THE INSTITUTE OF MATHEMATICAL SCIENCES

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ANNUAL REPORT

Apr 2008 - Mar 2009

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Foreword

I am presenting the progress report of 2008-2009 with great pleasure noting that three of our members were given external awards including a Third World Academy fellowship, the J C Bose fellowship and the Prof Thathachari Science Award.

The first ever review of our Institute activities was conducted by an International committee of experts representing the three main areas of activity of our Institute. The Institute members presented their work to the committee over a period of one week during which time they also had extensive interactions with the committee.

This year continues to be academically productive for the members of our Institute. We organised several conferences and workshops this year. These include Entanglement in Quantum Condensed matter systems, RMS-SMF Indo-French conference on Mathematics, Non-Commutative geometry and Quantum Field theory, A workshop on Logic and social interaction, a workshop on von Neumann algebras ergodic theory and geometric group theory were organized in addition to the NBHM summer nurture programme.

IMSc faculty continue to organize conferences off-site. Some of these include the "Beyond the Finite" at Schloss Dagstuhl, the DST-RFBR Indo-Russian workshop on algebra, combinatorics and complexity, perspectives on concurrencty theory a festschrift for Prof Thiyagarajan at CMI, Cipher Retreat II, workshop on cryptography, signalling the arrival of LHC era at ICTP, Indian String Meeting at Pondichery, workshop on concurrency, automata and timed systems, the national seminar on advances in Non-linear systems and Neutrinos in Particle physics and cosmology.

The Subashish Nag Memorial lecture was given this year by Prof Rajesh Gopakumar of the Harish-Chandra Research Institute.

This report was compiled through the efforts of a Annual Report Committee comprising of Drs Krishna Maddaly, V Arvind, Rahul Sinha, Paul Pandian, Mrs Usha Devi and Mr Parthiban. I owe my gratitude to all of them.

July, 2009 **R Balasubramanian**

Contents

Chapter 1

The Institute

1.1 Board

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(**Member**)

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(**Member**)

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

1.3 Faculty

Name	*Userid*	*Tel. Ext.*

Mathematics

Anirban Mukhopadhyay	anirban	251
Balasubramanian, R.	balu	200
Iyer, Jaya N.	jniyer	306
Kesavan, S	kesh	209
Kodiyalam, Vijay	vijay	212
Krishna, M.	krishna	309
Mohari, Anilesh	aniliesh	213
Nagaraj, D. S.	dsn	271
Paranjape, Kapil H.	kapil	214
Partha Sarathi, Chakraborty	parthac	252
Pralay Chatterjee	pralay	305
Prasad, Amritanshu	amri	207
Raghavan, K. N.	knr	264
Sanoli, Gun	sanoli	312
Sankaran, P.	sankaran	211
Srinivas, K.	srini	215
Sunder, V. S.	sunder	210

Physics

Anishetty, R.	ramesha	321
Baskaran, G.	baskaran	303
Basu, Rahul	rahul	311
Date, G.	shyam	304
Digal, Sanatan	digal	259
Govindarajan, Thupil R.	trg	205
Hassan, Syed Raghib	shassan	208

Indumathi, D.	indu	302
Jagannathan, R.	jagan	315
Jayaraman, T.	jayaram	312
Kaul, R.	kaul	317
Menon, Gautam I.	menon	266
Mishra, Ashok K.	mishra	323
Mukhopadhyay, Partha	parthamu	260
Murthy, M. V. N.	murthy	326
Nemani, V.S.	nemani	263
Prashanth Jaikumar, R.	jaikumar	261
Rajesh, Ravindran	rrajesh	255
Rama, S. Kalyana	krama	313
Ronojoy Adhikari	rjoy	253
Ray, Purusattam	ray	319
Sathiapalan, Balachandran	bala	320
Satyavani Vemparala	vani	257
Shankar, R.	shankar	327
Sharatchandra, H. S.	sharat	254
Sibasish Ghosh,	sibasish	216
Siddharthan, Rahul	rsidd	204
Simon, R.	simon	120
Sinha, Nita	nita	267
Sinha, Rahul	sinha	268
Sinha, Sitabhra	sitabhra	301
Sinha, Sudeshna	sudeshna	203
Sujay K.Ashok	sashok	265

Theoretical Computer Science

Arvind, V.	arvind	218
Lodaya, Kamal	kamal	310

Mahajan, Meena B.	meena	307
Raman, Venkatesh	vraman	220
Ramanujam, R.	jam	269
Subramanian, C.R.	crs	324

1.4 Scientific Staff

Subramoniam, G.	gsmoni	221
Ravindra, Reddy	ravi	222

1.5 Technical Staff

Paul Pandian, M.	pandian	383
Arangarajan, R.	arajan	247
Mohan, S.	mohan	300
Venkatesan, G.	gvenkat	384
Usha Devi, P.	usha	385

1.6 Project Scientists

Balakrishnan, Radha	radha	219
Mani, H.S.	hsmani	316
Jayaraj, V.	jayaraj	156
Rajasekaran, G.	graj	206

1.7 Project Staff

Advait Mewada	mewada	170
Akila	akila	167

Gayathri Jayaraman	gjayaraman	170
Dhinesh Kumar, V.	dinesh	226
Hari Priya, T.V.	tvhpriya	170
Md Izhar Ashraf	ashraf	172
Mangala Pandi, P.	mangal	217
Raina, P.M.	raina	226
Somasundaram,	sssunder	167
Srinivasan, N.S.	nss	381
Sridhar, S.	ssridhar	170
Srinivasan, G.	gsvasan	208
Umadevi, S.	umadevi	170
Archana, S.	ssarchana	170
Gaushik Parasuram	gaushikp	172
Sayanthan	sayantan	371

1.8 Post-Doctoral Fellows

Mathematics

Anisa Mohmad Husen, Chorwadwala	anisa	102
Anupam Kumar Singh	anupamk	105
Vivek Mohan, Mallick	vivekm	104
Tejas Kalelkar	tejas	105
Nicholas Paul Gill	nick	101
Prakash,R.	prakash	256
Prem Laxman Das M.	mprem	101
Tamil Selvi, A.	tamilselvi	308
Veerendra Vikram, Awasthi	vvawasthi	103

Physics

Debaprasad Maity	debu	102
Muthukumar B	bmuthu	104

Santhosh,G.	santhosh	322
Shreecharan,T.	shreet	108
Zahera Jabeen	zahera	308
Sujit Kumar Chaudhury	sujit	105
Subhadip Mitra	subhadip	258

Theoretical Computer Science

Madhu Kallingalthodi	kmadhu	256
Tribikram Gupta	tgupta	103

1.9 Ph.D. Students

Name	*Userid*	*Tel. Ext.*

Mathematics

Anoop, T.V.	tvanoop	371
Ajay Singh Thakur	thakur	382
Chattopadhyay Pratyusha	pratyusha	376
Dubey Umesh Vanktesh	dubey	382
George Scaria	george	287
Gupta, Ved Prakash	vpgupta	224
Krishna, K.S.	ksk	223
Krishnan, Rajkumar	rkrishnan	239
Madhushree Basu	madhu	114
Mubeena, T.	mubeena	241
Pal Sarbeswar	spal	376
Pampa Paul	pampa	241
Pooja Singla	pooja	223
Prem Prakash Pandey	premsmg	223
Samuel Preena	preena	376
Sarkar Swagata	swagata	294

Sundar, S.	ssundar	382
Tupurani Srikanth	tsrikanth	242
Anil Kumar, C.P.	anilcp	242
Tapas, Chatterjee	tapasc	171
Panchugopal, Bikram	panchugopal	171
Prateep, Chakraborty	prateepc	171
Arindam, Banerjee	arindamb	240

Physics

Anoop Varghese	ganoop	223
Amit Kumar, Bhattacharjee	amit	348
Banerjee, Kinjal	kinjal	209
Belliappa, A.B.	belliappa	241
Bhowmick, Samrat	samr	373
Chakravarty, Gaurav	gaurav	373
Gopala Krishna, K.	gkrishna	294
Karthik, I.	karthik	111
Krishnakumar Sabapathy	kkumar	223
Kumar, Alok	alok	272
Laddha, Alok	alokl	294
Lukose, Vinu	vinu	344
Misra, Basudha	basudha	294
Mitra, Mithun Kumar	mithun	211
Neeraj Kumar, Kamal	neeraj	237
Pan, Raj Kumar	rajkp	211
Pradeep Kanth, J. Maruthi	maruthi	299
Rajeev Singh	rajeev	223
Saket, Abhinav	abhinav	373
Sandeep K. Goyal	goyal	374
Sandipan Sengupta	sandi	371
Saptarishi, Mondal	saptarshi	344

Sharma, Chandradev	sharma	344
Sircar, Nilanjan	nilanjan	373
Solomon, Ivan J.	solomon	289
Somdeb Ghose	somdeb	223
Soumyajit, Pramanik	soumyajit	241
Sourish Kumar, Maitra	sourish	237
Syed Mohammed Kamil	kamil	223
Tanumoy, Mandal	tanumoy	241
Vallan Bruno Cruz, A.	bruno	223
Sudhir, N. Pathak	sudhirnp	106
Bijay, Kr. Agarwalla	bijay	241
Suman, Gaurab Das	suman	113
Rajarshi, Pal	srajarshi	109
Diganta, Das	diganta	242

Theoretical Computer Science

Aravind N.R.	nraravind	299
Amaldev	amal	373
Cyriac, Aiswarya	aiswarya	172
Das, Bireswar	bireswar	211
Easaw Simon, Sunil	ssimon	224
Geevarghese Philip	philip	371
Kunal, Dutta	kdutta	237
Limaye P. Nutan	nutan	294
Mukhopadhyay, Partha	partham	299
Narayanan, N.	narayan	259
Neeldhara, Mishra	neeldhara	119
Phawade, Ramachandra Babasaheb	ramachandra	299

Prajakta Nimbhorkar	prajakta	240
Praveen, M.	praveen	371
Rao B.V., Raghavendra	bvrr	299
Sankar, Bal Sri	balsri	172
Soumya, Paul	soumya	373
Jayalal Sarma, M. N.	jayalal	112
Sheerazuddin, S.	sheeraz	223
Shripad Joglekar, Pushkar	pushkar	299
Sikdar, Somnath	somnath	272
Sreejith, A.V.	sreejith	237
Sreenivasaiah, Karteek	karteek	172
Srikanth Srinivasan	srikanth	348
Vasudev, Yadu	yadu	171

1.10 Administrative Staff

Name	*Userid*	*Tel. Ext.*
Saraswathi Ramaraj *Registrar*	sarasram	150
VishnuPrasad, S. *Admn. Officer*	svishnu	151
Gayatri, E. *Accounts Officer*	gayatri	152

Amulraj, D.
Ashfack Ahmed
Babu, B.
Balakrishnan, J.
Elumalai, G.
Ganapathi, R.
Geetha, M.
Gopinath, S.
Indra, R.
Janakiraman, J.
Jayanthi, S.
Johnson, P.
Moorthy, E.
Munuswamy, N.
Muthukrishnan, M.
Nityanandam, G.
Padmanabhan, T.
Parijatham, S.M.
Parthiban, V.
Prema, P.
Radhakrishnan, M. G.
Rajasekaran, N.
Rajendran, C.
Ramesh, M.
Ravichandran, N.
Ravindran, A.
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Sankaran, K.P.
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Chapter 2

Research and Teaching

2.1 Mathematics

2.1.1 Research Summary

Algebra

From the combinatorial characterisations of the right, left, and two-sided Kazhdan-Lusztig cells of the symmetric group, 'KRS bases' have been constructed for certain quotients by two-sided ideals of the group ring and the Hecke algebra. Applications to invariant theory of the general linear group and representation theory of the symmetric group have been given. [**S**]

Algebraic Geometry

Some co-homology vanishing results are obtained for the symmetric power of Normal bundle twisted by powers of hyper-plane bundle of a projective variety [**Sn2**]. Study of morphisms from projective plane to Grassmannian variety of two dimensional quotients of four dimensional vector space was carried out.

Finitistic constructions of derived categories

In collaboration with Umesh Dubey, the work of Beilinson and Kapranov, which gives an elementary description of the derived category of coherent sheaves on complex projective homogeneous spaces is being studied. The following types of varieties are being studied with a view to identify their derived categories:

1. Complete intersections of three or more quadrics.
2. Quartic threefold.
3. Cubic fourfold.
4. The elliptic surface obtained by blowing up the plane at the intersection of two cubics.

5. Certain homogeneous spaces.

Work on IMSc Web Pages

The use of `drupal` for IMSc official mathematics web pages is being explored. This will allow members to edit portions of these pages without the intervention of the web master.

Study of GNU/Linux software and technology

The increasing power of computers has meant that computers can easily be used for multiple tasks. One solution to this is multi-tasking; however, different services residing on the same computer can interfere with each other. A better solution that isolates these services from each other is *virtualisation*. The use of chroots, Linux-Vserver, Xen, User-mode-linux, Qemu and KVM was explored. Appropriate schemes were deployed according to the requirement.

Analytic Number Theory

For an odd positive integer $n \geq 5$, assuming the truth of *abc* conjecture, it has been shown that for a positive proportion of pairs (a, b) of integers the trinomials of the form $t^n + at + b \;\; (a, b \in \mathbb{Z})$ are irreducible and their discriminants are square free [**Mu5**].

Let $f(n)$ denote the number of distinct unordered factorisations of the natural number n into factors larger than 1. For example, $f(28) = 4$ as 28 has the factorisations $28,\ 2{\cdot}14,\ 4{\cdot}7,\ 2{\cdot}2{\cdot}7$. In [**Mu4**] some interesting aspects of $f(n)$ has been addressed.

In [**Mu2**] the following problem has been addressed: Given $V > 0$, how many consecutive critical zeros of the Epstein's zeta-function associated to a certain positive definite Integral binary quadratic form are lying in the interval $[0, T]$ which are at least V distance apart?

Continued fraction expansions of a certain type (positive-definite J-fractions) corresponding to Polygamma functions are being studied. These expansions are to be used in obtaining proofs of irrationality of special values of these functions.

Transcendental Number theory

The algebraic nature of special values of L-functions constitutes an interesting, yet little-understood area in number theory. It is believed that the special values of L-functions should be, up to an algebraic factor, equal to a predictable period. However this belief is merely conjectural with very few explicit verifications. In [**G5**] the non-vanishing of a varying class of L-functions as well as their derivatives, mainly at the point s = 1 are investigated. In such cases, the algebraic nature of these L-values are also studied. Also, where the L-function has a pole at s = 1, like for Dedekind zeta functions and certain Artin L-functions, the algebraic nature of the residue at that point is investigated.

In [**G4**], the transcendental values of the logarithm of the gamma function is studied. For instance, it is shown that for any rational number x with $0 < x < 1$, the number $\log \Gamma(x) + \log \Gamma(1 - x)$ is transcendental with at most one possible exception. Assuming Schanuel's conjecture, this possible exception can be ruled out. Further, a variety of results on the gamma function as well as the transcendence of certain series of the form $\sum_{n=1}^{\infty} P(n)/Q(n)$, where $P(x)$ and $Q(x)$ are polynomials with algebraic coefficients are derived.

Modular Forms

Let N, k be natural numbers with k even and let $S_k(N)$ be the space of cusp forms of weight k and level N. Let $p \nmid N$ be a prime. Then by a result of Deligne the eigenvalues of the normalised p-th Hecke operator T_p lie in $[-2, 2]$. Fixing the level N and weight k and varying the prime p, one has the famous Sato-Tate conjecture which predicts the eigenvalues are equidistributed with respect to the measure

$$\frac{1}{\pi}\sqrt{1-\frac{x^2}{4}}\,dx.$$

Now if one fixes the prime p and varies the level N with $p \nmid N$ and weight k such that $N + k \to \infty$, then one has the vertical Sato-Tate conjecture considered by Serre[J. Amer. Math. Soc. 10 (1997)]. In this set up, he proved that the family of eigenvalues of the normalised Hecke operators are equidistributed in $[-2, 2]$ with respect a measure which involves the prime p and different from Sato -Tate measure. In [**G3**], considering the vertical Sato-Tate set up, a weighted equidistribution theorem for the eigenvalues of p-th Hecke operators with respect to the following measure

$$\frac{1}{2\pi}\frac{dx}{\sqrt{1-\frac{x^2}{4}}}$$

is proved. It is noted that this measure does not involve the prime p and much in the spirit of the Sato-Tate measure.

Differential Equations

(Control theory) Studied the existence of solutions to the degenerate operator Riccati equation. This appears naturally in the study of optimal control problem for the linear quadratic regulator with infinite time horizon. The existence of a solution with stabilisation properties has been proved for a class of such equations which cover the finite dimensional case and the parabolic case ([**Ke**])

(Calculus of Variations) The study of the optimization of the principal eigenvalue of the p-Laplacian in some multiply connected domains is in progress.

Differential Geometry

In this expository article, an elementary geometric proof of the Isoperimetric Theorem and the Isoperimetric Inequality on the simply connected surface having constant section curvature κ ($\kappa = 0, 1, -1$) is given. This proof applies to all three simply connected space forms.

Ergodic Theory

In [**Pr1**] ultrametric analogues of the results of Kleinbock and Margulis for shrinking target properties of semisimple group actions on symmetric spaces are announced. The main applications are S-arithmetic Diophantine approximation results and logarithm laws for buildings, generalizing the work of Hersonsky-Paulin on trees.

Group Theory

Locally compact abelian groups with symplectic self-duality arise in the context of Heisenberg groups. Conditions under which such groups are always isomorphic to the product of a locally compact abelian group and its Pontryagin dual were investigated. Examples were constructed which are not of the above type, thereby resolving an open problem.

Mathematical Physics

Regularity [**M1**] and Lifshitz tails property [**M2**] are shown for the interband Light Absorption Coefficient in various random models both on the d-dimensional lattice and the d-dimonsional space. We identified a correlation measure as the correct object to consider and once this is done the regularity properties follow from the properties of the density of states for such models.

Operator Algebras

About a year ago, Guionnet, Jones and Shlyakhtenko obtained a new proof, using Voiculescu's 'Free probability', of a theorem of Popa which asserts that every subfactor planar algebra does indeed arise from a finite index extremal subfactor. An alternate proof which is purely planar algebraic in nature, and does not use any free probability, is obtained in the paper [**Ko4**].

Subsequently, the subfactor obtained by applying the 'GJS' construction to the subfactor planar algebra arising from a finite dimensional Kac algebra was analysed and identified as an 'interpolated free group factor' in the paper [**Ko5**].

Most recently, an attempt is made to establish that the subfactor obtained by applying this construction to the planar algebra of any finite depth subfactor is always an interpolated free group subfactor. In contrast with the result of Popa and Shlyakhtenko that any subfactor planar algebra is the standard invariant of an extremal subfactor of the free group factor $LF(\infty)$, this will establish that any subfactor planar algebra of finite depth is the standard invariant of an extremal subfactor of the free group factor $LF(r)$ for any $r \in (1, \infty)$.

Non-commutative Geometry

A study of the geometry of determinant line bundles associated with families of spectral triples parametrized by the moduli space of gauge equivalent classes of Hermitian connections on a Hermitian finite projective module is initiated. An analog of the Quillen metric is constructed. For that purpose the notion of dimension spectrum introduced by Alain Connes and Henri Moscovici in their work on the local index formula was utilised. More precisely as a key technical tool it was shown that the dimension spectrum changes by integer shifts under perturbation by a one form. This allows one to perform the necessary zeta regularization to construct the Quillen metric.

Representation Theory

In [**Pr2**], a new notion of cuspidality for representations of GL_n over a finite quotient O_k of the ring of integers O of a non-Archimedean local field F using geometric and infinitesimal induction functors, which involve automorphism groups G_λ of torsion O-modules is defined. When n is a prime, it is shown that this notion of cuspidality is equivalent to strong cuspidality, which arises in the construction of supercuspidal representations of $GL_n(F)$. Strongly cuspidal representations share many features of cuspidal representations of finite general linear groups. In the function field case, it is shown that the construction of the representations theory of $GL_n(O_k)$ for $k \geq 2$ for all n is equivalent to the construction of the representations of all the groups G_λ. A functional equation for zeta functions for representations of $GL_n(O_k)$ is established for representations which are not contained in an infinitesimally induced representation. All cuspidal representations for $GL_4(O_2)$ are constructed. Not all these representations are strongly cuspidal.

The relationship between homogeneous operators and inductive algebras for the universal cover of the 2×2 real unimodular group was elucidated. A result of Bagchi and Misra on the classification of homogeneous shift operators was recovered using inductive algebras [**Pr7**].

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**]
Tamilselvi A.
Robinson - schensted correspondence for the g - vertex colored partition algebra.
2009.
(To be published).

[**B1**]
R. Balasubramanian, L. Ding*, S. Kanemitsu*, and Y. Tanigawa*.
On the partialfraction expansion of cotangentlike functions.
In series 6 Ramanujam Math Society lecture Notes, editor, *Number theory and Dicrete Geometry*, page 19, Aug 2008.

[**B2**]
R. Balasubramanian and Prem P. Pandey.
Catalan's conjecture over number fields.
2008.
(Preprint: arXiv 0901.4305).

[**C1**]
Partha Sarathi Chakraborty and Arupkumar Pal*.
Characterization of $su_q(\ell+1)$-equivariant spectral triples for the odd dimensional quantum spheres.
Journal fr die Reine und Angewandte Mathematik. [Crelle's Journal], **623**, 25, 2008.

[**C2**]
Partha Sarathi Chakraborty and Mathai Varghese*.
The geometry of determinant line bundles in noncommutative geometry.
Journal of Noncommutative Geometry, 2008.
arXiv:0804.3232 (To be published).

[**Ch1**]
Pralay Chatterjee.
On the power maps, orders and exponentiality of p-adic algebraic groups.
Journal fur die reine und angewandte Mathematik (Crelle's Journal), 2008.
0 (To be published).

[**Ch2**]
Pralay Chatterjee.
Automorphism invariant cartan subgroups and power maps of disconnected groups.
2008.
0 (Submitted).

[**Ch3**]
Pralay Chatterjee.
Surjectivity of the power maps of real algebraic groups.
2008.
(Preprint: 0).

[**Cho**]
Anisa M. Chorwadwala and A. Aithal*.
Convex polygons and the isoperimetric problem in simply connected space forms m_κ^2.
The Mathematical Intelligencer, 2008.
(To be published).

[**G1**]
S. D. Adhikari*, S. Gun, and P. Rath*.
Remarks on some zero-sum theorems.
Proc. Indian Acad. Sci. Math. Sci., 2008.
(To be published).

[**G2**]
S. Gun, M. Murty*, and P. Rath*.
Linear independence of digamma function and a variant of a conjecture of rohrlich.
2008.
(Submitted).

[**G3**]
S. Gun, M. R. Murty*, and P. Rath*.
Summation methods and distribution of eigenvalues of hecke operators.
Funct. Approx. Comment. Math., **39(2)**, 191, 2008.

[**G4**]
S. Gun, M. R. Murty*, and P. Rath*.
Transcendence of the log gamma function and some discrete periods.
J. Number Theory, 2009.
(To be published).

[**G5**]
S. Gun, M. R. Murty*, and P. Rath*.
Transcendental nature of special values of l-functions.
Canadian Journal of Mathematics, 2009.
(To be published).

[**G6**]
S. Gun, M. R. Murty*, and P. Rath*.
On a conjecture of chowla and milnor.
2009.
(Submitted).

[**G7**]
S. Gun and B. Ramakrishnan*.
On the representation of integers as sums of an odd number of squares.
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2.2 Physics

2.2.1 Research Summary

Astro-particle Physics

The r-mode oscillations and their damping timescales in various phases of normal and color superconducting quark matter were characterized. Rapidly rotating hybrid stars with gapped or ungapped quark matter cores were found to be stable against the r-mode instability at high temperature due to large bulk and shear viscosities, suggesting that millisecond pulsars can support deconfined quark matter in their cores and that targeted searches will discover a significant population of rapidly spinning neutron stars in low-mass X-ray binaries. This work is reported in [**Ja3**]

The case for Quark-Novae as possible sources for the reionization of the universe was examined. It was found that dual-shock Quark-Nova events can produce enough photons to reionize Hydrogen in the entire Inter-Galactic medium (IGM) by redshift of 6. Such events could explain the large optical depth of 0.17 as measured by WMAP, if the clumping factor of the material being ionized is small. A way in which a normal initial mass function (IMF) for the oldest stars can be reconciled with a large optical depth as well as the mean metallicity of the early IGM post reionization, was suggested. The main cosmological signatures and means of detection for Quark-Novae, and their interpretation as high redshift of 7-8 gamma-ray bursts was discussed. This work is reported in [**Ja2**]

Biological Physics

The electrostatic contribution to the elastic moduli of a cell or artificial membrane placed in an electrolyte and driven by a DC electric field has been studied. These results clarify and extend results obtained earlier, by providing a physical explanation for a destabilizing term proportional to k^3 in the fluctuation spectrum, which is related to a nonlinear (E2) electro-kinetic effect called induced-charge electro-osmosis (ICEO). Recent studies of ICEO have focused on electrodes and polarizable particles, where an applied bulk field is perturbed by capacitive charging of the double layer and drives flow along the field axis toward surface protrusions; in contrast, "reverse" ICEO flows around driven membranes are predicted, due to curvature-induced tangential fields within a non-equilibrium double layer, which hydrodynamically enhance protrusions. The effect of incorporating the dynamics of a spatially dependent concentration field for the ion channels has also been considered. This work is currently being extended in several new directions, including the calculation of effects due to asymmetry in the bilayers.[**Me1**]

Calculations of the end-to-end vector distribution in models for short DNA strands with bubbles arising from the transient melting of ds DNA have been extended to include length fluctuations. These calculations provide an elegant theoretical description (and precise fits to the data) of the recent experiments of Mathew-Fenn et al. (Science, 2008), which see cooperativity in DNA stretching fluctuations in molecular ruler measurements of short DNA strands.

In certain situations (e.g., in people suffering from an ischemic heart), the normal periodic activity of the heart can be hampered by arrhythmias, i.e., disturbances in the natural rhythmic activity of the heart. A fatal arrhythmia occurring in the ventricles is Ventricular Fibrillation (VT), during which there is no coherent activation of the muscle cells so that the heart stops beating. Death follows within minutes, unless large electrical shocks are applied to "reset" the heart to its normal rhythm. The problem with such treatment is that not only is it painful, but it also causes damage to the heart tissue, creating scars which can act as substrate for future arrhythmias. The underlying cause for VF is the onset of spatiotemporal chaos, through the spontaneous formation and subsequent breakup of electrical spiral waves. For this reason, physicists have tried to devise control methods (based on the principles of nonlinear dynamics) that use electrical pulses of extremely low magnitude. A novel method of controlling such spatially extended chaos by stimulation along an array of points has recently been proposed [**Sin6**]. By generating a simulated wave of control that is constantly replenished by external stimulation, even when it is temporarily annihilated by collision with chaotic fragments, the method is successful in removing chaotic behavior with only a single application of very low-amplitude pulse. This method seems to be robust against the presence of different inhomogeneities in the medium, which is important in view of the sensitive dependence of spiral wave dynamics on the location of such inhomogeneities, as pointed out in a parallel study [**Sin3**].

The biological cell responds to different stimuli in its environment by using a complicated machinery of reaction cascades involving several different types of molecules. In order to make the intra-cellular signaling system robust with respect to noise, nature has used a network architecture rather than a set of parallel input-output information pathways. This seems to be a design that has been used in several other biological systems, clearly underlining its efficiency [**Sin4**]. The utility of networks can be analyzed in subsets of the intra-cellular signaling system, such as the module of two parallel Map-kinase pathways that control the response to Leishmania infection. A low parasite load is seen to turn on an anti-parasitic response, while a higher parasite load is often seen to result in a pro-parasitic response, although both are mediated by the same receptor, CD40. This switch-like behavior downstream of the receptor has now been understood as an outcome of a series of reciprocal inhibitory interactions between two parallel pathways [**Sin2**].

The M2 protein of the influenza A virus is activated by low endosomal pH and performs the essential function of proton transfer into the viral interior. The resulting decrease in pH within the virion is essential for the uncoating and further replication of the viral genetic material. The x-ray crystal structures of the transmembrane region of the M2 homo-tetrameric bundle both revealed pores with narrow constrictions at one end, leaving a question as to how protons enter the channel. His-37, which is essential for protongating and selective conduction of protons, lies in the pore of the crystallographic and NMR structures. In this work, we explored different protonation states of the His-37 residues of the M2 bundle in a bilayer using molecular dynamics (MD) simulations. When the His-37 residues are neutral, the protein prefers an Openout-Closedin conformation in which the channel is open to the environment on the outside of the virus but closed to the interior environment of the virus. Diffusion of protons into the channel from the outside of the virus and protonation of His-37 residues in the tetramer stabilizes an oppositely gated Closedout-Openin conformation. Thus, protons might be conducted through a transporter-like mechanism, in which the protein alternates between Openout- Closedin and Closedout-Openin conformations, and His-37 is protonated/ deprotonated during each turnover. The transporter-like mechanism is consistent with the known properties of the M2 bundle, including its relatively low rate of proton flux and its strong rectifying behavior [**V1**]

Despite the widespread clinical use of anesthetics since the 19th century, a clear understanding of the mechanism of anesthetic action has yet to emerge. With the increased availability of high-resolution crystal structures of ion channels and other integral membrane proteins and the availability of powerful computers, it is becoming possible to investigate in atomic detail the structure-function relationship of anesthetic-protein interactions. A review of recent experiments and related computer simulation studies involving interactions of inhalational anesthetics and proteins, with a particular focus on membrane proteins is about to be submitted.[**V3**]

Infectious diseases and antibiotic resistance are now considered the most imperative global healthcare problem. In the search for new treatments, host defense, or antimicrobial, peptides have attracted considerable attention due to their various unique properties; however, attempts to develop in vivo therapies have been severely limited. Efforts to develop synthetic mimics of antimicrobial peptides (SMAMPs) have increased significantly in the last decade, and the work focused primarily on the structural evolution of SMAMPs and their membrane activity. In discussions regarding the membrane interaction of SMAMPs, close attention has been paid to the lipid composition of the bilayer. Despite many years of study, the exact conformational aspects responsible for the high selectivity of these AMPs and SMAMPs toward bacterial cells over mammalian cells are still not fully understood. The ability to design SMAMPs that are potently antimicrobial, yet nontoxic to mammalian cells has been demonstrated with a variety of molecular scaffolds. Initial animal studies show very good tissue distribution along with more than a 4-log reduction in bacterial counts. The results on SMAMPs are not only extremely promising for novel antibiotics, but also provide an optimistic picture for the greater challenge of general proteomimetics.[**V2**]

Classical and Quantum Gravity, Black Holes, Cosmology

Loop Quantum Gravity (LQG) contains the so-called Barbero-Immirzi parameter, γ, which is absent in the classical equations of motion, labels inequivalent quantum theories and shows up in the black hole (isolated horizon) entropy. Its similarity with the $\theta-$ parameter of non-abelian gauge theories has been suggested many times but never proven. In [**D1**], it was shown that adding a topological term in the action, the *Nieh-Yan* topological density, leads to a Hamiltonian formulation which coincides with the usual SU(2) gauge theory formulation in the so-called time-gauge, with the inverse of the coefficient of the Nieh-Yan term appearing as the Barbero-Immirzi parameter. This feature holds for *all* matter couplings to gravity in the tetrad formulation.

Some of the leading order quantum corrections in the isotropic loop quantum cosmology (LQC) have been available and can be summarised in the form of an effective action. Quite generally, there is also the general form of a generally covariant effective action for gravity. By specialising this effective action to the isotropic space-times, it is possible to compare it with the LQC effective action(s). This has been explored for LQC. The comparison of effective actions offers a way to compare reduced models with the full theory [**D2**].

Classical and Quantum Optics

In [**G1**], the time evolution of two-qubit quantum states under a common Markovian heat bath has been worked out. It has been shown that there is a class of two-qubit states each of which shows the feature of sudden death of entanglement, while there is another class of two-qubit states, whose entanglement do not change under the above-mentioned evolution. The change in the entanglement has been demonstrated to be quantitatively connected with the feature of energy exchange between the system and the heat bath.

Condensed Matter Physics

The origins of low-frequency, large amplitude noise with a nontrivial spectrum has been addressed in simulations of the depinning transition of polymorphic solids. Earlier, the existence of a "dynamical coexistence" regime in this system had been proposed. Results obtained suggest that the noise spectrum can be understood as arising out of interfacial fluctuations in the coexistence regime. These results have interesting implications for experimental observations of large flux-flow noise near the peak effect in type-II superconductors.

The ground state properties of a system of three particles on a four site closed isotropic chain in the limit of U infinity have been obtained employing (i) the orthofermion algebra which is consistent with the exact 1 - D nested Bethe ansatz solution in the $U \to \infty$ limit, and (ii) Gutzwiller projection operator formalism. It has been demonstrated that these two well known approaches for the U infinity Hubbard Hamiltonian lead to different results, and the Gutzwiller projection operator formalism does not reproduce the 2^N-fold degeneracy obtained through the exact Bethe ansatz and orthofermion approach. The reason for this discrepancy is that the wavefunctions employed to enforce the 'no double-occupancy' at any site are different in two approaches. In the former case, it is implemented through spinless fermions and in the Gutzwiller case, a projection operator is employed to remove the double occupancy at a site. In spite of this important distinction in these two approaches, often a Hamiltonian employing Gutzwiller projected creation and annihilation operators have been erroneously employed in the context of nested Bethe ansatz approach. The analysis brings out the limitation of the Gutzwiller projection operator technique which is one of the widely used methods of theoretical physics describing strongly interacting electron systems. This limitation has important consequences on thermodynamic transport properties of the system. The work highlights the equivalence between the nested Bethe ansatz formalism and orthofermions for the $U \to \infty$ limit of the Hubbard Hamiltonian. In both these approches, the wavefunctions factorize into a spinless spatial part times a spin component and do not obey the antisymmetry involving the composite spatial and spin indices. The results establish the importance of orthofermi statistics for the systems for which $U \to \infty$ limit is applicable. [**Mi2**, **Mi3**].

A second quantized representation for orthofermion operators is developed. Starting with the state vector, antisymmetric only in spatial indices, the commutation relations between the orthofermion creation and annihilation operators have been re-derived. It has been further shown that inspite of different sets of commutation relations for orthofermions and fermions, the second quantized representations of one and two-body operators have identical forms for both orthofermions and fermions. This result is useful for developing many body theories of strongly correlated electron systems with no double occupancy at any lattice site. Next, for the application of orthofermion statistics to the physical systems in the presence of a magnetic field, a representation of local spin number, raising and lowering operators in terms of orthofermion creation and annihilation operators are provided. It has also been shown that spin degrees of freedom form a special class of Greenberg infinite statistics [**Mi1**]

CP-Violation, Neutrinos, B-Physics and New Models

$B \to K^*\rho$ modes that are analogues of the much studied $B \to K\pi$ modes with B decaying to two vector mesons instead of pseudoscalar mesons, using topological amplitudes in the quark diagram approach. How $B \to K^*\rho$ modes can be used to obtain many more observables than those for $B \to K\pi$ modes, even though the quark level subprocesses of both modes are exactly the same. All the theoretical parameters (except for the weak phase γ), such as the magnitudes of the topological amplitudes and their strong phases, can be determined in terms of the observables without any model-dependent assumption. It is demonstrated how $B \to K^*\rho$ can also be used to verify if there exist any relations between theoretical parameters, such as the hierarchy relations between the topological amplitudes and possible relations between the strong phases. Conversely, if there exist reliable theoretical estimates of amplitudes and strong phases, New physics could be probed. It is shown that certain assumptions on the sizes and strong phases of amplitudes may allow a clean signal of New Physics. Also a numerical study to examine which of the observables are more sensitive to New Physics was presented [**Sha**].

A new solution to the problem of dark energy is proposed, connecting dark energy to neutrino condensate. The amount of dark energy then gets directly related to neutrino mass. Further the coincidence of the dark energy density to the present matter density in the universe also gets a natural explanation. This idea is demonstrated in a specific model of the neutrino masses.

Foundations of Quantum Mechanics

In [**G4**], generic forms of the entangled states of spin-1 and spin-3/2 bipartite systems, along with the set of appropriate spin observables that together exhibit maximum nonlocality under the Hardy's nonlocality test have been given; the maximum nonlocality has been shown to be 0.09017 in each case. It has been conjectured that these results hold good for any arbitrary spin bipartite system. It has also been shown that no maximally entangled state of any spin-j bipartite system responds to the Hardy's nonlocality test

Gisin's theorem assures that for any pure bipartite entangled state, there is violation of Bell-CHSH inequality revealing its contradiction with local realistic model. Whether, similar result holds for three-qubit pure entangled states, remained unresolved. In [**C1**], it has been shown analytically that all three-qubit pure entangled states violate a Bell-type inequality, derived on the basis of local realism, by exploiting the Hardy's non-locality argument

Mathematical Physics

One of the biggest challenges of Density Functional Theory (DFT) is to directly calculate the particle density, a key ingredient, in a given potential or mean-field, without directly solving the Schroedinger equation for the wave-functions. To this end, the relation between particle and kinetic energy densities are investigated for a system of Fermions confined in a local mean-field potential. Earlier exact relations, local virial theorems, were derived for spherical harmonic oscillator in arbitrary dimensions leading to an exact differential equation for particle density. These theorems are now generalised to arbitrary potentials and their validity is tested with various examples. The relevance of these results in the context of DFT is also discussed [**Mur2**].

Non-perturbative QCD, Lattice Gauge Theory, QGP

A gauge transformation provided by the three eigenfunctions of ${}^a(x) \cdot {}^b(x)$ (where ${}^a(x)$, with a=1,2,3, are the non-Abelian magnetic fields) exposes the topological configurations of the Yang-Mills fields. In particular, it gives Dirac monopoles interacting with 'photons' and massless charged vector bosons. A magnetic dipole field at each monopole corresponds to infinitesimal translation of the monopole, and provides the functional measure a la collective coordinates. The grand canonical partition function of the monopole plasma is exactly equivalent to a local field theory with certain scalar fields interacting with the Yang-Mills fields. This integrates topological degrees of freedom with perturbation theory.

Nonlinear Dynamics, Solitons and Chaos

Complex networks occur all around us, especially in the biological context, ranging from the protein contact network at the level of molecules to food webs at the level of ecological communities. Over the past few years, research has focussed on the issue of how network structure affects the dynamics that such a system is capable of, and in turn, how does any constraint on dynamics affect the kind of structure that the network will have. The first question has recently been addressed in a study looking at the role that modular structure plays in the functioning of networks [**P3**]. The existence of modules (i.e., subgroups of nodes which have a higher connection density than the overall network) has been observed in a large class of complex networks in nature. Independently, many of these networks have also been reported to exhibit the clustered small-world property of having low average path length, while at the same time having local clustering of nodes. The recent study has shown that these two properties are in fact related, with a modular network being almost indistinguishable from a small-world network with respect to any kind of structural measure. However, the two are found to have quite different dynamical properties, with the former exhibiting a characteristic time-scale separation between intra- and inter-modular activity. This is important for a large class of systems, including the nervous system, where fast local synchronization of activity is essential for information processing but global synchronization is undesirable and is considered to be clinically pathological (e.g., in epilepsy). In a follow-up study of Ising spins placed on modular networks, it has been shown that the network structure can result in a novel kind of phase corresponding to "modular" order [**P1**]. This involved spins in the same module being arranged in parallel, while spins in different modules may be directed oppositely. The interesting point is that two modules may get frozen in opposite alignments, despite the interaction between every pair of connected spins favoring parallel alignment. This study also has ramifications to the study of how polarization can occur in a society due to interaction networks, despite every individual trying to align his/her opinion to that of their neighbors. The second question, of how dynamics can lead to certain types of network structures, has been addressed by showing that the necessity of systems to be stable against dynamical perturbations can often force networks in nature to have hierarchical organization [**P2**].

Perturbative QCD

In the framework of perturbative QCD at next to leading order, two related observables which are usually considered to provide tests of the BFKL dynamics : jet-jet correlations at Tevatron energies and forward particle-jet correlations at HERA are studied [**Bas**]. In the first case the rapidity gap dependence of the azimuthal correlations is studied and slightly too strong correlations at large gap are found. In the second case the cross section as well as the azimuthal correlations over a rapidity gap range of 5 units are discussed. It is found that the requirement of a forward particle imposes strong kinematical constraints which distort the distributions, notably at small rapidity gaps. It is also shown that the decorrelation is stronger in electroproduction than in hadron-hadron collisions.

QFT, Topological QFT, Conformal Field Thoery

The dynamics of fermionic unparticles is developed from first principles. It is shown that any unparticle, whether fermionic or bosonic, can be recast in terms of a canonically quantized field, but with non-local interaction terms. We further develop a possible gauge theory for fermionic unparticles. Computing the consequent contribution of un-fermions to the β function of the theory, it is shown that this can be viewed as the sum of two contributions, one fermion-like and the other scalar-like. However, if full conformal invariance is imposed, the latter vanishes identically. We discuss the consequences thereof as well as some general phenomenological issues.

Much work has been done recently in noncommutative QFT and many calculations have been done within the framework of noncommutative standard model. All these suffer from the violation of isotropy of space. An elegant way has been found to correct for this. Work is in progress, incorporating this method in specific calculations.

In much of the phenomenological calculations in the recent literature on noncommutative Standard Model, a consistent truncation in the noncommutativity parameter theta has not been done. A consistent calculation requires a treatment of polarized crosssections and work is in progress.

Quantum Computations

In [**G2**], Hardy's non-locality theorem for multiple two-level systems has been explored in the context of generalized nonlocal theory. Nonlocal but non-signaling probabilities have been found, providing Hardy's nonlocal argument, which are higher than those in Quantum Mechanics. Maximum probability of success of Hardy's argument has been obtained for three two-level systems in quantum as well as in a more generalized theory. Interestingly, the maximum in the nonlocal generalized theory for both the cases have been turned out to be same.

In [**G3**], two-qubit local unitary operators $W_1 \otimes W_2$, which would rotate all equally entangled two-qubit pure states by the same but arbitrary amount, have been looked for. It has been shown that all two-qubit maximally entangled states can be rotated through the same but arbitrary amount by local unitary operators. But there is no local unitary operator which can rotate all equally entangled non-maximally entangled states by the same amount, unless it is unity. The optimal sets of equally entangled non-maximally entangled states which can be rotated by the same but arbitrary amount via local unitary operators $W_1 \otimes W_2$ have been found, where at most one these two operators can be identity. In particular, when $W_1 = W_2 = (i/\sqrt{2})(\sigma_x + \sigma_y)$, the local quantum NOT operation can be obtained. Interestingly, when one-sided local depolarizing map is applied, all equally entangled two-qubit pure states can be rotated through the same amount. Our result has been extended for the case of three-qubit maximally entangled state.

Statistical Mechanics

An investigation of the Landau-Ginzburg-De Gennes equations of nematodynamics and their consequences for phase ordering, the structure of nematic droplets in an isotropic medium and the nematic isotropic interface has been continued. Several new results have been obtained for the interface problem, in particular an improved parametrization of biaxiality at the interface. In addition, considerable progress has been made in simulations of the phase-ordering problem in three dimensions, including both the uniaxial and biaxial cases.

A study of a coupled map lattice model for the dynamics of sheared nematics has been shown to yield a large number of interesting phases, including phases characterized by spatio-temporally intermittent and chaotic behavior, in addition to ordered phases. These studies suggest the utility of coupled map lattice methods in the study of driven soft matter systems such as sheared nematics, since here the local map is known exactly and the spatio-temporal consequences of an imposed shear flow in the experiments can presumably be captured through a simple spatial coupling term in the coupled map lattice.

The proposal that the irreversible-reversible transition seen in experiments on sheared colloidal suspensions is of conserved directed percolation type has been taken further, through simulations which incorporate the effects of anisotropy. It has been shown that anisotropies do not affect the conserved directed percolation exponents predicted for the experiments. Ongoing work studies the coexistence of reversible and irreversible regions which are spatially separated, in a simple model for non-Brownian colloidal particles in a pipe flow. The relevance of similar models to the glass transition is also being studied.

In recent times there has been a surge of interest in applying statistical mechanics to understand socio-economic phenomena. The aim is to seek out patterns in the aggregate behavior of interacting agents, which can be individuals or groups or companies or nations. One such pattern is of social inequality, i.e., the distribution of resources across all societies. A well-known scaling relation in economics known as Pareto Law has asserted that the distribution of income (as well as wealth) across different societies has a power-law tail with a characteristic exponent α;according to the stricter version of this law, $\alpha = 1.5$ for all societies. This has recently come under attack, as a large number of empirical studies have observed various values of α for different national economies. Also, some groups have tried to present models that seek to explain how this distribution comes about through simple asset-exchange type mechanisms [**Sin5**].

A prominent feature of modern economic life is the existence of financial markets. The availability of large quantities of electronic data recording transactions in such markets has meant that physicists interested in looking for universalities in economics have found such data irresistible. Based on the study of price fluctuations, it had been suggested that the corresponding distribution has a power law with exponent -3. However, the universality of this "inverse cubic law" has recently come under attack, with certain groups claiming that it is violated in developing economies. An exhaustive analysis of price fluctuations in the Indian market has demonstrated that it follows the inverse cubic law, a result that is independent of the exact market that is being analyzed (i.e., BSE or NSE) or the actual period under study. Also, the cross-correlation behavior of the prices of different stocks is found to be much less affected by intra-sector influences than in the developed markets of the west. This implies that unlike the price fluctuation distribution, the network of interactions between stocks as inferred from the cross-correlation may be a better indication of the maturity of a market[**Sin5**].

Flowing granular media, characterized by inelastic collisions, exhibit varied physical phenomena. A simple model that isolates the effects of dissipative collisions is the freely cooling gas in which particles at a high temperature come to rest through inelastic collisions. A freely cooling granular gas with velocity dependent restitution coefficient is studied using event driven molecular dynamics simulations in one dimension. The restitution coefficient becomes near elastic when the relative velocity of the colliding particles is less than a velocity scale δ. It is shown that in the inhomogeneous cooling regime, for times smaller than a crossover time t_1 where $t_1 \sim \delta^{-1}$, the behaviour of the granular gas is described by the Burgers equation. When $\delta \to 0$, then $t_1 \to \infty$ and hence, the results support an earlier claim that the freely cooling inelastic gas is described by the inviscid Burgers equation. For a real granular gas with finite δ, the existence of the time scale t_1 shows that, for large times, the granular gas is not described by the inviscid Burgers equation [**Ra5**].

Cluster–cluster aggregation occurs when a collection of particles undergoing some transport mechanism, such as diffusion, have a finite probability of sticking irreversibly when any two particles get within a certain radius of each other. Of primary interest is the distribution of particle sizes. The kinetics of cluster–cluster aggregation is reviewed. Topics covered include Smoluchowski equation, scaling theory, gelation transition, and the effects of diffusion [**Ra3**].

In a nonequilibrium system, a constant flux relation expresses the fact that a constant flux of a conserved quantity exactly determines the scaling of the particular correlation function linked to the flux of that conserved quantity. This is true regardless of whether mean–field theory is applicable or not. For cluster–cluster aggregation, the consequences of mass conservation for the steady state of aggregation models with a monomer source in the diffusion-limited regime is derived. It is shown that the constant flux relation is independent of both the dimension and of the details of the spatial transport mechanism, a property which is atypical in the diffusion-limited regime [**Ra1**].

An analogy is drawn between cluster–cluster aggregation and turbulence. The breakdown of Kolmogorov scaling in cluster–cluster aggregation is reviewed [**Ra2**].

Multiple avalanches, initiated by simultaneously toppling neighbouring sites, are studied in three different directed sandpile models. It is argued that, while the single avalanche exponents are different for the three models, a suitably defined two-avalanche distribution has identical exponents. The origin of this universality is traced to particle conservation [**Ra4**].

String Theory

A gauge invariant action for the open bosonic string has been proposed in an earlier paper. We work out the consequences of this proposal for the lowest mode, viz. the tachyon. The action can be calculated for generic momenta, perturbatively, order by order in the tachyon field. For on shell tachyons we explicitly calculate the cubic action and show that it reproduces the correct equations of motion and coincides wih the β function to the required order. The calculation is done in terms of bare fields with a finite cutoff, which is the original prescription. We also show that it is possible in some momentum regions to renormalize the theory and eliminate the cutoff dependence so that the continuum limit can be taken. After renormalization, the parameter $\frac{R}{a}$ is replaced by $\frac{R}{L}$ where R is an IR cutoff, a is the UV cutoff and L is some renormalization scale. There is also some arbitrariness in the overall normalization due to the choice of regularization scheme - this does not affect on-shell quantities. We also rederive within this scheme, the action in the region of zero momentum, which gives the exact (tree level) tachyon potential. The tachyon potential is consistent with Sen's conjecture that the height of the potential is the same as the tension of the brane. [**S1**]

The partition function of BFSS matrix model is studied for two different classical backgrounds upto 1-loop level. One of the backgrounds correspond to a membrane wrapped around a compact direction and another to a localized cluster of $D0$-branes. It is shown there exist phase transitions between these two configurations - but only in presence of an IR cut-off. The low temperature phase corresponds to a string (wrapped membrane) phase and so we call this the Hagedorn phase transition. While the presence of an IR cut-off seemingly is only required for perturbative analysis to be valid, the physical necessity of such a cut-off can be seen in the dual supergravity side. It has been argued from entropy considerations that a finite size horizon must develop even in an extremal configuration of D0-branes, from higher derivative $O(g_s)$ corrections to supergravity. It can then be shown that the Hagedorn like transition exists in supergravity also. Interestingly the perturbative analysis also shows a second phase transition back to a string phase. This is also reminiscent of the Gregory-Laflamme instability. [**S2**]

In string theory it is usually understood that the world-sheet conformal invariance is the condition for an NS-NS (NS stands for Neveu-Schwarz) background to be on-shell. Although such a condition is not well formulated for R-R (Ramond-Ramond) backgrounds, it is interesting to notice that conformal invariance is expected to show up in Green-Schwarz formalism in semi-light-cone gauge. Recently Kazama and Yokoi (KY) attempted, in arXiv:0801.1561 [hep-th], to prove conformal invariance for such a theory in case of type IIB R-R plane-wave background. Such a task is not straightforward as the theory is interacting. However, KY adopted a phase-space operator method in order to establish Virasoro algebra. This can, in principle, be done once the equal time commutators of all the phase-space modes are known. The subtlety lies in defining the energy-momentum (EM) tensor in terms of such modes and in computing the Virasoro anomaly using a regularisation procedure. It turns out that, although the method used by KY was appealing, there were flaws in the details of how to define the theory and compute the Virasoro anomaly. In particular, using the universality property of pp-waves as discussed in hep-th/0611138 and arXiv:0704.0085 [hep-th], it is easy to argue that KY's procedure generically gives rise to a physical spectrum with negative dimensions. The correct procedure of how to define the EM tensor (which produces the correct physical spectrum) and how to compute the Virasoro anomaly (which leads to the correct on-shell condition for the background) have been found in [**Mu1**] and [**Mu2**].

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*.
Exact conformations of a thin elastic nanotube and their effect on electron transport.
In M. Daniel and S. Rajasekar, editors, *Nonlinear Dynamics*, page 113. Narosa Publishing House, New Delhi, Jan 2009.

[**B2**]
Rick Mukherjee* and Radha Balakrishnan.
Moving curves of the sine-Gordon equation: New links.
Physics Letters A, **372**, 6347, 2008.

[**B3**]
Indubala I. Satija*, Radha Balakrishnan, Phillip Naudus*, Jeffrey Heward*, Mark Edwards*, and Charles W. Clark*.
Symmetry-breaking and symmetry-restoring dynamics of a mixture of Bose-Einstein condensates in a double well.
Physical Review A, **79**, 033616, 2009.

[**Ba1**]
Kinjal Banerjee and Ghanashyam Date.
Loop quantization of polarized gowdy model on T^3: Classical theory.
Class. Quant. Grav., **25**, 105014, 2008.

[**Ba2**]
Kinjal Banerjee and Ghanashyam Date.
Loop quantization of polarized Gowdy model on T^3: Kinematical states and constraint operators.
Class. Quant. Grav., **25**, 145004, 2008.

[**Bas**]
Patrick Aurenche*, Rahul Basu, and Michel Fontannaz*.
Jet-jet and hadron-jet correlations in hadro- and electro-production.
European Journal of Physics C, **57**, 681, 2008.

[**Bh**]
Amit K. Bhattacharjee, Gautam I. Menon, and Ronojoy Adhikari.
Numerical Method of Lines for the Relaxational Dynamics of Nematic Liquid Crystals.
Phys. Rev. E, **78**, 026707, 2008.

[**C1**]
Sujit K. Choudhary, Sibasish Ghosh, Guruprasad Kar*, **and Ramij Rahaman***.
Complete proof of gisin's theorem for three qubits.
2009.
arXiv :0901.1669 (Submitted).

[**C2**]
Sujit K. Choudhary, Sibasish Ghosh, Guruprasad Kar*, **and Ramij Rahaman***.
Complete proof of gisiń theorem for three qubits.
2009.
arXiv:quant-ph/0901.1669 (Submitted).

[**D1**]
Ghanashyam Date, Romesh K. Kaul, and Sandipan Sengupta.
Topological interpretation of Barbero-Immirzi parameter.
Physical Review D, **79**, 041901, 2009.

[**D2**]
Ghanashyam Date and Sandipan Sengupta.
Effective actions from loop quantum cosmology: Correspondence with higher curvature gravity.
Class. Quant. Grav., 2009.
IMSc/2008/11/15 (To be published).

[**G1**]
Manirul M. Ali* **and Sibasish Ghosh**.
Entanglement control by common heat bath.
In H. S. Goan and Y. N. Chen, editors, *CP1074 (AIP conference proceeding), Solid-State Quantum Computing, 2nd International Workshop on Solid-State Quantum Computing and Mini-School on Quantum Information Science (2008)*, page 82. AIP, Nov 2008.

[**G2**]
Sujit K. Choudhary*, **Sibasish Ghosh, Guruprasad Kar***, **Samir Kunkri***, **Ramij Rahaman***, **and Anirban Roy***.
Hardyś non-locality and generalized non-local theory.
2008.
arXiv:quant-ph/0807.4414 (Submitted).

[**G3**]
Samir Kunkri*, **Swarup Poria***, **Preeti Parashar***, **and Sibasish Ghosh**.
Constant rotation of two-qubit equally entangled pure states by local quantum operations.
2008.
arXiv:quant-ph/0811.0249 (Submitted).

[**G4**]
Kaushik Parasuram S.* **and Sibasish Ghosh**.
Persistence of nonlocality for bipartite quantum spin systems.

2009.
(Preprint: arXiv:quant-ph/0903.3020).

[**I1**]
Solomon J. Ivan and Simon R.
Letter.
Physical Review Letters, 2009.
quant-ph/0808.1658 (Submitted).

[**I2**]
Solomon J. Ivan and Simon R.
Letter.
2009.
(Preprint: quant-ph/0812.2805).

[**I3**]
Solomon J. Ivan, Simon R., and Sanjay M. Kumar*.
Review article.
Physical Review A, 2009.
quant-ph/0812.2800 (Submitted).

[**J1**]
Zahera Jabeen and Neelima Gupte*.
Probabilistic signatures of spatiotemporal intermittency in the coupled sine circle map lattice.
Pramana, **70(6)**, 1055, 2008.

[**J2**]
Zahera Jabeen and Sudeshna Sinha.
Non-universal dependence of spatiotemporal regularity on randomness in coupling connections.
Phys. Rev. E, **78**, 066120, 2008.

[**Ja1**]
Prashanth Jaikumar, Manjari Bagchi*, and Rachid Ouyed*.
High-density Skyrmion matter and Neutron stars.
The Astrophysical Journal, **678**, 360, 2008.

[**Ja2**]
Prashanth Jaikumar, Ralph E. Pudritz*, and Rachid Ouyed*.
Quark-Novae, Cosmic reionization, and early r-process element production.
The Astrophysical Journal, 2009.
arXiv:0811.0041 (To be published).

[**Ja3**]
Prashanth Jaikumar, Gautam Rupak*, and Andrew W. Steiner*.
Viscous damping of r-mode oscillations in compact stars with quark matter.
Physical Review D, **78(12)**, 123007, 2008.

[**K1**]
S. M. Kamil, Sudeshna Sinha, and G. I. Menon.
Regular and chaotic states in a local map description of sheared nematic liquid crystals.
Physical Review E, **78**, 011706, 2008.

[**K2**]
S. M. Kamil, Sudeshna Sinha, and Gautam I. Menon.
Regular and Chaotic States in a Local Map Description of Sheared Nematic Liquid Crystals.
Physical Review E, **78**, 011706, 2008.

[**M1**]
Debaprasad Maity.
Domain walls in born-infeld-dilaton background.
Phys.Rev.D, **78(8)**, 084023, 2008.

[**M2**]
Debaprasad Maity.
Dynamic domain walls in maxwell-dilaton background.
Phys.Rev.D, **78(8)**, 084008, 2008.
(Preprint: arXiv:0806.2041).

[**Me1**]
David Lacoste*, **Gautam I. Menon, Martin Z. Bazant***, **and Jean-Francois Joanny***.
Electrostatic and Electrokinetic Contributions to the Elastic Moduli of a Driven Membrane.
Eur. Phys. J. E, **28**, 243, 2009.

[**Me2**]
Gautam I. Menon and Sriram Ramaswamy*.
Universality Class of the Reversible-Irreversible Transition in Sheared Suspensions.
Physical Review Letters, 2009.
0801.3881 (Submitted).

[**Mi1**]
Ram Kishore* **and Ashok K. Mishra**.
Second quantized representation of observables for orthofermions.
Physica B, 2008.
(To be published).

[**Mi2**]
Ashok K. Mishra and Ram Kishore*.
Orthofermions versus gutzwiller projection operator approach for infinite u hubbard model.
Physics Letters A, **372**, 6019, 2008.

[**Mi3**]
Ashok K. Mishra and Ram Kishore.
Distinct solutions of the infinite u hubbard model through nested bethe ansatz and gutzwiller

projection operator approach.
Physica B, 2008.
(To be published).

[**Mu1**]
Partha Mukhopadhyay.
On the conformal field theories for bosonic strings in pp-waves.
Journal of High Energy Physics, **JHEP (2008)(11)**, 034, 2008.

[**Mu2**]
Partha Mukhopadhyay.
Superstrings in type IIB R-R plane-wave in semi-light-cone gauge and conformal invariance.
Journal of High Energy Physics, 2009.
arXiv:0902.3750 [hep-th] (To be published).

[**Mur1**]
R. Bhaduri*, **M. Murthy, and M. Brack***.
Fermionic ground state at unitarity and haldane exclusion statistics.
J. Phys. B. Atomic, Molecular and Optical Physics, **41**, 115301, 2008.

[**Mur2**]
J. Roccia*, **M. Brack***, **A. Koch***, **and M. Murthy**.
Local virial theorems and closed-orbit theory for spatial density oscillations in fermionic systems.
Submitted to Physical Review A., 2009.
cond-mat:arXiv:0903.2172 (Submitted).

[**P1**]
Subinay Dasgupta*, **Raj K. Pan, and Sitabhra Sinha**.
Novel phase and slow ordering of ising spins on modular networks.
2009.
arxiv/0903.4529 (Submitted).

[**P2**]
Raj K. Pan and Sitabhra Sinha.
Modular networks with hierarchical organization: The dynamical implications of complex structure.
Pramana, **71(1)**, 331, 2008.

[**P3**]
Raj K. Pan and Sitabhra Sinha.
Modularity produces small-world networks with dynamical time-scale separation.
Europhysics Letters, **85(6)**, 68006, 2009.

[**R**]
G. Rajasekaran.
From atoms to quarks and beyond: A historical panorama.

In A N Mitra, editor, *India in the World of Physics:Then and Now*, page 361. Centre for Studies in Civilisations, New Delhi, 2009.

[**Ra1**]
C. Connaughton*, R. Rajesh, and O. Zaboronski*.
Constant flux relation for diffusion limited cluster-cluster aggregation.
Physical Review E, **78**, 041403, 2008.

[**Ra2**]
C. Connaughton*, R. Rajesh, and O. Zaboronski*.
Reaction-diffusion systems and turbulence.
In *Non-equilibrium statistical mechanics and turbulence, LMS lecture note series 355*, page 132. Cambridge University Press, 2008.

[**Ra3**]
C. Connaughton*, R. Rajesh, and O. Zaboronski*.
Kinetics of cluster-cluster aggregation.
In *Handbook of Nanophysics.* Taylor and Francis, 2009.
(To be published).

[**Ra4**]
R. Rajesh.
Multi-avalanche correlations in directed sandpile models.
Euro. Phys. Lett., **85**, 10001, 2009.

[**Ra5**]
M. Shinde*, D. Das*, and R. Rajesh.
On the equivalence of the freely cooling granular gas to the sticky gas.
Physical Review E, **79**, 021303, 2009.

[**S1**]
Balachandran Sathiapalan.
Gauge invariant action for the open bosonic string: Tachyon action.
JHEP, 2009.
IMSc/2009/02/02 (Submitted).

[**S2**]
Balachandran Sathiapalan and Nilanjan Sircar.
Can the hagedorn phase transition be explained from matrix model for strings?
Journal of High Energy Physics (JHEP), **0808**, 019, 2008.

[**S3**]
Balachandran Sathiapalan and Nilanjan Sircar.
Can the hagedorn phase transition be explained from matrix model for strings?
Journal of High Energy Physics, page JHEP08(2008)019, 2008.

[**Sh**]
Indrajit Mitra* **and H. S. Sharatchandra**.
Accounting for monopole configurations in yang-mills theory in three euclidean dimensions. 2009.
arXiv:0809.5175 (Submitted).

[**Sha**]
C. S. Kim*, **Sechul Oh***, **Chandradew Sharma, Rahul Sinha, and Yeo W. Yoon***.
Generalized analysis on $B \to K^* \rho$ within and beyond the standard model.
Int.J.Mod.Phys., **A23**, 3268, 2008.

[**Si1**]
Nita Sinha.
Determining the neutral D mixing parameters.
In *Proceedings of the 34th International Conference on High Energy Physics, Philadelphia, 2008*, Oct 2008.
arXiv:0810.4906 (Submitted).

[**Si2**]
Nita Sinha.
Status of CP violation.
In *Proceedings of the 18th Particles and Nuclei International Conference (PANIC08), Eilat, Israel*, Feb 2009.
arXiv: 0902.0470 (Submitted).

[**Sin1**]
Sitabhra Sinha and S. Sridhar.
Controlling spiral turbulence in simulated cardiac tissue by low-amplitude traveling wave stimulation.
In Jurgen Kurths Syamal K Dana, Prodyot K Roy, editor, *Complex Dynamics in Physiological Systems: From Heart to Brain*, page 69. Springer, Mar 2009.

[**Sin2**]
Archana Sareen*, **Uddipan Sarma***, **Raki Sudan***, **Shradha Khurana***, **Neetu Srivastava***, **Sushmita Pahari***, **Srijit Khan***, **P. L. Raghukumar***, **Ram K. Mathur***, **Somenath Roy***, **Indira Ghosh***, **Sitabhra Sinha, Ajit G. Chande***, **Robin Mukhopadhyaya***, **and Bhaskar Saha***.
Lyn and syk targeting in the reciprocal cd40 signaling modules offers host-protection. 2009.
(Submitted).

[**Sin3**]
T. K. Shajahan*, **Sitabhra Sinha, and Rahul Pandit***.
The mathematical modelling of inhomogeneities in ventricular tissue.
In P. K. Roy S. K. Dana and J. Kurths, editors, *Complex Dynamics in Physiological Systems: From Heart to Brain*, page 51. Springer, 2009.

[**Sin4**]
Sitabhra Sinha.
From network structure to dynamics and back again: Relating dynamical stability and connection topology in biological complex systems.
In A. Deutsch N. Ganguly and A. Mukherjee, editors, *Dynamics On and Of Complex Networks: Applications to Biology, Computer Science, and the Social Sciences*, page 3. Birkhauser, 2009.

[**Sin5**]
Sitabhra Sinha and Bikas K. Chakrabarti*.
Towards a physics of economics.
Physics News, 2009.
(To be published).

[**Sin6**]
Sitabhra Sinha and S. Sridhar.
Controlling spiral turbulence in simulated cardiac tissue by low-amplitude traveling wave stimulation.
In P. K. Roy S. K. Dana and J. Kurths, editors, *Complex Dynamics in Physiological Systems: From Heart to Brain*, page 69. Springer, 2009.

[**Sinh1**]
H. Ando*, Sudeshna Sinha, and K. Aihara*.
Emergent organization of oscillator clusters in coupled self-regulatory chaotic maps.
In R. Ramaswamy N. Gupte, editor, *Proceedings of the STATPHYS-22 Satellite conference 'Perspectives in Nonlinear Dynamics'*, page 1153. Pramana, Dec 2008.

[**Sinh2**]
W. L. Ditto*, K. Murali*, and Sudeshna Sinha.
Chaos computing : ideas and implementation.
In *Proceedings of* Experimental Chaos Conference *(ECC9), Brazil (2006) published in* Philosophical Transactions of the Royal Society of London *(Series A)*, Jun 2008.
(To be published).

[**Sinh3**]
K. Murali* and Sudeshna Sinha.
Exploiting the effect of noise on nonlinear systems to obtain reconfigurable logic gates.
In M. Daniels and S. Rajasekar, editors, *Nonlinear Dynamics*, page 283. Narosa, Jan 2009.

[**Sinh4**]
A. Miliotis*, Sudeshna Sinha, and W. L. Ditto*.
Exploiting nonlinear dynamics to store and process information.
International Journal of Bifurcation and Chaos, **18**, 1551, 2008.
(Submitted).

[**Sinh5**]
A. Mondal*, Sudeshna Sinha, and J. Kurths*.

Rapidly switched random links enhance spatiotemporal regularity.
Physical Review E, **78**, 066209, 2008.

[**Sinh6**]
K. Murali*, A. Miliotis*, W. L. Ditto*, and Sudeshna Sinha.
Logic from nonlinear dynamical evolution.
Physics Letters A, **373**, 1346, 2009.

[**Sinh7**]
K. Murali*, Sudeshna Sinha, W. L. Ditto*, and A. R. Bulsara*.
Reliable logic circuit elements that exploit nonlinearity in the presence of a noise-floor.
Physical Review Letters, **102**, 104101, 2009.

[**Sinh8**]
S. Poria*, M. D. Shrimali*, and Sudeshna Sinha.
Enhancement of spatiotemporal regularity in an optimal window of random coupling.
Physical Review E, Rapid Communication, **78**, 035201, 2008.

[**V1**]
Ekta Khurana*, Matteo Dal Peraro*, Russell Devane*, Satyavani Vemparala, William F. DeGrado*, and Michael L. Klein*.
Molecular dynamics calculations suggest a conduction mechanism for the m2 proton channel from influenza a virus.
Proceedings of National Academy of Sciences(PNAS), **106**, 1069, 2009.

[**V2**]
Abhigyan Som*, Satyavani Vemparala, Ivaylo Ivanov*, and Gregory N. Tew*.
Synthetic mimics of antimicroial peptides.
Peptide Science, **90**, 83, 2008.

[**V3**]
Satyavani Vemparala, Carmen Domene*, and Michael L. Klein*.
Interaction of inhalational anesthetics with membrane proteins.
Accounts of Chemical Research, 2009.
(Submitted).

[**Z**]
Z. Zabeen and Sudeshna Sinha.
Non-universal dependence of spatiotemporal regularity on randomness in coupling connections.
Physical Review E, **78**, 066120, 2008.

Books/Monographs Authored/Edited

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

[**D**]
Ghanashyam Date and Tarun Souradeep*, editors.
Proceedings of the Sixth International Conference on Gravitation and Cosmology, volume 140 of *Journal of Physics: Conference Series.*
Institute of Physics, IOP Publishing Ltd., Dirac House, Temple Back, Bristol BS1 6BE, United Kingdom, 2008.

2.3 Theoretical Computer Science

2.3.1 Research Summary

Algorithms and Data Structures

In [**Ra1**], the parameterized complexity of a generalization of dominating set is considered. Here, in addition to the given set of vertices and edges, a demand vector is also given. This vector has a component for each vector which indicates the minimum number of its neighbors that should be in the dominating set if the vertex is not in the dominating set. When each vector component is 1, this reduces to the standard Dominating Set problem and when each vector component is the degree of the corresponding vertex, then the problem becomes the well studied Vertex Cover problem. Dichotomy theorems are proved as to when (based on the properties of the vectors) this problem is fixed parameter tractable and when it is W-hard.

Graph Theory and Combinatorics

In [**A2**], a general notion of forbidden subgraph edge coloring was studied. Also bounds were obtained for the corresponding chromatic index. Given j and $\mathcal{F}$, these are proper edge colorings in which the subgraph induced by the union of any j-color classes has no copy of any member of $\mathcal{F}$. This notion generalizes several well-known restricted edge colorings like acyclic edge coloring, etc. For this coloring, an upper bound (in terms of d and θ) on the minimum number of colors sufficient to obtain such a coloring was obtained. Here, d refers to the maximum degree of the graph and θ is a number which depends only on $\mathcal{F}$. The proof is based on probabilistic arguments. As a consequence, $O(d)$ upper bounds were obtained for proper edge colorings with various interesting restrictions placed on the union of color classes like (i) the union of any 3 color classes should be an outerplanar graph, (ii) the union of any 5 color classes should be planar, Also, generalizations were considered where it is required simultaneously for several pairs $(j_i, \mathcal{F}_i)$ $(i = 1, \ldots, s)$ that the union of *any* j_i color classes has no copy of any member of $\mathcal{F}_i$ and upper bounds on the corresponding chromatic indices were obtained. As a corollary, using $O(d)$ colors, it is possible to simultaneously satisfy several forbidden subgraph restrictions.

In [**A1**], a general notion of forbidden subgraph vertex coloring was introduced and bounds were obtained for the corresponding chromatic number. Given j and $\mathcal{F}$, these are proper colorings in which the subgraph induced by the union of any j-color classes has no copy of any member of $\mathcal{F}$. This notion generalizes several well-known restricted colorings like acyclic vertex coloring ($j = 2$ and $\mathcal{F}$ is the collection of all even cycles), star vertex coloring, etc.

For this coloring, an upper bound of $O\left(d^{\frac{k-1}{k-j}}\right)$ on the minimum number of colors sufficient to obtain such a coloring was obtained. Here, d refers to the maximum degree of the graph and k is the size of the smallest member of $\mathcal{F}$. In particular, it was also shown that using $O(d^{8/7})$ colors, it is possible to obtain a proper coloring so that the union of any two color classes has treewidth atmost 2. Also, it was shown that this bound is tight within a poly logarithmic (in d) multiplicative factor. It was also shown that one can consider generalizations where it is required simultaneously for several pairs $(j_i, \mathcal{F}_i)$ $(i = 1, \ldots, l)$ that the union of *any* j_i color classes has no copy of any member of $\mathcal{F}_i$ and corresponding upper bounds on the chromatic numbers were also obtained.

In [**A3**], the upper bound on forbidden subgraph vertex colorings (obtained in [**A1**]) was improved for the case $j = 2$ and the new bound is also shown to be tight within a poly logarithmic factor in d. Also, an upper bound on the oriented chormatic number of an arbitrary graph in terms of a suitable forbidden subgraph chromatic number and oriented chromatic number of special classes of graphs was obtained. Using this relationship and an improved bound on the forbidden subgraph chromatic number of graphs of bounded genus, a significantly improved upper bound on the oriented chromatic number of graphs of bounded genus was obtained. Also, an improved upper bound on the oriented chromatic number of an arbitrary graph in terms of its degeneracy and maximum degree was obtained.

In [**Su**], the notion of list colorings was generalized to the notion of list hereditary colorings. Given a hereditary property $\mathcal{P}$ and an assignment of lists of colors to each vertex, the goal is to find a coloring of the vertices (with colors from their respective lists) so that each subgraph induced by vertices colored with the same color satisfy $\mathcal{P}$. The minimum size of each list to guarantee the existence of such a coloring for all possible list assignements is referred to as the $\mathcal{P}$-choice number. An upper bound on the $\mathcal{P}$-choice number in terms of n (number of vertices) and the $\mathcal{P}$-chromatic number was obtained. This generalizes a similar result and its proof (based on probabilistic arguments) obtained for the special case of usual choice numbers.

In the k-means problem, a finite set S of points in $\Re^m$, and integer $k \geq 1$, are given, and we want to find k points (centers) so as to minimize the sum of the square of the Euclidean distance of each point in S to its nearest center. This is a well-known and popular clustering problem that has also received a lot of attention in the algorithms community. No polynomial-time algorithm is known for the problem, although there are polynomial time algorithms that compute a constant factor approximation to the optimal solution. In fact, it is known that the k-means problem is NP-hard when the dimension m is part of the input, even for $k = 2$. However, there was no known NP-hardness result when the dimension m is fixed and k, the number of clusters, is part of the input. In [**M2**], this problem is settled; it is shown that the problem remains NP-hard even in the plane ($m = 2$).

It is shown that for any class of bipartite graphs which is closed under edge deletion and where the number of perfect matchings can be counted in NC (this includes planar bipartite graphs and $K_{3,3}$-free bipartite graphs), there is a deterministic NC algorithm for finding a perfect matching. A crucial ingredient is part of an interior-point algorithm due to Goldberg, Plotkin, Shmoys and Tardos. This approach can handle regular bipartite graphs as well. By a careful analysis of the polynomial time algorithm due to Galluccio and Loebl, it is shown that the number of perfect matchings in a graph of small ($O(\log n)$) genus can be counted in NC. So perfect matchings in small genus bipartite graphs can also be found via this approach. Finally, a new algorithm for finding a perfect matching in a planar bipartite graph is presented. This algorithm is substantially different from the algorithm described above, and also from the algorithm of Miller and Naor, which predates the approach of Goldberg *et al.* and tackles the same problem. The new algorithm extends to small genus bipartite graphs, but not to $K_{3,3}$-free bipartite graphs. It is shown that a non-trivial extension of this algorithm can compute a vertex of the fractional perfect matching polytope (such a vertex is either a perfect matching or a half-integral matching) in NC, provided the graph is planar or small genus but *not necessarily bipartite*, and has a perfect matching to begin with. This extension rekindles the hope for an NC-algorithm to find a perfect matching in a non-bipartite planar graph. This work is reported in [**M3**].

In [**M7**], we consider new parameterizations of NP-optimization problems that have nontrivial lower and/or upper bounds on their optimum solution size. The natural parameter, we argue, is the quantity above the lower bound or below the upper bound. We show that for every problem in MAXSNP, the optimum value is bounded below by an unbounded function of the input-size, and that the above-guarantee parameterization with respect to this lower bound is fixed-parameter tractable. We also observe that approximation algorithms give nontrivial lower or upper bounds on the solution size and that the above or below guarantee question with respect to these bounds is fixed-parameter tractable for a subclass of NP-optimization problems.

We then introduce the notion of 'tight' lower and upper bounds and exhibit a number of problems for which the above-guarantee and below-guarantee parameterizations with respect to a tight bound is fixed-parameter tractable or W-hard. We show that if we parameterize "sufficiently" above or below the tight bounds, then these parameterized versions are not fixed-parameter tractable unless P = NP, for a subclass of NP-optimization problems. We also list several directions to explore in this paradigm.

In [**Ra2**], we study algorithmic questions related to König-Egerváry graphs. A graph is König-Egerváry if the size of a minimum vertex cover equals that of a maximum matching in the graph. These graphs have been studied extensively from a graph-theoretic point of view. In this paper, we introduce and study the algorithmic complexity of finding König-Egerváry subgraphs of a given graph. More specifically, we look at the following two sets of problems. Given a graph G and a nonnegative integer k,

1. does there exist k vertices (edges) whose deletion makes the graph König-Egerváry?

2. does there exist k vertices (edges) that induce a König-Egerváry subgraph?

We show that these problems are NP-complete and study their complexity from the points of view of approximation and parameterized complexity. While studying the parameterized complexity of the vertex deletion version we show a number of interesting structural results on matchings and vertex covers which could be useful in other contexts.

In [**Mi**], we study a problem called the BUDGETED UNIQUE COVERAGE. We show, by a non-trivial application of the color-coding method of Alon et al, that BUDGETED UNIQUE COVERAGE (a variant of SET COVER) is fixed-parameter tractable, answering an open problem posed in a paper by Moser, Raman and Sikdar. We also give improved fixed-parameter tractable algorithms for two special cases of Budgeted Unique Coverage: Unique Coverage (the unweighted version) and Budgeted Max Cut.

To derandomize our algorithms we use an interesting variation of k-perfect hash families known as (k, s)-hash families which were studied by Alon et al. in the context of a class of codes called parent identifying codes. In this setting, for every s-element subset S of the universe, and every k-element subset X of S, there exists a function that maps X injectively and maps the remaining elements of S into a different range.

We give several bounds on the size of (k, s)-hash families. We believe that our application of color-coding may be used for other problems and that this is the first application of (k, s)-hash families to a problem outside the domain of coding theory.

We showed that for any fixed $i, j \geq 1$, the k-Dominating Set problem restricted to graphs that do not have $K_{i,j}$ as a subgraph is Fixed Parameter Tractable (FPT) and has a kernel of size (number of vertices) at most $(j+1)^{(i+1)} k^{i^2} = O\left(k^{i^2}\right)$. The kernelization algorithm runs in time $O\left(i^2 n^i\right)$. The most general class of graphs for which the problem was previously known to have an FPT algorithm was the class of d-degenerate graphs;the most general class of graphs for which the problem was previously known to have a polynomial kernel was the class of H-minor-free graphs.[**P**]

In pushkar-2008.1 we study the algorithmic complexity of lattice problems based on the sieving technique due to Ajtai, Kumar, and Sivakumar. Given a k-dimensional subspace $M \subseteq \mathbb{R}^n$ and a full rank integer lattice Ł $\subseteq \mathbb{Q}^n$, the *subspace avoiding problem* SAP is to find a shortest vector in Ł $\setminus M$. We give a $2^{O(n+k\log k)}$ time algorithm to solve the subspace avoiding problem. Applying this algorithm we give a $2^{O(n)}$ time algorithm to compute i^{th} successive minima of a full rank lattice in $\mathbb{Q}^n$ if i is $O(\frac{n}{\log n})$. We also give a $2^{O(n)}$ time algorithm to solve a restricted closest vector problem CVP where the inputs fulfil a promise about the distance of the input vector from the lattice. We also give a new approximation algorithm for SAP and the *Convex Body Avoiding problem* which is a generalization of SAP. Several of our algorithms work for *gauge* functions as metric, where the gauge function has a natural restriction and is accessed by an oracle.

Automata, Logic and Concurrency

[**R3**] and [**R4**] continue the research programme on a program-like formalism for specifying strategies, extending the logics and considering repeated games, whereby game theoretic notions like threat and punishment can be studied.

[**R1**] and [**R2**] study extensions of propositional game logic where, rather than game-indexed modalities, we have game-strategy pairs indexing modalities, interpreted over extensive form games and normal form games respectively. The advantage of imposing such structure is that we can speak of a player's strategic response in one game to a strategy employed by another player in a previous game. In the presence of iteration, a player has significant ability to strategise taking into account the explicit structure of games.

[**R5**] studies a dynamic logic whose programs are built over finite trees, and whose modalities quantify universally or existentially over frontiers, and proves that the logic is elementarily decidable. The logic is useful for reasoning with quantification over paths generated by finite state programs as in dynamic logic.

We are studying computational complexity of problems concerned with analyzing subclasses of Petri nets. Given a Petri net, an initial and a final configuration (called markings in Petri net theory), the reachability problem is to decide if the given Petri net can reach the final marking, starting at the initial marking. The coverability problem is to decide if the given Petri net, starting at the given initial marking, can reach some marking that is related to the given final marking in a formally defined way.

First part of our work consisted of providing a polynomial space upper bound and lower bound for reachability for the subclass of T-invariant-less Petri nets [**Pr**], for which A.E.Kostin had earlier given a reachability algorithm, but with no complexity analysis. We observed that the technique we used to obtain the PSPACE upper bound mentioned above is based on the same principle used in one of the lemmas used in the proof of decidability of reachability. In particular, we observed this link in S.R.Kosaraju and J.L.Lambert?s decidability proof, which are simplifications of E.Mayr?s proof. An adaptation of a restricted notion of another concept from this proof gave a subclass with some nice properties. However, a closer look revealed that this subclass is subsumed by an extended subclass we had defined in our earlier work [**Pr**].

The coverability problem is known to be EXPSPACE-complete. We looked at the EXPSPACE hardness proof given by R.Lipton with the aim of isolating the structural property of Petri nets that makes it hard. Defining a parameter k that restricts the influence of parts of Petri nets on other parts, we could do a finer analysis of C.Rackoff's EXPSPACE upper bound proof to provide a space complexity of the form $\mathcal{O}(f(k)p(n))$, where f is an exponential function of k, p is some polynomial and n is the input size. Though the parameter is well defined and better upper bound is obtained, it is not clear what kind of Petri nets will have low values for this parameter.

Computational Complexity

In [**Ar2**], using ideas from automata theory we design a new efficient (deterministic) identity test for the *noncommutative* polynomial identity testing problem (first introduced and studied by Raz and Shpilka, and then Bogdanov and Wee). More precisely, given as input a noncommutative circuit $C(x_1, \cdots, x_n)$ computing a polynomial in $\{x_1, \cdots, x_n\}$ of degree d with at most t monomials, where the variables x_i are noncommuting, we give a deterministic polynomial identity test that checks if $C \equiv 0$ and runs in time polynomial in $d, n, |C|$, and t. We apply this idea to obtain a number of other results including a connection between polynomial identity testing and derandomizing the isolation lemma in [**Ar3**].

In [**Ar6**], motivated by Magniez and Nayak's quantum algorithm for testing commutativity of black-box groups, we study the following problem: given a black-box finite ring R by an additive generating set $\{r_1, r_2, \cdots, r_k\}$ and a multilinear polynomial $f(x_1, \cdots, x_m)$ over R accessed as a black-box function $f : R^m \to R$ (where the indeterminates $x_1, \cdots, x_m$ can be commuting or noncommuting), test if f is an *identity* for the ring R. More precisely, test if $f(a_1, a_2, \cdots, a_m) = 0$ for all $a_i \in R$. We give a quantum algorithm with query complexity $O(m(1+\alpha)^{m/2}k^{\frac{m}{m+1}})$ assuming $k \geq (1+1/\alpha)^{m+1}$. Towards a lower bound, we also show a reduction from a version of m-collision problem (which is well studied in quantum computation) to this problem.

While visibly pushdown languages properly generalise regular languages and are properly contained in deterministic context-free languages, the complexity of their membership problem is equivalent to that of regular languages. However, the corresponding counting problem could be harder than counting paths in a non-deterministic finite automaton: it is only known to be in LogDCFL. In [**L1**], the membership and counting problems for generalisations of visibly pushdown automata, defined using the notion of height-determinism, are investigated. It is shown that when the stack-height of a given PDA can be computed using a finite transducer, both problems have the same complexity as for visibly pushdown languages. It is also shown that when allowing pushdown transducers instead of finite-state ones, both problems become LogDCFL-complete; this uses the fact that pushdown transducers are sufficient to compute the stack heights of all real-time height-deterministic pushdown automata, and yields a candidate arithmetization of LogDCFL that is no harder than LogDCFL.
(This work appears in [**L1**].)

Reachability and distance computation are known to be NLOG-complete in general graphs, but within unambiguous logspace if the graphs are planar. However, finding longest paths is known to be NP-complete, even for planar graphs. In [**L2**], it is shown that with the combination of planarity and acyclicity, finding the length of the longest path (and also enumerating one such path) is also in unambiguous logspace. The result extends to toroidal DAGs as well. The question of when reachability, distance, and longest path are indeed equivalent on DAGs is also addresses, and some partial bounds are given.

When the number of distinct paths is bounded by a polynomial, counting the number of paths is known to be in NLOG. It is shown in [**L2**] that for planar DAGs with this promise, counting can be done by a unambiguous auxiliary-logspace pushdown automata UAuxPDA in polynomial time. The UAuxPDA(poly) bound also holds for computing the number of longest paths, or shortest paths, when this number is bounded by a polynomial (irrespective of the total number of paths). Along the way, it is shown that counting in general DAGs is possible in LogDCFL when the number of paths is bounded by a polynomial and the target node is the only sink.

Functions in arithmetic NC^1 are known to have equivalent constant width polynomial degree circuits, but the converse containment is unknown. In a partial answer to this question, in [**M1**], it is shown that syntactic multilinear circuits of constant width and polynomial degree can be depth-reduced, though the resulting circuits need not be syntactic multilinear. Relationships between classes of functions obtained by imposing various resource (width, depth, degree) restrictions on polynomial-size syntactic multilinear circuits are studied. Along the way, a characterisation of NC^1 (and its arithmetic counterparts) in terms of log width restricted planar branching programs is obtained. The power of skew formulae is also studied, and it is shown that even exponential sums of these are unlikely to suffice to express the determinant function.

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**]
N. R. Aravind and C. R. Subramanian.
Bounds on proper colorings with restrictions on the union of color classes.
In *Preprint*. 2008.
(Submitted).

[**A2**]
N. R. Aravind and C. R. Subramanian.
Bounds on edge colorings with restrictions on the union of color classes.
In *Preprint*. 2008.
(Submitted).

[**A3**]
N. R. Aravind and C. R. Subramanian.
Forbidden subgraph colorings and the oriented chromatic number.
In *Preprint*. 2009.
(Submitted).

[**Ar1**]
V. Arvind and Pushkar S. Joglekar.
Some sieving algorithms for lattice problems.
In V. Vinay Ramesh Hariharan, Madhavan Mukund, editor, *Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2008*, Dec 2008.

[**Ar2**]
V. Arvind, Partha Mukhopadhyay, and Srikanth Srinivasan.
New results on noncommutative and commutative polynomial identity testing.
In *Proceedings of the 23rd Annual IEEE Conference on Computational Complexity*, pages 268–279, June 2008.

[**Ar3**]
V. Arvind and Partha Mukhopadhyay.
Derandomizing the isolation lemma and lower bounds for circuit size.
In *Proceedings of the 12th APPROX-RANDOM workshop, LNCS 5171*, pages 276–289. Springer, August 2008.

[**Ar4**]
V. Arvind and T. C. Vijayaraghavan.
The orbit problem is in the GapL hierarchy.
In *Proceedings of the COCOON 2008 conference, LNCS 5092*, pages 160–169. Springer, June 2008.

[**Ar5**]
V. Arvind, Bireswar Das, and Johannes Köbler*.
A logspace algorithm for partial 2-tree canonization.
In *Proceedings of the CSR 2008 conference, LNCS 5010*, pages 40–51. Springer, June 2008.

[**Ar6**]
V. Arvind and Partha Mukhopadhyay.
Quantum query complexity of multilinear identity testing.
In *Proceedings of the STACS 2009 conference, Dagstuhl Seminar Proceedings 09001, Schloss Dagstuhl - Leibniz-Zentrum für Informatik*, pages 87–98. Schloss-Dagstuhl Seminar, February 2009.

[**Ar7**]
V. Arvind and Pushkar S. Joglekar.
Arithmetic circuit size, identity testing, and finite automata.
In *Electronic Colloquium on Computational Complexity*. ECCC Archive, 2009.

[**L1**]
Nutan Limaye, Meena Mahajan, and Antoine Meyer*.
On the complexity of membership and counting in height-deterministic pushdown automata.
In Edward Hirsch, Alexander Razborov, A Semenov, and Anatol Slissenko, editors, *Proceedings of 3nd International Computer Science Symposium in Russia CSR, LNCS vol. 5010*, pages 240–251. Springer, Jun 2008.

[**L2**]
Nutan Limaye, Meena Mahajan, and Prajakta Nimbhorkar.
Longest paths in planar DAGs in unambiguous logspace.
In Rod Downey and Prabhu Manyem, editors, *15th Computing: The Australasian Theory Symposium CATS, Vol. 94 in CRPIT Series*, pages 99–105. ACS, Jan 2009.

[**L3**]
Nutan Limaye, Meena Mahajan, and B. V. Raghavendra Rao.
Arithmetizing classes around NC^1 and L.
Theory of Computing Systems, 2008.
(To be published).

[**Lo1**]
Kamal Lodaya, Paritosh K. Pandya*, and Simoni S. Shah*.
Marking the chops: an unambiguous temporal logic.
In G. Mauri G. Ausiello, J. Karhumäki and C.-H. Luke Ong, editors, *Proc. 5th IFIP TCS, Milano*, pages 460–476. Springer, Sep 2008.

[**Lo2**]
Kamal Lodaya.
Marking time.
In Madhabendra Nath Mitra Mihir K.Chakraborty, Benedikt Löwe and Sundar Sarukkai, editors, *Logic, navya-nyāya and applications*, pages 185–203. College Publications (London), 2008.

[**Lo3**]
Kamal Lodaya and Soumya Paul.
Folding systems of communicating agents.

In M. Mukund K. Lodaya and R. Ramanujam, editors, *Perspectives in Concurrency Theory.* Universities Press / CRC Press, 2009.

[**M1**]
Meena Mahajan and B V Raghavendra Rao.
Arithmetic circuits, syntactic multilinearity, and the limitations of skew formulae.
In *Proceedings of 33rd International Symposium on Mathematical Foundations of Computer Science, LNCS 5162.*, pages 455–466. Springer, Aug 2008.

[**M2**]
Meena Mahajan, Prajakta Nimbhorkar, and Kasturi Varadarajan*.
The planar k-means problem is NP-hard.
In S. Das and R. Uehara, editors, *3rd Annual Workshop on Algorithms and Computation, LNCS vol. 5431*, pages 274–285. Springer, Feb 2009.

[**M3**]
Raghav Kulkarni*, Meena Mahajan, and Kasturi Varadarajan*.
Some perfect matchings and perfect half-integral matchings in NC.
Chicago Journal of Theoretical Computer Science, **2008**, 4, 2008.

[**M4**]
Martin Kutz*, Khaled Elbassioni*, Irit Katriel*, and Meena Mahajan.
Simultaneous matchings: Hardness and approximation.
Journal of Computer and System Sciences, **74(5)**, 884–897, 2008.

[**M5**]
Meena Mahajan and Jayalal Sarma M N.
Rigidity of a simple extended lower triangular matrix.
Information Processing Letters, **107(5)**, 149–153, 2008.

[**M6**]
Meena Mahajan and Jayalal Sarma M. N.
On the complexity of matrix rank and rigidity.
Theory of Computing Systems, 2008.
(To be published).

[**M7**]
Meena Mahajan, Venkatesh Raman, and Somnath Sikdar.
Parameterizing above or below guaranteed values.
Journal of Computer and System Sciences., **75(2)**, 137, 2009.

[**Mi**]
Neeldhara Misra, Venkatesh Raman, Saket Saurabh*, and Somnath Sikdar.
The budgeted unique coverage problem and color coding.
In *Proceedings of the 4th Computer Science Symposium in Russia, CSR 2009.* Springer, Aug 2009.
LNCS (To be published).

[**Mu**]
Rahul Muthu, N. Narayanan, and C. R. Subramanian.
On k-intersection edge colourings.
Discussiones Mathematicae Graph Theory, 2009.
(To be published).

[**P**]
Geevarghese Philip, Venkatesh Raman, and Somnath Sikdar.
Polynomial kernels for dominating Set in $k_{i,j}$-free and d-degenerate graphs.
In *Preprint*, Feb 2009.
(Submitted).

[**Pr**]
M. Praveen and Kamal Lodaya.
Analyzing reachability for some petri nets with fast growing markings.
In V. Halava and I. Potapov, editors, *Proceedings of the Second Workshop on Reachability Problems in Computational Models (RP 2008)*, Sep 2008.

[**R1**]
R. Ramanujam and Sunil Simon.
Dynamic logic on games with structured strategies.
In Lang Brewka, editor, *Knowledge Representation*, page 49. AAAI Press., Sep 2008.

[**R2**]
R. Ramanujam and Sunil Simon.
Dynamic logic on normal form games.
In Broerson Meyer, editor, *Knowledge Representation for Agents and Multi-Agent Systems*, page 140. AAAI Press, Sep 2008.

[**R3**]
R. Ramanujam and Sunil Simon.
A logical structure for strategies.
In Wooldridge Bonanno, van der Hoek, editor, *Logic and the Foundations of Game and Decision Theory, Texts in Logic and Games Series*, page 151. Amsterdam University Press, 2008.

[**R4**]
R. Ramanujam and Sunil Simon.
Reasoning *in* games.
In Mitra Chakraborty, Loewe and Sarukkai, editors, *Logic, Navya Nyaya and Applications*, page 261. College Publications, King's College, London, 2008.

[**R5**]
R. Ramanujam and Sunil Simon.
Dynamic logic of tree composition.
In Ramanujam Lodaya, Mukund, editor, *Perspectives in Concurrency Theory*, page 408. Universities Press / CRC Press, 2009.

[**Ra1**]
Venkatesh Raman, Saket Saurabh*, **and Sriganesh Srihari***.
Parameterized algorithms for generalized domination.
In *Proceedings of the 2nd Annual International Conference on Combinatorial Optimization and Applications (COCOA)*, page 116. Springer Verlag, Aug 2008.

[**Ra2**]
Sounaka Mishra*, **Venkatesh Raman, Saket Saurabh***, **and Somnath Sikdar**.
König deletion sets and vertex covers above the matching size.
In *Proceedings of the 19th International Symposium on Algorithms and Computation.* Springer, Dec 2008.

[**Ra3**]
Daniel Lokshtanov*, **Venkatesh Raman, Saket Saurabh***, **and Somnath Sikdar**.
On the directed degree preserving spanning tree problem.
In *Preprint*, Mar 2009.
(Submitted).

[**Ra4**]
Venkatesh Raman and Saket Saurabh*.
Short cycles make w-hard problems hard: Fpt algorithms for w-hard problems in graphs with no short cycles.
Algorithmica, **52(2)**, 203, 2008.

[**Rao1**]
Raghavendra B. Rao and Jayalal M. Sarma*.
On the complexity of matroid isomorphism problem.
In *4th International Computer Science Symposium in Russia*, Aug 2009.
(To be published).

[**Rao2**]
Maurice Jansen* **and Raghavendra B. Rao**.
Simulation of arithmetical circuits by branching programs preserving constant width and syntactic multilinearity.
In *4th International Computer Science Symposium in Russia*, Aug 2009.
(To be published).

[**S1**]
Michael Dom* **and Somnath Sikdar**.
The parameterized complexity of the rectangle stabbing problem.
In *The Proceedings of the 2nd International Frontiers of Algorithmics Workshop (FAW 2008)*, page 67. Springer, Jun 2008.

[**S2**]
Daniel Lokshtanov*, **Saket Saurabh***, **and Somnath Sikdar**.
A simpler parameterized algorithm for odd cycle transversal.

In *Preprint*, Mar 2009.
(Submitted).

[**Su**]
C. R. Subramanian.
List hereditary colorings of graphs.
In *Proceedings of ICDM 2008, to appear*. 2008.
(Submitted).

Books/Monographs Authored/Edited

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

[**L**]
Kamal Lodaya, Madhavan Mukund*, and R. Ramanujan, editors.
Perspectives in Concurrency Theory.
Universities Press, 2008.

[**R**]
R. Ramanujam and Sundar Sarukkai*, editors.
Logic and its Applications, volume 5378 of *Lecture Notes in Artificial Intelligence.*
Springer-Verlag, Berlin - Heidelberg, Germany, 2009.

2.4 Student Programmes

2.4.1 Degrees Awarded

Doctoral Degrees Awarded during 2008 – 2009

Mathematics

Name: **Upadhyay, Shyamashree**
Thesis Title: Schubert varieties in the orthogonal Grassmannian
Thesis Advisor: Raghavan, K. N.
University: Chennai Mathematical Institute

Physics

Name: **Sharma, Chandradew**
Thesis Title: Phenomenology of B meson and CP violation
Thesis Advisor: Sinha, Rahul
University: Homi Bhabha National Institute

Theoretical Computer Science

Name: **Sarma M N, Jayalal**
Thesis Title: Complexity Theoretic Aspects of Rank, Rigidity and Circuit Evaluation
Thesis Advisor: Mahajan, Meena B.
University: Homi Bhabha National Institute

Name: **Saurabh, Saket**
Thesis Title: Exact Algorithms for Optimization and Parameterized versions of some Graph Problems
Thesis Advisor: Raman, Venkatesh
University: Homi Bhabha National Institute

Name: **Muthu, Rahul**
Thesis Title: Acyclic Edge Colouring: Bounds and Algorithms
Thesis Advisor: Subramanian, C.R.
University: Homi Bhabha National Institute

Name: **Vijayaraghavan, T.C.**
Thesis Title: Classifying certain algebraic problems using logspace counting classes
Thesis Advisor: Arvind, V.
University: Homi Bhabha National Institute

Doctoral Theses Submitted during 2008 – 2009

Mathematics

Name: **Jijo, S.**
Thesis Title: Planar algebra associated to the Asymptotic inclusion of a Kac algebra subfactor
Thesis Advisor: Sunder, V. S.
University: Chennai Mathematical Institute

Physics

Name: **Laddha, Alok**
Thesis Title: Parametrized Theories and Loop Quantization
Thesis Advisor: Date, G.
University: Homi Bhabha National Institute

Name: **Banerjee, Kinjal**
Thesis Title: Studies in Loop Quantization of Cosmological Models
Thesis Advisor: Date, G.
University: Homi Bhabha National Institute

Masters Theses during 2008 – 2009

Theoretical Computer Science

Name: **Philip, Geevarghese**
Thesis Title: Subexponential FPT algorithms for Graph Problems using Results from Graph Minor Theory
Thesis Advisor: Raman, Venkatesh
University: Homi Bhabha National Institute

Name: **Praveen, M.**
Thesis Title: Complexity of the reachability problem in subclasses of Petri nets
Thesis Advisor: Lodaya, Kamal
University: Homi Bhabha National Institute

2.4.2 Lecture Courses During 2008 – 2009.

The following **lecture courses** were offered during 2008 – 2009.

Course Title	Period	Lecturer
Mathematics		
Complex Analysis	Jan-Apr 2008	Chakraborty, Partha S.
Ergodic Theory (course with teaching shared by Krishna Maddaly)	Jan-Apr 2008	Sunder, V. S.
Functional Analysis	Jan-Apr 2008	Prasad, Amritanshu
Representations of Algebraic Groups–II	Jan-Apr 2008	Raghavan, K. N.
Ergodic Theory	Feb-Mar 2008	Krishna, M.
Algebra	Aug-Nov 2008	Paranjape, Kapil H.
Algebraic Geometry	Aug-Nov 2008	Iyer, Jaya N.
Real Analysis (measure theory)	Aug-Dec 2008	Sunder, V. S.
Arithmetic	Jan-Apr 2009	Sankaran, Parameswaran
Complex Analysis	Jan-Mar 2009	Krishna, M.
Functional Analysis	Jan-Apr 2009	Sunder, V. S.
Linear algebraic groups	Jan-Apr 2009	Raghavan, K. N.
Topology II	Jan-Apr 2009	Nagaraj, D. S.
Functors, Monads, Programming	Feb-Mar 2009	Paranjape, Kapil H.
Physics		
Particle Physics	Jan-Apr 2008	Sinha, Nita
Physics of Information and Computation (Quantum part)	Jan-May 2008	Ghosh, Sibasish
Physics of Information and Computing	Jan-Apr 2008	Sinha, Sitabhra
Statistical Mechanics	Jan-Apr 2008	Rajesh, R.
General Relativity	Aug-Dec 2008	Date, G.
Mathematical Physics	Aug-Dec 2008	Sharatchandra, H.S.
Nonlinear Dynamics (Advanced course)	Aug-Dec 2008	Sinha, Sudeshna
Quantum Field Theory II	Aug-Dec 2008	Basu, Rahul
Condensed Matter Physics	Jan-May 2009	Vemparala, Satyavani
Quantum Field theory I	Jan-Apr 2009	Sathiapalan, Balachandran
Theoretical Computer Science		
Algebraic automata theory	Jan-Apr 2008	Lodaya, Kamal
Complexity I	Jan-Mar 2008	Arvind, V.
Mathematical Logic	Jan-Apr 2008	Ramanujam, R.
Modal Logic (Reading Course)	Jan-Apr 2008	Lodaya, Kamal
Randomized Algorithms	Jan-Apr 2008	Subramanian, C. R.

Automata and Computability	Aug-Nov 2008	Mahajan, Meena B.
Complexity II	Aug-Dec 2008	Arvind, V.
Concurrency(Reading Course)	Aug-Dec2008	Lodaya, Kamal
Data Structures and Algorithms	Aug-Dec 2008	Raman, Venkatesh
Discrete Mathematics	Aug-Dec 2008	Subramanian, C. R.
Logic II	Aug-Dec 2008	Ramanujam, R.
Parameterized Complexity	Aug-Dec 2008	Raman, Venkatesh
Programming languages	Aug-Dec 2008	Lodaya, Kamal
Topics in Graph Theory and Combinatorics (Reading Course)	Aug-Dec 2008	Subramanian, C. R.
Computational Complexity	Jan-Apr 2009	Mahajan, Meena B.
Concurrency theory	Jan-Apr 2009	Lodaya, Kamal
Logic I	Jan-May 2009	Ramanujam, R.
Algebra & Computation	Jan-May 2009	Arvind, V.

In addition, the following **lecture courses** were offered during 2008 – 2009 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute and in the Integrated MSc Programme of the University of Mysore.

Course Title	Period	Lecturer
Mathematics		
Functional Analysis	Jan-Mar 2008	Kesavan, S.
Analysis I	Aug-Nov 2008	Kesavan, S.
Physics		
Particle Physics	Jan-Apr 2008	Rajasekaran, G.
Quantum mechanics II	Jan-Apr 2008	Mani, Harihara S.
Quantum Mechanics I	Aug-Dec 2008	Rajasekaran, G.
Quantum Mechanics II	Jan-Apr 2009	Rajasekaran, G.
Mathematical Physics II (Probability Theory and Numerical Method)	Mar-Apr 2009	Ghosh, Sibasish
Classical Mechanics III(Univ.of Mysore)	Aug-Dec 2008	Murthy, M.V.N. & Rajasekaran, G.

2.4.3 Summer Students

Every summer, a small number of students from various institutes/universities come to our institute and work on some learning/research projects with some faculty member for a period of four to six weeks. The following students visited the institute during Apr, 2008 - Mar, 2009.

Student	Faculty
Physics	
Govil, Karan, IIT, Madras	Basu, Rahul
Devi, Sharatha, Physics Dept., American College, Madurai	Ghosh, Sibasish
Rajasekaran, Meenakshi, Dept. Theo. Physics, University of Madras	Ghosh, Sibasish
Kaushik Parasuram,S., BITS, Pilani	Ghosh, Sibasish
Nariya, Maulik, Dept. of physics, University of Pune	Murthy, M.V.N.
Mallick, K., St. Stephens	Rajesh, R.
Dasgupta, Moumita, St Xaviers College, Mumbai	Sinha, Sitabhra
Sreenivasan, Varun, St Xaviers College, Mumbai	Sinha, Sitabhra
Jos, Anna, St Stephen's College, Delhi	Sinha, Sitabhra
Dasgupta, Abhishek, IISER, Kolkata	Sinha, Sitabhra
Pradhan, Neeraj, BITS-Pilani	Sinha, Sitabhra
Meena Devi,J., American College, Madurai	Vemparala, Satyavani
Matthew, John P., St. Stephens, Delhi	Vemparala, Satyavani

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 Apr, 2008 - Mar, 2009.

Student	Faculty
Mathematics	
Nishant, Suri	Nagaraj, D.S.
Devarajan, Kadambari, Anna University	Srinivas, K.
Physics	
Advait Mewada, MNS, Bangalore	Menon, Gautam I.
GuruMurugan, Ganesh	Rajesh, R
Sayanthan, Ghosh	Murthy, M.V.N.
Naskar, Sudip, Calcutta University	Sathiapalan, Balachandran
Rajagopalan, Deepti, SHASTRA University	Vemparala, Satyavani
Brain, Niebergal	Digal, Sanathan

Mayukh, Nilay Khan, IIT, Khragpur	Simon, R.
Rahul Devarani, HNB	Shankar, R
R, Ramya, SHASTRA University	Vemparala, Satyavani
K, Kiruthiga, SHASTRA University	Vemparala, Satyavani
Sameer Kumar, SHASTRA University	Vemparala, Satyavani

Theoretical Computer Science

Somit, NIT- Surathkal	Ramanujam, R.
Somindu, ISI- KolKata	Ramanujam, R.

2.5 Honours and Awards

Cyriac, Aiswarya was awarded Google India Women in Engineering Award, for 2009, by the Google India Pvt Ltd.

Sunder, V. S. was awarded J.C. Bose Fellowship, for 2008, by the DST.

Bhaskaran, G was awarded the fellowship of the Third World Academy of Sciences.

Shankar, R was awarded the Prof. Thathachari Science award.

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.

Chairman of Research and Technology Devolopement of Advisory committee of SETS during Apr 2007 – Apr 2008.

Vice president of Malibnet during Mar 2008 – Mar 2009.

Member of Scientific committee of Indo-French Institute of Mathematics (IFIM)

Member (2007-2010) of Science Engineering Research Council (SERC)of DST

Member of Governing Council, HRI, Allahabad

Member of the Advisory Board of Indian Jour of Pure and applied Mathematics

Basu, Rahul

Convener of International Organising Committee for Signaling the Arrival of the LHC Era held at ICTP, Trieste during Dec 8 – Dec 13, 2008.

Chakraborty, Partha S.

Member of Advisory Committee for NON COMMUTATIVE GEOMETRY AND QUANTUM FIELD THEORY held at IMSc during Dec 18 – Dec 24, 2008.

Date, G.

Secretary of The Indian Association for General Relativity and Gravitation

Lecture during the Science Day, 2009: at IMSc on Feb 28, 2009. Gave a lecture on *Relativity in Precision Navigation* during the National Science Day function held at IMSc.

Ghosh, Sibasish

Convener of Advisory Committee for Entanglement in Quantum Condensed Matter Systems held at IMSc during Nov 17 – Nov 29, 2008.

Convener of Local Organising Committee for Annual K. S. Krishnan Meeting on Quantum Matter and Quantum Entanglement held at IMSc during Dec 2 – Dec 3, 2008.

Speaker at CLRI, Chennai on Feb 28, 2009. I have given there a popular science talk on Quantum Theory of Raman Scattering.

Jaikumar, Prashanth

Organizer, National Science Day at IMSc, Chennai on Feb 28, 2009. Science day lectures and quiz for local college students from Chennai

Kesavan, S.

Reviewer of Mathematical Reviews

Member of Editorial Board, Journal of the Kerala Mathematical Association

Member of Board of Studies in Mathematics, Homi Bhabha National Institute

Member of Board of Studies in Engineering Sciences, Homi Bhabha National Institute

Member of Executive Committee, ICM, 2010

Member of Board of Studies in Mathematics (Postgraduate), University of Madras

Member of Board of Studies, Ramanujan School of Mathematics and Computer Science, Pondicherry University

Member of National Board for Higher Mathematics

Convenor of Academic Council, Chennai Mathematical Institute

Kodiyalam, Vijay

Lecture on "The art of counting" at Children's Club Mylapore on Jul 20, 2008.

Lecture on Combinatorics at Sankara School on Aug 29, 2008.

Lodaya, Kamal

Member of Programme committee, 33rd MFCS symposium, Toruń, 2008 during Jan – Aug, 2008.

Member of Programme committee, 28th FSTTCS conference, Bengaluru, 2008 during Apr – Dec, 2008.

Convener of Local Organising Committee for Perspectives on concurrency theory held at CMI during Dec 15 – Dec 16, 2008.

Member of Local Organising Committee for Workshop on Automata, Concurrency and Timed Systems (ACTS 09) held at CMI during Jan 29 – Jan 31, 2009.

Mahajan, Meena B.

Member of Programme Committee, Symposium on Theoretical Aspects of Computer Science STACS 2009, Germany during Aug 2008 – Feb 2009.

Member of Programme Committee, Jubilee Conference on Discrete Mathematics, Banasthali, India during Aug 2008 – Jan 2009.

Convener of International Organising Committee for DST-RFBR Indo-Russian Workshop on Algebra, Combinatorics, and Complexity. held at Ural State University, Ekaterinburg, Russia during Oct 1 – Oct 3, 2008.

Menon, Gautam I.

Associate Member of Centre for Computational Materials Science, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore during Feb 2007 – Feb 2009.

Member of Board of Studies for Physical Sciences, Homi Bhabha National Institute. Also Balancing Member on the Board of Studies for Biological Sciences during Apr 2007 – Apr 2008.

Associate Member of Advanced Materials Research Unit, S.N. Bose National Centre for Basic Sciences, Kolkata during Jan 2008 – Jan 2009.

Mukhopadhyay, Partha

Member of Local Organising Committee for Indian Strings Meeting 2008 (ISM08) held at Anandha Inn, Pondicherry, India during Dec 6 – Dec 13, 2008.

Murthy, M.V.N.

Member of Program Management Committee (PMC), INO

Member of Board of Studies, Department of Physics, University of Mysore

Paranjape, Kapil H.

Associate Editor of Editorial Board, Proceedings of Indian Academy of Sciences (Mathematical Sciences) during Apr 2006 – Mar 2009.

Member of Editorial Board, Journal of the Ramanujan Mathematical Sciences during Apr 2006 – Mar 2009.

Member of Advisory Board of arXiv.org during Apr 2006 – Mar 2009.

Debian Developer of The Debian Project during Aug 2007 – Mar 2009.

Convener of National Organising Committee for NBHM Summer Programme held at IMSc during Jun 16 – Jul 17, 2008.

Member of Local Organising Committee for RMS-SMF Indo-French Conference on Mathematics held at IMSc during Dec 15 – Dec 19, 2008.

Raghavan, K. N.

Treasurer of Ramanujan Mathematical Society

Member of Local Organising Committee for RMS/SMF/IMSc Indo-French Conference in Mathematics held at IMSc during Dec 15 – Dec 19, 2008.

Rajasekaran, G.

Member of Scientific Steering Committee of INO

Member of Academic Council of CMI

Chairman of Board of Studies for Physics,CMI

A pedagogical article "Is there a Final Theory?" appeared in the Students' Journal of Physics "PRAYAS" published by the Indian Association of Physics Teachers, Pune, in the May 2008 Issue.

Popular Science Lecture at Madras Christian College, Tambaram on Dec 15, 2008. Gave a lecture on "Broken Symmetry in High Energy Physics and the Nobel Prize in Physics (2008)" under the K S Krishnan Popular Science Programme

Popular Science Lecture at Vivekananda College, Chennai on Jan 27, 2009. Gave a lecture on "Journey into the mirocosmos"

Popular Science lecture at Stella Maris College,Chennai on Jan 30, 2009. Gave a lecture on "Journey into the microcosmos"

Raman, Venkatesh

Member of Program Committee of 6th Annual Conference on Theory and Applications of Models of Computation (TAMC 2009) during Jan – Mar, 2009.

Ramanujam, R.

Member, Programme Committee of Computability in Europe 2008: Logic and Theory of Algorithms during Jan – Jun, 2008.

Member, Programme Committee of Logic and the Foundations of Game and Decision Theory, LOFT 2008 during Feb – Jul, 2008.

Member, Programme Committee of Thirteenth International Conference on Implementation and Application of Automata CIAA during Mar – Jul, 2008.

Member, Programme Committee of 11th International Conference on Principles of Knowledge Representation and Reasoning during Mar – Sep, 2008.

Convener of International Organising Committee for Dagstuhl Seminar 08171 on "Beyond the Finite: New Challenges in Verification and Semistructured Data" held at Schloss Dagstuhl, Germany. during Apr 21 – Apr 25, 2008.

Chairperson, Executive Committee of Association for Logic in India

Member, Executive Council of Indian Association for Research in Computing Sciences during Apr – Dec, 2008.

Member, Programme Committee of International Conference on Distributed Computing and Networking ICDCN 2008 during Jul 2008 – Jan 2009.

Member, Programme Committee of 4th International Conference on Information Systems Security during Jul – Dec, 2008.

Member, Programme Committee of Compute 2009 Conference ACM Bangalore during Sep 2008 – Jan 2009.

Convener of International Organising Committee for Workshop on Logic and Social Interaction held at IMSc during Jan 7 – Jan 8, 2009.

Convener of International Organising Committee for Third Indian Conference on Logic and its Applications held at IMSc during Jan 9 – Jan 11, 2009.

Sinha, Rahul

Lecture at The Department of Physics, Chikkanna Govt. Arts College, Tiruppur on Feb 28, 2009. Gave a lecture in a Two Day Lecture Workshop on "Frontier Topics in Physics" during 27-28,February 2009, supported by the Indian Academy of Sciences, Bangalore under the auspices of the Science Education Panel.

Sinha, Sudeshna

Editor of American Institute of Physics Journal "Chaos" during Apr 2007 – Mar 2009.

Member of Advisory Committee for National Seminar on Advances in Nonlinear Systems (ANLS-2009) held at Visva Bharati University, Santiniketan during Feb 21 – Feb 23, 2009.

Srinivas, K.

Chief Guest at 14/20, 25th Street, Thillaiganga Nagar, Nanganallur, Chennai. on Jun 20, 2008. Sri P. K. Srinivasan's 3rd Remembrance day was celebrated. I delivered an invited talk to school teachers on how to teach mathematics to school students.

Convener of Local Organising Committee for Cipher Retreat-II held at The Institute of Mathematics and Applications, Bhubaneswar during Dec 7 – Dec 8, 2008.

Convener of Local Organising Committee for Workshop on Cryptography held at The Institute of Mathematics and Applications, Bhubaneswar during Dec 5 – Dec 6, 2008.

Sunder, V. S.

Convener of Board of Studies for Mathematical Sciences, Homi Bhabha National Institute during Sep 2006 – Sep 2008.

External expert of Selection Committee for IISERE-Pune during Dec – Dec, 2008.

Convener of Local Organising Committee for Workshop on von Neumann algebras, Ergodic Theory and Geometric Group Theory held at IMSc during Feb 2 – Feb 13, 2009.

Chapter 4

Colloquia

4.1 Conferences/Workshops Held at IMSc

4.1.1 NBHM Summer Programme

This is a summer workshop for gifted undergraduate students. Lectures were given by numerous mathematicians from IMSc.

4.1.2 Entanglement in Quantum Condensed Matter Systems

Sibasish Ghosh, R. Simon, G. Baskaran and R. Shankar together organized a workshop entitled "Entanglement in Quantum Condensed Matter Systems", held at IMSc from 17 to 29 Nov., 2008. More than sixty outstation participants were there in the workshop (including the invited participants). More than thirty local participants were there. Ph.D. students, post-docs, college/university lecturers, and even well-known researchers from the fields of quantum information theory as well as quantum many body systems were among the participants. All the participants were quite enthusiastic about the workshop and opined more repetition of it.

4.1.3 RMS/SMF/IMSc Indo-French Conference in Mathematics

There were 36 talks in the areas of algebraic geometry, complex geometry, number theory, probability theory, partial differential equations/ Euclidean harmonic analysis, and Lie groups non-commutative harmonic analysis. There was a panel discussion on applications of mathematics and a special session in honour of Henri Cartan. Of the 36 talks, 12 were plenary and 24 in parallel sessions. About half the number of speakers were French, the other half Indian.

4.1.4 Annual K. S. Krishnan Meeting on Quantum Matter and Quantum Entanglement

This is the 3rd Annual K. S. Krishnan Meeting on frontiers in quantum science, organized each year at IMSc by Prof. G. Baskaran, R. Simon, R. Shankar and A. K. Mishra.

4.1.5 Non Commutative Geometry and Quantum Field Theory

This workshop was planned to study the recent developements in Non commutative geometry and quantum field theory as a sequel to our earliar meeting held on January 2003. The focus was on the interactions between mathematical and physics ideas in this area and bring sections of both groups together for further developements. The workshop was in the form of review talks on recent developements as well as research seminars of importance to the theme.

4.1.6 Workshop on Logic and Social Interaction

There is now a growing body of research on formal algorithmic models of social procedures and interactions between rational agents. These models attempt to identify logical elements within our day-to-day social activities.

Largely using the language of logic and game theory, these studies have led to new insights into the dynamics of observation, updating of knowledge and belief, preference change, dialogues and processes of strategic interaction. Central to many of these studies is a multi-agent perspective on rational agency that situates inference in an interactive context.

This workshop focused on current advances made towards modelling such complex interactive situations, and comprised of talks given by some renowned experts in this area. It also featured shorter presentations of on-going research in these topics, providing opportunities for learning about interaction through interaction.

The workshop had nearly 55 participants, with more than 20 from abroad.

4.1.7 Third Indian Conference on Logic and its Applications

ICLA, the International Conference on Logic and its Applications is a biennial meeting organized by ALI, the Association for Logic in India. The third of this series was held at the Institute of Mathematical Sciences, Chennai, from January 711, 2009.

There were two pre-conference workshops on January 78, 2009 on Algebraic Logic and on Logic and Social Interaction. The main conference took place from January 911, 2009. The conference proceedings, co-edited by R. Ramanujam and Sundar Sarukkai, were published as volume 5378 of the Springer Lecture Notes in Artificial Intelligence (LNAI).

The earlier events in this series featured many eminent logicians as invited speakers, as was the case this year as well. Johan van Benthem, Rajeev Goré, Joel Hamkins, Johann

Makowsky, Rohit Parikh, Esko Turunen and Moshe Vardi gave invited talks. An international program committee considered all submitted papers and selected 12 for the proceedings, and another 10 for presentation at the conference. The page http://ali.cmi.ac.in/icla2009 contains details.

4.1.8 Workshop on von Neumann algebras, Ergodic Theory and Geometric Group Theory

There were two seies of lectures, viz:

(a) von Neumann algebras and ergodic theory, by Narutaka Ozawa (Univ. of Tokyo); and

(b) Ergodic and geometric group theory, by Nicolas Monod (EPLF, Lausanne)

The two workshops were attended by about 25 people, including about 17 people from outside Chennai, with Ph.D. students and post-doctoral scholars from Berkeley and Austin in the US as well as Leuven, Belgium and Tokyo, Japan, and Vivekanada University in Kolkata and TIFR, Mumbai.

4.1.9 Subhashis Nag Memorial Endowment Lecture

The Subhashis Nag Memorial Endowment Lecture for the year 2008-2009 was delivered by Professor Rajesh Gopakumar, Harish-Chandra Research Institute, Allahabad on 'What on earth is string theory?'. This was followed by two lectures by Prof. Gopakumar, on 'Gauge-String Duality'.

4.2 Other Conferences/Workshops Organized by IMSc

4.2.1 Dagstuhl Seminar 08171 on "Beyond the Finite: New Challenges in Verification and Semistructured Data"

Co-organized by: Anca Muscholl, R. Ramanujam, Michaël Rusinowitch, Thomas Schwentick and Victor Vianu.

Objective: *Exploring the interaction of model checking and database static analysis techniques in the development of novel approaches to the verification of software systems handling data.*

The seminar was held from April 21, 2008 until mid-day on April 25 in Schloss Dagstuhl. Since the seminar was centred on 7 themes (as outlined in the proposal, the event was structured accordingly: 7 invited talks (ranging from 60 to 90 minutes each) on each of the themes, and 25 presentations from participants (of 30 minutes each). An excursion to Trier on Wednesday afternoon provided a cultural interlude in a dense academic programme. With extensive interaction and discussions, the seminar was lively (with some heated debates) and highly educative. The central objective of the seminar was to look for common questions and techniques between research on verification and data, and to learn from each other; this was achieved satisfactorily.

Keynote talks were given by: Ahmed Bouajjani on Parameterized verification, Patricia Bouyer on timed systems, Florent Jacquemard on Security protocols, Anca Muscholl on Concurrent systems, Markus Müller-Olm on Software verification, Luc Segoufin on Automata over infinite alphabets, and Victor Vianu on Web services with data.

While logic and automata theory provided the lingua franca for the seminar, the discussions were not exclusively on these. There were presentations, especially in the context of software verification, on modelling issues as well as the use of (theorem proving and model checking) tools, and the pragmatics necessary in such a context.

4.2.2 DST-RFBR Indo-Russian Workshop on Algebra, Combinatorics, and Complexity.(1-3,Oct 2008)

The workshop was jointly organized by Meena Mahajan from IMSc and Mikhail Volkov from Ural State University, Ekaterinburg. The main purpose was to present to both groups some of the main research interests within the group and explore possibilities for future collaboration. Seven scientists from India participated, including two faculty members and three research scholars from IMSc, one faculty member from CMI, and one research scholar from TIFR. Overall there were 16 presentations, 8 from each country, spread out over three days.

4.2.3 Perspectives on concurrency theory

A festschrift for P.S. Thiagarajan.

4.2.4 Cipher Retreat-II

A two-day closed group activity called Cipher Retreat-II was held at Institute of Mathematics and Applications (IMA), Bhubaneswar, during the period December 7-8, 2008. This programme was jointly organised by IMSc, IMA and NISER, Bhubaneswar.

4.2.5 Workshop on Cryptography

A two-day workshop on cryptography was organized at Institute of Mathematics and Applications (IMA), Bhubaneswar during the period December 5-6, 2008. This programme was jointly organised by IMSc, IMA and NISER, Bhubaneswar.

The aim of the workshop was to give an overview of the area of cryptography and information security and to encourage research in this area. About 40 professionals (Graduate students, active researchers and industry professionals) participated in this workshop.

4.2.6 Signaling the Arrival of the LHC Era

This is a conference/school held at ICTP to discuss issues related to physics of the LHC. The Directors of the school were Bobby Acharya (ICTP), Rohini Godbole (IISc), Saurabh Rindani (PRL) and Rahul Basu (IMSc)

4.2.7 Indian Strings Meeting 2008 (ISM08)

The International Workshop ISM08 was the fourth in a series of biennial Indian Strings Meetings, the first , second and third of which were held at the Harish-Chandra Research Institute, Allahabad, in December 2002, at Khajuraho, in December 2004 and at Puri, in December 2006. These meetings are jointly organized by the Indian string theory community. The objective of these meetings is to have a gathering of young researchers and experts in String Theory and related areas in an atmosphere which stimulates expression and elaboration of new ideas. The academic plan is to have a few broad review talks, in addition to seminars, followed by several focussed discussion sessions.

Conference website: http://www.imsc.res.in/ism08/index.html

4.2.8 Workshop on Automata, Concurrency and Timed Systems (ACTS 09)

Concluding meeting of Indo-French project P2R Modiste-Cover/ RNP Timed-Discoveri.

4.2.9 National Seminar on Advances in Nonlinear Systems (ANLS-2009)

The objective of this meeting was to deal with different areas of nonlinear sciences, including mathematical methods, as well as biological, chemical and engineering applications, The seminar was informative and instructive for young researchers in the field.

4.2.10 Neutrinos in Particle Astrophysics and Cosmology

This was a satellite meeting of the ICTS program Aspects of Neutrinos. The focus for the satellite meeting was on neutrino astrophysics and cosmology.

4.3 Seminars

Date	Speaker Affiliation	Title
01-04-2008	John Ebenezer Augustine TRDDC, Pune	Applied Algorithms and Optimization at TRDDC
01-04-2008	G. Baskaran IMSc	High Temperature Superconductivity in a family of Iron based Compounds
02-04-2008	Harald Helfgott University of Bristol	a brief course in arithmetic combinatorics
03-04-2008	Syed R. Hassan Department de Physique, Université de Sherbrooke, Québec, Canada	Slave spin cluster mean field theory away from half-filling: Application to the multiband Hubbard and the extended Hubbard Model
07-04-2008	Vijay Kumar Vijay Kumar Foundation,Gurgaon	Novel growth behaviors of metal clusters and effects of doping
15-04-2008	Monika Sinha SINP, Kolkata	Damping of r-mode instability in neutron stars in presence of magnetic field
16-04-2008	R. Sujatha TIFR, Mumbai	A course of lectures on Catalan's Conjecture
16-04-2008	Yogesh Wadadekar NCRA-TIFR, Pune	Things that go bump in the night sky
17-04-2008	Sudipto Bhattacharyya Electroceramics group, Nanotechnology division Solid State Physics Laboratory, Delhi 110054	Exploring Novel Self-Patterning Routes For The Fabrication Of Nanoscale Multifunctional Hybrids
17-04-2008	A. Tamilselvi IMSc	Robinson-Schensted correspondence

18-04-2008	R. Sujatha TIFR, Mumbai	Catalan's conjecture
21-04-2008	R. Sujatha TIFR, Mumbai	Catalan's Conjecture
21-04-2008	S. Shankaranarayanan ICG, Portsmouth	Probing quantum gravitational physics via inflation
22-04-2008	R. Sujatha TIFR, Mumbai	Catalan's Conjecture
22-04-2008	Kasturi Varadarajan University of Iowa	Metric Clustering and Geometric Set Cover - 1
23-04-2008	Nilanjan Sircar IMSc	Can the Hagedorn phase transition be explained from Matrix model for strings?
23-04-2008	Kasturi Varadarajan University of Iowa	Metric Clustering and Geometric Set Cover - 2
24-04-2008	Sergei Pereverzyev Johann Radon Institute for Computational and Applied Mathematics, Austria	The balancing principle for the regularization of elliptic Cauchy problems
02-05-2008	Rajamanickam Murugan Harvard Medical School / Children's Hospital, Boston	Random walks and jumps in molecular biology
06-05-2008	Kasturi Varadarajan University of Iowa	Metric Clustering and Geometric Set Cover - 3
07-05-2008	Kasturi Varadarajan University of Iowa	Metric Clustering and Geometric Set Cover - 4
08-05-2008	Amritanshu Prasad IMSc	Conjugacy classses in $GL(3, R)$, R a finite local ring
13-05-2008	Roy Joshua Ohio State University	Motivic DGA

15-05-2008	Krishnendu Sengupta SINP, Kolkata.	Quenching dynamics in quantum critical systems
15-05-2008	K R Parthasarathy ISI Delhi	Quantum error correction and Weyl commutation relations.
16-05-2008	Tirthabir Biswas Penn State University	Non-singular Universes
16-05-2008	Mathew C Francis Indian Institute of Science, Bangalore	On boxicity and cubicity
20-05-2008	Pramod S. Joag Dept of Physics, Pune University	An Experimentally Accessible Geometric Measure for Entanglement in N-qubit Pure States
21-05-2008	V. Suneeta Dept. of Math. and Stat. sciences, University of Alberta, Canada	Investigating off-shell stability of string vacua
22-05-2008	Pinaki Chaudhuri Laboratoire des Colloides, Verres et Nanomateriaux (LCVN), Universite Montpellier, France	Dynamics during structural relaxation of a simple glass-former
22-05-2008	K R Parthasarathy ISI Delhi	Quantum error correction and Weyl commutation relations.
28-05-2008	Meena Mahajan IMSc	An arithmetization of LogDCFL that is in LogDCFL
29-05-2008	Ved Prakash Gupta IMSc	Planar algebra of the subgroup-subfactor
04-06-2008	Geevarghese Philip IMSc	Subexponential FPT algorithms for graph problems, using results from graph minor theory
11-06-2008	Bikash Chandra Paul North Bengal University, Siliguri	Emergent Universe Scenariao
12-06-2008	D. S. Ramana HRI, Allahabad	The Large Sieve

12-06-2008	A. J. Parameswaran TIFR, Mumbai	On the Poincare formula and Riemann singularity theorem over a nodal curve
16-06-2008	M Praveen IMSc	Complexity of the reachability problem in subclasses of Petri nets
17-06-2008	Rishikesh Vaidya BITS, Pilani	Flavor Changing Higgs Decay in Supersymmetry
18-06-2008	Siddharth Giridhar Ashok Parameswaran Princeton Uiversity	Order and Disorder in Valence Bond Solids
19-06-2008	Uma Shankar IIT, Bombay	Constraining new physics through $b \to s\mu^+\mu^-$ transition
20-06-2008	Arjun Menon Dept of Physics, University of Michigan	Interplay of B physics, Higgs Physics and Direct Dark Matter Detection limits in Minimal Flavor Violating MSSM
27-06-2008	Vilayanur S. Ramachandran Centre for Brain and Cognition, University of Californoia at San Diego	IS THE HUMAN BRAIN UNIQUE?
09-07-2008	Sergiu Bursuc ENS Cachan, France	Formal verification of security protocols (Deducibility constraints, equational theories and electronic money)
16-07-2008	Sunil Kumar Chebolu University of Western Ontario	A homotopy theoretic perspective of Tate cohomology.
17-07-2008	S. R. Das University of Kentucky	Cosmological Singularities and their gauge theory duals
17-07-2008	Anupam Singh IMSc	Real elements in Finite Linear Groups
22-07-2008	R. Swaminathan IIT Guwahati	Aggregation of lysozyme at alkaline pH: Mechanisms & Inhibition and How to identify an intrinsically disordered protein?

23-07-2008	Krishnaswamy Alladi University of Florida	Some new observations on Gollnitz-Gordon and Rogers Ramanujan Identities
23-07-2008	Anil Shaji Dept. of Physics and Astronomy, The University of New Mexico, Albuquerque, New Mexico	Quantum metrology from an information theory perspective
24-07-2008	S. K. Singh Dept of Physics, Aligarh Muslim University	Modelling Neutrino Cross sections for neutrino Oscillation experiments
24-07-2008	Sourav Chakraborty University of Chicago.	An Online Multi-unit Auction for Perishable Goods with Unknown Supply
28-07-2008	P. Ajith Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut) Hannover, Germany	Searching for gravitational waves from binary black holes
29-07-2008	B V Raghavendra Rao IMSc	Arithmetic circuits, syntactic multilinearity, and the limitations of skew formulae
30-07-2008	Joseph Cheriyan Univ. Waterloo, Canada	On packing Steiner trees and related problems
30-07-2008	P. N. Pandita North East Hill University (NEHU), Shillong	Higgs Physics beyond MSSM
08-08-2008	Golam Mortuza Hossain Institute for Gravitation and the Cosmos, Penn State Univ.	Reliable predictions from quantum cosmology?
11-08-2008	Marc Bourdon Universit des Sciences et Technologies de Lille	Coxeter groups and quasi-conformal geometry
11-08-2008	Gautami Bhowmik Universit de lille, France	Olson's Constant for some p-groups

12-08-2008	Marc Bourdon Universit des Sciences et Technologies de Lille	Gromov's generalisations of property T
13-08-2008	Balasubramanian Ravikumar University of Rhode Island	Some problems Related to leading digit computations
13-08-2008	Uri Onn Ben Gurion University, Israel.	Representations of Automorphism groups of finite O-modules
14-08-2008	R. Prakash IMSc	Spectral synthesis in the Fourier algebra and the Varopoulos algebra
18-08-2008	M. Tucsnak Universite de Nancy, France	Some interfaces between number theory and control of PDEs.
19-08-2008	Colin Benjamin Quantum Information Group, School of Physics and Astronomy, University of Leeds, UK	Quantum information processing in Graphene
20-08-2008	J. Pasupathi Centre for High Energy Physics, IISc, Bangalore	The measurement problem and stochastic reduction in quantum mechanics
05-09-2008	Sunil Simon IMSc	Dynamic logic on games with explicit strategies
10-09-2008	Gautam I. Menon IMSc	Universality in Random Organization
16-09-2008	Peter Koepke University of Bonn	Computation on Ordinals
16-09-2008	S. Senthamarai Kannan CMI	Invariant Theory of Finite Groups - Noether's Bound.
18-09-2008	Ambrus Pal Imperial College, London	Uniform bounds on the cardinality of preperiodic points of certain polynomials
19-09-2008	Subhash Chaturvedi University of Hyderabad	Classification of generalised Wigner distributions in odd prime dimensions

22-09-2008	S Senthamarai Kannan Chennai Mathematical Institute	Invariant Theory of Finite Groups - Noether's Bound (continued)
25-09-2008	T. N. Shorey TIFR, Mumbai	Irreducibility of certain polynomials considered by Schur
26-09-2008	James Libby Oxford University, UK	LHCb: flavour physics at the energy frontier
30-09-2008	Nemani Suryanarayana IMSc	Counting Wobbling dual-Giants
07-10-2008	Ventateswara Pai Technion - Israel Institute of Technology	Some Transport Anomalies in Two Dimensional Electron Systems
15-10-2008	Krishnendu Sengupta Indian Association for Cultivation of Science, Kolkata.	Graphene: What is so interesting about it ?
15-10-2008	Jijo	Planar algebra of asymptotic inclusion
16-10-2008	Debashish Goswami ISI, Kolkata	QUANTUM ISOMETRY GROUPS
23-10-2008	C S Rajan TIFR	Spectrum and Arithmetic
29-10-2008	S. Kalyana Rama IMSc	Stabilisation of Seven Directions in an M theoretic Early Universe Model
29-10-2008	Urjit Yajnik Physics Department, IIT Bombay	Does supersymmery breaking also communicate parity breaking? : some considerations from cosmology
31-10-2008	Urmie Ray Universite de Reims	Automorphic forms and infinite dimensional Lie algebras
04-11-2008	Samindranath Mitra American Physical Society, USA	PRL is 50
13-11-2008	Arnaldo Nogueira Institut de Mathematiques de Luminy, France	Lattice Orbits Distribution on $\mathbb{R}^2$

14-11-2008	K. Sridhar TIFR, Mumbai	Warped Scenarios at the LHC
18-11-2008	Arnaldo Nogueira Institut de Mathematiques de Luminy, France	On $SL(n,Z)_+$-orbits on R^n and positive integral solutions of linear equations.
25-11-2008	Pinaki Sengupta LANL, USA	The Spin Supersolid phase
27-11-2008	T S Radhakrishnan IGCAR, Kalpakkam	MEG - A Technique to Track Brain Dynamics
28-11-2008	Alan McIntosh Centre for Mathematics and its Applications,Australian National University, Canberra, Australia	Solvability of some elliptic PDEs with square integrable boundary data
03-12-2008	Venkatesan Guruswami University of Washington, USA	Expander codes, explicit Euclidean sections, and compressed sensing
03-12-2008	Pijushpani Bhattacharjee Saha Institute, Kolkata	Sizing up the WIMPs of the Milky Way
04-12-2008	Maurice Jansen University of Arhus, Denmark	Lower Bounds for Syntactically Multilinear Algebraic Branching Programs
04-12-2008	Vijay Kodiyalam IMSc, Chennai	Mobius inversion for posets
05-12-2008	Ashoke Sen HRI, Allahabad	Black holes and strings
08-12-2008	Surajit Sengupta IACS, Kolkata	Strain ordering in solids
10-12-2008	Arjendu Pattanayak Carleton College, USA	Hunting Quantum Butterflies: Chaos as a signature of non-monotonicity in the transition from the microscopic to the macroscopic world

11-12-2008	Indubala Satija George Mason University and National Institute of Standard and Technology, USA.	Two-Dimensional Electron Systems in Non-Abelian Gauge Potentials using Ultracold Atoms
12-12-2008	Yngve Villanger University of Bergen, Norway	Treewidth computation and extremal combinatorics
15-12-2008	Urbasi Sinha Institute for Quantum Computing, University of Waterloo	Testing Born's Rule in Quantum Mechanics with a Triple Slit Experiment
16-12-2008	Adam P Arkin VIMSS, Lawrence Berkeley National Laboratory, Berkeley	Noise and Evolution in the Design of Microbial Systems
16-12-2008	Liam McAllister Cornell University	Holographic Systematics of D-brane inflation
17-12-2008	Bulbul Chakraborty Brandeis University	Fluctuations, Response, Entropy and Temperature in Granular Packings
24-12-2008	Shrihari Gopalakrishna Brookhaven National Lab	Hidden sector dark matter and LHC signatures
24-12-2008	Dietmar Berwanger LSV, CNRS & ENS Cachan, France	Coordination Games
26-12-2008	Hans van Ditmarsch University of Otago, New Zealand; CNRS-IRIT, University of Toulouse, France	Quantifying over information change
29-12-2008	Alexis Saurin Alexis Saurin, Universita degli Studi di Torino, Italy and Ecole Polytechnique, France	Proof Search by Cut-Elimination: an Interactive Approach to Logic Programming
29-12-2008	Nilendra Deshpande University of Oregon	Invisible Higgs to Unparticles
30-12-2008	Kaneenika Sinha Univerisity of Alberta	Distribution of Fourier coefficients of certain cusp forms

02-01-2009	Sophie Pinchinat IRISA, Rennes, France	Diagnosis of Pushdown Systems
05-01-2009	Rajendran Raja Fermi Lab	"Opening up the Neutrino Physics Frontier".
05-01-2009	Anand Yethiraj Memorial University, Canada	Sedimentation Equilibrium, Experimental Equation of State, and Dynamics of Hard-sphere and Dipolar Colloids
06-01-2009	Dhrubaditya Mitra School of Mathematical Sciences, Queen Mary College, University of London	Turbulence with polymer additives
06-01-2009	Archana Pai Albert Einstein Institute, Potsdam, Germany	Fishing gravitational wave chirps with a multi-detector network
06-01-2009	M Ram Murty Queen's University, Canada	Artin L-series and applications
12-01-2009	Raymond F. Bishop University of Manchester	Journeys To and In Quantum Phase Space: Extended Quantum Phase-Space Formulations of Quantum Many-Body Theory and Quantum Information Theory
13-01-2009	A. M. M. Pruisken ITP, University of Amsterdam	The Coulomb blockade and superuniversality of the theta angle
13-01-2009	Johann Makowsky Technion - Israel	50 years of the spectrum problem
13-01-2009	Johann Makowsky	50 years of the spectrum problem (cont'd)
15-01-2009	Krishna Maddaly IMSc, Chennai	Interband Light Absorption Coefficient -Regularity
15-01-2009	Eric Allender Rutgers University, USA	Cracks in the Defenses: Scouting Out Approaches on Circuit Lower Bounds

15-01-2009	Michael Fellows University of New Castle, Australia	Some New Results and Open Problems in the Complexity Ecology of Structural Parameters
16-01-2009	R. Raghavan Virginia Polytechnic Institute and State University, Blacksburg VA 24061	Resonant Neutrino Capture as a Laboratory Probe of the Planck length
16-01-2009	Johann Makowsky Technion - Israel	Graph polynomials
16-01-2009	Rajesh Gopakumar HRI, Allahabad	WHAT ON EARTH IS STRING THEORY?
19-01-2009	Rajesh Gopakumar HRI, Allahabad	Gauge-String Duality - I
20-01-2009	Rajesh Gopakumar HRI, Allahabad	Gauge-String Duality - II
21-01-2009	Johann Makowsky Technion - Israel	Algorithmic uses of the Feferman-Vaught theorem
27-01-2009	Philippe Darondeau IRISA, Rennes, France	Recognizable Event Domains
27-01-2009	M.S. Raghunathan TIFR, Mumbai	Bruhat Tits Theory
28-01-2009	M.S. Raghunathan TIFR, Mumbai	Bruhat Tits Theory
28-01-2009	Saket Saurabh University of Bergen, Norway	Non existence of polynomial kernel for connected vertex cover
28-01-2009	Saurabh Basu IIT, Guwahati	Pairing, superconductivity and magnetism in single layers and bilayers (Some comments on the cuprates)
02-02-2009	Saket Saurabh University of Bergen, Norway	Counting subgraphs using graph homomorphism

03-02-2009	Jerome Henin University of Pennsylvania	Enhancing sampling in biomolecular simulations using the Adaptive Biasing Force method
06-02-2009	II MSc Students IMSc	Students Seminars
06-02-2009	Siddharth Parameswaran Princeton University, Princeton, NJ, USA	Quantum Hall Ferromagnetism in Bilayer Graphene
11-02-2009	Kavita Jain JNCASR, Bangalore	Two problems in Evolutionary Biology
11-02-2009	S Srinivasa Rao ITU Copenhagen	Succinct data structures
16-02-2009	Raghavan Narasimhan University of Chicago	Riemann RochTheorem-I
16-02-2009	A Thyagaraja Culham Science Center, Abingdon, UK	Issues in plasma turbulence and fusion research
16-02-2009	C. P. Anil Kumar IMSc	Mobius transformations and their geometric properties
17-02-2009	Areejit Samal Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany	Flows on complex biochemical networks: Role of low degree metabolites
18-02-2009	Arindam Kundagrami	Physics of charged polymers: effective charge, size, phase transitions, and other properties as soft materials
19-02-2009	Gautam Bharali IISc, Bangalore	The polynomial hull near a degenerate CR singularity: Bishopdiscs revisited
20-02-2009	Raghavan Narasimhan University of Chicago	Riemann RochTheorem-II

25-02-2009	Rajat K. Bhaduri Department of Physics and Astronomy, McMaster University, Canada	The two-body problem of ultra-cold atoms in a harmonic trap
26-02-2009	Dave Penneys University of California, Berkeley	Categories and Pictures
26-02-2009	Urjit Yajnik IIT, Bombay	Two themes in Topology and Stability
02-03-2009	Krishnan Rajkumar IMSc	Two proofs of the irrationality of zeta(3)
04-03-2009	K.T. Mahanthappa University of Colorado at Boulder	Tri-bimaximal Neutrino Mixing and Quark CKM Matrix from Finite Group (d)T
05-03-2009	Amritanshu Prasad IMSc, Chennai	The Weil Representation of a symplectic groups over Z/NZ when N is odd
09-03-2009	Umesh Dubey IMSc	Birational maps between rational surfaces
11-03-2009	Tapas Kumar Das HRI, Allahabad	Black Holes in Your Bathtub
11-03-2009	Piotr Pragacz Polish Academy of Sciences, Warsaw	The diagonal property versus homogeneous spaces
12-03-2009	Piotr Pragacz Polish Academy of Sciences, Warsaw	Thom Polynomials
12-03-2009	Tapas Kumar Das HRI, Allahabad	Astrophysical accretion as an analogue gravity phenomena
16-03-2009	Sarbeswar Pal IMSc	Geometry of the Jacobian of smooth projective hyperelliptic curves
16-03-2009	I Hal Sudborough University of Texas, Dallas, USA	An (18/11)n Upper Bound for the Pancake Problem

18-03-2009	Linda Morales Texas A&M University, Commerce, USA	A Quadratic Lower Bound for Knuth's "Top-Swaps" Open Problem
20-03-2009	Raul Garcia-Patron Sanchez Massachusetts Institute of Technology	Classical Capacity of Bosonic Channels
23-03-2009	Archana Achalere Department of Physics, Pune University	Mass anisotropy and vortex state properties of High-Tc superconductors
23-03-2009	Jaideep Mulherkar University of California Davis	Implementing quantum gates using the Heisenberg ferromagnetic quantum spinchain
23-03-2009	S. Sundar IMSc	The dimension spectrum for the odd dimensional quantum sphere
23-03-2009	Rajiv Raman MPI Saarbrucken	Maximum feasible subsystems of 0/1 matrices and profit maximizing pricing
24-03-2009	Sushanta Dattagupta IISER, Kolkata	Third Law of Thermodynamics in the Context of Dissipative Diamagnetism
24-03-2009	Debashis Ghoshal SPS, Jawaharlal Nehru University, New Delhi	The 'Character' of Logarithmic Conformal Field Theories
25-03-2009	Peter Grassberger John von Neumann Institute for Computing, Julich, Germany	Mutual Information: Applications from Independent Component Analysis to Sequence Alignment
30-03-2009	Tapas Chatterjee IMSc	Van Kampen Theorem-I

Chapter 5

External Interactions

5.1 Collaborative Projects with Other Institutions

5.1.1 Biology of CD40 signalling in uninfected and *Leishmania*-infected macrophages

This is a DBT project involving Rahul Siddharthan, Sitabhra Sinha and Gautam Menon from IMSc, together with Bhaskar Saha of the NCCS Pune and Parag Sadhale of the Indian Institute of Science, Bangalore

5.1.2 DST CP-STIO, Program for people of Indian Origin

Study of noncommutative geometry and particle physics

5.1.3 DST Indo Croatian project on Calogero-Sutherland model, Integrable models and Noncommutative geometry

We study integrable models, Calogero models and noncommutative geometry with the motivation to understand near horizon structure blackholes

5.1.4 Electron transport along monoatomic electrochemical wires and chains

A DST-DAAD project involving IMSc and University of Ulm, Germany. A.K. Mishra and Vallan Bruno Cruz are the project members from Indian side and Prof. W. Schmickler and Ms. Sonja Bartenschlager are German participants.

5.1.5 India-based Neutrino Observatory (INO)

As in previous years, INO group at IMSc is an active participant in the collaboration. The INO group at IMSc consists of D. Indumathi, Prashanth Jaikumar, M.V.N. Murthy, G. Rajasekaran and Nita Sinha. In addition a full time project member N.S. Sreenivasan is involved in the INO group activities related to engineering aspects and clearances.

Last one year has seen the INO group at IMSc active in getting statutory clearances for the project. The environmental clearance for the project was coordinated through IMSC and the clearance was given in April 2008 after making presentations to the expert committee of Ministry of Environment and Forests, Government of India.

However, the forest clearance which is necessary to start construction is yet to be given by Government of Tamil Nadu. Work is in progress towards this end as also obtaining the necessary clearances from the Pollution Control Board (PCB).

In view of concerns expressed regarding environment and ecology, many meetings with scientists working on the environment and ecology of the region in which INO site at Singara is located were held. INO team also met the environmental activists on April 17, 2008 in Collector's office at Ooty to brief them on the measures taken by INO to address environmental concerns. INO group from IMSc also participated in the Gram Sabhas meeting held at Masinagudi on May 1, 2008 to explain and seek the cooperation of the local villagers. A meeting with members of Madras Naturalists Society (MNS) was organised in IMSc in August 2008.

In connection with the Forest clearance, INO team also met the Chief Minister on December 18, 2008 along with the Chairman of AEC, Dr. Anil Kakodkar to impress upon him the urgency of getting the clearance. On the same day a meeting with Forest officials also took place at IMSc, chaired by the AEC Chairman and the Principal Chief Conservator of Forests, Dr. C.K. Shreedharan. Extensive discussions took place and it is hoped that this will pave way for obtaining the clearance.

The IMSc group continues to be associated with the Physics analysis and Simulations relevant to the Magnetised Iron Calorimeter (ICAL) detector at INO. Apart from the physics results that can be studied with atmospheric neutrinos and neutrinos from long base-line neutrino beams, the group is also engaged in studies such as track recognition and reconstruction using ICAL detector.

The members of the group continue to take active part in INO outreach activities, such as giving popular lectures at various universitities and other such institutions with the long term goal of creating awareness and interest in INO as well as generate human resources necessary for such a large project.

5.1.6 Physical Properties Relevant to Nanoscale Devices and Biological Motors in the Brownian Regime

Joint project with A.M. Jayannavar (IOP, Bhubaneswar) and Surajit Sengupta (SNBNCBS, Kolkata), funded by the Nanoscience and Nanotechnology Initiative of the DST, India. Our general goal in this project is posed in terms of the following questions which we will attempt to address: What are the generic ingredients of models for machines which can do work in a thermal (Brownian) environment? How do physics requirements constrain the design, performance and efficiency of nanoscale machines? Are there general principles governing how biological systems perform work at the nano-scale? Can we use models devised for understanding the functioning of nano-scale biological motors for insights into guiding principles for the construction of man-made devices at that scale? Finally, what materials properties of nano-scale devices might be optimally selected if they are to be used as machine components?

5.1.7 The Mechanics of Living Matter

Joint project with Sriram Ramaswamy (IISc, Bangalore), Jacques Prost (Institut Curie, Paris), J.-F Joanny (Institut Curie, Paris), Madan Rao (RRI and NCBS, Bangalore), Yashodhan Hatwalne (RRI, Bangalore) and David Lacoste (Institut Curie, Paris). Funded by the Indo-French Centre for the Promotion of Advanced Research (CEFIPRA). The project will focues on active systems, i.e. systems which contain components which are capable of taking up energy from their surroundings and turning it into motion via an irreversible chemical reaction. They arise primarily in biology, but soft-matter and nonequilibrium statistical physics are essential to understanding them.

5.1.8 Wave Propagation in disordered excitable media and simulated cardiac tissue

This is an IFCPAR project (no. 3404-4) funded by the Indo-French Centre for the Promotion of Advanced Research, being carried out in collaboration with Prof Alain Pumir of ENS-Lyon, France.

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 01.04.08 to 31.03.09 are :

D. Goverdhan Khadekar
Dept. of Mathematics, RTM Nagpur University, Nagpur
18.05.08 to 27.05.08

P.N. Pandita
NEHU, Shillong
20.06.08 to 07.08.08

Rajdeep Niyogi
IIT, Roorkee
20.06.08 to 17.07.08

Ramandeep S. Johal
Lyallpur Khalsa College, Jalandhar
06.06.08 to 03.07.08

Swarup Poria
Midnapore College, Midnapore, West Bengal
20.05.08 to 06.06.08

Subinay Das Gupta
Dept. of Physics, University of Calcutta, Kolkatta
15.06.08 to 28.06.08

5.3 Conference Participation and Visits to Other Institutions

A V, Sreejith

Participated in *Foundations of Software Technology and Theoretical Computer Science* held at IISc,Bangalore during Dec 9 – Dec 11, 2008.

Balakrishnan, Radha

Visited George Mason University, Fairfax, USA during Jun 1 – Jun 29, 2008. For collaborative research

Participated in *International Conference on Nonlinear Dynamical Systems and Turbulence* held at Indian Institute of Science, Bangalore during Jul 17 – Jul 22, 2008. Gave an invited talk on Quantum effective potential, electron transport and conformons in biopolymers/nanotubes

Visited Bharathidasan University, Tiruchirapalli during Nov 19 – Nov 20, 2008. As a Ph. D examiner and for discussions on problems of mutual interest

Visited Department of Physics, University of Pune, Pune during Jan 5 – Jan 8, 2009. Gave a TPSC seminar on Curvature induced quantum potentials in biopolymers and nanotubes

Visited Universite de Cergy-Pontoise, France during Mar 13 – Mar 31, 2009. For collaborative research

Participated in *Workshop on Geometry, Topology and Nonlinearity in Biophysics: Conformations in DNA, polymers and such* held at Universite de Cergy-Pontoise, France on Mar 26, 2009. Gave an invited lecture on Effect of curved geometry on electron transport in biopolymers

Basu, Madhushree

Participated in *Lectures on 'Operator Algebras' by Professor V. S. Sunder in the 'Panorama of Mathematics series'* held at Indian Statistical Institute, Kolkata during Nov 3 – Nov 7, 2008.

Participated in *Workshop on von Neumann Algebras, Ergodic Theory and Geometric Group Theory* held at The Institute of Mathematical Sciences, Chennai during Feb 2 – Feb 13, 2009.

Basu, Rahul

Participated in *Initial Conditions in Heavy Ion Collisions* held at International Centre, Goa, organised by TIFR, Mumbai during Sep 1 – Sep 19, 2008. Speaker

Participated in *Preparatory SERC School in High Energy Physics* held at Khalsa College, Delhi University during Sep 30 – Oct 13, 2008. Guest Lecturer for Particle Physics and Standard Model course

Visited ICTP, Trieste during Dec 8 – Dec 13, 2008. Signaling the Arrival of the LHC era

Bhowmick, Samrat

Participated in *Spring School on Superstring Theory and Related Topics* held at International Centre for Theoretical Physics (ICTP), Trieste, Italy during Mar 27 – Apr 4, 2008.

Chakraborty, Partha S.

Visited University of Adelaide during Apr 1, 2008 – Mar 6, 2009. 1) Gave a series of 4 lectures in June 2009 titled "A Categorical approach to KK-Theory."

2)Gave a series of 5 lectures at the Strings seminar in February 2009 titled "Towards Kontsevich's Deformation Quantization of Poisson Manifolds".

Visited Australian National University, Canberra during Dec 1 – Dec 5, 2008. Visited Prof. Adam Rennie.

Participated in *Algebras, Operators and Noncommutative Geometry* held at Australian National University, Canberra during Dec 1 – Dec 5, 2008. Satellite Meeting of the 7th Australia - New Zealand Mathematics Convention (ANZMC 2008); Gave an invited talk titled "Geometry of Odd Dimensional Quantum Spheres".

Visited Institute of Geometry and Applications, University of Adelaide on Feb 28, 2009. Gave a talk titled "Geometry of Odd Dimensional Quantum Spheres"

Chorwadwala, Anisa M.

Participated in *Attended the School and Conference on Differential Geometry* held at The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy during Jun 2 – Jun 20, 2008.

Visited The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy during Jun 9 – Sep 8, 2008, as a visiting scientist.

Participated in *Attended the RMS/SMF/IMSc Indo-french Conference in Mathematics 2008* held at IMSc and CMI, Chennai during Dec 15 – Dec 19, 2008.

Choudhary, Sujit K.

Participated in *Workshop on Entanglement and Condensed Matter Systems* held at The Institute of Mathematical Sciences, Chennai. during Nov 17 – Nov 29, 2008. Presented a poster entitled, "Local cloning of entangled states"

Participated in *K.S. Krishnan Discussion meet - Frontier in Quantum Sciences: Quantum Matter Quantum Information* held at The Institute of Mathematical Sciences, Chennai. during Dec 1 – Dec 2, 2008.

Cyriac, Aiswarya

Participated in *Microsoft Research India TechVista* held at Chennai Convention Centre, Chennai on Oct 1, 2008.

Participated in *Foundations of Software Technology and Theoretical Computer Science* held at IISc, Bangalore during Dec 9 – Dec 11, 2008.

Participated in *Microsoft Research India Theory Day* held at IISc, Bangalore on Dec 17, 2008.

Participated in *Third Indian Conference on Logic and its Applications* held at IMSc, Chennai during Jan 9 – Jan 11, 2009. Presented a paper titled 'Lower Bound for the Communication Complexity of the Russian Cards Problem'

Participated in *Workshop on Automata, Concurrency and Timed Systems* held at Chennai Mathematical Institute, Chennai during Jan 29 – Jan 31, 2009.

Date, G.

Participated in *From Black Holes to the Universe: Gravity at Work* held at Saha Institute of Nuclear Physics, Kolkata during Jan 28 – Jan 31, 2009. Gave a talk on *LQC Effective Actions and Higher Curvature Gravity* in the workshop on Quantum Gravity.

Visited Indian Institute of Technology, Kharagpur during Feb 1 – Feb 5, 2009. Gave a colloquium on *Relativistic Effects in Precision Navigation.*

Digal, Sanatan D.

Participated in *Quark Matter 2008* held at Jaipur, India during Feb 4 – Oct 10, 2008.

Ghosh, Sibasish

Visited School of Physical Sciences, JNU, New Delhi during Apr 13 – Apr 20, 2008. Invited by Prof. S. M. Roy, Raja Ramanna Fellow at SPS, JNU, for collaboration on a research problem on 'Joint Measurement'. Gave a talk.

Participated in *International Conference on Cold Atoms* held at IISER, Kolkata during Dec 12 – Dec 16, 2008. Gave an invited talk entitled, "Entanglement Sudden Death and Energy Exchange".

Participated in *AICTE Sponsored Two Day National Level Workshop on "Advanced Computing Concepts"* held at Sri Venkateswara College of Engineering and Technology, Chittoor, A.P. during Mar 13 – Mar 14, 2009. Gave an invited talk on Quantum Computing

Gun, S.

Participated in *Discussion meeting on Modular Forms* held at Harish-Chandra Research Institute during Feb 21 – Mar 6, 2009. Gave a series of lectures on modular forms

Participated in *International Conference in Mathematics* held at Harish-Chandra Research Institute during Mar 7 – Mar 8, 2009. Gave an invited talk on "A variant of Lehmer's Conjecture"

Ivan, Solomon J.

Participated in *Workshop on Entanglement and Condensed Matter Systems* held at IMSc, Chennai during Nov 17 – Nov 29, 2008. Gave a talk titled "From nonclassicality to entanglement".

Participated in *K.S. Krishnan Discussion Meet: Frontier in Quantum Sciences: Quantum Matter and Quantum Information* held at IMSc, Chennai during Dec 1 – Dec 2, 2008.

Jabeen, Zahera

Participated in *DST-SERC School on Nonlinear Dynamics* held at IMI, IISc Bangalore during Jun 26 – Jul 16, 2008. (Tutor)

Participated in *International Conference on Nonlinear Dynamical Systems and Turbulence* held at IMI, Department of Mathematics, IISc, Bangalore during Jul 17 – Jul 22, 2008.

Jaikumar, Prashanth

Visited Argonne National laboratory, Argonne, Illinois, USA during Apr 28 – Nov 30, 2008. Visiting scientist

Visited University of Chicago during Jun 17 – Jun 18, 2008. Gave an invited talk

Visited Ohio State University during Jul 10 – Jul 13, 2008. Gave an invited talk, collaborative work

Visited University of Calgary during Jul 19 – Aug 18, 2008. collaborative work

Participated in *Workshop on equation of state in astrophysics* held at Argonne national laboratory, Argonne, Illinois, USA during Aug 21 – Aug 26, 2008. Gave an invited talk

Participated in *DAE-BRNS symposium on high energy physics* held at Benares, UP, India during Dec 12 – Dec 18, 2008. Gave an invited talk

Visited California State University Long Beach during Feb 9 – Feb 11, 2009. Gave an invited colloquium

Jampa, Maruthi Pradeep Kanth

Participated in *"Disorder, Complexity and Biology II (DISCOMB-09)"* held at Banaras Hindu University, Varanasi during Jan 5 – Jan 8, 2009.

Joglekar, Pushkar S.

Participated in *Indian Algorithms Seminar* held at Khandala, India during Oct 15 – Oct 18, 2008. Gave atalk on : Some Sieving Algorithms for Lattice Problems.

Participated in *Foundtations of Software Technology and Theoretical Computer Science* held at IISc, Bangalore during Dec 9 – Dec 11, 2008. Presented the paper: "Some Sieving Algorithms for Lattice Problems".

Kalelkar, Tejas D.

Participated in *Workshop on Topology and Geometry of Foliations* held at Indian Statistical Institute, Kolkatta during Nov 24 – Dec 6, 2008.

Participated in *Indo-French conference in mathematics* held at IMSc during Dec 15 – Dec 19, 2008.

Kesavan, S.

Visited Université Paul Sabatier, Toulouse, France during May 1 – May 31, 2008. Visiting Professor. Delivered a colloquium talk.

Visited Institut Elie Cartan, Université Henri Poincaré, Nancy I, Nancy, France. during Jun 1 – Jun 15, 2008. Visitor under an IFCPAR (CEFIPRA) project.

Participated in *International Conference on Control Theory* held at Institut Henri Poincaré, Paris, France during Jun 16 – Jun 20, 2008.

Participated in *International Conference on partial Differential Equations and Applications, in honour of Professor Philippe G. Ciarlet's Seventieth Birthday.* held at City University of Hong Kong during Dec 5 – Dec 8, 2008. Delivered an invited talk.

Participated in *Indo-French Conference in Mathematics* held at IMSc and CMI, Chennai during Dec 15 – Dec 19, 2008. Delivered a plenary lecture.

Kodiyalam, Vijay

Visited Periyar University, Salem on Feb 13, 2009. Attended the NCAA and gave a talk on "The combinatorics of free probability"

Visited RIASM, Chennai on Mar 24, 2009. Gave a talk on "From planar algebras to subfactors"

Krishna, M.

Participated in *Annual Conference of Ramanujan Mathematical Society* held at IIT Kanpur during May 19 – May 21, 2008. Gave Plenary talk on "Spectrum of Random Operators".

Visited Pondicherry University during Jun 9 – Jun 15, 2008. Training Programme in Mathematics for Undergraduate students.

Participated in *Probability Theory and Stochastic Processes* held at Cochin University of Science and Technology,Cochin during Feb 6 – Feb 9, 2009. Talk on "Properties of spectral measures of some random operators"

Participated in *International Conference in Mathematics* held at Harishchandra Research Institute, Allahabad during Feb 16 – Feb 20, 2009. Talk on "Some questions in Spectral Theory"

Participated in *16th Ramanujan Symposium in Fourier Analysis and its Applications* held at Ramanujan Institute, Chennai during Feb 25 – Feb 27, 2009. Talk on "Continuity of some spectral measures"

Participated in *One day symposium in Mathematics* held at Department of Mathematics, University of Delhi on Mar 30, 2009. Talk on "Some questions in Spectral Theory"

Lodaya, Kamal

Visited TIFR, Mumbai during Jun 29 – Jul 3, 2008. Gave a talk on "Regular expressions".

Visited IIT Bombay during Jul 14 – Jul 16, 2008.

Participated in *7th Formal Methods Update* held at TRDDC, Pune during Jul 17 – Jul 19, 2008. Gave a talk on "Doing automata theory over dense linear orders"

Participated in *Mathematical foundations of computer science (MFCS)* held at Toruń during Aug 25 – Aug 29, 2008. Member of programme committee

Visited LIAFA, Paris during Aug 31 – Sep 12, 2008. Gave a talk on "Analyzing reachability for some Petri nets with fast growing markings"

Participated in *2nd Reachability Problems workshop* held at Liverpool during Sep 15 – Sep 17, 2008. Presented a paper on "Analyzing reachability for some Petri nets with fast growing markings", and gave a tutorial on the Petri net reachability problem

Visited School of computer science, University of Birmingham during Sep 18 – Sep 26, 2008. Gave a talk on "An unambiguous temporal logic"

Participated in *Workshop on Algebra, combinatorics and complexity* held at Ural State University, Ekaterinburg during Oct 1 – Oct 3, 2008. Gave a talk on "An unambiguous temporal logic"

Visited TIFR, Mumbai during Nov 16 – Nov 20, 2008. Gave a talk on "Petri net reachability".

Visited IIT Bombay on Nov 21, 2008. Gave a talk on "Marking the chops: an unambiguous temporal logic"

Participated in *Workshop on Automata, concurrency and timed systems (ACTS '09)* held at CMI during Jan 29 – Jan 31, 2009. Gave a talk titled "Around dot depth two".

Mahajan, Meena B.

Participated in *Workshop on Algebra, Combinatorics and Complexity* held at Moscow during Jun 6 – Jun 7, 2008. Gave a talk titled "Polynomial-size log-depth circuits: between NC^1 and AC^1".

Participated in *3rd International Computer Science Symposium in Russia (CSR 2008)* held at Moscow during Jun 8 – Jun 12, 2008. Presented the paper titled "On the Complexity of Membership and Counting in Height-Deterministic Pushdown Automata"

Participated in *DST-RFBR Indo-Russian Workshop on Algebra, Combinatorics and Com-*

plexity. held at Ekaterinburg, Russia. during Oct 1 – Oct 3, 2008. Gave a talk titled "Small-width arithmetic circuits"

Participated in *Indian Algorithms Seminar* held at Khandala, India during Oct 15 – Oct 19, 2008. Gave a talk titled "Small width arithmetic circuits".

Participated in *Perspectives in Concurrency Theory* held at CMI, Chennai during Dec 15 – Dec 16, 2008.

Participated in *Microsoft Research India Theory Day* held at Bangalore on Dec 17, 2008.

Participated in *3rd Annual Workshop on Algorithms and Computation (WALCOM 2009)* held at ISI Kolkata, India during Feb 18 – Feb 20, 2009.

Visited CS Dept., IIT Kanpur during Feb 22 – Mar 4, 2009.

Visited Madras Christian College on Mar 27, 2009. Gave two lectures, on Undecidability and on Intractability, in the one-day Workshop on Theory of Computation and Graph Theory.

Majumdar, Kaushik K.

Visited Odyessee Lab (in France, a joint venture between ENS, Paris and INRIA, Sofia Antipolis) during Jul 1, 2007 – Jun 30, 2008. Research as an Invited Scientist.

Mallick, Vivek M.

Participated in *RMS/SMF/IMSc Indo-French Conference in Mathematics 2008* held at Institute of Mathematical Sciences, Chennai and Chennai Mathematical Institute, Chennai during Dec 15 – Dec 19, 2008.

Participated in *Workshop on Vector Bundles* held at Chennai Mathematical Institute, Chennai during Feb 23 – Mar 6, 2009.

Menon, Gautam I.

Visited ESPCI, Paris on May 19, 2008. A months visit as part of an Indo-French Collaborative project. Seminar on "Numerical Methodologies for Nematodynamics"

Visited CEA Saclay on Jun 16, 2008. Seminar on "Driven Disordered Polymorphic Solids"

Visited European Molecular Biology Laboratory, Heidelberg during Jun 19 – Jun 21, 2008. Visited the group of Thomas Surrey. Delivered a seminar on "Pattern Formation in Motor-MIcrotubule Mixtures"

Visited Indira Gandhi Centre for Atomic Research, Kalpakkam on Jul 2, 2008. Popular-level lecture on "Biological Machines"

Visited Institute of Physics, Bhubaneshwar during Sep 14 – Sep 18, 2008. Delivered an Institute Colloquium on "The Reversible-Irreversible Transition"

Visited Utkal University on Sep 16, 2008. Seminar on "Polymer Loops and Rings"

Participated in *Indo-Belgian Symposium on the Statistical Physics of Small Systems* held at Indian Institute of Technology, Madras, Chennai during Nov 9 – Nov 11, 2008. Invited Talk on "Universality of Random Organization"

Visited Central Institute of Brackishwater Aquaculture on Dec 22, 2008. Colloquium Talk on "Molecular Machines"

Participated in *Workshop on Computational Physics* held at Stella Maris College, Chennai during Jan 23 – Jan 24, 2009. Inaugural Lecture on "The Purpose of Computation is Insight"

Participated in *Self-Organization and Dynamics of Active Matter* held at Institut Henri Poincare, Paris during Jan 27 – Jan 30, 2009. Invited Short Talk on "Universality of Random Organization"

Participated in *Fluid Mechanics Seminar* held at Chennai Mathematical Institute, Chennai on Feb 12, 2009. Two invited talks, one a Colloquium on "Random Organization and The Reversible-Irreversible Transition" and the other a technical seminar on "Hydrodynamics of Biological Membranes"

Participated in *Mahabaleshwar Seminar on Modern Biology: Mechanosignalling in Cell and Developmental Biology* held at National Centre for Biological Sciences, Bangalore during Feb 14 – Feb 19, 2009. Series of 4 invited lectures on "Physical Methods for Biologists"

Participated in *International Symposium on Emerging Areas in Biosciences and Bioengineering* held at Indian Institute of Technology, Bombay during Feb 26 – Feb 28, 2009. Invited Talk on "Bubbles and DNA Cyclization"

Visited Cochin Institute of Science and Technology (CUSAT), Kochi during Mar 5 – Mar 6, 2009. Visit and TPSC seminar

Participated in *G.N. Ramachandran Memorial Lecture* held at Maharaja's College, Ernakulam on Mar 6, 2009. Delivered Memorial Lecture on "Physics meets Biology at the Scale of the Cell"

Participated in *K.S. Krishnan Endowment Lecture,* held at Indian Association for the Cultivation of Science, Kolkata on Mar 25, 2009. Delivered Endowment Lecture on "Rods, Worms and Spring Theory: The Physics of DNA Revisited"

Participated in *Recent Trends in Condensed Matter Physics II* held at Saha Institute of Nuclear Physics, Kolkata during Mar 27 – Mar 28, 2009. Two invited talks on “Physics meets Biology at the Scale of the Cell”

Mishra, Ashok K.

Visited Instituto Nacional de Pesquisas Espaciais, S. J. Campos, Brazil during Oct 3, 2007 – Oct 2, 2008. Worked on orthofermion problem in the context of strongly correlated electron systems and taught a course on Electron Transfer Reactions and a course on Strongly Correlated Electron System at INPE.

Mukhopadhyay, Partha

Participated in *Indian Strings Meeting, 2008* held at Anandha Inn, Pondicherry (hosted by IMSc) during Dec 6 – Dec 13, 2008.

Murthy, M.V.N.

Participated in *NuBeam– Neutrino and Beams* held at Windamere Hotel, Darjeeling during May 5 – May 7, 2008. Invited talk on “INO site at Singara: Present Status”

Nagaraj, D. S.

Visited University of Lille during May 1 – May 31, 2008. Gave a talk titled “Morphisms from P^2 to $Gr(2,4)$”

Visited University of Hyderabad during Dec 30, 2008 – Jan 5, 2009. Attended a conference on Algebraic Groups and K- theory.

Paranjape, Kapil H.

Participated in *First Indo-Brazil Conference on Mathematics* held at IMPA, Rio de Janeiro, Brazil during Jul 28 – Aug 1, 2008. Gave an Invited Talk on ”Varieties defined over number fields”

Participated in *RMS SMF Indo-French Conference* held at IMSc/CMI, Chennai during Dec 15 – Dec 19, 2008. Was a local organiser.

Gave an invited talk on “A geometric characterisation of varieties defined over number fields”.

Participated in *ICLA 2009* held at IMSc, Chennai during Jan 7 – Jan 11, 2009.

Paul, Pampa

Participated in *Multiplicity Conjectures, Resolution of Singularities and Toric Geometry* held at IIT Madras during Dec 22, 2008 – Jan 3, 2009.

Prasad, Amritanshu

Visited University of East Anglia during Nov 16 – Nov 20, 2008. Research collaboration with Anish Ghosh.

Visited L'Institut des Hautes Etudes Scientifiques during Nov 20 – Dec 20, 2008. Research collaboration with Uri Onn, Alexander Stasinski, Anne-Marie Aubert and Ilya Shapiro.

Visited University of Bristol during Dec 2 – Dec 4, 2008. Research discussion with Nick Gill.

Participated in *16th Ramanujan Symposium on Fourier Analysis and its Applications* held at Ramanujan Institute of Advanced Study in Mathematics, University of Madras during Feb 25 – Feb 27, 2009. Invited speaker.

Praveen, M.

Visited Ural state university, Ekaterinburg, Russia during Oct 1 – Oct 3, 2008. Gave a talk based on our paper [**Pr**]. Also attended talks by faculty and students of Ural state university, which were based on algebraic studies of system models and synchronizing automata.

Participated in *Workshop on Automata, Concurrency and Timed Systems* held at Chennai Mathematical Institute, India during Jan 29 – Jan 31, 2009. Gave a talk titled *Petri nets with small path property*, which proposed a common property in our previous work [**Pr**] and others' work related to the reachability problem.

Raghavan, K. N.

Participated in *ISI Workshop on Group Theory* held at Indian Statistical Institute, Bangalore during May 12 – May 30, 2008. As resource person

Participated in *Annual Conference of the Ramanujan Mathematical Society* held at Indian Institute of Technology, Kanpur during May 19 – May 20, 2008. Gave a talk in the Algebra Symposium titlted "Invariant theory of square matrices in positive characteristic"

Participated in *Summer School on "Geometric Methods in Representation Theory"* held at Institut Fourier, Grenoble, France during Jun 16 – Jul 4, 2008. Gave a talk in the conference part on "Initial ideals of tangent cones to Schubert varieties in orthogonal Grassmannians"

Visited Abdus Salam International Centre for Theoretical Physics, Trieste, Italy during Sep

19 – Nov 20, 2008. As regular associate

Participated in *Hecke Algebras, Groups, and Geometry* held at Centre International de Rencontres Mathématiques, Luminy, France during Oct 13 – Oct 17, 2008.

Visited Dipartimento di Matematica, Università degli Studi di Genova, Genova, Italy during Oct 20 – Oct 21, 2008. Research collaboration; gave a talk "KRS bases for rings of invariants"

Visited Indian Institute of Science on Dec 26, 2008. Gave a talk entitled "KRS bases for rings of invariants"

Participated in *HRI International Conference in Mathematics* held at Harish-Chandra Research Institute during Mar 16 – Mar 20, 2009. Gave talk entitled "KRS Bases with applications to invariant theory and representation theory"

Participated in *One day Collquium (Sponsored by Prof. R. Vaidyanathaswamy Mathematics Trust)* held at Ramanujan Institute for Advanced Study in Mathematics on Mar 24, 2009. gave a talk entitled "Kazhdan-Lusztig cells and KRS bases"

Rajasekaran, G.

Participated in *Summer Training Programme in Physics* held at Department of Nuclear Physics, University of Madras during May 21 – May 29, 2008. Three lectures on 1. Is there a Final Theory?, 2. Neutrino Physics and 3. INO were given.

Participated in *Summer School in Physics at Kodaikanal* held at Solar Observatory, Kodaikanal during Jun 19 – Jun 21, 2008. Gave 6 lectures in High Energy Physics

Visited Tata Institute of Fundamental Research,Mumbai on Jul 29, 2008. Participated in Symposium marking the 80th birthday of Prof M G K Menon and talked on "Particle Physics at TIFR and my reminiscences"

Visited Tata Institute of Fundamental Research, Mumbai on Sep 2, 2008. Participated in the Farewell Meeting for Prof V Singh and talked on "History of Strong Interactions: A Personal View"

Visited Indian Institute for Science Education and Research, Pune during Sep 3 – Sep 5, 2008. Gave two talks (1) Is there a Final Theory? (2) Neutrino Physics and INO

Participated in *New Trends in Field Theory* held at Banares Hindu University,Varanasi during Nov 1 – Nov 2, 2008. Lectured on "Electroweak theory without Higgs boson" and "Physics Nobel Prize (2008)"

Visited National Institute of Science Education and Research and Institute of Physics, Bhubaneshwar during Nov 3 – Nov 6, 2008. Gave a General Colloquium "Is there a Final Theory?" and a Seminar "Induced QCD and Induced Gravity"

Participated in *Indian Strings Meeting 2008* held at Pondicherry (hosted by IMSc) during Dec 6 – Dec 13, 2008.

Participated in *Indian Physics and Megaprojects* held at Miranda House, Delhi University during Feb 2 – Feb 3, 2009. Gave the valedictory address on "Some mini projects with mega results"

Visited Variable Energy Cyclotron Centre,Kolkata on Feb 27, 2009. Participated in the INO Meeting held to mark the completion of the ICAL prototype, which is an important landmark for the INO project.

Raman, Venkatesh

Participated in *International Workshop on Paramaterized and Exact Computation (IWPEC)* held at Victoria (BC), Canada during May 14 – May 16, 2008.

Participated in *ACM Symposium on Theory of Computing (STOC)* held at Victoria (BC), Canada during May 17 – May 20, 2008.

Visited Simon Fraser University, Canada during May 20 – May 22, 2008. Gave two talks titled 'Parameterizing beyond the default values' and 'Fixed parameter algorithms for undirected feedback vertex set'.

Visited Bhilai Institute of Technology, Durg during Sep 18 – Sep 19, 2008. Gave a mini course on data structures and algorithms.

Visited Adi Shankara College of Engineering, Kalady, Kerala during Jan 2 – Jan 3, 2009. Gave a mini course on data structures and algorithms.

Visited Madurai Kamaraj University, Madurai during Feb 28 – Mar 1, 2009, gave talks on recent trends in algorithms.

Visited Annamalai University, Chidambaram on Mar 3, 2009. Gave an Endowment lecture on 'Introduction to Algorithms: from P to NP'

Visited National College, Tiruchi on Mar 4, 2009. Gave an Endowment lecture on 'Introduction to Algorithms: from P to NP'.

Ramanujam, R.

Visited TIFR, Mumbai during Apr 15 – Apr 19, 2008. Gave a talk on "Structured strategies on games on graphs".

Participated in *Dagstuhl Seminar Proceedings 08171 on "Beyond the Finite: New Challenges in Verification and Semistructured Data"* held at Schloss Dagstuhl, Germany during Apr 21

– Apr 25, 2008.

Visited Technishe Universiteit Dortmund, Germany. during Apr 28 – May 9, 2008. Gave a talk on "Verification of electronic voting protocols".

Participated in *CASDS Workshop* held at Rennes, France during May 12 – May 13, 2008. Gave a talk on "Non-zero-sum games on graphs".

Visited NIAS, Wassenaar, The Netherlands. during May 14 – May 17, 2008. Gave a talk on "Relating dynamic epistemic logics and epistemic temporal logics".

Participated in *ISTE Short -Term Training Programme for Faculty on Formal Languages and Models in Computing* held at RMD Engineering College, Chennai during Jun 17 – Jun 21, 2008. Gave a set of 4 lectures on Automata theory.

Visited Vellalar College of Engineering during Jul 4 – Jul 5, 2008. Gave a set of 6 lectures on "Foundations of security protocol analysis".

Participated in *European Summer School on Logic, Language and Information (ESSLLI)* held at Hamburg, Germany during Aug 11 – Aug 15, 2008. Gave an invited lecture titled "Some automata theory for epistemic logic".

Participated in *Lorentz Workshop on Logic and Information Security* held at Leiden, The Netherlands during Sep 22 – Sep 26, 2008. Gave an invited lecture on "Decidable issues in epistemic logics for security protocols".

Visited Chettinad college of engineering during Nov 7 – Nov 8, 2008. Gave a set of 4 lectures on distributed computing.

Participated in *Asia Pacific Conference on Computers and Philosophy (APCAP)* held at NIAS, Bangalore. during Dec 5 – Dec 7, 2008. Gave an invited lecture on "Agent identity in epistemic logics".

Participated in *Workshop on Automata, Concurrency and Timed Systems* held at CMI, Chennai during Jan 29 – Jan 31, 2009. Gave a talk on "Counting multiplicity over infinite alphabets".

Participated in *Workshop on "Mathematical Aspects of Computer Science"* held at Sambalpur University, Sambalpur. during Mar 14 – Mar 15, 2009. Gave two lectures on Foundations of computation theory.

Rao, Raghavendra B.

Participated in *Mathematical Foundations of Computer Science (MFCS)* held at Torun, Poland during Aug 25 – Aug 29, 2008. Presented the paper "Arithmetic Circuits, Syntactic Multilinearity and Limitations of Skew Formulae" (co-authered with Meena Mahajan)

Visited DIAMI, University of Arhus during Aug 30 – Sep 21, 2008. Visit was hosted by Prof. Peter Bro Milterson

Participated in *Daimi Workshop on Algebraic Complexity* held at Arhus, Denmark during Sep 3 – Sep 5, 2008.

Participated in *Indian Algorithms Seminar* held at Khandala, Maharashtra during Oct 15 – Oct 18, 2008.

Participated in *FSTTCS 2008* held at IISc, Bangalore during Dec 9 – Dec 11, 2008.

Sankaran, Parameswaran

Participated in *Annual Meeting of the Ramanujan Mathematical Society* held at IIT-Kanpur during May 19 – May 21, 2008. Organizer for the topology session.

Participated in *International Workshop/Conference on surface mapping class groups* held at North Eastern Hill University, Shillong during Jun 16 – Jun 28, 2008. Gave a talk on residual finiteness and chaotic group actions on the rationals.

Visited Abdus Salam International Centre for Theoretical Physics, Trieste, Italy. during Sep 30 – Nov 17, 2008. Gave a talk in the mathematics seminar on 'K theory of torus manifolds'.

Visited Comenius University, Bratislava, Slovak Republic during Nov 3 – Nov 7, 2008. Gave a talk on 'Degrees of maps between complex Grassmann manifolds'

Participated in *Multiplicity conjecture, Resolution of singularities, and Toric geomery* held at Indian Institute of Technology, Madras during Dec 22, 2008 – Jan 3, 2009. Gave twelve lectures on 'Toric geometry'

Visited Indian Institute of Technology-Bombay, Powai during Jan 21 – Jan 30, 2009. Gave four lectures on 'K-theory of homogeneous spaces'

Participated in *Annual Meeting of the Kerala Mathematical Society and International Conference on Recent Trends in Topology and Applications* held at St Joseph's College, Irinjalakula during Mar 19 – Mar 21, 2009. Gave the K.R.Unni Memorial Lecture on 'Residual finiteness and chaotic actions on the rationals'

Sathiapalan, Balachandran

Participated in *FTAG* held at Simla during Nov 15 – Nov 19, 2008.

Participated in *ISM08 (Strings)* held at Pondicherry during Dec 6 – Dec 13, 2008. Member of LOC

Sharatchandra, H.S.

Participated in *Strong Frontiers 2009* held at Bangalore during Jan 12 – Jan 18, 2009. Convener:Open Session on Non-perturbative aspects

Sikdar, Somnath

Participated in *The Indian Algorithms Workshop, Khandala.* held at Khandala during Oct 15 – Oct 19, 2008.

Participated in *The 19th International Symposium on Algorithms and Computation (ISAAC 2008)* held at Gold Coast, Australia. during Dec 15 – Dec 17, 2008.

Sinha, Nita

Participated in *Workshop on the Origin of P, CP and T Violations (cpt@ictp)* held at ICTP, Trieste, Italy during Jul 2 – Jul 5, 2008.

Visited Department of Physics, Cornell University, Ithaca, New York, USA during Jul 22 – Jul 29, 2008. Discussions and Collaboration

Participated in *34th International Conference on High Energy Physics* held at University of Pennsylvania, Philadelphia, USA during Jul 29 – Aug 5, 2008. Gave an invited review talk on theory of D mixing.

Participated in *18th Particles and Nuclei International Conference (PANIC08)* held at Eilat, Israel during Nov 9 – Nov 14, 2008. Gave an invited review talk on CP Violation.

Sinha, Rahul

Visited National Taiwan University, Taipei, Taiwan during May 4 – May 17, 2008. Collaboration

Participated in *FPCP 2008* held at National Taiwan University, Taipei, Taiwan during May 5 – May 9, 2008.

Visited High Energy Accelerator Research Organization, KEK, Japan, during Jun 30 – Jul 5, 2008. Gave talk at the Inaugural meeting of the Super Belle collaboration entitled "Clean Signals of New Physics in B decays" and to join the Belle and Super Belle collaborations.

Participated in *Inaugural meeting of the Super Belle Collaboration* held at High Energy Accelerator Research Organization, KEK, Japan during Jul 3 – Jul 4, 2008. Gave an invited plenary talk entitled "Clean Signals of New Physics in B Decays"

Visited Centre de Physique Théorique, at Luminy Campus, Marseille, France during Aug 31 – Sep 8, 2008. Collaboration and give talk "Clean Signals of New Physics in B decays"

Participated in *V International workshop on the Unitarity Triangle, CKM 2008* held at Università "Sapienza", Roma, Italy during Sep 9 – Sep 13, 2008. Gave an invited talk entitled "Measuring weak phases using $B \to D^*V$ modes"

Visited Laboratoire de Physique Théorique d'Orsay, Universite Paris-Sud 11, Paris, France during Sep 14 – Sep 18, 2008. Collaboration and give talk "Clean Signals of New Physics in B Decays"

Visited High Energy Accelerator Research Organization, KEK, Japan during Dec 7 – Dec 19, 2008. Collaboration and attend Belle and Super Belle meetings

Sinha, Sitabhra

Visited Indian Institute of Science Education and Research (IISER), Pune during Apr 11 – Apr 16, 2008. Taught a module in the Systems Biology core course for 2nd year undergraduate program and gave a colloqium talk.

Visited University of California, Berkeley, USA during Apr 28 – May 9, 2008. As part of IUSSTF collaborative project.

Visited University of California, Santa Cruz, USA during May 10 – May 17, 2008. For collaborative research.

Participated in *SERC School on Nonlinear Dynamics* held at Indian Institute of Science, Bangalore during Jul 7 – Jul 8, 2008. Gave 2 lectures on complex networks.

Participated in *International Conference on Nonlinear Dynamical Systems and Turbulence* held at Indian Institute of Science, Bangalore during Jul 17 – Jul 22, 2008. Gave invited talk on "The patterns of thought from C. elegans to human: Dynamics in brain networks".

Visited Ecole Normale Superieure (ENS-Lyon), Lyon, France during Oct 4 – Oct 31, 2008. As part of IFCPAR collaborative project.

Participated in *Winter School on Experimental Nonlinear Dynamics* held at Saha Institute of Nuclear Physics, Kolkata during Dec 1 – Dec 5, 2008. Gave invited talk on "Oscillating colors, patterned gels: Introducing nonlinear chemical dynamics".

Participated in *Symposium on Integrating Physics, Chemistry, Mathematics Biology to Understand Living Systems (IPCMB08)* held at Bose Institute, Kolkata during Dec 4 – Dec 6, 2008. Gave invited talk on "Action-at-a-distance in intracellular signaling networks"

Participated in *International Conference on Social Network Analysis* held at Tata Institute of Social Sciences, Mumbai during Dec 26 – Dec 27, 2008. Gave invited talk on "The emergence of modular and hierarchical complex networks in the social arena"

Participated in *Review Meeting of Project on Development of Indian Science Technology Through The Ages* held at Centre for Excellence in Basic Sciences, Mumbai University, Mumbai during Feb 10 – Feb 11, 2009. Gave talks on "What do the Indus sign sequences represent?" and "Geometrical knowledge of the Indus valley civilization".

Participated in *7th International Conference on Applications of Physics in Financial Analysis* held at Tokyo Institute of Technology, Tokyo during Mar 1 – Mar 5, 2009. Gave talk on "Seeking statistical signatures of market evolution".

Participated in *International Workshop on Econophysics of Games and Social Choices* held at Indian Statistical Institute, Kolkata during Mar 9 – Mar 13, 2009. Gave invited talk on "A mean-field model reproducing stylized facts of financial markets".

Sinha, Sudeshna

Visited Biomedical Engineering Department, University of Florida, Gainesville, USA during Apr 14 – Apr 30, 2008. Collaborative Research

Participated in *Bio-inspired Complex Networks in Science and Technology* held at Dresden, Germany during Apr 30 – May 5, 2008. Invited Speaker

Participated in *International Conference on Nonlinear Dynamical Systems and Turbulence* held at Bangalore, India during Jul 17 – Jul 22, 2008. Invited Speaker

Visited Biomedical Engineering Department, University of Florida, Gainesville , USA during Dec 1 – Dec 12, 2008. Collaborative Research

Sircar, Nilanjan

Participated in *Indian Strings Meeting* held at Pondicherry during Dec 6 – Dec 13, 2008.

Srinivas, K.

Visited St. Mary Matriculation Boy's H. S. Scchool, Perambur on Apr 18, 2008. Delivered a talk.

Visited SASTRA University, Kumbakonam during Apr 25 – Apr 26, 2008. Delivered a talk on the occassion of Ramanujan's Remembrance Day celebration.

Subramanian, C. R.

Participated in *Second International Conference on Discrete Mathematics (ICDM-2008).*

held at University of Mysore, Mysore, India. during Jun 6 – Jun 10, 2008. Gave an invited talk on “List Hereditary Colorings of Graphs”.

Participated in *International Conference on Graph Theory and its Applications.* held at Amrita Vishwa Vidyapeetham University, Ettimadai, Coimbatore, India. during Dec 11 – Dec 13, 2008. Gave an invited talk on “Bounds on restricted colorings”.

Sunder, V. S.

Participated in *First Indo-Brazilian Symposium in Mathematicss* held at IMPA, Rio de Janeiro, Brazil during Jul 28 – Aug 1, 2008. Gave a lecture titled ‘Planar algebras and Hopf algebras’

Visited Indian Institute of Technology, Kanpur during Oct 26 – Oct 31, 2008. Gave a course of five lectures titled *Operator algebras: the stage for non-commutativity* as part of the lecture series ‘Panarama of mathematics’ organised by the National Board for Higher Mathematics.

Visited Indian Statistical Institute, Kolkata during Nov 3 – Nov 7, 2008. Gave a course of five lectures titled *Operator algebras: the stage for non-commutativity* as part of the lecture series ‘Panarama of mathematics’ organised by the National Board for Higher Mathematics.

Visited Ramakrishna Mission Vidyamandira on Nov 6, 2008. Gave a lecture titled *Knot invariants.*

Visited Indian Institute of Science, Bangalore during Jan 27 – Jan 31, 2009. Gave a course of five lectures titled *Operator algebras: the stage for non-commutativity* as part of the lecture series ‘Panarama of mathematics’ organised by the National Board for Higher Mathematics.

T, Mubeena

Participated in *Workshop on "Multiplicity Conjectures, Resolution of Singularities and Toric Geometry"* held at IIT Madras during Dec 22, 2008 – Jan 3, 2009.

Tamilselvi, A.

Participated in *RMS/SMF/IMSc Indo-French Conference in Mathematics 2008* held at The Institute of Mathematical Sciences and Chennai Mathematical Institute during Dec 15 – Dec 19, 2008.

Participated in *65279;National seminar on Algebra and its Applications* held at Periyar University, Salem during Feb 12 – Feb 13, 2009. Gave an invited talk.

Participated in *16th Ramanujan Symposium on Fourier analysis and applications* held at The Ramanujan Institute for Advanced Study in Mathematics, Chennai during Feb 25 –

Feb 27, 2009.

Participated in *One Day Colloquium (Sponsored by Prof. R.Vaidhyanathaswamy Mathematics Trust, Chennai)* held at The Ramanujan Institute for Advanced Study in Mathematics, Chennai on Mar 24, 2009.

Vemparala, Satyavani

Visited National Center for Biological Sciences during Apr 16 – Apr 19, 2008. Gave a talk on "Synthetic mimics of antimicrobial peptides: computational insights"

Participated in *High performance computing user group workshop on Advancements in high performance computing and interoperability, SERC School* held at IISc, Bangalore on Nov 10, 2008. Gave an invited talk on "High performance computing in Biology: a Molecular dynamics perspective"

Participated in *India-Singapore Joint Physics Symposium* held at SNBNCBS, Kolkata during Jan 6 – Jan 8, 2009. Gave an invited talk on "Atomisitic Simulations of membrane proteins"

5.4 Visitors from Other Institutions

5.5 Visitors

SL. No	*Name*	*Affiliation*	*Date*
1	**Monika Sinha**	SINP, Kolkatta	13.04.08 - 16.04.08
2	**Vijay Kumar**	VKF, Gurgan	07.04.08 - 07.04.08
3	**Surajit Sengupta**	SNBNCBS, Kolkatta	31.03.08 - 03.04.08
4	**Syed Raghib Hassan**	University of Sherbrook Canada	02.04.08 - 05.04.08
5	**K. Moriya Bhavin**	HRI, Allahabad	19.03.08 - 05.04.08
6	**Mohan N. Chintamani**	HRI,Allahabad	24.04.08 - 05.04.08
7	**Nisha Yasav**	TIFR, Mumbai	23.03.08 - 04.04.08
8	**Mayank Vahia**	TIFR, Mumbai	31.03.08 - 04.04.08
9	**Kavita Gangal**	TIFR, Mumbai	23.03.08 - 04.04.08
10	**Prabal Paul**	HRI Allahabad	27.03.08 - 02.04.08
11	**Ajay Patwardhan**	St. Xavier College, Mumbai	02.05.08 - 17.05.08
12	**R. Thangadurai**	HRI Allahabad	14.05.08 - 17.05.08
13	**Anuradha Mishra**	University of Mumbai	13.05.08 - 19.05.08
14	**Tirthabir Biswas**	Pennstate University	14.05.08 - 16.05.08
15	**Roy Joshua**	Ohiostate University, USA	12.05.08 - 17.05.08
16	**Krishnendu Sengupta**	SINP, Kolkatta	11.05.08 - 16.05.08
17	**Vivek Tewari**	St. Xavier College, Mumbai	06.04.08 - 18.05.08
18	**Pinaki Chendhuri**	University of Montpellieva, France	21.05.08 - 24.05.08
19	**Vijay B. Shenon**	IISc, Bangalore	18.05.08 - 24.05.08
20	**Sandeep Pathak**	IISc, Bangalore	18.05.08 - 24.05.08
21	**Abhinjan Rej**	Clay Mathematics Institute, Cambridge, USA	10.05.08 - 24.05.08
22	**Manu Mathur**	SNBNCBS, Kolkata	28.05.08 - 10.06.08
23	**Anilesh Mohari**	SNBNCBS, Kolkata	20.05.08 - 07.06.08
24	**J. Meena Devi**	American College, Madurai	06.05.08 - 30.05.08
25	**A. Elangovan**	American College, Madurai	26.05.08 - 01.06.08
26	**G. Christa Nancy**	American College, Madurai	07.05.08 - 19.06.08
27	**Kavan Govil**	IIT Madras	05.05.08 - 19.06.08
28	**Jyoti Prasad Saha**	Serampore College, Hoogly	05.06.08 - 17.06.08
29	**Bikash Chandra Paul**	North Bengal University, Siligury	03.06.08 - 15.06.08
30	**D. Surya Ramana**	HRI, Allahabad	25.05.08 - 16.06.08
31	**Siddharth Parameswaran**	Princeton University, USA	02.06.08 - 29.06.08
32	**R.P.Singh**	PRL, Ahemadabad	24.06.08 - 26.06.08
33	**Nithin Nagaraj**	NIAS, Bangalore	05.05.08 - 24.06.08
34	**Dilip G. Banhati**	M.K. University, Madurai	19.06.08 - 21.06.08
35	**Indrajit Mitra**	IIT Kanpur	02.06.08 - 09.07.08
36	**Ranjit Nair**	CPFS, New Delhi	25.06.08 - 29.06.08

37	**N. Mukunda**	IISC, Bangalore	25.06.08 - 28.06.08
38	**Srinivasa Raghavendra**	National University of Ireland	09.07.08 - 16.07.08
39	**S.D. Adhikari**	HRI, Allahabad	08.07.08 - 16.07.08
40	**Gautam Pal**	RCC Institute of Information Technology, Kolkatta	01.06.08 - 19.07.08
41	**S.A. Katre**	University of Pune	14.07.08 - 16.07.08
42	**Raghunath Tewari**	University of Nebraska, USA	15.05.08 - 17.07.08
43	**E.Hari Kumar**	University of Hyderabad	15.05.08 - 17.07.08
44	**S.K.Singh**	A.M. University	22.07.08 - 25.07.08
45	**Dinakar Ramakrishna**	Caltech, Pasadeno, USA	08.07.08 - 27.07.08
46	**Mythily Ramaswamy**	TIFR, Mumbai	23.07.08 - 24.07.08
46	**Joseph Cheriyan**	University of Waterloo, Canada	29.07.08 - 31.07.08
47	**Onn Uri**	University of Maths Department Ben-Gurion	07.08.08 - 18.08.08
48	**Sachindeo Vaidya**	IISc, Bangalore	09.08.08 - 16.08.08
49	**T.E.S. Raghavan**	University of Illinois, Chicago, USA	14.07.08 - 14.08.08
50	**Madhvan Varadarajan**	RRI, Bangalore	10.08.08 - 15.08.08
51	**Gautami Bhowmick**	University of De Lille, France	05.08.08 - 13.08.08
52	**Bourden Marc**	University of De Lille, France	05.08.08 - 13.08.08
53	**Vijay B. Shenoy**	IISc, Bangalore	07.08.08 - 11.08.08
54	**Raja Sridharan**	TIFR Mumbai	08.08.08 - 24.08.08
55	**J. Pasupathy**	IISc, Bangalore	20.07.08 - 21.08.08
56	**Colin Benjamin**	University of Leeds, UK	18.08.08 - 20.08.08
57	**Marius Tucshnak**	University of Nancy, France	17.08.08 - 20.08.08
58	**H.S. Mani**	Visitor	13.06.08 - 19.08.08
59	**Parvati Shastri**	University of Mumbai	25.08.08 - 12.09.08
60	**Jijo.S**	Government CPT College, Kerala	08.09.08 - 11.09.08
61	**Nirmalk Viswanathan**	University of Hyderabad	29.08.08 - 30.08.08
62	**Kopke, Peter**	University of Bonn, Germany	15.09.08 - 18.09.08
63	**Nisha Yadav**	TIFR, Mumbai	08.09.08 - 16.09.08
64	**Mayank Vahia**	TIFR, Mumbai	08.09.08 - 16.09.08
65	**Venkateswara Pai**	Department of Physics, Techion	05.10.09 - 10.10.09
66	**M.S. Santhanam**	IISER, Pune	05.10.08- 13.10.08
67	**Ambrus Pal**	Imperial College Queens Gate, London	17.09.08 - 30.09.08
68	**Jijo.S**	Government CPT College, Kerala	11.10.08 - 18.10.08
69	**Krishnendu Sengupta**	IACS, Kolkata	12.10.08 - 16.10.08
70	**Jyoti Prasad Saha**	Serampore College, Hooghly	14.10.08 - 26.10.08
71	**Sachin Talathi**	University of Florida, USA	10.11.08 - 11.11.08
72	**D. Das**	IIT Bombay	16.11.08 - 19.11.08
73	**Ajay Patwardhan**	St. Xavier College, Mumbai	3.11.08 - 12.11.08
74	**M. Sanjay Kumar**	S.N. Bose National Centre, Kolkatta	09.11.08 - 03.12.08
75	**Dipanjan Chakraborty**	Indian Association for the cultivation of science	01.11.08 - 01.12.08
76	**Pinaki Sengupta**	Los Alamos National Lab, USA	23.11.08 - 25.11.08
77	**Surajit Sengupta**	Indian Association for the cultivation of science	08.12.08 - 10.12.08
78	**Arjendu Pattanayak**	Carleton College	
80	**Liam M.Allister**	Cornell University,USA	13.12.08 - 17.12.08

81	**Adam Arkin**	University of California, USA	14.12.08 - 18.12.08
82	**M.S. Narasimhan**	TIFR Centre, Bangalore	27.11.08 -29.11.08
83	**Bruce Normand**	Theretische Physics, Switzerland	24.11.08 - 11.12.08
84	**Ashoke Sen**	HRI, Allahabad	04.12.08 - 14.12.08
85	**Yngve Villanger**	Institute for Information	04.12.08 - 13.12.08
86	**Indu Satija**	George Masen Universtiy	03.12.08 - 13.12.08
87	**W.Schmickler**	Institute of Theoretical Chemistry, University of Ulum	07.12.08 -13.12.08
88	**Maurice Jansen**	Department of Computer Science, Arhus University	01.12.08 - 14.12.08
89	**Satadal Ganguly**	TIFR Mumbai	07.12.08 - 20.12.08
90	**Bulbul Chakraborty**	University of Brandeis	15.12.08 - 19.12.08
91	**Sukumar**	IISC, Bangalore	17.12.08 - 18.12.08
92	**Rajendran Raja**	Fermi National Lab, Chicago	04.01.09 - 06.01.09
93	**Anand Yethiraj**	Memorial University, Department of Physics	05.01.09 - 07.01.09
94	**Mohammed Rizwan Sadia**	Yeungnam University	03.10.08 - 02.01.09
95	**J. Meena Devi**	American College, Madurai	25.12.08 - 02.01.09
96	**Kaneenika Sinha**	University of Alberta	22.12.08 - 30.12.08
97	**Rabeya Basu**	IISER, Kolkata	16.12.08 - 2.01.09
98	**N.G.Deshpande**	University of Uregon	23.12.08 - 30.12.08
99	**Hans van Ditmarch**	University of Otago	20.12.08 - 30.12.08
100	**Shrihari Gopalakrishnan**	Brookhaven National Lab	23.12.08 - 24.12.08
101	**Chandrasekar**	Perimeter Institute Water loo	17.12.08 - 23.12.08
102	**P.N. Srikanth**	TIFR, CAM, Bangalore	28.11.08 - 30.11.08
103	**A.M.M. Pruisken**	University of Amsterdam	06.01.09 - 16.01.09
104	**R. Raghavan**	Virginia Tech Blackburg	14.01.09 - 17.01.09
105	**K. Ravishankar**	Suny - NewPaltz	07.01.09 - 15.01.09
106	**Dhrubaditya Mitra**	Queen Mary University	05.01.09 - 07.01.09
107	**Azan Micntosh**	Australian National University	26.11.08 - 29.11.08
108	**Raymond Bishop**	University of Machester	10.01.09 - 13.01.09
109	**R. Thangadurai**	HRI,Allahabad	31.12.08 - 05.01.09
110	**B.Ramakrishna**	HRI Allahabad	30.12.08 - 10.01.09
111	**Aninda Sinha**	Perimeter Institute, Canada	13.12.08 - 16.12.08
112	**R. Raghavan**	Virginia Tech Blackburg	14.01.09 - 17.01.09
113	**R. Gopakumar**	HRI Allahabad	15.01.09 - 21.01.09
114	**Manu Mathur**	SNBNCBS, Kolkatta	18.01.09 - 25.01.09
115	**Johann A.Makowksy**	Technion, Haifa	10.01.09 - 23.01.09
116	**A.P.Balachandran**	Suryacuse University, USA	06.12.08 - 19.01.09
117	**Mythily Ramaswamy**	TIFR, Bangalore	26.01.09 - 27.01.09
118	**Saket Saurabh**	University of Bergen	04.12.08 - 02.02.09
119	**Jerome Henin**	University of Pennsyluama, USA	01.02.09 - 03.02.09
120	**Rajesh Mahadevan**	Universtiy Conceprcion	19.01.09 - 06.02.09
121	**Ram Kishore**	INPE,Brazil	01.12.08 - 05.02.09
122	**T.V. Anoop**	TIFR CAM, Bangalore	26.01.09 - 27.01.09
123	**Saurabh Basu**	IIT, Gawahati	27.01.09 - 31.01.09
124	**P.P.Divakaran**	IUCAA, Pune	28.01.09 - 01.02.09
125	**Jayalal Sarma**	Tsinghani University	10.02.09 - 13.02.09

126	**Eleonoral Dellaevila**	Periheter Institute Waterloo	01.01.09 - 13.02.09
127	**Satti Srinivasa Rao**	University of Aarhms	03.02.09 - 16.02.09
128	**V. Kumar Murthy**	University of Toronto, Canada	12.02.09 - 13.02.09
129	**Gautam Bharali**	IISc, Bangalore	17.02.09 - 20.02.09
130	**Arindam Kudnagrami**	University of Massachusetts	18.02.09 - 19.02.09
131	**R. Thangadurai**	HRI Allahabad	15.02.09 - 17.02.09
132	**Areejit Samal**	Maxplank Institute	16.02.09 - 18.02.09
133	**Hildacerdeira**	UNESP, Brazil	28.02.09 - 07.03.09
134	**Subodh R. Shenoy**	University of Hyderabad	28.02.09 - 07.03.09
135	**Kalyana T.Mahanthappa**	University of Colorado	03.03.09 - 06.03.09

Chapter 6

Infrastructure

6.1 Computer Facilities

Ehnancement of Computer Facility during 2008-2009

- Hardware facility:
  1. 30 desktops were upgraded
  2. 2 Netbook of makes Asus-EEE and Acer Aspire One are added
  3. 10 Laptops of different makes(Apple/HP/Dell/Sony) were issued to faculty as a long term loan.
  4. To enhance the LAN performaces 2 backbone switches added in the network.
  5. One electronic scribling pad of A4 size(iBall TakeNote) added for general use.
  6. 2 LCD projectors fixed in the lecture rooms.
  7. New SMF batteries were added for four UPSs
  8. 2 Multifunction printers installed in the HBNI cell and other Office works.
- Sofware facility:
  1. Mathematica version 7 with 10 user network licenses added in the network
  2. Matlab 2008b with 10 user network licenses and the additional Toolboxes of Image processing, Compiler, Optimization, Signal and SimBiology added in the network.
  3. Maple version 12 with 5 user network licenses newly added in the network.
  4. Adobe Acrobat profession 9 S/W is installed the central place for general use.
- Students are encouraged to use Institute laptops while attending conferences and workshops.
- One Technical Assistant and one Administrative Assistant are appointed to handle the computer system facility under the Plan project.

6.2 The Library

The Institute Library holds a total collection of 61742 books and bound periodicals as on March 31, 2009. This includes an addition of 1267 volumes during the current year April 2008 - March 2009. The library subscribes to over 300 national and international journals in the subject areas of Theoretical Physics, Mathematics and Theoretical Computer Science including journals on exchange. 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. An average of about 5000 outside users in a year from colleges, universities and research institutions from different parts of the country make use of the library facilities for their academic and research information needs.

The library has access to over 3000+ online journals from major publishers such as Elsevier, American Mathematical Society, American Physical Society, Springer Verlag, World Scientific, Institute of Physics, Wiley, etc.

Library has also access to Nature online, Science Online, ACM Digital Library, SIAM Journals Archive, Duke Mathematical Journal, and JSTOR Full digital archive. It has also perpetual online access to backfile collection of journals from Elesevier under DAE consortium and Annual Reviews Electronic Backvolume collection. The library has added this year the Springer Online Collection Archive that provides perpetual access to journals in the areas of mathematics, physics and computer science and book series such as Lecture Notes in Mathematics, Physics and Computer Sciences from volume 1 till the year 1996.

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. Library has implemented RFID based system for self check-in and checkout of library materials. The library also provides effective 24x7 access to its resources with the help of RFID enabled access control system, perhaps the only library of this kind in the country.

Library has a website dedicated to host all the electronic information resources and to provide information about the library and its services.

Library is a member of DAE Libraries Consortium that subscribes to SCIENCE DIRECT SERVICE of Elsevier.

Library is also coordinating the MathSciNet consortium which provides online access to MathSciNet for 8 participating institutions at a deeply discounted rate in the southern region.

Library is an institutional member of AMS, MALIBNET, CURRENT SCIENCE Association, and IAPT.

Acknowledgment

The Library gratefully acknowledges the donation of valuable books journals, and other reading materials received during the current year from the persons and organizations mentioned below:

Alok Kumar, IMSc	Balasubramanian,R, IMSc
Gill, Nicholous Paul, IMSc	Kamal Lodaya, IMSc
Kesavan, S, IMSc	Radha Balakrishnan, IMSc
Rajasekaran,G, IMSc	Ramanujam,R, IMSc

Amitabha Gupta	Bala Ravikumar
Raghavan Narasimhan	Srivastava, A.M

DOOR Program	Kyoto University
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