

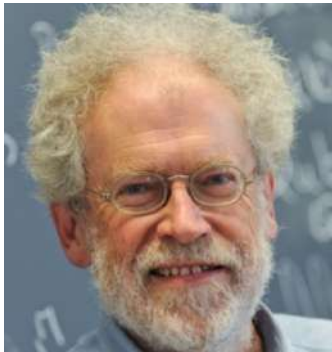


NEWSLETTER

COMMISSION INTERNATIONALE D'OPTIQUE • INTERNATIONAL COMMISSION FOR OPTICS

Nobel Prize for Entangled Photons

ICO celebrates 2022 Nobel Prize in Physics awarded for ground-breaking experiments in quantum optics



John Clauser (top) Alain Aspect (center) and Anton Zeilinger (bottom) received one-third each of the Nobel Prize in Physics 2022 for their experiments with entangled photons.

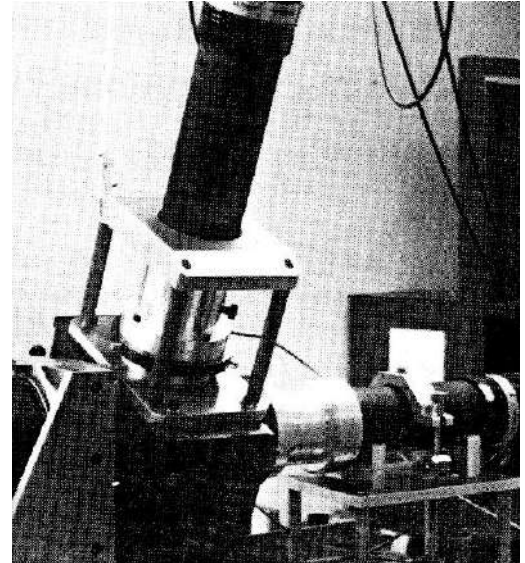
The Nobel Prize in Physics 2022 has been awarded to scientists belonging to the Optics and Photonics community "for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science".

John Clauser, Alain Aspect (ICO award in 1987) and Anton Zeilinger, received one-third of the Prize each "for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science". The achievements provided an experimental answer to the so-called EPR paradox which had been proposed in the 30's by Albert Einstein (E), Boris Podolsky (P), and Nathan Rosen (R), who tried to prove that quantum mechanics was incomplete by envisioning an experiment in which a pair of particles in an initially entangled quantum state are then separated to an arbitrarily large distance. EPR argued that the particles exhibited correlations that would violate their understanding of locality because they would yield nonlocally conditional violations of the Heisenberg uncertainty principle. They therefore concluded that quantum mechanics, in its then-current form, must be incomplete. As time progressed, it was argued that the incompleteness must be a result of "hidden variables" unavailable to the observer.

John Stewart Bell deduced that, if measurements are performed independently on the two separated particles of an entangled pair and there is a dependence upon hidden variables within each half of the outcomes, their correlations must be mathematically constrained. This constraint would later be named the Bell inequality. He then showed that quantum physics predicts correlations that violate this inequality.

John Clauser (US) in collaboration with Horne, Shimony and Holt, developed an experimentally friendly version of Bell's inequalities[1]. Clauser and Freedman then demonstrated the first experimental violation of Bell's inequalities[2]. It is hard to overstate the importance of Clauser's work and heroism in going against the sentiments of the time.

Alain Aspect (France) addressed an important loop-hole in Bell's inequality experiments.



Alain Aspect received the ICO Prize in 1987 for his work on the confirmation by optical means of the violation of Bell's inequalities using the polarizers setup shown above.

Essentially, the analyzer settings were static in previous experiments. Perhaps, nature would conspire to yield the observed correlations based on knowing the slower-than-light settings of the analyzers. Aspect chose to switch the settings of the analyzers in a time fast compared to the transit time of the photons. He showed that Bell's inequalities still held. The important impact of his work[3] was quickly understood within the community. He was awarded the ICO Prize in 1987.

Anton Zeilinger (Austria) made a plethora of important impacts in the field of quantum information using entangled photons. The most famous of these is quantum teleportation [4] in which a quantum state is destroyed at one location and recreated in another.

- [1] Physical Review Letters 23 (15), 880 (1969)
- [2] Physical Review Letters 28 (14), 938 (1972)
- [3] Physical Review Letters 49 (25), 1804 (1982)
- [4] Nature 390 (6660), 575-579 (1997)

John Howell
President of the ICO

ICO25/OWLS16 took place in Dresden, Germany

It was a great honor for the ICO territorial committee of Germany to have hosted the General Congress in its country after 30+ years again



Nobel Laureate Gérard Mourou (left) with the General Chairman of the congress, Prof. Jürgen Czarske (right).

Among the topics offered in the congress were: · Optical Engineering & Design · Material Processing & Lithography · Display and Vision · Optical MEMS and Micro-Optics · Optical Sensing and Measurement · Computational Metrology · Optical Information Processing · Quantum and Nonlinear Optics · Ultrafast Optics & High Power Lasers · X-Ray and High-Energy Optics · Plasmonics and Metamaterials · Nanophotonics & Nanosensing · Fiber Optics & Communications · Terahertz and Silicon Photonics · Microscopy, Biomedical Spectroscopy · Biomechanics & Optical Elastography · Biomedical Optics · Nanobiophotonics & Optogenetics · Optics for Infectious Diseases

The General Congress for optics and photonics ICO-25-OWLS-16 of the International Commission for Optics (ICO) and the international society for Optics Within Life Sciences (OWLS) was in-person celebrated 5-9 September 2022 at the TU Dresden, Dresden, Germany. The General Congress was sponsored by the ICO, OWLS, and TU Dresden. We gratefully acknowledge the financial co-sponsoring by the DGaO - The German Branch of EOS, Carl Zeiss AG, OPTICA (The society advancing optics and photonic worldwide, formerly OSA), SPIE (The International Society for Optics and Photonics - Connect Minds and Advance Light), Photonics Society of IEEE (Institute of Electrical and Electronics Engineers), IUPAP (The International Union of Pure and Applied Physics) and the City of Dresden. The EOS (European Optical Society), LAM (African Laser, Atomic and Molecular Physics Network), and RIAO (The Iberian American Network on Optics) have technically co-sponsored the General Congress.

The main theme was **"Advancing Society with Light"**, emphasizing the importance of modern light technology for society. Light has the potential to recognize the origins of diseases to prevent them, or to cure them early and gently. This is one of the central topics of OWLS, which was founded at the ICO-15 Congress in Garmisch-Partenkirchen in 1990. Therefore, a special commemorative event of the 30+ years anniversary of the foundation of OWLS in Germany was organized. For the first time in the history of ICO, a joint General Congress was celebrated together with OWLS. The General Congress is the most important scientific and technical meeting on all important topics of optics and photonics around the entire world. The General Congress presented insights into the almost limitless variety of application potentials of light technology, emphasizing crucial innovations such as optical networks for the internet, optical information technologies for advanced artificial intelligence, secure data transmission with quantum key distribution and

the quantum computer. Great potential to solving issues on the environment and global energy were highlighted. Perspectives for the disposal of nuclear waste and space debris are opened up, techniques for monitoring air quality and water including detection of microplastics and energy-saving lighting by OLEDs were presented. Novel methods providing advanced tools for biomedicine were emphasized, such as optogenetics, Brillouin elastography, advanced smart microscopy as well as the transfer of modern laser and deep learning techniques to clinics. In addition, breakthroughs in fundamental science were presented at the congress, such as laser interferometers for the measurement of gravitation waves, galactic archeology of exoplanets and deformable mirrors for adaptive telescopes.

Memorable in-person talks by **three Nobel Laurates** were presented: Gérard Mourou, 2018 Nobel Laureate in Physics, inspired the audience with the plenary talk "Extreme Light for the Benefit of Science and Society". Sensational perspectives were outlined on the particle production in empty space to acquire an understanding how the mass of elementary particles is defined. Furthermore, the transfer to medicine was highlighted. An exciting plenary talk, titled "Optical Microscopy: The Resolution Revolution" was presented by Stefan W. Hell, winner of the 2014 Nobel Prize in Chemistry. Optical microscopy has attained single-digit nanometer imaging resolution in the far-field, enabling molecule motion tracking in vivo to elucidate the secrets of life. The 2020 Nobel Prize laureate in Physics, Reinhard Genzel, delivered the fantastic plenary talk, titled "A 40-Years Journey". The existence of mass singularity at the center our Milky Way with four million solar mass objects was observed beyond any reasonable doubt, which could only be achieved through the disruptive advances of optical telescopes using adaptive optics and fiber interferometers. In addition to the 3 Nobel Prize winners, two other outstanding plenary lectures were presented and discussed.



Dresden attracted well-known scientists.



Nobel Laureate Reinhard Genzel gave a talk about his personal 40-year journey to discover black holes.



Nobel Laureate and ICO Prize winner 2000 Stephan Hell, talked about optical microscopy frontiers.

Well-known researchers have presented excellent invited talks such as Alexander Gaeta, Jannick Rolland, Alan E. Willner, Jun Ye, Malgorzata Kujawinska, Pietro Ferraro, Karl Leo, Polina Bayvel, Aydogan Ozcan, Bahram Javidi, Tobias Kippenberg, Yongkeun Park, Allard Mosk, Elizabeth Hillman, Christoph Zaczek, Heidi Ottevaere, Chris Xu, Martin Booth, Cather Simpson, Juergen Popp, Pablo Artal, Caroline Murawski, Guohai Situ, Malte C. Gather, Elaine Wong, Michael Kempe, Wilhelm G. Kaenders, Sudipta Maiti, Adrian Podoleanu, Clara Saraceno, Georg Barbastathis, Colin J. R. Sheppard, Frederique Vanholsbeeck, Eugene Serabyn, Olav Solgaard, Lucia Kleint, Andrew G. White, Cornelia Denz, Jeffrey Kuhn, Michèle Heurs, Ori Katz, Yuzuru Takashima, Maria Vinas-Pena, Jörg-Peter Elbers, Monika Ritsch-Marte, Markus Graefe, Gerd Leuchs, Mona Jarrahi, Jun Tanida, Dana Cialla-May, Kai Wicker, Miguel A. Alonso, Jan Huiskens, Kaoru Minoshima, Michel Meunier, Francesca Palombo, Michael Totzeck, Demetri Psaltis, and many others.



In order to foster students, OPTICA-SPIE prizes were awarded. 17 best student papers prizes with a donation of 300 Euro each were supported by OPTICA, SPIE and TU Dresden. They were presented by Michal Lipson, President Elect of OPTICA and Kent Rochford, CEO of SPIE. The DGaO awarded 3 prizes for the best posters during the closing session of the General Congress. Furthermore, the OPTICA-SPIE student chapter Dresden has invited for an evening seminar.

Michal Lipson spoke about „The Revolution of Silicon Photonics“, highlighting novel applications ranging from remote sensing to ultrahigh-bandwidth communications, which is crucial for advancing the internet. Karsten Danzmann presented a sensational talk, titled "Gravitational Wave Astronomy: Listening to the sounds of the dark universe!". Perspectives on understanding dark matter and hearing the Big Bang by laser interferometers on earth and in space were discussed. The General Congress planned to support expenses to the presenters or Bureau members from developing countries. Over 25 scholarships were granted based on the available budget of ICO, OWLS, OPTICA, SPIE, IEEE Photonics Society, and IUPAP. Elizabeth Rogan, CEO of OPTICA, spoke about the important topic "Diversity as a strategic driver". Great efforts have been made to increase the number of female speakers with extraordinary commitment of the international Technical Program Committee (TPC), especially by Wolfgang Osten. The 5 awards for outstanding scientist were special highlights of the General Congress. Nobel laureates have handled the medals to the honored scientists.

Two ICO Prizes were presented to Francesca Calegari with the topic "Attosecond technology for the real-time tracking of electron dynamics in molecules" and Andrea Alu with the topic "Extreme Light-Matter Interactions in Polaritonic Metasurfaces". Two IUPAP Young Scientist Prizes were awarded to Na Liu with the topic "Controlled multi-motion in high-order plasmonic architectures" and Can Bayram with the topic "Cubic-phase III-nitrides for Next Generation Quantum Devices". The Galileo Galilei Medal was presented to Alexander I. Nosich, Laboratory of Micro and Nano Optics, Kharkiv, Ukraine, with the topic "Microcavity lasers and plasmonic nanolasers on threshold". His outstanding contributions were achieved in unfavorable circumstances of Ukraine. His awarding at the General Congress was a special moment.

Immediately after the ICO-24 in 2017, the preparations for the General Congress already took place, but had to be stopped in 2020 due to the Covid-19 pandemic. The General Congress was postponed to 2021, but could not be held again. Fortunately, due a wise decision by ICO, no switch to digital presentation happens. However, there were **extraordinary circumstances** for the in-person General Congress by the war in Europe, shortcomings with flights and travel restrictions, supply chain limitations, etc. Most hurdles were taken together with the commitment of the worldwide network of sponsors and co-sponsors, the TPC especially the program chairs Wolfgang Osten and Alexander Heisterkamp, the fundraising chair Michael Pfeffer, adviser Bernd Kleemann and the unbelievable commitment of the local team, especially of Nektarios Koukourakis and Lars Buettner. The worldwide General Congress was celebrated with 5A (Africa, Asia, Australia, America and Amazing Europe). The total number of participants in ICO-25-OWLS-16 was around 400. For many participants it was the first face-to-face congress in two years.

The ICO as the umbrella organization with 54 territorial members and 7 scientific organizations has celebrated in Dresden the 75-years anniversary. The city hall of Dresden invited for a reception on Sunday, 4th September. The first mayor Detlef Sittel welcomed the international participants from 5A and highlighted science, industry and art in the capital of Saxony. On Monday, 5th September the General Congress was opened. The outstanding engagement of Frank Hoeller, Associate Secretary of ICO from 2017 to 2021, for the General Congress was highlighted. The ICO mourns his passing and the participants thought with a moment of silence. To commemorate of Frank Höller, the DGaO exhibited a poster.

John Howell, President of ICO, welcomed the participants and outlined the 75 years anniversary of the ICO, which was founded 2 years after second world war.

Top-quality contributions were presented from 55 countries of all continents

The 60+ years anniversary of LASER and 30+ years anniversary of OWLS were celebrated. The participants of the welcome reception enjoyed a fantastic organ concert in the Church of our Lady (Frauenkirche). A speech highlighted the unique construction, destruction and reconstruction of the Frauenkirche. On Tuesday, OPTICA organized a dinner. On Wednesday, the Rector of the TU Dresden, Ursula Staudinger has given a welcome address. The entire lecturing building could be used exclusively for the General Congress. We acknowledge this crucial support of TU Dresden. At the banquet in the Pulverturm, a historic (gun) powder tower, the exciting history of Dresden was lively demonstrated by jugglers with costumes of August the Strong and Countess Cosel. A guided tour around the Frauenkirche was a further highlight. The General Assembly (GA) debated and approved the strategic plans of ICO. Gilles Pauliat presented at the GA and the closing session the preparations for the next general congress ICO-26 in Dakar, Senegal. Humberto Michinel highlighted at the closing session that ICO became Category 1 Member of the International Science Council (ISC).

To conclude, we are pleased to have successfully celebrated the General Congress ICO-25-OWLS-16 in Dresden, thanks to the strong support by the ICO Bureau members and territorial committee, as well as international societies. It was the first postponed congress of ICO and the first merged congress of ICO and OWLS. We believe that ICO-25-OWLS-16 has become one of the most prestigious General Congresses in the whole history of the ICO with Three Nobel Laureates, well-known fantastic invited speakers and the highest quality of talks, posters, exhibition and discussions. Many invited speakers have won ICO Prizes before, such as the Nobel Laureate Stefan Hell. We express **our acknowledgements** to all committee members who contributed to the organization, the preparation, and the execution of the General Congress in Dresden, Germany. On behalf of ICO-25-OWLS-16 we hope everyone had an exciting and memorable time at this extraordinary General Congress.

Prof. Jürgen Czarske
ICO25/OWLS16 General Chairman

European Optics gathered in Porto at EOSAM2022

EOSAM is the flagship event of the European Optical Society, EOS, one of international societies member of the ICO.



Prof. Manuel Costa (right) and Prof. Maite Flores (left) were the general co-chairs of EOSAM 2022.

The annual congress of the European Optical Society (EOS) took place in the beautiful city of Porto (Portugal) from 12 to 16 last September. EOSAM, is a major international scientific conference covering all aspects of optics and photonics, covered by the topical meetings and sessions. It is attended annually by over 500 top researchers, key leaders, students, and industry experts. Each year EOSAM moves into different optics hubs better serving the local communities and at each time creating a unique EOSAM experience for the attendees. EOSAM has been previously organized in France, Scotland, Germany, Netherlands and Italy. It was also planned for Portugal in 2020, but was held online due to the pandemic.

This year, EOSAM was celebrated in person at the Faculty of Engineering of the University of Porto, FEUP, in close collaboration with the Portuguese Society for Research and Development in Optics and Photonics, SPOF, and INESC TEC - Institute for Systems and Computer Engineering, Technology and Science. EOS also collaborated with Sedoptica, PhotonicsFinland, Promoptica, and the European Photonics Industry Consortium, EPIC, for the event.

The conference was organized by Manuel Filipe Costa, President of SPOF, and Maite Flores-Arias, Secretary of EOS as General chairs; Orlando Frazao and Susana Novais, from INESC-tec as Local Chairs; and Patricia

Segonds, President-Elect of EOS and Gilles Pauliat, President of EOS as Program Chairs. The EOS Office coordinated and handled the organization led by the Executive Director, Elina Koistinen, together with Conference Manager Jussi Ahonen and Conference Assistant Tiina Romppanen.

EOSAM 2022 included high-quality program within the thirteen Topical meetings (TOMs), 3 special sessions and an exhibition. EOS once again provided tutorials on the topical meeting topics on Monday 12 September. This year there were nine. They were provided as an additional program, free of charge to all the EOSAM attendees. The tutorials were provided for the first time in 2014 and after a very successful start they have been included in the program ever since and have proved to be highly popular. Up to 140 attendees attended the parallel tutorials this year.

For the sixth time, EOS organized a special session for EU project partners to disseminate their goals and results to the conference audience. This year, nine projects were invited to join this session to present their goals and results.

The Early Stage Researcher Session is specially designed for participants in the first four years (full-time equivalent research experience) of their research careers and who have not been awarded a doctoral degree. PhD students were encouraged to express their ideas and describe



During EOSAM 2022, ICO Past-President Roberta Ramponi (right) received her EOS Fellow diploma from EOS past president and ICO Secretary General Humberto Michinel (left).

their scientific achievements to the conference audience. This year they were invited among those presenting a poster, and six students made very high-level presentations. The audience included mainly students but also many senior researchers.

Along the week there was a fantastic array of six plenary speakers on various topics, proposed and invited by Topical Meeting chairs .

During the week a two-day exhibition was held with Sphere, Thorlabs, Toptica, GloPhotonics , JEOS:RP and EDP Sciences, with a great buzzing at the booths all week. On Tuesday, an industrial optics podium session was held for the first time in co-operation with the European Optical Society, EOS, and the European Photonics Industry Consortium, EPIC. Challenges and solutions from companies were highlighted to researchers by Thorlabs, Toptica, Sphere, and GLOPhotonics. Afterwards, a very nice networking reception was enjoyed by all with live music from the faculty TUNA group, together with drinks and snacks.

The EOS Prize was given out to the best paper published in the Journal of the European Optical Society, JEOS:RP by Ines Fortmeier, Reyko Schachtschneider, Vit Ledl, Ondrej Matousek, Jens Siepmann, Antonia Harsch, Rolf Beisswanger, Youichi Bitou, Yohan Kondo, Michael Schulz and Clemens Elster. The purpose of the prize is to encourage a European dimension in research in pure or applied optics.

The newly elected EOS Executive Committee (Execom) started their work during EOSAM and is formed up by Patricia Segonds (President) Emiliano Descrovi (President-Elect), Gilles Pauliat (Past-President), Roelene Botha (Treasurer), Maite Flores-Arias (Secretary to the Board), Oliver Fähnle (Industrial Advisory Committee Chair) and Thomas Südmeyer (Scientific Advisory Committee Chair).

Elina Koistinen
EOS General Director

Contacts

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Forthcoming events with ICO participation

Below is a list of 2023 events with ICO participation. For further information, visit their official websites indicated for each meeting.

27-31 March 2023

RIAO/OPTILAS Iberoamerican Optics Meeting/XIV Latinamerican Meeting on Optics, Lasers and Applications

Costa Rica

Contact: Prof Manuel Costa

president@optica.pt

<https://riao-optilas-2022.org>

11-15 September 2023

EOSAM 2023. Annual Meeting of the European Optical Society

Dijon, France

Contact: Elina Koistinen

elina@europeanoptics.org

<https://europeanoptics.org>

Responsibility for the correctness of the information on this page rests with the International Commission for Optics <http://www.e-ico.org/>. **President:** Prof. John C Howell, Chapman University, USA; john.howell@mail.huji.ac.il **Treasurer:** Prof. Joseph Niemela, International Center for Theoretical Physics, Italy; niemela@ictp.it. **Secretary:** Prof. Humberto Michinel, Universidade de Vigo, Spain; secretariat@e-ico.org.