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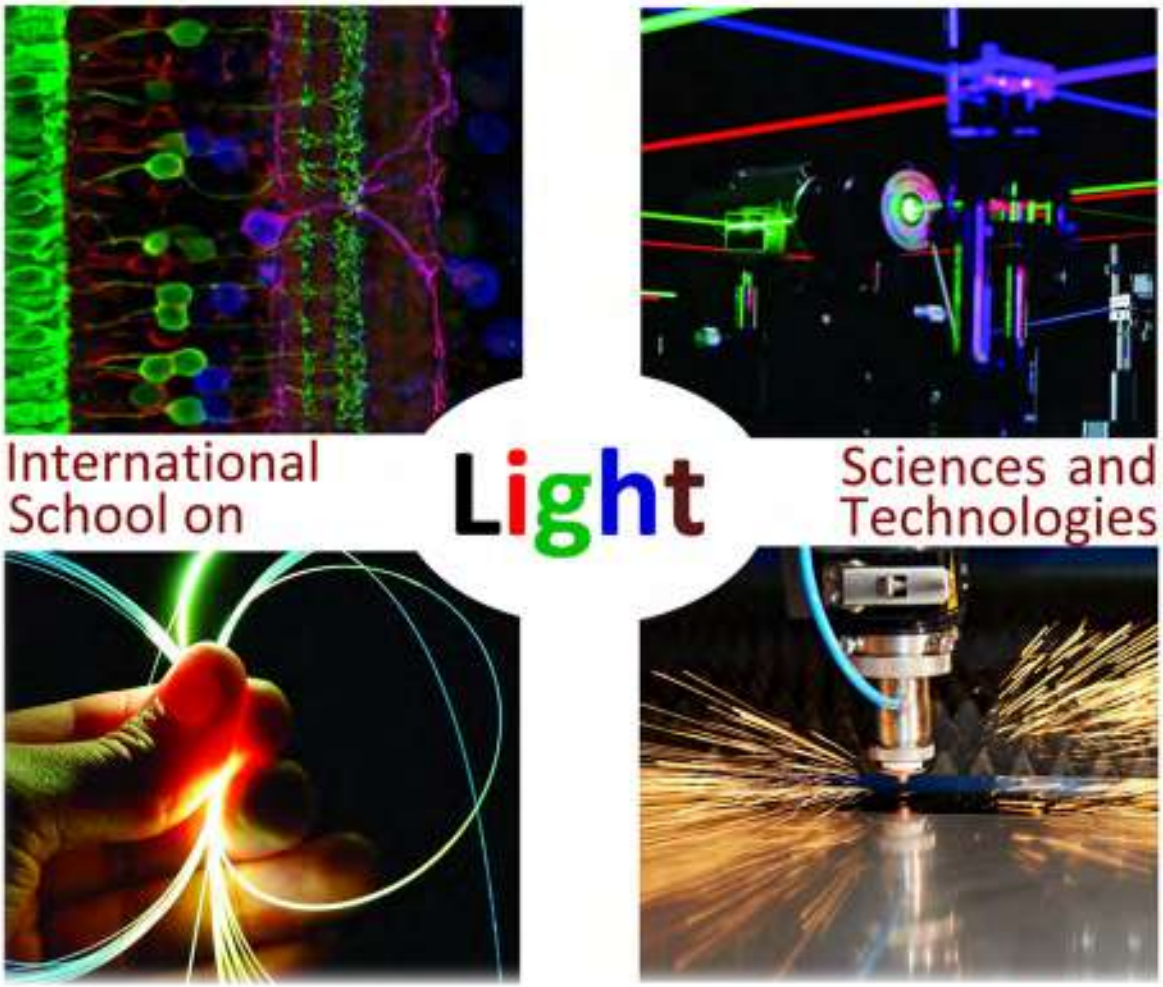

Core: Light in Health and Medicine

Santander 19-23 de junio de 2023
(Sala Riancho, Palacio de la Magdalena, Santander)

Final Report

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June 19-23, 2023, Santander, Spain

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1. Executive Summary

This International School has been conceived as an excellent opportunity to review, update 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 common citizens. It is also a great opportunity to ensure that legislators, entrepreneurs, and other key "actors" will be aware of the problem-solving potential of Photonics.

ISLIST is envisioned to be a worldwide top International forum on *Light Sciences and Technologies* in the framework of a *"special university" recognized as the "university of universities". It runs* (the third or fourth week of June every year) 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 Health and Medicine*** was the core of this 2023 edition.

Seventy-nine (79) attendees from 20 nationalities and from more than 25 different institutions gathered during the week of June 19 to 23, 2023, in Santander, Spain to receive the knowledge and experience from 17 of the most reputable professors and professionals of the academic and research institutions and companies of 7 diferent nationalities.

Figure 1.- General View of the Royal Palace of the Magdalena, venue of ISLIST.

The ISLIST participants had the privilege of receiving the teachings and experience of researchers of the stature of professors Aydogan Ozcan, Mariana G. Figueiro, Michael Schmitt, Pablo Artal, Susana Marcos, Kishan Dholakia, Paola Taroni, Laura Lechuga, Turgut Durduran, Tayyaba Hassan, Carlos Molpeceres, Mark Rea and JM López-Higuera. They also received the expertise of reputable professionals and researchers (all Drs) such as Angelos Karlas, Valentina Emiliani, Alessandro Corsi and Alexis Mendez. Hot topics in the use of light sciences and technologies in Health and Medicine were presented and discussed for the 17 one-hour lectures and two round tables that focused on the search for challenges pending both in light diagnosis (round table I) and in the use of light in treatments and tools (round table II).

Sponsored by the Santander Council (Ayuntamiento de Santander), the ISLIST attendees enjoyed the Santander Council Reception, a great opportunity to share experiences and an optimum occasion for networking in an incredible landmark enjoying “tapas” and Drinks.

To achieve this ambitious 2023 program, the Government of Cantabria has sponsored this International School of UIMP. VI-ISLIST has also been supported (as Gold collaborators) by two of the more reputed international scientific societies, such as SPIE and OPTICA (formerly OSA). It was also supported by companies and professional organizations such as Prysmian (Gold), Fyla Lasers (Silver), Ambar Telecommunication (Silver), OZ Optics (Bronze). ERZIA (Bronze), Semicrol (Bronze), Lasing (Bronze), Colegio Oficial de Médicos de Cantabria (Bronze) Santander City Council (Bronze), Hotel Santemar and Photonics Engineering Group of UC, CIBER-BBN and IDIVAL. Without these sponsors and collaborators, this top-quality school and the grants for international students would not have been possible. The UIMP, the direction of this event, and the scientific community using light are grateful for the generosity of all these organizations and all the Invited Speakers. **Thank you so much!**

At the end of the closing ceremony, the next edition of this international school was announced. The seventh edition of ISLIST (June 17-21, 2024) will have the core on **Light Communications, Sensing and Lighting.**

Santander, November 15, 2023.

Prof. José Miguel López-Higuera
Director ISLIST at UIMP

2.- VI-ISLIST: A Successful and truly International School

ISLIST at UIMP has been acknowledged as a high standard international meeting by the invited scientists, professionals, and attendees. It has been considered an edition with an excellent organization, where high-quality services were offered, cutting-edge ideas and technologies were presented and discussed, and where networking and interchange of experiences were also successfully carried out (see satisfaction survey).

The participants of this edition of the ISLIST at UIMP in Santander, Spain, enjoyed the Sixteen (17) invited talks and two round tables by highly renowned professors and researchers from the most prestigious worldwide institutions of Europe and USA. The hot topic of *Light in Health and Medicine* was the core of this 2023 edition.

Figure 2. Family photo of the ISLIST-2023 participants. It was taken just before the Santander Council reception. Around, Invited Speakers and organizers. Courtesy of Photonics Engineering Group (CPEG).

2.1 ISLIST 2023: Some data

Seventy-nine (79) attendees from 20 different nationalities (over 25 different institutions) participated in this meeting. As shown in the geographical breakdown in Figure 3, the participants came from Spain (more than 45), Italy, Morocco, UK, India, Nigeria, Russia, France, Cuba, Lithuania, Mexico, Ukraine, Ecuador and Romania.

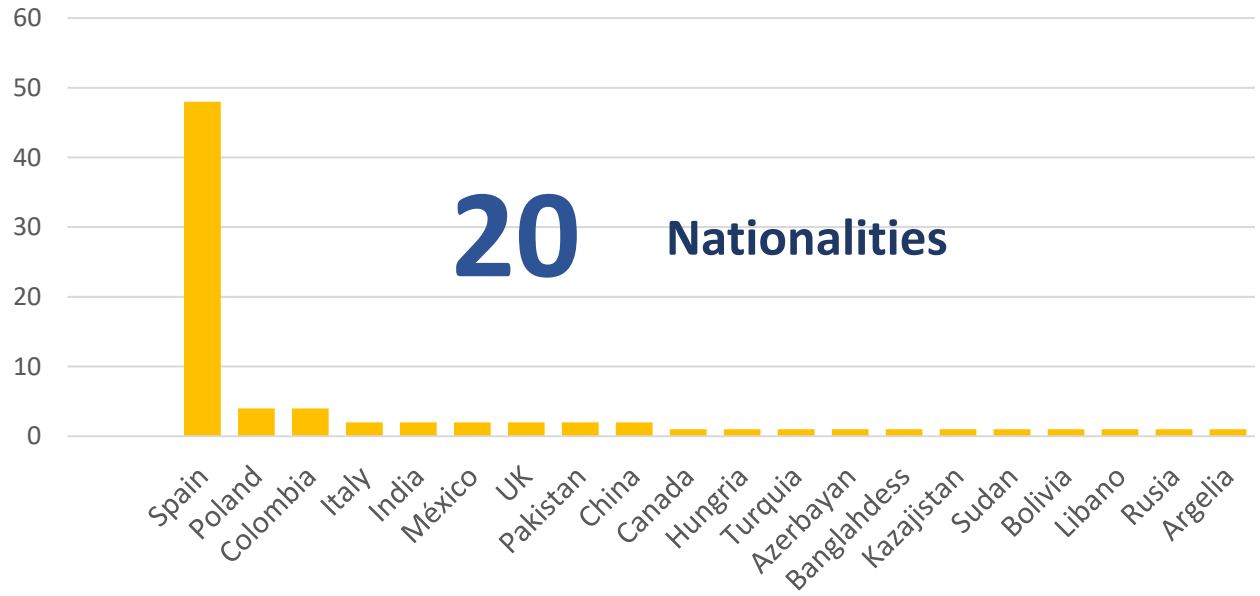


Figure 3.- ISLIST attendees by countries from Europe, Asia, America and Africa.

Seventy-nine per cent (79%), sixteenth (16%) and fifth (5%) of participants were from education institutions (universities), R&D centers and companies, respectively.

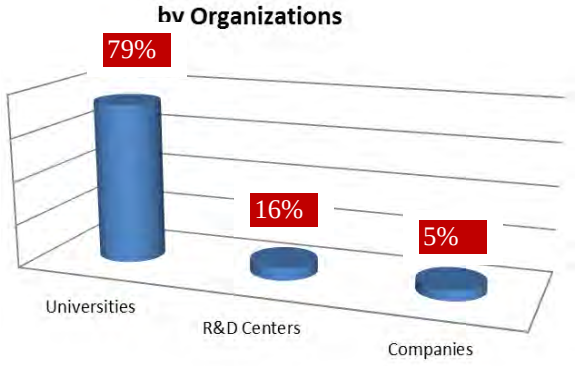


Figure 4.-Attendees by Organizations.

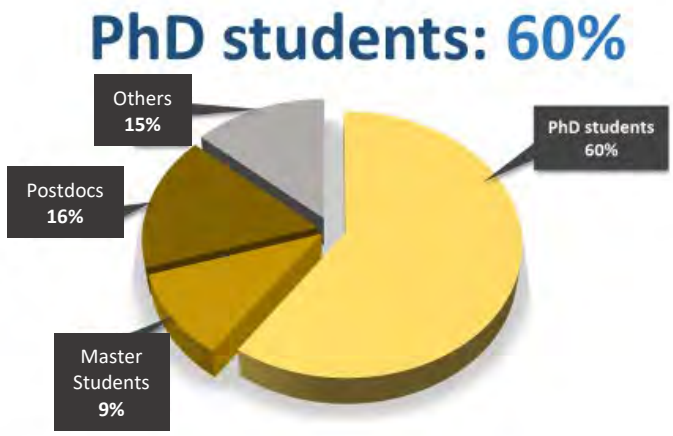


Figure 5.-ISLIST attendees by education.

Regarding the previously mentioned students, 60% were PhD students, 16% were PhD (Dr), 9% were Master Students (figure 5).

In terms of the participant age, 75% of the attendees were in the range from 20 to 30 years, which is in correlation with the education period working towards PhD degrees and also in post-docs. This fact suggests the excellent acceptance of this top-quality school and its positive potential impact on the education of outstanding researchers and professionals in the early stages of their careers. This fact will be a key issue for our globalised world's near future in which this key technology (Photonics) will play as relevant as Electronics played in the last XX Century. 19% of the attendees ranged from 26 to 30, 11% from 31 to 40, and 12% were attendees more than 41 years old, respectively. Only 2% of the attendees were less than 21 years old.

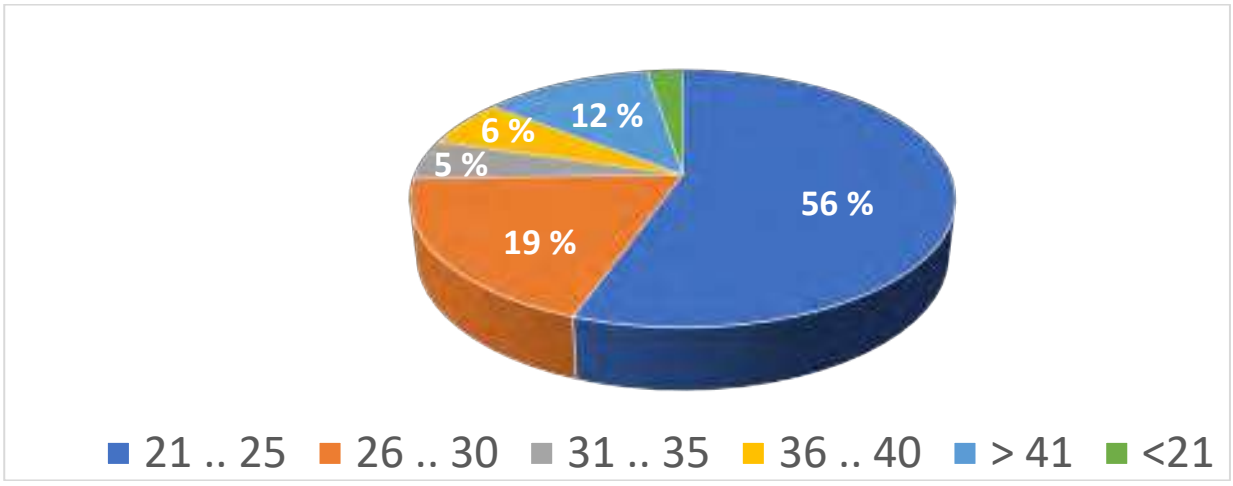


Figure 6.-ISLIST attendees by age.

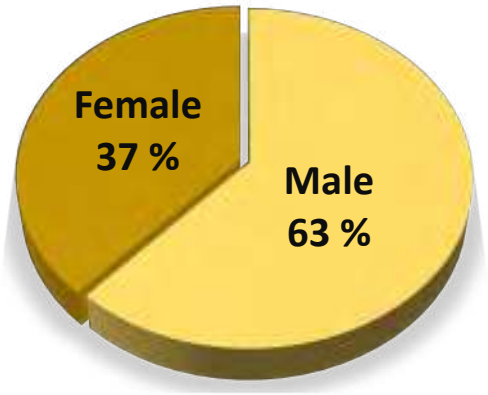


Figure 7.- ISLIST attendees by gender

Analyzing the gender distribution, 63% of the attendees were men and 37% were women, which is in correlation with the 2019 edition, in comparison with the gender distribution of the previous ISLIST editions [2017 (74% attendees were men and 26% women) and ISLIST 2018 (67% attendees were men and 33% women)] represents a small decrease of the gender gap. This also correlates with the actual situation in many countries in technical and scientific jobs. Considering the number of women as students in grade levels of the current education institutions, these numbers will progressively change towards a more homogeneous distribution without the need for any specific policy, just fighting against any discrimination. In any case, what really will help to decrease this gap are policies facilitating the familiar real conciliation lives of the families with very special emphasis on the youngest.

For Spanish Students or Students of any nationality but working/studying in Spanish institutions, UIMP offers grants with funds provided by the Spanish State. However, UIMP is not able to offer grants to any other international students. Thanks to the sponsors and collaborators, VI-ISLIST was able to offer 29 full grants for **international** students from non-Spanish institutions. A call for applications was opened for two kinds of student grants: i) Registration Grants or ii) Full Grants that cover course registration, accommodation and living expenses. http://www.teisa.unican.es/ISLiST/index.php/grants

A total of 64 grants were allocated (23 funded by the Spanish state and 41 with funds from the collaborators). 47 were complete grants (29 for international students), and 17 covered the school registration fee.

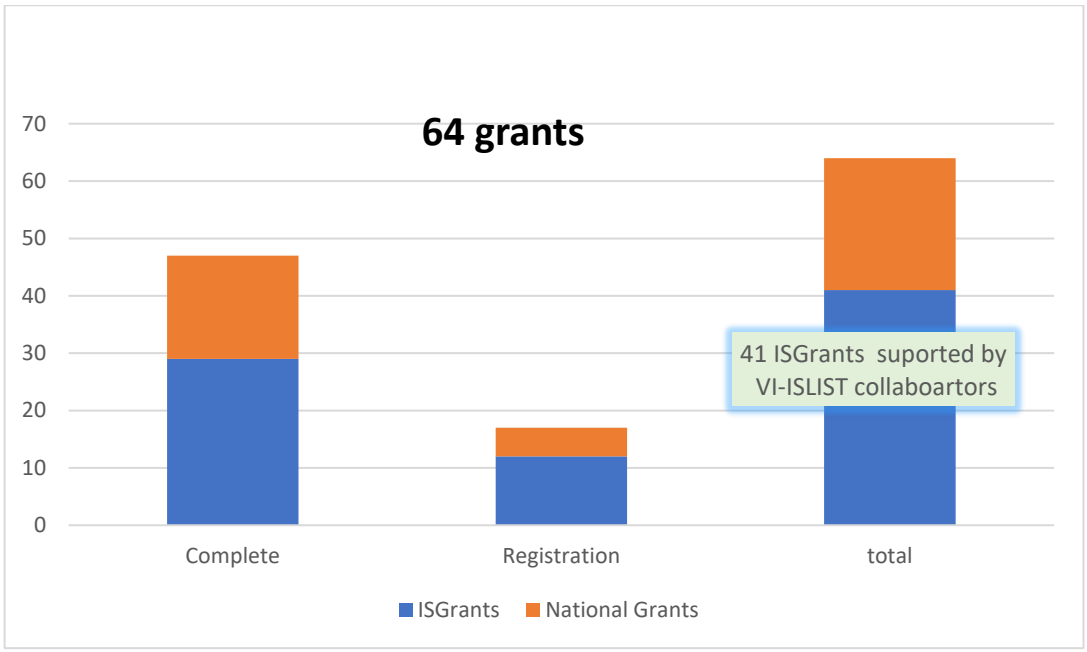


Figure 8.-ISLIST Student Grants distribution.

The International School on Light Sciences and Technologies (ISLIST) at the Menéndez Pelayo International University (UIMP), Spain, has consolidated as an international reference at the highest scientific and technical level.

It is confirmed by the fact that the highest quality lectures of the best experts of the most renowned institutions and organizations in the world in the use of Light Sciences and Technologies in Sources, in Health and Medicine, together with the numerous and high qualifications of international participants. In this regard, as it happened in the previous editions of ISLIST, the offer of scholarships to international students (from any institution around the world) has significantly contributed to the achievement of the recognition of ISLIST as a top international forum, what is "inscribed in the genes" of this very special **University of Universities** (the International University Menendez Pelayo, UIMP).

3.- PROGRAM AND ITS DEVELOPMENT

The School Programme was designed and published on the meeting website. The program and notebook were available for all the ISLIST participants:
CompleteProgram-English-VI-ISLIST-UIMP-FINAL 2023 C.pdf (unican.es)

3.1 The General Schedule **of VI-ISLIST (2023 edition)** was programmed and developed as shown in Figure 9.

International School on Light Sciences and Technologies (ISLiST)

June 19-23, 2023, Santander, Spain

Core: ***Light in Health and Medicine***

General Schedule

Time	Monday 19th	Tuesday 20th	Wednesday 21st	Thursday 22nd	Friday 23rd
9:30		Dr. **Angelos Karlas** Group Leader, Institute for Biological and Medical Imaging at the Helmholtz Zentrum München, Munich, Germany Listening to Light: Advances in Optoacoustic Imaging	Prof. **Kishan Dholakia** Director, Centre of Light for life and School of Biological Sciences, University of Adelaide, Australia Optical tweezers: Trapping and Manipulation for biomedical applications	Dr. **Alexis Méndez** President, MCH Engineering, Alameda, CA, USA Optical Fiber Technology on Biomedical Applications	Prof. **Carlos Molpeceres** Director, Laser Center, Polytechnic University of Madrid, Spain Laser fabrication technologies helping the regenerative medicine
10:15	**Opening Remarks**				
10:40	**Coffee Break**	**Coffee Break**	**Coffee Break**	**Coffee Break**	**Coffee Break**
11:00	Prof. **Aydogan Ozcan** / **Opening talk** Director, Bio&Nano Photonics Laboratory, University of California, Los Angeles, USA Deep- learning enabled computational microscopy and diffractive imaging	Prof. **Mariana G. Figueiro** Director, Light and Health Research Center (LHRC), Icahn School of Medicine, Mount Sinai, NY, USA Light's effects on human health, well-being, and behaviour	Prof. **Paola Taroni** Head, Photonics for health, Food and Cultural Heritage, Politecnico di Milano, Milano, Italy Optical Diffuse Systems for effective Management of breast cancer	Prof. **Tayyaba Hasan** Harvard Medical School and MIT, Wellman Center for Photomedicine, Boston, USA Light to fight cancer and infectious diseases: The Yin and Yang of the PDT	Prof. **Mark Rea** /closing talk Icahn School of Medicine, at Mount of Sinai, New York NY, USA Bridging the science of Circardian Rhythms to real-world applications
12:10	Prof. **JM López-Higuera** Head, Photonic Engineering Group, University of Cantabria, Ciber-BBN and IDIVAL, Spain Light in Health and Medicine: an introduction	Prof. **Michael Schmitt** Institute of Photonic Technology - Jena, Germany Raman based Spectroscopic techniques for Biomedical diagnosis life Sciences	Prof. **Laura Lechuga** Head, Nanobiosensors and Biomedical Applications Group, ICN2, CSIC, CIBER-BBN and BIST, Barcelona, Spain Bio-Photonic Sensors after the COVID-19 pandemic	Dr. **Alessandro Corsi** Director, Simple Vulnology Unit at the IRCCS, San Raffaele Hospital, Milano, Italy Photo-biomodulation for effective treatment of skin lesions	**12:30 Closing Remarks, ISLIST-2024 Announcement and Diploma Delivery**
13:30-15:0	**Lunch**	**Lunch**	**Lunch**	**Lunch**	
15:30	**Round Table I / Challenges to face on light in diagnostics** Aydogan Ozcan, Challenges in bio-wearable devices based on smartphone platforms Angelos Karlas, Challenges to focus on Optoacoustic Imaging in Pharmacology Marina G. Figueiro, Challenges on Science to improve the way of older adults Pablo Artal, light-based techniques to reach very efficient, efficient and precise diagnosis of human vision Moderator: **JM López-Higuera**	Prof. **Pablo Artal** Director, Laboratorio de Optica, University of Murcia, Murcia, Spain Light based techniques to evaluate vision	Dra. **Valentina Emiliani** Director of Photonics Department, Head of WFEMO, CNRS Vision Institute, Paris, France All-optical control of neuronal circuits by wave front shaping and optogenetics	**Round Table II /Challenges on light based treatments and tools** Susana Marcos, challenges and results on light and AM based bioprinting in ocular regeneration (3M-Eye project) Carlos Molpeceres, current challenges in regenerative medicine Valentina Emiliani, optics for humans: brain Tayyaba Hasan, on PDT translation to Clinic Mark Rea, Bridging the science of Circadian Rhythms to real -world applications Moderator: **JM López-Higuera**	
16:40		Prof. **Susana Marcos** D. R. W. Director, Center for Visual Science, The Institute of Optics, University of Rochester, NY, USA Light based technologies for vision correction	Prof. **Turgut Durduran** Head, Medical Optics Group, Instituto de Ciencias Fotónicas, ICFO, Barcelona, Spain Noninvasive measurement of deep tissue hemodynamics and oxygen metabolism at the intensive care		
17:55			**Family Photo** **Santander City Council Reception**		

Figure 9.-ISLIST-2023 General Schedule.

The **ISLIST-2023 Speakers** are also shown in figure 10.

Figure 10.-ISLIST-2023 Speakers (by apparition order).

3.2 Invited Talks and Round Tables in the frame of ISLIST-2023

After the Opening Ceremony, from June 19 to June 23, 2023, 17 invited talks and two Round Tables were developed. All photos used in this report are courtesy of the Photonics Engineering Group of the University of Cantabria.

Prof. Aydogan Ozcan (Chancellor's Professor and Volgenau Chair of Engineering Innovation at the University of California, Los Angeles, UCLA; Professor at the Howard Hughes Medical Institute, HHMI, and also Associate Director of the California NanoSystems Institute), after a brief introduction to the institutions with which he is affiliated, he discussed diffractive optical networks

Figure 11,12&13.- Prof. López-Higuera (director of ISLIST) introducing the invited opening speaker and two moments of Prof. Ozcan (right) during the development of his invited opening talk.

designed using deep learning for the all-optical implementation of various complex functions as input light diffracted through spatially designed surfaces. He mentioned that this type of diffractive processors can be used in relevant applications such as all-optical image analysis, feature detection, object classification, computational imaging and seeing-through diffusers, also enabling task-specific camera designs and new optical components for spatial, spectral and temporal beam shaping and spatially-controlled wavelength division multiplexing.

Professor Ozcan insisted that these diffractive systems designed with deep learning can have a broad impact in three main areas: all-optical statistical inference engines, camera and computational microscope designs and inverse design of task-specific optical systems.

In his outstanding and useful opening invited lecture, Professor Ozcan presented significant examples from each area, enabling transformative capabilities for various applications of interest, such as autonomous systems, defense/security, telecommunications, biomedical imaging and sensors.

Prof. **López-Higuera** first emphasized the relevance of Light Sciences and Technologies (Photonics) by recalling to the attendees the un-paramount number of awardees with the Nobel Prize recognizing relevant works based on light approaches for the advancement of humans over the past 10 years.

Figure 14&15. Prof. Quintela (talk moderator) introducing the speaker and Prof. Lopez-Higuera (Head of the Photonic Engineering Group of University of Cantabria, CIBER-BBN and IDIVAL, Spain) during his lecture.

He spoke about what should be understood as Light Sciences and Technologies (Photonics) and also remarked on the fact that Photonics is considered a Key Enabling Technology (KET) or an Essential Technology for the development of Europe, the USA and other main nations around the world. Then, very briefly, they summarized some key properties of Light and reviewed some key doctrinal conceptions to understand the use of light approaches in health and medicine. To remark on the key role of Light in Health and Medicine Prof. López Higuera carried out a "flight" over several significant examples of light-based approaches to human mood, adjusting the circadian cycle, in general, human health, in the generation of D vitamin, in diagnosis, treatments, trapping, in devices and tools for regenerative medicine, among others. He concluded his talk by summarising the main relevant conclusions concerning the use of Light sciences and technologies in Health and Medicine.

During the Round Table I on **Challenges to face on Light in Diagnosis and Healthy lives**, the attendees and the invitees enjoyed a very interesting round table with very active participations from both sides. After the moderator's presentation, each invited panellist presented a brief statement on their previously allocated topics.

Figure 16.- Round Table I: Challenges on Light in Diagnosis and Healthy lives. *From left to right hand: Dr. Angelos Karlas, Prof. Mariana Figueiro, Prof. Aydogan Ozcan, Prof. Pablo Artal and JM López-Higuera.*

The topics on Challenges to face on*: wearables devices based on Smartphone platforms* (**Aydogan Ozcan,** UCLA), *lighting to improve the way of older adults* (**Mariana Figueiro,** Director, Light and Research Center (LHRC) Icahn School of Medicine, Mount Sinai, USA)**,** *Optoacoustic Imaging in Pharmacology* (**Angelos Karlas**, Group Leader, Institute for Biological and Medical Imaging at the Helmholtz Zentrum München, Germany) and *light-based techniques to reach very effective, efficient and socialized diagnosis of humans´ vision by (***Pablo Artal***,* **Director,** Laboratorio de Óptica, **University of Murcia**, Spain) were, opportunely presented and discussed by each of the panellists.

Then, each panel member took the opportunity to debate different aspects among the panelists. After that, attendees asked different questions in an open and fully free environment, and an exciting debate took place inside the room. Numerous interactions were carried out among the panellists and the attendees, and discussions from both sides also took place. After two and a half hours, the round table concluded with several open questions anda half hours, the round table concluded with several open questions and very interesting conclusions and statements.

Figure 17.- The panelists (around) and the coordinator (middle) during a moment of their interventions in the round table I.

Dr. **Karlas** (Group Leader, Institute for Biological and Medical Imaging at the Helmholtz Zentrum München, Germany) developed the invited lecture on Listening to Light: Advances in Optoacoustic Imaging**.** He started with a brief statement about the tremendous impact of technological advancements to collect and analyse data from cells and tissues, and on generating biomedical knowledge at rates never before attainable to science.

Figure 18&19. Dr. Karlas in a moment during the development of his invited talk and also hearing one of very interesting questions from the participants.

However, converting this knowledge to patient benefits remains a slow process, he remarked. Then, he mentioned that to accelerate the process of reaching real healthcare solutions, it isessential to complement this culture of discovery with a culture of problem-solving. Then, he went into the core of his brilliant lecture by focusing on advances in optical and optoacoustic technologies from the perspective of problem-solving, particularly in early disease detection and monitoring. He concluded that new classes of imaging systems and sensors can play a critical role in the frequent assessment of biochemical and pathophysiological parameters of systemic diseases, complement knowledge from –omic analytics and drive integrated solutions for improving healthcare.

Figure 20&21. Two moments of Prof. Figueiro invited lecture.

Prof. **Mariana Figueiro** (Director of Light and Health Research Centre, Mount Sinai, NY, USA) spoke about light's effects on human health, well-being, and behaviour**.** She mentioned that every living being experiences internal biological cycles that repeat daily. She added that in humans, these cycles (known as circadian rhythms) regulate all metabolic, physiological, psychological, and behavioural processes, such as sleeping and waking, hormone production, and body temperature, among many others. Prof. Figueiro added that research shows that the daily pattern of light and dark incidents on the retinas sets the timing for many circadian rhythms, synchronizing human´s master biological clock with the 24-hour solar cycle at our place and time on Earth. Asynchrony between our circadian rhythms and local time, however, as might occur between our preferred sleep patterns and work schedules or air travel across several time zones, can lead to social, behavioural, and metabolic health problems such as diabetes, obesity, cardiovascular disease, and cancer, among others.

Prof. Figueiro summarised her astonishing invited talk by mentioning that experimental both in the lab and the field demonstrated that lighting interventions can help remedy the circadian disruption ,reduce health risks, and have an acute alerting effect on humans.

*Figure 22&23.- Prof. **Schmitt** in two instants of his Invited lecture.*

Prof. **Michael Schmitt** (Group Leader of the Institute of Photonic Technology, Friedrich-Schiller University, Jena, Germany), spoke about Raman-based Spectroscopic techniques for Biomedical diagnosis in Life Sciences. He stated that Raman-based technologies have greatly impacted life sciences and biomedical research and complement established analytical approaches like fluorescence.

He remembered that while the advantages of Raman spectroscopy are its unprecedentedly high molecular specificity and versatility, it suffers from its poor sensitivity. However, this disadvantage can be overcome by utilizing special Raman signal enhancing techniques (amplification) such as resonance Raman spectroscopy or coherent anti-Stokes Raman scattering (CARS). Then, he highlighted the great potential of linear and nonlinear Raman approaches for biological and biomedical analysis. Prof. Schmitt added that Raman spectroscopy allows for a label free characterization of various biological samples ranging from prokaryotic and eukaryotic cells, fungi, and biofilms via tissue sections towards whole organs. He concluded his impressive invited talk with significant examples about microbial analysis, intraoperative tumour characterization and the Raman spectroscopic visualization of metabolic, defense or chemical communication processes.

Figures 24&25.- Prof. ***Artal*** *in two moments of his invited* talk.

Prof. Artal (Director of Optical Laboratory, Optical and Nanophysics Research Centre, Universidad de Murcia, Spain) focused on Light-based technologies to evaluate vision.

He started his presentation by speaking about the human eye and some of its relevant optical properties to enable the school participants to understand how it works and can be checked. Then, he progressed in his presentation, sharing with the audience that new light-based technologies to evaluate and improve vision are very welcome. After that, Prof. Artal revised different experiments in his laboratory and/or in collaboration with others to evaluate how different types of optical corrections affect vision. The mentioned experiments were mainly based on adaptative optics.

In the final part of his fantastic talk, his very friendly presentation focused on the discussion of novel approaches to evaluate the effect of scattering in the eye and the use of pulsed invisible infrared lasers to produce vision through two-photon absorption photonic techniques.

Figure 26&27. Prof. Marcos in two moments during her invited lecture development.

-based techniques for human vision correction were addressed by **Professor Susana Marcos** (David R Williams Director of Center for Visual Science, Nicholas George Professor of Optics. Professor of Ophthalmology. Flaum Eye Institute University of Rochester, NY, USA)**.** During her invited talk, she reviewed why Light-based technologies are at the core of diagnostics and treatments for ophthalmology. She added that laser refractive surgery had been one of the most successful applications of lasers in medicine. Then she mentioned that the most common surgical procedure in the world (cataract surgery, 28 million/year) has also recently started using laser technologies. Eye procedures are increasingly image-guided, with optical technologies critical for treatment customization.

Along the lecture, Prof. Marcos presented novel vision photo-activated correction alternatives to where their lab has contributed, including corneal photo-crosslinking for corneal tissue stiffening, photobonding-enabled accommodating intraocular lenses for accommodation restoration in presbyopia, and laser-induced refractive changes contact lens customization. Then, she stressed that the key information for optimizing the mentioned procedures is provided by all light-based techniques such as Optical Coherence Tomography, Second Harmonic Generation Microscopy, Optical Coherent Elastography and aberrometry. She concluded her very didactic lecture emphasizing the key role that light-based technologies play in eye treatments or therapies.

Figure 28, 29&30.- Prof. Dholakia during his presentation by the director of the ISLIST, in a moment of his lecture and during the questions time after his online invited talk.

Prof**. Kishan Dholakia** (Director of Centre of Light for Life and School of Biological Sciences, University of Adelaide, Australia) spoke (online) about trapping and manipulation for biomedical applications or what can be summarized as Optical Tweezers.

Prof. **Dholakia** started his presentation by mentioning the incredible potential of Light, arguing that in addition to its exquisite use in areas such as imaging and sensing, light can exert miniscule forces in the form of optical tweezers area, which was recognised by the Nobel Prize Committee in 2018, awarding half of the prize for that year to Arthur Ashkin. He added that such optical tweezers are ideal for probing and measuring at the cellular or molecular level. Then, he went into the core of his invited presentation, describing the main background and fundaments concerning the mentioned area and the importance of advanced photonics topics such as beam shaping and near-field effects to the field. Then, significant examples were presented by Prof. Dholakia showing how optical tweezers are used for both in vitro and in vivo studies in single molecule biophysics, micro-rheology and intact behaving animals.

Prof**. Paola Taroni** (Head of the research group on Photonics for Health, Food and Cultural Heritage, Physics Department, Politecnico di Milano, Milan, Italy) developed her invited lecture on diffuse optics Systems for effective Management of Breast Cancer.

She introduced the physical principles of diffuse optics playing special attention to its time domain implementation for the highest informative content. She emphasized that diffuse optics is currently used for the non-invasive in-depth optical characterization of

*Figure 31&32. Prof. Taroni (*Politecnico di Milano, Milan, Italy*) during a moment concerning de development of her invited talk and other, hearing a question from an attendee.*

highly diffusive media, such as biological tissues. Then, she added that diffuse optical spectroscopy allows the non-invasive estimation of tissue composition (water, lipid, and collagen content) and functional blood parameters and provides information about the microscopic tissue structure.

Prof. Taroni, then highlighted the potential of the technique by describing its implementation and use for the management of breast cancer. Specifically, on non-invasive diagnosis, monitoring and prediction of neoadjuvant chemotherapy, and on the estimation of cancer risk due to breast density, she concluded.

Figures 33&34. Prof. Lechuga hearing her introduction by the talk´ chair and during a moment concerning de development of her invited talk.

Prof. **Laura M. Lechuga** (Head of Nanobiosensors and Bioanalitical Applications Group, Catalan Institute of Nanoscience and Nanotechnology, ICN2, CSIC, CIBER-BBN and BIST Barcelona, Spain) recalled ISLIST´s attendees that COVID-19 pandemics had evidenced the urgent need of having portable diagnostic tools that enable rapid testing and screening of the population with sensitivity and specificity levels comparable to lab techniques. She added that Biosensor technology is one of the best prepared to tackle the challenging goal of offering fast and user-friendly diagnostics tests that can be employed at the point of need. Then, she highlighted that photonic biosensors have the potential to provide sensitive, reliable and selective analysis while reducing test and therapeutic turnaround times, decreasing and/or eliminating sample transport, and using low sample volume.

Then Prof. Lechuga went into the main core of her lecture, showing several cutting-edge nanophotonic biosensors based on Nanoplasmonics and in Silicon photonics technologies that enable an ultrasensitive analysis of body fluids in a few minutes, all demonstrated in her laboratory. She added that by customizing the biochemistry of the sensor biochips, their POC nanophotonic biosensor technology can perform direct detection of proteins, genetic biomarkers or pathogens within <15 min; She added that with high sensitivity and selectivity, the biochemistry of the sensor biochips, their POC nanophotonic biosensor technology can perform direct detection of proteins, genetic biomarkers or pathogens, with high sensitivity and selectivity, she concluded.

Figures 35&36. Dra. Emiliani during two moments of her Invited talk.

Dra. **Valentina Emiliani** (Director of Photonics Department, Head of WFEMO, CNRS Vision Institute, Paris, France) developed her lecture on *All-optical control of neuronal circuits by wavefront shaping and optogenetics.*

She reviewed the most significant breakthroughs of the past years, which enable reading and writing neuronal activity at the relevant spatiotemporal scale for brain circuit manipulation. Dra. Emiliani emphasized the most recent advances in what is currently named *circuit optogenetics* or a combination of wavefront shaping approaches, including holographic light illumination and temporal focusing, with opsins engineering and laser development enabling the control of single or multiple targets independently in space and time with single-neuron and single-spike precision, at large depths. She explained that genetic targeting of neuronal cells with activity reporters (calcium or voltage indicators) and actuators had initiated the paradigmatic transition whereby photons have replaced electrons for reading and manipulating the neuronal activity of genetically identified cell populations. She mentioned that These progresses have stimulated the development of sophisticated optical methods to enable “all optical” in-depth brain circuits interrogation with high spatial and temporal resolution on large volumes.

Dra. Emiliani concluded her excellent invited talk with several examples where *circuits optogeentics* had been applied for the interrogation of mice's retina and cortical circuits.

Figures 37&38.- Prof. Durduran in two instants along his invited lecture.

Prof. Turgut Durduran (*Head Medical Group, ICFO, Barcelona, Spain*) presented and discussed the fascinating topic concerning the non-invasive measurements of deep tissue hemodynamics and oxygen metabolism at the intensive care.

Prof. Durduran, who delivered his lecture sitting due to health problem in his knee, started with a very didactic, illustrative and interesting introduction concerning the physical and technological background of using near-infrared diffuse light to measure deep tissue (~1 cm) hemodynamics and oxygen metabolism. Then he correlated them to the context of intensive care medicine and the ongoing efforts triggered by the COVID-19 pandemic. The clinical studies have revealed the ability of these methods to detect microvascular and endothelial dysfunction at the bedside, he added. Then he concluded his outstanding lecture by showing the platform developed during the VASCOVID project, a user-friendly, portable system for several clinical applications.

Figures 39&40. Dr. Mendez during two moments along his invited lecture.

Dr. Alexis Méndez (*President of MCH Engineering LLC, Alameda, California, USA) spoke about* Optical Fiber technology in Biomedical Applications.

Dr. Méndez emphasized that due to Optical fibers´s EM immunity, intrinsic safety, small size and lightweight, autoclave compatibility, and ability to perform multi-point and multi-parameter sensing remotely, optical fiber technologies are seeing increased acceptance and new uses for a variety of biomedical applications such as laser delivery systems to disposable blood gas sensors, intra-aortic pressure probes and digital x-rays, to name only a few.

Along with his very inclusive and useful overview, Dr. Mendez provided a broad overview of how optical fibers are used for illumination, imaging, digital X-rays, detection and laser delivery in the biomedical field, highlighting their intrinsic characteristics, advantages and limitations. A discussion concerning key industry trends, technological challenges and future business prospects was, finally, offered to the attendees.

Figures 41&42. Prof. Hasan in two instants along her invited lecture.

Prof. Tayyaba Hasan (Director, Harvard Medical School and MIT, Wellman Center for Photomedicine, Boston, USA) discussed how Light can fight cancer and infectious diseases: The Yin and Yang of PDT.

Prof. **Hasan** (an inventor of the photodynamic treatment of Age-Related Macular Degeneration, AMD, in the eye, which has been used for millions of patients and has over 300 publications and over 30 inventions) started her talk by mentioning that photochemistry-based photodynamic therapy (PDT) has been approved by regulatory authorities since 1995 as a local therapy. Then, she briefly spoke about how PDT Works by mentioning that it relies on the light activation of specific molecules, photosensitizers, to generate active molecular species that, in enough concentration, cause toxicity to biological targets. She mentioned that most of the light-activable molecules used in PDT have finite fluorescence quantum yields which, with appropriate harnessing, the photodynamic activation can be both used as a potent therapeutic and an imaging tool. She showed that with advances in optical technologies and the development of less expensive light source/detection systems, PDT lends itself to adoption in low resource settings, especially with the incorporation of mobile smartphone-based devices. By mentioning that with a deeper understanding of molecular medicine, PDT will be an enhancer of existing and emerging therapies with the potential for use in precision medicine, Prof. Hasan concluded her astonishingly invited lecture.

Figures 43,44&45. Prof. Cobo (talk´chair) introducing the invited speaker and two instants along Dr. Cosi lecture.

Dr. Alessandro Corsi (*Director of Simple Vulnology Unit at the IRCCS, San Raffaele Hospital, Milan, Italy*) spoke about how light can be used as an effective treatment of skin lesions.`

Dr. Corsi analyzed in detail the interference of light at different stages of the healing process, the outcomes, functional and aesthetic, and the economic impact of the use of this technology.

He mentioned that the application of light in treating skin lesions, acute and chronic, has been used for years to reactivate the tissue repair process to allow complete and rapid healing of lesions by skin regeneration (and not by scarring). He discussed that the use of monochromatic or fluorescence light has now become part of the normal activity of Wound Care centers. Thanks to his long experience in clinical settings, Dr. Corsi illustrated his experience based, enthusiastic invited talk with a broad set of real results using impacting photos obtained during his clinical works with patients.

Figures 46. Prof. Marcos on a moment along her statement and also panelist (Prof. Molpeceres, Hasan, Rea, Dra. Emiliani) and moderator (Prof. López-Higuera) of the round table II.

During the Round Table II on Challenges to face **on treatments and tools using light-based technologies**, the participants experienced a very interesting round table with very active participation from both sides. Moderated by the director of ISLIST, five relevant professionals integrated the panel on their respective areas of expertise. After the presentation by the moderator, each of the invited panellists **presented their brief initial statement on their previously allocated topic. They were:**

Challenges to face on

Prof**. Susana Marcos**, University of Rochester, NY, USA:
Light and silk-based biopolymers in ocular regeneration (Silk-Eye project)

Prof. **Carlos Molpeceres,** Laser Center, Polytechnic University of Madrid, Spain:
Laser based technology for regenerative medicine

Dra. **Valentina Emiliani,** Photonics Department, CNRS Vision Institute, Paris, France:
Optogenetic for light control of biological Systems

Prof. **Tayyaba Hasan,** Harvard Medical School, Wellman Center for Photomedicine, Boston, USA:
PDT translation to Clinic

Prof. **Mark Rea,** Icahn School of Medicine at Mount Sinai, New York, NY USA:
How does the light exposure affect memory and cognitive vitality?

Figures 47,48,49,50, 51&52.- The panelists (Professors Marcos, Molpeceres, Hasan, Dra. Emiliani, Prof. Rea) and moderator (Prof. López-Higuera) on several instants of their corresponding interventions.

Due to last-minute justified unexpected reasons, an exception to the format was implemented. The first statement was delivered by Prof. Marcos, and both comments and questions from the rest of the panelists and then from the participants were addressed and adequately replied by the panelist. After that, she left to get on a flight.

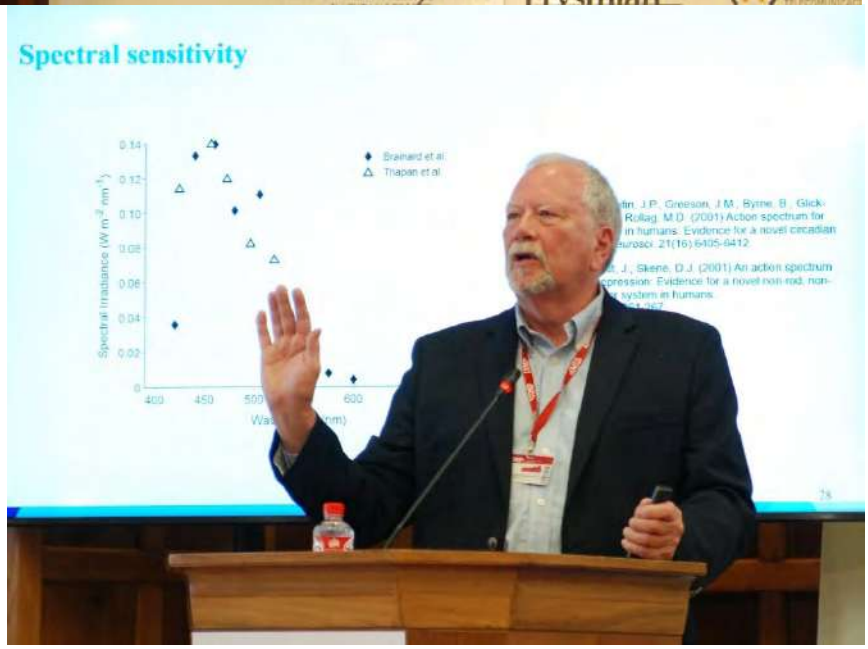
Then, the round table took the standard format, and each panelist addressed their respective initial statement. Then, each panel member took the opportunity to debate different aspects among the panelists. After that, attendees asked many different questions, in an open and fully-freedom environment, and a very interesting debate took place inside the room. Numerous interactions were carried out among the panelists and attendees, and discussions were established from both sides. After two and a half hours, the round table concluded with several open questions and very interesting and useful thoughts and conclusions.

Figure 53&54. Prof. **Molpeceres** *during two instants along his invited talk.*

Prof. **Carlos Molpeceres** (Director of Laser Centre of the Polytechnic University of Madrid, Spain) reviewed and discussed ongoing works concerning the laser Fabrication Technologies helping the Regenerative Medicine.

In his excellent presentation, he explored the fundamentals of laser-based additive manufacturing techniques and bioprinting processes in tissue engineering. He highlighted the differential characteristics of these techniques in comparison with competitive technologies. He also presented some of the relevant applications currently under development in regenerative medicine.

Prof. Molpeceres highlighted that since their invention, lasers have been used as a fundamental tool for the processing of inert materials, being a disruptive technology in manufacturing processes in practically any industrial sector. Then, he mentioned that the medical field has also benefited from the unique characteristics of this tool since its inception, presenting itself today as a technology of enormous impact in the diagnosis and treatment of diseases. In the currents, lasers are beginning to appear as an absolutely differential option in the field of tissue engineering, a multidisciplinary field of enormous growth and where laser-based additive manufacturing and laser bioprinting techniques are gaining interest for their unique characteristics, he added.



Figures 55&56.- Prof. **Rea** *during two instants along his invited closing lecture.*

Prof. **Mark Rea** (Former Director of Lighting Research Centre Rensselaer Polytechnic Institute; now at Icahn School of Medicine at Mount Sinai, New York, USA**),** in his closing invited lecture spoke about how can be translated the science of circadian rhythms to real-world applications.

He started his outstanding talk by reviewing some fundamentals of circadian rhythms and how the light-dark cycle entrains behavior and physiology to our local position on Earth. He added that these topics are understood well enough in the currents to be collectively translated into practice, improving the well-being and health of building occupants. But this has not happened on a large scale because science is not enough for widespread implementation.

Application guidelines and innovative products are certainly needed, he stated. Prof. Rea higlighted what is now needed most are large real estate owners employing strategies like the ones developed by the General Services Administration (GSA) in the United StatesHe concluded that the individuals in offices (home or commercial spaces) are provided with circadian-effective lighting without having to think about the science at all.

3.3 Some moments during the talks and free times

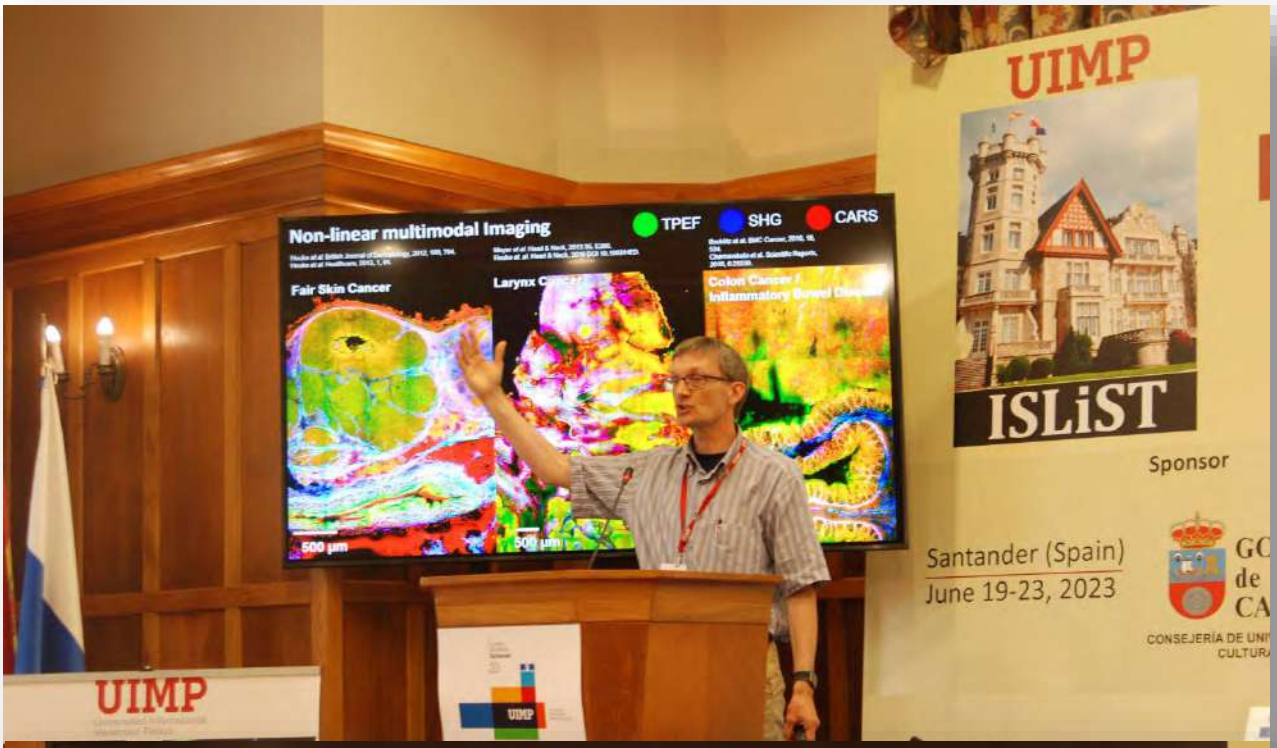
Figures 57,58&59.- Prof. **Ozcan** *during two instants along his invited closing lecture and the ISLIST director inside the Lecture questions time.*

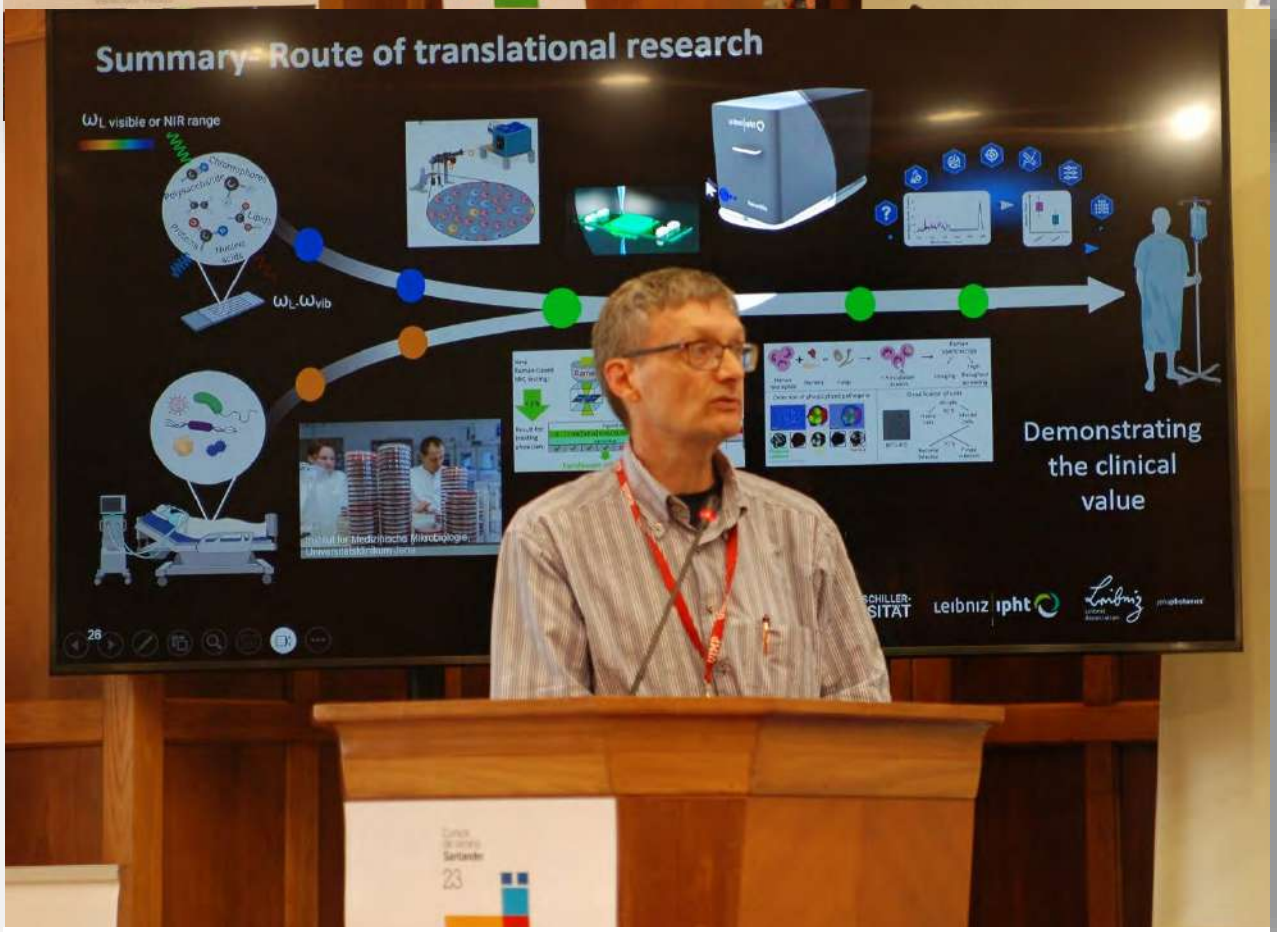
Figures 60&61.- Prof. López-Higuera *during two instants along his invited closing lecture and the talk´chair inside the Lecture questions time.*

Figures 62,63&64.- Three instants along the development of the Round Table I.

Figures 65&66.- Two instants along the development of the Dr. Karlas´s Lecture.

*Figures 67,68&69.- **Prof. Figueiro** in three instants along the development of her Lecture.*

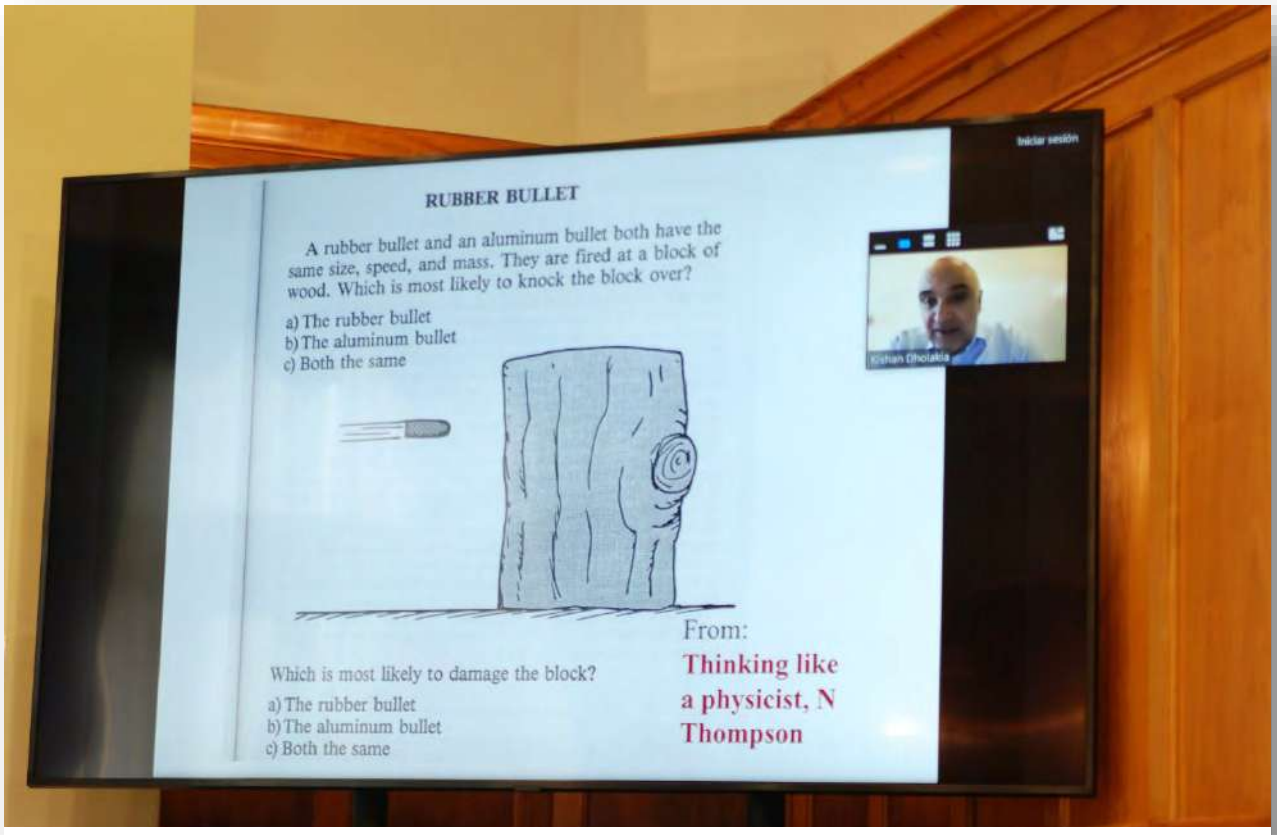




Figures 70&71.- ***Prof. Schmitt*** *in two instants along the development of his Lecture.*

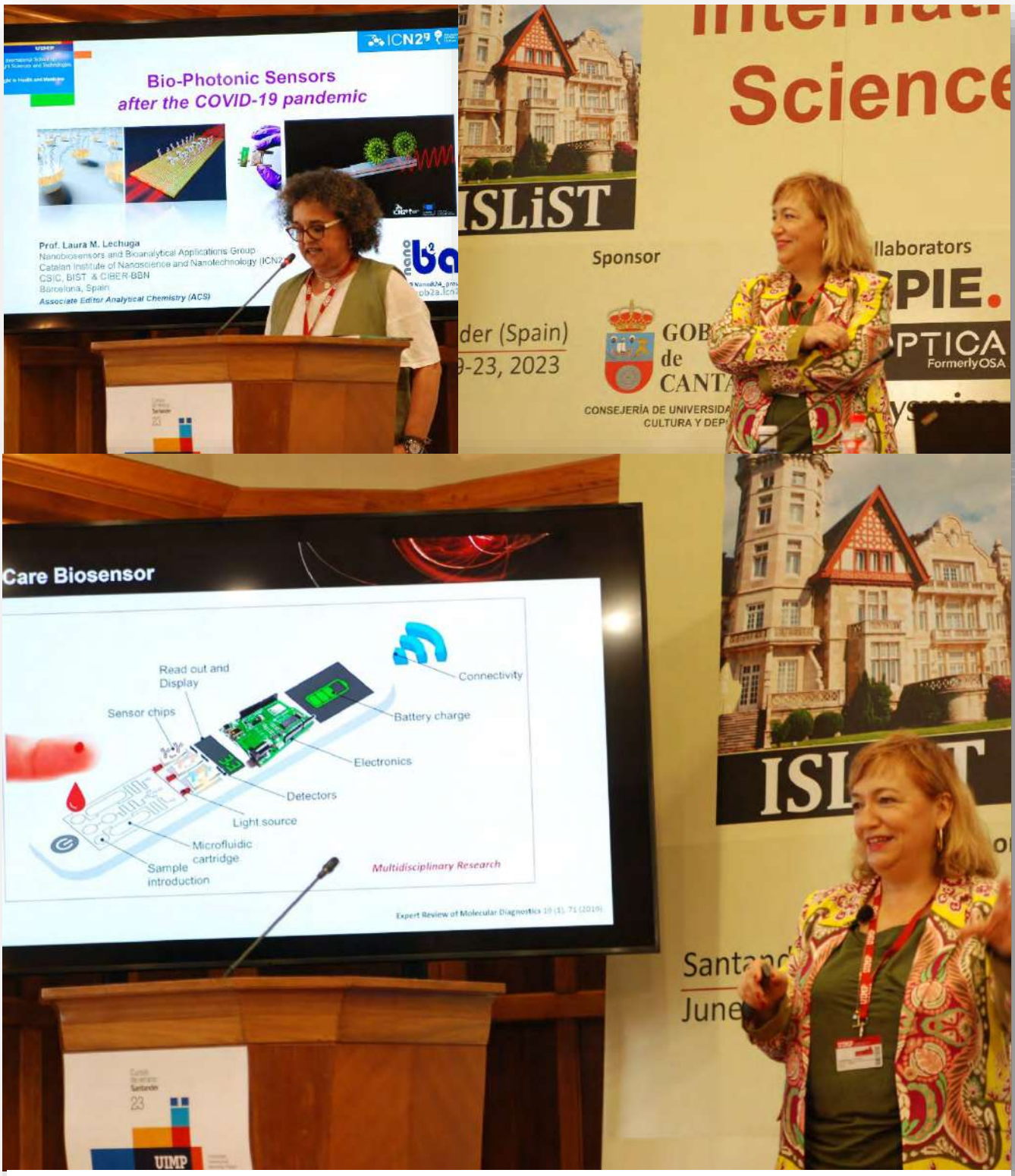
Figures 72&73.- ***Prof. Artal*** *in two instants along the development of his Lecture.*

*Figures 74,75&76.- **Prof. Marcos** in three instants along the development of her Lecture.*



*Figures 77&78.- **Prof. Dholakia** in two instants along the development of his online Lecture.*

Figures 79,80,81&82.- Dr. Algorri (talk´s chair), ***Prof. Taroni*** *in two instants along the development of her Lecture and a slide.*



*Figures 83&84.- **Prof. Lechuga** in two instants. One during her presentation by Prof. Conde (talk chair) the other one along the development of her Lecture.*

*Figures 85&86.- **Dra. Emiliani** in two instants along the development of her Lecture and questions´ time.*

Figures 87,88&89.- ***Prof. Durduran*** *(who did an extra effort to participate at ISLIST because his transitory illness of his knee) in two instants along the development of his Lecture.*

Figures 90&91.- ***Atendees*** *in two instants at the end of a lecture.*

Figures 92&93.- ***Dr. Mendez*** *being introduced by the ISLIST director and in two instants along the development of his Lecture.*

Figures 94,95&96.- ***Prof. Hasan*** *during in two instants along the development of her Lecture and during the lecture questions´ time in the presence of Prof. Quintela (talk´chair).*

Figures 97,98&99.- ***Dr. Corsi*** *during in two instants along the development of his Lecture and during the lecture questions´ time in the presence of Prof. Cobo(talk´chair).*

Figures 100&101.- Two instants along the development of Round Table II.

*Figures 102,103&104.- **Prof. Molpeceres** in three instants along the Lecture questions´ time.*

*Figures 105,106&107.- **Prof. Rea** in three instants along the development of his Lecture and also during Its questions´ time.*

4 Family Photo and Santander Council (Ayuntamiento de Santander) Reception

A family photograph was taken on the back stairs of the Royal Palace of Magdalena, just before the Santander Council Reception.

Figures 108, 109&110.- ISLIST Family Photo and two moments of the distended chat among the Chancellor of Santander Council Mss. Gema Igual, the Rector of UIMP Prof. Andradas and the Director of ISLIST.

The Santander Council was delighted to offer ISLIST attendees a special Reception. It was a great opportunity to chat, network, share experiences, and enjoy snacks and drinks inside an incredibly lovely environment in the Royal Hall at Magdalena Palace.

Figures 111&112. Welcome words from the chancellor of Santander Council, Mss. Gema Igual welcomed the ISLIST participants and the Rector of UIMP Prof. Carlos Andradas, addressing the acknowledgement to the Santander Council for their collaboration to reach the objectives of this International School.

Figures 113, 114&115.- ISLIST participants on the Royal Hall at the Magdalena Palace enjoying moments of socialization and networking during the Santander City Council Reception.

Figures 116 &117.- ISLIST participants on the Royal Hall terrace at the Magdalena Palace enjoying moments of socialization and networking during the Santander City Council Reception.

5. Opening, Closing remarks and Diploma Delivery

The opening ceremony was presided by the Vice-Chancellor of the International University Menendez Pelayo D. Francisco Matorras Weinig, who welcomed all participants to the event and stated that ISLIST International School is envisioned to be a worldwide top International forum (**every third or fourth week of June**) on *Light Sciences and Technologies* in Santander, Spain. He also spoke about UIMP's general vision and mission.

The IV ISLIST Director, Prof. López Higuera spoke on the relevant role of Light Sciences and Technologies (Photonics) in the XXI century. Then, he justified the creation of ISLIST in the frame of UIMP that runs the third or fourth week of June of every year with different cores. Then he offered an overview of the previous ISLIST editions. He remarked that it was a great honor for the 2022 season of the UIMP Advanced Courses in Santander that were inaugurated (in person) by the king of the Spain D. Felipe VI, who had the detail to chat for some minutes with a group ISLIST attendees in the presence of the VI ISLIST director and the rector of the UIMP, after the inauguration ceremony.

Figures 118.-Official Opening Ceremony of UIMP Advanced Courses (2002) in Santander inaugurated (in person) by the king of the Spain D. Felipe VI.

Then, the Director of VI ISLIST presented the panel of top-level international invited speakers for the V ISLIST edition with the core Light on Health and Medicine. Then, he introduced the schedule of activities planned to develop ISLIST 2023.

Figures 119.- Opening Ceremony of VI ISLIST presided by Prof. Matorras Vicechancellor of UIMP.

The ISLIST director explained the schedule school of the week, including the exceptional events in the programme. He also presented the statistics concerning the participants in the school and concluded with acknowledgement words for the Sponsors and Collaborators, with special thanks to all the Invited Speakers selected among the worldwide leader authorities in their respective matters. He added special mentions to the course secretary Maria Angeles Quintela, and to his secretary, Maria Ruiz, both at the University of Cantabria.

Figure 120.- The Vice-Chancellor of the International University Menendez Pelayo Prof. Matilde Carlón and the ISLIST ´Director during the Concluding Remarks and announcement of the ISLIST 2023.

During the **Closing Ceremony** the Pro-vice-Chancellor of UIMP Prof. Matilde Carlon shared with the attendees her satisfaction with the contribution of ISLIST to reach, without any debt, the objectives of the University of universities of to be, really, an international university inside what top quality science and technology is shared to contribute to the advancement of world organizations and societies. The panel of speakers and attendees (from 20 different nationalities), in real terms, corroborates her words.

Then, ISLIST director, after thanking the words spoken by the Vicechancellor offered an overview of the development of the sixth ISLIST edition. Illustrating his words with some slides created during the week, he remarked that it was very educative to attend the discussions and suggestions lived actively among all during the two round-tables programmed to identify, analyse and discuss challenges to face in both core areas. "*All of you have had the opportunity to chat, to share your views and to do networking in that informal and relapsing environment that took place during the Santander Council Reception at the Royal Hall after the Family Photo last Wednesday*", he added. Finally, he thanked all invited Speakers, Sponsors and Collaborators because they are a key part for the feasibility of this meeting. "*Without they, this top-quality School and the International Students Grants will not be possible*", he added.

Special Thanks to the School´s secretary Maria Angeles Quintela and Beatriz Moreno and the rest of the staff of UIMP for the support given during the organization and throughout the week.

Then, Prof. López-Higuera announced that the seventh International School on Light Sciences and Technologies will take place next year 2024. The VII ISLIST will have the Main Core on **Light on Communications Sensing and Lighting**. It will be developed during the week of June 17-21, 2024.

Finally, the Vice-Chancellor of the International University Menendez Pelayo declared closed the VI ISLIST.

Official Diploma delivery ceremony

As part of the Closing Ceremony, the personalized Official Diploma was delivered to the participants of the VI ISLIST who met the UIMP requirements for it. The ISLIST Secretary proceeded to call in blocks of five attendees (following alphabetical order) to whom a group of guest speakers, the Vice-Chancellor and the Director of ISLIST delivered the Diplomas to their corresponding recipients. Here are some samples of attendees holding their Diplomas.

Figure 121.- The Vice-Chancellor of the International University Menendez Pelayo, five ISLIST invited lecturers and the ISLIST Director with the official certificates ready to be delivered to the respective VI-ISLIST attendees.

Figures 122,123&124 Sample of ISLIST-2023 attendees receiving their respective diploma.

6. Quality: Satisfaction Survey

To have an objective index of quality, after closing the ISLIST international School a brief and anonymous survey was carried out online by the participants. The questions asked were:

***Q1**-Please indicate your overall opinion regarding the quality of the invited speakers*

0 - Very Poor
1 - Poor
2 - Average
3 - Good
4 - Very good
5 - Excellent!

***Q2**-Please indicate your overall opinion regarding the topics of the talks*

0 - Extremely uninteresting
1 - Not very interesting
2 - Average
3 - Interesting
4 - Very Interesting
5 - Really what I was looking for!

***Q3**-Please indicate your overall opinion regarding the ORGANIZATION of the school*

0 - Very Poor
1 - Poor
2 - Average
3 - Good
4 - Very good
5 - Excellent!

***Q4**-Please indicate your overall opinion regarding the INFORMATION that you received before attending the school*

0 - Very Poor
1 - Poor
2 - Average
3 - Good
4 - Very good
5 - Excellent!

***Q5**-Would you attend future editions if possible?*

0 - Not at all
1 - Not very likely
2 - Maybe
3 - If the main core suits me
4 - Probably
5 - I would love to come again to Santander and attend ISLiST-XX

***Q6**-Would you recommend ISLiST to other colleagues?*

0 - Not at all
1 - Not very likely
2 - Maybe
3 - If the main core suits him/her
4 - Probably
5 - Absolutely!

***Q7**-Finally, did the school meet your expectations?*

0 - No, it was a complete disappointment
1 - Not really
2 - Only partially
3- Yes, but it might have been better
4 - Yes, absolutely
5 - It was even better than I expected!

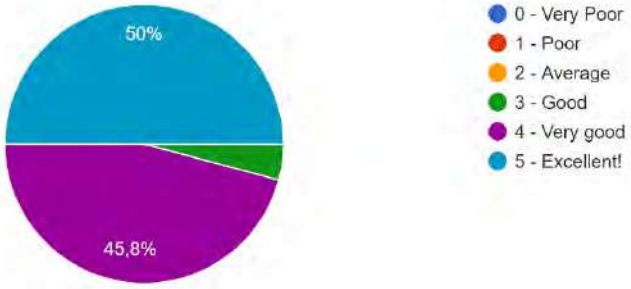
***Q8**-Please, tell us about the best things of the school (what we should go on considering in future editions)*

***Q9**-Please, tell us about the worst things of the school (what we should NOT consider in future editions)*

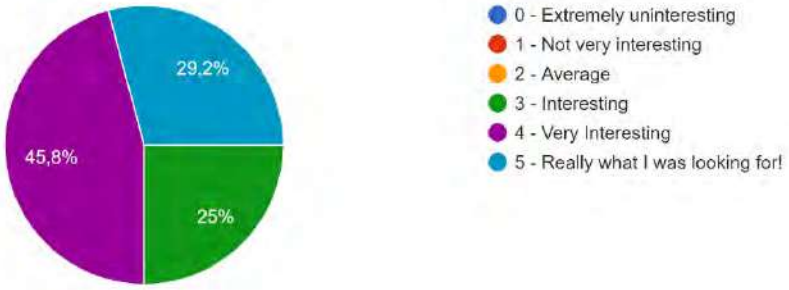
***Q10**-Do you have any suggestions, comments ...?*

After receiving the responses, the overall results of the survey are graphically summarized as follows:

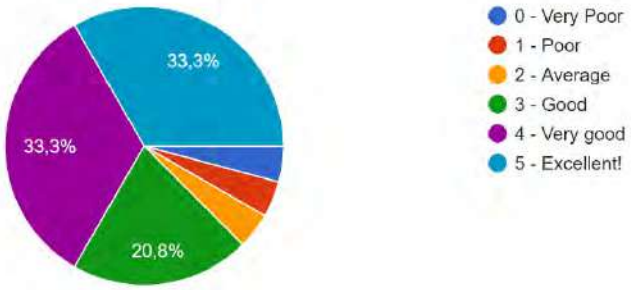
Please indicate your overall opinion regarding the quality of the invited speakers



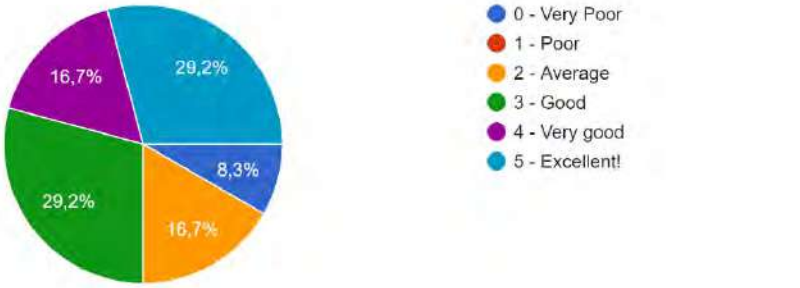
Please indicate your overall opinion regarding the topics of the talks



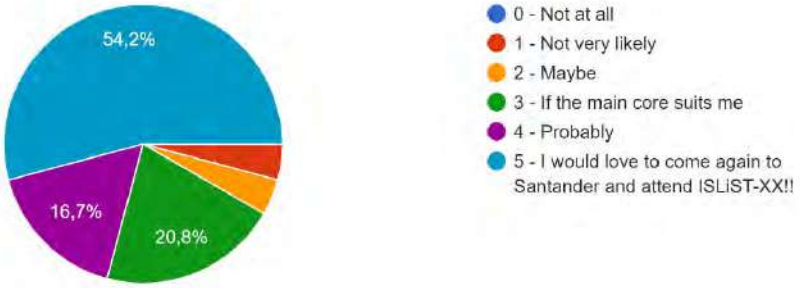
Please indicate your overall opinion regarding the ORGANIZATION of the school



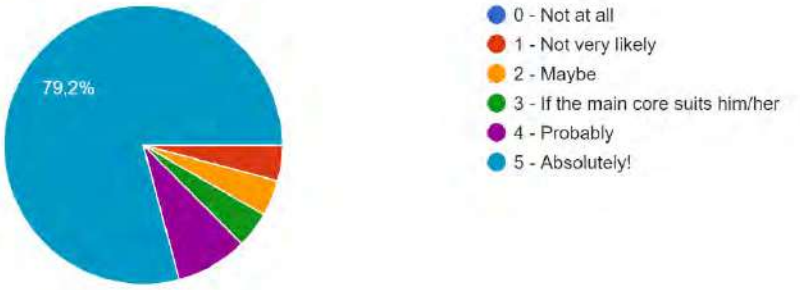
Please indicate your overall opinion regarding the INFORMATION that you received before attending the school

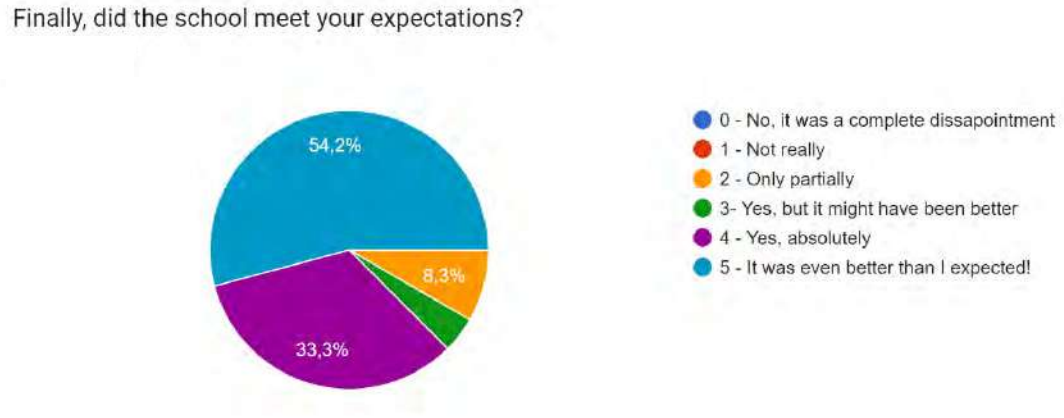


Would you attend future editions if possible?



Would you recommed ISLiST to other colleagues?





Q8-Please, tell us about the best things of the school (what we should go on considering in future editions)

Here, are the replies as they were received:

- *The speakers were brilliant. The catering towards the end of the school was really good.*
- *I could say that one of the best things about the school was the social interaction with students, professors, staff personnel, directives, and all.*
- *I think the best was the real internationality in the courses, the participants, and the participants' distribution. I really liked having undergraduate students and post-docs in the same courses with many possible discussions together.*
- *La instalación y el contenido de las charlas*
- *The talks were interesting, the food was very good (Pablo is also the best waiter ever), and being hosted in a palace was an amazing experience! Spanish people are also generally very kind and friendly.*
- *Hosting was the best part of the summer school.*
- *Interesting lectures, some far from the typical topics regarding photonics lectures and applications. It is an unexpected, yet entertaining perk that I would absolutely introduce again.*
- *The relevance of the speakers to the core theme and the open communication.*

Q9-Please, tell us about the worst things of the school (what we should NOT consider in future editions)

Here, are the replies as they were received:

- *The catering was totally unorganised for the first couple of days — long queues, limited options. You should also consider adding more vegan options for breakfast. The communications before the school could be better.*
- *There is nothing wrong with commenting; I think it was a great experience, and everything was outstanding.*
- *Unfortunately the organization of the meals and also timing of the dinner.*

- *La organización en general, la organización del comedor, espacio del comedor muy pequeño, el menú de comida carísimo, la cafetería no tenía recursos, no hubo transporte hasta la instalación, no había ni una botella de agua durante las charlas, el horario demasiado extendido y demasiado temprano.*
- *Sometimes the microphone or the general audio system wouldn´t work so well... and the line for the food downstairs would take too long!*
- *Everything was perfect.*
- *I really didn't find anything dissapointing.*

Q10-Do you have any suggestions, comments ...?

Here, are the replies as they were received:

- I'm very grateful to you for considering me to participate in this extraordinary event.
- Not sure but, topics may be more specialized.
- It would be good to get some papers or notebooks before the first talk to take notes... we received them a little bit too late at the end.
- Please provide some vegetarian food options for next time.
- Nothing to add in here. Again, well done!
- *Hablando desde mi propia experiencia, que el curso se impartiera la primera semana y la organización que había detrás, me destrozó en parte la experiencia. En primer lugar, la asistencia telefónica muy insatisfactoria, a parte de encontrar dificultad en que te atendieran, cuando atendían lo hacían con poco respeto. Luego, la resolución de la beca PROVISIONAL. No puede ser que se resuelva 2 semanas antes, haciendo que los alumnos busquen recursos para asistir con 2 semanas de antelación y con los elevados costes de transporte que hay hoy en día. Y ahora, hablamos de la beca definitiva, que yo en mi caso, nunca la descubrí. Estaba la 2da en lista de espera y por su NO resolución, me tocó separarme de mis compañeros y buscarme, además del transporte, el alojamiento cuando encima, este no se completó por falta de asistencia de gente que tampoco se tuvo en cuenta. Esto se habría solucionado con una gestión previa. Ojalá el próximo año lo hagáis. Ante la falta de material (libreta y bolígrafos), entiendo que fue algo que tampoco se gestionó bien, pero al igual que pongo mi comentario negativo, aporto el positivo y es que el compañero vuestro Manuel Hervás, atendió mi solicitud y ha enviado por correo postal este material, ya que no pudimos cogerlo porque nuestro transporte salía pronto. Es una experiencia muy chula que si solventara sus inconvenientes y fallos, sería recomendable.*

7.- Summing-up

The International School on Light Sciences and Technologies (ISLIST) at the Menéndez Pelayo International University (UIMP), Spain, has consolidated as an international reference at the highest scientific and technical level. It is confirmed by the fact of the highest quality of the lectures of the best experts (including **Nobel Prizes such us Andre Geim, Sujhi Nakamura and Donna Strickland**) of the most renowned institutions and organizations in the world in the use of Light Sciences and Technologies together with the numerous and high qualification of international participants. ISLIST was founded and is, since then, directed by José Miguel López-Higuera and has been assisted in this edition by Maria Angeles Quintela, both of the Photonics Engineering Group of the University of Cantabria, CIBER-BBN and IDIVAL.

VI ISLIST hosted 79 attendees from 20 nationalities and more than 25 different institutions gathered in the week of June 19 to 23, 2023, in Santander, Spain. The ISLIST participants (60% PhD students and 37% female) received knowledge and experience from 17 reputable professors and professionals of the most reputable academic and research institutions and companies of 7 different nationalities. They had the privilege of receiving top-quality inputs from researchers of the stature of professors Aydogan Ozcan, Mariana G. Figueiro, Michael Schmitt, Pablo Artal, Susana Marcos, Kishan Dholakia, Paola Taroni, Laura Lechuga, Turgut Durduran, Tayyaba Hassan, Carlos Molpeceres, Mark Rea and JM López-Higuera. They also received the expertise of reputable professionals and researchers (all Drs) such as Angelos Karlas, Valentina Emiliani, Alessandro Corsi and Alexis Mendez. Very hot topics in the use of light sciences and technologies in Health and Medicine were presented and discussed for the 17 one-hour lectures and two round tables that focused on the search for challenges pending both in light Diagnosis (round table I) and in the use of Light in treatments and tools (round table II). The fresh and enthusiastic questions and discussions among the participants and the panellists of the two round tables were unforgettable. https://www.teisa.unican.es/ISLiST/index.php/program

Thanks to the Santander Council Reception, the attendees and the invited speakers had the opportunity to share thoughts and experience and to network inside an unparalleled place, the Royal Palace of Magdalena, and have snacks and drinks. Thank you for that opportunity to Ayuntamiento de Santander.

According to the post VI-ISLIST survey, the program's quality, speakers, complementary events, and facilities offered can be considered at the top level worldwide. ISLIST has met their expectations. As numeric indicators, it can be considered that 95,8% of the attendees agreed with the very high quality of the invited speakers, considering the 50% into the rank of excellence, the 79,2 % of the attendees expressed that they will be very happy to recommend VII-ISLIST to other colleagues and the 87.5% indicated their interest in participating again in next editions of the ISLIST School.

More details: https://www.teisa.unican.es/ISLiST/

International School on Light Sciences and Technologies (ISLiST)

June 19-23, 2023, Santander, Spain

Core: ***Light in Health and Medicine***

ANEX

ISLIST-2023 PROGRAMME

Monday, 19

Morning

10:15 h

Opening Ceremony

10:40 h / **Break**

11:00 h **Opening Lecture**

Deep-learning enabled computational microscopy and diffractive imaging

Prof. Aydogan Ozcan

Director, Bio&Nano-Photonics Laboratory, **University of California**, Los Angeles, USA.

12:10 h / Introductory Lecture

Light in Health and Medicine: a general overview

Prof. José Miguel López-Higuera

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

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

Afternoon

15:30 h- 17:35 / **Round Table I**

Light in diagnostics: Challenges to face on

Prof. **Aydogan Ozcan,** University of California, Los Angeles, USA:

wearables devices based on Smartphone platforms

Dr. Angelos Karlas, Helmholtz Zentrum München, Germany:

Optoacoustic Imaging in Pharmacology

Prof. Marina G. Figueiro, Mount Sinai Hospital, NY, USA:

lighting to improve the way of older adults

Prof. Pablo Artal, University of Murcia, Spain:

light-based techniques to reach very effective, efficient and socialized diagnosis of humans´ vision

Prof. JM López-Higuera, Director ISLiST, **Moderator**

Tuesday, 20

Morning: Light in Diagnostics and Mood

9:30 h / Invited keynote

Listening to Light: Advances in Optoacoustic Imaging

Dr. Angelos Karlas

Group Leader, Institute for Biological and Medical Imaging at the **Helmholtz Zentrum München,** Munich, Germany

10:40 h **/ Break**

11:00 h / Invited Lecture

Light's effects on human health, well-being, and behaviour

Prof. Mariana G. Figueiro

Director, Light and Research Center, (LHRC), Icahn School of Medicine, **Mount Sinai**, NY, USA

12:10 h / Invited Lecture

Raman based Spectroscopic techniques for Biomedical diagnosis Life Sciences

Prof. Michael Schmitt

Group Leader, Institute of Photonic Technology, Jena, Germany

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

Afternoon: Light technologies in human visual system

15:30-16:30 / Invited Lecture

Light based techniques to evaluate vision

Prof. Pablo Artal

Director, Laboratorio de Óptica, **University of Murcia**, Murcia, Spain

16:40h / Invited Lecture

Light based techniques for human vision correction

Prof. Susana Marcos

D. R. W. **Director,** Center for Visual Science, The Institute of Optics, **University of Rochester**, NY, USA

Wednesday, 21

Morning: Light in Diagnostic/Sensing and Treatment

9:30 h / Invited Talk

Optical Tweezers: trapping and manipulation for biomedical applications

Prof. Kishan Dholakia

Director, Centre of Light for life and School of Biological Sciences, University of Adelaide, Australia

10:40h / **Break**

11:00h / Invited Talk

Optical Diffuse Systems for effective Management of breast cancer

Prof. Paola Taroni

Head, Photonics for health, Food and Cultural Heritage, Politecnico di Milano, Italy

12:10h / Invited Talk

Bio-Photonic Sensors after the COVID-19 pandemic

Prof. Laura Lechuga

Head, Nanobiosensors and Bioanalitical Applications Group, **ICN2, CSIC, CIBER-BBN and BIST,** Barcelona, Spain

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

Afternoon: Light in the human´s Brain

15:30-16:30 / Invited Talk

All-optical control of neuronal circuits by wave front shaping and optogenetics

Dr. Valentina Emiliani

Director of Photonics Department, Head of WFEMO, CNRS Vision Institute, Paris, France

16:40h / Invited Talk

Noninvasive measurement of deep tissue hemodynamics and oxygen metabolism at the intensive care

Prof. Turgut Durduran

Head, Medical Optics Group, Instituto de Ciencias Fotónicas, **ICFO**, Barcelona, Spain.

17:55 h **VI 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, 22

Morning: Light in Supervision, Sensing and Treatment

9:30h / Invited Lecture

Optical Fiber technology on Biomedical Applications

Dr. Alexis Méndez

President, MCH Engineering LLC, Alameda, **California,** USA

10:40h / **Break**

11:00h /Invited Lecture / To Be Confirmed

Light to fight cancer and infectious diseases: The Yin and Yang of PDT

Prof. Tayyaba Hasan

Director, **Harvard Medical School and MIT**, Wellman Center for Photomedicine, Boston, USA

12:10h / Invited talk

Photobiomodulation for effective treatment of skin lesions

Dr. Alessandro Corsi

Director, Simple Vulnology Unit at the IRCCS**, San Raffaele Hospital,** Milan, Italy

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

Afternoon

15:30h- 17:35h / Round Table II

Treatments and tools using light-based technologies

Challenges to face on

Susana Marcos, **University of Rochester, NY, USA:**
Light and silk-based biopolymers in ocular regeneration (Silk-Eye project)

Carlos Molpeceres, Laser Center, **Polytechnic University of Madrid**, Spain:
Laser based technology for regenerative medicine

Valentina Emiliani, **Photonics Department, CNRS Vision Institute, Paris, France:**
Optogenetic for light control of biological Systems

Tayyaba Hasan, **Harvard Medical School and MIT**, Wellman Center for Photomedicine, Boston, US:
PDT translation to Clinic

Mark Rea, **Icahn School of Medicine at Mount Sinai**, New York, NY USA:
How does the light exposure affect memory and cognitive vitality?

Prof. JM López-Higuera, Director ISLiST, **Moderator**

Friday, 24

Morning

Laser light in regenerative and human centric light

9:30-10:40h / invited Lecture

Laser fabrication technologies helping the regenerative medicine

Prof. Carlos Molpeceres

Director, **Director**, Laser Institute, **Polytechnic University of Madrid**, Spain

10:40h / **Break**

11:00-12:10h / Invited Closing Lecture

Bridging the science of circadian rhythms to real-world applications

Prof. Mark Rea

Former Director, Lighting Research Cener Rensselaer Polytechninic Institute. Now at **Icahn School of Medicine at Mount Sinai,** New York, USA

12:15 h

Closing Remarks, Announcement of ISLiST 2024 and Diploma Delivery

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