The Institute of Mathematical Sciences

Chennai

IMSc Research Highlights

July 2018 - June 2019

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1. The Institute

The Institute of Mathematical Sciences (IMSc), is an autonomous institute funded by the Government of India, through the Department of Atomic Energy. Its members work primarily in the areas of Computational Biology, Mathematics, Theoretical Physics and Theoretical Computer Science. The Institute is an autonomous body governed by a Governing Board and an Executive Council. Academic personnel of the Institute are designated as Faculty, Post-Doctoral Fellows and Junior Research Fellows. The academic programmes are ably supported by an administrative set-up. The Director is assisted by the Faculty in academic matters and by the Registrar in administrative matters. About 5 awards and honors were bestowed on our faculty during this period.

The Institute has a faculty strength of 55 during the current year, with 40 of them at the professor level. The Institute has 155 Junior Research Fellows, 39 Post Doctoral Fellows, 36 members of scientific, administrative and Accounts staffs. Also there are 55 project staffs at various levels.

The Institute has an excellent scientific library and computing environment with dedicated high speed network. The Institute has adequate infrastructure to host several national and international conferences, workshops and instructional schools which it does regularly. This includes the state of the art, 200 seater 'Ramanujan Auditorium' in our campus.

2. Teaching Programmes

IMSC has an intensive teaching programme with a high level quality. Students are selected at the graduate and postgraduate level each year through an all India joint entrance screening test followed by an interview. They undergo two years (typically) of rigorous course-work, and after successful completion of which they join doctoral thesis work under the supervision of a faculty member. The qualified thesis work is submitted to the Homi Bhabha National Institute, which is a deemed University of which IMSc is a part, for award of PhD degrees.

3. Research Highlights

Modular forms *:*

Ramanujan introduced the famous τ function as coefficients of the following infinite product;

$$\Delta(z) := \sum_{n\geq 1} \tau(n) q^n = q \prod_{\ell \geq 1} (1-q^\ell)^{24}$$

Ramanujan's investigation about the arithmetic properties of this function leads to the theory of modular forms. Development of this theory lead to solutions of some of the outstanding problems in Mathematics, e.g., Fermat's last theorem, Serre's conjecture, Sato-Tate conjecture and so on. One of the most well-known open problems about Ramanujan τ function is a conjecture of Lehmer which states that $\tau(n)$ is non-zero for all n. This conjecture has been investigated by Deligne, Serre, Rankin, Selberg and other distinguished mathematicians. In joint work with J.M. Deshouillers, Y.F. Bilu and F. Luca, Sanoli Gun of IMSc has shown show that the first k τ -values are non-zero if and only if infinitely many blocks of consecutive values of τ of length 2k are non-zero. In order to prove this, they use certain techniques of Ramanujan, some recently developed Sieve theoretic tools and the Sato-Tate conjecture which is now a theorem.

Automata, Logic and Concurrency :

Since the 1960s, logic has been related to formal language theory. Fixing words or trees as models, definable sets can be seen as word or tree languages. Many mathematical questions can be stated in first-order logic, making it a natural descriptive formalism. Rabin (1970) showed that a large number of questions can be formulated in first-order logic on trees, and solved the problem, whether a given sentence has a model. Meyer and Stockmeyer (1975) showed that the amount of memory used by the algorithm cannot be bounded by a fixed tower of exponentials. The answers connected logic to the theory of finite automata, and for the definability problem on words to algorithms based on the theory of finite algebras with an associative operation, developed by Sch ¨utzenberger (1965). Kamp showed in his PhD thesis (1976) that every first-order sentence can be expressed using three variables. Meyer and Stockmeyer's lower bound applies to three-variable logic.

This raised the definability problem for two-variable sentences of first-order logic, which was solved by Thérien and Wilke (1998), forming part of Wilke's habilitation thesis (1998). Algebraic techniques developed by Schützenberger (1976) were used. Given a finite automaton description, definability in two-variable logic is decided by an algorithm using a polynomial amount of memory. Given a sentence of two-variable logic, whether it has a model is decided by a nondeterministic algorithm using an exponential number of steps. In practice this means using an exponential amount of memory.

In joint work with Krebs, Pandya and Straubing over two years, Kamal Lodaya of IMSc has proposed a logic on words extending two-variable logic by relations which specify that a letter occurs between two positions on the word. These are typical three-variable properties, the idea goes back to Hilbert (1899). An algebraic condition is found, using operations developed by Schützenberger around his (1976) paper, which solves the definability problem for this intermediate logic, deciding it by an algorithm as in the earlier work. In particular there are (infinitely many) languages in three-variable logic which are not definable in the intermediate logic. Given a sentence of the intermediate logic, whether it has a model is decided using an exponential amount of memory. These computational bounds are shown to be tight.

Astrophysics :

Precision timing analysis of radio pulsars is used as a tool to probe various aspects of fundamental physics. The most basic task is to measure the spin and orbital periods of pulsars, and the rate of the change of these periods as accurately as possible. However, the measured values of the rate of change of the orbital and the spin periods are affected by different dynamical effects like velocity and acceleration of the pulsars relative to the solar system. For the last few decades, some simplistic models have been used to eliminate these dynamical effects and estimate the intrinsic values of the rate of change of periods. However, these simplified models are valid only for pulsars close to the solar system. Recently a more accurate model was developed, which is valid for even pulsars far away from the solar system. Being very accurate, this model has become popular among all pulsar astronomers worldwide. For example, this model was used to place the best ever limit of the non-violation of the universality of free fall, one of the fundamental aspects of Einstein's general theory of relativity (by Archibald et al. 2018, Nature 559, 730). The python code to implement this model is developed and the same is publicly available at https://github.com/pathakdhruv/GalDynPsr, and the paper describing the model has been published recently by Manjari Bagchi and Dhruv Pathak (Astrophysical Journal, 868(2), 2018). This work is a part of Dhruv Pathak's PhD thesis.

Size matters *:*

Rahul Siddharthan and Gautam Menon are investigators, with Leelavati Narlikar (NCL Pune; principal investigator), Uma Ram (obstetrician and gynaecologist at Seethapathy Clinic, Chennai) and Ponnusamy Saravanan (endocrinologist and professor at Warwick, UK) of a project "Size Matters" on predicting risk for pregnant women of delivering babies that are "small for gestational age". This project is funded by BIRAC, DBT and the Bill and Melinda Gates Foundation, and will use data from the Gates Foundation's "knowledge integration" initiative as well as in-house data from our clinical collaborators, and will run for 18 months from start of funding. Leelavati Narlikar and Rahul Siddharthan also attended a "Gates Grand Challenges Partners Meeting" in New Delhi, from March 14-16, 2019, and presented this proposal. The meeting was attended by awardees, officials from India, Brazil and Africa, as well as organizers and platform experts from those countries and the USA.

Path models for Kostant-Kumar modules *:*

Understanding the tensor product of two irreducible finite dimensional representations of a complex semisimple Lie algebras is a very important problem that has been studied intensely by mathematicians for the past 75 years. The celebrated conjecture of Parthasarathy-Ranga Rao-Varadarajan from the 1960s and its extensions by Kostant, Verma, Kumar and Montagard were the subject of recent research by members of the mathematics group at IMSc. Significant new results were obtained employing the "path model", a powerful combinatorial tool first formulated by Littelmann in the 1990s. Using the decomposition rule, we establish a lower bound for multiplicities of PRV components in Kostant-Kumar modules, thereby generalising simultaneously the KPRV and the refined PRV theorems of Kumar.

Game Theory Highlights Power of Local Reporting in Vaccine Decisions *:*

A recent article published by scientists from IMSc investigates how the social environment of an individual influences her decision to get vaccinated. This assumes importance in view of the recent dramatic increase in measles cases worldwide.

Systemic Risk: Frustration suggests imminent depression *:*

A recent article published by scientists at IMSc suggests that measuring the level of frustration, a concept central to the physics of disordered systems, in financial markets can give warning about the build-up of systemic risk, which, left unchecked can lead to a catastrophic failure of the economy. Unlike previous studies focusing on relatively short periods that possibly include only one extreme event, the article looks at the evolution of the largest financial market of the world for close to a century.

Explaining the ubiquity of complex patterns *:*

A recent paper published by scientists from IMSc shows that patterns seen in processes as diverse as chemical reactions, a cell undergoing division, and interactions between populations of predators and prey, can arise through the same fundamental mechanism. All of these systems (and more) consist of many oscillators, each trying to suppress the activity of its neighbors - a phenomenon that can be termed as lateral inhibition in analogy to the similar mechanism in operation in sensory systems. Although one may see a dazzling range of patterns that vary over space as well as in time, these can be traced to effectively two basic patterns - one which shows patterns frozen in time, and the other in which the oscillators are organized into clusters of synchronous activity

IMSc bags two SPARC grants for international collaboration *:*

Sanoli Gun and Amritanshu Prasad of IMSc received two separate grants under the Scheme for Promotion of Academic Research Collaboration (SPARC) of the Ministry of Human Resource Development. Prof. Gun's proposal on Arithmetical aspects of the Fourier coefficients of modular forms is for collaboration with Prof. Yuri Bilu of the University of Bordeaux, France. Prof. Prasad's proposal in Representation zeta functions is for collaboration with Prof. Uri Onn of the Australian National University.

4. Workshops /Seminars/Conferences Organised

Representation Theory*:* (5th – 8th December, 2018)

A. Prasad, K N Raghavan, and S Viswanath of IMSc, together with G Thangavelu and S Mohanty of IISER Thiruvananthapuram, organized the conference "Algebras, Combinatorics and Representation Theory" at IISER Thiruvananthapuram from 5th to 8th December 2018. The conference was jointly funded by IMSc and IISER Thiruvananthapuram. The program consisted of 13 invited talks and 12 contributed talks.

Symposium on Regulatory Epigenomics*:* (10th-13th March 2019)

Rahul Siddharthan was one of four organizers and the local organize of the India—EMBO Symposium on Regulatory Epigenomics: From Large Data to Useful Models, held in Muttukadu near Chennai from March 10-13, 2019. The event was primarily funded by European Molecular Biology Organization (EMBO) and DBT-Wellcome India Alliance (IA), with local support and some funding from IMSc. It featured 19 speakers including 11 international speakers, and about 70 participants, mostly from India. It is one of three symposia funded by EMBO and IA annually in India. The event was praised by speakers and participants as of very high quality and a rare opportunity for Indian students to hear about cutting-edge work in this field as well as to interact with speakers over coffee and meals.

Website: http://meetings.embo.org/event/19-regulatory-epigenomics.

The Stellar Legacy of Prof. Meghnad Saha: (3rd - 4th Jan 2019)

The Stellar Legacy of Prof. Meghnad Saha: from Society to the Cosmos – This two day event at IMSc was organized by Manjari Bagchi and Varuni P. to celebrate the 125th birth anniversary of Meghnad Saha. It consisted of a conference and a day of lectures aimed at school students. It was partially funded by NASI (Chennai local chapter). Eminent speakers from various institutes (IIA, TIFR, IUCAA, UC-Berkeley, and KIPAC-Stanford) presented their research work. Around 100 school children participated. Website: https://www.imsc.res.in/outreach/MSaha2019/

Mechanics of Complex Matter*:* (4th to 7th March 2019)

A workshop on "Mechanics of Complex Matter: Criticality, intermittency and collective behaviour" was organized by Pinaki Chaudhiru and Purusattam Ray at IMSc during March 04-07,2019. It is the seventh such workshop in the Fracmeet series of meetings that has been held at IMSc since 2012. The objective of the workshop was to provide graduate students and researchers with an exposure to the current developments in understanding how various materials, both soft and hard, in crystalline and amorphous forms, respond to mechanical perturbations of various kinds leading to plasticity, fracture, flow etc. This year, the workshop featured speakers from India, France, Spain, and Singapore, both theorists and experimentalists, signifying the need for an interdisciplinary approach to develop a common understanding across a wide range of materials, both hard and soft. The workshop also had strong participation of scientists from IGCAR, thus providing a scope for increased contact and exploration of possible collaborations between IMSc and IGCAR on the physics of materials.

Quantum Black Holes*:* (7th Jan 2019)

Sujay Ashok organized a public lecture on an encounter between Hawking and Ramanujan (part of the Nag memorial lecture series) by Atish Dabholkar, International Centre for Theoretical Physics. Website:https://www.imsc.res.in/outreach/lectures/posterNag_AD.jpg

Annual Meeting of the IPTA : (10th to 21st June, 2019)

The International Pulsar Timing Array (IPTA) consortium consists of established Pulsar Timing Array (PTA) efforts, that include the European Pulsar Timing Array (EPTA), the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), and the Parkes Pulsar Timing Array (PPTA) as well as the emerging efforts like the Indian Pulsar Timing Array (InPTA), South African Pulsar Timing Array

and the Chinese Pulsar Timing Array. The IPTA consortium aims to detect gravitational waves using an ensemble of millisecond pulsars located in our Galaxy. To nurture the collaborative nature of the IPTA consortium, annual meeting is held in different continents. This year, the annual meeting of the IPTA was held in Pune, India between June 10 to 21, 2019. The first week (June 10 - 14, 2019) was a school for students, where lectures and hands on experiments by international experts were arranged. This part was hosted by NCRATIFR. The second week (June 17 - 21, 2019) was the conference week, and was held in the Orchid Hotel, Pune. It was a very successful meeting. The conference week was attended by 90 scientists throughout the globe (26 Indians working in India, 12 Indian students and post-docs abroad, and 52 foreign nationals). There were presentations by scientists on their research results as well as policy making discussions for the IPTA.

There was a dedicated session on diversity and equity, lead by Prof. Ketki Ranade and Prof. Shewli Kumar from Tata Institute of Social Sciences, Mumbai. IMSc members had pivotal roles in organising both of the weeks. mr. Dhruv Pathak, Phd student in IMSc was part of the Scientific Organising Committee of the student workshop (the first week) and the Scientific Organising Committee of the conference week was chaired by Dr. Manjari Bagchi, faculty member of the theoretical physics group of IMSc. Additionally, Dr. Arpita Choudhury, DST-WOSA postdoctoral fellow at IMSc attended the meeting. Dr. Bagchi and Mr. Pathak presented their research work and Dr. Choudhury presented a collaborative work done by the InPTA team.

5. Awards:

V Ravindran (left) and **P. Sankaran** (right) were elected as Fellows of the Indian National Science Academy

Saket Saurabh was awarded the SwarnaJayanti Fellowship, 2017-18.

Areejit Samal was awarded Research Ambassador, for 2018, by the Deutscher Akademischer Austauschdienst (DAAD) for 'to promote bilateral cooperation between Germany and India'.

This appointment is for the period 2018-2022.

Sayantan Sharma was awarded Ramanujan Fellowship for 2018, by the SERB,

DST, Government of India.

6. Outreach Programmes:

Facets*:* (5th - 6th July 2018) Mathematics program for college students

This was the 2018 edition of the institute's outreach program for advanced undergraduate (BSc third year) and postgraduate (MSc) students of mathematics.

The speakers were

•Amritanshu Prasad, IMSc

•Aaloka Kanhere, Homi Bhabha Centre for Science Education (Mumbai)

•Balaji K, Adobe Research (Bangalore)

•Nemani Suryanarayana, IMSc

•Rahul Siddharthan, IMSc

•Sivaguru R, TIFR Centre For Applicable Mathematics (Banglaore)

•Sushmita V, IMSc

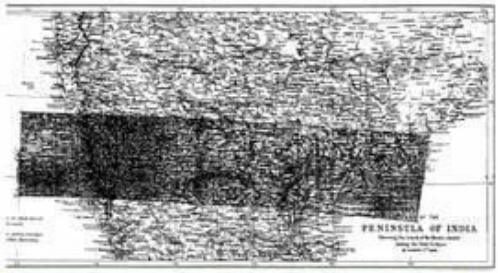
About 180 students participated in this program.

Science, Journalism, Media: Communicating Science in a Changing India (20th - 21st Aug 2018)

In collaboration with the Indian Academy of Sciences, IMSc organized a two-day workshop on "Science, Journalism, Media: Communicating Science in a Changing India" between August 20 - 21, 2018. The workshop was organized by Rahul Siddharthan and Gautam Menon from the Computational Biology group at IMSc. It brought together about 80 panelists and participants, largely scientists interested in communicating to the public across multiple media and science journalists with an interest in accurately describing Indian science, its breakthroughs as well as its problems. It tried to provide scientists with an idea of "what journalists really want" as well as to provide journalists with an idea of scientist's concerns about how their work was represented. The workshop was attended by a large number of journalists, including from such prominent outlets as the Hindu, the Indian Express,the Eastern Chronicle, Nature India, Anandabazar and the Wire as well as governmental organizations such as Vigyan Prasar. Large-scale science funders such as the DBT-Wellcome India Alliance were represented, as was the Indian Academy of Science along with scientists from NCBS, TIFR, INSTEM, IITM and JNCASR. Local language sites such as ippodhu.com, as well several independent science writers and individuals involved in science communication participated. The format was based on panel discussions rather than long talks. Each panelist made short presentations before opening the topic to discussion, enabling active participation by all attendees. Prof. K. VijayRaghavan, PSA to the GOI, attended the workshop and was part of a panel.The program was exceptionally successful. Its proceedings were videographed and are available freely from: https://www.imsc.res.in/~scimedia/

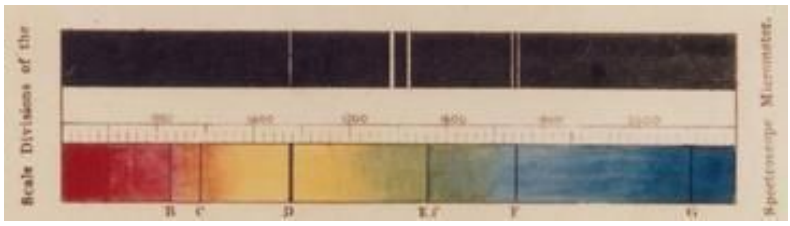
Discovery of Helium from Andhra Pradesh*:* (17th August 2018)

Lecture celebrating '150th anniversary of fingerprinting the Universe', by Dr. Niruj Mohan Ramanujam. The18th of August, 2018 marks the 150th anniversary of the discovery of the element Helium that happened during a Total Solar Eclipse observed by European astronomers from Machilipatnam and Guntur in 1868. Helium remains the only element to have been discovered first in space, before being found on Earth. The story of this discovery itself is fascinating – the truth behind who among Janssen, Lockyer and Pogson (of Madras Observatory) should get the credit, was cleared up only a few years ago. More importantly, this discovery truly marks the beginning of modern Astrophysics. This beginning is intricately linked with the history of thermodynamics, atomic theory, and chemistry.



Path of totality on 18 Aug 1868 (calculated by Major Tennant)


Norman Pogson (1829-1891)
Director, Madras Observatory



https://www.youtube.com/watch?v=eEbSV6HNWGU

IMSc Open Day: (15th Sept 2018)

A day of fun mathematics and science talks and activities for school children. The program was organized for students from 8th - 10th standards. The program comprised of lectures and demonstrations in a range of topics by students and professors of the institute. Sharing of the curiosity and excitement that we have for mathematics, science and research to the school students is the focus of this programme.

Enriching Mathematics Education*:* (4th - 5th Oct 2018)

This was the 7th edition of IMSc's outreach program for school teachers of classes XI and XII. This year, the workshop was hosted by PS Secondary School, Mylapore. The program included ideas about new ways to teach syllabus topics and different approaches to problem solving. 70 teachers attended the workshop.

Organizer: S. Viswanath, Varuni P. Speakers: Athmaraman R. (Retired Headmaster), P. Sankaran, Sushmita V., R. Ramanujam, S. Viswanath, Varuni P.

kaNita-kAnakam*:* (26th Oct 2018)

IMSc conducted kaNita-kAnakam, an outreach program in Tamil for children of classes VIII to XII on 26th October 2018. The program was attended by 150 students from 15 corporation schools in Chennai. Mathematical ideas were analyzed through hands-on activities such as modular origami, analyzing bicycle tracks, kolams (tamil-style rangoli), and games of strategy, conducted mostly in Tamil. An underlying theme was the pervasive role of mathematical thought in all aspects of modern life. The event received coverage in the local press with a detailed article in Dina Malar's Pattam (https://www.imsc.res.in/outreach/KK2018/pattam_29102018.pdf).

Organizers: Amritanshu Prasad, Varuni P. Speakers: R. Ganesh, Roopika Jayaram, R. Ramanujam, Vijay Ravikumar (CMI)

Photos: https://ekalavya.imsc.res.in/node/3708

kaNita-kAnakam: 26th Oct 2018- Audience

தினமலர் செய்திக் கட்டுரை 11

கணிதக் கானகம்:

மாணவர்களுடன் ஓர் உரையாடல்

Vigyan Pratibha Chennai Region Teachers Workshop*:* (15th - 16th Nov 2018)

This is the 1st edition of IMSc's teachers regional workshop for Vigyan Pratibha, a Government of India program to nurture of talent in Science and Mathematics among VIII - X students. The workshop was attended by 30 mathematics and science teachers from KV and AECS schools from Chennai, Kalpakkam and Puducherry.

Organizers: R. Ramanujam, Varuni P. Speakers: Chaitanya Ursekar (HBCSE), Jayashree S. (HBCSE), Niruj Mohan Ramanujam (ASIPOEC), R. Ramanujam, Reema Mani (HBCSE), Varuni P.

Photos: https://ekalavya.imsc.res.in/node/3719

Teacher's Enrichment Workshop*:* (26th Nov - 1st Dec 2018) 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. About 50 teachers 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 Teacher's Enrichment Workshop, a series co-sponsored by the National Centre for Mathematics (NCM).

Organizers: Anirban Mukhopadhyay, Srinivas Kotyada Speakers: Phoolan Prasad (IISc), T. N. Shanmugam (Anna University), S. Viswanath

Photos: https://ekalavya.imsc.res.in/node/3728

Science at the Sabha *:* (24th Feb 2019)

This year, Science at the Sabha, IMSc's flagship outreach program, was held as usual at the Music Academy on Sunday, 24th February. The talks are aimed at anyone with an interest in science, irrespective of age or background. Science at the Sabha is free and open to all. This year the speakers were: Sandhya Koushika (TIFR), Vijay Shenoy (IISc), Harini Nagendra (APU) and Sitabhra Sinha (IMSc). This event was attended by about 1200 people.

From Learning to Doing: Science, Education and Public Service in Chennai

This panel exhibition was unveiled at Science at the Sabha, highlighting Chennai's traditions in science, mathematics, education and public service, along with the people and institutions that helped to define them. Science at the Sabha and the accompanying exhibition received extensive press coverage:

https://www.thehindu.com/sci-tech/science/fourth-edition-of-science-at-sabha/article26365816.ece
https://timesofindia.indiatimes.com/city/chennai/science-at-the-sabha-educates-youngsters-andenthrals-old/articleshow/68143474.cms

Organizers: Gautam Menon, KN Raghavan, Varuni P

website: https://www.imsc.res.in/triveni/2019/

photos: http://ekalavya.imsc.res.in/node/3782

Indian Women in Science Exhibit display*:* (February - March 2019)

IMSc in collaboration with The Life of Science (TLoS) produced a poster exhibition on Indian Women in Science and premiered it at last year's Science at the Sabha (2018). It consists of 13 posters highlighting the life and work of women scientists of the country. The exhibition was displayed at Women's Christian College, Chennai, (25th Feb -- 1st March) and Stella Maris College (2nd March -- 7th March)

https://photos.app.goo.gl/1zRSUeVH9avQwmix8

https://photos.app.goo.gl/tC5cwGyoKT2Dgdu76

UN International Day for Girls and Women in Science*:* (11th Feb 2019)

IMSc hosted about180 girls from local schools to celebrate the UN International Day for Girls and Women in Science. The program included lectures by young women in science and mathematics: Shanti Bhattacharya (IITM), Prajakta Nimbhorkar (CMI) and Satyavani Vemparala (IMSc). IMSc students organized a series of demonstrations. In association with Nandita Jayaraj (TLoS) and the American Consulate (Chennai), we screened the film Hidden Figures (2016), the story of a team of female African-American mathematicians who served a vital role in NASA during the early years of the U.S. space program. Organizers: Meena Mahajan, Varuni P.

TNSF Chithirai FEST-I : (6th - 8th May 2019)

This is part of the efforts to popularize science to the general public and students who are pursuing science as their career and to fill the gap between what students are acquiring through the curriculum and what it is required. A Summer Camp was organised at Anna Centenary Library, Kotturpuram, Chennai, on June 15, 2019, hosting "Popular Science Lecture Series – VIII, LHC and Detection of Higgs Boson". The event was co-organised by The Institute of Mathematical Sciences, Indian Institute of Technology Madras, Anna Centenary Library & Tamil Nadu Science Forum.

Summer Camp for college students*:*

About 50 students from various local colleges attend a 3 day science workshop including talks on a range of topics from physics to evolution. (Co-organised by The Institute of Mathematical Sciences, Indian Institute of Technology Madras and Tamil Nadu Science Forum)

Organizer: R Ramanujam

Summer School Students Workshop*:* (14th - 22nd May 2019)

Week-long summer science workshop for high school students

IMSc students and post-doctoral students ran a 9-day summer workshop for students from class XI. We designed and ran activity and interactive problem sessions for school students on various topics in mathematics and science. About 30 students attended the workshop.

Organizers: Sushmita V, Varuni P

Photos : https://photos.app.goo.gl/EN7sWBBoXfyFg9Y88

Teacher's Enrichment Workshop*:* (20th - 25th May 2019)

Linear Algebra and Calculus on Rn (A workshop for mathematics teachers of Arts and Science colleges)

Organizer: Sanoli Gun

Exhibitions*:*

The "Indian Women in Science" exhibition was displayed at TCS Ignite and Periyar Science and Technology Center.

The "From Learning to Doing: Science, Education and Public Service in Chennai" exhibition was displayed at TCS Ignite and Chennai Mathematical Institute.

In short the Institute is contributing significantly and extensively to the DAE mandate for supporting basic sciences in the area of Theoretical Physics, Theoretical Computer Science, Mathematics and Computational Biology