



75 UNDER 50 SCIENTISTS SHAPING TODAY'S INDIA



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UNDER
50

**SCIENTISTS SHAPING
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DR AMRITANSHU PRASAD

Knowledge is Power

‘All mathematical reasoning is founded on certain simple principles, the truth of which is so evident that they are accepted without proof,’ from *School Geometry* by Hall and Stevens. It was owing to this book, gifted to him by his father, that Dr Amritanshu Prasad first learnt to enjoy the mathematical process.

Born and raised in Bangalore, after completing his schooling, Amritanshu joined the BStat (Hons) programme at the Indian Statistical Institute, Calcutta. Teachers like Somesh Bagchi and Kalyan Mukherjea went out of their way to encourage and guide him to explore the world of research mathematics.

During his undergraduate days, he met professors VS Sunder and V Pati from ISI Bangalore at a summer workshop for college students. He learnt about differentiable manifolds from Prof. Pati and Prof. Sunder encouraged him to apply to The University of Chicago for the PhD programme.

Amritanshu joined the PhD programme at The University of Chicago in 1995 and worked under the supervision of Prof. Robert Kottwitz, one of the foremost authorities on the Langlands Program. Kottwitz’s remarkable facility, as an advisor, to make aspects of this program concrete and accessible to young researchers made him popular with students.

After completing his PhD, Dr Prasad spent two years at the Centre for Mathematical Research (CRM) at the University of Montreal as a postdoctoral fellow in a research group headed by Prof. Henri Darmon. During this time, he also taught undergraduate courses at McGill and Concordia universities. And, he spent a summer at the Max-Planck Institute in Bonn, where he worked in Gunter Harder’s group on automorphic forms, and autumn at the Institute Des Hautes Études Scientifiques near Paris.

Dr Prasad decided to return to India in 2003. He joined the Institute of Mathematical Sciences in December

“Being engrossed in the process of mathematical discovery is in itself the greatest reward that a mathematician can seek.”



2003. The institute was run by the charismatic and inspiring mathematician, R Balasubramaniam, who encouraged Dr Prasad to pursue his path in research. Prof. CS Seshadri, the founder of Chennai Mathematical Institute, wanted the best teachers to teach there, hence Dr Prasad volunteered to teach undergraduate analysis at CMI.

Meanwhile, at IMSc, Prof. Prasad has worked in several areas of mathematics, including automorphic forms, harmonic analysis, representation theory, group theory and combinatorics. He has published his book *Representation Theory: A Combinatorial Viewpoint* part of the Cambridge Studies in Advanced Mathematics series in 2015, based on courses that he taught at IMSc and CMI, where he developed an approach to the subject.

In 2016-17, he published two papers in collaboration with Arvind Ayyer (IISc) and Steven Spallone (IISER-Pune), which generated great excitement in the community. Almost 50 years ago, Macdonald computed the number of odd-dimensional representations of the symmetric group using Frame, Robinson, and Thrall’s ideas. Dr Prasad, and his collaborators, gave a structural explanation for this phenomenon by showing that the subgraph induced in Young’s graph by odd-dimensional representations is an incomplete binary tree. Their work led to rapid developments on



AWARDS

- Fellow, Indian Academy of Science (2019)
- Swarnajayanti Fellowship (2014)
- Young Scientist Medal, Indian National Science Academy (2010)
- Associate, Indian Academy Science (2005)

PUBLICATIONS

- 'Representation Theory: A Combinatorial Viewpoint'. *Cambridge University Press* (2015).
- 'Schur algebras for the alternating group and Koszul duality'. *Pac J Math.* (2020).
- 'Representations of symmetric groups with nontrivial determinant'. *J Combin Th Ser A.* (2017).
- 'Odd partitions in Young's lattice'. *Sém Lothar Combin.* (2016).
- 'Similarity of matrices over local rings of length two'. *Indiana Univ Math J.* (2015).

bijjective aspects of the McKay correspondence by Bessenrodt, Gianelli, Kleshchev, Navarro, Olsson, Tiep, and others. In a second paper, they solved a much harder enumerative problem, counting the number of representations whose determinant was the sign character (chiral partitions).

One of his most long-term contributions has been to study matrix groups and rings over principal ideal local rings like integers modulo a prime power. Collaborations with Vaserstein, Onn, Singla, Spallone and others, over the years, have led to a revival of interest in what was considered to be a hopeless problem. Recent interest in this problem has been driven by conjectures of Larsen and Lubotsky on representation zeta functions, a complex-analytic approach to representation theory.

Along with Dr Kunal Dutta, Dr Prasad gave a simple complete decomposition of the Weil representation associated with any finite abelian group (*Pacific J.* 2015). This result was a vast improvement over earlier attempts by Prof. Gerald Cliff and his collaborators, who had obtained piecemeal results in a series of complicated articles. To carry this out, he developed a combinatorial

Clockwise: Teaching modular origami

With his father, Prof. Phoolan Prasad, while working at the Max-Planck-Institut in Bonn

Teaching mathematics with

origami models

Conducting paper-folding activity with students during Kanita-Kanagam in 2018

Conducting an origami workshop for school teachers

Inset: Working on the first calculations for his PhD thesis at The University of Chicago, 1998

theory of automorphism orbits infinite Abelian groups.

Dr Prasad enjoys popularizing mathematics through talks for varied audiences, sometimes using origami or software packages like Sage. He even ran an origami club in IMSc where members got together to fold mathematical shapes using modular origami. He used origami as a tool to teach group theory and symmetry to audiences ranging from school children to PhD scholars. He has been an enthusiastic contributor to the outreach programme of IMSc. He initiated and organized Kanita-Kanagam, an outreach programme for school children conducted primarily in Tamil. He has also delivered a talk at 'Science at the Sabha', conducted by IMSc at the iconic music academy in Chennai, where he tried to explain in layman's terms, the precise mathematics behind algorithms in cryptography.

Dr Prasad has been trying to better understand the restriction problem by applying two new lines of attack – the first is the idea of polynomial induction, and the second is the use of character polynomials. Working in collaboration with a team of students and postdoctoral fellows, he hopes to make more progress on this problem. •

