

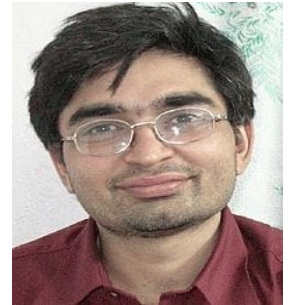


THE INSTITUTE OF MATHEMATICAL SCIENCES
TARAMANI, CHENNAI 600 113.

Quarterly Report July 2017 - September 2017

Awards:

Dr. Dishant Mayurbhai Pancholi has been awarded 'B M Birla Science prize' jointly with Neena Gupta of ISI. This award is mainly for Dishant Pancholi's contributions to the understanding of 5-manifolds. An intuitive outline of the work is below:

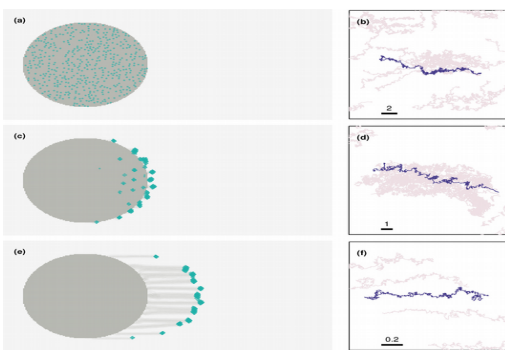


The macroscopic world is described using (time dependent) Hamiltonian mechanics. The mathematical formulation of Hamiltonian mechanics is made in a phase space. For an arbitrary manifold -- generalizing familiar geometric objects like curves and surfaces contained in the three dimensional space -- to be a phase space of a time dependent Hamiltonian system, it needs to have a geometric structure known as a contact structure on it. In his Annals of Mathematics paper titled "**Almost contact 5-manifolds are contact**" (jointly with two other authors), a necessary and sufficient condition is obtained for a 5-dimensional manifold to admit a contact structure.

<http://annals.math.princeton.edu/wp-content/uploads/annals-v182-n2-p02-p.pdf>

Research Highlights

Seeing the Light : Many micro-organisms can move in response to stimuli. Phototaxis, motion in response to the sensing of light, leads to complex collective dynamics in colony-forming cyanobacteria such as *Synechocystis* sp. Physical interactions between cells play an important role in the collective motion of cell colonies when light is sensed.



These aspects of phototaxis can be modelled using a powerful theoretical and simulational framework developed in recent years, that of active matter systems. Research at IMSc addresses phototaxis in cyanobacterial colonies through an agent-based model of motile units. The model allows for cells to physically interact with each other as well as with their environment. It replicates many experimentally observed colony

behaviours including cell aggregation and finger-formation and includes a number of predictions for future experiments. This is the first application of active matter ideas to the problem of collective phototaxis and should stimulate research along similar lines into other problems involving the physics of collective bacterial motion. The related paper, authored by P. Varuni P, Shakti N. Menon and Gautam I Menon, is accessible on the Bioarxiv and has been submitted for publication.

Generalized Dold manifolds

A new class of smooth manifolds, which are higher dimensional analogues of curves and surfaces, that generalize the classical manifolds introduced by Albrecht Dold sixty years ago, were introduced and their properties studied. A research article entitled, "On



generalized Dold manifolds” has been submitted for publication by Avijit Nath and P Sankaran.

Outreach Workshops for Students and Teachers

IMSc organised two workshops, one for advanced undergraduate and postgraduate mathematics college students and the other for secondary school mathematics teachers over this three month period. “Facets”, a 2 day outreach program was organized for advanced undergraduate and postgraduate mathematics college students by V. Sushmita, IMSc during 3rd to 4th July, 2017. Several lectures on a range of topics from 'Cartography' to 'String theory' were given. The program was attended by about 200 students from various colleges in Chennai. Priyavrat Deshpande (Mathematics, CMI), Gautam Menon (Physics and Computational Biology, IMSc), R. Ramanujam (Theoretical Computer Science, IMSc), Shubashree Desikan (Science Desk, The Hindu) and Alok Laddha (Physics, CMI)) were panelists at this event.

The 6th edition of IMSc's outreach program “Enriching Mathematics Education”, aimed at secondary school mathematics teachers was organized by S Viswanath, during 14th - 15th of September, 2017. This workshop was hosted by PSBB School, KK Nagar. The program included lectures on topics from high school curriculum as well as several problem solving sessions encouraging students to undertake open-ended explorations of mathematical topics. The workshop was attended by 75 teachers.

'Facets', held at IMSc, during 3rd – 4th July, 2017



Panel Discussion During 'Facets', July, 2017

