2015 OSA Biomedical Optics & Photonics Congress: Optics in the Life Sciences

Bio-Optics: Design and Application (BODA)

Novel Techniques in Microscopy (NTM)

Optical Molecular Probes, Imaging and Drug Delivery (OMP)

Optical Trapping Applications (OTA)

Optics and the Brain

12–15 April 2015

Pinnacle Vancouver Harbourfront Hotel, Vancouver, Canada

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Welcome to the 2015 OSA Biomedical Optics & Photonics Congress: Optics in the Life Sciences! This congress has five topical meetings: Bio-Optics: Design and Application (BODA); Novel Techniques in Microscopy (NTM); Optical Molecular Probes, Imaging and Drug Delivery (OMP); Optical Trapping Applications (OTA); and Optics and the Brain. The congress will kick-off with three phenomenal plenary speakers, two of whom are 2014 Nobel Prize winners in Chemistry. In addition, this congress brings together leaders and experts among the different communities to share information and discuss topics across the disciplines of optical science and engineering sure to provide you with a rich and informative experience.

The BODA meeting focuses on design, instrumentation, and applications of optical technologies for life sciences. This meeting provides an opportunity for researchers and engineers from academia and industry to discuss design, fabrication, instrumentation, and application of biomedical optical technologies for life science. This meeting’s program boasts 15 invited speakers, 42 contributed speakers, and 10 posters.

Advances in optical microscopy are continually enhancing imaging performance and versatility. The NTM meeting will provide a rich collection of fresh and creative technical developments in optical microscopy for biological or biomedical applications. NTM’s exciting program consists of 12 invited speakers, 35 oral presenters, and 5 poster presentations.

The OMP topical meeting, now in its third year, will address the exciting and timely convergence of optical physics, photonics technology, nanoscience and photochemistry with drug delivery, non-invasive diagnostics and clinical medicine. It will highlight recent advances in this rapidly evolving area with a goal of stimulating novel strategies for molecular probe development, site-specific drug delivery, monitoring treatment response, and clinical translation to improve diagnosis or treatment of diseases. OMP’s exciting program consists of more than 60 papers, with 14 invited speakers, 37 oral presenters, and 10 poster presentations.

This year, the OTA topical meeting covers the whole range of topical particle manipulation technologies currently being developed for studies in biophysics, single molecule, single cell and tissue level analysis, lab-on-a-chip development, optomechanical cooling, environmental monitoring and theoretical underpinnings. During the course of 3 days, the OTA meeting will present an exceptional program with 12 invited speakers, 33 contributed oral presentations, and 6 poster presentations demonstrating cutting-edge research and technology.

New to the Optics in the Life Sciences Congress this year is the Optics and the Brain meeting. This meeting creates a dynamic forum for researchers working in all aspects of optics to discuss existing and emerging techniques as well as future directions that could be envisaged to shed new light on the healthy and diseased brain. This new and exciting program consists of 25 invited speakers, 19 contributed oral presenters, and 8 poster presentations.

We all are pleased to have you join us and look forward to your continued participation in these topical meetings.

BODA
Tomasz Tkaczyk, Rice Univ., USA, General Chair
Chris Xu, Cornell Univ., USA, General Chair

BRAIN
Elizabeth Hillman, Columbia Univ., USA, General Chair
Francesco Pavone, European Lab for Non-Linear Spectroscopy, Italy, General Chair

OMP
Paul French, Imperial College London, UK, General Chair
Peter So, Massachusetts Institute of Technology, USA, General Chair
Samuel Achilefu, Washington Univ. in St Louis, USA, Program Chair
Irene Georgakoudi, Tufts Univ., USA, Program Chair

OTA
Steven Neale, Univ of Glasgow, UK, General Chair
Peter Reece, Univ. of New South Wales, Australia, General Chair
Reuven Gordon, Univ. of Victoria, Canada, Program Chair
Lene Oddershede, The Niels Bohr Institute, Denmark, Program Chair

NTM
Paul Campagnola, Univ. of Wisconsin-Madison, USA, General Chair
Eric Potma, Univ. of California Irvine, USA, General Chair
Program Committee

Bio-Optics: Design and Application (BODA)

**General Chairs**
Tomasz Tkaczyk, Rice Univ., USA
Chris Xu, Cornell Univ., USA

**Program Committee**
Pablo Artal, Univ. de Murcia, Spain
Xavier Intes, Rensselaer Polytechnic Institute, USA
Joseph Izatt, Duke Univ., USA
Stephen Kanick, Dartmouth College, USA
Guoqiang Li, The Ohio State Univ., USA
Xingde Li, Johns Hopkins Univ., USA
Rongguang Liang, Univ. of Arizona, USA
Qingming Luo, Huazhong Univ. of Science and Technology, China
Kristen Maitland, Texas A&M Univ., USA
Tony Wilson, Univ. of Oxford, UK
Joe Zhou, DMetrix Inc, USA

Optical Trapping Applications (OTA)

**General Chairs**
Steven Neale, Univ. of Glasgow, UK
Peter Reece, Univ. of New South Wales, Australia

**Program Chairs**
Reuven Gordon, Univ. of Victoria, Canada
Lene Oddershede, The Niels Bohr Institute, Denmark

**Program Committee**
Tomas Cizmar, Univ. of Dundee, UK
Andrew Forbes, CSIR National Laser Centre, South Africa
Nancy Forde, Simon Fraser Univ., Canada
Simon Hanna, Univ. of Bristol, UK
Brooke Hester, Appalachian State Univ., USA
Tony Jun Huang, Pennsylvania State Univ., USA
Carlos Lopez-Mariscal, US Naval Research Laboratory, USA
Onofrio Marago, CNR-IPCF, Italy
David McGloin, Univ. of Dundee, UK
Jack Ng, Hong Kong Baptist Univ., Hong Kong
Peter Pauzauskie, Univ. of Washington, United States
Ruben Ramos-Garcia, Inst. Nat Astrofisica Optica Electronica, Mexico
Giovanni Volpe, Inst. Nat Astrofisica Optica Electronica, Greece
Pavel Zemanek, Institute of Scientific Instruments ASCR, Czech Republic

Novel Techniques in Microscopy (NTM)

**General Chairs**
Paul Campagnola, Univ. of Wisconsin-Madison, USA
Eric Potma, Univ. of California Irvine, USA

**Program Committee**
Joerg Enderlein, Georg-August-Univ. Gottingen, Germany
Conor Evans, Massachusetts General Hospital, USA
Xingde Li, Johns Hopkins Univ., USA
Varun Raghunathan, Agilent Technologies, USA
Albert Stolow, Univ. of Ottawa, Canada
Shuo Tang, Univ. of British Columbia, Canada
Peter Török, Imperial College London, UK
Volker Westphal, Max-Planck-Inst Biophysikalische Chemie, Germany
Seok-Hyun Yun, Harvard Medical School, USA

Optics and the Brain

**General Chairs**
Elizabeth Hillman, Columbia Univ., USA
Francesco Pavone, European Lab for Non-Linear Spectroscopy, Italy

**Program Committee**
Katrin Amunts, Forschungszentrum Julich GmbH, Germany
Lawrence Cohen, Yale Univ., USA
Fritjof Helmchen, Univ. of Zurich, Switzerland
Timothy Holy, Washington Univ. in St Louis, USA
Thomas Knopfel, Riken Brain Science Institute, Japan
Frederic Leblond, Polytechnique Montreal, Canada
Qingming Luo, Huazhong Univ. of Science and Technology, China
Anita Mahadevan-Jansen, Vanderbilt Univ., USA
Tim Murphy, Univ. of British Columbia, Canada
Darcy Peterka, Columbia Univ., USA
Shy Shoham, Technion Israel Institute of Technology, Israel
Changhuei Yang, California Institute of Technology, USA
General Information

Congress Wireless Internet
OSA is pleased to offer complimentary wireless internet throughout the meeting space at the Pinnacle Vancouver Harbourfront Hotel for all attendees and exhibitors.

Wireless login:
Network: Pinnacle_CONFERENCE
Password: CONFERENCE

Registration Hours
Grand Foyer

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<tr>
<td>Sunday, 12 April</td>
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<td>Monday, 13 April</td>
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<td>Tuesday, 14 April</td>
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<tr>
<td>Wednesday, 15 April</td>
<td>07:30–16:30</td>
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Exhibit Hall Hours
Salon A

The Optics in the Life Sciences Exhibits is open to all registered attendees. Coffee breaks will be held with the exhibit from Monday - Wednesday.

Exhibit Only Hours

<table>
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<th>Date</th>
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<tbody>
<tr>
<td>Monday, 13 April</td>
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<td>Tuesday, 14 April</td>
<td>10:00–10:30</td>
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<td>15:30–17:00</td>
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<td>Wednesday, 15 April</td>
<td>10:00–11:00</td>
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Poster Presentation PDFs
The PDFs of select poster presentations will be available two weeks after the conference. While accessing the papers in Optics Infobase look for the multimedia symbol.

Update Sheet and Postdeadline Papers
All technical program changes will be communicated in the on-site Conference Program Update Sheet. All attendees receive this information with registration materials, and we encourage you to review it carefully to stay informed to changes in the program. Postdeadline papers will also be announced on the update sheet.

Early Online Access to the Technical Digest and Postdeadline Papers
Full Technical Attendees have both EARLY and FREE continuous access to the digest papers through Optics InfoBase. To access the papers go to www.osa.org/lifesciencesOPC and select the “Access digest papers” essential link on the right hand navigation. As access is limited to Full Technical Conference Attendees, you will be asked to validate your credentials by entering the same login email address and password provided during the Conference registration process. If you need assistance with your login information, please use the “forgot password” utility or “Contact Help” link.

Recorded Presentations
Selected sessions during this year’s Optics in the Life Sciences Congress are being digitally captured for on-demand viewing. Session content will be available within forty-eight hours of being recorded. Recorded sessions are indicated by 🎥. Recorded content can be accessed by visiting www.osa.org/lifesciencesOPC and clicking on the “Access meeting presentations/slidecasts” under Essential Links. As access is limited to Full Technical Conference Attendees, you will be asked to validate your credentials by entering the same login email address and password provided during the Conference registration process. If you need assistance with your login information, please use the “forgot password” utility or “Contact Help” link.

OSA is pleased to offer complimentary wireless internet throughout the meeting space at the Pinnacle Vancouver Harbourfront Hotel for all attendees and exhibitors.
Special Events

Opening Plenary Session
Monday, 13 April, 08:00–10:00
Harbourside Ballroom 1 & 2

The Optics in the Life Sciences Congress will feature three highly regarded plenary speakers during its opening plenary session, two of whom have been awarded the 2014 Nobel Prize in Chemistry. The following presentations will be given:


• Imaging Life at High Spatiotemporal Resolution, Eric Betzig, Janelia Research Campus, Howard Hughes Medical Institute, USA - Nobel Prize Winner in Chemistry 2014

• Photodynamic Therapy (PDT): A Photochemical Slice of Clinical Biophotonics, Tayyaba Hasan, Harvard Medical School, Massachusetts General Hospital, USA

For more information on the plenary speakers, see page 7 of the program.

Industry Program

Making the Connection between Biomedical Industry Products and Current Research in Optics and Photonics

Keynote Session
Tuesday, 14 April 2015, 10:30–11:15
Harbourside Ballroom 1 & 2

Keynote Speaker:
Barbara Paldus, CEO, Finesse Solutions, Inc., USA

Panel Session
Tuesday, 14 April 2015, 11:15–12:00
Harbourside Ballroom 1 & 2

Panelists from the academic, industrial, financial and agency funding world will discuss the challenges that exist when taking scientific knowledge from the bench-top to the patient-side. From success stories and some misadventures, we will learn from the panelist the best practices to commercializing the research presented at the conference. Funding issues in the start-up phase may be discussed; regulatory hurdles along the way examined; recovery from missteps reviewed; even challenges once a company matures and is ripe for its leaders to begin the exit process may be pondered. Bring questions and expect a highly interactive session with those who have ventured down this road.

Moderator: Brian Wilson, Senior Scientist, University Health Network, Canada

Participating panelists:
Eric Buckland, CEO, Bioptigen, USA
Lindsay Machan, Associate Professor, Dept. of Radiology, Univ. of British Columbia, Canada

Bright Ideas Pitch Panel Luncheon
Invitation to Present Your New Technology and Innovative Ideas to Entrepreneurs & Venture Capitalists
Tuesday, 14 April 2015, 12:00–13:30
Harbourside Ballroom 1 & 2

Do you have a startup or an idea for a new company? Present your technology, explain why it’s valuable and discuss the next steps to commercialization.

This is a unique opportunity to present and collaborate with entrepreneurs and venture capital panelists about your emerging company and/or new technologies that may offer solutions to the challenges faced by professionals in the life sciences.

Don’t miss this opportunity. Contact Jessica Pagonis, jpagonis@osa.org, today to secure your spot at the Bright Ideas Pitch Panel Luncheon.

Complimentary box lunch will be provided.

Sponsored by:

HAMAMATSU

Industry Program Committee

Alain Villeneuve, President, Optav Solutions Inc., Canada
Alex Fong, Senior VP, Life Sciences and Instrumentation, Gooch and Housego, USA
Tom Haslett, CTO, Avo Photonics, USA
Ken Kaufmann, Marketing Director, Hamamatsu Corp., USA

Joint Poster Sessions
Tuesday, 14 April, 15:30–17:00
Wednesday, 15 April 10:00–11:00
Salon A

The Congress will feature over 45 posters featured during two sessions for attendees to view. The sessions will take place in Salon A. Posters are an integral part of the technical program and offer a unique networking opportunity, where presenters can discuss their results one-to-one with interested parties.

Congress Reception
Monday, 13 April, 18:30–20:00
Salon A

Join your fellow attendees for the Congress Reception. The reception is open to all full congress attendees. Congress attendees may purchase extra tickets for their guest. The Congress reception will be held in Salon A.
Grants and Awards

OSA Foundation Student Travel Grant
We are pleased to announce The OSA Foundation Travel Grant recipient for the Optics in the Life Sciences Congress:

Dipankar Mondal, Indian Institute of Technology, Kanpur India

The OSA Foundation Student Travel Grant Program is designed to provide career development opportunities by assisting students who wish to attend conferences and meetings. The grant is given to a student working or studying science in qualifying developing nations so they can attend OSA-managed technical meetings and conferences. The student receives $1,500 USD in travel support and is selected by the co-chairs of the meeting. Their application is judged on the following criteria:

• Work or study in a qualifying developing nation
• Enrollment in an accredited undergraduate or graduate program
• Demonstrated need for travel support
• Statement on the value of attending the conference

The OSA Foundation was established in 2002 to support philanthropic activities that help further The Optical Society’s (OSA) mission. The Foundation is concentrating its efforts on programs that provide career and professional development resources and support awards and honors that recognize technical and business excellence. The grants funded by the Foundation are made possible by the generous donations of its supporters as well as the dollar-for-dollar match by OSA.

Give the Gift of Light

Join the LIGHT BLOX Education Kit Challenge

▶ 1,500 kits distributed and counting

To learn more, visit osa.org/IYLKIT
Opening Plenary Session
Monday, 13 April, 8:00–10:00
Harbourside Ballroom 1 & 2

**W.E. Moerner, Stanford Univ., USA**
Monday, 13 April, 08:05–08:40
Harbourside Ballroom 1 & 2

W. E. Moerner, the Harry S. Mosher Professor of Chemistry and Professor, by courtesy, of Applied Physics at Stanford University, conducts research in physical chemistry and chemical physics of single molecules, single-molecule biophysics, super-resolution imaging and tracking in cells, and trapping of single molecules in solution. His interests span methods of precise quantitation of single-molecule properties, to strategies for three-dimensional imaging and tracking of single molecules, to applications of single-molecule measurements to understand biological processes in cells, to observations of the photodynamics of single photosynthetic proteins and enzymes. He has been elected Fellow/Member of the NAS, American Academy of Arts and Sciences, AAAS, ACS, APS, and The Optical Society. Major awards include the Earle K. Plyler Prize for Molecular Spectroscopy, the Irving Langmuir Prize in Chemical Physics, the Pittsburgh Spectroscopy Award, the Peter Debye Award in Physical Chemistry, the Wolf Prize in Chemistry, and the 2014 Nobel Prize in Chemistry.

**Eric Betzig, Janelia Research Campus, Howard Hughes Medical Institute, USA**
Monday, 13 April, 08:40–09:20
Harbourside Ballroom 1 & 2

Eric Betzig, PhD, studied Physics at the California Institute of Technology, graduating with a BS degree in 1983. After from Caltech, Eric Betzig moved to Cornell, where his thesis involved the development of near-field optics — the first method to break the diffraction barrier in light microscopy. Betzig became a PI at AT&T Bell Labs in Murray Hill, NJ, where he further refined the technology and explored many applications, including high density data storage, semiconductor spectroscopy, and superresolution fluorescence imaging of cells. In 1993, Betzig was the first to image single fluorescent molecules under ambient conditions, and determine their positions to better than 1/40 of the wavelength of light. Tiring of academia, he then served as Vice President of R&D at his father’s machine tool company, developing a high speed motion control technology based on an electrohydraulic hybrid drive with adaptive control algorithms. The commercial failure of the technology left him unemployed and looking for new directions. This search eventually culminated in the invention and demonstration of the superresolution technique PALM by himself and his fellow unemployed colleague and Bell Labs expatriate, Harald Hess. Since 2005, Betzig have been a Group Leader at Janelia, developing new optical imaging technologies for biology. Betzig won the 2014 Nobel Prize in Chemistry.

**Tayyaba Hasan, Harvard Medical School, Massachusetts General Hospital, USA**
Monday, 13 April, 09:20–10:00
Harbourside Ballroom 1 & 2

Tayyaba Hasan, PhD, is a Professor of Dermatology at Harvard Medical School (HMS) and a Professor of Health Sciences and Technology (Harvard-MIT). The focus of her research is in photochemistry and photodynamic therapy of cancer and infections with over 200 publications and inventions. Dr. Hasan is an inventor of the FDA approved photodynamic treatment of Age-Related Macular Degeneration. In recognition for this translational work and other discoveries, she was awarded the Bench to Bedside Pioneer Award from the National Institutes of Health. Dr. Hasan directs a NCI funded multicenter P01 grant and has several other grants, and leads an NCI-funded international consortium (UH2/UH3 award) on developing low cost enabling technologies for image guided photodynamic therapy of oral cancer.

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**Save the date for the 2016 Biomedical Optics Meeting**
25–28 April 2016
The Diplomat Resort and Spa
Fort Lauderdale, Florida, USA
osa.org/biomed

**Chairs**
Stephen Boppart, University of Illinois at Urbana-Champaign, United States, General Chair
Christoph Hitzenberger, Medizinische Universität Wien, Austria, General Chair
Elizabeth Hillman, Columbia University, United States, Vice Chair
David Sampson, University of Western Australia, Australia, Vice Chair

Submission site opens August 2016.
Explanation of Session Codes

The first letter of the code designates the meeting (For instance, B=BODA, N=NTM, O=OMP, Ot=OTA, Br=Brain, J=Joint Session). The second element denotes the day of the week (Monday=M, Tuesday=Tu, Wednesday=W). The third element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.).

For example, a presentation coded BM1A.4 indicates that this paper is part of BODA (B) and is being presented on Monday (M) in the second series of sessions (2), and is the first parallel session (A) in that series and the fourth paper (4) presented in that session.

Invited papers are noted with Invited
Plenaries are noted with Plenary
Presentations selected for recording are noted with ➤

New Features for OSA Topical Meetings

Online Access to Technical Digest Now Available!

Full Technical Attendees now have both EARLY and FREE perpetual access to the Congress digest papers through Optics InfoBase. To access the papers go to www.osa.org/lifesciencesOPC and select the “Access digest papers” essential link on the right hand navigation. As access is limited to Full Technical Attendees only, you will be asked to validate your credentials by entering the same login email address and password provided during the conference registration process. If you need assistance with your login information, please use the “forgot password” utility or “Contact Help” link.

Recorded Technical Sessions on Demand

We are delighted to announce that your Optics in Life Sciences Congress technical registration includes a valuable new enhancement! A portion of the sessions at this year’s congress are being digitally captured for on-demand viewing. All captured content from listed sessions will be live for viewing within forty-eight hours of being recorded, and will be available for 60 days. Just look for the record symbol in the Agenda of Sessions and abstracts to easily identify the presentations being captured.

To access the presentations go to www.osa.org/lifesciencesOPC and select the “Access meeting presentations” essential link on the right hand navigation. As access is limited to Full Technical Attendees only, you will be asked to validate your credentials by entering the same login email address and password provided during the conference registration process. If you need assistance with your login information, please use the “forgot password” utility or “Contact Help” link.
### Agenda of Sessions — Sunday, 12 April

| 15:00–18:00 | Registration, Grand Foyer |

### Agenda of Sessions — Monday, 13 April

| 15:00–18:00 | Registration, Grand Foyer |

| 07:00–18:30 | Registration, Grand Foyer |
| 08:00–10:00 | JM1A • Opening Plenary Session, Harbourside Ballroom 1 & 2 |
| 10:00–10:45 | Exhibit Hall Opening and Coffee Break, Salon A |
| 10:45–12:45 | BM2A • Diffused Optical Imaging |
| 10:45–12:45 | BrM2B • Novel Approaches to Functional Brain Microscopy |
| 10:45–12:45 | NM2C • Super Resolution I (ends at 12:30) |
| 10:45–12:45 | OM2D • Theranostics (ends at 12:30) |
| 10:45–12:45 | OtM2E • Optical Manipulation Fundamentals and Technologies I |
| 12:45–14:00 | Lunch Break (On Your Own) |
| 14:00–16:00 | BM3A • New Approaches for Optical Diagnostics |
| 14:00–16:00 | BrM3B • Structural and Multiscale Brain Imaging |
| 14:00–16:00 | NM3C • Super Resolution II (ends at 15:45) |
| 14:00–16:00 | OM3D • Controlled Drug and Probe Delivery (ends at 15:30) |
| 14:00–16:00 | OtM3E • Optical Manipulation Fundamentals and Technologies II |
| 16:00–16:30 | Exhibits and Coffee Break, Salon A |
| 16:30–18:30 | BM4A • Novel Techniques and Applications in OCT |
| 16:30–18:30 | BrM4B • Optics in the Human Brain / Brain Blood Flow |
| 16:30–18:30 | NM4C • New Techniques and Approaches |
| 16:30–18:30 | OM4D • Nanobiophotonics (ends at 18:15) |
| 16:30–18:30 | OtM4E • Optical Manipulation Fundamentals and Technologies III (ends at 18:15) |
| 18:30–20:00 | Congress Reception and Exhibits, Salon A |

### Key to Conference Abbreviations

- **BODA**: Bio-Optics: Design and Application (BODA)
- **NTM**: Novel Techniques in Microscopy (NTM)
- **OMP**: Optical Molecular Probes, Imaging and Drug Delivery (OMP)
- **OTA**: Optical Trapping Applications (OTA)
- **Brain**: Optics and the Brain
# Agenda of Sessions — Tuesday, 14 April

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<th>Salon E</th>
<th>Salon C</th>
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<td>07:30–19:00</td>
<td>BODA</td>
<td>Brain</td>
<td>NTM</td>
<td>OMP</td>
<td>OTA</td>
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<tr>
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<table>
<thead>
<tr>
<th>Times</th>
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<tr>
<td>08:00–10:00</td>
<td>BT1A • Modern Microscopy for Diagnostics and Tissue Imaging</td>
<td>Salon A</td>
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<tr>
<td></td>
<td>JT1B • Functional Brain Two-photon Microscopy (Joint Brain and NTM)</td>
<td>Salon D</td>
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<td></td>
<td>OT1C • Imaging using Endogenous Contrast</td>
<td>Salon E</td>
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<tr>
<td></td>
<td>OtT1D • Optical Manipulations Fundamentals and Technologies / Optical Manipulation Applications I</td>
<td>Salon C</td>
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<tr>
<td>10:00–10:30</td>
<td>Exhibits and Coffee Break, Salon A</td>
<td>Salad A</td>
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<tr>
<td>10:30–12:00</td>
<td>Industry Keynote and Panel, Harbourside Ballroom 1 &amp; 2</td>
<td>Harbourside Ballroom 1 &amp; 2</td>
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<tr>
<td>12:00–13:30</td>
<td>Bright Ideas Pitch Panel Luncheon, Harbourside Ballroom 1 &amp; 2</td>
<td>Harbourside Ballroom 1 &amp; 2</td>
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<tr>
<td>13:30–15:30</td>
<td>BT2A • Active Optical Systems for Imaging and Treatment</td>
<td>Salon D</td>
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<td>BrT2B • Multi-scale Functional Brain Imaging In-vivo</td>
<td>Salon E</td>
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<td></td>
<td>NT2C • Nonlinear Optical Microscopy I</td>
<td>Salon C</td>
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<tr>
<td></td>
<td>OT2D • Advances in Imaging - Deeper and Faster</td>
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<td></td>
<td>OtT2E • Optical Manipulation Applications II (starts at 14:00 and ends at 15:15)</td>
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<tr>
<td>15:30–17:00</td>
<td>JT3A • Poster Session, Exhibits and Coffee Break, Salon A</td>
<td>Salon A</td>
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<tr>
<td>17:00–19:00</td>
<td>BT4A • Bio-photonic Technologies in Cancer Research</td>
<td>Salon D</td>
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<td>BrT4B • Imaging and Photomaniapulation</td>
<td>Salon E</td>
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<td></td>
<td>NT4C • Nonlinear Optical Microscopy II</td>
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<td>OT4D • Functional Imaging of Cells and Tissue</td>
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<tr>
<td></td>
<td>OtT4E • Optical Manipulation Applications III (ends at 18:30)</td>
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</table>

**Presentations selected for recording are designated with a ●.**

To view recorded presentations, go to [www.osa.org/lifesciencesOPC](http://www.osa.org/lifesciencesOPC) and click on Access meeting presentations slidecasts under Essential Links.

**Key to Conference Abbreviations**

- **BODA**: Bio-Optics: Design and Application (BODA)
- **NTM**: Novel Techniques in Microscopy (NTM)
- **OMP**: Optical Molecular Probes, Imaging and Drug Delivery (OMP)
- **OTA**: Optical Trapping Applications (OTA)
- **Brain**: Optics and the Brain
### Agenda of Sessions — Wednesday, 15 April

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<tr>
<th>Time</th>
<th>Salon F</th>
<th>Harbourside Ballroom 3</th>
<th>Salon D</th>
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<tr>
<td>07:30–16:30</td>
<td>BODA</td>
<td>Brain</td>
<td>NTM</td>
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<td></td>
<td>Registration</td>
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<tr>
<td>08:00–10:00</td>
<td>BW1A • Biosensing and Bio-Manipulation Techniques I</td>
<td>BrW1B • Optogenetics, Light Delivery and Fiber Probes</td>
<td>NW1C • New Illumination Schemes (ends at 09:45)</td>
<td>OW1D • Imaging and Image Guidance Using Exogenous Molecular Probes</td>
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<tr>
<td>10:00–11:00</td>
<td>JT3A • Poster Session, Exhibits and Coffee Break, Salon A</td>
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<tr>
<td>11:00–13:00</td>
<td>BW2A • Biosensing and Bio-Manipulation Techniques II</td>
<td>JW2B • Molecular Imaging and Optogenetics (Joint OMP and BRAIN)</td>
<td>NW2C • Tissue Tomography</td>
<td>OtW2D • Optical Manipulation Applications IV/Alternative Techniques I</td>
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<tr>
<td>13:00–14:30</td>
<td>Lunch Break (On Your Own)</td>
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<tr>
<td>14:30–16:30</td>
<td>BW3A • Clinical Technologies I</td>
<td>BrW3B • Functional Microscopy, Light Patterning and Going Deeper</td>
<td>NW3C • Light Scattering and Phase Microscopy</td>
<td>OW3D • Photoacoustic Imaging and Fast Tissue Scanning (ends at 16:00)</td>
<td>OtW3E • Alternative Particle Manipulation Techniques II (ends at 15:45)</td>
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All technical papers are currently available for online download. Access papers at www.osa.org/lifesciencesOPC and click on Access digest papers under Essential Links.

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**Optics in the Life Sciences • 12–15 April 2015**

**BM2A • Diffused Optical Imaging**

**Presider: Brian Pogue; Dartmouth College, USA**

<table>
<thead>
<tr>
<th>Concurrent Session</th>
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<th>Speaker(s)</th>
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<tr>
<td>BM2A.1 • 10:45</td>
<td>Diffuse Optical Imaging in the Spatial and Temporal Frequency Domain</td>
<td>Bruce J. Tromberg, Univ. of California Irvine, USA. Quantitative imaging in thick tissues is a significant challenge due to distortions from multiple light scattering. Diffuse Optical Imaging using spatially- and temporally-modulated sources controls path length-changing distortions and allows formation of tissue functional images.</td>
</tr>
<tr>
<td>BM2A.2 • 11:15</td>
<td>Real-time Quantitative Endogenous Molecular Contrast Imaging for Surgery</td>
<td>Sylvan Gioux, Harvard Medical School, USA; Beth Israel Deaconess Medical Center, USA. There is a pressing clinical need to provide image guidance during surgery. In this presentation, we will review our efforts in image-guided surgery using diffuse NIR light.</td>
</tr>
<tr>
<td>BM2A.3 • 11:45</td>
<td>Detecting Structural Information of Scatters using Spatial Frequency Domain Imaging</td>
<td>Nico Bodenschatz, Philipp Krauter, Steffen Nothelfer, Florian Foschum, Andrei Liemert, Alkon Kienle, ILM, Germany. Spatial frequency domain imaging is frequently used to derive scattering and absorption maps of turbid media. Using high spatial frequencies, we demonstrate mapping of the phase function parameter gamma which provides microscopic information of scatterers.</td>
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**BrM2B • Novel Approaches to Functional Brain Microscopy**

**Presider: Elizabeth Hillman; Columbia Univ., USA and Frances Pavone, European Lab for Nonlinear Spectroscopy, Italy**

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<tr>
<td>BrM2B.1 • 10:45</td>
<td>Whole-brain Dynamic Map of Neuronal Circuit</td>
<td>Alipasha Vaziri, Research Platform for Quantum Phenomena and Nanoscale Biological Systems, Univ. of Vienna, Austria; Inst. of Molecular Pathology, Austria. I will discuss our ongoing efforts on development of optical tools that are enabling whole-brain high-speed calcium imaging in small model organisms and illustrate the application of such imaging technique towards developing dynamic maps of neuronal circuits on the whole-brain level.</td>
</tr>
<tr>
<td>BrM2B.2 • 11:15</td>
<td>Photonic Interfacing with Large Scale Natural and Bioengineered Neuronal Networks</td>
<td>Shy Shoham, Technion Israel Inst. of Technology, Israel. We demonstrate wavefront shaping solutions for fundamental bidirectional neurophotonic interfacing challenges with retinas and 3D networks.</td>
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**NM2C • Super Resolution**

**Presider: Eric Potma; Univ. of California Irvine, USA**

<table>
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<tr>
<td>NM2C.1 • 10:45</td>
<td>Potential Information Gains from Superresolution with Correlated Emitter</td>
<td>Joseph Mezger, Stanford Univ., USA. We theoretically analyze information gains from using correlated (but spectrally distinct) fluorophores in superresolution localization microscopy at high labeling densities. Imaging with pairs of anti-correlated fluorophores reduces biases in estimation of fluorophore spacing.</td>
</tr>
<tr>
<td>NM2C.2 • 11:15</td>
<td>Optimal Point Spread Function for 3D High-Precision Imaging</td>
<td>Yoav Shechtman, Steffen J. Sahl, Lucien E. Weiss, Adam S. Baker, W.E. Moerner, Stanford Univ., USA. We theoretically discuss the optimal point spread function (PSF) for localization-based 3D imaging. Such a PSF exhibits excellent localization precision by design, as we demonstrate theoretically and experimentally, and can be tailored for specific imaging parameters.</td>
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</table>

**NM2C.3 • 11:45**

**Sub-Nanometer Particle Tracking by Point-Spread-Function Spatial Modulation**

**Amihai Meiri, Max Planck Inst. for Biophysical Chemistry, Germany. We generate an information-optimal point spread function (PSF) for localization-based 3D imaging. Such a PSF exhibits excellent localization precision by design, as we demonstrate theoretically and experimentally, and can be tailored for specific imaging parameters.**
10:45–12:30
OM2D • Theranostics
Presider: Laura Marca, Univ. of California Davis, USA

OM2D.1 • 10:45
Invited
Multimodality Optical Nanoparticles, Microbubbles and Instrumentation for Cancer Theranostics,
Brian C. Wilson1; Medical Biophysics, Univ. Health Network/U Toronto, Canada. We review porphyrin/ lipid conjugate nanoparticles and microbubbles as potential cancer theranostic agents. The former have intrinsic optical multifunctionality, while the latter have photoacoustic, fluorescence and ultrasound contrast. A corresponding trimodal imaging instrument is also presented.

OM2D.2 • 11:15
Near infrared photo-immunotherapy: A newly developed, target cell-specific cancer theranostic technology,
Hisataka Kobayashi1; Molecular Imaging Program, NIH National cancer Inst., USA. Highly targeted cell-selective near infrared photo-immunotherapy, a theranostic technology, was developed using photo-immunoconjugates targeting cancer cell-specific molecules. When exposed near infrared light, conjugates induce necrotic cell death to targeted cells by cellular membrane damage.

OM2D.3 • 11:30
Hemagglutinating virus of Japan envelope (HVJ-E) allows targeted and efficient delivery of photosensitizer for photodynamic therapy against advanced prostate cancer,
Mizuho Inai1, Masa Yamauchi1, Nonhiro Honda1, Hisanori Hazama1, Shoji Tachikawa1, Hirouki Nakamura1, Tomoki Nishida1, Hidehito Yasuda1, Yasufumi Kanesa1, Kunio Awazu1; Osaka Univ., Japan; Tokyo Inst. of Technology, Japan. Selective and efficient photosensitizer delivery was accomplished by utilizing inactivated Sendai virus particle. Drug delivering mechanism was addressed via transmission electron microscope and photocytotoxic activity was investigated thorough performing photodynamic therapy on cultured cells.

OM2D.4 • 11:45
Targeted Photoinduced Killing of Bacterial Pathogens: from Chemical Synthesis to Photobiological Application,
Andhela Gaityan1, Silke Niemann1, Michael Schallers1, Christian A. Strasser1, Andreas Faust1; European Inst. for Molecular Imaging, Germany; Center for Nanotechnology, Germany; Inst. for Medicinal Microbiology, Germany. This study focuses on the synthesis, photophysical characterization and examination of photodynamic efficiency of maltotriose-conjugated silicon phthalocyanines. In this paper we present symptomatically substituted derivative showing selective killing of Gram-positive S.aureus bacteria.

10:45–12:45
OtM2E • Optical Manipulation Fundamentals and Technologies I
Presider: Steven Neale; Univ. of Glasgow, UK

OtM2E.1 • 10:45
Invited
Complex Light for Optical Micro-Manipulation: Amplitude, Phase And Polarization Modulation,
Cornelia Denz1, Christina Alpmann1, Eileen Otte1, Christoph Schöler1, Christian Schlickriede1; Inst. of Applied Physics, Univ. of Muenster, Germany. Within the topical field of three-dimensional holographic beam shaping, the modulation of complex light fields in amplitude, phase and polarization is demonstrated. Different kinds of higher order modes will be discussed and applied in optical micro-manipulation.

OtM2E.2 • 11:15
Measurement of Hydrodynamic Coupling by Time-shared Optical Tweezers,
Wen Jun Toe1, Peter J. Reece1, Ana Andres-Arroyo1; The Univ. of New South Wales, USA. We demonstrate a technique for monitoring fast dynamics between multiple optically trapped particles using time-shared optical tweezers and back focal plane interferometry. We examine the viability of this method and show how it can be expanded to more complex systems.

OtM2E.3 • 11:30
Optical Chaining of Tens of Silica Beads with Single Trap,
Remy Avila1, Oscar Rodriguez-Herrera1, Arturo Gonzalez-Suarez1, Joaquin Ascencio-Rodriguez1; Univ Nacional Autonoma de Mexico, Mexico; College of Optical Sciences, Univ. of Arizona, USA; Instituto de Ciencias de la Salud, Universidad Veracruzana, Mexico. We present experimental results of optical confinement of up to 37 2.5-μm-diameter silica beads using a NIR gaussian laser and a 100x microscope objective with numerical aperture of 1.25, on an inverted configuration.

OtM2E.4 • 11:45
Optically-Trapped Particle Temperature Extraction with Hot Brownian Dynamics,
Paden Roder1, Bennett Smith1, Peter Pauzauskie1; Materials Science and Engineering, Univ. of Washington, USA; Fundamental and Computational Sciences Directorate, Pacific Northwest National Lab, USA. Combining hot Brownian motion theory with forward-scattered light analysis, we show a method for determining temperatures of optically-trapped nanoparticles in nonisothermal solvents. Results for trapped silica microspheres in D2O show heating to 35.9 °C.
## Bio-Opsics: Design and Application

**BM2A • Diffused Optical Imaging—Continued**

**BM2A.4 • 12:00**

Macroscopic imaging of microscopic tissue scattering parameters using high spatial-frequency imaging. Stephen C. Kanick1, David McClatchy2, Brian W. Pogue3; Dartmouth College, USA. This study describes the use of high spatial frequency imaging to quantitatively map the anisotropic scattering phase function distribution in tissue.

**BM2A.5 • 12:15**

Monitoring Molecular Aging of Lens Proteins using Noninvasive Quasi-Elastic Light Scattering. Srikant Sarangi1, Olga V Minaeva2, Juliet Moncaster3, Frank Weng4, Caitlin Roek5, Danielle Ledoux5, John Clark6, David Hunter7, Lee Goldstein8; 1Biomedical Engineering, Boston Univ., USA; 2Boston Univ., USA; 3Ophthalmology, Boston Children’s Hospital, USA; 4Biological Structure, Univ. of Washington, USA. Post-translational modifications of lens proteins during aging can be monitored with quasi-elastic light scattering. Here, we show the ability of the technique to detect these changes both in vitro and in vivo.

**BM2A.6 • 12:30**

Hyperspectral Single-Pixel Wide-Field Time Domain Diffuse Optical Tomography. Qi Pian1, Ruoyang Yao1, Xavier Intes1; 1Rensselaer Polytechnic Inst., USA. We report on the instrumentation design and experimental validation of a hyperspectral single-pixel wide-field time-resolved diffuse optical tomography (DOT) system. Reconstruction results show quantification and cross-talk improvements in fluorescence concentration mapping in turbid media.

### These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

### 12:45–14:00 Lunch Break (On Your Own)

### 14:00–16:00 BM3A • New Approaches for Optical Diagnostics

**Presider: Chris Xu; Cornell Univ., USA**

**BM3A.1 • 14:00 Invited**

High Resolution Molecular Imaging with Cerenkov Excited Luminescence Scanned Imaging (CELSI). Brian W. Pogue1, 2; Dartmouth College, USA. Using high energy x-rays to excite Cerenkov emission in tissue, it is possible to achieve high resolution optical molecular imaging at depths of a few centimeters, while delivering low radiation doses.

### 14:00–16:00 BrM3B • Structural and Multiscale Brain Imaging

**Presider: Polina Anikeeva; MIT, USA**

**BrM3B.1 • 14:00 Invited**

Introduction to Neurophotonics. Francesco S. Pavone1; 1European Lab for Non-Linear Spectroscopy, Italy. Abstract not available.

**BrM3B.2 • 14:15**

A multi-modal clearing method for brain imaging. Irene Costantin1, Anna Letizia Allegre Mascaro2, Antonio P. Di Giovanna1, Ludovico Silvestri1, Marie Caroline Müllerbroich1, Leonardo Sacconi2, Francesco S. Pavone1; 1LENS, Univ. of Florence, Italy; 2National Inst. of Optics, National Research Council, Italy; 3Dept of Physics and Astronomy, Univ. of Florence, Italy. In this work we investigate the effectiveness of a water-soluble agent, the 2,2'-thiodiethanol (TDE) to clear mouse and human brain. TDE is suitable with two-photon fluorescence microscopy and in combination with CLARITY with light sheet microscopy.

### 14:00–15:45 NM3C • Super Resolution II

**Presider: Alexander Small; California State Polytechnic Univ., USA**

**NM3C.1 • 14:00 Invited**

3D orbital tracking for super-resolving the dynamics of gene expression. Enrico Gratton1, 2; Univ. of California Irvine, USA. Optical super-resolution of fast dynamic processes can be achieved using the 3D orbital tracking technique and fluctuation spectroscopy analysis. Here we show application of the method to the dynamics of loci of gene expression.

**NM3C.4 • 12:00**

Optical resolution enhancement and background reduction by stimulated emission depletion structured illumination microscopy with structured excitation. Fumihiro Dake1, Shigena Nakayama1, Yusuke Tak1, Nikon Corporation, Japan. We propose stimulated emission depletion (STED) structured illumination microscopy (SIM), which has structured excitation and structured STED light with the same grating vector. Numerical simulation shows the possibility of improving resolution and reducing background fluorescence.

**NM2C.4 • 12:00**

Optical coherence tomography for enhanced detection of Drosophila neural activity. Michael Adams1, B. Hyle Park2; 1UCR, USA; 2Department of Physics and Astronomy, Univ. of Florence, Italy. In this work we investigate the effectiveness of a water-soluble agent, the 2,2'-thiodiethanol (TDE) to clear mouse and human brain. TDE is suitable with two-photon fluorescence microscopy and in combination with CLARITY with light sheet microscopy.
OM2D • Theronanostics—Continued
OM2D.5 • 12:00  Invited
Nanolook at Cancer: Can We Explode It?, Dmitri Lapotko¹; Rice Univ., USA. Treatment-resistant aggressive tumors that cannot be safely resected, and recur despite chemo- and radio-therapies, cause the lowest survival rate. We report a cell level cancer treatment whose efficacy is self-amplified in cells with cancer aggressiveness.

OtM2E • Optical Manipulation Fundamentals and Technologies I—Continued
OtM2E.5 • 12:00
Direct observation of temperature in an optical trap via ratiometric emission of nanoparticles, Matthew Crane¹; Univ. of Washington, USA. We directly measure superheated temperature from ratiometric emission of optically-trapped Er,Yb co-doped NaYF₄ and YLu crystals as well as core-shell nanoparticles and compare these results to temperatures from Hot Brownian Motion analysis.

OtM2E.6 • 12:15
Mechanical Effects of Light on Non Spherical Particles, Jean-Christophe Loudet¹; CNRS, France. Dielectric ellipsoids have been observed to undergo sustained oscillations driven by laser radiation pressure forces and torques. We show, both experimentally and numerically, that these oscillations can be suppressed using 2-counter-propagating beams by tuning their respective powers.

OtM2E.7 • 12:30
Optical Binding and Synchronisation in Arrays of Non-Spherical Particles, Stephen Simpson², Philip Jones³, Onofrio Marago⁴, Simon Hanna³; Univ. of Bristol, UK; Inst. of Scientific Instruments of the ASCR, Czech Republic; Physics, Univ. College London, UK; CNR-IPCF, Istituto per i Processi Chimico-Fisici, Italy. The optical binding forces between non-spherical particles in counter-propagating beams are simulated. Particle shape influences both separation and orientation while chirality leads to optically-induced synchronisation. The observed dynamics suggest applications in bio-inspired micromachines.

12:45–14:00 Lunch Break (On Your Own)

OM3D • Controlled Drug and Probe Delivery
Presider: Elina Vitol, Ecolab, Inc., USA

14:00–15:30
OM3D.1 • 14:00  Invited
Optically-controlled Drug Delivery, Jennifer West¹; Duke Univ., USA. Abstract not available.

14:00–16:00
OtM3E • Optical Manipulation Fundamentals and Technologies II
Presider: Simon Hanna; Univ. of Bristol, UK

OtM3E.1 • 14:00  Invited
Hydrodynamic Interactions in Driven Systems, David B. Phillips¹, Rebecca Hay¹, Graham Gibson¹, Stuart Boz¹, Luke Debono¹, Stephen Simpson¹, Miles Padgett¹; Univ. of Glasgow, UK; Univ. of Bristol, UK; Inst. of Scientific Instruments, Czech Republic. We show how low Reynolds number environments can produce rich behavior even in very simple systems. Understanding the physics of this regime is important to help connect the form and function of micro-scale biological systems.
Multimodal Nonlinear imaging of meningioma human biopsies, Marc Zanello1, David Sevran2, Pascale Varlet1, Bertrand Devaux3, Darine ABI HAIDAR4, 5, Laboratoire IMNC, France; Université Paris Diderot-Paris 7, France; 3Neuropathology Dept, Saint Anne Hospital, France, France. Nonlinear microscopy is of great interest in neuroangiography especially in neuro-oncology. We performed multimodal nonlinear imaging on three samples of meningioma: spectral, fluorescence lifetime, two-photon excitation and second-harmonic generation, which underlined diagnostic capacities.

Percutaneous single fiber spectroscopy of fatty changes in livers in a rat model of diet-induced hepatic steatosis, Daching Gong1, 2, Hui Delong1, 2, Jing Yuan2, Anan Li2, Xiangning Li2, Qingming Luo2; 1Wuhan National Lab for Optoelectronics, China; 2Huazhong Univ. of Science and Technology, China. To obtain a comprehensive view of brain structure, complementary approaches have been combined. In this presentation, we describe our recent advantages in correlation techniques proposing a wider methodological framework fusing multiple levels of brain investigation.

Brain-wide cartographic neuronal activation maps with cellular resolution, Ludovico Silvestri2, Nikita Rudinsky3, Marco Paciscopio4, 5, 6, Marie Caroline Mullerbruch7, Irene Costantini4, 5, Leonardo Sacconi1, 7, 8, Paolo Frassonic1, Bradley T. Hyman9; 1Univ. of Colorado at Boulder, USA; 2BC Cancer Research Center, Canada; 3Wayne State Univ., USA; 4 Universidad de Murcia, Spain; 5A.I.I. Italy; 6Non-Linear Spectroscopy, Italy. To obtain a comprehensive view of brain function. Here we present a method to study the complex architecture of nerve fibers in the sectioned brain and is well suited to address whole human brain analysis.

Brain-wide cartographic neuronal activation maps with cellular resolution, Ludovico Silvestri2, Nikita Rudinsky3, Marco Paciscopio4, 5, 6, Marie Caroline Mullerbruch7, Irene Costantini4, 5, Leonardo Sacconi1, 7, 8, Paolo Frassonic1, Bradley T. Hyman9; 1Univ. of Colorado at Boulder, USA; 2BC Cancer Research Center, Canada; 3Wayne State Univ., USA; 4 Universidad de Murcia, Spain; 5A.I.I. Italy; 6Non-Linear Spectroscopy, Italy. To obtain a comprehensive view of brain function. Here we present a method to study the complex architecture of nerve fibers in the sectioned brain and is well suited to address whole human brain analysis.

Optics and the Brain - Novel Techniques in Microscopy
OM3D • Controlled Drug and Probe Delivery—Continued

OM3D.2 • 14:30
Drug diffusion in soft self-aligned tissue, Tigran V. Galstian1,2; 1Universite Laval, Canada; 2R&D, Lensvector inc, USA. Optical microscope study of diffusion of chiral molecules through self-aligned molecular complexes is presented. The roles of chirality of the dopant, the elasticity and boundary conditions of the host are discussed to discriminate the diffusion process.

OM3D.3 • 14:45
Combined Raman Spectroscopy and Optical Coherence Tomography for Measuring Analytes in Targeted Tissues, Jason R. Maher1, Oranat Chuchuen1, Angela Kashuba2, David Katz1, Adam Wax1; 1Duke Univ., USA; 2The Univ. of North Carolina at Chapel Hill, USA. We report the development of a combined Raman spectroscopy and optical coherence tomography instrument. The instrument was used to accurately measure physiologically-relevant concentrations of microbicide drugs in ex vivo tissue samples.

OM3D.4 • 15:00
Biodegradable Plasmonic Nanoparticles: Overcoming Clinical Translation Barriers, Konstantin Sokolov1,2, Robert Stover3, Pratixa Joshi1,2, Soon Joon Yoon1, Avinash Murthy1, Stanislav Emelianov1,3, Keith Johnston1; 1The UT MD Anderson Cancer Center, USA; 2Biomedical Engineering, The Univ. of Texas at Austin, USA; 3Chemical Engineering, The Univ. of Texas at Austin, USA. We present biodegradable gold nanoparticles with plasmon resonances in the NIR region that can provide a crucial link between the enormous potential of metal nanoparticles for cancer imaging and therapy and translation into clinical practice.

OM3D.5 • 15:15
Single Molecule Protein Sizing in Double Nano-hole Optical Tweezers, Skyler Wheaton1, Reuven Gordon1; 1Univ. of Victoria, Canada. Single proteins are trapped in a double nano-hole optical tweezer and their molecular weight is inferred from analysis of the laser transmission fluctuations.

OM3D.6 • 15:30
Optical Trapping and Diagnostic Analysis of Au Nanoparticles Using Photonic Crystal Slot Cavity at sub-mW Laser Power, S. Hamed Mirsadeghi1, Jonathan Massey-Allard1, Jeff F. Young1; 1Physics and Astronomy, Univ. of British Columbia, Canada. We report our recent advances in using silicon-on-insulator (SOI) photonic integrated circuits for trapping sub-$60$nm gold spheres and rods with sub-mW laser powers and using transmission time-series histograms analysis to model the dynamics of trapped nanoparticles.

OM3D.7 • 15:45
Chip-scale Transport of Dielectric Particles using the Optical Near Field of Closely-Spaced Plasmonic Resonators, Jason Ryan1, Yukin Zheng1, Paul Hansen1; 1Stanford Univ., USA. We transport nano-scale objects across a distance of many microns using a repeated sequence of rotated C-shaped plasmonic resonators. Rotating the polarization angle of the overhead laser illumination drives the particles’ motion.

OtM3E • Optical Manipulation Fundamentals and Technologies II—Continued

OtM3E.2 • 14:30
Strong Interaction between Gold Particles in Light-assisted Templated Self-Assembly, Ningfeng Huang1, Luis J. Martinez1, Eric Jaquay1, Michelle L. Povinelli1; 1Univ. of Southern California, USA. We use kinetic Monte Carlo simulations to predict that templates with hexagonal symmetry promote the light-assisted assembly of regular 2D arrays of gold nanoparticles, despite optical binding effects.

OtM3E.3 • 14:45
Probing Telopeptide-Induced Collagen-Collagen Interactions Using Optical-Tweezers-Based Microrheology, Tuba Altindal1, Marjan Shayegan1, Evan Kiefl1, Nancy Forde1; 1Simon Fraser Univ., Canada. The local viscoelasticity was compared between full-length and telopeptide-removed collagen solutions using optical-tweezers-based microrheology. An enhanced modulus at higher concentrations in full-length collagen solutions suggests contributions from telopeptide-associated transient crosslinks.

OtM3E.4 • 15:00
Localized Surface Plasmon Resonance Spectroscopy Combined With Optical Tweezers For Nanorod Dynamics Characterization, Ana Andres-Arroyo1, Wen Jun Toe1, Fan Wang1, Peter J. Reece1; 1The Univ. of New South Wales, Australia. We offer a new route to nanoscale manipulation by exploiting plasmonic features of metallic nanorods that are favourable for optical trapping. The emergence of rotational dynamics at low powers allows characterisation of the nanorod dynamics.

OtM3E.5 • 15:15
Chip-scale Transport of Dielectric Particles using the Optical Near Field of Closely-Spaced Plasmonic Resonators, Jason Ryan1, Yukin Zheng1, Paul Hansen1; 1Stanford Univ., USA. We transport nano-scale objects across a distance of many microns using a repeated sequence of rotated C-shaped plasmonic resonators. Rotating the polarization angle of the overhead laser illumination drives the particles’ motion.

OtM3E.6 • 15:30
Optical Trapping and Diagnostic Analysis of Au Nanoparticles Using Photonic Crystal Slot Cavity at sub-mW Laser Power, S. Hamed Mirsadeghi1, Jonathan Massey-Allard1, Jeff F. Young1; 1Physics and Astronomy, Univ. of British Columbia, Canada. We report our recent advances in using silicon-on-insulator (SOI) photonic integrated circuits for trapping sub-$60$nm gold spheres and rods with sub-mW laser powers and using transmission time-series histograms analysis to model the dynamics of trapped nanoparticles.

OtM3E.7 • 15:45
Chip-scale Transport of Dielectric Particles using the Optical Near Field of Closely-Spaced Plasmonic Resonators, Jason Ryan1, Yukin Zheng1, Paul Hansen1; 1Stanford Univ., USA. We transport nano-scale objects across a distance of many microns using a repeated sequence of rotated C-shaped plasmonic resonators. Rotating the polarization angle of the overhead laser illumination drives the particles’ motion.
16:30–18:30 BM4A • Novel Techniques and Applications in OCT
Presider: Bruce Tromberg; Univ. of California, Irvine, USA

BM4A.1 • 16:30 Invited
Double-clad Fiber Couplers: Novel Devices Enabling Multimodal Imaging, Caroline Boudoux1,2; École Polytechnique Montréal, Canada. I will talk about these devices in the context of combining OCT+fluorescence and OCT+thermal laser therapy.

BM4A.2 • 17:00 Invited
Optical Imaging of Dynamic Events in Cardiovascular Development: Understanding Physical and Genetic Mechanisms Underlying Birth Defects, Mary Dickinson1; Baylor College of Medicine, USA. This talk will focus on the recent developments in Optical Coherence Tomography from our group, which is used to define changes in heart function and morphology, as well as the development of strategies to image mouse embryos using light sheet microscopy.

BM4A.3 • 17:30
In vivo Burn Severity Assessment in a Mouse Model Using Spectroscopic Optical Coherence Tomography, Ying Zhao1,2; Howard Levinson1,2; William Brown1; Adam Wax1; 1Dept of Biomedical Engineering, Duke Univ., USA; 2Dept of Surgery, Duke Univ. Medical Center, USA; 3Dept of Pathology, Duke Univ. Medical Center, USA. Depth resolved spectra obtained from spectroscopic optical coherence tomography (SOCT) are used to evaluate burn injuries in vivo in a mouse model. Spectral differences between different burn severities are quantified by a power-law fitting model.

BM4A.4 • 17:45
An endoscopic imaging system for co-registered Doppler optical coherence tomography and autofluorescence imaging of human airways in vivo, Hamid Pahlevaninezhad1,2, Anthony M. Lee1,2, Riley Marsh3, Stephen Lam4, Calum E. MacAulay4, Pierre Lane5, 1BC Cancer Research Center, Canada; 2Univ. of British Columbia, Canada. This work reports a fiber optic-based endoscopic imaging system capable of combined Doppler optical coherence tomography (DOCT) and autofluorescence (AF) imaging.

16:30–18:30 BrM4B • Optics in the Human Brain / Brain Blood Flow
Presider: Tim Murphy, Univ. of British Columbia, Canada

BrM4B.1 • 16:30 Invited
Optical Imaging of Functional Connectivity, Joseph P. Culver1; Biomedical Engineering, Washington Univ. in St Louis, USA. Optical imaging of spontaneous brain activity provides a potent assay of brain functions and networks. We are developing neurophotonic techniques for non-invasive imaging of humans in the clinic and for imaging mouse models of disease.

BrM4B.2 • 17:00 Invited
Blood Flow, Brain Vascular Dynamics, and the Basis of Resting State fMRI, David Klinefeld1; Univ. of California, San Diego, USA. The topology of cortical vasculature and the nature of the underlying blood flow is reviewed, along with vasomotor oscillations (0.1 Hz) that lead to variations in brain activity that may explain the basis of resting state fMRI.

BrM4B.3 • 17:30 Invited
Photostress Tomography Beats Optical Diffusion, Joon-Mo Yang1,2; 1Univ. of California in St Louis, USA; 2Texas A&M Univ., USA. We have developed fast functional photoacoustic microscopy (fPAM), which can be utilized for three-dimensional morphological, functional, flow dynamic and metabolic mouse brain imaging through an intact skull with endogenous contrast only.

BrM4B.4 • 17:45
In vivo Imaging of Human Blood Flow Using Photothermal Tomography: The State of the Art, Hamid Pahlevaninezhad1,2; Anthony M. Lee3,4, Riley Marsh3, Stephen Lam4, Calum E. MacAulay4, Pierre Lane5, 1BC Cancer Research Center, Canada; 2Univ. of British Columbia, Canada; 3Univ. of Victoria, Canada. We demonstrate the first optical trapping of a single free-solution, unlabeled, unlabeled macrophage using a double nanohole aperture trap and furthermore collected its Raman vibrational spectra using our new two photon EAR technique.

16:30–18:30 NM4C • New Techniques and Approaches
Presider: Eric Potma; Univ. of California, Irvine, USA

NM4C.1 • 16:30 Invited
3D Nanoimaging and Detection of Molecular Flow using the nSPiRO Method, Michelle Digman1,2; 1Univ. of California, Irvine, USA; 2Centre for Bioactive Discovery in Health and Ageing, School of Sci & Tech, Univ. of New England, Australia. Detecting proteins dynamics within cells grown in 3D micro-environments is challenging. We developed a 3D nano-imaging technique to uniquely probes proteins in cells grown on collagen. Results show paxillin and actin diffusion rates are unique.

NM4C.2 • 17:00
Fluorescent Microscope in a Needle, Ganghun Kim1,2; Naveen Nagarajan1,2; 1Dept of Electrical and Computer Engineering, Univ. of Utah, USA; 2Dept of Human Genetics, Univ. of Utah, USA. We present a computational microscopy technique to capture fluorescent images through a small glass cannula for minimally invasive in-vivo imaging. Proposed technique produced high fidelity images of microbeads and microglia cells and experimentally achieved resolution up to 1μm.

NM4C.3 • 17:15
Line-scan Time Domain Single-pixel Camera, Zhihong Weng1,2; Hongwei Chen1,2; Cheng Li1,2; Minghua Chen1,2; Sigang Yang1,2; Shuhong Xie1,2; 1Shanghai Univ., China. We report a high speed single-pixel imaging system based on compressive sensing theory and time-lens technique. This line-scan time domain single-pixel camera is 2000 times faster than the traditional single-pixel cameras with DMD.

NM4C.4 • 17:30
Wide-Field Confocal Interferometric Backscattering (iSCAT)-Raman Microscopy, Ashten Christy1, Najmeh Tavassoli1, Alison Bain1, Luke Melo1,2; 1Univ. of British Columbia, Canada; 2Dept of Chemistry, Univ. of Waterloo, Canada. We describe a novel instrument combining interferometric scattering microscopy (iSCAT) with confocal Raman microscopy. This system images the refractive index morphology of a complex material. Co-axial Raman sampling provides chemical information with a high degree of reproducibility.

NM4C.5 • 17:45
Optical Trapping and Raman Spectroscopy of a Single MS2 Bacteriophage, Ryan Gelfand1,2; Skyler Wheaton1, Reuven Gordon1; 1Univ. of Victoria, Canada; 2Univ. of California, Irvine, USA. We demonstrate the first optical trapping of a single free-solution, unlabeled, unlabeled macrophage using a double nanohole aperture trap and furthermore collected its Raman vibrational spectra using our new two photon EAR technique.
Optical Trapping Applications

used for thermometry on the nanoscale based on the high temperature sensitivity \((SR \approx 1.4 \% K^{-1})\) of such as TiO\(_2\), SiO\(_2\), Graphene and nanodiamond in Rd6G solution. Blue shift is identified regarding public of).

surface within a rat esophagus.

is developed for rotational imaging of biomarker-targeted SERS NPs topically applied on the lumenal monitor the molecular changes that are relevant to esophageal cancer, a miniature spectral endoscope

engineering, Univ. of Washington, USA; 2Dept of Biomedical Engineering, Stony Brook Univ., USA.

Vasyl Syrvatka1, Yurij Slyvchuk1, Ivan Rozgoni1, Ivan Gevkan1, Oksana Shtapenko1;

OM4D.3 • 17:15
Sensitive and Rapid Assay for Determination of Protein Concentration Using Silver Nanoparticles with Hyaluronan, Vasyl Syrvatka1, Yuri Slyvchuk1, Ivan Rozgoni1, Ivan Gevkan1, Oksana Shtapenko1;

1Inst. of Animal Biology NAAS, Ukraine. Developing and validating of the rapid and sensitive method for determination of protein concentration using silver nanoparticles with hyaluronan was carried out. The assay is easy performed at room temperature and no special equipment is required.

OM4D.4 • 17:30
Upconversion NaSc/YF\(_4\), Yb:Er nanoparticles co-doped with Gd\(^{3+}\) and Nd\(^{3+}\) for thermometry on nanoscale, Dennis Kile1,

3 Univ. of Potsdam, Germany. Upconversion nanoparticles (UCNP) were used for thermometry on the nanoscale based on the high temperature sensitivity \((S_R \approx 1.4 \% K^{-1})\) of upconversion luminescence. The performance of the UCNP was improved using Nd\(^{3+}\) as co-dopant utilizing the cascade sensitization mechanism in tri-doped UCNP.

OM4D.5 • 17:45
Ratiometric Quantification of SERS Nanoparticles for Molecular Endoscopy of the Rat Esophagus, Yu W. Wang1,2, Ataaz Khan1, Suyoung Kang3, Steven Y. Leigh4, Jonathan T. Liu1;

1Univ. of Washington, USA; 2Dept of Mechanical Engineering, Univ. of Washington, USA; 3Univ. of Glasgow, UK. To monitor the molecular changes that are relevant to esophageal cancer, a miniature spectral endoscope is developed for rotational imaging of biomarker-targeted SERS NPs topically applied on the luminal surface within a rat esophagus.

OM4D.2 • 17:00
Blue Spectral Shift of Laser-Induced Fluorescence Due to Suspension of Nano-structures in Rd6G Solution, Ali Bavali1, Parviz Parvin1, Reza Karimi1;

1Amirkabir Univ. of Technology, Iran (the Islamic Republic of). The spectral shift of laser-induced fluorescence is investigated due to trace nano-additives such as TiO\(_2\), SiO\(_2\), Graphene and nanodiamond in Rd6G solution. Blue shift is identified regarding chemical functionality of nano-structures in weakly scattering media.

OM4D.1 • 16:30
Carbon Dots for Biological Imaging, Raz Jelinek1, Sukhendu Nandi1, Ben Gurion Univ. of the Negev, Israel. Carbon dots (CDs) have attracted interest due to their luminescence properties and diverse applications. We show that CDs surface-functionalized with hydrocarbon chains constitute versatile labels of peptides, membranes, bacterial and mammalian cells, and biological matrices.

OM4D.4 • 17:30
Calculating and Engineering the Optical Gradient and Scattering Force, Jack Ng1, Junjie Du1;

3 Univ. of Glasgow, USA. A phenomenon called "trap split" had been found when gold nanoparticles were trapped by femtosecond laser pulses, and the trap split was strongly dependent on the polarization, energy and wavelength of the laser pulses. The 3-Dimension distribution of trap split was investigated in this work.

OM4D.5 • 17:45
Theory and Practice of Computational Modeling and Simulation of Optical Tweezers, Timo A. Nieminen1, Nathavel du Freez-Wilkinson1, Ann A. Bui1, Alexander B. Stilgoe1, Vincent Loke1, Halina Rubinsztein-Dunlop1;

1School of Mathematics and Physics, Australia. In theory, there is no difference between theory and practice, but, in practice, there is. While a diverse range of theoretical options exist, practical considerations play a major role in choosing which to use.

OM4D.3 • 17:15
Sensitive and Rapid Assay for Determination of Protein Concentration Using Silver Nanoparticles with Hyaluronan, Vasyl Syrvatka1, Yuri Slyvchuk1, Ivan Rozgoni1, Ivan Gevkan1, Oksana Shtapenko1;

1Inst. of Animal Biology NAAS, Ukraine. Developing and validating of the rapid and sensitive method for determination of protein concentration using silver nanoparticles with hyaluronan was carried out. The assay is easy performed at room temperature and no special equipment is required.

OM4D.4 • 17:30
Upconversion NaSc/YF\(_4\), Yb:Er nanoparticles co-doped with Gd\(^{3+}\) and Nd\(^{3+}\) for thermometry on nanoscale, Dennis Kile1,

3 Univ. of Potsdam, Germany. Upconversion nanoparticles (UCNP) were used for thermometry on the nanoscale based on the high temperature sensitivity \((S_R \approx 1.4 \% K^{-1})\) of upconversion luminescence. The performance of the UCNP was improved using Nd\(^{3+}\) as co-dopant utilizing the cascade sensitization mechanism in tri-doped UCNP.

OM4D.5 • 17:45
Ratiometric Quantification of SERS Nanoparticles for Molecular Endoscopy of the Rat Esophagus, Yu W. Wang1,2, Ataaz Khan1, Suyoung Kang3, Steven Y. Leigh4, Jonathan T. Liu1;

1Univ. of Washington, USA; 2Dept of Mechanical Engineering, Univ. of Washington, USA; 3Univ. of Glasgow, UK. To monitor the molecular changes that are relevant to esophageal cancer, a miniature spectral endoscope is developed for rotational imaging of biomarker-targeted SERS NPs topically applied on the luminal surface within a rat esophagus.
BM4A • Novel Techniques and Applications in OCT—Continued

BM4A.5 • 18:00
Amplified optical time-stretch optical coherence tomography for endoscopic imaging. Luoqin Yu1, Xiaoming Wei1, Jingjiang Xu1, Jianbing Xu1, William Hau1, Kevin Tsia1, Kenneth K. Y. Wong1; 1The Univ. of Hong Kong, Hong Kong. Ultrafast endoscopic optical coherence tomography is demonstrated based on inertia-free time-stretch mechanism. Images of finger skin and intravascular stent are obtained with a line-scan rate of ~11.5 MHz to showcase its capability in endoscopic bioimaging.

BM4A.6 • 18:15
High-quality amplified optical time-stretch optical coherence tomography beyond 10MHz, Jingjiang Xu1, Xiaoming Wei1, Luoqin Yu1, Chi Zhang1, Jianbing Xu1, Kenneth K. Y. Wong1, Kevin K. Tsia1; 1Dept of Electrical & Electronic Engineering, The Univ of Hong Kong, Hong Kong. We report an ultrafast (11.5MHz) and high-performance amplified optical time-stretch optical coherence tomography (AOT-OCT) system based on a highly stable and broadband (~60nm) mode-locked fiber laser, achieving high sensitivity (~90 dB), superior roll-off performance (4.1mm/dB).

BrM4B • Optics in the Human Brain / Brain Blood Flow—Continued

BrM4B.4 • 18:00
Optical Spectroscopy and Molecular Detection Technologies to Guide Neurosurgical Interventions, Frédéric Leblond1; 1Polytechnique Montreal, Canada. I will describe recent advances made in the development and clinical translation of optical spectroscopy technology (Raman spectroscopy and wide-field fluorescence quantification) designed to guide neurosurgical interventions and increase the volume of resected cancer tissue.

BrM4B.5 • 18:15
Investigation of optically cleared human skin in combined multiphoton and reflectance confocal microscopy, Ali Majdzadeh1,2, Zhenguo Wu3, Harvey Liu3, David McLean3, Haishan Zeng1,3; 1Faculty of Medicine, Univ. of British Columbia, Canada; 2Imaging Unit - Integrative Oncology Dept, British Columbia Cancer Agency Research Centre, Canada; 3Photomedicine Inst. - Dept of Dermatology and Skin Science, Univ. of British Columbia and Vancouver Coastal Health Research Inst., Canada. Glycerol-induced optical clearing of the skin is limited by the barrier effect of the stratum corneum (SC). Application of hypotonic glycerol on human skin following SC removal substantially increased light penetration, but altered skin morphology.

NM4C • New Techniques and Approaches—Continued

NM4C.6 • 18:00
Investigation of optically cleared human skin in combined multiphoton and reflectance confocal microscopy, Ali Majdzadeh1,2, Zhenguo Wu3, Harvey Liu3, David McLean3, Haishan Zeng1,3; 1Faculty of Medicine, Univ. of British Columbia, Canada; 2Imaging Unit - Integrative Oncology Dept, British Columbia Cancer Agency Research Centre, Canada; 3Photomedicine Inst. - Dept of Dermatology and Skin Science, Univ. of British Columbia and Vancouver Coastal Health Research Inst., Canada. Glycerol-induced optical clearing of the skin is limited by the barrier effect of the stratum corneum (SC). Application of hypotonic glycerol on human skin following SC removal substantially increased light penetration, but altered skin morphology.

NM4C.7 • 18:15
Cell-Cell Interactions in Diseased Conditions Analyzed by Two Photon, Three Dimensional, and High-Speed in Vivo Microscope: From Visualization to Quantification, Satoshi Nishimura1; 1The Univ of Tokyo and Jichi med Univ, Japan. By improved two photon in vivo visualization, photochemical reactions, and direct laser injuries, we revealed dynamic, three-dimensional, and pathological cellular interplay. In this system, we visualized cellular processes in thrombus formation and artery contractions.
Optical Molecular Probes, Imaging and Drug Delivery

Optical Trapping Applications

**These concurrent sessions are grouped across two pages. Please review both pages for complete session information.**

OM4D • Nanobiophotonics—Continued

OM4D.6 • 18:00
Near Infrared Fluorescent Quaterrylenedimide-cored Dendrimers for Bio-imaging, Pin Shao, Shaojuan Zhang, Mingfeng Bai, Univ. of Pittsburgh, USA. A series of photostable, hydrophilic and functional near infrared quaterrylenedimide-cored dendrimers (QR-4Gn-COOH, n=1-5) were developed. Preliminary in vitro fluorescence imaging of QR-4G5-COOH showed that the dendrimer was primarily located in cytoplasm.

All technical papers are currently available for online download. Access papers at www.osa.org/lifesciencesOPC and click on Access digest papers under Essential Links

18:30–20:00 Congress Reception and Exhibits, Salon A

NOTES
These concurrent sessions are grouped across two pages. Please review both pages for complete session information.
Optical Trapping Applications

Univ., Canada; 2Security & Disruptive Technologies, National Research Council, Canada; 3Dept of Phys-

systems, along with application examples in different fields.

The advantages of mid-infrared gas sensing instruments based on such lasers over commonly used

Material Systems, Universität Würzburg, Germany.

Imaging Nuclear Architecture at the Nanoscale for Cancer Detection and Prognosis,

We present a new method for depth-resolved

Pathology, School of Medicine, Univ. of Pittsburgh, USA.

we identify a strong relationship between collagen crosslink autofluorescence and matrix stiffness.

and organization from two-photon excited fluorescence and second harmonic generation imaging,

By establishing quantitative optical biomarkers to characterize extracellular matrix composition

of California Irvine, USA.

In this work we show label free, non-invasive detection of oxidative stress

by phasor approach to fluorescence lifetime imaging microscopy of an endogenous, autofluorescent

probe associated with lipid oxidation by ROS.

The immense vibrational and electronic nonlinearities of carotenoids are

The development of optical molecular imaging

involved in the development of optical molecular imaging for tissue engineering.

under the evanescent field of higher

Science & Technology, Japan.

This unusual optical trapping was achieved using a non-resonant technique based on a nanodiamond

propulsion of polystyrene particles under the evanescent field of higher

Integrated Resonant Trapping in Hollow Photonic Crystals Cavities for Lab-On-Chip Manipula-

tion, Torin Maro1, Flavio M. Mor1, Nicolas Descharnes1, Iulian Avadanea1, Sylvain Jeney1, Romuald Houdré1,

Here, we show the potential of the detection of changes in the light momentum as a precise

method to determine forces in complex samples: in non-homogeneous media, with non-Gaussian

beams and on non-spherical particles.

Optical Manipulation Applications I

OT1C.1 • 08:00

Clinical Translation of Optical Molecular Imaging to Tissue Engineering: Opportunities & Chal-

enges,

OT1C.2 • 08:30

Endogenous probe for oxidative stress detection by FLIM, Rupsa Datta1, Enrico Gratton1, ‘Univ.
of California Irvine, USA. In this work we show label free, non-invasive detection of oxidative stress

by phasor approach to fluorescence lifetime imaging microscopy of an endogenous, autofluorescent

probe associated with lipid oxidation by ROS.

OT1C.3 • 08:45

Sub-mm Imaging of Carotenoids Using Electronic and Vibrational Nonlinear Optical Microscopy,

Aaron M. Barlow1,2, Joel T. Tabarangos2, Andrew Ridsdale1, Albert Sitdow1, Aaron D. Stepnow1, Trent

Univ., Canada; Security & Disruptive Technologies, National Research Council, Canada; Dept of Phys-

ics, Univ. of Ottawa, Canada. The immense vibrational and electronic nonlinearities of carotenoids are

exploited for label-free Coherent anti-Stokes Raman (CARS) and four-wave mixing (FWM) microscopy

of live microrgaiae. Additionally, we present quantitative sub-millimolar imaging of astaxanthin in vitro.

OT1C.4 • 09:00

Interband Cascade Laser Based Sensing, Lars Nähle1, Michael von Edelinger1, Julian Scheurmann1,

Marc Fischer1, Johanna Koch1, Robert Wei1, Martin Kamp1, nanoplus Nanosystems and Tech-

nologies, Germany; Technische Physik and Wilhelm-Conrad-Röntgen Research-Center for Complex

Material Systems, Universität Würzburg, Germany. A discussion on Interband Cascade Lasers and the

advantages of mid-infrared gas sensing instruments based on such lasers over commonly used

systems, along with application examples in different fields.

OT1C.5 • 09:15

Non-linear optical characterization of extracellular matrix changes following myocardial infarction,

Kyle R. Quinn1, Kelly E. Sullivan1, Zachary Ballard1, Lauren Black1, Irene Georgakoudi1, Tufts Univ.,

USA. By establishing quantitative optical biomarkers to characterize extracellular matrix composition

and organization from two-photon excited fluorescence and second harmonic generation imaging,

we identify a strong relationship between collagen crosslink autofluorescence and matrix stiffness.

OT1C.6 • 09:30

Imaging Nuclear Architecture at the Nanoscale for Cancer Detection and Prognosis, Yang Liu1, Shikhar Uttam1, Hoa Pham1, Justin Laface1, Douglas Hartman3,2; Univ. of Washington, USA; 2Pacific Northwest National

Lab, USA; 3Physics, Seattle Univ., USA. By establishing quantitative optical biomarkers to characterize extracellular matrix composition and organization from two-photon excited fluorescence and second harmonic generation imaging, we identify a strong relationship between collagen crosslink autofluorescence and matrix stiffness.

OT1D.1 • 08:00

Force Measurements in Complex Samples with Optical Tweezers, A. Farre1, Impetux, Barcelona, Spain; 23 Del. Co. Barcelona, Spain; 3Impetux, Barcelona, Spain. We present the manipulation, in liquid, of optically trapped nanodiamonds containing NV centres to exert resonant forces onto them and, in turn, to the host diamond nanoparticles.

OT1D.2 • 08:30

Integrated Resonant Trapping in Hollow Photonic Crystals Cavities for Lab-On-Chip Manipula-
tion, Torin Maro1, Flavio M. Mor1, Nicolas Descharnes1, Iulian Avadanea1, Sylvain Jeney1, Romuald Houdré1, Ecole Polytechnique Federale de Lausanne, USA. We demonstrate the use of photonic crystal cavities in order to optically trap submicron-size objects. The resonant nature of the trap provides different capabilities compared to classical optical tweezers. We study the Brownian motion of trapped particles with back focal plane interferometry.

OT1D.3 • 08:45

Propulsion of particles using ultrathin optical fibers, Marmati Ali1, Viet Giang Truong1, Marios Sergides1, Ivan Gusachenko1, Sile Nic Chormaic1, Light-Matter Interactions Unit, Okinawa Inst of Science & Technology, Japan. Propulsion of polystyrene particles under the evanescent field of higher order microfiber modes was studied. Experimental and theoretical results demonstrated much faster speeds for particles under higher order mode propulsion compared with the fundamental mode.

OT1D.4 • 09:00

Thermal Noise Imaging of Cell Membrane Stiffness and Tracking of Membrane Protein Motion,

Ardh Pratap1, Yu Huang Hu1, Physics, Univ. at Buffalo, SUNY, USA. The thermal motion of membrane proteins is analyzed to create high resolution maps of the cell membrane stiffness, the protein diffusion and potential traps. We discuss the technical requirements and present novel results.

OT1D.5 • 09:30

Singlet-oxygen Generation from Nanostructures in a Near Infrared Optical Trap, Bennett Smith1, Paden Roder1, Jennifer L. Hanson1, Sandeep Manandhar1, Arun Devarg1, Daniel Perez1, Woon-Joong Kim1, A. L. D. Kilcoyne4, Ulagalandha P. Dharanipathy1, László Forró1, 1Univ. of Michigan, USA. Observation of Atomic Dipole Forces in Optically Trapped Nanodiamonds Containing NV Centres, in a Liquid Environment, Carlo Bradac1, Matthew Juan1, Benjamin Boss1, Gabriel Molina-Terriza1, Thomas Voel1, Physics and Astronomy, ARC Centre for Engineered Quantum System, Macquarie Univ., Australia. We present the manipulation, in liquid, of optically trapped nanodiamonds containing NV centres, via resonant forces. We use a laser beam slightly detuned from the dipole transition of target colour centres to exert resonant forces onto them and, in turn, to the host diamond nanoparticles.

OT1D.6 • 09:45

Optical Noise Imaging of Cell Membrane Stiffness and Tracking of Membrane Protein Motion,

Ardh Pratap1, Yu Huang Hu1, Physics, Univ. at Buffalo, SUNY, USA. The thermal motion of membrane proteins is analyzed to create high resolution maps of the cell membrane stiffness, the protein diffusion and potential traps. We discuss the technical requirements and present novel results.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.
13:30–15:30
**BT2A • Active Optical Systems for Imaging and Treatment**
*Presider: Na Ji, Howard Hughes Medical Inst., USA*

**BT2A.1 • 13:30**
*Imaging Luminescent Objects through a Single Optical Fiber, Jerome C. Mertz*, Roman Baranikov*, Boston Univ., USA. We demonstrate the possibility of image transmission through a single optical fiber, where spatial positions are converted to spectral codes that span the full bandwidth of the object spectrum.*

**BT2A.2 • 14:00**
*Image-guided Ultrafast Laser Microsurgery Scalpels, Adela Ben-Yakar*, Univ. of Texas at Austin, USA. We present the development of ultrafast laser scalpels for microsurgery with the capability to deliver energies in excess of 1μJ per pulse and ablate at clinically relevant high speeds. Nonlinear imaging is combined for guidance.*

**BT2A.3 • 14:30**
*In Vivo Femtosecond Ablation and Imaging in Bone with a High BT2A.3 • 14:30
Ablation Surgery Probe, Adam Shadfan 1, Michal Pawlowski 1, Design and Fabrication of Miniature Objective Lens for Laser deliver energies in excess of 1μJ per pulse and ablate at clinically melts with a capability to deliver energies in excess of 1μJ per pulse and ablate at clinically relevant high speeds. Nonlinear imaging is combined for guidance.

13:30–15:30
**BrT2B • Multi-scale Functional Brain Imaging In-vivo**
*Presider: Bruno Weber, Universitat Zurich, Switzerland*

**BrT2B.1 • 13:30**
*Point-source Maps: Relations between Mesoscopic Imaging of Mouse Cortex and Neuronal Spiking, Tim H. Murphy*, Univ. of British Columbia, Canada. We describe multiple recombiant sensors for imaging mouse cortical resting state activity. Single unit recording was used to examine relations between local firing (within cortex or sub-cortical areas) and cortical maps.*

**BrT2B.2 • 14:00**
*Simultaneous Multi-Region Imaging Of Neuronal Activity, Hemodynamics And Speckle Flow In Awake Mice, Mohammed Shakil*, Sharon H. Kim*, Harushi T. Zhao*, Elizabeth M. Hillman*, Columbia Univ., USA. We describe a system for wide-field optical imaging of neuronal GCAMP3 calcium activity, hemodynamic responses and cerebral blood flow using an EMCCD camera in awake animals. We demonstrate use of this system in obtaining resting state and stimulus-evoked data with high spatio-temporal resolution.*

**BrT2B.3 • 14:15**
*Cortical activity motifs that correspond to sensory modalities are organized within larger super-clusters, Matthieu Varni*, Allan Chan*, Dongsheng Xiao*, Gergely Silasi*, Jeff Ledue*, Mo-staffe Moukhaven*, Tim H. Murphy*, UBC, Canada. Spontaneous activity carries information about mesoscopic brain mapping. Calcium wide field imaging was used to reveal the parcellation of the mouse cortex in clusters of areas as well as the topology existing in each cluster.*

**BrT2B.4 • 14:30**
*Reflection-mode Subwavelength-resolution Photoacoustic Microscopy for Label-free Microvascular Imaging In vivo, Wei Song*, Wei Zheng*, Qiang Xu*, Rupang Lin*, Xueqiong Gong*, Liang Song*, CAS Shenzhen Inst of Advanced Technology, China. We developed reflection-mode subwavelength-resolution photoacoustic microscopy capable of label-free microvascular imaging of various anatomical sites in vivo, including the mouse brain cortex with the skull intact. It may provide new possibilities for studying neurovascular coupling.*

**BrT2B.5 • 14:45**
*Localization and Visualization of Depth-Resolved Changes in Attenuation Coefficient During Focal Seizure Propagation with Optical Coherence Tomography, Melissa Eberle*, Carissa L. Rodriguez*, Mike Hui*, Jenny I. Sau*, Devin K. Binder*, B. Hyle Park*, UBC, Canada. Spontaneous activity carries information about mesoscopic brain mapping. Calcium wide field imaging was used to reveal the parcellation of the mouse cortex in clusters of areas as well as the topology existing in each cluster.*

13:30–15:30
**NT2C • Nonlinear Optical Microscopy I**
*Presider: Eric Potma, Univ. of California Irvine, USA*

**NT2C.1 • 13:30**
*Imaging Living Plant Tissues with Coherent Raman Scattering (CRS) Microscopy, Julian Maget*, Univ. of Exeter, UK. I will present novel techniques that allow CRS imaging of living plant tissue and show how they are being employed to shed new light on global challenges such as food security and biofuel production.*

**NT2C.2 • 14:00**
*CARS Microscopy for Visualizing Treatment Response in Skin, Conor L. Evans*, Massachusetts General Hospital, USA. We have non-invasively tracked and monitored the damage and subsequent recovery of individual sebaceous glands using CARS microscopy in living mice from the first minutes following intervention to weeks after treatment.*

**NT2C.3 • 14:30**
*Biothorogon Dual-vibrational imaging of dynamic metabolism in living organisms, Lu Wei*, Wei Min*, Columbia Univ., USA. We developed a biothorogon vibrational imaging platform, by coupling stimulated Raman scattering microscopy with small, vibrant and bioorthogonal tags (e.g. isotopes, CTracer), to probe dynamic metabolism in living organisms with superb sensitivity, specificity and biocompatibility.*

**NT2C.4 • 14:45**
*High quality coherent anti-Stokes Raman scattering (CARS) microscopy imaging with an ultra-compact four-wave mixing based fiber laser sources, Thomas Gottschall*, Tobias Meyer*, Michael Schmidt*, Jens Limpert*, Jürgen Popp*, Andreas Tün-nermann*, Friedrich-Schiller-Universität Jena, Inst. of Applied Physics, Abbe Center of Photonics, Germany; Inst. of Physical Chemistry and Abbe Center of Photonics, Germany; Active Fiber Systems GmbH, Germany; Leibniz Inst. of Photonic Technology Jena (IPHT) e.V., Germany. I will present the development of a new CARS microscopy setup based on the use of an ultra-compact fiber laser source and a compact ultrafast optical parametric oscillator.*
<table>
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<th>Time</th>
<th>Session Title</th>
<th>Presider(s)</th>
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<tr>
<td>13:30–15:30</td>
<td>OT2D • Advances in Imaging - Deeper and Faster</td>
<td>Kyle Quinn, Tufts Univ., USA</td>
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<td></td>
<td>OT2D.1 • 13:30 Invited</td>
<td>Adaptive Optics for Microscopy and Nanoscopy in Thick Tissue Specimens, Martin J. Booth&lt;sup&gt;1,2&lt;/sup&gt;, Univ. of Oxford, UK; 1SAOT, Univ. of Erlangen-Nürnberg, Germany. High resolution microscopes are detrimentally affected by specimen-induced aberrations, which can be corrected using adaptive optics. Methods and applications are presented for a range of microscopes and for STED and single molecule localization nanoscopy.</td>
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<td>OT2D.2 • 14:00</td>
<td>Rapid in-vivo Optical Projection Tomography of Larval and Adult Zebrafish Disease Models with Angular Multiplexing and FLIM-FRET, Sunil Kumar&lt;sup&gt;1&lt;/sup&gt;, Nicola Lockwood&lt;sup&gt;2&lt;/sup&gt;, Natalie Andrews&lt;sup&gt;3&lt;/sup&gt;, Teresa Correas&lt;sup&gt;4&lt;/sup&gt;, Marie-Christine Ramei&lt;sup&gt;5&lt;/sup&gt;, Yury Alexandrov&lt;sup&gt;1&lt;/sup&gt;, Matilda Katari&lt;sup&gt;1&lt;/sup&gt;, Laurence Bugnon&lt;sup&gt;1&lt;/sup&gt;, Margaret Dallman&lt;sup&gt;1&lt;/sup&gt;, Simon Arridge&lt;sup&gt;1&lt;/sup&gt;, Paul Franklin&lt;sup&gt;1&lt;/sup&gt;, James McGinity&lt;sup&gt;1&lt;/sup&gt;, Paul M. French&lt;sup&gt;1&lt;/sup&gt;, Imperial College London, UK; 1Univ. College London, UK. We report angular multiplexed OPT and FLIM OPT applied to in-vivo imaging of cancer and FRET biosensors in larval and adult zebrafish. Multispectral 3-D datasets of entire adult zebrafish can be acquired in 3 minutes.</td>
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<td>OT2D.3 • 14:15</td>
<td>Technique for Real-Time Fluorescence Lifetime Overlay on Tissue White-Light Images, Dimitris Gorpas&lt;sup&gt;1&lt;/sup&gt;, Julien Bec&lt;sup&gt;2&lt;/sup&gt;, Diego Yankelevich&lt;sup&gt;1&lt;/sup&gt;, Dinglong Ma&lt;sup&gt;1&lt;/sup&gt;, Laura Marcu&lt;sup&gt;2&lt;/sup&gt;, Univ. of California Davis, USA. We report a method for overlaying lifetime values on the location of fluorescence measurements. This is achieved using imaging and segmentation of an aiming beam. Current method enables real-time tissue optical diagnosis in clinical settings.</td>
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<td>OT2D.4 • 14:30</td>
<td>Fibre-coupled handheld multiphoton microscope with active motion compensation for in vivo skin imaging, Benjamin Sherlock&lt;sup&gt;1&lt;/sup&gt;, Sean Warren&lt;sup&gt;1&lt;/sup&gt;, James Stone&lt;sup&gt;1&lt;/sup&gt;, Mark Neill&lt;sup&gt;1&lt;/sup&gt;, Carl Paterson&lt;sup&gt;1&lt;/sup&gt;, Jonathan Knight&lt;sup&gt;1&lt;/sup&gt;, Paul M. French&lt;sup&gt;1&lt;/sup&gt;, Chris Dursby&lt;sup&gt;1,2&lt;/sup&gt;, 1Dept of Physics, Imperial College London, UK; 2Dept of Physics, Univ. of Bath, UK; Centre for Histopathology, Imperial College London, UK. To address the challenge of sample motion during in vivo imaging, we present a handheld multiphoton microscope with active motion compensation. We demonstrate the system’s ability to compensate motion in ex vivo mouse skin.</td>
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<td>OT2D.5 • 14:45</td>
<td>High Resolution Fluorescence Imaging of Human Hand Pharmacokinetics using a Low-Cost Flatbed Scanner, Kripa Patel&lt;sup&gt;1&lt;/sup&gt;, Pubudu Thilanka Galeaduge&lt;sup&gt;1&lt;/sup&gt;, Katherine Chen&lt;sup&gt;1&lt;/sup&gt;, Margaret Dowd&lt;sup&gt;1&lt;/sup&gt;, Glenesra Bates&lt;sup&gt;1&lt;/sup&gt;, Vihali A. Patel&lt;sup&gt;1&lt;/sup&gt;, Robert Taub&lt;sup&gt;1&lt;/sup&gt;, Elizabeth M. Hillman&lt;sup&gt;1&lt;/sup&gt;, Columbia Univ., USA; 1Hematology/Oncology, Columbia Univ. Medical Center, USA; 2Dermatology, Columbia Univ. Medical Center, USA. We present a modified flatbed scanner for rapid and inexpensive imaging of fluorophores over large tissue surfaces. System properties are well-suited for monitoring the skin pharmacokinetics of fluorescent drugs such as Doxorubicin.</td>
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<th>Time</th>
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<tr>
<td>14:00–15:15</td>
<td>OtT2E • Optical Manipulation Applications II</td>
<td>Peter Reece; Univ. of New South Wales, Australia</td>
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<td>OtT2E.1 • 14:00 Invited</td>
<td>Structure Formation in Single Biological Molecules as a Diffusive Process Probed by Optical Tweezers, Michael Woodside&lt;sup&gt;1&lt;/sup&gt;, 1Univ. of Alberta, Canada; 2National Inst. for Nanotechnology, Canada. Folding of proteins and nucleic acids involves diffusion over a multi-dimensional energy landscape. Methods for measuring this landscape and determining the diffusion coefficient using force spectroscopy are described. Structure formation is well-approximated by 1D diffusion.</td>
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<td>OtT2E.2 • 14:30</td>
<td>Mapping low frequency vibrational spectra of ssDNA using DNH optical trap, Abhay Kotnala&lt;sup&gt;1&lt;/sup&gt;, Reuven Gordon&lt;sup&gt;1&lt;/sup&gt;, Univ. of Victoria, Canada. Low frequency resonant acoustic modes of ssDNA lying in the sub-100 GHz range are excited and detected using a double nanohole (DNH) optical trap. The technique shows potential for sequencing and characterization of DNA.</td>
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<td>OtT2E.3 • 14:45</td>
<td>Label-Free Free Solution Single Protein-Small Molecule Binding Kinetics: An Optical Tweezer Approach, Ahmed A. Al Balushi&lt;sup&gt;1&lt;/sup&gt;, Reuven Gordon&lt;sup&gt;1&lt;/sup&gt;, Univ. of Victoria, Canada. We use a double-nanohole optical tweezer to measure protein binding kinetics at the single molecule level in a label-free, free-solution environment.</td>
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Microscopy of Elodea Cells Using Excimer Laser, Titirat Kantasawang1, Jumras Limtrakul1, Sompol Sampaik1, Nattporn Chattham1; Kasetsart Univ., Thailand. Microscopy of Elodea cell wall was carried out and DNA filled Iposome was manipulated into the target cell by optical tweezers. Fusion between Iposome and protoplast is attempted inside the cell to obtain successful gene transfer procedure.

Optical regulation of ERK2 translocation, Shaoyang Wang1, Hao Dongning Wang1, Jun He1, Mingjie Hu1, Chongyue Wang1; Tianjin Univ., China; Shanghai Jiaotong Univ., China. Photostimulation by femtosecond laser can induce nuclear translocation of extracellular signal-regulated protein kinase 2 for activation of specific gene expression. And functional activity. Optical excitation of mitochondria may play a key role in this process.

Temperature Measurement, JT3A.3 All-fiber self-accelerating Bessel-like beam for optical trapping apparatus.

Microbubble Generation with Tapered Optical Fiber., JT3A.10 Compact multiphoton microscopy system based on frequency-doubled femtosecond erbium-doped fiber laser, Lin Huang1, Arthur Mills2, David Jones2, Yuan Zhao1, Shuo Tang1; 1Dept of Electrical and Computer Engineering, Univ. of British Columbia, Canada; 2School of Physics & Astronomy, Univ. of British Columbia, Canada. We report on a compact multiphoton microscopy system based on a frequency-doubled, femtosecond erbium-doped fiber laser. It has a great potential to transform the bench-top multiphoton microscopy to a portable system for in vivo imaging.

Super-resolution Imaging with Metamaterials for Cardiovascular Disease, Naomi Waterman1, Iain B. Styles1, Steven G. Thomas2, Shuang Zhang3; 1School of Computer Science, Univ. of Birmingham, UK; 2Centre for Cardiovascular Science, Univ. of Birmingham, UK; 3PSIBS Doctoral Training Centre, Univ. of Birmingham, UK; School of Physics and Astronomy, Univ. of Birmingham, UK. We propose a novel TIRF-like microscope design with a metamaterial lens. The microscope's structure offers evanescent field with subwavelength patterns that will breach the diffraction limit. With it we will study cell–matrix interactions, important in cardiovascular disease.

Synthesis of Caged G-Rhodamine Dye, Olga Vasalatyi1, Ana Christina Opina1, Vincent Coble1, George Patterson1, Hari Shroff1; 1School of Biomedical Engineering, Univ. of British Columbia, Canada. The Caged G-Rhodamine derivative, along with the synthesis of the caging group had been prepared using two synthetic approaches. UV-Vis profile showed an absorbance at 385nm which can be used to uncage the dye.
OT2D • Advances in Imaging - Deeper and Faster—Continued

Swept Confocally-aligned Planar Excitation’ (SCAPE) Microscopy for High Speed Volumetric Imaging in Behaving Animals
Elizabeth M. Hillman1, Matthew B. Bouchard1, Venkatakushik Vole1;
Columbia Univ., USA. SCAPE combines light-sheet optical sectioning with confocal de-scanning to produce very high-speed 3D imaging in a versatile single-objective geometry. SCAPE can image awake behaving mouse brain, zebrafish heart and crawling Drosophila larvae at 10-20 volumes-per-second.

Yuxiang Ma1, Yang He1, Haiyan Chen1, Yan Li1, Alex Forbrich1, Roger J. Zemp1, Robert E. Campbell1;
Medical Photonics Research Center, Korea Photonics Technology Inst., Korea (the Republic of). We improved thermal stability of an optical probe by near-infrared (NIR) fluorescence signal detection with a new liquid circulation module. We could confirm that the optical probe has a standard deviation of 2.19 °C.

Mingfeng Bai 1; Heng Guo 1, Dawei Deng 1, Zhiyu Qian 2, Yueqing Gu 1; 1Medical Photonics Research Center, Korea Photonics Technology Inst., Korea (the Republic of). 2BC Research Center, Canada. We could confirm that the optical probe has a standard deviation of 2.19 °C.

Invited

Optical Trapping Applications

15:30–17:00 JT3A • Poster Session, Exhibits and Coffee Break, Salon A

JT3A.13 Thermal stability improvement of the optical probe which uses LEDs as an optical source, In Hee Shin1, Joo Beom Eom1, Hyeong Ju Park1, Myung-Soo Han1, Arjin Park1, Byeong-II Lee1;
Medical Photonics Research Center, Korea Photonics Technology Inst., Korea (the Republic of). We improved thermal stability of an optical probe for near-infrared (NIR) fluorescence signal detection with a new liquid circulation module. We could confirm that the optical probe has a standard deviation of 2.19 °C.

JT3A.14 Characteristic of a drug carrier for hepatocellular carcinoma (HCC)-selective targeting, Yuxiang Ma1, Yang He1, Haiyan Chen1, Heng Guo1, Dawei Deng1, Zhiyu Qian1, Yueqing Gu1; 1China Pharmaceutical University, China; 2Nanyang Univ. of Aeronautics and Astronautics, China. Galactose can be specifically recognized by ASGPR. PEG-Gal-COS-CYPATE was constructed to target the drug to HCC cells. Due to steric hindrance of PEG, drugs will not bind to the normal liver cells to avoid damage.

JT3A.15 Near Infrared Quaterrylenediimide-cored Dendrimeric Dyes for Photoacoustic Imaging, Pin Shao1, Seunghan Ha1, Kang Kim1, Mingfeng Bai1; 1Univ. of Pittsburgh, USA; 2Nursing, Chungbuk Health & Science Univ., Korea (the Republic of). Here we report the preliminary study to evaluate the potential of two hydrophilic and photosensitive quaterrylenediimide-cored dendrimers for photoacoustic (PA) imaging applications. These dendrimers exhibit high PA signal intensity and remarkable chemical and photo stability.

JT3A.16 Monitoring Changes of Skin Raman Spectra Induced by Ultrafast Laser Irradiation: a Porcine Skin Model Study, Yime Hu1, Jianhua Zhao1, Harvey Lu1, David McLear1, Hashan Zeng1; 1BC Cancer Research Centre, Canada; 2Univ. of British Columbia, Canada. A customized confocal Raman spectroscopy system was used to measure the Raman spectra of porcine skin irradiated by high power ultrafast laser. The changes in Raman spectra indicate that the collagen was denatured and carbonized after high power ultrafast laser irradiation.

JT3A.17 Engineering a Chromoprotein Reporter for Photoacoustic Imaging and Biosensing Applications, Yan Li1, Alex Forbrich1, Roger J. Zemp1, Robert E. Campbell1; 1Univ. of Alberta, Canada. We developed a novel colony-based photoacoustic screening method to screen and evolve a chromoprotein. The improved protein was used as genetically-encoded photoacoustic reporter and as a dark acceptor in FRET-based caspase-3 biosensors and Ca2+ biosensors.

JT3A.18 An Evaluation and a Comparison of 3D-OSEM with Resolution Recovery (HÖSEM) Versus Flash 3D, Khalid Alzamami4, Moham-med Alkhorry4, Salem Sass4, Nicolas Sprov4, 1King Saud Univ., Saudi Arabia; 2Medical Physics Dept, Univ. of Surrey, UK; 3Medical Physics Dept, Prince Sultan Medical City, UK. The thrust of this study is to compare the performance of two SPECT image reconstruction algorithms: No significant difference in contrast between Flash 3D and HÖSEM. Flash 3D models noise properties more accurately than HÖSEM.

JT3A.19 Polyelectrolyte nanocarriers loaded with cyanian-type photosensitizers for Photodynamic Therapy: cellular localization and efficacy, Andrzej Gaman3, Urszula Bączyńska1, Jadwiga Pietkiewicz1, Joanna Rosowska1, Kazimiera A. Wil1; 1Dept of Medical Biochemistry, Medical Univ. of Wroclaw, Poland; 2Faculty of Chemistry, Wroclaw Univ. of Technology, Poland; 3Wroclaw Research Center ET+, Poland; 4Inst. of Immunology and Experimental Therapy Polish Academy of Sciences, Rudolph Wegla, Poland. Searching an effective nanocarriers for photodynamic therapy we performed newly designed biocompatible multilayer polyelectrolyte nano-capsules for the improved delivery of hydrophobic cyanine-type photosensitizers to the lung A549 and colon MC35 cancer cells.

JT3A.20 A handheld optical-sectioning device for early detection and surgical guidance, Prasanth Pillai1, Steven Y. Leigh2, Michael Mandella1, Gary Peterson1, Sanjeeva Abeytunga1, Milind Rajadhyaksha1; 1Univ. of Washington, USA; 2Stony Brook Univ., USA; 3Stanford Univ., USA; 4MSKCC, USA. Miniature dual-axis confocal (DAC) microscopes are being developed for the early detection of oral cancers and for guiding brain tumor resection. The design of MEMS-scanned DAC microscopes, and their analysis and optimization are described.

JT3A.21 Automatic Image Processing to Preclinical Biokinetic Modelling of 99mTc-Radiopharmaceuticals, Clara Leticia Santos Cuevas1, Luz Grindelia Correya Aragon1, Isaac Chavez Oro1; 1Instituto Nacional de Investigaciones Nucleares, Mexico; 2Universidad Autónoma del Estado de Mexico, Mexico; 3Instituto Politécnico Nacional (UPR2), Mexico. This investigation describes the development of a MATLAB algorithm to quantify automatically the radiation activity and kinetics from images acquired with the preclinical imaging system XTREME (Bruker) using 99mTc-Bombesin/99mTc-RGD5 radiopharmaceuticals in murine models.
JT3A.22 Analysis of follicular development in ovary using optical coherence tomography, Yuuki Watanabe1, Kei Takakura1, Reiko Kurosaki1, Hiroaki Abe2, Yamagata Univ., Japan. We analyze follicular development in ex vivo ovaries of a 25.5-day-old mouse using OCT. The time-varying OCT signals at the oocytes compared with surrounding tissues were clearly enhanced by the squared difference of OCT images.

JT3A.23 Characterization of Collagen in Human Pancreas, Breast and Lung with Polarization Resolved Second Harmonic Generation Microscopy, Ahmad Golarei1, Danielle Tokarz2, Michael Cisek3, 1UBC, Canada; 2Ryerson University, Canada; 3University of Toronto, Canada. Collagen organization in healthy and cancerous pancreatic, breast and lung tissues were investigated using polarization-dependent second harmonic generation microscopy. The imaging technique differentiated between tumor and non-tumor samples, and could be applied in cancer diagnostics.

JT3A.24 An optical probe implanted in conventional hypodermic needle for minimum invasive optical diagnosis, Jun Ki Kim1, Jee Young Kim2, 1ASAN Medical Center, Korea (the Republic of). We fabricate a novel conventional hypodermic needle implanted optical probe for murine brain imaging. A needle assisted side-view optical probe was designed to make minimal invasive repeated access results in monitoring brain disease over several weeks.

JT3A.25 Molecular Fluorescence Tomography with Structured Light and Compressive Sensing, Ruoyang Yao1, Qi Pian1, Xavier Intes1; 1UBC, Canada. We apply compressive sensing based imaging techniques to improve image reconstruction from wide-field FMT reconstructions. By designing masks to illuminate and detection experimentally basal level, the coherence of the sensitivity matrix is reduced and optical reconstructions are improved.

JT3A.26 Noninvasive Detection of Alzheimer’s Disease Lens Pathology in Down Syndrome by Quasi-Linear Light Scattering, Olgia V. Minava1, Mirkant Sarari1, Julian Moncaster1, Jeffrey Holland2, Caitlin Roek1, Danielle Ledoux1, John Clark2, David Hunter1, Lee Goldenstein3, 1Boston Univ., USA; 2Ophthalmoogy, Boston Children’s Hospital, USA; 3Biological Structure, Univ. of Washington, USA. In Down syndrome there is increased deposition of Alzheimer’s disease-related Amyloid-β protein in the brain and lens. Here we present quasi-linear light scattering to noninvasively detect Alzheimer’s disease lens pathology in subjects with Down syndrome.

JT3A.27 Size-Dependent Interaction of Gold Nanoparticles with Tryptophan: A Spectroscopic Analysis, Gelson Silva1, Joelson Ferreira1, Tiago Angu1, Gustavo Koziol1, Kazuharu Uchyma1, Hikoaka Hos1, Kayo Ishikawa1, Hikato Yonemura1, 1Univ. of Tokyo, Japan; 2Princess Margaret Cancer Centre, Canada; 3Univ. of Toronto, Canada. Here we investigated the optical behavior of tryptophan in the presence of nanoparticles. The nanoparticles were strongly dependent on the nanoparticle size and concentration.

JT3A.28 In vivo laser speckle measurements of skin roughness: clinical study, Loudmila Tchvilaeva1, 1UBC, Canada. Roughness introduces path lengths differences between the light waves scattered on the surface. Laser speckle technique has been applied for assessment of roughness of human skin in vivo. A significant difference between cancerous and benign skin tissues has been observed.

JT3A.29 Withdrawn

JT3A.30 Hyper spectral Near-Infrared Spectroscopy of the Brain, Vladislav Toronov1,2, Reihaneh Nosrat1,2, Ryonen Univ., Canada; 3Keenan Research Centre, Li Ka Shing Knowledge Institute, St. Michael’s Hospital, Canada. We use novel hyperspectral NIRS technique in studies of functional brain activity and cerebral monitoring in cardiac arrest patients. The technique appears to be more sensitive to cerebral hemodynamic changes than the multispectral NIRS, capable to directly assess neuronal oxygen metabolism.

JT3A.31 Withdrawn

JT3A.32 Nano-imaging for glia-synapse fine structures with a homemade near-field optical microscope, Masaru Saka1, Yukihi Shinozaki1, Shigeki Matsuyama2, Kazuhiko Koizumi1, 1Rensselaer Polytechnic Inst., USA; 2Princess Margaret Cancer Centre, Canada. Here we describe a novel homemade near-field optical microscope for imaging based on the scanning near-field optical microscopy (SNOM) technique. We have developed a novel near-field optical microscope and successfully visualized fine structures and nanoparticle of the states of astrocytes and neurons.

JT3A.33 Simulation-Based Validation of the Physical Model in 3D Polarized Light Imaging, Miriam Menzel1, Melanie Dohmen1, Hans De Raedt1, Kristel Michielsen1, Katrin Amunts1, Markus Axer2, 1Inst. of Neuroscience and Medicine (INM-1), Research Centre Jülich, Germany; 2Zernike Institute for Advanced Materials, Univ. of Groningen, Netherlands. To investigate basic processes responsible for brain functions by nano-imaging, we developed a novel near-field optical microscope and successfully visualized fine structures and nanoparticle of the states of astrocytes and neurons.

JT3A.34 Computational Modeling of Scattering of a Focused Beam in Zebrabrush Brain Tissue, Ilva Fave-Bulle1, Timo A. Nieminen1, Daryl Preece1, Luke A. Heap1, Ethan K. Scott1, 1School of Mathematics and Physics, The Univ. of Queensland, Australia; 2School of Biomedical Sciences, The Univ. of Queensland, Australia; 3School of Biomedical Sciences, The Univ. of Queensland, Australia. To achieve single-cell control in optogenetics, a focused beam can be used to illuminate a single cell. We compare Monte Carlo ray optics and Lorenz-Mie theory for modeling this spread of the beam through scattering.

JT3A.35 Decrease of optical attenuation in the cerebral cortex during detection of the cerebral cortex detected using optical coherence tomography, Carissa Rodriguez1, Jenny Sau1, Melissa Eberle1, Mike Hsu1, John P. Binder1, 1University of California Riverside, USA. In this study we examined the use of optical coherence tomography to detect optical changes in the cerebral cortex associated with cerebral edema progression in a mouse model.

JT3A.36 Detection of seizure induced transient structural changes in the mouse hippocampus using Optical Coherence Tomography, Md Monirul Hasan1, Md R. Haque1, Timothy Myers1, Oscar Gonzalez1, Michael Olivera1, Gregory Filato1, Masam Baharou1, B. Hyle Park1, 1UC Riverside, USA. We detected transient structural changes of neuron in seizure using phase resolved spectral domain optical coherence tomography by correlating changes in optical phase with electrophysiology using a multi-electrode array in a mouse hippocampal brain slice.

JT3A.37 A Structurally Relevant Lung Phantom for Optimization of Multiscale Imaging of Bacterial Infection, Madeleine Dueke1, Landon Nash2, Duncan Maitland3, Jeffrey Cirillo2, Kristen C. Maitland3, 1Biomedical Engineering, Texas A&M Univ., USA; 2Microbial Pathogenesis and Immunology, Texas A&M Health Science Center, USA. A structurally and optically pertinent phantom has been developed for the analysis of a microendoscope-based detection system. Addition of a structural component into the optical phantom will provide enhanced information regarding system performance.

JT3A.38 Super-resolution imaging of thick cells: methods for real-time 3D stabilization and accurate depth-localization, Reza Taftei1, David R. L. Scriven1, Edwin D. W. Moore1, Kong, C. Chou1, 1The Univ. of British Columbia, Canada. A 3D STORM microscope is described which enables the accurate super-resolution imaging of thick cells. Active stabilization of microscope in 3D and true calibration curves for axial localization are the keys in this design.

JT3A.39 3x3 Technique for RGB Snapshot Mapping of Skin Chromophores, Janis Spigulis1, 1Univ. of Latvia, Latvia. Three monochromatic spectral images were extracted from single RGB image data set at tri-chronic illumination of skin by 473nm, 532nm and 609nm spectral lines, and further transformed into distribution maps of melanin, oxy-hemoglobin and deoxy-hemoglobin.

JT3A.40 Optical spectroscopic methods to discriminate in vitro Hodgkin cancerous and normal tissues, Fatemeh Ghasemi1, Parviz Parn2, N Hossei-Motlagh1, Ali Bavali1, Reza Karimi1, Amirakbar U. University of technology, Iran (the Islamic Republic of). Laser induced fluorescence (LIF) and simultaneous laser induced- breakdown spectroscopy (LIBS) and acoustic response techniques are applied to investigate abnormal lymph tissues due to Hodgkin disease.

JT3A.41 Monte Carlo Photon Simulation of an Anti-Confoal System to Monitor Middle Ear Inflammation, David S. Jung1, John P. Binder1, 1UC Riverside, USA. We detected transient structural changes of neuron in seizure using phase resolved spectral domain optical coherence tomography by correlating changes in optical phase with electrophysiology using a multi-electrode array in a mouse hippocampal brain slice.

JT3A.42 Anisotropy Imaging of Supported Lipid Bilayers via Spectroscopic Imaging Ellipsometry, Peiter De Beule1, 1Adelaide Miranda1, 1INL, Portugal. Anisotropy imaging over a microscopic field of view with spectroscopic imaging ellipsometry has been evaluated theoretically and experimentally through the design and implementation of a new optical set-up. The impact of experimental noise is discussed.

JT3A.43 The model of skin surface temperature at sunlight exposure in presence of sunscreen nanoparticles, Alexey Popov1, 1Amirkabir University of Technology, Iran (the Islamic Republic of). Laser induced fluorescence (LIF) and simultaneous laser induced- breakdown spectroscopy (LIBS) and acoustic response techniques are applied to investigate abnormal lymph tissues due to Hodgkin disease.

 JT3A.44 Nano-imaging for glia-synapse fine structures with a homemade near-field optical microscope, Masaru Saka1, Yukihi Shinozaki1, Shigeki Matsuyama2, Kazuhiko Koizumi1, 1Rensselaer Polytechnic Inst., USA; 2Princess Margaret Cancer Centre, Canada. Here we describe a novel homemade near-field optical microscope for imaging based on the scanning near-field optical microscopy (SNOM) technique. We have developed a novel near-field optical microscope and successfully visualized fine structures and nanoparticle of the states of astrocytes and neurons.

JT3A.45 Computational Modeling of Scattering of a Focused Beam in Zebrabrush Brain Tissue, Ilva Fave-Bulle1, Timo A. Nieminen1, Daryl Preece1, Luke A. Heap1, Ethan K. Scott1, 1School of Mathematics and Physics, The Univ. of Queensland, Australia; 2School of Biomedical Sciences, The Univ. of Queensland, Australia; 3School of Biomedical Sciences, The Univ. of Queensland, Australia. To achieve single-cell control in optogenetics, a focused beam can be used to illuminate a single cell. We compare Monte Carlo ray optics and Lorenz-Mie theory for modeling this spread of the beam through scattering.

JT3A.46 Decrease of optical attenuation in the cerebral cortex during detection of the cerebral cortex detected using optical coherence tomography, Carissa Rodriguez1, Jenny Sau1, Melissa Eberle1, Mike Hsu1, John P. Binder1, 1University of California Riverside, USA. In this study we examined the use of optical coherence tomography to detect optical changes in the cerebral cortex associated with cerebral edema progression in a mouse model.

JT3A.47 Detection of seizure induced transient structural changes in the mouse hippocampus using Optical Coherence Tomography, Md Monirul Hasan1, Md R. Haque1, Timothy Myers1, Oscar Gonzalez1, Michael Olivera1, Gregory Filato1, Masam Baharou1, B. Hyle Park1, 1UC Riverside, USA. We detected transient structural changes of neuron in seizure using phase resolved spectral domain optical coherence tomography by correlating changes in optical phase with electrophysiology using a multi-electrode array in a mouse hippocampal brain slice.

JT3A.48 A Structurally Relevant Lung Phantom for Optimization of Multiscale Imaging of Bacterial Infection, Madeleine Dueke1, Landon Nash2, Duncan Maitland3, Jeffrey Cirillo2, Kristen C. Maitland3, 1Biomedical Engineering, Texas A&M Univ., USA; 2Microbial Pathogenesis and Immunology, Texas A&M Health Science Center, USA. A structurally and optically pertinent phantom has been developed for the analysis of a microendoscope-based detection system. Addition of a structural component into the optical phantom will provide enhanced information regarding system performance.
JT3A.44
High-Resolution Mesoscopic Fluorescence Molecular Tomography through $l_1$-norm regularization and a de-scanned 2D detector array, Mehmet S. Ozturk1, Fugang Yang2, Xavier Intes1; 1Rensselaer Polytechnic Inst., USA; 2Shendong Inst. of Business and Technology, China. Mesoscopic Fluorescence Molecular Tomography demonstrated a significant performance improvement through integrating 2D (EMCCD) detector array in de-scanned configuration and utilizing $l_1$-norm regularization in the reconstruction algorithm.

JT3A.45
How does the differential pathlength factor for steady-state near-infrared spectroscopy of homogeneous medium vary with geometry?, Daqing (Daching) Piao 1,2, Randall Barbour3,4, Harry Graber4, Daniel Lee5,2; 1Oklahoma State Univ., USA; 2Surgery, Oklahoma City VA Medical Center, USA; 3Pathology, SUNY Downstate Medical Center, USA; 4NIRx Medical Technologies LLC, USA; 5Univ. of Oklahoma College of Medicine, USA. We estimate analytically how much the differential pathlength factor for steady-state near-infrared spectroscopy of homogeneous medium varies when evaluated in geometries including sphere as applying to neonatal head, comparing to that in the semi-infinite half-space.

JT3A.46
A constant illumination optical transmission method for freespace biological networks, Forrest Jesse1,2, Zhenjiang Mao1, Yao Chen1, Hechen Bao2, Weidong Li2; 1Beijing Jiaotong Univ., China; 2Beijing Jiaotong Univ., China. We present a free-space, constant illumination light-based signaling protocol and its optigenetic neuron receiver. The transmission protocol maintains a visually apparent constant illumination while encoding spike trains. The signal is compatible with common indoor/outdoor lighting systems.

JT3A.47
When Wall-hindered Diffusion Dynamics Becomes Non-Gaussian, Mpumelelo Matse1; 1Simon Fraser Univ., Canada. We design and implement a feedback tracking system to study the correlated diffusive properties of a Brownian colloidal sphere near a flat wall. A feedback-controlled piezo vertical stage tracks the sphere's position.
These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

17:00–19:00  NT4C • Nonlinear Optical Microscopy II
Presider: Paul Campagnola; Univ. of Wisconsin-Madison, USA

17:00–19:00  BrT4B • Imaging and Photomanipulation
Presider: Francesco Pavone; European Lab for Non-Linear Spectroscopy, Italy

17:00–19:00  BT4A • Bio-photonic Technologies in Cancer Research
Presider: Adela Ben-Yakar; Univ. of Texas at Austin, USA

17:00–19:00  BT4A.1 • Multiple Roles for Autofluorescence (AF) Visualization, Multispectral AF and Reflectance Imaging and AF-OCT for Early Cancer Detection and Management
Catherine Poh1,2, Minam Rosn1, Stephen Lam1,2, Michele Follen1, Hamid Palhevarvashad1, Pierre Lane1,2, 1Univ. of British Columbia, Canada; 2Simon Fraser Univ., Canada.

17:00–19:00  BT4A.2 • In Vivo Quantification of Cell-Surface Receptors in Solid Cancers: Two Imaging Agents are Better Than One
Kenneth M. Tishauer1, Illinois Inst. of Technology, USA. Variability in physiology amongst tumors can significantly influence nonspecific delivery and retention of cancer targeted imaging agents. Here, the administration of a second, untargeted agent is explored to account for nonspecific effects, allowing quantitative analyses.

17:30–18:00  BrT4B.2 • Optoelectronic Probing of Neural Circuits with Multifunctional Fibers
Polina Anikeeva1,2, Andres Canales1,2, Xiaoting Jia1,2, Chi Lu1,2, Ulrich Froriep3, Ryan Koppes3, Christina Tingides3, Jennifer Selvidge1, Yoel Fink1,2, 1Materials Science and Engineering, MIT, USA; 2Research Lab of Electronics, MIT, USA. With its diversity of signaling modalities: electrical, chemical and mechanical, nervous system poses demands of multidisciplinary on neural interface technologies. Multimaterial fiber technology may enable minimal invasive multifunctional probing of the complexity of neural circuits.

18:00–18:15  BrT4B.3 • A multi-modal clearing method for brain imaging
Irene Costantini1, Anna Letizia Allegra Mascaro2, Antonio P. Di Giovanni1, Ludovico Silvestri3, Marie Caroline Mullerbrauch3, Leonardo Saccorni3, Francesco S. Pavone1,2, 1Univ. of Florence, Italy; 2National Inst. of Optics, National Research Council, Italy; 3Dept. of Physics and Astronomy, Univ. of Florence, Italy. In this work we investigate the effectiveness of a water-soluble agent, the 2,2-dithiodiethanol (TDE) to clear mouse and human brain. TDE is suitable with two-photon fluorescence microscopy and in combination with CLARITY with light sheet microscopy.

18:15–18:30  BrT4B.4 • Determinants of Second Harmonic Generation in live neurons, Michel A. Martens1, Valerie Van Steenhoven1, Pieter Baartman1, Koen Clays1, Marcel Ameloot1, Pieter Vanden Berghe1, 1VIB, Belgium; 2UHasselt, Belgium; 3VIB, Belgium. We investigated the possibilities of second harmonic imaging of microtubules clarifying the determinants of the second harmonic generation in live neurons. We used nonlinear microscopy correlated with electron microscopy to evaluate microtubule organization, dynamics and possible artifacts.
OtT4E.1 • 17:00 • Invited
Characterization of Surface Properties of Bacterial Spores Using Optical Tweezers, Giuseppe Pesce1, Giulia Rusciano1, Gianluigi Zito1, Antonio Sasso1, Rachele Isticato1, Tegh Sreec1, Ezio Rizca1; 1Dept of Physics, Univ degli Studi di Napoli Federico II, Universitario Monte S Angelo, Via Cintia, Italy; 2Dept of Biology, Univ degli Studi di Napoli Federico II, Universitario Monte S Angelo, Via Cintia, Italy. The charge and the hydrodynamic coefficient were measured by an accurate procedure based on the analysis of the motion of single spores confined by an optical trap. It is possible to discriminate genetically modified spores from their charge and to have information on their hydrophobicity.

OtT4E.2 • 17:30
Observation of Viscoelastic Behavior of Lipid Membrane via Optical Forces, Shao-Hua Wu1, Shuyang Wu2; 1Univ. of Pennsylvania, USA; 2Massachusetts General Hospital, USA. The physical characterization of giant unilamellar vesicles (GUVs) is achieved via a dual-beam optical trap. The instantaneous and delayed response in membrane surface area strain was observed, implying viscoelastic behavior of the membrane.

OtT4E.4 • 18:00
Optical Trapping on Two-Dimensional Photonic Crystal and Cell Viability Characterization, Peifeng Jing1, Jingda Wu1, Gary W. Lue1, Ethan G. Keefer1, Yao Yu1, Suze H. Fun1, Lil Y. Lin1; 1Electrical Engineering, Univ. of Washington, USA. We demonstrate higher trapping efficiency for cells on a two-dimensional photonic crystal. The viability is measured using yeast cells and the result shows exponential dependence on laser intensity.

OtT4E.5 • 18:15
Testing viscoelastic responses of biological cells in the optical tweezers, Lingyao Yu1, Yunlong Sheng2; 1Dept of Physics, Physical Engineering and Optics, Univ. Laval, Canada. We recommend more precise analyses to include the local stress and strain jumping in the time-sharing regime, and the 3D cell shape in the viscoelastic creep and dynamic testing with the optical tweezers and stretcher.

OtT4E.1 • 17:00 • Invited
Characterization of Surface Properties of Bacterial Spores Using Optical Tweezers, Giuseppe Pesce1, Giulia Rusciano1, Gianluigi Zito1, Antonio Sasso1, Rachele Isticato1, Tegh Sreec1, Ezio Rizca1; 1Dept of Physics, Univ degli Studi di Napoli Federico II, Universitario Monte S Angelo, Via Cintia, Italy; 2Dept of Biology, Univ degli Studi di Napoli Federico II, Universitario Monte S Angelo, Via Cintia, Italy. The charge and the hydrodynamic coefficient were measured by an accurate procedure based on the analysis of the motion of single spores confined by an optical trap. It is possible to discriminate genetically modified spores from their charge and to have information on their hydrophobicity.

OtT4E.2 • 17:30
Observation of Viscoelastic Behavior of Lipid Membrane via Optical Forces, Shao-Hua Wu1, Shuyang Wu2; 1Univ. of Pennsylvania, USA; 2Massachusetts General Hospital, USA. The physical characterization of giant unilamellar vesicles (GUVs) is achieved via a dual-beam optical trap. The instantaneous and delayed response in membrane surface area strain was observed, implying viscoelastic behavior of the membrane.

OtT4E.4 • 18:00
Optical Trapping on Two-Dimensional Photonic Crystal and Cell Viability Characterization, Peifeng Jing1, Jingda Wu1, Gary W. Lue1, Ethan G. Keefer1, Yao Yu1, Suze H. Fun1, Lil Y. Lin1; 1Electrical Engineering, Univ. of Washington, USA. We demonstrate higher trapping efficiency for cells on a two-dimensional photonic crystal. The viability is measured using yeast cells and the result shows exponential dependence on laser intensity.

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Recent Advances in Real-Time Raman Spectroscopy for In Vivo Skin Cancer Diagnosis, Jianhua Zhao1,2, Haishan Zeng 1,2, David McLean1; Jian Jian Li3, James W. Chan1,4; ‘Center for Biophotonics, Univ. of California-Davis, USA; ‘BD Biosciences, USA; ‘Dept of Radiation Oncology, Univ. of California-Davis, USA; ‘Dept of Pathology and Lab Medicine, Univ. of California-Davis, USA. We demonstrate long term, quantitative imaging of live breast cancer stem cells using SERS labels capable of providing information to better understand tumor resistance to therapy not achievable with traditional fluorescent staining methods.

Recent Advances in Real-Time Raman Spectroscopy for In Vivo Skin Cancer Diagnosis, Jianhua Zhao1,2, Haishan Zeng 1,2, David McLean1; Jian Jian Li3, James W. Chan1,4; ‘Center for Biophotonics, Univ. of California-Davis, USA; ‘BD Biosciences, USA; ‘Dept of Radiation Oncology, Univ. of California-Davis, USA; ‘Dept of Pathology and Lab Medicine, Univ. of California-Davis, USA. We demonstrate long term, quantitative imaging of live breast cancer stem cells using SERS labels capable of providing information to better understand tumor resistance to therapy not achievable with traditional fluorescent staining methods.
Optical molecular probes, imaging and drug delivery

Salon E
Optical Trapping Applications
Salon C

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

OT4D • Functional Imaging of Cells and Tissue—Continued

OT4D.6 • 18:30 Invited
Optics for Arteries—Imaging of Atherosclerosis and Coronary Interventions, Gis van Soest¹, Tianshi Wang¹, Pieter Kruizinga¹, Min Wu¹, Verya Daechin¹, Krista Jansen¹, Heleen van Beusekom¹, Ton van der Steen²;¹, Thoraxcenter Erasmus MC, Netherlands; ²CIN Netherlands Heart Inst., Netherlands; ¹²Imaging Science and Technology, Delft Univ. of Technology, Netherlands. This talk will present recent advances in super high speed intravascular OCT imaging for guidance of coronary interventions, and arterial tissue characterization using OCT and photoacoustic imaging to visualize atherosclerosis in unprecedented chemical detail.
Optics and the Brain

Wednesday, 15 April

08:00–10:00
BW1A • Biosensing and Bio-Manipulation Techniques I
Preiser: Guoqiang Li, Ohio State Univ., USA

BW1A.1 • 08:00 • Invited
Single cell analysis in Vivo, Charles P. Lin1, Massachusetts General Hospital, USA. Whole tissue
can grow from a single stem cell, so can cancer. I will discuss recent efforts to study the biology
of single cells in live animals.

BW1A.2 • 08:30 • Invited
Imaging with Multi-Mode Fibers, Demetri Psaltis1, Ecole Polytechnique Federale de Lausanne,
Switzerland. We describe how fibers capable of transmitting multiple spatial modes can be used
as imaging devices. Both wide field and scanning microscopy modalities are demonstrated. Digital
phase conjugation is used to eliminate distortions.

BW1A.3 • 09:00
Directional-Coupler Interferometer Realizes a Miniaturized and High Sensitive Biosensor, Ken
Uchiyamada1, Kyoshe Okubo1, Masatoshi Yokokawa1, Edwin T. Carlen1, Kyoshi Asakawa1, Hiroaki
Suzuki1, Tukuba Univ, Japan. Detection of droplets including several kinds of liquid and DNAs
conjugated quantum-dot was demonstrated by newly developed small-size and high-accuracy
optical directional-coupler based biochemical sensor. Measured optical intensities fitted well to the
theoretical fitting curve.

BW1A.4 • 09:15
High-throughput image-based single-cell analysis by ultrafast asymmetric-detection time-stretch
optical microscopy, Andy K. S. Lau1, Anson H. L. Tang1, Bob M. F. Chung1, P. Yeung1, Xiaoming Wei1,
Barbara P. Chan1, Ho Cheung Shum1, Kenneth K. Y. Wong1, Kevin Tsai1, Electrical and Electronic
Engineering, Univ. of Hong Kong, Hong Kong. We report imaged-based intrinsic single-cell analysis enabled by ultrafast
asymmetric-detection time-stretch optical microscopy (line-scan rate >10 MHz) – achieving high-
quality dual-contrast images with subcellular resolution at an imaging throughput of 120,000 cells/sec.

BW1A.5 • 09:30
Transient Phase Poration - a novel, all-optical tool for controllable and non-destructive poration
of cells with single-micron resolution, Duncan Casey1, Douglas Wylie1, Juan Gallo1, Michael Dent1,
Ali Salehi-Reyhani1, Rab Wilson1, Nicholas Brooks1, Nick Long1, Keith Willison1, David Klug1, Mark
Neill1, Steven L. Neale1, Jon Cooper1, Imperial College London, UK, BEST Research Inst.,
Leverpool John Moores Univ., UK, Dept of Biomedical Engineering, Univ. of Glasgow, UK. We
demonstrate controllable poration within +1 pm region of individual cells, mediated by a near-IR laser
interacting with thin-layer amorphous silicon substrates. This technique’s novel mechanism of action
will allow new experiments in single-cell biology, particularly in neuroscience.

BW1A.6 • 09:45
MEMS Resonator and Photonic Crystal Integration for Enhanced Cellular Mass Sensing, Ethan G.
Keefer1, Jingda Wu1, Peifeng Jing1, Lih Y. Lin1, Dept of Electrical Engineering, Univ. of Washington,
USA. This work describes the design and fabrication steps of a MEMS resonant-beam structure that
utilizes optical trapping technology and microfluidics in an attempt to enhance the precision and
accuracy of cellular-mass sensing devices.

BW1A.7 • 10:00
A Fiberoscopic for Spatially Selective Photoactivation and Functional Fluorescence Imaging in
Freely-Beaving Mice, Cathie Venton1, Vivien Szabo1, Vincent De Sars1, Jonathan Bradley2, Valentina
Emiliani1, Neophotonics Lab, Université Paris Descartes, France; 1BENS, Ecole- Normale
Supérieure, France; 2Laboratoire de Physiologie Cérébrale, Univ. Paris Descartes, France. We dem-
onstrate targeted photoactivation with near-cellular resolution and fluorescence imaging with optical
sectioning in freely-beaving mice. Photoactivation patterns were produced with computer-generated
holography and transmitted to the mouse using a fiber bundle.

BW1A.8 • 10:15
Time-Reversal Optical Focusing and its Application in Deep Brain Optogenetics, Changhui Yang1,
California Inst. of Technology, USA. I will discuss our recent work on applying time-reversal ultrasound
encoded focusing (TRUE) and Time Reversal by Analysis of Changing wavefronts from Kinetic targets
(TRACK) for living tissue optical imaging and stimulation.

08:00–10:00
BrW1B • Optogenetics, Light Delivery and Fiber Probes • Invited
Preiser: Viviana Gradinaru; California Inst. of Technology, USA

BrW1B.1 • 08:00 • Invited
Implantable semiconductor imaging devices for in vivo optical imaging of brain, Hiroaki Takehara1,
Makito Haruta1, Yasumi Ohta1, Mayumi Motoyama1, Toshikiko Noda1, Kyotaka Sasagawa1, Takashi
Tokuda1, Jun Ohta1, Nara Inst. of Science and Technology, Japan. We present ultra-small and
mass-producible semiconductor imaging devices for functional imaging of brain. Proof-of-concept
experiments including blood-flow estimation and fluorescence imaging of the brain demonstrated
promise for use in brain research.

BrW1B.2 • 08:30 • Invited
Optical Waveguide Mode Selection Based Pattern-adjustable Optrode for Optogenetics, Na
Dong1, Weifeng Jiang1, Patrick Degenaar2, Xiaohan Sun1, Nara Inst. of Science and Technology, Japan.
Pattern-adjustable optrode based on optical waveguide mode selection is proposed for optoge-
netics. Multi-mode silica-on-silicon waveguide is used for demonstration to observe adjustable output
patterns for at least 6 adjustable main propagating modes in the waveguide.

BrW1B.3 • 09:00
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netics. Multi-mode silica-on-silicon waveguide is used for demonstration to observe adjustable output
patterns for at least 6 adjustable main propagating modes in the waveguide.

BrW1B.5 • 09:30
Towards the combined use of Raman Spectroscopy and interstitial Optical Tomography to im-
prove the safety and diagnostic accuracy of brain needle biopsies, Joannie Desroches1, Andréanne
Goyette1, Julien Pichette1, Michael Jermyn1, Kelvin Mok2, Jeanne Mercier1, Karl St-Arnaud1, Marie-
Christine Guoret1, Kevin Petrececa1, Brian Wilson1, Frédéric Leblond1, Engineering Physics, Polytechnique
Montreal, Canada; 1Neuromonitoring Unit, Montreal Neurological Inst. and Hospital, Canada; 2Brain
Localisation Research Center, Montreal Neurological Inst. and Hospital, Canada; 3Dept of pathology, Division
of neuropathology, Montreal Neurological Inst. and Hospital, Canada; 4Division of Biophysics and
Bioimaging, Ontario Cancer Inst., Canada. We present the design of a fiberoptics system integrated
onto a commercial biopsy needle, which combines Raman spectroscopy and interstitial optical to-
mography for tissue characterization and blood vessel detection to reduce the risk of hemorrhages.

BrW1B.6 • 09:45
Development of a Multispectral Monte Carlo Simulation Technique for Blood Vessels Detection
during Brain Needle Biopsy Procedures, Julien Pichette1, Andréanne Goyette1, Gilles Soulez1, Brian
C. Wilson1, Frédéric Leblond1, Polytechnique Montréal, Canada; 1Division of Biophysics and Bioimaging,
Ontario Cancer Inst., Canada. We present the development and characterization of a multispectral
technique to detect blood vessels using a fiber optics system on a biopsy needle to reduce the risk of brain hemorrhages based on Monte Carlo light transport simulations.

07:30–16:30  Registration, Grand Foyer

08:00–10:00  JT3A • Poster Session, Exhibits and Coffee Break, Salon A

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.
Optical Molecular Probes, Imaging and Drug Delivery

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

08:00–09:45
NW1C • New Illumination Schemes
Presider: Randy Bartels; Colorado State Univ., USA

NW1C.1 • 08:00
Invited
Recent Innovations in Dual-Axis Confocal (DAC) Microscopy for Clinical Applications, Jonathan T. Liu1, SUNY Stony Brook, USA. Techniques to improve the imaging speed and contrast of DAC microscopes will be introduced, including line-scanned, sheet-scanned, and modulated-tilt dual-axis confocal microscopy. A clinical handheld system, currently under development, will also be described.

NW1C.2 • 08:30
Characterizing the beam steering and distortion of focused Gaussian and Bessel beams in tissues, Ye Chen1, Jonathan T. Liu1; Mechanical Engineering, Univ. of Washington, USA. We evaluate the motion and distortion of low-NA focused Gaussian and Bessel beams in tissues with microscopic heterogeneities. Low-NA Bessel beams exhibit reduced beam steering and distortion compared to Gaussian beams, which could be advantageous for dual-axis confocal microscopy in tissues.

NW1C.3 • 08:45
Open-top selective plane illumination microscope compatible with standard sample holders, Ryan McGorty1, Harrison Lu1, Daichi Kamiyama1, Bo Huang1; Univ. of California, San Francisco, USA. Selective plane illumination microscopy (SPIM) has emerged recently as a powerful tool in optically sectioning tissue samples. We have designed a new SPIM that allows samples to be mounted in a variety of common methods.

NW1C.4 • 09:00
Modulated alignment dual-axis (MAD) confocal microscopy to improve tissue-imaging contrast, Steven Y. Leigh1,2, Ye Chen1, Jonathan T. Liu1; Biomedical Engineering, Stony Brook Univ., USA; Mechanical Engineering, Univ. of Washington, USA. We present a strategy to enhance the contrast of dual-axis confocal microscopy. This new method improves imaging by adding a modulation signature to ballistic photons in addition to the spatial filtering inherent to confocal microscopy.

NW1C.5 • 09:15
Designer Illumination for Microscopy, Jen-Tang Lu1, Alexandre S. Goy1, Chien-Hung Lu1, Jason W. Fleischer1; Dept. of Electrical Engineering, Princeton Univ., USA. We demonstrate improved imaging by shaping the illumination to match the object. The nonlinear feedback can surpass trade-offs in linear imaging, e.g. resolution vs. contrast, and lays the foundation for more general designer illumination.

NW1C.6 • 09:30
High-resolution Light-field Fluorescence Microscopy with Scanning Bessel Beam Illumination, Kevin Takasaki1, Jason W. Fleischer1; Princeton Univ., USA. We combine light-field microscopy with scanning Bessel beam illumination to achieve 3D fluorescence imaging with uniformly high lateral resolution over 20 μm of axial thickness.

08:00–10:00
OW1D • Imaging and Image Guidance Using Exogenous Molecular Probes
Presider: Mingfeng Bai, Univ. of Pittsburgh, USA

OW1D.1 • 08:00
Near-infrared fluorescence molecular guidance in oncologic surgery and surveillance endoscopy, Pat B. García-Aliende1, Maximilian Koch1,2, Jürgen Glatt2, Fanagito Symvoulidis3,2, Vasilis Ntzachristou2; Technische Universität München, Germany; Inst. for Biological and Medical Imaging, Helmholtz Zentrum München, Germany. Wide-field targeted fluorescence evolves as a promising approach for interventional guidance. We present an overview of the key developments from our Lab and discuss their potential to shift the surgical and endoscopic imaging paradigm.

OW1D.2 • 08:30
Novel Intramolecular Spirocyclization-based Fluorogenic Probes: From Rapid Intraoperative Imaging of Tiny Tumors to Super-Resolution Imaging, Yasutera Utsuno1,2, Makio Kamiya1,2, Shin-nosuke Uno1, Masayo Sakabe1; Univ. of Tokyo, Japan; JST, Japan. We have established versatile and flexible design strategies for novel organic fluorogenic probes based on intramolecular spirocyclization. First-in-class probes for rapid detection of in vivo tiny tumors and for super-resolution imaging were successfully developed.

OW1D.3 • 08:45
In-vivo Fluorescence Imaging of Bacterial Infection in the Mouse Lung, Fatemeh Nooshabadi1, Hye-jeong Yang1, Jeffery Cirillo2, Kristen C. Martin2; Biomedical Engineering, Texas A&M Univ., USA; Microbial Pathogenesis and Immunology, Texas A&M Health Science Center, USA. A fluorescence fiber optic microendoscope is integrated into a whole-animal imaging system to enhance the detection sensitivity for fluorescent bacteria in lung infections of live mice.

OW1D.4 • 09:00
Optical Imaging of Cancer and Inflammation in a Mouse Model of Colorectal Cancer, Anne Helbust1, Daniel Rosen2,3, Sharmila Anandasabapathy2, Rebecca Richards-Kortum1; Rice Univ., USA; Baylor College of Medicine, USA; Michael E DeBakey VA Medical Center, USA. Fluorescent contrast agents were topically applied in vivo to colon tissue in a mouse model of colorectal cancer. Excised tissue was imaged with confocal microscopy ex vivo to differentiate dysplasia from normal tissue and benign inflammatory lesions.

OW1D.5 • 09:15
Correction for absorption distortion of dual-tracer fluorescence imaging of receptor binding potential, Stephen C. Kanick1, Kenneth M. Tichauer2, Jason Gunn1, Kimberly Sarno1, Brian W. Pogue1; Dartmouth College, USA; Illinois Inst. of Technology, USA. This study develops a correction for absorption-based distortions in ratiometric assessments of fluorescent markers that are sampled at different wavelengths.

OW1D.6 • 09:30
Improve the Signal-to-Noise Ratio of Ultrasound-Switchable Fluorescence Technique for Deep-tissue High-resolution Fluorescence Imaging, Baohong Yuan1; Univ. of Texas at Arlington, USA. Ultrasound-switchable fluorescence (USF) technique has been recently developed for imaging centimeter-deep tissues with microscopic resolution. Its signal-to-noise can be significantly improved via the method described in this study.

OW1D.7 • 09:45
Molecular imaging of topically applied SERS nanoparticles for guiding tumor resection, Soyoung Kang1, Yu W. Wang2, Altaz Khan2, Steven Y. Leigh2, Jonathan T. Liu1,2; Univ. of Washington, USA; Biomedical Engineering, Stony Brook Univ., USA. To quantitatively image a panel of disease biomarkers for guiding tumor resection, we have developed a wide-area raster-scanned imaging device to rapidly image molecularly targeted SERS nanoparticles topically applied on fresh excised tissues.

10:00–11:00
JT3A • Poster Session, Exhibits and Coffee Break, Salon A
Joint Optical Molecular Probes, Imaging and Drug Delivery / Optics and the Brain /

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Salon F

11:00–13:00
BW2A • Biosensing and Bio-Manipulation Techniques II
Presider: Rongguang Liang; Univ. of Arizona, USA

**BW2A.1 • 11:00 Invited**
Nanoplasmonic Interferometric Arrays for Ultra-sensitive Label-Free Biosensing, Filbert J. Bartoli1, Beibei Zeng1, Yongkang Gao2, Lehigh Univ., USA, 2Bell Lab, USA: We investigate nanoplasmonic interferometric biosensor arrays, which employ circular aperture-groove nanostructures in a simple collinear transmission geometry. Design principles for enhanced performance and multiplexed label-free biosensing are discussed, and the latest achievements reported.

**BW2A.2 • 11:30**
Ultrafast swept source at 1.0 μm for high-speed phase sensitive imaging, Xiaoming Wei1, Yaping Xu1, Andy K. S. Lau1, Kevin K. Tsia1, Kenneth K. Y. Wong1; The Univ. of Hong Kong, Hong Kong: We demonstrate a stable all-optical micro-comb swept source, promising for the ultrafast interferometric imaging modalities, operating at a wavelength sweep rate of 28 MHz over a tuning range of 55 nm in 1.0-μm window.

**BW2A.3 • 11:45**
Computer Vision In Vivo Flow Cytometry of Low-Abundance Circulating Cells, Stacey Markovic1, Li Siyuan1, Mario Snaas1, Octavia Camps1, Mark Niedre1; Electrical and Computer Engineering, Northeastern Univ., USA: We have developed and validated a new instrument and computer vision algorithm for fluorescence sensing, enumeration and tracking of rare circulating cells in mice in vivo without the need for drawing blood samples.

**BW2A.4 • 12:00**
Thermally Controllable Silicon Photonic Crystal Nanobeam Cavity for Bio-Sensing Applications, Vilson Almeida1, William Fegadolli1,2, Axel Scherer2; Instituto Tecnológico de Aeronáutica, Brazil, 2Caltech, USA: We demonstrate a photonic crystal nanobeam device that provides heat and interrogates the refractive index. Experimental results show sensitivity of 97 nm/RIU, temperature variation of ∼100°C, and temperature switching time of a few μs.

**BW2A.5 • 12:15**
Techniques to improve the spatial and temporal resolution in optical projection tomography: remote focal scanning and time-lapse cell tracking, James A. McGinty1, Lingling Chen1, Sunil Kumar1, Yuny Alexandrov1, Natalie Andrews1, Douglas Kelly1, Margaret Dallman1, Paul M. French1; Imperial College London, UK: Optical projection tomography is a 3-D imaging approach applicable to transparent samples and model organisms like zebrafish embryos. We present methods to improve the spatial resolution and realize 3-D cell tracking in OPT.

**BW2A.6 • 12:30**
A SERS-assisted 3D Barcode Chip for Multiplex Protein Analysis, Lei Wu1, Zhuyuan Wang1, Yiping Cui1; Southeast Univ. (China), China: A surface enhanced Raman scattering (SERS)-assisted three-dimensional (3D) barcode chip has been developed for one-step multiplex protein analysis. This platform provides a rapid, sensitive and automated tool for high-throughput biomedical applications.

**BW2A.7 • 12:45**
Pixel super-resolution in optical time-stretch microscopy using acousto-optic deflector, Antony C. Chan1, Edmund Y Lam1, Kevin K. Tsia1; Dept of Electrical & Electronic Engin, Hong Kong: We present experimental demonstration of pixel super-resolution time-stretch imaging by high-speed agile-beam-steering with the use of synchronized acousto-optic deflector—enabling high-resolution imaging rate of 1 MHz whereas relaxing the stringent requirement on extreme data acquisition.

13:00–14:30 Lunch Break (On Your Own)

Harbourside Ballroom 3

11:00–13:00
JW2B • Molecular Imaging and Optogenetics (Brain/OMP)
Presider: Ella Jones; Univ. of California, San Francisco, USA

**JW2B.1 • 11:00 Invited**
Visualizing the Activity and Anatomy of Brain Circuits: Optogenetic Sensors and Tissue Clearing Approaches, Viviana Gradinaru1; BBE, California Inst. of Technology, USA: Dr. Gradinaru’s group studies the mechanism of action for deep brain stimulation (DBS) and develops tools and methods for neuroscience: optogenetic actuators and voltage sensors; tissue clearing, e.g. CLARITY, and imaging.

**JW2B.2 • 11:30 Invited**
Seeing Molecular Vibrations: Optical Imaging of Small Molecules for Biomedicine, Wei Min1; Chemistry, Columbia Univ., USA: We report a novel imaging platform, by coupling stimulated Raman scattering microscopy with small vibrational tags (including isotopes and alkynes), to probe dynamics of small biomolecules in living organisms with superb sensitivity, specificity and biocompatibility.

**JW2B.3 • 12:00 Invited**
In Vivo Multispectral Photoacoustic Imaging of Gene Expression using Engineered Reporters, Roger J. Zemp1, Robert Paproski1, Alex Forbrich1, Yan Li1, Robert E. Campbell1; Univ. of Alberta, Canada: Recent strategies for in vivo photoacoustic imaging of gene expression are introduced and include inducible tyrosinase reporters, and chromoproteins optimized for photoacoustic imaging using directed evolution approaches.

**JW2B.4 • 12:30 Invited**
In Vivo Multispectral Photoacoustic Imaging of Gene Expression using Engineered Reporters, Roger J. Zemp1, Robert Paproski1, Alex Forbrich1, Yan Li1, Robert E. Campbell1; Univ. of Alberta, Canada: Recent strategies for in vivo photoacoustic imaging of gene expression are introduced and include inducible tyrosinase reporters, and chromoproteins optimized for photoacoustic imaging using directed evolution approaches.
Tomographic imaging methods. Three-dimensional imaging of fluorescently-labelled objects is demonstrated with several computed incoherent light emission—allowing for coherent tomographic imaging with fluorescent light emission. Propagation phase is of coherent illumination beams is transferred to temporal modulations on instantaneous light emission-allowing for coherent tomographic imaging with fluorescent light emission. Three-dimensional imaging of fluorescently-labelled objects is demonstrated with several computed tomographic imaging methods.


Optical tweezers: a tool for the stability investigation of double emulsion, Stef Van Deeweke1, Mathieu Balcacin2, Toon Brans1, Filip Beurnis3, Paul Van der Meer3, Kristiaan Neyts3. Electronics and Information Systems, Ghent Univ., Belgium; 2Center for Nano- and Biophotonics (NB-Photonics), Ghent Univ., Belgium; 3Applied Analytical and Physical Chemistry, Ghent Univ., Belgium. We developed a setup combining optical trapping and millifuorics enabling time-dependent tracking of a single particle in double emulsions. Changing the particle’s environment allows us to characterize the dynamics and stability of the trapped particle.

Dye Lasing and Laminar Flow-Induced Dissolution in Hydrodynamically Trapped Oil Microdroplets, Alper Kras1, Oguz Kayilloglu1, Ahmet Erten1, Melikhah Tanyeri1, Dept of Physics, Koç Univ., Turkey; 2Dept of Electrical-Electronics Engineering, Istanbul Sehir Univ., Turkey. Dye lasing and laminar flow-induced dissolution are demonstrated with hydrodynamically trapped oil microdroplets in a glycerol-water solution.

Optical Trapping Electrophoresis: A Tool for Fast and Accurate Electrical Characterization of Single Colloidal Particles, Filip Beurnis1, Toon Brans1, Caspar Schreuer1, Stijn Vandeweiel1, Filip Strubbel1, Kristiaan Neyts1, Ghent Univ., Belgium. Optical trapping electrophoresis is a technique that combines optical and electrical manipulation to electrically characterize single colloidal particles. With two applications we demonstrate the potential of the technique in a variety of fields.

Scattering and Acoustical and Optical Radiation Forces and Torques for Manipulation, Philip L. Marston1, Likan Zhang1, Physics & Astronomy Dept., Washington State Univ., USA; 2Physics Dept., Univ of Texas, USA. Selected conceptual developments here relate scattering with particle manipulation. Phenomena and formulations considered (emphasizing, but not limited to, asymmetric situations) include radiation torque, negative radiation force and tractor beams, optical theorems, and acoustical viscous effects.
<table>
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<th>Session Time</th>
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<td>14:30–16:30</td>
<td><strong>BW3A • Clinical Technologies I</strong></td>
<td>Salon F</td>
<td>Tomasz Tkaczyk; Rice Univ., USA</td>
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<td>14:30–16:30</td>
<td><strong>BrW3B • Functional Microscopy, Light Patterning and Going Deeper</strong></td>
<td>Harbour F3</td>
<td>Fritjof Helmchen; Univ. of Zurich, Switzerland</td>
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<td>14:30–16:30</td>
<td><strong>NW3C • Light Scattering and Phase Microscopy</strong></td>
<td>Salon D</td>
<td>Benjamin Vakoc; Harvard Medical School, USA</td>
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**BW3A.1 • 14:30**
Invited
Multimodal Optical Imaging Approaches for Early Detection of Oral Epithelial Cancer, Javier A. Jo1, Texas A&M Univ., USA. Early detection would double the five-year survival rate of oral epithelial cancer patient. An overview of our current efforts towards developing multimodal optical imaging approaches for early detection of oral epithelial cancer will be presented.

**BW3A.2 • 15:00**
Invited
System Design of Dual-mode Fluorescence Image Guided Surgical System, Rongqiang Liang1, Univ. of Arizona, USA. We will overview the current status of fluorescence image guided surgical systems and then focus on system design of dual-mode fluorescence image goggle system. We will also discuss prototype development, system evaluation, and experimental results.

**BW3A.3 • 15:30**
In Vivo Middle Ear Imaging with a Light Field Otoscope, Noah Bedard1, Iva Toli2, Lingfei Meng3, Alejandro Hoberman4, Jelena Kovacheva5, Kathryn Berkner6, Ritho Innovations Corporation, USA; 2Dept of Pediatrics, Univ. of Pittsburgh School of Medicine, USA; 3Dept of Electrical and Computer Engineering, Carnegie Mellon Univ., USA. We present a novel design of a light field otoscope for use in pediatric primary care settings to acquire diagnostic features such as 3D shape and multispectral information. Compared to prior art, the prototype improves speed, field-of-view, depth-of-field and illumination.

**BW3A.4 • 15:45**
Wavefront Sensorless Adaptive Optics for Ophthalmic Imaging, Yifan Jian1, Kevin Wong1, Daniel Wahl1, Michelle Cui2, Pengfei Zhang2, Stefano Bonora3, Robert Zawadski4, Marinka V Sarunic4, 1Engineering Science, Simon Fraser Univ., Canada; 2CNRS-Inst. of Photonics and Nanotechnology, Italy; 3Dept of Cell Biology and Human Anatomy, Univ. of California Davis, USA; 4Dept of Ophthalmology & Vision Science, Univ. of California Davis, USA. Wavefront sensorless adaptive optics is a novel technique that facilitates high resolution ophthalmic imaging such as OCT and SLO; it replaces the Hartmann Shack wavefront sensor with an image-driven optimization algorithm and mitigates some of the challenges encountered with sensor-based designs.

**BrW3B.1 • 14:30**
Invited
Visualizing Mammalian Brain Area Interactions by Dual-axis Two-photon Calcium Imaging, Jerome Lecoq1, Stanford Univ., USA. Collective dynamics across distal mammalian brain regions are generally inaccessible to investigation. Here we introduce a two-photon microscope possessing two articulated arms that can simultaneously image any pair of brain areas using microendoscopes.

**BrW3B.2 • 15:00**
Dual-region in vivo Functional Imaging with a Spatial Light Modulator, Weiyan Yang1, Joo-eun K. Miller2, Luis Carillo-Reid2, Rafael Yuste3, Darcy S. Petek2, Columbia Univ., USA. We demonstrate dual-region functional imaging, using a spatial light modulator as a programmable beam steering element. Two lateral cortical regions in layers 2/3 of a mouse expressing GCaMP6 are simultaneously scanned, and signals extracted using independent-component-analysis.

**BrW3B.3 • 15:30**
Simple Signal-Based Wavefront Correction for In-Vivo Two-Photon Microscopy in Mouse Brain, Pubudu Thilanka Galwaduge1, Sharon K. Kim1, Lauren E. Grosberg1, Elizabeth M. Hillman1, Columbia Univ., USA. We present a novel adaptive optics scheme for two-photon microscopy that is compatible with in-vivo mouse brain imaging. Signal-based modal optimization permits correction for both system and sample aberrations within 10-40 seconds.

**BrW3B.4 • 15:45**
Sculpted Light Microscopy for High-Speed Imaging of Neuronal Activity, Robert Prevedel1,2, Peter Rupprecht3, Alipasha Vaziri1, 1Biomedical Engineering/Dermatology, Ormond Health and Science Univ., USA; 2Dept of Pediatrics, Univ. of California Berkeley, USA. We demonstrate dual-region functional imaging that allow maximizing the obtainable volume speed and depth penetration for different experimental conditions.

**NW3C.1 • 14:30**
Invited
Phase Microscopy and 3D Imaging with Partially Coherent Light, Laura Walle1, Le Tian2, Zhong Jinggian2, Panoma Varma3, Univ. of California Berkeley, USA. This talk will describe new methods for achieving 3D and high-resolution brightfield, darkfield and phase images with partially coherent illumination. Such computational approaches add new capabilities to commercial microscopes without much cost or hardware modification.

**NW3C.2 • 15:00**
Invited
Probing Nanoscale Tissue Structure using Light Scattering, Steven L. Jacques1, Biomedical Engineering/Dermatology, Oregon Health and Science Univ., USA. Light scattering by a tissue encodes the size distribution and granularity of the scattering structures in the tissue. The paper discusses (1) goniometry, (2) diffuse light scattering, (3) confocal reflectance, and (4) planar backscatter spectrum.

**NW3C.3 • 15:30**
Field of view advantage of conjugate compared to pupil adaptive optics, Jerome C. Mertz1, Jiang Li1, Han Paudel1, Thomas G. Briano1, 1Boston Univ., USA. We provide theoretical and experimental comparison of conjugate versus pupil adaptive optics for the case of a single aberating screen. Conjugate AO is found to provide a significant FOV advantage.

**NW3C.4 • 15:45**
Dual acquisition of fluorescence and quantitative phase microscopy with high-speed switchable optics for DIC, Sharon V. King1, Mohammad S. Hossain2, Chyraneith Preza2, Univ. of Memphis, USA. A modified shearing interferometer for live-cell imaging is demonstrated in a commercial microscope. Results demonstrate dual image mode acquisition without need for Nomarski prisms or sample rotation for use with quantitative phase retrieval algorithms.
Optical Trapping Applications

14:30–16:00
OW3D • Photoacoustic Imaging and Fast Tissue Scanning
Presider: Peter So, Massachusetts Institute of Technology, USA

OW3D.1 • 14:30
Blood Oxygen Saturation Measurements using Photoacoustic Z-scan Technique, Albert Kamara1, Maryam Hatamimoslehabadi1, Chandra S. Yelleswarapu1, Univ. of Massachusetts Boston, USA. Blood oxygen saturation (SO2) estimation is important in medicine. Nonlinear absorption coefficient (β) of various SO2 level blood samples were measured using photoacoustic Z-scan technique. Results depict linear dependency between β and SO2.

OW3D.2 • 14:45
A novel folate-receptor targeted indocyanine green nanoprobe for in vivo photoacoustic/flourescence dual-modality imaging of breast carcinoma, Chengbo Liu1, Huina Wang1, Liang Song1, 2Shenzhen Insts of Advanced Technology, USA. A new type of folate-receptor targeted, indocyanine green doped nanoprobe of high biocompatibility was developed, offering excellent targeting capability for in vivo photoacoustic and fluorescence molecular imaging of breast cancer in a small animal model.

OW3D.3 • 15:00
Molecular Photoacoustic Imaging of Orthotopic Glioblastoma, Amalina E. Attia1, Chris Ho1, Prashant Chandrasekharan1, Ghayathini Balasundaram1, Kai-Hsiang Chuang1, Malini Olivo1, 2Singapore Biomaging Consortium, Singapore; 3School of Physics, National Univ. of Ireland, Ireland. We exploit multispectral optoacoustic tomography (MSOT) as a noninvasive in vivo and imaging modality for the molecular imaging of a NIR dye-glucose conjugate in an orthotopic glioblastoma mouse model with coregistration with MRI. The distribution of the probe in the abdomen organs was also studied.

OW3D.4 • 15:15
Linear and Nonlinear Absorption Enhanced Photoacoustic Response of BODIPY and Curcuminoid Photophores, Maryam Hatamimoslehabadi1, Mathieu Frenette1, Stephanie Bellingr-Buckley1, Jeffrey La1, Ezraa Ahmad1, Jonathan Rochford1, Chandra S. Yelleswarapu1, Univ. of Massachusetts Boston, USA. We report the development of efficient photoacoustic-phores based on BODIPY and curcuminoid fluorophores. Enhancement of PA response is attributed to strong linear absorption and excited state at incident wavelength, and long lived excited states.

OW3D.5 • 15:30
Identifying/digital staining of diseased regions by monitoring disease specific marker molecules using Raman spectral libraries, Aditya Pandya1, Jawad Hilaneh1, Carl Kumaradas1, Alexandre Doukakis1, 2Monash Univ., Australia; 3Singapore Univ. of Technology and Design, Singapore. We have collected Raman spectral libraries for obtaining operator independent diagnostics under ex-vivo and in-vivo conditions and we have tested this approach using multivariate analysis on known solutions with Raman active components.

OW3D.6 • 15:45
Optical Studies of Oxidative Stress in Persistent Pulmonary Hypertension Cells, Zahra Ghanian1, Ganesh Konduri2, Mahsa Ranji1, 2Univ. of Wisconsin Milwaukee, USA; 3MCW, USA. This study investigates the effect of hypertension on mitochondrial superoxide production using time lapse microscopy.

OW3D.7 • 16:00
Untwisting and Unzipping: Magnetic Tweezers Based Measurements of DNA Processing Enzymes, Keir C. Neuman1, Yeonee Seol1, 2Lab of Molecular Biophysics, National Heart, Lung, and Blood Inst., National Inst. of Health, USA. Magnetic tweezers provide a versatile tool enabling the application of force and torque on individual DNA molecules. We have developed a high-resolution, actively-stabilized, magnetic tweezers to measure the activity of DNA topoisomerases and DNA helicases.

OW3D.8 • 16:15
Feedback-driven microfluidic manipulation of a single fluorescent nanoparticle in solution as an alternative to optical trapping, Lloyd M. Davis1,2, Bo Wang1,2, Jason King1,2, James A. Germann1,2, Alexander A. Terekhov1, Brian K. Canfield1, 2Univ. of Tennessee Space Inst., USA; 3Physics and Astronomy, Univ. of Tennessee Knoxville, USA; 4Biomolecular Measurement Division, National Inst. of Standards and Technology, USA; 5Visual Optics and Biophotonics Lab, Instituto de Optica, Spain. We discuss several configurations for feedback-driven manipulation of a single fluorescent biomolecule or nanoparticle in solution, including experiments on electrokinetic trapping in three dimensions, and prospects for single-molecule diffusivity measurements by recycling in a nanochannel.

OW3D.9 • 16:30
Optical Molecular Probes, Imaging and Drug Delivery

14:30–15:45
OtW3E • Alternative Particle Manipulation Techniques II
Presider: Giorgio Volpe; Univ. College London, UK

OtW3E.1 • 14:30
Untwisting and Unzipping: Magnetic Tweezers Based Measurements of DNA Processing Enzymes, Keir C. Neuman1, Yeonee Seol1, 2Lab of Molecular Biophysics, National Heart, Lung, and Blood Inst., National Inst. of Health, USA. Magnetic tweezers provide a versatile tool enabling the application of force and torque on individual DNA molecules. We have developed a high-resolution, actively-stabilized, magnetic tweezers to measure the activity of DNA topoisomerases and DNA helicases.

OtW3E.2 • 15:00
Feedback-driven microfluidic manipulation of a single fluorescent nanoparticle in solution as an alternative to optical trapping, Lloyd M. Davis1,2, Bo Wang1,2, Jason King1,2, James A. Germann1,2, Alexander A. Terekhov1, Brian K. Canfield1, 2Univ. of Tennessee Space Inst., USA; 3Physics and Astronomy, Univ. of Tennessee Knoxville, USA; 4Biomolecular Measurement Division, National Inst. of Standards and Technology, USA; 5Visual Optics and Biophotonics Lab, Instituto de Optica, Spain. We discuss several configurations for feedback-driven manipulation of a single fluorescent biomolecule or nanoparticle in solution, including experiments on electrokinetic trapping in three dimensions, and prospects for single-molecule diffusivity measurements by recycling in a nanochannel.

OtW3E.3 • 15:15
Invited
2D individual particle grids patterned with surface acoustic waves, David Collins1,2, Tuncay Alan1, Adrian Neild1, 1Monash Univ., Australia; 2Singapore Univ. of Technology and Design, Singapore. Here we demonstrate the use of high-frequency acoustic fields to pattern individual particles in a 2D grid and explore the parameter space that determines the success of this trapping.

OtW3E.4 • 15:30
Invited
Magnetic tweezers as a single particle manipulator, Adrian Neild1, 1Monash Univ., Australia. Magnetophores are a new type of microfluidic manipulation technology for single particle manipulation in solution. The principles of operation are illustrated and the limitations of this approach are discussed.
BW3A.5 • 16:00
Large-Aperture Harmonic Diffractive Adaptive Liquid Crystal Lens for Vision Care, Guoqiang Li1, Yanjun Pernmata1, Luyao Xu1, Thomas Mauger1,2; The Ohio State Univ., USA; Harmonic diffractive adaptive liquid crystal lenses with large aperture and low driving voltage are designed for ophthalmic applications. Lenses with 20-30 mm aperture and 1-3.5 diopters power can be achieved.

BW3A.6 • 16:15
In vivo high speed multispectral fluorescence lifetime imaging (FLIm) of swine coronary arteries, Julien Bec1, Dinglong Ma1, Diego Yankelevich1, William T. Ferrier1, Jeffrey Southard1, Laura Marzu1, Univ. of California Davis, USA. We report an intravascular catheter system able to acquire multispectral time-resolved fluorescence lifetime images in pulsatile blood flow. Results demonstrate the ability of this system to acquire robust fluorescence lifetime images in pulsatile blood flow.

BrW3B.5 • 16:00
In vivo Three-photon Imaging of Brain Activity from Cortical and Subcortical Neurons in Intact Mouse Brain, Dimitre G. Ouzounov1, Tianyu Wang1, Nicholas Horton1, Jean Hernandez2, Danielle Feng1, Natsumi Nishimura1, Chris Xu1; School of Applied and Engineering Physics, Cornell Unv., USA; Dept of Biomedical Engineering, Cornell Univ., USA. We demonstrate three-photon microscopy (3PM) at 1300-nm-excitation for imaging neuronal activity through the entire neocortex and as deep as the hippocampal stratum pyramidale (SP) layer of the living adult mouse brain using genetically-encoded calcium indicators.

BrW3B.6 • 16:15
Non-degenerate multiphoton microscopy for deep brain imaging, Mu-Han Yang1, Maxim Abashin1, Payam Saisan2, Anna Devor2,3; Neurosciences and Radiology, UCSD, USA; 1Martinos Center for Biomedical Imaging, Harvard Medical School, USA. We achieve non-degenerate 2-photon excitation (ND2PE) using a pair of IR and NIR beams and show that the emission intensity is proportional to the power of each beam. ND2PE provides an alternative to 3-photon excitation.

NW3C.5 • 16:00
Detecting Mechanically Induced Displacements in Human Cell Cultures using Quantitative Phase Imaging, William Eldridge1, Adi Shenfield1, Matthew T. Rinehart1, Adam Wax1, Duke Univ., USA. We present a platform for detecting cellular deformations from mechanical stimuli. Rapid quantitative phase imaging was used to analyze changes in the optical path length of skin cancer cells during mechanical displacement.

NW3C.6 • 16:15
Quantitative Imaging and the use of OPTiSPIM to compensate attenuation, Jürgen Mayer1,2, Jim Swoger1,2, James Sharpe2,3; 1CRG, Spain; 2UPF, Spain. Mesoscopic 3D imaging deep in biological tissue faces the problem of attenuation. We use OPT to compensate the attenuation in light-sheet fluorescence microscopy via an integrated OPTiSPIM setup.
Key to Authors and Presiders

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