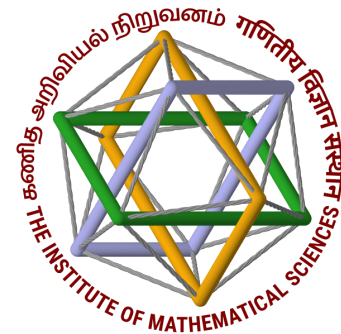


The Institute of Mathematical Sciences, Chennai



Quarterly Report

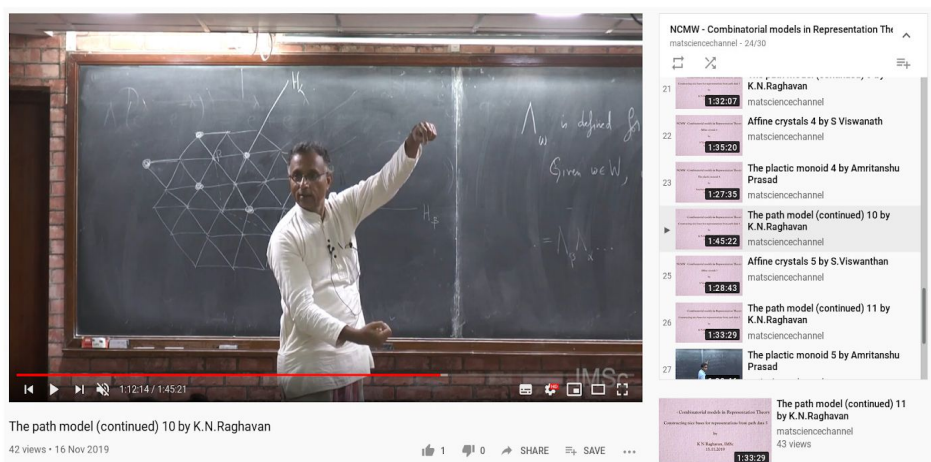
October - December 2019



Research Highlights

NCM Workshop on Combinatorial Models for Representation theory

A workshop sponsored by the National Centre for Mathematics on "Combinatorial Models for Representation theory" was held at IMSc during Nov 4-16, 2019. There was enthusiastic participation from Ph.D students and postdoctoral researchers from across the country.



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

In “Higgs vacuum stability with vector like fermions”, authored by Shrihari Gopalakrishna of IMSc and his collaborator Arunprasath Velusamy, the effects of vector like fermions (VLFs) on the stability of the Higgs electroweak vacuum, using the renormalization group improved Higgs effective potential was studied. The scale at which the effective Higgs quartic coupling becomes zero and goes negative, signaling vacuum instability was computed. For cases

where the vacuum is metastable, the probability of quantum tunneling from the false electroweak vacuum into a deeper true vacuum in our Hubble volume was computed by numerically solving for the bounce configuration in Euclidean space-time and computing the bounce action for it.

Graphs, Structures and Algorithms: November 28-29, 2019

Prof Pavol Hell, a renowned graph theorist from Simon Fraser University, Canada visited IMSc during November 27th to 30th, and in conjunction with the visit, a two day workshop was organized with the title, 'Graphs, Structures and Algorithms' on November 28th and 29th. The meeting had 13 talks by experts from IIT Madras, IISc Bangalore, IIT Hyderabad, Chennai Mathematical Institute and Indian Statistical Institute, Chennai apart from Prof Pavol Hell and students and faculty of IMSc. It had over 50 participants from IMSc, IIT Madras, CMI and other institutions in Chennai.

Automata, Logic and Concurrency

Notions of equilibria are central not only to game theory but also computational social choice theory and voting systems, and most algorithmic problems in these areas can be seen as computation of fixed-points of suitably defined operators. In "Reasoning about social choice and games in monadic fixed-point logic" an article published by Ramit Das, R. Ramanujam, and Sunil Simon, the authors suggest the extension of first order logic with monadic least fixed-point operators and counting is appropriate for a variety of these problems, and present a model checking algorithm for the logic, An important aspect of security theory is the study of algebraic properties of encryption algorithms and how they impact security verification. When encryption is distributive over pairing, as we have in the case of blind pairs, the associated Dolev-Yao theory is generally hard, and becomes non-elementary for Abelian group operators. The publication "Dolev-yao theory with associative blindpair operators" by Prof Ramanujam in collaboration with A. Baskar and S P Suresh, presents an intermediate theory of associative distributive encryption which is elementary but yet DEXPTIME-complete.

Term-modal logics are closely related to First order modal logics. These are of great interest for infinite state systems but are typically undecidable, hence it is a challenge to find decidable fragments. "Two variable fragment of term modal logic", an article by R. Ramanujam and Anantha Padmanabha, identifies the two variable fragment of term-modal

logic as a decidable one. The proof proceeds by constructing a new normal form as well as a novel inductive construction generalizing the one for two variable first order logic.

Honours and Awards:

Dr Biplab Paul, a recent graduate student in Mathematics, has been awarded JSPS post-doctoral fellowship in Japan.

Roohani Sharma, a senior research fellow(graduate student) in Theoretical Computer Science was offered a ‘Lisa Meitner Award’ postdoctoral fellowship, which is a two year fellowship position for excellent women computer scientists at “Max Planck Institute for Informatics”, that allows her to pursue independent research.

Highlights of Outreach Activities

Public lecture: A Symplectic World View: 15th October 2019

A public lecture on ‘Symplectic Geometry and its applications to the understanding of our physical world’ was delivered by Prof. Dishant Pancholi, IMSc, Shanti Swaroop Bhatnagar Prize 2019 awardee.

kaNita-kAnakam: 24th Oct 2019

This is the 3rd year of IMSc’s outreach program for school children in Tamil. The workshop was aimed at students of class VIII - XII. The program included Mathematics activities conducted by IMSc members for students to engage with topics more interactively. About 100 students from various government and corporation schools from the area attended the program.

Organizers: Amritanshu Prasad, Varuni P.

Speakers: R. Baskaran, S. Viswanath, R. Ventakesh (IISc)

Enriching Mathematics Education: 8th Nov 2019

This is the 8th edition of IMSc's outreach program for school teachers. This year, the workshop has focused on the use of Geogebra as an exploration tool for students. The program was attended by 25 teachers from various Chennai schools.

Organizers: Varuni P, S. Viswanath Speakers: Aaloka Kanhere (HBCSE)

Hosted by: Balasubramanian V (SSN College)

Public lecture: Using ancient DNA to understand Indian history: 11th Nov 2019

Vagheesh Narasimhan Department of Genetics, Harvard Medical School, delivered a public lecture on 'how the genetic makeup of modern Indian populations came to be'.

Topics in Biology: 21st Nov 2019

This is the 1st of the institute's outreach program for advanced undergraduate (BSc) and postgraduate (MSc) students of biology and related fields. This year, the program focused on Evolution and Ecology. The program was attended by 20 people from various local institutions.

Organizers: Rahul Siddarthan, Varuni P

Speakers: Analabha Basu (NIBMG, Kalyani), Geeta R (rtd, Delhi University), Manjari Jain (IISER-Mohali), Nandini Rajamani (IISER-Tirupati), Robin Vijayan (IISER-Tirupati)

Teacher's Enrichment Workshop: 25th - 30th Nov 2019:

Workshop for mathematics teachers of Engineering colleges This week-long workshop was aimed at mathematics teachers in Engineering colleges, to enable them to revisit and update content knowledge specifically focusing on Algebra, Linear Algebra, and Cryptography. The program was attended by 40 teachers who were selected from about 200 applicants. This program was part of IMSc's Enriching Collegiate Education (ECE) series of workshops as an effort to facilitate interactions between research mathematicians and college teachers. The workshop was held as a Teachers Enrichment Workshop of the National Centre for Mathematics (NCM). Workshop for mathematics teachers of Engineering colleges

Organizer: K. Srinivas

Speakers: K. N. Raghavan, Pralay Chatterjee, K. Srinivas.

Excitement in Science: 30th Nov 2019

A series of lectures on Science to celebrate Silver Jubilee year of the International Academy of Physical Sciences (IAPS). The program was attended by 100 students from various local colleges.

Organizers: Ashok Kumar Mishra, K. N. Raghavan

Speakers: Balasubramanian Ramachandran, Madhavan Mukund (CMI), G. Rajasekaran, K. Ramesha (CSIR-CECRI), Sitabhra Sinha (IMSc).