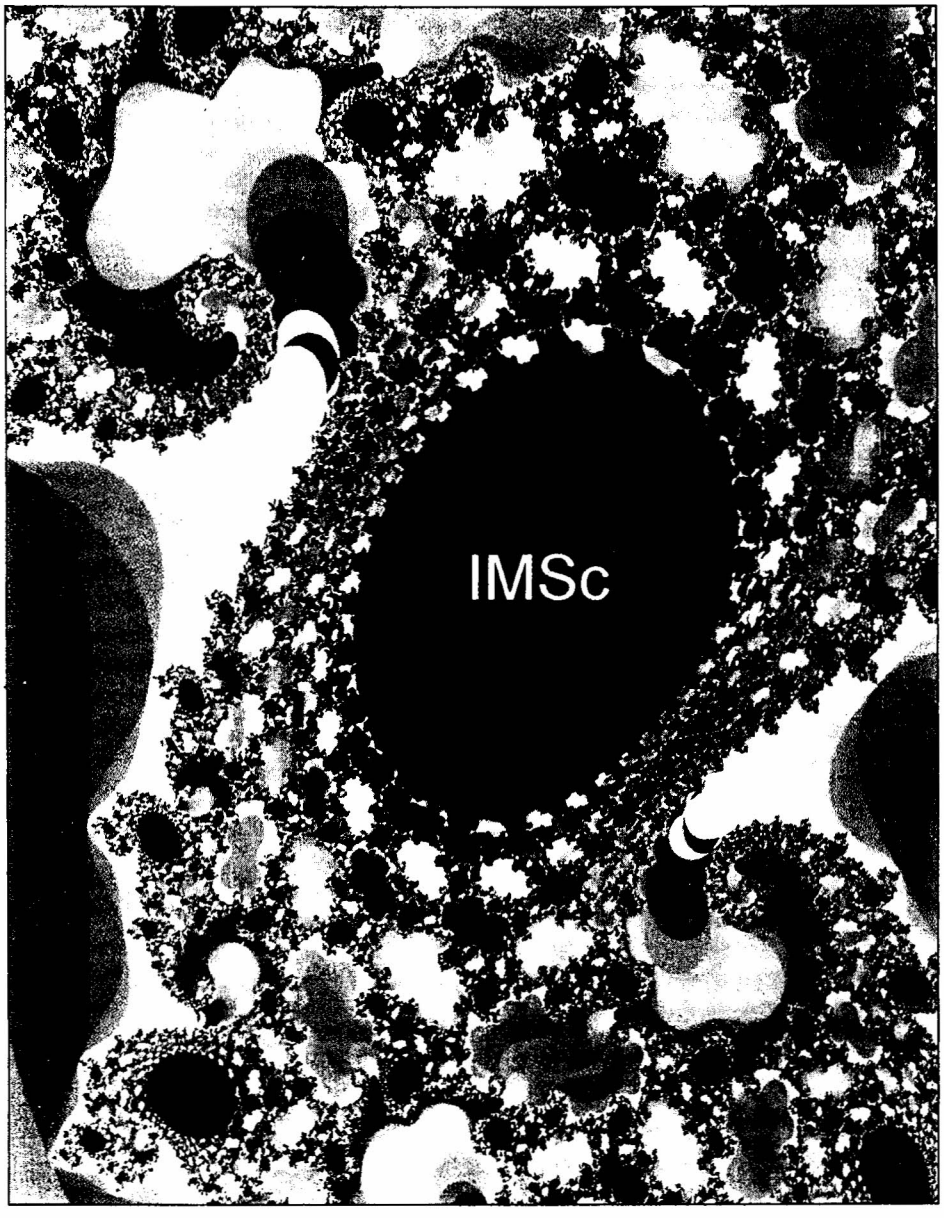
The Institute of Mathematical Sciences

MADRAS INDIA



ANNUAL REPORT

1993-94

THE INSTITUTE OF MATHEMATICAL SCIENCES

C.I.T. Campus, Taramani

Madras 600 113, India

ANNUAL REPORT

April 1993 – March 1994

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Contents

FOREWORD

I am pleased to present the progress made by the Institute during 1993-94 in its many subdisciplines and note the distinctive achievements of the members of the Institute.

As anticipated in the foreword of the last annual report, several more distinguished academicians joined our faculty, bringing with them a lot of freshness of approach and enthusiasm in the task of building up a strong academic tradition at IMSc. We hope to go through a period of consolidation in the areas of pursuit for research in the Institute, while the continued review of our efforts will persist. During the year under review, the Institute hosted WHEPP3, the *Workshop on High Energy Particle Physics*, with emphasis on Particle Phenomenology from January 10 - 22, 1994 as a sequel to WHEPP-1 and WHEPP-2 held at Bombay (1988) and Calcutta (1991) respectively. The Workshop analysed the scenerio in Particle Phenomenology and related developments in other Particle Physics areas and we hope to have the proceedings published as a Pramana supplement. The *Fifth Number Theory Conference* was held during July 20 - 23, 1993 and attracted a large number of distinguished Indian and French Number Theorists. On 27th and 28th December, in collaboration with the SPIC School of Mathematics, we hosted an intensive *Conference on Vector Bundles on Curves - New Dimensions*, which followed a ten day workshop on the same topic at the Tata Institute of Fundamental Research at Bombay.

This year we had done the necessary planning to have an Institute wide network linking the various faculty offices and other wings with the computer centre with its set of sparcstations, HP supermini workstations, laser and dotmatrix printers and other peripherals. The computers now serve not only as important research tools but also as a very effective communication channel among the members of the Institute as well as with the worldwide academic community. Very effective inter-institutional research collaborations are taking place and thus it enhances our potentials significantly. Library and the office activities will also be upgraded by the use of these networking efforts.

Professor K. Srinivasa Rao has spearheaded a collaborative project on some aspects of Mathematical Physics between our Institute and The University of Gent, Belgium, sponsored by the European Economic Commission. The project commenced during the preceeding year will promote the exchange of visitors between the two Institutions.

I should like to highlight among the laurels won by our academic staff, that of **Professor Rajiah Simon**, who won the coveted **Shanti Swarup Bhatnagar Award** this year.

I should also like to recall on this occasion that on January 3, 1994, Professor R. Vasudevan, one of the prime architechts of the Institute, breathed his last. The Institute is eternally beholden to him for various services he rendered, with single minded devotion and in particular, for his unique role in its build up.

This annual report has been compiled through the efforts of Profs. K. Srinivasa Rao, S. Kesavan, R. Ramanujam, R.Jagannathan, Mr. K.S. Santhanagopalan (Librarian) and Mr.G.Venkatesan and to all of them I owe my gratitude. As I close this foreword, I look forward to another year of exciting activities of the Institute.

R.Ramachandran
Director

August 1994.

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Prof. **R. Ramachandran**, Director, Institute of Mathematical Sciences, Madras (**Member Secretary**).

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Dr. **Sharatchandra**, H.S.
Dr. **Sinha**, Rahul
Dr. **Uma Sankar**, S.

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Dr. **Ramanujam**, R.
Dr. **Venkatesh Raman**
Dr. **Vinay**, V.[3]

SCIENTIFIC OFFICER

Dr. **Subramoniam**, G.[4]

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[1] *Resigned on 24.03.94*
[2] *Retired from service on 31.10.93*
[3] *Resigned on 24.9.93*
[4] *PDF completed on 31.10.93*

POST-DOCTORAL FELLOWS AND RESEARCH ASSOCIATES

PHYSICS

Dr. **Balakrishnan**, Janaki[1]
Dr. **Govindarajan**, Suresh[2]
Dr. **Ghosh**, Sasanka[3]
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Dr. **Mahapatra**, Swapna
Dr. **Mallick**, Basu
Dr. **Nandhini**, Durga[4]
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Dr. **Rajeswari**, V
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Dr. **Singh**, Vandana[5]
Dr. **Sinha** , Nita
Dr. **Subrahmanyam**, V.[6]

MATHEMATICS

Dr. **Sastry**, Swati
Dr. **Sengadir**, T

THEORETICAL COMPUTER SCIENCE

Dr. **Mahajan**, Meena
Dr. **Srinivasaraghavan**, G.

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[1] *Resigned from service from 23.3.94*
[2] *PDF completed on 30.8.93*
[3] *Resigned from Service from 31.8.93*
[4] *PDF completed on 31.1.94*
[5] *Resigned from service from 30.9.93*
[6] *PDF completed on 31.7.93*

STUDENTS

JUNIOR RESEARCH FELLOWS

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Mr. **Deodhar**, Shekar Ramesh
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Ms. **Elizabeth**, S. Mary
Mr. **John**, Varghese
Mr. **Khan**, S.A.
Mr. **Mathews**, Prakash[5]
Mr. **Muthukumar**, V.N.[6]
Mr. **Varadarajan, S.**[7]
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Mr. **Narayanan**, Mohan
Mr. **Prakash**, J.S.[2]
Mr. **Rakshit**, A.M.[3]
Ms. **Ramadevi**, P.
Mr. **Ravindran**, V.[4]
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Mr. **Sundar**, K
Ms. **Vathsan**, Radhika

MATHEMATICS

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Ms. **Kulkarni**, M.V.
Ms. **Nongkynrih**, Amora[1]
Ms. **Radha**, R
Mr. **Ramana**, Surya V.

THEORETICAL COMPUTER SCIENCE

Mr. **Chandran**, Vinod
Mr. **Chatterjee**, Jyotishman
Mr. **Mohalik**, Swarup Kumar
Mr. **Nagaraj**, S.V.

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[1] *JRF Completed on 31.12.93*
[2] *JRF Completed on 18.12.93*
[3] *JRF Completed on 31.7.93*
[4] *JRF Completed on 2.7.93*
[5] *JRF Completed on 31.7.93*
[6] *JRF Completed on 13.9.93*
[7] *DST Project*

ADMINISTRATIVE STAFF

Mr. **Sethuraman**, G.	Chief Administrative Officer
Mr. **Jayaraman**, R.	Administrative Officer
Mr. **Krishnan**, S.	Accounts Officer
Mr. **Santhanagopalan**, K.S.	Librarian

Mr. **Amulraj**, D.
Mr. **Ashfack Ahmed**, G.
Mr. **Balakrishnan**, A.R.
Mr. **Balakrishnan**, J.
Mr. **Chellakutty**, K.[1]
Mr. **Elumalai**, G.
Mr. **Ganapathi**, R.
Ms. **Gayatri**, E.
Ms. **Geetha**, M.
Ms. **Indra**, R.
Mr. **Jayaraman**, V.[2]
Mr. **Moorthy**, E.
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Ms. **Usha Otheeswaran**
Mr. **Vasudevan**, T.V.
Mr. **Varadaraj**, M.
Mr. **Venkatesan**, G.
Mr. **Venugopal**, T.

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[1] *Retired from service w.e.f. 31.3.94*
[2] *Retired from service w.e.f. 31.1.94*

ACADEMIC ACTIVITIES

Summary of Research work

Physics

Quantum Groups, Knot Theory, Generalized Statistics and applications

Realization of FRT algebra is built up for a coloured braid group representation and new solutions of quantum Yang-Baxter equation are subsequently found through Yang-Baxterisation of FRT algebra. These solutions help to construct Lax operators of several integrable lattice models associated with nonadditive R-matrix.

A novel quantum group, which might be considered as some quantization of classical $GL(2) \otimes GL(1)$ group, has been constructed. The two parameter deformed $GL_{p,q}(2)$ quantum group is found to be closely connected with this new quantum group. This connection opens up an alternative way of constructing Manin planes related to $GL_{p,q}(2)$ quantum group as well as its coloured extension.

Coherent states on quantum group $SU_q(2)$ are defined by using harmonic analysis and representation theory of the algebra of functions on the quantum group. Semiclassical limit $q \to 1$ is discussed and the crucial role of special states on the quantum algebra in an investigation of the semiclassical limit is emphasized. An approach to q-deformation as a q-Weyl quantization and a relevance of contact geometry in this context is pointed out.

q-deformed calculus, for small positive values of $q - 1$, has been identified with the stochastic calculus. Hopf algebraic aspects of Tamm-Dancoff deformation of bosonic oscillators have been analysed. A q-deformed version of the parasupersymmetric quantum mechanics has been constructed. The two-parameter(p, q) deformation of $U(gl(2))$ has been analysed using Reshetikhin's theory and its universal $\mathcal{R}$-matrix has been obtained. In a contraction limit $U_{p,q}(gl(2))$ goes over to a two-parameter deformation of the Heisenberg algebra which is found to be useful in the construction of a two-parameter deformation of the Virasoro algebra. Paraboson algebra is known to be related to the two-particle Calogero model and recently there have been attempts to look at the q-paraboson algebra as a modification of the q-oscillator algebra. In view of this, two-parameter deformations of paraboson algebras and the related quantum algebraic structures, including deformed Virasoro algebra, have been investigated. A unified approach has been devloped for constructing the analogues of single-photon and multiphoton coherent states for generalized boson oscillators. The variety of possibilities available for the deformations of the discrete spectrum of the hydrogen atom by deforming its symmetry and its relation to the oscillator algebra (via the Kustaanheimo-Steifel transformation) have been pointed out.

The formulation of the theory of generalized Fock spaces has been completed. The theory is based on a three-tiered structure consisting of Fock space, statistics and algebra. This general formalism not only unifies the various forms of statistics and algebras but also allows us to construct many new forms of quantum statistics and algebras: new algebras for infinite statistics, q - statistics and its many avatars, a consistent algebra for fractional statistics, null statistics, doubly-infinite statistics, many representations of orthostatistics, Hubbard statistics, statistics with a new **inclusion** principle and many more.

Following Witten's work , new knot invariants have been obtained for any compact semi-simple gauge group in the Chern-Simons theory.

Further studies in Chern-Simons theory as a theory of knots and links were made. Theory of coloured-oriented braids has been developed for this purpose. New representations of the generators of the groupoid of coloured-oriented braids have been obtained. These allow construction of new invariants for arbitrary coloured-oriented links. Thus $SU(2)$ Chern-Simons theory on S^3 is completely and explicitly solved. The different link invariants obtained in this frame work correspond to various $SU(2)$ spin representations living on the Wilson loop operators. These invariants appear to be more and more powerful as we go up in the spin. Spin $j = 1$ (Kauffman) invariants do distinguish some of the knots which are not distinguished by spin $j = 1/2$ (Jones) polynomials. Spin $j = 3/2$ invariants have been shown to be even more powerful. For example, chiral knots 9_{42} and 10_{71} whose chirality is not detected by any of the earlier known invariants (Jones and Kauffman), are now distinguished from their mirror images by the spin $j = 3/2$ invariants.

The method can also be extended to obtain new representations of the braids and consequently new link invariants from any arbitrary rational conformal field theory. This generalization has been developed. The link invariants obtained are related in a simple factorized way to the invariants associated with the factor groups in the coset representation of the rational conformal field theory.

The knot invariants obtained from Rational Conformal field theories, suggest the possible Chern-Simons theory for coset models(Minimal model, superconformal and W_N model).

Anyons, Fractional Statistics

It has been shown that all the known exact solutions in the problems of N anyons confined in oscillator solutions arise from collective degrees of freedom and that the system is pseudo-integrable. This is perhaps the first many body example of a pseudo-integrable system.

Haldane's definition of statistics in terms of a generalized exclusion principle was generalised to the case of infinite dimensional Hilbert spaces so that it can be applied to continuum systems with no natural cutoffs. It was shown that the exclusion statistics parameter was determined by the high temperature limit of the second virial coefficient, if the virial expansion existed in this limit. The definition was applied to compute the exclusion statistics parameter of (i) The anyon gas in two dimensions (ii) Anyon gas in a strong magnetic field (iii) Quasiparticles in a one dimensional Luttinger Liquid.

The Calogero-Sutherland model in one dimension was shown to be an ideal exclusion anyon gas in one dimension. It was shown that (i) The particles have nontrivial exclusion statistics. (ii) They had the statistical distribution functions of an ideal anyon gas (iii) The partition function factorizes as expected of an ideal gas. (iv) Only the second virial coefficient is dependent on the interaction strength.

The exactly known part of the spectrum of many anyons in an oscillator potential was explained by identifying two collective degrees of freedom and their partial separability. The spectrum of three anyons has been analysed in detail and in particular mechanisms for the existence of the nonlinearly interpolating energy eigenvalues have been identified.

Anyon superfluidity was studied by using non-relativistic currents and densities as coordinates. Excitation spectrum obtained by solving the equation of motion of a suitably constructed excitation operator reveals the importance of vortex excitations and predicts an anomalous phonon dispersion in the long-wavelength limit.

Nonlinear dynamics, Chaos

The quantum density of states of a classically chaotic system like the Henon-Heiles system shows pronounced beats which has been explained completely interms of the interference between three isolated classical periodic orbits of nearby periods and actions. This correspondence breaks down completely in the presence of a flux line passing through the origin even though classically the equations of motion are unchanged. In the presence of such nontrivial quantum diffraction effects, the standard periodic orbit theory is inadequate and the quantum corrections are needed to explain the results. To see what modifications are needed the periodic orbit theory applied to circular billiards has been considered as an example and the complete periodic orbit theory going beyond the saddle-point approximations and/or $\hbar$ corrections is attempted. The effect of the flux line on the statistics of the level spectra is also nontrivial and in the case of rectangular billiards it can be shown that the nearest neighbour spacing(NNS) distribution changes from Poisson to Wigner in a continuous manner as a function of the strength of the coupling of the particle to the flux line. Unlike the integrable (Poisson) and chaotic (Wigner) there appears to be no universal characterization of the NNS in the case of pseudointegrable systems.

The local geometric phase intrinsic to a class of soliton supporting nonlinear evolution equations of the Ablowitz-Kaup-Newell-Segur (AKNS) type is derived using the evolving space-curve formalism. The modified Korteweg de Vries equation, the sine-Gordon equation and the nonlinear Schrödinger equation are taken as illustrative examples.

A systematic study of the low energy nonlinear dynamics of the isotropic continuous antiferromagnetic chain is in progress. A hierarchy of exact multi-twist solutions for the staggered magnetization has been found. The hierarchy is labelled by a positive integer N, which represents the total number of twists and anti-twists propagating along the chain.

A formalism to classify integrable evolutions of a space curve is being formulated. Possible connection to the Belavin-Polyakov equation and integrable equations with x-dependent coefficients will be studied.

Mathematical Methods in Physics

Ambiguities arising in the straightforward generalization of Inonu-Wigner contraction to affine Lie algebras are exposed, with restrictions derived on the level of the algebra. Extension to the case of G/H coset spaces yield a $dim(G/H)$ dimensional translation algebra without any such restriction.

Self-dual system for gauge fields on a Riemann surface play important role in many areas of theoretical physics. Describing the immersion of a two dimensional surface in R^n by Gauss map, it has been demonstrated that for surfaces of constant mean curvature, the immersion produces self-dual Yang-Mills system. After proving this for immersion in R^3 and R^4, R^n has been considered. It is shown that when the Gauss map is harmonic the mean curvature becomes constant. Using this the self-dual system is established. The gauge connections are built out of the geometry of the immersion and are not external.

A calculus for SU(3) analogous to the Bargmann calculus for SU(2) is constructed. Some of the new features are, 1)explicit realization of the Gelfand-Zetlyn basis states of SU(3) using polynomials in four variables and positive or negative powers of a fifth variable. 2)a Gaussian measure with respect to which the basis states are orthogonal but not normalized, 3)simple generating functions for generating all basis states and also all invariants. An explicit formula for the Clebsch-Gordan coefficients of SU(3) are obtained for the first time.

Unitary irreducible representations (UIR's) of the proper homogeneous Lorentz group $SO(3,1)$ are realized in a manifestly covariant form, using Hilbert spaces of functions on suitable geometrical configurations of vectors in space-time. The concept and properties of isotropic lines, which are generators of spacelike hyperboloids, and of stability groups of light- like vectors, turn out to be crucial to these constructions. Both principal and supplementary series UIR's are treated.

Using methods of Atiyah and Manton and the meron model, it is shown that the topological charge distribution need not be uniform and can have two centers of one-half charge each. Homotopy classification of non-standard skyrmions is developed. Relevance to instantons on four torus are being looked into.

It is well known that the 9-j recoupling coefficient appearing in quantum theory of angular momentum has 72 symmetries. However, the simplest known form for the 9-j coefficient, the triple sum series expression, exhibits none of these symmetries. A study of the expressions for the stretched 9-j coefficients (stretched in the sense that one or more the six triangle inequalities comprising it is streched), for which a closed form (single term) expression exists, via the triple sum series shows the existence of summation theorems for the hypergeometric functions. Apart from the well known single summation theorems for hypergeometric functions - Viz. the Vander Monde theorem, the Pfaff-Saalschütz theorem and the Karlsson-Minton theorem, for the ${}_2F_1(1), {}_3F_2(1)$ and the ${}_4F_3(1)$, respectively – the study reveals new summation theorems for double and triple hypergeometric functions.

A new sequence of polynomials arising in the study of the reciprocal of power-Dirchlet series is introduced and interesting properties of arithmetical functions defined on such 'factor-chains' (divisor-paths) are reported. These are of interest in connection with the application of Möbius inversion in physical problems and Riemannian gas with chemical potentials.

Particle Physics, Quantum Field Theory, String Theory

Studies on the topological properties σ model were analyzed further by restating it in CP_1 variables. The Hopf term was included in the study with arbitrary coefficient $\theta = \frac{\pi}{2s}$. It was shown that the resulting model is exactly equivalent to an interacting theory of spin-s fields. An ansatz for spin-s operators in the σ model is given and the equivalence of the correlation functions shown. The relation between topological and Noether currents is shown. The Lorentz and discrete transformation properties of the spin-s operator from the fields of the σ model have been obtained.

The Maxwell Chern Simons(MCS) theory and Maxwell Lagrangians on a disk D were studied. They are of interest for the quantum Hall effect, and also when the disk and its exterior are composed of different media. It is shown that quantization is not unique, but depends on a nonnegative parameter λ where $1/\lambda$ is the penetration depth. For $\lambda = 0$, there are edge observables and edge states localized at the boundary ∂D for the MCS system. They describe the affine Lie group $\tilde{L}U(1)$. The MCS theory for $\lambda = 0$ has the huge symmetry group $\tilde{L}U(1) \times U(\infty)$. All these degeneracies are lifted and edge observables and their states cease to exist for $\lambda > 0$.

The partition function of the discretized superstring in a target superspace of three (Euclidean) bosonic dimensions, is shown, for a fixed triangulation of the random world sheet, to be derived from the partition function of a discretized bosonic string with an external field present in the action in the form of a specific constant matrix, using first order forms of the actions.

The contribution of electromagnetic charge-monopole interactions to the scattering of two point-like particles at center of mass energies of the order of the Planck scale, and very low momentum transfer, is shown to be comparable to that due to the gravitational interactions. The poles in the scattering amplitude are shown to be equally spaced with 'spin' values shifted by half-odd integers compared to the charge-charge scattering case.

Assuming the existence of an absolute lower bound on the lattice string tension, given in terms of the inverse string coupling, this bound is shown to be lower for a superstring in a superspace with three bosonic directions, than the corresponding bosonic case. The validity of the geometrical arguments leading to this bound in the bosonic case are re-examined for the superstring, and found to be suspect.

In view of the recent KARMEN experiment showing the neutrino neutral current excitation of $^{12}C(1^+; 15.1 MeV)$ for the first time, the earlier results are extended to low neutrino energies. The neutrino flux averaged cross sections are evaluated and are found to be in agreement with the KARMEN data. The effect of isospin mixing, induced weak magnetism and axial coupling are studied. A method to examine the extent (quantitative) of isospin mixing in ^{12}C is suggested.

Certain aspects of dilaton gravity and black holes in string theory are being studied.

Techniques for constructing the dual form of the partition function of theories with a non-Abelian symmetry are developed. A close relation between the dual form of 3-dimensional SU(2) pure lattice gauge theory and the Ponzano-Regge model of gravity is pointed out and explained.

There is interest in tests of the electroweak vector boson self interactions. Of particular significance are anomalous CP violating (CPV) gauge boson self interactions. If

CPV is to originate through the symmetry breaking sector, it would give rise to electric dipole/magnetic quadrupole moment of the W boson. Traditionally, each of the two CPV moments have been constrained by the neutron dipole moment $b \to s\gamma$ and $b \to se^+e^-$ have been used well to constrain both these moments. Another necessary test of such a scenario for CPV is compatibility of these moments with the CKM matrix. The elements of the CKM matrix have been related to these moments and bounds on these anomalous CPV couplings. have been obtained LEP I results are also being used to constrain anomalous WWZ CPV coupling using $\Gamma(Z \to b\bar{b})$. We are also examining for NLC the process $e^+e^- \to l_1^- \bar{\nu}_{l_1} l_2^+ \nu_{l_2}$, where l_1, l_2 are either of the three leptons e, μ or τ, with regard to measuring the internal properties of the W boson, and estimating the two CP violating terms. In addition to the above there is also interest in examining failure of the equivalent photon approximation, for production of massive spin one vector bosons pairs, eg. in $e^+e^- \to e^+e^-W^+W^-$. Previous calculations confirmed a calculation in literature and extended it to include nonstandard $WW\gamma$ couplings. At the moment the calculations are being extended to include the complete $SU(2) \times U(1)$ gauge invariant set of Feynman diagrams.

A rotating charged black string solution in the low energy effective field theory describing five dimensional heterotic string theory is constructed. This solution is labelled by mass, electric charge, axion charge and angular momentum per unit length. The extremal limit of this solution is also discussed.

New duality transformations have been obtained relating some exact string backgrounds, by defining the nilpotent duality. As is shown that the ungauged $SL(2,R)$ WZW model transforms by its action into the three dimensional plane wave geometry. Also, the inverse transformation from the plane wave to the $SL(2,R)$ model has been given and discuss the implications of the results have been discussed.

Within the supersymmetric $SO(10)$, a new mechanism is proposed for generating light neutrinos needed for the solution of the solar neutrino and the dark matter puzzles. A mass ratio of 10 - 50 between the intermediate scale M_I and the GUT scale M_{GUT} induces right-handed Majorana mass 3 - 4 orders smaller than M_{GUT} leading to the required neutrino masses.

It has been shown, using methods based on Ward Identities, Schwinger-Dyson equations and Renormalization Group analysis, that longitudinal susceptibility in the broken phase diverges due to the fluctuations(infrared) in the Goldstone mode.

An important reformulation of lattice gauge theories in 2+1 dimensions was given sometime ago by Anishetty and Sharatchandra. Now algorithms have been developed for a numerical simulation of this approach. The simulation involves the challenging problem of Markov moves on constrained surfaces. The programs are currently being run for SU(2) theories.

The problem of chiral order parameter within quenched QCD has been analysed. It is found that the chiral order parameter is singular in the chiral limit.

Condensed Matter Physics

Physical arguments as well as numerical evidence are presented to show that the Cooper pair (gap) function vanishes on the Fermi surface in strongly correlated electron systems such as t-J and large U Hubbard models in one and two dimensions; in addition, in two dimensions the gap has s-symmetry. Using exact diagonalization, correlation function has been studied which is a measure of the gap function even in a finite system, and present numerical results for this correlation function on small clusters of 8 (Hubbard) and 16 $(t-J)$ sites.

The results of an extensive numerical study of strongly correlated systems using exact diagonalization techniques. have been presented in particular, the results of studies on finite clusters for the Wheatley–Hsu–Anderson interlayer tunneling mechanism for superconductivity, odd–pairing in $t-J$ and Hubbard models and various other related matters have been presented.

The study of persistent current in a mesoscopic ring is a very active area of research where a major question is how the impurity-interaction and the electron-electron interaction affect the persistent current. A model has been developed where these questions can be answered quantitatively. The results are in agreement with some recent theoretical studies by other groups. Currently this work is being extended to include impurity interactions, spin degrees of freedom of electrons, etc.

The study of quantum dots in the range of magnetic fields and densities where the fractional quantum Hall effect sets in, is a very active area of research. There has been work on that problem and also on other aspects of quantum dots like the energy spectra for anisotropic dots.

A theory has been developed for studying the collective excitations in multilayer electron systems using the Jastrow variational approach. The numerical results when compared with other established methods, clearly show the accuracy of our approach. The aim is to apply this method to quantum wire superlattices where there are several experimental results available, but no reliable theory as yet. Work is also in progress on the fractional quantum Hall effect in a double-layer system.

The 'jamming limits' and the distribution of gaps of exact sizes are deduced for the case of random sequential multilayer deposition of different sized K-mers on a 1-D infinite substrate.

A new long range order in Spin-compensated fractional quantum Hall state is predicted. Experimental consequences are also discussed.

The anomalous NMR relaxation in the normal state of HTSC material is explained by a novel Spinon pair emission mechanism. The long standing controversy of the failure of Fermi liquid theory in 2-d Hubbard model in 2-d is addressed. A subtle signal from perturbation theory has been found, which indicates the failure. A striking behaviour has been shown in the vanishing of the superconducting order parameter on the fermi surface as a consequence of strong correlation using analytical as well as numerical approach. An exactly solvable model (introduced by G.Baskaran in 1991) has been studied and is shown to exhibit interlayer pair tunneling mechanism of superconductivity by exact calculation of two particle Green's functions.

Optics and Electron Optics

The problem of coherent mode decomposition for the ten parameter family of anisotropic Gaussian Schell-model beam is completely solved, taking advantage of the $Sp(4,R)$ dynamical symmetry underlying the problem and by exploiting the Iwasawa decomposition applicable to noncompact semisimple groups and the Williamson canonical form for symmetric matrices under symmetric symplectic transformations. A universal feature of the eigenvalue spectrum of this family is established.

An $U(2)$-invariant classification scheme for squeezing transformations in two-mode systems is developed and the canonical forms for these transformations are identified, taking advantage of the connection between the symplectic group $Sp(4,R)$ and the pseudo-orthogonal group $SO(3,2)$.

The geometric phase associated with the unitary representations of the group $SU(3)$ is analysed, using the recently developed quantum kinematic approach to geometric phases. The manifold structures of $SU(3)$ and $SU(3)/Z_3$, the Lie subgroups of $SU(3)$ upto conjugation, the descent from $SU(3)$ to the corresponding coset spaces and the Maurer-Cartan one-forms over $SU(3)$ along with their behaviour under pullback to the coset spaces play an important role in the analysis. The three-level system is treated as a physical application.

The normal (canonical) form for Mueller matrices in polarization optics was derived. It was shown that a non-singular real 4×4 matrix M qualifies to be the bonafide Mueller matrix of some physical system if and only if it has the canonical form $M = L' \wedge L$, where L and L' are elements of the proper orthochronous Lorentz group $L_+^\uparrow$ and $\Lambda = \text{diag}\ (\lambda_o, \lambda_1, \lambda_2, \lambda_3)$ where $\lambda_o \geq |\lambda_i| > 0$. It is further shown that λ_1, λ_2 can be taken to be positive so that the signature of λ_3 is the same as that of $\det M$. Several experimentally measured Mueller matrices are analyzed in the light of the normal form. The case of singular matrices was also briefly analyzed.

Having formulated an input - output theory for linear, dispersive, lossy dielectric media, the radiation pressure force acting on a single plate and between two parallel plates when finite bandwidth squeezed light is input at one of the ports are calculated. The second result generalizes the usual Casimir force between two plates in vacuum. Numerical studies were also done.

An instructive relationship between the kernel of Fractional Fourier Transform (FracFT), which has recently received the attention of several optics scientists, and the harmonic oscillator Green's function is exhibited. Taking advantage of the Iwasawa decomposition, a simple optical way of realizing FracFT through free propagation is shown. In particular, it is shown that FracFT is for Fresnel (near-zone) diffraction exactly what the conventional Fourier transform is for Fraunhofer (far-zone) diffraction. FracFT promises to play an important role in optical communication and information processing.

Optics of the transport of nonrelativistic and relativistic charged particle beams through electromagnetic systems (of importance for charged particle beam devices, like electron microscopy, microelectron beam lithography, etc, and accelerator design) is being analysed systematically on the basis of quantum mechanics.

Mathematics

Complex Analysis

A conjecture of Hall for star-like mappings of order 1/2 has been settled.

A necessary condition for the existence of the angular derivative for a class of strip domains defined by Rodin and Warchawski has been obtained.

A generalization of the complementary form of Ahlfors' defect relation has been proved for quasimeromorphic maps.

Differential Equations

Various questions relating to functional differential equations of the type

$$u'(t) = f(t, u(t), u(pt), u'(qt))$$

for $p, q > 0$ have been investigated. When $p, q < 1$, it has been proved that there exists a local solution which either can be extended globally or blows up in finite time. Sufficient conditions for the stability of solutions are also obtained.

As an application of a fixed point theorem, sufficient conditions for the existence of solutions vanishing at infinity have been obtained for a special case.

Isoperimetric inequalities for solutions of second order elliptic equations have been studied. It has been shown that the extreme case occurs only when the domain is a ball by a new approach bypassing the use of the classical isoperimetric theorem. This paves a way for the understanding of the inter- relationships between certain important results in symmetrization.

The homogenization of an optimal control problem in which both the state equation and the cost functional involve rapidly oscillating coefficients has been studied and properties of the limiting operator have been obtained.

Geometry

New results describing rank 2 bundles on a Riemann surface having more than one twisted endomorphism have been obtained.

The Polyakov volume form can be given a purely complex geometrical description. This corresponds to the presence of Mumford isomorphisms between the $13th$ tensor power of the Hodge line bundle with the canonical bundle over the moduli space of Riemann surfaces of genus g. Using certain inductive limits of finite dimensional Teichmüller spaces, these constructions have been done for non-perturbative string theory in a genus independent fashion over some universal Teichmüller spaces.

The characterization of the universal Schottky locus, namely, the image of the universal period mapping (within the universal Siegel space), has been investigated using the methods of quantum calculus of Connes.

Harmonic Analysis

Results were obtained on the characterization of the class of multipliers $M(S(G), L^p(G))$ where G is a compact abelian group and $S(G)$ is a Segal algebra contained in $L^p(G), 1 < p < \infty$. When $S(G)$ is contained in $A^p(G)$, the space of functions in $L^1(G)$ such that the $p-th$ powers of their Fourier transforms are integrable, the space of multipliers is identified as the dual of a concrete function space. The completion of this function space has also been identified as a Banach space of continuous functions.

A vector version of the result on the characterization of multipliers for the pair $(L^1(G, A), L^p(G, A))$, for $1 < p < \infty, G$ being a locally compact abelian group and A a commutative Banach algebra with bounded approximate identity, has also been obtained.

Number Theory

The investigations on the number of zeros of a generalized Dirichlet series (in particular $\zeta(s)-a$) and the mean square lower bound for a generalized Dirichlet series were continued.

Using Baker's theory of linear forms, the question whether a large subset of a set of consecutive integers can be a square has been discussed.

Using elementary methods, the finiteness of the solutions, for fixed k, of the equation

$$f(x+1)...f(x+k) = f(y+1)...f(y+mk)$$

has been proved.

The idea of the Huxley-Hooley contour developed by Ramachandra has been used to estimate certain number theoretic functions.

An asymptotic formula for the number of primitive roots of a prime has been obtained.

The problem of Galois module structure (*i.e.* the problem of determining the structure ring of integers of L as an A-module, where L is an extension of a field K and A is its associated order) has been solved for practically all abelian extensions of rationals and Gaussian integers of degree atmost 4.

Operator Theory

The problem of inverse spectral theory for a Jacobi matrix was studied and the almost periodicity of a class of random Jacobi matrices was proved.

Theoretical Computer Science

Complexity

Reducibility of several intractable complexity classes to sparse sets has been studied. For various deterministic and randomized reductions, collapse results have been obtained as consequences. Currently, these remain the best known collapse results.

Investigating a new notion of sets with low information content, it has been proved that sets with Kolmogorov random characteristic sequences are of low information content in precisely the same sense as sparse sets are.

It has been shown that p-selective sets cannot be hard for various intractable complexity classes like NP under quasi-linear truth-table reductions unless the class itself collapses to P. This solves a ten-year-old open question concerning p-selective sets.

Time-varying cellular automata (CA) have been introduced and interpreted variously to give the computation a nondeterministic, probabilistic or alternating flavour. The complexity of language classes obtained by applying language operators to standard CA language classes has been studied.

Studying properties of counting classes, it has been shown that the closure under subtraction of Span functions coincides exactly with the closure under subtraction of $\#P^{NP}$. A new characterization of $\mathrm{Mod}_k\mathrm{P}$ has been obtained, and a promise version used to neatly characterize the intersections of $\mathrm{Mod}_k\mathrm{P}$ classes. These results translate to the generalized Mod setting considering the disjunctive and conjunctive truth-table closures of ModP.

Sufficient conditions have been obtained for feasible depth reduction and parallelization in the presence of non-commutative operators. A generalization of the notion of left-skewness has been proposed. These generalizations form a proper hierarchy.

Interactive proofs have been studied, showing a logspace reduction from NC to languages accepted with polylog rounds of interaction by a logspace verifier.

Algorithms

Structural and Algorithmic research has been continuing on finding special structures in tournaments. Optimal sequential and parallel algorithms have been found for finding Hamiltonian cycles, Hamiltonian paths starting at a given vertex and finding an s-t path. Investigations continue for realizing and finding generalized Hamiltonian paths in general tournaments. Tight upper and lower bounds have been obtained for finding scores in tournaments.

Work is also underway in improving algorithmic bounds on constructing optimal binary search trees and alphabetic trees.

Some generalized notions of persistence of data structures, with applications to the design of efficient hidden surface elimination algorithms, are being studied.

Concurrency

A model of Knowledge Transition Systems (KTS) has been defined to capture the effect of agents' actions on their states of knowledge. A back-and-forth relationship has been established between KTSs and $ACSA$s, the model of systems of asynchronously communicating sequential agents studied earlier. This demonstrates a certain duality between the notion of knowledge in distributed systems and that of partially ordered event occurrences.

The study of tense logics for systems of communicating sequential agents continues.

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Kesavan,S., and Pacella,F.*
Symmetry of positive solutions of a quasilinear elliptic equation via isoperimetric inequalities,
Applicable Analysis (to appear).

Kesavan,S.
Comparison theorems via Schwarz symmetrization – A survey,
Proc. Int. Conf. on *Partial Differential Equations of Elliptic Type*,
Cortona, Italy, 1992,
Cambridge University Press (to appear).

Kesavan,S.
Comparison theorems via symmetrization-revisited,
Preprint IMSc-93/48.

Kesavan,S. and Saint Jean Paulin,J.*
Homogenization of an optimal control problem,
Département de Mathématiques,Université de Metz,
Metz, France (1994) Preprint.

Krishna,M.
Absolutely continuous spectrum for sparse potentials,
Proc. Ind. Acad. Sci. Math. Sci. **103** (1993) 333-339.

Nag,S. and Sankaran,P.*
Open String Diagrams I: Topological type,
J. Math. Phys. **34** (1993) 4562-4574.

Nag,S.
On the Tangent Space to the Universal Teichmüller Space,
Annales Acad. Scient. Fennicae **18** (1993) 377-393.

Nag,S.
Riemann Surfaces and their Jacobians: a Toolkit,
Indian J. Pure Appl. Math. **24** (1993) 729-745.

Nag, S and Sullivan, Dennis*
Teichmüller theory and the universal period mapping via
quantum calculus and the $H^{1/2}$ space of the circle,
Osaka Jour. of Math. (submitted by invitation of the Editors)
to appear.

Nag,S.
$Diff(S^1)$, Teichmüller space and period matrices :
Canonical Mappings via String Theory, *invited survey paper*,
Revue Roumaine Math., Proc. Int. Conf. Complex Analysis,
Europe 1993, Ed. C.A. Cazacu, et al (to appear).

Nag,S.
Conformally Natural Reflections and cross sections over Teichmüller spaces,
Abstracts of Colloquia in Mathematics,
Kyoto University (1993) 34-35.

Nag,S. **Biswas**,Indranil* **and Sullivan**,Dennis*
Universal Hodge bundle and Mumford Isomorphisms on the
Teichmüller space of the universal abelian lamination,
ICTP Preprint.IC 94/115.

Nagaraj,D.S. and Aithal,A.R.*
Splitting types of holomorphic bundles associated to some harmonic maps,
Comm. in Algebra **21** (1993) 3727-3731.

Nagaraj,D.S. and Ramanan,S.*
Polarisation of type (1,2,....,2) on Abelian Varieties.
Preprint.

Nagaraj,D.S. and Fatima,Laytimi*
Connectedness of trisecant curves,
Preprint.

Radha,R. and Unni,K.R.
Multipliers and $A^p(G)$-Algebras
Acta. Sci. Math. (to appear).

Radha,R. and Unni,K.R.
The Class of Multipliers $M(S(G), L^p(G))$
Vikram Math. J. (to appear).

Radha,R. and Unni,K.R.
Characterizations of the Multipliers for the Class $(L^1(G,A), L^p(G,A))$
Preprint IMSc (Submitted for Publication).

Sastry,Swati
Existence of Angular Derivative for a class of strip Domains
Proc. of the AMS (to appear).

Sastry,Swati
A Complementary form of the defect relation
Ann. Academiae Scientiarum Fernical (to appear).

Sengadir,T.
Existence of Solutions Vanishing at Infinity to Functional
Differential Equations,
J. Differential Equations (submitted).

Sengadir,T.
Existence and Stability of Non-linear Pantograph Equations,
J. Math. Anal. Appl. (submitted).

Srikanth,P.N. and Ruf,B.*
On periodic motion of Lattices of Toda type via critical point theory,
Arch. Rat. Mech. and Any.(to appear).

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* External collaborator.

Theoretical Computer Science

Arvind,V., Köbler,J.* and Mundhenk,M.*
Hausdorff reductions to sparse sets and to sets of high information content,
Proc. 18th Conf. Math. Foundations of Computer Science,
LNCS, Springer Verlag, **711** (1993) 232–241.

Agrawal,M.* and Arvind,V.
Polynomial-time truth-table reductions to p-selective sets.
Proc. of Nineth Annual Structure in Complexity Theory Conference,
IEEE Society, June 1994.

Arvind,V., Köbler,J.*and Mundhenk,M.*
Monotonous and randomized reductions to sparse sets,
Informatique Theorique et Applications Journal (submitted).

Arvind,V., Köbler,J.*and Mundhenk,M.*
Upper bounds for the complexity of sparse and tally descriptions,
Mathematical Systems Theory (1994).

Arvind,V., Köbler,J.*and Mundhenk,M.*
On reductions to sets of high information density,
Theoretical Computer Science (submitted).

Arvind,V., Han,Y.*, Hemachandra,L.*, Köbler,J.*, Lozano,A.*, Mundhenk, M.*, Ogiwara,M.*, Schöning,U.*, Silvestri,R.*and Thierauf,T.*
Reductions to sets of low information content,
Complexity Theory, Current Research,
Cambridge University Press (1993) 1–45.

Balasubramanian,R., Venkatesh Raman and Srinivasaraghavan,G.
The Complexity of Finding Certain Trees in Tournaments,
Proc. of the Third Workshop on Algorithms and Data Structures,
LNCS **709** (1993) 142–150.

Krasucki,P.*and Ramanujam,R.
Knowledge and the ordering of events in distributed systems,
Theoretical Aspects of Reasoning About Knowledge, Ed. R.Fagin,
Proc. Fifth Conf., Morgan Kaufmann,
San Francisco (1994) pp.267–283.

Lodaya,K., Ramanujam,R. and Thiagarajan,P.S.*
Decidability of a partial order based temporal logic,
ICALP 93, LNCS **700** (1993) 582–592.

Lodaya,K., Parikh,R.*, Ramanujam,R. and Thiagarajan,P.S.*
A logical study of distributed transition systems,
Information & Computation (1994) to appear.

Krithivasan,K.*and Mahajan,M.
Nondeterministic, probabilistic and alternating computations
on cellular array models,
Preliminary version presented at the
Developments in Language Theory Conference,
Turku, Finland, 12–15 July 1993 and TCS (to appear).

Mahajan,M. and Krithivasan,K.*
Languages classes defined by time-bounded relativised cellular automata,
R.A.I.R.O. Theoretical Informatics and Appl., **27** (1993) 403–432.

Mahajan,M. and Krithivasan,K.*
Language operations on cellular automata classes,
J. Math. Phy. Sci. **27** (1993).

Mahajan,M., Thierauf, Thomas*and **Vinodchandran, N.V.***
A note on Span P functions,
Information Processing Letters **51** (1994) 7 - 10.

Mahajan,M. and Vinay,V.
Skew circuits and non-commutative computation,
Preprint IMSc-94/09.

Srinivasaraghavan,G. and Mukhopadhyay,A.*
Stabbing Simple Planar Sets,
Proc. Third Natl. Seminar on TCS (1993) 223–232.

Srinivasaraghavan,G. and Mukhopadhyay,A.*
A Note on the Notion of *Completeness* for Reconstruction Algorithms on Visibility Graphs,
Proc. Fifth Canadian Conf. on Comp. Geometry (1993) 315–320.

Venkatesh Raman and Srinivasaraghavan,G.
Hamiltonian Cycles, Restricted Hamiltonian Paths and s-t Paths in Tournaments : Optimal Sequential and Parallel Algorithms,
Submitted.

Vinodchandran,N.V.*, Krithivasan,K.*and Mahajan,M.
On the structure within Mod classes,
Proc. Natl. Seminar on TCS, IIT Kharagpur (1993).

Vinodchandran,N.V.*and Mahajan,M.
A note on Mod and generalised Mod classes,
Preprint IMSc-94/08.

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* External collaborator

Visits to Institutions

Arvind,V.
Visiting Professor, Ulm university, Germany (June - July 1993).

Balakrishnan,Radha
Princeton University, Princeton, NJ, USA (14 - 17 Sept. 1993).
Centre de Recherches Mathematiques, Université de Montréal, Montréal, Canada (18 - 23 Sept. 1993).
Theoretical Division and Center for Nonlinear Studies, Los Alamos National Lab, Los Alamos, NM, USA (25 Sept. - 25 Nov. 1993).
University of California, Berkeley, USA (26 Nov. - 3 Dec. 1993).

Baskaran,G.
TIFR, Bombay (23 Feb. 1994).
Physics Department, Stanford University, Staford, CA, USA (10 Oct. - 13 Nov. 1993).
University of California, Berkeley, USA (26 Oct. 1993).
University of California, Los Angeles, USA (1,2 Nov. 1993).
IBM Lab, Yorktown Heights, USA (28 - 29 Oct. 1993).
Dept. of Theoretical Physics, University of Oxford, Oxford, England (14-18 Nov. 1993).
Cavendish Lab, Cambridge Unviesity, Cambridge, England (19 Nov. 1993).
ICTP, Trieste, Italy (1 June - 31 July 1993).
University of Salerno, Salerno, Italy (June 1993).
University of Naples, Naples, Italy (June 1993).

Govindarajan,T.R.
International Center for Theoretical Physics, Trieste, Italy (April - June 1993).
University of Bologna, Bologna, Italy (15 - 20 May 1993).
University of Genoa, Genoa, Italy (20 - 22 May 1993).
University of Barcelona, Barcelona, Spain (27 May - 3 June 1993).
University of Cochin, Cochin (15 - 22 Sept. 1993).
Institute of Physics, Bhubaneswar (27 Oct. - 4 Nov. 1993).

Tata Institute of Fundamental Research, Bombay (5 - 11 Jan. 1994).
Syracuse University, Syracuse, USA (14 March - 10 April 1994)

Hari Dass,N.D.
National Physical Laboratory, New Delhi (3 Nov.- 3 Dec. 1993).
IIT Kanpur (22 - 23 Nov. 1993).
Physical Research Laboratory, Ahmedabad (28 Feb. - 5 March 1994).
Tata Institute of Fundamental Research, Bombay (7 - 8 March 1994).

Jagannathan,R.
Department of Physics, Cochin University of Science and Technology, Kochi (July 12 - 16, 1993).
Department of Physics, Punjab University, Chandigarh (21 - 23 Feb. 1994).
Department of Physics, University of Mysore, Mysore (17 - 18 March 1994).

Kaul,R.K.
ICTP, Trieste, Italy (1 April - 18 May 1993).

Kesavan,S.
Université de Metz, Metz, France (1 - 31 Dec. 1993).

Maddaly, Krishna
Indian Statistical Institute, Bangalore (Oct. - Nov. 1993).

Mahajan, Meena
Abteilung für Theoretische Informatik, Universität Ulm, Ulm, Germany (28 - 30 June 1993).
Forschungsinstitut für Diskrete Mathematik, Universität Bonn, Bonn, Germany (1 - 3 July 1993).
Centre for Artificial Intelligence and Robotics, Bangalore (15 - 25 March 1994).

Mahapatra,Swapna
International Centre for Theoretical Physics, Trieste, Italy (16 April - 2 May 1993).
Institute of Physics, Bhubaneswar (6 Sept. - 8 Oct. 1993).
Mehta Research Institute, Allahabad (29 Oct.- 2 Nov., 8 - 14 Dec. 1993).

Majumdar, P.
Tata Institute of Fundamental Research, Bombay (15 Feb. - Mar. 7 1994).

Mishra, A.K.
Indian Institute of Science, Bangalore (14 - 15 July 1993).

Murthy, M.V.N.
Visiting Scientist, Dept. of Physics and Astronomy, McMaster Univ., Ontario, Canada (1 - 30 July 1993).
Visiting Scientist, Inst. for Theoretical Physics, Univ. of Regensburg, Regensburg, Germany (12 - 26 Oct. 1993).

Nag, Subhashis
Research Inst. of Math. Sciences, Kyoto University, Japan (30 Aug. - 10 Sept. 1993).
Visiting Scholar, University of Tokyo and Tokyo Inst. of Technology, Japan (10 - 23 Sept. 1993).
Visiting Professor, Osaka University and Osaka City University, Japan (23 - 30 Sept. 1993).
Tata Institute of Fundamental Research, Bombay (12 - 24 Dec. 1993).

Nagaraj,D.S.
Tata Institute of Fundamental Research, Bombay (13 - 25 Dec. 1993).

Parthasarathy,R.
Visiting Professor, Department of Physics, Simon Fraser University, Burnaby, Canada (15 May 1993 - 15 Aug. 1993).

Rahul Sinha
Physical Research Laboratory, Ahmedabad (Nov. 2 - 6 1993). Dept. of Physics and Astronomy, Delhi Univ.,Delhi (8 - 11 Nov. 1993) Dept. of Physics, Gauhati Univ. (14 -21 Nov. 1993)

Rajasekaran,G.
Mc Master University, Hamilton, Canada (14 June - 13 July 1993).
University of Toronto, Toronto, Canada (14 - 18 July 1993).
Syracuse Univ., Syracuse, USA (31 July - 9 Aug. 1993).
University of Rochester, Rochester, USA (16 - 18 Aug. 1993).
Mehta Research Institute, Allahabad (10 - 14 Oct. 1993).
CTS, Indian Institute of Science, Bangalore (10 Sept. 1993).
Raman Research Institute, Bangalore (23 Oct. 1993).
S.N. Bose National Centre for Basic Sciences, Calcutta (11 Feb. 1994).

Ramachandran,R.
Inter University Centre for Astronomy and Astrophysics, Pune
(27 June - 4 July 1993).
Indian Institute of Technology, Kanpur (11 - 17 Aug. 1993).
Indira Gandhi National Open University, New Delhi (18 Aug. 1993).
Manonmaniam Sundaranar University, Tirunelveli (13 - 14 Dec.1993).

Ramanujam,R.
Department of Computer Science, Graduate Center, City University of New York, USA (10 - 25 July 1993).
Department of Computer and Information Sciences, Rutgers University, Camden Campus, New Jersey, USA, (25 July - 31 Aug. 1993).
Institut National de Recherche en Informatique et en Automatique, Sophia Antipolis, France (5 - 25 Sept. 1993).

Rangarajan,S.K.
Department of Chemistry, Georgetown University, Washington D.C.
(15 Sept. - 15 Oct. 1993).

Ray,P.
Saha Institute of Nuclear Physics, Calcutta (1 - 9 Dec. 1993).

Sastry,Swati
T.I.F.R Centre and I.I.Sc, Bangalore (Jointly) (1 - 15 Sept. 1993).

Shankar,R.
Center for Theoretical Studies, IISc, Bangalore (May 1993).

Simon,R.
IGCAR, Kalpakkam (Dec. 1993).
American College, Madurai (March 1994).
S.N.Bose National Centre for Basic Sciences, Calcutta (March 1994).

Sridhar,R.
Cochin University of Science and Technology, Cochin
(14 - 19 Feb. 1994).

Srinivasa Rao,K.
Inter-University Center for Astronomy and Astrophysics, Pune
(25 April - 3 May 1993).
Center for Development of Advanced Computing, CDAC, Bangalore
(31 June 1993).
CTS, Indian Institute of Science, Bangalore (1 July 1993).
Educational Media Research Center, Madurai Kamaraj University, Madurai
(23 Aug. 1993, 15 - 16 Feb. 1994).
Department of Applied Mathematics and Computer Science, Univ. of Gent,
Gent, Belgium (1 Sept. - 30 Nov. 1993).
Department of Physics, University of Padova, Padova, Italy
(15 - 17 Nov. 1993).
Institute of Physics, Unviersity of Liege, Liege, Belgium (22 Nov. 1993).
Department of Physics, Calicut University, Calicut (26 - 31 Dec. 1993).
Institute of Physics, Bhubaneswar (22 - 25 Feb. 1994).
Department of Physics, Utkal Univesity, Bhubaneswar (24 Feb. 1994).
Department of Physics, University of Hyderabad (26 - 28 Feb. 1994).
Department of Physics, University of Delhi (1 - 4 Mar. 1994).
Department of Physics, IIT, Kanpur (5 - 8 Mar. 1994).

Uma Sankar,S.
CERN, Geneva, Switzerland (10 May - 15 July 1993).

Venkatesh Raman
University of Waterloo, Waterloo, Ontario, Canada (1 June - 13 Aug. 1993).
University of Western Ontario, Ontario, Canada (4 Aug. 1993).

Participation in Conferences

Anishetty, R.
Neural networks,
Indian Physics Association, (Madras Chapter) Kalpakkam.

Arvind,V.
Member, Programme Committee, National Seminar in TCS 1994.

Balakrishnan, Radha
"Space curve evolution, geometric phase and solitons",(Invited talk).
9th Int. Workshop NEEDS 93 on
Nonlinear EvolutionEquations and Dynamical Systems,
Gallipoli, Lecce, Italy, 3 - 12 Sept. 1993.
"Role of Computation in Nonlinear Dynamics",(Invited talk).
IPA Seminar on Computational Physics,IGCAR, Kalpakkam,
17 - 18 March 1994.
"Local geometric phase intrinsic to solitonevolution",(Invited talk).
National Seminar on Computational aspects of Chaos and Nonlinear
Dynamics, Cochin, 21 - 25 March 1994.

Balasubramanian, R.
Conf. on "Algebra and Graph Theory",(2 lectures).
Manonmaniam University, Tirunelveli, 4 - 6 March 1994.

Baskaran, G.
"K-Space Fauge Fields & Failure of Fermi-liquid Theory in 2-D",
(Invited talk), Nato ARW Conference on
"The Physics & Mathematical Physics of the Hubbard Model",
Sansebastian, Spain, 7 - 9 October 1993.
"RVB Theory & Beyond",(four lectures).
Workshop on Highly Correlated Electronic Systems & Electron
Localisation Effects, Indore, 21 - 31 March 1994.

Basu, Rahul
Int. Conf. on Non-accelerator Particle Physics 1994 (ICNAPP '94),
Indian Institute of Astrophysics, Bangalore, 2 - 9 January 1994.

Chakraborthy, Tapash
"Physics of the Fractional Quantum Hall Dots", (Invited talk).
DAE Solid State Physics Symposium, BARC, Bombay, 1993.
"Physics of Low-Dimensional Electron Systems",(4 lectures).
Workshop on Highly Correlated Electron Systems, Inter Univ.
Consortium for DAE facilities, Indore, 21 - 31 March 1994.

Das, Saurya
IX SERC school in High Energy Physics, Guwahati, 1 - 27 Nov. 1993.
Int. Coll. in Modern Quantum Field Theory,
TIFR, Bombay, 5 - 12 Jan. 1994.

Govindarajan, T.R.
Spring School on Strings and 2d Gravity,
ICTP, Trieste, Italy.
International Colloquium,
TIFR, Bombay, 5 - 11 Jan. 1994.

Hari Dass, N.D.
"Computational Techniques in Lattice Gauge Theories",(Invited talk)
and Chairman of the Panel Discussion on the "Computing Needs
of the Physics Community",
IPA Seminar on Computational Physics, IGCAR, Kalpakkam,
17 - 18 March 1994.

Jagannathan, R.
"Coherent states of generalized boson oscillators",(Invited talk).
Workshop on "Coherent states, New developments and Perspectives",
School of Phys., Univ. of Hyderabad,Hyderabad, 29 - 31 Oct.1993.
"Possible relevance of quantum algebras for theory of radiation",
(Invited talk), Discussion Meeting on
"Nonclassical aspects of radiation",
Jawaharlal Nehru Centre for Advanced Scientific Research,
Bangalore, 10 - 12 Jan. 1994.

Jayaraman,T.
"Operators correlation functions and multicritical flows in $C < 1$
string theory",(Invited talk).
Int. Coll. on Modern Quantum Field Theory, Bombay, Jan. 1994.

Kaul, R.K.

"Knot invariants from quantum filed theories",(Invited talk).
Int. Coll. on Modern Quantum Field Theory, Bombay, Jan. 1994.
WHEPP, Madras, Jan. 1994.

Kesavan, S.

"Spectral Theory of Laplacians",(3 Thematic lectures).
Ann. Meeting of the Ramanujan Math. Soc.,
Sri Venkateswara University, Tirupati, 24 - 26 June 1993.
"Weak Solutions of Partial Differential Equations",(3 lectures) and
"Talenti's Theorem and Applications",(3 lectures).
Resource Person to the Summer School on Geometric Measure Theory and Second Order Partial Differential Equations (sponsored by the DST), TIFR - IISc Programme,IISc.,Bangalore, 5 - 9 July 1993.
"Variational Methods for Nonlinear Problems",(Invited talk).
Seminar on Recent Trends in Mathematics, Racine Research Centre, Loyola College, 25 Feb. 1994.

Khan, S.A

The CERN Accelerator School : Phys. & Engg. for Particle Accelerators, Centre for Advanced Technology, Indore, 7 - 16 Nov. 1993.
"Theory of relativistic electron beam transport based on the Dirac equation", (Poster presentation),
3rd National Seminar on Physics and Technology of Particle Accelaerators and their Applications, (PATPAA-93),
IUC - DAEF, Calcutta, 25 -27 Nov. 1993.
"Quantum mechanics of charged particle beam optics :
An operator approach",
JSPS-KEK International Spring School : High Energy Ion Beams - Fuji Inst. of Training and Education, 17 -24 March 1993.
Novel Beam Techniques and their Applications, held in Japan at :
Inst. of Nuclear Study (INS), 25 March 1993,
Inst. of Physical and Chemical Research (RICKEN),26 March 1993.
National Lab. for High Energy Physics (KEK), 27 - 29 March 1993,

Lodaya, Kamal

Models for concurrency and communication,(2 lectures) and session Chairman, 3rd National Seminar on TCS, Kharagpur, June 1993.

Maddaly, Krishna

"On random Jacobi matrices",(Invited talk).
Conf. on Harmonic Analysis, IIT Bombay, 11 - 13 Feb. 1994.
Organized (with Prof.K.B.Sinha) Workshop on the "Spectral and inverse spectral theories", Kodaikkanal, 24 - 30 Aug. 1993.

Mahajan, Meena.
International Colloquium on Automata, Languages and Computing,
University of Lund, Sweden, 5 - 9 July 1993.
"Nondeterministic, probabilistic and alternating computations on
cellular array models"(contributed paper).
Developments in Language Theory,
University of Turku, Finland, 12 - 15 July 1993.
Foundations of Software Technology and Theoretical Computer Science,
Indian Institute of Technology, Bombay, 15 - 17 December 1993.

Mahapatra, Swapna
Spring school on Strings and Gravity at International Centre for theoretical
Physics, Trieste, Italy, 17 - 29 April 1993.
II Int. Coll. in Modern quantum field theory, TIFR, Bombay,
5 - 11 Jan. 1994.

Majumdar, Partha
"A Look at the Discretized Superstring Using Random Matrices",
(Invited talk), II Int. Coll. in Quantum Field Theory,
TIFR, Bombay, 5 - 11 Jan. 1994.

Mallick, Basu,B.
II Int. Coll. in Quantum Field Theory, TIFR, Bombay,
5 - 11 Jan. 1994.

Mishra,A.K.
Theory of Electron-Transfer Reactions,
National Symp. on Electrochemical Science and Technology,
Bangalore, 15 July 1993.

Murthy, M.V.N.
"Classical and Quantum Mechanics of Anyons", (Invited talk),
"Effect of flux line on billiards", (Invited talk),
Workshop on Manifestations of Classical Orbits in Quantum Systems,
Regensburg University, 20 - 22 Oct. 1993.

Nag, Subhashis
"Period Matrices for Universal Teichmüller space and string theory",
(Plenary Lecturer sponsored by the International Mathematical Union)
and Chairman of a plenary session on 25 Aug. 1993, in the
Int. Conf. on Complex Analysis and VII Romanian-Finnish Seminar,
Timisoara, August 23 - 27, 1993.

"Universal Moduli spaces and String Theory",
(Invited Main Lecture, 2 hours).
Math. Soc. of Japan Int. Res. Inst. on the"Topology of the moduli space of curves", RIMS, Kyoto, 1 - 9 Sept. 1993.
"Universal period matrices, Diff S^1, and String Theory",
(Special invited speaker).
Ann. Conf. of the Math. Soc. of Japan, Osaka, 27 - 30 Sept. 1993.
Invited organizing committee member of the Madras section,
Int. Conf. on "Vector Bundles on Curves : New Directions",
TIFR, Bombay - Matscience, Madras, 13 - 29 Dec. 1993.

Nagaraj,D.S.
Int. Conf. on "Vector Bundles on Curves : New Directions",
TIFR, Bombay, 13 - 25 Dec. 1993.

Parthasarathy, R.
"Quenching of g_A in nuclear medium using QCD sum rules",(Invited talk).
CAP Summer Institute, Queen's University, Canada, 25 July 1993.

Radha,R.
"4th Discussion meeting on Harmonic Analysis",
I.I.T Bombay, 11 - 13 Feb. 1993.

Rajasekaran, G.
XVII Int. Symp. on Lepton-Photon Interactions,
Cornell Univ., USA, 10 - 15 Aug. 1993.
"Generalized Fock spaces and a unified formalism for multioscillator systems", (Invited talk) and chaired a session at the Conference in honour of Harish-Chandra,
Mehta Research Institute, Allahabad, 10 - 14 Oct. 1993.
Annual General Meeting of the Indian National Science Academy,
Delhi, 15 Oct. 1993.
Chaired a session and gave a talk in the Second Meeting on Future High Energy Physics Experimentation in India,
TIFR, Bombay, 16 Nov. 1993.
"Generalized Quantum Statistics",(Invited talk)
Int. Conf. on Bose and 20th Century Physics,
S.N. Bose Centre, Calcutta, 30 Dec. 1993 - 1 Jan. 1994.
"Is there a future for High Energy Physics",(Invited talk)
and a member of the National Programme Committee for the International Conference on Nonaccelerator Particle Physics,
Indian Institute of Astrophysics, Bangalore, 2 - 4 Jan. 1994.

"Generalized Fock spaces",(Invited talk).
Int. Coll. on Modern Quantum Field Theory II,
TIFR, Bombay, 5 - 8 Jan. 1994.
Contributed to the research activities in two of the Working Groups,
Chaired a session and Member, National Org. Committee,
Workshop on High Energy Physics III, IMSc, Madras,
10 - 22 Jan. 1994.
India–CERN Meeting regarding participation in LHC,
TIFR, Bombay, 7 - 9 March 1994.
Organizing committee Member, speaker in the inaugural session and chaired a session in the IPA Seminar on Computational Physics, IGCAR, Kalpakkam, 17 - 18 March 1994.

Ramachandran, R.
Congress on Traditional Sciences & Technologies of India -
Preparatory Meeting at Madras, June 12 - 13, 1993.
"School Curriculum - Load Shedding",(seminar),
by BANYAN Centre for Educators at Max-Muller Bhavan,
Madras, 25 Sept. 1993.
One-day seminar on Accelerator based High Energy Physics program,
TIFR, Bombay, 16 Nov. 1993.
Chair, National Organizing Committee,
Workshop on High Energy Particle Physics (WHEPP-3),
IMSc., Madras, 10 - 22 Jan. 1994.
"Contributions of Satyendra Nath Bose", (inaugural Session Speaker),
All India People Science Congress, Hyderabad, 23 - 25 Feb. 1994.
Inaugural Speaker,
IPA Seminar on Computational Physics, IGCAR, Kalpakkam,
17 - 18 March 1994.

Ramadevi,P.
Int. Coll. in Modern Quantum Field Theory,
TIFR, Bombay, 5 - 12 Jan. 1994.

Ramanujam, R.
"Decidability of a partial order based temporal logic",
(Contributed paper with Kamal Lodaya and P S Thiagarajan).
ICALP 93, Lund University, Sweden, 5 - 9 July 1993.
Chaired a session on Concurrency Theory.
FST & TCS 94, IIT, Bombay, 15 - 17 Dec. 1993.

Rangarajan, S.K.

ISE meeting, Berlin, 5 - 10 Sept. 1993.

"New results in the multicomponent nucleation and growth",(Invited talk), and Organiser - Indo-German seminar on electrochemistry, Duisburg, Germany, 12 - 15 Sept. 1993.

Invited as a Fellow of TWAS, Gen. Meeting of the Third World Academy of Sciences, Trieste, Italy, 1 - 4 Nov. 1993.

Ray, P.

"Dynamics of Fracture",(Invited talk), Workshop on Nonlinearity and Breakdown in Soft Condensed Matter, SINP, Calcutta, 1 - 9 Dec. 1993.

Selvadoray, Mary

"Photon number distribution in two mode squeezed coherent states with complex squeezed and displacement parameters", Discussion meeting on Non-classical Aspects of Radiation, IISc, Bangalore, 10 - 12 Jan. 1994).

"Effect of squeezing of vacuum fluctuations on casimir forces", (poster with M.Sanjay Kumar), School in modern optics and recent advances in Quantum Optics, CAT, Indore, 3 - 10 Mar. 1994.

Sengadir,T.

IISc-TIFR Summer School on Geometic measure theory and applications to Second order partial differential equations, Indian Institute of Science, Bangalore, 28 June - 16 July 1993.

Shankar,R.

"FQHE physics in relativistic field theories",(Invited talk), Colloquium on Modern Field Theory, TIFR , Bombay, Jan. 1994.

Simon,R.

"Bose relations and their symmetries : structure and applications", (Invited talk), and Member, Advisory Committee, Bose and Twentienth Century Physics, S.N. Bose Centenary Conference, 30 Dec. 1993 - 5 Jan. 1994.

"Nonclassical states and local conditions on the photon distribution", (Invited talk), and Co-convenor for the Discussion meeting on "Non-classical Aspects of Radiation", Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, 10 - 12 Jan. 1994.

"Emerging trends in Modern Optics",(Invited talk),
National Laser Symposium, CAT, Indore, 29 Jan. - 2 Feb. 1994.
"New approach to Talbot self-imaging",(Invited talk),
XXI National Symp. of the Opt. Soc. of India, IIT, Madras,
10 - 12 Feb. 1994.

Sinha, Rahul
"Testing electroweak vector boson self interactions",(Invited talk).
Mini workshop in High Energy Physics,
PRL,Ahmedabad, 2 - 6 Nov. 1993.
"The triple gauge boson vertex and the moments of the boson",
(Invited talk), WHEPP-3, IMSc, Madras, 10 - 22 Jan.1994.

Sridhar, R.
"The pseudospin model of liquid ^4He",(Invited talk),
and Chaired a session in the Int. Symp. on Mathematical Physics,
Calcutta Math. Soc., Calcutta,
(during the birth Centenary of Prof.S.N.Bose.), 1 - 7 Jan. 1994.

Srinivasa Raghavan,G.
"Stabbing Simple Planar Sets",(contributed paper),
Natl. Seminar on TCS, I.I.T Kharagpur, June, 1993.
Participated in the Conf. on Foundations of Software Technology and
Theoretical Computer Science (FSTTCS), IIT, Bombay,
15 - 17 Dec. 1993.

Srinivasa Rao, K.
"Processor Farm Technique for parallel computation of Angular Momentum
coefficients and eigen values of regular Sturm - Liouville problems",
(Invited talk), First Indian Transputer Users' Group (ITUG),
CDAC, Pune, 13 - 15 Dec. 1993.
DAE Ann. Nucl. Phys. Symposium, Calicut University, 27 - 30 Dec. 1993.

"Recent Developments in Quantum Theory of Angular Momentum",
(Invited talk), and Convened and Conducted the one-day symp.
entitled "Perspectives in Theoretical Nuclear Physics",
in honour of late Prof.S.C.K.Nair, Calicut University,
Calicut, 31 Dec. 1993.

Subramoniam,G
"ICTP college on computational physics",
ICTP, Trieste, 17 May - 11 June 1993.

Swarup, K.M.
Winter School on Logic and Functional Programming,
ISI, Calcutta, 3 - 21 Jan. 1994.

Uma Sankar, S.
16th Lepton-Photon Symposium at Cornell University,
Ithaca, New York, 10 - 15 Aug. 1993.
Coordinated the activities of the phenomenology working group,
Mini-workshop on High Energy Physics, Physical Research Laboratory,
Ahmedabad, 2 - 6 Nov. 1993.
Coordinated the activities of the Heavy Flavour Theory working group,
3rd Workshop on High Energy Particle Physics (WHEPP-3),
IMSc, 10 - 22 Jan. 1994.
Discussion Meeting on Indian Participation in LHC,
TIFR, 7 - 9 March 1994.

Venkatesh Raman
"The Complexity of Finding Certain Trees in Tournaments",
(contributed paper), Third Workshop on
Algorithms and Data Structures,Montreal,Canada, 11 - 13 Aug.1993.
Canadian Conference on Computational Geometry,
Waterloo, Ontario, Canada, 5 - 9 Aug. 1993.

Books/Monographs

Perspectives in Theoretical Nuclear Physics,
Proc. of one-day Symposium in honour of Professor S.C.K. Nair,
Calicut University, Calicut, 31 Dec. 1993,
Edited by K.Srinivasa Rao and L.Satpathy,
Wiley - Eastern (1994) in press.

Stochastic Quantum Mechanics,
R.Vasudevan, sponsored by the Department of Science and Technology,
Government of India (to be completed).

Ph.D. Theses

Ms.**Indumathi,D.**, awarded the Ph.D. degree for her thesis entitled :
"Spin structure of the Proton – a phenomenological desiderata",
by the Madras University, under the guidance of Dr.M.V.N.Murthy.

Mr.**Mathews**, Prakash, awarded the Ph.D. degree for his thesis entitled :
"A Study of Polarised Structure of the Proton",
by the IIT, Kanpur, under the guidance of Prof.R. Ramachandran.

Mr.**Muthukumar,V.N.**, awarded the Ph.D. degree for his thesis entitled :
"The Interlayer Tunneling Mechanism of High T_c Superconductivity",
by the Madras University, under the guidance of Prof.G.Baskaran.

Ms.**Radha,R.**, submitted her Ph.D. thesis, entitled :
"Characterizations of certain Multiplier Classes",
to the University of Madras, under the guidance of Prof. K.R.Unni.

Mr.**Rakshit**, Amit Mohan, submitted his Ph.D. thesis entitled :
"A Global Topological Approach to the Standard Model of
Particle Physics over a 4 - Dimensional Universe",
.to the IIT, Kanpur, under the guidance of Prof.R.Ramachandran.

Mr.**Ravindran,V.**, awarded the Ph.D. degree for his thesis entitled :
"Partons to constituent quarks – a study of the hadron structure functions ",
by the Madras University, under the guidance of Dr.M.V.N.Murthy.

Mr.**Sardar**, Manas Kumar, submitted his Ph.D. thesis entitled :
"Theory of NMR Relaxation in High T_c Superconductors",
to the Madras University, under the guidance of Prof.G.Baskaran.

Mr.**Shaji,N.**, awarded the Ph.D. degree for his thesis entitled :
"Statistical transmutation in 2 + 1 dimensional relativistic quantum field theories",
by the University of Madras, under the guidance of Dr.H.S. Sharatchandra.

Ms.**Velammal,G.**, awarded the Ph.D. degree for her thesis entitled :
"On a conjecture of Erdös",
by the Madras University, under the guidance of Prof.R. Balasubramanian.

Mr.**Venkataraman,S.**, submitted his Ph.D. thesis entitled :
"On the structure of ring of integers of relative abelian extensions",
to the Madras University, under the guidance of Prof.R. Balasubramanian.

Mr.**Vytheeswaran,A.S.**, Submitted his Ph.D. thesis, entitled :
"Symmetries in systems with second class constraints ",
to the University of Madras, under the guidance of Dr.R.Anishetty.

Lecture Courses

Physics

Basu, R.
"Quantum Mechanics",(Aug. - Dec. 1993).

Baskaran, G.
"Statistical Physics",(Jan. - May 1994).

Date, S.
"Group Theory", (Aug. - Dec. 1993).
"Mathematical physics", (Aug. - Dec. 1993).

Majumdar, P.
"Classical Electromagnetic Theory", (Aug. - Dec. 1993).

Mishra, A.K.
"Condensed Matter Physics", (Jan. - Feb. 1994).

Ramachandran,R.
"Finite Temperature Field Theory", (Aug. - Dec. 1993).

Sharatchandra, H.S.
"Quantum field theory", (Jan. - May 1994).

Uma Sankar,S.
"Radiative corrections in electroweak theory", (March and April 1993).

Mathematics

Nag,S.
"Topics in Geometry and Complex Analysis", (first half of 1993).
"Lectures on Differential Geometry", (from March 1994).

Theoretical Computer Science

Arvind,V., Meena,Mahajan, **Vinay,V.** and **Agarwal, M.(SPIC).**
"Complexity theory", (Aug. - Dec. 1993).

Arvind,V., and Meena, Mahajan
"Interactive proof systems and Probabilistically checkable proofs", (Jan. - March 1994).

Kamal,Lodaya.
"Program Semantics", (Jan. - April 1993).
"Process Calculii", (Aug. - Nov. 1993).
"Introduction to Logic", (Aug. - Nov. 1993).

Ramanujam, R. and Thiagarajan,P.S.(SPIC)
"Dynamic and Temporal Logics", (Oct. - Dec. 1993).

Srinivasa Raghavan,G.
"Randomized Algorithms", (Sept. - Dec. 1993).

Seminars/Lectures

Arvind,V.
"Elementary notations in computational Complexity theory",
IMSc seminar, 3 March 1994.
"Reductions to geometric sets of low information content",
IMSc seminar, 9 March 1993.
"Logical Characterizations of Complexity Classes",(10 lectures),
Department of Computer Science, Ulm University, Germany,
1 June - 31 July, 1993.

Balakrishnan, Radha
"Geometric phase associated with a moving curve and connection to solitons",
Princeton University, USA, 17 Sep. 1993.
"Geometry of space curves and applications to magnetic chains",
Universite de Montreal, Canada, 21 Sep. 1993.
"Space curve evolution, geometric phase and solitons",
Los Alamos National Lab., USA, 26 Oct.1993
"Local geometric phase intrinsic to soliton evolution",
University of California, Berkely, USA, 30 Nov.1993
"Complexity in Chaos",
IMSc seminar, 24 Feb. 1994.

Balasubramanian,R.
"Fermat's last theorem",
IMSc seminar, 15 July 1993.
"The proof of C.Pomerance that there are infinitely many Carmichael numbers", IMSc semi , 8 Nov. 1993.
"Number Theory", (3 lectures),
Annamalai University, Chidambaram, Feb. 1994.

Baskaran,G.
"Resolving the controversy of failure of Fermi Liquid theory in $d = 2$",
IMSc seminar, 1 Sept. 1993.

"Failure of Fermi liquid theory in 2-dimensions".
Physics Dept., Stanford University, Staford, CA, USA,
10 Oct. - 13 Nov. 1993.
University of California, Berkeley, 26 Oct. 1993.
University of California, Los Angeles, 1,2 Nov. 1993.
Dept. of Theoretical Physics, Unviersity of Oxford, Oxford,
England, 15 Nov. 1993.
IBM Lab, Yorktown Heights, 28 Nov. 1993.
Cavendish Lab, Cambridge University, England, 19 Nov.1993.
"Interlayer pair tunneling and anomalous c-axis conductivity",
University of Salerno, Salerno, Italy, June 1993.
University of Naples, Naples, Italy, June 1993.
Physics Dept., Stanford University, Stanford, California,
10 Oct. 1993 - 13 Nov. 1993.
" Correlation Induced vanishing of gap function on the fermi surface
in high T_c superconductors,"
TIFR, Bombay, 23 Feb. 1994.
"Superconductivity", (Four lectures)
Nuclear Physics Dept., University of Madras,
in the Refresher Course for College teachers, 2 - 4 March 1994.

Bhattacharyya, Dakshini
"Fundamental regions for Fuchsian groups", (2 lectures)
IMSc seminars, 6 & 8 Oct. 1993.

Das, Saurya
" Almost forward scattering of electric charges and monopoles :
some results",
S.N. Bose National Center for Basic Sciences, Calcutta, 19 July 1993.
"Charge-Monopole Versus Gravitational scattering at Planckian energies",
IMSc seminar, 12 Aug. 1993.

Date, G.
"Classical Dynamics of Anyons and the Quantum Spectrum",
IMSc seminar, 7 April 1993.
BARC and TIFR , Bombay, 3 and 4 May 1993.

Deodhar, Shekhar
"Quantization of $2+1$ dimensional gravity on Torus $\times \mathbf{R}$",
IMSc seminar, 16 Aug. 1993.

Govindarajan, T.R.

" Edge states and Maxwell Chern Simons theory on a disc",
Dept. of Physics, University of Bologna, University of Genoa, Italy
and University of Barcelona, Spain, May 1993.

" Chern Simons theory as a theory of Knots and Links",
Dept of Physics, Barcelona University, Barcelona, Spain, May 1993.

"Chern Simons theory and Knot theory",
Inst. of Physics, Bhubaneswar, 2 Nov.1993.

" Chirality of Knots and Chern Simons theory",
Dept. of Physics, University of Syracuse, USA, 30 March 1993.

Hari Dass, N.D.

"Goldstone Phenomena in less than four dimensions",
IIT, Kanpur, 23 Nov. 1993; JNU, New Delhi, 24 Nov. 1993;
TIFR Bombay, 8 Mar.1994.

"Changing Perspectives in Elementary Particle Physics",
University of Delhi, 26 Nov. 1993.

"Statistical Mechanics Perspectives in Particle Physics,(Colloquium)",
IIT, Kanpur, 27 Nov. 1993.

"Universality in Physics", (Colloquium),
PRL Ahmedabad, 1 March 1994.

"Chiral Phase transition in finite temperature QCD",
PRL Ahmedabad, 3 Mar. 1994.

"The Hulse-Taylor Binary Pulsar",
INSA, Madras Chapter, 28 Mar.94

Jagannathan, R.

"Quantum Groups",(series of lectures).
Department of Physics, Cochin University of Science and Technology,
Kochi, 12 - 16 July 1993 (5 lectures).
Department of Theoretical Physics, University of Madras, Madras,
14 - 17 Feb. 1994 (4 lectures).
Department of Physics, Punjab University, Chandigarh,
22 Feb. 1994 (2 lectures).
UGC Refresher Course in Nuclear Physics and Electronics
for College Teachers, Department of Physics, University
of Mysore, Mysore, 17 - 18 March 1994 (2 lectures).

Kaul, R.K.

" Knot Theory ",(Four lectures),
Dept. of Theoretical Physics, Univ. of Madras, Madras, April 1994.

Kesavan, S.
"Isoperimetric Inequalities",
Cochin University of Science and Technology, Cochin, 15 Oct. 1993.
"On a Generalized Payne-Rayner Type Inequality",
Université de Metz, Metz,France, 14 Dec.1993.

Khan, S.A
"Theory of relativistic electron beam transport based on the
Dirac equation",
Poster Presentation, IUC - DAEF, Calcutta Centre, 26 Nov. 1993.

Mahajan, Meena.
"On Mod and Generalised Mod Classes",
Department of Computer Science, University Ulm, Germany,
29 June 1993.
"The Structure within Mod Classes",
Forschungsinstitut für Diskrete Mathematik, Universität Bonn,
Bonn, Germany, 1 July 1993.
"Depth Reduction in Non-commutative Circuits",
IMSc seminar, 2 Dec. 1993.
IIT, Bombay, 23 Dec.1993.
"The Power of Verification",
IISc, Bangalore, 24 March 1994.

Mahapatra, Swapna
"Non abelian duality",
Institute of Physics, Bhubaneswar, Sept. 1993.
"On the rotating charged black string solution",
Mehta Research Institute, Allahabad, Oct. 1993.

Majumdar, Partha
"Introductory lectures on Quantum Field Theory", (several)
and conducted the Problem Sessions as a Guest Faculty at the
IX SERC School in High Energy Physics, Guwahati, Nov. 1993.

Murthy, M.V.N.
"Deep inelastic scattering of leptons on hadrons and
Quark-Parton model",(Five lectures),
SERC Winter School in Nuclear Physics, University of Mysore,
14 - 19 Feb. 1994.
"Fractional statistics, anyons and generalised Pauli principle",
Dept. of Theoretical Physics, Univ. of Madras,
Feb. - Mar. 1994 (4 lectures).

Nag, Subhasis
"Conformally natural reflections and cross-sections over
Teichmüller spaces",(Colloquium),
Dept. of Mathematics, Kyoto University, 22 Sept. 1993.
"Teichmüller spaces and String theory",(Colloquium),
Okayama Univ. of Science, 10 Sept. 1993.
"Universal parameter spaces of Riemann surfaces and String theory",
(Colloquium), Tokyo Institute of Technology, 14 Sept. 1993.
"Period matrices for Universal Teichmüller space and string theory",
(Math.seminar), Tokyo Institute of Technology, 16 Sept. 1993.
"$Diff(S^1)$, period matrices and Teichmüller spaces :
Connections via String Theory",
(Math. seminar), University of Tokyo, Tokyo Institute of Technology,
17 Sept. 1993;
(Joint Colloquium), Osaka Univ. and Osaka City Univ., 24 Sept. 1994.
"Universal period matrices", and
"The Teichmüller space of the universal laminated Riemann surface",
(Two lectures, two hours), Joint Math. seminars of
Osaka Univ., Osaka City Univ., and Kyoto Univ.,
25 and 27 Sept. 1993.
"Universal Teichmüller space of compact Riemann surfaces",
SPIC School of Maths, 15 Apr. 1993.
"Universal parameter spaces for Riemann surfaces and String theory",
TIFR, Math. Physics Seminar, 14 Dec. 1993.
"Riemann surfaces and String Theory",(Weekly colloquium),
IIT Madras, 3 Feb. 1994.

Narayan, Mohan
"The Solar Neutrino Problem – a possible solution",
IMSc seminar, 18 Aug. 1993.

Parthasarathy, R.
"Harmonic Maps and self-dual systems for immersed surfaces",
IMSc seminar, 20 Sept. 1993.
"Special and General Relativity",(5 lectures),
UGC Refresher course, Theoretical Physics Department,
University of Madras, Nov. 1993.
"Weak Interactions",(2 lectures),
UGC Refresher Course, Dept. of Nuclear Physics,
University of Madras, Feb. 1994.

Radhika,V.
"Dynamical symmetry of anyons",
IMSc seminar, 20 Aug. 1993.

Rajasekaran,G.

"Quantum Statistics",(2 lectures),
"Neutrinos from the Sun",(2 lectures),
McMaster Univ., Hamilton,Canada 18 & 21 June, 6 & 8 July 1993.
"Orthostatistics",(seminar)
University of Toronto, Toronto ,Canada, 15 July 1993.
"New forms of quantum statistics",(2 lectures),
Syracuse University, Syracuse, USA, 4 & 6 Aug. 1993.
"Orthostatistics",(seminar),
Univ. of Rochester, Rochester, USA, 17 Aug. 1993.
"Report on Lepton-Photon symposium, Cornell – Part II",
IMSc seminar, 17 Sept. 1993.
"Current Algebra Sum Rules",
Seminar in honour of Prof. Virendra Gupta ,
Tata Institute of Fundamental Research, Bombay, 7 Oct. 1993.
"String Theory and Unification of Gravity with Rest of Physics",
Dept. of Theoretical Physics, Univ. of Madras, Madras,
19 & 20 Nov. 1993 (2 lectures).
"Can we go beyond Bose-Einstein and Fermi - Dirac Statistics?",
Dept. of Physics, Univ. of Delhi, Delhi, 3 Feb. 1994.
"Is there a Final Theory?"
Somaiya College and Vaze College, Bombay, 21 & 22 Feb. 1994.
"Experimental signals for QCD with broken colour",(seminar),
Centre for Detector & Software Technology, University of Delhi,
Delhi, 19 March 1994.

Ramachandran, R.

"Spin Manifolds and Standard Models",(Seminar),
IUCAA, Pune, 2 July 1993.
"On Symmetry and Dynamics",
One-day Symposium, Manonmaniyam Sundaranar University,
Tirunelveli, 13 Dec. 1993.

Ramanujam,R.

"PDL and partial order models of concurrency",
Edinburgh University, UK, 1 July 1993.
"Logics and models for partial order based concurrency",(2 lectures),
Graduate Center of the City Univ. of New York, USA,
21 - 22 July 1993.
"Some undecidability results for true concurrency",
University of Delaware, USA, 9 Aug. 1993.
"Distributed transition systems",
State University of New York at Albany, USA, 16 Aug. 1993.

"Logics for true concurrency",
Concordia University, Montreal, Canada, 1 Sept. 1993.
"Knowledge transition systems",
CMA, Ecole des Mines, Sophia Antipolis, France, 16 Sept. 1993.
"A duality theorem for partial order and knowledge",
Tata Institute of Fundamental Research, Bombay, 27 Sept. 1993.
"Logics of knowledge interpreted on transitions systems",
IMSc seminar, 16 March 1994.

Rangarajan, S.K.
"Diffusion to substrates of arbitrary shape",
Dept. of Chemistry, Georgetown Univ., Washington D.C., 7 Oct. 1993.
" Multipolar electrochemical reactor design",
Hooker Research Centre, Niagara Falls,25 Oct. 1993.

Ray, Purusattam
"Chiral ordering in spin-glass",
IMSc seminar, 30 March 1994.

Sastry, Swati
"Picard's Theorem & Rickman's Theorem by way of Harnack's Inequality",
T.I.F.R Centre, Bangalore.
I.S.I., Bangalore.
"A complementary form of the defect relation for quasimeromorphic maps",
T.I.F.R Centre, Bangalore.

Shankar, R.
"Haldane's exclusion statistics and the second Virial coefficient",
IMSc seminar, 7 Feb. 1994.
"Introductory Quantum Field Theory", (course of 12 lectures),
SERC - HEP school, Guwahati, Nov. 1993.

Simon,R.
"Symmetry and Invariance in Classical Optics",
IGCAR, Kalpakkam, Dec. 1993.
"Modular symmetry of the Diffraction Grating",
A.C.College of Technology, Madras, Dec. 1993.
"New approaches in Optics",
Ann. meeting of the Indian Phys. Soc., Calcutta, March 1994.
"Harmonic oscillator in quantum optics",
American College, Madurai, March 1994.

Sinha,Rahul

"Testing electroweak vector boson self interactions – The moments of the W boson.(TPSC Seminar)
Dept. of Physics and Astronomy, Delhi Univ., 9 Nov. 1993.

Sridhar,R.

"Phase transitions in solids",(4 lectures),
Refresher course in Condensed Matter Physics,
Cochin University of Science and Technology, Kochi, 14 - 19 Feb. 1994.
"Statistical Physics",(4 lectures),
Dept. of Theoretical Physics, Univ. of Madras, 20 - 24 March 1994.

Srinivasa Rao, K.

"Quantum Theory of Angular Momentum : Selected Topics",
IUCAA, Pune, 26 April 1993
IOP, Bhubaneswar, 23 Feb. 1994
Dept. of Physics, Univ. of Hyderabad, 28 Feb. 1994.
Dept. of Physics, Univ. of Delhi, 2 March 1994.
Dept. of Physics, IIT, Kanpur, 7 March 1994.
"Recent developments in quantum theory of Angular Momentum",
Univ. of Padova, Padova, Italy, 16 Nov. 1993.
Univ. of Calicut, Calicut, 31 Dec. 1993.
"Quantum theory of Angular Momentum and its q-generalization",
Univ. of Liege, Liege, Belgium, 22 Nov. 1993.
"Triple sum series for the $9-j$ coefficients and summation theorems",
IMSc seminar, 20 Dec. 1993.
"Numerical Computation of Angular Momentum Coefficients",
UGC Refresher Course, Nucl. Phys. Dept., Univ. of Madras,
17 Feb. 1994.
"Shell model and particle-hole formalism",
UGC Refresher course, Nucl. Phys. Dept., Univ. of Madras,
18 Feb. 1994.
"Role of Mathematics in Physics",
One-day Symp., Maths. Dept., Anna Univ., Madras, 22 Dec. 1993.
Dept. of Physics, Utkal Univ., Bhubaneswar, 24 Feb. 1994.
"Srinivasa Ramanujan : his life and work",
IOP, Bhubaneswar, 23 Feb. 1994.
Maths. Dept., Univ. of Hyderabad, 28 Feb. 1994.
Maths. Dept., Univ. of Delhi, 3 Mar. 1994.
Maths. Dept., IIT, Kanpur, 7 March 1994.
Kendriya Vidyalaya, Kanpur, Mar.8, 1994.

Subrahmanyam,V.
"Magnetism of fullerenes : Hubbard - Heisenberg models",
IMSc seminar, 26 July 1993.

Subramoniam,G.
"Equation of states and superconductivity of $LaGa_2$ and YGa_2",
ICTP, Trieste, 10 June 1993.

Uma Sankar,S.
" Report on Lepton-Photon Symposium, Cornell – Part I",
IMSc seminar, 6 Sept. 1993.

Venkatesh Raman
"Finding generalized Hamiltonian Paths and Scores in Tournaments",
Univ. of Waterloo, Waterloo, Ontario, Canada, 21 July 1993.
Univ. of Western Ontario, London, Ontario, Canada, 4 Aug. 1993.
"Some structural and algorithmic results in tournaments",
IMSc seminar, 28 March 1994.

Vytheeswaran, A.S.
"Gauge invariance in second class constrained systems",
IMSc seminar, 13 Oct. 1993.

Conferences/Workshop/Symposium

Sponsored or Cosponsored

Number theory conference, 20 - 23 July 1993.
(Convenor : Prof. R. Balasubramanian)

International Conference on Vector Bundles on Curves : New Directions,
27 - 29 Dec. 1993, Cosponsored by TIFR, IMSc. and SPIC.
(Members, Organising Committee : Prof.S.Nag, Prof.R.Balasubramanian and Dr.D.S.Nagaraj)

Perspectives in Theoretical Nuclear Physics,
One-day Symposium in honour of (late) Prof.S.C.K.Nair,
Cosponsored by IMSc, Madras; IOP, Bhubaneswar; PRL, Ahmedabad; Calicut University and held at the Dept. of Physics, Calicut Univ., Dec.31, 1993. (Convenor : Prof.K.Srinivasa Rao)

Workshop on High Energy Particle Physics, 10 - 22 Jan. 1994.
(Members of the Organising Committee :
Drs.R.Ramachandran – Chairman, G.Rajasekaran, Rahul Sinha, M.V.N.Murthy and S.Uma Sankar – Secretary)

Professional activities

Balasubramanian, R.
Member, Sectional Committee (Mathematics),
National Academy of Sciences.
Member, Selection Committee for Research Scientists award of UGC.

Baskaran, G.
Organized Mini Workshop on Strongly Correlated Electron Systems
and Regular Solid State Physics Workshop
at ICTP in the Summer of 1993.

Hari Dass, N.D.
Slide show with talk on "Astrophysical Objects",
Olcott Memorial School, Madras and
Children's Club Society, Madras.
Slide Show with talk on "Solar Eclipses",
Tamil Nadu Science Forum, Madras.

Kesavan, S.
Reviewer, Mathematical Reviews.
Member,Advisory Board,
Indian J. of Pure and Applied Mathematics (INSA).
Member,Board of Postgraduate Studies,
Cochin University of Science and Technology, Cochin.

Majumdar, P.
Ph.D. Thesis examiner for a student of TIFR in string theory.

Nag, S.
Member, Advisory Board of the Indian Journal of Pure and Applied
Mathematics, (Elected), Council of the INSA, New Delhi.
Member, Organizing Committee for International Conference on
Vector Bundles, Bombay-Madras, Dec. 1993.

Rajasekaran, G.

Chairman, Planning Committee for the DST sponsored SERC Schools on Theoretical High Energy Physics.

Secretary, IUPAP National Committee of the INSA, New Delhi.

President, Indian Physics Association, Madras Chapter.

Member of a number of national-level committees and Governing Councils of national institutions.

Ramachandran, R.

Member, Scientific Advisory Committee, IUCAA, Pune.

Member, Board of Studies, School of Physics, University of Hyderabad.

Member, Board of Studies, Indira Gandhi National Open Univ., New Delhi.

Member, Board of Research, University of Madras, Madras.

Member, Academic Council, Anna University, Madras.

Member, Planning Board, Manonmaniam Sundaranar Univ., Tirunelveli.

Regional Representative in Asia of ICTP, Trieste External Activities.

Senior Associate, ICTP, Trieste.

Member, Organising Committee, Professor R.Vasudevan Memorial Volume.

Rangarajan, S.K.

Member, Sectional Committee, INSA, Jan 94.

Chairman (Scientific Committee), Fifth Int. Symp. on Advances in Electrochemical Science and Technology. (Nov. 94), Madras.

Sridhar, R.

Convenor, Theoretical Physics Seminar Circuit (Madras Centre).

Member, Organising Committee, Professor R.Vasudevan Memorial Volume.

Srinivasa Rao, K.

"Developments in Elementary Particle Physics", Children's Club Society, Madras, 12 June 1993.

"Mathematics everywhere", (in Tamil "Engum Ganitham"), Avvai Kalai Kazhagam, Madras, 10 Dec. 1993.

Chairman, Organising Committee, One-day Symposium in honour of Prof.S.C.K.Nair, held at Calicut Univ. on Dec.31,1993.

Member, Organising Committee, Professor R. Vasudevan Memorial Volume.

Uma Sankar,S.

Cosmic Microwave Background radiation, Phys. News (submitted).

Miscellaneous

Professors G. Baskaran, S.K.Rangarajan and V.Balakrishnan (IIT, Madras) organized a group activity on "Interface with complexity in Biology", with a view to arrange lectures on the science of complexity in biological systems by experts from various fields including Physics, Biology and Medicine. The powerful tools developed by the physicists are considered quite useful to develop this field.

A joint research project between the Institute of Mathematical Sciences, coordinated by Prof.K.Srinivasa Rao and the University of Gent (Gent, Belgium), coordinated by Prof.G.Vanden Berghe, for research in the areas Quantum Theory of Angular Momentum, Quantum Groups and Quantum Algebras and Parallel Algorithms in Numerical Analysis, funded by the European Economic Community and approved by the Department of Science and Technology, Government of India, came into effect from February 1993. This project is for a period of four years. Professor G.Vanden Berghe visited the Institute in May - June 1993 and Dr.J.Van der Jeugt visited the Insitute in Jan. - Feb.1994. Professor K.Srinivasa Rao visited the University of Gent between Sept. - Nov.1993 in this ongoing Project. A Ph.D. student, Ms.Sangita N.Pitre was selected and she joined the University of Gent in November 1993. Earlier she had a three week training program with Professor K.Srinivasa Rao, at IMSc, in July - August 1993.

A joint research proposal made by Professors T.Chakraborty with Dr. P. Pietiläinen of the Department of Theoretical Physics, University of Oulu, Finland, has been approved for funding (1994-1995) by the Finnish Academy of Science, Finland.

Professor R.Sridhar was the coordinator for the activities of the Theoretical Physics Seminar Circuit (TPSC), Madras Center. Under this scheme 13 speakers visited the Institute, of this 9 were Category A (Post docs or those completing their Ph.D. theses work) and the rest were Category B speakers. Lectures delivered were in the following fields : High Energy Physics, Condensed Matter Physics, Non-linear Dynamics and Chaos and Quantum Theory of Measurement.

Professor Alladi Ramakrishnan, Founder Director, Matscience, was felicitated on the occasion of his 70th Birthday, on 6 Aug. 1993. The Patron of the Institute, Mr.C.Subramaniam, Former Governor of Maharashtra, presided over the function.

Summer Students

Name	Period
Ms.Radhika Vathsan	1 May - 31 July 1993
Mr.S.Vidhyadhiraja	15 May - 14 June 1993
Mr.D.S.Sethumadhavan	3 June - 5 July 1993
Mr.Mahesh Chandran	31 May - 28 June 1993
Mr.Tapobrata Sarkar	26 May - 26 June 1993

Honours and Awards

Balasubramanian, R.
Elected to the council of INSA.
Member, IMU National Committee (of INSA).

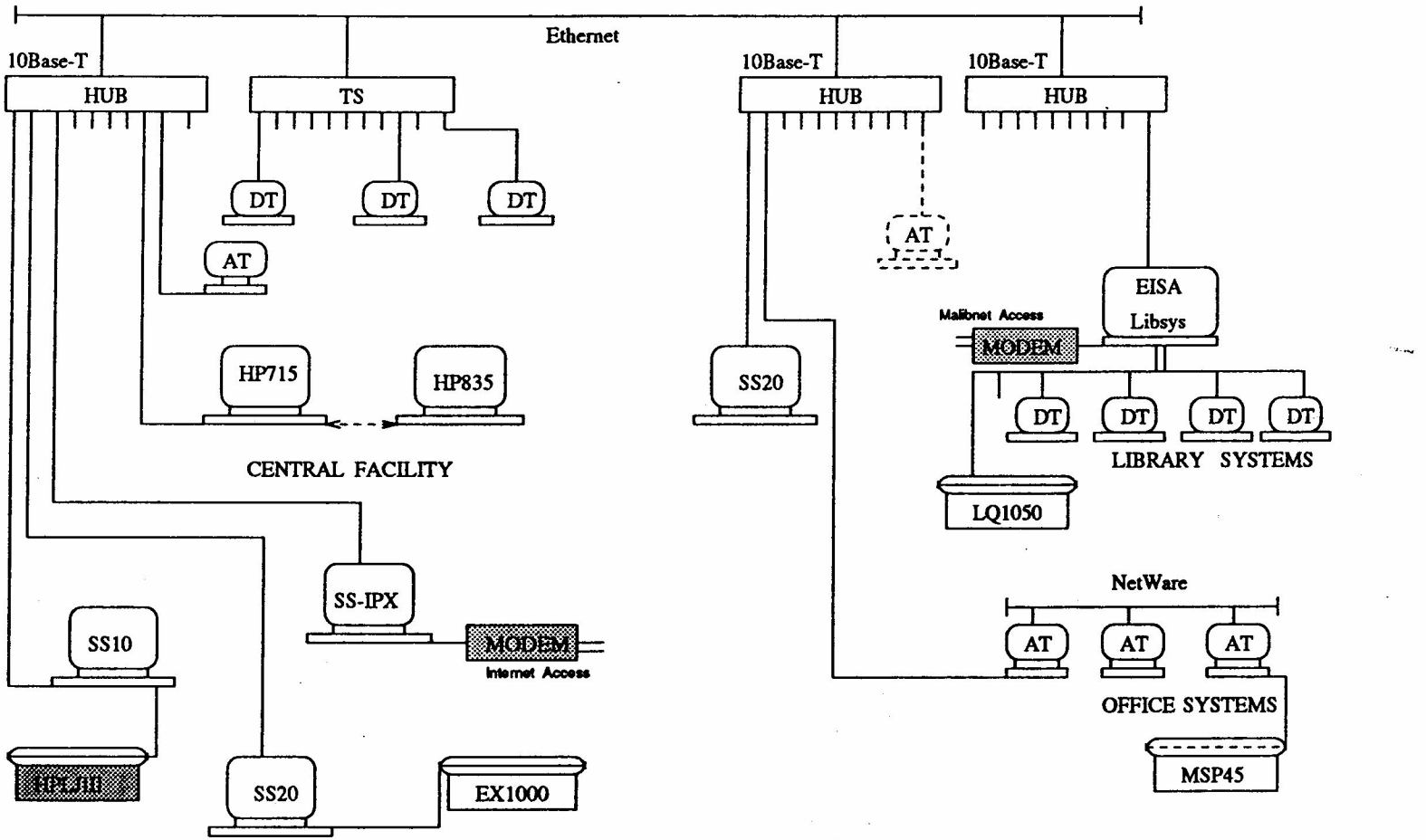
Chakraborty, T.
Nominated for an Honorary Doctorate and Docentship,
(highest academic degree awarded in Finland),
Department of Theoretical Physics, University of Oulu, Finland.

Nag, S.
Designated "Main Lecturer" and "Special Invited 1-hour Speaker"
of the Mathematical Society of Japan, during Aug. -Sept. 1993.
Invited Plenary Lecturer, Int. Conf. on Complex Analysis, Europe,
sponsored by the International Mathematical Union, Aug. 1993.

Rajasekaran, G.
Appointed as Hooker Distinguished Visiting Professor at McMaster
University, Hamilton, Canada for a month in 1993.
Awarded the DAE – CV Raman Lecturership for 1993
by the Indian Physics Association in recognition of
his research work in High Energy Physics Theory and
his communication skills.

Simon,R.
Awarded the **Shanti Swarup Bhatnagar** Prize for Physical Sciences,
for the year 1993, for his *outstanding contributions to topological phases; vectorial theory of beams; Guoy effect for squeezed light and applications of group theoretical ideas to optical problems.*
Appointed as Honorary Professor, S.N.Bose National Center for Basic
Sciences, Calcutta, in recognition of his noteworthy contributions
to Quantum Optics and related areas.

IMSc COMPUTER NETWORK



A profile of the IMSc Computer System

The present computing facility at IMSc had its inception in 1986 with an IBM-PC/AT[1] and was enlarged with the acquisition of a NELCO Force 20 (68020 based mini computer) and an HP-9000/835. The network of SUN SPARC stations had its origin in 1990 and given below is a profile of the IMSc SUN network as it is today.

Computer Network

The computer network is based on a Twisted Pair (10 Base-T) ethernet backbone. The network runs through the entire Institute with (RJ45) sockets provided in each office which can be connected to front end systems like PC-ATs/X-terminals/Workstations/Dumb Terminals (DT) with the help of HUBs and Terminal Servers by which each user can access all internet services as well as local system services. The network, as it is designed now, can in principle be expanded to accommodate any number of users (keeping in view future developments).

The network service is handled by a SPARC Station-10 model 512 (dual CPU) File Server under Solaris 2.3 operating system. Two SPARC Station-20 systems which were upgraded from SPARC Station-1s act as dataless clients to the file server. The network also includes the HP-Apollo 9000/715, HP 9000/835 and a host of AT386 and 286 machines distributed in various offices and user areas. This is the Central Facility of the IMSc Computer Network.

Internet Facility

The electronic mail and file transfer protocol services are handled by a SPARC station-IPX system which acts as the mail server and internet node running PPP (Point-to-Point Protocol) as the TCP/IP software. Leased line connectivity to the international gateway at Bombay is provided through the node at IIT Madras and allow users 'telnet' and 'ftp' facility to any internet node. These lines now run at 9600 bps and are soon to be upgraded to 64kb lines. These facilitate online searches of bulletin board data bases.

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[1]Donated to the Institute by the Alexander Von Humboldt Foundation of Germany.

Software Facility

As a multiuser network environment IMSc has a lot of multiuser licensed software and public domain license-free packages running on various systems.

1. Multiuser SUNPro compilers for FORTRAN and C languages under Solaris 2.3.

2. GNU C, C++ compilers under Solaris 2.3.

3. Numerical calculations are facilitated by NUMERICAL RECIPES and several other programs developed or modified inhouse. Subscription to the CERN information network provides access to the CERN-Program library and the use of the file transfer protocol (ftp) enables access to any program as and when needed.

4. For symbolic computations IMSc has a licensed copy of MACSYMA running under Solaris 2.3 and MATHEMATICA under DOS and FORM in HP-UX and Sun O/S. MAPLE will be acquired in addition to these so that most major applications can be covered.

5. Document preparation is done using packages like TeX, LaTeX, RevTeX, AMSTeX etc.

6. Super Mongo (SM) and GNU-plot for 3-D are used in graphics applications on the workstations and several other PC based packages are also available.

Extensive numerical and symbolic manipulations are undertaken in the following areas and some examples are given below:

1. Statistical mechanics of disordered system like percolation, spin glasses and glasses.

2. Lattice gauge theories - Variational investigations of Euclidian SU(3) Lattice Gauge Theory, Numerical simulations of Dual SU(2) Lattice Gauge Theory in 3-D, Numerical simulation of O(N) sigma model in 3 and 4-D.

3. Classical and Quantum chaos with particular emphasis on the statistical analysis of level spectra and the connection with classical periodic orbits in classical chaotic systems.

4. Pairing correlations in coupled Hubbard/tJ chains and planes. Symmetry of the order parameter in superconducting cuprates.

5. Electronic structure calculations and application to the study of properties of materials.

6. Particle Physics Phenomenology- Event generation for multiparticle final states at colliders - Phase space evaluation for cross section of collider processes/decays.

7. Symbolic evaluation of matrix elements - tree level and one-loop processes in High Energy Physics.

8. Fast algorithms for SU(2) recoupling coefficients.

9. Proof of positive-definiteness of the norm for Fock spaces corresponding to q − deformed oscillator algebras, which involves the computation of the determinants of matrices of very high dimensions.

The network as planned enables any user to access all these facilities from any terminal located in the Institute. In addition IMSc not only receives but also contributes to several bulletin boards like condensed matter physics, hightc, bucky ball, high energy physics, lattice gauge theory, mathematical physics, chaos etc. The abstracts received daily from these bulletin boards are stored systematically so that users are able to browse through them easily. Access to the bulletin boards is available through ftp and preprints can be obtained immediately. Apart from the above IMSc started an **anonymous FTP** site.

The network is accessible not only to the members of the Institute but also to students and research workers from other Institutions. Students from Anna University, University of Madras, IIT Madras, Bharathidasan University and Madurai Kamraj University are at present making use of the IMSc computer facility for their research.

In addition to this, library automation is taken care of by a EISA 486 machine running **Libsys** library package. Access to the Madras Library Network (Malibnet) is also provided in the Library of the Institute.

A network of AT386s machines on a LAN running Novell Netware takes care of office automation.

The computer system of the Institute of Mathematical Sciences is a state-of-the-art system providing its users with the very latest in hardware and software. It is continuously upgraded to remain at the forefront of the computer world. Much of the expertise needed to set up such a broad based network with access to world-wide information network was provided by several members of the Institute and in one of those rare instances the network did not have a single system manager for the first five years of its existence. With increased demand on the machines and some of the users, IMSc has now a Scientific Officer as its full time System Administrator.

Visitors to the Institute

Name & Affiliation	Period of Visit
Indumathi, D. IMSc, Madras.	17 - 31 March 1993
Srikanth, H. Physics Department IIs, Bangalore.	19 March 1993
Brown, A.L. Lecturer, Dept. of Maths & Statistics Univ. of New Castle-upon-Tyne England.	29 March - 1 April 1993
Jain, Sudhir Ranjan Scientific Officer (D) Theoretical Physics Division BARC, Bombay 400 085.	25 March - 4 April 1993
Deaton, Ed. Professor, Computer Science Department San Diego State University San Diego, CA 92182.	10 - 12 April 1993
Soni, Vikram National Physical Laboratory New Delhi 110 012.	14 - 24 April 1993
Ram Mohan, T.R. CSIR, Trivandrum.	7 May 1993
Reggiani, Lucia Ph.D. Student, University of Salerno Department of Physics, 84081 Banonissi (SA) ITALY.	1 February - 10 May 1993

Mohan, Subit Project Scientist, (Post Doc), Indian Institute of Technology Kanpur 208 016.	9 - 13 May 1993
Mohapatra, Anugraha Visiting Fellow, Indian Statistical Institute Delhi Centre.	12 April - 16 May 1993
Uplekar, G.M. Research Assistant, Physics Department Pune University 411 007.	26 May 1993
Narayanan, Prakash IIT, Madras-600 036.	10 May - 10 June 1993
Velammal, G. Visiting Student	10 April - 17 May 1993
Mochael Alphonse, V. Visiting Scientist Indian Statistical Institute, Calcutta 700 035.	27 May - 3 June 1993
Van Den Berghe, G. Rijksuniversiteit Gent, Belgium	22 May - 8 June 1993
Sarkar, Tapobrata Presidency College Calcutta - 700 073.	26 May - 26 June 1993

Ramaswamy, A. Visiting Scientist, TIFR, Bangalore	30 May - 5 June 1993
Chandran, Mahesh Department of Physics University of Poona Pune 411 007.	31 May - 28 June 1993
Dey, Tamal K. Department of CSCI, Indiana-Purdue University Indianapolis, USA 46202.	2 - 5 June 1993
Sethuraman, D.S. School of Physical Sciences Jawaharlal Nehru Univesity New Delhi - 110 067.	3 June - 5 July 1993
Padmanabhan, T. IIT, Kanpur.	7 June - 7 July 1993
Rajesh, R. IIT, Kanpur.	8 June - 11 July 1993
Vytheeswaran, A.S. Institute of Mathematical Sciences, Madras 600 113.	11 - 16 June 1993
Gupte, Neelima M. Lecturer, Dept. of Physics University of Poone Pune 411 007.	10 June - 3 July 1993
Ganesh, S. Chengalpettu - 603 209.	15 - 16 June 1993

Arjunwadkar, Mihir Department of Physics, University of Poone (SRF).	19 June - 5 July 1993
Srinivas, Aravind Princeton University, USA	28 June 1993
Patel, Apoorva Centre for Theoretical Studies Indian Institute of Science, Bangalore	4 - 5 July 1993
Venkataraman, S. TIFR, Bombay.	3 - 30 July 1993
Anandan, Jeeva S. University of South Carolina Columbia, SC 29208.	11 - 15 July 1993
Ramakrishnan, B. M.R.I. Allahabad - 211 002.	14 - 26 July 1993
Madhav, A.V. Jawaharlal Nehru Inst. of Adv. Scientific Research, Bangalore.	16 July - 18 July 1993
Bosco, E. Scientist, CECRI, Karaikudi	14 - 17 July 1993
Adhikari, S.D. M.R.I., Allahabad.	14 - 26 July 1993
Srinivas, K. TIFR, Bombay.	20 - 29 July 1993

Soundararajan,R. Student of University of Michgan Ann Arbor	20 July - 30 August 1993
Balachandran, A.P. Professot of Physics, Syracuse University Syracuse, NY 13244.	21 - 24 July 1993
Waldschmidt, Michael University of Paris, Paris.	12 - 23 July 1993
Chandramouli, Y. Researcher, AT & T Bell Labs	23 & 29 July 1993.
Janwa, Heeralal Reader, Mehta Research Institute for Mathematics & Mathematical Physics Allahabad 211 002.	21 July - 3 August 1993
Chandar, L. Student of Syracuse University	13 July - 13 August 1993
Joshi, Kisti TIFR, Bombay.	20 July - 5 August 1993
Mathews, Prakash Visiting Scientist	1 - 31 August 1993
Ravindran V. Visiting Scientist	1 - 31 August 1993
Isozaki, Hirozhi Department of Mathematics Osaka University, Toyanaka Japan.	16 - 22 August 1993

Bethuel, F. Professor, ENPC, CERMA, France	12 - 15 August 93
Soni, Vikram National Physical Laboratory New Delhi.	9 - 25 August 1993
Sitaraman, Ramesh Princeton University.	13 August 1993
Nakamura, Shu University of Tokyo Japan.	18 - 22 & 30 August 1993
Schwarzbach, Y.K. Universite de Lille I, 59655 France	18 - 26 August 1993
Sinha, K.P. IISc, Bangalore.	20 - 22 August 1993
Jansen, Arul Inst. Mittag - Leffler, Sweden.	21 - 22 August 1993
Bhaduri, Rajat K. Professor of Physics Mc Master University, Hamilton, Canada	23 - 29 August 1993
Satpathy, L. IOP, Bhubaneshwar.	24 - 26 August 1993
Kumar, C.V. Fellow of Worester, College Dept. of Theoretical Physics University of Oxford	12 - 4 September 1993

Sinha, Nita Madras.	4 October 1993
Karandikar, R.L. ISI, Delhi.	9 December 1993
Indumathi, D. PDF, Physical Research Laboratory Navrangpura, Ahmedabad 380 009	30 September - 9 October 1993
Vytheeswaran, A.S. Institute of Mathematical Sciences Madras 600 113.	6 September - 13 October 1993
Madhav, A.V. Student, IIT, Kharagpur	11 - 21 October 1993
Anderson, Richard Visiting Professor of Computer Science Indian Institute of Science, Bangalore	20 - 23 October 1993
Bhattacharya, Tilak Lecturer, Indian Statistical Institute New Delhi 110 016.	1 - 12 November 1993
Roy, Sisir Associate Professor, Indian Statistical Institute, Calcutta 700 035.	9 - 10 November 1993
Murty, Ram Professor, Math. Dept, McGill University Montreal, Canada.	9 - 25 November 1993
Vinay, V. Scientist "C", Centre for A I & Robotics (CAIR) Raj Bhavan Circle Bangalore	16 - 26 November 1993

Hindry Indo-French Centre in Delhi	1 - 15 November 1993
Vijaya Kumar, K.B. Post Doctoral Fellow, PRL, Ahmedabad	23 - 25 November 1993
Sa, Debanand Doctoral Scholar, Inst. of Physics	22 - 26 November 1993
Mathews, Prakash CTS, Bangalore	25 November - 4 December 1993
Ravindran, V. Institute of Mathematical Sciences Madras 600 113.	6 - 22 November 1993
Subramanian, Ashok Asst. Prof., Indian Inst. of Science Bangalore 560 012.	6 - 11 December 1993
Cheng, Allan Dept. of Computer Science Aarhus University, Denmark	7 - 13 December 1993
Anandan, Jeeva S. Dept. of Physics, Univ. of South Carolina Columbia, SC 29208.	15 - 21 December 1993
Mandal, Satya Associate Professor, University of Kansas Lawrence, KS 66045, USA.	26 - 29 December 1993
Joglekar, S.D. Professor, Indian Inst. of Technology Kanpur 208 016.	27 November 1993 1 January 1994

Alladi, Krishnaswami Professor, University of Florida Department of Mathematics, Gainwsville Florida 32611, USA.	7 December 1993 - 5 November 1993
Shiota, T. Kyoto University Maths.Dept, Faculty of Science, Kyoto, Japan.	20 December 1993 - 5 January 1994
Ramachandra, K. TIFR, Bombay	31 December 1993 - 9 January 1994
Leggett, A.J. University of Illinois, USA.	4 - 6 January 1994
Golterman, Maarten Asst. Professor, Dept. of Maths. Washington University, St.Louis MO 63130, USA.	11 - 18 January 1994
Zakrzewski, W.J.M. Dept. of Mathematical Sciences University of Durham, U.K.	10 - 13 January 1994
Maison, Dieter Senior Scientist, Max Planck Inst. of Phys.	29 December 1993 - 23 January 1994
Philippons, Patrice CNRS, France.	16 - 22
Muthukumar, M. Polymer Science and Engg., University of Massachusetts at Ahmerst, Amherst, MA 01003	13 December 1993 - 13 January 1994

Sardar, Manas Inst. of Physics, Bhubaneswar	22 - 16 January 1994
Mukunda, N. Professor, Indian Inst. of Science Bangalore	15 - 25 January 1994
Zuber, J.B. Service de Physique Theòrique France	22 - 27 January 1994
Padmanabhan, T. IUCAA, Post Bag 4, Ganeshkhind Pune 411 002.	30 January - 8 February 1994
Gaitonde, D.M. Indian Institute of Science Bangalore	9 - 12 February 1994
Thomee, Vidar Chalmers Inst. of Technology, Sweden	19 - 24 February 1994
Parvate, Vishakha Dept of Computer Science, Pune University	16 - 21 February 1994
Deshpande, Maneesh Unif. of Pennsylvania, Philadelphia	23 - 26 February 1994
Madouri, Fethi Laboratories de Physique, Theorique Morocco	16 August 1993 - 22 March 1994

Seminars/Colloquia by Visitors[1]

Physics

06.04.93	**Jain**, Sudhir R. BARC, Bombay	Fractals in area preserving maps
08.04.93	**Sahoo**, D. IGCAR, Kalpakkam	Nambu mechanics and its quantization
13.04.93	**Soni**, V. NPL, New Delhi	Electroweak baryon violations ; magnetic fields and sphalerons
15.04.93	**Soni**, V. NPL, New Delhi	$SU(2)$ superconductivity and Hubbard model
20.05.93	**Nayak**, S. IOP, Bhubaneshwar	The signature of CP violation in Astrophysics and Cosmology
21.05.93	**Sinha**, Rahul TIFR, Bombay	Triple electroweak vector boson cooplings and the magnetic moment of the W-Boson
24.05.93	**Biswas**, S.N. Univ. of Delhi	Anharmonic Oscillator
25.05.93	**Sen**, Asoj J. SINP, Calcutta	Metal insulator transition for non-interacting electron in ID incommensurate potential
26.05.93	**Vishweshwara**, C. IIA, Bangalore	Relativity and Rotation
27.05.93	**Vanden Berghe**, G. SUG, Belgium	Mixed interpolation in numerical analysis

[1]Seminars/Colloquia by the members of the Institute are listed in the section Academic Activities, in subsection Seminars/Lectures (pages 57 – 65).

03.06.93	**Vanden Berghe** G. SUG, Belgium	Non-trivial zeros of 6-j symbols and exceptional Lie algebras
25.06.93	**Pasupathy**, J. CTS, IISc, Bangalore	Sigma term in pion-nucleon scarttering
12.07.93	**Anandan**, J. Univ. of South Carolina, USA	Meaning of wave function
14.07.93	**Anandan**, J. Univ. of South Carolina, USA	Gravitational effects on Superconductors
22.07.93	**Balachandran**, A.P. Syracuse Univ., USA	Finite Approximation to Continuum Physics : Quantum points and their bundles
23.07.93	**Chandramouli**, Y. AT & T Bell Labs, USA	A Queueing model for Meteor Burst Packet communication systems
06.08.93	**Ramakrishnan**, Alladi Founder Director, IMSc.	Smiles and Tears of a Scientific Discovery
03.09.93	**Sukumar**, C.V. Oxford Univ., U.K.	Squeezing vaccum fluctuations of electromagnetic fields
17.09.93	**Ramakrishnan**, Alladi Founder Director, IMSc	Are elementary problems really elementary?
29.09.93	**Devanathan**, V. Univ. of Madras	Parton distributions and nucleon structure functions
30.09.93	**Balasubramanian**, S. M.K.Univ., Madurai	D^- Centres in Semiconductors
15.10.93	**Krishnan**, B. SCRI, F.S.U., USA	Numerical investigation of quantum gravity on a Regge skeleton
10.11.93	**Roy**, Sisir ISI, Calcutta	Non-dissipative nature quantum fluctuations
17.11.93	**Srinivasan**, R. Dept. of Biophysics Univ. of Madras	Synchrotron radition and its applications

24.11.93	**Kumar**, Vijaya PRL, Ahmedabad	N-N interaction with confinement model for QCD
25.11.93	**Sa**, Debanand IOP, Bhubaneshwar	Roman scattering in a correlated superconductor
01.12.93	**Abhiraman**, Ramesh Yale Univ., USA	An alternate bosonization of Thirring model
02.12.93	**Mukhi**, Sunil TIFR, Bombay (TPSC)	Topological symmetries in string theory - I
03.12.93	**Mukhi**, Sunil TIFR, Bombay (TPSC)	Topological symmetries in string theory - II
13.12.93	**Mitter**, P.K. Univ. of Paris	Renormalization group approach to interacting crumpled surfaces
17.12.93	**Anandan**, J. Univ. of South Carolina, USA	On the geometries of gravity and gauge fields
24.12.93	**Narain**, K.S. ICTP, Italy	Topological amplitudes in string theory
28.12.93	**Lieb**, Elliott Princeton Univ.	Some rigourous results and open problems
01.01.94	**Green**, H.S. Univ. of Adelaide South Australia	A cyclic symmetry principle in physics
06.01.94	**Leggett**, A.J. Univ. of Illinois, USA.	Nature of the order parameter in '123' superconductor
17.01.94	**Maison**, Dieter Max Planck Inst. of Phys.	Particle like solutions to Einstein-Yang Mills Systems

18.01.94	**Maison**, Dieter Max Planck Inst. of Phys.	Particle like solutions to Einstein-Yang Mills Systems
24.01.94	**Enoch**, Jay Univ. of California Los Angeles	Applications of Hyper-acuity in vision research
02.02.94	**Padmanabhan**, T. IUCCA, Poona	Open problems in quantum field theory on curved space
09.02.94	**Yarlagadda**, Sudhakar NTT, Japan	Towards an understanding of the spin-fermion model of the cu0 planes.
09.02.94	**Mandal**, Swapan Visva Bharathi Santiniketan (TPSC)	Some non-linear effects in double resonance spectroscopy
10.02.94	**Gupta**, Indra Das S.N.Bose Centre Calcutta (TPSC)	Qunatum transmittance and resonance in quantum percolation model
24.02.94	**Deshpande**, Manish Univ. of Penn. USA	Effects of orientational disorder on the normal state properties of fullerides
25.02.94	**Sengupta**, Surjit IGCAR, Kalpakkam	Some aspects of phase transition in absorbed systems
02.03.94	**Acharya**, Muktish Shaha Inst. of Phys. TPSC	Magnetic hysterisis in model systems
03.03.94	**Shrivastava**, K.N. Univ of Hyderabad	Flux lattice melting in Superconductors
16.03.94	**Valsamma**, K.M. Cochin Univ. TPSC	$F - \alpha$ soectrum and trajectory scaling function of polynomial circle maps

18.03.94	**Seshadri**, K. IISc., Bangalore	Superfluid - Bose glass transition in a disordered boson Hubbard model : a percolation scenario
22.03.94	**Parekh**, Nita JNU, New Delhi (TPSC)	Phase ordering dynamics in disordered systems
22.03.94	**Ray**, Partha Saha Inst., Calcutta	Excitons in semiconductor mesoscopic structures
23.03.94	**Kumar**, Alok Inst. of Phys. Bhubaneswar (TPSC)	Some results on black holes in string theory
31.03.94	**Balasubramanyan**, V.K. Bangalore	Do statistical laws govern structures in language discourses?

Mathematics[1]

12.04.93	**Sengadir**, T. IIT, Bombay	Leray-Schauder theorems for Frechet spaces an applications to differential equations on non-compact intervals
15.04.93	**Ramanan**, S. TIFR, Bombay	Geometry of canonical curves
28.05.93	**Alphonse**, Michael ISI, Calcutta	Commutators of singular integral operators
01.06.93	**Ramaswamy**, S. TIFR, Bombay	Viscosity solutions of PDE's
17.06.93	**Narayan**, Sivaram K. Central Michigan Univ.	A characterization of quasidiagonal shifts using marked graphs
05.07.93	**Patel**, Apoorva IISc, Bangalore	Another look at quantum mechanics and Bell's inequality
28.07.93	**Sunder**, V.S. ISI, Bangalore	Subfactors from vertex models
13.08.93	**Bethuel**, F. ENPC, Cerma, France	Vortices for the Ginzburg-Landau equation
19.08.93	**Kosmann-Schwarzbach**, Yvette Univ. of Lille, France	Poisson Lie groups
25.08.93	**Kosmann-Schwarzbach**, Yvette Univ. of Lille, France	Quantum groups
02.09.93	**Varadarajan**, K. Univ. of Calgary, Canada	Imbedding $G * F$ in F where F is a free group of rank C, for certain homeomorphism groups G"
28.10.93	**Cartier**, Pierre Paris, France	Quantum groups and applications

[1]Seminars/Colloquia by the members of the Institute are listed in the section Academic Activities, subsection Seminars/Lectures (pages 57 – 65).

04.11.93	**Bhattacharya**, Tilak ISI, New Delhi	Capacity and asymmetry
05.11.93	**Musili**, C. Univ. of Hyderabad	Hecke algebras and roots of unity
08.11.93	**Hindry**, M. Univ. of Paris VII	Size of Mordell-Weil group
09.11.93	**Hindry**, M. Univ. of Paris VII	Solutions of $P(x,y) = 0$ at roots of unity and their generations
11.11.93	**Hindry**, M. Univ. of Paris VII	Flating's theorem for the subvarieties of an abelian variety
18.11.93	**Ram Murthy**, M. Mc Gill Univ.	Automorphic L-functions and classical problems in Number theory
23.11.93	**Ram Murthy**, M. Mc Gill Univ.	Fermat's last theorem for physicists
24.11.93	**Ram Murthy**, M. Mc Gill Univ.	Selberg's conjectures
07.12.93	**Sinha**, K.B. ISI, New Delhi	Index theorems and applications
13.12.93	**Sitaram**, A. ISI, Bangalore	Pompeiu problem revisited
22.12.93 23.12.93 24.12.93	**Krishnaswami**, Alladi Univ. of Florida, Gainsville	The method of weighted words and applications to partitions (3 lectures)
29.12.93	**Raina**, A.K. TIFR, Bombay	Algebraic geometry point of view for a model quantum field theory on curves

29.12.93	**Mandal**, S. TIFR, Bombay	Projective modules and zero cycle subgroup
30.12.93	**Shiota**, T. Kyoto Univ., Japan	W-algebra actions on KP and Toda lattices
05.01.94	**Weinstein**, A. Univ. of California Berkely, USA	Differential geometry of Fedosov's quantization of symplectic manifolds
07.01.94	**Colliot-Thelene**, J.L. Univ. de Paris-sud, France	Hasse principle for pencil of varieties
19.01.94	**Philippons**, P. CNRS, France	Heights of abelian varieties
27.01.94	**Muralidharan**, T.K. Ramanujam Inst., Madras	Spectral synthesis
11.02.94	**Raman**, Ganapathy S. IISc., Bangalore	Certain decay properties of the eignvalues of a class of integral operators
21.02.94	**Thomee**, Vidar Chalmers Inst. of Tech., Sweden	Approximate solution of ode's in Banach spaces : rational approximation of semi groups
25.02.94	**Eymard** Univ. of Nancy, France.	Poisson kernel and group theory

Theoretical Computer Science[1]

07.10.93	**Mukund**, Madhavan SPIC Science Foundation	Determinizing asynchronous automata
21.10.94	**Anderson**, Richard Univ. of Washington Seattle, USA	Nearesh Neighbor Trees and N-Body Simulation
28.10.93	**Subrahmanyam**, K.V. TIFR, Bombay	Monotone contact networks and threshold functions
23.11.93	**Agrawal**, Manindra SPIC Science Foundation	The complexity of P-selective sets
23.11.93	**Vinay**, V. Bangalore	Forbidden submatrix characterization of $2S_1$
02.12.93	**Thomas**, D.G. MCC, Madras	Query learning with respect to regular sets and thue systems
07.12.93	**Subramanian**, Ashok IISc., Bangalore	An explanation of splaying
09.12.93	**Cheng**, Allan Arhus Univ., Denmark	Model checking labeled asynchronous transition systems
12.01.94	**De Simone**, Robert INRIA, France	A programming language for reactive synchronous systems
02.03.94	**Vidyasagar**, M. Bangalore	Learning Theory : An overview

[1]Seminars/Colloquia by the members of the Institute are listed in the section Academic Activities, subsection Seminars/Lectures (pages 57 - 65).

LIBRARY

During the period ended 31st March 1994, 794 books and bound volumes of periodicals were added to the Library. The Library received 300 journals, out of which about 50 were on an exchange basis.

Xerox facility is available and during the year, the library xeroxed more than one lakh pages for its faculty, office and other users of the library. Xerox articles published in journals not subscribed by us and required by our faculty, were obtained from different libraries.

The library acquired a new xerox machine with ADF facility as the existing machine is not able to cope with the demand by the faculty, administrative office and other outside users.

A preprint library is maintained in order to have rapid exchange of ideas with Physicists, Mathematicians and Theoretical Computer Scientists all over the World. There is an exchange programme for preprints with Research Institutions in India and abroad (such as CERN, NORDITA, DUBNA, SLAC, TIFR, IOP, PRL, SINP, etc.). Institute preprints are sent to these Institutions on a reciprocal basis and about 5000 preprints from various research centres were received.

Library has sent books on ILL to various academic libraries in the country and also borrowed books/periodicals for our researchers.

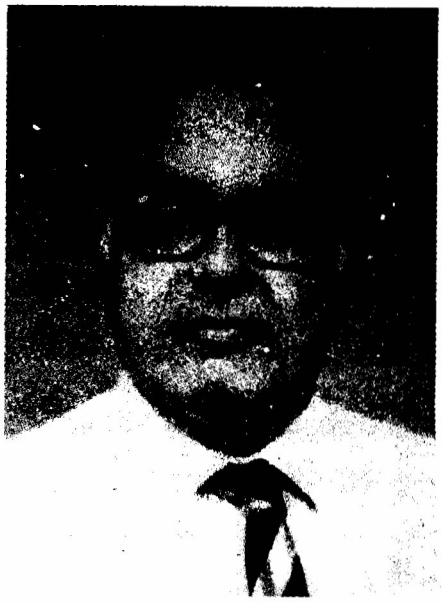
The number of visitors to the Library for reference work, making use of xerox facilities etc. has increased substantially compared to the previous years.

Mr. G. Venkatesan, Assistant Librarian, was deputed by the Institute to visit DMRL, Hyderabad, between 11 - 18 October 1993 to acquaint with library management procedures used in LIBSYS.

During the year, Institute Library received many valuable books/journals as gratis from the following and to them we owe our gratitude :

Prof. G. Baskaran, IMSc.	Dr. Rahul Sinha, IMSc.
Dr. Kamal Lodaya, IMSc.	Prof. N.R. Ranganathan, IMSc.
Prof. S. Kesavan, IMSc.	Prof. K. Srinivasa Rao, IMSc.
Prof. R. Balasubramanian, IMSc.	Prof. Toda, Tohoku Univ.
Prof. R. Ramachandran, IMSc.	Dr. V. Kumar Murthy, Toronto Univ.
Prof. Tapash Chakraborty, IMSc.	ICTP, Trieste, Italy
Dr. Meena Mahajan, IMSc.	Dr. Rohit Parikh, SIAA, NJ
Dr. Vandana Singh, IMSc.	Prof. Spenta Wadia, TIFR

R.Vasudevan (1926 – 1994)



Prof.R.Vasudevan was associated with the Institute of Mathematical Sciences from its inception. He is one of the original signatories of the memorandum related to the founding of the Institute. He was responsible for carrying through the academic programmes of the Institute - providing the necessary academic leadership and fraternal linkages between various elements. He has served as the spokesperson of the Institute in various scientific Institutions, conferences and meetings around the world.

Prof.Vasudevan was born on Nov.15, 1926 and become a Permanent Member of the Institute in 1963. He formally retired from the Institute on Nov.30, 1991, but continued to work in the Institute till the last day of his life. His scholarship has a very wide span covering subjects such as Many Body Theory and Statistical Mechanics, Superfluidity, Stochastic Theory and Applications, Coherence Optics, Invariant Imbedding Techniques for Linear and Nonlinear Transport, Biomathematics, Neural Networks, etc.

The end came on 3rd January 1994, while he was recollecting and paying tributes to one of his mentors, the late Prof. Richard Bellman. It was destined that till his last breath, he was involved in academic pursuits.

Cover Picture :

Computer Graphics illustrate the mathematical beauty of certain sets whose non-linear nature is the basis for exquisite patterns. The picture on the cover is a portion of one of the filled Julia sets corresponding to the iterations of the complex function : $f(z) = z^2 + c$. This picture was generated on the Institute's Computer System. It is just one illustration of an infinite variety of extraordinarily beautiful shapes encoded by such a simple function. (The parameters are : $z = x + iy$; $-1.0 \leq x \leq 0.0, -0.45 \leq y \leq 0.45$ and $c = -0.7435 + 0.11301.i$).