



ICO Prize for Attosecond Structured Light

A unique form of light that holds promising potential in fields such as Biology, Chemistry, and Materials Science.



In 2022, Dr. Hernández-García obtained a permanent academic position at the University of Salamanca (Spain) and now he leads the Unit of Excellence in Structured Light and Matter (LUMES).

The 2023 ICO Prize recognizes the theoretical contributions of Dr. Carlos Hernández-García from Universidad de Salamanca in Spain to the emerging field of short-wavelength structured light and “his seminal contributions in the theory and modeling of laser-driven high harmonic generation and understanding how to manipulate their waveforms to impart orbital and spin photon angular momentum”.

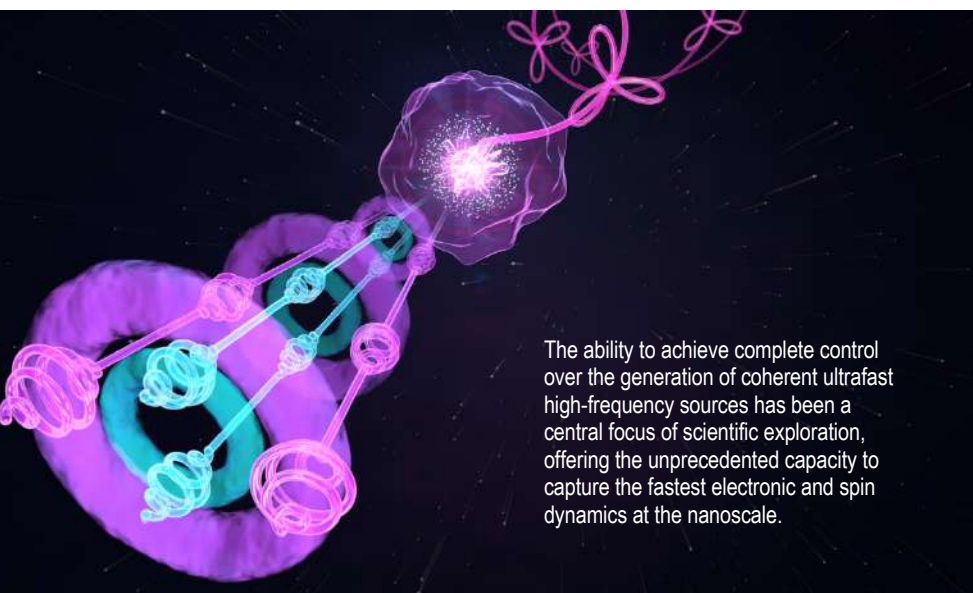
His work focuses on imparting orbital and spin angular momentum on attosecond, high frequency harmonic beams, offering an unprecedented capacity to capture the fastest electronic and spin dynamics at the nanoscale.

Of his notable contributions, Dr. Hernández-García’s work on identifying the orbital angular momentum rules in the high nonlinear process of high harmonic generation [1], has been instrumental in inspiring advancements in the

field of structured attosecond pulses [2]. Among other works, he pioneered the generation of extreme-ultra-violet vector beams [3]; he uncovered the underlying mechanisms to generate isolated attosecond pulses with controlled polarization [4]; he demonstrated the generation of high harmonics and attosecond pulses with both spin and orbital angular momentum [5], and contributed to understanding the conservation laws in terms of the torus-knot angular momentum [6]. By designing complex combinations of ultrafast laser pulses, he led the proposal to impart self-torque, or time-dependent orbital angular momentum into light pulses, a novel property of light beams that was generated experimentally with Margaret Murnane and Henry Kapteyn at JILA [7]. More recent contributions to the field include the proposal of ultrafast, ultraintense magnetic fields using structured light beams [8], the development of extreme ultraviolet vector vortex beams [9], and the extension of structured harmonic comb beams with controllable frequency and divergence to soft x-rays [10].

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- [6] Phys. Rev. Lett. 122, 203201 (2019)
- [7] Science 364, eaaw9486 (2019)
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- [10] Science Advances 8, eabj7380 (2022)

**ICO VP Leszek Sirko
chaired the ICO Award Committee**



The ability to achieve complete control over the generation of coherent ultrafast high-frequency sources has been a central focus of scientific exploration, offering the unprecedented capacity to capture the fastest electronic and spin dynamics at the nanoscale.

Dr. Mahdy awarded the ICO Galileo Galilei Medal

Prof. Dr. Mahdy Rahman Chowdhury Mahdy of North South University, Bangladesh, has won the ICO Galileo Galilei Medal Award 2023.



He is the first researcher in Bangladesh to win the award: "For outstanding contributions in optical (main) and Quantum mechanical manipulation".

Dr. Mahdy Rahman Chowdhury Mahdy is Associate Professor, Dept. of ECE (full-time) and Dept. of Math & Phys. (part-time) at North South University (NSU), Dhaka, Bangladesh. He received his PhD in Photonics (supervisor: Prof. Qiu Cheng Wei) from ECE dept., National University of Singapore in 2017 and later promoted to Associate Prof. in 2019 at NSU, where he established the Optics Lab in 2018 after winning TWAS international grant. He played a vital role to popularize Quantum computing and Optics in Bangladesh. During the Covid-19 lockdown period he conducted 4 online courses that played a pivotal role to start modern research areas in quantum & optical theories (including quantum manipulation & computing) in Bangladesh. He has also established Mahdy Research Academy in 2023, which is open for all Bangladeshi university students. Though private universities in Bangladesh like NSU are not permitted to offer PhD degrees, Dr. Mahdy has published 50 peer-reviewed international top journal articles, including Nature Publishing Group's Light: Science & Applications, ACS Nano, Computers in Biology & Medicine, Journal of Physical Chemistry C. He has also written one textbook of Electromagnetics. Many of his students and RAs of his research lab are pursuing PhD with full scholarships at reputed universities such as Cornell and Johns

Hopkins University. Recently, he received the North South University Research Excellence Award twice (in 2021 & 2023) and UGC Gold Medal Award in 2018. This award is handed over by the President of Bangladesh.

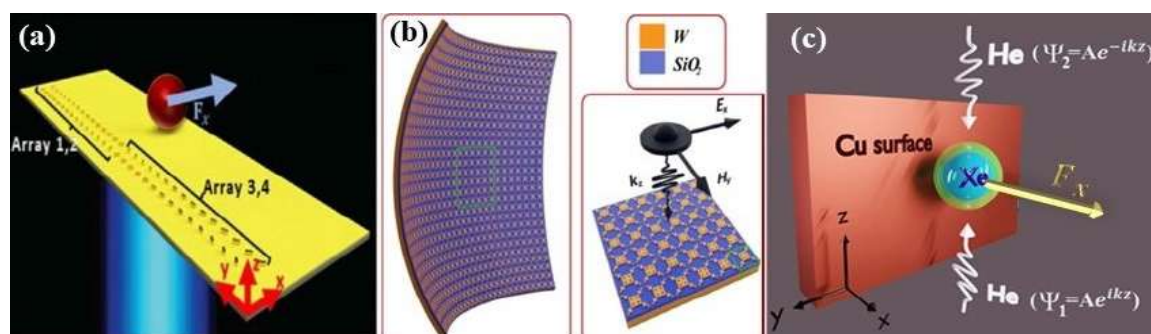
In the area of optical manipulation, Dr. Mahdy has worked on optical tractor beam effects, optical lateral force, reversal of near field binding, all-optical sorting of dielectric or plasmonic or chiral particle in a single set-up [1] (cf. Fig (a)) and broadband absorber based solar sails for spacecraft propulsion & orbiting telescopes [2] (cf. Fig (b)).

Dr. Mahdy (along with his team) is now trying to perform quantum mechanical manipulation beyond atomic trapping such as atomic level pulling or lateral or binding force and trapping atoms using matter wave instead of light, demonstrating quantum mechanical lateral force on Xe atom due to the incidence of matter wave [3] (cf. Fig (c)). Further investigations are going on by his team for other categories of novel manipulations from atomic to macroscopic scales.

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- [2] Adv. Eng. Materials 25 (20), 2300438, (2023)
- [3] Heliyon, e23449, (2023)

ICO VP Nataliya Kundikova chaired the committee for the ICO Galileo Galilei Medal Award



(a) All-optical sorting of nanoparticles using metasurface from [1]. (b) Photonic absorber based solar sail from [2]. (c) Quantum lateral force on an atom due to matter-wave [3].

ICO & IUPAP award nanophotonics research

Prof. Ríos Ocampo was awarded “for pioneering the integration of phase change materials with photonic integrated circuits for a wide range of applications”



Since 2021 Carlos A. Ríos Ocampo is a Colombian scientist an Assistant Professor at the University of Maryland (UMD) College Park, USA, with a joint appointment between the Department of Materials Science and Engineering and the Institute for Research in Electronics & Applied Physics. He leads the Photonic Materials and Devices group.

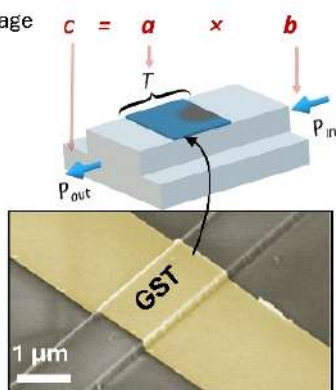
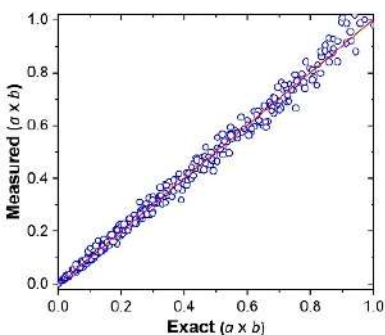
Before joining UMD at College Park, Prof. Ríos Ocampo completed a postdoc at MIT with Prof. Juejun Hu after his PhD in Materials Science from the University of Oxford, under Prof. Harish Bhaskaran's supervision. He has led the first experimental demonstration of reversible and controllable modulation of PCMs embedded into PICs. This achievement opened several opportunities in the fast-growing field “phase change photonics,” which exploits the nonvolatility and unprecedented large modulation of optical properties of such materials in various on-chip applications. The pioneering results led to the creation of the world's first light-based memory chip able to store digital and multi-level data indefinitely [1], [2], and to carry in-memory [3], synaptic [4], and other light-based computations [5]. These advances used the same building block: a PCM embedded in the cladding of photonic waveguides, an element also referred to as integrated optical memristors [6]. Moreover, Prof. Ríos Ocampo and his group and colleagues have dedicated efforts to explaining the mechanisms behind the light-matter interactions that result in the unique response of these materials [7], [8], the development of novel PCM alloys [9], and the development of different switching and material platforms, as silicon-doped [10] and graphene microheaters [11], [12]. Since 2021, Prof. Ríos Ocampo has been focusing on transparent PCMs to

control the phase of light on PICs. His efforts led to the most compact phase shifter, a crucial building block in PICs, which also displayed a nonvolatile response [10] and a totally new approach to achieving free-form rewritable PICs on PCM films, i.e. use the PCMs to pattern waveguides instead of being a modulating element [13]. Thanks to his contributions to the field of optics and photonics, Prof. Ríos Ocampo was named one of the 2021 Rising Stars of Light by the Journal Light: Science & Applications, one of the 2023 finalists of the 2nd Century Trailblazers award by the Journal of the American Society of Ceramics, and a member of the Early Career Editorial Advisory Board of the journal APL Photonics. Prof. Ríos Ocampo has also been listed since 2022 in the Top 2% of the world's scientists in the areas of optoelectronics and photonics, according to Elsevier and Stanford University.

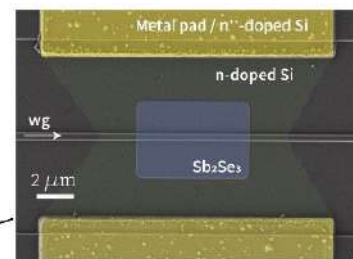
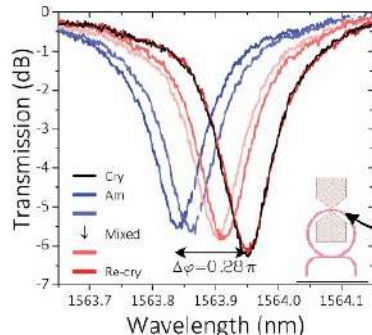
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ICO VP Gilles Paulliat chaired the committee for the IUPAP Young Scientist Prize in Optics

PCM as a computational memory: storage and scalar multiplication [3]



Low-loss PCM as a nonvolatile phase shifter in a microring resonator [10]



Active Learning in Optics activities in Pakistan

Imrana Ashraf coordinates many Optics and Photonics dissemination activities in Pakistan



A full report on the Active Learning in Optics (ALO) group will be published in the next special issue of the ICO Newsletter.

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The ALO (Active Learning in Optics) group, started educational outreach activities in the province of Khyber Pakhtunkhwa (KPK), in northwestern Pakistan in early 2019, beginning with a one-day workshop at Mardan Women University. In 2023, the plan included follow-up activities in Mardan and Swabi Women Universities, along with conducting outreach in the University of Swat and Karakoram International University.

We started 2023 with two scheduled events on January 3rd and 5th at "The Black Hole." These events were tailored for fifth-year and O-level high school students, respectively. Notably, "The Black Hole" is an organization dedicated to promoting art, science, and culture. They organize summer and winter clubs for students from various schools, with a focus on imparting scientific knowledge. Since the year 2022, ALO has been actively involved in overseeing the optics lab at The Black Hole and has established a long-term collaboration to bring science education to students.

For the younger participants, ALO utilized SPIE Explore Optics kits, while the older students engaged with the Photonic Explorer kits, enhancing their

learning experience in the field of science. In early March 2023, a ray of hope emerged with the approval of the SPIE Outreach grant. This support proved to be a blessing, enabling the ALO Group to plan more activities and travel to the remote areas of KPK.

The group had historically relied on self-funding for most endeavors. After receiving the SPIE Outreach Grant, we decided to go forward with four more activities in May.

On any outreach activity day, I need to leave home early to pick up my team of volunteers. The pickup points vary, ranging from Quaid-i-Azam University, which is 30 km away from my home, to volunteers taking Uber from their homes to a designated meeting point. Once assembled, we load into my car and head towards our destination. Although we originally planned to conduct some of these in remote areas in KPK, the compromised security concerns at the time limited us to schools in the twin cities (Rawalpindi-Islamabad).

Prof. Dr. Imrana Ashraf
ICO Territorial Committee
of Pakistan

Forthcoming events with ICO participation

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

16–19 July 2024

International Conference on Applications of Optics and Photonics (AOP)

Aveiro, Portugal

Contact: Marta S. Ferreira

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<https://aop2024.org>

21–24 October 2024

XXVI International Commission for Optics World Congress (ICO-26)

Cape-Town, South Africa

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<https://e-ico.org/blog/ico26>

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