

NEWSLETTER

COMMISSION INTERNATIONALE D'OPTIQUE · INTERNATIONAL COMMISSION FOR OPTICS

Low Cost Optics Against Tuberculosis

Two universities in Bolivia and Peru develop a low-cost 3D printed laser fluorescence inverted microscope for tuberculosis disease diagnosis

Tuberculosis is a serious public health concern worldwide, and early detection is crucial for effective treatment. However, conventional fluorescence microscopes for diagnosis are often expensive and inaccessible in low-resource settings.

using the auramine stained sputum smear technique.

The new device is an important step towards cost-effective tuberculosis diagnosis for low-income communities in developing countries.

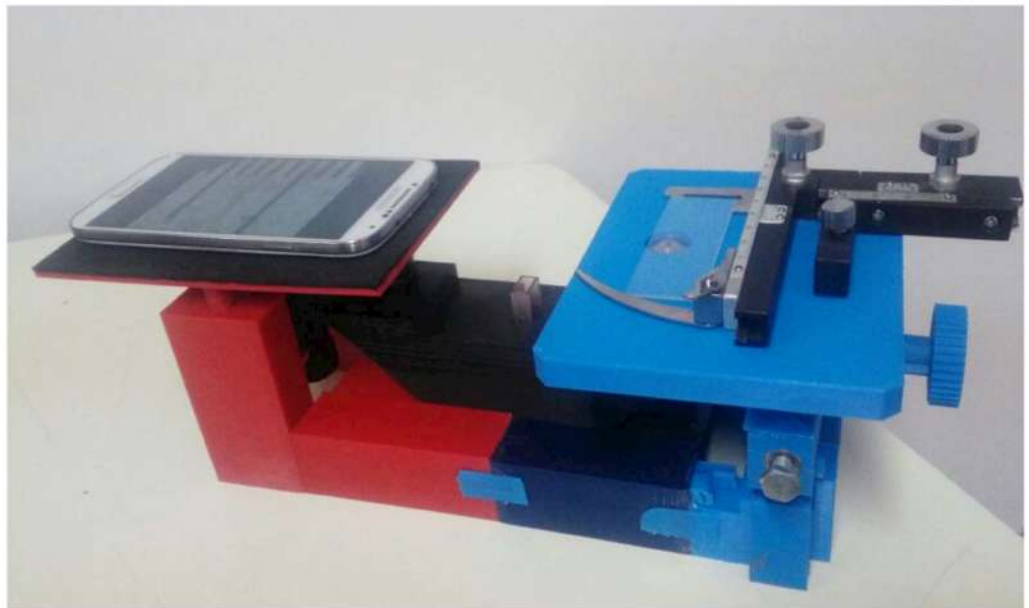
To address this issue, the Optical and Energy Research Center (CIOE) and the New Information Technology Research Center (CINTI) of Universidad Privada Boliviana (UPB), Cochabamba, Bolivia, and the Laboratory of Bioinformatics, Molecular Biology, and Technological Developments of Universidad Peruana Cayetano Heredia (UPCH), Lima, Peru, jointly developed a low-cost 3D-printed inverted laser fluorescence microscope for the detection of tuberculosis disease

The microscope is based on a low-cost CW laser (405 nm) and a laser-based simplified optical filter system. Additionally, a smartphone is used to visualize the fluorescence image of biological samples, and the device's smartphone app automates the interpretation of microscopic images to provide fast and accurate diagnosis.

The Bolivian and Peruvian researchers validated the device's efficacy using ten sputum samples from patients with tu-



Omar Ormachea (top) Alex Villazón (centre) and Mirko Zimic (bottom) have developed the low-cost inverted laser fluorescence microscope.



The 3D-printed structure of the smartphone-based inverted laser fluorescence microscope.

berculosis confirmed by Microscopic Observation Drug Susceptibility (MODS) assay culture test.

The samples were processed for auramine sputum smear microscopy and read in blind by an expert microbiologist using both the Carl Zeiss AxioLab fluorescence microscope and the 3D-printed inverted fluorescence microscope under 400x total magnification. The results showed 100% correlation in determining the positivity for tuberculosis in both devices.

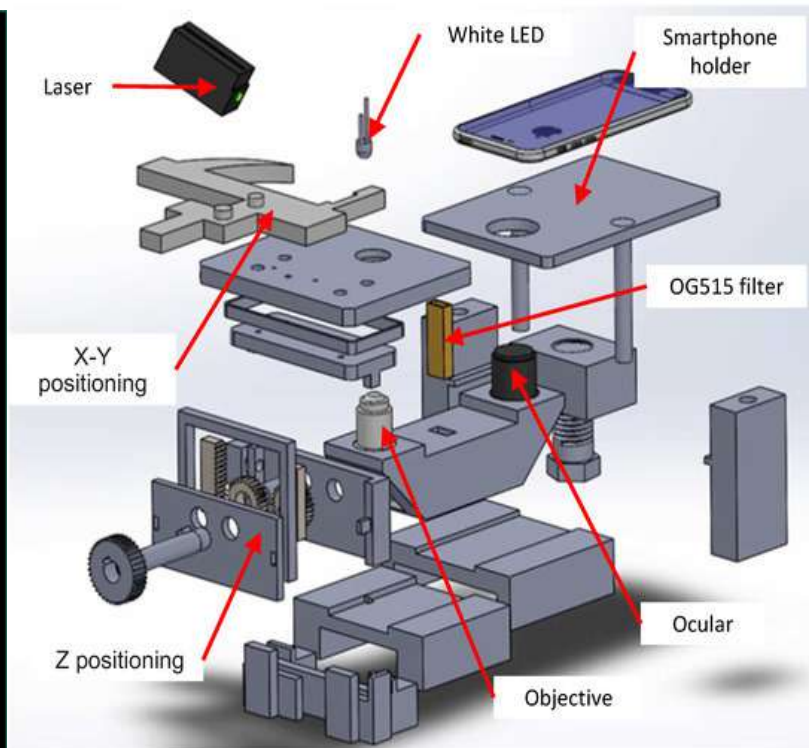
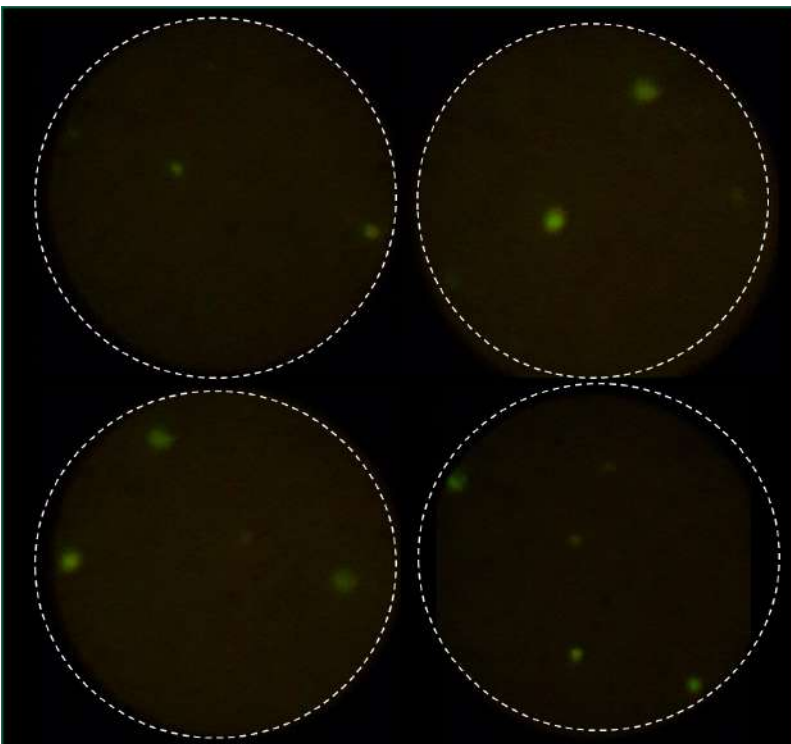
The 3D-printed inverted fluorescence microscope developed at UPB and UPCH is at least one order of magnitude less expensive than conventional fluorescence microscopes,

making it an accessible tool for low-income communities to fight against tuberculosis. Omar Ormachea PhD (UPB), Alex Villazón PhD (UPB), and Mirko Zimic, PhD (UPCH) were responsible for the conceptualization and experimental development of the device.

This work was presented at the XI Iberoamerican Optics Meeting / XIV Latin American Meeting on Optics, Lasers, and Applications (RIAO/OPTILAS 2023) held in San José, Costa Rica, on March 27-31 2023.

**Omar Ormachea and Alex Villazón
(Universidad Privada Boliviana)**

**Mirko Zimic
(Universidad Peruana Cayetano Heredia)**



Left: Fluorescence images of Tuberculosis bacilli using the auramine stain technique obtained with the inverted laser fluorescence microscope (400x magnification). Right: Block diagram of the 3D-printed laser fluorescence inverted microscope.

In Costa Rica, Most Beetles are Optically Left-Handed

The high density of biodiversity in Costa Rica offers numerous advantages, including being well-known for its natural attractions that attract tourism.



Marcela Hernández-Jiménez from Universidad de Costa Rica (top image) participates in the collection of different types of beetles (bottom image).

Costa Rica is a small developing country located in mainland Central America just 9.7 degrees North from the equator. Surrounded by the Pacific Ocean and the Caribbean Sea and sculpted with volcanoes and plains, it is home for around 5% of species on Earth[1].

Perhaps a lesser-known opportunity is the potential this richness has for interdisciplinary scientific research. This is why more than a decade ago, scientists from the University of Costa Rica formed an interdisciplinary work group to survey physical properties of insects found in the local biodiversity. They became interested in the study of beetles of the genus *Chrysinia* (Scarabaeidae: Rutelinae: Rutelini). These beetles are often known as “jewel beetles” because their bright iridescent and metallic colors. Also, *Chrysinia* beetles present an uncommon feature in nature: most species reflect predominantly mainly **left handed circularly polarized** light.

As far as we know, the first paper on optical properties of *Chrysinia resplendens* is from 1969[2]. Nevertheless, most articles regarding optical properties of jewel beetles have the down side of the scarce availability of specimens and/or dealing with museum specimens, with the restrictions this implies.

The fact that there are more than 24 *Chrysinia* species in Costa Rica motivates

our group to study structural color in different species by measuring reflectance from the cuticle and combining it with information about the self-assembled chitin structure in the cuticle. Our goal is to provide a theoretical model that links the self-assembled structure in the elytra with the observed optical properties. In the long term, we aim to synthesize a material inspired by local biodiversity[3,4,5,6,7,8].

However, we also find ourselves intrigued by other research questions that can only be answered with access to recently collected material, such as the relationship between the visual capabilities and ecology of these beetles. Our work has helped raise the visibility of Costa Rican scientific research through international and interdisciplinary collaborations.

REFERENCES:

- [1] Obando V Conservación y biodiversidad 2013
- [2] Neville AC, Caveney S Biol Rev 44 531 1969
- [3] Campos-Fernández C et al Opt Mat Exp 1 85 2011
- [4] Libby E et al J Opt 16 082001 2014
- [5] Hernández-Jiménez M et al Opt Mat Exp 4 2632 2014
- [6] Azofeifa DE et al. JQSRT 160 63 2015
- [7] Vargas WE et al. Biomimetics 3, 30 2018
- [8] Vargas WE Opt Continuum 1 409 2022

Marcela Hernández-Jiménez
Universidad de Costa Rica



Collection of different *Chrysinia* beetles displaying a rich variety of colors.

ICO-ICTP Award to Muhammad Qasim Mehmood

Prof. Mehmood has received the Gallieno Denardo Award.



The Gallieno Denardo award is given during the Winter College on Optics organized at the Abdus Salam International Center for Theoretical Physics (ICTP).

Dr. Muhammad Qasim Mehmood has received the 2023 ICO/ICTP Gallieno Denardo Award for his remarkable contributions to the field of Optics & Photonics through quality research, mentorship, community services, and outreach activities. He is working as an Associate Professor at the Department of Electrical Engineering, Information Technology University (ITU) of the Punjab Lahore, Pakistan. His research interests include Nanophotonics, Metamaterials, and Optical Engineering. He has been listed among the top 2% of scientists in a global list (o 2021 and 2022) released by Stanford University. Prof. Mehmood has published over ninety journals and fifty conference papers at prestigious venues. The cumulative impact factor of his journal papers is over 500, and his citations exceed 4000, as per Google Scholar. He secured various competitive funding for his research projects and won Microfellowship from ITMO University Russia in 2019. He has supervised/co-supervised five Ph.D., seventeen masters, and eighteen undergraduate theses.

Prof. Mehmood heads the vibrant MicroNano lab (<http://micronano.itu.edu.pk/>) at ITU, whose focus includes designing Photonics, Metaphotonics and Electronics devices or systems for

healthcare and energy. The lab's projects, like the development of intelligent microscopy as an autonomous diagnostic solution for the local health care system, promote the culture of indigenous development and are instrumental in creating collaborations and opportunities for the students. The lab has active collaborations with several prestigious institutes. These collaborations helped remarkably to strengthen ITU's MS/Ph.D. program by producing quality research output and developing global connectivity for the students.

He is the advisor of vibrant SPIE and OPTICA student chapters at ITU events. He has joined hands with the Pak-ICTP Alumni Society and student chapters (of various international societies like IEEE, IET, SPIE, and OPTICA) from different universities of Pakistan to promote science in general and optics & photonics in specific through organizing a range of students' development and outreach programs like symposiums, IDL events, seminars, internships, and awareness sessions, etc. The prime focus is to go the far-reach low resources of Pakistan to promote science and encourage/expose students of all genders to science education.

ICO VP Nathalie Westbrook chairs the award committee at the ICO



Some members of the MicroNano Lab (<http://micronano.itu.edu.pk/>) from the Information Technology University of Punjab Lahore, Pakistan

RIAO/OPTILAS 2023 Celebrated in Costa Rica

RIAO is the Iberoamerican Optics Network, one of the international organizations member of the ICO



Prof. Ernesto Montero Zeldón from Tecnológico de Costa Rica chaired the RIAO/OPTILAS 2023 congress.

The XI Ibero-American Conference on Optics (RIAO), and the XIV Latin-American Meeting on Optics, Lasers, and Applications (OPTILAS), was celebrated in San José (Costa Rica) from March 27th to 31st with the participation of remarkable speakers, and many Latin-American experts in their respective fields of study.

The plenary talks covered some of the most important aspects of optics and photonics and included "In-fiber Acousto-Optics & Optomechanics" (by M. Andres from Spain), "Laser spectroscopy applied in environmental, ecological, agricultural and medical

research" (by K. Svamberg and S. Svanberg, from Sweden), "Information processing by using speckle and optical vortices" (by M. Tebaldi from Argentina) "Bose-Einstein Condensation of Light and Superfluid Phenomena" (by T. Mendonça from Portugal), "Applications of optical spectroscopy in the UV-NIR range" (by E. Solarte Rodríguez from Colombia), "Optical techniques for three-dimensional scanning of micro and macro objects" (by A. Martínez-García from México) and "New topological structures in nonlinear optical media" (by H. Michinel from Spain).

During the congress, the new president of RIAO, José Luis Paz-Rojas, was elected. The congress was an excellent event for establishing new collaborations, scientific discussions and networking amongst the Latin-American optics community. The numerous students participating had the opportunity of presenting their on-going research, and learning about the last advances in optics and photonics in Latin-America.



ICO Secretary General, prof Humberto Michinel (left) with the new RIAO President, José Luis Paz-Rojas (right).

Prof. Eric Rosas is ICO VP appointed by RIAO

Contacts

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

Bureau members (2021-2024)

President J C Howell

Secretary H Michinel,

Escola de Enx. Aeroespacial
Universidade de Vigo,
Campus de Ourense (Spain)
e-mail: hmichinel@uvigo.es

Past-president R Ramponi

Treasurer J Niemela

Assoc. Secret. A Podoleanu

Vice-presidents, elected

J Czarske, P Ferraro, Q Gong,
N Kundikova K Minoshima,
S Otero, L Sirko, N Westbrook

Vice-presidents, appointed

G von Bally, K D Choquette,
Y Ismail, C Londoño,
G Pauliat, E Rosas, A Wagué,

IUPAP Council representative

C Cisneros

Editor in chief H Michinel

Editorial committee

J Harvey, University of
Auckland, New Zealand;
J Baldwin, Australian National
University, Australia;
J Dudley, Université Franche-
Comté, France



Forthcoming events with ICO participation

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

11-15 September 2023

EOSAM 2023. Annual Meeting of the European Optical Society

Dijon, France

Contact: Elina Koistinen
elina@europeanoptics.org
<https://europeanoptics.org>

30 September - 4 October 2024

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

Dakar, Senegal

Contact: Ahmadou Wagué and Ariel Levenson
ahmadou.wague@ucad.edu.sn
<https://ico26.org>

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. John C Howell, Hebrew University of Jerusalem, Israel; 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.