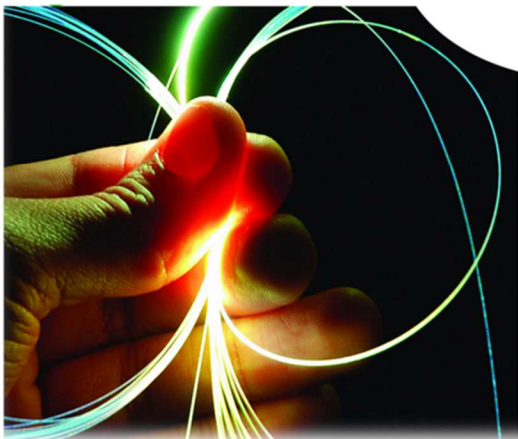


International
School on

Light

Sciences and
Technologies



Core: Light in Sources, Health and Medicine

Santander 17-21 de junio de 2019
(Sala Riancho, Palacio de la Magdalena, Santander)

PROGRAM



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Summary

Photonics is the science and technique of generating, controlling, propagating, storing and detecting light waves and photons, which are particles of light. Photonics is the field of Light Sciences and Technologies.

Light plays a vital role in our daily lives and is being an imperative cross-cutting discipline of science in the 21st century. It has revolutionized medicine, made possible international communication via the internet, enabled sustainable development and provided solutions to global challenges in education, energy, environment and agriculture. It continues to be a key discipline to link cultural, economic and political aspects of the global society. Today, it is widely accepted that the present century will depend as much on Photonics as the 20th century depended on electronics.

The United Nations Organization (UN) has recognized the **key or essential** role of Light Sciences and Technologies to raise global awareness and proclaimed 2015 as the International Year of Light and Light-based Technologies (IYL 2015). Aware of the key role of Photonics in the economies and in the societies of the XXI century, the UIMP has decided to create the “**International School on light Sciences and Technologies (ISLIST)**”.

This school is envisioned to be a worldwide top International forum (every fourth week of June) on *Light Sciences and Technologies* in the framework of a “*special top university*” that is recognized as the “*university of universities*” and in a privileged environment “the Royal Magdalena Palace” in Santander, Cantabria, Spain. Each edition of this international school will have an intensification or main core in a specific application area and additional current hot topics. ***Light in Sources, Health and Medicine*** is the core of this 2019 edition.

ISLIST has been conceived as a great opportunity to review, actualize and improve the knowledge of **scientists, professionals and technicians**; to contribute to the education and to enhance the motivation of **PhD students**; to offer an ideal frame for **networking** and also to contribute to the education of the **citizens**. It is also a great opportunity to ensure that **policymakers, entrepreneurs**, and other key “actors” will be aware of the problem-solving potential of Photonics.

Sixteen (16) **highly renowned** professors (including the Nobel Laureate Donna Strickland) and researchers from the most prestigious worldwide institutions and, as well, presidents of the most reputed international Photonic Scientific Organizations and some politicians will participate in this meeting.

The **City Council of Santander** will offer to ISLIST attendees a **Reception** at the Royal Palace of Magdalena. This Santander Happy Hour (with snacks and drinks) will be an optimum time to networking.

In this edition, the UIMP has distinguished Prof. **Donna Strickland** with a **Doctor Honoris Causa** award. This prestigious honor will be given at a solemn ceremony to be held in the Royal Hall of the Palace of Magdalena at the end of the morning, June 20, 2019. She will also be the recipient of the **Julio Peláez Award**.

To be able to reach this ambitious program this International School of UIMP is supported by several sponsors: **Gobierno de Cantabria, Fundación ACS, the Optical Society of America, OSA, ENSA, Fyla Lasers and Prysmian**.

It is also supported by several collaborators such as: **SPIE-the International Society for Optics and Photonics**; the Spanish Optical Society, **SEDOPTICA**; **AMBAR Telecommunications, B-Phot Brussels Photonic Team, OZ Optics, Semicroll, ERZIA, Ciber-BBN, Colegio de Medicos de Cantabria, Hotel Santemar** and the **Photonics Engineering Group** of the University of Cantabria.

Without these Sponsors and Collaborators, this top quality school and the 35 International Student Grants (already allocated from over 15 different nationalities) would not have been possible. The UIMP, the direction of this event and the scientific community using Light are grateful with the generosity of all these Organizations and all the Invited Speakers. Thank you so much!

Goals

To actualize and improve the knowledge of **scientists, professionals and technicians**; to contribute in the education and to enhance the motivation of **PhD students**; to offer an ideal frame for **networking**. It is also a great opportunity to ensure that policymakers, politicians and citizens in general terms will be made aware of the problem-solving potential of Photonics.

Overview

The event will take place from Monday (June 17, 2019) to Friday (June 21, 2019). The first one and a half days will be focused on key subjects concerning Light in Sources and the associated impact in the society. The rest of the week will be focused on the review of the current situation and the identification of challenges and trends in Light in Health and Medicine. Two round-tables will also take place. The first one (Tuesday afternoon) to analyse challenges of light technologies on sources (with special emphasis on medicine and health) and, the second one, (Thursday afternoon), to identify challenges on light technologies on several very hot topics for Health and Medicine.

General Schedule

Time	Monday 17 th	Tuesday 18 th	Wednesday 19 th	Thursday 20 th	Friday 21 st
9:30		Prof. Donna Strickland Nobel Prize in Physics 2018 University of Waterloo, Canada	Prof. Sune Svanberg Director, Lund Laser Center, Atomic Physics Division, Lund University, Sweden	Prof. Kishan Dholakia Director, School of Physics & Astronomy University of St Andrews, Scotland, UK.	Prof. Kishan Dholakia Director, School of Physics & Astronomy University of St Andrews, Scotland, UK
10:15	Opening Remarks	<i>From nonlinear Optics to High-Intensity Laser Physics</i>	<i>Fighting antibiotic resistance and food Safety using light based techniques</i>	<i>Optical Manipulation for Biomedicine</i>	<i>Wider, faster, deeper: new perspectives on imaging at depth</i>
10:40	Break	Break	Break	Break	Break
11:00	Prof. Aydogan Ozcan Director, Bio&Nano-Photonics Laboratory, Chancellor's Professor University of California, Los Angeles, USA <i>Toward a Thinking Microscope: Deep Learning- enabled Computational Microscopy and Sensing</i>	Prof. Roy Taylor Head, Femtosecond Optics Group, Imperial College of London, UK <i>Fiber based light Sources: from the UV to the mid infrared</i>	Prof. Michael Hamblin Principal Investigator, at Wellman Center for Photomedicine and Harvard Medical School, Boston, USA <i>The healing power of photobiomodulation or low-level light therapy (LLLT)</i>	10:50 Prof. Walter Margulis Senior Scientist, RISE-ACREO; Guest Prof. at KTH Royal Institute of Technology, Stockholm, Sweden <i>Flow Cytometry using Optical fibre technologies</i>	Prof. Robert Huber Head, of the Biomedical Imaging and Laser Technology Group University of Lübeck, Germany <i>Imaging the tissue structure: advances on Optical Coherence Tomography</i>
12:10	Prof. Susana Marcos Director, Visual Optics and Biophotonics Lab, Instituto de Optica, Professor of Research, CSIC <i>"Light in the Diagnostics and Therapy of the Vision human system"</i>	Prof. Luis Roso Director, Spanish Center for Pulsed Lasers, CLPU, Salamanca, Spain <i>Petawatt lasers and their potential applications in Biomedicine</i>	Prof. Katarina Svanberg Director, Medical Laser Centre Lund University, Sweden <i>Early tumor detection using Light and its fighting using Photodynamic Therapy (PDT): What next for extensive use in clinic?</i>	12:00 DHC ceremony Donna Strickland Nobel Laureate	12: 15 Closing Remarks, ISLIST-2020 Announcement and Diploma Delivery
13:30 15:00	Lunch	Lunch	Lunch	Lunch	
15:30	Prof. JM López-Higuera Head, Photonics Engineering Group University of Cantabria, CIBER-BBN and IDIVAL, Spain <i>Light on Health and Medicine</i>	Round Table I: Optical Source challenges <i>Prof. Donna Strickland Prof. Roy Taylor Prof. Luis Roso Dr. Pere Pérez-Millán</i>	Prof. Mark Hutchinson Director, Centre for Nanoscale BioPhotonics The University of Adelaide, Australia. <i>Towards quantification of pain using Light based approaches</i>	15:45 Round Table II: Light in Health & Medicine challenges <i>Prof. Katarina Svanberg Prof. Michael Hamblin Prof. Sune Svanberg Prof. Mark Hutchinson Prof. Robert Huber</i>	
16:40	Dr. Jan W. Denneman Founder, GoodLight Group / Honorary Ambassador of the Global Lighting Association <i>"Light, you need it!!". Semiconductor LED and Intelligent Lighting sources: Recent advances and their impact on mood and health</i>	Moderator: JM López-Higuera	Prof. Laura Lechuga Head, Nanobiosensors and Bioanalytical Applications Group, ICN2, CSIC, CIBER- BBN and BIST, Barcelona, Spain <i>Nano/micro-Biosensors using Light sciences and technologies</i>	Moderator: JM López-Higuera	
17:55		17:20 Julio Peláez Prize ceremony Donna Strickland	Family Photo Santander City Council Reception		

PROGRAM

Monday, 17

10:15 h

Opening Ceremony

10:40 h / **Break**

Light to see with smartness and treatments of the visual human system

11:00 h / Opening Talk

Toward a Thinking Microscope: Deep Learning-enabled Computational Microscopy and Sensing

Prof. Aydogan Ozcan

Director, Bio&Nano-Photonics Laboratory, Chancellor's Professor University of California, Los Angeles, USA

12:10 h / Invited Talk

Light in the Diagnostics and Therapy of the Vision human system

Prof. Susana Marcos

Director, Visual Optics and Biophotonics Lab, Instituto de Optica, CSIC, Spain

13:30-15:00 h / **Lunch Time**

Afternoon: **Light helping to maintain and to recover the health**

15:30 h / Invited Talk

Light in Sources, Health and Medicine

Prof. José Miguel López-Higuera

Director, ISLIST and Head of Photonic Engineering Group of UC, CIBER-BBN and IDIVAL, Spain

16:40 h / Invited Talk

"Light, you need it!!". Semiconductor LED and Intelligent Lighting sources: Recent advances and their impact on mood and health

Dr. Jan W. Denneman

Founder, GoodLight Group / Honorary Ambassador of the Global Lighting Association, Netherlands

Tuesday, 18

Morning: **Light Sources**

9:30 h / Invited Keynote



From nonlinear Optics to High-Intensity Laser Physics

Prof. Donna Strickland

Nobel Laureate in Physics 2018

Department of Physics & Astronomy, University of Waterloo, Canada

10:40 h / Break

11:00 h / Invited Talk

Fiber based light Sources: from the UV to the mid infrared

Prof. Roy Taylor

Head, Femtosecond Optics Group, Imperial College of London, UK

12:10 h / Invited Talk

Petawatt lasers and their potential applications in biomedicine

Prof. Luis Roso

Director, Spanish Center for Pulsed Lasers, CLPU, Salamanca, Spain

13:30-15:00 h / Lunch Time

Afternoon: **Challenges on Light Sources**

15:30 h- 17:55 / Round Table I

Light Sources: Challenges to face

Prof. **Donna Strickland**, Nobel Prize in Physics 2018, University of Waterloo, Canada

Challenges faced during the path towards high intensity lasers

Prof. **Roy Taylor**, Head, Femtosecond Optics Group, Imperial College of London, UK

Challenges on Broadband fiber laser sources for medicine

Prof. **Luis Roso**, Director, Spanish Center for Pulsed Lasers, CLPU, Salamanca, Spain

Challenges on Petawatt and ultrafast lasers

Dr. **Pere Pérez-Millan**, Director, Fyla Lasers, Spain

Challenges to face a successful innovation process towards a Fiber laser small company

Prof. JM López-Higuera, Director ISLiST, Moderator

17:20 h / Special Event

Julio Peláez Award / Awarding ceremony

Recipient: Donna Strickland

Wednesday, 19

Morning: **Light for food safety and to recover health**

9:30 h / Invited Talk

Fighting antibiotic resistance and food Safety using light-based techniques

Prof. Sune Svanberg

Former Director, Lund Laser Center, Lund University, Sweden

10:40 h / Break

11:00 h / Invited Talk

The healing power of photobiomodulation or low-level light therapy (LLLT)

Prof. Michael Hamblin

Principal Investigator at Wellman Center for Photomedicine and Harvard Medical School, Boston, USA

12:10 h / Invited Talk

Early tumor detection using Light and its fighting using Photodynamic Therapy (PDT): What next for extensive use in clinic?

Prof. Katarina Svanberg

Chairperson, Medical Laser Centre, Lund University, Sweden

13:30 -15:00h / Lunch Time

Afternoon: **Light for Sensing**

15:30 h / Invited Talk

Towards quantification of pain using Light based approaches

Prof. Mark Hutchinson

Director, Centre for Nanoscale BioPhotonics, The University of Adelaide, Australia.

16:40 h / Invited Talk

Nano/micro-Biosensors using Light sciences and technologies

Prof. Laura Lechuga

Head, Nanobiosensors and Bioanalytical Applications Group, ICN2, CSIC, CIBER-BBN and BIST, Barcelona, Spain.

17:55 h ISLiST Family Photo

18:05 h / Special Event

Santander Council Reception

The Santander City Council will offer to ISLiST attendees a special reception that, in addition, will be an optimum time to share experiences and promote networking.



Thursday, 20

Morning: **Light for manipulating and counting molecules**

9:30 h / Invited Talk

Optical Manipulation for Biomedicine

Prof. Kishan Dholakia

Director, **SUPA**, School of Physics & Astronomy, University of St Andrews, Scotland, UK.

10:40 h / Break

10:50 h / Invited Talk

Flow Cytometry using Optical fibre technologies

Prof. Walter Margulis

Senior Scientist, RISE-ACREO; Guest Prof. at KTH Royal Institute of Technology, Stockholm, Sweden

12:00 h / **Special Event**



Donna Strickland Doctor Honoris Causa Solemn Ceremony

UIMP will confer the Doctor Honoris Causa distinction to Prof. **Donna Strickland** by unanimous agreement of its Governing Council, which wants to recognize her relevant contributions to the Sciences and Technologies of Light.

13:30-15:00 h / Lunch Time

Afternoon: **Challenges on Light in Medicine**

15:45h- 17:45 / Round Table II

Challenges to face

Prof. Katarina Svanberg, Chairperson, Medical Laser Centre, Lund University, Sweden

Challenges to face to include PDT as a current clinical treatment

Prof. Michael Hamblin, Principal Investigator at Wellman Center for Photomedicine and Harvard Medical School, Boston, USA

Challenges on LLLT real clinical applications

Prof. Sune Svanberg, Former Director, Lund Laser Center, Lund University, Sweden

Challenges in using light based techniques in beating the antibiotic resistance and in food quality monitoring

Prof. Mark Hutchinson, Director, Centre for Nanoscale BioPhotonics, The University of Adelaide, Australia.

Challenges on Translational Biophotonics to Quantify Brain Health.

Prof. Robert Huber, Head, Biomedical Imaging and Laser Technology Group, University of Lübeck, Germany

Challenges on OCT clinical applications

Prof. JM López-Higuera, Director ISLiST, Moderator

Friday, 21

Light on medical imaging

9:30 /Invited Talk

Wider, faster, deeper: new perspectives on imaging at depth

Prof. Kishan Dholakia

Director, **SUPA**, School of Physics& Astronomy, University of St Andrews, Scotland, UK.

10:40 h / Break

11:00 /Invited Talk

Imaging the tissue structure: advances in Optical Coherence Tomography

Prof. Rober Huber, Head, of the Biomedical Imaging and Laser Technology Group, University of Lübeck, Germany

12:15 h

Closing Remarks, Announcement of ISLiST 2020 and Diploma Delivery

The UIMP official diploma will be delivery to each attendee by ISLiST invited speakers.

Abstracts/Bios

Highly renowned Professionals and Scientists from the most prestigious Organizations will highlight the importance of Photonics for a new world. Key trends and challenges will be identified in several areas of paramount importance.

Invited Speaker

Talk

Biography



Prof. Donna Strickland

**Nobel Laureate in
Physics 2018**

**University of Waterloo,
Canada**

June 18, 2019
9:30 h / Invited Keynote
15:30 / Round table

From nonlinear Optics to High-Intensity Laser Physics

The laser increased the intensity of light that can be generated by orders of magnitude and thus brought about nonlinear optical interactions with matter. Chirped pulse amplification, also known as CPA, changed the intensity level by a few more orders of magnitude and helped usher in a new type of laser-matter interaction that is referred to as high-intensity laser physics. In this talk, I will discuss the differences between nonlinear optics and high-intensity laser physics. The development of CPA and why short, intense laser pulses can cut transparent material will also be included. I will also discuss future applications.

Prof. Donna Strickland is one of the recipients of the Nobel Prize in Physics 2018 for co-inventing Chirped Pulse Amplification with Dr. Gérard Mourou, her PhD supervisor at the time of the discovery. She earned her PhD in optics from the University of Rochester and her B. Eng. from McMaster University. Dr. Strickland was a research associate at the National Research Council Canada, a physicist at Lawrence Livermore National Laboratory and a member of technical staff at Princeton University. In 1997, she joined the University of Waterloo, where her ultrafast laser group develops high-intensity laser systems for nonlinear optics investigations. She is a recipient of a Sloan Research Fellowship, a Premier's Research Excellence Award and a Cottrell Scholar Award. She served as the president of the Optical Society (OSA) in 2013 and is an OSA Fellow and an SPIE Fellow.



**Prof. Aydogan
Ozcan**

Director

Bio&Nano-Photonics
 Laboratory,
 Chancellor's Professor
 University of California, Los
 Angeles, USA

Monday, June 17, 2019

11:00 hours
 Invited Opening Talk

Toward a Thinking Microscope: Deep Learning-enabled Computational Microscopy and Sensing

Deep learning is a class of machine learning techniques that uses multi-layered artificial neural networks for automated analysis of signals or data. The name comes from the general structure of deep neural networks, which consist of several layers of artificial neurons, each performing a nonlinear operation, stacked over each other. Beyond its main stream applications such as the recognition and labeling of specific features in images, deep learning holds numerous opportunities for revolutionizing image formation, reconstruction and sensing fields. In fact, deep learning is mysteriously powerful and has been surprising optics researchers in what it can achieve for advancing optical microscopy, and introducing new image reconstruction and transformation methods. From physics-inspired optical designs and devices, we are moving toward data-driven designs that will holistically change both optical hardware and software of next generation microscopy and sensing, blending the two in new ways. Today, we sample an image and then act on it using a computer. Powered by deep learning, next generation optical microscopes and sensors will understand a scene or an object and accordingly decide on how and what to sample based on a given task – this will require a perfect marriage of deep learning with new optical microscopy hardware that is designed based on data. For such a thinking microscope, unsupervised learning would be the key to scale up its impact on various areas of science and engineering, where access to labeled image data might not be immediately available or very costly, difficult to acquire. In this presentation, I will provide an overview of some of our recent work on the use of deep neural networks in advancing computational microscopy and sensing systems, also covering their biomedical applications.

Prof. Ozcan is the Chancellor's Professor at UCLA and an HHMI Professor with the Howard Hughes Medical Institute, leading the Bio- and Nano-Photonics Laboratory at UCLA and is also the Associate Director of the California NanoSystems Institute. Dr. Ozcan is elected Fellow of the National Academy of Inventors (NAI) and holds 38 issued patents and >20 pending patent applications and is also the author of one book and the co-author of >500 peer-reviewed publications in major scientific journals and conferences. Dr. Ozcan is the founder and a member of the Board of Directors of Lucendi Inc. and Holomic/Cellmic LLC, which was named a Technology Pioneer by The World Economic Forum in 2015. Dr. Ozcan is also a Fellow of the American Association for the Advancement of Science (AAAS), the International Photonics Society (SPIE), the Optical Society of America (OSA), the American Institute for Medical and Biological Engineering (AIMBE), the Institute of Electrical and Electronics Engineers (IEEE), the Royal Society of Chemistry (RSC), and the Guggenheim Foundation, and has received major awards including the Presidential Early Career Award for Scientists and Engineers, International Commission for Optics Prize, Biophotonics Technology Innovator Award, Rahmi M. Koc Science Medal, International Photonics Society Early Career Achievement Award, Army Young Investigator Award, NSF CAREER Award, NIH Director's New Innovator Award, Navy Young Investigator Award, IEEE Photonics Society Young Investigator Award and Distinguished Lecturer Award, National Geographic Emerging Explorer Award, National Academy of Engineering The Grainger Foundation Frontiers of Engineering Award and MIT's TR35 Award for his seminal contributions to computational imaging, sensing and diagnostics.



Prof. Susana Marcos

Director

of Visual Optics and
Biophotonics Lab, Instituto
de Optica,
Professor of Research, CSIC,
Madrid, Spain

June 17, 2019

12:10 h

Invited talk

Light in the Diagnostics and therapy of the Vision human system

The eye projects images of the outside world onto the retina, where photoreceptors transform light into electrical signals that are transmitted to the brain. However, several ocular conditions such as myopia, presbyopia, corneal pathology) that degrade the quality of the retinal images affect billions of people who require from optical aids or treatments. In this lecture I will present how optical and photonic technologies allow us to better understand, quantify and diagnose ocular disease, as well as new optical and light-based therapies for treatment. The talk will shed light into new directions for treating and controlling myopia, restoring accommodation in the presbyopia or halting sight-threatening corneal disease.

Prof. Marcos is a Professor of Research at the Institute of Optics (CSIC) where she leads the Visual Optics and Biophotonics Laboratory. She is Director-at-Large of the Optical Society of America (OSA), and editor of the OSA journal Optica. She is the recipient of the Adolph Lomb Medal (OSA), European Young Investigator Award ICO Prize (International Commission for Optics), Doctor Honoris Causa by the Ukrainian Academy of Science and Technology, Physics, Technology and Innovation Award (Royal Society of Physics-Fundación BBVA), and the ARI Award (Alcon Research Institute), among others. She is also a European Research Council Advanced Grantee. She is an elected Fellow of the European Optical Society, Optical Society of America and Association for Vision in Research and Ophthalmology. She is an author of >150 publications, inventor in 15 patents, partner of spin-off Plenoptika Inc and co-founder of 2Eyes Vision.



**Prof. José Miguel
López-Higuera**

Head

Photonic Engineering
Group of University of
Cantabria, CIBER-BBN and
IDIVAL, Spain

June 17 / 15:30 h

Invited Talk

Moderator of
Round Tables I & II

Light on Sources, Health and Medicine

Photonics is considered a Key Enabling Technology (KET) or an Essential Technology for the development of Europe, USA and others main nations around the world. Photonic Sensing is understood as any sensing approach that employs light sciences and technologies and it is becoming an area with very substantial expectations of annual growths and with strong socio-economic impacts in the first decades of this XXI century.

In the talk, after a mention of what it must be understood, in wide sense, as the general and comprehensive concept Light Sciences and Technologies, we will do a "flight" over several significant examples of light use on a wide number cases inside the Sources, Health and Medicine applications. The trends for the near future will be also addressed and discussed.

Prof. López-Higuera is the founder and head of the Photonics Engineering Group of the University of Cantabria, CIBER-BBN of Institute of Health Carlos III and IDIVAL of Hospital Universitario Marqués de Valdecilla, Spain. He is a Member of a wide set of international Committees of Conferences, R&D Institutions, and Companies in the area of photonic sensing. His work is focused on optical sensor systems and instrumentations for any sector application. He has worked in a wide range of R&D&i projects, acting in more than 90 of them as manager.

He has contributed with more than 700 research publications including 20 patents closely related to optical and fiber techniques for sensors and instrumentations. He has worked as an editor and co-author of four R&D international books, as a co-editor of several conference proceedings and Journals and he has been the director of 17 PhD theses. He is co-founder of three technology-based companies.

Prof. López-Higuera is a Fellow of OSA, Fellow of SPIE, Senior of IEEE and a Member of the Royal Academy of Medicine of Cantabria.



**Mr. Jan W.
Denneman**

Founder the GoodLight
Group / **Honorary
Ambassador** of the Global
Lighting Association

Past-Vice-President
Industry Association, Philips
Lighting,
Eindhoven, Netherlands

June 17, 2019
16:40 h
Invited Talk

"Light, you need it!!" Semiconductor LED and Intelligent Lighting sources: Recent advances and their impact on mood and health

Many thousands of years' mankind indeed lived outside but the modern human being spends most of its life indoors. In offices, schools, factories, etc., the light is usually good enough to see, but biologically it is darkness. Our body and brain need much higher lighting levels to steer important biological processes in the body like the biological clock.

The Nobel Prize for medicine and physiology 2017 went to the scientists that studies the effect of light on people. But mankind still lives in biological darkness.

The chronicle light shortage has nasty consequences. People are less alert and have lower cognitive performance. The quality of sleep is less and people develop feelings of depression. People live with a continuous social jetlag.

Because most people have indoor jobs, we need to drastically improve the way we design our indoor spaces. Much more daylight needs to enter buildings and the electric lighting needs to compensate for the lack of natural daylight. The LED technology makes this possible in a sustainable way.

Dr. Denneman has worked many years in the lighting industry in innovative and leadership roles. In addition, he has been many years chairman of the European Light Companies Association and of the Global Lighting Association. He has created many alliances like Zhaga, LightingEurope, GLA. Now he is founder of theGoodLightGroup, which is a foundation that promotes Nutritional Light, indoor lighting which is also biologically active and good for body and brain.



Prof. Roy Taylor

Femtosecond Optics Group,
Imperial College of London,
UK

June 18, 2019
11:00 h
Invited talk

June 18, 2019
15:30
Round Table I

Fiber based light Sources: from the UV to the mid infrared.

The diversity of applications in the biomedical arena calls for equally diverse demands on wavelength, pulse duration and repetition rate for potentially deployable light sources. Although no single source can meet the exacting demands, nonlinear optical processes in fibres allows efficient wavelength flexibility. The integration of master oscillator power fibre amplifier (MOPFA) schemes with conventional and photonic crystal fibres has underpinned various applications, exemplified by the supercontinuum source, operating from the continuous wave to the femtosecond regimes. Despite the extensive wavelength coverage of the supercontinuum source from the ultra violet to the near infra-red in silica based fibres, which can be significantly extended in various glass fibre hosts, the limiting spectral power densities and uncertain pulse shapes can place limitations on the applicability. In this presentation the generation processes in supercontinuum generation will be reviewed, highlighting some of the characteristics which may restrict wide application. Alternative, highly efficient sources will be described, based on stimulated Raman in fibres and their frequency doubling, as well as parametric generation allowing wide tuneability at multi-watt average powers.

Prof. Taylor received his PhD from the Queen's University of Belfast in 1974. In 1986 he established the Femtosecond Optics Group at Imperial College. He is widely acknowledged for his basic research and development of diverse lasers systems, contributing extensively to advances in picosecond and femtosecond dye laser technology, compact diode-laser and fibre-laser-pumped vibronic lasers and their wide-ranging application to fundamental studies. Roy is also particularly noted for his fundamental studies of ultrafast nonlinear optics in fibres and their translation to commercial product, with emphasis on solitons, their amplification, the role of noise and self-effects, such as Raman gain and supercontinuum generation. He has contributed to over 850 scientific papers and conference presentation in these topical areas.



Prof. Luis Roso

Director

Centro de Láseres
Pulsados,
Salamanca, Spain.

June 18, 2019
12:10 h
Invited Talk

15:30 h
Round table

Petawatt lasers and their applications on Medicine

Ultrafast ultraintense lasers are a fabulous tool for many applications. They allow terawatt peak powers, in a relatively easy way, and petawatt or multipetawatt lasers. Now, with reliable lasers, it is time to consider their applications, basically as particle accelerators. The huge field of a petawatt pulse focused closed to diffraction limit can accelerate charged particles to very relevant energies.

Particle accelerators are relevant in our life (homeland security, phase contrast imaging, food processing, radio-therapy, and many more), and therefore CPA lasers have a promising potential to be relevant in such fields.

In particular, lasers offer new possibilities for radio-therapy because the radiation is all delivered at once, delivering dose rates at least one million times larger than with a conventional system. This is giving a new ingredient –time– to the therapy and to the study of the molecular mechanisms causing radiation cell damage. But now we are just at the starting point of this new field.

Prof. Roso, Barcelona 1955, Graduated in Physics and in Mathematics, at the University of Barcelona. PhD in Physics in 1981 at the Autonomous University of Barcelona, and Associate Professor at this university. Visiting Scholar at the University of Rochester, NY, in 1985-86 (at the time of the CPA development). Full professor of Optics at the University of Salamanca in 1991.

He is responsible for the first group in Spain devoted to ultraintense lasers, in 2003 at terawatt peak power. Since that time the record peak power in Spain is in his group, then at the University and now at the Salamanca Pulsed Center Lasers, CLPU, where is operative the first petawatt laser in our country. Luis Roso has been the promoter of CLPU and he is its Director.

June 18 / 15:30-17:15 h, Round Table I:

Light on Sources: Challenges to face

Prof. Donna Strickland, Nobel Laureate in Physics 2018, University of Waterloo, Canada

Challenges faced during the path towards high intensity lasers

Prof. Roy Taylor, Femtosecond Optics Group, Imperial College of London, UK

Challenges on Broadband fiber laser sources for medicine

Prof. Luis Roso, Director, Centro de Láseres Pulsados, Salamanca, Spain

Challenges on Petawatt and ultrafast lasers

Dr. Pere Pérez-Millán, Founder and CTO of Fyla Lasers, Valencia, Spain

Challenges to face a successful innovation process towards a Fiber laser small company

Prof. JM López-Higuera, Director ISLiST, Moderator



Prof. Sune Svanberg

Former Director
 Lund Laser Center
 Atomic Physics Division
 Physics Department
 Lund University, Sweden

June 19, 2019
 9:30 h
 Invited Talk
 June 20, 2019
 15:45 h
 Round Table II

Fighting antibiotic resistance and improving food safety using light based techniques

Applied laser spectroscopy can provide important tools in a variety of areas of major importance for human well-being. It has strong impact on energy-related research such as combustion studies, on environmental monitoring and in biomedical diagnostics, areas where the speaker has considerable experience. Recently, problems related to antibiotic resistance and food safety have received much attention. Also in these fields laser spectroscopy has emerging applications. Sinusitis and otitis are very common infections causing a tremendous overuse of antibiotics, mostly ineffective because of viral rather than bacterial origin. We are developing techniques based on the gas in scattering media absorption spectroscopy (GASMAS) technique to non-invasively study free gas in human cavities with bearing to the resistance problem. Similar techniques can be used to non-intrusively monitor the gas content in foods and food packages, where frequently modified atmosphere packaging is used for increased shelf-life.

Prof. Sune Svanberg, obtained his PhD from University of Gothenburg in 1972, and is since 1980 professor of physics at Lund University, Lund, Sweden. During 30 years he was head of the Atomic Physics Division, and during 20 years founding director of the Lund Laser Centre. Since 2011 he is also a distinguished professor at the South China Normal University, Guangzhou. With a wide background in atomic laser spectroscopy and light-matter interaction, his current research interests include laser spectroscopic applications to the environmental, food safety and biomedical fields. He received a number of scientific awards, is member of 6 academies and has 8 honorary doctor/professorships.



Prof. Michael R. Hamblin

Harvard Medical School
 and Principal Investigator
 at Wellman Center for
 Photomedicine,
 Massachusetts General
 Hospital
 Boston, USA

June 19, 2019
 11:00 h
 Invited Talk
 June 20, 2019
 15:45 h
 Round Table II

The healing power of PhotoBio-Modulation or low-level light therapy

Photobiomodulation (PBM) has been used for nearly 50 years to enhance tissue healing and to relieve pain, inflammation and swelling. The photons (from lasers or LEDs) are absorbed by cytochrome c oxidase (unit four in the mitochondrial respiratory chain) and also by light-sensitive ion channels. Increased mitochondrial respiratory chain activity, ATP production, calcium mobilization, brief burst of reactive oxygen species, lead to a signalling cascade and activation of transcription factors with up- and down-regulation of numerous genes.

Many pathways such as anti-apoptosis, antioxidant enzymes, heat shock proteins, anti-inflammatory cytokines, M2 phagocyte phenotype are activated by PBM.

Brain disorders can be classified into three groups: sudden events (stroke, TBI, global ischemia), degenerative diseases (dementia, Alzheimer's, Parkinson's), and psychiatric disorders (depression, anxiety, PTSD, autism). There is evidence that all these conditions can be treated by applying light to the head. PBM could even be used for cognitive enhancement in normal healthy people.

Prof. Hamblin, Michael R Hamblin Ph.D. is a Principal Investigator at Wellman Center for Photomedicine, Massachusetts General Hospital, and an Associate Professor at Harvard Medical School. He has interests in photodynamic therapy and photobiomodulation. He has published over 445 peer-reviewed articles, is Editor-in-Chief of "Photobiomodulation, Photomedicine and Laser Surgery", Associate Editor for 10 other journals and serves on NIH Study-Sections. He has an h-factor 95 and >35,500 citations. He has authored/edited 23 textbooks on PDT and photomedicine including SPIE proceedings. Dr Hamblin was elected as a Fellow of SPIE in 2011, received 1st Endre Mester Lifetime Achievement Award in Photomedicine from NAALT in 2017, and the Outstanding Career Award from Dose Response Society and the 1st Ali Javan Award in Basic Science Research from WALT in 2018.



**Prof. Katarina
Svanberg**

Chairperson

Medical Laser Centre
Lund University, Sweden

June 19, 2019

12:10h

Invited Talk

June 20, 2019

15:45h

Round Table II

Photodynamic therapy and early detection of malignant tumors – clinical experience and translational efforts

Laser spectroscopy is a valuable tool in oncology. The paramount prognostic factor is early tumor discovery. Many tumors show a cure rate of 90% if detected during the non-invasive stage. Laser-induced fluorescence (LIF) can visualise tumors of only 10-15 cell layers before later stage structural morphological changes appear as LIF monitors bio molecular changes. Photodynamic therapy is a selective modality and in its most simple mode of application, the illumination is directly onto the surface. Thousands of non-pigmented skin malignancies have been treated with very good clinical outcome. To overcome limited penetration due to light attenuation, interstitial delivery (IPDT) with the light transmitted via optical fibers was developed with interactive feedback dosimetry for optimizing. The technique has special interest where there are no other options, such as for recurrent prostate cancer after ionizing radiation. For correct dosimetry it is important to assess the tissue optical properties; this can be done by time resolving propagation techniques. Recently, IPDT with its refined dosimetry is in clinical trials both in Europe and overseas.

Prof. Katarina Svanberg obtained her PhD from Lund University in 1989. Her affiliation is with the Department of Oncology, Lund University Hospital, where she has been active as chief consultant and professor of oncology since more than 25 years. Since 2011, she is also a distinguished professor at the South China Normal University, Guangzhou. Her research interests concern applications of laser spectroscopy to the biomedical and biophotonics fields. She has been involved in the translation of laboratory work all the way out to the patients in different areas, such as in oncology, dermatology, ENT, and neonatology. Her research interest also includes quite diverse areas, such as fighting antibiotic resistance and improving food safety. She received the NIH-Bench-to-Bedside Pioneer Award in 2015 and in 2017 the Gold Medal from the International Society for Optics and Photonics (SPIE) recognizing her clinical work exploring and verifying the efficacy of photodynamic therapy and *in vivo* diagnosis in treating patients.



**Prof. Mark
Hutchinson**

Director
Centre for Nanoscale
BioPhotonics
*The University of
Adelaide, Australia.*

June 19, 2019
15:30 h
Invited talk

June 20, 2019
15:45 h
Round Table

Towards quantification of pain using Light based approaches

The aetiology of persistent pain in humans is comprised of a complex, twisted and multi factorial journey that culminates in a "cancer of the soul". Recent advances in the basic science underpinning our mechanistic understanding of persistent pain have embraced "the other brain" as an integrator of multiple life stimuli. This complex integration of life experiences, which are translated into neurokinin signals cause the neuroimmune cells of the central nervous system to adapt and change the environment in which the neuronal system operates. If these adaptations present in the somatosensory neuroanatomical locations then this can present as hypernociception and eventual persistent pain. Our appreciation for this neuroimmune signalling and its contributions to the health and disease of the brain has its origins in the study of the illness response. It is now apparent that these specialised brain-immune processes are engaged in a range of other disparate responses, including the rewarding properties of drugs of abuse. However, no one has yet visualised the working neuroimmune synapse in a behaving preclinical model. This also means that the molecular origins of pain have yet to be quantified. This presentation will summarise recent studies in this field and equip the attendees with further insights of the complexity and power that visualising and sensing the "other brain" with next generation light science and related technologies can bring to understanding persistent pain and drug responses.

Prof. Hutchinson is the Director of the ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP) and a Professor within the School of Medicine at the University of Adelaide.

Professor Hutchinson's research explores the "other brain" or the other 90% of cells in the brain and spinal cord. These immune-like cells are termed glia. Mark's research has implicated the brain immune-like cells in the action of drugs of dependence and the negative side effects of pain treatments.

He has pioneered research which has led to the discovery of novel drug activity at innate immune receptors. His work has enabled the translation of compounds at the lab bench to clinical agents used at the bedside.

Prof Hutchinson's work with the CNBP is to "Discover new approaches to measure nano-scale dynamic phenomena in living systems" and allow the first minimally invasive realtime visualisations of the "other brain".



Prof. Laura M. Lechuga

Head

Nanobiosensors and Bioanalytical Applications Group
Catalan Institute of Nanoscience and Nanotechnology (ICN2)
CSIC, CIBER-BBN and BIST
Barcelona, Spain

June 19, 2019

16:40 h

Invited Talk

Nano/micro-Biosensors using Light sciences and technologies

The need to detect biological elements, related to human and environment health in a fast and reliable way, is one of the challenges faced by humanity at the dawn of the 21st century. Tests done nowadays in laboratories are slow and expensive. Diagnostics is demanding novel analytical tools that could enable quick, accurate, sensitive, reliable and cost-effective results so that appropriate treatments can be implemented in time, leading to improved outcomes.

Portable point-of care (POC) devices will be a milestone for the achievement of universal healthcare and environmental protection. Photonics based-biosensors are the most suitable candidates to achieve this ambitious objective. They present advantages such as robustness, reliability and low power consumption and are able to operate in real samples at relevant sensitivities.

In this presentation we will review the main photonic biosensors, their biofunctionalization routes and their integration in full-compact lab-on-chip platforms. The crucial aspect of the applicability in real situations will also be discussed.

Prof. Lechuga has been at the forefront at worldwide level in the field of photonic biosensors with a principal focus in the development of novel nanobiosensor devices based on nanoplasmonics and silicon-based photonics principles, including surface biofunctionalization, microfluidics and complete lab-on-a-chip integration for point-of-care applications. Her research activities range from basic research to the demonstration of clinical or environmental applications, as well as their technological transfer to industry.

Her research work is summarised in 250 publications, 8 families of patents and an impressive track record of 360 invited presentations at worldwide level. She has co-founded two spin-offs companies, is Associate Editor of the J. Optics and Laser Technology (Elsevier) and Analyst (RSC) and has received several prizes and recognitions along her career.



Prof. Kishan Dholakia

Director

SUPA
School of Physics & Astronomy, University of St Andrews, Scotland, UK.

June 20, 2019

9:30 h / Invited Talk

Optical Manipulation for Biomedicine

In science fiction, one is quite familiar with the idea of moving objects using laser beams, evoking concepts such as a "tractor beam". In the laboratory science fiction turns into science fact: a powerful technique known as "optical tweezers" (OT) shows that micrometre-sized particles (and even biological material and atoms) can be grabbed, moved and generally manipulated without any physical contact using optical forces. This is a powerful demonstration of the optical dipole or gradient force in action and this approach was recognised in the Nobel Prize in Physics in 2018.

This talk will describe the use of such tweezers for fundamental physics as well as biomedical studies.

Kishan Dholakia is Professor at the University of St Andrews, Scotland and an honorary adjunct Professor at the Centre for Optical Sciences at the University of Arizona, USA and at Chiba University, Japan.

He works on advanced imaging for neuroscience and cancer diagnosis, beam shaping and optical manipulation leading a group of around 20 researchers. He has published over 300 journal papers, has in excess of 26,000 citations. His work is cited in the Guinness book of Records 2015.

He is a Fellow of the Royal Society of Edinburgh, OSA and SPIE. In 2016 he won the R.W. Wood Prize of the Optical Society, in 2017 he won the IOP Thomas Young Medal and Prize and is the 2018 recipient of the SPIE Dennis Gabor Award.



Prof. Walter Margulis

Senior Scientifics at RISE-ACREO; Guest Prof. at KTH Royal Institute of Technology, Stockholm, Sweden

June 20, 2019
10:50 h
Invited Talk

Flow Cytometry using Optical Fibre technologies

Many possibilities are created with the use in life-sciences of fibers with holes. Besides guiding light at various wavelengths with low loss, the fiber holes can be exploited for flowing organic samples for analysis. For example, fibers and capillaries enable counting cells that have been previously stained in portable flow-cytometer instruments that can be used in inhospitable environments.

All-fiber systems can be constructed to trap cells and identify them by their optical signature. Such microstructured fibers can equally be used for sucking cells of interest into the side-holes for further analysis in-vitro and potentially also in-vivo.

Separation of bacteria and the injection of cancer treatment substances are additional uses of fiber systems in life-sciences. Some of these applications will be discussed in this lecture.

Prof. Margulis studied physics and engineering in Rio de Janeiro before earning his PhD in applications of short laser pulses at Imperial College in 1981. He moved to Sweden in 1998 and joined the Institute of Optical Research/Acreo/Research Institutes of Sweden. He is also a guest professor at KTH. His present lines of research are: Fabrication, characterization and applications of fiber components and in particular electrically controlled fiber devices, distributed fiber sensors, photosensitivity, and optofluidics for nonlinear optics and life-sciences.

June 20/ 15:45-17:45 h, Round Table II:

Light in Health and Medicine: Challenges to face

Prof. Katarina Svanberg, Chairperson, Medical Laser Centre, Lund University, Sweden

to include PDT as a current clinical treatment

Prof. Michael Hamblin, Principal Investigator at Wellman Center for Photomedicine and Harvard Medical School, Boston, USA

on LLLT real clinical applications

Prof. Sune Svanberg, Former Director, Lund Laser Center, Lund University, Sweden

In using light based techniques in beating the antibiotic resistance and in food quality monitoring

Prof. Mark Hutchinson, Director, Centre for Nanoscale BioPhotonics, The University of Adelaide, Australia.

on Translational Biophotonics to Quantify Brain Health

Prof. Rober Huber, Head, Biomedical Imaging and Laser Technology Group, University of Lübeck, Germany

the inclusion on OCT clinical applications

Prof. JM López-Higuera, Director ISLIST, Moderator



Prof. Kishan Dholakia

Director SUPA
School of Physics &
Astronomy, University of
St Andrews,
Scotland, UK.

June 21, 2019
9:30 h
Invited Talk

Wider, faster, deeper: new perspectives on imaging at depth

Optical imaging has seen exceptional advances in the last two decades. In this talk I will describe routes for obtaining wide field images that minimise photodamage and enable deeper penetration into tissue.

The particular modes of imaging I will describe are light sheet microscopy using propagation invariant light fields, particularly Airy and Bessel beams. Fibre based studies will also be described.

The other approach involves the use of temporal focusing for multiphoton imaging at depth. This allows recovery of images through scattering media without resort to characterisation of the medium itself.

Kishan Dholakia is Professor at the University of St Andrews, Scotland and an honorary adjunct Professor at the Centre for Optical Sciences at the University of Arizona, USA and at Chiba University, Japan. He works on advanced imaging for neuroscience and cancer diagnosis, beam shaping and optical manipulation leading a group of around 20 researchers. He has published over 300 journal papers, has in excess of 26,000 citations. His work is cited in the Guinness book of Records 2015. He is a Fellow of the Royal Society of Edinburgh, OSA and SPIE. In 2016 he won the R.W. Wood Prize of the Optical Society, in 2017 he won the IOP Thomas Young Medal and Prize and is the 2018 recipient of the SPIE Dennis Gabor Award.



Prof. Robert Huber

Head
Biomedical Imaging and
Laser Technology Group
University of Lübeck,
Germany

June 21, 2019
11:00 h
Invited talk

June 20, 2019
15:30 h
Round table II

Imaging the tissue structure: advances on Optical Coherence Tomography

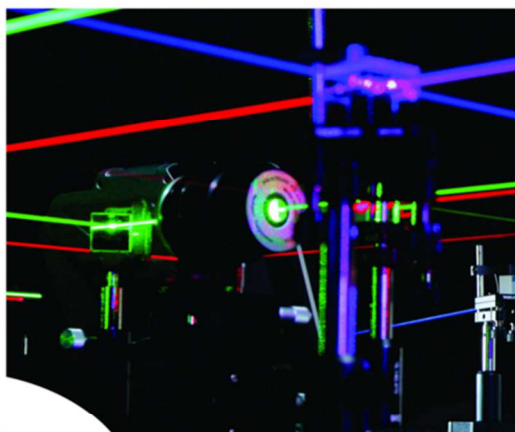
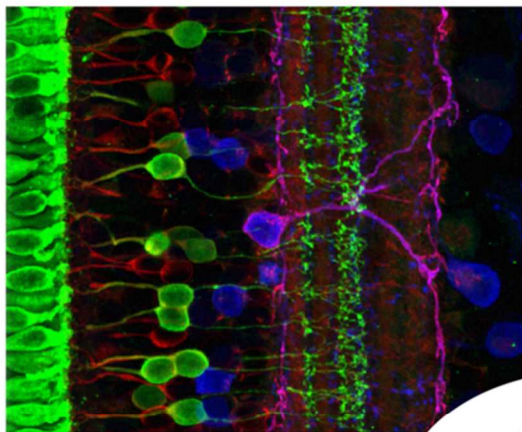
More than 25 years after its invention, OCT has now generated a multi-billion-dollar market with ten thousands of devices deployed worldwide. But also, OCT still is one of the hottest topics in fundamental optics research, covering mature systems for large in-patient studies but also new fundamental optics and photonics approaches for future entirely new generations of OCT systems.

One of the main drivers of these new directions is the ever increasing speed, which makes it now possible to use the full holographic phase information of the back-scattered light field – even in vivo. The recently developed FDML laser was key to the implementation of the first Megahertz-OCT (MHz-OCT) engines which can acquire, process and display more than 4 billion voxel elements per second.

The talk will discuss the physics of FDML, MHz-OCT technology in general and their most recent virtual and augmented reality applications in medicine.

Prof. Huber studied physics at the LMU Munich where he received his PhD in 2002 for work on ultrafast electron transfer processes. After postdoc in Frankfurt he joined James Fujimoto's group at MIT where he started to work on optical coherence tomography. Since 2013 Huber is professor at the Institute of Biomedical Optics at Universität zu Lübeck. His research interest are novel laser sources, 2-photon, stimulated Raman and optical coherence tomography technology. Robert Huber received 2 ERC grants, has co-authored more than 100 peer reviewed publications, holds more than 20 patents and in 2016 he was awarded the title Excellence Chair of the state Schleswig-Holstein. In 2017 he received the European inventor award for contributions to OCT together with Eric Swanson and James Fujimoto.

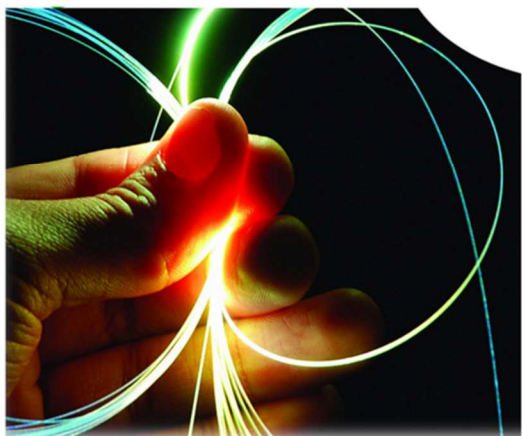
ISLiST / UIMP
Universidad Internacional
Menéndez Pelayo



International
School on

Light

Sciences and
Technologies



NOTEBOOK



June 17 / 11:00 h / **Prof. Ozcan**

Toward a Thinking Microscope: Deep Learning-enabled Computational Microscopy and Sensing

NOTES:



June 17 / 12:10h / **Prof. Marcos**

Light in the Diagnostics and Therapy of the Vision human system

NOTES:



June 17 / 15:30 h / **Prof. López-Higuera**

Light on Sources, Health and Medicine

NOTES:



June 17 / 16:40 h / **Dr. Denneman**

"Light, you need it!!".

Semiconductor LED and Intelligent Lighting sources: Recent advances and their impact on mood and health

NOTES:



June 18 / 9:30 h / **Prof. Strickland**

From nonlinear Optics to High-Intensity Laser Physics.

NOTES



June 18 / 11:00 h / **Prof. Taylor**

Fiber based light Sources: from the UV to the mid infrared.

NOTES:



June 18/ 12:10 h / **Prof. Roso**

Petawatt lasers and their applications on Medicine

NOTES:

June 18/15:30 h / Round Table I:

Light on Sources: Challenges to face



NOTES:



June 19 / 9:30 h / **Prof. Sune Svanberg**

Fighting antibiotic resistance and improving food safety using light based techniques

NOTES:



June 19 / 11:00 h / **Prof. Hamblin**

The healing power of photobiomodulation or low-level light therapy

NOTES:



June 19/ 12:10 h / **Prof. Katarina Svanberg**

**Photodynamic therapy and early detection of malignant tumors –
clinical experience and translational efforts**

NOTES:



June 19 / 15:30 h / **Prof. Hutchinson**

Towards quantification of pain using Light based approaches

NOTES:



June 19 / 16:40 h / **Prof. Lechuga**

Nano/micro-Biosensors using Light sciences and technologies

NOTES:



June 20 /9:30 h / **Prof. Dholakia**

Optical Manipulation for Biomedicine

NOTES:



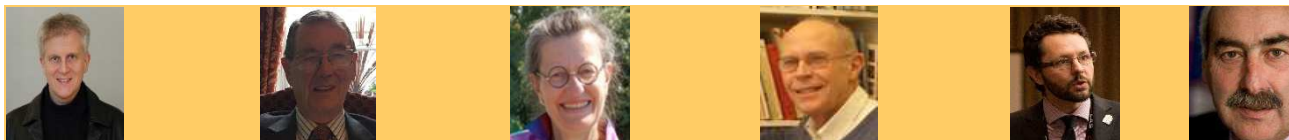
June 20 / 10:50 h / **Prof. Margulis**

Flow Cytometry using Optical Fibre technologies

NOTES:

June 20/15:45 h / Round Table II:

Light on Health and Medicine: Challenges to face



NOTES:



June 21 /9:30 h / **Prof. Dholakia**

Wider, faster, deeper: new perspectives on imaging at depth

NOTES:



June 21 / 11:00 h / **Prof. Huber**

**Imaging the tissue structure: advances on Optical Coherence
Tomography**

NOTES: