

# THE INSTITUTE OF MATHEMATICAL SCIENCES

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## ANNUAL REPORT

Apr 2011 - Mar 2012

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## Foreword

The Institute completes 50 years this January 2012 and I am pleased to present this year's annual report and note the distinctive achievements of the members of the Institute.

Our student strength has increased to 120 and it has been observed that incoming students are better prepared than a decade ago. We are proud to say that this has been possible due to the on-going outreach programmes and efforts of our faculty, both at an individual and institutional level.

As with every year, this year continues to be academically productive for the members of our Institute. There were several significant publications reported in national and international journals and our faculty authored a few books as well. Ten students were awarded Ph.D., two submitted their Ph.D. theses and five students submitted master's theses under the supervision of our faculty.

We organised eleven conferences and workshops at IMSc this year. These include Special year in Number Theory, Instructional Workshop on Infinite dimensional Lie algebras, Sudarshan Fest, Instructional workshop on the Functional Analysis of Quantum Information Theory, Recent Advances in Data Structures, Nonlinear Functional Analysis, ATM Workshop in Operator Algebras, Workshop on Parameterized Complexity, Workshop on Social Networks, FQS2012 and Fracture and Flow in Porous Media.

The list of off-site conference organization by IMSc faculty also continues to be impressive. This academic year the conferences organized outside were: Advanced Instructional School on Lie algebras, ATMW Representation Theory of Finite Group of Lie Type: Deligne-Lusztig Theory, Minisymposium on Cardiac Dynamics and Lorentz Workshop on Kernelization.

The Subashish Nag Memorial lecture was given this year by Mahan Maharaj, Vivekananda University, Belur.

This report was compiled through the efforts of an Annual Report Committee comprising of Drs. Rahul Sinha, R. Ramanujam, Anilesh Mohari, Krishna Maddaly, Paul Pandian and Usha Devi. I owe my gratitude to all of them.

June, 2012

**R. Balasubramanian**

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# Chapter 1

## The Institute

### 1.1 Board

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(**Member**)

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



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<b>Karteek Srinivasaiah</b>	karteek	114
<b>Kunal Dutta</b>	kdutta	237
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## 1.12 Administrative Staff

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Gayatri, E. <i>Accounts Officer</i>	gayatri	152
Amulraj, D.	Parthiban, V.	
Ashfack Ahmed	Prema, P.	
Babu, B.	Radhakrishnan, M. G.	
Balakrishnan, J.	Rajasekaran, N.	
Geetha, M.	Rajendran, C.	
Gopinath, S.	Ramesh, M.	
Indra, R.	Ravichandran, N.	
Janakiraman, J.	Ravindran, A.	
Jayanthi, S.	Rizwan Shariff, H.	
Johnson, P.	Sankaran, K.P.	
Moorthy, E.	Selvaraj, M.	
Munuswamy, N.	Seenivasa Raghavan, N.	
Muthukrishnan, M.	Tamil Mani, M.	
Nityanandam, G.	Varadaraj, M.	
Otheeswaran Usha	Vasudevan, T.V.	
Padmanabhan, T.	Vidhya Lakshmi	
Parijatham, S.M.		



# Chapter 2

## Research and Teaching

### 2.1 Mathematics

#### 2.1.1 Research Summary

##### Algebra

Ørsted and Wolf have introduced the notion of a Borel-de Siebenthal discrete series representation for a real connected simple Lie group  $G$  such that the non-compact Riemannian symmetric space  $G/K$  is not Hermitian symmetric. Corresponding to such a discrete series, there is naturally associated to it a holomorphic discrete series representation of the non-compact dual  $K^*$  of the maximal compact subgroup  $K$  of  $G$ . Denoting the maximal compact subgroup of  $K^*$  by  $L$ , it is shown that, in the quaternionic case, there are infinitely many  $L$ -types common to the Borel-de Siebenthal and the holomorphic discrete series if and only if  $G$  is not one of  $SO(4, 1)$  or  $Sp(1, l - 1)$ .

A somewhat strange determinantal identity involving a 3x3 matrix in 12 variables is established in [Ko] and is used to give a proof of a result of Mohan Kumar and Pavaman Murthy on 3x3 unimodular matrices.

The classification of matrices over rings like  $\mathbf{Z}/p^k\mathbf{Z}$  is a wild problem, generally considered intractable. Recent work has shed some light on the nature of this problem using the technique of *matrix reduction of extensions*. In particular, it is found that the classification of similarity classes of matrices over a principal ideal local ring of length two depends only on the residue field of the ring.

##### Algebraic Geometry

Study of vector bundles on symmetric powers of curves and morphisms to Grassmanians continued.

A class of smooth compact manifolds which arise as the orbit space of a cyclic group on the the complex Stiefel manifold was introduced. Lower bounds for the span of these manifolds

was obtained and it was shown that most of these manifolds are not (stably) parallelizable [S].

## **Algebraic Number Theory**

I have particular interests in results associated with irreducibility of polynomials, Galois groups of certain classical polynomials, computations with lacunary polynomials, Diophantine equations and class number problem for number fields and function fields.

## **Analytic Number Theory**

The problem of showing infinitely many critical zeros of functions in the Selberg class when the degree is  $> 3$  is under considerations and partial results have been obtained.

Work is in progress on problems of finding additive structures in dense (in the sense of Dirichlet density) subsets of integers and in primes. A particular case of such problem is to find elements  $a, b$  and  $c$  such that  $(a + b)/2$ ,  $(b + c)/2$  and  $(c + a)/2$  are also in the same set. Effort is on to improve some known results and also to prove it for primes.

The number of large gaps between consecutive zeros of the Riemann zeta function on the critical line has been studied. The problem of showing that there are infinitely many zeros on the critical line for functions in the Selberg class of degree  $d > 2$  has also been studied.

## **Group Theory**

Given an automorphism  $\phi$  of a finitely generated group  $G$  one has the notion of  $\phi$ -twisted conjugacy classes. The number of such twisted conjugacy classes is called the Reidemeister number of  $\phi$ . If the Reidemeister number of  $\phi$  is infinite for all automorphisms of  $G$  one says that  $G$  has the  $R_\infty$  property. It has been shown that abelian extensions of non-elementary hyperbolic groups and lattices in connected semisimple Lie groups with finite centre and having real rank at least two have the  $R_\infty$ -property [M1], [M2].

## **Mathematical Physics**

Spectral statistics for decaying randomness is studied and Poisson character of the limiting process is shown for a class of operators. The region associated with continuous spectrum is being studied.

## **Modular forms**

The nature and location of zeros of modular forms for the full modular group  $SL_2(\mathbf{Z})$  and other congruence subgroups constitutes an important area of research. In [B2], zeros of quasi-modular forms for  $SL_2(\mathbf{Z})$  are investigated. In particular, transcendence and existence of infinitely many  $SL_2(\mathbf{Z})$ -in-equivalent zeros for such quasi-modular forms has been established. Further, a quasi-modular analogue of a recent result of Ghosh and Sarnak has been derived.



## Representation Theory

Relations between various bases for representation spaces of complex semisimple Lie algebras and their infinite dimensional variations are being investigated.

## Transcendental number theory

The irrationality of  $\zeta(2)$  and  $\zeta(3)$  has been derived using functional equations for Polylogarithms.

In [G5], the question of linear independence of Hurwitz zeta values over number fields is considered. These are linked to the transcendence of  $\zeta(k)/\pi^k$  for odd integers  $k > 1$ . Also an extension of a theorem of Baker-Birch-Wirsing about non-vanishing of  $L(1, f)$  to number fields has been established.

In [G4], it has been shown that the values of Dirichlet  $L$ -functions at integer points can be recovered from algebraic linear combinations of values of Riemann zeta function and its derivatives at  $1/2$  and  $3/2$ . Also irrationality of  $\zeta(3)/\pi^3$  and  $G/\pi^2$ , where  $G$  is the Catalan's constant has been linked to the transcendence of some multiple gamma values.

### 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.

[B1]

**R. Balasubramanian, Cecile Dartyge\*, and Elie Mosaki\*.**

Sur la complexite de familles d'ensembles pseudo-aleatoires.

2012.

(Submitted).

[B2]

**R. Balasubramanian and S. Gun.**

On zeros of quasi modular forms.

2011.

(Submitted).

[B3]

**R. Balasubramanian and Florian Luca\*.**

On the number of factorizations of an integer.

*Integers*, **11(2011)**, 132, 2011.

[Ba1]

**Pradipto Banerjee and Srinivas Kotyada.**

Divisibility of class numbers of imaginary quadratic function fields by a fixed odd number.  
2011.  
(To be published).

[Ba2]

**Pradipto Banerjee and Srinivas Kotyada.**

Divisibility of class numbers of imaginary quadratic function fields by a fixed odd number.  
In Gadadhar Mishra, editor, *Proceedings Mathematical Sciences, Indian Academy of Sciences*. Springer, 2012.  
PMSC-D-11-00214R1 (To be published).

[Bas]

**Madhushree Basu, Vijay Kodiyalam, and V. S. Sunder.**

From graphs to free products.  
*Proceedings (Mathsci) of the Indian Academy of Sciences*, 2011.  
(To be published).

[Bi]

**Panchugopal Bikram, Kunal Mukherjee, R. Srinivasan\*, and V. S. Sunder.**

Hilbert von Neumann algebras.  
(special volume of) *Communications in Stochastic Analysis (in honour of Prof. K. R. Parthasarathy)*., 6(1), 2012.  
(To be published).

[C]

**Indranil Biswas\* and Pralay Chatterjee.**

On the exactness of kostant-kirillov form and the second cohomology of nilpotent orbits.  
*International Journal of Mathematics*, 2012.  
(To be published).

[Ch]

**Tapas Chatterjee.**

The strong chowla-milnor spaces and a conjecture of gun, murty and rath.  
*International Journal of Number Theory*, 2012.  
(To be published).

[D]

**Umesh V. Dubey, Amritanshu Prasad, and Pooja Singla\*.**

The Cartan matrix of a centralizer algebra.  
*Proc. Indian Acad. Sci. (Math. Sci.)*, **122(1)**, 67, 2012.

[Du]

**Kunal Dutta and Amritanshu Prasad.**

Degenerations and orbits in finite abelian groups.  
*Journal of Combinatorial Theory, Series A*, **118(6)**, 1685, 2011.

[G1]

**S. Gun, M. R. Murty\*, and P. Rath\*.**

On a conjecture of Chowla and Milnor.

*Canadian Journal of Mathematics*, **63(6)**, 1328, 2011.

[G2]

**S. Gun, R. Murty\*, and P. Rath\*.**

Algebraic independence of values of modular forms.

*Int. J. Number Theory*, **7(4)**, 1065, 2011.

[G3]

**S. Gun, R. Murty\*, and P. Rath\*.**

Transcendental values of certain Eichler integrals.

*Bull. Lond. Math. Soc.*, **43(5)**, 939, 2011.

[G4]

**S. Gun, R. Murty\*, and P. Rath\*.**

A note on special values of L-functions.

2011.

(Submitted).

[G5]

**S. Gun, R. Murty\*, and P. Rath\*.**

Linear independence of Hurwitz zeta values and a theorem of Baker-Birch-Wirsing over number fields.

2011.

(Submitted).

[K]

**S. Kesavan.**

On the degenerate operator Riccati equation.

In Raji Pilakkat, editor, *Proceedings of the International Conference on Number Theory, PDE and Geometry, University of Calicut, 2009*, page 83. University of Calicut, Nov 2011.

[Ke]

**S. Kesavan and T. Muthukumar\*.**

Homogenization of an optimal control problem with state-constraints.

*Differential Equations and Dynamical Systems*, **19(4)**, 361, 2011.

[Ko]

**Vijay Kodiyalam.**

On the genesis of a determinantal identity.

2011.

(Submitted).

[Kr]

**Srilakshmi Krishnamoorthy and Neil Dummigan\*.**

Powers of 2 in modular degrees of modular abelian varieties.  
2011.  
(Submitted).

[M1]

**T. Mubeena and P. Sankaran.**

Twisted conjugacy classes of abelian extensions of certain linear lie groups.  
2011.  
arXiv:1111.6181 (Submitted).

[M2]

**T. Mubeena and P. Sankaran.**

Twisted conjugacy classes in lattices in semisimple lie groups.  
2012.  
arXiv:1201.4934v2 (Submitted).

[Mu1]

**Jon Bannon\*, Jan Cameron\*, and Kunal Mukherjee.**

Completely positive joinings of  $II_1$ -factor dynamical systems.  
2012.  
(Preprint: ).

[Mu2]

**Jan Cameron\*, Junsheng Fang\*, and Kunal Mukherjee.**

Mixing abelian subalgebras of type  $II_1$  factors.  
2011.  
(Submitted).

[Mu3]

**Jan Cameron\*, Junsheng Fang\*, and Kunal Mukherjee.**

Mixing subalgebras of finite von Neumann algebras.  
*New York J. Math.*, 2011.  
(To be published).

[Mu4]

**Ken Dykema\* and Kunal Mukherjee.**

Measure-multiplicity of the laplacian masa.  
*Glasg. Math. J.*, 2012.  
(To be published).

[Mu5]

**Kunal Mukherjee.**

Comparison of one-sided modules.  
*Banach J. Math. Anal.*, **6(1)**, 132–138, 2012.

[Mu6]

**Kunal Mukherjee.**

Weak asymptotic homomorphism property for masas in semifinite factors.  
*Oper. Matrices*, 2012.  
(To be published).

[Muk]

**Anirban Mukhopadhyay, Krishnan Rajkumar, and Srinivas Kotyada.**

On the zeros of the epstein zeta function.

In B. Ramakrishnan and M. Manickam, editors, *Proceedings of the International Conference held in honor of Prof. T. C. Vasudevan*. RMS Lecture Notes Series, Mar 2012.

[N1]

**Jayanthan A V \* and Ramakrishna Nanduri.**

Depths and hilbert coefficients of fiber cones of stretched m-primary ideals.

In *Proceedings of 7th Japan-Vietnam Joint Seminar on Commutative Algebra*, Feb 2012.  
(Submitted).

[N2]

**Ramakrishna Nanduri.**

Hilbert coefficients of schubert varieties in grassmannians.  
2012.

(Submitted).

[P]

**Jayadev S. Athreya\*, Anish Ghosh\*, and Amritanshu Prasad.**

Ultrametric logarithm laws II.

*Monatshefte für Mathematik*, 2012.  
arXiv:1103.1698 (To be published).

[R]

**K. N. Raghavan, Preena Samuel\*, and K. V. Subrahmanyam\*.**

RSK bases and Kazhdan-Lusztig cells.

*Annales des l'Institut Fourier*, 2011.  
arXiv:0902.2842 (To be published).

[S]

**Shilpa Gondhali\* and Parameswaran Sankaran.**

Vector fields on certain quotients of stiefel manifolds.

*Mathematica Slovaca*, 2011.  
(To be published).

[Sh1]

**Sachin S. Sharma and Sankaran Viswanath.**

The  $t$ -analog of the level one string function for twisted affine Kac-Moody algebras (*announcement*).

*Comptes Rendus Mathématique*, **350(3)**, 133, 2012.

[Sh2]

**Sachin S. Sharma and Sankaran Viswanath.**

The  $t$ -analog of the basic string function for twisted affine Kac-Moody algebras.

*Journal of Algebra*, 2012.

(Submitted).

[Sn1]

**Nagaraj D. S, Laytimi Fatima\*, and El Mazouni A\*.**

Morphisms from  $p_2$  to  $gr(2,c_4)$ . *j. ramanujan math. soc.* 26 (2011), no. 3, 321332,.

*J. Ramanujan Math. Soc.*, **26(no. 3)**, 321, 2011.

[Sn2]

**Nagaraj D. S, Laytimi Fatima\*, and El Mazouni Abdelghani\*.**

Secant bundles on second symmetric power of a curve.

*Journal of Ramanujan Mathematical Society*, **26(no. 2)**, 181, 2011.

[T1]

**Mubeena T and Sankaran Parameswaran.**

Twisted conjugacy classes in abelian extensions of certain linear groups.

*Canadian Mathematical Bulletin*, 2012.

(To be published).

[T2]

**Mubeena T and Sankaran Parameswaran.**

Twisted conjugacy classes in lattices in semisimple lie groups.

*Transformation Groups*, 2012.

(Submitted).

[V]

**R. Venkatesh and Sankaran Viswanath.**

Unique factorization of tensor products for Kac-Moody algebras.

2012.

arXiv:1202.0123v1 (Submitted).

## 2.2 Physics

### 2.2.1 Research Summary

#### Astro-particle Physics

If massive stable charged particles exist (as allowed by the standard model), it will have interesting astrophysical consequences. By replacing one or more electrons from normal atoms by these “massive electrons” we get strongly bound neutral matter which could be a candidate for dark matter. However this has some unique signatures in astrophysics which are under study (G Rajasekaran, Divyakrupa Sahoo and Shiv Sethi\*, work in progress).

Standard model allows the possibility of a stable massive charged particle. This possibility with its consequences are pointed out [R2].

## Biological Physics

The uterus is normally an excitable medium which does not exhibit spontaneous activity. However, during pregnancy, the tissue changes its character and starts exhibiting transient episodes of self-excited oscillatory activity. Just before giving birth these oscillations become synchronized and the resulting organ-wide coherent activity allows the fetus to be ejected. Till date there has been no experimental evidence for a specialized pacemaker region in the uterus (unlike the heart) that can help coordinate this process. An alternative hypothesis has been put forward [Sin2], that proposes the oscillation to be arising from strong coupling between excitable cells and electrically passive cells that co-occur in the uterus. It is known that during pregnancy the gap junctions that couple these cells become numerous and also increase in conductance. By numerical simulations, it has been shown that this increase in coupling is sufficient to explain the emergence of spontaneous oscillations and their gradual synchronization resulting in system-wide coherent activity, explaining one of the long-lasting puzzles in uterine electrophysiology.

The recent swine flu pandemic that spread throughout the world in a remarkably short time and even affected India has shown once again the importance of understanding the dynamics of epidemic spreading. In order to be able to come up with meaningful counter-measures to combat an epidemic, one needs to quantitatively characterize its initial rate of amplification. With the help of data obtained during the recent Indian swine flu epidemic, the basic reproduction number of A(H1N1)v was calculated for India [Me]. The numbers obtained through a variety of rigorous statistical methods lie towards the lower end of the range of values reported from different countries. Region-wise analysis of the incidence of the disease showed that local climatic conditions and public response played an important role in spreading it.

## Classical and Quantum Gravity, Black Holes, Cosmology

One way to deduce the connection formulation of general relativity is to begin with the Hilbert-Palatini action and add the Nieh-Yan topological term. In presence of fermions, the torsion is non-zero even on-shell. The canonical formulation continues to hold and was demonstrated earlier in 2009. This analysis was further elaborated and two distinct notions of *parity* were distinguished in [D1].

A status review of matter couplings in loop quantum gravity was presented in [D2]. This is an invited review article jointly done with Golam Hossain, IISER, Kolkata.

Laws of black hole thermodynamics has a strong similarity with the laws of thermodynamics. This leads to the subject of black hole thermodynamics which may reveal important clues regarding the quantum nature of gravity. Hence it is important to study various generalizations of black hole thermodynamics. Working on these lines, a proof of a quasi station version of classical second law is given in [C] for black holes in Einstein Gauss Bonnet theory. This is the first generalization of Hawking area theorem beyond general relativity to well motivated, non trivial higher curvature gravity theories. [Sa] deals with the generalization

of the derivation of the field equation of general relativity from space time thermodynamics for a general diffeomorphism invariant theory of gravity.

## Classical and Quantum Optics

The effect of a number of mechanisms designed to suppress decoherence in open quantum systems are studied [Goy1] with respect to their effectiveness at slowing down the loss of entanglement. The effect of photonic band-gap materials and frequency modulation of the system-bath coupling are along expected lines in this regard. However, other control schemes, like resonance fluorescence, achieve quite the contrary: increasing the strength of the control leads to a faster decay of entanglement. The effect of dynamic decoupling schemes on two qualitatively different system-bath interactions are studied in depth. Dynamic decoupling control has the expected effect of slowing down the decay of entanglement in a two-qubit system coupled to a harmonic oscillator bath under a nondemolition interaction. However, nontrivial phenomena are observed when a Josephson charge qubit, strongly coupled to a random telegraph noise bath, is subject to decoupling pulses. The most striking of these reflects the resonance fluorescence scenario, in that an increase in the pulse strength decreases decoherence but also speeds up the sudden death of entanglement. This demonstrates that the behavior of decoherence and entanglement in time can be qualitatively different in the strong-coupling non-Markovian regime.

We show [Goy2] that qudits — the information carried by quantum systems with a number of  $d$  levels — encoded in the orbital angular momentum of single photons can be teleported using a particular array of beam splitters (a balanced multiport) and  $d$  additional photons prepared in an entangled anti-symmetric state. A  $d$ -fold coincidence count in the output modes of the beam splitter arrangement projects onto an anti-symmetric state of  $d$  photons and indicates successful teleportation. This scheme can also be employed to teleport information encoded in  $d/2$  photons with an efficiency of up to one qubit per additional photon. This is superior to earlier schemes where teleportation of a single qubit requires an additional pair of entangled photons.

## Condensed Matter Physics

Hubbard model plays a central role in the study of strongly correlated electron systems. The only available exact solutions in one dimension by nested Bethe ansatz show that there is spin-charge decoupling for the infinite  $U$  when there is no possibility of double occupancy of an electron orbital state. It had been shown that these features can be directly obtained by employing the orthofermion algebra. In the present work, numerical results for the thermodynamic properties, namely, specific heat, internal and free energies, magnetization and magnetic susceptibility are provided for a linear chain and 2-D square and triangular lattices using orthofermion approach. It is shown that in 1-D, orthofermion based thermodynamic results are identical to the known exact results. A comparison between the thermodynamic properties of free fermions and free orthofermions is also provided. The orthofermion results can also be used to ascertain the accuracy of the approximate methods employed in the context of infinite  $U$  Hubbard model [Mi2]. In addition, the orthofermion approach has been employed for determining the thermoelectric power in strongly correlated electron systems in one and two dimensions. In limiting cases, exact expression obtained here reduces to the generalized Heikes formula in atomic as well as high temperature limits and Stafford results



at low temperatures. The thermoelectric power as a function of the nearest neighbor hopping has been calculated and the results are compared with earlier studies [Mi1].

Formalisms based on density of states (*dos*) and potential energy curves (*pec*) are concurrently in use to model electrochemical electron transfer reactions. Explicit evaluation of the activation energy is central to the *pec* approach because the reaction rate is formulated in terms of an exponential of the activation energy, whereas the *dos* approach formulates the rate expression as a product of the reactants' density of states. The present work provides a critical comparison between the *dos* and *pec* based results for electrode kinetics. The variation of the electron transfer rate with the overpotential, the dependence of the rate constant on the temperature (apparent activation energy), and the change of these quantities with the reactant-electrode coupling strength are calculated and compared for these two formalisms. While the *pec* and *dos* formalisms coincide in the nonadiabatic limit, they deviate very significantly for large electronic couplings, beyond the nonadiabatic limit. The electron transfer rate obtained through the simple *dos* approach is shown to exceed, by orders of magnitude, a limiting transition state theory value for strong reactant-electrode interaction and a modification that removes this anomaly is proposed for the *dos* formalism. Both methods are applied to understanding the rate versus distance behavior for ferrocene tethered to gold electrodes by methylene groups, and it is found that the *dos* formalism best describes the experimental findings [Mi3]. The electron exchange between a metal electrode and an attached molecular wire with a redox centre at its end has been considered. The current transients for thermal and photo-excited electron transfer have been calculated. The thermal electron transfer shows a decay and hence a negative differential resistance at very high overpotentials. The transient for electron transfer after photoexcitation show oscillations at short time and an exponential decay at long times [Cr2].

## High Energy Physics Phenomenology

The group velocity of neutrino waves is discussed by introducing wave packets for the superposition of neutrino energy eigenstates with mixing. The implications for realistic values for the mixing and mass parameters for neutrino velocity is discussed in a full three neutrino mixing scenario. Our analysis shows the possibility of superluminal propagation of neutrino flavour in a very narrow range of neutrino parameter space, however in this narrow range the number of observable events are reduced drastically. [In3]

Since neutrino waves travel as a superposition of three waves corresponding to the three mass and energy eigenstates, their mutual interference can affect the group velocity of the neutrino waves. The calculation indeed shows this to be the case. However the parameters are such that the superluminality of neutrinos earlier claimed by the OPERA experiment cannot be explained. Observation of the superluminality will require experiments with neutrino beams of very low energy (of the order of electron volt).

In neutrino physics, the analysis of tau contamination of signals at future possible neutrino factories has now been completed [In1]. While the muon channel is (marginally) affected in what are known as the right-sign signals, the crucial wrong-sign electron channel is significantly enhanced by the inclusion of tau production and decay channels from the oscillations of either  $\nu_e$  or  $\nu_\mu$  to  $\nu_\tau$  neutrinos (the so-called platinum channel). The analysis was included, along with the earlier muon analysis, in the *International Design Study for the Neutrino*

*Factory: Interim Design Report [In2].*

In the meanwhile, intriguing signals from the OPERA experiment at Gran Sasso led to a number of discussions on the possibility of faster-than-light propagation of neutrinos. A group at IMSc clarified [?] the analysis for such propagation by introducing wave packets in the superposition of the eigenstates and showed that any (marginal) superluminality that may result will be essentially unobservable.

The determination of vector meson fragmentation functions is important in view of  $\rho$  and  $\phi$  production being signals of quark gluon plasma. In order to understand modification of these production processes in nucleus–nucleus collisions, it is crucial to first understand their production in free nucleon–nucleon collisions. A study to determine these fragmentation functions via the cleaner  $e^+ e^-$  collisions and then extend the analysis to that of  $pp$  collisions was completed to the leading order in perturbative QCD [In4] along with H. Saveetha of Madras University. This is now being extended to beyond the leading order.

The signatures of a vectorlike  $b'$  at the Large Hadron Collider (LHC) has been analyzed in a model-independent fashion. The analytical expressions for the partial widths to the various decay modes are presented. Both single and pair production channels of the  $b'$  are analyzed with subsequent decays into the  $bZ$  and  $bh$  channels as unique probes of the vectorlike nature of the  $b'$ , in addition to the  $tW$  mode. The LHC reach has been determined [Go].

## Foundations of Quantum Mechanics

We consider [P] a joint measurement of two and three unsharp qubit observables through an Arthur Kelly-type joint measurement model for qubits. We investigate the effect of the initial state of the detectors on the unsharpness of the measurement as well as the post-measurement state of the system. Particular emphasis is given on a physical understanding of the POVM to PVM transition in the model and entanglement between the system and the detectors. Two approaches for characterizing the unsharpness of the measurement and the resulting measurement uncertainty relations are considered. The corresponding measures of unsharpness are connected for the case where both the measurements are equally unsharp. The connection between the POVM elements and symmetries of the underlying Hamiltonian of the measurement interaction is made explicit and used to perform the joint measurement in arbitrary directions. Finally, in the case of three observables, we derive a necessary condition for the approximate joint measurement and use it to show the relative freedom available when the observables are non-orthogonal.

We [G2] give the generic form of the entangled states of a system of two spin-1 (and two spin-3/2) particles and the appropriate set of spin observables that together exhibit maximum nonlocality under Hardy's nonlocality test. We show the maximum nonlocality to be 0.09017 just as in the case of two spin-1/2 particles. We conjecture that this result holds good for a system of two spin- $j$  particles for all values of  $j$ .

In [Sati2] we have developed the following formalism for the emergence of a generalised quantum dynamics from matrix models, based on Adler's theory of trace dynamics.

There ought to exist a description of quantum field theory which does not depend on an external classical time. To achieve this goal, in a recent paper we have proposed a non-

commutative special relativity in which space-time and matter degrees of freedom are treated as classical matrices with arbitrary commutation relations, and a space-time line element is defined using a trace. In the present paper, following the theory of Trace Dynamics, we construct a statistical thermodynamics for the non-commutative special relativity, and show that one arrives at a generalised quantum dynamics in which space and time are non-classical and have an operator status. In a future work, we will show how standard quantum theory on a classical space-time background is recovered from here.

In this article [Sati1] we review an experimentally falsifiable phenomenological proposal, known as Continuous Spontaneous Collapse: a stochastic non Quantum mechanics is an extremely successful theory that agrees with every experiment. However, the principle of linear superposition, a central tenet of the theory, apparently contradicts a commonplace observation: macroscopic objects are never found in a linear superposition of position states. Moreover, the theory does not really explain as to why during a quantum measurement, deterministic evolution is replaced by probabilistic evolution, whose random outcomes linear modification of the Schrodinger equation, which resolves these problems, while giving the same experimental results as quantum theory in the microscopic regime. Two underlying theories for this phenomenology are reviewed: Trace Dynamics, and gravity induced collapse. As one approaches the macroscopic scale, the predictions of this proposal begin to differ appreciably from those of quantum theory, and are being confronted by ongoing laboratory experiments that include molecular interferometry and optomechanics. These experiments, which essentially test the validity of linear superposition for large systems, are reviewed here, and their technical challenges, current results, and future prospects summarised. We conclude that it is likely that over the next two decades or so, these experiments can verify or rule out the proposed stochastic modification of quantum theory.

## Nonlinear Dynamics, Solitons and Chaos

After a brief review of dark and bright soliton propagation in the Bose-Einstein condensate of a system of weakly repulsive and attractive bosons, respectively, our study of soliton propagation for a system of hard-core bosons (which is a system of strongly repulsive bosons) is presented. It is shown that while the weakly repulsive case supports only a dark soliton that dies at the speed of sound, the strongly repulsive case supports both dark and bright solitons for the particle density. Intriguingly, these dark (bright) solitons survive even at the speed of sound, if the background density has more (less) number of holes than particles.[Ba1]

In our previous work (Phys. Rev. Lett. 103, 230403 (2009)), mean field dynamics of a hard-core boson system with nearest-neighbour interactions was investigated using spin coherent state averages, and shown to support two types of solitons in the continuum. One is of the Gross-Pitaevskii (GP) type, where the Bose-Einstein condensate fraction is a dark soliton, and the other is a non-GP type which not only shows a brightening of the condensate fraction soliton, but also survives at the speed of sound, unlike the GP soliton. In the present work, it is first shown that the evolution of the above mean field solitons remains stable on the discrete lattice as well. Next, the exact quantum evolution of the initial mean field profiles on the lattice, using adaptive time-dependent renormalization group method is presented. It is shown that both species of solitons are stable under quantum evolution for a finite duration, their tolerance to quantum fluctuations getting enhanced as the width of the soliton increases.[Ba2]

A local action with both the real scalar field and its dual is presented in two Euclidean dimensions. The role of singular line discontinuities is emphasized. Exotic properties of the field with its dual, the generation of spin from scalar fields, and quantization of dual charges are pointed out. Wick's theorem and rotation properties of fermions are recovered for half-integer quantization.

Dirac, Schwinger and Zwanziger theories of electric and magnetic charges are obtained via duality transformation. Analogous construction for three Euclidean dimensions, with magnetic charges interacting with electric currents, is also done. The role of Dirac strings as dislocations in the configurations of gauge potential is emphasized.

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 focused on the issue of how network structure affects the dynamics that such a system is capable of (e.g., hierarchical structures in networks can produce dynamical time-scale separation [Sinh3]), 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. 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). Such meso-level organization has recently been observed in an actual nervous system, that of the invertebrate *C. elegans*, whose entire somatic inter-neuronal wiring diagram has been analyzed. To understand the role of modularity in the function of neuronal networks, a study of the basin structure of modular Hopfield neural networks has show significant increase in system performance at an optimal modularity [Sinh1].

In a follow-up study of Ising spins placed on networks where the interactions are arranged in a modular fashion (with all intra-modular interactions being ferromagnetic and all inter-modular interactions being anti-ferromagnetic), it has been shown that the network structure can result in a novel kind of dynamic ordering corresponding to the "chimera" state seen earlier in systems of interacting oscillators with non-local coupling [Sin1]. This involves spins in some modules being completely ordered, while spins in the other modules are disordered, although all of them are subjected to the same thermal environment and magnetic field. This study has ramifications to the study of how the same phenomenon or information can result in differential response among different communities in society which have mutually antagonistic relations with each other.

## **QFT, Topological QFT, Conformal Field Theory**

Noncommutative deformations of the BTZ blackholes are described by noncommutative cylinders. To study the nature and phases of matter field in such a non-commutative space a real scalar fields is considered. The spectrum is studied analytically and through numerical simulations and the existence of novel ‘stripe phases’ is established. These are different from stripes on Moyal spaces and stable due to topological obstruction [Di2].

## Quantum Computations

We consider [G1] the question of perfect local distinguishability of mutually orthogonal bipartite quantum states, with the property that every state can be specified by a unitary operator acting on the local Hilbert space of Bob. We show that if the states can be exactly discriminated by one-way local operations and classical communication (LOCC) where Alice goes first, then the unitary operators can also be perfectly distinguished by an orthogonal measurement on Bob’s Hilbert space. We give examples of sets of  $N$  (less than or equal to  $d$ ) maximally entangled states in  $d \times d$  for  $d = 4, 5, 6$  that are not perfectly distinguishable by one-way LOCC. Interestingly, for  $d = 5, 6$ , our examples consist of four and five states, respectively. We conjecture that these states cannot be perfectly discriminated by two-way LOCC.

## Relativistic Heavy Ion Collisions

The Quark-Gluon plasma fireball resulting from ultra relativistic high energy heavy ion collisions is a non-uniform medium. The whole system can be thought of as consisting of two parts, the core and the corona. The centrality dependence of charmonium production is studied in a simplified picture where only charmonium produced in the corona survives in the high energy nuclear collision, with full suppression in the hot, deconfined core. To eliminate cold nuclear matter effects as far as possible, the ratio of charmonium to open charm production is considered. The centrality dependence of this ratio is found to follow a universal geometric form, applicable to both RHIC and LHC in collisions at central and forward rapidities [Di3].

## Statistical Mechanics

Disorder or defect is the origin of fracture. Depending on the mobility, interaction and other characteristics of the disorder, fracture can be of brittle or ductile type. Brittle to ductile transition is an extremely important and interesting phenomena in science and engineering. We study the statistical physics of defects in the context of brittle-ductile transition.

We study the nature of the long range order in three and higher dimensional clock model. We find the signature of two transitions in the model arising from the discrete nature of the spins. The lower temperature transition demarcates the phase with long range power law correlations in one spin state to two simultaneous spin states.

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. Apart from price fluctuations

there are other quantitative variables which characterize financial markets, and there has been a running debate in the econophysics literature whether these too have universal distributions having the form of a power law. A detailed analysis of the Indian market has shown that, at least for this market, the universality of the power-law proposed for volume and number of trades distributions do not hold [?].

Statistical methods can be used to infer the existence of generating rules underlying symbol sequences in nature. Recently, a method has been developed for reconstructing the syntactic structure of linguistic sequences and it has been applied on the corpus of undeciphered inscriptions obtained from the ruins of the Indus Valley Civilization (2500-1900 BCE) [Sinh2]. This method, based on the concepts of complex network theory, uncovers the regularities in the sign associations and is used to build segmentation trees of the sequences. These results are currently being used to reconstruct the grammar underlying the sequences. A related core-periphery detection method has been used to detect the essential signary or “grapheme-ome” of the Indus writing system [A]. Information about the geometric patterns seen in the Indus artifacts has been used to infer the possible state of mathematical knowledge of this civilization [Sinh4].

Cooling granular media, characterized by inelastic collisions, exhibit varied physical phenomena. The dynamics and structure of clusters in the inhomogeneous clustered regime of the freely cooling granular gas of point particles is studied. Clusters undergo effective aggregation and fragmentation. The effective fragmentation rate of a cluster is shown to rise sharply beyond a certain time scale. This is argued to be the cause of violation of Porod law during coarsening of the freely cooling granular gas [Ra2]. Cooling granular gas when all particles are held stationary and one particle is given some energy was also studied. A recent experiment on this topic was analyzed in detail. The exponents characterizing the growth of the radius of disturbance and decay of energy were determined exactly and the experimental data was shown to be consistent with this. All results were confirmed using extensive simulations on model systems [Pa2, Pa1].

Long rods interacting only through excluded volume interactions have been studied for a long time as models for liquid crystals. In the current study, the problem is studied on two dimensional lattices. A new Monte Carlo algorithm is proposed for studying such systems. The algorithm does not suffer from slow-down due to jamming even at densities close to the maximum possible. Implementing this algorithm on a two dimensional square lattice, the existence of a transition from an ordered nematic phase to a disordered phase at high densities is shown [Ku].

Pressurised self-avoiding ring polymers in two dimensions are studied using Monte Carlo simulations, scaling arguments and Flory-type theories. The existence of a thermodynamic phase transition at a non-zero scaled pressure is demonstrated in a class of such models. This transition is driven by bond energetics and can be either continuous or discontinuous. It can be interpreted as a shape transition in which the ring polymer takes the shape, above the critical pressure, of a regular N-gon whose sides scale smoothly with pressure, while staying unafacted below this critical pressure [M].

The large scale fluctuations of the ordered state in active matter systems are usually characterised by studying the giant number fluctuations of particles in any finite volume, as compared to the expectations from the central limit theorem. However, in ordering systems, the fluctuations in density ordering are often captured through their structure functions de-

viating from Porod law. The relationship between giant number fluctuations and structure functions, for different models of active matter as well as other non-equilibrium systems is studied. A unified picture emerges, with different models falling in four distinct classes depending on the nature of their structure functions [Ra1].

Conformational properties of a single flexible polyelectrolyte chain in a poor solvent in the presence of divalent and trivalent counterions are studied using constant temperature molecular dynamics simulation. The counterion condensation is shown to be a continuous transition, while the extended-collapsed transition is shown to be a first order phase transition [V1]. The counterion condensation was on a two dimensional charged disc in the limit of infinite dilution was studied analytically. The energy–temperature relation obtained from the canonical free energy and microcanonical entropy were compared. The microcanonical entropy is piecewise linear in energy, and is shown to be concave for all energies. As a result, even though the interactions are long-ranged, the energy–temperature relation and hence the counterion condensation transition points are identical in both the ensembles [V2].

The Coleman-Mermin-Wagner theorem does not allow spontaneous symmetry breaking of continuous symmetries in two dimensions. This is related to the infra-red divergence of the Goldstone modes. This theorem has been seen to hold even for non-commutative spaces. A careful analysis shows that SSB is possible in the form of non-uniform condensates which naturally have lower cut off for the momentum(angular) modes. This has been shown for a  $O(3)$  scalar field on a fuzzy sphere via Monte-Carlo simulations [Di1].

## String Theory

This is a continuation of the general theme of applying string theory techniques to condensed matter physics. An attempt is made to obtain a holographic description of strong coupling BCS superconductivity. The idea is to use the similarity of this instability with chiral symmetry breaking in QCD. There is a string construction that realizes this and involves D8 branes in a background of D4 branes. This is referred to as the Sakai-Sugimoto model. When a finite number density of baryons is added to this model here is an instability in the bulk and a baryon number violating condensate is formed. It is proposed that this is the bulk version of the Cooper pairing instabilities. The solutions of the full Yang-Mills equations in this background are given, both analytically in some approximation and also numerically, without any approximation. The stability analysis is done. Some preliminary results on the Green's function is also given. [K]

Two dimensional non-linear sigma model with target space  $M$  can be viewed as a single particle relativistic quantum mechanics in the corresponding free loop space  $LM$ . This is an infinite dimensional space where a point represents an embedding of a loop in  $M$ . In a natural semi-classical limit ( $\hbar = \alpha' \rightarrow 0$ ) of this model the wavefunction localizes on the submanifold of vanishing loops which is isomorphic to  $M$ . One would expect that the relevant semi-classical expansion should be related to the tubular expansion of the theory around the submanifold and an effective dynamics on the submanifold is obtainable using Born-Oppenheimer approximation. In [Mu1] a framework to carry out such an analysis at the leading order in  $\alpha'$ -expansion has been developed. In particular, it has been shown that the linearized tachyon effective equation is correctly reproduced up to divergent terms all proportional to the Ricci scalar of  $M$ . The steps leading to this result are as follows: first a

finite dimensional analogue of the loop space quantum mechanics (LSQM) is defined where its tubular expansion and how that is related to a semi-classical expansion of the Hamiltonian are discussed. Then an explicit construction of the relevant tubular neighborhood in  $LM$  using exponential maps is studied. Such a tubular geometry is obtained from a Riemannian structure on the tangent bundle of  $M$  which views the zero-section as a submanifold admitting a tubular neighborhood. Using this result and exploiting an analogy with the toy model one arrives at the final result for LSQM.

Reference [Mu1] takes the approach of first understanding the problem in a finite dimensional setting and then figuring out how that may be interpreted in the language of loop space. Tubular expansion, i.e. a covariant Taylor expansion of a tensor around a submanifold embedded in a curved space, plays a crucial role in understanding the semi-classical expansion in this problem. The coefficients of this expansion are certain tensors of the ambient space evaluated on the submanifold. In [Mu2] an arbitrary submanifold embedded in a finite dimensional (pseudo-)Riemannian manifold has been considered. By generalizing certain differential geometric technique used earlier to study zero dimensional submanifold (i.e. a point), an all order result for the tubular expansion, also called Fermi normal coordinate expansion, of vielbein components have been obtained. Expansion coefficients are given in terms of the various combination of the curvature tensor, its covariant derivatives and spin connection. The result has been shown to be consistent with certain metric-integral theorem due to Florides and Synge (1971).

The study of microstate counting in four-dimensional string theories have given rise to interesting connections to modular forms, Lie algebras and sporadic groups. A class of four dimensional string theories known as CHL models are well known testing grounds for such counting problems. The counting of a class of states called twisted half-BPS states was studied within the CHL orbifold models. Some special cases where the twist generating group does not commute with the orbifold group were considered. It was found that the contribution to the degeneracy comes mainly from the untwisted sector of the orbifold. It was shown that the generating function for these twisted BPS states are modular forms that are related to representations of the Mathieu group  $M_{24}[\mathbf{I}]$ .

## 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.

[A]

**Izhar M. Ashraf and Sitabhra Sinha.**

Core-periphery organization of graphemes in written sequences: Decreasing positional rigidity with increasing core order.

In A. Gelbukh, editor, *CICLing 2012 (Springer Lecture Notes in Computer Science, Vol 7181)*, page 142. Springer, Mar 2012.

[B1]

**A.P. Balachandran, T. R. Govindarajan, and Amilcar R. de Queiroz\***.



Electric dipole moment from QCD  $\theta$  and how it vanishes for mixed states.  
2012.  
arXiv: 1204.6609v1[hep-th].

[B2]

**A.P. Balachandran, T. R. Govindarajan, and Amilcar R. de Queiroz\***.  
Novel studies on the  $\eta'$  effective lagrangian.  
2012.  
arXiv: 1202.3462v2[hep-ph].

[B3]

**A.P. Balachandran, T. R. Govindarajan, Amilcar R. de Queiroz\*, and A.F.\*  
Reyes-Lega.**  
Entanglement, particle identity and the GNS construction: A unifying approach.  
2012.  
arXiv: 1205.2882v1[quant-ph].

[B4]

**A.P. Balachandran, Seckin Kurkcuoglu\*, and Amilcar R. de Queiroz\***.  
Spontaneous breaking of lorentz symmetry and vertex operators for vortices.  
2012.  
arXiv: 1208.3175v1[hep-th].

[Ba1]

**Radha Balakrishnan and Indubala I. Satija\***.  
Solitons in Bose-Einstein condensates.  
*Pramana*, **77**, 929, 2011.

[Ba2]

**Chester P. Rubbo\*, Indubala I. Satija\*, W P. Reinhardt\*, Radha Balakrishnan,  
Ana Maria Rey\*, and S. R. Manmana\***.  
Quantum dynamics of solitons in strongly interacting systems on optical lattices.  
*Phys. Rev. A*, 2012.  
arXiv: 1202.3400v1(quant-phys) (To be published).

[C]

**Ayan Chatterjee and Sudipta Sarkar.**

Physical process first law and increase of horizon entropy for black holes in einstein-gauss-  
bonnet gravity.  
*Phys. Rev. Lett*, **108(9)**, 091301, 2012.

[Ch1]

**Chandrasekhar Chatterjee.**  
Some non perturbative aspects of gauge theories.  
2011.  
(Preprint: arXiv:1104.1922).

[Ch2]

**Chandrasekhar Chatterjee, E. Harikumar\*, Manu Mathur\*, Indrajit Mitra\*, and H. S. Sharatchandra.**

Line discontinuities, local action with both the field and its dual, and spin from no spin in two-dimensional scalar theory.

2011.

arXiv:1111.5218 (Submitted).

[Ch3]

**Chandrasekhar Chatterjee, Indrajit Mitra\*, and H.S. Sharatchandra.**

Two-potential theory of electric and magnetic charges via duality transformation.

*Physics Letters B*, **710**, 223, 2011.

[Cr1]

**A.V.B. Cruz and Ashok K. Mishra.**

Electron transfer reaction through an adsorbed layer.

*Journal of Electroanalytical Chemistry*, **659**, 50, 2011.

[Cr2]

**A.V.B. Cruz, Ashok K. Mishra, and Wolfgang Schmickler\*.**

Transient behaviour of electron exchange between a molecular wire and a metal electrode.

*Electrochimica Acta*, **56**, 5245, 2011.

[D1]

**Ghanashyam Date.**

Revisiting canonical gravity with fermions.

2011.

(Preprint: IMSc/2011/10/13, arXiv:1110.3416).

[D2]

**Ghanashyam Date and Golam M. Hossain\*.**

Matter in loop quantum gravity.

*SIGMA*, **8**, 010, 2012.

[Di1]

**S. Digal and T. R. Govindarajan.**

Topological stability of broken symmetry on fuzzy sphere.

2011.

arxiv:1108.3320[hep-th] (To be published).

[Di2]

**S. Digal, T. R. Govindarajan, K. S. Gupta\*, and X. Martin\*.**

Phase structure of fuzzy black holes.

*JHEP*, **1201**, 027, 2012.

[Di3]

**S. Digal, H. Satz\*, and R. Vogt\*.**

Charmonium production and corona effect.  
*Physical Review C*, **C85**, 034906, 2012.

[G1]

**Somshubhro Bandyopadhyay\***, **Sibasish Ghosh**, and **Guruprasad Kar\***.

Locc distinguishability of unilaterally transformable quantum states.

*New J. Phys.*, **13(12)**, 123013, 2011.

[G2]

**Kaushik P. Seshadreesan\*** and **Sibasish Ghosh**.

Constancy of maximal nonlocal probability in hardy's nonlocality test for bipartite quantum systems.

*J. Phys. A: Math. Theor.*, **44(31)**, 315305, 2011.

[Go]

**S. Gopalakrishna**, **T. Mandal**, **S. Mitra**, and **R. Tibrewala**.

Lhc signatures of a vector-like  $b'$ .

*Phys. Rev.D*, **84**, 055001, 2011.

arXiv:1107.4306 [hep-ph].

[Goy1]

**Sandeep K. Goyal**, **Subhashish Banerjee\***, and **Sibasish Ghosh**.

Effect of control procedures on the evolution of entanglement in open quantum systems.

*Phys. Rev. A*, **85(1)**, 012327, 2012.

[Goy2]

**Sandeep K. Goyal**, **Patricia E. Boukama-Dzoussi\***, **Sibasish Ghosh**, **Filippus S. Roux\***, and **Thomas Konrad\***.

Qudit-teleportation for photons with linear optics.

2012.

(Submitted).

[I]

**Karthik Inbasekar** and **Suresh Govindarajan\***.

A non-commuting twist in the partition function.

*JHEP*, 2012.

<http://arxiv.org/abs/1201.1628> (Submitted).

[In1]

**Rupak Dutta\***, **D. Indumathi**, and **Nita Sinha**.

Tau contamination in the platinum channel at neutrino factories.

*Phys. Rev.*, **D85**, 013003, 2012.

arXiv:1103.5578 [hep-ph].

[In2]

**R. J. Abrams\*** et al.

International design study for the neutrino factory: Interim design report.

*IDS-NF-020*, 2011.  
arXiv:1112.2853v1 [hep-ex].

[In3]

**D. Indumathi, Romesh K. Kaul, M.V.N. Murthy, and G. Rajasekaran.**  
Group velocity of neutrino waves.  
*Physics Letters*, **B709**, 413, 2012.

[In4]

**D. Indumathi and H. Saveetha\***.  
Study of vector meson fragmentation using a broken SU3 model.  
*Int. J. Mod. Phys.*, **A27**, 1250103, 2012.  
arXiv:1102.5594 [hep-ph].

[K]

**S. Kalyana Rama, Sawrnendu Sarkar\*, B. Sathiapalan, and Nilanjan Sircar\***.  
Strong coupling bcs superconductivity and holography.  
2011.  
(Preprint: IMSC/2011/04/2).

[Ka1]

**Jampa Maruthi Pradeep Kanth and Ramesh Anishetty.**  
Hydrophobic force a Casimir-like effect due to hydrogen-bond fluctuations.  
2011.  
(Preprint: arXiv:1109.2733).

[Ka2]

**Jampa Maruthi Pradeep Kanth and Ramesh Anishetty.**  
Molecular mean field theory for liquid water.  
*Physica A*, **391(3)**, 439, 2012.

[Ku]

**J. Kundu, R. Rajesh, D. Dhar\*, and J. F. Stilck\***.  
A monte carlo algorithm for studying phase transition in systems of hard rigid rods.  
In *Proceedings of the 56th DAE Solid State Physics Symposium*, Dec 2011.  
(To be published).

[M]

**M. K. Mitra\*, G. I. Menon, and R. Rajesh.**  
Thermodynamic behaviour of two-dimensional vesicles revisited.  
*Euro. Physics. Journal E*, **35**, 30, 2012.

[Me]

**T. Jesan\*, Gautam I. Menon, and Sitabhra Sinha.**  
Epidemiological dynamics of the 2009 influenza A H1N1v outbreak in india.  
*Current Science*, **100(7)**, 1051, 2011.

[Mi1]

**Ram Kishore\* and Ashok K. Mishra.**

Orthofermion approach for the thermoelectric power in the infinite u hubbard model.

In William P. Dempsey, editor, *Thermoelectric Power*, page 249. Nova Science Publishers Inc., 2012.

[Mi2]

**Ashok K. Mishra and Ram Kishore\*.**

An orthofermion approach for thermodynamic properties of infinite u hubbard model in one and two dimensions.

*Journal of Physics: Conference Series*, **273**, 012153, 2011.

[Mi3]

**Ashok K. Mishra and David H. Waldeck\*.**

Comparison of density of states (dos) and potential energy curve (pec) models for electro-chemical rate constant.

*The Journal of Physical Chemistry C*, **115**, 20662, 2011.

[Mp]

**Ponmurugan M and Satyavani Vemparala.**

Transient state fluctuation like relations for the driving force on a biomolecule.

*Physical Review E (Rapid Communications)*, **84**, 060101, 2011.

[Mu1]

**Partha Mukhopadhyay.**

On a semi-classical limit of loop space quantum mechanics.  
2012.

(Preprint: arXiv:1202.2735 [hep-th]).

[Mu2]

**Partha Mukhopadhyay.**

All order covariant tubular expansion.  
2012.

(Preprint: arXiv:1203.1151 [gr-qc]).

[Muk1]

**J. Solomon Ivan\*, N. Mukunda, and R. Simon.**

Generation and distillation of non-Gaussian entanglement from nonclassical photon statistics.  
*Quantum Inf. Process.*, **11**, 873 – 885, 2012.

[Muk2]

**J. Solomon Ivan\*, N. Mukunda, and R. Simon.**

Moments of non-Gaussian wigner distributions and a generalized uncertainty principle: I.  
The single-mode case.

*Jour. Phys. A: Math. Theor.*, 2012.

(To be published).

[Mur]

**R. Bhaduri\***, **M. Brack\***, and **M. Murthy**.

A semiclassical analysis of the Efimov energy spectrum in the unitary limit.

*Physical Review*, **A 83**, 063612, 2011.

[N]

**Gaurav G. Narain** and **Ramesh R. Anishetty**.

Short distance freedom of quantum gravity.

*Physics Letters B*, **711(1)**, 128, 2011.

[Ni]

**Nita Sinha**.

Tau contributions to muon/electron events at a neutrino factory.

In B.S. Acharya, Maury Goodman, and Naba K. Mondal, editors, *Proceedings of the 12th International Workshop on Neutrino Factories, Superbeams and Beta Beams-NuFact10. AIP Conference Proceedings, Vol 1382*, page 118. American Institute of Physics, Oct 2011.

[P]

**Rajarshi Pal** and **Sibasish Ghosh**.

Approximate joint measurement of qubit observables through an arthur-kelly model.

*J. Phys. A: Math. Theor.*, **44(48)**, 485303, 2011.

[Pa1]

**S. N. Pathak**, **Z. Jabeen\***, **R. Rajesh**, and **P. Ray**.

Shock propagation in a visco-elastic granular gas.

In *Proceedings of the 56th DAE Solid State Physics Symposium*, Dec 2011.

(To be published).

[Pa2]

**S. N. Pathak**, **Z. Jabeen\***, **P. Ray**, and **R. Rajesh**.

Shock propagation in granular flow subjected to an external impact.

2012.

arXiv:1202.0413 (Submitted).

[R1]

**Sumit T. Garg\***, **T. Shreecharan\***, **P. Das\***, **N. Deshpande\***, and **G. Rajasekaran**.

Tev scale implications of noncommutative space-time in laboratory frame with polarized beams.

*Journal of High Energy Physics*, **10**, 1107:024, 2011.

[R2]

**G. Rajasekaran**.

A stable massive charged particle.

*Modern Physics Letters A*, 2011.

arXiv:1105.5213 [hep-ph] (Submitted).

[R3]

**G. Rajasekaran.**

Cabibbo angle and the universality of weak interactions.

*Physics News*, **41(3)**, 21, 2011.

[R4]

**G. Rajasekaran.**

Profound truths.

*Current Science*, **101(6)**, 727, 2011.

[Ra1]

**S. Dey\***, **D. Das\***, and **R. Rajesh.**

Spatial structures and giant number fluctuations in models of active matter.

2012.

arXiv:1202.5994 (Submitted).

[Ra2]

**M. Shinde\***, **D. Das\***, and **R. Rajesh.**

Coarse grained dynamics of the freely cooling granular gas in one dimension.

*Physical Review E*, **84**, 011140, 2011.

[S1]

**J. Solomon Ivan\***, **Krishnakumar Sabapathy**, and **R. Simon.**

Operator-sum representation for bosonic gaussian channels.

*Phys. Rev. A*, **84**, article no. 042311 (26pp), 2011.

[S2]

**Krishnakumar Sabapathy**, **J. Solomon Ivan\***, and **R. Simon.**

Robustness of non-Gaussian entanglement against noisy amplifier and attenuator environments.

*Phys. Rev. Lett.*, **107**, article no. 130501, 2011.

[Sa]

**Raf Guedens\***, **Ted Jacobson\***, and **Sudipta Sarkar.**

Horizon entropy and higher curvature equations of state.

*Phys. Rev. D*, **85(6)**, 064017, 2012.

[Sat]

**Balachandran Sathiapalan.**

Loop variables and gauge invariant exact renormalization group equations for (open) string theory.

*Nucl Phys B*, 2012.

IMSC/2012/2/2 (To be published).

[Sati1]

**Angelo Bassi\***, **Kinjalk Lochan\***, **Seema Satin**, **Tejinder Singh\***, and **Hendrik Ulbricht\***.

Models of wavefunction collapse, underlying theories and experimental tests.  
2012.  
(Preprint: arXiv:0458994 ).

[Sati2]

**Kinjalk Lochan\***, **Seema Satin**, and **Tejinder Singh\***.

Statistical thermodynamics for non-commutative special relativity:emergence of a generalized quantum dynamics.  
2012.  
(Submitted).

[Si]

**J. Solomon Ivan\***, **M. Sanjay Kumar\***, and **R. Simon**.

A measure of non-Gaussianity for quantum states.  
*Quantum Inf. Process.*, **11**, 853 – 872, 2012.

[Sin1]

**Rajeev Singh**, **Subinay Dasgupta\***, and **Sitabhra Sinha**.

Chimera order in spin systems.  
*EPL*, **95(1)**, 10004, 2011.

[Sin2]

**Rajeev Singh**, **Jinshan Xu\***, **Nicolas G. Garnier\***, **Alain Pumir\***, and **Sitabhra Sinha**.

Self-organized transition to coherent activity in disordered media.  
*Physical Review Letters*, **108(2)**, 068102, 2012.

[Sinh1]

**Neeraj Pradhan\***, **Subinay Dasgupta\***, and **Sitabhra Sinha**.

Modular organization enhances the robustness of attractor network dynamics.  
*EPL*, **94(3)**, 38004, 2011.

[Sinh2]

**Sitabhra Sinha**, **Izhar M. Ashraf**, **Raj K. Pan\***, and **Bryan K. Wells\***.

Network analysis of a corpus of undeciphered indus civilization inscriptions indicates syntactic organization.  
*Computer Speech and Language*, **25(3)**, 639, 2011.

[Sinh3]

**Sitabhra Sinha** and **Swarup Poria\***.

Multiple dynamical time-scales in networks with hierarchically nested modular organization.  
*Pramana: Journal of Physics*, **77(5)**, 833, 2011.

[Sinh4]

**Sitabhra Sinha**, **Nisha Yadav\***, and **Mayank Vahia\***.

In square circle: Geometric knowledge of the indus civilization.



In H.N. Ramaswamy R. Sujatha and C.S. Yogananda, editors, *Math Unlimited: Essays in Mathematics*, page 451. Science Publishers and CRC Press, 2012.

[V1]

**A. Varghese, V. Vemparala, and R. Rajesh.**

Phase transitions of a single polyelectrolyte chain in a poor solvent with multivalent counterions.

In *Proceedings of the 56th DAE Solid State Physics Symposium*, Dec 2011.

(To be published).

[V2]

**A. Varghese, S. Vemparala, and R. Rajesh.**

Ensemble equivalence for counterion condensation on a two dimensional charged disk.

*Physical Review E*, **85**, 011119, 2011.

[Va]

**Anoop Varghese, Satyavani Vemparala, and Rajesh Ravindran.**

Phase transitions of a single polyelectrolyte in a poor solvent with explicit counterions.

*Journal of Chemical Physics*, **135**, 154902, 2011.

[Ve]

**Satyavani Vemparala, Sonali Mehrotra\*, and Hemalatha Balaram\*.**

Role of loop dynamics in thermal stability of mesophilic and thermophilic adenylsuccinate synthetase: a molecular dynamics and normal mode analysis study.

*Biochimica et Biophysica Acta (BBA)-Proteins and Proteomics*, **1814**, 630, 2011.

## Books/Monographs Authored/Edited

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

[M]

Gautam I. Menon and Purusattam Ray, editors.

*The Physics of Disordered Systems.*

Texts and Readings in Physical Sciences. Hindustan Book Agency, P19 Green Park Extension New Delhi 110 016, 2012.

[R]

Sitangshu B. Santra\* and Purusattam Ray, editors.

*Computational Statistical Physics.*

Texts and Readings in the Physical Sciences. Hindustan Book Agency, P 19 Green Park Extension New Delhi 110 016, 2011.

## 2.3 Theoretical Computer Science

### 2.3.1 Research Summary

#### Algorithms and Data Structures

In [R2], we study the  $k$ -FEEDBACK ARC/VERTEX SET problem where we are given a directed graph  $D$  and a positive integer  $k$  and the objective is to check whether it is possible to delete at most  $k$  arcs/vertices from  $D$  to make it acyclic. So far, the studies in the algorithmic direction for this problem have left the question of a kernel unaddressed. We obtain a cubic vertex kernel for  $k$ -FASBT. This completes the kernelization picture for the FEEDBACK ARC/VERTEX SET problem on tournaments and bipartite tournaments, as for all other problems polynomial kernels were known before.

In [R3], we investigate the parameterized complexity of VERTEX COVER parameterized above the optimum value of the linear programming (LP) relaxation of the integer linear programming formulation of the problem. By carefully analyzing the change in the LP value in the branching steps, we argue that even the most straightforward branching algorithm (after some preprocessing) results in an  $O(2.6181^r n^{O(1)})$  algorithm for the problem where  $r$  is the excess of the vertex cover size over the LP optimum.

Then, using known and new reductions, we give  $O^*(2.6181^k)$  algorithms for the parameterized versions of ABOVE GUARANTEE VERTEX COVER, ODD CYCLE TRANSVERSAL, SPLIT VERTEX DELETION and ALMOST 2-SAT, and an  $O^*(1.6181^k)$  algorithm for KÖNIG VERTEX DELETION, VERTEX COVER PARAM BY OCT and VERTEX COVER PARAM BY KVD. These algorithms significantly improve the best known bounds for these problems. The notable improvement is the bound for ODD CYCLE TRANSVERSAL for which this is the first major improvement after the first algorithm that showed it fixed-parameter tractable (Reed, Smith and Vetta, 2003). We also observe that using our algorithm, one can obtain a simple kernel for the classical vertex cover problem with at most  $2k - O(\log k)$  vertices.

In [R1], we consider König graphs which contain certain annotated vertices and characterize the ones which have minimum vertex covers containing these vertices using the classical notions of augmenting paths and flowers used in Edmonds' matching algorithm. Using this characterization, we develop an  $O^*(9^k)$  algorithm for the question of whether a general graph has a vertex cover of size at most  $m + k$  where  $m$  is the size of the maximum matching. Our algorithm for this well studied ABOVE GUARANTEE VERTEX COVER problem uses the technique of iterative compression and the notion of important separators, and improves the runtime of the previous best algorithm that took  $O^*(15^k)$  time. As a consequence of this result we get that well known problems like ALMOST 2-SAT (deleting at most  $k$  clauses to get a satisfying 2 SAT formula) and KÖNIG VERTEX DELETION (deleting at most  $k$  vertices to get a König graph), also have an algorithm with  $O^*(9^k)$  running time, improving on the previous bound of  $O^*(15^k)$ .

A Glushkov automaton corresponding to a regular expression  $R$  is an epsilon-free non-deterministic finite automaton accepting the language  $L(R)$ . This construction is an alternative to the more popular Thompson construction. Although well explored in theory,

the former is not commonly used in practice, perhaps because of the intricacies of its efficient implementations. In [P] a simple and compact representation for the Glushkov automaton is introduced. It naturally suits a well known algorithm given by Berry and Sethi to construct the Glushkov automaton. The representation uses the referential transparency inherent in functional programming to optimize space and time usage. The Berry-Sethi algorithm can construct this representation in  $O(|R|)$  time, where  $|R|$  is the size (number of nodes in the syntax tree) of  $R$ . The representation occupies  $O(|R|)$  memory. The representation also allows matching in  $O(n|R|)$  time, where  $n$  is the size of the input string. Moreover, the real time performance of the implementation is comparable to, and at times better than, some of the best competitors.

## Automata, Logic and Concurrency

In [Ma], we study a class of automata over infinite alphabets that has elementary decidability of emptiness checking and between register and class memory automata in terms of expressiveness.

[Pa1] offers a neighbourhood model for large games, whereby player play normal form games within a neighbourhood but have limited visibility of adjacent neighbourhoods, which may lead to switching. We characterize stable configurations in such games. In [Pa2], we study the mutual interdependence of individual rationality and societal rationality, synthesizing rules by which society may act to remove individual choices based on strategy distributions.

## Computational Complexity

Given two  $n$ -variable boolean functions  $f$  and  $g$ , we study the problem of computing an approximate isomorphism between them. Given two isomorphic boolean functions computable by constant-depth circuits, we give a randomized algorithm with running time exponential in  $\sqrt{n}$  and  $\text{polylog}(n)$  that computes a  $1/2^{\text{polylog}(n)}$ -approximate isomorphism between them. This is in contrast to the best known exact isomorphism algorithm of Luks that runs in time exponential in  $n$ . Our algorithm is based on a recent result for hypergraph isomorphism due to Babai and Codenotti and the classical Linial Mansour-Nisan result on approximating small depth and size boolean circuits by small degree polynomials using Fourier analysis. These results are reported in [A4].

Given a finite group  $G$  by its multiplication table as input, we give a deterministic polynomial-time construction of a Cayley graph on  $G$  with  $O(\log |G|)$  generators, which has a rapid mixing property and a constant spectral expansion. This gives a completely different and elementary proof of a result of Wigderson and Xiao. Our construction is based on properties of Erdo-Renyi sequences for groups. This result is reported in [A2].

Given as input a subgroup  $G$  of the symmetric group, by a generator set, we consider the problem of computing a small expanding generator set for  $G$ . In the general case we describe a fairly easy construction based on the Reingold-Vadhan derandomized graph squaring operation. The size of this generator set is far from the optimal  $O(n \log n)$  that is promised by the probabilistic method. However, in the case of solvable permutation groups we are able to exploit its structure and construct expanding generator sets of size  $O(n^2 \text{polylog}(n))$ . These results are presented in [A3].

In [M2], the problem of counting paths in width-2 planar branching programs is revisited. It is shown to be hard for Boolean  $NC^1$  under  $ACC^0[5]$  reductions, completing a proof strategy outlined by Allender, Ambainis, Barrington, Datta and LêThanh in 1999. On the other hand, for several restricted instances of width-2 planar branching programs, the counting problem is shown to be  $TC^0$ -complete. Also, it is shown that non-planar width-2 programs can be planarized in  $AC^0[2]$ . Using the equivalence of planar width-2 programs with the reduced-form representation of positive rationals, the evaluation problem for this representation in the Stern-Brocot tree is also shown to be  $NC^1$  hard. In contrast, the evaluation problem in the continued fraction representation is in  $TC^0$ .

In [M1], the study of proof systems where verification of proofs proceeds by  $NC^0$  circuits is initiated, and the question of which languages admit proof systems in this very restricted model is investigated. Formulated alternatively, the question asks which languages can be enumerated by  $NC^0$  functions. The results of this paper show that the answer to this problem is not determined by the complexity of the language. On the one hand,  $NC^0$  proof systems for a variety of languages ranging from regular to NP-complete are constructed. On the other hand, it is shown by combinatorial methods that even easy regular languages such as Exact-OR do not admit  $NC^0$  proof systems. Also, a general construction of  $NC^0$  proof systems for regular languages with strongly connected NFA's is presented.

## Graph Theory and Combinatorics

In recent works [S1, S6], the lower bound on the maximum size of an induced acyclic subgraph obtained in previous works was extended to the case of  $p \geq C/n$  ( $C > 0$  is a suitable constant). This extension was based on applications of the well-known Talagrand and Paley-Zigmund inequalities. In a recent work [S5], the previous work on the maximum size of an induced acyclic tournament was further strengthened. In particular, it was established that  $\mathcal{A}_n$  is 1-point concentrated for all  $n$  belonging to a subset of positive integers of density 1 provided edge probability  $p$  is fixed. Also, thresholds (on  $p$ ) are established for the existence of induced acyclic tournaments of size  $i$  which are sharp for  $i = i(n) \rightarrow \infty$ . These results are valid as long as  $p \geq 1/n$  and also hold (with some slight changes) for a related random model which allows 2-cycles. In a recent work [S7], it is shown that any graph which is subcubic but not cubic can be star colored using six colors. It is also shown that cubic graphs with some assumptions on girth can be colored using six colors.

### 2.3.2 List of Publications

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

[A1]

**V. Arvind and J. Kobler\***.

Canonizing hypergraphs under abelian group action.

- In Ding-Zhu Du and Bin Fu, editors, *Computing and Combinatorics - 17th Annual International Conference, COCOON*, page 432. Springer, Jul 2011.
- [A2]  
**V. Arvind, P. Mukhopadhyay\*, and P. Nimbhorkar\***.  
 Erdos-renyi sequences and deterministic construction of expanding cayley graphs.  
 In *Electronic Colloquium on Computational Complexity, ECCC*, 2011.  
 (Preprint: TR11-081).
- [A3]  
**V. Arvind, P. Mukhopadhyay\*, P. Nimbhorkar\*, and Y. Vasudev.**  
 Expanding generator sets for solvable permutation groups.  
 In *Electronic Colloquium on Computational Complexity, ECCC*, 2011.
- [A4]  
**V. Arvind and Y. Vasudev.**  
 Isomorphism testing of boolean functions computable by constant-depth circuits.  
 In Carlos Martn-Vide and Adrian Horia Dediu, editors, *Language and Automata Theory and Applications-6th International Conference, LATA, LNCS*, volume 7183. Springer, Mar 2012.
- [A5]  
**V. Arvind and J. Toran\***.  
 Solvable group isomorphism is(almost) in  $np \cap comp$ .  
*ACM Transaction on Computation Theory (TOCT)*, 2(2(4))(4), 2011.
- [L]  
**Kamal Lodaya, Madhavan Mukund\*, and Ramchandra B. Phawade.**  
 Kleene theorems for product systems.  
 In Pighizzini M. Holzer, M. Kutrib abd G, editor, *Proc. 13th Descriptive complexity of formal systems, Limburg*, pages 235–247. Springer, Jun 2011.
- [M1]  
**Olaf Beyersdorff\*, Samir Datta\*, Meena Mahajan, Gido Scharfenberger-Fabian\*, Karteek Sreenivasaiah, Michael Thomas\*, and Heribert Vollmer\***.  
 Verifying proofs in constant depth.  
 In *36th International Symposium on Mathematical Foundations of Computer Science MFCS, Warsaw, Poland. LNCS 6907*, pages 84–95. Springer, Aug 2011.
- [M2]  
**Meena Mahajan, Nitin Saurabh, and Karteek Sreenivasaiah.**  
 Counting paths in planar width 2 branching programs.  
 In Julian Mestre, editor, *Proceedings of 18th Computing: the Australasian Theory Symposium CATS; CRPIT series*, pages 59–68. Australian Computer Society, Jan 2012.
- [M3]  
**Samir Datta\*, Meena Mahajan, B V Raghavendra Rao\*, Michael Thomas\*, and**

**Heribert Vollmer\***.

Counting classes and the fine structure between  $NC^1$  and  $L$ .  
*Theoretical Computer Science (special issue for MFCS 2010)*, **417**, 36–49, 2012.

[M4]

**Maurice Jansen\***, **B. V. Raghavendra Rao\***, and **Meena Mahajan**.

Resource trade-offs in syntactically multilinear arithmetic circuits.

*Computational Complexity*, 2011.

(To be published).

[M5]

**Meena Mahajan** and **B. V. Raghavendra Rao\***.

Small-space analogues of Valiant’s classes and the limitations of skew formulas.

*Computational Complexity*, 2011.

(To be published).

[Ma]

**Amaldev Manuel** and **R. Ramanujam**.

Class counting automata on datawords.

*Int. Jnl. Foundations of Computer Science*, **22(4)**, 863, 2011.

[Mi]

**Neeldhara Misra**, **Geevarghese Philip**, **Venkatesh Raman**, and **Saket Saurabh**.

On parameterized independent feedback vertex set.

In Bin Fu and Ding-Zhu Du, editors, *Computing and Combinatorics, 17th International Conference, COCOON 2011*, page 98. Springer Verlag, Aug 2011.

[P]

**Abhay Parvate** and **Benoit Razet\***.

Fast regular expression matching with Glushkov automaton.

2012.

(Submitted).

[Pa1]

**Soumya Paul** and **R. Ramanujam**.

Neighbourhood structure in large games.

In K. Apt, editor, *Theoretical Aspects of Rationality and Knowledge*, page 121. TARK, Jul 2011.

[Pa2]

**Soumya Paul** and **R. Ramanujam**.

Dynamic restriction of choices: Synthesis of societal rules.

In Hans van Ditmarsch and Jerome Lang, editors, *Logic, Rationality and Interaction*, page 28. Springer LNCS 6953, Oct 2011.

[Ph1]

**Robert Bredereck\***, **André Nichterlein\***, **Rolf Niedermeier\***, and **Geevarghese**

**Philip.**

The Effect of Homogeneity on the Complexity of  $k$ -Anonymity.

In Owe, Olaf and Steffen, Martin and Telle, Jan, editor, *Fundamentals of Computation Theory - 18th International Symposium, FCT 2011, Oslo, Norway, August 22-25, 2011. Proceedings*, page 53. Springer Berlin / Heidelberg, Jun 2011.

**[Ph2]**

**Fedor V. Fomin\***, **Geevarghese Philip**, and **Yngve Villanger\***.

Minimum Fill-in of Sparse Graphs: Kernelization and Approximation.

In Supratik Chakraborty and Amit Kumar, editor, *IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2011, December 12-14, 2011, Mumbai, India*, page 164. Schloss Dagstuhl - Leibniz-Zentrum fuer Informatik, Dec 2011.

**[Ph3]**

**Marek Cygan\***, **Geevarghese Philip**, **Marcin Pilipczuk\***, and **Michał Pilipczuk\***.

Dominating Set is Fixed Parameter Tractable in Claw-free Graphs.

*Theoretical Computer Science*, **412(50)**, 6982, 2011.

**[R1]**

**Venkatesh Raman**, **Ramanujan M. S.**, and **Saket Saurabh**.

Paths, flowers and vertex cover.

In *Algorithms - ESA 2011 - 19th Annual European Symposium, Saarbrücken, Germany, September 5-9, 2011. Proceedings*, page 382, Sep 2011.

**[R2]**

**Pranabendu Misra\***, **Venkatesh Raman**, **Ramanujan M. S.**, and **Saket Saurabh**.

A polynomial kernel for feedback arc set on bipartite tournaments.

In *Algorithms and Computation - 22nd International Symposium, ISAAC 2011, Yokohama, Japan, December 5-8, 2011. Proceedings*, page 333, Dec 2011.

**[R3]**

**Narayanaswamy N. S.\***, **Venkatesh Raman**, **Ramanujan M. S.**, and **Saket Saurabh**.

Lp can be a cure for parameterized problems.

In *29th International Symposium on Theoretical Aspects of Computer Science, STACS 2012, February 29th - March 3rd, 2012, Paris, France*, page 338, Mar 2012.

**[R4]**

**Robert Crowston\***, **Gregory Gutin\***, **Mark Jones\***, **Venkatesh Raman**, and **Saket Saurabh**.

Parameterized complexity of maxsat above average.

In Davind Fernandez-Baca, editor, *10th Latin American Symposium (LATIN 2012)*, pages 184–194. Springer Verlag, Apr 2012.

**[R5]**

**Fedor V. Fomin\***, **Daniel Lokshantov\***, **B.V. R. Rao\***, **Venkatesh Raman**, and

**Saket Saurabh.**

Faster algorithms for finding and counting subgraphs.

*Journal of Computer and System Sciences*, **78(3)**, 698, 2012.

(To be published).

[S1]

**Kunal Dutta and C. R. Subramanian.**

On induced acyclic subgraphs in sparse random digraphs.

In *Proceedings of the European Conference on Combinatorics, Graph Theory and Applications (EuroComb-2011)*. Budapest, 2011.

[S2]

**N. R. Aravind and C.R. Subramanian.**

Forbidden subgraph colorings and the oriented chromatic number.

*European Journal of Combinatorics*.

To Appear.

[S3]

**N.R. Aravind, N. Narayanan, and C.R. Subramanian.**

Oriented colouring of some graph products.

*Discussiones Mathematicae Graph Theory*, **31(4)**, 675–686, 2011.

[S4]

**Kunal Dutta, Dhruv Mubayi, and C.R. Subramanian.**

New lower bounds for the independence number of sparse graphs and hypergraphs.

*SIAM Journal of Discrete Mathematics*.

To Appear.

[S5]

**Kunal Dutta and C.R. Subramanian.**

Induced acyclic subgraphs in random digraphs : Sharp concentration, thresholds and algorithms.

*Discussiones Mathematicae Graph Theory*.

Provisionally Accepted.

[S6]

**Kunal Dutta and C.R. Subramanian.**

Improved bounds on induced acyclic subgraphs in random digraphs. includes and extends the work reported in proceedings of ‘aofa’10’ and ‘eurocomb-2011’ conferences.

Preprint.

[S7]

**T. Karthick and C.R. Subramanian.**

Star coloring of subcubic graphs.

*Discussiones Mathematicae Graph Theory*.

To Appear.



## Books/Monographs Authored/Edited

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

[R1]

Sujata Ghosh\* and R. Ramanujam, editors.

*Logic and social interaction*, volume 177 of *Synthese*.

Springer, Heidelberg, 2011.

[R2]

Hans van Ditmarsch\*, Rohit Parikh\*, and R. Ramanujam, editors.

*Logic in India*, volume 40 of *Journal of Philosophical Logic*.

Springer, Heidelberg, 2011.

## 2.4 Student Programmes

### 2.4.1 Degrees Awarded

#### Doctoral Degrees Awarded during 2011 – 2012

##### Mathematics

Name: **Anoop, T.**

Thesis Title: On weighted eigenvalue problems and applications

Thesis Advisor: Kesavan, S.

University: HBNI

Name: **Thakur, Ajay S.**

Thesis Title: Complex structures on product of circle bundles over compact complex manifolds

Thesis Advisor: Sankaran, Parameswaran

University: HBNI

##### Physics

Name: **Sridhar, S.**

Thesis Title: Nonlinear dynamics of wave propagation in heterogeneous excitable media

Thesis Advisor: Sinha, Sitabhra

University: Madras University

Name: **Goyal, Sandeep K.**

Thesis Title: Controlled entanglement dynamics in open quantum systems

Thesis Advisor: Ghosh, Sibasish

University: HBNI

##### Theoretical Computer Science

Name: **Aravind, N.R.**

Thesis Title: Forbidden Subgraph colorings Oriented colorings and intersection dimensions of Graphs

Thesis Advisor(s): Balasubramanian, R. and Subramanian, C.R.

University: HBNI

Name: **Manuel, Amaldev**

Thesis Title: Counter automata and classical logics for data words

Thesis Advisor: Ramanujam, R.

University: HBNI

Name: **Baskar, Anguraj**  
Thesis Title: Decidability of extended Dolev Yao theories  
Thesis Advisor: Ramanujam, R.  
University: CMI, Chennai

Name: **Philip, Geevarghese**  
Thesis Title: The Kernelization Complexity of Some Domination and Covering Problems  
Thesis Advisor: Raman, Venkatesh  
University: HBNI

Name: **Misra, Neeldhara**  
Thesis Title: Kernels for the F-Deletion Problem  
Thesis Advisor: Raman, Venkatesh and Saurabh, Saket  
University: HBNI

Name: **Paul, Soumya**  
Thesis Title: A study of strategy switching in games  
Thesis Advisor: Ramanujam, R.  
University: HBNI

## **Doctoral Theses Submitted during 2011 – 2012**

### **Physics**

Name: **Sengupta, Sandipan**  
Thesis Title: Gauge Theory of Gravity with Topological Invariants  
Thesis Advisor: Date, G.  
University: HBNI

### **Theoretical Computer Science**

Name: **Sheerazuddin, S.**  
Thesis Title: Automata and logics for systems with unboundedly many processes  
Thesis Advisor: Ramanujam, R.  
University: HBNI

## **Masters Degrees awarded during 2011 – 2012**

### **Physics**

Name: **Gandhi, C**  
Thesis Title: Infrared behaviour of Massless QED—3  
Thesis Advisor: Sharatchandra, H.S.  
University: Madras University

Name: **Singal, Tanmay**

Thesis Title: Study of Gaussian channels: classification of one mode Bosonic channels, Kraus representation and a result from ESD

Thesis Advisor: Ghosh, Sibasish

University: HBNI

## **Masters Theses submitted during 2011 – 2012**

### **Mathematics**

Name: **Raghu Teja, P. Venkata**

Thesis Title: Representation theory of symmetric groups

Thesis Advisor: Prasad, Amritanshu

University: IISER, Pune

### **Physics**

Name: **Saravana Kumar, G.**

Thesis Title: Neutrino Oscillation probabilities-Sensitivity to solar parameters

Thesis Advisor: Sinha, Nita

University: University of Madras

### **Theoretical Computer Science**

Name: **Maadapuzhi Sridharan, Ramanujan**

Thesis Title: Graph Separation in Parameterized Algorithms

Thesis Advisor: Saurabh, Saket

University: HBNI

## **2.4.2 Lecture Courses During 2011 – 2012.**

The following **lecture courses** were offered during 2011 – 2012.

Course Title	Period	Lecturer
<b>Mathematics</b>		
Combinatorics in Representation Theory	Jan-Apr 2011	Prasad, Amritanshu
Differential Geometry	Jan-Apr 2011	Chakraborty, Partha S.
Elliptic curve cryptology	Jan-Apr 2012	Balasubramanian, R.
Functional Analysis	Jan-Mar 2011	Kesavan, S.
Number Theory and Cryptography	Jan-Apr 2011	Srinivas, K.

Algebra	Aug-Dec 2011	Kodiyalam, Vijay
Lie algebras	Aug-Nov 2011	Raghavan, K. N.
Spectral theory of Random Operators	Aug-Nov 2011	Krishna, M.
Topology I	Aug-Dec 2011	Nagaraj, D. S.
Zimmer's Ergodic Theory and Semisimple Group	Nov-Feb 2012	Chatterjee, Pralay
Algebraic Number Theory	Jan-Apr 2012	Srinivas, K.
Elliptic Curves	Jan-Apr 2012	Gun, S.
Topology-II	Jan-Apr 2012	Sankaran, Parameswaran

## Physics

Particle Physics	Aug-Dec 2011	Nita Sinha
Advanced Particle Physics	Aug-Dec 2011	Murthy, M.V.N.
Condensed Matter Physics	Jan-May 2011	Vemparala, Satyavani
General Relativity	Jan-Mar 2011	Date, G.
Quantum Information Theory	Jan-May 2011	Ghosh, Sibasish
Statistical Mechanics	Jan-May 2011	Murthy, M.V.N.
Classical Mechanics	Aug-Dec 2011	Murthy, M.V.N.
Quantum Field Theory I	Aug-Dec 2011	Gopalakrishna, Shri- hari
Statistical Mechanics-II	Aug-Dec 2011	Rajesh, R.
Gravitation and Cosmology	Jan-Apr 2012	Sathiapalan, Bal- achandran
Quantum Information Theory (Reading Course)	Jan-May 2012	Ghosh, Sibasish
Quantum Mechanics II	Jan-Apr 2012	Mukhopadhyay, Partha
Statistical Field Theory	Jan-Apr 2012	Ray, Purusattam

## Theoretical Computer Science

Advanced automata theory	Jan-May 2011	Lodaya, Kamal
Circuit Lower Bounds (reading course)	Jan-Apr 2011	Mahajan, Meena B.
Computational Complexity	Jan-Apr 2011	Mahajan, Meena B.
Kernelization	Jan-Apr 2011	Saurabh, Saket
Logic I	Jan-May 2011	Ramanujam, R.
Communication Complexity	Aug-Dec 2011	Mahajan, Meena B.
Design and Analysis of Algorithms	Aug-Dec 2011	Raman, Venkatesh
Strategies: a logic-automata study at ESSLLI, Ljubljana, Slovenia	Aug-Aug 2011	Ramanujam, R.
Theory of computation	Aug-Oct 2011	Ramanujam, R.
Randomized Algorithms	Aug-Dec 2011	Subramanian, C.R.
Linear programming and Combinatorial Optimization	Sep-Dec 2011	Mahajan, Meena B.
Discrete infinite structures	Nov-Dec 2011	Ramanujam, R.
Computational Complexity I	Jan-Apr 2012	Arvind, V.

Advanced Data Structures	Jan-May 2012	Raman, Venkatesh
Analysis of Boolean functions (reading course)	Jan-Apr 2012	Mahajan, Meena B.
Game theory	Jan-Apr 2012	Ramanujam, R.
Logic	Jan-Mar 2012	Ramanujam, R.

In addition, the following **lecture courses** were offered during 2011 – 2012 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

Course Title	Period	Lecturer
<b>Mathematics</b>		
Measure Theory	Aug-Nov 2011	Kesavan, S.
Representation Theory	Aug-Dec 2011	Prasad, Amritanshu
Functional Analysis	Jan-Mar 2012	Kesavan, S.
<b>Physics</b>		
Quantum Field Theory	Jan-Apr 2011	Rajasekaran, G.
Quantum Field Theory	Aug-Dec 2011	Rajasekaran, G.
Particle Physics	Jan-Apr 2012	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, 2011 - Mar, 2012.

Student	Faculty
<b>Mathematics</b>	
Sardar, Pranab, RKMVU, Belur	Chatterjee, Pralay
Soman, Abhay, IIT Bombay	Chatterjee, Pralay
<b>Physics</b>	
Sangamithirai, , Madras University, Chennai	Date, G.
Patil, Aashay, IISER Pune	Date, G.
Srinivasan, Harish, Madras Christian College, Chennai	Date, G.

Manikandan, B., Madras University, Chennai  
 Gopikrishnan, M., IISER Thiruvananthapuram  
 Satish, R. M., NIT Trichy  
 Salini, K., IISER Thiruvananthapuram  
 Chithra, Sharma H., IISER Thiruvananthapuram  
 Bhattacharya, Shounak, BITS Pilani  
 Manchala, Prathyush, CMI Chennai  
 Ghosh, Abhinandan, NIT Jamshedpur  
 Banadyupadhyay, Aritra, IIT Kanpur  
 Ballal, Aditya, IIT Bombay  
 Sengupta, Pallabi, IISER Kolkata  
 Yadav, Abhinav, IISER Kolkata  
 Mohan, Atul, IISER Thiruvananthapuram  
 Vigneshwar, N., IISER Thiruvananthapuram  
 Kar, Saurajyoti, NIT Durgapur  
 Agarwal, Amal, IIT Bombay

Date, G.  
 Ghosh, Sibasish  
 Ghosh, Sibasish  
 Ghosh, Sibasish  
 Ghosh, Sibasish  
 Mukhopadhyay, Partha  
 Sathiapalan, Balachandran  
 Sinha, Nita  
 Sinha, Rahul  
 Sinha, Sitabhra  
 Sinha, Sitabhra  
 Sinha, Sitabhra  
 Sinha, Sitabhra  
 Sinha, Sitabhra  
 Sinha, Sitabhra  
 Sinha, Sitabhra

### **Theoretical Computer Science**

Mohanty, Vakul, BITS Hyderabad  
 Agarwal, Shrishty, NITK Surathkal  
 Deshpande, Apoorva, BITS Goa

Ramanujam, R.  
 Ramanujam, R.  
 Ramanujam, R.

### **2.4.4 Other Students**

Students also do their projects under the supervision of our faculty during the academic year. The following students visited the institute during Apr, 2011 - Mar, 2012.

Student

Faculty

#### **Mathematics**

Singh, Priti, MNIT Allahabad  
 Narayanan, Sridhar P., BITS Goa  
 Valluri, Dinesh , BITS Goa  
 Raghu Teja, P. Venkata, IISER Pune  
 Nath, Atanu, SNBNCBS, Kolkata

Kodiyalam, Vijay  
 Prasad, Amritanshu  
 Prasad, Amritanshu  
 Prasad, Amritanshu  
 Sharatchandra, H.S.

### **Theoretical Computer Science**

Methuku, Abhishek, BITS Pilani

Mahajan, Meena B.

## 2.4.5 Apalat Fellowship



## 2.5 Honours and Awards

**Gun, S.** was awarded Associateship, for 2012, by the ICTP, Italy.



# Chapter 3

## Other Professional Activities

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

### **Arvind, V.**

Member of Editorial Board, International Journal of Computer Mathematics

Programme Committee member of Symposium on Theoretical Aspects of Computer Science during Apr 2011 - Jan 2012.

### **Balasubramanian, R.**

Member of Governing council of Institute of mathematics and applications , Bhubaneswar

Member of Academic Advisory committee of IISER , Trivandrum

Member of Governing council of Indian statistical institute , Kolkatta

Member of Governing Council, HRI, Allahabad

Chairman of Apex committee of National Centre for Mathematics(NCM), POWAI

President of Cryptology Research Society of India, Kolkata

Member of Fellowship Scrutiny Committee, The National Academy of Sciences, Allahabad

Member of Task force on Devolopement of higher mathematics for applications during May – Dec, 2011.

Chairman of Popularization of Mathematics, Vigyan Prasar, New Delhi during Jan – Mar, 2012.

Chairperson of the Local Chapter of NASI during Mar – Mar, 2012.

**Ghosh, Sibasish**

Convener of Local Organising Committee for Sudarshan Fest: A one-day programme to honour Prof. E. C. G. Sudarshan on his 80th birthday held at IMSc on Sep 16, 2011.

Convener of Local Organising Committee for Frontiers in Quantum Science (FQS2012) held at IMSc during Mar 19 – Mar 21, 2012.

**Gopalakrishna, Shrihari**

Member of the Computer Committee, Aug 2010 – Aug 2011 Member of the Guest house Advisory Committee, Aug 2011 - Present.

**Gun, S.**

Convener of International Organising Committee for Special year in Number Theory held at IMSc during Dec 1, 2010 – Apr 29, 2011.

Reviewer of Mathematical Reviews

Reviewer of Zentralblatt Reviews

**Kesavan, S.**

Reviewer of Mathematical Reviews

Member of National Board for Higher Mathematics

Secretary (Grants) of Commission for Developing Countries (CDC) of the International Mathematical Union (IMU)

Member of Academic Council, Chennai Mathematical Institute during Jul 2011 – Mar 2012.

Member of Review Committee (Mathematics), NISER, Bhubaneswar during Mar – Mar, 2012.

Member of UGC Review Committee (Mathematics), IISc, Bangalore during Mar – Mar, 2012.

Member of Sectional Committee (Mathematics), Indian Academy of Sciences, Bangalore.

**Kodiyalam, Vijay**

Convener of Local Organising Committee for Special Session on Algebra of the Annual

meeting of the RMS held at University of Allahabad during Oct 2 – Oct 5, 2011.

**Krishna, M.**

Convener of International Organising Committee for Nonlinear Functional Analysis held at IMSc during Jan 18 – Jan 20, 2012.

**Lodaya, Kamal**

Member of Indian Association for Research in Computing Science during Jan 2009 – Dec 2011.

President of Association for Logic in India during Jan 2011 – Jan 2012.

Convener of National Organising Committee for 10th Formal methods update meeting held at VIT Vellore during Jul 12 – Jul 14, 2011.

**Mahajan, Meena B.**

Member of Program Committee, The 6th International Computer Science Symposium in Russia CSR 2011 during Dec 2010 – Jun 2011.

**Mukhopadhyay, Anirban**

Member of Local Organising Committee for Number theory special year held at IMSc during Dec 1, 2010 – Mar 10, 2012.

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

University Nominee of Board of Studies, Vivekananda College, University of Madras

Lectures to school children at Blue Mountain School, Ooty on Jun 7, 2011. Popular talks and discussions on recent developments in Frontiers of Physics to high school children.

TNSF, Madurai at Madurai on Jul 10, 2011. Children Science Exhibition and lectures.

Popular Lecture at Madras Christian College, Tambaram on Sep 30, 2011. “Powering the Sun” popular lecture during Lecture Series “Apple Tree” 2011

Member of Advisory Committee for Hadron Physics 2011 held at BARC, Mumbai during Oct 31 – Nov 4, 2011.

Popular Lecture at Institute of Mathematical Sciences on Oct 15, 2011. “INO-science and environment” Talk given to students of Journalism, Asian College of Journalism.

DST Inspire Program at VVS First Grade College, Rajaji Nagar, Bangalore on Dec 28, 2011. Popular lecture on “Frontiers of Neutrino Physics”

Science in Every day life, Chennai Science Festival at Anna Gem School, on Jan 27, 2012. Exhibition on INO project by INO group during the Chennai Science Festival, 27-30 January 2012.

National Science Mela at Arul Anandar College, Madurai on Mar 16, 2012. INO poster display at the Exhibition, Inagural speech.

### **Prasad, Amritanshu**

DST INSPIRE internship at Veltech Dr. RR and Dr. SR Technical University, Chennai on Aug 9, 2011. Talked about the nature of research in mathematics and career opportunities.

### **Raghavan, K. N.**

Secretary of Forum D’Analystes

member of (Mathematics) Curriculum Development Committee of the School of Basic Sciences, Central University of Orissa during Apr – Jul, 2011.

Member of Local Organising Committee for Advanced Instructional School on Lie algebras held at Chennai Mathematical Institute and IMSc during Jul 4 – Jul 23, 2011.

DST Inspire Internship Camp at Vel Tech Technical University, Chennai on Aug 9, 2011. Participated as “mentor” and gave a lecture in mathematics.

DST Inspire Internship Camp at Vel Tech Technical University, Chennai on Aug 8, 2011. Participated as “mentor” and gave a lecture in mathematics.

Convener of Local Organising Committee for Instructional workshop on infinite dimensional Lie algebras held at IMSc during Aug 16 – Aug 26, 2011.

One-off mathematics lecture to school children at Bala Vidya Mandir School, Adyar, Chennai on Sep 3, 2011. Gave a one hour mathematics lecture titled “Ruler and compass constructions” to school children.

DST Inspire Internship Camp at Vel Tech Technical University, Avadi, Chennai on Oct 2, 2011. Participated as “mentor” and gave a lecture each to two batches of interns.

DST Inspire Internship Camp at Vel Tech Technical University, Avadi, Chennai on Oct 4, 2011. Participated as “mentor” and gave a lecture each to two batches of interns.

Member of Local Organising Committee for ATMW Representation Theory Of Finite Group Of Lie Type: Deligne-Lusztig Theory held at Tata Institute of Fundamental Research, Mum-

bai during Dec 5 – Dec 17, 2011.

DST Inspire Internship Camp at BSNL Regional Telecom Training Centre, SIDCO Industrial Estate, Maraimalainagar on Dec 26, 2011. Participated as “mentor” and delivered a 90 minute lecture each to two batches of students.

### **Rajasekaran, G.**

Chairman of Board of Studies in Physics, CMI

Member of Academic Council, CMI

Member of Scientific Steering Committee of INO

Wrote an essay of general physics interest for “Physics News”, Jul 1, 2011.

Gave Popular Science talk, on “The elusive neutrinos and their importance” and Participated in a panel discussion on “how to spread astronomy education in Colleges” at Jawaharlal Nehru Planetarium, Bangalore on Sep 9, 2011.

Wrote an essay of general scientific interest for “Current Science”, Sep 25, 2011.

Lectures at MIT, Anna University, Chennai on Jan 5, 2012. Gave two lectures:1. A Journey into the microcosmos, 2. Neutrinos and INO

Lectures at Vivekananda College, Chennai on Feb 21, 2012. Gave two lectures: 1.The elusive neutrino, 2. The India-based Neutrino Observatory

Lecture at Coimbatore on Mar 17, 2012. Gave a popular lecture on “Neutrinos and INO” to a group called “Friends Group” at Coimbatore who have been organizing public lectures on a monthly basis.

### **Raman, Venkatesh**

Member of Board of Studies in Mathematics at Cochin University of Science and Technology (CUSAT) during Apr 2009 – Mar 2012.

Member of Board of Studies in Mathematics at PSG Tech College, Coimbatore during Feb 2010 – Mar 2012.

Member of Program Committee of SPIRE 2011 during Apr – Aug, 2011.

Member of Program Committee of WALCOM 2012 during Sep – Dec, 2011.

Member of Program Committee of IWOCA 2012 during Dec 2011 – Mar 2012.

Convener of Local Organising Committee for Recent Advances in Data Structures held at IMSc during Dec 17 – Dec 20, 2011.

Convener of Local Organising Committee for One day workshop on Parameterized Complexity held at IMSc on Jan 21, 2012.

Gave a public lecture at IMSc Chennai on Mar 17, 2012. Gave a talk on ‘demystifying median finding algorithm’ in the Golden Jubilee thematic lecture on the theme ‘Aha, Divide and Conquer’

Gave a lecture at Manonmaniam Sundaranar University on Mar 26, 2012. Lectured on career opportunities in mathematics

Coordinator of the Thematic Lectures in Theoretical computer science at IMSc, Chennai on Mar 17, 2012. This is a thematic lecture series aimed at college teachers and students, in conjunction with IMSc’s 50th year celebrations. The aim is to have a series of lectures in one theme, on Saturday every month. The theme for March was ‘Divide and Conquer’.

### **Ramanujam, R.**

Member of Council of the Association for Symbolic Logic during Jan 2009 – Mar 2012.

Editor of Editorial Board of “Knowledge, Rationality and Action”, a section of Synthese during Jan 2009 – Dec 2011.

Editor of Editorial Board of Journal of Philosophical Logic during Sep 2009 – Mar 2012.

Area editor for automata theory of Editorial board, ACM Transactions on Computational Logic during Apr 2010 – Mar 2012.

Convener of National Initiative on Mathematics Education (NIME) at INSA, New Delhi on Jun 18, 2011. The NIME initiative, formed in June 2011, in Delhi, is an attempt to bring together different communities involved in mathematics education. A series of 5 regional conferences was organized during Nov - Dec 2011 (Cochin, Delhi, Guwahati, Patna and Pune)

### **Ray, Purusattam**

Convener of International Organising Committee for Fracture and Flow in Porous Media held at IMSc during Jan 11 – Jan 14, 2012.

### **Saurabh, Saket**

Member of IPEC Steering Committee during Sep 2009 – Aug 2011.

Convener of International Organising Committee for Lorentz Workshop on Kernelization



(WorKer 2010) held at Leiden, Netherlands during Nov 8, 2010 – Nov 12, 2011.

**Sinha, Nita**

Convener of the Workshop, “Frontiers in High Energy Physics”, in Celebration of Prof. Rajasekaran’s 75th Birthday, Jan 4 – Dec 21, 2011 <http://www.imsc.res.in/fhep/>

**Sinha, Rahul**

Member of Expert Panel on Fast Track Proposals for Young Scientists in Physical and Mathematical Sciences. during Jan 2010 – Jan 2012.

**Sinha, Sitabhra**

Member of Editorial Board of Frontiers in Fractal Physiology during Jul 2011 – Mar 2012.

Adjunct Faculty of National Institute of Advanced Studies during Sep 2011 – Mar 2012.

Adjunct Professor of Department of Computer Science, IIT Kharagpur during Nov 2011 – Mar 2012.

Convener of National Organising Committee for Minisymposium on Cardiac Dynamics held at VITS Hotel, Pune on Jan 25, 2012.

Convener of Local Organising Committee for Workshop on Social Networks held at IMSc during Feb 20 – Feb 24, 2012.

**Srilakshmi, K.**

Judge at Bala Vidya Mandir Sr. Sec. School. on Jan 21, 2012. Judge for ‘Math Mind In Me’, Paper Presentation Event, Inter-School Math Expo, Chennai.

**Srinivas, K.**

Member of Kendriya Vidyalaya Management Committee during Jan – Dec, 2011.

Treasurer of Executive committee of RMS

Invited Speaker at VelTech University, Chennai on Aug 9, 2011. DST sponsored INSPIRE programme was organised by VelTech where about 500 students of +2 level attended lectures by experts in various subjects.

**Sunder, V. S.**

Convener of Local Organising Committee for Instructional workshop on the Functional Anal-

ysis of Quantum Information Theory held at IMSc during Dec 26, 2011 – Jan 6, 2012.

Convener of Local Organising Committee for ATM Workshop in Operator Algebras (funded by NBHM) held at IMSc during Jan 30 – Feb 11, 2012.

**Viswanath, Sankaran**

Lecturer in the Summer Course for College teachers at IMSc on May 5, 2011.

Convener of Local Organising Committee for Instructional Workshop on Infinite dimensional Lie algebras, held at IMSc during Aug 16 – Aug 26, 2011.

# Chapter 4

## Colloquia

### 4.1 Conferences/Workshops Held at IMSc

#### 4.1.1 Special year in Number Theory

The goal of this program is to acquaint researchers with some of the recent major developments in number theory.

#### 4.1.2 Instructional Workshop on Infinite dimensional Lie algebras

This workshop, organized by K.N Raghavan and S. Viswanath, was held in IMSc during 16-26th August 2011.

Prof. Vyjayanthi Chari of the University of California, Riverside, was the main lecturer. She gave a set of eight 90 minute lectures on representations of current algebras and their generalizations. In addition, there was a tutorial session each afternoon where the participants could meet, discuss, and clarify the lecture material. The lectures were pitched at a level accessible to second-year Ph.D students. and gradually led up to research questions that are at the current frontiers of the subject.

The lectures were attended by around 20 participants, from IMSc, CMI, and a couple of students from the USA. The lectures were videotaped, and are now available on the Youtube channel of IMSc.

#### 4.1.3 Sudarshan Fest: A one-day programme to honour Prof. E. C. G. Sudarshan on his 80th birthday

This was a one-day programme, organized by Sibasish Ghosh, R. Simon and N. Mukunda, held in IMSc in which there were four talks in the morning session, based on four important contributions of Prof. Sudarshan in Theoretical Physics. The speakers were Shiraz Minwalla of TIFR-Mumbai (spoke on V-A theory), R. Simon of IMSc-Chennai (spoke on digonal

representation), Anu Venugopalan of GGS Indraprastha University, New Delhi (spoke on quantum Zeno effect), and N. Mukunda of IMSc (spoke on symmetries in classical and quantum physics). In the afternoon, there was a felicitation programme for Prof Sudarshan. Total number of participants were more than one hundred from different universities/institutions of Chennai and nearby places.

#### **4.1.4 Instructional workshop on the Functional Analysis of Quantum Information Theory**

This intense inter-disciplinary workshop had courses of lectures with a mathematical bias by Gilles Pisier on ‘Operator Spaces and Completely bounded Maps’ and by Vern Paulsen on ‘Operator Systems and Completely Positive Maps’, as well as two courses of lectures with a bias towards physics applications by K.R. Parthasarathy on ‘Schmidt number and Schmidt rank of bipartite entangled states’ and by Andreas Winter on ‘Operator Methods in Quantum Information’ was attended by many post-docs and graduate students from places all over India as well as from Japan and Brazil.

#### **4.1.5 Recent Advances in Data Structures**

A workshop on recent advanced in data structures was held between December 17-20, 2011. The workshop covered recent research advances in various areas of data structures including succinct data structures, dynamic graph algorithms, data streams and external memory data structures and algorithms.

The list of speakers included

1. Surender Baswana, IIT Kanpur
2. Sumit Ganguly, IIT Kanpur,
3. Roberto Grossi, University of Pisa, Italy,
4. Ankur Gupta, Butler University, USA,
5. John Iacono, Polytechnic Institute of New York University, USA
6. T. S. Jayram, IBM Research Almaden, USA
7. Jaikumar Radhakrishnan, TIFR Mumbai
8. Rajeev Raman, University of Leicester, UK,
9. S. Srinivasa Rao, Seoul National University, South Korea
10. Sandeep Sen, IIT Delhi
11. Francesco Silvestri, University of Padova, Italy

### 4.1.6 Nonlinear Functional Analysis

The conference on nonlinear functional analysis was held in honour of Prof S Kesavan at IMSc. The other organizers were former colleagues of Prof Kesavan from CAM, TIFR Bengaluru. The conference had participation of mathematicians from France, Italy, Chile and India. Several students from India working in this and related areas also participated.

### 4.1.7 ATM Workshop in Operator Algebras (funded by NBHM)

This workshop, intended for Indian graduate students featured three courses of six 90 minute lectures, namely, (i)  $C^*$ -algebras by Partha Sarathi Chakraborty, (ii) von Neumann algebras by V.S. Sunder, and (iii) Planar algebras by Vijay Kodiyalam, as well as special lectures by R. Srinivasan of CMI, B.V. Rajarama Bhat of ISI Bangalore, (two lectures on K-theory of  $C^*$ -algebras by) S. Sundar of ISI Delhi, and by Paramita Das and Shamindra Ghosh of ISI Kolkata. There were close to thirty participants who enjoyed the workshop, if one goes by the feedback forms that were distributed towards the end of the workshop.

### 4.1.8 One day workshop on Parameterized Complexity

A one day workshop on Parameterized complexity was held at IMSc on 21st January, 2012 with eight talks covering various aspects of the area. The talks were given by

Mike Fellows (Australia), Serge Gaspers (Austria), Venkatesh Raman (IMSc), Saket Saurabh (IMSc), Neeldhara Misra (IMSc), M. S. Ramanujan (IMSc), Sebastian Ordyniak (Austria) and Daniel Lokshtanov (USA).

### 4.1.9 Fracture and Flow in Porous Media

Fracture and flow in porous systems have been actively investigated over the years, with researchers of different disciplines focusing on different aspects of the processes. The objective of the meeting was to summarize and integrate the current understanding of fracture and flow and conclude with discussions on future directions of the field. There were 15 speakers out of which 5 were from abroad. Speakers include faculties from engineering departments of IIT, Chennai and scientists from companies like SINTEF, Norway and ONGC, India.

### 4.1.10 Workshop on Social Networks

Analysis of social networks that describe the complex relationships between the members of a group, ranging in scale from a few individuals to the global population, has emerged as a key research tool in understanding complex social phenomena. While the study of communities and connectedness has a long tradition in the social sciences, with the recent advent of electronic communication over the internet it has captured the imagination of the general public and has become an important field of inquiry for practitioners in many different disciplines including graph theory, optimization, economics, game theory, psychology, statistics

and data mining. The workshop provided an in-depth introduction to modeling and analysis of social networks. By bringing together social scientists, physicists, mathematicians and computer scientists working on different aspects of social networks, it tried to foster cross-disciplinary interactions and long-term collaborations. The event was jointly organized by the Institute of Mathematical Sciences, Indian Institute of Technology-Madras (IIT-M) and the IISc Mathematics Initiative (IMI). The following gave lectures at the workshop:

- **Sanjay Jain**, Delhi University

*Complex systems and social networks*

- **S S Manna**, S N Bose National Center for Basic Sciences, Kolkata

*International Trade Network*

- **Ramasuri Narayanam**, IBM India Research Lab, Bangalore

*Game Theoretic Models for Social Network Analysis*

- **Niloy Ganguly**, IIT Kharagpur

*Growth with restriction in online social networks*

- **Sony Pellissery**, affiliations

*Human Organizational Networks*

- **Lakshmi Subramanian**, Centre for Studies in Social Sciences, Kolkata

*Merchant networks in the Indian Ocean in historical perspective*

- **Animesh Mukherjee**, IIT Kharagpur

*Opinion formation on time-varying social networks*

- **Raman Mahadevan**, Chennai

*Community/Kinship networks and Capital Accumulation in Colonial India: A case study of the Nattukottai Chettiars*

- **Rowena Robinson**, IIT Bombay

*Kinship structures and social cohesion*

- **Neelima Gupte**, IIT Madras

*Statistical characterizers of model and real networks*

- **Rabindranath Jana**, ISI Calcutta

*On social networks: Formation, data and few analytic techniques*

- **Santanu Sengupta**, Centre for Studies in Social Sciences, Kolkata

*The local experiences of a global network: Armenians in 17th-18th century Bengal*

- **Ravindran Balaraman**, IIT Madras

*Efficient Computation of Shapley Value for Centrality in Networks*

- **Sitabhra Sinha**, IMSc Chennai

*“Modularity” of Social Networks*

- **Rushi Bhat**, Yahoo! Labs, Bangalore

*The Science Behind On-line Advertising*

- **Srinath Srinivasa**, IIIT Bangalore

*Information Networks and Semantics*

- **Anindya Sinha**, NIAS Bangalore

*Ecological variability in social networks and individual behavioural strategies in a wild primate population*

#### 4.1.11 Frontiers in Quantum Science (FQS2012)

This year, the theme of Frontiers in Quantum Science (FQS2012) was on Tensor Product States for Quantum Matter. There was 2-3 talks in the morning session of each day while a discussion session was there in the afternoon of each day. Two speakers (E. M. Stoudenmire and Sukhwinder Singh) from outside of India spoke on Density Matrix Renormalization Group and its connection with Quantum Information Theory. There was also talks by experts from IISc (Diptiman Sen and S. Ramasesha) as well as IMSc (H. S. Saratchandra and G. Baskaran). There was both local as well as outside Chennai participation. The organizers of this meeting was: G. Baskaran, R. Shankar, S. R. Hassan, A. K. Mishra, R. Simon and Sibasish Ghosh, all from IMSc.

## **4.2 Other Conferences/Workshops Organized by IMSc**

### **4.2.1 Lorentz Workshop on Kernelization (WorKer 2010)**

Kernelization is a vibrant and rapidly developing area. The update meeting on kernelization was aimed at consolidate the results achieved in the recent years, discuss future research directions, and explore further the applications potential of kernelization algorithms, and give excellent opportunities for the participants to engage in joint research and discussions on open problems and future directions.

### **4.2.2 Advanced Instructional School on Lie algebras**

This was one of the ATM schools in 2011 sponsored by NBHM of which K. N. Raghavan and S. Viswanath were conveners jointly with Upendra Kulkarni of CMI.

The theory of structure and representations of complex semisimple Lie algebras was developed towards the end of the nineteenth century, and so is over a hundred years old. It is an important basic subject in mathematics, a sound knowledge of it being a must for research in many diverse areas. This AIS aims to develop such basics of the theory as the classification of the algebras by means of root systems, the structure of an algebra in terms of a Cartan subalgebra and root spaces, complete reducibility of representations, parametrization of the irreducible representations by means of highest weights, and well known character formulas for representations. In addition, two important twentieth century off-shoots of the theory: (1) Chevalley groups and their basic properties; (2) affine Kac-Moody Lie algebras and their representations, up to the Kac-Weyl character formula and the proof of the Macdonald identities, are introduced in this School.

### **4.2.3 ATMW Representation Theory of Finite Group of Lie Type: Deligne-Lusztig Theory**

This was one of the ATM Workshops sponsored by the National Board for Higher Mathematics (NBHM). K. N. Raghavan of IMSc was a joint convener of this activity with Dipendra Prasad of TIFR.

### **4.2.4 Minisymposium on Cardiac Dynamics**

This mini-symposium was organized as part of the International Conference on Mathematical and Theoretical Biology at Pune during January 23-27, 2012. The aim of the meeting was to give participants a broad overview of the wide scope of research in cardiac dynamics. The talks described computational investigation of arrhythmia generation mechanisms through irregularities in the electrical activity of the heart, application of research in electro-mechanical activity of the heart in clinical treatment of cardiac disorder and the time-series analysis of ECG signals to detect signs of possible anomalies alerting one to clinically dangerous conditions:



- **Sitabhra Sinha**, IMSc Chennai

*Introductory remarks*

- **Alexander V Panfilov**, University of Ghent, Belgium

*Anatomical modeling of electrical and mechanical function of the heart*

- **K R Balakrishnan**, Fortis Malar Hospital, Chennai

*Mathematical modeling of cardiac dynamics: Relevance to clinical situations*

- **Zbigniew R Struzik**, University of Tokyo, Japan

*Measures of heart rate complexity*

## 4.3 Seminars

Date	Speaker Affiliation	Title
5-4-2011	Jaya Iyer University of Hyderabad	Abel-Jacobi maps for non-compact varieties
5-4-2011	Tapas Chatterjee IMSc	Zeros of Eisenstein Series
6-4-2011	Chandrima Paul IIT Bombay	A new addition to strings/matrix model correspondence: some novel findings
7-4-2011	M. Waldschmidt University of Paris VI	Multiple zeta values
7-4-2011	Sourav Bhattacharya S.N. Bose National Centre for Basic Sciences, Kolkata	Black holes and the positive cosmological constant
7-4-2011	S. David University of Paris VI	Introduction to Lehmer's problem
9-4-2011	Francois Grey Citizen Cyberscience Center, CERN, Geneva, Switzerland	Citizen Cyberscience: a new frontier for Indian research
9-4-2011	Rajaram Nityananda TIFR, Hyderabad Campus	Why Gravity Rules the Universe
11-4-2011	Asrarul Haque Dept of Physics, IIT, Kanpur	Possible Detection of Causality Violation in a Nonlocal Scalar Model
11-4-2011	karen Hallberg Instituto Balseiro, Bariloche, Argentina	Quantum properties in transport through nanoscopic rings: charge-spin separation and interference effects
11-4-2011	S. David University of Paris VI	Introduction to Lehmer's problem

12-4-2011	G. Rajasekaran CMI/IMSc	Dark Energy, Neutrino Condensate and Pseudo-Dirac Neutrinos
12-4-2011	M. Waldschmidt University of Paris VI	Multiple zeta values
15-4-2011	M. Waldschmidt University of Paris VI	Multiple zeta values
18-4-2011	N S N Sastry ISI Bangalore	Polarities in low rank (incidence) geometries
19-4-2011	Sameer Murthy TIFR, Mumbai	Exact quantum entropy of black holes
20-4-2011	Sudipta Sarkar Dept of Physics, University of Maryland	Gravity from Thermodynamics: Beyond Einstein equation of State
21-4-2011	M. Waldschmidt University of Paris VI	Multiple zeta values
21-4-2011	Sameer Murthy TIFR, Mumbai	Quantum black holes, wall crossing and mock modular forms
25-4-2011	M. Waldschmidt University of Paris VI	Multiple zeta values
25-4-2011	Amiya Mukherejee ISI, Kolkata	A simple index theorem and applications
27-4-2011	Balachandran Sathiapalan IMSc	Strong Coupling BCS Superconductivity and Holography
28-4-2011	Prahladh Harsha TIFR, Mumbai	Almost Settling the Hardness of Noncommutative Determinant
28-4-2011	M. Waldschmidt University of Paris VI	Multiple Zeta Values
29-4-2011	Deepak Dhar TIFR, Mumbai	A simple model of proportionate growth

3-5-2011	M. S. Ramanujan IMSc	Separation in Parameterized Algorithms
6-5-2011	Deepak Dhar TIFR	Applications of tropical Algebra to sand pile models
9-5-2011	Matscience Faculty IMSc	Interesting Areas in Science
10-5-2011	Steven Avery IMSc	Entanglement Entropy in the D1D5 CFT: Twists of Twists
11-5-2011	Dileep Jatkar HRI, Allahabad	New Massive Gravity and $AdS_4$ counterterms.
12-5-2011	Pierre MATSUMI IMSc	LMST (Local Monodromy Specialization Theorem)
13-5-2011	Parameswaran Sankaran IMSc	The Grigorchuk group
18-5-2011	Jaydeb Chakrabarti SNBNCBS, Kolkata	Hydrophobic versus Electrostatic Interactions: Stable Macromolecular Clusters
19-5-2011	Bharath Sethuraman California State University, Northridge	Jet schemes of determinantal varieties
20-5-2011	Abhiram Soori CHEP, IISc.	Conductance of Tomonaga-Luttinger liquid wires and junctions with resistances
23-5-2011	Bruce C. Berndt University of Illinois at Urbana-Champaign	The Circle and Divisor Problems, Bessel Function Series, and Weighted Divisor Sums
26-5-2011	Sunil K. Chebolu Illinois State University	On a Small Quotient of a Huge Absolute Galois Group
1-6-2011	Ambarish Kunwar University of California at Davis	Mechanism of In-vivo Transport by Multiple Molecular Motors
2-6-2011	Pramod Kewat IMSc	On the exterior square L-function of $GL(n)$

3-6-2011	Mrinal Kanti Das ISI Kolkata	Projective modules and ideals
6-6-2011	N.R. Aravind Phd thesis viva-voce	Forbidden subgraph colorings, oriented colorings and intersection dimensions of graphs
16-6-2011	Pooja Singla Ben Gurion University of the Negev	Images of real representations of $SL_n(\mathbb{Z}_p)$
17-6-2011	Steven G Avery IMSc, Chennai	The Fuzzball Proposal for Black Holes
20-6-2011	Samrat Bhowmick IMSc / IoP, Bhubaneswar	Study of Early Universe in an M theoretic Model
21-6-2011	Sudhakar Panda HRI, Allahabad	Inflation and Quintessence models from String theory
21-6-2011	R.V. Gurjar TIFR, Mumbai	Locally nilpotent derivations of commutative rings
22-6-2011	Samrat Bhowmick IOP, Bhubaneswar	Anisotropic Power Law Inflation from Rolling Tachyons
23-6-2011	Pierre MATSUMI IMSc	Historical survey of class field theory
23-6-2011	Purabi Mukherji Rabindrabharati University	Renaissance of mathematics in Calcutta University in the 19th and 20th centuries
23-6-2011	Venkat Chakravarthy IBM India Research Lab, New Delhi	Covering demands with intervals
28-6-2011	Raj Kumar Pan Department of Biomedical Engineering and Computational Science, Aalto University, Finland	Path lengths, correlations and spreading dynamics in temporal networks

28-6-2011	Purabi Mukherji Rabindrabharati University	Renaissance of mathematics in Calcutta University in the 19th and 20th centuries - II
30-6-2011	Soumen Sarkar ISI, Kolkata	T2-cobordism of quasitoric 4-manifolds.
5-7-2011	Dilip Raghavan University of Toronto	P-ideal dichotomy and weak squares
7-7-2011	Anish Ghosh University of East Anglia	Diophantine approximation and homogeneous dynamics
11-7-2011	Sachin Gautam Columbia University	Kohno-Drinfeld type theorems
14-7-2011	Sachin Gautam Columbia University	Kohno-Drinfeld type theorems
20-7-2011	Kumar Rao Helsinki Institute of Physics	Top Polarization as a probe of New Physics
21-7-2011	Rajat Tandon Hydrabad University	$GL(n-1, F)$ -distinguished representations of $GL(n, F)$ , where $F$ is a non archimedean local field
26-7-2011	S M Kamil IISc, Bangalore	Thesis Defence
27-7-2011	Ashok Prasad Dept of Chemical and Biological Engineering, Colorado State University	Cross-talk and information transfer in some simple signaling circuits
27-7-2011	J. Solomon Ivan Raman Research Institute, Bangalore	Ph.D. Defence
27-7-2011	Raja Sridharan TIFR Mumbai	On the ubiquity of a theorem of Horrocks
28-7-2011	Shrihari Gopalakrishna IMSc	Search for New Physics at the LHC

28-7-2011	Narasimha Kumar IMSc	Tame Galois realizations of $GL_2(F_p)$ over $\mathbb{Q}$
1-8-2011	KartEEK Sreenivasaiah IMSc	Verifying Proofs in constant depth
4-8-2011	Narasimha Kumar	Narasimha Kumar
8-8-2011	Sarbeswar Pal IMSc	Geometry of Hitchin map
8-8-2011	N. Saradha TIFR, Mumbai	Recent Results on the conjecture of Pomerance
9-8-2011	R. Sujatha TIFR, Mumbai	Hida deformations and Galois representations
9-8-2011	Sinnou David University of Paris	Algebraic values of Meromorphic maps
10-8-2011	Suresh Govindarajan IIT-Madras	Unravelling Mathieu Moonshine
10-8-2011	N. Saradha TIFR, Mumbai	On Thue equations with few coefficients
10-8-2011	P. Sankaran IMSc	Seminar on Lie groups
10-8-2011	Sinnou David University of Paris	Algebraic values of Meromorphic maps.
12-8-2011	Sinnou David University of Paris	Algebraic values of Meromorphic maps
17-8-2011	Basavaraja Madivala Gurappa Chemical Engineering Department, IIT-Madras	Self-assembly: particles at fluid interfaces and surfactants in solution
17-8-2011	P. Sankaran IMSc	Lie groups
17-8-2011	Sinnou David University of Paris	Algebraic values of Meromorphic maps

18-8-2011	Sandeep K. Goyal IMSc	Controlled entanglement dynamics in open quantum systems
18-8-2011	Sinnou David University of Paris	Algebraic values of Meromorphic maps
19-8-2011	Sandip Pakvasa University of Hawaii	Galactic Neutrino Communication and SETI
22-8-2011	Carmen Molina-Paris and Grant Lythe Department of Applied Mathematics, University of Leeds, Leeds, United Kingdom	A stochastic T cell response criterion; Stochastic Dynamics in the Immune System
23-8-2011	Sandeep K. Goyal IMSc	Controlled entanglement dynamics in open quantum systems - II
24-8-2011	Balachandran Sathiapalan IMSc	String Theory as an Approach to Strong Coupling Problems
24-8-2011	V. S. Sunder IMSc	Lie groups
26-8-2011	Rohana Wijewardhana Cincinnati University	Computation of the S parameter in a model of Dynamical Electroweak Symmetry Breaking
26-8-2011	Tapas Chatterjee IMSc	A special case of Fermat's Last Theorem
7-9-2011	Pierre Matsumi IMSc	Riemann hypothesis for varieties over finite fields.
7-9-2011	V. S. Sunder IMSc	Lie groups
7-9-2011	Ramachandra Guha	The Rise and Fall of Indian Liberalism
8-9-2011	Kamales Kar SINP, Kolkata	r-process nucleosynthesis and collective oscillations
10-9-2011	Vandana Shiva	Dr. C.V.Seshadri Memorial Lecture



12-9-2011	Pushkar Joglekar	Randomized Algorithms in some Commutative and Noncommutative Domains
12-9-2011	Suvrat Raju HRI	Holographic Minimal Models
14-9-2011	Pierre Matsumi IMSc	Riemann hypothesis for varieties over finite fields.
14-9-2011	V. S. Sunder IMSc	Lie groups
15-9-2011	M. Azam BARC	Supernova explosion of white dwarf stars
15-9-2011	Dinakar Ramakrishnan Caltech	L-functions, their special values, and exact averages
15-9-2011	M. Sivakumar Hyderabad University	An Introduction to Vasilievs Higher spin equations.
19-9-2011	Pierre Matsumi IMSc	Riemann Hypothesis for varieties
20-9-2011	Albert Carlo Swiss Aquatic Research Center, Dupendorf	Methods from Theoretical Physics in Aquatic Research
21-9-2011	V. S. Sunder IMSc	Lie Groups
22-9-2011	M Praveen IMSc	Parameterized complexity of some problems in finite state concurrent systems
23-9-2011	Umesh Dubey IMSc	Bridgeland stability
26-9-2011	P. Ravindran University of Oslo, Norway	Microscopic Modelling of Materials for Hydrogen storage applications
27-9-2011	Ajay Thakur IMSc	Complex structures on products of circle bundles over complex manifolds

28-9-2011	Sudipta Sarkar IMSc	The Membrane Paradigm for Gauss Bonnet gravity.
28-9-2011	Partha Sarathi Chakraborty	Lie Groups
29-9-2011	B V R Tata IGCAR, Kalpakkam	Phase Transitions and Dynamics in Stimuli-responsive Nanogel Dispersions
3-10-2011	Assa Auerbach Technion University, Haifa, Israel	Elementary Particles of Superconductivity
3-10-2011	Partha Sarathi Chakraborty IMSc	Lie Groups
6-10-2011	T. Geetha IMSc	Cellularity of Diagram algebras
7-10-2011	Partha Sarathi Chakraborty IMSc	Lie Groups
11-10-2011	Roman Sverdlov IMSc	Ontological meaning of quantized Klein Gordon and electromagnetic fields
13-10-2011	T Geetha IMSc	Cellular algebras
17-10-2011	Probir Roy SINP, Kolkata	Leptogenesis I
19-10-2011	Probir Roy SINP, Kolkata	Leptogenesis II
20-10-2011	Ranja Sarkar	Tw-dimensional map for a lattice with quartic anharmonic potential
21-10-2011	Probir Roy SINP, Kolkata	Leptogenesis III
24-10-2011	Eric Laenen NIKHEF	Next-to-eikonal resummation

25-10-2011	Sreedhar Dutta IISER, Thiruvananthapuram	Ageing state and Memory loss
27-10-2011	Jean-Marc Deshouillers University of Bordeaux	Automatic Sequences
28-10-2011	Amritanshu Prasad IMSc	Lie Groups
28-10-2011	Mubeena T IMSc	Reidemeister number in fixed point theory
1-11-2011	Pooja Singla Ben Gurion University of the Negev, Israel	Polynomial Representations of Complex General Linear Groups
2-11-2011	Lalit Sehgal RWTH Aachen, Germany	Electron Excess in Low Energy Neutrino Reactions
2-11-2011	Amritanshu Prasad IMSc	Lie Groups
2-11-2011	Pooja Singla Ben Gurion University of the Negev, Israel	Polynomial Representations of Complex General Linear Groups
3-11-2011	T Geetha IMSc	Cellularity of Hecke algebras of type $A_n$
4-11-2011	Lalit Sehgal RWTH, Aachen, Germany	From CP Violation to Arrows of Time: A Voyage through Strangeness and Beauty
4-11-2011	Seshadri Chintapalli IMSc	Riemann Roch Theorem and applications
8-11-2011	Ronnie Mani Sebastian IMSc	Smash nilpotence on algebraic cycles
9-11-2011	Amritanshu Prasad IMSc	Lie groups
10-11-2011	Iftikhar Burhanuddin UCLA	Brauer-Siegel Analogue for Elliptic Curves over the Rationals

10-11-2011	Manindra Agrawal IIT Kanpur	Arithmetic circuit lower bounds
11-11-2011	Karthik Shankar Boston University	Torsion induced cosmology averts big-bang : An accelerating, oscillatory universe
14-11-2011	Rohini Godbole Indian Institute of Science, Bangalore	Top Polarisation: Measurement and use for BSM/SM
15-11-2011	Rohini Godbole Indian Institute of Science, Bangalore	Beyond the Standard Model (BSM): motivation and lessons from early LHC
15-11-2011	T. Geetha IMSc	Cellular algebras
16-11-2011	M. Praveen IMSc	Parameterized complexity of some problems in concurrency and verification: HBNI PHD Defence
16-11-2011	S Kalyana Rama IMSc	Higher dimensional static solutions with positive ADM mass and no horizon
16-11-2011	Olivier Ramare University of Lille	Selberg Sieves
16-11-2011	P. Sankaran IMSc	Lie groups
18-11-2011	Pralay Chatterjee IMSc	Lie Groups
18-11-2011	Shilpa Gondhali IMSc	Vector field problem
21-11-2011	Rajdeep Sensarma Univ. of Maryland, College Park	Dynamics of cold atoms near and far from equilibrium
22-11-2011	Karthik Shankar Boston University	Brain constructs an Inverse Laplace transformation to represent time

22-11-2011	Steven Spallone TIFR, Mumbai	Signs for self-dual representations
23-11-2011	P. Sankaran IMSc	Lie groups
24-11-2011	Bhavin Moriya IMSc	Some zero sum problems in combinatorial number theory.
24-11-2011	Abhay Parvate IMSc	Fast regular expression matching with Glushkov automaton
25-11-2011	Sanjit Das IIT Kharagpur	Geometric flows without and with higher order terms
25-11-2011	Anil Kumar IMSc	Birkhoff Standard Form For Subgroups
28-11-2011	Gilles Brassard Universite de Montreal	History and Perspective on Quantum Cryptography
29-11-2011	M S Santhanam IISER Pune	Extreme events on complex networks
29-11-2011	Gilles Brassard Universit de Montral	Key Establishment la Merkle in a Quantum World
30-11-2011	Nutan Limaye IIT Bombay	Streaming algorithms for context-free languages
30-11-2011	Abhishek Iyer IISc, Bangalore	Lepton Minimal Flavor Violation in warped extra dimensions
30-11-2011	P. Sankaran IMSc	Lie groups
2-12-2011	Parongama Sen Physics Department, Calcutta University	Opinion Dynamics models: some recent advances
7-12-2011	Sudhakar Yarlagadda SINP, Kolkata	Study of maximal bipartite entanglement and robustness in resonating-valence-bond states

7-12-2011	P. Sankaran IMSc	Lie groups
8-12-2011	Sridhara Dasu University of Wisconsin	Search for the Higgs Boson at the LHC
8-12-2011	Sumit Giri IMSc	Factoring Integers With Elliptic Curves.
9-12-2011	Pralay Chatterjee IMSc	Lie Groups
12-12-2011	Ram Murty Queen's University, Canada	The Mathematical Legacy of Srinivasa Ramanujan
13-12-2011	P. Sankaran IMSc	Lie Groups
15-12-2011	Yosef Nir Weizmann Institute	Flavor Physics: Past, Present, Future
15-12-2011	Sophie Pinchinat IRISA, Universite de Rennes, France	Uniform strategies
16-12-2011	Pralay Chatterjee IMSC	Lie groups
19-12-2011	Kevin McFarland University of Rochester	Neutrino Interactions I
19-12-2011	Kevin McFarland University of Rochester	Neutrino Interactions II
19-12-2011	V. Srinivas TIFR, Mumbai	Algebraic Cycles on a generic complex abelian 3-fold
20-12-2011	Kevin McFarland University of Rochester	Neutrino Interactions III
20-12-2011	Pierre Cartier IHES, France	On the Use of Groupoids in Geometry
20-12-2011	Subir Sarkar University of Oxford	Darkness Visible: the search for the 'missing mass' of the Universe

21-12-2011	Jan van Eijck CWI, Amsterdam, The Netherlands	Action Emulation Revisited
21-12-2011	Kevin McFarland University of Rochester	Neutrino Interactions IV
21-12-2011	Deborah Harris Fermilab	The Year in Neutrinos
21-12-2011	Pralay Chatterjee IMSc	Lie Groups
22-12-2011	Chris Smyth University of Edinburgh	Interlacing cyclotomic polynomials and PV numbers
22-12-2011	Alexander Lubotzky Hebrew University, Jerusalem, Israel	Ramanujan graphs and error correcting codes
23-12-2011	Hans van Ditmarsch University of Sevilla, Spain	Five ways of quantifying over information change
28-12-2011	M. Ram Murty Queen's University	The Fibonacci Zeta Function
30-12-2011	M. Ram Murty Queen's University	The partition function revisited
2-1-2012	Dietmar Berwanger CNRS and ENS-Cachan, France	A perfect-information construction for distributed games
2-1-2012	Mahan Mj Vivekananda University, Belur	Geometry and dynamics of Kleinian groups
2-1-2012	Soumya Paul IMSc	A computational study of strategy switching in large games
3-1-2012	Sanjib Agarwalla Instituto de Física Corpuscular, CSIC-Universitat de Valencia, Valencia - SPAIN	Neutrino Oscillation Parameters: Current Status and Future Prospects

4-1-2012	Uma Balakrishnan University of Pennsylvania	Multiscale modeling of nanocarrier motion with simultaneous adhesion and hydrodynamic interactions in targeted drug delivery
4-1-2012	Rohit Parikh City University of New York, USA	How Reasoning About Knowledge can help us Understand the World
4-1-2012	Mahan Mj RKM Vivekananda University	What is hyperbolic geometry?
5-1-2012	Sanjib Agarwalla Instituto de Física Corpuscular CSIC-Universitat de Valencia, Valencia - SPAIN	Very-short-baseline Neutrino Anomalies and Future Probes
5-1-2012	Mahan Mj RKM Vivekananda University	Existence of Cannon-Thurston Maps
6-1-2012	H. Iwaniec Rutgers University	The Spin of Prime Ideals
6-1-2012	Bhavtosh Bansal IISER Kolkata	Hydrogenic excitons in magnetic field: A two-body problem
6-1-2012	Sandip Pakvasa University of Hawaii	D Mixing and CP Violation in D decays
9-1-2012	Mahan Mj RKM Vivekananda University	Ending laminations and Cannon-Thurston maps
10-1-2012	Moitri Maiti Matscience	Classical dynamics of Dirac fermions in 2+1 dimensions
11-1-2012	R. Ganesh IFW, Dresden	Dimer Neel Transition in Bilayer Quantum Antiferromagnet
11-1-2012	Mahan Mj RKM Vivekananda University	Discreteness of commensurator
12-1-2012	Dorian Goldfeld Columbia University	Distribution of low lying zeros of Rankin-Selberg L-functions on $GL(3)$ .



12-1-2012	K.J. Thomas Sungkyunkwan University, Suwon, South Korea	Compressibility Measurements of Quasi One Dimensional Electron Systems
14-1-2012	Alberto Perelli University of Genova	Selberg class of L-functions
16-1-2012	P K Mohanty Saha Institute of Nuclear Physics, Kolkata	microRNA clusters : the building blocks of biological regulation
18-1-2012	Various	Various Combinatorics seminar
19-1-2012	H. Iwaniec Rutgers University	Critical zeroes of Dirichlet L-functions
20-1-2012	Jean Marc Deshouillers University of Bordeaux	Subsequences of automatic sequences with polynomial growth
20-1-2012	H. Iwaniec Rutger's University	Small population of zeroes of L-functions
21-1-2012	Mike Fellows et al	Parameterized Complexity
23-1-2012	Antal Balog Renyi Institute	Additive combinatorics
24-1-2012	Neeldhara Misra IMSc Chennai	PhD defence
24-1-2012	V. Ravi Srinivasan Catholic University of America, Washington DC	Liouvillian Extensions and the Galois theory of Linear Differential Equations
24-1-2012	G. Rajasekaran IMSc/CMI	Group velocity of neutrino waves and OPERA
25-1-2012	Kinjal Banerjee Beijing Normal University, China	Loop Quantization of Cosmological Models
25-1-2012	Antal Balog Renyi Institute	Additive combinatorics

25-1-2012	Kosuke Odagiri National Institute of Advanced Industrial Science and Technology, Tsukuba	Tadpole cancellation in top-quark condensation
25-1-2012	Gyan Prakash HRI	Szemerédi's theorem
26-1-2012	V. Ravi Srinivasan	Liouvillian extensions and the Galois theory of Linear Differential Equations
27-1-2012	Nitin Saurabh IMSc	Counting paths in planar width 2 branching programs
27-1-2012	Suchitra Sebastian Cavendish Lab, Cambridge University	Nodal pocket yielding multiple quantum oscillation frequencies in the underdoped cuprate $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$
27-1-2012	Tae-Hun Lee S.N. Bose National Centre for Basic Science	Particle with non-Abelian charge: classical and quantum
31-1-2012	Gyan Prakash HRI, Allahabad	Szemerédi's theorem
31-1-2012	Amaldev Manuel IMSc	Counter Automata and Classical Logics for Data Words
1-2-2012	Zbigniew Struzik University of Tokyo, Tokyo, Japan	Shine on you crazy diamond: Are we as original, creative and unpredictable as we think we are?
1-2-2012	Ravi Raghunathan IIT, Mumbai	Simultaneous non-vanishing
1-2-2012	Y. Bilu University of Bordeaux	Counting rational points on varieties, and applications
1-2-2012	Ravi Raghunathan IIT, Mumbai	Simultaneous non-vanishing
2-2-2012	D. S. Ramana HRI, Allahabad	Additive Energy of Large Sets of Primes and Monochromatic Representation.

2-2-2012	Mandy Engelsma Handfast Point Translation and Proofreading Agency	Writing a research paper in English - A Proofreader's perspective
2-2-2012	Gyan Prakash HRI	Szemerédi's theorem
3-2-2012	Antal Balog Renyi Institute	Additive combinatorics
3-2-2012	Gyan Prakash HRI	Szemerédi's theorem
4-2-2012	Krishna Nandivada IIT-Madras, Chennai	Multicore enablement of legacy programs
6-2-2012	Y. Bilu University of Bordeaux	Counting rational points on varieties, and applications
6-2-2012	Gyan Prakash HRI	Szemerédi's theorem
6-2-2012	Lynne Parker University of Tennessee, Knoxville, USA	Multi-Robot Path Planning and Motion Coordination
7-2-2012	Gyan Prakash HRI	Szemerédi's theorem
8-2-2012	R.K. Bhaduri McMaster University, Canada	Universal Equation of State of a Unitary Fermi Gas
9-2-2012	Aleksy Tralle University of Warmia and Mazury, Olsztyn, Poland.	On topology of a symplectomorphism group
9-2-2012	Antal Balog Renyi Institute	Additive combinatorics
10-2-2012	Petri Piiroinen National University of Ireland, Galway	Analysis of Piecewise Smooth Dynamical Systems
13-2-2012	Satya Lokam Microsoft Research, Bangalore	On Black-Box Reductions between Predicate Encryption Schemes

13-2-2012	Abhinav Saket IMSc	Topological Qubits in Quantum Spin Chains
13-2-2012	V Lakshmibai Northeastern University	Ubiquity of Schubert varieties
14-2-2012	Mithun Mitra S.N. Bose National Centre for Basic Sciences	Volume transition in charged polymer systems : Gels and brushes
14-2-2012	C. Gasbarri Universite' de Strasbourg	The abc conjecture over function fields
15-2-2012	Sandeep K. Goyal IMSc	Controlled entanglement dynamics in open quantum systems
15-2-2012	Hamsa Padmanabhan University of Pune	Electrostatics in a weak gravitational field
16-2-2012	Simon Kramer University of Luxembourg	A Logic of Interactive Proofs
16-2-2012	Hamsa Padmanabhan University of Pune	Some aspects of the nonrelativistic limit of Quantum Field Theory
17-2-2012	Subinay Dasgupta Department of Physics, University of Calcutta	Quantum Hysteresis in Transverse Ising Chain: An Exact Solution
17-2-2012	Yoram Moses Technion, Israel	On the interaction between Time, Communication and Coordination in distributed systems
17-2-2012	Pralay Chatterjee IMSc	Lie group Seminar
21-2-2012	C. Gasbarri Universite' de Strasbourg	Rational points over curves of genus zero
22-2-2012	Palash Sarkar ISI, Kolkata	The Balasubramanian-Koblitz Results
22-2-2012	Nabamita Banerjee Utrecht University	Constraints on Fluid Dynamics From Equilibrium partition Function

22-2-2012	M. S. Ramanujan IMSc Chennai	Faster Parameterized Algorithms through Linear Programming
23-2-2012	C. Gasbarri Universite' de Strasbourg	Rational points over elliptic curves (An analytic approach to Mordell Weil theorem over function fields)
24-2-2012	Madhu Raka Panjab University	Constacyclic codes over a finite field.
24-2-2012	Pralay Chatterjee IMSc	Lie groups
24-2-2012	Manoranjan Kumar Princeton University, NJ, USA	Frustration Induced Exotic Phases in Axial Anisotropic Spin-1/2 Chain
27-2-2012	Pierre Matsumi IMSc	The Brauer group of local fields
28-2-2012	Pierre Matsumi IMSc	The Brauer group of global fields
28-2-2012	Roman Sverdlov IMSc	Corrections to Klein-Gordon and Maxwell Lagrangians predicted by causal set theory
29-2-2012	A. Bharati IGCAR, Kalpakkam	Superconductivity and Magnetism in BaM2As2 systems; what is special about $M = Fe$
29-2-2012	Pierre Matsumi IMSc	Takagi's proof of class field theory
1-3-2012	Xavier Grard Viennot Directeur de recherche CNRS, LaBRI, France	Combinatorial operators and quadratic algebras
1-3-2012	Anirban Basu HRI, Allahabad	Supersymmetry Constraints on the $R^4$ multiplet in type IIB on $T^2$
2-3-2012	Roman Sverdlov IMSc	Can Grassman variables be viewed as realistic continuum parameters?
7-3-2012	H. Daboussi University of Paris	Analytic methods in number theory

8-3-2012	Sudipta Sarkar IMSc	Entropy increase during physical processes for black holes in higher curvature gravity
9-3-2012	Rishi Sharma TRIUMF, Canada	High transverse momentum quarkonium production and dissociation in heavy ion collisions
9-3-2012	Kajal Das IMSc	Lie groups seminar
13-3-2012	W. Kohlen University of Heidelberg	A characterization of cusp forms by the growth of their Fourier coefficients
14-3-2012	Amritanshu Prasad IMSc	Polynomial representations of $GL(n)$ and the Schur algebra
15-3-2012	Roger Wiegand University of Nebraska	Non-uniqueness of direct sum decompositions
15-3-2012	V. P. Nair City College of the CUNY, New York	Fluid Dynamics and the Chiral Magnetic Effect: A Group Theoretic Approach
16-3-2012	Raul Garcia Patron Sanchez Max-Planck-Institut für Quantenoptik, Garching, Germany	How much information can be sent through optical communication channels?
16-3-2012	S Ranganathan Indian Institute of Science, Bangalore	Mathematics, Arts and Quasicrystals A Golden Braid
16-3-2012	Kajal Das IMSc	Lie groups seminar
21-3-2012	Swastik Bhattacharya IMSc	Massless scalar fields in gravitation and cosmology
21-3-2012	S Viswanath IMSc	Unique factorization of tensor products
22-3-2012	Christophe Mourougane University of Rennes, France	Positivity in analytic and algebraic geometry

22-3-2012	William K. Wootters Williams College, USA	Qualitative Distinctions between Standard Quantum Theory and Its Real-Vector-Space Analogue
23-3-2012	William K. Wootters Williams College, USA	Quantum Mechanics as a Real-Vector-Space Theory with a Single Auxiliary Rebit
23-3-2012	Kajal Das IMSc	Lie groups seminar
27-3-2012	Alessandro Zaccagnini University of Parma, Italy	The Goldbach problem
28-3-2012	Alessandro Zaccagnini University of Parma, Italy	The Goldbach-Linnik problem
29-3-2012	Geevarghese Philip Max Planck Institute for Informatik, Germany	Thesis Defence
30-3-2012	Vaughan Jones Vanderbilt University.	Flatland- a great place to do algebra.





# Chapter 5

## External Interactions

### 5.1 Collaborative Projects with Other Institutions

#### 5.1.1 Algorithms and Complexity of Algebraic problems

The focus of this project is on algorithms and complexity theoretic questions for algebraic problems; more specifically, on identity testing problems, arithmetic circuit lower bounds, and isomorphism problems.

The project is funded by the Indo Max Planck Centre for Computer Sciences (IMPECS). The principal investigators include V Arvind and Meena Mahajan from IMSc, and Markus Bläser and B V Raghavendra Rao from Saarland University, Germany, and runs for a duration of 5 years beginning April 2011.

#### 5.1.2 Arithmetic vs Boolean complexity: the case of small-depth circuits

Boolean and arithmetic circuits provide complementary views on important algorithmic problems. This applies both for the design of efficient algorithms within these models as well as for the search for lower bounds. Both directions have seen remarkable progress during recent years. This project, funded by the DST, Government of India, and the DAAD, Germany, aims to clarify the relationship between these two computation models. In particular, research activity is centred on the connections between arithmetic circuits and small counting complexity classes. Resolving relations between these classes will also affect practical questions, as a number of algorithmic problems like testing for perfect matchings are intimately linked to such tractable complexity classes within P.

Participants in this project are Meena Mahajan (IMSc, principal investigator, Indian side), Heribert Vollmer (Leibniz University, Hannover, principal investigator, German side), Samir Datta (CMI, Chennai), B V Raghavendra Rao (formerly IMSc, now University of Saarlandes, Germany) and Michael Thomas (Hannover). The project is for 2 years, June 2009 to May 2011.

### 5.1.3 Belle Colaboration

The “Belle Collaboration”, is an experimental collaboration based in Japan. The Belle collaboration is an international team of 437 scientists from 71 institutions located in 15 different countries. Rahul Sinha, IMSc is an invited member of this collaboration.

### 5.1.4 Developing tools for dynamical modeling of *C. elegans* neuronal network activity

*Caenorhabditis elegans* is the only organism with its nervous system completely mapped. In addition to being small and well-characterized, its genetic amenability has made it an ideal system to study a whole animals behavior at the molecular and cellular levels. While the complete mapping of neuronal connections allows one to know the structural aspects of connectivity among neurons, there exists little information as to how the activities of individual neurons might correlate with particular behavioral patterns. This project intends to construct a dynamical neural network simulator for the entire *C. elegans* somatic nervous system using physiologically realistic single-compartment models of individual neurons. This will allow connecting electrical activity at the level of individual neurons to the behavior of the organism in response to specific stimuli, something which is experimentally still challenging. This will also permit prediction of hitherto unidentified neuronal members of specific behavioral circuits from activity patterns of the network. To verify the predictions obtained from the results of the model simulations, *C.elegans* strains with cameleon-labeled dopaminergic neurons for dynamical calcium imaging will be developed. The further aim of this proposal is to image and investigate activity-induced calcium changes in core cells of specific behavioral circuits.

### 5.1.5 DINO (Darkmatter at INO)

A multi-institutional collaborative project for the detection of Dark Matter has been initiated. The first meeting on this proposal was held on 24 August 2011 at TIFR, Mumbai and in the second meeting held at SINP, Kolkata, on 23-24 Dec 2011, the project has been given a more concrete form. Since the big Dark Matter detector will be mounted in the INO Cavern, it is to be called DINO (Darkmatter at INO). A MicroDINO to establish the technological feasibility and a MiniDINO which will be internationally competitive have also been planned. From IMSc, M.V.N. Murthy and G. Rajasekaran are participating in this project.

### 5.1.6 India-Based Neutrino Observatory (INO) Project

The INO project crossed many mile-stones during the year 2011-12. All statutory clearances for the project were completed. The land for setting up the project at Pottipuram in Theni District was transferred to DAE by the authorities of the TN Government in December. The preliminary project work is slated to begin any time soon. Very soon the INO centre will start functioning from Madurai. IMSc members played a crucial role in crossing these milestones.

In addition the IMSc members continue to contribute to the physics and simulations group. A physics and simulations white paper is getting ready for which the members have made important contributions.

IMSc is also aiding in establishing a detector laboratory at IIT, Madras.

The scientific members of the IMSc-INO group are: D. Indumathi, M.V.N Murthy, G. Rajasekaran, Nita Sinha, S Lakshmi Mohan, K Meghna.

Sri R. Sundarasrinivasan continues as Project Consultant working from Madurai. Sri N S Srinivasan completed his term of nearly six years with INO during which he steered the Project. He played a key role with very important contributions especially towards site selection, preparation of the site engineering Detailed Project Report and liasoning with the authorities of various ministries. He will continue to assist the project as a consultant as and when his expertise becomes necessary. The problem of getting the site for INO, which was one of the prime responsibilities of the IMSc group, was solved. All the government approvals have been obtained and the Tamil Nadu Government has already transferred 26 hectares of land in Theni District for the underground laboratory. In addition the government is transferring 12 hectares of land near Madurai city for the INO Centre. As a consequence, a major National Institution for High Energy Physics will come up in Southern Tamil Nadu.

### **5.1.7 Indo-UK Joint Project**

A joint project on above guarantee kernelization with Prof. Gregory Gutin and his group at Royal Holloway, University of London. Funded by British Royal Society.

### **5.1.8 Parameterized complexity of local search**

This is a joint project supported by the Department of Science and Technology of India with IMSc and Vienna University of Technology, Austria.

Venkatesh Raman, Saket Saurabh and Neeldhara Misra are the investigators from IMSc and Stefan Szeider, Serge Gaspers and Sebastian Ordyniak are the investigators from Vienna.

All three members of the Austrian group have made a visit to IMSc once, and Saket Saurabh and Neeldhara Misra have made a visit to Vienna from IMSc during this period.

### **5.1.9 Provably Efficient Pre-processing Algorithms**

This is a joint project with IMSc and Max Planck Institute for Informatik in Germany. The aim of the project is to design new lower and upper bounds for kernelization complexity of parameterized problems. This project is funded by Indo MaxPlanck Center for Computer Science(IMPECS). Venkatesh Raman and Saket Saurabh from IMSc are the Indian investigators in the project.

From the German side, the investigators are Kurt Mehlhorn, Jiong Guo and Ondra Suchy.

Ondra Suchy made two visits to IMSc during this period and Venkatesh Raman and Saket Saurabh made a visit each to Max Planck Insitute during this period.

## 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 01.04.11 to 31.03.2012 are :

### **Anirudh Pradhan**

Hindu PG College, Ghazipur, U.P.  
27.03.11 to 09.05.11

### **Samir Kunkri**

Mahadevananda Mahavidyalaya, Kolkata  
08.10.11 to 29.10.11

### **Sarait Maitra**

National Institute of Technology, Durgapur  
08.06.11 to 02.07.11

### **Anil Kr. Yadav**

Anand Engg. College, Agra, U.P.  
28.06.11 to 12.07.11

### **J. Sekar**

RKM Vivekananda College, Chennai  
25.04.11 to 05.06.11

### **K. Lakshmanan**

V.I.T., Vellore  
10.06.11 to 30.06.11

### **Anirban Pathale**

Jaypee Instt. of Information Technology, Noida, UP  
14.06.11 to 04.07.11

## 5.3 Conference Participation and Visits to Other Institutions

### Balakrishnan, Radha

Visited Department of Physics, BITS-Pilani, Goa Campus on Apr 15, 2011. Seminar on Persistent solitons in a hard core Bose-Einstein condensate

### Balasubramanian, R.

Visited University of Kingston, Canada during Jun 28 – Jul 4, 2011. Collaboration with Professor Ram Murty

Participated in *Transcendence and L functions* held at Fields institute, Toronto during Jul 6 – Jul 9, 2011. Delivered an invited talk on Catalan's conjecture

Visited University of Toronto during Jul 10 – Jul 16, 2011. Academic collaboration

Visited University of Waterloo, Canada on Jul 13, 2011. Delivered a talk

Participated in *Matheducation - trends and Challenges* held at Hyderabad university during Aug 19 – Aug 21, 2011. One of the panelists in the panel discussion

Participated in *RMS annual conference* held at Allahabad university during Oct 1 – Oct 5, 2011. Gave an invited talk on the contributions of Professor K.Ramachandra

Participated in *International meeting on Number theory* held at Harishchandra Research Institute during Dec 15 – Dec 20, 2011.

Visited Periyar Science and technology on Dec 23, 2011. Lecture on Ramanujam, in connection with their launch of year long programme on Ramanujam -Chandrasekar

Visited Vellore Institute of technology, Chennai on Feb 25, 2012. Delivered a lecture on Ramanujan as part of their Science Day

Visited IISER Trivandrum on Mar 3, 2012. Lecture on Ramanujam in the one day symposium

Visited Chennai Mathematical Institute on Mar 10, 2012. Two lectures on elliptic curve cryptology in the two day workshop on cryptology

### Basu, Madhushree

Participated in *Workshop on Functional Analysis of Quantum Information Theory* held at

Institute of Mathematical Sciences, Chennai during Dec 26, 2011 – Jan 6, 2012.

Participated in *Workshop and conference on Random matrix theory and applications* held at Indian Institute of Science, Bangalore during Jan 17 – Feb 1, 2012.

Participated in *ATM workshop on Operator Algebras* held at Institute of Mathematical Sciences, Chennai during Feb 2 – Feb 11, 2012.

### **Bhattacharya, Soumyadeep**

Participated in *DAE Solid State Symposium 2011* held at SRM University, Kattankulathur Campus, Tamil Nadu during Dec 19 – Dec 23, 2011.

Participated in *International Nonequilibrium Winter School 2011* held at IISER Kolkata, Mohanpur Campus, West Bengal during Dec 27, 2011 – Jan 11, 2012.

Participated in *Fracture and Flow in Porous Media* held at IMSc, CIT Campus, Chennai during Jan 11 – Jan 14, 2012.

### **Chatterjee, Tapas**

Participated in *workshop on Additive Combinatorics* held at HRI, Allahabad during Sep 20 – Oct 1, 2011.

Participated in *26th Annual Conference of Ramanujan Mathematical Society* held at Department of Mathematics, University of Allahabad during Oct 2 – Oct 5, 2011.

### **Date, G.**

Visited Madras Christian College, Chennai on Sep 29, 2011. Gave an invited talk on *Relativity in Every Day life*.

Participated in *International Conference on Gravitation and Cosmology* held at Goa during Dec 14 – Dec 19, 2011. Member of the Local Organizing Committee and chaired a session.

### **Ghosh, Sibasish**

Visited IIT - Rajasthan during Mar 28 – Apr 2, 2011. Visited Dr. Subhashish Banerjee of the physics department at IIT-Rajasthan. Worked together on our ‘on going research collaboration’ on open quantum systems, and in particular on the extension of adiabatic theorem, modeling of completely positive non-M

Visited Indian Statistical Institute, Kolkata during Sep 11 – Sep 18, 2011. Visited the Physics and Applied Mathematics Unit (PAMU) of I.S.I., Kolkata to continue my collaborative work

with Dr. Guruprasad Kar and his group members at PAMU. Gave a seminar on quantum estimation theory.

Participated in *School on Quantum Information* held at Institute of Physics, Bhubaneswar during Dec 13 – Dec 22, 2011. Gave three invited talks in the School part and also gave an invited talk in the Conference part.

Participated in *Recent trends in mathematical methods* held at Department of Applied Mathematics, University of Calcutta during Dec 14 – Dec 21, 2011. Gave four invited talks on Operator Theory.

### **Gun, S.**

Visited Harish-Chandra research institute during Apr 26 – Apr 30, 2011. Academic collaboration

Visited Harish-Chandra Research Institute during Apr 26 – Apr 30, 2011. Research collaboration

Visited Queen's University during Jun 6 – Jul 5, 2011. Research Collaboration

Participated in *Transcendence and L-functions* held at Fields Institute, Toronto during Jul 6 – Jul 9, 2011. Invited Speaker

Visited University of Toronto during Jul 10 – Jul 15, 2011. Research collaboration

Participated in *RMS conference* held at Allahabad University during Oct 1 – Oct 5, 2011. Invited Speaker

Participated in *International Meeting on Number Theory* held at Harish-Chandra Research Institute during Dec 15 – Dec 20, 2011. Invited Speaker

### **Han, Jung Hun**

Participated in *Special number theory(IMSc)* held at IMSc during Dec 1, 2010 – Mar 15, 2012.

### **Inbasekar, Karthik**

Participated in *National Strings Meeting* held at Delhi University during Dec 7 – Dec 13, 2011. Presented talk “A non-commuting twist in the partition function” based on <http://arxiv.org/abs/1201.1628>

Participated in *Asian Winter School in strings and cosmology* held at Kusatsu, Japan during



Jan 10 – Jan 20, 2012. Presented talk on “Generalized attractors in gauged supergravity” based on ongoing work.

Participated in *Spring School in superstring theory and related topics* held at ICTP, Trieste, Italy. during Mar 19 – Mar 27, 2012.

### **Kesavan, S.**

Participated in *Workshop on Variational Analysis and Optimization with Applications to Partial Differential equations* held at IIT, Gandhinagar during Apr 1 – Apr 4, 2011. Delivered two lectures on the theory of distributions.

Participated in *KVPY Summer Programme* held at IISER, Pune on May 19, 2011. Delivered an invited talk.

Participated in *Mathematical Olympiad Training Camp* held at HBCSC, TIFR, Mumbai on May 27, 2011. Delivered an invited talk.

Participated in *DST Inspire Programme* held at University of Madras, Guindy Campus, Chennai on Oct 15, 2011. Delivered an invited talk.

Participated in *Refresher Course on Partial Differential Equations* held at Ramanujan Institute for Advanced Study in Mathematics (RIASM), University of Madras, Chennai on Nov 11, 2011. Inaugurated the workshop, delivered the Keynote Address and an invited talk.

Participated in *DST Inspire Programme* held at University of Madras, Guindy Campus, Chennai on Dec 3, 2011. Delivered an invited talk.

Participated in *P. Subramanian Endowment Lecture* held at Presidency College, Chennai on Mar 15, 2012. Delivered the endowment lecture.

### **Kodiyalam, Vijay**

Participated in *Representations of Braid and Symmetric Groups - New Approaches* held at Aberystwyth University, Wales during May 2 – May 3, 2011. Gave two invited talks on ‘From graphs to free products I, II’

Participated in *International Conference on Algebra and Its Applications* held at Periyar University, Salem during Dec 14 – Dec 15, 2011. Gave a talk on ‘The genesis of a determinantal identity’.

### **Krishna, M.**

Participated in *Mathematical Physics, Spectral Theory and Stochastic Analysis* held at Goslar

Germany during Sep 11 – Sep 16, 2011. Part of the organizing committee. Conference held in honour of Prof M Demuth on his 65th birthday. Gave a talk on ‘Surprises from Commutators’.

Visited Department of Mathematics, Fern-Universität Hagen, Germany during Sep 17 – Sep 24, 2011. Collaborated on a research problem with Prof Werner Kirsch, Richard Froese and Spitzer.

Participated in *Workshop of Functional Analysis* held at Cochin University of Science and Technology, Cochin during Dec 12 – Dec 14, 2011. Gave a course of lectures on ‘Spectral Theory of Operators’

Participated in *International Conference on  $\dot{\cdot}$  Stochastic Modelling and Simulation (IC-SMS2011)* held at VelTech, Avadi, Chennai during Dec 15 – Dec 17, 2011. Gave a talk on ‘Absolutely continuous spectrum for some random operators’

### **Lodaya, Kamal**

Visited TIFR, Mumbai during May 16 – May 27, 2011. Gave a talk on “Counting, quantifiers and algorithms”.

Participated in *10th Formal methods update meeting* held at VIT Vellore during Jul 12 – Jul 14, 2011. Gave a tutorial talk on “Automata, concurrency and communication”.

### **Ramanujan, M.S.**

Participated in *Workshop on Kernelization (WorKer)* held at Vienna University of Technology, Vienna, Austria. during Sep 2 – Sep 4, 2011.

Participated in *European Symposium on Algorithms* held at Max Planck Institute, Saarbrücken, Germany during Sep 5 – Sep 7, 2011.

Participated in *International Symposium on Parameterized and Exact Computation (IPEC)* held at Max Planck Institute, Saarbrücken, Germany during Sep 7 – Sep 9, 2011.

Visited University of Bergen during Sep 9 – Oct 1, 2011. Research Visit

Participated in *International Workshop on Approximation, Parameterized and EXact algorithms* held at University Pierre et Marie Curie, Paris, France during Feb 27 – Feb 29, 2012.

Participated in *Symposium on Theoretical Aspects of Computer Science* held at University Pierre et Marie Curie, Paris, France during Mar 1 – Mar 3, 2012.

### **Mahajan, Meena B.**

Visited Max-Planck Institute for Informatics, Saarbrucken, Germany during Apr 29 – May 23, 2011. This visit was for research collaboration under an ongoing IMPECS project

Visited Computer Science Dept, Arhus University, Denmark during Aug 8 – Aug 19, 2011. The visit was part of a bilateral networking activity in the area “Simulations and lower bounds in circuit complexity”

Participated in *Workshop on Pseudorandomness* held at Chennai Mathematical Institute during Aug 22 – Aug 25, 2011.

### **Meena Devi, J.**

Participated in *Workshop on Computational Materials Science using Full potential Methods in International Conference on Advanced Materials (ICAM-2011)* held at PSG College of Technology, Coimbatore. during Dec 12 – Dec 16, 2011.

Participated in *CECAM School on Quantum Monte Carlo Methods at Work for Novel Phases of Matter* held at ICTP, Trieste, Italy during Jan 23 – Feb 3, 2012. Presented a paper entitled Simulation study on aggregation of thiol coated gold nanoparticles

### **Mishra, Ashok K.**

Visited Harish Chandra Research Institute, Allahabad during Jan 3 – Apr 22, 2011.

Visited Central Electrochemical Research Institute, Karaikudi during Feb 8 – Feb 9, 2012. Participated in the Brain-Storming-Session conducted by the Electrodeics and Electrocatalysis Division. Presented a talk on Electrochemical Rate Constant.

Visited Madura College, Madurai during Mar 1 – Mar 2, 2012. Participated in the National Conference on Mathematical modeling and methods, and gave a talk on Electrochemical Interface and Electron Transfer Reactions.

### **Mukherjee, Kunal K.**

Visited Dalian University of Technology, China during Sep 7 – Sep 17, 2011. Research

Visited Vassar College, Poughkeepsie, New York during Mar 9 – Mar 19, 2012. Research

Visited Texas AM University, College Station, Texas during Mar 20 – Mar 24, 2012. Groups, Geometry and Random Structures Conference

### **Mukhopadhyay, Anirban**

Participated in *RMS-HRI workshop on Additive combinatorics* held at HRI, Allahabad during Sep 20 – Oct 1, 2011. Gave a series of lectures on “Analytic proofs of Szemerédi’s theorem for progressions of length 3 and 4”.

Participated in *International meeting on number theory* held at HRI, Allahabad during Dec 15 – Dec 20, 2011. Gave a talk on “Moments of Rankin-Selberg L-functions”

### **Mukhopadhyay, Partha**

Participated in *Quantum Theory and Symmetries 7* held at Czech Technical University, Prague during Aug 7 – Aug 13, 2011. Contributory talk: Tubular neighborhood of target manifold in non-linear sigma model

Visited Harish-Chandra Research Institute, Allahabad during Nov 17 – Nov 22, 2011. Seminar: On a semi-classical limit of loop space quantum mechanics

Participated in *Higher Spin Theories and Holography Workshop* held at Harish-Chandra Research Institute, Allahabad during Nov 22 – Nov 26, 2011.

Participated in *National Strings Meeting 2011* held at University of Delhi during Dec 6 – Dec 12, 2011. Invited talk: On a semi-classical limit of loop space quantum mechanics

### **Nagaraj, D. S.**

Participated in *26th Annual Conference of Ramanujan Mathematical Society* held at Department of Mathematics, University of Allahabad, Allahabad during Oct 2 – Oct 5, 2011. Gave an invited talk on “Carlitz Modules”

Participated in *77th Annual meeting of Indian Academy of Sciences* held at PRL, Ahmedabad during Nov 18 – Nov 20, 2011. Gave an Invited talk on “Morphism of Varieties”

Participated in “*Advanced Instructional School on Geometric Invariant Theory*” held at Chennai Mathematical Institute Chennai, during Dec 12 – Dec 31, 2011. Gave 6 talks on Geometric Invariant Theory

Visited IISER Trivandrum on Mar 12, 2012. Gave a talk on “Plane Curve” in the “Algebraic Geometry Workshop”

### **Nanduri, Ramakrishna**

Participated in *The 7th Japan-Vietnam Joint Seminar on Commutative Algebra* held at Quy Nhon University, VIETNAM during Dec 12 – Dec 16, 2011.

### **Narain, Gaurav G.**

Participated in *International Conference on Gravitation and Cosmology (ICGC)* held at Goa, India during Dec 14 – Dec 19, 2011. Presented poster on Gravitational Analogue of Wilson Fisher Fixed Point

Participated in *International Conference on Modern Perspectives of Cosmology and Gravitation (COSGRAV)* held at Indian Statistical Institute, Kolkata, India during Feb 7 – Feb 11, 2012. Presented Talk on Short Distance Freedom of Quantum Gravity

Participated in *One day Meeting on Cosmology* held at IMSc, Chennai, India on Feb 14, 2012. Participation

Participated in *Meeting on Topology and and Differential Geometry in Quantum Physics* held at IMSc, Chennai, India on Mar 14, 2012. Participation

Participated in *Frontiers in Quantum Science (FQS-12)* held at IMSc, Chennai, India during Mar 19 – Mar 21, 2012. Participation

### **Paul, Pampa**

Participated in *Cohomology of Arithmetic Groups* held at Tata Institute of Fundamental Research, Mumbai during Dec 28 – Dec 31, 2011.

Participated in *Homogeneous Spaces and Geometric Representation Theory* held at Ruhr University, Bochum, Germany during Feb 27 – Mar 2, 2012.

### **Raghavan, K. N.**

Participated in *Summer programme for college teachers* held at Institute of Mathematical Sciences during Apr 25 – May 6, 2011. The programme was meant for teachers in city colleges teaching BSc courses in mathematics; helped organize the program and acted as a resource person.

Visited Chennai Mathematical Institute during Jul 4 – Jul 23, 2011. As organizer and resource person for the NBHM Advanced Instructional School on Lie algebras.

Participated in *Advanced Instructional School on Invariant Theory* held at Chennai Mathematical Institute during Dec 19 – Dec 30, 2011. This was one of the “Advanced Instructional Schools” sponsored by NBHM. Acted as resource person and gave five lectures.

Participated in *One day symposium on mathematical methods and applications (Ramanujan day celebrations)* held at Indian Institute of Technology, Madras on Dec 22, 2011. Lectured on “invariant theory of binary forms” to a general mathematical audience.

Participated in *One day seminar conducted by Professor Vaidyanathaswamy Trust* held at Ramanujan Institute for Advanced Studies in Mathematics, Chennai on Mar 29, 2012. Lec-

tured on “Gelfand-Tsetlin bases for representation spaces”.

## **Rajasekaran, G.**

Visited University of Madras during Apr 1, 2011 – Mar 31, 2012. Teaching Quantum Mechanics to a group of students every Sunday morning for three hours

Visited Texas A and M University, College Station, Texas, USA on Jul 5, 2011. Visited the Dark Matter Laboratory of Prof Rupak Mahapatra.

Visited University of California, Riverside during Jul 13 – Jul 20, 2011. Visited Physics Department for discussions with my former collaborators.

Participated in *Lepton Photon Symposium* held at TIFR, Mumbai during Aug 22 – Aug 27, 2011.

Participated in, International conference on Radiative Corrections, during Sep 26 - Sep 30, 2011 at Mamallapuram.

Visited Banares Hindu University during Dec 7 – Dec 11, 2011. Gave two lectures: 1. Neutrinos and India-based Neutrino Observatory, 2. Is there a Final Theory?

Visited Saha Institute of Nuclear Physics, Kolkata, Participated in ‘discussion Meeting on Dark Matter’, during Dec 23 - Dec 24, 2011.

Visited BARC, Mumbai on Jan 2, 2012. Meeting with the BARC engineers in connection with INO

Participated in *Workshop on High Energy Physics Phenomenology (WHEPP 12)* held at Mahabhaleshwar during Jan 9 – Jan 14, 2012. Talked on “Group Velocity of Neutrino Waves”

Participated in *NuHoRizons (Conference on Neutrinos)* held at Harishchandra Research Institute during Feb 1 – Feb 3, 2012. Gave a talk on “Group Velocity of Neutrino Waves”

Visited Banares Hindu University during Feb 4 – Feb 5, 2012. Gave two lectures on “A Journey into the microcosmos”: 1. Standard Model of HEP, 2. String Theory

Visited BARC, Mumbai during Feb 13 – Feb 15, 2012. Participated in the INO Collaboration Meeting

Participated in *National Symposium on Space Sciences* held at Sri Venkateswara University, Tirupati during Feb 14 – Feb 17, 2012. Gave an invited talk on “Neutrinos in Physics and Astronomy”

Visited Hyderabad University during Feb 22 – Feb 24, 2012. 1. Gave a Colloquium on “The elusive neutrino and INO” 2. Gave a seminar on “The group velocity of neutrino waves”

Visited Bharatidasan University, Trichy during Mar 8 – Mar 9, 2012. Gave two lectures: 1. A Journey through the microcosmos, 2. The elusive neutrino and INO

Visited Jamal Mohideen College on Mar 10, 2012. Talked on “The elusive neutrinos and INO”

Participated in *Symposium on Particles and Detectors* held at TIFR during Mar 21 – Mar 22, 2012.

### **Rajkumar, Krishnan**

Participated in *Arctic number theory school* held at University of Helsinki, Finland during May 18 – May 25, 2011.

Participated in *International Meeting on Number Theory* held at HRI, Allahabad during Dec 15 – Dec 21, 2011.

### **Raman, Venkatesh**

Visited PR Engineering College, Vallam, Thanjavur on Jun 2, 2011. Gave a talk on ‘Intractability’ in the staff development program

Participated in *Annual Conference on Association of Discrete Mathematics and Applications (ADMA)* held at National Institute of Technology, Calicut on Jun 11, 2011. Gave an invited talk on ‘Kernelization and Matching’

Visited Anna University on Jun 20, 2011. Gave a talk on ‘Matchings and Algorithmic Applications’ in the staff development program

Visited Royal Holloway University, London during Jul 21 – Jul 27, 2011.

Visited M.N.M. Engineering College, Chennai on Aug 11, 2011. Gave a talk on ‘Introduction to Algorithms’ and ‘Opportunities for Research career’

Participated in *Workshop on Kernelization (Worker) 2011* held at Vienna, Austria during Sep 2 – Sep 4, 2011.

Visited Max Planck Institute for Informatik, Saarbrücken, Germany during Sep 4 – Sep 9, 2011.

Participated in *European Symposium on Algorithms* held at Saarbrücken, Germany during Sep 5 – Sep 7, 2011.

Participated in *International Symposium on Parameterized and Exact Computation (IPEC) 2011* held at Saarbrücken, Germany during Sep 7 – Sep 9, 2011. Chaired a session

Participated in *Workshop on Algorithms and techniques* held at Abdur Rahman University, Chennai during Sep 22 – Sep 24, 2011. organized the academic programme and gave several lectures

Visited Vellore Institute of Technology, Vellore on Mar 10, 2012. Gave two sessions on NP-completeness

Participated in *Workshop on Algorithms and Complexity* held at Madras Christian College, Chennai on Mar 24, 2012. Gave a talk on Parameterized Algorithms for Vertex Cover

Visited St. John's College, Palayankottai on Mar 26, 2012. Gave a talk on Cryptography in the mathematics association of the college

Participated in *Workshop on Graph Algorithms* held at Indian Statistical Institute, Chennai on Mar 31, 2012. Gave a talk on 'Above guarantee parameterizations'

## **Ramanujam, R.**

Participated in *European Summer School on Logic, Language and Information* held at Ljubljana, Slovenia during Aug 1 – Aug 15, 2011. Taught a course (with Sujata Ghosh, Groningen University) on Strategies in games; participated in a workshop on Game theory.

Visited Beijing University during Oct 2 – Oct 7, 2011. Gave a lecture on 'Decidable fragments of first order logic'.

Participated in *New trends in Logical Dynamics* held at Beijing University during Oct 5 – Oct 7, 2011. Gave a talk on 'Desiderata for reasoning in large games'.

Participated in *Teaching Logic* held at Nankai University on Oct 8, 2011. Gave a talk on '5 questions for logic teaching'.

Participated in *Logic, rationality and interaction* held at Guangzhou University during Oct 10 – Oct 14, 2011. Gave an invited talk on 'The interplay of social and individual rationality'.

Participated in *Finite and algorithmic model theory* held at IIT-Bombay during Dec 9 – Dec 10, 2011. Gave a tutorial lecture on Logical definability and complexity classes.

Visited IIM, Indore during Dec 26 – Dec 27, 2011. Gave a lecture on Games and computations.

Participated in *Game theory and operations research* held at ISI-Chennai during Jan 3 – Jan 7, 2012. Gave a tutorial on 'Exploring structure in strategies' and a conference talk on



‘Dynamics in large games’.

Visited IISER-Pune during Mar 28 – Mar 31, 2012. Gave lectures in the course on Mathematical inquiry.

### **Ray, Purusattam**

Participated in *International Conference on Physics of Today* held at Department of Physics BUET, Dhaka Bangladesh during Mar 15 – Mar 17, 2012. Invited Speaker

### **Sankaran, Parameswaran**

Participated in *ATM Workshop on Geometric group theory* held at IISER, Chandigarh during May 16 – May 21, 2011. Gave an invited talk on ‘Grigorchuk groups’

Participated in *Durham Symposium on Geometry and arithmetic of Lattices* held at Durham University, Durham, UK during Jun 27 – Jul 8, 2011. Participated

Participated in *National Initiative in Mathematics Education* held at Bhavans Vidya Mandir, Kochi during Nov 10 – Nov 11, 2011. Gave an invited lecture on ‘Constructivism’.

Participated in *National Initiative in Mathematics Education* held at Bhavan’s Vidya Mandir, Elamakkara, Ernakulam, Kerala during Nov 11 – Nov 12, 2011. Gave an invited talk on ‘Constructivism–its implications and challenges’

Participated in *International conference on algebra and applications* held at Periyar Maniyam-mai University, Tanjavur, Tamil Nadu, during Dec 14 – Dec 15, 2011. Gave an invited talk on ‘Twisted conjugacy in linear groups’.

Participated in *Cohomology of arithmetic groups* held at TIFR, Mumbai during Dec 27 – Dec 31, 2011. Invited participant

Visited Vivekananda College, Mylapore, Chennai on Feb 15, 2012. Gave the Prof. K. Subramaniam endowment lecture on ‘An invitation to algebraic topology’.

Participated in *ATM Workshop on Geometry and Topology* held at IIT Bombay, Powai during Feb 21 – Feb 24, 2012. Gave four lectures on symmetric spaces

### **Sarkar, Sudipta**

Visited IUCAA, Pune during Dec 20 – Dec 30, 2011. This visit was for the collaboration with T Padmanabhan and Sanved Kolekar. Also gave a seminar in IUCAA

Participated in *COSGRAV 12* held at ISI, Kolkata during Feb 7 – Feb 11, 2012. Gave an

oral presentation in this conference.

### **Sathiapalan, Balachandran**

Participated in *KS Krishnan Meeting* held at IMSc during Mar 19 – Mar 21, 2012. Gave an informal talk on AdS/CFT

### **Satin, Seema**

Visited Tata Institute of Fundamental Research, Mumbai during Oct 15 – Nov 29, 2011. Collaborative Work

Participated in *International Conference on Gravitation and Cosmology* held at Holiday Inn Goa during Dec 14 – Dec 19, 2011.

### **Simon, R.**

Participated in *12th International Conference on Squeezed States and Uncertainty Relations* held at Fox do Iguacu, Brazil during May 2 – May 6, 2011. Key-note talk on ‘Nonclassicality and Entanglement’

Participated in *AQIS'11* held at Busan. Korea during Aug 22 – Aug 27, 2011. Talk on ‘Nonclassicality Breaking Gaussian Channels’

Visited Texas A & M University at Qatar, Doha during Oct 17 – Oct 23, 2011. Colloquium on ‘Hamilton’s Turns and a Geometric Representation for Qubit Gates’

### **Sinha, Nita**

Participated in INO Collaboration meeting, during Jul 11 – Jul 13, 2011 held at Variable Energy Cyclotron Centre, Kolkata

Participated in *Nufact2011*, 13th International workshop on Neutrino factories, superbeams and betabeams, Aug 1 – Aug 6, 2011 held at CERN and University of Geneva, Geneva, Switzerland

Participated in Lepton Photon 2011, “XXV International Symposium on Lepton Photon-interactions at High Energies”, held at Tata Institute of Fundamental Research, Mumbai, India during Aug 22 – Aug 27, 2011.

Participated in “iCAPP” (interface of Cosmology And Particle Physics), Meeting on Neutrinos beyond the Standard Model at Physical Research Laboratory, Ahmedabad during Sep 21 – Sep 23, 2011. Delivered an invited talk on “Tau combination in muon / electron events at neutrino factories”.

Participated in WHEPP12, XII Workshop on High Energy Physics Phenomenology, during Jan 2 – Jan 15, 2012 in Mahabaleswar.

### **Sinha, Sitabhra**

Visited Bose Institute, Kolkata on Apr 12, 2011. Delivered colloquium talk on “Minds, Modules and Memory: Exploring networks of the nervous system”

Participated in *National Workshop on Nonlinear Dynamical Systems (NDS 2011)* held at National Institute of Technology, Durgapur during Jul 4 – Jul 8, 2011. Invited talk on “Complex Network Dynamics” (in two parts)

Participated in *International Conference on Mathematical Biology* held at Indian Institute of Science, Bangalore during Jul 4 – Jul 7, 2011. Invited talk on “Onset of coherent dynamical activity in the pregnant uterus: Self-organized transition from excitatory to oscillatory behavior in heterogeneous media”

Visited Academia Sinica, Taipei, Taiwan during Jul 17 – Jul 23, 2011. Invited talk on “Patterns of life and death: Genesis and control of complex wave activity in heterogeneous biological systems” at the 2011 Taiwan International Workshop on Biological Physics and Complex Systems

Visited National Central University, Jhongli City, Taiwan during Jul 24 – Jul 29, 2011. Invited talk on “Minds, Modules and Memory: Exploring Networks of the Nervous System”

Participated in *European Conference on Complex Systems (ECCS 2011)* held at University of Vienna, Vienna during Sep 12 – Sep 17, 2011. Invited talk on “Network Meso-dynamics: How modular topology and hierarchical organization affect behavior of networks” at the Satellite Workshop on Dynamics On and Of Complex Networks V.

Visited Institut für Chemie und Biologie des Meeres, Carl von Ossietzky University, Oldenburg during Sep 18 – Sep 23, 2011. Seminar talk on “Why large, diverse and highly connected ecosystems should exist at all ? Lessons from nonlinear dynamics on complex networks”

Visited School of Computational and Integrative Sciences, Jawaharlal Nehru University, New Delhi on Oct 17, 2011. Viva-voce external examiner and seminar talk on “Computational Systems Biology: From the cell to the brain and beyond”

Visited Saha Institute of Nuclear Physics, Kolkata during Oct 21 – Oct 25, 2011. Invited talk on “Are complex financial systems unstable ? Analyzing cascading failures in networks of financial institutions” at the Econophys-Kolkata VI meeting

Visited National Brain Research Center, Manesar on Nov 1, 2011. Attended Indian National Node for Neuroinformatics members meeting

Visited Indian Institute of Science, Bangalore during Nov 4 – Nov 5, 2011. Invited talk

on “Are complex financial systems unstable ? Analyzing cascading failures in networks of financial institutions” at the Workshop on Networks: Structure and Function, in honor of 60th Birthday of Prof R E Amritkar

Visited VIT University, Vellore on Dec 6, 2011. Invited talk on “Computational Systems Biology: From the cell to the brain”

Visited Institute for Theoretical Physics, Technical University-Berlin, Berlin, Germany during Dec 11 – Dec 17, 2011. Seminar talk on “Minds, Modules and Memory: Exploring networks of the nervous system”

Visited Presidency University, Kolkata during Jan 9 – Jan 11, 2012. Invited talk on “Patterns of life and death: Onset of coherent excitation dynamics in the pregnant uterus” at 2nd International Symposium On Complex Dynamical Systems and Applications (CDSA II)

Visited Department of Mathematics, Jadavpur University, Kolkata during Jan 12 – Jan 13, 2012. Invited talk on “Minds, Modules and Memory” at the International Conference on Dynamical Systems (ICDS 2012)

Visited IISER Pune during Jan 23 – Jan 27, 2012. Organized mini-symposium on Cardiac Dynamics and gave invited talks on “Network ‘Meso’-dynamics: Mesoscopic approach to analyzing biological complex networks” and “Transmission on biological networks: From information propagation in intra-cellular sign”

Visited Department of Computer Science, IIT Kharagpur during Feb 27 – Mar 2, 2012. Taught a module in course on Complex Networks as Adjunct Professor

Participated in *Indo-US Workshop on “Modeling Electrical Activity in Physiological Systems”* held at Hotel Clarks Shiraz, Agra during Mar 5 – Mar 9, 2012. Invited talk on “Patterns of life and death: Coherence-incoherence transitions in models of heart and uterus”

Visited Department of Computer Science, IIT Kharagpur during Mar 19 – Mar 23, 2012. Taught a module in course on Complex Networks as Adjunct Professor

Visited Indus Research Center, RMRL, Chennai on Mar 30, 2012. Invited talk on “New Approaches to Understanding the Indus Inscriptions”

### **Srilakshmi, K.**

Visited Korea Advanced Institute of Science and Technology during Jan 2 – Jan 5, 2012. Gave a seminar talk on Jan 4, 2012 at KAIST. Invited Speaker.

Participated in *Postech Winter School 2012: The Birch and Swinnerton-Dyer conjecture* held at POSTECH, Pohang, South Korea. during Jan 6 – Jan 15, 2012. Participation.

**Srinivas, K.**

Participated in *Workshop on Academic Ethics* held at IMSc, Chennai during Jul 15 – Jul 16, 2011.

Participated in *Mathematics Education-Trends and Challenges* held at University of Hyderabad during Aug 19 – Aug 21, 2011.

Participated in *RMS Annual Meeting* held at H.R.I. Allahabad during Oct 2 – Oct 5, 2011. Participated and presented statements of accounts in the EC and GB meeting, attended talks.

Participated in *Indocrypt 2011* held at IMSc, Chennai during Dec 11 – Dec 13, 2011.

Participated in *International Meeting in Number Theory* held at H.R.I. Allahabad during Dec 15 – Dec 20, 2011. Delivered a talk on the zeros of the Epstein zeta function

Participated in *Ramanujan's 124th Birth Day* held at Ramanujan Institute of Advanced Studies, Chennai on Dec 22, 2011. Delivered a talk on some glimpses of Ramanujan's Mathematics

Participated in *Annual Conference of the Indian Mathematical Society* held at Swami Ramanand Teerth Marathwada University, Nanded (Maharashtra) during Dec 27 – Dec 28, 2011. Delivered a talk on Hardy's theorem for zeta functions

Participated in *International Colloquium on Automorphic Representations and L-functions* held at T.I.F.R. Mumbai during Jan 3 – Jan 11, 2012. Delivered an invited talk on the zeros of Selberg class of functions

Participated in *Workshop on Number Theory and Related Areas in Cryptology* held at I.S.I., Delhi during Feb 12 – Feb 14, 2012. Delivered a mini course of lectures on primes, quadratic sieve and number field sieve

Participated in *National Conference on Graph theory and Number theory* held at Department of Mathematics, University of Mysore, Mysore during Mar 21 – Mar 22, 2012. Delivered a talk on the zeros of general  $L$ -functions

**Subramanian, C. R.**

Attended *Second India-Taiwan Conference on Discrete Mathematics* held at Amrita University, Coimbatore, during Sep 8 – Sep 11, 2011. Gave a Plenary talk.

Visited Velammal Engineering College, Chennai on Srinivasa Ramanujan's 125th birthday 22 Dec 2011. Gave an invited Talk on "Randomness reduction using random walks on expander graphs".

Gave an expository talk on “Randomized algorithms” at National Institute of Technology-Surathkal, during Jan 10 – Jan 12, 2012.

**Sundar, V. S.**

Participated in *KRP75* held at ISI, Delhi during Dec 23 – Dec 25, 2011. Gave an invited talk titled “From Graphs to Free Probability”

Visited Chennai Math Institute on Feb 15, 2012. Delivered the ‘R.K. Rubgunday Endowment Lecture’ titled “von Neumann algebras and Free Probability”

Visited TIFR-CAM, Bangalore during Feb 20 – Feb 21, 2012. Gave a lecture titled ‘Spectra of Self-ajoint Operators’

**Mubeena, T.**

Participated in *ATM workshop in geometric group theory* held at IISER Mohali, Punjab. during May 16 – May 21, 2011.

Participated in *International Conference on “Geometric and Asymptotic Group Theory with Applications”* held at Escola Politcnica Superior d’Enginyeria de Manresa, Barcelona, Spain during Jul 5 – Jul 15, 2011.

Participated in *ATM Workshop on “Geometry and Topology”*. held at IIT Bombay, Mumbai during Feb 20 – Feb 28, 2012.

**Vemparala, Satyavani**

Participated in *Materials for Energy Applications - Experiment, Modeling and Simulations* held at Los Angeles, USA during Mar 31 – Apr 4, 2011. Invited Speaker

**Venkatesh, R.**

Visited Tata Institute of Fundamental Research during Nov 15 – Dec 5, 2011. Collaborated with Prof. C. S. Rajan

**Viswanath, Sankaran**

Participated in *Advanced Instructional School on Lie algebras* held at Chennai Mathematical Institute during Jul 4 – Jul 23, 2011.

Participated in *Instructional workshop on Infinite dimensional Lie algebras* held at IMSc, Chennai during Aug 16 – Aug 26, 2011.

## 5.4 Visitors from Other Institutions

<b>J. Selvaganapathy</b>	04/10/10 - 08/04/11	Madras University
<b>S. Subburam</b>	06/12/10 - 26/04/11	Sastra University
<b>Maitri Kulkarni</b>	26/03/11 - 02/04/11	S.P. College, Pune
<b>R. Thangadurai</b>	19/12/10 - 30/04/11	Harish Chandra Research Institute, Allahabad
<b>Amita Malik</b>	19/12/10 - 30/06/11	IISc, Bangalore
<b>Thirumalai Kumar</b>	02/12/10 - 16/05/11	Sastra University, Tanjavur
<b>Dorian Goldfeld</b>	01/01/11 - 13/01/12	University of Columbia
<b>Aditya Bawane</b>	02/01/11 - 18/06/11	BITS-Pilani, Goa
<b>B.C. Rohini</b>	04/02/11 - 04/05/11	University of Minnesota, Minneapolis, USA
<b>Pankaj Kumar Mishra</b>	16/02/11 - 19/02/11	IIT, Roorkee
<b>Swadhin Chandra Jana</b>	28/02/11 - 22/05/11	Bangalore
<b>Sebastian Kuhner</b>	08/03/11 - 07/04/11	Humboldt University, Berlin, Germany
<b>Sumathi Rao</b>	31/03/11 - 01/04/11	Harish Chandra Research Institute, Allahabad
<b>Jayant Pendharkar</b>	21/03/11 - 13/04/11	IISER, Pune
<b>Xavier Martin</b>	21/03/12 - 04/04/12	University of Tours, France
<b>Kumar S Gupta</b>	21/03/11 - 25/03/12	SINP Kolkata
<b>K. Subashini</b>	14/03/11 - 15/10/11	Kanchi mamunivar centre for postgraduate studies, Pondicherry
<b>Johannes Koebler</b>	08/03/11 - 22/04/11	Humboldt University, Berlin, Germany
<b>S. Arunagiri</b>	10/03/11 - 05/04/11	Pohan University, Korea
<b>Asrarul Haque</b>	10/04/11 - 14/04/11	RGUKT Basar, A.P
<b>Sameer Murthy</b>	18/04/11 - 24/04/11	TIFR, Mumbai
<b>R. Shobhana</b>	21/04/11 - 05/06/11	Lady Doak College, Madu- rai
<b>Prahladh Harsh</b>	26/04/11 - 28/04/11	TIFR Mumbai
<b>Seshadri Chintapalli</b>	26/04/11 - 29/04/11	University of Hyderabad
<b>Deepak Dhar</b>	21/04/11 - 07/05/11	TIFR, Mumbai
<b>Arnab Chakrabarthy</b>	25/04/11 - 27/04/11	Bharathiya Vidhya Bhavan, Kolkata
<b>Laytimi Fatima</b>	02/04/11 - 30/04/11	University of Lille, France
<b>MJ. Mohan</b>	03/04/11 - 06/04/11	RKM Vivekananda Univer- sity, West Bengal
<b>Chandrima Paul</b>	03/04/11 - 07/04/11	IIT Bombay
<b>Karen Hallberg</b>	09/04/11 - 11/04/11	Institute of Balseiro, Ar- gentina
<b>Archontia Giannopolou</b>	02/02/11 - 17/04/11	University of Athens, Greece
<b>NSN Sastry</b>	17/04/11 - 18/04/11	ISI, Bangalore
<b>Radha Mohan</b>	17/04/11 - 30/04/11	ST.Stephan College, Delhi
<b>Mithin Kumar Mitra</b>	03/04/11 - 18/04/11	University of Mas- sachusetts, USA
<b>Jaya N Iyer</b>	04/04/11 - 06/04/11	University of Hyderabad

<b>Sourav Bhattacharya</b>	04/04/11 - 09/04/11	Bose Centre, Salt Lake City, Kolkata
<b>Sudipta Sarkar</b>	20/04/11 - 22/04/11	University of Maryland , USA
<b>Michel Waldschmidt</b>	04/04/11 - 29/04/11	University of PETM- CURIE,Paris,France
<b>Rekha Jaiswal</b>	04/04/11 - 30/04/11	Hindu PG College, Ghazipur-U.P
<b>Patrick Semont</b>	01/05/11 - 29/06/11	University of Sherbrooke, Canada
<b>Siddhartha Sarkar</b>	02/05/11 - 27/05/11	IISER, Bhopal
<b>V. Kumar Murty</b>	07/05/11 - 17/05/11	University of Toronto
<b>Dileep Jatkar</b>	10/05/11 - 13/05/11	Harish Chandra Research Institute, Allahabad
<b>Bharath Sethuraman</b>	09/05/11 - 25/05/11	California State University, California
<b>Indranil Biswas</b>	10/05/11 - 13/05/11	TIFR, Mumbai
<b>Anil Asokan</b>	16/05/11 - 23/08/11	Ondalys/Indatech
<b>Ranjitha Mohapatra</b>	11/05/11 - 22/05/11	Institute of Physics, Bhu- vaneshwar
<b>Ambarish Kunwar</b>	31/05/11 - 04/06/11	University of California
<b>N.R. Aravind</b>	30/05/11 - 09/06/11	IIT Bombay
<b>M. Vanitha</b>	02/05/11 - 31/05/11	Bharathidasan University, Trichy
<b>Guahar Abbas</b>	07/05/11 - 22/05/11	Indian Institute of Science , Bangalore
<b>Ganesh Sundaram</b>	27/05/11 - 11/06/11	Amrita Vishwa Vidyapeeram, Kerala
<b>Mrinal Kanti Das</b>	25/05/11 - 04/06/11	Indian Statistical Institute , Bangalore
<b>Sunil K. Chebolu</b>	25/05/11 - 26/05/11	Illinois State Univer- sity,USA
<b>Sandipan Bhattacharya</b>	03/05/11 - 29/05/11	Chennai Mathematical In- stitute, Chennai
<b>Jaitra Chattopadhyay</b>	03/05/11 - 29/05/11	Chennai Mathematical In- stitute, Chennai
<b>M. Balamurugan</b>	17/05/11 - 05/07/11	University of Madras
<b>Arnab Chakrabarthy</b>	17/05/11 - 21/05/11	Bharathiya Vidhya Bhavan, Kolkata
<b>Rabeya Basu</b>	24/05/11 - 07/06/11	IISER, Pune
<b>C.S. Narayanamurthy</b>	24/06/11 - 26/06/11	IIST, Trivandrum
<b>K.R. Dhanajay</b>	24/06/11 - 31/07/11	Sastra University,Tanjavur
<b>Pooja Singla</b>	13/06/11 - 27/06/11	Ben Gurion University of the Negev
<b>Samrat Bhowmick</b>	18/06/11 - 24/06/11	Institute of Physics,Bhuvaneshwar
<b>Swarnendu Sarkar</b>	17/06/11 - 08/07/11	University of Delhi
<b>Sayanta Mandal</b>	20/06/11 - 27/06/11	Chennai Mathematical In- stitute, Chennai
<b>Alain Pumir</b>	28/06/11 - 03/07/11	ENS , Lyon ,France
<b>Subhadip Mitra</b>	28/06/11 - 08/07/11	IOP, Bhuvaneshwar
<b>Abbaj soman</b>	17/06/11 - 31/07/11	IIT, Bombay



<b>Pranab Sardar</b>	15/06/11 - 15/07/11	Ramakrishna Mission Vivekananda University Bharatiya Vidhya Bhavan
<b>Arnab Chakrabarthy</b>	06/06/11 - 12/06/11	IISER, Kolkata
<b>Abhishek Dasgupta</b>	21/06/11 - 16/07/11	ISI, Kolkata
<b>Souman Sarkar</b>	21/06/11 - 28/08/11	Amrita Vishwa Vidyapeeram,kerala
<b>Ganesh Sundaram</b>	20/06/11 - 27/06/11	BITS-Pilani, Goa
<b>Dinesh Vallur</b>	11/06/11 - 17/06/11	
<b>Kapil Hari Paranjape</b>	07/06/11 - 10/06/11	IISER, Mohali
<b>Swadhin Chandra Jana</b>	16/06/11 - 29/06/11	TIFR, Mumbai
<b>Abhishek Iyer</b>	01/06/11 - 31/07/11	IISc Bangalore
<b>Sudhakar Panda</b>	19/06/11 - 21/06/11	Harish Chandra Research Institute, Allahabad
<b>Indrajit Mitra</b>	26/06/11 - 25/07/11	University of Calcutta
<b>Raj Kumar Pan</b>	26/06/11 - 28/06/11	Aatto University School, Finland
<b>Kumar Rao</b>	19/07/11 - 22/07/11	Institute of Physics,University of Helsinki,Finland
<b>Anish Ghosh</b>	01/07/11 - 13/07/11	University of East An- glia,UK
<b>Janaki Raghavan</b>	11/07/11 - 10/10/11	University of Madras
<b>D. Murali</b>	11/07/11 - 11/10/11	IGCAR, Kalpakkam
<b>Sneh Bala Sinha</b>	03/07/11 - 24/07/11	Harish Chandra Research Institute,Allahabad
<b>Sudeshna Sinha</b>	04/06/11 - 07/07/11	IISER, Mohal
<b>Dilip Raghavan</b>	04/07/11 - 09/07/11	National University of Sin- gapore
<b>Jonathan Fernandes</b>	14/06/11 - 20/06/11	IISc Bangalore
<b>Rajdeep Niyogi</b>	04/07/11 - 15/07/11	IIT, Roorkee
<b>Sachin Gautam</b>	10/07/11 - 16/07/11	Columbia University,New Yark ,USA
<b>Pushkar S.Joglekar</b>	10/07/11 - 25/07/11	IIT, Kanpur
<b>Srinivas Sista</b>	04/07/11 - 15/12/11	BITS Pilani
<b>B.V.Raghavendra Rao</b>	12/07/11 - 14/06/11	University of Saarland
<b>A.M.M.Pruisken</b>	29/07/11 - 16/08/11	University of Amsterdam
<b>Piyush P.Kurur</b>	12/07/11 - 16/07/11	IIT , Kanpur
<b>Saptarshi Mandal</b>	25/07/11 - 06/08/11	IACS, Kolkata
<b>A.J. Parmeswaran</b>	12/07/11 - 16/07/11	TIFR, Mumbai
<b>Syed Mohammed</b>	23/07/11 - 29/07/11	IISc Bangalore
<b>Kamil</b>		
<b>Solomon Ivan</b>	24/07/11 - 31/07/11	RRI, Bangalore
<b>Eshita Mazumdar</b>	04/07/11 - 24/07/11	Harish Chandra Research Institute,Allahabad
<b>R.Venkatesh</b>	24/07/11 - 31/08/11	TIFR, Mumbai
<b>Uddipan Sarma</b>	08/07/11 - 21/07/11	NCCS, Pune
<b>V.Kumar Murthy</b>	05/07/11 - 17/05/11	University of Toronto,Toronto

<b>A.M.M.Pruisken</b>	29/07/11 - 16/08/11	University of Amsterdam
<b>Mythily Ramaswamy</b>	29/08/11 - 29/08/11	TIFR, Mumbai
<b>Kapil Hari paranjape</b>	07/08/11 - 09/08/11	IISER, Mohali
<b>Vyjayanthi Chari</b>	13/08/11 - 27/08/11	UC RIVERSIDE
<b>Sarada Natarajan</b>	07/08/11 - 11/08/11	TIFR, Mumbai
<b>David Sinnou</b>	02/08/11 - 24/08/11	University of Paris Franch
<b>Kumar Sankar Gupta</b>	16/08/11 - 18/08/11	SINP Kolkata
<b>Sandip Pakvasa</b>	16/08/11 - 20/08/11	University of Hawaii
<b>Sujatha Ramdorai</b>	08/08/11 - 09/08/11	TIFR, Mumbai
<b>Shilpa Godhali</b>	18/08/11 - 25/11/11	TIFR, Mumbai
<b>Maximilian Thess</b>	01/08/11 - 28/09/11	Technical University, Berlin
<b>R. Venkatesh</b>	28/08/11 - 30/09/11	TIFR, Mumbai
<b>Grant Lythe</b>	20/08/11 - 22/08/11	University of Leeds,UK
<b>Carmen Molina Paris</b>	20/08/11 - 22/08/11	University of Leeds,UK
<b>Sujit Sarkar</b>	06/09/11 - 09/09/11	Poornapranjan Institute of Scientific Research, Banga- lore
<b>Sujit K. Choudhary</b>	17/08/11 - 23/08/11	University of Kwazulu- Natal,South Africa
<b>Anu Vengopalan</b>	15/09/11 - 16/09/11	GGs Indraprastha Univer- sity
<b>Kasi Vishwanadhan</b>	05/09/11 - 10/12/11	Harish Chandra Research Institute,Allahabad
<b>Azam Moffazal</b>	14/09/11 - 17/09/11	BARC, Mumbai
<b>Somenath Biwas</b>	11/09/11 - 13/09/11	IIT, Kanpur
<b>K. Elankumaran</b>	14/09/11 - 28/09/11	RKM Vivekananda Col- lege,Chennai
<b>Esha Ghosh</b>	22/09/11 - 31/10/11	ISI,Chennai
<b>Kavitha Gangal</b>	13/09/11 - 20/09/11	Newcastle University,UK
<b>Carlo Albert</b>	13/09/11 - 21/09/11	Swiss Federal Instt of Aquatic Science and Tech- nology,Switzerland
<b>R. Venkatesh</b>	01/09/11 - 02/10/11	TIFR, Mumbai
<b>Shiraz Minwalla</b>	16/09/11 - 16/09/11	TIFR, Mumbai
<b>J. Solomon Ivan</b>	16/09/11 - 24/09/11	RRI, Bangalore
<b>R.V. Gurjar</b>	27/09/11 - 28/09/11	TIFR, Mumbai
<b>Gauhar Abbas</b>	30/09/11 - 08/10/11	IISc, Bangalore
<b>V. Kumar Murthy</b>	30/09/11 - 27/10/11	University of Toronto,Toronto
<b>Lalit Sehgal</b>	31/09/11 - 09/10/11	RWTH,Aachen, Germany
<b>Nilanjan Sircar</b>	02/09/11 - 09/09/11	TIFR, Mumbai
<b>Pushkar S.Joglekar</b>	07/09/11 - 15/09/11	CMI, Chennai
<b>Sujit Sarkar</b>	06/09/11 - 09/09/11	Poornapranjan Institute of Scientific Research, Banga- lore
<b>B.Ramakrishnan</b>	08/10/11 - 24/10/11	Harish Chandra Research Institute, Allahabad
<b>Kiran M.Kolwankar</b>	09/10/11 - 15/10/11	RJ College,Mumbai
<b>M. Manickam</b>	17/10/11 - 25/10/11	Kerala School of Mathemat- ics

<b>Ashish Gupta</b>	12/10/11 - 21/10/11	Harish Chandra Research Institute, Allahabad
<b>MD.Rajjak Gazi</b>	12/10/11 - 30/10/11	ISI, Kolkata
<b>Jean Marc Deshouillers</b>	12/10/11 - 30/10/11	University of Bordeaux, France
<b>R. Thangadurai</b>	10/10/11 - 31/10/11	Harish Chandra Research Institute, Allahabad
<b>Uri Onn</b>	21/10/11 - 31/10/11	Ben Gurion University of the Negev
<b>V. Yogesh</b>	04/10/10 - 08/04/11	Madras University, Chennai
<b>Gyan Prakash</b>	06/10/11 - 30/10/11	Harish Chandra Research Institute, Allahabad
<b>Swarup Poria</b>	03/10/11 - 16/10/11	University College of Sci- ence, Calcutta
<b>Jaban Meher</b>	11/10/11 - 29/10/11	Harish Chandra Research Institute,Allahabad
<b>Karam Deo Shankhad- har</b>	11/10/11 - 29/10/11	Harish Chandra Research Institute,Allahabad
<b>Sudhir Kumar Pujahari</b>	11/10/11 - 30/10/11	IISER, Kolkata
<b>Kiran M. Kolwankar</b>	09/10/11 - 15/10/11	RJ College, Mumbai
<b>Probir Roy</b>	16/10/11 - 22/10/11	SINP, Kolkata
<b>Guruprasad Kar</b>	16/10/11 - 26/10/11	ISI,Kolkata
<b>Pooja Singla</b>	18/10/11 - 03/11/11	Ben Gurion University of the Negev
<b>Amitha Mallick</b>	19/10/10 - 30/04/11	IISc Bangalore
<b>Aleksy Tralle</b>	19/10/11 - 27/02/12	University of Warmia and Mazury
<b>Sreedhar Dutta</b>	23/10/11 - 26/10/11	IISER,Trivandrum
<b>Lalit Sehgal</b>	31/10/11 - 09/11/11	RWTH, Achon, Germany
<b>Sanjit Chatterjee</b>	23/11/11 - 23/11/11	IISc Bangalore
<b>M. Masroor Ahmed</b>	19/11/11 - 11/12/11	Mirza Ghalib Col- lege,Magadh Univer- sity,Gaya
<b>Steven Spallone</b>	18/11/11 - 25/11/11	TIFR, Mumbai
<b>P. Akhilesh</b>	06/11/11 - 03/12/11	Harish Chandra Research Institute,Allahabad
<b>Ondra Suchy</b>	06/11/11 - 26/11/11	University of Saarland, Ger- many
<b>Gauhar Abbas</b>	08/11/11 - 22/11/11	Centre for High Energy Physics, IISc, Bangalore
<b>Ramare Oliver</b>	13/11/11 - 13/12/11	University of Lille, France
<b>Deepak D'Souza</b>	16/11/11 - 16/11/11	IISc Bangalore
<b>Rohini Godbole</b>	14/11/11 - 15/11/11	IISc Bangalore
<b>Nutan Limaye</b>	20/11/11 - 03/12/11	IIT,Bombay
<b>Rajdeep Sensarma</b>	20/11/11 - 22/11/11	University of Maryland , USA
<b>Mark Jones</b>	21/11/11 - 01/12/11	Royal Holloway University of London, UK
<b>G.N. Chandan</b>	21/11/11 - 17/12/11	Mysore University
<b>Abhishek Iyer</b>	25/11/11 - 02/12/11	IISc Bangalore
<b>M.S. Santhanam</b>	27/11/11 - 02/12/11	Pune

<b>Parongama Sen</b>	27/11/11 - 10/12/11	University of Calcutta
<b>Nilanjan Bondyopad- haya</b>	27/11/11 - 30/11/11	Vishvabharathi University
<b>Gilles Brassard</b>	25/11/11 - 29/11/11	University of Montreal, Canada
<b>Gyan Prakash</b>	28/11/11 - 10/12/11	Harish Chandra Research Institute,Allahabad
<b>Satti.Srinivasa Rao</b>	28/12/11 - 29/12/11	Seoul National University, Seoul
<b>V. Kumar Murthy</b>	25/12/11 - 03/01/12	University of Toronto,Toronto
<b>Datta Bidyukumar</b>	25/12/11 - 27/12/11	Math Calcutta Soci- ety,Kolkata
<b>Kiran Arora</b>	20/12/11 - 01/02/12	Indian National Science Academy, New Delhi
<b>Yosef Nir</b>	13/12/11 - 17/12/11	Weizmann Institute of Sci- ence, Israel
<b>Gyula Katona</b>	13/12/11 - 18/12/11	Renyi Institute Hungary
<b>S. Subburam</b>	06/12/11 - 26/04/12	Sastra University, Tanjavur
<b>Sudhakar Yarlagadda</b>	06/12/11 - 09/12/11	SINP Kolkata
<b>Chris Smith</b>	06/12/11 - 26/12/11	University of Edinburgh
<b>Sridhara Rao Dasu</b>	07/12/11 - 09/12/11	University of Wisconsin
<b>Jan Van Eijck</b>	12/12/11 - 23/12/11	CWI, Amesterdam
<b>Robert Crowston</b>	09/12/11 - 11/12/11	Royal Holloway University of London,UK
<b>Wesley Calvert</b>	09/12/11 - 16/12/11	IIT,Bombay
<b>M. Ram Murthy</b>	09/12/11 - 25/12/11	Queen's University, Canada
<b>Dietmar Berwaneer</b>	05/12/11 - 05/01/12	LSV, ENS Cachan
<b>Cartier</b>	16/12/11 - 23/12/11	Institute of math matiques de jussieu, France
<b>Kevin McFarland</b>	17/12/11 - 22/12/11	University of Rochester
<b>Deborah Harish</b>	17/12/11 - 23/12/11	Fermilab Mezzo, USA
<b>Chandran Sharma</b>	18/12/11 - 30/12/11	BITS,Goa
<b>Punya Plaban Satapa- thy</b>	02/12/11 - 09/01/12	IISER,Pune
<b>Rachel Cynthia</b>	02/12/11 - 16/05/12	Sastra University, Tanjavur
<b>Rahul Srivastava</b>	01/12/11 - 03/12/11	IISc Bangalore
<b>B. V. Raghavendra Rao</b>	04/12/11 - 14/12/11	University of Saarland, Ger- many
<b>Mridupawan Deka</b>	14/12/11 - 20/12/11	Institute for Theoretical physics, University of Regensburg, Germany
<b>Hans van Ditmarsch</b>	12/12/11 - 07/01/12	University of Sevilla, Spain
<b>Abhinav Saket</b>	21/12/11 - 21/02/12	IMSc Chennai
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<b>Moitri Maiti</b>	01/01/12 - 21/03/12	IMSC

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<b>Sunita Vatuk</b>	30/03/12 - 30/03/12	The State University of New Jersey





# Chapter 6

## Infrastructure

### 6.1 Computer Facilities

#### Enhancement of Computer Facility during 2011-2012

##### Hardware facility:

- A Quad-way Symmetric Multi-Processing server named SATPURA cluster was installed for the use of General purpose and Projects(INO & DBT). The seven node SMP cluster was built using the H/W from SuperMicro through the InfiniBand interface and the details are as follows.

System Name	: satpura
O/S	: x86_64 GNU/Linux
H/W	: 4xAMD Opteron 2.1GHz 12Core
Memory	: 192GB DDR3 ECC RAM
MotherBoard	: SuperMicro
Disk	: 4x2TB SATA disk
Cabinet	: 2U Rack Mountable
Compilers & S/Ws	: All GNU compilers,Open PBS,NAMD2,ACML etc.,
Performance	: HighPerformanceLinpack 275 GFLOPS/node

The performances of 7 nodes of satpura with the HPL benchmark shows 1848 GFLOPS with the efficiency of 67%

- The 50 obsolete desktops were replaced with Dell Optiplex desktops and an additional 10 desktops added for the new project staffs.
- Additional Laptops of different makes(Apple/Dell/Lenovo/Sony) were issued to faculty as a long term loan for those who have not availed the facility earlier.
- A new Dell PowerEdge server was installed to host the IMSc web services.
- Additional Ricoh Aficio and HP Laserjet printers installed in the IMSc network to enhance the printing facility through CUPS server.
- The National Knowledge Network(NKN) link service with a speed of 125 MBps is integrated in to the IMSc-LAN. The existing Internet service through an ISP acting as redundandant link.

- All recorded video lectures are edited and uploaded into our media server which are available for public access.

**Software facility:**

- The Final Cut Pro S/W was purchased to handle the video editing work by the newly appointed Technical Assistant(Media) under the plan project.
- The Mathematica version 8 Software with 20 users license was upgraded in the network.
- McAfee AVS was made available to the laptop users.

One additional Technical Assistant(Computer) is appointed under the plan project to handle the IMSc-LAN service activity.

## 6.2 The Library

The Institute Library holds a total collection of 67234 books and bound periodicals as on March 31, 2012. This includes an addition of 1735 volumes during the current year April 2011 - March 2012. The NBHM has recognized this Institute library as the Regional Library for Mathematics. An average of about 6000 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 a well balanced collection both print and online on the major subject areas of research such as Theoretical Physics, Mathematics and Theoretical Computer Science. The library subscribes to over 350 national and international journals.

The library has access to over 3500+ 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 contents from Volume 1 from some of the major publishers like Elsevier under DAE consortium, Springer, World Scientific, Wiley, deGruyter, Cambridge University Press, Turpion, IOP Publishing and Annual Reviews Electronic Backvolume collection.

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 on a linux platform, 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.

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