

Bangalore Microscopy Course: 2015

National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bangalore, Sept. 20-27, 2015

Course Organizers

Ron Vale, Nico Stuurman, Kurt Thorn: University of California, San Francisco, USA

Satyajit Mayor, H. Krishnamurthy: National Centre for Biological Sciences, India

Manoj Mathew: Sahrdaya College of Engineering and CCAMP/NCBS, India

Jason Swedlow: University of Dundee, UK

Faculty:

Andreas Schönle, Abberior Instruments, Germany

Christian Tischer, EMBL, Germany

Deepak Nair, Indian Institute of Science, India

Jennifer Ross, UMass Amherst, USA

Michael Davis, Nikon Inc., USA

Michael Kerber, Nikon Inc., USA

Rahul Roy, Indian Institute of Science, India

Roop Mallik, Tata Institute for Fundamental Research, India

Satyajit Mayor, National Centre for Biological Sciences, India

Shalin Mehta, Marine Biological Laboratory, USA

Sudipta Maiti, Tata Institute for Fundamental Research, India

Support and Attendance by:

Andor, Bruker, Cairn Research, Carl Zeiss, DSS Imagetech, Horiba, ibidi, Laser Science Services, Laser Spectra Services, LaVision BioTec, Leica Microsystems, MEL Sytems and Services, Nikon, Okolab, Olympus, PCO, Photometrics, PicoQuant, Prior Scientific, Towa Optics

Course Schedule

Sunday, Sept. 20: Opening Lecture, Poster Session

- 12:30-01:30pm** **Lunch**
Location: inStem Canteen
- 01:30-02:30pm** **Participants Registration**
Location: Southern Laboratories Complex (SLC) Reception
- 02:30-04:00pm** **Research Lecture 1: Opening remarks and lecture-Satyajit Mayor, NCBS**
Location: Dasher (NCBS Auditorium), Southern Laboratories Complex (SLC)
- 04:00-08:00pm** **Poster session by the students attending the course & Social**
Location: Southern Laboratories Complex (SLC) Atrium
- 08:00:09:00pm** **Dinner**
Location: inStem Canteen

Monday, Sept. 21: Basics of microscopy: Microscope Light Path, Diffraction/Resolution, Phase and Polarization

- 08:30-12:15pm** **Didactic Lecture 1 & Laboratory 1(a): Microscopy light path and Köhler illumination on rails.**
- Lab leader:** Jennifer Ross, UMass Amherst, USA
Lab Instructors: Andreas Schönle, Rahul Roy, Deepak Nair and Shalin Mehta
Lab Support: Deepanjali and Nitya
Location: New Teaching Lab
- 11:00-11:15am** **Coffee Break**
- 12:15-01:15pm** **Laboratory 1(b): Introduction to Transmitted Light Microscopy, Köhler Illumination and Resolution, Identify Parts of a Microscope and Light Paths, Köhler Illumination on Stained Histology Slides, Exercise to Look at Resolution/Diffraction with Diatoms**
Samples: Bead Slides, Diatoms, Pond Water
- Lab leader:** Jitu Mayor
Lab Instructors: Andreas Schönle, Rahul Roy, Jennifer Ross, Christian Tischer, Deepak Nair, Michael Davis, Michael Kerber and Shalin Mehta
Lab Support: Maitri and Vinaya
Location: New Teaching Lab
- 01:15-02:15pm** **Lunch**
Location: inStem Canteen

- 02:15-03:15pm** **Didactic Lecture 2:** Contrast enhancement -Phase Contrast, Dark Field, Polarized Light, DIC –Michael Davis, Nikon Inc., USA
Location: Dasher (NCBS Auditorium)
- 03:15-04:15pm** **Didactic Lecture 3:** Principles of Fluorescence and Fluorescence Microscopy - Andreas Schönle, Abberior Instruments, Germany
Location: Dasher (NCBS Auditorium)
- 04:15-04:30pm** **Coffee Break**
- 04:30-05:30pm** **Research Lecture 2:** Rahul Roy, IISc, India
Location: Dasher (NCBS Auditorium)
- 05:30-07:30pm** **Laboratory 2:** Phase Contrast, DIC and Dark Field
Lab leader: Michael Davis
Lab instructors: Jitu Mayor, Andreas Schönle, Rahul Roy, Jennifer Ross, Christian Tischer, Deepak Nair, Michael Kerber, Shalin Mehta and Company application specialists
Lab Support: Kavana and Maitri
Location: New Teaching Lab
- 07:30-08:30pm** **Dinner**
Location: inStem Canteen
- 08:30-11:00pm** **Free time on Microscopes**

Tuesday, Sept. 22: Fluorescence Microscopy

- 09:00-11:00am** **Laboratory 3:** Fluorescence Lab A: Examine the fluorescence light path and dichroics/filter. Take images of fluorescence fixed specimens, Fluorescence beads for psf and determining pixel shift

Lab leader: Rahul Roy
Lab instructors: Jitu Mayor, Andreas Schönle, Jennifer Ross, Christian Tischer, Deepak Nair, Michael Davis, Michael Kerber, Shalin Mehta and Company application specialists
Lab Support: Vinaya and Kavana
Location: New Teaching Lab
- 11:00- 11:15am** **Coffee Break**
- 11:15-12:15pm** **Didactic Lecture 4:** Fluorescent dyes, Fluorescent Proteins and Selection of Fluorescent Probes-Rahul Roy, IISc, India
Location: Dasher (NCBS Auditorium)
- 12:15- 01:15pm** **Lunch**
Location: inStem Canteen

01:15-03:15pm	<p>Laboratory 4: Fluorescence Lab B: Fluorescence, Time Lapse, Cameras and projections of PSFs</p> <p>Lab leader: Andreas Schönle Multi-wavelength Time Lapse Imaging of living cells, Measure read-out noise and photon conversion factor of the camera.</p> <p>Lab instructors: Jitu Mayor, Rahul Roy, Jennifer Ross, Christian Tischer, Deepak Nair, Michael Davis, Michael Kerber, Shalin Mehta and Company application specialists</p> <p>Lab Support: Maitri and Vinaya</p> <p>Location: New Teaching Lab</p>		
03:15-04:15pm	<p>Didactic Lecture 5: Image Analysis- Christian Tischer, European Molecular Biology Laboratory, Germany</p> <p>Location: Happus (LH1)</p>		
04:15-04:30pm	Coffee Break		
04:30-06:30pm	<table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <p>Laboratory 5: Image Processing/Analysis Workshop</p> <p>Instructor: Christian Tischer, EMBL, Germany</p> <p>Lab Support: Mugdha and Shilpa</p> <p>Location: New Teaching Lab</p> </td> <td style="vertical-align: top; border-left: 1px solid black; padding-left: 10px;"> <p>Meeting of sponsor representatives with course organizers to discuss BMC2016</p> </td> </tr> </table>	<p>Laboratory 5: Image Processing/Analysis Workshop</p> <p>Instructor: Christian Tischer, EMBL, Germany</p> <p>Lab Support: Mugdha and Shilpa</p> <p>Location: New Teaching Lab</p>	<p>Meeting of sponsor representatives with course organizers to discuss BMC2016</p>
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06:45-08:30pm	Dinner (For Faculty- Down Town Bangalore)		
06:30-07:30pm	<p>Non Commercial Technical Presentations- Session-1</p> <ol style="list-style-type: none"> 1. Combining Light Sheet With True Confocal Imaging - by Irmtraud Steinmetz, Leica Microsystems 2. Introduction to Scientific CMOS (sCMOS) Sensor Technology and it's Applicability to Microscopy - by Riswan Jaleel, Laser Science 3. High Resolution Confocal Imaging with Airyscan- by Rishi Kant, Carl Zeiss 4. An Innovative Solution for Confocal Super Resolution- by Ganesh Kadasoor, Olympus <p>Location: Dasherri (NCBS Auditorium)</p>		
07:30-08:30pm	Dinner (For Participants, Others- inStem Canteen)		
08:30-11:00pm	Free time on microscopes		

Wednesday, Sept. 23: Optical Sectioning and Enhancing Resolution

08:30-09:30am	<p>Didactic Lecture 6: Optical Detectors and Digital Image Acquisition- Jennifer Ross, UMass Amherst, USA</p> <p>Location: Happus (LH1)</p>
09:30-10:30am	<p>Didactic Lecture 7: Optical sectioning techniques- confocal, Two Photon Excited Fluorescence, etc.- Sudipta Maiti, TIFR, India</p> <p>Location: Happus (LH1)</p>
10:30-10:45am	Coffee Break

- 10:45-11:45am** **Didactic Lecture 8:** Super-Resolution Microscopy- Andreas Schönle, Abberior Instruments, Germany
Location: Happus (LH1)
- 11:45- 12:45pm** **Didactic Lecture 9:** TIRF Microscopy- Michael Davis, Nikon.
Location: Happus (LH1)
- 12:45- 01:45pm** **Lunch**
- 01:45- 05:00pm** **Laboratory 6:** Optical Sectioning Techniques (point scanning, line scanning, spinning disk).
2 x 2 hr modules
Lab Support: Manal, Deepanjali, Kamalesh, Nitya, Rudra, Raksha, Sunil, Divya, Amit.
- 1. Equipment:** Olympus FV1000 point scanning Microscope
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Olympus Application Specialist
- 2. Equipment: Bruker Opterra-** Multi Point scanning confocal microscope (opterra)-Bruker
Location: CIFF, Eastern Laboratories
Lab Instructor: Bruker Application Specialist
- 3. Equipment:** Leica SP5 point scanning microscope
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Leica Application Specialist
- 4. Equipment:** Andor spinning disk microscope
Location: Satyajit Mayor Lab, Southern Laboratories Complex (SLC)
Lab Instructor: Darius
- 5. Equipment:** Zeiss LSM 780 NLO point scanning microscope
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Sudipta Maiti and Thomas
- 6. Equipment:** Zeiss LSM 5 Live- Line scanning system
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Abrar
- 7. Equipment:** Zeiss LSM 800 –Point scanning microscope
Location: CIFF, Eastern Laboratories
Lab Instructor: Zeiss Application Specialist
- 8. Equipment:** Perkin Elmer Spinning Disk System
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Joseph
- 03:15-03:30pm** **Coffee Break**
- 05:00-06:00pm** **Research Lecture 3:** Sudipta Maiti, TIFR, India
Location: Dasherri (NCBS Auditorium)
- 06:00-07:00pm** **Dinner**
Location: inStem Canteen

07:00-10:00pm Cultural Event

Thursday, Sept. 24: Special Topics

09:00-10:00am Didactic Lecture 10: FRET Microscopy- Jitu Mayor, NCBS, India.
Location: Happus (LH1)

10:00-11:00am Didactic Lecture 11: Fluorescence Microscopy-based methods to study protein dynamics in live cells: from FRAP to FCS- Sudipta Maiti, TIFR, India
Location: Happus (LH1)

11:00- 11:15am Coffee Break

11:15-12:15pm Didactic Lecture 12: PALM and STORM Microscopy- Rahul Roy, IISc, India
Location: Happus (LH1)

12:15- 01:15pm Lunch

01:15-02:15pm Didactic Lecture 13: Optical Manipulation, Roop Mallik, TIFR, India
Location: Dasheri (NCBS Auditorium)

02:15-05:30pm Laboratory 7: Specialized techniques 2 x 2hr modules, distributed by student signup and selection. There will be 2 rotations of 2 hour each. Students can choose in advance and a rotation plan will be prepared.

Technique 1: Integrating microscope systems

Equipment: Nikon Ti

Location: New Teaching Lab

Lab Instructor: Michael Davis

Lab Support: Manal/Deepanjali

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

Equipment: Nikon TIRF microscope with dual camera

Location: Mayor Lab, Southern Laboratories Complex (SLC)

Lab Leader: Satyajit Mayor

Lab Instructor: Joey

Lab Support: Raksha/Sunil

Technique 3: Fluorescence Correlation Spectroscopy (FCS)

Equipment: Zeiss LSM 780 NLO

Location: CIFF, Southern Laboratories Complex (SLC)

Lab Instructor: Sudipta Maiti and Thomas

Lab Support: Sunil/Raksha

Technique 4: Stimulated Emission Depletion (STED) Microscopy

Equipment: Leica SP5 STED Microscope

Location: CIFF, Southern Laboratories Complex (SLC)

Lab Instructor: Leica Application Specialist

Lab Support: Neethu/Divya

Technique 5: Laser Micro Dissection and Catapulting system
Equipment: PALM Microbeam Laser microdissection and catapulting-
Carl ZEISS
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Zeiss Application Specialist
Lab Support: Kamalesh/Nitya

Technique 6: TIRF Microscopy
Equipment: Olympus Multi color TIRF
Location: 2nd Floor, Southern Laboratories Complex (SLC)
Lab Instructor: Nishan, Ananya
Lab Support: Nitya/Kamalesh

Technique 7: SIM and STORM Super Resolution Microscope
Equipment: Nikon N-SIM/N-STORM
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Nikon Application Specialist
Lab Support: Kavana/Vinaya

Technique 8: Configuring Automation Software for Microscope
Equipment: Olympus
Location: New Teaching Lab
Lab Instructor: Photometrics Application Specialist
Lab Support: Vinaya/Kavana

Technique 9: Ratio Fluorescence Microscopy
Equipment: PTI RatioMaster-Horiba
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Horiba Applications Specialist
Lab Support: Rudra/Maitri

03:45-04:00pm

Coffee Break

05:30-07:00pm

Non Commercial Technical Presentations- Session-2

- 1. Microscopic and Mesoscopic Imaging of Large Biological Samples – by**
Bernd Müller-Zülw, LaVision
- 2. High speed multi-channel imaging - by** Jeremy Graham, Cairn Research.
- 3. Understanding the Advantages of Quantitative Ratiometric Calcium**
Imaging Michael Kovach, HORIBA Scientific.
- 4. In vivo like, physiological conditions for cell based assays during live cell**
Imaging- by Christian Leibold, ibidi
- 5. Multiphoton Live Cell Photoactivation On Awake Animal-** by
Yikai Wu, Bruker

Location: Dasherri (NCBS Auditorium)

07:00-08:00pm

Dinner
Location: inStem Canteen

08:00-11:00pm

Free Time on Microscope

Friday, Sept. 25: Research Lectures, Specialized Techniques

- 09:00-10:00am** **Didactic Lecture 14:** Fluorescence Polarization measurements-
Shalin Mehta, MBL, USA
Location: Happus (LH1)
- 10:00-10:15am** **Coffee Break**
- 10:15-11:15am** **Research Lecture 4:** Jennifer Ross, UMass Amherst, USA
Location: Dasherri (NCBS Auditorium)
- 11:15- 12:15am** **Research Lecture 5:** Roop Mallik, TIFR, India
Location: Dasherri (NCBS Auditorium)
- 12:15-02:30pm** **Discussion over Lunch:** Small group discussions of students with faculty
over lunch about their Research/microscopy interests.
- 02:30-05:45pm** **Laboratory 8:** Specialized techniques
2 x 2hr modules, distributed by student signup and selection. There will
be 2 rotations of 2 hour each. Students can choose in advance and a
rotation plan will be prepared.

Technique 1: Integrating microscope systems

Equipment: Nikon Ti

Location: New Teaching Lab

Lab Instructor: Michael Davis

Lab Support: Kamalesh/Nitya

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

Equipment: Nikon TIRF microscope with dual camera

Location: Mayor Lab, Southern Laboratories Complex (SLC)

Lab Leader: Satyajit Mayor

Lab Instructor: Joey

Lab Support: Divya/Neethu

Technique 3: Fluorescence Correlation Spectroscopy (FCS)

Equipment: Zeiss 780 NLO

Location: CIFF, Southern Laboratories Complex (SLC)

Lab Instructor: Sudipta Maiti and Thomas

Lab Support: Manal/Deepanjali

Technique 4: Stimulated Emission Depletion (STED) Microscopy

Equipment: Leica SP5 STED Microscope

Location: CIFF, Southern Laboratories Complex (SLC)

Lab Instructor: Leica Application Specialist

Lab Support: Deepanjali/Manal

Technique 5: Laser Micro Dissection and Catapulting system

Equipment: PALM Microbeam Laser microdissection and catapulting-
Carl ZEISS

Location: CIFF, Southern Laboratories Complex (SLC)

Lab Instructor: Zeiss Application Specialist

Lab Support: Rudra/Maitri

Technique 6: TIRF Microscopy
Equipment: Olympus Multi color TIRF
Location: 2nd Floor, Southern Laboratories Complex (SLC)
Lab Instructor: Nishan, Ananya
Lab Support: Kavana/Vinaya

Technique 7: SIM and STORM Super Resolution Microscope
Equipment: Nikon N-SIM/N-STORM
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Nikon Application Specialist
Lab Support: Sunil/Raksha

Technique 8: Configuring Automation Software for Microscope
Equipment: Olympus
Location: New Teaching Lab
Lab Instructor: Photometrics Application Specialist
Lab Support: Raksha/Sunil

Technique 9: Ratio Fluorescence Microscopy
Equipment: PTI RatioMaster-Horiba
Location: CIFF, Southern Laboratories Complex (SLC)
Lab Instructor: Horiba Applications Specialist
Lab Support: Nitya/Kamalesh

- 04:00-04:15pm** **Coffee Break**
- 05:45-07:00pm** **Graduation, Group Photo**
- 07:00-09:00pm** **Discussion over Dinner:** Small group discussions of students with faculty over dinner about their research/microscopy interests.
- 09:00-11:00pm** **Free Time on Microscopes**

Saturday, Sept. 26:

- 09:00-12:00noon** **Equipment Demo**
- 10:00-01:00noon** **Student Projects**
- 01:00-02:00pm** **Lunch**
- 02:00-04:00pm** **Projects**
- 04:00-04:15pm** **Coffee Break**
- 04-15-06:15pm** **Projects**
- 06:00-10:00pm** **Workshop Dinner and Social (Downtown Bangalore)**

Sunday, Sept. 27:

- 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	Student Projects
04:00-04:15pm	Coffee Break
04:15-06:15pm	Project Presentation by Participants

Projects

Project-1: Optical Tweezers

Guide: Roop Mallik and Darius

Equipment: Thorlabs Optical Tweezers Kit

Location: Mayor Lab, SLC 1st floor

Lab Support: Abrar

Project-2: Imaging Brain Slices

Guide: Kambadur Ananthamurthy and Sriram Narayanan

Lab support: Deepanjali

Equipment: Beja Fry Multiphoton Microscope

Location: CIFF Southern Laboratories Complex (SLC) and Lab 13

Project-3: diSPIM Microscopy

Guide: Neethu Emmanuel/Manoj

Lab Support: Sunil/Amit

Equipment: ASI diSPIM

Location: CIFF Southern Laboratories Complex (SLC)

Project-4: Image Processing

Guide: Christian Tischer

Lab Support: Mugdha and Shilpa

Equipment: Perkin Elmer Spinning Disk and Olympus FV 100

Location: CIFF Southern Laboratories Complex (SLC)

Project-5: Confocal Polscope

Guide: Shalin Mehta

Equipment: LSM 780 with polscope attachment

Lab Support: Debakshi

Location: CIFF

Project-6: High Content Imaging

Guide: Lokavya Kurup

Lab Support: Raksha

Equipment: Cellomics

Location: HCS facility (Eastern Labs)

Project-7: Calcium Imaging

Guide: Bipan and Dhanya

Lab Support: Divya

Location: New Teaching Lab

Project-8: Single molecule receptor binding on T-cells

Guide: Marcus Taylor

Lab Support: Kamallesh

Location: Mayor Lab, SLC 1st floor