Bangalore Microscopy Course: 2015

National Centre for Biological Sciences, Tata Institute for 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: Dasheri (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: Dasheri (NCBS Auditorium)

03:15-04:15pm **Didactic Lecture 3:** Principles of Fluorescence and Fluorescence Microscopy - Andreas Schönle, Abberior Instruments, Germany
Location: Dasheri (NCBS Auditorium)

04:15-04:30pm **Coffee Break**

04:30-05:30pm **Research Lecture 2**: Rahul Roy, IISc, India
Location: Dasheri (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: Dasheri (NCBS Auditorium)

12:15- 01:15pm **Lunch**
Location: inStem Canteen

01:15-03:15pm **Laboratory 4:** Fluorescence Lab B: Fluorescence, Time Lapse, Cameras and projections of PSFs

Lab leader: Andreas Schönle
Multi-wavelength Time Lapse Imaging of living cells, Measure read-out noise and photon conversion factor of the camera.
Lab instructors: Jitu Mayor, Rahul Roy, Jennifer Ross, Christian Tischer, Deepak Nair, Michael Davis, Michael Kerber, Shalin Mehta and Company application specialists
Lab Support: Maitri and Vinaya
Location: New Teaching Lab

03:15-04:15pm **Didactic Lecture 5:** Image Analysis- Christian Tischer, European Molecular Biology Laboratory, Germany
Location: Happus (LH1)

04:15-04:30pm **Coffee Break**

04:30-06:30pm **Laboratory 5:** Image Processing/Analysis Workshop
Instructor: Christian Tischer, EMBL, Germany
Lab Support: Mugdha and Shilpa
Location: New Teaching Lab

Meeting of sponsor representatives with course organizers to discuss BMC2016

06:45-08:30pm **Dinner** (For Faculty- Down Town Bangalore)

06:30-07:30pm **Non Commercial Technical Presentations- Session-1**

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 Carl Zeiss
4. **OLYMPUS**

Location: Dasheri (NCBS Auditorium)

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 **Didactic Lecture 6:** Optical Detectors and Digital Image Acquisition- Jennifer Ross, UMass Amherst, USA
Location: Happus (LH1)

09:30-10:30am **Didactic Lecture 7:** Optical sectioning techniques- confocal, Two Photon Excited Fluorescence, etc.- Sudipta Maiti, TIFR, India
Location: Happus (LH1)

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: Dasheri (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 1.5 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: Yathish
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 Dr. Bernd Müller-Zülow, 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 Dr. Christian Leibold, ibidi
5. **Multiphoton Live Cell Photoactivation On Awake Animal**- by Yikai Wu, Bruker

Location: Dasheri (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: Dasheri (NCBS Auditorium)

11:15- 12:15am **Research Lecture 5:** Roop Mallik, TIFR, India
Location: Dasheri (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: Yathish
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: Kamalesh
Location: Mayor Lab, SLC 1st floor