

Biology at IISER Pune





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2006-2015



Table of Contents

	Page Number
About IISER Pune	5
Members in Biology	7-10
Teaching	11-15
PhD Program	17-21
BS-MS Fifth Year Projects	22-28
Funding	29-39
Infrastructure	41-45
Publications	47-64
Awards and Honors	65-70
Conferences, Workshops, and Seminars	71-73
International Relations	74-75
Profiles of Faculty Members in the research areas of	
Biochemistry and Biophysics	76-95
Cell and Developmental Biology	96-107
Chemical Biology	108-121
Ecology, Evolution, and Biodiversity	122-133
Epigenetics, Immunology, and Plant Biology	134-145
Neuroscience and Computational Biology	146-163
Outreach Activities	164-167
Living on Campus	168-171
Annexure 1: Curriculum	174-192
Annexure 2: Conferences and Workshops	193-233



About IISER Pune

The Indian Institute of Science Education and Research Pune is a premier institute dedicated to research and teaching in the basic sciences. It was established in 2006 by the Ministry of Human Resource Development, Govt. of India. Later in 2012, it was declared as an Institute of National Importance by an Act of Parliament. IISER Pune is one of the six such institutes in the country whose primary goals are (i) to integrate high quality research with undergraduate teaching to improve science education in India and (ii) to enhance the number and quality of future academic as well as industrial researchers of the country. As a unique initiative in science education in India, IISER Pune aims to be a Science University of the highest caliber devoted to both teaching and research. Our model of education is concept-based and inquiry driven, as opposed to the more traditional content-based models. There is a strong emphasis on the interdisciplinary nature of today's science, and recognition of the importance of research experience. In the shortest-time possible, IISER Pune has built excellent teaching and research labs with state-of-the-art instrumentation.

IISER Pune was started in a 10,000 sq ft building at NCL Innovation Park 2006, to which we added 50,000 sq ft of rented space in 2008. Slowly, but steadily, the construction of various buildings began in our permanent campus in 2008. As and when an academic building was ready, it was put into full use. Currently, except for experimental animal facility (which would be ready by mid 2016), all academic buildings are built and being used for research and education. While education program started in full earnest in 2006 itself, research work in full swing was initiated in 2009.

IISER Pune offers a 5-year BS-MS program, post-bachelor Integrated PhD programs and post-Masters PhD programs in an intellectually vibrant atmosphere of research. Apart from classroom instruction, IISER Pune builds student skills in areas such as scientific inquiry, problem solving, communication skills, computational sciences, electronics and instrumentation and workshop practices. IISER Pune offers advanced teaching and research labs where students have the opportunity to pursue experiments as well as advanced research under the mentorship of world-class faculty. Eventually, this should make education and careers in basic sciences more exciting and rewarding.

Research in Biology at IISER Pune focuses on frontier areas in Biological Sciences. We aim for research that seamlessly integrates physics, chemistry, mathematics and computational sciences to answer key biological questions. Research in Biology at IISER Pune currently encompasses both theoretical and experimental approaches to the broad areas of Systems Biology, Ecology and Population Dynamics, Evolutionary-Developmental Biology, Cancer Biology, Neurobiology, Epigenetics and Gene-Environment interactions. Over the past 8 years, IISER Pune has recruited nearly 30 biology faculty, who are carefully chosen for their research accomplishments, promise and teaching proficiency. Many of them have primary training and expertise in Chemistry, Physics or Mathematics. The current graduate school strength is more than 100 with contribution to research from a large number of undergraduate students. In the past 6 years IISER biologists have published more than 200 papers in reputed journals of their fields of research. The kind of journals, wherein referees dig deeper and deeper and, thereby, help improving the quality of publications.

We dedicate ourselves to learn, teach and serve society through excellence, in education research and public service, create learning and a working environment based on integrity, fairness, dignity and professionalism to provide equal opportunities for all and to develop and encourage a sense of environmental responsibility.

Biology Faculty



Listed row-wise, left to right

Chaitanya Atahle, Collins Assisi, Deepak Barua, Sudha Rajamani, Sutirth Dey, Saikrishnan Kayarat, Girish Ratnaparkhi

Sanjeev Galande, Aurnab Ghose, Anjan Banerjee, Krishna Ganesh, Akanksha Chaturvedi, Pranay Goel, L.S. Shashidhara

M.S. Madhusudhan, Suhita Nadkarni, Nishikat Subhedar, Thomas Pucadyil, Kundan Sengupta, Ramana Athreya, Mrinalini Puranik

Jeet Kalia, Raghav Rajan, Milind Watve, Richa Rikhy, Mayurika Lahiri, Jeetender Chugh, Krishanpal Karmodiya
Nagaraj Balasubramanian, Gayathri Pananghat, Nixon Abraham, Nishad Matange

Graduate Students

PhD

ABHISHEK S.
SAHASRABUDHE
ANIRUDDH SASTRY
JAY PRAKASH SHUKLA
SHRADDHA KARVE
RINI SHAH
N. BHAVANI
APARNA SHERLEKAR
VALLARI SHUKLA
ABHINAV PARIVESH
RASHMI KULKARNI
MANASI KULKARNI
ARCHANA PAWAR
DEVIKA RANADE
RAHUL K. JANGID
RAFEEQ A. MIR
ABHIJEET BAYANI
SACHIN HOLKAR
NEHA NIRWAN
TRUPTI THITE
SRISHTI DAR
MANASI MUNGEE
DARSHIKA TOMER
BHAGYASHREE KADUSKAR
AYANTIKA SEN GUPTA
MADHANAGOPAL B.
BOOMINATHAN M.
MANU KRISHNAN UNNI
MANASI GANGAN

SAMPADA MUTALIK
LIBI ANANDI
ISHTIYaq AHMAD
INDUMATHI PATTa
SHATARUPA GANGULY
SUDIPTA TUNG
MANAWA DIWEKAR
JYOTI BARANWAL
MANISH KUSHWAH
VIBHA SINGH
ANUSHREE CHAPHALKAR
SOUPARNA CHAKRABARTY
MAHESH CHAND
RAVI DEVANI
NIRAJA BAPAT
ARUN NERU B.
NEELES H SONI
TANUSHREE KUNDU
KUNALIKA JAIN
SHIVIK GARG
ABOLI KULKARNI
AMIT KUMAR
BIPASHA DEY
DEVIKA ANDHARE
DEVIKA BODAS
KRITI CHAPLOT
MAITHILEE KHOT
NATASHA BUWA
RAUNAQ DEO

SAMEER THUKRAL
SHRIKANT HARNE
YASHRAJ CHAVHAN
YOGENDRA RAMTIRTHA
MADHUMITA CHAKLADAR
GAJANAN KENDRE
M. VIDYADHARI
SIMRAN JUNEJA
SHWETA TENDULKAR
SIDDHI INCHANALKAR
AKANKSHA OJHA
PRAJNA NAYAK
DEBAYAN SARKAR
R. L. PRAVEENA
SANKET NAGARKAR
RUTUJA DIWAN
ABHISHEK KANYAL
ANKITA SHARMA
SOU MEN KHAN
SUJATA SHARMA
VIRENDER KUMAR SHARMA
SHALAKA PATIL
ANINDYA BHATTACHARJEE
KRISHNAKANTH BARATAM
NISHANT SINGH
ADHAV VISHAL ANNASAHEB
ABHISHEK MISHRA
SELVESHWARI S.
DEBJYOTI DUTTA

Integrated PhD

SAYALI CHOWDHARY
ROOPALI PRADHAN
KETAKEE GHATE
SHUBHANKAR KULKARNI
CHAITANYA MUNGI
AJAY LABADE
ANKITHA SHETTY
SUKRUT KAMERKAR
NEHA KHETAN

ADITI MADUSKAR
DNYANESH DUBAL
MUKUL RAWAT
AMARENDRANATH SOORY
DHRITI NAGAR
DIVYA RAO
GUNGI AKHILA
HARPREET SINGH KALSI
NEELADRI SEN

RON SUNNY
SWATI SHARMA
NILAM MALANKAR
PUNITA BATHLA
SANJANA NAIR
SHIKHA KALRA
YASHASWI SINGH
V. AISHWARYA
APARNA THULASIDHARAN



Integrated PhD

JOYEETA CHAKRABORTY
MEENAKSHI PARDASANI
MRINMAYEE BAPAT
PRATIMA SINGH
HARISHANKAR
ROHIT KANDPAL

SATHE RUPALI
RUTWIK BARDAPURKAR
K. SRINIVASA SASANK
SHIKHA DAGAR
SHUBHAM SINGH
SNEHA TRIPATHI

SUSHMITHA HEGDE
SUSOVAN SARKAR
SUTIRTHA BANDYOPADHYAY
VINAYAK S. TUMULURI
YAMINI MATHUR

Scientists & Postdoctoral Fellows

TRESSA JACOB
MANJUNATH
SONAM MEHROTRA
SHITAL AHALEY
ULFAT BAIG
KAUSHIKI BISWAS
ANIRBAN GUHA

SHIPRA GUPTA
ASHWIN KELKAR
SATYAJEET KHARE
KIRTIKUMAR KHONDARE
ASHOK KUMAR H.G.
UTTARA LELE
SRINU MEESALA


PRAMOD PATIL
ANUP PILLAI
CHANDRAMOULI REDDY
AMEYA SATHE
KETKI TULPULE
KEERTHI HARIKRISHNAN
SNEHA BANSODE

BS-MS Fifth Year Project Students

RINTU M. UMESH
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VISHNU K.N.
GHORPADE SMITA M
LAKSHMI P.S.
ASHIQ K.A.
RADHIKA R.
ASHWINI RAMESH
SISHIL SUSHANTH

ANU S.R
NIVEDITA RANGARAJAN
APARNA P.K.
ASMI JEZEERA M
AKILANDESWARI B.
MEERA BESSY K.A.
AGRIM SAINI
ROHIT KRISHNAN H.
ABHIJEET PETKAR

HARSHA K KUMAR
PRAVALLIKA GOVADA
NINGTHOUJAM BIRJEET SINGH
KALYANEE SHIRLEKAR
AFSAH HASAN V.P.
HIMANSHU V RAJMANE
AKASH BAHAI



Academic, Technical & Support Staff

SANTOSH BOTRE
TRUPTI BHINGARKAR
PIYUSH GADEKAR
SHITAL GIANCHANDANI
BONI HALDER
RUPALI JADHAV

ANKIT JAISWAL
BHARGAVI NAIK
GETTANJALI NERURKAR
SHABNAM PATIL
SNEHAL PATIL
YASHWANT PAWAR

HEMALATHA RAO
MAHESH ROTE
KALPESH THAKERE
MADHAV VIPRADAS
MRINALINI VIRKAR
VIJAY VITTAL

Project Fellows & Project Assistants

ABHISHEK RALE
NEHA DESHPANDE
APOORVA KULKARNI
SAGAR GORE
NEHA SHINDRE
TEJAL GUJARATHI
KETKI HOLKAR
NELCHI PRASHALI
KAJOL PATEL
ABHISHEK SAHASTRABUDHE
PRATIMA GURUNG
RAJNANDANI KASHYAP

ROHAN SHARMA
RAHUL JANGID
VAISHALI CHAKRAVARTY
PARICHIT SHARMA (Scientific
Programmer)
SHRADDHA KARVE
JAY PRAKASH SHUKLA
SRIPAD JOSHI
ROHAN CHIPPALKATTI
AJESH JACOB
VINITI TOMAR
D. SENTHILKUMAR
NEELIMA VADDADI

PRIYANKA GADE
AVANTIKA AHIYA
AVNI CHRISTIAN
SARANG MAHAJAN
NEHA M.
ANWESHA DASGUPTA
CECILY GEORGE
CHINMAY KULKARNI
POORTATA LALWANI
RACHEL PAUL
POOJA VAID
SHIVKUMAR BIRADAR
PRIYANKA BANSAL

Teaching



Teaching in Biology at IISER Pune

What are the courses?

BS-MS, iPhD, PhD

What is the aim?

To foster intellectual creativity, independence and diversity.

The primary teaching aim of the biology department of IISER Pune is to create high-quality researchers of the next generation. In other words, we would like to produce knowledge-creators as opposed to knowledge-consumers. This in turn means that the priority focus of our teaching is on developing student creativity and intellectual independence as opposed to imparting specialist knowledge. This is a somewhat challenging task as, epistemologically, biology is a very diverse field ranging from reductionist empirical approaches (e.g. molecular biology) to complex systems approaches (e.g. systems biology) and historical narratives (e.g. macro-evolutionary changes) and everything in between. Consequently, it takes some effort on part of the teachers as well as the students to critically examine each tradition and comprehend their domains of relevance/usefulness. Traditionally, this problem has been circumvented in India by making the students choose a subject of specialization (and hence a particular mode of “doing science”) at a very early stage in their education. At IISER Pune, we believe that every approach of scientific enquiry has its strengths and weaknesses, and a relevant biology education should expose students to as many of the approaches as possible, along with a strong interaction with practitioners of other disciplines.

What way are we different?

IISER Pune has no concept of “majors” in any subject and all students get a Masters degree in Sciences. In the first two years, all students must take courses in biology, chemistry, earth sciences, mathematics, physics and humanities and social sciences. In the next two years, the students are free to take courses in any combination from the six disciplines, subject only to time-table constraints.

Within this framework, some of the salient features of our teaching are:

- a) Strong interaction with other disciplines: Researchers from other disciplines co-teach bio courses. Example: Jeet Kalia and Jeet Chugh.
- b) Close correspondence between theory and lab demonstrations. Example: BIO 221
- c) Teaching philosophy focuses on how conclusions are reached as opposed to mere statement of the conclusions.
- d) Students are encouraged to join various research labs during the semesters and earn course credits for the research done. All such projects are monitored at the departmental level. Many such “semester-students” have ended up being authors on papers.
- e) Students are allowed to do their year-long dissertation (during the V year) anywhere in the world.

What have we achieved?

- a) Many of our students, by the time they finish their degree, have papers in peer-reviewed international journals, either from their semester projects or their V-year projects.
- b) A team of undergraduates from IISER Pune mentored by Chaitanya Athale has bagged a Bronze Medal at the international Genetically Engineered Machines (iGEM) contest held at Boston, U.S.A. from September 24-28, 2015. In this Synthetic Biology contest with over 280 teams from all over the world this year, participants are expected to design molecular “bio-devices” in a manner that combines their understanding of genetically encoded parts with additions from anything ranging from art to nano-fabrication.
- c) Our students are placed in some of the top-ranking universities of the world and have won some very prestigious scholarships.
- d) The practice of allowing students to take any combination of subjects have paid rich dividends as some of these students have ended up working on inter-disciplinary areas (e.g. Yagyik Goswami, Soumitra Athavale).

What next?

One of our ambitions is to facilitate independent student projects by sponsoring small-scale research grants for which the students would have to submit competitive proposals. These projects would then be reviewed for their scientific merit and feasibility. For the meritorious projects, the students would be given a modest sum of money and enough course credits, to allow them to carry out the investigations.

List of Courses in Biology (Annexure 1 (pages 172-190) contains course details)

Semester I

1. BIO 101 Introductory Biology I: Basic Principles [3 credits]
2. BIO 121 Biology Lab I: Basic Biology [3 credits]

Semester II

3. BIO 102 Introductory Biology II: Cellular and Molecular Biology [3 credits]
4. BIO 122 Biology Lab II: Biochemistry, Genetics & Molecular Biology [3 credits]

Semester III

5. BIO 201 Introductory Biology III: Evolution and Ecology [3 credits]
6. BIO 221 Biology Lab III: Ecology and Evolution [3 credits]

Semester IV

7. BIO 202 Introductory Biology IV: Biology of Systems [3 credits]

Semester V and VII

8. BIO 301 Lab Training / Theory Project [3 credits]
9. BIO 310 Biostatistics [4 credits]
10. BIO 311 Advanced Cell Biology [4 credits]
11. BIO 312 Animal Physiology II [4 credits]
12. BIO 313 Advanced Molecular Biology [4 credits]
13. BIO 314 Bioinformatics [4 credits]
14. BIO 320 Genetics [4 credits]
15. BIO 322 Biophysics [4 credits]
16. BIO 334 Neurobiology I [3 credits]
17. BIO 353 Immunology II [3 credits] *
18. BIO 401 Lab Training / Theory Project [3 credits]
19. BIO 410 Advanced Biochemistry I [4 credits]
20. BIO 411 Ecology I (Basic Ecology) [4 credits]
21. BIO 420 Developmental Biology [4 credits]
22. BIO 431 Epigenetics [3 credits]
23. BIO 452 Plant Biology II [3 credits] *
24. BIO 454 Structural Biology [3 credits]

Semester VI and VIII

25. BIO 302 Lab Training / Theory Project [3 credits]
26. BIO 321 Plant Biology I [4 credits]
27. BIO 323 Immunology I [4 credits]
28. BIO 335 Animal Behaviour [3 credits] *
29. BIO 351 Biology and Disease [3 credits]
30. BIO 352 Animal Physiology I [3 credits]
31. BIO 354 Neurobiology II [3 credits] *
32. BIO 402 Lab Training / Theory Project [3 credits]
33. BIO 412 Microbiology [4 credits]
34. BIO 413 Mathematical Biology [4 credits] *
35. BIO 417 Advanced Biochemistry II [4 credits] *
36. BIO 422 Evolution [4 credits]
37. BIO 423 Ecology II (Advanced Ecology) [4 credits] *
38. BIO 435 Biophysics II [3 credits] *
39. BIO 441 Genome Biology [3 credits] *
40. BIO 442 Computational Biology [3 credits] *
41. BIO 491 Literature Review [3 credits]

* Courses offered once in two years

PhD Program



PhD Program in Biology at IISER Pune

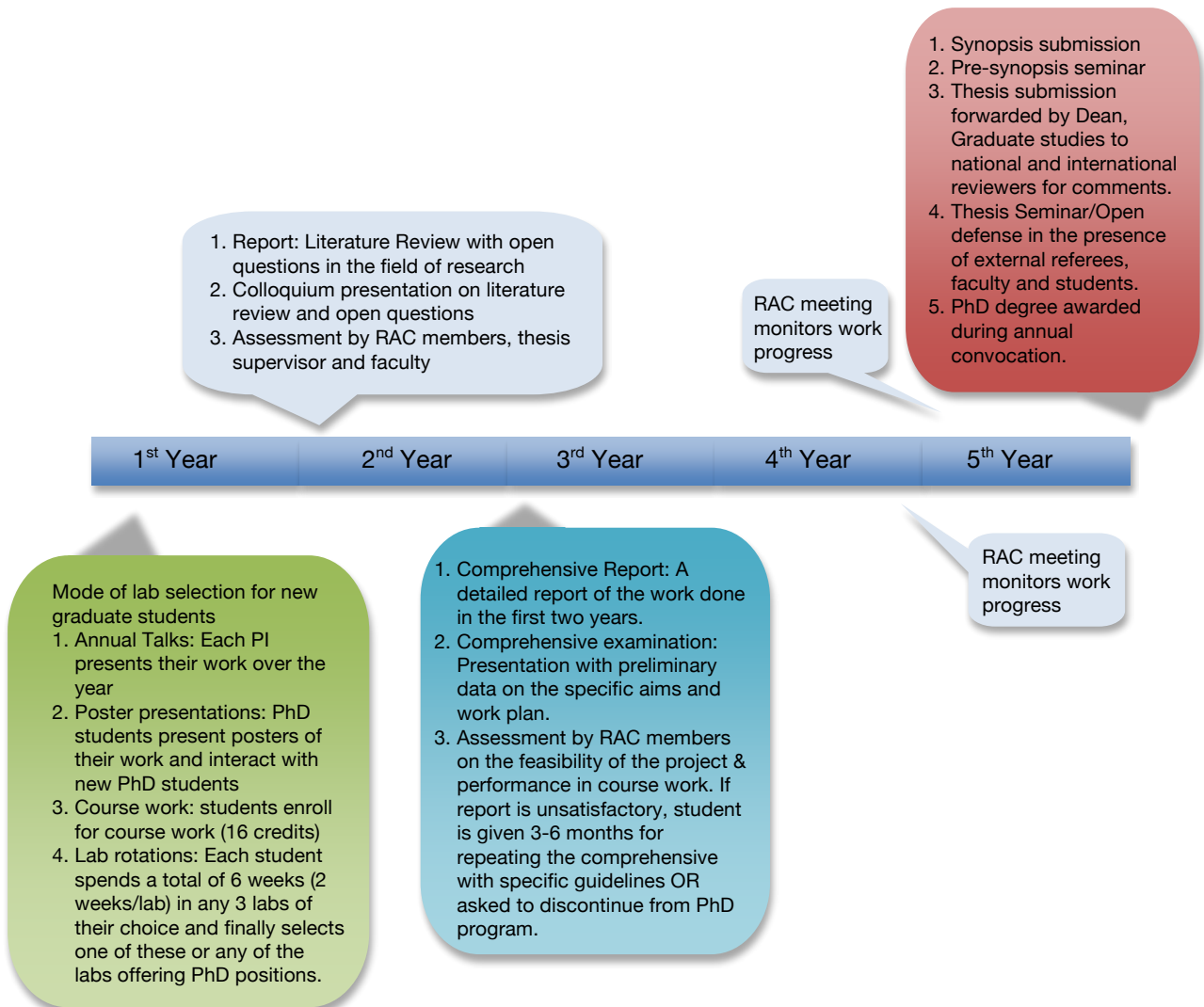
Selection Criteria

The biology, graduate program at IISER Pune has proven to be one of the best in the country in 7 years of its existence since 2008. Students have opted for our biology, PhD program even after being selected into the Indian Institute of Science (IISc) and National Center for Biological Sciences (NCBS) Bengaluru, further underscoring the success of our PhD program given the breadth and diversity of the research topics being offered.

Students with a Masters in Life Sciences are shortlisted to appear for our interviews based on the following criteria: (i) first class (minimum 60% marks in M.S) (ii) qualification in a national entrance test conducted by a government funding agency - CSIR/DBT/DST/UGC that funds their PhD fellowship (iii) qualification in a nationwide entrance test - Joint Graduate Entrance Examination for Biology and Interdisciplinary Life Sciences (JGEEBILSS). Shortlisted students appear for the first interview in one of the 10 panels of 3 faculty members each, where basic questions are posed including questions on their project/work experience in an interview lasting ~15 minutes. Students shortlisted from the first interview appear for the second interview, where 15 faculty members assess the student's ability to answer questions and solve analytical problems in an interview lasting ~45 minutes.

In summary, selection into the PhD program is rigorous, where out of ~2000 applicants, ~200 are shortlisted for the first round of interviews, from which ~60 students appear for the second interview. Finally, 10-15 students are enrolled into the PhD program based on the number of vacancies in each lab. Students can also opt for interdisciplinary and subject specific interview panels in computational biology, chemical biology and ecology-evolution.

Structure of the PhD Program



Integrated PhD Program

The Integrated PhD Program in Biology was launched in August 2011 at IISER Pune, to admit some of the brightest and highly motivated undergraduate students (B.S. Life Sciences), based on a first class and qualification in the Joint Graduate Entrance Examination for Biology and Interdisciplinary Life Sciences (JGEEBILS). On successful completion of this program, students are awarded M.S and PhD degree. Typically, since its inception ~2000 students have been appearing for the exam and ~200 students are invited for the preliminary interviews out of which 20-30 students join the program. They take a total of 84 credits that include credits for course work and up to 8 lab semester projects (4 semester, 2 summer and 2 winter projects) for a duration of ~1.5 years before they select the lab of their choice for their PhD.

PhD Degrees Awarded/Thesis Defense Completed

(till November 2015)

1. [Kamalvishnu Prasad G.](#) (PhD Supervisor: Sanjeev Galande) Role of SATB1 during T cell development and differentiation
2. [Sunita Singh](#) (PhD Supervisor: Sanjeev Galande) Comparative study of SATB family proteins
3. [Naveen Prasad](#) (PhD Supervisor: L.S. Shashidhara) Hox genes and evolution of arthropod body plan: A comparative analysis of targets of Ultrabithorax in *Drosophila melanogaster* and *Apis mellifera*
4. [Mithila Handu](#) (PhD Supervisor: Girish Ratnaparkhi) SUMOylation in the *Drosophila* innate immune response: Proteomics to immune signaling
5. [Shree Harsha T.T.](#) (PhD Supervisor: L.S. Shashidhara) Evolution and development of insect wings: A comparative analysis of the genome wide targets of the Hox protein Ultrabithorax in *Bombyx mori*, *Apis mellifera* and *Drosophila melanogaster*
6. [D. Senthilkumar](#) (PhD Supervisor: Girish Ratnaparkhi) *Drosophila* models of motor neuron disease
7. [Ameya Mahajan](#) (PhD Supervisor: Anjan Banerjee) Identification and functional characterization of Knotted like homeobox genes in potato
8. [Sneha Bhogale](#) (PhD Supervisor: Anjan Banerjee) Studying the role of micro RNAs in tuber development in potato
9. [Abhishek Sahasrabudhhe](#) (PhD Supervisor: Aurnab Ghose) Formin-2 function in growth cone motility and substrate attachment
10. [Savita Singh](#) (PhD Supervisor: L.S. Shashidhara) Functional and molecular characterization of targets of Ultrabithorax in *Drosophila*
11. [Payal Arya](#) (PhD Supervisor: Mayurika Lahiri) Role of TopBP1-Msh2 interaction in ATR-Chk1 pathway
12. [Rafeeq Ahmed Mir](#) (PhD Supervisor: Sanjeev Galande) Role and regulation of SATB1 in colorectal tumorigenesis and progression

BS-MS Fifth Year Projects



Fifth Year Projects of BS MS Students

Projects to complete in
2016

1. [Rintu M. Umesh](#) Role of TopBP1 in morphogenesis and cancer initiation
2. [Nitheesh K.](#) Isolation of G-quadruplex DNA structures from human cells using small molecular probes
3. [Vishnu K.N.](#) Behavioral modulation of theta oscillations in the hippocampal formation
4. [Ghorpade Smita M.](#) Role of Formin2b in axon guidance and neural development of zebrafish (*Danio rerio*)
5. [Lakshmi P.S.](#) Cytoskeletal regulation in neurons
6. [Ashiq K.A.](#) Elucidate the mechanism of PAF-induced transformation in MCF10A
7. [Radhika R.](#) Genetic correlations across life-stages in the evolution of immunity
8. [Ashwini Ramesh](#) Understanding oviposition site selection decisions in mosquitoes
9. [Sishil Sushanth](#) Spatial organization of telomeres and the genome in telomerase and lamin deregulated cancer cells
10. [Anu S.R.](#) Functional analysis of mitochondrial morphology and metabolism in *Drosophila melanogaster* neuroblast differentiation
11. [Nivedita Rangarajan](#) To study the cellular localisation of death domain associated protein (Daxx) in response to redox status of the cell and its role in neurodegeneration in Parkinson's disease
12. [Aparna P.K.](#) Effect of various catalysts on the oligomerization of prebiotically relevant monomers
13. [Asmi Jezeera M.](#) Variation in plant functional traits across contrasting habitats in a seasonally dry tropical forest in Northern Western Ghats
14. [Akilandeswari B.](#) Characterization of DMRT3 neurons and their effect on locomotion and spinal circuit function in mice
15. [Meera Bessy K.A.](#) Role of Lysine 251 acetylation of Api5 in its cellular function
16. [Agrim Saini](#) Studying the fitness effects of complex stressful environment in laboratory populations in *E. coli*
17. [Rohit Krishnan H.](#) Optogenetic regulation of intracellular dynamics during tissue morphogenesis in *Drosophila*
18. [Abhijeet Petkar](#) Functional analysis of mitochondrial metabolism in *Drosophila* oogenesis and embryogenesis
19. [Harsha K. Kumar](#) Acoustic signals and mating behaviour in tree crickets
20. [Pravallika Govada](#) Validating the function of Bin3 as a potential tumor suppressor that antagonizes the function of yorkie as an oncogene
21. [Ningthoujam Birjeet Singh](#) Biochemical and structural studies on SofG, a GTPase involved in motility of *Myxococcus xanthus*
22. [Kalyanee Shirlekar](#) The role of microtubules in mechanosensation in *Mus musculus*
23. [Afsah Hasan V.P.](#) Genome-wide RNAi-based genetic screen for novel tumor suppressor genes using *Drosophila* as a model system
24. [Himanshu V. Rajmane](#) Analysis of spike propagation in feed-forward neural networks
25. [Akash Bahai](#) The role of atomic packing in stabilizing protein structures



Projects completed in
2015

1. [Pimpale Lokesh Ghansham](#) A whole genome RNAi screen to identify modifiers of aggregation of mutant VAPB using automated computational analysis
2. [K.S. Supreeth](#) Exploring the role of AP2-like gene in the development of *Chara* an algal ancestor of land plants.
3. [Satish B.](#) Role of Apoptosis Inhibitor-5 (Api 5) in breast cancer morphogenesis
4. [Neeraja Revi](#) Exploring the role of novel miRNAs in potato development under photoperiodic conditions.
5. [Abinand Reddy K.](#) An investigation into brood parasitism by Asian koels on house crows
6. [V. Saudamini](#) An empirical assessment of the evolution of immune response using *Drosophila melanogaster* as a model system
7. [Vishnu M.S.](#) To identify and characterize proteins in early *Drosophila* embryo using monoclonal antibodies from neuronal hybridoma library
8. [Abhilesh Dhawanjewar](#) Principles governing the viability of mitochondrial-nuclear interactions in respiratory chain complexes
9. [Jagdhane Prarabdha Ulhas](#) Protective role of ART in Amyloid beta peptide induced degeneration in AD
10. [Dincy Mariyam](#) Seasonal distribution of large mammalian herbivores in the Shola-grasslands of the Western Ghats
11. [Jirapure Surabhi Suresh](#) The biological significance of accessory and subtype-specific natural variations in drug resistance of HIV-1 subtype C
12. [Desai Nisarg Parimal](#) Primate behavioral flexibility
13. [Kawale Prasenjeet Bhimrao](#) To explore the effect of polycyclic aromatic hydrocarbons (PAHs) on cyclic reaction
14. [Shewale Dipeshwari Janardhan](#) Role of Chromatin organizing proteins SATB1 & SATB2 in stress induced accelerated aging model of Rat: Interplay of chromatin organization & Insulin like growth factor (IGF) signaling
15. [Ajesh Jacob](#) Role of Actin Nucleators in spinal cord development
16. [Ram Krishna Vinayak](#) Behavioral game theoretic model for evolution of cooperation
17. [Ravindra P.N.](#) Usage of nest mate and non-nest mate recognition in *Ropalidia marginata*
18. [Shailendra Kushwaha](#) Establishment of VIGS based knockdown system of OIGs in *Coccinia* sp
19. [Anurag Mishra](#) Phylogeography of *Philautus* genus of frogs in Arunachal Pradesh
20. [Abhishek Mishra](#) Effects of reflection for dispersal on life-history of laboratory population of *Drosophila melanogaster*
21. [Marina Victor](#) Role of acetylation of Api5 and its interaction with TopBP1
22. [Neha M.](#) Studying Intraspecific variation in plant functional traits across rainfall and environmental gradients
23. [Viraj Doddihal](#) Post transcriptional regulation essential for stem cell function and regeneration
24. [Krishna Anujan](#) The effect of chital disturbance in the diversity and functional traits of understory vegetation in the forests of Andaman islands

Projects completed in
2014

25. [Kavya Leo Vakkayil](#) Biochemical and genetic characterization of chromatin organizer protein Dve-1 and its role in *C. elegans* development and aging
 26. [Lalwani Poortata Shirish](#) Cognitive ability and functional brain connectivity
 27. [Rachana Suhas Bhave](#) To study the presence & correlation between alternative mating tactics (AMT) and Behavioral syndromes (BS) using *Prammophilus doralis* as a model system
 28. [Sane Niharika Vinay](#) Pre-natal exposure to stress affects cognitive development in pups
 29. [Landge Yovhan Vardhaman](#) Role of human tyrosine kinases in dengue virus replication
 30. [Sadhana Panzade](#) Molecular dynamics simulations of proteins: Multiscale modelling studies of the dengue virus
-
1. [Abhijit Awadhiya](#) Comparative analysis of targets of the Hox gene Ultrabithorax in *Drosophila melanogaster* and *Apis mellifera*
 2. [Arya Gaurav Ramlal](#) Lipid assisted peptide formation under SIPF conditions
 3. [Suryesh Kumar Namdeo](#) Role of Lamin A and Lamin B2 in chromosome positioning in the interphase nucleus
 4. [Khanale Dhanashree Prakash](#) Evolution of divergent functions of the Hox protein Ultrabithorax in insects: comparison in transgenic *Drosophila melanogaster*
 5. [Mallikarjuna Mullangi](#) Development and evaluation of in vitro intestinal epithelial models to study ameliorative effects of probiotics on inflammation induced barrier dysfunction
 6. [Brihaspati Kumar Gaurav](#) Seed traits and their correlates in Indian tropical trees
 7. [Montu Patar](#) Molecular cloning and characterization of coniferyl alcohol acyltransferase from *Orimum* sp.
 8. [Beeraka Sai Prashanth Kumar](#) Investigating the role of Arp2/3 and formins in neuronal growth cones
 9. [Shikari Sravani](#) Understanding Tea and Vascular Function
 10. [Kaniganti Tarun](#) Neural mechanisms underlying feeding drive
 11. [Tirthasree Das](#) Molecular characterization of plasma membrane organization during early *Drosophila* Embryogenesis
 12. [Mokashi Aniket Jayrath](#) Evolutionary analysis of freshwater bagrid catfishes from western ghats of India
 13. [Pranita Somawar](#) Proteomic and metabolomic studies in *linum Usitatissimum*
 14. [Mishra Anurag Ramsuman](#) Understanding early morphological changes in B cell activation
 15. [Devabathini N. Krishna Chowdary](#) Exploring chara as a model system to know the function of homeobox genes in macroalgae
 16. [Sharma Sheetal Parasnath](#) Variation in Leaf Mass per unit Area (LMA) in evergreen and deciduous species in a seasonally dry tropical forest
 17. [Bhide Sourabh Jagdish](#) Role of Epidermal Growth Factor signaling in epidermal homeostasis of *Danio rerio* (zebrafish)
 18. [Akash G.](#) Neuromodulatory circuits of feeding drive
 19. [Somendra Singh Kharola](#) Whatever does not kill you makes you stranger: *E. coli* populations selected in randomly fluctuating stressful environments could become superior invaders
 20. [Suraj Chawla](#) Towards statistical species concept and speciation



Projects completed in
2013

1. Siddharth Bharath Iyengar Facilitative effects of a dwarf shrub in an Alpine rangeland
2. Apurv Kulkarni Role of MADF-BESS domain protein family in gene regulation and wing development in *Drosophila melanogaster*
3. Ritesh Raghavan *In vitro* studies on lipid metabolism in keratinocytes of different racial origin
4. Ankita Jha The role of inflammation in type-2 Diabetes Mellitus and its correlation with endothelial dysfunction
5. Amita G. Ghadge Characterization of *Coccinia grandis* as a model system to study sex determination in plants
6. Jagruti Jagadish Pattadkal A study of neuronal response to mechanical tension
7. Pooja Naik Analysis of mitochondrial metabolism control on organism development
8. Roshni Bano Mechanical responses of membranes probed with force spectroscopy
9. Krithika Mohan Visual categorization: The nature of category templates
10. Ramya Balaji Molecular characterization of inception of polarity in the plasma membrane during early *Drosophila* embryogenesis
11. Soumitra Athavale Protein engineering with zinc fingers and TALs
12. Mihir Sadanand Umarani Study of effects of ecological determinants on morphological variations of impatiens species in North Western Ghats
13. Sachit Evolution as evolvability: Yeast as a system
14. Kunal Sinha Why do dogs play?

Projects completed in
2012

1. P. Rahul *In vitro* expression of *Drosophila melanogaster* formins
2. Surojit Sural Investigating dynamics of checkpoint activation in response to DNA alkylation damage in breast epithelial cells.
3. Sameer Parihar Reproductive ecology of *Randia dumetorum*: Factors affecting the high flower to fruit ratio
4. P. Vivekananda Reddy Non-Invasive Endocrine profiling of captive asian elephants (*Elephas maximus*) in two south Indian zoos
5. Anuradha Bhukel Spermidine based amelioration of age-dependent memory impairment under the paradigms of enhanced autophagy and altered epigenome in *Drosophila melanogaster*
6. Apeksha Tare Identifying novel candidate regulators of kidney morphogenesis using developmental metabolomics as a tool
7. Srija Bhagavatula Development of threshold sensitive NF- κ B reporters for live imaging in *Drosophila melanogaster*
8. Neelesh Soni Computational modeling of 3D structure of keratin intermediate filament by satisfaction of spatial restraints
9. Manoj Sahu Purification and biochemical characterization of *Drosophila* VAP-MSP domain
10. Swati Venkat Developing Magnetic tweezers for constant load experiments on microtubule motor proteins
11. Ajinkya Deogade Neuropeptide Y: A novel olfactory modulators in Zebrafish, *Danio rerio*
12. Kumar Brajesh Prasad Role of Lamin A in maintaining genome stability and nuclear organization of cancer cells
13. Madhur Mangalam Strategies in novel food extraction tasks and responses to perceived threats in stray dogs, *Canis familiaris*



Projects completed in
2011

1. [Sisir C. Anand](#) Correlates of dichotomous moral judgement
2. [Nitin Singh Chouhan](#) Learning and memory consolidation in aggression behavior
3. [Madhuresh Sumit](#) Impact of cellular geometry on nuclear dynamics
4. [Susheel Kumar](#) Loyal or promiscuous: A search for female mate preference in *Drosophila melanogaster*
5. [Prabhdeep Singh](#) Molecular phylogeny of skipper butterflies (Lepidoptera: Hesperidae) from the Western Ghats, India
6. [Hemant Kumar Verma](#) RNA interference based screen to identify genetic modifiers of dVAPB
7. [S. Ajay Subramanian](#) The influence of diazepam on cocaine- and amphetamine-regulated transcript peptide (CART) immunoreactivity in the telencephalon and preoptic area of zebrefish *Danio rerio*
8. [Kale Girish Ravindra](#) Quantitative analysis of traction forces exerted by translocating neuronal growth cone
9. [Subhajit Das](#) Empirical investigation of population dynamics of *Alona cambouei*
10. [Stanzin Dadul](#) In silico analysis, cloning and overexpression of miR172 in Potato (*Solanum tuberosum* L. ssp andigena)

Funding

Extra-mural Funding in Biology at IISER Pune

PROJECT LEADER	PROJECT TITLE	FUNDING AGENCY	FROM	TO	TOTAL OUTLAY (lakhs)
1. Milind Watve	An Ecological study of complex life cycle parasites of wild mammalian carnivores	DST	06.10.07	05.10.10 ext to 05.04.2011 - closed	21.45
2. Milind Watve	Indo-Norwegian Project on Wild life - Human conflict	IISc, Bengaluru	22.11.07	21.11.10 - closed	4.50
3. Sutirth Dey	Investigating the dynamics of spatially structured and unstructured lab populations of Drosophila melanogaster under constant perturbations	CSIR	16.11.09	15.11.2012	18.96
4. Saikrishnan Kayarat	Structural studies on NTP-dependent restriction modification enzymes	Wellcome Trust - DBT India Alliance	04.01.10	03.01.2015	328.16
5. Mayurika Lahiri	Characterization of the novel interaction between check point protein TopBP1 and anti-apoptotic protein Api5	DBT	11.01.10	10.01.2013 (6months extn)	18.98
6. Aurnab Ghose & 7. Pramod A. Pullarkat	Biomechanics of synaptogenesis: the role of mechanical tension	DBT	14.01.10	13.01.13	21.42
8. Sanjeev Galande	Study of CTCT mediated long range interactions in human genome	IUSSTF	01.04.10	31.03.2012 - closed	11.15
9. L.S. Shashidhara	Genetic control of cell proliferation, cell size and cell affinities - Indo SPANISH Grant	DST	26.04.10	25.04.2013 closed	31.23
10. Sanjeev Galande	Virtual Centre of Excellence on Epigenetics	DBT	19.03.10	18.03.2015 extn 30.09.2015	602.77

11. Girish Ratnaparkhi	Transcription Regulation in heterochromatin : Role of MADF - BESS domain proteins - DBT-RGY	DBT	06.05.10	05.05.13 extended to 05.11.13	22.13
12. Girish Ratnaparkhi	Modulation of the innate immune response by SuMOylation	Wellcome Trust - DBT India Alliance	01.07.10	30.06.2015	350.03
13. Sutirth Dey	Theoretical and empirical investigation on the interaction of asymmetric migration and intrinsic growth rate on the dynamics of laboratory metapopulation of <i>Drosophila melanogaster</i>	DBT	31.05.10	30.05.2013	20.32
14. Sanjeev Galande	Data Integration to identify biomarkers to diagnose and monitor Type I diabetes and other inflammatory diseases	DBT	17.09.10	16.09.13	202.11
15. Sanjeev Galande	Swarnajayanti Fellowship - Capturing the active chromatin in mammalian cell nucleus: comprehensive and large scale mapping of interactions between genomic elements	DST	Aug 2008	Jul 2013	490.00
16. Aurnab Ghose	Coordination of actin and Microtubule dynamics in neuronal pathfinding: Role of Formin-2	DBT	27.09.2010	26.09.2013	57.18
17. Anjan Banerjee	Molecular characterization of the BEL-1 like homologs in potato and their role in long distance signaling of tuberization	DST	Oct.2010	Sept.2013 Proj closed	37.37

18. Nishikant Subhedar	Glucose sensing mechanisms in the brain of teleost fish: identification, characterization and physiological significance	DST	Oct-2010	18.10. 2013	42.24
19. Nagaraj Balasubramanian	Regulators of adhesion-dependent membrane trafficking role in anchorage independence of cancer	DBT Ramalingaswamy Fellowship - 2009-10	02.09.10	01.09.2015 - closed	70.00
20. Jayeeta Anjan Banerjee	Development on aptamer mediated TRAP (targeted reversibly attenuated probes) for in vivo imaging of RNA	DST	Oct.2010	Sept.2013 Proj closed	20.00
21. Sanjeev Galande	Role of Chromatin Architecture in Cellular Senescence	IFCPAR-CEFIPRA	01.4.10	31.03.2011	22.38
22. Thomas Pucadyil	Mechanistic Analysis of endocytosis of the amyloid precursor protein	Wellcome Trust - DBT India Alliance	01.01.11	31.12.2015	246.84
23. Kundan Sengupta	Molecular mechanisms of nuclear structure-function relationship in cancer	Wellcome Trust - DBT India Alliance	01.01.11	31.12.2015	343.97
24. Shivprasad Patil	Micro-cantilever based calorimetric biosensor for decentralized diagnostics and drug-discovery using a novel detection mechanism	Wellcome Trust - DBT India Alliance	15.01.11	14.01.2016	230.93
25. L.S. Shashidhara	JC Bose Fellowship	DST	Feb-2010	Jan-2015	68.00
26. L.S. Shashidhara	Molecular and genetic characterisation of Drosophila and mouse Ataxin-2 binding protein 1 in the context of spinocerebellar Ataxia type-2	DBT	28.03.2011	27.03.2014	147.57

27. Girish Ratnaparkhi	RNAi based genetic screen to identify interactors of dVAP33 and their in VAPB mediated ALS	DBT	Mar.2011	Feb 2014 extended to 08.03.2015 - closed	25.2
28. N.S. Subhedar / Aurnab Ghose	Neurobiology of fear: Involvement of CART neuropeptide	DBT	16.03.2011	15.03.2014	82.65
29. Nagaraj Balasubramanian	Integrin - dependent regulation of anchorage independence in cancers	Wellcome Trust - DBT India Alliance	01.09.11	31.08.16	437.20
30. Anjan Banerjee	A transcriptomic approach to decipher the alarm signals in phloem of wild solanum species in response to pathogen challenge	DBT	Nov 2011	Oct 2014	34.68
31. L.S. Shashidhara	DBT/IISER Partnership: Facilitation of Research collaboration in emerging areas of Biology - Phase-I / NISER	DBT			52.70
32. Ram Kulkarni	Epigenetics of the fetal odor learning	DST	Feb 2012	Jan 2014	12.48
33. Sanjeev Galande	Study of novel nuclear function(s) of fibronectin	DST	14.10.11	15.10.12	20.22
34. Sudipta Basu	Chimeric Nanoparticle: A novel nanoplatform for signaling pathway driven cancer chemotherapy - Ramalingaswami Fellowship	DST	06.02.2012	05.02.2017	74.50
35. Harinath Chakrapani	Hypoxia - Activated Prodrugs of Nitric Oxide (Innovative Young Biotechnologists Award - 2011 (IYBA 2011)	DST	29.03.2012	28.03.2015 to 30.09.2015	41.19

36.	L.S. Shashidhara	Science Media Centre at IISER Pune	DST - NCSTC Div	16.04.2012	15.04.2015- ext upto 15.10.15	77.00
37.	Ashwin Kelkar	The role of SATB proteins in the structure and function of the inactive X	Wellcome Trust - DBT India Alliance	01.05.12	30.04.16	141.85
38.	Sanjeev Galande	SanGenix: A comprehensive Next Generation Sequence (NGS) data analysis solution (BIPP)	DBT	30.03.12	Sept 2015	11.43
39.	Collins Assisi	Role of network topology in the generation of coordinated neuronal activity	Wellcome Trust - DBT India Alliance	01.09.2012	31.08.2017	217.94
40.	Suhita Nadkarni	Investigating the role of intracellular calcium signal remodeling in the pathogenesis of Alzheimer's disease	Wellcome Trust - DBT India Alliance	01.08.2012	31.07.2017	273.64
41.	Ramana Athreya	Elevational species diversity patterns in the Eastern Himalayas (Arunachal Pradesh)	DST - SERB	06.09.2012	05.09.2015	33.50
42.	Ramana Athreya	Study of Wildlife issue in general and the Schedule I (WPA) endangered Blyth's Tragopan in particular in West Kameng District against Diversion of 78.45 Ha forest land for implementation of 96MW Nafra Hydroelectric project	Govt of Arunachal Pradesh / SEW Nafra Power Corporation Ltd.		May 2013 - Extended to 31.12.15	6.56
43.	Mayurika Lahiri	DNA damage surveillance and repairs : Characterizing the Interaction between Topbl and Msh2-Msh6 complex	DBT	09.11.2012	08.11.2015	75.827

44. Ramana Athreya	Impact study on Wild life for Nyamjang Chhu hydropower project in Tawang District of Arunachal Pradesh	Nyamjang Chhu Hydro Power Ltd., New Delhi	Dec 2012	Jan 2013 - Extended up to 31.12.15	9.31
45. Neelesh Dahanukar	INSPIRE Faculty Award: IFA 12-LSBM21	DST	16.10.2012	15.10.2017	83.00
46. M.S. Madhusudhan	Structural descriptors of protein-protein and protein ligand binding sites and knowledge based design of new interfaces and ligands	Wellcome Trust - DBT India Alliance	01.04.2013	31.03.2018	412.88
47. Gayathri Pananghat	INSPIRE Faculty Award	DST	01.04.2013	31.03.2018	35.92
48. Shital Sarah Ahaley	Role of RNA binding proteins in Hedgehog signalling	Wellcome Trust - DBT India Alliance	01.05.2013	30.04.2017	122.25
49. Raghav Rajan	Ramalingaswamy Re-entry Fellowship Understanding the neural mechanisms underlying initiation of learned motor behaviours- Raghav Rajan	DBT	01.05.2013	30.04.2018	82.00
50. L.S. Shashidhara	Documenting and disseminating the activities of DST-INSPIRE being implemented by Prof. L.S. Shashidhara	DST	22.04.2013	21.04.2013 - closed on 20.12.2014	24.00
51. Anjan Banerjee	Indo-Argentina joint project - Deciphering the transcriptional and miRNA mediated control of calcium dependent protein kinases (StCDPKs) in potato (solanum tuberosum L) tuber development	MST	01.03.2013	28.02.2016	10.37



52. Richa Rikhy	Origin of plasma membrane polarity during embryogenesis	DBT	23.08.2013	22.08.2016	43.99
53. Chaitanya Athale / Co PI Sudipto Muhuri, IoP, BBH	Molecular motor driven centrosomal microtubule mobility: Mechanics and spatio-temporal organization (RGYI)	DBT	03.09.2013	02.09.2016	13.92
54. Chaitanya Athale	Systems modeling and experimental testing of cytoskeletal polarization in cellular pattern formation	DBT	03.09.2013	02.09.2016	67.942
55. Richa Rikhy / Co-PI L.S. Shashidhara	Developmental control of mitochondrial morphology	DBT	04.09.2013	03.09.2016	25.00
56. Krishanpal Karmodiya	INSPIRE Faculty Award (IFA-13 LSBM-53)	DST	02.09.2013	01.09.2018	83.00
57. Aurnab Ghose	Learning and memory in aggression: identifying the neurogenetic substrates and memory traces of a complex social behaviour	DST	17.10.2013	16.10.2016	41.40
58. Tressa Panikulangara Jacob	Understanding the functional relevance of twist paralogs and their interaction with developmental pathways during dermis formation using zebrafish as a model organism	DBT	17.10.2013	16.10.2016	47.63
59. Sutirth Dey	Stabilizing the dynamics of laboratory populations of Drosophila melanogaster using Limiter control	CSIR	01.10.2013	30.09.2016	26.32

60.	L.S. Shashidhara, IISER Pune / G Rangarajan, IISc Bangalore	National Network for Mathematical and computational Biology	DST-SERB (Mathematical Sciences)	20.11.2014	19.11.2017	37.92
61.	Aurnab Ghose	Role of neuropeptid Y in zebrafish olfaction	SERB	17.12.2013	16.12.2016	48.82
62.	Milind Watve	To set up Maharashtra Gene Bank in Maharashtra State	RGSTC, Maharashtra State	09.01.2014	08.01.2019	475.43
63.	Milind Watve	Capacity building among village youth for self study and self employment along western boundary of Tadoba, Andhari Tiger Reserve, Maharashtra	DST-SEED Division	05.02.2014	04.02.2017	14.02
64.	Anjan Banerjee / L.S. Shashidhara	Understanding doecy by exploring floral organ identify gens (OIGs) in coccinia grandis-A New Model for study under DBT's Twinning Programme for NE	DBT - BCIL	13.03.2014	12.03.2017	35.40
65.	L.S. Shashidhara	Disk-B Denmark-India in vivo screen for cancer biomarkers	DBT	27.02.2014	26.02.2019	209.25
66.	Madhuri Vangala	Synthesis of new fluorinated tumor-associated glycopeptide antigens and meningitis vaccine A analogues	DST-SERB	03.07.2014	02.07.2017	24.5
67.	Anjan Banerjee	Target gene identification, Regulation and Functional Characterization of the shoot meristemless (STM) ortholog in Potato (Solanum tuberosum L)	DST-SERB	27.06.2014	26.06.2017	53.2

68. Gayathri Pananghat	Structure and filament dynamics of the cytoskeletal protein fibril (Fib) involved in spiroplasma motility - IYBA-2013	DBT	30.06.2014	29.06.2017	52.59
69. Aurnab Ghose	Identification and characterization of the card neuropeptide receptor	Lady Tata Memorial Trust	11.09.2014	10.09.2016	10.00
70. Sutirth Dey	Evolution of evolvability in laboratory populations of E.coli	DBT	01.11.2014	31.10.2017	54.48
71. Sanjeev Galande	DBT Programme support for Fetal Programming Research	DBT	10.11.2014	09.11.2019	76.25
72. PI - Mayurika Lahiri - Co-PI L.S. Shashidhara	Studying neoplastic transformation of mammosphere cultures in 3D using chemical carcinogens	DBT	12.11.2014	11.11.2019	97.00
73. Pranay Goel / Saroj Ghaskadbi, SPU	Quantitative characterization of threshold behavior of oxidative stress towards development of insulin resistance	DBT	11.12.2014	10.12.2017	20.62
74. Jeet Kalia	Elucidating the role of lipids in ion channel function	Wellcome Trust - DBT India Alliance	01.03.2015	28.02.2020	356.54
75. Srinivas Hotha & Sneha Komath, JNU	Tailoring glycosylphosphatidylinosit of substrates and substrate mimetics to study the GPI biosynthetic pathway and modulate host-pathogen interactions	DST-SERB	23.03.2015	22.03.2018	60.86

76. L.S. Shashidhara	British Council Division - Knowledge Economy Partnership 2015 - Public Lecture series on Science and Pedagogy workshops on Science Education	British Council	July 2015	April-2016	20.50
77. Sonam Mehrotra	A Drosophila model to study adult epithelial stem cells and their role in cancer initiation	DBT	18.04.2015	17.04.2018	24.51
78. G.V. Pavan Kumar	Development of multi-modal nonlinear plasma optical microscopy workstation to probe nanoarchitectures	DST	22.05.2015	21.05.2018	123.90
79. Nixon Abraham	Synaptic and molecular determinants controlling speed of olfactory information processing and decision making	Wellcome Trust - DBT India Alliance	01.06.2015	31.05.2017	304.65
80. Jayeeta Banerjee	A (WOS-A) - A Proteomic investigation to understand sex expression and modification in dioecious <i>C. Grandis</i>	DST	04.06.2015	03.06.2018	32.23
81. Deepak Barua	Programme support on Biotechnology Approaches for conservation and sustainable utilization of plant wealth of western ghats	DBT	14.05.2015	13.05.2018	17.89
82. Nishad Matange	INSPIRE Faculty Award- Nishad Matange	DST	15.06.2015	14.06.2020	19.00



83.	Sanjeev Galande + Saurabh Pradhan-JRF / Carl Philipp Heisenberg, Mateusz Sikora, Jana Slovakova (PDRF)	Indo Austrian (DST-BMWF) Joint Project "Role of Chromatin organizer (SATB2 in gastrulation in Danio rerio"	DST	21.05.2015	20.05.2017	3.30
84.	Milind Watve	Finding alternative crop strategies for farmers affected due to crop raiding by wild herbivores along western boundary of Tadoba-Andhari Tiger Reserve	DeFries Bajpai Foundation	03.07.2015	02.07.2017	3.70
85.	Chaitanya Athale	Travel funds for Participation in International Genetically Engineered Machines Contest (iGEM) at Massachusetts Institute of Technology (MIT), Boston, USA during 24-28 Sept 2015	DBT	19.08.2015	28.09.2015	10.00
86.	Sanjeev Galande	Exploring the potential of Gamma-delta T Lymphocytes for Immunotherapy of cancer	DBT	08.09.2015		22.53
					Total Amount	
						8,386.28

Infrastructure

Infrastructure in Biology at IISER Pune

Biological research at IISER Pune covers a large spectrum of Biology and necessitates the availability of a wide range of instrumentation and specialist infrastructure. Generous support from IISER Pune and extramural funding agencies has allowed us to develop high quality research infrastructure and facilities in a relatively short time.

Please visit <https://www.youtube.com/watch?v=j8P0w4EVpLs> to see the laboratory facilities.



The biology infrastructure includes spacious research and training laboratories, computational resources, greenhouses, experimental field plots, an outsourced animal house and several other facilities. Institutionally, we have access to a range of spectroscopy techniques, a micro-/nano-fabrication suite, a proteomics and mass spectroscopy unit and workshop facilities. The custom-designed building and facilities have been created to impart research training and undertake research of the highest quality.

Open laboratories are a key feature of our organizational philosophy. Apart from efficient utilization of resources, this creates a border-free intellectual environment – a critical requisite of contemporary Biology. Key facilities have been developed as autonomous units and are maintained and administered by technical staff and associated faculty. The facilities provide basic training for new users, specialized technical support to advanced users and are responsible for maintenance and upgradation.

Fly Facility

All fly pushing related needs, including preparation of media, organization of common fly rooms, waste disposal and ordering of fly stocks is centrally managed by the facility. The stock centre maintains a large collection of fly stocks, both locally generated and from public collections.

Animal Cell and Tissue Culture Cluster

Positive pressure, filtered air clean areas cater to our tissue culture needs that include cell lines, primary cultures and viral work. Training in handling animal cells in culture and maintenance of related infrastructure and reagents is managed by the group. Common media is centrally prepared and distributed leading to a significant reduction in expenditure and batch-to-batch variability.

Plant Biology Facilities

A plant tissue culture suite and transformation facility is available with the necessary equipment to grow plants *in vitro*. Multi-tiered culture rooms, growth incubators and plant growth chambers with programmable modular light banks for plant growth in controlled conditions are available. A research greenhouse with modular temperature and light control has been developed along with an experimental plot for field trial purposes.

Imaging Centre

This is an operator-free facility providing training and maintaining our extensive microscopy resources. Multiple confocals, a two-photon confocal, a SEM, live cell imaging and microinjection stations, a TIRF system and stereomicroscopes are managed by this facility. This apart we

have access to biological AFM, FE-SEM and Raman spectroscopy.

Computing Resources

Management and maintenance of high-performance research computing clusters, networked storage servers, centralized access to key commercial softwares and other computational requirements are coordinated by this group.

Library and e-journals

The library provides access to a large collection of journals, collections, books, databases and an internal digital repository.

Structural Biology Core Facility

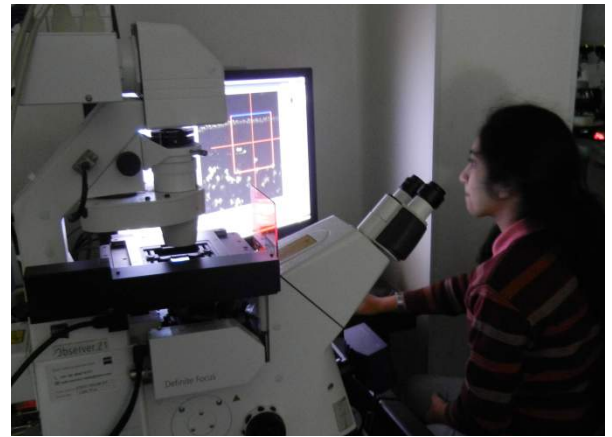
This facility includes a macromolecular crystal data collection system and a crystallisation robot. The data collection system, consisting of a Rigaku MicroMax-007HF X-ray generator, VariMax optics, Marresearch dtb345 detector and Oxford cryosystem, facilitates in-house crystal screening and data collection. TTP Mosquito liquid handling robot automates extensive screening for potential crystallisation conditions.

Histology Core Facility

Plant and animal tissue processing facility includes, microtomes, cryotomes, vibratomes, ovens, hot and cold plates and a sophisticated laser capture microdissection system.

Animal House

While our in-campus animal house is being constructed, we have access to a rented animal facility. The facility includes, regular animal maintenance and procedural rooms, a barrier facility with IVC units, setup for stereotaxic manipulations and a behaviour analysis facility with a several behavioural apparatus and videotracking systems.



Publications



Publications in Biology at IISER Pune

Publications in 2015

1. Varma, V., Barua, D., et.al. (2015). Perceptions of priority issues in the conservation of biodiversity and ecosystems in India. *Biological Conservation* 187:201-211.
2. Padhye, S. and Dahanukar, N. (2015). Determinants of 'water fleas' (Crustacea: Branchiopoda: Cladocera) diversity across seasonal and environmental gradients of a polluted river. *Current Science* 109(10).
3. Raghavan, R., Dahanukar, N., Philip, S., Iyer, P., Kumar, B., Daniel, B. and Molur, S. (2015). The conservation status of decapod crustaceans in the Western Ghats of India: an exceptional region of freshwater biodiversity. *Aquatic Conservation-Marine and Freshwater Ecosystems* 25:259-275.
4. Dahanukar, N., Kumkar, P., Katwate, U., Raghavan, R. (2015). Badis britzi, a new percomorph fish (Teleostei: Badidae) from the Western Ghats of India. *Zootaxa* 3941:429-436.
5. Raghavan, R. and Dahanukar, N. (2015). Taxonomy matters. *Current Science* 108:1416-1418.
6. Molur, S., Krutha, K., Paingankar, M.S., Dahanukar, N. (2015). Asian strain of Batrachochytrium dendrobatidis is widespread in the Western Ghats, India. *Diseases of Aquatic Organisms* 112:251-255.
7. Katwate, U., Raghavan, R. and Dahanukar, N. (2015). The identity of Hamilton's Ticto Barb, *Pethia ticto* (Teleostei: Cyprinidae). *Zootaxa* 3964(4):401-418.
8. Raghavan, R., Dahanukar, N. and Molur, S. (2015). Curbing academic predators: JoTT's policy regarding citation of publications from predatory journals. *Journal of Threatened Taxa* 7(10):7609-7611.
9. Karve, S.M., Daniel, S., Chavhan, Y.D., Anand, A., Kharola, S.S. and Dey, S. (2015). Escherichia coli populations in unpredictably fluctuating environments evolve to face novel stresses through enhanced efflux activity. *Journal of Evolutionary Biology* 28(5):1131-1143.
10. Reddy, P.C., Sinha, I., Kelkar, A., Habib, F., Pradhan, S.J., Sukumar, S. and Galande, S. (2015). Comparative sequence analyses of genome and transcriptome reveal novel transcripts and variants in the Asian elephant *Elephas maximus*. *Journal of Biosciences* (Accepted for Publication).
11. Pusalkar, M., Suri D., Kelkar, A., Bhattacharya, A., Galande, S. and Vaidya, V.A. (2015). Early stress evokes dysregulation of histone modifiers in the medial prefrontal cortex across the life span. *Developmental Psychobiology* doi: 10.1002/dev.21365. [Epub ahead of print].
12. Sawant, A.A., Tanpure, A.A., Mukherjee, P.P., Athavale, S., Kelkar, A., Galande, S. and Srivatsan, S.G. (2015). A versatile toolbox for posttranscriptional chemical labeling and Imaging of RNA. *Nucleic Acids*

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control. *Medical Hypotheses*, 74:578-579.

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Awards and Honors

Awards and Honors of Biology Members

2014-2015

[Sanjeev Galande](#) Felicitated for research contributions in the Senior Scientist category by the Pune Municipal Corporation on the occasion of Science Day (February 28, 2015)

[Jeet Kalia](#) Wellcome-DBT India Alliance Intermediate Fellowship

2013-2014

[Krishanpal Karmodiya](#) INSPIRE Faculty Award 2013 • DBT Innovative Young Biotechnologist Award (IYBA) 2014

[Gayathri Pananghat](#) INSA Young Scientist Medal 2014 • Innovative Young Biotechnologist Award (IYBA) for 2013, Department of Biotechnology (DBT) • DST-INSPIRE Faculty Fellowship

[Raghav Rajan](#) DBT Ramalingaswami Re-entry Fellowship

2012-2013

[Neelesh Dahanukar](#) DST- INSPIRE Faculty Fellowship

[Nishikant Subhedar's](#) research paper from his group titled "Nicotine evoked improvement in learning and memory I mediated through NPY Y1 receptors in rat model of Alzheimer's disease" has been selected for the Olson Prize awarded by the Journal *Peptides*

2011-2012

[Ramana Athreya](#) One of the seven finalists of the prestigious Whitley Fund for Nature Awards of UK. He received the award at the hands of HRH The Princess Royal for his contributions to nature conservation and empowering the locals in Arunachal Pradesh. The award includes a research grant of GBP 30,000.

[Sanjeev Galande](#) Elected as a Fellow of the Indian National Science Academy (FNA) for the year 2012

[Thomas Pucadyil](#) Elected as Young Associate of the Indian Academy of Sciences, Bengaluru

2010-2011

[Sutirth Dey](#) Awarded Young Scientist Medal of the Indian National Science Academy, New Delhi, India

[Sanjeev Galande](#) Selected for the Shantiswaroop Bhatnagar Award-2010

by the Council of Scientific and Industrial Research (CSIR), New Delhi and was elected as the Fellow of the Indian Academy of Sciences, Bangalore, India

[L.S. Shashidhara](#) Awarded JC Bose Fellowship of the Department of Science and Technology, Government of India

[Milind Watve](#) Elected as a Fellow of the Indian National Science Academy, New Delhi, India

2009-2010

[Nagaraj Balasubramanian](#) DBT Ramalingaswami Re-entry Fellowship

[Anjan Banerjee](#) Elected to the Membership of Plant Cell Culture Association of India

[Sutirth Dey](#) Awarded the guest fellowship of Wissenschaftskolleg zu Berlin

[L.S. Shashidhara](#) Awarded the Shanti Swarup Bhatnagar Prize for the year 2008 in Biological Sciences for his contribution to the understanding of appendage development in animals

2006-2007

[L.S. Shashidhara](#) Elected as a Fellow of Indian National Science Academy (INSA), New Delhi and as a Fellow of Indian Academy of Sciences, Bengaluru



Awards and Honors of Biology Members

Graduate Students

Niraja Bapat Best Poster Award at the Origins 2014 conference, the second joint International conference of ISSOL (<http://www.issol.org>) and Bioastronomy (Commission 51 of the International Astronomical Union) held in Nara, Japan during July 6-11, 2014

Srishti Dar First prize for Poster Presentation on *Inhibition of Dynamin-Catalyzed Membrane Fission by the Accessory Endocytic Protein Sorting Nexin 9*, at Lipid-protein Interactions in Membranes: Implications for Health and Disease, a Biophysical Society Sponsored Meeting 11-POS at Centre for Cell and Molecular Biology Hyderabad in 2012 (Abstract published in *Biochemical Journal*)

http://www.biochemj.org/bj/news/poster_winners/Dar_S.htm

Kunalika Jain Dr. Manasi Ram Memorial prize for Best Poster Presentation by young scientists in poster session during the XXXVII All India Cell Biology Conference, December 2013, InStem, Bengaluru

Rashmi Kulkarni DST travel grant and Immunology Foundation travel bursary to support my talk at 1st International Conference on Modeling Metabolic Health, held at University of Cambridge, United Kingdom from October 6-7, 2015

Dhriti Nagar Best poster award for presenting a poster on *Role of Formin2b in the development of neural circuits in zebrafish* at the Biennial Indian Society of Developmental Biologists meeting held at Centre for Cellular and Molecular Biology (CCMB), Hyderabad during July 15-18, 2015

Bhavani Natarajan International Travel Award of \$1500 from the Board of Directors of 11th International Congress of Plant Molecular Biology (IPMB2015) to attend IPMB2015 Meeting (<http://www.ipmb2015.org/index.php>) held in Iguazú Falls, Brazil from October 25-30, 2015

Abhinav Parivesh Dr. Manasi Ram Memorial Prize for best paper presentation by young scientists in poster session at the XXXVI All India Cell Biology Conference held at Bhabha Atomic Research Centre, Mumbai from October 17-19, 2012 • Elsevier DNA Repair Best Poster Award at Zing Conference on Genomic Integrity, held at Cairns, Australia between August 1-5, 2015 • DBT travel Grant to present poster at Zing Conference on Genomic Integrity held at Cairns, Australia, between

August 1-5, 2015

[Archana Pawar](#) Best Poster Award at the International Conference on Cancer Research: New Horizons, National Centre for Cell Science (NCCS), Pune, India, November 19-21, 2015

[Neeladri Sen](#) CSIR All India Rank 5, Shyama Prasad Mukherjee Fellowship awarded for NET December 2014

[Aparna Sherlekar](#) DBT Travel Support to attend 2014 American Society for Cell Biology (ASCB)/International Federation for Cell Biology (IFCB) Meeting in Philadelphia, PA, December 6-10, 2014

[Ankitha Shetty](#) ERASMUS Experts for Asia Grant for 6 months to work in the laboratory of Prof. Riitta Lahesmaa at Turku Center for Biotechnology, Turku, Finland

[T. Shreeharsha](#) DBT Travel Grant to travel to the 9th International Workshop on Molecular Biology and Genetics of the Lepidoptera held in August 2014 in Crete Greece • Best Poster Award at the EMBO Workshop on Upstream and downstream of *Hox* genes held in December 2014 in Hyderabad

[Jay Prakash Shukla](#) Best Poster Award in Biology Science Day, IISER Pune

[L.A. Viswanathan](#) DST Travel Grant to present a poster at the Dynamics of Cellular Behavior during Development and Disease meeting, Cold Spring Harbor Asia's conference held November 17-21, 2014 in Suzhou, China



Awards and Honors of Biology Members

Scientists & Postdoctoral Fellows

[Tressa Jacob](#) DBT Funding as Women Scientist Scheme of DBT- called BIOTECHNOLOGY CAREER ADVANCEMENT AND Re-ORIENTATION programme (Bio-CARe) for project titled *Understanding the functional relevance of Twist paralogs and their interaction with developmental pathways during dermis formation using zebrafish as a model organism* with co-PI Prof. L.S. Shashidhara (October 2013 to October 2016)

[Anup Pillai](#) DST-SERB travel fellowship to present a research poster at the International Neuroscience meeting at Chicago, U.S.A. October 17-21, 2015

Conferences, Workshops, and Seminars



Conferences, Workshops and Seminars in Biology at IISER Pune

IISER Pune Biology has organized and hosted over 30 events such as conferences and workshops and over 350 seminars since its inception in 2006. They are listed here and details related to participation and program schedule are in Annexure II.

1. Indo-French Seminar 2016 - "Frontiers in cytoskeleton research: coordination, adaptation, fine tuning"
October 25 - 27, 2015
2. A Banquet of Biological Research: IISER Pune-Biology Annual Talks
July 28 - 29, 2015
3. 18th Transcription Assembly Meeting 2015
March 12-14, 2015
4. INSA - Leopoldina Symposium: Human Evolution Towards Language – From Genes to Behaviour
January 15-16, 2015
5. Winter School on Foundations of Ecology and Evolution
December 15-28, 2014
6. Brain Circuits, SERB School in Neuroscience
December 8-21, 2014
7. ICTS Program on Advances in Mathematical Biology
December 7-16, 2014
8. A Banquet of Biological Research: IISER Pune-Biology Annual Talks
July 28-30, 2014
9. Mathematical and Computational Methods in Life Sciences
April 11-12, 2014
10. 35th Annual Meeting of Plant Tissue Culture Association (India)
National Symposium on Advances in Plant Molecular Biology & Biotechnology
March 10-12, 2014
11. Biophysics Paschim 6
March 1, 2014
12. Workshop on NGS Analysis
February 24-27, 2014
13. Asian Conference on Raptor Research
February 6-7, 2014
14. International Symposium on Protein Structure, Function and Dynamics
January 30, 2014

15. Indo-U.K. Scientific Seminar on Complementary Approaches in Structural Molecular Biology
January 27-29, 2014
16. Hippocampus: From Synapses to Behavior
December 1-3, 2013
17. Symposium on Evolution of Human Cognition
November 17-19, 2013
18. Principles of Autonomous Neurodynamics: The 10th Annual Meeting of the Society for Autonomous Neurodynamics (SAND)
August 5-7, 2013
19. A Banquet of Biological Research: The First IISER Biology Annual Talks
July 29-31 2013
20. Workshop and Symposium on XRD
January 19, 2013
21. IISER-NISER Meeting
July 21-22, 2012
22. Cell Compartmentation, Division & Signaling
April 10-11, 2012
23. International Conference on Mathematical and Theoretical Biology
January 23-27, 2012
24. Mini-Symposium on Modern Biology
September 28-29, 2011
25. Indo-UK International Scientific Seminar
August 27-28, 2011
26. Workshop and Symposium on Mathematical Physiology
January 15-23, 2011
27. Imaging the Nervous System: Third SERC School in Neuroscience
December 7-21, 2009
28. Workshop and Symposium on Theoretical and Mathematical Biology
October 10-11, 2009
29. Plant Biology Symposium
August 8, 2009
30. Mini Symposium in Systems Biology
June 19, 2009
31. Indo-Sokendai Meeting on Trends in Modern Biology
October 24-25, 2008

International Relations



International Relations

IISER Pune currently has active collaborations with the following partners in areas of academic co-operation, and student & faculty exchange.

1. Bioinformatics Institute, Singapore
2. Enovex Technology Limited, Canada
3. Max Planck Institute of Colloids and Interfaces, Potsdam
4. National University of Singapore
5. New Mexico State University, U.S.A.
6. University of Glasgow, U.K.
7. Georg-August-Universität Göttingen, Germany
8. The University of Parma, Italy
9. Leibniz University Hannover, Germany
10. University of Bath, U.K.
11. The University of Melbourne, Australia

As a part of understanding with universities and institutes abroad, the following students and researchers from outside India pursued research activities in Biology between April 2014-March 2015 at the institute.

Visitor	Affiliation	Host at IISER Pune	Duration
Vanessa Carle	Martin Luther University	Saikrishnan Kayarat	April 2014-February 2015
Alexandra Wells	Ohio State University, U.S.A.	L.S. Shashidhara	May-July 2014
Teena D'Cruz	Ohio State University, U.S.A.	Kundan Sengupta	May-July 2014
Sofa Elizarova	University of Göttingen, Germany	Akanksha Chaturvedi	November 2014-January 2015
Casper Groth	Senior Visiting Fellow from University of Copenhagen, Denmark	Prof. L.S. Shashidhara	January 2015-December 2015

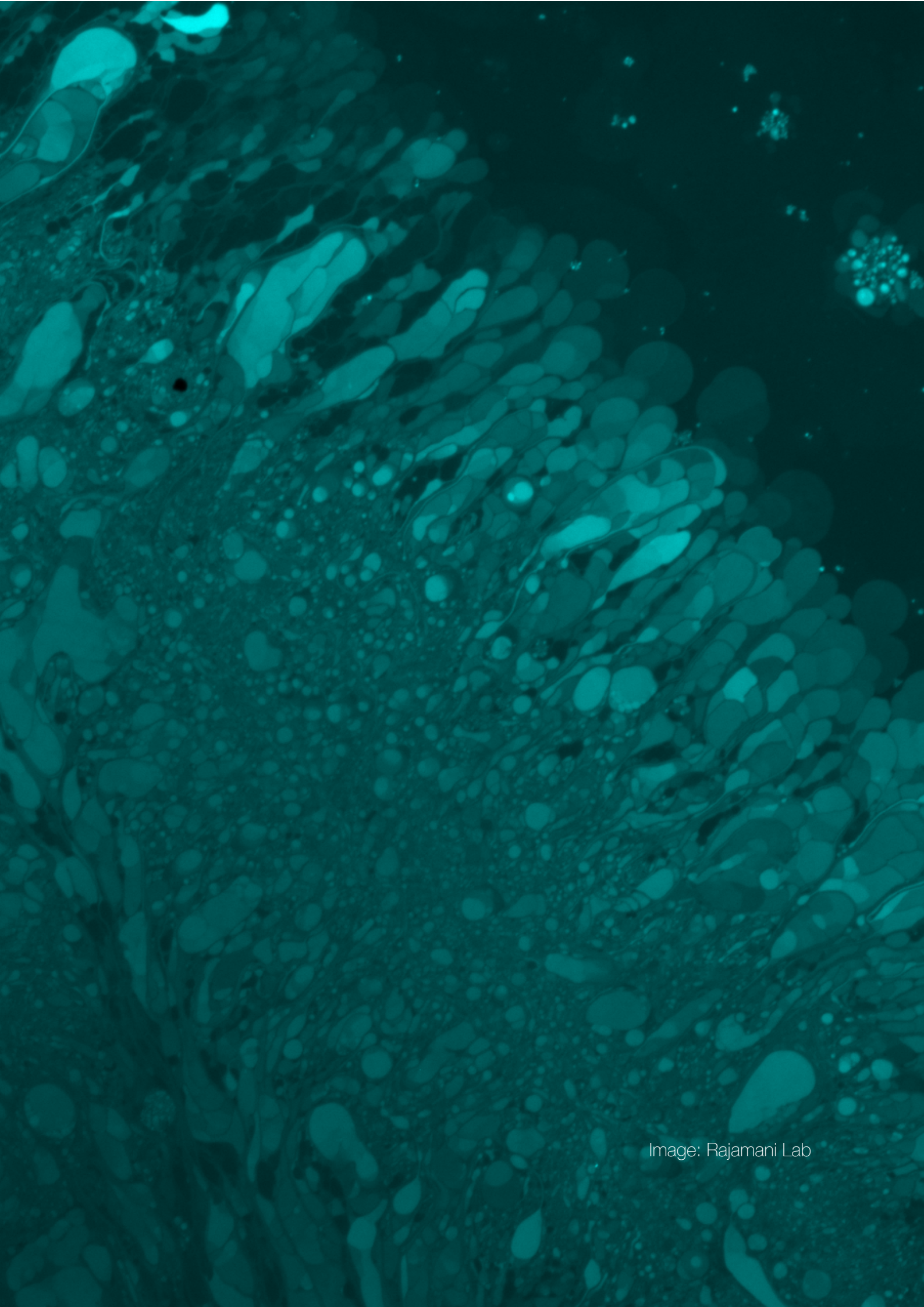


Image: Rajamani Lab

Biochemistry and Biophysics

Chaitanya Athale

Jeetender Chugh

Krishna N. Ganesh

Jeet Kalia

Saikrishnan Kayarat

Gayathri Pananghat

Thomas Pucadyil

Mrinalini Puranik

Sudha Rajamani



Chaitanya A. Athale

Associate Professor

cathale@iiserpune.ac.in; <http://www.iiserpune.ac.in/~cathale>

PhD: University of Heidelberg, Germany

Postdoc: HST (MGH-MIT), Boston, U.S.A.; EMBL Heidelberg, Germany

With IISER Pune since August 2009

Mechanobiology: Collective Properties of the Cytoskeleton

The shape and size of a cell are fundamental properties and appear to influence higher-order structures. We are interested in addressing the role of mechanics driven by the cytoskeleton in cell shape. To this end we employ a combination of mathematical model building and computer simulations, *in vitro* experiments, microscopy and computational image analysis.

The cytoskeletal element we have chosen to focus on is the microtubule (MT) cytoskeleton. Using a coupled model of MT regulation by Stathmin and sliding due to kinesin in a neuronal growth cone geometry, we have predicted the sensitivity of the MT polarization network in *Aplysia* neuronal growth cones². The model of radial MT transport in meiotic spindle assembly predicted a novel tug-of-war arising in the presence of a single motor species alone³. We are in the process of testing this tug-of-war using an *in vitro* reconstitution of a gliding assay (Fig. 1a). At the same time, MT polarization during neurite outgrowth is being tested using a pheochromocytoma (PC12) cell system (Fig. 1b). Based on our recent findings of cell length variability in a population of growing *E. coli*¹, we are developing a microfluidics based continuous culture system combined with agar-pad based imaging (Fig. 1c) to uncover the role of growth rate in regulating cell division by the bacterial cytoskeletal protein FtsZ. This will feed into a theoretical model, which will help develop a model of the role of cell population on individual cell division events. Such a systems level

approach has led us recently to develop a coupled model simulation and experimental approach to examine bacteria cell division, as a part of the international genetically engineered machines (iGEM) undergraduate contest.

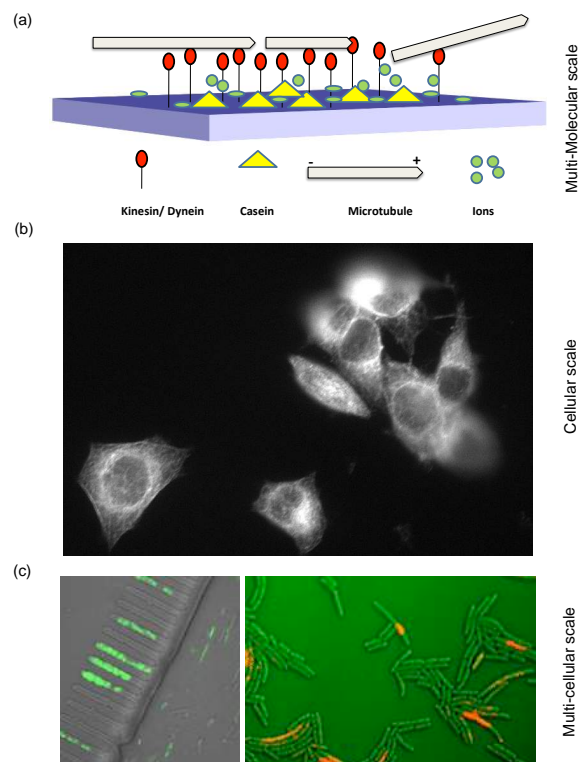


Fig. 1. Multiple scales of cellular self-organization. (a) A schematic representation of an MT gliding assay setup with immobilized motors and polymerized MTs. (b) Fixed adherent PC12 cells labelled with FITC-anti- α -tubulin. (c) A microfluidics chip for continuous culture of rod-shaped bacteria with MG1655 cells in DIC (grey) and HupA-GFP (green) channels. (right) An agar pad of a batch-growth of *E. coli* DH5a cells in DIC (green) is overlaid with the fluorescence image of HupA-GFP (red).

Publications

1. Athale, C.A., Chaudhari H. (2011). Population length variability and nucleoid numbers in *E. coli*. *Bioinformatics* 27:2944-2948.
2. Mahajan, S., Athale, C.A. (2012). Spatial and temporal sensing limits of microtubule polarization in neuronal growth cones by intracellular gradients and forces. *Biophysical Journal* 103:2432-2445.
3. Athale, C.A., Dinarina, A., Nedelec, F. and Karsenti, E. (2014). Collective behavior of minus-ended motors in mitotic microtubule asters gliding toward DNA. *Physical Biology* 016008:12pp.
4. Pawar, A.B., Deshpande, S.A., Gopal, S.M., Wassenaar, T.A., Athale, C.A. and Sengupta, D. (2014). Thermodynamic and kinetic characterization of helix association. *Physical Chemistry Chemical Physics* 17:1390-1398.

Grants

Title: Systems modeling and experimental testing of cytoskeletal Polarization in cellular pattern formation; Source: Dept. of Biotechnology, Govt. of India; Amount: INR 6.79 millions (3 year)

Title: Molecular motor driven centrosomal microtubule motility: mechanics and spatio-temporal organization; Source: RGYI, Dept. of Biotechnology, Govt. of India; Amount: INR 1.39 millions (3 year)

Title: Sponsorship for international Genetically Engineered Machines (iGEM) 2015 Contest; Dept. of Biotechnology, Govt. of India; Amount: INR 1 million (3 months)

Affiliations, Awards and Honors

Biophysical Society (2012-2015)

Institutional Activities

Member, Biology PhD committee (2011-2012); Coordinator, Biology Trainee Program (2010-2013); Coordinator, Biology Lab Safety Orientation for incoming students (2013-2015); Member, Joint Aptitude Test Committee, IISER (2014-2015); Member, Fifth year thesis committee, IISER Pune (2015)



Students Graduated

BS-MS Fifth Year Project Student: P. Priyatham

Non-IISER / External MS Students who have done a full thesis:

Hemangi Chaudhari (Pune University), Vinay Nair (Pune University)

Teaching

BIO 322: Biophysics 1 (Fall, 2011-2015)

BIO 435: Biophysics 2 (Spring, 2011-2013)

BIO 491: Literature Review (Spring, 2014)

BIO 121: Introductory Biology Lab (Fall, 2013-2015)

Outreach

Exciting Science Group, Pune; Kendriya Vidyalaya, Mandapam

Current Group Members

PhD Students: Gangan Manasi, Chaphalkar Anushree, Jain Kunalika, Khetan Neha; Project Assistants: Mishra Prangya, Nilangekar Kiran; Trainees: Kutsch Anna-Lea (University of Goettingen, Germany)



Jeetender Chugh

Assistant Professor

cjeet@iiserpune.ac.in; <http://www.iiserpune.ac.in/~cjeet>

PhD: Tata Institute of Fundamental Research (TIFR), Mumbai, India

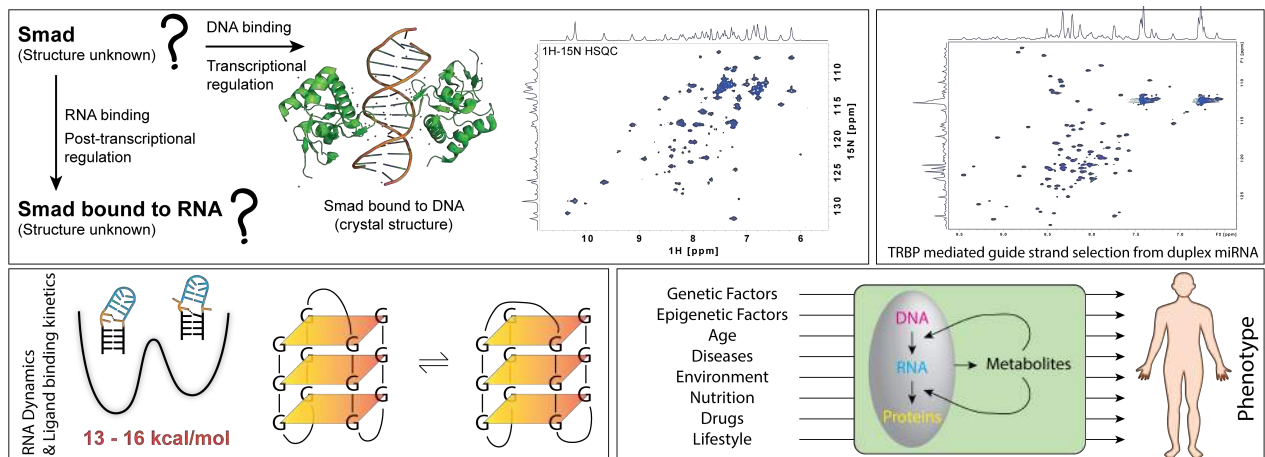
Postdoc: University of Michigan, Ann Arbor, U.S.A.

With IISER Pune since March 2013

NMR Spectroscopy of Biomolecules

Focus of our lab is on various aspects of solution NMR spectroscopy including theoretical design and implementation of new NMR experiments to probe the biophysical characteristics of RNA, protein and RNA-protein complexes; understanding functional aspects of non-coding RNAs (G-quadruplexes, RNA aptamers); and studying structural biology of microRNA and their regulation under various disease settings. We are also looking at metabolic profiles of various body fluids (urine, blood, saliva etc.) in normal and disease conditions and cell extracts under various stressed conditions to understand and correlate the metabolic pathways with specific disease/stressed conditions. We are actively collaborating with other scientists (within IISER Pune and outside) to understand advanced materials, primitive informational polymers of the pre-RNA world, etc.

Why NMR? NMR spectroscopy can be used to measure dynamics at atomic resolution and to deduce structural, kinetics and thermodynamics characteristics of many motional modes occurring at different timescales. NMR spectroscopy has broad sensitivity to motions spanning picosecond to second and longer timescales and can be used to characterize very subtle changes in conformation, including those involving minutely populated conformers that have exceptionally short lifetimes (in the order of nanoseconds). Last but not the least, NMR spectroscopy is a powerful approach for exploring how the dynamic structure landscape is modulated by cellular cues, and time-resolved methods can be used to follow these perturbations in real time.



Overview of various projects currently undertaken in the lab; SmaD is a DNA and RNA binding protein for which the structure is not known when bound to RNA; TRBP protein mediates guide strand selection from duplex to mature microRNA and we are trying to understand the dynamics of TRBP-miRNA interaction that is hypothesized to facilitate this selection; G-quadruplex conformational rearrangements from parallel to anti-parallel and mixed conformations; and metabolomics by NMR

Publications

1. Chugh, J. (2014). Determining transient nucleic acid structures by NMR. *Chemical Biology of Nucleic Acids: Fundamentals and Clinical Applications* Springer 2014:181-198.
2. Chugh, J. (2015). Visualizing transient structures in A-site RNA of the ribosome: New structures of known molecules for drug target. *Journal of Proteins and Proteomics* 6:JPP10.
3. Bhatia, P., Raina, S., Chugh, J. and Sharma, S. (2015). miRNAs: Early prognostic markers for type 2 *Diabetes mellitus*. *Biomarkers in Medicine* 9:1025-40.
4. Gupta, A.K., Yadav, A., Srivastava, A.K., Ramya, K.R., Paithankar, H., Nandi, S., Chugh, J. and Boomishankar, R. (2015). A neutral cluster cage with a tetrahedral [Pd12III₆] framework: Crystal structures and host-guest studies. *Inorganic Chemistry* 54:3196-3202.

Grants

Title: Structural delineation of Smad mediated regulation of miRNA biogenesis pathway using Smad3 and miRNA-21 as model system(s); Source: Department of Science and Technology, Govt. of India (Applied)

Title: Investigations of interactions between Escherichia coli DNA repair proteins SSB, UvrD and RecA: Implications for regulation of DNA recombination and repair in Eubacteria; Source: Board of Radiation and Nuclear Sciences, Govt. of India (Applied)

Affiliations, Awards and Honors

Travel and accommodation award from AILM2015 organizers for attending the AILM2015 conference held at Grenoble, France (2015)

Institutional Activities

Management of purchase of liquid Nitrogen (since September 2015); Maintenance and management of 400 Jeol, 400 Bruker and 600 Bruker NMR spectrometers (since Jan 2015); Member, Committee on Students Activities (since April 2014); Member, Rajbhasha Karyanvayan Committee (since April 2014)

Teaching

CHM 430: Advanced Physical Chemistry Laboratory (Fall 2013, 2014, 2015)

CHM 121: Physical Chemistry Laboratory I (Spring 2014, 2015)

CHM 420: Structural Methods and Analysis (Spring 2014, 2015)

Outreach

Teaching in different departments of universities and colleges including Department of Biotechnology and Bioinformatics Center at SP Pune University, NCCS Pune, DY Patil Biotechnology and Bioinformatics Institute; Nominated as the local coordinator to conduct KVPY Aptitude test in 2013 at the exam center in KV.



Current Group Members

PhD Students: Himani Rawat, Harshad Paithankar, Sachin Kumar Singh, Saleem Youf



Krishna N. Ganesh

Professor and Director, IISER Pune

kn.ganesh@iiserpune.ac.in; <http://www.iiserpune.ac.in/~kn.ganesh/>

PhD: Delhi University, India; University of Cambridge, U.K.

Previous Positions: Centre for Cellular and Molecular Biology, Hyderabad; National Chemical Laboratory (NCL), Pune
With IISER Pune since 2006

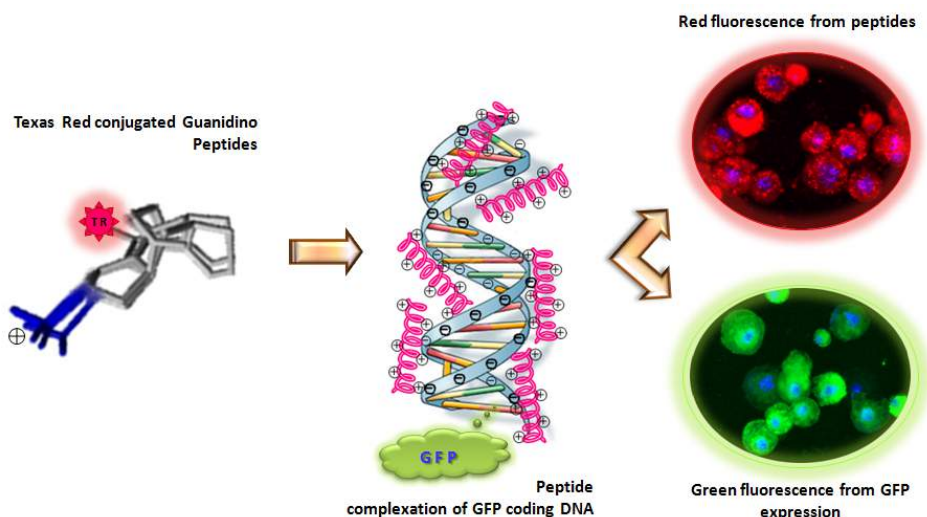
Chemical Biology of Nucleic Acids and Peptides; DNA Nanoscience

Research in our group for more than a decade is focused on rational design of a novel class of DNA mimics—PNA analogues, incorporating chiral, non-chiral conformational constraints and cationic substituents in backbone to make them bind differentially to DNA/RNA, promote cell entry and be bioviable. These attributes would make them good candidates for the development of nucleic acid targeted therapeutic and diagnostic agents. Recently, we have shown that PNAs carrying methylene amino side chains on backbone exhibit regio- and stereo specific effects on both DNA/RNA binding and on cell uptake properties of derived PNAs.

Another project involves synthesis of a series of 4-aminoproline containing collagen mimics that

form highly stable triple helices that are stable to collagenase in order to develop scaffolds for tissue engineering.

Aminoproline polypeptides have been shown to undergo switching from novel beta structure in hydrophobic solvent to PPII conformation in water. The alignment of cationic lysine capped nanoparticles on anionic DNA template in combination with electron source such as ferrocene would enable generation of conducting molecular wires and exploiting the DNA sequence dependent self-assembly of these systems may lead to design of molecular circuits.



Publications

1. Jain, D.R., Anandi, V.L., Lahiri, M. and Ganesh, K.N. (2014). Influence of pendant chiral C γ -(alkylideneamino/guanidino) cationic side-chains of PNA backbone on hybridization with complementary DNA/RNA and cell permeability. *Journal of Organic Chemistry* 79:9567-9577.
2. Ganesh, K.N. and Krishnan, Y. (2013). Nucleic acids – Chemistry and applications. *Journal of Organic Chemistry* 78:12283-12287.
3. Nanda, M. and Ganesh, K.N. (2012). 4(R/S)-Guanidinyloxy collagen peptides: On-resin synthesis, complexation with plasmid DNA and the role of peptides in enhancement of transfection. *Journal of Organic Chemistry* 77:4131-4135.
4. Gourishankar, A. and Ganesh, K.N. (2012). Achiral PNA analogs that form stronger hybrids with cDNA relative to isosequential RNA. *Artificial DNA: PNA and XNA* 3:1.
5. Mitra, R. and Ganesh, K.N. (2011). PNAs grafted with (α/γ , R/S)-aminomethylene pendants: Regio and stereo specific effects on DNA binding and improved cell uptake. *Chemical Communications* 47:1198-1200.
6. Patwa, A.N., Gonnade, R.G., Kumar, V.A., Bhadbhade, M.M., Ganesh, K.N. (2010). Ferrocene-bis(thymine/uracil) conjugates: Base pairing directed, spacer dependent self-assembly and supramolecular packing. *Journal of Organic Chemistry* 75:8705-8708.
7. Sonar, M.V. and Ganesh, K.N. (2010). Water induced switching of β -structure to polyproline II conformation in the 4S-aminoproline polypeptide via H-bond rearrangement. *Organic Letters* 12:5390-5393.

Affiliations, Awards and Honors (since 2006)

Fellow, The World Academy of Sciences (TWAS), Trieste (2006)
President, Organic and Biomolecular Chemistry Division (Div III),
IUPAC (2012-2013)
SASTRA-CNR Rao Award (Chemical Sciences) (2014)
Memberships of Editorial Boards of Journals: *Journal of Organic Chemistry* (ACS-International Editorial Advisory Board);
Chemistry – An Asian Journal (Wiley, Germany) Member of
the International Advisory Board; *Beilstein Journal of Organic Chemistry* (Germany); *Artificial DNA:PNA, XNA*
(Landbiosciences, U.S.A.); *Oligonucleotides* (Mary Ann Liebert
Inc, U.S.A.); *Nature: Scientific Reports* (Nature Publishing
Group)

Teaching

General Chemistry, Bio-organic Chemistry, Chemical Biology,
Self-assembly

Current Group Members

PhD and Project Students: Nitin Bansode, Vijay Kadam, Satheesh Elelipilli, Madan Gopal, Shahaji More, Prabhakar Pawar, Pramod Bhingardev, Manoj Kumar Gupta, Pradnya Kulkarni (NCL); **BS-MS Students:** Pramod Kumar; **Post-Doctoral Fellows:** Dhruvajyoti Dutta



Jeet Kalia

Assistant Professor and Wellcome Trust-DBT India Alliance Intermediate Fellow
jkalia@iiserpune.ac.in; <https://sites.google.com/site/chemicalbiologychannelslipids/>

PhD: University of Wisconsin-Madison, U.S.A.

Postdoc: National Institutes of Health, Bethesda, U.S.A.

With IISER Pune since June 2013

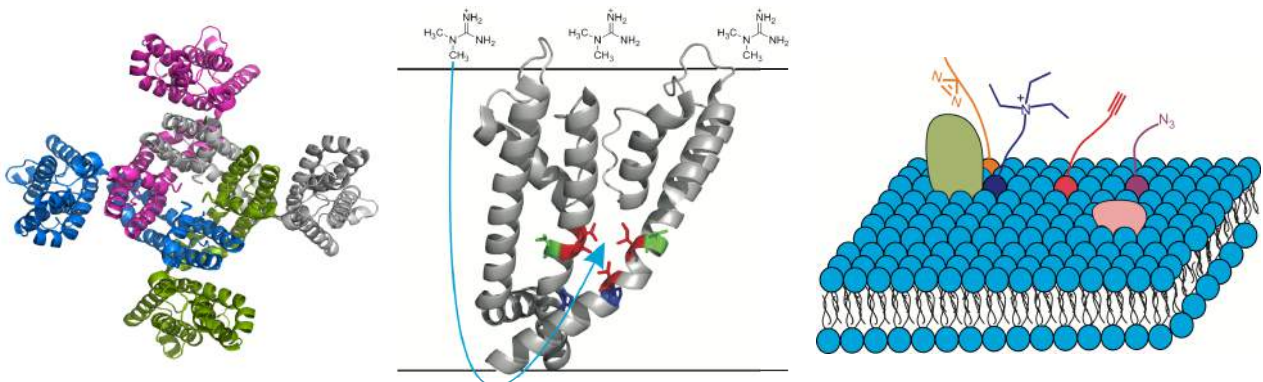
Chemical Biology: Ion Channels, Lipids, and Bioconjugation

Research in our laboratory is inherently interdisciplinary and lies at the interface of chemistry and biology. We employ a diverse range of approaches including electrophysiology, imaging, protein chemistry and organic synthesis to address questions in ion channel biology, lipid biology and bioconjugation.

Our work on ion channels is focused on tetrameric cation channels, especially voltage-activated potassium (Kv), voltage-activated sodium (Nav) and Transient Receptor Potential (TRP) channels (left panel of figure below). We utilize electrophysiological approaches to elucidate how these ion channels open and close in response to specific stimuli such as voltage, chemical ligands (middle panel of figure below) and peptide toxins.¹ Our recent work on targeting Nav channels has resulted in the discovery of a novel anti-epileptic triazole compound that attenuates seizures in rodents.²

Our interest in ion channels extends into understanding how lipids present in the membrane interact with and modulate their function. To address this challenging problem, we are developing chemical biology based methods for the cellular incorporation of non-natural lipids with the aim of having these modified lipids serve as “lipid mutants” (right panel of the figure below). We envisage that this technology will significantly contribute to several aspects of lipid and membrane biology including membrane protein function, membrane proteomics and lipid imaging.

Our third major research interest is in developing facile methods for bioconjugation that would overcome the limitations of the state-of-art methods including poor conjugate stability and slow rates of formation.



Left: Structure of the voltage-activated potassium (Kv) ion channel visualized from the extracellular vantage point (pdb: 2R9R).

Middle: Our work on the inhibition of Kv channels by the drug, guanidine that unraveled its binding site on the channel.

Right: Our proposed approach for introducing non-natural lipid “mutants” into cells to facilitate interrogation of the roles of lipids.

Publications

1. Kalia, J., Milesco, M., Salvatierra, J., Wagner, J., Klint, J.K., King, G.F., Olivera, B.M. and Bosmans, F. (2015). From foe to friend: Using animal toxins to investigate ion channel function. *Journal of Molecular Biology* 427:158-175. <http://www.ncbi.nlm.nih.gov/pubmed/25088688>.
2. Gilchrist, J., Dutton, S., Diaz-Bustamante, M., McPherson, A., Olivares, N., Kalia J., Escayg, A. and Bosmans, F. (2014). Nav1.1 modulation by a novel triazole compound attenuates epileptic seizures in rodents. *ACS Chemical Biology* 9:1204-1212. <http://www.ncbi.nlm.nih.gov/pubmed/24635129>.

Grants

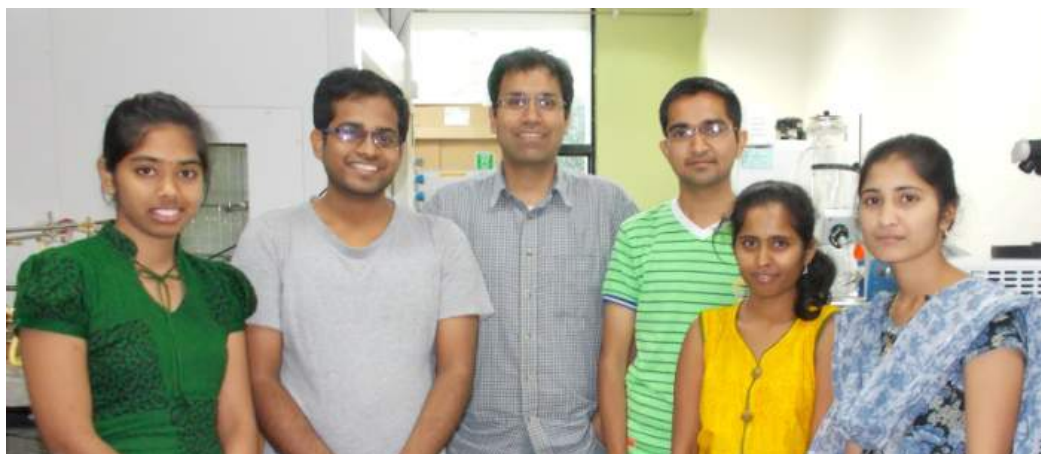
Title: Elucidating the role of lipids in ion channel function;
Source: Wellcome Trust-DBT India Alliance: Amount: INR 35.6 million for 5 years (2015-2020)

Institutional Activities

Organizing committee for the ISBOC X conference at IISER Pune (11th-15th January, 2015); Faculty in-charge for organizing Chemistry seminars (2014-2015)

Teaching

BIO 121: Biology Lab (Fall 2013, 2014, 2015)
BIO 122: Biology Lab (Spring 2014, 2015)
CHM 423: Medicinal Chemistry (Spring 2014, 2015)
CHM 340: Advanced Organic Chemistry Lab (Fall 2013)



Current Group Members

PhD Students: Debayan Sarkar, Rahul Nisal, Aditi Dixit; BS-MS Students: Sushma Tejashri, Abhishek Kumar; Post-Doctoral Fellow: Gregor Jose; Project Assistants: Chitra Shanbhag; International Visiting Student: Carola Schmidt



Saikrishnan Kayarat

Assistant Professor

saikrishnan@iiserpune.ac.in; <http://www.iiserpune.ac.in/~saikrishnan/>

PhD: Molecular Biophysics Unit, Indian Institute of Science, Bengaluru, India

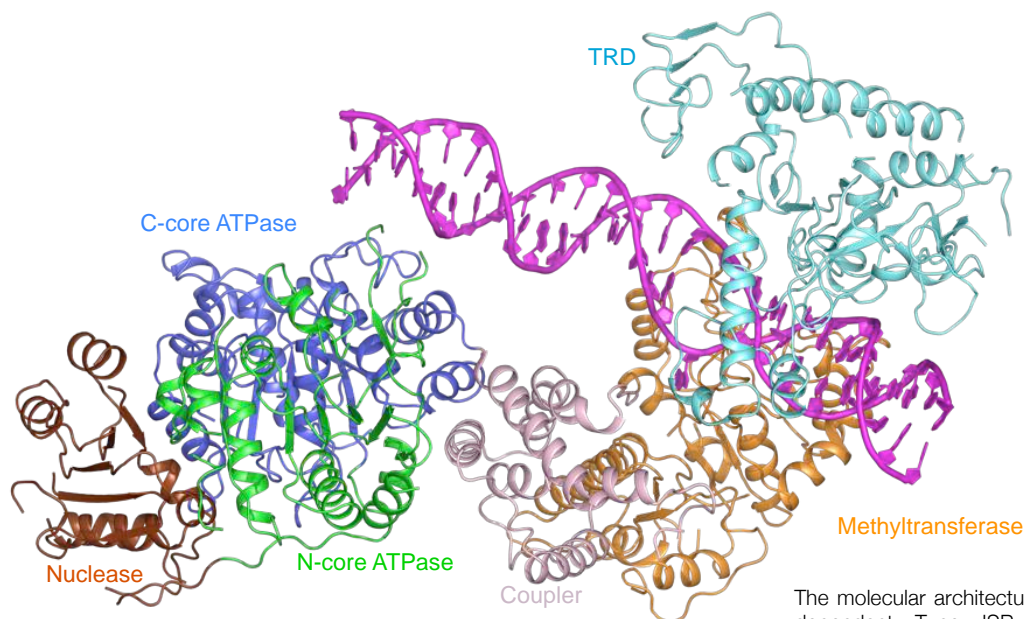
Postdoc: Clare Hall Laboratories, Cancer Research U.K.

With IISER Pune since January 2010

Structural Biology

Biological process involving nucleic acid transactions employ enzymes driven by motors energized by the hydrolysis of nucleoside triphosphate (NTP). Many of these enzymes, often referred to as protein machines, have many modular functional domains that act in concert to carry out a specific task. Aberrations in the coordination can be deleterious to the cell. My group is interested in understanding the molecular mechanism of how these complex enzymes coordinate their action and function. We employ the tools of structural biology, biochemistry and biophysics to dissect out the mechanism of action. One of the model systems that we study is the NTP-dependent restriction-modification (RM) enzyme, a major bacterial defense system against invading foreign DNA, such as bacteriophage DNA. These enzymes coordinate the activities of four functional

domains – nuclease, helicase-like NTPase motor, methyltransferase and target recognition domain (TRD). TRD facilitates binding to a target sequence. The NTPase-motor translocates DNA. Endonucleolytic cleavage of the DNA occurs when two such translocating enzymes physically collide with one another. The methyltransferase methylates the host genomic DNA to protect it from the nuclease. We recently determined the first crystal structure of such an enzyme, the Type ISP RM enzyme. The structure revealed the molecular details of target recognition, methylation, and provided insights into translocation-coupled nucleolytic activity. Biochemical and single-molecule biophysical studies carried out based on the structure revealed a new mechanism of double-strand DNA-break formation resulting from multiple nicks of the DNA strands.



The molecular architecture of the ATP-dependent Type ISP RM enzyme bound to a DNA substrate mimic.

Publications

1. van Aelst, K., Saikrishnan, K.* and Szczelkun, M. (2015). Mapping DNA cleavage by the Type ISP restriction-modification enzymes following long-range communication between DNA sites in different orientations. *Nucleic Acid Research* pii:gv1129 [Epub ahead of print] (* Co-corresponding author)
2. Chand, M.K., Nirwan, N., Diffin, F., van Aelst, K., Kulkarni, M., Pernstich, C., Szczelkun, M. and Saikrishnan, K. (2015). Translocation-coupled DNA cleavage by the Type ISP restriction-modification enzymes. *Nature Chemical Biology* 11:870-877.

Grants

Title: Structural studies of NTP-dependent restriction-modification enzyme; Source: Wellcome Trust-DBT India Alliance; Amount: INR 32 million (2010-2015)

Affiliations, Awards and Honors

Wellcome Trust-DBT India Alliance Intermediate Fellow

Institutional Activities

Member, Courses and Evaluation Committee (2011-2014)

Member, 5th year Project Committee (since 2012)

Member, Dining Committee (since 2014)

Students Graduated

Non-IISER / External MS Students who have done a full thesis:
Vanessa Carle (Master's in Pharmaceutical Biotechnology, Martin-Luther Universitat, Halle-Wittenberg, Halle, Germany);
Rohit Thakur (B Tech Biotechnology, Vellore Institute of Technology)

Teaching

BIO 322: Biophysics I (Fall, 2010)

BIO 452: Structural Biology (Fall, 2011-2015)

BIO 491: Literature Review (Spring, 2012)

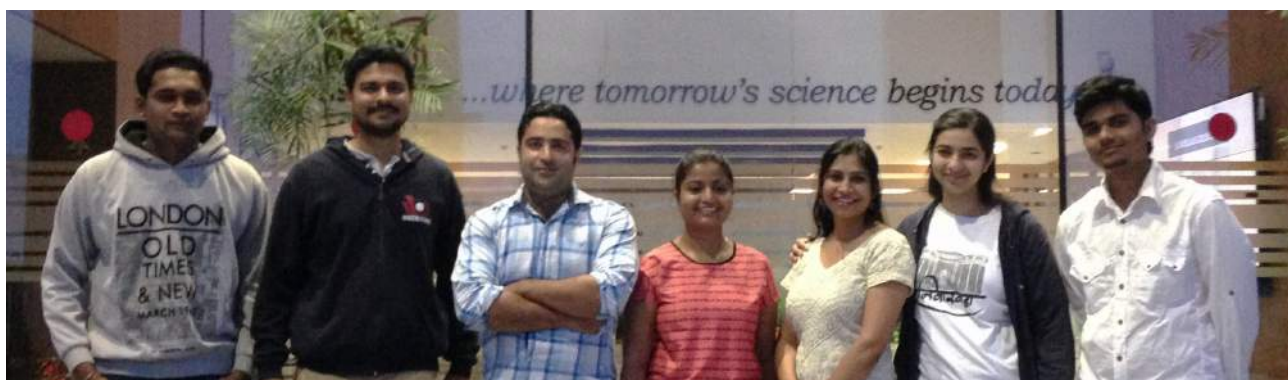
BIO 121: Biology Lab I (Fall, 2013, 2014, 2015)

BIO 122: Biology Lab II (Spring, 2014)

BIO 417: Advanced Biochemistry II (Spring, 2013, Spring, 2015)

Outreach

Talks and interaction with students at New Arts, Commerce and Science College, Ahmednagar; INSPIRE camp at Kottayam; St Ann's College, Hyderabad; MACFAST, Tiruvalla; Sahyadri School, Pune



Current Group Members

PhD Students: Manasi Kulkarni, Neha Nirwan, Ishtiyaq Ahamad Khan, Mahesh Chand, Vishal Adhav, Sujatha Sharma; BS-MS Students: Gyan Gourab Mishra



Gayathri Pananghat

DST-INSPIRE Faculty Fellow

gayathri@iiserpune.ac.in; www.iiserpune.ac.in/~gayathri

PhD: Indian Institute of Science, Bengaluru, India

Postdoc: MRC Laboratory of Molecular Biology, Cambridge, U.K.

Previous Positions: Visiting Faculty, IISER, Pune, India, January – August 2008

With IISER Pune since April 2013

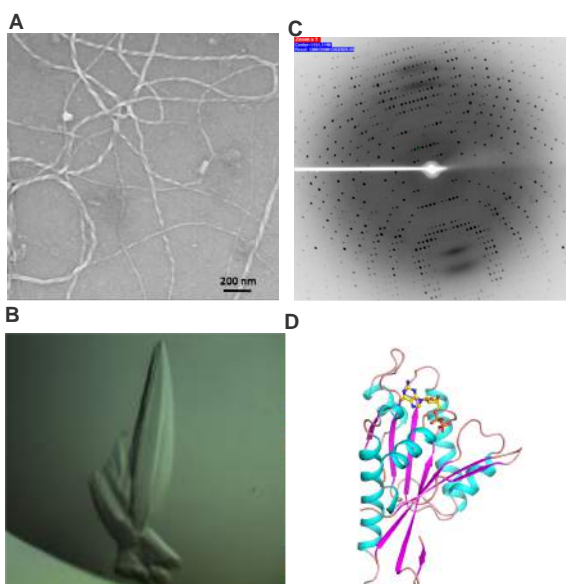
Bacterial Cytoskeleton-based Motility

Cell motility is a fundamental process in biology. In many organisms, movement is mediated by appendages like cilia, flagella and pili. In addition, motility is also driven by the dynamics of assembly of cytoskeletal filaments, as in eukaryotic cell crawling. Research in bacterial cell biology has identified a few novel modes of motility based on the bacterial cytoskeleton. My research focus is to understand the molecular mechanism of motility based on the bacterial cytoskeleton using *Spiroplasma* and *Myxococcus xanthus* as model systems.

I utilize the techniques of structural biology (mainly X-ray crystallography and electron microscopy) and single-molecule fluorescence microscopy to study the structure and dynamics of assembly of the macromolecular complexes

involved in motility, thus capturing the assemblies at both spatial and temporal resolutions. The role of the bacterial cytoskeleton and interacting proteins in active positioning of macromolecular complexes in bacteria will be explored.

A long-term objective of the research is to compare and contrast different systems of motility based on their molecular mechanism and bring out unifying features between bacterial and eukaryotic cell motility, thus understanding the basic principles of cell motility. The fundamental nature of the research has potential to establish significant links in the evolution of cytoskeletal systems across the different domains of life.



A. Scanning electron microscope image of purified bacterial cytoskeletal filaments. B – D. Crystals (B), X-ray diffraction image (C) and crystal structure of a bacterial motility protein from *Myxococcus xanthus* (D).

Grants

Title: Structural studies on spatial positioning of *Myxococcus xanthus* motility complexes; Source: Department of Science and Technology, India; Amount: INR 5 million (2015-2018)

Title: Structure and filament dynamics of the cytoskeletal protein Fibril (Fib) involved in *Spiroplasma* motility; Source: Innovative Young Biotechnologist Award, Department of Biotechnology, India; Amount: INR 4.6 million(2014-2017)

Title: Structural studies of motility complexes in adventurous gliding motility of *Myxococcus xanthus*; Source: INSPIRE, Department of Science and Technology, India; Amount: INR 3.5 million (2013-2018)

Affiliations, Awards and Honors

INSA Medal for Young Scientists, Indian National Science Academy, India (2014); Innovative Young Biotechnologist Award, Department of Biotechnology, India (2013); Ramalingaswamy Re-entry Fellowship (selected), Department of Biotechnology, India (2013); INSPIRE Faculty Fellowship, Department of Science and Technology, India (2013)

Institutional Activities

Member, Curriculum Committee (since 2014)

Students Graduated

Non-IISER / External MS Students who have done a full thesis: Smarth Lakhanpal, VIT University, Vellore, Thesis, B.Tech Biotechnology, December-May 2014

Teaching

BIO 102: Introductory Biochemistry (Spring, 2008)
BIO 122: Biology Lab (Spring, 2008)
BIO 121: Biology Lab (Fall, 2013)
BIO 410: Microbiology (Spring, 2014, 2015, 2016)
BIO 412: Advanced Biochemistry (Fall 2014, 2015)
BIO 454: Structural Biology (Fall, 2015)

Outreach

Lectures at St. Ann's College, Hyderabad; Fergusson College, Pune; MACFAST, Tiruvalla and Sahyadri School, Pune; Volunteer for NCL-IISER Exciting Science Group



Current Group Members

PhD Students: Shrikant Harne, Jyoti Baranwal; BS-MS Students: Ningthoujam Birjeet Singh (5th year project), Saket Bagde, Yaikhomba Mutum, Sonal Lagad, Manil Kanade; Integrated PhD Rotation Student: Susovan Sarkar; Project Assistants: Rajnandani Kashyap, Priyanka Gade



Thomas J. Pucadyil

Assistant Professor

pucadyil@iiserpune.ac.in; <http://www.iiserpune.ac.in/~pucadyil/Welcome.html>

PhD: Centre for Cellular and Molecular Biology, Hyderabad, India

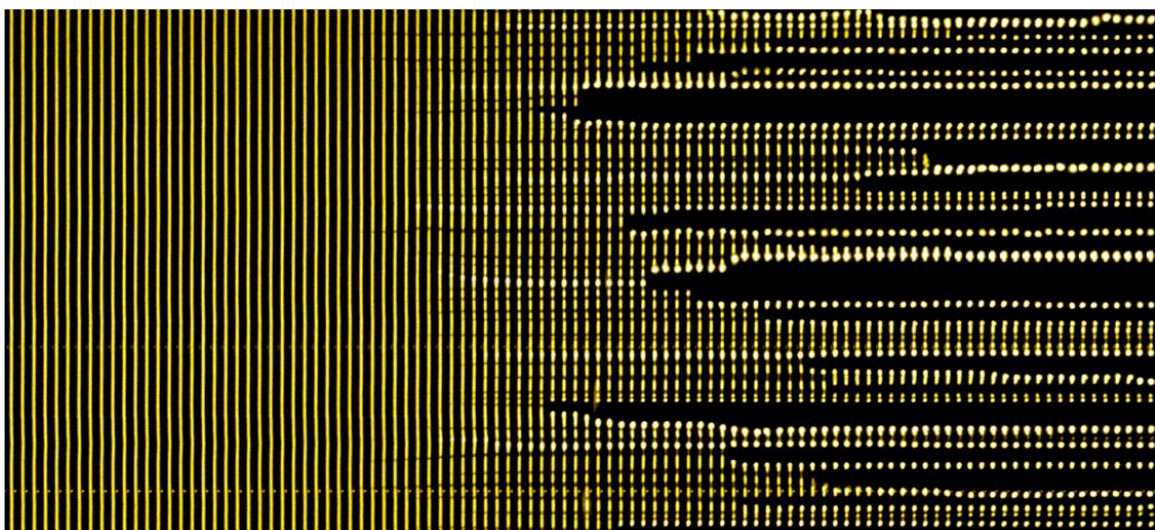
Postdoc: Leukemia and Lymphoma Society Postdoctoral Associate, The Scripps Research Institute, La Jolla, U.S.A.

With IISER Pune since October 2010

Mechanisms of Membrane Fission

Generation of vesicles from a membrane compartment is fundamental to diverse cellular processes such as synaptic transmission, organelle biogenesis and protein degradation. Every vesicle that is formed in the cell is an outcome of membrane fission. Membrane fission requires the localized application of curvature stresses to the lipid bilayer in order for a membrane tube-like intermediate to go from a highly constricted to a cut state. Since these topological transformations require the bilayer to deviate from its preferred planar configuration, membrane fission is an energetically unfavorable

process. Cells have evolved protein machines that often utilize energy provided by nucleotide hydrolysis to catalyze this process. Our research efforts are directed towards understanding the mechanisms by which such proteins manage to cut membranes. Tools for such analysis constitute direct reconstitution of membrane fission on a novel model membrane system of supported membrane tubes (see figure) that mimic the topology of transport intermediates and observing the reaction pathway using fluorescence-based approaches.



A high throughput assay for membrane fission: Shown here is a montage of a single membrane tube of ~40 nm in diameter seen under the fluorescence microscope undergoing multiple cuts in response to a membrane fission catalyst.

Publications

1. Dar, S., Kamerkar, S. and Pucadyil, T. (2015). A high-throughput platform for real-time analysis of membrane fission reactions reveals dynamin function. *Nature Cell Biology* (in press).
2. Holkar, S., Kamerkar, S. and Pucadyil, T. (2015). Spatial control of epsin-induced clathrin assembly by membrane curvature. *Journal of Biological Chemistry* 290:14267-14276.
3. Shnyrova, A., Bashkurov, P., Akimov, S., Pucadyil, T., Zimmerberg, J., Schmid, S. and Frolov, V. (2013). Geometric catalysis of membrane fission driven by flexible dynamin rings. *Science* 339:1433-1436.
4. Neumann, S., Pucadyil, T. and Schmid, S. (2013). Analyzing membrane remodeling and fission using supported bilayers with excess membrane reservoir. *Nature Protocols* 8:213-222.

Grants

Title: Mechanistic analysis of endocytosis of the amyloid precursor protein; Source: Wellcome Trust-DBT India Alliance; Amount: INR 24 million (Jan 2011-Dec 2015)

Affiliations, Awards and Honors

Young Associate, Indian Academy of Sciences, Bengaluru, India

Institutional Activities

Coordinator (Chair), Integrated Ph.D. Program, Biology (since 2011)

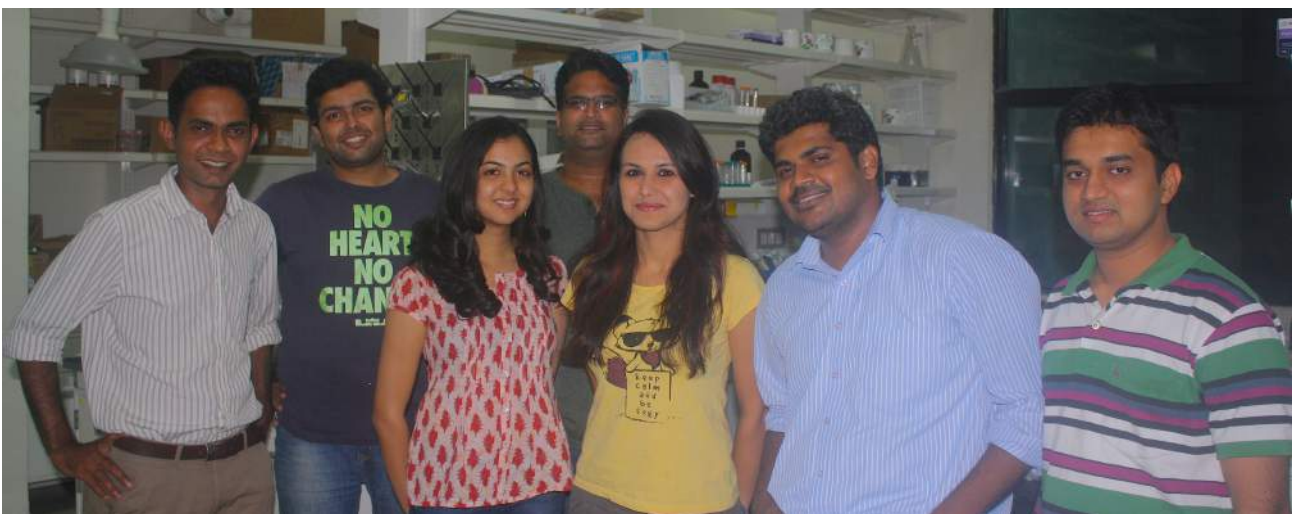
Students Graduated

BS-MS Fifth Year Project Student: Roshni Bano

Teaching

BIO 417: Advanced Biochemistry (2010-present)

BIO 311: Advanced Cell Biology (2011-present)



Current Group Members

PhD Students: Srishti Dar, Manish Kushwah, Sukrut Kamerkar, Devika Andhare, Raunaq Deo; Post-Doctoral Fellow: Herschel Dekhne



Mrinalini Puranik

Associate Professor

mrinalini@iiserpune.ac.in; <http://www.iiserpune.ac.in/~mrinalini/>

PhD: Indian Institute of Science (IISc), Bengaluru, India

Postdoc: Princeton University, U.S.A.

Previous Positions: National Centre for Biological Sciences (NCBS) Bengaluru, India

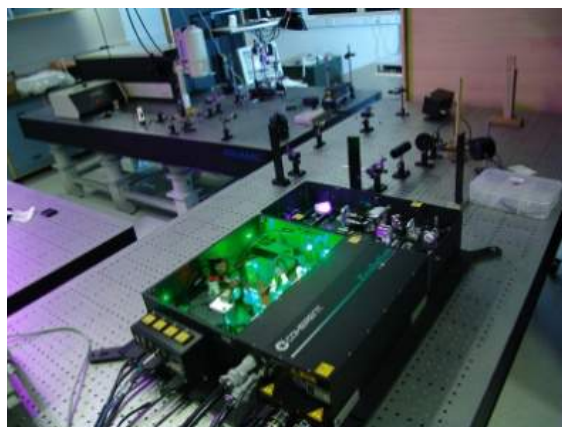
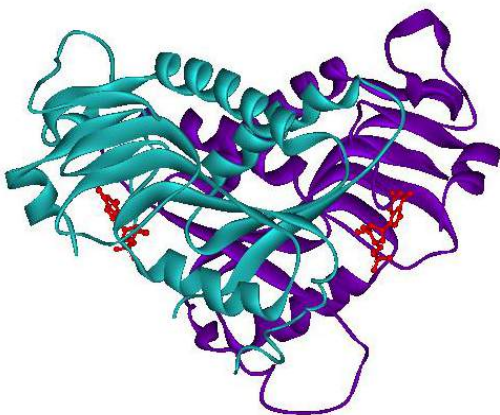
With IISER Pune since 2013

Design Principles of Proteins: Structure, Function and Dynamics

A majority of cellular processes do ultimately arise from protein-protein, protein-nucleic acid, and protein-lipid interactions. Deconstructed to a molecular level, these interactions are governed by rates of enzymatic catalysis and allosteric control of access to interaction sites. Therefore a strategy underlying drug design is modulation of the function of proteins. Eco-friendly industrial processes rely on our ability to develop enzymes designed for specific chemical catalysis of small molecules. To attain these goals it is critical to understand the fundamental design principles of natural proteins. Natural enzymes can achieve turnover rates of 10¹⁸ while designed enzymes rarely achieve 1% of this rate. Clearly, we still do not have sufficient understanding to modulate desired properties

with the required specificity for target proteins. Particularly less understood is the role of protein dynamics in governing function.

We are using innovative approaches that combine spectroscopic, biochemical and computational strategies to understand the design principles of proteins with high spatial and temporal resolution. Proteins being studied in the lab are: protein-nucleic acid complexes involved in purine metabolism, ATP homeostasis and DNA repair. These fascinating proteins have the ability to catalyze many types of substrates. We aim to understand how catalytic efficiency and protein plasticity coexist. We are also measuring the dynamics of proteins relevant to the chemical step of the catalysis.



Left: Structure of human HGPRT with bound substrate (guanine monophosphate (1HMP)); *Right:* Raman Lab showing the Ti-S based tunable deep UV excitation source

Publications

1. Karnawat, V. and Puranik, M. (2015). Solution structures of purine base analogues 9-deazaguanine and 9-deazahypoxanthine. *Journal of Biomolecular Structure and Dynamics* 10.1080/07391102.2015.1042916
2. Karnawat, V., Gogia, S., Balaram, H. and Puranik, M. (2015). Differential distortion of purine substrates by human and *Plasmodium falciparum* hypoxanthine-guanine phosphoribosyl transferase to catalyse the formation of mononucleotides. *ChemPhysChem* 16:2172-2181.
3. Karnawat, V. and Puranik, M. (2015). Solution structure of ligands involved in purine salvage pathway. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 10.1016/j.saa.2015.07.013
4. Milan-Garces, E.A, Thaore, P., Udgaonkar, J.B. and Puranik, M. (2015). Formation of a CH- π Contact in the core of native barstar during folding. *Journal of Physical Chemistry B* 119: 2928-2932.
5. Gogia, S. and Puranik, M. (2014). Solution structures of purine base analogues 6-chloroguanine, 8-azaguanine and allopurinol. *Journal of Biomolecular Structure & Dynamics* 32:27-35.
6. Milan-Garces, E.A., Mondal, S., Udgaonkar, J.B. and Puranik, M. (2014). Intricate packing in the hydrophobic core of barstar through a CH- π interaction. *Journal of Raman Spectroscopy* 45:814-821.
7. Ramachandran, G., Milan-Garces, E.A., Udgaonkar, J.B. and Puranik, M. (2014). Resonance Raman spectroscopic characterization of the kinetics of Tau fibril formation. *Biochemistry* 53 (41):6550-6565.
8. Milan-Garces, E.A., Kaptan, S. and Puranik, M., (2013). Mode-specific reorganization energies and ultrafast solvation dynamics of tryptophan from Raman line-shape analysis. *Biophysical Journal* 105:211-221.

Current Group Members

PhD Students: Sayan Mondal, Vishakha Karnawat, Sudeb Ghosh, Yashwant Kumar, Anil Yadav, Shahila Mohammed; Project Fellow: Prashant Badgujar



Sudha Rajamani

Assistant Professor

sudha@iiserpune.ac.in; <http://www.iiserpune.ac.in/~srajamani/>

PhD: National Institute of Immunology, New Delhi, India

Postdoc: FAS Center for Systems Biology at Harvard (Cambridge, U.S.A.); University of California (Santa Cruz, U.S.A.)

With IISER Pune since February 2012

Role of Lipids in the Evolution of Life

The fundamental question of how life originated is one of the greatest scientific mysteries. In particular, the processes by which polymers capable of catalysis and replication emerged and propagated on early Earth are still elusive. Plausible prebiotic mechanisms have been described that result in biologically important monomers. These are required for the self-assembly of biomolecules like nucleic acids and peptides. However, it is still unclear what relevant abiotic processes might have enabled the formation of complex mixtures of such oligomers. Furthermore, recent work from our lab and a few other groups justify the need to delineate the actual sequence of events that might have led to the origin of an RNA World¹; a time when RNA molecules enabled, both, information processing and catalytic activity. Given this, the important questions we hope to answer are: What plausible prebiotic processes might have resulted in the emergence of primitive informational molecules? What selection pressures might have shaped the emergence of molecules of an RNA World? How did the functional RNA sequences replicate their

information efficiently even in the face of high intrinsic mutation rates; a hallmark of non-enzymatic replication mechanisms? What was the role of other prebiotically relevant co-solutes on relevant prebiotic nonenzymatic reactions? In this context, we are interested in delineating the role of amphiphiles and also of other prebiotically pertinent co-solutes such as amino acids etc. Amphiphiles are thought to have played a crucial role in setting the stage for the emergence and evolution of first encapsulated life (protocells). Therefore, understanding the interactions between the individual components of a putative protocell will contribute towards what could be a reality soon i.e. to evolve synthetic life in the lab using a bottom-up approach. Additionally, in recent work² we characterized the effect of co-solutes on the rate and accuracy of nonenzymatic replication of RNA. Our results suggest that presence of co-solutes in the reaction have implications for fidelity of early replication processes, which in turn, will have important implications for the emergence and evolution of protocells.

Publications

1. Bapat, N.V. and Rajamani. S. (2015). Effect of co-solutes on template-directed nonenzymatic replication of nucleic acids. *Journal of Molecular Evolution* 81(3):72-80.
2. Mungi, C.V. and Rajamani. S. (2015). Characterization of RNA-like oligomers from lipid-assisted nonenzymatic synthesis: Implications for origin of informational molecules on early earth. *Life* 5(1):65-84.

Grants

Title: Biochemical characterization of RNA-like oligomers from lipid-assisted nonenzymatic synthesis; Source: Science and Engineering Research Board, Department of Science and Technology, Government of India (Approved on September 15, 2015)

Institutional Activities

Within the Discipline

Member and, subsequently, Coordinator, PhD Committee in Biology (August 2012-August 2015); Member, Bio PhD Postdoc Committee (August 2013-August 2015); Infrastructure Committee, Biology: June 2015 onwards

Within the Institute

Member, Dining Committee (since May 2014); Member, Housing Committee (since April 2015); Faculty Coordinator, Drama Club and Prutha

Students Graduated

BS-MS Fifth Year Students: Gaurav Arya, Prasenjeet Kawale

Teaching

BIO 491: Literature Review Course (Spring 2012)

BIO 410: Advanced Biochemistry (Fall 2012, 2013, 2014, 2015)

BIO 102: Introductory Biology II (Spring 2013, 2014, 2015)

Outreach

Organized KVPY Summer Program in conjunction with Dr. Mrinalini Puranik; May 21-26, 2012; Nominated as the local coordinator to conduct KVPY Aptitude test on November 4, 2012 at the exam centre in KV, Southern Command, Camp, Pune; Nominated to coordinate KVPY interviews for the western region (Feb 1-3, 2013); Invited talk on "Life in Our Universe: How did it come about?" as part of the 'Popular Science Talks', a science outreach programme series of Exciting Science Group (An Initiative of NCL scientists and IISER-P faculty), NCL Innovation Park, July 14th, 2013; Student Councillor, International Society for Astrobiology (elected for a period of 3 years, 2011-2014); Invited outreach talk on "Life in our Universe: How did it come about?" at Muktangan Exploratory Science Center, April 21, 2015



Current Group Members

PhD Students: Chaitanya Mungi, Niraja Bapat; BS-MS Fifth Year Student: Aparna P.K.; Integrated PhD Rotation Student: Pratima Kumari Singh

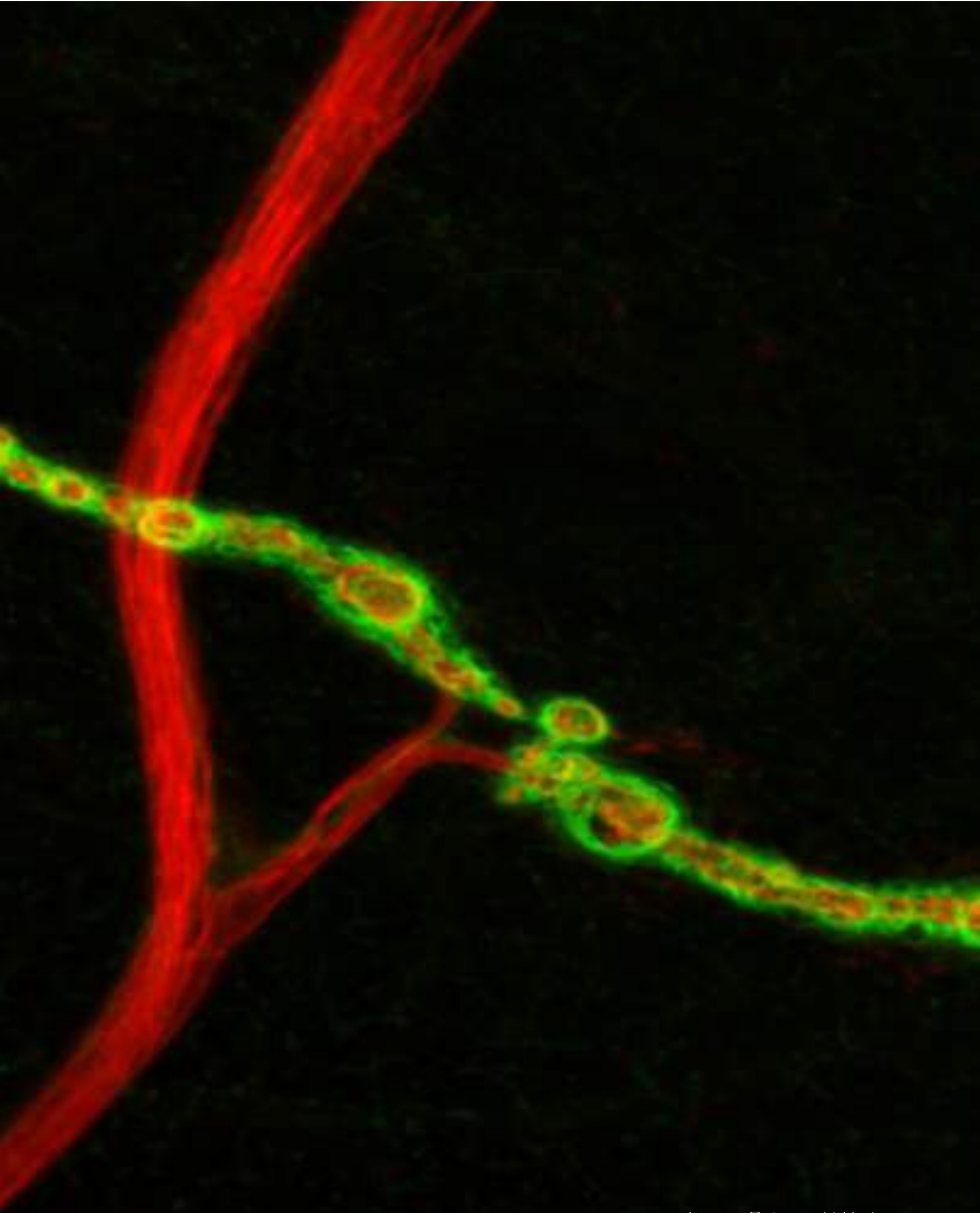


Image: Ratnaparkhi Lab

Cell and Developmental Biology

Nagaraj Balasubramanian

Mayurika Lahiri

Girish Ratnaparkhi

Richa Rikhy

L.S. Shashidhara



Nagaraj Balasubramanian

Assistant Professor, Wellcome Trust-DBT India Alliance Senior Fellow
nagaraj@iiserpune.ac.in; www.iiserpune.ac.in/~nagaraj/home.html

PhD: Cancer Research Institute, Tata Memorial Centre, Mumbai

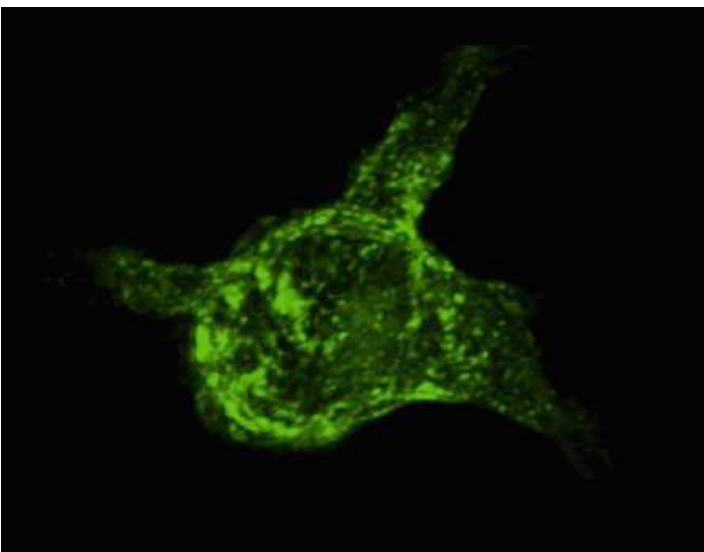
Postdoc: Cardiovascular Research Centre, University of Virginia, Charlottesville, Virginia

Previous Positions: Assistant Professor of Research, Department of Microbiology, University of Virginia
With IISER Pune since September 2010

Cell Adhesion and Trafficking

Most cells in the human body depend on their ability to attach to the extracellular matrix (ECM) to grow, survive and migrate. Signaling pathways controlling these functions are regulated by integrin mediated adhesion to the ECM to confer anchorage dependence. Cancer cells overcome this regulatory control to become anchorage independent and acquire their unique growth and survival advantage. Understanding how adhesion regulates these signals and how transformed cells overcome this regulation is a major focus of the lab. Integrin mediated adhesion regulates the trafficking and plasma membrane localization of cholesterol and sphingolipid enriched membrane raft microdomains to control anchorage dependent Erk, Akt and Rac signaling. On loss of adhesion rapid endocytosis of these microdomains through caveolae turns off signaling and re-

adhesion returns them to the plasma membrane using the exocyst complex to restore signaling. Our ongoing studies aim at understanding the role caveolin phosphorylation has in regulating caveolar trafficking along this pathway in normal and cancer cells and in 2D vs 3D matrices. Our studies are also looking at regulators of exocyst function, Ral and Arf6, testing the differential regulation of Ral isoforms by adhesion and the Ral crosstalk with Arf6. We are particularly interested in understanding their significance in normal and cancer cells. We are also exploring new strategies for targeting Ral and Arf6 in cancers using novel self-assembling nanovesicle drug delivery systems. The lab is further exploring novel roles for adhesion in regulating organelle architecture and function and their impact on cellular function and disease.



Expression of caveolin-1 GFP in WTMEFs embedded in 3D collagen matrix observed by 3D reconstitution of confocal Z stack images. This shows the distinct morphology of cells in 3D collagen making distinct protrusions and localizing caveolin-1 to the membrane. Further imaging of caveolin-1-GFP in live cells in 3D collagen can also now be done. (Image credit: Trupti Thite)

Publications

1. Pramod, P., Shah, R., Chapekar, S., Balasubramanian, N.* and Jayakannan, M.* (2014). Polysaccharide nano-vesicular multidrug carrier for synergistic killing of cancer cells. *Nanoscale* 6:11841-11855.
2. Pramod, P., Takamura, K., Chapter, S., Balasubramanian, N.* and Jayakannan, M.* (2012). Dextran vesicular carriers for dual encapsulation of hydrophilic and hydrophobic molecules and delivery into cells. *Biomacromolecules* 13(11):3627-3640.

Grants

Title: Adhesion dependent regulation of caveolar endocytosis;
Source: DBT-Ramalingaswami Fellowship (2010-2011)

Title: Integrin-dependent regulation of anchorage independence in cancers; Source: Wellcome Trust DBT India Alliance Senior Fellowship (2011-2016)

Institutional Activities

Member, iPhD committee in Biology (2015 onwards); Member, Bio PhD Postdoc Committee (2013-2015); Member Animal Ethical Committee - CPCSEA (since 2013); Member, Council of Student Activities (since 2013); Member, IT Committee (2010-2012); Member, UG Academic Course Committee (2010-2012); Faculty Coordinator for Student Film Club (2011-2012); Faculty Coordinator Society for Promotion of Indian Classical Music and Art Among Youth (SPICMACAY) (since 2011)

Students Graduated

Non-IISER / External MS Students who have done a full thesis: Manali Patil (IBB, Pune), Amey Deolay (Fergusson College, Pune), Jiss James (VIT, Vellore)

Teaching

BIO 102: Introduction to Biology (since Spring 2011)
BIO 311: Advanced Cell Biology (since Fall 2012)
BIO 313: Biology of Diseases (Fall 2010)
BIO 301/ BIO 401: Lab Theory course (Spring 2011-2012)
BIO 491: Literature Review (Fall 2011)
BIO 121: Undergraduate Practical (1 Module) (Fall 2014-2015)

Outreach

Faculty Coordinator of PRARAMBH at IISER Pune (since 2011); Participant, Exciting Science Program, NCL-IISER Pune; Participant, KVPY program; DST-INSPIRE camps; and Teacher Training Programs conducted by the Lady Tata Memorial Trust



Current Group Members

PhD Students: Archana Pawar, Trupti Tithe, Vibha Singh, Natasha Buwa, Siddhi Inchnalkar, Akanksha Ojha; BS-MS Students: Nivedhika Kannan; Post-Doctoral Fellows: Keerthi Ramakrishnan; Project Assistants: Neha Deshpande, Anwasha Dasgupta



Mayurika Lahiri

Associate Professor

mayurika.lahiri@iiserpune.ac.in; <http://www.iiserpune.ac.in/~mayurika.lahiri/Home.html>

PhD: University of Wolverhampton, U.K.

Postdoc: Tufts University, Medford, Massachusetts, USA and Massachusetts General Hospital Cancer Center, Harvard Medical School, Boston, U.S.A.

With IISER Pune since January 2008

Genomic Integrity and DNA Damage

The research in my lab focuses on the use of biochemical, cell and molecular techniques in human cell culture systems to better understand the DNA damage response mechanisms of cells to maintain genome stability. Damage response mechanisms include cell cycle checkpoint arrest, DNA repair and apoptosis. Understanding the key processes involved in the maintenance of genomic integrity is critical in the prevention, diagnosis and treatment of a number of human pathologies, including cancer.

One avenue that the lab is currently engaged in studying is the effect of alkylating agents on morphogenesis of non-tumorigenic breast epithelial cells using 3D culture systems. Loss of cellular architecture and polarity of breast tissue is one of the early markers for onset of breast cancer. Addition of alkylating agents to non-transformed 3D breast acini cultures caused disruption of apico-basal polarity as well as upregulation of vimentin thus denoting a transformed phenotype⁵. Currently, the non-tumorigenic cells are being modified to have altered expression of key genes, which are known or have been speculated to play a vital role in the process of breast carcinogenesis with

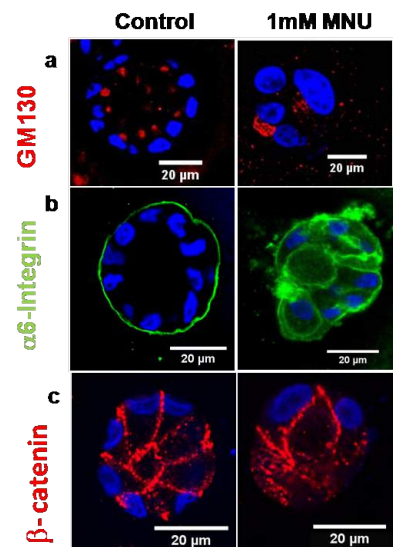
an attempt to dissect out the molecular mechanism(s) involved in the process of tumorigenesis initiated by the absence or presence of such genes.

We are also investigating the molecular mechanism by which platelet activating factor, PAF is able to induce transformation of non-tumorigenic breast epithelial cells grown as spheroids as well as promote migration of metastatic breast cancer cells¹.

Another avenue that my lab is working on is the characterization of the interaction between checkpoint protein, TopBP1 and mismatch repair protein complex, Msh2-Msh6 as well as an anti-apoptotic protein, Api5 following DNA damage. Both Msh2-Msh6 and Api5 were observed to interact physically with TopBP1. Currently, the functional relevance of the interaction is being investigated.

Representative images of 3D cultures exhibiting methylation damage induced transformation:

MCF10A, a non-tumorigenic breast epithelial cell line, were grown as 3D 'on top' cultures, for 16 days. On exposure to N-nitroso methylurea (MNU) these spheroids exhibit loss of (a) apical polarity (mislocalization of GM130, a golgi marker), (b) basal polarity (mislocalization of α^6 -integrin) and (c) disrupted cell-cell junctions (aberrant staining of β -catenin).



Publications

1. Libi Anandi, V., Ashiq, K.A*, Nitheesh, K* and Lahiri, M. (2016). Platelet activating factor promotes motility in breast cancer cells and disrupts non-transformed breast acinar structures. *Oncology Reports* 35:179-188. *equal contribution
2. Kand, D., Saha, T., Lahiri, M. and Talukdar, P. (2015). Lysosome targeting fluorescence probe for imaging intracellular thiols. *Org Biomol Chem.* 13(30):8163-8168.
3. Mallick, A., More, P., Ghosh, S., Chippalkatti, R., Chopade, B.A., Lahiri, M. and Basu, S. (2015) Dual drug conjugated nanoparticle for simultaneous targeting of mitochondria and nucleus in cancer cells. *ACS Applied Material Interface* 7(14):7584-7598.
4. Jain, D.R., Anandi, V.L., Lahiri, M. and Ganesh, KN. (2014) Influence of pendant chiral C(γ)-(alkylideneamino/guanidino) cationic side-chains of PNA backbone on hybridization with complementary DNA/RNA and cell permeability. *Journal of Organic Chemistry* 79 (20):9567-9577. doi: 10.1021/jo501639m.
5. Bodakuntla, S., Anandi V.L., Sural, S., Trivedi, P. and Lahiri, M. (2014) N-nitroso-N-ethylurea activates DNA damage surveillance pathways and induces transformation in mammalian cells. *BMC Cancer* 14(1):287. doi: 10.1186/1471-2407-14-287.
6. Kand, D., Chauhan, D.P., Lahiri, M. and Talukdar, P. (2013) δ -Unsaturated γ -amino acids: enantiodivergent synthesis and cell imaging studies. *Chemical Communications (Cambridge)* 49(34):3591-3593.
7. Kar, M., Tiwari, N., Tiwari, M., Lahiri, M* and Sengupta, S.* (2013) Poly-L-Arginine grafted silica nanoparticles for enhanced cellular uptake and their application in DNA delivery and controlled drug release. *Particle & Particle Systems Characterization* 30(2): 166-179. * corresponding authors
8. Kand, D., Mishra, PK., Saha, T., Lahiri, M. and Talukdar, P. (2012) BODIPY based colorimetric probe for selective thiophenol detection: theoretical and experimental studies. *Analyst* 137(17): 3921-3924.

Grants

Title: Studying neoplastic transformation of mammosphere cultures in 3D using chemical carcinogens; Source: DBT; Amount: INR 9.7 million (2014-2017)

Title: DNA Damage Surveillance and Repair: Characterizing the Interaction between TopBP1 and Msh2-Msh6 Complex; Source: DBT; Amount: INR 7.6 million (2012-2015)

Title: Characterization of the novel interaction between checkpoint protein, TopBP1 and anti-apoptotic protein, Api5; Source: DBT; Amount: INR 1.9 million (2010-2013)

Affiliations, Awards and Honors

IISER Faculty Outstanding Contribution to Institute Award (2015)

Institutional Activities

Member of the Tender Opening Committee (2008-2009); Helped compile the 2007-2008 Annual Report for IISER Pune; Member of the Stores and Purchase Committee (2009-2011); Chairperson of Women Cell (2014-current), Chairperson of Daycare Committee (2014-current)

Students Graduated

PhD Students: Payal Arya

BS-MS Fifth Year Project Students: Surojit Sural, Satish Bodakuntla, Marina Victor

Non-IISER / External MS Students who have done a full thesis: Prasad Trivedi, Sneha Parab, Nilay Taneja, Vidya Sethunath, Poonam Shinde

Teaching

BIO 202: Systems Biology (Spring 2008)

BIO 311: Advanced Cell Biology (Fall 2008-2012)

BIO 313: Advanced Molecular Biology (Fall 2012-current)

BIO 351: Biology and Disease (Spring 2010-2012, 2014)

BIO 122: Biology Practicals (Spring 2015)



Current Group Members

PhD Students: Libi Anandi, Abhinav Parivesh, Virender Kumar Sharma; BS-MS Students: Ashiq K.A., Rintu Umesh, Meera Bessy, Amruta Nayak, Fasela E.E., Kezia Ann, Vishakha Kasherwal; Integrated PhD Students: Shikha Dagar, Sneha Tripathi; Project Assistants: Vaishali Chakraborty, Satish Bodakuntla



Girish Ratnaparkhi

Associate Professor

girish@iiserpune.ac.in; Lab Website: <http://www.iiserpune.ac.in/~girish>

PhD: Indian Institute of Science, Bengaluru, India

Postdoc: National Centre for Biological Sciences (NCBS), Bengaluru, India; University of California at Los Angeles, U.S.A.

With IISER Pune since June 2008

Universal Mechanisms in Animal Development

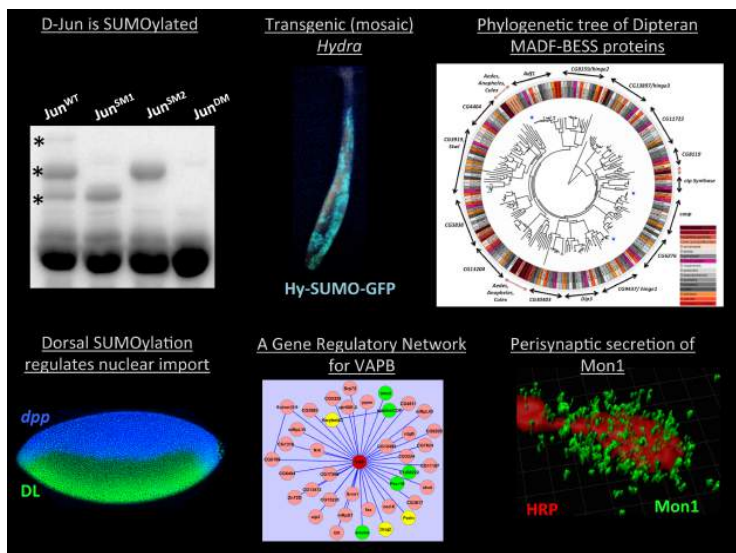
Animals as different as humans, worms and flies use remarkably similar molecular mechanisms to control their development¹. We utilize *Drosophila melanogaster* and *Hydra magnipapillata* as model organisms to study common molecular principles underlying animal development and disease.

SUMO is a post-translational modifier that conjugates to substrate proteins and modifies their properties and activity. Proteins modified with SUMO can be discovered using MS based proteomics. We have generated animal transgenics with tagged SUMO in both *Hydra*² and *Drosophila*, to identify SUMOylated species and to study roles for SUMO in stress, immunity and regeneration. Using *Drosophila* cells in culture we have identified a list of proteins that change their SUMOylation status in response to immune stress³. Novel SUMO targets have been identified and validated³. SUMOylated proteins

are found in immune signaling pathways and in large protein complexes such as the multi acetyl tRNA synthetase, proteasome and splicing complexes.

In collaboration with Dr. Anuradha Ratnaparkhi, ARI, Pune, we study human disease models for motor neuron degeneration. We show that TOR signaling, a key metabolic pathway, is upregulated in ALS⁴. Mon1, a regulator of Rab7- which is involved in CMT neuropathy, was found to be secreted from neurons and regulate glutamate receptor levels⁵.

We also find that the sixteen-member MADF-BESS family of transcription factors sub-functionalize, over 40 million years of evolution, post gene duplication and expansion⁶. The sixteen members have distinct expression patterns, and seemingly independent roles in regulating animal development⁶.



A) *Drosophila* Jun, identified in our SUMO-immunity-proteome screen³, regulates the innate immune response and is conjugated at two sites³. Our data suggests that one of the sites is bi-SUMOylated. B) A transgenic *Hydra*² showing mosaic patches of 6XHis-FLAG-SUMO-GFP expression. C) A phylogenetic tree representing MADF-BESS proteins in Dipterans⁶. Flies show a dramatic expansion of MADF and BESS domain families. D) SUMOylation of Dorsal at K382 is important for formation of the DL gradient. Maternal DL(K382R) expression does not rescue D/V patterning in a *dorsal* null animal. E) A Gene Regulatory Network for VAPB in flies, discovered using a reverse genetics screen⁴. We hypothesize that an understanding of VAPB interactors will help us understand VAPB mediated Amyotrophic Lateral Sclerosis. F) Secretion of Mon1 from boutons is important for synaptic function⁵.

Publications

1. Ratnaparkhi, G.S. & Courey, A.J. (2014). Cascades, gradients and gene-networks in dorsoventral patterning. In *Principles of Developmental Genetics* Sally Moody (Ed.), Elsevier Publishing. (Book Chapter)
2. Khan, U., Mehre, P., Senthilkumar, D., Ratnaparkhi, G.S. (2013). The SUMO Cycle in Hydra. *Genesis: Journal of Genetics & Development* 51:619-629.
3. Handu, M., Kaduskar, B., Ravindranathan, R., Elango, V., Giri, R., Gowda, H. and Ratnaparkhi, G.S. (2015). SUMO enriched proteome for the *Drosophila* innate immune response. *G3: Genes, Genomes & Genetics* 18:2137-2154.
4. Senthilkumar, D., Verma, H.K., Ueda, R., Ratnaparkhi, A. and Ratnaparkhi, G.S. (2014). A genetic screen identifies Tor as an interactor of VAPB in a *Drosophila* model of Amyotrophic Lateral Sclerosis. *Biology Open* 3:1127-1138.
5. Senthilkumar, D., Basargekar, A., Shweta K., Sonavane, P., Ratnaparkhi, G.S. and Ratnaparkhi, A. (2015). A pre-synaptic regulatory system acts trans-synaptically via Mon1 to regulate glutamate receptor levels in *Drosophila*. *Genetics* 201:651-664.
6. Shukla, V.S., Habib, F., Kulkarni, A. and Ratnaparkhi, G.S. (2014). Gene duplication, lineage-specific expansion, and sub-functionalization in the MADF-BESS family pattern's the *Drosophila* wing hinge. *Genetics* 196:481-496.

Grants

Title: Transcriptional regulation in heterochromatin: Role of MADF-BESS domain proteins; Source: RGYI-DBT; Amount: INR 2.6 million (2010-2013)

Title: RNAi based genetic screen to identify interactors of dVAP33 and their roles in VAP mediated ALS; Source: DBT-Neurobiology; Amount: INR 2.33 million (2011-2014)

Title: Modulation of the innate immune response by SUMOylation; Source: Wellcome-Trust DBT India Alliance; Amount: INR 36 million (2010-2015)

Title: Peptidyl Prolyl Isomerases as modifiers of protein aggregation and disease progression in a *Drosophila* model of Amyotrophic Lateral Sclerosis; Source: DST; Amount: INR 5.66 million (2016 -)

Students Graduated

PhD Students: Senthilkumar D., Mithila Handu

BS-MS Students: Senthilkumar A. (2009); Ritika Giri (2010); Umair Khan (2011); Sakshi Korde (2011); Shalaka Chitale (2011); Hemant Kumar Verma (2011); Manoj Sahu (2012); Srija Bhagvatula (2012); Apurva Kulkarni (2013), Lokesh Pimpale (2015)

Institutional Activities

Graduate Student Committee (2008-2010); Student Awards Committee (2009-2014); Academic Committee (2011-2014, since 2014); IISER Senate (2011-2014); Chair, Semester Committee (2013-2014); Member Secretary, Institutional Biosafety Committee (since 2013); IISER Safety Committee (since 2014); Biology Annual Talks (2013, 2014, 2015)

Teaching

BIO 101: Introduction to Biology (2008, 2011)
BIO 102: Introduction to Biology (2011, 2012)
BIO 420: Biochemistry (2009-2011)
BIO 320: Genetics (2009-2015)
BIO 421: Developmental Biology (2010, 2012-2015)
BIO 323: Immunology (2012)
BIO 491: Current Topics in Biology (2010-2014)
BIO 202: Systems Biology
Biology Practicals: 2008, 2012-2015

Outreach

KVPY Workshops; Teaching in local colleges; Lectures in local schools as part of the NCL-IISER Exciting Science Group; Sophia College Mumbai, Annual Retreat, 2015



Current Group Members

Post-Doctoral Fellows: Senthilkumar D., Sneha Bansode; PhD Students: Vallari Shukla, Bhagyashree Kaduskar, Kriti Chaplot, Amarendranath Soory, Shweta Tendulkar, Prajna Nayak; BS-MS Students: Neena Dhiman, Darshini Ravishankar



Richa Rikhy

Assistant Professor

richa@iiserpune.ac.in; <http://www.iiserpune.ac.in/~richa>

PhD: Department of Biological Sciences, Tata Institute of Fundamental Research, Mumbai, India

Postdoc: National Institutes of Health, Bethesda, MD, U.S.A.

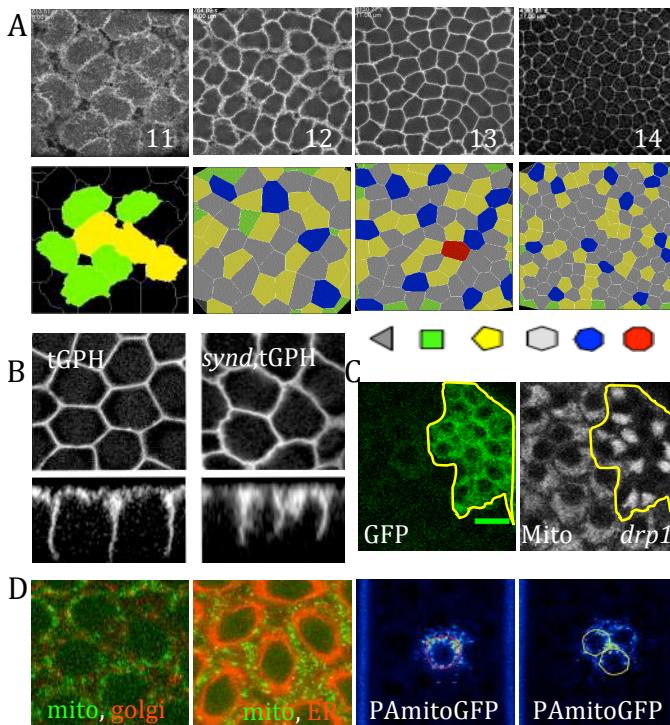
With IISER Pune since August 2010

Cell Biology of Development and Differentiation

Metazoan embryogenesis comprises evolutionarily conserved morphogenetic changes including the formation of epithelial cells as the first distinctly polarized cell. We are interested in understanding mechanisms, which guide the organization and remodeling of the plasma membrane and organelles during embryogenesis and stem cell differentiation. We use *Drosophila* embryogenesis and follicle stem cell differentiation as paradigms for addressing these interests. Methods combining genetics with live imaging allow an analysis of onset and maintenance of asymmetries in developing tissues. We are currently probing the role of junctional and Bar domain containing proteins in determining epithelial like plasma membrane

organization and remodeling in the syncytial embryo.

Organelle distribution and activity are closely related to key physiological processes in cells and we are studying the role of mitochondrial distribution and dynamics in follicle stem cell differentiation and embryogenesis. We find that mitochondria are fragmented in posterior follicle cells, which respond to EGFR signaling and this is essential for the signaling pathway. We are further dissecting the mechanisms by which mitochondrial morphology and metabolism affect different developmental signaling pathways.



A. The plasma membrane is organized like that of epithelial cell in the syncytial *Drosophila* embryo with polygonal packing beginning from cycle 12 onwards showing a predominance of grey colored hexagons.

B. Plasma membrane furrows separate adjacent polygons in metaphase of the syncytial cycle. The length of these furrows is decreased in mutants of F-Bar domain containing protein Syndapin.

C. Mitochondrial fission protein mutant follicle cells (GFP) have clumped mitochondria present in multiple layers.

D. Mitochondria in the syncytial *Drosophila* embryo seen as compared to the Golgi complex and the Endoplasmic reticulum. Photoactivatable GFP tagged mitochondrial targeting sequence shows a distribution from the mother to the daughter pseudocells in the syncytial division cycle.

Publications

1. Rikhy, R*, Mavrikakis, M., and Lippincott-Schwartz, J. (2015). Dynamin regulates metaphase furrow formation and plasma membrane compartmentalization in the syncytial *Drosophila* embryo. *Biology Open* 6;4(3):301-11
*corresponding author
2. Rikhy, R., Kumar, V., Basole, A., and Sanyal, S. (2015). Remembering K.S. Krishnan (1946-2014). *Journal of Neurogenetics* 29(1):1-3.
3. Mitra, K*, Rikhy R*, Lilly M and Lippincott-Schwartz, J. (2012). Mitochondria regulate signaling events underlying cell differentiation in the follicle cell layer during *Drosophila* oogenesis. *Journal of Cell Biology* 197(4):487-497 * equal contribution
4. Daniels, B., Rikhy, R., Renz, M., Dobrowsky, T., and Lippincott-Schwartz, J. (2012). Multiscale diffusion in mitotic *Drosophila* syncytial blastoderm. *Proceedings of the National Academy of Sciences* 109(22):8588-8593.
5. Sherlekar, A., and Rikhy, R*. (2011). Syncytial Cellular Architecture and gradient dynamics, is there a correlation?. *Frontiers in Biology* 7,1:73-82. *corresponding author

Grants

Title: Origin of plasma membrane polarity in embryogenesis;
Source: Department of Biotechnology; Amount: INR 4.5 million (2013-2016)

Title: Developmental control of mitochondrial morphology;
Source: Department of Biotechnology; Amount: INR 2.7 million (2013-2016)

Title: EGFR signaling regulation of mitochondrial morphology;
Source: Department of Science and Technology; Amount: INR 4.0 million (2016-2019)

Affiliations, Awards and Honors

INSA Young Scientist Award (2005)

Institutional Activities

Microscopy Facility Coordinator (2010-Present), Kalpa Students Magazine Coordinator (2013-Present), Women's Cell (2011-2014), Internal Complaints Committee (2014-Present)

Students Graduated

BS-MS Fifth Year Project Students: Ramya Balaji, Pooja Naik, Srijja Bhagvatula, Tirthasree Das, Vishnu M.S.

Non-IISER / External MS Students who have done a full thesis: Ankush Auradkar, Anvita Karara, Rukmini Gurjalwar, Devashree Sambre, Rohan Chippalkatti

Teaching

BIO 311: Cell Biology (2010)

BIO 420: Developmental Biology (2010-Present)

BIO 320: Genetics (2011-Present)

Biology Practical: (2012-2013)

Outreach

St. Xavier's College, Mumbai (2011 and 2012), Pune University (2011), KVPY IISER, Bhopal (2012), Sophia's College, Mumbai (2014)



Current Group Members

PhD Students: Aparna Sherlekar, Darshika Tomer, Sayali Chowdhary, Sameer Thukral, Bipasha Dey, Dnyanesh Dubal, Swati Sharma;

BS-MS Students: Anu S.R., Abhijeet Petkar, Mekhala Kumar; Project Assistants: Rohan Chippalkatti, Tirthasree Das



L.S. Shashidhara

Professor and Chair (Biology)

shashi@iiserpune.ac.in; <http://www.iiserpune.ac.in/~ls.shashidhara/>

PhD: University of Cambridge, U.K.

Postdoc: University of Cambridge, U.K.; National Centre for Biological Sciences, Bengaluru, India

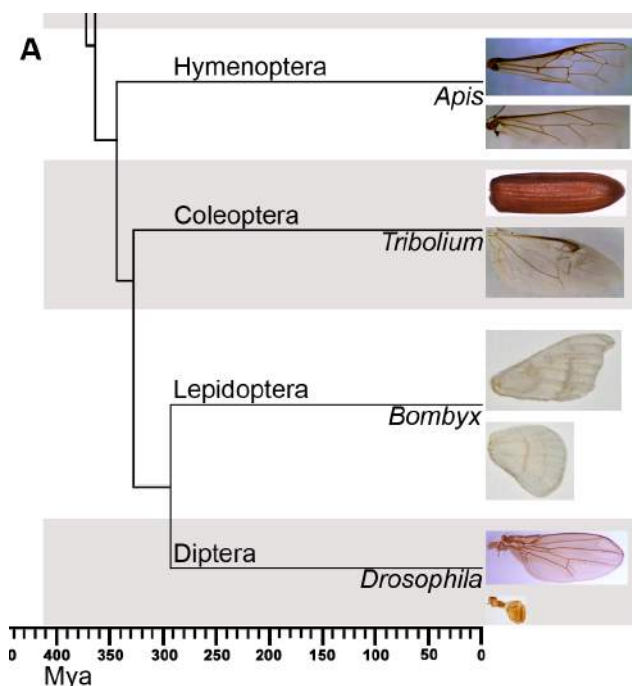
Previous Positions: Centre for Cellular and Molecular Biology (CCMB), Hyderabad

With IISER Pune since August 2007

Genetics and Evolutionary Developmental Biology

Research in our laboratory aims to understand developmental mechanisms that determine physical position, size and shape of various cells/tissues/organs in our body. Our experimental model system is the development of flight appendages in the fruit fly *Drosophila melanogaster*. While most insects have two pairs of wings (all directly contribute to the flight), dipterans such as *Drosophila* have only one pair of wings. In these insects, the hind-wings are modified as small club-shaped balancing organs called haltere. The differential development of wing and haltere, which differ in cell size, number and morphology, is dependent on the function of Ultrabithorax (Ubx), a member of the Hox family of transcriptional regulators. We have exploited this genetic system to understand basic molecular mechanisms regulating cell

number, cell size and cell fate during development. Our current efforts are to understand molecular changes associated with the evolution of halteres. Our approach towards this is genome-wide comparison of genes regulated by Ubx in different insect lineages such as the honeybee, *Apis mellifera*, a member of Hymenoptera and the Silkworm, *Bombyx mori*, a member of Lepidoptera and *Drosophila*. While the majority of the targets are species-specific, a considerable number of wing-patterning genes are retained as targets of Ubx over the past 300 millions years. Detailed bioinformatics and experimental validation of regulatory sequences are being pursued to understand the diversity in Ubx function across the three insect families.



Phylogenetic relationship of four major types of endopterygote insects and their wing morphology. This traces the divergence of 4 major orders of endopterygote insects for nearly 350 million years. Forewing and hindwing morphology of each insect is shown in the panels to the right.

Publications

1. Singh, S., Sánchez-Herrero, E. and Shashidhara, L.S. (2015). Critical role for Fat/Hippo and IIS/Akt pathways downstream of Ultrabithorax during haltere specification in *Drosophila*. *Mechanisms of Development* (in press).
2. Prasad, N. and Shashidhara, L.S. (2015). Glioblastin positively regulates Notch signalling during wing-vein specification in *Drosophila*. *International Journal of Developmental Biology* (in press).
3. Agrawal, P., Habib, F., Yelagandula, R. and Shashidhara, L.S. (2011). Genome-level identification of targets of Hox protein Ultrabithorax in *Drosophila*: Novel mechanisms for target selection. *Scientific Reports* 1, DOI: 10.1038/srep00205.
4. Usha, N. and Shashidhara, L.S. (2010). Interaction between Ataxin-2 Binding Protein 1 and Cubitus-interruptus during wing development in *Drosophila*. *Developmental Biology* 341:389-399.
5. Berger, C., Ramakrishnan, K., Myneni, S., Renner, S., Shashidhara, L.S. and Technau, G.M. (2010). Cell cycle independent role of Cyclin E during neural cell fate specification in *Drosophila* is mediated by its regulation of Prospero function. *Developmental Biology* 337:415-424.
6. Ramakrishnan, K., Berger, C., Myneni, S., Technau, G.M. and Shashidhara, L.S. (2010). Abdominal-A mediated repression of Cyclin E expression during cell-fate specification in the *Drosophila* central nervous system. *Mechanism of Development* 127:137-145.
7. Agrawal, P., and Shashidhara, L.S. (2014). ChIP for Hox proteins from *Drosophila* imaginal discs. In *Methods in Molecular Biology*, Humana Press, Springer Publications. (Book Chapter)
8. Ghose, A. and Shashidhara, L.S. (2011). Cyclin beyond the cell cycle: New partners at the synapse. *Developmental Cell* 21, 601-612. (Review)

Grants

Title: DISC-B: Denmark-India in vivo Screen for Cancer Biomarkers; Source: Indo-Danish Joint Grant, Indian component funded by DBT; Amount: INR 25 million for 5 years (2014-2019)

Title: Molecular and genetic characterization of *Drosophila* and mouse Ataxin-2 binding protein 1 in the context of Spinocerebellar Ataxia type 2. Source: DST; Amount: INR 15 million for 3 years (2010-2013)

Title: Genetic control of cell proliferation, cell size and cell affinities. Source: Indo-Spanish Joint project, DST; Amount: INR 1.75 million for 3 years (2010-2013)

Affiliations, Awards and Honors

JC Bose National Fellowship (2011)

SS Bhatnagar Prize (2008)

Fellow, National Academy of Sciences, India (2008)

Honorary Faculty Member, JNCASR, Bangalore

Associate Editor, Journal of Genetics (since 2007)

Member Editorial Board and MS Handling Editor, Scientific Reports (NPG) (since 2011)

Institutional Activities

Chair, Biology (since 2007); Dean, Faculty and Research (2008-2015); Dean, Research and Development (since 2015); Chair, Purchase Committee (2007-2013); Chair, Curriculum Committee (2008-2014)

Students Graduated

PhD Students: Pavan Agrawal, Savita Singh, Naveen Prasad and TTS Harsha

BS-MS Fifth Year Students: Abhijit Awadhiya and Dhanashree Khanale

Teaching

Introductory Biology courses (2007, 2008, 2009, 2012)
Developmental Biology (2008, 2009)

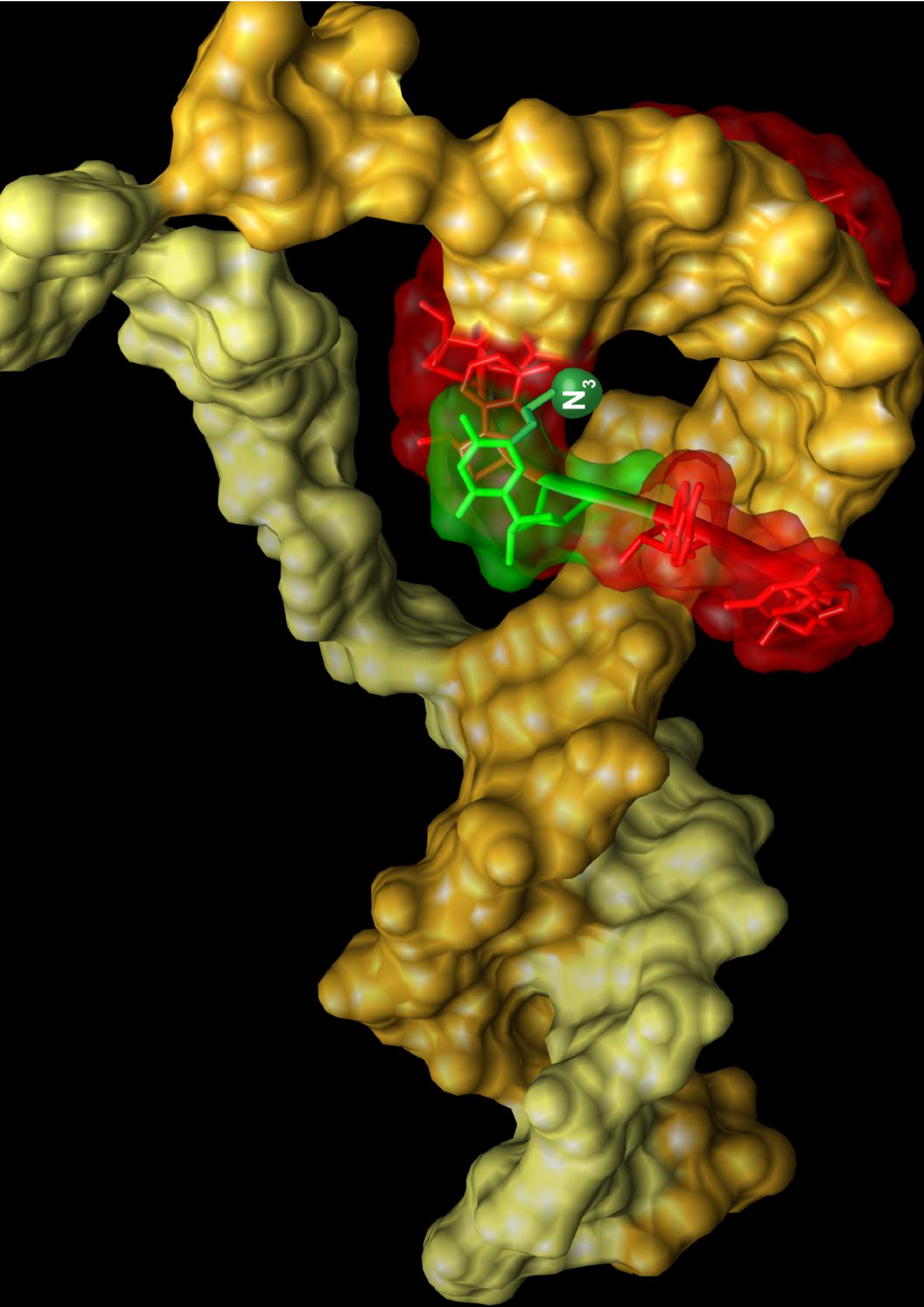
Outreach

Mentor in nearly 15 INSPIRE internship camps
Popular Science talks in Schools/Colleges and Universities:
Nearly 100 in the past 8 years



Current Group Members

PhD Students: Jay Prakash Shukla, Sanket Nagarakar, Soumen Khan; BS-MS Fifth Year Students: Govada Pravallika, Afsah Hasan; Project Assistants: Nelchi Prashali, Avantika Ahiya, Pooja Vaid, Rachel Paul; Shital Sarah-Ahaley (Wellcome Trust-DBT India Alliance Early Career Fellow); Casper Groth (Post-Doctoral Fellow, jointly with Steve Cohen of University of Copenhagen)



Chemical Biology

Sudipta Basu

Harinath Chakrapani

Raghavendra Kikkeri

Arnab Mukherjee

S.G. Srivatsan

Pinaki Talukdar



Sudipta Basu

Ramalingaswami Fellow

sudipta.basu@iiserpune.ac.in; Lab Website: <http://www.iiserpune.ac.in/~sudipta.basu>

PhD: Max-Planck Institute for Molecular Physiology, Dortmund, Germany

Postdoc: Brigham and Women's Hospital, Harvard Medical School, Boston, U.S.A.

With IISER Pune since February 2012

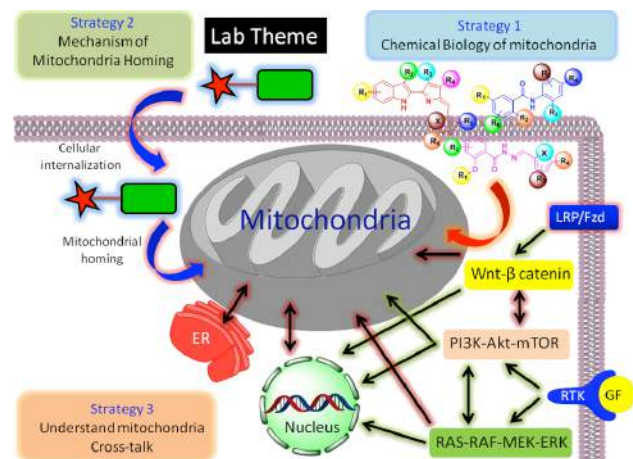
Targeting Mitochondria in Cancer

Mitochondrion is a crucial organelle in eukaryotic cells which controls the cellular bioenergetics as “powerhouse” via oxidative phosphorylation and plays a vital role in cell death pathways. Mitochondrion also performs diverse yet interconnected cellular functions including modulating calcium homeostasis, tricarboxylic acid/urea cycle, fatty acid oxidation, amino acid metabolism and redox signalling. Furthermore, mammalian mitochondria contain over 1500 proteins and mitochondrial circular DNA (mtDNA) as genome material. Subsequently, mitochondrial dysfunctions are associated with an increasingly large number of human inherited diseases as well as common diseases like neurodegenerative disorders, cardiomyopathies, metabolic syndroms, obesity and cancer. As a result, mitochondrion has emerged as potentially important, but seemingly neglected therapeutic

target. Currently, the therapeutic strategies targeting mitochondria in diseased states are elusive. For successful targeting in diseased states, the key challenges in mitochondrial chemical biology are manifold: (a) Understanding the complex interconnected mitochondrial signalling cascades (b) Modulating and targeting of mitochondrial signalling in diseased states. (c) Understanding the cross-talk of mitochondria with other signalling hubs or sub-cellular organelles and (d) Synchronised targeting of mitochondria and related signalling hubs for improved next generation therapeutics.

To address these challenges, we are currently developing different strategies inspired by chemical biology based tools and techniques to target mitochondria as signalling hub in cancer as disease model (Figure).

Targeting of mitochondria in cancer



Publications

1. Patil, S., Patil, S., Gawali, S. Shende, S., Jadhav, S. and Basu, S. (2013). Novel self-assembled lithocholic acid nanoparticles for drug delivery in cancer. *RSC Advances* 3:19760-19764.
2. Patil, S., Gawali, S., Patil, S. and Basu, S. (2013). Synthesis, characterization and in vitro evaluation of novel vitamin D3 nanoparticles as versatile platform for drug delivery in cancer. *Journal of Materials Chemistry B* 1:5742-5750.
3. Palvai, S., Nagraj, J., Mapara, N., Chowdhury, R. and Basu, S. (2014). Dual drug loaded vitamin D3 nanoparticle to target drug resistance in cancer. *RSC Advances* 4:57271-57281.
4. Mallick, A., More, P., Ghosh, S., Chippalkatti, R., Chopade, B. A., Lahiri, M. and Basu, S. (2015). Dual drug conjugated nanoparticle for simultaneous targeting of mitochondria and nucleus in cancer cells. *ACS Applied Materials & Interfaces*, 7:7584-7598.
5. Palvai, S. and Basu, S. (2015). Biocompatible vitamin D3 nanoparticle in drug delivery. *Nano Based Drug Delivery*, IAPC Publication, Zagreb, Croatia, ISBN: 978-953-56942-2-9, Chapter 16, Page 413-428.
6. Palvai, S., More, P., Mapara, N. and Basu, S. (2015). Chimeric nanoparticle: A platform for simultaneous targeting of phosphatidylinositol-3-kinase signalling and damaging DNA in cancer cells. *ACS Applied Materials & Interfaces*, 7:18327-18335.

Grants

Title: Chimeric Nanoparticle: A novel nanoplatform for signaling pathway driven cancer chemotherapy; Source: DBT-Ramalingaswami Fellowship; Amount: INR 7.45 million (2012-2017)

Title: Engineering novel supramolecular nanoplatform for paclitaxel delivery in cancer; Source: DST-SERB; Amount: INR 2.5 million (2012-2016)

Title: Chimeric nanoparticle for targeting signaling network as next-generation cancer therapeutics; Source: DBT; Amount: INR 5.15 million (2014-2017)

Affiliations, Awards and Honors

DBT-Ramalingaswami Fellowship (2012-2017)

Students Graduated

BS-MS Fifth Year Project Students: Suhas Gawali, Deepali M. Koturkar

Non-IISER / External MS Students who have done a full thesis: Sumersing Patil (IBB), Piyush More (IBB)

Teaching

CHM 411: Organic Synthesis II (Fall 2012, 2013, 2014, 2015)
CHM 351: Bioorganic Chemistry (Spring, 2013, 2014)

Outreach

Taught high school kids at DST-INSPIRE Internship Science Camp in Mysore, 2015 about "Molecules That Changed the World"



Current Group Members

PhD Students: Abhik Mallick, Sandeep Palvai, Chandramouli Ghosh, Sohan Patil; BS-MS Students: S.M.M. Kamil; Project Assistants: Piyush More; Integrated PhD Student: Aditi Nandi



Harinath Chakrapani

Associate Professor

harinath@iiserpune.ac.in; www.iiserpune.ac.in/~harinath

PhD: Duke University, U.S.A.

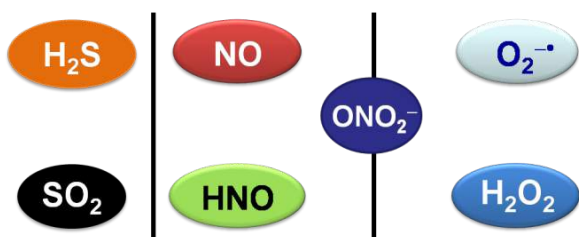
Postdoc: National Cancer Institute, U.S.A.; Wake Forest University, U.S.A.

With IISER since July 2009

Chemistry and Biology of Reactive Species

The main research focus of our lab is the development of methodologies for controlled generation and release of short-lived redox-active biological species such as reactive nitrogen, oxygen and sulfur species. These species have been implicated in mediating numerous cellular processes and are associated with various pathophysiological conditions. They play a vital role in maintenance of redox homeostasis and are in several instances primary responders to induction of stress. Their mechanisms of action, however, remain to be completely characterized. In order to achieve controlled release, we design and develop small molecule-based tools that would be useful to study the chemistry and biology of such reactive species. A representative example of the utility of the technology developed in our lab in understanding the roles of reactive oxygen

species (ROS). Recent studies have shown that antibiotics exert their lethality, in part, through enhancement of ROS. Our lab has designed and developed a new class of ROS generators and we find that certain bacteria such as *Mycobacterium tuberculosis* and *Staphylococcus aureus*, including multi-drug resistant ones, are sensitive to enhanced ROS. This finding may enable developing new strategies to address antibiotic resistance. Such systematic investigations carried out by our laboratory revealed that the cross-talk among these reactive species is an important determinant for survival and resistance. Together, our tools lay the foundation for understanding mechanisms of antibiotic resistance and cancer progression and enabling strategies to overcome such problems.



Some redox-active biological reactive species

Publications

1. Dharamaraja, A. T; Chakrapani, H. (2014). A Small Molecule for Controlled Generation of Reactive Oxygen Species (ROS). *Organic Letters* 16:398-401.
2. Dharamaraja, A. T; Ravikumar, G.; Chakrapani, H. (2014). Arylboronate Ester Based Diazeniumdiolates (BORO/NO), a Class of Hydrogen Peroxide Inducible Nitric Oxide (NO) Donors. *Organic Letters* 16:2610-2613.
3. Khodade, V. S.; Sharath Chandra, M.; Banerjee, A.; Lahiri, S.; Pulipeta, M.; Rangarajan, R.; Chakrapani, H. (2014). Bioreductively Activated Reactive Oxygen Species (ROS) Generators as MRSA Inhibitors. *ACS Medicinal Chemistry Letters* 5:777-781.
4. Sharma, K.; Iyer, A.; Sengupta, K.; Chakrapani, H. (2013). INDQ/NO, a Bioreductively Activated Nitric Oxide Prodrug. *Organic Letters* 15:2636-2639.
5. Dharamaraja, A. T; Alvala, M.; Sriram, D.; Yogeewari, P.; Chakrapani, H. (2012). Design, synthesis and evaluation of small molecule reactive oxygen species generators as selective *Mycobacterium tuberculosis* inhibitors. *Chemical Communications* 48:10325-10327.
6. Malwal, S. R.; Sriram, D.; Yogeewari, P.; Konkimalla, V. B.; Chakrapani, H. (2012). Design, Synthesis and Evaluation of Thiol-Activated Sources of Sulfur Dioxide (SO₂) as Antimycobacterial Agents. *Journal of Medicinal Chemistry* 55:553-557.

Grants

Title: Small molecule donors of reactive sulfur species; Source: DST India; Amount: INR 5.59 million (2015-)

Title: Hypoxia-activated prodrugs of Nitric Oxide; Source: DBT, India; Amount: INR 4.2 million (2012-2015)

Title: Redox-directed mycobacterial therapeutics; Source: DBT, India; Amount: INR 5.67 million (2012-2016)

Title: Organic sources of gaseous entities with physiological relevance; Source: DST, India; Amount: INR 2.6 million (2011-2015).

Affiliations, Awards and Honors

Innovative Young Biotechnologist Award, DBT India (2011); Early Career Scientist, Royal Society of Chemistry-West India (2012); Young Scientist Award, Chemical Research Society of India (2015); Young Scientist Award, Pune Municipal Corporation (2015)

Institutional Activities

Member, Academic Committee (2012-); Member, Ethics Committee (April 2014-); Member, Massive Open Online Course Committee (Sep 2014-); Faculty In Charge, Science Media Centre, (Sep 2015-); Member, Curriculum Development Committee (2009-2012)

Students Graduated

PhD Students: Satish Malwal, Allimuthu Dharamaraja
BS-MS Fifth Year Project Students: Rohan Kumbhare, M. Sharath Chandra

Teaching

CHM 311: Physical Organic Chemistry (2012-2015)
CHM 423: Medicinal Chemistry (2013)
HSS 202: Practice of Science: Ethics Safety & Communication (2014)
CHM 201: Introductory Organic Chemistry (2010, 2011)
CHM 321: Organic Synthesis I (2011)
CHM 411: Organic Synthesis II (2009)
Organic Chemistry Laboratory (2009-10, 2013-14)

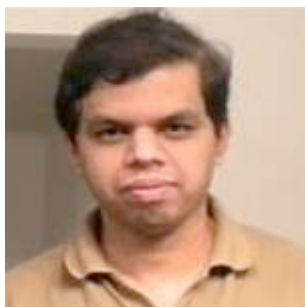
Outreach

Kishore Vaigyanik Protsahan Yojana (KVPY) Summer Camp, 2010, 2011 & 2012



Current Group Members

PhD Students: Kavita Sharma, Vinayak Khodade, Kundansingh Pardeshi, Govindan Ravikumar, Amogh Kulkarni, Preeti Chauhan, Ajaykumar Sharma; BS-MS Students: Abhishek Kumar, Shreyas Malpathak, Anjana Sathyan, Mrutyunjay Nair, Harsha, M.B.; Post-Doctoral Fellows: Ritu Mangain



Raghavendra Kikkeri

Assistant Professor
rkikkeri@iiserpune.ac.in

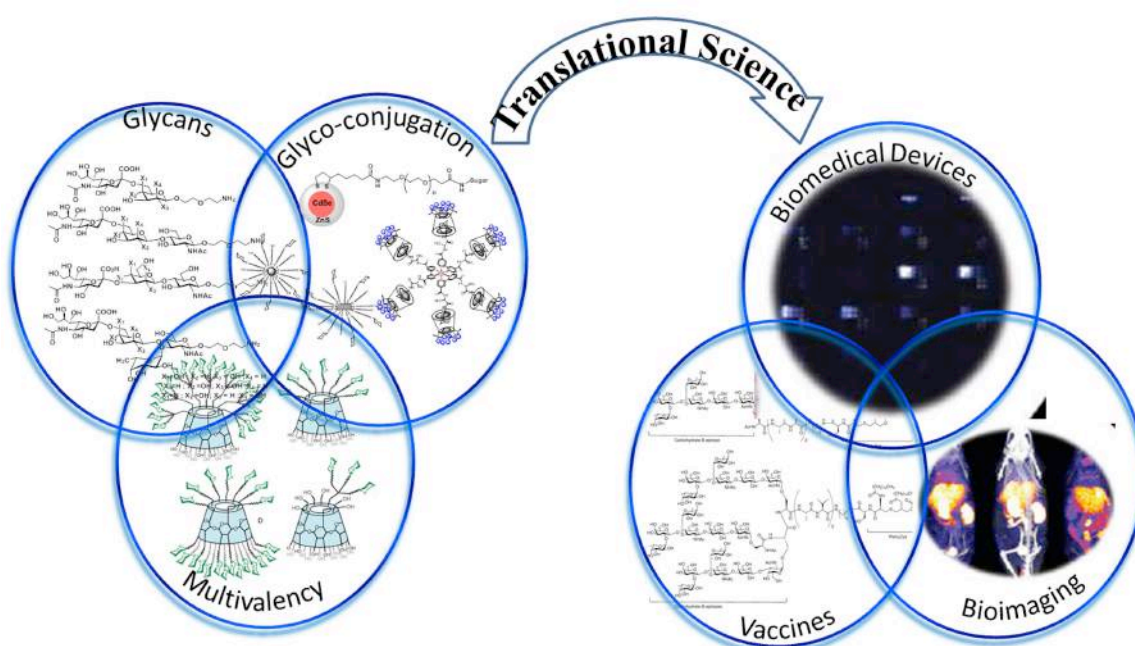
PhD: Weizmann Institute of Science, Israel
Postdoc: ETH Zurich, Switzerland; MPIKG Berlin, Germany; University of California, San Diego, U.S.A.
With IISER Pune since Dec 2010

Multivalent Glycoprobes: From Structural Probes to Diagnostic Tools

Carbohydrates play an important role in many biological systems by virtue of their lectins which recognize them. Carbohydrate-lectin interactions are involved in expansively diverse biological processes which include embryonic development, intracellular trafficking, cell-cell recognition, cell activation, cell adhesion, cell homing, endocytosis, phagocytosis, inflammation, tumor cell metastasis, and apoptosis. One main drawback for investigating carbohydrate-lectin interactions is their weak affinity to bind, which will require enhanced tools to analyze carbohydrate-lectin interplay. To unravel the sugar core, we combine our knowledge in sugar science and nanotechnology to build novel and useful systems – based metal-complexes or quantum

dots, Fe_3O_4 or Au nanoparticles – that show great potential for studying the sugar-mediated interactions (carbohydrate-lectin and carbohydrate-carbohydrate interactions) but also for *in vivo* diagnostics and imaging, targeted therapeutics and biosensing.

Besides this, we developed the synthesis of fluorescent glycodendrimers with different shapes, size and chirality that impact the comprehension of fundamental weak carbohydrate-protein interactions. Those dendrimers have been also conjugated on interfaces and showed ability to be used as carbohydrate-mediated biosensors, imaging agents and targeted drug delivery systems.



Sugar based translational research

Publications

1. Chaudhary, P.M., Sangabathuni, S., Murthy, R.V., Paul, A., Thulasiram, H.V. and Kikkeri, R. (2015). Assessing the effect of different shapes of glycol-gold nanoparticles on bacterial adhesion and infections. *Chemical Communications* 51:15669-15672.
2. Chaudhary, P.M., Murthy, R.V., Yadav, R. and Kikkeri, R. (2015). A rationally designed peptidomimetic biosensor for sialic acid on cell surfaces. *Chemical Communications* 51:8112-8115.
3. Yadav, R., Murthy, R.V. and Kikkeri, R. (2015). Sialic acid hydroxamate: A potential antioxidant and inhibitor of metal-induced b-amyloid aggregates. *ChemBioChem*. 16:1448-1453.
4. Gade, M., Paul, A., Alex, C., Choudhury, D., Thulasiram, H.V. and Kikkeri, R. (2015). Supramolecular scaffolds on glass slides as sugar based rewritable sensors for bacteria. *Chemical Communications* 51:6346-6349.
5. Bavireddi, H. Bharate, P. and Kikkeri, R. (2013). Use of Boolean and fuzzy logics in lactose glycocluster research. *Chemical Communications* 49:9185-9187.

Grants

Title: Direct assembly of sialic acid specific peptidomimics on cantilever array: A prospective label free low cost early detection of cancer progress; Source: Department of Science and Technology, Government of India (2014-2017)

Title: Carbohydrate capped nanoparticles for cancer specific drug delivery; Source: Max-Planck partner group (2011-2016)

Affiliations, Awards and Honors

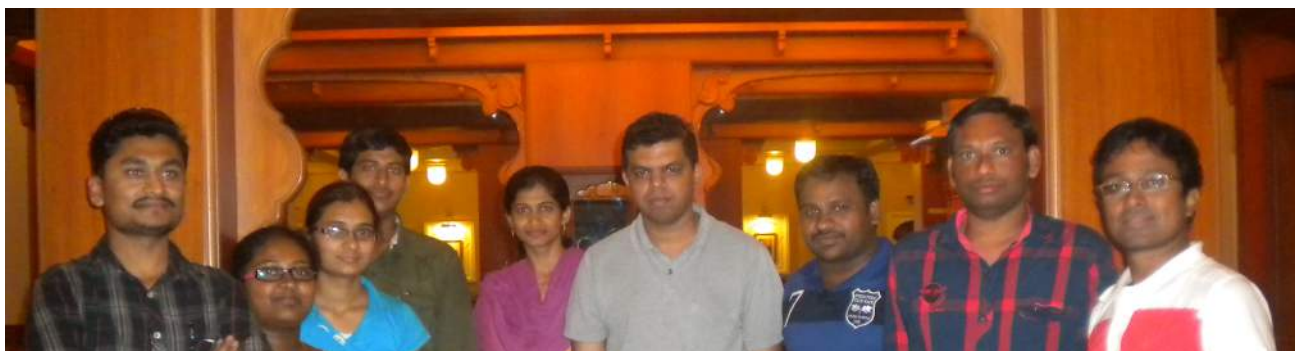
Max-Planck partner Group Head (2011-16)
DAE Young Researcher Award (2011)

Institutional Activities

Member of Undergraduate Lab Management Committee (since 2013); PhD Selection Committee (2012-14)

Teaching

CHM 221: Introductory Organic Chemistry
CHM 340: Advanced Organic Chemistry Laboratory
CHM 431: Chemical Biology
CHM 351: Bioorganic Chemistry



Current Group Members

PhD Students: Rohan Yadav, Sivakoti, Harikrishna, Madhuri Gade, Chethan, Balamurgan, Suraj, Prashanth; BS-MS Students: Phaneendra, Catherina Alex; Post-Doctoral Fellows: Preeti Chaudhari



Arnab Mukherjee

Associate Professor

arnab.mukherjee@iiserpune.ac.in; www.iiserpune.ac.in/~arnabm

PhD: Indian Institute of Science, Bengaluru, India

Postdoc: Ecole Normale Supérieure, Paris, France & University of Colorado, Boulder, U.S.A.

With IISER Pune since November 2009

Computational Chemistry and Biophysics

The focus of our group is to study molecular recognition processes (drug-DNA, protein-DNA) using computational methods (both classical and quantum). We calculate free energy profile for the recognition processes and from that probe into the detailed molecular mechanism.

DNA Intercalation is a method by which some anti-cancer drugs such as daunomycin, proflavine functions. Our study on DNA intercalation shows that the intercalation happens through a sequential process that defies natural fluctuation hypothesis and point towards a drug-induced cavity formation mechanism. We also showed the origin of experimentally observed millisecond timescale for the complex intercalation process of the proflavine molecule. Currently, we are working towards the dynamical effect of intercalation and protein-DNA interaction. Some of the results are shown in Fig. 1a. Polymorphism of DNA is an interesting and fundamental biophysical phenomenon with a variety of biological implications. We have studied how in the local

dinucleotide level the propensity of B- to A-form transition occurs in DNA (Fig. 1b). The ultimate goal of the study involved in structural transition of DNA is to find how this natural polymorphism can be used in nanodevice.

Design of a drug molecule often has an important entropic contribution from water. Since slow water molecules contribute to free energetic stability upon replacement by a drug, it is important to identify the entropy of the individual water molecules. We developed a new method to calculate the entropy of a single water molecule and showed that in a single protein cavity, water molecules may have different entropy values (Fig. 1c). This method is being applied to calculate the single water entropy around DNA, around hydrophobic cavity.

Other studies involve protein misfolding, water residence time, azeotropic binary mixtures, etc. Some representative images are shown (Fig. 1d).

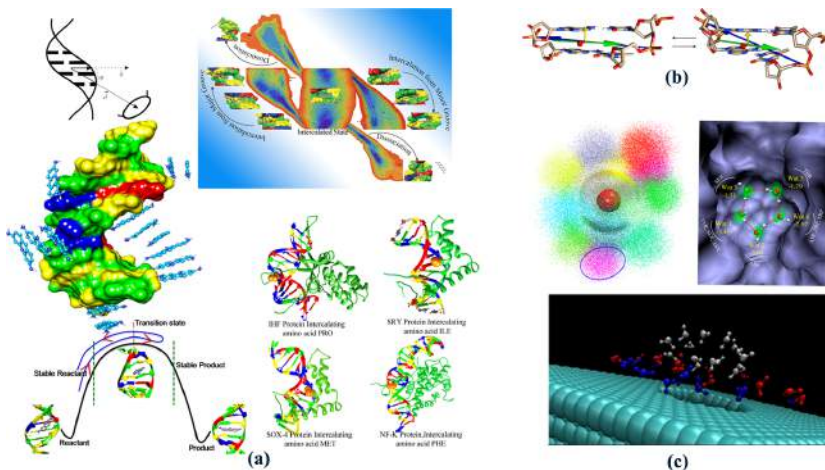


Figure 1: Representative image of (a) DNA Intercalation, (b) local conformational change in DNA, (c) the single water entropy, and (d) other collaborative projects.

Publications

1. Mukherjee, A. (2011). Entropy balance in the intercalation process of an anti-cancer drug daunomycin. *Journal of Physical Chemistry Letters* 2:3021-3026.
2. Sasikala, W.D. and Mukherjee, A. (2012). Molecular mechanism of direct proflavine-DNA intercalation: Evidence for drug-induced minimum base-stacking penalty pathway. *Journal of Physical Chemistry B* 116:12208-12212.
3. Sengupta, A., Sasikala, W.D., Mukherjee, A. and Hazra, P. (2012). Comparative study of flavins binding with human serum albumin: A fluorometric, thermodynamic, and molecular dynamics approach. *ChemPhysChem* 13:2142-2153.
4. Wilhelm M, *et al.* (2012) Multistep drug intercalation: Molecular dynamics and free energy studies of the binding of daunomycin to DNA. *Journal of the American Chemical Society* 134:8588-8596.
5. Gavvala K, *et al.* (2013) Modulation of excimer formation of 9-(dicyano-vinyl)julolidine by the macrocyclic hosts. *Physical Chemistry Chemical Physics* 15:330-340.
6. Kulkarni, M. and Mukherjee, A. (2013). Sequence dependent free energy profiles of localized b- to a-form transition of DNA in water. *Journal of Chemical Physics* 139.
7. Mukherjee, A. and Sasikala, W.D. (2013). Drug-DNA intercalation: From discovery to the molecular mechanism. *Dynamics of Proteins and Nucleic Acids* 92:1-62.
8. Sasikala, W.D. and Mukherjee, A. (2013). Intercalation and de-intercalation pathway of proflavine through the minor and major grooves of DNA: Roles of water and entropy. *Physical Chemistry Chemical Physics* 15:6446-6455.
9. Saha, T., *et al.* (2014). Hopping-mediated anion transport through a mannitol-based rosette ion channel. *Journal of the American Chemical Society*
10. Sasikala, W.D. and Mukherjee, A. (2014). Single water entropy: Hydrophobic crossover and application to drug binding. *Journal of Physical Chemistry B* 118:10553-10564.
11. Sengupta A, *et al.* (2014). Urea induced unfolding dynamics of flavin adenine dinucleotide (fad): Spectroscopic and molecular dynamics simulation studies from femto-second to nanosecond regime. *Journal of Physical Chemistry B* 118:1881-1890.
12. Kumar, P.S., Mukherjee, A. and Hazra, A. (2015). Theoretical study of structural changes in DNA under high external hydrostatic pressure. *Journal of Physical Chemistry B* 119:3348-3355.
13. Saha, D., Supekar, S. and Mukherjee, A. (2015). Distribution of residence time of water around DNA base pairs: Governing factors and the origin of heterogeneity. *Journal of Physical Chemistry B* 119:11371-11381.
14. Singh, R.K., Sasikala, W.D. and Mukherjee, A. (2015). Molecular origin of DNA kinking by transcription factors. *Journal of Physical Chemistry B* 119:11590-11596.

Grants

Title: Dynamical effects in the mechanism of intercalation of anti-cancer drugs; Source: SERB, DST; Amount: INR 5.475 million (May 2013-April 2016)

Institutional Activities

Integrated PhD Coordinator for Chemistry (2010-2015);
Member, Joint Admission Committee (JAC) (2011-present);
Member, IT Committee; Seminar-In-Charge, Chemistry (2010);
Ph.D. Coordinator, Chemistry (2010-2011)

Students Graduated

BS-MS Fifth Year Project Students: Shreyas Supekar, Piyush Agrawal, Hutashan Vajpeyi

Teaching

CHM 422: Statistical Thermodynamics (Spring 2010-2015)
CHM 436: Molecular Modeling and Simulation (Fall 2011-2012)
CHM 101: Chemical Principles I (Fall 2014-2015)
CHM 121: Physical Chemistry Lab I (Spring 2010)



Current Group Members

PhD Students: Wilbee D. Sasikala, Mandar Kulkarni, Reman K. Singh, Debasis Saha, Hridya V.M.



Seergazhi G. Srivatsan

Associate Professor

srivatsan@iiserpune.ac.in; <http://www.iiserpune.ac.in/~srivatsan>

PhD: Indian Institute of Technology, Kanpur, India

Postdoc: Alexander von Humboldt Fellow, University of Bonn, Germany; University of California, San Diego, U.S.A.

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Nucleic Acid Chemistry and Biophysics

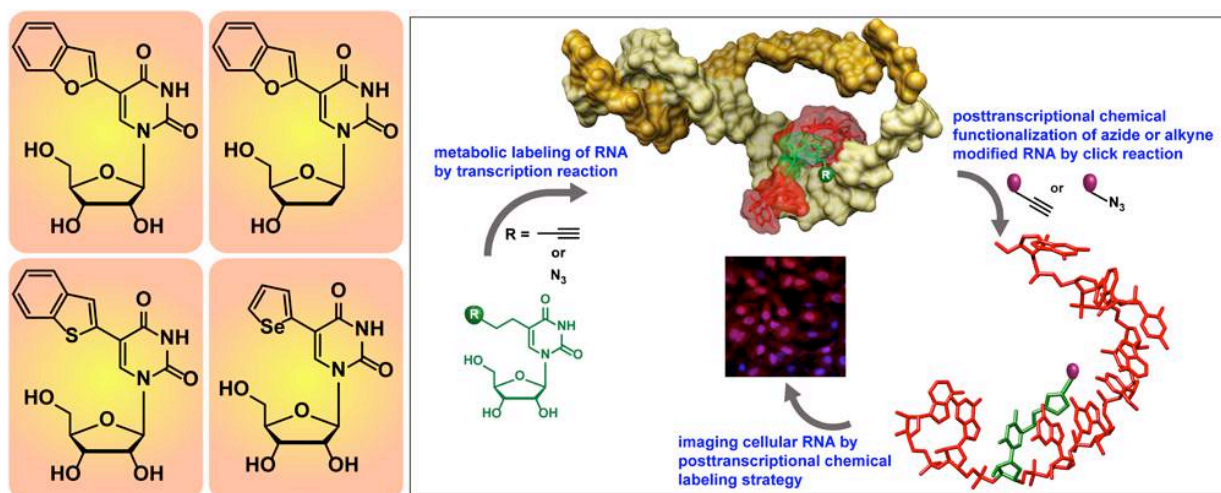
My group is interested in developing tools to assess biological events by utilizing contemporary nucleic acid functions and synthetic biology. In particular, we are interested in developing biophysical tools that would enable the study of nucleic acid structure, dynamics and function *in vitro* and in cells.

Functionalized nucleoside analogues: We have initiated a research program to develop structurally non-perturbing and conformation-sensitive fluorescent nucleoside analogue probes for studying nucleic acid structure, dynamics and recognition properties. Some of the analogues, which we have developed, are highly sensitive to conformational changes. We

have utilized them in developing fluorescence assays to (i) detect abasic sites (depurinated site) in DNA and RNA, (ii) monitor RNA-drug binding and (iii) study oligonucleotide dynamics in cell-like confined environment.

Chemical labeling and imaging of RNA:

We have developed a practical chemical labeling and imaging technique for cellular RNA by using novel toolbox made of azide- and alkyne-modified UTP analogues. These analogues are readily incorporated into transcribing RNA by endogenous RNA polymerases, which can be posttranscriptionally labeled with a variety of probes by bioorthogonal chemical reactions.



Representative examples of fluorescence nucleoside analogues and posttranscriptional chemical labeling methodology developed by our group.

Selected Publications

1. Sawant, A.A., Tanpure, A.A., Mukherjee, P.P., Athavale, S., Kelkar, A., Galande, S. and Srivatsan, S.G. (2015) A versatile toolbox for posttranscriptional chemical labeling and imaging of RNA. *Nucleic Acids Research* DOI: 10.1093/nar/gkv903.
2. Tanpure, A.A. and Srivatsan, S.G. (2015) Conformation-sensitive nucleoside analogues as topology-specific fluorescence turn-on probes for DNA and RNA G-quadruplexes. *Nucleic Acids Research* DOI: 10.1093/nar/gkv743.
3. Sabale, P.M., George, J.T. and Srivatsan, S.G. (2014) Base-modified PNA-graphene oxide platform as a turn-on fluorescence sensor for the detection of human telomeric repeats. *Nanoscale* 6: 10460-10469.
4. Tanpure, A.A. and Srivatsan, S.G. (2014) Synthesis, photophysical properties and incorporation of a highly emissive and environment-sensitive uridine analogue based on the lucifer chromophore. *ChemBioChem* 15: 1309-1316.
5. Rao, H., Sawant, A.A., Tanpure A.A. and Srivatsan, S.G. (2012) Posttranscriptional chemical functionalization of azide-modified oligoribonucleotides by bioorthogonal click and Staudinger reactions. *Chemical Communications* 48: 498-500.
6. Rao, H., Tanpure A.A., Sawant, A.A. and Srivatsan, S.G. Enzymatic incorporation of an azide-modified UTP analog into oligoribonucleotides for post-transcriptional chemical functionalization. *Nature Protocols* 7:1097-1112.

Grants

Title: Environment-responsive fluorescent peptide nucleic acid conjugates: Design, synthesis, and applications in nucleic acid diagnosis; Source: SERB-DST, India; Amount: INR 6.6 million (2015-2018)

Title: Fluorescent nucleoside-based amphiphiles: Synthesis, self-assembly properties and applications; Source: CSIR, India; Amount: INR 2 million (2012-2015)

Title: Equipment grant; Source: Alexander von Humboldt Foundation, Germany; Amount: INR 1.5 million

Title: Functionalized Ribonucleoside Analogues: Synthesis, Site-Specific Enzymatic Incorporation and Applications; Source: SERB-DST, India; Amount: INR 3.5 million (2010-2013)

Affiliations, Awards and Honors

Emerging Young Scientist in India: Awarded at the Chemical Frontiers Conference 2014
RSC West India Section: Early Career Scientist award 2012
IUPAC Prize for Young Chemists, 2004

Students Graduated

PhD Students: Maroti Pawar
BS-MS Fifth Year Project Students: Haritha Rao, Anurag Agrawal, Sarangamath Sangamesh, Pooja Patheja

Teaching

General Chemistry, Bioorganic Chemistry, Chemical Biology, Structural Methods and Analysis, Chemistry Lab III-Organic Chemistry and Advanced Organic Chemistry Lab



Current Group Members

PhD Students: Anupam Sawant, Arun Tanpure, Pramod Sabale, Ashok Nuthanakanti, Sudeshna Manna, Jerrin Thomas George, Manisha Walunj; BS-MS Students: Haritha Rao, Anurag Agrawal, S. Sangamesh; Post-Doctoral Fellows: Cornelia Panse; Project Assistants: Progya Mukherjee, Shewta Yelgaonkar, Siddheshwar Aland



Pinaki Talukdar

Associate Professor

ptalukdar@iiserpune.ac.in; <http://www.iiserpune.ac.in/~ptalukdar/>

PhD: University of Geneva, Switzerland

Postdoc: University of Illinois at Urbana Champaign, U.S.A.

Previous Positions: AMRI Global Inc., Hyderabad; Institute of Life Sciences, Hyderabad

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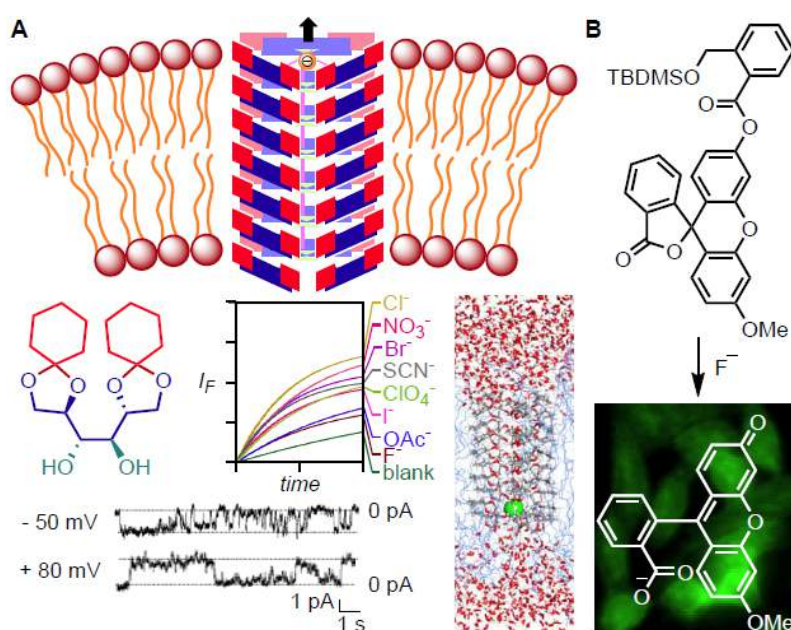
Molecules for Self-Assembly and Sensing

We design functional molecules for diverse applications in chemistry and biology. In the area of synthetic chemistry, we are interested to develop new strategies for natural and nonnatural product libraries. During last few years, we have reported syntheses of (+)- β -conhydrine and its analogues, δ -unsaturated- γ -amino acids, (2*S*,3*R*)- α -hydroxy- β -amino acids, etc.

We also design synthetic ion carriers and channels for selective anion transport across lipid membranes. Beyond fundamental understanding of noncovalent interactions, we

explore the therapeutic roles of these systems. Recently, we have reported Cl⁻ selective ion transporters and channels based on cyclo-oligo-glucosamine and mannitol derivatives, respectively. We have also developed small molecule Cl⁻ ion transporters and evaluating their anticancer activity.

We have developed fluorescent probes for the sensing of thiols, anions, cations, etc. These probes are useful for rapid, selective and sensitive detection of respective analytes, and applicable for live cell imaging studies.



(A) Mannitol-based supramolecular ion channel for hopping mediated anion transport. (B) Turn-on fluorescent probe for selective detection of F⁻ ion in living cell.

Publications

1. Roy, A., Saha, T., Gening, M.L., Titov, D. V., Gerbst, A.G., Tsvetkov, Y. E., Nifantiev, N.E. and Talukdar, P. (2015). Trimodal control of ion-transport activity on cyclo-oligo-(1 \rightarrow 6)- β -D-glucosamine-based artificial ion-transport systems. *Chemistry - A European Journal* DOI: 10.1002/chem.201502656.
2. Deshmukh, S.C. and Talukdar, P. (2014). Stereoselective synthesis of (2S,3R)- α -hydroxy- β -amino acids (AHBAs): Valinocin A, (2S,3R)-3-amino-2-hydroxydecanoic acid and a fluorescent-labeled (2S,3R)-AHBA. *The Journal of Organic Chemistry* 79: 11215-11225.
3. Saha, T., Dasari, S., Tewari, D., Prathap, A., Sureshan, K.M., Bera, A.K., Mukherjee, A. and Talukdar, P. (2014). Hopping-mediated anion transport through a mannitol-based rosette ion channel. *Journal of the American Chemical Society* 136: 14128-14135.
4. Roy, A., Kand, D., Saha, T. and Talukdar, P. (2014). A cascade reaction based fluorescent probe for rapid and selective fluoride ion detection. *Chemical Communications* 50:5510-5513.
5. Saha, T., Roy, A., Gening, M.L., Titov, D.V., Gerbst, A.G., Tsvetkov, Y.E., Nifantiev, N.E. and Talukdar, P. (2014). Cyclo-oligo-(1 \rightarrow 6)- β -D-glucosamine based artificial channels for tunable transmembrane ion transport. *Chemical Communications* 50:5514-5516.

Grants

Title: Sugar derived cyclic α -peptides as artificial ions channels and transporters; Source: SERB-DST, India; Amount: INR 1.43 million for 3 years (2015-2018)

Title: Studies on non-covalent modulation of gating and selectivity of synthetic ion channels; Source: SERB-DST, India; Amount: INR 5.2 million for 3 years (2013-2016)

Title: Study of transmembrane ion channel activity of cyclo-(1 \rightarrow 6)- β -D-glucosamine derivatives and evaluation of their antibacterial potential; Source: DST, India (under DST-RFBR scheme); Amount: INR 1.39 million for 3 years (2011-2013)

Affiliations, Awards and Honors

Life Member, Chemical Research Society of India, DAE Young Scientist Research Award (2011-2014)

Institutional Activities

Member, CEC Committee (2009-2015)
Member, Purchase Committee (since 2013)
Member, Campus Development Committee (2009-2010)

Students Graduated

PhD Students: Dnyaneshwar Kand
BS-MS Fifth Year Project Students: Pratyush K. Mishra, Sreejith J. Varma, Ashutosh Priyadarshi

Teaching

CHM 331: Self-assembly in chemistry (2015, 2014, 2013)
CHM 311: Physical organic chemistry (2012)
CHM 201: Introductory Chemistry III-Organic Chemistry (2011, 2009, 2010)
CHM 420: Structural methods and analysis (2012, 2011, 2010)
Chemistry Lab courses (2009-2013, 2014, 2015)

Outreach

KVPY Summer Programme in IISER-Pune during 31st May – 5th June, 2010



Current Group Members

PhD Students: Sharad Chandrakant Deshmukh, Dinesh Pratapsinh Chauhan, Tanmoy Saha, Arundhati Roy, Sopan V. Shinde, Sanjit Dey, Javid Ahmad Malla; Int. PhD Students: Mishika Virmani, Saptashwa Chakraborty



Image: Barua Lab

Ecology, Evolution, and Biodiversity

Ramana Athreya

Deepak Barua

Sutirth Dey

Nishad Matange

Milind Watve



Ramana Athreya

Associate Professor

rathreya@iiserpune.ac.in; <http://www.iiserpune.ac.in/~rathreya/>

PhD: National Centre for Radio Astrophysics (Tata Institute of Fundamental Research), Pune

Postdoc: l'Institut d'Astrophysique de Paris; European Southern Observatory, Chile

Previous Positions: Reader, NCRA-TIFR, Pune

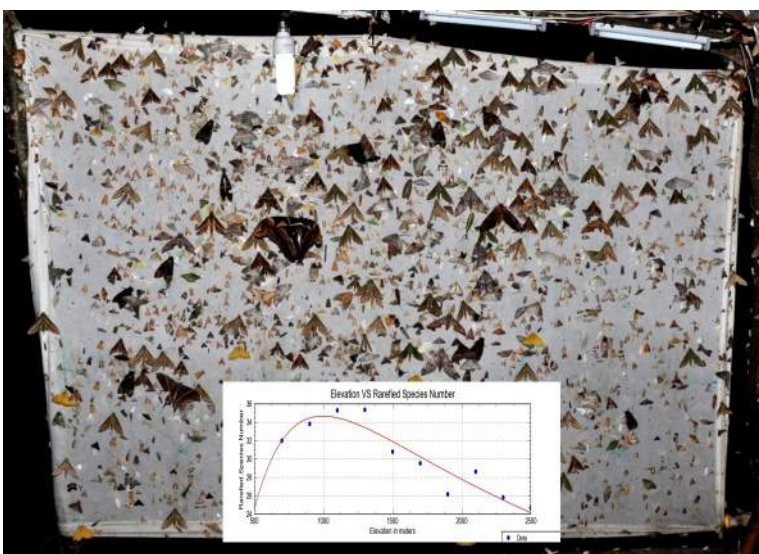
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Biological Diversity – Patterns and Processes

The distribution of biological diversity is the principal observable of evolutionary processes responsible for the generation and sustenance of the diversity. Global and regional patterns of biodiversity have been used to tease apart the biotic and abiotic factors responsible for the same. My group has been focusing on diversity patterns along a montane transect in Arunachal Pradesh. Arunachal hosts over two-thirds of India's biodiversity, and is near the top of the list of global biodiversity hotspots. We are studying the diversity profile of birds, moths and ants along a 3000m elevational transect. We are also developing techniques to generate large scale genetic data sets to understand the population-level genetic diversity which must anchor the

profusion of diversity seen at higher taxonomic levels in the region. In addition to ecological research I have also been working with local tribal communities on wildlife conservation projects and also in training their personnel for long-term faunal monitoring projects in the context of climate change.

My primary training was in astronomy in which I did my PhD. I continue to carry out research and supervise students in astronomy, largely in low frequency radio astronomy including imaging algorithms, galaxy cluster radio haloes, pulsars, active galaxies and the high redshift Universe.



Hundreds of species of moths congregate at our sampling locations, attracted by a UV lamp against a screen. Our work shows that the elevational diversity distribution between 500m and 2800m has a hump-shaped pattern with a peak at about 1300m (inset). We intend to use this simple procedure to institute a long-term monitoring project to understand how faunal populations may be changing in the context of climate change.

Grants

Title: Local Communities and Conservation of Protected Areas in Arunachal Pradesh; Source: Whitley Fund for Nature, UK; Amount: INR 2.2 million (2011-2012)

Title: Elevational Species Diversity Patterns; Source: DST, Govt of India; Amount: INR 3.35 million (2012-2015)

Title: Mitigation of Damage to Wildlife Habitats Caused by Infrastructure Projects; Source: Govt of Arunachal Pradesh; Amount: INR 1.7 million (2012-2015)

Affiliations, Awards and Honors

Whitley Award, from Whitley Fund for Nature, UK (2011)
Member, Arunachal Pradesh State Wildlife Advisory Board (2009 - present)

Institutional Activities

Chair, Summer Student Programme; Member, Physics Curriculum Committee; Member, Biology Stores Committee

Students Graduated

BS-MS Fifth Year Project Students: Anurag Mishra (+ 3 students in Astronomy)
Non-IISER / External MS Students: Jay Waghela

Teaching

PHY 334: Astronomy & Astrophysics (2009-2013; 2015)
PHY 121: Physics Introductory Lab (2010-2012)
BIO 310: Biostatistics (2013-2015)
IDC 204: Mathematical Methods (2013)
Plus parts of a few courses

Outreach

KVPY/DST/INSPIRE lectures for high school and college students; Workshops for DST SERB (Animal Science) and YETI (forum for young ecologists)



Current Group Members

PhD Students: Mansi Mungee, Rutuja Diwan, Debjyoti Dutta; Project Assistants: Chintan Sheth, Phurpa Atjaipu, Shreya Pathak



Deepak Barua

Assistant Professor

dbarua@iiserpune.ac.in; <http://www.iiserpune.ac.in/~dbarua>

PhD: Syracuse University, U.S.A.

Postdoc: University of Potsdam, Germany; University of Toledo, U.S.A., Harvard University, U.S.A.

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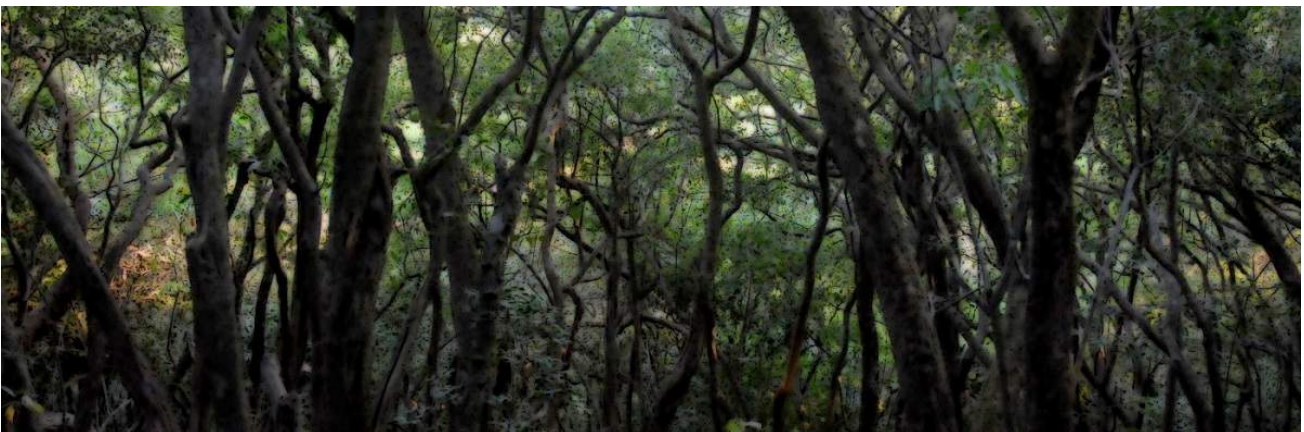
Plant Ecology

There is tremendous diversity in plant responses to the environment and in the underlying traits and mechanisms. Broad goals of my research are to characterize such variation, identify key traits and interactions between traits, understand how these translate to plant performance, and test how variation in performance influences population persistence and adaptation in complex ecological environments.

Using an integrated approach, work in my lab examines variation in and relationships between morphological, physiological and phenological traits in woody tree species from various sites in peninsular India that span a gradient in vegetation types from seasonally dry forests to tropical wet evergreen forests. We are trying to understand how the relationships between leaf, stem and reproductive traits relate to distribution of species across these environmental gradients.

Complementary experiments conducted in the greenhouse/growth chambers allow greater control on conditions used to grow, manipulate and assess performance. These help understand the mechanistic basis of variation in leaf and stem functional traits, the integration between leaf and stem traits, and the consequences of this for plant performance under varying experimentally manipulated conditions.

Other work in the lab investigates patterns in plant phenology, examining proximate environmental cues and the underlying endogenous mechanisms, and the ultimate consequences of diverse phenological patterns in tropical plants. The work done by students in the lab is often independent of the major focus of my research and addresses varied questions including: thermotolerance in tropical trees, plant-pollinator interactions, and evolutionary ecology of plant sexual systems.



Seasonally dry tropical forests in the Northern Western Ghats, India

Publications

1. Chiang, G.C.K., Bartsch, M., Barua, D., Nakabayashi, K., Debieu, M., Kronholm, I., Koornneef, M., Soppe, W.J.J., Donohue, K. and de Meaux, J. (2011). DOG1 expression is predicted by the seed-maturation environment and contributes to geographic variation in germination in *Arabidopsis thaliana*. *Molecular Ecology* 20:3336-3349.
2. Barua, D., Butler, C.M., Tisdale, T.E. and Donohue, K. (2012). Natural variation in germination responses to seasonal cues and their associated physiological mechanisms. *Annals of Botany* 109:209-226.
3. Donohue, K., Barua, D., Butler, C.M., Tisdale, T.E., Chiang, G.C.K., Dittmar, E. and Rubio de Casas, R. (2012). Maternal effects alter natural selection on phytochrome nulls through effects on seed germination. *Journal of Ecology* 100:750-757.
4. Rubio de Casas, R., Kovach, K., Dittmar, E., Barua, D., Barco, B. and Donohue, K. (2012). Seed afterripening and dormancy determine germination responses to environmental cues and post - germination life history. *New Phytologist* 194:868-879.
5. Chiang, G.C.K., Barua, D., Dittmar, E., Kramer, E.M., Rubio de Casas, R. and Donohue, K. (2013). Pleiotropy in the wild: the dormancy gene DOG1 exerts cascading control over life cycles. *Evolution* 67:883-893.
6. Varma, V. *et al.* (2015). Perceptions of priority issues in the conservation of biodiversity and ecosystems in India. *Biological Conservation* 187:201-211.

Grants

Title: Community level plant pollinator interactions in a forest-plantation matrix; Source: DBT, India; Amount: INR 2 million (2015-2018)

Institutional Activities

Member, PhD and Int-PhD Program Committee (since 2015); Member, Organizing Committee for "Ishan Vikas" workshops for school children from North-Eastern India (since 2014); Member, Summer Program Committee (since 2011); Organizer "Biology Lab Orientation and Training" workshop for Graduate students and other Biology personnel (2010 and 2011); Workshop Organizer 'Science Ethics and Communication', IISER Pune, (December 2009); Member, Curricula Committee (2009-2011); Member, PG Courses and Assessment Committee (2009-2011); Hostel non-resident Warden (2009-2011); TA Program Coordinator, Biology (since 2009); Coordinator, PhD Admissions in Biology (2008-2009)

Students Graduated

BS-MS Fifth Year Project Students: Sameer Parihar (2012), Mihir Umrani (2013), Siddharth Iyengar (2013), Sheetal Sharma (2014), Brihaspati Kumar Gaurav (2014), Neha M. (2015)
Non-IISER / External MS Students: Parima Kabhya, TERI University, Delhi (2012), Kajol Patel, Garware College, Pune (2013)

Teaching

BIO 411: Basic Ecology (Fall 2009, 2010, 2011, 2012, 2013, 2014, 2015)
BIO 423: Advanced Ecology (Spring 2009, 2010, 2011, 2012, 2014)
BIO 491: Introduction to the Scientific Literature (Spring 2010, 2011)
BIO Practicals (2013, 2014, 2015)

Outreach

Advisory Board, Honey Bee Conservation and Livelihood Programme, Kalpavriksh, Pune, 2015-present; Research Advisory Committee, Season Watch, Citizen Science Program, NCBS, Bangalore and NCF, Mysore, 2013-present; Executive member of steering committee to establish the Indian Society for Evolutionary Biology, 2009-present; Conference Co-organizer Young Investigators Meet (YIM), Calcutta, India, 2010



Current Group Members

PhD Students: Aniruddh Sastry, Shatarupa Ganguly, Souparna Chakrabarty, Aboli Kulkarni, Ron Sunny; BS-MS Students: Asmi Jezeera; Post-Doctoral Fellows: Anirban Guha; Project Assistants: Neha M.



Sutirth Dey

Associate Professor

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PhD: Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India

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Life-History Evolution and Population Stability

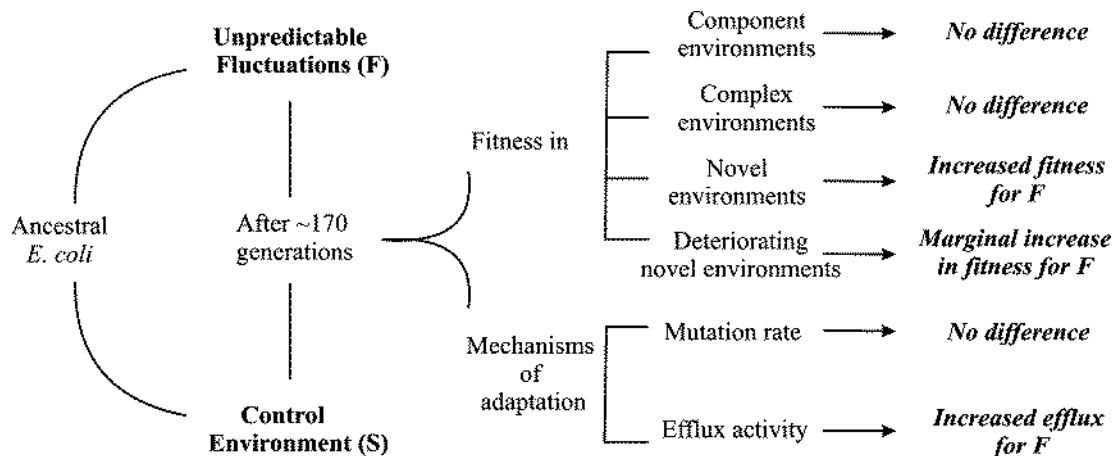
Currently there are three major lines of work in the lab:

Stabilizing the dynamics of populations and metapopulations: We have proposed a new method for stabilizing the dynamics of unstable populations and empirically verified it on laboratory populations and metapopulations of *Drosophila melanogaster*^{3,6}. We have also undertaken a comparison of the various control methods in the literature⁴ and shown that constant restocking is one of the better methods of stabilizing populations. We have also empirically verified the predictions coming out of this study (manuscripts under review).

Effects of unpredictable environmental fluctuations on the evolution of *E. coli*: In nature,

environments typically comprise of multiple stresses that fluctuate unpredictably and simultaneously. When *E. coli* populations are selected under such conditions, they acquire higher growth rate than the controls under novel environments including antibiotics. We have investigated multiple reasons for this observation (manuscript under review) and shown that this is primarily due to evolution of increased efflux activity¹.

Evolution of dispersal: We have used laboratory populations of *D. melanogaster* to show that dispersal ability and dispersal kernel can evolve as a result of selection (manuscript under preparation).



Effects of unpredictably fluctuating environments on evolution of *Escherichia coli* populations

Publications

1. Tung, S., Mishra, A. and Dey, S. Stabilizing the dynamics of laboratory populations of *Drosophila melanogaster* through upper and lower limiter controls. *Ecological Complexity* (in press).
2. Karve, S.M., Daniel, S., Chavhan, Y.C., Anand, A., Kharola, S.K., and Dey, S. (2015). *Escherichia coli* populations in unpredictably fluctuating environments evolve to face novel stresses through enhanced efflux activity. *Journal of Evolutionary Biology* 28:1131-1143.
3. Prasad, N.G., Dey, S., Joshi, A. and Vidya, T.N.C. (2015). Rethinking inheritance, yet again: Inheritomes, contextomes and dynamic phenotypes. *Journal of Genetics* 94:367-376.
4. Sah, P. and Dey, S. (2014). Stabilizing spatially-structured populations through Adaptive Limiter Control. *PLoS One* 9(8):e105861.
5. Tung, S., Mishra, A. and Dey, S. (2014). A comparison of six methods for stabilizing population dynamics. *Journal of Theoretical Biology* 356:163-173.
6. Nagaraj, N., Balasubramanian, K. and Dey, S. (2013). A new complexity measure for time series analysis and classification. *European Physical Journal Special Topics* 222:847-860.
7. Sah, P., Salve, J. and Dey, S. (2013). Stabilizing biological populations and metapopulations by Adaptive Limiter Control. arXiv 1205.4086. *Journal of Theoretical Biology* 320(7):113-123.

Grants

Title: Investigating the dynamics of spatially structured and unstructured laboratory populations of *Drosophila melanogaster* under constant perturbations; Source: CSIR-India; Amount: INR 1.75 million (2009-2012)

Title: Theoretical and empirical investigations on the interaction of asymmetric migration and intrinsic growth rate on the dynamics of laboratory metapopulations of *Drosophila melanogaster*; Source: DBT-India; Amount: INR 2.67 million (2010-2013)

Title: Stabilizing the dynamics of laboratory populations of *Drosophila melanogaster* using limiter control; Source: CSIR-India; Amount: INR 2.56 million (2013-2016)

Title: Evolution of evolvability in laboratory populations of *E. coli*; Source: DBT-India; Amount: INR 5.44 million (2014-2017)

Title: Evolution of dispersal in laboratory populations of *Drosophila melanogaster*; Source: DST-India; Amount: INR 2.99 million (Sanctioned)

Affiliations, Awards and Honors

Guest Fellowship of Wissenschaftskolleg zu Berlin (2008-2009)

Young Scientist Medal awarded by Indian National Science Academy, New Delhi (2010)

IISER Pune recognition for outstanding contribution in promoting student creativity (2011)

Institutional Activities

Warden (2007-2013); Founding Member, Outreach Committee (since 2007); Member, Library Committee (since 2012); Member, Biology Curriculum Committee (since 2014); Biology Coordinator, IISER-Tirupati Cell (since 2015); Member, Institutional Biosafety Committee (since 2014)

Students Graduated

BS-MS Fifth Year Project Students: Subhajt Das, Sachit Daniel, Somendra Kharola, Abhishek Mishra

Non-IISER / External MS Students who have done a full thesis: Pratha Sah, Kanishka Tiwary, Satvika Kumbhare, S. Selveshwari

Teaching

BIO 201: Ecology and Evolution (Semester III, 2007 onwards)

BIO 422: Evolution (Semester VIII, 2010 onwards)

BIO 222: Practicals, Ecology and Evolution (as instructor of 1-2 modules)

BIO 491: Literature Review (as instructor of 1-2 modules)

Outreach

I have been associated with outreach at IISER Pune since 2007. In this capacity I have given numerous popular talks all over India.



Current Group Members

PhD Students: Shraddha Karve, Sudipta Tung, Yashraj Chavhan, Abhishek Mishra, S. Selveshwari; BS-MS Students: Agrim Saini, Project Assistants: Shripad Joshi, Cecily George



Nishad Matange

DST-INSPIRE Faculty Fellow
nishad@iiserpune.ac.in

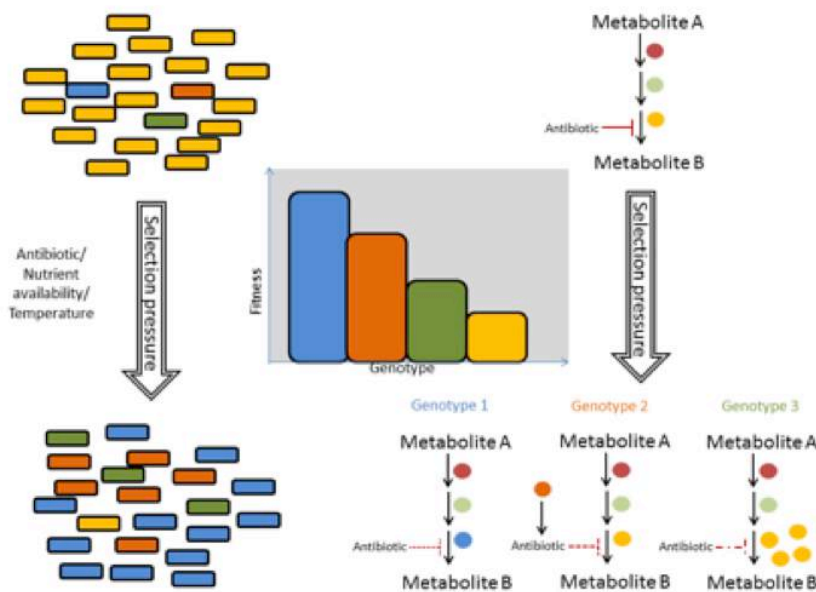
PhD: Indian Institute of Science, Bengaluru, India
With IISER Pune since July 2015

Fitness and Fitness Costs in Bacterial Evolution

As bacteria evolve under selection, several novel genotypes have the potential to emerge. These may be thought of as alternative solutions to dealing with an environmental pressure. Yet, in real life or in laboratory selections not all potential evolutionary paths are equally successful. The genotypes that are more successful are termed 'fitter' than their competitors.

While 'fitness' is a commonly encountered principle in evolutionary biology, its biochemical basis is poorly explored. A convenient system for the study of the biochemistry of fitness is the

evolution of resistance to antibiotics in bacteria. Though various mechanisms may confer antibiotic-resistance, some are known to bear large 'fitness costs', i.e. in the absence of antibiotic are detrimental to the bacterium. Using laboratory selections, biochemical investigations and eventually systems level approaches, I am interested in teasing out the mechanistic basis of fitness costs and relative fitness of drug resistant genotypes. Finally, I hope to extend these ideas to other kinds of selection such as nutrient utilization and non-specific stresses.



Schematic representation of the relative fitness of bacterial genotypes under selection and a possible scheme for the biochemical basis of fitness and fitness costs

Publications

1. Matange N. (2015). Revisiting bacterial cyclic nucleotide phosphodiesterases: cyclic AMP hydrolysis and beyond. *FEMS Microbiology Letters* 362(22):fnv183 doi: 10.1093/femsle/fnv183. (Editor's choice minireview)

Grants

Source: DST-INSPIRE Amount: Indian Rupees 3.5 million (2015-2020)

Affiliations, Awards and Honors

DST-INSPIRE Faculty Fellowship, Department of Science and Technology, Govt. of India (2015)
Indian Institute of Science-Research Associate fellowship (2013-2014)
Senior Research fellowship' by the Council for Scientific and Industrial Research, Govt. of India (2011-2013)
Dr. R.K. Maller Medal, Indian Institute of Science (2009)

Teaching

BIO 301/401: Laboratory Training (Fall 2015) Co-coordinator
HSS 201: History of Science (Fall 2015) Teaching Assistant



Milind G. Watve

Professor

milind@iiserpune.ac.in; <http://www.iiserpune.ac.in/~milind/wordpress/>

PhD: Indian Institute of Science, Bengaluru, India

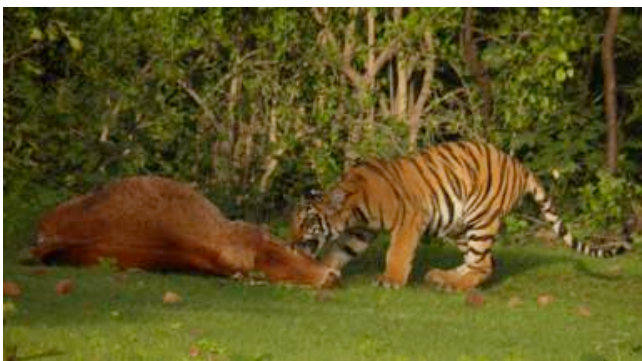
Previous Positions: Head of the Department (Microbiology) Abasaheb Garware College Pune

With IISER Pune since 2009

Evolutionary Biology: Behavior, Life History, Metabolism and Health

My focal interest is in the nature of questioning and methods of investigation in biology, and I pursue it by asking questions and undertaking investigations in a number of different and apparently unrelated areas of biology including microbial ecology, social behavior, sex, sexual behavior and mating systems (including human), human-wildlife conflict, many aspects of human behavior, resource ecology of human communities, aging and evolutionary medicine (particularly type 2 diabetes and other lifestyle disorders). The thread connecting the different fields of biology is principles of evolution. Of

particular interest are the aspects of question “why” in biology, the relationship between ultimate and proximate causation, nature of causal inferences, correlation-causation relationship, causation in perturbed state versus steady state etc. The tools used in my lab include simple mathematical models, statistical analysis, meta-analysis of secondary data and interpretation of compiled literature, field biology, simple to perform experiments dictated by novel theoretical possibilities and above all – common sense.



Publications

1. Doves, diplomats and diabetes: a Darwinian reinterpretation of type 2 diabetes and related disorders. Springer, New York, Heidelberg, London 2013 (Book)
2. Watve, M.G., Jog, M.M., Ashraf, N.V.K. (2015) Diseases of Mammals In: Mammals of South Asia Vol II, Eds AJT Johnsingh, Nima Manjrekar, University Press. (Book Chapter)
3. Baig, U., Bhadbhade, B., Mariyam, D. and Watve, M.G. (2014). Protein Aggregation in *E. coli*: Short term and long term effects of nutrient density. *PLoS One* 9,9, e107445.
4. Baig, U., Bhadbhade, B., Mariyam, D. and Watve, M.G. (2014). Evolution of Aging and Death: What insights bacteria can provide. *Quarterly Reviews in Biology* 89(3):209-233.
5. Lele, U. and Watve, M. (2014). Bacterial growth rate and growth yield: is there a relationship? *Proceedings of the Indian National Science Academy* 80:531-546.
6. Kumbhar, C., Mudliar, P., Bhatia, L., Kshirsagar, A. and Watve, M. (2014). Widespread predatory abilities in the genus *Streptomyces*, *Archives in Microbiology* 196:235-248.
7. Watve, M., Bodas, A. and Diwekar, M. (2014). Altered autonomic inputs as a cause of pancreatic beta cell amyloid. *Medical Hypothesis* 82:49-53.
8. Kumbhar, C. and Watve, M. (2013). Why antibiotics: comparative evaluation of different hypotheses for the natural role of antibiotics and an evolutionary synthesis. *Nat Sci*, 5:26-40.
9. Watve, M.G., Damle, A., Ganguly, B., Kale, A. and Dahanukar, N. (2011). Blackmailing: the keystone in the human mating system *BMC Evolutionary Biology* 11:345 doi:10.1186/1471-2148-11-345
10. Karve, S., Shurpali, K., Dahanukar, N., Paranjape, S., Jog, M., Belsare, P. and Watve, M. (2011). Money handling and obesity: A test of the exaptation hypothesis. *Current Science* 100:1695-1700.
11. Baig, U., Belsare, P., Jog, M. and Watve, M. (2011). Can thrifty gene(s) or predictive fetal programming for thriftiness lead to obesity? *Journal of Obesity*, 2011:861049.
12. Lele, U., Baig, U. and Watve, M. (2011). Phenotypic plasticity and effects of selection on cell division symmetry in *Escherchia coli*. *PLoS One* 6(1);e14516.
13. Joshi, A., Kondekar, S., Belsare, P., Ghaskadbi, S., Watve, M. and Jog, M. (2010). People with metabolic syndrome disorders give lower offers in ultimatum game. *Psychology* 1:128-133.
14. Watve, M., Dahanukar, N. and Watve, M. (2010). Sociobiological control of plasmid replication regulation. *PLoS One* 5(2):e9328.
15. Belsare, P., Watve, M., Bhat, D., Ghaskadbi, S., Jog, M. and Yajnik, C. (2010). Metabolic syndrome: aggression control mechanisms gone out of control. *Medical Hypotheses* 74:578-589.
16. Belsare, P., Balasubramaniam, S. & Watve, M. (2009). Cooptimization of nectar content and floral display. *Journal of Bioscience* 34:963-967.
17. Dahanukar, N. and Watve, M. (2009). Group selection and reciprocity among kin. *The Open Biology Journal* 2:66-79.
18. Dahanukar, N. and Watve, M. (2009). Refinement of defection strategies stabilizes cooperation. *Current Science* 96 (6).

Grants

Title: Maharashtra Gene Bank Project, Rajeev Gandhi Science and Technology Commission, Maharashtra State; Amount: INR 50 million (2014-2019)

Title: Capacity building in village youth along the western boundary of Tadoba Andhari Tiger Reserve; Source: DST; Amount: INR 1.6 million (2013-2016)

Affiliations, Awards and Honors

INSA Fellow (2012)

Students Graduated

PhD Students: Charushila Kumbhar; Uttara Lele; Ulfat Baig

Teaching

BIO 101: Introductory Biology (2009-2015)
BIO 422: Evolutionary Biology (2009-2015)

Outreach

KVPY Workshops; Teaching in local colleges; Lectures in local schools as part of the NCL-IISER Exciting Science Group; Member of Animal Ethics Committee, NTC, Pune

Current Group Members

PhD Students: Abhijeet Bayani, Manawa Diwekar, Shubhankar Kulkarni; Post-Doctoral RAs: Pramod Patil; Ulfat baig; Uttara Lele; Srinu Meesala; Sneha Asai; Project Assistants: Ketki Holkar; Neha Shintre; Tejal Gujarathi; Kajal Patel; Poortata Lalwani; Chinmay Kulkarni



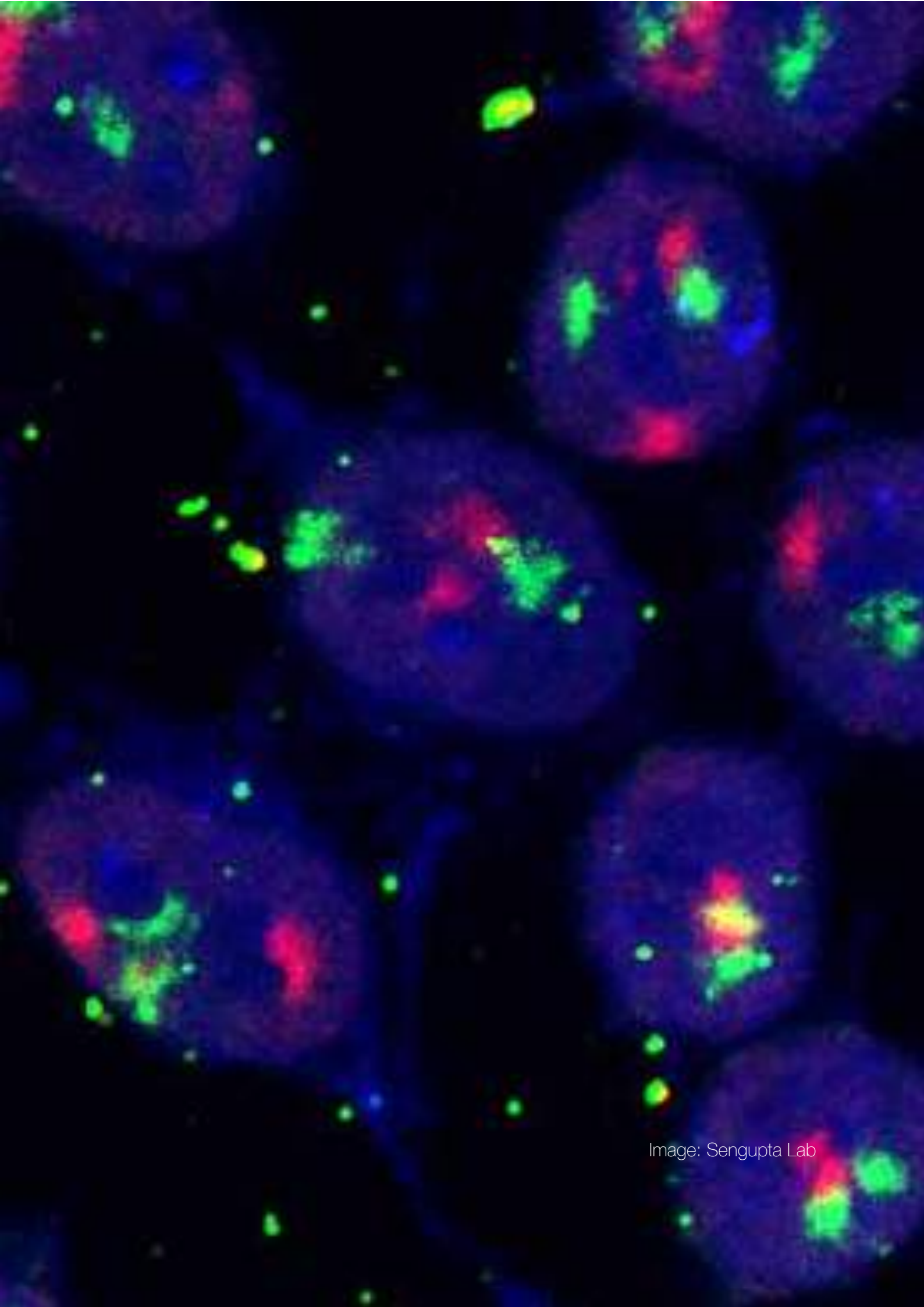


Image: Sengupta Lab

Epigenetics, Immunology, and Plant Biology

Anjan Banerjee

Akanksha Chaturvedi

Sanjeev Galande

Krishanpal Karmodiya

Kundan Sengupta



Anjan K. Banerjee

Associate Professor

akb@iiserpune.ac.in; http://www.iiserpune.ac.in/~akb/

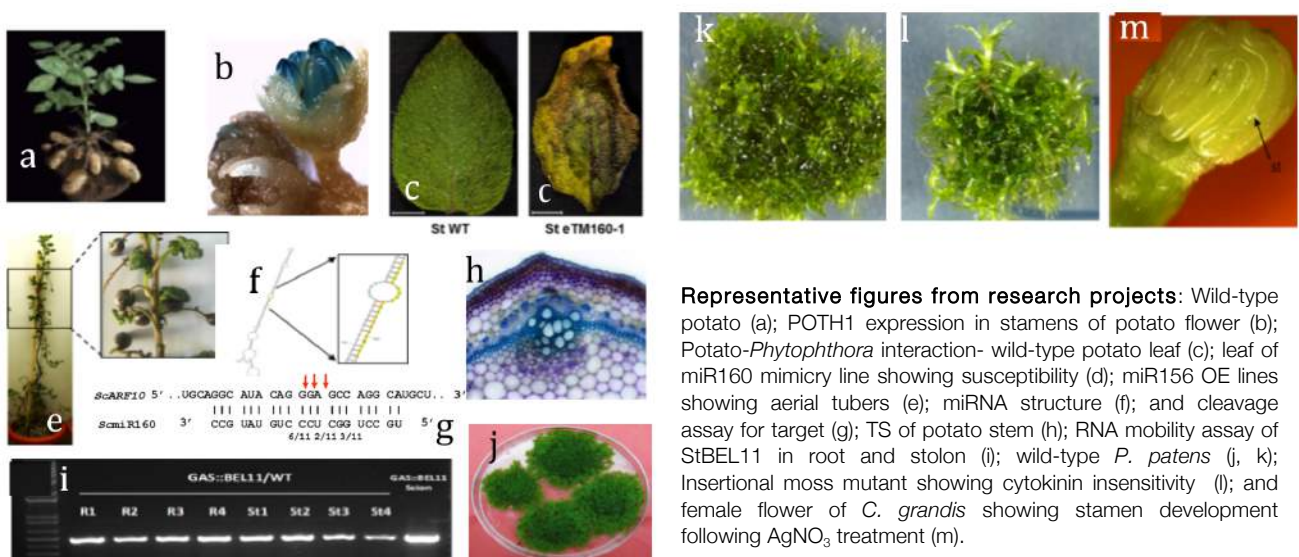
PhD: SPPU University (Formerly University of Pune), Research work at National Chemical Laboratory, Pune
Postdoc: Iowa State University (ISU), Ames, Iowa, U.S.A.

With IISER Pune since July 2008

RNA Signaling in Plant Development

Land plants have evolved a long-distance vascular signaling network not only for effective cell-to-cell communications, to transport sugars, metabolites, proteins through phloem, the major conduit for transport. Emerging evidence suggest that full length transcripts (mRNAs), small RNAs are also conveyed through phloem and plant use these non-cell autonomous RNA molecules as long distance molecular signals to regulate a myriad physiological and developmental processes and respond to biotic and abiotic environments. We use potato, the third most important food crop, to understand the molecular signal for tuber development. How does a tiny stolon perceive the signal from the leaf and develops in to a mature tuber (potato) is an intriguing question. We showed that full

lengths transcripts as well as micro RNAs play an important role in tuber development and act as a long distance phloem mobile signaling molecule. Further, we show that mRNAs of two BELL-1 TFs, StBEL11 and StBEL29 are phloem mobile and suppress the growth of tubers and roots in potato. Epigenetic control of tuberization is being investigated currently. We have identified the novel role of miR160 and miR166 in long distance systemic signaling in potato-*Phytophthora* interaction. In addition, we study the apical cell mediated modular growth in plants using *Physcomitrella patens* as model system and employ both forward and reverse genetics approaches. Using *C. grandis* as a model, we investigate the evolution of dioecy as well.



Publications

1. Ghadge, A., Karmakar, K., Devani, R., Banerjee, J., Boominathan M., Sinha, R., Sinha, S. and Banerjee, A.K. (2014). Flower development, pollen fertility and sex expression analysis of three sexual phenotypes of *C. grandis*. *BMC Plant Biology*
2. Bhogale, S., Mahajan, A., Natarajan, B., Rajabhoj, M., Thulasiram, V. and Banerjee, A.K. (2014). *MicroRNA156*: A potential graft-transmissible microRNA that modulates plant architecture and tuberization in *Solanum tuberosum* ssp. *Andigena*. *Plant Physiology* 164(2):1011-1027.
3. Mahajan, A., Bhogale, S., Kang, I.H., Hannapel, D.J. and Banerjee, A.K. (2012). The mRNA of a Knotted 1-like transcription factor of potato is phloem mobile. *Plant Molecular Biology* 79:595-608.
4. Banerjee, A.K., Lin, T & Hannapel, D. J. (2009). The untranslated regions of a mobile transcript mediate RNA metabolism. *Plant Physiology* 151:1831-1843.

Grants

Title: Molecular Characterization of the BEL1 like homologs in potato and their role in long distance signaling of tuberization;
Source: DST; Amount: INR 3.3 million (2010-2013)

Title: A transcriptomic approach to decipher the alarm signals in phloem in wild *Solanum* sp in response to pathogen challenge;
Source: DBT; Amount: INR 4 million (2011-2014)

Understanding dioecy by exploring floral organ identity genes (OIGs) in *C. grandis*; Source: DBT; Amount: INR 3.6 million (2014-2017)

Title: Target gene identification, regulation and functional characterization of the shoot meristemless (STM) ortholog in potato; Source: DST; Amount: INR 5.6 million (2014-2017)

Affiliations, Awards and Honors

Elected Member, Plant Cell Culture Association, India
Executive Member, International Scientific Board, IPMB-2015
Member, Indian Society of Cell Biology; American Society of Plant Biology; Indian Society of Developmental Biology

Institutional Activities

UG Student Award Committee (2014-2015); Member, Purchase Committee (since 2014); Member, Survey/Disposal Committee; Member, IISER Tirupati Curriculum and Extracurricular Activity Committee

Students Graduated

PhD Students: Ameya Mahajan, Sneha Bhogale
BS-MS Fifth Year Project Students: Stanzin Dadul, Amita Ghadge, Navakrishna K., Neeraja Revi, Supreeth K.S., Shailendra Kushwaha

Non-IISER / External MS Students who have done a full thesis: Mohit Rajabhoj, Meenu Singla, Anagha Ghadge, Neha Pattihal, Vaishali Pawar, Farheen Khan, Kedar Limbkar, Tejashree Ghate

Teaching

BIO 121: Lab courses (since 2010)
BIO 321: Plant Biology-I (since Spring 2009)
BIO 452: Plant Biology-II (since Fall 2009)

Outreach

Mentor in INSPIRE camps, Talks in city colleges and presentation and interaction with students from city schools



Current Group Members

Post-Doctoral Fellows: Kirtikumar Kondhare; PhD Students: Bhavani Natarajan, Boominathan M., Ravi Devani, Amit Kumar, Gajanan Kendre, Harpreet Sing Kalsi; BS-MS Students: Sukanya Jogdand, Vyankatesh Rajmane; Project Assistants: Shivkumar Biradar; Green House Technician: Nitish Lahigude



Akanksha Chaturvedi

Assistant Professor

akanksha@iiserpune.ac.in; <http://www.iiserpune.ac.in/~akanksha/>

PhD: ICGEB, New Delhi, India

Postdoc: Laboratory of Immunogenetics, National Institute of Allergy and Infectious Diseases (NIAID), NIH, U.S.A.

With IISER Pune since January 2013

Integration of Adaptive and Innate Receptor Signaling in B Cells

Antibodies are essential in providing protection against many infectious agents. Antibody responses are initiated by B cells that recognize and respond to foreign antigens through antigen-specific B cell receptors (BCRs). In addition to the BCRs, B cells also express various germline encoded innate immune system receptors, Toll like receptors (TLRs) that recognize highly conserved motifs present in microorganisms. This dual expression allows B cells to not only sense antigen but also survey their environment for danger signals associated with the presence of pathogens. How the BCR and TLRs function independently of one another is known in considerable molecular details. We know little about the mechanisms that integrate

BCR and TLRs signaling at subcellular and molecular levels. Although both BCR and TLRs initiate signal independently, in response to antigens and PAMPs, B cells are able to integrate both antigen-specific and danger signals into a qualitatively and quantitatively unique molecular response.

The goal of my lab is to determine the cellular and molecular mechanism by which B cells integrate BCR and TLR signaling to modify and tailor antibody responses. In addition, we also plan to understand how inappropriate B cell activation by TLRs potentially results in autoimmunity and even tumorigenesis.

Publications

1. Chaturvedi, A., Davey, A., Liu, W., Sohn, H. and Pierce, S.K. (2012). B Lymphocyte Receptors, Signaling Mechanisms and Activation, Fundamental Immunology, Ed. W.E. Paul, 7th Edition Lippincott Williams & Wilkins, U.S.A.
2. Chaturvedi, A.,* Martz, R., Dorward, D., Waisberg, M. and Pierce, S.K.* (2011). Endocytosed B cell receptors sequentially regulate MAP kinase and Akt signaling pathways from intracellular compartments. *Nature Immunology* 12:1119 (*corresponding authors)
3. Chaturvedi A,* and Pierce, S.K.* (2009). How location governs Toll-like receptor signaling. *Traffic* 10:621 (*corresponding authors)
4. Chaturvedi, A., Dorward, D. and Pierce, S.K. (2008). The B cell receptor governs the subcellular location of Toll-like receptor 9 leading to hyper-responses to DNA-containing antigens. *Immunity* 28:799.
5. Chaturvedi, A., Siddiqui, Z., Bayiroglu, F. and Rao, K.V.S. (2002). A GPI-linked isoform of the IgD receptor regulates resting B cell activation. *Nature Immunology* 3:951.



Sanjeev Galande

Professor

sanjeev@iiserpune.ac.in; <http://www.iiserpune.ac.in/~sanjeev/>

PhD: Indian Institute of Science, Bengaluru, India

Postdoc: Lawrence Berkeley National Laboratory, Berkeley, CA, U.S.A.

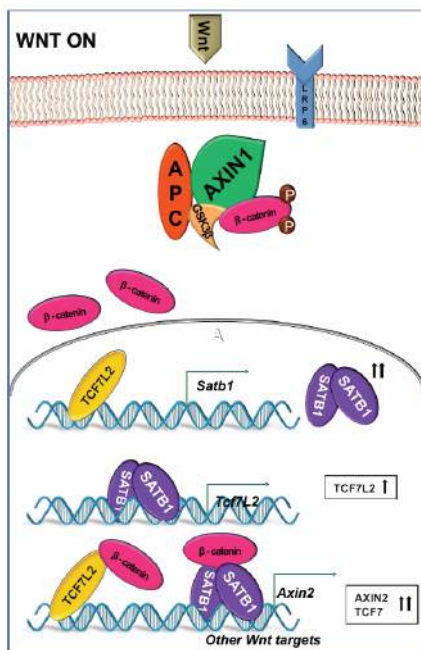
Previous Positions: National Centre for Cell Science, Pune

With IISER Pune since May 2010

Chromatin Biology and Epigenetics

Research in Galande laboratory is focused on studying how the dynamic changes in higher-order chromatin assembly govern gene expression in a spatial and temporal manner. To fulfill this he has established a multidisciplinary program engaged at the interface of biochemistry, molecular biology, bioinformatics, cell biology, proteomics, and genomics. The packaging of chromatin is hierarchical and its different states are interconvertible depending upon the physiological need of the cell and also contribute in variety of ways to achieve stringent regulation of gene activity. Dynamic nature of chromatin loops is one such mechanism. Technological advances in recent years have provided unprecedented insights into the role of chromatin organization and interactions of various structural-functional components towards gene regulation. The global chromatin

organizer SATB1 has emerged as a key factor integrating higher-order chromatin architecture with gene regulation. Studies in recent years have unraveled the role of SATB1 in organization of chromatin “loopscape” and its dynamic nature in response to physiological stimuli. At genome-wide level, SATB1 seems to play a role in organization of the ‘transcriptionally poised’ chromatin, the part of chromatin that contains genes that are actively involved in specific cellular processes. A major emphasis is on studying epigenetic modifications, the heritable changes that influence gene function without changing DNA sequence. We are particularly interested in studying the implications of these phenomena towards development and differentiation of cells. To accomplish this we use variety of model systems such as cells of the immune system, stem cells and cancer cells.



Model depicting the proposed molecular mechanism for regulation of SATB1 and its functional consequences. In Wnt-ON state, β -catenin levels increase through stabilization. Subsequent to nuclear accumulation of β -catenin, the TCF7L2/ β -catenin complex binds to Satb1 promoter and induces its expression. SATB1/ β -catenin complex binds to Tcf7l2 promoter to maintain its expression. The TCF7L2: β -catenin and SATB1: β -catenin complexes subsequently bind to multiple Wnt responsive genes to induce their expression.

Publications

1. Reddy, P.C., Sinha, I., Kelkar, A., Habib, F., Pradhan, S.J., Sukumar, S. and Galande, S. (2015). *Journal of Biosciences* (Accepted for Publication).
2. Pusalkar, M., Suri D., Kelkar, A., Bhattacharya, A., Galande, S. and Vaidya, V.A. (2015). *Developmental Psychobiology* doi: 10.1002/dev.21365. [Epub ahead of print].
3. Karmodiya, K., Pradhan, S.J., Joshi, B., Jangid, R., Reddy, P.C. and Galande, S. (2015). *Epigenetics & Chromatin* 8:32. doi: 10.1186/s13072-015-0029-1. eCollection 2015.
4. Sawant, A.A., Tanpure, A.A., Mukherjee, P.P., Athavale, S., Kelkar, A., Galande, S. and Srivatsan, S.G. (2015). *Nucleic Acids Research* Sep 17. pii: gkv903. [Epub ahead of print].
5. Reddy, P.C., Unni, M.K., Gungi, A., Agarwal, P. and Galande, S. (2015). *Mechanisms of Development* doi: 10.1016/j.mod.2015.08.005. [Epub ahead of print].
6. Hardikar, A.A., Satoor, S.N., Karandikar, M.S., Joglekar, M.V., Puranik, A.S., Wong, W., Kumar, S., Limaye, A., Bhat, D.S., Januszewski, A., Umrani, M.R., Ranjan, A.K., Apte, K., Yajnik, P., Bhonde, R.R., Galande, S., Keech, A.C., Jenkins, A.J. and Yajnik, C.S. (2015). *Cell Metabolism* 22:312-319.
7. Mir, R., Pradhan, S.J., Patil, P., Mulherkar, R. and Galande, S. (2015). *Oncogene* Jul 13. doi: 10.1038/onc.2015.232.
8. Kulkarni, R. and Galande, S. (2014). *Journal of Visualized Experiments* 93:e52178. doi: 10.3791/52178.
9. Karmodiya, K., Krishanpal, A., Muley, V., Pradhan, S.J., Bhide, Y. and Galande, S. (2014). *Scientific Reports* 4:6076. doi: 10.1038/srep06076.
10. Narlikar, L., Mehta, N., Galande, S., Arjunwadkar, M. (2013). *Nucleic Acids Research* 41:1416-1424.
11. Suri, D., Veenit, V., Sarkar, A., Thiagarajan, D., Kumar, A., Nestler, E.J., Galande, S. and Vaidya, V.A. (2012). *Biological Psychiatry* Dec 10; doi:pii: S0006-3223(12)00950-X. 10.1016/j.biopsych.2012.10.023. [Epub ahead of print].
12. Mir, R., Pradhan, S.J. and Galande, S. (2012). *Current Drug Targets* 13:1603-1615.
13. Burute, M., Gottimukkala, K.P. and Galande, S. (2012). *Immunology & Cell Biology* 90:852-859.
14. Khare, S.P., Habib, F., Sharma, R., Gadewal, N., Gupta, S. and Galande, S. (2012). *Nucleic Acids Research* 40(Database issue):D337-342.
15. Notani, D., Ramanujam, P.L., Kumar, P.P., Gottimukkala, K.P., Kumar-Sinha, C. and Galande, S. (2011). *Journal of Bioscience* 36: 461-469.
16. Jayani, R.S., Ramanujam, P.L. and Galande, S. (2010). *Methods in Cell Biology* 98:35-56.
17. Notani, D., Limaye, A.S., Kumar, P.P. and Galande, S. (2010). *Methods in Molecular Biology* 647:317-335.
18. Vermpati, R.K., Jayani, R.S., Notani, D., Sengupta, A., Galande, S. and Haldar, D. (2010). *Journal of Biological Chemistry* 285:28553-28564.
19. Ahlfors, H., Limaye, A., Elo, L.L., Tuomela, S., Burute, M., Gottimukkala, K., Notani, D., Rasool, O., Galande, S. and Lahesmaa, R. (2010). *Blood* 116:1443-1453.
20. Notani, D., Gottimukkala, K.P., Jayani, R.S., Limaye, A., Damle, M.V., Mehta, S.M., Purbey, P.K., Joseph, J. and Galande, S. *PLoS Biology* 8(1): e1000296. doi:10.1371/journal.pbio.1000296.

Grants

Title: Centre of Excellence in Epigenetics; Source: DBT; Amount: INR 60 million (2010-2015)

Title: Centre of Excellence in Biotechnology; Source: DBT; Amount: INR 7 million (2014-2017)

Title: Indo-Austrian Bilateral program; Source: DST; Amount: INR 0.5 million (2014-2016)

Title: Unit of Excellence in Biotechnology; Source: DBT; Amount: INR 11 million (2015-2018)

Affiliations, Awards and Honors

GD Birla Award-2014 for Scientific Excellence from the KK Birla Foundation

Shantiswaroop Bhatnagar Award-2010 from the Council of Scientific and Industrial Research

Swarnajayanti Fellowship-2007 from the Department of Science and Technology

National Bioscience Award for Career Development-2006 from the Department of Biotechnology

Fellow of the Indian Academy of Sciences, Bangalore, 2010 onwards

Fellow of the Indian National Science Academy, 2012 onwards

Honorary Faculty Member: University of Sydney, Australia (as Affiliate, 2013 onwards)

Editor for the international journal *Genes & Genetic Systems* (2014 onwards)

Institutional Activities

Member, Purchase committee, 2012-2014; Member, Senate, 2014 onwards; Chair, Purchase committee, 2015 onwards; Member, Endowment and Investment committee, 2015 onwards

Current Group Members

PhD Students: Praveena R.L., Rahul Jangid, Rini Shah, Indumathi Patta, Manu Unni, Akhila Gungi, Ankitha Shetty, Ankita Sharma; BS-MS Students: Suyash Naik; Post-Doctoral Fellows: Ashwin Kelkar, Puli Chandramouli Reddy, Satyajeeet Khare, Ameya Sathe, Rafeeq Mir; Project Assistants: Saurabh Pradhan

Students Graduated

PhD Students: Sunita Singh, Kamalvishnu Gottimukkala, Rafeeq Mir

BS-MS Fifth Year Project Students: Soumitra Athavale

Non-IISER / External MS Students who have done a full thesis: Priyasha Mishra, Rachel Paul, Manjiri Bhat, Snehal Nimal, Sweta Singh, Meghna N.C., Tejas Valake

Teaching

BIO 431: Epigenetics (Fall, 2010-2015)

BIO 323: Immunology (Spring 2011-2013)

Biology Practicals (2012-2015)

Outreach

Mentor in nearly 12 INSPIRE internship camps; Popular Science talks in Schools/Colleges and Universities all across the country; Nearly 60 in the past 5 years; Talks and demos at Science Exploratory in Pune: 5





Krishanpal Karmodiya

DST-INSPIRE Faculty Fellow

krish@iiserpune.ac.in; <http://www.iiserpune.ac.in/~krish/>

PhD: Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India

Postdoc: Institut de Génétique et de Biologie Moléculaire et Cellulaire, Strasbourg, France

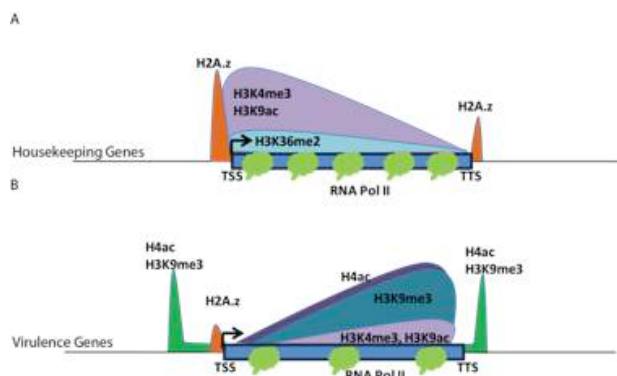
With IISER Pune since September 2012

Epigenetics and Transcriptional Control in *Plasmodium*

Malaria is a major public health problem in many developing countries, with the *Plasmodium falciparum* causing the most malaria-associated mortality. Moreover, the emergence of drug-resistant parasites thwarts efforts to control malaria. One of the major challenges is the identification of new drug targets for efficacious, affordable treatment. Our lab focuses on epigenetic and transcriptional regulation as potential avenues to disrupt the progression of this deadly parasite. To accomplish this, our research combines tools from functional genomics, molecular biology, biochemistry and computational biology to understand the fundamental molecular mechanisms underlying the development of this parasite. The focus is predominantly on the red blood cell stage of development, which is the stage in which all of the clinical manifestations of the malaria disease occur.

Transcriptional regulation and Epigenetics are underexplored area in *Plasmodium falciparum*, which control vital virulence processes such as host cell invasion and cytoadherence. Recently, we have generated high-resolution genome-

wide profiles of several histone modifications and integrated them with publicly available data for histone modifications in *P. falciparum*. Our comprehensive comparative analysis suggests distinct mode of epigenetic regulation in malaria parasite (Figure). Furthermore, for the first instance, we identified H3K36me2 as a global repressive mark in *P. falciparum* and revealed a unique mode of regulation of gene expression by altering the ratio of activation and repression marks. Moreover, virulence genes, which are involved in virulence and pathogenicity, have differential epigenetic signatures as they are prominently regulated by H3K9me3 and H4ac histone modifications, which are absent on other housekeeping genes (Figure). We are also interested in systematic profiling and integrative analysis of chromatin signatures with chromatin modifiers, HATs and HDACs. Our goal is to define the dynamic transcriptional regulatory network of the malaria parasite and to determine which HATs/HDACs are the master regulators governing the various stages of parasite development with the goal of targeting these proteins as a way to develop inhibitors against malaria.



Model depicting differential occupancies of histone modifications and RNA polymerase II regulating transcription of housekeeping (top panel) and virulence (bottom panel) genes in *P. falciparum*.

Publications

1. Rawat, M., Bhosale, M. and Karmodiya K. (2015). *Plasmodium falciparum* epigenome: A distinct dynamic epigenetic regulation of gene expression. *Genomics Data* (in press).
2. Karmodiya, K.[§], Pradhan, S.J., Joshi, B., Jangid, R., Reddy, P.C. and Galande, S. (2015). A comprehensive epigenome map of *Plasmodium falciparum* reveals unique mechanisms of transcriptional regulation and identifies H3K36me2 as a global mark of gene suppression. *Epigenetics Chromatin* 8:32. (¶corresponding author).
3. Karmodiya, K.[§], Anamika, K., Muley, V., Pradhan, S.J., Bhide, Y. and Galande, S. (2014). Camello, a novel family of Histone Acetyltransferases that acetylate histone H4 and is essential for zebrafish development. *Scientific Reports* 4:6076. (¶corresponding author).

Grants

Title: Identification and comprehensive genome-wide analysis of GCN5-containing complex(es) in *Plasmodium falciparum*;
Source: DST-INSPIRE; Amount: Grant-INR 3.5 million and Fellowship-INR 4.8 million (2013-2018)

Title: Characterization and comprehensive genome-wide analysis of histone deacetylase, PfHda1 that may regulate expression of var genes involved in virulence and pathogenicity of *Plasmodium falciparum*; Source: DBT-IYBA; Amount: INR 5.0 million (2015-2018)

Affiliations, Awards and Honors

Innovative Young Biotechnologist Award (IYBA), DBT, 2014, Govt. of India
INSPIRE Faculty Award, DST, 2013, Govt. of India
Member Editorial board, Scientific Reports (Nature Publishing Group), 2015

Institutional Activities

Member, Common Chemicals and Consumable Committee for Biology division (2015)

Students Graduated

Non-IISER / External MS Students who have done a full thesis: Bhagyashree Joshi, Institute of Bioinformatics and Biotechnology, University of Pune; Binithamol K. Polakkatti, Department of Computational Biology, University of Kerala

Teaching

BIO 402: Lab/Theory project (Spring 2013)
BIO 431: Epigenetics (Fall 2013)
BIO 121: Practical: Basic Biology (Fall 2013, 2014, 2015)
BIO 122: Practical: Biochemistry, Genetics and Molecular Biology (Spring 2015)

Outreach

Joy of Learning Summer School: Organized Biology lab session on model organism (May 19 and June 3, 2015)



Current Group Members

PhD Students: Mukul Rawat, Abhishek Kanyal; Project Assistant: Pratima Gurung; Project Trainees: Suyog Ubhe, Madhvi Bhosale; Integrated PhD Rotation Student: Punita Bathla; BS-MS Students: Sameer Jagirdar, Abhishek Anand



Kundan Sengupta

Assistant Professor

kunsen@iiserpune.ac.in; <http://www.iiserpune.ac.in/~kunsen/Welcome.html>

PhD: Tata Institute of Fundamental Research (TIFR), Mumbai, India

Postdoc: National Cancer Institute (NCI), National Institutes of Health (NIH), U.S.A.

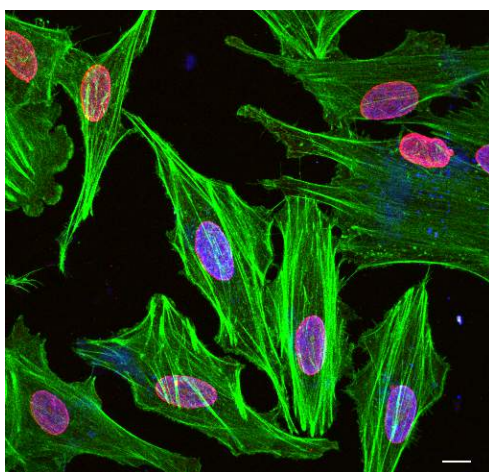
Previous Positions: Research Fellow, NCI/NIH

With IISER Pune since July 2010

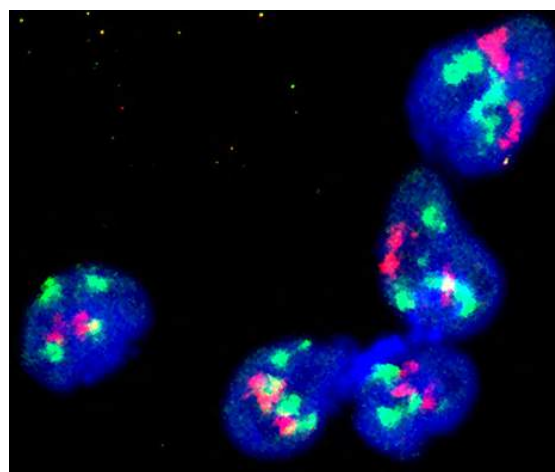
Nuclear Structure-Function Relationships in Cancer

The human genome is non-randomly organized. High-resolution imaging studies have revealed that chromosomes assume a non-random position in the interphase nucleus. Gene rich chromosomes (human chromosome 19) are localized towards the nuclear center, while gene poor chromosomes (Chromosome 18) are closer to the nuclear periphery in human cells. Such an arrangement is strikingly conserved in evolution, strongly suggesting a functional significance. This is further substantiated by Hi-C approaches. Further, looping-out of gene loci from its chromosome territory positively correlates with its gene expression levels. In the nucleus, Lamins serve as docking stations for genes localized towards the nuclear periphery. Lamins are further connected with the cellular cytoskeleton by the LINC complex proteins (EMERIN, SUN/KASH, NESPRINS), which play a pivotal role in

perceiving and relaying external signals into the genome. Cancer cells serve as a useful model to address mechanisms of chromosome territory and gene loci organization in the interphase nucleus. Furthermore, the spatial organization of aberrant chromosomes (chromosomal aneuploidies and translocations) in the interphase nucleus is largely unclear. The focus of our lab is to address the mechanisms that regulate spatial organization of chromosome territories and gene loci in cancer cells and in models of cancer progression in (i) Diploid and aneuploid colorectal cancer cells, cancer cell lines and normal cells (early passage) (ii) Models of cellular differentiation and de-differentiation for example in epithelial to mesenchymal transitions (EMT).



A549 lung fibrosarcoma cells treated with TGF- β show the formation of actin stress fibers in the cell cytoskeleton, Scale bar: ~10 μ m (Image credit: Maithilee Khot, Chromosome Biology Lab, IISER Pune)



A549 lung fibrosarcoma cells treated showing aneuploid chromosome territories 18 (green) and 19 (red) Scale bar: ~10 μ m (Image credit: Maithilee Khot, Chromosome Biology Lab, IISER Pune)

Publications

1. Malwal, R.S., Labade, A., Andhalkar, S.A., Sengupta, K. and Chakrapani, H. (2014). A highly selective sulfinate ester probe for thiol bioimaging. *Chemical Communications* 50:11533
2. Ranade, D. and Sengupta, K. (2013). Nuclear organization of cancer cells. In *Recent Trends in Gene expression*, Mandal, S.S. (Ed.), Nova Science Publishers Inc pp. 133-146
3. Sharma, K., Iyer, A., Sengupta, K. and Chakrapani, H. (2013). INDQ/NO, a bioreductively-activated nitric oxide prodrug. *Organic Letters* 15:2636-2639.
4. Sharma, K., Sengupta, K. and Chakrapani, H. (2013). Nitroreductase-activated nitric oxide (NO) prodrugs. *Bioorganic & Medicinal Chemistry Letters* 23:5964-5967.
5. Paranjape, A.N., Mandal, T., Mukherjee, G., Kumar, M.V., Sengupta, K. and Rangarajan, A. (2011). Introduction of SV40ER and hTERT into mammospheres generates breast cancer cells with stem cell properties. *Oncogene* 31:1896-1909.

Grants

Title: Molecular mechanisms of nuclear structure-function relationships in cancer cells; Source: Wellcome Trust-DBT India Alliance; Amount: INR 34 million (January 2011-January 2016)

Title: Spatiotemporal organization of oncogenes and cancer associated genes in models of cancer progression; Source: Department of Biotechnology, DBT, New Delhi

Affiliations, Awards and Honors

Wellcome Trust-DBT India Alliance Intermediate Fellow (January 2011-January 2016)

Institutional Activities

Co-coordinator of graduate program of Biology Department (Post admission); Committee for monitoring academic progress of undergraduate students (CoMAP)

Students Graduated

BS-MS Fifth Year Project Students: Brajesh Prasad; Suryesh Namdeo

Non-IISER / External MS Students who have done a full thesis: Urvi Thaker; Sumit Pawar; Aishwarya Iyer; Archit Bagul; Amrita Shrivastava; Apoorva Kulkarni

Teaching

BIO 101: Introductory Biology (2011-2015)

BIO 351: Biology & Disease (2013)

BIO 441: Genome Biology (2011, 2013)

Outreach

Experiments in chemistry and biology for school students, February 17, 2012; Outreach program (lab demonstrations in cytogenetics and cell biology for college faculty of Lady Tata Memorial Trust)



Current Group Members

PhD Students: Devika Ranade, Ayantika Sen Gupta, Maithilee Khot, Roopali Pradhan, Ajay Labade, Shalaka Patil; BS-MS Fifth Year Project Student: Sishil Sushanth; Project Assistants: Apoorva Kulkarni, Neelima Vaddadi; Integrated PhD Students: Sushmita Hegde, Rupali Sathe, BS-MS Student: Mithila Unkule

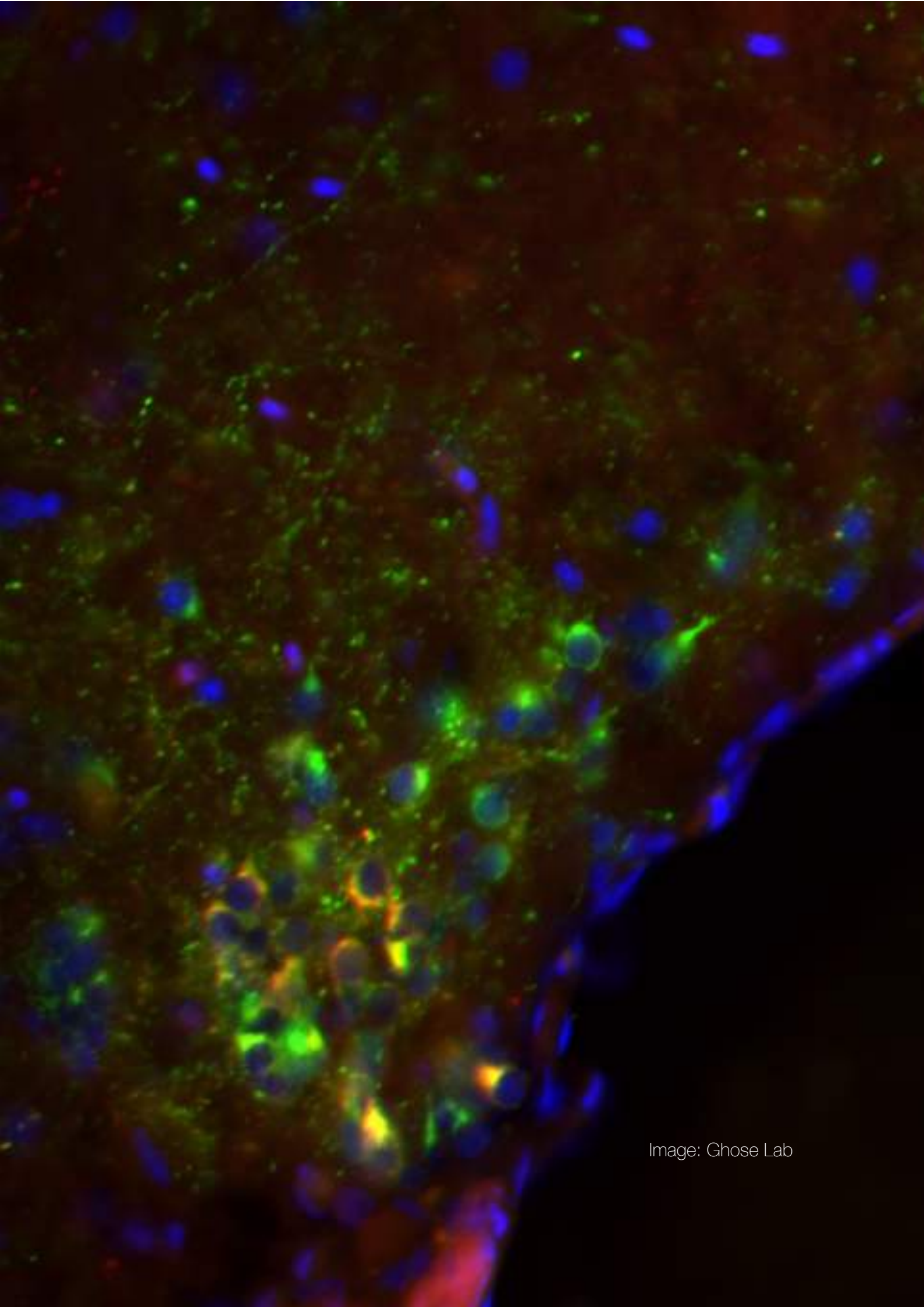


Image: Ghose Lab

Neuroscience and Computational Biology

Nixon Abraham

Collins Assisi

Pranay Goel

Aurnab Ghose

M.S. Madhusudhan

Suhita Nadkarni

Raghav Rajan

Nishikant Subhedar



Nixon M. Abraham

Assistant Professor and Wellcome-DBT India Alliance Intermediate Fellow
nabraham@iiserpune.ac.in; <http://www.iiserpune.ac.in/~nabraham/>

PhD: Max-Planck Institute for Medical Research, Heidelberg, Germany

Postdoc: University of Heidelberg, Germany; University of Geneva, Switzerland

Previous Positions: Radboud Excellence Fellow, Donders Institute, Nijmegen, The Netherlands

With IISER Pune since June 2015

Neural Circuits and Behaviour

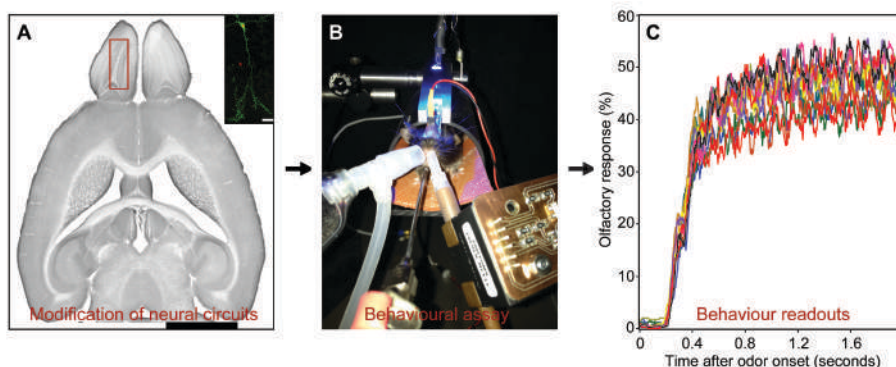
The specific behaviours shown by individuals provide the ultimate read-outs from the brain. These behaviours happen through the interactions of different neuronal circuits and are judged by decisive or non-decisive actions performed by the individual. Our laboratory studies the key question of how different neuronal circuits shape perception and decision-making that leads to well-defined behaviours. We use rodent olfaction as a model and combine the state-of-art automated behavioural training, electrophysiology and optogenetics.

Olfactory decisions: One of our scientific goals is to help unravel the behavioural relevance of genetically identified subsets of neurons in the olfactory pathway. We are aiming to identify the circuit motifs that give rise to olfactory specific behaviours by controlling the neural activity in a cell-type specific manner. Addressing these

questions will further allow creation of novel animal models for brain disorders associated with excitatory/inhibitory imbalance.

Multisensory decisions: The second, and a complimentary, focus of the lab is the neural mechanisms of multisensory decision-making, with a particular interest in understanding the mechanisms how animals combine sensory information across modalities. As most of our decision-making involves the processing of multimodal sensory signals, combining the information coming from the sensory periphery will help us to understand how synergy and redundancy in sensory information across sensory modalities can help to encode the sensory stimulus and create stimulus percept. This work is a collaborative initiative between IISER Pune and Radboud University/Donders Institute in the Netherlands.

From neural circuits to behaviour



Modifications of neural circuits are reflected in animal behaviour

A. Modification of GCs in the OB by direct stereotaxic delivery of viral vectors into the GC layer. Red square shows the Cre recombinase expressing GCs in the OB in comparison to the whole brain (DAB-stained transverse section). Scale bar 2.5 mm. Right upper corner: confocal image of a single GC (Cre expressing, labeled with mGFP). Scale bar 25 μ m; Abraham et al 2010. B. Mouse involved in an olfactory behavioral assay. C. Example traces olfactory responses towards a rewarded odor in a discrimination assay.

Publications

1. Abraham, N.M., Spors, H., Carleton, A., Margrie, T.W., Kuner, T. and Schaefer, A.T. (2004). Maintaining accuracy at the expense of speed: Stimulus similarity defines odor discrimination time in mice. *Neuron* 44:865-876.
2. Abraham, N.M., Egger, V., Shimshek, D.R., Renden, R., Fukunaga, I., Sprengel, R., Seeburg, P.H., Klugmann, M., Margrie, T.W., Schaefer, A.T. and Kuner, T. (2010). Synaptic inhibition accelerates odor discrimination in mice. *Neuron* 65:399-411.
3. Abraham, N.M.,* Guerin, D., Bhaukaurally, K. and Carleton, A.* (2012). Similar odor discrimination behavior in head-restrained and freely moving mice. *PLoS One* 7:e51789 (*Corresponding authors).
4. Abraham, N.M.,* Vincis, R., Lagier, S., Rodriguez, I. and Carleton, A.* (2014). Long term functional plasticity of sensory inputs mediated by olfactory learning. *eLife* 3:e02109 (*Corresponding authors).
5. Gschwend, O.,* Abraham, N.M.,* Lagier, S., Begnaud, F., Rodriguez, I. and Carleton, A. (2015). Neuronal pattern separation in the olfactory bulb improves odor discrimination learning. *Nature Neuroscience* 18(10):1474-1482 (*Equal contribution).

Grants

Title: Wellcome Trust DBT India Alliance Intermediate Fellowship; Source: Wellcome Trust DBT India Alliance; Amount: INR 35 million (5 Years)

Affiliations, Awards and Honors

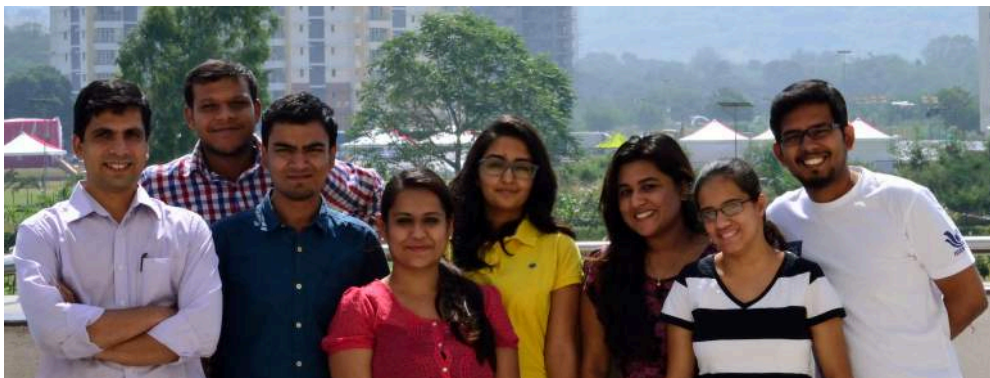
Radboud Excellence Fellowship (An excellence initiative by Radboud University)
Ruprecht-Karls-Prize 2008 (Best PhD thesis award from the University of Heidelberg)
Joachim Siebeneicher Promotions Prize 2008 (Best PhD thesis award from the Faculty of Medicine, University of Heidelberg)

Teaching

Bio 334: Neurobiology I (Fall, 2015)

Outreach

Talks given at different institutions



Current Group Members

PhD Students: Anindya Bhattacharjee; BS-MS Students: Athira D.P.; Project Assistants: Avni Anthony Christian, Sarang Mahajan; Integrated PhD students: Meenakshi Pardasani, Sasank Konakamchi, Shikha Kalra (In rotation)



Collins Assisi

Assistant Professor and Wellcome Trust-DBT India Alliance Intermediate Fellow
collins@iiserpune.ac.in; <http://www.iiserpune.ac.in/~collins>

PhD: Center for Complex Systems, Florida Atlantic University, U.S.A.
Postdoc: Salk Institute and University of California Riverside, U.S.A.

With IISER Pune since August 2012

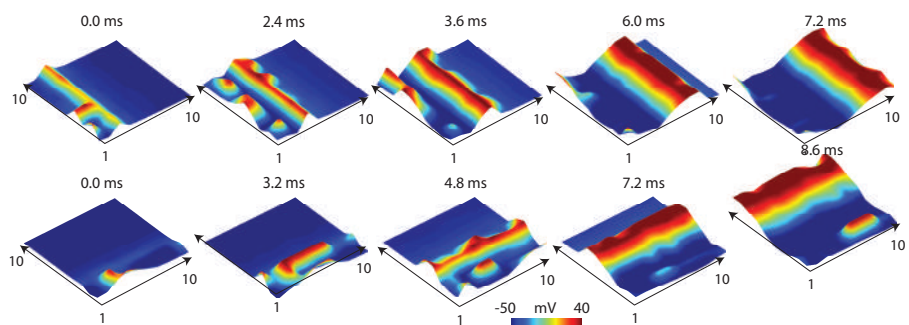
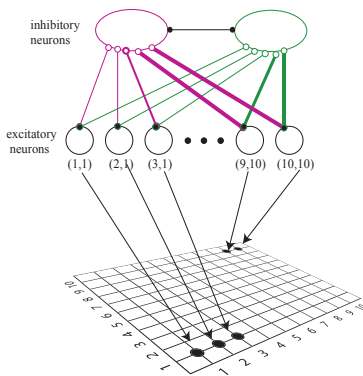
Information Processing by Neuronal Networks

Animals can rapidly detect changes, characterize, and respond to a constantly changing environment. The richness of this milieu is reflected in the variety of dynamic patterns that neuronal networks can generate. The goal of our research is to study how cellular and network properties constrain the generation of these spatiotemporal patterns and determine their functional role in two paradigmatic systems in neuroscience, the hippocampal network and the olfactory system. We construct and simulate detailed and idealized models of neuronal networks to understand the peculiarities of these systems while also abstracting broad principles underlying information processing in the brain.

Spatial navigation As animals navigate the world, they maintain an internal representation of their own spatial location. The ability to do so

has been attributed, in part, to the activity of place and grid cells that respond with higher activity in circumscribed regions of space. As the animal moves through space, groups of these cells are sequentially activated. Retaining this spatial and temporal organization then provides a neural instantiation of the memory of a path traversed. Our lab tries to understand how the structure of the network facilitates the formation of these sequences and their subsequent storage as memory representations.

Olfaction The representation of an odor changes as it traverses multiple layers of the olfactory system. Our research examines mechanisms underlying these transformations and the computational advantages of transforming sensory representations from one layer to the next in the olfactory system.



Hidden metric spaces in neuronal networks. The coloring of the inhibitory network allowed the construction of a metric space in which the complex dynamics of the excitatory population appears as a series of orthogonally propagating traveling waves.

Grants

Title: Role of network topology in the generation of coordinated neuronal activity; Source: Wellcome Trust-DBT India Alliance; Amount: INR 21 millions (2012-2017)

Institutional Activities

Member, IT Committee (since 2012); Member, PhD Committee (since 2013); Member, Daycare Committee (since 2014)

Teaching

Bioinformatics (5 Lectures, Fall 2012)

BIO 202: Biology of Systems (With Aurnab Ghose, Semester 4 Spring 2013, 2014, 2015)

Computational Biology (Spring 2014)

Introduction to Computing (Semester 1, 2 Spring, Fall 2015)

Outreach

Talks at undergraduate and graduate level including Welingkar Inst. of Management and MES Ratnam College

Teaching computation at the Ishaan Vikaas program for school students from the North Eastern states

Talk about the work that led to the 2015 Nobel prize in Physiology and Medicine to John O'Keefe and May-Britt and Edvard Moser at National Institute For Research in Reproductive Health, Parel, Mumbai

Talk about the work that led to the 2015 Nobel prize in Physiology and Medicine to John O'Keefe and May-Britt and Edvard Moser at IISER Pune. Organized by the Science Club.

Taught a short workshop in computational neuroscience to students at IISER Mohali. The module included the Hodgkin-Huxley model and lab sessions using InSilico to model neuronal networks

Conducted two lectures at the SERB School for Neuroscience at IISER Pune

Lecture on 'Navigation and the hippocampus' at Dept. of Bioinformatics, Pune University



Current Group Members

PhD Students: Shivik Garg, Arun Neru and Krishnakanth Baratam; BS-MS Students: Shubham Singh, Abhilash Sawant, Vishnu K.N.



Pranay Goel

Associate Professor

pgoel@iiserpune.ac.in; <http://www.iiserpune.ac.in/~pgoel/>

PhD: University of Pittsburgh, U.S.A.

Postdoc: Mathematical Biosciences Institute, Ohio State University; NIDDK, U.S. National Institutes of Health

With IISER Pune since February 2009

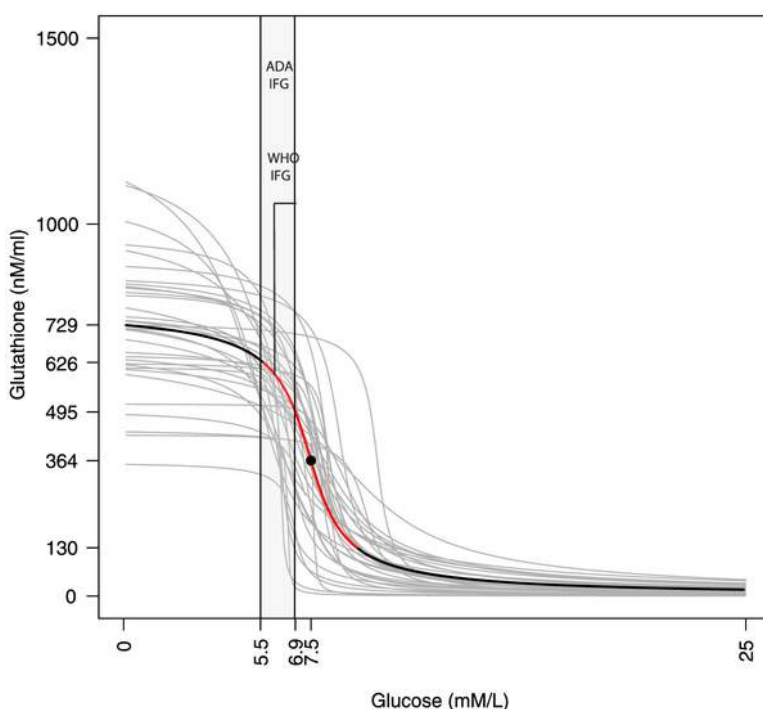
Mathematical Biology

I am interested in understanding the dynamical behavior of biological processes through mathematical modeling. My recent research focuses on oxidative stress in type 2 diabetes.

Glucose metabolism produces reactive oxygen species (ROS) as a natural by-product of respiration. As a corollary: Glycemic stress produces oxidative stress (OS), the un-neutralized, over production of ROS. However, OS is much more than simply a consequence of high glucose. In fact, OS is a central causal factor in the development of insulin resistance. We believe that OS is likely to be responsible for

the very development of diabetes. We study various implications of this phenomenon. For instance, we have shown that in newly diagnosed diabetic patients measuring OS can be used to predict personalized targets of glucose control.

We continue to pursue the study of OS in diabetes. More generally, we believe that biomarkers of oxidative stress hold crucial information regarding diabetic management and therapy and are therefore useful in the diagnostics of anti-diabetic treatment.



The GSH response to glucose reduction is unique to an individual patient. Source: Kulkarni, R., Acharya, J., Ghaskadbi, S., Goel, P. (2014) Thresholds of oxidative stress in newly diagnosed diabetic patients on intensive glucose-control therapy. *PLoS ONE* 9(6): e100897. <http://journals.plos.org/plosone/article?id=info:doi/10.1371/journal.pone.0100897>

Publications

1. Barua, A. and Goel, P. (2016). Isles within islets: The lattice origin of small-world networks in pancreatic tissues. *Physica D* 315:49-57.
2. Goel, P. (2015). Insulin resistance or hypersecretion? The β IG picture revisited. *Journal of Theoretical Biology* 384:131-134.
3. Barua, A., Acharya, J., Ghaskadbi, S. and Goel, P. (2014). The relationship between fasting plasma glucose and HbA1c during intensive periods of glucose control in antidiabetic therapy. *Journal of Theoretical Biology* 363:158-163.
4. Kulkarni, R., Acharya, J., Ghaskadbi, S. and Goel, P. (2014). Thresholds of oxidative stress in newly diagnosed diabetic patients on intensive glucose-control therapy. *PLoS ONE* 9(6):e100897.
5. Kulkarni, R., Acharya, J., Ghaskadbi, S. and Goel, P. (2014). Oxidative stress as a covariate of recovery in diabetes therapy, *Frontiers in Endocrinology* 5(89):10.3389.
6. Goel, P. and Mehta, A. (2013). Learning theories reveal loss of pancreatic electrical connectivity in diabetes as an adaptive response. *PLoS ONE* 8(8): e70366.
7. Goel, P. and Sneyd, J., (2012), Gap junctions and excitation patterns in continuum models of islets. *Discrete and Continuous Dynamical Systems - Series B (DCDS-B)* 17(6):1969-1990.
8. Goel, P. (2012). An introduction to mathematical biology. R. Sujatha, H.N. Ramaswamy, C.S. Yogananda (Eds.), *Math Unlimited: Essays in Mathematics*, CRC Press, USA, 313- 331.
9. Goel, P. and Sherman, A., (2009), The Geometry of Bursting in the Dual Oscillator Model of Pancreatic beta-cells. *SIAM Journal on Applied Dynamical Systems (SIADS)*, 8(4):1664-1693.

Grants

Title: Quantitative characterization of threshold behavior of oxidative stress towards the development of insulin resistance (jointly with Saroj Ghaskadbi, Pune University); Source: Department of Biotechnology; Amount: INR 4.8 million (2014-2017)

Institutional Activities

Member, Library Committee (2 years); Organizer of the NNMCB Internship Program (Pune node) (2014-2015)

Students Graduated

BS-MS Fifth Year Project Students: Varun Karmshetty, Ankita Sharma, Ankit Diwedi, Anand Pathak

Teaching

MTH 324/BIO413: Mathematical Biology (Spring 2015)
MTH 324/BIO413: Mathematical Biology (Spring 2014)
MTH 101: Freshman Calculus (Fall, 2013)
MTH 324/BIO413: Mathematical Biology (Spring 2013)
MTH 419: Ordinary Differential Equations (Spring 2012)
MTH 201: Linear Algebra (Fall 2011)
PHY 342: Dynamical Systems (Spring 2011)
MTH 324/BIO 413: Mathematical Biology (Grad) (Fall 2010)
IDC 103: Introduction to Scientific Computing (Spring 2010)
Mathematical Modelling (Spring 2010)
MTH 324/BIO413: Mathematical Biology (Fall 2009)

Outreach

Organized various national and international conferences; Actively involved in developing and promoting the National Network for Mathematical and Computational Biology (NNMCB)



Current Group Member

PhD Student: Rashmi Kulkarni



Aurnab Ghose

Associate Professor

aurnab@iiserpune.ac.in; <http://www.iiserpune.ac.in/~aurnab>

PhD: Beatson Institute for Cancer Research, U.K.

Postdoctoral experience: Dept. of Cell Biology, Harvard Medical School, U.S.A.

With IISER Pune since January 2008

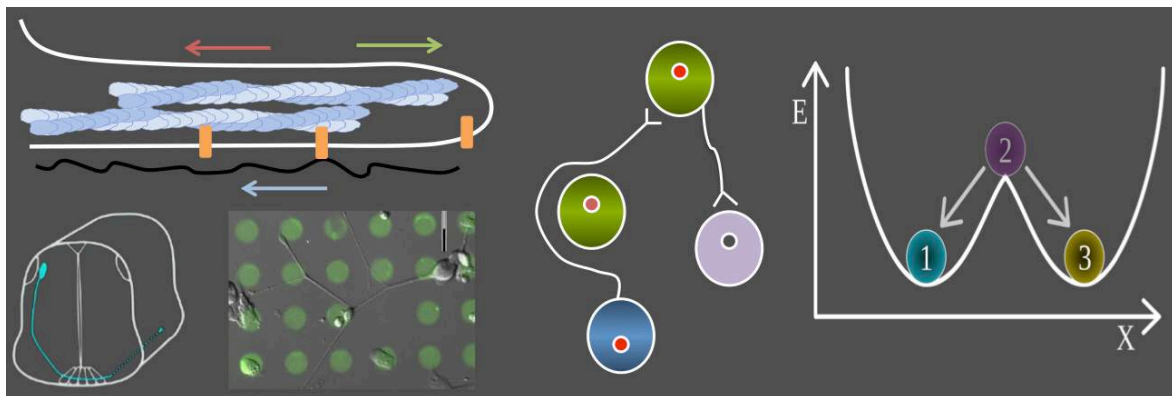
Neural Circuits: Development and Modulation

Development of neural circuits and tuning of their activity/s to issue measured behavioural outputs are the two key questions addressed by our group.

Stereotyped neuronal connectivity is established during development by chemotropic guidance of neuronal growth cones. Instructive remodeling of the neuronal cytoskeleton is central to directed translocation. Using the chick and zebrafish model systems we are investigating novel cytoskeleton regulatory activities in neurons. We have identified Formin-2 (Fmn2), as a new regulator of growth cone dynamics. Fmn2 organizes actin structures necessary for the stabilization and contractility of growth cone filopodia and is required in the development of spinal and hindbrain commissural tracts. In collaboration with Pramod Pullarkat, RRI Bangalore, we are investigating the role of active

axonal tension in the development of neural circuits.

Fine-tuning of neural circuit function is often mediated by peptidergic neuromodulation. Slower biochemical signalling by neuromodulators form an internal representation of interoceptive states. We have identified neuronal groups whose activity is modulated to generate long-lasting, bi-stable states by the opposing action of the CART and NPY neuropeptides in the context of hunger-satiety conditions and predator stress. NPY also tunes olfactory sensitivity of food-associated odorants to the animal's nutritional state. We find, beyond modulation at the first order synapse, NPY signalling directly modulates the sensitivity of the olfactory perireceptors to food cues. This work is in collaboration with N.K. Subhedar, IISER Pune.



Schematic reflecting the laboratory's interest in the development neuronal connectivity and modulation of neural circuit output (centre). Panel to the left summarizes our investigations into growth cone filopodial contractility, axonal pathfinding and neurite tension. The panel to right reflects our studies in neuromodulatory inputs conferring bi-stability in neuronal activity.

Publications

1. Sharma, A., Rale, A., Utturwar, K., Ghose, A.* and Subhedar, N. (2014). Identification of the CART neuropeptide circuitry processing TMT-induced predator stress. *Psychoneuroendocrinology* 50:194-208.
2. Akash, G., Kaniganti, T., Tiwari, N. K., Subhedar, N.K. and Ghose, A.* (2014). Differential distribution and energy status-dependent regulation of the four CART neuropeptide genes in the zebrafish brain. *Journal of Comparative Neurology* 522(10):2266-2285.
3. Sahasrabudhe, A., Vittal, V. and Ghose, A.* (2013) Peeping in on the cytoskeleton: Light microscopy approaches to actin and microtubule organization. *Current Science* 105 (11):1562-1570.
4. Sahasrabudhe, A. and Ghose, A.* (2012) Cytoskeletal remodeling in the establishment of the neuronal circuitry. *IISC Journal* 92(4):403-410.
5. Mukherjee, A., Subhedar, N.K. and Ghose, A.* (2012). Ontogeny of the Cocaine- and amphetamine-regulated transcript (CART) neuropeptide system in the brain of zebrafish, *Danio rerio*. *Journal of Comparative Neurology* 520:770-797.
6. Ghose, A. and Shashidhara, L.S. (2011). Cyclin beyond the cell-cycle: new partners at the synapse. *Developmental Cell* 21(4):601-602.
7. Prakash S., McLendon H.M., Dubreuil C.I., Ghose A., Hwa J., Dennehy K.A., Tomalty K.M., Clark K.L., Van Vactor D. and Clandinin T.R. (2009). Complex interactions amongst Ncadherin, DLAR, and Liprin-alpha regulate *Drosophila* photoreceptor axon targeting. *Developmental Biology* 336(1):10-19.
8. Ghose, A. and Van Vactor, D. (2008). Regulating receptor PTP activity. In R. A. Bradshaw and E. A. Dennis (eds.), *Handbook of Cell Signaling*, 2nd Ed., Oxford: Academic Press, 737-742.

* corresponding author

Grants

Title: Coordination of actin and microtubule dynamics in neuronal pathfinding: A role for Formin-2; Source: DBT; Amount: INR 5.7 million (2010-2013)

Title: Biomechanics of synaptogenesis: The role of mechanical tension (w/ P. Pullarkat); Source: DBT-RGYI; Amount: INR 4.1 million (2010-2013)

Title: Glucosensing mechanisms in the brain of teleost fish: Identification, characterization and physiological significance (w/ N.K. Subhedar); Source: DST; INR 4.2 million (2010-2013)

Title: Nanoscience unit at IISER Pune (multi-PI grant); Source: DST-Nanomission; Indian Rupee: INR 60 million (2009-2014)

Title: Neurobiology of fear: A role for the CART neuropeptide (w/ N.K. Subhedar); Source: DBT; Amount: INR 8.6 million (2011-2014)

Title: Learning and memory in aggression: Identifying neurogenetic substrates in a complex social behavior; Source: DST-CSI; Amount: INR 4.1 million (2013-2016)

Title: Identification and characterization of the CART neuropeptide receptor; Source: LTMT; Amount: INR 1.5 million (2014-2016)

Title: Role of Neuropeptide in zebrafish olfaction; Source: SERB; Amount: INR 4.8 million (2013-2016)

Affiliations, Awards and Honors

Member, Indian Society for Cell Biology (Life)
Member, Indian Academy of Neuroscience (Life)
Member, Society for Neuroscience, USA (Current)
Member, Indian Society for Developmental Biology (Life)
Member, Society for Neurochemistry, India (Life)

Institutional Activities (current)

Member, Institutional Bio-safety Committee (since 2013); Member, Academic Ethics Committee (since 2014); Member, Biology Faculty Applications Screening (since 2010); Member, IISER Pune Biology Postdoctoral Research Associate Selection Committee (since 2013); Co-coordinator, IISER Pune Light Microscopy Facility (since 2010)

Students Graduated

PhD Students: Abhishek Sahasrabudhe
BS-MS Fifth Year Project Students: Nitin Singh Chouhan; Girish Kale; Pasupareddy Rahul; Jagruti Pattadkal; Ajinkya Deogade; Kaniganti Tarun; Beeraka Prashanth Kumar, G. Akash; Ajesh Jacob
Non-IISER / External MS Students who have done a full thesis: Arghya Mukherjee; Rajan DasGupta; Ratnakar Mishra

Teaching

BIO 202: Introductory Biology IV Biology of Systems (2008 - 2016); Coordinator & primary lecturer
BIO 334: Neurobiology I (2009 - 2013); Coordinator & primary lecturer
BIO 491: Literature Review (2013); Coordinator & primary lecturer
BIO 121: Basic Biology Laboratory Course (2014-2015)
BIO 354: Neurobiology II (2010-2013); secondary lecturer
BIO 311: Advanced Cell Biology (2009-2010); secondary lecturer

Outreach

INSPIRE & KVPY camps; Exciting Science program for schools; Refresher courses for college teachers

Current Group Members

PhD Students: Ketake Ghate, Sampada Mutalik, Tanushree Kundu; Aditi Maduskar; Devika Bodas; Dhriti Nagar; BS-MS Students: P.S. Lakshmi, Smita Ghorpade; Research Associate: Abhishek Sahasrabudhe; Project Assistant: Ajesh Jacob; Exchange Student: Christina Wilhauk





M.S. Madhusudhan

Associate Professor and Wellcome Trust-DBT India Alliance Senior Fellow
madhusudhan@iiserpune.ac.in

PhD: Indian Institute of Science, Bengaluru, India

Postdoc: Rockefeller University; University of California at San Francisco, U.S.A.

Previous Positions: Bioinformatics Institute of Singapore

With IISER Pune since 2013

Biomolecular 3D Structure Modeling

The broad aim of our research is to accurately model the 3D structures of proteins and their complexes. To this end, we combine experimental observations, statistical knowledge and the laws of physics to develop computational methods in structural biology. Using the modeled 3D structures, we investigate the function of the modeled proteins/complexes. While the methods are broadly applicable, they are tested on particular systems of interest, often in close collaboration with experimentalists. Our research gives detailed information of cellular processes and hence impacts research on human health, nutrition and biology as a whole. The models we build utilize

spatial restraints, such as distances, angles, volumes etc. that are taken from template structures, extracted from experimental data, deduced using computational tools, or from a combination of the above. Our computational tools identify appropriate sources of spatial restraints (<http://cospi.iiserpune.ac.in/click>) and characterize the local environments and functions of the modeled structures (<http://mspc.bii.a-star.edu.sg/depth>). Besides predicting/modeling the 3D structures of proteins, protein-ligand (small molecule), protein-protein and protein- DNA/RNA complexes, we are now developing methods to design these molecules and complexes.



Our software CLICK compares structures and sub-structures of biomolecules that are structurally similar regardless of topology. Example: two completely unrelated proteins, the transcription factor GCN4 from yeast (PDB code 1ysa) and the type 6 E2 protein from the human papilloma virus (PDB code 2ayg) are superimposed along with their cognate double stranded DNA fragments. The CLICK superimposition shows that these unrelated proteins have common DNA recognition strategies, as observed by the position of the conserved Arginine residues.

1ysa 2A:TCC-TATGAC:10A
2ayg 8B:AATTCGGTTG:17D

30B:GAG-TCATA-GG:39B
1C:GC-A-ACC-GAA:9C

233D:ARNTEAARRSRARKL-Q:248D
292B:ESNCLRCFRYRLNDKHR:307B

Publications

1. Bajaj Pahuja, K., Wang, J., Blagoveshchenskaya, A., Lim, L., Madhusudhan, M.S., Mayinger, P. and Schekman, R. (2015). Phosphoregulatory protein 14-3-3 facilitates SAC1 transport from the endoplasmic reticulum. *Proceedings of the National Academy of Sciences U.S.A.* 112(25):E3199-E3206. PMID: 26056309
2. Neogi, U., Rao, S.D., Bontell, I., Verheyen, J., Rao, V.R., Gore, S.C., Soni, N., Shet, A., Schülter, E., Ekstrand, M.L., Wondwossen, A., Kaiser, R., Madhusudhan, M.S., Prasad, V.R., Sonnerborg, A. (2014). Novel tetra-peptide insertion in Gag-p6 ALIX-binding motif in HIV-1 subtype C associated with protease inhibitor failure in Indian patients. *AIDS* 28(15):2319-2322. PMID: 25102091
3. Tan, K.P., Khare, S., Varadarajan, R., Madhusudhan, M.S. (2014). TSpred: a web server for the rational design of temperature-sensitive mutants. *Nucleic Acids Research* 42(Web Server issue):W277-W284. PMID: 24782523
4. Hotta, K., Ranganathan, S., Liu, R., Wu, F., Machiyama, H., Gao, R., Hirata, H., Soni, N., Ohe, T., Hogue, C.W., Madhusudhan, M.S. and Sawada, Y. (2014). Biophysical properties of intrinsically disordered p130Cas substrate domain-- implication in mechanosensing. *PLoS Computational Biology* 10(4):e1003532. PMID: 24722239

Grants

Wellcome Trust-DBT India Alliance Senior Fellowship (April 2013 - March 2018)

Title: Targeting the purine binding sites, and understanding the protein interactions of the multifunctional dengue virus proteins NS3 and NS5 for discovery and development of novel antivirals; Co-Investigator on NMRC grant IRG11May051 (Singapore) (2011-2014)

Affiliations, Awards and Honors

Adjunct Faculty, Bioinformatics Institute, ASTAR, Singapore (since 2013)

Adjunct Assistant Professor, Department of Biological Sciences, National University of Singapore (since 2008)

Editorial Board: *Biology Direct*

Institutional Activities

Associate Dean of Graduate Studies (2014-onwards); Committee memberships: IISER-Senate; Academic Committee; Joint Admission Committee (2013-2014); IT Committee; Biology Department Post-doc Selection Committee; Faculty Coordinator of Karavaan'15 – IISER Pune student's annual festival

Students Graduated

BS-MS Fifth Year Project Students: Neelesh Soni (2012);

Abhilesh Dhawanjewar (BS/MS 2015); Akash Bahai (BS/MS 2015)

Non-IISER / External MS Students who have done a full thesis: Yogendra Ramtirtha (BS/MS from University of Pune 2014)

Teaching

BIO 314/BIO 637: Bioinformatics course for BS-MS semesters 5/7, Int Phd and PhD students; course coordinator (2015)

MTH 107: Introduction to programming for BS-MS semester 2 students (2015)

BIO 491: Literature Review for BS-MS semesters 6/8, Int Phd and PhD students, course coordinator (2015)



Current Group Members

In Pune: PhD Students: Neelesh Soni; Yogendra Ramtirtha; Post-Doctoral Fellow: Shipra Gupta; BS-MS Students: Akash Bahai; Integrated PhD Students: Neeladri Sen; Project Assistant: Sagar Gore; Scientific Programmer: Parichit Sharma; Visiting Students: Ankit Roy (University of Pune); Rotation Students: Sanjana Nair (Int Phd); Abhinash Palai (BS-MS); Vishrut Patel (BS-MS); Rahul Iyer (BS-MS); Nida Farheen (BS-MS); Sukanya Pandey (BS-MS)

In Singapore: Post-Doctoral Fellows: Minh Ngoc Nguyen; PhD Students: Kuan Pern Tan; Binh Thanh Nguyen



Suhita Nadkarni

Assistant Professor and Wellcome-DBT India Alliance Intermediate Fellow
suhita@iiserpune.ac.in; <http://www.iiserpune.ac.in/~suhita>

PhD: Ohio University, Ohio, U.S.A.

Postdoc: University of California San Diego and Salk Institute, La Jolla, CA, U.S.A.

With IISER Pune since August 2012

Biophysics of Synaptic Transmission and Plasticity

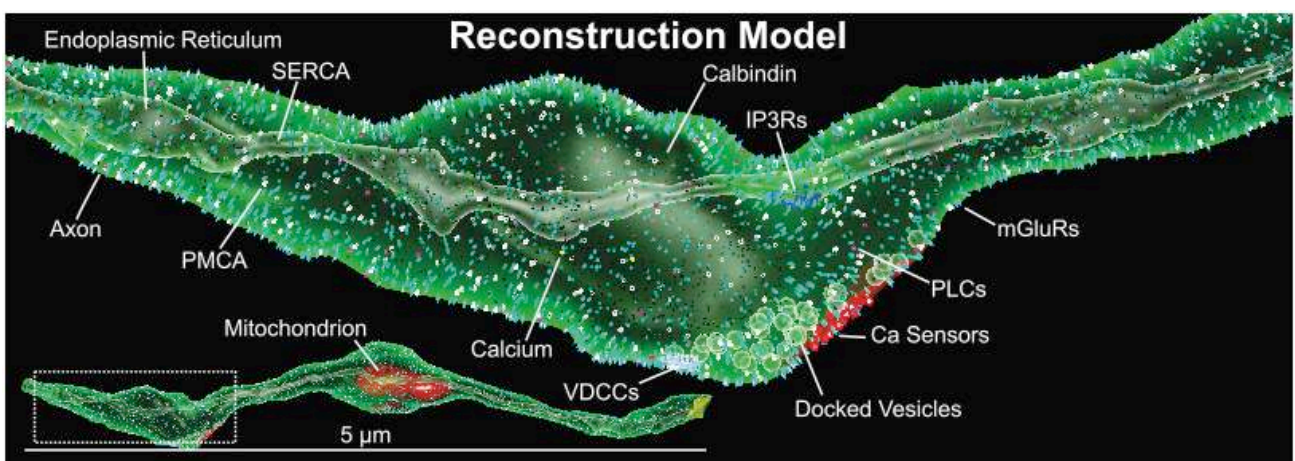
Our broad goal is to understand and quantify signaling pathways involved in synaptic transmission and plasticity and its link to higher-level function in health and disease. The approach in our lab is to devise realistic biophysical computational models of these sophisticated neural components that allow for 'In-Silico' experiments and make testable predictions.

1) Calcium hypothesis of Alzheimer's Disease (AD): Calcium is a key molecule in synaptic transmission that finely orchestrates all forms of plasticity. In an inherited form of AD it is seen that the intracellular calcium signal is modified. This project aims to quantify each of the cascades involved in changing the calcium signal to understand the basis of early cognitive dysfunction in AD.

2) Modeling astrocyte–neuron signaling: Astrocytes, the non-neuronal cells (and often ignored) cells of the brain play an important role in information

processing. These cells release a variety of gliotransmitters like glutamate, Adenosine Triphosphate (ATP) and D-serine in response to neuronal activity ensuring multiple levels of interaction with neurons. This project aims to develop computational models of glutamate and ATP release from astrocytes and investigate its effects on neuronal networks.

3) Computational models of presynaptic plasticity: Long Term Plasticity (LTP) the underlying cellular substrate for learning has been characterized in different parts of the brain however the precise locus (Pre or post synaptic) remains controversial. Most studies focus on postsynaptic processes, partly because direct presynaptic measurements are difficult. There exist no comprehensive computational models of presynaptic LTP. This part of the project aims to quantify various forms of presynaptic LTP and model its functional implications.



Insilico experiments on small hippocampal synapses: Shown here is a presynaptic terminal of a CA3-CA1 synapse in the hippocampus (crucially involved learning and memory). The geometry is reconstructed from serial electron microscope images. Described here are some of the key components of signaling pathways implicated in the disruption of intracellular calcium signaling seen in an inherited form of Alzheimer's disease. Since synaptic transmission and plasticity in small synapses involves small number of molecules moving around in tiny spaces, direct measurements are difficult. Computational simulations of molecular mechanisms in realistic geometries can provide important quantitative insights and be a valuable bridge between experiments and theory. *Reconstruction credits: Kristen Harris, University of Texas, Austin.*

Grants

Title: Investigating the role of intracellular calcium signal remodeling in the pathogenesis of Alzheimer's disease; Source: Wellcome Trust-DBT India Alliance Amount: INR 27.3 million (2012-2017)

Institutional Activities

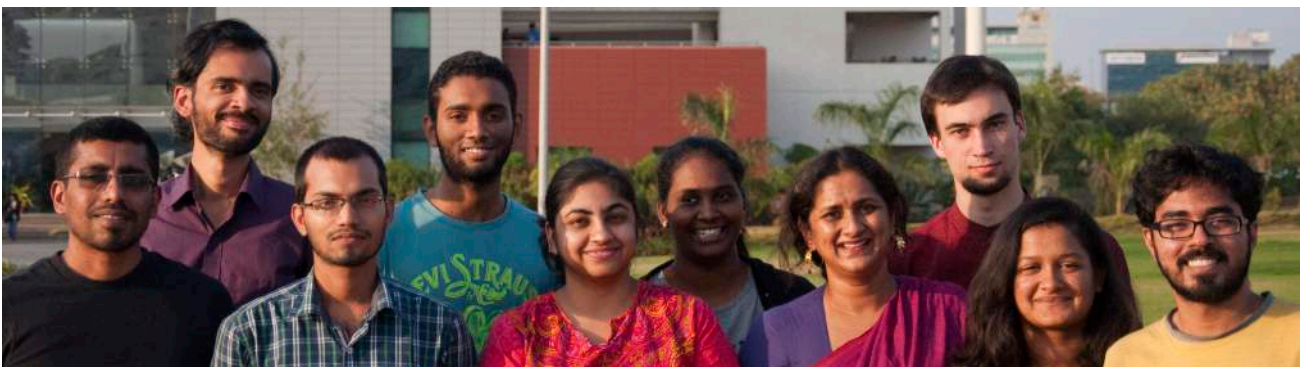
Member, Committee, Integrated PhD (since 2012)
Member, Committee on Student Activities (2014)

Teaching

BIO 334: Neurobiology I (Fall: 2012, 2013, 2014, 2015)
BIO 335: Neurobiology II (Spring: 2013, 2015)
BIO 334: Computational Biology (Spring, 2014)

Outreach

INSPIRE science camp for high school students, Nasik, May 2013
Lecture "Women in Science: A Career In Science" of the (IAS) Academy's panel (WIS) at Karnataka State Women's University (KSWU), March, 2015
Lecture at Third Research Conference for Little Scientists, IISER Pune, June, 2015
Lady Tata Memorial Trust lecture, IISER Pune September 2015



Current Group Members

PhD Students: M. Vidyadhari, Nishant Singh; BS-MS Students: Himanshu Rajmane, Subhadra Mokashe, Pratyush Ramachandra, S. Harini; Post-Doctoral Fellows: Anup Pillai, Gaurang Mahajan; Project Assistants: Rohan Sharma; Visiting Students: Pascal Hecker



Raghav Rajan

Ramalingaswami Fellow

raghav@iiserpune.ac.in; <http://www.iiserpune.ac.in/~raghav>

PhD: National Centre for Biological Sciences, Bengaluru, India

Postdoc: University of California at San Francisco, U.S.A.

With IISER Pune since May 2013

Neural Basis of Ethologically Relevant Behaviors

Animals produce a vast variety of behaviors that are well suited for survival and reproduction in their environment. We are interested in understanding how neural activity mediates the learning and successful execution of such ethologically relevant behaviors.

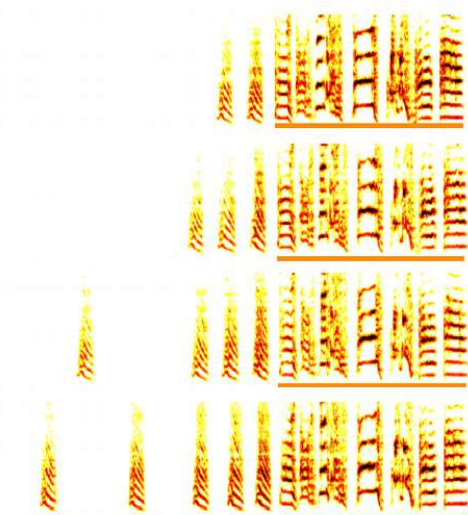
One well-studied example of an ethologically relevant behavior is the song of an adult male zebra finch, a songbird. The song consists of a highly stereotyped sequence of sounds interleaved by silent gaps and forms part of a courtship ritual performed by the male to attract females. While a lot is known about how the brain mediates song production, how song is initiated each time the bird courts a female remains poorly understood.

Each song bout begins with a variable number of introductory elements. We have previously

suggested that these introductory elements represent a process by which the brain gets “ready” to sing. Currently, research in our laboratory is aimed at understanding how introductory elements of zebra finch song are produced and what role they play in song initiation.

To achieve this goal, we use a variety of different techniques: a) electrophysiological recordings of the activity of individual neurons and neuronal populations in the awake singing bird, b) reverse microdialysis techniques to pharmacologically manipulate the activity of neuronal populations during singing and c) behavioral conditioning techniques and preference assays with female birds to examine the contribution of songs towards successful courtship.

Spectrogram representations of the start of 4 different song bouts produced by an adult male zebra finch. In each bout, the orange line shows the stereotyped song sequence (~800ms in duration) consisting of 4 different elements. While the song sequence is highly similar across different song bouts, the number of introductory elements preceding each bout varies from one bout to another. Our lab is currently focused on understanding the neural origins of this variability in introductory element number, each time the bird sings.



Publications

1. Woolley, S.C., Rajan, R., Joshua, M. and Doupe, A.J. (2014). Emergence of context-dependent variability across a basal ganglia network. *Neuron* 82(1):208-223.

Grants

Title: Understanding the neural mechanisms underlying initiation of learned motor behaviors; Source: DBT Ramalingaswami Re-entry Fellowship: INR 3.25 million (5 years)

Affiliations, Awards and Honors

DBT Ramalingaswami Re-entry Fellowship (2013-18); DST Ramanujan Re-entry Fellowship (2013, declined)

Institutional Activities

Member, Library Committee (since 2014); Member, Biology Curriculum Committee (2014-2015); Member, Biology Postdoctoral Selection Committee (since 2015); In-charge, G1/UG Labs (since 2015)

Students Graduated

Non-IISER / External MS Students who have done a full thesis: Sayli Dongre, IBB, University of Pune, Pune

Teaching

BIO 334: Neurobiology I (Fall 2013)
BIO 335: Animal Behavior (Spring 2014)
BIO 121: Practical: Basic Biology (Fall 2014, 2015)
BIO 354: Neurobiology II (Spring 2015)
BIO 301/401: Lab Theory Project (Spring 2015)
BIO 491: Literature Review Module (Spring 2015)

Outreach

Popular Science talk as part of NCL Exciting Science Group series of talks



Current Group Members

PhD Students: Divya Rao, Shikha Kalra; BS-MS Students: Harini S., Prasanth P., Vishruta Yawatkar, Vrushali Rao Gumnur; Post-Doctoral Fellows: Payal Arya; PhD Rotation Students: Aparna Thulasidharan; Project Assistants/Technician: Gaurav Isola, Harsha Koneru, Prakash Raut



N.K. Subhedar

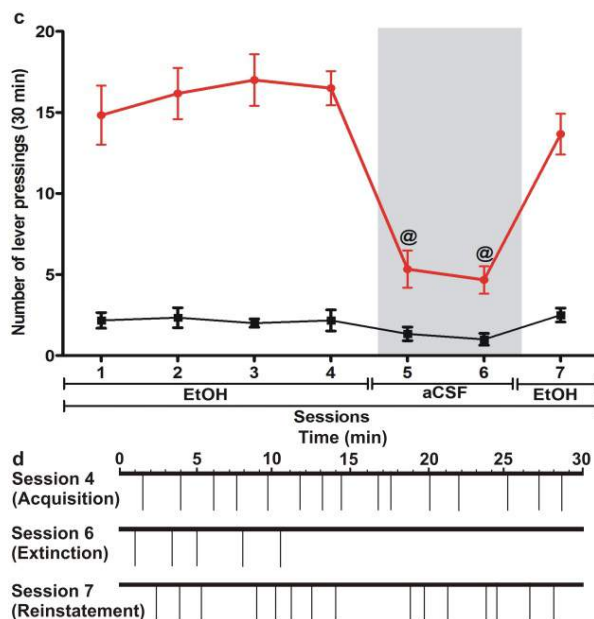
Visiting Faculty
subhedar@iiserpune.ac.in

PhD: Nagpur University, India
Postdoc: University of Hong Kong, Hong Kong; University of Florida, U.S.A.
Previous Positions: Professor of Pharmacology, Department of Pharmaceutical Sciences, Nagpur University, India
With IISER Pune since July 2008

Neuropeptides in Central Processing

Neuropeptides play a critical role in modulating traffic of information in the brain. We investigate the role of neuropeptides in sensory perception, emotive processing and etiology of affective disorders using a range of behavioral models. The neuropeptide CART seems to play an important role in innate fear in the amygdala (studies with Aurnab Ghose), produce anxiety and support spatial learning and episodic memory in the hippocampus (studies with DM Kokare). Our studies also show anti-depressive and anti-Parkinson's activities of the molecule hinting at the clinical potentials of the agent. Using operant conditioning paradigms, we show

that CART plays a critical role in reward and reinforcement. CART cells in the lateral hypothalamus seem to promote reward associated with ingestion of palatable food via its action on the mesolimbic system. The peptide promotes reinforcement associated with drugs of abuse like ethanol, morphine and nicotine. We demonstrate that reciprocal communication between the ventral tegmental nucleus and the locus coeruleus is essential for the ethanol reinforcement. The studies help us to understand the circuitry as well as the neural plasticity underlying addiction.



The rat was trained to press the lever in an operant chamber. With each press, the rat self-infused a measured quantity of dilute ethanol directly in the ventral tegmental area of the brain. The 'addicted' rat was subjected to a 30 min session, each day for 7 days and the lever press activity was recorded (red line). Note that ethanol supported the high self-infusion activity for first 4 sessions, however, it was attenuated in sessions 5 and 6 when ethanol was replaced with artificial CSF. Providing ethanol in the 7th session, reinstated the self-infusion activity. Black line represents pressings of the inactive lever (control with no ethanol). Lower panels are actual lever press events of a representative rat in sessions with (4th and 7th) and without (6th session) ethanol.

Publications

1. Shelkar, G.P., Kumar, S., Singru, P.S., Subhedar, N.K. and Kokare, D.M. (2015). Noradrenergic inputs from locus coeruleus to posterior ventral tegmental area are essential to support ethanol reinforcement. *Addiction Biology* doi:10.1111/adb.12321.
2. Bharne, A.P., Borkar, C.D., Subhedar, N.K., Kokare, D.M. (2015). Differential expression of CART in feeding and reward circuits in binge eating rat model. *Behavioural Brain Research* 291:219-231.
3. Borkar, C.D., Upadhya, M.A., Shelkar, G.P., Subhedar, N.K. and Kokare, D.M. (2015). Neuropeptide Y system in accumbens shell mediates ethanol self-administration in posterior ventral tegmental area. *Addiction Biology* doi: 10.1111/adb.12254.
4. Shelkar, G.P., Kale, A.D., Singh, U., Singru, P.S., Subhedar, N.K. and Kokare, D.M. (2015). Alpha-melanocyte stimulating hormone modulates ethanol self-administration in posterior ventral tegmental area through melanocortin-4 receptors. *Addiction Biology* 20:302-315.
5. Desai, S.J., Bharne, A.P., Upadhya, M.A., Somalwar, A.R., Subhedar, N.K. and Kokare, D.M. (2014). A simple and economical method of electrode fabrication for brain self-stimulation in rats. *Journal of Pharmacological and Toxicological Methods* 69:141-149.
6. Subhedar, N.K., Nakhate, K.T., Upadhya, M.A. and Kokare, D.M. (2014). CART in the brain of vertebrates: Circuits, functions and evolution. *Peptides* 54:108-130.
7. Sharma, A., Rale, A., Utturwar, K., Ghose, A. and Subhedar, N. (2014). Identification of the CART neuropeptide circuitry processing TMT-induced predator stress. *Psychoneuroendocrinology* 50:194-208.

Grants

Title: Glucose sensing mechanisms in the brain of teleost fish: Identification, characterization and physiological significance;
Source: DST; Amount: INR 5 million (2010-2013)

Title: Neurobiology of fear: Involvement of CART neuropeptide:
Source: DBT; Amount: INR 8.6 million (2011-2014)

Affiliations, Awards and Honors

Bursary Award, Royal Society, London (1980)
Olson Prize (2014)

Institutional Activities

Coordinator, Animal Ethical Committee (since 2011)

Students Graduated

BS-MS Fifth Year Project Students: Ajinkya Deogade (jointly with Aurnab Ghose)

Teaching

BIO 312: Animal Physiology I (2008-2015)
BIO 352: Animal Physiology II (2009-2015)
BIO 334: Neurobiology I (2008-2013)
BIO 354: Neurobiology II (2008-2013)

Outreach

Participation in Disha and other outreach activities



Current Group Members

Project Assistants: Ninad Shendye, Abhishek Rale

Outreach Activities

Outreach Activities at IISER Pune

Outreach at IISER Pune reflects its commitment to connect the science it practices to the society at large and its strong sense of social responsibility and concern for environment. The faculty at IISER Pune have been actively



engaged in several outreach activities aimed at not only promoting scientific thinking among students but also addressing many social issues in the local community. Many of these outreach activities involve students at IISER Pune aiming to inspire them to be more socially responsible citizens in their community and nation at large.

Promoting an interest in science among students has been on the national agenda and is supported by programs such as the Kishore

Vaigyanik Protsahan Yojana (KVPY), aimed at identifying students with talent and aptitude for research and helping them take up research careers in science. Faculty at IISER Pune are active participants in the KVPY screening process at multiple levels and also regular contributors to the National Science Camp/Vijyoshi Programme held for KVPY students. These camps aim to introduce students to scientific concepts and research work that labs are engaged in. To foster such a scientific curiosity in students in the local community IISER Pune faculty also regularly engage with students in schools and colleges in and outside Pune, through talks and discussions. Also part of this outreach, faculty from IISER Pune and CSIR-NCL have joined hands to initiate the Exciting Science Program, that along with talks in schools also mentors students for science fair projects, through science clubs in these schools. IISER Pune has also been instrumental in organizing a series of DST-INSPIRE Internship camps. These 5-day residential camps bring together students and scientists from across the country. Students as part of these residential camps not only get a chance to visit labs in IISER Pune but also get a chance to chat informally with scientists about their interests in science and beyond. To take this one step further, the institute also runs an annual IISER Pune

Summer Student Program that gives students the opportunity to spend 2 months in a research lab in IISER Pune. Receiving more than 3,500 applications in 2015, this is a very popular program with students from across the country. For many students, this is their first real research and work experience in a scientific lab and inevitably has a significant impact on their future pursuits.

Science educators inevitably form an important link in communicating the excitement of science to students. Recognizing this, IISER Pune faculties also conduct regular workshops for science teachers from schools and colleges. Along with talks introducing teachers to recent advances in scientific fields and techniques, these workshops also have special practical sessions aimed at giving teachers a closer look at experimental setups in labs. Faculty conducts these sessions with help from graduate students.

With support from faculty, students in IISER Pune are also involved in making the scientific work at the institute more accessible to the general public through a series of talks, quizzes and plays on National Science Day. This open day at IISER Pune sees many (not just students) visit and explore the work that IISER Pune does. IISER Pune students also conduct what has now become one of the more coveted national science quizzes, Mimamsa, that sees participation by student teams from across the

country. Faculty support has also meant that in 2015 IISER students submitted their maiden entry to International Genetically Engineered Machine (iGEM) Competition, winning a bronze medal on debut. These characterize a growing trend in students to think outside the box in exploring and presenting science.

Taking further these educational endeavors to more grass root level are two voluntary organizations at the institute, Disha and Prarambh, run

primarily by the IISER Pune student community in association with faculty coordinators. Disha is a voluntary organization that works toward bringing



quality education to children from underprivileged sections of the local community. Towards this end it runs daily Abhyasika sessions (study circles) at the Sanjay Gandhi Vasahat & Lamanvasti in Pune through the year. Disha also organizes an annual science fest, Vigyan Mela, which brings a broader section of the society in contact with science and provides an opportunity for IISER Pune students to showcase their work as well. Students also take this program to schools in neighboring villages as part of an annual month-long Spread the Smile program. Disha recently also started a Mind Spark program that aims to prepare about 25 selected 6th grade students from 5 different Pune Municipal schools for “7th class scholarship exam” conducted by the state of Maharashtra. Prarambh is a non-profit organization that IISER Pune has been associated with since 2011. Working with similar goals as Disha, Prarambh provides children from the local Ambedkar Basti basic education and skills in Math and English. Prarambh also runs a library for kids that recently secured a grant from Credit Suisse to expand its collection of books. Students coming from this program has gone on to do well in professional courses and one of the students from Prarambh was recently placed in a multinational IT company following her graduation.

Another student initiative at IISER Pune is Prutha, the green club, which works to raise awareness in campus on environmental issues. Prutha regularly organizes cleanliness drives in and around IISER and has been instrumental in ensuring the collection and recycling of plastic and paper waste on campus. To take their message further this year, Prutha as part of the Kirloskar Vasundhara International Film Festival organized the screening of films on issues related to the environment and talks by leading environmentalist in IISER Pune.

Together, these initiatives aim to make students more aware and responsible for their communities and environment, broadening the impact IISER Pune has on society at large.

Relevant Links

<http://www.kvpy.iisc.ernet.in/main/index.htm>; <http://kvpy.iisc.ernet.in/vijyoshi2014/>;
<http://www.excitingscience.org/>; <http://www.inspire-dst.gov.in/internship.html>;
<http://www.iiserpune.ac.in/~sspc/>; http://igem.org/Main_Page; <https://iiserpunedisha.wordpress.com/>;
<https://www.facebook.com/iiserpune.mimamsa.quiz>;
<http://www.iiserpune.ac.in/prarambh/Prarambh/Prarambh.html>;
<http://www.iiserpune.ac.in/outreach/social/prutha-green-initiative>

On Campus Living

Student Life at IISER Pune

Both IISER Pune campus and Pune city offer a vibrant environment to complement the academic pursuits of students. Campus housing and dining facilities are available for all students at quick reach to working and learning spaces of the campus as are the multitude eating out options outside the campus. Students get to interact with the larger scientific community brought together at IISER Pune through the national and international conferences hosted by the institute. Various student clubs at the institute actively organize events related to art, music, drama, dance and sports within the campus. Opportunities for social outreach can be explored through *Disha*, *Prarambh*, and *Prutha* -- outreach initiatives by students and faculty members at the institute.







Getting to Pune

Pune is connected by Air to the major cities across the country. The airport at Lohegaon doubles as an air force base. Pune is also well connected by trains. It is one of the major hubs for the rail network in the western part of the country. Pune is also accessible from Mumbai by road, which is a 3-hour drive. The Mumbai international airport has a regular taxi service to Pune. Regular bus service runs between the two cities as well.



The Cultural Scene

Pune is one of the major cultural centers of the country. Home to several Indian classical music and dance traditions, Pune is also home to many renowned artists. It also hosts a series of annual music festivals ranging from Indian Classical to Jazz. Most notable among these is the annual Savai Ghandharva Music Festival. Pune is also home to the National Film Institute and National Film Archives and hence boasts of a rich celluloid heritage. It also hosts the annual Pune Film festival.



The Western Ghats

The richly biodiverse Western Ghats are mountain ranges that run parallel to the west coast of India. The Sahyadri hill range housing major hill stations such as Matheran, Lonavala-Khandala, and Mahabaleshwar and many other ecological hotspots are within reachable distances to Pune as are some of the spectacular beaches in this part of the country.



Photo/Image Contributions:

Nagaraj Balasubramanian

Deepak Barua

Apurva Barve

Abhinav Parivesh

Girish Ratnaparkhi



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Pune-411008, Maharashtra, India

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Annexure 1

Curriculum



Curriculum in Biology at IISER Pune

The overarching philosophy of the curriculum in Biology stems from one of the primary mandates of the IISERs—to expose undergraduate students to interdisciplinary research in the basic sciences and to provide them with the necessary skills, knowledge and training to pursue successful careers in science.

The first four semesters serve as an introduction to Biology. Keeping in mind the diversity amongst the incoming students in their school education, we introduce all students to the unity and diversity of biology and the hierarchy of organization of biological systems. We emphasize the distinctness of biological systems while demonstrating the continuum from the physical/chemical world to Biology.

The courses in these semesters introduce variation, evolution, diversity and the irreducible complexity of life and biological systems. The unity of life is presented through a thorough description of biology at sub-organismal (reductionist as well as systems view) and organismal levels. At the sub-organismal reductionist level, students are introduced to the building blocks of life (biochemistry and molecular biology), information perpetuation and transfer (genetics), cells as the basic functional unit of life (cell biology) and higher levels of organization (tissue systems and physiology). In terms of the systems view at the sub-organismal level, the students learn about design principles of biological systems (systems biology) and the development of the organism. In organismal biology, students focus on interactions of the organisms with the environment, dynamics of populations/communities and evolution at various temporal and structural scales.

Courses in the third and fourth years cover in greater detail the content introduced in the first two years. Courses such as cell and molecular biology, biophysics and biochemistry, physiology, genetics, biostatistics and evolution and ecology comprise core courses that allow students to obtain a deeper understanding of biology. Advanced courses in areas such as immunology, neurobiology, disease biology, developmental biology, ecology, and epigenetics provide students an opportunity to gain a specialized and comprehensive understanding of those fields.

Building on the foundations in physical, mathematical, chemical and information sciences, the Biology curriculum integrates concepts, examples and techniques from other disciplines. Experts from other disciplines regularly contribute to courses in Biology, and the curriculum emphasizes quantitative and computational applications in biology through courses in mathematical biology, biostatistics, bioinformatics, biophysics, chemical biology and computational biology.

There is a strong emphasis on using current primary literature in the classroom. This ensures a continually updated content, and at the same time, trains students to read, understand, and critically evaluate the primary scientific literature. Participatory teaching techniques such as group learning, assignments and student presentations are actively used.

To encourage research-based learning techniques, our lab courses of the first three semesters are designed with small open-ended experimental modules. Third and fourth year students are encouraged to participate in lab/theory projects in Biology research groups in addition to the classroom-based courses. These provide an opportunity to independently design and carry out laboratory and/or theoretical projects and participate in reading projects, often leading to meta-analysis of published literature in a given field. The goal is to expose students to contemporary research practices and tools including literature reviews, advanced techniques, data collection and analysis, and to scientific writing and presentation.

In the final (fifth) year, students undertake an independent, stand-alone research project. The project can be carried out in any laboratory within or outside Pune. The goal is to develop the technical, analytical and cognitive skills necessary to pursue a career in scientific research. This is the culmination of the training from the previous years and is an opportunity to directly participate in the process of knowledge production in Biology.

List of Courses in Biology

Semester I

1. BIO 101 Introductory Biology I: Basic Principles [3 credits]
2. BIO 121 Biology Lab I: Basic Biology [3 credits]

Semester II

3. BIO 102 Introductory Biology II: Cellular and Molecular Biology [3 credits]
4. BIO 122 Biology Lab II: Biochemistry, Genetics & Molecular Biology [3 credits]

Semester III

5. BIO 201 Introductory Biology III: Evolution and Ecology [3 credits]
6. BIO 221 Biology Lab III: Ecology and Evolution [3 credits]

Semester IV

7. BIO 202 Introductory Biology IV: Biology of Systems [3 credits]

Semester V and VII

8. BIO 301 Lab Training / Theory Project [3 credits]
9. BIO 310 Biostatistics [4 credits]
10. BIO 311 Advanced Cell Biology [4 credits]
11. BIO 312 Animal Physiology II [4 credits]
12. BIO 313 Advanced Molecular Biology [4 credits]
13. BIO 314 Bioinformatics [4 credits]
14. BIO 320 Genetics [4 credits]
15. BIO 322 Biophysics [4 credits]
16. BIO 334 Neurobiology I [3 credits]
17. BIO 353 Immunology II [3 credits] *
18. BIO 401 Lab Training / Theory Project [3 credits]
19. BIO 410 Advanced Biochemistry I [4 credits]
20. BIO 411 Ecology I (Basic Ecology) [4 credits]
21. BIO 420 Developmental Biology [4 credits]
22. BIO 431 Epigenetics [3 credits]
23. BIO 452 Plant Biology II [3 credits] *
24. BIO 454 Structural Biology [3 credits]

Semester VI and VIII

25. BIO 302 Lab Training / Theory Project [3 credits]
26. BIO 321 Plant Biology I [4 credits]
27. BIO 323 Immunology I [4 credits]
28. BIO 335 Animal Behaviour [3 credits] *
29. BIO 351 Biology and Disease [3 credits]
30. BIO 352 Animal Physiology I [3 credits]
31. BIO 354 Neurobiology II [3 credits] *
32. BIO 402 Lab Training / Theory Project [3 credits]
33. BIO 412 Microbiology [4 credits]
34. BIO 413 Mathematical Biology [4 credits] *
35. BIO 417 Advanced Biochemistry II [4 credits] *
36. BIO 422 Evolution [4 credits]
37. BIO 423 Ecology II (Advanced Ecology) [4 credits] *
38. BIO 435 Biophysics II [3 credits] *
39. BIO 441 Genome Biology [3 credits] *
40. BIO 442 Computational Biology [3 credits] *
41. BIO 491 Literature Review [3 credits]

* Courses offered once in two years

Details of Courses in Biology

BIO 101	Introductory Biology I: Basic Principles	3 credits
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Introduction: Students attending this course need not have taken biology at the HSC level. The course is intended as an introduction to the main conceptual framework of biology as a science, outlining the diversity, organization and fundamental principles of living systems.

Content:

Module 1: Introduction: What is biology: Salient features of life; Importance of biology on the frontiers of science and technology; Brief history of biology; How plants, animals and microorganisms shaped human history.

Module 2: The logical structure of biology: concepts of complexity, emergent properties, adaptation, optimality, diversity, chance and necessity, structure-function relationship, theme and variations, individual variability and plasticity; Nature of experimentation in biology and statistical inference.

Module 3: Broad overview of life on earth, origin and progression of life on earth, Evolution, concept of adaptive versus neutral evolution; classification/taxonomy and phylogeny; Molecular relationships between life forms.

Module 4: Biological information: Nature of biological information; Mechanisms of transmission of information: genetic, epigenetic, cultural and other mechanisms of inheritance; Central dogma of molecular biology.

Module 5: Mechanism of perpetuation of life at molecular, cellular, organismal and population levels.

Recommended Reading:

1. Principles of Biology: Interactive textbook from Nature Education
2. Biology: N. Campbell and J. Reece (2005) 7th edition, Pearson, Benjamin, Cummings

BIO 102	Introductory Biology II: Cellular and Molecular Biology	3 credits
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Introduction: This course aims to introduce you to several important facts and fundamental concepts in biology. It is aimed to give you an insight on how organisms work at the single and multicellular levels (cellular aspects) by initially providing a molecular framework to understand the basic inter-molecular interactions (biochemical aspects) that drive underlying cellular processes. This course, more than anything, hopes to spark your imagination and thinking about how biological systems function and are regulated.

Content: This course will cover a wide range of topics starting with the very basic molecules necessary for life (water) and go on to discover the structure, function and interrelationships between all important biomolecules (like proteins, carbohydrates, nucleic acids and lipids) that collectively carry out the essential functions of life. We will then move higher on the complexity scale to understand the principles underlying cellular organization and talk about the development of cell theory, cell types: prokaryotes vs. eukaryotes, single cell to multi-cellular organism. We will study cell structures, beginning with the cell envelope of bacteria, plant and animal cells, cell membranes and their properties and structure of the cell membrane. We will also discuss the cellular cytoskeletal components, actin, microtubules and microfilaments and motor proteins. Moving on, we will study the endomembrane system (endoplasmic reticulum, Golgi complex, endosomes, lysosomes), cell nucleus and chromatin structure. We will also look at how cells use many of the above components and processes to talk to each other and the environment. Finally, we will briefly discuss the central dogma of life, looking at DNA replication, mitosis and meiosis, RNA, transcription and translation.

Recommended Reading:

1. Biochemistry: D. Voet, and J.G. Voet (2010), 4th edition, Wiley
2. Harper's Illustrated Biochemistry: R. Murray, V. Rodwell, D. Bender, K.M. Botham, P.A. Weil and P.J. Kennelly (2009) 28th edition, McGraw Hill-Medical
3. Biology: N. Campbell and J. Reece (2005) 7th edition, Pearson, Benjamin, Cummings
4. Biology: P.H. Raven, G.B. Johnson, J.B. Losos and S.R. Singer (2005) 7th edition, McGraw Hill
5. Molecular Biology of the Cell: B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2007) 5th edition, Garland Science

BIO 121	Biology Lab I: Basic Biology	3 credits
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Content: This practical course will cover basic concepts in biology, cell biology and cell culturing techniques with an emphasis on 3D's in biology – draw, describe and differentiate. Experiments include: Basics of microscopy; Field trip; Microscopy of samples; Micrometry of different cells; Staining of bacteria, fungi, Plant cells, Blood cells and Bone marrow; Osmosis; Mitosis; Crude cultures – Bacteria and Protozoa; Pure culture techniques; Sterilization and media preparation; Streaking of bacteria; Enumeration of bacteria.

BIO 122	Biology Lab II: Biochemistry, Genetics and Molecular Biology	3 credits
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Content: This practical course will cover biochemical, genetic and molecular basis of life. Experiments include: Glucose estimation; Lipid estimation; Amino acid Paper chromatography; Protein estimation; Enzyme assay and Kinetics; Human genetic traits and blood grouping; DNA isolation; DNA estimation; Transformation; Plasmid isolation; Agarose gel electrophoresis; Restriction digestion and Ligation; PCR demonstration; ATC PTC demonstration; Animal handling, inoculation, dissection.

BIO 201	Introductory Biology III: Evolution and Ecology	3 credits
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Introduction: This is an introductory course that would help the students in terms of A) understanding of: 1) the basic concepts in ecology and evolution, 2) how organisms interact with each other, and the environment, to form various patterns of distribution and behaviour, and 3) the modes of inquiry in the investigation of ecological and evolutionary questions; and B) ability to: 1) visualize how these concepts connect to real-life situations, and 2) investigate questions in classical genetics, ecology and evolution using the modes of inquiry in (A 3), as well as in biology/science/academic inquiry in general.

Content: Introduction: An overview of biological processes; Why study ecology and evolution?

Population ecology: Survivorship curves, Life-tables, Simple population dynamics models and their behavior, Spatial ecology.

Life history evolution: Basic concepts; Community ecology/ Species interaction: Competition; Predation; Ecosystem dynamics: Food webs; biodiversity; conservation biology; Classical Genetics: Mendel's laws, linkage; Population genetics: H-W equilibrium; mutation; selection; genetic drift; inbreeding

Macroevolution and diversity of life: Macroevolutionary concepts: reproductive isolation, speciation

Recommended Reading:

No single text book can be prescribed. The following books shall cover much of the proposed syllabus:

1. Ecology - From Individuals to Ecosystems: M. Begon, C.R. Townsend, and J.L. Harper (2005) Blackwell Publishing
2. Ecology Concepts and Applications: M.C. Molles (2009) McGraw Hill
3. Evolutionary Analysis: S. Freeman, and J. Herron (2004) 4th edition, W. Prentice Hall

BIO 202	Introductory Biology IV: Biology of Systems	3 credits
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Introduction: Biological systems are elaborate machines with parts that interact in surprising ways. This course can be envisaged as the antithesis of reductionism. Rather than take the biological machine apart, we will try to put it together and demonstrate that the properties that emerge are often more than a sum of its parts. Using thematic examples from subcellular to organismal scales, we will try to derive organizational principles that mediate interactions between components. The course will introduce quantitative methods necessary to develop a systems perspective.

The goal of the course is to build from the previous introductory courses, introduce the concept of complex systems and demonstrate that by probing the design principles of complex biological systems one can begin to address the following:

What are the engineering constraints operating in biological systems?

How do biological systems achieve robustness?

How does complexity emerge from simple interactions?

How are biological systems optimized for efficiency?

Content: Introduction to complex systems; Emergent properties and evolution of biological complexity; Signal transduction; Gene regulation and gene regulatory networks; Network motifs; Fertilization and organismal development; Pattern formation; Reaction-diffusion; Evolution of body plans; Regeneration and stem cells; Physiology and models of the immune system; Physiology and models of the nervous system; Oscillation in biology.

Recommended Reading:

1. Molecular Biology of the Cell: B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2002) 4th edition, Garland Science
2. Principles of Development: L. Wolpert, J. Smith, T. Jessell, P. Lawrence, E. Robertson and E. Meyerowitz (2006) 3rd edition, Oxford University Press
3. An Introduction to Systems Biology: Design Principles of Biological Circuits: U. Alon (2006) 1st edition, Chapman & Hall/CRC
4. Mathematical Biology: J.D. Murray (2007) Vol. I. 3rd edition, Springer

BIO 221 **Biology Lab III: Ecology and Evolution** **3 credits**

Content: This practical course will cover basic concepts in ecology and evolution. Practicals include: Evolution of Ethnocentrism; Isolation of organisms; Global Population Dynamics Database; Plant Biodiversity field work; Growth curve (Factorial design 3 pH × 2 temperatures); Effect of nutritional selection on bacterial growth; Chemical ecology and its impact on diatom diversity; Behavioral Ecology.

BIO 301/302 **Lab Training/Theory Project** **3 credits**

The larger objective of this course is to encourage students to participate in ongoing research at IISER. This may be in the form of a reading/literature review/theoretical and computational project/lab based research project.

The student has to identify, talk to and mutually agree on a research project with a faculty member before registering for this course. The scope, duration, structure, expectations, and evaluation criteria for the course are decided by the project supervisor.

BIO 310 **Biostatistics** **4 credits**

Introduction: The course introduces biologists to probability and statistics with a strong emphasis on using computer simulation of random number distributions to understand the importance of statistical analysis.

Content: Statistical measures, Probability: Basic concepts, distribution functions, change of variables; Fitting data: fitting functions, goodness of fit, correlation, regression, smoothing, interpolation, extrapolation; Statistical tests: Parametric and non-parametric tests, null hypothesis, statistical significance, confidence intervals, Type I and II errors, ANOVA, multiple testing; Time series analysis: Correlation, periodicity.

Recommended Reading:

1. Biometry: The Principles and Practice of Statistics for Biological Research: R.R. Sokal and H.A. Rohlf (1995) 3rd edition, W.H. Freeman
2. Biostatistical Analysis: J.H. Zar (1998) 4th edition, Prentice Hall

BIO 311 **Advanced Cell Biology** **4 credits**

Introduction: This course will provide a detailed insight into advanced concepts of cellular structure and function. It also aims to give you a sense of the complex regulatory mechanisms that control cell function.

Content: This course covers a wide range of advanced cell biology topics discussing in some detail membrane structure, transport, intracellular compartments, protein sorting and vesicular traffic. It will also discuss the cell cycle and cell division. Finally we will be looking at mechanisms of cell

communications, cell junctions and adhesion to the extracellular matrix, looking at the role and regulation of the cytoskeleton and motor proteins and also see how many of these process work together to drive cell migration. This course will also provide an introduction to the types and role of mechanical forces in cells. www.iiserpune.ac.in/~nagaraj/Bio311_Adv_Cell_Bio.html

Recommended Reading:

1. Molecular Biology of the Cell: B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2007) 5th edition, Garland Science
2. Molecular Biology of the Gene: James Watson et al., (2007) 6th edition, Benjamin Cummings
3. Molecular Cell Biology: H. Lodish, A. Berk, C.A. Kaiseretal (2007) 6th edition, W.H. Freeman
Reviews recommended on the course website

BIO 312	Animal Physiology I	4 credits
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Introduction: The course aims at imparting in-depth knowledge of the human physiology. The rationale is to provide an insight into the various organ systems, their functions, interactions, regulation and pathology. The course will also include a lab-work and demonstrations of the live systems using fish models and histological preparations. The course material will be useful to any undergraduate who is keen to understand the physiological process and will help to broaden the understanding of biological processes.

Content: Skeletal and smooth muscle systems, human cardio-vascular system and blood, excretion and regulation of the body fluids, gaseous exchange, transport and tissue respiration, physiology of digestion and gastrointestinal hormones, endocrines and reproduction.

Recommended Reading:

1. Textbook of Medical Physiology: A.C. Guyton, J.C. Hall (2008) Elsevier-Saunders
2. Williams Textbook of Endocrinology: H.M. Kronenberg et al. (2008) Saunders
3. Eckert Animal Physiology: D.J. Randall et al. (2002) W.H. Freeman
4. Comparative Animal Physiology: P.C. Withers et al. (2001) Brooks Cole
5. Animal Physiology: R.W. Hill, G.A. Wyse and M. Anderson (2008) Sinauer Associates

BIO 313	Advanced Molecular Biology	4 credits
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Introduction: This course will provide fundamental concepts from this enormous and ever-growing field of Molecular Biology to undergraduate students. This course will help students to have a sound knowledge of molecular biology, which will also enable them to carry out research using molecular biology techniques.

Content: This course covers a detailed analysis of the molecular mechanisms that control the maintenance, expression, and evolution of prokaryotic and eukaryotic genomes. The topics covered in lectures and readings of relevant literature include maintenance and expression of the genome including DNA replication, mutability and repair of DNA, genetic recombination, gene regulation, transcription, RNA splicing and translation. In particular, the logic of experimental design and data analysis is emphasized in particular molecular cloning methods and tools for studying gene and gene activity.

Recommended Reading:

1. Molecular Biology of the Gene: J.D. Watson, T.A. Baker, S.P. Bell, A.A.F. Gann, M. Levine and R.M. Losick (2007) 7th edition, Benjamin Cummings
2. Molecular Biology: Weaver (2011) 5th edition, McGraw-Hill Science
3. Principles of Gene Manipulation: S.B. Primrose, R. Twyman and R.W. Old (2002) 6th edition, Wiley-Blackwell
4. Molecular Biology and Genomics: C. Mulhardt (2006) 1st edition, Academic Press

BIO 320	Genetics	4 credits
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Introduction: The goal of this course is to build upon Basic Genetics, which the students learnt in their high school and the first few semesters at IISER Pune. This course is designed to revise basic concepts

and then move on to advanced concepts. A strong emphasis will be laid on modern tools and techniques as also the utility of model organisms, which are the workhorses of the science of genetics. The course is taught with a historical timeline, introducing concepts in genetics as they occurred over time.

Content: A Refresher Course for Mendelian Genetics, Non-Mendelian Genetics: Linkage, Incomplete Dominance, Maternal Inheritance, Extra-nuclear inheritance, Sex-linked inheritance, Sex determination, Dosage Compensation, Epigenetics, Genomic imprinting. The Chromosomal basis of inheritance. Genomes, genomics and the Dynamic Genome. The Genetics of Bacteria and Bacteriophages. Bacterial transposons. Vertical and Horizontal gene transfer. Transformation, Transfection & Transduction. Genetic Complementation. Genetic Mapping. Genetic screens as a basis for functional genomics. Deficiencies, EMS & X-ray based mutagenesis screens. Creating alleles. Enhancer traps, EP-Lines, RNA-inheritance, FLP-FRT & Cre-Lox Systems. Nusslein-Volhard & Weischaus Zygotic and Maternal Screens. Gene isolation Manipulation and the techniques that revolutionized modern genetics Working with Nucleic Acids and Proteins. Polymerase Chain Reaction. DNA Sequencing, Southern, Western & Northern Blots. In-situ Hybridization, FISH, SNP's, RFLP's, EST's, STS & Oligonucleotide Arrays. Gene Cloning vs. Animal Cloning, Nuclear transplantation, stem cells & iPS cells. The utility of the following Model Organisms will be discussed: *Escherichia coli*, *Arabidopsis thaliana*, *Caenorhabditis elegans*, *Drosophila melanogaster* & *Mus Musculus*. In addition to the lectures the course will include student presentations on famous geneticists and a book review or an essay.

Recommended Reading:

1. Introduction to Genetic Analysis: A.J. Griffiths et al. (2008) 9th edition, W.H. Freeman
2. Reviews and Essays provided by the Coordinator
3. The Selfish Gene: R. Dawkins (1976) Oxford University Press

BIO 321

Plant Biology I

4 credits

Introduction: The objective of this course is to acquaint students with the fundamentals of plant biology, evolution of land plants, plant architecture, growth & development (signal perception & transduction), phytohormones and their functions. For every topic, information from the molecular level to physiological level will be discussed. This course will also help the students to acquire basic knowledge about plant's life. The students will have an in depth understanding to follow the contemporary research in basic and applied plant sciences.

Content: Introduction to land plants, evolutionary history of plants; plant cell and plasmodesmata, tissue organization; photosynthesis- light and dark reactions, molecular mechanisms, ecological considerations; respiration; lipid metabolism; water transport and mineral nutrition; translocation in the phloem, macromolecular (RNA/Protein) transport, transporter genes; plant hormones (biogenesis and mode of actions); plant growth and development, embryogenesis, pattern formation, stem cells & Shoot Apical Meristem (SAM) architecture; the control of flowering, ABC models, molecular mechanisms; photoreceptors and light control of plant development.

Recommended Reading:

1. Plant Physiology: L. Taiz and E. Zeiger (2010) 5th edition, Sinauer Associates Inc
2. Biochemistry and Molecular Biology of Plants: B. Buchanan et al. (2002) American Society of Plant Physiologists (ASPP)
3. Physiology and Behavior of Plants: P. Scott (2008) 1st edition, Wiley Publishers
4. Plant Biochemistry: H.W. Heldt and B. Piechulla (2010) 4th edition, Wiley Publishers

BIO 322

Biophysics I

4 credits

Introduction: Students will be introduced to the new and interdisciplinary field of physical biology of the cell. This topic is at the intersection of physics and biology, with connections to mathematics, physical chemistry and cell physiology.

Content: Order of magnitude physics applied to biology, molecular biophysics, cellular biophysics, physics in development, and biophysical techniques with special emphasis on light in biology.

Laboratories will be conducted for measuring molecular thermodynamics of biological macromolecules, quantifying cellular dynamics and measuring diffusion.

Recommended Reading:

1. Biological Physics: Energy, Information, Life: P. Nelson (2003) W.H. Freeman
2. Physical Biology of the Cell: R. Phillips, J. Kondev and J. Theriot (2008) Garland Sciences
3. Biological Physics of the Developing Embryo: G. Forgacs (2005) Cambridge University Press

BIO 323	Immunology I	4 credits
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Introduction: Immunology (BIO 323) is a 4 credit-hour lecture course that will acquaint you with the molecules, cells and organs of the immune system. You will learn about the structural features of the components of the immune system as well as their functions, but the primary emphasis of this course will be on the mechanisms involved in immune system development and responsiveness. This course is essentially a series of lectures highlighting basic concepts in immunology.

Content: Development of the immune system, innate immunity, immunoglobulin structure and genetics, antigen-antibody reactions, the major histocompatibility complex and antigen presentation, T cell receptors (genetics, structure, selection), T cell activation and effector functions, adhesion molecules, immune responses to infections organisms and tumors, autoimmune diseases, allergies, immune deficiencies and AIDS. The major experiments that allowed the elucidation of various mechanistic features of the immune system will be featured to help you understand how immunologists think and work towards unraveling such complex interplay of molecules and cells.

Recommended Reading:

1. Janeway's Immunobiology: K.M. Murphy, P. Travers and M. Walport (2007) 7th edition, Garland Science
2. Kuby Immunology: T.J. Kindt, B.A. Osborne and R.A. Goldsby (2006) 6th edition, W.H. Freeman

BIO 334	Neurobiology I	3 credits
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Introduction: The course introduces neuroscience as a specialized discipline. The overarching goal of the course is to provide a detailed description of the logic of the nervous system from the perspectives of evolution, organization, development, physiology and its emergent properties. The course is aimed at students interested in understanding the fundamental basis of the neural function and those interested in pursuing neuroscience in the future.

Content: Evolution and organization of the nervous system; electrical properties of neurons; ionic basis of membrane potentials and the action potential; synaptic transmission and neurotransmitters; development of the nervous system; experience-dependent synaptic refining & plasticity; introduction to Hebb's postulate and learning and memory.

Recommended Reading:

1. Principles of Neural Science: E. Kandel et al. (2000) 4th edition, McGraw-Hill Medical
2. Neuroscience: M. Bearet al. (2006) 3rd edition, Lippincott Williams & Wilkins
3. Development of the Nervous System: D. Saneset al. (2005) 3rd edition, Academic Press
4. Foundations of Cellular Neurophysiology: D. Johnstonand S. Wu (1994) 1stedition, MIT Press

BIO 335	Animal Behaviour	3 credits
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Introduction: This course provides an introduction to theories and methodologies in the study of animal behaviour. During the course, students gain first-hand experience in both reading and critiquing scientific studies, and in designing and carrying out methodical studies in behaviour. Many of the classes revolve around discussions of scientific papers, calling for active student participation. This course is especially relevant to students interested in ecology and evolution, and generally to any student of biology.

Content: Research methodologies. Proximate and ultimate causes of behaviour. Evolution of behaviour, adaptationism, genetic and cultural inheritance. Individual and social learning, cognition. Behavioural ecology of foraging, group living, sociality, movement, mating, parental care, aggression, interspecific interactions: theories and empirical tests. Evolution of cooperation and communication.

Recommended Reading:

1. Principles of Animal Behaviour: L.A. Dugatkin (2004) W.W. Norton & Co
2. An Introduction to Behavioural Ecology: J.R. Krebs and N.B. Davies (1993) Blackwell Publishing
3. Animal Behaviour: J. Alcock (2009) Sinauer Associates

BIO 351	Biology and Disease	3 credits
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Introduction: Objectives of this course are to 1) integrate the biology (cell, molecular and physiology) taught so far, 2) develop insights into biology revealed by the disease condition, and 3) teach technology development and translation prompted by the disease condition. Cancer, neurodegenerative disorders, infectious diseases, disorder of the cardiovascular system and genetic diseases will be studied.

Content: What is Cancer and profile of a cancer cell; causes of cancer and how it spreads; molecular biology of cancer; What is neurodegeneration and biology of the disease; molecular basis of neurodegenerative disorders; Major types of heart diseases and their causes; review some of the methods for detecting and investigating heart disease; How genetic traits are inherited; effects of single gene mutations; types of chromosomal mutations; ways in which single gene mutations are treated; Types and symptoms of some common infectious diseases; outline preventive measures; general effects of antibiotics on infectious organisms, discuss some general aspects of the management and treatment of specific infectious diseases.

Recommended Reading:

1. Biology of Disease: N. Ahmed, M. Dawson, C. Smith and E. Wood (2006) 1st edition, Taylor & Francis
2. One Renegade Cell: The Quest For The Origin Of Cancer (Science Masters): R.A. Weinberg (1999) 1st edition, Basic Books
3. The Biology of Cancer: R. Weinberg (2006) 1st edition, Garland Science
4. The Biology Of Disease: Murray, Jonathan and Kirk (2001) 2nd edition, Wiley-Blackwell

Prerequisite: Advanced Cell Biology (BIO 311) and Advanced Molecular Biology (BIO 313)

BIO 352	Animal Physiology II	3 credits
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Introduction: While the students have been given extensive training in human physiology during BIO 312, BIO 352 offers insights into the physiology of non-mammalian vertebrates and invertebrates. Special physiological adaptations displayed by animals, radiated in diverse habitats will be studied and their relevance to evolution will be analyzed. Insect physiology will be dealt in considerable detail. The course will provide in-depth knowledge regarding a range of biological processes operating at levels from cell to organism and prepare him/her to pursue research in any area of animal and human physiology.

Content: Physiology of circulation, respiration, excretion, ionic balance in sub-mammalian vertebrates, physiology of reproduction, thermoregulation in ectothermic and endothermic animals; Nervous and sensory systems across various invertebrate groups; Circulation, ionic balance and excretion, respiration, digestion, moulting, sensory, nervous and neuroendocrine systems and reproduction in insects.

Recommended Reading:

1. Eckert Animal Physiology: D.J. Randall et al. (2002) W.H. Freeman
2. Comparative Animal Physiology: P.C. Withers et al. (2001) Brooks Cole
3. Animal Physiology: R.W. Hill, G.A. Wyse and M. Anderson (2008) Sinauer Associates

Prerequisite: Animal Physiology I (BIO 312)

BIO 353	Immunology II	3 credits
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Introduction: This course will cover advanced topics in immunology.

Content: Toll-like receptors; Regulation of NK cell activity; Host-pathogen interactions; Subversion of the host immune responses by intracellular parasites; Ontogeny and function of dendritic cells; Autoantibodies in health and disease; Molecular interactions between the T cell receptor and MHC molecules; Immune synapse; Polyspecificity of T cell receptor recognition; Molecular mimicry and epitope spreading; T cell memory; Peripheral tolerance and regulatory lymphocytes; Animal models of immune dysregulation; Interactions between the immune and the nervous systems.

Recommended Reading:

1. Kuby Immunology: T.J. Kindt, B.A. Osborne and R.A. Goldsby (2006) 6th edition W.H. Freeman
2. In addition, reading assignments for this course will be from recently published papers from the primary literature

Prerequisite: Immunology I (BIO 323)

BIO 354	Neurobiology II	3 credits
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Introduction: This course builds from BIO 334 (Neurobiology I), and focuses on higher functions of the nervous system. Systems level functions like, sensory and motor systems, processing of pain and emotion, arousal and circadian rhythms will be discussed from qualitative and quantitative perspectives. Traditional and new imaging modalities will be introduced. Emerging areas of astrocytic and glial feedback, mirror neurons and current understanding of cognition will also be discussed. This course is essential for students desirous of pursuing research in any branch of neurosciences.

Content: Autonomous nervous system; Sensory systems and sensory processing; Motor control and pattern generators; Brain imaging: electro-encephalography, positron emission tomography, functional magnetic resonance imaging; Sleep and circadian rhythms; Processing of emotion; Learning and memory; Neurobiology of perception and cognition; astrocyte and glial feedback; Current topics: mirror neurons, neurodegeneration.

Recommended Reading:

1. Principles of Neural Science: E. Kandel et al. (2000) 4th edition, McGraw-Hill Medical
2. Neuroscience: M. Bear et al. (2006) 3rd edition, Lippincott Williams & Wilkins
3. Foundations of Cellular Neurophysiology: D. Johnston and S. Wu (1994) 1st edition, MIT Press
4. The Other Brain: D. Fields (2009) 1st edition, Simon and Schuster
5. Mathematical Physiology I: J. Keener and J. Sneyd (2008) 2nd edition, Springer
6. Neuroscience: D. Purves et al. (2011) 5th edition, Sinauer Associates

Prerequisite: Neurobiology I (BIO 334)

BIO 401/402	Lab Training/Theory Project	3 credits
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The larger objective of this course is to encourage students to participate in ongoing research at IISER Pune. This may be in the form of a reading/literature review/theoretical and computational project or a lab based research project.

The student has to identify, talk to and mutually agree on a research project with a faculty member before registering for this course. The scope, duration, structure, expectations, and evaluation criteria for the course are decided by the project supervisor.

BIO 410	Advanced Biochemistry I	4 credits
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Introduction: This course aims to provide students with a comprehensive grounding in the fundamentals of Biochemistry. We start with the very basic molecule necessary for life (water) and go on to discover the structure, function and interrelationships between important biomolecules that collectively carry out the essential functions of life (like nucleic acids, proteins and carbohydrates). It also introduces the concepts underlying routine and advanced methodologies that are used in analyzing biochemical data. This course is a prerequisite for BIO 417 (Advanced Biochemistry II).

Content: Water and life; Biomolecules: Structural and functional aspects of proteins, nucleic acids and carbohydrates; Nucleic acids: Structure and function, RNA world, ribozymes, DNA as the genetic information carrier; Protein folding, dynamics and interaction: Thermodynamic principles, binding and protein folding reactions analyzed from the framework of enthalpy, entropy, free-energy and heat capacity. Enzyme biochemistry: Enzymes as biological catalysts, kinetics of unireactant systems, inhibition systems, enzyme activation, multisite and allosteric enzymes; Carbohydrates: Structure and function; Biochemical techniques: Protein and nucleic acid isolation, electrophoresis, chromatography, mass spectrometry, isothermal titration calorimetry and isotope exchange.

Recommended Reading:

1. Biochemistry: D. Voet and J.G. Voet (2010/2004), 4th/3rd edition, Wiley
2. Biochemistry: The chemical reactions of living cells: D.E. Metzler(2003) Volumes I & II, 2nd edition, Academic Press

BIO 411	Ecology I (Basic Ecology)	4 credits
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Introduction: This course will cover the basic theoretical framework of ecology. The basic organizing structure of the course is centered around the hierarchical levels of biological organizations in Ecology: starting at the level of individuals, to populations, species interactions, communities and finally ecosystems.

Content: Topics covered will include: Introduction - history, philosophy and practice of ecology; Ecology of individual organisms - physiological ecology; population ecology - population growth and regulation, evolution of life-history, species interactions, trophic interactions; Community ecology - community structure and properties, succession and disturbance; Ecosystem ecology - biodiversity, productivity and energy flow, biogeochemistry.

Recommended Reading:

1. Ecology: from individuals to ecosystems: M. Begon, C.R. Townsend, and J.L. Harper (2006) 4th edition, Blackwell Publishing
2. Ecology: R.E. Ricklefs and G.L. Miller (2000) 4th edition, W.H. Freeman
3. The Ecology of Plants: J. Gurevitch, S.M. Schener, and G.A. Fox (2006) 2nd edition, Sinauer and Associates

BIO 412	Microbiology	4 credits
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Introduction: This course covers the unique aspects of microbial life. Students are assumed to have studied basic courses in biochemistry, physiology, molecular biology and population biology. A number of phenomena are unique to the microbial world which may not be covered under general biology courses. This course emphasizes on aspects of both basic and applied biology of prokaryotic and eukaryotic microorganisms.

Content: Microbial diversity: Cultural and culture independent methods, taxonomy, functional anatomy of prokaryotic and eukaryotic microbial cells. Microbial physiology: Unique pathways for fermentation, biodegradation and biosynthesis. Microbial growth kinetics. Development and differentiation in microorganisms: spores, cysts, biphasic growth, Dictyostelium development, myxobacterial development, Biofilms and signaling among microbial cells. Microbial genetics. Regulation of gene expression in prokaryotes; bacteriophage life cycle and phage genetics. Bacterial cell cycle and cell division in bacteria, host-parasite interactions, a brief overview of virology.

Recommended Reading:

1. Microbiology: An Introduction: G.J. Tortora, B.R. Funke and C.L. Case (2004) 8th edition, Pearson Education
2. Bacterial and Bacteriophage Genetics: E.A. Birge (2006) Springer
3. Flint S.J., Enquist L.W., Racaniello V.R., Skalka A.M. (2008) Principles of Virology (Volume I), 3rd Edition.

BIO 413	Mathematical Biology	4 credits
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Introduction: This course is an introduction to modeling biological processes and systems. Classical examples, such as from neuroscience and other topics in physiology, will be used to examine various methods and techniques that are frequently useful. This course will be interesting to applied math students looking to understand how mathematics is useful in biology, and modeling in general. It is now well recognized that quantitative methods are profoundly important to solving biological problems of the present century; biology students will learn to appreciate how quantitative methods improve understanding of experimental data, and in some cases are indispensable.

Content: Classical examples will be drawn from the literature that best illustrate the seamless integration of mathematics and biology, such as modeling in neuroscience (the classification of spiking activity based on different bifurcation scenarios), enzyme kinetics (slow-fast analysis and the Michaelis-Menten equations), cell cycle modeling, and others.

Recommended Reading:

1. Dynamic Models in Biology: S.P. Ellener and J. Guckenheimer (2006) Princeton University Press
2. Mathematical Physiology: J. Keener and J. Sneyd (2008) Springer
3. Theoretical Neuroscience: P. Dayan and L. Abbott (2005) MIT Press
4. Mathematical Models in Biology: L. Edelstein-Keshet (2005) Random House

BIO 417	Advanced Biochemistry II	4 credits
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Introduction: This course constitutes specialized topics related to membrane biochemistry and metabolism. The first deals with understanding physical principles underlying formation, organization and dynamics of membranes and also includes case studies from contemporary literature discussing working with artificial membrane systems and reconstitution of membrane proteins into such systems. The second constitutes a survey of metabolic pathways from a molecular point-of-view.

Content: Membrane Biochemistry: Lipid structure and dynamics, membrane protein insertion and folding, lipid and protein organization in membranes, Molecular recognition principles on membranes, Lipid and protein sorting, membrane fusion and fission, homeoviscous adaptation, Membrane-mimetic systems, membrane protein purification and reconstitution; Metabolism: Amino acid, lipid, carbohydrate, nucleotide and glycogen metabolism, metabolic pathways such as glycolysis, citric acid cycle, electron transport and oxidative phosphorylation.

Recommended Reading:

1. Molecular Biology of the Cell: B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2002) Garland Science
2. Life - As a Matter of Fat: O. Mouritsen (2004) Springer
3. The Structure of Biological Membranes: P. Yeagle (2004) CRC Press
4. Biochemistry: The chemical reactions of living cells: D. Metzler (2001) Academic Press
5. Primary research articles and reviews will be utilized to provide contemporary insights into the field

Prerequisite: Advanced Biochemistry I (BIO 410)

BIO 420	Developmental Biology	4 credits
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Introduction: The goal of this course is to introduce students to the patterns and mechanisms of Animal and Plant development. Model organisms such as *Drosophila*, *Xenopus*, *C.elegans* and *Arabidopsis* will be used to explain commonalities and differences in molecular mechanisms. The instructors will move on to advanced topics, using current research papers, once the history and basic concepts of development have been explained.

Content: History of developmental Biology, evolutionary developmental biology, an overview of early development, from Egg to Embryo. Commonly used Experimental methods in developmental biology; Introduction to positional information, axes, coordinates and morphogen gradients; Generation and Interpretation of gradient information and Pattern formation; Modes of cell-cell interactions during tissue organization: Self-organization, lateral inhibition, induction, and recruitment; Growth, differentiation and cancer; Evolution of body plan; Stem cell biology and tissue repair; Regeneration; Nervous system development; Embryogenesis in plants. Genes controlling embryogenesis; The control of flowering and molecular signaling. Specification of the floral organ identity; New twists on old model and Quartet theory for floral organ specification.

In addition to the lectures, the course will include paper reading, group discussions, some demonstrations, debates and assignments.

Recommended Reading:

1. Developmental Biology: S.F. Gilbert (2006) 8th edition, Sinauer Associates
2. Principles of Development: L. Wolpert, R. Beddington, T. Jessell, P. Lawrence, E. Meyerowitz and J. Smith (2008) Oxford University Press
3. Plant Physiology: L. Taiz and E. Zeiger (2006) 4th edition, Sinauer Associates

Prerequisite: Courses in Genetics, Cell Biology and Molecular Biology, at IISER Pune or in your B.Sc/ M.Sc course.

BIO 422	Evolution	4 credits
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Introduction: This course provides an introduction to the diverse field of evolutionary biology. In the first part of the course, the mechanisms of evolution within populations are explored using mathematical models for changes in gene frequencies and trait values. These principles are used to build theories to explain different facets of the diversity of life in the latter part of the course, hence introducing the student to various sub-fields of evolutionary biology. This course will be useful to any student interested in studying complex systems, mathematical modeling or biology.

Content: Brief history of evolutionary thought. Population genetics: Hardy-Weinberg equilibrium, models for selection, mutation, drift, migration, inbreeding, linkage. Molecular evolution and neutral theory. Quantitative genetics, adaptive landscapes, Fisher's fundamental theorem, Price's equation, Wright's shifting balance theory; History of life on earth; Species concepts, speciation, phylogenetic trees. Adaptations, life history evolution, experimental evolution, multi-level selection, sexual selection, sociobiology. Evolutionary developmental biology, extended evolutionary synthesis. Evolutionary psychology, evolutionary medicine, evolution and society; Critical thinking in evolutionary biology.

Recommended Reading:

1. Evolutionary Analysis: S. Freeman and J.C. Herron (2007) Prentice Hall
2. Evolution: D.J. Futuyma (1997) Sinauer Associates
3. Evolution: N.H. Barton, D.E.G. Briggs, J.A. Eisen, D.B. Goldstein and N.H. Patel (2007) Cold Spring Harbor Laboratory Press
4. Principles of Population Genetics: D.L. Hartl and A.G. Clark (1997) Sinauer Associates
5. Evolution—The Extended Synthesis: M. Pigliucci and G.B. Muller (2010) MIT Press

BIO 423	Ecology II (Advanced Ecology)	4 credits
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Introduction: This course will cover current topics in Ecology. Instead of attempting a comprehensive review of general Ecology, this course will focus on in-depth coverage of a few select topics. Some of the topics introduced in BIO 411 (Ecology I) will be covered in greater detail here and other topics like

Molecular Ecology and Global Warming and Climate Change will be introduced. The primary method of organization for this course will be readings and class discussions from the primary literature in Ecology. Knowledge of elementary mathematics and statistical procedures is desirable but not essential.

Content: History, Philosophy and the Practice of Ecology; Physiological Ecology; Ecological Genetics; Functional Ecology; Phenotypic Plasticity; Biodiversity and Climate Change; Macroecology; Applied Ecology – Conservation Biology; Recreational Ecology

Recommended Reading:

1. Ecology: From Individuals to Ecosystems: M. Begon, C.R. Townsend and J.L. Harper (2006) 4th edition, Blackwell Publishing
2. Ecology: R.E. Ricklefs and G.L. Miller (2000) 4th edition, W.H. Freeman
3. The Ecology of Plants: J. Gurevitch, S.M. Schener and G.A. Fox (2006) 2nd Edition, Sinauer and Associates
4. Assigned readings from scientific journals

Prerequisite: Ecology I (Basic Ecology): BIO 411

BIO 431	Epigenetics	3 credits
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Introduction: The objectives of this course are to introduce students to basic concepts in gene regulation, chromatin biology, genome-environment interaction, epigenetics and its applications in genomics and disease biology. The course would be useful for the students who are interested in learning about the organization of genes and their organization at molecular level and also using a systems approach. The discussions will encompass biochemistry, bioinformatics, genomics, proteomics, computational biology and systems biology.

Content: This course will begin with the fundamentals of regulation of gene expression and chromatin organization (6 lectures) and then emerging concepts of how DNA sequence can dictate chromatin organization at the domain level will be discussed (6 lectures), with specific emphasis on regulatory elements such as boundary elements and insulators (6 lectures). The implications of these in development, differentiation and disease will be discussed using specific examples (12 lectures).

Recommended Reading:

1. Histone variants – ancient wrap artists of the epigenome: Talbert, P.B. and Henikoff, S. *Nat. Rev. Mol. Cell Biol.*, 2010 doi:10.1038/nrm2861
2. Divide and (epigenetic) rule: Chromatin domains as functional and structural units of genomes. Mishra, R.K. and Galande, S. *Journal of Indian Academy of Sciences, Platinum Jubilee issue*, 2009, pp 211-224
3. Bernstein et al. (2007). The mammalian epigenome. *Cell*, 128:669-681
4. Fuks, F. (2005). DNA methylation and histone modifications: teaming up to silence genes. *Curr Opin Genet Dev.*, 15(5):490-495
5. Lunyak, V.V. (2008). Boundaries. Boundaries...Boundaries??? *Curr Opin Cell Biol.*, 20(3):281-287

Prerequisite: Genetics (BIO 320)

BIO 435	Biophysics II	3 credits
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Introduction: This course, Biophysics II, will deal with molecules, cells and tissues. The novelty of this course will be an introduction to the non-equilibrium aspects of biophysics applied to molecules. The course will begin with a detailed treatment of the role of water and its biophysics and end with the physics of developmental pattern formation. Assessment will be based on research paper reading, assignments, laboratories and a term paper. The term paper topic will be chosen by the student within two-weeks of the start of the course, a mid-semester update and an end-semester submission.

Content: Mathematics of water and crowding, dynamics of macromolecules particular molecular motors and the cytoskeleton, non-equilibrium approaches, mechano-biology of cells with a focus on muscles, nerves and stem cells, tissue dynamics and development (embryology), literature review, term paper,

labs on macromolecular crowding and pattern formation.

Recommended Reading:

1. Mechanics of the Cell: D. Boal (2001) Cambridge University Press
2. Physical Biology of the Cell: Philips, Kondev, Theriot & Orme (2009) Garland Science, Taylor and Francis Group LLC.3
3. Biological Physics of the Developing Embryo: G. Forgacs and S. Newman (2005) Cambridge University Press
4. Biological Physics: P. Nelson (2007) W.H. Freeman
5. Biophysics: An Introduction: R. Glaser (2010, 2012) Springer
6. Life in Living Fluids: S. Vogel (1996) Princeton University Press
7. Lehrbuch Der Biophysik: E. Sackmann and R. Merkel (2010)Wiley-VCH Verlag GmbH & Co KGaA

Prerequisite: Biophysics (BIO 322)

BIO 441	Genome Biology	3 credits
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Introduction: The goals of this course are to introduce students to the recent and ongoing excitement in the science of Genome Biology and Genomics. This course would be useful to any student with an interest to understand the basic workings of our genomes and how recent findings are being translated using interdisciplinary methods at a rapid rate to address fundamental biology of cells. This is now paving the way for the diagnosis and treatment of complex human diseases.

Content: Nucleic acid chemistry, DNA, RNA, proteins, DNA-hydrogen bonding, base pairing, replication, sequencing, annealing, hybridization, RNA, transcription, Amino acids, proteins, protein synthesis. Biology of Genomes; Synthetic genomes; Biology of the nucleus – nuclear architecture (cell biology and cytogenetics meets genomics); Mechanobiology and the nucleus; Advanced Chromosome biology – karyotyping & Spectral Karyotyping (SKY), FISH methods, chromosome painting studies and molecular cytogenetics, Copy number variations (CNV), array-comparative genomic hybridization (a-CGH), Chromosome conformation capture, 3C, 4C and Hi-C; microarrays, Next generation DNA sequencing; RNA Sequencing; Chip-Seq, Functional Genomics, Bioinformatics & computational biology; Transcriptomics; Cancer Genomics, Epigenomics, Chemical Genomics; Metabolomics; Proteomics; Genomics & stem cells; Systems biology

Recommended Reading:

1. Molecular Biology of the Cell:B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2007) 5th edition (Sections: 1-3, Chapters: 1-8)
2. Gibson et al. Science, 2010:329, 52–56
3. http://cshperspectives.cshlp.org/cgi/collection/the_nucleus
4. Shivashankar, G.V.(2010). Nuclear mechanics and genome regulation, Methods Cell Biol., 98:xiii
5. Vorsanova, S.G. et al (2010). Human interphase chromosomes: a review of available molecular cytogenetic technologies, Mol Cytogenet., Jan 11;3:1
6. Padilla-Nash, H.M. et al (2006). Spectral karyotyping analysis of human and mouse chromosomes. Nat Protoc.,1(6):3129-3142
7. Metzker, M.L. (2010) Nature Reviews Genetics 11:31-46

BIO 442	Computational Biology	3 credits
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Introduction: The goal of this course is to gain a broad understanding of the computational methods that are applied to various problems in biology. One could study the computational methods in isolation, or learn them by applying them to a set of eclectic problems from various sub-fields in Biology. The approach that we choose is grounded in a discipline that has arguably gained the most from the application of mathematical and computational tools, namely Neuroscience. In this hands-on course, we will apply various computational methods to model different aspects of neurobiology across spatial and temporal scales. These methods will find wide application across different biological systems.

Content: Simulating the dynamics of single neurons and networks using ordinary differential equations;

Modeling channel kinetics in single neuron models; Intracellular dynamics using reaction diffusion equations; Monte Carlo simulations of cellular signaling pathways; Parameter optimization

Recommended Reading:

1. David Sterratt, Bruce Graham, Andrew Gilles. Principles of Computational Modeling in Neuroscience, Cambridge University Press; 1st edition (August 15, 2011)
2. Erik de Schutter, Computational Modeling Methods for Neuroscientists, The MIT Press; 1st edition
3. Leah Edelstein-Keshet, Mathematical Models in Biology (Classics in Applied Mathematics). SIAM: Society for Industrial and Applied Mathematics; 1st edition (February 2005)

BIO 452

Plant Biology II

3 credits

Introduction: This course would enable students to learn applied aspects of plant science. Students would gain knowledge of a variety of techniques as well as their direct applications in crop improvement program. Hands on practical sessions in this course would give them the exposure to a number of tools which are essential in plant biotech industries. The training will equip the students with necessary intellectual background and the skills to undertake research in cutting edge areas of plant biology.

Content: Plant cell, tissue and organ culture (micropropagation, somatic embryogenesis, organogenesis, protoplasts and somatic hybridization); plant genetic transformation and transgenic and transplastomic plants; plant metabolites and engineering of plant metabolic pathways; production of phyto-chemicals by cell, tissue and hairy root cultures; molecular farming; phyto-remediation; crop improvement tools: molecular markers and marker mediated applications in plant breeding techniques, quantitative genetics, breeding strategies, biotechnology in crop improvement (biotic and abiotic stress, nutritional quality, defense responses); seed technology, molecular tests for seed analysis; visits to plant biotech companies.

Recommended Reading:

1. Introduction to Plant Tissue Culture: M.K. Rajdan (2003) 2nd edition, Science Publishers
2. Plant Biotechnology-the genetic manipulation of plants: A. Slater (2008) 2nd edition, Oxford University Press
3. Genetically Modified Crops (2011) 2nd edition, Imperial College Press, World Scientific Publishers

Prerequisite: Plant Biology I (BIO 321)

BIO 454

Structural Biology

3 credits

Introduction: The emphasis of the course is on conceptual understanding of structure of biomolecules and some of the techniques used to determine and analyze them. The course also aims to enable students to understand, critically evaluate and use biomolecular structural information available in literature and public databases.

Content: Introduction to structures of biomolecules: proteins and nucleic acids; Recombinant technology and purification techniques to isolate biomolecules; Determination of atomic structure using X-ray crystallography; Studying macromolecular assembly using electron microscopy; Biophysical and spectroscopic techniques to understand structures; Graphics tools to visualize and analyze atomic structure of biomolecules; Understanding biological phenomenon with structures.

Recommended Reading:

1. Introduction to Protein Structure: C. Branden and J. Tooze (1999) 2nd edition, Garland Science
2. Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology: B. Rupp (2009) 1st edition, Garland Science
3. Understanding DNA: C. Calladine, H. Drew, B. Luisi and A. Travers (2004) Elsevier Academic Press
4. Textbook of Structural Biology: A. Liljas, L. Liljas, J. Piskur, G. Lindblom, P. Nissen and M. Kjeldgaard (2009) 1st edition, World Scientific Publishing

Prerequisite: Advanced Biochemistry I (BIO 410)

BIO 491

Literature Review

3 credits

Introduction: This main objective of this course is to familiarize students with the primary scientific literature. This will include use of search tools; reading, analyzing, and critically evaluating the primary literature; and, effectively summarizing and communicating (oral and written) this information.

Content: The scientific literature – primary, secondary, and tertiary literature; Database searches – tools and strategies; Reading and evaluating the scientific literature - Academic writing – plagiarism and referencing, Format and Style; Writing a literature review. Different members of the Biology faculty will contribute to this course. Faculty member will choose topics from their own area of research expertise, and highlight through readings and discussions the nuances of reading and evaluating the literature in diverse topics like biochemistry, neurobiology, theoretical biology, etc.

Recommended Reading:

Reading assignments for this course will be from a variety of scientific journals.

Annexure 2

Conferences and Workshops

Conferences and Workshops in Biology at IISER Pune

1. Indo-French Seminar 2015: Frontiers in cytoskeleton research: coordination, adaptation, fine tuning October 25 to 27, 2015

The meeting was attended by about 25 PIs along with students from across India as well as local students from Pune who are interested in understanding cytoskeletal processes. There were 20 talks along with 9 short talks and 35 posters. Apart from scientific exchange, this meeting has provided a platform to initiate possible collaboration; staff exchange and training; and awareness of scientific culture in the 2 countries. This meeting was organized by Aurnab Ghose (IISER Pune), Roop Mallik (TIFR, Mumbai), Carsten Janke (Institut Curie, Orsay).



Session 1: Cytoskeletal complexity in cell motility (Chair: D. Panda)

Alexis Gautreau (Ecole Polytechnique Palaiseau) Branched actin networks in cell migration and proliferation.

Danijela Vignjevic (Institut Curie Paris): Role of microenvironment in cancer cells invasion

Mithila Burute (iRTSV/LPCV CEA, Grenoble) Short talk

Session 2: Functional linkage of the cytoskeleton to membranes (Chair: R. Mallik)

Franck Perez (Institut Curie Paris) Microtubules and the control of Golgi-dependent secretion in non-polarized epithelial cells.

Bidisha Sinha (IISER Kolkata) Effect of acto-myosin cortex on plasma membrane fluctuations

Devika Ranade (IISER Pune) Short talk

Session 3: Modelling the cytoskeleton (Chair: R. Paul)

Ranjith Padinhateeri (IIT Bombay): Microtubule shrinkage: Powerful elastic bending or stochastic thermal unzipping?

Raphael Voituriez (Laboratoire de Physique Théorique de la Matière Condensée, Paris) Universal features in cell trajectories.

Ishutesh Jain (IIT Bombay) Short talk

Session 4: Cytoskeletal coordination in complex assemblies I: cilia (Chair: S. Koushika)

Nathalie Spassky (IBENS Paris) Development and roles of ciliated cells in the mammalian brain

Krishanu Ray (TIFR Mumbai) Intracellular transport by kinesin-2: one motor many destinations

Aparna Sherlekar (IISER Pune) Short talk

Session 5: Cytoskeletal coordination in complex assemblies II: neurons (Chair: N. Spassky)

Sandhya Koushika (TIFR Mumbai): Transport of synaptic vesicles in neurons

Pramod Pullarkat (RRI Bengaluru): The role of microtubules in induced axonal beading and retraction

Sushil Dubey (RRI, Bengaluru) Short talk

Session 6: Cytoskeletal functions in development (Chair: A. Gautreau)

Richa Rikhy (IISER Pune) Onset of epithelial like plasma membrane polarity and polygonal packing in early *Drosophila* embryos

Dulal Panda (IIT Bombay) Microtubule dynamics influences the association of the transcription factor NF- κ B with microtubules

Tapas Manna (IISER Thiruvananthapuram) Short talk

D. Vignjevic, A. Ghose Career discussion: presentation of career paths of Indian and French PIs, gender issues, opportunities in Indian and French research

Session 7: Complex assemblies – the mitotic spindle (Chair: R. Padinhateeri)

Raja Paul (IACS Kolkata) Changes in the kinetochore geometry accelerates spindle assembly during mitosis

Phong Tran (Institut Curie Paris) Spindle mechanics and aneuploidy

Kunalika Jain (IISER Pune) Short talk

Session 8: Coordination in cytoskeletal networks (Chair: C. Janke)

Laurent Blanchoin (iRTSV/LPCV CEA Grenoble) Symmetry and mechanics of contractile actin network

Aurnab Ghose (IISER Pune) Neuronal pathfinding and regulation of filopodial adhesions by Formin-2

Darius Koester (NCBS, Bengaluru) Short talk

Session 9: Complex transport processes (Chair: B. Sinha)

Chaitanya Athale (IISER Pune) A tug-of-war in the transport of radial microtubule arrays

Roop Mallik (TIFR Mumbai) Motors, Lipid droplets and the COP1 pathway: a new connection?

Sukrut Kamerkar (IISER Pune) Short talk

Session 10: Active tracks: tuning and repairing the microtubule cytoskeleton (Chair: A. Ghose)

Manuel Théry (iRTSV/LPCV CEA Grenoble, EMBO YIP lecture) Microtubules self-repair in response to mechanical stress

Carsten Janke (Institut Curie Orsay) Fine-tuning of microtubule functions by posttranslational modifications

R. Mallik, A. Ghose, C. Janke, M. Théry Round table discussion: Frontiers in cytoskeleton research – key questions for the next decade

2. A Banquet of Biological Research: IISER Pune-Biology Annual Talks

July 28-29, 2015

The 3rd IISER Annual Talks were held on July 28-29, 2015 at CV Raman Auditorium. The meeting has multiple goals and included sharing and discussion of research conducted in the department in the last year as well as functioning as a forum to welcome new students and introduce them to science in IISER via seminars, discussions and posters. This year 22 faculty and post-doctoral fellows presented a seminar-based overview of their research while all students presented posters. The meeting ended with a departmental dinner where the student organizers (Ayantika, Bhagyashree, Boomi, Darshika, Mansi M, Manu, Neha N, Srishti, Trupti) projected a movie which had interesting interviews of members of the Biology Community.





3. 18th Transcription Assembly Meeting 2015 March 12-14, 2015

Investigators interested in studying various modes of gene regulation at transcription/chromatin level and their biological implications in prokaryotic and eukaryotic model systems attended this meeting. This national meeting is being organized every year for over one and a half decades to discuss the recent advancement in the field and to share the expertise among all researchers working in India. The 18th episode of this meeting was organized by Dr. Sanjeev Galande, Dr. Krishanpal Karmodiya and colleagues at IISER Pune and the theme of the meeting was various modes of gene regulation at transcription/chromatin level and their biological implications in prokaryotic and eukaryotic model systems.

Dipankar Chatterji (IISc, Bengaluru): Introduction about Transcription Assembly Meeting

Session 1: Transcription in Prokaryotes (Chair: Sudha Bhattacharya)

Ranjan Sen (CDFD, Hyderabad) Does Rho-dependent transcription termination an integral part of DNA repair processes?

Dipankar Chatterji (IISc, Bengaluru) Second messengers (p)ppGpp and c-di-GMP regulate glycopeptidolipids, polar lipids synthesis and cell division in *Mycobacterium smegmatis*

Jayanta Mukhopadhyay (Bose Institute, Kolkata) Novel mechanism of gene regulation: the protein Rv1222 of *Mycobacterium tuberculosis* inhibits transcription by anchoring the RNA polymerase onto DNA

Deepak Dutta (IMTECH, Chnadigarh) Demonstrating replication transcription conflict: sequestration of replisome machineries by ColE1 plasmid affects the growth of Escherichia coli

Session 2 Transcription Assembly (Chair: B.J. Rao)

Natarajan (JNU, New Delhi) SAGA of Shared TAFs: Specialized TAF12 variants in transcription and stress response

Sudha Bhattacharya (JNU, New Delhi) Properties of the autocatalytic circular noncoding RNA from ribosomal RNA spacer in Entamoeba histolytica

Dipti Vernekar (CCMB, Hyderabad) Yeast RNA polymerase III assembly is modulated by Bud27 at the Transcriptional and translational level control of the Rpc128 and Rpc160 biogenesis

Rakesh Mishra (CCMB, Hyderabad) Anchoring the transcription assembly by Matrix Attachment Regions in *Drosophila*

Session 3: Replication, Repair and transcription (Chair: Dipankar Chatterjee)

BJ Rao (TIFR, Mumbai) Regulation of ATR signalling post transient replication stress in mammalian cells

Vikas Jain (IISER, Bhopal) p45: Born for replication, evolved for transcription

Devyani Haldar (CDFD, Hyderabad) Regulatory role of histone acetylation/deacetylation in DNA damage response

Saumya Gupta (TIFR, Mumbai) Temporal expression profiling identifies pathways mediating effect of causal variant on phenotype

Session 4: Transcription and Disease-Part-I (Chair: Sudha Bhattacharya)

Samit Chattopadhyay (NCCS, Pune) Loss of control on CD44 alternative splicing causes breast cancer progression

Gopal Kundu (NCCS, Pune) CD133+ cells control melanoma growth and metastasis through differentially modulating emt regulators in response to TGF β

Susanta Roychaudhary (IICB, Kolkata) Impairment of transcriptional control of mitosis causes genomic instability in human cancer

Devika Ranade (IISER, Pune) Role of Lamins in regulating transcription and genome organization in colorectal cancer cells

Tapas K. Kundu (JNCASR, Bengaluru) Histone interacting proteins in the regulation of Chromatin Dynamics and Transcription Regulation: Implications in disease and differentiation

Session 5: Transcription and Disease-Part-II (Chair: Tapas Kundu)

Sanjay Gupta (ACTREC, Mumbai) Unraveling the epigenome deregulation in cancer: Role of histone isoforms

Ullas Kolthur (TIFR, Mumbai) Sir2 and insulin signaling regulate remote control gut immune response and microbiota

Sreenivas Kurukuti (University of Hyderabad) Prolactin signalling mediated Transcriptome dynamics in lactogenic differentiation of mouse mammary epithelial stem cells

Session 6: Genomics and Epigenomics- Part-I (Chairperson: Rakesh Mishra)

Jagan Pongubala (University of Hyderabad) Decoding chromatin dynamics during B cell fate commitment

Krishanpal Karmodiya (IISER, Pune) Plasmodium epigenome: A distinct dynamic epigenetic regulation of gene expression

Amit Dutt (ACTREC, Mumbai) Progesterone regulates the expression of a tumor suppressor gene through an evolutionary conserved transcriptional network pathway in breast cancer cells.

Ranga Udaykumar (JNCASR, Bengaluru) A novel NF-kappaB and Sp1 interaction regulates gene expression from HIV-1 subtype C viral promoter

Session 7: Genomics and Epigenomics- Part-II (Chairperson: Rakesh Mishra)

Seergazhi G. Srivatsan (IISER, Pune) Chemical labeling of RNA transcripts by using bioorthogonal chemical reactions

4. INSA - Leopoldina Symposium: Human Evolution Towards Language – From Genes to Behaviour January 15-16, 2015

A two-day symposium sponsored by the Indian and German National Science Academies (INSA and Leopoldina) was organized by Prof. Shashidhara (IISER Pune) and Prof. Angela Friederici (Max Planck Institute for Human Cognitive and Brain Sciences, Germany). The main theme of the symposium was human language. The symposium consisted of 5 sessions and a total of 13 talks. The talks were aimed at understanding the neural origins of human language from many different perspectives - sequence learning in animals, sequence learning in humans, reward pathways in animals pertaining to motivation for learning, role of experience in modifying neuronal structures, etc. The conference speakers included 7 Indian speakers and 7 foreign speakers from Germany, Netherlands, France and United Kingdom. The conference was attended by a total of 35 registered participants and a number of students from IISER Pune.

Partha Majumdar (National Institute of Biomedical Genetics, West Bengal, India) Key Note Talk: Genes, Languages and Peoples of India
Angela Friederici (Max Planck Institute for Human Cognitive and Brain



Sciences, Leipzig, GERMANY) Key Note Talk: Language as a uniquely human trait

Session 1: Basic principles of learning (common to visual, olfactory and language learning)

Upinder Bhalla (National Centre for Biological Sciences, Bengaluru, India) Odour sequences and odour tracking

Brigitte Roeder (University of Hamburg, Hamburg, GERMANY) The role of experience in brain development



Session 2: Sequence learning in birds, rats and humans

Sachin Deshmukh (Centre for Neuroscience, IISc, Bengaluru, India) Space, Semantics, Sequences and Memory in the Hippocampus

Raghav Rajan (IISER Pune, India) Stereotype and variability: the Dr. Jekyll and Mr. Hyde of motor sequence learning and production - insights from the zebra finch

Jutta L Mueller (Institute of Cognitive Science, University of Osnabruck, Osnabruck, Germany) Neurophysiological evidence for complex auditory sequence learning in early human development

Session 3: Sequence learning in apes vs. humans

Nandini Chatterjee Singh (National Brain Research Centre, Manesar, India) Sound sequence learning - Implications for reading acquisition

Christopher Petkov (Institute of Neuroscience, Newcastle University Medical School, Newcastle upon Tyne, UK) Sequence Processing and the Primate Brain: Perspectives from fMRI, EEG and neurophysiology

Session 4: Language-related gene

Christiane Schreiweis (Institut National de la Santé et de la Recherche Médicale, Paris, FRANCE) Is faster better? The role of Foxp2 in procedural learning

Sonja Vernes (Max Planck Institute for Psycholinguistics, Nijmegen, THE NETHERLANDS) Deciphering neurogenetic mechanisms of vocal communication

Session 5: The effect of experience on brain structure

Shona Chattarji (National Centre for Biological Sciences, Bengaluru, India) To be or not to be afraid

Martin Korte (Helmholtz Centre for Infectious Diseases, Braunschweig, GERMANY) Keeping the delicate Balance between Change and Stability: Cellular correlates of learning, forgetting and memory
Nishikant K Subhedar (IISER Pune, India) Addiction initiated neuroplasticity - a model for studying how experiences shape the brain

5. Winter School on Foundations of Ecology and Evolution December 15-28, 2014

IISER Pune and IISER Mohali jointly organized this School the aim of which was to give a broad introduction in ecology and evolution to II and III year undergraduates from all over the country. 286 students applied for this workshop. Out of this, 154 were invited to take an online test. Based on their performance in this test, 16 students from all over India were invited for the workshop.

The workshop involved 7 resource people and 4 guest lecturers. The resource people were:

Prof. Amitabh Joshi (JNCASR), Dr. T.N.C. Vidya (JNCASR), Dr. N.G.



Prasad (IISER Mohali), Dr. Sutirth Dey (IISER Pune), Mr. Sudipta Tung (IISER Pune) and Mr. Syed Zeeshan Ali (IISER Mohali). The four guest lecturers were Dr. Sayajit Rath (NII, Delhi), Dr. Umashankar (GKVK), Dr. Milind Watve (IISER Pune) and Dr. Ullasa Kodandaramiah (IISER TVM).

The workshop involved 12 days of teaching. Each day consisted of three hours of lectures, three hours of hands on practical sessions, and another hour devoted to guest lectures or exams.

Although, the official contact hours were only 7-8 per day, the hands on nature of the workshop ensured that the students had to work late into the night almost every day, just to finish the practical tasks and enter data.

The details of the syllabus are on the website:

<https://sites.google.com/a/acads.iiserpune.ac.in/ecolevolwinterschool/home>

At the end of the workshop, feedback was taken from all students and in general extremely positive comments were received.

Module 1

Theory: Mathematical modelling in Ecology and Evolution; Instructor: Sutirth Dey (IISER Pune)

Topics: Modelling population growth: Simple models of population growth. Introduction to bifurcation maps. Lotka-Volterra models of competition and predation • Modelling simple evolutionary processes: Hardy-Weinberg model for 1-locus 2-allele case. Simple departures from the Hardy-Weinberg case • Optimality approaches to modelling and game theory

Hands-on: Introduction to computer programming; Instructor: Sudipta Tung (IISER Pune)

Topics: Simulating the various models learned during the theory session

Module 2

Theory: Behavioral Ecology; Instructor: T.N.C. Vidya (JNCASR, Bengaluru)

Topics: Evolutionary approach to animal behaviour • Tracing the evolution of behaviour • The ecology of social relationships • Kin selection • Sexual selection • Mating systems

Hands-on: Simple lab/field experiments in ecology and evolution; Instructors (Neelesh Dahanukar / TNC Vidya / NG Prasad)

Module 3

Theory: Experimental evolution in the laboratory: the evolutionary wonderland; Instructor: N.G. Prasad (IISER Mohali)

Topics: Experimental methods to study evolution • Life -history evolution: basic idea of a life-history, mathematical models and predictions, empirical studies of life-history evolution • Empirical evaluation of selection, mutation, migration and genetic drift • Empirical approaches to studying co-evolutionary processes

Hands-on: Introduction to Biostatistics through analysis of data obtained in previous module; Instructors: Statistics theory: Amitabh Joshi and Sutirth Dey. Software implementation: Syed Zeeshan Ali (IISER Mohali)

Topics: Measures of central tendencies and variation • Hypothesis testing • Analysis of variance • Simple linear regression

Module 4

Theory: The big picture in ecology and evolution; Instructor: Amitabh Joshi (JNCASR, Bengaluru)

Topics: Overview of biology as an interplay of development, ecology and heredity • Concepts of ecological and evolutionary fitness • Genetic equilibrium and one-locus model of viability selection • Breeding value,

additive genetic variance and the genetic dynamics underlying adaptive evolution

Hands-on: Constructing phylogenetic trees; Instructor: Neelesh Dahanukar (IISER Pune)

Topics: The logic of phylogenetic trees • Measuring morphological traits from diverse groups of organisms to construct phylogenetic trees • Molecular phylogeny • Phylogeography

6. Brain Circuits, SERB School in Neuroscience

December 8-21, 2014

This 8th edition of SERB School focused on the development, organization, plasticity and computation of brain circuits. The School saw talks along with sessions on experiments and analysis. Participants included undergraduate PhD scholars, postdoctoral fellows and young faculty members from diverse disciplines participated in the course. Twenty-seven faculty members with expertise in research and teaching skills, from India and abroad, were invited to deliver pedagogical talks and share their excitement in science.

[M.K. Mathew](#) (National Centre for Biological Sciences, Bengaluru) Electrical signalling in the nervous system; Introduction to synaptic transmission

[Vidita Vaidya](#) (Tata Institute of Fundamental Research, Mumbai) Introduction to neurotransmitters and synapse function; Introduction to opto- and chemogenetics

[N.K. Subhedar](#) (IISER Pune) Organization of the vertebrate nervous system

[B.S. Shankaranarayana Rao](#) (National Institute of Mental Health and NeuroSciences, Bengaluru) Synaptic plasticity: Activity-dependent rewiring and remodeling of brain circuits; Neural plasticity: a tool to treat brain disorders

[Kavita Babu](#) (IISER Mohali) Regulation of synaptic development and function; Genetic model organisms in neuroscience

[Praful Singru](#) (National Institute for Science Education and Research, Bhubaneswar) Exploring neural circuits and their organization in the brain using neuronal tracing, trans-synaptic mapping, and array tomography

[Sheeba Vasu](#) (Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru) Invertebrate circadian clocks - networks and physiology; Mechanisms for entrainment to temperature cycles in *Drosophila*

[Nixon Abraham](#) (Donders Institute, Radboud University, Netherlands and IISER Pune) Perceiving the olfactory world

[Sandhya Koushika](#) (Tata Institute for Fundamental Research, Mumbai)
Transport and functional polarization in neurons: implications of circuit function

[Ronald L. Calabrese](#) (Emory University, U.S.A.) From electrophysiology to a neuronal model; From a neuronal model to a hybrid system and back again

[Soumya Iyengar](#) (National Brain Research Centre, Gurgaon) Auditory System

[Mani Ramaswami](#) (Trinity College Dublin, Ireland)

[Suresh J. Jesuthasan](#) (Institute of Molecular and Cell Biology, Singapore)
Imaging neural activity; Neural circuits underlying emotion

[Rishikesh Narayanan](#) (Indian Institute of Science, Bengaluru) Basic dendritic physiology and computation

[Gerhard M. Technau](#) (Institute of Genetics, University of Mainz, Germany)
Neurogenesis in *Drosophila*; Techniques for studying neurogenesis on a single cell level

[Naren Ramanan](#) (Indian Institute of Science, Bengaluru) Mechanisms of neuronal outgrowth in development and regeneration; Glia in development, homeostasis and disease

[Hitoshi Okamoto](#) (RIKEN Brain Science Institute, Japan) Investigating the role of the evolutionary conserved limbic circuit within vertebrates; Exploring the role of habenula in emotional behaviors

[Vatsala Thirumalai](#) (National Centre for Biological Sciences, Bengaluru)
Motor systems, locomotion and pattern generation; Neuromodulation

7. ICTS-PIMS-IISER Pune Program on Advances in Mathematical Biology

December 7-16, 2014

In addition to ICTS and IISER Pune, this Program was also supported by the Pacific Institutes of Mathematical Sciences (PIMS), Canada. The Program brought together leading mathematical biology researchers from Canada together with Indian scientists to deliver a series of pedagogical lectures on contemporary topics of interest. The opening lectures by Pranay Goel on the first day were an introduction to some essential mathematical techniques that were useful to later topics. The rest of the time was divided between three themes:

1. Mark Lewis, Daniel Coombs and Pauline van den Driessche lectured on topics in Ecology, Epidemiology and Immunology. Milind Watve, Ram Rup Sarkar and Sutirth Dey participated in the Discussions sessions centred on these topics.



2. Subhash Lele, Anil Gore, Shailaja Deshmukh and Akanksha Kashikar delivered lectures on Statistical inference in biological systems.

3. Lectures on Collective behaviour in cellular and organismal biology were delivered by Sitabhra Sinha, Debashish Chowdhury, Somdatta Sinha and Madan Rao. Collins Assisi participated in the discussion session on the topic.

Over 65 participants attended the Program from both Pune and all over India. The participants were drawn from varied backgrounds, rooted in theoretical science in some form or another, be it physics or mathematical biology or bioinformatics and so on. The participants were mostly at the early PhD level although some faculty and younger students also attended.

The atmosphere was vibrant with a very active participation from students, which was well appreciated by the speakers. The participants as well as speakers gave excellent feedback. All seemed to welcome the breadth of lectures, the high quality of the Program, the organization itself, and were generally pleased to have participated in the meeting.

The Program's success indicates just how attractive topics in mathematical biology are for students in the country at this time. It speaks to a burgeoning development of the field, and the awareness and maturity of the participants begs for an even greater investment in the conduction of such Programs that will disseminate high quality instruction to a very willing audience.

[Pranay Goel](#) (IISER Pune) Introductory lectures

[Mark Lewis](#) (University of Alberta) The mathematics behind biological invasions

[Ram Rup Sarkar](#) (National Chemical Laboratory) Mathematical and

statistical modelling of malaria

[Milind Watve](#) (IISER Pune) Inferring causation from correlations in a homeostatic steady state: the case of glucose regulation.

[Daniel Coombs](#) (University of British Columbia) Stochastic approaches to within-host dynamics Discussion talk: Individual and population approaches to biological motion

[Pauline van den Driessche](#) (University of Victoria) Basic ideas of mathematical epidemiology. Discussion topic: Extension to cholera models

[Sutirth Dey](#) (IISER Pune) Controlling the dynamics of populations: an experimental biologist's perspective

[Anil Gore](#) (Cytel), Healthy numbers and Clinical trials for health and beauty

[Shailaja Deshmukh](#) (Pune University) together with Akanksha Kashikar (Pune University), Statistical inference for microarray data analysis

[Sitabhra Sinha](#) (Institute of Mathematical Sciences) Patterns of life & death: Excitable dynamics of biological cells & tissue. Discussion talk: Pattern formation through lateral inhibition in arrays of coupled relaxation oscillators

[Collins Assisi](#) (IISER Pune) Information processing in the olfactory system

[Debashish Chowdhury](#) (Indian Institute of Technology Kanpur) Collective dynamics in force generation and information processing in a cell

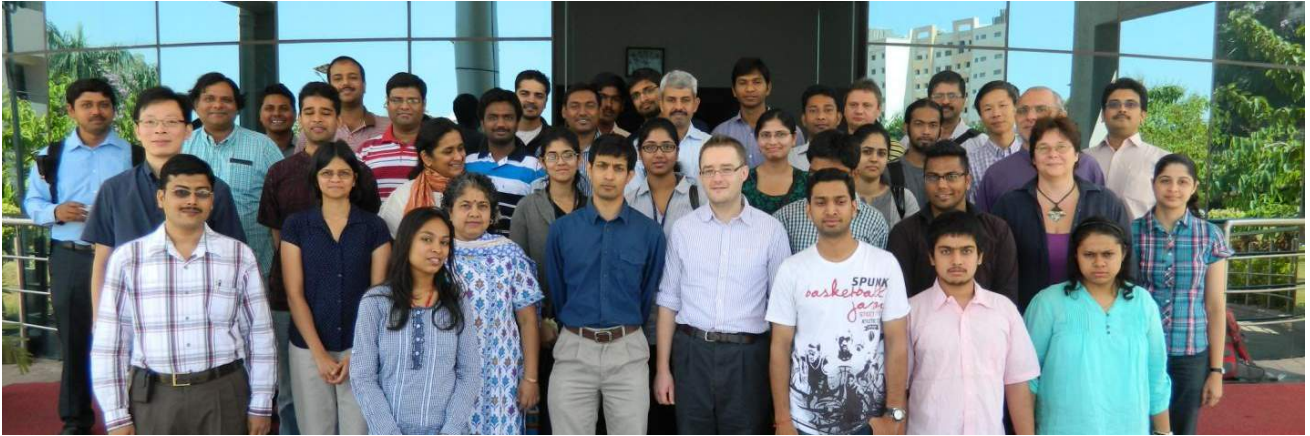
[Somdatta Sinha](#) (IISER Mohali) Collective behaviour in cells and populations

[Madan Rao](#) (National Center for Biological Sciences, Bengaluru) Active biological matter

8. A Banquet of Biological Research: IISER Pune-Biology Annual Talks

July 28-30, 2014

The Biology discipline conducted its Annual Seminars where faculty members presented seminars while students and post-doctoral fellows presented posters. All members of the department, including newly joined Ph.D., Integrated-Ph.D., and project staff attended the talks. The goal of the talks is to share ideas and communicate research done within the laboratories in the past year. The second IISER Annual Talks were held in CV Raman Hall in IISER Campus. As is the norm, faculty and post-docs gave research talks while students presented posters. The new batch of graduate students (Ph.D, Int-PhD.) as well as as new staff in the Department were present and these talks along with associated lunches and dinners served as an introduction to the community.



9. Mathematical and Computational Methods in Life Sciences

April 11-12, 2014

This meeting was jointly organized by IISER Pune and the Bioinformatics Institute (BII) Singapore. The broad intent of the meeting was to showcase the breadth of scientific problems in biology that could be mathematically modeled or computationally enumerated. Speakers at this 2-day event showed how modeling/simulation complemented experimental work. The BII contingent was headed by the Director Frank Eisenhaber and included 8 other principal investigators. Local speakers included faculty from IISER Pune, TCS and NCL. Experimental biologists and computational specialists connected over the course of the event and plausible new collaborative ventures were discussed.

Sequence-function relationships

[Frank Eisenhaber](#) (Executive Director, BII, Singapore) From genome sequences to biological interpretations: opportunities and bottlenecks
[Sharmila Mande](#) (TCS Innovation Labs, Pune) Taxonomic and functional characterization of metagenomic sequences
[Birgette Eisenhaber](#) (BII, Singapore) Molecular function discovery for transamidase components in the GPI lipid biosynthesis pathway

Protein structure modeling and dynamics

[Peter Bond](#) (Bioinformatics Institute, Singapore) The secret life of lipids: A computational approach to molecular recognition and signalling beyond the membrane
[Durba Sengupta](#) (National Chemical Laboratory, Pune) Elucidating membrane-protein interactions
[Chandra Verma](#) (BII, Singapore) Stapled diet: New food for thought
[Arnab Mukherjee](#) (IISER Pune) Molecular mechanism of intercalation of

proflavine into DNA

M.S. Madhusudhan (IISER Pune and BII, Singapore) Residue depth and its utility

Mathematical modeling of Biological systems

Keng-Hwee Chiam (BII, Singapore) Computational modeling of cell migration

Lee Hwee Kuan (BII, Singapore) Application of computer vision algorithms on biomedical research

Chetan Gadgil (National Chemical Laboratory, Pune) Mathematical analysis of gene expression and post-transcriptional regulation

Pranay Goel (IISER Pune) Gaping holes: The small worlds of pancreatic islets

Computational neurobiology/systems biology

Ram Rup Sarkar (National Chemical Laboratory, Pune) Study of large biochemical pathways to identify alternative drug targets for different cancers

Suhita Nadkarni (IISER Pune) In-silico experiments on small synapses using Monte Carlo simulations (How to build a synapse from molecules and membranes)

Next gen sequencing/RNA and DNA sequence analysis

Farhat Habib (IISER Pune) Genotype-phenotype correlation in presence of phylogeny

Igor Kurochin (BII, Singapore) Secreted microvesicles and exosomes: cell waste bags or highly informative packages? Computational and experimental insights

Vivek Tanavde (BII, Singapore) Role of miRNA in stem cell differentiation

Leelavati Narlikar (National Chemical Laboratory, Pune) Characterizing the heterogeneity in high-throughput ChIP

10. 35th Annual Meeting of Plant Tissue Culture Association (India) & National Symposium on Advances in Plant Molecular Biology & Biotechnology March 10-12, 2014

National Symposium of Advances in Plant Molecular Biology and Biotechnology was organized in conjunction with the 35th Annual Meeting of PTCA (India). Dr. Anjan Banerjee was the convener and organizer. In all, there were 230 participants in this meeting. A number of eminent plant biologists attended this meeting and delivered talks. A special session on



plant growth and development was also organized during this symposium. The symposium was inaugurated by Prof. K.N. Ganesh, Director, IISER Pune and Prof. J.P. Khurana gave the PTCA Secretary's address. The keynote address was delivered by Prof. K. Veluthambi, Madurai Kamaraj University on "Gene targeting in rice by positive/negative selection knockout of the OsMADS1 gene". There were 51 oral presentations and over 100 poster presentations.

[K. Veluthambi](#) (Madurai Kamaraj University, Madurai) Keynote Address: Gene targeting in rice by positive/negative selection: knockout of the OsMADS1 gene

[H.Y. Mohan Ram](#) (Indian National Science Academy, New Delhi) Prof. H.C. Arya Memorial Lecture 2013-2014: Tracing the beginnings of plant tissue culture research in India

[Paramjit Khurana](#) (University of Delhi (South Campus), New Delhi) Prof. F.C. Steward Memorial Lecture: Molecular regulation of plant somatic embryogenesis



Session I: Emerging Technologies in Plant Cell, Tissue & Organ Culture (Chair: V.A. Bapat)

[I.D. Arya](#) (Arid Forest Research Institute, Jodhpur) In vitro Clonal Propagation of Important desert trees– Kair, Neem, Ardu and Bamboo's
[Varsha A. Parasharami](#) (CSIR-NCL, Pune) Callus and Suspension cultures from fruits of *Ficus religiosa* Linn. : Detection and characterization of Lectin / hemagglutinin activities

[C. Aswath / Dr. Leela Sahijram](#) (Indian Institute of Horticultural Research, Bengaluru) Production of dihaploids in solanaceous vegetable crops with special emphasis on peppers (*Capsicum* spp.)

[Shiveirou Raomai](#) (North-Eastern Hill University, Shillong) In vitro plantlets regeneration using thin cell layer and determination of steroidal saponin content in *Paris polyphylla* Sm., a medicinally important plant

[Shikha Srivastava](#) (Central Institute of Medicinal and Aromatic Plants, Lucknow) Establishment of an efficient callus induction and direct regeneration system in *Decalepis arayalpathra*

Session II: Advances in Plant Transformation (Chair: K.V. Krishnamurthy)
[Subhra Chakraborty](#) (NIPGR, New Delhi) Understanding nutrient-

responsive protein and metabolic networks: Nuptials between genetic engineering and proteomics

[M.V. Rajam](#) (University of Delhi (South Campus), New Delhi) Delayed ripening and improved fruit processing quality in tomato through RNAi-mediated silencing of three homologs of 1 aminopropane-1-carboxylate synthase gene

[D.K. Srivastava](#) (Dr Y. S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh) Agrobacterium-mediated insect resistance gene transfer studies in leaf tissues of Himalayan poplar (*Populus ciliata* wall.)

[Parthadeb Ghosh](#) (Department of Botany, University of Kalyani, West Bengal) A high throughput DNA extraction method from chemotypically heterogenous plant species

[Dipasree Roychowdhury](#) (University of Calcutta, Kolkata) Morphological and molecular characterization of Ri-transformed cultures of *Tylophora indica* (Burm.f.) Merrill

[Renuka Diwan](#) (University of Pune, Pune) Exploring gene transfer capacity of diverse species of bacteria (TransBacter™) in *Ruta graveolens*

[H.N. Verma](#) (Jaipur National University) H.C. Arya Memorial Lecture 2012-2013: Micropropagation of *Boerhaavia diffusa* and *Clerodendrum aculeatum* for production of Resistance inducing proteins and their role in enhancing the growth of explants, shoot proliferation and virus disease management

[P.B. Kirti](#) (University of Hyderabad, Hyderabad) Prof. V.N. Gadgil Memorial lecture: Annexins- Multifunctional Proteins

[H.S. Chawla](#) (G.B. Pant University of Agriculture and Technology, Pantnagar) Prof. F.C. Steward Memorial Lecture: Biotechnology Research: IPR Protection Issues

Session III A: Secondary Metabolites and Metabolic Engineering in Plants (Chair: G.A. Ravishankar)

[B.M. Khan](#) (CSIR-NCL, Pune) Metabolic engineering of medicinal plants with special reference to *Withania somnifera* and *Bacopa monniera*

[P. Giridhar](#) (CSIR-Central Food Technological Research Institute, Mysore) Differential expression of isoflavone synthase genes during elicitor mediated stress in soybean with respect to isoflavones biosynthesis

[Padma Kumar](#) (University of Rajasthan, Jaipur) Isolation, quantification and antimicrobial screening of flavonoids from callus of *Vitex negundo*

[A.B. Nadaf](#) (University of Pune, Pune) Molecular mechanism of 2-acetyl-1-pyrroline biosynthesis in *Pandanus amaryllifolius* Roxb

[Chiranjit Mukherjee](#) (Indian Institute of Technology, Kharagpur) Diversion of metabolic flow from phenylpropanoid biosynthesis to methyl-erythritol 4-phosphate (MEP) pathway in green hairy roots of *Daucus carota* L

[Vithal B. Awad](#) (Interactive Research School for Health Affairs (IRSHA), Bharati Vidyapeeth Deemed University, Pune) Microbial elicitation as yield

enhancement strategy for glycyrrhizic acid production by root cultures of *Taverniera cuneifolia* (Roth) Arn

Session III B: Molecular taxonomy, Diversity, Conservation (Chair: Anand Karve)

Vidya Gupta (CSIR-NCL, Pune) Molecular biodiversity: Issues to address phylogeography

Indra D. Bhatt (G.B. Pant Institute of Himalayan Environment and Development, Almora, Uttarakhand) In vitro approaches for conservation and sustainable utilization of *Habenaria edgeworthii*: a rare medicinal orchid in West Himalaya, India

Veena Agrawal/Kuldeep Sharma (Department of Botany, University of Delhi, New Delhi) Molecular markers assisted selection of male and female plants in dioecious crops with special reference to Jojoba [*Simmondsia chinensis* (Link) Schneider] - a shrub of immense economic importance

Shyamal K. Nandi (G.B. Pant Institute of Himalayan Environment & Development, Almora, Uttarakhand) Propagation and conservation of medicinal plants: Biotechnological approaches

Myo Ma Ma Than (Department of Botany, University of Calcutta, Kolkata) Micropropagation, germplasm conservation and DNA fingerprinting profiles of an endangered orchid *Bulbophyllum auricomum* Lindl

Session IV: Plant and Environment Interactions (Biotic) (Chair: Vidya Gupta)

Ashis Nandi (Jawaharlal Nehru University, New Delhi) Salicylic acid signaling in Arabidopsis: Some missing links

Malay Das (Presidency University, Kolkata) Parasitic plant genome project: A comparative evolutionary approach to study the genetic changes associated with parasitism

Pious Thomas (Division of Biotechnology, Indian Institute of Horticultural Research, Bengaluru) Plant cell and callus cultures show extensive cytoplasmic and periplasmic intracellular colonization by bacterial endophytes

Pamela Jha (DBT-ICT-Centre for Energy Biosciences, Institute of Chemical Technology, Mumbai) Evaluation of remediation of textile dye Acid Red 114 by hairy roots of *Ipomoea carnea* J. and assessment of degraded dye toxicity with the HaCaT cytotoxicity test

Session IV: Plant and Environment Interactions (Abiotic) (Chair: Sujata Bhargava)

Debasis Chattopadhyay (NIPGR, New Delhi) CIPK6- a double-edged sword

P.B. Kavi Kishor (Department of Genetics, Osmania University, Hyderabad) Comparative genomics, cloning and overexpression of Na⁺/H⁺ antiporter (SbNHX) gene in tomato for salt stress tolerance

Pratibha Misra (NBRI, Lucknow) WsSGTL1 gene of *Withania somnifera* conferring abiotic and biotic stress tolerance in transgenic tobacco and *Arabidopsis*

Manisha P. Shinde (National Research Centre for Grapes (NRC-Grapes), Pune) Expression analysis of salinity responsive transcription factors in grapevines (*Vitis vinifera* L.)

Session V: Signalling in Plant Growth and Development (Chair: S. Sopory)

Satish Maheshwari (Jaipur National University, Jaipur) New mysteries of chromatin biology –Pervasive transcription and non-coding RNAs

Utpal Nath (IISc, Bengaluru) Diverse leaf growth allometry and its regulation by miR396

Sourav Datta (IISER Bhopal) The intensity of a pulse of transcription factor synthesis controls cell size in root hairs

Sanjay Kapoor (Delhi University (South Campus)) Regulators of reproductive development in rice

Shree Pandey (IISER Kolkata) Small RNA pathways in plants: evolution and functional specialization for stress adaptation

Ashok Giri (CSIR-NCL, Pune) Biological significance of induced proteinase inhibitor diversity in *Capsicum annuum* (L.)

Sandip Das (Delhi University (North Campus), New Delhi) Mining and analysis of regulatory elements from Brassica species

Ameya Mahajan (IISER Pune) KNOX genes in Potato: The multipurpose regulators of plant development

Sneha Bhogale (IISER Pune) miR156: A potential mobile signal that affect plant architecture and tuberization in potato

11. Biophysics Paschim 6

March 1, 2014

Dr. Chaitanya Athale and Dr. Aurnab Ghose jointly organized a Working Group Meeting “Biophysics Paschim 6” between IISER Pune, TIFR Bombay, NCL Pune, IIT-Bombay, University of Pune and ACTREC Mumbai on March 1, 2014. This meeting included seminars by researchers from the participatory institutes, short talks by PhD students and posters. The meeting was attended by 150 delegates and saw some exciting new results presented, ranging from protein folding (Arijit Bhattacharyay, IISER Pune) to cell mechanics in development (Maythreyi Narasimha, TIFR Bombay).

Session 1: Molecular Biophysics A

Arijit Bhattacharyay (IISER Pune) Non-Boltzmann probability distribution and possibility of its application in protein folding

Suman Chakrabarty (CSIR-NCL Pune) The curious case of Cytochrome c Oxidase: Some simple ideas to approach complex problems
Santosh Kumar Jha (CSIR-NCL Pune) Denaturants unfold proteins by a two-step mechanism

Session 2: Molecular Biophysics B

Ravi Venkatramani (TIFR, Mumbai) Stability and Flexibility of Proteins
Ruchi Anand (IIT Bombay) Structure and mechanism based protein engineering to confer selectivity of a guanine deaminase
Kakoli Bose (ACTREC, Kharghar, Mumbai) Dual regulatory switch modulating HtrA2 proteolytic activity: tighter control?
S.S. Soumya (IIT Bombay) Trypsin assisted de-adhesion dynamics: How much of cell mechanics can we learn?
Priyabrata Panigrahi (CSIR-NCL Pune) Redesign – An Integrated protein engineering interface
Anand Das (TIFR, Mumbai) Distinct segments of amyloid beta mediate initial steps of toxicity in Alzheimer's Disease
Shibdas Banerjee (TIFR, Mumbai) Selective Deletion of the internal lysine residue from the peptide sequence by collisional activation
Chaganti Lalit (ACTREC, Mumbai) Discerning the molecular mechanism HtrA2 and PEA15 interaction
Manasi Gangan (IISER Pune) Cell length variability in the clonal populations of E. coli
Mandar Kulkarni (IISER Pune) The B-DNA to A-DNA transition: Interplay of entropy and water

Session 3: Cellular Biophysics

Maithreyi Narasimha (TIFR, Mumbai) Assemble, align, polarise, synchronise: How cytoskeletal networks drive cell behaviour
Ranjith Padinhateeri (IIT, Mumbai) Mathematical modelling of amyloid filament kinetics

12. Workshop on NGS Analysis

February 24-27, 2014

A workshop on NGS Analysis was organized along with Persistent Systems Ltd. This comprehensive workshop was aimed to provide hands-on genomics data analysis to biologists with none or limited basic bioinformatics experience. Workshop provided an introduction to data analyses and quality control, and tools and resources for genomics and transcriptomics analysis of NGS data. The workshop had a balanced mix of lectures and discussion with case studies from life science research by

eminent scientists working in the area of genomics and computer-based practical sessions. The event was attended by 30 participants from industry and academia and received very good feedback. The entire event was covered by IISER radio and was broadcast on University of Pune's community radio Vidyavani 107.4 FM. The workshop was coordinated by Prof. Sanjeev Galande and Dr. Farhat Habib.

[Mitali Mukerji](#) (IGIB, Delhi) NGS: Cues and Clues

[Amit Dutt](#) (ACTREC, Mumbai) Integrated Cancer Genomics Approach to Identify Driver Alterations in Individual Samples

[Krishanpal Karmodiya](#) (IISER Pune) A tale of two histone tail modifications

[Amol Kolte](#) (IISER, Pune) Short talk: RNASeqdata analysis

[K. Thangaraj](#) (CCMB, Hyderabad) Human origin, health and disease in India: Genomic perspectives

[Farhat Habib](#) (IISER Pune) Short Reads and assembly

[Vineet Sharma](#) (IISER Bhopal) Systemic understanding of our microbial planet through metagenomics: Computational challenges

[Anamika Krishanpal](#) (Persistent Systems, Pune) SanGeniX: A comprehensive NGS data analysis solution

Training sessions: Unix commands; file formats, Quality Control; Mapping and alignment; Genome Variant detection; SanGeniX; ChIP-seq; SanGeniX; RNA-seq; SanGeniX; Assembly; Transcriptomics; SanGeniX

13. Asian Conference on Raptor Research

February 6-7, 2014



The 8th Asian Raptor Research Conservation Network (ARRCN) Symposium Conference was held during February 6-7, 2014 at the Institute. This is the first Symposium to be held in India and was organized by Ela Foundation, Pune and ARRCN with the theme "Raptor Conservation and Culture". IISER Pune provided the logistic support for accommodation and conference facilities for this Symposium. The Symposium was inaugurated by Shri Rishad Naoroji, Director, Raptor Research and Conservation Foundation. Department of Posts, Govt. of India released a special cover on this occasion. More than 70 delegates from 20 countries participated in this symposium.

14. International Symposium on Protein Structure, Function and Dynamics January 30, 2014

This international symposium was co-organized by IISER Pune, NCL and NCCS Pune. Eminent structural biologists and protein chemists from India and U.K. presented their research work to an audience of researchers and students from IISER Pune, NCL, NCCS, University of Pune, IIT Mumbai and colleges from Pune.

Proteins: Folding and Dynamics

[R.V. Hosur](#) (TIFR, Mumbai, India) Understanding Protein Folding Landscape by NMR

[Arwen Pearson](#) (University of Leeds, UK) Getting the most out of a diffraction experiment: combining X-ray crystallography with complementary methods

[K.N. Ganesh](#) (IISER Pune, India) Collagen triplex: The tale of two prolines

Structural Biology of Cellular Processes

[R. Sankaranarayanan](#) (CCMB, Hyderabad, India) Chiral proofreading during translation of the genetic code

[B. Gopal](#) (IISc, Bengaluru, India) Structural studies on the mechanisms that couple environmental stimuli with bacterial transcription

[Lori Passmore](#) (MRC Laboratory of Molecular Biology, Cambridge, U.K.) The end of the message: Insights into mRNA 3'-end processing and transcription termination

Structural Biology in Biomedicine

[Amit Sharma](#) (ICGEB, New Delhi, India) Insights into inhibitor discovery against malaria parasite proteins

[Ravi Acharya](#) (University of Bath, U.K.) Power of structural biology tools in tackling problems related to human health and disease

[C.G. Suresh](#) (NCL, Pune, India) Structure-function studies of some N-terminal nucleophile hydrolases, their evolution and application potential

Molecular Pathogenesis

[Susan Lea](#) (University of Oxford, U.K.) Complementary approaches applied to study bacterial secretion systems

[Steve Matthews](#) (Imperial College, London, U.K.) Atomic resolution insight into host-pathogen interactions

[Shekhar Mande](#) (NCCS, Pune, India) Very high resolution structure of M. tuberculosis NrdH

15. Indo-U.K. Scientific Seminar on Complementary Approaches in Structural Molecular Biology January 27-29, 2014

The aim of this seminar coordinated by Dr. Saikrishnan Kayarat was to discuss the latest developments in the field of structural biology and to promote interaction, collaboration and networking amongst researchers from India and U.K. The 20 participating researchers shared their expertise in diverse yet complementary fields of research applied for understanding the structure and function of biomolecules. The fields included X-ray crystallography, electron cryomicroscopy, spectroscopic techniques such as NMR and resonance Raman, super-resolution microscopy, and computational and systems biology.

Session A: Dissecting molecular mechanisms

[Sunando Datta](#) (IISER Bhopal) Emerging roles of Vps components in Rab7 mediated endosomal recruitment of core retromer complex

[Radha Chauhan](#) (NCCS, Pune) Structural and functional basis of the nuclear pore complex assembly and functions

[Kiran Kulkarni](#) (CSIR-NCL, Pune) Regulation of Rho GTPases by DOCK guanine nucleotide exchange factor

[Janesh Kumar](#) (NCCS, Pune) Assembly mechanisms of glutamate receptor ion channels

Session B: Visualizing molecular machines

[Susan Lea](#) (Sir William Dunn School of Pathology, Oxford) Complementary approaches applied to study bacterial secretion systems

[Lori Passmore](#) (MRC LMB, Cambridge) Towards understanding the molecular mechanisms of important cellular machines

[Partha Datta](#) (IISER Kolkata) Investigating dynamics of ribosome-factors interactions by cryo-EM

Session C: Spectroscopy in structural biology

[Sudipta Maiti](#) (TIFR, Mumbai) The close relationship between molecular conformation, aggregation, toxicity of amyloid beta

[Mrinalini Puranik](#) (IISER Pune) Substrate distortion by enzymes of the purine salvage pathway

[Arwen Pearson](#) (University of Leeds) Getting the most out of a diffraction experiment: combining X-ray crystallography with complementary methods

[Jeetender Chugh](#) (IISER Pune) Visualizing transient structures in A-site RNA of the ribosome



Session D: Computational approaches, systems biology and structural bioinformatics

Nagasuma Chandra (IISc, Bengaluru)

Structure-based function annotation of the mycobacterial proteome

M.S. Madhusudhan (IISER Pune)

Modeling the 3D structures of proteins and their complexes

Session E: Modulation of nucleic acid by proteins – structural approaches

Rahul Roy (IISc, Bengaluru) Biology, one molecule at a time

Saikrishnan Kayarat (IISER Pune)

Structure of a Type I restriction-modification enzyme bound to its target DNA sequence

Session F: Structural Biology in biomedicine

Steve Matthews (Imperial College, London) Atomic resolution insight into host-pathogen interactions

B. Gopal (IISc, Bengaluru) Structural basis for the diverse mechanisms that regulate Mycobacterium tuberculosis σ factor/anti- σ complexes

Amit Sharma (ICGEB, New Delhi) Insights into inhibitor discovery against malaria parasite proteins

K. Ravi Acharya (University of Bath, U.K.) Power of structural biology tools in tackling problems related to human health and disease

16. Hippocampus: From Synapses to Behavior

December 1-3, 2013

This international workshop was sponsored by the Indian National Node for Neuroinformatics (INNI), an International Neuroinformatics Coordinating facility during December 1-3, 2013 and was co-organized by Dr. Collins Assisi and Dr. Suhita Nadkarni. Several international experts who study hippocampus gave fascinating talks over three days. Due to its pedagogical structure, it was attended by more than 200 participants. As an outreach effort by the IISER Pune Science Media Center, interviews of the visiting eminent scientists were broadcast on IISER Science radio program on Vidyavani 107.4 FM.

Mayank Mehta (University of California, Los Angeles) Multisensory control

of hippocampal activity and multimodal behavior

[Rishikesh Narayanan](#) (Indian Institute of Science, Bengaluru) Active dendrites regulate spectral selectivity in spike initiation dynamics of hippocampal model neurons

[Sujit Sikdar](#) (Indian Institute of Science, Bengaluru) Electrophysiological studies on hippocampal subicular neurons and 2D neuronal networks.

[Tom Bartol](#) (Salk Institute for Biological Studies, La Jolla, California) How to build a synapse from molecules, membranes and Monte Carlo methods

[Vidita Vaidya](#) (Tata Institute of Fundamental Research, Mumbai) Early life stress and long lasting effects on neurogenesis, BDNF expression and cognition

[Sourav Banerjee](#) (National Brain Research Center, Manesar) Braking the silence at synapse : Regulatory mechanisms of neuronal connectivity and plasticity by non-coding RNA and ubiquitin proteasome system

[Trygve Solstad](#) (Norwegian University of Science and Technology, NTNU, Trondheim, Norway) Neural code for spatial localization

[Hiroshi Ito](#) (Norwegian University of Science and Technology, NTNU, Trondheim, Norway) A neural circuit for trajectory-dependent firing in hippocampal place cells

[Collins Assisi](#) (Indian Institute of Science Education and Research, Pune) Spatiotemporal patterning of neural activity by inhibitory networks

[Suhita Nadkarni](#) (Indian Institute of Science Education and Research, Pune) Sophisticated Synapses - a quantitative insight into complex components of neuronal networks

[B.S. Shankarnarayana Rao](#) (National Institute of Mental Health and Neurosciences, Bengaluru) Restoration of Hippocampal Synaptic Plasticity and Cognitive Functions in Stress and Depression

[Jonaki Sen](#) (Indian Institute of Technology, Kanpur) Insights gained from chick embryo about the development of the hippocampus

[Upi Bhalla](#) (National Center for Biological Sciences, Bengaluru) Watching memories form, by imaging hippocampal activity during learning

[Kechen Zhang](#) (Johns Hopkins University, Baltimore, Maryland) Computational mechanisms of spatially correlated activities in the hippocampus



17. Symposium on Evolution of Human Cognition

November 17-19, 2013

The nature of human cognition is one of the oldest and greatest unsolved mysteries. With the agenda of discussing current ideas and generating new

testable hypotheses to understand the evolution of human cognition, a select group of researchers working on various aspects of cognition met at a symposium on Evolution of Human Cognition at IISER Pune in November 2013. The meeting, coordinated by Prof. L.S. Shashidhara, consisted of an introductory session, 11 discussion sessions and a closing session. In



order to promote greater interaction, each discussion session consisted of a 45 minute talk by one of the researchers, followed by 30 minutes of discussion on the subject of the lecture and its relation to the broader questions on the origins of the human mind.

[Ajit Varki](#) (San Diego, La Jolla, California) Introduction and Overview of Human Evolution

[Tetsuro Matsuzawa](#) (Primate Research Institute, Kyoto University, Japan)

Discussion Theme 1: Exploring the Mind of the Chimpanzee

[Anindya Sinha](#) (National Institute of Advanced Studies, Bengaluru)

Discussion Theme 2: Social Cognition and Experiential Knowledge in Nonhuman Primates

[Carel van Schaik](#) (Anthropological Institute and Museum, Universitat Zurich, Zurich) Discussion Theme 3: How Natural Selection Favors Increased Brain Size: Implications for Hominin Evolution

[Sumantra Chattarji](#) (NCBS, Bengaluru) Discussion Theme 4: Erring on the side of caution: from behavior to circuits and cells

[Govindan Rangarajan](#) (Department of Mathematics, Indian Institute of Science, Bengaluru) Discussion Theme 5: Analyzing Functional Connectivity Patterns of the Brain

[Patricia Kuhl](#) (Institute for Learning and Brain Sciences, University of Washington, Seattle) Discussion Theme 6: The Scientist in the Crib: early Development of the Human Mind

[Aditya Murthy](#) (Centre for Neuroscience, Indian Institute of Science, Bengaluru) Discussion Theme 7: How our Brains Control our Actions

[Andrew Meltzoff](#) (Institute for Learning and Brain Sciences, University of Washington, Seattle, U.S.A.) Discussion Theme 8: The Developmental Origins of Theory of Mind

[Ajit Varki](#) (San Diego, La Jolla, California) Discussion Theme 9: Mind over Reality Theory for Evolution of the Modern Human Mind

[Thomas Metzinger](#) (Johannes Gutenberg-Universitat Mainz, Mainz, Germany) Discussion Theme 10: The Ego Tunnel: Body Representation and Self-Consciousness

Nicholas Humphrey (London School of Economics, London & Darwin College, Cambridge) Discussion Theme 11: Nature's Hidden Persuaders: Self-regulation and the Placebo Effect

Ajit Varki (San Diego, La Jolla, California) Summary

Vijayalakshmi Ravindranath (Centre for Neuroscience, IISc, Bengaluru) Closing Remarks: Opportunities for human cognition research in India

18. Principles of Autonomous Neurodynamics: The 10th Annual Meeting of the Society for Autonomous Neurodynamics (SAND)

August 5-7, 2013

This meeting had an interesting mix of talks that spanned mathematical modeling of neurological disorders, spatial navigation, neuroepistemology and the 'art brain'. It was an out of the box meeting that allowed the visiting scientists and students (from Poland, USA and Canada) to have long and interesting interactions with the faculty and students of IISER Pune. The meeting was coordinated by Dr. Suhita Nadkarni.

Elan Ohayon A brief primer on Autonomous Neurodynamics & SAND

Session 1: Networks and Complexity: Theory, Clinical Implications & Behavior (Chair: Ann Lam)

Collins Assisi (IISER Pune) Topological Constraints on the Dynamics of Neuronal Networks

Piotr Suffczynski Critical Transitions in Epilepsy

Berj Bardakjian Spatial Coherence Patterns of Slow Interictal Oscillations in the Human Brain

Raghav Rajan Initiating Complex Learned Movements: Lessons from a Song Bird Discussion

Session 2: Complex Activity: Mechanisms and Analysis (Chair: Bhushan Kapur)

Raghav Rajan Initiating Complex Learned Movements: Lessons from a Song Bird Autonomous

Marc Koppert Computational Neuronal Models of Epileptic Seizure Dynamics

Maciej Labecki Time Evolution of Steady State Visual Evoked Potentials

Stiliyan Kalitzin Multiple Oscillatory States in Models of Collective Neuronal Dynamics

Session 3: Autonomy through Scientific Practice and Art (Chair: Piotr Suffczynski)

Ann Lam Foundations of Green Neuroscience
Vivian Reiss The Dynamics of Art and the Beauty of Freedom

Session 4: Clinical Perspectives: Theory and Applications (Chair: Alisa Munoz)

Bhushan Kapur Formic acid is a fetal neurotoxin in alcohol abusing pregnant women

Peter Carlen Metabolic Presynaptic Terminal Dysfunction in Ictogenesis

Suhita Nadkarni Investigating Calcium Signal Remodeling in Alzheimer's Disease

Session 5: Knowledge and Creativity (Chair: Stiliyan Kalitzin)

Karuvannur Mohanan Neuroepistemology and How the Brain Creates Knowledge: A Wishlist Speaker Creating for the Self or for Others?

Session 6: Atoms, Molecules and Evolution (Chair: Marc Koppert)

Sudha Rajamani Origin of Informational Molecules on Prebiotic Earth

Shiva Patil TBA (On Nano-Mechanics of Lipid Bi-Layers and Cell Membrane)

Ann Lam Atomic Neuroscience: Electron Flows in Metals and Mind

Aurnab Ghose Neuromodulation of the Feeding Drive: A Fishy Story

Milind Watve Eco-Neuro-Behavior: The Missing Link in Our Understanding of Complex Disorders

Session 7: Dynamics, Embodiment and Feedback

Pranay Goel Synchronization and Frustrated Waves in Homogenized Models of Bursting in Pancreatic Islets of Langerhans

Elan Ohayon On Developing Open, Green and Autonomous Principles for Embodied Network Modeling

Alisa Munoz Music and EEG: Toward a Personalized Neurofeedback Approach

Chaitanya Athale Simulating Neuronal Microtubule Dynamics in Aplysia Growth Cone Polarization: Testing the Limits

Session 8: Neuromodulators & Discussion

Nishikant Subhedar (On Neuromodulators)

Ann Lam & Stiliyan Kalitzin: Facilitators for Round Table on the Art of being Free

Elan Ohayon & Suhita Nadkarni Facilitators for Round Table on Future Meetings and Collaborations

19. A Banquet of Biological Research: The First IISER Biology Annual Talks July 29-31 2013

The First Annual Talks in Biology. The dates were synchronized with the joining dates of the new batch of Ph.D. students so that they would get an overview of Biology@IISER Pune.



A Banquet of Biological Research

Biology Annual Talks (29-31st July, 2013)

29th July (Monday)

9:15 – 9:30	Kick Off (Shashi)
9:30 – 10:00	LS Shashidhara
10:00 – 10:30	Thomas Pucadyil
10:30 – 11:00	Sai Krishna Kayarat
11:00	Posters A
11:30 – 12:00	Mayurika Lahiri
12:00 – 12:30	Mrinalini Puranik
12:30 – 1:00	Deepak Barua
1:00	Lunch & Posters A
3:30 – 4:00	Collins Assisi
4:00 – 4:30	Raghav Rajan
4:30	Posters A
5:00 – 5:30	Gayathri Pananghat
5:30 – 6:00	Jeetender Chugh
6:00 – 6:30	Richa Rikhy
6:30 – 7:00	Chittaranjan Yajnik
7:00	Departmental Dinner

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20. Workshop and Symposium on 100 Years of X-Ray Diffraction XRD January 19, 2013



A two day workshop on Powder Diffraction and Small Angle X-ray/Neutron Scattering was organized for Ph.D. students from IISER Pune, NCL, and University of Pune. This workshop focused on introducing students to x-ray diffraction and small angle scattering and on providing them with a theoretical background and hands-on-experience of data analysis using the technique of

Rietveld refinement of powder diffraction data. The workshop was addressed by Sunil Nair, Vaidyanathan, IISER Pune; P.D. Babu, from UGC-DAE-CSR, Mumbai; V.K. Aswal, S.K. Deshpande, S.N. Chary, BARC, Mumbai.

A half-day workshop on XRD was conducted on 19th January 2013, in association with NCL and NCCS, to commemorate the 100 years of X-ray diffraction, for the benefit of undergraduate and post-graduate students. Distinguished X-ray crystallographers like Prof. M. Vijayan, Prof. D.D. Sharma and Prof. Ashwin Nangia spoke in the workshop. The workshop was video-recorded by students of IISER Pune and was telecast on the Loksabha channel on January 31, 2013.

[M. Vijayan](#) (IISc, Bengaluru) X-ray Crystallography. Mineralogy to Biology
[D.D. Sarma](#) (IISc, Bengaluru) XRD and EXAFS: Two complementary approaches for a more complete understanding
[Ashwini Nangia](#) (Univ. of Hyderabad) From Polymorphs to Pills
[Saikrishnan Kayarat](#) (IISER, Pune) Enlightening Biology by X-ray crystallography
[Radha Chauhan](#) (NCCS, Pune) X-ray crystallography in Medicine: Achievements and Challenges

21. IISER-NISER Meeting

July 21-22, 2012

A two day meeting of Biology faculty from all five IISERs (Pune, Mohali, Bhopal, Trivandrum, Kolkata) and NISER-Bhubaneswar was organised at Sai-Trinity Building building of IISER Pune. The goals of the meeting included exchange of ideas and discussions on teaching and research along with formation of groups that would plan collaboratory projects in the future. The Meeting was funded by a DBT grant that encouraged travel and interactions between the newly established IISERs and NISER. 80 faculty participants attended the meeting.

The first day of the meeting involved talks from 1 representative from each institute after which participants were grouped into 6 subgroups. The subgroups held individual meetings to discuss collaborations and an agenda for a subgroup meeting to be held within 6 months.

22. Cell Compartmentation, Division & Signaling

April 10-11, 2012

This scientific meeting was organized by Dr. Kundan Sengupta at IISER Pune along with discussions with the visiting delegation consisting of Vivek Malhotra (Head, Cell & Developmental Biology, Center for Genomic Regulation, Barcelona, Spain); Tom Misteli (Head, Cell Biology of Genomes Group & Senior Investigator, National Cancer Institute (NCI), National Institutes of Health (NIH) U.S.A.) and Chief Editor of Journal of Cell Biology); Tarun Kapoor (Head, Laboratory of Chemistry and Cell Biology, The Rockefeller University, U.S.A.); Liz Williams (Executive Editor, Journal of Cell Biology, USA); Karin Dumstrei (Senior Editor, EMBO Journal, Heidelberg, Germany, Senior Editor, EMBO Journal, Heidelberg, Germany). The meeting included talks and panel discussion interactions with delegates and students of IISER Pune. A panel discussion was on Challenging Career moves after PhD was held.

[Vivek Malhotra](#) (Cell & Developmental Biology, Center for Genomic Regulation, Barcelona, Spain) Collagen Secretion and Disease

[K.N. Ganesh](#) (IISER Pune) Collagen Analogs: Structure and Properties

[Nagaraj Balasubramanian](#) (IISER Pune) Cell Adhesion Dependent Regulation of Trafficking

[Thomas Pucadyil](#) (IISER Pune) Mechanistic Insights into Membrane Fission Gained Through Reconstitution

[Srinivas Hotha](#) (IISER Pune) 3G: Gold-catalyzed Glycosidation for Glycoconjugates Synthesis

[Shivprasad Patil](#) (IISER Pune) Mechanical Properties of Interfacial Water

[Sanjeev Galande](#) (IISER Pune) Signalling to Chromatin: Tale of a Genome organizer

[Kundan Sengupta](#) (IISER Pune) Transcriptional Consequences of Aneuploid Chromosomes

[Tom Misteli](#) (Cell Biology of Genomes Group & Senior Investigator, National Cancer Institute (NCI), National Institutes of Health (NIH) U.S.A.) Genome Architecture and Disease

[S. Ramaswamy](#) (Institute for Stem Cell Biology and Regenerative Medicine, Bengaluru) Ubiquitin regulates signaling by NOD1 and NOD2

[Girish Ratnaparkhi](#) (IISER Pune) SUMOylation in the innate immune response

[Richa Rikhy](#) (IISER Pune) Cellular Mechanisms Controlling Origin of Plasma Membrane Polarity in Embryogenesis

[Peter Rubenstein](#) (University of Iowa, U.S.A.) Regulation of Actin Polymerization by Profilin and Formin

[Karin Dumstrei](#) (Senior Editor, EMBO Journal, Heidelberg, Germany) A

Behind the Scenes Look at Scientific Publishing

Liz Williams (Executive Editor, Journal of Cell Biology, U.S.A.) What's in a Picture? The Temptation of Image Manipulation

Tarun Kapoor (Laboratory of Chemistry and Cell Biology, The Rockefeller University, U.S.A.) Examining Mechanisms Required for Error-free Cell Division

23. International Conference on Mathematical and Theoretical Biology

January 23-27, 2012

The Society for Mathematical Biology (SMB) is an international society which exists to promote and foster interactions between the mathematical and biological sciences communities through membership, journal publications, travel support and conferences. (For a short history see http://www.smb.org/governance/smb_history.shtml.) Its international World Outreach programme is responsible for starting several national societies in different countries to spread this highly interdisciplinary area among larger communities.

An International Conference on Mathematical and Theoretical Biology was organized by IISER Pune and actively supported by the SMB, an international society to promote and foster interactions between mathematical and biological science communities and Center for Mathematical Biology at Indian Institute of Science, Bengaluru. It brought together more than 150 scientists and students from India and abroad to discuss recent advances in mathematical and theoretical biology, and also



to interact with each other. Apart from plenary talks by Indian and international speakers, there were several parallel Mini-symposia held on Pattern formation, Physiology/Neurobiology, Bioinformatics and Computational Biology, Ecology and Epidemiology, Education, Genetics and Evolution, Intracellular processes (genetic and biochemical networks), Oscillations and Chaos (Dynamical Systems), Stochastic Processes and more. This meeting was a key conference in a series of several workshops and symposia that have been centered on mathematical biology in the past several years.

With several researchers actively pursuing this field in the twin cities of Pune and Mumbai (at IISER Pune, NCL, IIT Bombay, Piramal Life Sciences), the region is emerging as a leading center for the pursuit of mathematical and theoretical biology in the country.

25. Indo-U.K. International Scientific Seminar August 27-28, 2011

An Indo-UK meeting on “Neurobehavioral origins of metabolic syndrome disorders – testing the hypothesis and discussing its implications” was held on August 27 & 28, 2011. The neurobehavioral origins of metabolic syndrome disorders hypothesis was proposed by Watve and Yajnik in 2007. It proposes that metabolic dysfunction in modern day humans can be traced to ecological and evolutionary roots, with the behavioural manifestation of aggression playing central role. The objective of the meeting was to bring together a diverse team of investigators from the UK and India to rigorously debate the issue, identify specific predictions made by the hypothesis and design collaborative research studies which could test such predictions.

The meeting was coordinated by Prof. Milind Watve of IISER Pune and Dr Jason Gill, Institute of Cardiovascular and Medical Sciences, College of Medical, Veterinary and Life Sciences, West Medical Building, University of Glasgow, Glasgow, Scotland, U.K.

The meeting was attended by four researchers from U.K. and 23 from various research organization from India who discussed and debated a variety of issues related to the new hypothesis, a comparative evaluation of the old and the new way of thinking, the possible new lines of research stimulated by the new insights and ways to test the predictions of the hypothesis. The meeting could set-up an inter-disciplinary dialogue between scientists from a number of diverse fields to discuss factors leading to metabolic dysfunction. This enabled outside-the-box thinking

which has generated novel testable hypotheses on the causes of metabolic dysfunction in humans. Many possible collaborations were visualized during the meeting and some new project proposals were conceptualize.

The discussions on the meeting also contributed to a book by Prof. Milind Watve entitled “Doves, Diplomats and Diabetes: a Darwinian reinterpretation of type 2 diabetes and related disorders” which is due to be published later in 2012. A new strategic link has been established between the University of Glasgow and Indian Institute of Science Education and Research, Pune, which will facilitate future collaborations between the two institutions.

26. Workshop and Symposium on Mathematical Physiology

January 15-23, 2011

Although the field of mathematical biology has been around for decades, it has received a new recognition in recent times. Researchers from various fields, from mathematics, physics, chemistry and engineering are now interested in problems originating in the biosciences. Further, given a global push to increase quantitation in biology as well as the necessity to manage experimental data using mathematical and theoretical models, biologists often now tackle experiments within interdisciplinary frameworks. In India, although there are a number of excellent groups engaged in research in mathematical biosciences, there is a shortage of people trained in these disciplines.

To offset this difficulty, and to bolster leading-edge research in mathematical biosciences, the DST Center for Mathematical Biology at IISc, the IISc Mathematics Initiative (IMI) and several research/academic institutions including Andhra University, CCMB Hyderabad, IISc Chennai, IISER Pune, IISER Kolkata, IIT Kanpur, NCL Pune, Piramal Life Sciences and Purdue University, USA, have organized nine workshops and symposia on various topics throughout the year at various places in the country. A workshop and symposium on Mathematical Physiology was



held at IISER Pune as part of this program between January 15 and 23, 2011.

This meeting was attended by over 40 participants from all over the country. A week-long workshop introduced numerous topics including metabolism, neural and pancreatic excitability, calcium dynamics, chronobiology, vision and cardiac modelling. The workshop was followed by a two-day symposium.

27. Imaging the Nervous System: Third SERC School in Neuroscience

December 7-21, 2009

About 25 young researchers were selected to participate at this School supported by DST with the aim of promoting excellence in the field of Neurosciences in India. Following 3 days of orientation, various aspects of imaging were taught by renowned experts in the field. In addition to the talks listed below, participants had hands-on training in the following: Techniques and applications of immunofluorescence and immunostaining in the study of neuronal architecture ii) Live imaging of neurons iii) Timelapse video microscopy iv) Confocal microscopy v) Spinning disc confocal microscopy vi) 3D Deconvolution vii) Principle of image acquisition and analysis viii) Analysis of fMRI data



[K.S. Krishnan](#) (NCBS, Bengaluru) Brain and behavior
[M.K. Mathew](#) (NCBS, Bengaluru) Electrical signaling in the neuron - I and II

[Vidita Vaidya](#) (TIFR, Mumbai) 1) Neuroplasticity – a lifelong dialogue between your brain and the environment 2) Making new neurons in the adult brain

[N.K.Subhedar](#) (IISER, Pune) Synaptic transmission and neurotransmitters - I and II

[Aditya Murthy](#) (CNS, IISc, Bengaluru) Introduction to

the visual system

[Sudipta Maiti](#) (TIFR, Mumbai) 1) Confocal and beyond: theory and application 2) Basic principles of multiphoton microscopy

[Krishanu Ray](#) (TIFR, Mumbai) 1) Neuronal development 2) Light and electron microscopy 3) Digital image acquisition and image analysis

[Brian M. Salzberg](#) (University of Pennsylvania, School of Medicine, Philadelphia, PA, U.S.A.) 1) Optical Recording of Membrane Potential Using Voltage-Sensitive Dyes in Invertebrate Systems 2) Optical



Recording of membrane Potential Using Voltage-Sensitive Dyes in Mammalian Systems 3) Intrinsic Optical Signals Arising in Mammalian Nerve Terminals. 4) Optical and Mechanical Signals from Mammalian Nerve Terminals (and 2 Photon Recordings of Action Potentials 150 Microns Deep in the Brain)

[Lawrence Cohen](#) (School of Medicine, New Haven, Connecticut, U.S.A.) 1) Optical recording of brain activity: calcium sensitive dyes 2) Voltage sensitive dye recording:

membrane potential in the processes of individual neurons 3) Voltage and calcium sensitive proteins: photostimulation 4) Attempts to understand the function of the olfactory bulb in odorant processing

[Yevgeniy B. Sirotni](#) (Columbia University, New York) 1) Blood, brain and the BOLD signal 2) fMRI and other functional imaging modalities 3) BOLD: Getting data and interpreting the results 4) Data Analysis tutorial

[Aniruddha Das](#) (Columbia University, New York) 1) Positron emission tomography I 2) Positron emission tomography II 3) Task Anticipation and Visual Processing in Primary Visual Cortex

[Roland Strauss](#) (Johannes Gutenberg-University Mainz, Germany) 1) Oriented walking and climbing in flies and robots 2) The central complex and its functions in *Drosophila* 3) Over Hill and Dale with Flies and Robots

[Vinod Kumar](#) (Department of Zoology, University of Delhi, Delhi) Neurobiology of circadian rhythms

[Aurnab Ghose](#) (IISER Pune) Optogenetics

[N.R. Jagannathan](#) (All India Institute of Medical Sciences, New Delhi) 1) Magnetic Resonance- I: Basics of imaging 2) Magnetic Resonance- II: Spectroscopy – understanding the disease processes at the molecular level 3) Magnetic Resonance- III: Application of MRI and MRS to experimental model systems

[Mriganka Sur](#) (Massachusetts Institute of Technology, USA) 1) Cortical plasticity and dynamics 2) Brains, Computers and Intelligence

[Rahul Kulkarni](#) (Deenanath Mangeshkar Hospital and Research Center, Pune) Electro-encephalography – theory and application

[Joshita Singh](#) (Deenanath Mangeshkar Hospital and Research Center, Pune) Principles and applications of CT

[Satyajit Mayor](#) (NCBS, Bengaluru) Only connect: how cells tune-in via multiple mechanisms of endocytosis – I and II

30. Mini Symposium in Systems Biology: Cellular Biomechanics & Bioengineering June 19, 2009

Sameer Shah (Fischell Department of Bioengineering, Neuroscience and Cognitive Science Graduate Program (NACS), University of Maryland, College Park, U.S.A.) Disruption of axonal transport and cytoskeletal instability due to oxidative stress

Makarand Risbud (Department of Orthopaedic Surgery and Graduate Program in Tissue Engineering & Regenerative Medicine, Thomas Jefferson University College of Medicine, Philadelphia, U.S.A.) Osmotic regulation of intervertebral disc cell survival and function: Role of TonEBP/NFAT5

Shivprasad Patil (IISER Pune) Force Microscopy imaging of individual protein molecules with sub-piconewton force sensitivity using higher flexural modes of the cantilever

31. IISER (India)-SOKENDAI (Japan) Lecture Workshop on Trends in Modern Biology October 24-25, 2008

This lecture workshop was designed for students of Biology who are in advanced stages of graduation or pursuing Masters degree in Biology jointly organized by Indian Institute of Science Education and Research Pune (<http://www.iiserpune.ac.in>) and The Graduate University for Advanced Studies, Japan (SOKENDAI; <http://www.soken.ac.jp/en/>).



K.N. Ganesh (IISER Pune) and Hiroyuki Sasaki (National Institute of Genetics, Japan): Opening Remarks

Norihiro Sadato (National Institute for Physiological Sciences, Japan) Plasticity in the human brain regions revealed by functional neuroimaging techniques

Vidita Vaidya (TIFR, Mumbai) Mapping melancholy with motherless mice

Anuradha Ratnaparkhi (Agharkar Research Institute, Pune) A *Drosophila* model of ALS: human ALS-associated mutation in VAP33A suggests a dominant negative mechanism

Mayurika Lahiri (IISER Pune) The DNA damage surveillance pathway in human

pathologies

[Girish Ratnaparkhi](#) (IISER Pune) Gene regulation by *Drosophila* Dorsal interacting proteins

[Ryuji Kodama](#) (National Institute for Basic Biology, Japan) Cellular mechanism of insect wing morphogenesis

[Minoru Tanaka](#) (National Institute for Basic Biology, Japan) Importance of Germ Cells in Sexual Differentiation

[Krishanu Ray](#) (TIFR, Mumbai) Sperm development in *Drosophila*: A model to study the cell biology of male fertility

[Sutirth Dey](#) (IISER Pune) Space matters: Metapopulation dynamics of *Drosophila melanogaster*

[Arijit Bhattacharyay](#) (IISER Pune) A mathematical model for dynamic phase transitions in cell spreading

[Akatsuki Kimura](#) (National Institute of Genetics, Japan) Mathematical modeling of intracellular architectures in animal cells

[Surendra Ghaskadbi](#) (Agharkar Research Institute, Pune) Pattern forming genes in Hydra: insights into evolution of developmental mechanisms

[Kiyoshi Naruse](#) (National Institute for Basic Biology, Japan) Genome sequence of a new model fish, Medaka: insights into the chromosomal evolution and gene evolution

[Parag Sadhale](#) (IISc, Bengaluru) Genome wide studies lead to paradigm shift in understanding transcriptional regulation

[Hiroyuki Sasaki](#) (National Institute of Genetics, Japan) Epigenetics and small RNAs in mammalian germ cells

[Sanjeev Galande](#) (National Centre for Cell Science, Pune) New player in the Wnt signaling: Global regulator SATB1 recruits beta-catenin and mediates Wnt/beta-catenin response.

[Anjan Banerjee](#) (IISER Pune) Moving a signal mRNA through Phloem superhighway

[Tatsumi Hirata](#) (National Institute of Genetics, Japan) Axon outgrowth inhibition mediated by a growth cone membrane protein

[Aurnab Ghose](#) (IISER Pune) Cell biological logic of axon guidance: insights from a single receptor

[Hiroyuki Sasaki](#) (National Institute of Genetics, Japan): About SOKENDAI

32. Meetings/Workshops carried out under the Maharashtra Gene Bank Programme

PI – Prof. Milind Watve

The RGSTC funded Maharashtra Gene Bank (MGBP) project takes a broad view and design a live gene bank with both in situ and ex situ components. The project idea was conceived by Late Dr. Vasant Rao Gowarikar and Prof

Madhav Gadgil and later it was promoted by current chairman of the RGSTC, GOM, Dr. Anil Kakodkar. The work focuses on networking with a diversity of agencies in the country and within the state, making special efforts to reach out to people at the grassroots. The work areas include marine biodiversity of invertebrates and associated microorganisms, indigenous crop diversity, grassland biodiversity, community forest eco-restoration and local domestic animal varieties. The component groups implementing the project are diverse and range from government institutions across the state and also smaller non-government organizations working in specific districts of the state. The approach to work is equally diverse. On the one hand, it will consist of technology intensive components such as cryopreservation, culture collection, molecular characterization, chemical diversity and bio-prospecting. On the other hand, it will reach out to people throughout the state and involve tribal villages, farmers, fishermen, pasteurers and other people appropriately. The project also has an educational component that will involve students and teachers and focus of awareness and people's involvement. The MGB programme involves 21 such organizations from across Maharashtra.

Following is the list of meetings, seminars and workshops conducted under this project.

Date	Details
February 15-16, 2014	MGBP general meeting: Meeting of Principle Investigators (PIs) was conducted to give operational instructions to participating organizations and institutes. A plan of execution was developed and approved for the first phase in order to initiate activities under various project heads
April 22, 2014	The 1 st monitoring committee meeting: PIs of all the project components presented their project objectives and work plan in front of members of the MC. MC Members made some valuable comments on each project head.
May 22, 2014	Meeting: The meeting regarding “working towards the Wiki platform based system to build a Knowledge Resource through the contributions of various project teams working in different parts of Maharashtra as part of the Maharashtra Gene Bank (MGB) project” was held at IISER, Pune.
January 14-15, 2015	Information system design meeting: A meeting on information system design for Maharashtra Gene Bank project, focusing on water and grasslands themes was arranged at IISER, Pune.
February 12, 2015	Executive committee meeting: A meeting of the Executive committee members at was held at IISER, Pune.
March 3-4, 2015	Workshop: A workshop on data analysis, writing and communication skills was arranged during at IISER, Pune to learn or revise the data analysis, writing and Communication skills of the PIs. The PI or Co-PI and two other individuals from project staff for each 7component participated in the workshop. The workshop helped the organizations to learn or revise their data analysis, writing and Communication skills and also discussed the preparation for the group wise presentations in annual MC meeting.
April 7, 2015	Monitoring committee meeting: MC meeting for reviewing the annual progress and planning for the next phases of all the thematic components was held at IISER, Pune.