annual report-1991-92

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES.

DB-17 SECTOR-1 SALT LAKE
CALCUTTA-700 064

ANNUAL REPORT

(1991-92)

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

(ESTD. 1986)

DB 17, SECTOR I, SALT LAKE,
CALCUTTA-700 064

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES CALCUTTA

ANNUAL REPORT

April 1, 1991 to March 31, 1992

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.

GOVERNING BODY

The present Governing Body of the Centre consists of the following members

1. Professor P. Rama Rao Chairman	Secretary Department of Science & 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. J. Pal Chaudhuri Non-member secretary	Administrative Officer S N Bose National Centre for Basic Sciences, Calcutta

The Centre now operates from a rented house at DB 17, Sector I, Salt Lake City, Calcutta-700 064. It has additional space at CD 85 — a short walk from the main office. The Centre's own campus is being built in Block JD, Sector III, Salt Lake City, Calcutta.

ACADEMIC PROGRAMMES

The Academic Programme Advisory Committee considers the yearly academic activities of the Centre. It has now 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

Professor N. Mukunda Chairman	Indian Institute of Science, Bangalore
Professor P. K. Kaw Member	Institute of Plasma Research, Gandhinagar
Professor A. Raychaudhuri Member	Formerly of Presidency College, Calcutta
Professor H. S. Mani Member	Indian Institute of Technology, Kanpur
Professor S. S. Jha Member	Tata Institute of Fundamental Research, Bombay
Professor K. B. Sinha Member	Indian Statistical Institute, New Delhi
Professor J. V. Narlikar Member	Inter-University Centre for Astronomy and Astrophysics, Pune
Professor C. K. Majumdar Member-Convener	S. N. Bose National Centre for Basic Sciences, Calcutta

Research Advisory Committee - II

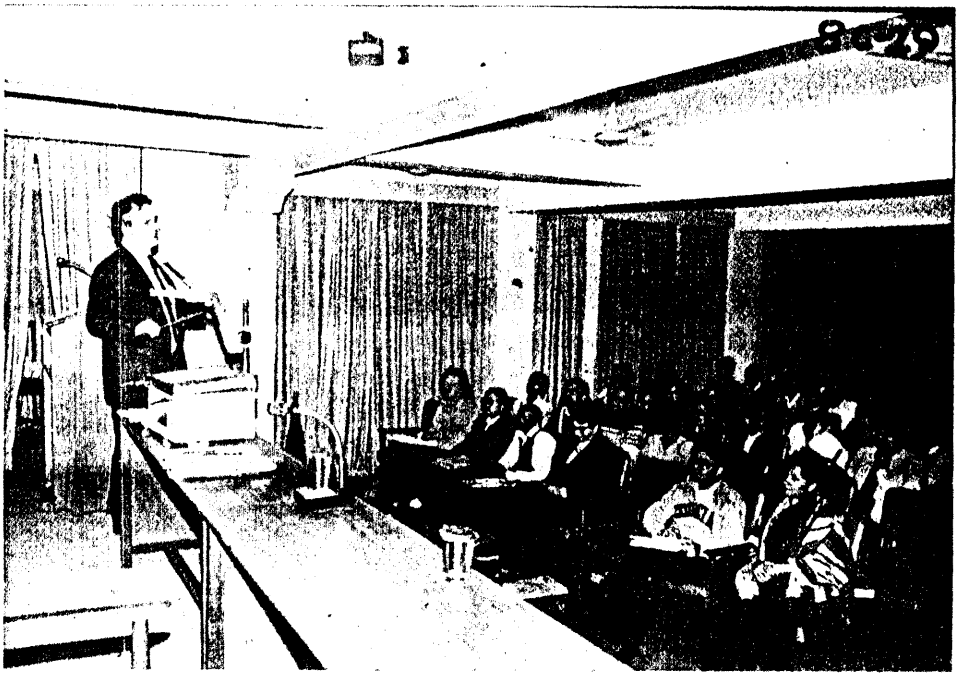
Professor Mihir Chowdhury Chairman	Indian Association for the Cultivation of Science, Calcutta
Professor Sarat Chandra Member	Centre for Cellular and Molecular Biology, Hyderabad
Professor Jyotirmoy Das Member	Indian Institute of Chemical Biology, Calcutta
Professor V. Nanjundiah Member	Indian Institute of Science, Bangalore

Professor G. Govil Member	Tata Institute of Fundamental Research, Bombay
Professor J. C. Parikh Member	Physical Research Laboratory, Ahmedabad
Professor B. M. Deb Member	Punjab University, Chandigarh
Professor R. Ramaswamy Member	Jawaharlal Nehru University, New Delhi
Professor S. Ramasesha Member	Indian Institute of Science, Bangalore
Professor N. Satyamurthy Member	Indian Institute of Technology, Kanpur.
Professor C. K. Majumdar Member-Convener	S. N. Bose National Centre for Basic Sciences, Calcutta

Conferences/Workshops/Symposia

STATPHYS, Calcutta

The Centre organised a discussion meeting on the Statistical Physics of Disordered Solids, Glasses and Polymers. It was held at the Ramakrishna Mission Institute of Culture, Calcutta, from December 27, 1991 to January 7, 1992. The main topics covered in the meeting were : (1) Fractals — Gene Stanley (Boston), (2) Porous media — Pabitra Sen (Schlumberger) and Partha Mitra (Harvard), (3) Glasses — Chandan Das Gupta and Sriram Ramaswamy, Indian Institute of Science (IISc.) Bangalore, (4) Polymers — Somen Bhattacharyya, Institute of Physics (IOP) Bhubaneswar, (5) Granular System — Anita Mehta (Birmingham), (6) Amphiphilic Membrances — Debashis Chowdhuri, Jawaharlal Nehru University (JNU) New Delhi, (7) Statistical Physics of Neural Networks — Chandan Dasgupta, Indian Institute of Science (IISc.) Bangalore, (8) Statistical Physics of Quantum Networks — A. Mookerjee, S. N. Bose National Centre for Basic Sciences (SNBNCBS) Calcutta, and A. K. Sen, Saha Institute of Nuclear Physics (SINP) Calcutta, (9) Self Organised Criticality — D. Dhar, Tata Institute of Fundamental Research (TIFR) Bombay, and (10) Kinetics of clusters in Ising Models — D. Stauffer (Koeln)



Prof. H. E. Stanley delivering the third S. N. Bose Memorial Lecture

Prof. K. L. Chopra delivering the key note address at STATPHYS, CALCUTTA

The Participants were :

1. Dr. H. E. Stanley
University of Boston, USA
2. Dr. D. Stauffer
University of Koeln, Germany
3. Dr. Pabitra Sen
Schlumberger Doll Research, USA
4. Dr. Anita Mehta
University of Birmingham, UK
5. Dr. Jyotsana Lal
Laboratoire Leon Brillouin,
Saclay, France
6. Mr. Muktish Acharya
SINP, Calcutta
7. Mr. A. A. Ali
TIFR, Bombay
8. Dr. V. Balakrishnan
IIT, Madras
9. Dr. Srilekha Banerjee
SNBNCBS, Calcutta
10. Mr. K. Barat
SINP, Calcutta
11. Dr. Soumen Basak
SINP, Calcutta
12. Ms. Chaitali Basu
SNBNCBS, Calcutta
13. Dr. Somen Bhattacharyya
IOP, Bhubaneswar
14. Dr. Debashis Chowdhury
JNU, New Delhi
15. Dr. B. K. Chakraborty
SINP, Calcutta
16. Dr. Chandan Dasgupta
IISc, Bangalore
17. Mr. Indra Dasgupta
SNBNCBS, Calcutta
18. Dr. Subinoy Dasgupta
University of Calcutta
19. Mr. Abhijit Datta
SNBNCBS, Calcutta
20. Dr. Sushanta Dattagupta
JNU, New Delhi
21. Dr. Deepak Dhar
TIFR, Bombay
22. Dr. M. H. Engineer
Bose Institute, Calcutta
23. Dr. D. Gangopadhyay
SNBNCBS, Calcutta
24. Ms. Sarmistha Gangopadhyay
SINP, Calcutta
25. Dr. S. Ghatak
IIT, Bombay
26. Dr. Mahua Ghosh
IISc., Bangalore
27. Mr. M. K. Hari
TIFR, Bombay
28. Mr. A. Kar Gupta
SINP, Calcutta
29. Dr. S. N. Karmakar
SINP, Calcutta
30. Dr. K. Kundu
IOP, Bhubaneswar
31. Mr. S. K. Manna
SNBNCBS, Calcutta
32. Dr. C. K. Majumdar
SNBNCBS, Calcutta

33. Mr. S. Majumdar
TIFR, Bombay

34. Mr. Partha Mitra
Harvard University, USA

35. Dr. Sujata Modok
SINP, Calcutta

36. Dr. Abhijit Mookerjee
SNBNCBS, Calcutta

37. Ms. Sutapa Mukherjee
IOP, Bhubaneswar

38. Dr. Arun Pratap
University of Rajasthan, Jaipur

39. Mr. S. S. Rao
IOP, Bhubaneswar

40. Dr. S. Ramaswamy
IISc., Bangalore

41. Dr. Apurba K. Roy
Shantipur College, Shantipur

42. Ms. Tanusri Saha
SNBNCBS, Calcutta

43. Mr. S. B. Santra
Bose Institute, Calcutta

44. Dr. Subir K. Sarkar
JNU, New Delhi

45. Dr. Bimal K. Sarma
University of Wisconsin, USA

46. Dr. Aloke Satpathy
Jadavpur University, Calcutta

47. Dr. A. K. Sen
SINP, Calcutta

48. Ms. Parangama Sen
SINP, Calcutta

49. Dr. Surajit Sen
Michigan State University, USA

50. Ms. P. B. Thomas
TIFR, Bombay

51. Dr. M. Yussouff
Michigan State University, USA

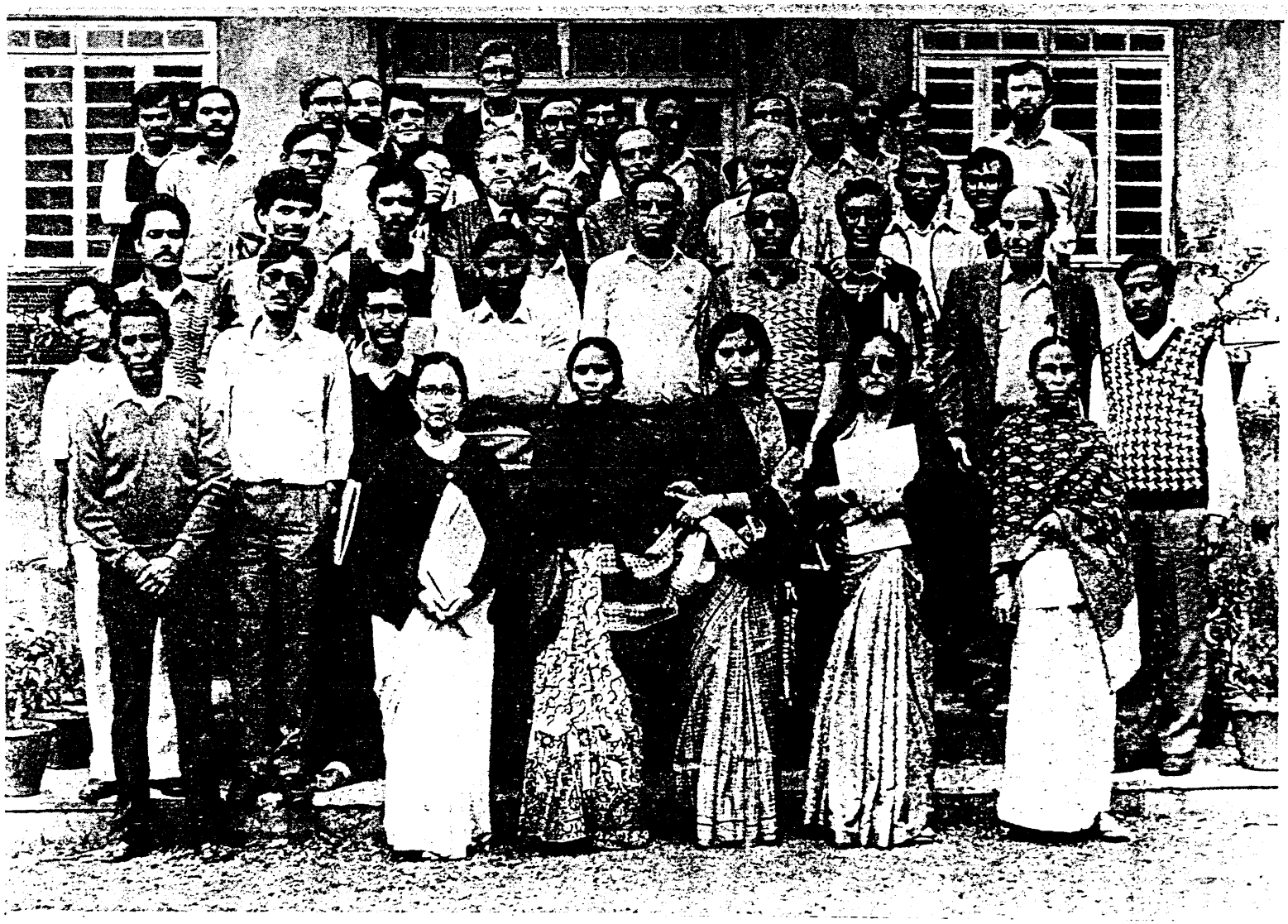
52. Dr. Ms. Indrani Bose
Bose Institute, Calcutta

53. Dr. Mangal Mahato
University of Hyderabad, Hyderabad

QFT & STATMECH, CALCUTTA

The Centre, in collaboration with the Indian Statistical Institute, held a symposium on 'Quantum Field Theory and Statistical Mechanics' during January 28-31, 1992.

C. Hurst spoke on the algebraic structure of the Pfaffian solution of the two dimensional Ising model; S. P. Mishra reviewed the description of phase transitions in quantum field theory by non-perturbative method. Some topics of current interest in statistical mechanics covered in lectures included anyons and virial coefficients (D. Sen); quantum groups in non-linear dynamics (A. Kundu); quantum field theoretic (QFT) approach to a dissipative system (K. Hazra) and QFT approach to high Tc superconductors (G. Baskaran) and thermofield dynamics (H. P. Mishra).



Some of the Participants of the Symposium on Quantum Field Theory and Statistical Mechanics

Topics with more QFT bias included dynamical breaking of Chiral Symmetry in QCD motivated confinement model (A. N. Mitra); Euclidean fermions and the Feynman path integrals (H. Banerjee); new forms of quantum statistics (G. Rajasekaran); magnetic monopoles and Clifford algebra (E. Recami) and Berry phases in topological QFT (P. Bandyopadhyay).

Stochastic quantization was talked about by S. Tanaka. Malin gave a clear lecture on a field theoretic approach to quantum gravity. S. R. Das talked on interesting properties of strings in two dimensions. S. Ghosh and J. Fuchs discussed operator algebra in quantum field theory. It was obvious that practitioners of both disciplines would benefit by mutual discussions in such meetings.

The participants were :

1. Prof. G. Baskaran
   Inst of Math. Sc., Madras
2. Prof. H. Banerjee
   SINP, Calcutta
3. Prof. P. Bandyopadhyay
   ISI, Calcutta
4. Sri A. Bandyopadhyay
   Calcutta University
5. Dr. Srilekha Banerjee
   SNBNBCS, Calcutta
6. Dr. R. Banerjee
   SNBNCBS, Calcutta
7. Sri B. Basu Mallick
   SINP, Calcutta
8. Dr. Indrani Bose
   Bose Inst., Calcutta
9. Dr. A. K. Bandyopadhyay
   T.D.B. College, Raigunj
10. Dr. B. Bhattacharya
    Fakir Chand College, Calcutta
11. Dr. Banasri Basu
    ISI, Calcutta
12. Ms. Dipti Banerjee
    ISI, Calcutta
13. Mr. B. Basu Roy
    SINP, Calcutta
14. Dr. P. M. Chatterjee
    T.D.B. College, Raigunj
15. Dr. S. R. Das
    TIFR, Bombay
16. Dr. A. K. Das
    Scottish Church College, Calcutta.
17. Dr. Mira Dey
    Lady Brabourne College, Calcutta
18. Dr. Jishnu Dey
    Hooghly Mohsin College, Hooghly
19. Prof. J. Fuchs
    NIKHEF-H, Amsterdam
20. Prof. M. H. Engineer
    Bose Inst. Calcutta
21. Dr. S. Ghosh
    Inst. of Math. Sc., Madras
22. Dr. P. Ghose
    SNBNBCS, Calcutta

25. Mr. A. K. Ghosh
Kalna College

26. Mr. A. Ghosh
SINP, Calcutta

27. Dr. P. Ghosh
MMC College, Calcutta

28. Mr. Gautam Goswami
ISI, Calcutta

29. Dr. K. Hajra
ISI, Calcutta

30. Prof. C. A. Hurst
University of Adelaide,
South Australia

31. Dr. D. Home
Bose Inst., Calcutta

32. Prof. A. Khare
Inst. of Phys, Bhubaneswar

33. Dr. A. Kundu
SINP, Calcutta

34. Mr. A. Kundu
ISI, Calcutta

35. Prof. S. Malin
Colgate University,
Hamilton, USA

36. Prof. S. P. Misra
Inst. of Phys, Bhubaneswar

37. Mr. H. Misra
Inst. of Phys, Bhubaneswar

38. Prof. A. N. Mitra
University of Delhi

39. Prof. A. Mookerjee
SNBNCBS, Calcutta

40. Dr. S. Mallick
SINP, Calcutta

41. Dr. T. Mukherjee
IACS, Calcutta

42. Sri P. Mukherjee
University of Calcutta

43. Sri. S. Mukhopadhyay
SINP, Calcutta

44. Prof. C. K. Majumdar
SNBNCBS, Calcutta

45. Dr. P. Mahato
Narashingha Datta College

46. Ms. Lipika Mullick
ISI, Calcutta

47. Dr. S. Pal
SNBNCBS, Calcutta

48. Dr. K. Patari
Serampore College

49. Sri A. Rahaman
SINP, Calcutta

50. Sri A. Roy
University Calcutta

51. Prof. E. Recami
State University of Catanie, Italy

52. Prof. G. Rajasekaran
Inst. of Math. Sc., Madras

53. Mr. A. K. Roy
ISI, Calcutta

54. Dr. D. Sen
IISc, Bangalore

55. Dr. D. P. Sarkar
Jhargram College

56. Sri S. Sen
IACS, Calcutta

Anita Mehta and D Stauffer at lunch-break, STATPHYS

D. P. Roy, Rohini Godbole and Partha Ghose during the Mini-Workshop on Beyond the Standard Model and Super Collider Physics

57. Sri V. V. Sridhar
SINP, Calcutta

58. Ms. Krishna Sen
Anandamohan College, Calcutta

59. Dr. M. Sinha Roy
Bidhannagar Govt. College

MINI-WORKSHOP ON 'BEYOND THE STANDARD MODEL AND SUPERCOLLIDER PHYSICS'

The Centre organized a Mini-workshop on 'Beyond the Standard Model and Supercollider Physics' at the University of Bombay, Kalina Campus, during February 10-13, 1992. The speakers included the following :

1. Prof. A. A. Rangwala
University of Bombay

2. Prof. Partha Ghose
SNBNCBS, Calcutta

3. Prof. S. N. Ganguli
TIFR, Bombay

4. Prof. Probir Roy
TIFR, Bombay

5. Prof. A. Raychaudhuri
University of Calcutta

6. Dr. K. Sridhar
PRL, Ahmedabad

7. Dr. R. M. Godbole
University of Bombay

8. Dr. P. N. Pandita
NEHU, Shillong

9. Dr. S. Umasankar
TIFR, Bombay

10. Dr. K. V. L. Sarma
TIFR, Bombay

11. Dr. S. Banerjee
TIFR, Bombay

12. Dr. A. Datta
Jadavpur University, Calcutta

13. Dr. G. Bhattacharyya
University of Calcutta

S. N. BOSE MEMORIAL LECTURE

The Third S. N. Bose Memorial Lecture was delivered by Professor H. Eugene Stanley, Director, Centre of Polymer Studies, Department of Physics, University of Boston, Boston, USA, on January 3, 1992, at the Ramakrishna Mission Institute of Culture, Gol Park. The title of his lecture was "Fractal Landscapes in Physics and Biology". On behalf of the Centre Professor A. Mookerjee introduced Professor Stanley to the audience.

SEMINARS ORGANIZED AT THE CENTRE

Bose Centre Seminars :

Regular seminars are held every Tuesday and Thursday/Friday in various areas of Physics and Mathematics. So far the topics covered include —

- High temperature superconductivity
  - C. K. Majumdar (SNBNCBS), S. K. Bandyopadhyay, P. Barat, U. De and B. Ghosh (VECC), I. Bose (Bose Inst.).
- Renormalization groups
  - D. Gangopadhyay (SNBNCBS)
- Conformal field theory and its applications to statistical mechanics
  - V. Sreedhar (SINP) and S. K. Paul (SNBNCBS)
- Commutative Algebra and Algebraic Geometry
  - Amritasu Sinha (NERIST, Arunachal Pradesh)
- Current status of grand unified theories
  - Utpal Sarkar (PRL, Ahmedabad)

Short Lectures :

- An overview of developments in high temperature superconductivity
  - Ranjan Chaudhury (SNBNCBS) (April 3, 1991)
- Wn Algebra
  - Samir K. Paul (SNBNCBS) (April 24, 1991)
- Single particle experiments to probe wave-particle duality and collapse
  - Partha Ghose (SNBNCBS) (May 15, 1991)
- On Instanton Induced compactification on $M^4 \times CP^2$, spin structures and chiral fermions and

  Quantum effects in Kaluza-Klein theory and stability analysis
  - Biswajit Chakraborty (IMSc., Madras) (May 16 & 17, 1991)
- Statistical mechanics of neural networks
  - Probodh Shukla (NEHU, Shillong) (June 3, 1991)
- (1) Chaos : An introduction; (2) An introduction to polarons; and (3) Polarons and bipolarons in two and higher dimensions and possibility of superconductivity.
  - Ashok Chatterjee (University of Hyderabad) (June 5, 12, 14, 1991)
- An introduction to the theory and applications of wavelet functions
  - Wim Sweldens (Dept. of Comp. Sc.,) Katholieke Universiteit Leuven, Belgium) (July 8, 1991)
- Krichever Novikov formulation of topological conformal field theory.
  - G. Sengupta (IOP, Bhubaneswar) (July 31, 1991)
- Quantum kinematic approach to the geometric phase
  - N. Mukunda (IISc., Bangalore) (September 18, 1991)
- States and operators in minimal CFT coupled to Liouville CFT
  - Partha Majumdar (IMSc., Madras) (December 30, 1991)

- Sensors for Lasers and optical devices
  - K. Chakraborty (Naval Surface Warfare Centre, Silver Spring, Maryland, USA) (January 15, 1992)
- Fast parallel graph searching
  - Pranay Chaudhuri (School of Comp. Sc. & Engg., University of New South Walse, Australia)
- The problem of families and fermion masses
  - J. C. Pati (University of Maryland, USA), (January 16, 1992)
- Calculations on C60 molecules
  - G. Baskaran (IMSc. Madras) (January 31, 1992).
- Non-classical states of light & quantum systems
  - G. S. Agarwal (University of Hyderabad) (March 4, 5, 6, 1992)

RESEARCH ACTIVITIES AT THE CENTRE

Physics

The research activities in physics are in the areas of foundation of quantum mechanics, particle physics, condensed matter physics and quantum optics.

The experiment proposed to test the nature of wave particle duality of single photon states by P. Ghose, D. Home and G. S. Agarwal [Physics Letters A153 403 (1991)] has been performed by Y. Mizobuchi and Y. Ohtake of Hamamatsu Photonics UK, Japan (to be published in Physics Letters A). The results confirm the prediction of quantum optics and contradicts the 'mutual exclusiveness' of wave and particle aspects which constitutes a fundamental tenet of Bohr's complementarity principle. The paper has been presented at several science centres throughout the world. In view of the interest generated, Ghose, Home and Agarwal have been elaborating on the implications of the Japanese experiment in further work. Ghose and Home have been invited to contribute an article on the wave-particle duality of single photon states to a special issue of the Foundation of Physics to be published on the occasion of Louis de Broglie's birth centenary. The work on the manifestly covariant formulation of the EPR problem using the Tomonaga-Schwinger formalism was presented at the International Conference on Bell's Theorem and the Foundations of Modern Physics at Cessna, Italy, in October 1991. The paper entitled "The EPR problem in the light of the Tomonaga-Schwinger formalism" by P. Ghose and D. Home will appear in the conference proceedings to be published by World Scientific, Singapore. The paper contains further clarifications of the

issues raised in the context of an earlier paper in Physical Review A43, 6382 (1991).

A relativistic quantum mechanical interpretation of the Kemmer-Duffin equation for spin-0 and spin-1 bosons (so far thought to be impossible) has been developed. Applications to single boson states, supersymmetry and Higgs bosons are being investigated.

An algebraic approach to the study of anomalous sigma models in 2 dim by R. Banerjee and S. Ghosh has led to new class of solutions with a non-vanishing curvature, though in 4 dim the standard results are reproduced. Quantization of Chern-Simons theories coupled to complex scalars has been done in the Hamiltonian formalism using non-local gauge-fixing conditions; it suggests a novel structure of the anyon operator. Inclusion of the Maxwell term leads to some interesting consequences. A hamiltonian analysis of 2 dim gravity focussing on complete gauge fixing and the connection with the SL2 (R) algebra has been done by R. Banerjee, E. Abdalla and M.L.B. Abdalla, A gauge independent analysis of matter coupled Chern-Simons theory has been done; a gauge invariant anyon operator displaying fractional spin and generalized statistics is found and its compatibility with the spin-statistics theorem is shown.

Interaction between two vortices in an Abelian Higgs Model with Chern-Simons terms has been studied (Int. J. Mod. Phys. *A6* 3441 (1991); the coupling has the properties required to be a part of viable field theoretic models for high temperature superconductors. Evolutions of the Neveu-Schwarz-Ramond type II closed superstring in curved background and of heterotic string in the background of graviton, antisymmetric tensor field and gauge field are considered. In the first case, anomaly free closure of the quantum constraint superconformal algebra on higher genus Riemann surface gives background equation for graviton (viz. the target manifold of dimension ten and Ricciflat). In the second case the classical constraint algebra on higher genus Riemann surface has been developed, and a method of background field perturbation theory has been indicated to obtain the quantum constraint superconformal algebra. The anomaly free closure of the algebra would again produce background field equations. At present Polyakov's two-dimensional quantum gravity formulation is being done on a torus in the light cone gauge. The work at the Centre aims to write down the Ward identity and compare the critical exponents of the theory with those obtained by Distler and Kawai in the conformal gauge.

Quantum q-oscillators are objects which satisfy a q-deformed commutation (anticommutation) relation. They provide a realization of q-deformed lie algebras. D. Gangopadhyay has studied fermionic q-oscillators by an algebraic technique and obtained their harmonic oscillator realization and transformations resembling canonical q-transformations with two bosonic q-oscillators. Two types of operators satisfying relations similar to the q-fermionic oscillator have been constructed using the bosonic q-oscillator operators.

Self-dual and antiself-dual solutions of classical Yang-Mills theory are being studied by D. Gangopadhyay and A. Sinha. In the light of E. Witten's work on self-dual solutions (instantons), the antiself-dual solutions (antiinstantons) have been obtained by choosing a different gauge and demanding that, like instantons, antiinstantons also satisfy the Liouville's equation.

In Moessbauer spectroscopic studies of iron bearing minerals, the analysis of chromites from Sukinda, Orissa, and Chimal Pahad, Madhya Pradesh, has presented difficulties. No satisfactory resolutions of the observed patterns can be found in the existing literature; a new one has to be found. Several ilmenite (oxide mineral of iron and titanium) samples are being examined.

General numerical studies on resistance and conductance fluctuations in electronic motion in random media are continued by A. Mookerjee and his students. In particular, the study of electronic propagation in two dimensional disordered media, around which there has been considerable controversy has been addressed in detail. These include the problem of quantum percolation, the existence of non-exponentially localized states and characterization of stochastic resonances. The last topic was discussed during the Condensed Matter Workshop, Trieste, Italy in July 1991.

The methodology to treat a path integral formulation of a random Hubbard model using a modified version of the augmented space formalism suggested by A. Mookerjee in 1973 has been developed. It is now being applied to a study of a model for $La_{2-x} Sr_x CuO_4$ to explain variable range hopping type of resistivity in the normal phase and the stability of various magnetic phases with hole concentration.

Radiofrequency (RF) infrared double resonance in a laser cavity involve situations where the RF separation falls within the laser linewidth; for example, quadrupole splitting of rotation-vibration levels in a symmetric top molecule. Multiple coupling occurs in such systems, and its effect on infrared (IR) polarization for RF detuning has been studied in a three level system with mixed parity levels interacting with IR and RF fields simultaneously. It is found that multiple coupling enhances refractive index.

Work has been initiated in squeezed laser and squeezing in the non-degenerate two photon process. The generation of non-classical field, in particular squeezing, confined in a microwave or an optical cavity by means of two photon and one photon interaction is being looked into.

Based on the above work, the following papers have been completed and already accepted for publication.

1. Banerjee, R. and Ghosh, S. — Algebraic approach to anomalous sigma models (in. Z. Phys. C : Particles and Fields).
2. Mookerjee, A., Chakrabarti, B. K. Dasgupta, I., and Saha, T. — Quantum percolation and breakdown absence of the delocalization transition in two dimensions (in Physica A).

3. Manna, S. K. and Mookerjee, A. — Numerical studies of resistance and conductance fluctuations in a chain with a continuous disordered potential (Int. J. Mod. Phys. B).
4. Datta, A. and Mookerjee, A. — The recursion method – agumented space method for the calculation of electronic structure of random alloys (Int. J. Mod. Phys. B).
5. Das, D., Chakraborti, M. B., Choudhury, K., Nambissan, P. M. G., Babu, B. R. S., Sen P., Sangeeta and Majumdar, C. K. — Moessbauer, XRD and positron annihilation studies on natural magnetite and hematite ore from Ari Dongri, Central India (in Bull. Materials Science).
6. Bullough, B. K., Bogoliubov, N. M., Nayak, N., and Thompson, B. V., — Q-boson and Boson Cavity Quantum Electrodynamics. Fundamental Theory of the Micromaser, in Proceedings of the Dubna meeting on "Problems in Quantum Optics, 30 Sept. – 5 Oct, 1991, as Quantum Nonlinear Phenomena 1" editor A. S. Shumovsky, (in press, 1992).

Mathematical Modelling

Light scattering studies from thin spherical shells have important applications in biophysics. Phospholipid vesicles, which serve as a useful model system for biological membrances, are a system of this type. Validity of various approximate methods for the analysis of light scattered from a thin spherical shell is being examined by S. K. Sharma.

The numerical modelling for river estuaries is possible with modern high speed computers. Using finite element method, preliminary flow pattern in the Hooghly estuary has been obtained by S. Banerjee.

Collaborative Research with Warwick University, U.K./LINK Program

The collaborative work with Catalysis laboratory of Dr. A. K. Bhattacharya at Warwick concentrated on the catalytic effects of small transition and rare metal clusters. The computer programs for some such calculations was developed in Calcutta and installed by Prof. A. Mookerjee in the VAX computer at Warwick. The general method can be found in the paper accepted for publication :

Datta, A. and Mookerjee, A. — The recursion method – augmented space method for the calculation of electronic structure of random alloys (Int. J. Mod. Phys. B).

Research Projects

1. Quantum Transmittance in Disordered Systems

This research project with Professor A. Mookerjee is sponsored by the Department of Science and Technology, New Delhi and has two research scholars, — Indra Dasgupta and Tanusree Saha.

A vector recursion package for the calculation of transmittance, reflectance and resistance has been developed. The stability tests has been carried out.

The package has been used to study the following systems :

(i) Metal-insulator transition in one dimensional Harper models (incommensurate potentials with phase inhomogeneities). Further a multifractal analysis has been developed to describe the internal geometry of the transmittance vs length behaviour. This analysis also clearly distinguishes between different kinds of states : extended, localized and critical.

(ii) Stochastic resonances in one-dimensional random chains. We attempt to distinguish between the predictions of Azbel and Pendry regarding these resonances. Two-point statistics has been developed to study 'clumping' behaviour in the wavefunctions at the resonances. It is concluded that our results are consistent with Pendry's idea of 'necklace' states.

(iii) Two dimensional random lattices. We have combined the vector-recursion technique with real space renormalization ideas to conclude that in the intermediate disordered regime and band centres, the electronic states in such lattices show a power-law localization. With increasing disorder the power-law localization merges with exponential localization, while for low disorders the conductance shows logarithmic corrections. Towards the band edges there seems to be transition from these weekly localized states to strongly localized states.

(iv) Two dimensional quantum percolation problem. Using finite size scaling we have concluded that there is no delocalization transition in two dimensions.

The work was reported in several publications (Nos. 3, 4, 5 in Pub. Sc. journals). Other papers accepted for publication are :

(i) Numerical study of the distribution of phase as an electron moves in a one-dimensional continuously and randomly varying potential. S. K. Manna and Abhijit Mookerjee (Int. J. Mod. Phys. B).

(ii) Multifractal analysis for electronic transmittance in an incommensurate potential at the mobility edge. P. K. Thakur, C. Basu and A. Mookerjee (J. Phys. Cond. Matter).

2. High T_c Superconductivity

This project "Activities of VECC and SNBNCBS on high T_c and extension to LTSC" is sponsored by National Superconductivity Program (NSP) and has been continued beyond September 1991 till March 1995. This is carried out by Dr. C. K. Majumdar in collaboration with scientists at the Variable Energy Cyclotron Centre (VECC), Salt Lake, Calcutta. Sri Sanjay Kar joined the project on April 23,

1992. The objectives of the project have been extended by including a study of the degradation and training for NbTi wires/magnets.

The post of a junior research fellow has also been sanctioned and will have to be recruited according to procedures laid down.

Several pellets of (2212) Bi-Sr-Ca-Cu-O of superconducting transition 65K when exposed to alpha particles (energy about 20 MeV, dosage above 10^{13} alpha particles/cm^2) showed considerable rise in T_c for a dose above 10^{15} particles/cm^2. The samples were oxygen-rich, and the alpha bombardment broke metal-oxygen bonds and caused oxygen disorder and expulsion, raising T_c to its higher value around 80K attained at the correct stoichiometry. On other superconductors further experiments — in particular annealing studies to recover Tc when it goes down by radiation damage — are progressing. The increase in T_c is reported in :

1. S. K. Bandyopadhyay, P. Barat, S. Kar, U. De, A. Poddar, P. Mandal, B. Ghosh and C. K. Majumdar : Increase in Critical Temperature of $Bi_2Sr_2CaCu_2Ox$ Superconductor due to Alpha Particle Irradiation (accepted in Solid State Communications).

Measurements of critical current and the effect of radiation damage on it have been planned. Preliminary reports were presented in the Workshop on Theories of High T_c Superconductivity at North Eastern Hill University, Shillong (March 16-21, 1992)

Some work has been carried out, partly in collaboration with IGCAR, Kalpakkam, in acoustic emission studies for NbTi wires for reduction of 'training' in superconducting magnet.

3. Electronic Structure of Random Alloys

This project supported by the Department of Science & Technology, New Delhi, is run by Professor A. Mookerjee of the Centre, jointly with Professor R. N. Singru, Dr. Rajendra Prasad and Dr. Vijay Singh of IIT Kanpur.

The cluster version of the KKR-CPA has been established. This version is, unlike earlier attempts, self-consistent and has the correct analytic properties. Applications to model hamiltonians have been successful. In collaboration with Dr. Rajendra Prasad, the Centre's workers are applying this to bcc refractive alloys.

The computer programmes for the augmented space-recursion method have been completed. This methodology has been successfully incorporated with both the Linear Combination of Atomic Orbitals (LCAO) and the Tight Binding Linearized Muffin Tin Orbitals (TB-LMTO) methods. The energy structure for the following alloys has been completed : CuPd, CuPt, AgPd and AgPt. The order-disorder phase diagrams will be studied soon.

The following paper has been accepted :

Ab Initio pair potentials for fcc metals : an application of the method

of Moebius transform — A. Mookerjee, Nan-Xian Chen, Vijay Kumar and Md. Abdus Satter (J. Phys. Cond. Matt.).

Publications

A. Scientific Journals

1. Banerjee R. : Chern-Simons terms and anomalies in gauge theories — Mod. Phys. Lett. A. 1991, **6** (21), 1915-1921.
2. Banerjee, R. and Rothe, H. : A novel approach to double commutators in chiral gauge theories consistent with the Jacobi identity — Int. J. Mod. Phys. 1991, **A6**, 5287.
3. Basu, C. and Mookerjee, A. : Two-point Statistics on multifractal analysis of resonant states — J. Phys. Cond. Matt. 1991, **4**, 2857-2864.
4. Basu, C., Mookerjee, A., Sen, A. K. and Thakur, P. K. : Azbel Resonances — J. Phys. Cond. Matt., 1991 **3**, 9055-9065.
5. Basu, C., Mookerjee, A., Sen, A. K. and Thakur, P. K. : Metal-hypherinsulator transition in one-dimensional quasi-periodic systems — J. Phys. Cond. Matt., 1991, **3**, 6041-6053.
6. Bhattacharjee, A. K. : Molecular structure of derivatives of some model anticholingergic and anti-inflammatory compounds : A theoretical conformational and electrostatic potential study — Ind. J. Chem., 1991, **30B**, 991.
7. Chakrabarti, J. and Chaudhury, R. : Coherent Bond States — Mod. Phys. Lett. B., 1991, **5** (22), 1525-1532.
8. Chaudhury, R. : High temperature superconductivity-current status, our theoretical and experimental work — Ind. J. Phys., 1992 **66A** (1 & 2) 159-180.
9. Gangopadhyay, D. : On Canonical q-transformation with two q-oscillators — Mod. Phys. Lett. A. 1991, **6**, 2909-2916.
10. Gangopadhyay, D. : On Quantum (q–) oscillators — Acta, Phys. Pol. 1991, **22** (10), 819.
11. Ghose, P. and Home, D. : A manifestly Lorentz covariant formulation of the Einstein-Podolsky-Rosen problem using the Tomonaga-Schwinger formalism — Phys. Rev. 1991, **A43**, 6382.
12. Ghose, P. and Home, D. : Testing wave function collapse and the complementarity principle using neutron self-interference and tunnelling — Physica, 1991, **B174**, 403-405.
13. Ghose, P. and Sinha Roy, M. N. : Confronting the complementarity principle in an interference experiment — Phys. Lett. 1991, **A161**, 5-8.
14. Ghoshal, S. and Datta, A. : Doppler-free radio frequency lineshape theory for a three-level system with three allowed transitions in presence of an IR pump — Chem. Phys. 1991, **153**, 161-168.
15. Jacobs, L., Khare, A., Kumar, C. N. and Paul, S. K. : The

interaction of Chern-Simons Vortices — Int. J. Mod. Phys. 1991, A6, 3441-3466.

16. Maharana, J., Paul, S. K. and Sengupta, G. : Krichever Novikov Global Operator Formalism : NSR Superstring in Curved Background Commun. Math. Phys. 1991, **139**, 527-549.
17. Mukhopadhyay, G., Das, D., Majumdar, C. K. and Rao, K. R. P. M. — Study of radiation damage in stainless steel SS 302 by conversion electron Moessbauer spectroscopy — Phil. Mag. Lett., 1991, **63** (6), 315-318.
18. Razee, S. S. A., Mookerjee, A., Prasad, R. : On the augmented space cluster coherent potential approximation and its analytic properties — J. Phys. Cond. Matt., 1991, **3**, 3301-3310.

B. Proceedings of Conferences & Symposia

1. Maharana J., Paul, S. K., Sengupta, G. : Superstring in curved space : Application of Krichever — Novikov Algebra, 1990 Summer School in High Energy Physics and Cosmology, Trieste, Italy, 18 June - 28 July, 1990 (ICTP series in Th. Phys. Vol. 7, 1991, 176-187).
2. Mookerjee, A., Basu, C., Chakraborti, B. K. and Sen, A. K. : Quantum transimttance in chains with diagonal disorder and Fibonacci like incommensurate potentials, Proc. Asia-Pacific Conf., Seoul, Korea, 1991, World Scientific, Vol. 1, 519.
3. Paul, S. K. : Krichever-Novikov global operator formalism : NSR string in curved background, Int. Coll. Mod. Quant. Field Th., 8-14 January, 1990, TIFR, Bombay — World Sci., 1991, 209-224, Eds. S. Das, A. Dhar, S. Mukhi, A. Raina and A. Sen.

C. Miscellaneous

1. Banerjee, R. : Gauge independent analysis of Chern-Simons theory with matter coupling — IFUSP/ December/1991/P-961. (IFUSP - Institute de Fisica, Universidade de Sao Paulo).
2. Banerjee, R. : Quantisation of matter coupled Chern Simons theory without gauge constraints and the Anyon operator IFUSP/ January/1992/P-963 (Institute de Fisica, Universidade de Sao Paulo).
3. Chatterjee, D., Banerjee, H., Mitra, P. and Banerjee, R. : Solving the strong CP Problem — Taming of the Demon - Phys. Teacher, 1990, **32** (4), 154-157.
4. Das, D., Brahma, P., Roy, S. M., Chakraborty, D., and Majumdar, C. K. : Moessbauer investigation of barium hexaferrites prepared by sol-gel route — DAE Solid St. Phys. Symp. at BHU, Varanasi, Dec. 1991.
5. Ghose, P. : Relativity for students : Book Review (Relativity : An Introduction to the Special Theory, Asghar

Quadir, World Scientific, Singapore — Current Science, 1991, **60** (7).

6. Maharana, J., Paul, S. K. and Sengupta, G. : Heterotic string in arbitrary background : Constraint Algebra on a Riemann Surface - IP/BBSR/91-34. (IP/BBSR - Institute of Physics, Bhubaneswar).
7. Majumdar, C. K. : Wolfgang Pauli (Scientific Correspondence with Bohr, Einstein, Heisenberg, Part II, 1930-1939). Sources in the History of Mathematics and Physical Sciences, Vol. 6, edited by K. Von Meyenn, Springer Verlag 1985 : Book Review, Ind. J. Phys. 1990, **64B** (3).
8. Sarkar, D., and Majumdar, C. K. : Liquid Helium 3 (Pt II) - Physics Teacher, 1990 - p. 105-143.

D. Books

1. Basu, S. G. : Public Library Services to Visually Disabled Children, McFarland & Co. Inc. (North Carolina, USA), 1991, pp. 160.
2. Datta, A., Ghose, P. and Raychaudhuri, A. : Particle Phenomenology in the 90s, World Scientific, Singapore 1992 (Proc. Workshop on High Energy Physics Phenomenology II, Jan. 2-15, 1991 held in Calcutta).

E. Ph.D. Theses

1. Mukhopadhyay, G. — Radiation damage study by Moessbauer and Positron Annihilation Spectroscopy — Awarded Ph.D. degree from Jadavpur University.

   Joint Supervisors : Dr. C. K. Majumdar (S. N. Bose National Centre for Basic Sciences) and Dr. P. Sen (Saha Institute of Nuclear Physics).
2. Das, D. — Studies of Iron Minerals of Eastern India : Awarded Ph.D. degree from Jadavpur University. Supervisor : Dr. C. K. Majumdar.
3. Bardhan, S. — An Embedding Method for the Study of Electronic Properties of Random Binary Alloys : Awarded Ph.D. degree from IIT Kanpur. Supervisor : Dr. A Mookerjee.
4. Ganguli, B. — Optical Properties of Random Alloys : Awarded Ph.D. degree from IIT Kanpur. Supervisor : Dr. A. Mookerjee.

F. Honours received by the Centre's Staff

i) Dr. Partha Ghose of the S. N. Bose National Centre (jointly with Mr. Samar Bagchi, formerly of National Science Museum) received a National Award for the best Science and Technology Media Coverage during 1986-90 in the National Council for Science and Technology Communication, Government of India.

(ii) Dr. C. K. Majumdar was elected Fellow of the American Physical Society.

Visits of Centre's staff for attending conferences, seminars etc.

1. Banerjee R. — Attended workshop on "High Energy Physics" at PUC (Catholic University Petropolis, Rio de Janeiro (Brazil) from 17.10.91 to 20.10.91.
   - Attended workshop on "Quantum Mechanics of Fundamental System" at Centre for Scientific Studies, Santiago, Chile, from 27.12.91 to 31.12.91.
   - Attended workshop on the "Physics and Mathematics of Anyons", at CTS, I.I.Sc., Bangalore from 18.2.92 to 21.2.92.
2. Banerjee S. : Visited Centre for Development of Advanced Computing (C-DAC), Pune during 17.7.91 to 12.9.91.
3. Ghose, P. : Attended the CSIR Golden Jubilee Seminar on "Vistas in Science & Technology Communication" at CLRI, Madras (23.3.92).
   - Attended a meeting organized by FAMTSIT, Dept. of Phil., Jadavpur University (3.2.92).
   - Conducted Science Workshop for School Teachers at Ashok Hall Girls School (12.12.91).
   - Attended International Conference on "Bell's Theorem & the Foundation of Modern Physics", Cesena, Italy (7-10 Oct, 1991)
   - Participated in the "Teachers' Workshop" organized by Orient Longman held at the Birla Ind. & Tech. Museum, Calcutta (10.8.91).
   - Acted as a Judge at the Colloquium for Young Physicists (1991) organized by the Ind. Phys. Soc. (21 & 22.8.91).
   - Attended an "Environmental Round Table" organized by the Environment and Safety Committee, Rotary Club of Calcutta at the Bengal Club (22.6.91).
4. Majumdar, C. K., Dasgupta, I. and Saha, T. : Attended the discussion meeting on "Metal-Non-metal transition" at the Jawaharlal Nehru Centre, Bangalore (6.2.92).
   - Majumdar, C. K. : Attended a meeting of FAMTSIT, Dept. of Philosophy, Jadavpur University (3.2.92).
5. Mookerjee, A. : Visited the University of Warwick, U.K. and collaborated with their Surface Catalysis Group on the Link Program of the British Council.
   - Visited the Int. Cent. for Theo. Phys. (ICTP), Trieste, to participate in the research workshop in Condensed Matter, Atomic and Molecular Physics (17.6.91 & 27.9.91).
   - Visited Australia and attended Gordon Godfrey Conference in University of New South Wales, Sydney, Australia July, 91.

6. Paul, S. K. : Attended Workshop on 'Topological Field Theory' organized by the High Energy Physics Group of the Institute of Physics, Bhubaneswar (28.10.91 to 1.11.91).

Seminars/Talks by the Centre's Staff

1. Banerjee R. ● A novel approach to double commutator in chiral gauge theories consistent with the Jacobi identity.
   - Catholic University of Petropolis, Rio de Janeiro R. J., Brazil (18.10.91).
   - Institute Fisica Teorica, Sao Paulo, Brazil (30.10.91).

   ● Gauge independent analysis of Chern-Simons with matter coupling.
   - PUC (Catholic University), Rio de Janeiro R. J., Brazil (4.12.91).
   - CBPF, Rio de Janeiro, (February 1991).
   - CTS, IISc., Bangalore (February 1991).

   ● Fractional spin and statistics in 2+ dim theories : a new look.
   - University of Sao Paulo, Brazil (18.12.91).

2. Chaudhury, R. ● An overview of development in high temperature superconductivity.
   - At SNBNCBS (3.4.91).

3. Ghose, P. ● Manifestly Lorentz covariant formulation of the EPR problem using Tomonaga-Schwinger formalism.
   - Int. Conf. on Bell's Theorem and the Foundation of Modern Physics, Cesena, Italy (9.10.91).

   ● Confronting the complementarity principle in an interference experiment.
   - Atom institut der Osterreichischen Universitaeten, Vienna (18.10.91).
   - Mathematical Institute, University of Oxford (22.10.91).

   ● Lorentz covarient treatment of EPR.
   - Dept. of Math. Sc., Univ. of York, UK (30.10.91).
   - University of Durham, UK (1.11.91).
   - Dept. of Hist. & Phil. Sc., University of Camb., UK (5.11.91).

   ● Confronting the complementarity principle in an interference experiment.
   - Dept. of Phys. Visva-Bharati (22.11.91).
   - Inst. of Phys., Bhubaneswar (9.1.92).
   - Physics Dept. IIT, Bombay (11.2.92).
   - Bhabha Atomic Res. Centre, Trombay (12.2.92).
   - Tata Inst. of Fund. Res., Bombay (14.2.92).

   ● Symmetries and Aesthetics in Physics.
   - Annual Reunion of Dept. of Physics, Jadavpur University (23.2.92).

   ● Scientific Progress in Calcutta.
   - At STATPHYS (Calcutta)

- Determinism, Causality, Predictability and Chaos in Physics.
  – Dept. of Phil. Jadavpur University (8.7.91 & 9.7.91).
- Syadvada.
  – Dept. of Philosophy, Jadavpur University.
- Bastur Roop. (Bengali)
  – Birla Ind. & Tech. Museum, Calcutta (2-5 June 1991).
- Single particle experiments to probe wave-particle duality and collapse.
  – At SNBNCBS (15.5.91).
- A couple of optical illusions.
  – At the Calcutta Club (25.4.91).
- Relativistic Quantum Mechanics of Single Bosons.
  – Inst. of Math. Sc., Madras (24.3.92).
  – University of Hyderabad (26.3.92).
- Confronting the complementarity principle.
  – Inst. of Math. Sc., Madras (25.3.92).

4. Gangopadhyay, D. ● On quantum (q-) oscillators.
   – At SNBNCBS (29.5.91).

5. Majumdar, C. K. ● The Ganga Estuary Study by Finite Element Method.
   – Computational Fluid Dynamics at the Centre for Atmospheric Science, Calcutta University (29.2.92).

- Moessbauer Studies of Iron Minerals of Eastern India. (Santanu Ghosh Memorial Lecture).
  – Ind. Sc. News Assen. (17.5.91).
- Use of Positron in Metal Physics.
  – At the Dept. of Physics, Calcutta University (10.3.92).
- The Moessbauer Effect and the Positron Annihilation Technique in Metal Physics.
  – At the Workshop on Material Science with Accelerated Charged Particles, VECC (March 19 - April 2, 1992).
- Radiation Effects on High Tc Superconductors. At the seminar on Recent Trends in Nuclear Chemistry, Radiation and Photochemistry.
  – Ind. Assocn. Nucl. Chem. & Alld. Sc. (IANCAS) at SINP (30.3.92)

6. Mookerjee, A. ● Quantum Transmittance through random media.
   – Cond. Matt. Workshop at Int. Conf. Th. Physics, Trieste, Italy.
- Quantum percolation in two-dimensions.
  – At the Workshop on STATPHYS Calcutta (4.1.92)
- Electron propagation in a Markov Bath : a dissipative system.
  – At QFT & STATMECH Seminar at ISI, Calcutta (29.1.92).

- Quantum Percolation.
  – At IIT, Kanpur (25.11.91).
- Quantum transmittance in disordered Systems.
  – Aust. Nat. University, Canberra (July, 91).
  – RMIT, Melbourne (July, 91).

7. Nayak, N. ● Cavity Quantum Electro-dynamics.
   – At SNBNCBS (24.4.91).
8. Paul, S. K. ● Wn Algebra.
   – At SNBNCBS (24.4.91).
   ● Polyakov's formulation of 2D Gravity on a Sphere.
   – Inst. of Math. Sc., Madras (March, 92).

Library

Last year (1991-92), the S. N. Bose National Centre Library added 72 new books to its collection. The technical processing of these books is almost complete.

The library renewed subscription to all of the journals of the previous year. A new title, "Economic Theory" (Springer International) that started publication in mathematical economics recently was added to our 1992 subscription list. We also subscribed to Vigyan, — the International edition of the Scientific American for 1992.

The following list includes titles of journals subscribed to by the library for 1992. :

A. Foreign Journals

1. Computer Journal
2. Computers in Physics (AIP)
3. Economic Theory
4. Journal of Physics A : Mathematical and General
5. Nature
6. Physical Review Letters
7. Physics Letters (Section A)
8. Physics Letters (Section B)
9. Physics Reports

B. Indian Journals

1. Bulletin of Material Science
2. Current Science
3. Indian Journal of Pure & Applied Physics
4. Journal of Astrophysics and Astronomy
5. Journal of Biosciences
6. Journal of Genetics
7. Pramana
8. Proceedings of the Indian Academy of Science (Chemical Sciences)
9. Proceedings (Earth and Planetary Sciences)
10. Proceedings (Engineering Sciences) — Sadhana
11. Proceedings (Mathematical Sciences)
12. Vigyan (Indian Edition of Scientific American)

The library renewed subscription to SLAC preprints in *Particles and Fields* for 1991-92. 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. More than ten thousand

xerox copies from different research materials were distributed to the academic members last year.

In view of the limited subscription to foreign journals in the library, this year we have sought help of the Indian National Scientific Documentation Centre (INSDOC) for providing us with xerox copies of papers from different foreign periodicals under the normal arrangements.

The library supplied relevant materials to the attending participants of the Workshop when the S. N. Bose National Centre organized a Workshop on Statistical Physics of Disordered Solids, Glasses and Polymers, at the Ramakrishna Mission Institute of Culture, Golpark, Calcutta.

COMPUTER CENTRE

The HP 9000 System, which was made operational in September 1989, has performed very satisfactorily during the period April '91 to March '92 and proved to be the mainstay of operation of the Centre. The System comprises a 19" B & W console, a hard disc, one cartridge drive, a dot matrix printer and a 8-pen graphics plotter. At present we are using one Quantum Work Station and a VT-100 compatible terminal as terminals of the HP 9000. This system is extensively used by scientists of this Centre and also by some scientists and visitors from outside the Centre.

The number of users for the HP 9000 computer has recently increased considerably. As the storage capacity of the computer has become nearly full, we are planning to procure another Winchester Disk in the near future. To provide short-term relief, files that are not frequently needed are transferred to a Cartridge Tape by the System Administrator.

A Quantum PC with 80386 CPU running at 33 MHz, 80387 Co-processor 64 KB Cache Memory, 4 MB RAM has recently been installed as a part of a research project with Professor A. Mookerjee sponsored by the Department of Science & Technology. In addition, a Quantum Workstation with Double Drive facility is used extensively for Teacher's Training Program. This particular system went out of order during a power crash in West Bengal in August, and we had to wait several months before it could be made functional again. This delayed the start of the teacher's training course.

The Computer Centre is looked after by a Computer Engineer cum System Administrator who also provides day to day Software consultancy.

From January '91 we have made operational a regular e-mail facility to World-wide network through NCST Bombay. The system Administrator acts as the 'POSTMASTER' of the e-mail in our Centre. Some courses on

Structured language on PASCAL and OCCAM will be offered in the near future.

This year the Teacher Training Course started in February 1992. College Teachers of the surrounding colleges of Calcutta have been attending the training course offered by the Centre. The course material included MSDOS, GWBASIC and elements of WORDSTAR and FORTRAN 77. Each trainee has two hours hands-on experience on a machine per week. The demand for training in PASCAL and other utility software programmes can be considered later when more facilities are added.

The DTP System with Laser printer has already been installed and will be used for scientific publication.

The Centre also purchased one PC with 80286 CPU for its library and one PC with 80386 CPU for installing some Transputer Card in the near future.

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. V. M. Nandakumaran, Department of Physics, Cochin University of Science & Technology, 'Chaos in a modulated logistic map' and 'Stability of periodic orbits in coupled map lattices' (April '91).
2. G. Ambika, Department of Physics, Cochin University of Science & Technology, 'Chaos in Josephson junctions' and 'Crisis induced chaos' (April '91).
3. B. J. Cherayil, Dept. of Inorg. & Physical Chem., Indian Institute of Science, Bangalore, 'Critical phenomena in polymer solutions' and 'Stretched exponential relaxation in polymer dynamics' and 'Polymers in random media' (June '91).
4. Arghya Taraphdar, Dept. of Physics, Indian Institute of Science, Bangalore, 'High Tc Superconductivity in Ba-Bi systems' and 'Modelling barium — bismuthates' (June '91).
5. V. Subramanyam, TIFR, Bombay, 'Commensurability effects and degeneracies in simple integrable systems' (July '91).
6. Y. Durga Devi, PRL, Ahmedabad, 'The role of hexadecupole degree of freedom in nuclei and the SDG interacting boson model' (July '91).
7. A. P. Balachandran, Syracuse University, Syracuse, USA, 'A topological spin-statistics theorem or a use of the antiparticle' (July '91).
8. Manu Mathur, Inst. of Math. Sci., Madras, 'Manifestly Lorentz covariant local quantum field theory of Dyons' and 'N-2 SUSY Quantum mechanics' (Aug. '91).
9. M. Lakshmanan, Dept. of Physics, Centre for Nonlinear Dynamics, Bharathidasan

University, Trichi, 'Symmetries and integrability of finite dimensional nonlinear systems' and 'Analytic structure of certain chaotic dynamical systems' (Sept '91).

10. Biplab Bhawal, Dept. of Phys., IIT Kanpur, 'Modified geodesic equation as a test for the principle of equivalence' and 'Particle production in higher dimensional cosmological models' (Oct '91).
11. Mangal C. Mahato, School of Physics, Univ. of Hyderabad, 'Hysteresis as rate competition' and 'Calculation of phonon spectra at high temperature using the density-functional theory of freezing' (Oct. '91).
12. P. C. Vinodkumar, Dept. of Phys., School of Science, Univ. of Gujarat, Ahmedabad, 'Current confinement model and phenomenology of glueballs' (Oct. '91).
13. Anirban Sengupta, TIFR, Bombay, 'Instabilities in the black hole background and string theory' (Nov. '91).
14. V. Rajeswari, Matscience, Madras, 'Quantum groups and generalizations of angular momentum coefficients of SU (2)' (Nov. '91).
15. Manas Sardar, Matscience, Madras, 'Theory of NMR Relaxation in High Tc Superconductors' (Nov. '91).
16. N. C. Rana, IUCAA, Pune, 'The Structure and composition of the solar neighbourhood' and 'Mass function of stars in the solar neighbourhood' (Nov. '91).
17. S. K. Khosa, University of Jammu, 'Mechanism of sudden onset of deformation in the mass region A = 100' (Dec. '91).
18. Y. K. Gambhir, IIT, Powai, Bombay, 'The relativistic mean field approach for nuclei' (Dec. '91).
19. K. C. Rustagi, Centre for Advanced Technology, Indore, 'Quantum size effects in semiconductors' and 'Fullerenes — linear and nonlinear optical properties' (March '92).

CONSTRUCTION OF THE NEW CAMPUS

The Campus of the S. N. Bose National Centre for Basic Sciences is being built on a fifteen acre plot of land in Block JD, Sector-III, Salt Lake. At this stage, the work will be concentrated on construction of a section of the main building which would house the Computer Centre and the Library, a portion of the Guest House, and one block of Essential Staff Quarters and the necessary infrastructural facilities. The work of piling and foundation has been done by Gannon Dunkerley & Co. and the work of superstructure has been started by Nabin Designers & Constructors Pvt. Ltd. Hopefully the Centre will be in a position to move to its new campus by the end of 1993.

The work of landscaping of the new campus is continuing.

MEETING OF THE VARIOUS COMMITTEES OF THE CENTRE

Governing Body

The newly constituted Governing Body of the Centre under the Chairmanship of Professor P. Rama Rao met twice during the period April 1991 to March 1992. The first meeting was held on September 17, 1991 at the Centre's office in Calcutta. The second meeting took place on February 22, 1992 at the office of the Chairman of the Governing Body, Technology Bhavan, New Delhi.

Academic Programme Advisory Committee

The Research Advisory Committee I (Physics and Mathematics) held its meeting at the office of the Director of the Centre on September 10 1991. The Research Advisory Committee II (Chemistry & Life Sciences) also had its meeting at the same venue on September 12, 1991.

Finance Committee

The Finance Committee of the Centre met twice during the period under review. The first meeting took place on September 17, 1991 in Calcutta and the second on February 21, 1992 at the office of the Joint Secretary & Financial Adviser, DST, New Delhi. The present members of the Finance Committee are :

1. Professor C. K. Majumdar Director, SNBNCBS	...	Chairman
2. Mr. S. B. Krishnan Jt. Secy & Financial Adviser, DST	...	Member
3. Professor A. K. Raychaudhuri Professor of Physics (Retd.), Cal	...	Member
4. The Director I.A.C.S., Calcutta	...	Member

5.	The Secretary Department of Finance, Govt. of WB	...	Member
6.	Dr. J. Pal Chaudhuri Administrative Officer, SNBNCBS	...	Member-Secretary

Construction Committee

During the period under review the Construction Committee met on May 16, May 29, August 5, November 30, December 1, 1991 and January 16, 1992. The members of the present committee are :

1.	Professor C. K. Majumdar Director, SNBNCBS	...	Chairman
2.	Professor G. S. Sanyal Director, STEP, IIT Kharagpur	...	Member
3.	Professor T. K. Chattopadhyay Professor of Architecture, J. U.	...	Member
4.	Chief Engineer, CPWD (EX) represented by Mr. A. K. Saxena Superintending Engineer, CPWD	...	Member
5.	Dr. J. Pal Chaudhuri Administrative Officer, SNBNCBS	...	Member-Secretary

Dr. P. J. Lavakare, Adviser (STP), DST and Shri B. K. Chaturvedi, Joint Secretary and Financial Adviser, DST met the Director, the Administrative Officer, the Project Engineer of the Centre and the representatives of Ghosh Bose & Associates, Consultant Architects and Gannon Dunkerley & Company, Contractors at a Special Meeting held at the Office of the Director on May 9, 1991. The purpose of the meeting was to discuss issues related to construction work.

Centre's Staff as on March 31, 1992

Academic

Dr. Chanchal Kumar Majumdar	Director
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. Samir Kumar Paul	Post Doctoral Fellow
Dr. Ranjan Chaudhury	Post Doctoral Fellow (on leave)
Dr. Pratip Mukhopadhyay	Post Doctoral Fellow
Mrs. Rina Das	Scientific Officer
Dr. Srilekha Banerjee	Scientific Officer

Administrative, Technical and Auxiliary

Dr. Jyotirmoy Pal Chaudhuri	Administrative Officer
Dr. Santi Gopal Basu	Librarian
Mr. Apurba Kanti Sarkar	Administrative Assistant (Accts.)
Mr. Bhaskar Das Gupta	Office Superintendent
Mr. Sunish Kumar Deb	Stenographer
Mr. Tapan Kumar Sen	Junior Assistant
Mr. Sukanta Mukherjee	Junior Assistant
Mr. Jaydeep Kar	Junior Assistant
Mr. Prasenjit 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. Kuntal Sarkar	Sub-Assistant Engineer (Resigned in October, 1991)
Mr. Aditya Paul Choudhury	Project Assistant

Scientists on Projects

Dr. Sharmistha Ghosal (née Bhattacharya)	Research Associated, CSIR
Ms. Chaitali Basu	Senior Research Fellow, CSIR
Mr. Susil K. Manna	Teacher Fellow, UGC
Mr. Abhijit Datta	Research Scholar, UGC

Mr. Indra Dasgupta	Junior Research Fellow, DST
Ms. Tanusree Saha	Junior Research Fellow, DST
Ms. Roshni Sen	Junior Research Fellow, CSIR
Mr. Tapas Mitra	Junior Research Fellow, CSIR
Mr. Sanjay Kar	Research Fellow, DST
Dr. P. Roychoudhury	Part Time Researcher

Laboratory Assistant Attached to a Project

Mr. Sanad Kumar Shukla

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

DB 17, SECTOR I, SALT LAKE,
CALCUTTA-700 064

STATEMENT OF ACCOUNTS FOR THE YEAR ENDED
31ST MARCH, 1992

D. P. SEN & CO.
Chartered Accountants
8/2, KIRON SHANKAR ROY ROAD,
CALCUTTA-700 001
PHONE : 28-1495 28-7785

D. P. Sen & Co.
CHARTERED ACCOUNTANTS

8/2, KIRAN SHANKAR ROY ROAD
CALCUTTA-700 001
PHONE : 28-1495 28-7785

AUDITORS REPORT

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

We have audited the attached Balance Sheet as at 31st March, 1992 of Satyendra Nath Bose National Centre for Basic Sciences and the annexed Income & Expenditure Account for the year ended 31st March, 1992. We report as follows :

1. a) Depreciation on Fixed Assets has neither been ascertained nor charged since inception (Schedule M, Note 1).

   b) Consequent to change in accounting policy regarding accounting for unprovided expenses related to prior periods (Schedule M, Note 5), the surplus for the year has been overstated by Rs. 54,753.48.

   c) Capital Work-in-Progress has not been separately disclosed (Schedule M, Note 6).

   d) Accrued and reinvested interest on earmarked investments of the Employees' Provident Fund and the Gratuity Fund has neither been ascertained nor accounted for in the books, thereby, understating the Employees' Provident Fund and the General Fund as well as the respective Investment accounts.

   e) Pending approval of the Provident Fund scheme, deductions from employees' remunerations and contributions made by employees are on the basis as referred to in Schedule M, Note 8 (iv).

   f) The Bye-Laws of the Centre are pending final approval from the Department of Science & Technology, Government of India.

   g) Indemnity bonds against advances made to a contractor have not been obtained in a number of cases, in contravention of the agreements with such contractors.

2. All necessary information, books and records required for audit were produced to us.

3. Subject to paragraphs 1 (f) and 1 (g) above, the transactions that came to our notice were within the delegated powers conferred by the Bye-Laws of the Centre.

4. Subject to paragraphs 1 (a) to 1 (e) 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 the schedules A to L and the Notes on Accounts attached thereto, reflect a true and fair view :

   i) in case of the Balance Sheet as to the state of affairs of the Centre as on 31st March, 1992 and

   ii) In case of the Income & Expenditure Account as to the excess of Income over expenditure for the year ended 31st March, 1992.

11.01.1992
Calcutta

for D. P. Sen & Co.
Chartered Accountants

S/d Abhijit Bandyopadhyay
Partner

SATYENDRA NATH BOSE NATIONAL

Balance Sheet as at
DB 17, Sector I,

Figures for the Previous year	Funds & Liabilities	Schedule		
Rs.			Rs. P.	Rs.. P.
	Capital fund :			
	Balance as per last A/c		249,51,000.00	
	Add : 1) Grant in-Aid received from Govt of India for Non-recurring Expenses		85,00,000.00	
	2) Value of 15 acres of land gifted by the Dept. of science & Technology & West Bengal Govt. accounted for during the year			
249,51,000	(as per pt. 7 of Sch. M)		108,89,999.60	443,40,999.60
	General Fund :			
	Balance as per last Account		25,57,821.99	
	Add : Net Excess of Income over Expenditure for the year transferred from Income & Expenditure Account		4,75,531.73	
			30,33,353.72	
	Less : Amount transferred to			
25,57,822	Project Fund		1,348,42	30,32,005.30
	Other Funds :			
	1) Computer Fund : Donations received from J Bose upto last Account	150,001.00		
	Add : Received during			
1,50,001	the year	50,000.00	2,00,001.00	
	2) Project Fund : Balance as per last Account	776,712.13		
	Add : a) Amount transferred from General Fund	1,348.42		
	b) Excess of Income over Expenditure for the year transferred from Income & Expen-			
7,76,712	diture Account	295,430.79	10,73,491.34	
	3) TPSC Fund :			
4,512	Balance as per last Account		4,512.30	
1,39,018	4) Employees Provident Fund		4,47,438.06	
60,571	5) Gratuity Fund		83,722.00	18,09,164.70
2,86,39,636	Carried Forward			4,91,82,169.60

CENTRE FOR BASIC SCIENCES

31st March, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year	Properties & Assets	Schedule		
Rs.			Rs. P.	Rs. P.
	Fixed Assets :			
77,82,938	At Cost/Capitalised value	A		290,01,597.94
	Investments :			
161,01,984	1) In Short Term Deposits with Scheduled Banks	I	167,22,502.19	
33,942	2) Gratuity Fund invested in Short Term Deposits with Scheduled Bank		60,571.00	
1,22,000	3) Provident Fund invested in Short Term Deposits with a Scheduled Bank		4,12,000.00	171,95,073.19
	Current Assets :			
3,17,758	1) Interest Accrued on Investments in Short term deposits		2,99,529.79	
8,961	2) Stock of Printing & Stationery at cost		11,313.80	
	3) Cash & bank Balances :			
62	a) Cash in hand		335.07	
26,30,206	b) With Scheduled Banks	J	7,10,838.06	10,22,016.72
	Loans & Advances :			
700	1) Advance to Employees from Provident Fund		9,200.00	
16,61,052	2) Advance to suppliers & Contractors	E	42,73,888.47	
97,850	3) Deposit for Rent	D	69,650.00	
18,590	4) Security Deposits	F	18,590.00	
20,773	5) Advance against Expenses receivable	G	21,203.00	
10,700	6) Other Advances	K	67,021.00	
1,49,735	7) Prepaid Expenses	L	1,70,515.00	46,30,067.47
2,89,57,251	Carried Forward		Rs.	5,18,48,755.32

SATYENDRA NATH BOSE NATIONAL

Balance Sheet as at
DB 17, Sector I,

Figures for the Previous year	Funds & Liabilities	Schedule		
Rs.			Rs. P.	Rs. P.
2,86,39,636	Brought Down			4,91,82,169.60
	Current Liabilities & Provisions			
50,335	(1) Outstanding Liabilities for revenue expenditure	B	63,653.44	
—	(2) Outstanding Liabilities for Capital Expenses	B	20,29,042.37	
1,19,220	(3) Security Deposits from Contractors	H	3,17,658.31	
1,18,000	(4) Sundry Creditors	C	1,24,330.38	
20,000	(5) Earnest Money from Contractors		40,000.00	
10,060	(6) Provision for Bonus to Employees		9,771.00	
—	(7) Provision for rent on Leasehold land (including Rs. 54,753.48 relating to prior period)		82,130.22	26,66,585.72
2,89,57,251			Rs.	5,18,48,755.32

- Notes on Accounts are separately given in Schedule 'M'
- 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 Sankar Roy Road
Calcutta-700 001
June 11, 1992

FOR D. P. SEN & CO.
Chartered Accountants
S/d Abhijit Bandyopadhyay
Partner

CENTRE FOR BASIC SCIENCES

31st March, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year	Properties & Assets	Schedule				
Rs.			Rs.	P.	Rs.	P.
2,89,57,251	Brought Down				5,18,48,755.32	
2,89,57,251			Total		5,18,48,755.32	

S/D J PAL CHAUDHURI
Administrative Officer

S/D C. K. MAJUMDAR
Director

SATYENDRA NATH BOSE NATIONAL

Receipts and Payments Account for
DB 17, Sector I,

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Receipts	Project Account Rs. P.	General Account Rs. P.
		Opening Cash & Bank Balances		
2,86,627.93	11,78,741.69	Indian Overseas Bank, Salt Lake Branch	182,087.34	2331,805.44
—	—	United Bank of India, Mayukh Bhavan Branch	—	99,995.00
	61.37	Cash in hand		62.34
		Recovery of Staff Advances		
	6,442.00	Festival Advance		4,920.00
		Grant-in-aid Received		
	100,50,000.00	For Plan Expenditure		8500,000.00
	875,000.00	For Non-Plan Expenditure (including Rs. 500,000 for the year 1990-91)		1800,000.00
370,000.00	313,343.00	**Misc. Grant-in-aid Received**		
		For CSIR Fellows	71,350.00	
		For Projects	435,500.00	
		For TPSC Programme		85,000.00
		For UGC Fellows		16,512.00
	6549,590.00	**Encashment of Short Term Deposits**		5039,890.00
	20,000.00	**Earnest Money from Contractors**		20,000.00
	119,219.49	**Security Deposits from Contractors**		391,932.48
	1325,007.83	**Interest from Short Term Deposits**		317,990.00
	43,654.26	**Recovery of Advance to Supplies**		309,049.83
—		**Recovery of Advance to Contractors**		1340,473.00
—		**Recovery of Deposit for Rent**		48,450.00
		Donation Received		
		J Bose		50,000.00
		P Das (Refundable)		5,000.00
		Deposit from Dr. N Nayak		1,250.00
		Transfer from General Fund	1,348.42	
	3,549.00	**Misc. Incomes**		
		Income from Guest House		2,940.00
		Others		170.00
656,627.93	20484,608.64	Carried Over	690,285.76	20365,440.09

CENTRE FOR BASIC SCIENCES

the year ended 31st March, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Payments	Project Account Rs. P.	General Account Rs. P.
33,128.00	835,392.73	Salary & Allowances	75,866.67	1058,542.09
	31,470.95	Wages (Casual)		31,874.00
	72,415.00	Employees' Contribution to Provident Fund		84,245.00
	4,800.00	Festival Advance		4,800.00
	17,502.25	Medical Claim		37,089.79
	9,623.00	Ad-hoc Bonus to Employees		11,039.00
	6,867.08	Electricity Charges		10,779.28
	58,224.09	Hire of Transport		67,351.48
	6,040.00	Hire of Generator		42,120.00
	151,200.00	Hire of Office Premises		184,500.00
	73,650.00	Deposit for Rent		20,250.00
	14,538.72	Office Contigency Expenses		20,013.30
	43,667.77	Printing & Stationery		77,251.44
	312.00	Repair of Equipment		1,208.00
	10,276.35	Postage & Telegram		29,849.00
	15,067.00	Insurance Premium		14,465.00
	42,501.70	Telephone & Trunk Calls		45,291.60
	—	E-Mail		47,824.00
	19,697.00	TA/DA to Academic Staff (India)		7,911.70
	34,204.00	TA/DA to Academic Staff (Abroad)		39,012.00
	982.05	TA/DA to Non-Academic Staff		560.20
	23,191.30	Meeting Expenses		81,065.35
568.00	2,838.20	Bank Charges	48.00	935.20
	37,982.21	Campus Beutification		60,655.00
	2055,599.21	Construction of Building		6990,253.04
	500,473.00	Mobilization Advance to Contractors		1220,280.00
	840,000.00	Advance to Contractors		2254,435.20
	—	Ad-hoc Payment to Ghosh, Bose & Assoc.		300,000.00
	5,415.25	Car Maintenance		24,991.21
	—	POL		16,226.62
	6,104.02	Office Maintenance		10,702.45
	165,000.00	Computer Maintenance		189,500.00
	1,540.00	Library General Expenses		10,016.00
	19,232.79	Library Furniture		26,642.18
	79,998.06	Library Books		80,140.50
	184,267.00	Library Journals		257,744.00
	250.00	Payment to Creditors		—
	11168,285.77	Short Term Deposits with IOB, Salt Lake Branch		2036,690.00
	391,462.78	Short Term Deposits with UBI, Mayukh Bhavan Branch		2500,000.00
11,529.64	88,953.13	Advance to Suppliers		387,798.93
45,225.64	17019,014.41	Carried Over	75,914.67	18284052.56

SATYENDRA NATH BOSE NATIONAL

Receipts and Payments Account for
DB 17, Sector I,

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Receipts	Project Account Rs. P.	General Account Rs. P.
656,627.93	20484,608.64	Balance Brought Forward	690,285.76	20365,440.09
656,627.93	20484,608.64	Carried Over	690,285.76	20365,440.09

CENTRE FOR BASIC SCIENCES

the year ended 31st Match, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Payments	Project Account Rs. P.	General Account Rs. P.
45,225.64	17019,014.41	Balance Brought Forward	75,914.67	18284052.56
	185,690.55	Seminar & Other Academic Expenses		244,074.80
	275,829.10	WHEPP-II		—
	30,000.00	Accommodation for Visiting Scientists		30,000.00
	1,867.47	Furnishing Accommodations for Visiting Scientists		1,677.29
		Guest Houses Furniture		64,190.00
	18,017.86	Small Equipment		105,201.48
	97,641.34	Visiting Member Fellowship		112,756.00
	15,451.82	Office Equipment		—
	62,173.98	Office Furniture		93,372.01
	13,822.32	Director's Research Expenses		9,464.39
		Director's Research Equipment		103,116.00
	15,154.38	Academic Staff Research		10,044.40
	25,243.00	Publication of Seminar Proceedings		48,885.08
	16,950.00	Installation of Computer		75,874.99
	16,291.10	Computer & Accessories		302,796.00
	2,400.00	Legal Charges		4,800.00
	16,929.75	Outstanding Liabilities		50,335.89
	71,180.00	UPS		50,915.21
	500.00	Refund of Earnest Money		—
	33,942.00	Gratuity Fund Investment		26,629.00
	—	Refund of Security Deposits to Contractors		185,760.49
	24,134.20	TA/DA to TPSC Speakers etc.		84,511.80
	121.00	Project Account		4,200.00
	—	Stipend & Contingency to UGC Fellows		16,499.80
	—	Advance to Staff		41,181.00
		Contractors' Income Tax		410.00
	5,120.00	Security Deposit with WBSEB		—
		Advance to the Registrar, Bombay University		20,000.00
		Advance for Equipment	104,274.34	
8,934.00		Travel	5,662.00	
		Advance for Contingency & Raw Materials	20,432.00	
405,105.75		Equipment	7,341.40	
	63,244.58	Stipend & Contingency to CSIR Fellows	71,788.80	
11,992.00		Contingency & Raw Materials	98,377.70	
		Transfer to General Fund	121.00	
3,283.20		Supplies & Materials	16,110.68	
474,540.59	180,10,718.86	Carried Over	400,022.59	199,70,748.19

SATYENDRA NATH BOSE NATIONAL

Receipts and Payments Account for
DB 17, Sector I,

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Receipts	Project Account Rs. P.	General Account Rs. P.
656,627.93	20484,608.64	Balance Brought Forward	690,285.76	20365,440.09
656,627.93	20484,608.64		690,285.76	20365,440.09

8/2, Kiran Sankar Roy Road
Calcutta-700 001
June 11, 1992

FOR D. P. SEN & CO.
Chartered Accountants
S/d Abhijit Bandyopadhyay
Partner

CENTRE FOR BASIC SCIENCES

the year ended 31st Match, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Payments	Project Account Rs. P.	General Account Rs. P.
474,540.59	180,10,718.86	Balance Brought Forward	400,022.59	199,70,748.19
	11,254.00	Employees' Contribution to Provident Fund		—
		Insurance Premium (Recoverable)		20.00
	10,000.00	Refundable Contribution for Seminar		—
	10,000.00	Recoverable Expenses on Seminar		—
	10,773.00	Recoverable Expenses on WHEPP-II		—
		Closing Cash & Bank Balances		
	62.34	Cash in hand		335.07
182,087.34	2331,805.44	Indian Overseas Bank Salt Lake Branch	290,263.17	169,346.83
	99,995.00	United Bank of India, Mayukh Bhavan Branch		224,990.00
656,627.93	20484,608.64		690,285.76	20365,440.09

S/D J PAL CHAUDHURI
Administrative Officer

S/D C. K. MAJUMDAR
Director

SATYENDRA NATH BOSE NATIONAL

Income and Expenditure Account
DB 17, Sector I,

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Expenditure	Project Account Rs. P.	General Account Rs. P.
33,146.00	844,888.73	Salary & Allowances	75,866.67	10,91,611.26
	33,464.95	Wages (Casual)		31,874.00
	45,297.00	Employer's Contribution to P.F.		84,245.00
	27,842.63	Medical Claims		50,473.74
	10,077.00	Bonus to Employees		10,750.00
	6867.08	Electricity Charges		10,779.28
	59,158.25	Hire of Transport		72,023.80
	8,140.00	Hire of Generator		42,120.00
	180,000.00	Hire of Office Premises		1,84,500.00
	17.098.72	Office Contingency Expenses		20,131.30
	49,044.81	Printing & Stationery		67,439.64
	312.00	Repair to Equipments		1,208.00
	11,298.80	Postage & Telegram		30,606.00
	15,716.00	Insurance Premium		14,310.00
	41,306.30	Telephone & Trunkcalls		45,942.60
	982.05	T.A./D.A. to Non-Academic Staff		560.20
	19,697.00	T.A./D.A. to Academic Staff (India)		7,911.70
	34,204.00	T.A./D.A. to Academic Staff (Abroad)		39,012.00
	23,008.80	Meeting Expenses		90,005.35
568.00	2,838.20	Bank Charges	48.00	935.20
	5,415.25	Car Maintenance		27,991.21
	165,000.00	Computer Maintenance		1,68,875.00
	6,104.02	Office Maintenance		10,702.45
	185,690.55	Seminar & Other Academic Expenses		2,44,074.80
	275,829.10	WHEPP-II		—
	30,000.00	Accommodation for Visiting Scientists		30,000.00
	1,867.47	Furnishing Accommodation for Visiting Scientist		1,677.29
	97,641.34	Visiting Member Fellowships		1,12,756.00
	15,097.32	Director's Research Exp.		9,464.39
	15,594.38	Academic Staff Research		10,044.40
	25,243.00	Publication of Seminar Proceedings		48,885.08
	63,244.58	Stipend & Contingency to CSIR Fellows	71,788.80	
	2,400.00	Legal Expenses		4,800.00
	1,540.00	Library General Expenses		10,016.00
	26,629.00	Provision for Gratuity		23,151.00
	6,000.00	Audit Fees		6,500.00
8,934.00		Travel	5,662.00	
9,956.60		Contingency & Raw Materials	54,101.54	
	24,134.20	T.A/D.A. to TPSC Speakers etc.		84,511.80
		E-Mail		47,824.00
		Stipend & Cont. to UGC Fellow		16,499.80
52,604.60	23,78,672.53	Carried Over	207467.01	27,54,212.29

CENTRE FOR BASIC SCIENCES

for the year ended 31st March, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Income	Project Account Rs. P.	General Account Rs. P.
3,70,000.00	8,75,000.00	Grant-in-aid Received		18,00,000.00
		Misc. Grant-in-aid Received		
		For PROJECT	4,35,500.00	
	63,343.00	For CSIR Fellows	71,350.00	
	28,646.50	For TPSC Programme		85,000.00
		For UGC Fellow		16,512.00
	2,50,000.00	For WHEPP-II		
	15,83,895.70	Interest on Short Term Deposit		14,23,478.86
		Misc. Income		
	1,240.00	Income from Guest House		2,940.00
		Others		170.00
	2,060.00	Income from WHEPP-II		—
3,70,000.00	28,04,185.20	Carried Over	5,06,850.00	33,28,100.86

SATYENDRA NATH BOSE NATIONAL

Income and Expenditure Account for
DB 17, Sector I,

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Expenditure	Project Account Rs. P.	General Account Rs. P.
52604.60	2378672.53	Brought Forward	207467.01	2754,212.29
	11,324.75	POL		16,226.62
		Lease Rent		27,376.74
		Supplies & Materials	3,952.20	
317,395.40	414187.92	Excess of Income Over Expenditure for the year c/d	2,95,430.79	5,30,285.21
370,000.00	2804,185.20		506,850.00	33,28,100.86
—	—	Adjustment relating to prior period	—	54,733.48
317,395,.40	414,187.92	Excess of Income Over Expenditure transferred to General Fund	295,430.79	475,531.73
3,17.395.40	4,14,187.92		2,95,430.79	5,30,285.21

8/2, Kiran Sankar Roy Road
Calcutta-700 001
June 11, 1992

FOR D. P. SEN & CO.
Chartered Accountants
S/d Abhijit Bandyopadhyay
Partner

CENTRE FOR BASIC SCIENCES

the year ended 31st March, 1992
Salt Lake, Calcutta 700 064

Figures for the Previous year				
Project Account Rs. P.	General Account Rs. P.	Income	Project Account Rs. P.	General Account Rs. P.
370,000.00	28,04,185.20	Brought Forward	506,850.00	33,28,100.86
370,000.00	2804,185.20		506,850.00	33,28,100.86
317,395.40	441,187.92	Excess of Income Over Expenditure for the Year b/f	295,430.79	530,285.21
317.395.40	414,187.92		2,95,430.79	530,285.21

S/D J PAL CHAUDHURI
Administrative Officer

S/D C. K. MAJUMDAR
Director

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCE

Schedule A

FIXED ASSETS :

	Opening Balance as on 01.04.91	Additions During the Year	Adjustments During the Year	Closing Balance as on 31.03.92
	Rs. P.	Rs. P.	Rs. P.	Rs. P.
Office Equipment				
Xerox Machine	97,040.00	—		97,040.00
Typewriters	66,868.72	—		66,868.72
Fixograph	6,401.05	—		6,401.05
Calculators	933.00	—		933.00
Weighing Machine	1,258.15	—		1,258.15
Binding Machine	9,854.00	—		9,854.00
TOTAL	1,82,354.92	—		1,82,354.92
Furniture & Fixture				
Office Furniture	2,93,477.51	93,372.01		3,86,849.52
Fans & Clocks etc.	37,153.34	—		37,153.34
Library Furniture	76,502.23	26,642.18		1,03,144.41
TOTAL	4,07,133.08	1,20,014.19		5,27,147.27
Guest House Furniture				
Refrigerator	6,600.00	—		6,600.00
Water Heaters	4,300.00	—		4,300.00
Fans	1,710.00	—		1,710.00
Emergency Lights	1,240.00	—		1,240.00
Clock	135.00	—		135.00
Other Furniture (Cots, Dining Chairs & Table etc.)	40,707.36	—		40,707.36
Television Set	—	12,600.00		12,600.00
Air Conditioning Machines	—	51,590.00		51,590.00
TOTAL	54,692.36	64,190.00		1,18,882.36
Small Equipment				
Duplicating Machine	19,148.60	—		19,148.60
Projectors	13,474.98	8,689.10		22,164.08
Voltage Stabiliser	9,131.00	—		9,131.00
Glass Boards	7,354.00	—		7,354.00
Vacuum Cleaner	3,650.00	—		3,650.00
Plastic Screen	1,212.12	—		1,212.12
Franking Machine	9,289.26	—		9,289.26
Others	2,281.95	2,167.38		4,448.73
Fax Machine	—	74, 400.00		74,400.00
Electronic Weighing Machine	—	14,945.00		14,945.00
Acquaguards-SE-1000	—	5,000.00		5,000.00
TOTAL	65,541.31	1,05,201.48		1,70,742.79

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCE

Schedule A (Contd.)

FIXED ASSETS :

	Opening Balance as on 01.04.91	Additions During the Year	Adjustments During the Year	Closing Balance as on 31.03.92
	Rs. P.	Rs. P.	Rs. P.	Rs. P.
Books & Journals	5,58,152.39	3,37,884.50		8,96,036.89
Director's Research Equipment	41,398.48	1,03,116.00		1,44,514.48
Boundary Wall	10,38,937.20	—		10,38,937.20
Construction of Building*	31,75,873.56	89,68,093.79		121,43,967.35
Computer (Quantum + HP9000/5350)	13,08,680.44	—		13,08,680.44
Computer & Accessories	16,291.10	3,54,078.00		3,70,369.10
Campus Land	60,694.40	108,89,999.60		109,50,694.00
Air Condition Machines	33,600.00	75,874.99		1,09,474.99
Campus Beutification	80,398.11	60,655.00		1,41,053.11
Office Car (WNW 8486)	1,04,794.00	—		1,04,794.00
UPS	71,180.00	50,915.21		1,22,095.21
	64,89,999.68	208,40,617.09		2,73,30,616.77
PROJECT ASSETS				
Equipment	5,77,794.55	86,979.20		6,64,773.75
Books & Periodicals	5,421.60	1,658.48		7,080.08
TOTAL	5,83,216.15	88,637.68		6,71,853.83
GRAND TOTAL	77,82,937.50	212,18,660.44		290,01,597.94

*Included Rs. 9,25,185.89 representing a bill of M/s. Ghose Bose & Associates which is pending approval.

Schedule B

	Rs. P.
(a) Outstanding Liabilities (Revenue)	
1. Misc. Contingency Expenses	118.00
2. Postage & Telegram	757.00
3. Telephone & Trunkcalls	651.00
4. Hire of Transport	4,672.32
5. Printing & Stationery	1,502.00
6. Car Maintenance	3,000.00
7. Medical Claim	13,383.95
8. Salary & Allowances	33,069.17
9. Audit Fee	6,500.00
	63,653.44

	Rs. P.
(b) Outstanding Liabilities (Capital)	
Computer & Accessories	51,282.00
Construction of Building :	
(a) Ghosh, Bose & Associates	9,25,185.89
(b) Gannon Dunkerley & Co. Ltd.	10,52,574.48
	20,29,042.37

Schedule C

	Rs. P.
Sundry Creditors	
1. Deposit from A. Mookerjee	18,000.00
2. Ghosh, Bose & Associates	1,00,000.00
3. Deposit from N. Nayak	1,250.00
4. Gannon Dunkerley & Co. Ltd.	80.38
5. Refundable donation from P. Das	5,000.00
	1,24,330.38

Schedule D

	Rs. P.
Deposit for Rent	
N. Das Gupta	18,000.00
Rama De	1,250.00
K. Pal Chaudhuri	5,000.00
T. B. Dey	26,400.00
J. B. Bhowmik	19,000.00
	69,650.00

Schedule E

	Rs. P.
Advance to Suppliers & Contractors	
1. Gannon Dunkerley & Co. Ltd.	827,007.20
2. Godrej & Boyce Mfg. Co. Ltd.	29,176.91
3. Allied Publishers (P) Ltd.	208,880.00
4. Ghosh, Bose & Associates	300,000.00
5. Nabin Designers & Constructors (P) Ltd.	26,36,908.00
6. Systronics	35,937.02
7. GBC-HI-Tech & Co.	10,500.00
8. Network Ltd.	45,000.00
9. HCL Ltd.	48,705.00
10. Synchronous Engg. Co.	9,600.00
11. B. B. Construction	10,800.00
12. Associated Electricals & Equipment Corporation	104,274.34
13. Jubilee Enterprise	7,100.00
	42,73,888.47

Schedule F

	Rs. P.
Security Deposits	
West Bengal State Electricity Board	16,990.00
Department of Telecommunication	1,600.00
	18,590.00

Schedule G

	Rs. P.
Advances against expenses recoverable	
1. Recoverable exp. on Seminar (PATPAA)	10,000.00
2. Recoverable exp. on WHEPP II	10,773.00
3. Recoverable Insurance Premium	20.00
4. Contractor's Income Tax	410.00
	21,203.00

Schedule H

	Rs. P.
Security Deposit from Contractors	
Gannon Dunkerley & Co. Ltd.	310,726.31
B. B. Construction	6,932.00
	317,658.31

Schedule I

	Rs. P.
Short Term Deposit (Including Accrued & Reinvested interest)	
(a) Indian Overseas Bank	
Salt Lake Branch	
STD (91 days)	60,68,055.00
STD (46 days)	40,00,000.00
STD (one year)	27,79,026.15
(b) United Bank of India	
Mayukh Bhavan Branch	
STD (91 days)	25,00,000.00
STD (One year)	73,607.17
STD (191 days)	13,01,813.87
	167,22,502.19

Schedule J

	Rs. P.
Bank Balance	
With IOB, Salt Lake Branch	
General Fund Account	1,38,903.53
TPSC Fund Account	30,443.30
PROJECT Fund Account	2,90,263.17
Provident Fund Account	26,238.06
With UBI, Mayukh Bhavan Branch	2,24,990.00
	7,10,838.06

Schedule K

	Rs. P.
Other Advance	
1. Registrar of Bombay University	20,000.00
2. Rabin Banerjee	41,181.00
3. Festival Advance	1,640.00
4. Project Advance	4,200.00
	67,021.00

Schedule L

	Rs. P.
Prepaid Expenses	
1. Insurance Premium	12,390.00
2. Computer Maintenance	1,58,125.00
	1,70,515.00

Schedule M

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. 2,90,01,597.94 as disclosed in the Balance Sheet includes Library Books and Journals Valued at Rs. 8,96,036.89.
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 expenditure for the year has been transferred to General Fund.
5. Separate accountal for Prior Period Expenditure, not provided for earlier, has been initiated from this year.
6. As per consistent practice, all capital work - in - progress including Buildings under construction, Plant & Machinery and Equipment pending installation have been directly debited to the asset heads instead of opening Capital Work-in-progress account.
7. The Centre possesses 15.0401 acres of leasehold land out of which 10 acres had been allotted by the Government of West Bengal free of cost; a consideration of Rs. 36.30 lakhs was paid by the Department of Science & Technology directly to the Salt Lake Reclamation & Development Circle, Government of West Bengal for 5 acres, not hitherto reflected in the accounts of the Centre; an amount of Rs. 60,694.00 was paid by the Centre for the balance 0.0401 acres. During the current year, the 10 acres of land received free of cost has been brought into the books at the valuation arrived at by applying the rate at which the 5 acre plot has been purchased and paid for by the Department of Science & Technology. The 5 acre plot has also been capitalized in this year. This has resulted in further capitalization of Rs. 1,08,89,999.60 during the year; being the value of land received free of cost by the Centre in prior periods. A corresponding credit of the same amount has been taken in the Capital Fund.
8. i) The Employees' Provident Fund and Gratuity Fund have not been registered/ recognized. The schemes framed in this respect are pending approval by the Competent Authority.

   ii) Out of the accumulated balances in the Employees' Provident Fund and the Gratuity Fund, Rs. 4,12,000.00 and

Rs. 60,571.00 have been invested in separate, earmarked short term deposits with a bank. The balance amount of Rs. 35,438.06 and Rs. 23,151.00 are lying in Provident Fund Account and General Account with the I.O.B., Salt Lake Branch respectively.

iii) Accrued and reinvested interest on earmarked investment of the Employees' Provident Fund and the Gratuity Fund have not been accounted for in the books.

iv) Pending finalization of the Provident Fund Scheme, rates of P.F. deduction from the employees' remuneration and contributions made by the employer are as per the West Bengal Provident Fund Rules.

9. Certain comparative figures for the previous year in the accounts have been reclassified to conform to the current year's presentation.