JANUARY 2022

NEWSLETTER

COMMISSION INTERNATIONALE D'OPTIQUE · INTERNATIONAL COMMISSION FOR OPTICS

IEEE Photonics Society & IEEE SIGHT Bring Humanitarian Projects to Light

IEEE SIGHT
Special Interest Group on Humanitarian Technology

Find more information at:
sight.ieee.org/get-involved

If a technical group, NGO, and/or university within photonics and optics has an interest in these projects or partnering on similar sustainable development efforts, please email (PhotonicsChapters@ieee.org) for funding details.

Photonics connects the world through the Internet and provides practical and cost-effective solutions to meet global challenges in energy production. Optical technologies play a key role in medicine, from simple diagnostics and monitoring to advanced treatment options and research. Remote light sensing technologies promote the development of sustainable agriculture to fight hunger and to protect life on land and in rivers, lakes, and oceans. Modern lighting provides important opportunities to improve quality of life with efficient and green solutions. And, light-based technologies are critical for monitoring and predicting climate change [LightDay.org]. These are only a few of the light-based science application and innovation examples improving quality of life.

To reach its members through the utilization of technology and applying their technical skills to address local problems, the IEEE Photonics Society, partner of International Commission of Optics (ICO) and home to a network of scientists and engineers who represent the laser, optoelectronics, and photonics community, has begun an active collaboration with the IEEE Special Interest Group on Humanitarian Technology (SIGHT) program to address such public imperative initiatives. Within the IEEE Foundation and parent IEEE, the largest technical professional organization dedicated to advancing technology for the benefit of humanity, IEEE SIGHT focuses on sustainable solutions that make a long-term difference in the lives of underserved communities around the world that benefit from technology as they seek to take on real-world challenges. Projects funded by IEEE SIGHT address: poverty; hunger; health and wellbeing; quality education; clean water & sanitation; affordable & clean energy; climate action; sustainable, smart cities; responsible consumption & production; etc.

In 2022, the Society's IEEE SIGHT partnership is set to work with sections in Africa, Latin America, India, and the broader Asia/Pacific region, with a particular focus on mobilizing optics and photonics solutions in developing nations. Preliminary 2021 projects were funded in Kenya, such as: Smart Classroom/Solar Installations; Pandemic-driven Sustainable and Reusable Sanitation Projects; Solar Charging Stations; and a Nanosatellite Launch.

For example, from the tiny room of the Chandaria Incubation Centre at Kenyatta University in Kenya, student leaders of University's IEEE Photonics Student Chapter and IEEE Student Branch created a nanosatellite prototype in connection with the Kenya Space Agency (KSA). The IEEE Photonics Society supported the prototype project with educational seed funding to help organize a series of training sessions.

The nanosatellite, named "KU Cube", measures 10 by 10 centimeters, and weighs one kilogram, which the team says was one of the conditions set by the regulator, the KSA. It is designed to be light to launch but also to cut cost once mass produced.

The IEEE Photonics Society also encourages photonics and optics organizations to establish a joint IEEE Photonics Chapter and IEEE SIGHT group within their section if one does not already exist. There is a toolkit available for those who wish to create a new humanitarian group for their community.

The team of 11 student members and three advisors, drawn from different disciplines, have been working on the project since last year.

The overall purpose of the nanosatellite is to help farmers in Kenya predict and mitigate agricultural disasters, such as locust invasion. The students also focus on aerial surveillance and gathering information on weather patterns and natural disasters, like flooding, that are likely to affect farmers. JKUAT University, in which the Society also has a student chapter, launched a similar satellite within the KSA initiative that encompassed a thermal imager. The imager was designed to monitor surface temperatures and additional tasks, such as tracking wildebeest migration. In October 2021, the nanosatellites were launched at a formal ceremony and is currently operating in test orbit.

It will orbit 37 kms from the Earth's surface for two years before, if all goes well, the agency plans to launch a space-grade satellite into space. The lower earth orbit phase is set for 2022. IEEE SIGHT funds large-scale projects, comparably 101 in 2020, that support broader case studies and rely locally manufactured materials/hands-on participation from underserved community leads. Such projects included: Quantum Dot Solar Panels for Water Treatment, Power Conservation for Electrically Assisted Rickshaw-Vans with PV Support, Wireless Communication Systems for Catastrophic Emergencies, and Automated and Sustainable Drip Irrigation System for rural villages.

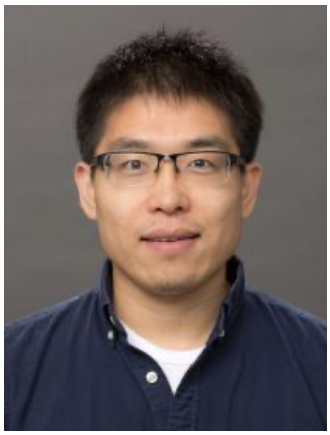
Lauren Mecum-Smith
Senior Manager, Strategic Programs
IEEE Photonics Society

“ Several years ago, I heard the phrase, ‘First observe, then serve’. The next ICO general assembly will be in Dakar, Senegal in 2024. In preparation for this assembly, **we have turned our focus to Africa**. To help us ‘observe’, we assembled a group of African Scholars to understand the needs and potential solutions for the advancement of African science. We have received very valuable input from these discussions. The underlying theme was ‘capacity building’ with four main thrusts: computer hardware and software, active learning, collaboration and mentoring and using decommissioned equipment donated from developed countries. To serve, we are now in discussions with African Academy of Science and will engage the African Union in how we can realize these goals. We are also working with the member societies of the ICO to help further the projects. Our hope is that this capacity building will aid in solving global problems, aid in water sustainability and disease prevention to name a few. For the next year, we will hear from the member societies of the ICO about their efforts in Africa and how we can all participate. Our first contributor is the IEEE (in this newsletter). They highlight the IEEE SIGHT program and its remarkable outcomes throughout the world, but especially in Africa.”

John Howell, ICO President

ICO PRIZE : TOPOLOGICAL PHOTONICS

"Topological photonics provides a platform to both explore new phases of matter and revolutionize optoelectronic systems".



Prof. Zhen works on topological photonics at the University of Pennsylvania (USA).

Bo Zhen, from the Department of Physics and Astronomy in the University of Pennsylvania (US), has been awarded the 2020 ICO Prize for "pioneering research on optical bound states in the continuum, exceptional points, and other topological states in photonics".

Prof. Zhen received his B.S. degrees (Mathematics and Physics) from Tsinghua University (China) and his Ph.D. degree in Physics from Massachusetts Institute of Technology (US). His group at the University of Pennsylvania focuses on novel phenomena in topological photonic systems and their applications in nonlinear optics, optoelectronics, and quantum electronics. This prize was awarded on his contributions to the discovery and understanding of topological states in photonics, which include the topological nature of optical bound states in the continuum [1, 2], exceptional rings [3] and bulk Fermi arcs [4] in optical systems, and unidirectional guided resonances [5]. Recently, his own group at the University of Pennsylvania has also extended topological photonics beyond linear structures into general nonlinear optical systems. They have identified a series of new topological phases that do not exist in static systems but appear when the system is periodically driven by an external field. Some of the examples include Floquet Chern insulators of light [6] and Floquet dipole phases [7]. They have also proposed a method to greatly suppress or even forbid unwanted nonlinear frequency generation using concepts from topology [8]. These results pave the way to future exploration and classifi-cation of all possible topological phases in driven nonlinear optical systems. These scientific findings may also find applications in optoelectronics and lead to novel functionalities significant superior to the existing approaches.

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ICO VP Prof. Leszek Sirko chairs the ICO Award Committee

Photo of a nonlinear photonic crystal being driven by a strong laser to produce new topological phases that do not exist in static settings.

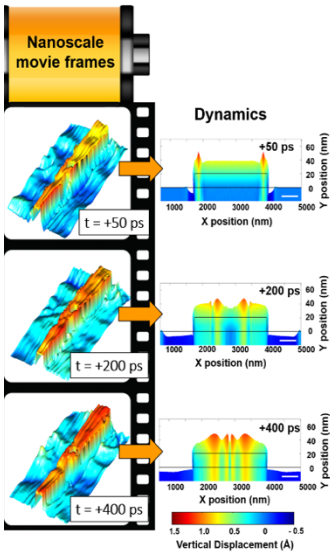
ICO/IUPAP Young Scientist Prize in Optics 2021

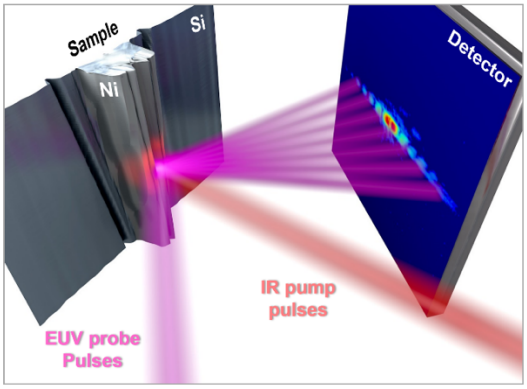
"For her contributions to imaging and scattering of nanostructured materials using high-harmonic soft X-ray sources and research on extreme ultraviolet imaging"

Prof. Giulia Fulvia Mancini is an Associate Professor at the Physics Department of the University of Pavia (Italy).

Prof. Mancini is the head of the Laboratory for Ultrafast X-ray and Electron Microscopy (LUXEM) and Principal Investigator of the ERC Starting Grant ULTRAIMAGE. Her research group studies light-matter interactions and structure-property relations in functional nanomaterials and interfaces in the ultrafast domain. The group utilizes innovative coherent imaging and scattering techniques from pulsed electrons and EUV/X-rays - tabletop High-Harmonic Generation (HHG) and facility-scale sources.

Prof. Mancini obtained her Ph.D. with distinction in 2015 from the École Polytechnique Fédérale de Lausanne (EPFL), with an experimental thesis focused on the implementation of a new Ultrafast Electron Diffraction setup. She studied structure-property relationships in two-dimensional self-assembled superlattices, pioneering diffractive imaging with pulsed electrons in the femtosecond domain.
In 2015-2017 she was an SwissNSF Postdoctoral Research Associate with Prof. Margaret Murnane and Prof. Henry Kapteyn at JILA, University of Colorado Boulder and NIST (USA). In 2017-2020 she was Senior Research Associate in the group of Prof. Majed Chergui at EPFL and SwissFEL (PSI). Giulia contributed with pioneering work to the demonstration of ultrafast ptychographic Coherent Diffractive Imaging (CDI) for materials science.





Stroboscopic microscopy from ptychography CDI with tabletop EUV light from High Harmonic Generation (right). The reconstructed snapshots (above) create frames of a nanoscale motion picture. Adapted from reference [4]

The combination of EUV light from HHG with ptychography enabled quantitative imaging of reactions at buried interfaces[1], and of the extended structure of a silica close-packed colloidal crystal multilayer, with quantitative precision to the number of layers, in a non-destructive approach[2].

Key to this progress were advances in image-reconstruction algorithms, which led to demonstrate a record sub-wavelength coherent imaging of periodic samples using a 13.5 nm tabletop high-harmonic light source [3]. She was also the lead developer of the first microscope relying on Dynamic Coherent Diffractive Imaging with ptychography and HHG, which she utilized to demonstrate ultrafast EUV ptychography with a single harmonic at 28.9nm. The result (see figure) was a stroboscopic movie of the complex, impulsive response of an individual nanostructure irradiated by an ultrafast laser pulse, with sub-100nm transverse 0.5Å axial and ≈10fs temporal resolutions [4].

Moreover, this approach allowed to image a special excited mode in a nanoantenna (called lowest order generalized Lamb wave) and to visualize its dispersion. Prof. Mancini's work is addressing the possibility to image dynamical processes in functional materials upon interaction with light pulses and across length-scales, a current grand challenge in nanotechnology relevant to a host of systems including photovoltaic, optoelectronic and biomedical devices.

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ICO VP Gilles Pauliat chairs the Prize Committee

Galileo Galilei Medal Award to Prof. Victor Balykin

Prof. Balykin works at the Institute of Spectroscopy in Troitsk, Russia.

Prof. V.I. Balykin is devoted to the study of fundamental processes of the interaction of laser radiation with atoms, molecules, charged particles and nanostructures.

The ICO Galileo Galilei Medal Award was given in 2021 to Prof. Victor Balykin "for outstanding contributions to the laser cooling, trapping, control and manipulation of the mechanical motion of atoms" [1-2]. For the development of laser cooling of free neutral atoms, he, together with V.S. Letokhov and V.G. Minogin was awarded the Rozhdestvensky Prize (2001). The ideas of laser cooling of neutral atoms, after successful experiments with atomic ensembles, were transferred to charged atomic particles-ions. In joint experiments with the Institute for Nuclear Research (Heidelberg, Germany), the pioneering work was carried out on laser cooling of relativistic ion beams in The Test Storage Ring [3]. The research conducted by Balykin and his group contributed to the foundation of the so-called "atom optics" [4,5], where control of the motion of atoms, molecules and ions is obtained by light pressure of laser radiation. He also led experiments on focusing atomic beams with laser light [6]. A resonator for de Broglie atomic waves, similar to an optical resonator has been also investigated[7] as well as the optical Stern-Gerlach effect[8]. The schemes of atomic traps, which make it possible to localize a single atom, have been studied theoretically and experimentally [9,10]. Concerning applied research, new standards of quantum frequency are being created on the basis of ultracold atoms; specular reflection of atomic beams makes it possible a new generation of gravitational field detectors; deep focusing of atoms formed the basis of atomic nanolithography.

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ICO VP Prof. Natalya Kundikova chairs the Award Committee

Contacts

Forthcoming events with ICO participation

Below is a list of forthcoming events with ICO participation. For further information, visit their official websites listed below.

18–22 July 2022
AOP2022: V International Conference on Applications in Optics and Photonics
Guimarães, Portugal
Contact: Prof. Manuel Costa
info@aop2021.org
https://aop2022.org/

5-9 September 2022
OWLS-16: 16th International Conference on Optics within Life Sciences
Dresden, Germany
Contact: Prof. Jürgen Czarske
ico25@intercom.de ico-office@mailbox.tu-dresden.de
https://ico25.org

5-9 September 2022
25th Congress of the International Commission for Optics
Dresden, Germany
Contact: Prof. Jürgen Czarske
ico25@intercom.de ico-office@mailbox.tu-dresden.de
https://ico25.org

21-25 November 2022
XI Iberoamerican Optics Meeting/XIV Latiname-rican Meeting on Optics, Lasers and Applications
Costa Rica
Contact: Prof Manuel Costa
president@optica.pt
https://riao-optilas-2022.org

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