

Bangalore Microscopy Course: 2018

**National Centre for Biological Sciences (NCBS), Tata Institute of
Fundamental Research (TIFR), Bangalore, Sept. 16-23, 2018**

Course Organizers

Satyajit Mayor, Anjana Badrinarayanan, H. Krishnamurthy: NCBS, India

Ron Vale, Nico Stuurman: University of California, San Francisco (UCSF), USA

Minhaj Sirajuddin, Sangeeta Nath: inStem, India

Rahul Roy: Indian Institute of Science (IISc), India

Manoj V Mathew: Carl Zeiss, Singapore

Feroz M. H. Musthafa: Centre for Cellular and Molecular Platforms (C-CAMP), India

Faculty

Abhishek Kumar: University of Maryland College Park and NIST, USA

Aliaksandr A Halavaty: European Molecular Biology Laboratory, Germany

Erik Manders: University of Amsterdam, Netherlands

Ian Ross: Nikon Instruments Inc., USA

Joshua Rappoport: Northwestern University, USA

Manoj Mathew: Carl Zeiss, Singapore

Rahul Roy: Indian Institute of Science, India

Ronald D. Vale: University of California, USA

Satyajit Mayor: National Centre for Biological Sciences, India

Sudipta Maiti: Tata Institute for Fundamental Research, India

Tony Pakorn Kanchanawong: Mechanobiology Institute, Singapore

Support and Attendance by

Aurox, Carl Zeiss, Confocal.nl, Cornell Scientific, DSS Imagetech, Hamamatsu, Nikon, Olympus, Photometrics, Towa Optics, Leica Microsystems, Tokai Hit.

Course Schedule

Sunday, Sept. 16: Opening Lecture, Poster Session

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| 12:30-01:30pm | Lunch Location: Glass roof top Canteen |
| 01:30-02:00pm | Participants Registration Location: Reception, Southern Laboratories Complex (SLC) |
| 02:00-03:30pm | Opening Remarks: Satyajit Mayor, NCBS, India Research Lecture 1: Satyajit Mayor, NCBS, India Location: Dasherri (SLC) |
| 03:30-04:00pm | Coffee Break |
| 04:00-05:00pm | Didactic Lecture 1: Basics of Microscopy, Köhler illumination and Resolution, Diffraction. - Ronald D Vale, UCSF, USA Location: Dasherri (SLC) |
| 05:00-05:15pm | Group Photo |
| 05:15-08:00pm | Poster session by the students attending the course & Social Location: SLC Atrium |
| 08:00-09:00pm | Dinner Location: Glass roof top Canteen |

Monday, Sept 17:

Basics of microscopy: **Microscope Light Path, Diffraction/Resolution, Phase and Polarization**

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| 08:30-01:15pm | Laboratory 1: Microscopy and Köhler illumination on rails Lab leader: Manoj Mathew Lab Instructors: : Abhishek Kumar, Aliaksandr A Halavatyi, Anjana Badrinarayanan, Erik Manders, Ian Ross, Joshua Rappoport, Minhaj Sirajuddin, Rahul Roy, Ronald D. Vale, Satyajit Mayor Lab Support: Rimple and Jahnvi/Rashmi Location: Raspuri (New Teaching Lab) |
| 11:00-11:15am | Coffee Break |
| 01:15-02:15pm | Lunch Location: Glass roof top Canteen |
| 02:15-03:15pm | Didactic Lecture 2: Contrast enhancement -Phase Contrast, Dark Field, Polarized Light, DIC – Joshua Rappoport, Northwestern University, USA Location: Raspuri (New Teaching Lab) |
| 03:15-04:15pm | Didactic Lecture 3: Principles of Fluorescence and Fluorescence microscopy, (and Fluorescent dyes, Fluorescent |

Proteins and Selection of Fluorescent Probes) – Ronald D Vale, UCSF, USA

Location: Raspuri (New Teaching Lab)

04:15-04:30pm

Coffee Break

04:30-06:30pm

Laboratory 2: Phase Contrast, DIC and Dark Field Microscopy

Lab leader: Joshua Rappoport

Lab instructors: Abhishek Kumar, Aliaksandr A Halavatyi, Anjana Badrinarayanan, Erik Manders, Ian Ross, Manoj Mathew, Minhaj Sirajuddin, Rahul Roy, Ronald D Vale, Satyajit Mayor

Lab Support: Rimple and Jahnavi/Rashmi

Location: Raspuri (New Teaching Lab)

06:30-07:30pm

Didactic Lecture 4: Practical Aspects of Objective Lens Design, covering lenses and aberrations - Ian Ross, Nikon Inc., USA

Location: Raspuri (New Teaching Lab)

07:30-08:30pm

Dinner

Location: Glass roof top Canteen

08:30-11:00pm

Free time on Microscopes

Tuesday, Sept. 18: Fluorescence Microscopy

08:30-10:30am

Laboratory 3: Fluorescence Lab A: Examine the fluorescence light path and dichroic mirrors/filters.

Lab leader: Rahul Roy

Lab instructors: Abhishek Kumar, Aliaksandr A Halavatyi, Anjana Badrinarayanan, Erik Manders, Ian Ross, Joshua Rappoport, Manoj Mathew, Minhaj Sirajuddin, Ronald D Vale, Satyajit Mayor

Lab Support: Rimple and Jahnavi/Rashmi

Location: Raspuri (New Teaching Lab)

10:30- 10:45am

Coffee Break

10:45-11:45am

Didactic Lecture 5: Detectors- Manoj Mathew, Carl Zeiss, Singapore

Location: Raspuri (New Teaching Lab)

11:45-12:45pm

Didactic Lecture 6: Image Analysis- Aliaksandr A Halavatyi, European Molecular Biology Laboratory, Germany

Location: Raspuri (New Teaching Lab)

12:45-01:45pm

Lunch

Location: Glass roof top Canteen

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| 01:45-03:45pm | <p>Laboratory 4: Fluorescence Lab B: Fluorescence, Time Lapse, Cameras and Z projections of PSF</p> <p>Lab leader: Erik Manders</p> <p>Lab Instructors: Abhishek Kumar, Aliaksandr A Halavatyi, Anjana Badrinarayanan, Ian Ross, Joshua Rappoport, Manoj Mathew, Minhaj Sirajuddin, Rahul Roy, Ronald D Vale, Satyajit Mayor</p> <p>Lab Support: Rimple and Jahnvi/Rashmi</p> <p>Location: Raspuri (New Teaching Lab)</p> |
| 03:45-04:45pm | <p>Research Lecture 2: Ronald D Vale, UCSF, USA</p> <p>Location: Dasherri (SLC)</p> |
| 04:45-05:00pm | Coffee Break |
| 05:00-07:00pm | <p>Laboratory 5: Image Processing/Analysis Workshop</p> <p>Lab leader: Aliaksandr A Halavatyi</p> <p>Lab Support: Lakshmi B and Mugdha</p> <p>Location: Raspuri (New Teaching Lab)</p> |
| 07:00-08:00pm | Free Time on Microscopes |
| 06:30-09:00pm | Dinner (For Faculty- Down Town Bangalore) |
| 08:00-09:00pm | Dinner (For Participants- Glass roof top Canteen) |
| 09:00-11:00pm | Free time on microscopes |

Wednesday, Sept. 19: Optical Sectioning and Enhancing Resolution

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|----------------------|---|
| 08:30-09:30am | <p>Didactic Lecture 7: FRET Microscopy- Satyajit Mayor, NCBS, India</p> <p>Location: Raspuri (New Teaching Lab)</p> |
| 09:30-10:30am | <p>Didactic Lecture 8: Optical Sectioning Techniques- Confocal Microscopy - Erik Manders</p> <p>Location: Raspuri (New Teaching Lab)</p> |
| 10:30-10:45am | Coffee Break |
| 10:45-03:45pm | <p>Laboratory 6: Optical Sectioning Techniques (point scanning, line scanning, spinning disk). 2 x 2hr modules</p> <p>Lab Leader: H. Krishnamurthy</p> <p>Lab Support: Ashish, Chandrima, Chaitra, Divya, Manisha, Reena, Rukmini, Saheli, Suchitha, Nishan, Drisya</p> <p>1. Equipment: Olympus FV3000 point scanning microscope Lab Instructor: Olympus Application Specialist Location: CIFF, SLC</p> <p>2. Equipment: Leica SP5 point scanning microscope Lab Instructor: Leica Application Specialist</p> |

Location: CIFF, SLC

3. Equipment: Andor spinning disk microscope

Lab Instructor: Chandrima Patra

Location: Satyajit Mayor Lab, SLC, First Floor

4. Equipment: Zeiss LSM 780 NLO point scanning microscope

Lab Instructor: Chaitra Prabhakara, Nishan Shettigar

Location: CIFF, SLC

5. Equipment: Olympus Upright point scanning microscope

Lab Instructor: Olympus Application Specialist

Location: CIFF, SLC

6. Equipment: Nikon A1R HD point scanning confocal microscope

Lab Instructor: Nikon Application Specialist

Location: CIFF, SLC

12:45- 01:45pm

Lunch, Glass roof top Canteen

03:45-04:00pm

Coffee Break

04:00-05:00pm

Research Lecture 3: Anjana Badrinarayanan, NCBS, India

Location: Dasherri (SLC)

05:00-06:00pm

Research Lecture 4: Minhaj Sirajuddin, inStem, India

Location: Dasherri (SLC)

06:00-6:30pm

Zeeshan Khan Memorial Award Presentation

06:30-7:30pm

Dinner, Glass roof top Canteen

07:00-10:00pm

Cultural and Social Event

Thursday, Sept. 20: Special Topics

08:30-09:30am

Didactic Lecture 9: Super-Resolution Microscopy - STED,
- Tony Pakorn Kanchanawong, NUS, Singapore

Location: Raspuri (New Teaching Lab)

09:30-10:30am

Didactic Lecture 10: TIRF Microscopy, Light sheet,
Structured illumination - Abhishek Kumar

Location: Raspuri (New Teaching Lab)

10:30-10:45am

Coffee Break

10:45-02:45pm

Laboratory 7: Specialized techniques 2 x 1.5hr modules, distributed by student signup and selection. There will be 2 rotations of 1.5 hour each. Students can choose in advance and a rotation plan will be prepared.

Technique 1: Integrating microscope systems and
Configuring Automation Software for Microscope

Equipment: Nikon Ti2-E Microscope
Lab Instructor: Ian Ross , Joshua Rappoport
Lab Support: Rukmini, Reena
Location: Raspuri (New Teaching Lab)

Technique 2: Homo-Försters Resonance Energy Transfer (Homo-FRET)

Equipment: Nikon TIRF microscope with dual camera
Lab Leader: Satyajit Mayor
Lab Instructor: Joseph Mathew K.
Lab Support: Chandrima, Rashmi
Location: Mayor Lab, SLC

Technique 3: Fluorescence Correlation Spectroscopy (FCS)

Equipment: Zeiss LSM 780 NLO
Lab Instructor: Chaitra Prabhakara /Thomas Van Zanten
Lab Support: Manisha, Chandrima
Location: CIFF, SLC

Technique 4: Laser Micro Dissection and Catapulting

Equipment: PALM Microbeam Laser microdissection and catapulting- Carl ZEISS
Lab Instructor: Ritusree Biswas
Lab Support: Lakshmi K, Manisha
Location: CIFF, SLC

Technique 5: TIRF Microscopy

Equipment: Olympus Multi line CellTIRF Microscope
Lab Instructor: Ananya Mukherjee, Nishan Shettigar
Lab Support: Ashish, Saheli
Location: 2nd Floor, SLC

Technique 6: SIM Super Resolution Microscopy

Equipment: Nikon N-SIM/N-STORM Microscope
Lab Instructor: Nikon Application Specialist
Lab Support: Saheli, Ashish
Location: CIFF, SLC

Technique 7: Multi-Photon Microscopy

Equipment: Leica SP8 Dive
Lab Instructor: Leica Application Specialist
Lab Support: Drisya, Prakash
Location: CIFF, SLC

Technique 8: Re-Scan Super Resolution Confocal Microscopy

Equipment: Re-Scan Confocal Microscope, Confocal.nl
Lab Instructor: Erik Manders

Lab Support: Chittaspandini, Divya

Location: CIFF, SLC

Technique 9: Fluorescence Recovery After Photobleaching (FRAP)

Equipment: Olympus FV3000 6 Laser Microscope

Lab Instructor: Olympus Application Specialist

Lab Support: Reena, Rukmini

Location: CIFF, SLC

Technique 10: Laser Free Confocal Microscopy

Equipment: AUROX Laser Free Confocal Microscope

Lab Instructor: Phillipa Timmins

Lab Support: Divya, Satyaghosh

Location: CIFF, SLC

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|-----------------------|---|
| 12:15- 01:15pm | Lunch |
| 02:45-03:00pm | Coffee Break |
| 03:00-05:00pm | Technical Presentations Location: LH1 |
| 05:00-05:15pm | Coffee Break |
| 05:15-06:15pm | Didactic Lecture 11: Single Molecule Imaging - Rahul Roy, IISc, India Location: Raspuri (New Teaching Lab) |
| 06:15-07:30pm | Free Time on Microscopes |
| 07:30-08:30pm | Dinner, Glass roof top Canteen |
| 08:30-10:00pm | Free Time on Microscopes/Camera Lab |

Friday, Sept. 21: Research Lectures, Specialized Techniques

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| 08:30-09:30am | Didactic Lecture 12: Fluorescence Microscopy based methods to study protein dynamics in live cells: from FRAP to FCS - Sudipta Maiti, TIFR, India Location: Raspuri (New Teaching Lab) |
| 09:30- 10:30am | Didactic Lecture 13: PALM/STORM - Tony Pakorn Kanchanawong, NUS, Singapore Location: Raspuri (New Teaching Lab) |
| 10:30-10:45am | Coffee Break |
| 10:45-03:45pm | Laboratory 8: Specialized techniques, 2 x 1.5hr modules, distributed by student signup and selection. There will be 2 rotations of 1.5 hours each. Students can choose in advance and a rotation plan will be prepared. |

Technique 1: Integrating microscope systems and Configuring Automation Software for Microscope

Equipment: Nikon Ti Microscope

Lab Instructor: Ian Ross , Joshua Rappoport

Lab Support: Priyanka, Ramya

Location: Raspuri (New Teaching Lab)

Technique 2: Homo-Försters Resonance Energy Transfer (Homo-FRET)

Equipment: Nikon TIRF microscope with dual camera

Lab Leader: Satyajit Mayor

Lab Instructor: Joseph Mathew K.

Lab Support: Ramya, Priyanka

Location: Mayor Lab, SLC

Technique 3: Fluorescence Correlation Spectroscopy (FCS)

Equipment: Zeiss LSM 780 NLO

Lab Instructor: Chaitra Prabhakara, Thomas Van Zanten

Lab Support: Saheli, Ashish

Location: CIFF, SLC

Technique 4: Laser Micro Dissection and Catapulting

Equipment: PALM Microbeam Laser microdissection and catapulting- Carl ZEISS

Lab Instructor: Ritusree Biswas

Lab Support: Reena , Rukmini

Location: CIFF, SLC

Technique 5: TIRF Microscopy

Equipment: Olympus Multi line CellTIRF Microscope

Lab Instructor: Ananya Mukherjee, Nishan Shettigar

Lab Support: Rashmi, Reena

Location: 2nd Floor, SLC

Technique 6: SIM Super Resolution Microscopy

Equipment: Nikon N-SIM/N-STORM Microscope

Lab Instructor: Nikon Application Specialist

Lab Support: Manisha, Rashmi

Location: CIFF, SLC

Technique 7: Multi-Photon Microscopy

Equipment: Leica SP8 Dive

Lab Instructor: Leica Application Specialist

Lab Support: Lakshmi K, Jahnavi

Location: CIFF, SLC

Technique 8: Re-Scan Super Resolution Confocal Microscopy

Equipment: Re-Scan Confocal Microscope, Cofocal.nl
Lab Instructor: Erik Manders
Lab Support: Satyaghosh, Rimple
Location: CIFF, SLC

Technique 9: Fluorescence Recovery After Photobleaching (FRAP)

Equipment: Olympus FV3000 6 Laser Microscope
Lab Instructor: Olympus Application Specialist
Lab Support: Divya, Lakshmi K
Location: CIFF, SLC

Technique 10: Laser Free Confocal Microscopy

Equipment: AUROX Laser Free Confocal Microscope
Lab Instructor: Phillipa Timmins
Lab Support: Ashish, Saheli
Location: CIFF, SLC

12:15-12:30pm

Group Photo

12:30-2:15pm

Discussion over Lunch: Small group discussions of students with faculty over lunch about their Research/Microscopy interests

03:45-04:00pm

Coffee Break

04:00-05:00pm

Research Lecture 5: Sudipta Maiti, TIFR, Mumbai
Location: Dasherri (SLC)

05:00-06:00pm

Research Lecture 6: Rahul Roy, IISc, India
Location: Dasherri (SLC)

6:00-06:30pm

Technical Lecture
Location: Dasherri (SLC)

6:30-07:30pm

Graduation

07:30-09:00pm

Glass roof top Canteen

09:00-11:00pm

Project briefing /Free Time on Microscopes

Saturday, Sept. 22: Projects

09:00-10:00am

Research Lecture 7: Tony Pakorn Kanchanawong, NUS, Singapore
Location: Dasherri

10:00-11:00am

Research Lecture 8: Vinothkumar Kutti Rangunath, NCBS, India
Location: Dasherri

11:00-11:15am

Coffee Break

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|----------------------|--|
| 11:15-01:00pm | Projects |
| 01:00-02:00pm | Lunch |
| 02:00-04:00pm | Projects |
| 04:00-04:15pm | Coffee Break |
| 04-15-06:15pm | Projects |
| 06:15-10:00pm | Workshop Dinner and Social (Downtown Bangalore) |

Sunday, Sept. 23: Projects

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|----------------------|---|
| 09:00-11:00am | Projects |
| 11:00-11:15am | Coffee Break |
| 11:15-01:00pm | Projects |
| 01:00-02:00pm | Lunch |
| 02:00-04:00pm | Projects |
| 04:00-04:15pm | Coffee Break |
| 04:15-06:15pm | Project Presentation by Participants |