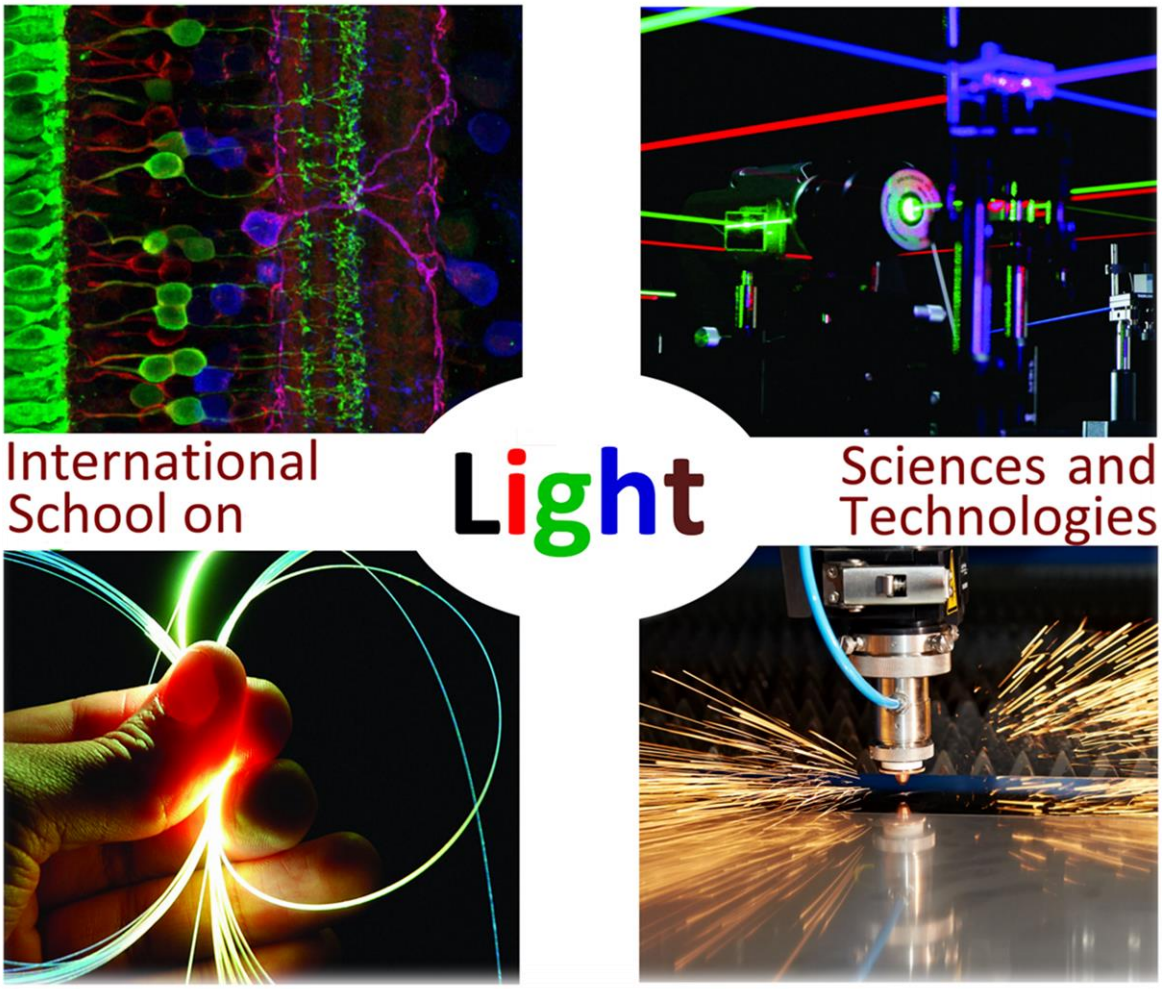
ISLiST / UIMP
Universidad Internacional Menéndez Pelayo



Core: Light in Communications, Sensing and Lighting

Santander June 17-21, 2024
(Riancho room,, Palacio de la Magdalena, Santander)

Final Report

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1. Executive Summary

This International School 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 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" that is recognized as the "university of universities". It runs* (the third or fourth week of June of 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 Communications, sensing and Lighting*** was the core of this 2024 edition.

Fifty-five (55) participants of 17 nationalities and from more than 20 different institutions or corporations met during the week of June 17 to 21, 2024, in Santander, Spain, as a consequence of VII-ISLIST. They received knowledge and technique from 16 of the most reputable professors and professionals in the world (of 9 different nationalities) from 15 academic research institutions and companies.

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

The atendees had the privilege of receiving the teachings and experience of researchers of the stature of professors, José Capmany, Francesco Poletti, Ton Koonen, Sinead O´KeeffeRoberto Osellame, Andrea Cusano, Kennet Grattan, Valerio Prunery, Sonia Martín López, Mar Rea, Mariana Figueiro and JM López-Higuera. They also received the expertise of reputable professionals and researchers (all Drs) such as Peter Winzer, Michael Leeby, Elisaberta Rugi Grondi, and Vincent Menoret. Very hot topics in the use of light sciences and technologies inside the Coomunications; sensing and Lighting were presented and discussed for the 17 one-hour lectures and two round tables that focused on the search for challenges pending in light Communications (round table I) and in sensing and Lighting both in helath and in civil applications (round table II). It worthy to be mentioned the very active participation of the participants both by asking questions and by sharing their thoughts both after the lectures and along the both rouun tables.

Sponsored by the Santander Council (Ayuntamiento de Santander), the VII-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.

In order to achieve this 2024 ambitious program, the **Government of Cantabria** has sponsored this International School of UIMP. VII-ISLIST has been also supported (as Gold collaborator) by one the more reputed international scientific societies such us **SPIE** the international society for optics and photonics (https://spie.org/); It was also supported for companies and professional organizations such as **Prysmian** the planet´s pathways in Spain https://www.prysmian.com (Gold), Ambar Telecommunication https://ambar.es/ (Silver) and Acorde https://next.acorde.com/ (Silver). It was also Supported by as Bronze collaborators such as OZ Optics, ERZIA, Aragón Photonics, Copsesa , TTI Celestia and Santander City Council. We were also supported as Copper colaborators by Semicrol, OPTICA (formerly OSA), Hotel Santemar and Photonics Engineering Group of UC, CIBER-BBN and IDIVAL. Without these Sponsor 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 eight edition of ISLIST (June 16-20, 2025) will have the core on **Light in Energy, Environment and Laser-Manufacturing.**

Santander, December 29, 2024.

Prof. José Miguel López-Higuera
Director ISLIST at UIMP

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

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

During the week along seventeen outstanding lectures a wide set of key topics on light and light sciences and technologies useful for optical communications, sensing and lighting communities were presented and discussed. In addition to the invited talks in very hot topic, lectures, concerning the currents state of the art, trends and challenges to be faced, were commented and discussed along the 17 invited talks and the two round tables.

It was really a privilege to heard, to see, to ask questions and to chat with the sixteen highly renowned professors and researchers from the most prestigious worldwide institutions of Europe, UK and USA.

Figure 2. Family photo of the ISLIST-2024 participants. It was taken just before the Santander Council reception. Around, Invited Speakers and organizers. Courtesy of Photonics Engineering Group (CPEG).

2.1 ISLIST 2024: Some data

Fifty-five (55) attendees from 17 different nationalities (from over 20 different institutions) participated in this meeting. As shown in the geographical breakdown in Figure 3 the participants came from: Spain (more than 25), Poland, Portugal, Italy, India, México, Pakistan, Cuba, China, Canada, Romania, Ecuador, Honduras, Bangladesh, Nigeria, Russia and Colombia.

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

Regarding the previously mentioned students: 60% were PhD students, 15% were Master Students, 9% were Drs, and 16% were others (figure 4).

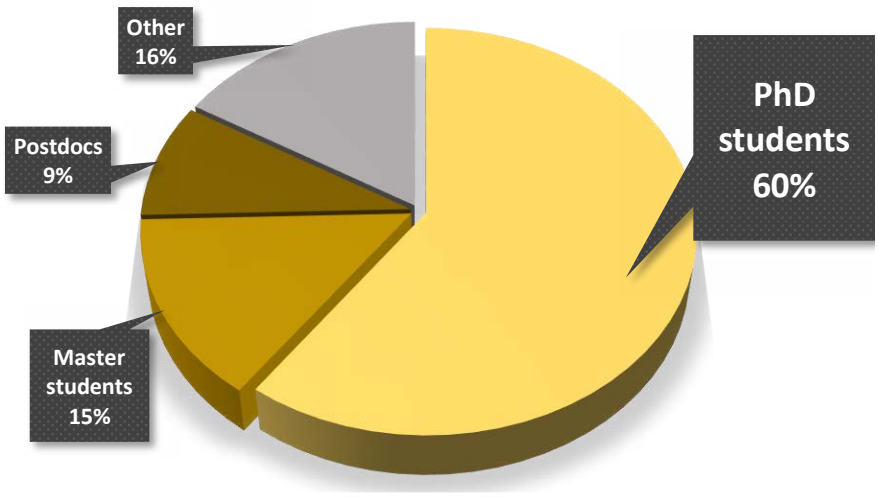


Figure 4.-VII-ISLIST attendees by education.

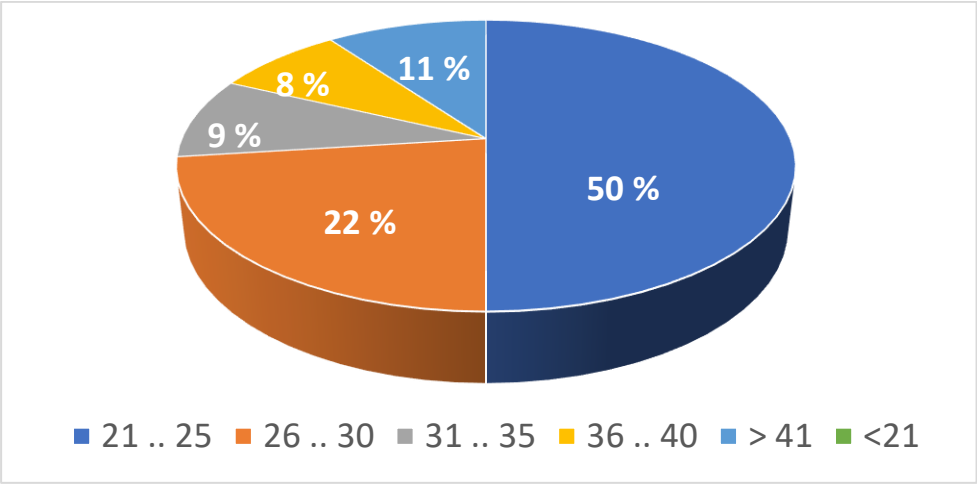


Figure 5.-ISLIST attendees by age.

In terms of the participant age: 72% of the attendees were in the range from 20 to 30 years, which is in correlation with the fact of the education period working towards PhD degrees and also in post-docs. This fact suggests the very good acceptance of this top-quality school and its positive potential impact on the education of very good researchers and professionals in the early stages of their careers. This fact will be key issue for the near future of our globalized world in which this key technology (Photonics) will play as relevant roll as Electronics played in the last XX Century. 22% of the attendees were in the range from 26 to 30, 17 % in the range from 31 to 40, and 11% were attendees of more than 41 years old, respectively.

Concerning the gender distribution, 64% of the attendees were men and 36% women, that in quite good correlation with the previous edition and also, it could be deducted a little decrease of the gender gap: ISLIST 2017 (74% attendees were men and 26% women); ISLIST 2018 (67% attendees were men and 33% women); ISLIST 2022(70% attendees were men and 30% women). This also correlates with the real situation in many countries in technical and scientific jobs.

Taking in consideration the number of women as students in grade levels of the current education institutions, these numbers will be progressively change towards a more homogeneous distribution without the need of any specific policy, just fighting against any kind of 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.

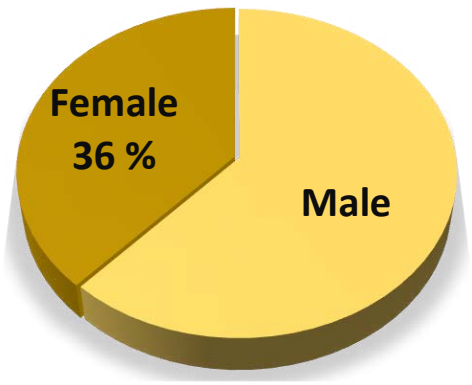


Figure 6.- ISLIST attendees by gender. Closing the gender gap.

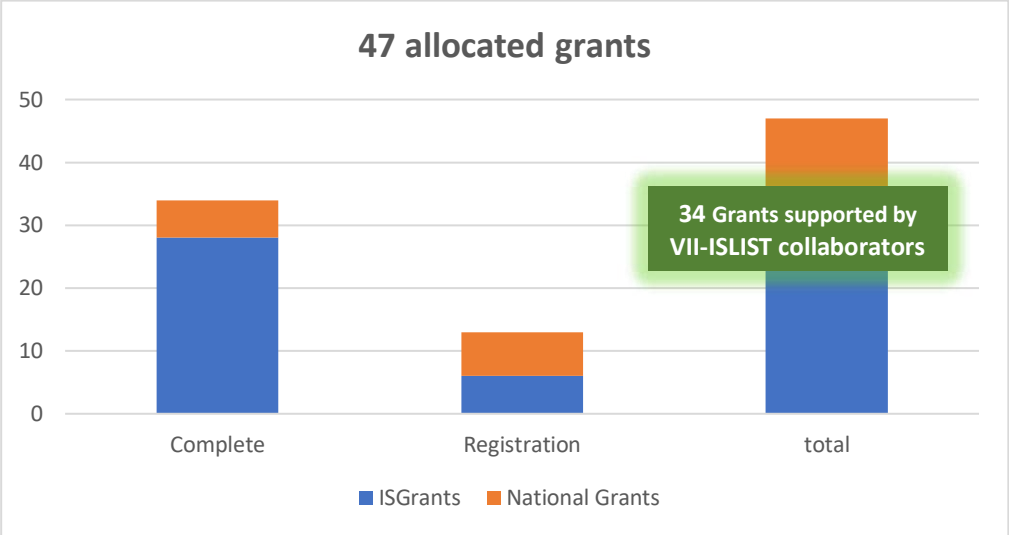


Figure 7.-ISLIST Student Grants distribution.

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 for any other international Students. Thanks to the sponsors and collaborators, VII-ISLIST was able to offer 28 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 47 grants were allocated. 13 funded by the Spanish State and 34 with funds from the collaborators from what, 28 were complete or full grants. 13 covered only the school registration fee.

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 on the fact of the highest quality of the 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 qualification 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** (UIMP).

3.- PROGRAM AND ITS DEVELOPMENT

The School Program was designed and published in the meeting web site. The program and notebook were available for all the VII-ISLIST participants:
https://www.teisa.unican.es/ISLiST/images/2017-Slides/CompleteProgram-English-VII-ISLIST-UIMPv6.pdf

3.1 **The General Schedule of VII-ISLIST (2024 edition)** was programmed and developed as shown in figure 8.

Time	Monday 17th	Tuesday 18th	Wednesday 19st	Thursday 20nd	Friday 21rd
9:30		**Prof. Francesco Poletti** Head of Group, Optoelectronic Research Centre, University of Southampton, UK Hollow Core Optical fibres: a revolution-nary technology for optical communications, quantum applications and laser delivery	**Prof. JM López-Higuera** Head, Photonic Engineering Group of University of Cantabria, Ciber-BBN and IDIVAL, Spain Sensing Using Light: doctrinal conception, currents and trends	**Prof. Kennet Grattan** OBE, FREng, Royal Academy of Engineering, Director of Instrumentation & Sensors Research Centre, City University of London, UK Optical sensing technologies for key environmental measurands in the I4.0 era applications	**Prof. Mark Rea** Icahn School of Medicine, at Mount of Sinai, New York NY; Former Director, LRC Rensselaer Poly. Institute, USA Light's effects on human health, well-being, and behaviours
10:15	**Opening Remarks**				
10:40	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00	Opening talk / **Dr. Peter Winzer** Founder and Chief Technical Officer, CTO, Nubis Communications New Providence, NJ07974, USA The Next Generation of Optical Communications: will be massively Parallel	**Dra. Elisabeta Rugi Grond** CEO, Thales Alenia Space, Switzerland, Switzerland Optical communications in space: Currents and trends	**Prof. Siniad O´Keeffe** Head of Group, Optical Fibre Sensors Research Centre; Health Research Institute, University of Limerick, Ireland Optical Fibre Sensors for Radiation Dosimetry: Challenges and Opportunities	**Prof. Valerio Pruneri** Head, Optoelectronic Group, Instituto de Ciencias Fotónicas, ICFO, Barcelona, Spain. Engineering surfaces and devices for the display and imaging industries	Closing talk /**Prof. Mariana Figueiro** Director, Light and Health Research Center (LHRC), Icahn School of Medicine, Mount Sinai, NY, USA Principles of Indoor and Outdoor Lighting for Healthy Environments
12:10	**Prof. Michael Leeby** Chief Executive Officer,,CEO, Lightwave Logic, San Francisco, USA Next Generation of Photonics Integrated Circuits as key for communications and sensing.	**Prof. Ton Koonen** Scientific Director,Institute for Photonic Integration, University of Technology, Eindhoven, Netherlands Optical Wireless Communication – a green wireless communication technology with high potential and great prospects	**Dr. Vincent Menoret** Head of Quantum Sensors R&D Exail Quantum Systems, Institut d'Optique d'Aquitaine, Talence, France Cold atom quantum sensors for field applications'	**Prof. Sonia Martín López** Co-Head of Photonics Engineering Group, of Alcala de Henares, Spain Distributed Acoustic Sensors (DAS) for Seafloor Seismic Monitoring: from earthquakes to tsunamis	12:30 **Closing Remarks, ISLIST-2024 Announcement and Diploma Delivery**
13:30-15:0	Lunch	Lunch	Lunch	Lunch	
15:30	**Prof. José Capmany** Director, iTEAM Institute Technical University of Valencia, Valencia, Spain Programable Integrated Photonic Circuits: what?, why? and when?	**Round Table I /Challenges to reach next generation of Optical Communications.** Prof. **Leeby,** Challenges to face *high Performance Polymer Photonics for Next Generation PICs* Dr. **Winzer,** *Challenges to face in massive integrated spatial parallelism in future Optical Communications* Dra. **Rugi Grond** *on laser-based communications in Space in the Era of 6G* Prof. **Koonen** *Challenges to face in indoor optical wireless Communications in the Era of 6G* Moderator: **JM López-Higuera**	**Prof. Roberto Osellame** Director, Institute of Photonics and Nanotechnologie-CNR, Milano Polytechnic, Italy Advanced photonic and optofluidic devices fabricated in glass using femtosecond lasers for Lab-On Chip sensors	**Round Table II /Challenges to reach next generation of Sensing and Lighting** Prof. **Grattan,** Challenges to face to reach real industrial application of Optical sensing technology **Prof. Osellame,** *Challenges to face to reach useful Integrated advanced microscopy in optofluidic lab-on-a-chips.* Prof. **Figueiro,** Challenges to be faced on next generation of human centred lighting Prof. **Rea,** Uniting the science of circadian rhythms with real lighting applications and especially with hospitals and nursing homes Moderator: **JM López-Higuera**	
16:40	**Prof. José Capmany** Director, iTEAM Institute Technical University of Valencia, Valencia, Spain Microwave Photonics		**Prof. Andrea Cusano** Head, Optoelectronic and Photonic Group Università degli Studi del Sannio, Benevento (UniSannio), Italy Lab On Fiber: a key enabling technology for Precision Medicine		
17:55			**Family Photo** **Santander City Council Reception**		

Figure 8.-ISLIST-2024 General Schedule.

The **ISLIST-2024 Speakers** are also, shown in the figure 9.

Figure 9.-ISLIST-2024 Speakers (by apparition order).

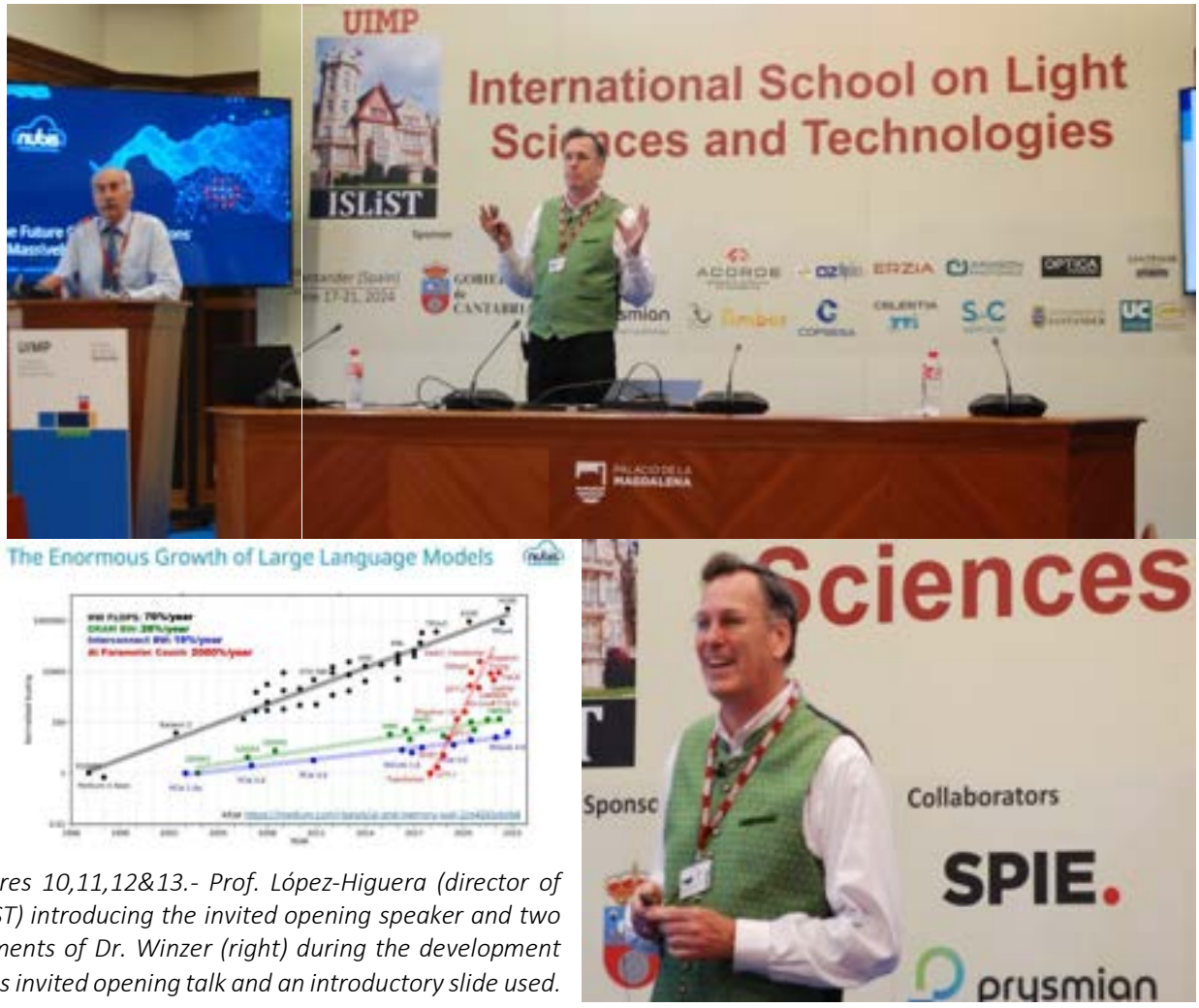
3.2 Invited Talks and Round Tables in the frame of VII-ISLIST

After the Opening Ceremony, from June 17 to June 21, 2023, 17 invited talks and two Round Tables were developed. All photos used in this report are courtesy of the Photonics Engieering Group of University of Cantabria.

Dr. Peter I. Winzer *(Founder and Chief Technical Officer, CTO of Nubis Communications, Bell Labs Fellow, Fellow of the IEEE, Optica, and the US National Academy of Inventors, and an elected member of the US National Academy of Engineering)* delivered an outstanding, clarifying, inspiring and useful opening invited lecture entitled ***The Next Generation of Optical Communications will be massively Parallel.***

Dr. Winzer started his talk with a brief review of the background in what he enphasized the very hight growth rate experimented by the communication systems consequence of the enormous requirements of the flux data in the world what trend will remain in the coming years. By using top quality slides in his presentation, he insisted in the fact that, over the past decade, the high-speed communications technologies reached severe scalability limits, from shortreach electrical chip-to-chip interconnects to ultra-long-haul subsea optical fiber cables. He commented that while these scalability limits have **different origins ranging from saturating** high-speed electronics bit rates, to systems approaching fiber.

Dr. Winzer then explained the fact on what must be invested R&D&I works to face the required challenges. Then he added that taking in consideration Shannon capacities, to energy



Figures 10,11,12&13.- Prof. López-Higuera (director of ISLIST) introducing the invited opening speaker and two moments of Dr. Winzer (right) during the development of his invited opening talk and an introductory slide used.

density/distribution limits, there seems to be only a single long-term viable solution that is common to economically overcome all these limits up to reach his **final conclusion**: *the future of communications is /will be massively parallel.* Massively integrated spatial parallelisms technologies will be key for short-reach optical links for ML/AI clusters and also for long-haul optical links spanning continents.

Prof. **Michael Leeby** (*Chief Executive Officer, CEO of Lightwave Logic, San Francisco, USA and Chair of the Corporate Engagement Council and Board Member of Optica*) developed the invited lecture on **Next Generation of Photonic Integrated Circuits (PICs) for communications and sensing and associated PIC roadmap over the next decade.**

He started with a brief introduction concerning electro-optic (EO) polymer modulators, and especially slot modulators as a hot topic in the industry in the currents as the industry strives to increase modulation speed while reducing optical network equipment power consumption.

He added that EO polymers are currently applied to silicon photonics wafers to increase the performance of silicon photonics PICs. Dr. Lebby remarked the key advantages offered by the EO Polymers and after that, he discuseed about the latest results with commercial grade electro-optic polymer materials that are being licensed for device applications for datacom at 1310 and 1550nm. He mentioned that as silicon foundry fabricated silicon slot modulators, polymer PIC device designs for use with integrated photonics platforms can also be fabricated.

Figure 14&15. Prof. Leeby in two moments one along his lecture and other answering a question from one attendee.

Material and device demonstrations showed that EO polymers exceeding electro-optical and electrical 3dB bandwidths of 110GHz, low voltage, and very small form factors, he added. He also presented reliability and stability results that are suggesting the robustness of the technology platform with respect to thermal and photostability.

Finally, Prof. Leeby discussed the Photonic PIC technology roadmaps for the next decade showing the expected technology advancements and customer performances.

Figures 16,17&18.- A moment during the development of Prof. Capmany s first invited talk. Prof. López-Higuera (director of ISLIST) introducing the questions and comments time invited speaker (lower left) and the invitee answering one of the very interesting questions answered.

Two very interesting and didactic invited talks were developed along the afternoon session by Prof. **Jose Capmany** (Director of Photonic Research Lab, iTEAM Institute, of the Technical University of Valencia, Spain; Fellow of Optica (former Optical Society of America, OSA) and the Institute of Electrical and Electronics Engineers, IEEE). In his first talk, the lecturer spoke about **Programmable integrated Photonic Circuits: what? why? and when?**

Prof. Capmany started his presentation with a brief introduction emphasizing that photonic devices and systems embed the unique properties of light for the transmission and processing of information into a semiconductor chip.

He also commented that by incorporating photonic functions into integrated circuits and using light instead of electric current to transmit information and to take over some of the information processing operations, the speed and energy consumption limitations of conventional computing approaches can be overcome. He added that despite the considerable progress, such integrated photonic chips have been designed and fabricated separately for each different specialized task – so-called "application-specific" photonic chips what increases engineering cost, reduces possible economies of scale, and inhibits adaptability to different scenarios and changing requirements.

Then, Prof. Capmany stated that programmable integrated photonics is emerging as a disruptive revolution in the traditional world of application-specific photonic circuits. While application-specific chips are designed for a fixed task and cannot adapt to changes in the operating conditions or system requirements, programmable integrated photonics offers a new paradigm of manipulating light with unprecedented versatility.

In summary Prof, Capmany very didactic, comprehensive and useful lecture addressed the essential principles, fundamentals and applications of this emerging programmable integrated Photonic Circuits technology.

In his second invited lecture, Prof. **Capmany** spoke about one of the topics in which he is considered a reputed expert: **Microwave Photonics (MP)**

He defined the field as an interdisciplinary one that combines microwave engineering and photonic technology for the generation, transmission, processing, and control of microwave signals, to take advantage of the broad bandwidth, high frequency, and low loss offered by modern photonics. MP has been intensively researched for the last few decades, and numerous solutions have been proposed and demonstrated, He added.

Figure 19. Prof. Capmany starting his second invited talk.

Figure 20&21. VII-ISLIST participants following the Prof. Capmany (below right) explanations to a question addressed after his second invited lecture.

During his very well documented lecture, Prof. Capmany, offered to the VII-ISLIST an comprehensive overview concerning MP covering the basic concepts, photonic-assisted microwave signal generations and analog to digital conversion, photonic-assisted microwave signal processing, and true time delay beamforming. He also reviewed the implementation of microwave photonic systems based on photonic integrated circuits, including the design, fabrication, and material platforms, application-specific photonic integrated circuits for microwave photonics, and, programmable integrated microwave photonics. He concluded discussing the challenges and potential future applications of technologies of this very interesting field.

Prof. Francesco Poletti (Head of Hollow Core Fibres Group and also at Microsoft Azure Fibre, Romsey, UK), delivered a lecture entitled **Hollow Core Optical fibres: a revolutionary technology for optical communications, quantum applications and laser delivery.**

Figure 22&23. Prof. Poletti in two moments along his invited lecture.

He exposed briefly key pieces of research mentioning that hollow-core fibres have had intrigued investigators for decades evolving from scientific curiosities to relevant technological advances enablers of current practical innovations. Dr. Poletti emphasized recent breakthrough designs that have transformed them from scientific tools to real-world products. By guiding light through air (instead by glass) outperforming traditional glass-based ones offering the limitations imposed by glass-light interactions, he added. As consequence, these novel fibres allow launching more power without fibre damage, transmit information a higher speed, losing less power as light propagates and are able to operate at customized wavelengths.

In summary, along his lecture Prof. Poletti offered a complete review, very well justified, of the current state of the art and key advancements of novel hollow core optical fibre technology capable to offers very remarkable opportunities that were unthinkable in previous times.

Figure 24&25. Dra. Elisabetta Rugi delivering her lecture and, after that, answering very interesting questions from school's participants.

Dra. Elisabetta Rugi Grondi *(CEO of Thales Alenia Space Swirtzerland and* member of the Swiss Federal Commission for Space Affairs*) who's team is very active in optical communications payloads for direct to Earth applications from LEO and GEO and on products for inter-satellite links in constellations* developed the inspirational lecture entitled: **Optical communications in space: Currents and trends.**

She started by recalling that despite that the first activities in the field of optical communications for space applications are from more than 25 years, nevertheless the use of this technology in this field is still limited or is just taking up. After this statement, Dra. Rugi asked key questions and, after each one, she answered using supporting references as methodology to develop very didactically her talk. Some of the questions were: Why? What has been done and what are the present fields of application and trends for the use of optical communication in space? What are the challenges and the opportunities? She also spoke briefly about relevant aspects that are necessary to take into account to implement successful implementations of this technology in present and future space programs. Aspects such as standardization, interoperability, complexity, costs and business cases were commented. Finally, Dra. Rugi shared with the attendees a long-term vision for a new era of space missions.

Figure 24,27&28. Prof. Koonen delivering his lecture and, after that, answering very interesting questions from school´s participants.

Prof. Ton Koonen *(Emeritus Professor of University of Technology, Eindhoven, and former Scientific director of the Institute for Photonic Integration at TU/e, Netherlands, Paises Bajos),* delivered his invited lecture entitled **Optical Wireless Communication –a green wireless communication technology with high potential and great prospects.**

Prof. Koonen started his talk emphasizing the need for wireless communication is growing fast, driven by the growing numbers of people who want to use broadband internet services, fast data file

transfer, video streaming, among others, wherever they are; He also mentioned that this growth is also fueled by the internet-of-things. Then he added that wireless communication by radio techniques (such as WiFi and 5G) are running into its limits due to spectrum congestion within the (licensed) RF bands and crosstalk in densely populated areas. Optical wireless communication by steered narrow beams can alleviate these mentioned problems, as it can provide 'fiber-like' high capacity at high user densities without causing crosstalk and experiencing congestion in the abundant optical spectrum available, he added. He also remarked that OWC is highly energy efficient, it is capable to offer capacity only where and when needed, and it is free from electro-magnetic interference issues.

In short, along his very impressive lecture, Prof. Koonen, offered a brief and comprehensive overview concerning the state-of-the-art in Optical wireless communication (OWC), discussed both the pros and cons of beam-steered OWC and also how the key functions can be implemented and show how these have been realized and validated in bidirectional experimental OWC systems featuring high-definition video streaming. He concluded his talk with the presentation of the main concluding remarks.

During the Round Table I on **Challenges to face on communications**, both the attendees and the invitees enjoyed a very interesting round table with very actives participations from both sides. After the moderator's presentation, each of the invited panellists presented their brief statement on their previously allocated topics.

Figure 29.- Round Table I: Challenges on Communications. *From left to right hand: Prof. Koonen, Dr. Winzer, Dra. Rugi and Prof. López-Higuera.*

The topics on Challenges to face on,were: ***massive integrated spatial parallelism in future Optical Communications*** (**Dr., Winzer**, **Founder and Chief Technical Officer, CTO,** Nubis Com, USA); ***high Performance Polymer Photonics for Next Generation PICs*** (**Prof. Leeby,** **Chief Executive Officer**, **CEO**, Lightwave Logic, San Francisco, USA)**;** ***Laser-based communications in Space in the Era of 6G*** (**Dra. Rugi Grond**, **CEO**, Thales Alenia Space, Switzerland, Switzerland) and **in indoor OWC*communications in Space in the Era of 6G*** *by (***Prof***,* **Koonen,** University of Technology, Eindhoven, Netherlands, Paises Bajos) were, opportunely presented and discussed by each of the panellists.

Then, each member of the panel took the opportunity to debate different aspects among the panelists. After that, attendees asked 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 from the attendees and discussions from both sides also took place. After two and half hours, the round table concluded with several open questions and also with very interesting conclusions and statements.

Figure 30.- The panelists and the coordinator during a moment of their interventions in the round table I.

Figure31,32&33. Prof. Maria Angeles Quintela doing the presentation of the speaker Prof. López-Higuera delivering his lecture and, after that, a school´s participant asking one of the interesting addressed questions.

Prof. **López-Higuera,** *Professor and Head of Photonics Engineering Group of University of Cantabria, CIBER-BBN and IDIVAL, Spain)* delivered his invited lecture entitled **Sensing using Light: doctrinal conception, currents and trends.**

He first of all emphasized the relevance of Light Sciences and Technologies (Photonics) by recalling to the attendees the un-paramount number awardees with the Nobel Prize recognizing relevant works based on light approaches for the advancement of the humans along the recent 10 years. Then he spoke about what should be under-stood as Photonics and, also remarked the fact that 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. Then very briefly, summarized some key properties of Light and reviewed some key doctrinal conceptions to understand the use of light approached in communications, sensing and lighting. Then, he went into the core of the lecture presenting a doctrinal conception that will enable a comprehensive understanding of any sensor using light-based technologies including their constituent parts and types. To enable a better understanding

of the proposed doctrinal conception and to demonstrated to the participants that is a flexible a useful doctrinal conception, Prof. Lopez-Higuera offered a concise overview of important cases using different sensing principles, techniques, technologies, to detect a wide set of different parameters (measurands) and inside different sector applications such as civil engineering, industrial processes, health and medicine, environment, energy, among others.

He also offered a brief and synthetic overview concerning currents state of the market and trends for the near future.

During the conclusions, Prof. López Higuera emphasized that by using the proposed doctrinal conception, any sensing approach using light can be easily identified as a light-based sensor or Photonic sensor in which optical fiber sensors are, really, a particular case.

Figure 34,35&36. Two moments of Dra. Sinead O´Keeffe *invited lecture and a sample of the slides used.*

Dra. **Sinead O´Keefe** *(Optical fibre Sensors Research Centre and Health Research Institute of University of Limerick, Ireland),* spoke concerning **optical Fibre Sensors for Radiotherapy Dosimetry: Challenges and Opportunities**

She, started her talk reviewing key concepts for radiotherapy in medicine. She stooks that it is the use of ionising radiation for the treatment of cancer emphasizing that between 50 to 60 % of patients commonly require this type of treatment at some point during their treatment.

Optical fibre sensors have demonstrated excellent potential for radiotherapy dosimetry, due to their small size, high sensitivity, immunity to electromagnetic interference and remote sensing capability, she added. Dra. O´Keeffe mentioned that, monitoring radiation doses within clinical environments presents a number of significant challenges that must be overcome before optical fibre dosimeters will be embraced by the clinical end users. The low doses, wide ranging dose rates and varying radiation energies, associated with radiotherapy, all compound the complexities of dosimetry in this application area, she added.

Dra. O´Keefe, finally, in her very interesting and useful presented their latest advances in optical fibre sensors for radiation dosimetry, with a particular focus on radiotherapy dosimetry, and discuss the main challenges and opportunities for improving patient outcomes.

Dr. **Vincent Monoret** (Head of Quantum Sensors R&D Exail Quantum Systems, Institut d'Optique d'Aquitaine, Talence, France) spoke about **quantum sensors for field applications.**

He started his lecture mentioning that quantum inertial sensors based on matter-wave interferometry with laser-cooled atoms have significantly improved over the last decade. Quantum gravimeters are industrially and technically mature for large-scale use in field conditions, he added. Dr. Menoret, remarked that, they are deployed in challenging environments around the world and provide

Figure 37,38&39. Session chair presenting the invited speaker and two moments Dr. Menoret

valuable data for geophysiscists studying hydrology, geodesy or volcanology. To go from static measurements to larger scale mapping, we have developed a differential quantum gravimeter, he added. Our development, is particularly suited to the detection of small sources at shallow depths while operating at the quantum projection noise limit, he remarked.

Then he spoke about the next generation of quantum sensors that will be able to operate on moving platforms, explaining the reasons for what this is a challenging task because atom interferometers have an intrinsically small dynamic range. He also explained how his team is addressing this challenge by hybridizing the quantum sensor with classical accelerometers and fiber-optic gyroscopes in a 'best of both worlds' approach.

Finally, during the concluding remarks he mentioned that their recent results are paving the way to onboard quantum sensor applications in sectors such as geophysics and inertial navigation.

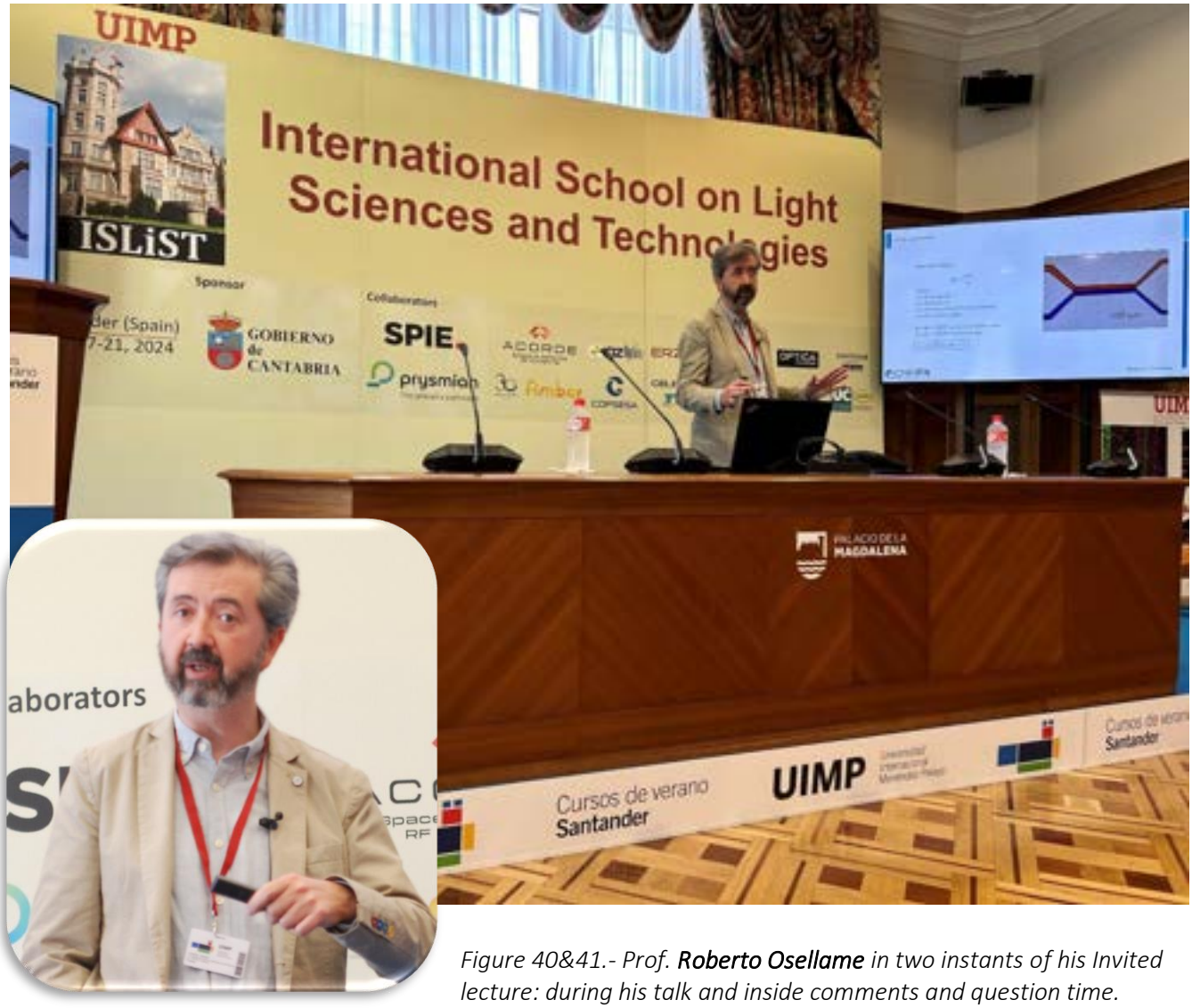


Figure 40&41.- Prof. ***Roberto Osellame*** *in two instants of his Invited lecture: during his talk and inside comments and question time.*

Prof. **Roberto Osellame** (Research Director of Institute for Photonics and Nanotechnologies, CNR, Milano, Italy), spoke about **advanced photonic and optofluidic devices fabricated in glass using femtosecond lasers for Lab-On-Chip sensors**.

He started his brilliant talk doing an overview about key concepts for an appropriate following and understanding of the talk. He mentioned that femtosecond laser micromachining (FLM) is rapidly becoming a widely appreciated method for processing transparent materials that are very relevant for optofluidic devices. By being contactless, maskless, cost-effective and capable of 3D structuring, this laser processing technology is raising great interest both in scientific as well as in industrial applications, he added. Its properties are particularly advantageous for the realization of lab-on-chip devices where the combination of microfluidics and photonic components enable the integrated manipulation and high-quality imaging of biological samples, from organoids to single cells, he added.

As concluding remarks, Prof. Osellame, in short, remarked mainly: that capabilities of FLM have been fundamental for the successful fabrication of advanced integrated system; and also, that structured LSFM on chip has enabled 3D imaging, high throughput and automation and, enhanced resolution and improved contrast.

Figure 42&43.- Prof. ***Andrea Cussano*** *in two instants of his Invited lecture: during his talk and inside comments and question time.*

Prof. Andrea Cussano (Head of Optoelectronic and Photonic Group of Università degli Studi del Sannio, Benevento (UniSannio), Optoelectronics and Photonic Research Center for Life Science –CNOS, Italy) was focused on the topic Lab on Fiber: A key enabling technology for precision medicine.

He started his presentation by recalling that 2000 years ago, Hippocrates recognized that "The right therapy depends exclusively on the right diagnosis". He thus anticipated what we now call the era of personalized medicine, in which treatments are selected on the basis of individual molecular markers in order to obtain a precise diagnosis and find the right treatment for the right patient at the right time, he added.

In the mentioned context, Lab on fiber technology was introduced ten years ago as a promising key enabling technology aimed to develop new theranostic devices that can be integrated into the working channels of mini-invasive clinical instruments (needles, catheters and nano-endoscopes) for in vivo liquid and tissue biopsy, supporting light-assisted local therapies, he added. After one-decade, new functionalities and unprecedented performances have been achieved connected with relevant milestones and significant breakthroughs, showing that lab on fiber technology is much more than a simple vision, especially when personalized life sciences are envisaged as a target application area.

Prof. Cussano concluded his excellent and enthusiastic invited lecture by given to the attendees several **scientific and real-life take-home messages** to bridge the gap between the past and the future and with a final statement: ***Never forget that your goals are only the starting point and not the arrival one*****!**

Figure 44&45. Prof. Grattan in two moments during his invited lecture.

Optical sensing technologies for key environmental measurands in the I4.0 era was the subject addressed by **Professor Kenneth Grattan** (OBE, FREng, Royal Academy of Engineering, Director of Instrumentation & Sensors Research Centre, City-University of London, UK)**.**

He started his lecture reviewing the situation of Optical Fibre Sensors (OFS) in what he mentioned that this area of sensors has been developed extensively now over some four decades and more. It has refined during that time to address a range of challenging industrial applications, usually where conventional sensors often are badly conditioned and do not fit well, especially for 'niche' sensing needs, he added.

Prof. Grattan emphasized that such sensing systems are required to enhance safety, to allow assets to be used for longer, to schedule repair and maintenance better and to create a more cost effectively and improve the working environment for us all. The 'Grand Challenges' that will transform our world have produced many interesting opportunities for new sensor systems, he added.

Summing up, along the comprehensive, didactic and useful invited lecture Prof. Grattan reviewed, focused on a series of 'case studies' carried out at City, University of London, the essential background to optical fibre sensors and then looked at how a range of optical fibre-based techniques can be applied to topical problems and offer alternative, and better solutions to those from current technologies to enhance the environment and respond to the I4.0 era in which we are living and working.

Figure 46&47. Prof. Pruneri answering questions after his presentation and during his invited lecture.

Prof. Valerio Pruneri (Head of Optoelectronics Group of Instituto de Ciencias Fotónicas, ICFO, Barcelona, Spain) spoke about **Engineered surfaces and devices for the display and imaging industries.**

Prof. Pruneri started his presentation mentioning the strong interest and incredible potential on increasing light-matter interaction, interference effects and enhancing surface properties for display and imaging. Then, he reviewed some state-of-the-art and present the group's research on nano-structured transparent surfaces and devices for display screens with multiple functionalities and imaging systems. He emphasized, in particular, novel designs and implementations of transparent screens with conductive, antireflective or antimicrobial properties; large-field-of-view phase imagers for detecting material defects, morphology, biomarkers or cells with light matter interaction enhanced by nano-structuring; and finally, quantum-enhanced imaging using photon correlations and entanglement

Figure 48&49. Prof. Sonia Martín answering questions after her invited lecture presentation and hearing another comment and question from VII-ISLIST attendees.

Prof. **Sonia Martin** Lopez (Co-Head of Photonics Engineering Group, of Alcala de Henares, Spain) developed her invited lecture on **Distributed Acoustic Sensors (DAS) for Seafloor Seismic Monitoring: from earthquakes to tsunamis.**

She recalled ISLIST´s attendees that in recent decades, the massive use of telecommunications has driven the need to lay millions of kilometers of optical fiber cables all over the planet, particularly in the oceans. Then, she shared recent developments in the field of fiber optic sensing have revealed the possibility of transforming all these cables into powerful arrays of geophysical sensors. They, are capable of measuring variables such as deformation and temperature with high sensitivity, over tens of kilometers of distance and providing spatial information, she added.

In short, Prof. Martin along her very well explained invited lecture reviewed the key technological aspects behind these distributed acoustic sensors their high application potential with special attention to the performance achievable in Seafloor Seismic Monitoring: from earthquakes to tsunamis.

Figures 50. Prof. Rea on a moment along his statement and also panelist (Prof. Figueiro, Grattan, Osellame) and moderator (Prof. López-Higuera) of the round table II.

During the Round Table II on Challenges to face on **optical sensing technologies for real industrial applications and Lighting,** the participants experienced a very interesting round table with very actives participations from both sides. Moderated by the director of ISLIST five relevant professionals, on their respective area of expertise, integrated the panel. After the presentation by the moderator, each of the invited panellists presented their brief initial statement on their previously allocated topic. They were:

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Challenges to face on

Prof. Roberto Osellame, Director, Institute of Photonics and Nanotechnologie-CNR,Milano Polytechnic, Italy.

to reach useful integrated advanced microscopy in optofluidic Lab-on-Chip devices

Prof. **Kennet Grattan,** Director of Instrumentation & Sensors Research Centre, City-University of London, UK

optical sensing technologies for real industrial applications

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

to be faced on next generation of human centred lighting

Prof. **Mark Rea,** Former director of LRCR Polytechnic Institute; now at Icahn School of Medicine at Mount Sinai, NY, USA

uniting the science of circadian rhythms with real lighting applications and especially with hospitals and

Figures51,52,53,54&55.- The panelists (Professors Osellame, Grattan, Figueiro and Rea) and moderator (Prof. López-Higuera) on several instants of their corresponding interventions. along the round table II.

nursing homes

The round table took, then, the common format and each of the panelist addressed their respective initial statement. Then, each member of the panel took the opportunity to debate different aspects among the panelists. After that, attendees asked a very significant number of 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 from the attendees and also discussions were established from both sides. After two hours, the round table concluded with several open questions and also with very interesting and useful thoughts and conclusions.

3.3.-Especial session on LIGHTING

Taking into account the key roll that light plays in live of humans, an especial session on Ligthing was included in the VII-ISLIST programme. To speak about it, two of the more respected Scientifics world-wide were invited: Prof. Mar Rea and Prof. Mariana Figueiro both from Icahn School of Medicine at Mount Sinaí, New York, USA.

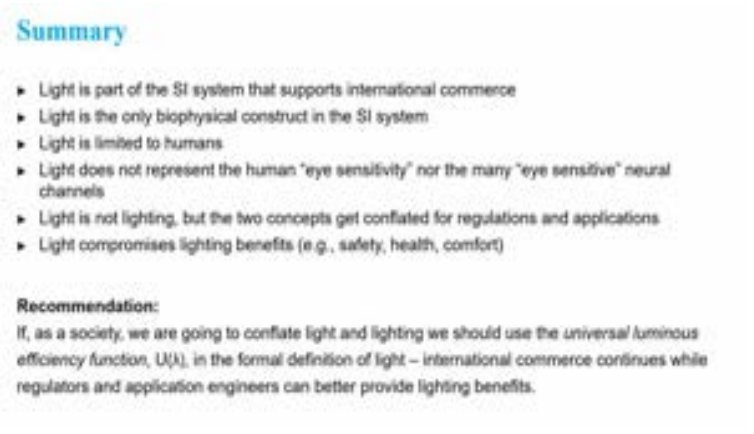
Prof. **Mark Rea** (Former Director of Lighting Research Cener Rensselaer Polytechnic Institute; now at Icahn School of Medicine at Mount Sinai, New York, USA) in his closing invited lecture spoke about how can be translated **Light's effects on human health, well-being, and behaviours.**

He began his outstanding talk by reviewing some fundamentals about the key behaviors of light to use it properly. He stated that light is a biophysical construct, unlike all other Standard International (SI) quantities and units characterizing the physical world. Then Prof. Rea mentioned that the candela quantifies light in terms of radiant intensity spectrally weighted in terms of the photopic luminous efficiency function, ***c*** derived from human vision experiments conducted in the 1920s. From the candela, all other photometric quantities and units can be derived: *luminous flux* (lumens), *illuminance* (lux), and *luminance* (nits), he added. Then, he higlighted that technically, light as defined in the SI system has no meaning to any other species, plant or animal, because their spectral sensitivities to optical radiation are different and never the same as $\boldsymbol{V}_{(l)}$.

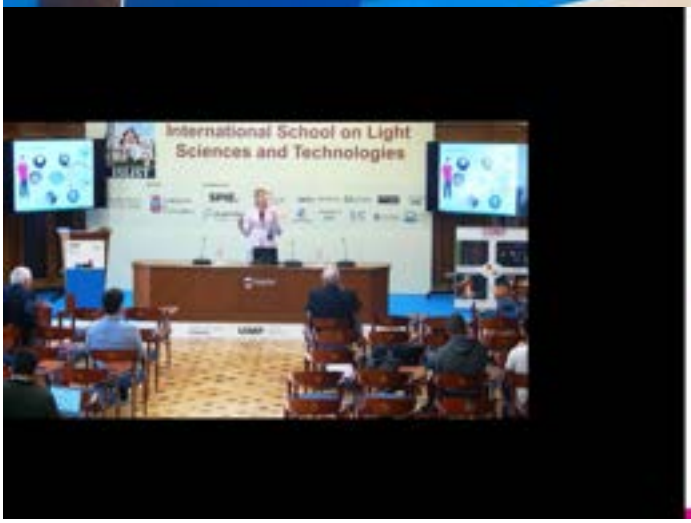
Thus, instruments calibrated in terms of V(l) can seriously mislead scientific investigation when it has been assumed that the instrumentation is agnostic with respect to the species under study, he commented. Then he stated that there are multiple spectral sensitivity functions for humans, so light as it is formally defined has no meaning for quantifying the photic stimulus for many important human visual and non-visual functions like detection of moving objects in the periphery, glare judgments of automobile headlights, or regulation of circadian rhythms. Here again, scientists can be misled by photometric measurements based upon $\boldsymbol{V}_{(l)}$.

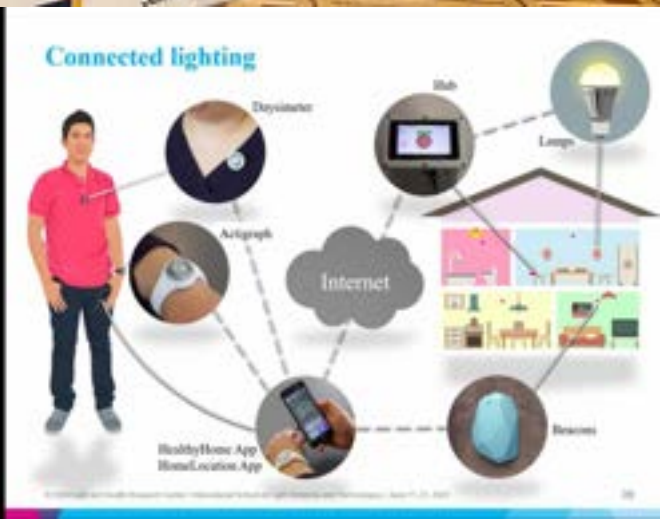
In **summary**, in his outstanding and useful invited lecture Prof. Rea described how the definition of light was developed, its limitations as a SI quantity, and how a family of spectral sensitivity functions can be used to quantify optical radiation in terms of important human visual and non-visual functions.

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



*Figures 56&57.-**ESPECIAL SESSION ON LIGHTHING:** Prof. Rea during a moment of his invited talk and stablished the final conclusions*





*Figures 58&59.-**ESPECIAL SESSION ON LIGHTHING:** Prof. Figueiro during two moments of his invited talk.*

Prof. **Mariana Figueiro** (Director, Light and Research Center, (LHRC), Icahn School of Medicine, Mount Sinai, NY, USA) spoke about **Principles of Indoor and Outdoor Lighting for Healthy Environments.**

She began her invited lecture by reviewing some interaction effects between light and the eyes, such as those that occur when light hitting the retina affects humans through three systems: visual, non-visual and perceptual. While the lighting characteristics affecting these systems differ, lighting designed to promote human health can effectively and comfortably meet the needs of all three systems, he added.

In short, Professor Figueiro described the visual, non-visual and perceptual systems, specifically focusing on how they are affected by the quantity, spectrum, time, duration and distribution of light stimuli. He then discussed key principles for designing and applying indoor and outdoor lighting to promote health and well-being. Emphasizing in particular real-world examples of how simple, energy-efficient sensing technologies can be used to achieve both indoor and outdoor lighting to promote health and well-being, she concluded her excellent, very well explained and useful lecture.

3.4 Some moments during the talks and free times

Figure 60.- A view of Dr. ***Winzer*** *and participants inside the VII-ISLIST room during the invited opening talk*

Figures 61,62 &63- A view of Professors ***Leeby****,* ***Capman****y and* ***Poletti*** *participants inside the VII-ISLIST room during their invited talks.*

Figures 64,65 &66.- A view of Dra. ***Rugir,*** *Prof.* ***Koonen*** *and participants inside the VII-ISLIST Room during their invited talk and also the secretary of the school Prof.* ***Quintela*** *introducing a speaker.*

Figures 67,68 &69.- A view of Dra. ***O´Keefe*** *, Prof.* ***Cussano*** *and Dr.* ***Menoret*** *and participants inside the VII-ISLIST room during their invited talks..*

Figures70,71 &72.- A view of Professors ***Osellame****,* ***Pruneri*** *and* ***Grattan*** *during moments of their invited talks.*

Figures73&74.- A view of Prof. ***Martin Lopez****, and participants inside the VII-ISLIST Room during her invited talk. Also (below) the four participants in the round table II with the coordinator during a moment inside the discussion of one aspect of the addressed topic.*

Figures 75 &76.- Two moments during the development of round table II.

Figure 77&78.- VII-ISLIST´s participants during socializing times.

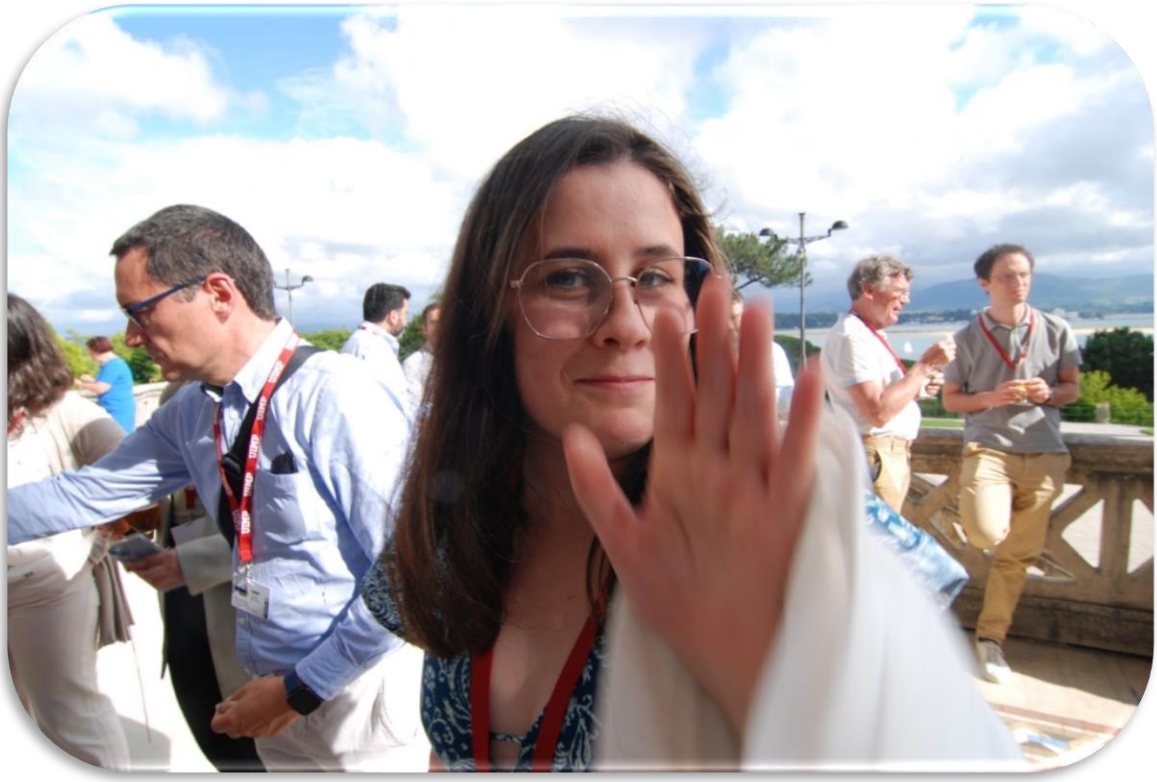


Figure 79&80.- VII-ISLIST´s participants during socializing and networking times

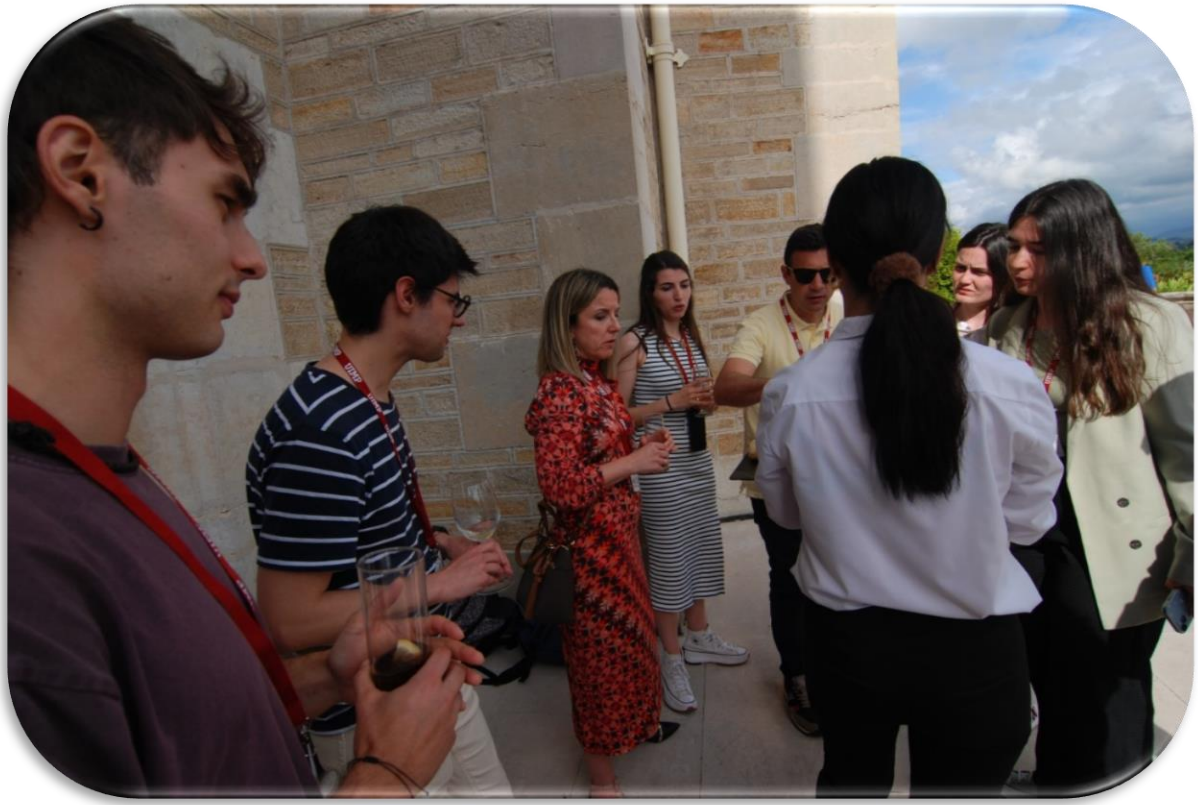


Figure 81&82.- VII-ISLIST´s participants during socializing and networking times

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

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

VII-ISLiST 2024 Family Photo

Figures 85,86&87.- VII-ISLIST´s participants in the Royal Hall during the welcome words from the chancellor of Santander Council Mss. ***Gema Igual*** *(below lefth) and from the Rector of UIMP Prof.* ***Carlos Andradas*** *(below right) addressing the acknowledging to Santander Council for their collaboration to reach the objectives of this International School*

The Santander Council was very pleased to offer to ISLIST attendees a Special Reception. It was a great opportunity to chat, to do networking and to share experiences, enjoying with snacks and drinks inside an incredible nice environment in the Royal Hall at Magdalena Palace.

Figure 88.- Distended moments during the Santander council Reception at the Royal Hall at the Magdalena Palace

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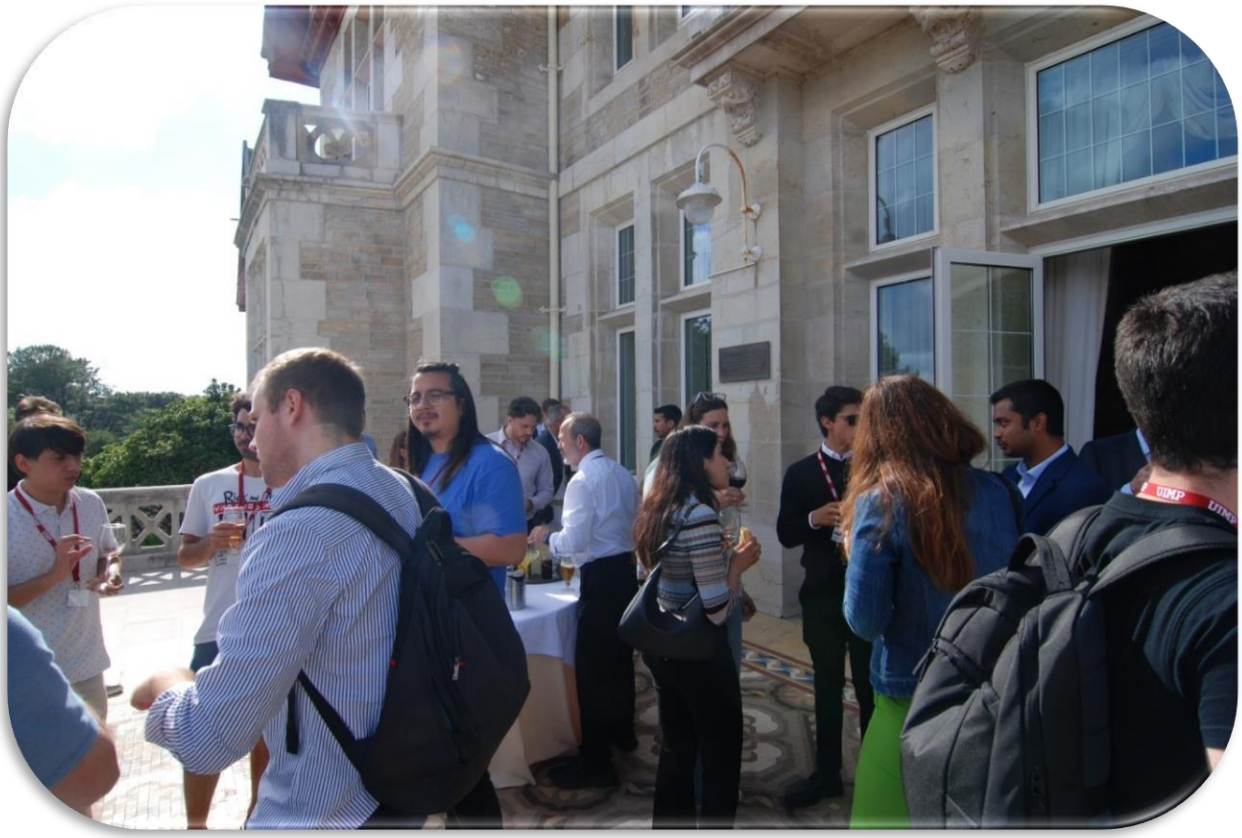

Figures 89-97.- VII-ISLIST´s participants in the Royal Hall during the welcome words from the chancellor of Santander Council Mss. ***Gema Igual*** *(below lefth) and from the Rector of UIMP Prof.* ***Carlos Andradas*** *(below right) addressing the acknowledging to Santander Council for their collaboration to reach the objectives of this International School*

5. Open meeting with Professor Juan Ignacio Cirac

The academic opening ceremony of the Summer Courses of UIMP at the Magdalena Palace in Santander took place on June 20, 2024. In this ceremony, the inaugural lecture was given by Prof. **Juan**

Figures 98&99.- VII-ISLIST´s Students asking questions during the meeting with prof. ***Cirac****.*

Ignacio Cirac, very well-known quantum physicist and director of the Max Plan Institute of Quantum Optical in Garching, Germany, entitled Quantum technology: dream or reality?

In the afternoon, Prof. **Cirac** had a very rich and interesting conversation with VII-ISLIST students at an event open to the public in the Magdalena Auditorium. In a packed auditorium at the meeting, each VII-ISLIST student on stage had the opportunity to ask what they considered appropriate and to dialogue with Professor Cirac in an environment of freedom as it is expected inside a university.

Figures 100.- VII-ISLIST´s Students at the end of the meeting with prof. ***Cirac****.*

There were numerous questions and comments raised by the VII-ISLIST students, and Prof. Cirac's answers were very illuminating and in simple and familiar language. After about 2 hours, the meeting ended in an atmosphere of cordiality and great satisfaction.

6.-VII-ISLIST 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 three or fourth week of June**) on *Light Sciences and Technologies* in Santander, Spain. He also spoke about the general vision and mission of UIMP.

Figures 101.- Opening Ceremony of VI ISLIST presided by Prof. Matorras Vicechancellor of UIMP.

The IIV 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 of fourth week of June of every year with different core. Then he offered and overview of the previous ISLIST editions. 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.

The ISLIST director explained how the school was planned to be developed along the week including the special and exceptional events included in the programme. He presented also the statistics concerning the participants on the school and concluded with acknowledgement words for the Sponsors and Collaborators with special thanks to all the Invited Speakers selected among the world-wide leader authorities in their respective matters. He added special mentions to the of the secretary of the international school, Maria Angeles Quintela to his secretary Maria Ruiz, both at University of Cantabria and also, to Beatriz Moreno the technician allocated to this school by UIMP

Figure 102.- The ISLIST´Director and Secretary during the Concluding Remarks and announcement of the ISLIST 2025.

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) is, in real terms, corroborate her words.

Then, ISLIST director shared with the attendees his satisfaction with the contribution of ISLIST to reach, without any debt, the objectives of the UIMP (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 several different nationalities) is, in real terms, corroborate his words. Then, he offered and overview of the development of the seventh ISLIST edition. Illustrating his words with some slides created along the week, he remarked that it was very educative the discussions and suggestions lived actively among all during the two round-tables programmed to identify, analyse and discussed challenges to face on both areas of the core. *"All of you have had the opportunity to chatting, 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 that took place 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 Studenst Grants will not be posible*", 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 also along the week.

Finally, the director of the school declared closed the VII ISLIST and announced that the eight International School on Light Sciences and Technologies next year 2025. The VII ISLIST will have the Main Core on **Light on Energy, Enviromment and Laser Manufacturing**. It will be developed during the week of June 16-20, 2025.

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 VII-ISLIST Secretary proceeded to call in blocks of attendees (following alphabetical order) to whom a group of guest speakers, the Director of ISLIST and several invited speakers delivered the Diplomas to their corresponding recipients. Here are some samples of attendees holding their Diploma.

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Figure 103,104 &105.- Professors, Grattan and O´keefe VII- invited lecturers and the Director with VII-ISLIST attendees with their respective official certificates.

7. 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!

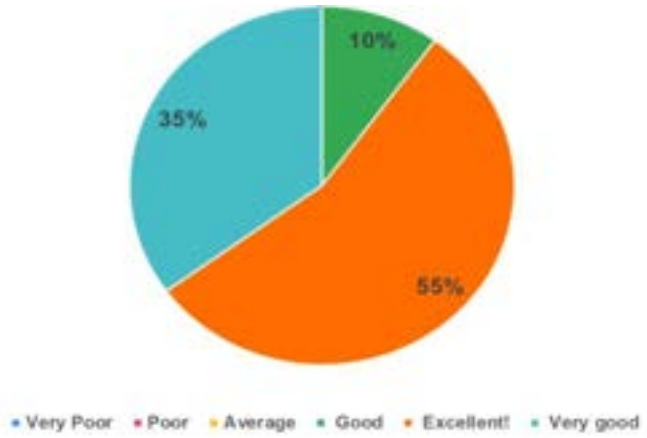
Q8*-Please, tell us about the best things of the school (what we should go on considering in future editions)*

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

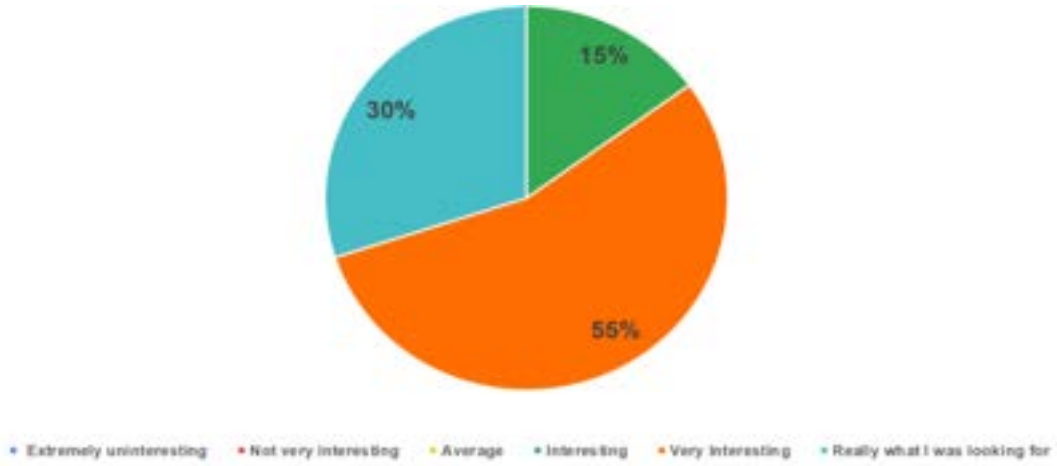
Q10*-Do you have any suggestions, comments ...?*

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

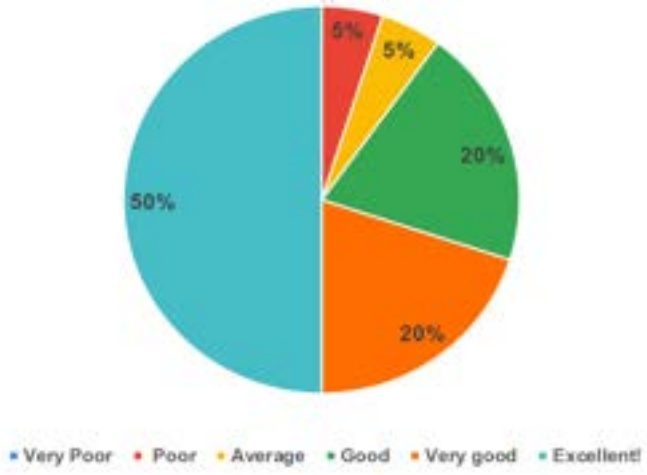
Q1-Please indicate your overall opinion regarding the quality of the invited speakers



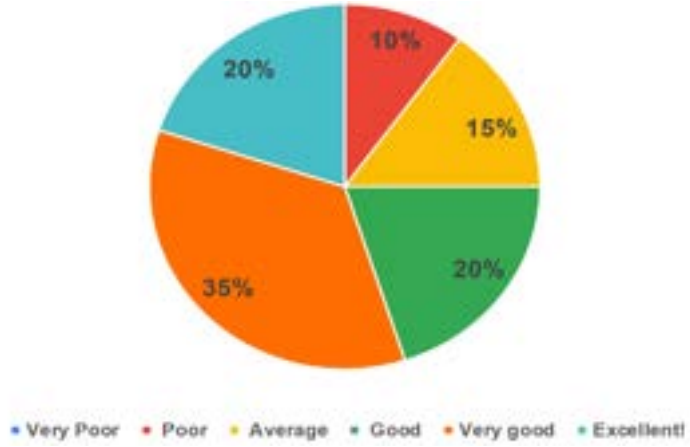
Q2-Please indicate your overall opinion regarding the topics of the talks



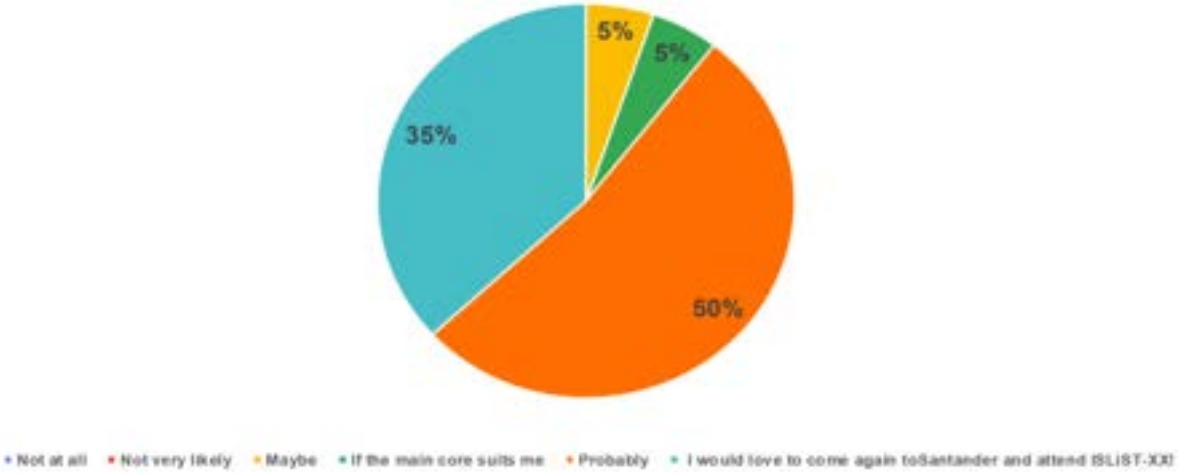
Q3-Please indicate your overall opinion regarding the ORGANIZATION of the school



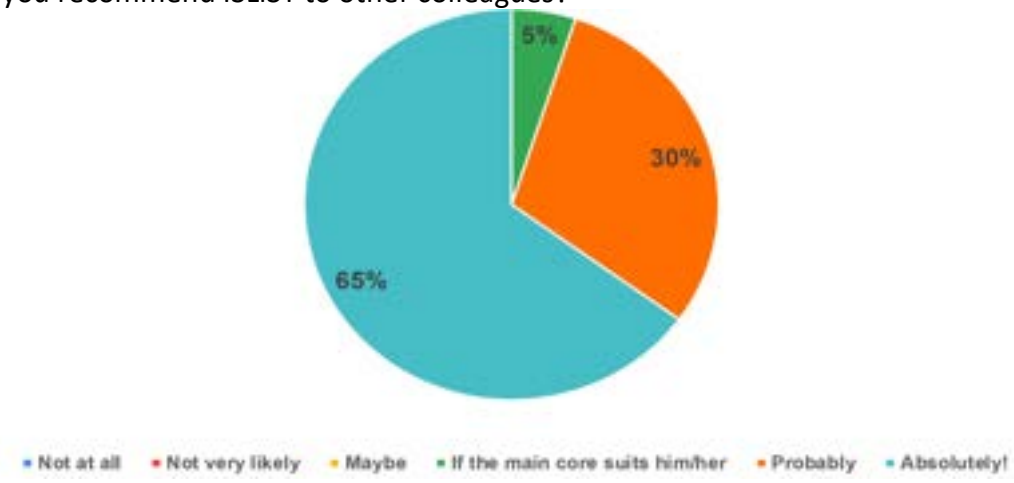
Q4-Please indicate your overall opinion regarding the INFORMATION that you received before attending the school



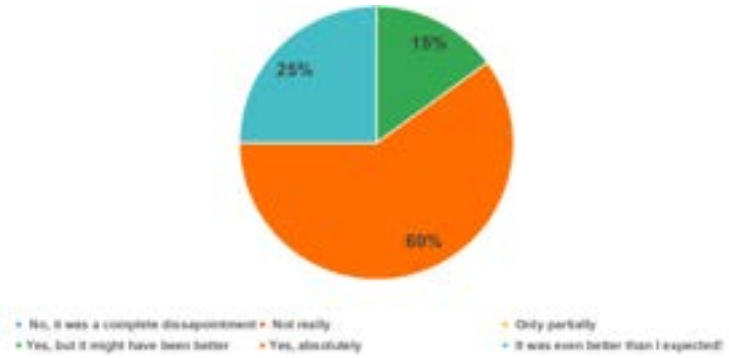
Q5-Would you attend future editions if possible?



Q6-Would you recommend ISLiST to other colleagues?



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



8.- Comments and suggestion to improve ISLIST

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 high quality of the invited speakers
- The speakers, the gathering of the students in the same location to improve bonding, the palacio de la magdalena that is very beautiful
- Everything is good.
- The quality of the invited speakers and the nice welcome and organization for the accomodation. The venue (Palacio de la Magdalena) was incredible
- The quality of the speakers, the topics, the location and the program in general
- The best thing about the school is the quality of the invited speakers, regarding future editions I think it would be interesting Quantum technologies for instance
- The quality of the speakers and interaction with other PhD students with similar backgrounds
- I found the course really interesting and would love to attend the next edition. It has been a magnificent opportunity to learn about photonics applications directly from experts in the field
- Quality of speakers and talks
- Energetic speakers that come to expose their recent achievents starting from tha basic principles of their research, making themselves undestood very well
- The organization
- The location, in addition to being beautiful, enhances the overall experience by combining academic content with a pleasant space to be in. Additionally, the quality of the talks and discussions is consistently high, offering valuable insights and learning opportunities.

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:

- Poor communication before the arrival.
- Many talks were difficult to follow for non-experts. It is better to give less information in the talks, starting from the most basic common ground for the audience
- the school dorms were average, the bus was a single time schedule only and there was no ride back, the happy hour was too short

- The transport from the airport to the accomodation (I would improve the instructions if it is not possible to improve the transport*)*
- The method for ensuring the assistance to the talks was neither efficient nor effective, as many people for example went to the toilets between sessions and missed the chance to certify their assistance to the following talk
- Many people hasn't received the digital certificate of attendance yet, 3 months after the event
- The organization for the distribution of people in the restaurants should be improved. Many mates had difficulties being allowed into the restaurants
- I have nothing to say
- I think the organization should consider decreasing the number of hours spent at the School. We didn't have almost any time to explore the beautiful city of Santander which felt like a missed opportunity. This could be done by reducing the lunch time (it was a little excessive and we always ended up killing time), or slightly reducing the time of each lecture. For example lectures of 45 minutes instead of 1 hour would make a big difference, as 1 hour lectures were a little big exhausting
- Unfortunately, the cafeteria was closed during the course, and there were not enough power outlets to charge electronic devices for taking notes. Regarding the course, I felt the roundtable sessions could have been more engaging, since sometimes it seemed like the speakers were talking on their own.
- I would appreciate having some material such as the slides, or recordings of the talks
- Round tables in which each participant speaks on a different topic than the others, without conexion. There was a lack of exchange of professional opinios among all on each topic.
- La organización de la comida fue fatal, al principio no sabíamos el lugar que nos correspondía para comer. Por otra parte, nos separaron y comí sola.
- One issue encountered was that the cafeteria was closed, making it difficult to take breaks between sessions. Moreover, the rear screen would turn off at the end of some sessions, which resulted in missing part of the talk.,

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.
- One issue encountered was that the cafeteria was closed, making it difficult to take breaks between sessions. Moreover, the rear screen would turn off at the end of some sessions, which resulted in missing part of the talk.
- Keep the level high!
- The general experience was great and the talks were interesting. As suggestions, improve the points 1., 2. and 3. specified in the previous box.

9.- 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 on 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 that 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.

VII ISLIST hosted 55 attendees from 17 nationalities and from more than 20 different institutions gathered in the week of June 17 to 21, 2024, in Santander, Spain. The VII-ISLIST participants (60% PhD students and 36% female) received knowledge and experience from 16 reputable professors and professionals of the most reputable academic and research institutions and companies of 9 diferent nationalities. They had the privilege of receiving top-quality inputs from researchers of the stature of professors, José Capmany, Francesco Poletti, Ton Koonen, Sinead O´KeeffeRoberto Osellame, Andrea Cusano, Kennet Grattan, Valerio Prunery, Sonia Martín López, Mar Rea, Mariana Figueiro and JM López-Higuera. They also received the expertise of reputable professionals and researchers (all Drs) such as Peter Winzer, Michael Leeby, Elisaberta Rugi Grondi, and Vincent Menoret. Very hot topics in the use of light sciences and technologies inside the Coomunications; sensing and Lighting were presented and discussed for the 17 one-hour lectures and two round tables that focused on the search for challenges pending in light Communications (round table I) and in sensing and Lighting both in helath and in civil applications (round table II). Unforgettable were also the fresh and enthusiastic questions and discussions among the participants and the panellists of the two round tables. 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, experience and to do networking inside an unparalleled place, the Royal Palace of Magdalena, and having snacks and drinks. Thank you for that opportunity to Ayuntamiento de Santander.

According to the post VII-ISLIST survey, the quality of the program, of the speakers, of the complementary events, of the facilities offered, can be considered at the top level worldwide. ISLIST has met their expectations. As numeric indicators it can be consider that more than 90% of the attendees agreed with very hight quality of the invited speakers considering the 55% into the rank of excellence; more than 85% of the students mentioned that the topics of the talks were very interesting and they what they were looking for; and the 95 % of the attendees expressed that they will be very happy to recommend VIII-ISLIST to other colleagues and the 85% 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 17-21, 2024, Santander, Spain

Core: ***Light in Communications, Sensing and Lighting***

ANEX

ISLIST-2024 PROGRAMME

Monday, 17

Morning

10:15 h

Opening Ceremony

10:40 h / **Break**

11:00 h Opening Lecture

The Next Generation of Optical Communications will be massively Parallel

Dr. Peter Winzer

Founder and Chief Technical Officer, CTO, Nubis Communications, New Providence, NJ07974, USA

12:10 h / Invited Lecture

Next Generation of Photonics Integrated Circuits as key for communications and sensing

Prof. Michael Leeby

Chief Executive Officer,, CEO, Lightwave Logic, CEO OIDA, San Francisco, USA

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

Afternoon: **Light in Communications**

15:30 h / Invited Lecture

Programmable integrated Photonic Circuits: what?, why? and when?

Prof. José Capmany

Director, iTEAM Institute, Technical University of Valencia, Valencia, Spain.

16:40 h / Invited Lecture

Microwave Photonics

Prof. José Capmany

Director, iTEAM Institute, Technical University of Valencia, Valencia, Spain.

International School on Light Sciences and Technologies (ISLiST)

June 17-21, 2024, Santander, Spain

Core: ***Light in Communications, Sensing and Lighting***

Tuesday, 18

Morning: Light in Communications

9:30 h / Invited Lecture

Hollow Core Optical fibres: a revolution-nary technology for optical commu-nications, quantum applications and laser delivery

Prof. Francesco Poletti

Head of Hollow Core Fibres Group,Optoelectronic Research Centre, University of Southampton, UK

10:40 h **/ Break**

11:00 h / Invited Lecture

Optical communications in space: Currents and trends

Dra. Elizabeta Rugi Grond

CEO, Thales Alenia Space, Switzerland, Switzerland

Director, LIFI Research Development Centre, University of Strachclyde, Scotland, UK

12:10 h / Invited Lecture

Optical Wireless Communication – a green wireless communication technology with high potential and great prospects

Prof. Ton Koonen

Emeritus professor, University of Technology, Eindhoven, Netherlands

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

Afternoon: Light in Communications

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

Light in Communications: Challenges to face on

Dr. Winzer, Founder and Chief Technical Officer, CTO, Nubis Communications, New Providence, NJ07974, USA

massive integrated spatial parallelism in future Optical Communications

Dra. Rugi Grond, CEO, Thales Alenia Space, Switzerland, Switzerland

Laser-based communications in Space in the Era of 6G

Prof. Koonen, Emeritus professor, University of Technology, Eindhoven, Netherlands

In indoor optical wireless communications in Space in the Era of 6G

Moderator: Prof. JM López-Higuera, Director ISLiST

International School on Light Sciences and Technologies (ISLiST)

June 17-21, 2024, Santander, Spain

Core: ***Light in Communications, Sensing and Lighting***

Wednesday, 19

Morning**: Light in Sensing**

9:30 h / Invited Lecture

Sensing Using Light: doctrinal conception, currents and trends

Prof. José Miguel López-Higuera

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

10:40h / **Break**

11:00h / Invited Lecture

Optical Fibre Sensors for Radiotherapy Dosimetry: Challenges and Opportunities

Prof. Siniad O´Keeffe

University of Limerick, Ireland, Optical Fibre Sensors Research Institute, Ireland

12:10h / Invited Lecture

Cold atom quantum sensors for field applications.

Dr. Vincent Menoret

Head of Quantum Sensors R&D , Exail Quantum Systems, Institut d'Optique d'Aquitaine, Talence, France

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

Afternoon: **Light in Sensing: Laboratory On Site**

15:30-16:30 / Invited Lecture

Advanced photonic and optofluidic devices fabricated in glass using femtosecond lasers for Lab-On Chip sensors

Prof. Roberto Osellame

Director, Institute of Photonics and Nanotechnologie-CNR, Milano Polytechnic, Italy

16:40h / Invited Lecture

Lab On Fiber: a key enabling technology for precision medicine

Prof. Andrea Cusano

Head, Optoelectronic and Photonic Group, Università degli Studi del Sannio, Benevento (UniSannio), Italy

17:55 h **VII 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.

International School on Light Sciences and Technologies (ISLiST)

June 17-21, 2024, Santander, Spain

Core: ***Light in Communications, Sensing and Lighting***

Thursday, 20

Morning: **Light in Sensing**

9:30h / Invited Lecture

Optical sensing technologies for key environmental measurands in the I4.0 era

Prof. Kenneth Grattan

Director of Instrumentation & Sensors Research Centre, City-University of London, UK

10:40h / **Break**

11:00h /Invited Lecture

Engineered surfaces and devices for the display and imaging industries

Prof. Valerio Pruneri

Head, Optoelectronic Group, Instituto de Ciencias Fotónicas, ICFO, Barcelona, Spain.

12:10h / Invited talk

Distributed Acoustic Senors (DAS) for Seafloor Seismic Monitoring: from earthquakes to tsunamis

Prof. Sonia Matín López

Co-Head of Photonics Engineering Group, of Alcala de Henares, Spain

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

Afternoon: **Light in Sensing and Lighting**

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

Challenges to face in optical sensing technologies and lighting

Challenges to face on

Kenneth Grattan, Director of Instrumentation & Sensors Research Centre, City-University of London, UK

Challenges to face in optical sensing technologies for real industrial applications.

Roberto Osellame, Director, Institute of Photonics and Nanotechnologie-CNR,Milano Polytechnic, Italy.

To reach useful integrated advanced microscopy in optofluidic Lab-on-Chip devices

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

challenges to be faced on next generation of human centred lighting

Mark Rea, Former Director, Lighting Research Cener Rensselaer Polytechninic Institute

Uniting the science of circadian rhythms with real lighting applications and especially with hospitals and nursing homes

Moderator: Prof. JM López-Higuera, Director ISLiST

International School on Light Sciences and Technologies (ISLiST)

June 17-21, 2024, Santander, Spain

Core: ***Light in Communications, Sensing and Lighting***

Friday, 21

Morning/**Special session**: **Light in Lighting**

9:30-10:40h / Invited Lecture

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

Prof. Mark Rea

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

10:40h / **Break**

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

Principles of Indoor and Outdoor Lighting for Healthy Environments

Prof. Mariana G. Figueiro

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

12:15 h

Closing Remarks, Announcement of VIII-ISLiST, 2025, and Diploma Delivery

The UIMP official diploma delivered to each attendee by ISLIST invited speakers.