

ANNUAL REPORT

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**SATYENDRA NATH BOSE NATIONAL CENTRE
FOR BASIC SCIENCES**

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SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

CALCUTTA

ANNUAL REPORT

April 1, 1994 to March 31, 1995

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OBJECTIVES

The S. N. Bose National Centre for Basic Sciences was established in June 1986 as a registered society functioning under the umbrella of the Department of Science and Technology, Government of India. Its objectives are :

to foster, encourage and promote the growth of advanced studies in selected branches of basic sciences;

to conduct original research in theoretical and mathematical sciences and other basic sciences in frontier areas, including challenging theoretical studies of future applications;

to provide a forum for personal contacts and intellectual interaction among scientists within the country and also between them and scientists abroad;

to train young scientists for research in basic sciences.

CONFERENCES / WORKSHOPS / SYMPOSIA

1. Discussion Meeting-cum-Workshop in Biology (May 6-10, 1994)

A discussion meeting-cum-workshop on Theories and Models in Biology was held at the North Eastern Hill University, Shillong, from 6 to 10 May, 1994. It was jointly sponsored by the S. N. Bose National Centre, the Indian Academy of Sciences, Bangalore, and NEHU, Shillong. The number of participants was 30 comprising speakers, post-graduate students and active researchers. The aim of the meeting was two-fold : to expose persons trained in the physical sciences, as well as biologists, to concepts and issues in modern biology that might be amenable to theorizing or mathematical modelling, and to foster intense discussions on specific problems.

Formal presentations were made by J. Das, P. Sinha (Calcutta), S. Sinha (Hyderabad), M. K. Chandrashekar (Madurai), D. Roy, P. Nongkynrih (Shillong), A. Elepfandt (Berlin), N. Behera and V. Nanjundiah (Bangalore).

The relative degree of emphasis given to theories (or models) and experiments varied from speaker to speaker. However, all took pains to emphasize that there needed to be a close interplay between the two; the reality being, of course, that this is not widely acknowledged among biologists.

2. International Symposium on Spectra, Structure and Dynamics (November 28-30, 1994)

The S. N. Bose National Centre, in collaboration with IACS, organised a three day symposium on Spectra Structure and Dynamics at the M. L. Sircar Memorial Hall, IACS, Calcutta. Professor Sushil Mukherjee, President, IACS inaugurated the Symposium. Distinguished theoreticians and experimentalists from all over India and abroad were among the speakers of this symposium. The first S. Basu Memorial lecture was delivered by S. Mcweeny, Universita di Pisa. The Ripon Professorship lecture was delivered by M. Ito, Japan. Other talks were given by D. Zhu (Inst. of Chemistry, China), K. Morokuma (Emory Univ., USA), T. Kitagawa (IMS, Japan), K. Kayo (Keio Univ., Japan). Speakers from different parts of India included N. Periasamy (TIFR, Bombay), J. P. Mittal (BARC, Bombay), N. Sathyamurthy (IIT, Kanpur), K. L. Sebastain (Cochin Univ., Cochin), B. Bagchi (IISc, Bangalore), and S. P. Bhattacharyya (IACS, Calcutta). K. K. Rohatgi-Mukherjee, R. K. Moitra, T. N. Misra, P. K. Ghosh, A. K. Sennigrahi and C. K. Majumder acted as Chairpersons.

3. International Symposium on Mantle Dynamics and its Relation to Earthquake and Volcanism (December 12-14, 1994)

In collaboration with the National Academy of Sciences, Allahabad, the Centre organized an International Symposium on Mantle Dynamics and its relation to Earthquake and Volcanism. The venue was the IIT Kharagpur Calcutta Centre, Salt Lake. The total number of registered participants was 62. The speakers were: Professor P. J. Wyllie, USA; Professor W S. Fyfe, Canada; Professor E. G. Lidiak, USA; Professor D. C. Presnall, USA; Professor S. Uyeda, Tokyo and Professor K. Yagi, Sapporo, Japan. Professor Alok Gupta, Allahabad was the Convener.

Professor M. G. K. Menon former President and Professor U. S. Srivastava, President, National Academy of Sciences also attended the symposium.

4. Winter School on Some Recent Development in Quantum Many Body Physics (December 19, 1994 — January 6, 1995)

The Winter School was jointly sponsored by the S. N. Bose National Centre and the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. The venue was Choksi Hall, IISc Campus. The School was attended by scientists from IITs (Kanpur, Bombay & Madras), TIFR, CAT, SNBNCBS, SINP, IOP, IMSC, IISC, RRI, Madurai K Univ and others. Speakers for the Long Courses were W. Kohn, B. Altshuler, L. Levy, A. J. Leggett, D. Vollhardt, A. K. Rajagopal, H. R. Krishnamurthy, R. Pandit and S. Ramasesha. Other speakers included : A. McDonald, T. Giamarchi, B. S. Shastri, T. V. Ramakrishnan, P. Pattnaik, D. Sen, A. Pande, S. Jain, G. Baskaran, E. V. Sampathkumaran, G. Mukhopadhyay and I. Bose. There were 70 participants.

5. Instruction Programme and Symposium on Density Functional Theory (February 10-17, 1995)

This programme was organized in collaboration with the Department of Chemistry and the Centre of Advanced Studies in Chemistry of the Panjab University at Chandigarh during February 10 to 17, 1995. Professor B. M. Deb was the Convener of the Organizing Committee. The topics for instruction included : density functional theory (DFT); momentum densities; time dependent DFT; quantum fluid dynamics; applications to excited states, solids and liquids; and Thomas-Fermi and related models. The programme was attended by participants from all over India and also from abroad. The speakers included among others : S. P. Bhattacharyya (IACS, Calcutta), B. M. Deb (Panjab University, Chandigarh), G. P. Das (BARC, Bombay), S. K. Ghosh (BARC, Bombay), N. Sathyamurthy (IIT, Kanpur), Y. Singh (BHU, Varanasi), I. Boustani (Germany) and P. Geerlings (Belgium).

S. N. BOSE MEMORIAL LECTURE

The sixth S. N. Bose Memorial Lecture was delivered by Professor Virendra Singh, Tata Institute of Fundamental Research on 24 March, 1995, at the Mahendra Lal Sircar Hall, IACS. The lecture was entitled 'High Energy Physics in India During the Past Decade.'

SEMINARS ORGANIZED AT THE CENTRE

1. Ganguly, P., National Chemical Laboratory, Pune : High Tc Superconductivity (April 1, 4 & 5, 1994).
2. De, U., Variable Energy Cyclotron Centre, Calcutta: Review of single crystal growth of Bi based superconductivity (April 26, 1994).
3. Sinha, S., TIFR, Bombay: Adaptive dynamics on a chaotic lattice (May 3, 1994).
4. Saha, S., National Physical Laboratory, New Delhi: Magnetic Hysteresis on high Tc superconductors (May 24, 1994).
5. Mookerjee, A., SNBNCBS, Calcutta : Many-body theory (May 1994).



Assembly in the Symposium on 'Density Functional Theory' organized in collaboration with the S N Bose National Centre

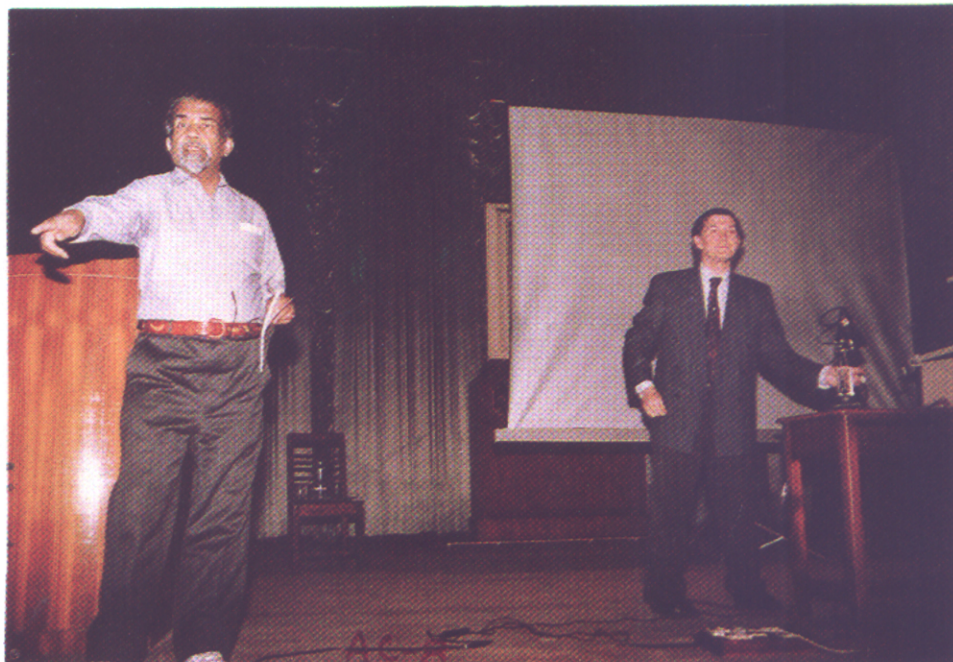
6. Malik, R. P., Bogoliubov Theoretical Laboratory, JINR, DUBNA, Moscow: Matreoshka Structure in nonlinear realization of W_3 -Algebra (June 7-16, 1994).
7. Banerjea, A., SNBNCBS, Calcutta: Numerical methods and simulations (June 1994).
8. Mandal, K., SNBNCBS, Calcutta: Seminar on high Tc Superconductivity (June 7, 1994).
9. Bose, S. K., SNBNCBS, Calcutta: Understanding chaos in iterative maps and control (July 20, 1994).
10. Maharana, J., IOP, Bhubaneswar: High energy behaviour of scattering amplitudes (Aug 11, 1994).
11. Mukhopadhyay, G., Dept. of Physics, IIT, Bombay: Magnetic susceptibilities of RE-Garnets using modified BPW method (Aug 17, 1994).
12. Saha, J., Dept. of Physics, Calcutta University: Monte Carlo simulation of cholesteric liquid crystals (Aug 30, 1994).
13. De, J., Calcutta : Quantum Poincare group and applications (Sept. 5, 1994).
14. Chaudhury, R., SNBNCBS: Highlights of Fourth International Conference on Superconductivity (M^2S -HTSC IV) held at Grenoble, France (Sept. 6, 1994).
15. Roy, A., ISI, Calcutta: Spinon structure of space-time SL (2,C) gauge theory and chiral anomaly (Sept 15, 1994).
16. Biswas, P. P., SNBNCBS: Simulation projects-I (Sept 19, 1994).
17. Sanyal, B., SNBNCBS: Simulation Projects-II (Sept 19, 1994).
18. Basu Mallick, B., IMS, Madras: Yangian Algebra and integrable chains (Oct 20, 1994).
19. Hossain, M. A., University of Dhaka, Bangladesh: MHD Natural convection along vertical and horizontal surface with vectored mass transfer (Nov 17, 1994).
20. Marino, Eduardo C., Pontificia University, Catolica, Rio di Jeneiro, Brazil: (i) Electrically charged topological excitations in a generalization of CED (Dec 16, 1994).
21. ----- (ii) Quantum cosmic string (Dec 16, 1994).
22. Kalyan Rama, S., MRI, Allahabad: Inconsistent Physics in the presence of time machines (Dec 26, 1994).
23. Dey, S. K., Eastern Illinois University, Charlesville, USA: (i) Parallel Computations (Dec 30, 1994).
24. ----- (ii) Indian Philosophy and its impact on Mathematics (Dec 30, 1994).
25. Ramaswamy, S., Mehta Research Inst, Allahabad: FQHE at finite temperature (Jan 5, 1995).
26. Dasgupta, K., SNBNCBS: Possibility of x-ray laser (Feb 21, 1995).
27. Ghosh, S., SNBNCBS: Negative-U properties of DX centre in $Al_xGa_{1-x}As$ (Feb 23, 1995).

Visitors at the Centre

1. Dr. Susri Dipasree Dutta, Women's College, Durgapur: visited the Centre from May 2-18, 1994, to complete the work on Reflections from a stack of layers under uniaxial Pre-stress, with Professor S. K. Bose.
2. Dr. S. Ghosh, Mehta Research Institute, Allahabad: visited the Centre from May 9-23, 1994 and collaborated with Dr. S. K. Paul to complete the work on Super W-algebra and its nonlinear realization.
3. Dr. R. P. Malik, Bogoliubov Theoretical Laboratory, JINR, DUBNA, Moscow: visited the Centre from 7-16 June.
4. Dr. S. N. Biswas, Univ of Delhi: visited the Centre (June 1994).
5. Dr. R. Nair, NISTADS, New Delhi: visited the Centre (June 1994).
6. Dr. A. Chatterjee, University of Hyderabad: visited the Centre during the summer vacation (June-July 1994).
7. Dr. A. Roy, Indian Statistical Institute, Calcutta joined the Centre as a Visiting Scientist from October 1, 1994.
8. Dr. B. Basu Mallick, Institute of Mathematical Sciences, Madras visited the Centre on October 20, 1994.
9. Dr. M. K. Parida, Department of Physics, North Eastern Hill University, Shillong, visited the Centre during the first week of October 1994.
10. Professor M. A. Hossain, Department of Mathematics, University of Dhaka, Bangladesh, visited the Centre for a week in the second week of November, 1994.
----- visited and interacted with Prof. A. Mookerjee and his students on January 5, 1995.
11. Professor S. K. Dey, Department of Mathematics, Eastern Illinois University, Charlesville, USA, visited the Centre during December 1994.
12. Professor Eduardo C. Marino, Pontificia University, Catolica, Rio de Janeiro, Brazil, visited the Centre during Dec 15-18, 1994.
13. Dr. S. Kalyanan Rama, MRI, Allahabad, visited the Centre during Dec 22-27, 1994.
14. Dr. S. Ghosh, MRI, Allahabad, visited the Centre since Dec 15, 1994.
15. Dr. S. Ramaswamy, MRI, Allahabad, visited the Centre from Dec 19, 1994 to Jan 6, 1995.
16. Dr. W. Kohn, former Director, Institute of Theoretical Physics, Santa Barbara, California, U. S. A., visited the Centre on Dec 28, 1994.
17. Professor K. Dasgupta, Texas Tech University visited the Centre (Feb 21, 1995).
18. Professor M. Shamsher Ali, Vice-Chancellor, Bangladesh Open University, Dhaka, visited the Centre (Feb 27, 1995).
19. Professor R. Chatterjee of the University of Calgary, Canada who visited the S. N. Bose Centre in 1993, published *Some comments on q-calculus of a harmonic oscillator* in Phys. stat. Sol. (b) 186, 461 (1994), and thanked the Centre for its hospitality during his stay when it was worked out.



*Inaugural ceremony : Symposium on 'Mantle Dynamics and its relation to Earthquake and Volcanism' (December 12-14, 1994) : Professor M G K Menon
With Professor C K Majumdar and Professor Alok K Gupta*



Professor E C G Sudarshan and Professor Roger Penrose in the international conference on "Bose & 20th Century Physics".

RESEARCH ACTIVITIES AT THE CENTRE

The Centre has active groups in Physics and Applied Mathematics; some work in chemical and life sciences has been done by visiting scientists and collaborators.

A. Physics

Electronic structure calculations for disordered alloys is one of the major interesting areas of research today. To have a comparison with angle-resolved photoemission experiments, electronic structure has been calculated in reciprocal or k-space instead of real space. The method used is Augmented Space Recursion in k-space in the framework of tight binding linear muffin tin orbital in augmented space analysis (LMTO-ASA). Test run has been carried out for disordered AgPd system by A. Mookerjee, P. Biswas and B. Sanyal, and reasonable agreement with results obtained by others has been noticed.

The basic package for the study by the electronic structure and phase stabilities of binary random alloy systems had been set up previously by A. Mookerjee, T. Saha and I. Dasgupta. Based on this, the alloy systems CuNi, AuFe and CuMn were studied in collaboration with M. Ahmed and A. Halder of the University of Dhaka in Bangladesh; they have set up the Augmented Space Recursion (ASR) package for the calculation of the spectral densities and momentum densities in alloys. The method yields complex energy bands and fuzzy Fermi surfaces for comparison with positron annihilation and Compton scattering experiments.

A. Banerjea, R. P. Datta and A. Mookherjee have set up a package for the study of energetics of metallic clusters; it deals with the structural part semi-empirically and the energetics using both the tight binding linear muffin tin orbital (TB-LMTO) and the linear combination of atomic orbital (LCAO) methods. The energetics of clusters of Cu and Au atoms have been studied with regard to sizes and with temperature.

A. Banerjea has been looking at the phenomenon of avalanche as two solid surfaces are brought into adhesive contact, and extending earlier studies to bcc metals and to different surface planes. Loss of registry between the approaching surfaces inhibits but does not prevent avalanche; critical separation for avalanche varies logarithmically with the thickness of the approaching slabs. Along with B. S. Good of the NASA Lewis Research Centre, USA, A. Banerjea has examined the stability of the probe tip in the Atomic Force Microscope (AFM) and finds that a milder form of avalanche is observed when an atomically sharp tip approaches a sample surface.

The low temperature laboratory (down to liquid nitrogen temperature) is being set up by P. K. Mukhopadhyay; a susceptibility measurement procedure has been tested, and other measuring techniques are being set up.

With a view to finding an explanation for the anomalies in the properties of the normal phase of the layered high T_c materials, R. Chaudhury, in collaboration with B. K. Chakravorty and M. Avignon at LEPES (CNRS), Grenoble, France, has examined the criteria for fermionic bound state. They have found that in 2-dimension in

vacuum a fermionic bound state with zero centre-of-mass momentum can be formed with arbitrarily small attractive interaction, and that the presence of a very small interlayer coupling requires a finite threshold value for interaction. In the realistic situation with the background of the Fermi sea, a finite minimum value of interaction is required for a bound state. The same collaboration has looked for fermion pairs in real space in the context of negative- U Hubbard model and superconducting phase fluctuations in the ordered state of a layered BCS superconductor.

P. Thakur and T. Mitra have been investigating electronic transmittance in two coupled random dimer chains with vector recursion formalism, and the nature of extended states in the same chains by multifractal analysis.

T. Mitra and A. Mookerjee have developed a formalism for calculating electronic transmittance in ballistic systems (in mode basis). The 3-D character of leads attached to the sample has been taken into account (ICTP Preprint No. IC/95/7).

A detailed analysis for converting second class systems into first class systems has been done by R. Banerjee, N. Banerjee and S. Ghosh in the Hamiltonian formulation of Batalin, Fradkin and Tyutin (BFT). The contact terms appearing in the discussions revealing the equivalence between a self dual model and the Maxwell-Chern-Simons theory are interpreted as time ordering ambiguities (R. Banerjee, H. Toth and K. Rothe). Further this equivalence follows systematically in the BFT hamiltonian approach. The connection with the usual lagrangian (Stueckelberg) formalism has been elucidated. Contrary to claims in the literature (for example by Hagen), the classical Poincare covariance of a theory comprising fermions coupled to the non-abelian Chern-Simons term is established by R. Banerjee and B. Chakraborty using Dirac's constraint analysis. Using the same analysis and the Jordan map, they have connected the Landau-Lifshitz (LL) model of ferromagnetism with a non-relativistic version of the CP^1 model. The gauge invariant and gauge fixed sectors of the latter govern, respectively, the dynamics and the geometry of the LL model; thus a resolution of the momentum problem of the LL model can be given.

R. Banerjee and N. Banerjee have shown that implementing Bose symmetry on the vertices of a Feynman diagram naturally yields the 1-cocycle that is relevant in 'smooth bosonization'. By starting from a novel master lagrangian, bosonization in $2+1$ dimensions has been analyzed in a path integral approach. The massive Thirring model, to all orders in the inverse mass, is related to a gauge theory with two gauge fields. the usual results of Polyakov, Deser and Redlich, and Fradkin and Schaposnik are reproduced in the lowest order.

S. K. Paul and S. Ghosh (MRI) have studied the large- n limit of super W_n algebra, which is the universal algebra containing all super conformal spins ($n > 2$) and found that a non-linear realization of super W_∞ algebra is possible through a consistent $N=2$ super Kadomtsev-Petviashvili formulation. A representation of this algebra can arise as a symmetry of some super coset model based on the works of Bakas, Kiritsis and Inami Kanno.

Various fermionic models with realistic static screened interactions have been studied in the low energy limit by R. Chaudhury and D. Gangopadhyay using a scaling procedure of R. Shankar and J. Polchinsky. They find an unconstrained breakdown of fermi liquid behaviour for the electron gas in two dimensions interacting with a bare interaction of logarithmic form. R. Chaudhury, D. Gangopadhyay and S. K. Paul have used Van der Waerden's Colouring theorem (well known in combinatoric number theory) to map an antiferromagnetic spin chain with periodic boundary conditions to an equivalent ferromagnetic one. This mapping has been extended to the case with arbitrary number of colours by R. Chaudhury and D. Gangopadhyay.

In N -dimensions, a metric that admits the maximum number $N(N+1)/2$ of Killing vectors is said to be maximally symmetric. Spaces with maximally symmetric metrics are homogeneous and isotropic about all points and correspond to spaces of globally constant curvature. A generalization of maximal symmetry when torsion is present has been made by D. Gangopadhyay and S. Sengupta (PC); the curvature has a contribution from the torsion, and the torsion fields are subject to constraints. They have shown that for a string moving in a background consisting of maximally symmetric gravity, dilation field and second rank anti-symmetric tensor field, the $O(d) \times O(d)$ transformation on the vacuum solution gives inequivalent solutions that are not maximally symmetric. In the presence of torsion, the generalized maximal symmetry can be preserved by $O(d) \times O(d)$ transformation under certain conditions. D. Gangopadhyay and P. Dey are investigating the possibility of finding the analogues of the Isgur-Wise function for systems with more than one heavy group in the context of Heavy Quark Effective Theory.

P. Ghosh has continued his work on the foundation of Quantum theory in collaboration with D. Home, M. N. Sinha Roy and A. S. Majumdar. Using the relativistic quantum theory of bosons proposed earlier, it has been shown that, like fermions, bosons also have Bohmian trajectories. (Further details in Research Projects (No. 5)).

The micromaser is created in a process of pumping selectively excited two-level Rydberg atoms into a microwave cavity of very high Q at such a rate that one atom is present at any time in the cavity. In the theory of micromaser developed earlier (publications A. 27), the coarse grained time deviation was employed to obtain the steady state photon statistics; N. Nayak has been examining the validity of some aspects of the theory by numerical simulation. He has also considered two-photon micromaser where the Rydberg atom emits two photons simultaneously.

C. Das, a CSIR Research Associate, has been studying laser plasma interaction plans to study the properties of squeezed coherent number states of finite temperature. S. Ghosh is interested in lasers based on semiconductors (particularly nitride based semiconductors), and has been planning to set up several spectroscopic techniques.

S. Ghoshal (Bhattacharyya) has been examining the non-classical behaviour of phonons in a general polariton system. In her work with A. Chatterjee (CUH) it is

established that the probability distribution of the phonon subsystem is classical at all temperatures, although the polariton complex as a whole may have non-classical behaviour below a threshold temperature whose value depends on the phonon-phonon coupling constant. Studying the infrared lineshape theory for a coupled three level system, with the upper two levels interacting with the near resonant RF field, S. Ghoshal and A. Datta (SINP) find an enhancement of the refractive index.

Moessbauer studies based on ^{57}Fe have been carried out on synthetic iron silicates of geophysical interest prepared by A. K. Gupta (Allahabad University).

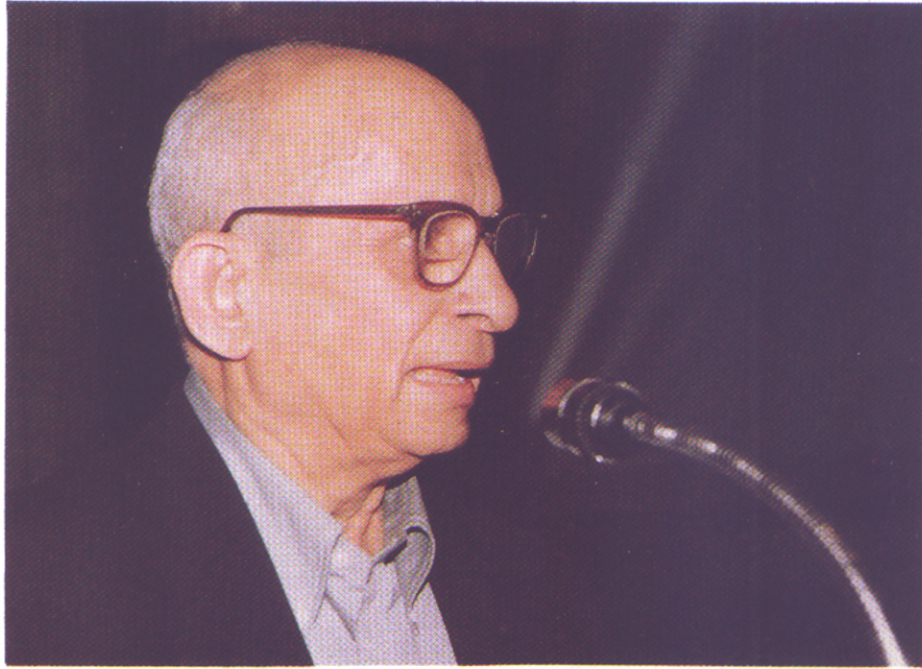
K. Mandal has developed microcrystallinity in amorphous Fe 40 Ni 40 B 20 alloy by different kinds of heat treatment to control its anisotropy energy and other magnetic properties. The effect of size and exchange disorders on the critical behaviour of a disordered ferromagnetic Ising binary alloy has also been studied by him and S. K. Ghatak (IITKGP).

In statistical mechanics, the size distribution of different types of sites in two dimensional Abelian sandpile avalanches has been studied by S. Banerjee with S. B. Santra and I. Bose (BI). Further expansion of the activity in statistical mechanics is planned.

J. Saha, a senior Research Fellow, has been developing computer programmes for analyzing the EPR spectrum. Ms. Saha has formulated a mean field model for the phase diagram of a series of mesogens of flexible molecules with a terminal phenyl ring. She has also calculated the critical indices by Wilson's recursion relations for the nematic-isotropic phase transition.

Based on the work reported above, some papers accepted for publication are:

1. Banerjea, A. : Semi-empirical simulations of solid surfaces and interfaces (in Ind. J. Pure & Appl. Phys).
2. Banerjee, N., Banerjee, R. and Ghosh, S.: Quantisation of second class systems in the Batalin-Tyutin formalism (in Ann of Phys).
3. Banerjee, N., and Banerjee, R.: Bose symmetry and bosonisation (in Nucl. Phys. B).
4. Banerjee, R.: Geometry and dynamics of the Landau-Lifshitz model of ferromagnetism as a constrained system (in Phys. Lett. B).
5. Banerjee, R.: Bosonisation in three-dimensional quantum field theory (in Phys. Lett. B).
6. Banerjee, R. and Rothe, H. J.: Batalin-Fradkin-Tyutin embedding of a self-dual model and the Maxwell-Chern-Simons theory (in Nucl. Phys. B).
7. Banerjee, R. and Chakraborty, B. : Formulation of the Landau-Lifshitz model of ferromagnetism as a constrained dynamical system (in Nucl. Phys. B).
8. Basu, C. and Thakur, P. K.: Characterisation of the delocalised states in a continuous correlated disorder model (in Physica A).



*Professor Jagadish Sharma speaking in the Bose Centenary
Celebration meeting*



*Professor P K Kabir delivering the memorial address in the
Bose Centenary meeting*

9. Chakraborty, B.: Relativistic particles coupled to Chern-Simons term-revisited (in *Annals. Phys.*).
10. Chaudhury, R.: Schemes for the calculations of the free energy and specific heat for marginal Fermi liquids in the normal and superconducting phase (in *Canad. Jr. Phy.* 73, 1995).
11. Ghosh, S. and Kumar, V. : Deep level transient spectroscopic study of DX Center in heavily doped ionimplanted GaAs (in *Solid Stat Comm*).
12. Ghoshal, S. and Chatterjee, A.: Phonon distribution in a model polariton system (in *Phys. Rev B*).
13. Hassan, S. S., Frege, O. M. and Nayak, N.: Off-resonant squeezed vacuum effects on a driven two-level atom: absorption and intensity harmonics (in *J. Opt. Soc. Am. B*).
14. Majumdar, A. S., Das Gupta, P. and Saxena, R. P.: Baryogenesis from black hole evaporation (in *Int. Jour. Mod. Phys. D*).
15. Mathur, M. and Gavai, R. V.: Universality and the deconfinement phase transitions in SU(2) lattice gauge theory (in *Nuc. Phys B*).
16. Mookerjee, A.: Complex systems: an introduction (in *Ind. J. Phys.*, 1995).
17. Nayak, N.: Influence of reservoir-induced-interactions on the one-photon micromaser action (in *Optics Communications*).
18. Nayak, N., Kremid, A., Thompson. B. V. and Bullough, R. K.: Nonclassical fields in one-photon micromaser action (in *Proceedings of the International Workshop on Quantum communications and Measurements*, eds, V. P. Belavnik, R. L. Hudson and O. Hirota).
19. Thakur, P. K. and Basu, C.: Existence of cross-over states in electronic transmittance due to delta-function potential with inhomogeneous and slowly varying periods (in *Physica A.*).

B. Applied Mathematics

Broad areas of researches have been in Vibration Control (Control Theory), Geophysics and Chaotic Dynamics under the supervision of Professor Sujit K. Bose. A Junior Research Fellow of CSIR: Sri Ganeshchandra Gorain is working on control of (torsional) vibration of a rectangular panel (material damping included) when the control torque is applicable at the hoisted end only (boundary control). The observability, exact controllability and stabilizability of the problem have been established.

In collaboration with Dr. Dipasree Dutta, Durgapour Women's College, Durgapur (W.B.), earlier work on reflection of seismic P-waves from a stack of layers under uniform unidirectional thrust was investigated. This problem relates to the seismic behaviour of earth's crust during tectonic thrust development.

In Chaotic Dynamics, transformations of iterative maps are being studied, following Newton iterations for the zeros of a function to seek alternative maps with decreased chaotic oscillation. Constructions have been obtained for the logistic, the delayed-logistic and the Henon map.

Some earlier work on NDE (non-destruction evaluation) of Composite Laminates has been completed. Based on the above work the following paper has been accepted for publication:

1. Dutta, D. and Bose. S. K. : Reflection of P-waves in prestressed dissipative layered crust (In Proc. Math. Sc. of Ind. Acad. Sci, Bangalore).

C. Mathematical Modelling

Studies towards examining the role of various soft particle approximation methods in the context of light scattering by dielectrics have been continued by S. K. Sharma. The scattered intensities and the extinction efficiencies of a homogeneous spherical particle were studied in the S-approximation and were contrasted with those obtained in other soft particle approximations. A large domain of particle sizes and relative refractive indices was examined. Work towards obtaining approximate formulae in the S-approximation for the scattering of light by an infinitely long cylinder is under progress.

The problem of transmission of electromagnetic waves in a multiparameter reflectionless dielectric was examined. The exact phase was shown to lead to the eikonal phase in the small wavelength limit. The small wavelength limit also implied $\{n(\mathbf{r}) - 1\} \ll 1$ where $n(\mathbf{r})$ is the index profile of the dielectric.

Stability aspects of a few ecological and biological systems and the evolution of patterns are investigated by A. Roy through simple mathematical modelling.

To handle large matrices, a parallel algorithm for matrix multiplication based on column block partitioning has been developed on the transputer systems by S. Banerjee. This program minimizes the storage requirement to a considerable extent.

A numerical simulation of the tidal flow pattern in the Hooghly estuary for a full tidal cycle has been done using both sequential and parallel algorithms by S. Banerjee and coworkers.

D. Theoretical Chemistry

Ultrafast dynamics of molecules in the excited state and quantum optical processes have been studied by G. Gangopadhyay. In some chaotic systems with a few degrees of freedom, statistical mechanical considerations can still be applied; model system are being developed and examined. Atoms and molecules interacting with some external field may be stationary or nonstationary systems; optimization techniques such as the Fourier-Grid Hamiltonian method and the simulated annealing methods are used by P. Dutta, a CSIR Research Associate, to solve the Schrodinger equation in both these cases. A new method (Genetic algorithm) has also been tried.

Based on the work the following paper has been accepted for publication :

1. Bandyopadhyay, A. and Gangopadhyay, G.: Population trapping in the Jaynes-Cummings model with a cavity Kerr nonlinearity (in J. Mod. Op).

RESEARCH PROJECTS

1. **Electronic Structure of Random Alloys**

The project sponsored by the Department of Science and Technology, New Delhi, with Prof. A. Mookerjee and collaborators at the IIT, Kanpur, was completed in May 1994. Results have been published in Pub A 13, 25 and 29.

2. **Numerical Studies of Alloy Phase Diagram**

The project supported by DST has Prof A. Mookerjee as principal investigator. Dr. G. P. Das, BARC, Bombay, is the coinvestigator. They have studied, along with S. Banerjee and A. Arya (BARC), the phase diagram of the alloy system NiMo with the Conolly-Williams Augmented Space Recursion (ASR) methods. Short range order has been obtained as a function of temperature through the concentration-concentration correlation functions. This has then been reincorporated in the basic electronic structure calculated through the Augmented space techniques. The aim is to study the alloy systems NiPb, NiPd and NiCr systematically.

3. **Activities of VECC and SNBNCBS on High T_c Superconductivity and Extension to Low Temperature Superconductors**

The project is sponsored by the National Superconductivity Programme (NSP) as a collaborative effort by the S. N. Bose National Centre and the Variable Energy Cyclotron Centre (VECC). Bi 2212, (Bi-Pb) 2212, Tl 2212 and Tl 2223 superconductors were subjected to alpha particle bombardment at the cyclotron. Positron annihilation studies were done on some of them. An effort to prepare Hg-based oxide superconductor is being made. Texturing phenomena in YBa₂Cu₃O₇ and Tl₂Ba₂CuO₆ due to pelletization pressure and sintering have been examined by P.K. Mukhopadhyay and others. Excess conductivity analysis in high temperature superconductors has been attempted. Some results were published in Pub. A 2.

4. **Nuclear Fission and Nuclear Structure Calculation**

The Emeritus Scientist's project sponsored by CSIR is operated by Professor M. K. Pal. Calculation on the nuclear properties of nuclei far away from the stability curve is continuing. Based on the work, a paper has been communicated (revised in March 1995).

Pal, M. K. and Chattopadhyay, S.: Antisymmetrised cluster model of ¹¹Li.

5. **Probing the Foundation of Quantum Theory**

Professor P. Ghosh, Dr. D.Home (BI) and Dr. A. Datta (JU) are being supported by the Department of Science and Technology, New Delhi for carrying on this interdisciplinary research on foundation of quantum theory. A. S. Majumdar joined as Research Associate in the project. Home and Majumdar have shown that quantum non-local correlations (in the sense of violating classical realism embodying both locality and non-contextuality) persist even in the strong macroscopic limit involving arbitrarily large values of both the number N and the spin j of the correlated particles.

The possibility of violating signal locality and unitarity in a merger of quantum mechanics and general relativity has been investigated by Ghosh and Majumdar. Some cosmological implications of the continuous spontaneous localization model and some tests for explicit collapse models of the GRWP type and their variants and off-shoots are under investigation.

6. Structure-Property Correlation in the Phase Transition of Metallo-mesogens (liquid crystals)

The work in this project with Prof. Monisha Bose and Prof C. K. Majumdar commenced in June 1993. The research fellow J. Nanda left in June 1994, and Ms. J. Saha joined as SRF on September 1994. EPR studies of alkyl substituted β - diketonates of Cu (C_nCu) in concentrated (pure) and dilute (doped) systems show very different behaviour. At the molecular level alkyl or alkoxy substitution makes no difference, but in concentrated system, the bulky alkoxy group affects packing; long range exchange effects cause columnar structure in C_nCu , but short range effects cause a staggered lamellar structure in C_nOCu . Further it has been shown that Eastman's contention of C_8Cu (C_nCu) being a Heisenberg antiferromagnet at room temperature is not correct. Thus though C_8Cu does not order even at liquid Helium temperatures, there is a strong exchange interaction in the concentrated system within the columnar structure leading to a single narrow asymmetric g line. However, in C_8OCu , due to absence of long-range exchange interaction, a complex hyperfine structure is obtained. Interestingly, a similar complex hyperfine structure is obtained in C_8Cu and $C_{10}Cu$ doped in corresponding palladium compounds as also in frozen $CHCl_3$ solution. Thus in dilute systems, not only the quadrupolar forbidden transitions as in C_8OCu are observed, hyperfine quartets from Cu spin ($I=3/2$) are clearly brought out, along with the seldom observed hyperfine doublets from ^{63}Cu and ^{65}Cu isotopes. The absence of exchange and dipolar interaction is responsible for this behaviour.

7. Collaborative Programme with Warwick University

As part of a collaborative program with Prof A. K. Bhattacharyya, Calaysis and Solid State Research Laboratory, University of Warwick, Prof A. Mookerjee, Dr. A. Banerjea and Dr.R. P. Datta have begun calculations on the structure and electronic properties of small transition metal clusters. The method chosen is equivalent crystal theory (J. R. Smith and A. Banerjea, Phys. Rev. Lett. 59, 2452 (1987) based on the universal binding energy relation (UBER, A. Banerjea and J. R. Smith, Phys. Rev. 37 6632 (1988)). Zero temperature optimization calculations on clusters of Au, Cu and Ni have been performed. These have been extended to finite temperature using the Monte Carlo procedure. Further progress through the linear combination of atomic orbital (LCAO) method, particularly the parametrization scheme due to Harrison (Electronic Structure and Properties of Solids, Dover 1980) will be attempted.

PUBLICATIONS

A. Scientific Journals

1. Bagchi, A. and Bose, S. K.: Acoustic plane wave reflection from a composite laminate: normal incidence, *J. Sound & Vibration*, 1994, **173**(1), 43-55.
2. Bandopadhyay, S. K., Barat, P., Sen, P., De, U., De, A., Mukhopadhyay, P. K., Kar, S. K. and Majumdar, C. K.: Effect of alpha irradiation on polycrystalline Bi-2223 superconductor, *Physica*, 1994, **C228**, 109-114.
3. Banerjee, A. and Good, B. S.: Avalanche in adhesion at bcc metal interfaces, *Ind. J. Phys*, 1995, **69A**, 105-111.
4. Banerjee, N., Ghosh, S. and Banerjee, R.: Quantisation of O(N) invariant nonlinear sigma model in the Batalin-Tyutin formalism, *Nucl. Phys.*, 1994, **B417**, 257-266.
5. Banerjee, R.: Gauge independent analysis of O(3) nonlinear sigma model with Hopf and Chern-Simons terms, *Nucl. Phys.*, 1994, **B419** [FS] 611-631.
6. Banerjee, R. and Chakraborty, B.: Fractional spin and Galilean symmetry in a Chern-Simons matter system, *Phys. Rev.*, 1994, **D49**, 5431-5437.
7. Banerjee, R., Rothe, H. J. and Rothe, K. D.: Batalin-Fradkin quantisation of anomalous chiral gauge theories, *Phys. Rev.*, 1994, **D49**, 5438-5445.
8. Banerjee, R., Rothe, H. J. and Rothe, K. D.: Batalin-Fradkin quantisation of the unitary gauge abelian Higgs model, *Nucl. Phys.*, 1994, **B426**, 129-139.
9. Banerjee, S., Santra, S. B. and Bose, I.: Size distribution of different types of sites in Abelian sandpile avalanches, *Z. Phys.*, 1995, **B96**, 571-575.
10. Bullough, R. K., Thompson, B. V., Nayak, N. and Bogoliubov, N. M.: Micromaser cavity quantum electrodynamics : I. One and many Rydberg atoms in micromaser cavities; II. fundamental theory of the micromaser, in *Studies in Classical and Quantum Nonlinear Optics*, ed. Ole Keller; Nova Sciences Publications, Inc.; New York, 1995, pp 87-132.
11. ** Bullough, R. K., Nayak, N. and Thompson, B. V. : Fundamental theory of the micromaser; in *Recent Developments in Quantum Optics*, ed. R. Inguva; Plenum, New York, 1993, pp. 273-288.
12. Chaudhury, R.: Stability of marginal Fermi liquid and its free energy formula, *Physica C*, 1994, **235-240**, 2327-2328.
13. Dasgupta, I., Saha, T. and Mookerjee, A.: An augmented space recursive method for the study of alloy phase stability random binary alloys, *Phy. Rev.*, 1995, **B51**, 3413-3423.
14. Dasgupta, I., Saha, T. and Mookerjee, A.: Stochastic resonances at the mobility edges in three dimensional Anderson model, *Phys. Rev.*, 1994, **B50**, 4867-4869.

15. Datta, A., Bhattacharjee, A. K. and Mookerjee, A.: A predictive scheme for energies of metal clusters in a tight-bonding linearized muffin-tin orbital formalism and its application to some simple metals, *Mod. Phys. Lett.*, 1994, **B8**, 883-888.
16. Datta, A. and Thakur, P. K.: The coherent potential approximation in TB LMTO formalism for a single band model of solid, *J. Phys. Cond. Matt.*, 1994, **6**, 4707-4720.
17. De, U., Pandit, V. S. and Mandal, K.: Alpha irradiation damage to specific heat in Thallium-2212 and Tl-2223 oxide superconductors, *Ind. J. Phys.* 1995, **A69**, 37-43.
18. Deb, B., Gangopadhyay, G., and Ray, D. S. : Generation of a class of arbitrary two-mode field states in a cavity, *Phys. Rev.*, 1995, **A51**, 2651-2653.
19. Gangopadhyay, D. : On the classical limit of some q-commutation relations, *Acta Physica Polonica*, 1994, **B25**, 1053-1064.
20. Ghosh, P. and Home, D.: On Boson trajectories in the Bohm model, *Phys. Lett.*, 1994, **A191** (5 & 6), 362-364.
21. Ghosh, S. and Paul, S. K.: N=2 Super W_∞ Algebra and its nonlinear realization through super KP formulation, *Phys. Lett.*, 1995, **B341**, 293-301.
22. Majumdar, A. S. Sethi, S. K., Mahajan, S., Mukherjee, A., Panchapakcsan, N. and Saxena, R. P.: R-G improved bounds on Higgs boson and top quark masses from electroweak baryogenesis, *Mod. Phys. Lett.*, 1994, **A9**, 459-464.
23. Mandal, K. and Ghatak, S. K.: Magnetic properties of disordered binary alloy, *Int. J. Mod. Phys.*, 1995, **B9**, 145-160.
24. Manna, S. K., Thakur, P. K. and Mookerjee, A.: Transmittance fluctuations and nonlinearity in random chains in the presence of applied electric fields, *Phys. Rev.*, 1994, **B50**, 5740-5743.
25. Mookerjee, A.: A first principles technique for the analysis of alloy phase stability in random binary alloys, *Bull. Mat. Sci.*, 1995, **18**, 3-15.
26. Mukhopadhyay, P. K., Barat, P., Kar, S.K., Bandyopadhyay, S. K. and Sen, P.: Unexpected behaviour of core materials of electrical coils at low temperatures, *Cryogenics*, 1994, **34**(3), 241-243.
27. ** Nayak, N. and Das, D.: Theory of the Rydberg atom one-photon micromaser, *Phys. Rev.*, 1993, **A48**, 2475-2479.
 ** The above two papers, although cited in the Annual Report 1994-95, were published in the year 1993-94.
28. Saha, J., Nandi, B., Mukherjee, P. K. and Saha, M.: Monte Carlo simulation of disc-like molecules with Gay-Berne type pair interaction potential, *Ind. J. Phys.*, 1995, **69A**(1), 121-126.

29. Saha, T., Dasgupta, I. and Mookerjee, A.: Augmented Space recursion approach to electronic structure of random binary alloys, *J. Phys. Cond. Matt.*, 1994, **6**, L245-L251.
30. Saha, T., Dasgupta, I. and Mookerjee, A.: An augmented space recursive technique for the study of short ranged ordering effects in binary alloys, *Phys. Rev.*, 1994, **B50**, 13267-13275.
31. Sain, A. and Mookerjee, A.: Scaling of resistance in the two dimensional Anderson tight-bonding model for disordered systems: effect of a random environment, *Mod. Phys. Lett.*, 1994, **8**, 195-203.
32. Sharma, S. K. and Somerford, D. J. : An analysis of Angular Scattering functions for particles in marine sediments, *J. Environ Sci. Health*, 1994, **A29**, 1635-1648.
33. Sharma, S. K. and Somerford, D. J. : An approximation method for backward scattering of light by a soft spherical obstacle, *J. Mod. Opt.*, 1994, **41**, 1433-1444.

B. Proceedings of Conferences & Symposia

1. Bandyopadhyay, S. K., Sen, P., Barat, P., Mukherjee, P. and Mandal, K.: Analysis of excess conductivity of α -irradiated Bi-2212 single crystal, *Curr. Tr. Cond. Matt. Phys.*, SINP, Aug 9-11, 1994, A14.
2. Banerjee, S.: Column Block partitioning algorithm for matrix multiplication, in *Scientific Applications with Transputers*, 1994, 10-17. Proc. of Indian Transputer User Group. 1994.
3. Das, P. K., Das, R., and Chaudhuri, A.: A Computerized Braille Transcriber for the Visually Handicapped, Proc. RC-IEEE-EMBS and 14th BMESI-1995, 3-7 — 3-8.
4. Dasgupta, I., Saha, T., Mookerjee, A. and Chakraborti, B. : Quantum transmittance and resonance in the two-dimensional quantum percolation model, AIP Conf. Proc. 1994, 286, 249-251.
5. De, U., Mandal, K., Sanyal, D., Banerjee, D. and Bhattacharyya, R. L.: Composition of Bi-2212, (Bi, Pb)-2212 and (Bi, Pb)-2223 from positron life time measurements, DAE Sol. St. Phys. Symp., Jaipur, Univ. of Rajasthan, 1994, 37C, 536.
6. Ghosh, S., Reddy, V. R., Das, D., Chintalapudi, S. N., Gupta, A. K. and Majumdar, C. K.: ^{57}Fe Moessbauer studies on synthetic pyroxenes, DAE Sol St. Phys. Symp., Jaipur, Univ. of Rajasthan, Dec. 27-31, 1994, 37C, 505.
7. Good, B. S. and Banerjee, A. : Monte Carlo investigation of AFM tip stability, Fall Meeting of Materials Research Society, Boston, Mass, USA, Nov 27-Dec 2, 1994, 519.
8. Pal, M. K.: Some problems in nuclear structure in *Perspectives in theoretical nuclear physics*, ed. K. S. Rao and L. Satpathy, Wiley-Eastern Ltd., 1994, 1-18.

9. Sen, P., Bandyopadhyay, S. K., Barat, P., Mukherjee, P., Mukhopadhyay, P. K. and De, A.: Texturing effect on polycrystalline Bi-2212, DAE Sol. St. Phys. Symp., Jaipur, Univ. of Rajasthan, Dec. 27-31, 1994, 37C, 328.
10. Dutta, R. and Roy, A. K. (editors): *Dirac and Feynman : Pioneers in Quantum Mechanics* (Wiley Eastern Ltd. New Delhi, 1993). (Proceedings of National Seminar on Sixty Years of Dirac Equation held at Visva Bharati, Santiniketan, January 28-30, 1989, organized by S. N. Bose National Centre for Basic Sciences, Visva Bharati University and the Department of Science and Technology, Govt. of India, New Delhi.)

C. Miscellaneous

1. Ghosh, P.: The Man of Science, review of *Einstein Lived here*, by A. Pais (Oxford Univ Press). in *The Statesman*, Calcutta, Dec 17, 1994).
2. Ghosh, P.: Quantum Tattwa, Satyen Basu O Einstein, Shata Barse Shraddanjali (Proc. of char Bijnanir Janma Satabarsha Utjapan Committee, May 14-18, 1994, Barasat, 24 Parganas (North) (in Bengali).
3. Majumdar, C. K. : *Richard Phillips Feynman*, In *Dirac and Feynman : Pioneers in Quantum Mechanics* (eds. R. Dutt & A. K. Ray, Wiley Eastern Ltd., New Delhi, 1993) pp. 5-8.
4. Majumdar, C. K. : *Two cultures revisited*, (Book review of C. P. Snow's *Two Cultures*) in *The Statesman*, Calcutta, August 6, 1994.
5. Majumdar, C. K. : *M. N. Saha: From the next generation*, In *M. N. Saha in Historical Perspective* (ed. J. Gupta, Thema, Calcutta 1994) pp. 226-238.
6. Majumdar, C. K.: *Magnetism*, in *Physics in India: A Status Report*, ed by S. S. Jha, Diamond Jubilee Publ., Indian National Science Academy, New Delhi, 1994) pp. 164-8.
7. Majumdar, C. K. : *The man who never owned his cat*, book review of W. Moore, *A Life of Erwin Schroedinger* (Canto distributed by Foundation Books) in *The Statesman*, Calcutta, Jan 7, 1995.

D. Ph. D. Thesis

1. Basu, C.: *Quantum Transmittance in random and quasi-periodic potentials*. Awarded Ph.D. degree from Jadavpur University (Sept 14, 1994). (Guide: Prof A. Mookerjee).

E. Books

1. Chatterjee, S. (Principal editor), Majumdar, C. K., Ghosh, P., Chatterjee, E., Bandyopadhyay, S.: *S. N. Bose: The Man and His Work*, Part I Collected Scientific Paper, 336 pages.
2. ----- Part II. Life, Lectures and Addresses, Miscellaneous Pieces, 328 pages (S. N. Bose National Centre for Basic Sciences, Calcutta, 1994).

Visits by Centre's Staff to attend Conferences, Seminars etc.

1. Banerjea, A. attended: (i) Workshop on Current Trends in Condensed Matter Physics, At SINP, Calcutta (Aug 8-10, 1994).
 - (ii) Fall Meeting of the Materials Research Society, at Boston, Massachussetts (Nov 27-Dec 1, 1994).
 - (iii) Visited NASA Lewis Research Centre, Cleveland, Ohio (Nov-Dec, 1994).
 - (iv) General Motors Technical Center, Warren, Michigan (Nov-Dec, 1994).
 - (v) Case Western Reserve University, Cleveland, Ohio (Dec, 1994).
 - (vi) Attended the 37th Solid State Physics Symposium; University of Rajasthan, Jaipur (Dec 26-31, 1994).
2. Banerjee, R.: Visited Heidelberg University for 3 months as a Humboldt Fellow (Feb 1-April 30, 1994).
3. Banerjee, S. attended : (i) Workshop on parallel processing at IIT, Kharagpur (June 27-July 1, 1994).
 - (ii) International Conference cum Workshop on Current Trends in Data Acquisition and Control of Accelerators (CTDCA), at VECC, Calcutta (Dec 6-8, 1994).
 - (iii) Workshop on computer Networks at IUCAA, Pune (Jan 2-13, 1995).
 - (iv) School on Complex Systems at IACS, Calcutta (Jan 30-Feb 3, 1995).
4. Basu Chaudhuri, C. attended: (i) Current Trends in condensed Matter Physics, at SINP, Calcutta (Aug 9-10, 1994).
 - (ii) Spectra, Structure & Dynamics, at IACS, Calcutta (Nov 28-30, 1994).
 - (iii) Mantle Dynamics & Its Relation to Earthquakes & Volcanism, IIT (Kharagpur) Centre, Calcutta (Dec 12-14, 1994).
 - (iv) Lasers & Spectroscopy, IACS, Calcutta (Jan 2, 1995).
 - (v) School on Complex Systems IACS (Jan 30-Feb 3, 1995).
 - (vi) Sixth S. N. Bose Memorial Lecture on High Energy Physics in India during the Past Decade, IACS, (March 24, 1995).
5. Biswas, P. attended: (i) Winter School on Some Recent Developments in Quantum Many Body Physics, IISc, Bangalore (Dec. 19, 1994-Jan 6, 1995).
 - (ii) School on Complex Systems: An Introduction, IACS, Calcutta (Jan 30-Feb 3, 1995).
6. Bose, S. K. attended : (i) Diamond Jubilee Meeting of Indian Academy of Sciences, Bangalore (Nov 29-Dec 1, 1994).

- (ii) Lecture by Prof. M. S. Narasimhan on Geometry and Nonlinear Differential Equations, at TIFR Centre, Indian Institute of Sciences, Bangalore (Jan 5, 1995).
7. Chakraborty, B. visited University of Delhi (March 1995).
 8. Chaudhury, R. attended: (i) Fourth International Conference on Materials and Mechanisms of Superconductivity and High Temperature Superconductors (M^2 SHTSCIV) at Grenoble, France (July 5-9, 1994).
 - (ii) Visiting Scientist at LEPES(CNRS) in Grenoble, France under Indo-French collaboration on High Temperature Superconductivity (Oct 24, 1994 to April 29, 1995).
 9. Das, C. attended IPS Diamond Jubilee Symposium at IACS, Calcutta (March 22-25, 1995).
 10. Das, Rina exhibited: (i) Computerised Parkins Brailler at the Theme Pavillon at CSI 1994 Exhibition at Netaji Indoor Stadium, Calcutta (Nov 21-24, 1994).
 - (ii) Attended International Conference cum Workshop on Current Trends in Data Acquisition and Control of Accelerators, at VECC, Calcutta (Dec 6-8, 1994).
 - (iii) Symposium on Mantle Dynamics and its relation to Earthquake and Volcanism, at IIT Kharagpur Calcutta Centre (Dec 12-14, 1994).
 - (iv) First Regional Conference of the IEEE Engineering and Biology Society at Vigyan Bhavan, New Delhi on A computerised Braille Transcripator for the Visually Handicapped (Feb 14-18, 1995).
 - (v) Attended 2-week training course on CD-ROM & ONLINE Systems and Services, Organised by NISSAT, Govt. of India at RIC, Jadavpur University, Calcutta (Feb-March, 1995).
 11. Datta, R. P. attended: International Workshop on Clusters and Nano Structured Materials, IOP Bhubaneswar (Dec 29, 1994 to Jan 2, 1995).
 12. Dey, P. attended: Tenth SERC School for Theroretical High Energy Physics, at Banaras Hindu University (Feb 16-March 14, 1995).
 13. Gangopadhyay, D. attended: Workshop on Effective Field Theory and QCD at CTS, IISc, Bangalore (Aug 22-Sept 2, 1994).
 14. Ghosh, P. attended : (i) 5th BCSPIN Summer School at Kathmandu (May 22-28, 1994).
 - (ii) 12th Young Physicists Colloquium at SINP, Calcutta (Aug 24-25, 1994) (Chaired one session on 25th Aug).
 - (iii) Diamond Jubilee Symposium of the Indian Physical Society at IACS, Calcutta (March 22-25, 1994).
 - (iv) Brisphys 94 (6th APPC/11th AIP Congress), at Brisbane (July 4-8, 1994).

- (v) SERC School on Coherence and Correlations in Modern Optics and Quantum Physics, at IMSC, Madras (Jan 23-Feb 10, 1995).
15. Ghoshal, S. attended (i) Symposium on Spectra, Structure and Dynamics, at IACS, Jadavpur, Calcutta (Nov 28-30, 1994).
 - (ii) IPS Diamond Jubilee Symposium at IACS, Jadavpur (March 22-24, 1995).
 16. Majumdar, A. S. attended Diamond Jubilee Symposium at IACS, Calcutta (March 22-25, 1995).
 17. Mandal, K.: Attended Conference on Current trends in Condensed Matter Physics, SINP, Calcutta (Aug 9-10, 1994).
 18. Mitra, T. attended School on Complex Systems: An Introduction, at IACS, Calcutta (Jan 30-Feb 5, 1995).
 19. Mookerjee, A. attended (i) : Workshop on Many-Body Theory, Department of Applied Mathematics, University of Calcutta (April 29, 1994).
 - (ii) Network workshop on Electronic Structure of Disordered Alloys at the University of Dacca (June 3-11, 1994).
 - (iii) Workshop Group on Alloy Phase Stability, ICTP, Trieste (August 8-19, 1994).
 - (iv) Meeting of the 1994 Solid States Advisory Committee at ICTP, Trieste (August 8, 1994).
 - (v) Visited the Technical University of Vienna, Vienna, Austria (August 22-29, 1994).
 - (vi) The Indian Science Congress, University of Jadavpur, Calcutta (January 5, 1994).
 - (vii) VIIth Workshop on Total Energy and force Methods, ICTP, Trieste (January 13-20, 1995).
 - (viii) School on Complex Systems, IACS, Calcutta (January 30-February 3, 1995).
 - (ix) Presented poster in MRSI-GBM and Satellite Symposia, IIT Kharagpur (February 7-10, 1995).
 - (x) Visited University of Dhaka, Department of Physics, under the Network Scheme on Alloys of ICTP, Trieste (March 1-7, 1995).
 - (xi) S. N. Bose Centenary Conference, Bangladesh Physical Society, Dhaka (March 7-8, 1995).
 - (xii) IPS Diamond Jubilee Conference, IACS, Calcutta (March 23, 1995).

20. Mukhopadhyay, P. K. visited (i) CAT, Indore (April 11, 1994).
 - (ii) Attended Workshop on Current Trends in Condensed Matter Physics, at SINP, Calcutta (Aug 8-10, 1994).
21. Nayak, N. visited (i) University of Manchester Institute of Science and Technology as EPSRC (UK) Visiting Fellow (May 10-Dec 11, 1994).
 - (ii) attended International Workshop on Quantum Communications and Measurements at University of Nottingham, UK (July 11-16, 1994).
 - (iii) Symposium on Lasers and Spectroscopy at IACS, Calcutta (Jan 2, 1995).
 - (iv) School on Complex Systems at the IACS, Calcutta (Jan 30-Feb 3, 1995).
 - (v) Diamond Jubilee Symposium on Physics in India: Achievements in Past Ten Years and Future Projections at IACS, Calcutta (March 22-24, 1995).
22. Paul, S. K. attended: Physics at the Planck scale, at Puri, (Dec 12-21, 1994).
23. Saha, T. attended (i) The Network Workshop on Electronic Structure of Disordered Alloys, University of Dhaka (June 3-11, 1994).
 - (ii) Working Group on Alloy Phase Stability, ICTP, Trieste (August 23-29, 1994).
24. Sanyal, B. attended: (i) Winter School on Some Recent Development in Quantum Many Body Physics, IISc, Bangalore (Dec 19, 1994-Jan 6, 1995).
 - (ii) School on Complex Systems: An Introduction, IACS, Calcutta (Jan 30-Feb 3, 1995).

SEMINARS / TALKS BY THE CENTRE'S STAFF

1. Banerjea, A.: (i) *Avalanche in adhesion at bcc metal surfaces*, at the Workshop on Current Trends in Condensed Matter Physics, SINP, Calcutta (Aug 8-10, 1994).
 - (ii) *Energies of small metal clusters using the equivalent crystal theory*, poster presented at the Workshop on Current Trends in Condensed Matter Physics, SINP, Calcutta (Aug 8-10 1994).
 - (iii) *Monte-Carlo simulation of AFM tip stability*, poster presented at the Fall Meeting of the Materials Research Society, Boston, Massachusetts (Nov 1994).
 - (iv) *Simulations of Atomic Force Microscopy*, Seminar at the General Motors Technical Centre, Warren Michigan (Dec 1994).
 - (v) *Simulations of transition metal clusters*, seminar at Physics Dept. Case Western Reserve University, Ohio (Dec 1994).
 - (vi) *Semi-empirical simulations of solid surfaces and interfaces*, at the 37th DAE Solid State Physics Symp, University of Rajasthan, Jaipur (Dec 1994).
2. Banerjee, R.: *Constrained hamiltonian dynamics and its applications*, at ISI, Calcutta (Nov 23, 30 and Dec 7, 1994).

3. Biswas, P.: *Monte Carlo Simulation of Ar atoms and study of anomalous diffusion*, at SNBNCBS, Calcutta (Sept 19, 1994).
4. Bose, M.: (i) *The contrasting effects of Alkyl and Alkoxy substituents in the molecular self-assembly of discotic Copper β Diketonates*, at the 4th International Symposium on Molecular Electronics and Biocomputing, Goa, India (Sept 25-30, 1994).
 - (ii) *EPR of Alkyl Substituted Aryl diketonates of Cu in concentrated and dilute systems*, at the 2nd National Seminar of the Indian Liquid Crystal Society, Itanagar, India (Dec 26-28, 1994).
 - (iii) *Magnetic Resonance Studies of alkyl vs. alkoxy substituted diketonates of Copper*, at the 1st meeting of National Magnetic Resonance Society, IISC, Bangalore (Feb 2-3, 1995).
 - (iv) *Structure-property correlation in liquid crystalline metallomesogens*, IMSC, Madras (Jan , 1995).
5. Bose, S. K.: (i) *Understanding Chaos in iterative maps and control*, at SNBNCBS, Calcutta (July 20, 1994).
 - (ii) *Logistic and delayed logistic maps as Newton interactions and chaos reduction*, at IISc., Bangalore (Dec 16, 1994).
6. Chakraborty, B.: *Landau-Lifshitz model of 2+1 dimensional continuum ferromagnets as a gauge fixed version of Non Relativistic CP model and the related issues*, at the University of Delhi (March , 1995).
7. Chaudhury, R.: *Stability of marginal fermi liquid and its free energy formula*, in Grenoble, France (July 6, 1994).
8. Ghosh, P.: (i) *Testing wave-particle duality of photons*, at IACS (April 26, 1994).
 - (ii) *Do Bosons have trajectories*, at IACS (April 27, 1994).
 - (iii) *Testing wave-particle duality*, at Syracuse University (Oct 17 & 19, 1994).
 - (iv) *Testing wave-particle duality of single photon states*, at:
 - University of Adelaide (July 12, 1994);
 - Flanders University of South Australia (July 13, 1994);
 - Canberra University (July 19, 1994);
 - Syracuse University (Oct 18, 1994);
 - McMaster University (Nov 11, 1994);
 - McGill University (Nov 16, 1994);
 - University of Toronto (Nov 17, 1994);
 - SINP, Calcutta (Dec 7, 1994).
 - (v) *Relativistic quantum mechanics of bosons*, at:
 - Adelaide University (July 15, 1994);

- Syracuse University (Oct 12, 1994);
 - TIFR, Bombay (Nov 23, 1994).
- (vi) *Violation of signal locality and unitarity in a merger of quantum mechanics and general relativity*, in Fundamentals of Physics & Astrophysics, in honour of Professor R. K. Verma at the Physical Research Laboratory (March 14-16, 1995).
 - (vii) *A popular lecture on Particle Physics*, to high school students at BITM, Calcutta (May 2, 1994).
 - (viii) *Delivered a talk (with video cassette) on S. N. Bose*, at the Barasat Govt. College (May 14, 1994).
 - (ix) *A lecture at the seminar, Will the 21st Century bring a pollution free world ?* Organized by PUNCH at Sisir Mancha (June 4, 1994).
 - (x) *A lecture on the life and works of Professor S. N. Bose*, organized by the Faculty Club, Bose Institute (June 7, 1994).
 - (xi) *A lecture on: The life and works of Professor S. N. Bose, in the conference "Professor Satyendranath Bose : his achievements and his association with France"*, organized at Alliance Franchise (June 14, 1994).
 - (xii) *Our Environment: A Synoptic View*, at Shivatosh Mookerjee Science Centre (Sept 10, 1994).
 - (xiv) *The Citizen's Role in Urban Management*, at Calcutta Management Association (Sept 13, 1994).
9. Majumder, A. S. : (i) *A study of higher dimensional theories in the early universe*, at the Dept of Phys. & Astrophysics, University of Delhi (Aug. 1994).
 - (ii) *Inflation in Kaluza-Klein theories*, at the Relativity and Cosmology Research Centre, Jadavpur University (March 1995).
10. Majumder, C. K. (i) : *Oxygen irradiation of Bi-based single crystal & polycrystalline superconductors*, at the Users Workshop on Materials Science with High Energy Heavy Ion Beams, NSC, New Delhi (July 1-2, 1994).
 - (ii) *The River: a study of Hooghly estuary problem by parallel processing in the finite element method*, SINP, (Nov 16, 1994).
 - (iii) *University-Industry Interaction*, at the discussions in the Physics Section of the Indian Science Congress, Calcutta (Jan 5, 1995).
11. Mandal, K. : (i) *The effect of stress and annealing on the magnetic properties of soft magnetic materials*, at IIT, Kharagpur (June 14, 1994).
 - (ii) *Alpha irradiation studied on high temperature superconductors and the magnetic properties of amorphous magnetic materials*, at TIFR, Bombay, (March 7, 1995).

12. Mookerjee, A. : (i) *Theories of many electron systems*, Department of Applied Mathematics, University of Calcutta (April 29, 1994).
 - (ii) *Quantum theory of many electron systems*, SNBNCBS, Calcutta (eight lectures, Monday-Wednesday, May 1994).
 - (iii) *Electronic structure of random binary alloys*, Department of Physics, University of Dhaka (June 5-8, 1994).
 - (iv) *Augmented space recursive technique for the study of alloy electronic structure of random alloys*, (two lectures at ICTP, Trieste, August 14-15, 1994).
 - (v) *Design of alloys*, (Plenary Lecture at ICTP, Trieste, August 19, 1994).
 - (vi) *Alloy phase stability*, VIIth Workshop on Total Energy and Force Methods, ICTP, Trieste (January 15, 1995).
 - (vii) *Complex systems : an introduction*, Workshop on Complex Systems, IACS, Calcutta (January 30, 1995).
 - (viii) *Spin glasses*, at IACS, Calcutta (February 1, 1995).
 - (ix) *Evolution on a rugged fitness landscape: complex systems and spin glasses*, S. N. Bose Centenary Conference, Bangladesh Physics Society, Dhaka (March 8, 1995).
 - (x) *Disordered alloys: electronic structure*, IPS Diamond Jubilee Conference, IACS, Calcutta (March 23, 1995).
13. Nayak, N. : (i) *Nonclassical fields in one-photon micromaser action*, at Int. Workshop on Quantum Communications and Measurements, University of Nottingham, UK (July 11, 1994).
 - (ii) *Validity of effective 2 level Hamiltonian in the context of 2 photon squeezing*, at Int. Workshop on Quant Comm & Meas, Univ. of Nottingham, UK (July 11-16, 1994).
14. Pal, M. K.: *From nuclear fission to heavies and superheavies*, at Atomic Energy Research Centre, Dhaka, Bangladesh (March 20, 1995).
15. Saha, J. *Landau-de Gennes theory of nematic-isotropic phase transition in liquid crystals, a series of lectures given at Calcutta University* (January 1995).
16. Saha, T. (i) *Electronic structure of alloys with lattice relaxation effect*, The Network Workshop on Electronic Structure of Disordered Alloys, at University of Dhaka (June 6, 1994).
 - (ii) *Augmented space recursive technique for the of alloys with off-diagonal disorder*, Working Group on Alloy Phase Stability, ICTP, Trieste (August 18, 1994).
17. Sanyal, B. : *Monte Carlo simulation in 2-d Ising and X-Y models*, SNBNCBS (Sept 19, 1994).

THEORETICAL PHYSICS SEMINAR CIRCUIT

The Centre continued to function as the coordinating centre of the Theoretical Physics Seminar Circuit (TPSC).

The Calcutta Centre Sub-committee held a meeting of the members on April 8, 1994. Members reviewed the last year's programme and recommended a list of speakers for the next year.

The Annual meeting of the convenors was held on 22 April, 1994 at the Director's Office on the Centre. Members discussed the last year's programme, made recommendations to improve the organization of the programme and finalized a list of the new speakers for the year 1994-95. Members expressed great satisfaction over the increased grant sanctioned by DST. The next TPSC year will commence from 1 June 1994.

The Calcutta Centre Sub-committee met at the Director's Office of the Centre on 15 June to select the list of category 'A' and 'B' speakers to be invited to visit Calcutta during 1994-95.

The following scientists under the TPSC programme gave seminars :

1. M. K. Parida, North Eastern Hill University, Shillong: *Uncertainty in gut predictions*, at SINP, Calcutta (Oct 6, 1994).
2. T. Saha, SNBNCBS, Calcutta: (i) *Quantum transmittance in two and three dimensional disordered media*, at IOP, Bhubaneswar, (November 16, 1994).
(ii) *Quantum transmittance in two and three dimensional disordered media*, at Central University of Hyderabad (Nov 18, 1994).
(iii) *Phase stability in alloy systems: an augmented space approach*, at Central University of Hyderabad (November 19, 1994).
(iv) *Phase stability in alloy systems: an augmented space approach*, at IMSC, Madras (November 25, 1994).
(v) *Phase stability in alloy systems : an augmented space approach*, at IIT, Kanpur (January 19, 1995).
(vi) *Quantum transmittance in two and three dimensional media*, at MRI, Allahabad (Jan 24, 1995).
3. Kiran S. Balyan, PRL, Allahabad: *Atomic data for the Interpretation of solar spectra*, at SINP, Calcutta (Dec 14, 1994).
4. Prakash Mathews, IISc, Bangalore: *Photon structure functions: Target photon mass effects and QCD correlations*, at SINP, Calcutta (Jan 4, 1995).
5. Jaydeb Chakraborti, IISc, Bangalore: *Density functional theory of laser induced freezing of colloidal suspensions*, at IACS, Jadavpur (Jan 27, 1995).
6. Romesh Kaul, IMSc, Madras: *Knots and links*, at SNBNCBS (Jan 19, 1995).

7. Sudipta R. Burman, IISc, Bangalore: *Electronic structure of non-stoichiometric oxides*, at SNBNCBS (Feb 14, 1995).
8. H. N. Ghosh, IOP, Bhubaneswar: *Model Study of some high Tc Superconductors*, at SNBNCBS (March 27, 1995).
9. C. S. Unnikrishnan, TIFR, Bombay: (i) *Gravitational collapse and cosmic censorship*, at SINP, Calcutta (March 28, 1995).
(ii) *Modern experimental gravitation*, at SNBNCBS, Calcutta (March 29, 1995).
10. Deepak Kumar, SPSc, JNU: *Effect of decoherence on Bell's inequalities*, at SNBNCBS, Calcutta (March 31, 1995).

EDUCATIONAL ACTIVITIES

The Centre's scientists have helped neighbouring universities in teaching some special courses. Professor A. Mookerjee lectured on Solid State Physics (Special Paper) at the M. Sc. level at Presidency College, Calcutta, during September 1994-February 1995. Professor C. K. Majumdar taught part of the Solid State Physics (Special Paper) course in Calcutta University. Dr. D. Gangopadhyay taught part of High Energy Physics (Special paper) of Presidency college. Dr. A. Banerjea has been lecturing on "Numerical Techniques and Simulation", "Molecular Dynamics", and "Group Theory", to research students at the Centre.

LIBRARY

The S. N. Bose National Centre Library added 77 and (2-donated) new books in 1994-95 to its collection. The technical processing of library books are being carried out by using a 286-MINICOMP Personal Computer, supplied with an EPSON FX-1000 printer possessed by the library. Mostly, two computer softwares, the dBASE III and WordPerfect 5.1 are being used for various types of library work. While the dBASE III software is being used mainly for technical processing and database management of library books, the WordPerfect 5.1 program is being used for preparing Annual Report and other wordprocessing activities.

The library renewed subscription to the following journals for the year 1994:

A. Foreign Journals

1. Computer Journal
2. Computers in Physics (AIP)
3. Economic Theory
4. Journal of Modern Optics
5. Journal of Physics A: Mathematical and General
6. Monthly Notice of Royal Society of Astronomy

7. Nature
8. Physical Review Letters
9. Physics Letters (Section A)
10. Physics Letters (Section B)
11. Physics Reports

B. Indian Journals

1. Bulletin of Material Science
2. Current Science
3. Indian Journal of Pure & Applied Physics
4. Journal of Astrophysics & Astronomy
5. Journal of Biosciences
6. Journal of Genetics
7. Pramana
8. Proc. Ind. Acad. of Sc. (Chemical Sciences)
9. Proc. Ind. Acad. of Sc. (Earth & Planetary Sciences)
10. Proc. Ind. Acad. of Sc. (Engineering Sciences)-Sadhana
11. Proc. Ind. Acad. of Sc. (Mathematical Sciences)

Preprints received in the library from more than 25 research institutes all over the world were displayed and preserved in the Preprint Library at DB 17, Salt Lake.

The library offers xerox facilities on a regular basis to its users during seminars, symposia and other academic activities. About 14700 xerox copies from different research materials were distributed last year to the library users.

In view of the limited subscription to foreign journals in the library, the library has sought help of the Indian National Scientific Documentation Centre (INSDOC) for providing its users with xerox copies of papers from different foreign scientific periodicals.

COMPUTER CENTRE

The HP9000 systems with Printer and Plotter, the laser printer and four 80386 PC AT machines have provided service satisfactorily. The Quantum double drive has been used for the College Teachers' Training Programme. The Teachers' Training Programme was satisfactorily completed during the last year. The course material covered MSDOS, GWBASIC and elements of WORDSTAR and FORTRAN and the Teachers practised problem solving on the computer. However, the Quantum Workstation, a 286-machine, has been developing frequent problems (because it has become old after heavy use) and would have to be replaced. The system HP 9000

with only 130 Megabyte memory has become overloaded with the increase of the number of scientists; urgent expansion will be necessary.

Regular e-mail facility in the centre was extensively offered to different scientists as well as visiting scientists by R. Das, the System Administrator as well as the Postmaster of the e-mail service. Various scientists of our centre regularly availed the bulletin board facility for obtaining paper abstracts in High Energy Physics group as well as HTC group. It helped them in their research work.

The transputers used by S. Banerjee are working satisfactorily. The system must be upgraded, and expanded for developing extensive parallel processing work.

A collaborative research work with Jadavpur University was undertaken by Mrs. R. Das, System Administrator of the centre. The project has developed a PC-based system to produce Braille plates to ease the production of Braille books. The Project BRAILESCRIPT sponsored by the Department of Electronics, Government of India, with Mrs. R. Das as a Coinvestigator is being carried out at the Ramakrishna Mission Blind Boys' Academy, Narendrapur. The software, which has been implemented using a rule-based translation scheme, can be extended to include vernacular transcriptions as well involving the phonetic principle.

CONSTRUCTION OF THE NEW CAMPUS

Land measuring 15 acres situated in Block JD, Sector III, Salt Lake, Calcutta was earmarked for the above purpose in phases. The first phase comprising of a part of the main building, a part of the Guest House and one block of Essential Staff Quarters is essentially over. This phase included the following :

- (a) Library and Computer building;
- (b) A four storied Guest House Complex consisting of forty-eight rooms;
- (c) A three storied essential staff quarter having twelve independent flats;
- (d) An underground water reservoir to cover the entire campus;
- (e) An overhead tank for supply of water in the entire campus;
- (f) A transformer building; and
- (g) Paved roads linking the aforesaid buildings.

Necessary infrastructural facilities are nearing completion so far as Phase 1 construction programme is concerned. The major impediment in this sphere may be attributed to the delay receiving power connections. The shifting in the new premises, to be organized in phases, is likely to commence on June, 1995.

Interlinked with the above contemplated shifting is de-hiring of some of the hired premises from which the Centre is now operating. Certain formalities have already been taken in respect of the ground floor of the hired premises at DB17, Sector I, Salt Lake.

MEETINGS OF THE VARIOUS COMMITTEES OF THE CENTRE

Governing Body

The Governing Body of the Centre held its ninth meeting on Thursday, 14 April, 1994 at the Office of the Secretary, Department of Science and Technology, New Delhi under the Chairmanship of Professor P. Rama Rao.

Academic Programme Advisory Committee

There was no meeting held during the subject period.

Finance Committee

There was no meeting held during the subject period.

Construction Committee

This Committee held its meeting on 11 June, 1994 at the Centre.



*Main Building where the Library, Laboratory, Computer Room
are currently housed*



Guest House in the new Campus of the Centre

GOVERNING BODY

During the period under review/report, the Governing Body of the Centre consists of the following members :

- | | |
|--|---|
| 1. Professor P. Rama Rao
Chairman | Secretary
Department of Science and
Technology, Government of India,
New Delhi. |
| 2. Professor S. K. Joshi
Member | Director-General
Council for Scientific and Industrial
Research, New Delhi. |
| 3. Professor Mihir Chowdhury
Member | Indian Association for the Cultivation
of Science, Calcutta. |
| 4. Professor N. Mukunda
Member | Indian Institute of Science,
Bangalore. |
| 5. Shri S. B. Krishnan
Member | Joint Secretary and Financial
Advisor, Department of Science &
Technology, Government of India,
New Delhi. |
| 6. Shri N. Krishnamurthi
Member | Chief Secretary
Government of West Bengal,
Calcutta. |
| 7. Professor C. K. Majumdar
Member | Director
S. N. Bose National Centre for Basic
Sciences, Calcutta. |
| 8. Dr. S. K. Sharma
Non-member secretary
(upto 9 Feb, 1995) | Administrative Officer (Actg)
S. N. Bose National Centre for Basic
Sciences, Calcutta. |
| Shri Abhijit Gupta
Non-member Secretary
(Since 10 Feb, 1995) | Administrative Officer
S. N. Bose National Centre for Basic
Science, Calcutta. |

ACADEMIC PROGRAM ADVISORY COMMITTEE

This committee is being reconstituted.

Staff of the Centre as on March 31, 1994

Academic

Dr. Chanchal Kumar Majumdar

Director

Dr. Sujit Kumar Bose	Professor
Dr. Partha Ghosh	Professor/Academic Programme Coordinator
Dr. Abhijit Mookerjee	Professor
Dr. Subodh Kumar Sharma	Reader
Dr. Nilkantha Nayak	Reader
Dr. Rabin Banerjee	Reader
Dr. Debashis Gangopadhyay	Fellow
Dr. Samir Kumar Paul	Fellow
Dr. Srilekha Banerjee	Fellow
Dr. M. Mathur	Fellow
Dr. Ranjan Chaudhury	Lecturer
Dr. Pratip Mukhopadhyay	Lecturer
Dr. Amitava Banerjee	Lecturer
Dr. Biswajit Chakraborty	Post Doctoral Fellow
Mrs. Rina Das	Scientific Officer (Computer)

Administrative, Technical and Auxiliary

Shri Abhijit Gupta	Administrative Officer (Since 10 Feb, 1995)
Dr. Santi Gopal Basu	Librarian
Mr. Apurba Kanti Sarkar	Administrative Assistant (Accts)
Mr. Sunish Kumar Deb	Stenographer
Mr. Sukanta Mukherjee	Assistant (General)
Mr. Tapan Kumar Sen	UDC
Mr. Jaydeep Kar	Junior Assistant
Mr. Prosenjit Talukdar	Junior Assistant
Mr. Sanad Kumar Sukla	Junior Assistant
Mr. Santosh Kumar Singh	Junior Assistant
Mr. Gopal Chandra Ghosh	Driver
Mr. Pradip Kumar Bose	Helper
Mr. Partha Chakraborty	Helper

Personnel on Campus Construction

Mr. Nirmal Bhattacharya	Project Engineer
Mr. Samar Sur	Sub-Assistant Engineer
Mr. Aditya Paul Choudhury	Project Assistant

Scientists on Projects

Prof. Manoj Kumar Pal	Emeritus Scientist, CSIR
Prof. Manisha Bose	Co-principal Investigator in a DST project.

Ms. Chaitali Basu	Senior Research Fellow, CSIR (resigned on 30.9.94)
Mr. Abhijit Datta	Research Scholar
Dr. Prabhat Kumar Thakur	Pool Officer, CSIR
Mr. Indra Dasgupta	Senior Research Fellow
Ms. Tanusree Saha	Senior Research Fellow
Mr. Tapas Mitra	Senior Research Fellow, CSIR
Dr. P. Roychoudhury	Part Time Researcher
Dr. Kalyan Mandal	Senior Research Fellow, DST Project (from Sept '94)
Mr. J. Nanda	Junior Research Fellow, DST Project (resigned on 20.7.94)
Mr. B. Bhattacharya	Junior Research Fellow, DST Project (resigned on 30.6.94)
Mr. P. Biswas	Junior Research Fellow, CSIR
Ms. Jayashree Saha	Senior Research Fellow, DST Project (from 2.9.94)
Ms. Indrani Basu	Junior Research Fellow (from 1.12.94)
Dr. Radhika Prasad Datta	Research Associate, Univ of Warwick Project (from 12.9.94)
Dr. Priyatosh Datta	Research Associate, CSIR
Dr. Chandra Das	Research Associate, CSIR (from 1.2.95)
Mr. Prantick Dey	Junior Research Fellow, CSIR
Mr. Ganesh Ch. Gorain	Junior Research Fellow, CSIR
Ms. Chhanda Basu Chaudhuri	Junior Research Fellow, CSIR (from 1.2.95)
Dr. Archana S. Majumdar	Research Associate, DST Project (from 20.6.94)
Mr. Biplab Sanyal	Junior Research Fellow, DST Project (from 18.7.94)
Dr. Subhasis Ghosh	Visiting Scientist
Dr. Gautam Gangopadhyay	Visiting Scientist
Dr. Sarmistha Ghoshal	Visiting Scientist
Dr. Ashim Kumar Roy	Visiting Scientist

Abreviation

BARC	=	Bhabha Atomic Research Centre, Bombay
BI	=	Bose Institute, Calcutta
CAT	=	Centre for Advanced Technology, Indore
CSIR	=	Council of Scientific & Industrial Research
CU	=	Calcutta University
CUH	=	Central Univeristy of Hyderabad
DAE	=	Department of Atomic Energy
DST	=	Department of Science & Technology, New Delhi
IACS	=	Indian Assoc. for the Cultivation of Sc., Calcutta
ICTP	=	International Centre for Theoretical Physics, Trieste, Italy
IISC	=	Indian Institute of Science, Bangalore
IIT	=	Indian Institute of Technology
IITK	=	Indian Institute of Technology, Kanpur
IITKGP	=	Indian Institute of Technology, Kharagpur
IMSC	=	Institute of Mathematical Sciences, Madras
INSA	=	Indian National Science Academy, New Delhi
IOP	=	Institute of Physics, Bhubaneswar
IPA	=	Indian Physics Association
IPS	=	Indian Physical Society
ISI	=	Indian Statistical Institute, Calcutta/Delhi
IUCAA	=	Inter-Univ Centre for Astronomy & Astrophy, Pune
JNU	=	Jawaharlal Nehru University, New Delhi
JU	=	Jadavpur University, Calcutta
MRI	=	Mehra Research Institute, Allahabad
NASA	=	National Aeronautics and Space Administration, USA
NEHU	=	North-Eastern Hill University, Shillong
NPL	=	National Physical Laboratory, New Delhi
NSC	=	Nuclear Science Centre, New Delhi
NSF	=	National Science Foundation, USA

PC	=	Presidency College, Calcutta
RRI	=	Raman Research Institute, Bangalore
SINP	=	Saha Institute of Nuclear Physics, Calcutta
SLAC	=	Stanford Linear Accelerator Centre, Calif., USA
SNBNCBS	=	S.N. Bose National Centre for Basic Sciences
TIFR	=	Tata Institute of Fundamental Research, Bombay
UGC	=	University Grants Commission, New Delhi
VECC	=	Variable Energy Cyclotron Centre, Calcutta

BUDGET SUMMARY

(1994— 95)

The funds come from the Department of Science and Technology. The following is the summary of the budget estimates of the year 1994-95 :

(Amount in Rs./Lakh)

	Actuals	Budget Estimate	Revised Estimate
	1993-94	1994-95	1994-95
Non Plan	29.50	36.08	37.72
Plan	244.24	220.44	212.46
Total	273.74	256.52	250.18

July 10, 1995

AUDITORS' REPORT

To
The Director
Satyendra Nath Bose National Centre for Basic Sciences
DB-17, Sector-I
Salt Lake City
Calcutta-700 064.

We have audited the attached Balance Sheet as at 31st March 1995 of Satyendra Nath Bose National Centre for Basic Sciences and the annexed Income and Expenditure Account for the year ended 31st March 1995. We report as follows :

1. a) As per Note of Schedule 'O' to the Accounts depreciation on Fixed Assets has neither been ascertained nor charged since inception.
b) Capital Work-In-Progress has not been separately disclosed as stated vide Note-5 of Schedule 'O' to the annual accounts.
c) The Bye-Laws of the Centre are pending final approval from the Department of Science & Technology, Government of India.
d) As stated vide Note 8 of Schedule 'O' to the annual accounts no confirmation of balance have been obtained from parties.
2. All necessary information, books and records required for audit were produced before us.
3. Subject to paragraph 1(c) above, the transactions that came to our notice were within the delegated powers conferred by the Bye-Laws of the Centre.
4. Subject to Paragraphs 1(a), 1(b) and 1(d) above, and to the best of our information and explanations given to us, in our opinion, the said Balance Sheet and the Income and Expenditure Account read together with Schedules 'A' to 'N' and the notes on Accounts attached thereto, reflect a true and fair view.
 - i) in case of Balance Sheet as to the state of affairs of the Centre as on 31st March 1995 and
 - ii) in case of the Income & Expenditure Account as to the excess of Income over Expenditure for the year ended 31st March 1995.

For D. P. SEN & CO.
Chartered Accountants
Abhijit Bandyopadhyay
Partner

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Balance Sheet as at**

Figures for the previous year	FUNDS & LIABILITIES	Schedule	
		Rs.	P.
	CAPITAL FUND :		
7,70,12,135.60	Balance as per last A/c.	7,70,12,135.60	
	<i>Add:</i> Grant-in-aid received from Govt. of India for non- recurring expenses	1,03,03,250.00	8,73,15,385.60
	GENERAL FUND :		
	Balance as per last A/c	60,76,279.52	
60,76,279.52	<i>Add:</i> Net excess of Income over Expenditure for the year transferred from Income & Expenditure Account	4,56,225.91	65,32,505.43
	OTHER FUNDS :		
	1) Computer Fund : Donation received from J. Bose as per last A/c	3,00,001.00	
3,00,001.00	<i>Add:</i> Received during the year	25,000.00	3,25,001.00
	2) Project Fund : Balance as per last A/c	23,68,434.53	
23,63,434.53	<i>Add:</i> Excess of Income over Expenditure for the Year transferred from Income & Expenditure A/c	4,80,844.10	28,49,278.63
7,500.00	3) Library Fund (Donation)		7,500.00
9,98,860.18	4) Employees' Provident Fund		14,63,317.98
1,53,492.21	5) Gratuity Fund		2,17,527.21
—	6) Corpus Fund		6,221.00
<u>8,69,16,703.04</u>	Carried Forward		<u>9,87,16,736.85</u>

CENTRE FOR BASIC SCIENCES

Salt Lake, Calcutta 700 064

31st March, 1995

Figures for the previous year		PROPERTIES & ASSETS	Schedule		
Rs..	P.			Rs.	P.
596,15,341.76		FIXED ASSETS : At Cost/Capitalised value	D	796,08,180.21	
		INVESTMENTS :			
132,02,284.00		1) In Short Term Deposit with Schedule Banks	E	45,99,610.00	
1,11,339.88		2) Gratuity Fund Investments : In Short Term Deposit with Schedule Bank		1,62,414.21	
8,42,000.00		3) Provident Fund Investment : In Short Term Deposit with Schedule Bank		12,33,471.92	
		CURRENT ASSETS :			
1,40,356.00		1) Interest Accrued on Investments :			
16,596.33		a) General Fund		84,201.00	
1,19,638.12		b) Gratuity Fund		18,821.00	
45,913.25		c) Provident Fund		1,46,714.00	
		2) Stock of Printing & Stationery		60,196.27	
		3) Cash & Bank Balances :			
1,387.44		a) Cash in hand		287.37	
24,11,807.16		b) Cash at Bank	F	52,87,638.61	
		LOANS & ADVANCES			
27,720.00		1) Advance to Employees from Provident Fund		24,294.00	
144,03,459.53		2) Advance to Suppliers & Contractors	G	80,62,469.12	
82,590.00		3) Deposit for Rent	H	83,450.00	
18,590.00		4) Security Deposits	I	4,55,918.00	
10,000.00		5) Advance against Expenses receivable	J	10,000.00	
74,500.00		6) Other Advances	K	3,23,871.20	
2,39,113.00		7) Prepaid Expenses	L	1,95,403.00	
<u>9,13,62,996.77</u>		Carried Forward		<u>10,03,56,939.91</u>	

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Balance Sheet as at**

Figures for the previous year	FUNDS & LIABILITIES		Schedule	
	Rs.	P.	Rs.	P.
8,69,16,703.04				
		Brought Down		9,87,16,736.85
		CURRENT LIABILITIES & PROVISIONS :		
1,05,625.40		1) Outstanding Liabilities for Revenue Expenditure	A	177,473.35
39,10,574.21		2) Outstanding liabilities for Capital Expenditure	A	2,12,216.00
3,14,399.12		3) Security Deposit from Contractors	B	10,18,806.71
53,168.00		4) Sundry Creditors	C	24,361.00
40,000.00		5) Earnest Money from Contractors	N	85,000.00
11,100.00		6) Provision for Bonus to employees		10,479.00
9,227.00		7) Provision for Rent on Lease-hold land		18,454.00
—		8) Contractors' Income Tax		15,165.00
2,200.00		9) Adjustable Rent		2,200.00
—		10) Employees Professional Tax		1,829.00
		11) Employer's Income Tax		35,201.00
		12) Contractors' Sales Tax		10,813.00
		13) Landlord's Income Tax		26,405.00
		14) Outstanding Liabilities-Project A/c		1,800.00
				16,40,203.06
<u>9,13,62,996.77</u>		TOTAL :		<u>10,03,56,939.91</u>

* Notes on Accounts are separately given in Schedule 'O'

* The Schedules referred above from an integral part of the Balance Sheet

AUDITORS' REPORT

In terms of our report of even date.

8/2, Kiron Shankar Roy Road
Calcutta 700 001
The 10th day of July, 1995

For D.P.SEN & CO.
Chartered Accountants
A. BANDYOPADHYAY
Partner

CENTRE FOR BASIC SCIENCES

Salt Lake, Calcutta 700 064

31st March, 1995

Figures for the previous year		PROPERTIES & ASSETS	Schedule		
Rs.	P.			Rs.	P.
9,13,62,996.77		Brought Down		10,03,56,939.91	

9,13,62,996.77

TOTAL :

10,03,56,939.91

(A. Gupta)
Administrative Officer

(C. K. MAJUMDAR)
Director

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Income & Expenditure Account for**

Figures for the previous year		EXPENDITURE	Project Account		General Account	
Project Account Rs.	General Account Rs.		Rs.	P.	Rs.	P.
1,28,718.00	15,30,700.02	Salary & Allowances	2,28,516.00		21,27,331.94	
	65,080.75	Wages			78,822.60	
	64,843.00	Employer's Contribution to P.F.			77,324.00	
1,175.00	61,809.62	Medical Claim			88,843.51	
	11,100.00	Adhoc Bonus to Employees			10,499.00	
	51,099.14	Electricity Charges			49,748.95	
	86,012.18	Hire Charges of Transport			98,093.35	
	54,600.00	Hire Charges of Generators			54,600.00	
	3,21,000.00	Rent of Office Premises			3,25,000.00	
	30,002.86	Office Contingency Expenses			48,290.33	
	93,931.30	Printing & Stationery			1,03,507.51	
	11,669.45	Repairs to Equipment			25,470.00	
1,550.00	51,526.00	Postage & Telegram	6,888.00		49,340.50	
	14,826.15	Insurance Premium			15,784.00	
	1,30,001.30	Telephone & Trunkcalls			1,26,545.00	
	566.20	TA/DA/ to Non Academic Staff			4,568.90	
	31,904.75	TA/DA/ to Academic Staff (India)			20,197.70	
	36,373.89	TA/DA/ to Academic Staff (Abroad)			79,518.50	
	83,799.45	Meeting Expenses			44,514.50	
415.00	3,986.00	Bank Charges	368.20		4,880.00	
	28,559.83	Car Maintenance			28,635.58	
	30,804.20	Office Maintenance			10,355.12	
	2,67,656.60	Seminar & Other Academic Expenses			3,75,457.24	
	30,000.00	Accommodation for visiting Scientists			30,000.00	
	1,28,254.30	Visiting Member Fellowship			2,08,227.00	
	36,384.99	Director Research Expenses			20,769.35	
	21,700.26	Academic Staff Research Expenses			60,264.58	
	29,820.00	Publication of Seminar Proceedings			31,000.00	
15,000.00	2,70,483.00	Computer Maintenance	12,000.00		2,84,888.00	
1,63,739.00	—	Stipend to CSIR Fellows	2,24,919.00			
	10,027.00	Library General Expenses			280.00	
<u>3,10,597.00</u>	<u>35,88,022.24</u>	Carried Forward	<u>4,72,691.20</u>		<u>49,82,757.16</u>	

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
the year ended 31st March, 1995

Project Account		General Account		EXPENDITURE	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
				Grant-in-aid Received				
			20,00,000.00	Non-Plan			21,00,000.00	
			34,77,746.00	Plan			36,96,750.00	
16,00,312.00		—		Misc. Grant-in-aid received :				
				For Project	9,91,554.00			
2,21,332.00		—		For CSIR Fellows	3,18,953.90			
			11,74,385.33	Interest on short Term Deposits			7,76,901.00	
			1,054.25	Misc. Income			1,786.00	
			1,290.00	Income from Guest House			10,085.00	
			30,500.00	Registration charges for S.N. Bose Birth Centenary			7,250.00	
			44,118.00	Contribution from ICTP for S.N. Bose Birth Centenary			—	
			—	Income from Seminar proceedings			8,680.00	
<u>18,21,644.00</u>		<u>67,29,093.58</u>		Carried Forward	<u>13,10,507.90</u>		<u>66,01,452.00</u>	

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Income & Expenditure Account for**

Figures for the previous year		EXPENDITURE	Project Account		General Account	
Project Account	General Account		Rs.	P.	Rs.	P.
Rs.	P.		Rs.	P.	Rs.	P.
3,10,597.00	35,88,022.24	Brought Forward	4,72,691.00		49,82,757.16	
	25,556.00	Provision for Gratuity			36,292.00	
	7,250.00	Audit Fee			7,250.00	
64,572.10	—	Travel	63,688.50			
1,23,519.34		Contingency & Raw Materials	2,77,687.14			
	5,08,817.00	TA/DA to TPSC Speakers			5,82,010.60	
	1,24,640.00	E-Mail			1,98,268.00	
	20,395.91	P O L			23,610.41	
	—	Building Maintenance			—	
	9,227.00	Lease Rent			9,227.00	
740.00		Supplies & Materials	9,918.00			
	8,18,902.20	S.N. Bose Birth Centenary			1,72,917.65	
	1,186.70	Furnishing Accommodation for visiting Scientists			1,15,393.27	
	25,893.20	L T C			20,280.00	
		RSIC Charges	2,270.00			
		Refund of Grand-in-aid	3,408.96			
<u>4,99,428.44</u>	<u>51,29,890.25</u>		<u>8,29,663.80</u>		<u>61,48,006.09</u>	
13,22,215.56	15,99,203.33	Excess of Income over Expenditure for the year C/D	4,80,844.10		4,53,445.91	
<u>18,21,644.00</u>	<u>67,29,093.58</u>	Carried Forward	<u>13,10,507.90</u>		<u>66,01,452.00</u>	

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
the year ended 31st March, 1995

Figures for the previous year				EXPENDITURE	Project Account		General Account	
Project Account Rs.	P.	General Account Rs.	P.		Rs.	P.	Rs.	P.
18,21,644.00		67,29,093.58		Brought Forward	13,10,507.90		66,01,452.00	

<u>18,21,644.00</u>	<u>67,29,093.58</u>			<u>13,10,507.90</u>	<u>66,01,452.00</u>
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<u>18,21,644.00</u>	<u>67,29,093.58</u>	Carried Forward	<u>13,10,507.90</u>	<u>66,01,452.00</u>
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**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Income & Expenditure Account for**

Figures for the previous year				EXPENDITURE			Project Account Rs. P.	General Account Rs. P.
Project Account		General Account						
Rs.	P.	Rs.	P.					
13,22,215.56		16,00,713.33		Excess of Income over Expenditure transferred to General Fund		4,80,844.10		4,56,225.91
<u>13,22,215.56</u>		<u>16,00,713.33</u>				<u>4,80,844.10</u>		<u>4,56,225.91</u>

8/2, Kiron Shankar Roy Road
Calcutta 700 001
The 10th day of July, 1995

For D.P.SEN & CO.
Chartered Accountants
A. BANDYOPADHYAY
Partner

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
the year ended 31st March, 1995

Project Account		General Account		EXPENDITURE	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
13,22,215.56		15,99,203.33		Excess of Income over Expenditure for the year B/F	4,80,844.10		4,53,445.91	
		1,510.00		Adjustment relating to prior period (Sch-M)			2,780.00	
<u>13,22,215.56</u>		<u>16,00,713.33</u>			<u>4,80,844.10</u>		<u>4,56,225.91</u>	

(A. Gupta)
 Administrative Officer

(C. K. MAJUMDAR)
 Director

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Receipts and Payments Account**

Figures for the previous year		RECEIPTS	Project Account		General Account	
Project Account	General Account		Rs.	P.	Rs.	P.
Rs.	P.		Rs.	P.	Rs.	P.
OPENING CASH & BANK BALANCES						
54,375.60	15,03,473.96	Indian Overseas Bank	11,27,914.39		9,10,183.77	
	2,24,985.00	United Bank of India	—		2,84,156.94	
	214.11	Cash in hand	—		1,337.44	
—	—	Contribution for WHEPP-II				
	7,800.00	Festival Advance (Recovery)			7,920.00	
GRANT-IN-AID RECEIVED :						
	2,27,00,000.00	For Plan Expenditure			1,40,00,000.00	
	20,00,000.00	For Non-plan Expenditure			21,00,000.00	
MISC. GRANT-IN-AID RECEIVED :						
1,64,935.00		For CSIR Fellows	3,19,041.00			
16,60,709.00		For Projects	9,91,554.00			
	1,39,01,859.00	ENCASHMENT OF SHORT TERM DEPOSIT :				
		I O B			41,25,454.00	
		U B I			44,77,220.00	
	20,000.00	Earnest Money from Contractors			81,500.00	
	4,86,278.85	Security Deposits from Contractors			6,84,114.59	
		Recovery of Advance to				
	5,53,559.37	Suppliers			7,66,504.74	
	88,96,946.82	Recovery of Advance to				
		Contractors			74,45,114.23	
	2,00,000.00	Recovery of Advance to				
		Ghosh, Bose & Associates			1,00,000.00	
<u>18,80,019.60</u>	<u>5,04,95,117.11</u>	Carried Forward	<u>24,38,509.39</u>		<u>3,49,83,555.71</u>	

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1995

Project Account		General Account		PAYMENTS	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
1,32,658.00		15,18,764.57		Salary & Allowances	2,26,679.00	20,92,901.48		
		63,384.00		Wages (Casual)		72,176.60		
		64,843.00		Employer's Contribution to P. F.		77,324.00		
		9,000.00		Festival Advance		7,200.00		
1,175.00		48,342.14		Medical Claims		62,390.62		
		10,876.00		Adhoc Bonus to Employees		8,365.00		
		51,099.14		Electricity charges		49,748.95		
		86,012.18		Hire charges of Transport		93,773.35		
		54,600.00		Hire Charges of Generators		50,050.00		
		3,21,000.00		Hire charges of office Premises		3,14,600.00		
		73,700.00		Deposit for Rent		500.00		
		30,002.86		Office Contingency Expenses		48,290.33		
		1,08,375.34		Printing & Stationery		1,17,015.53		
		11,669.45		Repair of Equipment		25,470.00		
		51,526.00		Postage & Telegram		47,770.50		
		14,145.00		Insurance Premium		15,477.00		
		1,30,001.30		Telephone & Trunkcalls		1,26,545.00		
		1,24,640.00		E-Mail		1,98,268.00		
		30,825.75		TA/DA to Academic Staff (India)		20,197.70		
		36,373.89		TA/DA to Academic Staff (Abroad)		79,518.50		
		566.20		TA/DA to Non-Academic Staff		4,568.90		
		83,799.45		Meeting Expenses		44,514.50		
415.00		3,932.00		Bank Charges	368.20	4,880.00		
		42,303.00		Campus Beautification		47,150.00		
		1,08,18,646.98		Construction of Buildings		2,02,91,143.64		
		1,20,06,633.50		Advance to Contractors		14,24,366.23		
1,87,679.67		7,58,308.47		Advance to Suppliers	25,467.00	4,42,313.00		
		2,00,000.00		Adhoc payment to Ghosh Bose & Associates		2,00,000.00		
		34,27,604.00		Advance to WBSEB		—		
<u>3,21,927.67</u>		<u>3,01,80,974.22</u>		Carried Forward	<u>2,52,514.20</u>	<u>2,59,66,518.83</u>		

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Receipts and Payments Account**

Figures for the previous year		RECEIPTS	Project		General	
Account			Account		Account	
Rs.	P.		Rs.	P.	Rs.	P.
18,80,019.60	5,04,95,117.11	Brought Forward	24,38,509.39	3,49,83,555.71		
	1,25,500.00	Recovery of Deposit for Rent				
	20,000.00	Recovery from Bombay University				
	27,554.75	Recovery Expenses for BCSPIN	—			
	20.00	Recovery of Insurance Premium			30.00	
	56,000.00	Recovery from S. Chatterjee			—	
		Donation Received :				
	25,000.00	J. Bose			25,000.00	
	1,054.25	Misc. Income (Income from Bose Centenary)			1,786.00	
	1,290.00	Income from Guest House			10,085.00	
	30,500.00	Registration charges for S N Bose Birth Centenary			7,250.00	
	77,836.00	Contribution from ICTP for S. N. Bose Birth Centenary			—	
	200.00	Deposit from N Nayak			—	
	4,200.00	Receipts of Adjustable Rent			—	
	12,28,685.50	Interest on short term Deposits			8,58,574.33	
		Income from Seminar				
	—	Proceedings			8,680.00	
		Corpus Fund			6,221.00	
<u>18,80,019.60</u>	<u>5,20,92,957.61</u>	Carried Forward	<u>24,38,509.39</u>	<u>3,59,01,182.04</u>		

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1995

Project Account		General Account		PAYMENTS	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
3,21,927.67		3,01,80,974.22		Brought Forward	2,52,514.20		2,59,66,518.83	
			3,000.00	Advance against LTC			1,408.00	
			6,729.20	Advance to Indian Physical Society			—	
			13,010.00	Advance to ECRA			—	
5,087.00			1,500.00	Advance to Staff	61,619.90		1,08,119.00	
			3,253.00	Advance to National Board of Higher Mathematics			—	
			20,000.00	Advance to Sankho Chowdhury			—	
			28,559.83	Car Maintenance			28,635.58	
			30,804.20	Office Maintenance			10,355.12	
15,000.00		2,61,785.00		Computer Maintenance	12,000.00		2,41,485.00	
			10,027.00	Library General Expenses			280.00	
			—	Library Furniture			28,374.99	
			98,765.25	Library Books			1,02,880.47	
			4,41,416.30	Library Journals			5,43,771.70	
		1,49,01,095.50		Short Term Deposits with IOB			—	
		18,33,659.00		Short Term Deposits with UBI			—	
			25,892.00	Employees Provident Fund			—	
			2,67,656.60	Seminar & Other Academic Expenses			8,75,457.24	
			30,000.00	Accommodation for visiting Scientists			27,500.00	
			1,186.70	Furnishing Accommodation for visiting Scientists			3,74,485.27	
			21,678.24	Small Equipment			1,373.00	
			—	Office Equipment			12,430.00	
			7,548.47	Office Furniture	6,800.00		5,98,245.86	
			1,28,254.30	Visiting Fellowship			2,08,227.00	
			36,384.99	Directors' Research Expenses			20,769.35	
			60,652.00	Directors' Research Equipments			—	
			20,395.91	P O L			23,610.41	
<u>3,42,014.67</u>		<u>4,84,34,227.71</u>		Carried Forward	<u>3,32,934.10</u>		<u>2,91,73,926.82</u>	

**SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Receipts and Payments Account**

Figures for the previous year				RECEIPTS			Project		General	
Project		General					Account		Account	
Rs.	P.	Rs.	P.				Rs.	P.	Rs.	P.
18,80,019.60		5,20,92,957.61		Brought Forward	24,38,509.39		3,59,01,182.04			
		2,500.00		Library Fund (Donation)						
				Corpus Fund						
31,065.00		---		Received from General Fund	---		---			
---		---		Deduction of Taxes			89,413.00			
---		---		Provident Fund			45,084.00			
---		---		Recovery of Advance to National Board of Higher Mathematics				3,253.00		
<u>19,11,084.60</u>		<u>5,20,95,457.61</u>		Carried Forward	<u>24,38,509.39</u>		<u>3,60,38,932.04</u>			

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1995

Project Account		General Account		PAYMENTS	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
3,42,014.77		4,84,34,227.71		Brought Forward	3,32,934.10		2,91,73,926.82	
		21,483.70		Academic Staff Research Expenses			60,264.58	
		10,334.54		Academic Staff Research Equipment			—	
		16,170.00		Publication of Seminar Proceedings			31,000.00	
		1,62,067.00		Computer & Accessories			5,97,221.00	
4,000.00		1,53,149.75		Outstanding Liabilities			1,04,825.40	
		—		U P S			—	
		27,617.88		Gratuity Fund Investment			51,074.33	
		7,00,393.93		Refund of Security Deposits to Contractors			6,207.00	
		20,000.00		Refund of Earnest Money to Contractors		10,000.00		
		5,08,817.00		TA/DA to TPSC Speakers			5,76,799.60	
1,61,934.00				Stipend & Contingency to CSIR Fellow	2,38,514.00			
52,112.10				Travel	20,124.50			
99,650.00				Advance for Equipment	7,97,495.00			
1,22,719.34				Contingency & Raw Materials	1,66,999.12			
740.00				Supplies & Materials	2,395.00			
				Insurance Premium Recoverable			30.00	
		7,66,922.20		S. N. Bose Birth Centenary			1,72,917.65	
		46,910.00		Transfer to Project Account			—	
		984.00		Contractors' Income Tax			—	
				Equipment	2,56,829.95			
				Payment to General Fund	90,188.50			
				Refund of Grant-in-aid	3,408.96			
				RSIC Charges	2,270.00			
<u>7,83,170.21</u>		<u>5,08,69,077.71</u>		Carried Forward	<u>19,11,159.13</u>		<u>3,07,84,266.38</u>	

SATYENDRA NATH BOSE NATIONAL
DB 17, SECTOR-I,
Receipts & Payments Account

Figures for the previous year				RECEIPTS	Project Account		General Account		
Project Account Rs.	P.	General Account Rs.	P.		Rs.	P.	Rs.	P.	
19,11,084.60		5,20,95,457.61		Brought Forward		24,38,509.39		3,60,38,932.04	

<u>19,11,084.60</u>	<u>5,20,95,457.61</u>	TOTAL :	<u>24,38,509.39</u>	<u>3,60,38,932.04</u>
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8/2, Kiron Shankar Roy Road
 Calcutta 700 001
 The 10th day of July, 1995

For D.P.SEN & CO.
 Chartered Accountants
A. BANDYOPADHYAY
 Partner

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1995

Figures for the previous year		PAYMENTS	Project Account		General Account	
Rs.	P.		Rs.	P.	Rs.	P.
7,83,170.21	5,08,69,077.71	Brought Forward	19,11,159.13	3,07,84,266.38		
	—	Building Maintenance		—		
	25,893.20	L T C		20,280.00		
	4,758.55	Library Books & Journal (Out of Donation)		—		
	—	Refund of Contribution from ICTP		33,718.00		
	—	Advance to JNC, Madras		72,816.00		
		Security Deposit with WBSEB		4,37,328.00		
		Project Account		33,411.40		
		Advance to National Academy of Science		70,688.00		
		Closing Cash & Bank Balances :				
11,27,914.39	9,10,183.77	Indian Overseas Bank	5,27,350.26	42,59,634.43		
	2,84,156.94	United Bank of India		3,26,502.46		
	1,387.44	Cash in hand		287.37		
<u>19,11,084.60</u>	<u>5,20,95,457.61</u>	TOTAL :	<u>24,38,509.39</u>	<u>3,60,38,932.04</u>		

(A. Gupta)
Administrative Officer

(C. K. MAJUMDAR)
Director

**SATYENDRA NATH BOSE NATIONAL
CENTRE FOR BASIC SCIENCES
Schedule — 'A'**

	Rs.	P.
a) Outstanding Liabilities (Revenue)		
1. T. A. / D. A. to TPSC Speakers	5,211.00	
2. Wages	6,646.00	
3. Rent for Office Premises	10,400.00	
4. Hire Charges of Generators	4,550.00	
5. Hire Charges of Transport	4,320.00	
6. Medical Claim	26,452.89	
7. Printing & Stationery	775.00	
8. Campus Beautification	3,230.00	
9. Salary & Allowance	34,405.46	
10. Postage & Telegram	1,570.00	
11. Furnishing Accommodation for visiting Scientists	70,163.00	
12. Audit Fee	7,250.00	
13. Rent for Accommodation for Visiting Scientists	2,500.00	
	<u>1,77,473.35</u>	
b) Outstanding Liabilities (Capital)		
Construction of Buildings	2,12,216.00	
	<u>2,12,216.00</u>	
c) Outstanding Liabilities (Project)		
Contingency — CSID	1,800.00	
	<u>1,800.00</u>	
TOTAL (a + b + c)	<u>Rs. 3,91,489.35</u>	

SCHEDULE 'B'

Security Deposit from Contractors

1. Pradhan & Associates	2,21,876.71	
2. Nabin Designers & Constructor (P) Ltd.	4,85,166.45	
3. Ghosh Bose & Associates	1,26,769.00	
4. CMC Ltd.	1,79,440.00	
5. ASCO Stormech (P) Ltd.	5,554.55	
TOTAL :	<u>10,18,806.71</u>	

SCHEDULE 'C'

Sundry Creditors

1. Deposit from A Mukherjee	18,000.00	
2. Deposit from N Nayak	1,450.00	
3. C M C Ltd.	4,911.00	
TOTAL :	<u>24,361.00</u>	

**SATYENDRA NATH BOSE NATIONAL
CENTRE FOR BASIC SCIENCES**

Schedule — 'D'

FIXED ASSETS

Name of Block of Assets	Opening Balance as on 1.4.94 Rs. p.	Addition during the year Rs. p.	Adjustment during the year Rs. p.	Closing Balance as on 31.3.95 Rs. p.
A. Office Equipment	2,31,104.92	12,430.00	—	2,43,534.92
B. Guest House Furniture	1,18,882.36	3,29,255.00	—	4,48,137.36
C. Small Equipment	2,03,551.03	1,373.00	—	2,04,924.03
D. 1) Books & Journals	18,47,684.26	6,46,652.17	—	24,94,336.43
2) Directors' Research Equipment	2,48,191.55	—	—	2,48,191.55
3) Boundary Wall	10,38,937.20	—	—	10,38,937.20
4) Computer & Accessories	6,91,998.10	4,92,789.00	—	11,84,787.10
5) Construction of Buildings	4,04,17,498.01	1,66,97,217.43	—	5,71,14,715.44
6) Computer	13,08,680.44	—	—	13,08,680.44
7) Campus Land	1,09,50,694.00	—	—	1,09,50,694.00
8) Air Condition Machineries	1,09,474.99	—	—	1,09,474.99
9) Campus Beautification	2,22,884.61	50,380.00	—	2,73,264.61
10) Office Car (WNW 8486)	1,04,794.00	—	—	1,04,794.00
11) UPS	2,17,685.21	—	—	2,17,685.21
12) Academic Staff Research Equipment	59,498.31	—	—	59,498.31
E. Furniture & Fixture	7,48,293.40	6,26,620.85	—	13,74,914.25
	<u>5,85,19,852.39</u>	<u>1,88,56,717.45</u>	<u>—</u>	<u>7,73,76,569.84</u>
F. Project Assets :				
1) Equipment	10,88,409.29	11,29,321.00	—	22,17,730.29
2) Books & Periodicals	7,080.08	—	—	7,080.08
3) Furniture & Fixture	—	6,800.00	—	6,800.00
	<u>10,95,489.37</u>	<u>11,36,121.00</u>	<u>—</u>	<u>22,31,610.37</u>
TOTAL :	<u>5,96,15,341.76</u>	<u>1,99,92,838.45</u>	<u>—</u>	<u>7,96,08,180.21</u>

SCHEDULE — 'E'

Short Term Deposits (Including accrued and re-invested interest)

a) Indian Overseas Bank, Salt Lake Branch STD (46 days)	Rs. 38,73,878.01
b) United Bank of India, Mayukh Bhawan Branch : STD (91 days)	Rs. 7,25,731.99
TOTAL :	<u>Rs. 45,99,610.00</u>

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Schedule — 'F'

BANK BALANCES :

	Rs.	P.
a) With Indian Overseas Bank, Salt Lake Branch :		
General Fund Account	42,59,634.43	
Project Fund Account	6,07,697.66	
Provident Fund Account	93,804.06	
b) With United Bank of India, Mayukh Bhawan Branch :		
General Fund Account	3,26,502.46	
TOTAL :	<u>52,87,638.61</u>	

SCHEDULE — 'G'

ADVANCES TO SUPPLIERS AND CONTRACTORS

A. General Account		
1. ASCO Strumech (P) Ltd	37,500.00	
2. Nabin Designer & Constructors (P) Ltd.	14,51,879.61	
3. Pradhan & Associates	22,66,454.51	
4. Ghosh Bose & Associates	1,00,000.00	
5. West Bengal State Electricity Board	34,27,604.00	
6. OTIS	2,50,000.00	
7. Allied Publishing Agency	4,42,313.00	
	<u>79,75,751.12</u>	
B. Project Account		
1. Advance Micronic Devices	14,443.00	
2. Jubilee Enterprise	12,275.00	
3. Pertech Computers	60,000.00	
	<u>86,718.00</u>	
TOTAL (A + B)	<u>80,62,469.12</u>	

SCHEDULE — 'H'

DEPOSIT FOR RENT

1. N. Dasgupta	18,000.00
2. Rama De	1,450.00
3. K. Pal Chowdhury	5,000.00
4. T. B. Dey	33,000.00
5. J. B. Bhowmick	26,000.00
TOTAL :	<u>83,450.00</u>

SCHEDULE — 'I'

SECURITY DEPOSITS

1. West Bengal State Electricity Board	4,54,318.00
2. Department of Telecommunication	1,600.00
TOTAL :	<u>Rs. 4,55,918.00</u>

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Schedule — 'J'

	Rs.	P.
ADVANCES AGAINST EXPENSES RECOVERABLE		
1. Recoverable Expenses on Seminar (PATPAA)	10,000.00	
TOTAL :	<u>10,000.00</u>	

SCHEDULE 'K'

OTHER ADVANCES

A. General Account :		
1. Staff Advance	1,10,219.00	
2. Rabin Banerjee	13,181.00	
3. Festival Advance	2,920.00	
4. S. Manna	4,500.00	
5. Advance against LTC	4,408.00	
6. Indian Physical Society	6,729.20	
7. ECRA	13,010.00	
8. Sankho Chowdhury	20,000.00	
9. National Academy of Sciences	70,688.00	
10. JNC, Madras	72,816.00	
	<u>3,19,471.20</u>	
B. Project Account :		
Advance to P. Biswas	5,400.00	
TOTAL :	<u>3,23,871.20</u>	

SCHEDULE 'L'

PREPAID EXPENSES

1. Insurance Premium	11,784.00
2. Computer Maintenance	1,83,619.00
TOTAL :	<u>1,95,403.00</u>

SCHEDULE 'M'

PRIOR PERIOD ADJUSTMENT ACCOUNT :

	Debits	Credits
1. Salary & Allowances	—	25.00
2. Adhoc Bonus to Employees	—	2,755.00
TOTAL :	<u>—</u>	<u>2,780.00</u>

SCHEDULE 'N'

EARNEST MONEY FROM CONTRACTORS

1. Pradhan & Associates	60,000.00
2. Nabin Designers & Constructors (P) Ltd.	20,000.00
3. Larica (P) Ltd.	5,000.00
TOTAL	<u>85,000.00</u>

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Schedule — 'O'

NOTES ON ACCOUNTS

1. The Fixed Assets have been disclosed at historical cost without any provision for depreciation, on a consistent basis.
2. Fixed Assets of Rs. 7,96,08,180.21 as disclosed in the Balance Sheet includes Library Books and Journals valued at Rs. 24,94,336.43.
3. The grants received from the Department of Science & Technology, Government of India have been accounted for on cash basis.
4. Surplus of Grants received from Government of India for non-plan and plan (Recurring Expenditure) expenditure for the year has been transferred to General Fund Account.
5. As per consistent practice, all Capital Works-in-Progress including buildings under construction, Plant and Machinery and equipment pending installation have been directly debited to the respective asset heads instead of segregating the total amount between work completed and Capital Work-in-Progress.
6. Consequent to accounting for unprovided expenses and incomes related to prior periods a net credit balance of Rs. 2,780.00 has been taken into account for this year, the detailed of which are furnished vide Schedule 'M' to this annual account.
7.
 - i) Specific guidelines / bye-laws regarding Employees' Provident Fund are yet to be register / recognised. During the year an ad-hoc deduction @ 10% on basic Salary has been made from Employee Gross Salary and deposited in a separate account maintained with a National Bank together with an equal amount of contribution from the Employer.
 - ii) Specific guidelines / bye-laws regarding Gratuity are yet to be registered / recognised.
 - iii) Out of the accumulated balance in the Employees' Provident Fund and the Gratuity Fund Rs. 12,33,471.92 and Rs. 1,62,414.21 have been invested in separate, earmarked short term deposit with a nationalised bank. Amount of Rs. 93,804.06 and Rs. 55,113/- are lying in Provident Fund Account and General Fund Account respectively with the Indian Overseas Bank, Salt Lake Branch.
8. No certificates confirming the balances outstanding as at the end of the year have been obtained from the parties.
9. Previous year's figures have been re-grouped / re-arranged wherever necessary.

