THE INSTITUTE OF MATHEMATICAL SCIENCES

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ANNUAL REPORT

Apr 2013 - Mar 2014

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Foreword

The Institute has completed 52 years and I am pleased to present this year's annual report and note the strength of the Institute and the distinctive achievements of its members. Our student strength has increased to 129. We are proud to say that more and more students are getting benefitted from the thriving outreach programmes that we have and the efforts of our faculty, both at an individual and institutional level. Our post-doctoral student strength has gone up to 53. 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 few books as well. Six students were awarded Ph.D., Four students have submitted their Ph.D. theses and two students were awarded M.Sc., by Research. Three students have submitted master's theses under the supervision of our faculty. 19 conferences and workshops were organized at IMSc during 2013-2014. These include Discussion Meeting in Topology, Brainstorming Meeting on Econophysics: Science for the Economy, 13th Asian Quantum Information Science Conference (AQIS13), One Per Cent: Mathematics workshop for students of classes XI and XII, joint IMSc-ISI workshop on Subfactors, Games of Imperfect Information via Automata and Logic, Discussion meeting on statistical physics of fracture, 1st IMSc School on Quantum Information, Advanced school on Parameterized and Kernelization (ASPAK)to name but a few. There were 58 lectures/lecture series conducted at the Institute during the reporting period. In addition, 4 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 9 conferences were organized outside namely, 'Satellite Meeting on Quantum Correlation and its application in communication and cryptography, International Workshop on Optical Quantum Information, Advanced Instructional School in Number Theory, Round Table on Complex Systems, India-France Technology Summit, Winter School on Measure Theory and Functional Analysis, National Strings Meeting, Recent Advances in High Energy Physics (Sponsored by National Science Academies), Conference on Operator and spectral theory, and Operator algebras and non-commutative geometry'. We are proud to note the awards and honors bestowed on our faculty at the individual level. Prof. Sanoli Gun was awarded SERB Women excellence award for 2013, by the Science and Engineering Research Board, DST. This report was compiled through the efforts of an Annual Report Committee comprising of Drs. Purusattam Ray, C. R. Subramanian, Pralay Chatterjee, Paul Pandian and Usha Devi. I owe my gratitude to all of them.

June, 2014 **R. Balasubramanian**

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Chapter 1

The Institute

1.1 Board

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Chapter 2

Research and Teaching

2.1 Mathematics

2.1.1 Research Summary

Algebraic Geometry

The one dimension a Anderson Model and a twice continuously differentiable function pair are considered and shown the central limit theorem for a stationary process associated with this pair.

The dimer and higher rank i.i.d random potentials are considered on the lattice and shown that the local statistics is a compound Poisson process.

Study of morphisms to Grassmannians continued.

Study of deformations of moduli space of Hitchin pairs on curves continued.

Equivariant vector bundles on wonderful compactification of adjoint groups were studied.

Stability properties of tangent bundle of a wonderful compactification of adjoint groups were studied.

Algebraic Number Theory

Milnor formulated a conjecture about rational linear independence of some special Hurwitz zeta values. In an earlier paper, the second and the third authors along with M. Ram Murty studied this conjecture and suggested an extension of Milnor's conjecture. In [**Gu2**], the authors investigate the number field generalisation of this extended Milnor conjecture. The authors indicate the raison d'être for considering the number field case by noting that such a phenomenon is true in an analogous context. The authors also study some new spaces related to normalised Hurwitz zeta values.

In [**Gu9**], the authors study the arithmetic properties of generalized Euler-Lehmer constants.

Using properties of Ramachandra units, it is shown that these infinite family of numbers are transcendental with at most one exception. This result extends a recent result of Murty and Zaytseva. These constants appear in an equivalent criterion for Riemann hypothesis proved by Diamond and Ford.

Analytic Number Theory

Asymptotic formulas for the number of representations of zero and of large positive integers by the cubic forms in seven variables which can be written as $L_1(x_1, x_2, x_3)Q_1(x_1, x_2, x_3) + L_2(x_4, x_5, x_6)Q_2(x_4, x_5, x_6) + a_7x_7^3$ where L_1 and L_2 are linear forms, Q_1 and Q_2 are quadratic forms and a_7 is a non-zero integer were obtained earlier in case certain quantities related to L_1Q_1 and L_2Q_2 are non-zero . In [**V1**], the case when one or both of these quantities is zero is dealt with.

The square-root barrier of the circle method implies that it cannot yield an asymptotic formula for the number of representations of integers by a form of degree d if the number of variables is less than $2d+1$. For $d \geq 4$, no example of an asymptotic formula for the number of zeros of a form of degree d with $2d+1$ variables seems to exist in literature. In [**V2**], for each $d \geq 4$ an asymptotic formula for the number zeros of a particular form of degree d in $2d+1$ variables is obtained using the circle method.

Group Theory

Given an automorphism of a group, one has the notion of twisted conjugacy relation, generalizing the familiar notion of conjugacy relation which corresponds to the identity automorphism. A group Γ is said to have the R_∞-property, if there are infinitely many twisted conjugacy classes for any automorphism of Γ. It has been shown in [**Mu**] that irreducible lattices in connected semisimple Lie groups with finite centre and having rank at least two, have the R_∞-property.

Modular forms

Serre proved that any holomorphic cusp form of weight one for $\Gamma_1(\mathrm{N})$ is lacunary while a holomorphic modular form for $\Gamma_1(\mathrm{N})$ of higher integer weight is lacunary if and only if it is a linear combination of cusp forms of CM-type. In [**Gu7**], it is shown that when a non-zero modular function of arbitrary real weight for any finite index subgroup of the modular group $\mathrm{SL}_2(\mathbf{Z})$ is lacunary, it is necessarily holomorphic on the upper-half plane, finite at the cusps and has non-negative weight.

In [**Gu4**], the growth of the Petersson norms of Fourier-Jacobi coefficients f_m, for m's in arithmetic progressions, of Siegel cusp forms F of weight k and genus $n > 1$ is estimated. As a consequence, a result of Böcherer, Bruinier and Kohnen is strengthened. Further, another result of Kohnen is sharpened.

In [**Gu3**], the authors give an explicit upper bound for the first sign change of the Fourier coefficients of an arbitrary non-zero Siegel cusp form F of even integral weight on the Siegel modular group of arbitrary genus $g \geq 2$. This is the first general result in this direction.

Let $d(n)$ denote the number of divisors of n. In [**Gu5**], the authors study the average value of $d(a(p))$, where p is a prime and $a(p)$ is the p-th Fourier coefficient of a normalized Hecke eigenform of weight $k \geq 2$ for $\Gamma_0(N)$ having rational integer Fourier coefficients.

In [**Gu8**], the authors study the nature of zeros of weakly holomorphic modular forms. In particular, they prove results about transcendental zeros of modular forms of higher levels and for certain Fricke groups. This extends an earlier work of Kohnen. Furthermore, the authors discuss about the algebraic independence of values of weakly holomorphic modular forms.

Operator Algebras

In line with earlier investigations into continuous minimax theorems, continuous analogues of Wielandt's minimax theorem as well as Lidskii's majorisation result concerning eigenvalues of sums of Hermitian matrices, were obtained. [**Su**]

A purely operator-theoretic proof of the spectral theorem for bounded normal operators on separable Hilbert space was worked out, without any appeal to operator algebras or Gelfand theory of commutative Banach algebras. It is hoped that this will be part of a book which will be published on par with a second edition of my earlier book on Functional Analysis which appeared in the TRIM series of books brought out by the Hindustan Book Agency. During the course of working out this approach to the spectral theorem, an elementary proof of the Fuglede-Putnam Theorem was also obtained.

Representation Theory

Let G_0 be a simply connected non-compact real semisimple Lie group, K_0 a maximal compact subgroup of G_0. Suppose that K_0 is semisimple and has the same rank as G. Any Borel-de Siebenthal positive system of G_0 gives rise to hermitian symmetric pair (K_0, L_0) of compact type. To any Borel-de Siebenthal discrete series π_λ with Harish-Chandra parameter λ there arises a holomorphic discrete series π_λ^{hol} of the non-compact dual K_0^*. It has been shown that π_λ and π_λ^{hol} have infinitely many common L_0-types under certain hypotheses.

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.

Topology

A criterion for the formality of a cell-attachment $X \cup_\alpha e^n$ was obtained assuming that X is a rationally formal topological space. Also a necessary condition for formality of a cell-attachment has been obtained. As an application, connected finite CW complexes of dimension 4k whose cohomology ring is generated by degree 2k elements are formal.

It has been shown that the Richard Thompson group T, which is a certain group of PL-homeomorphism of the circle, has the so-called R_∞-property, that is, it has infinitely many ϕ-twisted conjugacy classes for any automorphism ϕ of T.

Transcendental number theory

In [**Gu1**], the authors extend a result of Murty and Saradha about transcendence of digamma function at rational arguments. Further, the authors prove the transcendence of the family of p-adic Euler-Lehmer constants with at most one exception.

In [**Gu6**], it has been shown that the values of Dirichlet L-functions at integer points can be recovered from algebraic linear combinations of values of Riemann zeta function and its derivatives at 1/2 and 3/2. Also irrationality of $\zeta(3)/\pi^3$ and G/π^2, where G is the Catalan's constant has been linked to the transcendence of some multiple gamma values.

2.1.2 List of Publications

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

[**A**]
C. P. Anilkumar and Amritanshu Prasad.
Orbits of pairs in abelian groups.
2013.
(Submitted).

[**B1**]
R. Balasubramanian and S. Gun.
Ramanujan and Quasi-modular forms.
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2.2 Physics

2.2.1 Research Summary

Astro-particle Physics

The possibility of the unexplained Kolar events, recorded in the 70's and 80's in the neutrino experiments underground at Kolar Gold Fields, being due to the decays of dark matter particles of mass in the range of 5–10 GeV is pointed out [**Mur2**].

A reinterpretation of the anomalous events seen in the Kolar experiments of 60's, 70's and 80's as decays of light dark matter particles is given [**Mur2**] .

Biological Physics

A combination of theoretical and simulational approached to the computation of the properties of chromosomes within the nuclei of (diploid) human cells has been proposed[**Me**]. Predictions from the theory have been shown to agree well with experimental data. These methods address and solve two outstanding problems in the literature on nuclear architecture - the presence of gene-density dependent radial segregation of chromosomes within near-spherical nuclei as well as the existence of a territorial organization of chromosomes. Currently, we are setting up collaborations with a number of experimental groups at IISER, Pune and at NCBS, Bangalore to further explore how theoretical models for chromatin may help to clarify issues of stem cell differentiation, X-chromosome inactivation and the interaction of looped segments of chromosomes at transcription factories.

A program of research initiated over the past three years with the group of Sandhya Koushika (NCBS, Bangalore and TIFR Mumbai) on modeling axonal transport has begun to yield close agreement of theoretical models with the experimental results. In nerve cells, groups of motors transport cargo encapsulated in vesicles across long cellular extensions called axons. The cargo can be transported either anterogradely (away from the cell body) or retrogradely (towards the cell body). The experiments invovle imaging such transport in an effort to understand what regulatory mechanisms might exist and whether at least some of these mechanisms might involve physical mechanisms. Our results include the explanation of vesicle"clusters" seen in many imaging experiments over the years, the prediction that microtubule ends may play a role in the formation of such clusters in addition to the direct interactions of oppositely directed vesicles, and the direct comparison of kymographs in the experiments and the simulations. This is the most detailed theory of axonal transport available so far. These results will be communicated soon.

The uterus is normally an excitable medium which does not exhibit spontaneous activity. However, during pregnancy, the tissue changes its character and starts exhibiting transient episodes of self-excited oscillatory activity. Just before giving birth these oscillations become synchronized and the resulting organ-wide coherent activity allows the fetus to be ejected. Till date there has been no experimental evidence for a specialized pacemaker region in the uterus (unlike the heart) that can help coordinate this process. An alternative hypothesis has been put forward 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 [**Sin2**]. 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 [**Sinh1**], 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.

Human immune system is not adequately understood in terms of generality and system behaviour, and even in terms of molecular details that are piling up with each single day. While a group of immunologists are trying to focus on molecular details and detailed understanding of each and every immune component, some physicists are looking for the basic laws that govern the immune system as a whole. It is becoming clearer that neither the self-nonself discrimination theory (for which, F. M. Burnet and P. Medawar shared Nobel Prize in Physiology or Medicine-1960), nor Jerne's immune network theory (Nobel Prize in Physiology or Medicine-1984), nor even the danger model of immune response by P. Matzinger, can explain the current status of experimental immunology completely. The present understanding of autoimmunity, cancer Biology, transplantation immunology and stress response mechanisms, fails to furnish answer to a lot of questions. Basic mechanisms of immune response, learning & adaptation in immune system, auto-reactivity, self-tolerance and immune-memory are still far from adequate and satisfactory understanding. Theoretical research in search of these answers and underlying physical phenomenon of immune system, is initiated using non-equilibrium statistical physics, nonlinear dynamics, cellular automata and complex network theory. The dynamics and general features of autoimmune disorders are also being studied by using simple nonlinear differential equations.

Condensed Matter Physics

A phenomenological approach for the equation of state of a unitary Fermi gas was proposed. The universal equation of state is parametrised in terms of Fermi-Dirac integrals. This reproduces the experimental data over the accessible range of fugacity and normalised temperature, but cannot describe the superfluid phase transition found in the MIT experiment. The most sensitive data for compressibility and specific heat at phase transition can, however, befitted by introducing into the grand partition function a pair of complex conjugate zeros lying in the complex fugacity plane slightly off the real axis.

Third and higher order quantum virial coefficients require the solution of the corresponding quantum many-body problem. Nevertheless, in an earlier paper (Phys. Rev. Lett. 108, 260402 (2012)) it was proposed that the higher-order cluster integrals of a dilute unitary fermionic gas may be approximated in terms of the two-body cluster, together with an appropriate suppression factor. The objective of the present work is to give some physical

arguments in favour of this ansatz [**Mur1**].

The potential energy curve based activation energy approach and density of states methods developed by us are two main formalism for determining heterogeneous electron transfer reaction rates. It has been shown how voltammetric experiments can establish the validity of either of these two formalism. [**Mi**].

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

The results of a Monte Carlo simulation study of the hadron energy response for the magnetized Iron CALorimeter detector, ICAL, proposed to be located at the India-based Neutrino Observatory (INO) is presented. Using a GEANT4 modeling of the detector ICAL, interactions of atmospheric neutrinos with target nuclei are simulated. The detector response to hadrons propagating through it is investigated using the hadron hit multiplicity in the active detector elements. The detector response to charged pions of fixed energy is studied first, followed by the average response to the hadrons produced in atmospheric neutrino interactions using events simulated with the NUANCE event generator. The shape of the hit distribution is observed to fit the Vavilov distribution, which reduces to a Gaussian at high energies. In terms of the parameters of this distribution, the hadron energy resolution is presented as a function of hadron energy, and the calibration of hadron energy as a function of the hit multiplicity. The energy resolution for hadrons is found to be in the range 85% (for 1 GeV) 36% (for 15 GeV) [**L1**].

A detailed study of the hadron energy resolution as a function of the thickness of the absorber plates for the proposed Iron Calorimeter (ICAL) detector at the India-based Neutrino Observatory (INO) was done to compare the hadron resolutions obtained with absorber thicknesses in the range 1.5 –8 cm for neutrino interactions in the energy range 2 – 15 GeV, which is relevant to hadron production in atmospheric neutrino interactions. It is found that at lower energies, the thickness dependence of energy resolution is steeper than at higher energies, however there is a constant contribution that dominates at the lower thicknesses discussed in this paper. As a result, the gain in hadron energy resolution with decreasing plate thickness is marginal. The results are presented in the form of fits to a function with energy-dependent exponent[**L2**].

An update of the earlier RG analysis of neutrino masses and mixings in the framework of high-scale-unification of leptonic mixing with quark mixing is undertaken. This is necessary in view of the recent determination of the reactor angle by the Daya Bay and RENO experiments. An important result of this work is that the atmospheric angle lies in the second octant [**A2**].

The renormalization group evolution of mixings and masses of Dirac neutrinos is done under the hypothesis of unification of the leptonic and quark mixings. This evolution is unique and does not suffer from the ambiguities that plague the similar evolution of Majorana neutrinos arising from the Majorana phases [**A1**].

An intriguing opposite sign of the CP violating asymmetry was recently measured in the tau decay modes $\tau^{\pm} \to K_s\pi^{\pm}(-)\nu_{\tau}$ by the BaBar collaboration, than that expected within the

Standard Model. If confirmed with higher precision, then the observed decay rate asymmetry A_{CP}, could only arise from some Non-Standard Interactions(NSI) occurring possibly in both the hadronic as well as in the leptonic sectors. It was shown that while a simple charged scalar interaction cannot yield this rate asymmetry, it could be generated in the presence of a tensor interaction. Parameterizing the strength and weak phase of this NSI contribution, the observed branching ratio and the decay rate CP asymmetry for the particular mode $\tau^{\pm} \to K_s\pi^{\pm}(-)\nu_{\tau}$, were used to determine the CP violating weak phase and the coupling of a tensorial interaction that could give a consistent sign and magnitude of the asymmetry [**Z**].

Foundations of Quantum Mechanics

It is shown in [**Ku1**] that three unsharp binary qubit measurements are enough to violate a generalized noncontextuality inequality, the LSW inequality, in a state-dependent manner. For the case of trine spin axes we calculate the optimal quantum violation of this inequality. Besides, it is shown that unsharp qubit measurements do not allow a state-independent violation of this inequality. Thus a minimal state-dependent proof of measurement is provided contextuality requiring one qubit and three unsharp measurements. The result rules out generalized noncontextual models of these measurements which were previously conjectured to exist. More importantly, this class of generalized noncontextual models includes the traditional Kochen-Specker (KS) noncontextual models as a proper subset, so the result rules out a larger class of models than those ruled out by a violation of the corresponding KS-inequality in this scenario.

Mathematical Physics

The purpose of this paper [**Ku2**] is to study the equivalence relation on unitary bases defined by R. F. Werner [*J. Phys. A: Math. Gen.* **34** (2001) 7081], relate it to local operations on maximally entangled vectors bases, find an invariant for equivalence classes in terms of certain commuting systems, and relate it to mutually unbiased bases and Hadamard matrices. Illustrations are given in the context of latin squares and projective representations as well. Applications to quantum tomography are indicated.

Nonlinear Dynamics, Solitons and Chaos

A gauge-invariant approach for associating a geometric phase with the phase space trajectory of a classical dynamical system is presented. As an application, the classical analog of the quantum Aharonov-Bohm Hamiltonian for a charged particle orbiting around a current-carrying long, thin solenoid is considered. The classical geometric phase of a closed trajectory is computed, and compared and contrasted with the well known quantum Aharonov-Bohm phase associated with the particle wave function of the Hamiltonian. In addition, a method to measure the classical geometric phase of the system using an appropriate optical fiber ring interferometer is suggested [**B1**].

A unified formulation that obtains solitary wave solutions for the Bose-Einstein condensate wave function in a system of hard-core bosons with nearest neighbor attractive interactions is presented. In general, two species of solitons appear: A non-persistent (NP) type that

delocalizes at the maximum soliton speed, and a persistent (P) type that survives even at the maximum speed, and transforms into a periodic train of solitons above this speed. When the background condensate density is nonzero,the soliton is associated with a constant frequency, its maximum speed is the speed of sound and the two species coexist. When the background condensate vanishes, its frequency becomes a variable parameter, and the maximum soliton speed is dependent on its frequency, and the two species do not coexist: The frequency can be tuned to support either the NP-type or the P-type soliton, depending on the relative strength of the energy associated with the frequency and an effective energy of the hard-core system. A cross-over between the two types is predicted at a critical frequency. A single functional form for the soliton solution is derived, from which diverse, effective energy dependent characteristics of the solitons can be found. Using a mapping to spin systems, this function also finds magnetic solitons for various anisotropies in a unified fashion [**B2**].

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. To this end, the collective behavior of a system of globally coupled Wilson-Cowan (WC) oscillators has been investigated over a range of coupling strengths. The WC model is a simple representation of the dynamics in a local region of the brain comprising a cluster of excitatory and inhibitory neurons. The interaction of the pair of field variables corresponding to the fractions of active excitatory and active inhibitory neurons is seen to generate oscillations over a large region in the space of model parameters. In the course of this investigation, it has been found that a system of N globally coupled oscillators can give rise to a rich variety of dynamical behavior. Patterns that resemble those seen with more realistic, sparser connectivity schemes can be reproduced in the globally coupled limit (which is effectively, a mean-field model) indicating that such complex behavior may be independent of the specific network architecture.

On the other hand, the precise topological structure of a network can strongly affect the functional significance of individual nodes. To investigate this in detail, a recently published database of connectivity pathways in the macaque brain has been used to reconstruct a modified network of connected brain areas. Mesoscopic structures in this network have been analyzed in order to identify those brain areas that play a significant role in the coordination of activity. For this purpose, the modular architecture of the network has first been identified. A new method for identifying functionally important nodes in a complex network based on their structural role (in terms of different types of betweenness centrality measures) has been proposed and applied to the network. Nodes corresponding to brain regions known to be involved in important functional tasks appear in the results, validating the analytical methods used.

The heart is a fascinating example of nonlinear dynamics at work in biology. 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 [**Sinh6**]. 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 [**Sinh5**] 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.

QFT, Topological QFT, Conformal Field Thoery

The nilpotent and absolutely anticommuting (anti-)co-BRST symmetry transformations for the bosonized version of (1 + 1)-dimensional (2D) vector Schwinger model have been derived. These symmetry transformations turn out to be the analogue of co-exterior derivative of differential geometry as the total gauge-fixing term remains invariant under it. The exterior derivative is realized in terms of the (anti-)BRST symmetry transformations of the theory whereas the bosonic symmetries find their analogue in the Laplacian operator. Finally, at the algebraic level, it has been shown that the above mentioned symmetry transformations follow the same algebra as the algebra obeyed by the de Rham cohomological operators of differential geometry [**Gu**].

Work is in progress, on the study of 'Non-perturbative aspects in lower dimensional QFTs'. Currently, Non-trivial vacua like vortices and solitons are considered, and its implications on response functions and excitation spectrum of the theory are being studied.

Quantum Computations

Maximally entangled states–a resource for quantum information processing–can only be

shared through noiseless quantum channels, whereas in practice channels are noisy. Here in [**P1**] the following question is asked: 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? An exact formula of the maximum singlet fraction attainable for a qubit channel is found and given an explicit protocol to achieve the optimal value. The protocol distinguishes between unital and nonunital channels and requires no local post-processing. 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.

The optimization conditions for minimum error discrimination of linearly independent pure states comprise of two kinds: stationary conditions over the space of rank one projective measurements and the global maximization conditions. A discrete number of projective measurments will solve the former of which a unique one will solve the latter. In the case of three real linearly independent pure states shown in [**Si**] that the stationary conditions translate to a system of simultaneous polynomial (non linear) equations in three variabes thus explaining why it's so difficult to obtain a closed-form solution for the optimal POVM. Additionally, our method suggests that as an ensemble of LI pure states is varied as a smooth function of some independent parameters, the optimal POVM will also vary smoothly as a function of the same parameters. By employing the implicit functions theorem, this fact is exploited to obtain a technique to find the solution of MED of LI pure states by dragging the solution from a known example (say, pure orthogonal states) to any general linearly indepenent ensemble of pure states in the same Hilbert space. By employing RK4 to solve the first order coupled non-linear differential equations find that the resulting error is within the RK4 error performance.

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. First passage and universal properties of coarsening systems are studied.

The concept of networks is of great importance in studying social phenomena [**Sinh3**]. In recent times there has been a surge of interest in applying statistical mechanics of such networks to understand economic phenomena. The recent worldwide economic crisis of 2007-09 has focused attention on the need to analyze correlations among the economies and currencies of nations around the world. The linkages among different countries and their economies, as indicated by correlations in the fluctuations of the exchange rates for their corresponding currencies has been investigated recently [**Sinh4**]. In particular, the cross-correlations between the exchange rate fluctuations of 74 currencies over the period 1995-2012 have been analyzed. The eigenvalue distribution of the cross-correlation matrix exhibits a bulk which approximately matches the bounds predicted from random matrices constructed using mutually uncorrelated time-series. However, a few large eigenvalues deviating from the bulk contain important information about the global market mode as well as important clusters of strongly interacting currencies. This allows construction of the network structure

of the world currency market by using two different graph representation techniques, after filtering out the effects of global or market-wide signals on the one hand and random effects on the other. The two networks reveal complementary insights about the major motive forces of the global economy, including the identification of a group of potentially fast growing economies whose development trajectory may affect the global economy in the future as profoundly as the rise of India and China has affected it in the past decades.

In many complex systems, heterogeneous connections can subject constituent elements to conflicting influences, resulting in frustration. Recently a numerical investigation has been undertaken which shows that an initially frustrated system can achieve structural balance by a link adaptation process inspired by Hebbs principle, with interaction strengths evolving in accordance with the dynamical states of its components. In the presence of fluctuations the time required to converge to the balanced state exhibits large dispersion characterized by a bimodal distribution, pointing to an intriguing problem in the study of evolving energy landscapes [**Sinh2**].

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. It was shown that the exponents characterizing the large time behaviour could be related to the well studied model of ballistic aggregation [**Pa**].

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. For $m = 1$, a model of monodispersed rigid rods of length k with repulsive interactions on the random locally tree-like layered lattice is solved exactly. It is shown that with increasing density, the system undergoes two phase transitions: first, from a low-density disordered phase to an intermediate density nematic phase and, second, from the nematic phase to a high-density reentrant disordered phase [**K1**, **K2**].

Cortical bone, found in the central part of long bones like femur, is known to adapt to local mechanical stresses. This adaptation has been linked exclusively with Haversian remodelling involving bone resorption and formation of secondary osteons. Compared to primary/plexiform bone, the Haversian bone has lower stiffness, fatigue strength and fracture toughness, raising the question why nature prefers an adaptation that is detrimental to bone's primary function of bearing mechanical stresses. It is shown that in the goat and bovine femur, Haversian remodelling occurs only at locations of high compressive stresses. At locations corresponding to high tensile stresses, a microstructure that is non-Haversian is observed. Compared with primary/plexiform bone, this microstructure's mineralisation is significantly higher with a distinctly different spatial pattern. Thus, the Haversian structure is an adaptation only to high compressive stresses rendering its inferior tensile properties irrelevant as the regions with high tensile stresses have a non-Haversian, apparently primary microstructure [**Ra2**].

The fluctuation relation in unfolding forces in unfolding experiments is reexamined taking into account the explicit time dependence of the force distribution. The stretching of a tethered Rouse polymer is exactly solved and the ratio of the probabilities of positive to negative forces is shown to be an exponential in force. Extensive steered molecular dynamics simulations of unfolding of deca alanine peptide confirm the form of fluctuation relation proposed earlier, but with explicit correct time dependence of unfolding forces taken into account. From exact calculations and simulations, a linear dependence of the constant in the exponential of the fluctuation relation on average unfolding forces and inverse temperature is proposed [**V**].

A d-dimensional lattice model of diffusing, coalescing massive particles, with two parameters controlling deposition and evaporation of monomers is studied. The unique stationary distribution for the system exhibits a phase transition in all dimensions greater than one between a growing phase, in which the expected mass is infinite at each site, and an exponential phase in which the expected mass is finite. Rigorous upper and lower bounds are established on the critical curve describing the phase transition for this system, and some asymptotics for large or small deposition rates [**Ra1**].

String Theory

The Exact Renormalization Group on the string world sheet for closed string backgrounds is formulated. The same techniques that were used for open strings is used here. There are some subtleties. One is that holomorphic factorization of the closed string vertex operators does not hold in the presence of a cutoff on the Euclidean world sheet. This introduces extra terms in the Lagrangian at the cutoff scale and they turn out to be crucial for implementing gauge invariance. This naive generalization from open string to closed strings requires a *massive* graviton and the gauge symmetry is Abelian, just as in open string theory. Interestingly, it turns out that if a non dynamical background metric (as in background field formalism) is introduced and a gauge transformation on the field is combined with a transformation on the coordinates and background metric, the graviton can be massless. Some examples of background coordinate covariant equations are worked out explicitly. A preliminary discussion of massive modes, massive gauge transformations and the role of world sheet regulator terms is given. Some of the gauge transformations can be given a geometric meaning if space time is assumed to be complex at some level [**Sa**].

The motion of a stochastic string in background of a BTZ black hole is studied. The 1+1 dimensional boundary theory has a very heavy external particle, interacting with the fields of a CFT at finite temperature, and describing Brownian motion. The drag and the thermal mass shift for the Brownian particle are calculated from the boundary Green function for which an exact expression is obtained. Interestingly dissipation even at zero temperature for this 1+1 system is obtained[**Ba**].

A holographic description of BCS superconductivity is given in an earlier paper. This model was constructed by insertion of a pair of D8-branes on a D4-background. The spectrum of intersecting D8-branes has tachyonic modes indicating an instability which is identified with the BCS instability in superconductors. Our aim is to study the stability of the intersecting branes under finite temperature effects. Many of the technical aspects of this problem are captured by a simpler problem of two intersecting D1-branes on flat background. In the

simplified set-up the one-loop finite temperature corrections to the tree-level tachyon mass are computed using the frame-work of SU(2) Yang-Mills theory in (1 + 1)-dimensions. It is shown that the one-loop two-point functions are ultraviolet finite due to cancellation of ultraviolet divergence between the amplitudes containing bosons and fermions in the loop. The amplitudes are found to be infrared divergent due to the presence of massless fields in the loops. The finite temperature mass correction to all the massless fields is computed and these temperature dependent masses are used to compute the tachyonic mass correction. Numerically, the existence of a transition temperature at which the effective mass of the tree-level tachyons becomes zero is shown, thereby stabilizing the brane configuration [**C**].

In previous years a loop-space description of non-linear sigma model (NLSM) describing motion of a quantum string in a curved manifold M was considered. In [**Mu1**] a semi-classical limit was discussed. For further progress it was necessary to work out the tubular geometry of LM (loop-space corresponding to M) around $\Delta \cong M$ which is the submanifold of vanishing loops. In order to understand the UV divergences, it was also necessary to find a regularization of the theory. In an ongoing work first the tubular geometry is worked out around $\Delta \hookrightarrow M^N := M \times M \times \cdots (N\text{-factors})$, where $\times$ is the Cartesian product and Δ is the diagonal submanifold of M^N. Then by restricting to a cyclic ordering of the factors and taking a large-N limit, the tubular geometry in LM has been obtained. This work can also be viewed as providing certain natural metrics on the bundle $T^{(N-1)}M$ whose base is M and the fiber at $x \in M$ is $(T_xM)^{N-1}$. Notice that for $N = 2$ the bundle is the tangent bundle TM. Various consequences and computations from the point of view of Riemannian geometries on such bundles, NLSM and description of multi-particle bound states in curved space are being looked at.

Two dimensional conformal field theories (CFTs) are of great interest to string theorists since this is the traditional approach to describe strings propagating in a given spacetime. The equations for conformality in a two dimensional sigma model coincide with Einstein's equation in spacetime, while the spectrum of the CFT can be matched to particles in spacetime. In most cases it is difficult to calculate the exact spectrum of the conformal field theory since the theory is strongly interacting. Much of my recent work has focused on the calculation of a particular observable in a class of supersymmetric CFTs called the elliptic genus. It is a twisted partition function that captures part of the spectrum of the theory. It turns out to be very interesting from a mathematical point of view.

It has been known since the past few years that the elliptic genus of certain noncompact CFTs are modular completions of certain known mock theta functions. These are holomorphic and elliptic functions which have anomalous modular transformations. By a modular completion, it is meant that these can be completed into modular forms by adding a specific non-holomorphic remainder term. In fact, such mock-theta functions were first written down by Ramanujan and have been of great interest to mathematicians for many decades, but a systematic study of their modular completion is less than a decade old.

The original calculation of the elliptic genus for one particular non compact model exploited our complete understanding of the CFT involved. It might seem as though calculation of the elliptic genus is impossible if such an exact description of the CFT is not available. However one exploits the fact that the elliptic genus is a supersymmetric index on the worldsheet and is therefore insensitive to RG flow. So, in order to calculate the elliptic genus we studied a class of models with a well-defined ultraviolet description, which flows to interesting noncompact

CFTs in the infrared. For these models we calculated the elliptic genus by using techniques of supersymmetric localization in the UV theory [**As1**]. In another publication, we also studied their modular and elliptic properties, along with their decomposition into a holomorphic (elliptic) piece and a real analytic remainder term [**As3**]. Interestingly, these are new classes of mock Jacobi forms distinct from those already studied in the literature.

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.

[**A1**]
Gauhar Abbas, Saurabh Gupta, G. Rajasekaran, and Rahul Srivastava.
High scale mixing unification for dirac neutrinos.
Physical Review Letters, 2013.
arXiv: 1312.7384 [hep-ph] (Submitted).

[**A2**]
Gauhar Abbas, Saurabh Gupta, G. Rajasekaran, and Rahul Srivastava.
Predictions from high scale mixing unification hypothesis.
Physical Review D, **89**, 093009, 2014.
arXiv: 1401.3399 [hep-ph].

[**As1**]
Sujay K. Ashok, Nima Doroud*, and Jan Troost*.
Localization and real jacobi forms.
Journal of High Energy Physics, 2014.
1311.1110 (To be published).

[**As2**]
Sujay K. Ashok, Suresh Nampuri*, and Jan Troost*.
Counting strings, wound and bound.
Journal of High Energy Physics (JHEP), **2013(4)**, 096, 2013.

[**As3**]
Sujay K. Ashok and Jan Troost*.
Elliptic genera and real jacobi forms.
Journal of High Energy Physics (JHEP), **2014(01)**, 082, 2014.

[**Av**]
Steven G. Avery, Rohan R. Poojary, and Nemani V. Suryanarayana.
An sl(2, R) current algebra from $AdS_3 gravity$.
$Journal of High Energy Physics$, **01**, 144, 2014.
$arxiv$: 1304.4252.

[**B1**]
Radha Balakrishnan and Indubala I. Satija[*].
Geometric phase in a classical Aharonov-Bohm Hamiltonian.
Physics Letters A, **377**, 1095, 2013.

[**B2**]
Radha Balakrishnan and Indubala I. Satija[*].
Unified formulation of solitons in strongly repulsive Bose-Einstein condensates.
2014.
(Preprint: IMSc/2014/3/2).

[**Ba**]
Pinaki Banerjee and B. Sathiapalan.
Holographic brownian motion in 1+1 dimensions.
Nucl. Phys. B, **884**, 74–105, 2014.
IMSC-2013-08-6.

[**C**]
Sudipto P. Chowdhury, Swarnendu Sarkar[*]**, and B. Sathiapalan**.
Bcs instability and finite temperature corrections to tachyon mass in intersecting d1-branes.
2014.
(Preprint: IMSc/2014/3/1).

[**G1**]
Manik Banik[*]**, MD. Razzak Gazi**[*]**, Sibasish Ghosh, and Guruprasad Kar**[*].
Degree of complementarity determines the nonlocality in quantum mechanics.
Phys. Rev. A, **87**, 052125, 2013.

[**G2**]
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.

[**Gu**]
Saurabh Gupta.
Novel symmetries in vector schwinger model.
Modern Physics Letters A, **29**, 1450076, 2014.
arXiv:1312.6395.

[**K1**]
Joyjit Kundu and R. Rajesh.
Reentrant disordered phase in a system of repulsive rods on a bethe-like lattice.
Physical Review E, **88**, 012134, 2013.

[**K2**]
Joyjit Kundu and R. Rajesh.

Phase transitions in a system of hard rectangles on the square lattice.
2014.
arXiv:1401.5590 (Submitted).

[**Ku1**]
Ravi Kunjwal and Sibasish Ghosh.
Minimal state-dependent proof of measurement contextuality for a qubit.
Phys. Rev. A, **89**, 042118, 2014.
arXiv:1305.7009.

[**Ku2**]
Ravi Kunjwal, Chris Heunen∗, and Tobias Fritz∗.
Quantum realization of arbitrary joint measurability structures.
Phys. Rev. A, **89**, 052126, 2014.

[**L1**]
M. Devi*, A. Ghosh*, D. Kaur*, S. Lakshmi, S. Choubey*, A. Dighe*, D. Indumathi, S. Kumar*, M. Murthy, and M. Naimuddin*.
Hadron energy response of the iron calorimeter detector at the india-based neutrino observatory.
Journal of Instrumentation (JINST), **8(11)**, P11003, 2013.

[**L2**]
S. Lakshmi, A. Ghosh*, M. Devi*, D. Kaur*, S. Choubey*, A. Dighe*, D. Indumathi, M. Murthy, and M. Naimuddin*.
Hadron energy resolution as a function of iron plate thickness at ical.
2014.
arXiv:1401.2779 [physics.ins-det] (Submitted).

[**M**]
Somshubhro Bandyopadhyay* and Prabha Mandayam.
Operational measure of incompatibility of noncommuting observables.
Physical Review A, **87(4)**, 042120, 2013.

[**Me**]
Nirmalendu Ganai*, Surajit Sengupta*, and Gautam I. Menon.
Chromosome positioning from activity-based segregation.
Nucleic Acids Research, 2014.
doi: 10.1093/nar/gkt1417 (To be published).

[**Mi**]
Liu-Bin Zhao*, Ashok K. Mishra, and David H. Waldeck∗.
Voltammetry can reveal differences between the potential energy curve (pec) and density of states (dos) models for heterogeneous electron transfer.
Journal of Physical Chemistry C, **117**, 20746, 2013.

[**Mu1**]
Partha Mukhopadhyay.
On a semi-classical limit of loop space quantum mechanics.
ISRN High Energy Physics, **2013**, 398030, 2013.

[**Mu2**]
Partha Mukhopadhyay.
All order covariant tubular expansion.
Rev.Math.Phys., **26(1)**, 1350019, 2013.

[**Mur1**]
R. Bhaduri*, W. van Dijk*, and M. Murthy.
Higher virial coefficients of a unitary fermi gas.
Physical Review A, **88(4)**, 045602, 2013.

[**Mur2**]
M. Murthy and G. Rajasekaran.
Anomalous kolar events revisited: Dark matter?
Pramana-Journal of Physics, **82(3)**, 609, 2014.

[**P1**]
Rajarshi Pal, Somshubhro Bandyopadhyay*, and Sibasish Ghosh.
Entanglement sharing through noisy qubit channels: One-shot optimal singlet fraction.
Phys. Rev. Lett., 2014.
arXiv:1401.1388 (Submitted).

[**P2**]
Rajarshi Pal and Sibasish Ghosh.
Non-locality breaking qubit channels.
2013.
(Preprint: arXiv:1306.3151).

[**Pa**]
Sudhir N. Pathak, Zahera Jabeen*, Dibyendu Das*, and R. Rajesh.
Energy decay in three-dimensional freely cooling granular gas.
Physical Review Letters, **112**, 038001, 2014.

[**R**]
G. Rajasekaran.
Fermi and the theory of weak interactions.
Resonance, **19(1)**, 18, 2014.

[**Ra1**]
C. Connaughton*, R. Rajesh, R. Tribe*, and O. Zaboronski*.
Non-equilibrium phase diagram for a model with coalescence, evaporation and deposition.
Journal of Statistical Physics, **152**, 1115, 2013.

[**Ra2**]
A. Mayya*, A. Banerjee*, and R. Rajesh.
Mammalian cortical bone in tension is non-haversian.
Scientific Reports, **3**, 2533, 2013.

[**Ray**]
S. Biswas*, P. Ray, and B. K. Chakrabarti*.
Equivalence of the train model of earthquake and boundary driven edwards-wilkinson interface.
The European Physics Journal B, **86**, 388, 2013.

[**S**]
Krishna K. Sabapathy, J. I. Solomon*, Sibasish Ghosh, and R. Simon.
Quantum discord plays no distinguished role in characterization of complete positivity: Robustness of the traditional scheme.
2013.
(Preprint: arXiv:1304.4857 (quant-ph)).

[**Sa**]
B. Sathiapalan.
Loop variables and gauge invariant exact renormalization group equations for closed string theory.
Int.J.Mod.Phys. A, **A28(24)**, 1350116, 2013.

[**Si**]
Tanmay Singal and Sibasish Ghosh.
Minimum error discrimination of linearly independent pure states: Analytic properties of povm.
2014.
(Preprint: arXiv:1402.4553).

[**Sin1**]
Rajeev Singh, Ravi Kunjwal, and R. Simon.
Relative volume of separable bipartite states.
Physical Review A, **89**, 022308, 2014.

[**Sin2**]
Jinshan Xu*, Rajeev Singh, Nicolas B. Garnier*, Sitabhra Sinha, and Alain Pumir*.
Effect of quenched disorder on dynamical transitions in systems of coupled cells.
New Journal of Physics, **15(9)**, 093046, 2013.

[**Sinh1**]
T. Jesan*, Uddipan Sarma*, Subhadra Halder*, Bhaskar Saha*, and Sitabhra Sinha.
Branched motifs enable long-range interactions in signaling networks through retrograde

propagation.
PLOS ONE, **8(5)**, e64409, 2013.

[**Sinh2**]
Rajeev Singh*, **Subinay Dasgupta***, **and Sitabhra Sinha**.
Extreme variability in convergence to structural balance in frustrated dynamical systems.
EPL (Europhysics Letters), **105(1)**, 10003, 2014.

[**Sinh3**]
Sitabhra Sinha.
The importance of community: How modular organization of social networks affects their collective dynamics.
Studies in Microeconomics, **2(1)**, 49, 2014.

[**Sinh4**]
Sitabhra Sinha and Uday Kovur*.
Uncovering the network structure of the world currency market: Cross-correlations in the fluctuations of daily exchange rates.
In F. Abergel, H. Aoyama, B. K. Chakrabarti, A. Chakraborti, and A. Ghosh, editors, *Econophysics of Agent-Based Models*, page 203. Springer, 2014.

[**Sinh5**]
S. Sridhar*, **Antina Ghosh***, **and Sitabhra Sinha**.
Critical role of pinning defects in scroll-wave breakup in active media.
EPL (Europhysics Letters), **103(5)**, 50003, 2013.

[**Sinh6**]
S. Sridhar*, **D-M Le***, **Y-C Mi***, **Sitabhra Sinha, P-Y Li***, **and C. K. Chan***.
Suppression of cardiac alternans by alternating-period-feedback stimulations.
Physical Review E, **87(4)**, 042712, 2013.

[**V**]
Anoop Varghese*, **Satyavani Vemparala, and R. Rajesh**.
Force fluctuations in stretching a tethered polymer.
Physical Review E, **88**, 022134, 2013.

[**Z**]
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, 2013.
arXiv: 1308.4383 (Submitted).

Books/Monographs Authored/Edited

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

[**R**]
Y. Kagan*, editor.
Earthquakes: Models, Statistics, Testable Forecasts.
Statistical Physics of Fracture and Breakdown. Wiley-Blackwel, Chichester, West Sussex, PO19 8SQ, UK, 2014.

2.3 Theoretical Computer Science

2.3.1 Research Summary

Algorithms and Data Structures

In [**Ra4**], a new computational model is introduced that lies between 'read-only memory model' where the input is not allowed to be modified, and 'standard random-access memory model'. This is called 'Restore' model and here the input, while, can be modified, need to be restored to its original permutation after the computation.

The model was motivated by the selection problem of finding the median or the k-th smallest element. It is shown that when the input is a set of integers, both selection and sorting can be performed in this model almost matching the time and space bounds in the classical random-access memory model. In [**Ra2**], the selection problem in read-only memory model was considered, for the first time, for a sequence of integer inputs and better time and space bounds were obtained compared to the problem in comparison model. In [**Ra1**], succinct data structures (those that take space close to the 'information theoretically optimal' number of bits) are developed for representing equivalence classes.

In [**Ra3**], an investigation into parameterized complexity of reconfiguration problems were initiated. Here the goal is to determine whether one can obtain a solution (say vertex cover or an independent set) t from another solution s by 'local reconfigurations' (say addition or removal of vertices) maintaining feasibility at every step of the way.

A challenge to current theories of computing in the continua is the proper treatment of the zero test. Such tests are critical for extracting geometric information. Zero tests are expensive and may be uncomputable. So we seek geometric algorithms based on a weak form of such tests, called soft zero tests. Typically, algorithms with such tests can only determine the geometry for "nice"(e.g. non-degenerate, non-singular, smooth, Morse, etc) inputs. Algorithms that avoid such niceness assumptions are said to be complete. Can we design complete algorithms with soft zero tests? In [1] we address the basic problem of determining the geometry of the roots of a complex analytic function f. We assume effective box functions for f and its higher derivatives are provided. The problem is formalized as the root clustering problem, and we provide a complete (δ, ϵ)-exact algorithm based on soft zero tests.

Automata, Logic and Concurrency

Work continues on foundations of game theory from a logic and computation perspective.

[**R3**] raises questions for a structural theory of strategies. Continuing research on games with a large number of players, [**R1**] studies the interplay between rational decisions of individual players and a hypothetical 'society' player, offering optimal strategy constructions for players under assumption of rules for social intervention, and conversely, synthesis of social rules under assumption of player type distributions. [**R2**] pursues another strand of work on large games offering a model of *neighbourhood structures* whereby players' visibility and choices are determined by their neighbourhoods but may switch types or locality depending on observation.

Computational Complexity

A proof system for a language L is a function f such that Range(f) is exactly L. The paper [**M1**] looks at proof systems from a circuit complexity point of view and studies proof systems that are computationally very restricted. The restriction studied is: they can be computed by bounded fanin circuits of constant depth (NC^0), or of $O(\log \log n)$ depth but with $O(1)$ alternations (polylogAC^0). Each output bit depends on very few input bits; thus such proof systems correspond to a kind of local error-correction on a theorem-proof pair.

Exactly how much power is needed for proof systems to capture all regular languages is identified. It is shown that all regular languages have polylogAC^0 proof systems, and from a previous result in [**M3**] (Beyersdorff et al, MFCS 2011, where NC^0 proof systems were first introduced), this is tight. The technique also shows that the language MAJORITY has polylogAC^0 proof system.

Further, the question of whether the language of propositional tautologies TAUT has NC^0 proof systems is explored. Addressing this question about 2-TAUT, and since 2-TAUT is closely related to reachability in graphs, the same question is asked about Reachability. It is shown that both Undirected Reachability and Directed UnReachability have NC^0 proof systems, but Directed Reachability is still open.

In the paper [**M5**], the problem of testing if the polynomial computed by an arithmetic circuit is identically zero (PIT) is studied. A deterministic polynomial time algorithm for this problem when the inputs are read-twice formulas is given. This algorithm also computes the MLIN predicate, testing if the input circuit computes a multilinear polynomial.

Further, two related computational problems on arithmetic circuits are studied. Given an arithmetic circuit C, 1) ZMC: test if a given monomial in C has zero coefficient or not, and 2) MonCount: compute the number of monomials in C. These problems were introduced by Fournier, Malod and Mengel [STACS 2012], and shown to characterize various levels of the counting hierarchy (CH).

The above problems are addressed on read-restricted arithmetic circuits and branching programs, and several complexity characterizations for the above problems on these restricted classes of arithmetic circuits are proved.

In [**A2**], the complexity of isomorphism problem is studied for boolean functions when the boolean functions are input as decision trees or decision lists. Known hypergraph isomorphism algorithms are used for bounded rank hypergraphs to obtain upper bound results. When the functions are given as decision lists, a (near) dichotomy result is obtained, classifying the problem as coNP-hard in some cases and equivalent to Graph Isomorphism in

other cases.

In [**A1**] it is shown that the problem of finding a fixpoint free element, in a permutation group given by generators, has a simple deterministic polynomial-time algorithm. Based on Jordan's theorem, a simple randomized algorithm was well-known and a deterministic algorithm based on the CFSG was also known. This algorithm is applied to show some permutation group problems are fixed parameter tractable.

In [**A3**] it is shown that, hypergraph isomorphism under the action of abelian permutation groups has an efficient parallel algorithm. More precisely, the problem is the logspace counting hierarchy (which is contained in the parallel complexity class NC^2).

Graph Theory and Combinatorics

In an ongoing work, the problem of weighted stochastic matching is being studied under the probe and commit model with tolerances. The problem is being studied for both the offline and online scenarios. For the offline version, a natural greedy algorithm has been studied and is shown to approximate the optimality within a multiplicative factor which depends inversely on the square of the minimum edge probability. A lower bound on the worst-case approximation ratio is also established. For the online scenario, the problem was studied for the bipartite graphs where vertices of one of the partite sets arrive in an online fashion with some assumptions about their edges and associated distributions. A new strategy was proposed and was shown to have an approximation ratio which is better than the previously known ratio. Further improvements are being carried out.

2.3.2 List of Publications

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

[**A1**]
V. Arvind.
The parameterized complexity of fixpoint free elements and bases in permutation groups.
In Gregory Gutin and Stefan Szeider, editors, *International Workshop on Parameterized and Exact Computation*, page 4. Springer, LNCS Series, Sep 2013.

[**A2**]
V. Arvind, Johannes Koebler*, Sebastian Kuhnert*, Gauav Rattan, and Yadu Vasudev.
On the isomorphism problem for decision trees and decision lists.
In L.Gasieniec and F.Wolter, editors, *Fundamentals of Computation Theory*, page 16. Springer, LNCS Series, Aug 2013.

[**A3**]
V. Arvind and Johannes Koebler*.

The parallel complexity of graph canonization under abelian group action.
Algorithmica, **67(2)**, 247, 2013.

[**M1**]
Andreas Krebs*, **Nutan Limaye***, **Meena Mahajan, and Karteek Sreenivasaiah**.
Small depth proof systems.
In K. Chatterjee and J. Sgall, editors, *Proceedings of 38th International Symposium on Mathematical Foundations of Computer Science. LNCS 8087.*, pages 583–594. Springer, Aug 2013.

[**M2**]
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*. Springer, Aug 2014.
(To be published).

[**M3**]
Olaf Beyersdorff*, **Samir Datta***, **Andreas Krebs***, **Meena Mahajan,** * **Gido Scharfenberger-Fabian, Karteek Sreenivasaiah, Michael Thomas***, **and Heribert Vollmer***.
Verifying proofs in constant depth.
ACM Transactions on Computation Theory, **5(1)**, 2:1–2:23, 2013.

[**M4**]
Maurice Jansen*, **B. V. Raghavendra Rao***, **and Meena Mahajan**.
Resource trade-offs in syntactically multilinear arithmetic circuits.
Computational Complexity, **22(3)**, 517–564, 2013.

[**M5**]
Meena Mahajan, Raghavendra B. Rao*, **and Karteek Sreenivasaiah**.
Monomials, multilinearity and identity testing in simple read-restricted circuits.
Theoretical Computer Science, **524**, 90–102, 2014.

[**R1**]
Soumya Paul* **and R. Ramanujam**.
Dynamics of choice restriction in large games.
International Journal of Game Theory Review, **15(4)**, 31, 2013.

[**R2**]
Soumya Paul* **and R. Ramanujam**.
Subgames within large games and the heuristic of imitation.
Studia Logica, **102(2)**, 361, 2014.

[**R3**]
R. Ramanujam.
Strategies in games: a perspective from logic and computation.

In Johan van Benthem and Fenrong Liu, editors, *Logic across the University*, page 112. Tsinguha Press, 2013.

[**Ra1**]
Moshe Lewenstein*, Ian Munro*, and Venkatesh Raman.
Succinct data structures for representing equivalence classes.
In *International Symposium on Algorithms and Computation (ISAAC) 2013*, page 502. Springer Verlag, Dec 2013.

[**Ra2**]
Timothy Chan*, Ian Munro*, and Venkatesh Raman.
Faster space-efficient selection algorithms in read-only memory for integers.
In *International Symposium on Algorithms and Computation (ISAAC) 2013*, page 405. Springer-Verlag, Dec 2013.

[**Ra3**]
Amer Mouawad*, Naomi Nishimura*, Venkatesh Raman, Narges Seymour*, and Akira Suzuki*.
On the parameterized complexity of reconfiguration problems.
In Gregory Gutin and Stefan Szeider, editors, *International Symposium on Parameterized and Exact Computation (IPEC)*, page 281. Springer Verlag, Sep 2013.

[**Ra4**]
Timothy Chan*, Ian Munro*, and Venkatesh Raman.
Selection and sorting in the "Restore" model.
In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, Jan 2014.

[**S**]
Michael Sagraloff*, Vikram Sharma, and Chee Yap*.
Analytic root clustering: A complete algorithm using soft zero tests.
In *Computational complexity in the continuous computability in Europe (CiE2013)*, page 434, Jul 2013.

[**Su1**]
N. R. Aravind* and C. R. Subramanian.
Forbidden subgraph colorings and the oriented chromatic numbers.
European Journal of Combinatorics, **34(3)**, 620–631, 2013.

[**Su2**]
K.Dutta and C. R. Subramanian.
Induced acyclic tournament in random digraphs: sharp concentration, thresholds and algorithms.
Discussiones Mathematicae Graph Theory.
(Accepted).

2.4 Student Programmes

2.4.1 Degrees Awarded

Doctoral Degrees Awarded during 2013 – 2014

Mathematics

Name: **Rajkumar, Krishnan**
Thesis Title: Zeros of general L-functions on the critical line
Thesis Advisor: Srinivas, K.
University: HBNI

Name: **Bikram, Panchugopal**
Thesis Title: Extendable Endomorphisms of Factors
Thesis Advisor: Sunder, V. S.
University: HBNI

Name: **Venkatesh, R.**
Thesis Title: Unique Factorization Of Tensor Products For Kac-Moody Algebras.
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Name: **Sharma, Sachin S.**
Thesis Title: The t-analogue of string functions for the affine Kac-Moody algebras.
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Name: **Chatterjee, Tapas**
Thesis Title: Periodic Dirichlet series and Transcendence
Thesis Advisor: Gun, S.
University: HBNI

Physics

Name: **Singh, Rajeev**
Thesis Title: Order-disorder transitions and spatio-temporal pattern formation in complex systems
Thesis Advisor: Sinha, Sitabhra
University: HBNI

Doctoral Theses Submitted during 2013 – 2014

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

Physics

Name: **Jesan, T.**
Thesis Title: Systems Biology from Cell to Society: Transmission dynamics in complex networks with mesoscopic organization
Thesis Advisor: Sinha, Sitabhra
University: HBNI

Theoretical Computer Science

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

Masters Theses during 2013 – 2014

Physics

Name: **Mitra, Tanmay**
Thesis Title: Molecular Dynamics simulation study of pure $[bmim][PF_6]$ and its aqueous solution
Thesis Advisor: Vemparala, Satyavani
University: HBNI

Theoretical Computer Science

Name: **Chakraborty, Sankardeep**
Thesis Title: Topics in Correlation Bounds
Thesis Advisor: Mahajan, Meena
University: HBNI

Masters Theses submitted during 2013 – 2014

Theoretical Computer Science

Name: **Ayitam, Tarun**
Thesis Title: Partially coupled dynamics in large games
Thesis Advisor: Ramanujam, R.
University: IISER, Pune

Name: **Varunkumar Jayapal**
Thesis Title: Finding and maintaining medians under constraints
Thesis Advisor: Raman, Venkatesh
University: CMI, Chennai

Name: **Abhishek Dang**
Thesis Title: Lower bound techniques for dynamic data structures
Thesis Advisor: Raman, Venkatesh
University: CMI, Chennai

2.4.2 Lecture Courses During 2013 – 2014.

The following **lecture courses** were offered during 2013 – 2014.

Course Title	Period	Lecturer
Mathematics		
Characteristic classes	Aug-Mar 2013	Sankaran, Parameswaran
Algebraic Topology	Jan-Apr 2013	Nagaraj, D. S.
Arithmetic	Jan-Apr 2013	Balasubramanian, R.
Functional Analysis	Jan-Apr 2013	Chakraborty, Partha S.
Infinite dimensional Lie algebras	Jan-Apr 2013	Viswanath, Sankaran
Problem Seminar in Commutative Algebra	Jan-May 2013	Kodiyalam, Vijay
Representation Theory	Jan-Apr 2013	Prasad, Amritanshu
Representations of semisimple Lie groups	Jan-Feb 2013	Sankaran, Parameswaran

Topics in Probability theory (elective course)	Jan-Apr 2013	Sunder, V. S.
Transforms on Function spaces	Jan-Mar 2013	Krishna, M.
A course in arithmetic	Mar-Apr 2013	Gun, S.
Algebra-I	Aug-Dec 2013	Viswanath, Sankaran
Linear algebraic groups: an introductory course	Aug-Nov 2013	Raghavan, K. N.
Measure and Integration	Aug-Nov 2013	Kesavan, S.
Sieve Methods	Aug-Dec 2013	Balasubramanian, R.
Topology-I	Aug-Dec 2013	Sankaran, Parameswaran
Transcendental Number Theory	Aug-Dec 2013	Balasubramanian, R.
von Neumann algebras	Aug-Dec 2013	Sunder, V. S.
Algebra II	Jan-Apr 2014	Raghavan, K. N.
Modular Forms	Jan-Apr 2014	Balasubramanian, R.
Topology-II	Jan-Apr 2014	Chatterjee, Pralay
Analysis-II	Jan-Apr 2014	Mohari, Anilesh

Physics

Nonlinear Dynamics	Jan-May 2013	Sinha, Sitabhra
General Relativity and Cosmology	Jan-Mar 2013	Date, G.
Introduction to AdS/CFT	Jan-Apr 2013	Sathiapalan, Balachandran
Quantum Information Theory	Jan-May 2013	Ghosh, Sibasish
Quantum Mechanics II	Jan-Apr 2013	Ashok, Sujay K.
Advanced Statistical Mechanics	Aug-Nov 2013	Menon, Gautam I.
Classical Mechanics	Aug-Dec 2013	Murthy, M.V.N.
Introductory Biophysics	Aug-Nov 2013	Menon, Gautam I.
Mathematical Methods I	Aug-Dec 2013	Rajesh, R.
Mathematical Methods II	Aug-Dec 2013	Ashok, Sujay K.
Quantum Mechanics - I	Aug-Dec 2013	Ghosh, Sibasish
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 Mechanics II	Jan-Apr 2014	Mukhopadhyay, Partha
Statistical Field Theory	Jan-Apr 2014	Rajesh, R.
Statistical Mechanics	Jan-Apr 2014	Ray, Purusattam
Systems Biology	Jan-Apr 2014	Sinha, Sitabhra

Theoretical Computer Science

Advanced automata theory	Jan-May 2013	Lodaya, Kamal
Algorithms for special graph classes	Jan-Apr 2013	Francis, Mathew C.
Mathematical Logic	Jan-Apr 2013	Ramanujam, R.
Model theory and decidability	Jan-Apr 2013	Ramanujam, R.
Logical Foundations of Proof Complexity (reading course)	Feb-Jun 2013	Mahajan, Meena
Algebra and Computation (shared with Vikram Sharma)	Apr-Mar 2014	Arvind, V.
Logic	Apr-May 2013	Lodaya, Kamal
Communication Complexity	Aug-Dec 2013	Mahajan, Meena
Design and analysis of algorithms	Aug-Dec 2013	Subramanian, C. R.
Discrete Mathematics (jointly with V Arvind)	Aug-Dec 2013	Subramanian, C. R.
Discrete Mathematics (shared with C.R. Subramanian)	Aug-Nov 2013	Arvind, V.
Game theory	Aug-Dec 2013	Ramanujam, R.
Mathematical foundations of artificial intelligence	Aug-Dec 2013	Ramanujam, R.
Theory of computation: I	Aug-Nov 2013	Ramanujam, R.
Parameterized Complexity	Sep-Dec 2013	Raman, Venkatesh
Computational Complexity	Jan-May 2014	Mahajan, Meena
Infinite discrete structures	Jan-Apr 2014	Ramanujam, R.
Linear Programming and Combinatorial Optimization	Feb-May 2014	Sharma, Vikram

In addition, the following **lecture courses** were offered during 2013 – 2014 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

Course Title	Period	Lecturer

Physics

Overview of Physics	Nov-Jan 2013	Rajasekaran, G.
Quantum Mechanics	Jan-Apr 2013	Rajasekaran, G.
Mathematical Physics (Lie Groups and applications)	Aug-Nov 2013	Rajasekaran, G.
Particle Physics	Jan-Apr 2014	Rajasekaran, G.

2.4.3 Summer Students

Every summer, a small number of students from various institutes/universities come to our institute and work on some learning/research projects with some faculty member for a period

of four to six weeks.The following students visited the institute during Apr, 2013 - Mar, 2014.

Student	Faculty
Mathematics	
Chaturvedi, Akshay, IISER, Kolkata	Balasubramanian, R.
Ananthapadmanabhan,S., BITS, Pilani	Balasubramanian, R.
Gupta, Karthik, IIT,Madras	Balasubramanian, R.
Sheth, Mihir Dilip, IISER, Pune	Balasubramanian, R.
Sahay, Anurag, IIT, Kanpur	Balasubramanian, R.
Jana, Subhajit, ISI,Bangalore	Balasubramanian, R.
Raj, Phani, IISER, TVR	Gun, S.
Roy, Manami, IISER, Kolkata	Gun, S.
Sengupta, Ayan, CMI	Kodiyalam, Vijay
Raychaudhury, Debaditya, CMI	Kodiyalam, Vijay
Mukherjee, Jayan, CMI	Kodiyalam, Vijay
Maiti, Ayan, CMI	Kodiyalam, Vijay
Sampath, Kannappan, ISI, Bangalore	Prasad, Amritanshu
Physics	
Sarangi, Sohan, IISER – Pune	Ghosh, Sibasish
Jacob, Kevin V., IIT – Kanpur	Ghosh, Sibasish
Varghese, Minu, NISER, Bhubaneswar	Menon, Gautam I.
Mathews, Cherian, MCC, Chennai	Murthy, M.V.N.
Akshaya, J., Dept. of Physics, Univ. of Hyderabad	Murthy, M.V.N.
Vaniyamathi, , Dept. of Nuclear Physics, Univ. of Madras	Murthy, M.V.N.
Gopi, K., Dept. of Theo. Physics, Univ. of Madras	Murthy, M.V.N.
Arulkumar, K., Dept. of Theo. Physics, Univ. of Madras	Murthy, M.V.N.
Niveadhitha, S., Dept. of Theo. Physics, Univ. of Madras,	Murthy, M.V.N.
kela, Aditya, CMI	Sathiapalan, Balachandran
Madaan, Pulkit, Institute of Technology, Banaras Hindu Univ., Varanasi	Sinha, Sitabhra
Rajiv, V., NIT, Karnataka	Sinha, Sitabhra
Shreshtha, Mayank, IISER, Kolkata	Sinha, Sitabhra
Adhyapok, Priyom, IISER, Kolkata	Sinha, Sitabhra
Priyanga, G., NISER, Bhubaneswar	Sinha, Sitabhra
Theoretical Computer Science	
Tamas, Danyluk, Eotvos Lorand Univ., Budapest, Hungary	Mahajan, Meena
Kumar, Mahati, SSN College of Engineering, Chennai	Ramanujam, R.

Ramesh, Vaishnavi, BITS, Pilani	Ramanujam, R.
Seshadri, Aditya, SSN College of Engineering, Chennai	Ramanujam, R.

2.4.4 Other Students

Students also do their projects under the supervision of our faculty during the academic year. The following students visited the institute during Apr, 2013 - Mar, 2014.

Student	Faculty
Physics	
Krishnan, Vinay, National Institute Of Technology, Calicut	Ashok, Sujay K.
Theoretical Computer Science	
Banerjee, Niranka, CMI	Mahajan, Meena

2.5 Honours and Awards

Gun, S. was awarded SERB Women excellence award, for 2013, by the SERB.

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.

Editor of Computational Complexity Column of the Bulletin of the European Assoc. of Theoretical Computer Science during Jun 2011 – Mar 2014.

Programme Committee member of Workshop on Algorithms and Computation (WALCOM) 2014 during Sep – Dec, 2013.

Associate Editor of ACM Transactions on Comptation Theory during Feb – Mar, 2014.

Ashok, Sujay K.

Member of National Organising Committee for National Strings Meeting held at IIT-Kharagpur during Dec 22 – Dec 27, 2013.

Balasubramanian, R.

Member of Governing council of Institute of Mathematics and Applications, Bhubaneshwar during Mar 2013 – Mar 2014.

Member of Court of the University of Hyderabad during Mar 2013 – Mar 2014.

Member of Senate of the Indian Institute of Science Education and Research[IISER], Thiruvananthapuram during Mar 2013 – Mar 2014.

Chairman of National Board for Higher Mathematics

Member of Governing Council, HRI, Allahabad

President of Cryptology Research Society of India, Kolkata

Member of the Selection Committee for NASI Young Scientist Platinum Jubilee Awards 2014.

Member of Academic Advisory Body and the Board of Management of R.C. Bose Centre for Cryptology and Security.

Visitor Nominee of Indian Institute of Technology, Madras

Chairman of the Apex Committee of National Centre for Mathematics, Mumbai

Chairman of Governing Council of Chennai Mathematical Institute during Aug 2013 – Mar 2014.

Chairman of Research Council of SAG during Nov 2013 – Mar 2014.

Member of Governing council of Indian Statistical Institute, Kolkatta during Nov 2013 – Mar 2014.

Chairman of Peer Review for the project SANKYA of SAG during 2014.

Date, G.

Lecture during IMSc Open Day at IMSc on Feb 15, 2014. Gave a talk on *Gravity: From Newton to Einstein to ...* at the IMSc Open House Day.

President of The Indian Association for General Relativity and Gravitation during Mar – Mar, 2014.

Ganguli, Saibal

Selected as Reviewer of Mathematical Reviews, AMS.

Reviewer of Zentralblatt Mathematics.

Geetha, T.

Reviewer of Mathematical Reviews during Oct 2012 – Apr 2013.

Ghosh, Sibasish

Convener of Local Organising Committee for 13th Asian Quantum Information Science Conference (AQIS13) held at IMSc during Aug 25 – Aug 30, 2013.

Member of Advisory Committee for International Workshop on Optical Quantum Information held at Jaypee Institute of Information Technology, Noida during Sep 1 – Sep 2, 2013.

Member of Local Organising Committee for Satellite Meeting on Quantum Correlation and its application in communication and cryptography held at Indian Statistical Institute, Kolkata during Sep 2 – Sep 3, 2013.

Convener of Local Organising Committee for 1st IMSc School on Quantum Information held at IMSc during Jan 19 – Jan 31, 2014.

Gun, S.

Reviewer of Mathematical Reviews during Jul 2008 – Mar 2014.

Reviewer of Zentralblatt Reviews during Apr 2011 – Mar 2014.

Convener of International Organising Committee for Analytic theory of Automorphic forms held at IMSc during Dec 9 – Dec 13, 2013.

Kesavan, S.

Member of Academic Council, Chennai Mathematical Institute

Reviewer of Mathematical Reviews

Fellow of Forum d' Analystes

Member of Editorial Board, Journal of the Kerala Mathematical Association

Member of National Board for Higher Mathematics

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

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

Member of Selection Committee, Abel Visiting Scholars Programme, International Mathematical Union during Aug 2013 – Mar 2014.

Member of Editorial Board, Mathematics Newsletter, Ramanujan Mathematical Society during Sep 2013 – Mar 2014.

Chair of Selection Committee, NANUM Travel Scheme for ICM 2014: West Asia and the Indian Subcontinent during Nov – Dec, 2013.

Kodiyalam, Vijay

Speaker in "Enriching mathematics education" workshop at IMsc on Oct 1, 2013. Gave a talk on 'Ramblings in Ramsey theory'

Speaker in "One per cent" mathematics workshop at IMSc on Nov 29, 2013. Gave a talk on 'Rotations and quaternions'

Speaker in "Enriching collegiate mathematics" workshop at IMSc on Mar 13, 2014. Gave a talk on 'The Lindstorm-Gessel-Viennot lemma and its applications'

Krishna, M.

Member of National Organising Committee for Winter School on Measure Theory and Functional Analysis held at Department of Mathematics, Andhra University, Visakhapatnam during Nov 25 – Dec 6, 2013.

Convener of Local Organising Committee for Conference on Operator and spectral theory, operator algebras and non-commutative geometry held at Kerala School of Mathematics, Kozhikode, Kerala during Feb 7 – Feb 14, 2014.

Lodaya, Kamal

Workshop organization at IMSc on Apr 20, 2013. Was the local organizer for the 'Thulir science writers' workshop, 20-21 April 2013, held at IMSc.

Mahajan, Meena

Member of Programme Committee of FSTTCS 2013 during Jul – Dec, 2013.

Murthy, M.V.N.

Lecture program on recent developments on High Energy Physics at Department of Physics, J.A College for Women, Periyakulam, Theni District on Sep 16, 2013. Lecture on "Mysterious Dark Matter"

Science Outreach Program with emphasis on Neutrinos at Science City Auditorium in Kolkata on Nov 8, 2013. Member of the expert Science Panel

DST Inspire Science Lectures to school students at HNB Garhwal University, Srinagar Garhwal (Uttarakhand) on Dec 20, 2013. Two talks: "Powering the Sun" "What is Dark Matter"

Convener of National Organising Committee for Recent Advances in High Energy Physics (Sponsored by National Science Academies) held at St.Joseph's College, Irinjalakuda during Jan 28 – Jan 29, 2014.

INO outreach Program at St GITS, Pattanamthitta, Kottayam, Kerala on Jan 30, 2014. Lectures on High Energy Physics with special emphasis on INO.

INO outreach Program at Pottipuram and Ramakrishnapuram, Theni District on Jan 24, 2014. Discussion on the impact of INO on local villages

Popular Lecture "Playing Cards with Atoms" at International Gandhian Institute for Non-violence and Peace (IGINP), Madurai on Jan 18, 2014. Lecture on Standard Models over time to a group of scholars and public from multidisciplinary areas.

Lecture on "How the Sun shines" at Nadar Mahajana Sangam S. Vellaichamy Nadar College, Nagamalai, Madurai on Jan 23, 2014. Popular Science lecture

Raghavan, K. N.

Convener of Local Organising Committee for Lecture course on "Cohomological finite generation" by Van der Kallen held at IMSc during Jun 18 – Jul 12, 2013.

Convener of Local Organising Committee for Mathematics: Aspects, Prospects, and a bit of History held at IMSc during Jul 1 – Jul 2, 2013.

Workshop for school students sponsored by the Science Academies at Chennai Mathematical Institute, Chennai on Jul 29, 2013. Gave a lecture on "Ruler and compass constructions: an application of algebra to geometry"

"Mentor" for DST INSPIRE Camp for school students at Vickram College of Engineering, Madurai on Jul 27, 2013. Over an entire morning session lectured to and interacted with school students

Guest Speaker for workshop on "Efficient document writing using at Department of Computer Science and Engineering, SRM University, Kattankolathur, Chennai on Aug 7, 2013. Over an entire afternoon session, lectured to the workshop participants about personal experience with LaTeX.

Acted as "mentor" in DST INSPIRE programme at Vel Tech Technical University, Avadi, Chennai on Aug 3, 2013. Lectured to school students on mathematics.

Acted as mentor in DST INSPIRE programme at Presidency College, Chennai on Aug 3, 2013. Lectured to two batches of school students on mathematics.

Mathematics lecture to senior secondary students at Sri Sankara senior secondary school, Adyar, Chennai on Aug 12, 2013. Gave a lecture on "Some multiplicative arithmetical functions: an invitation to number theory"

Member of Advisory Committee for IMSc outreach three day workshop: Quadratic fields: an invitation to number theory held at University of Mysore during Aug 22 – Aug 24, 2013.

Acted as "mentor" in DST INSPIRE programme for school children at Presidency College, Chennai on Sep 23, 2013. Lectured on mathematics to school children.

Speaker at Mathematics Project Day at S. R. M. Nightingale Matriculation Higher Secondary School, West Mambalam, Chennai on Oct 26, 2013. Commented on mathematics projects by school children. Lectured to 12th standard students about opportunities for pursuing education and research in science.

Convener of Local Organising Committee for Lecture course on "Modular representations of algebraic groups" by Peter Fiebig held at IMSc during Oct 7 – Oct 18, 2013.

Acted as "mentor" in DST INSPIRE programme for school children at DMI College of Engineering, Palanchur, Chennai on Oct 22, 2013. Lectured to school students on mathematics.

Speaker at Science Exhibition at Smt. Kasturba Nimchand Shah P. Muthyalu Chetty Vivekananda Vidyalaya, Perambur, Chennai on Oct 24, 2013. Spoke to school children and teachers about opportunities for science education and research.

Convener of Local Organising Committee for One Per Cent: Mathematics workshop for students of classes XI and XII held at IMSc on Nov 29, 2013.

Acted as "mentor" for DST INSPIRE program for school children at SRM University, Kattankulathur, Tamil Nadu on Dec 27, 2013. Lectured to school students on elementary number theory and talked to them about prospects for higher studies in mathematics

Acted as "mentor" at DST INSPIRE programme for school children at University of Madras, Department of Geology, Guindy Campus, Chennai 600025 on Dec 6, 2013. Lectured to school students on mathematics and opportunities for pursuing higher studies in mathematics.

Convener of Local Organising Committee for Lecture course on "Soergel bimodules and Kazhdan-Lusztig theory" by Ben Elias held at IMSc during Jan 21 – Feb 3, 2014.

Acted as "mentor" for DST INSPIRE program for school children at Sacred Heart College, Thevara, Cochin on Jan 24, 2014. Lectured to school students on elementary mathematics and on prospects for higher studies in mathematics

Judge at a mathematics modelling competition at SRM University, Ramapuram Campus, Chennai 600089 on Feb 19, 2014. Acted as judge at a mathematics modelling competition for engineering students.

Acted as "mentor" in DST INSPIRE programme for school children at University of Madars, Department of Geology, Guindy Campus, Chennai 600025 on Feb 7, 2014. Lectured to school students on some elementary mathematics and on opportunities for pursuing higher studies in mathematics.

Rajasekaran, G.

Chairman of Board of Studies in Physics, CMI

Member of Academic Council of CMI

Convener of Indian National Science Academy (Chennai Chapter)

Popular Science Lecture at Rajarajan Institute of Science, Madurai on Apr 2, 2013. Gave the Second Rajarajan Memorial Lecture on "Science and Beyond Science" in Tamil

Popular Science article at Madurai on Apr 1, 2013. Tamil article titled "Vignanamum atharku appalum" was published in Mulumai Ariviyal Udayam Vol 6,No 4.

Popular science talk at Vivekananda College, Chennai on Sep 27, 2013. Gave a lecture on "Fundamental Physics in the last hundred years" in Tamil.

Popular Science Lecture at Rajarajan Institute of Science, Madurai on Sep 14, 2013. Gave a lecture on "Neutrinos and INO"

Popular Science article at Madurai on Oct 1, 2013. Tamil article titled "Alamana unmaihal" was published in Mulumai Ariviyal Udayam,Vol 6, No 10.

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

Popular Science article at Bangalore on Jan 1, 2014. Published the article "Fermi and the Theory of Weak Interactions" in Resonance Vol 19, No 1.

Raman, Venkatesh

Member of Program Committee of STACS 2014 during Oct 2013 – Feb 2014.

Member of Program Committee of SWAT 2014 during Jan – Mar, 2014.

Convener of Local Organising Committee for Advanced school on Parameterized and Kernelization (ASPAK) held at IMSc during Mar 3 – Mar 8, 2014.

Ramanujam, R.

Member of Program Committee of Games and Logics for Formal Verification, Aug 2013 during Feb – Aug, 2013.

Member of Programme Committee of FST&TCS, December 2013 during Apr – Dec, 2013.

Invited speaker, Conference on Math Sciences Communication at Charles Darwin University, Australia on Aug 1, 2013. Gave a talk on "From content to process in classrooms" in the PDC for university teachers; Gave a talk on "Mathematics and science festivals" at the conference.

Convener of Local Organising Committee for Games of Imperfect Information via Automata and Logic held at IMSc during Dec 7 – Dec 10, 2013.

Ray, Purusattam

Convener of National Organising Committee for Discussion meeting on statistical physics of fracture held at IMSc on Jan 6, 2014.

Sankaran, Parameswaran

Member of Section Committee (Mathematics), Indian Academy of Sciences during Jan – Dec, 2013.

Member of Joint Science Education Panel, Representative of the Indian Academy of Sciences during Jan – Dec, 2013.

Associate Editor of Proceedings (Mathematical Sciences), Indian Academy of Sciences, Bangalore. during Jan – Dec, 2013.

Convener of Local Organising Committee for Discussion Meeting in Topology held at IMSc during May 2 – May 4, 2013.

Convener of Local Organising Committee for Nag Memorial Lecture in Mathematics held at IMSc on Nov 12, 2013.

Sinha, Sitabhra

Member of Editorial Board of Frontiers in Fractal Physiology

Adjunct Faculty of National Institute of Advanced Studies

Convener of Local Organising Committee for Brainstorming Meeting on Econophysics: Science for the Economy held at IMSc on Jul 30, 2013.

Convener of National Organising Committee for Round Table on Complex Systems, India-France Technology Summit held at Hotel Lalit, Barakhamba Avenue, New Delhi on Oct 24, 2013.

Srinivas, K.

Acting Secretary and Treasurer of Executive Committee, Ramanujan Mathematical Society

VMC member of KV, CLRI

Convener of Local Organising Committee for Advanced Instructional School in Number Theory held at KIIT University, Bhubaneswar during Jun 10 – Jun 29, 2013.

Convener of Local Organising Committee for Hindi Kavi Sammelan held at IMSc on Sep 16, 2013.

Member of Local Organising Committee for 15th DAE Akhil Bharatiya Raj Bhasha Sammelan held at IMSc during Jan 16 – Jan 17, 2014.

Convener of Local Organising Committee for Enriching Collegiate Mathematics held at IMSc during Mar 13 – Mar 14, 2014.

Sunder, V. S.

Member of Committee to conduct Peer Review of the Dept. of Mathematics at IIT(M) during Nov – Nov, 2013.

Convener of Local Organising Committee for Joint IMSc-ISI workshop on Subfactors held at IMSc during Dec 30, 2013 – Jan 10, 2014.

Member of Sectional Committee of INSA for Math. Sciences during Jan – Mar, 2014.

Viswanath, Sankaran

Convener of Local Organising Committee for the "Enriching Mathematics Education" workshop held at IMSc during Sep 30 – Oct 1, 2013.

Lecturer in Mathematics workshop for school students at IMSc on Nov 29, 2013. Workshop titled "ONE PER CENT" aimed at students of classes XI and XII.

Chapter 4

Colloquia

4.1 Conferences/Workshops Held at IMSc

4.1.1 Discussion Meeting in Topology

The first meeting of its kind in topology brought experts and young researchers to talk about their current research in topology. There were three special talks, one each by Mahan Mj, Siddhartha Gadgil, and Goutam Mukherjee. There were about fifteen talks by other participants. The meeting was well attended by about thirty participants including about twenty-five out-station participants.

4.1.2 Lecture course on "Cohomological finite generation" by Van der Kallen

Details of the lecture course (including videos, notes, etc.) are available at
http://www.imsc.res.in/ knr/past/vdk/announcement.html.

4.1.3 Brainstorming Meeting on Econophysics: Science for the Economy

Econophysics is a relatively new field that has taken a very different approach to understanding social and economic phenomena - but it hasn't become well-known to the general public and its impact on policy making has largely been ignored until now. The meeting aimed at bringing together some of the leading practitioners of this new discipline who engaged in discussions related to how current research can be harnessed to real economic issues such as understanding the key drivers of economic growth and prosperity, as well as other issues that are vital to nation building. The speakers were

- Bikas K. Chakrabarti (Saha Institute of Nuclear Physics, Kolkata)
- Sanjay Jain (Delhi University, Delhi)

- Ishita Mukhopadhyay (Calcutta University, Kolkata)
- Raman Mahadevan (Chennai)
- Arnab Chatterjee (Aalto University, Helsinki)
- Anindya S. Chakrabarti (Boston University, Boston)

4.1.4 13th Asian Quantum Information Science Conference (AQIS13)

This is a yearly series of international conference in the field of quantum information, which, so far were held in Japan, China, and Korea. This was the first time that this conference was held in India. Sibasish Ghosh was the Chair of the Organizing Committee for the Conference. There were about 110 presentations (long talks, short talks, and posters) in the conference out of about 140 submissions. Total number of participants were about 175, out of which about 40 were locals, 35 were foreigners, and rest were from within India but not locals.

4.1.5 Hindi Kavi Sammelan

On the eve of Hindi Diwas, IMSc organized Hindi Hasya Kavi Sammelan. The participating poets were Sri. Uday Meghani, Sri Srimali, Sri Mahendra Singh, Sri Anil Awasthi, Smt Ravita Bhatiya. The programme was compered by K. Srinivas.

4.1.6 Enriching Mathematics Education

The workshop featured lectures by IMSc members as well as faculty members from Lady Shriram College, Delhi and Ramanujan Institute, Chennai. The topics were drawn from the school syllabus (of classes XI and XII) and the lecturers provided a more in-depth perspective. There was also an interactive session on formulating mathematics projects at the school level. Around 65 teachers from schools in and around Chennai participated.

4.1.7 Lecture course on "Modular representations of algebraic groups" by Peter Fiebig

Details of the lecture course (including videos) are available at
http://www.imsc.res.in/ knr/past/fiebig/index.html.

4.1.8 Nag Memorial Lecture in Mathematics

The Subhashis Nag Memorial Endowment Lecture for mathematics for the year 2013 was held on 12th November. The speaker, Professor Jaques Hurtubise of McGill University, Montreal, Canada, delivered the lecture on 'Moduli spaces'. This was followed by a series of four lectures by Prof Hurtubise in the mathematics seminar. The public lecture as well

as the seminar lectures were well attended by the Institute members as well as some special invitees from TIFR, Mumbai.

4.1.9 One Per Cent: Mathematics workshop for students of classes XI and XII

Details (including videos, slides, notes, etc.) are available on the website of the workshop: http://www.imsc.res.in/ knr/past/131129workshop/report.html.

4.1.10 Joint IMSc-ISI workshop on Subfactors

ISI and IMSc contributed two resource persons each, financing and infra-structural assistance to run this two-week workshop focusing on some of the basics in the theory of subfactors. Six inter-related courses were given by Ved Prakash Gupta (of JNU), Paramitha Das and Shamindra Ghosh of ISI (Kolkata) and Vijay Kodiyalam and V.S. Sunder(IMSc). The tutorials would at least have helped some of our own students to quickly get a toe-hold into the subject.

4.1.11 Games of Imperfect Information via Automata and Logic

Reasoning about global behaviour in the presence of partial information is an essential feature of distributed systems, and a central topic of study in concurrency theory. Games of imperfect information provide a natural model of interaction in the presence of uncertainty as well. Studying computational issues in such games from the perspective of automata theory and logic has led to new insights. The Workshop was intended as an occasion for exchanging ideas on this topic, especially on identifying appropriate solution concepts, as well as structural and computational arguments for analysing them.

Details of the workshop programme are available at:
http://www.imsc.res.in/ jam/giminal/programme.html.

4.1.12 Analytic theory of Automorphic forms

The theory of automorphic forms constitutes a central theme in the development of modern number theory. It is a rapidly evolving domain with a large number of proponents throughout the world. It is also an area which has a strong foothold in India.

In the joint CMI-IMSc-IUSSTF conference, leaders in the topic of automorphic forms, both from India and abroad, highlighted the state-of-the-art as well as indicated some of their recent works. This conference also provided a platform for the young researchers to showcase their work via lectures as well as poster presentations.

4.1.13 15th DAE Akhil Bharatiya Raj Bhasha Sammelan

About 150 officials from Hindi departments of various DAE organizations participated in this conference. Many eminent people were invited to deliver talks in this programme. A cultural programme was held on the second day in which many of our Institute members performed and entertained the public.

4.1.14 Discussion meeting on statistical physics of fracture

Various aspects of fracture and breakdown processes are discussed from the point of view of statistical physics. The avalanche dynamics and the associated scaling ideas, fracture surface roughness, extreme statistics and ductile brittle behavior are discussed.

4.1.15 Lecture course on "Soergel bimodules and Kazhdan-Lusztig theory" by Ben Elias

Details of the lecture course (including notes, videos, tutorial sheets, etc.) are available at http://www.imsc.res.in/ knr/past/elias/.

4.1.16 1st IMSc School on Quantum Information

There were about 70 participants in the School, out of which about 13-14 were foreign participants including a couple of speakers. There were about 25 local participants, and rest were from outside of Chennai. Most of the lectures were being held during the morning session, while the afternoon sessions were arranged for discussions/tutorials. Sibasish Ghosh was the Chair of the Organising Committee for the School.

4.1.17 Advanced school on Parameterized and Kernelization (ASPAK)

Parameterized complexity and kernelization, developed more than 20 years back has become a central theme in theoretical computer science with a number of recent developments in algorithms and lower bound theory.

This advanced school was held, to bring up to speed on the recent developments to researchers in the field, during March 3rd to 8th, 2014. The school was organized by Neeldhara Misra, Venkatesh Raman and Saket Saurabh who gave about ten lectures each. There were also tutorial and problem sessions in the afternoon. The school was attended by about 50 graduate students and faculty from Indian Institute of Science, Bangalore, Indian Statistical Institute, Kolkata, Indian Institute of Technology, Madras and a few other institutions from India and abroad.

4.1.18 Enriching Collegiate Mathematics

A two-day workshop for college lecturers was held at IMSc as part of it's outreach programmes. Lectures were delivered by IMSc faculty on fundamentals of Algebra, Linear algebra, Galois theory and Complex analysis. About 94 teachers from Chennai participated in this workshop. Every one gave a positive feedback and wanted IMSc to hold such important workshops more frequently.

4.2 Other Conferences/Workshops Organized by IMSc

4.2.1 Advanced Instructional School in Number Theory

About 35 participants (post graduate students, research scholars, university teachers) participated in this programme. The resource people were Professors T. N. Shorey, Ram Murty, Thangadurai, Kaneenika Sinha, R. Padma and from IMSc, K. Srinivas. The feedback from the participants reflects that the programme was well organized and was useful for the participants. It is proposed that the lecture notes of this school will be eventually published by RMS.

4.2.2 IMSc outreach three day workshop: Quadratic fields: an invitation to number theory

This was an IMSc outreach initiative. There were six lectures and six tutorial sessions over three days, conducted by two IMSc faculty D. S. Nagaraj and K. N. Raghavan, addressed to 3rd semester MSc Mathematics students at the University of Mysore.

4.2.3 International Workshop on Optical Quantum Information

Sibasish Ghosh was a member of the Program Advisory Committee for the Workshop, which is a Satellite meeting for AQIS'13, held at IMSc.

4.2.4 Satellite Meeting on Quantum Correlation and its application in communication and cryptography

This was a satellite meeting of AQIS'13.

4.2.5 Round Table on Complex Systems, India-France Technology Summit

Complex Systems science and engineering bridges the gap between the individual and the collective: from genes to organisms to ecosystems, from atoms to materials to products, from citizens to society. By combining sciences across the social and technical disciplines, it may lead to personalized health and education, the prevention and resilience of epidemics, and, more generally, support policies to manage extreme events, locally and globally. Reducing uncertainty on the impact of our actions on complex systems will lead to a transformation in the relationship between science, engineering, ethics and politics. The aim of the Round Table was to explore these issues and specifically how Indian and French scientists can collaborate in this front.

The invited speakers were:

- Sitabhra Sinha (IMSc, Chennai)
- Paul Bourgine (CNRS, Paris)
- Sanjay Jain (University of Delhi, Delhi)
- Gautam Menon (IMSc, Chennai)
- Bikas K. Chakrabarti (Saha Institute of Nuclear Physics, Kolkata)
- Jean-Philippe Cointet (INRA-SenS, Marne)
- Nadine Peyrieras (CNRS INAF, Gif sur Yvette)
- Arpan Banerjee (NBRC, Manesar)
- Eric Daude (UMIFRE-CNRS CSH, Delhi & UMR-IDEES, Rouen)
- Cyrille Bertelle (University of Le Havre, Le Havre)
- Karmeshu (JNU, New Delhi)

4.2.6 Winter School on Measure Theory and Functional Analysis

The Winter School was held to train MSc students in Functional Analysis. Resource persons came from IMSc and Andhra University, Department of Mathematics. The participants were from colleges in Andhra Pradesh and Tamil Nadu.

4.2.7 Recent Advances in High Energy Physics (Sponsored by National Science Academies)

Workshop sponsored by the three National Academies

4.2.8 Conference on Operator and spectral theory, operator algebras and non-commutative geometry

The conference/Workshop was held during 7-14 February in honour of Professor K B Sinha who completed 70 years. The workshop was held initially and culminated in a conference the last three days of the program. The speakers were from many countries and the conference focussed mostly in the research areas where Professor K B Sinha contributed actively.

4.3 Seminars

Date	Speaker Affiliation	Title
8-4-2013	K Vijay Kumar Max Planck Institute for the Physics of Complex Systems, Germany	The cell cortex : A thin film of active matter
10-4-2013	Nilanjan Sircar TIFR, Mumbai	Extremal Horizons with Reduced Symmetry : Towards Novel Phases of Nature
10-4-2013	Kamalakshya Mahatab IMSc	Representation-theoretic approach to ADG problem
12-4-2013	Nilanjan Sircar TIFR, Mumbai	Extremal Horizons with Reduced Symmetry:Novel Phases of Nature
15-4-2013	Sachin Sharma IMSc and HRI	The t-analogue of string functions for the affine Kac-Moody algebras.
15-4-2013	V Sasidevan TIFR, Mumbai	Stochastic strategies in Minority game
17-4-2013	Uday Bhaskar Sharma IMSc	Gabriel's Theorem
18-4-2013	V Sasidevan TIFR, Mumbai	A Continuum Percolation Problem
19-4-2013	Barath Coleppa University of Arizona	Constraining Models With Strong Top-Quark Dynamics
24-4-2013	G. Arunkumar IMSc	Wedderburn's theorem
24-4-2013	Ekata Saha IMSc	Hilbert's Nullstellensatz
24-4-2013	Priyamvad Srivastav IMSc	The Frobenius Density Theorem

24-4-2013	P. A. Narayanan IMSc	Choquet Theorem
24-4-2013	Kesab Chandra Bakshi IMSc	Hausdorff measure and its elementary properties
24-4-2013	Venkata Raghu Tej Pantangi IMSc	Brauer Induction Theorem
24-4-2013	Biswajyoti Saha IMSc	Dimension in finitely generated k-algebra
24-4-2013	Sohan Lal Sahni IMSc	Analytic set and Souslin's Theorem
24-4-2013	Nidhish Unnikrishnan IMSc	Cardinal and Ordinal Invariants in Topology with reference to Dimension Theory
25-4-2013	Uday Bhaskar Sharma IMSc	Gabriel's Theorem
2-5-2013	Madhusree Basu IMSc	Continuous Minmax Theorems (joint work with V. S. Sunder)
2-5-2013	Krishnan Rajkumar SNU, Delhi	PhD Thesis Defense
4-5-2013	Tapas Chatterjee IMSc	Ph.D Thesis defense talk
19-6-2013	Samrat Bhowmick IOP, Bhubaneswar	Anisotropic branes
19-6-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
20-6-2013	N.S. Vidhyadhiraja JNCASR, Bangalore	Non-Fermi liquid behaviour due to Disorder in correlated Fermi liquids
20-6-2013	Rishi Vyas University of Cambridge	Introductory homological algebra

21-6-2013	Krishnendu Sengupta IACS, Kolkata	Dynamics of the Bose-Hubbard model
21-6-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
21-6-2013	T. S. Subramanian The Hindu	Discoveries from Khirsara - a new Indus Valley site in Gujarat
21-6-2013	Rishi Vyas University of Cambridge	Introductory homological algebra II
24-6-2013	J. Maharana IOP and NISER, Bhubaneswar	T-duality of NSR superstring
24-6-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
24-6-2013	Rishi Vyas University of Cambridge	Introductory homological algebra III: Spectral sequences
25-6-2013	Upendra Kulkarni: convener CMI	Informal discussion
26-6-2013	Debajyoti Sarkar City University of New York, USA	Black Hole formation at the Correspondence Point
27-6-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
28-6-2013	Jayalal Sarma IIT Madras	Arithmetic Circuit Lower Bounds via Partial Derivatives Matrix
28-6-2013	K N Raghavan: convener IMSc	Comological finite generation
3-7-2013	P. Ravindran Central University of Tamil Nadu, Thiruvarur	Multifunctional oxides: Design and development from first principle calculations
3-7-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation

4-7-2013	Informal discussion (convener: K. N. Raghavan) IMSc	Cohomological finite generation
5-7-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
8-7-2013	Sankardeep Chakaborty IMSc	Topics in Correlation Bounds
8-7-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
8-7-2013	Travis Scrimshaw UC Davis	Introduction to Sage
9-7-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
10-7-2013	Anil Shukla IMSc	Resolution Proof Systems
10-7-2013	Kajari Mazumdar TIFR	What next at the LHC?
11-7-2013	Ram Murty Queen's University	The Twin Prime Problem (apres Yitang Zhang)
11-7-2013	R. Venkatesh TIFR, Mumbai	Unique Factorization Of Tensor Products For Kac-Moody Algebras
12-7-2013	Uma Sankar IIT Mumbai	Expectations from NOvA
12-7-2013	Wilberd van der Kallen Universiteit Utrecht	Cohomological finite generation
12-7-2013	Travis Scrimshaw UC Davis	Crystals and Rigged Configurations
15-7-2013	T Prasad Ahalia School of Engineering and Technology, Palakkad	Variations of Weyl type theorems and hypercyclic/supercyclic operators

15-7-2013	Travis Scrimshaw UC Davis	Introduction to Sage
16-7-2013	Ram Murty Queen's University	The Goldston-Pintz-Yildirim Theorem
17-7-2013	Travis Scrimshaw UC Davis	Introduction to Sage (part two)
17-7-2013	Kamalakshya Mahatab and Kannappan Sampath IMSc, ISI Bangalore	Consequences of Failure of Chinese Remainder Theorem in the Ring of Polynomials over Integers
18-7-2013	Ram Murty Queen's University	Zhang's Theorem
19-7-2013	Travis Scrimshaw UC Davis	Introduction to Sage (part three)
19-7-2013	Kamalakshya Mahatab and Kannappan Sampath IMSc, ISI Bangalore	Consequences of Failure of Chinese Remainder Theorem in the Ring of Polynomials over Integers (part two)
22-7-2013	Michael Griffin Emroy University	Weierstrass Mock Modular Forms and Elliptic Curves
22-7-2013	Travis Scrimshaw UC Davis	Introduction to Sage (part four)
23-7-2013	Anuradha Jagannathan University of Paris, France	Introduction to Quasicrystals and Quantum Models
23-7-2013	Michael Griffin Emory University	Mock modular forms
24-7-2013	M.S. Raghunathan IIT Mumbai	Lie Groups
25-7-2013	M. S. Raghunathan IIT Mumbai	Lie Groups
26-7-2013	Travis Scrimshaw UC Davis	Introduction to k-Schur functions

26-7-2013	M.S. Raghunathan IIT Mumbai	Lie Groups
29-7-2013	M. S. Ramanujan IMSc	Parameterized Graph Separation Problems: New Techniques and Algorithms
1-8-2013	Rajarshi Pal IMSc	Optimal teleportation fidelity of a generic qubit channel
2-8-2013	AP Balachandran Syracuse University	Edge States: Topological Insulators, Superconductors
2-8-2013	Kamalakshya Mahatab IMSc	Counting Irreducibles in Group Semirings of Z/2Z and Z/3Z
3-8-2013	Chennai Theory Day IMSc	Chennai Theory Day
4-8-2013	Chennai Theory Day IMSc	Chennai Theory Day
5-8-2013	C. P. Anilkumar IMSc	Ring of Integers in the biquadratic extension
7-8-2013	Anupam Kundu LPTMS, University of Paris-SUD, Orsay	Exact distributions of the number of distinct and common sites visited by N independent random walkers
7-8-2013	Parimala Raman Department of Mathematics CS Emory University	Period-index questions for function fields
7-8-2013	Debtosh Chowdhury CHEP, IISc, Bangalore	Three roads to SUSY: Impact of direct and indirect searches
8-8-2013	Karteek Sreenivasaiah IMSc	Small depth proof systems
12-8-2013	A.M.M. Pruisken University of Amsterdam	Friend or Foe ? The quantum criticality observed in the quantum Hall regime.
13-8-2013	V. S. Sunder IMSc	About the Horn Conjecture

13-8-2013	Matthew Lunde UC Riverside	Representation theory of quantum (loop) algebras
13-8-2013	S. Arulmozhiraja Bharathiar University, Coimbatore	Is Density Functional Theory Inadequate ?
14-8-2013	E. C. G. Sudarshan and Mark Selover Univ. of Texas at Austin	CPT Theorem
14-8-2013	K. R. Parthasarathy ISI Delhi	Gaussian states and their symmetry group
14-8-2013	Matthew Lunde UC Riverside	Representation theory of quantum (loop) algebras
16-8-2013	K R Parthasarathy ISI Delhi	Gaussian states and their symmetry (part 2)
22-8-2013	Nitin Saurabh	Complexity reading group
23-8-2013	Jaya Maji IMSc	Efimov-like states and conformational transitions of DNA
23-8-2013	Amritanshu Prasad IMSc	Extensions and orbits of finite abelian groups
23-8-2013	K R Parthasarathy Indian Statistical Institute, New Delhi	Gaussian states and their symmetry - III
23-8-2013	Ayan Mukhopadhyay Ecole Polytechnique, France	Spacetime emergence from holographic RG flow and the fluid-gravity correspondence
29-8-2013	Manoj Verma IMSc	Circle Method
30-8-2013	M. Praveen Labri, U. Bordeaux-1	Reasoning about data repetitions with counter systems
30-8-2013	A.J. Parameswaran TIFR, Mumbai	On the geometry of regular maps from a quasi-projective surface to a curve

2-9-2013	Kamal Bardhan SINP, Kolkata	Universal Scaling in Disordered Systems: tale of nonlinearity exponents.
3-9-2013	Pinaki Banerjee IMSc	Holographic Brownian Motion in 1+1 Dimensions
4-9-2013	K N Raghavan IMSc	Semi-invariants of quivers and the saturation conjecture
5-9-2013	K N Raghavan IMSc	Semi-invariants of quivers and the saturation conjecture II
5-9-2013	Dhriti Ranjan Dolai IMSC Chennai	Random Operator Seminar
5-9-2013	Manoj Verma IMSc	Circle Method
6-9-2013	C. P. Anilkumar IMSc	Orbit Of Pairs in Finite Modules Over Discrete Valuation Rings and Permutation Representations
6-9-2013	B. Ramakrishnan HRI	Jacobi forms of weight two and restriction map
10-9-2013	A. J. Parameswaran TIFR, Mumbai	Picard bundles and Brill-Noether loci in the compactified jacobian of a nodal curve
10-9-2013	Anirban Mukhopadhyay IMSc	Twin prime conjecture
11-9-2013	Debraj Roy SNBNCBS	'Trivial Symmetries' in models of gravity
11-9-2013	K N Raghavan IMSc	Semi-invariants of quivers and the saturation conjecture
12-9-2013	R. Chandrashekar IMSC	Statistical Mechanics based on generalized entropies and its applications

12-9-2013	S. Kotani Kwansei Gakuin University, Sanda , Japan	On the limit set of KdV flows
16-9-2013	Arijit Roy Laufer Center for Physical and Quantitative Biology, Stony Brook University	A method for calculating conversion free-energies between protein conformations
16-9-2013	Jainendra Jain Pennsylvania State University, USA	Composite Fermions: The Magical Beauty of Emergence
17-9-2013	G. Baskaran IMSc	Is Silicene a Carbon Copy of Graphene ?
17-9-2013	Anirban Mukhopadhyay IMSc	Bounded gaps between primes
17-9-2013	Ramamohan Paturi University of California, San Diego	Exact Complexity and Satisfiability
18-9-2013	R. Shankar IMSc.	The Story of Climate Change
18-9-2013	Anilkumar C. P. IMSc	Orbits of Pairs in Finite Modules Over Discrete Valuation Rings and Permutation Representations
19-9-2013	Manoj Verma IMSc	Circle Method
19-9-2013	K R Balakrishnan Director, Cardiac Sciences, Malar Fortis Hospital, Chennai	Artificial Heart: Current Options
19-9-2013	N Minami Keio University	The Stochastic Airy Operators
20-9-2013	Siddarth Parameswaran University of California, Berkeley	Fractionalization from Crystallography
20-9-2013	Amritanshu Prasad IMSc	Similarity classes modulo p^2 and pairs of commuting matrices

21-9-2013	B P Ajith Kumar IUAC, New Delhi	Make your computer a science lab
23-9-2013	Siddarth Parameswaran University of California, Berkeley	A Typology for Toplological Liquids
24-9-2013	Anirban Mukhopadhyay IMSc	Bounded gaps between primes
24-9-2013	R. Srinivasan CMI	E_0 - semigroups on factors
25-9-2013	Pampa Paul IMSc	L_0 types common to a Borel-de Siebenthal discrete series and its associated holomorphic discrete series
25-9-2013	Pampa Paul IMSc	L_0 types common to a Borel-de Siebenthal discrete series and its associated holomorphic discrete series
26-9-2013	Panchugopal Bikram IMSc	Extendability of endomorphisms of factors
26-9-2013	B.V. Rajarama Bhat ISI, Bangalore	Nilpotent completely positive maps
27-9-2013	Shivakumar Jolad IIT Gandhinagar	Modeling spatial patterns of spread of Dengue with Human and Vector Mobility
27-9-2013	T. Geetha IMSc	The Structure Constants of the Schur Algebra
1-10-2013	Indrakshi Raychowdhury IMSc	Prepotential Formulation of Lattice Gauge Theories
1-10-2013	R. Srinivasan CMI	E_0 -semigroups on factors-II
3-10-2013	Sushant Raut PRL, Ahmedabad	Synergies between neutrino oscillation experiments: Economizing future facilities
3-10-2013	Prabha Mandayam IMSc	Incompatibility and complementarity in quantum information theory

4-10-2013	Senthamarai Kannan CMI	Automorphism group of a smooth Schubert variety
4-10-2013	T. Geetha IMSc	Graphic interpretation of structure constants of the Schur algebra
8-10-2013	Ramesh Sreekantan ISI Bangalore	Higher Chow cycles on Abelian Surfaces
9-10-2013	Peter Fiebig FAU, Erlangen-Nuernberg	Modular representations of algebraic groups
10-10-2013	S P Suresh CMI, Chennai	Primal infon logic: proof theory and efficient decidability
10-10-2013	Manoj Verma IMSc	Representation of Integers by a Family of Cubic Forms
15-10-2013	Peter Fiebig FAU, Erlangen-Nuernberg	Modular representations of algebraic groups
15-10-2013	R. Srinivasan CMI	E_0 - semigroups on factors-III
15-10-2013	Gyan Prakash HRI, Allahabad	Roth's theorem in primes and its generalisation
17-10-2013	Peter Fiebig FAU, Erlangen-Nuernberg	Modular representations of algebraic groups
17-10-2013	Yashonidhi Pandey IISER, Mohali	Brauer group of moduli of torsors under parahoric group scheme $\mathcal{G}$ over a curve
18-10-2013	Bobby Ezhuthachan Vivekananda University, Belur	Giant gravitons in $AdS_4 \times S^7/Z_k$
18-10-2013	Kamalakshya Mahatab IMSc	Nonnegative Solutions of Linear Diophantine Equations-1
18-10-2013	Peter Fiebig FAU, Erlangen-Nuernberg	Modular representations of algebraic groups

22-10-2013	Maneesh Thakur ISI, Delhi	The Kneser-Tits problem
23-10-2013	Manjari Bagchi ICTS, Bangalore	Why Study Pulsars: They Are Awesome
23-10-2013	T. Mubeena IMSc	Twisted conjugacy classes in lattices in semisimple Lie groups
23-10-2013	Gyan Prakash HRI, Allahabad	Roth's theorem in primes and its generalisation
24-10-2013	Manjari Bagchi ICTS, Bangalore	Binary Radio Pulsars: Prospects and Problems
24-10-2013	Maneesh Thakur ISI Delhi	The Kneser-Tits problem
24-10-2013	Gyan Prakash HRI, Allahabad	Roth's theorem in primes and its generalisation
24-10-2013	Arvind Ayyer IISc, Bangalore	Markov chains based on Jeu de Taquin
24-10-2013	Yanjing Wang Peking University, China and ISI-Chennai Centre	An epistemic logical perspective on interpretations of extensive games with imperfect information
25-10-2013	Arvind Ayyer IISc, Bangalore	Two Species Semipermeable Exclusion Processes
26-10-2013	Gyan Prakash HRI, Allahabad	Roth's theorem in primes and its generalisation
30-10-2013	R. Ganesh IFW, Dresden	Polar Superconductivity in Ti Se_2
31-10-2013	G. P. Balakumar IMSc	Classifying domains in C^n by their automorphism group: a short survey and a case study of domains with abelian automorphism group
1-11-2013	Arghya Mondal IMSc	Hirzebruch's Proportionality Principle

1-11-2013	Anirban Mukhopadhyay IMSc	Polynomial Freiman-Ruzsa Conjecture
5-11-2013	Biplob Bhattacherjee Kavli IPMU,University of Tokyo	Supersymmetry and dark matter search: prospects and challenges
6-11-2013	Amitabh Virmani IOP, Bhubaneswar	Non-supersymmetric Mircostates of the MSW System
7-11-2013	Sayan Bhattacharya Max Planck Institute, Germany	Price of Anarchy, Auctions and Approximations
7-11-2013	T. Geetha IMSc	Schur-Weyl dualities and diagram algebras
8-11-2013	Anirban Mukhopadhyay IMSc	Polynomial Freiman-Ruzsa Conjecture
12-11-2013	J. Hurtubise McGill University, Montreal, Canada	Moduli spaces
14-11-2013	Amitabh Virmani IOP, Bhubaneswar	Inverse Scattering and the Geroch group
14-11-2013	Kaushal Verma IISc, Bangalore	Quadrature domains - a survey
14-11-2013	J. Hurtubise McGill University, Montreal.	Moduli and gauge theory on complex curves
15-11-2013	Rukmini Kumar Vantage Research	Mathematical modeling in pharmaceutical R & D
15-11-2013	Amritanshu Prasad IMSc	Frobenius's Characteristic Function Explained
18-11-2013	J. Hurtubise McGill University, Montreal, Canada	Moduli and gauge theory on complex surfaces
20-11-2013	J. Hurtubise McGill University, Montreal, Canada	Moduli and maps of complex curves

21-11-2013	Karam Deo Shankhadhar IMSc	Jacobi forms of weight 2 and restriction map
21-11-2013	Christian Schubert Inst. for Physics and Mathematics, Michoacan University, Ciudad Universitaria	String-inspired calculation techniques in quantum field theory,
22-11-2013	J. Hurtubise McGill University, Montreal, Canada	Infinite dimensional aspects of moduli of curves
26-11-2013	M. Ram Murty Queen's University	Indra's Pearls
27-11-2013	Sayantani Bhattacharyya Ramkrishna Mission Vivekananda University	Fluid Dynamics and Gravity
28-11-2013	Rishi Raj Dept. of Mathematics, Yale University	Old and New on the Moduli Spaces of Local Systems on Surfaces
28-11-2013	Sayantari Ghosh Bose Institute, Kolkata	Bistability in Biology: Signature, Origin and Consequences
28-11-2013	J. Pasupathy CHEP, IISC, Bangalore	Bose, Bosons and the Higgs Boson
29-11-2013	Sayantani Bhattacharyya Ramkrishna Mission Vivekananda University	Partition Function and Entropy current in Hydrodynamics
29-11-2013	Amritanshu Prasad IMSc	Counting Conjugacy Classes of Tuples of Commuting Elements in a Finite Group
4-12-2013	Himani Sachdeva TIFR, Mumbai	Phase Transitions in an Open-Boundary Aggregation-Fragmentation Model
5-12-2013	Hans-Peter Schlickewei University of Marburg, Germany	The Subspace Theorem in Diophantine Approximation

5-12-2013	J.Pasupathy CHEP, IISc, Bangalore	BCS Theory and the Standard Model of Particle Physics
5-12-2013	Ashutosh Rai IMSc, Chennai	Polynomial Kernels for Lambda-extendible Properties Parameterized Above the Poljak-Turzk Bound
10-12-2013	P Sekhar Burada University of Gottingen, Germany	Passive and active transport
11-12-2013	Partha Mukhopadhyay IMSc	Bound configurations, strings and tubular geometry
11-12-2013	Sanjoy Sarker University of Alabama	Quantum Lattice (Gauge) order connecting High Tc Superconductivity in Cuprates to Mott insulators
12-12-2013	Glen Evenbly Caltech	Tensor network states beyond the entropic area law
16-12-2013	Samit Bhattacharyya Pennsylvania State University	Oscillations in Biological Populations: Theory and Models
20-12-2013	Vijay Ganesh University of Waterloo, Canada	SAT and SMT solvers for software engineering and security
23-12-2013	K B Sinha JNSCR Bangalore	Trace formula in two variables
26-12-2013	K B Sinha JNCASR, Bangalore	Stopped CCR-flows and Isometric Cocycles
1-1-2014	Sinai Robins Nanyang Technological University	Cone Theta functions, volumes of spherical polytopes, and their relations to classical Theta functions
2-1-2014	Hans van Ditmarsch LORIA (CNRS - University of Lorraine) and IMSc (associate)	Refinement modal logic
3-1-2014	J. Maharana IOP, Bhubaneswar	T-duality and scattering of stringy states

3-1-2014	Areejit Samal ICTP, Trieste, Italy	Reconstruction and systems analysis of plant cell wall deconstruction network in filamentous fungus Neurospora crassa
6-1-2014	Ashivni Shekhawat Material Science and Engineering, UC Berkeley.	What hasfractureg ot todowith magnets and the liquid-vapor critical point?
7-1-2014	Martin Bojowald Institute for Gravitation and the Cosmos, University of Penn., USA	Effective space(-time) in canonical quantum gravity.
8-1-2014	Ram Gopal Vishwakarma Universidad Autnoma de Zacatecas, Mexico	Introduction of T^{ik}: Einsteins Real Biggest Blunder?
9-1-2014	Yuri Bilu University of Bordeaux	Effective methods in Diophantine Analysis
10-1-2014	Supravat Dey Universita' di Roma La Sapienza,	Short range interaction from long-range correlation in flocks of birds
10-1-2014	Dhriti Ranjan Dolai IMSc	Spectral statistic for Anderson model with decaying random potential
10-1-2014	Amritanshu Prasad IMSc	Abacus Proofs of Schur Function Identities (Following Nicholas A. Loehr)
13-1-2014	Rajsekar Manokaran KTH Sweden	Invariance Principle and Unique Games
14-1-2014	Yuri Bilu University of Bordeaux	Effective methods in Diophantine Analysis
14-1-2014	Barbara Fantechi CMI, VISITOR	An introduction to Intersection Theory
15-1-2014	Rajsekar Manokaran KTH Sweden	Approximation hardness using Unique Games

17-1-2014	Rohit Parikh City University of New York, USA	Regular Sets, Well Partial Orders and Levels of Knowledge
17-1-2014	C.P. Anil Kumar IMSc	Characterization of Rational Triangles in the plane
17-1-2014	Arijeet Samal	Metabolic Networks
21-1-2014	S. Sundar CMI	Groupoids associated to Semigroup actions
21-1-2014	Shivam St Xevier's School Ahmedabad	Computing some integrals
21-1-2014	S. Srinivasa Rao	Alphabet friendly FM index
23-1-2014	S. Sundar CMI	Groupoids associated to Semigroup actions (Reloaded)
23-1-2014	Ben Elias Massachussets Institute of Technology	Categorical actions of Coxeter groups and braid groups
24-1-2014	Mansi Dhuria IIT Roorkee	Aspects of D3/D7 mu-split Supersymmetry
24-1-2014	Yuri Bilu University of Bordeaux	Effective methods in Diophantine Analysis
24-1-2014	Arjun Menon University of Oregon	SUSY in light of the 8 TeV LHC
24-1-2014	Amritanshu Prasad IMSc	Character Tables of Alternating Groups
24-1-2014	Prateep Chakraborty IMSc	Stable Homotopy and Spectra
27-1-2014	Samir Mathur Ohio State University	Nag Memorial Lecture: technical seminar 1/3

27-1-2014	Suratna Das Astronomy and Astrophysics Division, TIFR, Mumbai	CSL as a plausible mechanism for quantum to classical transition of primordial perturbations
28-1-2014	Samir Mathur Ohio State University	Nag Memorial Lecture: technical seminar 2/3
28-1-2014	S. Sundar CMI	Groupoids associated to Semigroup actions (Revolutions)
29-1-2014	Samir Mathur Ohio State University	Nag Memorial Lecture: technical seminar 3/3
29-1-2014	Yuri Bilu Universit de Bordeaux	Effective methods in Diophantine Analysis
29-1-2014	Ueli Grossniklaus Institute of Plant Biology, University of Zurich	Theoretical and Experimental Approaches to Study Cell Specification in the Embryo Sac of Arabidopsis thaliana
30-1-2014	Arjun Menon University of Oregon	Searching for neutral Higgs bosons in non-standard channels
30-1-2014	Samir Mathur Ohio-State University	Informal discussion on fuzzballs
30-1-2014	Nivedita Chatterjee Vision Research Foundation, Chennai	Neuroscience (part of Biology-2 course of Comp Bio)
31-1-2014	Samir Mathur Ohio State University	Nag Memorial Lecture
31-1-2014	Ben Elias Massachussets Institute of Technology	Soergel bimodules and Kazhdan-Lusztig theory
31-1-2014	Ben Elias Massachussets Institute of Technology	The new homological algebra: p-complexes and categorification at roots of unity
3-2-2014	Arijit Saha University of Basel, Switzerland	Transport signatures of Fractional Fermions in Nanowires

3-2-2014	Ben Elias Massachussets Institute of Technology	Soergel bimodules and Kazhdan-Lusztig theory
3-2-2014	Satyavani Vemparala IMSc	On our research works
4-2-2014	Yuri Bilu University of Bordeaux	Effective methods in Diophantine Analysis
4-2-2014	Ian Munro University of Waterloo, Canada	Succinct Data Structures for representing equivalence classes
4-2-2014	Sudhakar Yarlagadda SINP, Kolkata	An analysis of the extremely anisotropic next-nearest-neighbour Heisenberg Model
4-2-2014	Sandipan De IMSc	Crossed Products of Hopf algebras, the Drinfeld Double construction and a Duality Theorem.
5-2-2014	Rahul Sinha IMSc	New Physics effects and Hadronic form factor uncertainties in $B \to K^* \ell\ell$
6-2-2014	S. Kalyana Rama IMSc	On our research works
7-2-2014	B. Ravinder IMSc	Current algebras and their Representations
7-2-2014	Nivedita Chatterjee Vision Research Foundation, Chennai	Neuroscience - 2 (part of Biology-2 course of Comp Bio)
10-2-2014	Prabwal Jyoti Phukon IIT, Kanpur	R charged black holes and holographic optics
10-2-2014	R. Rajesh IMSc	On our research works
11-2-2014	Sudipto Paul Chowdhary IMSc	BCS Instability and Finite Temperature Corrections to Tachyon Mass in Intersecting D1-Branes

12-2-2014	Swastik Bhattacharya IMSc	Einstein Equation from Thermodynamics: A Generalisation
12-2-2014	Mukund Thattai NCBS Bangalore	The watchmaker's apprentice: building a synthetic genetic oscillator with parts borrowed from nature.
12-2-2014	G Arunkumar IMSc	The Weyl Character Formula
13-2-2014	Shrihari Gopalakrishna IMSc	On our research works
14-2-2014	Somdeb Ghose IMSc	Population fluctuations, non-equilibrium flows and instabilities in some model systems.
17-2-2014	M. Muthukumar University of Massachusetts, Amherst	Menagerie of Viruses: Organizing Principles of Virus Assembly
17-2-2014	Sujay Ashok IMSc	On our research works
17-2-2014	Patrick Nicholson Max Planck Institute, Germany	Deterministic schemes for membership in the bitprobe model
18-2-2014	Denis Benois University of Bordeaux	Iwasawa theory
18-2-2014	Saurabh Gupta IMSc	High Scale Mixing Unification for Dirac Neutrinos
18-2-2014	Yash Raj Shrestha University of Saarland, Germany	The complexity of disjoint Pi-vertex deletion
19-2-2014	G. Arun Kumar IMSc	The Weyl Character Formula
21-2-2014	Santosh Ansumali JNCASR	Lattice Based Computing: Role of Symmetry and Structures
21-2-2014	Kamalakshya Mahatab IMSc	Rough Numbers in Arithmetic Progressions

24-2-2014	Biswajit Paul SNBNCBS, Kolkata	Gauge Symmetries In higher derivative theories
25-2-2014	Mridupawan Deka BLTP, Joint Institute of Nuclear Reasearch, Russia	"Proton Spin Crisis" and A Lattice Study of Quark Gluon Angular Momenta Contributions
26-2-2014	Zodinmawia Indian Institute of Technology, Mumbai	Knot invariants from Chern-Simons theory and Knot homology
26-2-2014	Ramray Bhat Life Sciences Division, Lawrence Berkeley National Laboratory	Key themes on the development and evolution of mesenchymal morphogenesis and patterning
27-2-2014	Can Baskent LORIA, Nancy, France	Game semantics and non-classical logics
27-2-2014	Fabien Schang Moscow State University, Russia	A logic for Tetris
27-2-2014	Indira Mishra IMSc	C-semigroups and almost periodic solution
27-2-2014	Sitabhra Sinha IMSc	On our research works
28-2-2014	Abhishek Iyer IISc	How to hide lepton number violation
28-2-2014	Ramkarthik Seshadri IIT-Madras	Two studies on Quantum Entanglement: Optimal Mixtures and Dimerization in the Majumdar-Ghosh Model
28-2-2014	Uday Bhaskar Sharma IMSc	Counting Simultaneous Similarity Classes of Commuting Matrix Tuples
3-3-2014	Varuni Prabhakar New York University	The dynamics of age in populations of Saccharomyces cerevisiae
4-3-2014	Ravin Bhatt Princeton University and Institute of Advanced Study, Princeton	The Anderson Model of Localization: Has the fat lady sung yet?

6-3-2014	Vikas Bansal Pacific Northwest National Lab, US	Prospects of Leptoquark discovery with ATLAS at the LHC
7-3-2014	Shreedevi Masuti IMSc	Rees Theorem
7-3-2014	Chandrajit Lahiri IMSc, Chennai	Disease Complexity - A Bird's Eye View
7-3-2014	Uday Bhaskar Sharma IMSc	Counting Conjugacy Classes of Tuples of Commuting Elements in a Finite Group
10-3-2014	D. Yogeswaran Technion, Israel	Central limit theorems for some random simplicial complexes
10-3-2014	M. V. N. Murthy IMSc	On our research works
13-3-2014	R. Srinivasan CMI	Many CCR flows
13-3-2014	Purusattam Ray IMSc	On our research works
17-3-2014	Ronny Thomale Institut fr Theoretische Physik 1, Julius-Maximilians Universitt Wrzburg, Germany	The Quest of the Kagome Hubbard Model
18-3-2014	Preeda Patcharamaneepakorn JNU	Travelling Front of a Decaying Brane
18-3-2014	Leelavati Narlikar NCL, Pune	Regulatory motif discovery
18-3-2014	P. Sankaran IMSc	Topology seminar
19-3-2014	Leelavati Narlikar National Chemical Laboratory, Pune	Characterizing the heterogeneity in high-throughput sequencing data to understand transcriptional regulation

19-3-2014	S. Kalyana Rama IMSc	Stars in M theory (made up of intersecting branes)
19-3-2014	Leelavati Narlikar NCL Pune	Regulatory motif discovery (part 2)
20-3-2014	Saibal Ganguli IMSc	Mckay correspondence and almost complex structures on quasitoric orbifolds
20-3-2014	Leelavati Narlikar NCL Pune	Regulatory motif discovery (part 4)
20-3-2014	Leelavati Narlikar NCL Pune	Regulatory motif discovery (part 3)
21-3-2014	Pierre Fima University of Paris 7	Graphs of Quantum Groups and K-Amenability 1
21-3-2014	L. Sriramkumar IIT Madras	On the detection of the imprints of primordial gravitational waves on the CMB by BICEP2
24-3-2014	Pierre Fima University of Paris 7	Graphs of Quantum Groups and K-Amenability 2
24-3-2014	Vijay Ravikumar TIFR	The Cohomology Ring of the Complex Grassmannian
24-3-2014	Rahul Siddharthan IMSc	On our research works
25-3-2014	Pierre Fima University of Paris 7	Graphs of Quantum Groups and K-Amenability 3
25-3-2014	Vijay Ravikumar TIFR	Triple Intersection Formulas for Isotropic Grassmannians
25-3-2014	P Sankaran IMSc	Topology seminar
26-3-2014	Pierre Fima University of Paris 7	Graphs of Quantum Groups and K-Amenability 4

27-3-2014	A.P. Dimri JNU, New Delhi	Role of the Himalaya in defining Indian Weather and Climate
31-3-2014	R. Shankar IMSc	On our research works

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

Caenorhabditis elegans is the only organism with its nervous system completely mapped. In addition to being small and well-characterized, its genetic amenability has made it an ideal system to study a whole animals behavior at the molecular and cellular levels. While the complete mapping of neuronal connections allows one to know the structural aspects of connectivity among neurons, there exists little information as to how the activities of

individual neurons might correlate with particular behavioral patterns. This project intends to construct a dynamical neural network simulator for the entire C. elegans somatic nervous system using physiologically realistic single-compartment models of individual neurons. This will allow connecting electrical activity at the level of individual neurons to the behavior of the organism in response to specific stimuli, something which is experimentally still challenging. This will also permit prediction of hitherto unidentified neuronal members of specific behavioral circuits from activity patterns of the network. To verify the predictions obtained from the results of the model simulations, C.elegans strains with cameleon-labeled dopaminergic neurons for dynamical calcium imaging will be developed. The further aim of this proposal is to image and investigate activity-induced calcium changes in core cells of specific behavioral circuits.

5.1.4 Fracture and Flow in Porous Media: Application in Geothermal Installation, Hydrocarbon Production and CO2 Storage.

Rock far beneath the earths surface can be fractured to allow for better flow-through. More fundamental knowledge is the key to environmental applications such as improving the utilization of terrestrial heat and acquiring more space for CO2 storage. This knowledge will also be useful for extracting more natural gas from the reservoirs.

The project partners are SINTEF Petroleum Research, Norway, Norwegian University of Science and Technology, Saha Institute of Nuclear Physics and S.N. Bose National Centre for Basic Sciences. The project is funded by the Research Council of Norway under the Research cooperation with India (INDNOR) project scheme.

5.1.5 India-based Neutrino Observatory (INO)

INO is moving to construction phase. The activities of the Inter Institutional Centre for High Energy Physics (IICHEP), nodal centre of INO earlier called NCHEP, started in a rented premises opposite the Madurai Kamaraj University. The construction of the centre in its own land will begin soon. This will house the engineering prototype of the full detector as well as start the INO graduate training program from Madurai. The clearing and fencing work at the Underground Laboratory has begun. Tunneling will begin once the cabinet clearance is obtained.

IMSc group(*) continues to engage in outreach activities of INO whose coordinator is D. Indumathi. In addition the group is engaged in the detector simulation activities as well as addressing the physics goals. Work on designing a neutrino event generator specifically addressed to the needs of ICAL detector at INO has begun. (*)Tapasi Ghosh, D Indumathi, Lakshmi S Mohan, K K Meghna , M V N Murthy, Sumanta Pal, G Rajasekaran, Nita Sinha. H S Saveetha and R. Thirusenthil are project assistants.

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 (2011-2014) from the Humboldt Foundation that supports research visits between research groups in Humboldt University, Berlin and IMSc. The project proposal is mainly on the Graph Isomorphism problem. The principal investigators for the two sides are Johannes Koebler and V. Arvind.

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.

5.2 Conference Participation and Visits to Other Institutions

Arvind, V.

Visited Humboldt University, Berlin during Jul 23 – Aug 2, 2013. Research. Visit supported by a joint project funded by the Humboldt Foundation.

Participated in *Intl Workshop on Parameterized and Exact Computation, 2013* held at Sophia Antipolis, France during Sep 4 – Sep 6, 2013.

Ashok, Sujay K.

Visited Department of Physics, INFN, Torino during Jun 24 – Jun 28, 2013. Invited talk

Visited Perimeter Institute during Jul 1 – Jul 20, 2013. Started collaboration that resulted in a publication

Participated in *National Strings Meeting* held at IIT-Kharagpur during Dec 22 – Dec 27, 2013. Invited speaker

Balakrishnan, Radha

Participated in *NMI Workshop on Nonlinear Integrable Systems and Applications* held at Centre for Nonlinear Dynamics, Bharathidasan University, Tiruchirapalli during Feb 24 – Mar 1, 2014. Gave an invited talk on "Solitons in the Bose-Einstein condensate of a strongly repulsive bosonic system".

Balasubramanian, R.

Visited SRM University on Feb 4, 2014. Chief guest for Engineering Mathematical Festival

Participated in 'JSPS-DST Asian Academic Seminar 2013' at University of Tokyo during November 03-06, 2013 and delivered a lecture on "Additive Combinatorics".

Participated as Chief Guest in "National Instructional Workshop in Cryptology", Cochin University of Science and Technology during May 06-10, 2013 and delivered a lecture on "Elliptic Curves on Cryptography".

Participated in Ramanujan's Mathematics and IT(RMIT, 2013) in International Institute on Information Technology, Bangalore during June 06-07, 2013 and delivered a lecture on "Additive Combinatorics".

Participated in Mathematics Workshop for College Teachers(MWCT) and delivered a talk on "Complex Analysis" at Nanda Arts and Science College, Erode during June 02-04, 2013.

Visited ISI, Bangalore and delivered a talk on Additive Combinatorics in Advance Instructional school on Algebraic combinatorics on July 08, 2013.

Participated as Chairman in the Round Table "Economic Benefits of Mathematical Science Research" of the Indo-France Summit held on October 24, 2013.

Chaired a session in National Seminar on Number Theory and Discrete Mathematics in honor of Prof. R.J. Hans-Gill at Punjab University during November 12-13, 2013.

Participated in Mathematics Workshop for College Teachers(MWCT) and delivered a talk on Linear Algebra at Vellalar College for Women, Erode during November 20-22, 2013.

Gave an introductory speech on "Elliptic Curves on Cryptography" in Indocrypt 2013 at Nuclear Power Corporation of India Ltd., during December 07-11, 2013.

Participated as Chief Guest in the Foundation Day of National Institute of Science Education and Research, Bhubhaneshwar on December 27, 2013.

Participated in International Conference on Mathematics and Computing (ICMC 2013), December 26-29, 2013, Haldia University and delivered a talk on "Elliptic Curves on Cryptography" during December 27-28, 2013.

Banerjee, Pinaki

Participated in *US-India Advanced Studies Institute on Thermalization : From Glasses to Black Holes* held at Indian Institute of Science, Bangalore during Jun 10 – Jun 21, 2013.

Participated in *National Strings Meeting, 2013* held at IIT Kharagpur, India during Dec 22 – Dec 27, 2013. Presented a paper titled "Holographic Brownian Motion in 1+1 Dimensions".

Participated in *The 8th Asian Winter School on Strings, Particles and Cosmology* held at Puri, India during Jan 9 – Jan 18, 2014.

Chatterjee, Tapas

Visited ICERM, Brown University during Mar 20 – Apr 20, 2013. Workshop participation

Participated in *Workshop on Combinatorics, Multiple Dirichlet Series and Analytic Number Theory* held at ICERM, Providence, RI, USA during Apr 15 – Apr 19, 2013.

Date, G.

Visited Perimeter Institute of Theoretical Physics during Jul 18 – Aug 1, 2013. Visited thr institute primarily to attend the Loops-2013 conference.

Participated in *Loops 2013* held at Perimeter Institute of Theoretical Physics, Waterloo, Canada during Jul 22 – Jul 26, 2013. Gave a talk on *Continuous Symmetries in Polymer Quantization.*

Participated in *Field Theoretic Aspects of Gravity 2013* held at IIT Gandhinagar, Gandhinagar during Sep 5 – Sep 8, 2013. Gave invited talk on *Continuous Symmetries in Polymer Quantization*

Visited IISER Mohali during Mar 24 – Mar 28, 2014. Gave a colloquium on *Why a Quantum Theory of Gravity* and a seminar on *General Relativity in Global Positioning System.*

De, Sandipan

Participated in *Advanced School and Discussion meeting on Knot Theory and its Applications* held at IISER Mohali during Dec 10 – Dec 20, 2013.

Dutta, Soma

Participated in *4th World congress and school on Universal Logic (UNILOG2013)* held at ECEME, Rio De Janeiro, Brazil during Mar 29 – Apr 7, 2013. Presented a paper on 'Proof theory for the theory of graded consequence'

Visited Federal University of Rio De Grande Do Norte (UFRN), Natal, Brazil during Apr 8 – Apr 14, 2013. (i) Delivered two lectures on 10th and 12th April 2013 on the topic of graded consequence. (ii) Discussed the research topic on interval-valued semantics for graded consequence relation with the collaborators from UFRN, Natal, Brazil.

Ghosh, Sibasish

Visited Saha Instititute of Nuclear Physics (SINP), Salt Lake City, Kolkata during Jul 24 – Jul 28, 2013. Attended the Doctoral Committee meeting for one of the Ph.D. students of Prof. Yarlagadda at SINP as a member. Later I gave a talk there entitled, Entanglement in two site Bose-Hubbard model.

Participated in *13th Asian Quantum Information Science Conference (AQIS13)*

held at The Institute of Mathematical Sciences, Chennai during Aug 25 – Aug 30, 2013. Gave a talk on our work entitled, Entanglement in two site Bose-Hubbard model which was accepted in AQIS13 for a short talk presentation.

Participated in *Satellite Meeting (of AQIS13) entitled, International Workshop on Optical Quantum Information* held at Jaypee Institute of Information Technology, Noida during Sep

1 – Sep 2, 2013. Gave an invited talk there entitled, Qudit teleportation for photons with linear optics.

Participated in *Satellite Meeting (of AQIS13) entitled, Quantum correlation and its application in communication and cryptography* held at Indian Statistical Institute, Kolkata during Sep 2 – Sep 3, 2013. Gave an invited talk there entitled, Non-locality breaking qubit channels.

Visited Indian Statistical Institute, Kolkata during Sep 4 – Sep 8, 2013. Collaborated with the members of the group of Prof. Guruprasad Kar.

Participated in *International School on Quantum and Nano Computing Systems and Applications (QANSAS-2013)* held at Dayalbagh Educational Institute, Dayalbagh, Agra during Nov 28 – Dec 1, 2013. Gave an invited talk entitled, "Quantum discord plays no distinguished role in characterization of complete positivity: Robustness of the traditional scheme"

Participated in *Quantum Information Processing Applications (QIPA-2013)* held at Harish Chandra Research Institute, Allahabad during Dec 2 – Dec 8, 2013. Gave an invited talk entitled, Minimal state-dependent proof of measurement contextually for a qubit

Participated in *International Meet on Quantum Correlations and Logic, Language and Set Theory* held at IIT-Rajasthan during Dec 9 – Dec 14, 2013. Gave an invited talk entitled, Quantum channels and their properties in the School part of the Meet.

Participated in *1st IMSc School on Quantum Information* held at The Institute of Mathematical Sciences, Chennai during Jan 19 – Jan 31, 2014. Participated in the School

Gun, S.

Visited ICTP during May 7 – Jun 25, 2013. Associate Visit

Participated in *Algebraic Curves* held at HRI during Feb 19 – Mar 5, 2014. Invited Speaker

Visited HRI during Feb 23 – Mar 14, 2014. Lectured in a school on Algebraic curves

Gupta, Saurabh

Participated in *International Workshop on "Supersymmetries & Quantum Symmetries"* held at Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia during Jul 29 – Aug 3, 2013. Delivered a talk entitled "Jackiw-Pi Model: A Superfield Approach".

Participated in *School on Supersymmetry and Unification of Fundamental Interactions* held at AS-ICTP, Trieste, Italy during Aug 20 – Aug 23, 2013.

Participated in *21st International Conference on Supersymmetry and Unification of Fundamental Interactions* held at AS-ICTP, Trieste, Italy during Aug 26 – Aug 31, 2013.

Kesavan, S.

Visited Kumaon University, Nainital on Apr 30, 2013. Delivered a seminar talk.

Participated in *Nonlinear Partial Differential Equations, NPDE, PG Level Training Programme* held at IIT, Madras during May 27 – May 30, 2013. Delivered a series of 4 lectures on Laplace's equation.

Participated in *Mathematics Workshop for College Teachers* held at Nandha Arts and Science College, Erode during Jun 3 – Jun 5, 2013. Delivered a series of 6 lectures on Analysis.

Participated in *Mathematics: Aspects, Prospects and a bit of History* held at IMSc during Jul 1 – Jul 2, 2013. Delivered one lecture.

Visited Rathinam College of Arts and Science, Coimbatore on Aug 22, 2013. Delivered an invited talk under the INSPIRE programme.

Participated in *Enriching Mathematics Education: Workshop for school teachers* held at IMSc during Sep 30 – Oct 1, 2013. Delivered one lecture

Visited Loyola College, Chennai on Oct 3, 2013. Delivered the R. P. Ranga Memorial Endowment Lecture

Participated in *Nonlinear Functional Analysis and Applications* held at University of Kashmir, Srinagar during Oct 23 – Oct 25, 2013. Delivered a series of 4 lectures on Sobolev Spaces

Participated in *National Conference on Advanced partial Differential Equations (NCAPDE-2013)* held at Shastra University, Kumbakonam on Dec 14, 2013. Delivered an invited talk.

Visited S. V. University, Tirupati on Jan 20, 2014. Delivered an invited talk under the INSPIRE programme.

Participated in *Mathematics Workshop for PG Students* held at Sri Saradha College for Women, Salem during Feb 24 – Feb 25, 2014. Delivered 4 lectures on Analysis.

Participated in *National Workshop on Mathematical Analysis* held at Ayya Nadar Janaki Ammal College, Sivakasi during Mar 14 – Mar 15, 2014. Delivered 3 lectures on Analysis.

Kodiyalam, Vijay

Visited IIT, Madras on Oct 24, 2013. Gave a talk on 'Hopf algebra crossed products, recognition and the Drinfeld double'

Krishna, M.

Participated in *Mathematical Physics of Disordered Systems (A conference in honour of Leonid Pastur)* held at Fern University Hagen during May 13 – May 17, 2013. Gave a talk on "Level repulsion for a class of random operators"

Participated in *JSPS-DST Asian Academic Seminar* held at University of Tokyo, Tokyo, Japan during Nov 3 – Nov 10, 2013. Gave a talk on "Delocalization in some continuous and discrete random operators"

Visited University of Kentucky, Lexington, Kentucky during Jan 26 – Feb 7, 2014. Gave a talk on "Level repulsion for random operators" and also collaborated with Prof Peter Hislop on a problem of local statistics for higher rank random operators.

Participated in *Workshop on IDAQP and their Applications* held at The Institute for Mathematical Sciences, NUS, Singapore during Mar 3 – Mar 7, 2014. Gave a talk on "Local statistics for random self adjoint operators"

Lodaya, Kamal

Visited TIFR, Mumbai during May 31 – Jun 14, 2013. Gave a talk on "50 years of the Krohn-Rhodes theorem".

Mahajan, Meena

Participated in *Mysore Park Workshop: Recent Trends in Algorithms and Complexity* held at Mysore during Aug 15 – Aug 18, 2013.

Participated in *Workshop on Recent Progress in Arithmetic Complexity* held at TIFR, Mumbai during Feb 13 – Feb 17, 2014.

Participated in *Dagstuhl Seminar on Computational Complexity of Discrete Problems* held at Leibniz Centre for Informatics, Schloss Dagstuhl, Germany during Mar 16 – Mar 21, 2014. Gave a talk titled "Testing Read-Restricted Formulas".

Participated in *Workshop on Algebraic Complexity Theory - WACT 2014* held at Saarland University, Saarbrucken, Germany during Mar 24 – Mar 28, 2014. Gave an invited talk titled "The quest for VP-completeness".

Majumder, Souradeep

Visited Tata Institute of Fundamental Research during Mar 16 – Mar 22, 2014.

Participated in *Discussion Meeting on Analytic and Algebraic Geometry* held at Tata Institute of Fundamental Research, Mumbai during Mar 17 – Mar 21, 2014.

Menon, Gautam I.

Visited Centre for Interdiscplinary Science, Tata Institute of Fundamental Research on May 24, 2013. Gave a Colloquium on "Through a Vortex Glass, Darkly"

Participated in *India-France Technology Summit and Technology Platform* held at Qutub Hotel, New Delhi on Oct 24, 2013. Talk on "Complex Systems (Bio) Science"

Participated in *Active Matter: Cells, Tissues and Flocks* held at KITP, Santa Barbara during Jan 12 – Feb 14, 2014. Invited Talk on "Chromosome Positioning from Activity-based Segregation"

Visited Department of Physics, Banaras Hindu University during Mar 11 – Mar 14, 2014. Gave a series of TPSC lectures in the Department of Physics: "The Mechanics of DNA" (11 March), "Nuclear Oscillations in Stem Cells" (12 March) and "Chromosome Positioning and Active Matter" (13 March)

Menon, Shakti N.

Participated in *Workshop on Nonlinear Dynamics in Biology* held at Indian Institute of Science, Bangalore during Jul 8 – Jul 13, 2013.

Mishra, Ashok K.

Visited Harish Chandra Research Institute, Allahabad during Jan 1 – Jan 10, 2014.

Participated in *29th Young Scientist Congress* held at Madhya Pradesh Council of Science and Technology, Bhopal during Feb 28 – Mar 1, 2014. Acted as a judge for evaluating research papers in Mathematical Sciences

Participated in *16th International Conference of the International Academy of Physical Sciences* held at IIIT, Jabalpur during Mar 20 – Mar 22, 2014. Given an invited talk on Generalized Fock Spaces and New Forms of Quantum Statistics

Visited Advance Material and Process Research Instiute - CSIR, Bhopal during Mar 25 – Mar 28, 2014.

Mitra, Tanmay

Visited Raman Research Institute (RRI), Bangalore during Apr 1 – Apr 13, 2013. Participation in : 4th RRI Statistical Physics School

Participated in *LSS-2013 : IX DAE-BRNS Life Sciences Symposium on Current Advances in Immunobiology and Cancer.* held at Bhabha Atomic Research Centre (BARC), Mumbai

during Nov 28 – Nov 30, 2013. Contribution-Poster presentation on : Identifying pharmaceutical drugs and diseases having critical roles in the network of cancer-related agents by exploiting its modular organization, based on the work done with T. Jesan and Prof. Sitabhra Sinha.

Visited International Centre for Theoretical Sciences (ICTS), IISc Campus, Bangalore. during Dec 9 – Dec 20, 2013. Participation in : ICTP-ICTS Winter School on Quantitative Systems Biology, Contribution : A group project on modelling the foraging behaviour of Dictyostelium discoideum, in collaboration with Wei Xiang Chew, Shreyas Gokhale and Pradeep.

Participated in *National Symposium on Non-equilibrium Statistical Physics and Nonlinear Dynamics* held at Indian Association for the Cultivation of Science (IACS), Kolkata during Jan 2 – Jan 4, 2014.

Participated in *Indo-Canadian Workshop on the Mathematical Modelling of Infectious Diseases-2014* held at Indian Institute of Technology, Roorkee during Jan 20 – Jan 22, 2014. Contribution-Talk on : Challenges in Immunophysics.

Participated in *India-UK Scientific Seminar on Experiments, Theory and Simulation of Complex Biochemical Systems* held at The Institute of Mathematical Sciences, Chennai during Feb 24 – Feb 26, 2014.

Mukhopadhyay, Anirban

Participated in *CIMPA research school: Fourier analysis of groups in combinatorics* held at North-Eastern Hill University, Shillong, Meghalaya during Nov 18 – Nov 30, 2013. Gave a course of lectures on Analytic Methods in Number Theory

Participated in *Enriching Collegiate Mathematics* held at IMSc, Chennai during Mar 13 – Mar 14, 2014. Lectured on Complex Analysis

Murthy, M.V.N.

Visited Material Science Division, IGCAR on Jul 2, 2013. Colloquium on "Kolar Events and Dark Matter" Summer Student Program at IGCAR

Participated in *INO Collaboration Meeting* held at Madurai Kamaraj University during Sep 13 – Sep 15, 2013. Talk on "Anomalous Kolar Events: Dark Matter?"

Participated in *International Symposium on Nuclear Physics.* held at BARC-TIFR Mumbai during Dec 2 – Dec 6, 2013. Plenary talk on "Three's company: Efimov Effect"

Participated in *SERC School on Experimental High Energy Physics* held at IIT Madras on Dec 17, 2013. "Anomalous Kolar events: Reinterpretation and A proposal for Darkmatter

particle detection at INO".

Visited Department of Physics, Madurai Kamaraj University, Madurai during Jan 15 – Jan 25, 2014. Second of half of a course on "Introduction to Particle Physics", II year MSc students and Research Scholars.

Nagaraj, D. S.

Visited Bits Pillani- Goa during Apr 15 – Apr 17, 2013. Gave two talks: 1) Groups and Symmetries of Structures. 2) Algebraic Verities an Introduction.

Visited Univesity of D'Artois, at Lens, France. during May 1 – May 31, 2013. Gave a course titled "Representation Theory"

Visited University of Mysore during Aug 22 – Aug 24, 2013. Gave lectures and conducted tutorials as part of the IMSc Mysore university-workshop "An introduction to algebraic number theory via Quadratic fields"Conducted by Prof. K.N. Ragahavan.

Visited IISER, Pune during Sep 16 – Sep 18, 2013. Gave a talk titled "Complex Projective Varieties"

Participated in *Automorphisms of Affine Varieties* held at Kerala School of Mathematics(KSOM), Calicut during Feb 17 – Feb 26, 2014.

Participated in *Analytic and Algebraic Geometry Related to Bundles* held at KSOM, Calicut during Mar 24 – Mar 27, 2014. Gave a talk on "Morphisms from P^2 to Grassmannian".

Prasad, Amritanshu

Participated in *Current Trends in Algebra* held at IISER Bhopal during Aug 30 – Aug 31, 2013. Invited talk.

Participated in *XIII Discussion Meeting on Harmonic Analysis (Workshop and Conference)* held at CMI and IMSc, Chennai during Dec 9 – Dec 19, 2013. Delivered a course of lectures on Harmonic Analysis on Locally Compact Abelian Groups.

Raghavan, K. N.

Visited Vel Tech University, Avadi, Chennai on Apr 7, 2013. Evaluation of R D projects by mathematics faculty

Participated in *Advanced Instructional School on Chevalley Groups* held at Indian Institute of Science Education and Research, Pune during May 13 – May 23, 2013. Participated as a resource person; gave three lectures.

Participated in *Summer Training Programme in Mathematics* held at Ramanujan Institute for Advanced Study in Mathematics, Chennai during Jun 3 – Jun 6, 2013. Lectured and conducted tutorials in group theory for college students, over four morning sessions.

Participated in *Mid Year Meeting of the Indian Academy of Sciences* held at Indian Institute of Science, Bangalore on Jul 6, 2013. Gave a short presentation titled "Invariant theory and standard monomial theory"

Visited Indian Institute of Science Education and Research, Pune on Sep 17, 2013. Meeting

Visited Indian Institute of Science Education and Research, Thiruvananthapuram on Sep 27, 2013. Attended a meeting. Lectured to undergraduate students.

Participated in *Enriching Mathematics Education: a programme for high school teachers* held at IMSc on Sep 30, 2013. Delivered a lecture on "partial fractions", notes of which are available at http://www.imsc.res.in/ knr/past/part$_f$*rac.pdf*.

Participated in *Second Mathematics Workshop for College Teachers* held at Vellalar College for Women, Erode during Nov 18 – Nov 21, 2013. Was the resource person in algebra. Gave lectures and conducted tutorials.

Participated in *Mathematics Lecture Series of the Karnataka Science and Technology Academy, Bangalore* held at University of Mysore during Nov 22 – Nov 23, 2013. Participated as a resource person. Gave two lectures entitled "Spectra of real symmetric matrices"

Participated in *Advanced Instructional School on Classical Groups* held at IISER, Pune during Dec 12 – Dec 15, 2013. Participated as a resource person

Visited St. Xavier's College for Women, Aluva, Cochin on Jan 24, 2014. Lectured to undergraduate students

Participated in *Mathematics Workshop for PG Students 2014* held at Sri Sarada College for Women (Autonomous), Salem, Tamilnadu during Feb 24 – Feb 25, 2014. Participated as the resource person for algebra. The workshop was sponsored by NBHM and DAE.

Rai, Ashutosh

Visited Royal Holloway, University of London during Mar 18 – Apr 8, 2013. Visited Prof. Gregory Gutin.

Participated in *Workshop on Kernelization (WorKer) 2013* held at University of Warsaw, Warsaw, Poland during Apr 10 – Apr 12, 2013.

Rajasekaran, G.

Participated in *Workshop on Neutrinos and INO Project* held at Kalasalingam University, Krishnan Koil during Apr 3 – Apr 4, 2013. Gave a talk on "The elusive neutrinos and their importance"

Visited IISER, Mohali on Apr 19, 2013. Gave a Colloquium talk on "The elusive Neutrinos and the INO"

Visited IIT, Ropar, Punjab on Apr 20, 2013. Gave a Colloquium talk on "Standard Model, Higgs Boson and What Next?"

Participated in *Workshop on NDBD,Neutrinos and Dark Matter* held at IIT, Ropar and Punjab University, Chandigarh during Apr 20 – Apr 21, 2013. Gave a talk on NDBD and Dark Matter

Participated in *Science Academies' Refresher School in Quantum Mechanics* held at St Berman's College, Chenganacherry during May 1 – May 7, 2013. Gave two lectures everyday during the whole week

Visited University of California, Riverside during May 28 – Jun 12, 2013. Pursued collaborative research with Physics Department

Visited IIT, Madras on Aug 14, 2013. Gave a talk on HEP at the function held to inaugurate the HEP laboratory at IIT, Madras

Participated in *Asian Quantum Information Conference* held at IMSc during Aug 25 – Aug 30, 2013. Participated

Participated in *INO Collaboration Meeting* held at Madurai Kamaraj University during Sep 13 – Sep 15, 2013. Participated in the Collaboration Meeting and also gave a lecture to students on "Standard Model,Higgs Boson and What Next?"

Participated in *Science Academies' Workshop on HEP* held at JM College, Periakulam on Sep 16, 2013. Talked on "SM and Higgs discovery"

Participated in *Workshop on Higgs discovery* held at IIT, Madras on Nov 15, 2013. Talked on "Standard Model and Higgs".

Participated in *SERC School on Experimental HEP* held at IIT, Madras during Dec 2 – Dec 21, 2013. Gave the inaugural talk, Colloquium and two more talks on the Standard Model of HEP.

Participated in *Science Academies' Refresher School in Quantum Mechanics* held at JSS Institution, Suttur, Karnataka during Dec 7 – Dec 14, 2013. Gave two lectures everyday during the whole week

Visited Madurai Kamaraj University during Dec 22, 2013 – Jan 5, 2014. Gave a course of

about 24 lectures on HEP

Participated in *National Seminar on Higgs and Neutrinos* held at Sri Krishna College of Technology, Coimbatore on Jan 10, 2014. Gave two talks on "SM and Higgs" and "Neutrinos"

Visited Bharathiar University, Coimbatore on Jan 11, 2014. Gave a Colloquium talk on "Standard Model, Higgs Boson and What Next?".

Participated in *Science Academies' Workshop on HEP* held at St Joseph's College, Irinjalakuda, Kerala on Jan 29, 2014. Gave two lectures on "Standard model" and "Neutrinos"

Visited Saintgits College of Engineering, Kottayam on Jan 30, 2014. Gave a talk on "Neutrinos and INO".

Visited Alagappa University, Karaikudi on Mar 3, 2014. Gave two lectures:1.Standard Model and Higgs,2. Neutrinos and INO

Participated in *Science Academies' Lecture Workshop in Theoretical Physics* held at Presidency College, Chennai during Mar 10 – Mar 11, 2014. Gave two lectures on "Basic Principles of Quantum Mechanics".

Raman, Venkatesh

Visited University of Waterloo, Canada during Aug 26, 2012 – Aug 25, 2013. On Sabbatical

Ramanujam, R.

Visited Peking University, Beijing, China during Apr 1 – Jun 28, 2013. Gave a seminar on "Decision procedures for first order theories" on April 3, 2013 and taught two semester-long courses: "Decidable fragments of first order logic" and "Logic and game theory".

Visited Tsinghua University, Beijing, China during Apr 18 – Apr 20, 2013. Gave a seminar on "Exploring structure in strategies".

Visited Institute of software, Chinese Academy of Sciences, Beijing, China during May 20 – May 22, 2013. Gave a seminar titled "Auomata for counting data, and some logic".

Participated in *Epistemic Protocol and Epistemic Planning* held at Peking University, Beijing, China during May 27 – May 29, 2013. Gave a talk on "Plans, protocols and strategies"

Participated in *Logic across the university* held at Tsinghua University, Beijing, China during Oct 14 – Oct 18, 2013. Gave a talk titled "Towards a structural theory of strategies".

Participated in *Formal methods in cryptography* held at University of Hyderabad, Hyderabad

during Nov 8 – Nov 9, 2013. Gave a talk on "Formal logics for security protocols".

Participated in *Indian School on Logic and Applications* held at Tezpur University, Assam during Jan 6 – Jan 11, 2014. Gave three tutorial lectures on first order logic.

Ray, Purusattam

Visited SINTEF Petroleum Research and Norwegian University of Science and Technology, Trondheim, Norway during Jun 6 – Jun 30, 2013. Scientific collaboration.

Visited Physics Department, University of Oslo, Oslo, Norway. during Jul 1 – Jul 3, 2013. Seminar speaker.

Visited Ecole Normale Superieure, Lyon, france. during Jul 4 – Jul 6, 2013. Seminar speaker.

Visited Saha Institute of Nuclear Physics, Kolkata during Aug 5 – Aug 9, 2013. Scientific research collaboration.

Participated in *Workshop on Theoretical Physics* held at Bharathiar University, Coimbatore, during Dec 9 – Dec 12, 2013. Invited speaker

Participated in *Indian Statistical Physics Community Meeting 2014* held at Physics Department, Indian Institute of Science, Bangalore during Feb 1 – Feb 3, 2014. Invited Speaker

Visited Saha Institute of Nuclear Physics during Feb 12 – Feb 18, 2014. Collaborative research work.

Visited Presidensy University, Kolkata during Mar 24 – Mar 28, 2014. Collaboration and colloquium speaker.

Sankaran, Parameswaran

Participated in *Almora Mathematical Survey* held at Centre for Excellence in Mathematics, Almora during Oct 3, 2012 – Oct 5, 2013. Gave an invited talk on 'The vector field problem'.

Participated in *Refresher course on Galois theory* held at Kerala School of Mathematics, Kozhikode during Oct 11 – Oct 12, 2013. Gave four lectures on Galois theory for college lecturers.

Participated in *Annual Foundation School-I* held at Kerala School of Mathematics, Kozhikode during Dec 2 – Dec 28, 2013. Gave six lectures on topology.

Visited Central University of Pondicherry during Dec 10 – Dec 11, 2013. Gave two lectures, one on hyperbolic geometry and one on infinite simple groups.

Participated in *Refresher course in topology* held at Kerala School of Mathematics, Kozhikode. during Feb 27 – Mar 2, 2014. Gave six lectures in topology.

Sinha, Nita

Participated in *The Heavy Flavour Meet* held at IIT Mumbai during Apr 29 – May 1, 2013. Presented an invited talk, "CP violation in tau decays"

Participated in *PASCOS, 19th International Symposium on Particles, Strings, and Cosmology* held at Taipei, Taiwan during Nov 20 – Nov 26, 2013. Presented a talk, Can the observed CP asymmetry in $\tau \to K\pi\nu_\tau$ be due to non-standard tensor interactions?

Visited Academia Sinica, Taipei, Taiwan during Nov 27 – Dec 7, 2013. Presented a seminar, CP violation in tau decays, discussions, collaboration

Participated in *Whepp13, Workshop on High Energy Physics and Phenomenology* held at Puri during Dec 12 – Dec 21, 2013. Presented an invited talk, CP violation in tau decays

Sinha, Sitabhra

Visited Department of Physics, University of Calcutta during May 8 – May 9, 2013.

Visited Department of Computer Science, Indian Institute of Technology, Kharagpur on Jun 17, 2013. External examiner for PhD viva voce examination

Visited RIKEN Brain Science Institute, Saitama, Japan during Jun 23 – Jul 1, 2013. Invited talk on "Minds, Modules and Memory: Exploring Networks of the Nervous System from the Worm to the Primate"

Visited University of Tokyo, Tokyo, Japan on Jun 25, 2013. Invited talk on "Coupling relaxation oscillators in a spatially extended array results in complex spatio-temporal patterns"

Participated in *RIKEN AICS Workshop on Network and Complexity* held at RIKEN Advanced Institute for Computational Science, Kobe, Japan on Jul 2, 2013. Invited talk on "Modularity of Social Networks"

Participated in *35th Annual International IEEE EMBS Conference* held at Osaka International Convention Center, Osaka, Japan during Jul 3 – Jul 7, 2013. Invited minisymposium talk on "Minds, Modules and Memory: Exploring Networks of the Nervous System from the Worm to the Primate"

Participated in *Workshop on Nonlinear Dynamics in Biology* held at Indian Institute of Science, Bangalore during Jul 8 – Jul 13, 2013. Invited talk on "Patterns of life and death: Nonlinear dynamics of the heart and the pregnant uterus"

Participated in *C. K. Majumdar Memorial Summer Workshop in Physics* held at S. N. Bose National Centre for Basic Sciences, Kolkata during Jul 10 – Jul 11, 2013. Invited mini-series of 3 lectures on "Complex systems"

Participated in *Workshop on Nonlinear Differential Equations: Dynamics of Complex Systems* held at Department of Applied Mathematics, University of Calcutta, Kolkata during Jul 23 – Jul 28, 2013. Invited mini-series of 3 lectures on "Pattern formation and wave propagation in nonlinear media", "Patterns of life and death: Complex spatio-temporal dynamics in nonlinear biological systems" and "Physics of the Heart"

Participated in *Symposium on Complex Systems: From Physics to Biology* held at Jawaharlal Nehru University, New Delhi during Oct 15 – Oct 16, 2013. Invited talk on "Identifying the movers and shakers in cancer: Mesoscopic analysis of the network of cancer diseases and genes"

Participated in *International Workshop on Socio-Economic Networks* held at Indian Institute of Technology-Rajasthan, Jodhpur during Oct 25 – Oct 27, 2013. Invited talk on "Are large complex economic networks unstable ?"

Visited Department of Mathematics, University of Delhi-South Campus, Delhi on Oct 29, 2013. Invited talk on "Mathematics of the Heart"

Visited Lady Shri Ram College, Delhi on Oct 29, 2013. Invited talk on "Networks, Modules and Games: Dynamics of social networks with community organization"

Participated in *Bioworld2013: Computational Biology in Disease and Disorder* held at Indian Institute of Technology, Bangalore during Dec 9 – Dec 11, 2013. Invited lecture on "The role of mesoscopic organization of biological networks in health and disease"

Participated in *5th International Conference on Pattern Recognition and Machine Intelligence (PReMI 2013)* held at Indian Statistical Institute, Kolkata during Dec 10 – Dec 14, 2013. Invited talk on "Inferring the laws of finance from big data: Data-driven modeling of market dynamics"

Visited Tata Institute of Fundamental Research on Dec 18, 2013. DBT Neuroscience Task Force Project Meeting

Visited Department of Physics, Indian Institute of Science, Bangalore on Dec 26, 2013. External examiner for PhD viva voce examination and invited talk on "Patterns of life and death: Complex spatio-temporal dynamics in nonlinear biological systems"

Visited National Center for Biological Sciences, Bangalore on Dec 27, 2013. External examiner for PhD viva voce examination

Participated in *Information Technology Research Academy (ITRA) Workshop* held at Vishwa Yuvak Kendra, New Delhi during Jan 1 – Jan 2, 2014. Presented ITRA project on traffic network dynamics

Participated in *CEFIPRA-IFCAM Workshop on New Avenues for Network Models and Social Networks* held at Indian Institute of Science, Bangalore during Jan 13 – Jan 16, 2014. Invited talk on "Persistence of epidemics in networks with modular organization"

Participated in *Indo-Canadian workshop on the Mathematical Modeling of Infectious Diseases* held at Indian Institute of Technology, Roorkee during Jan 20 – Jan 22, 2014. Invited talk on "Community organization of social networks can make epidemics persistent"

Participated in *International Seminar on Emerging Trends in Applied Mathematics* held at Department of Applied Mathematics, University of Calcutta during Feb 12 – Feb 14, 2014. Invited talk on "Using nonlinear dynamics and complex networks to understand the brain"

Participated in *Workshop on Nonlinearity in Economics* held at Department of Economics, University of Calcutta during Feb 17 – Feb 18, 2014. Invited talk on "Introduction to Econophysics"

Participated in *3rd International Symposium on Complex Dynamical System and Application (CDSA 2014)* held at Indian Statistical Institute, Kolkata during Mar 10 – Mar 12, 2014. Invited talk on "A Mesoscopic Approach to Large-scale Dynamical Patterns of Brain Activity"

Participated in *Econophys-Kolkata VIII* held at Saha Institute of Nuclear Physics, Kolkata during Mar 14 – Mar 17, 2014. Invited talk on "Newton's Revenge: the Inverse Square Law of Price Fluctuations in the Bitcoin Market"

Visited Department of Physics, Indian Institute of Science, Bangalore on Mar 20, 2014. External examiner for PhD viva voce examination

Sharma, Vikram

Visited Max Planck Institute for Informatics (MPII) during Jun 29 - Aug 11, 2013.

Srinivas, K.

Visited Amrita Vishavidyalay, Coimbatore during Apr 10 – Apr 11, 2013. External examiner for pre-PhD viva, delivered a talk on *factoring large numbers*

Participated in *One-Day Instructional Workshop on Elliptic Curve Cryptography* held at V.I.T, Vellore on Apr 20, 2013. Delivered a course of 4 lectures on elliptic curve cryptography.

Visited Department of Mathematics, Andhra University during May 16 – May 17, 2013. Delivered a talk.

Participated in *Annual Conference of Ramanujan Mathematical Society* held at REVA Institute, Bangaluru during Jun 25 – Jun 27, 2013. Attended the conference.

Participated in *One-day skill building workshop for Free Tuition Centre Teachers* held at Computer Society of India, Chennai on Aug 29, 2013. Delivered a talk on How to teach Mathematics in an easy way.

Participated in *RMS-UGTE programme* held at Lady Sriram College, Delhi during Nov 8 – Nov 9, 2013. Delivered 4 talks in number theory to undergraduate teachers.

Visited KV, CLRI, Chennai on Nov 10, 2013. Judge for Hindi Skit, essay competitions.

Participated in *One-day Colloquium sponsored by Dr. Vaidyanathaswamy Mathematical Trust* held at Ramanujan Institute, Chennai on Mar 28, 2014. Delivered a talk with the title- a first step towards Riemann Hyothesis.

Subramanian, C. R.

Participated in *National Seminar on Recent Developments in Algebraic Graph Theory* held at SSN College of Engineering, Kalavakkam, Chennai during Jul 5 – Jul 6, 2013. Gave an invited talk on "Randomness reduction and random walks on expander graphs"

Visited SSN College of Engineering, Kalavakka, Chennai on Oct 21, 2013. Gave an expository talk on "NP-hardness and coping with it".

Sunder, V. S.

Participated in *GPOTS 2013* held at UC Berkeley (honouring the contributions of the late William Arveson) during May 21 – May 25, 2013. I lectured on 'Extendable E_0 semigroups on factors

Visited University of California at San Diego during Jun 2 – Jun 3, 2013. Gave a lecture titled 'From graphs to Free Probability'

Participated in *Focus Program on Non-Commutative Distributions in Free Probability Theory* held at Fields Institute, Toronto during Jul 1 – Jul 26, 2013. Gave a two-hour lecture entitled 'Free products from Graphs' and a one-hour lectue on 'Continuous Minimax Theorems'

Participated in *Anusandhan 2013* held at Presidency University, Kolkata during Dec 13 – Dec 15, 2013. Gave an invited talk on *When is a knot not the unknot* on the occasion of their bicentennary celebrations.

Participated in *IWOTA* held at IISc, Bangalore during Dec 16 – Dec 20, 2013. Gave an invited plenary lecture titled *Continuous minimax theorems.*

Participated in *Conference felicitating K.B. Sinha's 70th birthday* held at KSOM, Kozhikode during Feb 12 – Feb 14, 2014. I gave an invited talk on a new proof of the Putnam-Fuglede Theorem

Visited Chennai Math. Imstitute on Mar 11, 2014. Gave an invited Colloquium lecture on *The Spectral Theorem*.

Visited IISER Bhopal during Mar 21 – Mar 23, 2014. Gave a plenary lecture on *A Pedagogical re-take on the Spectral Theorem* at the Conference in Harmonic Analysis and Operator Theory.

Vaish, Vaibhav

Visited TIFR Mumbai during Apr 14 – Apr 19, 2013. Academic Discussions

Verma, Manoj

Participated in *Fourier analysis of groups in combinatorics* held at North-Eastern Hill University, Shillong during Nov 18 – Nov 30, 2013.

Participated in *Conference on Analytic Theory of Automorphic Forms* held at IMSc, Chennai during Dec 9 – Dec 13, 2013.

Visited Harish-Chandra Research Institute, Allahabad during Feb 17 – Feb 28, 2014. Attended lectures on Algebraic Curves being held in HRI during the period.

Vijayakumar, Sasidevan

Visited TIFR Mumbai during Mar 10 – Mar 13, 2014. Thesis defence

Participated in *ECONOPHYS-KOLKATA VIII* held at SINP, Kolkata during Mar 14 – Mar 17, 2014. Presented a work titled "Can selfish rational agents achieve co-operation ?"

Vyas, Vivek M.

Participated in *DST-SERC School on Nonlinear Dynamics* held at Department of Physics, Panjab University, Chandigarh during Jan 27 – Feb 18, 2014.

5.3 Visitors from Other Institutions

Ram Kishore	25/3/13 - 30/4/13	INPE, Brazil
Argha Banerjee	5/4/13 - 14/4/13	IISER, Kolkatta
Debraj Chakrabarti	15/4/13 - 19/4/13	TIFR, Bangalore
Swarup Poria	14/4/13 - 27/4/13	Calcutta University, Kolkatta
CH.V.G. Narasimha Kumar	28/4/13 - 3/5/13	IIT, Hyderabad
Ritabrata Munshi	2/5/13 - 2/5/13	TIFR, Mumbai
Sury B.	4/5/13 - 4/5/13	Bangalore
Samir Kumkri	16/5/13 - 6/6/13	Mahadevananda Mahavidyala, Kolkatta
Ishita Mukhopadhyay	20/5/13 - 24/5/13	Calcutta
Christophe Chatelain	22/5/13 - 26/5/13	IISER
Apte S.K.	27/5/13 - 28/5/13	BARC, Mumbai
Prashant Gade	24/5/13 - 31/5/13	Nagpur University
Vishal Saraswat	10/5/13 - 12/5/13	CR Rao AIMSCS, Hyderabad
Basudha Misra	3/6/13 - 11/6/13	BITS, Pilani, Hyderabad
Dibyendu Das	10/6/13 - 13/6/13	IIT, Bombay
Shiv Chaitanya K.V.S.	10/6/13 - 14/6/13	BITS, Pilani, Hyderabad
Rao B.J.	9/6/13 - 12/6/13	TIFR,Mumbai
Deepak Kumar	9/6/13 - 14/6/13	Jawaharlal Nehru University, New Delhi

Mithun Kumar Mitra	27/5/13 - 26/6/13	IIT, Bombay
Sunitha V.	4/5/13 - 22/6/13	DA IICT, Gandhinagar
Vidhyadhiraja N.S.	16/6/13 - 21/6/13	JNCASR, Bangalore
Krishnendu Sengupta	20/6/13 - 21/6/13	IACS, Kolkatta
Indranil Biswas	24/6/13 - 26/6/13	TIFR, Mumbai
Maharanya	23/6/13 - 29/6/13	NISER,BBSR
Mukunda N	30/6/13 - 3/7/13	IAS, Bangalore
Rajdeep Niyogi	30/6/13 - 12/7/13	IIT,Roorkee
Ravindran P.	1/7/13 - 7/7/13	Central University of Tamil-nadu
Swarmemdi Sarkar	24/6/13 - 13/7/13	University of Delhi
Somshubhro Bandy-opadhyay	7/7/13 - 3/7/13	BASKS,Kolkatta
Guruprasad Kar	7/7/13 - 13/7/13	ISI, Kolkatta
Solomonivan J.	23/5/13 - 14/7/13	IIST, Trivandrum
Sudeshna Sinha	9/7/13 - 16/7/13	IISER,Mohali
Umashankar S.	10/7/13 - 12/7/13	IIT, Bombay
Kajri Majumdar	10/7/13 - 12/7/13	TIFR, Mumbai
Thangadurai R.	8/7/13 - 14/7/13	HRI, Allahabad
Rajan C.S.	11/7/13 - 13/7/13	TIFR, Mumbai
Piyusha Chatterjee	15/7/13 - 17/7/13	School of art design and technology, Bangalore

Indira Chowdhury	15/7/13 - 17/7/13	School of art design and technology, Bangalore
Anurajha Jasannathan	18/7/13 - 23/7/13	Laboratorie de physique des solides universite paris-sud
Kalyan chakraborty	22/7/13 - 24/7/13	HRI, Allahabad
Manickam N.	15/7/13 - 23/7/13	Kerala School of Mathematics
Purisken A.M.M.	21/7/13 - 10/8/13	University of Amsterdam, Netherland
Yogananda C.S.	29/7/13 - 30/7/13	S.J.College of Engineering, Mysore
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Chapter 6

Infrastructure

6.1 Computer Facilities

IMSc Computer Facility during 2013-2014

Hardware facility:

- The IMSc network was upgraded to 26 Mbps(1:1) Internet Bandwidth with AIRTEL through leased line(fiber loop).
- New laptops of Dell, Fujitsu Stylistics Q702, Apple MacBook Pro, Apple Macbook Air were issued to faculty those who have not availed the facility earlier.
- Few students who opted for only laptops and not for desktops are provided with Lenovo B490 laptops and will return while leaving the Institute.
- Additional 3 networked laserjet printers(Canon Image class LBP - 6780X) enabled with duouble sided printing are installed in the students offices.
- One portable document camera(EPSON ELPDC 11) was made available to users for taking classes.
- Obsolete Apple MacBook laptops of 10 numbers older than 5years were replaced with Apple Mac Book Air and issueded to faculty.
- New desktops of Dell Optiplex 9020 MT(70) were installed in replacement of desktops which were purchased during 2006 become obsolete & old.
- The Obsolete 100Mbps LAN swithces were replaced with 1Gig switches(20).
- Purchase process of "HPC Hybrid System" is initiated to improve the computing facility.

Software facility:

- IMSc SSL certification was renewed upto 2015.

Acivities :

- Training Session on GPU Computing organised jointly by IMSc, Chennai, NVIDIA & Hinditron, Bangalore during September 20-12, 2013 and it was well received by young participants of about 30 from various Institutions.
- Training Session on Intel Phi Programming organised jointly by IMSc, Chennai & Intel Team, Bangalore on August 22, 2013 at IMSc and was attended by students of neighbouring Institutions.

Dr.G.Subramoniam, Scientific Officer-F participatd the 2^{nd} Annual NKN Workshop at IISc, Bangalore during October 17-19,2013.

Mr.B.Raveendra Reddy, Scientific Officer-F attended the meetings on CISAG, DAE, Mumbai during Aug 26 & Oct 8, 2013

Mr.Mangala Pandi, Project System Administrator participated in the ICTP Workshop on HPC Architecture and Applications at ICTP, Trieste, Italy during October 14 to 25, 2013

6.2 The Library

The Institute Library holds a total collection of 70484 books and bound periodicals as on March 31, 2014. This includes an addition of 2685 volumes during the current year April 2013 - March 2014. 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.

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