THE INSTITUTE OF MATHEMATICAL SCIENCES
TARAMANI, CHENNAI 600 113.

Quarterly Report
January - March 2018

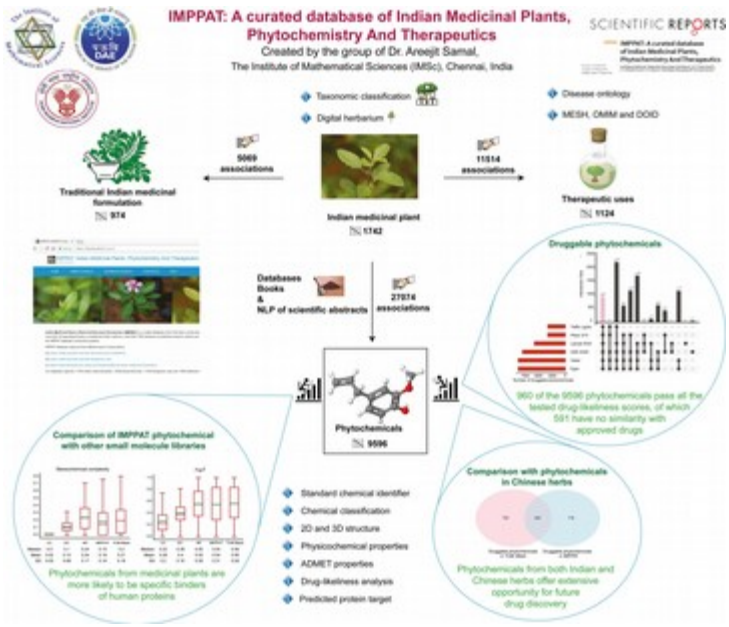
1. Research Highlights :

(a) Knowledge base on phytochemicals of Indian medicinal plants:

Areejit Samal and his students have built an open access digital knowledge base, IMPPAT, which compiles 1742 Indian Medicinal Plants, 9596 Phytochemicals, and 1124 Therapeutic uses. Notably, IMPPAT has generated a small molecule library of 9596 phytochemicals which can be derived from Indian medicinal plants with 2D and 3D structures and this library can be used for virtual screening and drug discovery. In addition, IMPPAT provides the computed physicochemical properties, predicted ADMET properties, drug-likeliness scores and predicted human gene targets for the phytochemicals in the database. Druggability analysis led to a subset of 960 phytochemicals which pass multiple standard scores used by pharma companies in drug discovery pipeline. Furthermore, among the 960 druggable phytochemicals, only 28 are existing approved drugs and 369 share chemical similarity with approved drugs.

IMPPAT is freely accessible at: https://cb.imsc.res.in/imppat

This work was published in the journal Scientific Reports on March 12.
Subsequently, the work has received coverage in print and online media such as Hindustan Times, Nature India, Hindu, Indian Science Wire, Down to Earth, Research Stash, Biotech News, BioVoice News and Dinamalar.



Schematic diagram summarizing the reconstruction and analysis of IMPPAT database

(b) The handedness of Language :

There have been many attempts at inferring unifying patterns that may underlie the extraordinary diversity of human languages. The few common features of language that are well-known, e.g., Zipf's law, generally concern the distribution of words. However, words are themselves composed of signs (e.g., letters). Traditional linguistic investigations have tended to focus on the language-specific combinations of consonants and vowels allowed in syllables.

In a recently published paper (Md Izhar Ashraf and Sitabhra Sinha. ``The ``handedness'' of language: Directional symmetry breaking of sign usage in words." PloS One 13.1 (2018): e0190735, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0190735) we have shown the existence of a remarkable universality in the distinct heterogeneous nature of the frequency distributions of signs that occur at the beginning (and end) of a word. Using quantitative measures of inequality on large written corpora of languages belonging to diverse linguistic families, and expressed in different types of writing systems, we have characterized this asymmetry between the probability distributions of graphemes which occur as the initial character and that for the final character. Our results show that the beginning of a word is less restrictive in sign usage than the end, a phenomenon that we also observe in undeciphered inscriptions from the Indus Valley Civilization (2500-1900 BCE) and which has been used by us to infer the direction of writing that agrees with the archaeological evidence. Our results strongly suggest that this observed "handedness" of words may be a universal property of language, reflecting an innate feature of the human cognitive phenomenon.

This work has attracted media attention with stories about it appearing in:

The Telegraph (Jan 29,2018): Hidden pattern of sound in languages found
https://www.telegraphindia.com/india/hidden-pattern-of-sounds-in-languages-found-204379

The Hindu (Feb 1,2018): Indus script was written from right to left, says computation
http://www.thehindu.com/news/national/indus-script-was-written-from-right-to-left/article22613418.ece

The Wire (Feb 26, 2018): Scientists Elicit Universal Pattern of Sound Use in Languages
https://thewire.in/227572/scientists-elicit-hidden-universal-pattern-sound-use-languages/

The work was partially supported by the IMSc PRISM project funded by the Department of Atomic Energy (DAE), Government of India.

2. <u>Outreach Activities Highlights</u> :

(a) Foldscope Workshop, 2nd January 2018:

IMSc hosted a small Foldscope workshop for a diverse group of educators, teachers, students and users from IMSc, TIFR Hyderabad, APU, TNSF and local schools. The aim was to try out new Foldscopes (arranged for by DBT) and discuss curricula that can be designed around Foldscopes.

Organizers: Jayashree Ramadas (TIFR Hyderabad), Varuni P

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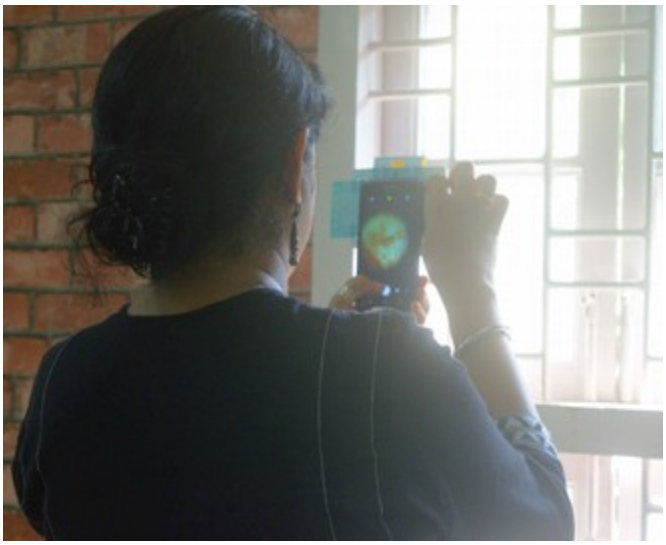
Participants assembling Foldscopes

Preparing samples to view



Capturing images of puddle water on Foldscope

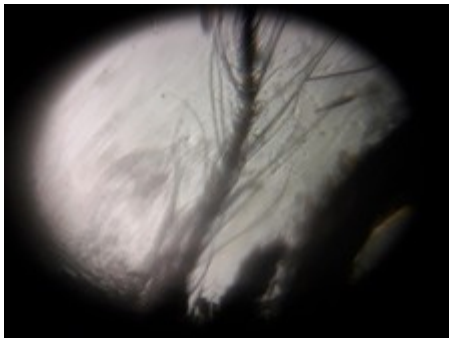


Image of Mosquito Antenna as viewed through a Foldscope (PC: Pappitha N, Vedavalli Vidylaya)

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(b) Science at the Sabha, 11th February 2018:

"Science at the Sabha" is the flagship outreach event of the Institute of Mathematical Sciences. It connects accomplished mid-career scientists who care deeply about science communication, with the public at large. While IMSc organizes several other programs where scientists interact with those outside their peer group, these are for the most part targeted at specific audiences---usually some section of teachers or students---and are about the nitty-gritty of some slice of science itself (e.g., a school on quantum mechanics for university students, or a workshop for mathematics teachers at higher secondary level). None of these would be appropriate for a member of the lay public such as an IT professional, a business manager, a retired government servant, or an artist, even though they might have an abiding interest in science and a desire to know about the contributions that Indian scientists make. Science at the Sabha attempts to bridge this gap.

The Science at the Sabha event is always held on a Sunday afternoon, between 4 and 8pm, on a date close to the National Science Day. It was started in February 2016, and February 2018 saw the third edition of this program. Every year, there are four talks, of 40 minutes duration, with each followed by a short question-answer session. There is a half an hour refreshment break between the second and the third talks. At the end of the event, all the four speakers collectively field questions from the audience. Both before the event and during the break, IMSc screens videos that feature the institute and its contributions as well as other material relevant to science education and outreach. The event is advertised widely both via traditional media (poster distribution, newspaper articles, TV and radio announcements) and on Twitter and Facebook. Video recordings of the entire proceedings are freely and perpetually available (for viewing/downloading) on the Science at the Sabha web page: https://www.imsc.res.in/triveni/

The topics featured at the event typically cover all the sciences and mathematics. In the most recent edition, for instance, there was a neuroscientist speaking on brain perception, a statistical physicist on why time goes forward, a chemical engineer speaking about composite materials, and a mathematician who described the basics of the theory of knots. Talks in the previous editions have dealt with the Indian monsoon, with subatomic particles, with insect flight, and with tiger conservation, among other topics. The speakers are chosen from mid-career scientists who enjoy the experience of explaining their work to a large, enthusiastic, but heterogeneous audience of non-experts. The point of the talks is to convey some of the spirit and excitement of recent scientific developments, avoiding technicalities. All editions of the event have featured both men and women speakers, with the cumulative numbers split about evenly.

The venue of this event is always the iconic Music Academy in Chennai, easily the most prominent of the "Sabhas" where music concerts are held, thus explaining the choice of the name. The Music Academy is centrally located and well equipped to accommodate a large gathering, with a total capacity of around 1400. A deliberate part of the design of this event is that scientists are speaking at a venue not usually associated with the sciences. This choice of venue for an outreach event was intended to break down the barriers that would inevitably exist if the audience had to enter a scientific institution to hear these talks.

Participation at the event is free and open to all. Online registration is, however, required, The actual number of people who showed up has been growing. Starting from an estimated 600--700 in the first edition, to about 800 in the second, numbers at the latest edition easily exceeded 1000. The number of registrations was over 1500 for the latest edition.

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The day of this year's Science at the Sabha, 11 February 2018, was also the United Nations International Day for Women and Girls in Science. IMSc teamed up with the outreach organization "The Life of Science" to celebrate the occasion with a poster exhibition featuring 13 eminent Indian women scientists. The posters were displayed in the lobby of the Music Academy during the event and have also been borrowed by other institutions for display purposes since then.

The event is extensively covered in the press, both before and after. The feedback that has been received has been uniformly positive, with many members of the public urging us to hold it even more regularly and speakers enthused by the opportunity to speak before an engaged audience at such an iconic venue.

Science at the Sabha 2018 was attended by about 1200 people

***Shubha Tole**: Outside-in: How we perceive the world*

***R. Rajesh**: Why does time go forward?*

***Guru Kumaraswamy**: Materials: The Hard, the Soft and the Squishy*

***Vijay Kodiyalam**: Knotty problem: how many different ways can you tie your shoelaces?*

Speakers answering questions from the audience

(c) **Indian Women in Science Exhibition:**

To mark the UN International Day of Women and Girls in Science on 11th February, IMSc partnered with "The Life of Science" (https://thelifeofscience.com/) to feature 13 Indian Women in Science as a poster exhibition. The posters described the work and the achievements of the scientists in their respective fields.

(d) The exhibition was displayed:

Science at the Sabha 2018, The Music Academy: 11th February 2018,
Chennai Mathematical Institute: 5th to 9th March 2018

We plan to display the poster at various other public places in the coming months.

Collaborators: Aashima Dogra & Nandita Jayaraj (TloS)
Organizers: Gautam Menon, Varuni P

People viewing posters at Science at the Sabha in the foyer of The Music Academy

The exhibition being set up for display at Chennai Mathematical Institute