



NEWSLETTER

COMMISSION INTERNATIONALE D'OPTIQUE • INTERNATIONAL COMMISSION FOR OPTICS

Another Nobel Prize for Optics

ICO celebrates 2018 Nobel Prize in Physics awarded to well-known laser technologies: optical tweezers and chirp pulse amplification.



Arthur Ashkin (USA, top image) and Gérard Mourou (France, bottom image) have been awarded the Nobel Prize in Physics 2018 for the invention of optical tweezers and chirped pulse amplification, respectively. Ashkin received $\frac{1}{2}$ of the price and Mourou shares $\frac{1}{2}$ with Donna Strickland (Canada)

The Nobel Prize in Physics 2018 has been awarded to scientists belonging to the Optics and Photonics community "for groundbreaking inventions in the field of laser physics".

Arthur Ashkin received one half of the prize "for the optical tweezers and their application to biological systems". This research began immediately after the invention of the laser, when he experimented with the interaction of laser fields and small particles. Dr. Ashkin and colleagues reported from the first observation on the possibility of using a highly focused beam of light to capture microscopic particles in 3D. They managed to move transparent beads, which are drawn into the point with the highest light intensity. This was the birth of the "optical tweezers". Arthur Ashkin quickly realized that the laser is great for holding and moving small objects, just like the Tractor Beam in the Star Trek series.

Of particular importance is that living objects can be moved without contact. Arthur Ashkin initiated a new area of application for his method, namely biological systems, such as bacteria, viruses, living cells, or even proteins and DNA. The optical tweezers allow to study the mechanical properties of molecular motors. In recent years, many researchers have advanced the method of observing, turning and stretching small objects without touching them. The in vivo mapping of the refractive index and the elasticity is important for elucidating the inner workings of cells. One of the latest ideas is the digital holographic optical tweezer, in which thousands of tweezers work simultaneously to separate unhealthy blood cells from healthy ones, which could be useful in the fight against malaria.

G. Mourou and D. Strickland have been also recognized "for their method of generating high-intensity, ultra-short optical pulses". The CPA technique presently allows increasing the energy and hence the peak intensity of femtosecond (fs) laser pulses 5 orders of magnitude. Before this invention, high values were hampered by the damage occurring in the chain of optical amplifiers. In CPA, a pulse is first stretched, decreasing the beam intensity by



Prof. Donna T. Strickland (Canada) former member of the ICO bureau, is the third woman in History that has been awarded the Nobel Prize in Physics.

orders of magnitude. This low-intensity, frequency-chirped optical pulse is then amplified in a chain of optical amplifiers up to, almost, the damage threshold of the amplifiers. Lastly, this high-energy pulse is compressed by a second passive delay line. In this way, the pulse duration is shortened again to fs values, while keeping the pulse energy. The achievement of such high-intensity optical pulses has opened new perspectives for studying extreme states of matter and for a new type of inertial thermonuclear fusion. Another relevant applications are high-harmonic generation for attosecond science and the acceleration of charged particles up to about 1 GeV over a distance of only 1 cm. It is worth mentioning that fs lasers are currently used for micro-machining metallic materials or for LASIK procedure to treat myopia and astigmatism. Under the initiative of Gérard Mourou, the so-called Extreme Light Initiative (ELI) was launched in Europe to construct three large research centers located respectively in Check Republic, Hungary and Romania.

**Jürgen Czarske
Orazio Svelto**

Petawatt laser first shot by the King of Spain

Prof. Luis Roso is the director of the CLPU: the Center of Ultrashort Laser Pulses in Salamanca (Spain)



Last 18th September, Their Royal Highnesses, the King and the Queen of Spain presided over the commissioning of the first Spanish petawatt laser - called VEGA - in the Pulsed Lasers Center (CLPU) facility in Salamanca (Spain). They were accompanied by the current Spanish Minister of Science, Innovation and Universities, Pedro Duque, and the director of CLPU, professor Luis Roso, among other authorities. VEGA is one of only three petawatt lasers in the world capable of being fired once per second. With this state-of-the-art equipment, the CLPU becomes a center of international reference in scientific and technological research in the field of intense pulsed lasers.

This facility is the result of the collaboration agreement between the Spanish Government, the local administration of Castilla-León (Spain) and the University of Salamanca (Spain). The three organizations have deeply collaborated since the creation of the consortium that manages the design, construction, infrastructure equipment and operation, whose financing amounts to more than twenty millions of euros for investments. The special architecture of the facility allows the researchers to have three different outputs that can be synchronized: VEGA-1 of 20 terawatts, VEGA-2 of 200 terawatts and VEGA-3, of one petawatt. Although experiments with VEGA-2 have already been carried out this year, the operation of VEGA-3 makes the Pulsed Lasers Center into

a fully operational facility and an international benchmark infrastructure example of the success of the collaboration between public administrations and researchers from the university. Thanks to the versatility of its design, VEGA has potential impact in many disciplines and fields such as plasma physics, particle acceleration, physics at extreme intensities, laboratory astrophysics, etc.; thus contributing to the development of the scientific ecosystem of Salamanca.

The goal of CLPU is to offer state-of-the-art technology to national researchers as international. Therefore, although the CLPU does its own research in support of scientific-technical development of high-intensity lasers, is primarily a center of users. To this unique profile of leading research, the facility has developed two other strategic lines: innovation and knowledge transfer (promoting public-private collaboration with companies in the field of health, safety road and the aeronautical sector, among others); and disclosure (focused primarily on information to society and in the promotion of scientific vocations). The CLPU and its VEGA petawatt laser, co-financed by the ERDF Funds, are located in the Science Park of the University of Salamanca, which this year commemorates its eighth centenary.

**Luis Roso
(CLPU Director)**

Right: His Royal Highness, the King of Spain, in the presence of Queen Letizia, pushes the button for the first shot of the petawatt VEGA laser in CLPU facility, last 18th September. The photos are a courtesy of CLPU in Salamanca (Spain).



ICO bureau meets in Delft for 70th anniversary

The first meeting of the ICO bureau was held in Delft in 1948. For this anniversary, the current board met in Delft in 2018 and took a symbolic photo in front of the same building as 70 years ago.



Photo of members of the current ICO board in front of the same building, where the first ICO bureau took place in 1948. From left to right, in the top row: P. Urbach, J. Harvey, L. Sirko, J. Howell. Middle row: F. Höller, E. Rosas, G. von Bally, Q. Gong, J. Czarzke, M. Zghal. Bottom row: C. Londoño, R. Ramponi, Y. Arakawa, H. Michinel, N. Kundikova, S. Park. In the column on the left, the original photo of the 1948 meeting is shown.

With the goal of celebrating the 70th anniversary of the first ICO bureau meeting, the board of directors of ICO met in Delft last 8th October in Delft (The Netherlands) and took a commemorative photo in front of the same building where the first ICO meeting took place in 1948. 70 years have passed and ICO has grown and expanded, as it was commented in the previous newsletter dedicated exclusively to this anniversary.

Several issues from the agenda were approved by the board and reports from the ICO committees were presented. Among the most important, the ICO awards for 2018. The ICO-IUPAP prize 2018, chaired by Prof. Dr. Adrian Podoleanu, has been awarded to Dr. Can Bayram, from the university of Illinois, who revolutionized the way graphene has been employed, making major contributions to III-V photonic devices.

The ICO Galileo Galilei award 2018, chaired by Prof. Dr. Nataliya Kundikova has been given to Dr. Debabrata Goswami, from Indian Institute of Technology, India, for extensive contributions to the frontiers of interdisciplinary research that involved both theoretical and experimental developments in the fundamental aspects of femtosecond laser-matter interactions under comparatively difficult circumstances. The Gallieno Denardo award 2018 has been also approved and, following the tradition, the winner of the 2019 edition will be announced during the ICTP winter school in Trieste, Italy, next February. The next meeting of the ICO bureau will take place in Carthage (Tunis), during the celebration of the optical meeting OPTISUD-2019, from 1st to 5th September, 2019. The workshop will be organized by ICO vice-president Prof. Dr. Mourad Zghal.

EOS celebrated its biannual meeting

Prof. Humberto Michinel from the University of Vigo (Spain) is the new president of EOS for the period 2018-2020.



The European Optical Society, an international society member of ICO, has celebrated its biannual congress, the EOSAM-2018 in the beautiful city of Delft (The Netherlands) from 8th to 12th October, 2018. The ICO board acknowledges EOSAM-2018 organizers their hospitality for holding the ICO Bureau meeting in parallel with their congress, that was chaired by ICO Appointed Vice-President Paul Urbach from Delft Technical University. Close to 500 participants have discussed about different topics, covering a broad panorama of current Optics and Photonics technologies.

Plenary talks about different topics related with fabrication and measurement processes were presented, in deep connection with industrial problems. For instance: scatterometry based measurements, ultrathin optical fibers applications, industrial fabrication of aspheres, computational microscopy, circular ranging

OCT, surface plasmons, new materials for solar energy conversion or silicon nanophotonics, among others. Special attention has been paid to the great challenges of photonics, which were covered in a special session where examples of novel projects were presented. For instance, Willem Vos from Complex Photonic Systems (the Netherlands) talked about the control of the energy density of light in 3D nanostructures which has potential applications in quantum computation and Ronald Hanson, from Delft University of Technology, who gave a lecture on the dawn of quantum networks.

The EOS general assembly appointed Humberto Michinel from the University of Vigo (Spain) as its new president until 2020. Gilles Paulliat from the Institute d'Optique in Palaiseau (France) has been appointed President-Elect. Next EOSAM will be the last week of September 2020 in Porto (Portugal).

Contacts

International Commission for Optics (<http://e-ico.org>).

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Forthcoming events with ICO participation

Below is a list of 2018/19 events with ICO participation. For further information, visit the new ICO webpage at <http://e-ico.org/node/103>.

25–28 November 2018
15th Conference in Optics within life sciences (OWLS-2018)
Perth, Australia
Contact: David Sampson
tel: +61 8 6488 7112
avid.sampson@uwa.edu.au
www.owls2018.org

31 May–4 June 2019
4th International Conference on Applications of Optics and Photonics
Lisbon, Portugal
Contact: Manuel Costa
tel: + 351 253 604 070
aop2019@optica.pt
www.aop2019.org

25–26 October 2018
2nd International workshop in Biophotonics & Optical Angular Momentum (BIOAM-2018)
Paris, France
Contact: Tatiana Novikova
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23–26 November 2017
International Conference on Optics-photonics Design & Fabrication
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Responsibility for the correctness of the information on this page rests with the International Commission for Optics (ICO); <http://www.e-ico.org/>. **President:** Prof. Roberta Ramponi, Director IFN-CNR, Politecnico di Milano, Italy; roberta.ramponi@polimi.it. **Treasurer:** Prof. Joseph Niemela, International Center for Theoretical Physics, Italy; niemela@ictp.it. **Secretary:** Prof. Humberto Michinel, Universidade de Vigo, Spain; hmichinel@uvigo.es. **Associate Secretary:** Dr. Frank Höller, Carl Zeiss AG, Germany; frank.hoeller@zeiss.com

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