THE INSTITUTE OF MATHEMATICAL SCIENCES

C. I. T. Campus, Taramani,

Chennai - 600 113.

ANNUAL REPORT

Apr 2014 - Mar 2015

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Foreword

The Institute of Mathematical Sciences, Chennai has completed 53 years and I am pleased to present the annual report for 2014-2015 and note the strength of the institute and the distinctive achievements of its members.

Our PhD students strength is around 140, and our post-doctoral student strength is presently 45.

We are very pleased to note that an increasing number of students in the country are benefiting from our outreach programmes (for instance, Enriching Collegiate Education 2015, One Percent 2014), and we are proud of the efforts of our faculty, both at an individual and at institutional level in this regard.

IMSc has started a monograph series this year. We plan to publish at least one book every year.

Academic productivity of the members of Institute has remained high. There were several significant publications reported in national and international journals and our faculty have authored a few books as well. Six students were awarded Ph.D., five students have submitted their Ph.D. theses. One student was awarded M.Phil., degree. Five students were awarded M.Sc. by Research, and a student has submitted master's thesis under the supervision of our faculty.

16 conferences and workshops were organized at IMSc during 2014-2015. These include Mock Modular Forms and Physics, Aspects of Mathematics, Dynamics Days Asia Pacific 08, Fracture: From Micro-Scale Processes to Macro-Scale Response, Sage Days workshop on combinatorics and representation theory, 18th workshop on elliptic curve cryptology, Master Class in Modular Theory of von Neumann algebras, Indo-UK Workshop on Computational Complexity Theory, Second Conference on Creative Mathematical Sciences Communication, to name but a few. There were 51 lectures/lecture series conducted at the Institute during the reporting period. In addition, 3 lecture courses were given at Chennai Mathematical Institute for their National Undergraduate Programme. The list of off-site conferences organized by IMSc faculty also continues to be impressive. This academic year 12 conferences were organized outside including, Annual Foundational School–II, AIS on Schemes and Cohomology, OTOA 2014, FSTTCS, Workshop on New Developments in Exact Algorithms and Lower Bounds.

We are proud to note the awards and honors bestowed on our faculty at the individual level. Prof. Partha Sarathi Chakraborty was awarded SwarnaJayanti Fellowship and NASI-SCOPUS Young Scientist Award-2014; Dr. Areejit Samal was awarded Ramanujan Fellowship of the Department of Science and Technology (DST), India, a Max Planck DST Mobility Grant for the period 2015-2018, and a Simons Associateship of the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy for the period 2015-2020. Dr. C.M. Chandrashekar was awarded Ramanujan Fellowship for the year 2015.

This report was compiled through the efforts of the IMSc Annual Report Committee comprising of Drs. C. R. Subramanian, Shrihari Gopalakrishna, Pralay Chatterjee, Paul Pandian and Usha Devi. I owe my gratitude to all of them.

July, 2015 **V. Arvind**

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The Institute

1.1 Governing Board

Thiru. **P. Palaniappan**, Hon'ble Minister for Higher Education, Government of Tamil Nadu, Fort St. George, Chennai 600 009
(**Chairman**)

Dr. **R.K. Sinha**, Chairman, AEC & Secretary to Government of India, Department of Atomic Energy, CSM Marg, Mumbai 400 001
(**Vice-Chairman**)

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

Prof. **Mustansir Barma**, Distinguished Professor, Tata Institute of Fundamental Research, Mumbai 400 005
(**Member**)

Prof. **C. S. Seshadri**, Director-Emeritus, Chennai Mathematical Institute, Plot Nos. D19 & D20, SIPCOT Information Technology Park, Padur Post, Siruseri-603 103
(**Member**)

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(**Member**)

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Shri **Pradeep R. Baviskar**, IAS, Joint Secretary(R&D), Department of Atomic Energy, CSM Marg, Mumbai 400 001
(**Member** upto 64th Board Meeting)

Shri **Pranay Verma**, IFS, Joint Secretary (R&D) to Government of India, Department of Atomic Energy, CSM Marg, Mumbai 400 001
(**Member** Forthcoming Meeting)

Shri **R.A. Rajeev**, IAS, Joint Secretary (Finance) to Government of India, Department of Atomic Energy, CSM Marg, Mumbai 400 001
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Shri **Hemant Kumar Sinha**, IAS, Principal Secretary to Government, Secretariat, Higher Education Department, Govt of Tamil Nadu, Fort St. George, Chennai - 600 009
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Selvi **Apoorva**, IAS, Secretary to Government, Secretariat, Higher Education Department, Govt of Tamil Nadu, Fort St. George, Chennai - 600 009
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Prof. **R. Balasubramanian**, Director, The Institute of Mathematical Sciences, CIT Campus, Taramani, Chennai - 600 113
(**Member Secretary** upto 22/12/14)

Prof. **V. Arvind**, Director-in-Charge, The Institute of Mathematical Sciences, CIT Campus, Taramani, Chennai - 600 113
(**Member Secretary** with effect from 22/12/14)

1.2 Executive Council

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1.3 Faculty

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Lakshmi S. Mohan	slakshmi	116
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1.11 Administrative Staff

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Vishnu Prasad S. *Registrar*	svishnu	150
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Janakiraman, J.
Jayanthi, S.
Johnson, P.
Moorthy, E.
Munuswamy, N.
Muthukrishnan, M.
Otheeswaran Usha
Padmanabhan, T.
Prafull Kumar
Parijatham, S.M.
Parthiban, V.
Prema, P.
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Rajasekaran, N.
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Ravindran, A.
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Chapter 2

Research and Teaching

2.1 Computational Biology

2.1.1 Research Summary

Computational Biology

A simulation model for cargo transport in the axonal processes of neurons has been developed. A collaboration with scientists at NCBS, Bangalore and TIFR, Mumbai seeks to uncover fundamental aspects of neuronal transport by relating experimental observation with simulation predictions. We have explored, in particular, the role of stationary cargo in axonal transport. We find that, far from being passive spectators to transport processes, such cargo might function to regulate transport, specifically ensuring that a steady flux is maintained. A detailed examination of the role of crowding and its significance for active transport processes is the highlight of this work [**K**]

A model for chromosome positioning and the properties of individual chromosomes has been extended in several ways. The model now incorporates the effects of looping in chromosomes as inferred through Hi-C data, as well as transcriptome data, as inferred from RNA-seq experiments. The prime motivation for this line of work is to see if a first-principles, predictive approach to the large-scale properties of chromatin which is cell-type specific can be developed. A number of current collaborations, specifically with Prof. Kundan Sengupta (IISER, Pune) and with Profs. D. Palakodeti and Shravanti Rampalli (INSTEM, Bangalore), will explore the combination of experiment and simulation in an effort to understand the properties of stem cell chromatin and their evolution during differentiation.

Modelling of the auxeticity (a negative Poisson's ratio) of stem cells in a transitional state is being carried out. A simple dynamical model, coupling chromatin compaction states to the nuclear dimension, appears to reproduce significant features of the experimental data.

An image processing and analysis scheme for the analysis of labelled mitochondria in C. elegans touch neurons is being developed. Methodologies for the study of correlations in mitochondrial positions and their potential disruption in mutants and in diseased states are

being tested.

We are working on quantifying mitochondrial positioning in Caenorhabditis elegans neurons. To this end, Varuni Prabhakar has developed an image analysis algorithm to process the microscope images that have been collected in Prof. Koushika's lab (TIFR, Mumbai). Mitochondrial positioning along the axon has important effects on the movement and integrity of vesicles and signals in the axon. The developmental dynamics and control of mitochondrial positioning has not been characterized quantitatively in this system. This project aims to understand how mitochondria are positioned along an axon and how that contributes to the functioning of the neuron.

System-level properties of metabolic networks may be the direct product of natural selection or arise as a byproduct of selection on other properties. Using Markov Chain Monte Carlo (MCMC) sampling and Flux Balance Analysis (FBA), it was shown in a recent study [**S1**] that two properties of metabolic networks, latent versatility to function in additional environments and the average carbon efficiency, increase with the number of directly constrained environments for growth and size of the networks. These results [**S1**] expand the growing body of evidence about non-adaptive origins of key functional properties of biological networks.

Several investigations have established that the transcriptional regulatory networks (TRNs) in bacteria have an inherently hierarchical architecture, although the design principles and the specific advantages offered by this type of organization have not yet been fully elucidated. In a recent study [**S2**], the hierarchical structure of the TRN of the gram-positive bacterium *Bacillus subtilis* was compared with that of the gram-negative bacterium *Escherichia coli* to identify many similarities and few specific differences. Majority of the few differences in the structure of the TRNs could be explained by variations in the distribution of σ-factors across the hierarchical levels in the two organisms. Furthermore, the study [**S2**] also investigated the differential regulation of three distinct metabolic subsystems (catabolism, anabolism and central energy metabolism) by transcriptional regulators in the two distinct bacteria.

Recent interest in cell reprogramming has revived Waddington's concept of epigenetic landscape which represents a quasi-potential function. The quasi-potential function derived from interactions in a gene regulatory network (GRN) quantifies the relative stability of network states which determine the effort required for transitions between states of a multi-stable dynamical system. However, quasi-potential landscapes developed for continuous models of GRNs are not suitable for widely used discrete models of GRNs. In a recent study [**S4**], a framework was developed to determine the relative stabilities and transition rates of network states in Boolean models of GRNs. Application of the proposed framework [**S4**] to a Boolean model of Pancreas development led to the inference of logical functions recapitulating the observed ordering of attractors during cell fate dynamics.

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.

[**K**]
Kausalya Murthy*, **Parul Sood***, **Aparna Ashok***, **T. V. Kumar, Gautam I. Menon, and Sandhya Koushika***.
Stationary cargo act as local regulators of transport in neurons.
2015.
(Submitted).

[**S1**]
Marco Bardoscia*, **Matteo Marsili***, **and Areejit Samal**.
Phenotypic constraints promote latent versatility and carbon efficiency in metabolic networks.
2014.
arXiv:1408.4555 (Submitted).

[**S2**]
Santhust Kumar*, **Michele Vendruscolo***, **Amit Singh***, **Dhiraj Kumar***, **and Areejit Samal**.
Analysis of the hierarchical structure of the B. subtilis transcriptional regulatory network.
Molecular Biosystems, **11**, 930–941, 2015.

[**S3**]
Areejit Samal and Olivier C. Martin*.
Statistical physics methods provide the exact solution to a long-standing problem of genetics.
Physical Review Letters, 2015.
(To Appear.) arXiv:1407.3219.

[**S4**]
Joseph X. Zhou*, **Areejit Samal, Aymeric Fouquier d'Hèrouël***, **Nathan D. Price***, **and Sui Huang***.
Relative stability of network states in Boolean network models of gene regulation in development.
2014.
arXiv:1407.6117 (Submitted).

2.2 Mathematics

2.2.1 Research Summary

Algebra

It is shown in [**Ko1**] that there is an interesting analogue of the length formula of Hoskin and Deligne for integrally closed modules over a two-dimensional regular local ring. This also has some numerical consequences relating the Buchsbaum-Rim multiplicity of the module with its length and those of its Fitting ideal.

Motivated by a series of talks of Masaki Izumi here in 2012, we show in [**Ko2**] that for a finite dimensional Hopf algebra, an associated natural inclusion of infinite crossed products is the crossed product by the Drinfeld double, and, more interestingly, that this is a characterisation of the double.

It is shown in [**D**] that a subfactor planar algebra of finite depth k is generated by a single s-box, where $s \leq min\{k+4, 2k\}$.

Stability of the Chari-Pressley-Loktev bases for local Weyl modules over the current algebra of type A_1 was established. By passing to the direct limit, bases for level one representations of the corresponding affine algebra were obtained.

Similarity classes of matrices in fields have been well-understood from the work of Camille Jordan in 1870. Many closely related problems remain open, with a lot of interesting work in the recent past. For example, the problem of classifying simultaneous similarity classes of matrices in fields has been understood to be a "wild" problem, which means that a classification along the lines of Jordan's work is not possible. However, by working over finite fields, this problem can be viewed as a combinatorial problem: count the number $a_{n,k}(q)$ of simultaneous similarity classes of k-tuples of $n \times n$ matrices with entries in a finite field of order q. This problem fits into the theory of representations of quivers, and a deep result, finally proved Hausel, Letellier and Rodriguez-Villegas, and separately by Mozgovoy shows that there exists a polynomial $f_{n,k}(t)$ with non-negative integer coefficients whose value at q is $a_{n,k}(q)$ for every prime power q. In this case, the existence of the polynomial $f_{n,k}(t)$ was observed by Victor Kac as an easy consequence of Burnside's lemma and the results of Jordan. The non-negativity of coefficients was the hard part, even after using the Weil conjectures (Deligne's theorem).

In contrast, little is known about the number $b_{n,k}(q)$ of simultaneous similarity classes of tuples of *pariwise commuting* matrices in a finite field. As of now, it is not known whether $b_{n,k}(q)$ is represented by a polynomial function of q. The work done in [**Pr4**] suggests an intriguing connection with a combinatorial problem that has its origins in number theory: counting the number $c_{n,k}(q)$ of similarity classes of $n \times n$ matrices with entries in a principal ideal local ring R of length k and residue field of order q (when $q = p$, a prime, we may take $R = \mathbf{Z}/p^k\mathbf{Z}$). It was found that $c_{n,2}(q) = b_{n,2}(q)$ for all n. Moreover, for $n \leq 4$, it was found that $c_{n,2}(q)$ is a polynomial with non-negative coefficients. The paper [**Sh**] focusses on $b_{n,k}(q)$. It begins with the observation that for each n, the generating function $B_n(q,t) = \sum_{k=0}^{\infty} b_{n,k}(q)t^k$ is rational in t for each q and goes on the compute these functions for $n \leq 4$. It is found that $b_{n,k}(q)$ is represented by a polynomial in q with non-negative integer coefficients for $n \leq 4$ and for all k.

Let λ be a partition and p be a prime number. Let $A_\lambda(p)$ denote the finite abelian p-group obtained by taking a product of cyclic group of orders p^m as m runs over the parts of λ. Each p-primary finite abelian group A is isomorphic to $A_\lambda(p)$ for a unique partition λ. When this happens, we say that A is of type λ. Philip Hall showed that, given partitions λ, μ and ν, the number of subgroups in a p-group of type λ which are of type μ and induce quotients of type ν is given by the value at $t = p$ of a polynomial $H^\lambda_{\mu,\nu}(t)$ whose leading term is a Littlewood-Richardson (LR) coefficient. LR coefficients occur in the representation theory of symmetric groups, and lie at the heart of a large part of algebraic combinatorics. The paper [**A**] is a step towards understanding whether or not similar results can be obtained

when one counts subgroups up to automorphisms of the ambient group. In this paper, an algorithm was found to enumerate automorphism-orbits of pairs of elements. A surprising experimental discovery of [**A**] was that the numbers of such orbits when λ is fixed and p is allowed to vary seem to be represented by polynomials in p with non-negative integer coefficients.

Algebraic Geometry

Study of morphisms from projective varieties to Grassmannain is continued.

Let E be an equivariant vector bundle on a complete symmetric variety. Study of how the properties of E can be deduced from the properties of the restriction of E to some natural sub varieties is undertaken [**N1**].

Studied the properties of equivariant principal bundles on wonderful compactification [**N2**]

In a joint work by Dr. J.N.Iyer and Dr. Kalyan Banerjee, it has been proved that the kernel of the push-forward homomorphism at the level k-cycles modulo rational equivalence, induced by the closed embedding of the theta divisor or an ample divisor linearly equivalent to some multiple of the theta divisor inside the Jacobian variety of a smooth projective curve of genus g, is trivial.

Analytic Number Theory

Let S be a subset of F , where F is the finite field of p elements . Let d be a given positive integer . In [**B1**], we study the following question . What is the maximum value of k such that for any subset D of F of size k and for all possible way of writing D as a disjoint union of two subsets A and B , there exists a polynomial P with coefficients in F of degree at most d , such that P(x) is in S if x is in A and P(x) is not in S if x is in B

Let $E(n)$ be the error term in the summatory function upto n of the Euler's phi function ϕ. Using an earlier result, in [**B2**] we study the following question . Let $S(n)$ be the summatory function of Eulers function. For how many values of n , is $S(n)$ a square.

In [**B5**], we consider the mean value of the product of two real valued multiplicative functions with shifted arguments. The functions F and G under consideration are close to two nicely behaved functions A and B, such that the average value of $A(n-h)B(n)$ over any arithmetic progression is only dependent on the common difference of the progression.

Let E be an elliptic curve defined over rational field $\mathbb{Q}$ and N be a positive integer. Now $M_E(N)$ denotes the number of primes p, such that the group $E_p(\mathbb{F})$ is of order N. Using the shifted multiplicative function method defined mentioned above, in balu-2015.3, we also compute the mean value of $NK(N)/\phi(N)$, where $NK(N)/\phi(N)\log N$, under a reasonable conjecture, is the average value of $M_E(N)$ over a large class of curves. In [**B4**], We show that $M_E(N)$ follows Poisson distribution when an average is taken over a large class of curves.

Let $\mathcal{A} = \{a_1 < a_2 < a_3 \cdots < a_n < \cdots\}$ be an infinite sequence of non-negative integers and let $R_2(n) = |\{(i,j) : a_i + a_j = n;\ a_i, a_j \in \mathcal{A};\ i \leq j\}|$. We define $S_k = \sum_{l=1}^{k}(R_2(2l) - R_2(2l+1))$. In [**B3**], we prove that if the L^∞ norm of $S_k^+ (= \max\{S_k, 0\})$ is small, then the L^1 norm

of $\frac{S_k^+}{k}$ is large.

An Ω-result has been obtained for the function $\tau(n, \theta)$. Currently Working on smooth numbers in some arithmetic sequences.

Differential Equations

Extended earlier results obtained on the degenrate algebraic Riccati equation [**?**] to the parabolic case involving unbounded operators. This will be useful in the study of boundary control problems.

Differential Geometry

My thesis and earlier work was on spaces called quasitoric orbifolds.Orbifolds are spaces which are locally Rn /G where G is a finite group. Quasitoric orbifolds are spaces which are generalizations of toric varieties or toric orbifolds used in algebraic geometry and string theory. Quasitorics differ from the torics in the sense they have no algebraic structure.I have provided them with smooth orbifold charts,almost complex structure existence conditions,proved a versiion of Mckay Correspondence and Hodge stucture, This year apart from the hodge structures I am focussing on Contact structures and have communicated a paper on providing contact structures on 3- dim cyclic orbifolds.

Group Theory

One has the notion of twisted conjugacy classes, generalizing the usual conjugacy relation in a group. The Reidemester number of an automorphism ϕ of a group is the number of ϕ-twisted conjugacy classes in that groups. It has been shown that groups of pure symmetric automorphism free groups (of finite rank) and the Houghton groups have the so-called R_∞-property, namely that the Reidemester number of any automorphism of any these groups is infinite.

Mathematical Physics

In the paper [**Dol1**] we prove some upper and lower bounds on the integrated density of states of the Anderson model with decaying potentials outside the interval [-2d, 2d].

In the paper [**M2**] we prove Poisson statistics for eigenfucntions of the Anderson model when the single site potentials are distributed by a Holder continuous distribution.

In [**Do**], eigenfunction statistics for discrete Anderson tight binding model with singular continuous distribution is studied. The eigenfunction statistics is shown to be Poisson point process.

In [**M1**], the Anderson model with finite rank single site potential was considered. For this model the matrix-valued spectral measure of the random self adjoint operator associated with the single site potential were shown to be mutually equivalent as measure.

Modular forms

In [**Gu1**], the authors consider the question of simultaneous sign change of Fourier coefficients of two modular forms with real Fourier coefficients. In an earlier work, Kohnen with Sengupta proved that two cusp forms of different (integral) weights with real algebraic Fourier coefficients have infinitely many Fourier coefficients of the same as well as opposite sign, up to the action of a Galois automorphism. In the first part of the paper, the authors strengthen their result by doing away with the dependency on the Galois conjugacy. In fact, they extend their result to cusp forms with arbitrary real Fourier coefficients. Further, they consider simultaneous sign change at prime powers of Fourier coefficients of two integral weight Hecke eigenforms which are new forms. Finally, they consider an analogous question for Fourier coefficients of two half-integral weight Hecke eigenforms.

In [**Gu2**], the authors extend two identities proved by Ramanujan involving the Riemann zeta function and the Dirichlet L-function associated to the non-trivial Dirichlet character modulo 4. More precisely, given two power series

$$\sum_{n=0}^{\infty} a_n T^n \qquad and \qquad \sum_{n=0}^{\infty} b_n T^n$$

which are both rational functions with certain property, the authors show that

$$\sum_{n=0}^{\infty} a_n b_n T^n$$

is again a rational function with similar property. This they do by obtaining explicit descriptions of the said rational function. They use this to explain Ramanujan's identities and also analyse the Rankin-Selberg convolutions of automorphic L-functions.

Operator Algebras

The author of [**S1**] had long been wanting to have a treatment of the spectral theorem for normal operators on (separable) Hilbert space as a statement on the existence of appropriately homeomorphic continuous and measurable functional calculii which did not involve elaborate digressions into the Gelfand theory of commutative Banach algebras - in short, as a theorem in *operator theory*. The fruition of these ideas is [**S1**].

This involved coming up with some novel treatments of old theorems, as in [**Ss**].

Another project was the culmination of something that has taken three years in coming to fruition. The first of those years was spent trying to find a suitable and feasible set of speakers for an inter-disciplinary workshop. After the very successful workshop, in response to several suggestions that a readable set of notes would be very useful and much appreciated, the hard work of writing up such notes was taken up by the three authors of what finally became [**S2**].

Representation Theory

The Schur algebra $S_K(n,d)$ is the commuting algebra for the action of the symmetric group S_d on the tensor space $(K^n)^{\otimes d}$. Its importance in representation theory stems from the

fact that, when K is an infinite field, then $S_K(n,d)$-modules are precisely representations of $GL_d(K)$ whose matrix entries are homogeneous polynomials of degree d in the entries of $g \in GL_d(K)$. In the article [**Ge**], a combinatorial interpretation of the structure constants of $S_K(n,d)$ is given in terms of configurations of d distinguishable balls in n numbered boxes. An explicit construction of the primitive central idempotents of $S_K(n,d)$ (when K has characteristic greater that d) is described in [**Pr2**].

Demazure modules for level 1 representations of the affine Lie algebra $\widehat{\mathfrak{sl}}_2$ were studied. New bases for these modules introduced by Chari and Loktev were shown to stabilize, and to thereby define a basis for the full representation.

Let $\mathfrak{g}$ be a finite-dimensional complex simple Lie algebra with highest root θ. Let m, n be two non-negative integers. In [**Bh**], it is proved that the fusion product of m copies of the level one Demazure module $D(1,\theta)$ with n copies of the adjoint representation $\mathrm{ev}_0 V(\theta)$ is independent of the parameters and given explicit defining relations. As a consequence, for $\mathfrak{g}$ simply laced, the author showed that the fusion product of a special family of Chari–Venkatesh modules is again a Chari–Venkatesh module. He also gave a description of the truncated Weyl module associated to a multiple of θ.

In the article [**Nr**], it is proved that stability of the Chari-Pressley-Loktev bases for natural inclusions of local Weyl modules of the current algebra $\mathrm{sl}_2[t]$.These modules being known to be Demazure submodules in the level 1 representations of the affine Lie algebra $\widehat{\mathfrak{sl}_2}$,the authors obtained, by passage to the direct limit, bases for the level 1 representations themselves.

Transcendental number theory

In [**Gu5**], the authors generalise an identity of Lehmer. The techniques developed in this work allows them to furnish a new proof of Lehmer's identitiy. Further, this generalised identity facilitates the investigation of the (conjectural) transcendental nature of generalized Briggs-Euler-Lehmer constants. Consequently, the authors strengthen their earlier work in [**Gu4**].

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**]
C. P. Anilkumar and Amritanshu Prasad.
Orbits of pairs in abelian groups.
Séminaire Lotharingien de Combinatoire, **70**, B70h, 2014.

[**B1**]
R. Balasubramanian, Cecile Dartyge*, and Elie Mosaki*.

Sur la complexite de familles d'ensembles pseudo-aleatoires.
les Annales de l'institute Fourier, **vol 64, no 1(2014)**, 267, 2015.

[**B2**]
Balasubramanian R, Luca Florian *, and Ralaivaosaona Dimbinaina*.
Arithmetic properties of the sum of the first n values of eulers function.
Boletinde la sociedad matematica Mexicana, **21(2015)**, 9, 2014.

[**B3**]
Balasubramanian R and Sumit Giri.
On additive representation functions.
International Journal of Number theory, **11(2015)(4)**, 1165, 2015.

[**B4**]
Balasubramanian R and Sumit Giri.
Poisson distribution of a prime counting function corrospending elliptic curves.
2015.
(Submitted).

[**B5**]
Balasubramanian R and Sumit Giri.
The mean value of a product of shifted multiplicative functions and the average number of points of an elliptic curve.
2015.
(To appear in Journal of Number Theory).

[**Bh**]
Ravinder Bhimarhi.
Demazure modules, chari-venkatesh modules and fusion products.
SIGMA, **10(110)**, 10pp., 2014.

[**C1**]
Partha Sarathi Chakraborty and Satyajit Guin.
Connes' calculus for the quantum double suspension.
2014.
(Preprint: arXiv:1404.2708).

[**C2**]
Partha Sarathi Chakraborty and Arupkumar Pal*.
An invariant for homogeneous spaces of compact quantum groups.
2014.
(Preprint: arXiv:1405.4149).

[**Ch**]
T. Chatterjee and S. Gun.
Generalization of a problem of Davenport, Heilbronn and Cassels.
J Number Theory, **145**, 352, 2014.

[**D**]
Sandipan De and Vijay Kodiyalam.
Note on infinite iterated crossed products of Hopf algebras and the Drinfeld double.
Journal of Pure and Applied Algebra, 2015.
(To be published).

[**Do**]
Dhriti R. Dolai and Anish Mallick.
Eigenfunction statistics for anderson model with hölder continuous single site potential.
2014.
(Submitted).

[**Dol1**]
Dhriti Ranjan Dolai.
Some estimates regarding integrated density of states for random schrdinger operator with decaying random potentials.
2015.
(Preprint: arXiv:1501.05055).

[**Dol2**]
Dhriti Ranjan Dolai and M. Krishna.
Poisson statistics for anderson model with singular randomness.
Journal of Ramanujan Mathematical Society, 2014.
(To be published).

[**Du**]
Kunal Dutta and Amritanshu Prasad.
Combinatorics of finite abelian groups and Weil representations.
Pacific Journal of Mathematics, 2014.
(To be published).

[**G1**]
Saibal Ganguli.
Hodge structures orbifold hodge numbers and a correspondence in quasitoric orbifolds.
2014.
1406.4596 (Submitted).

[**G2**]
Saibal Ganguli.
Contact structures in cyclic 3-orbifolds independent of open book decompsitions.
2015.
(Preprint: 1503.05645).

[**Ge**]
T. Geetha and Amritanshu Prasad.
Graphic interpretation of the structure constants of the Schur algebra.

In *Electronic booklet of Proceedings of International Congress of Women Mathematicians.*, Aug 2014.

[**Gu1**]
S. Gun, W. Kohnen*, and P. Rath*.
Simultaneous sign change of Fourier-coefficients of two cusp forms.
2015.
(Submitted).

[**Gu2**]
S. Gun and R. Murty*.
Generalization of an identity of Ramanujan.
2015.
(Submitted).

[**Gu3**]
S. Gun and B. Saha.
On the zeros of weakly holomorphic modular forms.
Archiv der Mathematik, **6(102)**, 531, 2014.

[**Gu4**]
S. Gun, E. Saha, and S. Sinha*.
Transcendence of Generalized Euler-Lehmer constants.
J Number Theory, **145**, 329, 2014.

[**Gu5**]
S. Gun, E. Saha, and S. Sinha*.
A generalisation of an identity of Lehmer.
2015.
(Submitted).

[**Gun**]
Sanoli Gun and Biswajyoti Saha.
On the zeros of weakly holomorphic modular forms.
Arch. Math., **6(102)**, 531–543, 2014.

[**K**]
S. Kesavan.
On the general equation of the second degree.
Resonance, 2015.
(To be published).

[**Ko1**]
Vijay Kodiyalam and Radha Mohan*.
Lengths and multiplicities of integrally closed modules over a two-dimensional regular local ring.
Journal of Algebra, **425**, 392, 2014.

[**Ko2**]
Vijay Kodiyalam and Srikanth Tupurani.
A note on generators for finite depth planar algebras.
Proceedings of the Indian Academy of Sciences (Mathematical Sciences), 2014.
(To be published).

[**Kr**]
Peter D. Hislop* **and M. Krishna**.
Eigenvalue statistics for random Schrodinger operators with non-rank one perturbations.
2014.
To appear in Commun. Math. Phys.(Preprint: arXiv 1409.2328).

[**M1**]
Anish Mallick.
Jakšić-last theorem for higher rank perturbations.
2014.
(Submitted).

[**M2**]
Anish Mallick and Dhriti Ranjan Dolai.
Eigenfunction statistics for anderson model with hlder continuous single site potential.
2014.
(Preprint: arXiv 1409.7424v1).

[**Mo1**]
Anilesh Mohari.
Translation invariant pure state on $m_d(c)$ and haag duality.
Complex Anal. Oper. Theory, **8(3)**, 745–789, 2014.

[**Mo2**]
Anilesh Mohari.
A mean ergodic theorem of an amenable group action.
Infin. Dimens. Anal. Quantum Probab. Relat. Top. 17 (2014),, **17(1)**, 1450003, 2014.

[**Mo3**]
Anilesh Mohari.
Pure inductive limit state and kolmogorov's property. ii.
J. Operator Theory, **72(2)**, 387–404, 2014.

[**Mo4**]
Anilesh Mohari.
Hann-banach-arveson extension theorem and kadison isomorphism.
2015.
(Preprint: arXiv:1304.6849).

[**Mu**]
Anirban Mukhopadhyay, R. Thangadurai*, and Kasi Vishwanadham*.

Unique representation of integers with base a.
Archiv Der Mathematik, 2015.
(To be published).

[**N1**]
I. Biswas*, S. S. Kannan*, and D. S. Nagaraj.
Equivariant vector bundles on complete symmetric varieties of minimal rank.
International Journal of Mathematics, **25(14)**, 1450120, 2014.

[**N2**]
I. Biswas*, S. S. Kannan*, and D. S. Nagaraj.
On equivariant principal bundles over wonderful compactifications.
Journal of Algebra, **426**, 313, 2014.

[**Ne**]
Neeraj Kumar and Senthil Kumar.
Note on vanishing of power sums of roots of unity.
The Mathematics Student, 84(3-4), Jul. - Dec. 2015.

[**Nr**]
Raghavan K. N, Ravinder B, and Viswanath Sankaran.
Stability of the chari-pressley-loktev bases for local weyl modules of $\mathrm{sl}_2[t]$.
Algebras and Representation Theory, 2014.
arXiv : 1407.0789(*Tobepublished*).

[**P**]
Pierre Fima*, Kunal Mukherjee*, and Issan Patri.
On compact bicrossed products.
2015.
arXiv:1504.00092 (Submitted).

[**Pa**]
Pampa Paul, K. N. Raghavan, and Parameswaran Sankaran.
Borel-de Siebenthal discrete series and associated holomorphic discrete series.
Journal of Lie Theory, **24(2)**, 475, 2014.

[**Pr1**]
Jayadev S. Athreya* and Amritanshu Prasad.
Growth in right-angled groups and monoids.
2014.
(Preprint: arXiv:1409.4142).

[**Pr2**]
T. Geetha* and Amritanshu Prasad.
Centre of the Schur algebra.
Asian European Journal of Mathematics, 2015.
(To be published).

[**Pr3**]
Amritanshu Prasad.
Equivalence classes of nodes in trees and rational generating functions.
2014.
(Preprint: arXiv:1407.5284).

[**Pr4**]
Amritanshu Prasad, Pooja Singla*, and Steven Spallone*.
Similarity of matrices over local rings of length two.
Indiana University Mathematics Journal, 2014.
(To be published).

[**Pra1**]
T. Prasad and M.H.M.* Rashid.
Weyl type theorems for algebraically quasi-hnpHNP operators.
Annals of Functional Analysis, **6(3)**, 262–274, 2015.

[**Pra2**]
T. Prasad and K.* Tanahashi.
On class p-wa(s,t) operators.
Functional Analysis, Approximation and Computation, **6(2)**, 39–42, 2014.

[**R**]
K. N. Raghavan, B. Ravinder, and S. Viswanath.
Stability of Chari-Pressley-Loktev bases for local Weyl modules of $sl_2[t]$.
Algebras and Representation Theory, 2014.
arXiv:math/1407.0789 (To be published).

[**S1**]
Jay Mehta*, Biswajyoti Saha, and G.K. Viswanadham*.
An elementary approach to the meromorphic continuation of multiple zeta functions.
2014.
(Submitted).

[**S2**]
M. Ram Murty* and Biswajyoti Saha.
On the error term in a Parseval type formula in the theory of Ramanujan expansions.
2014.
(Submitted).

[**Sa**]
Parameswaran Sankaran and Prateep Chakraborty.
Maps between certain complex Grassmann manifolds.
Topology and Applications, **170**, 119, 2014.

[**Sh**]
Uday B. Sharma.

Simultaneous similarity classes of commuting matrices over a finite field.
2014.
arXiv:1409.2698 (Submitted).

[**Ss**]
Sunder V. S.
Fuglede's theorem.
Indian J. of Pure and Appl. Math., 2014.
(To be published).

[**V**]
R. Venkatesh* **and Sankaran Viswanath**.
Chromatic polynomials of graphs from kac-moody algebras.
Journal of Algebraic Combinatorics, 2014.
(To be published).

Books/Monographs Authored/Edited

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

[**P**]
Amritanshu Prasad.
Representation Theory: A Combinatorial Viewpoint, volume 147 of *Cambridge Studies in Advanced Mathematics*.
Cambridge University Press, Darya Ganj, Delhi, 2015.

[**R**]
V. Chari*, J. Greenstein*, K. C. Misra*, K. N. Raghavan, and S. Viswanath, editors.
Recent Developments in Algebraic and Combinatorial Aspects of Representation Theory, volume 602 of *Contemporary Mathematics*.
American Mathematical Society, Providence, Rhode Island, 2014.

[**S1**]
V. S. Sunder.
Operators on Hilbert Space.
TRIM. Hindustan Publishing Agency, New Delhi, 2015.
(To be published).

[**S2**]
V. S. Sunder, Prabha Mandayam*, and Ved P. Gupta*.
Functional Analysis of Quantum Information Theory, volume 902 of *Springer LNP*.
Springer-Verlag, Springer DE, 2015.
(To be published).

2.3 Physics

2.3.1 Research Summary

Astrophysics

After their death through supernova explosions, moderate mass (10 to 25 times of the Sun) stars becomes neutron stars. Neutron stars are mostly composed of neutrons and a few protons, electrons and probably other baryons. Density at the centre of a neutron star can be as high as 10^{14} gm cm^{-3}. Neutron stars usually weigh around 1.4 times that of the Sun but have radii of only around 10 km. These stars take only 1 millisecond to 1 second to complete one full rotation around their own axis. The value of the magnetic field at the surface of neutron stars usually lies between $10^8 - 10^{14}$ Gauss. These stars emit electromagnetic beams along their magnetic axis which are generally misaligned with the spin axes. Thus the beam also rotates and might fall onto earth once in each rotation, i.e., the neutron star behaves like a light-house and we call it a pulsar. Pulsars, especially when in binary systems, are excellent tools to test various theories of basic physics physics including general relativity and the physics of ultra-dense matter. I am interested in different types of binary pulsars. Presently, I am working on a project on population synthesis of double neutron star binaries with my collaborators in West Virginia University (USA). This project is aimed to understand the formation and evolution of such systems. My other interest is in pulsars with very low mass companions, where it is believed that the winds from the pulsars evaporate the companions. I am continuing a theoretical project with my collaborators in IEEC-CSIC (Barcelona, Spain) on this topic. I also have GMRT data for a few of such systems and data analysis is under progress. I am also involved in a big pulsar survey with my collaborators in the USA and Germany (see 2013, ApJ, 775, 51 for preliminary results) and another paper on the double neutron star system discovered in this survey is about to be submitted. I am also interested in testing gravity using binary pulsars, paying special attention to neutron star-black hole binaries.

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 [**Me3**]. 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 recently that proposes the oscillation to be arising from strong coupling between excitable cells and electrically passive cells which 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. A key role seems to be played by the highly variable distribution of passive cells which connect to an excitable cell. This can be seen as a form of quenched disorder, similar to that seen in glass systems studied in physics.

Recently, the role of this disorder in expediting the transition from queiscence to coherent oscillations in the pregnant uterus close to term has been investigated. This has revealed the importance of the spontaneously emerging "oscillation centers" in uterine tissue through local fluctuations in the passive cell density. To validate whether the results of simplified models of excitable media are valid for the real, biological system, an investigation has been undertaken using a recently developed, highly detailed electrophysiological model of uterine myocyte cells. The study investigates how an increase in coupling between myocytes and neighbouring, electrically passive cells can give rise to spontaneous, contraction-inducing oscillatory electrical activity and finds results similar to those seen for the simpler model. In addition, the role of the strength of diffusive coupling between adjacent myocytes arranged on a two-dimensional lattice (with each myocyte coupled to a random number of passive cells that represents the structural disorder in biological tissue) on the collective dynamics has been investigated.

Intra-cellular signaling networks coordinate all the processes necessary for maintaining life by coordinating appropriate response to a wide variety of possible signals in the presence of a high degree of noise. It is important to idetify the strategies used by such networks that allow them to perform efficient and robust information processing. A very important structural motif in such networks is the three-component Mitogen-Activated Protein Kinase (MAPK) signalling module. This pathway is found in all eukaryotic cells and is involved in many critical cellular functions including cell cycle control, stress response, differentiation and growth. Its crucial importance is underscore by the fact that it is seen to be affected in many diseases including cancer, as well as, immunological and degenerative syndromes and is, therefore, an important drug target. The basic linear cascade structure involves regulation of the activity of a MAPK kinase kinase (MAP3K) enzyme by an upstream signal. MAP3K on being activated can act as the enzyme for activation of a MAPK kinase (MAP2K) enzyme which in turn controls the activity of a MAPK enzyme. MAPK, on activation, can be involved in many functions, such as initiation of transcription or stimulation of other kinases. However, such linear or chain-like reaction schemes imply a rigid relation between stimulus and response, precluding the possibility of the system switching to a different response for the same signal under altered circumstances. As many linear cascades are actually part of branched pathways (e.g., the MAP3K enzyme MEKK-1 is known to activate multiple types of MAP2K enzymes in the T-cell and B-cell receptor signalling networks involved in immune response), it is important to investigate the dynamics of branched MAPK modules. In a recent study, it has been demonstrated that enzyme-substrate dynamics on such motifs allow surprisingly long-range communication in the absence of direct long-range interaction between molecules through retrograde propagation between the different (non-interacting) branches of MAPK pathways. Numerical simulations show that perturbing the activation of MAPK enzyme in one branch can result in a series of changes in the activity levels of molecules upstream to that enzyme, eventually reaching the branch-point and thence affecting the other branches. Our results have recently been verified by biological experiments (at NCCS, Pune). An important aspect of retrograde propagation in branched pathways that is distinct from previous work on retroactivity focusing exclusively on single chains is that varying the type of perturbation, e.g., between pharmaceutical agent mediated inhibition of phosphorylation or suppression of protein expression, can result in opposing responses in the other branches. This can have potential significance in designing drugs targeting key molecules which regulate multiple pathways implicated in systems-level diseases such as cancer and diabetes.

The representation of proteins as networks of interacting amino acids, referred to as protein contact networks (PCN), and their subsequent analysis using graph theoretic tools, can provide novel insights into the key functional roles of specific groups of residues. A recent study [**Sin2**] has characterized the networks corresponding to the native states of 66 proteins (belonging to different families) in terms of their core-periphery organization. The resulting hierarchical classification of the amino acid constituents of a protein arranges the residues into successive layers having higher core order with increasing connection density, ranging from a sparsely linked periphery to a densely intra-connected core (distinct from the earlier concept of protein core defined in terms of the three-dimensional geometry of the native state, which has least solvent accessibility). The results show that residues in the inner cores are more conserved than those at the periphery. Underlining the functional importance of the network core, it is seen that the receptor sites for known ligand molecules of most proteins occur in the innermost core. Furthermore, the association of residues with structural pockets and cavities in binding or active sites increases with the core order. From mutation sensitivity analysis, it is observed that the probability of deleterious or intolerant mutations also increases with the core order. It is also seen that stabilization center residues are in the innermost cores, suggesting that the network core is critically important in maintaining the structural stability of the protein. A publicly available web resource for performing core-periphery analysis of any protein whose native state is known has been made available.

Condensed Matter Physics

In this work [**G2**] we study the decoherence and entanglement properties for the two-site BoseHubbard model in the presence of a non-linear damping. We apply the techniques of thermo field dynamics and then use Hartree-Fock approximation to solve the corresponding master equation. The expectation values of the approximated field operators appearing in the solution of master equation are computed self-consistently. We solve this master equation for a small time t so that we get the analytical solution, thereby we compute the decoherence and entanglement properties of the solution of the two-mode bosonic system. We have found that for a small initial time t, the entanglement of the system increases but at the same time the system decoheres exponentially.

Using computational techniques, we have studied the formation of different dynamically arrested states (e.g. glasses, gels, etc.) and also how such materials respond to external shear.

We have studied the relaxation dynamics of a model for oil-in-water microemulsion droplets linked with telechelic polymers [**Cha2**]. This system exhibits both gel and glass phases and we show that the competition between these two arrest mechanisms can result in a complex, three-step decay of the time correlation functions, controlled by two different localization lengthscales. For certain combinations of the parameters, this competition gives rise to an anomalous logarithmic decay of the correlation functions and a subdiffusive particle motion, which can be understood as a simple crossover effect between the two relaxation processes. We also characterize how the competition of gel and glass arrest mechanisms affects the dynamical heterogeneities and show that for certain combination of parameters these heterogeneities can be unusually large.

Understanding how flow starts from a quiescent glassy state is important for wide-ranging applications involving soft amorphous materials. For a model colloidal glass, we have in-

vestigated the onset of Poiseuille flow in a microfluidic geometry [**Cha1**]. Starting from the quiescent state, steady flow sets in at a time scale which increases with a decrease in applied forcing. At this onset time scale, a rapid transition occurs via the simultaneous fluidisation of regions having different local stresses. In the absence of steady flow at long times, creep is observed even in regions where the local stress is larger than the bulk yielding threshold. Finally, we show that the time scale to attain steady flow depends strongly on the history of the initial state.

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

Problems related to Dark Matter is studied from the perspective of high energy particle physics and phenomenology. As the quality of experimental searches become more satisfactory, various theoretical explanation becomes necessary. How the different Lorentz structure can help in explaining certain data and how the current experimental bounds go with such an explanation is currently being studied. The role of resonant coupled channel final state interactions, as well as weak annihilation and exchange contributions in explaining all the two body hadronic $D \to PP$ decay modes data was examined. The un-unitarized amplitudes included non-factorizable corrections as parameters and the z-series expansion method was used for the q^2 dependence of the hadronic form factors. The final state interaction effects were incorporated via a phenomenological approach with widths of resonances to various channels taken from observations where available, and others as additional parameters to be determined from fits of all the theoretical rates to the measured ones. Our results for the rather hard to explain $D \to K^+K^-, \pi^+\pi^-$ rates, were in agreement with the measured values. We demonstrated that both weak exchange as well as FSI effects are required to get the correct branching ratio for the $D^0 \to K^0\bar{K}^0$ mode. The strong phase difference between the amplitudes for $D^0 \to K^-\pi^+$ and $D^0 \to K^+\pi^-$ was evaluated and found to be in complete agreement with the recent BES III result. [**Ni1**]

Foundations of Quantum Mechanics

Entanglement breaking channels play a significant role in quantum information theory. In the work [**P**], we investigate qubit channels through their property of 'non-locality breaking', which is defined in a natural way but within the purview of CHSH non-locality. This also provides a different perspective on the relationship between entanglement and non-locality through the dual picture of quantum channels instead of through states. For a channel to be entanglement breaking, it is sufficient to 'break' the entanglement of maximally entangled states. We provide examples to show that for CHSH nonlocality breaking such a property does not hold in general, although for certain channels and for a restricted class of states for all channels this holds. We also consider channels whose output remains local under SLOCC and call them 'strongly non-locality breaking'. We provide a closed-form necessary-sufficient condition for any two-qubit state to show hidden CHSH non-locality, which is likely to be useful for other purposes as well. This in turn allows us to characterize all strongly non-locality breaking qubit channels. It turns out that unital qubit channels breaking non-locality of maximally entangled states are strongly non-locality breaking while extremal qubit channels cannot be so unless they are entanglement breaking.

In this note [**G7**] we discuss a closed-form necessary and sufficient condition for any two-

qubit state to show hidden nonlocality w.r.t the Bell-CHSH inequality. This is then used to numerically compute the relative volume of states showing hidden Bell-CHSH non-locality , among all two-qubit states with one-sided reduction maximally mixed.

Mathematical Physics

The purpose of this short note [**G3**] is to utilize the work on isotropic lines, described by Albouy [J. Phys. A. Math. Theor., vol. 42 (2009), 072001], on Wigner distributions for finite-state systems as described by Chaturvedi et al. [J. Phys. A. Math. Theor., vol. 43 (2010), 0753075302], estimation of the state of a finite level quantum system based on Weyl operators in the L2-space over a finite field as described by Parthasarathy in [Inf. Dimens. Anal. Quantum Prob. Relat. Top., Vol. 07, Issue 4, Dec. 2004. 607-617] to display maximal abelian subsets of certain unitary bases for the matrix algebra Md of complex square matrices of order d¿3; and then, combine these special forms with constrained elementary measurements to obtain optimal ways to determine a d-level quantum state. This enables us to generalise illustrations and strengthen results related to quantum tomography by Ghosh and Singh in [**G4**] .

The minimum error discrimination problem for ensembles of linearly independent pure states are known to have an interesting structure; for such a given ensemble the optimal POVM is given by the pretty good measurment of another ensemble which can be related to the former ensemble by a bijective mapping 8475; on the "space of ensembles". In this work [**G9**] we generalize this result to ensembles of general linearly independent states (not necessarily pure) and also give an analytic expression for the inverse of the map, i.e., for 8475;8722;1. In the process of proving this we also simplify the necessary and sufficient conditions that a POVM needs to satisfy to maximize the probability of success for the MED of an LI ensemble of states. This simplification is then employed to arrive at a rotationally invariant necessary and sufficient conditions of optimality. Using these rotationally invariant conditions it is established that every state of a LI mixed state ensemble can be resolved to a pure state decomposition so that the corresponding pure state ensemble (corresponding to pure states of all mixed states together) has as its optimal POVM a pure state decomposition of the optimal POVM of mixed state ensemble. This gives the necessary and sufficient conditions for the PGM of a LI ensemble to be its optimal POVM; another generalization for the pure state case. Also, these rotationally invariant conditions suggest a technique to give the optimal POVM for an ensemble of LI states. This technique is polynomial in time and outpeforms standard barrier-type interior point SDP in terms of computational complexity.

Nonlinear Dynamics, Solitons and Chaos

An intriguing interpretation of the time-evolution of dynamical systems is to view it as a computation that transforms an initial state to a final one. This paradigm has been explored in discrete systems such as cellular automata models, where the relation between dynamics and computation has been examined in detail. A recent study [**Me1**] motivated by microfluidic experiments on arrays of chemical oscillators, shows that computation can be achieved in continuous-state, continuous-time systems by using complex spatiotemporal patterns generated through a reaction-diffusion mechanism in coupled relaxation oscillators. Two paradigms are presented that illustrate this computational capability, namely, using perturbations to (i) generate propagating configurations in a system of initially exactly syn-

chronized oscillators, and (ii) transform one time-invariant pattern to another. In particular, a possible implementation of NAND logic has been demonstrated. This raises the possibility of universal computation in such systems as all logic gates can be constructed from NAND gates. The work suggests that more complex schemes can potentially implement arbitrarily complicated computation using reaction-diffusion processes, bridging pattern formation with universal computability.

Dynamical patterns that arise in complex networks are often attributed to their non-trivial connection structure. However, the precise link between the fine topological structure of a network and the emergence of complex collective dynamics is unclear. For example, most social networks exhibit the meso-scale feature of modular organization, i.e., occurrence of communities whose members are more likely to be connected to each other than to members of other communities. A study [**Ch**] was undertaken to look at how the existence of modules in the contact structure of a population affects its adoption of an innovation that is characterized by a given perceived advantage. For this theoretical models of modular networks as well as the empirical social network of a village in Karnataka were considered. First, a network generalization of the well-known Bass model of diffusion, which is a variant of the SI compartmental model of contagion propagation, was applied on the empirical network and on an ensemble of degree-preserved randomized surrogates. By comparing the dynamics of the diffusion process in these networks, it was seen that the modular organization reduces the speed of adoption in the population. However, as there are limitations of the diffusion model, an alternative dynamical process based on spin-spin interaction that is inspired by statistical physics was also considered. Here, individuals try to coordinate their action with that of neighbors on the contact network, while having randomly distributed thresholds (that measures their inrinsic resistance to adoption). By varying the external field, which is a measure of the perceived advantage of the innovation, transitions of the population to a state of complete adoption were seen. While the model network with community organization shows that the occurrence of modularity increases the critical value of perceived advantage at which the transition happens, surprisingly in the empirical network the process of adoption can occur faster than in the corresponding degree-preserved randomized surrogate. By reducing the inter-modular connectivity of the empirical network, the process can indeed be made slower than the corresponding randomized networks. These results underline the critical importance of modular organization in social networks in affecting the process of adoption of innovation in society.

Why do some places evolve into large sprawling metropolitan settlements over time, while other initially similar sites decay into obscurity? Identifying the factors underlying the phenomenon of urban growth has sparked the curiosity of scientists ever since Walter Christaller proposed the Central Place Theory in order to explain the observed number, sizes and locations of settlements in southern Germany. However, lack of availability of sufficient empirical data has hampered progress in developing a quantitative understanding of this process. In order to initiate a data-driven approach to answer questions on the growth of settlements, recently a study has been undertaken to analyze a large database of economic, demographic and infrastructural factors associated with different sites of habitation in India [**Sr**]. Preliminary results of the analysis for a few of the most populous states of the Indian Union, viz., Maharasthra, Tamil Nadu and Uttar Pradesh, show interesting features. As rapid urbanization taking place in many parts of the country provides a window into the fast-changing rural-urban landscape, the growth/decay of population centers in these states has been investigated using information gleaned from government census reports. In particular,

combining demographic data with geographical information allows the identification of specific locations as being either growth hot-spots and decay cold-spots. In addition, the process of growth in different states (which have distinct trajectories for the evolution of the total population size) has been compared across multiple scales of settlement sizes. It is also seen that for all the states considered, the nature of the population distribution at different scales (of settlement sizes) appear to change from a sharply bounded to a long-tailed one as one considers larger settlement size scales, implying that distinct population growth processes are at work in different scales.

The study of games and their equilibria is central to developing insights for understanding many socio-economic phenomena. Recently, a dynamical systems approach to understand the equilibria of two-person, payoff-symmetric games has been undertaken [**S**]. In particular, using this perspective, the differences between two solution concepts for such games - namely, those of Nash equilibrium and co-action equilibrium - have been analyzed. For the Nash equilibrium, the dynamical view can provide an equilibrium refinement, selecting one equilibrium among several possibilities, thereby solving the issue of multiple equilibria that appear in some games. This dynamical perspective has been applied to understand several well known 2-person games, such as, the Prisoners Dilemma, game of Chicken and the Stag-Hunt. It is seen that in all of these cases, co-action equilibria tends to correspond to nicer strategies than those corresponding to Nash equilibria.

The heart is a fascinating example of nonlinear dynamics at work in biology [**S**]. Alternans response, comprising a sequence of alternating long and short action potential durations in heart tissue, seen during rapid periodic pacing can lead to conduction block resulting in potentially fatal cardiac failure. A method of pacing with feedback control has been proposed to reduce the alternans and therefore the probability of subsequent cardiac failure. The reduction is achieved by feedback control using small perturbations of constant magnitude to the original, alternans-generating pacing period T , viz., using sequences of two alternating periods of $T+\Delta T$ and $T-\Delta T$, with $\Delta T << T$. This alternans suppression scheme has been proposed and investigated in detail by simulations of ion-channel-based cardiac models both for a single cell and in one-dimensional spatially extended systems. Such a control scheme for alternans suppression has been verified experimentally in isolated whole heart experiments (in Academia Sinica, Taipei). The mechanism of the success of the proposed method can be understood in terms of dynamics in phase space, viz., as the state of activity of the cell being confined within a narrow volume of phase space for the duration of control, resulting in extremely diminished variation in successive action potential durations. The method is much more robust to noise than previous alternans reduction techniques based on fixed point stabilization and should thus be more efficient in terms of experimental implementation, which has implications for clinical treatment for arrhythmia.

Another fascinating aspect of cardiac dynamics is the role that spatial dimensions play in generating new types of transitions from order to disorder. While the major bulk of studies in cardiac modeling has been on two-dimensional media, as the heart wall has some thickness, investigating different aspects of activity propagation in three-dimensional excitable media is the correct approach. A natural question that can arise is whether the introduction of a third dimension introduces any novel dynamical phenomenon. In particular, if the heart wall has an inexcitable obstacle (e.g., generated as a result of an episode of myocardial infarction) that does not extend completely through the entire thickness of the medium, it is of great interest to know how it will interact with a reentrant wave. Earlier investigations in two-dimensional media suggest that a reentrant (or spiral wave) pinned to such an inexcitable

obstacle is fairly robust and does not degenerate into spatiotemporal chaos. However, in the present case, as the reentrant wave moves at different rotational speed in the region where it is wound around the obstacle compared to the region where it is free, it is easy to see that the wave will get progressively more twisted. In fact, investigations carried out recently show that this can result in a breakup of the wave into spatiotemporal chaos. This provides a novel route to fibrillation-like disorganized activity in three-dimensional excitable media as it does not involve the filament (the line joining the vortex singularities at each plane perpendicular to the axis of the obstacle) at all. This result is potentially of great significance to the clinical treatment of cardiac arrhythmia.

Analysis of time-series data of different markets have produced evidence for several stylized facts (universal features) including heavy tails characterized by power law exponents, which provide tantalizing hints of the nonlinear dynamics underlying such complex systems. It is especially important to see how these features evolve over time after themarket is created and gradually develops. The recent advent of the digital currency,Bitcoin, and its growing popularity as an asset traded between agents over the last fewyears, provides us with an invaluable dataset for such a study. Similar to many financial markets, Bitcoin is de-centralized and its value is not controlled by a single institution, (e.g., a central bank. A recent study [**E**] has analyzed high-frequency Bitcoin trading data (with a resolution of one tick, i.e., a single trading event). It is shown that the distribution of price fluctuation (measured in terms of logarithmic return) has a heavy tail. The exponent of the tail implies that Bitcoin fluctuations follow an inverse square law, in contrast to the inverse cubic law exhibited by most financial and commodities markets. The distribution of transaction sizes and trading volume are seen to have Levy-stable distribution. Multi-scale analysis show the presence of long term memory effects in market behavior.

QCD effects for Higgs, Drell-Yan productions and beyond at the LHC

2loop corrections to the production of a real graviton associated with a jet at the LHC : New physics may show up as tiny deviations from the prediction of the Standard Model(SM)! To exploit this possibility it is absolutely necessary to make the theoretical predictions at very high accuracy within the SM and beyond. Multiloop computations play a crucial role to achieve this golden task. The complexity of these computations grows very rapidly with the increase of number of loops and/or external particles. We have performed a similar computation of 2loop virtual corrections to the production of a real graviton associated with a jet within the framework of massless QCD. The process, in particular, involves three massless gluons and one massive spin-2 graviton as external particles. We assume, spin-2 graviton couples to SM fields through SM energymomentum tensor (large extradimension model). In the process of computation, a large number of Feynman diagrams, generated using QGRAF, have been encountered, namely, 108 at 1loop and 2362 at 2loop order. Due to presence of a large number of Feynman diagrams and, additionally, involvement of spin-2 field, the computation becomes highly tedious and challenging! Color simplification and most of the other manipulations have been done with the help of some inhouse routines written in FORM and Mathematica. We have made use of integrationbyparts (IBP) and Lorentzinvariant (LI) identities to reduce the number of independent integrals, to be computed, substantially. For this purpose, one Mathematica based package named LiteRed has been used. Upon substituting the results of these integrals and performing the QCD UV renormalization, we get the final 1loop as well as 2loop results. The final results contain some additional divergences arising from infrared and collinear sectors, which we call IRdivergences.

Our results exhibit the correct and universal IRdivergences which confirms the correctness of our computation. This computation explicitly verifies the fact that even in the presence of a spin-2 field the universal structure of QCD IR divergence at 2loop holds true. Also, our result is very general in the sense that it can be used to study the production of a jet with missing energy due to KKgraviton escaping the detector or a process with resonant massive spin-2 particle in associationwith a jet.

2loop corrections to the production of the Higgs boson associated with a jet from bottom antibottom annihilation : Though the observables associated with the Higgs boson production get dominant contributions from gluon initiated partonic subprocesses, it is important to include the subdominant ones coming from other channels to test the SM to an unprecedented accuracy and see the possible physics beyond SM. We have worked on one such channel, namely, the Higgs boson production in association with a jet in bottom antibottom annihilation process. We compute relevant amplitude $H \to b + \bar{b} + g$ up to two loop level in QCD where Higgs couples to bottom quark through Yukawa coupling. We use projection operators to obtain the coefficients for each tensorial structure appearing in this process. Remaining calculation is similar to the earlier one. We have demonstrated that the renormalized amplitudes do have the right infrared structure predicted by the QCD factorization in dimensional regularization.

The Drell-Yan and Higgs boson productions at threshold in N^{3}LO QCD : Precise theoretical predictions for Drell-Yan (DY) production of pair of leptons and the Higgs boson production in gluon fusion at next to next to leading order (NNLO) in perturbative Quantum Chromodynamics (pQCD) have played an important role to test the Standard Model to an unprecedented accuracy. The recent computation, by Anastasiou et. al., on the full threshold contributions to the Higgs boson production at N^{3}LO in QCD contains valuable information on the soft gluons resulting from virtual and real emission partonic subprocesses. Extracting that relevant information and exploiting the factorization property of QCD amplitude along with Sudakov resummation of soft gluons and renormalization group invariance, we have established an elegant framework to compute the crosssection and rapidity distribution of the processes, in which the final state particle is colorless, to all order in QCD perturbation theory. Using this framework, we have computed the following observables :

Crosssection of Drell-Yan production at threshold in N^{3}LO QCD,

Rapidity distribution of Drell-Yan and the Higgs boson (from gluon fusion) productions at threshold in N^{3}LO QCD,

Crosssection of the Higgs boson production through $b\bar{b}$ annihilation at threshold in N^{3}LO QCD and

Rapidity distribution of the Higgs boson produced through $b\bar{b}$ annihilation at threshold in N^{3}LO QCD.

We have shown the numerical impact of these results in the context of LHC. These are indeed very important step towards the high precision result.

RS resonance in di-final state production at the LHC to NLO+PS accuracy. A selection of the results has been presented with PDF and scale uncertainties for various distributions. Using the di-lepton and di-photon final states, we present the search sensitivity, for the 14 TeV LHC at 50 fb^1 luminosity.

Associated production of Higgs boson with vector boson at threshold N^3LO in QCD. We find that the inclusion of such corrections do reduce theoretical uncertainties resulting from the renormalization scale.

Ongoing works : Computing the the inclusive crosssection of the Higgs boson produced through gluongluon fusion at threshold beyond N^3LO QCD and analyzing the numerical impact of threshold contribution, Real graviton production at hadron colliders in NNLO QCD in the context of large extra dimensions and Three photon production in LED model at NLO + PS accuracy at the LHC. Renormalisation group invariant approach to Higgs production at the LHC. Three loop form factors for energy momentum tensor in QCD.

QFT, Topological QFT, Conformal Field Theory

Non-perturbative aspects of QFTs are an area of active research. Currently some projects studying topological charges in QFTs and their implications to various physical properties are being pursued, with the central theme being interplay of symmetry and topological charge. Topological charges in presence of non-trivial vacua like vortices and solitons, and its consequences are also being studied. Some projects looking at aspects of gauge invariance in QFTs are also being pursued.

Quantum Computations

In the present paper [**G1**], we extend Simon's separability criterion for Gaussian states to the multi-mode Gaussian states using the Marchenko-Pastur theorem. We show that the Marchenko-Pastur theorem from random matrix theory is necessary and sufficient for separability of multi-mode Gaussian states.

Maximally entangled statesa resource for quantum information processingcan only be shared through noiseless quantum channels, whereas in practice channels are noisy. Here [**G6**] we ask: Given a noisy quantum channel, what is the maximum attainable purity (measured by singlet fraction) of shared entanglement for single channel use and local trace preserving operations? We find an exact formula of the maximum singlet fraction attainable for a qubit channel and give an explicit protocol to achieve the optimal value. The protocol distinguishes between unital and nonunital channels and requires no local postprocessing. In particular, the optimal singlet fraction is achieved by transmitting part of an appropriate pure entangled state, which is maximally entangled if and only if the channel is unital. A linear function of the optimal singlet fraction is also shown to be an upper bound on the distillable entanglement of the mixed state dual to the channel.

Inspired by the work done by Belavkin [BelavkinV.P.Stochastics,1,315(1975)] and C. Mochon [Phys.Rev.A73,032328,(2006)], we formulate [**G8**] the problem of minimum error discrimination of an ensemble of n linearly independent pure states by embedding the optimal conditions in a matrix equation and matrix inequality. This isolates the rotationally invariant aspect of the problem from the rotationally covariant part of it. Employing the implicit function theorem in the matrix equation we get a set of first-order coupled ordinary non-linear differential equations which can be used to drag the solution from an initial point (where solution is known) to another point (whose solution is sought). This can be done through a simple taylor series expansion and analytic continuation when required. Thus, we

complete the work done by Belavkin and C. Mochon by ultimately leading their theory to a solution for the MED problem of LI pure state ensembles. We also compare the computational complexity of this technique with a barrier-type interior point method of SDP and show that our technique is computationally less expensive than the SDP algorithm, with the added advantage of being simpler to implement.

Statistical Mechanics

Statistical physics and phase transitions and different phases are studied in Z(q) symmetric spin systems. Ductile to brittle and quasi brittle transition is studied in fiber bundle models from the point of vie of phase transitions. The microscopic process of crack nucleation is investigated First passage and universal properties of coarsening systems are studied.

The concept of networks is of great importance in studying social phenomena. In recent times there has been a surge of interest in applying statistical mechanics of such networks to understand economic phenomena [**Sin1**]. The recent worldwide economic crisis of 2007-09 has focused attention on the need to analyze correlations in economic systems. In this context, financial markets can be seen as complex systems that comprise many agents interacting with each other as well as responding to external information. Earlier studies on the cross-correlations of price movements of different stocks have revealed the interaction structure of various financial markets - which has resulted in the intriguing speculation that the evolution of a market from emerging or developing to developed status is accompanied by systematic changes in its interaction structure. In a recent study [**C**] using a very large data-base of daily price changes of equities listed in the New York Stock Exchange, the long-term changes that this financial market has undergone over a period of nearly nine decades (1925-2012) has been investigated. Spectral analysis of the daily log-return cross-correlations has been done in order to reveal the network of significant interactions between equities. It has been found that the distribution of interaction strengths varies with the state of the economy. In particular, the skewness of the distribution shows a remarkable increase in recent years. The strength distribution over the network in different periods has been investigated by treating the network as resulting from a percolation process where the threshold value of interaction strength for deciding whether to connect a pair of nodes is varied. It is seen that the formation of the giant component can occur very differently in different periods - which reflects the micro-structure of the interactions between the equities.

The movement of large numbers of vehicles along the complex network of roads in a city result in interactions between them that become stronger as the traffic density increases. The non-trivial behavior arising from the collective dynamics of vehicles include the occurrence of persistent congestion at different points of the transport network that typically reduce the efficiency of overall traffic flow. In order to understand the mechanisms responsible for the characteristic spatio-temporal patterns of urban traffic, we first need to identify statistically robust features from empirical observations, which one can then try to recreate in computational models of traffic dynamics. A recent study [**M**] has analyzed the GPS traces collected round the clock for more than a hundred taxis operating in a major Indian city over a period of 1 month. The available information allows precise measurement of the periods during which the vehicle is static and when it is moving. The study focuses on the intermittent patterns of rest and motion that a car exhibits during its passage through city traffic, which provides a window into key aspects of collective dynamics resulting from

congestion. The distribution of waiting time, i.e., the period during which a car is static between two successive epochs of movement, has a highly skewed nature. The bulk of the probability distribution appears to follow power-law scaling with exponent value of 1.78. As city traffic has very different densities during peak hours and off-peak hours, this distribution has been computed for different times of the day. While the power-law scaling is found to be robust, the exact value of the exponent does change slightly. The active time distribution, i.e., the period of movement between two epochs when the car is static, does not exhibit a power-law signature but rather resembles a inverse Gaussian or a log-logistic distribution. These results can be used to help understand how the statistical properties of large-scale traffic movement over complex road networks which characterize cities deviate from that of other types of collective dynamics, e.g., the diffusion of random walkers.

Many complex systems can be represented as networks of dynamical elements whose states evolve in response to interactions with neighboring elements, noise and external stimuli. The collective behavior of such systems can exhibit remarkable ordering phenomena such as chimera order corresponding to coexistence of ordered and disordered regions. Often, the interactions in such systems can also evolve over time responding to changes in the dynamical states of the elements. Link adaptation inspired by Hebbian learning, the dominant paradigm for neuronal plasticity, has been earlier shown to result in structural balance by removing any initial frustration in a system that arises through conflicting interactions. A recent study [**Pa**] was done to show that the rate of the adaptive dynamics for the interactions is crucial in deciding the emergence of different ordering behavior (including chimera) and frustration in networks of Ising spins. In particular, it was observed that small changes in the link adaptation rate about a critical value result in the system exhibiting radically different energy landscapes, viz., smooth landscape corresponding to balanced systems seen for fast learning, and rugged landscapes corresponding to frustrated systems seen for slow learning.

Cooling granular media, characterized by inelastic collisions, exhibit varied physical phenomena. The large scale effects of inelastic collisions are best studied in the freely cooling granular gas – a collection of ballistic particles undergoing inelastic collision in the absence of any external driving. The temporal evolution of energy and formation of clusters were studied using large scale event driven simulations in three dimensions for a system with tangential friction. It was shown that the exponents characterizing the large time behaviour could be related to the well studied model of ballistic aggregation [**Pat**].

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 related problem of hard rectangles with aspect ratio k is studied on two dimensional lattices. The phase diagram of a system of monodispersed hard rectangles of size $m \times mk$ is determined for all m, k using a combination of Monte Carlo simulations and Bethe approximations. The existence of a disordered phase, a nematic phase with orientational order, a columnar phase with orientational and partial translational order, and a crystalline sublattice phase is shown. Some of these results may be made more rigorous. The solid phase is shown to exist only when the greatest common divisor of the length and width is different from one. For the nematic–columnar transition, a systematic high density expansion is derived allowing one to estimate the critical density. When the rods are polydispersed, a transfer matrix approach allows the determination of a phase boundary separating a nematic phase from a isotropic phase [**K1**, **N1**, **K2**, **R**, **K3**].

The hard sphere system in two dimensionsional continuum is known to undergo two entropy

driven transitions with increasing density: first from a liquid phase to a hexatic phase with quasi long range orientational order and second from the hexatic phase to a solid phase with quasi long range positional order and long range orientational order. The corresponding lattice problem, relevant for the study of adsorption of gas molecules onto surfaces, is not that well understood. The k-NN hard core lattice gas model in which the first k next nearest neighbor sites of a particle are excluded from occupation by other particles is studied on a two dimensional square lattice. This model is the lattice version of the hard disc system with increasing k corresponding to decreasing lattice spacing. The lattice model has been known to show only one transition. Here, based on Monte Carlo simulations and high density expansions of the free energy and density, it is argued that for $k = 4, 10, 11, 14...$, the lattice model undergoes multiple transitions with increasing density. These are confirmed using Monte Carlo simulations for $k = 4, \ldots, 11$. This, in turn, resolves an existing puzzle as to why the 4-NN model has a continuous transition against the expectation of a first order transition [**N2**]

A system of particles which on undergoing a two-body collision either coalesce to form a single particle or are removed from the system have been studied using Smoluchowski equation. The system is driven to a steady state by a constant input of particles of the smallest mass. The collision kernel studied is a generic one: $K(m_1, m_2) = (m_1^\mu m_2^\nu + m_1^\nu m_2^\mu)/2$. The Smoluchowski equation for this kernel is analyzed using the relation between different moments, the singular structure of the generating functions, a numerical solution, and exact solutions of solvable limits. The exponents characterizing the mass distribution for small and large masses are also found.

It has been a long debated subject whether the failure mode of a disordered solid is governed by nucleation (growth of a single damage causing the failure) or percolation (distributed damages coalesce before the final failure). It is expected that the range over which the stress field within the solid is modified following a local damage plays a crucial role in determining the mode of failure. However, a specific criterion for this range was not obtained before. We have obtained [**Bi1**] a finite size scaling criterion that determines the mode of failure. In particular, we have used the fiber bundle model as prototype and obtained the scaling criterion that if the effective range of stress release scales slower than L^ζ with $\zeta = 2/3$, the failure is nucleation dominated. Otherwise it is percolation dominated. The results are generally expected to be valid for systems with finite (normalizable) disorder and with a form of load-sharing function that has an effective range.

In an interconnected set of nodes, each having some failure threshold, it can be an essential requirement to figure out the best possible way to redistribute the load of a failed node so that the system is maximally robust. This is an important issue for a network of power-grids and also relevant for traffic in parallel roads. We have obtained [**Bi2**] the specific redistribution rules for sudden and quasi-static loadings of the system. It is also seen that the nature of the failure transition becomes abrupt (without precursor) when the most effective redistribution rule is adopted.

String Theory

Earlier discussions on the exact renormalization group and loop variables on the string world sheet for closed and open string backgrounds are continued . The world sheet action

with a UV regulator is written in a generally background covariant way by introducing a background metric. It is shown that the renormalization group gives background covariant equations of motion - this is the gauge invariance of the graviton. Interaction is written in terms of gauge invariant and generally covariant field strength tensors. The basic idea is to work in Riemann normal coordinates and covariantize the final equation. It turns out that the equations for massive modes are gauge invariant only if the space time curvature of the (arbitrary) background is zero. The exact RG equations give quadratic equations of motion for all the modes *including* the physical graviton. The level (2,2) massive field equations are used to illustrate the techniques. At this level there are mixed symmetry tensors. Gauge invariant interacting equations can be written down. In flat space an action can also be written for the free theory. [**Sa3**]

A proposal for solving the problem of constructing a manifestly background independent formulation of string theory is made: A simple prescription for the map from loop variables to space time fields is given whereby for arbitrary backgrounds the equations are generally covariant and gauge invariant. Extra terms involving couplings of the curvature tensor to (derivatives of) the Stueckelberg fields have to be added. The background metric is chosen to be the physical metric without any restrictions. This method thus gives manifestly background independent gauge invariant and general covariant equations of motion for both open and closed string modes [**Sa4**] .

In a loop space description of non-linear sigma model, the semi-classical expansion is related to the tubular expansion of loop space around the submanifold of vanishing loops. In [**Mu**] this geometry has been worked out explicitly to all orders. The procedure involves first defining a cut-off tubular geometry at finite N and then taking $N \to \infty$ limit.

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**]
Sujay K. Ashok, Marco Billo*, Eleonora DellÁquila, Marialuisa Frau*, Renjan R. John, and Alberto Lerda*.
Non-perturbative studies of n=2 conformal quiver gauge theories.
Fortschritte der Physik (Progress of Physics), 2015.
1502.05581 (To be published).

[**A2**]
Sujay K. Ashok, Eleonora Dell'Aquila, and Jan Troost*.
Higher poles and crossing phenomena from twisted genera.
Journal of High Energy Physics (JHEP), **2014(08)**, 087, 2014.

[**B1**]
Upayan Baul, Kenichi Kuroda*, and Satyavani Vemparala.

Interaction of multiple biomimetic antimicrobial polymers with model bacterial membranes.
The Journal of Chemical Physics, **141(8)**, 084902, 2014.

[**B2**]
Upayan Baul and Satyavani Vemparala.
Ion hydration and associated defects in hydrogen bond network of water: Observation of reorientationally slow waters beyond first hydration shell.
Physical Review E, **91(1)**, 012114, 2015.

[**Bi1**]
Soumyajyoti Biswas, Subhadeep Roy, and Purusattam Ray.
Nucleation versus percolation: Scaling criterion for failure in disordered solids.
2014.
arXiv:1411.7827 (Submitted).

[**Bi2**]
Soumyajyoti Biswas and Parongama Sen*.
Maximizing the strength of fiber bundles under uniform loading.
2015.
arXiv:1502.07433 (Submitted).

[**C**]
K. Chandrashekar, Anindya S. Chakrabarti*, and Sitabhra Sinha.
Long-term evolution of the topological structure of interactions among stocks in the new york stock exchange 19252012.
In B. K. Chakrabarti A. Chakraborti F. Abergel, H. Aoyama and A. Ghosh, editors, *Econophysics and Data Driven Modelling of Market Dynamics*, page 105. Springer, 2015.

[**Ch**]
K. Chandrashekar and Sitabhra Sinha.
Contagion, coordination and communities: Diffusion of innovations on social networks with modular organization.
In *Proc. IEEE 7th International Conference on COMmunications Systems and NETworkS (COMSNETS), Bangalore*. IEEE, Jan 2015.

[**Cha1**]
Pinaki Chaudhuri and Juergen Horbach*.
Poiseuille flow of soft glasses in narrow channels: From quiescence to steady state.
Physical Review E, **90**, 040301, 2014.

[**Cha2**]
Pinaki Chaudhuri, Pablo Hurtado*, Ludovic Berthier*, and Walter Kob*.
Relaxation dynamics in a transient network fluid with competing gel and glass phases.
Journal of Chemical Physics, **142**, 174503, 2015.
arXiv:1502.00249 (To be published).

[**Cha3**]
Ehsan Irani*, **Pinaki Chaudhuri, and Claus Heussinger***.
Impact of attractive interactions on the rheology of dense athermal particles.
Physical Review Letters, **112**, 188303, 2014.

[**E**]
Soumya Easwaran, Manu Dixit*, **and Sitabhra Sinha**.
Bitcoin dynamics: The inverse square law of price fluctuations and other stylized facts.
In B. K. Chakrabarti A. Chakraborti F. Abergel, H. Aoyama and A. Ghosh, editors, *Econophysics and Data Driven Modelling of Market Dynamics*, page 121. Springer, 2015.

[**G1**]
K. V. S. Shiv Chaitanya*, **Sibasish Ghosh, and V. Srinivasan***.
Entanglement criterion for multi-mode gaussian states.
2015.
(Preprint: arXiv:1501.06004 (quant-ph)).

[**G2**]
K.V.S. Shiv Chaitanya*, **Sibasish Ghosh, and V. Srinivasan***.
Entanglement in two-site bose-hubbard model with nonlinear dissipation.
Journal of Modern Optics, **61**, 1409, 2014.

[**G3**]
S. Chaturvedi*, **K. R. Parthasarathy***, **Sibasish Ghosh, and Ajit Iqbal Singh***.
Optimal quantum state determination by constrained elementary measurements.
arxiv: 1411.0152.

[**G4**]
Sibasish Ghosh and Ajit Iqbal Singh*.
Invariants for maximally entangled vectors and unitary bases.
arxiv: 1401.0099.

[**G5**]
Sandeep K. Goyal*, **Patricia E. Boukama-Dzoussi***, **Sibasish Ghosh, Filippus S. Roux***, **and Thomas Konrad***.
Qudit-teleportation for photons with linear optics.
Scientific Reports, **4**, 4543–1, 2014.

[**G6**]
Rajarshi Pal, Somshubhro Bandyopadhyay*, **and Sibasish Ghosh**.
Entanglement sharing through noisy quit channels: One-shot optimal singlet fraction.
Physical Review A, **90**, 052304, 2014.

[**G7**]
Rajarshi Pal and Sibasish Ghosh.
A closed-form necessary and sufficient condition for any two qubit state to show hidden non

locality with respect to the Bell-CHSH inequality.
arxiv: 1410.7574 (Accepted as Poster in QIP, 2015).

[**G8**]
Tanmay Singal and Sibasish Ghosh.
Minimum error discrimination for an ensemble of linearly independent pure states.
arxiv: 1407.5389.

[**G9**]
Tanmay Singal and Sibasish Ghosh.
Algebraic structure of the minimum error discrimination problem for linearly independent density matrices.
arxiv: 1412.7174.

[**Gu**]
Saurabh Gupta.
Novel symmetries in vector schwinger model.
Modern Physics Letters A, 2014.
arXiv:1312.6395 (To be published).

[**K1**]
Joyjit Kundu and R. Rajesh.
Phase transitions in a system of hard rectangles on the square lattice.
Physical Review E, **89**, 052124, 2014.

[**K2**]
Joyjit Kundu and R. Rajesh.
Asymptotic behavior of the isotropic-nematic and nematic-columnar phase boundaries for the system of hard rectangles on a square lattice.
Physical Review E, **91**, 012105, 2015.

[**K3**]
Joyjit Kundu and R. Rajesh.
Phase transitions in systems of hard rectangles with non-integer aspect ratio.
2015.
arXiv:1501.06402 (Submitted).

[**Ku1**]
Ravi Kunjwal.
Fine's theorem, noncontextuality, and correlations in specker's scenario.
Phys. Rev. A, **91**, 022108, 2015.

[**Ku2**]
Ravi Kunjwal and Sibasish Ghosh.
Minimal state-dependent proof of measurement contextuality for a qubit.
Phys. Rev. A, **89**, 042118, 2014.

[**Ku3**]
Ravi Kunjwal, Chris Heunen*, and Tobias Fritz*.
Quantun realization of arbitrary joint measurability structures.
Phys. Rev. A, **89**, 052126, 2014.

[**M**]
Abdul Majith and Sitabhra Sinha.
Statistics of stop-and-go traffic: Emergent properties of congestion behavior arising from collective vehicular dynamics in an urban environment.
In *Proc. IEEE 7th International Conference on COMmunications Systems and NETworkS (COMSNETS), Bangalore*. IEEE, Jan 2015.

[**Me1**]
Shakti N. Menon and Sitabhra Sinha.
Defective logic: Using spatiotemporal patterns in coupled relaxation oscillator arrays for computation.
In *Proc. Int. IEEE Conf. Signal Processing and Communication, Bangalore*. IEEE, Jul 2014.

[**Me2**]
Shakti N. Menon, Sridhar S, and Sitabhra Sinha.
Designer dynamics through chaotic traps: Controlling complex behavior in driven nonlinear systems.
Physical Review Letters, 2015.
(Submitted).

[**Me3**]
Jinshan Xu*, Shakti N. Menon, Rajeev Singh, Nicolas B. Garnier*, Sitabhra Sinha, and Alain Pumir*.
The role of cellular coupling in the spontaneous generation of electrical activity in uterine tissue.
PLoS ONE, **10(3)**, e0118443, 2015.

[**Mu**]
Partha Mukhopadhyay.
A cut-off tubular geometry of loop space.
2014.
(Preprint: arXiv:1407.7355).

[**N1**]
Trisha Nath, Joyjit Kundu, and R. Rajesh.
High-activity expansion for the columnar phase of the hard rectangle gas.
2014.
arXiv:1411.7831 (Submitted).

[**N2**]
Trisha Nath and R. Rajesh.

Multiple phase transitions in extended hard core lattice gas models in two dimensions.
Physical Review E, **90**, 012120, 2014.

[**Ni1**]
Aritra Biswas, Nita Sinha, and Gauhar Abbas*.
Non-leptonic decays of charmed mesons into two pseudoscalars.
Physical Review D, 2015.
arXiv:1503.08176 (Submitted).

[**Ni2**]
Animesh Chatterjee*, **K. Meghna, Kanishka Rawat***, **Tarak Thakore***, **Vipin Bhatnagar***, **Raj Gandhi***, **D. Indumathi, Naba Mondal***, **and Nita Sinha**.
A simulations study of the muon response of the iron calorimeter detector at the india-based neutrino observatory.
Journal of Instrumentation, **9**, P07001, 2014.

[**Ni3**]
Hijam Zeen Devi, L.Dhargyal, and Nita Sinha.
Can the observed cp asymmetry in $\tau \to K\pi\nu_\tau$ be due to non-standard tensor interactions?
Physical Review D, **90(1)**, 013016, 2014.

[**Ni4**]
Rupak Dutta, Nita Sinha, and Sushant K. Raut*.
Determining neutrino mass hierarchy from electron disappearance at a low energy neutrino factory.
Physical Review D, **89(7)**, 073011, 2014.

[**Ni5**]
Kanishka Rawat*, **K.Meghna, Vipin Bhatnagar***, **D. Indumathi, and Nita Sinha**.
Simulations study of muon response in the peripheral regions of the iron calorimeter detector at the india-based neutrino observatory.
Journal of Instrumentation, **10**, P03011, 2015.

[**P**]
Rajarshi Pal and Sibasish Ghosh.
Non-locality breaking qubit channels: the case for chsh inequality.
J. Phys. A: Math. Theor., **48**, 155302, 2015.

[**Pa**]
Anand Pathak and Sitabhra Sinha.
Complex ordering in spin networks: Critical role of adaptation rate for dynamically evolving interactions.
Journal of Physics: Conference Series, 2015.
(To be published).

[**Pat**]
Sudhir N. Pathak, Dibyendu Das*, **and R. Rajesh**.

Inhomogeneous cooling of the rough granular gas in two dimensions.
Europhysics Letters, **107**, 44001, 2014.

[**R**]
J. Stilck* **and R. Rajesh**.
Polydispersed rods on the square lattice.
Physical Review E, **91**, 012106, 2015.

[**Ra1**]
T. Ahmed, M. Mahakhud*, P. Mathews*, N. Rana, and V. Ravindran.
Two-loop QCD corrections to higgs $\to b + \overline{b} + g$ amplitude.
JHEP, 1408(075), 2014.
(arXiv:1405.2324).

[**Ra2**]
T. Ahmed, M. K. Mandal*, N. Rana, and V. Ravindran.
Higgs rapidity distribution in $b\bar{b}$ annihilation at threshold in n^{3}lo QCD.
JHEP, 1502(131), 2015.
(arXiv:1411.5301).

[**Ra3**]
T. Ahmed, M.K. Mandal*, N. Rana, and V. Ravindran.
Rapidity distributions in drell-yan and higgs productions at threshold to third order in QCD.
Phy. Rev. Lett., 113(212003), 2014.
(arXiv:1404.6504).

[**Ra4**]
T. Ahmed, N. Rana, and V. Ravindran.
Higgs boson production through $b\bar{b}$ annihilation at threshold in n^{3}lo QCD.
JHEP, 1410(139), 2014.
(arXiv:1408.0787).

[**Ra5**]
G. Das*, P. Mathews*, V. Ravindran, and S. Seth*.
RS resonance in di-final state production at the LHC to NLO+PS accuracy.
JHEP, 1410(139), 2014.
(arXiv:1408.3970 [hep-ph]).

[**Ra6**]
D. de Florian*, P. Mathews*, J. Mazzitelli*, M. Mahakhud*, and V. Ravindran.
Quark and gluon spin-2 form factors to two loops in QCD.
PoS LL, 2014(068), 2014.

[**Ra7**]
M.C. Kumar, M.K. Mandal*, and V. Ravindran.
Associated production of higgs boson with vector boson at threshold n^{3}lo in QCD.

JHEP, 03(037), 2015.
(arXiv:1412.3357 [hep-ph]).

[**Ra8**]
T.Ahmed, M.Mahakhud*, N.Rana, and V.Ravindran.
Drell-yan production at threshold to third order in QCD.
Phys. Rev. Lett., **113(11)**, 112002, 2014.
(arXiv:1404.0366).

[**Ra9**]
T.Ahmed, M.Mahakhud*, P.Mathews*, N.Rana, and V.Ravindran.
Two-loop QCD correction to massive spin-2 resonance $\rightarrow$ 3 gluons.
JHEP, 1405(107), 2014.
(arXiv:1404.0028).

[**Ray**]
P. Sen* and P. Ray.
$a + a \rightarrow \emptyset$ model with a bias towards nearest neighbor.
2014.
arXiv:1409.7541 (Submitted).

[**Ro**]
S. Roy and P. Ray.
Criticality in fiber bundle model.
2014.
(Preprint: arXiv:1412.1211).

[**S**]
V. Sasidevan and Sitabhra Sinha.
A dynamical view of different solution paradigms in two-person symmetric games: Nash versus co-action equilibrium.
In B. K. Chakrabarti A. Chakraborti F. Abergel, H. Aoyama and A. Ghosh, editors, *Econophysics and Data Driven Modelling of Market Dynamics*, page 213. Springer, 2015.

[**Sa1**]
Balachandran Sathiapalan.
Loop variables and gauge invariant exact renormalization group equations for (open) string theory.
In Vinod Nautiyal Usha Kulshreshtha Daya Shankar Kulshreshtha, Supriya K. Kar and Swarnendu Sarkar, editors, *International Conference on Light-Cone Physics: Hadronic and Particle Physics*, page 111. Nuclear Physics B Proceedings:Elsevier, Jun 2014.

[**Sa2**]
Shankhadeep Chakrabortty* and Balachandran Sathiapalan.
Schwinger effect and negative differential conductivity in holographic models.
Nucl.Phys. B, **890**, 241, 2014.

[**Sa3**]
Balachandran Sathiapalan.
Gauge invariance and equations of motion for closed string modes.
Nucl.Phys.B, **B889 (2014)**, 261, 2014.

[**Sa4**]
Balachandran Sathiapalan.
Background independence, gauge invariance and equations of motion for closed string modes.
International Journal of Modern Physics A, 2014.
IMSC-2014-12-13 (To be published).

[**Si**]
Rajesh Singh, Somdeb Ghose, and Ronojoy Adhikari.
Many-body microhydrodynamics of colloidal particles with active boundary layers.
Journal of Statistical Mechanics Theory and Experiment, 2014.
(Submitted).

[**Sin1**]
Anirban Chakraborti *, Yoshi Fujiwara*, Asim Ghosh *, Jun ichi Inoue*, and Sitabhra Sinha.
Physicistsápproaches to a few economic problems.
In B. K. Chakrabarti A. Chakraborti F. Abergel, H. Aoyama and A. Ghosh, editors, *Econophysics and Data Driven Modelling of Market Dynamics*, page 237. Springer, 2015.

[**Sin2**]
Arnold Emerson* and Sitabhra Sinha.
Analysis of core-periphery organization in protein contact networks reveals groups of structurally and functionally critical residues.
Journal of Biosciences, 2015.
(To be published).

[**Sr**]
S. Sridhar, Tara Thiagarajan*, and Sitabhra Sinha.
Spatio-temporal patterns of development in india: Identifying geographical features of growth and urbanization.
In B. K. Chakrabarti A. Chakraborti F. Abergel, H. Aoyama and A. Ghosh, editors, *Econophysics and Data Driven Modelling of Market Dynamics*, page 225. Springer, 2015.

[**V1**]
Sasidevan Vijayakumar and Sitabhra Sinha.
A dynamical view of different solution paradigms in two-person symmetric games: Nash vs co-action equilibria.
In F. Abergel et al., editor, *Econophysics and Data Driven Modelling of Market Dynamics*, page 213. Springer, Jan 2015.
(To be published).

[**V2**]
Sasidevan Vijayakumar and Sitabhra Sinha.
Cooperation among rational agents in co-action equilibrium of prisoner's dilemma and other single-stage symmetric games.
2015.
(Preprint: arXiv:1501.05145).

[**Vy1**]
Kumar Abhinav*, **Vivek M. Vyas, and Prasanta K. Panigrahi***.
Solitons and matter transport in Graphene boundary.
Pramana, 2014.
(To be published).

[**Vy2**]
Rama Gupta*, **C. N. Kumar***, **Vivek M. Vyas, and Prasanta K. Panigrahi***.
Manipulating rogue wave triplet in optical waveguides through tapering.
Physics Letters A, **379(4)**, 314, 2015.

[**Vy3**]
Aritra Mukhopadhyay*, **Vivek M. Vyas, and Prasanta K. Panigrahi***.
Rogue solitons in Heisenberg spin chain.
2014.
(Preprint: nlin:1406.6524).

[**Vy4**]
P. S. Vinayagam*, **R. Radha***, **Vivek M. Vyas, and K. Porsezian***.
Generalized gauge transformation approach to construct dark solitons of coupled nonlinear Schrödinger type equations.
Romanian Reports in Physics, 2014.
(To be published).

[**Vy5**]
Vivek M. Vyas.
A gauge theory of massive spin one particles.
2015.
(Preprint: IMSC/2015/03/02).

[**Vy6**]
Vivek M. Vyas, Rama Gupta*, **C. N. Kumar***, **and Prasanta K. Panigrahi***.
A method to solve nonlinear Schrödinger equation using Riccati equation.
2014.
(Preprint: IMSC/2014/11/12).

[**Vy7**]
Vivek M. Vyas and Prasanta K. Panigrahi*.
Some results on topological currents in field theory.

2014.
(Preprint: IMSC/2014/11/11).

Books/Monographs Authored/Edited

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

[**D1**]
Ghanashyam Date.
General Relativity: Basics and Beyond.
CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway, NW, Suite 300, Boca Raton, FL 33487-2742., 2014.

[**D2**]
L. Goehring*, A. Nakahar*, T. Dutta*, A. Kitsunezaki*, and S. Tarafdar*, editors.
Desiccation Cracks and their Patterns.
Statistical Physics of Fracture and Breakdown. Wiley-Blackwel, Chichester, West Sussex, PO19 8SQ, UK, 2015.

[**S**]
Sitabhra Sinha and S. Sridhar, editors.
Patterns in Excitable Media: Genesis, Dynamics and Control.
CRC Press, Boca Raton, USA, 2014.

2.4 Theoretical Computer Science

2.4.1 Research Summary

Algorithms and Data Structures

In [**Ra3**], explicit deterministic schemes are designed to represent a two element subset of an m element universe using $O(m^{2/5})$ bits of space where membership queries can be answered using 3 bit probes. This matches a probabilistic bound shown earlier. When $t > 3$ bits can be probed to answer membership, and for representing $n > 2$ elements, improved space bounds are given.

In [**Ra1**], work is continued on succinct representation of equivalence classes. An earlier work gave upper and lower bounds for the representation when each of the n elements should get a label from 1 to n. In this paper, data structures with better bounds are shown and interesting tradeoffs are obtained when the labels can take values from 1 to cn for some constant $c > 1$.

In parameterized complexity each problem instance comes with a parameter k and the parameterized problem is said to admit a *polynomial kernel* if there is a polynomial time algorithm (the degree of polynomial is independent of k), called a *kernelization* algorithm,

that reduces the input instance down to an instance with size bounded by a polynomial $p(k)$ in k, while preserving the answer. This reduced instance is called a $p(k)$ *kernel* for the problem. If $p(k) = O(k)$, then it is called a *linear kernel*. A central notion in parameterized complexity is *fixed parameter tractability (FPT)*, which means, for a given instance (x, k), solvability in time $f(k) \cdot p(|x|)$, where f is an arbitrary function of k and p is a polynomial in the input size.

In the classic Minimum Bisection problem we are given as input a graph G and an integer k. The task is to determine whether there is a partition of $V(G)$ into two parts A and B such that $||A| - |B|| \leq 1$ and there are at most k edges with one endpoint in A and the other in B. In [**Sa1**] we gave an algorithm for Minimum Bisection with running time $O(2^{O(k^3)}n^3 \log^3 n)$. This was the first fixed parameter tractable algorithm for Minimum Bisection. At the core of our algorithm lied a new decomposition theorem that states that every graph G can be decomposed by small separators into parts where each part is "highly connected" in the following sense: any cut of bounded size can separate only a limited number of vertices from each part of the decomposition. Our techniques generalized to the weighted setting, where we seek for a bisection of minimum weight among solutions that contain at most k edges.

In [**K1**] we designed linear time parameterized approximation algorithms for several problems such as, Odd Cycle Transversal, Almost-2-SAT, Above Guarantee Vertex Cover and Deletion Backdoor to q-horn. Our algorithm proceeded by first reducing the given instance to an instance of the Skew Symmetric Multicut problem, and then computing an approximate solution to this instance. The main features of our algorithm were,

- It ran in polynomial time and returns a solution whose size is bounded quadratically in the parameter. This makes it useful in the design kernelization algorithms.
- The running time has a linear dependence on the size of the input. This makes it useful in the design of linear time FPT algorithms.

Our algorithms relied on an combinatorial object called (L, k)-set, which has recently been used by Ramanujan and Saurabh to design a linear time FPT algorithm for Odd Cycle Transversal.

In [**Mi**], we studied the following family of connectivity problems. For a given λ-edge connected graph $G = (V, E)$, a set of links L such that $G + L = (V, E \cup L)$ is $(\lambda + 1)$-edge connected, and a positive integer k, the questions are

Augmentation Problem: whether G can be augmented to a $(\lambda+1)$-edge connected graph by adding at most k links from L; or

Deletion Problem: whether it is possible to preserve $(\lambda + 1)$-edge connectivity of graph $G + L$ after deleting at least k links from L.

We obtained the following results.

- An $9^k|V|^{O(1)}$ time algorithm for a weighted version of the augmentation problem. This improves over the previous best bound of $2^{O(k \log k)}|V|^{O(1)}$ given by Marx and

Vegh [*ICALP 2013*]. Let us remark that even for $\lambda = 1$, the best known algorithm so far due to Nagamochi [*DAM 2003*] runs in time $2^{O(k \log k)}|V|^{O(1)}$.

- An $2^{O(k)}|V|^{O(1)}$ algorithm for the deletion problem thus establishing that the problem is fixed-parameter tractable (). Moreover, we show that the problem admits a kernel with $12k$ vertices and $3k$ links when the graph G has odd-connectivity and a kernel with $O(k^2)$ vertices and $O(k^2)$ links when G has even-connectivity.

Our results were based on a novel connection between augmenting sets and the Steiner Tree problem in an appropriately defined auxiliary graph.

In the Tree Deletion Set problem the input is a graph G together with an integer k. The objective is to determine whether there exists a set S of at most k vertices such that $G \setminus S$ is a tree. The problem is NP-complete and even NP-hard to approximate within any factor of OPT^c for any constant c. In [**Sa2**] we gave an $O(k^5)$ size kernel for the Tree Deletion Set problem. An appealing feature of our kernelization algorithm was a new reduction rule, based on system of linear equations, that we use to handle the instances on which Tree Deletion Set is hard to approximate.

In [**Sa3**] we studied the paramereteized complexity of the following connectivity problem. For a vertex subset U of a graph G, trees $T_1, \ldots, T_s$ of G are completely independent spanning trees of U if each of them contains U, and for every two distinct vertices $u, v \in U$, the paths from u to v in $T_1, \ldots, T_s$ are pairwise vertex disjoint except for end-vertices u and v. Then for a given $s \geq 2$ and a parameter k, the task is to decide if a given n-vertex graph G contains a set U of size at least k such that there are s completely independent spanning trees of U. The problem is known to be NP-complete already for $s = 2$. We proved the following results

- For $s = 2$ the problem is solvable in time $2^{O(k)}n^{O(1)}$;
- For $s = 2$ the problem does not admit a polynomial kernel unless $NP \subseteq CoNP/\text{poly}$;
- For arbitrary s, we show that the problem is solvable in time $f(s,k)n^{O(1)}$ for some function f of s and k only.

In [**Sa4**] we gave a fixed-parameter tractable algorithm that, given a parameter k and two graphs G_1, G_2, either concludes that one of these graphs has treewidth at least k, or determines whether G_1 and G_2 are isomorphic. The running time of the algorithm on an n-vertex graph is $2^{O(k^5 \log k)} \cdot n^5$, and this is the first fixed-parameter algorithm for Graph Isomorphism parameterized by treewidth. Our algorithm in fact solved the more general *canonization* problem. We namely designed a procedure working in $2^{O(k^5 \log k)} \cdot n^5$ time that, for a given graph G on n vertices, either concludes that the treewidth of G is at least k, or:

- finds in an isomorphic-invariant way a graph $\tilde{G}$ that is isomorphic to G;
- finds an isomorphism-invariant *construction term* — an algebraic expression that encodes G together with a tree decomposition of G of width $O(k^4)$.

Hence, the isomorphism test reduces to verifying whether the computed isomorphic copies or the construction terms for G_1 and G_2 are equal.

In the MULTICUT problem, we are given an undirected graph $G = (V, E)$ and a family $= \{s_i t_i \mid s_i, t_i \in V\}$ of pairs of requests and the objective is to find a minimum sized set $S \subseteq V$ such that every connected component of $G \setminus S$ contains at most one of s_i and t_i for any pair $s_i t_i \in$. In [**Sa5**] we gave the first non-trivial algorithm for MULTICUT running in time $O(1.987^n)$.

A subfamily $\mathcal{F}'$ of a set family $\mathcal{F}$ is said to *q-represent* $\mathcal{F}$ if for every $A \in \mathcal{F}$ and B of size q such that $A \cap B = \emptyset$ there exists a set $A' \in \mathcal{F}'$ such that $A' \cap B = \emptyset$. In a recent paper we gave an algorithm that given as input a family $\mathcal{F}$ of sets of size p together with an integer q, efficiently computes a q-representative family $\mathcal{F}'$ of $\mathcal{F}$ of size approximately $\binom{p+q}{p}$, and demonstrated several applications of this algorithm. In this paper, we consider the efficient computation of q-representative sets for *product* families $\mathcal{F}$. A family $\mathcal{F}$ is a product family if there exist families $\mathcal{A}$ and $\mathcal{B}$ such that $\mathcal{F} = \{A \cup B \ : \ A \in \mathcal{A}, B \in \mathcal{B}, A \cap B = \emptyset\}$. In [**Pa**] our main technical contribution is an algorithm which given $\mathcal{A}$, $\mathcal{B}$ and q computes a q-representative family $\mathcal{F}'$ of $\mathcal{F}$. The running time of our algorithm is *sublinear* in $|\mathcal{F}|$ for many choices of $\mathcal{A}$, $\mathcal{B}$ and q which occur naturally in several dynamic programming algorithms. We also gave an algorithm for the computation of q-representative sets for product families $\mathcal{F}$ in the more general setting where q-representation also involves independence in a matroid in addition to disjointness. This algorithm considerably outperforms the naive approach where one first computes $\mathcal{F}$ from $\mathcal{A}$ and $\mathcal{B}$, and then computes the q-representative family $\mathcal{F}'$ from $\mathcal{F}$. We also gave two applications of our new algorithms for computing q-representative sets for product families. The first is a $3.8408^k n^{O(1)}$ deterministic algorithm for the MULTILINEAR MONOMIAL DETECTION (k-MLD) problem. The second is a significant improvement of deterministic dynamic programming algorithms for "connectivity problems" on graphs of bounded treewidth.

In CLOSEST STRING problem we are given an alphabet Σ, a set of strings $S = \{s_1, s_2, \ldots, s_k\}$ over Σ such that $|s_i| = n$ and an integer d. The objective is to check whether there exists a string s over Σ such that $d_H(s, s_i) \leq d$, $i \in \{1, \ldots, k\}$, where $d_H(x, y)$ denotes the number of places strings x and y differ at. CLOSEST STRING is a prototype string problem. This problem together with several of its variants such as DISTINGUISHING STRING SELECTION and CLOSEST SUBSTRING have been extensively studied from parameterized complexity perspective. These problems have been studied with respect to parameters that are combinations of k, d, $|\Sigma|$ and n. However, surprisingly the kernelization question for these problems (for the versions when they admit fixed parameter tractable algorithms) was not studied at all. In [**B**] we filled this gap in the literature and did a comprehensive study of these problems from kernelization complexity perspective. We almost settled all the problems by either obtaining a polynomial kernel or showing that the problem does not admit a polynomial kernel assuming a complexity theoretic assumption.

A backdoor set of a CNF formula is a set of variables such that fixing the truth values of the variables from this set moves the formula into a polynomial-time decidable class. In this work we obtain several algorithmic results for solving d-SAT, by exploiting backdoors to d-CNF formulas whose incidence graphs have small treewidth. For a CNF formula ϕ and integer t, a *strong backdoor set* to treewidth t is a set of variables such that *each* possible partial assignment τ to this set reduces ϕ to a formula whose incidence graph is of treewidth at most t. A *weak backdoor set* to treewidth t is a set of variables such that there is a partial assignment to this set that reduces ϕ to a *satisfiable* formula of treewidth at most t. In [**Sa6**] our main contribution was an algorithm that, given a d-CNF formula ϕ and an integer k, in time $2^{(k)}|\phi|$,

- either finds a satisfying assignment of ϕ, or
- reports correctly that ϕ is not satisfiable, or
- concludes correctly that ϕ has no weak or strong backdoor set to treewidth t of size at most k.

As a consequence of the above, we showed that d-SAT parameterized by the size of a smallest weak/strong backdoor set to formulas of treewidth t, is fixed-parameter tractable. Prior to our work, such results were know only for the very special case of $t = 1$ (Gaspers and Szeider, ICALP 2012). Our result not only extended the previous work, it also improved the running time substantially. The running time of our algorithm is linear in the input size for every fixed k. Moreover, the exponential dependence on the parameter k is asymptotically optimal under Exponential Time Hypothesis (ETH). One of our main technical contributions was a linear time "protrusion replacer" improving over a $O(n \log^2 n)$-time earlier procedure . The new deterministic linear time protrusion replacer has several applications in kernelization and parameterized algorithms.

The *c-pumpkin* is the graph with two vertices linked by $c \geq 1$ parallel edges. A *c-pumpkin-model* in a graph G is a pair $\{A, B\}$ of disjoint subsets of vertices of G, each inducing a connected subgraph of G, such that there are at least c edges in G between A and B. In [**Sa7**] we focused on hitting and packing c-pumpkin-models in a given graph in the realm of approximation algorithms and parameterized algorithms. We gave an FPT algorithm running in time $2^{O(k)}n^{O(1)}$ deciding, for any fixed $c \geq 1$, whether all c-pumpkin-models can be hit by at most k vertices. This generalizes known single-exponential FPT algorithms for Vertex Cover and Feedback Vertex Set, which correspond to the cases $c = 1, 2$ respectively. Finally, we present an $O(\log n)$-approximation algorithm for both the problems of hitting all c-pumpkin-models with a smallest number of vertices, and packing a maximum number of vertex-disjoint c-pumpkin-models.

In [**Sh**] we present the first purely numerical (i.e., non-algebraic) subdivision algorithm for the isotopic approximation of a simple arrangement of curves. The arrangement is simple in the sense that any three curves have no common intersection, any two curves intersect transversally, and each curve is non-singular. A curve is given as the zero set of an analytic function $f : \mathbb{R}^2 \to \mathbb{R}^2$, and effective interval formsof f, $\frac{\partial f}{\partial x}$, $\frac{\partial f}{\partial y}$ are available. Our solution generalizes the isotopic curve approximation algorithms of Plantinga-Vegter (2004) and Lin-Yap (2009). We use certified numerical primitives based on interval methods. Such algorithms have many favorable properties: they are practical, easy to implement, suffer no implementation gaps, integrate topological with geometric computation, and have adaptive as well as local complexity.

In [**Ra4**], the study of vertex cover reconfiguration has been continued. In this problem, we are given two vertex covers of a graph, and the question is whether there is a way to obtain one from the other by a sequence of vertex removals and additions. It was known that this problem is $W[1]$-hard for general graphs when parameterized by ℓ, the length of the path. In this paper, it is shown that the problem remains $W[1]$-hard in bipartite graphs, NP-hard but fixed-parameter tractable in bounded degree graphs and polynomial time solvable in even-hole free graphs and cactus graphs.

In [**Ra5**] the complexity of the reconfiguration problem of graph coloring and constraint satisfaction problems are studied. In this problem, the aim is to modify a k-coloring of the graph to another, by recoloring one vertex at a time, while maintaining k-coloring throughout. It is shown that the problems is $W[1]$-hard when parameterized by ℓ, the length of the path, while it is fixed-parameter tractable when parameterized by $k + \ell$.

For the more general problem of ℓ-length bounded reconfiguration of satisfiable assignments of constraint satisfaction problems, we show it $W[2]$-hard when parameterized by ℓ, and fixed parameter tractable when parameterized by $k + \ell + r$ where k is the maximum domain size, and r is the arity of the constraints.

Automata, Logic and Concurrency

In earlier work, it was shown that a graph-theoretic condition called structural cyclicity enables extraction of syntax from a conflict-equivalent product system of automata. In [**Ph**] a pairing property is introduced in the syntax which allows connection to a broader class of product systems (called product systems with matching), where the conflict-equivalence is not statically fixed. These systems have been related to labelled free choice nets in the PhD thesis of Phawade (submitted, 2014).

Work continued on many applications of logic in computer science. [**R5**] consider theories of play in games where it is hard to prove completeness of type spaces for players, and shows the possibility of *constructible* player types when interaction is logically specified. In Web Service specification, an important issue is one of realizability: [**R2**] considers a local temporal logic which ensures that every definable choreography is realizable. [**R3**] considers a simple logical language for expressing certificates used in security protocols and how they can strengthen the Dolev Yao model. The proof theoretic study here offers more general questions for complexity of intuitionistic logics with the possibility of new paramaterizations ([**R1**]). Work was also done to survey research in epistemic temporal logics and present it in a uniform logical framework ([**R4**]).

Computational Complexity

The VP versus VNP question, introduced by Valiant, is probably the most important open question in algebraic complexity theory. Thanks to completeness results, a variant of this question, VBP versus VNP, can be succinctly restated as asking whether the permanent of a generic matrix can be written as a determinant of a matrix of polynomially bounded size. Strikingly, this restatement does not mention any notion of computational model. To get a similar restatement for the original and more fundamental question, and also to better understand the class itself, a complete polynomial for VP is needed. Ad hoc constructions yielding complete polynomials were known, but not natural examples in the vein of the determinant. In [**M2**], several variants of natural complete polynomials for VP are given, based on the notion of graph homomorphism polynomials.

Polynomial Identity Testing (PIT) algorithms have focussed on polynomials computed either by small alternation-depth arithmetic circuits, or by read-restricted formulas. Read-once polynomials (ROPs) are computed by read-once formulas (ROFs) and are the simplest of read-restricted polynomials. Building structures above these, in [**M1**], the following are

shown:

1. A deterministic polynomial-time non-black-box PIT algorithm for $\sum^{(2)} \cdot \prod \cdot \mathsf{ROF}$.

2. Weak hardness of representation theorems for sums of powers of constant-free ROPs and for 0-justified alternation-depth-3 ROPs.

In [**Ra2**], it is shown that odd cycle transversal in perfect graphs has a two approximation algorithm improving on the straightforward 3-approximation. This is done using the polyhedral structure of the clique polytope in perfect graphs. This is extended to show an $\lceil (r+1)/2 \rceil$ approximation algorithm for r-clique transversal in perfect graphs.

In [**A3**] we study the complexity of solving linear equations parameterized by the hamming weight of the solution. Given a system of linear equations over the binary field and an integer $t \geq 1$, we consider computing solutions of weight at most t and of weight exactly t, with t as parameter. A special aspect of our study is to show how the maximum multiplicity k of variable occurrences influences the complexity. We show a sharp dichotomy: for k more than 3 the problems are W[1]-hard. For k=2, the problems can be efficiently solved using matching algorithms.

In [**A2**] we study Geometric Graph Isomorphism: given two sets of n points A and B with rational coordinates in k-dimensional euclidean space, with k as fixed parameter, the problem is to decide if there is bijection between them that preserves all distances. We give a $O^*(k^{O(k)})$ time algorithm for the problem. This is substantially faster than the previous best time bound of $O^*(2^{O(k^4)})$ for the problem.

Graph Theory and Combinatorics

The problem of weighted stochastic matching (under the *probe-and-commit* model and subject to patience constraints) was studied. In [**Mu**], a natural greedy heuristic was analyzed and an upper bound of $\frac{2}{p_{min}^2}$ was obtained on the approximation factor of its performance. Here, p_{min} refers to the minimum edge probability. No previous analysis of any greedy algorithm for the weighted stochastic matching (under the probe-and-commit model) is known. Also, a lower bound of $\frac{2}{p_{min}}$ was established on the worst-case value of the approximation ratio of the greedy heuristic. Some other greedy variants were introduced and they were also shown to have unbounded approximation ratio even if we restrict ourselves to unweighted instances.

Currently, we are working on b-coloring and Harmonious coloring of graphs. It is noted that finding the harmonious coloring[2] or b-coloring[1] of a graph is NP-complete.

Also, we work on graceful labeling and antimagic labeling of trees. It was conjectured that "All trees are graceful" by Rosa[3],Ringel and Kotzig in the year 1967. Further, in 1990, Ringel and Hartsfield[4] conjectured that Every tree than than $K_2 is antimagic$.

References: [1] Robert W. Irving and David F. Manlove, The b-chromatic number of a graph, Disc. Appl. Math, 91, 1999, 127-141.

[2] J.E. Hopcroft and M.S. Krishnamoorthy, On the Harmonious coloring of graphs, SIAM J. Alg. Disc. M, Vol.4, No.3, 1983, pp 306-311.

[3] Rosa A,On certain valuations of the vertices of a graph, Theory of graphs, (International Symposium, Rome, July 1966), Gordon and Breach, N.Y. and Dunod Paris, (1967),349-355.

[4] N. Hartsfield and G. Ringel, Pearls in Graph Theory, Academic Press, INC., Boston, 1990, pp. 108-109, revised version 1994.

2.4.2 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, S. Raja, and AV Sreejith.
On lower bounds for multiplicative circuits and linear circuits in noncommutative domains.
In E. Hirsch et al, editor, *International Computer Science Symposium in Russia, CSR 2014*, page 65. Springer Verlag, Jun 2014.

[**A2**]
V. Arvind and Gaurav Rattan.
The parameterized complexity of geometric graph isomorphism.
In M. Cygan et al, editor, *Parameterized and Exact Computation, IPEC 2014*, page 51. Springer Verlag, Jul 2014.

[**A3**]
V. Arvind, J. Koebler*, S. Kuhnert*, and J. Toran*.
Solving linear equations parameterized by hamming weight.
In M. Cygan et al, editor, *Parameterized and Exact Computation, IPEC 2014*, page 39. Springer Verlag, Jul 2014.

[**A4**]
V. Arvind and S. Raja.
The complexity of bounded register and skew arithmetic computation.
In ask others Zhipeng Cai et al, editor, *Computing and Combinatorics Conference, COCOON 2014*, page 572. Springer Verlag, Aug 2014.

[**A5**]
V. Arvind, B. Das*, J. Koebler*, and S. Toda*.
Colored hypergraph isomorphism is fixed parameter tractable.
Algorithmica, **71(1)**, 120, 2015.

[**A6**]
V. Arvind and Y. Vasudev.

Isomorphism testing of boolean functions computable by constant-depth circuits.
Information and Computation, **239**, 3, 2014.

[**B**]
Manu Basavaraju, Fahad Panolan, Ashutosh Rai, M. S. Ramanujan, and Saket Saurabh.
On the kernelization complexity of string problems.
In *20th International Conference on Computing and Combinatorics (COCOON)*, page 141, Aug 2014.

[**K1**]
Sudeshna Kolay, Pranabendu Misra, M. S. M. Ramanujan*, and Saket Saurabh.
Parameterized approximations via d-skew-symmetric multicut.
In *39th International Symposium on Mathematical Foundations of Computer Science (MFCS)*, page 457, Aug 2014.

[**K2**]
Gautam Das*, Minati De*, Sudeshna Kolay, Subhas Nandy*, and Susmita Sur-Kolay*.
Approximation algorithms for maximum independent set of a unit disk graph.
Inf. Process. Lett., **115(3)**, 439, 2015.

[**K3**]
Esha Ghosh*, Sudeshna Kolay, Mrinal Kumar*, Pranabendu Misra, Fahad Panolan, Ashutosh Rai, and MS Ramanujan*.
Faster parameterized algorithms for deletion to split graphs.
Algorithmica, **71(4)**, 986, 2015.

[**M1**]
Meena Mahajan, B V Raghavendra Rao*, and Karteek Sreenivasaiah.
Building above read-once polynomials: identity testing and hardness of representation.
In *20th Annual International Computing and Combinatorics Conference COCOON, 4-6 Aug 2014, Atlanta, USA. LNCS 8591.*, pages 1–12. Springer, Aug 2014.

[**M2**]
Arnaud Durand*, Meena Mahajan, Guillaume Malod*, Nicolas de Rugy-Altherre*, and Nitin Saurabh.
Homomorphism polynomials complete for VP.
In Venkatesh Raman and S P Suresh, editors, *Foundations of Software Technology and Theoretical Computer Science FSTTCS*, pages 493–504. LIPIcs, Dec 2014.

[**Mi**]
Manu Basavaraju*, Fedor V. Fomin*, Petr A. Golovach*, Pranabendu Misra, M. S. Ramanujan*, and Saket Saurabh.
Parameterized algorithms to preserve connectivity.
In *41st International Colloquium on Automata, Languages, and Programming (ICALP)*, page 800, Jul 2014.

[**Mu**]
Joydeep Mukherjee and C. R. Subramanian.
Greedy heuristics and stochastic matchings.
2015.
(Submitted).

[**P**]
Sethuraman G. Gurusamy*, **Ragukumar P. Pandurangan, and Peter J. Slater***.
Any tree with m edges can be embedded in a graceful tree with less than 4m edges and in a planar graceful graph.
Discrete Mathematics, 2014.
(Submitted).

[**Pa**]
Fedor V. Fomin*, **Daniel Lokshtanov***, **Fahad Panolan, and Saket Saurabh**.
Representative sets of product families.
In *22th Annual European Symposium on Algorithms (ESA)*, page 443, Sep 2014.

[**Ph**]
Ramchandra Phawade and Kamal Lodaya.
Kleene theorems for labelled free choice nets.
In Daniel Moldt and Heiko Rölke, editors, *Proc. 8th International Workshop on Petri Nets and Software Engineering, Tunis*, pages 75–89. CEUR Workshop Proceedings, Jun 2014.

[**R1**]
R. Ramanujam and S. P. Suresh*.
Intuitionistic modal logics: efficient fragments and parameterized complexity.
In M. Fellows and S. Gaspers, editors, *Parameterized Complexity and Computational Reasoning*, Aug 2014.

[**R2**]
R. Ramanujam and S. Sheerazuddin*.
A local logic for realizability in web service choreographies.
In Maurice ter Beek and Antonio Ravara, editors, *Worldwide Web Verification*, page 16. ENTCS Series, Vol 634, Aug 2014.

[**R3**]
R. Ramanujam, Vaishnavi Sundararajan*, **and S. P. Suresh***.
Extending Dolev-Yao with assertions.
In *ICISS 2014*, page 50. Springer, Dec 2014.

[**R4**]
Clare Dixon*, **Claudia Nalon***, **and R. Ramanujam**.
Knowledge and time.
In van der Hoek van Ditmarsch, Halpern and Kooi, editors, *Handbook of Epistemic Logic*, page 205. College Publications. UK, 2015.

[**R5**]
R. Ramanujam.
Logical player types for a theory of play.
In A. Baltag and S. Smets, editors, *Johan van Benthem on Logical and Informational Dynamics*, page 509. Springer, 2014.

[**Ra1**]
Hicham El-Zein*, J. Ian Munro*, and Venkatesh Raman.
Tradeoff between label space and auxiliary space for representation of equivalence classes.
In Hee-Kap Ahn and Chan-Su, editors, *Proceedings of International Symposium on Algorithms and Computation (ISAAC)*, page 543. Springer Verlag, Dec 2014.

[**Ra2**]
Samueal Fiorini*, R. Krithika*, N. S. Narayanaswamy*, and Venkatesh Raman.
Lp approaches to improved approximation algorithm for clique traversal in perfect graphs.
In Andreas S. Schulz and Dorothea Wagner, editors, *European Symposium on Algorithms*, page 430. Springer Verlag, Sep 2014.

[**Ra3**]
Moshe Lewinstein*, Ian Munro*, Pat Nicholson*, and Venkatesh Raman.
Improved explicit data structures in the bitprobe model.
In Andreas S. Schulz and Dorothea Wagner, editors, *European Symposium on Algorithms*, page 630. Springer Verlag, Sep 2014.

[**Ra4**]
Amer Mouawad*, Naomi Nishimura*, and Venkatesh Raman.
Vertex cover reconfiguration and beyond.
In Shin Ahn, Hee-Kap and Chan-Su, editors, *International Symposium on Algorithms and Computation (ISAAC)*, page 452. Springer Verlag, Dec 2014.

[**Ra5**]
Paul Bonsma*, Naomi Nishimura*, Amer Mouawad*, and Venkatesh Raman.
The complexity of bounded length graph recoloring and csp reconfiguration.
In *International Symposium on Parameterized and Exact Computation (IPEC)*, page 110. Springer Verlag, Sep 2014.

[**Ra6**]
Venkatesh Raman and S. P. Suresh*.
Proceedings of the 34th international conference on foundations of software technology and theoretical computer science. Editors.
2014.

[**Ra7**]
Daniel Lokshtanov*, N. S. Narayanaswamy*, Venkatesh Raman, M. S. Ramanujan, and Saket Saurabh.
Faster parameterized algorithms using linear programming.
ACM Transaction on Algorithms, **11(2)**, 1, 2014.

[**S**]
Ruiwen Chen*, **Valentine Kabanets***, **and Nitin Saurabh**.
An improved deterministic sat algorithm for small de Morgan formulas.
In Zoltn sik Ersbet Csuhaj-Varj, Martin Dietzfelbinger, editor, *Proceedings of 39th International Symposium on Mathematical Foundations of Computer Science (MFCS)*, pages 165–176. Springer Berlin Heidelberg, Aug 2014.

[**Sa1**]
Marek Cygan*, **Daniel Lokshtanov***, **Marcin Pilipczuk***, **Michal Pilipczuk***, **and Saket Saurabh**.
Minimum bisection is fixed parameter tractable.
In *46th Annual Symposium on the Theory of Computing (STOC)*, page 323, May 2014.

[**Sa2**]
Archontia C. Giannopoulou*, **Daniel Lokshtanov***, **Saket Saurabh, and Ondra Suchy***.
Tree deletion set has a polynomial kernel (but no $opt^{O(1)}$ approximation).
In *34th International Conference on Foundation of Software Technology and Theoretical Computer Science (FSTTCS)*, page 85, Dec 2014.

[**Sa3**]
Manu Basavaraju*, **Fedor V. Fomin***, **Petr A. Golovach***, **and Saket Saurabh**.
Connecting vertices by independent trees.
In *34th International Conference on Foundation of Software Technology and Theoretical Computer Science (FSTTCS)*, page 73, Dec 2014.

[**Sa4**]
Daniel Lokshtanov*, **Marcin Pilipczuk***, **Michal Pilipczuk***, **and Saket Saurabh**.
Fixed-parameter tractable canonization and isomorphism test for graphs of bounded treewidth.
In *55th IEEE Annual Symposium on Foundations of Computer Science (FOCS)*, page 186, Oct 2014.

[**Sa5**]
Daniel Lokshtanov*, **Saket Saurabh, and Ondra Suchy***.
Solving multicut faster than 2^n.
In *22th Annual European Symposium on Algorithms (ESA)*, page 666, Sep 2014.

[**Sa6**]
Fedor V. Fomin*, **Daniel Lokshtanov***, **Neeldhara Misra***, **M. S. Ramanujan***, **and Saket Saurabh**.
Solving d-sat via backdoors to small treewidth.
In *Twenty-Sixth Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, page 630, Jan 2015.

[**Sa7**]
Gwenael Joret*, **Christophe Paul***, **Ignasi Sau***, **Saket Saurabh, and Stephan**

Thomasse*.
Hitting and harvesting pumpkins.
SIAM J. Discrete Math., **28(3)**, 1363, 2014.

[**Sh**]
Jyh-Ming Lien*, Vikram Sharma, Gert Vegter*, and Chee Yap*.
Isotopic arrangement of simple curves: An exact numerical approach based on subdivision.
In Hoon Hong and Chee Yap, editors, *Mathematical Software - ICMS 2014 - 4th International Congress, Seoul, South Korea, August 5-9, 2014.*, page 277. Springer, Aug 2014.

[**Su1**]
C. R. Subramanian.
Probabilistic arguments in graph coloring (invited talk).
In Sumit Ganguly and Ramesh Krishnamurthy, editors, *Proceedings of the First International Conference on Algorithms and Discrete Mathematics (CALDAM-2015), February 8-10, 2015, LNCS Volume 8959*, pages 1–8. Springer International Publishing, Feb 2015.

[**Su2**]
Kunal Dutta* and C. R. Subramanian.
Induced acyclic tournaments in random digraphs : Sharp concentration, thresholds and algorithms.
Discussiones Mathematicae Graph Theory, **34(3)**, 467–495, 2014.

2.5 Student Programmes

2.5.1 Degrees Awarded

Doctoral Degrees Awarded during 2014 – 2015

Mathematics

Name: **Anilkumar, C. P.**
Thesis Title: Orbits of Pairs in Finite Modules over Discrete Valuation Rings and Permutation Representations
Thesis Advisor: Prasad, Amritanshu
University: HBNI

Name: **Tupurani, Srikanth**
Thesis Title: Skein theories for finite depth subfactor planar algebras
Thesis Advisor: Kodiyalam, Vijay
University: HBNI

Physics

Name: **Pal, Rajarshi**
Thesis Title: Aspects of joint measurement and interrelation of quantum correlations and channels
Thesis Advisor: Ghosh, Sibasish
University: HBNI

Name: **Pathak, Sudhir N.**
Thesis Title: Large scale behaviour of the freely cooling granular gas
Thesis Advisor: Rajesh, R.
University: HBNI

Theoretical Computer Science

Name: **Sreenivasaiah, Karteek**
Thesis Title: On verifying proofs in constant depth, and polynomial identity testing
Thesis Advisor: Mahajan, Meena
University: HBNI

Name: **Dutta, Kunal**
Thesis Title: On certain invariants of random digraphs and uniform hypergraphs
Thesis Advisor: Subramanian, C. R.
University: HBNI

Doctoral Theses Submitted during 2014 – 2015

Mathematics

Name: **Dolai, Dhriti Ranjan**
Thesis Title: Spectral statistics for Anderson Model with decaying randomness and singular potentials.
Thesis Advisor: Krishna, M.
University: HBNI

Name: **Chakraborty, Prateep**
Thesis Title: Formality of Certain CW complexes and applications
Thesis Advisor: Sankaran, Parameswaran
University: HBNI

Physics

Name: **Kundu, Joyjit**
Thesis Title: Phase transitions in systems of hard anisotropic particles on lattices
Thesis Advisor: Rajesh, R.
University: HBNI

Theoretical Computer Science

Name: **Phawade, Ramchandra B.**
Thesis Title: Labelled free choice Petri nets, finite Product Automata, and Expressions
Thesis Advisor: Lodaya, Kamal
University: HBNI

Name: **Vasudev, Yadu**
Thesis Title: The complexity of some exact and approximate isomorphism problems
Thesis Advisor: Arvind, V.
University: HBNI

Master of Philosophy Thesis awarded during 2014 – 2015

Mathematics

Name: **Raman, Viswanathan**
Thesis Title: Implementation of Number Field Sieve
Thesis Advisor: Srinivas, K.
University: HBNI

Masters Degrees Awarded during 2014 – 2015

Physics

Name: **Cherian, Prathik J.**
Thesis Title: Entanglement and Decoherence in Two Site Bose-Hubbard Model
Thesis Advisor: Ghosh, Sibasish
University: HBNI

Name: **Chakraborty, Sagnik**
Thesis Title: Reality of Quantum States
Thesis Advisor: Ghosh, Sibasish
University: HBNI

Theoretical Computer Science

Name: **Tawari, Anuj**
Thesis Title: Recent Trends in Arithmetic Complexity
Thesis Advisor: Mahajan, Meena
University: HBNI

Name: **Lodha, Neha**
Thesis Title: Consensus through Public Communication
Thesis Advisor: Ramanujam, R.
University: HBNI

Name: **Swaroop, N.P.**
Thesis Title: τ - Conjecture of lower bounds on arithmetic circuits
Thesis Advisor(s): Sharma, Vikram & Arvind, Vikraman
University: HBNI

Masters Thesis submitted during 2014 – 2015

Physics

Name: **Oak, Prafulla**
Thesis Title: c-theorem and some peripheral aspects
Thesis Advisor: Sathiapalan, Balachandran
University: HBNI

2.5.2 Lecture Courses During 2014 – 2015.

The following **lecture courses** were offered during 2014 – 2015.

Course Title	Period	Lecturer
Computational Biology		
Biology-1	Aug-Sep 2014	Samal, Areejit
Physical Biology	Aug-Nov 2014	Menon, Gautam I.
Biology-2	Jan-Feb 2015	Samal, Areejit
Infectious Diseases	Jan-Apr 2015	Menon, Gautam I.
Mathematics		
Algebra II	Jan-Apr 2014	Raghavan, K. N.
Topology I	Jan-Apr 2015	Gun, S.
Topology-II	Jan-Apr 2014	Chatterjee, Pralay
Analytic Number theory-I	Aug-Nov 2014	Mukhopadhyay, Anirban
Complex Analysis	Aug-Dec 2014	Srinivas, K.
Lie Algebras and their Representations	Aug-Nov 2014	Raghavan, K. N.
Real Analysis	Aug-Dec 2014	Sunder, V. S.
Algebra II	Jan-Apr 2015	Kodiyalam, Vijay
Analytic number theory-II	Jan-Apr 2015	Mukhopadhyay, Anirban
Topology II	Jan-Apr 2015	Nagaraj, D. S.
Physics		
Advanced Particle Physics	Jan-Apr 2014	Sinha, Nita
Gravitation and Cosmology	Jan-Apr 2014	Sathiapalan, Balachandran
Nonlinear Dynamics	Jan-Apr 2014	Sinha, Sitabhra
Quantum Information Theory (a reading course)	Jan-May 2014	Ghosh, Sibasish
Quantum Information Theory (reading course)	Jan-May 2014	Ghosh, Sibasish
Quantum Mechanics II	Jan-Apr 2014	Mukhopadhyay, Partha
Statistical Field Theory	Jan-Apr 2014	Rajesh, R.
Systems Biology	Jan-Apr 2014	Sinha, Sitabhra
Advanced Statistical Mechanics	May-Nov 2014	Ray, Purusattam
Quantum Mechanics (in IMSc School of Theoretical Physics)	Jun-Jun 2014	Rajasekaran, G.
Quantum Mechanics I	Aug-Nov 2014	Date, G.
Classical Theory of Fields	Jan-Apr 2015	Ashok, Sujay K.
Computational Neuroscience	Jan-Apr 2015	Sinha, Sitabhra
Gravitation and Cosmology	Jan-Apr 2015	Sathiapalan, Balachandran
Nonlinear Dynamics	Jan-Apr 2015	Sinha, Sitabhra
Quantum Information Theory (reading course)	Jan-May 2015	Ghosh, Sibasish

Quantum Mechanics II	Jan-Apr 2015	Mukhopadhyay, Partha
Statistical Field Theory	Jan-Apr 2015	Ray, Purusattam
Systems Biology	Jan-Apr 2015	Sinha, Sitabhra

Theoretical Computer Science

Advance Graph Algorithms	Jan-Apr 2014	Saurabh, Saket
Computational Complexity	Jan-May 2014	Mahajan, Meena B.
Concurrency	Jan-May 2014	Lodaya, Kamal
Infinite discrete structures	Jan-Apr 2014	Ramanujam, R.
Linear Programming and Combinatorial Optimization	Feb-May 2014	Sharma, Vikram
Algorithms for solving polynomial equations	Aug-Dec 2014	Sharma, Vikram
Approximation Algorithms	Aug-Dec 2014	Subramanian, C. R.
Design and Analysis of Algorithms	Aug-Dec 2014	Raman, Venkatesh
Discrete Mathematics	Aug-Dec 2014	Mahajan, Meena
Kernelization	Aug-Dec 2014	Raman, Venkatesh
Logic I	Aug-Dec 2014	Ramanujam, R.
Logics of programs	Aug-Dec 2014	Lodaya, Kamal
Model theory	Aug-Dec 2014	Ramanujam, R.
Theory of Computation	Aug-Dec 2014	Lodaya, Kamal
Computational Complexity	Jan-Mar 2015	Arvind, V.
Dynamic Graph Algorithms	Jan-Apr 2015	Bhattacharya, Sayan S.
Infinite discrete structures	Jan-Apr 2015	Ramanujam, R.
Parameterized Complexity	Jan-Apr 2015	Saurabh, Saket

In addition, the following **lecture courses** were offered during 2014 – 2015 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

Course Title	Period	Lecturer

Physics

Particle Physics	Jan-Apr 2014	Rajasekaran, G.
Quantum Mechanics I	Aug-Nov 2014	Rajasekaran, G.
Quantum Mechanics II	Jan-Apr 2015	Rajasekaran, G.

2.5.3 Summer Students

Every summer, a small number of students from various institutes/universities come to our instituteand 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, 2014 - Mar, 2015.

Student	Faculty

Computational Biology

Dev, Sunipa, IISER, Kolkata	Siddharthan, Rahul
Kashyab, Purba, IISER, Kolkata	Siddharthan, Rahul
Majumdar, Abhishek, IIT, Roorkee	Sinha, Sitabhra
Piduri, Chandrahas,	Sinha, Sitabhra

Mathematics

Negi, Kajal, IIT, Kanpur	Balasubramanian, R.
Sannyasi, Kunal, West Bengal	Balasubramanian, R.
Saini, Rijul, CMI, Chennai	Balasubramanian, R.
Jain, Tanay, CMI, Chennai	Balasubramanian, R.
Dey, Satavisha, IITM, Chennai	Gun, Sanoli
Kar, Arpita, CMI, Chennai	Gun, Sanoli
Ray, Mishty, IISER, Mohali	Gun, Sanoli
Singh, Jyotiraditya, NISER, Bhubaneswar	Gun, Sanoli
Rajeev Tawri, Krutika, BITS Pilani, Goa	Mohari, Anilesh
Kansal, Arpit, Indian Institute of Technology, Delhi	Raghavan, K. N.
Singh, Jagdeep, IISER, Mohali	Raghavan, K. N.
Barot, Aman, CMI, Chennai	Sunder, V.S.
Das, Nilanjan, IIT, Kanpur	Sunder, V.S.
Sangeetha, A., SIET College, Chennai	Sunder, V.S.

Theoretical Physics

Bharadwaj, Lakshya, CMI, Chennai	Ashok,Sujay
Roy, Anarta, IISER, Bhopal	Ghosh, Sibasish
Sarangi, Sohan, IISER–Pune	Ghosh, Sibasish
Saravanan, D., University of Madras	Ghosh, Sibasish
Uprety, Sagar, BITS, Pilani	Ghosh, Sibasish
Baskaran Balakumar, Loyola College, Chennai	Hassan, Raghbib Syed
Syed, Rafeeq, NISER, Bhubaneswar	Hassan, Raghbib Syed
Sanal, Athira, MCC College, Tambaram	Indumathi, D.
Varghese, Minu, IISER, Bhubaneswar	Menon, Gautam I.
Das, Bharati Sanjeeda, Assam	Nemani, V.S.
Nikkin, D., SSN Engineering	Sathiapalan Bala
Mitra, Soumik, West Bengal	Shankar, R.
Verma, Sonali, Uttar Pradesh	Shankar, R.
Banerjee, Abhishek, IISER, Kolkata	Sinha, Nita
Reddy, Abhiram, NISER, Bhubaneswar	Vemparala Vani
Sahoo, Abhilash, IISER, Kolkata	Vemparala, Vani

Theoretical Computer Science

Kaushik, P., SSN College, Chennai	Raman, Venkatesh
Krishnamurthy, Kumar Sanath, CMI, Chennai	Raman, Venkatesh
Naveen, Kodali, BITS Pilani, Hyderabad	Raman, Venkatesh
Umesh, Megha, SSN College, Chennai	Raman, Venkatesh
Varsha, P., Anna University	Raman, Venkatesh
Venkatraghavan, S., SSN College, Chennai	Raman, Venkatesh
Anish, V., PSG College of Technology	Saurabh, Saket
Aparna, M., NITK, Surathkal	Saurabh, Saket
Bajpal, Preetish, ISI, Kolkata	Saurabh, Saket
Ghosh, Sebati, ISI, Kolkata	Saurabh, Saket
Gupta, Chetan, CMI, Chennai	Saurabh, Saket
Manasi, K.S., PSG College of Technology	Saurabh, Saket
Potukuchi, Aditya, CMI, Chennai	Saurabh, Saket
Rajeswaran, Aravind, IIT Madras	Saurabh, Saket
Ramachandran, Sabareesh, Indian Institute of Science	Saurabh, Saket
Ramanathan, Varun, CMI, Chennai	Saurabh, Saket
Ravichander, Abhilasha, PES Institute of Technology	Saurabh, Saket
Sarkar, Soumajyoti, Bengal Engg Science Univ., Shibpur	Saurabh, Saket
Shrivasatva, Ashish, IIT Madras	Saurabh, Saket
Sood, Saksham, SRM University, Chennai	Saurabh, Saket

2.5.4 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, 2014 - Mar, 2015.

Student	Faculty

Mathematics

Abhyankar, Neeraja, IIT Madras	Prasad, Amritanshu
Chowdhury, Nilesh, IIT–Gwahati	Ghosh, Sibasish

2.6 Honours and Awards

Chakraborty, Partha S. was awarded Swarna Jayanti Fellowship 2012-13, for 2014, by the DST.

Chakraborty, Partha S. was awarded NASI-SCOPUS Young Scientist, 2014.

Samal, Areejit was awarded Ramanujan Fellowship, for 2015, by the Department of Science and Technology (DST), India.

Samal, Areejit was awarded Simons Associateship, for 2015, by the The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy for the period 2015-2020.

Samal, Areejit was awarded Max Planck-DST Mobility Grant, for 2015, by the Max Planck Society (MPG) and Indo-German Science and Technology Centre (IGSTC) for the period 2015-2018.

Chandrashekar was awarded Ramanujan Fellowship, for 2015.

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.

Associate Editor of ACM Transactions on Computation Theory

Editor of Computational Complexity Column of the Bulletin of the European Association of Theoretical Computer Science.

Ashok, Sujay K.

Convener of Local Organising Committee for Mock Modular Forms and Physics held at IMSc during Apr 14 – Apr 18, 2014.

Convener of Local Organising Committee for Indian Strings Meeting held at Puri during Dec 15 – Dec 20, 2014.

Bagchi, Manjari

Life membership of Astronomical Society of India (ASI) during Mar – Mar, 2015.

Balasubramanian, R.

Member of Governing council of Institute of mathematics and applications, Bhubaneshwar during Mar 2014 – Mar 2015.

Chairman of Governing council of Chennai Mathematical institute

Member of DST INSPIRE Faculty award (Mathematics)

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, Board of Management of R,C.Bose centre for cryptology and security, Indian Statiscal Institute, kolkatta

Chairman of National Board for Higher Mathematics

Chairman of Governing Council of Chennai Mathematical Institute during Aug 2014 – Mar 2015.

Member of Review of the mathematics Department of NISER, Bhuvaneshwar during Aug – Aug, 2014.

Chairman of Advisory committee of the Shantiswarup Bhatnagar prize in Mathematical Sciences during Sep – Sep, 2014.

Convener of Local Organising Committee for 18 th workshop on elliptic curve cryptology held at IMSc during Oct 8 – Oct 10, 2014.

Chairman of Research Council of SAG during Nov 2014 – Mar 2015.

Member of Governing council of Indian statistical institute, Kolkatta during Nov 2014 – Mar 2015.

Convener of Local Organising Committee for Annual meeting of the Indian Academy of Science held at IIT Madras during Nov 7 – Nov 9, 2014.

Member of Review committee of mathematics Department of IISER Kolkatta during Mar – Mar, 2015.

Chaudhuri, Pinaki P.

Convener of Local Organising Committee for Fracture: From Micro-Scale Processes to Macro-Scale Response held at IMSc during Jan 6 – Jan 10, 2015.

Date, G.

President of Indian Association for General Relativity and Gravitation

Ghosh, Sibasish

Invited speaker at Computer Society of India, Chennai Chapter on Sep 20, 2014. Gave a pedagogical talk on Quantum Computation, entitled, "Introduction to Quantum Computing and Its Potentials".

Ganguli, Saibal

Selected as AMS Reviewer, for the year 2014, by the American Mathematical Society. 12 reviews in 10 months

Gun, S.

Convener of International Organising Committee for Winter School on modular functions in one and several variables held at Goa University, Goa during Dec 7 – Dec 17, 2014.

Managing Editor at Institute of Mathematical Sciences on Mar 15, 2015. IMSc Lecture Notes Series

Kesavan, S.

Member of Advisory Committee, Centre for Excellence in Mathematics (CEMS), Kumaon University, Almora. during Mar 2013 – Apr 2014.

Member of Editorial Board, Mathematics Newsletter, Ramanujan Mathematical Society

Member of Selection Committee, Abel Visiting Scholars Programme, International Mathematical Union

Member of Steering Board, Indo-French Centre for Applied Mathematics (IFCAM)

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

Member of Academic Council, Chennai Mathematical Institute

Member of National Board for Higher Mathematics

Chair of UGC Review Committee (Mathematics), IISc, Bangalore

Member of Editorial Board, Journal of the Kerala Mathematical Association

Fellow of Forum d' Analystes

Reviewer of Mathematical Reviews

Member of Editorial Board, Proceedings of the Indian Academy of Sciences, Mathematical Sciences during Jan – Mar, 2015.

Krishna, M.

Member of Editorial Board, Proceedings of the Indian Academy of Sciences (Math Sci) during Jan – Mar, 2015.

Lodaya, Kamal

President of Association for logic in India during Feb 2013 – Jan 2015.

Member of Programme committee, 59th European logic colloquium, Vienna during Sep 2013 – Jul 2014.

Member of Programme committee, 11th Theory and applications of models of computation conference, Chennai during Nov 2013 – Apr 2014.

Member of Programme committee, 14th Automata and Formal Languages conference, Szeged during Mar – May, 2014.

Member of 21st Temporal representation and reasoning symposium, Verona during Apr – Sep, 2014.

Member of Programme committee, 34th FSTTCS, New Delhi during Jul – Dec, 2014.

Member of Programme committee, 14th Asian logic conference during Aug 2014 – Jan 2015.

Mahajan, Meena

Convener of International Organising Committee for Indo-UK Workshop on Computational Complexity Theory held at IMSc during Jan 5 – Jan 9, 2015.

Menon, Gautam I.

Member of Local Organising Committee for Dynamics Days Asia Pacific held at Held jointly between IMSc and IITM during Jul 21 – Jul 24, 2014.

Mukhopadhyay, Partha

Member of Local Organising Committee for Indian Strings Meeting 2014 held at Blue Lily Hotel, Puri, India during Dec 15 – Dec 20, 2014.

Nagaraj, D. S.

Convener of National Organising Committee for AIS on Schemes and Cohomology. held at KSOM, Calicut, Kerala during Dec 1 – Dec 19, 2014.

Prabhakar, Varuni

Maths activity sessions for schools at Besant Arundale Senior Secondary School, Kalakshetra on Sep 1, 2014. Running regular Mathematics activity sessions for students from various age groups at BASS School to help give a hands on understanding of the subject.

Prasad, Amritanshu

Convener of Local Organising Committee for Sage Days workshop on combinatorics and representation theory held at IMSc during Aug 14 – Aug 17, 2014.

Conducted a workshop for school teachers at P S Senior Secondary school, Mylapore on Jan 5, 2015. The workshop was an exploration of the Platonic solids using origami models. Part of GANIT (Growing Aptitude in Numerical Innovations Training), organized by teachers of the school.

Chief guest at Patrician College, Chennai on Feb 5, 2015. Mathematical Exhibition of the Ramanujan Mathematics Association.

Raghavan, K. N.

Secretary of Forum D'Analystes during Apr 2012 – Mar 2015.

Convener of National Organising Committee for Annual Foundational School–II held at CEMS, Almora during May 1 – May 28, 2014.

Convener of National Organising Committee for Mathematics Workshop for Students (MWS) 2014 held at Vellalar College for Women, Erode during Jun 25 – Jun 27, 2014.

Convener of Local Organising Committee for Aspects of Mathematics, a two-day mathematics programme held at IMSc during Jun 30 – Jul 1, 2014.

Acted as "mentor" at DST sponsored INSPIRE program at Vignan University, Guntur on Jun 5, 2014. Lectured to school students on mathematics and on opportunities for higher studies in mathematics

Mentor in DST INSPIRE programme for school children at Veltech University, Avadi, Chennai on Jul 3, 2014. Lectured to school students on elementary number theory and also about opportunities for higher education in mathematics.

Mentor in DST INSPIRE programme for school students at Madras University, Guindy

Campus on Aug 25, 2014. Lectured to school students on some elementary number theory and also about opportunities for higher education in mathematics.

Convener of Local Organising Committee for Enriching Mathematics Education 2014 held at IMSc during Oct 16 – Oct 17, 2014.

Mentor in DST INSPIRE programme for school students at Madras University, Guindy Campus on Oct 31, 2014. Lectured to school students on some elementary number theory and also talked about opportunities for higher education in mathematics.

Guest lecture to senior secondary school students at Bala Vidya Mandir Senior Secondary School, Adyar, Chennai on Nov 21, 2014. Gave a lecture on "permutations and combinations".

Convener of Local Organising Committee for One Per Cent 2014 held at IMSc on Nov 28, 2014.

Mentor in DST INSPIRE programme for school students at SRM University, Kattankulathur, Chennai on Dec 30, 2014. Gave a lecture to school students on fair division of a cake.

Guest lecture during school maths week at Vidya Mandir Senior Secondary School, Mylapore, Chennai on Dec 19, 2014. Gave a lecture to X standard students on fair division of a cake.

Mentor in DST INSPIRE programme for school students at Madras University, Guindy Campus on Dec 29, 2014. Lectured to school students on fair division of a cake and also about opportunities for higher education in mathematics.

Mentor in DST INSPIRE programme for school children at Chennai Institute of Technology, Kundrathur, Chennai on Feb 23, 2015. Lectured to school students on some elementary number theory and also about opportunities for higher education in mathematics

Convener of Local Organising Committee for Enriching Collegiate Education 2014 held at IMSc during Mar 11 – Mar 13, 2015.

Rajasekaran, G.

Convener of INSA (Chennai Chapter)

Member of Academic Council, CMI

Chairman of Board of Studies in Physics, CMI

Convener of Local Organising Committee for INSA Award Function (IIT, Chennai) 4 August 2014 held at IIT, Chennai on Aug 4, 2014.

Popular Science in TV at New Delhi on Sep 3, 2014. Participated in a live TV panel

discussion on INO and Science in general, in the Rajya Sabha TV.

Popular Science Talk at Inter-Institutional Centre for High Energy Physics,Transition Campus, Madurai on Sep 20, 2014. Talked in Tamil on "Another Great Institution For Madurai" at an INO outreach meeting.

Science in Tamil at Centre for Tamil Culture, Coimbatore on Oct 24, 2014. Talked on the need for writing many popular science books in Tamil. The Centre has accepted this suggestion and is willing to support it.

Member of Local Organising Committee for Annual Meeting of the Indian Academy of Science, IIT, Chennai, 7-9 Nov 2014 held at IIT, Chennai during Nov 7 – Nov 9, 2014.

Lectures at Department of Nuclear Physics, University of Madras on Jan 1, 2015. Lectures on Quantum Mechanics given on alternate Sundays throughout the year.

Popular Science in TV at Madurai and Chennai on Jan 1, 2015. Gave many TV interviews in Tamil on INO and Science in general, on several days.

Lectures and Discussion at Rajarajan Institute of Science Education,Madurai on Jan 17, 2015. Gave lecture in Tamil on INO and answered questions

Popular Science Talk at A village near Kalpakkam on Jan 31, 2015. Gave two talks in Tamil to teachers of the Reward Trust Schools (run by IGCAR scientists): 1. Science and Beyond Science 2.INO

Convener of Local Organising Committee for Indian Science Congress 2015, University of Mumbai, 3-7 January 2015, Symposium on HEP held at University of Mumbai during Jan 3 – Jan 7, 2015.

Article in Tamil at Madurai on Feb 1, 2015. "More on INO" in Tamil was published in Muzhumai Ariviyal Udayam, 8, 6153 (2015)

Popular Science Talk at IMSc on Feb 8, 2015. Gave a talk in Tamil about INO in a meeting organized by Tamil Nadu Science Forum

Raman, Venkatesh

Co-Chair of Program Committee of 34th FSTTCS conference during Nov 2013 – Dec 2014.

Convener of National Organising Committee for Workshop on New Developments in Exact Algorithms and Lower Bounds held at IIT Delhi during Dec 13 – Dec 14, 2014.

Ramanujam, R.

Member of Senate of IIIT-D&M, Kanchipuram during Apr 2011 – Mar 2015.

Member of National Resource Group of Sarva Shikhsha Abhyan, MHRD during Apr 2012 – Mar 2015.

Member of Board of studies in Computer Science, Stella Maris College, Chennai during Apr 2012 – Mar 2015.

Member of Academic Council of National Institute of Education, Mysore during Apr 2012 – Mar 2015.

Member of Court of Central University of Tamil Nadu, Tiruvarur during Apr 2013 – Mar 2015.

Member, Program Committee of Joint Meeting of the 23rd EACSL Annual Conference on Computer Science Logic and the 29th ACM/IEEE Symposium on Logic in Computer Science during Aug 2013 – Aug 2014.

Member of Governing Board of Vigyan Prasar, DST, during Aug 2013 – Mar 2015.

Member, Program Committee of Logical Aspects of Multi-Agent Systems during Jan – Aug, 2014.

Member, Program Committee of 5th International Symposium on on Games, Automata, Logics, and Formal Verification during Feb – Sep, 2014.

Member, Program Committee of 6th Indian Conference on Logic and its Applications during Jun 2014 – Feb 2015.

Convener of International Organising Committee for Second Conference on Creative Mathematical Sciences Communication held at IMSc during Dec 9 – Dec 12, 2014.

Convener of International Organising Committee for Asian Logic conference held at IIT, Bombay during Jan 5 – Jan 8, 2015.

Convener of National Organising Committee for Instructional Seminar on Logical Aspects of Multi-Agent Systems held at IMSc during Feb 1 – Feb 3, 2015.

Ray, Purusattam

Convener of National Organising Committee for Fracture: From Micro-scale Processes to Macro Scale Response held at IMSc during Jan 6 – Jan 9, 2015.

Samal, Areejit

Director of Workshop on the Economy of a Cell: Resource Allocation, Trade-Offs and Efficiency in Living Systems held at The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy during Jun 23 – Jun 27, 2014.

Sankaran, Parameswaran

Member of Board of Studies, Ramanujan School of Mathematical Sciences, Pondicherry University, Pondicherry during Jan – Apr, 2014.

Member of Board of Studies, Central University of Kerala, Kasargode, Kerala.

Convener of Local Organising Committee for Research in Mathematics held at IMSc on Nov 6, 2014.

Saurabh, Saket

Committee Member of Program committee of 25th International Symposium on Algorithms and Computation(ISSAC) during Jun – Dec, 2014.

Committee member of Program Committee of 9th International Symposium on Parameterized and Exact Computation (IPEC) during Jun – Sep, 2014.

Convener of International Organising Committee for Summer school on parameterized algorithms and complexity held at Bedlewo, Poland during Aug 17 – Aug 22, 2014.

Co-Convener of International Organising Committee for New Developments in Exact Algorithms and Lower Bounds – Pre FSTTCS workshop held at New Delhi during Dec 13 – Dec 14, 2014.

Sinha, Sitabhra

Member of Editorial Board of Frontiers in Fractal Physiology

Adjunct Faculty of National Institute of Advanced Studies

Member of Frontiers in Physics Editorial Board

Chennai Node Coordinator of National Network of Mathematical and Computational Biology

Convener of Local Organising Committee for Dynamics Days Asia Pacific 08 held at IMSc during Jul 21 – Jul 24, 2014.

Convener of Local Organising Committee for IMSc-IITB-IISERP Research Meeting on Physiological Modeling held at IMSc during Sep 1 – Sep 3, 2014.

Convener of Local Organising Committee for Social Networking Workshop, 7th International Conference on COMmunication Systems and NETworkS (COMSNETS) held at Hotel Chancery Pavillion, Bangalore on Jan 6, 2015.

Srinivas, K.

Vidyalaya Managing Committee member of Kendriya Vidyalaya, CLRI

Committee member of Vidyalaya Managing Committee

Guest speaker at G. S. Jain Vidyalaya, Chennai on Jul 28, 2014. Delivered a talk on *Careers in Mathematics* to XII std students.

Chief Guest at SRM Nightingale Higher Secondary School, Chennai on Aug 2, 2014. Delivered a *Motivational Talk* on Higher Studies in Mathematics to higher Secondary class students attending their Science Maths Talent Exams. About 300 students participated in this programme.

Convener of Local Organising Committee for Enriching Mathematics Education held at IMSc during Oct 16 – Oct 17, 2014.

Convener of Local Organising Committee for One Percent held at IMSc on Nov 28, 2014.

Invited Speaker at Veliammai Engineering College, Chennai on Dec 20, 2014. Delivered a talk entitled *The mathematics behind some elementaty looking problems.*

Resource person at CIT, Chennai on Mar 23, 2015. Delivered two talks in the DST sponsored INSPIRE programme conducted by Chennai Institute of Technology, Chennai.

Convener of Local Organising Committee for Enriching Collegiate Education held at IMSc during Mar 11 – Mar 13, 2015.

Subramanian, C. R.

Member of Programme Committee, CALDAM-2015 (First International Conference on Algorithms and Discrete Applied Mathematics), Kanpur during Jun 2014 – Feb 2015.

Sunder, V. S.

Member of Sectional Committee of INSA for Mathematical Sciences

Convener of Local Organising Committee for Master Class in Modular Theory of von Neumann algebras held at IMSc during Nov 24 – Dec 5, 2014.

Convener of National Organising Committee for OTOA 2014 held at ISI Bengaluru during Dec 9 – Dec 19, 2014.

Chapter 4

Colloquia

4.1 Conferences/Workshops Held at IMSc

4.1.1 Mock Modular Forms and Physics

There have been exciting developments in recent years on mock modular forms and their appearance in a variety of situations in physics:

The discovery of the Mathieu moonshine relates the geometry of K3 surfaces to the representation theory of the Mathieu group M24, and to a certain mock modular form. The Umbral moonshine phenomena generalizes this observation to a sequence of mock modular forms that are related to a corresponding sequence of finite groups, and to the 23 Niemeier lattices.

There is a fascinating interplay between the wall-crossing phenomena in supersymmetric gauge theory and string theory, and the realization of modular or automorphic symmetries in the corresponding systems. In N=4 string compactifications, the degeneracies of supersymmetric black holes have been shown to be Fourier coefficients of mock modular forms. Although some hints have been uncovered, the corresponding general story for N=2 compactifications remains to be developed.

Mock modular forms have been realized as the supersymmetric partition functions of certain non-compact superconformal field theories. These conformal field theories play a key role in the physics of black holes and black strings, and seem to be an important piece of the above puzzles.

In all these explorations, there is a feeling among the researchers that something rich and mysterious remains unknown. It seems very likely that there are underlying structures, perhaps originating in string theory, that unify these a priori different directions. These underlying structures should have implications for representation theory, number theory, geometry, gauge theory and string theory. There has already been some work on bringing these diverse developments together from both a physical and mathematical point of view, but a lot remains to be uncovered.

The idea of the workshop is to bring together people working on different aspects of these problems in an informal environment in order to share new ideas and to encourage cross-

disciplinary collaborations. The workshop will have the participation of international experts working on the above topics, alongside local researchers and students who are new to the topic and wish to learn about it.

4.1.2 Aspects of Mathematics, a two-day mathematics programme

The programme featured eight lectures on various aspects of mathematics by experts engaged in research. It was primarily aimed at advanced undergraduate and postgraduate students of mathematics, but anybody with a college background in mathematics was welcome. About 160 registered online for the programme. About 120 actually participated.

For more information (including links to slides and videos of the lectures),

visit http://www.imsc.res.in/ knr/past/mathasp14/

4.1.3 Dynamics Days Asia Pacific 08

Dynamics Days Asia Pacific 08 (DDAP 08) was the eighth of a series of major international conferences with a long-standing tradition in nonlinear dynamics. This event was co-hosted by the Indian Institute of Technology-Madras (IIT-M) and Institute of Mathematical Sciences (IMSc). The meeting highlighted nonlinear science research, providing a useful forum for the exchange of ideas, for presenting research, and for catalyzing collaborative research. The scientific program for the meeting consisted of invited and contributed presentations, both oral and poster, and a set of minisymposia.

4.1.4 Sage Days workshop on combinatorics and representation theory

Sage is a community-developed open source mathematical software. It builds on top of many existing open-source packages: NumPy, SciPy, matplotlib, Sympy, Maxima, GAP, FLINT, R and many more.

The participants of the workshop were introduced to the capabilities of Sage and the development process. Time was also devoted to development of Sage.

4.1.5 IMSc-IITB-IISERP Research Meeting on Physiological Modeling

The aim of the meeting was to explore possibility of collaborations based on the connections between the work done by researchers focusing on physiological modeling in IMSc, IIT Bombay and IISER Pune. There were three broad themes. On the first day we looked at models of phenomena that show a transition from quiescent, excitable behavior to oscillatory behavior and back again (as in the uterus and urinary bladder). On the second day we looked at models of networks connecting elements with bursting activity (as in the brain and the

pancreas). The third day was devoted to looking at the worm Caenorhabditis elegans as a model system.

4.1.6 18 th workshop on elliptic curve cryptology

ECC is an annual workshops dedicated to the study of elliptic curve cryptography and related areas , which started in Waterloo in 1977 . Now it has broadened its scope and covers a wide range of areas within modern cryptography IMSc Chennai and Indian statistical Institute organised the 18th edition with support from NBHM, KU Leuven, Microsoft research, Redmond and CRSI. Balasubramanian was a member of the scientific committee

4.1.7 Enriching Mathematics Education

A two day workshop for school teachers of Chennai Higher Secondary schools was organized as part of Outreach activities of IMSc. About 90 teachers participated in this programme. Lectures and interactive sessions we conducted by iMSc mathematics faculty. This 2-day workshop was aimed at mathematics teachers of classes XI and XII.

This was the third year running that such a workshop was held. The broad goal of this series of workshops is to bring research mathematicians and school teachers together in an effort to enrich mathematics education in schools. Typical activities include lectures on school level mathematics from alternate perspectives, talks on pedagogy, and discussions related to the teaching and learning of mathematics.

In this edition there were 7 talks and one discussion hour.

Nominations for participation were invited from school heads. Nearly 100 teachers representing 40 schools participated in the programme.

For more information (including notes and videos of the entire proceedings), please visit http://www.imsc.res.in/ knr/eme14/

4.1.8 Master Class in Modular Theory of von Neumann algebras

See the home-page http://www.imsc.res.in/ sunder/serbichi.html for details of this workshop; or more briefly, see the blurb http://www.imsc.res.in/ sunder/smpost.pdf for a feeling for this quite unique workshop.

4.1.9 Research in Mathematics

A one-day workshop for the city science and engineering college students was organized on the eve of the Annual Meeting of the Indian Academy of Sciences. There were three talks in the morning one each by Rahul Siddharthan, Venkatesh Raman, and R. Shankar. In the afternoon, a documentary on G N Balachandran was screened. Dr R. Ramachandran, the director of the documentary presented the documentary. Finally, there was a panel discussion on 'Reseach in Science as a career'.

4.1.10 One Percent

A one-day worshop for higher secondary school children from in and around chennai schools was organized as part of the Institute's Outreach activities.

This is an annual event aimed at students of classes XI and XII. The 2014 edition featured four one-hour talks and a written quiz. Two hundred students from 40 schools, along with 31 school teachers who came as escorts, participated in the event. More information (including videos of the lectures) are available on the web page of the event: http://www.imsc.res.in/ knr/onepercent14/

4.1.11 Second Conference on Creative Mathematical Sciences Communication

This was the second in a conference series that explores new ways of helping students achieve 21st Century competencies in mathematics and computer science, which includes math activities across the curriculum. The main theme of the conference was popularizing the rich mathematics underlying computer science, a new kind of mathematics much of the school / college education community is largely untouched by.The conference featured keynote talks by researchers and communicators with original work in popularizing mathematics and computer science, and sharing of experience by activists with extensive experience in education and outreach.

Details are available at: http://www.imsc.res.in/ cmsc2014/

4.1.12 Indo-UK Workshop on Computational Complexity Theory

The Indo-UK Workshop on Computational Complexity Theory was funded by the EPSRC-DST Indo-UK Initiative in Applied Mathematics, and was organised at IMSc, Chennai, during 5–9 January, 2015.

The Scientific Organisers (Principal Investigators) were Meena Mahajan from IMSc and Rahul Santhanam from the University of Edinburgh, UK. There were 10 participants from the UK, and 50 participants from India (the latter included 33 graduate students).

There were 21 talks spread out over the duration of the workshop. The talks were a mix of survey-style presentations giving an overview of an area and leading up to open problems, and focussed presentations on specific research advances obtained by the speaker. A few slots were set aside for senior graduate students too to present their work. There was one session for discussion of interesting open problems.

The detailed program, as well as abstracts of most talks, are available on the workshop webpage http://www.imsc.res.in/∼meena/indo-uk-complexity-workshop-jan2015.html

4.1.13 Fracture: From Micro-scale Processes to Macro Scale Response

Fracture is a fascinating nonlinear dynamic phenomenon that occurs over many length and time scales. In brittle and quasi-brittle systems, small scale perturbations at the micro-scale often lead to large scale fragilities and catastrophic failures. Accordingly, understanding the mechanisms at different length scales and their implications for macroscopic fracture is of vital importance not only to theoretical physicists but also for many engineering, biological and geophysical applications. This meeting aims at a collective understanding of all fields related to multi-scale characterization of these processes. Possible topics may include, but are not limited to, (1) multi-scale experimental investigations of fracture toughness, (2) constitutive modeling appropriate for nucleation of fracture at the micro-scale, and (3) multi-scale computational studies of fracture.

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4.1.14 Instructional Seminar on Logical Aspects of Multi-Agent Systems

LAMAS is an international research network on Logical Aspects of Multi-Agent Systems. There is a growing interdisciplinary community of researchers and research groups working on logical aspects of multi-agent systems from the perspectives of philosophy, artificial intelligence, computer science, game theory, etc. ISLAMAS acted as a forum for sharing research in this area, but with an instructional flavour, largely comprising talks of a tutorial nature by eminent researchers in the area.

For details, see: http://www.imsc.res.in/ jam/lamas/lamas.html

4.1.15 Enriching Collegiate Education

A three day workshop was conducted at IMSc for College/University teachers. More than 90 teachers participated in this programme. Lectures on complex analysis, differential equations, finite fields, linear algebra, group theory and number theory were delivered by IMSc faculty. This workshop is intended as an annual event and has been held for the last three years. It is aimed at college and university mathematics teachers. The 2015 edition emphasized problem solving. On each of the three days, there were four interactive sessions, each

of 75 minutes duration. Eighty nine teachers participated. More information is available from the web page of the workshop: http://www.imsc.res.in/ knr/ece15/

4.1.16 IMSc School in Theoretical Physics (ISTP) 2-14 June 2014

Helped the Convener to organize this ISTP in Quantum Mechanics for College Students in and around Chennai

4.2 Other Conferences/Workshops Organized by IMSc

4.2.1 Annual Foundational School–II

Participated as academic convener of the school. Details of the school are available at http://www.imsc.res.in/ knr/14mayafs/.

4.2.2 Mathematics Workshop for Students (MWS) 2014

Participated as one of the organizers and as one of three resource persons. About 80 M.Sc. students participated in the workshop.

4.2.3 INSA Award Function (IIT, Chennai) 4 August 2014

As Convener of INSA, Chennai Chapter, organized the function in which Dr Baldev Raj was awarded the Dr Brahm Prakash Award for 2014

4.2.4 Annual meeting of the Indian Academy of Science

80 th annual meeting of the Indian academy of sciences was held at IIT chennaiduring 7-9 Nov 2014. The meeting was hosted by IMSc in association with IIT -M, CLRI, CMI, MSSRF, and IGCAR Helped to organize a Session on “Neutrinos”

4.2.5 AIS on Schemes and Cohomology.

This is advanced instructional school for 1st year Phd students from allover India.

4.2.6 OTOA 2014

See the web-site http://www.isibang.ac.in/ jay/OTOA2014/OTOA14.html of the workshop-cum-conference.

4.2.7 Winter School on modular functions in one and several variables

This advanced instructional school was primarily aimed at graduate students. We had around 30 Indian graduate student participants. There were 20 speakers from all over the world. The speakers covered a wide range of topics starting from classical elliptic modular forms to half-integral weight modular forms, Jacobi forms and its applications and Periods of modular

forms. There were also courses on algebraic Independence of periods of Elliptic curves. The lectures culminated with an initiation to the modern aspect of weakly holomorphic modular forms and Borcherds products.

4.2.8 Indian Strings Meeting

The Indian Strings Meeting 2014 is the seventh in a series of biennial internatinal meetings held in India. These meetings are jointly organized by the Indian string community. The objective is to have a gathering of young and experienced researchers in string theory and related areas in an atmosphere which stimulates expression and elaboration of new ideas. We have a few broad review talks in addition to seminars, followed by focused discussion sessions. IMSc was the main organizer of the event this year.

4.2.9 Indian Science Congress 2015, University of Mumbai, 3-7 January 2015, Symposium on HEP

A HEP Symposium was organized as a part of Indian Sciecne Congress. It's main theme was to focus attention on a Deep Crisis in Fundamental Physics that can be met only by the discovery of new methods of particle acceleration such as laser plasma acceleration. The Symposium consisted of five talks: 1. A Crisis in Fundamental Physics: G Rajasekaran (IMSc/CMI) 2. Standard Model and Beyond : Shrihari Gopalakrishna (IMSc) 3. Neutrinos and INO : Naba Mondal (TIFR) 4. String Theory and Quantum Gravity: Sunil Mukhi (IISERP) 5. Laser Plasma Accelerators : Srinivas Krishnagopal (BARC/CBS)

4.2.10 Asian Logic conference

The Asian Logic Conference series is sponsored by the Association for Symbolic Logic, and the meetings are major international events in mathematical logic. The series features the latest scientific developments in the fields in mathematical logic and its applications, logic in computer science, and philosophical logic. The 14th Asian Logic Conference was held at the Indian Institute of Technology, Bombay, from January 5 to 8, 2015. ALC 2015 was co-located with ICLA 2015, the 6th Indian Conference on Logic and Its Applications to be held during January 8-10, 2015.

For details, see: http://www.cse.iitb.ac.in/ alc15/index.html

4.2.11 Social Networking Workshop, 7th International Conference on COMmunication Systems and NETworkS (COMSNETS)

Social networking is profoundly changing the way people communicate and interact on a daily basis. Online social networks are serving as a vital means for supporting information and resource sharing, aiding discovery of connected individuals, improving communication between globally dispersed individuals, and even measuring scientific impact. A significant

fraction of mind-share in the form of applications, diverse access interfaces, and a large economic ecosystem has developed around this field. Going past the simple characterization and enumeration of properties, the networking research community has shown significant interest in attacking various problems associated with social networks. The workshop strove to bring together academic, RD, and industry researchers from these disciplines to address both the science and engineering challenges associated with the rapidly evolving domain of social networking. Its aim was to facilitate cross-disciplinary discussion of relevance to social networking, involving novel ideas and applications, and experimental results, as well as, provide opportunities to compare and contrast the ethological approach to social behaviour in human with web-based evidence of social interaction, perceptual learning, information granulation, the behaviour of humans and affinities between web-based social networks.

4.2.12 Workshop on Design and Analysis of Algorithms

Organized the academic program and gave lectures on 'amortization', 'string matching' at IIIT, Trivandrum.

4.3 Seminars

Date	Speaker Affiliation	Title
1-4-2014	Tanumoy Mandal IMSc/HRI	Phenomenology and LHC Signatures of Exotic Fermions
1-4-2014	P Sankaran JSJ decomposition	Topology seminar
2-4-2014	V. Arvind IMSc	Complexity Theory Day at IMSc
2-4-2014	Anamitra Banerjee University of Tennessee, Knoxville	Some aspects of correlated material phenomena
2-4-2014	V. Arvind IMSc	Complexity theory day
3-4-2014	V. Arvind and others IMSc	Computational Complexity meeting
3-4-2014	Santhust Kumar University of Delhi	Hierarchical structure of B. subtilis transcriptional regulatory network in comparison with E. coli
3-4-2014	Sreerup Raychaudhuri Tata Institute of Fundamental Research	Future of SUSY
4-4-2014	Srikanth Tupurani IMSc	Skein theories for finite depth subfactor planar algebras
8-4-2014	Probir Roy Saha Institute of Nuclear Physics and Centre for Astroparticle Physics and Space Science Bose Institute, Kolkatta	CONSTRAINED ANALYTICAL INTERRELATIONS IN NEUTRINO MIXING
8-4-2014	P Sankaran	Topology seminar

9-4-2014	Arnab Chatterjee Aalto University, Espoo, Finland	Statistical physics of social systems
10-4-2014	Probir Roy SINP and CAPPS (Bose Institute), Kolkata	DARK ENERGY OF THE UNIVERSE
10-4-2014	Gautam I. Menon IMSc	On our research works
11-4-2014	Panchugopal Bikram Ben Gurion University	Infinitely many non-extendable semigroups
11-4-2014	Sumit Giri IMSc	Bombieri-Vinogradov type theorems for sparse sets of moduli
14-4-2014	S. R. Hassan IMSc	On our research works
15-4-2014	Anish Sarkar Indian Statistical Institute	Convergence of rightmost paths in super critical oriented percolation to Brownian Web
15-4-2014	Kunal Dutta Max-Planck Institute fur Informatik, Saarbrucken, Germany	On Certain Invariants of Random Digraphs and Uniform Hypergraphs
16-4-2014	Punit Parmananda Department of Physics, IIT Bombay	Coupling chemo-mechanical oscillators
23-4-2014	N.D.Hari Dass TIFR-Hyd, CMI CQIQC	A massive saga
25-4-2014	Srikanth Tupurani IMSc	Skein theories for finite depth subfactor planar algebras
5-5-2014	1st year students IMSc	Research Methodology
6-5-2014	1st Year Students IMSc	Research Methodology

12-5-2014	A P Balachandran Syracuse and IISc	Matrix models for QCD
15-5-2014	Chandan Dalawat HRI, Allahabad	A sum worthy of Gauss
21-5-2014	H. Zeen Devi IMSc	CP violation in charged leptons and neutrinos
22-5-2014	Nikhil Srivastava Microsoft Research, Bangalore	The Solution of the Kadison-Singer Problem
22-5-2014	Rahul Srivastava IMSc	Predictions from High Scale Mixing Unification Hypothesis
26-5-2014	Borun D Chowdhury Arizona State University, U. S. A	A hole-ographic spacetime
27-5-2014	Borun D Chowdhury Arizona State University, U. S. A	The case of the missing CFTs
29-5-2014	Srikanth Tupurani IMSc	The Tomita-Takesaki theorem
12-6-2014	Ajay Ramadoss Indiana University, Bloomington	Representation homology, Lie algebra cohomology and the derived Harish-Chandra homomorphism
17-6-2014	Ryan Vinroot College of William and Mary	Rogers-Szego polynomials: the old and the new
18-6-2014	R. Balaji Unvi. of Colorado	On the Mid-Holocene Hydroclimate Wetness over India - Is the Past a Prelude?
19-6-2014	A Taraphder IIT KGP	Novel Physics in Transition metal dichalcogenides
20-6-2014	Tulika Maitra IIT ROORKEE	Modelling correlated electrons in frustrated systems
24-6-2014	R. Venkatesh TIFR	Fusion product structure of Demazure modules

24-6-2014	Jose Faro Department of Biochemistry, Genetics and Immunology, University of Vigo, Spain	t-Independent and t-Dependent Lymphocyte Population Studies
25-6-2014	Tanmay Singal IMSc	Minimum Error Discrimination For Linearly Independent States
25-6-2014	Ram Lal Awasthi Harich-Chandra Research Institute	Prospects of experimentally reachable beyond Standard Model physics in non-SUSY SO(10) Grand Unification
26-6-2014	Emilio Faro Universidad de Vigo, Spain	Why should I care about Category Theory?
27-6-2014	S. David University of Paris VII	Baker's Theorem
28-6-2014	S. David University of Paris VII	Baker's theorem
30-6-2014	Ravi Kunjwal IMSc	Lessons for logic and quantum theory from Specker's parable of the overprotective seer
30-6-2014	Anuj Tawari IMSc	Recent Trends in Arithmetic Complexity
30-6-2014	Pierre Matsumi IMSc	Fermat's Last Theorem
30-6-2014	Sumiran Pujari TIFR	Neel to Valence-Bond Solid transition on the honeycomb
2-7-2014	S. David University of Paris VII	Baker's theorem
2-7-2014	Kamalakshya Mahatab IMSc	Ehrhart Polynomials
2-7-2014	Roy Joshua Ohio State University, Ohio	Comparison of cohomology operations in motivic and etale cohomology

3-7-2014	S. David University of Paris VII	Baker's theorem
3-7-2014	K. Sumesh IMSc	Bures distance between completely positive maps.
3-7-2014	Carmen Molina-Paris University of Leeds	IL7 and T-cell homeostasis
3-7-2014	Harshavardhan Solanki (summer student) IIT Kanpur	Regular Path queries on graphs with data
3-7-2014	Soumyadeep Bhattacharya	Doctoral Committee Meeting
3-7-2014	Subhadeep Roy	Doctoral Committee Meeting
4-7-2014	Purabi Mukherji -	The development of Geometrical Research in Bengal ; From Sir Asutosh Mookerjee (1864 - 1924) to Professor M. C. Chaki (1931 - 2007)
4-7-2014	Swatee Naik University of Nevada, Reno	Knots and Links: 3- and 4-dimensional aspects
4-7-2014	N.P. Swaroop IMSc	The Tau Conjecture and Arithmetic Circuit Lower Bounds
8-7-2014	K. Sumesh IMSc	Bures distance between completely positive maps.
8-7-2014	Rekha Biswal IMSc	Combinatorial proof of a representation-theoretic identity
9-7-2014	Tarun Kanti Ghosh Indian Institute of Technology, Kanpur	Novel properties of spin-orbit coupled two-dimensional fermionic systems
10-7-2014	Seshadri Chintapalli TIFR, Mumbai	Semistability and embedding theorems
10-7-2014	Anish Mukherjee Chennai Mathematical Institute	A survey on the exact exponential -time complexity of SAT

10-7-2014	Yeshonidhi Pandey IISER, Mohali	Properness of degenerate quadratic bundles
10-7-2014	Vinod Kumarappan Kansas State University	Laser-driven rotational wavepackets in asymmetric top molecules: A route to molecular frame measurements
11-7-2014	Veeky Baths BITS Goa	Disruption of Fatty Acid Biosynthesis in Mycobacterium Tuberculosis: Using graph-theoretic approaches
15-7-2014	S. Govindarajan Indian Institute of Technology, Madras, Chennai	Estimating the asymptotics of solid partitions
15-7-2014	T. Geetha IMSc	Jucys-Murphy elements for Brauer Algebra
17-7-2014	Rahul Dandekar TIFR, Mumbai	Growing patterns in the rotor-router model and the KPZ class
18-7-2014	Michael Renardy Virginia Tech, USA	Null controllability of the linearized compressible Navier-Stokes system in one dimension
18-7-2014	K. Sumesh IMSc	Bures distance and CP maps-iii
22-7-2014	Muthuvel Murugan CMI	Convex Optimization - Random Walks, Localization Lemma and an Isoperimetric Inequality
22-7-2014	Ritwik Mukherjee IMSc	Distribution of a biased Coin Toss
24-7-2014	Nanda Kishore IISc, Bangaluru	Spectral distributions of Products of Random Matrices
25-7-2014	Jayadev Athreya University of Illinois at Urbana-Champaign	Effective Quantitative Oppenheim for almost every quadratic form
28-7-2014	K. Sumesh IMSc	CP maps and Bures Distance- iv

30-7-2014	B Ravinder IMSc	Area maximizing Gelfand-Tsetlin patterns
30-7-2014	Ekata Saha IMSc	Generalized Euler Lehmer constants
1-8-2014	M. Ram Murty Queen's University, Canada	Ramanujan expansions and twin primes
1-8-2014	Snigdhayan Mahanta University of Muenster	Homotopy and homology of non-commutative spaces
1-8-2014	C. P. Anilkumar ISI Bangalore	Orbits of Pairs in Finite Modules over Discrete Valuation Rings and Permutation Representations
4-8-2014	K. Sumesh IMSc	CP Maps and Bures Distance iv
5-8-2014	Amritanshu Prasad IMSc	Length Generating Functions for Right-Angled Groups and Monoids
5-8-2014	Gloria Kang and Kaja Abbas Department of Population Health Sciences, Virginia Tech, USA	Epidemiological modeling of infectious diseases
7-8-2014	Shamik Gupta Universite Paris-Sud, Orsay	Thermodynamics and dynamics of systems with long-range interactions
7-8-2014	Karl-Dieter Crisman Gordon College	A Sampler of the Mathematics of Voting and Choice
7-8-2014	K. Sumesh IMSc	CP maps and Bures Distance
8-8-2014	Director, DAAD Information Center, Chennai	Research and Funding Opportunities in Germany
8-8-2014	Neha Lodha IMSc	Consensus through communication
8-8-2014	E. C. G. Sudarshan Dept. of Physics, University of Texas, Austin	A second look at the Quantum Zeno Effect

8-8-2014	M. Ram Murty Queen's University, Kingston, Ontario, Canada	Ramanujan Graphs and the Kadison-Singer Problem
12-8-2014	Siddharth Parameswaran University of California, Irvine	Quantum Revivals and Many-Body Localization
14-8-2014	Dhriti Ranjan Dolai IMSc	Spectral Statistic of Random Schrodinger Operator with Singular Continuous Potential.
16-8-2014	Soma Dutta IMSc	Godel Incompleteness Theorem 2
19-8-2014	Natasha Mhatre University of Bristol	A tool to sing louder and an amplifier to hear better: biophysical innovation in a tree cricket
19-8-2014	Venkatakrishnan Ramaswamy Interdisciplinary Center for Neural Computation, The Hebrew University of Jerusalem	Theoretical Connectomics
21-8-2014	Nitin Saurabh IMSc	An Improved Deterministic SAT Algorithm for Small De Morgan Formulas
21-8-2014	R. Parthasarathy Bharatiyar University	Classification of Discrete series by lowest K type
25-8-2014	Rajesh Gupta ICTP, Trieste	Some Developments in Computation of Quantum Entropy of Extremal Black Hole
26-8-2014	Fahad Panolan IMSc Chennai	Representative Sets of Product Families
27-8-2014	Abhijit Chakraborty S N Bose National Centre for Basic Sciences	Some studies of complex networks in multidisciplinary fields
28-8-2014	Daphne Lopez VIT, Vellore	Big Data Analytics for Predicting Seasonal Diseases under Climate Change Conditions

28-8-2014	Arghya Mondal IMSc	The Banach-Tarski paradox and Amenability
1-9-2014	Ipsita Mandal Perimeter Institute, Canada	Low Energy Physics of a Non-Fermi Liquid System
1-9-2014	Pranay Goel IISER Pune	How two-timescale singular perturbation methods help understand bursting in neuronal models
1-9-2014	Prakash Belkale University of North Carolina	Numerically effective divisors on the moduli space of curves from conformal field theory
2-9-2014	Sumilan Banerjee Ohio State University	Quantum oscillations in high-temperature superconductors
2-9-2014	Rohit Manchanda Department of Biosciences and Bioengineering, IIT Bombay	Maths and Biology: Strange Bedfellows No More?
2-9-2014	Prakash Belkale UNC Chapel Hill	Horn's conjecture, saturation conjecture and the Littlewood-Richardson rule
3-9-2014	Arunprasath IISc	Top polarization measurement and anomalous Wtb coupling
3-9-2014	Arghya Mondal	Bounded cohomology
5-9-2014	Souradeep Majumder IMSc	Principal bundles on root stacks
8-9-2014	T Jesan IMSc and BARC Kalpakkam	Systems Biology: From the cell to society
9-9-2014	Rabeya Basu IISER, Pune	Results in classical algebraic K-theory
10-9-2014	Arghya Mondal IMSc	Bounded cohomology
11-9-2014	Prahlad Vaidyanathan IISER, Bhopal	Classification of Continuous Fields of C* Algebras

11-9-2014	Neeraj Kumar IMSc	Newton's symmetric polynomials and some open problems
12-9-2014	Krishanu Dan IMSc	Certain Vector Bundles over Symmetric Product of Curves
13-9-2014	Priyamvad Srivastav IMSc	Early Approach to the Twin Prime Problem
16-9-2014	Amritanshu Prasad IMSc	Cartier-Foata monoids, heaps of pieces and chromatic polynomials
17-9-2014	Aprameyan Parthasarathy Universitt Paderborn.	Scattering theory on symmetric spaces
17-9-2014	Arghya Mondal IMSc	Bounded cohomology
18-9-2014	Joyjit Kundu IMSc	Phase transitions in hard core lattice gas models of anisotropic particles
18-9-2014	Prateep Chakraborty ISI, Bangaluru	Formality of certain CW complexes and applications
18-9-2014	Anish Mallick IMSc	Kotani theory for 1 dimenional jacobi matrices
19-9-2014	Arghya Mondal IMSc	Bounded cohomology
22-9-2014	Arghya Mondal IMSc	Bounded cohomology
24-9-2014	Tuhina A Mark Brown University, School of Engineering, 02912 Providence RI, USA	Theory of stress effects on catalysis at close-packed surfaces
26-9-2014	Anirban Mukhopadhyay IMSc	Smooth numbers in arithmetic progression
29-9-2014	Naveen Gaur University of Delhi (Dyal Singh College)	Vector-like top-partner multiplets in a realistic mixing setup

1-10-2014	Manjari Bagchi IMSc	Atypical Neutron Star Binaries and Triples
6-10-2014	Raghu Raghavan Therataxis,USA	The Soups and The Sparks
6-10-2014	Raghu Raghavan Therataxis,USA	A mechanical view of the misfolding of a-synuclein
8-10-2014	A.P. Balachandran CHEP,IISc Bangalore	Dark Radiation from Self-Dual Gravity
9-10-2014	S. Boecherer	What is NOT known about Eisenstein series ?
10-10-2014	Shreedevi Masuti IMSc	Bhattacharya and Hilbert Coefficients
14-10-2014	Upayan Baul IMSc	Interaction of multiple biomimetic antimicrobial polymers with model bacterial membranes
15-10-2014	B Sathiapalan IMSc	Schwinger Effect and Negative Differential Conductivity in Holographic Models
16-10-2014	Manimala Mitra IPPP Durham University	On the Origin of Neutrino Mass and Experimental Searches
16-10-2014	Kamalakshya Mahatab IMSc	Eliminating linear relations in combinatorial enumerations
17-10-2014	SAIBAL GANGULI IMSc	MCKAY CORESPONDENCE IN QUASI-TORIC ORBIFOLDS
17-10-2014	Priya Ramesh	Counselling at IMSc
21-10-2014	Arjun Krishnan Princeton University	Understanding multicellular function and disease with human tissue-specific networks
27-10-2014	Prasanta Tripathy IITM, Chennai	Multiple Single-Centered Attractors

27-10-2014	Raghavan Rangarajan Physical Research Laboratory	Gravitinos, Reheating and the Matter-Antimatter Asymmetry of the Universe
30-10-2014	Nirmalya Kajuri IMSc	Path Integrals in Polymer Quantized Scalar Fields
31-10-2014	Anirban Mukhopadhyay IMSc	Duality of large sieve and Selberg sieve
3-11-2014	Tridip Sadhu CEA Saclay	Macroscopic fluctuation theory and its application.
6-11-2014	Krishanu Dan IMSc	Completability of Unimodular Rows
11-11-2014	Satish Kitambi Division of Molecular Neurobiology, Karolinska Institute, Sweden	The soft underbelly of cancer cells; Acquired vulnerability of glioblastoma cells to catastrophic vacuolization and death
12-11-2014	Hidenori Sonoda Kobe University, Japan	Renormalization for harmonic oscillators
12-11-2014	Meena Mahajan IMSc	Homomorphism polynomials complete for VP
12-11-2014	Anupam Kumar Singh IISER Pune	Row-Column operations in (finite) classical groups
13-11-2014	Anupam Kumar Singh IISER, Pune	Word problem in finite classical Chevalley groups
13-11-2014	Sayan Bhattacharya IMSc	Deterministic fully dynamic data structures for vertex cover and matching
17-11-2014	Bijan Saha Joint Institute for Nuclear Research, Dubna	Spinor field in Cosmology and the problem of isotropization
18-11-2014	Hidenori Sonoda Kobe University	Lecture on ERG

18-11-2014	Debajyoti Nandi Rutgers University	Combinatorial identities arising from representation theory of affine Lie algebras using vertex-operator-theoretic techniques
19-11-2014	Soumyajyoti Biswas IMSC, Chennai	Equivalence of earthquakes and interface propagation in disordered media: Models and avalanche statistics
20-11-2014	Ramesh Sreekantan ISI, Bangaluru	Algebraic Cycles and the Fundamental Group
20-11-2014	Hidenori Sonoda Kobe University	Lecture on ERG
24-11-2014	50 - a Celebration G. Baskaran	ICTP
25-11-2014	Alexander Guterman Moscow State University	Invitation to Tropical Linear Algebra
26-11-2014	Saumia P. S. IMSc	Baryons in Heavy-Ion Collisions
1-12-2014	Prabhakar Mateti Wright State University	Semantics of programs
1-12-2014	Raghavan Rangarajan Physical Research Laboratory	Inflation after Planck and BICEP2
2-12-2014	M Sivakumar University of Hyderabad	Higher spin theories: From Dirac to Vasiliev
3-12-2014	Saurabh Niyogi IMSc	Multileptons and top-jets in the hunt for gluinos in RPV Supersymmetry
4-12-2014	Gautami Bhowmik University of Lille 1, France	Goldback Generating Functions
16-12-2014	Ayan Banerjee IISER-Kolkata	Study and manipulation of meso-scale systems using optical tweezers

17-12-2014	Aswin Sai Narain Seshasayee NCBS Bangalore	Xenogene silencing, stress response and chromosome architecture in E. coli
18-12-2014	Anirban Bose IMSc, Chennai	Real elements in groups of type F_4
22-12-2014	Nikolai Tyurin BLTP, JINR	Special lagrangian submanifolds I
23-12-2014	Nikolai Tyurin BLTP, JINR	Special lagrangian submanifolds II
23-12-2014	Deepa Thomas U Texas at Austin	Measurements of heavy-flavour decay electrons with ALICE at LHC
29-12-2014	Thanu Padmanabhan IUCAA, Pune	Emergent Gravity Paradigm: Recent Advances
1-1-2015	Harald Upmeier University of Marburg, Germany	Holomorphic Vector Bundles and Intertwining Operators over Symmetric Domains
30-12-2014	M. Ram Murty Queen's University, Canada	The Chowla problem and generalizations
30-12-2014	Anindita Ganguly Dept of Electrical Engineering, St. Thomas' College of Engineering and Technology, Kolkata	Introduction to Control Theory
1-1-2015	Varun Sreenivasan Laboratory of Sensory Processing, Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland	Motor control in the rodent whisker system
2-1-2015	Harald Upmeier Univ. of Marbourg	Dixmier trace of Toeplitz operators on bounded symmetric domains
9-1-2015	Karteek Sreenivasaiah IMSc, Chennai	On verifying proofs in constant depth, and polynomial identity testing (HBNI PhD Defense)

9-1-2015	Rajat Bhadhuri Mcmaster University, Hamilton, Canada	Dark Matter and Dark Energy from Bose-Einstein Condensate
9-1-2015	Kaja Abbas Department of Population Health Sciences, Virginia Tech, USA	Epidemiological Modeling of Zoonotic Diseases
12-1-2015	S. Kalyana Rama IMSc	Singularity Resolution + Unitary Evolution + Horizon = Firewall ?
12-1-2015	S. R. S. Varadhan New York University	Compactness and Large Deviations
13-1-2015	Abhishek Majhi IMSc	Energy spectrum of equilibrium black holes in LQG
13-1-2015	Kunal Dutta Max-Planck Institute fur Informatik, Germany	Size-sensitive packing number for the Hamming cube and its consequences
14-1-2015	K. B. Athreya Iowa State University	Statistical Estimation of integrals w.r.t infinite measures
16-1-2015	Kabir Ramola LPTMS, Paris	Correlated Extreme Values in Branching Brownian Motion
19-1-2015	Amitabha Nandi Max-Planck Institute for the Physics of Complex Systems, Dresden, Germany	Active mechanics and dynamics of epithelia during morphogenesis
19-1-2015	Philibert Nang ENS, Gabon	Introduction to D-modules, definition of D-modules, coherent D-modules, characteristic variety associated to D-module, Examples
19-1-2015	S. R. S. Varadhan New York University	Entropy and Probablity
20-1-2015	N D Hari Dass TIFR-TCIS Hyderabad, & CQIQC	Non-GR approaches to Gravitational Radiation

20-1-2015	Rakesh Chatterjee IMSc Chennai	Statistical perspectives of symmetric and asymmetric exclusion in closed geometries
20-1-2015	Philibert Nang ENS, Gabon	Geometry of characteristic variety, connection with holonomic D-modules, Regularity of holonomic D-modules.
22-1-2015	Sujit Das Martin Luther University Halle-Wittenberg	Antiferromagnetic coupling due to charge transfer in transition metal oxide heterostructures
22-1-2015	Peter Symonds University of Manchester	Groups of power series under substitution and automorphisms of curves.
22-1-2015	Saptarshi Mandal ICTP	Frustrated Magnetism on Hollandite lattice
23-1-2015	Ramakrishnan Natesan Dept. of Bioengineering, University of Pennsylvania, USA	Multiscale Approaches to Understand Membrane Morphogenesis and Applications to Targeted Drug Delivery
23-1-2015	Atul Dixit Tulane University	Ramanujan, Vorono summation formula, circle and divisor problems and some modular transformations
27-1-2015	Soavn Chakraborty Max-Planck-Institut fur Physik at Munich	Neutrino Astrophysics: Challenges and Possibilities
28-1-2015	L Sriramkumar IIT Madras	Inflationary three-point functions
29-1-2015	Sumesh Thampi Oxford University	Active Turbulence
2-2-2015	Kalyan Banerjee IMSc, Chennai	Rational equivalence of algebraic cycles supported on a general hyperplane section
3-2-2015	Manikandan Narayanan NIAID, NIH, Bethesda, MD, USA	Computational challenges in network biology: from brain tissues to single cells

4-2-2015	Arun Thalapillil NHETC, Rutgers University	The Higgs as a Probe for New Physics : Higgs Portals, Soft Yukawas and Extended Gauge Mediation
5-2-2015	Rahul Srivastava IMSc	Dirac or Inverse Seesaw Neutrino Masses with B-L Gauge Symmetry and S3 Flavour Symmetry
6-2-2015	Sudhir N Pathak IMSc	Large scale behaviour of the freely cooling granular gas
6-2-2015	Hans van Ditmarsch LORIA, Nancy, France	Five Funny Bisimulations
9-2-2015	Satyajit Guin ISI, Delhi	Differential Calculus and YM Functional in NCG
9-2-2015	Sanchari Goswami S. N. Bose National centre for Basic Sciences	Quantum Random Walk : Overview and recent results
11-2-2015	Justin David	A universal correction to higher spin entanglement entropy
11-2-2015	Neeraj Manhas Dept of Mathematics, NIT, Bhopal India	Modelling the transition from simple to complex Ca2+ oscillations in pancreatic acinar cells
12-2-2015	Xavier Viennot Laboratoire Bordelais de Recherche en Informatique, Bordeaux	The birth of a New Domain: Combinatorial Physics
16-2-2015	Siddharth Barman California Institute of Technology	Approximating and Testing Equilibria
16-2-2015	Sayak Mukherjee Ohio State University, Columbus OH, USA	Understanding Cell Signaling: Model, Mechanism Inference
17-2-2015	Vidyanand Nanjundiah MRDG and CES, Indian Institute of Science, Bangalore	A Present-Day View of Evolutionary Theory

17-2-2015	Uday Bhaskar Sharma IMSc	Asymptotic for Counting Similarity Classes of Tuples of Commuting Matrices
17-2-2015	Vijay Ganesh University of Waterloo, Canada	Impact of community structure on SAT solver performance
18-2-2015	R. Ganesh IMSc	Topology in a quantum magnet
18-2-2015	Vidyanand Nanjundiah IISc Bangalore	Darwin's "One Special Difficulty" as seen in the cellular slime moulds
19-2-2015	Dileep Jatkar HRI	Analytic Structure of Some Interpolating Functions
20-2-2015	G Rajasekaran IMSc CMI	Hundred years of Fundamental Physics and a Crisis
23-2-2015	Ethayaraja Mani Department of Chemical Engineering, IIT-Madras	Finite-sized clusters in passive and active colloidal suspensions
23-2-2015	Saikat Guha Microsoft Research India, Bangalore	Towards Catching Click-Spam on Facebook Ads
24-2-2015	Ashwin Joy IPR, Gandhinagar	Microscopic Origin of Shear Relaxation in Strongly Coupled Yukawa Liquids
24-2-2015	Xavier Viennot University of Bordeaux	Tamari Lattice and its Extensions - 1
25-2-2015	Upayan Baul IMSc	Ion Hydration and Associated Defects in Hydrogen Bond Network of Water: Effects on Structural and Dynamical Properties of Water
3-3-2015	Pankaj Jain IIT Kanpur	Large Scale Anisotropy in the Universe
3-3-2015	Xavier Viennot University of Bordeaux	Tamari Lattice and its Extensions - 2

3-3-2015	Yash Lodha EPFL, Lausanne	A new solution to the von Neumann-Day problem for finitely presented groups.
4-3-2015	Amitabh Virmani IOP Bhubaneswar	Inverse scattering construction of the JMaRT fuzzball
4-3-2015	Yadu Vasudev	PhD thesis defence
5-3-2015	Discussion Meeting	Solids out of equilibrium
5-3-2015	Sebastien Palcoux IMSc	Generalization of a theorem of Oystein Ore from groups to subfactor planar algebras: an easy route to the wonderland of "quantum arithmetic"
6-3-2015	Swarnendu Tripathi Department of Physics, University of Houston and Center for Theoretical Biological Physics, Rice University, Houston, USA	Lessons in Protein Design from Combined Evolution and Structural Dynamics
10-3-2015	Jyoti Sengupta TIFR	Determination of GL(3) Hecke Maass forms from twisted central L-values
11-3-2015	Makoto Yamashita Ochanomizu University	Poisson boundaries of monoidal categories
12-3-2015	Soumya Bhattacharya CIRM, Trento	Factorization of holomorphic eta quotients
13-3-2015	Vaishnavi Sundararajan CMI	Formal verification of security protocols with certification
13-3-2015	Makoto Yamashita Ochanomizu University	Poisson Boundaries of Monoidal Categories
16-3-2015	Biswarup Mukhopadhyaya Harish Chandra Research Institute	The Messiah of Mass with Message of More?
16-3-2015	Makoto Yamashita Ochanomizu University	Poisson Boundaries of Monoidal Categories

17-3-2015	Amita Malik UIUC	Siegel norm and character values
17-3-2015	D Indumathi IMSc, Chennai	INO: The India-based Neutrino Observatory–Facts and Fiction
18-3-2015	Pinaki Chaudhuri IMSc, Chennai	Exploring the rheology of soft disordered solids
18-3-2015	Ayan Paul Universita' di Roma La Sapienza	Probing Higgs Couplings with Kinematic Distributions
19-3-2015	Daciberg L. Goncaves University of Sao Paulo	Configuration spaces, products, and fibre
23-3-2015	Sundar Naganathan MPI-CBG, Dresden	Active torque generation by the actomyosin cell cortex drives left-right symmetry breaking
23-3-2015	Suman Ganguli IOP Bhubaneshwar	Energy conditions in gravitational collapse of null fluid
24-3-2015	K. B. Sinha JNCASR	Helton-Howe and Krein's Trace Formulas
25-3-2015	Dharamvir Ahluwalia IIT-Kanpur and University of Canterbury, New Zealand	Connections in Physics
26-3-2015	T. Bakkyaraj IMSc	Applications of one parameter Lie group of transformations to fractional differential equations
26-3-2015	Shankar Prasad Das Jawaharlal Nehru University, Delhi	Qualitatively different collective and single particle dynamics in a supercooled liquid
26-3-2015	Ruben Martos University of Paris 7	The formulation of the Baum-Connes conjecture
27-3-2015	Arindam Ghosh IISc, Bengaluru	Broken symmetry states in high-performance atomically-patterned nanostructures in silicon and germanium

27-3-2015	Trilochan Bagarti Harish-Chandra Research Institute, Allahabad	Inhomogeneous reaction-diffusion models
27-3-2015	Ruben Martos University of Paris 7	The categorical framework for the Baum-Connes conjecture
30-3-2015	Martin Lopez-Garcia 769; Department of Applied Mathematics, University of Leeds, United Kingdom	Analyzing stochastic descriptors in an SIR epidemic model with heterogeneous contacts in small networks
30-3-2015	V. Lakshmibai Northeastern University, Boston	Free resolutions of some Schubert singularities

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 from Saarland University, Germany, and runs for a duration of 5 years beginning April 2011.

5.1.2 Arithmetic circuits computing polynomials

The aim of this project is to better understand arithmetic circuit computations of polynomials and related counting and enumeration complexity questions.

The project is funded by the Indo-French Centre for the Promotion of Advanced Research (IFCPAR/CEFIPRA). The principal investigators are Meena Mahajan from IMSc, and Guillaume Malod from Institut Mathmatique de Jussieu, Universit Paris Diderot, Paris 7, and the project runs for a duration of 3 years beginning May 2012.

5.1.3 Computational methods for identifying and analyzing design features of metabolic networks

This proposal was funded by the Max Planck Society and Indo-German Science and Technology Centre for a period of 4 years (2015-2018) to maintain the existing collaboration between Areejit Samal at IMSc and Jürgen Jost at Max Planck Institute for Mathematics in the Sciences, Leipzig. The aim of the proposal is to develop improved methods for analyzing metabolic networks to address specific challenges in systems and synthetic biology.

5.1.4 Correctness by Construction (CORCON)

This project is funded by the Marie Curie Actions – International Research Staff Exchange Scheme (IRSES) of the European Union FP7. It involves multiple nations and researchers, and runs for five years beginning January 2014. IMSc is involved in the sub-project on proof verification and proof complexity, jointly with the University of Leeds, UK. The principal investigators for this sub-project are Meena Mahajan from IMSc and Olaf Beyersdorff from the University of Leeds.

5.1.5 India-based Neutrino Observatory (INO)

During this year, INO crossed an important milestone. The project which had its birth at IMSc exactly 15 years ago, in January 2000, got the full approval of the Government of India in Jan. 2015. We have traveled quite far, but have many more miles to go.

The IMSC group (D. Indumathi, Meghna K.K., Lakshmi S. Mohan, M.V.N. Murthy, Sumanta Pal, G. Rajasekaran, Nita Sinha and project assistant, TiruSenthil) continue to be actively involved in the detector simulations and physics analysis. The group published three papers in the Journal of Instrumentation in the last one year. One student, Sumanta Pal completed his Ph.D thesis. Members of the group also contributed significantly to the INO Physics White paper, that will be submitted to the arXiv by the collaboration, very shortly. The IMSc group has been playing a significant role in the INO project outreach. Hopefully this will yield positive results in removing opposition (including litigation) to the project.

5.1.6 India-EU program on Mathematics for Health and Disease

The main aim of this project is to set up an Indo-European Research Network in Mathematics for Health and Disease, INDOEUROPEAN-MATHDS, that will allow the transfer of knowledge, research and training between partners. The Network involves physicists, mathematicians, statisticians, probabilists, biologists, immunologists and engineers. The Network will create new collaborations between previous INTI partners (Leeds, UCL, Utrecht, Vigo, Comillas, UBC, LANL, WEHI and IISc) and new partners (Basel, Hamilton, MIT, University of Hyderabad, JNCASR, IMSc and NII), and reinforce existing ones between INTI partners, in order to develop a lasting and fruitful research cooperation between all partners. It is planned to develop mathematical and computational models of host-pathogen and virus dynamics, with a focus on pathogenic and molecular characterisation of HIV-1, and the distribution of virulence in intra-host HIV quasispecies, in order to understand if regulation of immune activation can be a potentially optimum way for disease management,to develop mathematical and computational models of immune cellular processes, such as differentiation and cellular fate, as well as ageing, validated by experimental data, with a focus on T cells, to develop stochastic mathematical models of receptor-mediated processes in health and disease, with a focus on the CCR5 receptor, VEGF receptor, T cell receptor and B cell receptor, and to develop statistical tools and methods, using evolutionary game theory, to characterise the genomic fluidity of human pathogens, in order to understand microbial pathogen evolution and what constitutes the boundary between commensal and pathogenic organisms.

5.1.7 Indo-German research grant funded by the Humboldt Foundation

This is a three year research grant (originally for the period 2011-2014, extended to 2014-2015) from the Humboldt Foundation.

5.1.8 ITRA-Media Lab Asia Project on De-congesting India's transportation networks using mobile devices

The project envisages the use of mobile phones to estimate congestion and traffic patterns on urban roads. Based on the congestion metrics thus obtained, the project aims to develop algorithms and tools for traffic planning and management, using the mobile phone as a service platform. The proposed solution strategy consists of two distinct focus areas. The first focus area deals with the problem of estimating mobile phone densities to measure prevailing congestion and traffic patterns. The second focus area involves developing algorithms for traffic routing, control and prediction, based on the estimated congestion. The proposed work has enormous potential for applications, such as dynamic route planning, peak hour rush control, routing of emergency vehicles to and from disaster affected areas, evacuation planning, and traffic prediction. In addition, this work is expected to shed new conceptual insights into the general problem of control of complex networks with strategic agents, by bringing together ideas from several technical disciplines.

5.1.9 Mechanism of Active Intracellular Transport: Connecting Theory and Experiment

This DAE-Plan project attempts to combine experimental investigations, using fluorescence microscopy, of the motion of vesicle in axons of touch neurons of C. elegans with theoretical models. Smooth axonal transport is crucial for the healthy functioning of nerve cells and impairment of this transport is often seen in neurodegenerative disease. We plan to closely link the theory and experimental observations to come up with a detailed simulation of axonal transport mechanisms which can then be compared to experiments.

5.1.10 Quantitative analysis of Mitochondrial positioning in C. elegans axons

Under this project Varuni Prabhakar along with Prof. Gautam Menon, in collaboration with Prof. Sandhya Koushika (TIFR, Mumbai), have been working on Quantifying mitochondrial positioning in Caenorhabditis elegans neurons. Varuni Prabhakar has been working on an image analysis algorithm to process the microscope images that has been collected in Prof. Koushika's lab in order to understand how mitochondria are positioned along axons of neurons over the development of the worm.

5.2 Institute Associateships

The Institute has established short-term associateships in **Mathematics, Theoretical Physics, Theoretical Computer Science and Computational Biology** 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 01.04.14 to 31.03.15 are :

Prof. **Hans Van Ditmarsch**
Loria, Vandoeuure France
11.01.2015 to 08.02.2015

Dr. **S.K. Monowar Hossien**
Aliah University, Kolkata
26.05.2014 to 05.07.2014

Dr. **Gopal Chandra Shit**
Jadavpur University, Kolkata
15.06.2014 to 06.07.2014

Dr. **K. Reji Kumar**
NSS College, Nilamel, Kerala
25.08.2014 to 23.09.2014

5.3 Conference Participation and Visits to Other Institutions

Agrawal, Ankit

Visited TIFR Centre for Interdisciplinary Sciences (TCIS) during Apr 14 – Apr 19, 2014. Collaboration work

Participated in *International Centre for Theoretical Physics (ICTP)* held at Trieste, Italy during Sep 15 – Sep 19, 2014. Conference on Chromosome Organization

Arvind, V.

Visited Humboldt University, Berlin, Germany during Sep 8 – Sep 20, 2014. Research. Visit supported by a joint project funded by the Humboldt Foundation.

Participated in *Dagstuhl workshop on Algebra in Computational Complexity* held at Dagstuhl Castle, Wadern, Saarland, Germany during Sep 21 – Sep 25, 2014.

Participated in *Indian-Russian workshop on Discrete Math and Cryptography* held at Moscow State University, Moscow, Russia during Oct 15 – Oct 18, 2014. Gave a talk at the workshop

Ashok, Sujay K.

Visited Tata Institute for Fundamental Research during Aug 23 – Aug 27, 2014. Invited Talk, External member for a Ph.D defense

Ravinder, B.

Participated in *Workshop on Combinatorial representation theory* held at CRM, Montreal, Canada during Apr 17 – May 17, 2014. As a part of the thematic semester on New Directions in Lie Theory.

Bagchi, Manjari

Visited The National Centre for Radio Astronomy Tata Institute of Fundamental Research, Pune, India during Nov 19 – Nov 21, 2014. To participate in the workshop entitled Neutron Stars: A brainstorming workshop.

Participated in *Neutron Stars: A brainstorming workshop* held at The National Centre for Radio Astronomy Tata Institute of Fundamental Research, Pune, India during Nov 20 – Nov 21, 2014. Delivered two talks: (a) The population of neutron stars: looking through theory,

simulation and observation – invited review talk. (b) Fast Radio Bursts – contributed talk.

Balasubramanian, R.

Participated in *group discussion meeting on Mock Modular forms* held at Harishchandra Research institute, Allahabad during Apr 24 – Apr 28, 2014.

Participated in *Award Distribution function of the International Mathematical Olympiad training camp* held at Mumbai on May 19, 2014. Chief guest

Participated in *National instructional workshop on cryptology* held at MNNIT Allahabad on Jun 5, 2014. Chief guest. Also delivered a talk

Participated in *National Statistics day* held at Indian statistical institute , Chennai on Jun 29, 2014. Gave a talk on number theory

Participated in *Indocrypt, 2014* held at India habitat Centre, New Delhi during Dec 14 – Dec 17, 2014.

Participated in *80 th annual conference of Indian Math Society* held at ISM Dhanbad on Dec 28, 2014. Inagurated the conference

Participated in *Conference in Algebraic Number theory and Modular forms* held at S.P.Pune University during Jan 2 – Jan 3, 2015. Delivered a lecture on euler,s phi function

Participated in *Discussion meeting on Analytic Number theory* held at Tata Institute of Fundamental Research , Bobmbay during Jan 5 – Jan 7, 2015. Gave a lecture on "counting rational points on Elliptic curves "

Participated in *CFS lecture series* held at NISER, Bhubaneshwar on Jan 13, 2015. Gave a lecture on additive number theory

Visited CRRAO AIMSCS on Jan 16, 2015. Gave Ramanujam Distinguished lecture organised by CR Rao institute under a DST sponsored project

Visited District Science Centre, Gulbarga on Jan 17, 2015. Inaugurated the Maths Gallery

Participated in *Annual Conference of Odisha maths society* held at jajpur Road , odisha on Feb 7, 2015. Chief guest . Also delivered a lecture

Biswas, Soumyajyoti

Participated in *Statphys-Kolkata VIII* held at S. N. Bose National Center for Basic Sciences, Kolkata during Dec 1 – Dec 5, 2014. Presented a poster titled: Self-organized dynamics in local load sharing fiber bundle models

Participated in *Fracmeet 2015* held at The Institute of Mathematical Sciences, Chennai during Jan 6 – Jan 9, 2015. Gave a talk titled: Nucleation versus percolation: Scaling criterion for failure in disordered solids

Chakraborty, Abhijit

Participated in *Short-term Course and Workshop on Machine Learning and Complex Networks* held at Indian Institute of Technology, Kharagpur, India during Feb 28 – Mar 7, 2015.

Chaudhuri, Pinaki P.

Participated in *Discussion Meeting on Glass Formers and Glasses* held at JNCASR, Bangalore, India during Aug 8 – Aug 9, 2014. Talk on "Yielding of confined soft glasses"

Visited ICTS, Bangalore during Sep 6 – Sep 13, 2014.

Participated in *Indo-British Frontiers of Science (FOS) Symposium* held at Hotel Dukes Retreat, Khandala during Oct 9 – Oct 12, 2014. Poster on "Exploring the world of jammed materials"

Visited TIFR Centre for Interdisciplinary Sciences, Hyderabad during Nov 18 – Nov 21, 2014.

Participated in *2nd Soft Matter Young Investigators Meet* held at Hotel Atithi, Pondicherry during Dec 18 – Dec 20, 2014. Talk on "Rheology of soft jammed particles: role of attractive interactions"

Participated in *2nd Indian Statistical Physics Community Meeting* held at IISc, Bangalore during Feb 13 – Feb 15, 2015. Talk on "Cavitation in a model amorphous solid"

Visited TIFR Centre for Interdisciplinary Sciences, Hyderabad during Feb 27 – Mar 3, 2015.

Participated in *2nd Discussion Meeting on Glass Formers and Glasses* held at JNCASR, Bangalore during Mar 27 – Mar 28, 2015. Talk on "Cavitation in a model amorphous solid"

Date, G.

Participated in *International Conference on Matters of Gravity and the Universe* held at Centre for Theoretical Physics, Jamia Millia Islamia, New Delhi during Oct 27 – Oct 29, 2014.

Participated in *Celebrating the Centenary Year of General Relativity: The 28th Meeting of the IAGRG.* held at Raman Research Institute, Bangaluru during Mar 18 – Mar 20, 2015.

Participated in my capacity as the President of the IAGRG.

Devanand, T.

Participated in *Aspects of Gene Regulation* held at IMSc, Chennai on Dec 16, 2014.

Dolai, Dhriti Ranjan

Participated in *School on Random Schrodinger Operators* held at Pontificia Universidad Catlica de Chile, Santiago during Nov 13 – Nov 21, 2014. Participated

Participated in *Spectral Theory and Mathematical Physics* held at Pontificia Universidad Catlica de Chile, Santiago, Chile during Nov 24 – Nov 28, 2014. Gave talk on "Local statistics for some random operators".

Dutta, Arghya

Participated in *STATPHYS-KOLKATA-VIII* held at SNBNCBS, Kolkata during Dec 1 – Dec 5, 2014. Presented a poster.

Participated in *Indian Statistical Physics Community Meeting 2015* held at IISc, Bangalore during Feb 13 – Feb 15, 2015. Presented a poster.

Ganguli, SAibal

Participated in *ICM satellite conference on topology of torus actions and applications in Geometry and combinatorics* held at Dajeon during Aug 7 – Aug 12, 2014. Contributed Speaker.Talked on my work Mckay Correspondence on Quasitoric Orbifolds

Ghosh, Ria

Participated in *ICTS-Pacific Institute of Mathematical Sciences, Canada-IISER Pune Program - Advances in Mathematical Biology* held at IISER Pune during Dec 7 – Dec 16, 2014.

Ghosh, Sibasish

Visited Indian Statistical Institute, Kolkata during Jun 12 – Jun 22, 2014. Visited the Physics and Applied Mathematics Unit (PAMU) of ISI, Kolkata to continue collaborative work with Prof. Guruprasad Kar and his group members as well as to give a seminar.

Participated in *Discussions Meeting on Quantum Measurement (DMQM, 2014)* held at Physics Department, IISc, Bangalore during Oct 22 – Oct 24, 2014. I participated in the

meeting as an invited participant.

Visited Bose Institute, Kolkata during Nov 14 – Nov 23, 2014. Visited the Physics department of Bose Institute, Kolkata to continue collaborative work with Dr. Somshubhro Bandyopadhyay and his group members as well as to give a seminar.

Participated in *QANSAS, 2014* held at Dayal Bagh Educational Institute, Agra during Nov 27 – Nov 30, 2014. I gave an invited talk in the conference.

Visited IISER – Kolkata during Feb 6 – Feb 12, 2015. To discuss with Prof. Prasant Panigrahi and Dr. Chiranjib Mitra on several aspects of Quantum Information, to initiate collaborative research work, and to give a seminar.

Visited Visva-Bharati University during Mar 16 – Mar 20, 2015. To discuss (with Prof. Prasanta Chatterjee of Math. Dept.) on certain techniques of Quantum Plasma in the context of entanglement theory, and to give a seminar.

Gun, S.

Visited HRI during Apr 23 – May 4, 2014. Research Collaboration

Visited KSOM during May 7 – May 21, 2014. Lectured in AFS II

Participated in *Discussion meeting on Analytic number theory 2015* held at TIFR, Mumbai during Jan 5 – Jan 9, 2015. Invited Speaker

Kesavan, S.

Visited Institut de Mathématiques, Université Paul Sabatier, Toulouse, France during Apr 28 – May 24, 2014. Visiting Professor under a project of IFCAM. Delivered a seminar talk.

Participated in *General Assembly of the International Mathematical Union* held at Gyeongju, S. Korea during Aug 10 – Aug 11, 2014. Presented the four year report of the Commission for Developing Countries.

Participated in *Mathematics in Emerging Nations:Achievements and Opportunities (MENAO)* held at Seoul, S. Korea on Aug 12, 2014. Represented the National Board for Higher Mathematics (NBHM).

Participated in *International C0ngress of Mathematicians (ICM 2014)* held at Seoul, S. Korea during Aug 13 – Aug 21, 2014.

Visited Hindustan University, Chennai on Oct 7, 2014. Delivered a seminar talk.

Participated in *Refresher Course on Linear Algebra* held at Ramanujan Institute for Ad-

vanced Study in Mathatematics (RIASM) during Nov 11 – Nov 13, 2014. Delivered a course of 6 lectures.

Participated in *National Conference on Advances in Partial Differential Equations (NCAPDE)* held at Periyar University, Salem during Dec 4 – Dec 5, 2014. Inaugurated the conference, delivered the key-note address, and delivered an invited talk.

Participated in *Workshop on Variational Methods* held at TIFR-CAM, Bangalore during Dec 15 – Dec 16, 2014. Delivered a course of 5 lectures.

Participated in *Recent Advances in Partial Differential Equations* held at TIFR-CAM, Bangalore on Dec 17, 2014. Delivered an invited talk.

Visited IMU Headquarters, Berlin during Mar 11 – Mar 14, 2015. Attended the meeting of the Commission for Developing Countries in the capacity of Secretary, Grants Selection.

Lodaya, Kamal

Participated in *13th Formal methods update* held at IIT Kharagpur during Jul 28 – Jul 30, 2014. Gave a talk on "Automata from left and right".

Participated in *Calcutta Logic Circle annual meeting* held at IBRAD, Kolkata during Oct 17 – Oct 19, 2014.

Participated in *2nd international conference on Creative Mathematical Sciences Communication* held at IMSc during Dec 9 – Dec 12, 2014.

Participated in *34th FSTTCS* held at New Delhi during Dec 15 – Dec 17, 2014. Programme committee member.

Participated in *16th international workshop on Verification of Infinite-state systems* held at IIT Delhi on Dec 18, 2014.

Participated in *14th Asian logic conference* held at IIT Bombay during Jan 5 – Jan 8, 2015. Programme committee member. Presented an abstract on "Counting quantifiers and linear arithmetic on word models" (with A.V. Sreejith).

Participated in *6th Indian conference on Logic and Applications* held at IIT Bombay during Jan 8 – Jan 10, 2015.

Participated in *16th international conference on Verification, Model checking and Abstract interpretation* held at TIFR, Mumbai during Jan 12 – Jan 14, 2015.

Participated in *42nd international symposium on Principles of Programming Languages* held at TIFR, Mumbai during Jan 15 – Jan 17, 2015.

Participated in *Instructional seminar on Logic and Multi-agent systems* held at IMSc during Feb 1 – Feb 3, 2015.

Participated in *4th international workshop on Automata, concurrency and timed systems* held at CMI during Feb 9 – Feb 13, 2015.

Visited Tezpur University during Mar 16 – Mar 20, 2015. Gave 4 lectures on "Model checking".

Mahajan, Meena

Visited Université Paris Diderot - Paris 7, France. during May 12 – Jun 3, 2014. This visit was for research collaboration under an ongoing IFCPAR project.

Participated in *Dagstuhl seminar on Algebra in Computational Complexity* held at Leibniz Centre for Informatics, Schloss Dagstuhl, Germany during Sep 21 – Sep 26, 2014. Gave a talk titled "Homomorphism Polynomials complete for VP".

Majumdar, Diptapriyo

Visited Indian Institute of Technology, Delhi during Dec 13 – Dec 14, 2014. Attending Pre-FSTTCS Workshop

Participated in *New Developments in Exact Algorithms and Lower Bounds* held at Indian Institute of Technology, Delhi during Dec 13 – Dec 14, 2014. Pre-FSTTCS workshop

Participated in *Foundations of Software Technology and Theoretical Computer Science 2014* held at India International Center, New Delhi during Dec 15 – Dec 17, 2014.

Majumder, Souradeep

Visited Centre for Quantum Geometry of Moduli Spaces,Aarhus during Jun 1 – Jun 30, 2014.

Visited Indian Statistical Institute, Bangalore during Feb 26 – Feb 28, 2015.

Meesum, Syed M.

Visited University of Bergen, Norway during Sep 15 – Nov 30, 2014.

Menon, Gautam I.

Visited TCIS, TIFR - Hyderabad during Apr 16 – Apr 19, 2014. Physics Colloquium on

"Chromosome Positioning and Active Matter"

Visited INSTEM-NCBS, Bangalore on Apr 28, 2014. Seminar on "Chromosome Positioning and Active Matter"

Visited University of Leeds, UK during May 20 – Jun 4, 2014. Academic visit to the Department of Applied Mathematics, University of Leeds in connection with an Indo-EU project on "Mathematics in Health and Disease"

Visited Wolfson-Wohl Cancer Centre, University of Glasgow, UK on May 27, 2014. Seminar on "Chromosome Positioning and Active Matter"

Visited Warwick Medical School, University of Warwick, UK on Jun 2, 2014. Seminar on "Chromosome Positioning and Active Matter"

Visited Mechanobiology Institute, National University of Singapore, Singapore on Jul 2, 2014. Colloquium on "Active Matter: Connecting Theory and Experiment"

Visited Raman Research Institute during Sep 11 – Sep 13, 2014. Colloquium on "Chromosome Positioning and Active Matter"

Visited Indo-UK Frontiers of Science, Khandala during Oct 7 – Oct 12, 2014. Invited Talk on "New Topics in Statistical Mechanics"

Visited IIT Kanpur, Kanpur, India during Nov 12 – Nov 16, 2014. Physics Colloquium on "The Nuclear Physics of Chromosome Positioning"

Visited HRI, Allahabad during Nov 16 – Nov 19, 2014. Delivered two talks, A seminar on "Chromosome Positioning" and a Colloquium on "Crowding: Why it might not be a bad idea after all"

Visited International Conference on Genome Architecture and Cell Fate Regulation, School of Life Sciences, University of Hyderabad during Dec 1 – Dec 4, 2014. Invited talk on "A Quantitative Model for Chromosome Positioning"

Visited 6th Indo-Israeli Meeting on Condensed Matter Physics, Jerusalem, Israel during Dec 8 – Dec 12, 2014. Invited talk on "Chromosome Positioning from Activity-based Segregation"

Visited Aspects of Gene Regulation, IMSc, Chennai on Dec 16, 2014. Invited talk on "Chromosome Positioning from Activity-based Segregation"

Visited Complex Fluids Symposium, JNCASR, Bangalore during Dec 21 – Dec 24, 2014. Invited Talk on "Nuclear Architecture and Active Matter"

Visited Mechanobiology Institute, National University of Singapore, Singapore during Jan 5 – Jan 12, 2015. Visit included a number of collaborative discussions with scientists at MBI

Visited Frontiers of Biology: The DAE Spectrum, SINP, Kolkata during Jan 21 – Jan 22, 2015. Invited talk on "A Quantitative Model of Nuclear Architecture"

Visited Statistical Mechanics Community Meeting, ICTS-IISc, Bangalore during Feb 12 – Feb 15, 2015. Invited talk on "The Wisdom of Crowding"

Visited Department of Biotechnology, New Delhi during Feb 12 – Feb 13, 2015. Visit in connection with Star College Scheme of the DBT

Visited IISER-Kolkata, Kalyani during Mar 11 – Mar 12, 2015. Visit and Physics Colloquium on "Active Matter"

Visited S.N. Bose National Centre for Basic Science, Kolkata on Mar 13, 2015. Physics Colloquium on "Active Matter"

Menon, Shakti N.

Participated in *Dynamics Days Asia Pacific 08 (DDAP 08)* held at IIT-M and IMSc, from 21 – 24, July 2014.

Participated in *Social Modelling and Simulations + Econophysics colloquium (SMSEC 2014)* held at Nichii Gakkan in Kobe, Japan from 4 – 6, Nov. 2014.

Participated in STATPHYS conference held at SN Bose Center for Basic Sciences, Kolkata from 1 – 5 Dec. 2014.

Mukhopadhyay, Anirban

Participated in *AIS school on "Diophantine Equations"* held at HP University, Shimla during Jun 16 – Jul 4, 2014. gave a course of lectures on "Circle method in Diophantine equations"

Participated in *AIS school on "Algebraic number theory"* held at CMI, Chennai during Jul 7 – Jul 26, 2014. lectured on xi"quadratic reciprocity"

Participated in *Enriching Mathematics Education 2014* held at IMSc during Oct 16 – Oct 17, 2014. gave a lecture on euclidean geometry

Participated in *Indian Math society annual conference* held at Indian school of mines, Dhanbad during Dec 27 – Dec 30, 2014. gave a talk in Number theory symposium

Mukhopadhyay, Partha

Participated in *India-JINR Forum, Frontiers in Nuclear, Elementary Particle and Condensed Matter Physics* held at Joint Institute of Nuclear Research, Dubna, Russia during

Jun 16 – Jun 20, 2014. Presented talk: Non-linear sigma model, loop space and tubular geometry

Visited Institute of Physics, Bhubaneswar during Dec 8 – Dec 14, 2014. Delivered talk: Non-linear sigma model, loop space and tubular geometry

Participated in *Indian Strings Meeting 2014* held at Puri, India during Dec 15 – Dec 20, 2014.

Nagaraj, D. S.

Visited University of Lille 1, Lille, France. during May 1 – May 31, 2014. Participated in a conference and gave an invited talk.

Participated in *"Positivity, Vanishing Theo- rems, and Applications"* held at CEMPI, Lille 1, University of Lille, France. during May 12 – May 18, 2014. Gave a talk titled "Degenerate mapping of projective plane to Grassmannain"

Visited University of Paris VI, Paris during Jun 1 – Jun 30, 2014. Gave talk on Special Projections of Veronese surface at the seminar Groupe dEtude sur les ProBlemes Diophantiens Gave a talk on Null correlation bundle on projective three space at the "Alg. Geom." seminar, at University of Paris VI.

Participated in *Manipal days in Mathematics; Workshop on Algebraic Geometry* held at Manipal University, Manipal. Karnataka during Jan 5 – Jan 9, 2015. Gave a talk on "VECTOR BUNDLES ON SYMMETRIC PRODUCT OF CURVES".

Participated in *Algebra and Analysis* held at central University of Tamilnadu, Thiruvaur, Tamilnadu. during Jan 31 – Feb 2, 2015. Gave 6 lectures on Algbra

Niyogi, Saurabh

Participated in *LHCDM-2015 (LHC and Dark Matter)* held at Indian Association for the Cultivation of Science, Kolkata during Feb 9 – Feb 13, 2015.

Panolan, Fahad

Participated in *FSTTCS 2014* held at India International Centre, New Delhi during Dec 15 – Dec 17, 2014. It is a annual Conference on Foundations of Software Technology and Theoretical Computer Science

Patri, Issan

Visited Texas A and M University during Sep 1 – Nov 24, 2014. Visiting Graduate Student

invited by Prof. Gilles Pisier.

Prabhakar, Varuni

Visited Tata Institute for Fundamental Research, Mumbai during Aug 8 – Aug 17, 2014. Collaborative work with Prof. Sandhya Koushika

Visited Tata Insititute for Fundamental Research during Mar 5 – Mar 18, 2015. Collaborative work with Prof. Sandhya Koushika

Prasad, Amritanshu

Participated in *Refresher course on linear algebra* held at University of Madras during Nov 14 – Nov 17, 2014. Gave a course of lectures.

Participated in *Workshop on probability and representation theory* held at IISc, Bangalore during Mar 6 – Mar 7, 2015. Invited talk.

Raghavan, K. N.

Participated in *Sixth Summer Training Programme in Mathematics* held at Ramanujan Institute for Advanced Study, Madras University during May 29 – Jun 2, 2014. Conducted lectures and tutorials for MSc Mathematics students (from various parts of Tamilnadu) on Linear Algebra

Visited Indian Academy of Sciences, Bengaluru during Jun 6 – Jun 8, 2014. CSIR committee work

Visited Indian Statistical Institute, Delhi during Aug 4 – Aug 6, 2014. External examiner for doctoral thesis.

Visited St. Stephen's College, Delhi on Aug 4, 2014. Gave a lecture organized by the Mathematics Society of St. Stephen's College.

Participated in *Research in Science 2014* held at IMSc on Nov 6, 2014. Gave a lecture titled "How much is a real symmetric matrix controlled by its spectrum?"

Participated in *80th Annual Meeting of the Indian Academy of Sciences* held at Indian Institute of Technology, Chennai during Nov 7 – Nov 9, 2014. IMSc was one of the main organizers of the event. Helped in organization.

Participated in *Refresher course on Linear Algebra* held at Ramanujan Institute for Advanced Study in Mathematics, University of Madras during Nov 15 – Nov 17, 2014. Resource person

Visited Central Leather Research Institute, Chennai during Nov 22 – Nov 24, 2014. CSIR committee work

Participated in *Advanced Instructional School on Schemes and Cohomology* held at Kerala School of Mathematics, Kozhikode, Kerala during Dec 2 – Dec 5, 2014. Resource person.

Participated in *Recent Advances in Operator Theory and Operator Algebras* held at Indian Statistical Institute, Bangalore during Dec 9 – Dec 13, 2014. Attended the workshop part of the meeting.

Visited University of Hyderabad on Jan 5, 2015. Gave a talk "On Gelfand Tsetlin patterns".

Participated in *Royal Society – DST India UK research meeting* held at Chennai Mathematical Institute, Chennai during Jan 12 – Jan 15, 2015. This was a meeting to explore possible research collaboration in the areas of commutative algebra and modular representation theory. There were about fifteen invited participants, five from the UK, and about ten from India.

Visited Vel Tech University, Avadi, Chennai on Feb 8, 2015. Evaluation of R D projects by mathematics faculty

Participated in *Workshop on Probability and Representation Theory* held at Indian Institute of Science, Bangalore during Mar 6 – Mar 7, 2015. Gave a talk on "Littelmann's LS paths and Brownian motion"

Rajasekaran, G.

Participated in *INO Collaboration Meeting* held at VECC, Kolkata during Apr 3 – Apr 5, 2014.

Participated in *Research Science Initiative Chennai (RSIC)* held at IIT, Madras during May 3 – Jun 6, 2014. Gave a talk "Hundred Years of Fundamental Physics and the Discovery of the Higgs Boson"

Participated in *Science Academies' Refresher Course on Quantum Mechanics* held at Bishop Moore College, Mavelikara, Kerala during May 5 – May 10, 2014. Gave a course of Quantum Mechanics

Participated in *Unification and Cosmology 2014* held at Punjab University, Chandigarh during May 13 – May 15, 2014. Gave the Keynote Talk on "High Energy Physics 2014 and its Future" and a contributed talk " Was dark matter detected in India 40 years ago?"

Participated in *Summer Program for Students* held at Department of nuclear Physics, University of Madras on Jun 12, 2014. Gave two lectures: 1. Standard Model, Higgs Boson and What Next? 2. Neutrinos and INO

Visited Indian Institute of Astrophysics, Bangaluru on Jul 3, 2014. Gave a Colloquium on "Neutrinos and INO".

Participated in *Meeting of the Science Education Panel of the Indian Academy of Sciences, Bangaluru* held at Indian Academy of Sciences, Bangaluru on Jul 3, 2014.

Participated in *Academy Mid-Year Meeting* held at Indian Institute of Science, Bangaluru during Jul 4 – Jul 5, 2014.

Visited Chennai Mathematical Institute on Jul 31, 2014. Gave the Convocation Address and spoke on "Hundred Years of Fundamental Physics and a Crisis"

Visited IISER-Mohali during Aug 25 – Aug 30, 2014. Gave a course of 7 lectures on High Energy Physics and two Colloquia

Visited IIT-Ropar on Aug 29, 2014. Gave a lecture on High Energy Physics to students.

Participated in *INO Collaboration Meeting* held at Inter-Institutional Centre for High Energy Physics, Madurai during Sep 18 – Sep 20, 2014.

Visited IISER, Thiruvananthapuram during Sep 24 – Sep 26, 2014. Gave two Colloquia: 1. Standard Model, Higgs Boson and What Next? 2. Neutrinos and INO

Participated in *International Conference on Ultra-high Intensity Lasers* held at Hotel Cidade de Goa, Goa during Oct 12 – Oct 15, 2014. I proposed that a National Task Force for Laser Plasma Accelerator must be formed and this must lead to the creation of a National Centre for Laser Plasma Accelerator and this proposal has been accepted.

Participated in *International Conference on Quantum Field Theory* held at Banares Hindu University during Nov 1 – Nov 5, 2014. Gave an invited talk on "Hundred Years of Fundamental Physics and a Crisis"

Participated in *Annual Meeting of the Indian Academy of Sciences* held at IIT, Chennai during Nov 7 – Nov 9, 2014.

Visited Institute for Plasma Research, Gandhinagar during Nov 23 – Nov 24, 2014. Gave a Colloquium "Hundred Years of Fundamental Physics and a Crisis"

Visited Physical Research Laboratory, Ahmedabad on Nov 25, 2014.

Visited Indian Institute of Astrophysics, Bangaluru during Nov 26 – Nov 28, 2014. Gave 5 lectures on HEP (including two Colloquia).

Participated in *XXI DAE-BRNS HEP Symposium 2014* held at IIT, Guwahati during Dec 8 – Dec 12, 2014. Apart from chairing the Opening Session, I gave an invited review talk on Neutrino Masses and Mixing and a contrbuted talk "Was dark matter detected in India 40

years ago?"

Participated in *Science Academies' Refresher Course in Classical Mechanics and Electromagnetic Theory* held at SDM College, Ujire, Karnataka during Dec 15 – Dec 20, 2014. Gave a Course of lectures on Classical Elecrodynamics

Participated in *Indian Science Congress 2015* held at University of Mumbai during Jan 3 – Jan 7, 2015. Organized a Symposium "High Energy Physics in 2015 and its Future" and spoke on "A Crisis in Fundamental Physics".

Visited Madurai Kamaraj University during Jan 15 – Jan 17, 2015. Gave about six lectures to MSc students, as a part of a Course on High Energy Physics

Visited Tata Institute of Fundamental research, Mumbai during Feb 12 – Feb 13, 2015. Gave a Colloquium "Hundred Years of Fundamental Physics and a Crisis"

Visited BARC, Mumbai during Feb 14 – Feb 15, 2015. Participated in an important meeting to decide on the structure of the INO collaboration.

Visited Lucknow University during Feb 27 – Mar 1, 2015. Gave a Colloquium on Science Day "Hundred Years of Fundamental Physics and its Future"

Visited University of Madras, Guindy Campus on Mar 13, 2015. Gave a Colloquium Talk to Science Students "Hundred Years of Fundamental Physics and the Discovery of Higgs Boson"

Visited Madurai Kamaraj University during Mar 27 – Mar 31, 2015. Gave lectures for about 15 hours to MSc students as part of a Course on High Energy Physics

Participated in *National Symposium on Particles, Detectors and Instrumentation* held at Inter-Institutional Centre for High Energy Physics, Transit Campus,Madurai during Mar 27 – Mar 31, 2015. Chaired the first Session and gave the last talk on "Hundred Years of Fundamental Physics and a Crisis"

Raman, Venkatesh

Visited St. Xavier's College for Women, Aluva on Aug 8, 2014. Gave a talk on 'Turan's theorem and an algorithmic application'

Participated in *New Developments in Exact Algorithms and Lower Bounds* held at IIT Delhi during Dec 13 – Dec 14, 2014. Organized the event

Participated in *IARCS 34th annual conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)* held at New Delhi during Dec 15 – Dec 17, 2014. Program Committee Co-chair

Participated in *Indo-German Workshop on Algorithms* held at ISI Kolkata during Mar 9 – Mar 12, 2015. Gave an invited talk on 'Selection in Realistic Models'

Ramanujam, R.

Visited Amrita University during Apr 11 – Apr 12, 2014. Gave a talk on "Games and distributed algorithms".

Participated in *ASL Annual Meeting on Logic* held at Boulder, Colorado, USA during May 19 – May 22, 2014. Gave a talk titled "Logical dynamics of rational choice in large games" in the Special Session on Logic and Game Theory.

Visited City University of New York, USA during May 22 – Jun 6, 2014. Gave talks on "Semantics of messages" and "Dynamics in large games".

Participated in *Logic Colloquium* held at Vienna, Austria during Aug 4 – Aug 7, 2014. Organized a special session on "Logics of Rational Choice"

Participated in *Parameterized Complexity and Computational Reasoning* held at Vienna, Austria during Aug 5 – Aug 8, 2014. Gave a talk on "Intutionistic proof theory and paramaterized complexity".

Participated in *World Wide Web Verification* held at Vienna, Austria during Aug 7 – Aug 8, 2014. Gave a talk on "Realizability in web service choreographies".

Visited Ethiraj College during Feb 27 – Feb 28, 2015. Gave a mini-workshop on "Research Methodology".

Visited IIT-Madras on Mar 5, 2015. Gave a talk on "Axiom of choice: It's so obvious that it's a puzzle"

Visited Amrita University during Mar 7 – Mar 8, 2015. Gave a talk on "Epistemic logic and distributed systems"

Visited Tezpur University during Mar 14 – Mar 16, 2015. Gave a talk on "Challenges for Logic in AI".

Ransingh, Biswajit

Participated in *Perspective in Lie theory* held at Scuola Normale Superiore Pisa ITALY during Dec 7, 2014 – Jan 19, 2015.

Participated in *Aspect of Lie theory* held at INdAM, Rome, Italy during Jan 7 – Jan 10, 2015.

Ray, Purusattam

Visited CEN, Saclay, Paris, France during Aug 1 – Aug 5, 2014. Collaboration and seminar presentation.

Saha, Biswajyoti

Visited Harish-Chandra Research Institute, Allahabad during Feb 4 – May 4, 2014. Worked in a research project under supervision of Prof. Joseph Oesterle.

Participated in *Annual Foundational School-2* held at Kerala School of Mathematics, Kozhikode during May 8 – May 21, 2014. Invited as a tutor.

Participated in *Advanced Instructional School in Algebraic number theory* held at Chennai Mathematical Institute, Chennai during Jul 7 – Jul 26, 2014.

Participated in *Winter School on Modular functions in one and several variables* held at Goa University, Goa during Dec 8 – Dec 16, 2014.

Participated in *Discussion Meeting on Analytic Number Theory 2015* held at Tata Institute of Fundamental Research, Mumbai during Jan 5 – Jan 9, 2015.

Participated in *International Conference on Automorphic Forms and Applications* held at Kerala School of Mathematics, Kozhikkode during Feb 13 – Feb 14, 2015. Invited speaker.

Participated in *Spring school on Characters of Representations and Modular Forms* held at Max Planck Institute for Mathematics, Bonn during Mar 23 – Mar 27, 2015.

Saha, Ekata

Participated in *Advanced Instructional School in Algebraic number theory* held at Chennai Mathematical Institute, Chennai during Jul 7 – Jul 26, 2014.

Participated in *Winter School on Modular functions in one and several variables* held at Goa University, Goa during Dec 8 – Dec 16, 2014.

Participated in *Discussion Meeting on Analytic Number Theory 2015* held at Tata Institute of Fundamental Research, Mumbai during Jan 5 – Jan 9, 2015.

Samal, Areejit

Participated in *Workshop on Economy of a Cell* held at ICTP, Trieste, Italy during Jun 23 – Jun 27, 2014. Invited talk: An introduction to flux balance analysis and related methods for studying metabolic genotype-phenotype relationships.

Participated in *International Mycological Congress* held at Bangkok, Thailand during Aug 3 – Aug 7, 2014. Invited talk: Reconstruction and systems analysis of plant cell wall deconstruction network in filamentous fungus Neurospora crassa.

Visited Jawaharlal Nehru University, Delhi on Sep 2, 2014. Seminar on Network approaches towards understanding microRNA regulation of cardiomyocyte proliferation.

Visited Indraprastha Institute of Information Technology (IIIT), Delhi on Sep 4, 2014. Seminar on Phenotypic constraints drive the architecture of metabolic networks.

Participated in *Functional Genomics Workshop* held at Ljubljana, Slovenia during Oct 15 – Oct 16, 2014. Contributed talk: Reconstruction and systems analysis of plant cell wall deconstruction network in filamentous fungus Neurospora crassa.

Visited Institut des hautes tudes scientifiques (IHES), Bures-sur-Yvette, France during Nov 10 – Nov 24, 2014. Selected as scientific visitor to collaborate on topics of systems biology.

Participated in *Aspects of Gene Regulation* held at IMSc, Chennai on Dec 16, 2014. Talk: Reconstruction and systems analysis of plant cell wall deconstruction network in filamentous fungus Neurospora crassa

Visited School of Chemical and Biotechnology, SASTRA University, Thanjavur on Jan 21, 2015. Invited talk: Reconstruction and systems analysis of plant cell wall deconstruction network in filamentous fungus Neurospora crassa.

Participated in *International Workshop on Drug Development and Neglected Tropical Infectious Diseases* held at CAS in Crystallography and Biophysics, University of Madras, Chennai during Feb 22 – Feb 27, 2015. Invited talk: Network approaches towards understanding microRNA regulation of cardiomyocyte proliferation.

Sankaran, Parameswaran

Visited IIT Bombay, Powai, Mumbai on Apr 3, 2014. Gave a talk on 'Twisted conjugacy in lattices in Lie groups'.

Visited IISER Pune, on Apr 4, 2014. Gave a talk on 'Twisted conjugacy in Richard Thompson groups'

Participated in *Brazilian Topology Meet* held at Universidade Estadual Paulista, São José do Rio Preto Campus. during Aug 3 – Aug 9, 2014. Gave an invited talk on 'Twisted conjugacy in certain PL homeomorphism groups'.

Participated in *Workshop in Algebraic Topology for College Lecturers* held at Kerala School of Mathematics during Sep 11 – Sep 14, 2014. Gave four lectures on applications of homology theory.

Participated in *National Seminar on Topology and Analysis* held at St Paul's College, Kalamassery, Kochi. on Oct 9, 2014. Invited talk on 'Borsuk-Ulam Theorem and its applications'.

Visited Cochin University of Science, Arts and Technology on Oct 10, 2014. Gave a talk on topological methods in group theory.

Participated in *Refresher course in linear algebra* held at Ramanujan Institute for Advanced Study in Mathematics, University of Madras. during Nov 8 – Nov 11, 2014. Gave three lectures on vector spaces.

Visited Indian Institute of Science, Bangalore on Nov 15, 2014. Gave a talk on 'The BNS invariant and twisted conjugacy'.

Participated in *Annual Foundation School-I* held at NISER, Bhubaneswar during Dec 2 – Dec 6, 2014. Gave four lectures on topology.

Participated in *National Seminar on Topology* held at Sarada College, Salem during Feb 11 – Feb 12, 2015. Gave a talk on 'The vector field problem'.

Participated in *National Seminar on Topology and Applications* held at Avinasilingam College for Women, Coimbatore during Feb 12 – Feb 13, 2015. Gave a talk on 'The Borsuk-Ulam Theorem'.

Sathiapalan, Balachandran

Participated in *Advanced String School* held at Puri during Sep 22 – Sep 28, 2014. Lectured on "Applications of AdS/CFT"

Saurabh, Nitin

Participated in *Mathematical Foundations of Computer Science (MFCS)* held at Budapest, Hungary during Aug 25 – Aug 29, 2014.

Participated in *Workshop on New Developments in Exact Algorithms and Lower Bounds* held at IIT Delhi during Dec 13 – Dec 14, 2014.

Participated in *International Conference on Foundation of Software Technology and Theoretical Computer Science (FSTTCS 2014)* held at IIT Delhi during Dec 15 – Dec 17, 2014.

Participated in *Indo-UK workshop on Computational Complexity Theory* held at IMSc, Chennai during Jan 5 – Jan 9, 2015.

Saurabh, Saket

Participated in *ICERM Semester Program on Network Science and Graph Algorithms* held at Brown University, USA during Apr 20 – May 7, 2014. Invited Speaker for a workshop.

Visited Laboratory of Mathematical Logic of St. Petersburg Department of Steklov Institute of Mathematics during Sep 17 – Sep 27, 2014. Invited to give three lectures on Matroids based parameterized algorithms. Video recordings can be found at

https://www.youtube.com/watch?v=yGMi6ObL25o

Participated in *25th International Workshop on Combinatorial Algorithms* held at Duluth, USA during Oct 15 – Oct 17, 2014. Invited Speaker

Participated in *Dagstul Seminar on Optimality and tight results in parameterized complexity* held at Dagstuhl, Germany during Nov 2 – Nov 7, 2014. Gave an invited talk

Participated in *Formal Software Technology and Theoretical Computer Science (FSTTCS)* held at New Delhi during Dec 15 – Dec 17, 2014. Gave a talk

Participated in *ELC/B01 Workshop on Parameterized Algorithm* held at Tokyo, Japan. during Feb 28 – Mar 1, 2015. Invited Speaker.

Sharma, Vikram

Participated in *4th International Congress of Mathematical Software* held at Seoul, South Korea during Aug 5 – Aug 9, 2014. Conducted a special session

Participated in *International Congress of Mathematicians* held at Seoul, South Korea during Aug 13 – Aug 21, 2014.

Sinha, Nita

Participated in *NORDITA scientific program, News in Neutrino Physics* held at NORDITA in Stockholm, Sweden during Apr 7 – May 2, 2014.

Participated in *Frontiers of New Physics: Colliders and Beyond* held at ICTP, Trieste during Jun 23 – Jun 27, 2014.

Participated in *XXI DAE-BRNS High Energy Physics Symposium* held at IIT Guwahati during Dec 8 – Dec 12, 2014. Delivered an invited, plenary talk on 'Future Atmospheric Experiments'.

Participated in *International Conference on Massive Neutrinos* held at Nanyang Technological University, Singapore during Feb 9 – Feb 13, 2015. Delivered an invited talk on

'Neutrino Observatory in India'.

Participated in *Workshop on Recent advances in HEP* held at University of Hyderabad during Feb 26 – Feb 28, 2015. Delivered an invited lecture on 'Flavour Physics, Standard Model and Beyond'.

Sinha, Sitabhra

Visited Indian Statistical Institute, Chennai on Apr 8, 2014. Gave invited talk on "Econophysics: Towards a physical theory of socio-economic phenomena"

Visited BITS-Pilani, Goa Campus during Apr 11 – Apr 14, 2014. Gave invited talks on (i) "Mind, Memory and Modules: Using nonlinear dynamics and complex networks to understand the brain" and (ii) "Econophysics: Towards a physical theory of socio-economic phenomena"

Participated in *British Society of Immunology Meeting on Mathematical Modelling in Immunology* held at Microsoft Research, Cambridge during May 19 – May 20, 2014. Gave invited talk on "Action-at-a-distance in cell signaling networks"

Visited Department of Applied Mathematics, University of Leeds, Leeds, United Kingdom during May 21 – Jun 5, 2014. Gave talk on "Module-omics: The role of mesoscopic organization of biological networks in health and disease".

Visited Wolfson Wohl Cancer Research Centre, Glasgow, United Kingdom on May 27, 2014. Gave invited talk on "Module-omics: The role of mesoscopic organization of biological networks in health and disease"

Visited Institute of Biodiversity, Animal Health and Comparative Medicine, University of Glasgow, Glasgow, United Kingdom on May 27, 2014. Gave invited talk on "Modeling the dynamic patterns of epidemic propagation"

Participated in *Joint Telematics Group/IEEE Information Theory Society Summer School 2014 in Signal Processing, Telecommunication, and Networking* held at Indian Institute of Technology, Madras during Jun 16 – Jun 19, 2014. Gave a eight lecture series on the theme "The middle path to understand complex systems: A mesoscopic perspective on network dynamics"

Visited Indian Institute of Technology, Gandhinagar during Sep 18 – Sep 20, 2014. Gave invited Hira7751;yagarbha lecture on "Patterns of life and death: Using physics to understand complex dynamics in human physiology"

Visited Department of Applied Mathematics, University of Calcutta during Oct 13 – Oct 17, 2014.

Participated in *Workshop on Mathematical Modelling and Data Analysis in Biology* held at

Indian Institute of Technology, Mandi during Oct 27 – Oct 29, 2014. Gave invited talk on "Network Biology: Emergent complexity in biological systems"

Visited University of Allahabad, Allahabad during Nov 24 – Nov 26, 2014. Gave invited talks on (i) "Minds, Modules and Memory: Exploring networks of the nervous system" and (ii) "Why it pays to be nice to complete strangers: Co-action equilibrium in non-cooperative games"

Visited Harish-Chandra Research Institute, Allahabad during Nov 26 – Nov 28, 2014. Gave invited talk on "Patterns of life and death: Using physics to understand complex dynamics in human physiology"

Participated in *StatPhys-Kolkata VIII* held at S N Bose National Centre for Basic Sciences, Kolkata during Dec 1 – Dec 5, 2014. Gave invited talk on "Learning to Balance: Extreme variability in convergence to structural balance in frustrated systems"

Participated in *ICTS-PIMS-IISER Pune Program on Advances in Mathematical Biology* held at IISER Pune during Dec 7 – Dec 16, 2014. Gave invited talks on (i) "Patterns of life death: Excitable dynamics of biological cells tissue" and (ii) "Pattern formation through lateral inhibition in arrays of coupled relaxation oscillators"

Participated in *Workshop on Quantitative Biology* held at Institute of Life Sciences, Pune on Dec 17, 2014. Gave invited talk on "Exploring biology through networks: From the worm to the human"

Visited Bose Institute, Kolkata on Jan 30, 2015. Gave seminar talk on "Cancer "Module"-omics: Mesoscopic analysis of the network of cancer diseases and genes reveals "movers" and "shakers" of the disease"

Participated in *National Workshop on Scale-Free Networks* held at Cochin University of Science and Technology (CUSAT), Kochi during Feb 12 – Feb 15, 2015. Gave invited talk on "Community detection in networks"

Participated in *Interdisciplinary Conference on the Science and Application of Networks* held at Shiv Nadar University, Uttar Pradesh during Mar 20 – Mar 22, 2015. Gave invited talk on "Complexity of social and economic networks: The importance of community organization"

Srinivas, K.

Participated in *29th Annual Conference of Ramanujan mathematical Society* held at IISER, Pune during Jun 23 – Jun 27, 2014. Delivered an invited talk in the Number theory symposium.

Participated in *Discussion meeting on Analytic Number Theory 2015* held at TIFR, Mumbai during Jan 5 – Jan 9, 2015. Delivered an invited talk with the title *On the angles of eigen forms*

Subramanian, C. R.

Visited SSN College of Engineering, OMR, Kalavakkam, Chennai - 603110 on Jun 19, 2014. Was a Resource Person in the Faculty Development Programme of Department of Mathematics. Gave a lecture on "Principle of Inclusion-Exclusion and exact algorithms for hard probelems".

Participated in *ICTCSDM-2014 (International Conference on Theoretical Computer Science and Discrete Mathematics)* held at SSN Colleg of Engineering, Kalavakka, Chennai. during Dec 8 – Dec 10, 2014. Invited Speaker

Participated in *CALDAM-2015 (First International Conference on Algorithms and Discrete Applied Mathematics)* held at IIT-Kanpur during Feb 8 – Feb 10, 2015. Invited Speaker

Sunder, V. S.

Participated in *ICLAA 2014* held at Manipal University during Dec 17 – Dec 19, 2014. Gave an invited talk on 'Uhlmann's theorems' at this conference held to felicitate Prof. R.B. Bapat on his 60th birthday.

Vijayakumar Sasidevan

Participated in *Social Modeling and Simulations + Econophysics Colloquium 2014* held at Kobe, Japan during Nov 4 – Nov 6, 2014.

Participated in *Indian Statistical Physics Community Meeting 2015* held at Physics Department, Indian Institute of Science, Bangalore during Feb 13 – Feb 15, 2015.

Participated in *Recent Advances in Reinforcement Learning Workshop 2015* held at IIT Chennai during Mar 23 – Mar 28, 2015.

Vyas, Vivek M.

Visited Indian Institute of Technology Kharagpur during May 21 – May 30, 2014. Attended ISWT Lecture series by Prof. Micheal Berry

Visited Indian Institute of Science Education and Research Kolkata during Oct 23 – Oct 30, 2014. Gave a talk titled "A gauge theory of massive spin one particles"

Participated in *New Trends in Field Theories* held at Banaras Hindu University, Varanasi during Nov 1 – Nov 5, 2014. Gave a talk titled "Some results on topological currents in field theory"

Participated in *Mini Winter School on Ultra Cold Atoms - 2014* held at Government College

for Women, Kumbakonam during Dec 22 – Dec 25, 2014. Gave three lectures on Bose-Einstein condensation

Participated in *Advances in High Energy Physics* held at School of Physics, University of Hyderabad during Feb 26 – Feb 28, 2015. Gave a talk titled "A gauge theory of massive spin one particles"

5.4 Visitors from Other Institutions

Srijita Kundu	10.02.14 - 11.05.14	CMI, Chennai
Dileep Jatkar	14.02.15 - 20.02.15	HRI, Allahabad
Gauhar Abbas	14.02.14 - 21.12.14	IFIC, Valencia, Spain
Sandeep K Goyal	01.03.14 - 30.05.14	University of Kwazulu-Natal, Durban, South Africa
Gyan Prakash	16.03.14 - 05.04.14	HRI, Allahabad
Blanchard Nicolas	20.03.14 - 15.08.14	Student Civil Servant, Paris
Manoj Kumar	31.03.14 - 30.04.14	HRI, Allahabad
Anamitra Mukherjee	01.04.14 - 04.04.14	University of Tennessee, Knoxville, US
Arnab Chatterjee	03.04.14 - 10.04.14	Alto University of Technology, Helsinki, Finland
Samir Kunkri	05.04.14 - 31.05.14	Mahadevananda Mahavidyalaya, Barrackpore
Probir Roy	06.04.14 - 11.04.14	Retired TIFR / Saha Institute, Kolkatta
Sachin Subhash Sharma	12.04.14 - 27.04.14	TIFR, Mumbai
Anish Sarkar	14.04.14 - 15.04.14	ISI, Delhi
Punit Parmananda	15.04.14 - 18.04.14	IIT, Mumbai
Usha K. Sangale	20.04.14 - 29.06.14	SRTM University, Nanded
Haridass N. D.	21.04.14 - 28.04.14	TIFR, Hyderabad
Pooja Singla	21.04.14 - 26.04.14	IISC, Bangalore

Indranil Biswas	22.04.14 - 25.04.14	TIFR, Mumbai
Swarup Poria	28.04.14 - 14.05.14	University of Calcutta, West Bengal
Kasi Viswanadham G.	05.05.14 - 18.05.14	HRI, Allahabad
Priya A.	05.05.14 - 04.06.14	Madras Christian College, Chennai
RejiKumar K.	05.05.14 - 30.05.14	NSS College, Kerala
Bipul Saurabh	07.05.14 - 04.07.14	ISI, New Delhi
Indira Chowdhuri	08.05.14 - 09.05.14	Srishti School of Arts Design Tech, Bangalore
Priyanka Seshadri	08.05.14 - 09.05.14	Srishti School of Arts Design Tech, Bangalore
Sujatha R.	08.05.14 - 31.07.14	IISER, Thiruvananthapuram
Dalawat C.S.	08.05.14 - 16.05.14	HRI, Allahabad
Balachandran A.P.	09.05.14 - 14.05.14	ISI, Bangalore
Abhishek Banerjee	11.05.14 - 21.06.14	IISER, Kolkatta
Suneeta Varadarajan	12.05.14 - 15.06.14	IISER, Pune
Soumya Jyoti Biswas	14.05.14 - 07.06.14	SINP, Kolkatta
Selvakumar C	14.05.14 - 25.06.14	University of Madras, Chennai
Sathika V.	14.05.14 - 25.06.14	University of Madras, Chennai
Shiv Chaitanya K.V.S.	14.05.14 - 17.05.14	BITS Pilani, Hyderabad
Subhaksha	15.05.14 - 15.06.14	PSG College of Technology, Coimbatore
Nilesh Chaudhuri	15.05.14 - 22.07.14	IIT, Guwahati

Lakshmi Priya C.P.	16.05.14 - 25.06.14	University of Madras, Chennai
Jayanthi M.P.	16.05.14 - 25.06.14	University of Madras, Chennai
Ramij Rahman	19.05.14 - 31.05.14	University of Allahabad, Uttar Pradesh
Sahoo P. K.	20.05.14 - 10.06.14	BITS Pilani, Hyderabad
Guruprasad	24.05.14 - 31.05.14	ISI,Kolkatta
Boron D Chowdhury	25.05.14 - 28.05.14	Arizona State University, USA
Monowar Hossein S.K.	26.05.14 - 05.07.14	Aliah University, Kolkatta
Gyan Prakash	27.05.14 - 25.06.14	HRI, Allahabad
Paritosh Kulinpandya	28.05.14 - 09.06.14	TIFR, Mumbai
Muthusamy A.	28.05.14 - 09.06.14	PSG College og Technology, Coimbatore
Arvind Kumar	29.05.14 - 31.07.14	HRI, Allahabad
Pushkar S Joglekar	01.06.14 - 20.06.14	Vishwakarma Institute of Technology, Pune
Kevin Valson Jacob	01.06.14 - 31.07.14	IIT, Kanpur
Jebarathinam C.	02.06.14 - 18.06.14	IISER, Mohali
Ajay C Ramadoss	02.06.14 - 30.06.14	Indiana University,Bloomington
Baskar A.	09.06.14 - 02.07.14	BITS Pilani, Hyderabad
Ryan Vinroot	13.06.14 - 25.06.14	University of William, US
Preena Samavad	13.06.14 - 20.06.14	BITS Pilani, Hyderabad

Gopal Chandra	15.06.14 - 06.07.14	Jadavpur University, Kolkatta
Arghya Taraphder	15.06.14 - 21.06.14	IIT, Kharagpur
Tulika Maitra	15.06.14 - 21.06.14	IIT, Roorkee
Sanhita Modak	15.06.14 - 30.06.14	Netaji Subhash Engineering College, Kolkatta
Venkatesh R	18.06.14 - 30.06.14	CRM, Udem, Montreal, Canada
Manu Dixit	19.06.14 - 25.07.14	BITS Pilani, Hyderabad
Sreejit T.R	21.06.14 - 16.07.14	S.N. Bose Institute, Kolkatta
Ramlal Awasthe	23.06.14 - 25.06.14	HRI, Allahabad
Sumiran Pujari	28.06.14 - 30.06.14	TIFR, Mumbai
Swatee Naik	29.06.14 - 05.07.14	University of Nevada,USA
Purabi Mukherjee	29.06.14 - 05.07.14	University of Calcutta, West Bengal
Rita Brata Munshi	30.06.14 - 30.06.14	TIFR, Mumbai
Roy Joshua	30.06.14 - 07.07.14	Ohio State University, Columbia
Soham Biswas	30.06.14 - 16.07.14	TIFR, Mumbai
Ajay Deep Kachhvah	01.07.14 - 30.09.14	IPR, Gandhinagar
Santhosh Kumar Rajamanickam	01.07.14 - 30.11.14	PSG College of Technology, Coimbatore
Nagarajan S	01.07.14 - 30.11.14	PSG College of Technology, Coimbatore
Harish G	01.07.14 - 30.11.14	PSG College of Technology, Coimbatore
Kamal Dutta	02.07.14 - 30.09.14	IIT, Guwahati

Balachandran A.P.	03.07.14 - 13.07.14	IISc, Bangalore
Swagataa Acharya	06.07.14 - 25.07.14	IIT, Kharagpur
Radha Mohan	06.07.14 - 18.07.14	St. Stephen's College, New Delhi
Tarun Kanti Ghosh	07.07.14 - 11.07.14	IIT, Kanpur
Varsha Sreenivasan	09.07.14 - 08.10.14	IIT, Madras
Veeky Baths	09.07.14 - 12.07.14	BITS, Goa
Vinod Kumarappan	09.07.14 - 11.07.14	Kansas State University, USA
Yashonidhi Pandey	09.07.14 - 16.07.14	IISER, Mohali
Parameswaran A.J.	10.07.14 - 11.07.14	TIFR, Mumbai
Yogeshwar Prasad	14.07.15 - 18.07.15	IISc, Bangalore
Sreekanth K M	14.07.14 - 30.07.14	IISER, Thiruvananthapuram
Michael Renardy	17.07.14 - 21.07.14	Virginia Tech, USA
Hilda A Cerdeira	25.07.14 - 03.08.14	Instituto de Fisica Teorica, Sao Paulo, Brazil
Syed Mohammad Kamil	27.07.14 - 03.08.14	Shiv Nadar University, Uttar Pradesh
Sneh Bala	28.07.14 - 30.11.14	HRI, Allahabad
Vishal Saraswat	29.07.14 - 02.08.14	University of Hyderabad
Surya Ramana D.	29.07.14 - 24.08.14	HRI, Allahabad
Snigdhayan Mahanta	29.07.14 - 02.08.14	University of Munster, Germany

Anil Kumar C.P.	30.07.14 - 01.08.14	ISI, Bangalore
Sury B.	01.08.14 - 01.08.14	ISI, Bangalore
Parimala Raman	01.08.14 - 07.08.14	Emory University, USA
Shiv Prasad	04.08.14 - 14.08.14	IISER, Mohali
Dilpreet Kaur	04.08.14 - 14.08.14	IISER, Mohali
Kannappan Sampath	04.08.14 - 14.08.14	ISI, Bangalore
Karl Dieter Crisman	04.08.14 - 15.08.14	Gorden College, MA, USA
Siddharth Parameswaran	05.08.14 - 05.09.14	University of California, USA
Manickam M.	06.08.14 - 12.08.14	School of Mathematics Kozhikode, Kerala
Shamik Gupta	06.08.14 - 09.08.14	University Paris-Sud, Orsay, France
Prusken A.M.M.	13.08.14 - 18.08.14	University Amsterdam, The Netherlands
Sachin Subhash Sharma	13.08.14 - 28.08.14	TIFR, Mumbai
Parthasarathy R	19.08.14 - 22.08.14	Bharathiyar University, Coimbatore
Vasudharani	19.08.14 - 05.09.14	M S University, Baroda
Parimala Raman	22.08.14 - 30.08.14	Emory University, USA
Rajesh Kumar Gupta	24.08.14 - 27.08.14	ICTP, Trieste, Italy
RejiKumar K.	25.08.14 - 23.09.14	NSS College, Kerala
Abhijit Chakraborty	26.08.14 - 28.08.14	SN Bose National Centre, Kolkata
Manchanda R.	31.08.14 - 03.09.14	IIT, Bombay

Pranay Goel	31.08.14 - 03.09.14	IISER, Pune
Rabeya Basu	31.08.14 - 10.09.14	IISER, Pune
Ipsita Mandal	31.08.14 - 02.09.14	Perimeter Institute of Theoretical Physics, Ontario, Canada
Amlan Barma	31.08.14 - 03.09.14	IISER, Pune
Sumilan Banerjee	31.08.14 - 03.09.14	Ohio State University, USA
Rashmi Sharma	01.09.14 - 03.09.14	IIT, Bombay
Shailesh	01.09.14 - 03.09.14	IIT, Bombay
Nilapratim Sengupta	01.09.14 - 03.09.14	IIT, Bombay
Arun Prasath V	01.09.14 - 09.09.14	Centre for high energy physics, IISC, Bangalore
Prashant Batra	01.09.14 - 30.09.14	Technical University, Hamburg-Harburg, Germany
Daisuke Harada	01.09.14 - 15.10.14	IISc, Bangalore
Ravi S Kulkarni	02.09.14 - 04.09.14	HRI, Allahabad
Adhikari S.D.	03.09.14 - 08.09.14	HRI, Allahabad
Prahlad	11.09.14 - 12.09.14	IISER, Bhopal
Indranil Biswas	12.09.14 - 13.09.14	TIFR, Mumbai
Kumari Saloni	15.09.14 - 17.10.14	IIT, Guwahati
Prateep Chakraborty	16.09.14 - 20.09.14	ISI, Bangalore

Bhaskar Saha	16.09.14 - 18.09.14	NCCS, Pune
Paritosh Pandya	16.09.14 - 23.09.14	TIFR, Mumbai
Pramod Padmanabhan	19.09.14 - 19.12.14	University of Sao Paulo, Brazil
Narendra Dixit	23.09.14 - 23.09.14	IISc, Bangalore
Tata B.V.R.	23.09.14 - 23.09.14	IGCAR, Kalpakkam
Venkatesh R.	25.09.14 - 05.10.14	TIFR, Mumbai
Naveen Gaur	27.09.14 - 06.10.14	Dyal Singh College, Delhi
Samir Kunkri	30.09.14 - 28.10.14	Mahadevananda College, Kolkata
Shanta Laishram	04.10.14 - 07.10.14	ISI, New Delhi
Balachandran A.P.	07.10.14 - 09.10.14	CHEP, IISc, Bangalore
Vishal Saraswat	08.10.14 - 10.10.14	CR Rao AIMSCS, University of Hyderabad
Siegfried Boecherer	08.10.14 - 12.10.14	University of Mannheim, Germany
Sandipan Sengupta	09.10.14 - 15.10.14	RRI, Bangalore
Bikas Chandra Paul	13.10.14 - 28.10.14	University of North Bengal, West Bengal
Manimala Mitra	14.10.14 - 19.10.14	IPPP, Durham
Ramakrishnan B.	20.10.14 - 05.11.14	HRI, Allahabad
Usha K. Sangale	21.10.14 - 16.11.14	SRTM University, Nanded
Swagata Acharya	25.10.14 - 05.11.14	IIT, Kharagpur

Raghav Rangarajan	27.10.14 - 28.10.14	Physical Research Laboratory, Ahmedabad
Narayana Rana	01.11.14 - 31.12.14	HRI, Allahabad
Manoj Kumar	01.11.14 - 31.12.14	HRI, Allahabad
Taushif Ahmed	01.11.14 - 31.12.14	HRI, Allahabad
Sivakumar M.	01.11.14 - 05.12.14	University of Hyderabad, Hyderabad
Patrick Scharp Fenecker	02.11.14 - 22.11.14	University of Ulm, Germany
Rajdeep Niyogi	02.11.14 - 14.11.14	IIT, Roorkee
Tridib Sadhu	02.11.14 - 04.11.14	University of Paris, France
Hidenori Sonoda	06.11.14 - 26.11.14	Kobe University, Japan
Anupam Kumar Singh	10.11.14 - 18.11.14	IISER, Pune
Bijan Saha	14.11.14 - 21.11.14	JINR, Dubna, Russia
Gaurav Narain	14.11.14 - 07.12.14	Phitsanulok University, Thailand
Kanishka Rawat	16.11.14 - 31.12.14	Punjab University, Chandigarh
Marc Bourdon	17.11.14 - 05.12.14	University of Lille, France
Mayuri Chatterjee	19.11.14 - 19.02.15	TIFR, Mumbai
Ramesh Sreekantan	19.11.14 - 22.11.14	ISI, Bangalore
Mridupawan	19.11.14 - 27.11.14	JINR, Dubna, Russia
Sujatha, R.	01.12.14 - 02.01.15	IISER, Thiruvananthapuram

Raghav Rangarajan	01.12.14 - 02.12.14	Physical Research Laboratory, Ahmedabad
Ram Murty	02.12.14 - 31.12.14	Queen's University, Kingston, Canada
Ajit	05.12.14 - 08.12.14	ISI Delhi
Nanasiddharth	08.12.14 - 06.03.15	CMI, Chennai
Reji Kumar K.	08.12.14 - 08.01.15	NSS College, Kerala
Thomas Earl Browder	11.12.14 - 13.12.14	University of Hawaii, USA
Parimala R	12.12.14 - 09.01.15	Emory University, USA
Shiv Chaitanya K.V.S.	15.12.14 - 21.12.14	BITS Pilani, Hyderabad
Parudamasen	15.12.14 - 21.12.14	SN Bose Institute, Kolkatta
Ayan Banerjee	15.12.14 - 18.12.14	IISER, Mohanpur
Nikolai Tyurin	15.12.14 - 31.12.14	JINR, Dubna, Russia
Pushkar S Joglekar	15.12.14 - 09.01.15	Vishwakarma Institute of Technology, Pune
Sunil Singh Shah	17.12.14 - 28.12.14	HNB, Garhwal University, Uttarakhand
Andreas Krebs	17.12.14 - 22.12.14	University of Tubingen, Germany
Sumantapal	19.12.14 - 20.12.14	University of Sheffield, UK
Swarup Poria	21.12.14 - 04.01.15	University of Calcutta, West Bengal
Anindita Ganguly	24.12.14 - 03.01.15	St Thomas College of Engineering Tech., Kolkata
Narayana Rana	01.01.15 - 08.01.15	HRI, Allahabad

Nang Philibert	02.01.15 - 26.01.15	Ecole Normale Superior, Gabon, Africa
Ubaid Hussain	05.01.15 - 31.01.15	Aligarh Muslim University, Uttar Pradesh
Prahladh Harsha	05.01.15 - 09.01.15	TIFR, Mumbai
Bhaduri R.K.	07.01.15 - 15.01.15	McMaster University, Canada
Olaf Beyerdorff	09.01.15 - 16.01.15	University of UC, US
Johan Bartel	11.01.15 - 16.01.15	University de Strasbourg, France
Jaban Meher	11.01.15 - 29.01.15	IISc, Bangalore
Hans Van	11.01.15 - 08.02.15	Loria, Nancy, France
Kabir Ramola	12.01.15 - 16.01.15	TIFR, Mumbai
Subinay Dasgupta	14.01.15 - 28.01.15	University of Calcutta, West Bengal
Indranil Biswas	16.01.15 - 25.01.15	TIFR, Mumbai
Haridass N. D.	16.01.15 - 25.01.15	TIFR, Hyderabad
Amitabanandi	18.01.15 - 21.01.15	MPI, Dresden, Germany
Sujit Das	20.01.15 - 23.01.15	Martin Luther University Halle-Wittenberg, Germany
Yogeshwar Prasad	20.01.15 - 04.02.15	IISc, Bangalore
Peter Hislop	20.01.15 - 19.02.15	University of Kentucky, Lexington, USA
Atul Dixit	22.01.15 - 23.01.15	Tulane University, USA
Singh J.B.	23.01.15 - 25.01.15	Punjab University, Chandigarh
Sumesh P.T.	28.01.15 - 30.01.15	Oxford University, UK

Anantha Narayan B.	29.01.15 - 01.02.15	IISc, Bangalore
Ram Kishore	30.01.15 - 16.02.15	INPE, Brazil
Gyan Prakash	30.01.15 - 01.02.15	HRI, Allahabad
Avinash Sonawane	30.01.15 - 01.02.15	Kitt University, Odissa
Sudipta Kumar Bera	01.02.15 - 30.04.15	IISER, Kolkatta
Arun Madhav Thalapilli	01.02.15 - 06.02.15	NHETC, Rutgers, State University of New Jersey, USA
Sanjay Puri	05.02.15 - 06.02.15	JNU, New Delhi
Nilendra Ganesh Deshpande	05.02.15 - 07.02.15	University of Oregon, USA
Dandoloff Rossen	05.02.15 - 25.02.15	University de Cergy-Pentoise, Paris, France
Sanchari	05.02.15 - 13.02.15	SN Bose National Centre Kolkata
Balaraju Battu	06.02.15 - 07.03.15	University of Allahabad, Uttar Pradesh
Arup Kumar Pal	07.02.15 - 13.02.15	ISI, Kolkata
Ashok Priyadarshan Dimri	09.02.15 - 10.02.15	JNU, New Delhi
Justin David	09.02.15 - 11.02.15	IISc, Bangalore
Satti Srinivasa Rao	10.02.15 - 20.02.15	HRI, Allahabad
Neeraj Manhas	10.02.15 - 17.02.15	Maulana Azad Institute of Technology, Bhopal
Kumar Murty V.	14.02.15 - 28.02.15	University of Toronto, Canada
Guruprasad Kar	15.02.15 - 17.02.15	ISI, Kolkata

Sayak Mukherjee	15.02.15 - 17.02.15	Ohio State University, US
Siddarth Barman	15.02.15 - 17.02.15	California Institute of Technology, USA
Markus Blaser	16.02.15 - 26.02.15	University of Saarland, Germany
Vasudharam Devananthan	16.02.15 - 27.02.15	M S University, Baroda
Vijay Ganesh	16.02.15 - 17.02.15	University of Waterloo, Canada
Jacobo Toran	18.02.15 - 05.03.15	University of Ulm, Germany
Yogeshwar Prasad	22.02.15 - 16.03.15	IISc, Bangalore
Aswin Joy	22.02.15 - 25.02.15	IPR, Gandhinagar
Somshubhro Bandyo Padhyay	23.02.15 - 28.03.15	Bose Institute, Kolkatta
Luigi Accardi	24.02.15 - 28.03.15	University of Rome, Italy
Yash Lodha	01.03.15 - 12.03.15	Haus Anna, Finland
Piyush P. Kurur	01.03.15 - 05.03.15	IIT, Kanpur
Pankaj Jain	02.03.15 - 04.03.15	IIT, Kanpur
Amitabh Virmani	03.03.15 - 06.03.15	IOP, Bhubaneshwar
Jurgen Hurbach	03.03.15 - 05.03.15	University of Dusseldorf, Germany
Daciberg Lima Goncalves	03.03.15 - 19.03.15	University of Sao Paulo, Brazil
Anand Yethiraj	04.03.15 - 07.03.15	Memorial Institute, Canada
Swarnendu Tripathi	05.03.15 - 07.03.15	University of Houston, US

Sengupta J.	08.03.15 - 15.03.15	TIFR, Mumbai
Karen Hallberg	09.03.15 - 10.03.15	Centro Atomico Bariloche, Institute Balseiro, Argentina
Makoto Yamashita	09.03.15 - 20.03.15	Ochanomizu University, Tokyo, Japan
Farhat Habib	10.03.15 - 14.03.15	IISER, Pune
Soumya Bhattacharya	10.03.15 - 19.03.15	CIRM Trento Italy
Biswarup Mukhopadhyaya	15.03.15 - 18.03.15	HRI, Allahabad
Anantha Narayan B.	15.03.15 - 18.03.15	IISc, Bangalore
Amita Malik	16.03.15 - 17.03.15	Department of Mathematics, Illinois
Ruben Martos	16.03.15 - 30.03.15	University of Paris, France
Ayan Paul	18.03.15 - 20.03.15	Universita di Roma La Sapienza, Italy
Sinha K.B.	21.03.15 - 24.03.15	JNCASR, Kolkata
Trilochan Bagarti	21.03.15 - 31.03.15	HRI, Allahabad
Benoit Rittaud	23.03.15 - 24.03.15	University of Paris, France
Guruprasad Kar	23.03.15 - 31.03.15	ISI, Kolkata
Dharam Vir Ahluwalia	23.03.15 - 28.03.15	IIT, Kanpur
Arindam Ghosh	27.03.15 - 27.03.15	IISc, Bangalore
Pankaj Narula	01.02.15 - 01.03.15	IIT, Bombay

Chapter 6

Infrastructure

6.1 Computer Facilities

Enhancement of Computer Facility during 2014-15

Hardware facility:

- HPC Hybrid System **nandadevi** was installed. It was built using Dell R720 Rack Servers of 49 nodes and it consists of 10 TF cluster for MPI jobs, 10 Serial computing nodes using high memory, 8 GPU computing nodes, 3 Intel MIC-Phi computing nodes, Luster server with dual controller based 25 TB Parallel Storage. The total compute power is 43 TeraFlops(19TF in CPU + 24TF in GPU/PHI) and the H/Ws have provisions to add additioanl GPU/PHI cards on demand to increase the performances.

  The **nandadevi** ranked 27 in the top supercomputers in India list 2014.

- New Laptops of different brand/models were issued to faculty as a replacement of obsolete laptops.

- New Desktops of Dell Optiplex 9020 MT 30 nos were released to new students, Auditorium, Technical Assistants and Medical Officers' office.

- Additional disks(Enterprise SATA) were installed in the mail server(banyan).

- Color laser printer capable of handling A3 size media, Reverse Automatic Document Feeder(RADF), Networked, Copier, Scan to mail/usb installed. Most important thing is that the facility is enabled with RFID card reader so that the users can access through their IMSc Id card instead of login. The Ricoh Afficio MFP 2003SP serves the purpose.

- MFP laser printers with ADF, networked, duplex print, copier, scan to mail/usb were provided to Directors' Office, Engineers' offices, Medical Officers' office etc. The Richo Aficio SP 3510 SF serves the purpose.

- Panasonic PT-EX510 projector was installed in the Ramanujam auditorium as a replacement of obsolete Canon XEED projector.

- Internet bandwidth service contract was renewed for one more year with Airtel for 32 Mbps (1:1) through fiber loop.
- In-campus WiFi facility was revamped by using the Fortinet APs with controller enabled through the customised wifidog named as hotwifi portal.
- Setting up of Media room facility was in process.

Activities :

Dr.G.Subramoniam, Scientific Officer-F participated the Workshop on Project Management conducted by Indian Institute of Management, Ahemedabad during Feb 23-28, 2015 organised by DTI,DAE

Mr.B.Raveendra Reddy, Scientific Officer-F attended the meetings on CISAG, DAE, Mumbai during 2014

6.2 The Library

The Institute Library holds a total collection of 71602 books and bound periodicals as on March 31, 2015. This includes an addition of 1118 volumes during the current year April 2014 - March 2015. The NBHM has recognized this Institute library as the Regional Library for Mathematics. An average of about 4000 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 Elesevier 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 participating institutions in the southern region.

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

Acknowledgment

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

Amritanshu Prasad, IMSc
Balasubramanian, R., IMSc
Kamal Lodaya, IMSc
Radha Balakrishnan, IMSc
Phawade Ramchandra Babasaheb, IMSc
Raja, S., IMSc
Rajesh Singh, IMSc
Ritwik Mukherjee, IMSc
Sudhir N. Pathak, IMSc

Arvind, V., IMSc
Date, G., IMSc
Sanoli Guin, IMSc
Sitabhra Sinha, IMSc
Prafulla Kumar Tale, IMSc
Rajarshi Pal, IMSc
Ramanathan Thinniyam Srinivasan, IMSc
Sumit Giri, IMSc

Chandra Sekaran, P.
Masuda Kayo
Swami Suchitananda, Ramakrishna Mission

Delli Babu, RWTH Univ., Germany
Patnaik Lingaraj

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