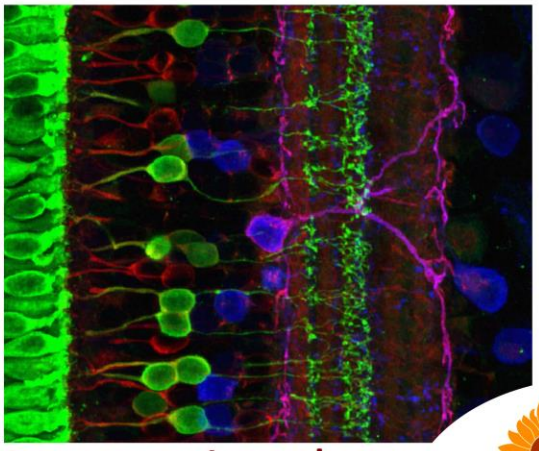
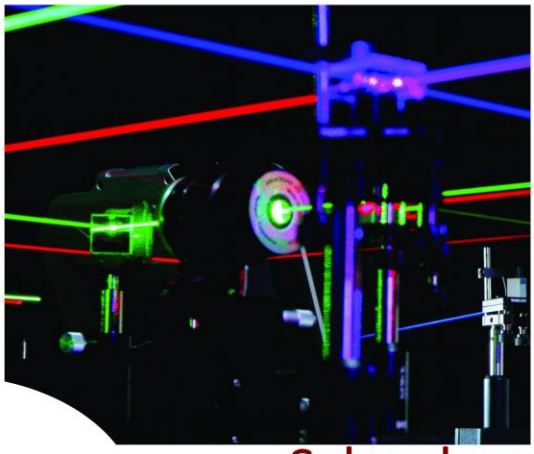
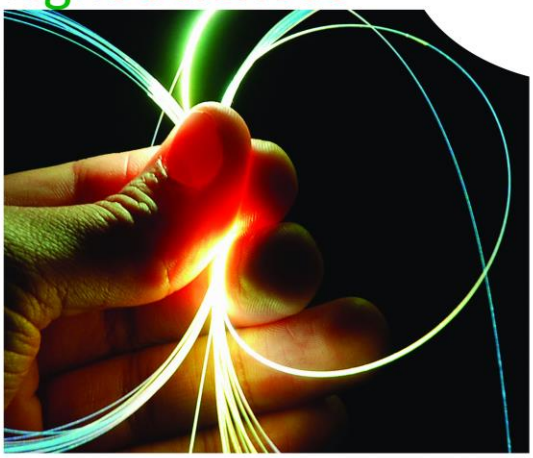
UIMP
Universidad Internacional
Menéndez Pelayo





International
Light Sciences

School on
and Technologies



ISLiST

June 19-23, 2017

Santander, Spain

FINAL REPORT

DIRECTOR:
José Miguel López Higuera
Professor in Electronics and Photonics
Head of the Photonic Engineering Group
University of Cantabria
e-mail: lopezhjm@unican.es

SECRETARIO:
Jesús Mirapeix Serrano
Photonic Engineering Group
University of Cantabria
e-mail: jesus.mirapeix@unican.es

International School on Light Sciences and Technologies (ISLiST)

June 19-23, 2017, Santander, Spain

Core: ***Light in Energy and Environment***

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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 citizens. It is also a great opportunity to ensure that policymakers, entrepreneurs, and other key "actors" will be aware of the problem-solving potential of Photonics.

ISLIST is envisioned to be a worldwide top International forum (the fourth week of June of every year) on *Light Sciences and Technologies* in the framework of a *"special top university" that is recognized as the "university of universities"* and in a privileged environment "the Royal Magdalena Palace" in Santander, Cantabria, Spain. Each edition of this international school will have an intensification or main core in a specific application area and additional current hot topics. *Light in Energy and Environment* was the core of this 2017 edition.

68 attendees from 23 different nationalities all around the world received knowledge and shared experiences with the fifteen (15) highly renowned professors (including the Nobel Laureate Shuji Nakamura) and researchers from the most prestigious worldwide institutions of Europe, USA and Japan, and as well, presidents of the most reputed international Photonic Scientific Organizations took place of the school panel of invited speakers.

Figure 1.- Family photo of the ISLIST-2017 on the Royal Palace of the Magdalena, venue of the event.

Seventeen Invited Talks and two round tables were developed along the week. The first round table was focused on challenges in Light in Energy and Environment. The second one was designed to discuss the transference of Knowledge and Technique.

Sponsored by the Santander Council (Ayuntamiento de Santander), the ISLIST attendees enjoyed the Santander Council Reception. This was a great opportunity to share experiences and also was an optimum time for networking.

In this edition, UIMP has distinguished *Prof. Shuji Nakamura* with its *Doctor Honoris Causa*. This prestigious honor was given at a solemn ceremony held in the Royal Hall of the alace of Magdalena at the end of the morning, June 22. It was an unforgettable time to maintain in our "minds" forever: we had the unique opportunity to see in action a great scientist during his acceptance speech.

At the end of the closing ceremony, the next edition of this international school was announced. The fourth edition of ISLiST (June 25-29, 2018) will have the core on Light in Communications and Sensing. It will include a very special session on Photonic Crystals with the participation of the two more well-known scientist on the subject: Prof. **Eli Yanoblowitch**, the father of the Photonics Crystal concept (University of California at Berkeley, USA) and Prof. **Philip Russell**, the inventor of the Photonic Crystal Fibers (Max Planck Institute for the Science of Light, University Erlangen-Nuremberg, Germany).

To be able to reach this 2017 ambitious program, this International School of UIMP is supported by several sponsors: Gobierno de Cantabria, Fundación ACS, the Optical Society, OSA and Equipos Nucleares Sociedad Anónima, ENSA.

It has also been supported by several collaborators such as: Santander Council, AMBAR Telecommunications, B-Phot Brussels Photonic Team, Fyla Lasers, SPIE-the International Society for Optics and Photonics, the Spanish Optical Society, SEDOPTICA; OZ Optics, Lasing, INNOVA Scientific, Grupo Alava, EPIC, Photonics 21, Hotel Santemar and the Photonics Engineering Group of the University of Cantabria. 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 with the generosity of all these Organizations and all the Invited Speakers. Thank you so much!

Santander, September 27, 2017.

Prof. José Miguel López-Higuera
Director ISLIST at UIMP

2.- ISLIST-2017: A SUCCESSFUL AND TRULY INTERNATIONAL SCHOOL

ISLIST at UIMP has been acknowledged as a high standard international meeting by the invited scientist and professionals and as well as 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).

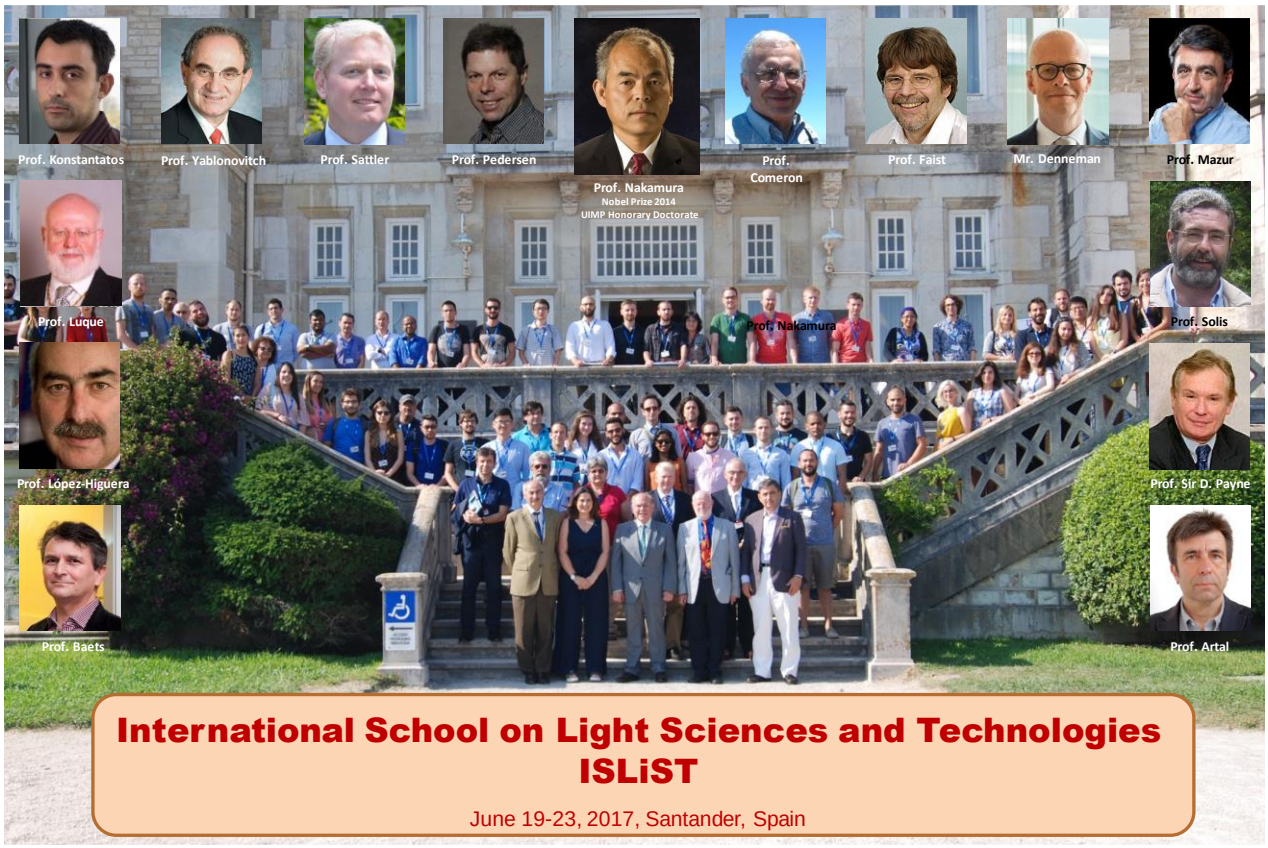

Figure 2. Family photo of the ISLIST-2016 participants. It was taken just before the Santander Council reception.

The participants of this first edition of the ISLIST at UIMP in Santander, Spain, enjoyed the fifteen (15) invited talks and two round tables by highly renowned professors (including the Nobel Laureate Shuji Nakamura) and researchers from the most prestigious worldwide institutions of Europe, USA, and Japan, and, as well, presidents of the most reputed international Photonic Scientific Organizations.

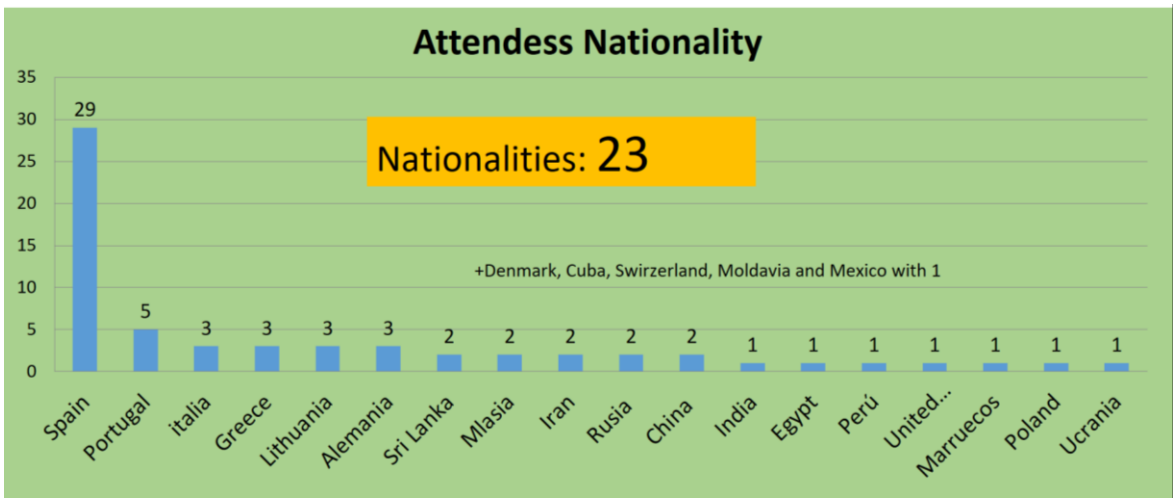

Figure 3.-ISLIST attendees by countries from Europe, Asia, America and Africa.

85 attendees form 20 different nationalities (from over 34 different places) participated in this meeting. As shown in Figure 3, 52 participants came from Spain, 6 from Italy, 5 from Portugal, 3 from China and 2 from Iran and Lithuania and Poland. Other 13 attendees from 13 different countries also participated in the School.

Eighty-seven per cent (87%), seven (7%) and six (6%) of participants were from education institutions (Universities), R&D centers and companies, respectively.

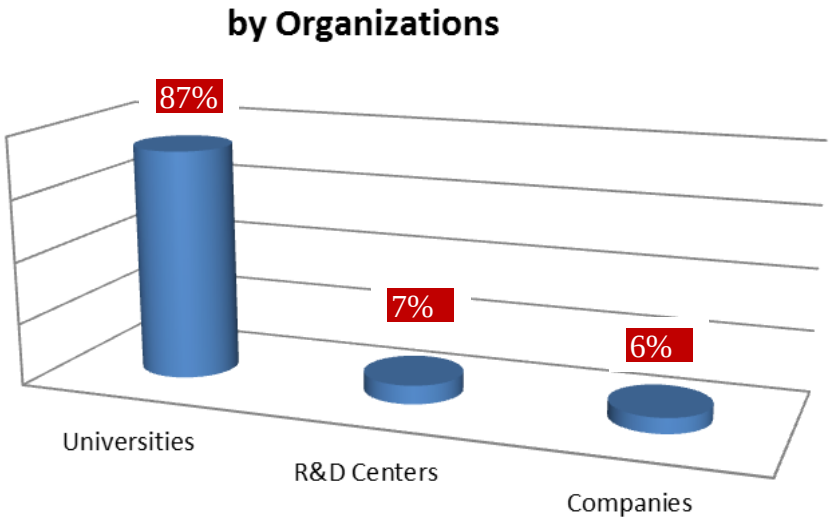

Figure 4.-Attendees by Organizations.

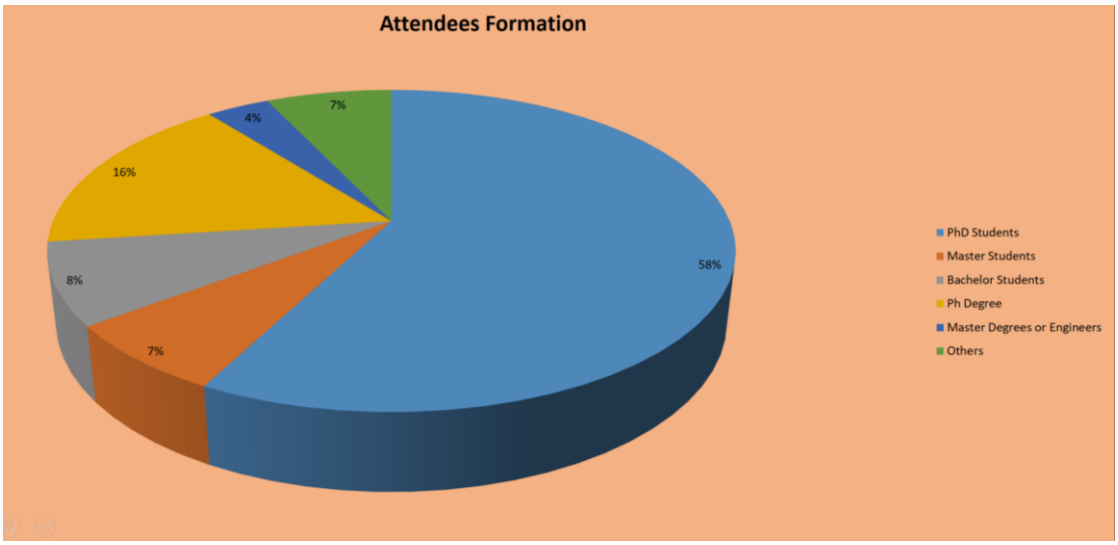

Figure 5.-ISLIST attendees by education

Regarding the previously mentioned students: 58% were PhD students, 16% were PhD (Dr), 8% were Bachelor Students, 7% were Master Students and 4% were Engineers.

In terms of the students age: 71% of the attendees were in the range from 20 to 30 years, what 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. 16% were attendees of more than 41 years old.

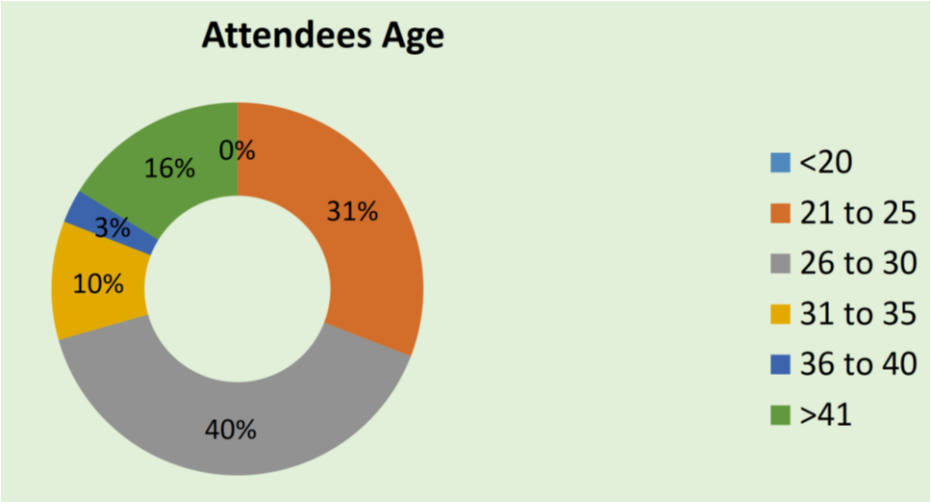

Figure 6.-ISLIST attendees by age.

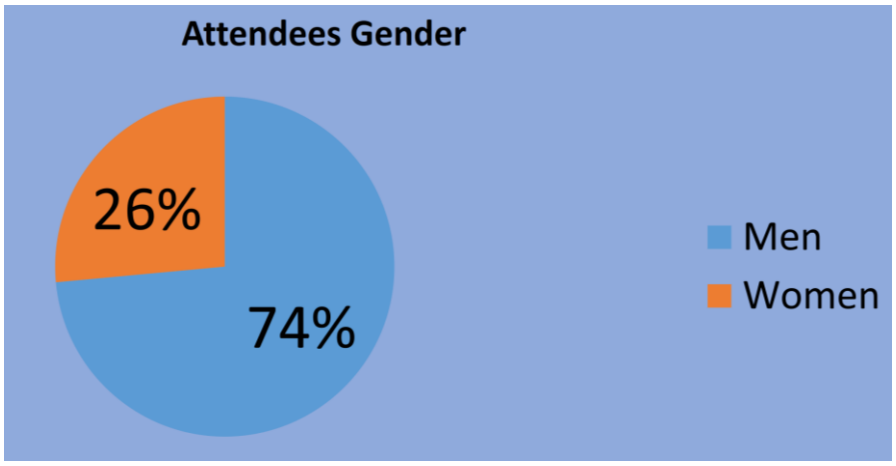

Figure 7.-ISLIST attendees by gender

Analyzing the gender distribution: 74% attendees were men and 26% women. This is in same way in correlation with the real situation in many countries in technical professions. Taking in consideration the high 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.

For Spanish Students or Students of any nationality but working/studying in Spanish institutions, UIMP is able to offer grants using the funds form the Spanish State. However, UIMP is not able to offer grants for any other international Students. Thanks to the sponsors and collaborators, ISLIST was able to offer grants for **international** students from non-Spanish institutions. http://www.teisa.unican.es/ISLiST/index.php/grants

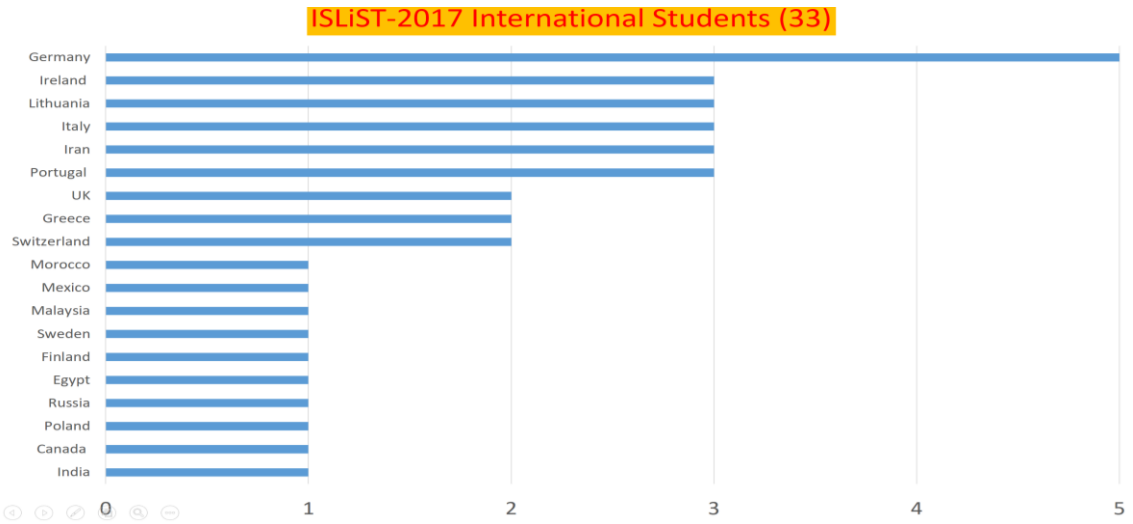

Figure 8.-ISLIST International Student Grants distribution by countries

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.

ISLiST at UIMP received a total of 68 applications (30 from students in Spain and 38 from any other international students). A total of 54 grants were allocated (21 funded by the public Spanish state funds and 33 using the funds form the sponsors and collaborators. 43 were complete or full grants (32 for international students) and 11 covered only the school registration fee (1 for International student).

As it happened in the previous editions of ISLiST, the offer of scholarships to 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).

3.- PROGRAM AND ITS DEVELOPMENT

The School Programme was designed and published in the meeting web site:
http://www.teisa.unican.es/ISLiST/index.php/program

A School Handbook was printed and included in the bag of all the ISLIST participants:
http://www.teisa.unican.es/ISLiST/images/ISLiST2017-Program-Web.pdf

The general Schedule of ISLIST-2017 was programmed and developed as shown in figure 9.

Time	Monday 19th	Tuesday 20st	Wednesday 21nd	Thursday 22rd	Friday 23th
9:30		Prof. Eli Yablonovitch Univ. of California at Berkeley, USA.	Jan Denneman Global and Industry Lighting Associations, Philips Lighting, Netherlands	Prof. Shuji Nakamura Nobel Laureate Univ. of California at Santa Barbara, USA	9:10 Prof. Eric Mazur Harvard University USA
10:15	Opening Remarks				
10:40	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00	Prof. Roel Baets Ghent University Belgium	Prof. Christian Sattler Inst. of Solar Research Germany	Round Table I Light on Energy and Environment Challenges Professors: Luque, Yablonovitch, Sattler, and Jan Denneman Moderator: Prof. López-Higuera	Prof. Sir David Payne University of Southampton UK	10:25 Round Table II Education on KET's Profs.Nakamura, Payne, Mazur, Education State Secretary of Spain Moderator: Prof. López-Higuera
12:10	Prof. López-Higuera Univ. of Cantabria Spain	Prof. Christian Pedersen Technical Univ. of Denmark Denmark		12:00 Prof. Nakamura Doctor Honoris Causa Ceremony	12:15 Diploma Delivery 12:30 Closing Remarks
13:30 15:00	Lunch	Lunch	Lunch	Lunch	
15:30	Prof.Antonio Luque Inst. of Solar Energy Spain	Prof. Adolfo Comeron Univ. Polytechnic of Catalonia Spain	Prof. Eric Mazur Harvard University USA	16:15-17: 15 h Prof. Pablo Artal Univ. of Murcia, Spain	
16:40	Prof. G. Konstantatos ICFO Spain	Prof. Jérome Faist Inst. Of Quantum Electronics Switzerland	Prof. Javier Solis CSIC Spain	17:25 Prof. López-Higuera Univ. of Cantabria Spain	
			17:55 ISLIST PHOTO		
			18:05 Santander Council Reception		

Figure 9.-ISLIST-2017 General Schedule

3.1 Invited Talks and Round Table in the frame of ISLIST-2017 core

After the Opening Ceremony, from June 19 to June 23, 2016 during the afternoon, 17 keynotes and invited talks and two Round Tables were developed.

Figure 10.-Moment of the Opening Invited Talk by Prof. Roel Baets (Ghent University, Belgium)

After the opening speech by the Professor *Roel Baets* of the University of Ghent, Belgium, and after the introductory Conference of the Director upon the role of Photonics in energy and the environment, key issues concerning to the ISLiST-2017 core were addressed by the invited recognized researchers and directors of R&D centres and Corporations. The renowned Prof. *Antonio Luque*, president of the Institute of Solar Photovoltaics Energy of the Polytechnic University of Madrid and founder of ISOFOTÓN, shared his deep expertise on photovoltaics (PV). Prof. *Gerasinos Konstatantaos* (ICFO, Barcelona, Spain) spoked about Nanophotonics to achieve more efficient solar cells.

The father of the Photonic Bandgap concept, who coined the Photonic Crystals term, Prof. *Eli Yablonowitch* director of the NSF Center for energy efficient electronics science of University of California at Berkeley (USA) shared, very didactically, his incredible deep knowledge on how a good PV device must be at the same time a good emitter; Prof. *Christian Sattler* (Institute for the study of solar energy, Germany) shared his knowledge on the use of the concentration of solar energy to generate electricity and fuels (from sunlight) that can be stored, transported and that will play key roles in the future clean energy sources.

Figure 11.- Moments of the invited keynote by Prof. Luque (Solar Energy Institute of University Polytechnic of Madrid, UPM, Spain); and the invited talks by Prof. López-Higuera (University of Cantabria, Spain), and Prof. Konstantatos (Institute of Photonic Sciences, ICFO, Barcelona, Spain)

Dr. *Pedersen* (Technical University of Denmark) presented the latest advances of semiconductor LIDAR systems of reduced size and cost able to be used with advantage to the generation of energy from wind; Prof. *A. Comerón* (Polytechnic University of Catalonia, Spain) offered, as well, key concepts about LIDAR and a review of the results obtained by his Group in the detection and measurement of aerosols in the environment; Prof. *Jérome Faist* (Institute of electronic quantum ETH of Zurich, Switzerland) shared his expertise in the measurement of environmental pollutants using combos of frequencies via lasers. Dr. *Denneman* (from Philips lighting) spoked about the huge energy savings by using semiconductor light sources and, in addition, the use of the latter in the smart cities of the future communications, among other possibilities.

International School on Light Sciences and Technologies (ISLiST)

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Core: ***Light in Energy and Environment***

Figure 12- Moment of the invited keynote by Prof. Yablonowitch (University of California at Berkeley, USA).

Figure 13.- Moments of the invited talks by Prof. Sattler (Institute of Solar Energy, Germany), Prof. Pedersen (Technical University of Denmark, Denmark).

Figure 14.- Moments of the invited talks by Prof. Comerón (university Politechnique of Cataluña, Spain) and Prof. Faist (Institute of Quantum Electronics ETH Zurich, Switzerland) and invited keynote by Dr. Denneman (Global Lighting Association, Netherlands)

Figure 15.- The four panelists before and during the round table (Light on Energy and Environment challenges: during the introduction by the moderator (Prof. Lopez-Higuera) and four moments of the invited panelists speeches: Prof. Luque (UPM, Madrid, Spain); Prof. Yablonovitch (UC, at Berkeley, USA); Prof. Sattler (aerospace Center Institute of Solar Energy, Germany) and Dr. Denneman (Philips Ligthing, Eindhoven, Netherlands).

3.2 Invited Talks and second Round Table in hot topics

Six invited talks and keynotes and the second round table were developed. All were focused on additional current hot topics where light plays a key role: light in nano-metamaterials and materials processing, light in lighting and communications, light in medicine, and education on light sciences. The second round table was focused on Education and Training on a key Enabling Technology: Photonics.

Figure 16.-Moments of the invited keynote by Prof. Mazur (University of Harvard, Boston, USA,) and the invited talk by Prof. Solis (Optics Institute of CESIC, Madrid, Spain)

The ISLiST attendees experienced the pleasure of listening to Prof. *Eric Mazur* (renowned scientist at Harvard University, USA and also the 2017 President of the Optical Society of America, OSA). He delivered a conference at the frontier of knowledge, on nano-metamaterials. In the talk he showed the way to create new optical materials with customized refractive indexes. Prof. *Javier Solís* (CSIC, Madrid) spoked, with detail, on the materials processing by using ultrafast laser technologies. He shared his knowledge on how to create compositional changes on materials, techniques that are very useful for photonic applications.

The ISLiST attendees had also the privilege of listening, dialoguing and discussing knowledge, technique and experience with the Nobel Laureate 2014 Shuji Nakamura. He delivered a keynote and also, participated in the second round table discussion on education. It was a great delight and a privilege to hear the experiences and teachings from who, following a line of research completely different that followed the scientists of that time ("popes"), he reached, for the first time, a new feasible procedure to fabricate blue LEDs that were missing to make white light in the visible spectrum.

Their invention of efficient blue light-emitting diodes, which enabled bright and energy-saving white light sources, conferred to him a great worldwide recognition. From that moment he was recipient of great number of honours such as the Nishina Memorial Award (1996), the Prince of Asturias Award for Technical Scientific Research (2008), the Nobel Prize on Physics 2014 and inducted him into the National Inventors Hall of Fame in 2015, just to mention some examples. Prof. Nakamura is Research Director of the Solid State Lighting & Energy Electronics Center and co-founder of Soraa, Inc. in California's Silicon Valley and Santa Barbara.

Figure 17.-Moments of the introduction of Prof. Shuji Nakamura, Nobel Laureate 2014, (University of California at Santa Bárbara, USA) and during his keynote presentation. This 2008 Principe de Asturias awarded Professor, delivered a memorable presentation on the invention of High Efficient BLUE LED.

Figure 18.-Prof. Jesús Mirapeix (ISLiST´s Secretary) during one of his invited Speaker introductions.

Figure 19.-Moments of the invited keynote by Prof. Payne (ORC, University of Southamton, UK)

Prof. David Payne, President of the Optoelectronics Research Centre (ORC) of the University of Southampton, United Kingdom, pioneer of optical fiber manufacturing technology and inventor of Erbium-doped optical fiber lasers that revolutionized optical communications at the beginning of the last decade of the last century, delivered a very impressive talk on optical communications. With his habitual mastery, he offered to the attendees relevant inputs concerning Optical Communications beyond the Fibre capacity crunch in the XXI century. He also participated in the round table on education that shared with Profs. Nakamura and Mazur.

Two talks were developed in medicine. Prof. Artal (Optical and Nanophysical Centre, University of Murcia, Spain) delivered, enthusiastically, a very interesting and useful talk concerning the light science and technology for a better vision. Prof. López-Higuera (University of Cantabria, Spain) spoke about the power of light on healing by means of the Photodynamic Therapies. He also showed the new optoelectronic device for brachytherapy treatments.

Figure 20.-Moments of the invited talks by Prof. Artal (Optical and Nanophysical Centre, University of Murcia, Spain) and Prof. López-Higuera (University of Cantabria, Spain).

Prof. Mazur delivered a talk on innovation in education in the new times and also participated in the round table on education with Profs. Nakamura and Payne. He, in his unforgettable keynote, demonstrated, and also experienced with the attendee's participation, how he conceived the new methodologies to Educate Innovators.

Figure 21.-Moments of the invited keynote by Prof. Mazur (University of Harvard, Boston, USA.) and the active participation of the attendees in his proposed methodology

Figure 22.- The three panelists before (exterior part of the Royal Palace-bottom) and during the round table on Education and Training on a key Enabling Technology: Profs. Payne, Nakamura, Mazur and López-Higuera (round table coordinator).

Fig.22.-Three moments of the invited panelist speeches and debates by Profs. Mazur, Nakamura and Payne.

After the introduction on the core-matter of the round tables by the moderator, each panelist delivered a first brief statement about his position on the subject. Then, each member of the panel took the opportunity to debate different aspects among the panelists. After that, attendees asked, in an open and fully-freedom-environment, different questions, and very interesting debates took place inside the room. Very interesting and useful thoughts and conclusions were extracted from both round tables.

From the first round table, the main challenges to face, concerning the use of light based technologies for a more efficient generation and use of the energy and for a better and sustainable environment, were addressed. Challenges on highly efficient energy conversion and storage, on PV cells, on harnessing the light with solar concentrator systems and on highly efficient lighting devices were widely commented and analysed.

During the second round table on Education and Training on a Key Enabling Technology based on light, the participants had the opportunity to hear statements and thoughts and participate in a very "lively" debate with the panellists. The attendees received lessons on education and training from experiences from a Nobel Laureate at Japan and USA; the insights gained from education Innovator at Harvard University and also comments on some of the OSA actions on training and education and, also, the insights gained from the UK education system and from ORC at University of Southampton.

Finally, the moderator asked the panelist about their position concerning the inclusion of light based matters in the new study-plans of the education systems. After explaining the reasons of their respective positions, all panelists reached the same conclusion: ***as in the previous century were introduced first concepts on electricity and later on electronics, now, it will be strictly necessary to include in the new Study-Plans of Education Institutions courses concerning the new and horizontal field of Photonics or Light based Sciences and Technologies.***

3.3 Special Events

Within the frame of ISLiST, three special events were allocated and developed: The Santander Council Reception, a Press Conference and an exceptional event.

3.3.1 Santander Council (Ayuntamiento de Santander) Reception

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 of the Magdalena Palace.

Figure 23.- Prof. Nombela, Rector of the UIMP, welcoming the ISLIST attendees in the Royal Hall and external view of the ISLiST participants on the Ayuntamiento de Santander Reception.

Figure 24.- Moments of ISLIST attendees during the Santander Council Reception at the Royal Palace of Magdalena. It was a great opportunity to shared thoughts and to do Networking.

3.3.3 Press Conference

Shuji Nakamura, Nobel Laureate on physics 2014 and professor of the University of California at Santa Barbara, offered a press conference accompanied by the rector of the UIMP, César Nombela and Professor of Electronics and Photonics of the University of Cantabria Jose Miguel Lopez-Higuera. He outlined the latest developments in his fields of research, within the activities of the International School on the UIMP Light Sciences and Technologies (ISLIST).

Figure 25. The Nobel Laureate 2014 Prof. Nakamural, UIMP DHC, and Prof. César Nombela, Rector of UIMP during the round press.

The Nobel of Physics Laureate 2014 and also “Premio Príncipe de Asturias” 2008 has praised the academic level of the UIMP and acknowledged the "high quality" of the content of this top level international School.

He mentioned to he thinks of himself as a very lucky person for having achieved this invention. Along with two other people, Hiroshi Amano and Isamu Akasaki, he achieved a great milestone in the field of physics and Chemistry: the development of a blue LED that enabled the simulation of sunlight, the healthier light for the human being. Nakamura, in relationship to solve the problems of food, also mentioned the advantage of being able to use this artificial-natural light in greenhouses. Without the presence of insects, and then without the need to use chemicals on food, this LED-based light helps plants to grow faster as there is no night for them, he also pointed, out among many other comments.

3.4 Exceptional Event: Doctor Honoris Causa Ceremony

To recognize his very relevant contributions to the sustainability and the advance and of the mankind by inventing the blue LED that enabled the generation of light emulating the natural sunlight, the Menendez Pelayo International University, UIMP, recognised Prof. Shuji Nakamura with its Honorary Doctorate. He received this prestigious distinction in a solemn ceremony held in the Royal Hall at the end of the morning of the fourth day (June 22, 2017) of the International School on Light Sciences and Technologies. This International prestigious institution (university of universities) conferred this honorary doctorate to Prof. Nakamura by unanimous agreement of its Governing Council.

Figure 26. UIMP Governing Council members and the ceremony attendees standing.

In his "laudation-speech", Prof. Lopez-Higuera, Nakamura´s Godfather at the Ceremony, made a revision of the scientific, technical entrepreneurial profiles of the honored and concluded:

"Our honored is a reputed scientist fascinated by the solid state physics. This world citizen, is an un-common human being who is always keen on taking nothing for granted, to remove misconceptions going back to the basics, encouraging people to work it out for themselves and developing their own intuition. He is someone, in which mind there is always something going on, someone, whose mind is always at work.

Professor Nakamura is a deep thinker, a genius certainly far above most people. He is capable of generating theoretical ideas, solving complex theories and transposing them to a level that can be understood by "normal people". He is well known and respected throughout the field, recipient of many prestigious awards and prizes for their relevant contributions to the advancement of the sciences and technologies of light with special emphasis on the semiconductor materials to develop sources of light bright and never imagined efficiencies that are contributing, decisively, both to save energy and combat climate change as well as to the achievement of media environments clean and free of contaminants, objectives indispensable for the last Summit in Paris in December 2015.

Figure 27. Three moments of the Godfather ("padrino") laudatio speech.

His inventions in light sources based on semiconductor diode structures have improved and will continue to improve, the quality of life of an immensity of citizens of the world including the developing one that, lacking of electrical networks, however, have the possibility to transform the abundant solar energy into light types which contribute to tissue and useful medical sterilization and to illuminate their living environments...

Así pues, Rector, dignísimas autoridades y claustrales, agradezco a esta universidad de universidades, que en base a sus relevantes méritos haya otorgado al Profesor Shuji Nakamura, el Supremo Grado de Doctor Honoris Causa y se honre incorporarle hoy a su claustro de doctores".

Figure 28. Four moments of the ceremony in which the Rector of the UIMP Prof. César Nombela, in presence of the Godfather invested Shuji Nakamura as Doctor Honoris Causa (DHC).

Figure 29. The honored (two moments) during his acceptation speech.

…in his acceptance speech the Honored started:

"I am deeply honoured and grateful to be awarded with a Honorary Doctorate from the Universidad Internacional Menéndez Pelayo. I would like to thank Professor César Nombela, Rector of the University, for supporting my nomination, and Professor José Miguel López-Higuera for his Laudation Speech about me"….he explained the difficulties and the hard work that has made together to many of my colleagues to achieve goals that seemed "impossible".

….and followed … *mentioning that the advances made by him and his colleagues have been always motivated to maintain the "beauty" of places such as Santander, and avoid the enormous pollution that affects many cities…. He has also reminded the "big problem" that represent the continuous growth of the population……Increasingly consumed more food and more water…., he conclude pointed out, that the scientists" have the ability to provide solutions to the effects that these facts can generate a to change things…. For a better world.*

……and the Rector Prof. Nombela in his closing ceremony talks ensured…..*the distinction of Nakamura is an authentic "honor" for the institution, which continues the tradition of recognizing those who "reach higher dimensions in the development of knowledge, teaching, and the transfer of knowledge and the" technology," said…… and concluded…. the invention of the blue-LED, it is a "revolution that improves our lives", and is another proof that science "responds to the challenges that humanity faces", such as "the sustainability of the environment and the protection of the dignity and race human", has been completed.*

Figure 30.-The UIMP Rector (Prof. Nombela) during his closing DHC ceremony speech

Figure 31. UIMP Governing Council and the godfather moments after the DHC Ceremony.

Figure 32.-The honored with Prof. Nombela (Rector UIMP) and JM López-Higuera (Honoree-Godfather)

*Figure 33.-The honored (prof. Nakamura) with several members of the UIMP Government Council, ISLIST speakers, invited by the Rector of UIMP to enjoy having lunch in the royal room of the **Sala de los Infantes** after the Solemn DHC ceremony.*

*3.5.-*Opening, Closing remarks and Diploma Delivery

The opening ceremony was presided by the Vice-Chancelor of the UIMP Prof. Martinez del Val Peñalosa, who welcomed all participants to the event and stated that ISLIST international School is envisioned to be a worldwide top International forum (**every fourth week of June**) on *Light Sciences and Technologies* in Santander, Spain.

He also added that ISLIST has been conceived as a great opportunity to review and actualize knowledge in this Key or Essential science and technology for the development of the nations. It offers a great opportunity to contribute to the education of citizens and to ensure also that policymakers are made aware of the problem-solving potential of Photonics.

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 15 Invited Speakers selected among the world-wide leader authorities in their respective matters. He added special mentions to the secretary of the course Jesús and to his secretary Maria, both at University and to Margarita Montes, to the Vicerrector Rodrigo Martinez and the Rector César Nombela at the UIMP for their understanding, support and facilities offered during the organization of the event.

Figure 34.-The UIMP Vice-chancellor and ISLIST Director during the Opening Ceremony

Figure 35.-Two moments of the Diploma delivery to the ISLIST participants. The Diploma were delivered to the attendees by Prof. Payne, Prof. Mazur and Prof. Solis.

Before the closing ceremony a personalized Official Diploma was delivered to the participants that participated in the school.

The Closing ceremony was presided by the Vice-Chancellor of the UIMP Prof. Val Peñalosa, who remarked the UIMP satisfaction for the high quality of the ISLIST international school and its splendid development, concluding his Closing Speech with the confirmation of the continuation of this international School in next years.

Prof. López-Higuera announced that the Fourth International School on Light Sciences and Technologies next year will have the Main Core on **Light on Communications and Sensing**. It will be developed during the week of **June 25-29, 2018**. The ISLIST director announced also that several invitations were, at that time, submitted.

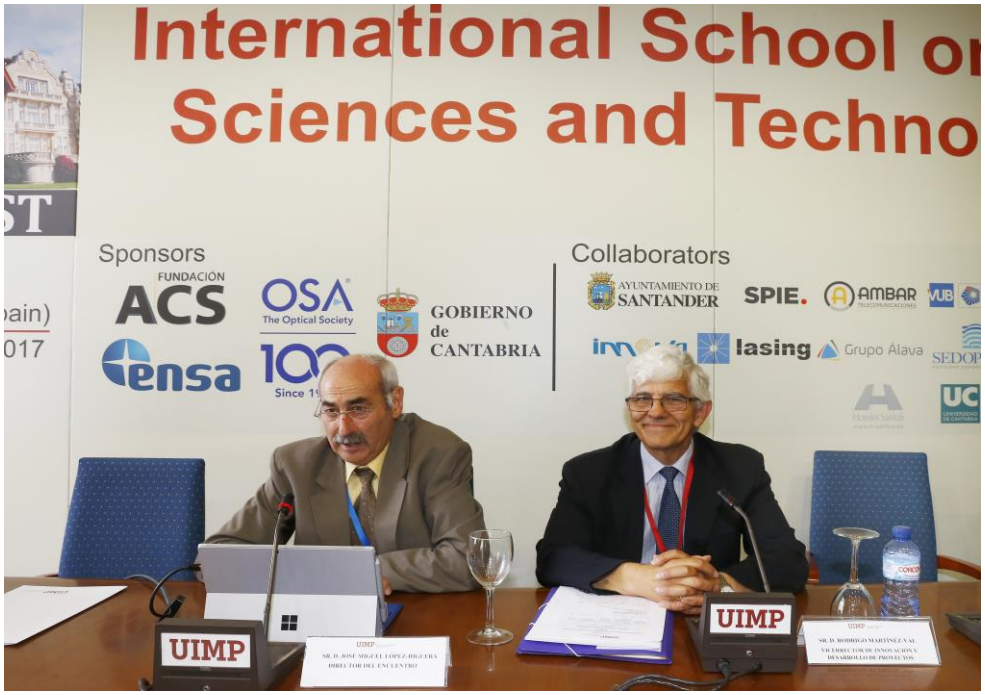


Figure 36.-The UIMP Vice-chancellor (Prof. Val-Peñalosa) and the School Director during the Concluding Remark and announcement of the ISLIST 2018.

At the time to conclude this report it is fully confirmed the participation of several top and worldwide well-known researchers including Prof. **Yablonowitch** and Prof. **Russell,** the fathers of the Photonic Crystals and the Photonic Crystals Fibers, respectively. Prof. Eli Yablonovitch is the **Director** of NSF Center for Energy Efficient Electronics Science University of California, Berkeley, USA, and Prof. Philip Russel is the Director of Max Planck Institute for the Science of Light, University Erlangen-Nuremberg, German). Both of them will develop a very special session on Photonics Crystals, which are useful for both communications and sensing areas.

Figure 37.-After the conclusion of ISLiST-2017 three spontaneous moments of the International Students. In two of they with the director of the international School.

4.- 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:

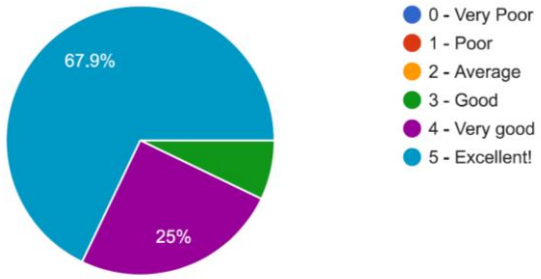


*Figure 38.-Regarding the **quality of the invited speakers** (Q1), the 67.9 %, the 25 % and the 7.1% of the participants considered that they were excellent, very good and good respectively. There were no answers qualified as average, poor or very poor.*

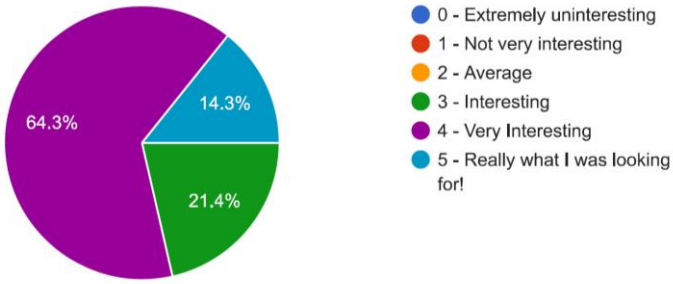


*Figure 39.- Regarding the **topics of the talks** (Q2), the 64.3 % and the 21.4 % and 14.3 %, of the participants considered that they were Really it was what I was looking for, very interesting and interesting respectively. There were no answers qualified in the other possibilities.*

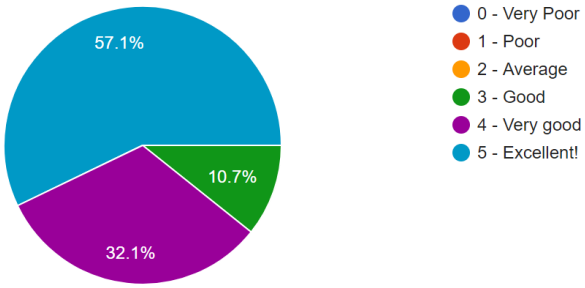


*Figure 40.-Regarding the **organization of the School** (Q3), the 57,1 %, the 32,1 % and the 10,7 % of the participants considered that they were excellent, very good and good respectively. There were no answers qualified as average, poor or very poor.*

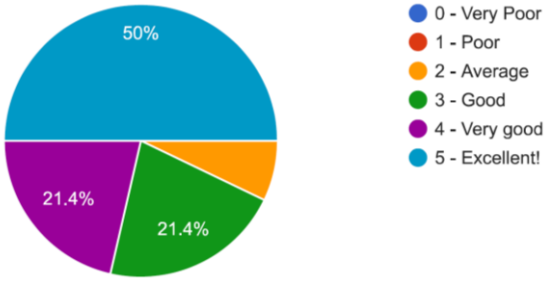
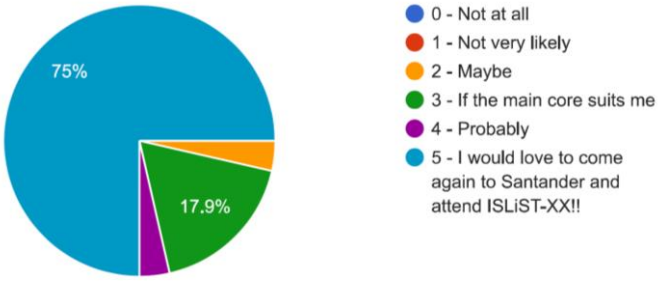


*Figure 41.- Regarding the **information received before attending the School** (Q4), the 50 %, the 21.4 % the 21.4 % and the 7.1% of the participants considered that they were excellent, very good, good and average respectively. There were no answers qualified as poor or very poor.*



Would you recommed ISLiST to other colleagues?

28 responses

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in core suit they,

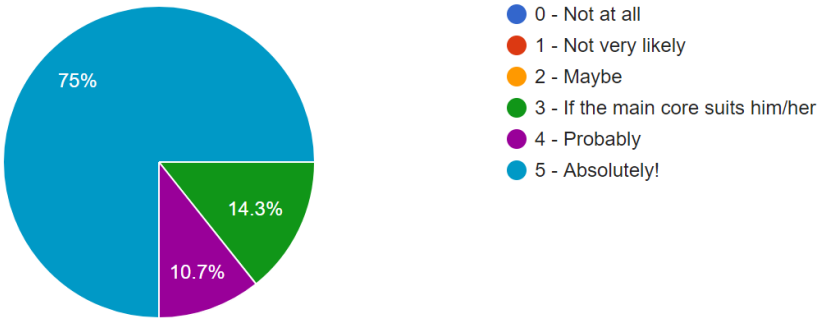

*Figure 43.-Concerning **if they would recommend ISLIST to other colleagues** (Q6), the 75 %, the 14.3 % and the 10.7 % of the participants considered that they will absolutely, If the main core suit they, and probably respectively will recommend the school to other colleagues.*

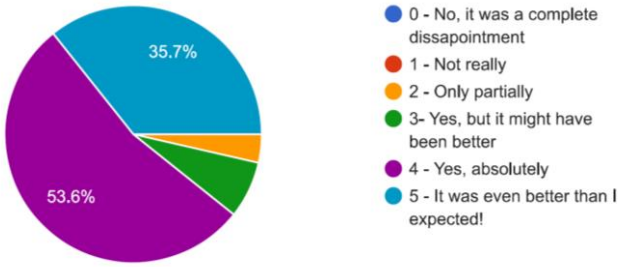

Figure 44.-Concerning ***if the ISLIST meet your expectations*** *(Q7), the 53.6 %, the 35.7 %, and the 7 % of the participants considered that: yes absolutely,* it was even better than they expected *and* yes, but it might have been better *respectively the school meet their expectations.*

Concerning the three additional questions (Q8, Q9 and Q10), we have received the following (**they are as they have been received**):

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

the location and the speakers
the venue, organizing committee
Very good speakers! Keep on inviting them!
EVERYTHING WAS AMAZING
The real good organization, invited speakers of first level, actual and interesting topics... and specially, the internationalisation of course.
Meeting new people from all over the world
I feel privileged by the hospitality of the organizer and the other staff members. The accommodation and the venue is well chosen, such a nice and beautiful place. The time table was great because we got enough time to interact with the Professors. The selection of the Professors for the talks are excellent because they are pioneer of each field.
Great Speakers
1) The location: The palace was so <wonderful> and unexpected for me. Please don't change the location! 2) The fact that a Nobel Prize winner attends. I think it helps attracting good speakers and push the pressure for the speakers to make a good presentation. For me it was the first time that I could meet a Nobel Prize winner. I really really enjoyed meeting Nakamura and being able to eat dinner with him.
La calidad de las presentaciones
Quality of the speakers and its lectures
Prestigious speakers; good relation between members of the organisation, speakers and attendees
highly renowed speakers, a low-key, relaxed atmosphere and enough breaks for networking opportunities.
Organization and speakers

I was excited to listen the most cited scientists in photonics.
The diversity of topics under a really relevant theme.
timetable
Invited students from more different institute
I think the quality of the speakers should be mantained.
International list of speakers and attendees
The Full Grant! Talks by Pr. Mazur, Pr. Yablonovitch, Prof. Artal. The amazing venue of the school - Palacio de la Magdalena. The fact of sharing the lectors' presentations. Nice notebooks with all the names of the presentations and free space for notes. Delicious food!
Wednesday evening when we were able to talk open and free to the invited speakers. This is the most important moment for young researchers to get in contact with new groups and ideas.
Everything was great! Loved it.

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

the student accommodation
most of the staff not speaking English
NOTHING
Perharps, if the coffe breaks would be free, our wallets will express your gratitude.
None
technical issues
Nothing else.
1) No breaks between the talks. Because there were no breaks, people anyway took breaks and then made noise during the presentation while coming back. Maybe you can start a bit earlier and end a bit later but make at least 5 minutes break. It is also difficult (for me:impossible) to stay fully focused for hours without any break. 2) The other problem is during the coffee breaks: the coffee queue that was too long. They should prepare coffee in advance of the break or put more coffee machines to serve everybody within a reasonable time. Many people had to come back without coffee. It also means less income for you. 3) In my case, the chairs were not comfortable. After some time I felt the need to constantly change position.
Freezing conference room, too expensive meals for students
sometimes it was impossible to get a coffee or other beverages in the breaks, due to long queues at the cafeteria. A warning for international guests, that a few words of spanish are a huge benefit at the reception and a few more details in advance, concerning registration, accomodation and meals would have been nice.
Participants should be reminded to return punctually from coffee so as not to interrupt the the other people.

I don't know
Maybe it should be nice to make some networking. Organizing some short visit to Santander, some drinks together or something like this. Otherwise, specially if you are not sleeping at Palacio de la Magdalena, it is difficult to meet other people.
Schedule the same time for lunch for several events, that are simultaneously going on at the same venue.
Round tables maybe less long (around 1 hour). It is too long for following the conversation concentrated.
To be honest, can't think of a bad thing.. Will e-mail if something comes to my mind

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

I'd appreciate 1 social event during the week
NOTHING
Keep it up :-)
I suggest for International students you should also manage to send the hard copy of the invitation letter and the accommodation details which may help in applying for visa.
My opinion is that it was very close to perfection!
No deben separar más a la comunidad española del resto!!!!. No imagino el pretexto para tal acción. Eso no propicia el intercambio académico
Increase room temperature, free coffee break, cheaper meals for students at lunch
It would have been nice, if the speakers joined the meals, since these are the most valuable chances for networking.
Maybe, It will be great to invite scientists in other area of photonics. The School was significantly biased in photovoltaics area.
Great summer school, superb venue, excellent program and organisation. Excellent selection of speakers, every speaker was articulate, passionate and having up-to-date insights of their respective fields. The summer school has a good balance between general knowledge and technical details. The environment is relaxing for students and professors to interact (communicate over dining table, coffee). The pedagogic talk on the last day was great. Overall, it is an eye-opening experience.
Create more opportunities of communication between students and invited speakers
It would be nice to have all the people with a complete grant sleeping in the same place. Palacio de la Magdalena is far from some residences (Salesianos) and it makes difficult to go and come back to the Palace. If not possible, maybe it could be organized some bus to come back to Salesianos (for instance). Because it is very difficult to arrive there by public transport. Anyway, the course is very interesting and I would like to thanks the organization for their work.
Provide water/tea/coffee during the allocated break as bar became crowded very quickly. Release accommodation information (dates & location) well in advance of school.
Many thanks to the organizers of this amazing event! I will definitely consider taking part in any future events. I've spent some very nice time in Santander. I am happy that I had a chance to attend this School!
Very nice organized and very well prepared everything! Congratulations!
May be a session on day 1 for the students to get to know each other ? Not that important but just a suggestion.

5.- CONCLUSIONS

Sixty-eight (68) people from 23 different nationalities from all around the world participated on ISLiST 2017. During the development of the whole programme, they received knowledge and shared experiences with fifteen (15) highly renowned professors (including the Nobel Laureate Shuji Nakamura) and researchers from the most prestigious worldwide institutions of Europe, USA and Asia. They also enjoyed the programmed special event, where they took advantage of the great opportunities to do networking on matters of their interest.

Very special moments were lived during several talks and interventions during the Round Tables with special emphasis on the talks by Prof. Nakamura, Prof. Yablonowitch, Prof. Payne and the two talks of Prof. Mazur. His second talk about education was absolutely memorable.

Unforgettable were also the fresh and enthusiastic questions and discussions among the participants and the panellists of the two round tables.

Thanks to the Santander Council Reception, the attendees and the invited speakers had the opportunity to share thoughts in an unparalleled place, the Royal Palace of Magdalena, and having snacks and drinks.

It also was memorable the solemn ceremony investing Doctor Honoris Causa to Prof. Nakamura.

According to the post-ISLíST survey, the quality of the program, of the speakers, of the complementary events the facilities offered, can be considered at the top level worldwide. ISLIST has met their expectations, being the 75% of the attendees very happy to recommend ISLIST to other colleagues and about the 75% indicating their interesting in participating again *in next editions of the ISLíST School.*

International School on Light Sciences and Technologies (ISLiST)

June 19-23, 2017, Santander, Spain

Core: ***Light in Energy and Environment***

ANEX

ISLiST-2017 PROGRAMME

Monday, 19

Why Light matters for Energy and Environment?

10:15 h

Opening Ceremony

10:40 h / **Break**

11:00 h / Opening Invited Talk

The future of compact and low cost spectroscopy: Advanced spectrometers on Silicon Photonics

Prof. Roel Baets

Director of Center for Nano- and Biophotonics Ghent University IMEC Department of Information Technology, Belgium.

12:10 h / Invited Talk

Light in Energy and Environment

Prof. José Miguel López-Higuera,

Head of Photonic Engineering Group, Universidad de Cantabria, Spain

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

Afternoon: **Photovoltaic clean Energy**

15:30 h / Invited Keynote

Photovoltaics for highly efficient energy conversion and storage

Prof. Antonio Luque,

President of Institute of Solar Energy of Polytechnic University of Madrid, Spain.

16:40 h / Invited Talk

Nanophotonics and colloidal quantum dots for more efficient solar cells

Prof. Gerasinos Konstantatos,

Head of Functional Optoelectronic Nanomaterials Group, ICFO, Barcelona, Spain.

International School on Light Sciences and Technologies (ISLiST)

June 19-23, 2017, Santander, Spain

Core: ***Light in Energy and Environment***

Tuesday, 20

Morning: **Light in efficient clean Energy**

9:30 h / Invited Keynote

A Great Solar Cell Also Needs to Be a Great LED: Electro Luminescent Refrigeration

Prof. Eli Yablonovitch,

Director of NSF Center for Energy Efficient Electronics Science University of California, Berkeley, USA

10:40 h **/ Break**

11:00 h / Invited Talk

Solar Fuels and Electricity by using Sunlight concentrating Systems

Prof. Christian Sattler

Director Department of Solar Chemical Engineering Aerospace Center´s Institute of Solar Research, Germany

12:10 h / Invited Talk

Diode Laser LIDARs for renewable energy generation

Dr. Christian Pedersen

Head of Optical Sensor Technology Group, Technical University of Denmark, Denmark.

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

Afternoon: **Light in Environmental measurements**

15:30 h / Invited Talk

LIDAR Systems for air atmospheric probing: principles and trends in aerosol vertical profiling

Prof. Adolfo Comerón

Head of Optical Remote Sensing Group, Polytechnic University of Cataluña, Spain.

16:40 h / Invited Talk

Laser Frequency Comb and their application on spectroscopic sensing of environmental Pollutants

Prof. Jérome Faist,

Director of Quantum Optoelectronic Group Institute for Quantum Electronics ETH Zurich, Switzerland

International School on Light Sciences and Technologies (ISLiST)

June 19-23, 2017, Santander, Spain

Core: ***Light in Energy and Environment***

Wednesday, 21

Morning: **Light in efficient lighting and Challenges**

9:30 h / Invited Keynote

The strategic roadmap of the European and Global Lighting Industry driven by LEDs and Intelligent Lighting Systems

Mr. Jan W. Denneman
President Global Lighting Association and **Vice-President** of Lighting Europe and Philips Lighting, Eindhoven, Netherlands

10:40 h / **Break**

11:00 h / **Round Table I:**

Light on Energy and Environment: Challenges to face

Prof. Antonio Luque, **President** of Institute of Solar Energy of Polytechnic University of Madrid, Spain.
Challenges on highly efficient energy conversion and storage.

Prof. Eli Yablonovitch, **Director** NSF Center for Energy Efficient Electronics Science University of California, Berkeley, USA
Challenges on PV cells.

Prof. Christian Sattler, **Director** Department of Solar Chemical Engineering, Aerospace Center Institute of Solar Research, Germany
Challenges on harnessing the light with solar concentrator systems.

Mr. Jan W. Denneman, **President** Global Lighting Association and **Vice-President** of Philips Lighting, Eindhoven, Netherlands.
Challenges on highly efficient lighting devices.

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

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

Afternoon: **Light in nanometamaterials and Materials Processing**

15:30 h / Invited Keynote

Less is More: Extreme Optics with Zero Refractive Index

Prof. Eric Mazur
Director of Applied Physics at Harvard University, USA. **2017 OSA President.**

16:40 h / Invited Talk

Femtosecond-laser induced compositional changes for photonics applications

Prof. Javier Solis
Director of the Department of Non-linear, Ultrafast and Nano-scale Photonics, Instituto de Optica-CSIC, Madrid

17:55 h ISLIST Family Photo

18:05 h / Special Event

Santander Council Reception

The Santander 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 19-23, 2017, Santander, Spain

Core: ***Light in Energy and Environment***

Thursday, 22

Morning: **Light in future lighting and communications**

9:30 h / Invited Keynote

The born of High Efficient Blue LEDs and Future Lighting

Prof. Shuji Nakamura

2014 Nobel Prize
2008 Prince Asturias Award
University of California Santa Barbara, USA.

10:35 h / **Break**

10:50 h / Invited Keynote

Light based Communications beyond the Fibre capacity crunch in the XXI century

Prof. Sir David Payne

Director Optoelectronic Research Centre (ORC), University of Southampton, UK.

12:00 h / **Special Event**

Shuji Nakamura Doctor Honoris Causa Solemn Ceremony

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

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

Afternoon: **Light in Medicine**

16:15 h / Invited Talk

Light science and technology for a better vision

Prof. Pablo Artal

Director Optical Laboratory **of** Optical and Nanophysics Research Centre**,** Universidad de Murcia**,** Spain

17:25 h / Invited Talk

The healing power of light: Photodynamic Therapy

Prof. José Miguel López-Higuera,

Head of Photonic Engineering Group, Universidad de Cantabria, Spain

Friday, 23

Education on Light Sciences and Technologies

9:10 / Invited keynote

Innovating Education to Educate Innovators

Prof. Eric Mazur

Director of Applied Physics Department at Harvard University, USA. **2017 OSA President**

10:05 h / **Break**

10:25 h / **Round Table II:**

Education and Training on a Key Enabling Technology: Photonics

Prof. Shuji Nakamura, 2014 Nobel Prize, Prince Asturias Award, Materials Department, University of California Santa Barbara, **USA**

Lessons on education and training on a KET from Experiences of a Nobel Laureate at Japan and USA

Prof. Eric Mazur, 2017 **OSA President**, Director, Applied Physics Department, Harvard University, **USA**

OSA actions to promote the education and the insights gained from education Innovator at Harvard University

Prof. Sir David Payne, Director, Optoelectronic Research Centre (ORC), University of Southampton, **UK**

Insights gained from UK education system and from ORC at University of Southampton

Mr. Marcial Marín, Education and Universities **State Secretary** of **Spain**

The Spanish position on Education for Key Enabling Technologies

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

12:15 h

Diploma Delivery

12: 30 h

Closing Remarks and Announcement of ISLiST 2018