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THE INSTITUTE OF MATHEMATICAL SCIENCES

Madras INDIA

ANNUAL REPORT & AUDITED STATEMENT OF ACCOUNTS

1990 - 91

THE INSTITUTE OF MATHEMATICAL SCIENCES

ANNUAL REPORT & AUDITED STATEMENT OF ACCOUNTS

April 1990 - March 1991

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FOREWORD

It is my privilege to present the Annual Report of the Institute of Mathematical Sciences for the year 1990-91.

As was mentioned in the preceding Annual Report, the academic strength of the Institute is sought to be increased in all disciplines in order that the Institute becomes viable and play its role as an Institute of National Importance. We received an overwhelming response from a number of outstanding scholars seeking both regular and visiting positions in response to the advertisement inviting faculty applications we placed in a few professional journals and leading newspapers, and notices we sent to all major institutions around the world. We were able to make several offers and are very pleased that almost all of them have accepted and either have already joined or about to join shortly. Indeed this has resulted in an increased tempo of activities in the Institute. Encouraged by this, we shall be continuing in our quest for outstanding faculty for the Institute in the coming years as well.

In the year under review, the newly constructed library building and the Hostel and Guest House complex became fully functional. This has enabled us to conduct a Workshop on 'Random Matrices, Strings and 2-D Gravity'(Nov'90), a group discussion meeting on 'New Insights into the old Hubbard Model' (Feb '91) and a 'National Seminar on Theoretical Computer Science' (July '91). I am pleased to receive the feedback that each one of these activities was lauded as one of excellent quality, both in terms of academic content and utility and in its organisational aspects. We have also been able to welcome a number of distinguished visitors to the Institute who gave very useful and informative seminars and colloquiums and participated in collaborative research with us.

While we are now augmented with sufficient space and other facilities in the Hostel and Guest House, we are afflicted by a space crunch in the main Institute building. There is neither adequate and decent office space for the faculty, postdocs and visitors nor much needed additional lecture halls for increased number of activities of the Institute. We are looking forward, to the early completion of the additional floor for the new Library Building to provide us with the necessary relief.

The Institute is known by the achievements of its faculty and students. We are proud that Prof.R.Balasubramanian and Prof.G.Baskaran received the distinction as the recepients of Shanti Swarup Bhatnagar Award for 1990 in Mathematics and Physics respectively. Prof.Balasubramanian was also honoured to receive B M Birla Award as outstanding Mathematician for this year. Other important achievements and activities of the members of the Institute are given in detail in the Annual Report. Indeed it is not surprising that several among us are invited to participate and give lectures, keynote address, etc.in both national and international gatherings.

During the year under review, Shri G.Sethuraman was absorbed in the Institute as its Chief Administrative Officer and he together with the administrative staff has been responsible for the responsive and willing assistance for all the activities of the

Institute. To all of them, I owe my gratitude. I am thankful to Drs.R.Jagannathan, Ramesh Anishetty, R.Balasubramanian and Mr.K.P.Sankaran for their valuable help in the preperation of this report;thanks are also due to Dr.K.Srinivasa Rao in this connection.

R.RAMACHANDRAN
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August 1991

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[1] *On long leave from the Institute*
[2] *Director-in-Charge till June 18, 1990*
[3] *Tenure over during 90-91*
[4] *On leave from the Institute*

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[1] *Joined the Institute in February '91.*
[2] *Tenure at the Institute ended in 1990-91*

RESEARCH WORK:SOME OUTLINES

MATHEMATICS

For any point P(x,y) $\in Z^2$ on the Elliptic curve E, having complex multiplication by Z[i], it is known that, for all prime $p \equiv 3(mod4)$, $\psi_{p+1}(P) \equiv 0(modP)$, where ψ_{p+1} is the division polynomial. It has been proved that the number of composite n with $\psi_{n+1}(P) \equiv 0(modn)$ is small.

Continuing the work on $\delta_k(n)$, the results of Maxsein and Herzog about lim sup $\frac{|E_k(x)|}{x)}$ have been improved.

A conjecture, due to Ramachandra, on the value of lower bound for the mean square of a general Dirichlet series has been proved.

The problem of generating the ring of integers of a ray class field over an imaginary quadrative field by adjoining torsion value of Fueter function to the ring of integers of the Hilbert class field of the imaginary quadratic field has been dealt with. The recent results of Ph.Casso-Nogues-M.J.Taylor (in the odd conductor case) are extended for all conductors.

Character sums have been calculated for the cubics $f(x)$ which are such that $y^2 = f(x)$ are elliptic curves with complex multiplication by $Q(\sqrt{-19})$, $Q(\sqrt{-43})$, $Q(\sqrt{-67})$ and $Q(\sqrt{-163})$.

Sarkozy has proved that $\binom{2n}{n}$ is never square free for large enough n. The conjecture has been proved for all n $\geq$4.

Pizer operators c(p^2) for p|2M have been introduced in the space of cusp forms of weight k+$\frac{1}{2}$ for $\Gamma_0(4M)$ with quadratic character χ the diagonalisation of the square has been achieved with respect to Hecke operators T(P^2), p$\dagger$2M and C(p^2), p|2M. Also the space of cusp forms of weight k, level p (p$\equiv$3(4)) is diagonalised with respect to all Hecke operators.

It has been possible to connect two fundamental approaches to string theory-namely the geometric quantization and path integral approaches-by discovering an intimate link between the diffeomorphism group of the circle and the Teichmuller spaces. The complex structurs coincide. The Kahler structures match and a form of Mostow rigidity theorem is deducible. The above leads to smoothness questions about the foundational conformal invariant known as "Welding". Some questions regarding conformal welding are settled by using infinite spirals. A technique has been found using functional equations satisfied by germs of conformal mappings.

Two models of Teichmuller space,-one using harmonic functions and the other using self-dual connections have been shown to be identical.

Work is in progress to prove the smoothness of the density of states in the Anderson Model.

Work is also in progress to obtain the spectrum of U=∞ Hubbard model with one hole in the presence of finitely many atoms. Some partial results have been obtained.

A method of construction of hypergroups of matrices has been given. This method leads to several new examples of hypergroups.

PHYSICS

QUANTUM MECHANICS/FIELD THEORY/NUCLEAR AND PARTICLE PHYSICS

Nelson's stochastic approach to quantum mechanics by associating a basic brownian motion with a microparticle is being analysed in detail. This approach is used to probe questions like whether quantum fluctuations and thermal ensemble behaviour have same roots, where do quasi- probabilities of quantum-optics stand, and what is the connection between the nonlocality underlying Bell's inequality and quantum potentials appearing in the Hamilton-Jacobi equation of the Madelung quantum fluid.

Optics of relativistic electron beams is being studied entirely on the basis of the Dirac equation. This work is of significance for high voltage electron microscopy and accelerator physics.

An algebra corresponding to a new form of quantum statistics which may be called orthostatistics has been constructed. Orthofermions obey a new exclusion principle which is "more exclusive" than Pauli's exclusion principle: an orbital state shall not contain more than one particle, whether spin up or spin down. The consequences and applications of this algebra are investigated.

Fundamental group of configuration space for sigma-model on arbitrary genus surface has been explored for its dependence on the genus. This is a field-theoretical example analysed as generalization of quantization procedure. A Complete classification of inequivalent representations of the fundamental groups for all genera is given. Statistics of solitons/particles in 2-dimensional compact surfaces is found to be decided by a group generated by X, Y and Z such that $XYX^{-1}Y^{-1} = Z^2$, YZ = ZY, ZX = XZ. This group and its representations will be more relevant than braid group on surfaces.

Physical Hilbert space of gauge theories are understood both on the lattice and in the continuum without any ambiguities. This can help in understanding the possible mechanisms for confinement such as due to monopole condensation.

An interesting vacuum has been constructed using path integral formulation for gauge theories wherein an electric field condensate makes the gluons unstable particles while there are still other degrees of freedom which can be stable.

A new formulation based on parallel transport and obstruction theory for understanding spin manifolds is being studied. Using the index theorems and other geometrical features of space-time, attempt has been made to relate the fermion (light) content and the cosmological variables of the universe.

It has been shown that the spontaneous compactification in M^4 X CP^2 is possible with instantons defined on CP^2. By coupling the U(1) instanton with fermions and using index theorem arguments it has been shown that one can possibly define chiral fermions consistently, though ordinarily CP^2 does not admit spin structure.

Taking the energy-momentum tensor to be arising from total matter potential (classical + 1-loop quantum corrections) obtained by integrating out the fluctuations around the classical compactified solution in the Gell-Man and Zwiebach σ-model induced compactification, it has been shown that the compactification can be made to persist even

at the quantum level with vanishing cosmological constant. A definite size is got for the extra space taken to be S^n. The solution is stable against uniform dilations or contractions.

The infinite dimensional Lie algebra of symmetries of null and nonnull paths in R^N has been studied and identified, for N=2, with quasi- conformal maps, thus furnishing an intrinsic meaning to the string concept.

Using statistical field theory methods attempts are being made to understand the phase diagram of the standard model of particle physics.

The explicit inclusion of the effect of the anomalous magnetic moment of the electron in the electron-proton scattering cross section has been shown to lead to contradictions with the experimental data.

The spin structure of the hadrons, nucleons in particular, are believed to be affected by the axial anamoly in quantum chromodynamics (QCD); consequently the gluon polarization in proton turns out to be significant. Phenomenological consequences in several possible reactions have been studied.

A detailed analysis of the spin-dependent parton densities has been carried out and proposals have been made as to how they can be measured in various interactions like deep inelastic scattering and direct photon production in hadron-hadron collissions. Some of these programs are likely to be carried out experimentally in the near future.

An analysis of the moments of the spin-dependent and spin-independent structure functions of the nucleon through operator product expansion method reveals a low energy mass scale for the quarks consistent with the constituent quark mass of about 300 MeV.

CLASSICAL AND QUANTUM OPTICS

Coherent mode decomposition has been obtained for twisted Gaussian Schell-model beams.

Group theoretic methods have been used to study squeezed states in single-mode and multimode optical systems, and geometric methods have been developed for their description.

A systematic quantum kinematic approach to geometric phases has been developed and applied to optical problems.

CONDENSED MATTER PHYSICS

An exactly solvable fermion model has been constructed. This model exhibits a non-fermi liquid behaviour, metal-insulator transitions, holon and spinon excitations. This is the first exactly solvable model in 2 and higher dimension which exhibits the above properties. This model captures essential properties of the so called t-J model, a model used to understand high T_c superconductors.

A new spontaneous symmetry breaking has been predicted in spin compensated even

denominator fractional Quantized Hall effect. This brings a new dimension to the spin liquid state of FQHE.

Various aspects of RVB theory of high T_c superconductors such as interlayer tunnelling, NMR relaxation, SU(2) symmetry aspects etc. are being studied. A numerical investigation of strongly correlated electronic system is being done under a superconductivity project.

The study of moving space curves finds applications in many areas of physics such as evolution of spin vectors on an interacting spin chain, motion of vortex filaments in a fluid, etc. It has been shown that the time evolution of a space curve is associated with a geometric phase. Applications to magnetic chains have been discussed in detail.

Within the framework of the pseudospin model of liquid ^{4}He it has been shown that in a superfluid ^{4}He film of a given thickness, finite-amplitude density fluctuation can propagate as a 'hot' or 'cold' solitary wave, depending on the initial disturbance. The solitary-wave velocity is always less than that of the linear sound-made.

The pseudospin model of ^{4}He has been shown to support a cylindrically symmetric vortex solution. A gauge field (the depletion velocity field) corresponding to the interaction of the condensate and normal part of the fluid has been identified.

A pseudospin formulation of the bipolaron model in the spin coherent state representation has been shown to lead to several interesting nonlinear characteristics reminescent of superfluidity.

A linearized gap equation for a superconductor in presence of a strong magnetic field has been found using the BCS-pairing of the Landau levels of electrons along with the dynamical interactions. Several new results obtained recently in the literature are recovered (as in high-T_c situation) and the change in the invariance properties of the new state of the system are accounted for.

Anyons have become "hot" objects in the last couple of years as possible candidates for the explanation of high -T_c superconductivity and quantum Hall effect. In this context studies are being made on the semiclassical and quantum treatments of few particles (anyons) interacting via statistical interaction in two-dimensions.

Electron transfer reactions in a homogeneous medium is influenced by solvent friction effect. A quantum mechanical description has been provided for the friction effect and both the underdamped and overdamped motions of the reactant have been obtained in a unified manner. Theoretical calculations show that friction leads to $1/\sqrt{\eta}$ dependence of the reaction rate on the coefficient η.

MATHEMATICAL METHODS OF PHYSICS

It has been shown that a recursive use of the transformation of a terminating $3F_2(1)$ series used by Weber and Erdelyi, which belongs to a set of ${}_3F_2(1)$ functions obtained by Thomae (1879), results in a 72-element group associated with 18 terminating series. Invariant subgroups, and irreducible representations of this group have been studied in detail.

The Lie algebra generated by coupled so(3)-tensor operators was constructed; 9-

j coefficients become the structure constants in this algebra. As an example it was shown how an exceptional subalgebra can be realized. The closure requirement for the exceptional Lie algebra does not seem to be related to nontrivial 9-j sumbols but rather to vanishings of relations involving 6-j symbols.

Deformations of classical Lie groups and their universal enveloping algebras, with one or more parameters, are called quantum groups and quantum algebras. These "quantized" algebras become "classical" in the limit of the deformation (quantization) parameters taking special values. These mathematical structures are gaining significance in several physical applications. In this context, representations of one and two-parameter deformations of GL(n), and its superanalogues are being studied.

The Racah-Wigner algebra for the quantum group $su_q(2)$ has been developed to derive explicit expressions for the q-analogues of the Van-der-Waerden, Racah, Wigner and Majumdar forms of the 3-j coefficient given in terms of sets of basic hypergeometric functions. Interrelationships between the members of a given set of ${}_3\phi_2$ are established using the reversal of series or the $q \longleftrightarrow q^{-1}$ operation. Starting with the Van-der Warden set and using three transformations of ${}_3\phi_2'$s twelve other sets have been obtaiend. In the simpler case of the 6-j coefficients two sets of ${}_4\phi_3$'s related to each other by reversal of series have been obtained.

OTHER INTERDISCIPLINARY AREAS OF MATHEMATICAL SCIENCES

While fixating on an object the image in the retina is subject to jittery motions and also saccadic jumps. Modeling these stochastic eye involvements in the two-dimensional plane, the experimental findings, obtained using scanning Laser ophthalmoscope and other sophisticated techniques, have been analysed.

THEORETICAL COMPUTER SCIENCE

The theoretical computer scientists in the Institute mainly study distributed systems. The class of distributed transition systems (dts's) has been defined earlier to represent the notion of a finite set of events occurring independently of each other and axiomatized. This work has been extended to subclasses of dts's using the same logical language. Some turn out to be decidable, others are axiomatizable but not decidable (e.g. deterministic dts's), yet others are not even axiomatizable (e.g. deterministic dts's over a finite alphabet). An attempt has been made to bring together these and other results on distributed systems with "true concurrency"

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**External collaborator*

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R.JAGANNATHAN
Quantum theory of electron lenses based on the Dirac equation
Phys. Rev. A 42 (1990) 6674

R.CHAKRABARTI* and **R.JAGANNATHAN**
On the representations of $GL_q(n)$ using the Heisenberg-Weyl relations
J. Phys. A: Math. Gen.

R.CHAKRABARTI* and R.JAGANNATHAN
On the representations of $GL_{p,q}(2)$, $GL_{p,q}(1/1)$ and the noncommutative spaces

R.CHAKRABARTI* and R.JAGANNATHAN
A (p,q)-oscillator realization of two-parameter quantum algebras

A.K.MISHRA and G.RAJASEKARAN
Algebra for fermions with a new exclusion principle
Pramana

A.GOCHEV*, G C.McMANIS*, A.K.MISHRA, S.ADELMAN* and M.J.WEAVE
Solvent dynamical effects in electron transfer: models and rate formulations using the spectral density function approach.

M.V.N.MURTHY, R.K.BHADURI*, R.S.BHALERAO*, Avinash KHARE*, and J.LAW*
Semi-classical two-and three-anyon partition functions
Phys. Rev. Lett. 66 (1991) 523

M.V.N.MURTHY, R.K.BHADURI* and J.C.WADDINGTON*
Identical superdeformed bands and two dimensional motion
Proc. Workshop and Symposium on "Future Directions in Nuclear Physics", March 1991, Strasbourg, France.

G.RAJASEKARAN
Electroweak symmetry
Current Science 59 (1990) 1080

G.RAJASEKARAN
The discovery of Dirac equation and its impact on present-day physics
Proc. National Seminar on 60 years of Dirac Equation, Santiniketan, January 1989 (to be published by Wiley Eastern)

G.RAJASEKARAN
The discovery of Dirac equation and its impact on present-day physics
Preprint:imsc/91-18.

V.RAJESWARI and K.SRINIVASA RAO
Generalized basic hypergeometric functions and the q-analogues of 3-j and 6-j coefficients
J. Phys. A: Math. Gen.

V.RAJESWARI and K.SRINIVASA RAO
Generalized basic hypergeometric functions and q-analogues of 3-j and 6-j coefficients

R.RAMACHANDRAN and Prakash **MATHEWS**
Large P_T P-P collisions to probe the gluonic and sea spin distributions in the proton
Int. J. Mod. Phy. A

R.RAMACHANDRAN
Spin statistics connections
Current Science

R.RAMACHANDRAN and Prakash **MATHEWS***
Probing gluon and sea spin in proton
Proc. 25th International Conference on High Energy Physics, Singapore, August 1990
(to be published by World Scientific, Singapore)

R.RAMACHANDRAN and Prakash **MATHEWS***
Large P_T - P-P collisions to probe the gluonic and sea spin distribution in the proton
Preprint:Indian Institute Technology, Kanpur

R.SIMON and **N.MUKUNDA***
SO(N,1) Wigner rotation as an SL (2,R) problem
Found. Phys. Lett. 3 (1990) 425

R.SIMON
Nondepolarizing systems and degree of polarization
Opt. Commun. 77 (1990) 349

G.S.AGARWAL* and **R.SIMON**
Berry phase, interference of light beams, and the Hannay angle
Phys. Rev. A 42 (1990) 6924

S.CHATURVEDI*, **R.SANDHYA***, **V.SRINIVASAN*** and **R.SIMON**
Thermal counterparts of nonclassical states in quantum optics
Phys. Rev. A 41 (1990) 3969

R.SIMON
Optical phases and the symplectic group
Curr. Sci. 59 (1990) 1168

S.CHATURVEDI*, **A.K.KAPOOR***, **R.SANDHYA***, **V.SRINIVASAN*** and **R.SIMON**
Generalized Commutation relations for a single-mode oscillator
Phys. Rev. A

R.SIMON
Geometric phases in optical interference: Are they Berry phases or Hannay angles?
Proc. International Conference on Quantum Optics, Hyderabad, January 1991

R.SRIDHAR
Non-linearities in bipoloronic superconductivity
Physica B166 (1990) 1043

R.SRIDHAR, V.C.KURIAKOSE* and K.BABU JOSEPH*
A Modified Ginzburg-Landau model for high-T_c superconductivity
Indian J. Phys. 65A (1991) 95

R.SRIDHAR
Single and two-phonon excitations in superfluid helium-4
Phonons in Condensed Matter Physics, Eds. R.K.Singh and S.P.Sanyal (Wiley Eastern, New Delhi 1990) p.47

K.SRINIVASA RAO and V.RAJESWARI
Some aspects of angular momentum coefficients for $su_q(2)$
Proc. XVIII International Colloquium on Group Theoretical Methods in Physics, Moscow, June 1990

K.SRINIVASA RAO
New results in quantum theory of angular momentum
Proc. IV Regional Conference in Math. Physics, Tehran, May 1990

K.SRINIVASA RAO, J.Van der JEUGT* J.RAYNAL*, R.JAGANNATHAN and V.RAJESWARI
Group theory of terminating ${}_3F_2(1)$ series

K.SRINIVASA RAO, T.S.SANTHANAM and V.RAJESWARI
Multiplicative Diophantine equations

J.Van der JEUGT* and K.SRINIVASA RAO
Realisations of $su_q(2)$ in terms of q-differential operators
Preprint:Rijksuniversiteit Gent, Jan.1991

K.SRINIVASA RAO and J.Van der JEUGT* and G.Van den BERGHE*
On the algebra of coupled SO(3) tensors

R.VASUDEVAN and A.K.RAJAGOPAL *
Superconductivity and magnetic field in a new relationship
Phys. Rev. B

R.VASUDEVAN and S.K.SRINIVASAN*
Particle multiplicity distribution a la invariant imbedding and natural scaling
J. Appl. Math.

R.VASUDEVAN
Stochastic quantum mechanics
Proc. Indian Statistics and Probability Society Conference, Bombay, January 1991 (to be published by Springer Verlag, Heidelberg)

R.VASUDEVAN and S.K.SRINIVASAN*
Invariant imbedding methods and Particle Multiplicities
Proc. Bellman Continuum Conference, Kansas State University, Kansas, USA, 1990

PUBLICATIONS EDITED/MONOGRAPHS/BOOKS etc.,

G.BASKARAN "Strongly Correlated Electronic Systems", World Scientific, Singapore, Eds. G.Baskaran, E.Tosatti and Yu Lu.

R.RAMACHANDRAN
"Solitons, Monopoles and Instantons-Introduction to Topological Features in Quantum Field Theory" (Lectures given in III SERC School on Theoretical High Energy Physics at Santiniketan, Oct-Nov 1987: to appear as SERC Schools (DST) Series, Ed. N.Mukunda)

THEORETICAL COMPUTER SCIENCE

K.LODAYA and R.K.SHYAMSUNDAR*
Proof theory for exception handling in a tasking environment
Acta. Informatica. 28 (1990) 7

K.LODAYA, R.RAMANUJAM and P.S.THIAGARAJAN*
Temporal logics for communicating sequential Agents-Part I
International Journal on Foundation of Computer Science. *(submitted for publication)*

K.LODAYA, M.MUKUND*, R.RAMANUJAM and P.S.THIAGARAJAN*
Models and logics for true concurrency
Preprint:imsc-90/42

SCIENTIFIC ARTICLES IN POPULAR MAGAZINES and OTHER PUBLICATIONS

K.LODAYA
Iravu daan, a monthly column on the night sky
to appear in Thulir (translated)

R.RAMACHANDRAN
Grand unity in physics
to appear in Physics News

K.SRINIVASA RAO
Sanskrit and Artifical Intelligence
Diamond Jubilee Commemoration Volume
The Samskrita Academy, Madras (1990) 9

K.SRINIVASA RAO
Computer in Education
Physics Education 7 (1991) 315

PARTICIPATION IN CONFERENCES AND OTHER PROFESSIONAL ACTIVITIES OF THE ACADEMIC STAFF

Visits to other Institutions in India and abroad

Radha BALAKRISHNAN	S N Bose National Centre for Basic Sciences, Calcutta,April 4-8, 1990. Under Theoretical Physics Seminar Circuit (TPSC) programme. IIT,Kanpur, April 9-12, 1990. (Under TPSC Programme) Jawaharlal NehruUniversity, New Delhi, April 12 1990. Los Alamos National Laboratory,LosAlamos, USA, Feb. 4-31, 1991.
G.BASKARAN	NORDITA, Copenhagen, Denmark, May 14 - 18, 1990. Institute of Physics, Cargese, France, June 18 - 30, 1990. International Centre for Theoretical Physics (ICTP) Trieste, Italy, May - July, 1990. Raman Research Institute, Bangalore, One week, April, 1990. Tribhuvan University, Kathmandu, Nepal, Jan. 21 - Feb.1, 1991.
Hemant BHATE	IIT, Bombay, Nov.29-30, 1990.
G.DATE	Department of Physics, Cochin University of Science and Technology, Cochin, Dec.1990.
T.R.GOVINDARAJAN	International Centre for Theoretical Physics, (ICTP) Trieste, Italy, April 23 - July 6,1990.
N.D.HARI DASS	Instituut Voor Theo. Fysica Universiteit V.Amsterdam, Amsterdam, Jan. 91.
M.V.N.MURTHY	Department of Physics, University of Mysore, May 1 - 13 1990 Department of Physics and Astronomy McMaster University, Sept. 17 - July 9, 1991.

S.NAG	Tata Institute of Fundamental Research (TIFR), Bombay, Jan 14 - 19, 1991. (Under TPSC programme)
G.RAJASEKARAN	TIFR, Bombay, Sept. 18-19, 1990. Cochin University of Science and Technology, Cochin. Dec. 8 - 15, 1990. Saha Institute of Nuclear Physics, Calcutta, Jan. 15, 1991.
R.SIMON	University of Rochester, Rochester, New York Aug 1 - Dec 30, 1990.
R.SRIDHAR	Department of Postgraduate Studies and Research, University of Gulbarga, Gulbarga, One week during Sept. 1990.
K.SRINIVASA RAO	Sharif University of Technology, Tehran, Iran, May 12 -17, 1990. Moscow State University, Moscow, June 4 - 9, 1990. Gulbarga University, Gulbarga, Aug 21 - 29, 1990. Institute .for Theoretical Nuclear Physics, University of Bonn, Bonn, Germany, Oct. 30 - 31, 1990 and Feb.7 - 11 1990. Technical University of Clausthal, Germany, Feb. 7, 1991. Laboratorium voor Numerieke Wiskunde en Informatica, Rijksuniversiteit Gent, Gent Belgium. Nov 1, 1990 - Jan. 31, 1991. University of Brussels, Brussels, Belgium, Dec. 12, 1990.

Participation in Conferences

Radha BALAKRISHNAN	One-day Interdisciplinary Seminar organised by School of Physical Sciences, Jawaharlal Nehru University, New Delhi. April 12, 1990. (Invited talk on "Hot and Cold Solitary Waves in Superfluid ^{4}He Films".)
G.BASKARAN	Danish Physical Society Meeting, Aarhus, Denmark. May 17 - 18, 1990. (Invited talk on "RVB Theory of

	high T_c superconductivity and chiral symmetry Breaking") Experimental results on high-T_c superconductors,, Indian Institute of Science, Bangalore. Aug. 8-10, 1990. (Invited talk on "A model for superconductivity in doped $BaBi0_3$").
G.DATE	VI SERC School, Cochin, Dec.10-22, 1990 (gave a course on "Topology and Differential Geometry": 12 Lectures 75 minutes each and 10 10 tutorials (with B.R.Sitaram of Physical Research Laboratory, Ahmedabad))
R.JAGANNATHAN	Tutorial School on Modern Developments in Optics, Indian Institute of Science, Bangalore, June 18-30, 1990. (Invited talk on "The Analogy between Light Optics and Electron Optics")
Kamal LODAYA	Participated in the 10th Conference on Foundation of Software Technology and Theoretical Computer Science, Bangalore, Dec.17-19, 1990
Krishna MADDALY	Conference on Quantum Probability, Indian Statistical Institute, New Delhi, Dec 31-Jan 4, 1991. (Talk on "Smoothness of the Density of States in the Anderson Model")
K.H.MARIWALLA	XVIII International Colloquium on Group Theoretical Methods in Physics, Moscow, USSR, June 4-9, 1990. (Talk on "Lie structure of Quasi-conformal Maps in IR^N and Physics of String Theories".) Post - XVIII Group Theoretical Colloquium School Rachow, Ukraine, USSR, June 11-18, 1990. (Two Invited talks: 1. Strings without strings 2. Universe/Black Hole as a Space of Negative Curvature of Finite Volume; (Chaired two sessions))
A.K.MISHRA	Indo-German Seminar on Electrochemistry: Surface Structure and Surface Modification, Central Electrochemical Research Institute, Karaikudi, March 1-2, 1991. (Invited talk on "Electrochemisorption at Electrochemical Tubeface")

M.V.N.MURTHY	Conference on Novel Trends in Nuclear Physics, held in honour of Mel Preston, McMaster University, Canada, May 17, 1991. UGC Advanced Summer School for College and Univesity Teachers, Department of Physics, Univesity of Mysore, May 1-13, 1990 (Course of 18 lectures on "Quark - Parton Phenomenology")
S.NAG	International Conference on Geometric Function Theory, Madras, July 26-31, 1990 (Invited talk on "Riemann Surfaces and String Theory") INDO-USSR Geometry Conference, TIFR Bombay, Jan 14-19, 1991. (Invited 1-hour talk on "The Diffeomorphisms of S^1 and Teichmuller spaces")
R.RAMANUJAM	Foundation of Software Technology and Theoretical Computer Science 10, Bangalore, Dec. 17-19, 1990.
G.RAJASEKARAN	Nuclear Physics Symposium, University of Madras, Dec.1-4, 1990. (Invited talk on "Low Energy Nuclear Physics Experiments Contributing to Particle Physics") Workshop on High Energy Physics Phenomenology-II, S N Bose National Centre for Basic Sciences, Calcutta, Jan.2-15, 1991 (Member of Organising Committee, Gave Key-Note address, As Convener and coordinator of one of the Working Groups, organised the activities on Radiative Corrections and Precision Tests of the Standard Model as well as on Baryon Number violation in Electro-weak Theory) Miniworkshop on Matrix Models, Random Surfaces and 2-d Gravity,I.M.Sc, Madras, Nov.19-23, 1990 Presented the Concluding Remarks) Participated in the Meeting on Hubbard Model I.M.Sc., Madras, Feb.25-28, 1991
R.SIMON	Tutorial School on Modern Optics, Indian Institute of Science, Bangalore, June 18-30, 1990 (A course of lectures on "Generalized Coherent States and Squeezed States"; Convenor of the School with N.Mukunda and S.V.Lawande)

	Annual Meeting of the Optical Society of America, Boston, Nov 4-9, 1990 International Conference on Quantum Optics, Hyderabad, Jan 5-10, 1991 (Invited talk on "Geometric Phases in Optical Interference: Are they Berry Phases or Hannay Angeles?")
V.RAJESWARI	Fifth Annual Conference of the Ramanujan Mathematical Society, Mysore, June 7-9, 1990, India (Invited talk on "Some Aspects of Angular Momentum Coefficients of $su_q(2)$")
R.RAMACHANDRAN	25th International Conference on High Energy Physics, Singapore, Aug 2-8, 1990 (Invited talk in parallel session on "QCD and high-P_T Physics") Workshop on High Energy Physics Phenomenology II, Calcutta Jan 2 - 15, 1991 (Member of the National Organising Committee; Chaired the Concluding Planery Session) Indian Academy of Sciences, Bangalore, Mid-year meeting, July 26, 1990 (Participation as a new Fellow) Indian Academy of Sciences, Annual Meeting, Bhubaneswar, Nov. 8-11, 1990. DAE Symposium in Nuclear Physics, Madras Dec 1-4,1990 (Evening lecture on "Grand Unity in Physics"; Dec.2) VI SERC School on Theoretical High Energy Physics, Cochin, Dec. 3-29, 1990 (Six lectures on "QCD Applications in the Standard Model")
K.SRINIVASA RAO	IV Regional Conference on Mathematical Physics, Tehran, Iran, May 12-17,1990, (Invited Talk on "New Results in Quantum Theory of Angular Momentum"; Chairman of a session; Elected ad hoc committee member from India for the Regional Conference on Mathematical Physics) XVIII International Colloquium on Group Theoretical Methods in Physics, Moscow, June 4-9, 1990. (Invited Talk on "Some aspects of Angular Momentum Coefficients for $su_q(2)$")

R.VASUDEVAN Miniworkshop on Matrix Models, Random Surfaces and 2-d Gravity, IMSc, Madras, Nov.19 - 23, 1990. Meeting on Hubbard Model, IMSc, Madras, Feb.15-28, 1991 (chaired a session)

Seminars/Lectures given outside the Institute

Radha BALAKRISHNAN Bose Institute, Calcutta. (Under TPSC Programme.) "Solitons in Condensed Matter Physics" (April 5, 1990)
Saha Institute of Nuclear Physics, (Under TPSC Programme). "Nonlinear Dynamics in Superfluid ^{4}He" (April 6, 1990.)
IIT, Kanpur. (Under TPSC Programme), "Solitons" (April 9, 1990) "Nonlinear Dynamics in Superfluid ^{4}He". (April 10, 1990)
Theoretical Physics Department, University of Madras. "Geometric Phases Associated with Moving Space Curves" (August 1, 1990) Ethiraj College for Women, "Waves", (September 23, 1990)

Hemant BHATE Dept.of Mathematics, IIT, Bombay "Inverse Scattering Theory and Nonlinear Evolution Equations" (November, 1990)

R.JAGANNATHAN Dept.of Theoretical Physics, University of Madras, "Quantum Theory of Electron Optics: Microscopes to Accelerators" (December 6, 1990)

M.V.N.MURTHY Department of Theoretical Physics, University of Madras "Spin Structure of the Proton" (March 15, 1991)
Department of Physics, McMaster University, "From Partons to Constituent Quarks" (December 17, 1990) "Deep-Inelastic Scattering and the Structure of the Nucleon" [An account of the discovery that lead to the 1990 Nobel prize](Colloquium, February 13, 1991)

S.NAG New York Geometry and Dynamics Colloquium at C.U.N.Y, New York" Conformal Welding for Jordan curves" (December 11, 1990; 1 1/2 hour Lecture Videotaped)

	Centre for Theoretical Studies, Indian Institute of Science, Bangalore, "Diff(S^1) and String Theory". (Colloquium, September 1990) Spic Science Foundation, School of Mathematics, Madras. "Welding Homeomorphisms" (July 28, 1990) "Diffemorphisms of S^1" (September 12, 1990) CUNY Complex Analysis Seminar, New York, "Construction of Hyperbolic Manifolds by Teichmuller Theory" (December 14, 1990) IIT, Madras, Two invited Colloquia on "Reimann Surfaces" (March 14, 21, 1991) TIFR, Bombay, "A Connection between the Geometrical Quantisation and Functional Integral Approaches to String Theory" (Jan 14, 1991) Mathematical Physics Seminar/Journal Club, "Conoical measures on moduli spaces of Riemann Surfaces". (Jan 15, 1991)
G.RAJASEKARAN	TIFR, Bombay, "Algebra for Fermions with a New Exclusion Principle" (September 18, 1990) Dept of Theoretical Physics, University of Madras, "Shadow Poles and Molecular Hadrons" (September 26, 1990)
V.RAJESWARI	Women's Christian College, Madras, "Milestones in the History of Theoretical Physics", (September 7, 1990, Lecture in connection with the Platinum Jubilee Celebrations of the College)
R.RAMACHANDRAN	Inter University Centre for Astronomy and Astrophysics, Pune, "Spin, Statistics and their Connection" , (Colloquium, December 10, 1990) Delhi University, Delhi, "Spin Statistics on two Dimensional Compact Surfaces, (March 9, 1991, Lecture under the Visitors Programme) Anna University, Physics Department, Madras, "Gauge Dogma:Unification of Forces" (September 17, 1990) Meeting of the Tamil Nadu Academy of Sciences, held at Anna University, Madras, "Spin structure of Nucleons"

K.SRINIVASA RAO Department of Physics, Gulbarga University, Gulburga, course of 20 lectures on "Special Functions of Mathematical Physics" (August 21 - 29, 1990) Physics Association, Gulburga University, Gulbarga, "Group Theory in Physics" (Colloquium, August 27, 1990) Birla Auditorium, Madras, "Elementary Particle Zoo" (October 4, 1990); "Unification Program" (October 5, 1990) University of Brussels, "Quantum Theory of Angular Momentum" (December 12, 1990) State University of Gent, Gent, Belgium, "Recent Results in Quantum Theory of Angular Momentum" (December 20, 1990). "Srinivasa Ramanujan: His Life and Work" (January 15, 1991); "Numerical algorithms for 3n-j Coefficient" (Jan 30, 1991)

OTHER PROFESSIONAL ACTIVITIES

Prof. R.BALASUBRAMANIAN is a member of Sectional Committees of Indian Academy of Sciences, Indian National Science Academy and CSIR. He is a member of the Board of Studies of Pondicherry University.

Dr. Subhashis NAG presided over the Annual Talent Contest Prize Distribution Ceremony, Association of Mathematics Teachers of India, March 1991, as Chief Guest.

Prof. G.RAJASEKARAN has spent much time and energy as member of the Governing Councils of a number of national Institutions and many other national-level Committees. As Chairman of the Committee on the DST (SERC) Schools on Theoretical High Energy Physics, he has been involved in the organisation of these Schoolf for the past few years. The Sixth School in this series was conducted at Cochin University of Science and Technology in December 1990 and the Seventh will be at the Physical Research Laboratory, Ahmedabad, in December 91-January 1992.

Prof. R.RAMACHANDRAN serves as a member of the Boards of Studies of School of Physics, University of Hyderabad and Indira Gandhi National Open University. He is also a member of the Academic Council of Anna University, Madras. He helps the International Centre for Theoretical Physics, Trieste, Italy, in its external activities as its Regional Representative in Asia.

Dr. R.SRIDHAR gave two lectures to the students of plus 2 classes in P.S.Senior Secondary School on the Life and Work of J J Thomson and Lord Rutherford. (under the auspices of Alladi Centenary Foundation)

Prof. K.SRINIVASA RAO's talk on "Quest for the Unknown in the realm of Science" was broadcast by All India Radio (AIR), Madras, on September 4, 1990.He interviewed the Bhatnagar Awardees Profs.G.Baskaran and R.Balasubramanian of the Institute in the AIR (Madras) broadcast on March 9, 1991. His talk on "Nature of Symmetry" was broadcast by AIR, Madras, on March 16, 1991.

Prof. R.VASUDEVAN is a member of the Board of Studies of the Elite School of Optometry, Madras (A Unit of the Medical Research Foundation, Madras). He is also an Associate Editor of the International Journals, "Applied Mathematics and Computation" (North-Holland Pub., Netherlands) and "Neurological Research" (Butterworth-Heinemann Pub., U.K.)

Awards and Honours

PROF.R.BALASUBRAMANIAN got the S.S.Bhatnagar Award for Mathematics for the year 1990. He has also got the B.M.Birla Award for Mathematics for the year 1990.

Prof.G.BASKARAN got the S.S.Bhatnagar Award for Physics for the year 1990.

Dr.Subhashis NAG visited the City University of New York in Fall 1990 as Einstein Chair Visiting Professor.

Prof.R.RAMACHANDRAN has been elected a Fellow of the Indian Academy of Sciences.

Dr.R.SIMON has been elected a Fellow of the Indian Academy of Sciences.

Ph.D's from the Institute during 1990-91

C.S.YOGANANDA received Ph.D Degree in Mathematics from the University of Madras. He had submitted his Thesis entitled "Dirichlet series associated to modular forms" under the guidance of R.BALASUBRAMANIAN.

Lecture Courses for Ph.D students during 1990-91
Physics

(i) For 1st year students:

I SEMESTER (Sept-Dec'.90)

Classical Mechanics and Field Theory	H.S.SHARATCHANDRA
Quantum Mechanics	G.DATE
Mathematical Physics	R.JAGANNATHAN

(Besides the above a short course on "Special functions of Mathematical Physics" was given by K.SRINIVASA RAO)

II SEMESTER (Jan-May'91)

Statistical Mechanics	V.RADHAKRISHNAN
Quantum Field Theory	G.RAJASEKARAN
Lie Groups and Differential Geometry	R.SIMON

(Besides the above a short course on "Invariant Imbedding Approach and Applications for Solving Differential and Integral Equations" was given by R.VASUDEVAN)

Advanced Level Courses (for II year students)

Solid State Physics	G.BASKARAN
Lattice Gauge Theories	Ramesh ANISHETTY

MATHEMATICS

Functional analysis (June'90-Feb'91)	Krishna MADDALY
Calculus on Manifolds	H.BHATE
Modular Forms (Dec'90-April'91)	B.RAMAKRISHNAN
Advanced Complex Analysis	Subhashis NAG

Theoretical Computer Science

"Model Checking in Temporal Logic" (May-June'90)	R.RAMANUJAM

Conferences/Workshops/Schools Sponsored/Cosponsored by the Institute

(1) A Workshop on "Random Surfaces, 2-d Gravity and Matrix Models" was held at the Institute during Nov.19-23, 1990. About forty participants took part in the Workshop, 23 were from outside Madras, from all parts of India. (Organizing Committee" N.D.Hari Dass (Convener) R.Ramachandran, T.R.Govindarajan and G.Date)

(2) A Group Discussion Meeting on "New Insights into the Old Hubbard Model" was held at the Institute during 25th Feb - 1st March'91. The meeting was attended by about 35 outside participants besides the Institute members. The topics discussed in the meeting included: Failure of the Fermi liquid theory, Nagaoka theorem, Structure of holes in a Mott insulator, Numerical studies on Hubbard model, and Chiral symmetry breaking. (Organizing Committee: G.Baskaran (Convener), A.K.Mishra, R.Shankar and G.Subramoniam)

New Projects sponsored by the Department of Science and Technology

In a DST sponsored project (Investigators: R.Ramachandran of the Institute with J.K.Bhattacharjee and H.S.Mani of I.I.T.-Kanpur) "Statistical Field Theory Methods in Gauge Theories and Strings" attempts are being made to understand the phase diagram of the standard model.

Library

The Library started functioning in the New Library building complex from 1.4.1991 with a seating capacity for about 70 readers. The number of visitors to the Library has increased substantially compared to the previous years. Presently the number of volumes in the Library is 26912 as on 31.3.1991. 1073 Volumes were added during the period ended March 1991. 234 Journals were subscribed to for the year 1991. As usual, we have been getting about 55 journals, Lecture Notes, etc, on exchange basis. 3723

Preprints have been received during the year by our library from Research Institutions and Universities all over the world.

During the year, the Institute library received many valuable books/journals as gratis and we would like to thank the following for this kind gesture:

Prof.G.Baskaran, Prof.N.D.Hari Das, Prof.R.Ramachandran, Dr.R.Ramanujam, and Dr.R.Sridhar, I.M.Sc; Prof.R.Hotta and Prof.T.Oda, Tohoku University, Japan; Prof.Mobarak Ahmed, University of Kashmir; Indiana University Library, Bloomington, Indiana, USA; U.S.I.S, New Delhi.

SEMINARS/COLLOQUIA AT THE INSTITUTE

PHYSICS

Afsar ABBAS Institute of Physics Bhubaneswar	Charge quantizations in the standard model and a new constraint on GUTs
ALOK KUMAR LPTENS-Paris, FRANCE	Uniqueness of partition function in superstring models
K.BABU JOSEPH Department of Physics Cochin University of Science and Technology, Cochin	Symmetries of dissipative systems
Radha BALAKRISHNAN IMSc	Geometric phase in the continuous antiferromagnetic chain
BARCELLI	Detection theory in quantum optics: Quantum stochastic calculus
G.BASKARAN, IMSc	Spin glasses and large scale complex problems
A.BAUMGARTNER IFF, Julich, GERMANY	Modelling of random surfaces
G.CASSATI University of Milan, ITALY	Introduction to quantum chaos
D.K.CHOUDHURY Guahati University Guahati	Studies on QCD structure functions
Russel DEVALOIS Department of Psychology University of Berkeley, California USA	Physiological optics and neurobiology (Colloquium)

C.DEVCHAND Centre for Theoretical Studies Indian Institute of Science Bangalore	Introduction to quantum groups
T.FERBAL Department of Physics and Astronomy,	Production of hybrid mesons in the nuclear coulomb field
Sasanka GHOSH Saha Institute of Nuclear Physics Calcutta	Application of Bethe ansatz technique in conformal field theories (TPSC lecture)
N.D.HARI DASS, IMSc	Link polynomials and Chern Simons field theory
N.D.HARI DASS, IMSc	Ising model on random two dimensional surfaces
K.P.HARIKRISHNAN Cochin University of Science and Technology, Cochin	Chaos in a modulated logistic system
T.JAYARAMAN, IMSc	Monodromy preserving deformations and string equations of motion
Avinash KHARE Institute of Physics Bhubaneswar	Nontopological Abrikosov vortices
Anand KUMAR Rice University, Texas USA	Modelling and analysing fractal intensity point processes
Anjan KUNDU Saha Institute of Nuclear Physics Calcutta	Understanding the relationship between integrable systems and conformal theories (TPSC lecture)
H.S.MANI Indian Institute of Technology Kanpur	A new test of the equivalence principle

K.T.MAHANTHAPPA University of Colarodo at Boulder, USA	Sypersymmetric nonlinear sigma model in (2+1)-dimensions
V.I.MAN'KO Lebedev Physical Institute Moscow, USSR.	Integrals of motion and dynamical symmetries of nonstationary quantum systems
P.M.MATHEWS Dept. of Theoretical Physics University of Madras	Nutations of the Earth: Recent developments
M.R.MEHTA Indian Institute of Science Bangalore	Supercurrent and superconformal current anomalies
Subhendra MOHANTY Center for Theoretical Studies Indian Institute of Science Bangalore	On the possibility of detecting wormholes using SQUIDS
M.MUKHERJEE Department of Physics University of California at Los Angeles, USA	Compact to noncompact transition
V.MUTHUKUMAR University of Massachusetts Amhrest, USA	Segregation in polymers
R.RAJARAMAN Indian Institute of Science Bangalore	Topological field theory
G.RAJASEKARAN, IMSc	Algebra for fermions with a new exclusion principle
G.RAJASEKARAN, IMSc	Shadow poles and molecular hadrons
Jacques RAYNAL CEN, Saclay, FRANCE.	Multiple expansion of a two body interaction and its use in the microscopic description of inelastic scattering;

	Transformation coefficients, hyper spherical hermonics and Moshinsky/ Smirnov coefficients (27/9/90)
R.SAROJA Tata Institute of Fundamental Resarch Bombay	Six point amplitudes (TPSC lecture)
K.V.L.SARMA Tata Institute of Fundamental Research Bombay	B-meson physics
K.B.SINHA Indian Statistical Institute New Delhi	Quantum theory of measurement
Vikram SONI National Physical Laboratory New Delhi	Baryon number violating classical solutions in Weinberg-Salam theory (TPSC lecture)
K.SRINIVASA RAO, IMSc	Some aspects of the Racah-Wigner algebra for $su_q(2)$
V.SUBRAMANYAM Tata Institute of Fundamental Research Bombay	Commensurability effects and degeneracies
SUMATHI RAO Institute of Physics Bhubaneswar	Anyons and Gaussian conformal field theories (TPSC lecture)
N.SUKUMAR Chandigarh University	Symmetry breaking and gauge fields in molecular structures
S.UMASANKAR Tata Institute of Fundamental Research Bombay	Indirect evidence for the top-quark mass
R.VASUDEVAN, IMSc	Introduction to stochastic quantum mechanics
Michael VITTOT CNRS, Luminy, Marseille, FRANCE	Quasi-integrable dynamical systems and KAM-theorem

Raju VISWANATHAN International Centre for Theoretical Physics, Trieste, ITALY.	Matrix models with positive susceptibility

MATHEMATICS/THEORETICAL COMPUTER SCIENCE/
INTER-DISCIPLINARY AREAS OF MATHEMATICAL SCIENCES

S.D.ADHIKARI	Application of dynamical systems to to combinatorial number theory
C.ADIMOOLAM	Formal groups
Krishnawami ALLADI Department of Mathematics University of Florida. Gainesville, Florida, USA	Schur's partition theorm and generalization ; New combinatorial interpretations for Ramanujan's partition congruences
J.M.ANDERSON University College University of London ENGLAND	Boundary behaviour of univalent functions
Richard ANDERSON University of Washington, Seattle, USA	Asynchronous parallel compactification (Colloquium)
S.ARUNDHATHI, IMSc	Some problems in real function algebras
K.B.ATHREYA Iowa State University USA	Mathematics of bootstrap
H.BHATE IMSc	Exactly solvable models and related topics
Gautamie BHOWMIK Jesus and Mary College Delhi	Arithmetical functions of integer matrices

N.D.CHAKRABORTY University of Burdwan Burdwan	Some open problems in weak Radon-Nikodym property and Petties integration
Dale CUTKOSKY University of Missowri, USA	Factorization of complete ideals
Basudeb DATTA Math/Stat Unit Indian Statistical Institute Bangalore	Twistor of standard S^{2n}; Relations between complex and hypercomplex manifolds
DERSANAMBIKA Indian Institute of Technology Madras	On normed almost linear space (Colloquium)
Fred DIAMOND Boston University USA	Main conjecture of Iwasawa theory: Recent work of Kolyvagin and Rubia
FAURE	Quasi-random number generation with permutations
T.GNANABHASKAR	Study of mixed linear ordinary differential operators
A.V.HOLDEN Leeds University ENGLAND	Mathematical aspects of cardiac arrhythmia
V.A.ISKOVSKY Steklov Institute of Mathematics Moscow, USSR	On Fermat's theorem: Approach of Frey
Heeralal JANWA Michigan State University East Lansing, USA.	Error correcting codes from algebraic geometry
DEEPA KRISHNAMURTI, IMSc	Resource allocation mechanisms for finite sets (Colloquium)

A.M.MATHAI Centre for Mathematical Sciences Trivandrum	On some integral equations in mathematical statistics
D.MIKLOS Mathematical Institute of the Hungarian Academy of Sciences HUNGARY	Shannon capacity of highly symmetric graphs
MURALIDHARAN Tata Consultancy Services Madras	Ergodic averages (Colloquium)
N.R.NANDAKUMAR Department of mathematics Delaware State College USA	Ring homomorphisms on algebras of analytic functions
V.V.NIKULIN Steklov Institute of Mathematics Moscow, USSR	Classification of arithmetic groups generated by Reflections on hyperbolic groups
K.R.PARTHASARATHY Indian Statistical Institute New Delhi	An invitation to quantum stochastic calculus
RAMA Madras Institute of Technology Madras	Some studies of substitutions in Lindenmayor systems
B.RAMAKRISHNAN, IMSc	Shintani correspondence (Colloquium)
K.RAVISHANKAR State University of New York USA	Microscopic structure of shock nonlinear conservation laws
SANKARANARAYANAN	Riemann zeta function
A.SITARAM Indian Statistical Institute Bangalore	The spherical mean value operator for compact symmetric spaces

R.TANDON University of Hyderabad Hyderabad	Conduct of representations of Weyl groups
Richard TAYLOR Cambridge University ENGLAND	Langland's philosophy and Serre's conjecture
B.D.THATTE Indian Institute of Science Bangalore	Graph reconstructions
Jacques TILOUINE CNRS, Paris, FRANCE	Deformation of Galois representation; p-adic analytic families of Hilbert modular forms Kummer's criterion for CM fields (Colloquium)
R.TIFJDEMAN L.C.WASHINGTON Universitty of Maryland USA	S-Unit equation Modular curves and units of number fields ; Introduction to Iwasawa theory Colloquium
Shankar M.VENKATESAN Rutgers University, Camden USA	The set of Fibonacci numbers is not context-free

A monthly Seminar on Theoretical Computer Science was held with the participation of other Institutions in Madras. Under this programme the following seminars were held.

Amitava DATTA IIT, Madras	Art gallery theorems and visibility graphs (at IMSc; Jan'91)
V.KRISHNAMOORTHY Anna University Madras	Some new sorting and merging algorithms (at Madras Christian College; Dec'91)
Kamala KRITHIVASAN IIT, Madras	Shortest path across rectilinear barriers (at IMSc; Sept'90)
Kamal LODAYA, IMSc	Decidability of bisimulation equivalence for context-free grammars (at IIT; Oct'90)

Meena MAHAJAN IIT, Madras	P, NP, PSPACE relativised (at Anna University; March'91)
Madhavan MUKUND School of Mathematics Spic Science Foundation Madras	W-automata and the decidability of S1S (at Anna University; Nov'90)
K.G.SUBRAMANIAN Madras Christian College Madras	Learning of formal languages (at Spic Science Foundation; Feb'91)

THE INSTITUTE OF MATHEMATICAL SCIENCES
MADRAS 600 113
RECEIPTS AND CHARGES FOR THE YEAR ENDING 31ST MARCH 1991

RECEIPTS			Rs. P.
Opening balance	- Cash		1197.00
	- Bank	- BOI	1237187.20
		SBI	2541610.56
Tamil Nadu Government Grants			1500000.00
Recurring (89-90)	- 1125000		
Recurring (90-91)	- 375000		
Department of Atomic Energy Grants			13300000.00
Recurring (90-91)	- 8500000		
Non-Recurring (90-91)	- 4800000		
CPF Management contribution lapsed to Main Account			668201.80
i) of those opted for pension	- 666143.80		
ii) of those who left the Institute within 5 years	- 2058.00		
OTHER RECEIPTS			
Sale of IMSC Reports			2016.00
Xeroxing Receipts			3144.50
Guest Room Charges			45527.50
Sale of Tender Documents			3160.00
Sales Tax received on tenders sold			192.00
Sale of old batteries			585.00
Sale of old newspapers			1815.00
Sale of JRF's application			2328.00
Catering Receipts			2400.75
		c/f	19309365.31

CHARGES		Rs. P.
I. ACADEMIC STAFF - EXPANSION PROGRAMME		
i)	Academic Staff	1941006.15
ii)	Post Doctoral Fellowship	145227.00
iii)	Junior Research Fellowship	595652.00
II.ADMINISTRATIVE AND SUPPORTING STAFF		
i)	Administrative/Supporting Staff	1112408.65
ii)	Overtime Allowance	15147.00
III. LIBRARY		
i)	Library	2829867.00
IV. TA TO STAFF, LTC ETC		
i)	Board and Committee Members	9731.00
ii)	Participation by acad.staff in Conferences	59947.50
iii)	Other official visits by staff	26664.00
iv)	Candidates called for interview	7634.60
v)	LTC to Staff	27152.50
vi)	Others	8257.00
V. VISITING/ACADEMIC TRAINING PROGRAMME		
i)	Visiting Scientists Programme (Travelling) Allowance, Honorarium payable to Visiting Scientists/Lecturers/Res.Scholars)	83704.00
ii)	Hosting of Scientific Conference, (Summer Schools, Workshop etc.)	0.00
VI. OFFICE AND MAINTENANCE EXPENSES		
i)	Building Maintenance	16577.90
ii)	Furniture and Fittings and Equipments (Purchase, Repairs and Renewals)	299561.05
iii)	Stationery and Printing	89238.15
	c/f	7267825.50

RECEIPTS		RS. P.
	b/f	19309365.31
OTHER GRANTS		
National Board for Higher Mathematics		102440.70
Council of Scientific and Industrial Research		54400.00
Theoretical Physics Seminar Circuit		35000.00
University Grants Commission		41940.00
DST Grants for Prof.N.D.Hari Dass's Project		129893.80
- Grants 102600.00		
- Interest 27293.80		
DAE Grants for Dr.G.Baskaran's Project		1404369.46
- Grants - 1400000.00		
- Interest - 4369.46		
OTHER RECOVERIES		
GPF/CPF recoveries		317942.00
Income Tax recoveries		333174.00
Postal Life Insurance recoveries		19794.60
Cumulative Time Deposits recoveries		600.00
Profession Tax recoveries		12025.00
Official Car use recoveries		700.00
HDFC recoveries		52296.00
LIC recoveries		14890.00
GPF recoveries for Registrar		3350.00
Motor Car Advance recoveries for Registrar		6000.00
Group Insurance Scheme recoveries for Registr		720.00
Family Benefit Fund recoveries for Registrar		18.00
GPF recoveries for Director		5400.00
Vehicle advance recovery		46850.00
Festival advance recovery		15760.00
Other advances/deposits recovery		1100.00
OTHERS		
Temporary advances recoveries		1209047.70
EMD/Deposits payable		104738.00
Interest received on investments		62509.35
Miscellaneous Receipts		19782.72
Deposits Receivables		9500.00
Excess remittances made		37.00
	c/f	23313643.64

CHARGES		RS. P.
OFFICE AND MAINTENANCE EXPENSES CONTD...		
	b/f	7267825.50
iv) Postage		49642.90
v) Contingent and Miscellaneous		34789.20
vi) Telephone charges		122924.00
vii) Advertisement charges		90900.00
viii) Canteen Facilities (Cutlery, Crockery, gas etc)		2751.50
ix) Vehicle Maintenance		79164.40
x) Petrol/Diesel for vehicles		67182.20
xi) Computer Stores/charges/maintenance		124846.00
xii) Uniforms to Staff		15311.05
xiii) Electricity and Water charges		102123.00
xiv) Xeroxing charges		47119.00
xv) Entertainment and Hospitality expenses		29316.90
xvi) Accommodation for Director (Rent, Furniture & Fittings, Maintenance)		20215.15
xvii) Guest House cum Students Hostel (Rent, Furniture & Fittings Maintenance)		214161.90
- Rs. 211731.85		
Catering Expenses - Rs. 2430.05		
VII. ADVANCES, RETIREMENT BENEFITS AND WELFARE MEASURES		
1) Advances		
i) House Building Advance		200000.00
ii) Purchase of vehicles		8765.00
iii) Festival Advance		14400.00
iv) Other advances/deposits		33200.00
2) Retirement Benefits to Staff		
i) Pension including Family Pension		61151.00
ii) Death cum Retirement Gratuity including Service Gratuity		16801.00
iii) Encashment of Earned Leave		4298.00
iv) Employers Contribution to CPF		59243.00
v) Pension contribution		11234.00
vi) Leave Salary Contribution		9817.00
3) Other Welfare Measures		
i) Ex-gratia payment (bonus to staff)		30884.00
ii) Health Care Scheme		107229.35
iii) Childrens Educational Allowance & reimbursement of tuition fees		990.00
	c/f	8826285.05

RECEIPTS		RS. P.	CHARGES		RS. P.
	b/f	23313643.64		b/f	8826285.05
			VIII. NEW SCHEMES		
			i) Annual Seminars at National level		68443.30
			ii) Annual International Conferences		0.00
			iii) Visitors Programme (directed towards College and University Teachers)		0.00
			iv) One Year Post M.Sc Trainees		45407.00
			NON - RECURRING		
			i) Construction of Hostel cum Guest House Complex		4867847.35
			Works - 4787211.85		
			Wages - 27945.00		
			Establishment - 52690.50		
			ii) Construction of Library Building including airconditioners		358213.00
			iii) Furnishing to Hostel cum Guest House Complex		675249.00
			iv) Furnishing to Library Building		126961.00
			v) Computer Facilities		1333886.50
			vi) Purchase of Xerox		53495.00
			vii) Installation of EPABX system		253424.95
			viii) Construction of Vehicle Shed		165000.00
			OTHER AGENCIES		
			National Board for Higher Mathematics		94185.15
			Council of Scientific and Industrial Research		46592.50
			Theoretical Physics Seminar Circuit		21451.00
			University Grants Commission		15915.00
			DST Project - Prof.N.D.Hari Dass		40779.00
			DAE /PMB Project - Prof.G.Baskaran		958363.00
			DAE/PMB Project - Investment		300000.00
			RECOVERIES-REMITTANCES		
			GPF/CPF remittances		317942.00
			Income Tax remittances		325400.00
			PLI remittances		19730.60
			CTD remittances		600.00
			Profession Tax remittances		12025.00
			HDFC remittances		52296.00
	c/f	23313643.64		c/f	18979491.40

RECEIPTS		RS. P.	CHARGES		RS. P.
	b/f	23313643.64		b/f	18979491.40
			RECOVERIES-REMITTANCES CONTD...		
			LIC remittances		14890.00
			GPF remittances for Registrar		3350.00
			Motor Car Advance remittances for Registrar		6000.00
			GIS remittances for Registrar		720.00
			Family Benefit Fund remittances for Registrar		18.00
			GPF remittances for Director to IIT, Kanpur		5400.00
			Salex Tax remittances		568.00
			OTHERS		
			Temporary Advances paid		749341.50
			Deposits Payable		287660.00
			Investments Outstanding - Main Account		750000.00
			Miscellaneous Payments		12614.00
			CLOSING BALANCE		
			- Cash		4802.50
			Main Account - Bank of India		403204.25
			- State Bank of India		1710441.23
			Project Account -		
			DST - Prof.N.D.Hari Dass - Bank of India		239136.30
			PMB - Prof.G.Baskaran - Bank of India		146006.46
TOTAL		23313643.64	TOTAL		23313643.64

SIGNED
INSPECTOR OF LOCAL FUND ACCOUNTS
LOCAL FUND AUDIT

SIGNED
ADMN./ACCOUNTS OFFICER
IMSc

SIGNED
CHIEF ADMINISTRATIVE OFFICER
IMSc

THE INSTITUTE OF MATHEMATICAL SCIENCES
MADRAS 600 113.

PROVIDENT FUND ACCOUNT FOR THE YEAR 1990-91

RECEIPTS	Rs. P.	CHARGES	Rs. P.
Opening Balance	2,80,542.79	P.F.Advances	80,405.00
Subscriptions and Refunds of withdrawals	3,17,942.00	Part Final Withdrawals	36,000.00
Interest earned on deposits	49,347.80	Final Settlement of PF Accounts	60,911.00
Savings Bank Account interest	18,288.50	PF recovery of Director transferred to IIT, Kanpur	1,459.00
Investments matured	5,94,938.35	CPF Management Contribution lapsed to Main Account	6,68,201.80
		i) of those who opted for pension - 666143.80	
		ii) of those left the Institute within five years - 2058.00	
		Investments made	3,00,000.00
		Refund of excess recovery of PF (recovered in 2/91 pay bill)	1,906.00
		Closing Balance	1,12,176.64
	12,61,059.44		12,61,059.44

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DEPUTY INSPECTOR OF
LOCAL FUND ACCOUNTS

SIGNED
ADMN./ACCOUNTS OFFICER

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CHIEF ADMINISTRATIVE OFFICER

THE INSTITUTE OF MATHEMATICAL SCIENCES
MADRAS 600 113.

N.B.H.M. LIBRARY GRANTS

1990-91	Rs. P.
Opening Balance	38,065.81
ADD: Grants received during 1990-91	---
	38,065.81
ADD: Savings Bank interest	1,268.40
	39,334.21
LESS: Amount spent	37,492.00
(Unspent) Balance	1,842.21

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LOCAL FUND ACCOUNTS

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CHIEF ADMINISTRATIVE OFFICER