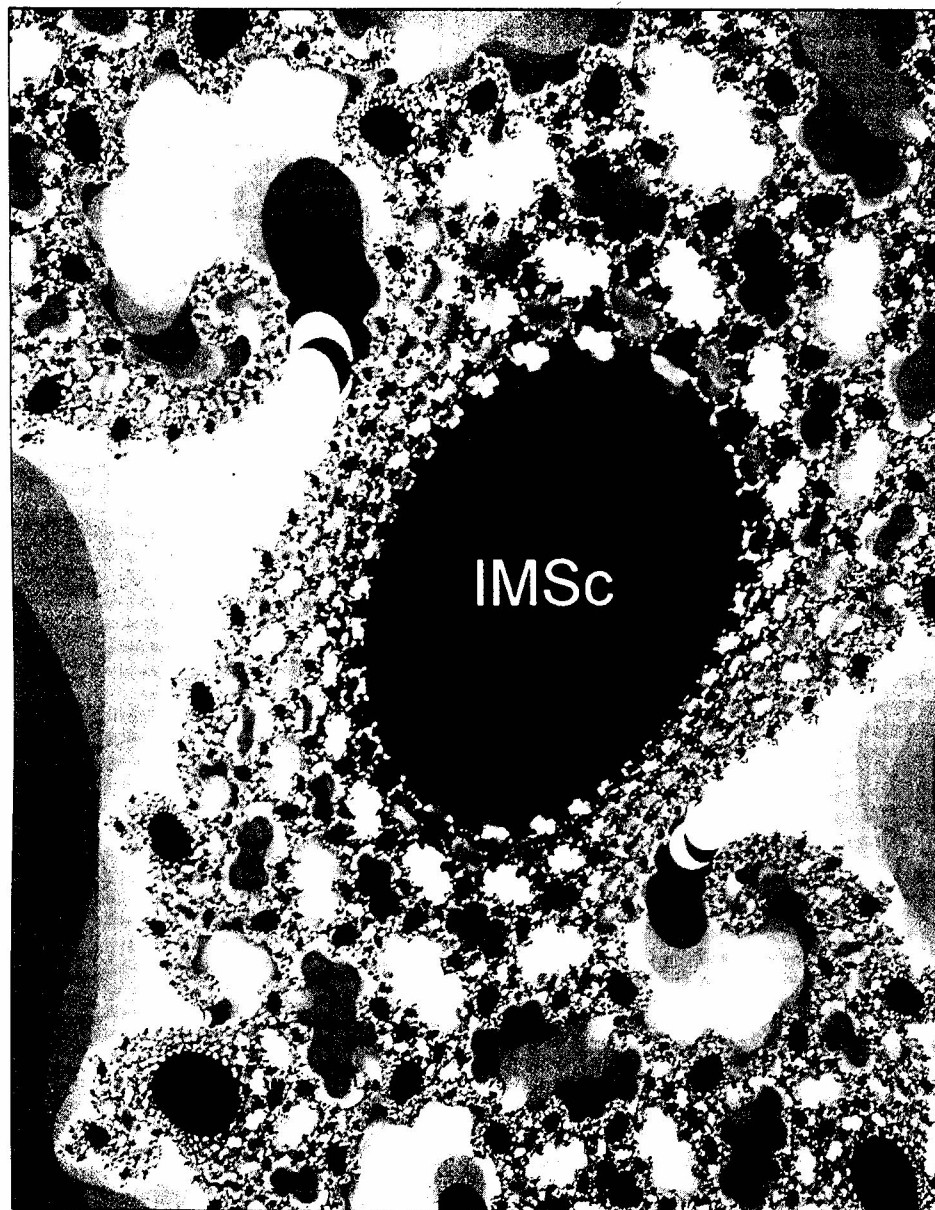


**The Institute of Mathematical Sciences**

MADRAS

INDIA



**ANNUAL REPORT**

**1994-95**

# **THE INSTITUTE OF MATHEMATICAL SCIENCES**

**C.I.T. Campus, Taramani**

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## **ANNUAL REPORT**

**April 1994 - March 1995**

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## FOREWORD

As I write this note for the annual report for 1994-95, I begin my second term as the Director of this august Institute. Just as the annual report is an occasion to review the achievements of the Institute over the year that has gone by, I may also reminisce my association with it in the last five years.

This has been a particularly rewarding experience for me, in moving from the Indian Institute of Technology at Kanpur, where one was in the midst of many a starry eyed student as well as among the faculty drawn from sciences, engineering and a small sample of humanities and social sciences disciplines, to a highly focussed pure research Institute, where one is among the distinguished colleagues engaged in competitive research in the frontline of basic Theoretical Physics, Mathematics and Theoretical Computer Science. The last five-year period for the Institute witnessed a substantial growth in the size of the faculty and in the range of areas of interest. This has the effect of finding us among something like a second set of pioneers of the institute and reminds me of the similar spirit, I had experienced in the early days at IITK.

Since research and teaching are two sides of the same coin, it will be appropriate that strong linkages are developed between the Research Institutes, such as ours and the other Institutions such as IITs and Universities with their fresh continual stream of ever fresh students and their teaching cum research faculty. The specially designed academic programme of MSc (by research) for the exceptionally talented youngsters for an early start of research that we have in collaboration with Anna University is part of this endeavour. This year saw the first two graduates of the programme receive their degrees. There is now a perception that there is a need, felt both by the Institutes and Universities, for focussed interaction that could be of value for symbiotic growth for both. With the increasing adaption of credit system of courses in the Universities, it should be possible for the Institute faculty to offer courses, that can be taken for credit by students of the Universities/IITs and thereby add further dimension to our progress. Early systematic exposure of University UG/PG students to research can make their learning more effective and at the same time offer us an opportunity to spot talent and nurture the same. I believe, we are presently at the stage, of redefining our goals and aspirations and in the process establishing a more wholesome formula for higher education and research in basic sciences.

Since the last annual report, we now have with the Institute three more faculty members in Mathematics and added one in Theoretical Computer Science and they are now part of the strong academic tradition at IMSc. We hope to continue this period of consolidation and are on the look out for enthusiastic fresh talent, either with proven experience or with a great promise.

During the year under review the Institute hosted the XIV Conference on Foundation of Software Technology and Theoretical Computer Science (FST-TCS), organised jointly with

SPIC Science Foundation and IIT, Madras, during Dec. 15-17, 1994. The conference was preceded by a three day workshop on the Algebraic Methods of Complexity (Dec 11-13, 1994) and a one-day workshop for graduate students in TCS from all over the country on December 14, 1994.

The International workshop on Novel Physics in Low-Dimensional Electron Systems (Recent Developments in Fractional Quantised Hall Effect, Quantum Dots and other Nanostructures) during Jan. 9-14, 1995 was inaugurated by the distinguished pioneer Klaus Von Klitzing (MPI, Stuttgart) and was attended by many distinguished physicists including Walter Kohn (Santa Barbara) and many front ranking state of the art experimentalists in micro electronics.

The Institute hosted the first of the SERC schools (an advanced pedagogically oriented national activity sponsored by the DST) in the area of Lasers and Quantum Optics during Jan.23 - Feb.10, 1995. The school on 'Coherence and Correlations in Modern Optics and Quantum Physics' was directed by Professor R. Simon and is expected to be the trendsetter for the remaining set of schools in the sequence.

In keeping up with the pace of development in the field of Information Exchange, which we recognise as essential for ensuring efficient access to various databases and preprint archives etc, the Institute has joined the select few with VSAT (Very Small Apartine Terminal) satellite link. This connects our ernet (Educational and Research Network) node with the Internet through an alternate reliable high speed link. Further augmentation of computing power has started with the arrival of the next generation (100 plus MIPS rating) workstation - Power Indigo of Silicon Graphics - and other necessary peripherals.

It is my pleasure to record here that our faculty continue to win many laurels for themselves and hence for the Institute. I should like to make a special mention of Professor S. Nag, who has been elected a Fellow of the Indian Academy of Sciences during the last year.

This annual report has been compiled through the efforts of Prof. K. Srinivasa Rao, Dr. V. Arvind, Dr. P. Majumdar, Dr. D.S. Nagaraj and Mr. K.S. Santhanagopalan. Mr. G. Venkatesan, Mr. A.R. Balakrishnan and Mr. R. Ganapathy assisted in typesetting the annual report using  $\LaTeX$  and to all of them I owe my gratitude. As I close this foreword, I look forward to the next 5 years of exciting activities of the Institute.

September 1995

R. Ramachandran  
Director

## BOARD

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Prof. **G. Rajasekaran**, Joint Director, Institute of Mathematical Sciences, Madras (Member)

Prof. **V.S.Ramamurthy**, Director, Institute of Physics, Sachivalaya Marg, Bhubaneswar (Member)

Prof. **K.R. Parthasarathy**, Distinguished Scientist, Indian Statistical Institute, Delhi Center, New Delhi (Member)

Shri **V. Ranganathan**, I.A.S., Joint Secretary to Government of India, Department of Atomic Energy, Bombay (upto Aug. 31, 1994)(Member)

Shri **B.K. Saha**, I.A.S., Joint Secretary to Government of India, Department of Atomic Energy, Bombay (from Sept. 1, 1994) (Member)

Tmt. **Jayanthi**, I.A.S., Secretary to Government, Education Department, Government of Tamil Nadu, Fort St. George, Madras (Member)

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

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Prof. V.S. Ramamurthy, Director, Institute of Physics, Sachivalaya Marg,  
Bhubaneswar (Member)

Prof. G. Rajasekaran, Joint Director, Institute of Mathematical Sciences,  
Madras (Member)

Shri V. Ranganathan, I.A.S., Joint Secretary to Government of India,  
Department of Atomic Energy, Bombay (upto Aug. 31, 1994) (Member)

Shri B.K.Saha, I.A.S., Joint Secretary to Government of India, Department  
of Atomic Energy, Bombay (from Sept. 1, 1994) (Member)

Tmt. Jayanthi, I.A.S., Secretary to Government, Education Department,  
Government of Tamil Nadu, Fort St. George, Madras (Member)

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

## PATRON

Sri C. Subramaniam

## FACULTY

### DIRECTOR

Prof. Ramachandran, R.

### PHYSICS

Prof. Baskaran, G.	Dr. Anishetty, Ramesh
Prof. Chakraborty, Tapash	Dr. Balakrishnan, Radha
Prof. Hari Dass, N.D.	Dr. Basu, Rahul
Prof. Jagannathan, R.	Dr. Date, G.
Prof. Kaul, Romesh K	Dr. Govindarajan, T.R.
Prof. Parthasarathy, R.	Dr. Jayaraman, T.
Prof. Rajasekaran, G.	Dr. Madan Rao
Prof. Rangarajan, S.K.	Dr. Majumdar, Partha
Prof. Sharatchandra, H.S.	Dr. Mishra, A.K.
Prof. Simon, R.	Dr. Murthy, M.V.N.
Prof. Sridhar, R.	Dr. Ray, Purusattam
Prof. Srinivasa Rao, K.	Dr. Shankar, R.
	Dr. Sinha, Rahul
	Dr. Uma Sankar, S.*

### MATHEMATICS

Prof. Balasubramanian, R.	Dr. Krishna, M.
Prof. Kesavan, S.	Dr. Nagaraj, D.S.
Prof. Mandal, Sathya	Dr. Sastri, Swathi
Prof. Nag, Subhashis	

### THEORETICAL COMPUTER SCIENCE

Dr. Arvind, V.	Dr. Meena, Mahajan
Dr. Lodaya, Kamal	Dr. Seth, Anil
Dr. Ramanujam, R.	Dr. Venkatesh Raman

### SCIENTIFIC OFFICER

Dr. Subramoniam, G.

---

\* Resigned from 17.12.1994



## POST-DOCTORAL FELLOWS AND RESEARCH ASSOCIATES

### PHYSICS

Dr. Ali, Abbas  
Dr. Basu Mallick, Bireshwar <sup>1</sup>  
Dr. Qureshi, Tabish  
Dr. Sa, Debanand  
Dr. Sheshadri, K  
Dr. Sinha, Nita <sup>2</sup>

### MATHEMATICS

Dr. Guha, Partha  
Dr. Sengadir, T

### THEORETICAL COMPUTER SCIENCE

Dr. Srinivasaraghavan, G <sup>3</sup>

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<sup>1</sup> PDF completed in Feb. 1995

<sup>2</sup> PDF completed in Feb. 1995

<sup>3</sup> PDF completed in Sept.1994

## STUDENTS

### JUNIOR RESEARCH FELLOWS

#### PHYSICS

Mr. Babu, Dutta Sreedhar	Mr. Majumdar, Pushan
Mr. Chelluvaraja, Srinath	Mr. Nandakumar, Ramavarma
Mr. Das, Jayajit	Mr. Narayanan, Mohan
Mr. Das, Saurya	Ms. Ramadevi, P
Ms. Dasgupta, Arundhati	Mr. Sarkar, Subhajit
Mr. Deodhar, Shekar Ramesh <sup>1</sup>	Mr. Sarkar, Tapobrata
Ms. Desikan, Shubashree	Mr. Sinha, Subhashis
Ms. Elizabeth, S. Mary	Mr. Sundar, K
Mr. John, Varghese <sup>2</sup>	Ms. Vathsan, Radhika
Mr. Khan, S.A	

#### MATHEMATICS

Ms. Bhattacharya, Dakshini	Mrs. Radha, R
Mr. Ghosh, Dibyendu	Ms. Rajesh, M
Ms. Kulkarni, M.V	Mr. Ramana, Surya
Mr. Naga Subramanian	Mr. Sabu, N

#### THEORETICAL COMPUTER SCIENCE

Mr. Vinodchandran, N.V	Mr. Madhusudan, P
Mr. Chatterjee, Jyotishman <sup>3</sup>	Mr. Mohalik, Swarup Kumar
Mr. Gopalakrishnan, <sup>4</sup> C.P	Mr. Nagaraj, S.V

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<sup>1</sup> *JRF Completed on 31.10.94*

<sup>2</sup> *JRF Completed on 30.9.94*

<sup>3</sup> *Has left the Institute*

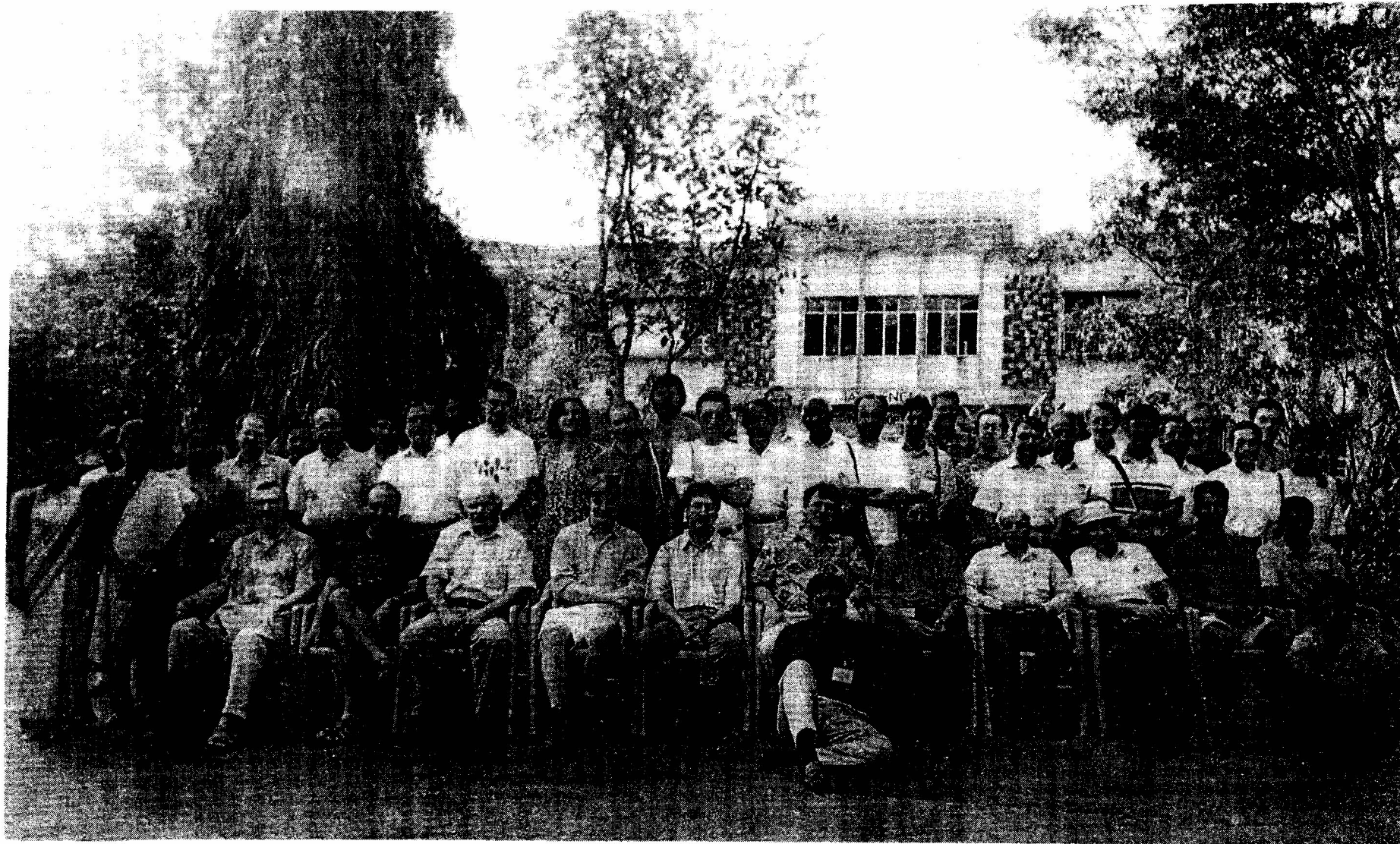
<sup>4</sup> *Resigned from 6.3.95*

## ADMINISTRATIVE STAFF

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

Mr. Amulraj, D.	Mr. Radhakrishnan, M.G.
Mr. Ashfack Ahmed, G.	Mr. Rajasekaran, N.
Mr. Balakrishnan, A.R.	Mr. Rajendran, C.
Mr. Balakrishnan, J.	Mr. Ravichandran, N.
Mr. Elumalai, G.	Mr. Ravindran, A.
Mr. Ganapathi, R.	Mr. Rizwan Shariff, H.
Ms. Gayatri, E.	Mr. Sankaran, K.P.
Ms. Geetha, M.	Mr. Selvaraj, M.
Ms. Indra, R.	Mr. Tamil Mani, M.
Ms. Moorthy, E.	Mr. Usha Devi, P.
Mr. Munuswamy, M.	Ms. Usha Otheeswaran.
Mr. Muthukrishnan, M.	Ms. Vasudevan, T.V.
Mr. Muthusigamani, S.	Mr. Varadaraj, M.
Mr. Nithyanandam, G.	Mr. Venkatesan, G.
Ms. Parijatham, S.M.	Mr. Venugopal, T.
Mr. Parthiban, V.	

## **ACADEMIC ACTIVITIES**



Group Photograph taken on the occasion of the **Workshop on Novel Physics in Low-Dimensional Electron Systems**, held at the Institute, from Jan. 9 to 14, 1995.

# Summary of Research Work

## Physics

### Quantum Groups, Generalized Statistics, Mathematical Methods

The quantum algebra corresponding to a two-parametric nonstandard  $R$ -matrix has been studied, its universal  $\mathcal{R}$ -matrix has been determined, and its connection with  $U_{p,q}(gl(2))$  and  $U_{p,q}(gl(1|1))$  has been established. The theory of Fronsdal and Galindo (1993) on the exponential relationship between a quantum group and the associated quantum algebra has been used to obtain the finite-dimensional (co)representations of the quantum group  $GL_{p,q}(2)$  from the well known  $(2j+1)$ -dimensional representations of  $U_{p,q}(gl(2))$ . The exponential map from the quantum superalgebra  $U_{p,q}(gl(1|1))$  to the corresponding quantum supergroup  $GL_{p,q}(1|1)$  has also been obtained. Certain polynomial deformations of the  $osp(1|2)$  algebra, associated with a class of generalized parabosons, and their representations have been studied.

Squeezed angular momentum states for the quantum group  $SU_q(2)$  are constructed in terms of quantum group analogue of Wigner d-functions. The notion of rotation for quantum group is extended and a 'continued fraction' representation for rotation matrices is obtained.

A Fock space representation for differential calculus on noncommutative spaces has been constructed. The Fock space representation reveals the incompleteness of the Woronowicz-Wess-Zumino calculus and leads us to construct the complete calculus.

The observation that while the 9-j recoupling coefficient, appearing in the quantum theory of angular momentum has 72 symmetries is well known, the triple-sum series expression for the 9-j coefficient exhibits none of these symmetries is not known, has been exploited in a study of a stretched 9-j coefficient, for which a closed form (single-term) expression exists. A study of its symmetries, vis-a-vis the triple sum series, results in summation theorems. Apart from well known single summation theorems for hypergeometric functions (viz. Gauss, Vander Monde, Saalschutz, Pfaff, Karlsson, Minton summation theorems), four new summation theorems, two for triple hypergeometric functions have been obtained, in an ongoing study.

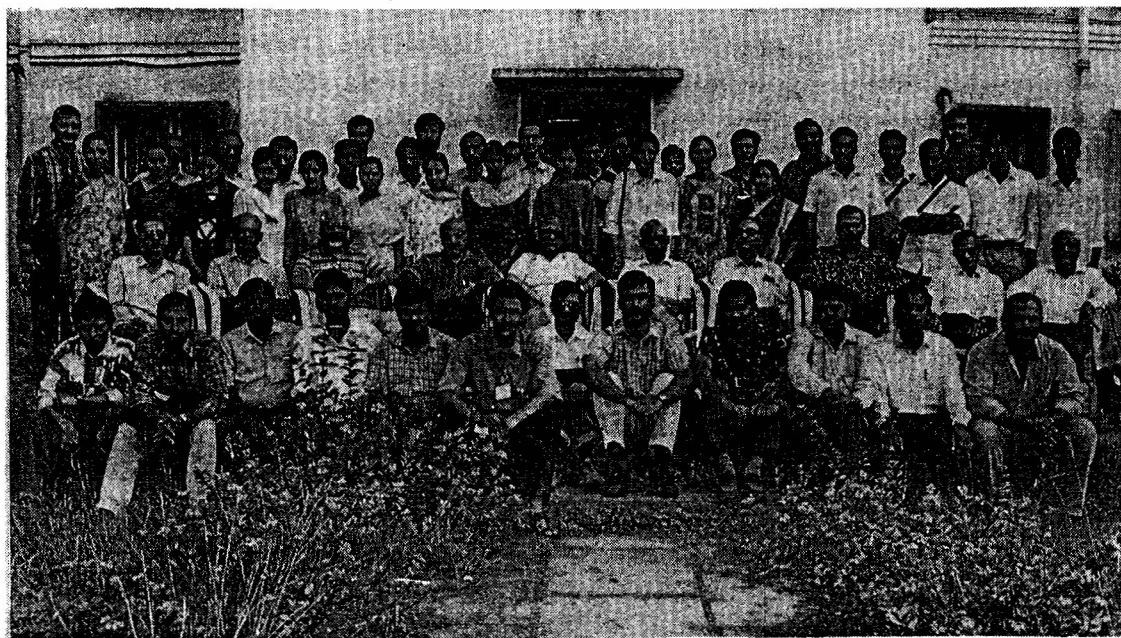
New integral representations for the 3-j angular momentum coefficient, have been obtained, using a generalization of the Pochhammer integral representation for the Gauss hypergeometric function.

### Dynamical Systems, General Quantum Mechanics

Certain basic differences in the nonlinear dynamics of the Heisenberg ferromagnetic and



From left to right : Prof.Klaus von Klitzing (Nobel Laureate), Prof.T.Chakraborty, Prof.R.Ramachandran (Director), Prof.G.Baskaran, Prof.Walter Kohn and Prof.K.Srinivasa Rao.



Group Photograph taken on the occasion of the SERC School on Coherence and Correlation in Modern Optics and Quantum Physics, held at the Institute from Jan. 23 to Feb. 10, 1995.

antiferromagnetic chains which have hitherto been unnoticed are pointed out. Their associated geometric phases are studied. Exact multi-twist solutions of the Belavin-Polyakov equation are derived. These are important dynamical solutions to the antiferromagnetic chain, and belong to a class quite distinct from the well known instantons and merons. Using classical differential geometry of surfaces and moving curves it is shown that the Belavin-Polyakov equation is a C-integrable equation, by mapping it to the elliptic Liouville equation whose general solution is known. Work is in progress to derive exact dynamical solutions of the inhomogeneous Heisenberg Hamiltonian, for a wide class of inhomogeneities, using surface theory.

The spectrum of the rectangular billiard in presence of a flux line is computed numerically and analysed for the nearest neighbour spacing statistics. This is shown to imply that classically pseudo-integrable systems do not show any generic level spacing statistics. The simplicity of the model which permits drawing this implication is emphasized.

The methods of reduced phase space quantization and Dirac quantization have been studied in the context of a simple gauge theory, viz  $S^2$ . A condition for the possible equivalence of the two methods is discussed.

A unified treatment of various quantum interference effects is given based on the earlier higher-dimensional formalism for these interference effects. In particular the geometrical (Berry) phase is derived from the same formalism and the so-called dynamical phase is also given a geometrical meaning.

It is shown that higher order corrections to the lowest order semiclassical quantization rule vanish in the case of three known shape invariant potentials with broken supersymmetry thereby establishing that the lowest order formula is indeed exact for these shape invariant potentials with broken supersymmetry.

A large class of bosonic coherent states, constructed recently in a unified way by Shanta, Chaturvedi, Srinivasan, Agarwal and Mehta (1994) has been extended to generalized (or  $q$ -) bosonic oscillator systems.

STM current in presence of chemisorbed intermediates is analyzed and it is demonstrated the weak and strong chemisorbed states can be distinguished through such studies.

## Particle Physics, Quantum Field Theory, String Theory

The decays  $b \rightarrow s\gamma$  and  $b \rightarrow se^+e^-$  are used to constrain the electric dipole and the magnetic quadrupole moments of the W-boson to explore possible CP violating effects due to it.



Compatibility with the elements of the CKM matrix is also being used to constrain these moments. LEP I results are also being used to constrain anomalous  $WWZ$  CPV coupling using  $\Gamma(Z \rightarrow b\bar{b})$ . Under investigation also is the process  $e^+e^- \rightarrow l_1^- \bar{\nu}_{l_1} l_2^+ \nu_{l_2}$ , where  $l_1, l_2$  are either of the three leptons  $e, \mu$  or  $\tau$ , with regard to measuring the internal properties of the  $W$  boson, and estimating the two CP violating terms. The validity of the equivalent photon approximation for the production of intermediate vector boson pairs is also under examination.

A new asymmetry has been found which will make it possible to see CP violation in  $B$  decays produced even at hadron colliders.

Phenomenological analysis of the spin content of the nucleon has been performed, based on the current understanding following the latest experimental results of EMC collaboration at CERN.

Solar and atmospheric neutrino problems have been analyzed in the context of three neutrino oscillations. It has been shown that in contrast to the two-neutrino scenarios, there exists a substantial region of the 5-parameter space of three-neutrino mixing in which both problems can be solved.

It is shown that if preons were orthofermions, the original Harari-Shupe model with a novel origin for quark colour can be made consistent with quantum field theory.

The issue of chiral symmetry breaking in QCD is studied using a chiral quark sigma model in which besides quarks and gluons, pions are taken as elementary fields. Quantum one loop effects in the instanton background are calculated. The effective potential leads to chiral symmetry breakdown induced by instanton effects with massive  $\eta'$ . The validity of the model at suitable energy range is discussed.

It has been demonstrated that there is a large class of asymptotically free theories which contain the conventional QCD, and which are such that QCD becomes the dominant component at very high energies. However, the structure of the standard model is such that the only additional fields that can be allowed are massive chiral multiplets if the high accuracy Z-width data are not to be contradicted. A number of interesting phenomenological tests for these models have been proposed.

Fluctuations of Goldstone bosons are studied using Renormalization Group flows, Ward identities and Schwinger Dyson equations. It is shown that generically the longitudinal susceptibility diverges as one of the consequences of the masslessness of Goldstone bosons, being characterised by an anomalous dimension  $(d-2)$  in space-time dimensions  $2 < d < 4$ . In  $d = 4$ , the divergence is logarithmic. An explicit form of generating functional of 1PI vertices of the  $O(N)$  non-linear sigma models in the leading  $1/N$  approximation has been derived.

A framework for studying knot and link invariants from any rational conformal field theory was developed. In particular, minimal models, superconformal models and  $W_N$  models were studied. The invariants are related to the invariants obtained from the Wess-Zumino models associated with the coset representations of these models. It has been demonstrated that mutant knots and links can not be distinguished by the elementary Chern-Simons invariants. Representation theory of a class of composite braids made of certain number of strands has been developed in an attempt to find new invariants that would distinguish mutants. Even these invariants turn out to be unable to detect mutations in knots. However links related by mutations in strands from different component knots can be distinguished by these composite invariants.

Numerical simulation of a recent formulation of lattice gauge theory on a dual lattice space has been investigated. An algorithm which is also capable of studying the centre degrees of freedom in a controlled way has been devised. The numerical approach is promising from many other angles also such as elucidating the nature of the disordered variables.

Investigations into  $W$ -geometry have continued. Earlier ideas on the moduli space of  $W$ -geometry have been augmented to include an explicit uniformisation of the  $W$ -space. Currently the case of the  $n$ -punctured sphere is being analyzed in order to explicitly construct the analogue of the cross-ratio for the usual four-punctured sphere.

The world sheet supersymmetry algebra has been realized in an explicitly duality invariant form in which the world sheet action for the superstring has been worked out as well, generalizing earlier work on the bosonic string.

Investigations into the various forms of duality in string theory are in progress, with special emphasis on the so-called S-duality which is believed to exist as a quantum symmetry between the strong and weak coupling sectors of string theory.

The complete deformed Yangian algebra for multiparameter dependent  $R$ -matrix for integrable models which respect a Yangian symmetry has been completely worked out.

An effective action of a string world sheet in  $R^3$  and  $R^4$  is obtained utilizing its correspondence with the constrained Grassmannian  $\sigma$  model. Two class of surfaces, minimal and harmonic are considered and quantum fluctuations of these are calculated. The resulting partition function represents a two dimensional modified Coulomb gas. The fugacity is found to depend upon the running coupling constant. At low momenta, long range correlations are obtained thereby suggesting confinement. At large momenta, the system is in plasma phase with a mass gap. The flux lines curl up thereby explaining asymptotic freedom.

Finite size analysis of dynamically triangulated two dimensional random surfaces have been performed. Exact solutions of 2-Matrix models have been exploited to devise efficient algorithms to generate finite area partition sums on the one hand, and to develop analytical methods to isolate finite size effects on the other. A general ansatz for parametrising finite size effects has been proposed, which should prove useful in numerical approaches to the so called  $c=1$  barrier problem.

Point particle scattering at Planckian centre-of-mass energies and low fixed momentum transfers, occurring both due to electromagnetic and gravitational interactions are investigated, with particular emphasis on novel features arising in charge-monopole scattering. Unlike ordinary charge-charge scattering, monopoles are seen to produce effects that are as large as those due to pure gravity in this kinematical limit. Also, the poles of the eikonal amplitude are seen to shift by half-odd integral values in accord with expectations based on early work by M. N. Saha. The issue of possible mixing of electromagnetic and gravitational shock waves is addressed. In general relativity, the shock waves appear to act independently of each other, in contrast to the case of dilaton gravity where non-trivial mixing is obtained. An external metric approach, analogous to Coulomb scattering, is employed to study the scattering away from the limit of very small momentum transfers. The leading corrections to the eikonal amplitude obtained in the shock wave approach are derived. The decoupling of gravitational and electromagnetic shock waves persist through the leading order correction, but fail at higher orders (i.e., at smaller impact parameters).

### Condensed Matter Physics, Statistical Mechanics

The problem of effective mass divergence in the quantized Hall fluid at  $\nu = \frac{1}{2}$  has been an outstanding issue in the last few years in the field of fractional quantized Hall effect. A natural explanation for this anomaly invoking some novel properties of the structure of the composite fermion quasi-particles has been found and a BCS type of low temperature instability that follows from the structure of the quasi particles has been predicted. An unsuspected anomalous character of the quasi particle has also been brought out.

A model to explain superconductivity in the nickel borocarbide systems has been developed. Using the experimental results, a fundamental role played by correlations has been found, as well as some fundamental similarities of this system with the layered cuprates. Some new predictions based on this modelling have been made.

The anomalous c-axis conductivity of the layered cuprates have been explained as an anomalous paraconductivity arising from the interlayer pair tunneling processes. A model developed to bring this out exhibits several intriguing features of the c-axis Cooper pair dynamics as well as certain predictions.

The g-on concept has been extended to a 2-dimensional t-J model and the interesting statistics transmutation as a function of doping as well as temperature found. This work goes beyond the conventional slave boson type of mean field theories.

Numerical results regarding the gap function in strongly correlated systems using t-J and Hubbard models in one and two dimensions have been obtained. A combination of numerical, experimental and physical arguments are provided to argue that correlations lead to a local constraint on charge fluctuations in k-space close to the Fermi Surface in high- $T_c$  superconductors.

A periodic array of scatterers in a two-dimensional electron gas (antidots) subjected to a strong perpendicular magnetic field is found to have a significant influence on the correlated states of the electrons. A unique interaction and disorder driven spin transition in the system is observed. For a Gaussian form of antidot potential, the ground state at  $\frac{1}{3}$ -filled lowest Landau level gradually transforms from a fully spin-polarized state to a spin-partially-polarized and eventually to a spin unpolarized state as the potential strength and width are increased. The signature of those transitions is also evident in the lowest energy spin and charge excitations.

The persistent current in a quantum ring in the presence of a Gaussian impurity and/or Coulomb interactions has been studied. The impurity potential mixes the states, lifts the degeneracies in the energy spectrum, and reduces the persistent current from its impurity-free value. The role of interactions in the absence or presence of impurity was found to be insignificant. Results for charge density of the system in the presence of the impurity with or without the Coulomb interactions have also been obtained.

A microscopic derivation of the Ginzburg Landau free energy functional starting from a non-Fermi liquid ground state is presented. Assuming a BCS like pairing interaction, an analytical expression for the Ginzburg Landau coefficient  $a(T)$  and  $b$  as a function of the scaling exponent  $\alpha$  ( $\alpha$  is the exponent which appears in the single particle propagator, characterising the non-Fermi liquid ground state,  $\alpha=0$  corresponds to that of Fermi liquid) has been obtained. It has been shown that the non vanishing value of the exponent  $\alpha$  which leads to the breakdown of the Fermi liquid theory in the normal state gives rise to qualitatively and quantitatively different results in the superconducting state.

Haldane's definition of fractional statistics given for finite dimensional spaces has been extended to infinite dimensional Hilbert spaces. It has been shown that the exclusion statistics described by a parameter  $g$ , may be completely determined by the second virial coefficient of the system of particles. The thermodynamics of particles in one dimension which obey Haldane's fractional exclusion statistics is worked out in detail. A set of counting rules that completely specifies the occupancy of a given cell by these exclusion statistics particles has

Electron correlation effects in quantum dots and rings which include repulsive scattering centers and subjected to a perpendicular magnetic field have also been studied. The results for the dipole-allowed absorption spectrum show good qualitative agreement with the observed magnetoplasmon dispersion. The present work unifies our understanding of the role of electron correlations in quantum dots, antidots and quantum rings in a magnetic field.

been obtained. From these rules one arrives immediately at the dimension of the many body state as given by Haldane. The statement of these rules also immediately rules out some apparent pathologies pointed out several authors recently.

The phenomenon of charge fractionalisation of the spatially confined particle in chiral models is shown to be interpreted as a manifestation of the exclusion statistics. The parameter of fractional exclusion statistics is then related to the fractional charge. Analogous phenomenon also occurs in the Kondo system. The collision term in the Boltzmann-Nordheim transport equation has been generalized for quasiparticles obeying the fractional statistics in one dimension. For equilibrium situation this leads to the golden rule factor for quantum transitions.

The dynamics of quantum tunneling of atoms in metals where the effect of electron assisted tunneling is relevant is studied to throw light on the experiments showing "Kondo scattering" without magnetic impurities. The model is also connected to the two-channel Kondo Hamiltonian. The dynamics of a dissipative two-level system is studied in regimes where earlier approximations failed. New results were obtained which describe the intermediate and long time dynamics of a Kondo impurity spin.

A two-dimensional lattice model of dense polymer melt is studied by Monte Carlo simulation, as a model of glass transition. A finite size dependence is seen in the dynamical properties of the model at low temperatures which suggests the presence of a correlation length.

Investigations have been made on the zero-temperature pressure induced freezing transition from superfluid to solid  $^4\text{He}$ . A density-functional approach is employed to study this problem.

## Optics and Particle Beams

The algebraic approach developed earlier for spinor electron optics, by Jagannathan *et al.*, has been extended to scalar electron optics using a Feshbach-Villars-type form for the optical representation of the Schrödinger/Klein-Gordon equation and a Foldy-Wouthuysen-like transformation technique. This scalar quantum theory of charged-particle optics can handle systematically aberrations up to any desired order of accuracy. A phase space formulation of charged particle wave optics, using Wigner functions, is being developed.

# Mathematics

## Algebraic and Analytic Number Theory

If  $f(n)$  denotes the minimal cardinality of a set  $S$  such that any lattice point in the square of side  $n$  is visible from some point of  $S$ , then an upper and lower bound for  $f(n)$  has been obtained. A partial answer to the question of Erdős regarding the maximal subset  $A$  in  $[1, N]$  such that no  $h + 1$  elements of  $A$  are pairwise coprime has been obtained.

The problem of Galois module structure was completely settled for extensions of small degree. In particular, the cases

(a)  $[L : Q] = 4, [L : K] = 2$

(b)  $K = Q[i], L = K[a^{\frac{1}{4}}]$

(c)  $K = Q[i], [L : K] = 3$

were covered.

## Algebraic Geometry and Commutative Algebra

The loci of bundles  $E$ , in the moduli of rank two vector bundles on a smooth curve, for which  $ad(E) \otimes L$  has two linearly independent sections was completely described. Some new results on the moduli of rank two depth one sheaves on a reducible curve  $C$  which is the union of two smooth curves meeting transversally at one point were obtained. It was observed that the ampleness condition in the criterion of Fulton and Lazarsfeld on the connectedness of degeneracy loci of mapping between vector bundles cannot be weakened to *nef* and *big*.

The relationship between complete intersection and K-theory has been studied. Partial answers were obtained for the following questions :

- (i) Construction of projective modules with preassigned chern classes.
- (ii) When is an ideal the image of a projective module of appropriate rank?
- (iii) If a projective module  $P$  of rank  $r$  is free, whenever it is restricted to a subvariety of codimension  $r$ , then is  $[P] - r$  torsion in the Grothendieck group?

## Complex Analysis

Rodin and Warschawski showed that a sufficient condition for the existence of angular derivative is that euclidean area of  $S - R^i$  is finite. It was shown that the condition is necessary. For a non constant  $K$ -quasi meromorphic map, a suitable upper bound for  $n(r, a_j)$  was obtained.

## Differential Equations

The asymptotic stability and the asymptotic integration of the equations of the form

$$\begin{aligned}u'(t) &= F(t, u(t), u(pt)) \quad \text{and} \\u'(t) &= au(t) + bu(t/2) + cu'(t/2) + (u'(t/2))^2\end{aligned}$$

were studied.

It has been shown that all isolated solutions with non vanishing topological index of  $p$ -Laplacian equation on a symmetric domain possess the desired symmetries.

## Differential Geometry

Using Grothendieck - Riemann - Roch theorem via "Deligne pairings" a general construction of universal  $\text{Det}(\bar{\partial})$  bundles in the context of  $T(\Delta)$  was given. The perturbation theory of welding invariant has been obtained to arbitrary orders by formulae involving Cauchy integrals.

## Functional Analysis

Currently work is in progress on a way to recover one dimensional Schrödinger operators from a flow in a general sapce, in an attempt to generalize the picture valid for periodic and almost periodic operators.

## Harmonic Analysis

Multipliers for the vector version of the pair  $(L^1(G), L^p(G))$  were got. Multipliers for the Weyl transform related to Schrödinger representation of the Heisenberg group also were studied.

# Theoretical Computer Science

## Complexity Theory

Under the assumption of NP having polynomial-time circuits—apart from the known polynomial-time hierarchy collapse to  $ZPP^{NP}$ —it is shown that there is an additional “inner collapse” of the two classes AM and MA.

The complexity of honest provers in interactive proof systems is investigated. Upper bounds for the prover complexity of languages in FewEXP and for sparse sets in NP are derived. Interactive protocols with provers that are reducible to sets of low information content are considered. If the verifier communicates only with provers in P/poly, then the accepted language is shown to be low for  $\Sigma_2^P$ . For honest provers that are reducible to log-sparse sets or to sets in Strong-P/log, the protocol can be simulated by a BPP machine. New collapse consequences are derived as corollary.

Reductions of self-reducible sets equipped with the OR (or AND) function to languages accepted by non-uniform constant-depth circuits with *Mod* gates or threshold gates are studied. Upper bounds are proved for the complexity of such self-reducible sets. New collapse consequences concerning reductions to sparse sets are obtained as corollary.

A new characterisation of  $\text{Mod}_kP$  is obtained, and using a promise version intersections of  $\text{Mod}_kP$  classes are neatly characterized. These results translate to the generalised Mod setting considering the disjunctive and conjunctive truth-table closures of ModP.

Sufficient conditions for feasible depth reduction and parallelisation in the presence of non-commutative operators is studied. A generalisation of the notion of left-skewness is proposed; these generalisations form a proper hierarchy.

A logspace reduction from NC to languages accepted with polylog rounds of interaction by a logspace verifier is presented. NP is characterised by interactive proof systems where the verifier uses log space, polynomial time, and an auxiliary pushdown store. PSPACE is shown to be characterised by similar proof systems where the auxiliary store is a non-erasing readable stack, and the verifier alternates between pushdown mode and scan mode exactly once.

## Concurrency and logic

It has been shown that knowledge and next-state modalities can together force com-



muting transitions on models thereby leading to undecidability. This is seen as establishing the need for logics of knowledge where formulas interpreted over local rather than global states.

A subclass of event structures, where sequential agents communicate by synchronization, has been studied. Transition system models for such structures typically require global state information which cannot be obtained by taking products of transition systems. A class of transition systems has been proposed with shared local states and a new product operation, which does manage to capture synchronization structures.

## Resource-bounded logic

We completely characterize the recursively enumerable classes of finite structures on which PFP captures all PSPACE queries of arbitrary arities. We also give examples of classes of rigid structures which are of unbounded rigidity but Least fixed point (Partial fixed point) logic can express all Boolean PTIME (PSPACE) queries on these classes.

The "Oracle Turing Machine" model is extended to compute functionals of all finite types. Using this model analogs of class  $C_1$  are defined in all finite types. Two apparently different classes are obtained corresponding to two different ways of querying higher type inputs. One class turns out to be the BFF whereas the other one is apparently larger than BFF for types 3 and above. However, showing separation between these two classes is open.

Type 2 analogs of the type 1 polynomial hierarchy are examined and some limitations on finding a completely faithful type 2 analog are shown. Most notions of type 2 poly-hierarchies already proposed in the literature are surveyed and two natural definitions of type 2 poly-hierarchies are presented. Various notions of resource bounded reductions between functionals of type 2 are also introduced.

## Algorithms

Search for exact bounds for finding vertices of any prescribed degree in a tournament is continued. This problem generalizes the well studied problem of selection in transitive tournaments. Earlier reported upper and lower bounds for the problem are improved, and the same problem on general directed graphs and undirected graphs is studied.

It is shown that finding minimum weighted hamiltonian paths, hamiltonian cycles or dominating sets is NP-hard in weighted tournaments. The dominating set problem for unweighted case is also shown to be hard for the parametrized complexity class  $W[2]$  and hence as a corollary for the class *LOGSNP*.

Structural properties of the optimal binary search trees are studied, algorithms and lower bounds to construct and verify optimal trees and heuristics to construct nearly-optimal trees and other related results are also examined.

An algorithm for testing if a number is a perfect power is developed, where the input is assumed to be chosen from an interval of polynomial size as opposed to a result of Bach where a super-polynomial interval size was assumed. This settles a conjecture of Bach.

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\* External collaborator

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**Balasubramanian, R. and Adhikari, S.D.\***

On a question regarding visibility of lattice points  
Mathematika (to appear)

**Cukierma, Fernando\* and Mandal, Satya**

Study of Vector Bundles by Restriction,  
Communication in Algebra, (to appear)

**Kesavan, S**

Comparison theorems via Schwarz symmetrization - A survey, partial differ-  
ential equations of elliptic type,  
Symposium Mathematica Eds. A. Alviso, E. Fabes and G.Talenti  
XXX p.185-196.

**Kesavan,S.,Pacella,F.\*,Grossi,M.\*,and Ramaswamy,M.\***

Symmetry of solutions of a class of nonlinear equations, Preprint.

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\* External collaborator

**Kulkarni, Manisha**

Galois Module Structure of Bicyclic Biquadratic And Cyclic Quartic Extensions Over Their Quadratic Subfields,  
Indian Journal of Pure and Applied Mathematics (submitted)

**Kulkarni, Manisha and Venkataraman, S.\***

On the Galois Module structure of Kummer extensions of degree 3 and 4,  
Journal of Number Theory (submitted)

**Kulkarni, Manisha and Venkataraman, S.\***

An Analogue of Leopoldt's Theorem,  
Acta Arithmetica (submitted)

**Mandal, Satya**

Complete Intersection and K-theory-1 (preprint)

**Mandal, Satya**

Complete Intersection and K-theory-2 (preprint)

**Mandal, Satya and Raja Sridharan\***

Complete Intersection and Euler Classes (preprint)

**Nag, S.**

Singular Cauchy integrals and conformal welding on Jordan curves

*Max-Planck-Institut preprint MPI-94-58;*

Annales Acad. Scient. Fenn., Series A1, Math. **20** (1995) (to appear)

**Nag, S and Sullivan, D\*.**

Teichmüller theory and the universal period mapping via quantum calculus  
and the  $H^{1/2}$  space of the circle

*Max-Planck-Institut preprint MPI-94-54;*

Osaka Jour. of Math., **32** (1995) (to appear).

**Nagaraj, D.S. and Ramanan, S.\***

Polarisation of type  $(1, 2, \dots, 2)$  on abelian Varieties.

Duke Journal of Mathematics (to appear).

**Radha, R.**

Multipliers for the pair  $(L^1(G, A), L^p(G, A))$ ,

IMSc Preprint (submitted)

**Sengadir, T.**

Existence and Stability of Nonlinear Functional Differential Equations  
J. Math. Anal. Appl. (Revised, to appear)

**Sengadir, T.**

Stability of Neutral Functional Differential Equations (submitted)

**Sastri, S.**

A converse defect relation for quasi-meromorphic maps,  
Ann. Acad. Sci. Fenn., Series A.I. Math., **20** (1995) 61-79

**Sastri, S.**

Existence of angular derivative for a class of strip domains,  
Proc. Am. Math. Soc. **123** (1995) 1075-1082.

## Theoretical Computer Science

**Arvind, V., Köbler, J.\*, Schöning, U.\*, and Schuler, R.\***

NP has polynomial-size circuits implies  $AM=MA$ .

*Theoretical Computer Science*, **137** (1995) 279-282

**Arvind, V., Köbler, J.\*, and Schuler, R.\***

On helping and interactive proof systems.

*Proc. 5th Int. Symposium on Algorithms, Automata, and Computation*,

Lecture Notes in Computer Science **834**, Springer Verlag, (1994)

**Agrawal, M.\* and Arvind, V.**

Reductions of Self-Reducible Sets to Depth-1 Weighted Threshold Circuit Classes, and Sparse Sets.

*Proc. of Tenth Annual Structure in Complexity Theory Conference*,

IEEE Society (1995) (to appear)

**Balasubramanian, R. and Nagaraj, S.V.**

Perfect power testing (IMSc Preprint)

**Balasubramanian R., Venkatesh Raman and Srinivasaraghavan G.**

Tight Bounds for Finding Degrees from the Adjacency Matrix,

*Proc. of the LATIN 95 conference*, Lecture Notes in Computer Science,

Springer Verlag **911** (1995) 49 - 59

**Lodaya, Kamal; Parikh, Rohit\*; Ramanujam, R. and Thiagarajan, P.S. \***

A logical study of distributed transition systems,

*Inf. Comput.* **119** (1995) 91 - 118

**Mahajan, M. and Vinay, V.\***

Non-commutative computation, depth reduction, and skew circuits,

*Proc. of the 14th International FST&TCS Conference*

LNCS **880** (1994) 48 - 59.

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\* External collaborator

**Mahajan, M. and Vinay, V.\***

The varying power of a logspace verifier,  
Technical Report IMSc-94/27

**Ramanujam, R**

Knowledge and the next state modality,  
National Seminar in TCS, (1994) 62 - 80

**Ramanujam, R.**

A local presentation of synchronizing systems,  
Springer, *STRICT, Berlin*, May 1995 (to appear)

**Seth, Anil**

When do Fixed Point Logics Capture Complexity Classes ?  
Proc. of the 10th annual IEEE Symposium on Logic  
in Computer Science, San Diego, (1995) 353 - 363.

**Seth, Anil**

Turing Machine Characterizations of Feasible Functionals of All Finite Types,  
in Feasible Mathematics II, eds. J. Remmel and P. Clote, pages 401-428,  
Birkhauser, 1995

**Seth, Anil**

Type 2 Polynomial Hierarchies,  
Proc. of Logic and Computational Complexity workshop, Indiana, Oct. 1994  
(submitted).

**Venkatesh Raman**

Some Hard Problems in Weighted Tournaments  
Proc. of the 5th National Seminar on TCS, Bombay, Aug. (1995) 115 - 122.

**Vinodchandran N.V. and Mahajan, M.**

A note on Mod and generalised Mod classes,  
Inf. Proc. Letts. 1995 (to appear)



# Visits to Institutions

including Conference participation & Lectures<sup>1</sup> by Institute members

## **Abbas Ali**

Spring School in String Theory and Quantum Gravity,  
I.C.T.P., Trieste, Italy, Mar. 27 - Apr. 4, 1995

Int. Workshop on "Physics at Planck Scale",  
Puri, Dec. 12 - 20, 1994

Workshop on String Theory and Quantum Gravity,  
I.C.T.P., Trieste, Italy, Apr. 5 - 7, 1995,  
seminar : "Duality Invariant - Superstring Actions"

"Trieste Conference on Statistical Mechanics and Quantum Field Theory",  
I.C.T.P., Trieste, Italy, Apr. 10 - 12, 1995

## **Anishetty, Ramesh**

"Symposium on the Early Universe '94",  
I.I.T., Madras, Dec. 20-22, 1994  
invited talk : "Phase Transitions in the early Universe"

## **Arvind, V**

Indo-French Workshop on 'Proofs and Types', IIT, Kanpur, March 1 - 9, 1995  
talk : "On the lengths of proofs in propositional proof systems."

## **Balakrishnan, Radha**

School of Physical Sciences, J.N.U., New Delhi, Dec. 22, 1994,  
seminar : "Novel exact solutions to the Belavin-Polyakov equation"

## **Balasubramanian, R**

University of Paris VI, France,  
Indo-French Collaboration, April 25 - May 24, 1994

## **Baskaran, G**

One of the Directors: Summer Workshop on Solid State, Atomic & Molecular Physics,  
I.C.T.P., Trieste, Italy, June - Aug. 1994

Mini Workshop on Strongly correlated Electron Systems, I.C.T.P., Trieste, Italy, July 1994

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<sup>1</sup>Seminars at the Institute are also included here

Workshop on 'Strongly Correlated Electron Systems',  
Lake Hamana, Japan, Nov.13 - 17, 1994,  
invited talk: 'Pair tunneling and anomalous c-axis paraconductivity in Cuprates'

Int. Conf. on 'Spectroscopies in Novel Superconductors'  
SLAC, Stanford, USA, March 15 - 18, 1995,  
invited talk: 'Are there similarities between the layered Nickel Borocarbide and Cuprate Superconductors ?'

Tokyo University, Hongo Campus, Tokyo, Japan, Nov. 7 - Dec. 17, 1994,  
talks : 1) A sharper version of RVB theory of HTC superconductors  
2) Some consequences of pair tunneling in HTC superconductors  
3) Fractional quantum Hall effect at Half filling

Yukawa Institute of Kyoto University, Nov. 30, 1994,  
talk: 'Constraints on the superconducting order parameters in strongly correlated electron systems'

Applied Physics Dept., Nagoya University, Nagoya, Nov. 24, 1994,  
talk: 'Pair tunneling and anomalous c-axis paraconductivity in cuprates'

Physics Department, Osaka University, Osaka, Nov. 28, 1994,  
talk: 'A sharper version of RVB theory of superconductivity'

Physics Department, Tokyo Science University, Dec. 1, 1994,  
talk: 'A sharper version of RVB theory of HTC superconductivity'

Physics Department, Tokyo Institute of Technology, Dec. 6, 1994,  
talk: 'Constraints on the superconducting order parameter from electron correlations'

Physics Department, Tokyo Metropolitan University, Dec. 7, 1994,  
talk: 'Novel effects at fractional quantum Hall fluid at half filling'

Physics Department, Tokyo University, Komaba Campus, Dec. 14, 1994,  
talk: 'Strong correlation and singular modification of order parameter in k-space'

Inst. of Theoretical Physics, Seoul National Science Univ., Seoul, Korea, Dec. 10 - 13, 1994,  
talk: 'Present status of the theory of HTC superconductivity'

Summer School on 'Modern Many body theory'  
I.I.Sc., Bangalore, Dec. 94 - Jan. 95,  
talks on Many body theory of strongly correlated systems

Workshop on "Novel Physics in low dimensional electron systems",  
I.M.Sc., Jan. 9 - 14, 1995,  
invited talk: "On the origin of Effective Mass divergence in the FQH fluid  $\nu = \frac{1}{2}$ "

Seminar on Recent Trend in Physics,  
Physics Dept., Anna University, Madras, Feb. 28, 1995,  
talk : 'Novel superconducting Materials'

Prof.K.Lakshminarayanan Endowment Lecture,  
Ramakrishna Mission Vivekananda College, Madras, Feb.27, 1995,  
talk: 'High Temperature Superconductors'

INSA one-day Symposium on Breakthroughs in Mathematics and Physics  
I.M.Sc., Madras, Aug. 5, 1994,  
talk: 'Surprises in the Physics of 2 space dimensions'

I.M.Sc., April 28, 1994  
Mechanism of superconductivity in Nickel Borocarbides

Basu Mallick  
I.M.Sc., June 27, 1994  
seminar : Yangian algebra and quantum integrable spin chains

I.M.Sc., Aug. 22, 1994  
seminar : Extension of  $U(S(1|N))$  Yangian algebra through multiple deformation

**Basu, Rahul**  
ICTP, Trieste, Italy, Oct. 3 - Nov.1, 1994,  
seminar : "Infrared Behaviour of systems with Goldstone bosons"

I.M.Sc., May 26, 1994  
seminar : Correlation induced vanishing gap function in strong correlated system

**Chakraborty, Tapash**  
Visiting Scientist : Max-Planck Institute for Solid State Research  
Stuttgart, Germany, July - Aug., 1994,  
seminar : Quantum Rings in a Magnetic Field

Visiting Professor : Dept. of Theoretical Physics, Univ. of Oulu, Aug. – Sept., 1994,  
gave a course of six lectures on “Electronic Properties of Mesoscopic Systems”

Helsinki University of Technology, Helsinki, Finland, Aug. 1994 (2 days).

University of Jyväskylä, Jyväskylä, Finland, Aug. 1994 (2 days),  
talk : Quantum Dots and Rings in Magnetic Fields

Discussion meeting on “Condensed Matter Science – Current status and plan for action”,  
IISc, Bangalore, April 18 – 19, 1994  
invited talk : “Quantum Dots and Other Mesoscopic Systems”

I.M.Sc., Oct.7, 1994  
seminar: “Persistent problems on persistent currents

IMSc., Oct.10,1994  
seminar: The Physics of antidots

I.M.Sc., June 17, 1994  
Quantum Dots - Here I go again

**Das, Saurya**  
BCSPIN School in high energy physics,  
Kathmandu, Nepal, May 22 – June 7, 1994

Mini-Workshop on Black Holes,  
I.O.P., Bhubaneswar, Sept.12 – 17, 1994

International Workshop on Physics at Planck Scale,  
Puri, Dec. 12 - 21, 1994

DAE Symposium on HEP,  
Visva-Bharati University, Santiniketan, Dec. 28, 1994 - Jan. 2, 1995

Spring School on String Theory, Gauge Theory and Quantum Gravity,  
ICTP, Trieste, Italy, March 27 – April 7, 1995

Trieste Conference on Recent Developments in Statistical Mechanics and Quantum Field  
Theory, ICTP, Trieste, Italy, April 10 – 12, 1995

**Date, G**

Mini-Workshop on Black Holes,  
I.O.P., Bhubaneswar, Sept.12 – 17, 1994,  
three talks : “Review of black holes and black hole thermodynamics”

**Georgatos, K**

I.M.Sc., May, 1994  
seminar : Logics for knowledge acquisition

**Govindarajan, T.R**

Syracuse University, Syracuse, U.S.A., Mar. 14 – April 10, 1994

Visiting Scientist and participated in Summer School on Quantum Phases,  
I.C.T.P., Trieste, Italy, April – May, 1994

SERC School on High Energy Physics,  
Banaras Hindu University, Varanasi, Feb. 15 – Mar. 1, 1995,  
course of 12 lectures on Differential Geometry and Topology

**Guha, Partha**

I.M.Sc. Sep. 6, 1994  
seminar : Multiple zeta functions and generalised Bernoulli numbers

**Hari Dass, N.D**

International Symposium on Lattice ('94),  
Bielefeld, Germany, Sept.27 – Oct.1, 1994

Max-Planck Institute for Physics, Munich, Sept.1 – Oct. 10, 1994  
seminar : “Infrared Behaviour of Systems with Goldstone Bosons” (Sept. 1994)

IMSc., Nov.1; 1994  
seminar:“Summary of Lattice 94 meeting”.

University of Utrecht, Netherlands, Oct. 2 – 9 Oct. 1994  
seminar : “Infrared Behaviour of Systems with Goldstone Bosons” (Oct. 1994)

Monbusho Visiting Professor, KEK National Laboratory for High Energy Physics, Tsukuba,  
Japan, Nov. 7, 1994 – Oct.1995.  
seminar : “Infrared Behaviour of Systems with Goldstone Bosons” (Nov. 1994)

Research Institute for Fundamental Physics, Kyoto, Feb. 8 – 15, 1995  
invited talk : “Finite Size Effects for the Ising Model Coupled to 2-D Random Surfaces”

Department of Physics, Hokkaido University, Mar. 7 – 12, 1994,  
seminar : “Infrared Behaviour of Systems with Goldstone Bosons” (Mar.1994)

**Jagannathan, R**

High Energy Section, I.C.T.P., Trieste, Italy, Aug. 1 – 28, 1994

Department of Applied Mathematics and Computer Science,  
University of Gent, Ghent, Belgium, Sept. 1 – Nov. 30, 1994

“Generalized Clifford algebras and quantum groups”

Department of Mathematics, University of Gent, Ghent, Belgium, Nov.24,1994.

XI International Congress of Mathematical Physics,  
Paris, France July 18 – 23, 1994,

“ $U_{p,q}(gl(2))$ ,  $(p, q)$ -oscillator and applications” (short communication)

One-day meeting on Mathematical Physics sponsored by the National Fund for Scientific  
Research (Belgium),

Brussels Free University, Belgium, Oct. 28, 1994,

invited talk : “Two-parameter deformations of  $GL(2)$  and  $gl(2)$ , and their applications”

SERC School on Coherence and Correlations in Modern Optics and Quantum Physics, Jan.  
23 – Feb. 10, 1995,

talk : “Coherence and Correlations in Charged Particle Optics”

**Jayaraman, T**

Seminars delivered at :

CERN Theory Group, CERN, Geneva, Sep.28 – Oct.27 1994

High-Energy Group, ICTP, Trieste, Oct.28 – Nov. 10 1994

Physics Dept. Univ. of Bonn and MPI für Mathematik, Bonn, Nov. 12 – 17, 1994

Workshop on Planck-Scale Physics,

Puri, India, Dec. 12 – 21, 1994,

invited talk : “ W-geometry and W-strings”

**Kaul, Romesh**

Institute of Physics, Bhubaneswar,

two talks on “Knots and links” and on “Topological field theories”, Jan. 1995

S.N. Bose Center, Calcutta,

talk : “Knots and links”, in Jan. 1995

Department of Physics, Delhi University,  
talk : "Knots and links" in Jan. 1995

**Kesavan, S**

Six lectures on Numerical Analysis,  
University of Calicut, April 19 - 22, 1994

Invited speaker, Indo-French Conference on Applied Mathematics,  
TIFR-IISc Programme, June 27 - July 1, 1994

Invited speaker, Indo-French Colloquium, University of Pondicherry,  
Pondicherry, July 4, 1994

Six lectures on Weak Topologies,  
University of Calicut, July 11 - 13, 1994

One-day Colloquium on Breakthroughs in Mathematics and Physics,  
organized by MATSCIENCE under the auspices of INSA, Aug. 5, 1994, invited talk

Colloquium on "Homogenization of an optimal control problem",  
Anna University, Madras, Aug. 25, 1994

Participated in the School and Workshop on local and variational methods in the study of  
Hamiltonian systems,  
I.C.T.P., Trieste, Italy, Oct. 7 - 28, 1994

Visiting Professor, University of Rome I "La Sapienza",  
course of lectures (15 hours) on "Degree theory and applications", Oct. 29 - Nov. 25, 1994

University of Rome I - Colloquium on "Comparison theorems via symmetrization - revisited,  
Nov.14, 1994

University of Rome II - Colloquium on "Symmetry of solutions of a quasilinear equation via  
isoperimetric inequalities", Nov.15, 1994

Invited Speaker at the Ramanujan Day Celebrations,  
IIT, Madras, Dec. 23, 1994

Visiting Professor, University of Paris VI, Jan. 23 - July 23, 1995,  
course of lectures on Numerical Analysis

**Khan, S. A**

SERC School on Coherence and Correlations in Modern Optics and Quantum Physics,  
Jan. 23 – Feb. 10, 1995,  
talk : “Wigner Functions in Charged Particle Optics”

**Krishna, Maddaly**

University of Bochum, Bochum , Germany, June 1 – 30, 1994,  
five lectures on “Random Schrödinger operators”

Int. Conf. on “Partial Differential equations”,  
Holzhau, Germany, July 2 – 9, 1994,  
talk : “Inverse spectral theory for Jacobi matrices”

Int. Conf. on “Spectral theory of Operators”,  
University of Clausthal, Clausthal, Germany, July 10 – 17, 1994,  
talk : “Almost periodicity of Jacobi Matrices”

Participated in Int. Congress of Mathematical Physics,  
Paris, July 19 – 30, 1994

Visiting Associate Professor,  
Brown University, Providence, USA, July 1, 1994 – June 30, 1995

“Western States Mathematical Physics Meeting”,  
California Institute of Technology, Pasadena, Feb. 27 – 28, 1995,  
talk : “Inverse Spectral theories in one dimension”

Univ. of British Columbia, Vancouver, Canada, Mar. 25 – 29, 1995,  
talk : “Jacobi Matrices”

**Lodaya, Kamal**

I.I.T., Kanpur, Jan. 19 – 20, 1995

**Manisha Kulkarni**

Visiting Student, Mehta Research Institute, Allahabad, April - June 1994

Participated in the Instructional School on Algebraic number Theory,  
Bombay University, Dec.27 – Jan. 14, 1995



**Meena, Mahajan**

National Seminar on Theoretical Computer Science, Kanpur, June 1994,  
"Depth reduction in non-commutative circuits", (informal presentation)

XIVth Conference on FST & TCS,  
I.M.Sc., Madras, Dec. 15 - 17, 1994,

talk : "Non-Commutative computation depth reduction, & skew circuits"

**Majumdar, Parthasarathi**

"Electromagnetic and Gravitational Scattering at Planckian Energies",  
seminar : T.I.F.R., Bombay, April 18 - 22, 1994

S.I.N.P., Calcutta, Sept. 5 - 9, 1994,

seminar : "High Energy Electromagnetic and Gravitational Scattering of Pointlike Particles"

Mini-Workshop on Black Holes,

I.O.P., Bhubaneswar, Sept. 12 - 17, 1994,

Survey of G.'t Hooft's approach to black hole quantum mechanics

"Planckian Energy Electromagnetic and Gravitational Scattering",

seminar : I.C.T.P., Trieste, Italy, Oct. 24 - Dec. 2, 1994

Int. Conf. on "the Physics of the Planck Scale",

Puri, Dec. 12 - 21, 1994,

invited talk : "Planckian Scattering and Shock Wave Mixing in General Relativity  
and Dilaton Gravity"

"Aspects of Planckian Scattering and Shock Wave Mixing",

seminar : S.I.N.P., Calcutta, Jan. 9 - 13, 1995

"Spontaneous Symmetry Breaking",

introductory talk : Physics Dept., Presidency College, Calcutta, Jan. 10, 1995

Scattering of point particles at Planckian energies,

I.M.Sc., Oct. 10, 1994

**Mishra, A.K**

XI DAE Symposium on High Energy Physics,

Shantiniketan, Dec. 28, 1994 - Jan. 1, 1995,

invited talk : "Recent Results in Generalized Fock Spaces"

Seminar on "Recent Trends in Electroanalytical Techniques",  
SAEST, Madras, June 21, 1994,  
invited talk : "Theory of Scanning Tunnelling Microscopy"

**Murthy, M.V.N**

I.M.Sc., Sep, 1994

seminar : Thermodynamics of an ideal gas with fractional statistics

**Nag, Subhashis**

Visiting Mathematician, I.C.T.P., Trieste, Italy, May 28 - June 12, 1994

Invited Research Mathematician,

Max-Planck Institut für Mathematik, Bonn, Germany, June 13 - July, 1994

Visiting Professor,

Sondersforschungsbereich 288 für Differentialgeometrie und Quantenphysik,  
Berlin, Germany, June 30 - July 2, 1994

Universität Karlsruhe, Germany, July 14 - 17, 1994

Visiting (Full) Professor,

Universite de Lille, France, March 1- 31, 1995

I.M.Sc., April 6, 1994

seminar : Universal Polyakov form on a certain Universal Teichmuller space

I.M.Sc., Nov. 17, 1994

seminar : The Heisenberg group and Theta - I

I.M.Sc., Nov. 24, 1994

seminar : The Heisenberg group and Theta - II

**Murthy, M.V.N.**

I.M.Sc., Sept. 21, 1994

seminar: Thermodynamics of an ideal gas with fractional statistics.

**Nagaraj, D.S**

Visiting Professor at the University of Lille, France, May 1 - 31, 1994,

lectures : Moduli of curves having theta Characterstics with given number of  
independent sections, and on Fulton-Lazeresfeld connectedness theorem (special lecture)

“Geometry Seminar”,  
School of Mathematics, SPIC Science Foundation, Madras, Feb. 1995,  
two lectures : “Deformation theory”

**Nagaraj, S.V**

seminar : Optimal binary search trees  
I.M.Sc., Madras, Sept. 16, 1994

**Parthasarathy, R**

Visiting Professor, Department of Physics, Simon Fraser University,  
Burnaby, Canada, Aug. - Oct. 1994

Department of Mathematics, Simon Fraser University, Canada,  
seminar : “Harmonic Gauss Maps and Self Dual Equations”

Workshop on ‘Physics at The Planck Scale’,  
Puri, India, Dec. 12 - 21, 1994,  
invited talk : “QCD strings as constrained Grassmannian sigma model”

**Qureshi, Tabish**

“Dynamics of a Kondo spin revisited”,  
(TPSC talk) Department of Physics, Univ. of Poona, April 9 - 12, 1995

“Dynamics of tunnelling centers in metals”,  
School of Physical Sciences, J.N.U., April 28, 1995

I.M.Sc., April, 13, 1994  
seminar : Dynamical of Kondo spin revisited

**Radha, R**

“Some multiplier classes”, Stat - Math Unit, ISI, Bangalore,  
Jan. 23 - 27, 1995

**Radhika, Vathsan**

Mini-Workshop on Black Holes,  
I.O.P., Bhubaneswar, Sept.12 - 17, 1994

**Rajasekaran, G**

IX Annual Conference of the Ramanujan Mathematical Society,  
Kerala University, Thiruvananthapuram, May 17 - 19, 1994,  
invited talk : “Generalized Fock spaces and q-deformations”

Workshop on QCD, Bangalore, June 1 – 10, 1994

Seminar : “Generalized Fock spaces, new forms of quantum statistics and their algebras”, C.T.S. Bangalore, June 10, 1994

Madras Christian College, Tambaram, Sept. 28, 1994,  
talk : “Is there a final theory?”

Meeting for the Indian Collaboration at the Large Hadron Collider at CERN,  
TIFR, Bombay, Nov. 28 – 29, 1994

Diamond Jubilee meeting of the Indian Academy of Sciences,  
Bangalore, Nov. 30 – Dec. 2, 1994

Workshop on “Physics at the Planck Scale”,  
Puri, Dec. 12 – 21, 1994,  
talk : “Space-time at the Planck Scale”

Visited S.I.N.P., Calcutta, Dec. 22 – 27, 1994,  
seminar : “Generalized Statistics”

XI High Energy Physics Symposium,  
Santiniketan, Dec. 28, 1994 – Jan. 3, 1995

X SERC School on Theoretical High Energy Physics,  
Banaras Hindu University, Varanasi, March 8 – 14, 1995,  
course of six lectures on “Neutrino Physics”

Visited Mehta Research Institute, Allahabad, March 15 – 16, 1995  
seminar on : “Neutrinos from the Sun”

### **Ramadevi, P**

Spring School, ICTP, Trieste, Apr. 11 – 24, 1994

Mini-Workshop on Black Holes,  
I.O.P., Bhubaneswar, Sept. 12 – 17, 1994

Int. Workshop on Physics at Planck Scale,  
Puri, Dec. 12 – 21, 1994

DAE Symposium on HEP,  
Visva-Bharati, Santiniketan, Dec. 28, 1994 - Jan. 2, 1995

T.I.F.R., Bombay, Nov. 28 – Dec. 2, 1994

Mehta Research Institute, Allahabad, Dec. 6 – 9, 1994

Institute of Physics, Bhubaneswar, Dec 22 – 24, 1994

C.T.S., I.I.Sc., Bangalore, Feb 27 – Mar 2, 1995

**Ramachandran, R**

Visitor, Imperial College, London, UK, July 28, 1994

Senior Associate, I.C.T.P., Trieste, Italy, July 29 - Aug.31, 1994

Visiting Professor, Advanced International School of Physics,  
(SISSA), Italy, Sept. 1 – 30, 1994

Department of Physics & Astronomy, Delhi Univ., Nov. 17, 1994,  
Colloquium : “Spin Manifolds”

I.I.T., Kanpur, Nov. 18 – 24, 1994,  
Colloquium : “Spin Manifolds”, on Nov. 22

“Condensed Matter Physics - Current Status and Plans for Action”,  
I.I.Sc., Bangalore, April 18 –19, 1994

“Laws of Physics” (Inaugural Special Lecture),  
Gifted Children Prog. organised by Bharatiya Vidya Bhavan with Anna University,  
CLRI, IMSc. and SPIC School of Mathematics, May 2 – 28, 1994

Invited Participant, XXVII Int’l Conf. on High Energy Physics,  
Glasgow, UK, July 20 – 27, 1994

Chairman, Organising Committee, Conference on Information Sciences  
and Management of Data (CISMOD 94) Madras (hosted by MALIBNET,  
DIIT and INSDOC), Oct. 26 – 28, 1994

Invited Seminar on “Challenges in Physical Applied Sciences in the  
21st century” INSA Diamond Jubilee Symposium on “Science and Technology in the 21st  
Century”, organised by COSTED, Madras Science Association and INSA Madras chapter  
at CLRI, Madras, Nov. 12, 1994

Diamond Jubilee meeting of the Indian Academy of Sciences,  
Bangalore, Nov. 30 – Dec. 2, 1994

Invited Participant, Workshop on Physics at the Planck Scale,  
Puri, Dec. 12 – 21, 1994, chaired a session

Keynote address at the XI DAE Symposium on High Energy Physics at  
Santiniketan, Dec. 28, 1994 – Jan. 3, 1995,  
talk: “Challenges and Opportunities in Particle Physics”

**Ramanujam, R**

National seminar in TCS, I.I.T., Kanpur, June 1994,  
“Knowledge and the next state modality”, (contributed paper)

**Rao, Madan**

Visiting Scientist, I.C.T.P., Trieste, Italy, March 1 – June 31, 1994

Talk : “Universality in the dynamics of phase ordering of Random and Frustrated Systems”,  
University of Napoli, Napoli, Italy, May 1994

Talk : “Super-universality in the dynamics of phase ordering”  
I.I.Sc., Bangalore, Aug. 1994

Talk : “Dynamics of phase ordering in generic systems dominated by two diverging  
length scales”, Material Sciences Division, IGCAR, Kalpakkam, Oct. 1994

“Emergence of Scale Invariance in Martensite Growth”,  
Invited talk : Indo-French Workshop on Instabilities and Patterning in Material Science,  
I.I.Sc., Bangalore, Nov. 29 – Dec. 3, 1994

“Emergence of Scale Invariance in Martensite Growth”,  
Poster presentation : DAE Conf. on Solid State Physics, Univ. of Jaipur, Jaipur, Dec. 27 –  
31, 1994

**Ray, Purusattam**

S. N. Bose National Centre for Basic Sciences, Calcutta  
May. 24 – 31, 1995, (TPSC visit)

**Sa, Debanand**

I.O.P., Bhubaneswar, Oct. 25 – Nov. 9, 1994

I.M.Sc., June 10, 1994

seminar : On the symmetry of the superconductivity order parameter

Winter School on "Some recent development in Quantum Many Body Physics",  
I.I.Sc. Bangalore, Dec. 19, 1994 - Jan. 6, 1995

**Sarkar, Tapobrata**

SERC School on High Energy Physics, Banaras Hindu University, Feb. 16 - Mar. 14 1995

I.M.Sc., Sep. 27, 1994

seminar : High Energy scattering in QCD

**Sengadir, T**

I.M.Sc., Sep. 29, 1994

seminar : Stability of certain functional differential equations

**Seth, Anil**

Workshop on "Types and Proofs", I.I.T., Kanpur, March 1995,

talk : Complexity theory of higher type functionals

Seminar : Finite Model Theory, an Overview,

I.M.Sc., Madras, Aug. 19, 1994

Seminar : 0-1 laws in finite model theory,

I.M.Sc., Madras, Sept. 2, 1994

**Shankar, R**

W-symmetry in the Calogero - Sutherland model

seminar : I.M.Sc., Oct. 14, 1994

Colloquium : "Generalized Exclusion Principle",

T.I.F.R., Bombay, Nov. 1994

Winter school on "Some Recent Developments in Quantum Many-Body Physics",  
Bangalore, Dec. 19 - Jan. 6, 1995,

seminar : "The Calogero Sutherland Model as an Ideal gas with fractional  
exclusion statistics"

Workshop on "Novel Physics in Low-Dimensional Electron Systems",

I.M.Sc., Madras, Jan. 9 - 14, 1995,

invited talk : "Exclusion Statistics and Strongly Correlated Electron Systems"

**Sharatchandra, H.S**

“Discussion Meeting on Effective Field Theories and QCD”,  
C.T.S., I.I.Sc., Bangalore, Aug. 22 – Sept. 2, 1994,  
invited talk : “Infrared behaviour of  $\pi$  and  $\sigma$  and implications for Nuclear forces

“Quark confining mechanism in QCD”,  
(three lectures), I.M.Sc., June 1994

“Duality transformations in non-Abelian gauge theories”,  
(four lectures), C.T.S., I.I.Sc., Bangalore, June 1994

**Sridhar, R**

One-day symposium on “Quantum Groups”,  
during IXth annual Meeting of the Ramanujan Mathematical Society,  
University of Trivandrum, Thiruvananthapuram, May 17 – 19, 1994,  
invited talk : “Quantum mechanics in non-commutative spaces”

**Srinivasa Rao, K**

Convened and conducted a one-day symposium on “Quantum Groups”,  
during IXth Annual Meeting of the Ramanujan Mathematical Society,  
University of Trivandrum, Thiruvananthapuram, May 17 – 19, 1994,  
introductory lecture : “Quantum Groups and Quantum Algebras”

Refresher course, Dept. of Theoretical Physics,  
Univ. of Madras, Aug. 30 – Sept.4, 1994,  
(four lectures) : “Angular Momentum”

Lecture on “Multiple hypergeometric series and summation theorems”,  
Dept. of Mathematics, IIT, Madras, Oct. 20, 1994

Refresher course in Mathematics,  
Bharathidasan University, Tiruchi, Oct. 25, 1994,  
lecture : “Hypergeometric functions”

Refresher course in Physics,  
Calicut University, Oct. 28, 1994,  
(two lectures) : “Quantum Theory of Angular Momentum”

Professor S.C.K.Nair Endowment lecture,  
“Hypergeometric series”, Dept. of Physics, Calicut Univ., Oct. 29, 1994



One-day symposium in honour of Professor R.Vaidyanathaswamy,  
Sri Venkateswara University, Tirupathi, Dec.9, 1994,  
invited talk : "Summation theorems and multiple hypergeometric functions"

Symp. on "Recent Advances in Information Technology" READIT -95,  
IGCAR, Kalpakkam, March 23, 1995,  
invited talk : "Global network for Libraries in India"

U.G.C. Seminar on "q-series and their applications",  
B.I.T.S., Pilani, March 25 - 26, 1995,  
(two lectures) : "q-series and Angular Momentum Theory"

### **Venkatesh Raman**

"National Seminar on Theoretical Computer Science",  
I.I.T., Kanpur, June 6 - 10, 1994,  
(presented a problem in the open problem session)

I.I.Sc., Bangalore, June 15 - 16, 1994 and Jan. 25 - 26 1995,  
talks : "Tight Bounds for Finding Degrees from the Adjacency Matrix", June 16, 1994, and  
"On Finding a Minimum Dominating Set in a Tournament", Jan. 25, 1995

XIVth Conference on FST & TCS,  
I.M.Sc., Madras, Dec. 15 - 17, 1994, Chaired a session

Seminar : "On Finding a Minimum Dominating Set in a Tournament",  
School of Mathematics, SPIC Science Foundation, Feb 15, 1995

University of Waterloo, Canada, March 9 - 25, 1995,  
two lectures : "Amortized Analysis and Splaying"

LANIA, Xalapa, Mexico, March 26 - April 3, 1995,  
talk : "Tight Bounds for Finding Degrees from the Adjacency matrix "

### **Vinodchandran, V.N**

seminar : "The Blum-Schub-Smale model for a Complexity Theory of Reals",  
I.M.Sc., Madras, May 1, 1994

I.M.Sc., May 23, 1994  
seminar : On a theory of computation over real and complex numbers

### **Uma Shankar**

I.M.Sc. seminar : Top events at Fermilab, May 5, 1994

## Addendum

The following research activities of Professor S. Nag under Participation in Conferences and Seminars/Lectures given outside the Institute have been inadvertently left out in the appropriate places:

*European Community Workshop on Conformal Geometry*, [organized by the European Community Project on Computational Conformal Geometry], at the University of Helsinki and on board the Silja-Europa liner (Helsinki-Stockholm-Helsinki). July 25th to 30th, 1994. Main Lecturer for delivering the Opening Address: "Universal parameter spaces of Riemann surfaces, period matrices, and string theory".

*International Congress of Mathematical Physics*, Paris, July 18th to 23rd, 1994. Invited participant.

*Mathematics in Bonn*, Bonn, Germany; one-day conference organized by Max-Planck-Institut Bonn and the University of Bonn. June 18, 1994; Participant.

### Seminars/lectures delivered outside the Institute

*Max-Planck-Institut für Mathematik, Seminar on Arakelov theory*; "Quillen metrics and Mumford isomorphisms on inductive limits of Teichmüller spaces", June 27th, 1994.

*Technische Universität Berlin, Seminar Mathematische Physik*, "Universal parameter spaces for Riemann surfaces and String theory", July 1st, 1994.

*Universität Karlsruhe, Mathematisches Kolloquium*, "Universal parameter spaces for Riemann surfaces and String theory", July 14th, 1994.

*Universite de Rennes, France, Colloquium*, "Universal Mumford isomorphisms on universal moduli", March 30th, 1995.

*Universite de Lille, France, Colloquium*, "Teichmüller spaces and String theory", March, 1995.

## Professional Activities

### Arvind, V

Refereed papers for the journals: 'Theoretical Computer Science'  
and 'Informatique Theorique et Applications'

Chairman, Organizing Committee, Algebraic Methods in complexity theory,  
IMSc Workshop, Dec. 1994

Member, Organizing Committee, Indo-French Workshop on "Proofs & Types",  
March 1995 at I.I.T, Kanpur

Member, Program Committee, FST & TCS Conference, 1994

### Balakrishnan, Radha

Ph.D Thesis examiner for a student of Jawaharlal Nehru University, New Delhi

### Balasubramanian, R

Member, Sectional Committee - Indian Academy of Sciences

Member, Council of Indian National Science Academy

Co-opted for this year as Member, Sectional Committee I of INSA

Member, Subcommittee to consider INSA Young Scientist Programme

### Govindarajan, T.R

Reviewed "The Knot Book", by Colin C. Adams, for Physics Today

### Kesavan, S

Resource Person, "Gifted Children Programme", for talented students, by Bharathiya Vidya  
Bhavan with IMSc, CLRI, Anna Univ. and SPIC School of Mathematics, May 2 - 28, 1994

### Khan, S. A

Member, Local Organizing Committee, SERC School on Coherence and Correlations  
in Modern Optics and Quantum Physics, I.M.Sc., Jan. 23 - Feb 10, 1995

### Meena Mahajan

Referee for the NSTCS 94 and FST&TCS 94 conferences

Referee for the journals : (1) Int. J. of Foundations of Computer Science  
(2) Journal of Ramanujan Mathematical Society

Member, Organising Committee, *Algebraic Methods in Complexity Theory*, IMSc workshop,  
Dec. 11 - 13, 1994

### Nag, S

Member, Advisory Board of the Indian Journal of Pure and Applied Mathematics  
by election of the Council of the Indian National Science Academy

Reviewer for *Zentralblatt für Mathematik* and *Mathematical Reviews*

Referee for *Acta Mathematica (Sweden)*, *Annales Acad. Scientiarum Fennicae (Helsinki)*, etc.

**Rajasekaran, G**

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

Chairman, IUPAP National Committee of the INSA, Delhi

President, Madras Chapter of the Indian Physics Association

Convener, Madras Chapter of INSA

Member, Governing Council of the Mehta Research Institute and of many national-level committees

Organized a one-day Symposium at Madras,  
"Breakthroughs in Physics and Mathematics", Aug.5, 1994,  
under the auspices of the Diamond Jubilee Programme of INSA

**Ramachandran, R**

Senior Associate and Regional Representative of the External Activities, ICTP, Trieste, Italy

Member, Scientific Advisory Committee, IUCAA, Pune (until Dec. 1994)

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

Member, Board of the School of Physics, University of Hyderabad

Member, Board of Research, University of Madras

Member, Planning Board, Manonmaniam Sundaranar University, Tirunelveli

Member, Sectional Committee, Indian Academy of Sciences, Bangalore

**Sridhar, R**

Member, Organizing Committee for the Professor R. Vasudevan Memorial Volume

**Srinivasa Rao, K**

"Parallel Computers - a revolution in the making", English Talk,  
All India Radio, Broadcast on April 22 and June 24, 1994

Conducted the Ph.D. Viva voce examination of Mr. Premanand,  
Nuclear Physics Department, University of Madras, Sept. 1994

Member, Organizing Committee for the Professor R. Vasudevan Memorial Volume

Letter to the Editor, on the National Science University, Current Science, Dec. 1994

Chairman, Organising Committee, SERC School on "Coherence and Correlation  
in modern optics and quantum physics", I.M.Sc., Jan. 23 - Feb. 10, 1995

Organised a one-day symposium on "Quantum Groups"  
at the IXth Annual meeting of the Ramanujan Mathematical Society,  
University of Trivandrum, Thiruvananthapuram, May 17 - 19, 1994

Srinivasa Rao, K and Sridhar, R  
Obituary, "Ramabhadra Vasudevan", Phys. Today 47 (1994) 106

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### Summer students

Name	Period
Mr. Dilip, V	June 6 - July 5, 1994
Mr. Jaydeep Majumdar	June 6 - July 14, 1994
Ms. Gomathy, S	June 16 - 30, 1994
Mr. Karthikeyan, R	June 13 - July 12, 1994
Mr. Kedar S. Vaidya	June 13 - July 12, 1994
Mr. Madhuri Thakur	June 25 - July 24, 1994
Mr. Nagrajan, N	April 30 - May 29, 1994
Mr. Subhodeep Roy Choudhery	June 13 - July 12, 1994

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# Lecture Courses

## Physics

Lecturer	Lecture Course	Duration
Anishetty, R	Advanced Quantum Field Theory	Jan. - May 1995
Chakraborty, T	Condensed Matter Physics	Feb. - April 1995
Parthasarathy, R	Particle Physics	Jan. - April 1995
Ray, P	Statistical Mechanics	Jan. - April 1995
Ramachandran, R	GUTs, SUSY and Introduction to strings (C-level)	Aug. 94 - Jan. 95
Rajasekaran, G	Gravitation and Cosmology (C-level)	from March 95
Sridhar, R	Classical Mechanics	Aug. - Dec. 1995
Simon, R	Mathematical Physics	Aug. - Dec. 1994
Shankar, R	Quantum Mechanics	Aug. - Dec. 1994
Sinha, Rahul	Electrodynamics	Aug. - Dec. 1994

## Mathematics

Lecturer	Lecture Course	Duration
Balasubramanian, R	Algebra	Aug. – Dec. 1994
Kesavan, S	Analysis	Aug. – Dec. 1994
Mandal, Satya	Algebra – II	Jan. – May 1995
Nag, S	Differential Geometry	March – April 1994
Nag, S	Complex Analysis (Core)	Jan. – May 1995
Nagaraj, D.S	Algebraic Topology	Jan. – March 1995
Radha, R	Harmonic Analysis (Introductory)	March – April 1995
Sastri, Swathi	Functional Analysis	Jan. – May 1994
Sengadir, T	General Topology	Aug. – Dec. 1994

## Theoretical Computer Science

Lecturer	Lecture Course	Duration
Arvind, V	Kolmogorov complexity and applications	March – May 1994
	Design and Analysis of Algorithms	Jan – May 1994
Lodaya, K	Automata Theory	Aug. – Nov. 1994
Mahajan, M	The Polynomial Method in Circuit Complexity (Adv.level)	Aug. – Oct. 1994
Mahajan, M	Introduction to Computability theory (Core)	Jan. – May 1995
Ramanujan, R and Madhavan Mukund (SPIC)	Formal semantics of Programming Languages	Feb. – May 1995
Seth, Anil	Intro. to Mathematical Logic	Aug. – Dec. 1994
Venkatesh Raman	Data Structures and their analysis	Aug. – Dec. 1994



## Conferences / Workshop / Symposium Sponsored / cosponsored by the Institute

A one-day Symposium "Breakthroughs in Mathematics and Physics" was organized by the Institute on 15 August 1994 under the auspices of the INSA, Madras Chapter, to mark the Diamond Jubilee of INSA. Drs N.D. Haridass, S. Kesavan, S. Nag and G. Baskaran talked on "Can one hear the shape of a drum?", "Exotic calculus in 4-dimensional space-time" and "Surprises in the physics of two space dimensions" respectively. A large number of teachers and students from colleges and University departments attended the symposium.

A colloquium to commemorate the Birth Centenary of R. Vaidyanathaswamy was organised by the School of Mathematics, SPIC Science Foundation and the Institute of Mathematical Sciences, on Nov. 24, 1994 at the Institute premises. Professors K.R.Parthasarathy, M.S.Raghunathan and C.S.Seshadri, were the main speakers, on the theme: "Mathematics in India". This colloquium was cosponsored by the Indian National Science Academy.

The Fourteenth Conference on Foundations of Software Technology (FST) and Theoretical Computer Science (CTS) was jointly organised by the Institute of Mathematical Sciences, the School of Mathematics of SPIC Science Foundation and the Indian Institute of Technology, Madras, from Dec. 15 - 17, 1994. The venue of the conference was SAMEER, C.I.T. Campus, Madras. The conference was preceded by a workshop on Algebraic Methods in Complexity Theory (AMcoT) from Dec. 11 - 13, 1994 and a one-day workshop for graduate students on Dec. 14. The Tata Institute of Fundamental Research provided generous financial assistance for the conference and the workshop was supported by a grant from the National Board for Higher Mathematics. The proceedings of the conference are to be published by Springer Verlag in the series *Lecture Notes in Computer Science*.

A one-day Symposium to mark the thirty-third Anniversary of the Institute was held at the Seminar Hall of the Institute on Jan. 3, 1995. Prof. R.Ramachandran spoke on "Challenges and Opportunities" and Prof. V. Lakshminarayanan (Univ. of Missouri, St. Louis) spoke on "Photoreceptor Optics", in the forenoon session. In the afternoon session, Prof. G. Vanden Berghe (Univ. of Gent, Belgium) lectured on "Exact Solutions of the Radial Schrödinger Equation", followed by Prof. K. Ananthanarayanan's (San Diego State Univ., San Diego) lecture on "Role of Architecture in Operation systems Design".

An International meeting on "Novel Physics in Low - Dimensional Electron Systems", was organised during Jan. 9 - 14, 1995, with Prof. T.Chakraborty as its Convenor. There were 27 invited talks which covered the fields of quantum dots, the quantum Hall effect,

exclusion statistics and various other topics. Eminent physicists, like **Professor Klaus von Klitzing, Nobel Laureate** (Stuttgart) and **Professor Walter Kohn** (Santa Barbara), as well as bright young experimentalists like Paul McEuen (Berkeley), Ray Ashoori (MIT), Annette Plaut (Exeter, Bellcore) attended the meeting and presented their talks. The Workshop was attended by about 100 participants. Among them, 25 were from abroad: USA (10), Germany (4), UK (3), Finland (2), Japan (2), Belgium (1), Denmark (1), Ireland (1), Spain (1), and the rest were from India. Prof. Klitzing's inaugural lecture was entitled : " From Micro-electronics to Nano-electronics", on Jan. 9. Prof. Kohn delivered an evening lecture entitled : "Shifting Viewpoints in Condensed Matter Physics (1950 - 1995)", on Jan.10. This meeting was also funded by the Department of Science and Technology, the Council of Scientific and Industrial Research, the International Center for theoretical Physics (Trieste, Italy) and the Alexander von Humboldt Foundation (Germany). The proceedings of this workshop was published by Elsevier as a special issue of *Physica B* **212** August, 1995.

A SERC School on "Coherence and correlation in Modern Optics and quantum physics" was organized at the Institute during the period January 23 - February 10, 1995, with Prof.R.Simon as the Course Director. This was part of a series of SERC Schools in the thrust area of Lasers and Optics, sponsored by the Department of Science and Technology. The school primarily consisted of courses of lectures (and tutorials) by experts on the fundamentals of Coherence and Correlations and on the applications of these concepts to the foundations of Quantum Mechanics as well as to several emerging fields of research. The present school was directed by Prof.R.Simon. About 40 outstation participants and 15 participants from the Institutions in Madras attended the School.

The Institute co-sponsored the "Gifted Children's Programme", for talented Science Students, by Bharatiya Vidya Bhavan, with CLRI, Spic School of Mathematics and Anna University from May 2 to 23, 1994. Professor S.Nag served as an organising committee member and was the coordinator for Mathematics . He delivered a series of lectures on "Geometry and calculus", and guided three projects. Professor S.Kesavan also acted as a Resource Person for Mathematics . All Mathematics lectures were held at IMSc.

## Honours and Awards

### **Chakraborty, T**

Awarded 1995 the "Docentship" (highest academic degree awarded in Finland) by the University of Oulu, Finland

### **Nag, S**

Elected as a **Fellow of the Indian Academy of Sciences**, from January 1995

Designated "**Main Lecturer**". *Opening Address to the European Community Conference on Conformal Geometry*", Helsinki-Stockholm, July 25 - 30, 1994

### **Srinivasa Rao, K**

Member, American Mathematical Society

## Books / Monographs

### **Perspectives in Theoretical Nuclear Physics**

Edited by K.Srinivasa Rao and L.Sathpathy\*

Wiley - Eastern (1994)

### **The Quantum Hall Effects : Integral and Fractional**

T.Chakraborty and P.Pietiläinen\*

Springer-Verlag, New York, Heidelberg (1995)

(Monograph, second edition)

### **Novel Physics in Low-Dimensional Electron Systems**

Proceedings of the Workshop held in Madras, Jan. 9 - 14, 1995

Physica **B 212**, Aug. 1995, North-Holland

### **Selected Topics in Mathematical Physics : Professor R. Vasudevan Memorial Volume**

Editors : R.Sridhar, K.Srinivasa Rao and V.Lakshminarayanan\* (to appear)

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\* External collaborator

## Ph.D. Degree Awarded

Manas Sardar, Ph.D. (Madras University)

Thesis : "Theory of NMR relaxation in high  $T_c$  superconductors"

Guide : Prof.G.Baskaran

Radha, R., Ph.D. (Madras University)

Thesis : "Characterizations of certain multiplier classes"

Guide : Prof.K.R.Unni

Rakshit, Amit Mohan, Ph.D. (IIT, Kanpur)

Thesis : "A global topological approach to the standard model of particle physics over a 4-dimensional universe"

Guide : Prof.R.Ramachandran

Venkataraman, S., Ph.D. (Madras University)

Thesis : "On rings of integers of relative Abelian extensions of Number fields"

Guide : Prof.R.Balalsubramanian

Vytheeswaran, A.S., Ph.D. (Madras University)

Thesis : "Symmetries in systems with second class constraints"

Guide : Dr.R.Anishetty

## Ph.D. Thesis submitted

John, Varghese, submitted to the University of Madras

Thesis : "Some studies in Non-critical string theory"

Guide : Dr.R.Anishetty / Dr.T.Jayaraman

Nongkynrih, Amora, submitted to the University of Madras

Thesis : "On primitive roots"

Guide : Prof.R.Balalsubramanian

## M.Sc. Degree Awarded

Das, Saurya was awarded the M.Sc. degree in Physics, by research, under the joint programme of the Institute with Anna University, in March 1995, for his

Thesis : "Electromagnetic and Gravitational Scattering of Pointlike Particles at High Energies"

Guide : Parthasarathi Majumdar

Nagaraj, S.V. was awarded the M.Sc. degree in Theoretical Computer Science, by research, under the joint programme of the Institute with Anna University, in March 1995, for his

Thesis : "Optimal Binary Search Trees"

Guide : Venkatesh Raman

## Committees for 1994 – 95

Sept. 1, 1994 – Aug. 31, 1995

### JRF Programme Co-Ordinators

Physics : P. Majumdar & R. Simon  
Mathematics & Computer Science : S. Nag & Venkatesh Raman

Library : G. Rajasekaran (Chair)  
G. Date  
S. Kesavan  
V. Arvind  
R. Shankar  
K.S. Santhanagopalan, Librarian

Computers : M.V.N. Murthy (Chair)  
R. Sinha  
T. Jayaraman  
Meena Mahajan  
R. Basu  
P. Ray

Guest House Advisory Committee : R. Parthasarathy (Chair)  
R. Anishetty  
T. Chakraborty  
S. Krishnan, Accts. Officer  
R. Jayaraman, Admn. Officer

Hostel Faculty Counsellor : Kamal Lodaya

Space Planning & Allocation : R. Ramachandran (Chair)  
R. Balasubramanian  
Radha Balakrishnan  
G. Rajasekaran  
G. Sethuraman, Chief Admn. Officer

## Seminar / Colloquium Coordinator

Physics : R. Sridhar  
Mathematics : Swati Sastry  
Computer Science : R. Ramanujam

**TPSC Coordinator** : R. Sridhar

**Annual Report** : K. Srinivasa Rao (Chair)  
P. Majumdar  
V. Arvind  
D.S. Nagaraj  
K.S. Santhanagopalan, Librarian

## Miscellaneous

M. Agrawal (SPIC), V. Arvind, M. Mahajan, and K. V. Subrahmanyam jointly delivered a series of lectures on 'Algebraic Methods in Complexity Theory', during Aug. - Nov. 1994

D.S. Nagaraj gave a Talk on "Numbers" at "The Children's club society", Mylapore, Madras, on Sep.5, 1994

Under the auspices of the EEC Project between Gent University, coordinated by Prof. G.Vanden Berghe and this Institute, coordinated by Prof. K.Srinivasa Rao, Prof.G.Vanden Berghe visited Matscience from December 29, 1994 to January 16, 1995. Prof.R.Jagannathan visited Gent University from Oct. - Dec. 1994. During his visit to this Institute, Prof.Vanden Berghe gave a mini-course of lectures on Numerical Analysis of Differential Equations at the Mathematics Department of I.I.T. Madras.

Two 20 minute programs were made by the Audio Visual Research Centre of Anna University, in collaboration with this Institute. Prof. Klaus von Klitzing and Prof.T.Chakraborty took part in the program: "Quantum Hall Effect". Prof. Walter Kohn and Prof.G. Baskaran took part in the program: "Condensed Matter Physics". Both these programs were presented by Prof.K.Srinivasa Rao.

The book entitled: "Recent Trends in Theoretical Nuclear Physics: Professor S.C.K.Nair Memorial Volume", edited by K.Srinivasa Rao and L.Satpathy, was formally released, on Oct. 14, 1994, at this Institute, when the first copy of the book was presented to Prof. R. Ramachandran, Director, by Mr. Purushothaman, Regional Manager of Wiley - Eastern. Copies of the book were handed-over to Prof.(Mrs.) Vimala Nair and Prof.V.K.Thankappan, both of Calicut University, after Prof. K.Srinivasa Rao delivered the third Professor S.C.K. Nair Endowment Lecture at that University, at a function presided over by Prof. T.K.Ummer, Registrar, Calicut University, on Oct. 29, 1994.

Dr.N. Jawahar, the institute physician gave a lecture to the members of the institute on the " Prevention and Treatment of Plague", on Oct. 3, 1994, in the Seminar Hall of the Institute.



# VISITORS TO THE INSTITUTE

including Seminars/Colloquia by Visitors

Name & Address	Period of visit	Title of lecture
Konstantinos Georgatos Visiting P D F, I.M.Sc.	25.4.94-6.1.95	(i)Logics for Knowledge acquisition (ii) Nonmonotonic consequence relation, Belief revision, Default logics: What do they have in common?
Tarantello, G. Univ. of Rome II Italy	8-14.4.94	Phase formation in alloy An augmented space approach
Sudha Swaminathan University of Michigan U.S.A		A study of the symplectic algebra of the Fermion dynamical model
Deb, S.K. B.A.R.C. Bombay	8-10.4.94	Resonance Raman scattering from in Ga.As.
Raja Sreedharan T.I.F.R. Bombay		Euler classes & vector bundles
Venkatesan, S.M. Rutgers University U.S.A	13-20.4.94	Proof Techniques in Graph Separator Theorems
Gupta, L.C* T.I.F.R. Bombay		Discovery of New Quaternary Boro carbide Superconductors
Ramaswamy, S. T.I.F.R. Bangalore	6-11.5.94	
Grady, M. SUNY, Fredonia U.S.A	2-6.5.94	Spurious first order phase transition for topological effects on the lattice
Rajaram Nithyananda Raman Research Institute Bangalore	9-12.5.94	The Physics of self Gravitating Systems

Ms.Dhanalakshmi Avinashilingam Institute for Women's Education Coimbatore	2-13.5.94	
Govindarajan, S T.I.F.R.,Bombay	18.5.94	A proposal for geometry of W algebra
Srinivasan, T.P. Madurai Kamaraj University Madurai	23.5-23.6.94	
Arvind Indian Institute of Science Bangalore	18-19.5.94	
Malik, R.P. Dubna, Moscow	22-28.5.94	"Matreoshka" structure in Non-linear Realization of $W_\infty$ - Algebra
Bhandari, S.K. Indian Statistical Institute Calcutta	28.5-4.6.94	
Sundaresan, M.K. Carleton University Ottawa, Canada	24-27.6.94	
Chakravarti, S. California State University U.S.A	6.4-2.7.94	
Mandal, S. University of Kansas, U.S.A.	26.6-4.7.94	
Supriya Kar Institute of Physics Bhubaneswar	5.6-8.7.94	Chiral gauged WZW models & string backgrounds

Balachandran, A.P. Syracuse University U.S.A	4-8.7.94	
Jean-Christophe Dubacq Magistere d'Informatique Ecole Normale Superieure France	25.6.-11.7.94	
Berestycki, H. Univ. of Paris, France	8.7.94	Superlinear Elliptic Problems & Nonlinear Liouville's theorems
Bardos, C. Univ.of Paris, France	7-8.7.94	Frequency analysis of control & stabilization for the wave equation
Chandar, L. Syracuse University U.S.A	15.6-15.7.94	Duality & fractional quantum hall effect
Verma, P.L.N. Mehta Research Institute Allahabad	10-16.7.94	i) Suslin's stability theorem an algorithmic approach ii) Projective modules & extendability
Kumar, S.D. Mehta Research Institute Allahabad	9-16.7.94	
Cutkosky, S.D. University of Missouri U.S.A		Lefschetz's type theorems in arbitrary characteristics
Haridas Banerjee* Saha Institute of Nuclear Physics Calcutta	14-24.7.94	Resolution of the strong CP & U(i) problems & the Euclidean Dirac fermion
Moss, L.S. Indiana University U.S.A	23-28.7.94	i) Existence & non-existence of Universal graphs ii) Evolving algebras & mathematical models of Language

Madhavan, V. Utah State University U.S.A		Energy in 2+1 Dimensions
Adimoolam, C. Bharathidasan University Trichy		Elliptic Cohomology
Varadarajan, M. Pennsylvania State University U.S.A	27-30.7.94	
Vytheswaran, A.S. Bangalore	30.7-2.8.94	
Braides, A. University of Brescia Italy		Properties of Hyperelastic composites
Srinivasan, V. University of Hyderabad Hyderabad	31.7.-3.8.94	Non-equilibrium thermofield dynamics
Sardar, M.K. Institute of Physics Bhubaneswar	8.7.-3.8.94	
Bhaduri, R.K. McMaster University Canada	19.7.-6.8.94	
Ponnuswamy, S. School of Mathematics SPIC Science Foundation Madras	13.6-15.8.94	
David, S. Universite de Paris France	10-15.8.94	
Ashok Subramanian I.I.Sc., Bangalore	26.8.94	.878 Approximation algorithms for MaxCut and Max2Sat

Shankar, R. Institute of Physics Bhubaneswar	10-17.8.94	i)Renormalization group for non-relativistic fermions ii)Berry Phase Dirac equation
Govindarajan, S. T.I.F.R., Bombay	17-23.8.94	A proposal for the geometry of $W_n$ -gravity
Pablo Aries Gastesi T.I.F.R. Bombay	23.8.-5.9.94	Construction of Klienian groups & co-ordinates for Teichmuller spaces
Laad, M.S. I.I.T., Bombay	4-9.9.94	Impurity models & non-fermi liquid phases - The Hubbard models in High dimensions
Subramanian, A. Indian Institute of Science Bangalore	26-27.8.94	
Saint Jean Paulin, J. Universite Metz France	29.8.-7.9.94	Homogenization methods Applied to perforated domains
Sethuraman, J. American College Madurai	10-13.9.94	
Agarwal, R.P. Lucknow University Lucknow	7-14.9.94	New look at Ramanujan's lost note book
Sukumar, C.V. University of Oxford England	12-15.9.94	Inelastic scattering & Path integrals
Vittot, M. CPT - CNRS Luminy Case 907 France	20.6.-17.9.94	A non-iterative approach to kam theorem: Tree expansion

Bela Bollobas Cambridge University U.K.	21.9.94	Hereditary Properties of Hypergraphs & Projections of Bodies
Tata, B.V.R. IGCAR, Kalpakkam		Experimental proof of an effective attraction between similarly charged colloidal particles
Panigrahi, P.K. University of Hyderabad Hyderabad	22-24.9.94	An alternate Mechanism for Photon Mass Generation
Anuradha Jagannathan Orsay Paris		Structure & electronic properties of Quasi Crystals: studies in 2 dimension
Sunil Kumar Raman Research Institute Bangalore		i) Imbibition in random porous media ii) Freezing of simple magnetic-hole systems
Michel Wiedenbech Physical Research Laboratory Ahmedabad		Origin & Evolution of the early Universe
Sudhakar Yarlagada Visiting Scientist Hyderabad	15.4.-14.10.94	
Adhikari, S.D. Mehta Research Institute Allahabad	8-24.10.94	
Parida, M.K.* North Eastern Hill University Shillong	15-20.10.94	Uncertainties in GUT predictions
Ravishankar, K. S.U.N.Y. New Paltz, U.S.A		Dynamics of a spin exchange model

Swaminathan, S. Dalhousie University Canada		Geometric aspects of Banach spaces: a survey
Vikram Vyas University of Utah U.S.A	23-30.10.94	Calculating quark propagators in lattice QCD using Renormalization Group
Kunthala Jayaraman Anna University Madras		Fallacies of Modelling
Soni, V. National Physical Laboratory Delhi	17.10.-3.11.94	
Neelima Gupte* University of Poona Pune	7-12.11.94	Enhancement of mixing in chaotic systems
Prakash, J.S. Institute of Physics Bhubaneswar	18.10.-10.11.94	
Ramanathan, R. University of Delhi Delhi	9-16.11.94	
Jaya Iyer Bombay University Bombay	10-30.11.94	Line Bundles on Complex tori
Chakrabarti, A.* Scottish Church College Calcutta	15-18.11.94	Electron states in Aperiodic lattices: Recent results in one dimension
Gautam Mukherjee SPIC Science Foundation Madras		Enumeration of regular homotopy classes of Immersion of Grassmann manifolds $G_k(\mathbb{R}^{n+k})$ into $\mathbb{R}^{2nk}$

Parthasarathy, K.R. Indian Statistical Institute New Delhi		Radon nikodym theorem & Lebegue decomposition for completely positive maps on $C^*$ algebras
Bhasin, V.S.* University of Delhi Delhi	18-23.11.94	Three-Body approach to structural properties of Halo Nuclei - case of Li
Tanusri Saha* S.N. Bose Centre Calcutta	24-29.11.94	Phase formation in alloy systems : an augmented space space approach
Chitre, S.M. T.I.F.R., Bombay	3-6.12.94	Windows on the Sun's interior
Rohit Parikh City University of New York U.S.A	14-20.12.94	How far can we formalise Language Games?
Bansal, R.K. Punjab University Chandigarh	17-21.12.94	Nuclear structure from transfer reactions using sum rules methods
Buti, B. National Physical Laboratory Delhi	18-21.12.94	Chaos & its implications
Vladimir Estiville-Castro Lania, Mexico	13-22.12.94	Floodlight visibility in Polygons & Polygonal chains
Mahanthappa, K.T. University of Colorado U.S.A		Composite gauge field models & dynamical symmetry breaking
Balachandran, A.P. Syracuse University U.S.A	26-30.12.94	



Rasclé, M. University of Nice France	27-30.12.94	Relaxation Problems arising in Elasto-Plasticity
Susan Marshall Simon Fraser University Canada	17.10.-16.12.94	A generalization of tournaments to Hypergraphs
Shiv Dutt Kumar Mehta Research Institute Allahabad	12.10.-7.12.94	
Bhatwadekar, S.M. T.I.F.R., Bombay	26-30.12.94	On affine fibration & subalgebra of polynomial algebras
Masaki Kashiwara R.I.M.S. Kyoto		On Lusztig program: Kazhdan- Lusztig polynomials & modular representations of Chevalley groups
Tamizhmani, K.H. Pondicherry University Pondicherry	28-30.12.94	
't Hooft, G. University of Utrecht The Netherlands	25.12.94	Quantum Black Holes
Srinivasa Rao, Arikati Max-Planck Institut Germany	1.12.-28.2.95	$A(2+\epsilon)$ approximation algorithm for edge connectivity
Ambar Sengupta Louisiana State University U.S.A	25.12.-8.1.95	The semiclassical limit of quantum Yang-Mills on compact surfaces Moduli spaces of flat connections over compact surfaces
Babu Joseph, K.* Cochin University Cochin	4.1.95	sq oscillator : a new paradigm of quantum oscillator

Walter Kohn Santa Barbara U.S.A	10-1-95	Shifting view points in condensed matter physics 1950-1995
Muthusamy, A. Islamiah College Vaniyambadi		On perfect Graphs
Avinash Khare Institute of Physics Bhubaneswar		Recent advances about charged vortex solutions
Pietilainen, P. University of Oulu Finland	21.12.94-19.1.95	Electron correlations in Quantum Ring and Dot Systems
Van den Berghe, G. University of Gent Belgium	28.12.94-15.1.95	Solutions for radial one- dimensional Shroedinger Equation
Indrani Biswas T.I.F.R. Bombay	13.-27.1.95	Secondary Invariants of Higgs bundles
Murthy, M.P. University of Chicago U.S.A	28.1.-14.2.95	Projective modules & efficient generation of ideals
Vanchinathan, R. SPIC Science Foundation Madras		Small resolutions of singularities of schubert varieties
Subramanian, C.R. Indiañ Institute of Science Bangalore	2-3.2.95	Colouring Random Graphs
Chidambaram, R. Chairman, Atomic Energy Commission, Bombay	7.2.95	Quasi Crystals

Amit Ghosh Saha Institute of Nuclear Physics, Calcutta	7-12.2.95	
Agarwal, M. SPIC Science Foundation Madras		Degree Theoretic characterizations of Complexity class separations
Gangal, A.D.* University of Poona Pune	14-18.2.95	
Sinha, S. Raman Research Institute Bangalore	20-24.2.95	
Ady Mann Technion Israel Institute Israel	3.2.-4.3.95	
Harindranath, A.* Saha Institute of Nuclear Physics Calcutta	4-11.3.95	i) Constituent picture from field theory: pions or put out? ii) Non-perturbative QCD : a perturbative approach? iii) Parton model from field theory : the good, the bad and the terrible.
Daniel, M. Bharathidasan University Trichy	27.3.95	
Chitra, R. Indian Institute of Science Bangalore	6-9.3.95	Density matrix renormalization group & Quantum spin
Sivakumar, M. University of Hyderabad Hyderabad	2.3.-2.4.95	
Uma Maheswari Institute of Physics Bhubaneswar		Nuclear compressibility : Finite nuclei to Nuclear Matter

Ansari, A. Inst. of Physics, Bhubaneswar	13.3.95	Structure of hot nuclei
Prabhakar Pradhan Indian Institute of Science Bangalore	12-16.3.95	Anderson localizations & mirrorless laser
Lakshminarayanan, A. Physical Research Laboratory, Ahmedabad	11-21.3.95	
Saxena, R.P. University of Delhi Delhi	22-26.3.95	Baryo genesis from black hole evaporation
Narasimhan, V.S. T.I.F.R., Bombay	23-25.3.95	Observation of top quarks at Fermilab
Kundu, A. Saha Institute of Nuclear Physics, Calcutta	26-31.3.95	i) Integrable system: classical & quantum ii) Quantized algebra & Quantum integrability of ultralocal & non-ultralocal models
Menon, G.I. T.I.F.R., Bombay	24.3.-4.4.95	Flux lattice melting in High T <sub>c</sub> Superconductors

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\* TPSC Visitor

## IMSc Computer Network – Upgradation

The IMSc Computer Network has been expanded by providing terminals in the individual offices – the user was given the option of an X-Terminal (30 units), AT-386 (10 units) or a Dumb Terminal (10 units). As such 60 nodes are under the Unshielded Twisted Pair network supported by two additional intelligent Synoptics hubs which sit on the thin ethernet backbone. Our internet link is handled by a CISCO-2500 Router through the 4-wire leased-line link to the nearest node and through the node to the ERNET Gateway at NCST, Bombay. Eventually, this Router can support an additional Data Communication service through the recently acquired VSAT (Very Small Aperture Terminal) – which is essentially a 1.8 Meter dish antenna for inroute/outroute Data transmission through the INSAT-2A satellite, communicating with the Earth Station at Bangalore, under the ERNET project of the Department of Electronics. VSAT is an additional link for a reliable internet service, which is being implemented.

IMSc has upgraded two of its Sun SPARC Station-1s to two Sun SPARC Station-20s (SS20 @ 40 MHz) with 20" colour monitors. New SUN-spro FORTRAN compiler with 10-user license for the Solaris 2.x environment is implemented on a SS20 system. Also the new Solaris version of network-licensed Macsyma-419 is made available on the network which is installed in the other upgraded SS20.

## LIBRARY

The Institute has a well equipped, computerised library with a total collection of about 31000 volumes. The collection consists of about 15000 books and about 16000 bound volumes of journals. The library subscribes to over 250 journals. The books and the journals range over various areas of physics, mathematics and theoretical computer science.

The computerisation was completed in the past year. This was also taken as an opportunity to switch over to the UDC classification scheme to organise the books in the library.

The computerisation is based on a comprehensive library automation software, LIBSYS version 3.1, running on a 486 based EISA MINI platform under a UNIX based operating system. The library computer system is also integrated with the main computer network of the institute enabling easy access from a variety of terminals distributed in the institute.

The various modules of the LIBSYS software aid in different aspects of library management and maintenance such as house keeping, acquisition of new books, subscription to journals, internal accounts, managing lending/return of books/journals etc. Its Open Public Access Catalogue (OPAC) module, which is accessible to all the users, enables users to retrieve full information about the books/journals by using searches based on author name(s), title, Keywords or search-strings in combination with boolean operations etc., with flexibility and ease. The use of the UDC classification scheme and the computerization will make it easier for the institute library to integrate with other libraries elsewhere in the future. During the period ended 31st March 1995, 2195 books and bound volumes of periodicals were added to the Library.

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.

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.

During the year eight new journals have been subscribed to by the library on the recommendations of the faculty of the Institute.

Mr.G.Venkatesan, Assistant Librarian was deputed by the Institute to attend a one-day seminar entitled Recent Advances in Information Technology, READIT 95, held at IGCAR, Kalpakkam, on March 23, 1995.

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

Prof.Oda, Tohoku Univ.,Japan	Dr.Uma Sankar, IMSc
Prof.K.Srinivasa Rao, IMSc	Prof.R.Ramachandran, IMSc
U.S.Library of Congress, New Delhi	NBHM, Bombay
ICTP, Italy	Dr.Thangavelu
Prof.Rohit Parikh, City Univ.,NY, USA	M/s.Allied Publishers, Madras
Dr.Kamal Lodaya, IMSc	I.I.T., Kanpur
Prof.R.Balasubramanian, IMSc	Prof.N.R.Ranganathan, IMSc
Prof.Elliot Lieb, Princeton Univ.,USA	Prof.V.Lakshminarayanan,St.Louis,USA

### Cover Picture :

Computer Graphics illustrate the mathematical beauty of certain sets whose non-linear nature is the basis of 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 Network 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  $c = -0.7435 + 0.11301i$ ). This topic, Computer Graphics, is at the intersection of the three main areas of research activity at this Institute - viz. Theoretical Physics, Mathematics and Computer Science.