



# Chennai Mathematical Institute

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## Annual Report 2005 - 2006

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Padur Post, Siruseri, Tamilnadu 603 103. India.

## **Chennai Mathematical Institute**

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Photographs courtesy Dr. K. Narayan Kumar, CMI

Design and Printing by: Balan Achchagam, Chennai 600 053



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## Preface

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The Chennai Mathematical Institute (CMI) was founded in 1989 with a charter to build up an institution of excellence in Mathematics and Computer Science. Over the years, CMI has succeeded amply in this goal. The Mathematics and Computer Science groups at CMI are among the best known in the research community in the country. The Institute has nurtured an impressive collection of Ph.D. students. Members of CMI maintain active research collaborations with leading research institutes throughout the world. A number of scholars from around the world visit CMI each year, enhancing the vibrant research atmosphere at the Institute.

Chennai Mathematical Institute began in 1989 as the School of Mathematics, a division of the SPIC Science Foundation. In August 1996, it became an independent institution called the SPIC Mathematical Institute (SMI), managed by a Trust of the same name, through a Governing Council. In order to place the Institute in a larger public domain, the name of the Institute was changed to Chennai Mathematical Institute (CMI) in January 1999.

Since its inception, the Chennai Mathematical Institute has had an active group of researchers in the fields of pure mathematics and theoretical computer science. Algebraic geometry, representation theory, differential geometry, commutative algebra and topology are the areas that are currently being pursued in Mathematics. In Computer Science, research is being pursued in the areas of formal specification and verification, the theory of timed and hybrid systems, the design and analysis of algorithms and computational complexity. Other areas of interest include control theory, partial differential equations and mechanics.

Over the years it has made very substantial contributions in these areas, as evidenced by the important research papers as well by the number and quality of doctoral students who are placed in various centres in India and abroad. The research activity is also enhanced and supported by seminars and lectures both by the faculty

and the students of CMI as well as through a healthy inflow of visitors from other research centres in India and abroad. The seminars are the life-line of any research group and CMI has had a rich tradition in this.

A major component of the Institute is its Ph.D. programme. CMI has evolved a joint Ph.D. programme with the Birla Institute of Technology and Science, Pilani. The Ph.D. programme at CMI is also recognized by the University of Madras.

Though all premier research institutions in India have very visible Ph.D. programmes, without a steady supply of bright students taking to science at the university level, these programmes are rapidly becoming unsustainable.

CMI has taken the initiative to bridge the gap between teaching and research by starting B.Sc. and M.Sc. programmes in Mathematics and allied subjects which are entirely conducted by faculty who are active in research. The teaching programme began in 1998 with the National Undergraduate Programme in Mathematics and Computer Science, leading to a B.Sc. (Honours) degree awarded by the Madhya Pradesh Bhoj Open University (MPBOU). In 2001, separate M.Sc. courses were introduced in Mathematics and Computer Science. In 2003, the B.Sc. (Honours) programme was expanded to include a Physics stream. The present strength of the students in the B.Sc., M.Sc. and Ph.D. is 76.

In the teaching programmes at CMI, talented students are selected at the national level and are taught by experts who have contributed to these fields. CMI has the continued support of scientists from other institutions, especially the Institute of Mathematical Sciences (IMSc), Chennai, the Tata Institute of Fundamental Research (TIFR), Mumbai, the Indian Institute of Technology (IIT) Madras, Chennai, Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Homi Bhabha Centre for Science Education (HBCSE), Mumbai and Institute for Financial Management and Research, Chennai (IFMR). Substantial support for this initiative is being provided by the National Board for Higher Mathematics (NBHM), an autonomous body constituted and funded by the Department of Atomic Energy (DAE).

The teaching programmes at CMI have turned out to be highly successful. Five batches have already graduated in the B.Sc. programme in Mathematics and Computer Science and moved on to some of the best institutions in the world. The first B.Sc. Physics batch will graduate in 2006. Three batches of M.Sc. students have graduated and have been well placed in both academia and industry.

Members of the Faculty have strong academic ties with reputed research institutions in India and abroad. The Institute participates in a programme of the Third World Academy of Sciences (TWAS), Trieste, Italy called the “Associate Membership Scheme at Centres of Excellence in the South”.

The Institute has a memorandum of understanding with the Ecole Normal Supérieure in Paris, France, one of the leading institutions in the world for teaching and research in Mathematics. This agreement provides for regular exchange visits by academic members of CMI and ENS, Paris including, in particular, exchanges of visits by undergraduate students between the two institutions. Since 2000-2001, there have been regular visits from both sides each year under this programme.

CMI is in the third year of its Memorandum of Understanding with the Institute for Financial Management and Research (IFMR), in connection with IFMR’s new one-year programme in Financial Mathematics. Faculty from CMI teach some courses in this programme. Joint research is also envisaged as part of this arrangement.

CMI is also involved in a number of collaborative research projects, both with academic and industrial partners. The Institute is currently involved in a four year project on timed and distributed computing systems under the Indo-French Networking programme, jointly funded by the French Ministry of Science, CNRS and the Indian Department of Science and Technology. The project involves scientists from CMI, IMSc and IISc, Bangalore in India and the University of Paris 7, ENS de Cachan and the University of Bordeaux 1 in France.

CMI has a sponsored research project with Honeywell Technology Solutions Laboratory, Bangalore, in the field of avionics controls, initiated in 2004-2005. New collaborative projects are being formulated with Microsoft Research, Bangalore and Siemens’ Corporate Technology research centre, also in Bangalore.

The Institute actively supports conferences and workshops and other activities that contribute to the growth of Mathematics and Computer Science in the country. CMI co-sponsored the conference on “Commutative Algebra and Algebraic Geometry” held at the Institute of Mathematical Sciences, Chennai, in August 2005.

Recently, CMI has received a large grant from the Board for Research in Nuclear Sciences (BRNS) and the Department of Science and Technology (DST). This funding covers an ambitious visitors’ programme as well as support to enhance computational infrastructure and library facilities at the Institute.

CMI's new campus on the southern outskirts of the city, at the SIPCOT Information Technology Park, Siruseri became operational in October, 2005. The funds for the campus have come from private sources, with major contributions from Matrix Laboratories, Hyderabad, the Shriram Group Companies, Chennai, the Willingdon Trust, Chennai and the Infosys Foundation, Bangalore.

All academic activities of the Institute have shifted to the new campus. The academic and administrative building has been completed. The library and hostel are expected to be completed in 2006. For the moment, students continue to stay in hostels in the city. A bus service has been organized to transport students to and from the new campus. There are also regular shuttle services between CMI and IMSc.

To commemorate the shift to the new campus, CMI organized an Inaugural Symposium during the first three weeks of January, 2006. A number of distinguished visiting scientists delivered lectures on Mathematics, Computer Science and Physics. During the Symposium, on 12 January, 2006, the campus was formally inaugurated by Dr. Anil Kakodkar, Chairman, Atomic Energy Commission.

**C S SESHADRI**

*Director*







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Courant Institute of Mathematical Sciences  
New York University, New York, U.S.A.
6. **Prof. M. Vidyasagar**  
Executive Vice-President  
Tata Consultancy Services, Hyderabad



## Research Activities

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### Mathematics

The research activity in Pure Mathematics in CMI has been primarily in the fields of Algebraic Geometry, Algebra, Differential geometry and Partial Differential Equations, Functional Analysis, Representation theory and History of Mathematics.

In the field of Algebraic Geometry the concept of algebraic holonomy groups of stable bundles on smooth projective varieties was defined. These holonomy groups are described in a number of ways and applied to prove interesting results on stability of symmetric powers of stable bundles. It also ties up with a number of differential geometric invariants as well as conjectures of Yau on symmetric spaces. Analogues of the Donaldson-Uhlenbeck spaces for the moduli spaces of parabolic bundles on algebraic surfaces were constructed and studied. The compactification is described and related to the differential geometric construction of Kronheimer and Mrowka. The study of these moduli spaces is important for addressing some basic conjectures of Thom on diffeomorphism types of pairs  $(Y, X)$ , where  $Y$  is smooth 2-dimensional submanifold of a 4-manifold  $X$ . The non-emptiness of these moduli spaces was also proven by generalising the classical Serre construction for parabolic bundles.

In the field of Duality theory in Algebraic geometry a generalized notion of Serre's  $S_n$  conditions for complexes has been studied with coherent homology on a formal scheme. It was shown that this condition is preserved under dualization. A comparison of two possible approaches to duality was also studied, one relying on compactifications and another via residual complexes. In the field of Commutative Algebra there has been a study of the canonical module of toric surfaces in a projective space. These produce examples where the canonical module is Cohen-Macaulay.

In the field of Functional Analysis there has been work in the theory of semigroups. The earlier work in this field provides a functional analytical construction of the Tsirelson's type III product systems. These are called as 'product systems arising from sum systems'. The following works are done in continuation of that, and are in

the process of submitting. There is an explicit construction of the  $E_0$ -semigroup associated with a product system arising from a sum system. This is done by generalising an already existing elementary examples of  $E_0$ -semigroups called as CCR flows. The research work carried out provides better condition for this which turn out to be also necessary and sufficient for the semigroup to be type of III. This provides new examples, which cannot be distinguished by the invariants of Tsirelson. In a different direction a theory of stochastic integration has been developed with respect to the above class of product systems arising from sum systems, which is a generalisation of the quantum stochastic calculus developed by Hudson and K.R. Parthasarathy. There are some crucial differences from the Hudson-Parthasarathy case. A 'fundamental lemma' is also proved.

In the field of Game Theory there has been work on problems related to semi-definite linear complementarity problems.

In the field of Algebraic Groups research work is being done in the study of binary quantics using Schubert varieties. There is also a study of some class of subgroups of a group with BN pair which we term as almost parabolic subgroups. The problem of obtaining a crystal basis for the cohomology modules of line bundles (for a non-dominant weight) on Schubert varieties is being studied. There has been a study of the classical plethysm problem for the symmetric group-what are the irreducible submodules of the symmetric group which appear in the tensor product of two irreducible representations of the symmetric group. Partial progress has been obtained in this which includes a geometric proof of a result of Remmel and Whitehead in the case when the two irreducible representations are parametrized by tableaux having at most two rows.

In the field of Differential Geometry there has been progress in couple of questions. The first one is the problem of geodesic conjugacy between the unit tangent bundles of two closed negatively curved manifolds with negative curvature. The aim is to adopt the Besson-Courtois-Gallot method of constructing the natural map to see if an explicit homeomorphism can be constructed. In a different direction existence of 'thin' subsets of the real line was shown; a subset is said to be thin if it is nowhere dense and has zero Lebesgue measure. In dimension 2, the sets constructed by Besicovitch are thin. The question of construction of newer Besicovitch sets arising out of our construction in dimension 1 is being studied.

## Computer Science

The research activity in Computer Science at CMI has been primarily in

computational complexity theory, specification and verification of distributed systems, temporal logics and analysis of security protocols.

In computational complexity theory, research was centered on problems falling in low computational complexity classes—in particular, the problem of determining whether there exists a path between two vertices (“reachability”) in a planar or toroidal graph. It was shown that the problems for planar and toroidal graphs are equivalent, planar reachability is reducible to its complement and also that it is equivalent to reachability in grid graphs. Special cases of the problem, namely, single source planar DAG reachability and layered grid graph reachability, were shown to be contained in classes smaller than the obvious upper bound of NL, namely, L and UL, respectively. Various lower bounds for special cases of grid graph reachability were also proved.

Message sequence charts (MSCs) are a visual notation for specifying the behaviour of communicating agents. A new notion of concatenation for MSCs called anchored concatenation has been developed, which lies between the traditional extremes of synchronous and asynchronous concatenation. When High-Level Message Sequence Charts (HMSCs) are interpreted using anchored concatenation, checking for the existence of implied scenarios is decidable. Separately, a new notion of realizability, called causal realizability, has been defined for MSC languages. This notion strengthens the notion of weak realizability in the literature. Importantly, checking causal realizability is decidable for regular MSC languages, whereas checking weak realizability is known to be undecidable for this class.

In the area of temporal logic, different fragments of interval logics have been considered that include operators to “move” to adjacent intervals. It has been shown that even in the absence of the chop operator, undecidability follows from the mere presence of an operator that checks if the length of an interval is some fixed constant. Undecidability has also been established for the fragment which allows the comparison of lengths of intervals.

In the areas of security protocol verification, a generic methodology has been proposed for verifying secrecy properties using the automated model-checking tool Spin. This approach also establishes that a weaker intruder model than the traditional Dolev-Yao model suffices to verify secrecy properties. In addition, some decidability results have been extended to a logic of knowledge for security protocols. This has led to the development of a new logic for easily specifying security properties for which decidability has been proved under a general setting.



## Campus and Infrastructure

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During 2005-2006, CMI moved into its own campus at Siruseri in the outskirts of Chennai. The campus is set on a 5.35 acre plot in the SIPCOT IT Park. The campus has been designed by the award winning Chennai-based architect K.S. Ranganath.

The first phase of the campus, the academic block, was completed in September 2005. This block includes office space for faculty, postdoctoral fellows and research scholars, as well as the administrative staff. There are seven lecture halls, including a large seminar hall that can accommodate 100 persons.

The Institute has a high-speed dedicated Internet connection and a campus wide network equipped with high performance file servers. The entire campus is covered by a wireless network. Much of the equipment has been obtained through a grant from BRNS and DST.

The construction of the second phase of the campus, the library block, is in progress and should be completed by the end of 2006. This phase also includes two large rooms to house undergraduate Physics laboratories. Construction of the students' hostel was also begun in 2005-2006 and the facility should be completed by the end of 2006.

The funds for the campus have come from private sources, with major contributions from Matrix Laboratories, Hyderabad, the Shriram Group Companies, Chennai, the Willingdon Trust, Chennai and the Infosys Foundation, Bangalore.



## The National Undergraduate Programme

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In 1998, CMI initiated a National Undergraduate Programme in the Mathematical Sciences in collaboration with the Madhya Pradesh Bhoj Open University with a 3 year course in Mathematics and

Computer Science, leading to a B.Sc. Honours degree. In 2001, this programme was extended to the postgraduate level with separate 2 year courses leading to M.Sc. degrees in Mathematics and Computer Science. The scope of the undergraduate programme was expanded in 2003 to incorporate a 3 year course leading to a B.Sc. Honours degree in Physics.

The undergraduate and postgraduate teaching programmes at CMI are both run in cooperation with the Institute of Mathematical Sciences (IMSc), Chennai. These programmes tap the teaching talent available at the elite research institutes of the country, which are normally outside the university system. Students are thus exposed to lectures by active researchers who bring a very different perspective to the teaching.

### **B.Sc. (Hons.) Mathematics**

In 2005, the eighth batch of students was admitted to the undergraduate programme. 25 students were offered admission and 9 have joined the programme. Of these, one is from the INMO stream and three are from the INOI stream. The second year B.Sc. class has 9 students, while the third year B.Sc. class has 10 students.

Out of the 12 students of the 2002 batch who took their degrees at the convocation in August, 2005, several have been placed in very prestigious institutions. Two of the top three students in the batch, Amruth Krishnan and Ganapathy Subramanian joined the one year course in Financial Mathematics at IFMR, Chennai with a full scholarship. Amruth Krishnan also had offers with full scholarship from Caltech and the new European Master's programme ALGANT (Algebra, Geometry and Number Theory) at Bordeaux. Shuvra Gupta has joined the graduate programme in



Mathematics at University of Pennsylvania, USA with a full scholarship. Rohith Varma and Tapopriya Majumdar have joined the ALGANT programme at Bordeaux with full scholarship. Raghunath Tewari has joined the graduate programme in Computer Science at the University of Nebraska, USA with full scholarship. Sushmita Gupta has joined the graduate programme in Computer Science at Simon Fraser University, Canada. Pradeep Kumar Jha has joined IIT Bombay for a Ph.D. in Mathematics. B. Raghuram has joined the Master's programme in Quantitative Economics at ISI, Kolkata. Saurabh Trivedi has joined the M.Sc. Mathematics programme at CMI while Sourasis Roy and Swati Rupa Das have joined the M.Sc. Computer Science programme at CMI.

## **B.Sc. (Hons.) Physics**

This programme was started in 2003 with the assistance of the Physics Faculty of the IMSc., Chennai, and the active participation of physicists across the country. The senior batch, now in the third year year, has 5 students. The second batch, now in the second year, also has 5 students. We record, with profound regret, the untimely death of Mr. Deep Roy, one of the most promising students of this batch, during the summer vacation at his residence in Kolkata.

In 2005, letters of admission were offered to 17 students, of whom 5 students have joined the programme.

During the course of the academic year, Physics students perform some basic experiments in class at CMI. In addition, students have an intensive laboratory programme at the Homi Bhabha Centre for Science Education (HBCSE), Mumbai, during the summer vacation after the first year. A similar arrangement has been worked out with the Indira Gandhi Centre for Atomic Research (IGCAR),

Kalpakkam for students at the end of the second year. Regular laboratory classes are conducted with the help of IIT Madras for students in the third year. A full-fledged Physics laboratory is part of the new library complex that will be ready by the summer of 2006.

## **M.Sc. Mathematics**

Of the 2002 batch, one remaining student completed the M.Sc. programme in 2005 and got his degree in August, 2005.

All three students who joined the programme in 2003 have completed the programme successfully. Of these, T. Saravanan has joined the Ph.D. programme at the University of Chicago. Pranab Sardar is continuing as a Ph.D. student at CMI.

In 2005, two students have joined the programme.

## **M.Sc. Computer Science**

All ten students who joined the MSc programme in Computer Science in 2003 have completed their course. Many have found employment in the industry. One student has joined NIT, Surathkal as an instructor. Two students who joined in 2004 are now in their second year. In 2005, ten students have joined the course. An eleventh student has switched over from the M.Sc. Mathematics programme to the M.Sc. Computer Science programme.

## **Convocation**

The 3rd convocation of CMI was held on 2nd August 2005. Degrees were awarded to 25 successful candidates at various levels. Of these, 12 were at the Undergraduate level and 13 were at the Postgraduate level. Dr. Kamlakar Singh, Vice-Chancellor, Madhya Pradesh Bhoj (Open) University, Bhopal handed out the degree certificates. Prof. M.S. Narasimhan, F.R.S., Honorary Fellow, TIFR, Bangalore Centre delivered the convocation address and Mr. N. Ram, Editor-in-Chief, “The Hindu” was the Chief Guest.

The CMI Medal of Excellence in Mathematics (instituted by Prof. K.R. Nagarajan) was awarded to Amruth Krishnan for his outstanding performance at the undergraduate level.





# Activities of the Undergraduate Students

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## Informatics Olympiad

CMI faculty coordinate the training and selection of students to represent India at the International Olympiad in Informatics through the Indian Association for Research in Computer Science (IARCS). CMI hosts the official IARCS website. From September 2004, a monthly online programming competition has been conducted by the CMI faculty via the IARCS website.

## Achievements of CMI students

Arnold Noronha and Preyas Popat, both first year students in the B.Sc. Mathematics programme, won bronze medals at the International Olympiad in Informatics in Nowy Sacz, Poland, in August, 2005.

In March, 2006, the well-known software company Google conducted the second edition of its programming contest Google Code Jam, open to all individuals in South Asia. The first round was held online and the top 50 contestants were flown into Bangalore for the final round. Four CMI students figured in the final round, at the end of which, R. Shreevatsa (2nd year B.Sc. Mathematics) won third place in the contest. In addition, Indraneel Mukherjee (3rd year B.Sc. Mathematics) was placed 16th in the contest, Tanmoy Chakraborty (3rd year B.Sc. Mathematics) was placed 25th, and Preyas Popat (1st year B.Sc. Mathematics) was placed 28th.

## SANKHYA 2005

(Sri Venkateswara Engineering College, August 2005)

Event	Participants	Place
Applex (an event based on Applied Math)	Arul Shankar Ramprasad Saptarishi R. Shreevatsa	I

Event	Participants	Place
Ground Zero (Olympiad)	R. Shreevatsa	I
	Anirbit Mukherjee	II
Game Set and Math (Quiz)	A.B. Belliappa	II
	Achal Agrawal	
	Vineeth S. Varma	

## National Science Day Celebrations

(Institute of Mathematical Sciences, February 2006)

Event	Participants	Place
Science Quiz	R. Shreevatsa & Ramprasad Saptarishi	1st
	Satyanarayan Mukhopadhyay & Arghya Mondal	2nd
	Swarnava Mukhopadhyay & Anirbit Mukherjee	3rd

## Summer camps/courses/visits to other centres

- A number of students attended the Visiting Students' Research Programme (VSRP) held both at TIFR, Mumbai and HRI, Allahabad. A few students also visited IIT, Kanpur, IISc. ISI, Bangalore and IMSc., Chennai for nurture/research programmes.
- Ritwik Banerjee, Swati Rupa Das, Pronita Ghosh, Kumar Madhukar and T.M. Harish worked at M/s. Pinstorm, Mumbai.

## Interaction with graduate students from Ecole Normale Superieure

Chennai Mathematical Institute has an agreement with the Ecole Normale Superieure in Paris, France, one of the leading institutions in the world for teaching and research in Mathematics. This agreement provides for regular exchange visits

by academic members of CMI and ENS, Paris. This includes, in particular, exchanges of visits by undergraduate students between the two institutions.

The annual visitors from the ENS arrived in two groups: two for the period January-February and one for the period March-April. Colas Bardavid and Vincent Pilloni visited CMI during January-February, 2006 while Loic Dubois was here during March-April, 2006. They taught, examined and evaluated the course Calculus II (second semester of B.Sc. I). The fourth student, Oana Ivanovici, was not able to come because of administrative difficulties with her scholarship in France.

Every year, the top three students passing out from the B.Sc. Mathematics programme spend 8 weeks at the ENS, where they work on research projects with the ENS faculty. In May-June, 2005, Shuvra Gupta, Amruth Krishnan and Ganapathy Subramanian visited the ENS.





## Inaugural Symposium

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To commemorate the shift to the new campus, CMI organized an Inaugural Symposium during the first three weeks of January, 2006. A number of distinguished visiting scientists delivered lectures on Mathematics, Computer Science and Physics. Some of these talks were of a general nature and accessible to a general audience. During the Symposium, on 12 January, the campus was formally inaugurated by Dr. Anil Kakodkar, Chairman, Atomic Energy Commission.

### **The following scientists gave invited lectures in the symposium.**

- Prof. Manjul Bhargava, Princeton University, New Jersey, U.S.A.:  
“Counting field extensions of the rational numbers”.
- Prof. M. Ram Murty, Queen’s University, Canada: “The art of research”.
- Prof. S.R.S. Varadhan, Courant Institute of Mathematical Sciences, U.S.A.:  
“Probability, Large deviations, Entropy”.
- Prof. P.S. Thiagarajan, National University of Singapore, Singapore:  
“Approximating Hybrid Dynamics”.
- Prof. Manindra Agrawal, Indian Institute of Technology, Kanpur:  
“Determinant V/s Permanent”
- Prof. S Abhyankar, Purdue University, U.S.A.: “In the Footsteps of Algebraic Geometry: from Salmon to Zariski” and “Shreedharacharya’s Completing the Square Method and Newton’s Theorem”.
- Prof. S. Ramanan, Adjunct Professor, Chennai Mathematical Institute:  
“Fundamental group of projective varieties”.
- Prof. M. Vidyasagar, Executive Vice President, Tata Consultancy Services Ltd.:  
“Mathematics Statistics in Biology”.

- Prof. Robert Langlands, Institute for Advanced Study, Princeton, U.S.A.:  
“On seeing the theory of Automorphic forms as a whole”.
- Prof. C. De Concini, University of Rome, “La Sapienza”, Italy:  
“Partition functions and cohomology of toric arrangements”.
- Prof. N. Mukunda, Center for High Energy Physics, Indian Institute of Science, Bangalore: “The Einstein-Podolsky-Rosen paper of 1935: an important event in the history of Quantum mechanics”.
- Prof. David Mumford, Brown University, U.S.A.: “Differential geometry of the space of simple closed curves” and “What is Pattern Theory?”.
- Prof. K.R. Parthasarathy, Emeritus Distinguished Scientist, Indian Statistical Institute, Delhi: “Entropy, Information Communication”.
- Prof. Kalyan Sinha, Indian Statistical Institute, Delhi: “Quantum Random Walk”.
- Prof. Rohit Parikh, CUNY, U.S.A.: “If P, then Q; the mystery of the conditionals”.
- Prof. M.S. Raghunathan, TIFR, Mumbai:  
“Playing on the seashore? The pursuit of Science”.
- Prof. Jean-Marc Deshouillers, University of Bordeaux I, France:  
“Down to sixteen biquadrates”.
- Prof. T. Padmanabhan, IUCAA, Pune: “Dark energy: the cosmic conundrum”.
- Prof. Alladi Sitaram, Professor Emeritus, Indian Statistical Institute, Bangalore:  
“Uncertainty principles in harmonic analysis on Lie groups”.
- Prof. Rajeeva Karandikar, Indian Statistical Institute, Delhi:  
“Opinion polls and exit polls”.
- Prof. Rajendra Bhatia, Indian Statistical Institute, Delhi:  
“Riemannian Geometry and the Geometric Mean”.
- Prof. V.S. Sunder, Institute of Mathematical Sciences, Chennai:  
“von Neumann algebras”.
- Prof. G. Baskaran, Institute of Mathematical Sciences, Chennai:  
“The formidable Biology front”.
- Prof. V. Arvind, Institute of Mathematical Sciences, Chennai:  
“The algorithmic complexity of finite group problems”.



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- Readers
  - C.S. Aravinda
  - Clare D'Cruz
  - K. Narayan Kumar
  - S. Senthamarai Kannan
  - K.V. Subrahmanyam



■ Fellows	Bharat Adsul Samir Datta R. Srinivasan Suresh Nayak S.P. Suresh M.K. Vemuri
■ Scientific Officer	P. Vanchinathan
■ NBHM Post-doctoral Fellow	V. Uma
■ Research Scholars	Anindya Mozumdar (until May 2005) Gayathri Nair Nagarajan Krishnamurthy C. Prakash Pranab Sardar Puneet Bhateja R. Parthasarathi Rishi Raj (until May 2005) T. Saravanan (until July 2005) Suman Bandyopadhyay
■ NBHM Research Scholars	Santosha Kumar Pattanayak Shyamashree Upadhyay
■ CSIR Research Scholars	A. Baskar S. Jijo
■ Administrative Staff	S. Sripathy V. Vijayalakshmi Rajeshwari Nair G. Samson



## Faculty Profiles

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### C.S. Seshadri

C.S. Seshadri received his B.A. Hons. (Mathematics) degree from Madras University (1953) and his Ph.D. from Bombay University (1958). He was at the School of Mathematics, Tata Institute of Fundamental Research, Bombay from 1953 to 1984 starting as a Research Scholar and rising to a Senior Professor. He was then a Senior Professor at the Institute of Mathematical Sciences, Madras (1984-89). He has been a Visiting Professor at the University of Paris, France; Harvard University, Cambridge, U.S.A.; Institute for Advanced Study, Princeton, U.S.A.; University of California at Los Angeles, Los Angeles, U.S.A.; Brandeis University, U.S.A.; University of Bonn, Bonn, Germany; Kyoto University, Kyoto, Japan. He has given invited talks at many international conferences including the International Congress of Mathematicians, Nice, France, 1970. He has received the Shanti Swarup Bhatnagar Award and the Srinivasa Ramanujan Medal of Indian National Science Academy (INSA). He was awarded the D.Sc. Degree (Honoris Causa) of Banaras Hindu University, Varanasi. He has also been awarded the Shanti Swarup Bhatnagar Medal (1995) of INSA. He is a Fellow of the Indian Academy of Sciences, Indian National Science Academy and a Fellow of the Royal Society. His research interests are: Algebraic Geometry and Algebraic Groups.

### Shiva Shankar

Shiva Shankar received his B.Tech. (Electrical Engineering) from the Indian Institute of Technology, Delhi (1978) and his Ph.D. from SUNY, Stony Brook (1983). He has been an Assistant Professor, at the Department of Applied Mathematics, SUNY, Stony Brook (1983-84), a Visiting Fellow at the School of Mathematics, Tata Institute of Fundamental Research, Bangalore (1984-88), an Associate Professor at the Department of Electrical Engineering, Indian Institute of Technology, Bombay (1988-2000). Visiting Positions include Institute of Mathematical Sciences, Chennai, and at Mathematics

Institute, University of Groningen. His research interests are: Partial Differential Equations, Mechanics and Control Theory.

## **Rani Siromoney**

Rani Siromoney received her B.A. (Hons.) (Mathematics) degree from Madras University (1950), Master's degree from Columbia University (1960) and Ph.D. from Madras University (1970). She has been associated with the Madras Christian College since 1951, starting as a Lecturer and is now Professor Emeritus in the Department of Computer Science. She has been a Visiting Professor at the Boston University (1974) and Visiting Scientist at the IAS-Fujitsu Laboratories Numazu, Japan (1991). She has given invited talks in Theoretical Computer Science at many national and international conferences and lectures at several universities and Research Institutes. She has been awarded the Smith Mundt/Fulbright Scholarship for study in Columbia University (1958-59), "Outstanding Woman Professional" by the Federation of Industries and Chamber of Commerce (India) Ladies Organization, New Delhi (1984-85) and "Lifetime Achievement Award" by the Tamil Nadu State Council of Science and Technology (2002). Her research interests are: Formal languages and Automata, Picture languages, Cryptography, Machine learning and DNA Computation.

## **R. Sridharan**

R. Sridharan received his B.A. (Mathematics) degree from Vivekananda College, Chennai (1952), his M.A. (Mathematics) from Vivekananda College, Chennai (1955) and his Ph.D. (Mathematics) from Columbia University, New York (1960). He has been a Professor at the University of Bombay, Mumbai (1964-67) and a Senior Professor at the Tata Institute of Fundamental Research, Mumbai (1967-2000). He is a Fellow of the Indian Academy of Sciences and Indian National Science Academy. He received the Shanti Swarup Bhatnagar Prize of the Indian National Science Academy (1980). He has been an INSA Honorary Scientist since January 2001. His research interest is: Algebra.

## **K.R. Nagarajan**

K.R. Nagarajan received his B.Sc. (Mathematics) Hons. degree from Annamalai University (1953), his M.S. (Mathematics) from University of Chicago (1958) and his Ph.D. (Mathematics) from University of Chicago (1962). He has been a Lecturer at the Kerala University, Kerala (1965-67), a Reader at the Madurai Kamaraj University, Madurai (1967-76), a Professor and the Head of School of Mathematics, Madurai

Kamaraj University (1976-78-93) and a Visiting Professor, Central University, Pondicherry (1995-96). His research interest is: Commutative Algebra - Invariants.

## **V. Balaji**

V. Balaji received his B.A. Hons. (Mathematics) from University of Delhi (1982), his M.A. (Mathematics) degree from University of Delhi (1984), his Ph.D. from University of Madras (1991). He has been an NBHM Post-doctoral Fellow at the Chennai Mathematical Institute (1989-92). His research interest is: Algebraic Geometry.

## **Madhavan Mukund**

Madhavan Mukund received his B.Tech. (Computer Science) degree from the Indian Institute of Technology, Bombay (1986) and his Ph.D. from Aarhus University, Aarhus, Denmark (1992). He has been a Visiting Professor at the University of Paris 7 (2001, 2005). He is a member of the Executive Council and the Secretary of the Indian Association for Research in Computing Science (IARCS). He is also the National Coordinator of the Indian Computing Olympiad. His research interests are: Partial order based models for concurrent systems and Logics for specifying and verifying concurrent systems.

## **C.S. Aravinda**

C.S. Aravinda received his B.Sc. degree from Bangalore University (1983), his M.Sc. (Mathematics) degree from Bangalore University (1985) and his Ph.D. from the University of Bombay (1995). He has been a Visiting Mathematician at ICTP, Trieste, Italy (1991-92) and a Research Associate at the Indian Statistical Institute, Bangalore (1995-97). He has been a visiting Associate Professor at the State University of New York at Binghamton (2000-2002). His research interests are: Ergodic Theory, Riemannian Geometry and Topology.

## **Clare D' Cruz**

Clare D' Cruz received her M.Sc. (Mathematics) from the Indian Institute of Technology, Bombay (1991) and her Ph.D. (Mathematics) from the Indian Institute of Technology, Bombay (1996). She has been a Post-Doctoral Fellow at the Tata Institute of Fundamental Research, Mumbai (1996-98) and a Visiting Scholar at the Northeastern University, Boston, U.S.A. (1997-98). Her research interest is: Commutative algebra.

## **K. Narayan Kumar**

K. Narayan Kumar received his M.Sc. (Tech.) in Computer Science from Birla Institute of Technology and Science, Pilani (1990). He received his Ph.D. degree from the University of Bombay (1997). He has been a visiting scholar at the State University of New York at Stony Brook (1997-98). He has been a Visiting Professor at the University of Paris 7 (2003). His research interests include Logic, Automata theory and Concurrency.

## **S. Senthamarai Kannan**

S. Senthamarai Kannan received his B.Sc. degree from HKRH College, Uthama Palayam (1985-88), M.Sc. degree from the Madurai Kamaraj University (1988-90) and Ph.D. from the Chennai Mathematical Institute, (1992-98). He has been a Post-doctoral Fellow at the International Centre for Theoretical Physics (1999-2000). His research interests are: Representation Theory and Algebraic Geometry.

## **K.V. Subrahmanyam**

K.V. Subrahmanyam received his B.Tech. (Computer Science) degree from the Indian Institute of Technology, Bombay (1986) and M.S. from Vanderbilt University, U.S.A. in 1987. He received his Ph.D. degree from the University of Bombay in December, 1995. His research interests are: Circuit Complexity, Algebraic methods in Complexity theory.

## **Bharat Adsul**

Bharat Adsul received his B.Tech. (Computer Sc. and Engg.) degree from the Indian Institute of Technology, Bombay (1997) and Ph.D. (Computer Sc. and Engg.) degree from the Indian Institute of Technology Bombay (2003). His research interests are: Logic, Concurrency and Combinatorics.

## **Samir Datta**

Samir Datta received his B. Tech. degree from the Indian Institute of Technology, Kanpur (1995), M.S. degree from Rutgers University (1997) and Ph.D. degree from Rutgers University (2004). He has been a Network Architect at Tellium Inc. (2000-03) and a Post Doctoral Fellow at WINLAB, Rutgers University (2004-05). His research interests are: Complexity Theory, Wireless and High Speed Networking.

## **R. Srinivasan**

R. Srinivasan received his Ph.D. degree in Mathematics from the Indian Statistical Institute and the Institute of Mathematical Sciences (1998). He has been a Visiting Fellow at the Harish-Chandra Research Institute, Allahabad (1998-2000), a Post Doctoral Fellow at the Indian Statistical Institute (2000-01), a Post Doctoral Fellow at Universite d'Orleans, France (2001-02), a Visiting Scientist at the Indian Statistical Institute (2002-03), a Visiting Fellow at ICTP, Trieste, Italy (2003) and a JSPS Post Doctoral Fellow at University of Tokyo, Japan (2003-2005). His research interests are: Operator Algebras and Operator Theory.

## **Suresh Nayak**

Suresh Nayak received his B.Tech. (Computer Science) degree from the Indian Institute of Technology, Bombay (1991), M.S. and Ph.D. (Mathematics) degree from the Purdue University, (1997,98). He has been a Visiting Fellow at the Harish-Chandra Research Institute, Allahabad (1999-2001). His research interests are: Algebraic Geometry and Commutative Algebra.

## **S.P. Suresh**

S.P. Suresh received his M.C.A. degree from R.E.C. Trichy (1996), received his M.Sc. (by Research) from Anna University (1999) and received his Ph.D. degree from the Institute of Mathematical Sciences (2003). His research interests are: Logic in Computer Science, Reasoning about Security protocols and Classical Indian Epistemology.

## **M.K. Vemuri**

M.K. Vemuri received his M.S. (Mathematics) from Syracuse University, U.S.A. (1989) and Ph.D. from the University of Chicago, U.S.A. (1997). He has been a Visiting Assistant Professor at Colgate University, U.S.A. (1997-99), an Instructor at Polytechnic University, U.S.A. (1999-2000) and a Teaching Research Associate at Syracuse University, U.S.A. (2000-2002). His research interest is: Analysis



## Publications

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### Journal Articles

#### Mathematics

- [J1] R. Balaji, T. Parthasarathy, D. Sampangi Raman and V. Vetrivel: On the Lipschitz continuity of the solution map in semidefinite linear complementarity problems, *Mathematics of Operations Research*, Volume 30(2), (2005) 462-471.
- [J2] V. Balaji, I. Biswas and D.S. Nagaraj: Krull-Schmidt Theorem for principal bundles, *J. reine. angew. Math*, 578 (2005) 225-234.
- [J3] V. Balaji, I. Biswas and D.S. Nagaraj: Tannakian Krull-Schmidt Theorem, to appear in *J. reine. angew. Math*, (2006).
- [J4] V. Balaji, I. Biswas, D.S. Nagaraj and P.E. Newstead: Universal Families on moduli of principal bundles, *International Math Research Notices*, (2006), No. 2.
- [J5] Clare D’Cruz: Multi-graded extended Rees algebras of  $\mathfrak{m}$ -primary ideals, to appear in *Beitrage zur Algebra und Geometrie*.
- [J6] Clare D’Cruz and A. Guerrieri: Multi-graded Hilbert coefficients in Commutative Algebra with a focus on geometric and homological aspects , *Lecture Notes in Pure and Applied Mathematics* 244, Chapman Hall/CRC, Boca Raton, FL (2006) 59-68.
- [J7] C.S. Seshadri: Geometric reductivity (Mumford’s Conjecture) - revisited, *Contemporary Mathematics*, 390 (2005) 137-145.
- [J8] C.S. Seshadri, P. Littelmann and V. Lakhmibai: *Standard Monomial Theory*, Birkhauser, to appear.

- [J9] R. Sridharan and K.R. Nagarajan: On Brahmagupta's and Kummer's quadrilaterals, to appear in *Elemente der Mathematik*.
- [J10] M.K. Vemuri and Tim Steger: Inductive algebras for, *Illinois J. Math.*, 49(1), (2005) 139-151.

## Computer Science

- [J11] Ganapathy Subramaniam and Rani Siromoney: An Efficient DNA Method to solve P Complete problems, *Bulletin of Kerala Mathematics Association*, Vol 2(2), (2005) 9-24.
- [J12] Ganapathy Subramaniam and Rani Siromoney: Contextual insertion for SAT, *Bulletin of the European Association for Theoretical Computer Science*, No 88 (2006).
- [J13] J.G. Henriksen, Madhavan Mukund, K. Narayan Kumar, M. Sohoni and P.S. Thiagarajan: A Theory of Regular MSC Languages, *Information and Computation*, 202(1), (2005) 1--38.
- [J14] R. Ramanujam and S.P. Suresh: A (restricted) quantifier elimination for security protocols, To appear in a special issue of *Theoretical Computer Science* (2006).

## Conference Papers

### Mathematics

- [C1] K.R. Nagarajan: Valuations, to appear in the *Proceedings of the International Workshop on Commutative Algebra Algebraic Geometry*.
- [C2] Shiva Shankar: Control Theory and Algebraic Geometry, to appear in the *Proceedings of the XXI Annual Meeting of the Ramanujam Mathematical Society*.
- [C3] R. Sridharan: A Proof of the Riemann Roch Theorem for Functional Fields of Curves, to appear in the *Proceedings of the International Workshop on Commutative Algebra Algebraic Geometry*.
- [C4] R. Sridharan: On Yet Another Marginal Note of Fermat, to appear in the *Proceedings of a joint conference of Mathematics Teachers of U.S and India*, organised by the N.B.H.M.



- [C5] R. Sridharan: On Pingala Sutras and binary Arithmetic, in History and Culture of Mathematics, G.G. Emch, R. Sridharan and M.D. Srinivas (eds), Hindustan Publishing Agency (2005).
- [C6] R. Sridharan: On the History of Ancient, Classical and Medieval Indian Mathematics, in History and Culture of Mathematics, G.G. Emch, R. Sridharan and M.D. Srinivas (eds), Hindustan Publishing Agency (2005).

## Computer Science

- [C6] Eric Allender, David A. Mix Barrington, Tanmoy Chakraborty, Samir Datta and Sambuddha Roy: Grid Graph Reachability Problems, Proc. 21st Annual IEEE Conference on Computational Complexity (2006) 299-313.
- [C7] Eric Allender, Samir Datta and Sambuddha Roy: The Directed Planar Reachability Problem, Proc. Foundations of Software Technology and Theoretical Computer Science FSTTCS 2005, Springer Lecture Notes in Computer Science 3821 (2005) 238-249.
- [C8] Eric Allender, Samir Datta and Sambuddha Roy: Topology inside in Proc. 20th Annual IEEE Conference on Computational Complexity (2005).
- [C9] S. Biswas and Samir Datta: Energy Savings by Intelligent Interface Idling in 802.11 based Wireless Networks, IEEE Electro/ Information Technology Conference (2005).
- [C10] Samir Datta, M. Demirhan, S. Mau, D. Raychaudhuri and I. Seskar: Ad-hoc extensions to the 802.15.3 MAC Protocol, in Proc. WoWMoM2005, IEEE Computer Society (2005).
- [C11] Samir Datta and Tanmoy Chakraborty: One-input-face MPCVP is Hard for L, but in LogDCFL, to appear in Proc. 26th annual Conference on Foundations of Software Technology and Theoretical Computer Science FSTTCS 2006, Lecture Notes in Computer Science.
- [C12] Bharat Adsul, Madhavan Mukund, K. Narayan Kumar and Vasumathi Narayanan: Causal closure for MSC languages, Proc. Foundations of Software Technology and Theoretical Computer Science FSTTCS 2005, Springer Lecture Notes in Computer Science, 3821 (2005) 335-347.

- [C13] Abdul Sahid Khan, Madhavan Mukund and S.P. Suresh: Generic verification of security protocols, Proceedings of SPIN 2005, Springer Lecture Notes in Computer Science 3639 (2005) 221-235.
- [C14] Madhavan Mukund, K. Narayan Kumar, P.S. Thiagarajan and Shaofa Yang: Anchored Concatenation of MSCs, to appear in K.G. Subramanian, K. Rangarajan and M. Mukund (eds.): Formal Models, Languages and Applications, Papers dedicated to Prof. Rani Siromoney on her 75th birthday, World Scientific (2006).
- [C15] R. Ramanujam and S.P. Suresh: Deciding knowledge properties of security protocols, Proceedings of the Tenth Conference on Theoretical Aspects of Rationality and Knowledge, (2005) 219-235.

## Preprints and Reports

### Mathematics

- [P1] C.S. Aravinda: Riesz Representation Theorems, Mathematics Newsletter of the Ramanujan Mathematical Society, 15(2), (2005).
- [P2] V. Balaji: Principal bundles on projective varieties and the Donaldson-Uhlenbeck compactification, (arXiv:math.AG/0505106)
- [P3] V. Balaji: A. Dey and R. Parthasarathi: Geometry of parabolic bundles on surfaces I, The Donaldson-Uhlenbeck compactification, (archiv:math.AG/0601274).
- [P4] V. Balaji, J. Kollar: Holonomy groups of stable vector bundles, (archiv:math.AG/0601120).
- [P5] Clare D'Cruz and T. Puthenpurakal: The Hilbert Coefficients of the fiber cone and the a-invariant of the associated graded ring, (2006).
- [P6] S. Senthamarai Kannan and J. Juyumaya: Almost parabolic subgroups, (2006).
- [P7] S. Senthamarai Kannan: Cohomology of line bundles on Schubert varieties in the Kac-Moody setting.
- [P8] Suresh Nayak and Pramathanath Sastry: Applications of duality theory to Cousin complexes, Preprint (2006).

## Computer Science

- [P9] Prakash Chandrasekaran and Madhavan Mukund: Automated Verification of Communicating Systems.
- [P10] K. Narayan Kumar: Lecture Notes on Automata, Logics, Games and Algebra, Part I (Words).

## Physics

- [P11] Tulsı Dass: Measurements and Decoherence [CMI report CMI/PHYS-2005-2, May 2005; Arxiv: quant-ph/0505070].
- [P12] Tulsı Dass: Dynamical probability, particle trajectories and completion of traditional quantum mechanics [CMI report CMI/PHYS-2005-3, May 2005; Arxiv: quant-ph/0505190].

## Ph.D. Thesis

- [T1] K. Paramasamy was awarded the Ph.D. degree by the University of Madras, Chennai for his thesis entitled “Cohomology of Line Bundles on Schubert Varieties”, in June 2005.





## Conferences, Visits and External Lectures

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### C.S. Seshadri

- Gave a special lecture at the Twentieth Annual Conference of the Ramanujan Mathematical Society, held at the University of Calicut, Kerala, in July 2005.

### Rani Siromoney

- Gave a talk at Marudhar Kesari Jain College for Women, Vaniyambadi, Vellore, in July 2005.
- Gave a talk on “Context-free Grammars and Languages” at Vel Tech Engineering College, Chennai, in July 2005.
- Gave a talk on “Formal Languages and its applications to Computer Science”, at the National Conference on “Discrete Mathematics and Probability Theory for Computer Science”, Sponsored by University Grants Commission and Sacred Heart College, Tirupattur, in July 2005.
- Gave a talk on “Mathematical Modelling in Computer Science with Applications to Biology” at the UGC Sponsored Symposium on “Interdisciplinary Applications on Mathematical Modeling” held at V.V. Vanniaperumal College for Women, Virudhunagar, in August 2005.
- Gave a talk on “A New Efficient Method to solve Enumeration Problems that are P-Complete” at the National Conference on “Recent Trends in Discrete and Fuzzy Mathematics”, sponsored by UGC, NBHM, and CSIR and Kerala Mathematical Association Dept of Mathematics, Bharata Mata College, Kochi, in November 2005.
- Gave a talk on “Code words for the solution of  $\Sigma_1^1$ -Complete problems” at the National Seminar on “Algebra and Coding Theory” at Kanjirapally, Kottayam, Kerala, in November 2005.

- Gave lectures to the M.Phil. students at the Department of Computer Science, University of Madras on “Theory of Computation and Bio-informatics”, in November-December 2005.

## **R. Sridharan**

- Gave a lecture on “A Proof of the Riemann Roch Theorem for Functional Fields of Curves” at the International Workshop on Commutative Algebra Algebraic Geometry organized by the Department of Mathematics, St. Joseph’s College, Irinjalakuda, Kerala and the Kerala Mathematical Association during July 2005.
- Gave a lecture on “Bilinear Forms” at the Twentieth Annual Conference of the Ramanujan Mathematical Society, held at the University of Calicut, Kerala, in July 2005.
- Attended the Symposium in “Algebraic Number Theory” held jointly by Thakur College of Science and Engineering, Khandivli and the Bombay Mathematical Colloquium and gave invited lectures on “The lemniscate and Gauss’ last entry in his diary” and “Luroth’s theorem and Klein’s theorem on the finite subgroups of ” in November 2005.
- Delivered the Prof. R.K. Gupta endowment lecture on “Pratyayas in Prosody” at the Annual Meeting of AMTI in Valsad in December 2005.
- Attended AMS-NBHM Joint Conference at NCERT, Delhi and gave a talk entitled “On yet another marginal note of Fermat” during January 2006.
- Gave a talk on “Pratyayas beginning with Pingala Sutras” at the National Seminar on “History and Philosophy of Indian Science” held at the Indian Institute of Technology, Bombay, in February 2006.
- Delivered the Sahu Kishori Lal Memorial Lecture on “Brahmagupta’s and Kummer’s quadrilaterals and a theorem of Fermat” at the National Conference on “History of Mathematics and Recent Developments” in Patna, organized by the Indian Society for History of Mathematics and Department of Mathematics, Patna University in collaboration with Council of Scientific and Industrial Research, New Delhi, in March 2006.

## **K.R. Nagarajan**

- Gave a talk on “Valuations” at the International Workshop on Commutative Algebra Algebraic Geometry organized by the Department of Mathematics, St. Joseph’s College, Irinjalakuda, Kerala and the Kerala Mathematical Association during July 2005.

## V. Balaji

- Visited and gave talks about work on Donaldson-Uhlenbeck compactifications in University of Liverpool, UK, Imperial College, London, University of Essen, Germany and Institut Fourier, Grenoble during April-June 2005.

## Tulsi Dass

- Attended lectures in the International Workshop on “Noncommutative geometry and quantum Physics” at the Institute of Mathematical Sciences, Chennai (2005).

## Madhavan Mukund

- Visiting Professor at the University of Paris 7, France, in May 2005.
- Visited LIAFA, University of Paris 7, LSV, ENS de Cachan and LaBRI, University of Bordeaux 1 for one month during May-June 2005 to pursue joint research with Paul Gastin, Anca Muscholl and Pascal Weil. Gave a talk entitled “Causal realizability for MSC languages” at LIAFA, University of Paris 7 in June 2005.
- Participated in the 4th Update Meeting on “Advanced Formal Methods” at the Indian Institute of Technology, Bombay, and gave a talk on “Verification of Message Sequence Charts” in July 2005.
- Participated in the workshop on “Formal Methods for Design and Analysis of Software” at IISc/Microsoft Research, Bangalore, and gave a talk on “Causal closure for MSC languages” in October 2005.
- Visited LSV, ENS de Cachan and LaBRI, University of Bordeaux 1 for three weeks in November 2005 on the Indo-French Networking Research Programme project “Timed and distributed models for control and verification (Timed-DISCOVERI)”. Gave a talk entitled “Causal closure for MSC languages” at LSV, ENS de Cachan on November 29, 2005.
- Participated in the workshop on “Perspectives in Verification”, at LSV, ENS de Cachan, in November 2005.
- Participated in the FSTTCS pre-conference workshop on “Software Verification” at the University of Hyderabad in December 2005.
- Participated in FSTTCS 2005, at IIIT, Hyderabad, chaired a session and gave a talk on “Causal closure for MSC languages” in December 2006.

## **C.S. Aravinda**

- Attended the National Seminar on “Recent trends in Analysis and Applications” held at G.H. College, Haveri, Karnataka and gave a talk on “Classifying low-dimensional manifolds” during June, 2005.
- Attended the National Seminar on “Recent trends in Analysis and Applications” held at the Periyar University, Salem, and gave a talk on “Continued Fractions and Khinchine’s Theorem” during October 2005.
- Attended the National Conference on “Relativity and its impact on Mathematical Sciences” held at KRC PG Centre of Karnatak University, Belgaum, Karnataka and gave a talk on “Ricci flow and the Poincare Conjecture” during October 2005.
- Attended the UGC National Seminar on “Perspectives in Mathematics” held at the Ramakrishna Vidyamandira, Belur Math, Kolkata and gave a talk on “Keakeya Needle Problem” during February 2006.
- Visited the Statistics and Mathematics Unit of the Indian Statistical Institute, Delhi and gave three talks on “Ricci flow and Perelman’s work on the Poincare Conjecture” during February, 2006.

## **K. Narayan Kumar**

- Attended the 6th Update Meeting on “Formal and Verification”, at the Indian Institute of Technology, Bombay and gave lectures on “Game Theory”, in July 2005.
- Attended the Workshop on “Formal Methods for Design and Analysis of Software” at Microsoft Research India, Bangalore, in October 2005.
- Attended FSTTCS pre-conference workshop on “Software Verification”, Hyderabad, in December 2005.
- Attended the 25th conference on Foundations of Software Technology and Theoretical Computer Science, Hyderabad, India in December 2005.

## **K.V. Subrahmanyam**

- Participated in the annual FSTTCS held at Hyderabad in December 2005.
- Gave a public lecture on “The P Vs NP problem” at the Arunai Engineering College in February 2006.
- Visited Prof. Milind Sohoni at the Indian Institute of Technology, Bombay during March 2006.

## **S. Senthamarai Kannan**

- Visited the Institute of mathematics at Oberwolfach, Germany for the RIP programme and Department of Mathematics at University of Aarhus, Aarhus, Denmark and gave a seminar talk during October-November 2005.

## **Clare D' Cruz**

- Gave a talk on “The length formula for finitely supported complete ideals”, at the Indian Institute of Technology, Madras, in March 2006.

## **M.K. Vemuri**

- Gave four lectures on “A minimal introduction to Kahler geometry” at the Institute of Mathematical Science, Chennai, during April 2005.
- Attended the conference on “Operator theory and Operator Algebras” and gave a lecture on “Inductive Algebras” at the Indian Statistical Institute/Indian Institute of Science, Bangalore, in December 2005.

## **R. Srinivasan**

- Attended a workshop and a subsequent conference on Operator theory and operator algebra held in Indian statistical Institute, Bangalore and gave a talk titled “Generalised CCR flows” in December 2005.
- Visited B.V. Rajarama Bhat at Indian Statistical Institute, Bangalore, in February 2006.

## **Bharat Adsul**

- Attended 4th Update Meeting on “Advanced Formal Methods” and gave a talk on “Memoryless winning strategies in parity games” at the Indian Institute of Technology, Bombay, in July 2005.
- Attended Workshop on “Formal Methods for Design and Analysis of Software” at Microsoft Research India, Bangalore in October 2005.
- Attended FSTTCS 2005 at IIIT Hyderabad, in December 2005.
- Visited Prof. Milind Sohoni at the Indian Institute of Technology, Mumbai in June and December 2005.
- Attended TCS Excellence in Computer Science (TECS) Week on Embedded Systems at Pune in January 2006.



## **S.P. Suresh**

- Gave a course of lectures on “Verification of security protocols” at the DIT instructional school on security for NIT lecturers held at Tata Institute of Fundamental Research, Mumbai, in June 2005.
- Attended Formal Methods Update meeting and gave a talk on “logics for security protocols” at the Indian Institute Technology, Bombay in July 2005.
- Attended Workshop on “Formal Methods for Design and Analysis of Software” at the Indian Institute of Science, Bangalore, in October 2005.
- Attended FSTTCS annual conference in Theoretical Computer Science at IIIT Hyderabad, and the pre-conference workshop on software model checking in December 2006.
- Attended the First Indian Winter School on Logic and its Relationship with other disciplines, at the Indian Institute Technology, Bombay and gave lectures on Godel’s Incompleteness Theorem in the Logic school in January 2006.
- Visited K S R College, Erode and gave a talk on “Linear Algebra and Galois Theory” in July 2005.
- Visited K S R College, Erode and gave a talk on “Number Theory and Public Key Cryptosystems” in February 2006.

## **A. Baskar**

- Attended Formal Methods Update meeting at Indian Institute of Technology, Mumbai, in July 2005.
- Attended the Workshop on “Formal Methods for Design and Analysis of Software” at the Indian Institute of Science, Bangalore, in October 2005.
- Attended the FSTTCS annual conference in Theoretical Computer Science at IIIT Hyderabad, in December 2006.

## **C. Prakash**

- Visited TRDDC, Pune, for Summer Internship during May-June 2005.
- Attended Formal Methods Update Week 05 at the Indian Institute of Technology, Mumbai, in July 2005.
- Visited Microsoft Research India, Bangalore during November 2005, for a project discussion.
- Attended FSTTCS 2005 at IIIT Hyderabad, in December 2005.
- Attended TECS Week 2006 at TRDDC, Pune, in Jan 2006.



## Other Professional Activities

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### Shiva Shankar

- Associate Editor, Intl. Jour. on Multidimensional Systems and Signal Processing (Springer Verlag).

### Rani Siromoney

- Reviewer for Mathematical Reviews, Referee for Journals and Conference Proceedings.

### Tulsi Dass

- Continued work on the book tentatively entitled 'Foundations of Geometry, Probability and Physics'.

### Madhavan Mukund

- Member, Editorial Board, Formal Methods Letters
- Member, Program Committee, 23rd Symposium on Theoretical Aspects of Computer Science (STACS 2006), Marseilles, France, 2006.
- Member, Program Committee, 27th International Conference on Application and Theory of Petri Nets (ICATPN 2006), Turku, Finland, 2006.
- Member, Program Committee, 33th International Colloquium on Automata Languages and Programming (ICALP 2006), Venice, Italy, 2006.
- Member, Program Committee, 4th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2006), Pune, India, 2006.
- Member, Program Committee, 26 International Conference on Foundations of Software Technology and Theoretical Computer Science FSTTCS 2006, Kolkata, India, 2006.

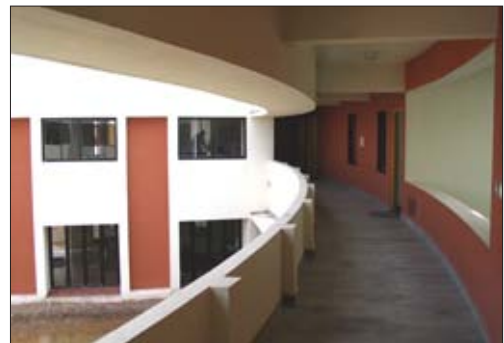
- Member, Organizing Committee, Workshop on Formal Methods for Design and Analysis of Software, IISc/Microsoft Research, Bangalore, October 2005.
- Secretary, Indian Association for Research in Computing Science (IARCS).
- National Coordinator, Indian National Olympiad in Informatics.
- Team Leader of the Indian team, International Olympiad for Informatics, Nowy Sacz, Poland, August 2005.
- Column editor, “News from India”, Bulletin of the European Association for Theoretical Computer Science (EATCS).

### **K. Narayan Kumar**

- Coach at the training camp for selecting the Indian team to participate in the International Informatics Olympiad at Nowy Sacz, Poland.
- Deputy Leader of the Indian team to the International Informatics Olympiad held at Nowy Sacz, Poland in September 2005.
- Coach of the CMI teams to the ACM ICPC programming competitions held at Calcutta and Coimbatore.

### **P. Vanchinathan**

- Along with Madhavan Mukund carried out consultation work for HCL BPO in building a mathematical/statistical model in real-estate pricing.





## Undergraduate / Graduate Courses

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Course	Instructor
■ Algebra I .....	V Balaji
■ Calculus I .....	T Parthasarathy
■ English .....	Shreekumar Varma
■ Classical Mechanics I .....	P P Divakaran
■ Introduction to Programming I .....	Madhavan Mukund
■ Algebra III .....	K R Nagarajan
■ Design Analysis of Algorithms .....	K V Subrahmanyam
■ Analysis I .....	Amritanshu Prasad, IMSc
■ Calculus III .....	Suresh Nayak
■ Algebra IV .....	R Sridharan
■ Differential Equations .....	M G Nadkarni, University of Bombay
■ Theory of Computation .....	R Siromoney / K Narayan Kumar
■ Mathematical Physics .....	K S Balaji
■ Properties of Matter .....	R Shankar, IMSc
■ Quantum Mechanics I .....	Tulsi Dass
■ Physics Laboratory .....	R Shankar, IMSc
■ Quantum Mechanics III .....	N D Hari Dass, IMSc
■ Statistical Physics II .....	R Jagannathan, IMSc
■ Condensed Matter Physics .....	R Sridhar

- Laboratory ..... M S R Rao, IIT Madras
- Algebra ..... Clare D’Cruz
- Measure Integration ..... M K Vemuri
- Algebraic Topology ..... C S Aravinda
- Global Calculus ..... S Ramanan
- Lie Algebra ..... S Senthamarai Kannan
- Riemannian Geometry ..... C S Aravinda
- Database Systems ..... Madhavan Mukund
- Computer Networks ..... Samir Datta
- Distributed Computing ..... S P Suresh
- Computer Systems Verification ..... Bharat Adsul
- Algebra II ..... K R Nagarajan
- Calculus II ..... Colas Bardavid / Vincent Pilloni  
Loic Dubois, ENS, France
- Discrete Mathematics ..... Bharat Adsul
- Introduction to Programming II ..... K Narayan Kumar
- Economics ..... S K Shanti, IFMR
- Analysis II ..... Suresh Nayak
- Computer Organization ..... S P Suresh
- Electromagnetic Theory I ..... K S Balaji
- Topology ..... V Balaji
- Programming Language Concepts ..... Madhavan Mukund
- Probability ..... P Vanchinathan
- Partial Differential Equations ..... Shiva Shankar
- Game Theory ..... T Parthasarathy
- Electromagnetic Theory II ..... R Parthasarathy, IMSc
- Atomic Molecular Physics ..... S Sivakumar, IGCAR, Kalpakkam

- Quantum Mechanics II ..... H S Mani
- Classical Mechanics II ..... M V N Murthy, IMSc
- Statistical Mechanics ..... K P N Murthy, IGCAR, Kalpakkam
- Computational Methods ..... Rahul Sidhartan, IMSc.
- Nuclear Particle Physics ..... R K Bhaduri, McMaster University,  
Canada / Tulsı Dass
- General Relativity Cosmology ..... G Rajasekharan, IMSc.
- Laboratory II ..... M S R Rao, IIT Madras
- Algebra II (Core) ..... S Senthamarai Kannan
- Functional Analysis (Core) ..... S Kesavan, IMSc.
- Complex Analysis (Core) ..... M K Vemuri
- Algebraic Topology II ..... C S Aravinda
- Compilers ..... K V Subrahmanyam
- Discrete Mathematics ..... Bharat Adsul
- Mathematical Logic ..... S P Suresh
- Data Mining ..... Madhavan Mukund
- Automata and Concurrency ..... Madhavan Mukund / Kamal Lodaya
- Automata, Logics, Games Algebra ..... K Narayan Kumar
- Topics in Parallel and Circuit ..... Samir Datta  
Complexity





## Courses, Special Lectures

- Prof. G. Rajasekaran, Institute of Mathematical Sciences, Chennai. Gave talks on “Physics at the turn of the century”, “Classical Physics”, “Relativity and Quantum Physics A pedagogical overview of the basic concepts” and “Is there a Final Theory?” (September 2005).
- Prof. Rahul Basu, Institute of Mathematical Sciences, Chennai.: The Rhythm of Time: The evolution of the calendar through the ages - Midweek Colloquium Series (October 2005).
- Prof. C.V.K. Baba, Ex Tata Institute of Fundamental Research, Mumbai. Gave a series of lectures on “Some Landmark Experiments in Physics” (October-November 2005).
- Prof. Tulsi Dass. Gave a talk on “General (Noncommutative) Supersymplectic Mechanics: A Unified Symplectic View of Physics” (November 2005).
- Tanmoy Chakraborty. Gave a talk on “Reachability in Single Source Planar DAGs” (November 2005).
- Dr. K. Narayan Kumar. Gave a course of lectures on “Automata, Logics, Games and Algebra” (November 2005-March 2006).
- Dr. Suresh Nayak. Gave a talk on “On Kempf’s instability theorem” - Seminar on Algebraic Geometry (January 2006).
- Dr. R. Srinivasan. Gave a talk on “Simple semigroups and its generalisations” (February 2006).
- Prof. V. Balaji. Gave a talk in the Seminar on Algebraic Geometry (February 2006).
- Dr. S. Senthamarai Kannan. Gave a talk on “Steinberg tensor product theorem and Steinberg representation” - Seminar on Algebraic Geometry (March 2006).
- Dr. Amritanshu Prasad, Institute of Mathematical Sciences, Chennai. Gave a talk on “On Bruhat decomposition over local principal ideal rings” - Seminar on Algebraic Geometry (March 2006).

## Visitors

- Prof. K. Varadarajan, University of Calgary, Canada. Gave a talk on “Exchange rings and clean rings (Part II)” (June 2005).
- Prof. Lorenzo Ramero, Universite Bordeaux I, France. Gave a talk on “Local monodromy on the non-archimedean punctured disc” (July 2005).
- Prof. K. Thulasiraman, School of Computer Science, University of Oklahoma. Gave a talk on “QoS Path Problems in Communication Networks” (July 2005).
- Prof. Alladi Sitaram, Indian Statistical Institute, Bangalore. Gave talks on “Some open problems in harmonic analysis on symmetric spaces semi-simple groups” (July 2005) and Harmonic analysis - from Fourier to Harish-Chandra” (November 2005).
- Prof. M.S. Raghunathan, Tata Institute of Fundamental Research, Mumbai. Gave talks on “Cocompact lattices in semisimple groups” and “Bruhat-Tits Theory” (July 2005).
- Sourav Chakraborty, University of Chicago, U.S.A. Gave a talk on “Online algorithms” (September 2005).
- Prof. Evgeny Mukhin, Indiana-Purdue university, U.S.A. Gave a talk on “Bethe Ansatz and problems of real and complex algebraic geometry” (December 2005).
- Naveen Garg, Indian Institute of Technology, Delhi. Gave a talk on “Minimizing flow time on related machines” (January 2006).
- Prof. Oscar Garcia-Prada, CSIC, Madrid. Gave a talk on “Representations of surface groups and Higgs bundles” (January 2006).
- Prof. V.Lakshmibai, Northeastern University, U.S.A. Gave a talk on “Schubert varieties, Classical and Affine” (March 2006).



*N. K. Rajendiran & Co.,*  
Chartered Accountant.

Off : 2488 0116  
Res : 2654 4897

**FORM NO. 10-B**  
(See Rule 17 - B)

**AUDITOR'S REPORT**

**Audit report u/s 12A(b) of the Income Tax Act 1961, in case of charitable or religious Trust or institutions**

We have examined the Balance sheet of **CHENNAI MATHEMATICAL INSTITUTE**, Plot No. H1, SIPCOT IT Park, Siruseri 603 103 as at 31<sup>st</sup> March 2006 and also the Income & Expenditure Account for the year ended on that date which are in agreement with the books of accounts maintained by the said Institution.

We have obtained all the information and explanations, which to the best of our knowledge and belief, were necessary for the purpose of our audit. In our opinion, proper books of account, have been kept by the Head Office and the Branches of the above named institution visited by us so far as appears from our examination of the books, and proper returns adequate for the purposes of Audit have been received from Branches not visited by us.

In our opinion, and to the best of our information and according to the information given to us the said accounts give a true and fair view.

- i) in case of Balance Sheet, of State of affairs of the above named Institution as at 31<sup>st</sup> March 2006, and
- ii) in case of Income & Expenditure Account, of the Excess of Expenditure over Income for the year end on that date.

Prescribed particulars are annexed hereto.

**FOR N.K.RAJENDIRAN & CO.**  
Chartered Accountants.

Place: Chennai  
Date: 20-07-2006

*N.K. Rajendiran*  
(N.K.RAJENDIRAN)  
PROPRIETOR



**CHENNAI MATHEMATICAL INSTITUTE**

PAN. NUMBER : AAATS2229M  
 G.I.R. NUMBER : 4725-C  
 WARD : DIT(EXEMPTION) IV  
 STATUS : TRUST  
 ASSESSMENT YEAR : 2006-07

**STATEMENT OF TOTAL INCOME FOR THE PURPOSE OF INCOME TAX**

<u>GROSS RECEIPTS DURING THE YEAR:</u>	RS.	RS.
Voluntary Contributions	18770750	
Interest Income	796,573	
Fees and Other Receipts (As per Income & Expenditure A/c)	553,710	
	<hr/>	
<b>GROSS INCOME BEFORE</b>		<b>20,123,033</b>
<b>CHARITABLE EXPENSES</b>		
Research & Establishment Expenses	11919477	
Operational Expenses	7902049	
Other Administrative Expenses	591066	
	<hr/>	
		<b>20,412,593</b>
<b>CAPITAL INVESTMENTS</b>		
Fixed Deposits		1,395,469
Capital Expenditure (As per Fixed Assets Schedule)		24,890,534
Depreciation		2,738,703
<b>TOTAL OF APPLICATION</b>		<b>49,437,299</b>
Income to be Applied 85% of the Income		17,104,578
Actually Applied		49,437,299
Taxable Income		NIL
Tax Deducted at Source		51,627
Refund Due		<b>61,627</b>

**Note: Excess of application was met out of capital receipt and fixed deposit realisation during the year**

**For CHENNAI MATHEMATICAL INSTITUTE**

*Chidambaram*  
**Trustee/Director**



**Place: Chennai**  
**Date: 20/09/2006**

**CHENNAI MATHEMATICAL INSTITUTE  
PLOT NO. H1, SIPCOT IT PARK, SIRUSERI 603 103.**

**BALANCE SHEET AS AT 31ST MARCH 2006**

<u>SOURCES OF FUNDS</u>	SCH	31.03.2006 Rs.	31.03.2005 Rs.
Capital Fund	A	13499597	13499597
Endowment Fund	B	23250000	6000000
Project Fund	C	12148910	312820
Revenue Surplus	D	14317313	17345576
<b>TOTAL</b>		<b><u>63215820</u></b>	<b><u>37157993</u></b>

**APPLICATION OF FUNDS**

Fixed Assets	E	45317756	23165925
Investments	F	15584654	14189185
<u>Current Assets, Advances &amp; Deposits</u>			
Current Assets	G	750486	891834
Advances and Deposits	H	1875136	1946740
Project Expenses - BRNS/DST		3532747	-
Total		<u>6158369</u>	<u>2838574</u>
Less: Current Liabilities	I	<u>3844959</u>	<u>3035691</u>
Net Current Assets		2313410	(197117)
<b>TOTAL</b>		<b><u>63215820</u></b>	<b><u>37157993</u></b>

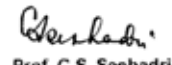
Notes forming part of Accounts J

Significant Accounting Policies K

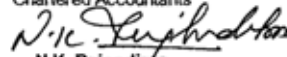
  
Dr. A.C. Muthiah  
Founder Trustee



  
Shri K. Madhava Sarma  
Trustee/Secretary

  
Prof. C.S. Seshadri  
Trustee/Director

As per our report of even date annexed  
For M/s. N.K. Rajendiran & Co.,  
Chartered Accountants

  
N.K. Rajendiran  
Proprietor




Place : Chennai  
Date : 20-03-2006


**CHENNAI MATHEMATICAL INSTITUTE**  
**PLOT NO. H1, SIPCOT IT PARK, SIRUSERI, 603 103.**

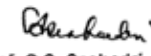
**INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2006**

<u>INCOME</u>	SCH	31.03.2006 Rs.	31.03.2005 Rs.
Voluntary Contributions	L	18770750	21500150
Fee Receipts	M	538960	439925
Interest on Investments	N	798573	1305626
Other Receipts	O	14750	15087
<b>TOTAL</b>		<u>20123033</u>	<u>23260788</u>
 <u>EXPENDITURE</u>			
Research & Establishment	P	11919477	12157972
Operational Expenses	Q	7902049	3485807
Administrative & General Expenses	R	591066	934948
Depreciation		2738703	-
<b>TOTAL</b>		<u>23151296</u>	<u>16578726</u>
Excess of Expenditure Over Income transferred to Balance Sheet		3028263	(6682062)

  
**D. A.C. Muthiah**  
 Founder Trustee

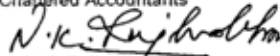


  
**Shri K. Madhava Sarma**  
 Trustee/Secretary

  
**Prof. C.S. Seshadri**  
 Trustee/Director

Place : Chennai  
 Date : 20-03-2006

As per our report of even date annexed  
 For M/s. N.K. Rajendiran & Co.,  
 Chartered Accountants

  
**N.K. Rajendiran**  
 Proprietor

