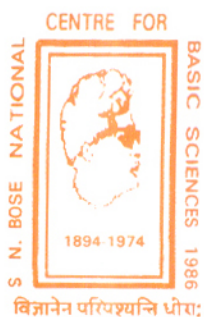


ANNUAL REPORT

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

(Estd. 1986)

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SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

CALCUTTA

ANNUAL REPORT

April 1, 1993 to March 31, 1994

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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 of 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. S. N. Bose Birth Centenary

The S. N. Bose birth centenary was celebrated on January 1, 1994. A week-long international conference **Bose and 20th Century Physics** was also held on this occasion.

The centenary function was held in the Vivekananda Hall of the Ramakrishna Mission Institute of Culture, Calcutta. Among those who attended the celebration, many were former students of S. N. Bose. Some of the students who are now residing abroad came to Calcutta to attend this function. Some of the members of his family also attended the celebration.

In his welcome address Professor C. K. Majumdar, Director of the Centre, described the brief history and the objectives of the S. N. Bose National Centre for Basic Sciences which was set up in 1968 by the Department of Science and Technology, Government of India. Messages received on this occasion from several dignitaries were read out. A model of the campus of the Centre under construction at the JD Block, Salt Lake, Calcutta, was exhibited. Newsletters and annual reports of the activities of the Centre were made available to the public.

Professor C. K. Majumdar said that the S. N. Bose National Centre for Basic Sciences had already been functioning as a forum of interaction among scientists from all over the world. He earnestly hoped that the Centre would grow into an institution where excellence in science and technology would be pursued for the benefit of all mankind.

The memorial address was given by Professor P. K. Kabir (University of Virginia, Charlottesville, Virginia, USA). He was closely associated with S. N. Bose at one stage of his career. His lecture brought out the scientific brilliance as well as other facets of Bose's personality — his knowledge of European literature, love of music and ability to play musical instruments, love for the motherland and efforts to bring science to her people.

Bose published in four languages — English, German, French and, in his mother tongue, Bengali. The scientific writings of Bose were collected by a research team from resource materials available in different universities and scientific institutions both in India and abroad. Dr. Santimay Chatterjee, who was a student of Professor S. N. Bose, headed the team.

A book, **S. N. Bose- the man and his work : Collected Scientific Papers** was published. It was released by Professor R. Penrose (Oxford University, England) at the centenary function. A biography of S. N. Bose will be published soon. For giving us access to information, source materials and documents, we must thank the Asiatic Society (Calcutta), IACS, INSA, ISI, Bangiya Vijnan Parishad (Calcutta), Bibliotheque Nationale (Paris), CSIR, Dhaka University (Dhaka), the Jewish National and University Library (Jerusalem), Musee Curie, Institut Curie (Paris), NPL, National

Library (Calcutta), Nehru Memorial Museum and Library (New Delhi), Rabindra Bhavan, Visva-Bharati, Rajya Sabha Secretariat (New Delhi), The Royal Society (London), SINP and VECC. We must also thank several members of the family of S. N. Bose for help and cooperation : Rathindranath and Benu Bose, Ramendranath Bose, Nilima Mitra, Ruchira Mitra and Jayanti Chattopadhyay.

The Indian Post and Telegraph Department released a stamp on S. N. Bose on this occasion and Sri P. K. Bagchi, Chief Post Master General of the West Bengal Circle, performed the official ceremonies.

In offering a vote of thanks, Professor P. Ghose of the Centre mentioned that help was received from the National Science Foundation of the United States, the International Centre for Theoretical Physics, Trieste, Italy, and several academic and local science institutes and universities for the centenary function and the conference.

2. International Conference on Bose and 20th Century Physics (December 30, 1993-January 5, 1994)

The birth centenary conference was held at the Ramakrishna Mission Institute of Culture, Calcutta. Invited talks on particle physics, quantum optics and foundations of quantum mechanics, condensed matter physics, chemical physics, astronomy and the history of science were delivered by the following speakers :

1. G. S. Agarwal (Univ of Hyderabad) : Photon correlations and interferences in complementary spaces.
2. J. Anandan (Univ of South Carolina, Columbia, SC, USA) : Reality of states and observables in quantum theory.
3. A. Aspect (Institut d'Optique Théorique et Appliquée, Orsay Cedex, France) : Laser cooling of atoms towards the Bose regime.
4. B. Bagchi (IISc, Bangalore) : Molecular relaxation in dense dipolar liquids : microscopic studies of orientational relaxation, solvation dynamics, and electron transfer reactions.
5. S. Banerjee (TIFR, Bombay) : Precision measurement of Z boson properties at LEP.
6. C. Dasgupta (IISc, Bangalore) : Statistical mechanics of flux lines in oxide superconductors.
7. R. M. Godbole (Univ of Bombay) : Structure of light.
8. H. S. Green (Univ of Adelaide, South Australia) : Statistical symmetries in physics.
9. D. J. Gross (Princeton University, USA) : String theories of everything and of something.



The congregation celebrating the centenary day

10. R. Hanbury Brown (Andover, England) : From the correlation between photons to the construction of SUSI.
11. M. A. Harun ar Rashid (Univ of Dhaka, Bangladesh) : Bose in Dacca.
12. D. Home (BI, Calcutta) : Perspectives on quantum nonlocality and directions for further studies.
13. P. K. Kabir (Univ of Virginia, Charlottesville, Virginia, USA) : The discovery of quantum statistics.
14. A. Khare (IOP, Bhubaneswar) : Quantum mechanics and statistical mechanics of anyons.
15. A. J. Leggett (Univ of Illinois, USA) : Does quantum mechanics really describe the everyday world?
16. H. Leutwyler (Univ of Bern, Switzerland) : Goldstone bosons.
17. A. N. Mitra (Univ of Delhi) : Bose-Fermi and the story of quark statistics.
18. N. Mukunda (IISc, Bangalore) : A kinematic approach to the geometric phase in quantum mechanics.
19. K. Nishijima (Chuo Univ, Tokyo) : Colour confinement.
20. A. Pandey (JNU, New Delhi) : Weakly-broken symmetries in quantum chaotic systems.
21. R. Pandit (IISc, Bangalore) : Disordered interacting bosons.
22. J. C. Pati (Univ of Maryland, USA) : Bose-Fermi symmetry : a crucial element in achieving unification.
23. R. Penrose (Oxford Univ, England) : Twistors and the Einstein equations - new developments.
24. G. Rajasekaran (IMSc, Madras) : Generalized quantum statistics.
25. S. Ramasesha (IISc, Bangalore) : Theoretical studies on models for organic ferromagnetism.
26. A. Raychaudhuri (Univ of Calcutta) : News from 'nu's from the sun.
27. S. M. Roy (TIFR, Bombay) : Deterministic quantum mechanics.
28. N. Sathiyamurthy (IIT, Kanpur) : Time-dependent quantum mechanical approach to reactive scattering.
29. A. Sen (TIFR, Bombay) : Black holes and other classical solutions in string theory.
30. R. Simon (IMSc, Madras) : The Bose relations and their symmetries : structure and applications.

31. V. Singh (TIFR, Bombay) : Chandrasekhar mass limit for boson stars.
32. B. Sinha (SINP, & VECC, Calcutta) : Quark-gluon plasma, terrestrial and cosmological.
33. J. Stachel (Boston Univ, Massachusetts, USA) : Einstein and Bose.
34. E.C.G. Sudarshan (Univ of Texas, Austin, USA) : Quantum theory of identical particles.
35. K. C. Wali (Univ of Syracuse, USA) : From the indestructible to the invisible : is there an end to physics ?
36. W. H. Zurek (Los Alamos, New Mexico, USA) : Decoherence, chaos and the second law.

There were 171 registered participants who came from all over India.

The Conference was organized with special fund allocations in the Centre's budget by the Department of Science & Technology, Government of India. Financial supports from NSF (USA) and ICTP, Trieste, were gratefully acknowledged. It was held in collaboration with the Ramakrishna Mission Institute of Culture and the Indian Association for the Cultivation of Science. Generous help was received from other academic institutions in Calcutta, especially the National Council of Science Museums, Variable Energy Cyclotron Centre, Saha Institute of Nuclear Physics, University of Calcutta and Visva-Bharati.

3. Workshop in High Energy Particle Physics 3 (WHEPP 3) (January 10-21, 1994)

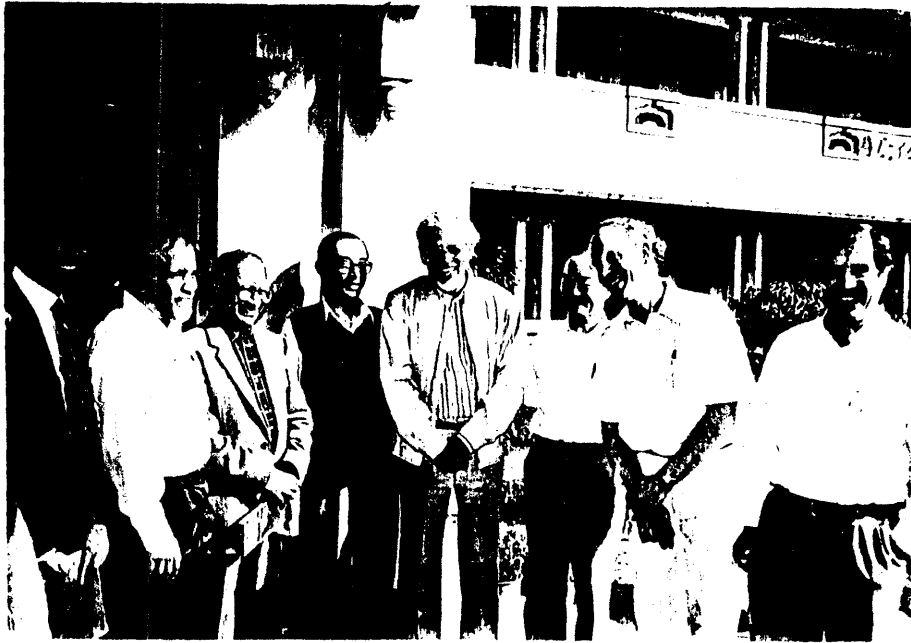
WHEPP 3 was held in Madras in collaboration with the Institute of Mathematical Sciences. Plenary talks were given by D. P. Roy, N. K. Mondal, R. J. N. Phillips, P. Frampton, U. G. Meissner, J. Randall, N. G. Deshpande, K. S. Babu, J. Valle, A. Joshipura, M. Goltermann, R. Sinha, D. Indumathi, T. Aziz, S. D. Rindani, C. Burgess, M. Drees, M. K. Parida and L. M. Sehgal. Working group activities were held in four specific areas :

- (i) structure functions and collider physics,
- (ii) beyond the standard model and neutrino physics,
- (iii) quark-gluon plasma and
- (iv) heavy flavour physics.

Ninety-seven participants attended the workshop.

4. Miniworkshop in High Energy Physics (November 2-6, 1993)

The miniworkshop was organized in Ahmedabad in collaboration with the Physical Research Laboratory, Ahmedabad, in preparation for WHEPP 3. Apart from a few pedagogical reviews on current developments, group activities on specific



Some scientists at the Bose Centenary Conference :(From left)
M K Dasgupta, E C G Sudarshan, P K Kabir, CK Majumdar, P Ghose,
K Nishijima, D J Gross and A Aspect



Discussion during the Centenary conference :(From left) W H Zurek,
A J Leggett and D Home

problems were held in two broad areas : (1) beyond the standard model, collider physics and neutrino physics (organized by S. Umasankar, A. Raychaudhuri and D. P. Roy) and (2) phase transitions, baryogenesis, cosmology and strong interaction physics (organized by R. GavaI, S. Gupta and B. Banerjee). Talks were given by B. Banerjee, P. Roy, M. Novakowski, R. GavaI, R. Sinha, J. C. Parikh, A. S. Joshipura, B. Mukhopadhyay, U. Yajnik, U. Sarkar, R. K. Varma, D. P. Roy, A. Raychaudhuri, S. B. Khadkikar, R. M. Godbole, S. D. Rindani and S. Gupta, There were 39 participants.

5. Workshop on Astroparticle Physics (February 21-25, 1994)

The workshop was held in Pune in collaboration with IUCAA, Pune. Pedagogic lectures on cosmology for particle physicists and particle physics for cosmologists, physics and astrophysics of condensed objects, inflationary models of the universe, topological defects in the early universe, baryogenesis, models of structure formation, detection of weakly interacting massive particles in the laboratory, supernova and astroparticle physics and particle physics aspects of quasi-steady state cosmology were given by K. Subramanain, R. Godbole, S. M. Chitre, V. Sahni, N. Panchapakesan, T. Padmanabhan, C. S. Unnikrishnan, Kamalesh Kar and J. V. Narlikar. There were 24 participants from different parts of India.

6. Causality in Physics and Philosophy (August 26-29, 1993)

The Centre collaborated with FAMTSIT and the Department of Philosophy, Jadavpur University, in organizing a seminar on Causality in Physics and Philosophy. Professor R. Ramanna (NIAS, Bangalore) gave the inaugural address on Causality, Cardinality and Conditional Reality ; K. Basu (IITK) talked on Causality in the Information Entropy Meta-theory and N. Singh (NISTADS) on Prolegomena for causal model of the mind. Other speakers included N. Mukunda (IISc), T. Pradhan (IOP), D. Home (BI), P. Bandyopadhyay (ISI) on the science side, and S. Bhattacharya (CU), H. Banerjee (JU), P. K. Mukhopadhyay (JU) on the philosophy side. It was felt that the dialogue between the groups should continue and improved communication would be possible with better preparation on both sides.

7. Colloquium on S. N. Bose - The Man and his Times (January 7-8, 1994)

In collaboration with the Centre, the department of Physics at Visva-Bharati organized a two-day colloquium on S. N. Bose at Santiniketan. Sabyasachi Bhattacharya, Upacharya, Visva-Bharati inaugurated the colloquium and E. C. G. Sudarshan was the Guest-in-Chief. Speakers, panellists and chairpersons of the sessions included P. K. Kabir, John Stachel, Partha Ghose, E. C. G. Sudarshan, Jayanta Bose, D. Chattarji, Amlan Dutta, N. Mukunda, A. K. Ray, Satyesh Chakraborty, Santimay Chatterjee, B. C. Sinha and Enakshi Chatterjee. There were 45 participants.

S. N. BOSE MEMORIAL LECTURE

The fifth S. N. Bose Memorial Lecture was delivered by Professor E. C. G. Sudarshan, University of Texas at Austin, USA, on 4 January 1994 at the M. L. Sarkar Memorial Hall, IACS. The lecture was entitled **Quantum theory of identical particles.**

SEMINARS ORGANIZED AT THE CENTRE

1. Biswas, S. N., Delhi Univ : Quantum Groups (May 7, 1993).
2. Bist, H. D. IIT, Kanpur : Non-destructive characterization of diamond and diamond like carbon films by STM and Micro-Raman (June 3, 1993).
3. Das, S., IMSc, Madras : Almost forward scattering of very high energy magnetic monopole and electric charges (July 19, 1993)
4. Chatterjee, R., Univ. of Calgary, Canada : Recent development in condensed matter physics (Sept 7 & 21, 1993).
5. Banerjee, A., NASA Lewis Research Centre, Cleveland, USA : Computations for real materials : semi-empirical approach to total energies (Sept 28, & Oct 10, 1993).
6. Kundu, P., Laboratory for Atmospheres, NASA/Godard Space Flight Centre, Greenbelt, USA : Gravitational radiation from massive isolated systems (Nov 3, 1993).
7. Mukhopadhyay, P.K., SNBNCBS, Calcutta : High Tc superconductivity (Dec 21, 1993).
8. Majumdar, M., Cornell University, USA : Chaos in dynamical systems and applications in economic models (Jan 17-18, 1994).
9. Singh, P.P., LLNL, California, USA : Phase stability studies of metallic alloys from first principles (Jan 21, 1994).
10. Mukherjee, S., Free Univ, Berlin, Germany : Theory of step morphology and equilibrium crystal shape of silicon near (100) (Jan 31, 1994).
11. Das Adhikari, S., MRI, Allahabad : Introduction to elliptic curves and modular forms - I & II (March 18 & 21, 1994).
Some problems in combinatorial and additive number theory (March 23 & 25, 1994).
12. Chakraborty, A., Univ. of Chicago, USA : Alternative model of CP violation (March 25, 1994).
13. Simon, R., IMSc, Madras : Applications of Gauss sums to quantum mechanics (March 25, 1994).



Professor H S Green lecturing on Statistical Physics



Professor A Raychaudhuri inaugurating the birth centenary celebration

Visitors at the Centre

1. Dr. G. P. Das, BARC, Bombay: visited the Centre from 28th March to 5th April, 1993.
2. Dr. A. Banerjea, NASA Lewis Research Centre : worked as a Visiting Scientist (From 10.6.93 onwards)
3. Dr. R. Chatterjee, University of Calgary, Canada : worked as a Visiting Scientist for five months (from 12.7.93 to 18.12.93).
4. Dr. Vincent A. Barker, Institute of Numerical Analysis, Technical University of Denmark, Denmark : worked as a Visiting Scientist for two months (Oct & Nov 1993).
5. Dr. P. K. Mitter, Laboratoire de Physique Théorique at Hautes Energies, Université de Paris 6 and CNRS, Paris : spent two months as a Visiting Scientist during Oct, 1993 to Jan 1994.
6. Dr. A. Bagachil, University of Twente, Enschede, Holland : worked as a Visiting Scientist (from Nov 22 to Dec 2, 1993).
7. Dr. M. Bhowmik, Los Angeles : visited the Centre on November 23, 1993.
8. Dr. M. Majumdar, T. T. Warshaw and Irving Warshaw Professor of Economics, Cornell University, Ithaca, USA : visited the Centre from January 17 to 25, 1994.
9. Dr. P. P. Singh, LLNL, California: visited the Centre on January 21, 1994.
10. Dr. S. Mukherjee, Free University, Berlin, Germany : visited the Centre on January 31, 1994.
11. Dr. M. Ahmed Peer, Physics Department, University of Kashmir: visited the Centre (February 1994).
12. Dr. G. Gangopadhyay, University of North Texas, USA : working as a Visiting Scientist since March, 1994.

RESEARCH ACTIVITIES AT THE CENTRE

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

A. Physics

The research activities in physics are concentrated in the following fields : condensed matter physics, quantum field theory, foundations of quantum theory, quantum optics.

In condensed matter physics, A. Mookerjee and his students and coworkers have been working on alloy phase diagrams. The Augmented Space Recursion on TB-LMTO (tight binding linear muffin tin orbitals) programme with local symmetry reduction has been completed. Test runs on AgPd, CuPd, CuZn and FeTi random alloy systems proved successful. Short range order has been incorporated through the Cowley parameter; ordering tendency has been seen in AgPd and segregating tendency in FeNi in agreement with expectations from experiments. Local lattice distortion effect due to large size-mismatch has been incorporated. Its effect on CuPd alloys has been found to be in agreement with photoemission experimental data; this is a significant improvement over earlier results. CuBe (Beryllium Bronze) system is under study from this view point. Clustering effects in CuZn alloys in the low Cu(bcc) and low Zn (fcc) phases have been studied and clustering structures in the impurity bands seen. Mean field or coherent potential approximation (CPA) theories do not show these effects. The present calculation agrees better with the structures shown in inverse photoemission data. Generalization of CPA for TB-LMTO approach is also being attempted by P. K. Thakur.

The Orbital-Peeling method has been developed to construct the two-body (pair) potentials which are used to study the phase diagrams of Binary alloy systems. The stable phase L12, L10 and DO22 at 25%, 50% and 75%, respectively, in PdV system have been identified and the antiphase boundary energies between L12 and DO22 and L10 and A2B2 structures have been calculated and found to agree well with earlier predictions. In the phase diagram of PdRh, the coexistence curve with an asymmetry towards higher Rh concentrations agrees well with experimental data. Orbital Peeling with a Bragg-Williams type approximation for the entropy has been used to study surface segregation in CuNi alloys. The concentration profile agrees well with Auger spectroscopy studies of surface concentrations.

Spin dependent local density approximation (LSDA) -based LMTO has been set up to study magnetic alloys. It has been used to obtain the following results : (i) magnetization of FeNi system with increasing concentration of Ni has been studied; (ii) effects of disorder on the series of intermetallic FeAl, CoAl and NiAl (50% in the B2 structure) has been seen; and (iii) explanation has been found for the discrepancy in specific heat and local magnetization of the CoAl system between calculations on the perfectly ordered alloy at $T = 0$ K and experiments at finite temperature.



Roger Penrose releasing the book 'S N Bose - the man and his work ;
Collected Scientific Papers'



The ceremony on the birth centenary day : C K Majumdar, R. Penrose,
P K Bagchi (CPMG, WB Circle) and P Ghose

The vector recursion technique has been used to study the nature of the electronic states in the vicinity of the mobility edge in a three dimensional Anderson model. It has been found that the mobility edge is straddled by a dense set of resonances. Their effect on conductivity and magnetoresistance may have some implications on anomalous behaviour near Mott's minimum metallic conductivity and on negative magnetoresistance due to the destruction of the fragile weakly localized states near the mobility edge.

The augmented space theorem was used to study the difference between annealed and quenched averaging in disordered systems. The former includes a class of scattering diagrams; a method for summing these diagrams has been proposed. Electrons in contact with non-Markovian stochastic baths have been studied through a mean field theory with a memory function technique.

P. K. Thakur, a CSIR Pool Officer, studied electron localization in correlated random potential problems. Interplay of randomness and short range order may produce multiple metal insulation transition and cross-order states.

The effect of dynamics on the Hubbard alloy analogy solution of the Hubbard model has been examined by A. Mookerjee and his students. For low U of the Hubbard model, there is a Fermi liquid behaviour. At a critical U_c , the Migdal discontinuity is seen to vanish before any gap opens in the density of states. This indicates the existence of a non-Fermi liquid conducting state, but so far the nature of this state — whether it is Resonating Valence Bond (RVB) type or not — is not known.

A Hubbard-like model, the electron-phonon system and the electron gas have been investigated by R. Chaudhury and D. Gangopadhyay by Polchinski's recently developed effective field theory. Marginal behaviour in the sense of the renormalization group is always found in the Copper scattering channel for the 2-dimensional interacting electron gas with the logarithmic form of bare Coulomb interaction. The other two models also exhibit interesting behaviour (marginal and relevant) when certain constraints involving electronic density of states and some other electronic parameters are satisfied. The possibility of breakdown of normal Fermi liquid behaviour for the 2-dimensional interacting electron gas with bare Coulomb interaction of logarithmic form is under investigation by R. Chaudhury.

A convenient way to get a path integral quantization for spins is to follow Fradkin and Stone and use coherent states. In this way the nature of excitations in anisotropic Heisenberg model in one and two space dimensions has been studied by S. Paul and R. Chaudhury. A one-dimensional isotropic XY model does not have topological excitation, whereas an additional infinitesimal coupling in the Z-direction produces topological excitations. All results obtained by Affleck by fermionization of spin-chain can be recovered.

The gauge-independent quantization of matter-coupled Chern- Simons theories has been pursued by R. Banerjee. Inclusion of the Chern-Simons term converts the original non-local Wilczek-Zee model ($O(3)$ non-linear-model with the Hopf term) to a local one. The role of constraints in establishing gauge invariance is important. The

gauge invariant symmetric angular momentum operator differs from the usual Noether form by a boundary term. In the presence of a vortex configuration this boundary term is non-trivial and corresponds to the fractional spin in the model. These ideas have been applied by R. Banerjee and B. Chakraborty to the planar dynamics of nonrelativistic point particles coupled to the Chern-Simons term. The relevant Galilean algebra has been found to be closed.

An exhaustive analysis of the quantization of second class systems in the Batalin-Fradkin-Tyutin scheme has been done. A novel Hamiltonian embedding of a theory comprising complex scalars coupled to the Chern-Simons term has been carried out. It leads to an effective Lagrangian unconventional in several respects : (i) it does not reduce to the original Lagrangian by switching off the additional new fields; (ii) it includes a nonpolynomial term; and (iii) it is non-relativistic. R. Banerjee, N. Banerjee and S. Ghosh exploit this approach to convert the second class non-linear model into a first class one and to obtain a local theory.

D. Gangopadhyay, A. Sinha (NERIST) and S. Banerjee have shown that certain types of compositions of vacuum configurations (zero instanton sector) of the classical Yang—Mills equations can mimic gauge transformations and give rise to other gauge-related solutions. Similar compositions in the non-zero instanton sector do not give any solutions. The symmetry underlying these solutions are similar to the two parameter group of collinear transformations in complex one dimension. D. Gangopadhyay and S. Sengupta have found that for a string moving in a background of maximally symmetric gravity, dilation field and second rank antisymmetric tensor field, the $O(d) \times O(d)$ transformation on the vacuum solutions in general give inequivalent solutions which are not maximally symmetric.

The study of q -commutation relations has been continued by D. Gangopadhyay. From boson q -oscillator two types of operators can be constructed; they satisfy q -commutation relations similar to fermionic q -oscillator, and become fermionic oscillator in the limit q going to 1. One type involves parameters of $U(1)$ transformations, the other parameters of $GL(2, R)$ transformations. The fermionic number is now connected to the bosonic harmonic oscillator number operator.

Considerable progress has been achieved by P. Ghose, D. Home and M. N. Sinha Roy in developing a consistent relativistic quantum mechanics of bosons. One paper has already appeared in Physics Letters A (Pub No. A. 10), and a second one, incorporating Bohmian trajectories, has been submitted for publication. Work is in progress to find new applications of the formalism. Also, a new test of the waveparticle duality of single photon states involving double refraction and conical refraction is being developed.

Radiation fields having non-classical properties cannot be expected in the micromaser cavity available at the Max Planck Institute in Munich, Germany. These fields are sensitive to damping processes and real possibilities of generating these fields must examine first all incoherent mechanisms. Bullough, Thompson and Nayak have proposed the theory taking into account all the dissipative processes, however small, involved in the dynamics. The theory nicely reproduces the

experimental findings reported so far. In fact, the theory suggests a possible further reduction of the operating temperature of the Munich micromaser now operating at 0.09K. Another suggestion is that the laser and micromaser dynamics can be explained by a common foundation, with the numerical values of certain parameters deciding on the type of action. When the Rydberg atoms coming into the cavity are in a coherent superposition of two masing levels, it is possible to have a macroscopic superposition of two field states which are also known as Schrodinger's Cat States, "squeezing" one of the quadrature of the radiation field and other non-classical fields.

The non-classical character of phonon in a polariton-like system has been investigated by S. Ghoshal. The threshold temperature below which the phonon becomes non-classical is found to vary with the phonon-photon coupling.

The Moessbauer studies of synthetic iron silicates of geophysical interest and of short lived isotopes are being planned. P. Mukhopadhyay has concentrated on improving low temperature measurement capabilities, for example, standardization of a diode thermometer in a cryogenerator. More effort has gone into making the laboratory for high T_c measurement better (vide sec. 3 in projects).

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

1. Banerjee, N., Ghosh, S. and Banerjee, R. : Quantisation of $O(N)$ invariant nonlinear sigma model in the Batalin-Tyutin Formalism (In Nucl. Phys. B.)
2. Banerjee, R.: Gauge independent analysis of $O(3)$ nonlinear sigma model with Hopt and Chern Simons terms (In Nucl. Phys. B).
3. Banerjee, R. and Chakraborty, B. : Fractional spin and Galilean symmetry in Chern Simons matter system (In Phys. Rev. D.)
4. Banerjee, R., Rothe, H. J. and Rothe, K. D. : Batalin-Fradkin quantisation of anomalous chiral gauge theories (In Phys. Rev. D).
5. Barat, P., Chakraborty, A. K., Mukhopadhyay, P. K., Bandyopadhyay, S. K., Kar, S. K. and Sen, P. : Data compression of ultrasonic signals (In Ultrasonics)
6. Bullough, R. K., Thompson, B. V., Nayak, N. and Bogolubov, N. M. : Microwave quantum electrodynamics : (I) One and many Rydberg atoms in microwave cavities;(II) Fundamental theory of the micromaser (In Proc. 2d Intl. Summ. School on Nonlinear Optics.), (ed Ole Kellar, Nova Scientific Pub., New York).
7. Chatterjee, A. and Ghoshal, S. : Non-Classical behaviour of phonons in a simple polariton-like system (In Rec. Adv. In Quant Op.)
8. Chaudhury, R. : Schemes for calculation of free energy and specific heat for marginal fermi liquid in normal and superconducting phase (In Canad. Jr. of Phys.)
9. Dasgupta, I. and Mookerjee, A. : Fermi-liquid to non-Fermi liquid transition in a dynamical-CPA approach to the Hubbard model (In J. Phys. Cond. Matt).

10. Dasguta, I., Saha, T. and Mookerjee, A. : Stochastic resonances at the mobility edges in three dimensional Anderson model (in Phys. Rev. B).
11. Datta, A. and Thakur, P. K. : The coherent potential approximation in TB-LMTO formalism for a single band model of solid (in J. Phys. Cond. Matt).
12. Gangopadhyay, D. : On the classical limit of some q-commutation relations (in Acta. Phys. Pol. B)
13. Manna, S. K., Thakur, P. K. and Mookerjee, A. : Transmittance fluctuations and non-linearity in random chains in the presence of applied electric fields (in Phys. Rev. B.)
14. Mukhopadhyay, P. K., Barat, P., Kar, S. K., Bandyopadhyay, S. K. and Sen, P. : Unexpected behaviour of the core materials of electrical coils at low temperatures (in Cryogenics).
15. Sain, A and Mookerjee, A. : Scaling of resistance in 2d-disordered Anderson model II (in Int. J. Mod. Phys. B.)

B. Applied Mathematics

Professor S. K. Bose joined the Centre in December 1993. The investigation of a vibration control problem of a rectangular space panel by Hilbert Uniqueness Method avoiding modal decomposition was completed by him after joining the Centre, and the results have been submitted for publication. An earlier work "Acoustic plane Wave Reflection from a Composite Lamina - Normal Incidence on Non Destructive Evaluation (NDE) of Composite laminates" will be appearing in Journal of Sound and Vibration. The grim tragedies of Bihar-Nepal, Uttarkashi, Latur of the great earthquake of 1988 (Magnitude 7.3, at Indo-Burma border), awaken scientists to the catastrophic tectonic forces under play along the Himalayan arc and the Western Ghats. In the like manner of flaw detection by NDE, a new element in earthquake prediction, viz, studying the seismic signature of tectonic thrust development in fault zones by sounding techniques is being thought of. Preliminary results on reflection from a stack of layers under tectonic thrust have already been obtained and the main investigation is proposed to be carried out in future in collaboration with the **University of Roorkee. Some work in another direction — Chaotic Dynamical Systems and Control of Chaos—has also been initiated.**

C. Mathematical Modelling

The validity of approximation methods used in light scattering by a soft scatterer has been studied further. The relationship between Hart-Montroll approximation and various other soft particle approximations has been examined for the scattering of light by an infinitely long homogeneous cylinder. Numerical tests of this approximation with exact results and other approximations have been performed. It is noted that it can be used to obtain the cylinder diameter to within 1% in the domain $m \leq 1.15$ and $5 \leq x \leq 20.0$, m and x being the relative refractive index and size of the particle in units of the scattering radiation.

The angular scattering functions for concentric spheres comprising a quartz core and a biological coating found in marine sediments have been examined for various coating thicknesses. Particles having diameters in the range 15 μ m. to 375 μ m. are considered. It is found that a coated particle may be distinguished from a homogeneous particle by its scattering pattern, provided the coating thickness is $\geq 0.75 \mu$ m. It is also found that positions of extrema in the near forward scattering pattern cannot be taken as a guide for sizing coated particles found in marine sediments.

Based on the above work the following papers have been accepted for publication :

1. Sharma, S. K. : On the validity of soft particle approximations for the scattering of light by infinitely long homogeneous cylinders (in J. Mod. Op.)
2. Sharma, S. K. and Somerford, D.J. : An analysis of angular scattering functions for particles in marine sediments (in J. Environ. Sci, Health).

Much time has been spent by S. Banerjee in developing and implementing essential mathematical routines on the recently installed four node transputer board at the Centre. The underlying techniques are the farming and message passing on pipelined MIMD architecture. Using a simple column block partitioning algorithm, she has developed a parallel program for matrix multiplication which can elegantly handle situations where the memory is not large enough to store the matrices in full form. The other area of interest relates to a simulation study of tidal flow pattern in an estuary using the finite element method. Considerable progress has been made and hopefully realistic situations can be handled.

Based on the concept of 'self organised criticality', a numerical simulation study of a two dimensional Abelian Sandpile model has been carried out by S. Banerje and I. Bose. Starting from a far-from-equilibrium state and relaxing under specific toppling rules with open boundary conditions, the system approaches a critical state. The avalanches are generated when such a static state is perturbed locally. A detailed statistical analysis of the cluster so formed is being carried out.

RESEARCH PROJECTS

1. Quantum Transmittance in Disordered Systems

This project with Professor A. Mookerjee, sponsored by the Department of Science and Technology, New Delhi, was extended till February, 1994, and was completed within that date. During this time the last remaining problem in the project — electronic states and transmittance in three dimensional disordered systems — was studied. It was found that the states in the vicinity of the mobility edge in a three dimensional disordered system was straddled by a dense set of resonances. As we approach the mobility edge from the extended side, the extended states give way to fragile resonances and finally to stable localized states in the mobility gap. The effect of these resonances gives anomalous conductivity beyond Mott's minimum metallic conductivity and a negative magnetoresistance due to the destruction of the fragile weakly localized states by an external magnetic field. The results have been published in Pub. A. 7 & 14.

I. Dasgupta and T. Saha were Research Fellows of this project. C. Basu, S. K. Manna and P. K. Thakur of the Centre, and A. K. Sen of SINP also collaborated in the project. Prof. B. K. Chakrabarti of Saha Institute was a coinvestigator.

2. Electronic Structure of Random Alloys

This project sponsored by the Department of Science and Technology, New Delhi, with Prof. A. Mookerjee and collaborators (Professors R. N. Singru, Project Coordinator, V. A. Singh and R. Prasad) was also extended till May, 1994. The work proposed by Prof. Mookerjee in the project has been completed. The results have been published in Pub. A. 12.

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. Irradiation of $\text{YBa}_2\text{Cu}_3\text{O}_x$, Bi-2212 and Bi-2223 systems by alpha particles generally diminishes the critical temperature. The dominant effect in Bi-2212 seems to be oxygen knock-out; in Pb-doped Bi-2223 this is not so. When T_c diminishes, the correct annealing procedure to recover the original T_c has not yet been found. Single crystals of Bi-2212 have been produced and showed a decrease of T_c on alpha bombardment. Application of pressure has produced texturing of random polycrystalline samples of $\text{YBa}_2\text{Cu}_3\text{O}_x$ (Pub A6). At the Nuclear Science Centre, a polycrystalline pellet of Bi-2223 was bombarded with $^{16}\text{O}^{5+}$ ions (12 MeV terminal voltage on the Pelletron). For a dose of 2.3×10^{15} particles, T_c diminishes by 3K. The results have been published in Pub. A. 6 & Pub. B. 1, 2, 4 & 5.

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

The work in this project with Prof. C. K. Majumdar and Prof. Monisha Bose commenced in June 1993. J. Nanda joined as research scholar in January 1994.

An interesting effect of alkyl or alkoxy substituent in oxyl diketonates of copper was presented by Prof. M. Bose at a seminar in Mysore held under the auspices of the Indian Liquid Crystal Society in October 1993. The work on the mixed alkyl/alkoxy compounds have clearly brought out the role of packing effect of the larger alkoxy group, rather than the electronic effect arising from electronegative oxygen.

5. Nuclear Fusion and Nuclear Structure Calculations

This Emeritus Scientist's project sponsored by CSIR is operated by Professor M. K. Pal. Satisfactory numerical agreement has been obtained with experimental data on rms radii, total interaction cross section, electromagnetic dipole excitation, ground state energies of $^9\text{-}^{11}\text{Li}$, the recoil momentum distribution of ^9Li and the momentum distribution of emitted neutrons after Zn-dissociation of ^{11}Li . Further calculations have been planned on ^{12}Be , ^{14}Be and ^{17}B .

Based on this work two papers have been completed and communicated for publication in Nuclear Physics A. :

1. Pal, M. K. : A fully antisymmetrised variational treatment of neutron-halo nuclei.
2. Pal, M. K. and Chattopadhyay, S. : Antisymmetrised cluster model of ^{11}Li .

6. Numerical Studies of Alloy Phase Diagrams

This new project with Professor Abhijit Mookerjee sponsored by the Department of Science and Technology, New Delhi, has begun from March, 1994. The co-investigator is Dr. G. P. Das, BARC, Bombay. Some of the work has already begun. The phase diagrams of some standard systems like PdV and PdRh have been studied to check the accuracy of the Augmented Space Recursion Package developed by them. Dr. Das has studied the total energies of most possible structures in the LiAl system. Others have begun the study of the series FeAl, CoAl and NiAl.

7. Collaborative Program with Warwick University

As a part of a renewed collaborative program with Professor A. K. Bhattacharyya, Catalysis and Solid State Research Laboratory, University of Warwick, Professor Abhijit Mookerjee and Dr. Amitabha Banerjee have begun to set up molecular dynamical calculations of small clusters of transition metals and study their formation energies as a function of shape and size and absorption energies of atoms on their surfaces.

8. Probing the Foundations of Quantum Theory

Its main objective is to carry out interdisciplinary research on foundation problems of quantum theory using primarily quantum optics and elementary particle physics. The principal investigator is Professor Partha Ghosh. The other investigators are Dr. Dipankar Home, Bose Institute, and Dr. Amitava Datta, Jadavpur University.

One paper on the relativistic quantum mechanics of bosons has already been published in Physics Letters A.

PUBLICATIONS

A. Scientific Journals

1. Banerjee, N., Ghosh, S. and Banerjee, R. : Batalian-Tyutin Quantisation of CP^{N-1} model, *Phys. Rev.* 1993, **D49**, 1996-2000.
2. Banerjee, R. : Gauge-independent analysis of dynamical systems with Chern-Simons term, *Phys. Rev.*, 1993, **D48**, 2905-2915.
3. Banerjee, R. : Hamiltonian embedding of a second class system with a Chern Simons term, *Phys. Rev.*, 1993, **D48**, R5467-R5470.
4. Banerjee, R. : Quantum equivalence of $O(3)$ nonlinear sigma model and the CP^1 model formulation, *Phys. Rev.*, 1994, **D49**, 2133-2176.
5. Banerjee, R. : Reply to comment on "Gauge independent analysis of Chern-Simons theory with matter coupling, *Phys. Rev. Lett.*, 1993, **70**, 3519.
6. Barat, P., Bandyopadhyay, P., Dasgupta, P., Sen, P., De, U., Kar, S. K., Mukhopadhyay, P. K. and Majumdar C. K. : Effect of pelletization pressure on texturing of a $YBa_2 Cu_3 O_7$ sample, *Physica*, 1993, **C218**, 63-68.
7. Dasgupta, I. and Mookerjee, A. : Study of electrons in contact with non-Markovian baths, *J. Phys. Cond. Matt.*, 1994, **6**, 1545-1552.
8. Datta, A., Thakur, P. K. and Mookerjee, A. : Self-consistent cluster coherent-potential approximation for the tight-binding linearized-muffin-tin-orbital approach to random binary alloys, *Phys. Rev.*, 1993, **B48** (12), 8567-8571.
9. Ghose, P. : Confronting wave-particle complementarity using tunneling, *Laser News*, 1994, **5**(1), 10-11.
10. Ghose, P., Home, D. and Sinha Roy, M. : Relativistic quantum mechanics of bosons, *Phys. Lett.*, 1993, **A183**, 267-271.
11. Majumdar, D., Bhattacharjee, A. K., Das, K.K. and Guha, S : Conformational and electronic properties of several novel heterocyclic carditonic : a theoretical approach, *J. Mol. Struct. (Theochem)*, 1993, **288**, 411-453.
12. Mookerjee, A. and Prasad, R. : An augmented space approach to correlated disorder, *Phys. Rev.*, 1983 **B48**, 17724-17731.
13. Pal, M. K. : ATDHF calculations on the fission of some actinide nuclei, *Nucl. Phys.*, 1993, **A556**, 201-227.
14. Saha, T. and Mookerje, A. : A study of annealed & quenched averaging of the thermodynamic potential in a disordered system : an augmented space approach, *J. Phys. Cond. Matt.*, 1994, **6**, 1529-44.

15. Sharma, S. K. : A modified anomalous diffraction approximation for intermediate size soft particles, *Opt. Commn.*, 1993, **100**, 13-18.

B. Proceedings of Conferences & Symposia

1. Bandyopadhyay, S. K., Sen, P., Barat, P., De, U., Mukhopadhyay, P.K. and Kar, S.K. : Annealing studies of irradiated Bi-2223, DAE Sol. St. Phys. Symp., BARC, Bombay, Dec 27-31, 1993, **36C**, 360.
2. Barat, P., De, U., Bandyopadhyay, S.K., Kar, S., Sen P. and Mukhopadhyay, P.K. : Quenching effect in YBa₂ Cu₃ O₇ High Tc Superconductor, DAE Sol. St. Phys. Symp., BARC, Bombay, Dec. 27-31, 1993, **36C**, 358.
3. Das, D., Sudarshan, N., Ghose, V., Krishna, J.B.M., Chintalputli, S.N., Babu, D.B.B., Damodarani, A.D., and Majumdar, C.K. : Moessbauer spectroscopic investigation of Indian Ilmenites, DAE Sol. St. Phys. Symp., BARC, Bombay, Dec. 27-31, 1993, **36C**, 498.
4. De, U., Barat, P., Mukhopadhyay, P.K., Bandyopadhyay, S., Sen, P., Kar, S.K., Dasgupta, P., and Majumdar, C.K. : Anisotropic resistivity of textured YBa₂ Cu₃ O₇ Pellets, DAE Sol. St. Phys. Symp., BARC, Bombay, Dec 27-31, 1993, **36C**, 359.
5. Mukhopadhyay, P.K. Barat, P., Kar, S.K., De, U., Bandyopadhyay, S.K., Dasgupta, P., Sen, P. and Majumdar, C.K. : Microstructure of Textured YBCO Pellets, DAE Sol. St. Phys. Symp., BARC, Bombay, Dec. 27-31, 1993, **36C**, 89.

C. Miscellaneous

1. Ghose, P. : England, Shakespeare O Newton (in Bengali), *Desh*, June 19, 1993, 65-69.
2. Ghose, P. : Prachin Bharatiya Vignaner Itihas O Debiprosad (in Bengali), *Anustup*, 1993, **28**, 134-143.
3. Ghose, P. : Syadvada, Relativity and Complementarity, Project of History of Indian Science, Philosophy and Culture, Occasional paper, 15.
4. Ghose, P. : EPR Paradox O Quantum Darshan (in Bengali), *PramA*, Jul-Sep, 1993, 411-415.
5. Ghose, P. : Sristi Rahasya (in Bengali), *Desh*, Dec 18, 1993, 115-121.
6. Ghose, P. : 'Quantum Tattwa', Satyen Basu O Einstein (in Bengali), *Desh*, Jan 15, 1994, 33-39.
7. Majumdar, C.K. : Bose and his Statistics, *Phys. News*, 1993, **24(4)**, 135-144.
8. Majumdar, C.K. : Excellence and Accountability in Science in Universities, in *Science in India : Excellence and Accountability* (ed. Srivastava, P.N.), Angkor Pub, New Delhi, 1994, pp. 186-194.
9. Majumdar, C.K. : Gnan Jetha Mukta (Where Knowledge is Free) (in Bengali), *Nostalgia*, (Presidency College 175th Year Celebrations), 1993, 145-149.

10. Majumdar, C.K. : Moessbauer studies of Iron minerals (Santanu Ghosh Memorial Lecture, 1991), Sc. & Cul., 1991, **57**(12), 262-272.

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

1. Banerjee, R. visited the University of Heidelberg in the Humboldt programme (June 1-August 31, 1993).
2. Banerjee, Srilekha attended (i) : Saha and Bose : Birth Centenary Seminar, organized jointly by Indian Physics Association (Calcutta Chapter) and Indian Physical Society, Calcutta (September 23-24, 1993).

(ii) First Conference of Indian Transputer User Group (ITUG 93) at CDAC, Pune (December 13-15, 1993).
3. Bose Manisha attended : (i) Third International Symposium on Metallomesogens at Periccola, Spain (3-5 June, 1993).

(ii) visited University of Bordeaux, Laboratoire du Chimie de Solids (CNRS).
4. Chaudhury, R. visited : (i) National Chemical Laboratory, Pune (April 28 - May 7, 1993).

attended : (ii) Causality in Physics and Philosophy at Jadavpur University (August 28, 1993).

(iii) Saha and Bose : Birth Centenary Seminar, organized jointly by Indian Physics Association (Calcutta Chapter) and Indian Physical Society, Calcutta, Calcutta (September 23-24, 1993).
5. Das, Rina. attended : (i) seminar on Genetic Algorithm at Jadavpur University (July 2, 1993).

(ii) Self Stabilisation : A Formal & Unified Approach to Fault Tolerance Computing at Jadavpur University (July 9, 1993).

(iii) Shared Memory Multiprocessing Using Optical Fibre Interconnection at Jadavpur University (Dec 9, 1993).

(iv) Seminar on Image Processing & Computer Vision, organized by JEEE Calcutta Section at Taj Bengal, Calcutta (December 17, 1993).

(v) International Conference on Bose and 20th Century Physics at Ramakrishna Mission Institute of Culture, Calcutta (December 30, 1993 — January 5, 1994).

(vi) The Seventh International Conference on VLSI Design at Taj Bengal (January 6-8, 1994).
6. Gangopadhyay, D. : (i) attended Saha and Bose : Birth Centenary Seminar (September 23-24, 1993).

- (ii) participated as Guest Faculty in the IXth SERC School in Theoretical High Energy Physics at Guwahati University (November 15-27, 1993).
7. Ghose, P. visited : (i) Bangladesh Open University, Dhaka to discuss the making of a video programme on Professor S.N. Bose (May 24-27, 1993).
- (ii) attended meetings of BCSPIN Committee for the Kathmandu Summer School 1994 at ICTP, Trieste (June 19-27, 1993).
- visited : (iii) Applied Physics Department, University of Portsmouth (July 1, 1993).
- visited : (iv) Department of Mathematical Sciences, University of Durham for collaborative work with Professor E.J. Squires (July 4-9, 1993).
- visited : (v) British Library Document Supply Centre, Boston Spa, to collect materials for the S.N. Bose Centenary volume (July, 1993).
- (vi) attended Workshop in Astroparticle Physics at Pune (February 21-25, 1994).
8. Ghoshal, S. attended : (i) Saha and Bose : Birth Centenary Celebration (September 23-24, 1993).
- (ii) International Conference on Bose and 20th Century Physics at Ramkrishna Mission Institute of Culture, Calcutta (December 30, 1993 - January 5, 1994).
- (iii) National School on Modern Optics at CAT, Indore (March 3-5, 1994).
- (iv) National Workshop on Recent Advances in Quantum Optics at CAT, Indore (March 7-10, 1994).
9. Mookerjee, A. attended : (i) the Summer School on Computational Physics at ICTP, Trieste (May 16-June 16, 1993).
- (ii) Research Workshop in Condensed Matter Physics at ICTP Trieste (June 21-July 29, 1993).
- (iii) Meeting of the 1993 Solid State Advisory Committee at ICTP, Trieste (July 30-31, 1993), and was named Director of the Working Group of Alloy Phase Stability to be held during August 8-19, 1994.
- visited : (iv) Centre for Catalysis and Solid State Science, University of Warwick (August 2-6, 1993).
- (v) University of Cambridge (August 9-14, 1993).
- attended : (vi) Indo-French Workshop on Non-Linearity & Breakdown in Soft Condensed Matter, at SINP, Calcutta (November 1-9, 1993).
- (vii) Conference on Perspectives on Ceramic Research, at IACS (January 28, 1994).
- (viii) Workshop on Implementation of the new B.Sc. Syllabus in Physics of Calcutta University (February 25, 1994).

- (ix) Regional Workshop on Condensed Matter Physics, Dhaka (February 7-13, 1994).
10. Nayak N. attended : (i) the Research Industry meet on Photonic Devices and Technology at Calcutta, organized by IIT Kharagpur and Delhi (April 30, 1993).
(ii) Saha and Bose : Birth Centenary Seminar, organized jointly by Indian Physics Association (Calcutta Chapter) and Indian Physical Society, Calcutta (September 23-24, 1993).
11. Pal, M.K. visited : (i) California Institute of Technology (June 14-15, 1993).
(ii) City University of New York, Brooklyn College, N.Y. (June 17-18, 1993).
(iii) Drexel University, Philadelphia (June 23-25, 1993).
12. Paul, S.K. attended : (i) Saha and Bose : Birth Centenary Seminar, organized jointly by Indian Physics Association (Calcutta Chapter) and Indian Physical Society, Calcutta (September 23-24, 1993).
13. Shirma, S.K. attended : Saha and Bose : Birth Centenary Seminar, organized jointly by Indian Physics Association (Calcutta Chapter) and Indian Physical Society, Calcutta (September 23-24, 1993).

SEMINARS/TALKS BY THE CENTRE'S STAFF

1. Banerjee, R. : *Gauge independent analysis of the theory comprising complex scalars coupled to Chern Simons term*, at the University of Kaiserslautern (August, 1993).
2. Basu, C. : (i) *Quantum transmittance in continuous quasiperiodic 1-d chain*, at Central University of Hyderabad (January 27, 1994).
(ii) *Vector recursion methodology and its application*, at the Institute of Physics, Bhubaneswar (February 23, 1994).
(iii) *Metal-insulator transition in discrete and continuous quasiperiodic chains*, at Institute of Mathematical Sciences, Madras (March 24, 1994).
3. Bose, Monisha : (i) *Magnetic resonance and high pressure studies of lithium intercalates of V_2O_5* , at University of Bordeaux, Laboratoire du Chimie de Solides (CNRS) (June 1993).
(ii) *Phase transitions in Octyl, Octyloxy and mixed Octyl-Octyloxy substituted discotic copper B diketonates*, at the seminar on Liquid Crystals held under the auspices of the Indian Liquid Crystal Society at the Physics Department, University of Mysore (October 16-20, 1993).
4. Chaudhury, R. : (i) *Stability of marginal fermi liquid and its consequences*, at the National Chemical Laboratory, Pune (May 5, 1993).
5. Dasgupta, I : (i) *Quantum transmittance and resonance in quantum percolation model*, at Institute of Mathematical Sciences, Madras (February 10, 1994).
(ii) *A first principles calculation of electronic structure of random alloys*, at Central University of Hyderabad (February 15, 1994).
(iii) *Electrons in contact with stochastic bath*, at Centre for Theoretical Studies, IISc, Bangalore (March 21, 1994).
(iv) *First principles calculation of electronic structure and surface segregation of disordered alloys*, at Department of Physics, IISc, Bangalore (March 22, 1994).
6. Gangopadhyay, D. : *Introduction to the renormalisation group*, at Presidency College, Calcutta (March 25, 1994).
7. Ghose, P. : (i) *Confronting the complementarity principle in a double prism experiment*, at the Physics Department, Dhaka University (May 26, 1993).
(ii) *Relativistic quantum mechanics of bosons*, at the Applied Physics Department, University of Portsmouth (July 1, 1993).
(iii) *S. N. Bose's Life and Works*, at the Annual Re-Union of the Department of Physics, Jadavpur University (March 5, 1994).

- (iv) *S. N. Bose's Life and Works*, at the Ramakrishna Mission Residential College, Narendrapur (March 9, 1994).
- (v) *S.N. Bose's Life and Works*, at IIT Kharagpur (March 22, 1994).
- (vi) *Testing the complementarity principle*, at IIT, Kharagpur (March 22, 1994).
8. Majumdar, C.K. : (i) *Use of two nuclear techniques (Moessbauer and NMR) for the study of minerals in India*, Centenary Lecture in the Geology Department, Presidency College, Calcutta (July 17, 1993).
- (ii) *Creativity in Science*, at the INSA meeting in Delhi on Aesthetics, Economics and Creativity (August 4, 1993).
- (iii) *Bose and his statistics*, at Saha and Bose Birth Centenary Seminar organized by Indian Physical Association and Indian Physical Society at SINP (September 24, 1993).
- (iv) *Behaviour of high temperature superconductors after charged particle irradiation from accelerators*, at a seminar on Modern Aspects in Superconductivity and Applications in Calcutta, organized by Max Muller Bhavan and Humboldt Club, Calcutta with the German Academic Exchange Service (DAAD), New Delhi (November 26, 1993).
- (v) *Zeros of partition function and phase transitions in the Ising model*, at Physics Department, Allahabad University (January 24, 1994).
- (vi) *Moessbauer studies of iron minerals of Eastern India*, at National Academy of Sciences, Allahabad, (January 25, 1994).
9. Mookerjee, A : (i) *Electrons in contact with stochastic baths : various applications including motional narrowing, Mott alloys and the disordered Hubbard model*, Plenary Lecture at ICTP, Trieste (July 21, 1993).
- (ii) *Open problems in disordered alloys*, Working Group Lecture at ICTP, Trieste (July 19, 1993).
- (iii) *Short ranged order in alloys*, Working Group Lecture at ICTP, Trieste (July 28, 1993).
- (iv) *Electrons in contact with Stochastic Baths*, Plenary Lecture at ICTP, Trieste (July 14, 1993).
- (v) *Outstanding problems in random alloys*, Working Group Lecture at ICTP, Trieste (July 16, 1993).
- (vi) *Predictive scheme for metallic clusters : Na, Cu*, at Warwick University (August 4, 1993).
- (vii) *Study of ordering and phase transitions in alloys*, IPS Meeting at SINP, Calcutta (September, 22-23, 1993).

- (viii) *Phase stability in alloys*, at Jadavpur University (November 18, 1993).
- (ix) *Phase stability in alloys*, series of lectures at SNBNCBS on Tuesdays & Thursdays (Jan 13-Feb 24, 1994).
- (x) *First Principles approach to phase stability*, at IACS, Calcutta (January 28, 1994).
- (xi) *Alloy phase stability and behaviour near the mobility edge*, at the Regional Workshop on condensed Matter Physics, Dhaka University (February 7-13, 1994).
10. Nayak, N. : (i) *One photon micromaser action in the high Q cavity*, at the National Workshop on Recent Advances in Quantum Optics at C.A.T., Indore (March 7-10, 1994)
- (ii) *Laser micromaser formalism*, at the Department of Physical Chemistry, IACS, Calcutta (March 23, 1994).
11. Pal M.K. :(i) *Neutron-Halo nuclei*, at Caltech, USA (June 15, 1993) and at CUNY, New York (June 18, 1994).
- (ii) *ATDHF calculations on fission in actinide nuclei*, at Drexel University (June 24, 1993).
12. Paul, S.K. :(i) *Kac Moody algebra, integrable systems and conformal field theories*, at SNBNCBS (January 18 & 28, 1994).
- (ii) *Drinfeld-Sokolov Hamiltonian reduction, Integrable systems and Conformal Field Theory*, at MRI, Allahabad (Dec 1993).

THEORETICAL PHYSICS SEMINAR CIRCUIT

The Centre continued to function as the coordinating centre of the Theoretical Physics Seminar Circuit (TPSC). The following scientists visited Calcutta under the programme and gave seminars :

1. S. Banerjee, TIFR, Bombay : *Precision measurements from LEP and tests of standard model* (Sept 28, 1993).
2. S. R. Shenoy, Univ of Hyderabad : *Anisotropic high Tc superconductors and vortex loops* (Oct 1, 1993).
3. B. Chakrabarty, Mehta Research Inst., Allahabad : *Fractional spin in a Galilean invariant model* (Oct 1, 1993).
—, *Induced representation and spinors* (Oct 11, 1993).
4. A. K. Roy, IISc Bangalore : *Some aspects of squeezed states* (Oct 11, 1993).
5. K. N. Shrivastava, Univ of Hyderabad : *Microwave absorption in superconductors* (Oct 18, 1993).
6. S. Kar, IIT, Kanpur : *Traversable wormholes* (Dec 6, 1993).
7. Dr. H. Sharan, TIFR, Bombay : *High energy gamma rays (5-35 MeV) following nuclear reactions* (Dec 29, 1993).
—, *Non statistical gamma-ray production in low energy alpha-nucleus collisions* (Jan 5, 1994).
8. B. Mukhopadhyay, Mehta Research Institute, Allahabad : *Some CP-violating effects from gauge boson coupling at LEP-II* (Feb 8, 1994).
9. S.D. Joglekar, IIT, Kanpur : *A superspace formulation of gauge theories, ward identities and renormalization* (Feb 14, 1994).
10. V. S. Uma Maheswari, IOP, Bhubaneswar : *Study of multi-quark droplets* (Feb 23, 1994).
11. A. S. Majumdar, Univ of Delhi : *Two mechanisms of baryogenesis* (March 7, 1994).
12. Nita Parekh, JNU, New Delhi : *Phase ordering dynamics in disordered systems* (March 16, 1994).
13. J. Prakash, IMSc, Madras : *A calculus for SU(3) and an application* (March 16, 1994).
14. A. S. Vytheeswaran, IMSc, Madras : *Gauge invariance in systems with second class constraints* (March 29, 1994).

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) and Quantum Mechanics II in Presidency College, Calcutta. He also give lectures in the Condensed Matter Workshop in Trieste, Italy on Alloy phase stability. Professor C. K. Majumdar taught part of the Solid State Physics (Special Paper) course in Calcutta University and Presidency College, Calcutta.

LIBRARY

The S. N. Bose National Centre Library added 65+7 new books in 1993-94 to its collection. Seven books on mathematics were purchased from rupees five thousand (Rs. 5000.00) received as donation from Dr. P. Das who had visited the Centre in (1993). The technical processing of library books are being carried out by using a 286-MINICOMP Personal Computer, supplied with an EPSON FX-1000 printer meant for the library. The dBASEIII and WordPerfect 5.1 computer softwares are being used for technical processing of books and other library 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)

The library could not renew subscription to the SLAC preprints in *Particles and Fields* for 1993-94, as it ceased publication from 1993. Preprints received in the library from more than 25 research institutes all over the world were displayed and preserved in the Preprint Library.

The library offers xerox facilities on a regular basis to its users during seminars, symposia and other academic activities. About 13,000 xerox copies from different research materials were distributed last year to the library users.

In view of the limited subscription to foreign journals, the library has sought the 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 system, the Quantum Workstation, the laser printer and the two 80386 PC AT machines have worked satisfactorily. The Quantum double drive has been used for the Teachers Training programme. The Teachers Training programme was satisfactorily completed; the course material covered MSDOS, GWBASIC, and elements of WORDSTAR and FORTRAN and the teachers practised problem solving on the computer.

Regular e-mail facility in the centre was extensively offered to different scientists by R. Das, the System Administrator as well as the Postmaster of the e-mail service. Major correspondence for the Bose Centenary Conference was made possible through the e-mail facility of the Centre. Besides regular e-mail service there was a heavy load of incoming and outgoing e-mails at the specific period of postal strike during the Bose Centenary Conference.

The transputers are working satisfactorily. The system must be upgraded as the workload is increasing. The dBASEIII plus was extensively used by S. Banerjee for storage and retrieval of relevant information for the Bose Centenary Conference and TPSC.

Another collaborative research work with Jadavpur University was undertaken by Mrs. R. Das, System Administrator of the Centre. The Eastern Regional Braille Press at the Ramakrishna Mission Blind Boys' Academy, Narendrapur, has been successfully interfaced with a PC-AT/386 through a microcomputer to automate the transcription of English text to the equivalent Braille form. The entire work, which involved pneumatically robotic fingers and an intelligent interface for unified software control, was successfully coordinated by Mrs R. Das of this Centre. The effort, which is the first of its kind in India, resulted in nearly 10-fold increase in productivity of the Braille Press and was widely acclaimed in the national and local newspapers. The work involved various state-of-the-art technologies, all of which were indigenously developed. The software, which has been implemented using the rule-based translation scheme, can be extended to include vernacular transcriptions as well involving the phonetic principle, and some members of the faculty of the Department of Computer Science and Engineering, Jadavpur University, are actively involved in this work.

Efforts are currently on to integrate the system with the National e-mail network to link the Regional Braille Press with various libraries to transcribe any text or reference works available in electronic form instantaneously for the blind.

CONSTRUCTION OF THE NEW CAMPUS

The Centre now operates from a rented house at DB17, Sector I, Salt Lake City, Calcutta 700 064. It has additional space at CD 85—, a short walk from the main office. The campus of the S. N. Bose National Centre for Basic Sciences is under construction on a 15 acre plot of land in Block JD, Sector III, Salt Lake City, Calcutta. A part of the main building, a portion of the Guest House and one block of Essential Staff Quarters and the necessary infrastructural facilities are nearing completion.

MEETINGS OF THE VARIOUS COMMITTEES OF THE CENTRE

Governing Body

The Governing Body of the Centre under the Chairmanship of Professor P. Rama Rao met on October 1, 1993, in Delhi.

Academic Programme Advisory Committee

The Research Advisory Committee I (Physics and Mathematics) held its meeting at the Centre's Office in Calcutta in the morning on August 7, 1993. The Research Advisory Committee II (Chemistry and Life Sciences) met in the afternoon on the same day.

Finance Committee

The Finance Committee of the Centre met on September 6, 1993, at the Centre's Office.

Construction Committee

The Construction Committee met on July 8, 1993, in the Centre's Office to advise the Centre on the final stages of the construction of the campus. The members were the same as in the last year's Committee.

GOVERNING BODY

The present 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 Adviser,
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 | Administrative Officer (Actg), S. N. Bose
National Centre for Basic Sciences, Calcutta |

ACADEMIC PROGRAMME ADVISORY COMMITTEE

The Academic Programme Advisory Committee considers the yearly academic activities of the Centre. It has been split into two smaller committees called Research Advisory Committee I (for Physics and Mathematics) and Research Advisory Committee II (for Chemistry and Life Sciences). The present composition of the RACs is as follows :

Research Advisory Committee - I

- | | |
|--|---|
| 1. Professor N. Mukunda
Chairman | Indian Institute of Science, Bangalore |
| 2. Professor P. K. Kaw
Member | Institute of Plasma Research, Gandhinagar |
| 3. Professor A. Raychaudhuri
Member | Formerly of Presidency College, Calcutta |
| 4. Professor H. S. Mani
Member | Mehta Research Institute, Allahabad |

- | | |
|--|---|
| 5. Professor S. S. Jha
Member | Tata Institute of Fundamental Research,
Bombay |
| 6. Professor K. B. Sinha
Member | Indian Statistical Institute, New Delhi |
| 7. Professor J. V. Narlikar
Member | Inter-University Centre for Astronomy and
Astrophysics, Pune |
| 8. Dr. V. P. Bhaskar
Member | Centre for Development of Advanced
Computing, Pune |
| 9. Professor N. Kumar
Member | Centre for Development of Advanced
Computing, Pune |
| 10. Professor C. K. Majumdar
Member | S. N. Bose National Centre for Basic
Sciences, Calcutta |

Research Advisory Committee - II

- | | |
|---|--|
| 1. Professor Mihir Chowdhury
Chairman | Indian Association for the Cultivation of
Science, Calcutta |
| 2. Professor H. Sharat Chandra
Member | Centre for Cellular and Molecular Biology,
Hyderabad |
| 3. Professor Jyotirmoy Das
Member | Indian Institute of Chemical Biology,
Calcutta |
| 4. Professor V. Nanjundiah
Member | Indian Institute of Science, Bangalore |
| 5. Professor G. Govil
Member | Tata Institute of Fundamental Research,
Bombay |
| 6. Professor J. C. Parikh
Member | Physical Research Laboratory, Ahmedabad |
| 7. Professor B. M. Deb
Member | Punjab University, Chandigarh |
| 8. Professor R. Ramaswamy
Member | Jawaharlal Nehru University, New Delhi |
| 9. Professor S. Ramasesha
Member | Indian Institute of Science, Bangalore |
| 10. Professor N. Sathyamurthy
Member | Indian Institute of Technology, Kanpur |
| 11. Professor C. K. Majumdar
Member-Convenor | S. N. Bose National Centre for Basic
Sciences, Calcutta |

Staff of the Centre as on March 31, 1993

Academic

Dr. Chanchal Kumar Majumdar	Director
Dr. Sujit Kumar Bose	Professor (From Dec. 1993)
Dr. Partha Ghose	Professor/Academic Programme Coordinator
Dr. Abhijit Mookerjee	Professor
Dr. Subodh Kumar Sharma	Reader
Dr. Nilkantha Nayak	Reader
Dr. Debashis Gangopadhyay	Lecturer
Dr. Rabin Banerjee	Post Doctoral Fellow
Dr. Sanir Kumar Paul	Post Doctoral Fellow
Dr. Ranjan Chaudhury	Post Doctoral Fellow
Dr. Pratip Mukhopadhyay	Post Doctoral Fellow
Mrs Rina Das	Scientific Officer
Dr. Srilekha Banerjee	Scientific Officer

Administrative, Technical and Auxillary

Dr. Santi Gopal Basu	Librarian
Mr. Apurba Kanti Sarkar	Administrative Assistant (Accts)
Mr. Sunish Kumar Deb	Stenographer
Mr. Sukanta Mukherjee	UDC
Mr. Tapan Kumar Sen	UDC (From Sept 1993)
Mr. Jaydeep Kar	Junior Assistant
Mr. Prosenjit Talukdar	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	Coprincipal Investigator in a DST Project.
Dr. Sharmistha Ghosal	Research Associate, CSIR
Ms. Chaitali Basu	Senior Research Fellow, CSIR

Mr. Abhijit Datta
Dr. Prabhat Kumar Thakur
Mr. Indra Dasgupta

Ms. Tanusree Saha

Mr. Tapas Mitra
Mr. Sanjay Kar

Dr. P. Roychoudhury
Dr. Kalyan Mandal
Mr. J. Nanda

Mr. B. Bhattacharya
Mr. P. Biswas

Research Scholar
Pool Officer, CSIR
Junior Research Fellow at the Centre
(from March 15, 1994)
Junior Research Fellow at at the Centre
(from March 15, 1994)
Junior Research Fellow, CSIR
Research Fellow, DST
(resigned on 31.7.93)
Part Time Researcher
Research Scientist, DST Project
Junior Research Fellow, DST Project
(From Jan 1994)
Junior Research Fellow, DST Project
Junior Research Fellow, CSIR
(From January 1994)

Abbreviations

BARC	Bhabha Atomic Research Centre, Bombay
BI	Bose Institute, Calcutta
CAT	Centre for Advanced Technology, Indore
CDAC	Centre for Development of Advanced Computing
CSIR	Council of Scientific & Industrial Research
CU	Calcutta University
DAE	Department of Atomic Energy
DST	Department of Science & Technology, New Delhi
FAMTSIT	Foundation and Methodology of Theoretical Sciences in the Indian Tradition, Jadavpur University
IACS	Indian Association for the Cultivation of Science, Calcutta
ICTP	International Centre for Theoretical Physics, Trieste, Italy
IICB	Indian Institute of Chemical Biology, Calcutta
IIM	Indian Institute of Management, Ahmedabad
IISC	Indian Institute of Science, Bangalore
IIT	Indian Institute of Technology
IITK	Indian Institute of Technology, Kanpur
IMSC	Institute of Mathematical Sciences, Madras
INSA	Indian National Science Academy, New Delhi
IOP	Institute of Physics, Bhubaneswar
IPA	Indian Physics Association
IPR	Institute of Plasma Research, Gandhinagar
IPS	Indian Physical Society
ISI	Indian Statistical Institute, Calcutta/Delhi
IUCAA	Inter-University Centre for Astronomy & Astrophysics, Pune
JNU	Jawaharlal Nehru University, New Delhi
JU	Jadavpur University, Calcutta
LLNL	Lawrence Livermore National Laboratory, USA
MRI	Mehra Research Institute, Allahabad
NASA	National Aeronautics and Space Administration, USA
NCL	National Chemical Laboratory
NIAS	National Institute of Advanced Studies, Bangalore
NEHU	North-Eastern Hill University, Shillong
NERIST	North-Eastern Regional Institute of Science & Technology Itanagar
NPL	National Physical Laboratory, New Delhi
NSF	National Science Foundation, USA
PRL	Physical Research Laboratory, Ahmedabad
SINP	Saha Institute of Nuclear Physics, Calcutta
SLAC	Stanford Linear Accelerator Center, California, USA
SNBNCBS	S. N. Bose National Centre for Basic Sciences
TIFR	Tata Institute of Fundamental Research, Bombay
UCLA	University of California, Los Angeles, USA
UGC	University Grants Commission, New Delhi
VECC	Variable Energy Cyclotron Centre, Calcutta

BUDGET SUMMARY

(1993 — 94)

The funds come from the Department of Science and Technology. The following is the summary of the budget estimates of the year 1993-94 :

(Amount in Rs./Lakh)

	Actuals	Budget Estimate	Revised Estimate
	1992-93	1993-94	1993-94
Non Plan	27.14	30.87	33.40
Plan	219.82	360.30	340.58
Total	246.96	391.17	373.98

D. P. Sen & Co.
CHARTERED ACCOUNTANTS

8/2, KIRAN SHANKAR ROY ROAD
CALCUTTA 700 001
Phone : 248-1495/248-7785

4th August, 1994

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, 1994 of Satyendra Nath Bose National Centre for Basic Sciences and the annexed Income and Expenditure Account for the year ended 31st March, 1994. We report as follows :

1. a) As per Note of Schedule 'N' 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 'N' 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 'N' to the annual accounts no confirmation of balances have been obtained from parties.
2. All necessary information, books and records required for audit were produced before us.
3. Subject to paragraphs 1(c) above, the transactions that come 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 Schedule 'A' to 'M' and the notes on Accounts attached thereto, reflect a true and fair view
 - i) in case of Balance Sheet as to state the affairs of the Centre as on 31st March, 1994 and
 - ii) in case of the Income & Expenditure Account as to the excess of Income over Expenditure for the year ended 31st March, 1994.

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 Rs.	FUNDS & LIABILITIES	Schedule	Rs.	P.
	CAPITAL FUND :			
	Balance as per last A/c.		5,77,89,881.60	
5,77,89,882	<i>Add</i> : Grant-in-aid received from Govt. of India for non-recurring Expenses		<u>192,22,254.00</u>	7,70,12,135.60
	GENERAL FUND :			
	Balance as per last A/c		44,75,566.19	
44,75,566	<i>Add</i> : Net excess of Income over Expenditure for the year transferred from Income and Expenditure Account		<u>16,00,713.33</u>	60,76,279.52
	OTHER FUNDS :			
	1) Computer Fund :			
	Donation received from J. Bose as per last A/c.		2,75,001.00	
2,75,001	<i>Add</i> : Received during the year		<u>25,000.00</u>	3,00,001.00
	2) Project Fund :			
	Balance as per last A/c.		10,46,218.97	
10,46,219	<i>Add</i> : Excess of Income over Expenditure for the year transferred from Income and Expenditure Account		<u>13,22,215.56</u>	23,68,434.53
—	3) Library Fund (Donation)		7,500.00	
7,75,707	4) Employees' Provident Fund		9,98,860.18	
1,24,871	5) Gratuity Fund		<u>1,53,492.21</u>	11,59,852.39
<u>6,44,87,246</u>	Carried Forward			<u>8,69,16,703.04</u>

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
31st March, 1994

Figures for the previous year		PROPERTIES & ASSETS	Schedule	Rs.	P.
Rs.	P.				
4,39,32,897		FIXED ASSETS :	D	5,96,15,341.76	
		At Cost/Capitalised value			
		INVESTMENTS :			
1,03,69,389		1) In short term Deposit with Schedule Banks	E	1,32,02,284.00	
		2) Gratuity Fund Invested :		1,11,339.88	
83,722		In Short Term Deposits with Schedule Bank		8,42,000.00	
		3) Provident Fund Invested :			
6,32,000		In Short Term Deposit With Schedule Bank			
		CURRENT ASSETS :			
		1) Interest Accrued on Investments :			
1,94,656		a) General Fund		1,40,356.00	
13,531		b) Gratuity Fund		16,596.33	
87,062		c) Provident Fund		1,19,638.12	
31,469		2) Stock of Printing & Stationery		45,913.25	
		3) Cash & Bank Balances :			
214		a) Cash in hand		1,387.44	
18,25,842		b) With Schedule Banks	F	24,11,807.16	
		LOANS & ADVANCES			
13,638		1) Advance to Employees from Provident Fund		27,720.00	
74,73,740		2) Advance to Suppliers & Contractors	G	1,44,03,459.53	
1,34,750		3) Deposit for Rent	H	82,950.00	
18,590		4) Security Deposits	I	18,590.00	
37,575		5) Advance against Expenses receivable	J	10,000.00	
98,721		6) Other Advances	K	74,500.30	
2,48,492		7) Prepaid Expenses	L	2,39,113.00	
<u>6,51,96,288</u>		Carried Forward		<u>9,13,62,996.77</u>	

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

Figures for the previous year Rs.	FUNDS & LIABILITIES	Schedule	Rs.	P.
6,44,87,246	Brought Down		8,69,16,703.04	
	CURRENT LIABILITIES AND PROVISIONS :			
1,54,250	1) Outstanding Liabilities for revenue expenditure	A	1,05,625.40	
2,870	2) Outstanding liabilities for Capital expenditure	A	39,10,574.21	
5,28,514	3) Security Deposit from Contractors	B	3,14,399.12	
24,250	4) Sundry Creditors	C	53,168.00	
40,000	5) Earnest Money from Contractors		40,000.00	
12332	6) Provision for Bonus to Employees		11,100.00	
—	7) Provision for rent on leasehold land		9,227.00	
984	8) Contractors' Income tax		—	
—	ADJUSTABLE RENT		2,200.00	
<u>6,52,50,446</u>	TOTAL		<u>9,13,62,996.77</u>	

* Notes on Accounts are separately given in Schedule 'N'.

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

AUDITORS' REPORT

In terms of our report of even date.

8/2, Kiran Shankar Roy Road
Calcutta 700 001
The 4th day of August, 1994.

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

CENTRE FOR BASIC SCIENCES

Salt Lake, Calcutta 700 064

31st March, 1994

Figures for the previous year		PROPERTIES & ASSETS		Rs.	P.	Rs.	P.
Rs.	P.						
6,51,96,288		Brought Down				9,13,62,996.77	
54,158		Employees' Provident Fund					—

6,52,50,446

TOTAL

9,13,62,996.77

(S. K. SHARMA)
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		General Account			Rs.	P.	Rs.	P.
Rs.	P.	Rs.	P.					
1,05,045		14,20,928		Salary & Allowances	1,28,718.00		15,30,700.02	
		54,685		Wages			65,080.75	
		62,619		Employers' Contribution to P.F.			64,843.00	
		80,706		Medical Claims	1,175.00		61,309.62	
		12,332		Adhoc Bonus to Employees			11,100.00	
		34,881		Electricity Charges			51,099.14	
		73,757		Hire Charges of Transport			86,012.18	
		50,767		Hire Charges of Generator			46,600.00	
		2,62,800		Rent of Office Premises			3,21,000.00	
		24,022		Office Contingency Expenses			30,002.86	
		94,160		Printing & Stationery			93,931.30	
		7,895		Repairs to Equipment			11,669.45	
		44,472		Postage & Telegram	1,550.00		51,526.00	
		18,170		Insurance Premium			14,826.15	
		90,821		Telephone & Trunkcalls			1,30,001.30	
		947		TA/DA to Non Academic Staff			566.20	
		24,889		TA/DA to Academic Staff (India)			31,904.75	
		74,258		TA/DA to Academic Staff (Abroad)			36,373.89	
		77,797		Meeting Expenses			83,799.45	
		3,871		Bank Charges	415.00		3,986.00	
		12,480		Car Maintenance			28,559.83	
		18,972		Office Maintenance			30,804.20	
		2,48,735		Seminar & Other Academic Expenses			2,67,656.60	
		30,000		Accommodation for Visiting Scientists			30,000.00	
		1,33,785		Visiting Member Fellowship			1,28,254.30	
		6,295		Director's Research Expenses			36,384.99	
		25,199		Academic Staff Research Expenses			21,700.26	
		38,185		Publication of Seminar Proceedings			29,820.00	
14,175		1,96,425		Computer Maintenance	15,000.00		2,70,483.00	
1,44,417				Stipend to CSIR Fellows	1,63,739.00			
		4,657		Library General Expenses			10,027.00	
		27,618		Provision for Gratuity			25,556.00	
		6,500		Audit Fees			7,250.00	
45,262				Travel	64,572.10			
62,733				Contingency & Raw Materials	1,23,519.34			
		4,42,437		TA/DA to TPSC Speakers			5,08,817.00	
		1,57,520		E-Mail etc			1,24,640.00	
<u>3,71,632</u>		<u>38,63,585</u>		Carried Forward	<u>4,98,688.44</u>		<u>42,54,285.24</u>	

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
the year ended 31st March, 1994

Figures for the previous year				INCOME	Project Account		General Account	
Project Account Rs.	P.	General Account Rs.	P.		Rs.	P.	Rs.	P.
		15,00,000		Grant-in-Aid Received Non-Plan			20,00,000.00	
		25,51,118		Plan			34,77,746.00	
2,02,891				Misc. Grant-in-Aid Received : For Project	16,00,312.00			
1,45,027				For CSIR Fellows	2,21,332.00			
		25,829		For WHEPP-II				
		17,34,764		Interest on short term deposits			11,74,385.33	
				Misc. Income			1,054.25	
		6,420		Income from Guest House			1,290.00	
		130		Others			—	
		6,445		Contribution against WHEPP-II			—	
		—		Registration charges for S.N. Bose Birth Centenary			30,500.00	
		—		Contribution from ICTP for S.N. Bose Birth Centenary			44,118.00	
<u>3,47,918</u>		<u>58,24,706</u>		Carried Forward	<u>18,21,644.00</u>		<u>67,29,093.58</u>	

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

Project Account		General Account		EXPENDITURE	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
3,71,632		38,63,585		Brought Forward	4,98,688.44		42,54,285.24	
		20,210		POL			20,395.91	
		24,950		Building Maintenance			—	
		9,226		Lease Rent			9,227.0	
3,558				Suppliers & Materials	740.00			
		7,973		S.N. Bose Birth Centenary			8,18,902.20	
		2,296		Furnishing Accommodation for Visiting Scientists			1,186.70	
		5,42,830		BCSPIN Account				
				LTC			25,893.20	
<u>3,75,190</u>		<u>44,71,070</u>			<u>4,99,428.44</u>		<u>51,29,890.25</u>	
—		13,53,636		Excess of Income over expenditure for the year C/D.	13,22,215.56		15,99,203.33	
<u>3,75,190</u>		<u>58,24,706</u>		Carried Forward	<u>18,21,644.00</u>		<u>67,29,093.58</u>	

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
the year ended 31st March, 1994

Project Account		General Account		INCOME	Project Account		General Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
3,47,918		58,24,706		Brought Forward		18,21,644.00		67,29,093.58
27,272		—		Excess of Income over expenditure for the year carried over		—		—
<u>3,75,190</u>		<u>58,24,706</u>				<u>18,21,644.00</u>		<u>67,29,093.58</u>
<u>3,75,190</u>		<u>58,24,706</u>		Carried Forward		<u>18,21,644.00</u>		<u>67,29,093.58</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.
27,272		—		Excess of expenditure over Income b/f		—		—
		14,39,049		Excess of Income over expenditure transferred to General Fund	13,22,215.56		16,00,713.33	
<u>27,272</u>		<u>14,39,049</u>			<u>13,22,215.56</u>		<u>16,00,713.33</u>	

8/2, Kiron Shankar Roy Road
Calcutta 700 001
The 4th day of August, 1994.

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

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
the year ended 31st March, 1994

Figures for the previous year				INCOME	Project Account		General Account	
Project Account		General Account			Rs.	P.	Rs.	P.
Rs.	P.	Rs.	P.					
—		13,53,636		Excess of Income over Expenditure for the year b/f.	13,22,215.56		15,99,203.33	
—		85,412		Adjustment relating to Prior period Adjustment (SCH-M)		—	1,510.00	
27,272		—		Excess of Expenditure over Income transferred to Fund		—		—
<u>27,272</u>		<u>14,39,048</u>			<u>13,22,215.56</u>		<u>16,00,713.33</u>	

(S. K. SHARMA)
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.							
OPENING CASH & BANK BALANCES										
2,90,263		1,69,347		Indian Overseas Bank	54,375.60		15,03,473.96			
		2,24,990		United Bank of India			2,24,985.00			
		335		Cash in hand			214.11			
		6,445		Contribution for WHEPP-II						
		6,400		Recovery of Staff Advances						—
		28,000		Festival Advance			7,800.00			
				Staff Advance						—
				Grant in-aid Received :						
		1,60,00,000		for Plan Expenditure			2,27,00,000.00			
		15,00,000		for Non-Plan Expenditure			20,00,000.00			
		25,829		For WHEPP-II						—
				Misc. Grant-in-aid Received :						
1,45,027				For CSIR Fellows		1,64,935.00				
2,02,891				For Projects		16,60,709.00				
				Encashment of Short Term						
				Deposits IOB	1,29,01,859.00					
		1,47,67,237		UBI	10,00,000.00		1,39,01,859.00			
		—		Earnest Money from Contractors			20,000.00			
		4,21,794		Security Deposits from Contractors			4,86,278.85			
		18,39,637		Interest on Short Term Deposits			12,28,685.50			
		2,27,084		Recovery against advance to Suppliers			5,53,559.37			
		1,24,14,854		Recovery of Advances to Contractors			88,96,946.82			
		—		Recovery of Advances to						
				Ghosh, Bose & Associates			2,00,000.00			
<u>6,38,181</u>		<u>4,76,31,952</u>		Carried Forward		<u>18,80,019.60</u>		<u>5,17,23,802.61</u>		

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1994

Figures for the previous year				PAYMENTS	Project		General	
Project Account		General Account			Account		Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
1,01,075		14,20,088		Salary & Allowances	1,32,658.00	15,18,764.57		
		54,685		Wages (Casual)		63,384.00		
		85,841		Employer's Contribution to P.F		64,843.00		
		7,200		Festival Advance		9,000.00		
		56,005		Medical Claims	1,175.00	48,342.14		
		10,317		Adhoc Bonus to Employees		10,876.00		
		34,881		Electricity Charges		51,099.14		
		73,757		Hire of transport		86,012.18		
		50,768		Hire of Generators		54,600.00		
		2,63,250		Hire of Office Premises		3,21,000.00		
		1,44,000		Deposit for Rent		73,700.00		
		23,676		Office Contingency Expenses		30,002.86		
		1,14,315		Printing & Stationery		1,08,375.34		
		4,024		Repair of Equipment		11,669.45		
		43,477		Postage & Telegram		51,526.00		
		18,552		Insurance Premium		14,145.00		
		90,662		Telephone & Trunkcalls		1,30,001.30		
		57,270		E - Mail		1,24,640.00		
		24,889		T.A/D.A to Academic Staff (India)		30,825.75		
		74,258		T.A/D.A to Academic Staff (Abroad)		36,373.89		
		947		T.A/D.A to Non-academic staff		566.20		
		77,797		Meeting Expenses		83,799.45		
		3,870		Bank Charges	415.00	3,932.00		
		39,529		Campus Beautification		42,303.00		
		1,56,19,663		Construction of Building		1,08,18,646.98		
		1,56,52,123		Advance to Contractors		1,20,06,633.50		
		7,79,240		Advance to Suppliers	1,87,679.67	7,58,308.47		
				Adhoc payment to Ghosh Bose & Associates		2,00,000.00		
		—		Advance to W B S E B		34,27,604.00		
<u>1,01,075</u>		<u>3,48,25,084</u>		Carried Forward	<u>3,21,927.67</u>	<u>3,01,80,974.22</u>		

**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.					
6,38,181		4,76,31,952		Brought Forward		18,80,019.60		5,17,23,802.61
		78,900		Recovery of Deposit for Rent				1,25,500.00
		4,174		Recovery of Project Account				—
		10,773		Recovery of Expenses for WHEPP-II				—
				Recovery from Bombay University				20,000.00
				Recovery of Expenses for BCSPIN				27,554.75
		20		Recovery of Insurance Premium				20.00
		—		Recovery from Santimoy Chatterjee				56,000.00
		1,394		Contractors' Income Tax deduction				—
				Donation received:				
		75,000		J Bose				25,000.00
				Misc. Incomes :				
		6,420		Income from Guest House				1,290.00
		130		Others (Misc. Receipts)				1,954.25
		—		Registration Charges for				
				S.N. Bose Birth Centenary				30,500.00
				Contribution from ICTP for				
				S.N. Bose Birth Centenary				77,836.00
				Deposit from N. Nayak				200.00
				Receipt of Adjustable Rent				4,200.00
<u>6,38,181</u>		<u>4,78,08,763</u>		Carried Forward		<u>18,80,019.60</u>		<u>5,20,92,957.61</u>

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1994

		Figures for the previous year		PAYMENTS	Project Account		General Account	
					Rs.	P.	Rs.	P.
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
1,01,075		3,48,25,084		Brought Forward	3,21,927.67	3,01,80,974.22		
				Advance against LTC			3,000.00	
				Advance to Indian Physical Society			6,729.20	
				Advance to ECRA			13,010.00	
		600		Advance to Staff	5,087.10		1,500.00	
				Advance to National Board of Higher Maths			3,253.00	
				Advance to Sankho Chowdhury			20,000.00	
		4,500		Advance to S. Manna			—	
		12,480		Car Maintenance			28,559.83	
		17,221		Office Maintenance			30,804.20	
14,175		274,020		Computer Maintenance	15,000.00		2,61,785.00	
		4,658		Library General Expenses			10,027.00	
		84,970		Library Furniture			—	
		104,818		Library Books			98,765.25	
		93,010		Library Journals			4,41,416.30	
		79,20,251		Short Term Deposit with IOB			149,01,095.50	
		493,872		Short Term Deposit with UBI			18,33,659.00	
		—		Employees' Provident Fund			25,892.00	
		248,135		Seminar & Other Academic Expenses			2,67,656.60	
		30,000		Accommodation for visiting scientists			30,000.00	
				Furnishing Accommodation for Visiting Scientists			1,186.70	
		2,296		Small Equipment			21,678.24	
		630		Office Equipment			—	
		3,750		Office Furniture			7,548.47	
		99,451		Visiting Fellowship			1,28,254.30	
		133,785		Director's Research Expenses			36,384.99	
		6,295		Director's Research Equipment			60,652.00	
		23,347		POL			20,395.91	
		20,210						
<u>1,15,250</u>		<u>4,44,03,383</u>		Carried Forward	<u>3,42,014.77</u>	<u>4,84,34,227.71</u>		

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1994

Figures for the previous year				PAYMENTS	Project		General	
Project		General			Account		Account	
Rs.	P.	Rs.	P.		Rs.	P.	Rs.	P.
1,15,250		4,44,03,383		Brought Forward	3,42,014.77	4,84,34,227.71		
		24,709		Academic Staff Research Expenses		21,483.70		
		32,904		Academic Staff Research Equipment		10,334.54		
		38,185		Publication of Seminar Proceedings		16,170.00		
		57,707		Computer & Accessories		162,067.00		
		63,653		Outstanding Liabilities	4,000.00	1,53,149.75		
		95,590		UPS		—		
		23,151		Gratuity Fund Investment		27,617.88		
		210,938		Refund of Security Deposits to Contractors		700,393.93		
		—		Refund of Earnest Money to Contractors		20,000.00		
		442,437		T.A./D.A. to TPSC Speakers		5,08,817.00		
				Stipend & Contingency to CSIR Fellow	161,934.00			
144,417				Travel	52,112.10			
45,262				Advance for Equipment	99,650.00			
212,611				Contingency & Raw Materials	122,719.34			
62,707				Supplies & Materials	740.00			
3,558		20		Insurance Premium Recoverable		—		
		6,398		S N Bose Birth Centenary		766,922.20		
		—		Transfer to Project Account		46,910.00		
				Contractors' Income Tax		984.00		
		2,000		Adjustable Rent		—		
		27,680		Lease Rent		—		
		561,783		BCS PIN Account		—		
		8,602		Recoverable expenses for BCS PIN		—		
<u>5,83,805</u>		<u>4,59,99,140</u>		Carried Forward	<u>7,83,170.21</u>	<u>5,08,69,077.71</u>		

**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.					
6,38,181		4,78,08,763		Brought Forward	19,11,084.60		5,20,95,457.61	

<u>6,38,181</u>	<u>4,78,08,763</u>	TOTAL	<u>19,11,084.60</u>	<u>5,20,95,457.61</u>
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8/2 Kiron Shankar Roy Road
Calcutta -700 001
The 4th day of August, 1994.

CENTRE FOR BASIC SCIENCES
Salt Lake, Calcutta 700 064
for the year ended 31st March, 1994

Figures for the previous year				PAYMENTS	Project Account		General Account	
Project Account		General Account			Rs.	P.	Rs.	P.
Rs.	P.	Rs.	P.					
5,83,805		4,59,99,140		Brought Forwad	7,83,170.21	5,08,69,077.71		
		24,950		Building Maintenance				—
		—		L T C				25,893.20
		—		Library Books & Journal (Out of Donation)				4,758.55
		56,000		Advance to Santimoy Chatterjee				—
				Closing Cash & Bank Balances :				
54,376		15,03,474		Indian Overseas Bank, Salt Lake	11,27,914.39	9,10,183.77		
		2,24,985		United Bank of India Mayukh Bhavan Branch		2,84,156.94		
		214		Cash		1,387.44		
<u>6,38,181</u>		<u>4,78,08,763</u>		TOTAL	<u>19,11,084.60</u>	<u>5,20,95,457.61</u>		

(S. K. SHARMA)
Administrative Officer

(C. K. MAJUMDAR)
Director

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

	Rs.	P
a) Outstanding Liabilities (Revenue)		
i) Casual Labour	1,696.75	
ii) Construction of Building	4,050.16	
iii) Medical Claim	12,967.48	
iv) Salary & Allowances	11,935.45	
v) Academic Staff Research Expenses	216.56	
vi) TA/DA to Academic Staff (India)	1,079.00	
vii) S.N. Bose Birth Centenary	51,980.00	
viii) Publication of Seminar Proceedings	13,650.00	
ix) Audit Fee	7,250.00	
x) Outstanding Contingency (Project A/c.)	800.00	
	<u>1,05,625.40</u>	
b) Outstanding Liabilities (Capital)		
i) Construction of Building	38,06,142.21	
ii) Computer & Accessories	1,04,432.00	
	<u>39,10,574.21</u>	

Schedule — 'B'

Security Deposit from Contractors

1. Gannon Dunkerley & Co. Ltd.	NIL	
2. Nabin Designers & Constructor (P) Ltd.	1,32,405.85	
3. Ghosh, Bose & Associates	1,16,851.00	
4. Pradhan & Associates	58,935.27	
5. Sarala Construction	6,207.00	
6. Mitra Construction	NIL	
	<u>3,14,399.12</u>	

SCHEDULE — 'C'

Sundry Creditors

1. Deposit from A. Mukherjee	18,000.00	
2. Deposit from N. Nayak	1,450.00	
3. Refundable unutilised contribution to ICTP	33,718.00	
	<u>53,168.00</u>	

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

FIXED ASSETS

Name of Block of Assets	Opening Balance as on 1.4.93		Additions during the year		Adjustment during the year		Closing Balance as on 31.4.94	
	Rs.	P	Rs.	P	Rs.	P	Rs.	P
	A. Office Equipment	2,31,104.92			—		—	2,31,104.92
B. Guest House Furniture	1,18,882.36			—		—	1,18,882.36	
C. Small Equipment	1,81,872.79		21,678.24			—	2,03,551.03	
D. 1) Books & Journals	13,02,744.17		5,44,940.09			—	18,47,684.26	
2) Director's Research Equipment	1,87,539.55		60,652.00			—	2,48,191.55	
3) Boundary Wall	10,38,937.20			—		—	10,38,937.20	
4) Construction of Buildings	2,57,88,658.66		1,46,28,839.35			—	4,04,17,498.01	
5) Computer	13,08,680.44			—		—	13,08,680.44	
6) Computer & Accessories	4,25,499.10		2,66,499.00			—	6,91,998.10	
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	1,80,581.61		42,303.00			—	2,22,884.61	
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	49,163.77		10,334.54			—	59,498.31	
E. Furniture & Fixture	7,40,744.93		7,548.47			—	7,48,293.40	
F. Project Assets								
1) Equipment	9,88,759.29		99,650.00			—	10,88,409.29	
2) Books & Periodicals	7,080.08			—		—	7,080.08	
TOTAL Rs.	4,39,32,897.07		1,56,82,444.69			—	5,96,15,341.76	

Schedule — 'E'

SHORT TERM DEPOSITS (Including Accrued & re-invested Interest)

	Amount	
	Rs.	P.
a) Indian Overseas Bank, Salt Lake Branch		
STD (46 days)	42,00,000.00	
STD (91 days)	15,99,318.00	
STD (6 months)	2,00,014.00	
STD (1 year)	20,00,000.00	79,99,332.00
b) United Bank of India, Mayukh Bhawan Branch		
STD (91 days)		52,02,951.99
TOTAL Rs.		1,32,02,283.99

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

Schedule—'E'

	Rs.	P
BANK BALANCES		
a) With Indian Overseas Bank, Salt Lake Branch :		
General Fund Account	9,10,183.77	
Project Fund Account	11,27,914.39	
Provident Fund Account	89,552.06	
b) With United Bank of India, Mayukh Bhawan Branch		
General Fund Account	2,84,156.94	
TOTAL Rs.	<u>24,11,807.16</u>	

Schedule — 'G'

ADVANCES TO SUPPLIERS AND CONTRACTORS

A. General Account		
1. Nabin Designers & Constructors (P) Ltd.	64,14,902.84	
2. Advance to C-DAC	2,16,266.94	
3. Godrej & Boyce Mfg. Co. Ltd.	1,08,971.80	
4. Allied Publishing Agency	3,92,191.00	
5. CMC Ltd.	20,34,380.00	
6. Graf-M-Publishers	49,075.00	
7. WBSEB	34,27,604.00	
8. Pradhan & Associates	8,79,588.28	
9. Blue Star Ltd.	4,42,800.00	
10. Otis Ltd.	2,50,000.00	
	<u>1,42,15,779.86</u>	
B. Project Account		
1. Hewlett Packard India Ltd.	45,760.00	
2. Polytronic Corporation	41,899.05	
3. Micronic Devices	14,443.00	
4. Jubilee Enterprise	13,900.00	
5. National Physical Laboratory	17,545.00	
6. IVP Ltd.	54,132.62	
	<u>1,87,679.67</u>	
TOTAL (A+B)	<u>1,44,03,459.53</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	37,500.00
5. J. B. Bhowmick	21,000.00
	<u>82,950.00</u>

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

Schedule—'I'

	Rs.	P
SECURITY DEPOSITS		
1) West Bengal State Electricity Board	16,990.00	
2) Department of Telecommunication	1,600.00	
TOTAL Rs.	<u>18,590.00</u>	

Schedule — 'J'

ADVANCES AGAINST EXPENSES RECOVERABLE		
1. Recoverable Expenses on Seminar (PATPAA)	10,000.00	
2. Recoverable of Insurance Premium	—	
3. Recoverable Expenses on BCS PIN	—	
	<u>10,000.00</u>	

Schedule — 'K'

OTHER ADVANCES		
1. Staff Advances (Project A/c)	5,087.10	
2. Rabin Banerjee	13,181.00	
3. Festival Advance	3,640.00	
4. Misc. Staff Advance	2,100.00	
5. S. Manna	4,500.00	
6. Advance against LTC	3,000.00	
7. Indian Physical Society	6,729.20	
8. ECRA	13,010.00	
9. National Board of Higher Maths	3,253.00	
10. Sankho Chowdhury	20,000.00	
	<u>74,500.30</u>	

Schedule — 'L'

PREPAID EXPENSES		
1. Insurance Premium	12,091.00	
2. Computer Maintenance	2,27,022.00	
	<u>2,39,113.00</u>	

Schedule — 'M'

	Debit Rs.	Credit Rs.
PRIOR PERIOD ADJUSTMENT		
Bonus to Employees	—	1,456.00
Bank Charges	—	54.00
TOTAL	<u>—</u>	<u>1,510.00</u>

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

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. 5,96,15,341.76 as disclosed in the Balance Sheet includes Library Books and Journals valued at Rs. 18,54,764.34.
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.
5. As per consistent practice, all Capital Work-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. 1,510/- has been taken into account for this year, the details of which are furnished vide Schedule M to this annual accounts.
7.
 - i) Specific guidelines/bye-laws regarding Employees' Provident Fund are yet to be registered/recognised. During the year an ad-hoc deduction @ 10% on basic Salary has been made from Employees Gross Salary and deposited in a separate account maintained with a Nationalised 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 balances in the Employees' Provident Fund and the Gratuity Fund, Rs. 8,42,000/- and Rs. 1,11,339.88 have been invested in separate, earmarked short term deposits with a nationalised bank. Amount of Rs. 89,552.06 and 25,556/- 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. Certain comparative figures for the previous year in the accounts have been reclassified to conform to the current years' presentation.

