Ag, Pb, Bi were detected and quantified. The results have been sent for interpretation and preparation of manuscript.

*(G.B.Pant University and UGC DAE CSR-KC)*

**Laser Cleaning of Materials**

Environmentally degraded ferrous and non ferrous samples, cleaned by laser cleaning technique, were analysed by EDXRF to check effect of cleaning. A semi quantitative analysis was carried out. Work is still in progress.

*(Jadavpur University and UGC DAE CSR-KC)*

### 4.2.2 Nuclear technique based condensed matter studies.

**Preparation and characterization of Ferrite Nano particles**

Nanoparticles mixed spinel ferrite with composition Ni0.2Zn0.6Cu0.2Fe2O4 were prepared by the standard co-precipitation method. The formation of nanocrystalline spinel phase has been confirmed by X-ray diffractograms and particles size estimated from XRD and TEM measurements lie in the range 7.0 nm to 29.8 nm . Mössbauer effect measurements at room temperature and at various temperatures down to 20 K clearly indicate the presence of superparamagnetic particles in all the samples. Blocking temperature measured from AC susceptibility data shows systematic fall with decrease of particle sizes of the samples. AC susceptibility measurements also indicate that the samples up to particle sizes 18.7 nm are superparamagnetic below the room temperature whereas the samples having sizes 24.5 nm and 29.8 nm are superparamagnetic above 352 K and 372 K respectively. The results have been communicated for publication.

Nanocrystalline Co(1-x)ZnxFe2O4 (x = 0.25, 0.50 and 0.75) spinel ferrites were prepared by controlled co-precipitation method and characterized by Mossbauer spectroscopy and ac susceptibility measurements. XRD measurements of the heat-treated samples show that particle size lie in the range 5.5 nm to 41.2 nm. Mössbauer spectra recorded at different temperatures from 300 K down to 20 K confirm the presence of superparamagnetic relaxation in the samples. AC susceptibility measurements confirms superparamagnetic relaxation in the samples. Also, anisotropy energy constant as well as the blocking temperature for a given particle size is found to decrease with the increase of Zn substitution. The results will be sent for communication shortly .

*(UGC DAE CSR-KC & Ashutosh College)*

**Fe/MgO nanocomposites prepared by ball milling**

Fe/MgO nanocomposites were synthesized by mechanical-energy high transfer technique (ball milling). By varying the duration of mechanical attrition, powders with different grain sizes were produced. The grain sizes were determined by XRD. The nanocomposites exhibit a two-component Mössbauer spectrum due to the presence of two phases: the crystalline phase and the grain boundary region between them. In particular it was seen that the grain boundary phase gave rise to a distribution of hyperfine field typical of an amorphous like configuration. The results have been communicated for publication.

*(UGC DAE CSR - KC, Calcutta University & Jadavpur University)*

**Preparation and characterization of nano-gels**

Nanocrystalline Fe3O4 and γ-FeOOH in polyvinyl alcohol gel matrix have been synthesized via a novel route without using a cross-linking agent. The ferrogels were characterized by Mossbauer spectroscopy and transmission electron microscopy. Mossbauer spectra of the as prepared gels at different temperatures showed the presence

of superparamagnetic particles in them. TEM results show that the particles are mostly spherical with average size 10 nm. Further work is in progress.

*(UGC DAE CSR - KC & SNBNCBS, Kolkata)*

**Niobium substituted nano-crystalline Nickel ferrite**

Nickel ferrite doped with niobium ions has been characterized by Mossbauer spectroscopy , XRD and dc magnetization measurements. Doping of Nb2O5 reduces the size of nickel ferrite to about 33 nm which was explained as due to the breaking up of the ferromagnetically active oxygen polyhedra . An increase of coercive field and a decrease of magnetization are observed as the size of the ferrite is reduced. Mossbauer spectra confirm superparamagnetic relaxation due to small particle size. The results are communicated for publication.

*(UGC DAE CSR - KC & Vidya Sagar University)*

**Synthesis and characterization of nanoparticles of yttrium iron garnet (YIG)**

Nanoparticles of yttrium iron garnet (YIG) prepared by a chemical route with different size have been studied by Mossbauer spectroscopy. Mössbauer spectra of the samples with size 9 nm and 14 nm showed clear doublets at room temperature. These were attributed to ultrafine YIG particles undergoing superparamagnetic relaxation. The spectrum of 25 nm sized sample recorded at room temperature shoed with two broad sextets and one doublet in the central region. The data analysis is under progress.

*(UGC DAE CSR- KC & Warwick University, UK)*

**4.2.3 Chemical sciences and radiochemistry research work**

**Size tunable synthesis of cysteine-capped CdS nanoparticles by γ-irradiation**

Highly water-soluble and biocompatible L-cysteine-capped CdS nanoparticles having narrow size distribution were synthesized for the first time by γ-irradiation technique without using any additional stabilizer. FTIR study shows that CdS nanoparticles are capped through mercapto-group of cysteine amino acid while its free amino and carboxylate groups make it amenable to bio-conjugation. Size and luminescence of the nanoparticles can be well controlled by varying the parameters like radiation dose, pH and concentration of cysteine. The observed results suggest that pH~7 can be optimum for the synthesis of L-cysteine-capped CdS nanoparticles. CdS nanoparticles synthesized with molar ratio of $Cd^{2+}$: Cysteine, 1:60 at pH 7 were found to be most luminescent. All nanoparticles formed lie in the size quantization regime and exhibit good crystallinity. Remarkable improvement in stability and luminescence was achieved on changing pH of as-prepared nanoparticles from 7 to 11.

*(UGC DAE CSR- KC, Jadavpur University & VECC)*

**Size dependent interaction of biofunctionalized CdS nanoparticles with tyrosine at different pH**

Tyrosine quenches fluorescence of CdS nanoparticles at pH 7 following Stern-Volmer relation while tyrosine enhances luminescence significantly at pH 10. However, both quenching and enhancement were found to depend on the size of nanoparticles. Glycine and tryptophan only quenched the fluorescence of the particles even at this pH which makes this enhancement effect on CdS fluorescence quite specific for tyrosine. To reveal the nature of interaction of CdS nanoparticles with tyrosine at this pH, the effect of ionic strength on the enhancement of luminescence in presence of tyrosine was studied. The fluorescence intensity remained unchanged with gradual increase in KCl concentration, which indicates that the nature of interaction is not electrostatic rather it is covalent. Considering that pKa for the dissociation of phenolic -OH in tyrosine is 10.1, tyrosine is expected to be more dissociated into tyrosinate form and this enhancement could be attributed to binding of phenolate group of tyrosine to the surface of CdS nanoparticles. This may lead to more passivation of trap states on the nanoparticle surface thereby increasing the fluorescence intensity of nanoparticles. Maximum enhancement achieved is nearly same for nanoparticles of different sizes, but amount of tyrosine required is different. For the same change in the concentration of tyrosine, the enhancement is greater for the smaller nanoparticles.

In summary, this work is the first step in comprehending the interaction of CdS nanoparticles with amino acids. Quenching of CdS fluorescence by tyrosine at pH 7 gives us an idea about how the nanoparticle fluorescence will be affected under physiological conditions and the magnitude of the effect for particles of different sizes. Most significantly, the enhancement of fluorescence of CdS nanoparticles at pH 10 is specific for tyrosine and could be attributed to tyrosinate anion. The possibility of using the linear range of enhancement plot for determination of tyrosine or proteins with exposed tyrosine residues can be explored in the near future. As the rise in luminescence with variation in tyrosine concentration is much sharper for smaller particles, better sensitivity of detection can be achieved by using nanoparticles of smaller size**.**

*(UGC DAE CSR - KC, Jadavpur University & VECC)*

**Effect of colloidal CdS nanoparticles on photoluminescence of tryptophan**

In continuation of our earlier work on the use of colloidal CdS nanoparticles as possible sensor for biological components, we have attempted here to study the effect of colloidal CdS nanoparticles on the photoluminescence of tryptophan. For monitoring the luminescence of tryptophan, excitation wavelength of 275 nm is used, at which absorbance of CdS is almost negligible. Luminescence of tryptophan was investigated both in sulfide enriched CdS sol as well as in Cadmium enriched CdS sol. In Temperature dependence studies indicate the possibility of dynamic quenching. Moreover, using different solvents like THF, hexane, ethanol, ethylenediamine, acetonitrile etc. polarity of the sol was changed. Emission spectra showed a blue shift as the polarity of solvent was reduced. Hence, quenching may be additionally thought to be due to Förster energy transfer.

The presence of tyrptophan has been found to modify the absorption spectrum of $Cd^{2+}$ enriched CdS sol. The absorption spectra are red shifted with increasing tyrptophan concentration. However, quenching pattern of tryptophan in presence of Cd enriched CdS sol is different to that observed in case of S enriched CdS sol. In the presence of $Cd^{2+}$ enriched CdS nanoparticles, the emission of tyrptophan in phosphate buffer shows typical spectral broadening and a long wavelength increase in fluorescence emission. This may be attributed to the sensitized emission of CdS itself.

*(UGC DAE CSR - KC & S N College, Kolkata)*

**Interaction of flavins with peroxynitrite**

Peroxynitrite is synthesized by the quenched-flow set-up developed in our laboratory. Free radical initiated oxidative damage to the bio-molecules is a well-debated mechanism on interaction with peroxynitrite. On the other hand radiation-induced oxidative damage of bio-molecules is known to be mediated via free radical pathway. The study aims at understanding and exploring the oxidative injury involved during the interaction of peroxynitrite with flavin mononucleotide. A new fluorescence emission with maximum at 415 nm appeared when peroxynitrite treated flavin was excited at 350 nm. Synchronous fluorescence study shows its singular nature. The identical emission of flavin irradiated with γ- radiation indicates that formation of new fluorescent species is the result of OH radical mediated reaction with flavin moiety. The results therefore confirmed the radical nature of peroxynitrite toxicity.

*(UGC DAE CSR - KC & Calcutta University)*

**Synthesis of iron-doped Polyaniline and characterization by UV-VIS and Mossbauer spectroscopic studies**

Polyaniline (PANI), one of the most promising intrinsically conducting polymer, has received much attention in recent years due to its straightforward polymerization, chemical stability, relatively high conductivity and potential applications in electronic devices, batteries and sensors. In the present work PANI (Emeraldine salt) was synthesized using the "standard" procedure. The protonated form of PANI is insoluble in conventional organic solvents so it was deprotonated to PANI base. $FeCl_3$ was preferred as a dopant because of its electrical and magnetic property enhancing nature. The doping concentration of Fe was kept same as Genoud et al. Room temperature Mössbauer measurements were carried and the spectrum obtained was deconvoluted using two symmetric doublets. The parameters calculated were: IS 0.29 mm/s, QS 0.70 mm/s and IS 0.49 mm/s, QS 0.75 mm/s. The Mössbauer parameters given above are characteristics of Fe(III) high spin complexes. No signature of Fe(II) was detected. Doping of PANI with Fe also induces UV-Vis spectral changes. Disappearance of the characteristic visible band of PANI base is observed with an increased extended absorption towards the higher wavelength region. This may be attributed to delocalization of charge carriers (polarons). Low temperature Mössbauer studies (up to 20 K), conductivity measurements and FT-IR spectroscopic studies are being carried out. In future we hope to see the variations of the properties with different percentages of dopant (Fe).

*(UGC DAE CSR - KC)*

**Study of Radiosensitizing Properties of Copper (II) Ions and its Complexes**

In an attempt to explore its potential as radiosensitizers in cellular systems, we sought to follow influence of Cu(II) ions and its complexes on radiosensitivity of E.coli K12 strain. Toxicity of copper ions can be reduced quite significantly by suitable complexation. Structure of metal complex and presence of electron affinic site(s) play an important role in its cellular incorporation and to function as radiosensitizer. The present study indicates that CuNTA may be considered a suitable model for development of radiosensitizing drug. In order to look into the role of cytotoxicity of Cu(II) ions and its derivatives, AFM studies were carried out at Indore Centre. The results are being analyzed. Preliminary findings suggest that Cu(II) ions enter into the cell by damaging membrance, while NTA enters without any significant damage on the membrane.

Besides above, in order to see the role of different metal ions in complexed states in the radiation-induced damage or protection, Mn-, Mo- and Cu-glutathione complexes have been synthesized and characterized by UV-VIS, FTIR and magnetic moment studies. Attempts have been made to follow the role of these molecules on the calf-thymus DNA damage by binding with ethedium bromide as probe and monitored by absorption and fluorescence.

*(UGC DAE CSR -KC & Jadavpur University)*

**4.2.4 Biological Sciences using High LET radiation:**

In continuation with the ongoing programs using high LET radiation ($O^{16}$) from Cyclotron facility at VECC, Kolkata, experiments were carried out in biological sciences under the collaborative research schemes from different departments of universities. As a part of the project involving study of potential of radiation in modulating virulence of the protozoan parasite, Leishmania, radiation altered parasites were tried for infection trial in mammalian host system.

The high let induced DNA damage study was further undertaken to probe into the specificity and molecular mechanism of the damage. For this southern hybridisation experiments were done using specific bands from the RAPD (done earlier ) as probes. This indicates the damage sites of the heavy ion irradiated DNA strands**.**

***(****Dept of Zoology, Dept of Biophysics &Molecular Biology ,Calcutta University and UGC DAE CSR- KC)*

**4.2.5 Radiation Biological Sciences using in-house facilities:**

**Morphological, biochemical and molecular changes in relation to in vitro plant regeneration of Vigna radiata (L) Wilczek induced by gamma ray and heavy ions**

Experiments were performed using the in-house facilities of gamma irradiation from $Co^{60}$ source under the collaborative research program involving effect of gamma exposure on biochemical and molecular changes in relation to *in vitro* plant regeneration. Data obtained indicated over expression of stress marker enzymes like SOD and peroxidases. DNA damage is nonrandom distinct pattern and dose-dependant repair and

recovery depends on time and absorbed dose. Noted intensity of DNA polymorphism reflects a cluster effect (linkage) between groups as a function of absorbed dose range.

*(Calcutta University and UGC DAE CSR- KC)*

**Investigation of the mechanism of High-LET induced apoptosis in human cells**

To study radiation induced apoptosis in mammalian cell lines culture of HeLa, Hep2 cell lines in DMEM and primary cell line of lymphocytes in RPMI with and without mitogen PHA was standardized. Apoptosis was scored by simple DAPI staining after irradiation with gamma rays. Results indicated that induction and expression of apoptosis is dose dependant after a critical dose depending upon the cell type. Indirect immuno labeling was done on HeLa cells grown on cover slips. Both in primary and secondary cell lines the repair proteins Ku 70 and Rad 51 (non-homologous recombination and homologous recombination) form distinct foci in response to IR in dose-dependant manner. Signal observed showing involvement of p21 in cell cycle arrest & DNA dsb repair.

*(Jadavpur University and UGC DAE CSR - KC)*

**Studies on the effects of infectious fungi on storage grains using gamma irradiation and proton beam**

During this period experiments involving study of gamma radiation induced effects on seed-borne fungi was continued with two crop seeds *Tricum aestivum* and *Phaseolus mungo*. Effective dose for decontaminating these seed types from fungi was assessed in relation to membrane permeability, nutritional value of the exposed seeds as a function of dose. Results compared with the other seed grains to determine fungal diversity and differential radiosensitivity and host specific interaction. Additionally radiation induced chromosomal aberration study in relation to alteration if any in total DNA content of the exposed seeds was also carried out during this period.

(*Kalyani University, Centre for Studies of Man and Environment and UGC DAE CSR - KC)*

## *4.3 Condensed Matter Research at Mumbai Centre*

### 4.3.1. Study of counter-ion distribution around a micelle

CTAB micelle is an aggregate of $CTA^+$ ions and the $Br^-$ ions, referred to as counter ions, tend to stay near the $CTA^+$ micelles. A combined SANS and SAXS study was carried out to investigate, for the first time, distribution of counter ions around ionic micelles such as CTAB and CTAC. Neutrons are largely scattered from the core consisting of C, H etc. of the micelle and x-rays are mainly scattered from outer shell of $Br^-$ ions. It was seen that compared to $Br^-$ ions around CTAB micelles, $Cl^-$ ions around CTAC micelles are more dispersed away from the micelles. This work has been published in Pramana.

(*V. K. Aswal, B.A.R.C and P. S. Goyal, UGC-DAE CSR*).

### 4.3.2 Neutron Diffraction from a bilayered manganite

The magnetic properties of Ru-doped $La_{1.2}Sr_{1.8}Mn_{1.9}Ru_{0.1}O_7$ bilayered manganite were studied using neutron diffraction (ND) technique at Dhruva, BARC. The measurements show that the compound exhibits ferromagnetic ordering with the spin direction parallel to the c-axis. This is in sharp contrast to the parent compound where the spins are oriented along the a – b plane. The large spin-orbit coupling constant of $Ru^{+4}$ ion seems to play an important role on lifting the orbital degeneracy of the $e_g$ state by which the $e_g$ electrons prefer to occupy the $d^3z^2or^2$ orbital and, therefore, the spins align along the c-axis. This work has been published in J. Magn. Magn. Mater.

(*R. K. Sahu, UGC-DAE CSR, and A. Das, BARC*).

### 4.3.3 High Pressure Structural and Magnetic Studies of $UT_2Ge_2$ Compounds

In continuation of the study of high-pressure structural behaviour on $UMn_2Ge_2$, it was proposed to extend the study to other members of the series $UT_2Ge_2$ (T = Fe, Co, Ni and Cu). The compounds have been synthesized and XRD patterns showed some minor impurity lines in some of the compounds. These lines disappeared after an extended annealing treatment. It is proposed to perform structural studies on these compounds up to pressures of 30 GPa to search for structural phase transitions, as found in the T = Mn compound [V. Siruguri et al., Physica B 344, 255 (2004)]. To lend more support to the experimental studies, electronic and magnetic structure calculations on the above compounds are being carried out in collaboration with ICMCB-CNRS, France. The main aim of this study is to find out the magnetic ground state of the compounds as a function of pressure. Preliminary studies on $UMn_2Ge_2$, showed interesting results, where the magnetic moments of both U and Mn show a sharp decrease as a function of pressure. Calculations on other compounds of the series are currently being carried out.

(*V. Siruguri, UGC-DAE CSR*).

### 4.3.4. Rheological Studies

It is known that the spherical cationic micelles transform to the rod-like micelles and their sizes increase with addition of hydrotrope salt. In the present study the effect of

surfactant chain lengths on this transition have been investigated in the presence of Sodium Salicilate (NaSal) using Rheology method and SANS. The surfactants of different chain lengths, e.g., $C_nH_{2n+1}N^+(CH_3)_3Br^-$, where n = 12 (DTAB), 14 (TTAB), and 16 (CTAB), were added to de-ionized water at a concentration of 100 mM, with NaSal concentrations varied in the range of 0 – 100 mM. It was found while CTAB shows large increase in viscosity with the addition of small amount of NaSal, there were decreasing trends of viscosity for both DTAB and TTAB. SANS studies show that the size of CTAB micelles increase relatively more than DTAB and TTAB micelles upon addition of NaSal. These studies suggest that the counterion adsorption, which causes the structural transition in micelles, by the electrolyte, strongly depends on the surfactant chain length.

(*J. V. Joshi and P. S. Goyal, UGC-DAE CSR, and V. K. Aswal, BARC*).

### 4.3.5 X-Ray Diffraction (XRD) studies

(i) The phase formation in Si/C multilayer films irradiated with 40keV $Ar^+$ ions was investigated using Grazing Incidence X-ray Diffraction (GIXRD). It was shown that after annealing, the hexagonal phase of SiC is formed in samples subjected to low fluence ($5\times10^{16}$ ions/cm$^2$), and the cubic phase is formed in those subjected to higher fluence ($1\times10^{17}$ ions/cm$^2$).
(*D. M. Phase, UGC-DAE CSR, Indore, and S. K. Deshpande, UGC-DAE CSR, Mumbai*).

(ii) To study the phase transformation at the surface due to passage of swift heavy ions in materials, GIXRD measurements were carried out on $\alpha$-$GeO_2$ irradiated with 100MeV Ag ions at different fluence. It was found that at high fluence of $8\times10^{12}$ ions and greater, there is some surface modification, with possible clusters of other phases of $GeO_2$. Further analysis is in progress.
(*D.C.Kothari, University of Mumbai, B.K.Godwal, BARC, and S.K.Deshpande, UGC-DAE CSR*).

### 4.3.6 Dielectric Relaxation and Impedance Measurements

(i) Impedance studies were carried out on a series of Li-Zn silicate glass samples prepared with different $Li_2O$ content, from room temperature to 370C over the frequency range of 100Hz to 15MHz. These glass samples are of interest since they are precursors to glass-ceramics whose dielectric properties are of technological importance. This work has been published in Current Science.
(*V.K.Shrikhande, BARC, M.S.Jogad, S.B.College of Science, Gulbarga, and S.K.Deshpande, UGC-DAE CSR*).

(iii) Studies on $NO_2$ gas sensors based on Tellurium films on glass were carried out to determine contribution from different components of the resistance in order to understand gas-detection mechanism. It was seen that the bulk resistance of the films decreased significantly on exposure to $NO_2$ gas, while the grain boundary resistance marginally increased. XPS studies revealed formation of $TeO_2$ upon exposure to $NO_2$, causing an increase in hole concentration and a decrease in bulk resistance, leading to the observed response. Impedance studies on similar films deposited on alumina substrates when exposed to $H_2S$ gas have also been carried out, where increase in bulk resistance

was observed due to removal of adsorbed oxygen by $H_2S$. This paper has been published in Asian J. Phys. (*S.K.Gupta, S.Sen, BARC, and S.K.Deshpande, UGC-DAE CSR*).

### 4.3.7 Dynamic Light Scattering (DLS) studies

(i) DLS measurements were carried out to study the effect of surfactants (Cetyl-peridinium bromide and Cetyl-peridinium chloride) and salts (NaBr and NaCl) on micellar size (i.e., hydrodynamic diameter) of a poly (ethylene oxide)-block-poly (propylene oxide)-block-poly (ethylene oxide) (PEO-PPO-PEO) amphiphilic copolymer (Pluronic P123). Results show the presence of both mixed micelles of surfactants and copolymers, as well as pure surfactant micelles (bimodal) in the solution of P123 + [CPB/CPC] in the absence of salt (see Figures 2, 3 and 4). But the size of the copolymer micelles decreases continuously (monomodal) in the presence of salts (NaBr/NaCl). Data analysis is in progress.

(*P. Bahadur, South Gujarat Univ., and G. Ghosh, UGC-DAE CSR*).

(ii) The effect of urea (U), thiourea (TU), monomethylurea (MMU), dimethylurea (DMU), tetramethylurea (TMU), dimethylthiourea (DMTU) and tetramethylthiourea (TMTU) on the structural transition (sphere-to-rod, s→r) in sodium dodecylbenzenesulfonate (SDBS)-1-pentanol system has been investigated using DLS at 25 $^0$C. 1-Pentanol, at 0.14 M, is found to promote s→r in this system (0.2 M SDBS). The presence of the additives causes, in almost all cases, decrease and increase in this 1-pentanol concentration depending upon concentration and nature of the additive. These effects are explained in terms of increased dielectric constant of the solvent medium due to the presence of additives and the increased micellar hydration due to repulsion of charged monomers caused by adsorption of the additives. Taken together, the data signaled towards the exposure of biological assemblies to water at higher [additive] which causes decrease in hydrophobic interactions responsible for compact structure formation (i.e., native protein). The manuscript has been accepted in Langmuir.

(*Kabir-ud-Din, Aligarh Muslim University, and G. Ghosh, UGC-DAE CSR*).

(iii) Polymer – surfactant interaction has been investigated between a poorly water-soluble polymer hexadecyl-trimethyl-ammonium polyacrylate, PACTA, and the aqueous sodium dodecylsulfate, SDS, in micellar form, using DLS method. According to experiment, the dissolution of the polymer (PACTA) is mediated by the adsorption of surfactant, at concentrations above the cmc. The resulting super-colloid is presumably formed by micelle binding onto the polymer. The above hypothesis is supported by dielectric relaxation methods. DLS gives information on the size of the complex and indicates the occurrence of equilibrium between free and polymer-bound states for micelles. Light scattering indicates that former hypotheses on micelle-assisted formation of super-colloid particles are reasonable. Accordingly, micelles adsorbed on the outer hydrophobic polymer surface form a sort of necklace. The agreement between information from DLS and dielectric relaxation findings is noticeable. The manuscript has been communicated to Langmuir. (*G. Ghosh, UGC-DAE CSR*).

# 5. NEW FACILITIES ACQUIRED/DEVELOPED:

## *5.1 Development of facilities at Indore Centre*

### 5.1.1. Laser Raman Laboratory

A laboratory equipped with a Laser Raman set-up is developed. Specifications of the Raman system with a view of suitability and demand of the user community have been finalized. Various users of the Raman system were contacted and detailed discussions were carried out to finalize the requirements of a Laser Raman equipment. On the basis of this a dispersive micro Raman spectrometer HR-800 from JOBIN YVON with x-y scanning and temperature attachments have been procured. All necessary accessories and equipments are procurred and the system has been installed and running successfully The system has two laser sources for excitation: He-Ne 632.81 nm and Argon 488 nm. It uses a spectrograph with 800 mm focal length and two gratings of 600 and 1800 grooves per mm. The achieved rsolution is about $1cm^{-1}$. It has a confocal microscope with objective lenses of 10×, 50×, 100× magnification. The size of the focal spot is between ~10 microns to ~1 micron depending on the objective lens.

*(V. G. Sathe)*

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### 5.1.2. Development of Pulsed Laser Deposition

A Pulsed Laser Deposition system for making thin films of oxides, nitrides, metals etc. is under development. For the same a ultra high vacuum deposition chamber is designed with various ports for laser entry, target holder, substrate holder with heater, various vacuum guages, vacuum pump, gas leak valve etc. along with two straight ports for RHEED gun and detector. All these ports are fitted in a chamber diameter of 300 mm. A four target holder motion assembly is designed. With the prior experience and rigorous discussions with many experts in this field it is noted that for all kind of depositions a minimum of 2 to 5 Joule/$Cm^2$ energy flux is required on the target. To get this an Excimer laser with a power of 600 mJ is ideal. Excimer laser and various vacuum components have been procured. The order for vacuum pumps, gases and other accessories like a furnace, palletizer etc. is placed. The fabrication of vacuum chamber is nearly complete and will be vacuum tested soon. The laboratory space is being made ready and the laboratory will be functional very shortly.

*(V. G. Sathe and D. M. Phase)*

### 5.1.3 Laue set-up

A Laue set-up for recording Laue patterns using a laboratory rotating anode X-ray source is developed using a CCD detctor and home made collimator. The laue pattern of Mica is recorded in transmission mode which matches with the literature.

*(V. G. Sathe and A. V. Pimpale)*

### 5.1.4 In-situ Microevaporator for workstation at PES beamline on INDUS-1

Recently, PES workstation of beamline installed on Indus-1 has been equipped with a micro-evaporator for in-situ deposition of thin films. The system can be used to deposit thin films with low melting points (~$500^0$C) under UHV environment. For depositing the thin films and multilayers, particularly of materials having high melting points, an electron beam gun has been installed in a separate vacuum chamber and will be attached through UHV gate valve to the experimental station of the beamline.

*(S. M. Chaudhari)*

### 5.1.5 X-ray reflectivity and standing wave set-up

Home made (in collaboration with Instruments & Control division of CAT, Indore) XRR setup for measuring the reflectivity of thin films. Using Si PIN diode detector, it is possible to measure the fluorescence from the constituent elements – useful for the X-ray standing wave based experiments

*(A. Gupta and V. R. Reddy)*

### 5.1.6 Transmission electron microscope

Transmission eletron microscope (TEM) equipped with EDAX and various types of holders and TEM sample preparation facility was proposed/acquired under the $10^{Th}$ plan. This will be installed and become functional till July 2005.

*(N. P. Lalla)*

### 5.1.7 DST Projects

Low temperature and high magnetic field facilities at IUC-DAEF, Indore has been sanctioned by DST during 2002.
The project aims at setting up a 14T VSM for magnetic measurements and a 14T/0.3K system for resistivity and heat capacity measurements. Extensive efforts were made during this period in planning and executing the project. A 14T/0.3 K Magnet system with He3 inserts has been installed during March 2005 under this Project. The capabilities of the system in general has been tested in March and extensive data collection at high fields is being planned. The VSM is commissioned at the Magnetism laboratory of UDC, Indore.

A 14T/0.3 K Magnet system with He3 inserts has been installed during March 2005 under the on going DST-Project. The capabilities of the system include resistivity and heat capacity measurements down to 2K/0.5K and fields upto 14T.

The 14 Tesla Vibrating Sample Magnetometer is installed and is being tested.

*(B.A.Dasannacharaya (till Oct 2002), A.Gupta (since Oct 2002), V.Ganesan and A. Banerjee)*

### 5.1.8 Energy dispersive X-ray Diffractometer

The stepper motor controls have been success fully interfaced with the fabricated goniometer. A computer program using Visual Basic has been developed to control all the aspects of the goniometer, alignment and slow scanning etc. Various wide angle and small angle (XRR) ADXD test runs have been performed to check the working of the goniometer. Using this goniometer EDXD x-ray reflectivity experiments on some standard samples like W-C, Mo-C and W-Si multilayers has been successfully done. As a result of comparative study we have shown that EDXD is much faster than ADXD and a very good reflectivity data can be collected just in a minutes time.

*(N. P. Lalla)*

### 5.1.9 Inverse photoemission spectrometer

The work on the project entitled "Investigation of unoccupied electronic structure by inverse photoemission" has progressed satisfactorily. The acetone/$CaF_2$ detector has ben chanracterized and the optimal operating conditions have been determined and compared its performance with an ethanol/$MgF_2$ detector. We determine the optimal operating conditions to be 4~mbar acetone pressure and 745±20~V anode voltage. At optimised operating conditions, count rate is improved by about a factor of 3 than what has been reported earlier for acetone/$CaF_2$ detector. We show that the dead time of the acetone/$CaF_2$ detector is negligible and addition of multiplier gas like argon worsens its performance. Unlike other gas filled detectors, this detector works in the proportional region. The unoccupied valence bands of Ag and Ta are studied, which are in agreement with literature. We obtain a band-pass of 0.48±0.01~eV for the acetone/$CaF_2$ detector. High count rate, reasonable resolution, negligible dead time, no requirement of multiplier or quench gas, satisfactory stability, and ease of handling make the acetone/$CaF_2$ detector an attractive candidate for use in IPES. This work has been published in Review of Scientific Instruments.

A second electron gun following the Stoffel-Johnson design has been fabricated. It consists of a diode extraction source ( BaO cathode and cathode aperture) and a three-element (extractor, focus and final ) refocusing lens. Voltages applied on cathode aperture, extractor, focus and output lens are in the ratio $V_C : V_A : V_F : V_O$ = -V : + 5V : -0.9V : 0 respectively.
A sample holding system for changing single crystal sample with heating, cooling, sample aligning and temperature measurement facility has been fabricated and tested.

*(S. R. Barman*)

### 5.1.10 Polarised light beamline

A project proposal on Polarized light beamline on INDUS-2 bending magnet source for Magnetic Circular Dichroism (MCD) and Photoelectron Spectroscopy (PES) which was submitted to DST have been presented before the Expert Committee for funding. On the

recommendation of the said committee a revised proposal is submitted for funding the project *(S. M. Chaudhari and A. Banerjee)*

### 5.1.11 UGC Research project "Bio Electret State in Amino Acids"

The above said project has been sanctioned to Prof. R. Nath and aims at using the thermally stimulated discharge current (TSDC) measurements to study electrets, and to extend it to the study of bio-electrets. A student Ms. Deepti Jain has recently joined in this project. The initial measurements of samples like Caesin and Diastase have revealed certain technical difficulties in using the old inserts. Hence a new TSDC spectrometer is planned and fabricated with in the frame work of availability of infrastructure. A reasonable success has been obtained in terms of precision and the TSDC of PET polymers obtained using this down to 80K are on line with the literature. Efforts were being made to confirm these results using thermal cleaning methods known in this field.

*(R.Nath and V.Ganesan)*

## *5.2 Development of facilities at Kolkata Centre*

### 5.2.1. Oxygen hardened SSBD detectors

Silicon wafers enriched with oxygen by 140 MeV O6+ ions were annealed at 750oC to anneal out the radiation damage caused by the energetic ions. A surface barrier detector fabricated with this wafer shows good resolution and other detector characteristics like reverse leakage current , biasing voltage etc. which are at par with the detector fabricated with the un-irradiated wafer. The radiation (gamma rays, neutrons and hadrons) hardened properties of the oxygen enriched detector is under progress . A couple of wafers have been uniformly implanted with 140 MeV oxygen at VECC, Kolkata using a rotating degrader. After annealing out the radiation damage, the depth profile of oxygen in the wafers will be studied by SIMS. These wafers will be used for the fabrication of radiation hardened surface barrier detectors. Further work is in progress.

*(UGC DAE CSR- KC & VECC)*

### 5.2.2 Preparation of Mossbauer and positron sources

A 10 mCi Co-57 Mossbauer source has been prepared, tested and supplied to Dept. of Physics, Rajasthan University. Another 5 mCi source has been prepared and given to Dept. of Physics, Calcutta University. Positron source of 20 μCi Na-22 was prepared on Al matrix for positron annihilation spectroscopic measurements.

*(UGC DAE CSR- KC)*

### 5.2.3 Installation of Gamma Irradiation Chamber

A 2 kCi Co-60 Gamma Irradiation Source has been installed in the centre. Average absorbed dose rate has been determined to be around 4 kGy/hr. Installation of this camber

may be considered one of major developments in the field of radiation research in the centre and many Universities/institutes in the country. About 12 research groups from different Universities (details given below) have already used these facilities.

| S.No | User | Experimental programme |
|---|---|---|
| 1 | Dr S K Das, VECC | Synthesis of nano-particles |
| 2 | Dr S Santra,<br>University of Kalyani | Radiation induced effects on seeds |
| 3 | Dr P Karmakar,<br>Jadavapur University | Low LET induced apoptosis in human cells. |
| 4 | Dr S B Chakraborty,<br>University of Calcutta | Effect of gamma irradiation on O.miloticns specimens |
| 5 | Dr R Bajpai,<br>Rani Durgawati University | Effect of gamma irradiation on PUF and PUFD isomorphic blend specimen |
| 6 | Dr S Chaterjee,<br>University of Calcutta | Synthesis of Thiol capped CdS nano-particle. |
| 7 | Prof V N Bhoraskar,<br>University of Pune | Modification of polymeric materials & synthesis of nano materials. |
| 8 | Prof S B Dhole,<br>University of Pune | Modification of polymeric materials & synthesis of nano materials. |
| 9 | Dr S R Choudhury,<br>Jadavpur University | Radiation effect on specimens from waste water bodies |
| 10 | Prof P C Mondal, SINP | Dose rate effect on Anthraquinone compounds |
| 11 | Prof K K Mukherjee,<br>Jadavpur University | Chemical and Radiation induced DNA Damage: |
| 12 | Dr S Kesri, BIT Ranchi | Effect of gamma irradiation on Ca doped CMR compound |

### 5.2.4 DST Project

This is joint collaborative project which has now received financial approval from the DST. The project is entitled "Studies of exotic nuclei under extreme conditions using an Indian National Gamma Detector Array Facility (INGA)". INGA is a multi-institutional project with NSC, VECC, SINP, TIFR and BARC with UGC DAE CSR - Kolkata Centre as one of the active participant-institute of the project. A 24 clover gamma detector array will be made operational under this project for a world class facility for studies of exotic nuclear high spin behaviour.The INGA facility will be rotated among the three accelerator centres., viz., VECC, NSC and BARC/TIFR. The funds for the Kolkata centre under the project is Rs. 266.35 Lakhs which covers the expansion of the existing detector array of the UGC DAE CSR - KC for experiments at VECC, Kolkata.

## *5.3 Development of facilities at Mumbai Centre*

### 5.3.1 Neutron beamline facility at Dhruva reactor, BARC:

As mentioned in the earlier reports, the Neutron Shielding Assembly and Neutron Diffractometer have already been installed (Fig.1 on page ), though the diffractometer is not yet operational. This year, the computer-controlled goniometer, developed at the University of Pune for the UGC-DAE CSR neutron beamline, was tested successfully. The Si focusing monochromator for neutron powder diffractometer was mounted on this goniometer and the assembly was tested for remote operation of X-Y motion, rotation, and tilt. This assembly was installed in the neutron beamline. The side plug for 90 degrees take-off was replaced by the collimator plug, and the neutron beam was successfully obtained at the diffractometer sample position for the first time. Detailed radiation survey has been carried out to estimate level of radiation in the beam path and around the diffractometer. Appropriate shielding was placed to ensure radiation safety near working area. The monochromator was moved to the estimated Bragg position for 1.76 Å wavelength, and the neutron counts were measured with a fission chamber detector. Components such as sample stand, holder for fission chamber, traveling microscope, etc. have been fabricated/procured. Fabrication of automatic beam shutter and an assembly for measuring beam profile is in progress along with the testing of the He3 position-sensitive detectors. The progress of this activity was partly hindered because of restrictions on purchases and partly because of the fact that Dr. Siruguri, who was actively involved in this work, is on EOL for one year.

(*P. S. Goyal, V. Siruguri, P. D. Babu, S. K. Deshpande, UGC-DAE CSR, and V. N. Bhoraskar, Univ. of Pune*).

The neutron Triple Axes Spectrometer (TAS), to be installed at the neutron beamline, is expected to work at different incident wavelengths, and two monochromators – pyrolitic graphite (PG) at 76 degrees take-off and Si at 94 degrees take-off – shall be placed in the beamline to provide a choice of about five distinct neutron wavelengths. The two bent-crystal monochromators were being developed at the University of Pune for use with the TAS. The design of the Si monochromator was based on the design of the focusing monochromator used with the diffractometer, with the horizontal curvature (radius 13 m) achieved by mechanical bending of Si strips, and vertical bending (1.8 m) by segmentation. Nine strips of Si would be used. The PG monochromator consists of an aluminium sheet bent to required curvatures (horizontal radius 5.05 m, vertical radius 1.91 m) and a 12×10 array of graphite crystals, each 10 mm × 10 mm, and 1.5 mm thick, arranged on the sheet. Both these monochromators have been procured and will be tested when the instrument scientist Dr. P. D. Babu returns from his EOL.

(*P. S. Goyal, and P. D. Babu, UGC-DAE CSR, and S. K. Kulkarni, Univ. of Pune*).

### 5.3.2 Temperature variation facility in Dynamic Light Scattering

A temperature variation (5 – 70 °C) attachment has been fabricated and installed in the in the existing home-built Light Scattering facility. The attachment has a low temperature water circulation jacket, which is connected to a chilling unit to cool down to 5 °C, and a heater arrangement to heat up to 70 °C. A temperature controller (on/off type) for this purpose has been fabricated and installed. The entire set up is functional.

(*G. Ghosh, M. Venugopal, and M. K. Verma*).

# 6. OTHER ACTIVITIES, ANNUAL DAY, ETC.

## 6.1 Annual Day Function

UGC-DAE Consortium for Scientific Research (formerly Inter University Consortium for DAE Facilities) celebrated its annual day on Wednesday, 22nd December 2004. Dr. S. Banerjee, Director, Bhabha Atomic Research Centre, Mumbai was the chief guest on the occasion and Dr. Amit Roy, Director, Nuclear Science Centre, New Delhi, presided over the function. Other eminent speakers on the occasion were Prof. Dhananjai Pandey, Banaras Hindu University, Varanasi and Prof. D.S. Misra, Indian Institute of Technology, Mumbai.

The programme started with Prof. V.N. Bhoraskar, Director, UGC-DAE-CSR, formally welcoming the guests and other invited speakers as well as various visitors from different institutions in Indore and some eminent guests from outside Indore. He described the progress made by the Institution in last several years and outlined the new facilities being acquired in the Institute. He also mentioned that now there exists a much broader scope for the Institution in interaction with Department of Atomic Energy in the fields of physical, chemical and engineering sciences.

Prof. Amit Roy in his presiding address discussed the roles of various Inter University Centres such as NSC, IUCAA and UGC-DAE CSR as catalysts in the growth of quality research in University sector. He also pointed out that the ultimate aim of Universities is to develop manpower that would contribute in the growth and progress of the country.

Dr. Banerjee in his inaugural address described the Department of Atomic Energy as a beneficiary of the University System in that the latter offered trained and talented manpower. He described at length the goals in research and development of the Department of Atomic Energy. He emphasized the dual aspect involved in DAE, particularly power generation and other applications as well as security requirement of the nation and he also laid stress on the strong base in basic research necessary for these. He started with a brief outline of various reactors in BARC, namely APSARA, DHRUVA, CIRUS. He discussed the neutron beam research and advanced fuel technology needed by the country if it has to increase the share of nuclear power from present 3% to 20%. He also described various other Research and Development programmes of the Department of Atomic Energy in general and Bhabha Atomic Research Centre in particular. He invited all the University community to participate in all the different programmes and contribute to the progress of the nation.

Prof. Dhananjai Pandey, BHU Varanasi, described the work of his group and himself in the area of phase transitions in High Piezo-Electric Ceramics. Prof. D.S. Mishra, IIT Mumbai made a presentation on Ni and Co inside the carbon nanutubes.

The programme concluded with a vote of thanks by Prof. Ajay Gupta, Centre-Director, UGC-DAE-CSR, Indore Centre. In the afternoon the visitors were shown around the laboratories of UGC-DAE CSR.

6.2 **Thesis**

1. "High spin states in nuclei near the neutron magic number N=50", N S Pattabiraman, under the guidance of Dr S S Ghugre, awarded by the University of Calcutta.
2. Mr. Sunil Nair submitted his Ph.D. Thesis to Barkatullah University, Bhopal. He is conferred ***"Best Thesis Award"*** in the DAE Solid State Physics Symposium, Amritsar (2004).
3. Mr. Deepak Sharma submitted his Ph.D. thesis to D.A. Univeristy in November, 2004.
4. The thesis entitled "Structural and Electrical studies of some Quasicrystals and their Approximants", of the Research student Ms.Archana Jaiswal working with Dr. N.P. Lalla, has been submitted in Sep.2004 to Barkatullah Vishwavidyalaya, Bhopal for the award of Ph.D degree
5. Ms. R. Bindu submitted her Ph. D. thesis on "X-ray spectroscopic studies of rare earth transition metal oxides of $ABO_3$ type". The degree was awarded by DAVV, Indore in February 2005.

**6.3 Visits abroad**

1. Prof. Ajay Gupta visited the following institutes:
   a) Satie-ENS de Cachan-umr CNRS, France in July, 2005 and University of Potsdam/Bessy-Berlin, Germany for scientific collaboration.
   b) European Synchrotron Radiation Facility, Grenoble in July, 2005 for experiment on x-ray standing waves.
   c) Paul-Sherr Institute (PSI), Switzerland for Neutron Reflectivity experiments in July, 2005.
2. Dr. P.S. Goyal visited Trieste, Italy during May 11- 19, 2004 to carry out SAXS experiments at Elettra.
3. Dr. P.D. Babu is on EOL from 1.4.2004 and is working at Tam Kang University in Taiwan as a Visiting Scientist.
4. Dr. V. Siruguri is on EOL from 20.12.2004 and is working at University of Bilbao in Spain as a Visiting Scientist.

# 7. WORKSHOPS / SEMINARS ORGANISED BY UGC-DAE CSR:

## 7.1 Awareness workshop organised by Indore Centre at Pondicherry University during 3 –4 November, 2004.

An awareness workshop on "The facilities of UGC-DAE Consortium for Scientific Research" was organized at the Physics Department, Pondicherry University, Pondicherry during November 3 – 4, 2004. Around 35 faculty members as well as students from various institutions participated in the workshop. Prof. Bhoraskar, Director, UGC-DAE CSR gave an introduction about UGC-DAE CSR and its objectives. Prof. Ajay Gupta, Centre-Director, UGC-DAE CSR, Indore Centre gave overview of the facilities available at Indore Centre. Detailed talks were delivered on the topics: Synchrotron Radiation facility at CAT by Dr. R.V. Nandedkar, Accelerator based research by Dr. A.K. Sinha, PES Beamline at Indus I by Dr. S.M. Chaudhari, Cryogenics and low temperature facilities by Dr. V. Ganesan, PES and other surface characterization probes by Dr. T. Shripathi, X-ray studies, Spectroscopy and diffraction by Dr. N.P. Lalla, magnetic measurement facilities and scanning probe microscopy by Dr. V. Ganesan, X-ray reflectivity, MOKE and Mossbauer spectroscopy by Prof. Ajay Gupta and SEM & TEM facilities by Dr. N.P. Lalla.

## 7.2 Awareness Workshop on "Radiation Applications : Basic and Applied Sciences" organized by Kolkata Centre at the Jadavpur University on February 9-10, 2005.

UGC DAE CSR- KC has organized "Awareness Workshop on Radiation Applications : Basic and Applied Sciences" at the University of Jadavpur on February 9-10, 2005. Aim of the workshop was to familiarize the University users about these programmes and encourage potential collaborators from Universities and Institutes in West Bengal and its neighbouring states. The topics covered are radiation detectors, irradiation studies in material, chemical and biological sciences, experimental nuclear physics, material synthesis, modification and characterization, elemental characterization using X-rays, ion beams. A large number of researchers from different universities including from north-eastern states participated in this workshop.

The review meetings of ongoing projects utilizing VECC was held in, June 2004 where all ongoing projects were reviewed.

For new projects utilising the IGCAR, Kalpakkam a meeting was held for selection of fresh proposals in March this year, with experts from IGCAR.

## 7.3 XIth Workshop on "Neutrons as Probes of Condensed Matter" organized by Mumbai Centre at BARC, Mumbai during 27-29 January, 2005

UGC-DAE CSR, Mumbai Centre, in collaboration with Solid State Physics Division, BARC organized XI Workshop on "Neutrons as Probes of Condensed Matter" at BARC, Mumbai during Jan. 27-29, 2005. The faculty members for the workshop were from SSPD, BARC and UGC-DAE CSR. About 30 young faculty members from university and research institutes participated in the workshop. During this workshop, students were not invited and that is why workshop was kept for 3 days. The objective of the workshop was to have intense discussions and generate fresh projects for neutron scattering experiments.

The project review meeting of UGC-DAE CSR, Mumbai Centre was held on Jan. 29, 2005 at Training School Hostel, BARC, Mumbai-400 085.

## 8. SEMINAR / WORKSHOP / LECTURES DELIVERED BY UGC-DAE CSR PERSONNEL:

1. Dr. V. Ganesan delivered the following lectures

a. "Quantum Liquids" and "Interesting aspects of Scanning Probe Microscopy" at the Department of Physics, University of Poona, Pune during April 2004

b) "Production and importance of low temperatures" and Scanning Probe Microscopy" at the Refresher course conducted by Department of Chemistry, Shivaji University, Kolhapur during Oct 2004.

c) "Cryogenics and Ultra Low Temperatures" and " Magnetic Measurement facilities and Scanning Probe Micrscopy" at the Awareness workshop on the "Facilities of UGC-DAE Consortium for Scientific Research" held at Pondicherry University, Pondicherry during Nov 4-5, 2004

d) "Atomic Force Microscopy for nano materials" in the National Seminar on Science and Technology of Low Dimensional Systems and Devices, at Nabira Mahavidyalaya, Katol, Nagpur during Dec 18-19, 2004

e) "Thermopower and heat capacity at low temperatures" and "Basic instrumentation at ultra low temperatures" at the National workshop on "Instrumentation and Measurement techniques organised by Bharathidasan University, Thiruchirappalli during March 2005.

2. Dr. Alok Banerjee delivered the following lectures:

a) Two talks in "Refresher Course in Experimental Physics" organized by the Indian Academy of Sciences, Bangalore at Bhavnagar during 25$^{th}$ October to 7$^{th}$ November, 2004.

b) One talk in the International workshop on "Synthesis of Nano Materials by Thermal Plasma" which is held during 17$^{th}$ November to 1$^{st}$ December, 2004 at University of Pune under the auspices of ICTP (Trieste, Italy), BARC (Mumbai) and International Atomic Energy Commission.

3. Dr. T. Shripathi delivered the following talks:

i) "Surface Chemistry study using X-ray Photoelectron Spectroscopy," at the National Conference on "Recent Trends & Surface Chemistry", Guru Jambheshwar University, Hisar, March 13-14, 2005.

ii) "X-ray photoelectron spectroscopy" at the Awareness Workshop organised by UDCSR at Pondichery University (Nov 4-5, 2004)

4. Dr. S.M. Chaudhari delivered the following lectures:

a) Photoelectron Spectroscopic studies with synchrotron radiation with special emphasis to UGC-DAE CSR beamline installed on Indus-1

b) Awareness workshop on " the facilities of UGC-DAE CSR" Nov 4-5, 2004, Dept. of Physics Pondichery University, Pondicherry-605 014

5. Prof. Ajay Gupta delivered the following invited lectures:

a) At the Indo-German Conference on Synthesis and Modification of Nano-structured materials by Energetic ion beams during $20^{th}$ – $24^{th}$ February, 2005 held at Nuclear Science Centre, New Delhi.

b) At the workshop on Nano-technology and ion beams at University of Mumbai during $21^{st}$ – $22^{nd}$ March, 2005.

6. Dr A. V. Pimpale gave a course of eight lectures on X-ray scattering and diffraction at the Physics department, University of Pune during August 2004.

7. Dr P. S. Goyal gave following talks

i) "Use of small angle neutron scattering in materials research" by P. S. Goyal in National Conference on Materials and their applications, during March 11 – 13, 2004 at Kurukshetra University, Hariyana, India.

ii) "Use of SANS and SAXS in study of Nano particles" by P. S. Goyal in National Conference on Thermophysical Properties, during January 19 – 20, 2005 at Goa University, Goa, India.

8. Dr. G. Ghosh gave a talk on "Super-colloids formed by a Non-soluble Alkyltrimethylammonium Poly-acrylate in presence of Anionic Surfactant in excess" at National Seminar on Polymers, Surfactants & Gels during March 11 – 13, 2005 at M. S. University, Baroda, India.

9. Dr A K Sinha, delivered the conference summary talk at the D A E Symposium on Nuclear Physics, held at B.H.U in December 2004.

10. Dr A Saha gave a talk at Discussion meeting on Nanoscience organized by S.N. Bose National Centre for Basic Sciences on August 5, 2004.

11. Dr M Sudarshan gave a talk on PIXE : A Powerful technique for Trace Element Analysis at School on Ion Beams in Material Science, October 2004, IOP, Bhubaneswar.

12. Dr A Chakraborty gave a talk on Trace elements & Carcinogenesis, at Cancer in developing worlds, at Cairo Egypt, in March 2005.

# 9. PUBLICATIONS IN JOURNALS:

## 9.1 Publications arising from collaborative research schemes and use of UGC-DAE CSR Facilities by University scientists:

(Names of authors from universities are shown in bold letters & marked by *, names of authors from UGC-DAE CSR are underlined and those from DAE are marked by #)

1. Variation of electrical resistance in metallic glasses subjected to 130 MeV $^{28}Si$ ion irradiation, **H. Narayan*, H. M. Agrawal*, R. P. S. Kushwaha***, V. Ganesan, and D. Kanjilal, Phy. Stat. Sol. (a), **201**, 536 (2004)
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## 10. PRESENTATIONS IN CONFERENCES / SYMPOSIA:

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50. An investigation of radiosensitivity of selected stored seed and seed borne, **J.P.Maity*, S. Chatterjee***, D. Mishra, A. Chakraborty, A. Saha, **S. C. Santra* and S. Chanda***, International Conference on recent Trends in Radiation Biology held at BARC, Mumbai, on December 1-3, 2004.

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55. A fluorescence of interaction of cysteine-capped CdS nanoparticles with tyrosine. Amiya Priyam, A. Chatterjee, S. K. Das# and A. Saha, International Conference on Soft Matter (Organized by Surface Science Centre, Jadavpur University), held at Park Hotel, Kolkata on November 18-20, 2004.

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65. "Rotational tunneling states in complex molecular systems", S. K. Pandey, A. V. Pimpale and P. S. Goyal, Proc. DAE Solid State Phys. Symp., **47**, 594 (2004).

*(Names of authors from universities are shown in bold letters & marked by *, names of authors from UGC-DAE CSR are underlined and those from DAE are marked by #)*

## 11. COLLABORATIVE RESEARCH SCHEMES:

### *On VECC, Kolkata*

1. CRS-051 : Dr. Parimal Karmakar - Dept. of Life Science and Bio-technology,Jadavpur University- To investigate the mechanism of High-LET induced apoptosis in human cells
2. CRS-050: Dr. Kalyan Kumar Mukherjee - Dept. of Chemistry, Jadavpur University- Chemical and radiation induced DNA damage : Biophysical and biochemical characterization and chemo-protection
3. CRS-043: Dr.(Mrs.) Sarmistha Raychaudhuri - Dept of Molecular biology, biophysics and genetics,Univ. of Calcutta - Morphological, biochemical and molecular changes in relation to invitro plant regeneration of Vigna radiata(L) wilczek induced by gamma rays and heavy ions
4. CRS-062 : Dr.Maitree Bhattacharyya - Dept. of Biochemistry, Univ. of Calcutta - Structural alteration in irradiated erythrocytes vis-à-vis cellular rejuvenation
5. CRS-033 : Prof. L. Chaturvedi, Dept. Of Nuclear physics, BHU - Nuclear structure studies of exotic nuclei.
6. CRS-070/PU/P/IMG, Prof. I.M Govil - X-Ray spectroscopy of Neutron Deficient nuclei 178Os and 182Pt.
7. CRS-071/MU/P/SBP, Prof. S.B Patel -Lifetime measurement in the magnetic dipole bands in 105Ag.
8. CRS-072, Prof. S.N Roy - Gamma ray spectroscopy of N ~ Z nuclei populated via deep inelastic collisions and fusion in the 20Ne + 40Ca system
9. CRS-073/BU/P/SS, Dr. Sukhendusekhar Sarkar - Spectroscopy of few-valence particle nuclei around 146Gd Core.
10. CRS-074/MSUB/P/SM, Dr. S Mukherjee - Measurement of linear momentum transfer in the complete and incomplete fusion process.
11. CRS-075/AMU/P/BPS, Dr. B.P Singh – A study of incomplete fusion in heavy ion induced reactions.
12. CRS-076/AMU/P/RP, Prof. Rajeshwari Prasad - A study of fission fragments produced in heavy ion (HI) reactions.
13. CRS-077/AMU/P/IAR, Dr. I.A Rizvi – Study of reaction mechanism in some natural elements using 16O & 20Ne beams.
14. CRS-078/GBPU/HMA, Dr. H.M Agrawal - Investigation of effect of projectile structure on incomplete fusion reactions.
15. CRS-079/AMU/P/AA, Dr. A Ansari - A study of complete and incomplete fusion in Heavy ion reactions.
16. CRS-080/BHU/P/LC, Prof. L Chaturvedi -Nuclear structure study of A~130 Nuclei.

17. CRS-082/UD/P/SCP, Prof. S.C Pancholi - Search for tri-axial super deformation in 160Lu.
18. CRS-083/BHU/P/PKJ, Dr. P.K Joshi - Measurement of lifetime of excited 0+level in 184Hg.
19. CRS-088/WBUT/B/SRC, Dr. Shaon Ray Chaudhuri - Ionizing radiation induced DNA DSB studies of methanogens isolated from East Calcutta Wetlands.
20. CRS-089/BC/B/MM, Dr. Madhumita Manna - Radiation and molecular immunology: Understanding the mechanism of protection against leishmania infection using radio attenuated leishmania parasites.
21. CRS-090/GU/B/DKS, Dr. D. K. Sharma - Use of low LET 16O beam in egg hatchability and control of Pebrin disease in Muga silk worm antheraea assama.
22. CRS-091/UC/B/UD, Prof. Uma Dasgupta - Molecular Characterization of Genetic damages produced by high LET radiation and their repair in mammalian cells.
23. CRS-092/JU/P/ST, Prof. Sujata Tarafdar - Ion beam modification of conducting oxides – polymers & inorganics.
24. CRS-093/UC/P/GG, G. Gangopadhyay - Spectroscopy of heavy nuclei transfer products.

## *11.1 On Pelletron at IOP, Bhubaneshwar*

1. CRS-036: Dr. B.Chattopadhyay - Government college of leather technolgy - Impact of waste metals from tanneries in East Calcutta wetland ecosystem
2. CRS-060: Dr. S.B. Reddy - Dept of Nuclear physics,Andhra Univ. - Trace elemental analysis in biological and environmental samples employing PIXE techniques
3. CRS-045 : Prof. I. M. Govil - Dept. Of Physics, PU - PIXE analysis of the archeological, geological and biomedicinal samples

## *11.2 On Low Energy Accelerator at Kalpakkam*

1. IG-17 - Dr. M. Abdul Khaddar, Univ. Of Kerala - “Optical and Electrical Properties of Nanostructured II-VI Semiconductors Doped Using Ion Implantation” -
2. IG-09 - Dr. A. D.Yadav, Univ. of Mumbai - “Ion Beam Synthesis of Buried Insulating layers in Silicon for Semiconductor devices”.
3. IG-08 - Dr. Ratnesh Gupta, School of Instrumentation, Devi Ahilya Univ. - “Ion beam induced Magnetic Modifications in Ferromagnetic Alloys

4. IG-16 - Dr. V.Ravichandran, Univ. of Madras - "Ion beam Synthesis of Hexagonal In N in P crystal and In N quantum dot structures and their characterization
5. IG-11 - Prof. A.P. Pathak, Hyderabad University - "Swift Heavy Ion Mixing and Strain measurements in strained Hetero-structures
6. IG-04 - Dr. P.K. Giri, IIT, Guwahati - "Studies of Irradiation Induced Defects and Impurities in Zinc Oxide Thin Films.
7. IG-22 - Prof. Ramani, Bangalore University - "Interaction of the Cluster ions of Si. Al, C with Si".
8. IG-23 - Dr. T. Kaliyappan, Pondicherry Engineering College - "Synthesis Structure and Optical Properties of Polymer Galled Photonic Crystal by irradiation and Ion-implantation techniques" -

## *11.3 On Dhruva Reactor, BARC, Mumbai:*

1. CRS-M-90: Dr. Atul Khanna, Applied Physics Department, Guru Nanak Dev University, Amritsar- Structural Investigations of Heavy Metal Oxide Borate Glasses by Neutron Diffraction Experiments.
2. CRS-M-91: Dr. R.V. Upadhyay, Department of Phyiscs, Bhavnagar University, Bhavnagar- Magnetic Fluid-CTAB emulsion: Scattering & Rheological Study.
3. CRS-M-93: Prof. H.B. Bohidar – School of Physical Sciences, Jawaharlal Nehru University, New Delhi – Structural Properties of Gelatin Coacervates.
4. CRS-M-94: Dr. S. Ravi – Department of Physics, IIT Guwahati, North Guwahati – Neutron Diffraction studies on $Ca(Cu_{1-x}Mn_xO_2)$ compounds.
5. CRS-M-95: Prof. (Mrs.) Surekha Devi – Department of Chemistry, M.S. University of Baroda- Small Angle Neutron Scattering Studies of mixed surfactant systems containing cationic Gemini Surfactants.
6. CRS-M-96: Dr. Rakesh K. Mahajan – Department of Chemistry, Guru Nanak Dev University - Aggregation behaviour of Tween 80 in the presence of Glycol Oligmers and Triblock polymers.
7. CRS-M-97: Dr. S. Lakshminarayana – Associate Professor, Department of Nuclear Physics, Andhra University - Measurement and compositional characterization of major, minor and trace constituents in representative environmental samples around visakhapatnam using neutron activation analysis.
8. CRS-M-98: Dr. Tarasankar Pal – Associate Professor, Department of Chemistry, IIT Kharagpur - Micelle Midicated Nanoparticle Catalysis.
9. CRS-M-101: Dr. Anjali Krishnamurthy – Associate Professor, Department of Physics, University of Rajasthan - Study of size dependence of magnetic properties of nano-particle spinel ferrites and their ferrofluids.

10. CRS-M-103: Dr. P. Bahadur – Department of Chemistry, South Gujarat University - SANS studies on some selected single and mixed surfactant systems in aqueous media.
11. CRS-M-104: Prof. S. Yashonath – Solid State & Structural Chemistry Unit, IISc. - Dependence of diffusivity on the bond length of linear molecule confined with aeolites : A neutron scattering study.
12. CRS-M-105: Dr. Kabir-ud-din – Professor, Department of Chemistry, Aligarh Muslim University - Association structure of surfactants near lower or upper Consulute curves : SANS and Viscometric studies.
13. CRS-M-106: Prof. Dhananjai Pandey – Institute of Technology, Banaras Hindu University - Neutron Scatteirng studies on Ferroelectric Ceramics and Crystals (Phase-III).
14. CRS-M-107: Dr. K.R.S. Priolkar – Department of Physics, Goa University - Neutron Scattering Study of Cerium Heavy Fermion Systems.
15. CRS-M-108: Dr. N.V. Sastry – Department of Chemistry, Sardar Patel University - Probing of Structural Characteristics of Silicone surfactant Mcelles in Aqueous and Non-aqueous Solutions.
16. CRS-M-109: Prof. V.S.S. Sastry – School of Physics, University of Hyderabad - Short-range of Nematic Order Fluctuations in Isotropic Phases.
17. CRS-M-110: Dr. K. Venu – School of Physics, University of Hyderabad - QENS and FCNMR Investigations of Protein Stability.

# 12.UTILISATION OF IN-HOUSE FACILITIES OF UGC-DAE CSR:

## *12.1 Indore Centre*

**EXAFS:**

| | |
|---|---|
| 1. Prof. C.L. Chaturvedi | Holkar Science College, Indore |
| 2. Dr. K.R. Priolkar./Prof. Sarode | Goa University |
| 3. Dr. A.N. Mishra | DAVV, Indore |
| 4. Shri Viju Kamath | CUSAT, Kochi |

**AFM:**

| | |
|---|---|
| 5. Mr. P.M. Shiraje/Prof. Pawar | Shivaji University, Kolhapur |
| 6. Mr. S.B. Sadale/Dr. C.D. Lokhande | Shivaji University, Kolhapur |
| 7. Ms. Rachana Sanghi/Dr. S.M. Gupta | CAT, Indore |
| 8. Mr. R. Shivkumar | Alagappa University, Karaikudi |
| 9. Mr. Suhas / Dr. A.P. Adhi | Pune University |
| 10. Ms. Sanjukta | Kolkata University |
| 11. Mr. A. Awadhia | APS University, Rewa |
| 12. Mr. Kamlesh Alti | IIT, Guwahati |
| 13. Ms. Anjum Qureshi | M.S. University, Baroda |
| 14. Ms. Sandya Kulkarni | Shivaji University |
| 15. Mr. R.B. Kale | Shivaji University |
| 16. Dr. Asokan | NSC, New Delhi |
| 17. Mr. Abhijit/Prof. V.N. Bhoraskar | Pune University |
| 18. Dr. Archita Patnaik | IIT, Madras |
| 19. Ms. Usha Chandra | Jaipur University |
| 20. Dr. S.V. Bhoraskar | Pune University |
| 21. Ms. Pratibha Sharma | Jaipur University |
| 22. Ms. Manisha Giri Gowaswami | Macro Mol. Research Centre, Jabalur |
| 23. Ms. Archana Rai | DAVV, Indore |
| 24. Ms. Shivani Agarwal | Jaipur University |
| 25. Mr. S. Ghosh | CSR, Kolkata |

**Low Temperature Measurements:**

| | |
|---|---|
| 26. Mr. Ashish Khandelwal | DAVV, Indore |
| 27. Mr. Vishnu Srivastava | Bhopal University |
| 28. Prof. D.D. Sarma | IISc., Bangalore |

**Magnetism Lab:**

| | |
|---|---|
| 29. Mr. Ashish Bodhe | Bhopal University |
| 30. Dr. S. Ravi | IIT, Guwahati |
| 31. Mr. P.K. Siwach | BHU, Varanasi |

| | |
|---|---|
| 32. Ms. Archana Rai | DAVV, Indore |
| 33. Ms. Puja Dey | IIT, Kharagpur |
| 34. Prof. R.J. Singh | Aligarh Muslim University |
| 35. Mr. R.K. Sharma | M.L.S. University, Udaipur |
| 36. Dr. Dipankar Das | CSR, Kolkata |
| 37. Mr. N. Patel | M.S. University, Vadodara |
| 38. Mr. S. Kulkarni | Shivaji University, Kolhapur |
| 39. Mr. S.N. Sadakale | Pune University |
| 40. Mr. S.T. Sulepetkar | S.B.College of Science, Gulbarga |
| 41. Mr. S. Kumar | Aligarh Muslim University |

**Scanning Electron Microscopy:**

| | |
|---|---|
| 42. Mr. Harpreet Singh | IIT, Roorkey |
| 43. Mr. Atula Jadhaw | Kolhapur |
| 44. Dr. Atul Khanna | GNDU, Amritsar |
| 45. Ms. Seem Lakhanpal | Jaipur |
| 46. Dr. A.K. Gupta | Jabalpur |
| 47. Mr. Amit Saraiya | DRDO, Kanpur |
| 48. Mr. Saumen Das | Jiwaji University, Gwalior |
| 49. Mr. S.K. Jain | Sagar |
| 50. Dr. K. K. Chaturvedi | Holkar Science College, Indore |
| 51. Mr. S.B. Mishra | IIT, Roorkey |
| 52. Ms. Gita Chaurasia | Sagar |
| 53. Mr. Mahapatra | Pune University |
| 54. Ms. Radha Tomar | Jiwaji University, Gwalior |
| 55. Ms. Rachna Malvia | DAVV, Indore |
| 56. Ms. Kavita Kabra | DAVV, Indore |
| 57. Ms. Divya Khale | DAVV, Indore |
| 58. Ms. Shilpi Bhargawa | Sagar |
| 59. Ms. Urmila Waxer | Jaipur |
| 60. Ms. Shikha Agarwal | Sagar |
| 61. Ms. Suman | Kurukshetra |
| 62. Dr. S.P. Taneja | Rohtak |
| 63. Mr. Narendra Kumar | Sagar |
| 64. Mr. S.S. Kulkarni | Kolhapur |
| 65. Mr. A.M. Hussain | Tezpur, Assam |
| 66. Mr. N.L. Singh | Baroda |
| 67. Ms. R. Tamrakar | Jabalpur |
| 68. Ms. Shefali Mishra | Jabalpur |
| 69. Mr. Ramphal Sharma | North Maharashtra |
| 70. Dr. Navinchand | RRL, Bhopal |
| 71. Mr. Hazoor Singh | Longowal Institute |
| 72. Dr. P.C. Shrivastava | BHU, Varanasi |
| 73. Ms. Sudama Kokate | APS, Rewa |
| 74. Mr. M. Roy | Udaipur |

| | |
|---|---|
| 75. Ms. Savita Gupta | Jiwaji, Gwalior |
| 76. Mr. Akshay Deshpande | Nagpur |
| 77. Ms. N. Lakshmi | Udaipur |
| 78. Mr. Arvind Awadhia | APS, Rewa |

**Resistivity/Magnetoresistance:**

| | |
|---|---|
| 79. Mr. A. Sarkar | Calcutta University |
| 80. Mr. Goverdhan Reddy | Osmania University |
| 81. Dr.K.R. Priyolkar | Goa University |
| 82. Mr. Narendra Patel | MS University |
| 83. Mr. Manoj Kumar/Dr. Usha Chandra | Jaipur University |
| 84. S.N. Sadakale | Pune University |
| 85. Mr. Narendra Patel | MS University |
| 86. Dr. S.N. Kale | Fergusson College, Pune |
| 87. Mr. Radhe Shyam/ Dr. Ashok Rao | SMIT, Majitar, Sikkim |
| 88. Dr. V.P.S. Awana | NPL, Delhi |
| 89. Ms. S. Kalavathi | IGCAR, Kalpakkam |
| 90. Ms. Seetha Lakshmi | IGCAR, Kalpakkam |

**Heat Capacity:**

| | |
|---|---|
| 91. Dr. D. Pandey | BHU, Banaras |
| 92. Mr. Mukesh Dimiri | IIT, Delhi. |
| 93. Dr. I. Das | SINP, Kolkata |
| 94. Ms. S. Kalavati | IGCAR, Kalpakkam |

**ESCA**

| | |
|---|---|
| 95. Ms. Anjali Jain | DAVV, Indore |
| 96. Mr. Atul Tiwari | DAVV, Indore |
| 97. Ms. Vaishali Upadhyay | DAVV, Indore |
| 98. Prof. O.N. Shrivastava | BHU, Varanasi |
| 99. Mr. Riyadh Mohammad | Pune University |
| 100. Ms. Kavita | DAVV, Indore |
| 101. Dr. L.M. Kukreja | CAT, Indore |
| 102. Mr. Prashant Alegaonkar | Pune University |
| 103. Mr. Santosh Mahapatra | Pune University |
| 104. Mr. K.V. Adarsh | IISc., Bangalore |
| 105. Mr. Jitendra Singh | DAVV, Indore |
| 106. Ms. Chitra Gautam | DAVV, Indore |

## PES

| | |
|---|---|
| 107. Mr. Santosh Mohapatra | Pune University. |
| 108. Mr. Vishwas Purohit, | Pune University |

| | |
|---|---|
| 109. Mr. Akshay Deshpande | Nagpur University |
| 110. Dr. K.V. R. Rao | Jaipur University |
| 111. Mr.Sudama Kokate | Rewa University |
| 112. Dr. G.S. Lodha/ Dr. S.B.Roy | CAT, Indore |
| 113. Mr. M.H. Modi | CAT, Indore |
| 114. Mr. V. K. Raghuvanshi | CAT, Indore |
| 115. Mr. Ganeshan | CAT, Indore |
| 116. Mr. Lakshmikant Aditya | CAT, Indore |
| 117. Dr. S. Kumar, | CAT, Indore |
| 118. Dr. M. Banerjee | DAVV, Indore |
| 119. Dr. Shailja Mahamuni | Pune University |

**Mössbauer**

| | |
|---|---|
| 120. Dr. S. N. Kane | DAVV, Indore,M.P. |
| 121. Mr. Narendra Patel | M.S.Univ., Baroda |
| 122. Dr. Manorama | IICT, Hyderabad |
| 123. Ms. Archana Rai | DAVV, Indore, M.P. |
| 124. Dr. R. Prasad | School of Chem. Sci., DAVV, Indore |
| 125. Mr. Thomas | CUSAT, Cochin |
| 126. Ms. Sanjukta Ghosh | Calcutta University, Calcutta |
| 127. Mr.Ramkripal Sharma | MLS university, Udaipur |
| 128. Ms.Suman | KUK, Kurukshetra |
| 129. Dr. Ratnesh Gupta | Institute of Instrumentation, DAVV, Indore |
| 130. Mr. Jacob Mathew M. | S.B.College, Kerala state |
| 131. Dr. Mukul Gupta | PSI, Switzerland |
| 132. Dr. Tripathi | Jodhpur University, Jodhpur |
| 133. Dr. S. Amrith Pandian | IGCAR, Kalpakkam |
| 134. Mr. Shailendra Kumar | Aligarh Muslim Univ., Aligarh |
| 135. Mr. Mukesh C Dimri | IIT, Delhi |
| 136. Mr. Shanker Lal Nama | Jodhpur University, Jodhpur |
| 137. Ms. Manisha Chhambbar | Sourastra University, Rajkot |
| 138. Kavita Amrute | University of Mumbai, Mumbai |

**MOKE**

| | |
|---|---|
| 139 Dr. S. Amrith Pandian | IGCAR, Kalpakkam |
| 140 Dr. Mukul Gupta | PSI, Switzerland |
| 141 Mr. Narender Patel | M.S.Univ., Baroda |
| 142 Mr. Ashish | Institute of Instrumentation, DAVV |
| 143 Ms. Raisa | Institute of Instrumentation, DAVV |
| 144 Dr. Laxmi | Udaipur University |
| 145 Mr. Yujvender Kumar | IIT, Delhi |
| 146 Ms. Shivani | University of Rajasthan, Jaipur |
| 147 Dr. T.Som | IOP, Bhubaneswar |

| | | |
|---|---|---|
| 148 | Ms. Smrita Sengar | Bhopal Univ |
| 149 | Mr. Arif | Pondichery Univ. |

**DSC:**

| | |
|---|---|
| 150. Mr. Hrishikesh Agashe | Dr. H.S.G. Univ., Sagar |
| 151. Mr. Anand Gupta | R.D. University, Jabalpur |
| 152. Mr. S.K. Jain | Dr. H.S.G. Univ., Sagar |
| 153. Ms. Gita Chaurasia | Dr. H.S.G. Univ., Sagar |
| 154. Mr. J.P. Tiwari | IIT, Kanpur |
| 155. Mr. D.K. Mishra | BHU, Varanasi |
| 156. Mrs. M.S. Oak | CAT, Indore |
| 157. Ms. R.K. Nagareh | Dr. H.S.G. Univ., Sagar |
| 158. Mrs. Priya Budhani | S.V.P.G.College, Bhopal |
| 159. Mr. M. Dimri | IIT, Delhi |
| 160. Mr. A. Shukla | DAVV, Indore |
| 161. Mr. Felix Regin | IIT, Roorkee |
| 162. Dr. P.K. Datta | M.N.N.Institute of Tech., Allahabad |
| 163. Dr. R. Prasad | DAVV, Indore |

**XRD**

| | |
|---|---|
| 164. Dr. P.S. Patil | Shivaji University |
| 165. Dr. R. Bajpai | Jabalpur University |
| 166. Ms. Rachna Malvia | DAVV, Indore |
| 167. Ms. Shilipi Bhargawa | Dr. H.S.G. Univ., Sagar |
| 168. Dr. R.P. Sarma | GTPC, Nandrbara |
| 169. Mr. Vijay Shukla | CAT, Indore |
| 170. Ms. Urmila Waxar | Rajasthan University |
| 171. Mr. Navendra P. Patel | M.S.University, Baroda |
| 172. Mr. Arvind Awadhiya | APS Univ., Rewa |
| 173. Dr. R. Prasad | DAVV, Indore |
| 174. Mr. Ramkumar | Sagar |
| 175. Mr. Nagendra Kumar | Sagar |
| 176. Mr. S. Kokate | APS Univ., Rewa |
| 177. Mr. Abu | Tezpur University |
| 178. Ms. Archna Rai | DAVV, Indore |
| 179. Ms. P. Pandit | CAT, Indore |
| 180. Prof. V.N. Bhoraskar | Pune University |

## *12.2 Kolkata Centre*

**Mossbauer Set up**

181.Prof. B.K.Ghosh, Physics Deptt Allahabad University

182. Dr. A.Sen, Central Gas and Ceramics Research Institute, Kolkata
183. Dr. K.Momon Singh, Physics Deptt, Manipur University
184. Dr. P.K.Chakraborty, Deptt of Physics, Asuthosh College, University of Calcutta
185. Dr. S Kumar, Deptt of Physics, Jadavpur University
186. Dr. A Mitra, N.M.L, Jamshedpur
187. Dr. A Nag, Deptt of Physics, BKC College, Kolkata
188. Dr. D Bandopadhyay, Deptt of Physics, BITS Pilani
189. Dr. P.K.Nayak, Deptt of Chemistry, A.K.College of Engineering, Tamilnadu
190. Dr. A Basumullick, Bengal Engineering & Science University Shibpur
191. Dr. J Ghosh, Deptt of Chemistry IIT Kharagpur
192. Dr. P.K.Dutta, Deptt of Chemistry, Motilal Nehru National Institute of Technology, Allahabad
193. Dr. A De, Deptt of Physics, Presidency College, Kolkata
194. Prof. P Pramanik, Deptt of Chemistry, IIT Kharagpur
195. Dr. M Pal, Deptt of Physics, University of Burdwan
196. Dr. T Kundu, Deptt of Physics, Viswabharati
197. Dr. S De, IACS, Kolkata
198. Prof. A.C Dash, Deptt of Physics, Utkal University
199. Dr. A Basumullick, Deptt of Metallurgy, Bengal Engineering & Science University Shibpur

**PAS set up**

200. Prof. A Sengupta, Deptt of Physics, Vishwabharati
201. Dr. U De, VECC, Kolkata
202. Prof. S Tarafdar, Deptt of Physics, Jadavpur University
203. Prof. R Prasad, Aligarh Muslim University
204. Prof. V.N.Bhorasker, University of Pune, Pune & IUC-DAEF, Indore
205. Dr. A Basumullick, Deptt of Metallurgy, Bengal Engineering & Science University Shibpur
206. Dr. J Dutta Majumdar, Deptt of Metallurgical Engineering, IIT Kharagpur
**207.** Dr. P K Mukhopadhyay, SNBNCBS, Kolkata

**Gel Electrophoresis, BOD Incubator, Autoclave, Laminar Flow**

208. Prof. S.Chanda, CSME, Kolkata
209. Prof. S.Santra, Kalyani University

**Ultra Freezer (-85$^0$), Freezer(-20$^0$)**

210. Dr.(Mrs.) M.Baruah, Dept. of Physics Govt. Ayurvedic College Gauhati University, Guwahati

211. Dr. A Bhattacharya, Deptt of Zoology, University of Calcutta

**Fluorescence Microscope**

212. Dr. (Ms)M.Bhattacharya, Deptt of Bio. Chemistry, University of Calcutta

213. Dr. P Karmarkar, Deptt of Bio-Technology, Jadavpur University

214. Prof. A Gomes, Deptt of Physiology, University of Calcutta

215. Prof. S Banerjee, Deptt of Zoology, University of Calcutta

**Laminar Flow**

216. Dr.(Ms) S.Roychoudhury, Deptt of Bio. Physics and Molecular Biology, University of Calcutta

217. Dr. P Karmarkar, Deptt of Bio-Technology, Jadavpur University

218. Prof. A K DuttaGupta, Deptt of Zoology, University of Calcutta

219. Prof. B Ghosh, School of Energy Studies, Jadavpur University

**Freeze drier, Table top pelletizer, Millipore vacuum filtration unit, Mettler Balance**

220. Dr. B.Chatterjee, College of Leather Technology, Kolkata

221. Dr. S.K.Mukherjee, Maulana Azad College, Kolkata

222. Dr.(Mrs.) M.Baruah, Dept. of Physics Govt. Ayurvedic College Gauhati University

223. Prof. H M Agarwal, Dept of Physics, G B Pant University of Agri. & Tech.

224. Dr. P.K.Chakraborty, Ashutosh College, Kolkata

225. Prof. A R Thakur, West Bengal University of Technology, Kolkata

**226.** Prof. A K Dutta, Deptt of Zoology, University of Calcutta

**UV-VIS Spectrophotometer**

227. Dr.(Mrs.) M.Baruah, Deptt. of Physics Govt. Ayurvedic College Gauhati University

228. Prof. K.Goswami, Deptt of Physics, Jadavpur University

229. Prof. S.Chatterjee, Deptt of Chemistry, Calcutta University

230. Prof. B Ghosh, School of Energy Studies, Jadavpur University

231. Dr. S.K.Das, Variable Energy Cyclotron Centre, Kolkata

232. Prof. M Muneer, Deptt of Chemistry, A MU, Aligarh

233. Dr. S.C.Santra, Dept of Environmental Science, Kalyani University

234.Prof. Rajendra Prasad, Aligarh Muslim University

**Luminiscence Spectrometer**

235.Prof. R.G.Bhattacharya , Department of Chemistry, Jadavpur University

236.Dr. S.Chatterjee, Calcutta University

**237.**Dr. K.K.Mukherjee, Department of Chemistry, Jadavpur University

238.Dr. A.Datta, Surafce Physics Division, SINP, Kolkata

239.Dr. S.K.Das, Variable Energy Cyclotron Centre, Kolkata

240.Dr. B Hazra, Pharmacy Deptt, Jadavpur University

241.Dr .S De, Deptt of Chemistry, University of Calcutta

242.Prof. B Ghosh, School of Energy Studies, Jadavpur University

**HPLC**

243.Dr. K.K.Mukherjee, Deptt of Chemistry, Jadavpur University

244.Prof. M Muneer, Deptt of Chemistry, AMU, Aligarh

**Energy Dispersive X-Ray Fluorescence Facility for elemental Analysis (EDXRF)**

245.Prof. H M Agarwal, Dept of Physics, G B Pant University of Agri. & Tech.

246.Dr. G C Joshi, College of basic Science and Humanity, G B Pant University of Agri. & Tech.

247.Prof. A R Thakur, West Bengal University of Technology, Kolkata

248.Prof. S B Choudhury, School of Laser Science & Energy, Jadavpur University

249.Prof. A K Dutta, Deptt of Zoology, University of Calcutta

**INGA Users**

250.Prof. S N Roy, Deptt of Physics, Viswabharati

251.Prof. I M Govil, Deptt of Physics, Panjab University

252.Prof. L Chaturvedi, Deptt of Physics, BHU, Varanasi

253.Prof. S B Patel, Deptt of Physics, University of Mumbai

254.Dr. S Mukherjee, Deptt of Physics, M S University of Baroda

255.Dr .S Sarkar, Deptt of Physics, University of Burdwan

256.Dr. Gautam Gangopadhyay, Deptt of Physics, University of Calcutta

257.Mr B K Yogi, Government College, Kota

## *12.3 Mumbai Centre*

**DLS**

| | |
|---|---|
| 258. Prof. P. Bahadur | V.N.S.G. University, Surat |
| 259. Prof. Kabir-ud-Din | Aligarh Muslim University, UP |

**XRD**

| | |
|---|---|
| 260. Dr. D. M. Phase | UGC-DAE CSR, Indore |
| 261. Prof. D. C. Kothari | Univ. of Mumbai, Mumbai |
| 262. Dr. S. V. Narasimhan | IGCAR, Kalpakkam |
| 263. Dr. Mrs. V. Borker | Dhempe College of Arts & Sciene, Goa |
| 264. Dr. Mrs. S. Sen | TPPED, BARC, Mumbai |

**Dielectric Setup:**

| | |
|---|---|
| 265. Mr. V. K. Shrikhande | TPPED, BARC, Mumbai |
| 266. Dr. Mrs. S. Sen | TPPED, BARC, Mumbai |

**Rheometer:**

| | |
|---|---|
| 267. Dr. (Smt) R. Banerjee | IIT, Mumbai |
| 268. Dr. R. V. Upadhyay | Bhavnagar University |
| 269. Prof. V. G. Gaikar | UICT, Mumbai |

# 13. GENERAL INFORMATION ON THE STAFF OF UGC-DAE CSR:

## a. Indore Centre

**A: The number of posts till 2004-2005 approved by UGC**

**B: Existing manpower as on 31.03.2005.**

| Sl. No. | Designation | A | B |
|---|---|---|---|
| 01 | Director of the Consortium | 1 | 1 |
| 02 | Centre-Director | 1 | 1 |
| 03 | Scientist | 15 | 11 |
| 04 | Engineers | 4 | 4 |
| 05 | Junior Engineers / Scientific Assistant | 19 | 14 |
| 06 | Administrative Officer-II | 1 | 1 |
| 07 | Administrative Officer – I | 1 | 1 |
| 08 | Administrative Officer – Accounts | 1 | 0 |
| 09 | Administrative officer – Stores | 1 | 1 |
| 10 | PS to Director | 1 | 1 |
| 11 | PS to Centre-Director | 1 | 1 |
| 12 | Assistant | 3 | 3 |
| 13 | Typist/Clerk/Steno-Typist/Steno-Clerk | 4 | 3 |
| 14 | Library Assistant | 1 | 1 |
| 15 | Driver/Driver-cum-Aux.Staff | 3 | 3 |
| 16 | Caretaker | 1 | 1 |
| 17 | Helper/Lab. Attendant/ Aux.Staff | 7 | 7 |
| 18 | Security Staff (internal) | 2 | 0 |

**b) Kolkata Centre :**

**A: The number of posts till 2004-2005 approved by UGC**

**B: Existing manpower as on 31.03.2005.**

| Sl. No. | Designation | A | B |
|---|---|---|---|
| 01 | Centre-Director | 1 | 1 |
| 02 | Scientist/Engineers | 7 | 6 |
| 03 | Junior Engineers / Scientific Assistant | 14 | 13 |
| 04 | Tradesman | 1 | 1 |
| 05 | Lab Attendent/Auxiliary | 4 | 4 |
| 06 | Administrative Officer – I Personnel | 1 | 1 |
| 07 | Administrative Officer – Accounts | 1 | 1 |
| 08 | Administrative officer – Stores | 1 | 1 |
| 09 | PA (to Centre-Director) | 1 | 1 |
| 10 | Stenographer, Clerk/Typist | 3 | 2 |
| 11 | Library Assistant | 1 | 1 |
| 12 | Driver | 2 | 2 |
| 13 | Guest House Attendant | 1 | 1 |

**c) Mumbai Centre:**

**A: The number of posts till 2004-2005 approved by UGC**

**B: Existing manpower as on 31.03.2005.**

| Sl. No. | Designation | A | B |
|---|---|---|---|
| 01 | Centre-Director | 1 | 1 |
| 02 | Scientist-D to E | 5 | 4 |
| 03 | Engineers | 1 | 1 |
| 04 | Junior Engineers / Scientific Assistant | 5 | 5 |
| 05 | Administrative Officer-I | 2 | 2 |
| 06 | P.A. to Centre-Director | 1 | 1 |
| 07 | Steno-Typist | 1 | - |
| 08 | Driver-cum-Aux. Staff | 1 | 1 |
| 09 | Attendant-cum-Staff | 1 | 1 |

# 14. LIST OF UGC-DAE CSR SCIENTISTS/ENGINEERS, THEIR SPECIALIASTIONS AND FACIITIES.

***Professor V. N. Bhoraskar, Director (upto 28.02.2005)***

| Name, Designation | Specialization | Facility |
|---|---|---|
| **A. M. Awasthi, Scientist-E** | Random covalent network systems | Modulated differential scanning calorimeter (-150 C to 550 C), quasi adiabatic calorimeter (5K to 300K), steady-state thermal conductivity set up (5K to 300K), melt-quench furnace (up to 1200 C) |
| **Dr. P.D. Babu, Scientist-E** | Magnetism of rare-earth inter-metallics, dynamical properties (phonons and magnons), Materials synthesis, Neutron Inelastic Scattering | Neutron diffraction, triple axis spectrometer, materials lab, impedance analyzer |
| **Alok Banerjee, Scientist-F** | Electron transport and magnetic properties of materials, synchrotron radiation | Ac-susceptibility setup, vibrating sample magnetometer, dielectric measurement setup, low field magnetoresistance setup |
| **S. R. Barman, Scientist-E** | Surface electronic structure | Photoemission and low energy electron diffraction (LEED) experimental station |
| **A.Chakraborty, Scientist-D** | Radiation biology | Fluorescent microscope, ultra centrifuge, electrophoresis set up ultra freezer, $CO_2$-incubator |
| **S. M. Chaudhari, Scientist-G** | Synchrotron beamline design and UHV instrumentation, photoelectron spectroscopy, thin film and multilayer structures, surface and interface modification and studies | Beamline for photoelectron spectroscopy at INDUS-1, UHV thin film and multilayer structure deposition laboratory. |
| **D. Das, Scientist.E** | Condensed matter physics, magnetic materials, | Mössbauer spectrometer, positron annihilation spectrometer |
| **S.K. Deshpande, Scientist-E** | X-ray absorption spectroscopy, material characterization | X-ray diffractometer, impedance analyzer |
| **V. Ganesan, Scientist-G** | Low temperature physics, cryogenics and microscopy, ultra low temperature measurement system for T< 1K and also at high magnetic fields | Transport measurements using cryogen free environment ~10-300K, Scanning Probe Microscopy especially contact mode AFM |
| **G. Ghosh, Scientist-D** | Soft matter, fullerenes | Static and dynamic light scattering |
| **S. S. Ghugre, Scientist-E** | In-beam gamma ray spectroscopy, nuclear physics | Clover array, radiation detectors and associated nuclear instrumentation, computational laboratory |
| **P.S. Goyal, Centre-Director** | Soft matter, small angle neutron scattering, light scattering, rheology | Mumbai centre, rheometer, viscometer |
| **A. Gupta, Centre-Director** | Nanostructured materials including nanocrystalline soft magnetic alloys, thin films and multilayers. | Indore Centre |

| | | |
|---|---|---|
| **J.B.M.Krishna, Jr. Eng.-F** | Accelerator and ion beam transport | Low energy accelerator system laboratory |
| **N.P.Lalla, Scientist-E** | Stuctural characterisation of materials using XRD and TEM, sysnthesis, phase transformation, quasicrystals and perovskites | . Powder XRD facility (with low-temperature-90K and high-temperature-1400K attachments), RF-induction furnace for synthesis of alloys |
| **T.Mishra, Engineer D** | Mechanical engineer, heat and mass transfer simulations | Mechanical workshop, vacuum systems |
| **G. S. Okram, Scientist/Engineer - D** | Experimental mesoscopic physics - development, characterization and electronic transport of low-dimensional composites | Dc electrical resistivity and thermoelectric power set up (5-300K). |
| **D. M. Phase, Engineer-E** | Synchrotron beamline design, thin films, bilayers and multilayers, low and high energy implantation, surface and interface physics, vacuum technology | SEM-EDX |
| **A. V. Pimpale, Scientist-G** | X-ray spectroscopy, numerical simulation of X-ray and neutron instrumentation, theoretical physics | EXAFS spectrometer |
| **R. Rawat, Scientist-D** | Magneto transport and calorimetry especially in rare earth intermetallics | Resistivity / magnetoresistance set up (1.5-325 K, 0-10 Tesla), heat capacity set up (3-300 K, 0-10 Tesla) |
| **V. Raghavendra Reddy, Scientist-D** | Experimental condensed matter physics | Mössbauer Spectroscopy: transmission geometry( 12-1000 K ) and conversion electron, X-ray reflectivity, grazing incidence X-ray diffraction and magneto optical Kerr effect |
| **A. Saha, Scientist-D** | Radiation Chemistry, HPLC | Fluorimeter, gas chromatography, IR spectrometer, Radio-chemistry |
| **P. Saravanan, Engineer-D** | Electronics and communications | Liquid helium and liquid nitrogen |
| **V. G. Sathe, Scientist-D** | X-ray and neutron diffraction, EXAFS spectroscopy, synchrotron radiation and data analysis, superconductors and thin films and nano-materials | EXAFS spectrometer |
| **T. Shripathi, Scientist-F** | Crystal growth, electronic structure of surfaces, thin fillms, oxides, semiconductors, nanostructured materials | Electron spectroscopy for chemical analysis (ESCA) and computer centre. |
| **A. K. Sinha, Centre-Director** | Experimental nuclear and accelerator physics | Kolkata centre |
| **V. Siruguri, Scientist-E** | Structure and magnetism of strongly correlated electron systems, disordered systems; neutron and high pressure X-ray diffraction | Neutron powder diffractometer, ac susceptometer |
| **M. Sudarshan, Scientist-D** | Trace elemental studies, proton induced X-ray emission | Energy dispersive X-ray fluorescence spectrometer, atomic absorption spectrometer, |

| | | |
|---|---|---|
| | | target preparation facilities - freeze drier, vacuum coating system, pelletiser |
| **S. S. Thakur, Engineer-D** | Civil engineer | |

## 15. LIST OF UGC-DAE CSR STAFF:

| Sl.No. | Cat. | Name | Designation |
|---|---|---|---|
| 1 | 1 | Prof. V.N. Bhoraskar | Director (upto 28.02.2005) |
| 2 | 2-I | Prof. Ajay Gupta | Centre-Director |
| 3 | 2-M | Dr. P.S. Goyal | Centre-Director |
| 4 | 2-K | Dr. A.K. Sinha | Centre-Director |
| 5 | 3-I | Dr. A.V. Pimpale | Scientist – G |
| 6 | 3-I | Dr. S.M. Chaudhari | Scientist – G |
| 7 | 3-I | Dr. V. Ganesan | Scientist – G |
| 8 | 3-I | Dr. T. Shripathi | Scientist – F |
| 9 | 3-I | Dr. Alok Banerjee | Scientist – F |
| 10 | 3-I | Dr. A.M. Awasthi | Scientist – E |
| 11 | 3-I | Dr. N.P. Lalla | Scientist – E |
| 12 | 3-I | Dr. S.R. Barman | Scientist – E |
| 13 | 3-K | Dr. Dipankar Das | Scientist –E |
| 14 | 3-K | Dr. S. Sitaram Ghughre | Scientist – E |
| 15 | 3-M | Dr. Vasudeva Siruguri | Scientist – E |
| 16 | 3-M | Dr. P.D. Babu | Scientist – E |
| 17 | 3-K | Dr. Abhijit Saha | Scientist –E |
| 18 | 3-M | Dr. S.K. Deshpande | Scientist – E |
| 19 | 4-I | Dr. D.M. Phase | Engineer – E |
| 20 | 3-I | Dr. Vasant Sathe | Scientist – D |
| 21 | 3-I | Dr. G.S. Okram | Scientist – D |
| 22 | 3-I | Dr. Rajeev Rawat | Scientist – D |
| 23 | 3-I | Dr. V.R. Reddy | Scientist - D |
| 24 | 3-K | Dr. M. Sudarshan | Scientist – D |
| 25 | 3-K | Dr. (Ms.) A. Chakraborty | Scientist – D |
| 26 | 3-M | Dr. Gautam Ghosh | Scientist – D |
| 27 | 4-I | P. Saravanan | Engineer – D |
| 28 | 4-K | Tapas Kumar Mishra | Engineer – D |
| 29 | 4-I | Sanjay Singh Thakur | Engineer – D |
| 30 | 4-M | Shiv Sharma | Engineer –C |
| 31 | 5-K | J.B.M. Krishna | SA-F/JE-F |
| 32 | 5-I | Suresh Bhardwaj | SA-E/JE-E |
| 33 | 5-M | J.V. Joshi | JE-D |
| 34 | 5-I | Uday P. Deshpande | JE-D |
| 35 | 5-I | S.C.Das | SA-D/JE-D |

| | | | |
|---|---|---|---|
| 36 | 5-I | Nandkishore L. Ghodke | SA-D/JE-D |
| 37 | 5-I | Avinash Wadikar | SA-D/JE-D |
| 38 | 5-I | Satish R. Potdar | SA-D/JE-D |
| 39 | 5-I | Bhushan Jain | SA-D/JE-D |
| 40 | 5-M | B.R. Mendole | SA-D |
| 41 | 5-K | P.V. Rajesh | SA-D/JE-D |
| 42 | 5-K | Pinaki Das | SA-D/JE-D |
| 43 | 5-M | M.K. Verma | SA-D/JE-D |
| 44 | 5-I | N. Vijayakumar | JE-D |
| 45 | 5-K | Ms. Aparna Basu | SA-D |
| 46 | 5-K | S. Selvaraj | SA-D |
| 47 | 5-I | Kranti Kumar Sharma | JE-C |
| 48 | 5-I | Vinay K. Ahire | JE-C |
| 49 | 5-K | Banni Choudhury | JE-C |
| 50 | 5-M | Mohd. Imran | JE-C |
| 51 | 5-M | Munshi Venugopal | JE-C |
| 52 | 5-K | Kaushik Basu | SA-B |
| 53 | 5-I | Mohan Kumar Gangrade | SA-B |
| 54 | 5-K | Mukesh Kumar | SA-B |
| 55 | 5-K | A.K. Rathore | SA-B |
| 56 | 5-K | Ms. M. Saha | Technician – G |
| 57 | 5-I | B.P. Joshi | Technician – F |
| 58 | 5-I | Nitin Patil | Technician – F |
| 59 | 5-I | Sanjay Srivastava | Technician – E |
| 60 | 5-K | K. Dey | Technician – F |
| 61 | 5-K | D.H. Raju | Technician – E |
| 62 | 5-K | Prabir Kumar Das | Technician – E |
| 63 | 6-I | M.C. Gupta | Administrative Officer –II |
| 64 | 7-I | C.M. Baphana | Administrative Officer –I ( Stores) |
| 65 | 7-K | M. K. Chakraborty | Administrative Officer –I (Personnel) |
| 66 | 7-K | R.P. Chattopadhyay | Administrative Officer-I (Accounts) |
| 67 | 7-K | Sanjay Kumar Sinha | Administrative Officer-I (Pur. & Stores) |
| 68 | 7-M | S.S. Narayanan | Administrative Officer –I |
| 69 | 7-I | Debasis Gupta | Administrative Officer –I |
| 70 | 7-M | Ramakant Kar | Administrative Officer –I |
| 71 | 8-I | Arjun R. Sanap | PS (to Director) |
| 72 | 9-I | J. Viswanadha Sarma | PA (to Centre-Director) |
| 73 | 9-M | Phanindra Kumar | PA (to Centre-Director) |
| 74 | 9-K | A.K. Sen | PA (to Centre-Director) |
| 75 | 10-I | Mrs. Rugma Menon | Steno-Typist |
| 76 | 10-K | Ms. Mahua Kar (Ghosh) | Library Assistant |
| 77 | 10-I | Utpal Sarkar | Assistant |
| 78 | 10-I | Rajeev Bhagwat | Assistant |
| 79 | 10-I | Ramesh Babu | Assistant |
| 80 | 10-I | Mrs. Madhulika | Library Assistant |

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|---|---|---|---|
| 81 | 10-I | Mrs. Radhika Tare | Clerk-cum-Typist |
| 82 | 10-I | C.L. Dwivedi | Clerk-cum-Typist |
| 83 | 10-I | S.C. Chaudhary | Clerk-cum-Typist |
| 84 | 10-K | T.K. Gngopadhyay | Clerk-cum-Typist |
| 85 | 10-K | Bireswar Pradhan | Guest House Attendent |
| 86 | 10-I | Ambrose Joseph | Caretaker |
| 87 | 11-I | Arun Yadav | Driver |
| 88 | 11-K | Joyanta Dhar | Driver |
| 89 | 11-K | Khokam Mitra | Driver |
| 90 | 11-I | Dilip Kaushal | Driver-cum-Aux. Staff |
| 91 | 11-M | Vinod C. Pagare | Driver-cum-Aux. Staff |
| 92 | 11-I | Anil Rao Jadhav | Driver-cum-Aux. Staff |
| 93 | 12-I | T.B. Thapa | Helper |
| 94 | 12-I | Anil Shrivastava | Lab Attendent |
| 95 | 12-I | Iqbal Hussain | Lab Attendent |
| 96 | 12-I | Ram Chandra Baniya | Lab Attendent |
| 97 | 12-K | Kapil Nayak | Lab Attendent |
| 98 | 12-K | N.K. Reddy | Lab Attendent |
| 99 | 12-K | Ram Chandra Maity | Lab Attendent |
| 100 | 12-I | Deepak Yadav | Aux-Staff |
| 101 | 12-I | Rakesh Kumar | Attendent/Aux-Staff I |
| 102 | 12-I | Ravindra Bhimgade | Attendent/Aux-Staff I |
| 103 | 12-K | Prafulla Chandra Das | Aux. Staff |
| 104 | 12-M | Nitin J. Patil | Attendent/Aux.Staff |

# Governing Council

(As on 31st March, 2005)

| | | |
|---|---|---|
| 1. | Dr. Arun Nigavekar<br>Chairperson, University Grants Commission,<br>New Delhi 110 002 | President |
| | EX-OFFICIO | |
| 2 | Prof. S.S. Jha,<br>Chairman, UGC-DAE CSR Governing Board<br>Department of Physics,<br>IIT, Powai, Mumbai – 400 076. | Member |
| 3 | Prof. V.N. Rajasekharan Pillai,<br>Vice-Chairman,<br>University Grants Commission,<br>New Delhi – 110 002. | Member |
| 4 | Dr. A. Kakodkar,<br>Secretary,<br>Department of Atomic Energy,<br>or his/her nominee<br>"Anushakti Bhavan"<br>Chhatrapati Shivaji Maharaj Marg,<br>Mumbai – 400 039. | Member |
| 5 | Prof. Ved Prakash,<br>Secretary,<br>University Grants Commission,<br>New Delhi – 110 002. | Member |
| 6 | Prof. V.S. Rammurthy,<br>Secretary,<br>Department of Science & Technology,<br>or his/her nominee<br>Government of India,<br>NEW DELHI 110 016 | Member |
| 7. | Dr. R.A. Mashelkar,<br>Director General,<br>Council for Scientific & Industrial Research,<br>or his/her nominee<br>Anusandhan Bhawan,<br>NEW DELHI 110 001 | Member |

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|---|---|---|
| 8. | The Director General,<br>Indian Council for Medical Research,<br>or his/her nominee<br>NEW DELHI 110 029 | Member |
| 9. | Director General,<br>Indian Council for Agricultural Research,<br>or his/her nominee<br>NEW DELHI 110 001. | Member |
| 10. | Shri C.S. Chadha,<br>Vice-Chancellor,<br>Devi Ahilya University,<br>Indore – 452 001. | Member |
| 11 | Dr. S. Banerjee,<br>Director,<br>Bhabha Atomic Research Centre<br>Trombay,<br>Mumbai – 400 085. | Member |
| 12. | Dr. V.C. Sahni,<br>Director,<br>Centre for Advanced Technology,<br>Indore – 452 013. | Member |
| 13. | Prof. Bikash Sinha,<br>Director,<br>Variable Energy Cyclotron Centre,<br>Sector-I, Block AF, Bidhan Nagar,<br>Kolkata – 700 064. | Member |
| 14. | Joint Secretary (Technical Education)<br>Dept. of Secondary & Higher Education,<br>Ministry of Human Resource Development,<br>'C' Wing, Shastri Bhawan,<br>New Delhi – 110 001. | Member |
| 15. | Prof. O.N. Srivastava,<br>Chairman,<br>Scientific Advisory Committee,<br>UGC-DAE CSR,<br>BHU, Varanasi – 221 005. | Member |

16. Prof. V.N. Bhoraskar, — Member-Secretary
Director,
UGC-DAE Consortium for Scientific Research,
University Campus, Khandwa Road,
INDORE – 452 017.
(upto 28.02.2005.)

NOMINATED:
**(Two eminent scientists nominated by UGC)**

17.. Prof. C. Mande, — Member
Professor – Emeritus,
S/29, Bharat Nagar,
Nagpur – 440 033
(From 14.01.05)

18. Prof. B.S.M. Rao, — Member
Department of Chemistry,
University of Pune,
Ganeshkhind,
Pune – 411 007
(from 14.01.2005)

Nominated Members:
**(Member of UGC nominated by Chairperson, UGC)**

19 Prof. S.K. Joshi, — Member
NPL, New Delhi

**(Two Vice-chancellors of Universities/Directors of Institute of higher learning and research nominated by President of the Council)**

20. Prof. P. Ramachandra Rao, — Member
Vice-Chancellor,
Banaras Hindu University,
Varanasi – 221 005.

21. Prof. A.N. Basu, — Member
Vice-Chancellor,
Jadavpur University,
Kolkata

**(One Director of an I.I.T. nominated by President of the Council)**

22 Prof. A. Misra, Member
Director,
Indian Institute of Technology, Bombay,
Powai, Mumbai – 400 076.

**(Two eminent Scientists from Physical Science nominated by President of the Council)**

23 Prof. Amit Roy, Member
Director, Inter-University Accelerator Centre,
Aruna Asaf Ali Marg,
New Delhi – 110 007.
(from 14.01.05)

24. Dr. L.M. Manocha, Member
Professor & Head,
Department of Materials Science,
Sardar Patel University,
Vallabh Vidyanagar – 388 120
(from 14.01.05)

**(One Agricultural Scientist nominated by President of the Council)**

25. Vacant Member

**(One Medical Scientist nominated by President of the Council)**

27. Prof. D. Balasubramanian, Member
Director of Research,
L.V.Prasad Eye Institute,
L.V.Prasad Marg, Banjara Hills,
Hyderabad – 500 034
(from 14.1.05)

**(Scientist nominated by MHRD, GOI)**

28. Prof. G.K. Mehta, Member
Vice-Chancellor,
Allahabad University,
Allahabad.

## Governing Board

(As on 31st March, 2005)

1. Prof. S.S. Jha, Chairman
Chairman, IUC-DAEF Governing Board

Ex-Officio Members:

2 Dr. A. Kakodkar, Member
Secretary,
Department of Atomic Energy,
or his/her nominee
"Anushakti Bhavan"
Chhatrapati Shivaji Maharaj Marg,
Mumbai – 400 039.

3 Prof. Ved Prakash, Member
Secretary,
University Grants Commission,
New Delhi – 110 002.

4. Shri C.S. Chadha, Member
Vice-Chancellor,
Devi Ahilya University,
Indore – 452 001.

5. Dr. S. Banerjee, Member
Director,
Bhabha Atomic Research Centre, Trombay,
Mumbai – 400 085.

6. Dr. V.C. Sahni, Member
Director,
Centre for Advanced Technology,
Indore – 452 013.

7. Prof. Bikash Sinha, Member

Director,
Variable Energy Cyclotron Centre,
Sector-I, Block AF, Bidhan Nagar,
Kolkata – 700 064.

8. Joint Secretary (Technical Education) — Member
Dept. of Secondary & Higher Education,
Ministry of Human Resource Development,
'C' Wing, Shastri Bhawan, New Delhi – 110 001.

9. Prof. O.N. Srivastava, — Member
Chairman,
Scientific Advisory Committee,
UGC-DAE CSR,
BHU, Varanasi – 221 005.

10 Prof. V.N. Bhoraskar, — Member-Secretary
Director,
UGC-DAE Consortium for Scientific Research,
University Campus, Khandwa Road,
INDORE – 452 017.
(upto 28.02.2005.)

Nominated Members:
**(Member of UGC nominated by Chairperson, UGC)**

11 Prof. S.K. Joshi, — Member
NPL, New Delhi

**(Two Vice-chancellors of Universities/Directors of Institute of higher learning and research nominated by President of the Council)**

12. Prof. P. Ramachandra Rao, — Member
Vice-Chancellor,
Banaras Hindu University,
Varanasi – 221 005.

13. Prof. A.N. Basu, — Member
Vice-Chancellor,
Jadavpur University,
Kolkata

**(One Director of an I.I.T. nominated by President of the Council)**

| | | |
|---|---|---|
| 14 | Prof. A. Misra,<br>Director,<br>Indian Institute of Technology, Bombay,<br>Powai, Mumbai – 400 076. | Member |
| | **(Two eminent Scientists from Physical Science nominated by President of the Council)** | |
| 15 | Prof. Amit Roy,<br>Director, Inter-University Accelerator Centre,<br>Aruna Asaf Ali Marg,<br>New Delhi – 110 007.<br>(from 14.01.05) | Member |
| 16. | Dr. L.M. Manocha,<br>Professor & Head,<br>Department of Materials Science,<br>Sardar Patel University,<br>Vallabh Vidyanagar – 388 120<br>(from 14.01.05) | Member |
| | **(One Agricultural Scientist nominated by President of the Council)** | |
| 17. | Vacant | Member |
| | **(One Medical Scientist nominated by President of the Council)** | |
| 18. | Prof. D. Balasubramanian,<br>Director of Research,<br>L.V.Prasad Eye Institute,<br>L.V.Prasad Marg, Banjara Hills,<br>Hyderabad – 500 034<br>(from 14.1.05) | Member |
| | **(Scientist nominated by MHRD, GOI)** | |
| 19. | Prof. G.K. Mehta,<br>Vice-Chancellor,<br>Allahabad University,<br>Allahabad. | Member |

# Finance Committee

(As on 31st March, 2005)

| | | |
|---|---|---|
| 1 | Prof. S.S. Jha,<br>Chairman, Governing Board, IUC-DAEF. | Chairman |
| | EX-OFFICIO | |
| 2. | Prof. Ved Prakash,<br>Secretary,<br>University Grants Commission,<br>New Delhi – 110 002. | Member |
| 3. | Shri Pawan Agrawal, IAS,<br>Financial Advisor,<br>University Grants Commision,<br>New Delhi – 110 002. | Member |
| 4. | Bureau Head,<br>Plan Budget Section,,<br>University Grants Commission,<br>New Delhi – 110 002. | Member |
| 5. | Prof. V.N. Bhoraskar,<br>Director,<br>IUC-DAEF, Indore.<br>(upto 28.02.2005) | Member - Secretary |
| 6. | Prof. Ajay Gupta<br>Centre-Director,<br>UGC-DAE CSR, Indore Centre,<br>Indore – 452 017. | Member |
| 7. | Dr. P.S. Goyal,<br>Centre-Director,<br>UGC-DAE CSR, Mumbai Centre,<br>Mumbai – 400 085. | Member |
| 8. | Dr. A.K. Sinha<br>Centre-Director,<br>UGC-DAE CSR, Calcutta Centre,<br>Kolkata | Member |

NOMINATED:
**(Member of GB, IUC-DAEF)**

| | | |
|---|---|---|
| 9. | Shri C.S. Chadha,<br>Vice-Chancellor,<br>Devi Ahilya Vishwavidyalaya,<br>Indore. | Member |

**(External Member nominated by UGC)**

| | | |
|---|---|---|
| 10. | Shri Ravi Katpalia,<br>(Former Controller of General of Accounts)<br>C.A.G. Government of India,<br>D-935, New Friends Colony,<br>New Delhi.<br>(upto September, 04) | Member |
| | Vacant<br>(from October, 04) | |

**(Nominated by Director, UGC-DAE CSR)**

| | | |
|---|---|---|
| 12. | Shri M.C. Gupta,<br>Administrative Officer,<br>UGC-DAE CSR, Indore. | Non-Member Secretary |

## Scientific Advisory Committee

(As on 31st March, 2005)

| | | |
|---|---|---|
| 1. | Prof. O.N. Srivastava,<br>Banaras Hindu University,<br>Varanasi. | Chairman |

**EX-OFFICIO**

| | | |
|---|---|---|
| 2 | Dr. S. Banerjee,<br>Director,<br>Bhabha Atomic Research Centre,<br>Trombay, MUMBAI – 400 085 | Member |
| 3 | Dr. Bikash Sinha,<br>Director,<br>Variable Energy Cyclotron Centre, | Member |

| | | |
|---|---|---|
| | Sector-I, Block-AF, Bidhan Nagar,<br>Calcutta – 760 064 | |
| 4 | Dr. V.C. Sahni,<br>Director,<br>Centre for Advanced Technology,<br>P.O. CAT, INDORE – 452 013 | Member |
| 5 | Dr. A. K. Sinha,<br>Centre-Director,<br>UGC-DAE CSR-Kolkata Centre,<br>Kolkata. | Member |
| 6. | Prof. Ajay Gupta,<br>Centre-Director,<br>UGC-DAE CSR-Indore Centre,<br>INDORE | Member |
| 7. | Dr. P.S. Goyal,<br>Centre-Director,<br>UGC-DAE CSR-Mumbai Centre,<br>MUMBAI. | Member |
| 8. | Prof. V.N. Bhoraskar,<br>Director,<br>UGC-DAE CSR, Univ. Campus<br>Khandwa Road, INDORE – 452 017.<br>(upto 28.02.05). | Member - Secretary |
| | **NOMINATED** | |
| 9 | Prof. S.B. Patel,<br>Dept. of Physics,<br>Mumbai University, Mumbai. | Member |
| 10 | Prof. B.K. Sharma,<br>Department of Physics,<br>Rajasthan University,<br>Jaipur. | Member |

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| 11 | Prof. D.D. Sarma,<br>Solid State & Structural Chemistry Unit,<br>Indian Institute of Science,<br>Bangalore | Member |
| 12 | Prof. S.S. Major,<br>Head, Department of Physics,<br>IIT, Powai, Mumbai. | Member |
| 13 | Dr. S. Bhattacharya,<br>SINP, Kolkata | Member |
| 14 | Dr. M. Ramanadham,<br>Head, SSPD,<br>Bhabha Atomic Research Centre,<br>Mumbai. | Member |