

# **ANNUAL REPORT 1989-90**



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

(Estd. 1986)

DB17 : SECTOR 1, SALT LAKE CALCUTTA - 700 064

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

**Calcutta**

**ANNUAL REPORT**

**April 1, 1989 to March 31, 1990**

**Objectives**

The objectives of the S N Bose National Centre for Basic Sciences established in June 1986 as a registered society functioning under the umbrella of the Department of Science & Technology, Government of India, 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 | Dr V Gowariker<br>Chairman       | Secretary<br>Department of Science & Technology<br>Government of India, New Delhi |
| 2 | Professor C N R Rao<br>Member    | Director<br>Indian Institute of Science<br>Bangalore                              |
| 3 | Professor C S Seshadri<br>Member | Dean<br>School of Mathematics SPIC, Science Foundation<br>Madras                  |

- |   |  |   |
|---|--|---|
| 4 | Professor J V Narlikar<br>Member           | Director<br>Inter-University Centre<br>for Astronomy & Astrophysics<br>Pune                                 |
| 5 | Shri B K Chaturvedi<br>Member              | Joint Secretary & Financial Adviser<br>Department of Science & Technology<br>Government of India, New Delhi |
| 6 | Shri T C Dutt<br>Member                    | Chief Secretary<br>Government of West Bengal<br>Calcutta  |
| 7 | Professor C K Majumdar<br>Member           | Director<br>S N Bose National Centre for Basic Sciences<br>Calcutta   |
| 8 | Dr J Pal Chaudhuri<br>Non-member-Secretary | Administrative Officer<br>S N Bose National Centre for Basic Sciences<br>Calcutta                           |

At the moment the Centre operates from a rented house located at DB 17, Sector I, Salt Lake City, Calcutta 700 064. However, a 15 acre plot of land in Block JD, Sector III, Salt Lake City, Calcutta has been made available to the Centre and a campus is in the process of being built.

### **Academic Programmes**

The Academic Programme Advisory Committee considers the yearly academic activities of the Centre. Scientists who are currently members of this committee are :

- 1 Professor V Singh : Director, Tata Institute of Fundamental Research, Bombay
- 2 Professor S N Biswas : University of Delhi, Delhi
- 3 Professor K L Chopra : Director, Indian Institute of Technology, Kharagpur
- 4 Professor S S Jha : Senior Professor, Tata Institute of Fundamental Research, Bombay
- 5 Professor S K Joshi : Director, National Physical Laboratory, New Delhi
- 6 Professor A K Raychaudhuri : Calcutta
- 7 Professor C K Majumdar : Director, S N Bose National Centre
- 8 Professor K P Sinha : Chairman, CTS, Indian Institute of Science, Bangalore
- 9 Professor G Rajasekaran : Institute of Mathematical Sciences Madras
- 10 Professor M Chowdhury : Indian Association for the Cultivation of Science, Calcutta
- 11 Professor O Siddiqi : Tata Institute of Fundamental Research, Bombay
- 12 Professor A K Sharma : Calcutta
- 13 Professor R P Bambah : Punjab University, Chandigarh
- 14 Professor M Datta : Calcutta Mathematical Society
- 15 Professor A S Gupta : Indian Institute of Technology Kharagpur
- 16 Professor N Mukunda : Indian Institute of Science Bangalore

- 17 Professor M S Narasimhan : Tata Institute of Fundamental Research  
Bombay
- 18 Professor P C Vaidya : Ahmedabad
- 19 Professor E C G Sudarshan : University of Texas, Austin, USA

#### **Conferences/Workshops/Symposia**

In April 1989 the S N Bose National Centre held a 4-day Topical Meeting on Critical phenomena in the Early Universe (April 4-7, 1989). The aim of the meeting was to understand the impact of the recent developments in Gauge Theory, High Energy Particle and Nuclear Physics, Field Theory of Critical Phenomena and related concepts of the Early Universe. In addition, topics on High Energy Astrophysics, galaxy formation and other similar things were also covered. A total of 33 scientists including 9 from outside Calcutta participated in the seminar. The universities of Tripura, Utkal, North Bengal, Delhi, Calcutta, Jadavpur, Vidyasagar and research institutes like Tata Institute of Fundamental Research, Saha Institute of Nuclear Physics, Variable Energy Cyclotron Centre (BARC) were represented.

From January 3 to 5, 1990, the Centre organized a Topical Meeting to celebrate the 25th anniversary of the discovery of CP Violation. A smaller group selected from among the participants continued the discussions through a workshop lasting till January 10. The topics covered were :

- a) Weak CP Violation in the standard model and beyond,
- b) Strong CP problem,
- c) CP Violation in the early universe, and its implications for cosmology, and
- d) Current experimental status and future prospects.

Among the 44 scientists who participated 4 came from the USA, 2 from Europe, 22 from Indian research institutes and universities located outside Calcutta, 12 from the sister institutes in Calcutta and 4 were attached to the S N Bose National Centre.

During the year the Centre extended financial support to many scientific conferences/workshops held in different parts of India. Some of the conferences/workshops which benefited from such gestures of the Centre were :

- 1) 'Recent trends in Relativity, Cosmology and Quantum Gravity'

(November 4-7, 1989) organized by the Department of Physics, North Bengal University, Darjeeling, West Bengal.

2) 'Supernovae and High Energy Astrophysics' (December 27-29, 1989) organized by the Indian Astronomical Society, Calcutta.

3) 'In search of Quantum Reality' (December 28, 1989 to January 2, 1990) organized by the National Institute of Science, Technology & Development Studies, New Delhi.

4) 'Winter School on Quark—Gluon Plasma' (December 5-16, 1989, Puri, Orissa) organized by the Variable Energy Cyclotron Centre, BARC, Calcutta.

5) 'Annual Topical Meeting on Nuclear Physics—1989' (September 21-22, 1989) organized by the Variable Energy Cyclotron Centre, BARC, Calcutta.

6) 'Regional Convention of Physics Teachers of Far Eastern India' (April 1990 at St Anthony's College, Shillong) organized by the Indian Association of Physics Teachers.

7) 'Seminar on the Physics & Technology of Particle Accelerators and their Applications (PATPAA-90) (February 5-7, 1990) organized by the Indian Physical Society.

8) 'National Seminar on Radiation and Photochemical Processes of the Environment' (January 17-19, 1990) organized by the Saha Institute of Nuclear Physics, Calcutta.

#### **Seminars organized at the Centre**

1 Dr E L Ivchenko (Ioffe Physico Technical Institute, Leningrad)—Optical phenomena of semiconducting GaAs and GaAlAs superlattices (April 1989).

2 Dr R Shankar (IIT, Kanpur)—Frustrated Heisenberg Antiferromagnets in two dimensions (July, 1989).

3 Dr D Gangopadhyay (S N Bose National Centre)—Field theory and spin systems (August, 1989).

4 Sri K L Patra (Behala College, Calcutta)—Inverse Scattering Methods at Fixed Angular Momentum and their Application to Physical Problems (September 1989).

5 Dr Partha Majumdar (Saha Institute of Nuclear Physics)—Strings in Curved Space-Time (October 1989).

6 Dr Indrani Bose (Bose Institute, Calcutta)—Quantum Antiferromagnetism and High Temperature Superconductivity (November 1989).

7 Professor S N Ganguli (Tata Institute of Fundamental Research)—Neutrino Counting (December 1989).

8 Professor S N Ganguli (Tata Institute of Fundamental Research)—Mass and width of Z (December 1989).

9 Professor Frank Close (Rutherford Appleton Laboratory, UK)—Polarized Scattering and the Proton Spin Problem (December 1989).

10 Dr J S Anandan (University of South Carolina, USA)—A Geometric View of Quantum Mechanics (January 1990).

11 Dr S K Dey (Department of Mathematics, Eastern Illinois University, USA)—Parallel Computation (January 1990).

12 Dr Akira Tonomura (Hitachi Ltd., Japan)—Applications of Electron Holography and the Aharonov—Bohm Effect (January 1990).

13 Professor R N Sen (Ben Gurion University, Israel)—Superposition Principle in Non-Relativistic and Relativistic Quantum Theory (January 1990).

14 Professor R N Sen (Ben Gurion University, Israel)—Quantum Field Theory on Hilbert Bundles (January 1990).

15 Professor R J Emrich (Department of Physics, Lehigh University—Bethlehem, USA) —Strange Flow Process in Fluid Dynamics (February 1990).

16 Professor Antonio Masiero (University of Padova, Italy)—Probing Supersymmetry in Flavour Changing Neutral Current Phenomena (February 1990).

17 Professor V De Sabatta (Institute di Fisica, Bologna, Italy)—Torsion and Magnetism (February 1990).

18 Professor V Soni (National Physical Laboratory, New Delhi)—Nucleon Models and Proton Spin (March 1990).

**Conferences attended and Seminars/Talks by the Centre's staff**

Dr Ashok Chatterjee—Attended the Solid State Physics Symposium (organized by the DAE at the IIT, Madras during 19.12.1989 to 22.12.1989)

and presented papers “A Variational Calculation for the two dimensional (2D) bound polaron” (jointly with S. Sil), and “Multidimensional Frohlich bipolaron and dimensional scaling” (jointly with S. Sil).

—Visited the Department of Physics, IIT, Kanpur during 2.1.1990 to 4.1.1990 and gave the following talks : “Large-N expansion in quantum mechanics and atomic physics”, and “Polarons and bipolarons”.

Dr Fartha Ghose—Attended a national Seminar “Recent Trends in Relativity, Cosmology and Quantum Gravity” held from November 4 to 7, 1989 at the North Bengal University.

—Attended the International Conference “In Search of Quantum Reality” organized by NISTADS, New Delhi, from 28.12.1989 to 2.1.1990 and presented a paper “Quantum Theory, Faster-than-Light Signals and Causal Paradoxes. A Re-examination” (Co-author : Dr Dipankar Home, Bose Institute).

Attended the Seminar, “History of Science, Technology and Medicine in India” (organized by the Centre for Study of Developing Societies, Delhi, March 18 to 20, 1990). He chaired one session and was the commentator on a paper by Dr Ranjit Nair.

—Attended the seminar on ‘SRSTI—Its Philosophical Entailments’ organized by the Department of Philosophy, Jadavpur University and the Indira Gandhi National Centre for the Arts, New Delhi—March 28 to 30, 1990. He chaired two sessions and presented a paper on ‘SRSTI—A Physicist’s Perspective’.

Dr C K Majumdar—Attended the meeting of National Committee on Mathematics Education and Research (NCMER) in Calcutta from December 25 to 27, 1989.

—Talked at the Saha Institute of Nuclear Physics on “Valence Bond States in High  $T_c$  Superconductors” in the Workshop on “Ceramic and High  $T_c$  Superconductors” from December 28, 1989 to January 6, 1990.

—Talked on “Science & Technology in the Indian Epics” (Science Day, Celebrations at Bose Institute (February 28, 1990).

—Professor Abhijit Mookerjee—Attended the Workshop “Ceramic and High  $T_c$  Superconductors” at the Saha Institute of Nuclear Physics, December 28, 1989 to January 6, 1990.

—Attended the Symposium “Band Structure Methods for Metals and Oxides”—(Anna University, Madras 12.2.1990 to 15.2.1990) and talked on



“The Augmented Space Technique and Cluster Generalizations of the KKR-CPA for random binary alloys”.

—Visited Matscience, Madras, and lectured on “Transmittance through a quantum random system” (February 16, 1990).

— Attended the Indo-Soviet Conference on ‘Phase Transitions’, Bangalore (February 20-23, 1990) and chaired a session.

—Visited Central University, Hyderabad, TIFR, Bombay and IIT, Kanpur from November 8 to 23, 1989, as part of the Theoretical Physics Seminar Circuit and talked on “Electronic Structure of Finite and Disordered Systems”, and “Quantum Transmittance in Disordered Systems: The Vector Recursion Method”.

Dr Samir Kumar Paul—Attended the International Colloquium on Modern Quantum Field Theory at TIFR, Bombay, and talked on “Krichever-Novikov Algebra in Superstrings in Curved Background” (paper jointly with J Maharana, G Sengupta) (January 8 to 14, 1990).

Dr M Sivakumar—Visited the Physical Research Laboratory, Ahmedabad, and talked on “Fractional Statistics in  $2+1$  Dimensions”.

—Attended the International Colloquium on Modern Quantum Field Theory at TIFR, Bombay, and talked on “Fermi-Bose Equivalence in a  $U(1)$  Gauge Theory with Chern-Simons Action” (January 8 to 14, 1990).

## Research Activities at the Centre

### Physics

The research activity was concentrated on condensed matter physics, particle physics, basic ideas of quantum mechanics and mathematics.

In particle physics, work is in progress on a consistent spin-3/2 theory, Fermi-Bose equivalence in  $2+1$  dimension, quantum algebra for heterotic strings in curved space-time manifolds and the continuum approach to two-dimensional quantum gravity. A gauge invariant Rarita-Schwinger theory of a massive spin-3/2 particle interacting with external electromagnetic, gravitational and dilation fields was obtained and its quantum consistency was proved. A  $U(1)$  gauge invariant scalar field theory with Chern-Simons term was shown to be exactly equivalent to a free fermion theory and the Fermion field was constructed explicitly in terms of the Bose fields. The interaction between two

vortices in the Abelian Higgs model with an additional Chern-Simons term is argued to be relevant for the physics of high temperature superconductors. Also statistical mechanics of quarks and gluons confined to a bag was developed to study their deconfinement as well as phase transition to a quark-gluon plasma.

Work has started on examining the current ideas on interpretations of quantum mechanics. Variants of single particle interference experiments were analysed to investigate the nature of quantum non-locality, collapse, the ensemble versus single particle interpretations of the wave function and the complementarity principle. A new experiment has been proposed which can throw more light on the wave-particle nature of "single photon states". Also the observability of non-local statistical effects of EPR correlations for time-like separated measurements and their compatibility with special relativity was studied. Close collaboration is maintained between workers at the Centre and the Bose Institute, Calcutta.

Cluster generalizations of the KKR-CPA (Korringa-Kohn-Rostoker coherent potential approximation) for non-isochoric alloys were worked out with an application to a Kronig-Penney alloy. The basic dynamical CPA formalism was worked out for electrons in contact with stochastic baths and an explanation was provided for the anomalous temperature coefficient of resistivity of Mooij alloys. The transmittance of several quasicrystalline and random systems has been studied; the restricted vector recursion program has been developed and the nature of states on generalized Aubry models have been studied. A simulation on mutually avoiding, many-particle directed random walk with sticky bottom geometries is in progress. Some of these investigations involve collaboration with workers from Indian Institute of Technology, Kanpur; Jawaharlal Nehru University, Delhi; University of Dhaka, Bangladesh; and Saha Institute of Nuclear Physics, Calcutta.

The ground and excited states of a purely two dimensional bound polaron have been studied and the phonon-induced Lamb shift corrections have been computed for several polar materials. The multidimensional free and bound optical polarons have been studied; the polaronic effects are found to diminish with increasing dimensionality. The formation of Frohlich bipolaron and its stability have been studied; the Coulomb correlation plays an important role, and the two dimensional bipolaron is more strongly bound than the three dimensional one.

The shifted  $1/N$  expansion has been organized in the framework of the pseudo-spin formalism. The method has yielded results for the ground state energies of a class of power law potentials and for the strong field Zeeman problem.

The numerical calculation of the antiferromagnetic phase boundary in the magnetic field-temperature (H-T) plane through Yang-Lee zeros was completed by S Dasgupta (working with C K Majumdar).

Radiation damage in some materials of technical importance—cobalt, stainless steel, high temperature superconductors—are being studied with the alpha particle beam at the Variable Energy Cyclotron Centre at Calcutta. Iron-based minerals in eastern India—mainly oxides and chromites—have been examined by Moessbauer spectroscopy down to liquid nitrogen temperature. The studies have been supplemented by information from x-ray diffraction and positron annihilation. Physico-chemical conditions prevalent during the formation and metamorphosis of these minerals can be unravelled from such studies.

### **Mathematics**

Work has been started by S K Bose, Visiting Professor at the Centre, to develop a two dimensional stochastic process theory for flaw detection by ultrasonic back-scattering technique in composite laminas. The back scattering from a normally incident wave from a unidirectional fibre reinforced lamina immersed in water (as in the technology used) has been calculated to obtain the average backscattered and transmitted wave. Three of the five elastic moduli of a fibre-reinforced composite for low frequency wave propagation are known. Computations in the high frequency domain, required for ultrasonic N. D. E., are continuing. Control of mechanical vibrations, specially of space structures, is an important problem. Using the idea of Hilbert uniqueness method introduced by J L Lions in 1988, the control of torsional mode of vibration of a rectangular panel is being studied. Discretization by the Finite Element Method avoids the current practice of modal expansion. In hydraulics, the mechanics of scouring of river beds around bridge piers and modelling of the flow are being investigated.

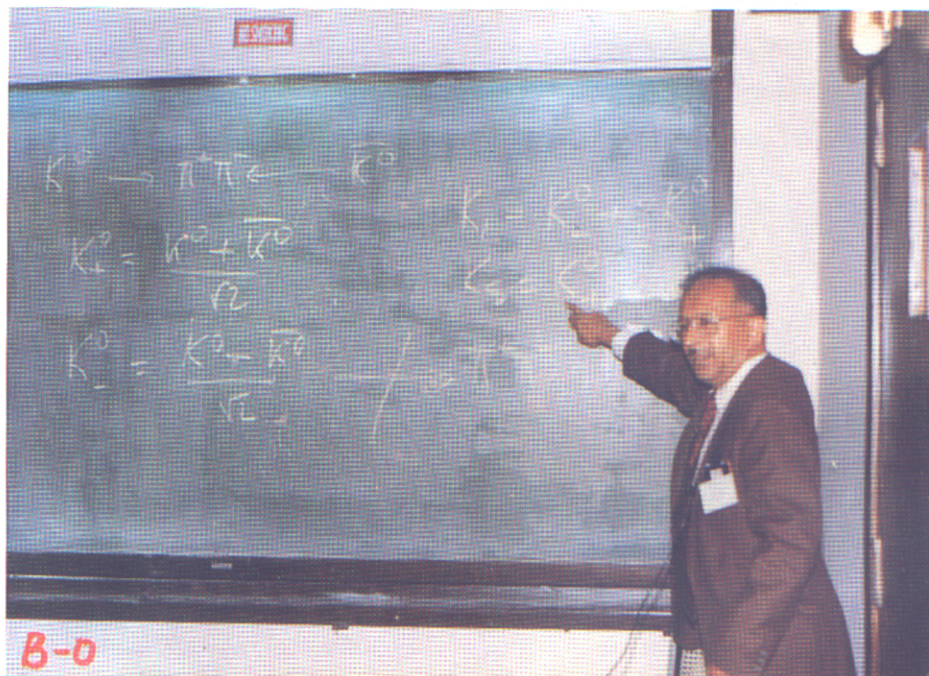
### **Quantum Chemistry**

Dr A K Bhattacharya of Lady Keane College, Shillong, was a Visiting Scientist at the Centre and worked on the quantum chemical model of anti-inflammatory compounds. A paper 'A Quantum Chemical Study of some model Anti-inflammatory Compounds: the preferred conformations and their electrostatic similarities' has been accepted for presentation in the International Congress on Ultra low Doses at Bordeaux, France, in September, 1990.

### **Project on High Temperature Superconductivity**

A project jointly with the Variable Energy Cyclotron Centre (VECC) on

TOPICAL MEETING TO CELEBRATE 25 YEARS OF  
THE DISCOVERY OF CP VIOLATION, JANUARY 3-5,  
1990

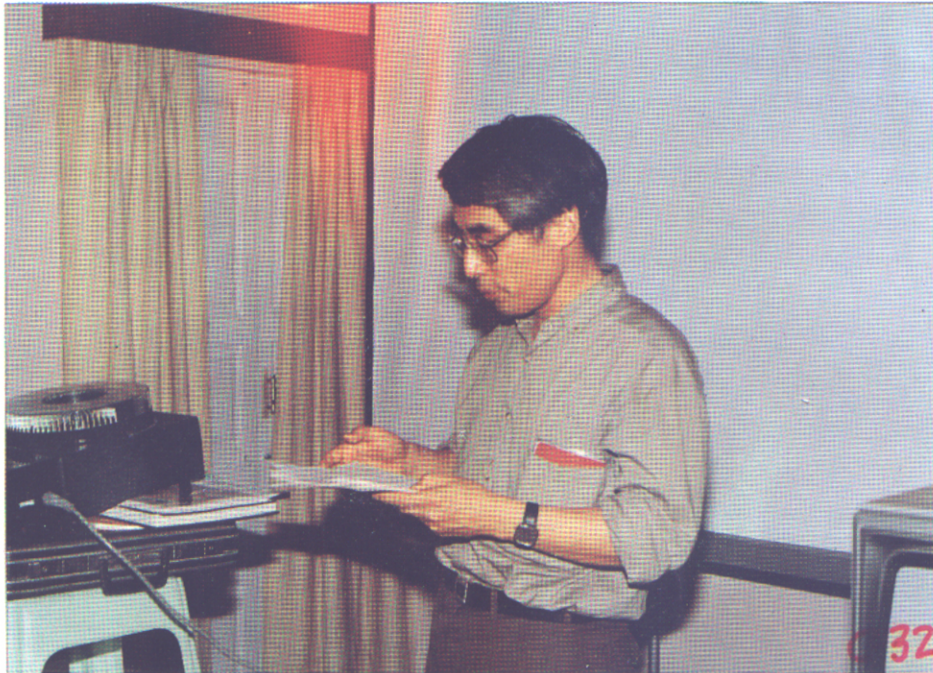


Professor P K Kabir, University of Virginia, delivering the key-note address.



Participants listening to a lecture





Dr Akira Tonomura, Chief Researcher, Advanced Research Laboratory, Hitachi Limited, Japan, giving a seminar at the Centre



Mr T C Dutt, Chief Secretary, Government of West Bengal and a delegation from the Overseas Development Administration, UK, and the British Council Division, in a meeting at the Centre

the study of high temperature superconductivity was sanctioned to the Centre in September 1989. The aim of the project is to understand the basic properties of these materials and their behaviour under particle irradiation, so that the workers may have experience of handling conventional or ceramic superconducting materials to be used in a future superconducting cyclotron. Work started in October 1989 when Dr R Chaudhury was appointed a Research Scientist in the project to work on the theoretical aspects. S K Bandyopadhyay, P Barat, U De and B C Sinha at VECC and A Mookerjee and C K Majumdar at the Centre are other scientists interested in the project. Dr Chaudhury has been investigating the possibility of high temperature superconductivity from the combined phonon and charge transfer exciton mechanism. Experiments on the high temperature superconductors after irradiation by the alpha beam at VECC are being planned.

Dr R Chaudhury attended the Workshop on Ceramic Superconductors held at Saha Institute of Nuclear Physics during December 28, 1989 to January 6, 1990 and talked on 'Some Phenomenological Aspects of Magnetism in the High  $T_C$  systems'. He also attended the International Conference on Superconductivity held in Bangalore during January 10 to 14, 1990.

Dr U De of VECC attended the Conference on "Critical Currents in High Temperature Superconductors" organized by Cryogenics at Karlsruhe, West Germany, during October 24-25, 1989 and presented a paper "EDXS Characterization of Citrate-route and Conventionally prepared  $YBa_2Cu_3O_{7-x}$  Superconductors" (jointly with V S Raghunathan of Kalpakkam).

#### **Collaborative Research with Warwick University, U.K.**

The Centre has been trying to set up a collaborative research programme on materials science with the Catalysis and Solid State Research Unit of the Warwick University, U K. A team from Britain visited the Centre on January 9, 1990 for discussion. The members were Professor J D E Beynon, Pro-Vice Chancellor, Surrey University, Dr J Taylor, British Council, London, Mr D Cordingley, British Council, Calcutta, and Mr Robert Sykes, First Secretary, British Council, Calcutta. During their discussion with the members of the Centre, Sri T C Dutt, Chief Secretary, Government of West Bengal and member of the Governing Body of the Centre, was present. As a follow up to the discussion Dr C K Majumdar visited Warwick University from March 6 to 16, to draw up a concrete plan of action.

#### **Publications**

##### **A. Scientific Journals**

1. Bhattacharya M, Chatterjee A and Mitra T K : Feynman-Haken

path-integral approach for the two-dimensional surface optical polaron bound to a Coulomb impurity—*Phys. Rev. B* 39, 8351 (1989).

2. Chatterjee A : Strong-coupling theory for the multidimensional free optical polaron—*Phys. Rev. B* 41, 1668 (1990).

3. Chatterjee A : Large-N expansions in Quantum Mechanics, Atomic Physics and some O (N) invariant systems—*Physics Reports* 186, 249 (1990).

4. Dasgupta S : ‘Phase boundary of an Ising antiferromagnet’—*J. Phys. Soc. Japan* 58, 4344 (1989).

5. Mookherjee A : Systems with static and dynamic disorder—generalized coherent potential approximation—*J. Phys. Condensed Matter* 2, 897 (1990)

6. Mukhopadhyay G, Das D, Majumdar C K and Sen P : Positron Annihilation Study of Alpha-irradiated Stainless Steel SS 302 and Cobalt’—*Radiation Effects and Defects in Solids* 112, 135-147 (1990).

7. Sil S and Chatterjee A : Intermediate coupling theory for the multi-dimensional polaron’—*Physics Letters A* 140, 59 (1989).

#### B. Proceedings of Conferences and Symposia

1. Majumdar C K : (a) High Temperature Superconductor : Experimental Results (pp. 119-131) ; (b) ‘The Ising Model’ (pp. 132-146). *Schroedinger Centenary Survey in Physics* (Ed. V Singh and S Lal, World Scientific, Singapore 1988).

2. Majumdar C K : Basic Theories of Conventional Superconductivity—*Indian Journal of Cryogenics* 13 (Special issue : High temperature Superconductors, editors S V Subramanyam and E S R Gopal, Wiley Eastern Limited, 1989 (pp. 130-150).

3. Mukherjee D (Editor) : ‘Aspects of Many Body Effects in Molecules and Extended Systems’—*Lecture Notes in Chemistry* No. 50, Springer Verlag, Berlin. It contains the proceedings of the workshop jointly sponsored by S N Bose National Centre for Basic Sciences and Indian Association for the Cultivation of Science.

#### C. Miscellaneous

1. Ghose Partha : ‘Kaler Sankhipta Itihas’—*Baromas* (Puja edition) 1989 (in Bengali).

2. Ghose Partha : 'Abhijan Kon Mahakashe'—Ananda Bazar Patrika (Sunday edition) September 3, 1989 ( in Bengali).

3. Ghose Partha : 'Calcutta—The Cradle of Science and Technology in India', Proceedings of the XXII Annual Conference of the Indian Pharmacological Society, December 1989.

4. Ghose Partha : 'Calcutta—300 Years of Science', '2001', January 1990, extracts from "Calcutta : The Living City", ed. by Sukanta Choudhuri, to be published by Oxford University Press.

5. Ghose Partha : 'Inquiry', a monthly column in '2001' written in collaboration with D Home.

6. Majumdar C K : Eulogy for Scholarship, Physics Teacher 31, January 1989, pp. 47-53.

7. Sarkar D and Majumdar C K : 'Liquid Helium 3, Part I' Physics Teacher 31, January 1989 pp 17-32.

#### **D. Books**

Ghose Partha and Home D : 'Riddles in Your Tea Cup' ( Rupa & Co., Delhi, January 1990).

#### **Audio Visual Educational Aid Production**

1. Ghose Partha : 'Classical Mechanics, Parts 8-13' (available from UGC Audio-Visual Research Centre, St. Xavier's College, Calcutta).

2. Ghose Partha : 'Twenty-five years of CP Violation' (available from UGC Audio-Visual Research Centre, St. Xavier's College, Calcutta).

3. Ghose Partha : 'A Quantum Leap Forward', an interview with Dr A Tonomura, Chief Researcher, Advanced Research Laboratory, Hitachi Limited, Kokubunji, Tokyo, Japan (available from UGC Audio-Visual Research Centre, St. Xavier's College, Calcutta).

#### **Short Term Visitors/Visiting Fellows of the Centre**

1. Dr E L Ivchenko, Ioffe Physico Technical Institute, Leningrad (April 1989).

2. Professor Arunabha Bagchi, Professor of Applied Mathematics, University of Twente, Enschede, The Netherlands (May 1989).



3. Dr Y S Yang, Physics Department, Shanxi University, Taiyuan, People's Republic of China (April & May 1989).
4. Dr D Gangopadhyay, Institute of Physics, Bhubaneswar (June-August, 1990).
5. Professor S N Ganguly, Tata Institute of Fundamental Research (December 1989).
6. Professor Frank Close, Rutherford Appleton Laboratory, UK (December 1989).
7. Professor J Mahanty, Australian National University (December 1989).
8. Professor Mesbahuddin Ahmed, Department of Physics, University of Dacca, Bangladesh (December 1989).
9. Professor K Dasgupta, Texas Tech University, Lubbock, Texas, USA (January and February 1990).
10. Professor R. N. Sen, Ben Gurion University, Beer Sheva, Israel (January 1990).
11. Professor J Carbotte, Department of Physics, McMaster University, Ontario, Canada (January 1990).
12. Professor J S Anandan, Department of Physics, University of South Carolina, USA (January 1990).
13. Professor P K Mitter, Laboratoire de Physique Theorique, University Pierre et Marie Curie, Paris (January 1990).
14. Dr A Tonomura, Advanced Research Laboratory, Hitachi Limited, Tokyo, (January 1990).
15. Professor A Masiero, University of Padova, Italy (February 1990).
16. Dr D Chowdhury, School of Physical Sciences, Jawaharlal Nehru University, New Delhi (February 1990).
17. Professor R J Emrich, Professor Emeritus, Department of Physics, Lehigh University, Bethlehem, USA (February 1990).
18. Professor V De Sabbata, Istituto di Fisica, Bologna, Italy (February 1990).

19. Professor V Soni, National Physical Laboratory, Delhi (February 1990).
20. Professor S K Bose, R E College, Durgapur (December, 1989 to — ).
21. Dr A K Bhattacharyya, Lady Keane Girls' College, Shillong, (December 1989 to February 1990).

#### **Theoretical Physics Seminar Circuit**

Until recently the Coordinating Committee of the TPSC was located at the Tata Institute of Fundamental Research, Bombay. From November 1989 it was transferred to the S N Bose National Centre. As a result, the Centre is having the privilege of being visited by many renowned scientists attached to various Indian Research Institutes and Universities. Beginning October 1989 the following scientists visited the Centre as TPSC speakers :

M Barma, Tata Institute of Fundamental Research, Bombay—'Metal Particles' (October 1989).

R Rajaraman, Indian Institute of Science, Bangalore—'New Results on Constraint Theory and Gauge Invariance' (November 1989).

D P Roy, Tata Institute of Fundamental Research, Bombay—(a) Overview of Collider Physics, (b) Looking for Top, and SUSY (November 1989).

A P Pathak, University of Hyderabad—(a) Charged Particle Probes to Crystalline Solids, and (b) Study of Crystal Defects and Strains in Superlattices using Channelling Radiation (December 1989).

D P Dewangan, Physical Research Laboratory, Ahmedabad—'High Energy Charge Transfer' and 'Scattering of electrons and positrons by a Coulomb potential' (February 1990).

Diptiman Sen, Indian Institute of science, Bangalore—'Conformal Field Theory and Two Dimensional Statistical Mechanics' (February 1990).

S M Bhattacharjee, Institute of Physics, Bhubaneswar—(a) 'Five Vertex Model in Three Dimensions—A colloquium' and (b) 'The tiling Model for Glass Transition—a group seminar' (February 1990).

Chandan Dasgupta, Indian Institute of Science, Bangalore—(a) 'The Liquid-to-Glass Transition' and (b) 'Intrinsic Pinning and Flux Creep in High  $T_c$  Superconductors.' (February 1990).

Sudhakar Panda, Tata Institute of Fundamental Research, Bombay—  
(a) 'Conformal Invariance in Physics and its implications' and (b) 'Classification of characters in rational conformal field theories' (February 1990).

Sridhar K, University of Bombay—'Nuclear effects in hadron-nucleus and nucleus-nucleus collisions' (March 1990)

V K B Kota, Physical Research Laboratory, Ahmedabad—'Spectral Averages in Nuclei : general principles' (March 1990)

Most of the seminars were given at the S N Bose National Centre ; some were held at SINP, IACS and Bose Institute.

**Honour received by the Centre's Staff :**

1) Dr Partha Ghose, Academic Programme Coordinator of the Centre, was awarded Honorary MBE by Her Majesty Queen Elizabeth II of U. K.

2) Dr S K Bose, Visiting Fellow at the Centre since December 11, 1989, has been made a Fellow of the Indian Academy of Science, Bangalore.

3) Dr C K Majumdar, Director of the Centre, was awarded the S N Bose Medal for 1989 by the Indian National Science Academy.

**Computer Centre**

HP 9000 was made operational in September 1989 and now operates a 19" B & W console, a hard disc, one cartridge drive, a dot matrix printer and a 8-pen graphics plotter. At present the Centre is also using two HP Quantum Workstations as terminals of HP 9000. The system is extensively used by scientists of this centre and by some scientists and visitors from outside the Centre. One Computer Engineer-cum-System Administrator looks after all the work. This Computer Centre provides some training on UNIX-based software for familiarity with the machine, VI Editor, Screen Editor and also some of the programming languages e.g. FORTRAN 77, TECHNICAL BASIC, UNIX-C, PASCAL etc. Some GRAPHICS PACKAGES have been developed. A MATHEMATICAL ROUTINE LIBRARY is under preparation. Scientists can prepare SLIDES with the help of HP Plotter. Moreover, the Centre is equipped with various software used for preparing different reports and various technical reports such as Chi-writer, HPG, NEWS MASTER, GALLERY etc.

The Computer Course for College Teachers which was initiated last year was conducted this year as well. During 1989-1990 eight college teachers participated in the training. The training was in Microsoft Disk Operating

System (MS DOS) and a version of BASIC for mathematical calculations (GWBASIC) available on Quantum Workstations of Hewlett-Packard. The trainees were also given some ideas of menu-driven software like WORDSTAR for wordprocessing and taught FORTRAN for scientific calculations. Most of the teachers also used Microsoft FORTRAN available on Workstation.

Courses on Structured Languages such as PASCAL and OCCAM will be planned in future. The Centre is toying with the idea of purchasing next year HP support services that provides UPDATES.

### **Library**

The Library of the S N Bose National Centre subscribed to 18 journals (6 foreign and 12 Indian) during the year 1989-90.

The six foreign journals are :

1. Physical Review Letters
2. Physics Letters (Section A)
3. Physics Letters (Section B)
4. Physics Reports
5. Computers in Physics
6. Computer Journal

Indian journals are :

1. Bulletin of Materials Science
2. Current Science
3. Journal of Astrophysics and Astronomy
4. Journal of Biosciences
5. Journal of Genetics
6. Pramana
7. Proceedings (Animal Sciences)
8. Proceedings (Chemical Sciences)
9. Proceedings (Earth and Planetary Sciences)
10. Proceedings (Mathematical Sciences)
11. Proceedings (Plant Sciences)
12. Sadhana (Engineering Sciences)

The SLAC preprints in Particles and Fields were also subscribed by the Library during this year. The Library receives free preprints and reprints from

about 20 Centres, including CERN, Geneva. The Centre hopes to add some more journals to its library next year.

The Library acquired 73 new books over the year. Title service to the scientists who attended the workshop on 'Chaotic Phenomena in Physical Systems' is being continued by the library. Preparations are being made to expand the library with a small reading room furnished with display racks. Library xeroxed 2424 pages.

### CONSTRUCTION OF THE NEW CAMPUS

Of the 15 acres of land where the campus for the Centre will be built, 10 acres have been gifted by the Government of West Bengal and 5 acres were purchased by the Centre. In April 1989 the formal signing of the deed pertaining to gift of land to the S N Bose National Centre for Basic Sciences took place. Some months later the process of registration of both the plots of land was completed. In February, the Centre received the Possession Certificate for the 15 acre plot of land from the Metropolitan Development Department, Government of West Bengal. The Centre is pleased to report that the Government of West Bengal was kind enough to grant exemption from payment of stamp duty normally required for registration of land.

Ghosh, Bose & Associates, the Consultant Architects for the Centre had suggested that the soil of the campus site should be tested before undertaking construction work. Based on this suggestion a competent company was assigned to test the soil in January 1989. It was recommended that pile foundation work was necessary before buildings were erected. Accordingly, the Centre, upon advice of the Consultant Architect, put up notices of pre-qualification tender both for pile foundation work as well as for construction work. The notices were advertised in Times of India, Bombay, The Statesman, Calcutta & New Delhi. Thirteen firms from different parts of India responded to the pile foundation work tender notice and sixteen firms from most of the major cities of India responded to construction tender notice. For obvious reasons priority was given to the pile foundation work and with the help of the Consultant Architect a short list of six firms who satisfied all the requirements has been prepared though actual work of pile foundation could not be started. Until recently the Salt Lake area was administered by the Salt Lake Authority. Recently this body has been abolished and replaced by Bidhannagar (Salt Lake Township) Notified Area Authority. This change has delayed the processing of papers which we had submitted for obtaining permission to start the construction work. However, in February 1990 the Notified Area Authority gave the Centre

a conditional 'go-ahead' only for pile foundation work. It is hoped that pile foundation work would begin soon.

The Centre is putting in some efforts to make the campus look aesthetically attractive. In accordance with a decision taken by the Construction Committee, Globe Nursery, a rather well-known horticultural firm has been contacted and based on its advice rows of trees are being planted. In order to protect the saplings and prevent encroachment, two openings, which the boundary wall (built last year) had, have been closed. Two gates have been installed. The campus land is now very secure.

The Centre has contacted Shri K G Subramaniam, the famous painter of Santiniketan for advice on interior decoration and landscaping.

#### MEETING OF THE GOVERNING BODY, GENERAL BODY AND OTHER COMMITTEES OF THE CENTRE

The Governing Body and the General Body of the Centre met on December 14, 1989 at the office of the Chairman, Department of Science & Technology, New Delhi.

The Academic Programme Advisory Committee met at the Centre's office in Calcutta on February 9, 1990.

The Committee on Bye-Laws presently consisting of the Director, S N Bose National Centre (Chairman), Registrar, Tata Institute of Fundamental Research, Bombay (Member), Deputy Secretary, Department of Science & Technology (Member), and Administrative Officer, S N Bose National Centre (Member-Secretary), had three meetings during the year. It met at the Centre's Office in Calcutta on April 26, 1989 and at the Tata Institute of Fundamental Research on May 29 and August 19, 1989. The committee prepared the final version of the draft bye-laws of the Centre which has been presented to the Governing Body at its meeting held on December 14, 1989. The Centre's bye-laws and regulations now await the Chairman's final approval.

The Finance Committee at the moment consists of the Director, S N Bose National Centre (Chairman), Financial Adviser & Joint Secretary, Department of Science & Technology (Member), Secretary, Department of Finance, Government of West Bengal (Member), Director, Indian Association for the Cultivation of Science (Member), Professor A K Raychaudhuri (Member), Administrative Officer, S N Bose National Centre (Member-secretary). The

committee met on April 27, 1989 in Calcutta and on December 13, 1989 at the office of the Department of Science & Technology, New Delhi.

The Construction Committee presently consists of the Director, S N Bose National Centre (Chairman), Professor G S Sanyal, Professor T K Chattopadhyay, Superintending Surveyor of Works (EZ), Central Public Works Department, and the Administrative Officer, S N Bose National Centre. The Construction Committee met on August 7, 1989 at the office of the Director.

The Purchase Committee of the Centre currently consists of the Director (Chairman), Professor Abhijit Mookerjee, Administrative Assistant (Accounts) and the Administrative Officer of the Centre (Member-Secretary). The committee met on September 27, 1990.

#### **Finance**

The Office of the Director of Audit, C. W. & M. Calcutta Branch, audited the accounts of the Centre for the period from its inception to March 31, 1988 and submitted its report in May 1989. Roy & Bagchi, a firm of Chartered Accountants, based at Calcutta who were approved by the Governing Body audited the accounts of the Centre for the period between April 1, 1988 and March 31, 1989. The report was submitted in September, 1989.

Copies of the budget estimates for (1990-1991) and statement of expenditure for (1989-1990) are given in the annexures to this annual report. Copies of the report on audit of accounts for (1988-89) by Roy & Bagchi and the report on the accounts of the Centre from the inception to March 1988 submitted by the Office of the Director of Audit, Government of India, are available for inspection.

#### **Donations of Centre**

During the year (1989-1990) the Centre received fifty thousand rupees as donations. We are pleased to inform that according to a notification dated March 27, 1990 issued by the Director-General (I. T. Exemptions) donations to the Centre would receive exemption from payment of taxes.

#### **Additional Office Space**

The increased academic work implies an increase of academic staff members and the visits of scientists to the Centre. Because of the Centre's involvement with the work on Theoretical Physics Seminar Circuit scientists from other parts of the country visit the Centre on a regular basis. This has put some pressure on space the Centre now has at its present office premises. To alleviate the situation

and to provide the scientists better library facilities the Centre has rented the ground floor (about 2000 sq ft) of a three storied house located at CD 85, Salt Lake City (ground floor) which is very near to the present office of the centre.

**Centre's Staff as on March 31, 1990**

**Academic**

- |                               |                                |
|-------------------------------|--------------------------------|
| 1) Dr Chanchal Kumar Majumdar | Director                       |
| 2) Dr Partha Ghose            | Academic Programme Coordinator |
| 3) Dr Abhijit Mookerjee       | Professor                      |
| 4) Dr Ashok Chatterjee        | Post Doctoral Fellow           |
| 5) Dr M Sivakumar             | Post Doctoral Fellow           |
| 6) Dr Rabin Banerjee          | Post Doctoral Fellow           |
| 7) Dr Samir Kumar Paul        | Post Doctoral Fellow           |
| 8) Mrs. Rina Das              | Scientific Officer             |

**Administrative, Technical and Auxilliary**

- |                               |                                     |
|-------------------------------|-------------------------------------|
| 1) Dr Jyotirmoy Pal Chaudhuri | Administrative Officer              |
| 2) Dr Santi Gopal Basu        | Librarian                           |
| 3) Mr Apurba Kanti Sarkar     | Administrative Assistant (Accounts) |
| 4) Mr Bhaskar Das Gupta       | Office Superintendent               |
| 5) Mr Sunish Kumar Deb        | Stenographer                        |
| 6) Mr Tapan Kumar Sen         | Junior Assistant                    |
| 7) Mr Sukanta Mukherjee       | Junior Assistant                    |
| 8) Mr Jaydeep Kar             | Junior Assistant                    |
| 9) Mr Prasenjit Talukdar      | Junior Assistant                    |
| 10) Mr Pradip Kumar Bose      | Helper                              |
| 11) Mr Partha Chakraborty     | Helper                              |



**NOTE**

The Department of Science and Technology has communicated the following budget provision for the S. N. Bose National Centre for Basic Sciences during the financial year 1990-91 through its letter no. G. 20011(28)/89—B & A/112 dated April 18, 1990.

**Budget Estimates 1990-91**

Plan	Rs. 2,01,00,000
Non-Plan	Rs. 19,00,000

**ANNEXURE**  
**REVISED ESTIMATES 1989-1990**

Sl. No.	Item	Actuals			B.E. 1989-90	Actual upto 8/89
		1986 87	1987-88	1988-89		
1	2	3	4	5	6	7
1.	Typewriters	—	0.37	0.25	0.02	—
2.	Small Equipment	—	0.24	0.10	0.15	0.03
3.	Boundary Wall	—	0.10	10.30	—	—
	Construction of Building					
4.	Office Building including Library & Computer Centre Internal Roads, Hostels & Gests Houses	—	—	0.27	70.00	9.12
5.	Overhead Reservoir & Water Supply Net Work	—	—	—	5.00	—
6.	Campus Plan	—	0.28	—	—	—
7.	Computer & Installation	—	9.45*	0.76	0.70	3.28
8.	Campus Land	—	—	0.61	—	—
9.	Furniture, Fans & Lights, ACs & Installation of Telephones	—	1.21	0.81	0.50	0.76
10.	Library Books & Journals	—	0.55	1.38	1.70	1.45
11.	Purchase of Staff Car	—	—	1.05	—	—
12.	UPS	—	—	—	—	—
13.	Generator	—	—	—	—	—
14.	Campus Beautification	—	—	—	0.20	0.03
15.	Furnishing Accommodation For Visiting Scientists	—	—	0.73	0.10	0.01
16.	Xerox Machine	—	0.97	—	—	—
17.	Library Almirah	—	—	0.14	0.20	0.16
		—	13.17	16.40	78.57	14.84

\* The grant for the Computer was Rs. 5 lakhs from DST and Rs. 5 lakhs from Donation. So far Rs. 150001/- has been received from donation.

— |  
**AND BUDGET ESTIMATES 1990-91**

**(PLAN CAPITAL)**

(FIGS. IN LAKHS)

Requirement for 9/89 to 3/90	R.E. 1989-90	Variation between B.E. & R.E. 1989-90	B.E. 1990-91	Variation between R.E. 1989-90 & B.E. 1990-91	Reasons for varia- tion between R.E. 89-90 & B.E. 90-91
8	9	10	11	12	13
0.08	0.08	0.06	0.35	0.27	
0.07	0.10	(-), 0.05	0.30	0.20	
—	—	—	—	—	
60.88	70.00	—	300.00	230.00	Construction work will start in 1990-91
0.30	0.30	(-)4.70	5.00	4.70	
—	—	—	—	—	
0.09	0.70	—	0.10	(-) 0.60	
—	—	—	—	—	
0.24	1.00	0.50	0.50	(-) 0.50	
0.25	1.70	—	2.30	0.60	
—	—	—	—	—	
0.75	0.75	0.75	—	—	
0.75	0.75	0.75	—	—	
0.17	0.20	—	0.50	0.30	
0.77	0.78	0.68	0.10	(-) 0.68	
—	—	—	—	—	
0.04	0.20	—	0.20	—	
64.39	76.56	—	309.35	—	

## ANNEXURE

Sl. No.	Head of Account Major Head/Minor Head Detailed Head/Sub-Head	Actuals			B.E.	Actuals
		1986-87	1987-88	1988-89	1989-90	upto 8/89
1	2	3	4	5	6	7
1.	<b>Salaries</b>					
	Plan	35,696	166,031	340,416	129,400	22,563
	Non-Plan*	—	—	—	900,689	275,371
2.	<b>Office Expenses</b>					
	Plan	—	329,400	552,532	578,500	215,765
	Non-Plan *	—	—	—	28,000	19,264
	<b>Total Provision</b>	35,696	495,431	892,948	1,636,589	532,963
	Recoveries to be taken as reduction in expenditure					
	<b>Net provision</b>	35,696	495,431	892,948	1,636,589	532,963

\* Actually there is no non-plan budget till March, 31, 1990, but the non-plan budget starts from April 1, 1990. The items for non-plan budget in 1990-91 are shown separately. In columns 6 to 10, the non-plan and plan amounts should be lumped together as plan amount.

—I (Contd.)

## (PLAN &amp; NON PLAN REVENUE)

( FIGURE IN RUPEES )

Anticipated Expenditure 9/89 to 3/90	R.E. 1989-90	Variation between B.E. & R.E. 1989-90	B.E. 1990-91	Variation between R.E. 89-90 & B.E. 90-91
8	9	10	11	12
102,837	125,400	(-) 4,000	611,860	486,460
586,664	862,035	(-) 38,654	1,015,061	153,026
479,737	695,500	117,000	1,052,500	357,000
148,136	168,000	140,000	198,000	30,000
13,17,374	1,850,935	214,346	2,877,421	1,026,486
1,317,374	1,850,935	214,346	2,877,421	1,026,486

**S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES****Budget Estimate 1990-91****NON-PLAN—RECURRING****A. Salary & Allowances :**

1. Director	...	Rs.	96,000.00
2. Academic Programme Coordinator	...	Rs.	60,600.00
3. Professor (1)	...	Rs.	55,500.00
4. Administrative Officer	...	Rs.	51,525.00
5. Librarian	...	Rs.	43,500.00
6. Scientific Officer	...	Rs.	28,050.00
7. Post Doctoral Fellowship (4)	...	Rs.	1,15,575.00
8. Administrative Asst. (Accounts)	...	Rs.	25,105.00
9. Superintendent	...	Rs.	17,240.00
10. Stenographer (1)	...	Rs.	17,480.00
11. Junior Assistant (4)	...	Rs.	46,800.00
12. Helper (2)	...	Rs.	18,960.00
13. D. A.	...	Rs.	1,67,057.00
14. H. R. A.	...	Rs.	1,09,200.00
15. C. C. A.	...	Rs.	17,160.00
16. Medical Claims	...	Rs.	30,000.00
17. Festival Advance	...	Rs.	5,600.00
18. Bonus	...	Rs.	9,600.00
19. Contribution to P. F.	...	Rs.	60,109.00
20. Provision for Gratuity & Leave Salary Etc.	...	Rs.	40,000.00
		Rs.	<b>10,15,061.00</b>

**B. Maintenance :**

1. Computer Maintenance	...	Rs.	1,65,000.00
2. Car Maintenance	...	Rs.	8,000.00
8. Petrol for car	...	Rs.	25,000.00
		Rs.	<b>1,98,000.00</b>
<b>Total Non-Plan Recurring=(A + B)=</b>		Rs.	<b>12,13,061.00</b>

## S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES

## Budget Estimate 1990-91

## PLAN—RECURRING

## A. Salary &amp; Allowances :

1. Visiting Member/Fellowship	...	Rs.	80,000.00
2. T. A./D. A. for Academic Staff for Attending Seminars :	...		
(a) Abroad	...	Rs.	50,000.00
(b) In India	...	Rs.	20,000.00
3. Casual Labour	...	Rs.	30,000.00
4. T.A./D.A. (Non-Academic Staff)	...	Rs.	5,000.00
5. Professor (2)	...	Rs.	1,08,000.00
6. Visiting P.D.F. (2)	...	Rs.	52,800.00
7. Stenographer (1)	...	Rs.	16,800.00
8. Driver	...	Rs.	11,400.00
9. D. A.	...	Rs.	47,850.00
10. H. R. A.	...	Rs.	40,800.00
11. C. C. A.	...	Rs.	5,880.00
12. Medical Claims	...	Rs.	7,200.00
13. Bonus	...	Rs.	4,800.00
14. Festival Advance	...	Rs.	1,600.00
15. Contribution to P. F.	...	Rs.	19,730.00
16. Provision for Gratuity & Leave & Salary etc.	...	Rs.	10,000.00
17. L. T. C.	...	Rs.	1,00,000.00
		Rs.	<u>6,11,860.00</u>

## S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES

## Budget Estimate 1990-91

## PLAN—RECURRING

**B. Other Expenditure :**

1. Telephone & Trunkcalls	...	Rs.	40,000.00
2. Postage & Telegrams	...	Rs.	40,000.00
3. Electricity Charges	...	Rs.	25,000.00
4. Municipal tax	...	Rs.	500.00
5. Printing & Stationery	...	Rs.	75,000.00
6. Hire of Office Premises	...	Rs.	1,56,000.00
7. Hire of Transport	...	Rs.	50,000.00
8. Meeting Expenses	...	Rs.	1,00,000.00
9. Misc. Expenses	...	Rs.	50,000.00
10. Seminar & Other Academic Activities	...	Rs.	2,50,000.00
11. Publication of Seminar Proceedings	...	Rs.	50,000.00
12. Director's Research Expenses	...	Rs.	50,000.00
13. Academic Staff Research Expenses	...	Rs.	50,000.00
14. Library Books	...	Rs.	80,000.00
15. Library Journals	...	Rs.	1,50,000.00
16. Library General Expenses (Binding, Stationery etc.)	...	Rs.	10,000.00
17. Accommodation for Visiting Scientists	...	Rs.	40,000.00
18. Legal Expenses	...	Rs.	5,000.00
19. Insurance Premium	...	Rs.	16,000.00
		Rs.	<u>12,37,500.00</u>



S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES

Budget Estimate 1990-91

PLAN—RECURRING

C. Maintenance :

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1. Building Maintenance	...	Rs.	15,000.00
2. Office Maintenance	...	Rs.	20,000.00
3. Repair of Equipment (Service Contract)	...	Rs.	10,000.00
		Rs.	<u>45,000.00</u>

Total Plan-Recurring=(A+B+C)= Rs. 18,94,860.00

**S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES**

**Budget Estimate 1990-91**

**PLAN NON-RECURRING**

**D. Equipment :**

1. Type Writers etc.	...	Rs.	35,000.00
2. Small Equipment	...	Rs.	30,000.00
		Rs.	<u>65,000.00</u>

**E. Building :**

1. Boundary wall	...		Nil
2. Campus Beautification	...	Rs.	50,000.00
3. Construction of Building	...	Rs.	3,00,00,000.00
	...	Rs.	<u>3,00,50,000.00</u>

**F. Furniture & Fixtures :**

1. Office Furniture	...	Rs.	50,000.00
2. Installation of Computer	...	Rs.	10,000.00
3. Library Almirah	...	Rs.	20,000.00
4. Furnishing Accommodation for Visiting Scientists (G. H.)	...	Rs.	10,000.00
		Rs.	<u>90,000.00</u>

**S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES****Budget Estimate 1990-91****PLAN—NON-RECURRING****G. Miscellaneous :**

1. Water Supply	...	Rs.	5,00,000.00
2. Car	...	Rs.	—
		Rs.	<u>5,00,000.00</u>

Total Plan—Non-Recurring = (D + E + F + G) = Rs. 3,07,05,000.00

**GRAND TOTAL :**

Non-Plan Recurring	...	Rs.	12,13,061.00
Plan Recurring	...	Rs.	18,94,360.00
Plan Non-Recurring	...	Rs.	<u>3,07,05,000.00</u>
	...	Rs.	<u>3,38,12,421.00 *</u>

\* This will be adjusted according to the allocation to the Centre by the Department of Science and Technology.

ANNEXURE  
S. N. BOSE NATIONAL CENTRE  
Statement of  
with effect from  
PLAN—

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Receipt

	Rs.	P.
To Grant Received	22.00.000.00	

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22.00.000.00

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—II

## FOR BASIC SCIENCES

## Expenditure

14.89 to 31.3.90

## RECURRING

Payments		Rs.	P.
By	Salary & Allowances	7,55,994.24	
,,	Contribution to P. F.	30,681.00	
,,	Medical Claim	10,582.81	
,,	Provision for Gratuity	33,942.00	
,,	Bonus	1,490.00	
,,	Wages (Casual)	28,824.55	
,,	Visiting Fellowship	61,600.52	
,,	Telephone & Trunk Calls	30,658.10	
,,	Postage & Telegram	15,321.60	
,,	Printing & Stationery	41,623.63	
,,	Hire of Office Premises	1,22,000.00	
,,	Accommodation for Visiting Scientists	30,000.00	
,,	Hire of Transport	57,429.79	
,,	Meeting Expenses	62,137.80	
,,	Electricity Charges	7,246.02	
,,	Seminar & Other Academic Expenses	1,79,046.31	
,,	General Insurance Premium	15,200.00	
,,	Legal Charges	3,000.00	
,,	Building Maintenance	22,246.41	
,,	Director Research Expenses	50,381.10	
,,	Academic Staff Research Expenses	8,570.00	
,,	Repair of Equipment	192.00	
,,	T.A./D.A. to Academic Staff (India)	7,908.50	
,,	T.A./D.A. to Academic Staff (Abroad)	15,518.00	
,,	T.A./D.A. to Non-Academic Staff	275.55	
,,	Office Maintenance	32,148.38	
,,	Computer Maintenance	1,65,775.92	
,,	Car Maintenance	20,067.92	
,,	Library (General Expenses)	2,868.50	
,,	Publication of Seminar Proceedings	1,090.00	
,,	Miscellaneous Expenses	31,636.45	
,,	TOTAL	18,45,457.10	
,,	Balance	3,54,542.90	
		<u>22,00,000.00</u>	

S. N. BOSE NATIONAL CENTRE

Statement of  
with effect from  
PLAN—

---

<b>Receipts</b>			Rs.	P.
To	Balance C/D from Last Year	...	86,03,803.04	
,,	Balance C/D from Plan-Recurring	...	3,54,542.90	
,,	Donation Received	...	53,000.00	
,,	Bank Interest	...	22,777.05	
,,	Interest on Short term Deposit	...	6,42,235.50	
,,	Grant Received	...	43,00,000.00	

1,39,76,358.49

**FOR BASIC SCIENCES**  
**Expenditure**  
**1.4.89 to 31.3.90**  
**NON-RECURRING**

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<b>Payments</b>		Rs.	P.
By	Small Equipment	22,208.28	
,,	Typewriters etc.	7,281.60	
,,	Construction of Building	10,97,490.60	
,,	Campus Beautification	39,947.90	
,,	Office Furniture	1,02,968.15	
,,	Furnishing Accommodation for visiting Scientists	2,779.00	
,,	Library Almira	17,088.10	
,,	Library Books	72,152.06	
,,	Library Journals	1,00,578.30	
,,	Installation Charge for Computer	79,571.04	
,,	Computer & Computer Accessories	2,67,421.40	
,,	UPS	71,180.00	
	<b>TOTAL</b>	<b>18,80,616.43</b>	
,,	Balance	1,20,95,742.06	
		<u>1,39,76,358.49</u>	

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