

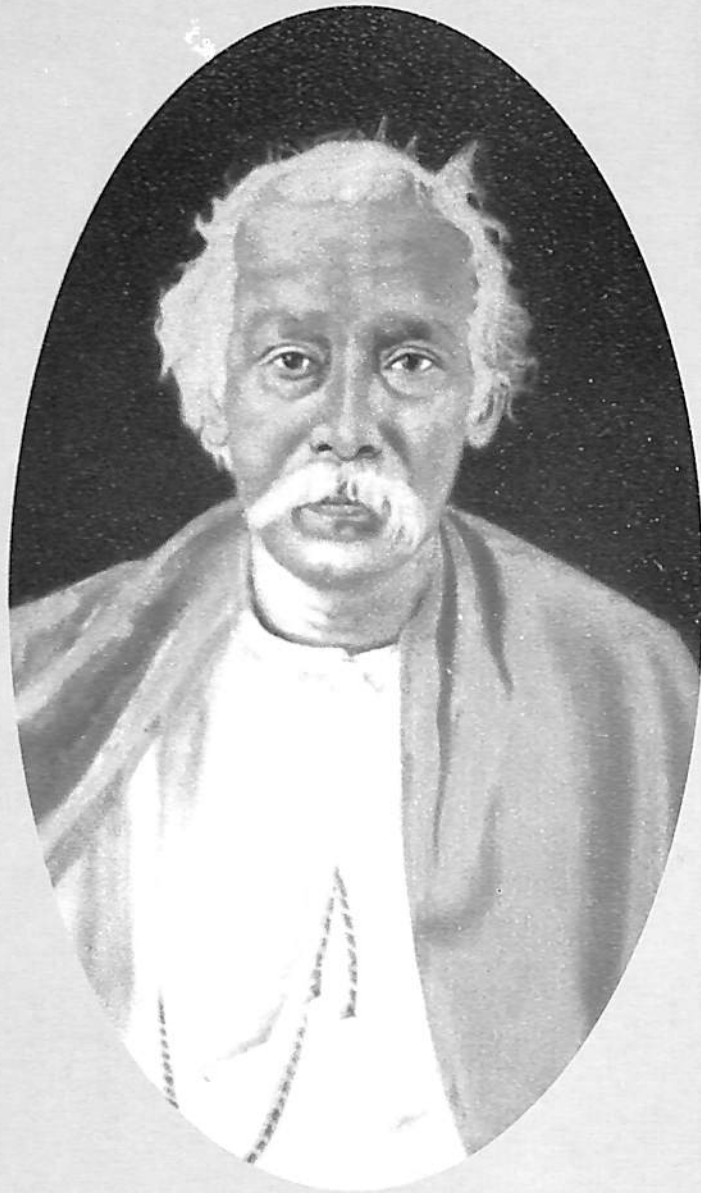


A N N U A L R E P O R T 2 0 0 0 - 2 0 0 1

- BIOLOGICAL CHEMISTRY
- ENERGY RESEARCH UNIT
- INORGANIC CHEMISTRY
- MATERIALS SCIENCE
- MLS PROFESSOR'S UNIT
- ORGANIC CHEMISTRY
- POLYMER SCIENCE UNIT
- PHYSICAL CHEMISTRY
- SOLID STATE PHYSICS
- SPECTROSCOPY
- THEORETICAL PHYSICS



INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE



*"The object of the Association is to enable
the Natives of India to cultivate Science in all its
departments with a view to its advancement by
original research and with a view to its varied
application to the arts and comforts of life."*

Dr. Mahendra Lal Sircar

A N N U A L

R E P O R T

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INDIAN ASSOCIATION FOR
THE CULTIVATION OF SCIENCE

JADAVPUR, CALCUTTA - 700032
(ESTABLISHED IN 1876)

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PART A

We have highlighted in this report the research activity and significant achievements of our institute during the academic year 2000-2001. Despite a severe fund crunch which threatens to thwart our activity, our faculty, student and staff together have continued to produce quality fundamental research in Chemical and Physical Sciences, along with works of technological potentiality. Our faculty members have also received national awards and critical acclaims for their achievements, and have been invited to deliver plenary and invited lectures in prestigious international meetings.

During the year, 236 papers have been published in reputed international and national journals and 25 scholars obtained their Ph.D. degrees.

The institute celebrated the Birth centenary of Professor K Banerjee on 15.07.2000. An international symposium honouring his memory was held between 15th and 16th September, 2000 in which many leading scientists from India and abroad participated and gave lectures. A high-point of the meeting was instituting an endowment award lecture in his name. The first of this lecture was given by Professor J R Helliwell of the University of Manchester on 15.09.2000. A plaque of Professor K Banerjee was also installed on this occasion. The institute observed the National Science Day on February 29, 2000 with a series of popular lectures for the school-going students. It also observed the National Technology Day on May 11, 2000.

Six endowment lectures were delivered by eminent scientists during the year. These were: Professor M N Saha Memorial Lecture (for 2000) by Prof R Rajaraman, MLS Award Lecture (for 1998) by Dr. R A Mashelkar, MLS Award Lecture (for 1999) by Prof Ashoke Sen, Victoria Professorship Lecture (for 2001) by Prof O Kajimoto, Dr. Ajit Memorial Lecture (for 2001) by Prof J K Chandrasekhar, Coochbehar Professorship Lecture (for 2001) by Prof Henry F Schaefer III.

My sincere thanks are due to all colleagues of the institute, in particular to the members of the Editorial Committee, Mr. N C Das Roy, Mr. G S Mukherjee, Mr. G Chatterjee and Dr. Swapan Deoghuria for their continued help and support in bringing out this report.

D Mukherjee
Director

IACS PROFILE

1876 was a landmark year in the Annals of Asian Science. In this year was founded a unique institution in Bengal which, barely about a decade after the Calcutta University started functioning, envisioned initiating teaching and research programs in Science. The Indian Association for the Cultivation of Science (IACS) was the first institute in Asia, which embarked on such a challenging task. The main inspiration to build IACS was Dr. Mahendralal Sircar, the first MD from Calcutta. He was the first Asian, who believed that a country could prosper only by the advancement of research in Science. Dr. Sircar's dream was realized by the inauguration of IACS at 210 Bowbazar Street on Saturday, July 29, 1876.

In the early phase, the list of lectures in Science in IACS included all the intellectual luminaries of the era: Rev. Father Lafont, Jagadish Ch. Bose, Asutosh Mukherjee, Chunilal Bose and Pramatha Nath Bose. Pandit Iswar Chandra Vidyasagar and Kesab Chandra Sen were among the members of the first Trustee Board of IACS, with Dr. Sircar himself as the first Honorary Secretary. Apart from these great scholars, the stalwart public figures like Gurudas Banerjee, Rajendralal Mitra and Surendra Nath Banerjee were its patrons. Raja Peary Mohan Mukherjee was the first Indian to take the position of the President of IACS in 1912. His other distinguished successors have been Dr. Nilratan Sircar, Jnan Chandra Ghosh and Satyendra Nath Bose. IACS entered a new phase with the emergence in the scene of C V Raman in 1907. He initiated serious research in IACS as a part-time worker, while carrying out his duties in the Accountant General's office in Calcutta—under the inspiring leadership of Dr. Sircar's son Amrita Lal Sircar—the then secretary of IACS. The rest was history. The celebrated Raman effect was discovered in 1928, which culminated in Raman's receiving the Nobel Prize in Physics in 1930. IACS still to-date remains the institute of India, which has fetched a Nobel Prize in Science. Raman started a vibrant School of research, which attracted quite a few talented scientists, who furthered the progress of research along with and after the departure of Raman. K S Krishnan started the pioneering school of modern magnetism and structural physics. K Banerjee pioneered the early development of the direct method of crystallography.

IACS in the independent India continued to flourish. The modern phase of IACS was started by Meghnad Saha, the eminent Astrophysicist. In the year 1948, on 26th September, the foundation stone of a new building of IACS was inaugurated by Dr. Bidhan Chandra Roy at Jadavpur. In the year 1951, the new building became functional, and several new departments were opened.

In 1953, Meghnad Saha became the first full-time Director of IACS. The Institute reached new heights with his scientific vision, leadership and personal influence. With the untimely demise in 1956 IACS suffered a temporary setback, but under the guidance of Satyendra Nath Bose, P Ray and others it rapidly started flourishing again in full vigor. Saha's leadership provided the mood and mantra of IACS in forms of development, expansion and progress. Some noted researchers of the immediate past who brought glory and distinction in the immediate past are Drs. A Raychaudhuri, S C Sircar, B N Srivastava, A Bose, P Ray, P C Datta, N K Dutta, S R Palit, and S Basu. All of them, with their younger compatriots gave a new dimension to the milieu of research by their original scientific contributions. Samarendra Nath Sen, the first Registrar of IACS, made pioneering contributions in the study of history of Indian science. This tradition in excellence of research continues unabated to this day. National and international recognition in the form of major prizes and medals, fellowship of distinguished scientific academics, editorship of leading journals followed. IACS has the highest number of Shanti Swarup Bhatnagar (SSB) Awardees among all the academic institutions in Bengal. It also has the highest number of Fellows of the learned Academies of India and abroad among institutes of Bengal.

Professor Henry F Schaefer ▶
delivering Coochbehar
Professorship Lecture



◀ Professor Arun K Sharma
unveiling the plaque of
Professor K Banerjee

The Department of Science and Technology (Delhi) and the Government of West Bengal are the principal fund-giving agencies supporting research in IACS. It also generates funding through various research projects from several funding agencies in India and abroad, including projects supported by DST.

IACS has currently eight departments:

1. Materials Science
2. Solid State Physics
3. Spectroscopy
4. Theoretical Physics
5. Biological Chemistry
6. Inorganic Chemistry
7. Organic Chemistry
8. Physical Chemistry

There are also three active units:

- a. Energy Research
- b. MLS Professor of Physics
- c. Polymer Science

In 1976, IACS completed its hundred years when the organization published a book, "A Century" which encapsulates IACS's past and the then achievements and future possibilities. The centenary celebration was inaugurated by the Prime Minister, Smt. Indira Gandhi on July 29th, 1976 which spread over a full year.

A unique feature of IACS is a strong synergy existing between theoretical and experimental sciences. Its theoretical research is considered first rate by any standard, and its experimental groups have charted new frontiers-be it with synthesis of novel molecules, designing polymers or fabricating new materials with tantalizing possibilities. The Chemistry and Physics wings have faculty members who are the acknowledged leaders in their field. Over the past two decades, IACS has initiated research activities with a strong technological bias. Several patents have been filed, and pilot plants to study the efficacy of alternative sources of energy have been initiated. IACS has world-class activity in synthetic chemistry, biomimetic chemistry and chemistry and physics of materials - including nanomaterials, in designer polymers, in unraveling the mechanism of ultrafast chemical dynamics, drug design and in theoretical chemistry/physics.

The future of IACS depends upon the new generation who will venture into newer domains and will open new vistas. On the eve of its 125th year, at the confluence of its past and present, IACS takes a vow to carry on its tradition, with visions of a future pregnant with possibilities, and bring to fruition the undying dreams of its founder and the compatriots.

In accordance with the suggestion given by DST in its letter no. A1/001/97 dated 1.8.97 the following materials on administrative and financial set up are also furnished :

1. ADMINISTRATIVE

1. Composition and tenure of -

a. Governing Council :

Prof. M M Chakraborty (President)

(Elected by General Body of IACS from amongst its members for three years).

Secretary to the Government of India, Deptt. of Science & Technology or his nominee.

Financial Adviser to the Government of India, Deptt. of Science & Technology

Secretary to the Government of West Bengal, Deptt. of Higher Education.

Dr. V D Gupta, Eminent Scientist (Head, Department of Physics, Lucknow Univ. U.P.)

(Nominated by Government of India, Ministry of Science & Technology for one year)

Prof. K L Chopra, I I T, Kharagpur, Eminent Physicist

Dr. R P Gandhi, Centre for Biochemical Technology, Delhi, Eminent Chemist

(Both nominated by INSA for three years)

Prof. S B Deb

Prof. S P Moulik

(Both elected by the General Body of IACS from amongst its members for three years).

Prof. S P Sengupta, Professor Representative

(Nominated by the Academic Board for one year)

Dr. Arun Kumar Nandy

(Elected from amongst Readers and Lecturers for one year).

Shri Partha Pratim Roy

(Elected from amongst Research Fellows and Associates for one year)

Shri Adhir Nath Ghatak

(Elected from amongst Administrative and Technical staff for one year).

Prof. D Mukherjee

Director, IACS

Shri P G Ghosh, Registrar, IACS

Non-Member Secretary (upto 31.12.2000)

Shri A K Biswas, Registrar, IACS

Non Member Secretary (from 01.01.2001)

b. **Finance Committee (Tenure : Permanent)**

President, IACS (Chairman)

Director

One Representative of Ministry concerned, GOI

One Trustee nominated by the Council

Principal Accountant General, Govt. of West Bengal

Jt. Secretary, Dept. of Finance, Govt. of West Bengal (Invitee Member)

Registrar, IACS, Non-Member Secretary

c. **Research Advisory Committee (Tenure : Three years)**

Prof. G. Mehta, (Chairman)

Director, IISc., Bangalore

Prof. B. M. Deb

Punjab University, Chandigarh

Prof. H. Junjappa

IIT, Kanpur

Prof. P. Natarajan

NCUP, Madras University

Prof. S. Subramanian

RSIC, IIT, Madras

Prof. S. Ranganathan

IICT, Hyderabad

Dr. A. Dasannacharya

IUC for DAE facilities, Indore

Prof. A. Vanumathi

Andhra University

Prof. G. S. Agarwal

PRL, Ahmedabad

Prof. S. Sivaram

NCL, Pune

Prof. C. K. Majumdar (expired on 20.06.2000)

S N Bose National Centre for

Basic Sciences, Calcutta

d. **Trustee (Tenure : Permanent)**

Prof. S. C. Shome

Prof. M. M. Chakraborty

Prof. S. N. Ghosh

e. **Editorial Committee for Annual Report (Tenure : One year)**

Prof. P Banerjee - **Chairman**

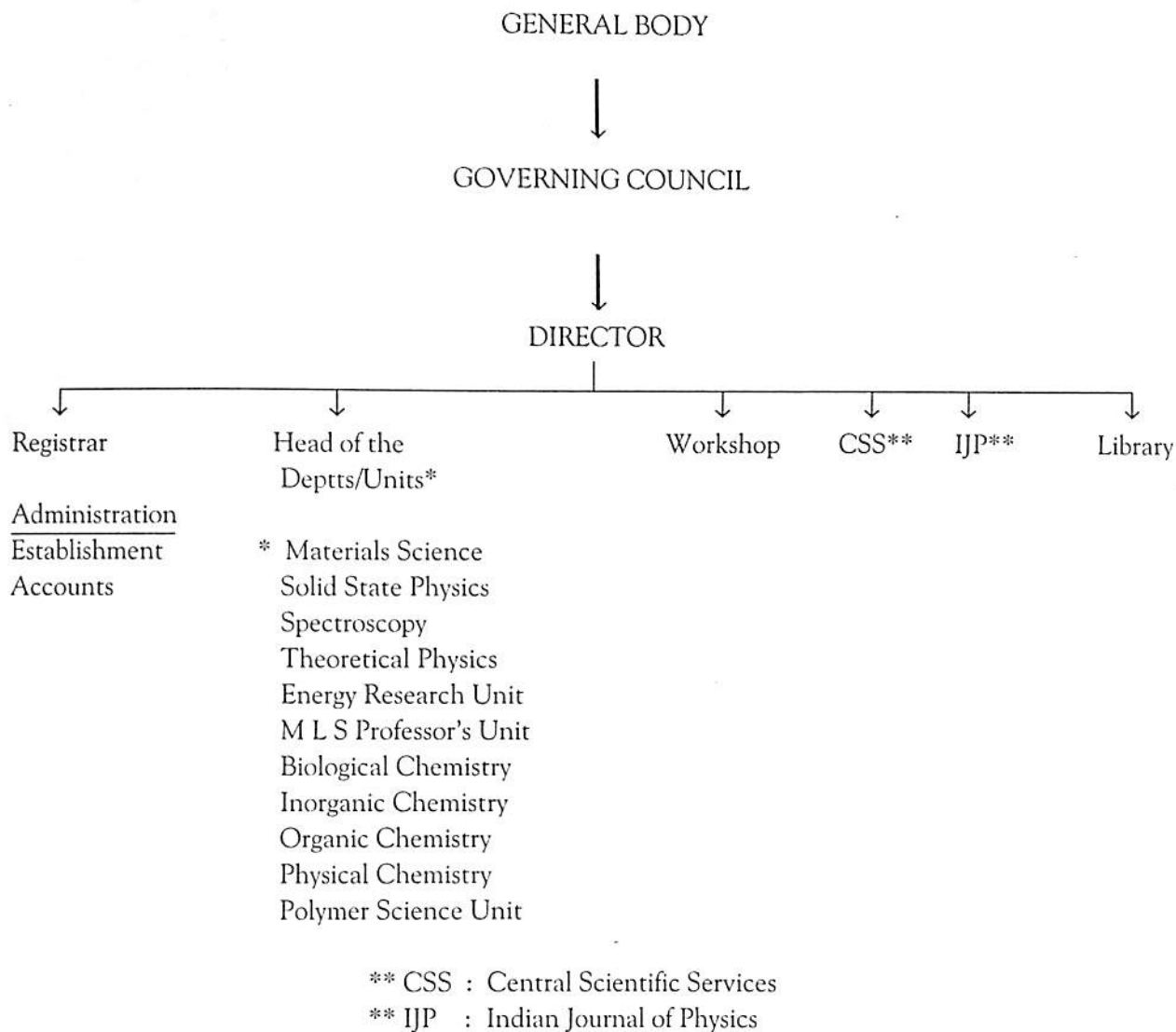
Prof. S Lahiri - **Member**

Dr. S Goswami - **Member**

Dr. A Ghosh - **Member**

Shri N C Das Roy - **Non-Member Secretary**

2. ORGANISATIONAL CHART



3. IMPLEMENTATION OF OFFICIAL LANGUAGE POLICY

The Association has taken steps to implement as far as practicable the provisions of Official Language Policy enunciated by Govt. of India from time to time. In this direction we have already an OFFICIAL LANGUAGE IMPLEMENTATION COMMITTEE in the Association under the Chairmanship of the Head of the Institute which is over-viewing the implementation of the policy. The Association has already started a Hindi Teaching Class for the benefit of its employees.

4. STATUS OF SC/ST/OBC RESERVATION

After the Governing Council adopted the principle of SC/ST/OBC reservation quota the Association has been following the policy of the Government in the matter of recruitment of Academic and Non-Academic staff.

5. PERSONNEL PROFILE

Group	No. of Scientific/Tech. Staff *	Academic *	Administrative/Secretarial*
A	5	100	9
B	23	-	11
C	87	-	57
D	36	-	71

* The above includes the substantive posts kept in abeyance under orders of Government of India.

6. PATENT AWARDED OR ACCEPTED

Solid State Physics

1. Patent Awarded : No. CSIR IOPMD Ref. No. NF-387/00
By Prof. B K Chaudhuri & V Rajendran
Name : A device for measurement of high temperature ultrasonic velocity and attenuation in solid materials.
(This patent has again been filed by CSIR for International Patent)

Energy Research Unit

2. Patent Awarded : No. 183391 dated 23.06.2000
By Prof. S Ray, Prof. A K Barua and Dr. S C Saha
Name : A process for preparing highly conductive phosphorous doped n-type microcrystalline hydrogenated silicon thin film at low power by plasma enhanced chemical vapour deposition
3. Patent Awarded : No. 183442 dated 14.07.2000
By Prof. S Ray, S Hazra and A R Middy
Name : A process for making low band gap amorphous silicon thin film at a low substrate temperature using He dilution at high plasma power regime.
4. Patent Awarded : No. 183811 dated 03.11.2000
By Prof. A K Barua, Prof. S Ray, Dr. P Chaudhuri and Dr. S C Saha
Name : A process for the preparation of wide band gap hydrogenated amorphous silicon buffer layer for application in amorphous silicon solar cells.
5. Patent Awarded : Appl. No. 924/CAL/94 (accepted 2000-2001)
By Prof. A K Barua, S Chatterjee and R Banerjee
Name : A continuous growth process for the preparation of hydrogenated amorphous silicon.

RESEARCH WORK CARRIED OUT IN VARIOUS DEPARTMENTS/UNITS

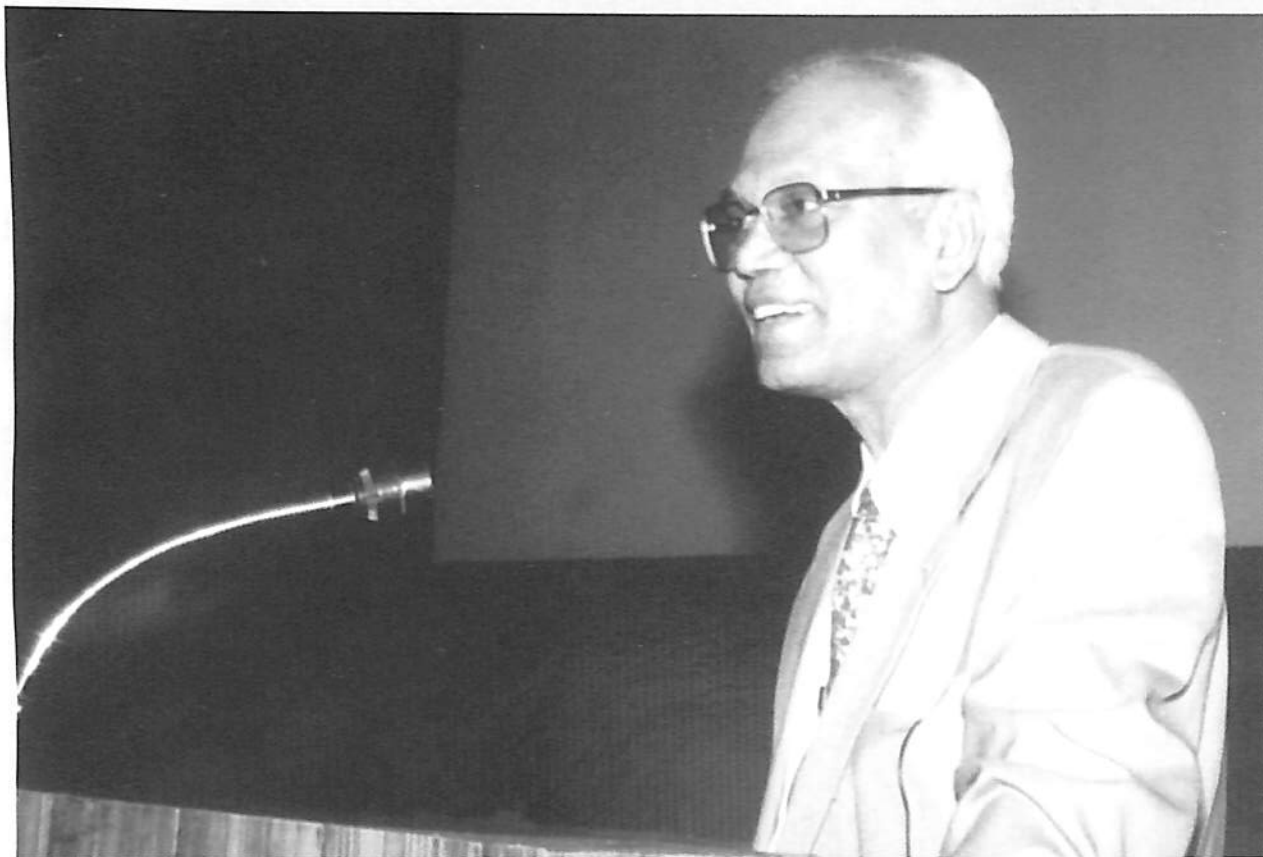
Research in IACS has always been a product of close interactions between experimental and theoretical innovations, with a synergistic interplay between the two modes of probing nature.

Research carried out in the Department of Materials Science can be grouped under the following broad headings: (a) experimental studies of (i) magnetic, semiconducting, medical, industrial, and non linear optical materials and (ii) device oriented thin film studies of emerging semiconducting photonic, nanostructured composites, transparent conducting oxides, conducting polymer materials; (b) theoretical studies of (i) electronic and magneto optical f-electron system, (ii) multiphonon dissociation in intense field and (iii) chirped lasers for coherent control in multilevel systems. Detailed structural studies in sugar modified nucleosides, natural products like pseudokobusine and nematogenic liquid crystal have been performed. The microstructural studies of industrial materials like Ni-Al-Ti, nanotitanium, mixed crystals are worth mentioning. In the areas of thin film quaternary semiconducting materials like $\text{CuIn}(\text{S}_x\text{Se}_{1-x})_2$, and $\text{Cu}(\text{In,Ga})\text{S}_2$ for solar cell applications, GaN for photonic application, diamond and diamond like carbon, nanostructured composite of CdSe, CdTe in SiO₂ matrix, transparent and conducting ZnO doped with Al and In have been synthesized using different cost effective and scalable techniques. The work on two-photon distribution of H₂ chirped bichromatic fields have been computed. The electronic structures of rare earth hexaborides have also been calculated.

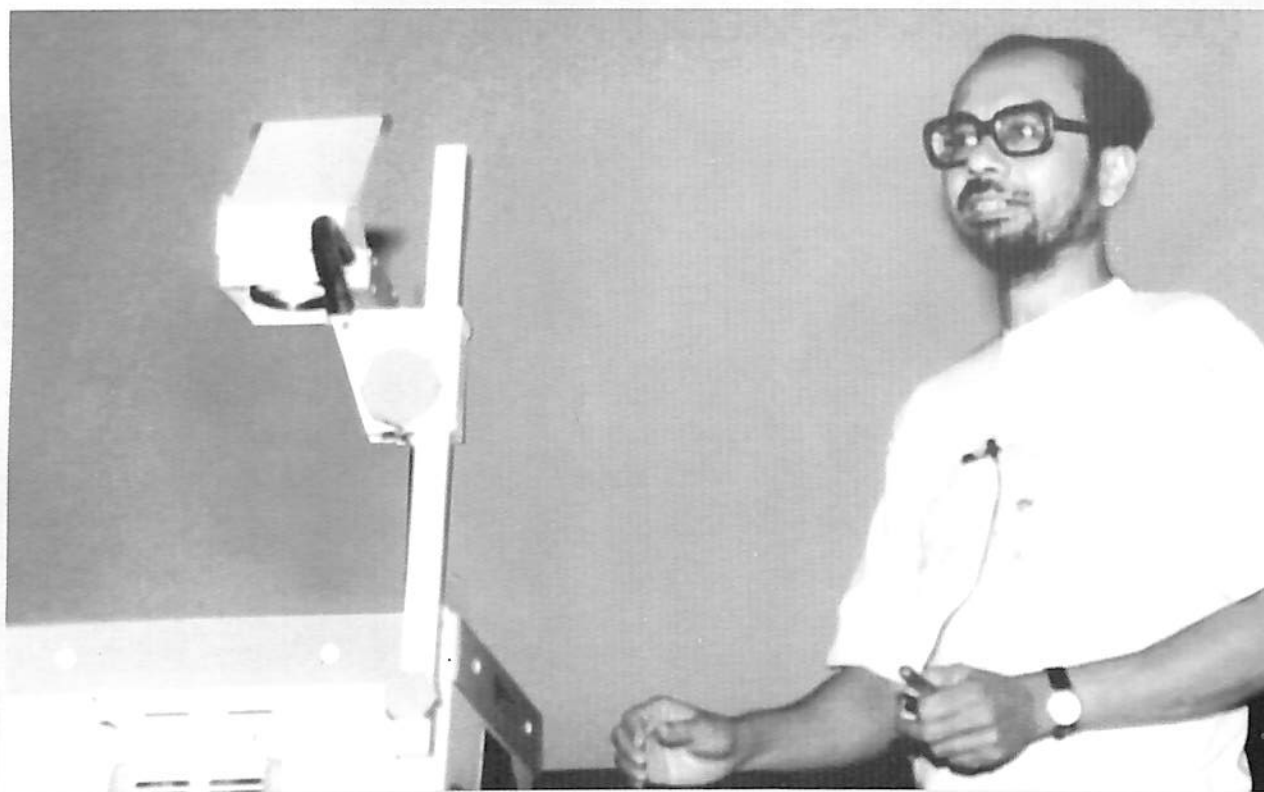
In the Department of Solid State Physics, ultrasonic and optical studies of tellurite glasses and some Na-Ca-B-Al-Si-P-O type bioactive glasses have been made. The scaling behavior of the conductivity spectra in fluoride and ionic conduction glasses has been studied. DC, AC and transient characteristics of light emitting devices have been studied in devices based on organic semiconductors and conjugated polymers. Effect of different impurities in the newly developed

MgB₂ high T_c superconductor has been thoroughly investigated. From the low temperature study of transport and magnetic properties of GMR materials, contributions of electron-magnon and electron-phonon interactions have been estimated. Signature of Spin-polaron in GMR materials has been observed. Grain size effects in Bi-Sr-Ca-Cu-Cr-O type glass-nanocrystal composites, oxide superconductors and Colossal magneto-resistive materials have been studied. For the first time, the magnetic and transport measurements of GMR oxides have been made under high pulsed magnetic field (4-ST) of micro sec duration showing spin-relaxation effect. Interesting correlation between the positron annihilation lifetime and the resistivity and magnetic susceptibility of La-Pb-Mn-Cr-O Colossal magnetic system has been observed. A novel 'phase penetration behavior at the SmC* and SmCA* phase boundaries has been detected from the dielectric relaxation studies of some ferroelectric and antiferroelectric liquid crystals and liquid crystalline polymers. Low temperature EPR, Mossbauer and heat capacity measurements of different Tutton salts)like $\text{Zn}(\text{K}_x\text{NH}_4)_{2-x}\text{SO}_4 \cdot 6\text{H}_2\text{O}$ and rare-earth (like $\text{R}_2\text{Ti}_2\text{O}_7$, R=Ho, Dy, Tb, Eu and Gd) compounds have been made showing interesting new results.

Theoretical and experimental investigations on atomic, molecular and condensed mater spectroscopy and various properties of liquid crystals have been carried out by the department of Spectroscopy. In surface Raman scattering adsorbate concentration dependence has been observed indicating different orientational change of molecules. Time evolution of SERS indicate the orientation of molecules controls the adsorption process. Contribution of different excited states of Raman scattering could be identified from Raman excitation profiles. Intramolecular charge transfer has been identified in a new molecule and the orientational selectivity could be observed in restricted geometry. Relative concentration of molecule was found to control the formation of aggregates in LB film. Efficient



Dr. R A Mashelkar delivering MLS Award Lecture



Prof. Ashoke Sen delivering MLS Award Lecture

photoconducting materials have been identified in some bichromophoric electron donor acceptor groups linked by single or double unsaturated spacers. Spectroscopic, dark and photoconductive properties of organic, organometallic and polymeric materials have been investigated. Studies on dielectric relaxation spectroscopy and electro-optical properties of polymer stabilized ferroelectric liquid crystal in polymer network have been made. High precision correlated calculation of atomic energy levels and structural properties of confined systems have been done. Ab-initio calculation of linear polarizabilities of molecules has been done and oscillatory photoelectron spectrum obtained in above-threshold ionization of H_2 molecules is in good agreement with experimental results. Lasing without population inversion could be obtained in H_2 and Li_2 molecules for ladder and V-schemes. Theoretical prediction of excited, ionized and electron-attached states of GeX_4 ($X=H, Cl$) have been made.

In the theoretical physics department research has been carried out on atomic physics, quark gluon plasma, statistical physics, solid state physics and cosmic ray physics. Positron-hydrogen scattering, ionisation cross-sections of hydrogen-like ions, ionisation cross-section in heavy particle collisions, laser induced transition cross-sections are some of the topics that have been investigated. Phase transitions in quark-gluon plasma, memory effects near a second order transitions bosonization in three dimensions and scaling features of loading DNA sequences have been studied. The vertical muon energy spectra at sea level, flux of neutrino induced muons, muons emitted by gamma rays of Markarian 501 are some of the contributions in cosmic ray physics. Work has been carried out in environmental science as well.

In the year 2000-01 different research activities carried out in Energy Research Unit are as follows :

- Development of large area multijunction of amorphous silicon modules (DST/MNES project)
- ITO Coating dichroic coating (funded by Hindustan Lever Ltd.)
- Intrinsic Microcrystalline/Nanocrystalline Si films for Solar Cells.
- $SiO_x:H$ layer by Photo-CVD
- Zinc Oxide layer for TCO coating
- Polycrystalline silicon thin films by SPC

- Plasma diagnostic of silane plasma used in the deposition of amorphous silicon solar cell (DST Project)
- Development of polymorphous silicon using argon dilution of silane (IFCPAR project)
- Theoretical modelling of solar cell
- $\alpha c-Si:H/SiO:H$ layer
- Development of dielectric coating for aircraft (DRDO project). Research activities with technological potentiality in the Energy Research Unit have focussed on the development of thin film solar cells based on silicon. Amorphous silicon solar cell has now come of age to enter into the consumer market. A project jointly funded by DST and MNES has been going on to develop a completely indigenous prototype plant for production of modules with amorphous silicon double tandem technology. Other research activities are also centered on further improvement of the different layers used in the amorphous silicon solar cell technology.

In the MLS Professor's Unit, a nanosized core-shell structure of $Ag_2O - Ag$ system was prepared and the optical properties delineated. The latter were explained on the basis of quantum confinement effect of carriers in the metallic shell. Nanocomposites of silver in a glass-ceramic containing ferroelectric lithium niobate were found to exhibit large values of dielectric permittivity. This was ascribed to an electronic mechanism. Core-shell of $Fe-Fe_3O_4$ grown by electrodeposition in a silica gel matrix exhibited a magnetic loop shift below $\sim 100K$. Silver nanowires were grown within the nanopores of a silica gel. These showed a single electron tunneling behaviour. Nanocrystalline nickel oxide synthesized within a silica gel showed large change in electrical resistance as a function of relative humidity.

In the Biological Chemistry Department, synthesis of two pentasaccharide derivatives and one tetrasaccharide derivative were carried out with the objective of their transformation into the repeating units of the antigens from *Shigella dysenteriae* types of 3 and 4 and *Shigella boydii* type 5. The detailed study on the carbohydrate specificity of the lectin from Phytopathogen *Macrophomina phaseolina* showed that it has extended combining site, which fits 3'-N-acetylneuraminylactosamine. Both excretory-secretory and somatic antigens of *Ascaris lumbricoides* work have identical secondary struc-

tures as observed by circular dichroism study, which confirms their functional similarity. Mycelia of *Pleurotus sajor-caju* grown in when have been found to contain all the essential amino acids. 3-phosphoglycerate kinase has been purified and characterized in order to study its role in aberrant glycolysis of malignant cells. Design, synthesis and structural studies of synthetic peptides and pseudopeptides using noncoded amino acids with a purpose to mimic protein structural elements (viz. hairpins, β -sheet) have been successfully achieved.

The major activities in the Department of Inorganic Chemistry were centred on : rhenium chemistry related to azopyridine oxo species and derivatives thereof, magneto-structural correlation in coordination polymers involving azide, fumarate and squarate anion bridges, molecular structures, magnetic, and spectroscopic properties of multinuclear metal complexes with a symmetrical macrocyclic ligand, coordination complexes of multidentate ligands with ruthenium(II), rhenium(III) and molybdenum(V), electron transfer reactions involving manganese(III) and manganese(III, IV) complexes derived from acyclic and macrocyclic ligands, reaction chemistry of a platinum(II)-peptide complex, alkali metal adducts of LVO₂ ligands as inorganic analogs of carboxylate (RCO₂) moiety, dinuclear species involving copper(II)/zinc(II) and copper(II)/copper(II) in unsymmetrical ligand environments, copper(I) chemistry with a Schiff base derived from vinyl amine and benzil, photophysics of ruthenium(II) complexes, metal promoted reactions and their applications, heteropolymetallic systems with M₂Ag₂, M₄Cu₂ and M₄Ni₂ cores (M= ruthenium(II) and osmium(II)).

Researches in the Organic Chemistry Department have been concerned with the synthesis of complex bioactive natural products, development of novel reagents and synthetic methodologies, photoinduced transformations and heterocyclic chemistry. During the period under review synthesis of a variety of multi-chiral centered molecules e.g. anti HIV cyclobut-A, sesquiterpenes tochuinyl acetate, herbertenediol, norzizanone, heliannuol-A, sesamin and cytotoxic arucadiol have been accomplished. Transition metal catalyzed novel carbon-carbon bond formation and heteroannulations, indium and

cerium reagents based synthetic transformations have been developed. Radical and photoinduced cyclisations have been employed to generate heteroannular systems of structural and synthetic interest.

The Department of Physical Chemistry focussed its attention on magnetic field effects (MFE) in chemical dynamics, spectroscopy of jet-cooled floppy molecules, ultrafast dynamics in organized assemblies, excited state proton transfer dynamics, etc., on the experimental front. The origin of large MFE on the lifetimes of certain triplet radical pairs has been traced to the relaxation mechanism. Water trapped in human serum albumin, lipid vesicles and micelles have been shown to be characterized by a typically slow solvation dynamics. An unusual strengthening of intermolecular O—H—N bonds in Schiff bases is yet another important finding. The theoretical researches carried out in the department are highlighted by a demonstration of the existence of a fluctuation-dissipation kind of relation in the chaotic dynamics in systems of low dimensionality and of a relation between chaotic-diffusion and entropy flux. Yet another noteworthy development has been the generalization of the multi-reference coupled cluster theory to enable it to handle excited states in an intruder-free manner via response function approach.

The principal findings in the Polymer Science Unit can be summarised as follows:

- (a) the effect of trapped free radicals on polymer solubility in the precipitation polymerization of acrylamide has been elucidated;
- (b) supermolecular organization in the conducting polymer, sulfonated polyaniline, has been modulated resulting in change of morphology and property;
- (c) vulcanization of elastomers of high and low unsaturation has been successfully achieved;
- (d) nanoparticles of tungstic acid and lead chromate have been prepared and characterised.

Total No. of Publications	-	236
Total No. of Ph.D Awarded	-	25
Total No. of Distinction/Award	-	5
Total No. of Patent Awarded	-	4



Professor J R Helliwell delivering Professor K Banerjee Endowment Lecture



Professor R Rajaraman delivering M N Saha Memorial Lecture

P ROJECTS

Sr. No.	TITLE	Investigator In-charge	Grant Received (Lakhs)	Expenditure (Lakhs)
DST				
1.	Establishment.....Spectroscopy	Prof. T N Misra	1.93	0.28
2.	Setting up.....Phase II	Prof. A Chakravorty	3.92	0.83
3.	Cytotoxic.....Chain	Prof. Manju Roy	-	0.22
4.	Investigation.....Conducting	Prof. T N Misra	2.30	0.02
5.	Growth.....Prospects	Prof. A K Pal	2.50	1.94
6.	Polyneuclear.....Interaction	Dr. S Goswami	0.50	1.66
7.	Synthesis.....Blends	Prof. B M Mondal	3.00	1.04
8.	Synthetic.....Bio-Cal Interest	Prof. N Roy	2.00	3.01
9.	8-Keto.....Photochemistry	Prof. S Lahiri	1.50	0.93
10.	Properties.....Nanomaterials	Prof. D Chakravorty	1.00	1.09
11.	Setting up.....Plasma	Dr. P Chowdhury	2.20	0.05
12.	Spectroscopic.....Films	Prof. G B Talapatra	5.00	1.22
13.	Synthesis.....Biochromophores	Prof. T Ganguly	8.00	2.54
14.	Positronium.....Physics	Prof. A S Ghosh	2.80	0.32
15.	I T O.....Coating	Prof. A K Barua	-	0.98
16.	Association.....Mythyl glyoxal	Prof. Manju Roy	17.00	2.44
17.	layered.....Materials	Dr. S Dey	-	0.89
18.	Transformation.....Chemistry	Prof. A Chakravorty	5.00	7.80
19.	Synthesis.....Strategies	Prof. R V Venkateswaran	1.50	2.00
20.	Spectroscopic.....Environment	Prof. P K Mukherjee	0.88	0.73
21.	Magneto.....Compound	Dr. S Dey	2.37	1.39
22.	Sulphydryl.....Enzyme	Dr. D Dutta	2.00	2.10
23.	Local.....Characterisation	Prof. B K Sarkar	-	0.37
24.	Synthesis.....Racical Sources	Prof. S C Roy	8.02	2.91
25.	ATRP.....Monomers	Prof. B M Mondal	11.00	6.20
26.	Study ofTransition	Prof. B K Chowdhury	-	2.26

MNES / DST

1.	Fabrication.....Modules	Prof. A K Barua	150.00	118.10
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INDO / US

1.	New Composite.....Ceramics	Prof. D Chakavorty	-	0.95
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MNES

1.	Develop.....Energy	Dr. P Chowdhury	-	0.15
2.	Development.....Solar Cells	Prof. Swati Roy	-	0.18

Sr. No.	TITLE	Investigator In-charge	Grant Received (Lakhs)	Expenditure (Lakhs)
IAE				
1.	Agency.....Region	Prof. Kanika Roy	-	0.10
DAE				
1.	Organic.....Devices	Dr. A J Pal	-	0.53
2.	RF Plasma.....Temperature	Prof. A K Pal	-	6.46
IFCPAR				
1.	DevelopmentDevices	Prof. Swati Roy	-	3.12
2.	Stable.....Process	Dr. P Chowdhury	6.42	8.39
INSA				
1.	Transition.....Chemistry	Prof. A Chakravorty	4.50	6.87
INDO / GERMAN				
1.	Silicon.....Solar Cells	Prof. Swati Roy	0.77	1.71
INDO / RUSSIAN				
1.	Preparation.....Films	Prof. A K Pal	-	2.20
DBT				
1.	Fermentative.....Application	Prof. B P Chatterjee	7.86	2.88
HLL				
1.	Development.....D Coating	Prof. A K Barua	4.73	0.72
W B				
1.	Waste.....Management	Prof. A K Guha	1.60	1.62

Sr. No.	TITLE	Investigator In-charge	Grant Received (Lakhs)	Expenditure (Lakhs)
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CSIR

1.	Manganese.....Studies	Prof. B Banerjee	0.72	-
2.	Fatigue.....Co-relation	Prof. B K Sarkar	1.81	2.29
3.	Study of..... Solid Phase	Prof. N Roy Chowdhury	0.81	1.31
4.	Binding.....Mechanism	Prof. P Banerjee	0.65	0.52
5.	Studies.....Conducting	Dr. A K Nandy	0.91	0.97
6.	Iron.....Diamines	Dr. S Goswami	1.20	1.50
7.	Samarium.....Noids	Prof. S Ghosh	0.25	0.32
8.	Synthesis.....Structure	Prof. A K Pal	-	0.31
9.	Identification.....Malignant Cell	Prof. Manju Roy	2.93	2.09
10.	Towards.....Environments	Prof. M Chowdhury	1.70	2.62
11.	Luminiscent.....Complex	Prof. K Nag	1.47	1.59
12.	Alternating.....Diodes	Dr. A J Pal	1.12	1.03
13.	Indium.....Organic	Prof. B C Ranu	1.50	1.80
14.	Synthesis.....Coli	Prof. N Roy	2.31	1.90
15.	Synthesis.....Diterpenses	Prof. D Mukherjee	2.45	2.53
16.	Ultrafast.....Assembles	Pror. K Bhattacharya	2.12	2.13
17.	Spectroscopic.....Diagnostic	Prof. P K Mukherjee	0.28	0.51
18.	Application.....Studies	Prof. Ashis De	1.47	1.08
19.	Exploring.....Clusters	Prof. SP Bhattacharya	0.35	0.24
20.	Synthetic.....Photocyclisation	Prof. S Ghosh	3.76	3.04
21.	Chemistry.....Derivatives	Prof. N Roy Chowdhury	3.30	2.16
22.	Co-ordination.....Photochemistry	Dr. S Goswami	2.02	-
23.	Transport.....Maganese	Dr. S K Dey	3.50	-
24.	Development.....States	Prof. D Mukherjee	4.37	3.98

JOURNAL AND SERVICES

INDIAN JOURNAL OF PHYSICS

BOARD OF EDITORS, IJP

S C Agarwal	A K Barua	A N Basu
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B R Nag	C V K Baba	S S Kapoor
V S Ramamurthy	H Banerjee	Avinash Khare
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Chanchal Das Gupta	Abhijit Mookerjee	T P Singh
Yashwant Singh		

S P Sen Gupta, Editor-in-Chief & Honorary Secretary

Articles published (during January, 2000 - December, 2000) in volume 74 of Indian Journal of Physics and volume 83 of Proceedings of the Indian Association for the Cultivation of Science

Sl. Nos.	Articles	PART A			PART B			A & B Grand Total
		Indian	Foreign	Total	Indian	Foreign	Total	
1.	Reviews	X	X	X	5	X	5	5
2.	Rapid Communications	3	X	3	6	X	6	9
3.	Full Papers	36	6	42	37	6	43	85
4.	Notes	8	X	8	15	7	22	30
5.	Proceedings	86	X	86 ⁽¹⁻³⁾	X	X	X	86
	Total No. of Articles	133	6	139	63	13	76	215
6.	Book Reviews			7			5	12
7.	Total No. of Issues			6			6	12
8.	Total No. of Pages Printed			621			505	1,126*

* Printed under new format of A4 size paper with double column

Part A : Condensed Matter & Materials Physics, Nuclear Physics, Particle Physics, Statistical Physics.

Part B : Astrophysics, Atmospheric & Space Physics, Atomic & Molecular Physics, General Physics, Optics & Spectroscopy, Plasma Physics, Statistical Physics, Biophysics & Complex Systems, Relativity & Cosmology.

Foreign Contributors :

Bangladesh, Botswana, Egypt, Germany, Iran, Iraq, Israel, Japan, Jordan, Mexico, Nigeria, Pakistan, Romania, Saudi Arabia, Turkey, United Kingdom, United States of America.

Articles Received :

Altogether 268 Articles have been received during the year of which 53 articles (20%) are Foreign Contributions.

Books Received :

11 Books received from the following Publishers for Review :

M/s. Allied Publishers Limited, New Delhi; CERN, Geneva, Switzerland; M/s Marcel Dekker Inc., New York, USA; M/s. Rostov State University Publishing, Russia, M/s. Springer-Verlag GmbH & Co. KG, Heidelberg.

Proceedings :

¹ Proceedings of National Seminar in Applied Physics held at Indian School of Mines, Dhanbad on March 25-26, 1998.

² Proceedings of the National Conference on Thermophysical Properties of Solid and Fluids (NCTP) held at the Department of Physics, Gauhati University, Guwahati - 781 014, Assam, India on March 11-13, 1999.

³ Proceedings of the Sixth Annual Seminar on Condensed Matter Days 1998 (CMDAYS-98) held at the Department of Physics, T M Bhagalpur University, Bhagalpur - 812 007 on August 27-29, 1998.

⁴ A special issue (Proceedings of the Conference on Physics and Technology of Accelerators held at Saha Institute of Nuclear Physics, Calcutta during February 11-13, 1998) on the occasion of Golden Jubilee of India's Independence.

Circulation :

71 through exchange, 208 sale in India, 36 sale in Foreign (such as in Australia, Austria, Bangladesh, Brazil, Canada, France, Germany, Holland, Italy, Russia, Sri Lanka, Switzerland, Turkey, U.K., U.S.A., etc.) and 115 complimentary copies for users of different Institutions in India and abroad. The sale proceeds during the year is amounting to Rs.16,59,000.00 (approx.) including exchanger copies.

LIBRARY

The Association Library, a grand repository in the field of basic Sciences of valuable collection of rare scientific journals of historical importance as well as currently subscribed core scientific Journals, extended its services to the Association members (Life/Ordinary), Temporary Members of the Library and Members of the Indian Physical Society, besides its own faculty members, scholars and the staff members, by providing ready references, Current Awareness Services and other Information Services from its own resources as well as from the Internet Resources. Open access facilities to Library Resources were extended to non-member Researchers, and Academicians from various Universities/Organisations/Companies and neighbouring Institutes on permission basis. Undergraduates and Postgraduates engaged in their Project Work for a short period, under various Faculty members were also extended liberal usage facilities for references, on special permission. Extensive reprographic services were offered to members/non-members and numerous Postal requests for photocopies were entertained during the above period.

Library was proud to serve the visitors and distinguished guests from all over India and abroad who

accessed the Library while attending the Symposiums, Seminars and Lectures held during the year under review. Materials were provided for the publication of the Souvenir on the occasion of the Centenary Celebration of 'Prof. Kedareshwar Banerjee', eminent scientist and ex-director of this Association.

In connection with the forthcoming 125th Anniversary Celebration of the Association, some of the Diaries of Dr. Mahendra Lal Sircar and Dr. Amritalal Sircar, received from the Collection of Sri Ramaprasad Mukherjee were micro-filmed and the printouts organised for consultation in the Library. Extensive reference services were extended from its own resources of archival materials to great scholars engaged in research in 'History of Science' which culminated in the publication of articles in Journals and valuable books authored by them, adding to the Library collection as gifts.

Besides its own yearly purchase, there were additions in the Library collection of books and monographs, received as gifts from faculty members, procured from their respective project funds or books reviewed by them and as donations from people with past connections with this Association. Library extended its help towards a noble cause, by donating a 'Classification Schedule' to the newly founded Deb Sangha National School, Deoghar for organising its Library.

Although a good number of Journals had to be discontinued due to shortage of funds, Resource Sharing with SINP and other neighbouring Institutes helped to compensate to some extent. Scholars and faculty members were assisted to Online Access of journals, offered alongwith the print subscriptions, through regular Site Registration with different Societies and Publishers and with information on Website Addresses of several journals not subscribed.

The Library is yet to be shifted to its new spacious centralized air-conditioned building to provide sound atmosphere with modern facilities to its users, as the completion of the building in its totality

is slightly delayed. Some prior exercises regarding the internal planning were done during the above period.

Some important Statistics of the Library

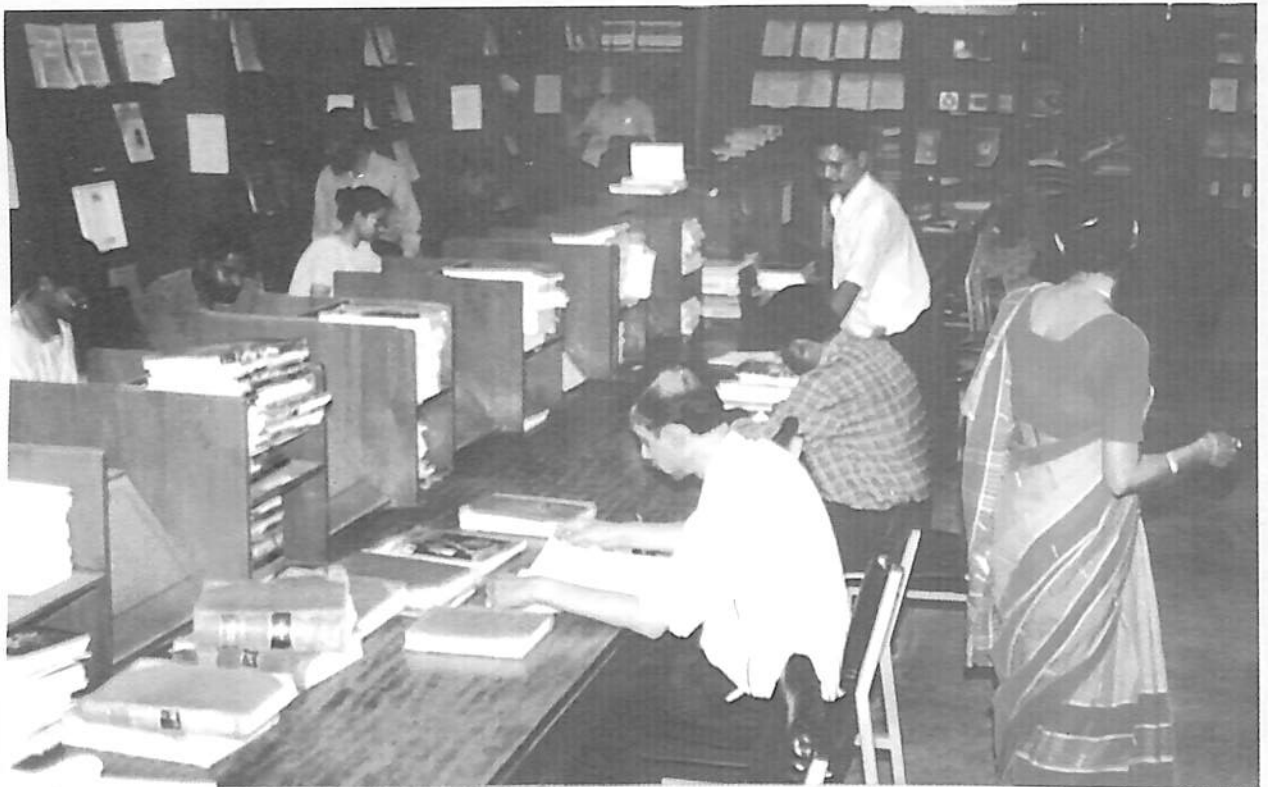
a) Total Stock of Books/Journals : (bound volumes) as on 31.3.2001	65,640
b) Total number of Journals : received by the Library (including Subs+Exchg+Comp)	194
c) Total number of Journals : Subscribed by the library	96
d) Total number of Books/Serials/ Standards/Reports added to the Library	167
e) Non-Book Materials : added to the Library	1
i) Microfiche :	
ii) Disc :	
iii) CD ROM :	1
f) Circulation of Books/Journals :	716/1364
g) Number of New Members : enrolled (including Temporary members)	162
h) Number of Non-Members : permitted to consult the library	166
j) Reprographic Services : (Number of copies served)	1,39,464

CENTRAL SCIENTIFIC SERVICES

During the year under review, this department rendered services to research workers of this Institute as well as to other Institutes utilizing the capacities of its centralized Instruments for the respective facilities :



Professor Aditya Bagchi delivering a popular lecture on the occasion of National Science day



Association Library

1. Scanning Electron Microscope (Hitachi S-415)

Incharge : Prof. S P Sen Gupta, Department of Materials Science.

Operator : N Choudhury & Chinmoy Chakraborty.

Operation : 200 jobs (internal and external) including gold coating - 100 samples and photographs taken - 1400, Hours - 2400.

Users : Materials Science, Solid State Physics, Polymer Science Unit, Spectroscopy, Energy Research Unit, Biological Chemistry.

Ext. Users : Jadavpur University, Calcutta University, Kalyani University, Indian School of Mines, C G & C R I, Inter University Consortium, B E College, College of Ceramic Technology.

Charge Realised : Rs. 5000/-

2. Transmission Electron Microscope (Hitachi II-600)

Incharge : Prof. B M Mandal, Department of Polymer Science Unit.

Operator : N Choudhury.

Operation : 50 jobs including carbon coating - 300 grids and photographs taken - 1000. Hours run - 280 hrs.

Users : Polymer Science Unit, MLS Professor's Unit, Energy Research Unit, Solid State Physics and Materials Science Department.

3. A. Shimadzu DT - 300 Thermal Analyser B. Differential Scanning Calorimeter (Perkin Elmer)

Incharge : Prof. N Ray Choudhuri, Department of Inorganic Chemistry

Operation : Routine work, IACS

4. Carbon, Hydrogen Nitrogen Analyser (2400 Series H)

Incharge : Prof. N Ray Choudhuri, Department of Inorganic Chemistry

Operator : B Pathak

Operation : 2129 samples out of which 1939 IACS, 190 external samples.

Users : Dept. of IC/OC/BC/PSU/ Mat.Sc./Phy.Chem./SSP/MLS of IACS And JU/CU/IICB/BHU/ IISc., Bangalore/KU/IIT Kharagpur, IIT Kanpur/Coal India/School of Chem. Hyd. University/IIT Gau./School of Mines, Dhanbad/Utkal Univ./ Univ. of Madras, Chennai/CLRI, Chennai/Hindustan Lever/NBU/ IJIRA, Calcutta/ Haldia Petrochem, Midnapore.

Charges realised : Rs. 57,500.00

5. Picoammeter (Keithley 486)

Incharge : Dr. A J Pal, Department of Solid State Physics

Operation : Routine work, IACS

6. Atomic Absorption Spectrometer

Incharge : Dr. A Ghosh, Department of Solid State Physics

Operation : Atomic Absorption spectrometer is not functioning properly due to non-availability of spares.

7. FT-NMR, Bruker DPX - 300 MHz NMR Spectrometer

Incharge : Prof. R V Venkateswaran, Department of Organic Chemistry

Operation : 3149 samples from IACS and 40 samples from external sources were analysed during the period under review.

Users : Dept. OC/IC/BC/PSU of IACS; NEHU, NBU, JU

Charge realised: Rs. 8,100.00

8. FTIR : Nicolet Magna - IR 750 System

Incharge : Prof. S K Roy, Department of Spectroscopy

Operator : A Banerjee

Operation : 1262 samples out of which 1238 IACS and 24 external samples

Users(ext.): CFRI-Dhanbad, Presidency College, MCPI-Haldia, M/s.

Eastern Setcrete Pvt. Ltd., Cal.
Govt. Degree College for
Women-Srikakulam, Ace-Cal,
SIPS (Utkal University).

Users (Int.): Spectroscopy, IC,MS,SSP,
PSU,ERU,PC,MLS,BC Depts.

Charges realised : Rs. 7300.00

9. Opto Densito Meter Fipp and Zonen

Incharge : Prof. R K Mukherjee, Department
of Solid State Physics

Operation : Routine work, IACS.

10. Par Vibrating Sample Magnetometer - 115

Incharge : Prof. K Nag, Department of
Inorganic Chemistry

Operation : 405 samples of IACS, several other
Institutes

Users : Inorganic Chemistry, Solid State
Physics, MLS Unit
JU, BU, Tripura University,
Hyderabad Univ. CMERI

11. Varian EPR Spectrometer

Incharge : Prof. A K Pal, Department of
Solid State Physics

Operation : Routine work, IACS, spectra
recorded - 252

12. Optical Microscope (C.Z. Jenavert 2000X)

Incharge : Prof. M De, Department of
Materials Science

Operation : 31 samples of various type of
materials viz.; metals, alloys,
nonlinear and ferroelectric crystals
etc. have been studied and
microhardness measured by
different research groups of the
Institute.

13. Helium Liquefier PLHC 212

Incharge : Prof. S Chatterjee, Department of
Materials Science

Operation : The liquifier was run after some
repair but the yield was still not
upto the mark. For this reason we

changed several condensers, heat
Exchangers and penumatic valves
in this year. The chiller also gave
problems and is now being repaired.
After repairing the chiller we hope
to run the liquefier successfully.

15. XRD Facility (Model : Rich, Seifert XRD 3000P)

Incharge : Prof. A K Pal, Department of
Materials Science

Operation : 556 samples examined

Revenue earned: Rs. 11,800.00

Users : IACS, JU, ACC, BE College etc.

16. Liquid Nitrogen Plant (Model: PLN- 106, MNP-901 and PCILN 2 - 15 LHP)

Incharge : Prof. A K Pal, Dept. of Materials
Science

Operation : 9,860 Litres

Revenue earned : Rs. 20,500/-

Users : IACS, IICB, JU, CGCRI, GSI etc.

WORKSHOP

The activities of Workshop during the year
under review in the following sections.

1. Mechanical

Total 335 nos of Job cards were turned out suc-
cessfully in this year. The job were various labo-
ratory equipment manufacturing, their parts and
also repairing of different equipment. Among
them, some of the work were of special sophis-
ticated type of intricated design.

2. Refrigeration & Air Conditioning

During this period 462 nos. of job cards were
received & turned out successfully. The repair
work of Air-conditioners, Water Coolers, Con-
stant temp. Refrigerators, HAKE water chillers
etc. were done satisfactorily. The performance
of A/c Plant throughout the year was very sat-
isfactory.

3. Glass-Blowing

Total 462 nos. of job cards were received and
turned out successfully by repairing of Quartz

tubes, Flasks, Condensers, distillation heads, glass nozzles & manufacturing of funnels, tubes, ampules sealing etc.

4. Carpentry

Total 214 nos. of job cards were received and successfully turned out. The volume of work received is double than previous year. Manufacturing of tables, racks, Poster Stands etc and repairing of laboratory fixtures, racks, tables, cabinet, desk, chair, palmate etc. were carried out.

5. Electrical

Total 1126 nos. of job cards were turned out successfully by power distribution maintenance, replacement of tube lights, bulbs, chokes, starter & other electrical parts. New electrical installations & renovation in various departments as per requirement. Maintenance of lift carried out successfully through contractor. Satisfactory service rendered in conducting all meetings and seminars in MLS Hall and Seminar Room by providing Audio Visual System and Central Air Conditioner.

COMPUTER CENTRE

Incharge : Prof. Subrata Ray
Scientist-II : Dr. Swapan Deoghuria

All the systems mentioned in the last Annual Report had been functioning normally. The performance of local area network (LAN) was satisfactory. The E-mail server, Web server and Compute servers were on 24 hours a day throughout the year. Apart from extensive use by the faculty members and fellows of IACS the computation facility of ICOSER project was extended to Jadavpur University, Jawaharlal Nehru University, Tripura University, Calcutta University, North Bengal University, S N Bose National Centre for Basic Sciences, BITS, Pilani, Visva Bharati University, Bose Institute, different colleges of West Bengal, distinguished

scientists visited IACS and students of earlier Summer Schools organised by IACS. Several hardware and software were procured for the Computer Centre for Desk Top Publishing of in-house requirement. A four page colour brochure on Perspectives and Prospects of IACS was prepared. The design, layout, artwork and typeset of last Annual Report of IACS was prepared by the Computer Centre. A 44 pages prestigious colour brochure to commemorate the 125th year of IACS was prepared by the Centre. The computer programs for salary calculation of IACS staff and fellows were developed by the Computer Centre and handed over to Accounts Section for future use. Necessary training was provided to the staff of Accounts Section. Different reports and forms (individual as well as departmental) regarding salary, income tax were prepared and printed from the Centre.

A course on computer programming and internet along with hands on practical was offered to participants of the Summer School for school leaving students. Another course on programming language, internet and allied topics with hands on practice was offered to the participants of Summer School for teachers of School, College and Polytechnics.

The Home Page of IACS was maintained and updated. Announcements of different seminar/symposia as well as job opportunities at IACS were put on our website from time to time. On line service of Indian Journal of Physics was done by hosting Contents and abstracts of different issues of IJP in our web site with downloadable format.

TEACHING PROGRAMME : SUMMER SCHOOL FOR SCHOOL LEAVING STUDENTS

The summer school for school leaving students was held between 12th May to 7th July - two lectures a day, five days a week. The lectures were in two categories :

- A. Course comprising a set of 5-6 lectures
- B. One or two lectures on a special topic

Category A :

1. CLASSICAL MECHANICS and SPECIAL RELATIVITY:

INSTRUCTORS : A K Mallick (IIT, Kanpur)
S Bhattacharyya (IACS)

A set of 10 lectures which covered the formal and practical aspects of classical mechanics and a quick introduction to relativistic kinematics.

2. MATHEMATICAL METHODS and the ELECTRO-MAGNETIC FIELD:

INSTRUCTORS: R K Moitra (SINP)
R Bhattacharyya (JU)

A set of twelve lectures which covered vector calculus, variational principle, the divergence and curl of the electric and magnetic fields, leading finally to Maxwells equations

3. QUANTUM PHYSICS :

INSTRUCTOR : J K Bhattacharjee (IACS)

A set of Nine lectures which explored the advent of quantum mechanics from two different perspectives.

4. ATOMS and MOLECULES :

INSTRUCTORS: Subir Bhattacharyya (CU)
S P Bhattacharyya (IACS)

A set of six lectures which explored the symmetries in nature and the origin of the chemical bond.

5. THERMODYNAMICS :

INSTRUCTOR : D S Ray (IACS)

A set of five lectures which discussed critically the three laws of thermodynamics.

6. GENETICS :

INSTRUCTOR: D Chatterjee (CU)

A set of four lectures which takes the listener from Mended to present day research.

7. GREAT EXPERIMENTS IN PHYSICS :

INSTRUCTOR : S Ray (IACS)

A set of six lectures describing six experiments that changed the concept of physical reality.

Category B :

TOPIC	SPEAKER
1. Ghost Stories of Rabindranath	T Ghosh (J U)
2. Greek Tragedy	A Dasgupta (J U)
3. Texts and Hypertexts	S Chaudhuri (J U)
4. Motivation	D Ray (RKM Shilapitha)
5. Gita as an Algorithm	S Brahmachari (Deoghar)
6. Western Classical Music	P Datta (Calcutta School of Music)
7. Chemical Reactions	Partha Sen Howrah N D College
8. Science Education and Scientific Values	Manoj K Pal
9. Internet: How it Works	S Deoghuria (IACS)

PART B

DEPARTMENT OF MATERIALS SCIENCE

Siba Prasad Sen Gupta, Professor

X-ray powder diffraction, surface studies in thin films, microstructures in metals, alloys and nanocrystalline materials, crystal growth & defects, optical & electron microscopy, X-ray Lang topography.

Associates : (1) S Sen Gupta, RA II; (2) S Bhaumik RA (CSIR) (up to 31.12.2000) (3) S Gupta, SRA (Pool-CSIR); (4) S Karan, SRF; (5) P Chatterjee (Collaborator); (6) P Basu Mallick (Collaborator).

Supriyo Chatterjee, Professor

Low temperature physics, conducting polymer, rare earth perovskite oxides.

Associates : (1) S Biswas, SRF; (2) P Datta, SRF.

Arun Kumar Pal, Professor & Head

Thin film solar cell, nanostructured material, Raman effect in semiconductor film, diamond like coatings, giant magneto resistance, sol-gel processing of thin film.

Associates: (1) S Bandopadhyay, SRF (DAE-BRNS); (2) B Deb, JRF; (3) S Chakraborti, JRF; (4) S K Bera (Hony.); (5) D Gunguli (Collaborator).

Sourindra Kumar Sen, Professor

Mass transport, interfaces in thin films, surface properties, conducting polymer, semiconducting oxide films.

Associates: (1) S Bandyopadhyay, SRF; (2) G K Paul, SRF.

Subhadra Chaudhuri, Professor

Synthesis of nanostructured thin film by chemical

route, semiconducting thin films, diamond and nitride films, photoluminescence of thin film, fabrication of thin film devices.

Associates: (1) S Roy, SRF; (2) P Guha, JRF; (3) B Bhattacharjee, JRF.

Samir Chandra Saha, Professor

Multiphoton processes in molecules, atomic and molecular physics in intense laser fields, laser control of chemical processes.

Associates : (1) S K Sen, SRF; (2) S Ghosh (Collaborator).

Madhusudan De, Professor

Studies on the microstructure of the industrially important materials by X-ray diffraction, optical and electron microscopy, crystal structure determination by X-ray diffraction.

Associates: (1) P Sahu, JRF; (2) A Chanda, (Hony.); (3) G Mazumder, (Hony.); (4) S K Shee, (Hony.); (5) S K Pradhan, (Collaborator); (6) S K Mazumder, (Collaborator).

Shib Shankar Bhattacharyya, Professor

Multiphoton processes in molecules, intense field effects on atomic and molecular dynamics, laser control of chemical processes.

Associates : (1) B Datta, JRF; (2) A Datta (Hony.)

Subodh Kumar De, Reader

Low temperature physics, giant magnetoresistance, polymer blends, strongly correlated electron systems

Associates : (1) M De, RA; (2) D B Ghosh, JRF (DST).

Tanusree Kar, *Sr. Lecturer*

Nonlinear optical materials, natural products, synthesis and crystal growth, nonlinear optical studies, electron microscopy, molecular & crystal structure determination.

Associate : (1) T Pal, JRF; (2) K Bhattacharyya, (Collaborator).

Asim Bhaumik, *Sr. Lecturer* (joined on 7th March, 2001)

Synthesis, characterization and catalytic properties of micro and mesoporous materials, ion-exchanger, photocatalyst, auto-exhaust catalyst.

Bijit Kumar Sarkar, *Emeritus Scientist* (CSIR)

Microstructure-property correlation, Fatigue and Fracture, Computer Modeling.

Associate : (1) R Roy (CSIR); (2) D Ray, SRF (CSIR).

A. Materials Science & Condensed Matter Physics

1.1 X-ray Powder Diffraction

S P Sen Gupta

X-ray powder profile analysis has been applied to a number of materials of considerable interest. Work on nano-titanium was further pursued using Rietveld method to determine both the crystallite size and volume fraction of the fcc phase produced after 10 hrs of milling. It was observed that the fcc phase originates as crystallisation of amorphous phase observed after 8 hrs of milling. Sample preparation and data collection of the entire phase space of binary alloy system Pb-Bi and ternary Cu-Sn-Zn in cold worked and annealed forms have been completed with different compositions to obtain microstructural features. Analysis of the fcc phase of Pb-Bi system is now in progress.

1.2 Studies with Vapour- Deposited Films

S P Sen Gupta

A new dislocation model for vapour -deposited Pb-films has been developed. Thin films of lower thickness $\sim 100\text{nm}$ has been characterised by screw dislocation inclined to film surface and twin faults, whereas films of higher thickness has been characterised by mainly edge dislocation and no twin faults. Further at lower film thickness the effect of [111] fiber texture was considered in the model but with increasing film thickness the probability of randomly oriented grains increases. The probability of randomly oriented dislocations decreases with a more probability of slip planes with burger's vector normal to {200} at higher film thickness ($\sim 1\mu\text{m}$).

1.3 Crystal growth, Defects and Properties

S P Sen Gupta

Mixed crystals of Ammonium Sulphate (AS) and Potassium Sulphate (PS), $[(\text{NH}_4)_{1-x}\text{K}_x]_2\text{SO}_4$ were grown by slow evaporation technique at room temperature. Mechanical characterization was done by studying the variation of microhardness on (100) faces of mixed AS-PS system with load for several compositions. Vickers Hardness numbers, H_v were found to increase primarily with increase in load and then become constant. Meyer indices n were always greater than 2 showing soft material characteristics. Kick's law has been established after making corrections to the observed values of the diagonals. Some hardness related constants such as crack length, fracture toughness, brittleness indices, elastic stiffness coefficients were also calculated. Defect configurations in as-grown mixed crystals of ammonium-potassium sulphate have been revealed by chemical etch technique with greater details for the first time. Interesting features like symmetrical pyramidal pits, circular terraced pits, row of closely spaced pits forming low angle tilt boundary indicating branching of dislocations etc. were clearly observed using aqueous solutions of various inorganic salts (etchants) applied for different timings. The results are briefly interpreted in the light of Cabrera's thermodynamic theory of dislocation etch pit formation. The optical and scanning micrographs show a good correspondence between formation of etch pits and dislocations.

1.4 Liquid Crystals – Structural studies

S P Sen Gupta and S Gupta

The introduction of a double bond at specific side chain positions markedly affects the properties of liquid crystals. The structures of the homologous series of cyanoalkenyl compounds are undertaken to solve from X-ray Crystallography. The crystal structure of the nematogenic compound 4 (1"-pentyl) 4' (cyano) 1,1' bicyclohexane has been solved at 273 K. The molecular packing and the phase sequences of this compound are the precursor to the nematic phase. The crystal and molecular structure of the other homologue of the cyanoalkenyls have been determined from X-ray diffraction at 273 K. Two independent molecules in the crystal have slightly different conformations but the geometric parameters are normal. The molecular packing is nematic-like.

1.5 Studies on the Microstructures and Mechanical Properties of Industrial Materials.

M De

Microstructural characterization of industrially important materials has been continued. Studies with ball milled ternary Ni-based super alloy, Ni-Al-Ti used as soldering or brazing material has been completed. From studies on the kinetics of transformation the phases evolved at different stages of milling have been identified and characterized microstructurally. Besides, binary NiTi and NiAl intermetallics, increased volume fractions of NiAlTi solid solutions are found to be formed. High dislocation densities with nano order crystallite sizes are observed after 64 hrs. of milling of elemental powders. Studies on martensitic transformation low temperature with Fe-Mn-C system is in progress. Characterization of the bulk martensites with 5-6% Mn and 1% C reveal martensite evolved to the extent of 35-45 mass %. The martensitic phase (bct) shows high dislocation density, lower crystallite sizes and higher r.m.s strains compared to those of the austenite. Studies with binary Cu-Ga, Ag-Ga and industrially important Cu-Ni-Sn alloys are in progress.

1.6 Crystal and Molecular Structure of Some Sugar Modified Nucleosides

M De

Structural studies on some sugar-modified nucleosides having anti-viral activities are being continued. During this period structural studies have been completed for the following compound: Hydronium-5-amino-uracil-6-sulphonate hydrate. Structural studies on some other compounds will be taken up.

1.7 Non linear Optical Materials.

T Kar

L-arginine hydrofluoride (LAHF), the most attractive nonlinear optical material of L-arginine halide group has been synthesized and grown during the period under review. X-ray powder diffraction, DTA, TG and FTIR studies revealed some important informations regarding the structural, thermal and optical properties of the LAHF. The results have been communicated to international journals. Apart from this second harmonic generation (SHG) efficiency, transparency range, and damage threshold of L-arginine hydrochloride (LAHCl) and L-arginine hydrobromide (LAHBr) and their mixed system have been studied. SHG efficiency of LAHCl, LAHBr and their mixed system are found to be 3.41, 2.80 and 2.64 times as that of standard quartz crystal. All the crystals show good transparency down to 240nm, so that phase matching for second harmonic and frequency mixing process can be achieved well into the ultraviolet region.

1.8 Structure Elucidation of Natural Products by X-ray Diffraction Method.

T Kar

Crystal and molecular structure determination of two important natural product namely Pseudokobusine, an diterpenoid alkaloid and Fern-9(11)-en-6 α -01-methanol (1/1), a triterpenoid alkaloid have been investigated during this review period. Pseudokobusine is an important medicinal product used in the treatment of weak constitution, poor metabolism, gout, chronic rheumatism and neuralgia. Fern-9(11)-en-6 α -01-methanol (1/1) is used as a medicine for bronchitis and cough. Crystal

and molecular structure of these two compounds have been solved by SHELXS-97.

2. Electronic and Magnetic Materials

2.1 Giant Magnetoresistance

S Chatterjee and S K De

Some electron doped rare earth based perovskite oxides are prepared to study the competition between the Ferromagnetism and Charge Ordering phenomena and also the Ferromagnetism and Antiferromagnetism phases. The effects of annealing in presence of oxygen at high temperature on the transport and magnetic properties are investigated. The layered manganites, $(R, D)_3Mn_2O_7$ (R= rare earth, D= divalent ion) by varying the ionic radius at the rare earth sites are prepared to study the magnetotransport properties.

2.2 Conducting Polymers and Composites

S Chatterjee and S K De

The dc conductivity, ac conductivity and dielectric permittivity of HCl doped polyaniline (PANI) - polyvinyl alcohol (PVA) composites and β -Naphthalene Sulfonic acid doped polyaniline are investigated as a function of temperature and frequency. The ac conductivity follows a power law with frequency. The temperature dependence of the frequency exponent predicts the quantum mechanical tunneling behavior of the charge carrier in ac conduction process. The broad and asymmetric loss peaks of dielectric spectra have been analysed by the stretched exponential decay of the electric field.

2.3 Electronic and Magneto - Optical Properties of f Electron Systems.

S K De

A systematic studies on magnetic and magneto-optical properties of some rare earth mononictides and chalcogenides are performed by the Full Potential Linear Muffin-Tin Orbital method with the local density approximation. The electronic structures

of heavy rare earth hexaborides are calculated to understand the roles of spin and orbital degrees of freedom for f electron in structural and magnetic properties under high pressure

3. Thin Films and Devices :

3.1 Emerging Semiconducting Materials for Device Applications

A K Pal and S Chaudhuri

Quaternary semiconducting films of $Cu(In,Ga)S_2$ and $CuIn(S_xSe_{1-x})_2$ were prepared by the Rapid Thermal Annealing (RTP) of the elemental stacks deposited by sequential evaporation technique. Raman, photoluminescence and microstructural measurements alongwith electrical conductivity studies were completed to ascertain the film quality for device application.

3.2 Synthesis and Characterization of GaN Films for Photonic Application

A K Pal and S Chaudhuri

Wurtzite GaN films were synthesized on p-Si (100) and n-Si (100) substrates by plasma assisted hot wall vapour deposition technique without using any buffer layer. The films were characterized by electrical and optical measurements while the microstructural information was obtained from AFM and XRD studies.

3.3 Synthesis of Cubic BN Films

A K Pal

R.F. plasma CVD technique was adopted to deposit c-BN films onto different substrates (Si, glass and NaCl single crystal) with borane-ammonia + nitrogen as the precursor. The substrate temperature was varied and it was found that the chemical and physical properties of BN film was strongly dependent on the deposition parameters e.g. substrate temperature, plasma temperature and the relative amounts of boron containing ion and nitrogen ion. The main issue in this project was to increase the incorporation of nitrogen in the film so that films with dominant c-

BN phase may be obtained at a lower substrate temperature.

3.4 Development of Process Technology for the Deposition of $\text{Cu(In,Ga)}\text{S}_2$ Film for Solar Cell Application.

A K Pal and S Chaudhuri

$\text{Cu(In,Ga)}\text{S}_2$ films were synthesized on glass and Mo coated glass substrates by graphite box annealing of stacked elemental layers (SEL) of In/Ga/Cu for solar cell application. The process parameters were optimised to obtain reduction of the defect states at the intercrystalline boundary regions of the polycrystalline films. The films were characterized by studying the optical, microstructural and electrical properties. The data, thus obtained, were correlated with one another to derive meaningful information on the optimum deposition parameters for the preparation of tailored film for device application.

3.5 Preparation and Characterization of Diamond and Diamond like Carbon Films

A K Pal and S Chaudhuri

Diamond films prepared from different carbon containing precursors were characterized by electrical, mechanical, optical and microstructural measurements. The sp^3/sp^2 ratio in the films were determined from the FTIR studies and the deposition parameters were varied to obtain sp^3 rich film for practical application. Diamond like carbon films were prepared by electrolysis of ethanol solution at low temperature ($\sim 60^\circ\text{C}$). Characterization of the films by XRD showed encouraging results. Measurement of Raman effect and C-H absorption in the FTIR are in progress.

3.6 Growth of Nanostructured Composite Films

A K Pal and S Chaudhuri

Binary semiconductors (CdSe and CdTe) embedded in SiO_2 matrix was prepared by high pressure (20-30 Pa) sputtering technique. Microstructural

and optical studies were completed in order to understand the optical processes in the nanocomposite films. Electrical characterization of the films are in progress.

3.7 Preparation and Characterization of CVD Diamond films : Integrated long term Programme (ILTP) of Cooperation in Science and Technology between India and Russia.

A K Pal and V G Ralchenko

High quality diamond films, prepared by microwave plasma CVD of methane-hydrogen-oxygen and camphor-hydrogen-oxygen gas mixtures as the precursor materials, were characterized by XRD studies which indicated (111) orientation from Harries analysis. Films deposited on Si substrate were characterized by FTIR studies which indicated predominant C-H absorption at $\sim 2900\text{ cm}^{-1}$. Raman and photoluminescence studies were completed to derive information on the impurities and defects in the films and their dependence on the deposition environment.

3.8 Sol-Gel Processing of Thin films for Flat Panel Display and other applications.

A K Pal and S Chaudhuri

The sol-gel technique was initiated for the preparation of semiconducting particles (CdS , ZnS and $\text{Cd}_x\text{Zn}_{1-x}\text{S}$) embedded in a SiO_2 matrix. Preliminary studies of the variation of physical properties (optical and microstructural) of the films with particle size showed encouraging results. Preparation of MgO films suitable as a protective layer in plasma display panels (PDP) are in progress.

4. Transparent and Doped ZnO Thin Film

S K Sen

Comparison of electrical properties of ZnO films doped with different concentrations of aluminum without surface modification by vacuum heat

treatment or by hydrogen annealing has been extensively studied. The Hall mobility, carrier concentrations and barrier height (BH) at grain boundary (g.b.) region have been determined. Attempts have been done to explain BH, assuming monovalent trapping states at the grain boundary. The density of trapped states has been estimated from the experimental data. A spray pyrolysis apparatus using air, as a carrier gas has been installed. A systematic study of the micro structural, electrical, optical and thermoelectrical properties of different doped films prepared by this method have been done. The surface morphology does not change very much with Al doping whereas the surface roughness decreases on In doping. There is slight shrinkage in band gap on In doping whereas no such shrinkage has been observed either for Al doping or undoped samples, which is quite contrary to the samples prepared by solgel method. The thermoelectric measurements indicate a hump around 150-200K which is much less in In doped sample. This has been explained as due to electron lattice interaction and might be due to boundary scattering of phonons.

5. Micro and Mesoporous Materials

5.1 Synthesis and Structural Evaluation of Novel Inorganic Porous Material

A Bhaumik

Zeolites, mesoporous silica and related metallo-silicate molecular sieves have been studied extensively. Some of these materials found numerous uses in chemical and petrochemical industries. Synthesis and detail characterizations of such type of novel micro and mesoporous materials with inorganic frameworks of oxide, phosphate, sulphide etc. are underway. Some of these materials have very high ion exchange capacities and moderate to good hydrothermal and thermal stability. Detail structural analysis of these materials are being carried out with the help of powder XRD, N_2 adsorption, SEM, TEM, NMR, FTIR, chemical analysis etc.

5.2 Liquid Phase Oxidation and Photocatalysis

A Bhaumik

Liquid phase oxidation catalysis are being performed over titanium based molecular sieves (TS-1, Ti-MCM-41 etc.) using H_2O_2 and TBHP as oxidant. This is an eco-friendly route for the synthesis of organic fine chemicals, as the reactions are being conducted under solvent-less to solvent-free conditions yielding minimum of byproducts. Easy separation and very high regeneration efficiency of the catalyst by simple calcination at 450-500°C or by acid exchange give further advantages to these materials. UV and visible light assisted photocatalytic decomposition of water for the generation of H_2 , an alternative energy source and photoreduction of CO_2 in air to clean our environment will also be conducted on such materials.

5.3 Exchanger for the Removal of Arsenic from Polluted Ground Water.

A Bhaumik

Our research is directed towards the synthesis of an efficient ion-exchanger for the removal of arsenic from the ground water. Layered double hydroxides (LDH) with lamellar frameworks have been found to be a good anion exchanger. We are currently employing the high ion-exchange property of these materials for the removal of arsenic from ground water. Precursors for the synthesis of this material are of very low cost and thus having exceptional promises for large-scale operation. Characterization of these exchangers will be performed using XRD, SEM, TEM, FTIR, UV-Visible spectrophotometer etc. Efforts are underway to make a suitable cartridge for the continuous flow of a large amount of As (V)/ (III) contaminated ground water.

6.1 Fatigue Behavior of Glass and Carbon Fiber Reinforced Composites and its Correlation with Mechanical and Microstructural Properties

B K Sarkar

E-glass and two varieties of carbon fibers were used to reinforce vinylester resin. The composites were prepared with different fiber to resin ratios. The

composites in the cylindrical forms were tested for their fatigue properties under liquid nitrogen environment. The susceptibility to fatigue was nearly reduced by 50% for the glass fiber composites and in the case of carbon fiber composites the susceptibility was almost negligible. This study indicated that the presence of moisture in the composites has made a major role in affecting the fatigue properties of all the composites investigated. Microstructure of the fractured surfaces by SEM revealed that the failure under fatigue of these composites have been by debonding, matrix cracking and eventual fiber failure.

6.2 The Cracking Behavior of Container Glass

BK Sarkar and S P SenGupta

The cracking behavior of the container glass was investigated. It was observed that the glasses are susceptible to delayed fracture affected by the moisture constituent of the liquid contained in the glass. Microstructure studies by SEM revealed that both the inside and outside surfaces of the glass contained a large amount of surface defects in the form of pits, discontinuities, scratches etc. These have been the sources for the crack initiations causing premature failures. The stress source from the aerated liquid and the water content in the liquid contained in the glass container have caused the propagation of the existing defects resulting into catastrophic failures.

B. Atomic and Molecular Physics Section

7.1 Multiphoton Dissociation(MPD) in Intense Fields

S Saha and S S Bhattacharyya

This is a continuation of our existing program. Ear-

lier we had developed the use of the time-independent close coupling formalism for obtaining above threshold dissociation rates and angular distributions. These techniques are being further refined for obtaining the branching ratios between various open MPD channels as functions of frequencies in multi-frequency fields. Also any possible effect of the higher lying electronic states of different symmetries on the angular distribution pattern of photofragments are being investigated in the context of some very recent experimental findings.

7.2 Chirped Lasers for Coherent Control in Multilevel Systems

S Saha and S S Bhattacharyya

The work on two photon dissociation of H_2 in chirped bichromatic fields has been completed. "Chirping" essentially refers to the process of arranging the frequency components of a laser pulse with certain phase ordering. We are investigating how this ordering of the frequency components can be used for enhancing or discriminating against certain product channels or selective population transfer to various excited levels. As a part of this project we have shown in detail how highly detuned chirped pulses can be used to control population transfer between excited states in hydrogen molecules. The underlying mechanism is a Raman like process where the adiabatic passages are controlled by varying the chirping parameters. Search for similar processes in other systems with an incoherent initial distribution is now continuing.

Arun Kumar Pal, *Professor*

EPR, Ligand Field, Phase Transition, Jahn-Teller (JT) Effect and Magnetic Low Dimensionality in solids, Dipolar and JT Glasses.

Associates: (1) K Dey, SRF; (2) S Mukhopadhyay, JRF; (3) A K Das, (Hony); (4) S Dutta, RA; (5) D Banerjee (Hony).

Ranajit Kumar Mukherjee, *Professor*

Investigation of spectroscopic levels of transition metal and rare earth ions in crystals by magneto-optical effects in high pulsed field, conductivity and magnetoresistance under high pulsed field and low temperatures.

Associates: (1) S Bhattacharya, JRF

Debjani Ghosh, *Professor*

Experimental and theoretical studies of magnetic susceptibilities, optical spectra, specific heat and Mossbauer spectra (MS) of rare earth compounds. Geophysical studies of Magnetic Minerals involving magnetic and Mossbauer experiments.

Associates: (1) P Das Gupta, JRF (2) A Nag, SRF (till Aug. 2000), (2) G Y V Victor (Hony), (3) Y Jana (Hony), (4) A Sengupta (Hony), (5) K Das (Hony).

Chitra Basu, *Reader*

Ultrasonic and acoustic properties of materials, nanoparticles.

Associates: (1) A Paul, RA, (2) P Roychoudhury, SRF; (3) S Batabyal, JRF.

Monika Mukherjee, *Professor*

Crystal structure, structural disorder and transition by X-ray, Application of direct method in macromolecules.

Associates: (1) S Maiti, JRF (upto Feb. 2001); (2) K Chowdhury, JRF.

Aswini Ghosh, *Reader*

Short range structure, transport and relaxation dynamics, conductivity spectra and scaling in glassy and crystalline solids.

Associates: (1) A Pan, SRF(CSIR), (2) S Ghosh, JRF (3) S Bhattacharya, JRF.

Amlan Jyoti Pal, *Reader*

Solid State Spectroscopy, device Physics, light-emitting diodes, photovoltaic devices, molecular electronic devices

Associates: (1) A Chowdhury, SRF (DAE), (2) S Roy, SRF (CSIR), (3) H S Majumdar, JRF.

Bijay Krishna Chaudhuri, *Professor and Head*

High T_c superconductors, Photoacoustic and photothermal spectroscopy, Dielectric spectroscopy, Phase transitions in H-bonded system, magnetoresistive materials under pulsed field, Low temperature heat capacity, magnetic and other properties of crystalline and amorphous materials, conductivity and magneto-resistance under high pressure, nano-composites.

Associates: (1) D K Modak, RA, (2) S Mukherjee (Bhattacharya), R A (CSIR), (3) A Banerjee, JRF; (4) S K Kundu, JRF (CSIR); (5) S Pal, JRF (DST); (6) M Karar (Hony), (7) S Moitra (Hony), (8) U K Mondal (Hony), (9) Palanivelu (Hony).

1.1 Magnetic Resonance and other Studies in Solids

A K Pal

From computer simulation of EPR spectra observed in (010) plane of mixed Tutton salt crystals of copper doped $Zn(K_xNH_{4(1-x)})_2 \cdot SO_4 \cdot 6H_2O$ in LN_2 temperature range, three kinds of Cu(II) octahedral centers have been identified, indicating the inhomogeneous distribution of the secondary ligands (K, NH_4) in the mixed crystal. The importance of secondary ligands in modifying the ligand fields at the magnetic sites has also been highlighted by such EPR experiments.

Transition metal ions doped silica glasses prepared by sol-gel method (dried and annealed at different temperatures up to $900^\circ C$) have been studied by X-band EPR in the LN_2 temperature range. Computer simulation of Cu(II) EPR spectra of $Cu(II):SiO_2$ glasses (both $100^\circ C$ dried and annealed at different temperatures) recorded in the 10K - 300K temperature interval have revealed the presence of three kinds of Cu(II) EPR spectra in the dried sample. Observed thermal dependence of g has been correlated with the relaxation dynamics of the Cu(II) centres in the SiO_2 glass matrix.

Thermal dependence of galvanomagnetic properties of single crystals of bismuth doped with various concentrations of gallium and indium in the temperature range 80 - 300K has been studied. Some unusual behaviour such as variation of Hall coefficient with magnetic field have been detected. Satisfactory explanation of the observed properties of Ga and In doped Bi has been obtained on the basis of the proposed theoretical model.

2.1 Study of the Energy States by Single Crystal Spectra at Low temperature and Magneto-optic Effect in Pulsed High Magnetic Field

R K Mukherjee

We have prepared $CaCdCl_2$, $CsMgCl$, etc. single crystals and magneto-optic study of these crystals, under pulsed high magnetic field, has been completed.

2.2 Application of Pulsed Magnetic Field and Study of Transport, Magnetic and Optical Properties of Crystalline and Nano-Composites

R K Mukherjee and B K Chaudhuri

We have successfully applied pulsed magnetic field for the study of rare-earth manganites containing nanocrystalline phases (observed from transmission electron microscopic study). Interestingly, we noticed that the transport properties of some of these samples, measured under pulsed magnetic field, show interesting differences arising due to the size of the nanocrystals in the said samples. The size of the nanocrystals was varied by grinding the sample for different time intervals. Similarly we also noticed that the amorphous or glassy samples embedded with different concentrations and sizes of the nanocrystals/clusters (nano-composites) are different in their transport behavior measured under the pulsed magnetic field of short duration (few micro second duration).

3.1 Experimental and Theoretical Studies of Magnetic Susceptibilities, Optical Spectra, Specific Heat and Mossbauer Spectra (MS) of Rare Earth Compounds

D Ghosh

In recent years pyrochlore rare earth titanates (RET), having the formula $R_2Ti_2O_7$, generated world wide interests as a new type of system exhibiting geometrically frustration (GF) at low temperatures (LT). The presence of a strong axial single ion anisotropy (SIA) of the rare earth atom in RET decides whether the system would exhibit GF, showing order-disorder phenomena and/or spin-ice/spin-glass like states, and/or developing cooperative paramagnetism at LT. The phenomena depend on the existence and relative strengths of SIA, the classical dipolar and nearest neighbor exchange (or super-exchange) interactions. SIA of few RET crystals with $R=Ho, Dy, Tb, Eu$ and Gd were numerically calculated for the first time from fitting magnetic, specific heat and Mossbauer data and the dipolar and exchange interactions were found out. It was found

that GF is not expected in ErT, EuT and GdT, because the first one showed strong planer anisotropy and the SIA in the remaining two are not strong enough. These are to be verified from future experimental studies at LT. The magnetic energy and entropy associated with antiferromagnetic ordering in Erbium and Dysprosium pyrogermanates were determined from the analyses of the sharp peak in the specific heat at 2K measured by us for the first time. Long range antiferromagnetic order in these pyrogermanate crystals was detected whereas in the Holmium crystal, a second peak at slightly higher temperature was noticed, the cause of which is being studied.

3.2 Geophysical Studies of Magnetic Minerals Involving Magnetic and Mossbauer Experiments

D Ghosh

Radiometric studies followed by measurements of magnetic susceptibilities of Charnockites from rock samples of coastal region of Tamil Nadu were performed to determine the ferromagnetic mineral contents. The study is important because sands formed from weathering of these rocks cause transportation problems and erosion of pipe lines.

For the first time a quantitative analysis of magnetic susceptibility, Mossbauer and optical spectral properties of orthopyroxene (OPX) or $\text{Fe}_x\text{Mg}_{1-x}\text{Si}_2\text{O}_6$ minerals was accomplished as a function of Fe content (x), using the symmetry properties of the Crystal Field acting at the two different distorted octahedral sites occupied by the Fe atoms in OPX.

The same theory was applied to analyse successfully different properties of Enstatites ($x = 0.1 - 0.2$), Bronzite ($x = 0.4 - 0.5$) and Ferrosilites ($x = 0.8 - 1$). Also structural and thermodynamical quantities like average Fe-O and Si-O bond distances, Gibbs free energy, entropy of formation, temperature of formation, site population and site preference by Fe atoms in OPX were determined. This method can be applied also to interpret physical and other properties of similar ferromagnesium silicate minerals, generated from other solid solutions of Fe-MG.

4.1 Ultrasonic Investigations

C Basu

Tellurite glasses are very special type of glasses. The study of temperature variation of ultrasonic velocity and attenuation in Pb-tellurite glasses of different compositions has been completed. We have noted some distinct discontinuities in ultrasonic velocity and attenuation for all the samples. But unlike Cu-tellurite glasses there is no discontinuity in the velocity variation with composition.

We have undertaken the study of crystallization phenomena in Pb-phosphate glasses. The knowledge of crystallization process is important for identifying glass compositions with high resistance towards devitrification and for fabricating glass-ceramics through controlled crystallization. Our study consists of determination of kinetics of crystallization using differential scanning calorimetry; determination of crystalline phases formed in the glasses which are subjected to different thermal treatments using powder X-ray diffraction and measurement of elastic constants of glassy and crystallized samples. The investigation also includes the attenuation measurement of ultrasonic waves in glassy and crystallized samples.

4.2 Nanoparticles

C Basu

We have initiated some exploratory works on nanophase materials preparation specially semiconductor nanoparticles. We are trying to prepare these materials by precipitation reaction and to characterize them.

5.1 Application of Direct Method in Macromolecules

M Mukherjee

Cytochrome C_6 , from the green alga monoraphidium brauni, is a heme-containing redox protein with 89 amino acid residues. Synchrotron X-ray data (obtained from Protein data bank) with an effective resolution of 1.2\AA and the presence of one iron and three

sulfur atoms enabled the *ab initio* structure determination using Direct method followed by the density modification technique. The graphical package 'O' has been applied effectively to elucidate the three dimensional model of the protein. The success of the experiment with Cytochrome C₆ structure having space group R3 reveals the possibility of substantial automation in the structure determination of proteins especially in the case of metalloproteins for which high resolution data are available.

5.2 Study of Crystal Structures, Structural Disorder and Transitions

M Mukherjee

Crystal and molecular structure determination and conformational studies of four synthetic N/O containing heterocyclic compounds of biological importance using single crystal X-ray diffraction have been carried out. The compounds studied were a) substituted benzoxamines b) substituted pyrimidines c) substituted quinazolines d) substituted trichloroethane. The results have been communicated for publication

6.1 Relaxation Dynamics, Conductivity Spectra and Scaling in Ionic Glasses

A Ghosh

We have studied relaxation dynamics of charge carriers in fast-ion-conducting heavy metal oxide and conducting fluoride glasses in a wide frequency range and in a wide temperature range. Using a recently developed formalism, we have shown that the dynamics of charge carriers and the conductivity spectra in ionic glasses are primarily determined by the hopping frequency (i.e. mobility) rather than the ionic concentration. We have introduced the concept of 'cation constriction' to correlate the ion dynamics with the structure of glasses and have shown that the cation constriction influences strongly the relaxation dynamics. We have also established that the scaling of the conductivity spectra is independent of compositions for fluoride glasses, while in the case of the fast-ion-conducting oxide glasses it depends strongly on the composition range.

6.2 Transport Mechanism and Short

Range Structure in Semiconducting Glasses

A Ghosh

We have investigated the short range structure and transport mechanism of strontium and magnesium vanadate glasses of different compositions and correlated transport mechanisms of these glasses with their short range structure. We have observed temperature dependent transport mechanism in disorder bismuth oxocuprate.

7.1 Light-Emitting Diodes Using Organic Semiconductors

A J Pal

DC, AC, and transient characteristics of light-emitting devices have been studied in devices based on organic semiconductors and conjugated polymers. Apart from spin-cast and vacuum-evaporated films, layer-by-layer self-assembled film deposition technique has been used to obtain ultra thin films of emitting materials. Device efficiencies and operation mechanisms have been compared in the devices fabricated following different routes.

7.2 Photovoltaic Devices Based on Conjugated Organics

A J Pal

With an aim to fabricate large-area photovoltaic devices, we have used layer-by-layer self-assembled films of conjugated organics as active material in such devices. We have initiated the work to compare the device efficiencies and performances in different dye-sensitized devices. We have introduced bulk heterojunctions and interpenetrating networks, which can increase both electron-hole separation and safe transport of the carriers to the electrodes, and therefore increase device efficiencies.

8.1 High T_c Superconducting Oxides and MgB₂

B K Chaudhuri

Bismuth based high T_c oxides of the form Bi-Sr-Ca-Cu-O have been prepared from the glassy phases. Recently it has been observed that some of these

glasses contain nanocrystalline particles/clusters of 20-100nm embedded in the glass matrix. Size and concentration of these nanoparticles depend on the quenching rate, melting time, composition of the glass etc. We are studying various microstructural and other physical properties of these glass-nanocrystal composites and also investigating the corresponding superconducting phases (obtained by annealing). Interestingly, it is noted that the Bi-Sr-Pb-Ca-Cu-K-O glasses, for example, show relaxor type ferroelectric behavior in the high temperature range around 600K. These glasses are also good precursors for the high temperature superconductors. Such a co-existence of superconductivity and ferroelectricity is an interesting phenomenon yet to be thoroughly investigated.

Recently we have started working with MgB_2 superconductor in collaboration with Professor H Sakata and his group (Tokai University, Japan).

8.2 Photoacoustic Spectroscopic Study of Structural Phase Transitions in Ferroelectric Oxides and Study of Concentration Dependent Optical Energy Gap in Magnetic Semiconductor

B K Chaudhuri

We have already studied the change of optical energy gap as a function of magnetic ion concentration in some magnetic semiconductors like Zn-Se-Mn. At present an arrangement is being made to prepare single crystals of Zn-Se-Mn, Zn-S-Mn etc. (using arc melting furnace) to study the change of optical band gap with concentration in these crystals.

8.3 Theoretical and Experimental (Heat Capacity and Dielectric Constant Measurements) Study of Phase Transition in H-bonded Mixed Crystals and in Other Oxide Systems

B K Chaudhuri

The origin of the increase in the number of phase transitions observed in the deuterated $(NH_4)_2PbCl_6$ type crystals has been studied theoretically. Some

of these crystals doped with K, Li and Na have been prepared to study the effect of doping on the deuteration induced phase transitions. This will help us to estimate the contribution of phonons in the transition mechanism. We have also investigated, theoretically, the phase transitions in rare-earth manganites like La-Ca-Mn-O system showing CMR behavior. It is also observed theoretically that these oxides are actually narrow-band gap semiconductors where strong electron-phonon interaction is present and this strong electron-phonon interaction is responsible for the anomaly (associated with the metal-insulator transition) around room temperature.

A pseudo-spin type model (transverse Ising type model) has been proposed to study the phase transitions (change of T_c etc.), spin glass behavior in mixed crystals of $(NH_4Cl)_x - (KCl)_{1-x}$, $(NH_4Br)_x - (KBr)_{1-x}$ etc. and in other H-bonded systems, particularly H-bonded liquid crystals.

8.4 Optical, Dielectric, Magnetic and Other Studies of Colossal Magnetoresistive Materials

B K Chaudhuri

We have studied dielectric spectra of the rare-earth manganites at high ($\sim 500^\circ C$) and low (LN2) temperature. Interestingly, we noticed that large giant magneto resistance observed in these manganites around the metal-insulator transition is also accompanied by giant dielectric anomaly. We have also investigated the magnetic field dependent Seebeck coefficient to separate the magnon contribution in such manganites. Furthermore, the grain size effect on the magnetic and transport properties of the GMR materials have also been measured. Optical conductivity and low temperature Hall measurements of these oxides are also being done. Attempts are being made to prepare thin films of these oxides by sol-gel and other techniques.

8.5 Study of Ferro and Antiferroelectric Liquid Crystals and Molecular Crystals

B K Chaudhuri

We have investigated three ferroelectric and two antiferroelectric liquid crystals of opto electronic applications. We have observed and reported the appearance of an interesting and new phase penetration behavior very close to the FE to AFE phase transition (critical region). Here co-existence of both the phases (FE and AFE) are visualized from the dielectric spectra.

8.6 Study of Transport and Dielectric Relaxation Behavior of Multi-component Transition Metal and Other Oxide Glasses and Nanocomposites

B K Chaudhuri

(V_2O_5 - P_2O_5)- xY , ($Y=TiO_2$, $NbTiO_3$, $KTiO_3$ etc.), (V_2O_5 - Bi_2O_3)- MnO_2 , (V_2O_5 - P_2O_5)- $La_{1-x}Pb_xMnO_3$ ($x=0$ - 0.7) etc. multicomponent glasses have been prepared. Interestingly, the transport and magnetic properties of these glasses show marked differences from those of the corresponding base glasses (V_2O_5 - P_2O_5 , V_2O_5 - Bi_2O_3 etc.). Some of these glasses also show relaxor-type ferroelectric behavior with very high dielectric constant. Proper explanation of such behavior in glassy system has not been possible. We, however, noticed that these glasses contained nanocrystalline clusters (5-200nm depending on the melting temperature, quenching rate etc.) formed during glass formation (studied by transmission electron microscopic technique).

8.7. Study of Ultrasonic and Dielectric Relaxation Behavior in Bio-active Oxide Glasses used for Bone Replacement

B K Chaudhuri

We have prepared some interesting bio-active glasses like Na-Ca-B-Al-Si-P-O, applicable for bone replacement (as reported in the literature), by fast quenching method. Hardness, elastic constants etc. of these glasses have been measured by ultrasonic technique. Since these are high temperature (~ 1400 - $1600^\circ C$) melting oxides, we find some difficulty in melting these glasses in our laboratory.

Recently we have also prepared a typical concentration of this glass by sol-gel technique in collaboration with Dr V. Rajendran, Head, MEPCO Eng. College, T.N., India.

8.8 Study of Magnetotransport and Spin Relaxation Behavior in Superconductors, Rare-earth Manganites, Garnets and Ferrite Under Pulsed High Magnetic Field.

B K Chaudhuri and R.K.Mukherjee

We have successfully applied, for the first time, pulsed field ($\sim 4.5T$) of short duration to study magnetoresistance of GMR materials. Attempts are being made to measure magnetic susceptibility, heat capacity, spin relaxation in magnetic materials like garnets, ferrites and GMR materials under pulsed magnetic field. Magnetothermal properties of several samples showing colossal behaviour have been studied and analysis of the data are in progress. It is found that the heat generated in the sample under high magnetic pulse is a measure of thermal conductivity heat capacity of the sample.

8.9 Development of High Temperature Melting Single Crystal Growing Unit

B K Chaudhuri , R K Mukherjee and D Ghosh

Preparation of some Fe-Ni alloys of two different (Fe30-Ni70% and Fe20-Ni80%) concentrations are in progress.

8.10 Positron Annihilation Study of La-Pb-Mn-O Type Materials

B K Chaudhuri and D Banerjee, CU

We have already studied La-Pb-Mn-O and La-Pb-Mn-Cr-O systems using Positron annihilation technique. Our results showed interesting correlation between positron annihilation life time (t) and other properties like resistivity, magnetization etc. Positron annihilation lifetime measurements at liquid nitrogen temperature is being carried out.

DEPARTMENT OF SPECTROSCOPY

Tridibendra Narayan Misra, *Professor* (Retired on February 28, 2001)

Electronic absorption and emission spectroscopy, Infra-red and Raman spectroscopy, Dark and photoconductivity, Exciton-exciton interaction, Phase transition, Solid state photoreaction, SERS, SERRS, Langmuir-Blodgett films, Molecular electronics, Biosensors.

Associates : (1) P Pal, RA (DST); (2) J Chowdury, SRF.

Prasanta Kumar Mukherjee, *Professor*

Theoretical Spectroscopy: Energy levels, singly excited states and their properties for highly stripped ions; Spectroscopy of confined atomic systems; Energy levels of atoms under exotic environments.

Associates : (1) T K Mukherjee, RA; (2) B Saha, SRF; (3) S Bhattacharya, JRF.

Subrata Chattopadhyaya, *Professor*

Vibrational Spectroscopy, Experimental Studies of Normal Raman, Resonance Raman, Surface Enhanced Raman, Surface Enhanced Resonance Raman, Analysis of Raman Excitation Profiles and Normal Coordinate Analyses.

Associates : (1) P Sett, SRF; (2) S K Brahma & (3) P K Mallick (Collaborator).

Sankar Chakravorti, *Professor and Head*

Raman Spectroscopy, Photophysics and photochemistry of molecules. Excited state photodynamics, Spectroscopy in constrained media.

Associates : (1) S Panja, JRF; (2) P Chowdhury, JRF

Subir Kumar Roy, *Professor*

Phase transition, Electro-optic, X-ray studies and Relaxation spectroscopy of various mesomorphic states of Liquid Crystal Materials.

Associates : (1) S Kundu, SRF; (2) T Ray, JRF; (3) M K Mitra (Collaborator)

T Ganguly, *Professor*

Photophysics and photochemistry of small molecules, bichromophores and the corresponding oligomers conducting polymers and nanostructured semiconductors (quantum dots).

Associates: (1) M Maiti, SRF (DST); (2) T Misra, SRF (CSIR); (3) T Bhattacharya, JRF (CSIR); (4) S K Pal, SRF; (5) C. Deb, RA (joint DST and CSIR projects with Prof. A. De of Organic Chemistry).

B. Mallik, *Professor*

Research fields: Electronic absorption and emission spectroscopy, Laser spectroscopy Semi- and photoconductivity of organics / organometallics.

Associates: (1) A Thander, SRF; (2) M K Sanyal, JRF (July 12, 2000 to Nov.30, 2000).

Gautam Buddha Talapatra, *Professor*

Laser Spectroscopy, Electronic absorption and Emission, Exciton Dynamics, Exciton-Exciton Interaction, Langmuir-Blodgett and Self assembled Films.

Associates : (1) T K Parichha, SRF; (2) S Acharyya, SRF; (3) S Das, SRF; (4) P K Pal, RA .

Krishna Rai Dastidar, *Reader*

Lasing Without Population Inversion, Multiphoton Processes, Squeezed Light, Photodissociation, Non-local Quantum Electrodynamics.

Associates: (1) R K Das, SRF; (2) A Bhattacharya, JRF.

Abhijit Kumar Das, Lecturer

Spectroscopic studies of the highly stripped ions and their applications to high temperature plasma diagnostics. Quantum chemistry of photo-biological systems.

1.1 National Laser Programme

T N Misra and G B Talapatra

a) Adsorbate concentration dependence of surface enhanced Raman scattering

It has been observed that within a certain concentration range, with small change in adsorbate concentration the SER spectra of isomeric benzoyl pyridines show significant change in their features, indicating different orientational change of different part of these flexible molecules on the colloidal silver surface. SERS excitation profile indicate that the resonance of the Raman excitation radiation with the new aggregation band contribute more to SERS intensity than that with the original sol band.

b) Study of time evolution of SERS bands

From the time evolution of SERS of *a*-bithiophene and *a*-terthiophene molecules show that the orientation of the molecule in the adsorbed state control the rate of the adsorption process and it has been concluded that the adsorption of these molecules on the silver surface through the S-atom is a faster process than that through the p-electrons. SERS spectra of isomeric benzoylpyridine molecules also show time evolution originated from the co-adsorption and replacement kinetics of the adsorbed solute and solvent molecules on the silver surface.

1.2 Spectroscopy of Molecules Organized in Langmuir-Blodgett Films.

T N Misra

Electronic absorption spectra of the *as-prepared* film

of Rh 123 reveals broadening of the absorption band and a finite red shift of 22nm of the absorption peak maximum in LB film compared to its solution spectra. This red shift is an indication of the aggregation of Rh 123 molecule in LB film. About 3-4 orders magnitude enhancement in Raman intensity is observed in SERS of Rh 123 in LB film compared to normal Raman spectra. Electromagnetic enhancement is found to be responsible for enhancement of the Raman bands in LB film. Considering the surface selection rule to be applicable, the orientation of the Rh 123 molecule organized in LB films have been estimated. The estimated enhancement factors of the principal Raman bands Rh 123 indicate that the xanthere ring plane is neither flat nor perpendicular to the surface but is tilted.

2.1 Spectroscopy of Highly Stripped Ions

P K Mukherjee

Energy levels and transition properties of multiply stripped closed and open shell ions of astrophysical interest are currently under study using time dependent variation perturbation theory. New results useful for high temperature plasma diagnostics are obtained. Relativistic corrections to energy levels and other properties under non relativistic model are presently aimed at.

2.2 Spectroscopy of Confined Atomic Systems

P K Mukherjee (Collaborative project with G H F Diercksen, MPI, Garching)

Energy levels of atoms under plasma confinement are under investigation. Correlated calculations performed under Debye screening model show interesting behaviour. Highly accurate variational calculations under such screening are under progress.

2.3 Spectroscopy of Atoms Under Exotic Environments

P K Mukherjee (Indo-Polish DST Project with Jack Karwowski)

This project is currently under progress with the aim of analyzing various confinement effects in atomic

energy levels with inclusion of relativistic effects. GRASP II computer program will be utilized for such a study.

3.1 Surface Enhanced Raman Scattering

S Chattopadhyaya

The surface enhanced Raman Scattering of a few pyridyl azo dyes in silver sol are being investigated where besides the predominant enhancement factor of some of the Raman laws and an idea about the orientation of the molecules with respect to surface (silver sol) is obtained.

3.2 Analysis of Raman Excitation Profiles

S Chattopadhyaya

From a critical analysis of several Raman excitation of some molecules, viz, biphenyl and three isomeric acetyl pyridines and acetophenone and the contribution of different excitation states of Raman Scattering have been obtained.

3.3 Normal Co-ordinate Analysis

S Chattopadhyaya

Normal coordinate calculation of triphenyl molecule has been carried out and values of frequencies have been found to agree favorably with the observed experimentally.

4.1 Photophysics and excited state properties of some photosensitizers

S Chakravorti

From the excited photodynamics of 4-N,N-dimethylamino cinnamaldehyde it was established that the dual fluorescence is due to intramolecular charge transfer (TICT) and in protic solvent there is a competition between intermolecular hydrogen bonding and TICT state where efficient fluorescence quenching channel trammels the TICT formation. 1:1 inclusion complex with β -cyclodextrin was found to occur with this molecule and more importantly orientational selectivity of inclusion complex was observed in aqueous and non-aqueous environment. Different features of dual fluorescence of 1-

phenylistin and Oxindole were delineated and the first compound was identified as a potential laser dye in suitable active medium.

5.1 Polymer stabilized Ferroelectric Liquid Crystal (PSFLC)

S K Roy

In order to study the mechanical stability of Ferroelectric liquid crystal in polymer network, the various modes of vibration of FLC as well as PSFLC molecules as a function of bias field and temperature has been determined in confined environment. Relaxation spectroscopy and electro-optical properties of Antiferroelectric liquid crystal molecules are being carried out.

5.2 Studies of higher order mesomorphic phases and their orientational order parameters by X-ray diffraction.

S K Roy

X-ray studies are being carried out on a liquid crystal molecule having nematic, smectic A and smectic E phases. Intermolecular distance and layer thickness of higher order phases and their orientational order parameters $\langle P_2 \rangle$ and $\langle P_4 \rangle$ of the samples will be determined.

6.1 Spectroscopic Investigation of Langmuir-Blodgett (LB) Films of Benzo(k)-fluoranthene

G B Talapatra

Non amphiphilic benzo(k)-fluoranthene (BFL) mixed with stearic acid (SA) has been incorporated in LB film. TT(π)-A-isotherms at different compositions reveal that the area per molecule decreases with increasing mole fraction of BFL. The area per molecule vs. mole fraction show positive deviations to the idealized data, indicates formation of aggregates Formation of J-type aggregates has been confirmed by studying absorption and fluorescence spectra. Changing mole fraction, number of layers, as well as the surface pressure of lifting can precisely control the order of aggregation.

6.2 Spectroscopic Characteristics of 9-

Cyanoanthracene mixed with Stearic acid and Polymethyl Methacrylate in Langmuir-Blodgett (LB) Films

G B Talapatra

Multilayers of stable Langmuir films of 9-Cyanoanthracene (CNA) mixed with Stearic acid (SA) as well as with Polymethyl Methacrylate (PMMA) at various mole fractions of CNA have been transferred onto quartz substrate to form stable LB films. At very low mole fraction of CNA; aggregation was formed in case of CNA-SA mixed LB films, while for CNA-PMMA, no such aggregation was found. The study of absorption and emission spectra confirms the formation of aggregates.

6.3 Design And Fabrication Of "Layer-By-Layer Sequential Adsorption" Instrument

G B Talapatra

The design and fabrication of a fully automated computer controlled programmable specialized instrument to produce layer-by-layer self-assembled high quality films has been under way. The design aspects of the instrument is such that in which one can build ultrathin films with supramolecular structure involving a wide variety of materials, manipulate the structures by simply changing solution parameters, use any size and type of substrate, vary the thickness of each bi-layer by simply selecting the pH of the polyions.

6.4 *Ab initio* molecular orbital calculation of linear polarizabilities of some model organic molecules having cinnamoyl structures

G B Talapatra and K Ohta (Photonic Chemistry Section, Department of Optical Materials, Osaka National Research Institute)

The basis set dependence of polarizabilities of some model organic molecules having cinnamoyl structures (trans-cinnamaldehyde, 3-phenylpropionaldehyde, methyl trans-cinnamate, methyl 3-phenylpropionate, ethyl trans cinnamate, and ethyl 3-phenylpropionate) have been studied using *ab initio*

CPHF method. The standard basis sets such as STO-3G, 6-31G, 6-31G* and 6-31G** with /without the inclusion of diffuse function were studied. Apart from the above basis sets, triple zeta sets, such as 6-311G, 6-311G** and when possible, 6-31+G(3df)+d have also been used for the calculation.

7.1 Analytical uses of coherent short wavelength vacuum ultraviolet laser sources for the detection and characterization of organic molecules and complex liquids exhibiting hydrogen bonding and hydrophobic effects.

B Mallik

The organic samples under investigation were excited by the coherent short wavelength vacuum ultraviolet laser source at the Supersonic Jet and the formation of laser induced products was studied by using the Time-Of-Flight Mass Spectrometry. Experiment with pure alcohols as well as binary mixtures of alcohols (e.g. methanol, ethanol etc.) has indicated the presence of hydrogen-bonded clusters in the vapour phase above the pure as well as binary mixtures of the alcohols.

7.2 Spectroscopic, Dark and Photoconductive Properties of Some Organometallic Compounds

B Mallik

Spectroscopic investigation has indicated photoinduced charge-transfer between ferrocene derivative (such as ferrocenemethanol, ferrocenecarbaldehyde, ferrocenecarboxylic acid, acetylferrocene) and chloroform molecules confined in the poly methyl methacrylate (PMMA) thin films. The photoresponse decreases with the increase in the value of the *para* Hammett constant for the substituent in the ferrocene unit and also with increasing half-wave potential for the ferrocene derivatives.

8.1 Photophysical Investigations on some

synthesized aryl bridged compounds by steady state, time resolved spectroscopic and electrochemical techniques

T Ganguly

Electronic absorption and steady state fluorescence and time resolved spectroscopic investigations were made on some aryl bridged compounds. Laser flash photolysis and electrochemical measurements demonstrate that these compounds are highly efficient as electron donating agents.

8.2 Photoinduced electron transfer studies on some novel synthesized benzothiophene donors. An approach to develop artificial photosynthetic devices

T Ganguly

Transient absorption spectra of some newly synthesized benzothiophene donors show the radical ion-pair formations, resulted from photoinduced electron transfer reactions, in the ground state indicating non-adiabatic nature of the reaction.

8.3 Photoinduced nonradiative processes and studies on photoconducting materials

T Ganguly and B Mallik

Photoconductivity experiments are being carried out to find the gain, measure of photoactivity, by xerographic and other standard techniques, on some systems comprising electron donors and acceptors.

8.4 Measurements on photogenerated charge carriers within nanostructured semiconductors

T Ganguly

By using electrochemical techniques, investigations are being made on TiO₂ nanostructured (<10 nm) semiconductor electrode to examine the photocarrier generation efficiency (electron accumulation) under UV radiation. Effect of size and shape of the nanomaterials on the charge separation efficiency are being studied.

9.1 Lasing Without Population Inversion

Krishna Rai Dastidar

Feasibility of Lasing Without Population Inversion (LWOPI) in small Diatomic molecules (Li, H₂ and LiH) is being theoretically studied by considering three level ladder, V and Lambola configurations, in presence of strong coherent field. It is found that the lasing can be obtained in different frequency range and the emission spectra depend on the choice of different vibrational and rotational levels as the upper lasing levels. Interaction of squeezed light with molecules giving rise to lasing with and without population inversion has been studied.

9.2 Laser-assisted Multiphoton processes in gases

Krishna Rai Dastidar

We have given a model for n-photon non-sequential double ionization by using non-local quantum electrodynamics for two-photon transitions, where two-photon rate is linearly dependent on laser intensity. Whereas for sequential double ionization local two-photon transition rate is proportional to square of the laser intensity. The double ionization rate can be modeled as a series of these two types of transitions and by considering different models for different laser intensity effects, we have found that the kink-like structure in the ionization yield as a function of laser intensity can be obtained, similar structure has been observed previously.

9.3 Model of Non-Local Quantum electrodynamics

Krishna Rai Dastidar

We have pointed out that in the phase correlated two-photon non-local absorption, leading to above-threshold ionization in atom, may not show any signature of electron correlation. This apparently perplexing feature has been observed in above-threshold ionization of Argon atom.

9.4 Photodissociation of molecules

Krishna Rai Dastidar

We have studied photodissociation of NaH and LiH molecules using time Dependent Fourier Grid Method. We have found that the photodissociation spectrum and the photon energy for maximum cross-section are different for the three different sets of potential energy curves for $X^1\Sigma$ and $B^1\Pi$ states (as obtained in the literature). Our results are significantly different from a previous calculation where the curves have been rearranged.

10.1 Low and high-lying Rydberg excited states of molecules

A K Das

The knowledge about the excitation properties of molecules having germanium has become radically important because of their wide practical use in semiconductor industry. The excited states of these molecules play a key role for the understanding of the photo induced chemical vapor deposition processes. Such molecules have been detected in the atmosphere of Jupiter and Saturn and is expected to be of major importance in the atmospheres of these giant planets. Moreover there are discrepancies among different experimental results regarding the assignment of excited levels.

10.2 Ionized and electron attached states of

molecules

A K Das

The ionized and electron attached states of molecules containing germanium have been studied to accurately predict the experimental spectra of such molecules.

10.3 Theoretical study of excitation spectra of bio-molecules

A K Das

The electron transfer process in bacterial reaction centres of Rhodobacter Sphaeroids are being studied by modelling chromophores and by calculating the binding site dependent electron affinity and reaction energy. It has been achieved so far that the residues tune the electron affinity of chromophores in electron transfer process.

10.4 Rydberg states of highly ionized atoms

A K Das

The study of Rydberg states of highly ionized atoms are important for the diagnostics of astrophysical and laboratory plasma. It also plays a key role to identify unknown lines obtained from astrophysical sources.

Arnab Sekhar Ghosh, Professor

Electron (Positron)-atom/molecule-collision at low and intermediate energies.

Associates: (1) M Tewary, JRF; (2) M Ghosal, JRF (resigned w.e.f 2.11.2000); (3) A Basu, JRF (CSIR); (4) P K Sinha (Hony); (5) A Chakraborty (Hony).

Vinod Prakash Gautam, Professor

Four body equations, fusion, hadron interactions, chiral symmetry and quark gluon condensates, QCD, String theory, Quark-gluon-plasma, heavy quark decays in standard model and beyond.

Associates: (1) M Nandy (Hony.); (2) S K Biswas (Hony); (3) H P Ray (Hony); (4) S Sengupta (Hony); (5) A K Maity (Hony).

Deba Prosad Bhattacharyya, Professor & Head

Astroparticle Physics and Particle Astronomy, Cosmic abundance, Nuclear Physics and Environmental Science and Biodiversity.

Associates: (1) M Mitra RA; (2) B Malakar, RA; (3) N Gupta, SRF; (4) J Dey (Hony); (5) K Samajpati (Hony); (6) N H Molla (Hony); (7) S Saha (Hony); (8) P Guptaroy (UGC Teacher Fellow); (9) T Halder (Hony); (10) P Pal (Hony); (11) A Mitra (Hony); (12) K Basu Choudhury (UGC Teacher Fellow).

Jayanta Kumar Bhattacharjee, Professor

Non linear dynamics and statistical physics.

Associates: (1) S Bhattacharyya, SRF (CSIR); (2) A K. Chattopadhyay, SRF (CSIR upto July 2000); (3) K Das, SRF; (4) S Datta, RA (CSIR); (5) D Sanyal, JRF (CSIR); (6) A K Ray, JRF (CSIR); (7) P Das, SRF; (8) A Bhattacharya, (Hony).

Kanika Roy, Professor

Atomic collisions with electron, positron and ions

Associates: (1) S Sahoo, RA; (2) R Das, SRF, (3) S Bhattacharyay (Hony).

Jayprokas Chakrabarti, Reader

Particle physics, Many body problems including high-temperature superconductivity, Neural and Quantum networks, Biological sequence analysis, Many body systems, Bosonisation, Electron in external Magnetic Field, Statistical aspects of biological chains like DNA, RNA, Evolution of DNA.

Associates: (1) A Som, SRF, (2) S Chattopadhyay, SRF, (3) A Basu (Hony.), (4) W A Kanner (John Fullbright Fellow, Sept 2000-July 2001); (5) B Bagchi (Collaborator); (6) D P Bandyopadhyay (Collaborator); (7) R Chaudhury (Collaborator); (8) S Sahoo (Collaborator).

Chandana Sinha, Reader

Atomic collisions with electrons, positrons and ions and also in presence of laser field, Quantum chaos.

Associates: (1) A K Das, JRF (resigned w.e.f 3.3.01), (3) B Nath (Hony), (2) A Dutta (Hony).

1. Positron and Positronium Physics

A S Ghosh

Recently interest has been focussed on Positronium-atom scattering. A good number of measurements have been carried out at low energies. The measured data differ amongst themselves significantly. Investigations have been carried out on Ps-H scattering at low and intermediate energies. Both projectile and target atoms have internal degrees of freedom. Internationally inelastic channels have been induced in the framework of target elastic close coupling

method. In our recent attempts projectile elastic CCA has been employ at using different basis sets

- a) $\text{Ps}(1s) + \text{H}(1s, 2s, 2p, 3s, 3p, 3d)$
- b) $\text{Ps}(1s) + \text{H}(1s, 2s, 2p, 3s, 3p, 3d, 4s, 4p, 4d)$
- c) $\text{Ps}(1s) + \text{H}(1s, 2s, 2p, 3s, 3p, 3d)$

Where in the model (c) $n=3$ states are pseudostates. It has been noticed that target inelastic channels effect the low energy elastic cross section appreciably. In atom-atom scattering, van der Waals interaction plays a crucial role. Considering this, we employ full CCA with following basis set

$$\text{Ps}(1s, 2s, 2p) + \text{H}(1s, 2s, 2p)$$

to study the Ps-H scattering problem. Inclusion of 2p states of both the atoms includes van der Waals force dynamically. The scattering parameters are reliable and the variational predictions are in good accord with those of ours.

2. Ion-Ion, Ion-Atom & Atom-Atom Collisions

K Roy

We calculate the total & differential cross sections for the ionization of hydrogen like ions (He^+ , Li^{2+} , Be^{3+} , B^{4+} , C^{5+}) by impact of bare ions and find out in the energy range of 10 to 2000 KeV/amu using a continuum state wave function which incorporates the distortion due to Coulomb fields of both the projectile & residual target. We find that our results always agree well with the experimental data at intermediate & high energy region.

We propose a theoretical model to calculate the ionization cross sections of heavy particle collisions in the impact parameter formalism. There we consider the influence of coupling with the important bound states in the direct as well as in the rearrangement channels in a two-centered atomic state approximation. In particular, the capture channels can be considered as a coupling with the ionization. We calculate the total ionization cross sections of systems $\text{He}^{++} - \text{H}$, $\text{He}^{++} - \text{He}^+$ & $\text{H}^+ - \text{He}^+$ and obtain the value which are found to be in very good agreement with the experiment at low and intermediate energy region.

We calculate the total ionization cross sections of

mono-electron & multi-electron targets by neutral hydrogen atom impact at different impact energies by First Born approximation. For multi-electron targets, simplifications are made assuming that the target has only one active electron & is influenced by an effective potential due to the passive electrons & the residual target core. The results thus obtained are in reasonably good accord at high energies with other existing theoretical & experimental values.

3. Ionisation and Excitation of Atoms by Electron and Positron Impact

C Sinha

The fully differential cross sections (5DCS) have been studied for the double ionization of H^+ ion using a correlated wave function for the target and a partially correlated double continuum in the final channel in both symmetric and asymmetric kinematics. Unlike other previous theoretical works for this process, the long-range Coulomb interaction arising between the projectile and the target ion has been taken into account in both channels within the framework of the Coulomb-Born approximation.

Triple differential cross sections (TDCS) have been studied for ionization of some helium like ions by fast electron impact in the coplanar geometry using a final-state correlated wave function that satisfies the asymptotic three body boundary condition and incorporating electron exchange effect properly. The initial channel wave function involves a Coulomb wave due to long-range Coulomb attraction between the incident electron and the screened ionic nucleus. The behaviour of the scaled TDCS with respect to the variation of the ionic charge (Z_1) for different ions in the helium isoelectronic series have been studied for asymmetric geometry for different sets of kinematics. A strong recoil peak is noted at low incident energy for all the ions except for the ions of high charge.

A model is proposed to study the inner shell (K-shell) ionization of the inert gas atoms (e.g. Ne, Ar etc.) by fast electron impact in coplanar geometry in the framework of a distorted wave approximation using RHF wave function for the multi electron target

atom. Triple differential cross-sections (TDCS) are presented for both symmetric and asymmetric kinematics of Ne atom. The most salient feature noted in the TDCS structure is the presence of intense recoil peak which for certain dynamics (particularly when the ejected energy is much lower than the K-shell binding energy) is even larger than the binary peak, an unusual feature for the outer shell ionization process. Results are in more or less good agreement with the experiments.

4. Laser Assisted Collisions

C Sinha

An approach has been developed to study the differential and total excitation cross sections of a ground state hydrogen like ion to its first excited state ($n=2$ level) under the simultaneous electron-photon impact in the framework of Coulomb Born approximation. The laser field is treated as monochromatic, linearly polarized, homogeneous and the frequency is assumed to be low (soft photon limit) so that a stationary state perturbation theory can be applied as is done in the adiabatic theory. The dressed wavefunctions for the ground state and excited states for the hydrogen ion have been constructed using first order perturbation theory. The dressed wavefunctions for the incident and scattered electron are obtained in the combined Coulomb and laser field.

5. Polaron

C Sinha

An approach has been proposed to study the scattering cross section, e.g., differential (DCS) and momentum transfer (MTCS) of a bound polaron in presence of a Coulomb impurity center as well as an external single mode, linearly polarised laser field. The main underlying assumptions of the present prescription are (i) the frequency of the laser field (ω_L) is assumed to be much larger than the optical phonon frequency (ω_p), (ii) the electrical component of the laser field intensity (ϵ_0) is kept much below the dielectric breakdown limit, (iii) the electron-phonon coupling parameter (α_p) is taken in the strong coupling region. The DCS is always

found to be perfectly symmetrical around the scattering angle 90° . The variation of the MTCS with respect to α_p , ω_L and the strength of the Coulomb impurity (β) have been studied.

6. Elementary Particle Physics

V P Gautam

Considering coloured singlet equation of state for a quark gluon plasma velocity of sound has been estimated also the first and second order phase transition has been investigated elaborately.

7. Non-linear Dynamics and Statistical Physics

J K Bhattacharjee

The main work done in the previous year centres around a small but observable effect in dynamic critical phenomena. Because of the strong critical fluctuations, the shear viscosity of a fluid shows a divergence (weak) near the liquid-gas critical point. If the viscosity is measured by an oscillating viscometer, the response is at a finite frequency and not at the usual zero frequency approximation of hydrodynamics. So long as the decay of critical fluctuations occur on a time scale much faster than the time period of the viscometer oscillation, the system fails to notice that the viscometer is oscillating and the usual hydrodynamic viscosity is measured. As the critical point is approached the fluctuations became long lived and can actually feel the effect of the oscillation of the viscometer. The measured viscosity will now be dependent on the oscillation frequency of the viscometer. This effect was predicted in the eighties and subjected to several experimental tests, the most accurate being the experiment done in the space shuttle in the late nineties. The last experiment revealed a quantitative mismatch between the theory of the eighties and the accurate experiment. We have calculated the higher order terms in perturbation theory to remove the discrepancy between theory and experiment.

8. Astroparticle Physics

D P Bhattacharyya

8.1 Muon and neutrino astronomy

D P Bhattacharyya

The vertical muon energy spectra at sea level have been estimated from the measured primary cosmic ray nucleon spectrum. The hadronic energy moments have been calculated from the CERN. LEBC EHS data on the Lorentz invariant cross section results for nonprompt mesons in pp interactions and subsequently are corrected for A-A collisions. The sea level muon energy spectra have also been calculated from the decay of conventional mesons using standard formulation. The estimated muon spectra are found in well agreement with the directly measured muon spectra obtained from the different experiments.

The flux of neutrino induced muons for different zenith angles has been calculated using the high energy neutrino spectra produced from active galactic nuclei (AGN). We have used the standard formulation developed by Gaisser which is, in general, based on charge-current interactions in rock along with the QED-based energy loss formulation to estimate the spectra of neutrino induced muons. The energy spectra of neutrino flux generated from AGN has been taken from the model calculations of Protheroe, Mannheim and Stecker et al. Latest charge-current and total cross-sections at ultrahigh energies from Kwiecinski et al. have been used to find the probability of muon generation from neutrinos and the loss of neutrinos during propagation through the Earth.

8.2 Cosmic Abundance and Nuclear Physics

D P Bhattacharyya

An investigation has been made on the matter traversed by cosmic ray nuclei in the interstellar medium (ISM) before they are detected experimentally. We have adopted a model which is slightly different from the conventional DRAC model with a new interpretation to the parameter "escape path length". We assume that the matter traversed before observation is different from the escape path length and

we find its value by calculating the secondary to primary flux ratios at the top of the atmosphere and fitting them to the experimental measurements. It is found that the energy dependence of the matter traversed obeys the parabolic form in the spectral range $E < 2$ GeV/nucleon and it can be described by logistic equation for the energy region $E > 2$ GeV/nucleon.

8.3 Gamma-ray Astronomy

D P Bhattacharyya

A detail investigation has been made on the muons reduced from gamma rays emitted by Markarian 501.

9. High Energy Physics

D P Bhattacharyya

The non-relativistic quantum chromodynamic interactions of heavy quarks are discussed to order $1/M^2$. From our analysis it turns out that at order $1/M^2$ the essential interactions are spin orbit interactions and a generalised "Darwin type" interactions caused by the heavy-quarks Zitterbewegung in the gluonic background. We have systematically analyzed the two-body weak radiative Λ_c decay to Λ_c of bottom baryon. The weak radiative decay proceeds through W-exchange accompanied by a photon emission.

Effective Lagrangian has been used for the W-exchange bremsstrahlung processes to estimate the long distance effect through pole. The short distance effect at the quark level ($b \rightarrow s\gamma$) are also estimated here.

10. Environmental Science & Biodiversity:

D P Bhattacharyya

An investigation has been made on the monitoring of water quality and accumulation pattern of heavy metals in mangroves and associates along the coastal stretch of West Bengal. The purpose of such study to identify those plants that can absorb considerable concentrations of heavy metals in their body tissues and it may act as a path finder to control heavy metal pollution in the coastal zone.

A survey has been made on the spatial diversity of the phytoplankton species in the north-east coast of the Bay of Bengal.

11. Many Body Systems, Bosonisation, Electron in external Magnetic Field

J Chakrabarti

The bosonisation program of Chakrabarti, Basu and Bagchi has been extended to higher dimensional systems. In $2+1D$ we have checked and verified the consistence of the scheme.

We started on the problem of electron in external magnetic field for the case the field is commensurate with the lattice.

12. Statistical Aspects of Biological Chains

(DNA, RNA)

J Chakrabarti

We considered the scaling features of directed random walk in 4 dimensional space and for the coding DNA sequences. We found that there are statistically significant differences.

We considered the codon distributions in coding DNA sequences and compared it with word distributions in natural languages. The codon distributions, we found, have certain Universal characteristics.

13. Evolution of DNA

J Chakrabarti

We considered a family of glycolytic enzymes. The DNA that code for these enzymes are present in wide variety of organisms - from the lowest bacteria to the highest mammals. We found the statistical quantities that change with evolution for these glycolytic enzymes.

A K Barua, *Professor*

Large area multijunction of amorphous silicon modules, ITO Coating, dielectric coating.

Associates: (1) M Jana, SRF (jointly with Dr. D Das); (2) A Sarkar, JRF (DST, MNES); (3) C Banerjee, JRF; (4) S Bose, RA (DST, MNES); (5) S Bhowmik, RA (DST, MNES).

Swati Ray, *Professor and Head*

Intrinsic Microcrystalline/ Nanocrystalline Si films for Solar Cells, $\text{SiO}_x\text{:H}$ layer by Photo-CVD, Zinc Oxide, Polycrystalline silicon thin films by SPC.

Associates: (1) S C Saha, RA ; (2) T Jana, RA (CSIR); (3) N Palit, RA (jointly with Dr. P Chatterjee); (3) S Mukhopadhyay, SRF (CSIR); (5) C Das, SRF; (6) R Das, JRF.

Partha Chaudhuri, *Reader*

Plasma diagnostic, Polymorphous silicon using argon dilution of silane.

Associates: (1) P P Ray, SRF; (2) N Dutta Gupta, SRF.

Parsathi Chatterjee, *Reader* (DST, MNES Project)

Theoretical modelling of solar cell.

Associates : (1) N Palit, SRF (jointly with Professor S Ray), (2) U Dutta, SRF.

Debajyoti Das, *Reader* (DST, MNES Project)

mc-Si:H/ $\text{SiO}_x\text{:H}$ layer.

Associate: M Jana, SRF (jointly with Professor A K Barua).

1.1 Development of Intrinsic Microcrystalline/ Nanocrystalline Si films for Solar Cells

S Ray

Control on fraction of microcrystallinity in silicon thin films has been realized varying the hydrogen dilution and substrate temperature. Interesting properties have been observed in the amorphous to microcrystalline transition region. Under certain conditions nanocrystalline films have been produced with low light induced degradation. Using Very High Frequency PECVD, silicon carbide and microcrystalline silicon films have been prepared at high deposition rate. Solar cells have been fabricated with the microcrystalline silicon as the active layer prepared in the newly set-up ultrahigh vacuum single chamber deposition system. Efficiency achieved till now is 5.4%. Degradation of this cell under light exposure is very little compared to amorphous silicon solar cell.

1.2 $\text{SiO}_x\text{:H}$ layer by Photo-CVD

S Ray

Silicon oxide films have been developed at low temperature (250°C) by mercury sensitized photo-CVD technique using silane, nitrous oxide and hydrogen gas. Varying the relative concentration of nitrous oxide and silane, refractive index of the layer was changed. The layer can be used to passivate the grain boundary defects present in microcrystalline/ polycrystalline silicon to reduce surface recombination losses.

1.3 Zinc Oxide: a transparent conducting IR reflector

S Ray

Zinc oxide films have been developed by RF Magnetron sputtering. The films are transparent in the visible region. Using reactive sputtering, stoichiometry of the Al doped ZnO was varied and

the film with 10^{-4} Wcm⁻¹ resistivity and 90% transmission in the visible range has been obtained. The films cut-off the infrared portion of the spectrum beyond 1400 cm⁻¹. Various applications are possible using these excellent properties of the ZnO films.

1.4 Polycrystalline silicon thin films by SPC

S Ray

A vacuum oven has been set-up where change in conductance of the films can be monitored in situ with annealing time and the process is computer controlled. Amorphous silicon films have been prepared at high deposition rates. The amorphous films are then annealed at 600°C for several hours. Polycrystalline films have been realized and the process of crystallization has been studied. The grain size varies from 2 to 3 mm as investigated by SEM.

1.5 Plasma diagnostic study

P Chaudhuri

Under a DST sponsored project the PECVD system has been modified to install plasma diagnostic equipment. We have studied glow discharge plasma with different gases. Argon has been preliminary used for the study. Plasma parameters like plasma potential, electron temperature, electron density and EEDF, ion density etc. are being measured with the help of an indigenously designed and fabricated Langmuir probe. Optical emission spectroscopy is also used to study the excited radicals within the plasma. The project has been completed and the final report has been submitted to DST.

1.6 Polymorphous silicon

P Chaudhuri

A project has been started jointly with a French group to develop a new variety of Si:H alloy which has been termed "polymorphous silicon". Preliminary studies have shown that the material has lower degradation compared to standard amorphous silicon. Under this project the material will be investigated further and devices will be tested with this material. The project is funded by Indo-French Centre for the Promotion of Advanced Research.

1.7 Fabrication of Large area multijunction of amorphous silicon modules

A K Barua, S Ray, D Das and P Chatterjee

Under a project jointly funded by the Ministry of Non-conventional Energy Sources and Department of Science and Technology, govt. of India a prototype production line for the fabrication of large area multijunction a-Si solar modules is being set up. The design of the equipment that has state-of-the art features has been completed and fabrication of the line is in advanced stage of completion. This will be first indigenously designed and fabricated production line for solar modules in India. The Laser Scribing System for integration the individual cells has been imported. The line is expected to be operational in September 2001.

As a part of the R and D related to the project high quality amorphous and mc-SiO:H films suitable for use as the window layer has been developed by the RF-PECVD method. This material has been successfully used as window layer of single and double junction a-Si solar cells.

n-type SiO:H amorphous and microcrystalline films have also been developed. This material has wide band gap (E 1.9 eV) but photoconductivity similar to that for n-a-Si:H films having band gap ~ 1.7 eV. This material has the potential for being used as the bottom n-layer and at the tunnel junction of a-Si solar cells.

For increasing throughput it is essential to increase deposition rate. By using Ar and Ar + H₂ as diluent the deposition rates of undoped and n-type mc-Si:H films to ~ 2.5Å/min from 6-7Å/sec generally obtained with H₂ as the diluent gas.

1.8 Development of ITO Coating for aircraft Canopy/windshield

A K Barua

This work is being done under a project funded by Aeronautical Development Agency (DRDO), Bangalore. It has been possible to develop ITO coating with proper characteristics on polycarbonate

and acrylic based substrates. However the coating on acrylic based substrates show increase in sheet resistance with time which is due to the porosity of the film. Attempt is being made to develop a suitable transparent coating to protect ITO layer.

1.9 Development of dielectric coating

A K Barua and S Ray

This project is being funded by Hindustan Lever Limited. The objective is develop suitable coating on glass and other types of substrates which will cut solar radiations $\lambda > 770$ nm. Good progress has been made with ITO coating on glass which cuts wavelengths $\lambda > 1600$ nm. Steps are being taken to fabricate ITO/TiO₂ multilayer for meeting the objective of the Project.

1.10 Theoretical modelling of solar cell

P Chatterjee

During this period our one-dimensional electrical-optical model ASDMP (Amorphous Semiconductor Device Modelling Programme) has been used to study the various hole transport mechanisms at the tunnel - recombination junction of thin film tandem solar cells and their effects on the illuminated current-voltage characteristics. For this purpose computer simulation of experimental current density-voltage (J-V) and quantum efficiency characteristics of thin film p-i-n-p and of double junction cells have been performed. The experiments were performed by Prof. S Ray's group. Two different types of p-layers at the junction have been studied : (i) hydrogenated microcrystalline silicon (mc-Si:H) and (ii) hydrogenated amorphous silicon carbide (a-SiC:H). The suitability of phosphorous-doped microcrystalline silicon n-layers (n-mc-Si:H) in single junction a-Si:H based solar cells, as a substitute for n-a-Si:H, has been probed using our ASDMP computer code, in conjunction with experiments, as part of an ongoing collaborative work with the group of Dr. P Roca i Cabarrocas at the Laboratoire PICM, Ecole Polytechnique, France. During this period, our ASDMP model was also used to analyse and optimise the performance of single junction solar cells with a-SiGe:H intrinsic layers,

and double junction a-Si:H/a-SiGe:H cells. Also during this period significant progress has been made to incorporate the defect pool model into our computer code, as an alternative way to describe the gap states in amorphous semiconductors. The process is expected to be completed in the next few months. Finally ASDMP has been used to analyse and optimise the performance of single junction cells incorporating new materials as intrinsic layers. One such material is a-Si:H prepared by 90% Argon dilution in our laboratory by Dr. P Chaudhuri's group; and another polymorphous silicon (pm-Si:H) prepared by suitable hydrogen dilution by Dr. P Roca i Cabarrocas' group at Ecole Polytechnique, France.

1.11 mc-Si:H/SiO:H layer

D Das

A favourable combination of high doping efficiency, high carrier mobility and low optical absorption has demonstrated the mc-Si:H/SiO:H material as enormously useful in the thin film technologies, particularly, its doped version as a window layer and also at the tunnel junction in a-Si based solar cells. In the preparation of mc-Si films by RF-PECVD, very high H₂-dilution of the SiH₄ plasma though efficiently facilitates the growth process but reduces the deposition rate drastically and that stands against the throughput at the production line for device fabrication using this material. By introducing argon to the hydrogen diluted silane plasma and controlling deposition parameters, we have tried to optimize doped and undoped mc-Si:H film properties maintaining a high deposition rate. Utilizing the atomic-H induced microcrystallization, very thin layer mc-Si films have been prepared by Layer-by-Layer growth process and compared to that prepared by Ar-induced process, with a view to utilizing those at the tunnel junction of the solar cells. By using CO₂ as the source of oxygen, doped and undoped mc-SiO:H films have been prepared for its efficient utilization as window layer in multijunction solar cells. Different individual layers have been used in the fabrication of single and double junction solar cells and significant improvement in the conversion efficiency has been achieved.

M LS PROFESSOR'S UNIT

Dipankar Chakravorty, *MLS Professor of Physics*

Amorphous Materials, Nanomaterials.

Associates : (1) M Pal RA (CSIR), (2) D Das SRF, (3) A Dan SRF, (4) K Chatterjee JRF (CSIR), (5) P Mukherjee JRF (CSIR), (6) B N Pal JRF (CSIR), (7) P Brahma (Hony.), (8) N Maiti (Hony.).

Research Activities

D Chakravorty

A core-shell structure in Ag_2O nanoparticles induced by a suitable heat treatment has shown an interesting optical absorption characteristic. This has been explained as arising due to a quantum confinement effect of carriers in the metallic shell. Nanocomposites of silver in a glass-ceramic containing the ferroelectric lithium niobate phase show a

large increase of dielectric constant as compared to that of the precursor glass-ceramic. Such an enhancement has been shown to be electronic in origin. Oxide-coated iron nanoparticles have been grown within a silica gel matrix by electrodeposition. Electron microscopic studies show these to possess a structure in which iron forms the core and Fe_3O_4 forms a shell. Magnetization measurements show a loop shift below $\sim 100\text{K}$. This is ascribed to the interaction between a spin glass like disorder at the interface between Fe and Fe_3O_4 and the ferromagnetic iron core. Silver nanowires have been grown both in a polymeric film and within the nanopores of a silica gel. Single electron tunneling behaviour has been observed in the latter after forming a break junction in the nanowire. Nanocrystalline nickel oxide produced by a controlled oxidation of nanosized nickel particles in a silica gel has shown useful sensing properties with respect to relative humidity (RH).

Arun Kumar Guha, *Professor and Head*

Microbial biochemistry.

Associates: (1) D Talukdar, RA (DST, WB); (2) J Bhowal, SRF; (3) R Mukhopadhyay, SRF.

Nirmolendu Roy, *Professor*

Synthesis of complex carbohydrates of biological interest.

Associates: (1) B Mukherjee, SRF; (2) S K Sarkar, SRF; (3) K Sarkar, SRF (CSIR); (4) S Roy (Hony).

Bishnupada Chatterjee, *Professor*

Lectins and their significance in biology; Allergens and their standardization for immunotherapy.

Associates: (1) T Bhattacharyya, SRF; (2) S Bandyopadhyay, SRF; (3) M Addhya, JRF (DBT); (4) B Sinha, JRF (CSIR); (5) S Chatterjee, JRF (DBT); (6) S Chaki (Hony).

Manju Ray, *Professor*

Biochemistry and bioenergetics of tumor cells and molecular enzymology.

Associates: (1) S Ghosh, RA; (2) M Ghosh, RA (DST); (3) K Mukherjee, SRF (CSIR); (4) K Ray, JRF; (5) R Som JRF (DST); (6) S Sinha Roy (CSIR).

Arindam Banerjee, *Lecturer*

Peptide design using noncoded (unusual) amino acids.

Associates: (1) S Majhi, JRF (CSIR); (2) A Bandyopadhyaya, JRF; (3) D Halder (Hony).

1. Synthesis of Complex Oligosaccharides of Biological Interest

N Roy

In continuation of our efforts to synthesise glycoconjugates related to bacterial antigens of *Shigella dysenteriae* and *Escherichia coli*, we have made considerable progress towards the synthesis of oligosaccharides related to *S. dysenteriae* types 4, 3, and 9 and *Shigella boydii* type 5, and *E. Coli* type O157. A pentasaccharide derivative of *S. dysenteriae* type 4 containing two azido groups have been synthesized. Transformation of the azido group into NHAc followed by removal of protecting groups will give the desired pentasaccharide. Two disaccharides and a tetrasaccharide related to *S. boydii* have been prepared. Inversion of the configuration of two hydroxyl groups will provide the desired tetrasaccharide.

In another series of experiments a tetrasaccharide containing β -D-galactosamine related to *S. dysenteriae* type 3 has been synthesized; our ultimate goal being the synthesis of the pentasaccharide repeating unit containing a D-galactofuranose and a D-galactosamine.

In our effort to synthesise a tetrasaccharide related to *E. coli* O157, we have prepared two disaccharides in which the one containing D-parosamine involved more than 30 steps. The two disaccharides were being allowed to react to give the desired tetrasaccharide.

2. Studies on Lectins

2.1 Studies on Plant Lectin

B P Chatterjee

In continuation of our research on lectins in Biology, lectin from *Ficus cunia* seeds studied earlier, was purified to homogeneity by affinity column of chitin,

a straight chain polymer of $(\beta 1-4 \text{ GlcNAc})_n$. The physical properties of the lectin were same as previously published from this laboratory.

2.2 Studies on Invertebrate Lectin

B P Chatterjee

Agglutinin from the hemolymph of gastropod *Belamya bengalensis* was purified to homogeneity by successive ion-exchange chromatography on DEAE-Sephacel and gel filtration by Superose 12 in FPLC. The lectin was found to be metal ion dependent, most active at pH 8, and stable upto 50°C.

2.3 Studies on Microbial Lectin

A K Guha and B P Chatterjee

Purified lectin from phytopathogen *Macrophomina phaseolina* exhibited growth inhibition in jute seedling. It was found to be highly specific for sialic acid as determined by ELISA. The detailed study of the carbohydrate specificity of the lectin is in progress.

3. Studies on Allergens

B P Chatterjee

In relation to the study of diagnostic efficacy of *Ascaris lumbricoides* antigens in ascariasis, molecular properties of both excretory-secretory (ES) and somatic (S) antigens of *A. lumbricoides* were investigated. They are glycoproteins containing small amount (2.8% and 2.5% respectively) of sugars; contain high amount of acidic and hydroxy amino acids and glycine, alanine and tryptophan. The CD spectra of ES and S antigens give an idea of their conformation and it has been observed that both have almost identical secondary structure, which again supports the experimental observations with regard to their functional similarity.

Sera from patients showing Type 1 allergy to fish were investigated for allergenicity to three different fish proteins. Immunoreactivity of Rohu, Hilsa and Pomfret fish extracts, by ELISA and ELISA-inhibition, showed Hilsa extract having strongest IgE-binding activity. Extracts of Pomfret and Rohu

showed 31% and 24% cross-reactivity respectively with that of Hilsa. Allergenicity was reduced significantly by periodate oxidation and Ca^{2+} depletion of the extract.

4. Studies on the Production of Single Cell Protein from Whey

A K Guha and B P Chatterjee

Nutritive value of the mushroom *Pleurotus sajor-caju* grown in deproteinised whey was determined in respect of amino acids and fatty acids composition of the proteins and lipids respectively. It was observed that the mushroom contained all the essential amino acids and specially rich in phenylalanine and lysine. Linoleic acid, an essential fatty acid constitutes 49% of the total lipid of *Pleurotus sajor-caju*.

5. Chitin and Chitosan from Shrimp Shells and Fungi: Properties and Application to Waste Management

A K Guha and B P Chatterjee

Swollen chitosan beads and gels prepared from shrimp shells have been found to be very efficient in removing metal ions from the industrial effluent. The beads and gels after treatment can be reused for number of times. Isolation of lactose from whey using chitosan gel as demineralising agent has been studied and found to remove metal ions from whey without increasing its volume.

Chitosan was obtained from the culture of *Mucor rouxii* (MTCC 683) in yeast peptone glucose (YPG), potato dextrose-agar (PDA) and modified Czapec-dox medium containing molasses. Comparison of the production of chitosan (g/100g dry mycelia) by three culture media showed Czapec-dox medium was a bit favourable. Degree of deacetylation determined by first derivative UV spectrophotometry was comparable in PDA (89%) and Czapec-dox (87%) media, whereas that of by YPG is 82% only.

6. **Biochemistry and Bioenergetics of Tumor Cells and Molecular Enzymology**

M Ray

3-Phosphoglycerate kinase has been purified and characterized in order to study its role in aberrant glycolysis of malignant cells.

7. **Design of Peptide and Pseudopeptide Using Noncoded Amino Acids**

A Banerjee

Design, synthesis, and conformational analysis of peptides and pseudopeptides containing noncoded amino acids are being performed with an aim to construct low molecular weight mimicry of protein structural elements (viz. reverse turns, hairpins, β -sheet) and to create new turn structures (viz. 12-atom hydrogen bonded ring). γ -Turn-induced hairpins have

been observed in short model peptides in solution. Antiparallel β -sheet structures are found in designed synthetic peptides and pseudopeptides containing nonprotein amino acids (viz. β -alanine, α -amino isobutyric acid, 3-amino phenyl acetic acid). A new motif, intramolecular 5-membered NH...N hydrogen bonded structure has been found in a short model peptide in crystals and in solution.

8. **Studies on Amyloid-like Fibrillar Structure in a Short Synthetic Model Peptide**

A Banerjee

Formation and deposition of amyloid plaque with fibrillar morphology is a common phenomenon of many neurodegenerative diseases like Alzheimer's and prion protein diseases. Amyloid-like fibrillar morphology has been observed in a terminally protected tripeptide containing noncoded amino acids in solid state.

DEPARTMENT OF INORGANIC CHEMISTRY

Animesh Chakravorty, *Professor; INSA Golden Jubilee Research Professor; JNCASR Honorary Professor*

Structure and reactivity of new transition metal compounds.

Associates : (1) B K Dirghangi, RA (CSIR); (2) M Shivakumar, SRF(CSIR); (3) K Ghosh, SRF(CSIR); (4) S P Bhattacharyya, SRF(CSIR); (5) S Chattopadhyay, SRF(CSIR); (6) I Chakraborty, SRF; (7) B Baruah, JRF(DST); (8) I Bhattacharyya, JRF(CSIR); (9) J Gangopadhyay, JRF(DST); (10) B K Panda, JRF(CSIR); (11) S Sengupta, JRF(CSIR); (12) S Das, JRF(CSIR).

Nirmalendu Ray Chaudhuri, *Professor*

Structure and molecular properties of polynuclear metal complexes.

Associates : (1) T K Maji, SRF; (2) P S Mukherjee, SRF; (3) S Sain, JRF(CSIR); (4) S Dalai, JRF(CSIR); (5) S Konar, JRF(CSIR).

Kamalaksha Nag, *Professor*

Macrocyclic polymetallic systems.

Associates : (1) B Dutta, JRF; (2) P Bag, JRF(CSIR).

Saktiprasad Ghosh, *Professor*

Synthetic and bioinorganic chemistry.

Associates : (1) P Sengupta, SRF; (2) R Dinda, JRF.

Pradyot Banerjee, *Professor and Head*

Kinetics and mechanism of reactions of metal complexes.

Associates : (1) S Dey, SRF; (2) N Shaikh, SRF; (3) A Panja, JRF(CSIR).

Muktimoy Chaudhury, *Professor*

Reactivity of metal-oxygen bond, Supramolecular chemistry and Coordination chemistry of less common metal oxidation state.

Associates : (1) S Samanta, SRF; (2) D Ghosh, SRF(CSIR); (3) S Mukhopadhyay, SRF; (4) M Bhar, JRF(CSIR).

Dipankar Datta, *Reader*

Concepts in chemistry, Organic synthesis, Coordination chemistry, Inorganic photophysics, Crystal engineering, Materials

Associates : (1) S Chowdhury, SRF; (2) P Pal, JRF(DST).

Sreebrata Goswami, *Reader*

Transition metal chemistry : Synthesis, Metal promoted reactions, Redox phenomena, Polynuclear complexes.

Associates : (1) P Mazumdar, RA; (2) A K Ghosh, SRF; (3) A Saha, SRF(CSIR); (4) K K Kamar, JRF; (5) C Das, JRF(CSIR); (6) D Mishra, JRF(CSIR).

1. Contribution to Transition Metal Chemistry

A Chakravorty

The contributions of this group during the year relate to chemistries of vanadium, rhenium, ruthenium, osmium and silver. The work on crystalline sugar vanadate esters has been augmented by synthesis and structure determination of new mannopyranoside systems. Contribution to rhenium chemistry include azopyridine oxo species and derivatives thereof including a novel oxo-imide dimer. Oxygen atom transfer from the oxo system to tertiary diphosphines have been shown to depend on spacer length. Using a hydridic route azo anion radi-

cal complexes of osmium and ruthenium, both mono and bis, have been isolated and characterized. Structure determination of silver azo-oximates has revealed the presence of unusual non-bonded metal-metal interactions.

2. Chemistry of Polynuclear Metal Complexes

N Ray Chaudhuri

The contributions of this group during this year include the following : observations of ferromagnetic interactions through end-to-end azido bridging pathway in 1D copper(II) systems where tridentate Schiff base used as coligand and dominant ferromagnetic interaction in unusual fumarate bridge 1D copper(II) system; design, synthesis and low temperature magnetic study of a novel bimetallic chain of copper(II) and nickel(II); construction of unique microporous array of cadmium(II) using squarate dianion as a building block; synthesis of 1D coordination polymer of copper(II) with three different bridging anions and its magneto-structural correlation; and 1D coordination polymer of copper(II) containing μ -1,1,3 azido ligand with alternating ferro-antiferromagnetic interactions.

3. Molecular Structures and Properties of Multinuclear Metal Complexes

K Nag

The incorporation of two non-isovalent metal sites in a symmetrical macrocyclic ligand environment has led to the observation of different reactivity patterns and the isolation of distinct structural entities. We have made detailed studies on two series of heterodinuclear and heterotetranuclear species obtained by juxtaposing a Fe(III) centre contiguous to a Fe(II), Mn(II), Cu(II), Zn(II), Co(II) or Ni(II) centre. Structure, magnetism and spectroscopic (Mössbauer, NMR and EPR) properties of these systems have been studied vis-a-vis structural signatures exhibited by the non-heme iron protein purple acid phosphatase. A series of diferrous complexes with each iron(II) having a labile coordination site have been designed to bind and activate molecular oxygen to act as functional model of methane monooxygenase.

4. Synthesis, Structure and Bio-inorganic Aspects of some Coordination Compounds

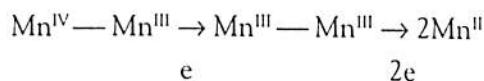
S Ghosh

Studies from our group during the year under consideration include synthesis, structural characterisation and biological activity of a number of ruthenium(II) and ruthenium(III) complexes of several multidentate NO, NS and NSO donor ligands. Several novel Mo(VI) and Mo(IV) complexes of some polydentate NO donor ligands have been isolated and characterised by various physico-chemical techniques. X-ray crystallography has been used to solve the crystal and molecular structure of several complexes of the type MoO_2LB (B = an alcohol ROH or a monodentate Lewis base like pyridine, imidazole etc). Structure of a bipyridyl bridged complex, $\text{MoO}_2\text{L-bipy-MoO}_2\text{L}$ has also been determined.

5. Kinetics and Mechanism of Reactions of Metal Complexes

P Banerjee

A new octahedral Mn^{III} -salen complex has been synthesised and structurally characterised. The geometry that ensues is different from the other reported (square-pyramidal) and reveals larger Mn^{III} -Cl distance. Reactions with dihydroxy benzenes show two stage process - the second of which has been demonstrated to be the electron transfer (et) act. Other interesting reaction systems include the kinetic study of $\text{LMn}^{\text{III}}-(\mu\text{-O})_2\text{-Mn}^{\text{IV}}\text{L}$ cores (L = macrocyclic ligand) with thiols whereby two definite et steps are discernible :



In another area of study, a platinum(II)-peptide complex has been investigated kinetically with respect to its binding to several aza bases. The pH-rate profiles display interesting features which allow to compute the reactivity trends of various species. The structures of these Pt(II) adducts have been ascertained by ^1H NMR study.

6. Chemistry of Metal-Oxygen Bond and Coordination Chemistry of Di- and Polynuclear Complexes

M Chaudhury

Studies from our group during the year include : (i) synthesis of pentacoordinated cobalt(II) compounds with TBP geometry, capable of reversible dioxygen binding at cryogenic temperatures, (ii) synthesis and characterization of alkali metal adducts of LVO₂ ligands, behaving as an inorganic analog of carboxylate (RCO₂) moiety and (iii) isolation of a series of copper(II)/zinc(II) and copper(II)/copper(II) dinuclear compounds in unsymmetrical ligand environments and their characterization by spectroscopic, magnetic and electrochemical methods.

7. Organic Synthesis

D Datta

We have synthesised 2*H*-benzimidazoles, which are highly unstable tautomers of 1*H*-benzimidazoles, for the first time from 1,2-phenylenediamine and appropriate ketones. We have introduced unsaturations into the 1,4,7-triazacyclononane skeleton through an unprecedented photochemical reaction between benzil and diethylenetriamine. Electrocyclic reactions which are limited only to carbon containing compounds, have been demonstrated by us for the first in a system containing imino N's which proves the generality of this class of reactions.

8. Coordination Chemistry

D Datta

While vinyl amine is not stable under laboratory conditions, we have synthesised a Schiff base of vinyl amine and benzil circuitously which is a novel N,N donor ligand with an extensive conjugation. We have studied its copper(I) chemistry. We have also synthesised and studied the copper complexes of several new acyclic and cyclic N donor ligands. We are also developing the ruthenium chemistry of bis-oxazolines which are now popularly used as chiral pools for asymmetric synthesis.

9. Inorganic Photophysics

D Datta

While quenching of fluorescence by transition metal ions is a common phenomenon, we have identified a new organic fluorophore, the emission of which is enhanced by several d¹⁰ metal ions like Cu⁺, Zn²⁺ and Cd²⁺. Its implications in connection with the development of chemical sensors are being examined by us.

Fluorescent copper(I) complexes are known only with the derivatives of 1,10-phenanthroline. In our continuing quest for the ligands that can yield fluorescent copper(I) complexes, we have synthesised a helical dinuclear copper(I) complex with bis(pyridinal)-ethylenediimine containing a fluorescent Cu^I₂N₈ core. We have initiated a systematic study on the photophysics of several Ru(II) complexes of bis-oxazolines.

10. Crystal Engineering

D Datta

We have formulated a new principle in connection with the crystallisation of the ionic complexes, where the anions are not coordinated to the metal, which states that the larger the ion, the less is the tendency of polymerisation in the counterion. This in a way means that in the process of crystallisation of the ionic complexes, a matching of the sizes of the counterions is approached. We have demonstrated its applications amply.

11. Materials

D Datta

We are engaged in synthesising new supramolecular complexes in order to study their thermoelectric properties.

12. Metal Promoted Reactions, Redox Phenomena and Polynuclear Complexes

S Goswami

During this period we have continued with our work on metal promoted reactions and their applications in organic and organometallic synthesis. Some new redox non-innocent ligands have been synthesised. The coordination compounds of these exist in re-

dox series whose members have been explored electrochemically and spectroelectrochemically. Our work on the design and synthesis of polymetallic systems have resulted in the successful synthesis of strongly coupled di-ruthenium complexes, heteropolymetallic systems with M_2Ag_2 , M_4Cu_2 and M_4Ni_2 cores [M = Ru(II), Os(II)]. While the M_2Ag_2 compounds are argentophilic, the other two *viz.* M_4Cu_2 and M_4Ni_2 show magnetic interactions.

DEPARTMENT OF ORGANIC CHEMISTRY

Subrata Ghosh, Professor and Head

Synthesis of complex natural products, development of new synthetic reagents and methodologies.

Associates : (1) J Panda, SRF (CSIR); (2) A Haque, SRF; (3) S Banerjee, SRF (CSIR); (4) S Ghosh, JRF (CSIR); (5) A Nayek, JRF (CSIR); (6) S Adhikari, (Collaborator).

Nitya Gopal Kundu, Professor (Retd. On 31.1.2001)

Associates : 1) B Nandi, SRF; (2) G Chaudhuri, SRF; (3) R Mukhopadhyay, SRF (CSIR); (4) M De (Hony).

Debabrata Mukherjee, Professor,

Synthesis of naturally occurring polycyclic compounds, terpenoids and related molecules.

Associates : (1) A Roy, SRF; (2) L C Pati, JRF (CSIR); (3) T Paul, JRF (CSIR); (4) P Dutta Gupta (Hony).

Ramanathapuram Vaideeswaran Venkateswaran, Professor

Synthesis of bioactive natural products, application of photochemistry in synthesis.

Associates : (1) G Paul, SRF; (2) K Tuhina, SRF (CSIR); (3) S Sabui, JRF (DST); (4) P K Sen, JRF (CSIR).

Aish De, Professor

Heterocyclic chemistry, use of organo-metallic reagents in synthesis.

Associates (1) S C Ghosh, RA (on leave since 21.4.2K); (2) C Basu, RA (DST); (3) C Mukherjee,

SRF; (4) S Kamila, SRF (CSIR); (5) B Nandi, SRF (From 1.2.01); (6) M De, (Hony, From 1.2.01); (7) T K Pradhan, JRF (CSIR).

Brindaban Chandra Ranu, Professor

Development of novel synthetic reagents and methodologies of general applicability.

Associates (1) A Majee, RA; (2) S K Guchhait, SRF (CSIR, resigned on 25.7.00); (3) P Dutta, SRF (CSIR); (4) A Hajra, JRF (CSIR); (5) S Samanta, JRF (CSIR); (6) S S Dey, JRF (CSIR); (7) J Dutta, JRF (CSIR).

Saswati Lahiri, Professor

Organic photochemistry in solutions and in organized assembly.

Associates (1) S Kar, RA; (2) M Chanda, SRF (DST); (3) I Chakraborty, JRF (CSIR); (4) D L Maji (Hony); (5) J Sarkhel (Hony); (6) G Chaudhury, SRF (from 1.2.01); (7) R Mukhopadhyay, SRF (CSIR, from 1.2.01).

Subhas Chandra Roy, Professor

Synthesis of carbocyclic and heterocyclic compounds related to natural products, development of new reagents and methodologies.

Associates : (1) K K Rana, SRF; (2) C Guin, JRF (CSIR); (3) B Banerjee, JRF (DST); (4) G Maiti (Collaborator).

1. Stereocontrolled Synthesis of Complex Natural products

S Ghosh, D Mukherjee, R V Venkateswaran, B C Ranu, S C Roy

A stereocontrolled synthesis of cyclobut-A, an anti HIV carbocyclic nucleoside analogue of naturally

occurring oxetanocin has been accomplished.

Tochuinyl acetate, a bicyclic sesquiterpene of the cuparane family containing two vicinal quaternary asymmetric centres on a five membered ring, has been synthesised stereoselectively employing an intramolecular ester alkylation strategy to generate the required bicyclic ring system. A total synthesis of herbertenediol, a bioactive sesquiterpene phenol isolated from the liverwort *Herberta adunca*, has been successfully accomplished involving one pot α,α -dimethylation of a sterically hindered bicyclic ester as a key reaction. In order to achieve a new synthesis of the tricyclic sesquiterpene aplysin, 2,3,4-trimethyl-4-(2'-methoxy-4'-methylphenyl)cyclopent-2-en-1-one has been prepared as a key intermediate.

A highly stereocontrolled total synthesis of (\pm)-norzizanone, a bridged tricyclic ketone incorporating the tricyclo[6.2.1.0^{1,5}]undecane ring system characteristic of the zizaane group of sesquiterpenes, has been accomplished involving base induced pinacol type rearrangement of the monomesylate of 2 α ,7,7-trimethyl-8 α (H)-tricyclo[6.2.1.0^{1,6}]undecane-5 β ,6 β -diol as the key step. The stereostructure of the diol has been conclusively established through single crystal X-ray crystallography. The present synthesis constitutes a formal total synthesis of (\pm)-tricyclovetivene, a sesquiterpene hydrocarbon isolated from vetiver oil.

12-Methoxyabieta-8,11,13-trien-20-oic acid, a naturally occurring ring C-aromatic tricyclic diterpene possessing significant bioactivity as a mite growth regulator has been synthesised in a stereocontrolled manner involving stereoselective reduction of an appropriately substituted hexahydrophenanthrene-dione as a key step.

Arucadiol, a dihydroxy tetrahydrophenanthrenone derivative and a constituent of the Chinese drug 'Danshen' has been synthesised involving sodium bismuthate mediated oxidation of 1,1-dimethyl-5,6-dimethoxy-7-isopropyl-1,2,3,4-tetrahydrophenanthrene as a key step. The diol possesses cytotoxic activity against Vero cells.

A total synthesis of heliannuol-A, a constituent of cultivar sun flowers, displaying allelopathic activity has been completed. The key eight membered ring in the benzooxocane ring system was formed through selective cleavage of a cyclopropyl ketone in a seven membered ring. In the course of the investigation an interesting PCC catalysed oxidative cyclisation of 2-(2-isopropenyl-5-methylphenoxy)-2-methylpropan-1-ol to a benzoxopinenone was observed. This was generalised by applying to a few other related systems. Efforts at application of this methodology to a synthesis of the corresponding hydrocarbon heliannane did not materialise due to difficulties in removal of the hydroxy group. Attempted radical deoxygenation led to a ring cleavage which was extended to complete a formal synthesis of heliannuol-D another allelopathic constituent, comprising a benzoxepane ring system.

A short and stereoselective total synthesis of a biologically active furofuran lignan, Sesamin has been achieved successfully by radical cyclization of an epoxide using a titanium (III) radical source. Titanium (III) species were generated *in situ* from commercially available titanocene dichloride and zinc dust in tetrahydrofuran.

2. Development of New Reagents and Synthetic Methodologies

S Ghosh, N G Kundu, D Mukherjee, B C Ranu, S C Roy

A novel methodology has been developed for the rapid construction of cis-syn-cis 4-5-5 linearly arrayed tricyclic system in enantiomerally pure form towards the total synthesis of the sesquiterpene kelsoene. The key step involves intramolecular [2+2] photocycloaddition of 1,6-dienes incorporated in a furano sugar. Unexpectedly the cis-syn-cis adducts were formed in both catalysed and sensitised reaction conditions.

A novel depropargylation reaction mediated through palladium-copper catalysis has been developed.

A useful method for the synthesis of 1,1,2,2-tetrasubstituted cyclopentanes related to herbertane and cuparane group of sesquiterpenes has been de-

veloped involving intramolecular cyclisation of substituted ω -bromoesters under appropriate conditions. Advanced intermediates to several sesquiterpenoid natural products have been prepared using this cyclisation procedure which has been relatively unexplored.

In continuation of our ongoing work on indium chemistry, we have achieved stereoselective reduction of aryl-substituted *gem*-dibromides to vinyl bromides by indium metal. Simple and general procedures have been developed for selective acylation of alcohols and amines, hydrolysis of carboxylic esters and direct conversion of THP-ethers to acetates using indium triiodide as catalyst.

In continuation of our interest in using cerium (IV) as a powerful single electron oxidant in organic synthesis, we have developed a method for selective bromoalkoxylation of activated cinnamyl compounds using lithium bromide and ceric ammonium nitrate. The bromoalkoxy compounds can be used as versatile intermediates towards various bioactive natural products. The reaction is only effective when the aromatic systems are activated.

3. Heterocyclic Chemistry

N G Kundu, A De, B C Ranu

Novel palladium-copper catalysed reactions have been developed for the highly regio- and stereoselective synthesis of various heterocyclic structures, e.g. (*Z*)-3-alkyl(aryl)idene isoindolinones, *E*-2-(2-arylvinyl)quinazolinones, (*Z*)-4-alkyl-2-alkyl(aryl)idene-3,4-dihydro-2*H*-1,4-benzoxazines, (*Z*)-4-tosyl-3-alkyl(aryl)idene-3,4-dihydro-2*H*-1,4-benzoxazines, 2-arylquinoxalines and 2-substituted-3,1-benzoxathinones. X-ray diffraction studies have been carried out to confirm unequivocally the structures of many of the compounds synthesised.

In continuation of the application of directed metallation in organic synthesis, two novel sulfur analogues of naturally occurring antifungal compound semiovioxanthin were synthesised using directed *ortho*-lithiation-anionic *ortho* Fries rearrangement-lithiation-transmetallation-allylation-cyclisation protocol.

In continuation of the utilisation of alkoxy benzo[*b*]thiophenes in photoinduced electron transfer reactions, two 5-alkoxybenzo[*b*]thiophenes were found as excellent electron donors in intermolecular photoinduced electron transfer to acceptor molecules. Intramolecular photoinduced electron transfer was observed between 4-methoxybenzo[*b*]thiophene and *p*-chloroacetophenone when the two molecules were linked with an unsaturated spacer.

Simple and efficient procedure for the synthesis of dihydropyrimidinones by three component coupling of 1,3-dicarbonyl compounds, aldehydes and urea by indium(III) chloride catalysed Biginelli reaction has been developed.

4. Photochemistry

R V Venkateswaran, S Lahiri

An intermolecular photolytic addition of acetylene to a chromone system followed by flash vacuum pyrolysis has been applied to generate the benzoxocane ring system of heliannane, a sesquiterpene constituent isolated from marine species.

In a bichromophoric system of β,γ -enone and *cis*-dibenzoylalkene, the phototransformation was found to lead to highly stable ketene derivatives. A 4-substitution in bicyclo[2.2.2]octa-5-en-2-ones, was found to be chromophore-selective on irradiation, whereas the selectivity decreased when the 4-substitution was changed to 1-substitution.

DEPARTMENT OF PHYSICAL CHEMISTRY

Mihir Chowdhury, Professor

Laser Spectroscopy, Chemical Dynamics, Magnetic Field Effects and Optical Activity.

Associates: (1) A Chakraborty (Hony); (2) M Haldar (Hony); (3) S Bandyopadhyay, JRF.

Debashis Mukherjee, Professor (on lien) and Director

Many-Body Theories of Electronic Structure and Dynamics and Statistical Physics.

Associates: (1) B Datta, RA (CSIR); (2) R N Ghosh (Hony); (3) B Bandyopadhyay (Hony); (4) S H Mandal (5) U K Sinha Mahapatra, (RA); (6) S K Chattopadhyay (RA); (7) D Jana, SRF; (8) P Ghosh, JRF (CSIR); (9) S Ghosh Dastidar, JRF (CSIR); (10) A Deb, JRF (CSIR); (11) D Pahari, JRF (CSIR).

Sankar Prasad Bhattacharyya, Professor and Head

Optimization Problems, Quantum Chemistry of Solvation, Chemical Dynamics, Nonlinear Optical Properties of Molecules.

Associates: (1) P Chaudhury (Hony); (2) C K Mondal, SRF (CSIR); (3) R Saha, JRF; (4) S Nandy (Hony).

Samaresh Mukherjee, Professor

Spectroscopy of Organic and Bio-Organic Molecules and Solvation Dynamics.

Associates: (1) D Guha, SRF (CSIR); (2) A Mondal, SRF.

Deb Shankar Ray, Professor

Theoretical Nonlinear Optics, Chaotic dynamics and Statistical Physics.

Associates: (1) J Ray Chaudhuri (Hony) (2) S K Banik, SRF (CSIR); (3) B Bag, SRF (CSIR); (4) D Banerjee, JRF.

Kankan Bhattacharyya, Professor

Ultrafast Spectroscopy.

Associates: (1) D Sukul, SRF (CSIR); (2) S Sen, JRF (CSIR); (3) P Dutta, JRF (CSIR).

Debnarayan Nath, Reader

Instrumentation, Laser and Magnetic Field Effects.

1.1 Spin Chemistry

D Nath and M Chowdhury

Large magnetic field effect on lifetimes of triplet radical pairs and yields of free radicals have been detected in the photosensitized systems consisting of biphenyl (donor) and phenylpyrylium salts (acceptors). The observed 20-fold increase in the yield of free radicals could be due to the nature of the micellar confinement of the charge neutral donor and the positively charged acceptors. The high-field effects have been ascribed to the Relaxation Mechanism.

1.2. Spectroscopy of jet-cooled molecules

D Nath and M Chowdhury

Hole-burning experiments on the jet-cooled tetrahydroisoquinoline (THIQ) molecule reveal the existence of two conformers for the bare molecule, corresponding to equatorial and axial hydrogen forms. Bands for five different water clusters have been identified.

1.3. Ultrafast Dynamics in Organized Assemblies

K Bhattacharyya

The major finding includes slow solvation dynamics of water confined in protein (human serum albumin), in lipid vesicles and micelles. Interaction of surfactants with a water-soluble polymer has been studied using excited state proton transfer (ESPT) of 1-naphthol. The dynamics of ESPT in polymer-surfactant aggregate is found to be different from that in micelles or polymer alone. In polymer-surfactant broadly two sites were detected in one of which ESPT is totally blocked and in another ESPT is allowed, though it occurs at a much slower rate compared to bulk water.

1.4 Unusual Strengthening of the intermolecular O... H... N hydrogen bonds in Schiff bases

S Mukherjee

Two orthohydroxy Schiff bases, 2-(N-benzyl- α -iminopropyl)-phenol have been synthesized. The crystal structures have been determined and *ab-initio* calculations with the B3LYP/6-31G** basis set performed. The shortest known O-H...N hydrogen bonds are found with O...N distance equal to 2.460 Å. Steric repulsion of substituent alkyl groups results in this unusual strengthening of the hydrogen bonds.

1.5 Proton transfer reaction in orthohydroxy compounds

S Mukherjee

The ground and excited state proton transfer processes of some orthohydroxybenzaldehyde derivatives have been studied by means of steady state absorption, emission and time resolved spectroscopy in different polar and nonpolar solvents at room temperature and 77K. The energetics of the ground and excited state proton transfer in such compounds have been examined by the configuration interaction method at AMI level of approximation. The ground singlet and excited triplet are predicted to have considerable barriers on the respective proton transfer pathway.

2.0 Nonlinear dynamics and Statistical mechanics

D S Ray

Fluctuation-dissipation theorem lies at the heart of nonequilibrium statistical mechanics. We have probed whether such a relation is viable for chaotic dynamics in a system of low-dimensionality. Based on a Fokker-Planck description, we establish that the drift and the diffusion coefficients can be related through a set of stochastic parameters that characterize the steady state of the dynamical system yielding a fluctuation-dissipation kind of relation. We have also established a relationship between chaotic diffusion and thermodynamics inspired quantities like entropy production and entropy flux. In another issue we have examined the interplay of nonlinearly of a dynamical system and thermal fluctuations of its environment in the physical limit of weak damping in a semiclassical context and showed how one can realize environment-induced dynamical chaos. We have also generalized Kramers theory of activated processes for open one-dimensional systems by considering stationary, Gaussian, external noise with arbitrary correlation functions in addition to internal coloured thermal noise.

3.1 Many-Body Effects in Ionization and Excitation Processes

D Mukherjee

Our recently formulated relaxation-inducing non-perturbative many-body formalism showed great efficacy in handling strong orbital relaxation and differential correlation effects accompanying electron detachment and attachment of neutral species. We have found a completely general formalism which subsumes our earlier developments, and showed that the new approach not only generates a very compact, accurate and computationally oriented theory for ionization/excitation processes, but also can be tailored in a way which furnishes state-energies *per se* of open-shell species. This has opened up the very interesting possibility of formulating explicitly spin-adapted many-body theories for general open-shell systems. Pilot numerical applications have already been undertaken, and the results are very impressive.

3.2 Formal Development of State-specific

Multi-reference Many-body Approaches

D Mukherjee

Prompted by the success of our recently developed state-specific multi-reference many-body formalism, we have extended the method to the generation of intruder-free excited states via a response function approach. The results for the potential energy surfaces (PES) of the excited states of various symmetries, relative to a multi-reference ground state, are very promising, bolstering our earlier contention that the state-specific multi-reference approach can serve as the starting point for generating intruder-free excited states even when a straightforward intruder-free choice of model spaces for such states is difficult to discern.

We have also formulated a preliminary version of an explicitly spin-free unitary-group based state-specific theory for general open-shell systems. The key point in the development is the construction of suitable mutually independent unitary generators, which produce linearly independent excitations of a given type. The use of spectator-scatterings is shown to be imperative to achieve this goal. Pilot applications are under way.

3.3 Relativistic Coupled Cluster Formalisms

D Mukherjee (Collaborators: Professor B P Das and Dr. Rajat K Chaudhury, IAP, Bangalore)

We have developed the relativistic nonperturbative cluster expansion formalism, taking care of the magnetic component of the Breit interaction in the relativistic hamiltonian in a self-consistent manner. This is being implemented numerically to explore the possible interference effects that may manifest in the magnetic properties and in the hyperfine splittings of moderately heavy atoms. The connected (extensive) component of the oscillator strength as obtained by large scale relativistic coupled cluster theory has been extensively investigated to elucidate the relative importance of correlation and relativistic effects in the atoms and ions of Be and B iso-electronic sequence.

3.4 Quantum Dynamics in Real- and

Imaginary-Time Domain

D Mukherjee

Inspired by the good performance of our nonperturbative cumulant expansion method for studying real- and imaginary-time dynamics, we have extended the formalism to incorporate a self-consistent description of a class of few-body correlation effects to all orders, keeping in view, in particular, of the importance of using modified thermal propagators in shaping the thermal properties of quantum systems in the medium to low range of temperature. The self-consistent inclusion of one-body effects is useful for studying low-temperature (Kohn-Luttinger) limit of extended quantum systems, while the two- and higher-body effects are important to study the effect of strong correlations in the medium to low temperature range.

The nonperturbative analogue of the Englert-Brout-Hurwitz formalism for the canonical partition function for Bose- and Fermi-systems has been fully developed, and the consistency of the formalism to generate the known perturbation series is thoroughly analyzed. Applications are under way to use this formalism to generate canonical partition functions of a class of simple but nontrivial quantum systems.

3.5 Genetic Algorithms in Quantum Chemistry

S P Bhattacharyya

We have developed and model tested stochastic diagonalization techniques based on Genetic Algorithms. The methods have shown promise in practical applications. The algorithms proposed are parallelizable.

3.6 Quantum Dynamics

S P Bhattacharyya

The phenomenon of quantum hysteresis in microscopic systems has been investigated. The response of the loop area to fluctuation in the potential, increase in temperature and changes in the parameters of the external field have been analyzed. It has been shown that the loop area can be used to measure the extent of energy flow from one mode to another.

Braja Mohan Mandal, *Professor and Head*

Conducting Polymers Colloids, Dispersion Polymerization, Controlled/Living Radical Polymerization.

Associates : (1) M Chakraborty, RA; (2) S Guha SRF; (3) N Biswas JRF(DST); (4) P Das JRF(CSIR); (5) S Jewrajka, JRF(CSIR); (6) U Chatterjee, JRF(CSIR); (7) D Chatterjee JRF (CSIR).

Dipak Kumar Basu, *Professor*

Accelerated Sulphur Vulcanization, Development of New Rubber Additives, Polymer Composites.

Associates : (1) S Debnath RA ; (2) A Ghosh SRF ; (3) A Das JRF.

Akhil Ranjan Das, *Reader*

Surfactant Systems, Dispersed Molecular Aggregates, Polymer-surfactant interactions.

Associates : (1) T Dey SRF; (2) Bedachanda Mukherjee JRF.

Arun Kumar Nandi, *Reader*

Polymer Crystallization, Polymer Gelation and Supramolecular organization of polymers.

Associates : (1) T Jana SRF; (2) S Malik SRF; (3) H Rahaman (Hony).

1. Conducting Polymer Colloids

B M Mandal

For the synthesis of polyaniline colloids the investigation on the role of initiators such as *p*-phenylenediamine and *N*-phenyl *p*-phenylenediamine on the course of polymerization was continued with the ultimate objective of pre-

paring polyaniline of well defined molecular weight with improved conductivity results.

1.1 Dispersion Polymerization for Water Soluble Polymers

The underlying causes leading to the anomalous solubility of polyacrylamide formed in the dispersion polymerization of acrylamide in certain solvent mixtures viz. aqueous *t*-butyl alcohol (TBA) with 82% < TBA ≤ 95% by volume have been unraveled. The conditions of polymerization that should be followed to avoid insoluble polymer formation have been identified.

1.2 Controlled/Living Radical Polymerization of Water Soluble Monomers

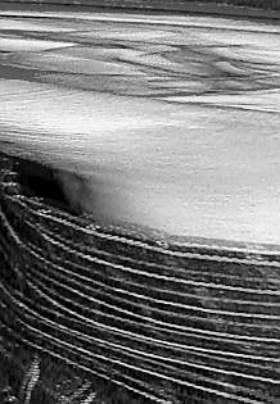
B M Mandal

The atom transfer radical polymerization of the water soluble monomer acrylamide has been extensively studied. Desirable control on polymer molecular weight and polydispersity was not achieved. The reason for such poor control was explored through a physico-chemical study of the polymerization process.

2. Studies on Novel Elastomer Blends

D K Basu

Successful utilisation of bis(diisopropyl) thiophosphoryl disulfide (DIPDIS) to co-vulcanize highly unsaturated natural rubber (NR) and ethylene-propylene diene rubber (EPDM) of low unsaturation by adopting two-stage vulcanization technique paves the way for co-vulcanization of other rubber blends, the constituents of which vary greatly in unsaturation level. Similarly, systematic studies were carried out for the co-vulcanization of rubber blends comprising SBR (styrene-butadiene rubber) - EPDM and NBR (acrylonitrile-butadiene rubber) - EPDM. The results indicate that migra-



tion of both curvatives and reinforcing fillers in the blends could be controlled and cure-rate mismatch could also be minimized. In both the cases the mechanical properties of the filled (carbon black and silica) blend vulcanizates are improved significantly. The phase morphology as evident from the SEM micrographs clearly indicates compact and coherent blend vulcanizates.

Diisopropyl thiophosphoryl N-oxydiethylene sulfenamide (DIPTOS) belonging to another class of rubber additive has been prepared and its effect on NR-EPDM blend vulcanization is being explored. It appears from the preliminary results that DIPTOS is capable of producing blend vulcanizates which are superior to those obtained by using thiophosphoryl disulfide.

Attempts are being made to prepare a safe curative for polychloroprene rubber (CR) by replacing carcinogenic ethylene thiourea with a thiophosphoryl compound.

2.1 Studies on the Effect of Surfactants in the Blends of Dissimilar Elastomers

D K Basu

Studies with various non-ionic surfactants (TWEEN- and BRIJ-series) reveal that these could be successfully utilized as compatibilizers for blends of rubbers varying in polarity.

3. Studies on Surfactant Systems

A R Das

Micellar properties of sodium dodecyl benzene sulfonate (SDBS), polyoxyethylene sorbitan monolaurate (Tween 20) and polyoxyethylene lauryl ether (Brij 30) and their binary and ternary combinations have been studied in details using tensiometric, fluorometric and conductometric techniques in aqueous solution. The critical micelle concentrations, counterion binding, interfacial adsorption, energetics of micellization as well as adsorption, micropolarity, aggregation numbers have been evaluated. The physicochemical properties of the surfactant systems are observed to depend on the solution composition. We have estimated the characteris-

tics of the micellar aggregates such as composition, activity coefficients, critical micelle concentrations and synergistic behaviour of the binary and ternary surfactant mixtures on the basis of the theoretical treatments.

3.1 Polymer-Surfactant Interactions

A R Das

Interactions of Hydroxypropylcellulose (HPC), a neutral water soluble polymer, with a few bile salts such as sodium cholate (NaC)5 sodium deoxycholate (NaDC), and sodium taurodeoxycholate (NaTDC) have been investigated in dilute aqueous solution employing titration microcalorimetry, conductometry and fluorescence probing.

3.2. Dispersed Molecular Aggregates

A R Das

Nanocollidal dispersions of tungstic acid (H_2WO_4) and lead chromate ($PbCrO_4$) have been prepared in water-in-oil microemulsion media e.g. (H_2O /Triton X-100 + alkanol)/n-heptane and H_2O /AOT/n-heptane respectively. The formation of H_2WO_4 by reacting Na_2WO_4 with HCl and of $PbCrO_4$ reacting $Pb(CH_3COO)_2$ with K_2CrO_4 in microwater pool have been established by FT-IR spectra. The size and shape of the colloidal dispersions in microemulsion media and isolated states have been obtained by scanning and electron microscopic measurements. The absorbance and fluorescence behaviour of the colloidal dispersions with varying pool size have been monitored. The enthalpy of H_2WO_4 formation in the water pool of microemulsion has also been determined microcalorimetrically.

4. Polymer Crystallization

A K Nandi

The crystallization of poly(ethylene terephthalate) in its blends with poly(vinylidene fluoride) has been studied. The depression of equilibrium melting point for different blend composition has been measured to evaluate the polymer-polymer interaction param-

eter. The crystallization kinetics of PET in the blends have been investigated. The crystallization mechanism of poly(3-alkyl thiophenes) have been studied for the samples with hexyl, octyl and dodecyl side chains.

4.1 Polymer Gelation

A K Nandi

Thermoreversible gelation of polyaniline has been studied thoroughly in presence of surfactants. The effect of surfactant composition on the morphology, structure, thermodynamics and conductivity has been investigated. Attempt has been made to find the structure of the gel through molecular modeling. The thermodynamic study of poly(3-hexyl thiophene) gels in xylene has been initiated.

4.2 Supramolecular Organization of Polymers

A K Nandi

The supramolecular organization of an important conducting polymer sulfonated polyaniline, (prepared from leuco-emeraldine base) has been investigated thoroughly. A gradual change of morphology from colloidal crystal to three dimensional network has been made by varying the charge density on the vesicle surface. Supramolecular organization of sulfonated polyaniline (prepared from emeraldine base) has been initiated.

Multi-reference Many-body Approaches

D Mukherjee

Prompted by the success of our recently developed state-specific multi-reference many-body formalism, we have extended the method to the generation of intruder-free excited states via a response function approach. The results for the potential energy surfaces (PES) of the excited states of various symmetries, relative to a multi-reference ground state, are very promising, bolstering our earlier contention that the state-specific multi-reference approach can serve as the starting point for generating intruder-free excited states even when a straightforward intruder-free choice of model spaces for such states is difficult to discern.

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INTERDEPARTMENTAL COLLABORATION

1. **Spectroscopic and Electrical Properties of Organized Molecular Assemblies in Langmuir-Blodgett Films**

G B Talapatra , T N Misra (Spectroscopy) and A J Pal (Solid State Physics)

Spectroscopic characteristics of Langmuir-Blodgett films of several molecules such as pentacene, benzo(k)-fluoranthene, 9-cyanoanthracene, 2,3,6,7,10,11-hexamethoxytriphenylene etc. mixed with stearic acid have been investigated. The relative concentration of the molecule is found to be important in formation of aggregates (confirmed by studying absorption and fluorescence spectra). Changing mole fraction, number of layers, as well as the surface pressure of lifting can precisely control the order of aggregation in many cases.

A Monte Carlo simulation method has been conducted to study transient response of electroluminescence in single-layer light-emitting devices. The simulated data have been compared with our experimental results. A recipe has been established to estimate different parameters of device operation from the comparison between simulation and experimental results.

2. **Synthesis of several heterocyclic compounds and laser flash photolysis measurements on them**

T Ganguly (Spectroscopy) and A De (Organic Chemistry)

Several heterocyclic compounds are being synthesized to develop artificial photosynthetic devices.

STAFF AND STUDENTS MATTERS

AWARDS / HONOURS / ACADEMIC ACTIVITIES

Materials Science Faculty/Staff/Fellow

Indian Physical Society President S P Sen Gupta

Materials Research Society of India, (MRSI) Calcutta Chapter Chairman S P Sen Gupta

Center for Space Physics, Calcutta President (Hony.) S P Sen Gupta

MRSI, Calcutta Chapter AGM, April 2000 Young Materials Scientist Award P Chatterjee

National Seminar on Recent Trend in Crystallography, Biophysics and Computational Biology, Univ. of Madras, Chennai Best poster award S Karan,
S Sen Gupta,
S P Sen Gupta

XXV Annual Conference of Electron Microscope Society of India and Allied Fields, Panjab University, Chandigarh Award for best paper in Physical and Materials Sciences B Bhattacharjee

Solid State Physics

Materials Research Society of India (MRSI) MRSI Medal 2001 A Ghosh

M.R.S.I., (Calcutta Chapter) Young Scientist Award Y M Jana

Indian Science Congress Association Young Scientist Award A Banerjee

(MRSI), Calcutta Chapter Young Scientist Award S K Kundu

W. B. Sc. Academy Fellow B K Chaudhuri

Spectroscopy

Laser Spectroscopy society of India Elected President & Fellow T N Misra

International Symposium on "Progress In Surface Raman Spectroscopy", Xiamen University, Xiamen, People Republic of China Member Scientific Committee T N Misra

Conference on Raman Spectroscopy (ICORS 2000) Dept. of Physics, Peking University, Beijing P.R.China, 2000	Young Investigator Award	Joydeep Chowdhury
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Theoretical Physics

Indian Society of Atomic & Molecular Physics	Vice-President	K Roy
Positron and Positronium Interactions: New Directions, Harvard Univ., USA	Panel Member	A S Ghosh
XIII National Conference on Atomic & Molecular Physics, 2001	Convenor	A S Ghosh
do	Co-Convenor	K Roy

Energy Research Unit

Indian Science Congress Association New Delhi, 2001	President of the Mat. Sc. Section of the 88 th Session	A K Barua
Int. Committee of the 28 th IEEE, Photovoltaic Specialists Conference Anchorage, USA, 2000	Member	A K Barua
West Bengal Academy of Science and Technology	President	A K Barua
Asia Pacific Academy of Materials	Member	A K Barua
Materials Science Section of 88 th Session of ISCA	Awarded best Poster Prize	Arindam Sarker

MLS Professor's Unit

Materials Research Society of India (MRSI)	President	D Chakravorty
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Biological Chemistry

Indian Science Congress Association	Treasurer	B P Chatterjee
Association of Carbohydrate Chemists and Technologists, India	President	B P Chatterjee
Indian Biophysical Society	Treasurer	B P Chatterjee
6 th Seminar on Biochemistry and Biophysics, IACS, Calcutta, 2000	Convener	B P Chatterjee

West Bengal Academy of Science and Technology	Council Member	B P Chatterjee
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Association of Food Scientists and Technologists (India)	Vice-President	A K Guha
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Inorganic Chemistry

Chemito 2000 Award in Chemistry	Awarded	K Nag
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Organic Chemistry

Chemical Research Society of India	Bronze Medal award	B C Ranu
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Physical Chemistry

Chemical Research Society of India	Silver Medal Award	D Mukherjee
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CONFERENCE ATTENDED, INVITED LECTURES, VISITS

Materials Science

Annual General Meeting Materials Research Society, Feb,2001 Science City,Kolkata	Address in Inaugural Session	S P Sen Gupta
Annual General Meeting of MRSI and International Workshop on Nanomaterials At Science City & SINP February 2001.	Member of the Organizing Committee	S P Sen Gupta
National Conference On Young Astrophysicists of Today's India, Org. by Centre for Space Physics, Birla Planetarium, March ,2001 .	Welcome address	S P Sen Gupta
Birth Centenary Celebration of Professor K.Banerjee (SRTCRA-2000) at IACS, Calcutta ,September , 2000	Chairman's address in Inaugural Session	S P Sen Gupta
National Seminar on Recent Trends in Crystallography , Biophysics and Computational Biology, April 24-26,2000 Univ.of Madras,Chennai	Invited Talk	S P Sen Gupta
Intt. Workshop Prep.& Charact. Tech. Imp. Single Crystals, National Physical Laboratory, , New Delhi Feb 26-28,2001	Lecture delivered at the felicitation programme of Dr.K.Lal, Director, NPL	S P Sen Gupta
International Conference on the Foundation and Philosophy of Mathematical and Physical Sciences, April 12-13,2000 RCMPS,Chittagong, Bangladesh	Invited Lecture	S P Sen Gupta

First SERC School on Nonlinear Optical and Laser Materials , June 22-July 08,2000 Indian Institute of Science,Bangalore	Attended	S Sen Gupta
National Seminar on Recent Trends in Crystallography , Biophysics and Computational Biology, April 24-26,2000 Univ.of Madras,Chennai	Attended & Presented Papers	S Karan, S Sen Gupta S P Sen Gupta
Intt. Workshop Prep.& Charact. Tech. Imp. Single Crystals, National Physical Laboratory, New Delhi Feb 26-28,2001	Attended & Presented Papers	S Karan, S Sen Gupta S P Sen Gupta
Institute of Solid State and Materials Research, Dresden, Germany, November 21 - December 20, 2000	Guest Scientist	S K De
XXV Annual Conference of Electron Microscope Society of India and Allied Fields, February 9-11, 2001, Panjab University, Chandigarh.	Invited Lecture	A K Pal
SERC School on Surfaces, Interfaces and Clusters, 9-30 th January, 2001, Saha Institute of Nuclear Physics, Calcutta.	Invited Lecture	A K Pal
General Physics Institute, Moscow, discussion meeting on integrated long term programme (ILTP) of cooperation in science and technology between India and Russia, October 10-17, 2000	Guest Scientist	A K Pal
4 th Indo-German Seminar on Molecular Electrochemistry, 10-14 July, 2000, Dresden, BAM-Berlin, DECHEMA-Frankfurt, Institute fur Mikrotechnik- Mainz	Member, Indian Delegation to Germany	A K Pal
General Physics Institute, Moscow, discussion meeting on integrated long term programme (ILTP) of cooperation in science and technology between India and Russia, October 18-24, 2000.	Guest Scientist	S Chaudhuri

Workshop on Vacuum Science and Technology : Applications in Materials Processing and Advance Instruments, March 10-11, 2001, University Science Instrumentation Centre, Calcutta University.	Invited Lecture	S Chaudhuri
Condensed Matter Days 2K , Bilaspur, Aug., 29-31, 2000.	Presented Paper	G K Paul
13 th National Conference on Atomic and Molecular Physics Calcutta, Jan. 16-20, 2001.	Invited Talk	S Saha
13 th National Conference on Atomic and Molecular Physics Calcutta, Jan. 16-20, 2001.	Chaired a session	S S Bhattacharyya
13 th National Conference on Atomic and Molecular Physics Calcutta, Jan. 16-20,2001.	Presented paper	S Sen, B Dutta A Datta, S Ghosh
Solid State Physics		
International Conference on Science and Technology of Synthetic Metals, Gastein, Austria, July 15-21, 2000	Presented paper	A J Pal
International Conference on Organized Molecular Films (LB9), Potsdam, Germany, August September 1, 2000	Presented paper	A J Pal
International Conference on Supramolecular Science & Technology, Leuven, Belgium, September 10-14, 2000	Presented paper	A J Pal
12 th Annual General Meeting, Materials Research Society of India, Science City, Kolkata, January 31- February 2, 2001.	Invited talk Presented a poster	A Ghosh A Pan
International Discussion Meeting on Mesoscopic and Disorder Systems, IISc, Bangalore, Dec. 18-20, 2000 .	Attended	A Ghosh
India and Abroad: Research Perspectives on Condensed Matter Physics, SNBNCBS, Kolkata, Jan. 2-4, 2001.	Presented paper	A Ghosh

Vacuum Science & Technology : Application in materials processing and advanced instrument, USIC, CU, March 10-11, 2001	Chaired a Session	A Ghosh
Symposium on Recent Trends In Crystallography & its applications (SRTCRA 2000), IACS, Sept. 2000	Invited talk	M Mukherjee,
do	Presented poster	S Maiti
do	Attended	K Chowdhury
Abo Akademi University, Turku, Finland, July-September, 2000	Visiting Scientist	A J Pal
12 th Annual General Meeting, Materials Research Society of India, Science City, Kolkata, January 31- February 2, 2001	MRSI Medal Lecture	A Ghosh
Spectroscopy		
Indian Science Congress, 88 th Session, I.A.R.I, New Delhi Jan. 3-7.2001	Invited Talk	T.N. Misra
'Surface Enhanced Raman Scattering : Some Applications in Surface Physics', Raman Research Institute, Bangalore, March 6, 2001.	Invited Talk	T.N.Misra
International Symposium on "Progress In Surface Raman Spectroscopy", Xiamen University, Xiamen, People Republic of China. August 14-17, 2000.	Invited Talk	T.N. Misra
International Symposium on Centenary of Planck's Law: Relevance in Science and Technology, Dec. 14-16, 2000, held at Max Muller Bhavan, Kolkatta	Attended	K. Rai Dastidar
Max Planck Institute, Garching, Germany	Visiting Scientist	P. K. Mukherjee
Physics Department, Nicolas Copernicus University, Torun, Poland	Visiting Scientist	P. K. Mukherjee
Vth European Workshop at Uppsala University, Sweden, April, 2000	Invited Speaker	P. K. Mukherjee

Theoretical Chemistry 2000 (TC2K), IIT, Kanpur, Dec. 2000	Invited speaker	P. K. mukherjee
International Symposium on the Centenary of the Discovery of Planck's Law, Max Muller Bhavan, Calcutta, Dec. 2000.	Chairman	P. K. Mukherjee
XIII th National conference on Atomic and Molecular physics, 16-20 January 2001 (Organized by Department of Theoretical Physics, IACS, Calcutta)	Participant	P. K. Mukherjee
Birth anniversary of IACS in the year 2000	Invited talk	T. K. Mukherjee
International symposium on centenary of Plank's law: Relevance in science and technology. December 14-16, 2000, (Organized by The West Bengal Academy of Science and Technology, Humboldt Club Calcutta)	Participant	B. Saha
XIII th National conference on Atomic and Molecular physics, 16-20 January 2001 (Organized by Department of Theoretical Physics, IACS, Calcutta)	Participant	B. Saha
SERC School on Concepts in Chemical Dynamics, IITM (Chennai) March 05 - March 24, 2001	Participiant	B. Saha
SERC School on Concepts in Chemical Dynamics, IITM (Chennai) March 05 - March 24, 2001	Participant	S. ,Bhattacharya
One day seminar on Condensed Matter Physics in the Memory of Prof. C. K. Majumdar, held at IACS, 31 August, 2000	Participant	K. Rai Dastidar
XIII National Conference on Atomic and Molecular Physics, held at IACS during 16-20 Jan., 2001	Invited Talk	K. Rai Dastidar
Quality Improvement Program sponsored by A.I.C.T.E. held at the Pharmaceutical Technology, Jadavpur University, Kolkata, March 19 - 26, 2001	A short-term course on "FTIR Spectroscopy" Delivered	S. Chakravorti
International symposium on centenary of Plank's law: Relevance in science and technology. December 14-16, 2000, (Organized by The West Bengal Academy of Science and Technology, Humboldt Club Calcutta)	Participant	S. Chakravorti

In the research group of Professor Villy Sundstrom, Chemical Physics department, Lund university, Lund, Sweden (May, 2000).	Invited Talk	T. Ganguly
In the Physical Chemistry department, Chalmers University of Technology, Goteborg, Sweden, June, 2000	Invited Talk	T. Ganguly
Photobiology Symposium, in the Dept. of Botany of Goa University, India, 11-13 January, 2001	Plenary Lecture	T. Ganguly
Laser studies of binary mixtures of organic solvent Vapours at the Centre for Chemical Physics, The University of Western Ontario, Canada.	Invited Talk	B. Mallik
Photonic Chemistry Section, G.B.T Department of Optical Materials, Osaka National Research Institute, JAPAN	STA Fellow	G. B. Talapatra
Theoretical Physics		
Workshop on Positronium Interactions: Invited Talk New Directions, Harvard Univ., USA, Oct. 12-14, 2000	Invited Talk	A S Ghosh
National Symp. On Atomic Phys. At the Frontiers (APF 2000), Roorkee, Apr 13-15, 2000	Invited Talk	A S Ghosh
do	Chaired a session . & presented paper	K Roy
do	Chaired a session & presented paper	C Sinha
do	Attended & presented paper	P K Sinha A Chakraborty A Basu R Das
XIII National Conf. On Atomic & Molecular Physics, I.A.C.S., Jan. 16-20, 2001	Invited Talk & presented paper	K Roy
do	Chaired a Session & presented paper	C Sinha

XIII National Conf. On Atomic & Molecular Physics, I.A.C.S., Jan. 16-20, 2001	Attended & presented Paper	P K Sinha J K Bhattacharjee A Chakraborty A Basu MTewary D P Bhattacharyya
Condensed Matter Physics Research Center, Jadavpur University, Calcutta, Aug. 3, 2000	Invited Lecture	J Chakrabarti
University of Maryland, USA April 2000	do	J K Bhattacharjee
I.A.C.S Summer School Courses at the Dept. of Theo. Phys., May-July 2000	Course lecture	do
IAPT Workshop at SNBNCBS, Calcutta, June-July 2000	Course lecture	do
Conf. On Current Topics in Theoretical Physics, HRI, Allahabad, Octo-Nov 2000	Invited Lecture	do
National Conf. On Plasma Physics, SINP Calcutta, Nov 2000	do	do
Dept. of Physics, J.N.U., New Delhi Feb 2001	do	do
Int. Conf. On Statistics and Physics, SNBNCBS, Calcutta, March 2001	do	do
Energy Research Unit		
Materials Science Section of the 88 th Session of Indian Science Congress Association.	Presidential Lecture	A K Barua
Annual General Meeting of the Materials Research Society of India	Invited lecture	A K Barua
National Renewable Energy Conference 2000, December 2000, IIT Bombay	Invited lecture	A K Barua
Technology Day Celebration organised by Birla Industrial and Technological Museum	Invited lecture	A K Barua
88 th Indian Science Congress, New Delhi, 3-7 Jan. 2001	Invited lecture	S Ray
19 th Symposium on Plasma Physics and Technology, June, 6 - 9, 2000 (Prague, Czech Republic)	Invited lecture	P Chaudhuri

Physics of semiconductor devices to the M.Sc. (Electronics) PG II students of Jadavpur University	Delivered 20 lectures	P Chaudhuri
Visit to Laboratoire de Génie Electrique de Paris and Universite Claude Bernard Lyon, France under Indo-French project no 2104-1	Delivered lecture	P Chaudhuri
MLS Professor's Unit		
DP Antia Memorial Seminar, Indian Institute of Metals At Taj Bengal Hotel, July 27, 2000	Invited Talk	D Chakravorty
14 th National Convention of Metallurgical and Materials Engineers, Institution of Engineers (India) At National Metallurgical Laboratory, Jamshedpur, September 7-8, 2000	Invited Talk	D Chakravorty
Prof. K. Banerjee Memorial Symposium, IACS, September 15-16, 2000	Invited Talk	D Chakravorty
International Workshop on Nanomaterials, SINP February 5-8, 2001	Invited Talk	D Chakravorty
Indo-Israel Workshop on Advanced Materials org. by International Advanced Research Centre (ARCI) For New Materials Hyderabad February 11-13, 2001	Invited Talk	D Chakravorty
Symposium on New Developments in Materials : Nanomaterials and Manganites, School of Physical Sciences, Jawaharlal Nehru University, New Delhi March 2-3, 2001	Invited Talk	D Chakravorty
Biological Chemistry		
XV Carbohydrate Conference, Sardar Patel University, Vallabh Vidyanagar, Oct. 16-17, 2000	Plenary lecture and chaired a session	B P Chatterjee
International Symposia on Advances in Bioinorganic Chemistry (ISABIC 2000) TIFR, Mumbai, Nov. 20-24, 2000.	Chaired a session	do
88 th India Science Congress, Biochemistry, Biophysics and Molecular Biology Section and Forensic Science Forum, New Delhi, Jan. 3-7, 2001	Invited lecture and chaired a session	do
National Symposium on Biophysics, IICB, Calcutta, Jan. 15-16, 2001	Invited lecture and chaired a session	do

88 th Indian Science Congress, Forensic Science Forum, Jan. 3-7, 2001	Invited lecture	A K Guha
Scientific Meeting on Forensic Science & Forensic Medicine, Calcutta Nov. 17-18, 2000	Chaired a session	A K Guha
National Symposium on Recent Challenges in Chemistry, Tripura University, Agartala, March 29-31, 2001	Invited Lecture	M Ray
Symposium on Recent Trends in Crystallography and its Application, IACS, Sept. 15-16, 2000.	Invited Lecture	A Banerjee
Organic Chemistry Colloquium, IACS, May, 2000	A Course of lectures on Synthetic Protein Mimics	A Banerjee
Inorganic Chemistry		
Max-Planck-Institut für Strahlenchemie, Mülheim, Germany, July-August, 2000.	Guest Scientist	K Nag
Max-Planck-Institut für Strahlenchemie, Mülheim, Germany, July 2000	Invited Talk	K Nag
Institut für Anorganische und Analytische Chemie, Universität Paderborn, Germany, August 2000	Invited Talk	K Nag
Academic Staff College, Himachal Pradesh University, Shimla	Invited Lectures	P Banerjee
Refresher course for Technical Teachers, Pharmacy Department, Jadavpur University	Invited Lecture	P Banerjee
Chuo-University, Tokyo, Japan May-June, 2000 (delivered a series of three lectures)	Visiting Scientist	S Goswami
Ochanomizu University, Japan, May, 2000	Invited Lecture	S Goswami
Institute of Molecular Science, Japan, May, 2000	Invited Lecture	S Goswami
University of Tokyo, Japan, June, 2000	Invited Lecture	S Goswami
One Day Symposium in Chemistry, Department of Chemistry, Indian Institute of Technology, Kharagpur, August, 2000	Invited Lecture	S Goswami
Symposium on Frontiers in Chemical Sciences, Vidyasagar University, Midnapore, February, 2001	Invited Lecture	S Goswami

National Symposium on the Reaction Trends in Coordination Chemistry, Utkal University, Bhubaneswar	Presented Paper	S Dey
Foundation Day Symposium, IACS, July 31 st , 2000	Delivered Lecture	D Ghosh
Organic Chemistry		
First Eurasian Meeting on Heterocyclic Chemistry Suzdal, Russia, Sept. 13-17, 00	Plenary Lecture	A De
Gordon Conference on Green Chemistry, Connecticut, USA, July 15-20, 2000	Invited Lecture	B C Ranu
2 nd Winter School on Chemistry, IIT, Kharagpur, Jan 8-13, 2001	Organometallic	B C Ranu
3 rd National Symposium in Chemistry, Chemical Research Society of India, Chandigarh, Feb. 2-4, 2001	Medal Lecture	B C Ranu
Symposium on Frontiers in Chemical Sciences, Vidyasagar University, Midnapore, Feb. 26-27, 2001.	Plenary Lecture	B C Ranu
National Seminar on Heterocyclic Chemistry – New Dimensions, Gorakhpur, March 18-20, 2001	Invited Lecture	B C Ranu
National Symposium on Recent Challenges in Chemistry, Agartala, Tripura, March 29-31, 01	Invited Lecture	B C Ranu
CDRI, Lucknow, April 18, 2000	Invited Lecture	S Ghosh
XIX Conference of Indian Council of Chemists, Kuvempu University, Shimoga, 27-29 th Nov., 2000	Invited Lecture	S Ghosh
Organic Synthesis : Retrospect and Prospects, BHU, 19-20, Jan, 2001.	Invited Lecture	S Ghosh
Rega Institute of Medical Research, Katholieke Universiteit, Leuven, Belgium, May 16, 2000.	Invited Lecture	N G Kundu
Department of Bioorganic Chemistry, Biomedical Centre, University of Uppsala, Uppsala, Sweden, May 19, 2000.	Invited Lecture	N G Kundu
Department of Chemistry, University of Manchester, Manchester, England, May 22, 2000.	Invited Lecture	N G Kundu
Department of Chemistry, University of East Anglia, Norwich, England May 25, 2000.	Invited Lecture	N G Kundu

Department of Chemistry, Bristol University Bristol, UK, June 1, 2000.	Invited Lecture	N G Kundu
Huntington Medical Research Institute Pasadena, California, USA, June 23, 2000.	Invited Lecture	N G Kundu
PET Center, University of Southern California Medical Center, Los Angeles, Calif., USA, June 27, 2000.	Invited Lecture	N G Kundu
CEMES CNRS, Toluouse, France Sept., 6, 2000.	Invited Lecture	A De
Universite de la Mediteranee Luminy, Marseilles, France, Sept., 8, 2000.	Invited Lecture	A De
Bhaba Atomic Research Centre, Mumbai, June 7, 2000.	Invited Lecture	B C Ranu
University of Florida, Gainesville, USA, July 24-25, 2000.	Invited Lecture	B C Ranu
Rice University, Houston, Texas USA, July 31, 2000.	Invited Lecture	B C Ranu
Indo-French Meeting on Organic Chemistry, Bangalore, Sept. 25, 2000.	Invited Lecture	B C Ranu

Physical Chemistry

The Recent Progress in Quantum Many-Body Theories, Bonn, Germany, 2000.	Plenary talk	D Mukherjee
The Xth International Congress of Quantum Chemistry, Menton, France, 2000.	Plenary talk	D Mukherjee
The Chemical Research Society of India, Chandigarh, 2001.	Invited Lecture	D Mukherjee
The Indo-French Workshop on Weak Intermolecular Interactions, Hyderabad, 2001.	Plenary talk	D Mukherjee
The American Chemical Society Annual Meeting, San Diego, 2001.	Invited Lecture	D Mukherjee
Stochastic Diagonalization by Genetic Algorithm: Trends in Theoretical Chemistry IIT (Kanpur), Dec. 22-24, 2000	Invited Lecture	S P Bhattacharyya
Genetic Algorithms, Challenges of Chemistry in the New Millenium: Tripura University, March 29-31, 2001.	Invited Lecture	S P Bhattacharyya

Natural Algorithms, Symposium on Frontiers of Chemical Sciences, Vidyasagar Univ., Midnapore Feb. 26-27, 2001	Invited Lecture	S P Bhattacharyya
Genetic Algorithms in the modelling of weakly bound clusters: International Symposium on Strategies and Perspectives in Drug development, design and molecular modelling, IICB, Calcutta, October 17-18, 2000.	Invited Lecture	S P Bhattacharyya
Computational Mathematics for Electronics, J.U., September to March 2001.	A course of 30 lectures	S P Bhattacharyya
Molecular Quantum Mechanics, Post-graduate Dept. of chemistry, Presidency College, Calcutta, December 2000 - March 2001.	A course of 10 lectures	S P Bhattacharyya
Nonequilibrium Statistical Mechanics, Calcutta University, February 2001-April 2001	A course of 10 lectures	D S Ray
Thermodynamics, IACS, Summer School for School Students, May 2000.	A course of 5 lectures	D S Ray
Statistical mechanics, IACS Summer School for College Students, May 2000.	A course of 5 lectures	D S Ray
Institute of theoretical physics, Calcutta, Sept. 2000	K C Kar Memorial Lecture	D S Ray
Weak - noise limit of Stochastic Processes, Theoretical Chemistry Conference at I. I. T, Kanpur, Dec., 2000	Invited talk	D S Ray
Statistical theories in chemical dynamics, Summer School in Chemical Dynamics, I.I.T, Chennai.	A set of 4 lectures	D S Ray
CSIR program on "Youth for Leadership in Science" IICB, 2000.	Invited talk	K Bhattacharyya
Discussion meeting on "Structure and Dynamics in Complex Systems", IISc, Bangalore, April, 2000.	Invited talk	K Bhattacharyya
Workshop on Recent Trends in Photochemistry, "Structure and Dynamics in Complex Systems", RRL, Trivandrum, January, 2001.	Invited talk	K Bhattacharyya
Discussion meeting on Dynamics in Confined Systems, "Structure and Dynamics in Complex Systems", IISc, Bangalore, January, 2001.	Invited talk	K Bhattacharyya

Department of Chemistry, University College,
Dublin, Ireland

Visiting
Professor

S Mukherjee

Polymer Science Unit

National Conference "Macro 2000"
DMSRDE, Kanpur, Dec. 1-2, 2000

Invited talk and
Chaired a technical
Season

B M Mandal

National Conference "Macro 2000"
DMSRDE, Kanpur, Dec. 1-2, 2000

Chaired a technical
season and presented
a paper

A K Nandi

National Conference "Macro 2000"
DMSRDE, Kanpur, Dec. 1-2, 2000

Presented a paper

S Guha,
P Das,
S Malik,
H Rahaman

National Polymer Symposium held at
DMSRDE, Kanpur December 2000

Invited Lecture

B M Mandal

IIT Kharagpur January 21, 2001

do

B M Mandal

IIT Kharagpur January 21, 2001.

do

B M Mandal

SEMINAR / LECTURES

Solid State Physics

Magnetic Levitation

Prof. D J Coey, Oxford

Theoretical Physics

Pattern formation in chemically active liquids

Dr. J Chakrabarty
S.N.B.N.C.B.S., Calcutta

Mixed ways superconductivity states

Dr. A Ghosh Chaudhuri
Sao Paulo, Brazil

Model studies of non-equilibrium statistical mechanics

Dr. A Basu, IISc., Bangalore

Constraints on masses and mixing of neutrinos from oscillation experiment

Dr. S Goswami, SINP, Calcutta

Quantum phase transitions

Dr. A Dutta, SINP, Calcutta

Computer simulation studies of biomembranes

Dr. J Saha
Univ. of Notre Dame, USA

Spin and statistics

Dr. Sreedhar, IAS, Dublin, UK.

Scaling and multiscaling in a coupled, driven diffusive model: Effects of kinematic waves and noise-correlation

Dr. A Basu
IISc., Bangalore

Semi-Perturbative Unification

Dr. B Brahmachari
Indiana Univ., USA

External Black Holes

Dr. B Rai, IOP, Bhubaneswar

Inorganic Chemistry

Bimetallic assemblies aiming for magnetic materials

Professor H Okawa,
Kyushu University, Japan

Coupling of organometallic electron transfer and reaction centres via bridging ligands

Professor W Kaim,
University of Stuttgart, Germany

Organic Chemistry

Tetraphenyl methane based molecular architecture

S Sengupta, JU

Development of chemosensors for biological important peptides and other possible applications development of chemosensors for biological important peptides and other possible applications Pd-Catalyzed cycloisomerisation	S Kar, Taiwan
Green Chemistry : Catalytic activation of hydrogen peroxide by TAMI activators for green oxidation processes	Guy Lloyd-Jones, UK
Synthetic protein mimics	Terry Collins, USA
Total synthesis of the marine macrolide	A Banerjee, IACS
New nucleosides and carbohydrates : synthesis with a purpose	S K Chattopadhyay, KU
Solid phase synthesis : application of heterogenized multivalent ligands in catalysis	T Pathak, NCL, Pune
Parallel synthesis and purification of small molecule libraries on a novel synthesis platform	G Panda, Canada
Synthesis of bioactive heterocycles	S Bhattacharyya, USA
Silicon in Synthesis Part I & II	K C Majumdar, KU
	T K Sarkar, IIT, Kharagpur
Physical Chemistry	
A course of (15) lectures on Mathematical analysis	Prof. Kalyan Kundu, IOP, Bhubaneswar
Multi-reference perturbation theory-New developments	Dr. Uttam K. Sinha Mahapatra
Magnetic field effect on triplet-born radical pairs	Dr. Mintu Haldar, Vidyasagar University
Eigenfrequencies of giant dipole-dipole interactions via whispering gallery modes of the microsphere	Prof. S Dutta Gupta, Dept. of Phys., University of Hyderabad
Single molecule spectroscopy with polymers	Prof. Biman Bagchi, SSCU, IISC, Bangalore
Energy transfer in multi-chromophoric compounds: A femtosecond up conversion study	Dr. Sivaprasad Mitra, Laboratory for Molecular dynamics and Spectroscopy , Dept. of Chemistry Katholieka University of Leuven, Belgium

Modelling of solvation using both discrete and continuum descriptions of the solvent: application to glycine

The role of orbital degrees of freedom on magnetic properties: a new spin-gap mechanism

Theoretical studies of transition metal catalyzed reactions

Explicitly correlated coupled-cluster theory- a new level of accuracy for computational chemistry

Femtosecond study of hydrogen-bond dynamics

Femtosecond studies of photophysics of organic molecules

Reactions and energy transfer in super critical fluids

Structures and dynamics of liquids at interfaces and in confined systems

Characterization of protonated formamide-containing clusters by infrared spectroscopy and ab-initio calculations: hydration of formamide in the gas phase

IR-UV double resonance of solvent clusters in jet

Polymer Science Unit

Polymeric materials for their novel biomedical applications

Control of polymeric nanoarchitecture by anionic living polymerization for photoelectronic researches.

Anionic living polymerization of isocyanates

Dr. Pradipta Bandyopadhyay,
Ames Laboratory, Dept. of
Chemistry, Iowa State University,
U.S.A

Dr. Swapan K Pati,
North Western University, U.S.A

Professor Gernot Frenking,
Department of Chemistry, Philip-
Universität Marburg, Germany

Professor Josef Noga,
Slovak Academy of Sciences,
Bratislava

Prof. S Bratos,
Physique Theorique des Liquides,
Paris, France

Prof. T Tahara, Institute of
Molecular Science, Okazaki

Prof. O Kajimoto,
Kyoto University, Japan, Victoria
Professorship Lecture

Prof. A Chandra,
I.I.T., Kanpur

Dr. Chanchal Chaudhuri,
Academia Sinica, Taiwan

Prof. N Mikami,
Tohoku University, Japan

P Banerjee
IIT, Kharagpur

J S Lee
Kwangju Institute of Science &
Technology, Korea.
do

CONFERENCE AND SYMPOSIA ORGANISED BY THE DEPARTMENT

Solid State Physics and Materials Science

Symposium on Recent Trends In Crystallography & its Applications (SRTCTRA 2000), September 15-16, 2000 to commemorate the birth centenary of Professor Kedaeswar Banerjee.

Joint Convenors : Prof. B K Chaudhuri and Prof. M Mukherjee

Theoretical Physics

A day long Seminar held on 11th Aug 2000 to commemorate the 62nd birth anniversary of Prof. C K Majumdar.

Convenor : Prof. J K Bhattacharjee

XIII National Conf. On Atomic and Molecular and Molecular Physics under the auspices of Indian Society of Atomic and Molecular Physics held from January 16-20, 2001,

Convenor : Prof. A S Ghosh and Co-Convenor : Prof. K Roy

A 2-month Summer School for students, who have just appeared for their H.S. Examination. The School consisted of lectures on various aspects of Physics, Chemistry and Biology and also included lecture on literature, art and philosophy.

Convenor : Prof. J K Bhattacharjee

Biological Chemistry

Sixth Seminar on Biochemistry and Biophysics September 2, 2000

Convenor: Prof B P Chatterjee

P H.D. (SC.) DEGREE AWARDED TO RESEARCH WORKERS

Name	Title of the thesis	University	Department	Supervisor
1. Swapan K. Mandal	Some aspects of II-VI semiconductors in nanocrystalline thin film form	Jadavpur	Materials Science	S Chaudhuri
2. Sudeshna Mukerji	Growth and characterization of single crystal of L-arginine halides (non linear optical materials)	do	do	T Kar
3. Avijit Datta	Multiphoton dissociation and excitation of some simple molecules in intense laser fields	do	do	S S Bhattacharyya
4. Mukul Sural	Electrical conductivity and conductivity relaxation in some heavy metal fluoride glasses	do	Solid State Physics	A Ghosh
5. Somaditya Sen	Structural and electrical properties of some alkaline earth vanadate semiconducting glasses	do	do	A Ghosh
6. Soma Bhattacharya	Study of the electronic and other properties of some semiconducting glassy precursors of high T_c superconductors and related systems	do	do	B K Chaudhuri & K Goswami
7. Yatramohan Jana	Crystal field studies on rare earth crystalline compounds involving low temperature magnetic, optical, paramagnetic specific heat and mossbauer spectral properties	do	do	D Ghosh

CONFERENCE AND SYMPOSIA ORGANISED BY THE DEPARTMENT

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A day long Seminar held on 11th Aug 2000 to commemorate the 62nd birth anniversary of Prof. C K Majumdar.

Convenor : Prof. J K Bhattacharjee

XIII National Conf. On Atomic and Molecular and Molecular Physics under the auspices of Indian Society of Atomic and Molecular Physics held from January 16-20, 2001,

Convenor : Prof. A S Ghosh and Co-Convenor : Prof. K Roy

A 2-month Summer School for students, who have just appeared for their H.S. Examination. The School consisted of lectures on various aspects of Physics, Chemistry and Biology and also included lecture on literature, art and philosophy.

Convenor : Prof. J K Bhattacharjee

Biological Chemistry

Sixth Seminar on Biochemistry and Biophysics September 2, 2000

Convenor: Prof B P Chatterjee

8.	P K Sinha	Positronium-atom scattering at low and medium energies	Jadavpur	Theoretical Physics	A S Ghosh
9.	S K Biswas	The study of flavour changing neutral current in the standard model and beyond	do	do	V P Gautam
10.	R K Saha	Investigation on the energy spectra of secondary cosmic ray anti protons, electrons and positrons near the top of the atmosphere.	do	do	D P Bhattacharyya
11.	Tapati Jana	Alloys of amorphous silicon: preparation, characterization and application on solar cells.	do	Energy Research Unit	S Ray
12.	Nandita Palit	Amorphous silicon based solar cells: experimental characterizations and computer modelling.	do	do	S Ray and P Chatterjee
13.	Swapna Ghosh	Understanding the biochemical basis of aberrant glycolysis in tumor cells with special reference to glyceraldehyde-3-phosphate dehydrogenase, a key enzyme of glycolytic pathway.	do	Biological Chemistry	M Ray
14.	Maya Shivakumar	Studies on the heavy transition metal chemistry of azo ligands	do	Inorganic Chemistry	A Chakravorty
15.	Inamur Rahaman Laskar	Chemistry of nickel(II)-diamine chelates: synthesis, characterisation and their thermal behaviour in the solid state	do	do	N Ray Chaudhuri
16.	Monojit Ray	Reactions of some platinum(II) and palladium(II) complexes : Kinetics and mechanisms	do	do	P Banerjee
17.	Partha Majumdar	Synthesis and electrochemical studies on ruthenium and osmium complexes of high nuclearity	do	do	S Goswami

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|----------------------------|--|----------|----------------------|-------------------|
| 18. Subhendu Sekhar Mandal | Studies on synthesis of benzo[b]thiophene and thienothiopyran derivatives | Jadavpur | Organic Chemistry | A De |
| 19. Dwijendra Lal Maji | δ -Keto- β,γ -enones : syntheses and reactivities in excited states | do | do | S Lahiri |
| 20. Mintu Haldar | Magnetodynamics of spin-correlated electron pair | do | Physical Chemistry | M Chowdhury |
| 21. Pinaki Chaudhury | Exploring natural algorithms for solving problems of theoretical chemistry | do | do | S P Bhattacharyya |
| 22. Dipanwita Guha | Spectroscopic studies on the molecular interaction of some organic and bio-organic compounds: solvent effects | do | do | S Mukherjee |
| 23. Sudip K. Chattopadhyay | Development and applications of state specific multireference theories to treat response properties of strongly correlated molecular systems | do | do | D Mukherjee |
| 24. Mukut Chakraborty | Physicochemical studies on conducting polymer dispersions and conducting polymer composites | Calcutta | Polymer Science Unit | B M Mandal |
| 25. Anupam Dasburman | Investigations on mixed micellar systems. | Jadavpur | do | A R Das |

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2. An X-ray profile analysis on the growth imperfections and internal strains in vapour deposited lead films- S Bhaumik, P Chatterjee and S P Sen Gupta, *Z.Kristallogr.* **215**, 632 (2000)
3. On the effect of heat treatment on thin films of lead vapour -deposited on Si (100) substrate- S Bhaumik and S P Sen Gupta, *Ind. J. Phys.* **74A**, 541(2000)
4. Microhardness and its related physical constants in solution-grown ammonium sulphate single crystals -S Karan, S Sen Gupta, S P Sen Gupta, *Mat. Chem. Phys.* **69**, 143 (2001)
5. Ethyl 3-(2'-deoxyuridin-5-yl)-3-hydroxy-2-iodopropanoate, a nucleoside analogue- G Mazumdar, M De, A Mukhopadhyay, S K Mazumdar, A K Das, E E Knaus, *Acta Cryst.* **C56**, 494(2000)
6. X-ray characterization of the microstructure of α -Cu-Ti alloys by Rietveld's method- A Chanda and M De, *J. Alloys and Compounds*, **313**, 104 (2000)
7. Correlation of Microstructure with mechanical property of Cu-Mn-Zn alloys- H Dutta, S K Shee, S K Pradhan and M De, *Mater. Engg.*, **11**, 159 (2000)
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111. Lectin-induced apoptosis and pathogenesis - B P Chatterjee, Biochemistry, Biophysics and Molecular Biology Section, 88th Indian Science Congress, New Delhi, Jan. 3-7, 2001

112. Lectin-carbohydrate interaction in the light of biochemical, biophysical and immunological aspects - B P Chatterjee, National Symposium on Biophysics, Calcutta, Jan. 15-17, 2001
113. Methylglyoxal based nontoxic formulation, a challenge for cancer therapy - M Ray, National Symposium on Recent Challenges in Chemistry, Tripura University, Agartala, March 29 - 31, 2001
114. Nutritive value of food yeast biomass produced from fermentation of deproteinized whey - R Mukhopadhyay, D Paul, B P Chatterjee and A K Guha, 69th Annual General Meeting of Society of Biological Chemists, Kolkata, Dec. 7-9, 2000
115. Role of *M. phaseolina* agglutinin in recognition and infection exemplified by lectin-carbohydrate interaction, J Bhowal, S Ghosh, A K Guha and B P Chatterjee, 69th Annual General Meeting of Society of Biological Chemists, Kolkata, Dec. 7-9, 2000
116. Food-microbiological hazards and control - A K Guha, 88th Indian Science Congress, Forensic Science Forum, New Delhi, Jan. 3-7, 2001
117. Design, synthesis and structural analysis of various reverse turn mimics in Synthetic Peptides and Pseudo-peptides - S K Maji, D Halder, R Banerjee and A Banerjee, Golden Jubilee Symposium on Cellular and Molecular Biophysics, Saha Institute of Nuclear Physics, Kolkata, Sept. 5 - 7, 2000
118. Various reverse turns in proteins, synthetic peptides and pseudopeptides - A Banerjee, Symposium on Recent Trends in Crystallography and its Application, IACS, Kolkata, Sept. 15-16, 2000
119. Role of glyceraldehyde - 3 phosphate dehydrogenase in aberrant glycolysis of malignant cell

- S Ghosh, Foundation day symposium, IACS, July 29, 2000

Organic Chemistry

120. Heteroannulation through Copper Catalysis : A Novel Cyclisation leading to a Highly Regio- and Stereoselective Synthesis of 2-Substituted Benzothiazolines - B Nandi in Symposium on Foundation Day Celebration at IACS, July 29, 2000
121. Zinc Borohydride - A Reducing Agent with High Potential and Indium Metal in Organic Synthesis - B C Ranu, 2nd Winter School on Organometallic Chemistry, IIT, Kharagpur, January 8-13, 2001
122. Indium Metal and Its Halides in Organic Synthesis - B C Ranu, 3rd National Symposium in Chemistry of Chemical Research Society of India, Chandigarh, February 2-4, 2001
123. Green Chemistry and Its Importance - Our Endeavour - B C Ranu, Symposium on Frontiers in Chemical Sciences, Vidyasagar University, Midnapore, February 26-27, 2001
124. Synthesis of Heterocyclic Compounds of Biological Importance by Simple and Eco-friendly Process - B C Ranu and A Hajra, National Seminar on Heterocyclic Chemistry - New Dimensions, Gorakhpur, March 18-20, 2001
125. Green Chemistry and Its Importance - Our Endeavour - B C Ranu, National Symposium on Recent Challenges in Chemistry, Agartala, Tripura, March 29-31, 2001

Polymer Science Unit

126. On the feasibility of atom transfer radical polymerization in water - B M Mandal, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Al-

lied Publishers, New Delhi, P-15-17, 2000

127. Dispersion polymerization of aniline in various media - M Chakraborty and B M Mandal, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Allied Publishers, New Delhi, P. 82-85, 2000
128. Trapped radical in precipitation polymerization of acrylamide - S Guha and B M Mandal, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Allied Publishers, New Delhi, P. 145-148, 2000
129. Studies on the polymerization of aniline using P-phenylene diamine as initiator, P Das and B M Mandal, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Allied Publishers, New Delhi, P. 149-152, 2000
130. Thermoreversible polyaniline gels in different sulfonic acids - T Jana and A K Nandi, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Allied Publishers, New Delhi, P. 256-259, 2000
131. Thermoreversible gelation of poly(3-hexyl thiophene) in xylene - S Malik and A K Nandi, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Allied Publishers, New Delhi, P. 277-280, 2000
132. Compatibility study of crystalline polymer-crystalline polymer blends - M Habibur Rahaman and A K Nandi, in 'Recent advances in polymers and composites' Eds. G N Mathur, L D Kandpal and A K Sen, Allied Publishers, New Delhi, P. 481-484, 2000

STAFF STRENGTH AS ON 31ST MARCH, 2001

DIRECTOR & HIS STAFF

D Mukherjee, Director
S Ray, Professor (Computer Centre)
D M Bhattacharyya, Lecturer
S Deoghuria, Scientist II (System Analyst)
G S Mukherjee, Assistant Registrar

ADMINISTRATION

Administrative

A K Biswas, Registrar (from 01.01.2001)
B N Bhattacharyya, Assistant Registrar-I
A Dey, Assistant Registrar
N C Das Roy, Assistant Registrar
A Pal, Assistant Registrar
S N Moullick, Assistant Registrar
B K Das Gupta, Assistant Registrar (Store)
N M Ghosh, Finance & Accounts Officer
S Roy, Finance & Accounts Officer,
S Bardhan, Finance & Accounts Officer
G Chattopadhyay, Finance & Accounts Officer
S Nath, Finance & Accounts Officer
P K Goon, Finance & Accounts Officer
B Sarkar, Finance & Accounts Officer
A Chakraborty, Office Superintendent (Accounts)
S Saha, Office Superintendent-I
M S Sarkar, Office Superintendent-I
S K Mukhopadhyay, Office Superintendent-I
P K Bagchi, Office Superintendent
A Roy, Office Superintendent
S S Das, Office Superintendent
P P Chakraborty, Security Officer-I
M Mukherjee, Office Superintendent
S Ghosh, Office Superintendent
P Kundu, Assistant (F&A)
D Majhi, Assistant (F&A)
S Thakur, Assistant (F&A)
B Mondal, Assistant
A Nandy, Assistant
A Chakraborty, Assistant
A K Majumdar, Assistant
D Mondal, UDC
P Kar, UDC
D Mukherjee, Sr. Tel.Op.-Cum-Receptionist
P Ghosh Dastidar, Sr. Tel.Op.-cum-Receptionist
B Barua, Sr. Record Keeper 'A'
R P Mondal, Helper 'B'
C S Naskar, Helper 'B'
S Behura, Helper 'B'

R K Routh, Helper 'A'
A Das, Helper 'A'
G Chakraborty, Helper 'A'
B Roy, Helper 'A'
D K Pal, Watch & Ward Assistant
N Yadav, Watch & Ward Assistant
R G Sharma, Watch & Ward Assistant
S N Das, Security Assistant 'B'
R Rai, Security Assistant 'B'
H P Sarma, Security Guard
S Mondal, Security Guard
Pradip Roy, Security Guard
G Chakraborty, Security Guard
P K Guria, Watchman
N Behura, Sr. Garden Chowdhury
H Karan, Sr. Garden Chowdhury
A Adhikari, Head Mali
N Majumdar, Head Mali
A Behura, Head Mali
S Harijan, Cons. Supervisor
R Prakash, Cons. Supervisor
B L Balmiki, Head Jamadar 'B'
J Singh Harijan, Jamadar
A Singh Harijan, Jamadar
R C Harijan, Jamadar
A Harijan, Sweeper
M Balmiki, Sweeper
S Mondal, Sweeper
H Rai, Jamadar

Technical

B K Roy, Engineer-I
M Chakraborty, Assistant Engineer
U N Das, Staff Car Driver 'D' (Sel.Gd.)
S K Pal, Staff Car Driver 'D' (Sel.Gd.)
N L Bera, Staff Car Driver 'B'
R C Ghosh, Senior Technical Supdt. (Plumbing)
H Majumder, Senior Technician
K Mondal, Junior Technician
S Chatterjee, Junior Technician
A Basak, Sr. Technician (Lift)

Temporary

A Bose, Staff Car Driver 'B'
S Adak, Staff Car Driver 'B'
P Ghosh, Junior Technician
B Paul, Junior Technician
S Mitra, Security Guard
R C Balmiki, Jamadar
Pitambar Sahoo, Head Mali

CANTEEN

S K Ghosh, Manager-cum-Salesman
K Barik, Washboy-cum-Bearer
B Sardar, Washboy-cum-Bearer
H Pusti, Washboy-cum-Bearer
S Mondal, Washboy-cum-Bearer
S Mitra, Washboy-cum-Bearer

CENTRAL SCIENTIFIC SERVICES

S Dhall, Office Superintendent
B K Haldar, Technical Officer-I
N Choudhury, Technical Officer-I
S Mukherjee, Technical Officer-I
S Khatua, Technical Officer-I
P Dasgupta, Technical Officer
C Chakraborty, Technical Officer
R Hazra, Technical Officer
S Saha, Technical Officer
S Bose, Technical Officer
S Choudhury, Technical Superintendent
P Sinha, Technical Assistant 'B'
M M Mistri, Technical Assistant 'B'
B B Majumdar, Technical Assistant 'B'
S K Sinha, Technical Assistant 'B'
A K Roy, Technical Assistant 'B'
A K Chakraborty, Technical Assistant 'A'
G K Manna, Technical Assistant 'A'
S S Roy, Technical Assistant 'A'
D Chakraborty, Technical Assistant 'A'
P K Das, Technical Assistant 'A'
D K Yadav, Helper 'B'

MATERIALS SCIENCE

A Bhattacharyya, Office Superintendent
T Das, Assistant
M M Chowdhury, Technical Officer-I
K K Das, Technical Officer
U Sinha, Technical Officer
P K Das, Technical Officer
G C Basak, Technical Superintendent-I
R N Chowdhury, Technical Superintendent
S S Routh, Technical Assistant 'B'
S Routh, Technical Assistant 'B'
S Ghosh, Technical Assistant 'B'
B Kurmi, Helper 'B'

SOLID STATE PHYSICS

S Roy Rakshit, Office Superintendent
S Pal, Office Superintendent
K Bhattacharyya, Technical Officer
R C Ghoshal, Technical Superintendent
S Bose, Helper 'B'
N Kurmi, Helper 'B'

SPECTROSCOPY

C Bhattacharyya, Office Superintendent
M Majumder, UDC
S K Bhattacharyya, Technical Officer
B Moitra, Technical Superintendent
S Das, Technical Superintendent
D K Majumdar, Technical Assistant 'B'
M K Ghosh, Technical Assistant 'B'
A K Bandyopadhyay, Technical Assistant 'B'
N C Barik, Helper 'B'
S Chakraborty, Helper 'A'

THEORETICAL PHYSICS

T K Moulik, Assistant Registrar
B Ghosh, Assistant
S K Mukherjee, Technical Assistant 'B'
M M Sardar, Technical Assistant 'B'
S Singha, Technical Assistant 'A'
S Mandal, Helper 'B'

ENERGY RESEARCH UNIT

S Das, Office Superintendent-I
B Hazra, Assistant
D Shome, Technical Officer
R G Manna, Technical Superintendent-I
I Bhowmik, Technical Superintendent
S Das, Technical Superintendent
S Dutta, Technical Superintendent
J Das, Technical Assistant 'B'
T K Dutta, Technical Assistant 'B'
S Sarkar, Technical Assistant 'B'
D Prasad, Technical Assistant 'A'
B. Roy, Technical Assistant 'A'
D Majumdar, Technical Assistant 'A'
B Bag, Staff Car Driver 'B'

MLS PROFESSOR'S UNIT

U Chakraborty, Assistant
S Chakraborty, Technical Assistant 'B'
S K Sarkar, Helper 'B'

BIOLOGICAL CHEMISTRY

R N Raha, Office Superintendent
S Saha, Assistant
L Sarkar, Technical Officer
P K Ghosh, Technical Superintendent
S K Banerjee, Technical Assistant 'B'
A Basu, Technical Assistant 'B'
P Singh, Technical Assistant 'A'
G C Bairagi, Helper 'A'

INORGANIC CHEMISTRY

S K Bhattacharyya, Office Superintendent
T Chakraborty, Office Superintendent

S Mukhopadhyay, Technical Officer I
S Chakraborty, Technical Officer
S Bhattacharya, Technical Officer
B Pathak, Technical Officer
P Mitra, Technical Superintendent
P K Manna, Technical Assistant 'B'
P Majumdar, Technical Assistant 'B'
D Pramanik, Technical Assistant 'B'
S Das, Technical Assistant 'A'
A K Nath, Technical Assistant 'A'
T Nath, Helper 'A'

ORGANIC CHEMISTRY

S Pal, Office Superintendent
A Basak, Assistant
A K Mukherjee, Technical Officer-I
P P Bhattacharyya, Technical Officer
S Seal, Technical Officer
N Dutta, Technical Officer
S K Sarkar, Technical Superintendent
B K Ghosh, Technical Assistant B
S Ray, Technical Assistant B
M K Naskar, Technical Assistant B
R K Dey, Technical Assistant A
M Chowdhury, Helper 'B'
B K Chandra, Helper A

PHYSICAL CHEMISTRY

K K Dutta, Assistant Registrar
M Bhattacharjee, UDC
D Das Roy, Assistant Registrar (Store)
A K Dasgupta, Technical Assistant 'B'
S Sinha, Technical Assistant 'B'
S Saha, Technical Assistant 'A'
J Mondal, Helper 'B'
T K Das, Helper 'A'

POLYMER SCIENCE UNIT

A Chakraborty, Office Superintendent
N Roy, Technical Officer-I
N Naskar, Technical Officer
S Roy, Technical Assistant 'B'
S Pal, Technical Assistant 'A'
P G Chakraborty, Technical Assistant 'A'
N Majumder, Helper 'A'

LIBRARY

S Mitra, Librarian
M Banerjee, Assistant Librarian
C K Das, Assistant Librarian
A K Sardar, Office Superintendent
T K Mukherjee, Doc. Superintendent
A Das Gupta, Doc. Superintendent
S K Dutta, Doc. Superintendent
S Roy, Sr. Doc. Assistant

S Roy Choudhury, Sr. Doc. Assistant
R Roy, Doc. Assistant
S Chonger, Doc. Assistant
S B Misra, Helper 'B'
B Dafadar, Helper 'B'
S K Chandra, Helper 'B'
B Chandra, Helper 'B'

INDIAN JOURNAL OF PHYSICS

K K Datta, Scientist II (Associate Editor)
S Sahoo, Assistant Registrar
A Choudhury, Office Superintendent
A N Ghatak, Technical Officer
A Banerjee, Senior Record Keeper 'A'

WORKSHOP

S Bandyopadhyay, Workshop-in-Charge
S Sil, Office Superintendent-I (Store)
S K Dutta, Office Superintendent (Store)
P Nayak, Assistant
B Roy, Technical Officer-I
P Mondal, Technical Officer
S N Nandy, Technical Officer
K N Guchhait, Technical Superintendent-I
S K Modak, Technical Superintendent -I
B P Ghosh, Technical Superintendent -I
S Roy, Technical Superintendent -I
K M Maity, Technical Superintendent -I
S Sarkar, Technical Superintendent
B Prasad, Technical Superintendent
S K Bose, Technical Superintendent
A K Mallik, Technical Superintendent
N K Roy, Technical Superintendent
S C Karmakar, Technical Superintendent
A Manna, Technical Superintendent
N Ganguly, Technical Superintendent
N C Ghosh, Technical Superintendent
B Pal, Senior Technician
D Mitra, Senior Technician
S S Prasad, Senior Technician
H Dutta, Senior Technician
S Halder, Senior Technician
J N Ghosh, Junior Technician
S Mistry, Junior Technician
S Majumdar, Junior Technician
S Bose, Junior Technician
T Maity, Junior Technician
B Ghosh, Junior Technician
S Basu, Helper 'B'
P Debnath, Helper 'A'
B Saha, Helper 'A'
P Mondal, Helper 'A'
M Saha, Helper 'A'
D Banerjee, Helper 'A'
G Das, Helper 'A'

ANNEXURE

ANNUAL ACCOUNTS, AUDIT REPORT AND BUDGET

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
 JADAVPUR, KOLKATA-700 032

LIABILITIES	SCHEDULE	Rs. P.	Rs. P.
GENERAL FUND:			
As per Last Account		40,79,50,097.58	
Add: Grant of WB Non-Rec. 2000-2001 (Received & Receivable)		(+)4,00,00,000.00	
Add: Excess of Revenue receipt over Expenditure		(+) 33,73,458.42	45,13,23,556.00
BIJNANER ITIHAS (As per Last Account)			17,541.52
SPECIAL GRANT (For Special Equipment)	B		1,03,38,439.65
SUSPENSE	I		2,33,465.00
SPECIAL RES. ENDOWMENT FUND	C		22,89,000.00
DEPOSIT (Earnest Money, Security Deposit Retention Money, Library Caution Money)	F		29,565.00
OTHER LIABILITIES	J		970.00
PROVISION AGAINST			95,331.00
PREMIUM & ROYALTY (As per Last Account)			
SCIENCE ADVANCEMENT FUND, IACS	K		1,38,13,233.52
PROJECT SECTION			15,02,04,312.48
Total			62,83,45,414.18

BALANCE SHEET AS ON MARCH 30, 2001

ASSETS	SCHEDULE	Rs. P.
FIXED ASSETS: (As per Schedule)	A	29,09,78,761.25
SPECIAL GRANT (For Special Equipment)	B	1,03,38,439.65
SPECIAL RES. ENDOWMENT FUND	C	22,89,000.00
HOUSE BUILDING LOAN	D	80.38,840.00
GRANTS RECEIVABLE FROM GOVT. OF WEST BENGAL	E	14,70,45,500.00
DEPOSITS	F	12,86,750.00
ADVANCES	G	41,46,915.71
PREPAID EXPENSES (As per Last Account Sri P.K.Basu)		24,790.00
CLOSING BALANCES	H	1,78,871.56
SCIENCE ADVANCEMENT FUND, IACS	K	1,38,13,233.52
PROJECT SECTION		15,02,04,312.48
	Total	62,83,45,414.18

A.K. Biswas
Registrar
Indian Association for the
Cultivation of Science
Jadavpur, Cal-32

D Mukherjee
Director
Indian Association for the
Cultivation of Science
Jadavpur, Cal-32

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, KOLKATA : 700 032

SCHEDULE – A1

Fixed Assets & Other Laboratory Fittings, Scientific Instruments as on March 30, 2001

Sr. No.	Particulars	Cost as on 01.04.2000	Addition in 2000-2001	Total cost as on 30.3.2001
1.	Land Acquisition Cost	6,60,858.38		6,60,858.38
2.	Main Building	109,03,347.01		109,03,347.01
3.	Gas Plant	71,203.30		71,203.30
4.	Power House	14,42,600.36		14,42,600.36
5.	Workshop Building	2,04,979.89		2,04,979.89
6.	Residential	38,354.24		38,354.24
7.	Hostel Buildings	1,02,983.19		1,02,983.19
8.	Essential Staff Qtrs.	11,51,844.19		11,51,844.19
9.	Pump House	27,661.12		27,661.12
10.	Ladies Hostel	10,50,110.37		10,50,110.37
11.	Helium Lab. Building	7,73,343.77		7,73,343.77
12.	Garage	45,263.50		45,263.50
13.	Store Room	60,791.04		60,791.04
14.	Library Building	2,73,34,173.00	7,246.00	
			16,69,500.00	2,90,10,919.00
15.	Electrical Installation	41,45,688.98	3,93,047.00	45,38,735.98
16.	Sanitary & Plumbing	20,58,347.11		20,58,347.11
17.	Laboratory Fittings & Fixtures	49,45,979.34	1,80,671.25	51,26,650.59
(Furniture, Fittings Electrical Equipment etc. merged within above)				
	a. Plant & Machinery	2,27,327.05		2,27,327.05
	b. Tubewell	9,81,730.82		9,81,730.82
	c. Air Cond. Equipment	2,13,090.49		2,13,090.49
	d. Generator	1,72,458.02		1,72,458.02
	e. Lift	38,583.62		38,583.62
18.	Land Development & Compound Wall	1,94,273.57		1,94,273.57
19.	Roads & Surface Drain Renovation	2,24,384.67		2,24,384.67
	a. Library-Books & Journal	9,76,71,513.60	1,07,24,496.05	10,83,96,009.65
	b. -do- Equipment & Furniture	1,03,14,532.64		1,03,14,532.64
20.	Dr. M. L. Sircar Gramin Janakalyan Kendra	17,128.60		17,128.60
Total		<u>16,50,72,551.87</u>	<u>1,29,74,960.30</u>	<u>17,80,47,512.17</u>

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, KOLKATA : 700 032

SCHEDULE – A2

Scientific Instruments & Laboratory Fittings, and Assets Acquired under Administration as on March 30, 2001

Sr. No.	Particulars	Cost as on 01.04.2000	Addition in 2000-2001	Total cost as on 31.3.2001
1.	C. S. S.	3,52,55,217.31	14,89,848.00	3,67,45,065.31
2.	-do- Computer	12,72,468.00	1,07,150.00	13,79,618.00
3.	Materials Science	93,61,639.49	3,05,927.00	96,67,566.49
4.	Solid State Physics	78,42,408.066	1,20,428.00	79,62,836.06
5.	Spectroscopy	78,01,019.78	77,875.20	78,78,894.98
6.	Theoretical Physics	44,70,751.66	1,93,027.35	46,63,779.01
7.	Physics Chemistry	81,02,934.32	1,12,795.00	82,15,729.32
8.	Organic Chemistry	53,86,601.31		53,86,601.31
9.	Inorganic Chemistry	70,04,017.00	20,000.00	70,24,017.00
10.	Biological Chemistry	64,45,260.32	2,48,094.08	66,93,354.40
11.	Workshop	10,30,123.12	3,100.00	10,33,223.12
12.	Energy Research Unit	26,54,742.59	1,66,141.30	28,20,883.89
13.	Polymer Science Unit	43,89,357.73	1,17,307.00	45,06,664.73
14.	M. L. S. Prof. of Phys.	20,95,650.44	13,081.00	21,08,731.44
15.	Administration			
	a. Equipements	10,42,200.45	55,539.00	10,97,739.45
	b. Motor Van	62,968.26	4,64,734.00	5,27,702.26
	c. Cycle	378.12	-	378.12
	d. Tools & Impl.	9,687.92	-	9,687.92
	e. Astray	150.00	-	150.00
	f. Inst. Internal Telephones	8,92,010.52	-	8,92,010.52
	g. Ambassador	2,21,277.11	-	2,21,277.11
	h. Tata Sumo	3,69,691.96	-	3,69,691.96
16.	Computer – CSS	33,49,154.68	-	33,49,154.68
	Total :	10,90,59,710.15	34,95,046.93	11,25,54,757.08

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, KOLKATA : 700 032

RECEIPTS	NON-PLAN Rs. P.	PLAN Rs. P.
To		
Opening Balance		
Imprest Cash		1,45,500.00
Cash & Cheque in hand		
S.B.I. J.U. Branch		
Current Account	70,944.52	
S.B.I. Main Branch		
Current Account	11,530.53	
Lein/Margin Amount	4,15,000.00	
Govt. of India Grant	3,10,00,000.00	8,00,00,000.00
Govt. of West Bengal	43,50,000.00	1,31,25,000.00
Misc. Receipts	1,21,358.50	
Ord. Membership Subscription	2,370.00	
Subs. of I.J.P.	7,78,447.50	
Sale of Books & Monographs	225.00	
Xerox Charges (Lib.)	29,181.50	
Sale of Liq. Nitrogen	31,935.00	
Inst. of Margin Money/TDR	8,052.32	
Car Parking of Basundhara Appt. (Garage rent)	5,400.00	
Inst. on Spl. & Research End. Fund	1,93,409.06	
Hostel Seat Rent	2,98,965.00	
Int. on Conveyance Advance	25,527.00	
Analysis Charges	92,850.00	
BALANCE CARRIED OVER	3,74,35,195.93	9,32,70,500.00

**RECEIPTS AND PAYMENTS ACCOUNT
FOR THE YEAR ENDED MARCH 30, 2001**

PAYMENTS	NON-PLAN Rs. P.	PLAN Rs. P.
By		
Establishment		
(ANNEXURE- A)		7,95,08,716.60
Travelling Allowance (ANNEXURE- C)		4,75,144.50
Contingency (ANNEXURE-D)	87,27,450.65	
Misc. & other charges (ANNEXURE-E)	6,98,282.99	36,62,196.46
Consumeable/Laboratory Charges (ANNEXURE-B)		49,81,387.76
Non-Recurring Exp. for purchase of Scientific Instruments/Equipments/Standard Reference Books & Building Development. (ANNEXURE- F)	1,64,70,007.23	
Pension Fund	66,00,000.00	20,00,000.00
Exp. on Special & Endowment Fund	57,187.85	
Chief Ministers' Relief Fund		22,243.00
Contribution to IACS Foreign Contribution	1,000.00	
Publication General	1,62,422.00	
Maintenance of Building	10,72,485.65	
Margin Money Deposit	4,15,000.00	
BALANCE CARRIED OVER	3,42,03,836.37	9,06,49,688.32

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
 JADAVPUR, KOLKATA : 700 032

RECEIPTS	NON-PLAN	PLAN
	Rs. P.	Rs. P.
BF	3,74,35,195.93	9,32,70,500.00
To		
Advance General		52,74,244.66
Conveyance Advance		87,417.00
Medical Advance		66,900.00
ADV. Flood		33,495.00
L.T.C. Advance		1,98,674.00
Suspense		81,01,031.00
Provident Fund Subs.		1,52,19,821.00
L.I.C. Prem. under S.S.S.		9,35,787.60
Puja Advance Recovered		14,89,500.00
Income Tax from Salary		68,03,592.00
Income Tax from Con. Bill		5,606.00
SAE Co-operative Credit Society		31,50,684.00
SAE Empl. Benefit Society		19,005.00
Sale Tax rec. from Cont. Bill		7,020.00
Earnest Money Deposit		1,610.00
Professional Tax		4,37,775.00
Cont. to Group Insurance		2,11,515.00
Recovery of House Building Loan		11,04,782.00
Interest on H.B.L.	3,82,012.00	
Attachment of Pay		13,800.00
Recovery of H.B.L. for GICI		3,08,216.00
General Fund		1,04,39,552.00
Chief Ministers' Relief Fund		22,243.00
Total	3,78,17,207.93	14,72,02,770.26

**RECEIPTS AND PAYMENTS ACCOUNT
FOR THE YEAR ENDED MARCH 30, 2001**

PAYMENTS	NON-PLAN Rs. P.	PLAN Rs. P.
B.F.	3,42,03,836.37	9,06,49,688.32
By		
Adv. Conveyance		1,226.00
Medical Advance		62,400.00
LTC Advance		1,02,622.00
Advance (General)		50,67,506.34
Suspense		79,53,422.00
Income Tax (Contractor)		5,606.00
Income Tax (Staff)		68,03,412.00
P.F. Subscription		1,52,19,821.00
LIC Premium under SSS		9,35,787.60
Puja Advance		13,55,000.00
Co-operative Credit Society		31,50,684.00
Professional Tax		4,37,775.00
SAE Benefit Society		19,005.00
Refund of EMD (Earnest)		757.00
Sales Tax from Contractor's Bill		7,717.00
HBL (GIC)		3,08,216.00
Superannuation Fund	36,00,000.00	24,00,000.00
General Fund		1,04,39,552.00
Attachment of Pay		13,800.00
HBL Loan		18,94,353.00
GSLI Premium		2,08,920.00
Closing Balance:		
Imprest Cash		1,65,500.00
SBI : Current A/c.		
a) Jadavpur University	6,414.51	
b) Main Branch	6,957.05	
Total	3,78,17,207.93	14,72,02,770.26

A.K . Biswas
Registrar
Indian Association for the
Cultivation of Science
Jadavpur, Cal-32

D Mukherjee
Director
Indian Association for the
Cultivation of Science
Jadavpur, Cal-32

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, KOLKATA : 700 032

EXPENDITURE	NON-PLAN Rs. P.	PLAN Rs. P.	TOTAL Rs. P.
Establishment charges (As per Annexure - A)		7,95,08,716.60	
Consumables (As per Annexure - B)		49,81,387.76	
Travelling Allowance (As per Annexure - C)		4,75,144.50	
Exp.on Special Endowment Fund	57,187.85		
Pension Fund	66,00,000.00	20,00,000.00	
Publication General	1,62,422.00		
Maintenance of Building	10,72,485.65		
Contingencies (As per Annexure D)	87,27,450.65		
Misc. & Other Charges (As per Annexure E)	6,98,282.99	36,62,196.46	
Payment to IACS Superannuation Fund	36,00,000.00	24,00,000.00	
IACS FOREIGN CONTRI. A/c.	1,000.00		
Total	2,09,18,829.14	9,30,27,445.32	11,39,46,274.46

GRAND TOTAL OF INCOME : Rs. 11,73,19,732.88

Less: GRAND TOTAL OF EXPENDITURE : Rs.11,39,46,274.46

Excess of revenue receipt over
Expenditure transferred to B/S. Rs. 33,73,458.42

**INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED MARCH 30, 2001**

INCOME	NON-PLAN Rs. P.	PLAN Rs. P.	TOTAL Rs. P.
Grant-in-Aid:			
i) Govt. of India	3,10,00,000.00	8,00,00,000.00	
ii) Govt. of West Bengal	43,50,000.00		
Other Receipts:			
1) Misc. Receipts	1,21,358.50		
2) Ordinary Membership Subs	2,370.00		
3) Indian Journal of Physics	7,78,447.50		
4) Sale of Books & Monograms	225.00		
5) Hostel Seat Rent	2,98,965.00		
6) Interest on House Bldg. Loan	3,82,012.00		
7) Xerox Charges	29,181.50		
8) Sale of Liquid Nitrogen	31,935.00		
9) Garage Rent(Basundhara)	5,400.00		
10) Interest on Margin Money	8,052.32		
11) Interest on Spl.Res.End.Fund	1,93,409.06		
12) Analysis Charges	92,850.00		
13) Interest on Conv. Advance	25,527.00		
Total	3,73,19,732.88	8,00,00,000.00	11,73,19,732.88

A.K. Biswas

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Jadavpur, Cal-32

D Mukherjee

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Cultivation of Science
Jadavpur, Cal-32

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

STATEMENT OF GRANT-IN-AID OF GOVERNMENT OF INDIA FOR SCIENTIFIC RESEARCH DURING 2000 - 2001

Sl No.	Sanction No.	Date	Amount Sanctioned During the Year	Amount Received During the Year	Amount B.F. from the last year (1999-2000)	Total Of Col. 5 & 6	Amount Expended during the year 2000-2001	Balance As on 31.03.2001
1	2	3	4	5	6	7	8	9

NON-PLAN (RECURRING)

1.	AI/IACS/003/2000	04.04.2000	51,00,000.00					
2.	- do -	29.05.2000	1,04,00,000.00					
3.	- do -	06.10.2000	75,00,000.00					
4.	- do -	02.01.2001	45,00,000.00					
5.	- do -	30.01.2001	35,00,000.00	3,10,00,000.00	68,729.20	3,10,68,729.20	3,20,47,574.03	(-) 9,78,844.83

PLAN

1.	AI/IACS/003/2000	04.04.2000	1,33,00,000.00					
2.	- do -	29.05.2000	2,67,00,000.00					
3.	- do -	06.10.2000	2,00,00,000.00					
4.	- do -	09.01.2001	1,20,00,000.00					
5.	- do -	30.01.2001	80,00,000.00	8,00,00,000.00	97,000.00	8,00,97,000.00	8,17,48,298.32	(-) 16,51,298.32

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

STATEMENT OF GRANT-IN-AID OF GOVERNMENT OF INDIA FOR SCIENTIFIC RESEARCH DURING 2000 - 2001

Sl No.	Sanction No.	Date	Amount Sanctioned During the Year	Amount Received During the Year	Amount B.F. from the last year (1999-2000)	Total Of Col. 5 & 6	Amount Expended during the year 2000-2001	Balance As on 31.03.2001
1	2	3	4	5	6	7	8	9
NON-PLAN (RECURRING)								
1.	AI/IACS/003/2000	04.04.2000	51,00,000.00					
2.	- do -	29.05.2000	1,04,00,000.00					
3.	- do -	06.10.2000	75,00,000.00					
4.	- do -	02.01.2001	45,00,000.00					
5.	- do -	30.01.2001	35,00,000.00	3,10,00,000.00	68,729.20	3,10,68,729.20	3,20,47,574.03	(-) 9,78,844.83
PLAN								
1.	AI/IACS/003/2000	04.04.2000	1,33,00,000.00					
2.	- do -	29.05.2000	2,67,00,000.00					
3.	- do -	06.10.2000	2,00,00,000.00					
4.	- do -	09.01.2001	1,20,00,000.00					
5.	- do -	30.01.2001	80,00,000.00	8,00,00,000.00	97,000.00	8,00,97,000.00	8,17,48,298.32	(-) 16,51,298.32

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

STATEMENT OF GRANT-IN-AID OF GOVERNMENT OF WEST BENGAL FOR SCIENTIFIC RESEARCH DURING 2000 - 2001

Sl No.	Sanction No.	Date	Amount Sanctioned During the Year	Amount Received During the Year	Amount B.F. from the last year (1999-2000)	Total Of Col. 5 & 6	Amount Expended during the year 2000-2001	Balance As on 31.03.2001
1	2	3	4	5	6	7	8	9
NON-PLAN (RECURRING)								
1.	86-Edn(HSE)2G	27.03.2000	5,16,667.00	(Recd.on 03.04.2000)				
2.	158 - do -	20.07.2000	8,50,000.00					
3.	183 - do -	11.09.2000	17,33,333.00					
4.	238 - do -	27.12.2000	12,50,000.00	43,50,000.00	13,745.85	43,63,745.85	53,41,262.34	(-) 9,77,516.49
PLAN								
1.	104-Edn(HSE)/2G-598	30.03.2000	45,00,000.00	(Recd.on 03.04.2000)				
2.	180 - do -	06.09.2000	66,50,000.00					
3.	212 - do -	02.11.2000	19,75,000.00	1,31,25,000.00	48,500.00	1,31,73,500.00	1,31,73,500.00	NIL

**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032**

BUDGET AT A GLANCE

(Rupees in lakhs)

EXPENDITURE R E C U R R I N G	Actual (Audited) 2000 – 2001			Budget Estimate 2001 – 2002			Revised Estimate 2001 – 2002			Budget Estimate 2002 - 2003		
	Non-Plan	Plan	Total	Non-Plan	Plan	Total	Non-Plan	Plan	Total	Non-Plan	Plan	Total
ESTABLISHMENT (Salary & Other Expn.)	102.01	876.38	978.39	389.27	753.40	1142.67	318.67	799.43	1118.10	414.50	895.76	1310.26
CONTINGENCIES (Office Expenses)	94.83	36.62	131.45	3.90	114.81	118.71	10.15	124.80	134.95	10.45	181.37	191.82
CONSUMABLE (Lab. Exp., Library, Workshop, Publications & Civil Maintenance Work)	12.34	49.82	62.16	91.25	12.80	104.05	91.00	33.30	124.30	93.50	91.50	185.00
Total :	209.18	962.82	1172.00	484.42	881.01	1365.43	419.82	957.53	1377.35	518.45	1168.63	1687.08
NON-RECURRING	164.70	-	164.70	-	535.00	535.00	-	1210.00	1210.00	-	2629.00	2629.00
GRAND TOTAL (REC+NON-REC)	373.88	962.82	1336.70	484.42	1416.01	1900.43	419.82	2167.53	2587.35	518.45	3797.63	4316.08

REVISED BUDGET ESTIMATE - 2001 – 2002

BUDGET ESTIMATE 2002 - 2003

RECEIPTS (Expected)	Non-Plan A	Plan		Plan Total B	Total (A+B)	Non-Plan A	P l a n		Plan Total B	Total (A+B)
		Recurring	Non – Recurring				Recurring	Non – Recurring		
Opening Balance (including commitment)	0.13	-	1.65	1.65	1.78	-	-	-	-	-
Government of India P :- 2:1, NP :- 6:1	325.00	582.00	258.00	840.00	1165.00	410.10	1168.63	1363.12	2531.75	2941.85
Government of West Bengal P :- 1:2, NP :- 1:6	54.17	-	-	420.00	474.17	68.35	-	-	1265.88	1334.23
I A C S Income	15.00	-	-	-	15.00	15.00	-	-	-	15.00
H B L and other Advance (Realisation)	25.00	-	-	-	25.00	25.00	-	-	-	25.00
Additional Grant Requested for				900.00	900.00					
T O T A L	419.30	582.00	259.65	2161.65	2580.95	518.45	1168.63	1363.12	3797.63	4316.08

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

STATEMENT / ANNEXURE
Name of the Activity

NON – PLAN
(Rupees in Lakhs)

Break up of Establishment (Recurring)

Major Head	Actual (Audited) 2000-2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between BE RE
Salary & Establishment							
1. Pay	-	165.18	69.60	97.44	167.04	170.54	
2. D A		53.14	24.85	34.78	59.63	61.42	
3. C C A		5.15	1.99	2.79	4.78	4.94	
4. H R A		47.81	19.18	26.85	46.03	47.40	
5. Transport Allowance		8.85	3.65	5.11	8.76	9.02	
6. Provision for D A		28.66	-	18.56	18.56	37.96	
7. Bonus							
8. Travelling Allowance							
9. Revision of Pay							
10. Reimbursement of Tution Fees							
11. Festival Advance							
12. Leave Encashment							
13. P F Contribution & D L I							
14. Contribution to Superannuation Fund	36.00						
15. Foreign Contribution	.01						
16. Vacant Post		80.48		**13.87	**13.87	83.22	For 2 (two) months
17. Pension	66.00						
18. Gratuity							
19. Commutation of Pension							
20. Miscellaneous (Estb.)							
TOTAL :	102.01	389.27	119.27	199.40	318.67	414.50	

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA - 700 032

STATEMENT SHOWING PROVISION FOR DA GRANTED / DUE WITH EFFECT FROM

(Rupees in Lakhs)

Category of Employee	Provision already made in B E in respect of DA sanctioned from 1%	Provision made in respect of DA for 2001-2002		Total including Column 3 & 4	Provision made in respect of DA for 2002-2003			Total Provision including Column 6,7, & 8
		Sanctioned from 01.01.2001 14 mths. @ 02%	Likely to be sanctioned from 01.07.2001 08 mths @ 0.2%		Sanctioned from 01.01.2001 12 mths @ 02%	Likely to be sanctioned from 01.07.2001 12 months 3%	Likely to be sanctioned from 01.01.2002 14 months 3%	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Drawing								
Basic Pay								
Rs. 2250-22400/-	28.66	11.81	6.75	18.56	10.12	10.12	17.72	37.96

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

STATEMENT / ANNEXURE
Name of the Activity

NON – PLAN
(Rupees in Lakhs)

Break up of Contingencies (Recurring) Non-Plan

Major head	Actual (Audited) 2000-2001	Original Budget Estimate	Actual Exp. Upto 31.07.2001	Projected Exp. for remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E	R E
B. Contingencies								
1. Telephone & Trunk Calls	5.59							
2. Postage Expenses	1.31	3.25	1.00	1.50	2.50	2.75		
3. Electrical Charges	65.59							
4. Municipal Tax								
5. Printing	0.64	0.65	-	0.65	0.65	0.70		
6. Advertisement	2.64							
7. Motor Van Up-Keep	2.25							
8. Stationary Contingency	9.26							
9. Miscellaneous & Others	7.55			7.00	7.00	7.00		
10. Generator (Running & Maintenance)								
11. Visiting of Parliamentary Committee								
12. Research Advisory Committee								
TOTAL:	94.83	3.90	1.00	9.15	10.15	10.45		

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

NON – PLAN
(Rupees in Lakhs)

STATEMENT / ANNEXURE

Name of the Activity

Break up of Consumables (Recurring) Non-Plan

Major Head	Actual (Audited) 2000 – 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
C. Consumables							
1. Maintenance of Building	10.72						
2. Laboratory Expenses		78.00	13.65	64.35	78.00	80.00	
3. Workshop		3.00	1.55	1.45	3.00	3.00	
4. Library		2.25	0.53	1.47	2.00	2.25	
5. Publication I J P		8.00	1.90	6.10	8.00	8.25	
6. Publication General	1.62						
7. Helium Plant							
TOTAL :	12.34	91.25	17.63	73.37	91.00	93.50	

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

NON - PLAN

(Rupees in Lakhs)

Statement showing the details of Miscellaneous and Other Expenses

Major Head	Actual (Audited) 2000- 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
Miscellaneous & Others							
1. Electrical Fittings							
2. Audit Fee							
3. Insurance Premium							
4. Meeting Expenses							
5. Bank Charges							
6. Legal Expenses							
7. Expenditure On Special Endowment Fund	0.57						
8. Contribution to Science Association Club							
9. Contribution to Hostel							
10. Contribution to Other Organisation							
11. Remuneration & or other Expenses for Course of Lecture to be delivered by Scientists & Language Classes							
12. Science Advancement Fund	6.98	-	-	7.00	7.00	7.00	
13. Contribution to Canteen							
TOTAL :	7.55	-	-	7.00	7.00	7.00	



**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032**

STATEMENT / ANNEXURE

Name of the Activity

Break up Establishment (Recurring) Plan

**PLAN
(Rupees in Lakhs)**

Major Head	Actual (Audited) 2000- 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
A. Salary & Establishment							
1. Pay	442.39	295.42	141.32	197.85	339.17	345.95	
2. D A	147.55	87.04	46.14	64.60	110.74	134.06	
3. C C A	10.08	6.23	2.44	3.42	5.86	6.04	
4. H R A	122.39	90.11	35.62	49.87	85.49	88.06	
5. Transport Allowance	16.87	9.69	4.47	6.26	10.73	11.05	
6. Washing Allowance	0.18	0.30	0.09	0.11	0.20	.020	
7. Medical Expenses (Staff & Fellows)	24.10	22.55	6.74	15.26	22.00	44.00	
8. Travelling Allowance	4.75	7.50	0.74	6.26	7.00	7.00	
9. Overtime	0.46	1.00	0.35	0.65	1.00	1.00	
10. L T C	2.22	6.00	-	-	-	-	
11. C E A	.12	0.20	0.06	0.14	0.20	0.20	
12. Festival Advance	13.55	17.00	-	15.00	15.00	15.00	
13. Leave Encashment	22.09	12.00	3.00	7.00	10.00	24.00	
14. P F Contribution	-	-	-	-	-	-	
15. Bonus	5.15	7.00	-	6.00	6.00	6.00	
16. Contribution to Superannuation Fund	24.00	60.00	-	60.00	60.00	60.00	
17. Pension	20.00	87.00	38.00	58.00	96.00	109.00	
18. Vacant Post	-	20.06	-	2.84	2.84	17.00	For 2 months
19. Miscellaneous & Others	-	0.30	-	0.30	0.30	.30	
20. House Building Advance	19.00	25.00	1.28	23.72	25.00	25.00	
21. D L I	1.20	1.50	-	1.50	1.50	1.50	
22. Spl. Duty Allowance	0.28	0.50	.004	.036	0.40	0.40	
23. Flood Advance	-	-	-	-	-	-	
TOTAL :	876.38	753.40	280.29	519.14	799.43	895.76	

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

STATEMENT / ANNEXURE
Name of the Activity

Break up of Contingencies (Recurring) Plan

PLAN
(Rupees in Lakhs)

Major Head	Actual (Audited) 2000 – 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
B. Contingencies							
1. Telephone & Trunk Calls	-	5.25	0.74	4.86	5.60	25.70	
2. Postage Expenses	-	-	-	-	-	-	
3. Electricity Charges	-	75.00	23.30	46.70	70.00	80.00	
4. Municipal Tax	-	.20	0.19	0.06	0.25	0.25	
5. Printing	-	-	-	-	-	-	
6. Advertisement	-	2.50	0.45	2.05	2.50	3.00	
7. Motor Van Up-Keep	-	3.25	1.11	1.39	2.50	3.00	
8. Stationary & Contingencies	-	10.00	1.98	8.02	10.00	12.00	
9. Miscellaneous & Others	36.62	18.46	1.39	32.41	33.80	57.27	
10. Generator (Running & Maintenance)	-	.15	-	.15	.15	.15	
11. Visiting of Parliamentary Committee	-	-	-	-	-	-	
12. Research Advisory Committee	-	-	-	-	-	-	
TOTAL :	36.62	114.81	29.16	95.64	124.80	181.37	

**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032**

STATEMENT / ANNEXURE

Name of the Activity

PLAN

Break up of Consumable (Recurring) Plan

(Rupees in Lakhs)

Major Head	Actual (Audited) 2000– 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
B. Consumables							
1. Maintenance of Building	-	11.50	17.00	15.00	32.00	30.00	
2. Laboratory Expenses	37.36	-	-	-	-	50.00	
3. Workshop	2.30	-	-	-	-	5.00	
4. Library	1.41	-	-	-	-	5.00	
5. Publication I J P	8.75	-	-	-	-	10.00	
6. Publication General	-	1.30	-	1.30	1.30	1.50	
7. Helium Plant	-	-	-	-	-	-	
TOTAL :	49.82	12.80	17.00	16.30	33.30	91.50	

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

PLAN

(Rupees in Lakhs)

Statement showing the details of Miscellaneous and Other Expenses

Major Head	Actual (Audited) 2000- 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
Miscellaneous & Others							
1. Electrical Fittings	3.19	3.15	0.68	2.47	3.15	4.00	
2. Audit Fee	0.17	0.16	-	0.17	0.17	0.17	
3. Insurance Premium	0.13	0.30	.13	-	0.13	3.00	
4. Meeting Expenses	0.53	1.00	0.02	0.98	1.00	2.00	
5. Bank Charges	0.14	0.25	-	0.25	0.25	0.25	
6. Legal Expenses	0.88	1.00	-	1.00	1.00	1.00	
7. Expenditure On Special Endowment Fund	-	1.50	0.03	0.97	1.00	1.50	
8. Contribution to Science Association Club	0.40	0.40	0.20	0.20	0.40	0.40	
9. Contribution to Hostel	13.80	9.00	-	9.00	9.00	9.25	
10. Contribution to Other Organisation	1.50	1.50	0.33	1.17	1.50	1.50	
11. Remuneration & or other Expenses for Course of Lecture to be delivered by Scientists & Language Classes	0.13	0.20	-	0.20	0.20	0.20	
12. Science Advancement Fund	15.52	-	-	16.00	16.00	34.00	
13. Contribution to Canteen	0.03	-	-	-	-	-	
TOTAL :	36.62	18.46	1.39	32.41	33.80	57.27	

**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032**

PLAN

(Rupees in Lakhs)

Statement showing the details of Travelling Allowances

Major Head	Actual (Audited) 2000 – 2001	Original Budget Estimate	Actual Exp. Upto 31.7.2001	Projected Exp. For remaining period for 2001-2002	Revised Estimate 2001-2002	Budget Estimate 2002-2003	Reasons for variation between B E R E
Travelling Allowances							
1. T. A. for attending Indian Science Congress and Meetings other than Meetings of the Association's Council or any of own Committee	1.06	2.00	0.12	1.88	2.00	2.00	
2. T.A. for enabling members of Research Dept. to attend Meetings, conference to Foreign Countries	0.69	2.50	0.55	1.95	2.50	2.50	
3. T. A. for attending Council / Selection Committee Meetings	3.00	3.00	0.07	2.43	2.50	2.50	
TOTAL :	4.75	7.50	0.74	6.26	7.00	7.00	

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, CALCUTTA – 700 032

PLAN
(Rupees in Lakhs)

STATEMENT OF NON-RECURRING EXPENDITURE

	Total Estimate	Revised Estimate 2001 – 2002	Budget Estimate 2002 – 2003
i. Library (Books & Journals)	-	170.00	176.00
ii. Laboratory Equipment	2,750.00	287.00	550.00
iii. Replacement of Helium Plant	200.00	-	200.00
iv. New Library Building	515.00	50.00	133.00
v. New Gents Hostels	300.00	100.00	150.00
vi. Guest House	300.00	100.00	150.00
vii. Renovation of Laboratories	70.00	10.00	50.00
viii. Corpus for four Chair Professorship /visiting & Emeritus Professorship	500.00	100.00	100.00
ix. Purchase of Land & Construction of New Lab.	1,550.00	200.00	600.00
x. Activities under Administration	-	*193.00	520.00
TOTAL :		1,210.00	2,629.00
* a) Civil			
i) Road repair & boundary wall	35.00		
ii) Repairing of Buildings	30.00		
iii) Construction of Overhead Tanl	60.00		
b) Electrical			
Transformer Renovation	30.00		
c) Replacement of Old Lift	16.00		
d) Furniture, etc.	5.00		
e) Replacement of EPBX System	7.00		
f) Others	10.00		
TOTAL :	193.00		

MOOKHERJEE BISWAS & PATHAK
CHARTERED ACCOUNTANTS

AUDITORS' REPORT

We have audited the attached Balance Sheet as at March 31, 2001 of Indian Association for the Cultivation of Science and annexed Income & Expenditure Account and Receipts & Payments Account for the ended March 31, 2001, we report as follows :

1. a) The Deed relating to residential Flats as Basundhara Apartment could not be produced to us for our verification.
- b) Balance standing in the debit and credit under various Current Liabilities, Assets, Advances, Security Deposits, Retention Money etc are subject to confirmation by the concerned parties and review by the Association.
- c) House Building Loans are paid against mortgage of House/Flat but we are unable to verify that all of them were covered by insurance. It is necessary that the owner of the House/Flat must get them properly insured for which they should pay insurance premium. A copy of such Insurance Policy should be submitted to the Association duly endorsed for further action in case of emergency.
- d) As per the practice followed by the Association, no depreciation is provided in the accounts.
- e) Prepaid expenses of Rs. 24,790/- shown in the Balance Sheet is in the nature of advance and requires early adjustment/refund and should have been shown under advances in schedule G and not under Prepaid Expenses.
- f) While checking Project Advance, we have found that a few numbers of Advances are lying unadjusted till date. The list of such unadjusted advances are given below :

Name of the Party	Date of Payment	Amount
Bengal Industries	03.05.1984	4,000.00
-do-	05.01.1985	3,000.00
Classic Telecommunication	05.07.1999	15,000.00
Godrej & Boyce	11.05.1999	4,000.00

Small unadjusted advances in paisa should be written off.

- g) The following are the advances lying unadjusted for a long period and require early adjustment/refund in the General Account.

Name of the Party	Date of Payment	Amount
B S Electrical (P) Ltd.	24.09.1994	9,853.00
Cine Photographic Agency	30.03.1998	91,575.00
Eureka Forbes Ltd.	19.11.1997	5,121.00
Godrej & Boyce Mfg. Co. Ltd.	13.12.1995	745.00
-do-	14.03.1997	2,581.00
Minicomp Ltd.	13.08.1994	4,000.00
-do-	20.02.1994	2,000.00
Regional Computer Centre	07.05.1977	5,000.00
Unique Sales	14.03.1997	16,600.00
Prof. Asish De	25.09.1998	24,320.00
Voltas Ltd.	16.04.1994	39,600.00
-do-	14.03.1997	30,336.00
-do-	07.11.1997	1,08,650.00
-do-	4.01.1998	36,860.00

- h) One Motor Van was sold for Rs.43,786 in the year 1999-2000 but no adjustment yet been made in the original cost of the asset.

Subject to paragraphs 1(a) to (h) above and to the best of our information and explanations given to us, in our opinion, the said Balance Sheet and the Income & Expenditure Account read together with Schedules and Notes to Accounts reflect a true and fair view -

- i) in case of Balance Sheet as to the State of affairs of the Association as at March 31, 2001
and
- ii) in case of the Income & Expenditure Account as to the excess of Income over Expenditure for the year ended March 31, 2001.

For MOOKHERJEE BISWAS & PATHAK
CHARTERED ACCOUNTS

Sd/- S P Mukherjee

Partner

Kolkata
September 11, 2001

**MOOKHERJEE BISWAS & PATHAK
CHARTERED ACCOUNTANTS**

AUDITORS' REPORT

We have audited the attached Balance Sheet of Indian Association for the Cultivation of Science Employees' Provident Fund as at March 31, 2001 and relative Income & Expenditure Account and Receipts & Payment Account for the year ended on that date.

We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit.

In our opinion, proper books of accounts have been kept by the Trustees.

The Balance Sheet along with the Income & Expenditure Account and Receipts & Payments Account are in agreement with the books of accounts.

For MOOKHERJEE BISWAS & PATHAK
CHARTERED ACCOUNTANTS

Sd/- S P Mukherjee

Partner

Kolkata
September 11, 2001

**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
JADAVPUR, KOLKATA - 700 032**

**ITEMWISE REMARKS OF IACS ON AUDITORS' REPORT
FOR 2001 - 2001**

Reference to itemwise number of the Remarks of I. A. C. S.	Auditors' Report
1. a) The Deed relating to residential Flats as Basundhara Apartment could not be produced to our verification.	The Deeds relate to cases which are subjudice.
b) Balances standing in the debit and credit under various Current Liabilities, Assets, Advances, Security Deposits, Retention Money etc. are subject to confirmation by the concerned parties and review of the Association.	There is no system of such confirmation by the concerned parties. Records maintained in IACS depict the total statement of accounts.
c) House Building Loans are paid against Mortgage of House/Flat but we are unable to verify that all of them were covered by insurance. It is necessary That the owner of the House/Flat must get them properly insured for which they should pay insurance premium. A copy of such insurance Policy should Be submitted to the Association duly endorsed for further action in case of emergency	Noted. While conveying the sanction a clause is also inserted for information and necessary action of the beneficiaries.
d) As per the practice followed by the Association, no depreciation is provided in the accounts.	Statement of fact — no comments
e) Prepaid expenses of Rs.24,790/- shown In the Balance Sheet in the nature of Advance and requires early adjustment/ Refund and should have been shown Under advances in schedule G and not under Prepaid Expenses.	The position is under verification afresh.

- f) While Checking project advance, we
Have found that a few numbers of
Advances are lying unadjusted till
Date. The list of such unadjusted
Advances are given below :

Name of the Party	Date of Payment	Amount	
Bengal Industries	03.05.84	4,000	The firm worked here and were due to be paid for a bigger amount. Due to non-submission of bills by them the amount could not be adjusted.
-do-	05.01.85	3,000	
Classic Telecommunication	05.07.99	15,000	The has been adjusted in April, 2001
Godrej & Boyce	11.05.99	4,000	The amount will be adjusted in the next financial year.
Small unadjusted advances in paisa should be written Off.			Noted

- g) The following are the advances lying unadjusted for a long period and require early these were taken have been achieved.

The cases are followed up for getting the adjustments. The purposes for which adjustment/refund in the General Account

Name of the Party	Date of Payment	Amount
B S Electrical (P) Ltd.	24.09.1994	9,853.00
Cine Photographic Agency	30.03.1998	91,575.00
Eureka Forbes Ltd.	19.11.1997	5,121.00
Godrej & Boyce Mfg.	13.12.1995	745.00
-do-	14.03.1997	2,581.00
Minicomp Ltd.	13.08.1994	4,000.00
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-do-	07.11.1997	1,08,650.00
-do-	14.01.1998	36,860.00

- h) One Motor Van was sold for Rs.43,786 in the year 1999-2000 but no adjustment yet been made in the original cost of asset.



Professor K Banerjee
1900 - 1975

