THE INSTITUTE OF MATHEMATICAL SCIENCES

C. I. T. Campus, Taramani,

Chennai - 600 113.

ANNUAL REPORT

Aug 2001 - Jul 2002

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Foreword

I am pleased to present the progress made by the Institute during 2001-2002 in its many sub-disciplines and note the distinctive achievements of the members of the Institute.

The construction of additional office space and an auditorium was completed and the new office space has now been occupied. The Auditorium, which has a seating capacity of 190, was named the Ramanujan Auditorium and was inaugurated on June 22nd by Dr. Anil Kakodkar. On behalf of the Institute, I convey my sincere thanks to Dr. R. Chidambaram (the previous Chairman of AEC), Dr. Anil Kakodkar (the present Chairman), and Mrs. Sudha Bhave (Joint Secretary, DAE), for the keen interest shown by them in the progress of this building project and the help and support extended to us at every stage.

I am pleased to mention that 2001-2002 was an academically productive year and many interesting events took place. The B. M. Birla Award was given to Dr. Kapil Paranjape for Mathematical Science for the year 1999, and to Dr. Sudeshna Sinha for Physical Sciences for the year 2001. Dr. Kapil Paranjape was awarded a DST-Swarnajayanthi Project on Cycles, Arithmetic and Cryptography. Prof. K. Srinivasa Rao was awarded the Tamil Nadu Scientists Award for the year 2000 by the Tamil Nadu State Council for Science and Technology.

A three day International Conference in "Analytic Number Theory with special emphasis on L-functions" was held during January 3 - 5, 2002. On this occasion, Prof. M. V. Subbarao, who turned 80, was felicitated. The Institute conducted an orientation course in Theoretical Computer Science for teachers from South Asia, a workshop on Reasoning about Parameterized and Infinite State Systems, a workshop on String Theory, an Indo-Russian workshop on Integrable Models, String Theory and Quantum Gravity under the Integrated Long Term Programme (ILTP), a mini-workshop on Theoretical Biology, and a Workshop on Topological Methods in Group Theory. The Institute co-sponsored and took active part in the Conference on Field Theoretic Aspects of Gravity-II (FTAG-II) held at RAC, Ooty; a Conference on Condensed Matter Physics held at Bangalore; a symposium on the occasion of the 70th birthday of Prof. C. S. Seshadri at Chennai Mathematical Institute, and the Indocrypt 2001 Conference at IIT, Madras.

The following activities have become an annual feature of the Institute: (i) The Institute Seminar Week, (ii) NBHM Nurture Programme, (iii) Refresher course in Physics (once in winter, for City colleges, and once in summer, for teachers throughout India).

This year the annual report committee consisting of Drs. G. Date, K. Srinivasa Rao, S. Kalyana Rama, D. S. Nagaraj, Meena Mahajan and Mr. Paul Pandian (Librarian) took the initiative to automate the preparation of the Annual Report. A project, which simplifies the task of data collection, report generation and subsequent editorial processing, was commissioned and completed. This report has been compiled using the automated procedure

through the efforts of the committee together with secretarial assistance from Ms. Usha Devi. Photographs have been contributed by Dr. Rahul Basu and the administration. I owe my gratitude to all of them.

I look forward to another year full of distinctive achievements for the Institute.

August, 2002   **R. Balasubramanian**

Contents

Chapter 1

The Institute

1.1 Board

Hon'ble Shri **M. Thambidurai**, Minister for Education, Government of Tamil Nadu, Fort St. George, Chennai 600 009 (From May 2001)
(**Chairman**)

Dr. **Anil Kakodkar**, Chairman, AEC & Secretary to Government of India, Department of Atomic Energy, CSM Marg, Mumbai 400 001 (From December 2000)
(**Vice-Chairman**)

Prof. **S. K. Joshi**, Honorary Scientist Emeritus CSIR, Vikram Sarabhai Professor, National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi 110 012
(**Member**)

Prof. **A. Kalanidhi**, Vice Chancellor, Anna University, Chennai 600 025. (upto May 2002)
(**Member**)

Prof. **E. Balagurusamy**, Vice Chancellor, Anna University, Chennai 600 025. (From May 2002)
(**Member**)

Prof. **C. S. Seshadri**, Director, Chennai Mathematical Institute, Chennai 600 017
(**Member**)

Prof. **Mustansir Barma**, Department of Physics, Tata Institute of Fundamental Research, Mumbai 400 005 (From March 2001)
(**Member**)

Prof. **H. S. Mani**, Director, Harish Chandra Research Institute, Chhatnag Road, Jhusi, Allahabad 211 019. (upto September 2001)
(**Member**)

Prof. **Ravi Kulkarni**, Director, Harish Chandra Research Institute, Chhatnag Road, Jhusi, Allahabad 211 019. (From October 2001)
(**Member**)

Prof. **S. S. Jha**, Director, Tata Institute of Fundamental Research, Mumbai 400 005
(**Member**)

Smt. **Sudha Bhave**, I.A.S., Joint Secretary to Government of India, Department of Atomic
Energy, CSM Marg, Mumbai 400 001
(**Member**)

Shri **Mohan Varghese Chunkath**, I.A.S., Secretary to Government, Higher Education
Department, Government of Tamil Nadu, Fort St. George, Chennai 600 009 (Upto May
2002)
(**Member**)

Shri **R. Sriram**, I.A.S., Secretary to Government, Higher Education Department, Government of Tamil Nadu, Fort St. George, Chennai 600 009 (From June 2002)
(**Member**)

Prof. **R. Balasubramanian**, Director, The Institute of Mathematical Sciences, Chennai
(**Member Secretary**)

1.2   Executive Council

Prof. **S. K. Joshi**, Honorary Scientist Emeritus CSIR, Vikram Sarabhai Professor, National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi 110 012
(**Chairman**)

Prof. **C. S. Seshadri**, Director, Chennai Mathematical Institute, Chennai 600 017
(**Member**)

Prof. **Mustansir Barma**, Department of Physics, Tata Institute of Fundamental Research, Mumbai 400 005 (From March 2001)
(**Member**)

Prof.**H. S. Mani,** Director, Harish Chandra Research Institute, Chhatnag Road, Jhusi, Allahabad 211 019 (Upto September 2001)
(**Member**)

Prof.**Ravi Kulkarni,** Director, Harish Chandra Research Institute, Chhatnag Road, Jhusi, Allahabad 211 019 (From October 2001)
(**Member**)

Smt. **Sudha Bhave,** I.A.S., Joint Secretary to Government of India, Department of Atomic Energy, CSM Marg, Mumbai 400 001
(**Member**)

Shri **Mohan Verghese Chunkath,** I.A.S., Secretary to Government, Higher Education Department, Government of Tamil Nadu, Fort St.George, Chennai 600 009(Upto May 2002)
(**Member**)

Shri **R. Sriram,** I.A.S., Secretary to Government, Higher Education Department, Government of Tamil Nadu, Fort St.George, Chennai 600 009(From June 2002)
(**Member**)

Prof. **R. Balasubramanian**, Director, The Institute of Mathematical Sciences,Chennai
(**Member Secretary**)

1.3   Faculty

Name	Userid	Tel. Ext.	Res. Phone No.
Mathematics			
Balasubramanian, R.	balu	201	245 3926
Kesavan, S	kesh	273	641 2839, 665 0535
Kodiyalam, Vijay	vijay	228	490 2041
Krishna, M.	krishna	285	449 1499
Nagaraj, D. S.	dsn	291	448 1260
Paranjape, Kapil H.	kapil	218	492 7243
Raghavan, K. N.	knr	255	844 6319
Sankaran, P.	sankaran	221	446 0909
Srinivas, K.	srini	244	448 1256
Sunder, V. S.	sunder	206	847 5543
Physics			
Anishetty, R.	ramesha	229	496 0586
Balakrishnan, Radha	radha	203	257 9653
Baskaran, G.	baskaran	233	492 7304
Basu, Rahul	rahul	284	245 4794, 245 3297
Chakraborty, T.	tapash	215	492 5271
Date, G.	shyam	280	245 6148
Govindarajan, Thupil R.	trg	281	492 7309
Hari Dass, N. D.	dass	275	442 2767
Indumathi, D.	indu	225	492 8138
Jagannathan, R.	jagan	219	263 1638
Jayaraman, T.	jayaram	248	492 9527
Kaul, R.	kaul	279	441 3264
Majumdar, Parthasarathi	partha	282	448 0793
Menon, Gautam I.	menon	292	619 4134, 621 3024
Mishra, Ashok K.	mishra	283	448 2684
Murthy, M. V. N.	murthy	227	257 9342, 257 0652
Parthasarathy, R.	sarathy	214	223 2021
Rama, S. Kalyana	krama	293	-
Ramachandran, R.	rr	207	442 0387
Ray, Purusattam	ray	231	492 8251
Sathiapalan, Balachandran	bala	278	492 7832
Shankar, R.	shankar	235	-
Sharatchandra, H. S.	sharat	276	252 1388
Simon, R.	simon	232	451 0280
Sinha, Rahul	sinha	290	448 2190
Sinha, Sudeshna	sudeshna	216	492 7243
Sridhar, R.	sridhar	213	441 9145
Srinivasa Rao, K.	rao	220	441 1347

Name	*Userid*	*Tel. Ext.*	*Res. Phone No.*
Theoretical Computer Science			
Arvind, V.	arvind	277	235 2556
Lodaya, Kamal	kamal	286	445 3312
Mahajan, Meena B.	meena	247	440 4396, 440 4395
Raman, Venkatesh	vraman	243	244 5374
Ramanujam, R.	jam	288	492 8138

1.4 Scientific Officers

Subramoniam, G.	gsmoni	217	246 0520
Raveendra, Reddy B.[1]	ravi	343	492 7845

1.5 Ernet Project Assistant

Ashokan, A.V.[2]	-	-	-
Sriram, V.[3]	-	-	-
Venkatesh, T.[4]	venky	323	-

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[1] From 01.11.2001
[2] Until 31.01.2002
[3] From 14.02.2002 until 14.05.2002
[4] From 31.05.2002

1.6   Visiting Scientists

Name	*Userid*	*Tel. Ext.*	*Res. Phone No.*
Parthasarathy, K. R.	krp	295	-
Rai, Balram	balram	328	-
Subramanian, C. R.	crs	226	448 0169

1.7   Project Scientists

Rajasekaran, G.	graj	230	441 3395
Sinha, Nita	nita	246	448 2190

1.8   Post-Doctoral Fellows

Mathematics

Gautam, Vishvajit V. [1]	vishvajit	296	254 2372

Physics

Barve, Sukratu [2]	sukratu	-	-
Ganguly, Avijit K.[3]	avijit	324	254 2588
Harikumar, E. [4]	hari	258	-
Mitra, Indrajit [5]	indrajit	328	-
Hiroyuki Takata [6]	-	-	-
Janaki, T. M. [7]	janaki	-	-
Gurappa, N.[8]	gurappa	-	-

Theoretical Computer Science

Mishra, Sounaka [9]	soun	319	-

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[1] From 09.11.2001
[2] Until 31.3.2002
[3] From 05.09.2001
[4] From 10.08.2001
[5] From 06.06.2002
[6] Until 31.03.2002
[7] From 31.05.2002
[8] From 25.06.2002
[9] From 01.05.2002

1.9 Ph.D. Students

Name	*Userid*	*Tel. Ext.*	*Res. Phone No.*
Mathematics			
Das, Paramita	pdas	224	254 2050
Dey, Arijit	arijit	209	254 2050
Ghosh, Shamindra Kumar	shami	224	-
Gyan, Prakash	gyan	211	-
Kanhere, Aaloka	aaloka	289	-
Muthukumar, T.	tmk	287	-
Sengupta, Ritabrata	ritabrata	272	254 2050
Uma, V.	uma	224	235 2556
Physics			
Bal, Subrata	subrata	-	-
Basak, Soumen	soumen	344	254 2050
Ezhuthachan, Bobby V. K.	bobby	334	254 2050
Ghosh, Tarun K.	tkghosh	-	-
Hossain, Golam Mortuza	golam	334	254 2050
Karthik, G. V. S.	karthik	287	-
Lukose, Vinu	vinu	344	-
Murugesh, S.	mgesh	211	-
Rajesh, V.	chinta	289	-
Roy, Arya	arya	289	-
Santosh, Kumar K.	sant	272	254 2050
Sankararaman, Sumithra	sumithra	259	-
Sarkar, Swarnendu	swarnen	209	254 2050
Surendran, Naveen	naveen	211	-
Theoretical Computer Science			
Kurur, Piyush P.	ppk	287	-
Meenakshi, B.	bmeena	259	-
Muthu, Rahul	rahulm	272	233 5558
Suresh, S. P.	spsuresh	344	-
Vijayaraghavan, T. C	tcvijay	259	466 0586

email: userid@imsc.ernet.in

1.10   Administrative Staff

Name	*Userid*	*Tel. Ext.*	*Res. Phone No.*
Ramakrishna Manja *Registrar*	manja	208	492 5297
Jayaraman, R. *Admn. Officer*	rjao	242	371 9889
Krishnan, S. *Accounts Officer*	skao	241	-
Santhanagopalan, K. S. [1] *Librarian*	-	237	-
Paul Pandian, M. [2] *Librarian*	pandian	237	-
Venkatesan, G. *Dy. Librarian*	gvenkat	240	-
Gayatri, E. *Jr. Accounts Officer*	gayatri	337	-
Sankaran, K. P. *Jr. Admn. Officer*	kpshank	338	242 0897
Indra, R. *Jr. Admn. Officer*	indra	222	-
Vasudevan, T. V. *Asst. Purchase Officer*	tvvasu	340	-
Mohan, S. *Jr. Engineer (Elec.)*	mohan	300	-
Arangarajan, R. *Jr. Engineer (Civil)*	arajan	297	-

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[1]   Retired after superannuation on 31.03.2002
[2]   From 15.04.2002

Name	*Userid*	*Tel. Ext.*	*Res. Phone No.*
Ganapathi, R.	gan	341	-
Balakrishnan A. R.	-	237	-
Parthiban, V.	parthi	510	496 4179
Usha Devi, P.	-	320	-
Parijatham, S. M.	-	212	-
Ashfack Ahmed	office	339	-
Usha, Otheeswaran	office	245	-
Muthusigamani, S.	office	202	-
Geetha, M.	office	245	-
Prema, P.	recept	204	-
Nandini, M.[1]	-	-	-
Babu, B.[2]	bbabu	339	-

Amulraj, D.	Rajasekaran, N.
Balakrishnan, J.	Rajendran, C.
Elumalai, G.	Ramesh, M.
Janakiraman, J.	Ravichandran, N.
Moorthy, E.	Ravindran, A.
Munuswami, M.	Rizwan Shariff, H.
Munuswami, N.	Selvaraj, M.
Muthukrishnan, M.	Tamil Mani, M.
Nityanandam, G.	Varadraj, M.
Radhakrishnan, M. G.	Venugopal, T.

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[1] Until 15.03.2002
[2] From 18.03.2002

Chapter 2

Research and Teaching

2.1 Mathematics

2.1.1 Research Summary

Algebra

Many properties of a category, for instance the existence of an adjoint or of a factorization system, are a consequence of the cowellpoweredness of that category. In the absence of cowellpoweredness, for general results, fairly strong assumption on the category are needed. Settling the question whether the category is cowellpowered can be a challenging problem. A number of novel and useful observations to tackle the cowellpoweredness problem of subcategories by means of regular closure operators is provided in [**G**]. A study of the question when two subcategories of a category induce the same regular closure operators is made and information about cowellpoweredness of subcategory is obtained.

The Categorical properties of Truaev's work on *Quantum Invariants of 3-Manifolds* is explored and some new results are obtained.

Algebraic Geometry

The notion of *Ramified G* bundle on non-singular projective variety with ramification along a normal crossing divisor is defined (here G is a reductive algebraic group) and shown that these geometric objects corresponds to earlier defined abstract notion of parabolic G bundles on the projective variety with parabolic structure along the divisor.

An old result of Atiyah states that every vector bundle over a projective variety (over an algebraically closed field) can be written as direct sum of indecomposable vector bundle and the decomposition is unique in a natural sense. Generalization of this result to the case of principal G bundles (where G is a reductive algebraic group) on a projective variety has been obtained by generalizing the notion of indecomposability in this context. "Tannakian" version of the above result being formulated and studied.

On the projective three space existence of nef and big rank two vector bundles which are

not ample was shown [**N2**].

It was shown [**N3**] that there are smooth subvarieties of small codimension in a smooth quadric, which cannot be obtained as a set theoretic intersection with the quadric of a smooth subvariety of correct codimension in the projective space.

Further investigations into the compactification of moduli space of vector bundles on a nodal curve and the fixed determinant moduli spaces was made.

G. .V. Belyi in 1983, proved that algebraic curves defined over number fields (i. e. arithmetic algebraic curves) can be characterized by the fact that they are obtained as covers of the projective line that are étale outside the three points 0, 1 and ∞. There has been a search for higher dimensional analogues of this statement ever since this result appeared. A notion of "geometric rigidity" is defined and a generalization of Belyi's result has been proved [**P2**].

A characterization of scheme theoretic structure on algebraic subsets of projective space by means of the "higher tangency loci" in certain bundles is obtained. This will allow one to generalize the results of [**P2**] to schemes as well. Following this it would be possible to characterize arithmetically defined differential equations.

The Hodge conjecture is proved for the Abelian variety which appears as the connected component of identity in the norm homomorphism associated with general morphism of degree two between algebraic curves [**P1**]. These results have been extended to some morphisms of higher degree as well.

In many situations the only way to detect the non-triviality of certain algebraic cycles relies on the existence of topological invariants that are non-trivial. It is shown that this happens to be true for all known examples except those that arise from arithmetic.

The modular varieties associated with Elliptic curves and Abelian surfaces are a rich source of examples in Geometry and Arithmetic. The connections between Elliptic modular varieties and moduli of Abelian surfaces have been explored. This is a fascinating trip through the finite Heisenberg group, invariant theory for the icosahedral group and the geometry of surfaces with trivial canonical bundle.

When the Elliptic Modular variety of a certain level and "weight" turns out to have trivial canonical bundle then there is a unique modular form of this weight and level. In such a case extra arithmetic information is expected. These objects are being studied.

In [**Ko3**], a recent conjecture of Kreiman and Lakshmibai on Hilbert functions of Schubert varieties in Grassmannians is proved.

Analytic Number Theory

Work is in progress towards getting good estimates on the difference between consecutive zeros of the zeta function of an ideal class in a quadratic number field.

Differential Equations

Using a variant of the moving plane method, it was shown that in a domain consisting of the region between two spheres in n- dimensional Euclidean space, the first eigenvalue of the Dirichlet spectrum of the Laplacian is maximal if, and only if, the two spheres are concentric

and minimal if, and only if, the two spheres touch each other. It was also shown that the first eigenvalue is strictly increasing as the centre of the inner sphere moves towards the centre of the outer sphere. The method used is also applicable to other doubly connected domains which posses certain symmetry properties[**K2**].

The asymptotic behaviour of a Bingham fluid, a non-Newtonian fluid with a special nonlinear constitutive law, was studied in a thin layer in two space dimensions. The limit problem was obtained in the form of a nonlinear variational inequality and was shown to possess a unique solution. It was shown that this limit problem had striking resemblance to a one-dimensional heuristic model suggested in the engineering literature. A by-product of this study was the study of a class of anisotropic function spaces of Sobolev type, for which a de Rham type theorem was proved [**K1**].

Mathematical Physics

In the work on the entropic uncertainty principle, the uncertainty principle of Massen-Uffink known for non-degenerate projective measurements in a finite level Quantum System is extended to cover all measurements [**Kr2**].

It is a long standing conjecture, not yet proved, that the density of states in the Anderson model is a smooth function on the spectrum, irrespective of the nature of the spectrum. This is known only for one dimensions and for high disorder in higher dimensions. In the work, [**Kr1**], it was shown that for models in one dimension with decaying or growing randomness, the density of states is differentiable to a degree determined by the distribution of randomness and based on some conditions relating it to the rate of decay of the coupling constants.

Using the Weyl commutation relations over a finite field F_q a family of error-correcting quantum stabilizer codes have been introduced based on a class of symmetric matrices over F_q satisfying certain natural conditions. When $q = 2$ the existence of a rich class of such symmetric matrices is demonstrated by a simple probabilistic argument depending on the Chernoff bound for i.i.d symmetric Bernoulli trials. If, in addition, these symmetric matrices are assumed to be circulant it is possible to obtain concrete examples by a computer program. The quantum codes thus obtained admit elegant encoding circuits [**A**].

Operator Algebras

Vaughan Jones introduced the notion of a 'planar algebra' and showed that every 'extremal subfactor' is associated canonically to such a planar algebra. The notion of 'planar depth' of a planar algebra was introduced. This notion is more fundamental than the known notion of 'depth of a subfactor' and satisfies the condition that the planar depth is no larger than the depth. A condition was obtained that helped to estimate the planar depth of some planar algebras; this condition was sufficient to exactly determine the planar depth of most planar algebras of finite depth of interest [**Su3**].

Some ways of constructing 'new planar algebras from old' were investigated. This study led to a determination of some subclasses of the collection of all tangles which 'generate all tangles with respect to composition'. This result yields another proof of the uniqueness assertion of Jones regarding planar algebras and subfactors.

The existing notion of 'exchange relation' planar algebras was extended, so as to cover the case when the planar algebra was not necessarily generated by its 'two-boxes'. And it was shown that most of the known examples of subfactors do indeed satisfy this 'higher exchange relation' [**Gh**].

Subfactors of 'depth two' are known to be in bijective correspondence with Kac algebras. The planar algebra of such 'depth two subfactors' was studied. A presentation of this planar algebra - in terms of generators and relations - was obtained, extending the known case where the Kac algebra is taken as the complex group algebra of a finite group [**Ko2**]. This has led subsequently to successful planar/pictorial descriptions of (and simplifications of existing facts about) the connections between subfactors and the so-called weak Hopf algebras. It was shown [**D**] that for a reducible depth two subfactor, certain relative commutants have mutually dual C^* weak Hopf algebra structures. Proof of this is based on exploiting the structure discovered by Jones on the tower of relative commutants of an extremal finite index subfactor that is encapsulated in the notion of a planar algebra.

Topology

The singular cohomology ring, the K-ring of complex vector bundles, the Chow ring and the Grothendiek ring of coherent sheaves of the total space of a fibre bundle with base a complex irreducible nonsingular Noetherian scheme and fibre a nonsingular projective T-toric variety associated to a principal T-bundle are determined in terms of the corresponding objects of the fibre and the base [**S3**].

2.1.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**A**]
V. Arvind and K.R. Parthasarathy.
A family of quantum stabilizer codes based on the Weyl commutation relations over a finite field.
www.arXiv.org/quant-ph/0206174, (2002).

[**B1**]
R. Balasubramanian, S. Naik*, S. Ponnusamy*, and M. Vuorinen*.
Elliottś identity and hypergeometric functions.
J. Math. Anal. and Appln., (2002).
(To be published).

[**B2**]
R. Balasubramanian, S. Ponnusamy*, and D. D. J. Prabhakaran*.
Duality techniques for certain integral transforms to be starlike.
J. Math. Anal. Appln., 2002.
(Submitted).

[**Ba**]
R. Balasubramanian, S. Ponnusamy*, and M. Vuorinen.
On hypergeometric functions and function spaces.
J. Computational and Applied Maths., **2(139)**, 299–322, 2002.

[**D**]
Paramita Das.
C^* weak Hopf algebras and depth two subfactors.
2002.
(Preprint: IMSc/2002/07/28).

[**G**]
Vishvajit V. Gautam.
On regular closure operators and cowellpowered subcategories.
www.arXiv.org/math.CT/0206124, 2002.
(Submitted to Comment. Math. Univ. Carolinae).

[**Gh**]
Shamindra Kumar Ghosh.
Higher exchange relation planar algebras.
Pacific J. of Math., 2002.
(To be published).

[**K1**]
R Bunoiu[*] **and S Kesavan**.
Asymptotic behaviour of a Bingham fluid in thin layers.
2002.
(Preprint: IMSc/2002/07/17).

[**K2**]
S Kesavan.
On two functionals connected to the Laplacian in a class of doubly connected domains.
The Royal Society of Edinburgh Proceedings A (Mathematics), 2002.
(To be published).

[**K3**]
S Kesavan.
The isoperimetric inequality.
Resonance, 2002.
(To be published).

[**K4**]
S Kesavan.
Homogenization of some low cost control problems.
In H. P. Dikshit and P. K. Jain, editors, *Analysis and Applications*, page 121. Narosa, 2002.

[**K5**]
S Kesavan and M Rajesh[*].
On the limit matrix obtained in the homogenization of an optimal control problem.
Proc. Indian Acad. Sci. (Math. Sci.), **112(2)**, 337, 2002.

[**Ko1**]
Vijay Kodiyalam.
$U_q(sl_2)$ and the quantum double construction.
In S. Parvathi, editor, *Quantum groups and their applications*. The Ramanujan Institute for
  Advanced Study in Mathematics, 2002.

[**Ko2**]
Vijay Kodiyalam, Zeph Landau[*]**, and V. S. Sunder**.
The planar algebra associated to a Kac algebra.
Proc. Ind. Academy of Sciences, 2001.
(To be published).

[**Ko3**]
Vijay Kodiyalam and K. N. Raghavan.
Hilbert functions of points on Schubert varieties in the Grassmannian.
2002.
(Submitted).

[**Kr1**]
M. Krishna.
Smoothness of density of states for random decaying interaction.
Proceedings of the Indian Academy of Sciences, **112(1)**, 163, 2002.

[**Kr2**]
M. Krishna and K. R. Parthasarathy.
An entropic uncertainty principle for quantum measurements.
Sankhya, 2001.
(To be published).

[**N1**]
D. S. Nagaraj.
Higher circular ℓ-units of Anderson and Ihara .
In S. D. Adhikari et al, editor, *Current Trends in Number Theory*, page 124. HBA. New
 Delhi, Mar 2002.

[**N2**]
D. S. Nagaraj.
Nef and big vector bundles.
In C. Musili, editor, *Advances in Algebra and Geometry (Hyderabad Conference 2001)*. HBA,
 New Delhi, Feb 2002.
(To be published).

[**N3**]
S. P. Inamdar* and D. S. Nagaraj.
Cycle class map and restriction of subvarieties.
Journal of Ramanujan Math. Soc., **17(2)**, 85, 2002.

[**N4**]
D. S. Nagaraj.
Quasi-bialgebras.
In S. Parvathi, editor, *Quntum groups and their applications*, page 241. The Ramanujan
 Institute, University of Madras, 2002.

[**P1**]
Indranil Biswas* and Kapil H. Paranjape.
The Hodge conjecture for a general Prym variety.
Journal of Algebraic Geometry, **11**, 33, 2002.

[**P2**]
Kapil H. Paranjape.
A geometric characterization of arithmetic varieties.
Proceedings of the Indian Academy of Sciences (Mathematical Sciences), **112(3)**, 1, 2002.
(To be published).

[Pa1]
K. R. Parthasarathy.
On extremal correlations.
J. Statist. Plann. Inference., **103(1-2)**, 173, 2002.

[Pa2]
K. R. Parthasarathy.
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2.2   Physics

2.2.1   Research Summary

Astro-particle Physics

It has been known for a long time that neutrino interactions in matter have very interesting properties. In the astrophysical context, these properties can be of utmost importance in understanding several astrophysical phenomena. On the other hand, most of the astrophysical objects usually come in association with a strong magnetic field. This makes it worth while looking at some of the neutrino properties and their interactions in a magnetized medium. Earlier studies looked into the aspects of neutrino interactions either in the presence of an external magnetic field or a medium. A consistent study involving both was some thing sought after. A systematic analysis had been performed to understand the role a magnetized medium plays in neutrino-photon interactions. These investigations were focused on the special role an external magnetic field plays on the axial nature of neutrino interactions. A one loop result for the neutrino effective charge has been obtained (treating the external constant magnetic field exactly), which shows that under special conditions, the axial contribution can be comparable to that of the medium (without any magnetic field). This effect might be of importance in understanding the physics of compact astrophysical objects [**G**].

Biological Physics

The following problems have been studied: (i) mode structure and static and dynamic correlations in two-component membranes at thermal equilibrium, (ii) such mode structure and correlations when the membrane is subjected to non-thermal noise, as arises in a biological context due to the presence of ion pumps and active channels and, (iii) the modification of the above results when the membrane is placed near a wall [**S**].

A recent study of two-headed molecular motors proposes a simple model for such systems and studies this model through Langevin simulations. This work will appear as part of a special issue of Physica honoring Prof. H.E. Stanley [**Me1**].

Classical and Quantum Gravity, Black Holes, Cosmology

The isolated horizon framework introduces a quasi-local generalization of the usual event horizons and Killing horizons. All these three horizons are logically distinct and can coexist simultaneously in a solution of the Einstein equations. The inter-relationships among these and conditions for their simultaneous occurrence are discussed in [**D1**].

The issue of how to describe semiclassical states for a constrained system was illustrated by means of simple examples in [**D3**].

The quantum geometric approach to non-perturbative quantum gravity has been successfully applied by Bojowald to cosmological models. These interesting developments were summarized in a review talk at the IGQR conference held at IUCAA. Further work on the loop quantum cosmology is in progress [**D2**].

Using the analogy between a shrinking fluid vortex ('draining bathtub'), modeled as a (2+1)

dimensional fluid flow with a sink at the origin, and a rotating (2+1) dimensional black hole with an ergosphere, it is shown that a scalar sound wave is reflected from such a vortex with an *amplification* for a specific range of frequencies of the incident wave, depending on the angular velocity of rotation of the vortex. The possibility of observation of this phenomenon, especially for inviscid fluids like liquid He-II, where vortices with quantized angular momentum may occur is also discussed [**Bas**].

Nearly two decades ago de Wit, Dirk Jan Smit and Hari Dass had studied the issue of residual supersymmetry in compactified supergravity. They had established a no-go theorem for non-trivial warped compactifications under very general circumstances. They had also established that de Sitter compactifications were generally disfavored. In the light of recent interest in de Sitter compactifications the earlier work has been recast along with some technical improvements [**H2**].

Logarithmic corrections to the Bekenstein Hawking formula for entropy was studied. De Sitter gravity in 3D was studied with particular reference to corrections to entropy and dS/CFT correspondence [**Go**].

Condensed Matter Physics

A detailed paper concerning a complete phenomenological approach to phase behavior in type-II superconductors with point pinning disorder provided calculations substantiating proposals made with regard to experiments [**Me4**]. This paper was selected to appear in the March 1, 2002 issue of the Virtual Journal of Applications of Superconductivity.

The data on a variety of low and high-T_c compounds was analyzed in terms of a proposed universal phase diagram in [**Me3**]. A related paper presented a novel conjecture for the nature of the transitions separating the disordered liquid phase from the "Bragg Glass" phase [**Me5**].

It is well known that the number fluctuation in the grand canonical ensemble, which is directly proportional to the compressibility, diverges for an ideal Bose gas at T_0. It is shown that this divergence is removed when the atoms interact in one dimension through an inverse square two-body interaction. In two dimensions, similar results may be obtained using a self-consistent Thomas-Fermi model for a repulsive zero-range interaction. Both models may be mapped on to a system of non-interacting particles obeying the Haldane-Wu exclusion statistics. The number fluctuation from the ground state of the gas in these interacting models may be obtained in the grand canonical as well as canonical ensemble and compared [**Mu2**].

Potential energy surfaces play a crucial role in determining the kinetics of electron transfer reaction and in understanding the pathway and mechanism of transfer process. The relevant potential energy curves (PEC) for electron transfer through an adsorbate layer at the electrode surface have been constructed and their dependence on the adsorbate coverage have been analyzed. This enables one to study the effect of metallization in an adsorbate layer on the electrode kinetics. It is observed that at low coverages, PEC exhibit features similar to a two-step electron transfer reaction. The shape of PEC gets altered with increase in coverage. This change is caused due to the progressive desolvation of metallic adsorbate with increasing coverage. In the mono-layer regime, the PEC corresponds to a direct heterogeneous electron-transfer reaction. This is an important new result.

The conventional approaches for describing the heterogeneous electron-transfer reactions have not yielded the excited state or upper PEC. These PEC are indispensable for a proper description of non-adiabatic electron-transfer reactions. By developing an appropriate formalism, the excited state PEC have been obtained.

The theory for the Faradaic-current corresponding to adsorbate mediated electron-transfer reaction has been developed. The density of states for the redox-couple and adsorbates are determined. These two density of states are the basic ingredients for the current calculation. It is shown how a resonance between adsorbate and reactant density of states leads to electrocatalysis [**Mi1**, **Mi2**].

Since the beginning of 2000, the effects of electron- electron interaction in 2p electronic systems are being studied in three different contexts: a) a theory which predicts that superconductivity in MgB_2 is arising primarily out of electron correlations. This theory also has an important prediction that well known semimetallic graphite can be converted into a high T_c superconductor under appropriate conditions; b) High temperature ferromagnetism in SrB_6 family has been explained as a consequence of strong correlation and local moment formation in boron atoms [**Bask1**] - this opens up a new direction in boride research; c) A totally unexpected spin-1 collective mode branch was predicted for the very familiar graphite, a text book material. This has important implications for carbon nanotubes and a new notion of 'neutral spin current' automatically emerges. A new term 'Spinonics' has been coined to describe a neutral spin current incorporated nano-electronics, that could emerge as a nice possibility out of this work. Physics News Update of American Institute of Physics (2 July 2002) carried a news item on 'Spinonics' covering this work [**Bask4**].

In a paper that appeared in N. Kumar's festschrift, it was argued that 'All basic phenomenon and notions in condensed matter physics mirror in biology'. This paper contains a prediction of Bose Einstein condensation of exciton in plant/bacterial photosynthetic systems [**Bask2**].

A cooperative ring exchange mechanism of quantum melting of vortex lattice (a kind of Wigner lattice in the case of quasi two dimensions) in rapidly rotating Bose-Einstein condensate has been suggested. An experimental conformation of this mechanism will be another feather in the cap of BEC in the sense it will make BEC a place to study another important solid state phenomenon devoid of solid state complications [**Gh3**].

CP-Violation, Neutrinos and B-Physics

A method for measuring the weak phase γ using isospin analysis of three body B decays into $K\pi\pi$ channels was presented. Differential decay widths and time dependent asymmetry in $B_d \to K_s\pi^+\pi^-$ mode needs to be measured into even isospin $\pi\pi$ states. The method can be used to extract γ, as well as the size of the electroweak penguin contributions. The technique is free from assumptions like SU(3) or neglect of any contributions to the decay amplitudes. By studying different regions of the Dalitz plot, it is possible to reduce the ambiguity in the value of γ [**Si4**].

As is well known, direct CP violation in $B \to J/\psi K$ is a clean test for new physics. However, the direct CP asymmetry will vanish if the new-physics amplitude has the same strong phase as the standard-model amplitude. It is shown that this type of new physics can still be detected via an angular analysis of the sister decay mode $B \to J/\psi K^*$. Time-dependent measurements and tagging are not necessary. Should new physics be found, this angular

analysis can be used to obtain information about the size of the new-physics parameters [**Si2**].

In the near future, measurements will be made which will permit one to extract the CKM angles α, β and γ from CP-violating rate asymmetries in the B system. It is hoped that these measurements will reveal the presence of new physics. As an example the effect of CP violating soft supersymmetry breaking terms in squark mixing on the measurement of γ was investigated. Limits on squark mixing parameters using the recent data on D^0–$\bar{D}^0$ and B_s^0–$\bar{B}_s^0$ oscillation were also derived. It was shown that, together with all the other constraints, the currents limits on these parameters still allow large contributions to the CP violating phases in B_s^0–$\bar{B}_s^0$ and D^0–$\bar{D}^0$ oscillations. This can in turn modify some of the proposed measurements of γ parameters in CP violating B decays. However, the current constraints already dictate that the one-loop squark mixing contributions to various B decay amplitudes cannot be competitive with that of the Standard Model (SM) for decay modes that are dominated by tree level amplitudes within the SM. Therefore they cannot contribute significantly to CP asymmetries in the corresponding B decays [**Si3**].

A significant contribution towards measuring α, was to obtain an upper bound on the penguin-pollution angle. This bound follows from the requirements that the two isospin triangles close and have a common base. The new bound is not just improvement over bounds suggested earlier, but is the *most stringent bound* possible on penguin pollution. A lower bound was also presented on the branching ratio $B \rightarrow \pi^0 \pi^0$, which is believed to be small. Current data may suggest that it is not very small, in which case α can be determined using a complete isospin analysis. Finally, it was also shown how to obtain a lower bound on the magnitude of the penguin amplitude P [**Si5**, **Si1**].

Neutrino mass textures proposed at high scales are known to be unstable against radiative corrections especially for nearly degenerate eigenvalues. Within the renormalization group constraints a mechanism was found in a class of gauge theories which guarantees reproduction of any high-scale texture at low energies with radiative stability. It was also shown how the mechanism explains solar and atmospheric neutrino anomalies through the bimaximal texture at high scale [**R6**].

The recent results from the observation of charged current $\nu_e d \rightarrow e^- pp$ events from solar neutrinos by the Sudbury Neutrino Observatory (SNO) have been analyzed assuming neutrino oscillations with three active flavors. The data seem to prefer a low mass-squared difference and large mixing angle solution (the so-called LOW solution) in the parameter space. However, when combined with earlier results from the Gallium charged current interaction data (from Gallex and GNO), distinct (1σ) allowed regions corresponding to the large mixing angle (LMA) and small mixing angle (SMA) appear. The LOW solution, which fits the SNO data best, is disfavored up to 3σ standard deviation when combined with the Gallium data. The physical electron neutrino survival probability corresponding to these best fit solutions are then determined and analyzed for their energy dependence and their implications for the up-coming Borexino detector [**I1**].

There is now overwhelming evidence that neutrino flavours mix resulting in neutrino oscillations. This is a direct pointer to a non-zero mass for neutrinos, which has immense implications in particle physics and astrophysics.

Neutrinos from supernovae have very different signals in water and heavy water detectors.

Since both such types of detectors exist, a comparison of the resulting signals at the two detectors could help distinguish many possible regions of neutrino mixing parameter space that are so far still allowed by current measurements in the solar and atmospheric neutrino sector [**I2**].

Foundations of Quantum Mechanics

A new method of cloning quantum state called "Information cloning" was introduced and applied to the case of harmonic oscillator coherent states. The statistical significance of this type of cloning has been investigated. A notion of "measurement fidelity" has been introduced and this has been applied to the so called Gaussian cloners as well as information cloning.

The Copenhagen interpretation says that a single quantum state has no ontological significance as the first measurement on it generically alters it in an uncontrollable fashion. The no-cloning theorem provides a subtle consistency to this as otherwise one could have prepared an ensemble out of a single state by repeated cloning. The issue of the statistical significance of single quantum states was addressed and it was found that harmonic oscillator coherent states can indeed be endowed with such a significance. Gaussian cloning, information cloning and repeated weak measurements are used to illustrate this claim [**H3**].

Mathematical Physics

The invariance groups for a set of transformations of the non-terminating $_3F_2(1)$ series and for the set of Baily transformations for th terminating $_4F_3(1)$ series are shown to be S_5 and S_6, respectively. Transformations which relate different basis states are used to discuss the symmetries of the $3 - j$ and $6 - j$ coefficients [**Sr3**].

Hypergeometric identities (or transformations) for the $_{p+1}F_p$ series and for Kampé de Fériet series of unit arguments have been derived systematically from known transformations of hypergeometric series and products of hypergeometric series, respectively, using the beta integral method, Mathematica and the software package HYP, resulting in some known identities and some which seem not to have been recorded before in literature. The possible q-generalization for this method is being studied.

Kummer published a set of 6 distinct solutions of the second order Gauss hypergeometric differential equation. Each of these six solutions has four forms, related to one another by Euler's transformations, giving 24 forms in all, which are referred to as the Kummer solutions of the hypergeometric equation. These 24 solutions are related to one another by a finite group of order 24 (or, if one includes the mirror symmetries, by a finite group of order 48). It is shown that the group of order 24 is the group of rotational symmetries of the cube (direct symmetry group of the cube) while the group of order 48 is the group of rotational, including reflections, symmetries of the cube (complete symmetry group of the cube).

Two aspects of the numerical computation of special functions were studied: one concerning the Lagrange interpolation formula based on the Lagrange polynomial and the other regarding the inherent advantages in the numerical computation of special functions through the use of the folded forms of the ordinary and the basic hypergeometric series [**Sr2**].

The incomplete work of the late Prof. R. Vasudevan, on *Stochastic Basis of Quantum Mechanics* was completed [**Sr4**].

q-deformed fermion oscillators are used to construct q-deformed higher order Virasaro algebra in the Fock space representation. These allow the realization of q-deformed W-infinity algebra. The vertex operators in 2d string theory are interpreted in terms of q-fermionic states [**P1**]. In another paper, explicit solutions to the conifold equations with complex dimension 3 and 4 in terms of complex coordinates are employed to construct the Ricci flat Kahler metrics on these manifolds. The Kahler two forms are found to be closed. The complex realization of these conifold metrics are used in the construction of 2d nonlinear sigma model with conifolds as target spaces. The action for the sigma model is shown to be bounded from below. By a suitable choice of the 'integration constants', arising in the solution of Ricci flatness requirement, the metric and the equations of motion are found to be non-singular. The inherent U(1) fibre over the base of the conifolds is shown to correspond to a gauge connection in the sigma model. The procedure is employed to construct the metric for the 'resolved conifold' in terms of complex coordinates and the action for a nonlinear sigma model with resolved conifold as target space is found to have a minimum value. The metric is expressed in terms of the real coordinates and compared with earlier works. The harmonic function, which is the warp factor in Type-II-B string theory is obtained exhibiting $AdS_5 \times X_5$ symmetry [**P4**]. A q-generalization of Sudarshan's diagonal representation of the quantum density matrix is made using q-Boson coherent states. The self-reproducing property of the density matrix and the kernel are demonstrated [**P2**].

The entropy of an orthogonal matrix is defined. It provides a new interpretation of Hadamard matrices as those that saturate the bound for entropy. The function has sharp maxima and other saddle points. The matrices corresponding to the maxima for 3 and 5 dimensions are presented. They are integer matrices (up to a rescaling) [**Sh1**].

Polynomial deformations of Lie algebras appear in the studies of several physical problems. Particularly, three dimensional algebras occur in many situations. Using boson algebras as basic building blocks many classes of quadratic algebras have been constructed and some of their representations have been found [**J2**]. It has been shown that three dimensional polynomial algebras can be constructed using a Jordan-Schwinger-type method [**J3**].

Non-perturbative QCD, Lattice Gauge Theory, QGP

A gauge theory of GL(2) gauge group is considered on a complex manifold and hermitian connections of holomorphic vector bundles of rank 2 over a compact complex manifold M are ableianized using monoidal transformation. The Abelianized connections of the line bundle over a manifold M' as P1 fibre over M are constructed explicitly. The Wilson loop of the GL(2,C) gauge theory is Abelianized to that of C* gauge theory. By this, the Polyakov's conjecture is verified for a GL(2) gauge theory on a complex manifold.

Continuing the earlier proposal of confinement by magnetic symmetry, chiral symmetry breaking has been investigated. The results indicate chiral symmetry breaking is possible in the infrared regime of QCD. This is done using truncated Schwinger-Dyson equation for the quark propagator [**P3**].

A dual form of 3+1-dimensional Yang-Mills theory is obtained as another SO(3) gauge theory. Duality transformation is realized as a canonical transformation. The non-Abelian Gauss

law implies the corresponding Gauss law for the dual theory. The dual theory is nonlocal [**Sh2**].

An exploration of various processors and networking alternatives for construction of a 128-node cluster for lattice gauge theory studies has been undertaken and an efficient algorithm for handling SU(3) matrices has been developed.

Nonlinear Dynamics, Solitons and Chaos

A unified formalism was presented to demonstrate that three distinct space curve evolutions are associated in a natural manner with an exact solution of an integrable nonlinear evolution equation belonging to a certain class. It was shown that this result in turn leads to new connections and insights, as it had been believed hitherto that only one such curve evolution was so associated [**Mur1**].

Applying the unified formalism, the three moving curves associated with the nonlinear Schrödinger equation (NLS) are obtained using its connections with the integrable Landau-Lifshitz equation. The surfaces swept out by the curves associated with a static envelope soliton are found and plotted [**Mur2**].

For the NLS, each of the three curves is shown to be endowed with a corresponding infinite set of geometric constraints. The velocity at each point of this first curve is a local expression in the curve variables, while the velocities of the other two curves are shown to be nonlocal expressions. The three evolving curves corresponding to the moving envelope soliton solution of the NLS were derived and displayed, their behaviors compared, and an application to shape-preserving vortex filament motion observed in fluids was given [**B2**].

The unified approach [**Mur1**] was applied to explicitly obtain the geometrical characterizations of the Lamb equation, by showing that the tangent of the first space curve associated with it, the binormal of the second and the normal of the third, all satisfy the exactly solvable Belavin-Polyakov equation. Exploiting these connections, envelope solitons and novel envelope instanton solutions of the Lamb equation were obtained. The swept-out surfaces associated with them were found and displayed. Possible applications were also suggested [**Mur3**].

Two distinct low-energy sectors (the sigma model sector and the kink sector) were identified in the classical isotropic antiferromagnetic Heisenberg chain, in the continuum limit. Two types of rotation generators for the field were shown to arise in each sector. The Lagrangian for each sector was found. The former sector supports precessing pulses as exact solutions, while the latter sector supports moving kinks [**B1**].

Flexible Parallel Implementation of Logic Gates Using Chaotic Elements: The basic principles for the direct and flexible implementation of all basic logical operations utilizing low dimensional chaos were demonstrated. The concept was then generalized to high dimensional chaotic systems, and the parallelism inherent in such systems was shown. As a case study, the proposed parallel computing architecture was implemented to obtain parallelized bit-by-bit addition with a 2-dimensional chaotic neuronal and a 3-dimensional chaotic laser model [**Sin2**, **Sin5**].

Parallel Computing with Extended Dynamical Systems: The scope of parallelism based on extended dynamical systems, in particular arrays of chaotic elements was outlined. As a

case study the rapid solution of the Deutsch-Jozsa problem was demonstrated utilizing the collective properties of such systems [**Sin6**].

Random Coupling of Chaotic Maps leads to Spatiotemporal Synchronization: The spatiotemporal dynamics of a network of coupled chaotic maps, with varying degrees of randomness in coupling connections was investigated. While strictly nearest neighbour coupling never allowed spatiotemporal synchronization in the system considered, randomly re-wiring some of those connections stabilized entire networks at x^*, where x^* is the strongly unstable fixed point solution of the local chaotic map. In fact, the smallest degree of randomness in spatial connections opened up a window of stability for the synchronized fixed point in coupling parameter space. Further, the coupling ϵ_{bifr} at which the onset of spatiotemporal synchronization occurs, scaled with the fraction of rewired sites p as a power law, for $0.1 < p < 1$. Further it was shown that the regularizing effect of random connections can be understood from stability analysis of the probabilistic evolution equation for the system, and approximate analytical expressions for the range and ϵ_{bifr} were obtained [**Sin4**].

Perturbative QCD

The Standard Model interactions of ultra high energy neutrinos with matter were reconsidered. The next to leading QCD corrections were presented for charged and neutral current processes. Contrary to popular expectations, these corrections were found to be quite substantial, especially for large (anti-) neutrino energies. Hence, they need to be taken into account in any search for new physics effects in high energy neutrino interactions. In these extrapolations of the parton densities to kinematical regions as yet unexplored directly in terrestrial accelerators, one was guided by double asymptotic scaling in the large Q^2 and small Bjorken x region and to models of saturation in the low Q^2 and low x regime. The sizes of the consequent uncertainties were commented upon [**Basu3**].

J/Ψ production through photon-photon collisions has been studied, both at e^+-e^- colliders as well as in future photon linear colliders. The case when one of the photons is resolved (1-res) is very sensitive to the gluon content of the photon. More important, the 1-res and the 2-res (where both photons are resolved) cases are sensitive to (different combinations of) the color octet matrix elements. Hence, this may be a good testing ground for color octet contributions in NRQCD [**I3**].

QFT, Topological QFT, Conformal Field Theory

The effective action for Maxwell and Kalb-Ramond fields induced by fermionic vacuum polarization was calculated. Techniques introduced by Schwinger to study the problem for Maxwell fields were generalized to include Kalb-Ramond fields also [**H6**].

A simplified method for computing trace anomalies in dimensions $d \leq 6$ was discussed. It is known that in the quantum mechanical approach trace anomalies in d dimensions are given by a (d/2 + 1)-loop computation in an auxiliary 1D sigma model with arbitrary geometry. It was shown how one can obtain the same information using a simpler (d/2)-loop calculation on an arbitrary geometry supplemented by a (d/2 + 1)-loop calculation on the simplified geometry of a maximally symmetric space [**H1**].

Non-Abelian gauge theories with fermions and scalars that nevertheless possess asymptotic

freedom were constructed. The scalars were taken to be in a chiral multiplet transforming as (2,2) under $SU(2)_L \times SU(2)_R$ and transforming as singlets under the color SU(3) group. Two distinct scenarios were considered, one in which the additional scalars are light and another in which they are heavier than half the Z-boson mass. It was shown that asymptotic freedom is obtained without requiring that all additional couplings keep fixed ratios with each other. It was also shown that neither scenario can be ruled out by what are considered standard tests of QCD such as the R parameter, g-2 for muons, or deep inelastic phenomena. The light mass scenario is, however, ruled out by high precision Z-width data. The heavy mass scenario is still viable and was shown to naturally pass the test of flavor changing neutral currents. It is also not ruled out either by precision electroweak oblique parameters or by the recent precise measurements at the Fermilab Tevatron. Many distinctive experimental signatures of these models were also discussed [**H8**].

An extended linear σ model in which the fermions are quarks and are coupled to gluons was considered. Equivalently, this is QCD extended by coupling the quarks to a colour singlet chiral multiplet of $(\sigma, \vec{\pi})$ fields. This theory has a phase governed by a UV fixed point where all couplings are AF (asymptotically free). This implies that the scalars are elementary at high energies (UV) and, as they are colour singlets, they are not confined at low energy (IR). Thus, the scalar particles are elementary at all scales [**H7**].

Statistical Mechanics

An investigation of the persistence phenomenon with *parallel* dynamics was carried out. The persistence exponents for one-dimensional Ising [**Me2**] and Potts models with parallel dynamics were obtained *exactly* [**Me6**], through a novel mapping onto the problem of persistence with two species of coalescing and annihilating random walkers. The persistence properties of the one-dimensional Domany-Kinzel automaton and coupled map lattices at the onset of spatio-temporal intermittency are currently being studied.

The issue of how a system can start off in a pure state and evolve at late times to something that can be described by a microcanonical ensemble density matrix was studied. This is important for understanding the foundations of quantum Statistical mechanics. It has also become interesting in the context of string theory black holes. A quantum mechanical analogue of the Gibbsian coarse graining in classical statistical mechanics was achieved dynamically with the help of soft quanta that are inevitably present in all many body systems. It was shown that with fairly plausible assumptions one can demonstrate the emergence of thermality. In some simple situations explicit calculations were done that support this picture. Also, this work was compared with the earlier works of von Neumann and Van Kampen [**H5**, **H4**].

The spatial pattern formed by the persistent regions in non-equilibrium evolution of interacting many-particle systems like phase-ordering processes was studied [**Ray**].

String Theory

New developments in String theory suggests the possibility of non-commutative space-time. Quantum mechanics in a two dimensional surface was seen to be related to the Landau Problem. The spectrum of states for a non-commutative AdS_2 was obtained and contrasted with the corresponding commutative case [**Ra**].

The dynamical consequences of Maggiore's unique generalized uncertainty principle (GUP) were studied. It was found that it leads naturally, and generically, to novel consequences. In the high temperature limit, there is a drastic reduction in the degrees of freedom, of the type found, for example, in strings far above the Hagedorn temperature. In view of this, the present GUP may perhaps be taken as the new version of the Heisenberg uncertainty principle, conjectured by Atick and Witten to be responsible for such reduction. Also, the present GUP leads naturally to varying speed of light and modified dispersion relations. They are likely to have novel implications for cosmology and black hole physics, a few of which were discussed qualitatively [**Ram1**].

The dynamical features of Maggiore's generalized commutation relations were studied, focusing on their generality and, in particular, their dependence on the Hamiltonian. The generalization of the Planck's law for black body spectrum was derived and the statistical mechanics of free particles was studied. The early universe evolution now exhibits non trivial features. It was found that the dynamical features, found here and in [**Ram1**], are all generic and vary systematically with respect to the asymptotic growth of the Hamiltonian [**Ram2**].

Self tuning solutions were considered for a brane embedded in an anti de Sitter spacetime. The higher derivative Gauss-Bonnet terms were included in the action and singularity free solutions with finite effective Newton's constant are studied. Using the methods of Csaki et al, it was proved that such solutions, when exist, always require a fine tuning among the brane parameters. A new method of analysis was then presented in which the qualitative features of the solutions can be seen easily without obtaining the solutions explicitly. Also, the origin of the fine tuning is transparent in this method [**V**].

Noncommutative spacetimes and field theories defined on them have been studied extensively for the past few years motivated mainly from string theory. Apart from this fact that these theories arise as low energy limits of string theory in a constant NS $B_{\mu\nu}$ background, their study as field theories in their own right is quite fascinating. UV/IR mixing is one of the most important features of these noncommutative field theories. As a consequence of this coupling of the UV and IR sectors, the configuration of fields at the zero momentum limit in these theories is a very singular configuration. It was found that the renormalization conditions set at a particular momentum configuration with a fixed number of zero momenta, renormalizes the Green's functions for any general momenta only when this configuration has same set of zero momenta. Therefore only when renormalization conditions are set at a point where all the external momenta are nonzero, the quantum theory is renormalizable for all values of nonzero momentum. This arises as a result of different scaling behaviors of Green's functions with respect to the UV cutoff (Λ) for configurations containing different set of zero momenta. These features were studied in the noncommutative ϕ^4 theory and similar results for the Gross-Neveu model at one loop level were analyzed. Next this general feature was shown using Wilsonian RG of Polchinski in the globally $O(N)$ symmetric scalar theory and the renormalizability of the theory was proved to all orders with an infrared cutoff. In the context of spontaneous symmetry breaking in noncommutative scalar theory, it is essential to note the different scaling behaviors of Green's functions with respect to Λ for different set of zero momenta configurations. It was shown that in the broken phase of the theory the Ward identities are satisfied to all orders only when one keeps an infrared regulator by shifting to a non-constant vacuum [**Sa**].

A longstanding problem in string theory is that of obtaining equations of motion for the massive modes of the string using the world sheet renormalization group. An approach that

uses variables defined on a loop, "loop variables", has been pursued for some years. The free case was solved many years ago. In the last couple of years significant progress has been made. Recently a version of the loop variable that seems to solve the problem has been proposed. It is essentially a version of Wilson's exact RG equations. The crucial point is that in this latest version of the method the proof of gauge invariance of the interacting version follows exactly the same path as the free case. Thus if this approach is correct one has a solution to the problem described in the first sentence [**Sat1**].

The proposal for solving the problem mentioned above involves keeping a finite cutoff on the world sheet. This allows one to go off shell. This is understandable from the point of view of the RG. Another feature is that the generalized momenta are, in the interacting theory, a function of a parameter that is a lot like proper time. Thus it looks a lot like the current source in field theory. This connection has been made precise and it has been shown that the loop variable prescription is not ad-hoc, but in fact just amounts to calculating the partition function for the sigma model, via the intermediate step of calculating the generating functional. An explanation of the precise connection with Wilson's formulation of the exact RG and how one goes from this to the Callan-Symanzik β function was also given. The loop variable method was applied to some exactly soluble examples and the equations of motion obtained . It was also shown that the equation is equal to the product of Zamolodchikov's metric and the β-function [**Sat2**].

Various aspects of D-branes on Calabi-Yau manifolds continued to be studied intensively. A linear sigma model for open-strings ending on special Lagrangian cycles of a Calabi-Yau manifold was constructed. The construction was illustrated for the cases considered by Aganagic and Vafa in hep-th/0012041. This led naturally to concrete models for the moduli space of open-string instantons. These instanton moduli spaces could be seen to be intimately related to certain auxiliary 'boundary' toric varieties. By considering the relevant Gelfand-Kapranov-Zelevinsky (GKZ) differential equations of the boundary toric variety, the contributions to the world volume superpotential on the A-branes from open-string instantons was obtained. By using an ansatz due to Aganagic, Klemm and Vafa in hep-th/0105045, the relevant change of variables from the linear sigma model to the non-linear sigma model variables, the open-string mirror map, was obtained. Using this mirror map, results for the counting of holomorphic disc instantons were obtained, in agreement with those of Aganagic, Klemm and Vafa [**Jay2**].

It was shown how to compute terms in an expansion of the world-volume superpotential for fairly general D-branes on the quintic Calabi-Yau using linear sigma model techniques. It was further demonstrated in examples that this superpotential captures the geometry and obstruction theory of bundles and sheaves on this Calabi-Yau [**Jay1**].

2.2.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**B1**]
Radha Balakrishnan and Rossen Dandoloff[*].
Nonlinear dynamics of the classical isotropic Heisenberg antiferromagnetic chain: The sigma model sector and the kink sector.
Phys. Lett. A, 2002.
(To be published).

[**B2**]
Radha Balakrishnan and S. Murugesh.
Kinematics of three moving space curves associated with the nonlinear Schrodinger equation.
Theor. Math. Phys., 133, 2002.
(To be published).

[**Ba**]
Sukratu Barve.
Conformal transformations near naked singularities.
Mod. Phys. Lett., 2002.
(To be published).

[**Bas**]
Soumen Basak and Parthasarathi Majumdar.
'Superresonance' from a rotating acoustic black hole.
Phys. Rev. Lett., 2002.
(Submitted).

[**Bask1**]
G. Baskaran.
High T_c ferromagnetism in SrB_6 family: A case of doped spin-1 Mott insulator in a valence bond solid phase.
Phys. Rev. B, **65**, 212403, 2001.

[**Bask2**]
G. Baskaran.
All basic condensed matter physics phenomena and notions mirror in biology - a hypothesis, two examples and a novel prediction.
Pramana - Journal of Physics, **58**, 427, 2002.

[**Bask3**]
G. Baskaran.
Anderson's theory of superconductivity and beyond.
In Ravin Bhatt and N.P. Ong, editors, *More is Different*. Princeton University Press, Prince-
  ton, NJ, USA, 2002.

[**Bask4**]
G. Baskaran and S. A. Jafari.
Gapless spin-1 neutral collective mode branch for graphite.
Phys. Rev. Lett., **89**, 016402, 2001.

[**Basu1**]
Sunanda Banerjee* and Rahul Basu.
Quark mass corrections to the perturbative thrust and its effect on the determination of α_s.
Pramana - Journal of Physics, 2002.
(To be published).

[**Basu2**]
Rahul Basu.
Muon anomalous magnetic moment and 'new physics'.
Current Science, **82**, 910, 2002.

[**Basu3**]
Rahul Basu, Debajyoti Choudhury*, and Swapan Majhi*.
NLO corrections to ultra high energy neutrino nucleon scattering, shadowing and small x.
JHEP, 2002.
(Submitted).

[**D1**]
G. Date.
Isolated horizon, Killing horizon and event horizon.
Class. Quant. Grav., **18**, 5219, 2001.

[**D2**]
G. Date.
Quantum geometric description of cosmological models.
Mod. Phys. Lett. A, **17**, 967, 2002.

[**D3**]
G. Date and Parampreet Singh*.
Semiclassical states in the context of constrained systems.
2001.
(Preprint: IMSc/2001/08/48).

[**G**]
Kaushik Bhattacharya* and Avijit K. Ganguly.
Neutrino photon interaction in a magnetized medium II.
2002.
(Preprint: IMSc/2002/07/21).

[**Gh1**]
Tarun K. Ghosh.
Collective excitation frequencies and vortices of a Bose-Einstein condensed state with gravity-
  like interatomic attraction.
Phys. Rev. A, **65**, 053616, 2002.

[**Gh2**]
Tarun K. Ghosh and G. Baskaran.
Modeling two-roton bound state formation in fractional quantum Hall system.
Phys. Rev. Lett., **87**, 186803, 2001.

[**Gh3**]
Tarun K. Ghosh and G. Baskaran.
Cooperative ring exchange and quantum melting of vortex lattices in atomic Bose- Einstein
  condensate.
2002.
(Submitted).

[**Gh4**]
Tarun K. Ghosh and Subhasis Sinha*.
Splitting between quadrupole modes of dilute quantum gas in a two dimensional anisotropic
  trap.
Euro. Phys. Jour. D, **19**, 371, 2002.

[**Go**]
T. R. Govindarajan, R. K. Kaul, and V. Suneeta.
Quantum gravity in dS_3.
Class. Quant. Grav., 2002.
(To be published).

[**H1**]
Fiorenzo Bastianelli* and N. D. Hari Dass.
Simplified method for trace anomaly calculations in $d = 6$ and $d < 6$.
Phys. Rev. D, **64**, 047701, 2001.

[**H2**]
N. D. Hari Dass.
A no go theorem for de Sitter compactifications?
Mod. Phys. Lett. A, **17**, 1001, 2002.

[**H3**]
N. D. Hari Dass and Pradeep Ganesh[*].
Information cloning of harmonic oscillator coherent states.
Pramana - Journal of Physics, 2002.
(To be published).

[**H4**]
N. D. Hari Dass, Kalyanarama, and B. Sathiapalan.
Passage from a pure state description to the microcanonical ensemble description for closed
 quantum systems.
Pramana - Journal of Physics, 2002.
(To be published).

[**H5**]
N. D. Hari Dass, S. Kalyana Rama, and B. Sathiapalan.
On the emergence of the microcanonical description from a pure state.
Nucl. Phys. B, 2001.
(Submitted).

[**H6**]
N. D. Hari Dass and K. V. Shajesh[*].
Vacuum polarization induced coupling between Maxwell and Kalb-Ramond fields.
Phys. Rev. D, **65**, 085010, 2002.

[**H7**]
N. D. Hari Dass and V. Soni[*].
An elementary (pseudo)scalar at all scales?
Phys. Lett. B, 2002.
(Submitted).

[**H8**]
N. D. Hari Dass and V. Soni[*].
Asymptotically free non-Abelian gauge theories with fermions and scalars as alternatives to
 QCD.
Phys. Rev. D, **65**, 095005, 2002.

[**Ho**]
Golam M. Hossain and Parthasarathi Majumdar.
Phenomenological equation of state and late time cosmic acceleration.
Phys. Rev. Lett., 2002.
(Submitted).

[**I1**]
C. V. K. Baba[*]**, D. Indumathi, and M. V. N. Murthy**.
Implications of recent solar neutrino observations: an analysis of charged current data.
Phys. Rev. D, **65**, 073033, 2002.

[**I2**]
G. Dutta[*]**, D. Indumathi, M. V. N. Murthy, and G. Rajasekaran**.
Neutrinos from stellar collapse: Comparison of signatures in water and heavy water detectors.
Phys. Rev. D, **64**, 073011, 2001.

[**I3**]
R. M. Godbole[*]**, D. Indumathi, and Michael Krämer**[*].
J/ψ production through resolved photon processes at e^+-e^- colliders.
Phys. Rev. D, **65**, 074003, 2002.

[**J1**]
R. Jagannathan.
Some introductory notes on quantum groups, quantum algebras, and their applications.
In S. Parvathi, editor, *Proceedings of the Institutional and Instructional Programme on Quantum Groups and their Applications*, page 1. Ramanujan Institute for Advanced Study in Mathematics, May 2002.

[**J2**]
V. Sunil Kumar[*]**, B. A. Bambah**[*]**, and R. Jagannathan**.
Three dimensional quadratic algebras: Some realizations and representations.
J. Phys. A: Math. Gen., **34**, 8583, 2001.

[**J3**]
V. Sunil Kumar[*]**, B. A. Bambah**[*]**, and R. Jagannathan**.
Jordan-Schwinger realizations of three dimensional polynomial algebras.
Mod. Phys. Lett. A, **17**, 1559, 2002.

[**Ja**]
Neelima Gupte[*]**, T. M. Janaki, and Sudeshna Sinha**.
Effect of asynchronicity on the universal behaviour of coupled map lattices.
Phys. Rev. E, 2002.
(Submitted).

[**Jay1**]
Michael R. Douglas[*]**, Suresh Govindarajan**[*]**, T. Jayaraman, and Alessandro Tomasiello**[*].
D-branes on Calabi-Yau manifolds and superpotentials.
2002.
hep-th/0203173 (Submitted).

[**Jay2**]
Suresh Govindarajan[*]**, T. Jayaraman, and Tapobrata Sarkar**[*].
Disc instantons in linear Sigma models.
2001.
hep-th/0108234 (Submitted).

[**M1**]
Parthasarathi Majumdar.
Black hole entropy: Classical and quantum aspects.
In *Proceedings of the National Workshop on Black Hole Astrophysics, YATI-2001, Kolkata, India.*, Oct 2001.
(Submitted).

[**M2**]
Saurya Das∗, Rajat K. Bhaduri∗, and Parthasarathi Majumdar.
General logarithmic corrections to black hole entropy.
Class. Quant. Grav., **19**, 2355, 2002.

[**M3**]
Sayan Kar∗, Parthasarathi Majumdar, Soumitra SenGupta∗, and Aninda Sinha.
Does a Kalb-Ramond field make spacetime optically active.
Euro. Phys. Jour., **C23**, 357, 2002.

[**M4**]
Sayan Kar∗, Parthasarathi Majumdar, Soumitra SenGupta∗, and Saurabh Sur∗.
Cosmic optical activity from an inhomogeneous Kalb-Ramond field.
Class. Quant. Grav., **19**, 677, 2002.

[**Me1**]
Debasis Dan∗, Arun M. Jayannavar∗, and Gautam I. Menon.
A biologically inspired model for two-headed Brownian motors.
In *Physica B*, May 2002.
(Submitted).

[**Me2**]
G. I. Menon, P. Ray, and P. Shukla∗.
Persistence in one-dimensional Ising models with parallel dynamics.
Phys. Rev. E, **64**, 046102, 2001.

[**Me3**]
Gautam I. Menon.
A new phenomenology for the disordered mixed phase.
Mod. Phys. Lett. B, **15**, 1023, 2001.

[**Me4**]
Gautam I. Menon.
Phase behavior of type-II superconductors with quenched point pinning disorder: A phenomenological proposal.
Phys. Rev. B, **65**, 104527, 2002.

[**Me5**]
Gautam I. Menon.
Structure and freezing of a disordered flux-line system.
Phase Transitions, **75**, 477, 2002.

[**Me6**]
Gautam I. Menon and Purusattam Ray.
Exact persistence exponent for one-dimensional Potts models with parallel dynamics.
J. Phys. A, **34**, L735, 2001.

[**Mi1**]
Ashok K. Mishra.
Electron transfer reaction through an adsorbate layer.
2002.
(Preprint: IMSc/2002/06/11).

[**Mi2**]
Ashok K. Mishra.
Potential energy surface for an adsorbate mediated electron transfer reaction.
2002.
(Preprint: IMSc/2002/06/12).

[**Mu1**]
R. K. Bhaduri*, **Sankalpa Ghosh***, **M. V. N. Murthy, and Diptiman Sen***.
Solitons in a one dimensional interacting Bose-Einstein system.
J. Phys. A: Math. Gen., **34**, 6553, 2001.

[**Mu2**]
R. K. Bhaduri*, **M. V. N. Murthy, and Muoi Tran***.
Number fluctuation in an interacting trapped gas in one and two dimensions.
J. Phys. B: At. Mol. Opt. Phys., **35**, 2817, 2002.

[**Mu3**]
Sankalpa Ghosh*, **M. V. N. Murthy, and Subhasis Sinha***.
Two component Fermi vapour in a 2d rotating trap.
Phys. Rev. A, **64**, 053603, 2001.

[**Mur1**]
S. Murugesh and Radha Balakrishnan.
New connections between moving curves and soliton equations.
Phys. Lett. A, **290**, 81, 2001.

[**Mur2**]
S. Murugesh and Radha Balakrishnan.
New geometries associated with the nonlinear Schrodinger equation.
Euro. Phys. Jour. B, 2002.
(To be published).

[**Mur3**]
S. Murugesh and Radha Balakrishnan.
Geometric characterizations of the Lamb equation.
2002.
(Preprint: IMSc/2002/07/15).

[**P1**]
R. Parthasarathy.
q-deformed W-algebra from q-fermion oscillators and the algebraic structure of vertex oper-
 ators in 2d string theory.
Mod. Phys. Lett. A, **17**, 399, 2002.

[**P2**]
R. Parthasarathy and R. Sridhar.
A diagonal representation of quantum density matrix using q-boson coherent states.
2002.
(Preprint: IMSc/2002/07/20).

[**P3**]
R. Parthasarathy and O. Suzuki[*].
Abelianization of Wilson loop of non-Abelian gauge theory on complex manifold and
 Polyakov's conjecture.
Rep. Math. Phys., **50**, 69, 2002.

[**P4**]
R. Parthasarathy and K.S. Viswanathan[*].
Nonlinear Sigma model on conifolds.
Mod. Phys. Lett. A, **17**, 517, 2002.

[**R1**]
G. Rajasekaran.
Indian contributions to HEP in the 20th century.
In *Proc. XIV Symposium on High Energy Physics*.
IMSc/2002/07/25.
(To be published).

[**R2**]
R. Adhikari[*]**, E. Ma**[*]**, and G. Rajasekaran**.
Supersymmetric model of muon anomalous magnetic moment and neutrino masses.
Phys. Rev. D, **65**, 077703, 2002.

[**R3**]
E. Ma[*] **and G. Rajasekaran**.
Light unstable sterile neutrino.
Phys. Rev. D, **64**, 117303, 2001.

[**R4**]
E. Ma* **and G. Rajasekaran**.
Softly broken A_4 symmetry for nearly degenerate neutrino masses.
Phys. Rev. D, **64**, 113012, 2001.

[**R5**]
Ernest Ma* **and G Rajasekaran**.
Double threefold degeneracies for active and sterile neutrinos.
Mod. Phys. Lett. A, **16**, 2207, 2001.

[**R6**]
M. K. Parida***, C. R. Das*****, and G. Rajasekaran**.
Radiative stability of neutrino-mass textures.
2002.
(Preprint: hep-ph/0203097).

[**Ra**]
Roberto Iengo* **and Raghavan Ramachandran**.
Landau levels in noncommutative AdS_2.
JHEP, **02**, 017, 2002.

[**Ram1**]
S. Kalyana Rama.
Some consequences of the generalized uncertainty principle: Statistical mechanical, cosmo-
  logical, and varying speed of light.
Phys. Lett. B, **519**, 103, 2001.

[**Ram2**]
S. Kalyana Rama.
Dynamical features of Maggiore's generalized commutation relations.
Phys. Lett. B, **539**, 289, 2002.

[**Ray**]
Purusattam Ray.
Spatial scaling in persistence.
Physica A, 2002.
(To be published).

[**S**]
Sumithra Sankararaman, Gautam I. Menon, and P. B. Sunil Kumar*.
Two-component fluid membranes near repulsive walls: Linearized hydrodynamics of equilib-
  rium and non-equilibrium states.
Phys. Rev. E, 2002.
(To be published).

[**Sa**]
Swarnendu Sarkar.
On the UV renormalizability of noncommutative field theories.
JHEP, **06**, 003, 2002.

[**Sat1**]
B. Sathiapalan.
Loop variables and gauge invariance in (open) bosonic string theory.
Mod. Phys. Lett.A, **17**, 1175, 2002.

[**Sat2**]
B. Sathiapalan.
Loop variables in string theory.
Int. Jour. Mod. Phys. A, 2002.
(To be published).

[**Sh1**]
H. G. Gadiyar∗, K. M. S. Maini∗, R. Padma∗, and H. S. Sharatchandra.
Entropy and Hadamard matrices.
2002.
math-ph/0206018 (Submitted).

[**Sh2**]
Pushan Majumdar∗ and H. S. Sharatchandra.
Duality transformation for 3+1-dimensional Yang-Mills theory.
Int. Jour. Mod. Phys., **17**, 175, 2002.

[**Si1**]
Nita Sinha.
Penguin pollution in $B_d \to \pi\pi$.
In *Proceedings of the Conference "Flavor Physics and CP Violation (FPCP), Philadelphia, Pennsylvania, 16-18 May 2002"*. Stanford Linear Accelerator Center Electronic Conference Proceedings Archive (eConf), Jun 2002.
(To be published).

[**Si2**]
David London∗, Nita Sinha, and Rahul Sinha.
New physics in $B \to J/\psi K^*$.
In *Proceedings of the Conference "Flavor Physics and CP Violation (FPCP), Philadelphia, Pennsylvania, 16-18 May 2002"*. Stanford Linear Accelerator Center Electronic Conference Proceedings Archive (eConf), Jun 2002.
(To be published).

[**Si3**]
Darwin Chang∗, We-Fu Chang∗, Wai-Yee Keung∗, Nita Sinha, and Rahul Sinha.
Squark mixing contributions to CP violating phase γ.
Phys. Rev. D, **65**, 055010, 2002.

[**Si4**]
N. G. Deshpande[*]**, Nita Sinha, and Rahul Sinha**.
Weak phase γ using isospin analysis and time dependent asymmetry in $B_d \to K_s \pi^+ \pi^-$.
Phys. Rev. Lett., 2002.
(Submitted).

[**Si5**]
Michael Gronau[*]**, David London**[*]**, Nita Sinha, and Rahul Sinha**.
Improving bounds on penguin pollution in $B \to \pi\pi$.
Phys. Lett. B, **514**, 315, 2001.

[**Sin1**]
Sudeshna Sinha.
Controlling chaos with threshold mechanisms.
In R. Sahadevan and M. Daniels, editors, *VIII Ramanujan Symposium on "Recent Developments in Nonlinear Systems"*. Narosa, Mar 2002.

[**Sin2**]
Toshinori Munakata[*]**, Sudeshna Sinha, and William Ditto**[*].
Chaos computing: Implementation of fundamental logical and arithmetic operations and memory by chaotic elements.
IEEE Trans. on Circuits and Systems, 2001.
(To be published).

[**Sin3**]
Sudeshna Sinha.
Asynchronous updating restores the law of large numbers in globally coupled systems.
Int. Jour. Bif. and Chaos, **12**, 663, 2002.

[**Sin4**]
Sudeshna Sinha.
Random coupling of chaotic maps leads to spatiotemporal synchronization.
Phys. Rev. E, **66**, 016209, 2002.

[**Sin5**]
Sudeshna Sinha, Toshinori Munakata[*]**, and William Ditto**[*].
Flexible parallel implementation of logic gates using chaotic elements.
Phys. Rev. E, **65**, 036216, 2002.

[**Sin6**]
Sudeshna Sinha, Toshinori Munakata[*]**, and William Ditto**[*].
Parallel computing with extended dynamical systems.
Phys. Rev. E, **65**, 036214, 2002.

[**Sr1**]
K. Srinivasa Rao, H. Doebner∗**, and P. Natterman**∗.
Group theoretical basis for some transformations of generalized hypergeometric series and
the symmetries of the 3-j and 6-j coefficients.
In S. Kanemitsu and Chaohua Jia, editors, *China-Japan Seminar*. Kluwer Academic Publishers, May 2002.
A Volume of the series: Developments of Mathematics (DEVM)(To be published).

[**Sr2**]
K. Srinivasa Rao.
Numerical aspects of special functions.
In *Proceedings of the Third Annual Conference of SSFA*. Society for Special Functions and
their Applications, Tara Press, Varanasi., Jun 2002.
(To be published).

[**Sr3**]
K. Srinivasa Rao.
Relevance of Ramanujan at the dawn of the new millennium.
In A. K. Agarwal, Bruce C. Berndt, Christian F. Krattenthaler, Gary L. Mullen, K. Ramachandra, and Michel Waldschmidt, editors, *Number Theory and Discrete Mathematics*,
page 261. Hindustan Book Agency, 2002.

[**Sr4**]
K. Srinivasa Rao and R. Sridhar.
Foreword.
In R. Vasudevan (late), K. V. Parthasarathy∗, and R. Ramanathan∗, authors, *Stochastic
Basis of Quantum Mechanics*. Narosa Publishing House, New Delhi, 2002.
(To be published).

[**Su**]
Naveen Surendran and R. Shankar.
Generalized Shastry-Sutherland models in three and higher dimensions.
Phys. Rev. B, **66**, 024415, 2002.

[**V**]
Samik Dasgupta∗**, Rajesh Venkatachalapathy, and S. Kalyana Rama**.
No go theorem for self tuning solutions with Gauss-Bonnet terms.
JHEP, **07**, 061, 2002.

Books/Monographs Authored/Edited

The list below follows the same conventions as those followed for the list of publications.

[**B**]
Radha Balakrishnan, R. Dandoloff*, V. Gerdjikov*, D. Pushkarov*, and A. Saxena*, editors.
Geometry, Integrability and Nonlinearity in Condensed Matter Physics.
Special issue. The European Physical Journal B, 2002.
(To be published).

[**I**]
D. Indumathi, M. V. N. Murthy, and R. Parthasarathy, editors.
Rajaji Symposium: Festschrift for the 65th Birthday of G. Rajasekaran.
IMSc Report 119. The Institute of Mathematical Sciences, CIT Campus, Chennai 600 113,
 2002.

2.3   Theoretical Computer Science

2.3.1   Research Summary

Algorithms and Data Structures

The *indexable dictionary* problem, which consists in storing a set $S \subseteq \{0, \ldots, m-1\}$ for some integer m, while supporting the operations of $rank(x)$ and $select(i)$, is considered. ($rank(x)$ returns the number of elements in S that are less than x if $x \in S$, and -1 otherwise; $select(i)$ returns the i-th smallest element in S.) A structure that supports both operations in $O(1)$ time on the RAM model and requires $\mathcal{B}(n, m) + o(n) + O(\lg \lg m)$ bits to store a set of size n is given, where $\mathcal{B}(n, m) = \lceil \lg \binom{m}{n} \rceil$ is the minimum number of bits required to store any n-element subset from a universe of size m. Previous dictionaries taking this space only supported (yes/no) membership queries in $O(1)$ time. In the cell probe model the $O(\lg \lg m)$ additive term in the space bound can be removed[**Ra1**]. Several applications of the dictionary structure are given including:

- an information-theoretically optimal representation for *k-ary cardinal trees* (also known as k-ary tries) that uses $\mathcal{C}(n, k) + o(n + \lg k)$ bits to store a k-ary tree with n nodes and can support parent, i-th child, child labeled i, and the degree of a node in constant time, where $\mathcal{C}(n, k)$ is the minimum number of bits to store any n-node k-ary tree. Previous space efficient representations for cardinal k-ary trees required $\mathcal{C}(n, k) + \Omega(n)$ bits; and

- a representation for multisets where (appropriate generalizations of) the *select* and *rank* operations can be supported in $O(1)$ time. The proposed structure uses $\mathcal{B}(n, m+n) + o(n) + O(\lg \lg m)$ bits to represent a multiset of size n from an m element set; the first term is the minimum number of bits required to represent such a multiset.

The problem of counting and sampling the k-colorings of a graph arises in several areas. Earlier work on sampling k-colorings of bipartite graphs had shown that for *some* bipartite graph G and for infinitely many values of k, any Markov chain from a large class of powerful chains cannot be used as an efficient sampler for bipartite graphs. In [**B**], this negative result has been further strengthened by showing that the proof actually works for *almost every* bipartite G. While for fixed k, this result follows from earlier results, the new results allow large values of k growing with increasing n (number of vertices).

It was also shown in [**B**] that the probabilistic arguments employed for colorings can be modified to derive negative results of similar generality (almost every bipartite G) on sampling independent sets in bipartite graphs. While such results have been obtained for random regular graphs of fixed degree, the new results are true for random graphs of unbounded maximum degree, random graphs of bounded average degree, etc.

Consider a random graph G on n vertices with edge probability p. It is known that the maximum size of an independent set I is close to $2g(n, p)$ for some function g. Suppose G is augmented with a large independent set J to get a graph G'. The aim is to find as large an independent set as possible in G'. In [**S4**], it is shown that a class of Metropolis-like chains (whose limiting distributions favor large independents sets) has super-polynomial

mixing time if J is very large compared to $2g$. Hence such chains cannot be used as efficient samplers to get a good approximation for the maximum independent set.

The problem of finding a large induced acyclic subgraph of a given digraph $D = (V, E)$ was considered. It is known that this problem is not approximable within a ratio of $O(|V|^\epsilon)$ for some $\epsilon > 0$. In [**S3**], it was shown that if D is a random instance, then any maximal solution is within an $o(\ln n)$ factor from the optimal one. In addition, except when D is very sparse (having $|V|^{1+o(1)}$ edges), this ratio is in fact $O(1)$. Thus, the optimal solution can be approximated in a much better way over random instances.

In [**S1**], lower bounds on the tree width of a graph are obtained from its structural parameters. For example, it was shown that if G has large vertex expansion, then it has large tree width. Similarly, lower bounds were obtained based on other parameters like girth, minimum degree, etc. Since expansion is related to the spectral parameters of G, it also implies a relationship involving tree width and spectral parameters. Using this, new or significantly improved lower bounds were obtained on some special classes of graphs. Applying these, very tight bounds were obtained on tree width of random graphs (with independent edge probability) and random d-regular graphs.

In [**Ra3**], new and faster fixed parameter algorithms are described for the feedback vertex set problem in undirected graphs. It was shown that these algorithms run in $O((4 \log k)^k \cdot n^3)$ time compared to the $O((2k)^k \cdot n^3)$ time of the previously best known algorithm. Here k denotes the parameter and n denotes the number of vertices in the input. This result is based on a structural result on the existence of cycles of constant length in graphs having a small feedback vertex set.

Automata, Logic and Concurrency

Over the last few years, work has been done on investigating languages over series-parallel posets and series Σ-algebras. A full development is presented in [**L**].

One of the weaknesses of this work was the absence of a relationship to an already existing model of concurrent computation. This has now been rectified. A precise syntactic characterizations for the languages of series-parallel posets accepted by 1-safe Petri nets has been obtained. Also, the subclasses of S-nets and communication free nets (which only accept sp-posets) has been characterized. A preprint of this paper is ready and is being submitted.

Message sequence charts (MSCs) are a standard notation used to describe interaction between communicating processes in a distributed system. Message sequence graphs (MSGs) and compositional MSGs (CMSGs) are models used to describe collections of MSCs. In [**M1**], the class of MSC languages definable by CMSGs was characterized in terms of regular representative linearizations. Also, the model checking problem for CMSGs against MSO specifications was shown to be decidable. A class of extended CMSGs (XCMSGs), which is strictly more expressive than CMSGs, was studied and characterized in terms of regular representative semi-linearizations. The model checking problem for this class against MSO specifications was also shown to be decidable.

Lamport diagrams constitute a natural generalization of MSCs. To capture classes of MSCs defined by MSGs and CMSGs, a notion of layering of Lamport diagrams is defined. In [**M2**], a temporal logic over Lamport diagrams was studied. The satisfiability problem for this logic

turns out to be undecidable even for restricted classes of layered Lamport diagrams. The logic becomes decidable for diagrams with communication closed layers (corresponds to diagrams generated by MSGs) and diagrams with bounded communication delay (corresponds to diagrams by CMSGs).

In continuing research on logics for analysis of security protocols, a simple logic to reason about security protocols was considered and the corresponding verification problem was studied. The verification of protocols where the honest agents generate only boundedly many nonces, but the intruder is allowed to generate unboundedly many nonces, was shown to be decidable. Also, if the behaviours of the honest agents are "finite-state", then the verification problem was proved to be decidable, even if the intruder generates unboundedly long messages.

Logics over strand spaces are being investigated. A strand space is formally associated with every protocol given as a sequence of communications between participating agents. A modal logic has been defined on such spaces, and questions regarding satisfiability and axiomatizability of the logic have been answered positively.

The use of the assumption commitment framework for compositional design and verification of distributed systems is being explored. An automata theoretic basis for such verification has been outlined in [**R2**], with a characterization of regular languages in terms of assumption compatible systems. A temporal logic has been defined and it is shown that there is an assumption compatible system associated with every formula of the logic, accepting exactly the models of the formula.

An attempt to formulate the foundations of game theory in propositional modal logic has been initiated. A dynamic logic has been proposed in [**R1**] in which characteristic formulas can be given for Zermelo's backward induction lemma and game theoretic solution concepts like Nash equilibrium.

Computational Complexity

In [**A3**], it is shown that Graph Isomorphism is in the complexity class SPP, and hence it is in $\oplus$P (in fact, it is in Mod_kP for each $k \geq 2$). This result is derived as a corollary of a more general result: it is shown that a *generic problem* FINDGROUP has an FP$^{\mathrm{SPP}}$ algorithm. This general result has other consequences: for example, it follows that the *hidden subgroup problem* for permutation groups, studied in the context of quantum algorithms, has an FP$^{\mathrm{SPP}}$ algorithm.

In [**A5**], a randomized fixed parameter tractable algorithm is given to approximately count the number of copies of a k-vertex graph with bounded treewidth in an n vertex graph. As a consequence, randomized algorithms with running time $k^{O(k)}n^{O(1)}$, approximation ratio $1/k^{O(k)}$, and error probability $2^{-n^{O(1)}}$ are obtained for the following problems:

- Approximately counting the number of matchings of size k in an n vertex graph.

- Approximately counting the number of paths of length k in an n vertex graph.

The algorithm is based on the Karp-Luby approximate counting technique applied to fixed

parameter tractable problems, and the color-coding technique (based on perfect hashing) of Alon, Yuster and Zwick.

Using the Weyl commutation relations over a finite field F_q, a family of error-correcting quantum stabilizer codes is introduced based on a class of symmetric matrices over F_q satisfying certain natural conditions. When $q = 2$ the existence of a rich class of such symmetric matrices is shown by a simple probabilistic argument depending on the Chernoff bound. If, in addition, these symmetric matrices are assumed to be circulant it is possible to obtain concrete examples by a computer program. The quantum codes thus obtained admit elegant and efficient encoding circuits. This research is reported in [**A4**].

2.3.2   List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**A1**]
V. Arvind and Nikhil Devanur*.
Symmetry breaking in trees and planar graphs.
Journal of Algorithms, 2002.
(To be published).

[**A2**]
V. Arvind and Johannes Köbler*.
New lowness results for ZPP(NP) and other complexity classes.
Journal of Computer and System Sciences, 2002.
(To be published).

[**A3**]
V. Arvind and Piyush P. Kurur.
Graph isomorphism is in SPP.
In *Electronic Colloquium of Compuational Complexity*, 2002.
(Preprint: ECCC-TR02-037).

[**A4**]
V. Arvind and K. R. Parthasarathy.
A family of quantum stabilizer codes based on the Weyl commutation relations over a finite
 field.
In *e-Print archive*, 2002.
(Preprint: quant-ph/0206174).

[**A5**]
V. Arvind and Venkatesh Raman.
Approximation algorithms for some parameterized counting problems.
In *Electronic Colloquium on Computational Complexity*, 2002.
(Preprint: ECCC-TR02-031).

[**A6**]
V. Arvind, K.V. Subrahmanyam*, **and N.V. Vinodchandran***.
Query complexity of program checking with constant depth circuits.
Chicago Journal of Theoretical Computer Science, 2002.
(To be published).

[B]
R. Balasubramanian and C. R. Subramanian.
Sampling and counting colorings of bipartite graphs.
2001.
(Preprint: IMSc/2002/07/22).

[L]
Kamal Lodaya and Pascal Weil∗.
Rationality in algebras with a series operation.
Information and Computation, **171(2)**, 269–293, 2001.

[M1]
P. Madhusudan∗ **and B. Meenakshi**.
Beyond message sequence graphs.
In Ramesh Hariharan, Madhavan Mukund and V. Vinay, editors, *Proceedings of FST & TCS 2001, LNCS 2245*, page 256. Springer, Dec 2001.

[M2]
B. Meenakshi and R. Ramanujam.
A layered specification of communications in temporal logic.
Jul 2002.
(Submitted).

[R1]
R. Ramanujam.
A note on modal logic for extensive form games.
In Giacomo Bonanno, editor, *Logic and formal theory of decisions*, page 142. ICER, Italy, Jul 2002.

[R2]
Swarup Mohalik∗ **and R. Ramanujam**.
Distributed automata in an assumption - commitment framework.
Sadhana, **27(2)**, 209, 2002.

[Ra1]
Rajeev Raman∗**, Venkatesh Raman, and S. Srinivasa Rao**.
Succinct indexable dictionaries with applications to representations of k-ary trees and multisets.
In *Proceedings of the Symposium on Discrete Algorithms (SODA)*, page 233. ACM-SIAM, Jan 2002.
Selected for the special issue of Journal of Algorithms.

[Ra2]
Jaikumar Radhakrishnan∗ **and Venkatesh Raman**.
A tradeoff between search and update in dictionaries.
Information Processing Letters, **80(5)**, 243, 2001.

[Ra3]
Venkatesh Raman, S. Saurabh[*]**, and C. R. Subramanian**.
Faster fixed parameter tractable algorithms for the undirected feedback vertex set problem.
2002.
(Preprint: IMSc/2002/07/27).

[S1]
L. Sunil Chandran[*] **and C. R. Subramanian**.
Lower bounds on treewidth based on expansion, girth, etc.
2002.
(Preprint: IMSc/2002/07/26).

[S2]
C. R. Subramanian.
Paths of specified length in a random k-partite graph.
Discrete Mathematics and Theoretical Computer Science, **4(2)**, 133–138, 2001.

[S3]
C. R. Subramanian.
Finding induced acyclic subgraphs in random digraphs.
2001.
(Preprint: IMSc/2002/07/23).

[S4]
C. R. Subramanian.
On finding large independent sets in random graphs.
2001.
(Preprint: IMSc/2002/07/24).

[S5]
C. R. Subramanian and C. E. Veni Madhavan[*].
General partitioning on random graphs.
Journal of Algorithms, **42**, 153–172, 2002.

2.4 Student Programmes

2.4.1 Degrees Awarded

Doctoral Degrees Awarded during 2001-2002

Physics

Name: **Das, Jayajit**
Thesis Title: Dynamics of Driven Heisenberg Spins with Inertia
Thesis Advisor: Murthy, M. V. N.
University: University of Madras

Name: **Balaji, Katali R.**
Thesis Title: Neutrino Masses, Large Mixings and Phenomenology
Thesis Advisor: Sinha, Rahul
University: University of Madras

Name: **Sinha, Subhasis**
Thesis Title: Confined Quantum Systems: A study of Ground State and Collective Excitations
Thesis Advisor: Murthy, M. V. N.
University: University of Madras

Name: **Suneeta, V.**
Thesis Title: Aspects of Black holes in Anti De Sitter Spaces
Thesis Advisor: Govindarajan, Thupil R.
University: University of Madras

Doctoral Theses Submitted during 2001-2002

Mathematics

Name: **Ravindra, G. V.**
Thesis Title: Cohomological Detection of Algebraic Cycles
Thesis Advisor: Paranjape, Kapil H.
University: University of Madras

Physics

Name: **Manoj, G.**
Thesis Title: Persistence in Non-equilibrium Systems: A Study on Spatial Correlations
Thesis Advisor: Ray, Purusattam
University: University of Madras

Name: **Murugesh, S.**
Thesis Title: Geometry of Moving Space Curves Associated with Integrable Equations: Connections and Applications
Thesis Advisor: Balakrishnan, Radha
University: University of Madras

Name: **Bal, Subrata**
Thesis Title: Aspects of Matrix Models
Thesis Advisor: Sathiapalan, Balachandran
University: University of Madras

Name: **Ghosh, Tarun K.**
Thesis Title: Theoretical Study of Excitations in Interacting Bose and Fermi Systems
Thesis Advisor: Baskaran, G.
University: University of Madras

Theoretical Computer Science

Name: **Madhusudan, P.**
Thesis Title: Control and Synthesis of Open Reactive Systems
Thesis Advisor: Ramanujam, R.
University: University of Madras

Name: **Srinivasa Rao, S.**
Thesis Title: Succinct Data Structures
Thesis Advisor: Raman, Venkatesh
University: University of Madras

Masters Theses during 2001-2002

Mathematics

Name: **Arijit, D.**
Thesis Title: Inverse Galois problem
Thesis Advisor: Nagaraj, D. S.
University: Anna university

Physics

Name: **Karthik, G.**
Thesis Title: Proper Time regularisation of Quantum Field Theories.
Thesis Advisor: Hari Dass, N. D.
University: Anna University

Theoretical Computer Science

Name: **Kurur, Piyush P.**
Thesis Title: Complexity issues in Quantum Computing
Thesis Advisor: Arvind, V.
University: Anna University

2.4.2   Lecture Courses During 2001 - 2002.

The following **lecture courses** were offered during 2001 - 2002.

Course Title	Period	Lecturer
Mathematics		
Quantum Computation	Aug-Feb 2002	Parthasarathy, K. R.
Real Analysis	Aug-Nov 2001	Srinivas, K.
Topology	Aug-Dec 2001	Nagaraj, D. S.
Cryptology	Jan-Apr 2002	Paranjape, Kapil H.
Functional Analysis	Jan-Apr 2002	Sunder, V. S.
Geometric group theory	Jan-Apr 2002	Sankaran, P.
Physics		
Classical Mechanics	Aug-Dec 2001	Sinha, Sudeshna
Electrodynamics	Aug-Dec 2001	Jagannathan, R.
Introduction to Elementary Particle Physics	Aug-Dec 2001	Hari Dass, N. D.
Quantum Mechanics	Aug-Dec 2001	Date, G.
String Theory	Aug-Dec 2001	Jayaraman, T.
Introductory Particle Physics	Jan-May 2002	Ramachandran, R.
Quantum Field Theory	Jan-May 2002	Rajasekaran, G.
Statistical Mechanics	Jan-May 2002	Menon, Gautam I.
Theoretical Computer Science		
An introduction to Logic	Jul-Dec 2001	Ramanujam, R.
Introduction to Model Theory	Jul-Dec 2001	Ramanujam, R.
Complexity Theory II	Aug-Nov 2001	Mahajan, Meena B. and Arvind, V.
Data Structures and Algorithms	Aug-Dec 2001	Mahajan, Meena B.
Discrete Mathematics	Aug-Dec 2001	Raman, Venkatesh
Approximation Algorithms	Jan-Apr 2002	Subramanian, C. R.
Complexity Theory I	Jan-Apr 2002	Arvind, V.
Temporal Logic and Verification	Jan-May 2002	Ramanujam, R.
Mathematical Models for Software Systems	May-Jun 2002	Ramanujam, R.
Online Algorithms	Jun-Aug 2002	Krishnamurti, Ramesh

In addition, the following **lecture courses** were offered during 2001 - 2002 by IMSc faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

Course Title	Period	Lecturer
Mathematics		
Algebra I	Aug-Dec 2001	Kodiyalam, Vijay
Analysis	Aug-Nov 2001	Parthasarathy, K. R.
Calculus I	Aug-Dec 2001	Paranjape, Kapil H.
Calculus-III	Aug-Dec 2001	Sankaran, P.
Calculus II	Jan-Apr 2002	Krishna, M.
Topology	Jan-Apr 2002	Raghavan, K. N.
Theoretical Computer Science		
Design and Analysis of Algorithms	Aug-Dec 2001	Mahajan, Meena B.
Introduction to Databases	Aug-Dec 2001	Lodaya, Kamal

IMSc faculty also participates in teaching courses offered at Anna University. During the year 2001 - 2002 the following course was taught at Anna University.

Course Title	Period	Lecturer
Mathematics		
Cryptography	Jan-Apr 2002	Balasubramanian, R.

2.4.3   Summer Students

Every summer, a small number of students from various institutes/universities come to our institute and work on learning/research projects with our faculty members for a period of four to six weeks. Following students visited the institute during Aug, 2001 – Jul, 2002.

Student   Faculty

Mathematics

Student	Faculty
Sachidanandan, Suganya, University of Pondicherry	Paranjape, Kapil H.
Sarkar, Swagata, University of Delhi	Paranjape, Kapil H.
Gautam, Sachin, IIT, Delhi	Paranjape, Kapil H.
Ghosh, Amitava, Durgapur University, W.B	Srinivas, K.
Padhy, Venkat P., Utkal University, Orissa	Srinivas, K.
Mohan, R., IIT, Chennai	Sunder, V. S.

Physics

Student	Faculty
Jadhao, Vikram, IIT, Kharagpur	Baskaran, G.
Paul, Ayan, Presidency College, Kolkata	Basu, Rahul
Baradhawaj, P. C., IIT, Chennai	Date, G.
Sahoo, Bindusar, IIT, Kharagpur	Date, G.
Sahoo, Himanshu B., Utkal University	Indumathi, D.
Simon, Benjamin, National Institute of Technology & Science, Chennai	Jagannathan, R.
Ranjith, P. IIT, Chennai	Menon, Gautam I.
Narayan, Vijay, Presidency College, Kolkata	Menon, Gautam I.
Vijayraghavan, A., IIT, Kanpur	Ray, Purusattam
Sanju, S., Pondicherry University	Ray, Purusattam
Dominic, Pramod, Department of Physics, IIT, Chennai	Srinivasa Rao, K.

Theoretical Computer Science

Student	Faculty
Kumar, Rakesh, IIT, Kanpur	Arvind, V.
Rustagi, Naveen, CMI, Chennai	Arvind, V.
Sharma, Arun, BIT, Ranchi	Lodaya, Kamal
Niranjan, K. S., REC, Raurkela	Lodaya, Kamal
Saurabh, Saket, CMI, Chennai	Raman, Venkatesh
Prasanna, S., Banaras Hindu University - Inst. of Technology	Ramanujam, R.

2.4.4 Other Students

Students also do their projects under the supervision of our faculty during the academic year. The following students visited the institute during Aug, 2001 – Jul, 2002

Student	Faculty

Physics

Gutti, Sashideep, IIT, Chennai	Hari Dass, N. D.
Ganesh, Pradeep, IIT, Chennai	Hari Dass, N. D.
Das, Satwik, IIT, Kharagpur	Hari Dass, N. D.

Theoretical Computer Science

Kumar, Reemus, Madurai Kamaraj University	Raman, Venkatesh
Krishnan, Shiju, Madurai Kamaraj University	Ramanujam, R.

2.4.5 Apalat Fellowship

In order to encourage bright B.Sc. students to take up Physics or Mathematics for their higher studies, the Institute is offering two fellowships, one in Mathematics and another in Physics for students studying in and around Chennai. This goes under the name of APALAT-IMSc scholarship. The scholarship amount is Rs.1000 per month for 10 months of the academic year and is paid during their M.Sc. programme. Each student is expected to work under the guidance of a faculty member in the respective discipline of the Institute.

Heads of the Departments in Physics and Mathematics of various colleges in the city are contacted to suggest five bright students of B.Sc (third year) who are likely to join M.Sc programme in an institution in Chennai. Out of them, one student in each subject is selected through a written test followed by an interview. The successful students are encouraged to attend seminars in the Institute and to work under the supervision of a faculty member at IMSc, during the summer vacation. They are expected to show their progress in their regular M.Sc course and if satisfied, the scholarship is extended to the second year of their M.Sc course.

During this academic year, the fellowship was awarded to Mr. R. M. Sarguna of Pachayappa's College and Mr. R. Chandrashaker of New College in Physics and to Ms. R. Srividya of Stelle Maris College and Mr. R. Sivaguru of Madras Christian College in Mathematics.

2.5   Honours and Awards

The project "Cycles, Arithmetic and Cryptography", proposed by **Paranjape, Kapil H.**, was approved under the prestigious DST Swarna-Jayanti Project Scheme.

Paranjape, Kapil H. was awarded B. M. Birla Science Prize in Mathematics, for 1999, by the B. M. Birla Science Foundation. The award for the year 1999 was announced in 2001.

Rajasekaran, G. was awarded Jawaharlal Nehru Visiting Professorship, for 2001, by the University of Hyderabad.

Sinha, Sudeshna was awarded B. M. Birla Award, for 2001, by the Birla Science Centre, Hyderabad for her contributions towards novel concepts in computing with distributed chaos.

Srinivasa Rao, K. was awarded Tamil Nadu Scientists Award in the discipline of Mathematical Sciences, for 2000, by the Tamil Nadu State Council for Science and Technology, for his work on *Aspects of quantum theory of angular momentum.* The award was presented on the Science Day, Feb. 28, 2002.

Chapter 3

Other Professional Activities

This chapter lists the activities carried out by the individual members of the institute in their professional capacity.

Balasubramanian, R.

Member of Advisory Organizing Committee for Second International Conference on Cryptology in India held at ICSR Auditorium, IIT, Chennai during Dec 16 – Dec 20, 2001.

Convener of Local Organizing Committee for Analytic Number Theory with special emphasis on L-functions held at IMSc during Jan 3 – Jan 5, 2002.

Baskaran, G

Member of Scientific Council of International Center for Condensed Matter Physics, Brasilia, Brazil during January 2002.

Convener of Local Organizing Committee for a Mini workshop on Theoretical Biology: An Exploration into Ecell, Vcell and Genesis held at IMSc during Jun 24 – Jun 28, 2002.

Basu, Rahul

Member of National Organising Committee of WHEPP-7 Jan 3-15 2002, Allahabad during Jan 2001 – Jan 2002.

Member of National Organising Committee (NOC) and Programme Advisory Committee (PAC) of XV DAE HEP Symposium Jammu, 11-15 November, 2002 during Jan – Jul, 2002.

Member of National Organising Committee of QCD 2002 IIT Kanpur, 18–22 November 2002 during Mar – Jul, 2002.

Date, G.

Member of Local Organising Committee for Field Theoretic Aspects of Gravity -II held at Radio Astronomy Centre, Ooty during Oct 3 – Oct 9, 2001.

Member of the Council of the Indian Association for General Relativity and Gravitation during Mar - Jul, 2002.

Govindarajan, Thupil R.

Member of Local Organising Committee for Field Theoretic Aspects of Gravity -II held at Radio Astronomy center, Ooty during Oct 3 – Oct 9, 2001.

Convener of International Organising Committee for Indo Russian Meeting II held at IMSc during Jan 15 - Jan 19, 2002.

Member of Local Organising Committee for Refresher course in Physics for college teachers held at IMSc during May 10 – Jun 5, 2002.

Hari Dass, N. D.

Visited Vivekananda College on Aug 1, 2001. Inaugurated their astronomy club and gave a slides demonstration on "The birth and death of stars".

Visited D.G. Vaishnav College on Aug 15, 2001. Gave a slide show on "Total Solar Eclipse".

Gave a talk on "Raman vs Einstein on wave particle duality" at the Science City Meeting at IMSc on Nov 1, 2001.

Member of International Organising Committee for Second Winter School on Foundations of Quantum Theory and Quantum Optics held at S.N.Bose Centre,Kolkata during Jan 1 – Jan 10, 2002.

Visited The School, KFI, Chennai on Feb 10, 2002. Gave two talks on "Understanding Special relativity" and "Feynman's thought experiment".

Gave a talk on "Entanglement and Quantum Mechanics" at the Science City Meeting, CLRI, Chennai on Mar 1, 2002.

Indumathi, D.

Visited Seethalakshmi Ramaswamy College, Tiruchi on Jul 17, 2002. and gave lecture on Particle Interactions to BSc and MSc students.

Jayaraman, T.

Member of Local Organising Committee for IMSC String Theory Workshop held at IMSc during Nov 15 – Dec 7, 2001.

Kesavan, S

Member of National Board for Higher Mathematics.

Member of Apex Committee, National Undergraduate Programme, Chennai Mathematical Institute.

Member of Programme Implementation Committee, National Undergraduate Programme, Chennai Mathematical Institute.

Member of Editorial Board, Mathematics Newsletter, Ramanujan Mathematical Society.

Reviewer of Mathematical Reviews.

Member of Editorial Board, Journal of Analysis and Applications during Apr – Jul, 2002.

Convener of Local Organising Committee for N. B. H. M. Nurture Programme held at IMSc during Jun 24 – Jul 12, 2002.

Lodaya, Kamal

Treasurer of Indian Association for Research in Computing Science during Apr 2000 – Jul 2002.

Member, Editorial Team, Jantar Mantar, a science magazine for children.

Member of Local Organising Committee for Workshop on Reasoning about Parameterized and Infinite State Systems held at IMSc during Dec 17 – Dec 18, 2001.

Mahajan, Meena B.

Council member of Indian Association for Research in Computer Science (IARCS)

Menon, Gautam I.

Member of Local Organising Committee for IMSc Refresher Course in Physics for College Teachers held at Loyola College, Chennai during Nov 9 – Nov 22, 2001.

Member of International Organising Committee for India and Abroad: A Conference on Condensed Matter Physics held at JNCASR, Bangalore during Jan 2 – Jan 4, 2002.

Member of Local Organising Committee for Institute Seminar Week held at IMSc during Feb 18 – Feb 22, 2002.

Member of Local Organising Committee for IMSC Refresher Course in Physics for College Teachers held at IMSc during May 10 – Jun 5, 2002.

Paranjape, Kapil H.

Associate Editor of Editorial Board, Proceedings of Indian Academy of Sciences (Mathematical Sciences) during Dec 1995 – Jul 2002.

Member of Editorial Board, Journal of the Ramanujan Mathematical Sciences during Jan 1996 – Jul 2002.

Member of Editorial Board, "Resonance", A journal of Science Education during Jan 1997 – Jul 2002.

Member of Editorial Board, Texts and Readings in Mathematics (TRIM) during Jul 1998 – Jul 2002.

Member of Committee on Electronic Information and Communication, International Mathematical Union during Oct 1999 – Jul 2002.

Member of National Organising Committee for International Conference on Algebra and Geometry held at University of Hyderabad during Dec 7 – Dec 12, 2001.

Member of National Organising Committee for INDOCRYPT 2001 held at IIT, Madras during Dec 16 – Dec 20, 2001.

Member of National Organising Committee for Symposium in honour of Seshadri held at CMI on Mar 1, 2002.

Member of Advisory Board of arXiv.org during Mar – Jul, 2002.

Member of Local Organising Committee for Topological Methods in Group Theory held at IMSc during Jul 15 - Jul 27, 2002.

Rajasekaran, G

Member of Advisory Committee of the INO Project.

Member of Physics Sectional Committee of INSA.

Gave a series of five elementary lectures on Particle Physics including Neutrino Physics, in Jan – Feb, 2002. The lectures were organised by Indian Physics Association, Madras Chapter and were held at IIT, Madras. Students from various colleges in Madras participated.

Ramachandran, R.,

Coordinator for Mathematical Sciences of Integrated Long Term Programme (ILTP) of Indo-Russian Co-operation in Science and Technology during Jan 2001 – Jul 2002.

Member, Finance Committee of SN Bose National Centre for Basic Sciences, Kolkata during Jan 2001 – Jul 2002.

Member of DST's International Division, PAC for International Programme in the Area of Computer Science, Electronics, and Mathematical Sciences during Apr 2001 – Jul 2002.

Vice President of Indian Association of Physics Teachers during Apr 2001 – Jul 2002.

Vice President, Founder member of Madras Library Network (MALIBNET) during Apr 2001 – Jul 2002.

Raman, Venkatesh

Member of Program Committee of the Second IFIP Conference on Theoretical Computer Science (TCS2002).

Ramanujam, R.

Convener of Local Organising Committee for A course on Theoretical Aspects of Computer Science held at IMSc during Oct 15 – Nov 9, 2001.

Member of Local Organising Committee for Workshop on Reasoning about Parameterized and Infinite State Systems held at IMSc during Dec 17 – Dec 18, 2001.

Sankaran, P.

Convener of Local Organising Committee for Topological Methods in Group Theory held at IMSc during Jul 15 – Jul 27, 2002.

Sathiapalan, Balachandran

Member of Local Organising Committee for IMSc String Theory Workshop held at IMSc during Nov 15 – Dec 7, 2001.

Sinha, Sudeshna

Advisory Editor of AIP Journal "Chaos".

Srinivas, K.

Member of Local Organising Committee for Conference in Analytic Number Theory held at IMSc during Jan 3 – Jan 5, 2002.

Srinivasa Rao, K.

Member of Local Organising committee for International Conference on Number Theory held at Kyoto University, Kyoto, Japan during Nov 25 – Nov 29, 2001.

'Theriyuma Ungalukku ?' (Do you know ?) – Meet the Scientists Program, A one hour live program on the TV channel Pothigai, Chennai Kendra of DD on Feb 16, 2002 when questions were asked by the public over telephone on Mathematical and Biological Sciences, to the experts Prof. K. Srinivasa Rao (IMSc) and Dr. E. Subramanian (University of Madras).

Sunder, V. S.

Member of Editorial Board of the Journal of the Ramanujan Mathematical Society

Member of Editorial Board of the Proceedings of the Indian Academy of Sciences (Math. Sci.).

Member of Editorial Board of the 'Texts and Readings in Mathematics' (TRIM) series published by the Hindustan Book Agency.

Member of 'Technical Advisory Committee' of the Indian Statistical Institute.

Member of Mathematical Sciences Research Committee constituted by the CSIR (to assess various proposals, etc.)

Member of Committee for the Promotion of Mathematics among Women, constituted by the NBHM.

Member of the School Board of 'the School of Mathematics & Computer/Information Science'.

Gave a lecture to school children at The Children's Club, Mylapore, Chennai on Jul 14, 2002.

Gave a popular lecture on 'Fourth Dimension' at the Science Club organised at the above venue for children at the finishing stages of school.

Chapter 4

Colloquia

4.1 Conferences/Workshops Held at IMSc

4.1.1 A course on theoretical aspects of computer science

An Orientation Course on Theoretical Aspects of Computer Science for College and University teachers from South Asia was organized at IMSc from October 15 to November 9, 2001. The course was organized jointly by IMSc and the United Nations University / International Institute of Software Technology (UNU/IIST), Macau. Participants hailed from Bangladesh, India, Nepal, Pakistan and Sri Lanka, with roughly one half of them from India and the other from the neighbouring countries. Mini-courses on Data structures and Algorithms, Automata theory, Computability, Distributed computing, Programming languages and Foundations of software technology, were complemented by theory projects taken up by participants in groups. The course helped participant teachers to address foundations of computer science and enthuse them in taking up research in this area.

4.1.2 IMSc String Theory Workshop

The IMSc String Theory Workshop was held from Nov. 15, 2001 to Dec. 7, 2001. The organizers were T. Jayaraman, S. Kalyana Rama and B. Sathiapalan. About 25 string theorists from within India (not including local participants) participated in the meeting, including Ph.D. students and post-doctoral workers in the field. The workshop featured some three lectures and five lectures courses on contemporary problems and advances in string theory by invited speakers as well as seminars by participants.

The lecture courses were:

- **Gautam Mandal**
  Matrix model descriptions of curved D-branes

- **Sumit Das**
  de Sitter spaces

- **Rajesh Gopakumar**
  Open/closed string dualities and M-theory

- **Dileep Jatkar**
  Brane worlds, Randall-Sundrum models and string theory

- **Debashish Ghoshal**
  Vacuum String Field Theory

- **Suresh Govindarajan**
  M-theory/String Compactifications on manifolds of G_2 holonomy

- **Sandip Trivedi**
  Moduli stabilization with Fluxes (with an introduction to phenomenological issues relevant to string theory)

- **Atish Dabholkar**
  Black-hole entropy in string theory

4.1.3   Workshop on Reasoning about Parameterized and Infinite State Systems

A Workshop on Reasoning about Parameterized and Infinite State Systems was held at IMSc during December 17-18, 2001. The workshop was organised jointly by IMSc and the Chennai Mathematical Institute, in conjunction with the 21st international conference on Foundations of Software Technology and Theoretical Computer Science (FST&TCS 2001) which took place at Bangalore during December 13-15, 2001.

The focus of the workshop was the verification of "arbitrarily" large systems. This class of systems includes those with dense state spaces, such as real-time and hybrid systems, as well as systems with infinite but discrete state spaces such as Petri Nets and automata extended with unbounded data structures such queues and counters. Also of interest are reactive systems that are parameterized by the number of participating processes.

The talks at the workshop dealt with adapting algorithmic techniques for model-checking finite-state systems to this larger class, as well as deductive approaches based on using formal logic and theorem proving. The list of talks was as follows.

- **Cristiano Calcagno**, Queen Mary's College, London, UK
  The Spatial Assertion Workbench

- **Deepak D'Souza**, CMI, Chennai
  Controller synthesis for timed systems

- **K Gopinath**, IISc, Bangalore
  What does it take to prove an advanced FS correct?

- **Madhavan Mukund**, CMI, Chennai
  Automata theory for message-passing systems

- **Paritosh Pandya**, TIFR, Mumbai
  Finding Optimal Models of Discrete Duration Calculus formulae using Symbolic Search

- **Amir Pnueli**, Weizmann Institute of Science, Israel
  Verifying Liveness Properties of Parameterized Systems

- **S Ramesh**, IIT, Mumbai
  Case study in industrial embedded system verification

- **Abhik Roychoudhury**, National University of Singapore
  Some techniques for combining induction and model checking

- **Mandayam Srivas**, RealChip Communications Inc., USA
  Challenges in verifying systems-on-chip

- **Colin Stirling**, University of Edinburgh, UK
  Rational graphs trace context-sensitive languages

- **P S Thiagarajan**, CMI, Chennai /National University of Singapore
  Finite 1-Safe Petri nets and Regular Event structures : A Conjecture

- **Lenore Zuck**, New York University, USA
  Verifying Liveness Properties of Parameterized Systems

4.1.4 Workshop on Integrable Models, Strings, Quantum gravity

The workshop was organized between 15-19, Jan 2002 in the framework of Integrated Long Term Program (ILTP) of cooperation in science and technology between India and Russia. It was supported by Department of Science and Technology (DST), Govt. of India, Russian Academy of Sciences (RAS), Joint Institute of Nuclear Research (JINR), Russia and Ministry for Atomic Energy of the Russian Federation.

The Organizing Committee consisted of R. Ramachandran, T. R. Govindarajan and R. Jagannathan (IMSc, Chennai), S. Wadia (TIFR, Mumbai), V. G. Kadyshovsky and S. Pakuliak (JINR, Dubna) and A. Morozov (ITEP, Moscow).

About 35 Scientists from India and 8 Russian Scientists from various Institutions participated in the workshop.

The following is the list of the speakers and titles of their talks:

- **Alexei Morozov**, ITEP, Moscow
  Issues in Integrable Models

- **Emil Akhmedov** ITEP, Moscow
  Multi-trace Operators and Holographic Renormalisation Group

- **Andrei Marshakov**, Lebedev Inst, Moscow
  On WDVV Equations

- **Andrei Mironov**, Lebedev Inst, Moscow
  Integrability in Quantum Field Theory: What it is about?

- **Stanislav Pakuliak**, JINR, Dubna
  Backlund Transformations and Q-operators in Integrable Models.

- **Corneliu Sochichiu**, JINR, Dubna
  Interacting Non-commutative Lumps

- **Mirian Tsulaia**, JINR, Dubna
  SUSY Breaking in Five Dimensional M-theory.

- **Alexei Yung**, Nuclear Phys. Inst., Petersburg
  Confinement near Argyres-Douglas Point in N=2 QCD and Low Energy Version of AdS/CFT Correspondence

- **Atish Dabholkar**, TIFR, Mumbai
  Tachyon Condensation and Black hole Entropy

- **Gautam Mandal**, TIFR, Mumbai
  Matrix Models, Brane-antibrane Systems and Fuzzy Spheres

- **Sandip Trivedi**, TIFR, Mumbai
  Moduli Stabilization with Fluxes

- **Avinash Khare**, IOP, Bhubaneswar
  Linear Superposition for Nonlinear Equations and New Identities for Jacobi Elliptic Functions

- **Alok Kumar**, IOP, Bhubaneswar
  On D-brane Bound States

- **Kumar Gupta**, SINP, Kolkata
  Near-Horizon Conformal Symmetry and Entropy of Schwarzschild Black Holes

- **Basu Mallick**, SINP, Kolkata
  Bound States of Calogero Model in the Absence of Confining Potential

- **T. Padmanabhan**, IUCAA, Pune
  Issues Related to Thermodynamics of Horizons

- **Rajesh Gopakumar**, HRI, Allahabad
  Non-commutative Multisolitons

- **Prashant Panigrahi**, University of Hyderabad
  Integrable Models of Calogero-Sutherland Type and Their Connection with Decoupled Systems

- **P. Ramadevi**, IIT, Mumbai
  Knots/Links, Three-Manifold Invariants and Topological String Duality.

- **Suresh Govindarajan**, IIT, Chennai
  Summing up open-string Instantons: the Special Lagrangian Story

- **Ranabir Chakrabarti**, Univ. of Madras
  Jordanian Quantum Algebras

- **T. Jayaraman**, IMSc, Chennai
  Boundary Fermions, Helices and Quivers on Calabi-Yau Manifolds

4.1.5 Conference in Analytic Number Theory

An international conference was held at IMSc for three days duration. The main theme of the conference was 'Analytic number theory' with special emphasis on L-functions. The Analytic properties of L-functions are closely linked with arithmetic. Starting from the classical results of Dirichlet, Riemann, Hadamard, de la vallee Poussin and others to the recent research on L-functions attached to Elliptic curves, Modular forms and Cryptography, the study of L-functions has very long history and rich tradition. Lectures intended to cover various aspects of analytic number theory in general and the theory of L-functions in particular, including some recent developments in this area.

On this occasion Professor M. V. Subba Rao who turned 80 was felicitated.

About 30 outstation mathematicians (including 6 foreigners) participated in this conference.

Organizing committee consisted of R. Balasubramanian (Convener), K. Srinivas (Local Coordinator) and S. D. Adhikari (HRI, Allahabad).

The proceedings of the conference will be brought out in book form by the end of the year 2002.

4.1.6 Institute Seminar Week

The **Institute Seminar Week** was organized during February 18-22, 2002. The coordinators were Gautam I. Menon (Physics), Venkatesh Raman (TCS) and Parameswaran Sankaran (Mathematics). Seminars were held from 10 a.m. to 1 p.m. daily, with a break in-between. The talks were well attended by students, faculty and visitors. An Institute lunch was held on the last day, to which all Institute members were invited. The list of talks was as follows:

- **M. Krishna**
  Smoothness of the Density of States for Random Jacobi Operators

- **S. P. Suresh**
  Decidability Issues in Security Protocol Verification

- **N. D. Hari Dass**
  Identity Crisis in the Quantum World: Statistical Significance of single quantum systems

- **R. Ramachandran**
  Non-commutative Quantum Mechanics

- **Avijit Ganguly**
  Photon Self-energy in the background of a moving neutrino stream

- **V. Raman**
  Searching a two-key table under a single key

- **G. Rajasekaran**
  Neutrino masses and mixings

- **A. K. Mishra**
  Spin-charge decoupling and orthofermi statistics

- **Parameswaran Sankaran**
  Chaotic Dynamics and residual finiteness

- **R. Jagannathan**
  Polynomially deformed (Lie) algebras

- **Parthasarathi Majumdar**
  Why does the entropy of a black hole depend on its area?

- **G. Baskaran**
  Andreev Reflection at Ferromagnetic Metal-Superconductor Junctions

- **Sumithra Sankararaman**
  Active Membranes near a repulsive wall

- **B. Meenakshi**
  Model checking Message-passing systems

- **B. Sathiapalan**
  Loop variables: An alternative to BRST-string field theory?

- **V. Uma**
  Geometry of Toric varieties

- **Sudeshna Sinha**
  Surprising consequences of randomly coupling chaotic maps

- **D. Indumathi**
  What do data on solar neutrinos tell us about neutrino properties?

- **Gautam I. Menon**
  Physical Robustness in Biological Systems

- **Gautham Dayal**
  The arithmetic of the Mumford-Horrocks bundle

- **C. R. Subramanian**
  Counting and sampling discrete structures using Markov chains

- **R. Shankar**
  Frustrated Antiferromagnets

- **Santhosh Kumar**
  Quark propagators in a confining theory

- **K. Srinivasa Rao**
  Group Theory of hypergeometric functions

- **Kapil H. Paranjape**
  Computers as content and context in research

- **T. M. Janaki**
  Spatiotemporal intermittency in coupled circle map lattices fall in the universality class of directed percolation

- **Vijay Kodiyalam**
  Hopf algebras and planar algebras

- **R. Ramanujam**
  Game Trees via Logic

- **T. Jayaraman**
  Open String Instantons: Some Maths-Physics connections

- **Radha Balakrishnan**
  Geometry of curve evolutions and integrable equations: Some new results

4.1.7   IMSc Refresher Courses in Physics for College Teachers

Two Refresher Courses in Physics were organized by the Institute of Mathematical Sciences during 2001-2002.

The first of these, actually the third Refresher course in a series conducted since 2000, was held at the Loyola College, Chennai in the period November 9-22, 2001. The topics covered were Mathematical Physics and Electromagnetic Theory and Special Relativity. The participants were lecturers from undergraduate and post-graduate teaching institutions in Chennai as well as some M. Phil students at the Loyola College. The lectures were delivered by R. Jagannathan, T. R. Govindarajan and P. Majumdar of IMSc, and M. Seetharaman of Madras University. Special lectures were given by Gautam Mandal (TIFR) and Sudeshna Sinha (IMSc).

A three week refresher course in Physics for college teachers was held at IMSc between May 10 and June 5, 2002, the second in the series of Refresher courses for college teachers. The topics covered were: Relativistic Quantum Mechanics and Particle Physics, Classical Mechanics and Special Relativity and Computational Physics. This course was targeted at lecturers from the college and University system and participants were drawn from all over India. The lectures were delivered by R. Sridhar, M. V. N. Murthy, Ghanashyam Date, D. Indumathi, R. Jagannathan, G. Rajasekaran, K. Srinivasa Rao, Gautam I. Menon, R. Shankar and Rahul Basu of IMSc and M. Seetharaman and K. Raghunathan of Madras University. Tutorial sessions were conducted by V. Murugan and J. Segar of Vivekananda College. Special lectures were delivered by Tapash Chakrabarty, R. Balasubramanian, Kapil Paranjape and T. Jayaraman of IMSc. These courses were coordinated by T. R. Govindarajan, Gautam I. Menon and R. Shankar.

4.1.8   NBHM Nurture Programme

The Nurture Programme for the INMO awardees of 1999 - 2000 continued at the Institute of Mathematical Sciences Chennai and the participants were under the charge of the faculty comprising of V. Balaji, S. Kesavan (Convener), K. H. Paranjape, P. Sankaran, K. Srinivas and V. S. Sunder. The syllabus for self-study during the second year of the programme,

i.e. 2001 - 2002, was Topology (based on the first part of the book by G. F. Simmons, Introduction to Topology and Modern Analysis), Algebra (Chapters 5, 6, 7,10, 11 and 13 of the book by M. Artin) and Complex Analysis (Chapters 1 - 10 of the book by D. Sarason).

The Contact Programme was held at IMSc, Chennai, from Monday, June 24 to Friday, July 12, 2002. Out of the 14 registered participants remaining at the end of the first year, 6 attended the programme.

During the first three days of this summer camp, the above subjects were revised by the members of the faculty. V. Balaji (Topology, 3 lectures), K. N. Raghavan (Algebra, 3 lectures) and K. H. Paranjape (Complex Analysis, 3 lectures) were in charge of this. This was followed by lecture courses which built upon these subjects. V. Balaji gave 4 lectures on Algebraic Topology followed by D. S. Nagaraj (2 lectures). K. H. Paranjape delivered 7 lectures on Complex Analysis. V. S. Sunder gave a course of 5 lectures on Measure and Integration. S. Kesavan gave 4 lectures on Degree Theory. K. N. Raghavan gave 5 lectures on Representations of Finite Groups. K. Srinivas gave 3 lectures on Analytic Number Theory. In addition S. Kesavan gave 1 lecture on the Isoperimetric Inequality, K. R. Parthasarathy gave 2 lectures on Finite Groups in Coding Theory and R. Balasubramanian gave 1 lecture on the Riemann Hypothesis.

During the last week, the participants were interviewed by the faculty to assess their progress.

4.1.9   A Mini workshop on Theoretical Biology: An Exploration into Ecell, Vcell and Genesis

Theoretical biology is taking new shape and new concepts and notions are emerging, thanks to the flood of experimental activities in biology and the enormous help from the newly acquired computational skills. Behind all these efforts is the desire to develop the science of living organisms from a bacteria to a blue whale that is predictive, corrective and quantitative.

Notable recent developments, that is mathematics/computer based but relies heavily on experimental inputs from biology/biochemistry/molecular biology/bio-informatics are the 'ecell', 'vcell' and 'genesis' projects, that simulates various activities in a cell in meaningful ways with remarkable and very often unanticipated results. A whole new field is at its birth.

The idea of this mini workshop was to explore some of the fascinating developments, with the view that the biology/mathematical science community may get into this field as users as well as contributors.

Critical parts of the workshop - demonstration, tutorials and hands-on training was done mostly by a set of bright students and scholars from Anna University and AU-KBC Center. Lectures were arranged mostly in the mornings, and tutorials and sessions using computers were arranged in the evenings. From outside Dr. Sitabhra Sinha, an expert on non linear dynamics of heart and Genesis came and gave two talks. There were also talks by S. Krishnaswamy, M. Geetha and others.

This workshop was organized in collaboration with Prof. P. Gautam of Anna University Bio-Technology Center, Prof. S. V. Ramanan of Anna University K. B. Chandrasekhar Research center, Prof. Guhan Jayaraman of Chemical Engineering Dept, IIT Madras and

Prof. S. Krisnaswamy from School of Biology, Madurai Kamaraj University. From our Institute Profs. G. Baskaran and Ramesh Anishetty were co-organizers.

This workshop provided an important link between the young biology community at Madras and IMSc. We plan to have more of these types of workshops with a view to begin and strengthen theoretical biology activity at IMSc.

4.1.10 Topological Methods in Group Theory

The Workshop, which is twelfth in a series of topology conferences held in India, was held at IMSc, Chennai. It aimed at creating awareness among young researchers and recent entrants to the subject, the rich interaction between topology and group theory and to bring forth the efficacy of topological and geometrical methods in understanding certain aspects of group theory.

The Programme Committee consisted of S. Gadgil (SUNY, Stony Brook), Ramji Lal (Allahabad University), D. S. Nagaraj (IMSc, Chennai), A. C. Naolekar (ISI, Kolkata), P. Sankaran (IMSc, Chennai), A. R. Shastri (IIT, Mumbai), G. A. Swarup (Univ of Melbourne, Australia).

The Local Organizing Committee consisted of V. Balaji (CMI, Chennai), D. S. Nagaraj, K. Paranjape, and P. Sankaran.

The following were the resource persons: A. R. Aithal, C. S. Aravinda, B. Datta, Satya Deo, S. Gadgil, C. K. Gupta, Ramji Lal, A. Mukherjee, H. K. Mukherjee, K. Paranjape, I. B. S. Passi, S. K. Roushon, P. Sankaran, N. S. N. Sastry, A. R. Shastri, G. Swarup, and K. Varadarajan. There were 43 lectures in all; morning lectures were of 90 minutes. duration and afternoon lectures, 75 minutes. On Saturdays lectures were held only in the mornings.

There were 34 outstation participants, including three from outside India, and about 20 local participants.

In keeping with the tradition of the topology conferences held in India, the following cultural events were held: (i) a trip to Mamallapuram on 22nd July, (ii) a classical music concert on 25th July 2002.

4.2   Other Conferences/Workshops Organized by IMSc

4.2.1   Field Theoretic Aspects of Gravity - II

This was the second of a series of workshops on field theoretic aspects of gravity. The first was organized by IUCAA, Pune. This series is intended to bring together a small number of researchers in the areas of classical and quantum gravity from research institutes, IITs and colleges/universities. This series is proposed to be made in to a regular annual feature.

FTAG-II was held at RAC, Ooty during Oct 2-9, 2001. About 15 participants including several from IMSc attended this workshop. The topics ranged from various aspects of black hole physics, naked singularities in gravitational collapse, to aspects of quantum gravity. The very informal and intense discussions were appreciated by the participants. Given below is the list of speakers and topics. The local organizing committee consisted of R. Kaul, P. Majumdar, T. R. Govindarajan and G. Date.

- **P. Ramadevi**, IIT, Mumbai
  Black Hole Area Quantization.

- **P. Mitra**, SINP, Kolkata
  Black Hole Near-horizon Symmetries.

- **G. Date**, IMSc, Chennai
  Isolated Horizons.

- **S. Shankaranarayanan**, IUCAA, Pune
  Acoustic Black Holes.

- **T. R. Govindarajan**, IMSc, Chennai
  De Sitter Space Entropy.

- **R. Kaul**, IMSc, Chennai
  Black Hole Entropy.

- **P. Singh**, IUCAA, Pune
  Coherent States in Quantum Systems.

- **A. Lahiri**, S. N. Bose Institute, Kolkata
  BF Gravity.

- **N. D. Hari Dass**, IMSc, Chennai
  Gauge Dependence in Quantum Gravity.

- **S. Barve**, IMSc, Chennai
  Aspects of Naked Gravitational Collapse.

- **N. K. Dadhich**, IUCAA, Pune
  Gravitational Collapse in Brane World.

- **B. Rai**, IMSc, Chennai
  AdS in two Dimensions.

- **L. Sriramkumar**, HRI, Allahabad
  Aspects of Unruh Effect.

- **S. Kalyana Rama**, IMSc, Chennai
  Generalized Uncertainty Principle.

- **P. Majumdar**, IMSc, Chennai
  Cosmic Optical Activity.

4.2.2 India and Abroad: A Conference on Condensed Matter Physics

The purpose of this conference, funded partially by IMSc and held at the JNCASR, Bangalore, was to bring together members of the condensed matter physics community in India and condensed matter physicists of Indian origin (interpreted broadly to include all with special ties to India) worldwide. In addition, the phrase "condensed matter" was itself to be interpreted broadly, to include statistical mechanics as well as material science, biophysics and related inter-disciplinary areas. Besides the purely scientific agenda defined by the program, the meeting had the broader aim of fostering closer integration between these two communities and facilitating a two-way flow of ideas and people.

The meeting consisted of 5 sessions with invited speakers: (I) Strongly correlated systems, (II) Materials: Mesoscopic systems, nanomaterials and novel materials, (III) Biological Physics, (IV) Soft condensed matter physics and (V) Disordered systems, non-equilibrium systems and Interface areas, in addition to (VI) A contributed poster session. Several IMSc members participated in this meeting, of which R. Shankar was a speaker in the session on strongly correlated electrons while G. Baskaran chaired the session on Biological Physics.

4.3 Seminars

Date	Speaker Affiliation	Title
2-8-2001	D. Thirumalai University of Maryland	Chaperonin-mediated Protein Folding
2-8-2001	M. S. Raghunathan TIFR, Mumbai.	Spaces of Morphisms of Curves in Homogeneous Spaces
3-8-2001	Shamindra Kumar Ghosh IMSc, Chennai	Higher Exchange Relation Planar Algebra
6-8-2001	Balram Rai IOP, Bhubaneshwar	Dynamics on AdS(2) and Enlargement of SL(2,R) to C=1 cutoff Virasoro Algebra
8-8-2001	A. P. Balachandran Syracuse University	Fuzzy Physics
9-8-2001	Douglas Hanes University of Minnesota, Minneapolis, USA	Hilbert Functions and Hilbert-Kunz Functions
16-8-2001	Nandini Ranganathan University of Texas at Austin	An Application of Group Cohomology to Splitting in Extensions of Regular Rings.
21-8-2001	Sujata Ghosh University of Calcutta	An Approximation of Semantics for Autoepistemic Logic
28-8-2001	V. S. Sunder IMSc, Chennai	Operator Algebras and Conformal Field Theory
29-8-2001	Pushan Majumdar TIFR, Mumbai.	Susceptibility and Screening Masses in QCD
30-8-2001	C. S. Seshadri CMI, Chennai	Standard Monomial Theory and K-Theory

3-9-2001	V. S. Sunder IMSc, Chennai	Operator Algebras and Conformal Field Theory
4-9-2001	Dilip Banhatti IMSc, Chennai	Recent Implications of Quasar Absorption Lines: A Brief Partial Review
5-9-2001	Onuttom Narayan IISc, Bangalore	Stresses, Force Chains and Failure in Granular Materials
6-9-2001	V. Kannan University of Hyderabad	Cellular Automata
7-9-2001	E. Harikumar IMSc, Chennai	Born-Infeld Chern-Simons Theory: Hamiltonian Embedding, Duality and Bosonization
10-9-2001	V. S. Sunder IMSc, Chennai	Operator Algebras and Conformal Field Theory
11-9-2001	Rajmohan Rajaraman Northeastern University, Boston	An Efficient Distributed Algorithm for Constructing Small Dominating Sets
13-9-2001	V. Sampath Dept of Metallurgy, IIT, Chennai	Shape Memory Alloys
14-9-2001	B. Sriram Shastry IISc, Bangalore	Pyrochlore Systems: Spin Ice, Field Driven Transitions and Unusual Hall Effect
17-9-2001	Subhasis Sinha Ecole Normale Superieure, Paris	Nucleation of Vortices in a Rotating Bose-Einstein Condensate
17-9-2001	V. S. Sunder IMSc, Chennai	Operator Algebras and Conformal Field Theory
18-9-2001	S. Sivaprakasam University of Wales, Bangor	Synchronization of Chaotic Diode Lasers

19-9-2001	S. Kalyana Rama IMSc, Chennai	Some Consequences of the Generalized Uncertainty Principle
20-9-2001	Sitabhra Sinha Weill Medical College, Cornell University	Physics of the Heart: Spatiotemporal Dynamics and Control
26-9-2001	Subrata Bal IMSc, Chennai	Interaction Between Two Fuzzy Spheres
27-9-2001	F. Fidaleo University of Rome-II	Quantum Markov Fields and Statistical Mechanics for d-dimensional Spin Lattices
3-10-2001	Tarun Kanti Ghosh IMSc, Chennai	Modelling Two-roton Bound State Formation in Fractional Quantum Hall Systems
5-10-2001	Habatwa V. Mweene University of Zambia, Lusaka	Generalization of Spin Theory
9-10-2001	Tobias Nipkow Technische Universitat, Munchen, Germany	Hoare Logics for Recursive Procedures and Unbounded Nondeterminism
12-10-2001	Naresh Dadhich IUCAA, Pune	Electromagnetic Duality in Gravity
19-10-2001	M. G. Nadkarni Mumbai University, Mumbai	Kolmogorov's Solution of Hilbert's 13th Problem
22-10-2001	Albert Libchaber Rockefeller University	Protein-DNA Computation by Stochastic Assembly Cascade:The Case of RecA Polymerization
24-10-2001	K. R. Parthasarathy ISI, Delhi	Quantum computing and coding
7-11-2001	Jasjeet S. Bagla HRI, Allahabad	Parallelising Cosmological N-Body Simulations

8-11-2001	Harvinder Kaur Jassal HRI, Allahabad	Inflation in Brane World Cosmology
8-11-2001	N. Mohan Kumar Washington University, St. Louis.	Reducedness of Quadrics
12-11-2001	L. C. Gupta TIFR, Mumbai	Recent Studies on Borocarbide Magnetic Superconductors
15-11-2001	Piyush Kurur IMSc, Chennai	Quantum Lower Bound Techniques
16-11-2001	R. Anantharaman Clark Atlanta University	Sequences in the Range of a Vector Measure
19-11-2001	S. G. Dani TIFR, Mumbai	Values of Quadratic Forms at Integral Points
21-11-2001	Sumit R. Das TIFR, Mumbai	Why Noncommutative Geometry?
29-11-2001	Ioan Badulescu University of Poitiers	Jacquet-Langlands Correspondence
29-11-2001	Rajesh Gopakumar HRI, Allahabad	Strings in Electric and Magnetic Fields
30-11-2001	Kim Griest University of California, San Diego	Searching for Dark Matter via Gravitational Microlensing
5-12-2001	Spenta Wadia TIFR, Mumbai	String Theory and Black Holes
6-12-2001	J. Zagrodzinski Polish Academy of Sciences, Warsaw	Applications of Riemann Theta Functions in Soliton Theory

6-12-2001	S. Dattagupta SNBNCBS, Kolkata	Coherence versus Decoherence
11-12-2001	P. Ranjith Department of Physics, IIT, Chennai	Dynamics of Semi-flexible Polymers
13-12-2001	R. Sridharan CMI, Chennai	Apropos Nadkarni's Colloquium: The Notion of Essential Dimension.
13-12-2001	Stefan Spanier SLAC, U.S.A	Results from the BaBar Experiment
14-12-2001	Gautam I. Menon IMSc, Chennai	Persistence with Synchronous Dynamics
17-12-2001	Arun Ram University of Wisconsin	Combinatorics, Hecke Algebras, and the flag variety.
18-12-2001	Dale Cutkosky University of Missouri	A Counterexample to Weak Simultaneous Resolution of Singularities
18-12-2001	Sadhan Kumar Adhikari Instituto de Fisica Teorica, Brazil	Bose-Einstein Condensation
19-12-2001	Uma Mahanta HRI, Allahabad	Rho Parameter Constraints on Radion Phenomenology and a Lower Bound on the Higgs Mass
20-12-2001	A. Jensen University of Alborg, Denmark	Ripples in Mathematics - An Elementary Introduction to Discrete Wavelet Transform
21-12-2001	Alfred Menezes University of Waterloo	Cryptology

21-12-2001	Rahul Roy ISI, New Delhi	Exit time of Equilateral Triangles
26-12-2001	G. Lusztig MIT, USA	Total Positivity in Semi Simple Groups
27-12-2001	Harish Parthasarathy Netaji Subhash Institute of Technology, New Delhi	An Application of Peter-Weyl Theorem to Matched Filtering of Image Detection
28-12-2001	Rahul Siddharthan ENS, Paris	Dynamical Mean Field Theory of Resonating Valence Bond Antiferromagnets
28-12-2001	K. T. Arasu	New Families of Perfect Sequences via Gauss Sums and Stickelberger Congruence
31-12-2001	Siva Athreya ISI, Delhi	Ballistic Deposition on a Planar Strip
31-12-2001	R. Narasimhan University of Chicago	Embedding and Immersion of Stein Manifolds
2-1-2002	A. Borel Institute for Advanced Study, Princeton	Eli Cartan and Hermann Weyl
7-1-2002	Avadh Saxena Los Alamos National Laboratory, U.S.A	Microstructure Evolution in Functional Elastic Materials
7-1-2002	V. Chandrasekhar North Western Univ, USA	Thermal Effects in Superconducting Proximity Regime
9-1-2002	Frederik Denef Columbia University	Quantum Quivers and Hole Halos
11-1-2002	C. Dasgupta IISc, Bangalore	Classical Liquids in a Quenched Random Potential

15-1-2002	Santosh Vempala MIT, USA	Solving Convex Programs through Random Walks
21-1-2002	T. Padmanabhan IUCAA, Pune	Cosmological Constant: Is it for Real?
23-1-2002	B. M. Jaffar Ali/Gautam Vivek Soni NCBS, Bangalore	Physical Analysis of Single Cell Bacterial Chemotaxis
23-1-2002	Anjan Kundu SINP, Kolkata	Quadratic Algebra and its Application to Integrable Systems
24-1-2002	K. R. Parthasarathy ISI, Delhi	An Entropic Uncertainty Principle for Finite Level Quantum System
24-1-2002	G. vanden Berghe University of Gent, Belgium	Runge-Kutta Methods of ODE: Generalization and Applications
25-1-2002	Venkatesh Srinivasan DIMACS, Rutgers University, USA	On the Advantage over a Random Assignment
25-1-2002	Elliott Lieb Princeton University, U.S.A	The Quantum-Mechanical World View: A remarkably successful but still incomplete theory
29-1-2002	Sasanka Ghosh IIT, Guwahati	Multicomponent Integrable Systems and Optical Solitons
30-1-2002	Naveen Surendran IMSc, Chennai	Anti-Ferromagnets with an Exact Ground State in Arbitrary Dimensions
31-1-2002	V. S. Sunder IMSc, Chennai	Naimark's Theorem, Stinespring's Theorem and all that
1-2-2002	H. Nicolai AEI, Potsdam, Germany	Maximal Gauged ($N = 16$) Supergravities in Three Dimensions

4-2-2002	Indrajit Mitra SINP, KolKata	Gravitational Couplings of Charged Leptons in a Medium
6-2-2002	S. Krishnaswamy School of Biotechnology, Madurai Kamaraj University	Systems Biology
7-2-2002	J. Weissmueller Institute for Nanotechnology, Karlsruhe Research	Nanomaterials with Interface-controlled Properties
7-2-2002	N. G. Deshpande University of Oregon, U.S.A	Phenomenology with Non-commuting Gauge Field Theories
8-2-2002	N. D. Hari Dass IMSc, Chennai	Self-thermalization, Coarse Graining and Related Conceptual Issues in Quantum Statistical Mechanics
12-2-2002	John Plaice The University of New South Wales, Sydney	Intentional Programming and Multidimensional Web Sites
14-2-2002	N. G. Deshpande University of Oregon, U.S.A	Some Aspects of B Physics
21-2-2002	V. Lakshmibai Northeastern University	K-theory and Standard Monomial Theory
25-2-2002	David Bailin University of Sussex	Standard Model on D-branes
25-2-2002	A. M. M. Pruisken ITP, Amsterdam	The Quantum Hall Effect I
26-2-2002	Umesh Waghmare JNCASR, Bangalore	Disorder Effects in Ferroelectrics and Supercooled liquid Si
26-2-2002	A. M. M. Pruisken ITP, Amsterdam	The Quantum Hall Effect II

27-2-2002	A. M. M. Pruisken ITP, Amsterdam	The Quantum Hall Effect III
27-2-2002	A. Bharathi IGCAR, Kalpakkam	The Effect of Carbon Substitution on Superconductivity in MgB2
28-2-2002	R. K. Varma PRL, Ahmedabad	Macroquantum Dynamics in the Correspondence Limit of Charged Particles in a Magnetic Field: Theory and Experimental
28-2-2002	A. M. M. Pruisken ITP, Amsterdam	The Quantum Hall Effect IV
1-3-2002	A. M. M. Pruisken ITP, Amsterdam	The Theta Vacuum Reveals Itself as the Fundamental Theory of the Quantum Hall Effect
4-3-2002	S. R. Ghorpade IIT, Mumbai	Grassmannians, Schubert Varieties, and Error Correcting Codes
4-3-2002	Priya Mahadevan NREL, Golden, U.S.A	On Charge and Orbital Ordering
7-3-2002	Girish Setlur JNCASR, Bangalore	Gales and Tidal Waves in the Fermi Sea: Introduction
12-3-2002	V. V. S. Gautam IMSc, Chennai	A Survey on "Tensor Categories in Low Dimensional Topology and elsewhere"
12-3-2002	P. P. Divakaran CMI and IMSc, Chennai	Minkowskian Lattices
13-3-2002	Venkatesh Raman IMSc, Chennai	Should Tables be Sorted?

13-3-2002	Girish Setlur JNCASR, Bangalore	Transient Phenomena in Quantum Many-body Systems
1-4-2002	Dilip Banhatti University of Muenster, Germany	Is the Sun Made of Iron?
3-4-2002	V. Balakrishnan IIT, Chennai	Diffusion, Velocity Correlations, Energy Transport and Stochasticity in a 1d Hard-point Gas
9-4-2002	V. M. Kenkre University of New Mexico	Theory of Charge Transfer in Organic Crystals: Lessons from the Past and Prospects for the Future
10-4-2002	Justin David UCSB, Santa Barbara	Perturbative and Non-perturbative Decay of Twisted Circle Compactifications
11-4-2002	K. Varadarajan University of Calgary	Criteria for the Asphericity of 2-Complexes
15-4-2002	Prashant Koulgi University of California, Santa Barbara	Some Problems in Zero error Information Theory
16-4-2002	K. R. Parthasarathy ISI, Delhi	History of Probability Theory
17-4-2002	R. Simon IMSc, Chennai	Quantum Entanglement I: Positive Maps and Bound Entanglement
17-4-2002	R. G. W. Brown International Editor Director, Journals, IOP	The Changing Face of Research Publishing

19-4-2002	Tapash Chakraborty IMSc, Chennai	Can you Keep a Secret with a Quantum Dot? (Nanostructures for quantum cryptography)
22-4-2002	R. Sankara Narayanan PRL, Ahmedabad	Competing Length Scales and Chaos
22-4-2002	Ramesh K. Sistla IIT, Chennai	Probing Short Range Order in Glasses by Computer Simulations
24-4-2002	R. Simon IMSc, Chennai	Quantum Entanglement II: Gaussian States and Entanglement of Formation
26-4-2002	B. Ananthanarayan CTS, IISc, Bangalore	π-π and π-K Scattering in Chiral Perturbation and Dispersion Relation Theories
6-5-2002	R. Rajesh Oxford University	Non-Equilibrium Phase Transitions in Models of Aggregation
8-5-2002	Shobhana Narasimhan JNCASR, Bangalore	Stars and Stripes: The Reconstruction of the Pt(111) Surface
10-5-2002	G. Rajasekaran IMSc, Chennai	SNO Solves the Solar Neutrino Problem
25-6-2002	Aravind Srinivasan University of Maryland, College Park	Distributions on Level-sets with Applications to Approximation Algorithms
27-6-2002	M. Muthukumar University of Massachusetts, Amherst	DNA Translocation through Protein Channels
27-6-2002	M. Geetha Anna University, Chennai	The Human Genome Project

1-7-2002	Madhav Ranganathan Department of Chemistry, Stanford University	Kinetic Theory for Simple Fluids: A Short-time Theory for Strongly Repulsive Systems
1-7-2002	C. V. Dharmadhikari Department of Physics, Pune University	Scanning Tunneling Microscopy as a Tool for Nanotechnology
2-7-2002	Kumar Rao University of Connecticut	Finite Temperature Induced Fermion Number
2-7-2002	Buddhapriya Chakrabarti Physics Department, IISc, Bangalore	Non-equilibrium Phase Transitions in Surface Growth
3-7-2002	Yashodhan Hatwalne RRI, Bangalore	The Cone Phase of Liquid Crystals
4-7-2002	Kasturi R. Varadarajan University of Iowa, Iowa	On Approximating the Radii of Point Sets in High Dimensions
11-7-2002	M. R. K. Krishna Rao James Cook University, Australia	On Learning Term Rewriting Systems from Entailment
15-7-2002	M. Muthukumar University of Massachusetts, Amherst	Introduction to Polymer Physics I
16-7-2002	Mukund Swaminathan Texax A& M University, U.S.A.	A New Scheme to Calculate Band Structure from First Principles Using Equilibrium Greens Functions
16-7-2002	M. Muthukumar University of Massachusetts, Amherst	Introduction to Polymer Physics II
17-7-2002	M. Muthukumar University of Massachusetts, Amherst	Introduction to Polymer Physics III

18-7-2002	M. Muthukumar University of Masschusetts, Amherst	Introduction to Polymer Physics IV
19-7-2002	M. Muthukumar University of Massachusetts, Amherst	Introduction to Polymer Physics V
22-7-2002	K. S. Narain ICTP, Trieste	Open Strings in pp Waves and their Gauge Theory Duals
25-7-2002	B. L. Sharma University of Allahabad	Invariance Problem for Characteristic Classes
25-7-2002	Piyush P. Kurur IMSc, Chennai	Graph Isomorphism is in SPP
29-7-2002	P. K. Mohanty TIFR, Mumbai	Sandpile Models with Directed Percolation Exponents
31-7-2002	M. D. Srinivas Centre for Policy Studies, Chennai	Optimal Uncertainty Relations in Quantum Information Theory

Chapter 5

External Interactions

5.1 Collaborative Projects with Other Institutions

5.1.1 Automata and Concurrency: Syntactic methods for verification

This project supported by the Indo-French Centre for Promotion of Advanced Research continues in this second year.

The general purpose of the project is to extend the methods of automata theory to be able to handle concurrent processes, towards the construction of efficient verification tools. The researchers involved in the project are: K. Lodaya, R. Ramanujam (IMSc), M. Mukund, N. Kumar (CMI) from the Indian side and P. Weil, P. Gastin, J.-M. Couvreur, A. Petit and J.-E. Pin from the French side.

5.1.2 India-based Neutrino Observatory

The feasibility study for a possible India-based Neutrino Observatory (INO) has begun. The National Neutrino Collaboration includes members from several institutes and universities in India. Members from IMSc who are involved in this project are D. Indumathi, M. V. N. Murthy and G. Rajasekaran.

A possible site for INO was located by the IMSc group at PUSHEP near Masinagudi,under the Nilgiri mountains, access being on the northern slope. Technical details of the site including geological and other information were collected into a Report presented in the INO-collaboration meeting at TIFR in September 2001 and March 2002. More details are being sought, with help from the Geological Survey of India.

In the area of simulation, the IMSc group is working on adapting available Neutrino Event generators for the proposed Iron-Calorimeter detector at INO.

Series of lectures on neutrinos are being given, in order to attract students towards joining INO. This being a major project we would need to train a large number of scientists and engineers for it. Lectures were given to physicists and students of the University of Hyder-

abad, BARC Training School, IIT Madras and various colleges at Chennai. The physics
goals of the project are being worked out, with the aim of achieving competitiveness with
the world-wide developments in the field.

5.1.3 Indo-UK project on Highly Efficient Data Structures

In this year, under this project, S. Srinivasa Rao visited Prof. Rajeev Raman at Leicester
University from August 20th to September 8th, 2001. Succinct dynamic data structures for
the dictionary problem were explored during this visit.

Later Rajeev Raman visited IMSc from November 20th to December 10th, 2001. Succinct
structures to represent a permutation were explored.

The project continues till March 2003.

5.1.4 Metal-Insulator Transition in an Adsorbed Layer at an Electrochemical Interface

The DST-DAAD joint research project on 'Metal-insulator Transition in an Adsorbate Layer'
is now running in its second year. A. K. Mishra (IMSc) and Prof. W. Schmickler (Univ. of
Ulm, Germany) are the project members. The project duration is for two years and it was
sanctioned in June, 2001.

5.1.5 Novel Materials for Applications in Molecular Electronics and Energy Storage Devices

DRDO has sanctioned in January 2002 a project on Novel Materials for Applications in
Molecular Electronics and Energy Storage Devices. The project team consists of A. K.
Mishra (IMSc), Sheela Berchmans (CECRI), and V. Yeganaraman (CECRI). The project
duration is for three years.

5.1.6 Studies in Quantum Statistics

An Indo-US Collaboration project on 'Studies in Quantum Statistics', involving Institute of
Mathematical Sciences (India) and University of Maryland (USA), has been approved. The
project team consists of A. K. Mishra (IMSc) and Prof. O. W. Greenberg (Maryland Univ.).
The project duration is for three years and it commences from May 2002.

5.1.7 IMSc – NMRC, C-DAC CD-ROM Project

The Institute of Mathematical Sciences and the National Multi-media Resource Centre of
the Centre for Development of Advanced Computing are to produce two or more CD-ROMs
on the 'Life and Work of Srinivasa Ramanujan'. This two year project, funded by DST,

commenced from July, 2001. The principle coordinators for the project are Prof. K. Srinivasa Rao from IMSc and Dinesh Katre from NMRC. The project is monitored by the Project Planning and Monitoring Group (PPMG) consisting of Drs. B. D. Acharya, H. K. N. Trivedi from the DST, Asha Rani Singhal from Meerut university, Hans-Gill from Punjab university, S. Bhargava from Mysore university and Kapil Paranjape from IMSc. After reviewing the project in April, 2002, the PPMG recommended the creation of a web site on Ramanujan for wider accessibility.

5.2 Institute Associateships

The Institute has established short-term associateships in **Mathematics, Theoretical Physics and Theoretical Computer Science** to enable teachers from colleges and universities to work at the institute. The programme is envisaged to develop interaction between the members of the faculty of the institute and scientists in the university system. Under this programme, an associate can visit the institute once or twice a year, up to a total of 90 days per year, each visit lasting a minimum of three weeks. The tenure of an associate will be for a period of three years and (s)he is expected to visit the institute at least twice during this period.

The institute will bear the expenses of round-trip travel (by rail) from the Associate's normal place of work to Chennai and will also pay a daily allowance to cover local expenses at Chennai. During their stay at Chennai, Associates will be accommodated in the institute Guest House.

Associates who visited the institute during the period 01.08.01 to 31.07.02 are :

Aranya B. Bhattacharjee
A.R.S.D. College, Univ of Delhi, Delhi
08.05.2002 to 25.06.2002

P. S. Jog
Dept. of Physics, Univ of Pune, Pune
23.06.2002 to 06.07.2002

M. Sivakumar
School of Physics, Univ of Hyderabad, Hyderabad
12.05.2002 to 01.06.2002

A. Ramakalyan
Regional Eng College, Trichy
01.05.2002 to 31.05.2002

Mihir K. Chakraborty
Dept. of Pure Maths, Univ of Calcutta, Kolkata
13.08.2001 to 02.09.2001

M. K. Parida
North Eastern Hill Univ, Shillong
15.01.2002 to 30.01.2002

Swapan Mandal
Dept. of Physics, Visva-Bharati, Santiniketan
17.12.2001 to 07.01.2002; 20.05.02 to 17.06.02

T. C. Vasudevan
Ramakrishna Mission, Vivekananda College, Chennai
15.04.2002 to 14.06.2002

Ranbir Chakraborti
Dept. of Physics, Visva-Bharati, Santiniketan
15.10.2001 to 28.10.2001; 18.12.01 to 31.12.01 and 18.04.02 to 14.06.02

G. V. Ravindranadh Babu
Dept. of Maths, Andhra Univ, Visakhapatnam
24.12.2001 to 15.01.2002

H. C. Chandola
Dept. of Physics, Kumaun Univ, Nainital
15.11.2001 to 12.12.2001

A. R. Usha Devi
Physics Department, Bangalore Univ, Bangalore
11.11.2001 to 30.11.2001

5.3 Conference Participation and Visits to Other Institutions

Arvind, V.

Visited BRICS, Aarhus University during Aug 6 – Sep 5, 2001. Gave two seminar talks.

Participated in *21st Conference on FST&TCS* held at IISc, Bangalore during Dec 12 – Dec 15, 2001.

Participated in *School on Quantum Information and Quantum Physics* held at TIFR, Mumbai during Feb 18 – Feb 27, 2002.

Balakrishnan, Radha

Participated in *International Conference on Nonlinear Evolution Equations and Dynamical Systems (NEEDS 2001)* held at Isaac Newton Institute for Mathematical Sciences, University of Cambridge, UK during Jul 24 – Aug 2, 2001. Gave an invited talk titled "Moving space curves and soliton equations: New results".

Visited Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, USA during Aug 6 – Dec 6, 2001.

Balasubramanian, R.

Visited Indian Statistical Institute, Calcutta during Oct 10 – Oct 12, 2001. Delivered lecture on Cryptology in the workshop on recent advances in cryptology.

Visited Ramanujan Institute for Advanced Study in Mathematics, University of Madras during Dec 7 – Dec 8, 2001. Delivered lectures on Complex Analysis in the 'Refresher course XVII Mathematics'.

Visited Department of Mathematics, Indian Institute of Technology, Madras on Feb 24, 2002. Delivered an invited lecture at FORAYS, the yearly mathematical festival conducted by the Department of Mathematics.

Visited Department of Mathematics, Bharathidasan University, Tiruchirappalli on Mar 15, 2002. Gave a special lecture on "the Life and Works of Srinivasa Ramanujan".

Visited Department of Mathematics, University of Mumbai, Mumbai during Mar 18 – Mar 23, 2002. Delivered a lecture on "Cryptography and Number Theory" in the Refresher Course for College Teachers.

Basak, Soumen

Participated in *Field Theoretic Aspects of Gravity* held at Radio Astronomy centre at Udhagmandalam during Oct 3 – Oct 9, 2001.

Baskaran, G.

Participated in *International Conference on Magnetism and Superconductivity* held at Mangalore during Oct 25 – Oct 28, 2001. Gave an invited talk on 'New Superconductors' and also the 'conference Summary Talk'

Participated in *India-Abroad Meeting in Condensed Matter Physics* held at JNCAR, Bangalore during Jan 2 – Jan 6, 2002.

Participated in *Indo-Israel Workshop on Condensed Matter Physics* held at Israel Academy of Sciences, Jersalem, Israel during Jan 25 – Jan 30, 2002. Gave the workshop Summary Talk.

Basu, Rahul

Visited Harish Chandra Research Institute (HRI) Allahabad during Dec 26, 2001 – Jan 2, 2002. Collaborative work and delivered a Institute Colloquium entitled 'Three Quarks for Muster Mark'.

Participated in *Seventh Workshop in High Energy Physics Phenomenology (WHEPP-7)* held at HRI, Allahabad during Jan 3 - Jan 15, 2002.

Participated in *Linear Collider Workshop* held at CTS, IISc,Bangalore during Mar 24 – Mar 27, 2002.

Visited LAPTH, Annecy-le-Vieux, France during Jun 17 – Jul 26, 2002.

Das, Paramita

Participated in *Workshop on Operator Theory and Operator Algebras* held at ISI, Bangalore during Dec 24, 2001 – Jan 4, 2002.

Date, G.

Participated in *Field Theoretic Aspects of Gravity – II* held at Radio Astronomy Centre, Udhagmandalam during Oct 3 – Oct 9, 2001. Gave a talk on 'isolated horizons'.

Participated in *Interface of Gravity and the Quantum Realm -I* held at IUCAA, Pune during Dec 17 – Dec 21, 2001. Gave an invited talk on 'Quantum Geometric Description of

Cosmological Models'.

Visited Raman Research Institute, Bangalore during Mar 18 – Mar 22, 2002.

Ezhuthachan, Bobby V. K.

Participated in *String Theory Workshop* held at IMSc during Nov 15 – Dec 7, 2001.

Participated in *ILTP Indo-Russian Workshop on Integrable Models, Strings, Quantum Gravity* held at IMSc during Jan 15 – Jan 19, 2002.

Participated in *Spring School On SuperStrings And Related Matters* held at Abdus Salam ICTP during Mar 18 - Mar 26, 2002.

Ganguly, Avijit K.

Participated in *XVII SERC Preparatory School On Theoretical High Energy Physics,* held at Department of Physics, Utkal University, Bhubaneshwar during Jan 21 – Feb 9, 2002. Guest Lecturer for a course on Quantum Field Theory.

Visited Saha Institute Of Nuclear Physics, Kolkata during Mar 1 - Mar 10, 2002.

Gautam, Vishvajit V.

Visited Indian Statistical Institute, Delhi during Feb 25 – Mar 8, 2002.

Participated in *Topological Methods in Group Theory* held at IMSc, Chennai during Jul 15 - Jul 27, 2002.

Ghosh, Shamindra Kumar

Participated in *Workshop on Operator Theory and Operator Algebras* held at ISI, Bangalore during Dec 24, 2001 – Jan 4, 2002. Gave a talk on "Exchange Relations".

Visited Morningside Center at Beijing, China during Jun 12 – Jul 31, 2002, to attend programmes under the Operator Algebra Year.

Ghosh, Tarun K.

Participated in *India and Abroad: A conference on Condensed Matter Physics.* held at JNCASR, Bangalore, India, during Jan 2 – Jan 4, 2002.

Govindarajan, Thupil R.

Participated in *Field Theoretic Aspects of Gravity -II* held at Radio Astronomy center, Ooty during Oct 3 – Oct 9, 2001. Gave a talk on 3D gravity and Chernsimons theory.

Visited IUCAA, Pune, India during Dec 17 – Dec 23, 2001.

Participated in *Interface of Gravity in Quantum realm -I* held at IUCAA, Pune during Dec 17 - Dec 23, 2001. Gave an invited talk on Logarithmic corrections for entropy.

Visited Dublin Institute of Advanced Studies, Dublin during May 17 – May 22, 2002.

Participated in *IX Irish Quantum Field theory Meeting* held at Dublin, Ireland during May 17 – May 18, 2002. Gave an invited talk on Quantum gravity in dS_3 .

Visited International center for Theoretical Physics, Trieste, Italy during May 23 – Jul 25, 2002.

Visited INFN, Napoli, Italy during Jun 17 – Jun 22, 2002.

Visited INFN, University of Perugia, Italy during Jun 23 – Jun 26, 2002.

Visited Albert Einstein Inst, Potsdam, Germany during Jul 1 – Jul 6, 2002.

Hari Dass, N. D.

Participated in *Meeting on Field Theoretic Aspects of Gravity -II* held at Ooty during Oct 2 – Oct 9, 2001. Gave a talk on "Gauge Independence in Quantum Gravity".

Participated in *Workshop on Interface of Gravitational and Quantum Realms -I* held at IUCAA, Pune during Dec 17 – Dec 21, 2001. Gave an invited talk on "A no-go theorem for de Sitter compactifications?"

Participated in *Second Winter School on Foundations of Quantum Mechanics and Quantum Optics* held at S.N.Bose Centre, Kolkata during Jan 1 – Jan 10, 2002. Gave two invited talks on "Information Cloning of harmonic oscillator coherent states" and "Passage from a pure state description to the microcanonical ensemble description for closed quantum systems".

Visited Saha Institute of Nuclear Physics, Kolkata on Jan 8, 2002. Delivered a seminar on "The emergence of the microcanonical ensemble from a pure quantum state".

Participated in *School on distributed computing and workshop on lattice gauge theories* held at HRI, Allahabad during Apr 13 – Apr 15, 2002. Gave a talk on "Numerical Simulation of Dual Lattice Gauge Theories".

Visited School of Physical Sciences,JNU,New Delhi on Apr 17, 2002. Delivered a seminar on "The emergence of the microcanonical ensemble from a pure quantum state".

Visited Physics Department, Jamia Millia University,Delhi on Apr 18, 2002. Gave a talk on "Quantum Error Correcting Codes".

Visited Tata Institute of Fundamental Research,Mumbai during Jun 17 – Jul 16, 2002. Interacted with various members of the theory group and gave talks on "The emergence of the microcanonical ensemble from a pure quantum state" and "Compositeness in quantum field theory".

Visited S.N.Bose National Centre,Kolkata during Jun 23 – Jun 25, 2002. Conducted the creativity test for JBNSTS, Kolkata and also gave a talk on "Compositeness in Quantum Field Theory".

Visited IUCAA, Pune during Jul 17 – Jul 19, 2002. Delivered a colloquium on "The emergence of the microcanonical ensemble from a pure quantum state".

Harikumar, E.

Participated in *ILTP Indo-Russian Workshop on Integrable Models, Strings, Quantum Gravity* held at IMSc, Chennai during Jan 15 – Jan 19, 2002.

Hossain, Golam Mortuza

Participated in *ILTP Indo-Russian Workshop on Integrable Models, Strings, Quantum Gravity* held at IMSc, Chennai, India during Jan 15 – Jan 19, 2002.

Participated in *Summer School on Astroparticle Physics and Cosmology* held at Abdus Salam ICTP, Trieste, Italy during Jun 17 – Jul 5, 2002.

Indumathi, D.

Visited TIFR, Mumbai during Sep 6 – Sep 7, 2001 to attend INO Collaboration Meeting.

Visited TIFR, Mumbai during Mar 21 – Mar 22, 2002 to attend INO Update meeting.

Visited CTS, IISc, Bangalore during Mar 24 – Mar 27, 2002 to attend Linear Collider Working group meeting.

Participated in *Refresher Course for Teachers*. Taught a course in *Computational Physics (Part 1 of 4)* held at IMSc, Chennai during May 11 – Jun 5, 2002.

Jayaraman, T.

Visited New High-Energy Theory Centre, Dept. of Physics, Rutgers University, USA during Oct 1 - Oct 31, 2001. Delivered talk on "Open String Instantons in Linear Sigma Models". Initiated collaborative research activity that was subsequently published.

Participated in *ILTP Indo-Russian Workshop on Integrable Models, Strings, Quantum Gravity* held at Institute of Mathematical Sciences, Chennai during Jan 15 – Jan 19, 2002. Delivered talk on " Boundary fermions, helices and quivers on Calabi-Yau manifolds"

Participated in *Institute Seminar Week* held at Institute of Mathematical Sciences, Chennai during Feb 1 – Feb 6, 2002. Delivered talk on "Open-string instantons: Some maths-physics connections"

Participated in *IPM String School and Workshop* held at Shiraz, Iran, during Apr 24 – May 2, 2002. Delivered a mini-course of 3 lectures on "D-branes on Calabi-Yau manifolds"

Visited Institute for Physics and Mathematics (IPM), Teheran, Iran. during May 3 – May 6, 2002.

Karthik, G.V.S.

Participated in *ILTP Indo-Russian Workshop on Integrable Models, Strings, Quantum Gravity* held at IMSc, Chennai, India during Jan 15 – Jan 19, 2002.

Kesavan, S

Visited Cochin University of Science and Technology on Sep 22, 2001. Delivered the Professor Abdi Memorial Endowment Lecture.

Visited Université de Metz, Metz, France during Oct 1, 2001 - Mar 12, 2002. Delivered a seminar talk in November 2001. Gave two lecture courses, one on Numerical Analysis and the other on Introduction to Homogenization as Visiting Professor.

Visited Université de Nancy I, Nancy, France on Feb 6, 2002. Delivered a seminar talk.

Visited Université de Pierre et Marie Curie, Paris VI, Paris, France on Feb 11, 2002. Delivered a seminar talk.

Visited Université de Strasbourg on Feb 19, 2002. Delivered a seminar talk.

Visited Banaras Hindu University, Banaras during Jun 10 – Jun 13, 2002. Gave the Professor M. N. Gopalan Endowment Lecture at the 17th Annual Meeting of the Ramanujan Mathematical Society.

Kodiyalam, Vijay

Participated in *International workshop on linear algebra, numerical functional analysis and wavelet theory* held at Cochin University of Science and Technology, Cochin during Aug 6 – Aug 15, 2001. Gave two talks on 'Paragroups and Hopf algebras' and 'Discrete series for discrete fusion algebras'.

Visited Indian Statistical Institute, Kolkata during Mar 18 – Mar 21, 2002. Gave talks on 'Planar algebras and subfactors' and 'Diagrammatics of Hopf algebras'.

Kurur, Piyush P.

Participated in *21st Conference on FST&TCS,* held at IISc Bangalore, during Dec 13 – Dec 15, 2001.

Participated in *School on Quantum Information and Quantum Physics,* held at TIFR, Mumbai, during Feb 18 – Feb 27, 2002.

Participated in *IEEE Conference on Computational Complexity,* held at Universite de Montreal, Montreal, during May 21 – May 24, 2002.

Lodaya, Kamal

Visited Indian Institute of Science, Bangalore during Sep 24 – Oct 3, 2001. Gave six lectures on Automata and Verification.

Participated in *IMSc-UNU/IIST Course on Theoretical Aspects of Computer Science* held at IMSc during Oct 15 – Nov 9, 2001. Gave six lectures on computability theory

Participated in *Workshop on Reasoning about Parameterized and Infinite-State Systems* held at IMSc during Dec 17 – Dec 18, 2001.

Participated in *Workshop on Current Practice and Future Challenges in Computer Science* held at IIT Kanpur during Jan 3 – Jan 4, 2002.

Visited IIT Madras on Feb 14, 2002. Gave a talk on "Algebras as automata".

Visited TIFR Mumbai during Mar 4 – Mar 28, 2002. Gave several lectures on Monadic second order logic, as well as a seminar talk on "A syntax for Petri nets".

Visited IIT Bombay on Mar 20, 2002. Gave a talk on "Combining word and tree automata".

Visited CMI on Apr 10, 2002. Gave a colloquium talk on "Let's do some linguistics".

Visited Velammal Engg College on Jul 3, 2002. Gave a talk on "Introduction to computability".

Mahajan, Meena B.

Participated in *IMSc-UNU/IIST Course on Theoretical Aspects of Computer Science* held at IMSc during Oct 15 – Nov 9, 2001. Gave three lectures and conducted one tutorial in the "Algorithms and Data Structures" stream.

Participated in *Workshop on Quantum Computing* held at Indian Institute of Science, Bangalore during Dec 11 – Dec 12, 2001.

Visited Department of Computer Science and Engineering, Indian Institute of Technology, Bombay during Apr 29 - May 31, 2002.

Meenakshi, B.

Visited LIAFA, University of Paris VII, Paris, France during Sep 11 – Sep 28, 2001.

Participated in *FISC Workshop on Message Sequence Charts* held at LIAFA, University of Paris VII, Paris on Sep 18, 2001. Gave a talk titled "Beyond Message Sequence Graphs".

Visited IRISA, Rennes, France during Sep 25 – Sep 26, 2001. Gave a talk titled "Reasoning about message-passing in finite state environments".

Visited LaBRI, CNRS, Bordeaux, France during Oct 1 – Oct 12, 2001. Gave a talk titled "Model Checking extensions of MSGs against MSO specifications".

Visited Lehrstuhl für Informatik VII, RWTH Aachen, Aachen, Germany during Oct 15 - Oct 19, 2001. Gave a talk titled "Model checking MSGs against MSO specifications".

Participated in *IMSc-UNU/IIST Course on Theoretical Aspects of Computer Science* held at IMSc during Oct 15 – Nov 9, 2001. Gave a lecture titled "Automata and Concurrency"

Participated in *21st Conference on FST&TCS* held at Indian Institute of Science, Bangalore during Dec 13 – Dec 15, 2001. Presented a paper titled "Beyond Message Sequence Graphs".

Participated in *Workshop on Reasoning about Parameterized and Infinite-State Systems* held at IMSc during Dec 17 – Dec 18, 2001.

Participated in *WG2.3/UNU-IIST/IARCS School on Formal Software Engineering* held at Tata Research Development and Design Centre, Pune during Jan 3 – Jan 10, 2002.

Participated in *Science Club Meet* held at IMSc on Jul 6, 2002. Gave a lecture on "Verifying Computer Programs".

Menon, Gautam I.

Visited IGCAR, Kalpakkam during Dec 17 – Dec 18, 2001. Delivered seminars on "A New Phenomenology for the disordered Mixed Phase" and "Persistence in one-dimensional Potts models with parallel dynamics".

Visited JNCASR, Bangalore during Dec 21 – Dec 22, 2001. Delivered a seminar on "Persistence with parallel dynamics".

Participated in *India and Abroad : A Conference on Condensed Matter Physics* held at JNCASR, Bangalore during Jan 2 - Jan 4, 2002.

Participated in *Workshop on Slow Dynamics and the Glass Transition* held at JNCASR, Bangalore during Jan 6 – Jan 9, 2002. Gave an invited Talk on "Deconstructing Vortex Glasses".

Participated in *Indo-Israeli Workshop on Condensed Matter Physics* held at Israeli Academy of Sciences, Jerusalem during Jan 27 – Jan 30, 2002. Gave an invited Talk on "Phenomenology of Phase behaviour in the Mixed phase of disordered type-II superconductors".

Participated in *National Conference on Biology Inspired Physics* held at SNBNCBS, Kolkata during Mar 17 – Mar 20, 2002. Gave invited Talk on "Physical Robustness as a Possible Organizing Principle for Intracellular Transport via the cytoskeleton".

Participated in *Mini-Workshop on E-Cell, V-Cell and Genesis* held at IMSc, Chennai during Jun 24 – Jun 28, 2002.

Mishra, Ashok K.

Visited Central Electrochemical Research Institute, Karaikudi during Sep 22 – Oct 14, 2001. The visit was under Visiting Associateship Programme.

Visited BARC, Mumbai during Oct 31 – Nov 5, 2001. Participated in discussions and delivered an invited talk on "Chemisorption at Electrochemical Interface".

Visited Department of Electrochemistry, University of Ulm, Germany during Nov 6 – Nov 27, 2001 and Carried out research work on the metallization in an adsorbate layer.

Visited Max-Planck Institute for Physics of Complex Systems, Dresden, Germany during Nov 28 – Nov 30, 2001.

Visited Hahn-Meitner-Institute, Berlin, Germany on Dec 3, 2001.

Visited Fritz-Haber-Institute, Berlin, Germany during Dec 4 – Dec 6, 2001. Delivered a talk on "Metallization Effect of an Adsorbate Layer on Electrochemical Processes".

Visited Institute of Physics, Humboldt University, Berlin, Germany on Dec 6, 2001. Delivered a talk on "Adsorbates in Electrochemical Environment".

Visited Central Electrochemical Research Institute, Karaikudi during Jan 16 – Jan 18, 2002. A detailed presentation on DRDO project on Novel Materials for Applications in Molecular Electronics and Energy Storage Devices was made.

Murthy, M.V.N.

Visited TIFR during Sep 6 – Sep 7, 2001 to attend INO- Collaboration Meeting.

Visited TIFR during Mar 21 – Mar 22, 2002 to attend INO-Collaboration meeting.

Participated in *Refresher Course for college teachers in Physics* held at The Institute of Mathematical Sciences during May 11 – Jun 5, 2002. Lectured on "Introduction to Particle Physics:Part I".

Murugesh, S.

Visited The Abdus Salam ICTP, Trieste, Italy during Jul 21 – Aug 28, 2001.

Muthu, Rahul

Participated in *Workshop on Quantum Computing* held at IISc, Bangalore during Dec 11 – Dec 12, 2001.

Participated in *21st Conference on FST&TCS* held at IISc, Bangalore during Dec 13 – Dec 15, 2001.

Participated in *Workshop on Reasoning about Parametrized and Infinite State Systems* held at IMSc, Chennai during Dec 17 – Dec 18, 2001.

Nagaraj, D. S.

Participated in *International conference on " Algebra and Geometry "* held at University of Hydrabad, Hydrabad during Dec 7 – Dec 12, 2001. Gave an invited talk titled "Nef and big vector bundles".

Participated in *"Algebraic Geometry and the Langlands Programme"* held at TIFR, Mumbai during Jan 7 – Jan 25, 2002.

Visited Univerity of Lille, France during May 1 – May 31, 2002. Gave a lecture titled "Compactification of moduli space of vector bundles on a nodal curve".

Visited University of Regensburg, Germeny during Jun 1 – Jun 15, 2002. Gave a talk titled "Atiyah Kurll Schmidt Remak reduction of Principal G bundles".

Paranjape, Kapil H.

Participated in *Conference in Analytic Number Theory* held at IMSc during Jan 3 – Jan 5, 2002.

Parthasarathy, R.

Visited Department of Physics, Bharathiar University, Coimbatore. during Feb 1 – Feb 3, 2002. Delivered four lectures on "Oscillator States and Recent Developments" at the UGC Refresher Course for College and University teachers.

Raghavan, K. N.

Participated in *International Conference on Algebra and Geometry* held at University of Hyderabad, Hyderabad during Dec 7 – Dec 14, 2001.

Visited New Mexico State University during Jan 2 – Feb 1, 2002 for research collaboration and gave a colloquium talk.

Participated in *Conference on the occasion of the 70th birthday of Professor C.S.Seshadri* held at CMI, Chennai on Mar 1, 2002.

Visited IIT, Mumbai during May 5 – May 21, 2002 for research collaboration and gave a talk as part of the year long program on Hilbert functions.

Participated in *Workshop on Topological Methods in Group Theory* held at IMSc, Chennai during Jul 15 – Jul 27, 2002.

Rai, Balram

Participated in *Field Theoretic Aspects of Gravity -II* held at Radio Astronomy Centre, Ooty during Oct 2 – Oct 9, 2001. Gave a talk titled "Entropy in Accelerating Universe".

Participated in *IMSc String Theory Meeting* held at Institute of Mathematical Sciences, Chennai during Nov 15 – Dec 7, 2001. Gave a talk titled "Entropy in Accelerating Universe".

Rajasekaran, G.

Visited HRI, Allahabad during Aug 20 – Aug 21, 2001 for HRI Council Meeting.

Participated in *Neutrino Collaboration Meeting* held at TIFR, Mumbai during Sep 5 – Sep 7, 2001. Gave a talk on "The Genesis of the INO project".

Visited University of Hyderabad during Sep 8 – Sep 21, 2001. Gave five lectures on Neutrino Physics and a Colloquium titled "Is there a Final Theory?".

Visited IIT,Madras during Oct 22 – Oct 29, 2001. Gave four lectures on Neutrino Physics

Participated in *Annual Meeting of Indian Academy of Sciences* held at Sri Venkateswara University,Tirupati,AP during Nov 9 – Nov 11, 2001.

Participated in *String Theory Workshop* held at IMSc during Nov 15 – Dec 7, 2001. Gave a talk titled "The number of fundamental constants".

Visited Nuclear Science Centre,New Delhi during Dec 19 – Dec 20, 2001. Gave the Foundation Day Lecture titled "Is there a Final Theory?".

Participated in *ILTP Indo-Russian Workshop on Integrable Models,Strings and Quantum Gravity* held at IMSc during Jan 15 – Jan 19, 2002.

Participated in *Annual Meeting of INSA* held at INSA,New Delhi during Mar 9 – Mar 11, 2002.

Participated in *Neutrino Collaboration Meeting* held at TIFR, Mumbai during Mar 22 – Mar 23, 2002.

Visited BARC, Mumbai during Jun 10 – Jun 14, 2002. Gave four lectures on Neutrino Physics to BARC Trainees and a Colloquium to the Physics Group of the BARC on Neutrinos.

Visited Homi Bhabha Centre for Science Education, Mumbai on Jun 14, 2002. Participated in the Valedictory Function of the Physics Olympiad Training Camp 2002 as Chief Guest and addressed the students including the award-winners.

Rama, S. Kalyana

Participated in *Field Theoretic Aspects of Gravity II* held at Radio Astronomy Center, Udaghmandalam during Oct 2 – Oct 9, 2001.

Participated in *String Theory Workshop* held at IMSc, Chennai during Nov 15 – Dec 7, 2001.

Participated in *Indo Russian workshop* held at IMSc, Chennai during Jan 15 – Jan 28, 2002.

Visited HRI, Allahabad during Feb 1 - Feb 14, 2002. Participated in a workshop, and presented a seminar.

Participated in *Indo Russian Workshop* held at HRI, Allahabad during Feb 1 – Feb 5, 2002.

Ramachandran, R.,

Visited Abdus Salam ICTP, Trieste, Italy during Oct 3 – Nov 30, 2001.

Visited IIT, Kanpur during Dec 2 – Dec 7, 2001. Seminar on "Quantum Mechanics on Non-commutative AdS_2 and Landau Levels".

Participated in *ILTP Indo-Russian Workshop on Integrable models, Strings and Gravity* held at IMSc, Chennai during Jan 15 – Jan 19, 2002.

Visited Indian Institute of Education, Pune during Apr 5 – Apr 6, 2002. Participated in the Executive Council Meeting of the Indian Association of Physics Teachers.

Visited University of Pune and IUCAA, Pune during Apr 6 – Apr 8, 2002. Seminar on "Non-commutative Quantum Mechanics and Landau Levels" on April 6, 2002.

Raman, Venkatesh

Participated in *Dagstuhl Seminar on Parameterized Complexity* held at Saarbrucken, Germany during Jul 27 – Aug 3, 2001. Gave talks in the workshop on "The parameterized complexity of finding hereditary properties" and "Parameterized Counting".

Participated in *IMSc-UNU/IIST Course on Theoretical Aspects of Computer Science* held at IMSc, Chennai during Oct 15 – Nov 9, 2001. Gave a series of lectures on "Data Structures and Algorithms" and handled a tutorial.

Participated in *Workshop on Quantum Computing* held at IISc, Bangalore India during Dec 11 – Dec 12, 2001.

Participated in *21st Conference on FST&TCS* held at IISc, Bangalore India during Dec 13 – Dec 15, 2001.

Participated in *Dagstuhl Seminar on Data Structures* held at Saarbrucken, Germany during Feb 24 – Mar 1, 2002. Gave a talk on "Two bitprobe Search"

Visited Sacred Heart College, Tirupattur, Vellore District during May 7 – May 8, 2002. Gave four lectures on "Introduction to Algorithms".

Ramanujam, R.

Participated in *Workshop on Reasoning about Parameterized and Infinite-State Systems* held at IMSc during Dec 17 – Dec 18, 2001.

Visited SSN College of Engineering on Jan 31, 2002. Gave a talk on "Cryptographic Protocols".

Visited University of Newcastle, U.K. during Jul 3 – Jul 4, 2002. Gave talk on "Reasoning about Lamport diagrams".

Visited King's College, London, U.K. during Jul 5 – Jul 6, 2002. Gave talk on "Local reasoning in temporal logic".

Visited Graduate Center of the City University of New York, USA. during Jul 8 – Jul 26, 2002. Gave lectures on "Temporal logics and concurrency" and "Modal logic and games" at the Graduate Center and a talk on "Local reasoning in distributed systems" at John Jay College, respectively.

Visited Naval Research Laboratory, Washington D.C., USA during Jul 22 - Jul 23, 2002. Gave a talk on "Limits to verification of security protocols".

Ray, Purusattam

Participated in *International conference on Horizons in complex systems* held at University of Messina, Messina, Italy during Dec 5 – Dec 8, 2001. Gave an invited talk on "Spatial scaling in persistence".

Participated in *Statphys-Kolkata IV, International conference on statistical physics* held at IACS and SINP, Kolkata during Jan 14 – Jan 19, 2002. Gave a talk on "Persistence in systems under synchronous dynamics".

Visited Saha Institute of Nuclear Physics, Kolkata during May 21 – May 24, 2002.

Visited North Eastern Hill Univeristy, Shillong during May 27 – May 30, 2002.

Sankaran, P.

Participated in *Algebra and Topology* held at Delhi University, New Delhi during Jan 1 – Jan 4, 2002. Gave an invited talk on cohomology of toric bundles.

Visited Ramanujan Institute for Advanced Study in Mathematics, University of Madras during Feb 1 - Feb 28, 2002. Gave four lectures on Countably infinite simple groups.

Visited Indian Statistical Institute, Kolkata during Apr 29 – May 10, 2002. Gave two talks

one on "Coincidence theorem for holomorphic maps to G/P", and other on "Cohomology of toric bundles".

Sankararaman, Sumithra

Participated in *Summer School on Fundamental Problems in Statistical Physics-X* held at Haus-Altenberg, Altenberg, Germany, during Aug 20 – Sep 2, 2001.

Participated in *International Conference on Statistical Physics (STATPHYS- KOLKATA IV)* held at Indian Association for the Cultivation of Science and Satyendra Nath Bose National Centre for Basic Sciences, Kolkata, during Jan 14 – Jan 19, 2002. Presented a poster on "Active Membranes Near Repulsive Walls".

Sarkar, Swarnendu

Participated in *String Theory Workshop* held at IMSc, Chennai during Nov 15 – Dec 7, 2001.

Participated in *ILTP Indo-Russian Workshop on Integrable models, Strings, Quantum Gravity* held at IMSc, Chennai during Jan 15 – Jan 19, 2002.

Sathiapalan, Balachandran

Visited CTS, Bangalore during Feb 4 – Feb 5, 2002. Gave a talk on "Emergence of Micro-canonical Description from a Pure State".

Sharatchandra, H.S.

Participated in *School on Parallel Programming* held at HRI, Allahabad during Apr 11 – Apr 19, 2002. Gave an invited talk on "Gauge theories with a finite number of modes: proposal for simulating continuum gauge theories", at the Lattice Gauge Theory Workshop.

Sinha, Nita

Participated in *Flavor Physics and CP Violation* held at University of Pennsylvania, Philadelphia, USA during May 16 – May 18, 2002. Gave an invited talk on "Penguin Pollution in $B_d \to \pi\pi$".

Participated in *2002 Conference of the Division of Particles and Fields of the American Physical Society* held at Williamsburg, Virginia, USA during May 24 – May 28, 2002. Presented a paper titled "Improving Bounds on Penguin Pollution in $B \to \pi\pi$".

Visited Laboratoire Renẽ J.-A. Lẽvesque, Université de Montréal, Montréal, Canada during May 29 – Jun 19, 2002.

Sinha, Rahul

Participated in *XVII SERC School in Theoretical High Energy Physics* held at Institute of Physics Bhubaneshwar during Feb 21 - Mar 1, 2002. Delivered nine lectures on B physics.

Participated in *Flavor Physics and CP Violation* held at University of Pennsylvania, Philadelphia, USA during May 16 – May 18, 2002. Gave an invited talk on "New Physics in $B \to J/\psi K^{*}$".

Participated in *2002 Conference of the Division of Particles and Fields of the American Physical Society* held at Williamsburg, Virginia, USA during May 24 – May 28, 2002. Presented a paper titled "Measurement of γ using $B \to VV$".

Visited Laboratoire Renẽ J.-A. Lẽvesque, Université de Montréal, Montréal, Canada during May 29 – Jun 19, 2002.

Visited Stanford Linear Accelerator Center, Stanford University, USA during Jun 19 – Jun 27, 2002. Delivered a Seminar "Extracting CP violating weak phases using angular analysis".

Visited Institute of Theoretical Science, University of Oregon, Eugene, USA during Jun 27 – Jul 9, 2002. Delivered a Seminar "Extracting CP violating weak phases using angular analysis" .

Visited Laboratoire Renẽ J.-A. Lẽvesque, Université de Montréal, Montréal, Canada during Jul 9 – Jul 12, 2002.

Sinha, Sudeshna

Participated in *Workshop on Dynamics of Networks and Spatially Extended Systems* held at Kolkata during Jan 21 – Jan 23, 2002 as invited Speaker.

Srinivas, K.

Participated in *Mathematics Training Camp* held at Institute of Mathematics and Applications, Bhubaneshwar, Orissa during Oct 18 – Oct 26, 2001. This training camp was organized by Prof. Swadheen Pattanayak, sponsored by NBHM. Gave five lectures in Number theory and two lectures in Real Analysis to the participants.

Visited Department of Mathematics, Andhra University, Visakhapattanam during Feb 16 - Feb 20, 2002. Gave a talk with the title "Some recent results in the Selberg class of functions".

Visited The Institute of Mathematics and Applications during Feb 21 – Mar 16, 2002. Gave a mini course on Number theory.

Participated in *National Conference of Orissa Mathematical Society* held at Orissa Engineering College, Bhubaneshwar, Orissa during Feb 23 - Feb 24, 2002. Gave an invited talk on "The application of Number theory".

Visited Utkal University, Bhubaneshwar during Feb 26 – Feb 27, 2002, gave a talk on "Applications of number theory in cryptography".

Visited REC Rourkela, Orissa during Mar 18 - Mar 22, 2002.

Participated in *NBHM Nurture programme* held at IMSc during Jul 10 – Jul 12, 2002. Gave three talks on Prime Number Theorem and Dirichlet theorem on primes in arithmetic progression.

Srinivasa Rao, K.

Visited University of Vienna, Austria and University of Ghent, Belgium during Aug 13 – Oct 21, 2001. Gave lectures at University of Antwerp and the Flemish Royal Academy, Brussels.

Visited Department of Mathematics, Graduate School of Advanced Technology, University of Kinki, Fukuoka, Japan during Nov 18 – Nov 22, 2001. Held discussions and gave a lecture on "Introduction to Quantum Theory of Angular Momentum".

Visited University of Kinki, Fukuoka, Japan during Nov 18 – Nov 22, 2001. Gave a lecture on "Introduction to Quatum Theory of Angular Momentum".

Participated in *Refresher Course XVII in Mathematics* held at Ramanujan Institute for Advanced Study in Mathematics, University of Madras, Chennai during Nov 22 – Dec 12, 2001. Gave a course of three lecutres on "Hypergeometric functions" on Dec. 11 and 12, 2001.

Visited Kyoto University, Kyoto, Japan during Nov 25 – Nov 29, 2001. Gave an invited talk on "Quantum Theory of Angular Momentum, Hypergeometric Series and Polynomial Zeros" and chaired a session.

Participated in *International Conference on Number Theory* held at University of Kyoto, Kyoto, Japan during Nov 25 – Nov 29, 2001. Gave an invited talk on "Quantum Theory of Angular Momentum, Hypergeometric series and Polynomial Zeros".

Visited Nagoya University, Nagoya, Japan during Dec 1 - Dec 3, 2001. Lectured on "Quantum Theory of Angular Momentum and Orthogonal Polynomials".

Participated in *Indian Science Congress: Symposium on Ramanujan's Mathematics* held at University of Lucknow, Lucknow on Jan 6, 2002. Lectured on "Relevance of Ramanujan's Mathematics today" and was rapporteur of the Symposium in which Professors George E. Andrews, Richard Askey and R. P. Agarwal were the other speakers.

Participated in *State level Conference on Challenges in Research and Teaching of Mathemaitcs* held at Stella Maris College, Chennai during Jan 31 – Feb 1, 2002. Gave an invited talk on "Introduction to Quantum Computing".

Visited CTS, IISc, Bangalore during Feb 4 – Feb 6, 2002. Gave a seminar talk on "Group theory of Hypergeometric transformations" on Feb. 5, 2002.

Participated in Refresher Course for College and University Teachers in mathematics during Mar 7 – Mar 28, 2002. Gave two lectures on "Hypergeometric series" and also the Valedictory Address on 28th March.

Visited National College, Tiruchirapalli on Mar 14, 2002, and gave Professor R. Balakrishnan Endowment Lecture on "Quantum Computing".

Visited Saranath Engineering College, Tiruchirapalli on Mar 14, 2002. Gave a lecture on the "Life and Work of Srinivasa Ramanujan"

Subramanian, C. R.

Participated in *21st Conference on FST&TCS* held at IISc, Bangalore during Dec 12 – Dec 15, 2001.

Sunder, V. S.

Visited Tata Institute of Fundamental Research during Oct 4 – Oct 8, 2001. Lectured on "Planar Algebras" at the Mathematics Colloquium on October 4th and attended a meeting of the Committee for promotion of mathematics among women, constituted by the National Board for Higher Mathematrics, on October 8.

Visited University of Hyderabad during Oct 22 – Oct 23, 2001. Gave a lecture on "Planar Algebras" and attended a meeting of the Board of the School of Mathematics and Computer Science.

Participated in *Workshop on Operator Theory and Operator Algebras* held at Indian Statistical Institute, Bangalore during Dec 24 – Dec 29, 2001. Gave a course of 5 lectures on "Planar Algebras".

Participated in *Workshop on Functional Analysis and Harmonic Analysis* held at Sardar Patel University, Gujarat during Jan 12 - Jan 13, 2002. Gave a lecture on "Instances of automatic continuity in Operator Algebras".

Visited Chennai Mathematics Institute on Feb 6, 2002. Lectured on "Knot invariants : the Jones polynomial" at their 'Mid-Week Colloquium'.

Visited University of Pune during Apr 29 – May 2, 2002. Gave a course of four 90-minute lectures on "Finite-dimensional spectral theory" at a refresher course for college teachers.

Participated in *NURTURE Programme* held at Institute of Mathematical Sciences during Jun 24 – Jul 12, 2002. Gave a course of 5 90-minute lectures on "Measure Theory".

Suresh, S.P.

Participated in *21st Conference on FST&TCS* held at IISc, Bangalore during Dec 13 – Dec 15, 2001.

Participated in *Workshop on Reasoning about Parametrized and Infinite State Systems* held at IMSc, Chennai during Dec 17 – Dec 18, 2001.

Uma, V.

Participated in *Workshop on Topological Methods in Group Theory* held at IMSc, Chennai during Jul 15 – Jul 27, 2002.

Vijayaraghavan, T. C.

Participated in *Workshop on Quantum Computing* held at IISc, Bangalore during Dec 11 – Dec 12, 2001.

Participated in *21st Conference on FST&TSC* held at IISc, Bangalore during Dec 13 – Dec 15, 2001.

5.4 Visitors from Other Institutions

Name	Affiliation	Period of Visit
Sayad Akbar Jafari	Sharif Univ. of Technology, Iran	02.04.01 – 17.08.01
Parampreet Singh	IUCAA, Pune	18.06.01 – 01.09.01
R. K. Bhaduri	McMaster Univ., Canada	02.08.01 – 08.08.01
A. P. Balachandran	Syracuse Univ., USA	06.08.01 – 10.08.01
D. Surya Ramana	HRI, Allahabad	09.08.01 – 20.08.01
Sujata Ghosh	Univ. of Calcutta	11.08.01 – 25.08.01
Pushan Majumdar	TIFR, Mumbai	27.08.01 – 01.09.01
M. G. Nadkarni	-	03.09.01 – 14.12.01
S. Sivaprakasam	Univ. of Wales, UK	13.09.01 – 18.09.01
B. Sriram Sastry	IISc, Bangalore	14.09.01 – 15.09.01
Francesco Fidaleo	Univ. of Rome II	24.09.01 – 28.09.01
S. K. Karthick Kumar	The American College, Madurai	25.09.01 – 03.10.01
N. Dadhich	IUCAA, Pune	10.10.01 – 13.10.01
Albert Libchaber	Rockefeller Univ., New York	22.10.01 – 24.10.01

Shrirang S. Deshingkar	RRI, Bangalore	19.11.01 – 24.11.01
Philippe Pitteloud	IISc, Bangalore	26.11.01 – 04.12.01
Satwik Das	IIT, Kharagpur	01.12.01 – 27.02.02
Uma Mahanta	HRI, Allahabad	07.12.01 – 21.12.01
Ram Kishore	INPE, St. Campos, Brazil	07.12.01 – 07.03.02
Sadhan Kumar Adhikari	Universidade Estadual Paulista, Brazil	12.12.01 – 19.12.01
Arun Ram	Univ. of Wisconsin	13.12.01 – 19.12.01
Suneeta Varadarajan	–	17.12.01 – 17.01.02
A. Jensen	Univ. of Aalbrey, Denmark	19.12.01 – 22.12.01
Rahul Roy	ISI, New Delhi	19.12.01 – 22.12.01
Kappu Viswanathan	QUT, Brisbane, Austria	21.12.01 – 10.01.02
Srinath Cheluvaraja	Lousiana State Univ., USA	26.12.01 – 27.12.01
Beyersdorff Olaf	Humboldt-Univ. Berlin	30.12.01 – 13.01.02
Eknath Ghate	TIFR, Mumbai	02.01.02 – 06.01.02
Devendra Kumar	D.S.M. Degree College, Moradabad, UP	07.01.02 – 08.02.02
Neyaz Ahmad Sheikh	Regional Eng College, Srinagar	09.01.02 – 08.02.02

Muoi Tran	McMaster Univ., Canada	09.01.02 – 20.02.02
Chandan Dasgupta	IISc, Bangalore	11.01.02 – 11.01.02
Aurenche Patrick	Lab Phys. Theorique, LAPTH, France	13.01.02 – 23.01.02
Michel Fontannax	LPTHE, Orsay, France	13.01.02 – 23.01.02
Santhosh Vempala	MIT, USA	14.01.02 – 15.01.02
H. Tich	GST- IBB	15.01-02 – 18.01.02
Rohini M. Godbole	IISc, Bangalore	17.01.02 – 23.01.02
Vanden Berghe Guido	Ghent Univ., Belgium	20.01.02 – 26.01.02
M. G. Deshpande	Univ. of Oregon, USA	21.01.02 – 27.01.02
Elliot Lieb	Princeton Univ., USA	24.01.02 – 27.01.02
H. Nicolai	AEI, Berlin, Germany	31.01.02 – 03.02.02
Ajay	G. B. Pant Univ., Uttaranchal	16.02.02 – 22.02.02
Rohini M. Godbole	IISc, Bangalore	19.02.02 – 20.02.02
M. Demuth	Technical Univ. of Clausthal, Germany	21.02.02 – 27.02.02
Umesh Vasudeo Waghmare	JNCASR, Bangalore	25.02.02 – 01.03.02

Biswajit Karmakar	TIFR, Mumbai	25.02.01 – 28.02.02
K. B. Sinha	ISI, Kolkata	01.03.02 – 02.03.02
K. Varadarajan	Univ. of Calgary, Canada	02.04.02 – 29.04.02
Justin David	UCSB, USA	10.04.02 – 11.04.02
Indranil Biswas	TIFR, Mumbai	22.04.02 – 27.04.02
B. Ananthanarayanan	IISc, Bangalore	25.04.02 – 27.04.02
V. Ravindran	HRI, Allahabad	01.05.02 – 14.05.02
J. Pasupathy	IISc, Bangalore	02.05.02 – 05.05.02
R. Rajesh	Univ. of Oxford, U.K.	05.05.02 – 06.05.02
Shobhana Narasimhan	JNCASR, Bangalore	06.05.02 – 09.05.02
J. Pasupathy	IISc, Bangalore	19.05.02 – 24.05.02
S. Sanju	Pondicherry Univ.	20.05.02 – 05.07.02
Ramesh Krishnamurti	SFU, Canada	29.05.02 – 31.07.02
H. S. Mani	S. N. Bose Institute, Kolkata	03.06.02 – 25.06.02
Lingaraj Sahu	ISI, Kolkata	06.06.02 – 18.07.02
Radhika Vathsan	BITS, Pilani	21.06.02 – 17.07.02

M. Muthukumar	Univ. of Massachussetts, MA	21.06.02 – 01.08.02
Buddhapriya Chakrabarti	IISc, Bangalore	26.06.02 – 07.07.02
Yashodhan Hatwalne	RRI, Bangalore	27.06.02 – 04.07.02
C. V. Dharmadhikari	Univ. of Pune, Pune	29.06.02 – 01.07.02
Ashwin S. Sampangiraj	JNCASR, Jakkur, Bangalore	01.07.02 – 21.07.02
Sunil Chandran L.	IISc, Bangalore	05.07.02 – 12.07.02
M. R. K. Krishna Rao	James Cook Univ.	09.07.02 – 12.07.02
S. Arunagiri	Univ. di Bari, Italy	09.07.02 – 31.07.02
N. Sabu	Univ. of Westminster, London	15.07.02 – 31.07.02
Pradeep Kumar Mohanty	TIFR, Mumbai	28.07.02 – 29.07.02

Chapter 6

Infrastructure

6.1   Computer Facilities

The Computer Facility of IMSc was further enhanced during 2001-2002.

The high bandwidth 2Mbps internet service was made available to IMSc computer network through the ISP, VSNL, Chennai by acquiring necessary H/Ws etc. The firewall security implementation through LFS was made to safeguard the IMSc LAN. An enhanced web-mail service was made available to users. We have registered with NCST for a new domain name as **imsc.res.in** and soon, all our internet services will be fully migrated through this new domain. A dialup PPP-service was made available through a dedicated server system.

The out-dated systems have been replaced with P-III systems and also uniformly upgraded with 17-inch flat-screen monitors. Also, out-dated Numeric-10KVA UPS in the library building was replaced with 20KVA UPS of APC make with one hour backup time. There are new additions for computational needs with two SunUltraBlade-1000 systems under Solaris-8 O/S with varsity pack.

An analytical S/W Maple under Linux O/S has been implemented in the network and the statistical package SPSS under Windows environment has also been added to our S/W library.

In the new building, the power supply for the computers was made through parallel redundant UPSs of capacity 2x40KVA(APC) with a backup of one hour, installed in the building. The LAN back bone connectivity was through fiber cable connected to high speed switches. Sufficient number of LAN switches were installed in the new building for providing services to users in that building. The central computer room in the second floor was furnished for 20 workstations and space provided for critical servers. The central facility area will have high speed LAN switches capable of 1Gbps. New laser printers (Xerox) capable of duplex printing are distributed in the three floors of the new building. The PDFs and students are being provided with new access stations of IBM-NetVista running Linux O/S.

The implementation of the automation package for the Office and Administration, through Profit5RM S/W under MySQL running on Linux O/S is in progress.

6.2   The Library

The Institute Library holds a total collection of 47769 books and bound periodicals as on March 31, 2002. This includes an addition of 2773 volumes during the current year. The library subscribes to about 270 national and international journals in the subject areas of Theoretical Physics, Mathematics and Theoretical Computer Science. The library has a well balanced collection on these subject areas and is a resource for research workers of the entire southern region. The NBHM has recognized this Institute library as the Regional Library for Mathematics.

The library has access to over 120 online journals from major publishers such as Elsevier, American Mathematical Society, American Physical Society, Springer Verlag, World Scientific, Institute of Physics, etc.

Access to online journals is restricted to members of the Institute.

Services

Apart from developing the collection, the library offers reprographic and inter library loan services. Using Libsys software, the library catalogue has been computerized and made available online to the readers both within and outside the Institute Campus. Online request for acquisition of books and status of borrowings have also been enabled using Libsys.

Currently, efforts are on to establish a Consortium of Libraries of DAE institutions to broaden the information resource base.

Acknowledgment

The Library gratefully acknowledges the donation of valuable books and journals received during the current year from the persons and organizations mentioned below:

NBHM	INSA
Researchco Book Centre	Kyoto University
K. Srinivasa Rao, IMSc	Tapobrata Sarkar, IMSc
S. Kesavan, IMSc	Surya Ramana, IMSc
G. Rajasekaran, IMSc	R. Sridhar, IMSc
V. S. Sunder, IMSc	Vijay Kodiyalam, IMSc
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