Chennai Mathematical Institute

Annual Report
2009 - 2010

H1, SIPCOT IT Park
Padur Post, Siruseri,
Tamilnadu 603 103. India.

Chennai Mathematical Institute

H1, SIPCOT IT Park
Padur Post, Siruseri,
Tamilnadu 603 103. India.
Tel: +91-44-2747 0226 - 0229
+91-44-3298 3441 - 3442
Fax: +91-44-2747 0225
WWW: http://www.cmi.ac.in

Design and Printing by: Balan Achchagam, Chennai 600 058

Contents

Preface

I take great pleasure in presenting the Annual Report of the Chennai Mathematical Institute for the period 2009-10.

CMI continues to expand as a centre of excellence for research and teaching in the Mathematical Sciences. In addition to an active PhD programme that has been in place since the Institute was founded in 1989 , CMI has successfully run for over a decade a unique National Undergraduate Programme in Mathematics and Computer Science and in Physics, combined with a National Postgraduate Programme in Mathematics, Computer Science and, from this year, Applications of Mathematics. Several CMI graduates have completed PhDs at the best institutions across the world and are now well placed in academic and research positions in India and abroad. Alumni from CMI have also taken up corporate positions in areas such as software and finance.

CMI has close academic cooperation with several institutions in India—special mention must be made of the Institute of Mathematical Sciences, Chennai—and abroad. Our collaboration with the Ecole Normale Supérieure of France continues with vigour with the three top students from BSc Mathematics and Computer Science going to Paris every summer for two months, while four students of the ENS come to CMI each year to teach in the undergraduate programme. CMI also sends its top three Physics graduates to the Ecole Polytechnique, France, for a summer internship.

CMI has also signed an MoU with the Université Pierre et Marie Curie (Paris VI) for research collaboration. It also has similar MoUs with the Université de Paris-Sud, Orsay, France, and the ENS at Cachan, France.

CMI is one of three non-European partners in the Erasmus Mundus Master Programme ALGANT (ALgebra Geometry And Number Theory), funded by the European Union. The ALGANT programme allows students to pursue Masters and Doctorate degrees across the institutions participating in the programme.

We have had several academic programmes on campus this year.

During May-July 2009, Dr Shrihari Sridharan coordinated a summer programme for students and research scholars, selected from universities and colleges. Some of the participants were sponsored by the Indian Academy of Sciences. The programme included regular lectures, lectures on special topics as well as project work mentored by faculty members.

Nobel Laureate Prof Gerhard 't Hooft visited CMI during November 2009. He gave five lectures, including a public lecture on "Mini Black Holes and Quantum Physics". The celebrated astrophysicist Prof Jayant Narlikar visited CMI during February 2010 and gave a series of talks on the "Interaction between Astronomy, Physics and Mathematics" as well a public lecture on "Searches for Micro-life in Earth's Atmosphere". Both these visits were made possible by funding from the TCS-CMI Academic Alliance.

Under the Advanced Training in Mathematics programme of the NBHM, an Annual Foundation School was coordinated by Dr Clare D'Cruz at CMI in December, 2009.

CMI conducted two short courses in the series "Tools of the Mathematical Trade". The first was by Prof Ramanan on "Spectral Sequences" in November, 2009 and the second on "Introduction to Intersection Theory and Motives" by Joel Riou of the University of Paris-Sud, Orsay, France in February, 2010.

CMI also hosted two other short courses. Prof Michel Waldschmidt from the University of Paris 6, France delivered a course on "Modular Algebraic Independence" in December 2009 and January 2010. Prof Xavier Viennot from LaBRI, University of Bordeaux, France offered a course on "Algebraic Combinatorics" in January 2010.

Professors Madhavan Mukund and K Narayan Kumar organized the 2nd Workshop on Automata, Concurrency and Timed Systems (ACTS II), during February 2010 at CMI with funding from TCS-CMI Academic Alliance and Ile-de-France/India project of the ARCUS programmme.

Starting January 2010, CMI has been organising a special semester on Analysis. Several mathematicians, mainly from Indian Statistical Institute, Institute of Mathematical Sciences, Indian institute of science, TIFR have visited CMI and given lectures to students on various topics in analysis. This activity is being coordinated by Dr Shrihari Sridharan.

In addition to the generous support from the Department of Atomic Energy (DAE), CMI also receives support from private sources. I take this opportunity to thank the Shriram Group Companies, Bajaj Allianz and Agilent Technologies for their support.

In April 2008, Chennai Mathematical Institute entered into a three year academic alliance with Tata Consultancy Services (TCS). Under this alliance, CMI faculty participate in training programmes at TCS and employees at TCS can enroll for the MSc Computer Science programme at CMI. TCS provides an annual grant to CMI that is used to fund computer equipment, academic visits to conferences and other institutions by CMI faculty and external visitors to CMI for academic collaboration. Academic visitors to CMI under this programme also deliver special lectures as part of the CMI-TCS Distinguished Lecture Series.

I thank the DST and the Board for Research in Nuclear Sciences (BRNS) whose BRNS-DST grant has allowed us to have a vibrant visitors' programme. The Ministry for Human Resources Development (MHRD) has used its good offices to organise a grant from the Universities Grants Commission (UGC) for an additional building to house an auditorium and additional academic space as well as guest rooms to accommodate visitors and students.

CMI enjoys the goodwill of individual donors too. Dr. Swaminathan made a generous endowment in the memory of his uncle Mr. K. Lakshmanan and Mrs. Usha Rubugunday made a similar endowment in memory of her husband. This has led to annual Lakshmanan and Rubugunday memorial lectures at CMI. This year, Prof Kalyan Sinha delivered the "K. Lakshmanan Memorial Distinguished Lecture" and Prof Michel Waldschmidt delivered the "R.K. Rubugunday Distinguished Lecture".

As you can see by the instances cited above, CMI enjoys the support of public, academic and private institutions as well as students and private individuals. Thanks to this support, we have been able to establish CMI as a much desired destination to work in the mathematical sciences. I am sure that CMI will continue to grow as a centre of excellence in the years to come.

C S SESHADRI
Director

Board of Trustees

1.	**Dr. A.C. Muthiah** Chairman SPIC Ltd., Chennai	-	Founder Trustee
2.	**Shri N. Prasad** Chairman Matrix Laboratories, Hyderabad	-	Trustee
3.	**Madhava Sarma** I.A.S. (Retd.) AB 50 Anna Nagar, Chennai 600 040	-	Trustee Secretary
4.	**Prof. C.S. Seshadri**, F.R.S. Director Chennai Mathematical Institute, Chennai	-	Trustee
5.	**Dr. M.R. Srinivasan** "Sunningdale", Kothagiri Road Uthagamandalam 643 002	-	Trustee
6.	**Shri R. Thyagarajan** Chairman Shriram Group Companies, Chennai	-	Trustee
7.	**Shri Jawahar Vadivelu** Chairman Cameo Corporate Services Ltd., Chennai	-	Trustee
8.	**Shri S. Venkitaramanan** New No. 6 Crescent Avenue Kesavaperumalpuram, Chennai 600 028	-	Trustee (Until February 2010)
9.	**Shri S. Ramadorai** Chief Executive Officer Tata Consultancy Services Limited, Mumbai	-	Trustee

Governing Council

1. **Shri A.C. Muthiah** - Chairman
   Chairman, SPIC Ltd., Chennai
2. **Shri S. Venkitaramanan** - Vice Chairman
   Former Governor, Reserve Bank of India, Director, SPIC Ltd., Chennai
3. **Shri R. Thyagarajan** - Member
   Chairman, Shriram Group Companies, Chennai
4. **Shri Jawahar Vadivelu** - Member
   Chairman, Cameo Corporate Services Ltd., Chennai
5. **Prof. R. Balasubramanian** - Member
   Director, Institute of Mathematical Sciences, Chennai
6. **Prof. M.S. Raghunathan,** F.R.S. - Member
   Professor of Eminence, Tata Institute of Fundamental Research, Mumbai
7. **Prof. C.S. Seshadri,** F.R.S. - Member
   Director, Chennai Mathematical Institute, Chennai
8. **Prof. P.S. Thiagarajan** - Member
   National University of Singapore, Singapore
9. **Prof. S.R.S. Varadhan,** F.R.S. - Member
   Courant Institute of Mathematical Sciences
   New York University, New York, U.S.A.
10. **Prof. K. Vijayraghavan** - Member
    Director, National Centre for Biological Sciences, Bangalore

Research Advisory Committee

1. **Prof. R. Balasubramanian**
   Director, Institute of Mathematical Sciences, Chennai.

2. **Prof. David Mumford**
   Brown University, Providence, R.I., U.S.A.

3. **Prof. M.S. Narasimhan,** F.R.S.
   TIFR Bangalore Centre, Bangalore

4. **Prof. M.S. Raghunathan,** F.R.S.
   Professor of Eminence
   Tata Institute of Fundamental Research, Mumbai

5. **Prof. S.R.S. Varadhan,** F.R.S.
   Courant Institute of Mathematical Sciences
   New York University, New York, U.S.A.

6. **Prof. M. Vidyasagar**
   Executive Vice-President
   Tata Consultancy Services, Hyderabad

Academic Council

1. **C.S. Seshadri,** F.R.S. (Chairman),
   Director, Chennai Mathematical Institute, Chennai
2. **S. Kesavan** (Convenor),
   Deputy Director and Dean of Studies, Chennai Mathematical Institute, Chennai
3. **Manindra Agrawal,**
   Professor, Indian Institute of Technology Kanpur
4. **M.S. Ananth,**
   Director, Indian Institute of Technology Madras, Chennai
5. **V. Balaji,**
   Professor, Chennai Mathematical Institute
6. **R. Balasubramanian,**
   Director, Institute of Mathematical Sciences, Chennai
7. **S.G. Dani,**
   Professor, Tata Institute of Fundamental Research, Mumbai,
   Chairman, National Board for Higher Mathematics
8. **H.P. Dikshit** (UGC nominee),
   Director General, School of Good Governance and Policy Analysis, Bhopal
9. **R.L. Karandikar,**
   Cranes Software, Bangalore
10. **Madhavan Mukund,**
    Professor, Chennai Mathematical Institute
11. **N. Mukunda,**
    Professor, Indian Institute of Science, Bangalore
12. **M.S. Raghunathan,**
    Professor, Tata Institute of Fundamental Research, Mumbai
13. **G. Rajasekaran,**
    Professor, Chennai Mathematical Institute
14. **Shiva Shankar,**
    Professor, Chennai Mathematical Institute

Boards of Studies

Mathematics

1. V. Balaji (CMI), Chair
2. S.A. Choudum (IIT, Madras)
3. R. Karandikar (Cranes Software, Bangalore)
4. S. Kesavan (CMI/IMSc)
5. Shiva Shankar (CMI)
6. V. Suresh (University of Hyderabad)
7. Madhavan Mukund (CMI, Chair, Board of Studies in Computer Science)

Computer Science

1. Madhavan Mukund (CMI), Chair
2. Manindra Agrawal (IIT, Kanpur)
3. V. Arvind (IMSc)
4. K. Narayan Kumar (CMI)
5. K.V. Subrahmanyam (CMI)
6. V. Vinay (LimberLink, Bangalore)
7. V. Balaji (CMI, Chair, Board of Studies in Mathematics)

Physics

1. G. Rajasekaran (IMSc/CMI), Chair
2. V. Balakrishnan (IIT Madras)
3. R. Jagannathan (CMI)
4. H.S. Mani (IMSc/CMI)
5. R. Parthasarathy (CMI)
6. V.V. Sreedhar (CMI)
7. C.S. Sundar (IGCAR, Kalpakkam)

Institute Members

Academic Staff

Director	C.S. Seshadri
Deputy Director	S. Kesavan
Professors	Shiva Shankar V. Balaji Madhavan Mukund K. Narayan Kumar Pramathanath Sastry V.V. Sreedhar S. Senthamarai Kannan K.V. Subrahmanyam
Associate Professors	Clare D'Cruz Govind S. Krishnaswami K. Narayan Samir Datta R. Srinivasan M. Sundari S.P. Suresh Suresh Nayak Upendra Kulkarni M.K. Vemuri
Assistant Professors	Purusottam Rath Shrihari Sridharan
Adjunct Professors	Alladi Sitaram P.P. Divakaran Kavita Ramanan V. Lakshmibai S. Dale Cutkosky R. Jagannathan V. Kumar Murty H.S. Mani

	Manindra Agrawal K. R. Nagarajan R. Parthasarathy B.P. Purnaprajna S. Ramanan Ramesh Hariharan Rani Siromoney Shreekumar Varma Sudarshan Ananth M. G. Nadkarni R. Parimala T. Parthasarathy G. Rajasekaran N. Ramanathan M. Ram Murty B.V. Rao R. Sridharan V. Vinay
Visiting Scientist	P. Vanchinathan
Visiting Fellow	Subhashish Banerjee
Post-doctoral Fellow	T.C. Vijayaraghavan (Until May 2009)
NBHM Post-doctoral Fellow	Sachindranath Jayaraman (Until July 2009)
Research Scholars	A. Baskar C. Prakash (Until July 2009) Prakash Saivasan Kumar Madhukar Nagarajan Krishnamurthy B. Narasimha Chary Prateek Karandikar Rohith Varma Ramprasad Saptharishi Rameshwar Pratap Yadav
NBHM Research Scholars	Santosha Kumar Pattanayak Pabitra Barik
CSIR Research Scholars	Ketan Tamhankar (Until August 2009)

Administrative Staff

S. Sripathy
V. Vijayalakshmi
Rajeshwari Nair
G. Samson

Faculty Profiles

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 (1972) 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 (1985). He has been awarded the Shanti Swarup Bhatnagar Medal (1995) of INSA and Srinivasa Ramanujan Birth Centenary Award (1995-96) of Indian Science Congress Association (ISCA). He has received G.M. Modi Science Award (1995), The Trieste Science Prize of the Academy of Sciences for the Developing World in (2006) and H.K. Firodia Award for Excellence in Science & Technology, Pune (2008). He has also been awarded Padma Bhushan by the President of India (2009).

He is a Fellow of the Indian Academy of Sciences, Indian National Science Academy and a Fellow of the Royal Society. He has been appointed a National Research Professor by the Ministry of Human Resource Development Government of India in 2006.

His research interests are: Algebraic Geometry and Algebraic Groups.

S. Kesavan

S. Kesavan received his B.Sc. (Mathematics) from University of Madras (1971), M.Sc.(Mathematics) from Indian Institute of Technology, Madras (1973) and Docteur-es-Sciences Mathematiques from Universite Pierre et Marie Curie (Paris VI), awarded for the thesis entitled Sur approximation de problemes lineaires et nonlineaires de valeurs propres, supervised by Professors J.L.Lions and P.G.Ciarlet (1979).

He is a Fellow of the National Academy of Sciences, Allahabad (1997) and the Indian Academy of Sciences, Bangalore (2008). He won the Tamil Nadu Scientist Award (TANSA), given by the Tamil Nadu State Council for Science and Technology, in Mathematical Sciences for 1998 and the C.L. Chandna Award for Outstanding Contributions to Mathematics Research and Teaching (1999). He is a Member of National Board for Higher Mathematics.

He is a Life Member of Indian Mathematical Society and Ramanujan Mathematical Society. He is a member of International Society for the Interaction of Mechanics and Mathematics (ISIMM), Indian Society of Industrial and Applicable Mathematics (ISIAM) and American Mathematical Society. He is a Fellow of Forum d'Analystes, Chennai.

Shiva Shankar

Shiva Shankar received his B.Tech. (Electrical Engineering) from the Indian Institute of Technology, Delhi (1978) and his Ph.D. from the State University of New York, Stony Brook, USA (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 IIAS - 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.

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 received the Shanti Swaroop Bhatnagar Award in Mathematical Sciences for the year 2006.

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 is a member of the Executive Council and the Secretary of the Indian Association for Research in Computing Science (IARCS).

His research interests are: Partial order based models for concurrent systems and Logics for specifying and verifying concurrent systems.

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 TIFR, University of Bombay (1997).

His research interests include Logic, Automata theory and Concurrency.

V.V. Sreedhar

V.V. Sreedhar received his BSc degree from Andhra University, Visakhapatnam, MSc degree in Physics from the Indian Institute of Technology, Madras and received his PhD degree in physics from Saha Institute of Nuclear Physics, Jadavpur University, Calcutta.

He has been an Assistant Professor in the Department of Physics at the Indian Institute of Technology, Kanpur, a Post-doc at the School of Theoretical Physics, Dublin Institute of Advanced Studies, Dublin, Ireland and a Post-doc at the Institute for Theoretical Physics, Uppsala University, Uppsala, Sweden.

His visiting positions include stints at the S. N. Bose National Centre for Basic Sciences, Kolkata, Raman Research Institute, Bangalore, Universities of Rochester, New York and Cincinnati, Ohio, U.S.A. and the High Energy Research Organization (KEK), Tsukuba, Japan.

His research interests are: Quantum Entanglement, Classical and Quantum Field Theory and Fluid Dynamics.

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 TIFR, University of Bombay in December, 1995.

His research interests are: Circuit Complexity, Algebraic methods in Complexity theory.

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.

Govind S. Krishnaswami

Govind S. Krishnaswami received his B. Sc (Physics), B. A. (Mathematics) from University of Rochester,U.S.A. (1999), M.A. (Physics), from University of Rochester, U.S.A. (2001) and Ph.D. (Physics) from University of Rochester, U.S.A. (2004).

He has been a Marie Curie Fellow, Spinoza Institute & Institute for Theoretical Physics, Utrecht University, The Netherlands.

His research interests are: Quantum Field Theory, Hydrodynamics and Mathematical Physics

K. Narayan

K. Narayan received his B.Tech. (Engineering Physics) from the Indian Institute of Technology Bombay, Mumbai (1997), M.S. (Physics) from the Cornell University, U.S.A. (1999) and Ph.D. (Physics) from the Cornell University, U.S.A. (2002).

He has been a Research Assistant at the Cornell University, U.S.A. (1998-2001), a

Research Assistant at the Cornell University, U.S.A. (2001-02), a Postdoctoral Research Fellow at the Duke University, U.S.A. (2002-04) and a Postdoctoral Research (Visiting) Fellow at the Tata Institute of Fundamental Research, Mumbai (2004-07).

His research interests are: String theory and cosmology, Stringy geometry and D-brane gauge theories.

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.

M. Sundari

M. Sundari received her M.Sc. (Mathematics) from the University of Hyderabad, Hyderabad (1988), M.Phil. (Mathematics) from the University of Hyderabad, Hyderabad (1990) and Ph.D. (Mathematics) from the Indian Statistical Institute, Bangalore (1996).

She has been a Visiting Mathematician at the International Center for Theoretical Physics, Trieste, Italy (1996), a Research Associate at the University of New South Wales, Sydney, Australia (1996-97), an Assistant Professor in the Effat College, Jeddah, Saudi Arabia (2000-01), a Faculty member at the ICFAI Institute of Science and

Technology, Hyderabad (2003-04) and an Assistant Professor at the Indian Institute of Technology Roorkee, Roorkee (2004-06).

Her research interests are: Representation theory of Lie groups, Uncertainty Principles in Harmonic Analysis, Wiener-Tauberian theorems.

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.

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.

Upendra Kulkarni

Upendra Kulkarni received his B.Tech (Computer Science) from the Indian Institute of Technology Bombay, Mumbai (1992) and Ph.D. (Mathematics) from Brandeis University, U.S.A. (1998).

He has been a Visiting Assistant Professor at the University of Massachusetts Amherst (1998-2000), an Assistant Professor at the Truman State University (2000-05), An Associate Professor at the Truman State University (2005), a Visiting Scientist at the Indian Statistical Institute, Bangalore (2005-06) and a Visiting Fellow at the Tata Institute of Fundamental Research, Bangalore (2006-07).

His research interests are: Representations of algebraic groups over the integers and in characteristic p, Algebraic aspects of Lie representation theory including Lie algebras, quantum groups and related combinatorics and in solving elementary challenging problems.

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

Purusottam Rath

Purusottam Rath received his Ph.D. (Mathematics) from Harish Chandra Research Institute, Allahabad (2006).

He has been a Visiting Fellow at the Institute of Mathematical Sciences, Chennai (2006-2007) and a Coleman Research Fellow at Queen's University, Canada (2007-2008).

His research interests are: Combinatorial Number Theory, Diophantine Approximation and Transcendental nature of special values of L-functions.

Shrihari Sridharan

Shrihari Sridharan received his B.Sc. (Mathematics) from Barathidasan University, Trichy (1998), M.Sc. (Mathematics) from Anna University, Chennai (2000) and Ph.D. (Mathematics) from the University of Manchester, Manchester (2004).

He has been a Post-doctoral Fellow at the Institute of Mathematical Sciences, Chennai (2004-2006), a Post-doctoral Fellow at the Indian Institute of Science, Bangalore (2006-2007) and a Senior Lecturer at the Department of Mathematics, Indian Institute of Technology, Guwahati (2007-2008).

His research interests are: Complex Dynamics and Ergodic Theory.

Awards

- **Ananth. S.**, a first year BSc Mathematics Student at CMI, won a Silver Medal at the International Mathematics Olympiad held at Bremen, Germany in July, 2009.
- **Govind Krishnaswami** was awarded the Ramanujan Fellowship for 2009-2010 by DST.

Research Activities

Mathematics

The areas of active research in mathematics at CMI include algebra, algebraic geometry, analysis, control theory, dynamical systems and partial differential equations, harmonic analysis, number theory, operator algebras, and representation theory.

Algebraic Geometry: The projective normality problem on finite group quotients of projective spaces given by multiple copies of the standard representations of the Weyl group has been solved. It has been shown that the Cousin complex pseudofunctor on formal schemes has a natural right D-module structure. This result may be viewed as a generalization of a result of Yekutieli for residual complexes on varieties, which in turn can be viewed as a generalization of the right D-module structure on the canonical bundle of a smooth variety. The study of Tannaka categories associated to semistable bundles on projective varieties has been initiated. An analogue in higher dimensions of the classical Narasimhan-Seshadri theorem for strongly stable vector bundles of degree 0 on a smooth projective variety X with a fixed ample line bundle t has been obtained. The tensor products of Hitchin pairs on smooth projective curves has been determined via an algebraic approach. The tensor product theorem for Higgs semistable Hitchin pairs over smooth projective curves defined over algebraically closed fields k of characteristic 0, and characteristic p with p satisfying some natural bounds, has been obtained. The irreducibility of the moduli space of parabolic bundles on smooth projective surfaces when the second Chern class is large has been shown. Parahoric bundles on smooth projective curves over complex numbers has been studied. This generalizes an earlier paper of Mehta and Seshadri on parabolic bundles.

Analysis: A higher dimensional Hermite coefficient estimate has been determined. This estimate is stronger than the one recently obtained by Garg and Thangavelu, but still not sharp. Efforts continue to get a sharp estimate using pluri-potential theory.

Control Theory: The problem of determining the Willems closure (the 'Nullstellensatz problem' for PDE) in spaces of periodic functions was solved and shown to be related to integral and rational points on affine algebraic varieties. The study of a class of Riccati equations involving unbounded operators is in progress.

Dynamical Systems and Partial Differential Equations: The family of hyperbolic rational maps T(z) defined on the Riemann sphere was studied and almost sure invariance principles on the natural extensions of Julia sets for the function $\log|T'|$ was established. This implies a number of well-known corollaries, including the weak invariance principle and the law of iterated logarithms. A uniqueness theorem for the solution of the Schrodinger equation with initial conditions on all semi-simple Lie groups has been proved. It was shown that flatness and injectivity are not adjoint properties in the category of topological modules over the C-algebra of constant coefficient partial differential operators. Isoperimetric inequalities involving fourth order elliptic equations are also being studied.

Number Theory: An important theme pursued at the institute is the investigation of the transcendental nature of special values of L-functions arising from arithmetic as well as analytic contexts. It is known that any zero of the Eisenstein series E_k in the upper half plane H, different from the CM-points ϱ or i, is necessarily transcendental. This phenomenon is being investigated for all modular forms (and even quasi-modular forms), combining the classical work of Schneider and the more recent work Chudnovsky and Nesterenko.

Operator Algebras: In the recent past a new construction of E0-semigroups called 'generalized CCR flows' was introduced. Work has been done at the institute on many basic question about this new class, such as finding gauge cocycle groups for this family, generalizing the above constructions to a more general framework of Hilbert modules,and developing the stochastic calculus for these generalized CCR flows. Work is also in progress on E0-semigroups on type II1 factors. A new class of E0-semigroups called Toeplitz CAR flows' has also been obtained. It has been shown that these Toeplitz CAR flows contain uncountably many mutually non cocycle conjugate E0-semigroups of type III. It has also been shown that Toeplitz CAR flows are always ither of type I or type III.

Computer Science

There are several streams of research in computer science at the Institute including Algorithms, Algorithmic Game Theory, Complexity Theory, Geometric Complexity Theory, Security, Formal Methods and Verification.

Techniques to extend polynomial time algorithms from planar games to the nonplanar games were considered resulting in such algorithms for K(3,3) free graphs. Extensions to K-5 free graphs are being studied.

Theoretical as well as computational aspects of stochastic games were studied, obtaining results on the orderfield property of mixtures of stochastic games. Sufficient conditions for a stochastic game to possess the orderfield property have been derived. Upper and lower bounds for the communication complexity of determining the existence of pure strategy Nash equilibria for some classes of stochastic games have been derived.

Dependency graphs of stochastic games were used to design polynomial time algorithms for some subclasses of Simple Stochastic Games (SSG), Perfect Information (PI) Stochastic Games and Switching Control (SC) Stochastic Games.

Previous results on the Domination Games, which are games between manufacturers trying to increase their respective market shares, were extended to the case of customers that need mulpiple units of products and manufacturers that produce multiple types.

In complexity theory the work focussed on planar graphs. Extending previous work, it was shown that testing the isomorphism of planar and near planar graphs (i.e. graphs that exclude either K-5 or K-(3,3) as a minor) is complete for Logspace. Algorithms have been proposed to solve two important graph theoretic problems viz. directed reachability and perfect matching, that work in Logspace for bounded tree width graphs (given the tree decomposition) improving on known upper bounds for general graphs. These bounds are also optimal.

Problems in identity testing of arithmetic circuits were studied.

The study of the Kronecker problem was continued. This is a key problem in the GCT approach to complexity theory separations. The Kashiwara theory of crystal graphs is a combinatorial model for irreducible representations of the general linear group. The crystal graph of the representation of GL(4) parametrized by a partition λ, is the graph whose vertices are semi-standard tableau of shape λ filled with entries from 1,2,3,4 and whose edges are labelled with numbers from 1,2,3.

A combinatorial rule to decompose the crystal graph of a GL(4) representation so that it acquires a left GL(2) crystal structure and a commuting right GL(2) crystal structure has been derived. This corresponds to the embedding of $GL(2) \times GL(2)$ in

GL(4) as a product of matrices, in the sense that multiplicity information is captured exactly by the combinatorial decomposition rule.

Work on a synthetic construction of irreducible representations of GL(4) (in the quantized setting) was also carried out. The idea is to construct these representations so that they come naturally equipped with a left GL(2) and a commuting right GL(2) structure (again, in the quantized setting). A construction in the case when the irreducible representation of GL(4) has at most two columns has been proposed.

In the area of security protocols, the focus was on analysis of models that capture electronic voting protocols. Electronic voting protocols is a burgeoning research area with much relevance to practice, but with a lot of unresolved theoretical issues. Non-trivial extensions of the basic deducibility problem in the model were considered. Extensions of the basic Dolev-Yao theory with operators for blind signatures and homomorphic encryption were considered and the decidability of the basic term derivability problem was established. Significant upper and lower bound results related to this problem were also obtained. An extension of the Dolev-Yao model to handle the use of zero-knowledge proofs was also studied.

In the area of formal methods and verification, the research focussed on the specification and analysis of systems using message sequence charts. Analysis of MSC specifications enriched with timing information was considered and results obtained for both local and global time stamps.

A visual notation for local specification of concurrent components based on message sequence charts (MSCs) was proposed. Each component is a finite-state machine whose actions are MSCs that specify its local view of the overall communication in the system. These local MSCs are composed into coherent global scenarios using a separately specified set of transactions. Intuitively, each MSC represents a phase of interaction. A mechanism to overlap phases that allows complex interactions to be specified without obscuring the logical structure of the constituent scenarios has been proposed.

The proposed notation combines the global view available in models such as high-level message sequence charts (HMSCs) with the local, asynchronous structure captured by message-passing automata (MPA). In fact, both HMSCs and MPAs are special cases of this proposed formalism.

Physics

Motivated by an attempt to circumvent the ultraviolet and naturalness problems in the scalar sector of the standard model of particle physics, a possible line of fixed points was discovered in relativistic four dimensional euclidean O(N) scalar field theory in the large-N limit. It was shown that a model constructed as a mass deformation, towards the infrared, from such a fixed point would have naturally light scalar particle excitations.

A differential calculus on the configuration space of a large-N multi-matrix model was studied.

Some insight into the stringy resolution of null cosmological singularities was obtained by analysing the near singularity string spectra, (time-dependent) oscillator masses and wavefunctions in backgrounds representing null Kasner-like cosmological singularities.

Nonsupersymmetric C^4/Z_N orbifold (and conifold-like) singularities were studied using their description in terms of the string worldsheet conformal field theory and its close relation with the algebraic geometry description of these singularities and their possible resolutions. Analytic and numerical study (using Maple) strongly suggests the absence of nonsupersymmetric Type II terminal singularities, although supersymmetric and Type 0 terminal singularities do exist. The phase structure of these singularities, which often involves 4-dimensional flip transitions, occurring between resolution endpoints of distinct topology, was analyzed using gauged linear sigma models. Aspects of M2-branes stacked at such singularities and nonsupersymmetric $AdS_4 \times S^7/Z_N$ backgrounds were also studied.

Scattering of point particles from knots was investigated. This generalises, to the lowest order, the Aharonov-Bohm effect to higher dimensions and produces a dependence of the scattering amplitude on two parameters, instead of the usual one.

A way of understanding the mathematical theory of knots and links in terms of simple dynamical systems involving generalised harmonic oscillators was developed.

Current work in three different areas is as follows: In 1+1 dimensional QCD in the multi-colour limit, attempts are afoot to derive and approximately solve an equation for the masses and form-factors of the ground and excited states of the baryon. Far from the baryon, 't Hooft's equation for the meson spectrum of 1+1 QCD is recovered. In string theory, attempts are being made to understand possible

string constructions of Lifshitz fixed points: while holographic constructions of such systems exist, the simplest ways to embed them in string theory seem to fail. In mathematical physics, the motion of a charged particle traversing along a general knot is being worked out, with a view to finding the optimal path it should take to minimise radiation losses. Attempts are being made to derive the topological invariants of knots and links entirely in terms of harmonic oscillator systems.

Publications

Journal Articles

Mathematics

1. V. Balaji and A. Dey: Parabolic bundles on algebraic surfaces II-Irreducibility of the moduli space, in Vector Bundles and Complex Geometry, Contemporary Mathematics, vol. 522, Amer. Math. Soc., Providence, RI, 2010, pp. 7-22.

2. V. Balaji and A.J. Parameswaran: An analogue of the Narasimhan-Seshadri Theorem in higher dimensions and some applications. (to appear in Journal of Topology) (archiv:math.AG 0809.3765)

3. V. Balaji, A.J. Parameswaran: Tensor product theorem for Hitchin pairs-An algebraic approach, (to appear in Annales de l'Institut Fourier, Volume 61, (2011) (archiv:math.AG 1009....)).

4. S. Kesavan: On the degenerate algebraic Riccati equation, Control and Cybernetics, Vol. 38, No. 4, 2009.

5. Purusottam Rath, S. Gun and M. Ram Murty: Linear independence of Digamma function and a conjecture of Rohrlich, J. Number Theory 129 (2009), no. 8, 1858-1873.

6. Purusottam Rath, S. Gun and M. Ram Murty: Transcendence of log-gamma function and some discrete periods, J. Number Theory 129 (2009), no. 9, 2154-2165.

7. Purusottam Rath, S. Gun and M. Ram Murty: Transcendental nature of special values of L-functions 0, Accepted for publication in the Canadian Journal of Mathematics

8. Purusottam Rath, S.D. Adhikari and S. Gun: Remarks on some zero-sum theorems, Proc. Indian Acad. Sci. Math. Sci. 119 (2009), no. 3, 275-281.

9. S.Senthamarai Kannan: Torus quotients of homogeneous Spaces-minimal dimensional Schubert varieties admitting semi-stable points, Proc. Indian. Acad. Sci. (Math.Sci), Vol.119, No.4, September 2009, pp.469-485.

10. Suresh Nayak, L.L. Avramov, S. Iyengar and J. Lipman: Reduction of derived Hochschild functors over commutative algebras and schemes, Adv. Math. 30 (2010) 735â??-772.

11. Shiva Shankar: The dual of a flat module in TOP, Linear Algebra and its Applications, to appear.

12. Shiva Shankar, D.Napp-Avelli and M.van der Put: Periodic behaviors, SIAM Journal of Control & Optimization, to appear.

13. Shrihari Sridharan: Statistical Properties for Hyperbolic Julia sets; Differential Geometry Dynamical Systems, 11, 2009, 175-184.

14. R. Srinivasan and Masaki Izumi: Toeplitz CAR flows and type I factorizations, accepted for publication in Kyoto Journal of Mathematics.

15. M. Sundari, Michael Cowling and B. Demange: Vector-valued distributions and Hardy's uncertainty principle for operators, Revista Math. Ibero. 26 (2010), 133-146.

16. M. K. Vemuri and Amritanshu Prasad: Inductive algebras for finite Heisenberg groups, appeared in 'Communications in Algebra'

17. M. K. Vemuri and Amritanshu Prasad and Ilya Shapiro: Locally compact abelian groups with symplectic self-duality, submitted to Advances in mathematics.

Computer Science

18. Nagarajan Krishnamurthy, T Parthasarathy and G Ravindran: Orderfield Property of Mixtures of Stochastic Games, 2010, Sankhya: The Indian Journal of Statistics, Series A, Vol. 72, Part 1, Pp. 1-30.

19. Samir Datta, Raghav Kulkarni, Nutan Limaye, Meena Mahajan: Planarity, Determinants, Permanents, and (Unique) Matchings. ACM Transactions On Computation Theory (TOCT) 1(3): (2010)

Physics

20. Govind S Krishnaswami: Possible large-N fixed-points and naturalness for O(N) scalar fields, J. Phys. A: Math. Theor. 42 (2009) 345403; arXiv:0904.4799 [hep-th].

21. Kallingalthodi Madhu and K. Narayan: String spectra near some null cosmological singularities, Phys. Rev.D 79, 126009 (2009), arXiv:0904.4532 [hep-th].

22. K. Narayan: On nonsupersymmetric C4/ZN, tachyons, terminal singularities and flips, J. High Energy Phys. 1003:019 (2010), arXiv:0912.3374 [hep-th].

23. K. Narayan: Null cosmological singularities and free strings, Phys. Rev. D 81, 066005 (2010), arXiv:0909.4731 [hep-th].

24. R. Parthasarathy: Stable Chromomagnetic QCD vacuum and confinement, hep-th/1003.1209, Mod. Phys. Lett A25 (2010) 2591-2598.

25. R. Parthasarathy: The Ehrenfest Theorem in Quantum Field Theory, hep-th/0911.5222.

26. Subhashish Banerjee and R. Parthasarathy: A q-deformed logistic map and its implications, arXiv:1003.5994.

Conference Papers

Mathematics

1. Purusottam Rath and S.D. Adhikari: Simplices with monochromatic vertices: reflections on some problems in Euclidean Ramsey Theory, to appear in the conference proceedings held at Chennai in honour of Prof. T.C. Vasudevan

2. Raja Sridharan, R. Sridharan and M.D. Srinivas: Studies in the History of Indian Mathematics: Combinatorial Methods in Indian Music: Pratyayas in Sa?ng¯itaratn¯akara of S¯ar?ngadeva, Proceeing of the Seminar held at CMI, Studies in the History of Indian Mathematics, Culture and History of Mathematics 5, Hindustan Book Agency, 55-112.

Computer Science

3. A. Baskar, R. Ramanujam and S.P. Suresh: A DEXPTIME-complete Dolev-Yao theory with distributive encryption, Mathematical Foundations of Computer Science (MFCS), 2010.

4. A Baskar, R Ramanujam, and S P Suresh: A Dolev-Yao model for Zero-Knowledge, Proceedings of ASIAN 2009, Springer LNCS volume 5913, 137-146, December 2009.

5. P. Chandrasekaran and M. Mukund: Specifying Interacting Components with Coordinated Concurrent Scenarios, Proc 7th IEEE International Conference on Software Engineering and Formal Methods (SEFM) 2009 IEEE Press (2009), 61-69.

6. Nagarajan Krishnamurthy, T Parthasarathy and G Ravindran: Communication Complexity of Stochastic Games, 2009, Proceedings of the International Conference on Game Theory for Networks (GameNets), IEEE Xplore, Pp. 411-417.

7. Nagarajan Krishnamurthy, T Parthasarathy and G Ravindran: Orderfield Property and Algorithms for Stochastic Games via Dependency Graphs, 2009, Proceedings of the International Conference on Frontiers of Interface between Statistics and Sciences, Pp. 286-297.

8. Ramprasad Saptharishi, Nitin Saxena and Chandan Saha: Power of depth two circuits over algebras, Proceedings of FSTTCS 2009.

9. Samir Datta, Nutan Limaye, Prajakta Nimbhorkar, Thomas Thierauf and Fabian Wagner: Planar Graph Isomorphism is in Log-Space. IEEE Conference on Computational Complexity 2009: 203-214.

10. Samir Datta, Prajakta Nimbhorkar, Thomas Thierauf, and Fabian Wagner: Graph Isomorphism for K3,3-free and K5-free graphs is in Log-space, FSTTCS 2009: 145-156.

11. Bireswar Das, Samir Datta, Prajakta Nimbhorkar: Log-space Algorithms for Paths and Matchings in k-trees, STACS 2010: 215-226.

In Books

Computer Science

1. Nagarajan Krishnamurthy and T. Parthasarathy: Multistage (Stochastic) Games (Chapters in Books), to appear in the Wiley Encyclopedia of Operations Research and Management Science.

2. M. Mukund: Automata on Distributed Alphabets, to appear in in D. D'Souza and P. Shankar (eds.): Modern Applications of Automata Theory, IISc Research Monographs Series, Vol 2, World Scientific, Singapore (2010).

3. M. Mukund: Finite-state Automata on Infinite Inputs to appear in in D. D'Souza and P. Shankar (eds.): Modern Applications of Automata Theory, IISc Research Monographs Series, Vol 2, World Scientific, Singapore (2010).

4. K. Narayan Kumar: The Theory of Message Sequence Charts, to Appear in in D. D'Souza and P. Shankar (eds.): Modern Applications of Automata Theory, IISc Research Monographs Series, Vol 2, World Scientific, Singapore (2010).

Physics

5. R. Parthasarathy: "Relativistic Quantum Mechanics", Narosa Publishing House, New Delhi, 2009.

Edited Volumes

Computer Science

1. Ravi Kannan and K Narayan Kumar (Editors): Proceedings of the 29th International Conference on the Foundations of Software Technology and Theoretical Computer Science, Leibniz International Proceedings in Informatics, Volume 4, Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik, 2009.

Preprints and Reports

Mathematics

1. Pramathanath Sastry, Zubair Adamjee and Ali Juma: Report on the Denef-Vercauten/Kedlaya Algorithm, to appear as Chapter 3 of Fields Institute Monograph Series No. 27, entitled Ganita Seminar on algebraic curves and cryptography, edited by Kumar Murty.
2. Purusottam Rath, S. Gun and M. Ram Murty: On transcendence of modular values.
3. Purusottam Rath, S. Gun and M. Ram Murty: On a conjecture of Chowla and Milnor.
4. Purusottam Rath: Real numbers with non-optimal complexity.
5. Purusottam Rath: Some musings on rational approximation and transcendental numbers.
6. Shrihari Sridharan and G. Rangarajan: Invariant Norm quantifying Nonlinear content in Hamiltonian systems.
7. M. Sundari: Uniqueness theorems for the solutions of Schrodinger equation on semisimple Lie groups, in preparation.

Computer Science

8. A Baskar, R Ramanujam, and S P Suresh: Partial secrecy in the Dolev-Yao model, Technical report, December 2009.

9. A Baskar, R Ramanujam, and S P Suresh: A DEXPTIME-complete Dolev-Yao theory with distributive encryption, to appear in Proceedings of MFCS 2010, August 2010.

10. R Ramanujam and S P Suresh: Challenges for epistemic logic from security protocols, to appear in "Games, Norms, and Reasons: Logic at the Crossroads", 221-237.

11. Nagarajan Krishnamurthy, T Parthasarathy and G Ravindran: Orderfield Property of Mixtures of Stochastic Games, December 2009, Technical Report No. SQCOR-2009-03, Indian Statistical Institute (ISI), Kolkata, India.

Ph.D. Theses

1. Prakash Chandrasekaran defended the thesis entitled "Design and Programming of Asynchronous Concurrent Systems: A Natural Verifiable Approach" in December 2009.

The National Undergraduate Programme

In 1998, CMI initiated an National Undergraduate Programme in the Mathematical Sciences in collaboration with 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 2009, the twelfth batch of students was admitted to the undergraduate programme. 16 students have joined the programme. Of these, four are from the INMO stream. The second year B.Sc. class has 11 students, while the third year B.Sc. class has 13 students.

All 6 students of the 2006 batch who took their degrees at the convocation in August, 2009 have been placed in prestigious institutions.

Name	Placement
Anupam Choudury	PhD Student, North-Eastern University, USA
Bodhayan Roy	PhD Student, TIFR, India.
Kshitij Bansal	PhD Student, Courant Institute, NYU, USA
Moulik K B	PhD Student, Rutgers University, USA

Nivedita Bhaskhar	PhD Student, North-Eastern University, USA
Vinay Kumaraswamy	MSc Student, CMI, India.

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.

In 2009, 8 students have joined the programme. The second year B.Sc. class has 7 students, while the third year B.Sc. class has 6 students.

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.

All 4 students of the 2006 batch who took their degrees at the convocation in August, 2009, have been placed in prestigious institutions.

Name	Placement
Arnab Kar	PhD Student, University of Rochester, USA
Arpith Siromoney	MSc Student, CMI, Chennai, India
Jayanth T N	PhD Student, Syracuse University, USA
Padmavathi S	MSc Student, CMI, Chennai, India

M.Sc. Mathematics

One student who joined the programme in 2007 has completed the programme successfully.

Name	Placement
Amit De	PhD Student, Aarhus Univeristy, Denmark

In 2009, five students have joined the programme.

M.Sc. Computer Science

Four students who joined the programme in 2007 have completed the programme successfully.

Name	Placement
Subhasree Basu	
Sandip Banerjee	
Ramprasad Saptharishi	PhD Student, CMI, Chennai, India
Jayant V	PhD Student, Univ. of Madeira, Spain.

Convocation

The 7th Annual Convocation of CMI was held on 30 July 2009. Degrees were awarded to 17 successful candidates at various levels. Of these, 10 were at the Undergraduate level, 5 were at the Postgraduate level and 2 were at Ph.D. level. Dr. R. Chidambaram, Principal Scientific Adviser, Government of India & DAE Homi Bhabha Professor, Bhabha Atomic Research Centre, Mumbai gave away the degree certificates. Prof. N. Mukunda delivered the convocation address.

The CMI Medal of Excellence (instituted by Prof. K.R. Nagarajan) was awarded to Nivedita Bhaskhar in Mathematics and Computer Science and S. Padmavathi in Physics for their outstanding performance at the undergraduate level. The Dr. S. Parthasarathy Commemorative Prize for research at the undergraduate level was awarded to Kshitij Bansal.

Activities of the Undergraduate Students

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

Summer camps/courses/visits to other centres

- Shreyas Patankar: Worked on topological defects at the Institute of Physics, Bhubaneswar during June-July 2009. Published article in PRAYAS, Journal of Physics: "Order parameter spaces with point group symmetry", PRAYAS, vol.3, no. 6.

- Arijit Bose: Participated in the National Symposium or Radiation Physics (NSRP), organised by Indian Society for Radiation Physics (ISRP) at MLSU, Udaipur, Rajasthan and received the Best Poster Award for the paper "Gamma scattering scanning of concrete block for detection of voids".

  Research work on Computational Methods applied to Radiation Physics studies at Indira Gandhi Centre for Atomic Research with Dr. N. Mohankumar and Dr. Shivaramu.

  Publication sited at http://arxiv.org/abs/0912.1554.

  Summer project at IMSc during May and July 2009.

- The third year BSc(P) students gave six short presentations, based on their experimental research projects carried out during the summer at the Indira Gandhi Centre for Atomic Research, Kalpakkam (August 2009).

Interaction with graduate students from Ecole Normale Supérieure

Chennai Mathematical Institute has an agreement with the Ecole Normale 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. This includes, in particular, exchanges of visits by undergraduate students between the two institutions.

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 2009, Kshitij Bansal, K.B. Moulik and Nivedita Bhaskhar visited the ENS.

Cedric Bounya and Tristan Bozec from the ENS visited CMI during January-February, 2010. They taught, examined and evaluated the course Calculus II (second semester of B.Sc. I).

Interaction with graduate students from Ecole Polytechnique

Chennai Mathematical Institute has an agreement with the Ecole Polytechnique in Paris, France, one of the leading institutions in the world for teaching and research in Physics.

Every year, the top three students passing out from the B.Sc. Physics programme spend 8 weeks at the Ecole Polytechnique, where they work on research projects. In May-July 2009, Arnab Kar, T.N. Jayanth and S. Padmavathi visited the Ecole Polytechnique.

Undergraduate / Graduate Courses

Course	Instructor
Algebra I	S.S. Kannan & Pramath Sastry
Algebra III	P. Vanchinathan
Algebra IV	R. Sridharan
Calculus I	T. Parthasarathy
Calculus III	Clare D'Cruz
Transcendental Number Theory	Purusottam Rath
Advanced Calculus	R. Srinivasan
Differential Equations	Anilesh Mohari
Linear Algebra	P. Vanchinathan
Real Analysis	M. Sundari
Real Analysis	B.V. Rao
Measure Theory	Krishna Maddaly
Elementary Algebraic Geometry	Suresh Nayak
Differential Forms in Algebraic Topology	Suresh Nayak
Distributed Systems	S P Suresh
Theory of Computation	K V Subrahmanyam
Cryptography	K V Subrahmanyam
Introduction to Logic	S P Suresh
Distributed Computing	S P Suresh
Data Mining	Madhavan Mukund
Databases	Madhavan Mukund
Basic Programming Laboratory	K Narayan Kumar
Real Analysis	B.V. Rao
Design & Analysis of Algorithms	Samir Datta
Topics in Graph Thoery	Samir Datta
Statistical Mechanics II	Subhashish Banerjee
Quantum Mechanics II	K Narayan
Quantum Mechanics III	G Rajasekaran

- Mathematical Physics III ..... R Jagannathan
- Linear Algebra ..... P. Vanchinathan
- Electromagnetism III ..... V V Sreedhar
- Classical Mechanics II ..... R. Sridhar
- Computational Methods in Physics ..... Rakesh Nigam
- Physics Laboratory ..... M.V. Rao
- Algebra II ..... P Vanchinathan
- Calculus II ..... Cedric Bounya/Tristan Bozec
- Discrete Mathematics ..... K V Subrahmanyam
- Advanced Programming ..... Madhavan Mukund
- Probability Theory ..... B V Rao
- Complex Analysis ..... Purusottam Rath
- Differential Equations ..... Shrihari Sridharan
- Topology ..... Shiva Shankar
- Programming Language Concepts ..... S P Suresh
- Electromagnetism II ..... Kalyana Rama
- Introduciton to Programming ..... K Narayan Kumar
- Mathematical Physics II ..... R Jagannathan
- Quantum Mechanics I ..... R Parthasarathy
- Statistical Mechanics I ..... Purusattam Ray
- Atom & Molecular Physics ..... H S Mani
- Classical Mechanics III ..... H K Sahu
- General Relativity ..... V V Sreedhar
- Quantum Mechanics III ..... K Narayan
- Statistical Mechanics III ..... Subhashish Banerjee
- Condensed Matter Physics ..... Radha Dilip Banhatti
- Nuclear & Particle Physics ..... B Sathiapalan
- Applied Algorithms ..... Rakesh Nigam
- Theory of Computation ..... K Narayan Kumar
- Game Theory ..... T Parthasarathy
- Compilers ..... S P Suresh
- Algebra ..... Suresh Nayak
- Complex Analysis ..... M K Vemuri
- Differential Geometry ..... V Balaji
- Automata, Concurrency & Timed Systems .... Madhavan Mukund
- Complexity Theory ..... K V Subrahmanyam/Samir Datta
- Introduction to Algebraic Geometry ..... S Ramanan

Short Courses, Special Lectures

- **Rajeeva Karandikar,** Cranes Software, Bangalore: Public Lecture - Opinion polls, Exit polls and Early seat projections - CMI-TCS Distinguished Lecture Series (July 2009).
- **G. Rajasekaran:** Homi Bhabha, Scientist and Institution Builder par Excellence (August 2009).
- **K.V. Subrahmanyam:** Towards the construction of quantum deformations of restrictions of GL(mn) module to GL(m) X GL(n) (September 2009).
- **Harikrishnan Ramani:** Some numerical estimates on cosmological parameters, quintessence and inflation. (October 2009).
- **Nagarajan Krishnamurthy:** Introduction to Stochastic Games, Communication Complexity of Stochastic Games and Orderfield Property of Stochastic Games via Dependency Graphs (October 2009) and Clustered Domination Game (January 2010).
- **S. Ramanan:** Tools of the Mathematical Trade - Spectral Sequences and Applications (November 2009).
- **Gerardus 't Hooft** (Winner of the 1999 Nobel Prize in Physics), Professor of Theoretical Physics, Utrecht University, The Netherlands, visited the Chennai Mathematical Institute in November 2009 (sponsored by the Academic Alliance between CMI and Tata Consultancy Services).

  During this period, a number of activities have been held.

  - Discussions
  - Research Seminar: Crystalline gravity

  "Tete-e-tete with a Nobel Laureate" (An Interactive Session with School Students)

- Research Seminar: Deterministic quantum mechanics

  Public Lecture: Mini Black Holes and Quantum Physics (CMI-TCS Distinguished Lecture Series held at CLRI)

- Research Seminar: Instantons and scalar mesons (held at IMSc.)

- Research Seminar: Quantum gravity without space-time singularities or horizons.

- **A. Baskar:** A Dolev-Yao model for Zero Knowledge (December 2009).

- **Michel Waldschmidt,** Universite Pierre et Marie Curie (Paris VI) France: "Modular Algebraic Independence" (December 2009 and January 2010).

- **Michel Waldschmidt,** Universite Pierre et Marie Curie (Paris VI) France: R.K. Rubugunday Distinguished Lecture - Number Theory Challenges of 21st Century (January 2010).

- **Kalyan Sinha,** Jawaharlal Nehru Centre for Advanced Scientific Research Bangalore: K. Lakshmanan Memorial Distinguished Lecture - Non-Commutative Analysis - a different way to look at "functions" (January 2010).

- **Xavier Viennot,** LaBRI, University of Bordeaux: Algebraic Combinatorics - sponsored by the CMI-TCS Academic Alliance (January 2010).

- **Joël Riou,** Université de Paris-Sud, Orsay, France: Tools of the Mathematical Trade - Introduction to Intersection Theory and Motives (February 2010).

- **J.V. Narlikar,** IUCAA, Pune: Interaction between Astronomy, Physics, and Mathematics and a public lecture at IMSc. on Searches for Micro-life in the Earth's Atmosphere as part of the CMI-TCS Distinguished Lecture Series. (February 2010).

Seminar Series for Summer Students in Mathematics

- **Amritanshu Prasad:** Finite Abelian Groups (May 2009).
- **S. P. Suresh:** Invitation to Logic (May 2009).
- **Murali K Vemuri:** Uniform convergence (May 2009).
- **Anirban Mukhopadhyay:** Quadratic Reciprocity (May 2009).
- **Anand Deopurkar:** Counting Problems in Geometry (May 2009).
- **T.E. Venkata Balaji:** Riemann Surfaces (May 2009).
- **V. Balaji:** Actions in Groups (May 2009).
- **M. Sundari:** Fourier Series (May 2009).
- **Shrihari Sridharan:** Arbitrarily Long Arithmetic Progressions (June 2009).
- **S. Kesavan:** Classical Isoperimetric Inequality (June 2009).
- **Krishnan Rajkumar:** Irrational Numbers (June 2009).
- **K.V. Subrahmanyam:** Computing Discrete Fourier Transforms (June 2009).
- **P. Vanchinathan:** Finite Groups and Symmetries : Part I (June 2009).
- **S. Senthamarai Kannan:** Finite Groups and Symmetries : Part II (June 2009).
- **V. Uma:** Introduction to Differentiable Manifolds (June 2009).
- **R. Radha:** Sequences of functions (June 2009).
- **Suresh Nayak:** Bezout's Theorem (June 2009).
- **V.V. Sreedhar:** Why (k)not Theory ? (June 2009).
- **Clare D'Cruz:** Dimension Theory (June 2009).
- **K.N. Raghavan:** Jordan decomposition (of a matrix) (June 2009).
- **Partha Sarathi Chakraborty:** Banach-Tarski Paradox (June 2009).

Special Semester on Analysis (January-April 2010)

As part of this programme, visitors to CMI throughout the semester delivered a series of lectures on various topics in Analysis. All lectures start at the beginning and the lecturers build a body of basic theory required to understand their subsequent lectures. The target audience for this activity was students from final year BSc Mathematics, students from both years of MSc Mathematics and students enrolled for PhD.

January 2010

- **P Veeramani,** IIT Madras: Best Approximation in Normed Linear Spaces (3 lectures).
- **Michael G Cowling,** University of Birmingham: Mappings of groups with geometric properties (2 lectures).
- **T.S.S.R.K. Rao,** ISI Bangalore: Some applications of the principle of local reflexivity (3 lectures).
- V.S. Sunder, IMSc Chennai: An invitation to free probability (3 lectures).

February 2010

- B.V. Rao, CMI: Excursions into probability (3 lectures).
- S. Thangavelu, IISc Bangalore: on the role of special functions in harmonic analysis (3 lectures).

March 2010

- Rajaram Bhat, ISI Bangalore: Dilation Theory (3 lectures).
- Somesh Bagchi, ISI Kolkata: Hardy-Littlewood Maximal Function (4 lectures).

- V. Muruganandam, NISER Bhubaneswar: Harmonic functions and all that (3 lectures).
- Alladi Sitaram, IISc Bangalore: An Introduction to Non-commutative Harmonic Analysis (4 lectures).
- R. Radha, IIT Madras: Time-Frequency Analysis (3 lectures).
- Gautam Bharali, IISc Bangalore: Analytic continuation in several complex variables (3 lectures).

April 2010

- Ajit Iqbal Singh, ISI Delhi: Uniformly continuous functions and some locally compact groups (4 lectures).
- C.S. Aravinda, TIFR Bangalore: A dynamic Borel-Cantelli Lemma (3 lectures).
- K. Parthasarathy, RIASM Chennai: Fourier algebra (3 lectures).

Advanced Training in Mathematics School

AFS-I school was organised at CMI in December 2009 on behalf of NBHM, by Clare D'Cruz. The list of courses taught at this school was as follows:

Algebra

S.S. Kannan	Modules over PID
K.N Raghavan	Galois Theory
P. Rath	Applications of Galois Theory

Analysis

M. Krishna	Differential Equations
S. Sridharan	Measure Theory
S. Kesavan	Foruier Analysis

Topology and Geometry

Kingshook Biswas	Differential Geometry
V. Uma	Smooth manifolds
P. Sankaran	Intro. to Algebraic Topology

Automata, Concurrency and Timed Systems (ACTS) II - February 2010

ACTS II (sponsored by the CMI-TCS Academic Alliance) was a follow-up to the ACTS workshop held in CMI in January 2009. The main theme of the workshop was the use of logic and automata for modelling and verifying distributed, open and timed systems. The list of talks at the workshop was as follows:

- Dietmar Berwanger (LSV, ENS Cachan)

  Information tracking in distributed games.

- Benedikt Bollig (LSV, ENS Cachan)

  Realizability of Dynamic MSC Languages.

- Ahmed Bouajjani (LIAFA, Paris 7)

  On the Verification Problem for Weak Memory Models.

- Deepak D'Souza (IISc, Bangalore)

  On the equivalance of the pointwise and continuous semantics of First-Order Logic with linear constraints.

- Laurent Doyen (LSV, ENS Cachan)

  Energy and Mean-payoff Games.

- Paul Gastin (LSV, ENS Cachan)

  Weighted MSO versus Probabilistic Logics.

- Stefan Haar (LSV, ENS Cachan)

  Event structure framework for supervising partially observable systems.

- Loic Helouet (IRISA, Rennes)

  Discovering covert channels with information theory.

- Akash Lal (MSR, Bangalore)

  Concurrency and Weighted Automata.
- Kamal Lodaya (IMSc, Chennai)

  LTL can be more succinct.
- Antoine Meyer (Marne-la Vallee)

  Counting CTL.
- Joel Ouaknine (Oxford)

  On Classical, Real-Time, and Time-Bounded Verification.
- Paritosh Pandya (TIFR, Mumbai)

  Chop Expressions.
- Sylvain Salvati (LaBRI, Bordeaux)

  Recognizability in the simply typed lambda-calculus.
- Stefan Schwoon (LSV, ENS Cachan)

  Unfoldings of contextual Petri nets.
- S.P. Suresh (CMI, Chennai)

  Extensions of Dolev-Yao theory and the secrecy problem.
- P.S. Thiagarajan (NUS, Singapore)

  Asynchronous Automata Based Approximations of Distributed Hybrid behaviors.
- Tayssir Touili (LIAFA, Paris 7)

  Reachability Analysis of Networks of Communicating Pushdown Systems.
- James Worrell (Oxford)

  Reachability in Parametric One-Counter Machines.

Conferences, Visits and External Lectures

C.S. Seshadri

- Participated in the Conference on "The Interplay of Algebra and Geometry" held in honour of Corrado De Concini at Cortona, Italy, in June 2009 and gave an invited talk on "Moduli and Monodromy".
- Inaugurated and delivered the Inaugural address at the two day UGC sponsored National Seminar on "Applications of Algebra and Number Theory" held at the Department of Mathematics, National College, Tiruchirapalli, in December 2009.

S. Kesavan

- Delivered a colloquium talk at NISER, Bhubaneswar, in April 2009.
- Delivered a talk at CMI in its Summer Programme, in June 2009.
- Attended the International Conference on Number Theory, PDE and Geometry (INTCON09) at University of Calicut, in August 2009 and delivered a plenary talk.
- Delivered a series of 5 lectures in the workshop on PDE and Related Analysis, IISc., Bangalore, during August-September 2009.
- Gave a colloquium talk at IIT, Madras, in October 2009.
- Attended Platinum Jubilee Meeting of the Indian Academy of Sciences at Bangalore, in November 2009 and delivered an invited talk.
- Attended IISC-CSIC workshop, in November 2009 and delivered an invited talk.
- Attended Conference on Control and Inverse Problems at the IISc., Bangalore, in December 2009 and delivered an invited talk.
- Delivered a series of 5 lectures in the AFS-VI: Advanced Foundational School at CMI during December 2009.
- Attended National Symposium on Mathaematics for Young Researchers at IIT, Gandhinagar in February 2010 and delivred an invited talk.

- Delivered a cpolloquium talk at HRI, Allahabad, in March 2010.
- Delivered 2 lectures in the ATMLDU-2010: Advanced Training for Mathematics lecturers, Delhi University, in March 2010.

R. Sridharan

- Visited ICER, Pune and lectured on "Sarangadeva's work on Combinatorics and the factorial Representation" in July 2009.
- Lectured on "Mathematics from Brahmagupta to Kummer" in the Science Day, at IMSc. in October 2009.
- Lectured on "The choice of a profession: A humble cobbler's looking back at his" at the Nehru's Science Association.

R. Parthasarathy

- Participated and delivered a talk on "Stable Chromomagnetic QCD vacuum and confinement" at the conference on "Strong Interactions in the 21st Century", held at the Tata Institute of Fundamental Research, Mumbai, in February 2010.

R. Jagannathan

- Gave a series of lectures on Partial Differential Equations as part of a course on Mathematical Physics in the Refresher Course in Theoretical Physics for College Teachers at Bishop Moore College, Mavelikara, Kerala, during December 2009, sponsored by the Indian Academy of Sciences.

Shiva Shankar

- Visited the Chinese University of Hong Kong, duirng May-June 2009.
- Visited IISc and lectured in a workshop on Control Theory, as well as in a conference on the subject.
- Gave an invited talk at Katholiek Universitat, Leuven, on the occasion of J.C.Willems' 70th birthday.

V. Balaji

- Visited University of Toronto and Queen's University at Kingston in September 2009 and gave talks on my work with A.J. Parameswaran.

- Visited University of Michigan at Ann Arbor in October-November 2009 and gave talks on "An analogue of the Narasimhan-Seshadri Theorem and some applications".
- Visited University of Michigan at East Lansing and gave an invited talk on "Uhlenbeck spaces for principal bundles".
- Gave an invited talk at University of Chicago in October 2009 on "Uhlenbeck spaces for principal bundles".
- Gave invited talk at University of North Carolina at Chapel Hill on "Uhlenbeck spaces for principal bundles".
- Visited Princeton university and gave invited talk in the Columbia-New York-Princeton Seminar on Algebraic Geometry in November 2009 on "An analogue of the Narasimhan-Seshadri Theorem and some applications".
- Gave invited talk in the TIFR Conference on Vector Bundles in April 2010 on "Parahoric bundles on curves".

Madhavan Mukund

- Visited LSV, ENS de Cachan, France for three weeks in May-June 2009 and gave a talk entitled "Specifying Interacting Components with Coordinated Concurrent Scenarios".
- Attended 8th Update Meeting on Advanced Formal Methods, IIT Roorkee, in July 2009 and presented a talk on "Model-Checking Event Structures".
- Attended Workshop on "Design and Validation of Concurrent Systems" at the International Conference and Research Center for Computer Science in Schloss Dagstuhl, Germany, during August-September 2009 and presented a talk.
- Attended Symposium for Mogens Nielsen's 60th birthday: an Aarhus celebration, Computer Science Department, Aarhus University, in October 2009 and presented a talk.
- Attended 7th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2009) at Hanoi, Vietnam, in November 2009, presented a paper and chaired a session.
- Attended Automata, Languages and Logic, AICTE Staff Development Program on "Automata Theory and Computability", at Mookambikai College of Engg, Tiruchi, in November 2009.

- Attended Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2009), IIT Kanpur, in December 2009 and chaired a session.
- Attended TECS Week 2010, Formal methods in software verification, testing and debugging, TRDDC Pune, in January 2010.
- Attended Mysore Park Workshop on "Building and Programming the Cloud", in Mysore, in January 2010.
- Attended ACM India Launch Event, Bangalore, in January 2010 and chaired a session.

K. Narayan Kumar

- Visited LSV, ENS de Cachan in May-June 2009 on the Indo-French Networking Research Programme project "Timed and distributed models for control and verification (Timed-DISCOVERI)" and the ARCUS project.
- Attended 8th Update Meeting on Advanced Formal Methods, IIT Roorkee, in July 2009 and gave a talk titled "Relating Existential MSO and Communicating Automata".
- Attended Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2009), IIT Kanpur, in December 2009.
- Attended Workshop on Automata, Concurrency and Timed Systems II, CMI, Chennai, in February 2010.

S. Senthamarai Kannan

- Visited UNC, Chapel Hill, USA during September- October, 2009.
- Visited University of Rome, Rome, Italy during October-November 2009.

K.V. Subrahmanyam

- Attended the annual FST&TCS conference held in Kanpur, in December 2010.
- Visited IIT Mumbai for a week in May 2009, in November 2009, and in February 2010.
- Attended a course of lectures on "PCP and limits of approximability" by Prahladh Harsha, at IMSc, February-March 2010.

Clare D'Cruz

- Gave six lecutures on Commutative Algebra at the Advanced Instructional School in Commutative Algebra during May-June 2009.

Govind S. Krishnaswami

- Attended Conference on Algebraic and combinatorial structures in quantum field theory, at Cargese, France, during April 2009.
- Attended 23rd meeting of the North British Mathematical Physics Seminar, Univ of York, in April 2009.
- Gave a talk on "Possible large-N fixed points and naturalness for O(N) scalar fields" in the School of Theoretical Physics Seminar at Dublin Institute for Advanced Studies, Ireland, in May 2009.
- Attended Conference on Hopf-in-Lux on Hopf algebras in mathematics and physics in Luxembourg in July 2009 and gave a talk on "Hopf Algebra in Matrix Models of Gauge Thoery".
- Attended 24th meeting of the North British Mathematical Physics Seminar, at Durham University, in July 2009.
- Gave a talk on "Baryons in 1+1 QCD: a relativistic Hartree-Fock theory", in Theory Colloquium held at Culham Science Centre, U.K., in July 2009.
- Delivered LMS-EPSRC Short Course on "Geometry, Field Theory and Solitons" in July 2009 at University of Leeds, U.K.
- Tutor for Mathematical Physics (Single Maths B) course taught by Prof. Edward Corrigan to first year undergraduates at Durham University. Tutored two sections of 20 students each during October-December 2009.
- Attended Annual Theory Meeting ("Christmas Meeting" on theoretical physics), at Durham University in December 2009.
- Attended Culham Centre for Fusion Energy, Culham, U.K. - 22 July 2009 & Dec 12-13 2009; gave a colloquium.
- Visited Durham University, Department of Mathematical Sciences, Autumn and Spring terms.

K. Narayan

- Attended Strings 09 Conference at Rome, Italy in June 2009.
- Attended ICTS Inaugural Event at Bangalore in December 2009.
- Gave a talk on "Null cosmological singularities and free strings" in the TIFR String theory group, in September 2009.

- Gave a talk on "Cosmological singularities, gauge theory duals and strings" in the IMSc seminar, October 2009.
- Gave a talk on "Nonsupersymmetric C4/ZN singularities and closed string tachyons" in the National Strings Meeting, NSM09, February 2010 at IIT Bombay.

Samir Datta

- Attended Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2009), IIT Kanpur, in December 2009.
- Visited the group of Heribert Vollmer in Leibniz University, Hannover in September 2009 and February 2010.

R. Srinivasan

- Gave a colloquium talk titled "Toeplitz CAR flows" at The Institute of Mathematical Sciences, Chennai, in July 2009.
- Visited Masaki Izumi at University of Kyoto, Japan, during July-August 2009.
- Attended 30th Conference on Quantum Probability and Related Topics held in Santiago, Chile in November 2009 and gave a talk.

Sundari Maddala

- Attended a workshop and conference on "Analysis and its Applications" in May 2009, held at Indian Institute of Science, Bangalore, India as part of the annual thematic programme of Department of Mathematics, Indian Institute of Science, Bangalore, India.
- Attended 11th Discussion Meeting on Harmonic Analysis held at National Institute for Science, Engineering and Research, Bhubaneswar, India in January 2010.
- Invited talks/lectures Gave an invited talk on 'An analogue of Benedicks theorem for the Heisenberg group' at the Mathematics department. IIT Madras on 25, February 2010.

S.P. Suresh

- Attended Formal Methods Update Meeting, in July 2009 at IIT Roorkee and gave a talk on "Successful and unsuccessful updates".

- Attended Third Indian School on Logic and Applications, in January 2010 at the University of Hyderabad.
- Attended Workshop on Automata, Concurrency and Timed Systems II, CMI, Chennai, in February 2010 and gave a talk on "Extensions of the Dolev-Yao model and the secrecy problem".

Suresh Nayak

- Gave a lecture at TIFR-CAM, Bangalore.
- Gave a lecture at the conference: CAAG, IIT-Madras.

M.K. Vemuri

- Was a Visiting research associate professor at West Virginia University, Fall 2009.
- Gave a talk on "The homogeneous shifts via inductive algebras" at the IMI seminar, IISc Bangalore, in April 2009
- Gave four lectures at the 'Advanced Training in Mathematics for Lecturers (Real Analysis)', at Delhi University during March-April 2010.

Purusottam Rath

- Was the co-ordinator of a six week lecture series delivered by M.Waldschmidt in CMI on the works of Nesterenko.
- Was in charge of the summer program along with Srihari Sridhran.
- Gave a series of lectures in the ATM school held at CMI in December, 2009.
- Gave a series of three talks on "Equi-distribution" in the workshop on Analytic Number Theory held at IMSc in February 2010.
- Gave a series of lectures on "Schmidt Subspace theorem" in the Number theory seminar at IMSc.

Shrihari Sridharan

- Attended Workshop and International Conference on "Analysis and its Applications" in Indian Institute of Science, Bangalore during May 2009.
- Visited Indian Institute of Science, Bangalore during May-June 2009.

A Baskar

- Attended Inter Research Institute Student Seminar in Computer Science (IRISS) in June 2009, held at IIT Guwhati and gave a talk on "A safe restriction for receipt-freenessâ?•.
- Attended Formal Methods Update Meeting, in July 2009, held at IIT Roorkee.
- Gave a talk on "A Dolev-Yao model for Zero Knowledgeâ?• at 13th Annual Asian Computing Science Conference (ASEAN), in December 2009 at Seoul National University, South Korea.
- Attended Indian School on Logic and its Applications, in January 2010, held at University of Hyderabad, Hyderabad.

Ramprasad Saptharishi

- Attended Workshop on algorithms for processing massive data sets, in December 2009 at IIT Kanpur.
- Visited Tata Institute of Fundamental Research during March-April 2010.

Nagarajan Krishnamurthy

- International Conference on Game Theory for Networks (GameNets), Istanbul, Turkey, May 2009.
- Attended International Conference on Game Theory (ICGT), Stony Brook University, New York, U.S.A., July 2009.
- Was a Visiting Scholar at Ohio State University, Columbus, Ohio, U.S.A., during June-August 2009.
- Attended International Symposium on Mathematical Programming (ISMP), Chicago, U.S.A., in August 2009.
- Attended the International Conference on Frontiers of Interface between Statistics and Sciences in honor of Prof. C.R. Rao, during December-January 2010 at University of Hyderabad, Hyderabad.

Prateek Karandikar

- Participated in the training-cum-selection camp for the Indian team to the International Olympiad in Informatics during June-July 2009.

Other Professional Activities

S. Kesavan

- Member, NBHM.
- Member, Executive Organizing Committee, ICM2010.
- Member, Board of Studies, Ramanujan School of Mathematics and Computer Science, Pondicherry University.
- Member, Board of Studies, Kanchi Mamunivar PG centre, Pondicherry.
- Member, PG Board of Studies in Mathematics, Madras University.
- Member, Board of Studies in Mathematical Sciences, Homi Bhabha National Institute.

Shiva Shankar

- Associate editor, Multidimensional Systems and Signal Processing, (Springer).

Madhavan Mukund

- Member, Editorial Board, LIPIcs, Leibniz International Proceedings in Informatics.
- Member, Editorial Board, Formal Methods Letters.
- Member, Editorial Board, Transactions on Petri Nets and Other Models of Concurrency (ToPNoC).
- Member, Program Committee, 30th International Conference on Application and Theory of Petri Nets and Other Models of Concurrency (Petri Nets 2009), Paris, France, June 2009.
- Member, Program Committee, 2nd Workshop on Interaction and Concurrency Experience (ICE'09), Bologna, Italy, August 2009.

- Member, Program Committee, 7th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2009), Hanoi, Vietnam, November 2009.
- Member, Program Committee, 36th International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM 2010), Spindleruv Mlyn, Czech Republic, January 2010.
- Member, Program Committee, CATS 2010 - Computing: The Australasian Theory Symposium Brisbane, Australia, January 2010.
- Member, Program Committee, 16th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2010), Paphos, Cyprus, March 2010.
- Member ACM India Council, Association of Computing Machinery (ACM).
- Member of the Council, European Association for Theoretical Computer Science (EATCS).
- Secretary, Indian Association for Research in Computing Science (IARCS).
- National Coordinator, Indian Computing Olympiad.
- Member, Scientific Board, Mysore Park Workshop Series.
- Team Leader of the Indian team, International Olympiad in Informatics, Plovdiv, Bulgaria, August 2009.
- Member, Website Committee, ICM 2010.
- Column editor, "News from India", Bulletin of the European Association for Theoretical Computer Science (EATCS).
- Member, Academic Council and Chairman, Board of Studies in Computer Science, Chennai Mathematical Institute.
- Member, Board of Studies in Mathematical Sciences, Homi Bhabha National Institute.
- Member, Board of Studies in Computer Science, PSG College of Technology, Coimbatore.

Pramathanath Sastry

- Ran a seminar on Picard schemes at CMI.

K. Narayan Kumar

- co-Chair, Program Committee, International Conference on the Foundations of Software Technology and Theoretical Computer Science (FSTTCS' 09), IIT Kanpur, Kanpur, December 2009..
- Member, Scientific Committee, Workshop on Automata, Concurrency and Timed Systems II, Chennai, January 2009.
- Coach, Indian Computing Olympiad.
- Deputy Leader of the Indian team, International Olympiad in Informatics, Sofia, Bulgaria, August 2009.

Clare D'Cruz

- Organised Sixth AFS-I (Annual Foundation School) at CMI (With P. Sankaran and K. N. Raghavan) in December 2009.
- Refereed papers for Rocky Mountain Journal of Mathematics, Osaka Journal of Mathematics.
- Refereed two MSC projects in April 2009.

Govind S. Krishnaswami

- Co-organiser of theoretical particle physics seminar series, Durham University.
- Helped to host visit of Nobel Laureate Gerard 't Hooft to CMI.
- Refereed papers for Journal of Physics A (Mathematical and Theoretical) and Journal of High Energy Physics.

Samir Datta

- Served on Program Committee of CSR (Computer Science in Russia) 2009.

S.P. Suresh

- Member of the Programme Committee, FSTTCS 2009, December 15-17, IIT Kanpur.
- Organised a workshop "Logic for information security", as part of the Third Indian School on Logic and Applications, January 19-22, 2010.

Shrihari Sridharan

- Guided two summer fellows; Akhil Bandhu Hens, IIT Kharagpur and Naveen Iyer, University of Illinois at Urbana-Champaign during the summer of 2009.
- Guided one KVPY project fellow, Mali Sundaresan, IIT Madras during the summer of 2009 and supervised his project report titled, 'Period three implies chaos.'
- Gave a public outreach lecture in the Children's club, Mylapore in July 2009 titled, 'The Notion of a Group in Mathematics.'
- Gave a public outreach lecture in D.B. Jain College, Perungudi in March 2010 titled, 'How far is zero from i? '
- Organised the CMI Summer Fellowship Programme in the summer of 2009; (with Prof Purusottam Rath).
- Organising the Special Semester on Analysis in CMI in this spring semester (January - April, 2010).

Nagarajan Krishnamurthy

- Referee for PAKDD 2010 (14th Pacific Asia Conference on Knowledge Discovery and Data Mining).
- Referee for CSR 2010 (The 5th International Computer Science Symposium in Russia).

Visitors

- **Preena Samuel,** Institute of Mathematical Sciences, Chennai: Gave a talk on "KRS Bases for rings of invariants and endomorphisms of irreducible modules" (April 2009).
- **Saswat Sarangi,** Columbia University, USA: Gave a talk on "Quantum Tunneling with the DBI Action BI correction" (April 2009).
- **Amritanshu Prasad,** Institute of Mathematical Sciences, Chennai: Gave a talk on "Locally compact abelian groups with symplectic self-duality" (April 2009).
- **Alvaro Anton,** ICMAT (CSIC), Madrid, Spain: Gave a talk on "Higgs Bundles and Triality" (May 2009).
- **N. Saradha,** TIFR, Mumbai: Gave a talk on "Irreducibility of polynomials via Newton Polygons" (May 2009).
- **Ritabrata Munshi,** Rutgers University: Gave a talk on "Nonvanishing of L-functions" (June 2009).
- **H. Krishna Chaitanya,** Kansas University at Lawrence, U.S.A.: Gave a course of lectures on "Resolution of singularities on curves and surfaces" (June 2009).
- **Arvind Rajaraman,** UC Irvine: Gave a talk on "Aspects of Unparticles" (July 2009).
- **Sasanka Roy,** IISc, Bangalore: Gave a talk on "Smallest enclosing circle centered on a query line segment" (July 2009).
- **Jnan Maharana,** IOP Bhubaneshwar: Gave a talk on "Informal discussion on Flux compactifications" (July 2009).
- **Brigadier S. Nambirajan:** Gave a talk on "Mathematics and Ancient Music" (August 2009).

- **'Ghatam' S. Karthick:** Gave a talk on "Laya Vadyas (Percussion Instruments) - Their Role in a Carnatic Concert" (August 2009).

- **John Augustine,** Visiting scientist, Institute of Mathematical Sciences, Chennai: Gave a talk on "Energy Efficient Shortest Path Algorithms for Convergecast in Sensor Networks" (August 2009).

- **S.D. Adhikari,** Harish-Chandra Research Institute, Allahabad: Gave a talk on "Colours in the fields: A walk in the garden of Ramsey-type theorems" (August 2009).

- **Madhusudan Parthasarathy,** Univ. of Illinois at Urbana-Champaign, U.S.A.: Gave a talk on "Annotations for Race-freedom" (August 2009).

- **S. Swaminathan:** Gave a talk on "Mamallapuram/Mahabalipuram" (August 2009).

- **Chitra Madhavan:** Gave a talk on "Temples of Chennai" (September 2009).

- **Indraneel Mukherjee,** Princeton University: Gave a talk on "What is machine learning? " and "A new model for multiclass boosting" (September 2009).

- **Raghav Kulkarni,** University of Chicago, U.S.A.: Gave a talk on "Evasiveness and the Music of Primes" (September 2009).

- **Sudhir R. Jain,** BARC, Mumbai: Gave a talk on "Quantum Chaos : randomness and correlations" (September 2009).

- **Sujatha Ramachandran:** Gave a talk on "Mohiniyattom - The classical Dance form of Kerala" (September 2009).

- **V. Sriram:** Gave a talk on "Emergence of Chennai as a Centre of Music" (October 2009).

- **Chiranjib Mukherjee,** Max Planck Institute for Mathematics in Sciences, Leipzig: Gave a talk on "Brownian motion: definition and some properties" and "Brownian intersection local time and large deviations" (October 2009).

- **Rajarshi Ray,** Verimag, Grenoble: Gave a talk on " "Design Principles for an Extendable Verification Tool for HybridSystems" (October 2009).

- **Harvendra Singh,** Saha Institute (SINP), Kolkata: Gave a talk on "M2-branes on resolved C4/Z4 and Chern-Simons level" (November 2009).

- **M. Ram Murty,** Queen's University: Gave a talk on "Hecke L-functions and Transcendence" (November 2009).

- **Shanta Laishram:** Gave a talk on "Irreducibility of generalised Schur Polynomials" (December 2009).

- **Anuj Dawar,** Cambridge University, U.K.: Gave a talk on "Descriptive Polynomial-Time Complexity" and "Logics with Matrix Rank Operators" (December 2009).

- **V. Kumar Murty,** University of Toronto: Gave a talk on "Splitting of Abelian Varieties" (January 2010).

- **R. Parimala,** Emory University, Atlanta, U.S.A.: Gave a talk on "Hasse Principle for quadratic forms" (January 2010).

- **R. Parthasarathi,** ICTP, Trieste, Italy: Gave a talk on "On parabolic bundles on algebraic surfaces" (January 2010).

- **A. Thyagaraja,** EURTOM/CCFE Fusion Association, Culham Science Centre, Abingdon, U.K.: Gave a talk on "Conservative Regularisation of Ideal Hydrodynamics and MHD" and "Plasma Physics in Noninertial Frames" (January 2010).

- **Snigdhayan Mahanta,** John Hopkins University, Baltimore: Gave a talk on "Twisted K-theory: an operator algebraic approach" and "John Hopkins University, Baltimore" (January 2010).

- **Koushik Balasubramanian,** MIT, U.S.A.: Gave a talk on "The particle number spectrum in Galilean holography" (January 2010).

- **Abhinav Kumar,** MIT, U.S.A.: Gave a talk on "Rational Points on Diagonal Quartic Surfaces" (January 2010).

- **D. Ramachandran,** California State University, Sacramento: Gave a talk on "On Monge - Kantorovich Duality spaces" (January 2010).

- **S. Viswanath,** IISc, Bangalore: Gave a talk on "Some special functions associated to infinite root systems" (January 2010).

- **K G Arun,** Washington University, U.S.A.: Gave a talk on " Audible Universe" and " Gravitational Waves from Inspiralling compact binaries: Modelling and implications" (February 2010).

- **K. Vishwanathan,** Simon Fraser University, Canada: Gave a talk on "Horava Gravity" (February 2010).
- **Ahmed Bouajjani,** LIAFA, University of Paris 7: Gave a talk on "On the Reachability Problem for Dynamic Networks of Concurrent Pushdown Systems" (February 2010).
- **Mangala Narlikar:** Gave a talk on "Five colour problem" (February 2010).
- **Tristan Bozec,** ENS, France: Gave a talk on "Homological study of some Hilbert schemes" (February 2010).
- **N. Somanathan,** Central Leather Research Institute, Chennai: Gave a talk on "Studies on South Indian Drums: Classification and Ethno-Musicological Studies" (February 2010).
- **Cedric Bounya,** ENS, France: Gave a talk on "The Arnold conjecture and Floer homology" (February 2010).
- **Alok Laddha,** Raman Research Institute, Bangalore: Gave a talk on "A Novel Way to Quantize the Harmonic Oscillator and its Connection to Loop Quantum Gravity" and "Introduction to Loop quantum gravity" (February 2010).
- **Stephen Lichtenbaum,** Brown University, U.S.A.: Gave two talks on "Weil-etale cohomology I and II" (February 2010).
- **Blaise Genest,** Institute for INFOCOMM Research, Singapore: Gave a talk on "Constructing Optimal Zielonka Automaton" (February 2010).
- **Bala Sathiapalan,** Institute of Mathematical Sciences, Chennai: Gave a talk on "BTZ black holes and Luttinger liquids" (March 2010).
- **R.Shankar,** Institute of Mathematical Sciences, Chennai: Gave a talk on "Environment Course Colloquium: The Scientific Evidence for Accelerated Climate Change" (March 2010).
- **Lakshmi Venkataraman:** Gave a talk on "Modern Art in Tamil Nadu (Part I)" (March 2010).
- **I.V. Ramakrishnan,** SUNY, Stony Brook, U.S.A.: Gave a talk on "Transforming Transaction Click Streams into Web Accessibility Models" (March 2010).
- **Lakshmi Venkataraman:** Gave a talk on "Modern Art in Tamil Nadu (Part II)" (March 2010).

- **Ramakrishnan Iyer,** University of Southern California: Gave a talk on "An AdS/CFT connection between Boltzmann and Einstein" (March 2010).
- **Jaydeep Chipalkatti,** University of Manitoba, Canada, and IIT Bombay: Gave a talk on "The saturation sequence of the rational normal curve" (March 2010).
- **Georg Schumacher,** University of Marburg, Germany: Gave a talk on "Positivity of the relative canonical bundle and applications to moduli spaces" (March 2010).
- **V.S. Varadarajan,** UCLA, U.S.A.: Gave a talk on "Unitary representations: what are they and why should anyone study them" (March 2010).
- **V. Lakshmibai,** Northeastern University, U.S.A.: Gave a talk on "An introduction to Standard Monomial Theory - I" (March 2010).

N.K. Rajendiran & Co.,
Chartered Accountants

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 31st March 2010 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 31st March 2010, and

ii) In case of Income & Expenditure Account, 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 : 12/8/2010

N.K.RAJENDIRAN
(PROPRIETOR)

N.K. RAJENDIRAN & CO. Chartered Accountants

No. 135 (Old No.147), Flat No. 3B, IIIrd Floor, Nelson Manickam Road, Aminjikarai, Chennai - 600 029.
Tel : 2374 1212, Fax : 2374 0303 E-mail : auditornkr@yahoo.com

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

BALANCE SHEET AS AT 31ST MARCH 2010

SOURCES OF FUNDS	SCH		31.03.2010 Rs.		31.03.2009 Rs.
General Fund	A		5383789		11514213
Capital Fund	B		59905510		54249597
Endowment Fund	C		61108334		57464754
Project Fund	D		-		3199864
TOTAL			126397633		126428428
APPLICATION OF FUNDS					
Fixed Assets	E		93247386		59572948
Investments	F				
Endowment Fund Deposits			28027028		55305866
Other Deposits			16779589		16941831
Current Assets, Advances & Deposits					
Current Assets	G	275235		270340	
Advances and Deposits	H	1464259		1940395	
Total		1739494		2210735	
Less: Current Liabilities	I	13395863		7602953	
Net Current Assets			(11656369)		(5392218)
TOTAL			126397633		126428428
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

Chennai Mathematical Institute Siruseri 603 103

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

N.K. Rajendiran
Proprietor

N.K. RAJENDIRAN & CO. Chartered Accountants

Place : Chennai
Date 10/8/10

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

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2010

INCOME	SCH	31.03.2010 Rs.	31.03.2009 Rs.
Voluntary Contributions	L	56046623	40212672
Professional & Technical Fees		5000000	5000000
Fee Receipts	M	1030033	1070840
Interest on Investments	N	2035829	2356601
Other Receipts	O	222722	148224
TOTAL		64335207	48788337
EXPENDITURE			
Research & Establishment	P	45073681	31855366
Operational Expenses	Q	16518551	7240171
Administrative & General Expenses	R	2545148	2408638
Depreciation		6328251	7325315
TOTAL		70465631	48829489
Excess of Expenditure Over Income transferred to Balance Sheet		6130424	41153

Dr. A.C. Muthlah
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

Place : Chennai
Date 12/9/10

N.K. Rajendiran
Proprietor

N.K. RAJENDIRAN & CO
Chartered Accountants