39th Newsletter of the ITN:

"NExt Generation of Tuneable LASers for optical coherence tomography"

(NETLAS)

led by University of Kent

October 2023

Mission : To improve health by accelerating support for medical research through recognition of research excellence, advocacy, and education

Lasker Foundation celebrate the contributions of scientists, clinicians, and public servants who have made major advances in the understanding, diagnosis, treatment, cure, or prevention of human disease. Their programs educate the public and promote scientific collaboration, and advocate for a healthier world through medical research.

The Lasker Awards program was created in 1945 by **Albert and Mary Lasker** to shine a spotlight on **fundamental biological discoveries and clinical advances that improve human health**, and to **draw attention to the importance of public support of science.**

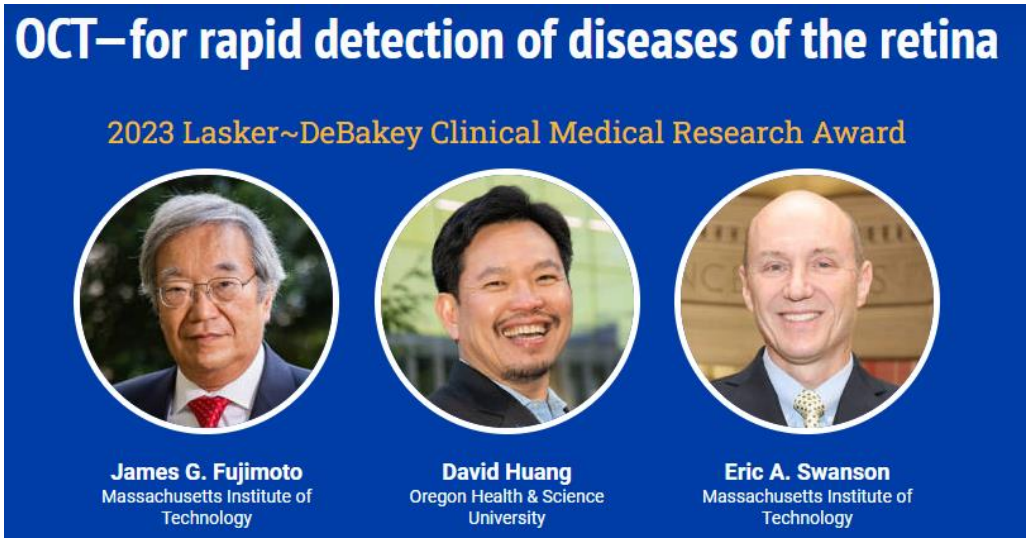
Lasker Awards are given in the categories of **Basic Research, Clinical Research, Special Achievement, and Public Service.** **The Foundation will begin accepting nominations for the 2024 Lasker Awards on November 1. Deadline for submission will be February 5, 2024.**

Watch the ceremony video for the 2023 winners here

Questions & Answers with James G. Fujimoto, David Huang, and Eric A. Swanson: Winners of the 2023 Lasker~DeBakey Clinical Medical Research Award

Measuring the delay in return of reflected light provides a noninvasive way to image delicate materials as well as human tissues. Originally **developed in 1991, optical coherence tomography (OCT) is now a standard of care in ophthalmology.** OCT is also used for myriad other medical and industrial applications, such as **optimizing stent placement in cases of coronary artery disease** and **testing packaging** without compromising the material contents.

James Fujimoto, David Huang, and Eric Swanson have won the 2023 Lasker~DeBakey Clinical Medical Research Award for the invention and development of OCT



All three winners sat down with The Proceedings of the National Academy of Sciences (PNAS) to describe the development of the technology and share their thoughts on its future applications.

Read more **here** and **here**.

On 24th October 2023 US President Joe Biden honors David Huang, M.D., Ph.D., for transformative imaging technology

US President Joe Biden presented on 24th October 2023 **David Huang** and others with the National Medal of Technology and Innovation for developing the imaging technology known as optical coherence tomography, or OCT, which routinely helps prevent blindness. **James G. Fujimoto, Ph.D.**, and **Eric A. Swanson, M.S.**, of the Massachusetts Institute of Technology and co-inventors of OCT with Huang, were also honoured at the White House ceremony.

The medal recognizes "**American innovators whose vision, intellect, creativity, and determination have strengthened America's economy and improved our quality of life**," the White House said in an announcement. Established by Congress and administered by the U.S. Patent and Trademark Office, the first Medal of Technology and Innovation was presented in 1985.

"**You're literally changing the world for the better**," **President Biden told Huang** and other honourees.

Huang, Fujimoto and Swanson invented OCT in the early 1990s, when Huang was an MD/PhD student working in Fujimoto's MIT lab. Last month, the trio also received the 2023 : asker-DeBakey Clinical Medical Research Award for their development of OCT

Huang is the director of research, associate director and World Family Chair in Ophthalmic Imaging at the OHSU Casey Eye Institute, and also serves as a professor ophthalmology and biomedical engineering in the OHSU School of Medicine.

A tweeter video of the **full ceremony is available** online also on **YouTube**: President Biden Awards the National Medal of Science and National Medal of Technology & Innovation - YouTube

OCT has transformed the way eye disease is diagnosed and managed. It enables ophthalmologists and optometrists to identify vision-threatening disease early, and often before patients experience symptoms.

President Joe Biden awards **Eric Swanson, David Huang, and James Fujimoto (l-r)** the National Medal of Technology and Innovation award during a ceremony in the East Room of the White House, Oct. 24, 2023.

The team was recognized for the invention and commercialization of optical coherence tomography, a breakthrough imaging technology used to identify life- and sight-threatening diseases in tens of millions of patients each year.

Photo: Ryan K. Morris/National Science and Technology Medals Foundation

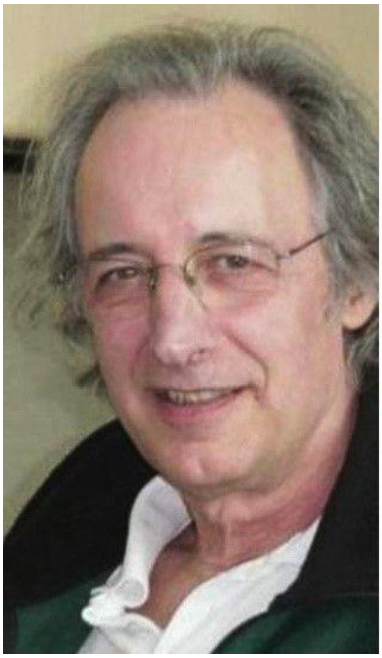
President Biden Honors Leading American Scientists, Technologists, and Innovators | U.S. Department of Commerce

Four from MIT awarded National Medals of Technology, Science | MIT News | Massachusetts Institute of Technology

President Biden honors David Huang, M.D., Ph.D., for transformative imaging technology | OHSU News

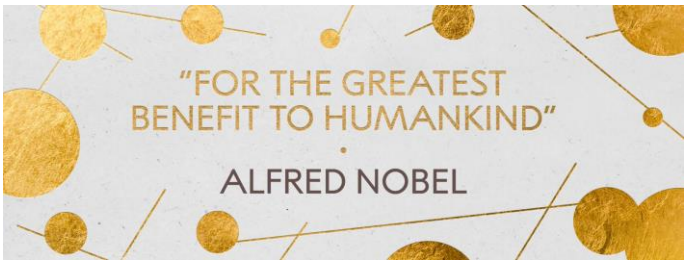
President Biden honors David Huang, MD, PhD, for transformative imaging technology (ophthalmologytimes.com)

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics 2023 to **Pierre Agostini** The Ohio State University, Columbus, USA, **Ferenc Krausz,** Max Planck Institute of Quantum Optics, Garching and Ludwig-Maximilians-Universität München, Germany and **Anne L'Huillier** Lund University, Sweden, ***"for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter"***



Pierre Agostini, Anne L'Huillier Ferenc Krausz

The three Nobel Laureates in Physics 2023 are being recognised for **their experiments**, which **have given humanity new tools for exploring the world of electrons inside atoms and molecules**. They have demonstrated a way to create extremely short pulses of light that can be used to measure the rapid processes in which electrons move or change energy.



Interested in the person behind the striking illustrations of the 2023 Nobel Prize laureates? Check out artist Niklas Elmehed.

Here Niklas is painting the portrait of 2023 economic sciences laureate, Claudia Goldin.

Viewed by millions within seconds

Within seconds after the Nobel Prize is announced **the portraits are published at many of the biggest news sites all over the world**.

The graphical concept behind the portraits is to give the portraits the expression of breaking news - a strong and unique visual impression.

The portraits are painted in black acrylics and gold foil

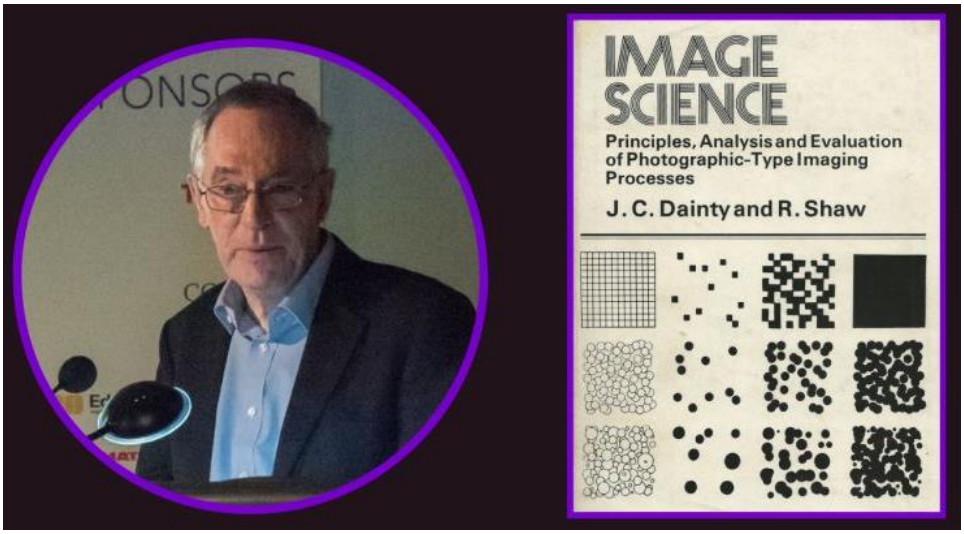
Read More about Niklas Elmehed

Congratulations to 2011 Optica President Chris Dainty
recipient for the **2023 RPS Progress Medal** and **RPS Honorary Fellowship** from The Royal Photographic Society in recognition of important advances in the scientific or technological development of photography!

As a pioneer in the field, Dainty's ground-breaking book, co-authored with Optica Emeritus Rodney Shaw, "**Image Science**," is one of the **most quoted texts in imaging**. The text provides ***fundamental foundations for the sensors that now appear in almost all modern imaging devices, from consumer cameras to cell phones and beyond***.

As a member of the Optica Community, Dainty has been awarded the C.E.K. Mees Medal and the Robert E. Hopkins Leadership Award for his contributions to speckle phenomena and his outstanding participation in the international optics community.

During his career, Dainty has investigated problems in optical imaging, scattering and propagation. In these areas, he has **co-authored or edited six books**, approximately **140 peer-reviewed papers** and **220 conference presentations**.



Professor Chris Dainty (rps.org)

Edwin Land Medal:

Recognizes pioneering work empowered by scientific research to create inventions, technologies, and products

The **Edwin Land Medal** was presented at FIO23 to OpticaFellow **Susana Marcos** (University of Rochester) for her **pioneering work developing new techniques to evaluate the eye, including understanding its structural, biomechanical and optical properties.** Marcos' work has impacted millions of people globally, as her developments have been applied to treatments of several eye conditions, including myopia, presbyopia, cataracts and corneal corrections.

Marcos joined the **University of Rochester** faculty in 2021 after serving as **Director of the Institute of Optics,** CSIC, Spain, (IO-CSIC), and Professor of Research at CSIC, where she founded the **Visual Optics and Biophonics Lab** (VIOBIO) in 2000.

Marcos is a Fellow of Optica, the European Optical Society, and the Association for Research in Vision Ophthalmology.

Marcos' **research recognitions** include the **Adolph Lomb Medal** (Optica), **ICO Prize**, **Doctor Honoris Causa** (Ukraine Academy of Science), **Ramón y Cajal Medal** (Royal Academy of Sciences), **King Jaime I Award**, and **National Research Award in Engineering.**

Marcos is a cofounder of 2EyesVision SL and a coinventor of the SimVis technology that **allows patients to 'try on' multifocal corrections before putting in contact lenses** or having an intraocular lens implantation. She has authored or co-authored more than 200 peer-reviewed papers in top journals and has 23 patents (14 licensed to industry).

Read More

Kevin P. Thompson Optical Design Innovator Award:

Recognizes **significant contributions to lens design, optical engineering, or metrology** by an individual as evidenced by one or more of the following: innovative and rigorous research; optical system design with a foundation in aberration theory; development of advanced metrology capabilities; product development; patents; or publications.

Optica (formerly OSA), Advancing Optics and Photonics Worldwide, is pleased to announce that **Dr. Eric M. Schiesser,** PhD, Synopsys Inc., Optical Solutions Group, USA, has been selected as the 2023 recipient of the Kevin P. Thompson Optical Design Innovator Award.

Eric is recognized for innovation and rigor in optical design methodology.

Eric's **doctoral work focused on reflective non-symmetric optical designs and associated aberration theory,** in which he explored design methods for freeform telescopes and a laser relay with tilted, spherical surfaces. He **investigated the reduction of aberrations in these systems using Nodal Aberration Theory**, with a particular interest in **automating the developed design techniques**. He continues to **explore solving a broad range of optical design challenges in his role at Synopsys**, where he focuses on algorithm research and development for imaging system design and analysis, and occasionally collaborates with the Optical Engineering Services Team on design projects.

2023 Kevin P. Thompson Optical Design Innovator Award Winner | Optica

AOG Visits

Charles Bibas, CO from Tecnica, Inc, US

visit the Applied Optics Group Labs

On Tuesday, 24th of October 2023, AOG lab members welcomed Tecnica CEO, Charles Bibas and its cofounder, Diana Rozenblum. Diana and Charles visited the labs of the AOG researchers, with the group's PhD students and post-docs being able to informally explain their area of research and potential applications. The visit was followed by a Tecnica presentation of their mirrorless 3D printing concept, which took place in Grimond LT3, University of Kent at 2 pm.

Charles Bibas is a visionary entrepreneur, founder, and CEO of Tecnica Inc, a **3D printing and scanning manufacturer**. With a passion for innovation and an unwavering commitment to **advancing 3D printing technology**, Charles has amassed a **portfolio of patents worldwide**, demonstrating **his expertise and ingenuity in SLS (Selective Laser Sintering) 3D printing, optics, and scanning.**

Charles **developed the Lens Free Optical Scanner (LFOS**), also known as Øgon. The LFOS represents a breakthrough in the field, transforming the capabilities of 3D SLS/SLM printing. By eliminating the need for traditional optical lenses, the **LFOS has overcome significant limitations and paved the way for enhanced efficiency and cost-effectiveness.**

Charles has published papers in the field of optics and material processing.
Charles holds a BSCE degree from Technion University – Israel Institute of Technology.

US patents: Six (6) granted patents in the field of AM and optical scanning
EU patent: 1 Granted and two pending in the field of AM and optical scanning.
Worldwide:
More than two dozen patents granted in the field of AM and optical scanning.

Solid Form Fabrication - Best paper list
https://utw10945.utweb.utexas.edu/sites/default/files/2021/2021%20Symposium%20Best%20Papers.pdf

JOM Journal - https://link.springer.com/article/10.1007/s11837-021-05044-8

SPIE conference paper - https://www.spiedigitallibrary.org/conference-proceedings-of-spie/12170/2600487/Advances-utilizing-the-Ogon-a-Lens-Free-Optical-Scanner-LFOS/10.1117/12.2600487.short?SSO=1

Charles delivering a presentation of Technica's mirrorless 3D printing concept with the title "***Elevating Sanning Technology: The Lens-free Optical Scanner (LFOOS) Advantage***" @photo by Prof Adrian Podoleanu

Charles delivering a presentation and visiting the campus at the University of Kent @AOG
Photos by Prof Adrian Podoleanu

AOG Journal Club

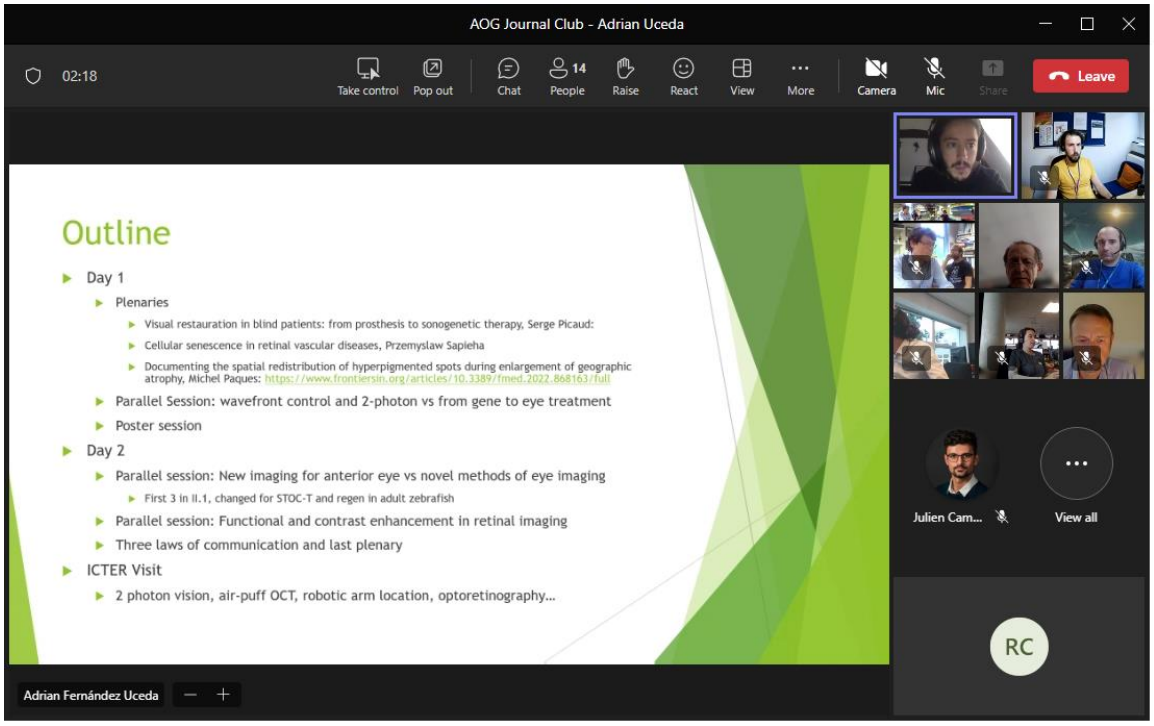
13/10/2023 at 12 pm

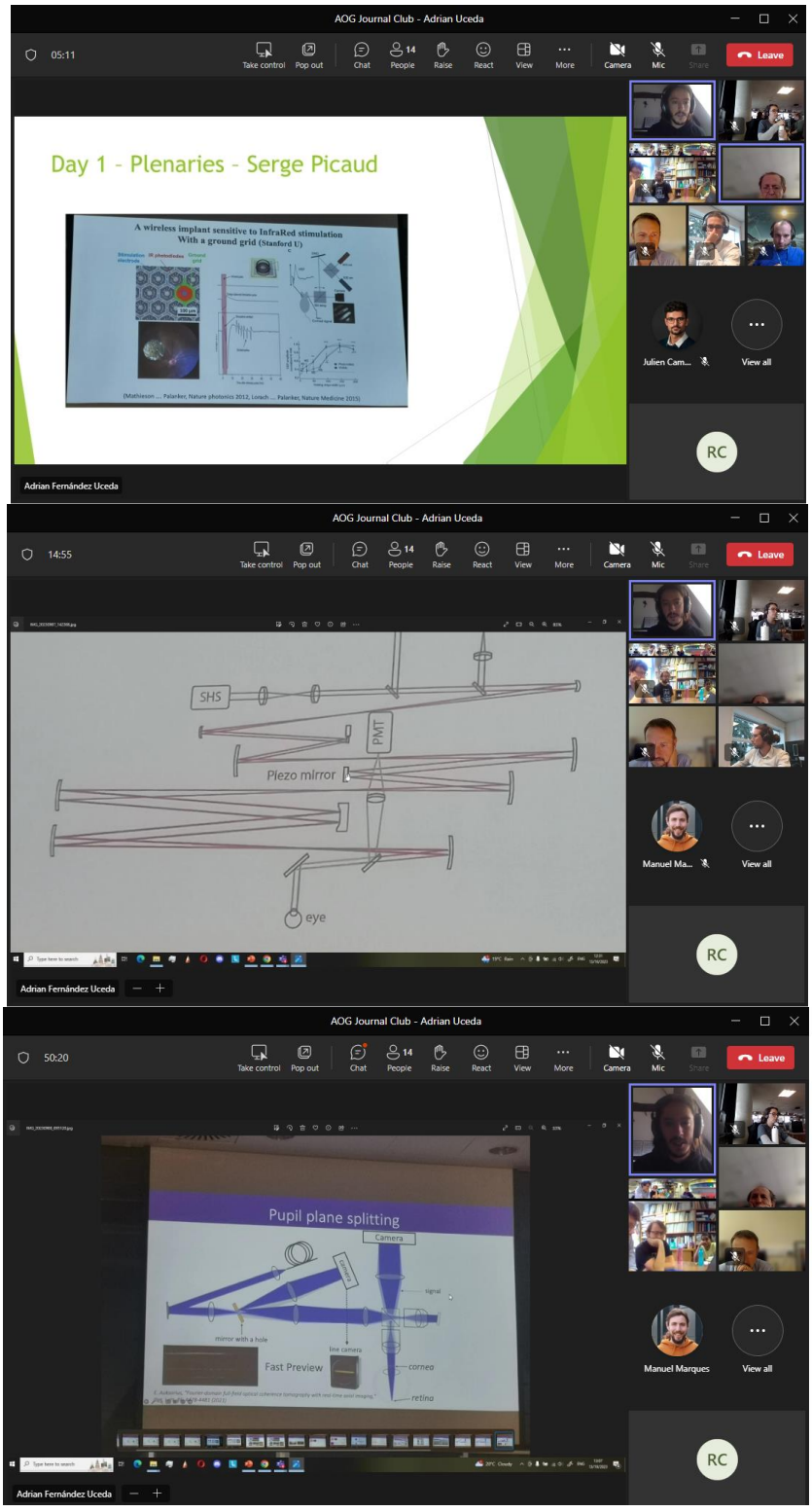
AOG PhD Student Adrian Fernandez

presented a review of the CRATER conference he attended 7-8 September 2023 in Warsaw, Poland in Copernicus Science Center. Adrian presented a poster at the conference with the title "*Endoscopic en-face optical coherence tomography and fluorescence imaging using correlation-based probe tracking*". Program of the conference can be found at:

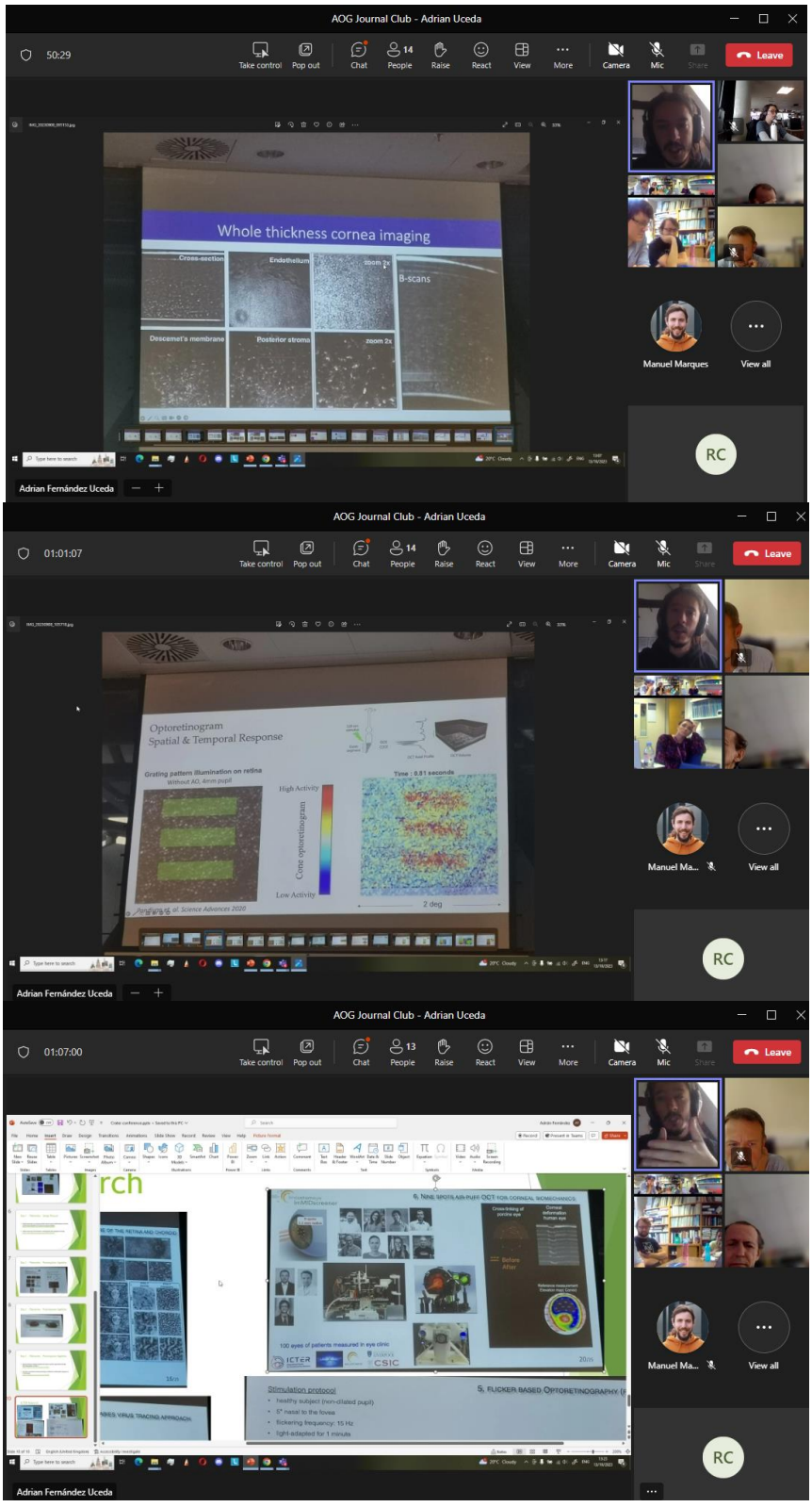
Crater - Conference on Recent Advances in Translational Eye Research 2023 (icter.pl)

Print screens from his presentation will follow.





A few slides from Adrian's presentation



A few slides from Adrian's presentation

Congratulations to Taylor Sanderson
4th year MPhys

School of Physics and Astronomy, Kent University

Taylor was between the undergraduate students who won the Summer Vacation Research Competition (SVRC) in 2022 working on a joint project with other undergraduate students on "*Investigating light intensity damage in a novel OCT imaging system for embryology using porcine sperm and modern semen analysis tools*" under Dr. Manuel Marques's supervision.

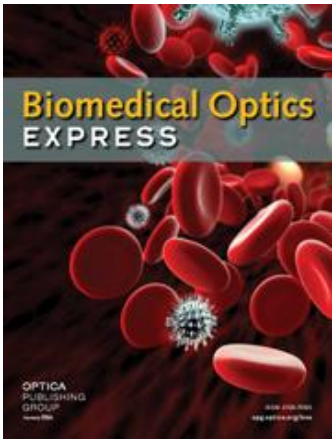
Taylor was **awarded MPhys project prize for best stage 4 final year project under Prof. Podoleanu's supervision,** project title **"Optical Fibre Probes for Position Sensing and Imaging within the Vitreous via Low Coherence Interferometry".**

From left to right,
Dr Manuel Marques,
Taylor Sanderson and
Prof. Adrian Podoleanu
@Taylor Sanderson

Currently Taylor is a PhD student within AOG working on the project "***Optical Coherence Tomography of the eye in low resource settings".***

Congratulations & Good Luck Taylor!

PUBLICATIONS



Biomedical Optics Express

30 Years of Optical Coherence Tomography

1 OCTOBER 2023, VOLUME 14, ISSUE 10, PP. 5022-5538, 36 ARTICLES

FEATURE ISSUE GUEST EDITORS

Rainer A. Leitgeb (Lead Editor), *Medical University of Vienna, Austria*
Brett Bouma, *Wellman Center of Medicine, Harvard Medical School, USA*
Kate Grieve, *Quinze Vingts Hospital and Vision Institute, France*
Christine Hendon, *Columbia University, USA*
Adrian Podoleanu, ***University of Kent at Canterbury, UK***
Maciej Wojtkowski, *Polish Academy of Sciences, Poland*
Yoshiaki Yasuno, *University of Tsukuba, Japan*

30 Years of Optical Coherence Tomography: introduction to the feature issue

Rainer A. Leitgeb, Brett Bouma, Kate Grieve, Christine Hendon, Adrian Podoleanu, Maciej Wojtkowski, and Yoshiaki Yasuno

Browse the 30 Years of Optical Coherence Tomography Feature Issue

Widely tunable 2 µm hybrid laser u sing GaSb semiconductor optical amplifiers and Si3N4 photonics integrated reflector

Nouman Zia, Samu-Pekka Ojanen, Jukka Viheriala, Eero Koivusalo, Joonas Hilska, Heidi Tuorila, and Mircea Guina

February 2023, Optics Letters

DOI:10.1364/OL.480867

Tunable lasers emitting in the 2–3 µm wavelength range that are compatible with photonic integration platforms are of great interest for sensing applications. To this end, combining GaSb-based semiconductor gain chips with Si_3N_4 photonic integrated circuits offers an attractive platform. Herein, **we utilize the low-loss features of Si_3N_4 waveguides and demonstrate a hybrid laser comprising a GaSb gain chip with an integrated tunable Si_3N_4 Vernier mirror.** At room temperature, the laser exhibited a maximum output power of 15 mW and a tuning range of ~90 nm (1937–2026 nm). The low-loss performance of several fundamental Si_3N_4 building blocks for photonic integrated circuits is also validated. More specifically, the single-mode waveguide exhibits a transmission loss as low as 0.15 dB/cm, the 90° bend has 0.008 dB loss, and the 50/50 Y-branch has an insertion loss of 0.075 dB. Read More

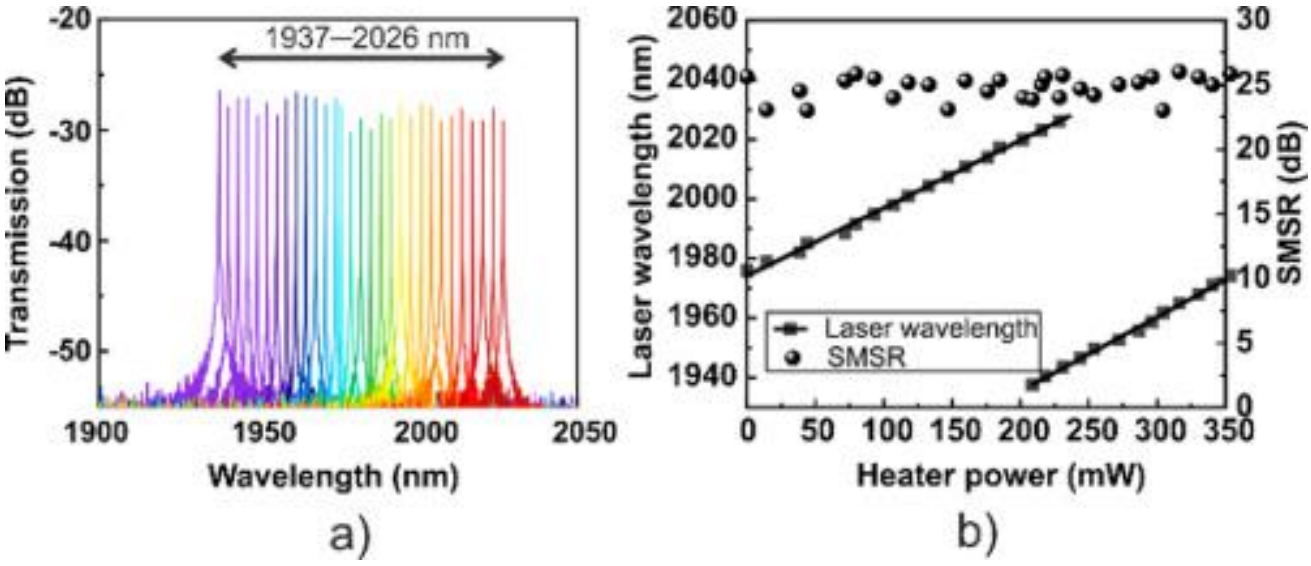


Fig. 7. (a) Superimposed emission spectra of the laser tuned by varying the RR heater power, and (b) wavelength tuning as a function of the heater power, and the SMSR across the entire tuning range.

Strain-Free GaSb Quantum Dots as Single-Photon Sources in the Telecom S-Band

Johannes Michl, Giora Peniakov, Andreas Pfenning, Joonas Hilska, Abhiroop Chellu, Andreas Bader, **Mircea Guina**, Sven Höfling, Teemu Hakkarainen, Tobias Huber-Loyola

Advanced Quantum Technologies 17 October 2023

https://doi.org/10.1002/qute.202300180

Generating single photons in the telecommunication wavelength range from semiconductor quantum dots (QDs) and interfacing them with spins of electrons or holes is of high interest in recent years, with research mainly focusing on indium-based QDs. However, there is not much data on the optical and spin properties of gallium antimonide (GaSb) QDs, despite it being a physically rich system with an indirect to direct bandgap crossover in the telecom wavelength range. **This work investigates the (quantum-) optical properties of GaSb QDs, which are fabricated by filling droplet-etched nanoholes in an aluminum gallium antimonide (AlGaSb) matrix**. Read More

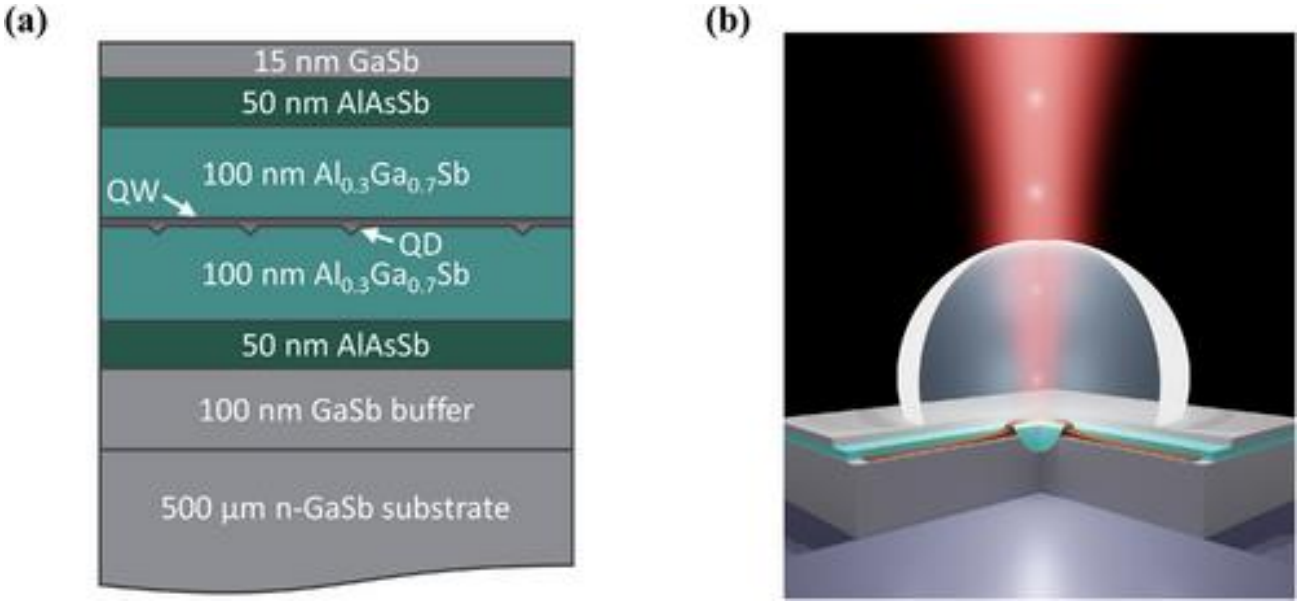


Fig. 1 Sample design and layer structure

Thermorefractive noise reduction of photonic molecule frequency combs using an all-optical servo loop

J. Connor Skehan, Anamika Nair Karunakaran, Poul Varming, Óskar B. Helgason, **Patrick B. Montague,** Jochen Schröder, Minhao Pu, **Kresten Yvind**, Victor Torres-Company, and Peter A. Andrekson

Opt. Express 31, 35208-35217 (2023)

https://doi.org/10.1364/OE.496895

Phase and frequency noise originating from thermal fluctuations is commonly a limiting factor in integrated photonic cavities. To reduce this noise, one may drive a secondary "servo/cooling" laser into the blue side of a cavity resonance. Temperature fluctuations which shift the resonance will then change the amount of servo/cooling laser power absorbed by the device as the laser moves relatively out of or into the resonance, and thereby effectively compensate for the fluctuation. In this paper, **we use a low noise laser to demonstrate this principle for the first time in a frequency comb generated from a normal dispersion photonic molecule micro-resonator.** Significantly, this configuration can be used with the servo/cooling laser power above the usual nonlinearity threshold since resonances with normal dispersion are available. **We report a 50 % reduction in frequency noise of the comb lines in the frequency range of 10 kHz to 1 MHz and investigate the effect of the secondary servo/cooling noise on the comb.** Read More

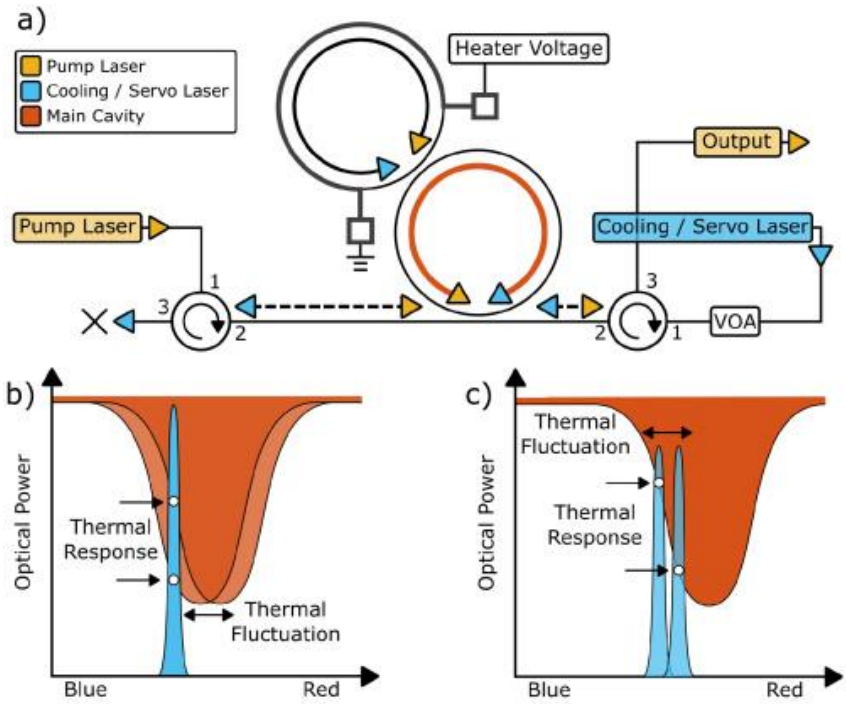


Fig. 1. a) The optical setup, including both the pump and servo/cooling lasers, two circulators, a packaged photonic molecule device with integrated heater only on the auxiliary ring, and a variable optical attenuator to tune the servo/cooling laser power. All fibers are single-mode.

Large field-of-view short-wave infrared metalens for scanning fiber endoscopy

Ningzhi Xie, Matthew D Carson, Johannes E Fröch, Arka Majumdar, Eric J Seibel, Karl F Böhringer

J Biomed Opt, 2023 Sep ;28(9):094802. Epub 2023 Mar 9.
doi: 10.1117/1.JBO.28.9.094802

Significance: The scanning fiber endoscope (SFE), an ultrasmall optical imaging device with a large field-of-view (FOV) for having a clear forward view into the interior of blood vessels, has great potential in the cardiovascular disease diagnosis and surgery assistance, which is one of the key applications for short-wave infrared biomedical imaging. The state-of-the-art SFE system uses a miniaturized refractive spherical lens doublet for beam projection. A metalens is a promising alternative that can be made much thinner and has fewer off-axis aberrations than its refractive counterpart.
Aim: We **demonstrate a transmissive metalens working at 1310 nm for a forward viewing endoscope to achieve a shorter device length and better resolution at large field angles.** Read More

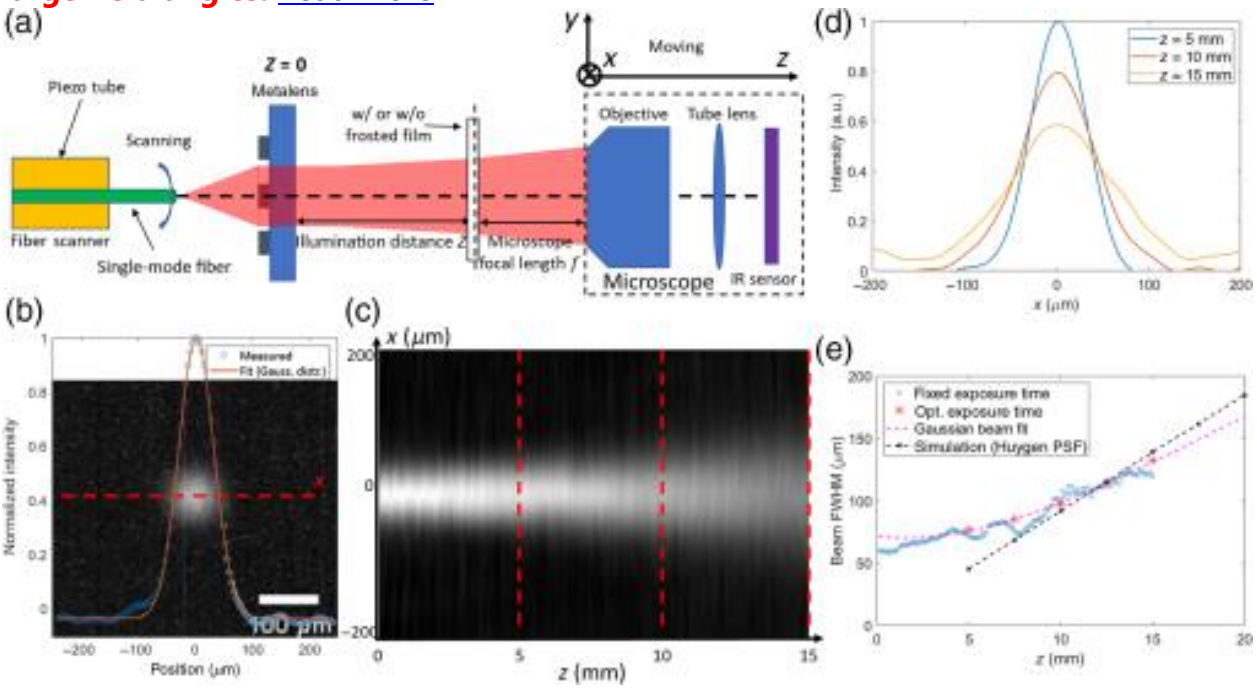


Fig. 4 (a) Schematic of the measurement setup for metalens characterization Read More

Quantitative Photoacoustic Tomography Using Iteratively Refined Wavefield Reconstruction Inversion: A Simulation Study

S. M. Ranjbaran, H. S. Aghamiry, A. Gholami, S. Operto and **K. Avanaki**

K. Avanaki – former AOG PhD Student under Prof. Podoleanu's supervision

IEEE Transactions on Medical Imaging, 17 October 2023

doi: 10.1109/TMI.2023.3324922

The ultimate goal of **photoacoustic tomography** is to accurately **map the absorption coefficient throughout the imaged tissue.** Most studies either assume that acoustic properties of biological tissues such as speed of sound (SOS) and acoustic attenuation are homogeneous or fluence is uniform throughout the entire tissue. These assumptions reduce the accuracy of estimations of derived absorption coefficients (DeACs). Our quantitative photoacoustic tomography (qPAT) method estimates DeACs using iteratively refined wavefield reconstruction inversion (IR-WRI) which incorporates the alternating direction method of multipliers to solve the cycle skipping challenge associated with full wave inversion algorithms. **Our method compensates for SOS inhomogeneity, fluence decay, and acoustic attenuation. We evaluate the performance of our method on a neonatal head digital phantom. Read More**

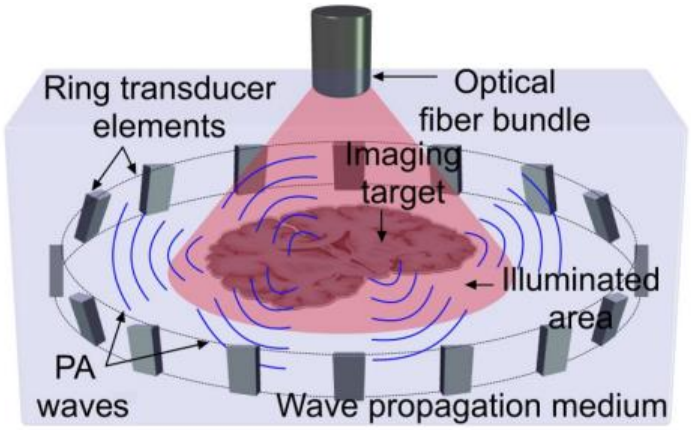


Figure 1: In photoacoustic imaging, a pulsed laser illuminates tissue, and acoustic pressure waves (PA waves) are generated by chromophores in the tissue. These PA waves propagate through the tissue and are measured by ultrasound (US) transducers.

In vivo characterisation of field pea stem wall thickness using optical coherence tomography

Fang Q, Castro-Urrea FA, Haederle F, Sanderson RW, Silva D, A Cowling W, Kennedy BF

Plant Methods, 2023 Oct 11;19(1):105
doi: 10.1186/s13007-023-01075-1.

Our study has demonstrated the efficacy of OCT for accurate measurement of the stem wall thickness of live field pea. Moreover, OCT shows that the trends of stem wall thickness and stem width along the internode positions are different for the two cultivars, Dunwa and Kaspa, potentially hinting at differences in their stem strength. This rapid, in vivo imaging method provides a useful tool for characterising physical traits critical in breeding cultivars that are resistant to lodging. Read More

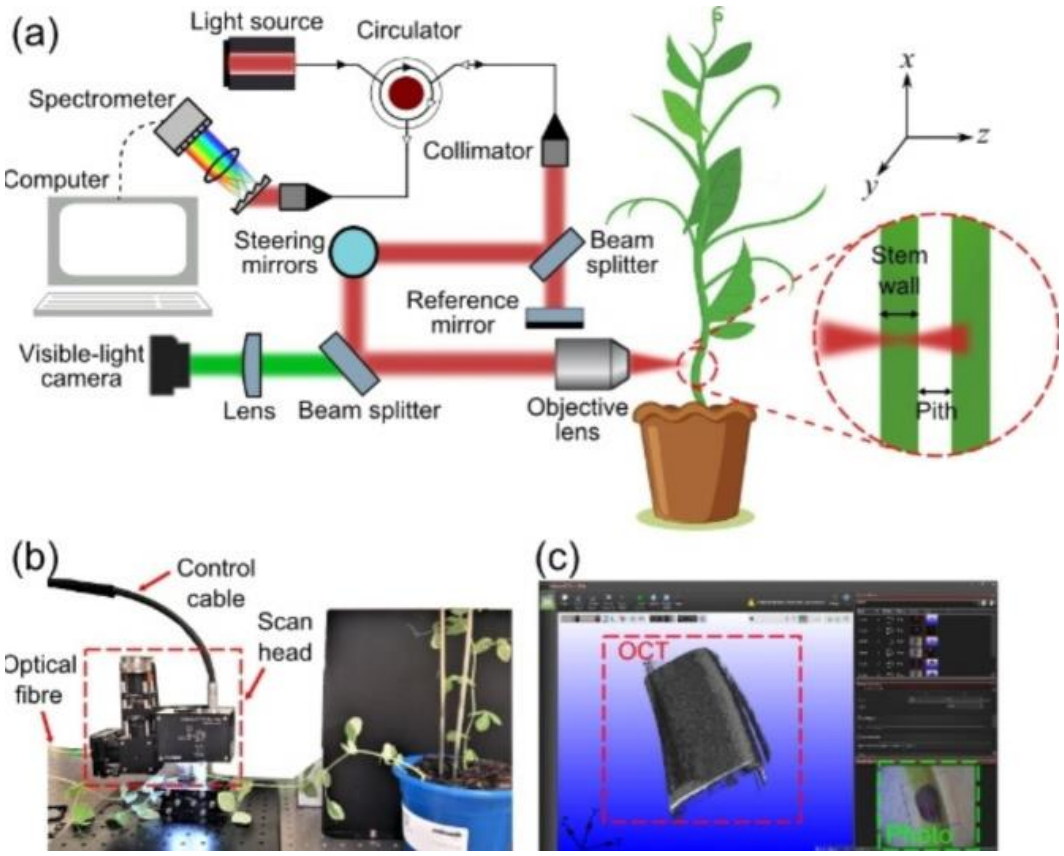


Fig. 2 (a) Schematic diagram of OCT for in vivo stem wall thickness measurements. (b) Photograph of the experimental setup. (c) Software interface for visualisation and measurement

The effect of pupil size on the measurement of corneal birefringence properties: preliminary study

Marcelina Sobczak, Magdalena Asejczyk & Maciej Wilczyński

Scientific Reports **volume 13**, Article number: 17439 (2023)

https://doi.org/10.1038/s41598-023-44706-2

We used a **partial Mueller matrix polarimeter** to measure the **corneal anisotropic properties at three pupil sizes** (dilated, natural, and constricted). The geometrical parameters of first order isochromes were described by quadrilaterals. These parameters are statistically significantly different between the three pupil sizes. The pupillary size changes do not influence the azimuth angle distribution α. The retardation R and birefringence distributions show asymmetry in the nasal–temporal cross-section. There are differences between pupil sizes for both nasal and temporal parts of the cornea for these distributions. Iridial light scattering and diffraction might be the reason for these differences.

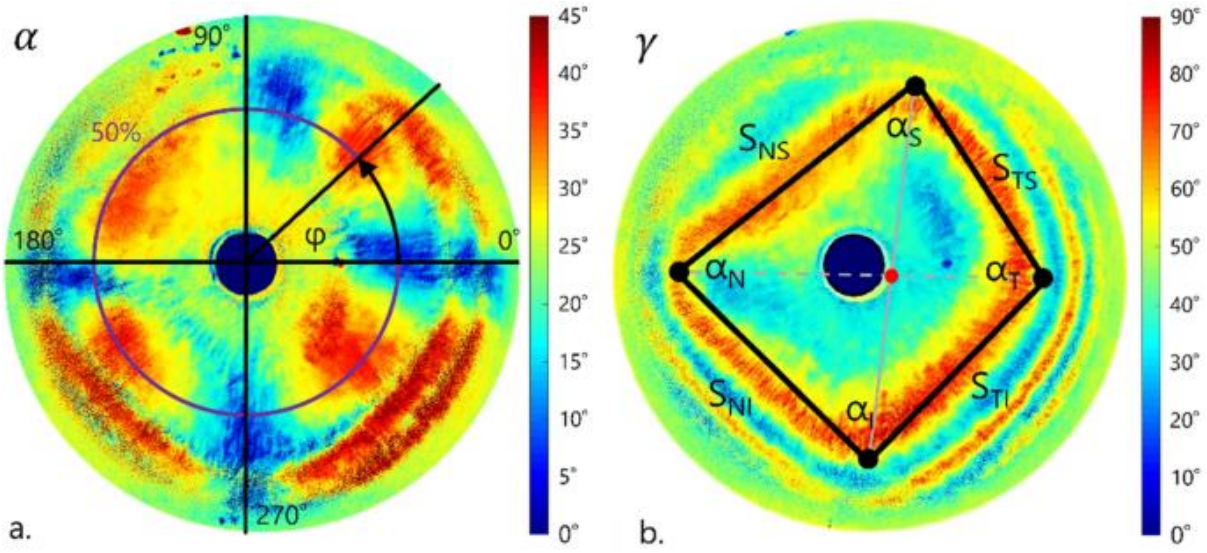


Fig.5 The azimuth angle α distributions with a scheme of transposition from cartesian to polar system (**a**), the retardation distributions described by a quadrilateral (sides lengths S_{TS}, S_{TI}, S_{NS}, S_{NI} and interior angles α_T, α_N, α_S, α_I) (**b**).

Use of a refractive index–coupled diffuser to both generate and measure high-numerical aperture illumination for light microscopy

Paul J. Tadrous

Journal of Microscopy, 17 October 2023

https://doi.org/10.1111/jmi.13237

While numerical aperture of transillumination at or above 1.25 can be achieved with a substage oiled Abbe condenser, such immersion-capable condensers can be expensive limiting their use in resource poor settings. Also the **measurement of numerical aperture generated by illuminators has received relatively little attention in the literature compared to methods for measuring the numerical aperture of acceptance by objectives.** In this article, I show how **an inexpensive paper diffuser** with refractive-index coupling to the sample slide **can generate illumination of a numerical aperture of over 1.4 at a small fraction of the cost of oiled dioptric condensers of comparable numerical aperture**. In addition, I present **two ways in which a diffuser may also be used to measure the numerical aperture generated by an illuminator** using either a calibrated index-coupled paper diffuser to implement an interpolative variation of the Horsfall method or a diffuser as a detector screen coupled to a self-built microscope slide-based illumination system apertometer.

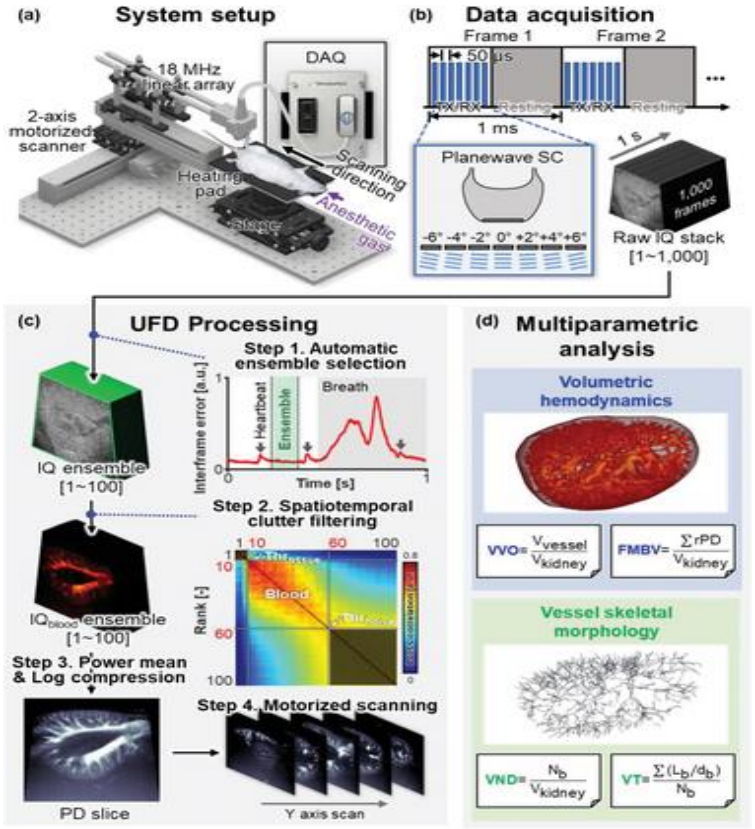
Contrast Agent-Free 3D Renal Ultrafast Doppler Imaging Reveals Vascular Dysfunction in Acute and Diabetic Kidney Diseases

Donghyeon Oh, Donghyun Lee, Jinseok Heo, Jooyoung Kweon, Uijung Yong, Jinah Jang, Yong Joo Ahn, Chulhong Kim

Advanced Science, 17 October 2023

https://doi.org/10.1002/advs.202303966

To combat the irreversible decline in renal function associated with kidney disease, it is essential to establish non-invasive biomarkers for assessing renal microcirculation. However, the **limited resolution and/or vascular sensitivity of existing diagnostic imaging techniques hinders the visualization of complex cortical vessels.**



Here, a **3D renal ultrafast Doppler (UFD) imaging system** that uses a high ultrasound frequency (18 MHz) and ultrahigh frame rate (1 KHz per slice) **to scan the entire volume of a rat's kidney in vivo is demonstrated**.

This work demonstrates the potential of 3D renal UFD to offer valuable insights into assessing kidney perfusion levels for future research in diabetes and kidney transplantation.

Read More

Fig 1; Data acquisition (DAQ), image processing, and multiparametric analyses in a 3D renal ultrafast Doppler (UFD) system

Near-Infrared Handheld Probe and Imaging System for Breast Tumor Localization

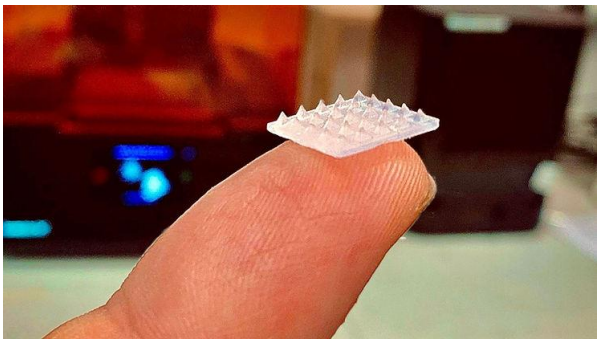
Shadi Momtahen; Majid Shokoufi; Ramani Ramaseshan; Farid Golnaraghi

IEEE Canadian Journal of Electrical and Computer Engineering

12 October 2023, **Electronic ISSN:** 2694-1783
DOI: 10.1109/ICJECE.2023.3259239

Diffuse optical tomography (DOT) is a breast imaging modality that measures the functional characteristics of breast lesions using near-infrared (NIR) light to calculate the optical properties (scattering and absorption coefficients) of breast tissues. In this study, **we have developed a NIR diffuse optical breast scanning (DOB-Scan) probe and evaluated a new imaging method based on a modified diffusion equation (MDE) for breast tumor localization**. The probe is applied to breast phantoms to collect reflectance or the intensity of backscattered light. To measure the optical properties of the phantoms, we also calculated the reflectance theoretically, where we initially utilized the original diffusion equation (DE) to arrive at the theoretical reflectance. Read More

No more big needles: scientists develop a skin patch that painlessly delivers drugs into the body

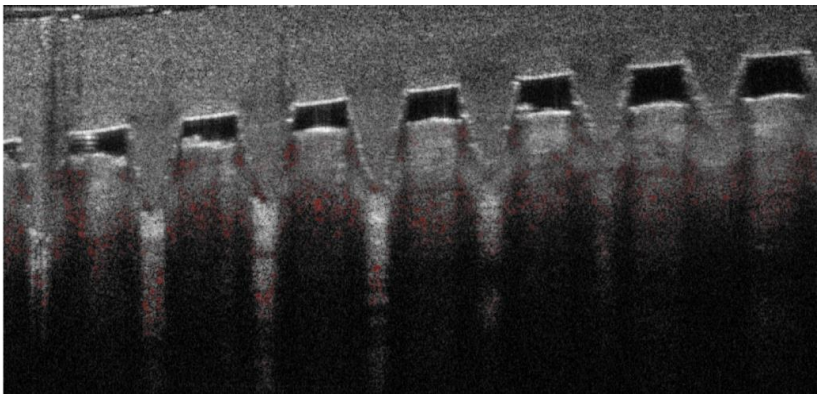


The patch is smaller than a pound coin and is covered in barely visible microneedles.

@ University of Bath

An affordable microneedle skin patch that delivers a controlled dosage of medicine directly into the body, eliminating the need for injections or oral medication, has been developed by a team led by scientists at the University of Bath. It is hoped that the patches, which are described in the journal *Biomaterials Advances*, will be ready for use within the next five to 10 years. What makes the microneedle patches unique is that they are made from a hydrogel (a gel-like substance in which water forms the liquid component), with the active ingredient encapsulated inside the hydrogel microneedle structure rather than in a separate reservoir. Read More

Great example of innovation in action. One of the undoubted challenges for Microarray Patch (MAP) developers is how to visualise the needle/skin interface in-vivo (i.e. during the actual insertion on live human skin). **Optical Coherence Tomography (OCT) imaging using VivoSight Dx is now enabling simple, rapid, non-invasive imaging of MAP performance** for 11 of worlds' leading development teams.



Visualise the needle/skin interface in-vivo i.e. during the actual insertion on live human skin

CALL for papers

Special Issue "Advancements in Optical Materials and Photonic Device Technologies"

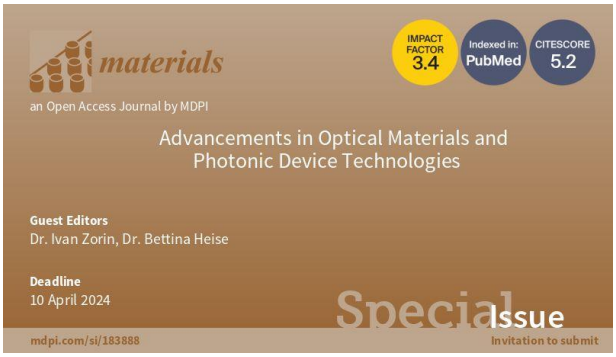
Deadline for manuscript submissions: **10 April 2024**

Keywords

- advanced optical materials
- enhanced optical properties
- glasses
- photonic crystals
- semiconductors
- optical fibers
- nonlinear crystals
- metamaterials
- material aspects of photonic devices
- coatings

Special Issue Editors:

NETLAS Associated partners from RECENDT



Dr. Ivan Zorin

E-Mail Website

Research Center for Non-Destructive Testing (**RECENDT**) GmbH, Linz 4040, Austria

Dr. Bettina Heise E-Mail Website

1. **RECENDT -**GmbH, Linz, Austria
2. Institute for Mathematical Methods in Medicine and Data Based Modelling, Johannes Kepler University (JKU), Linz, Austria

Manuscript Submission Information

Course on C programming

An AOG's former collaborator **Dr Paul Tadrous**, **Research Histopathologist and Image Analyst from Northwich Park Hospital, London** (now working as self-employed) released a **6 video course on YouTube to teach people computer programming with the C programming language,**

as part of his **'Image processing' education series**

- there will be more coming.

He is also currently working on a Photology series and there are already plenty of videos on his '**PUMA microscope**' **system of 3D printed optics for microscopy.**

All feedback welcome.

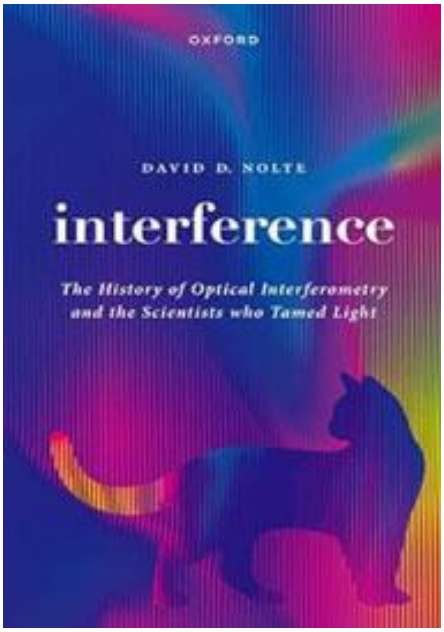
https://youtube.com/@PUMAMicroscope

Books & Reviews

Interference: The History of Optical Interferometry

David D. Nolte

Oxford University Press, 2023; 436 pages



Nolte has written a **unique history of interferometry** that is a masterpiece of research coupled with perspicuous explanations of physics.

His explanations of diverse topics such as **wave–particle duality, nonlinear optics, lasers, adaptive optics, quantum optics, holography, gravitational waves, entanglement, quantum computing, encryption, photon interference and stellar interferometry** are physically correct and are **readily understood by the general public. A surprising lacuna is the use of adaptive optics in ophthalmic imaging.**

Interference is the **story of the inventors of interferometers**, their applications and the new fields of optics that evolved from them. Nolte **introduces interferometers, their inventors and the key experiments that they facilitated that led to new physics and new interpretations of photons, light and quantum mechanics.**

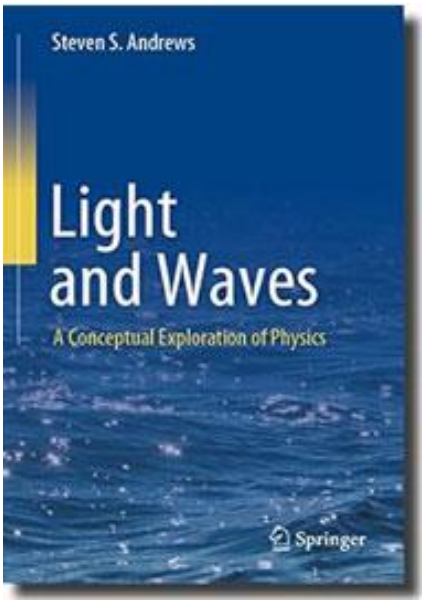
Extensive notes, figures and a bibliography augment the text. The scale of the instruments spans desktop interferometers to stellar interferometer satellites. ***Interference* induces excitement in the reader and can encourage young students to study and work in the field of optics.**

Interference: The History of Optical Interferometry and the Scientists Who Tamed Light: Amazon.co.uk: Nolte, David D.: 9780192869760: Books

Light and Waves: A Conceptual Exploration of Physics

Steven S. Andrews

Springer Nature, 2023; 539 pages, Publish Date: 26 October 2023



"Light and Waves" fills a need to **educate non-science majors and laypeople on the joy of optics.** This highly recommended book inspires questions, curiosity, excitement and interest in the natural universe.

The author's admirable aim is to clearly **present disparate phenomena with physical explanations that have both experimental and theoretical foundations.** The author achieves this aim with physically correct explanations augmented by many colored illustrations, graphs and images of natural phenomena.

The appendices aid those in need of a basic mathematical review. The spatial scales of the objects and phenomena discussed cover many orders of magnitude, from atoms to black holes.

What makes this book special is the **quality of the questions, the variety of worked problems with answers, the numerous exercises and crucial additional resources**. The author explains such unifying theories as relativity, quantum mechanics and the perplexing interpretation of quantum mechanics, the EPR Paradox, the prediction and detection of gravitational waves, rays and physical optics. More advanced topics such as quantum decoherence are designated with an asterisk.

Light and Waves: A Conceptual Exploration of Physics: Amazon.co.uk: Andrews, Steven S.: 9783031240966: Books

CONFERENCES

Optica Biophotonics Congress: Biomedical Optics

Fort Lauderdale, Florida USA, 7-10 April 2024

Topics central to this meeting are:

- ❖ **novel OCT methods and technologies**
- ❖ **imaging probes and systems**
- ❖ **computational modelling**
- ❖ **image processing algorithms**
- ❖ **multimodal technologies**
- ❖ **basic and translational applications**

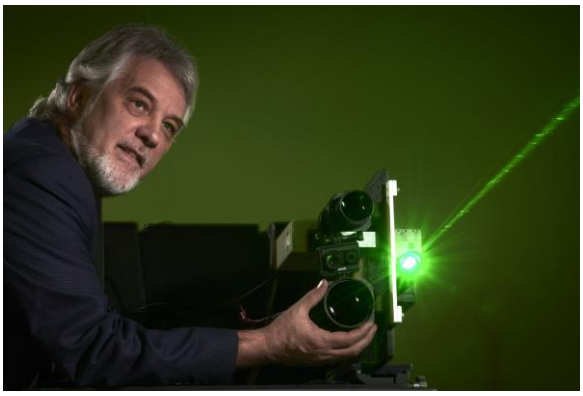
Deadline 05 December 2023

Submit Paper

A Research Career that Blends Curiosity and Problem Solving

*An interview with **Joseph Shaw**, PhD by David Guilter*

Joseph (Joe) Shaw is a distinguished professor of Optics and Photonics and Electrical Engineering and the director of the Optical Technology Center at Montana State University in Bozeman, Montana in the United States. He has a BS in Electrical Engineering from the University of Alaska, a MS in electrical engineering from the University of Utah, and a MS and PhD in Optical Sciences from the University of Arizona.



Montana State University professor Joe Shaw works with a laser in his Norm Asbjornson Hall lab on Tuesday, Jan. 24, 2023, in Bozeman, Mont. MSU Photo by Colter Peterson

⁇Which is better career for a PhD scientist?

Academia or industry? ⁇ What about doing both?

There has been a lot of conversation recently on LinkedIn about career options for **PhD scientists and whether industry or academia is better**. There is also a lot of discussion about whether universities should do a better job preparing students for the industry careers that most will have. Joseph Shaw is a **great example of a professor and academic researcher who contributes in all of these areas.** He does pure science. He works with **companies solving practical problems and making the world a better place.** Jo exposes his students to the world outside of academia, helping them see a broader spectrum of career choices than most graduate students ever see. **Read More**

Are you looking for a job in an [European Research Council (ERC)] funded research team?

Did you know that you can find a whole list of them on the EURAXESS website?

Check here, you might find something just right for you 👉 https://lnkd.in/evgVc4DX

NORBLIS
NORDIC BROADBAND LIGHT SOLUTIONS

NORBLIS is Hiring

Optical Engineer

About the job: **Be part of their Laser Development team:**

To support their growing ambitions, NORBLIS is now looking for **a talented Optical Engineer** to join their R&D team.

If you are **passionate about laser technology** and want to become part of a promising start-up company specializing in cutting-edge **mid-infrared supercontinuum sources and their application in Optical Coherence Tomography (OCT) imaging systems**,
then this is the **right opportunity for you.**

The position would be an **ideal opportunity** for candidates specialized in one or more of the following fields: ***laser developments, optical characterization of waveguides, laser physics, metrology and detection schemes, novel optical fiber materials, high-power lasers, inter-connection of optical components, such as fiber splicing, etc.***

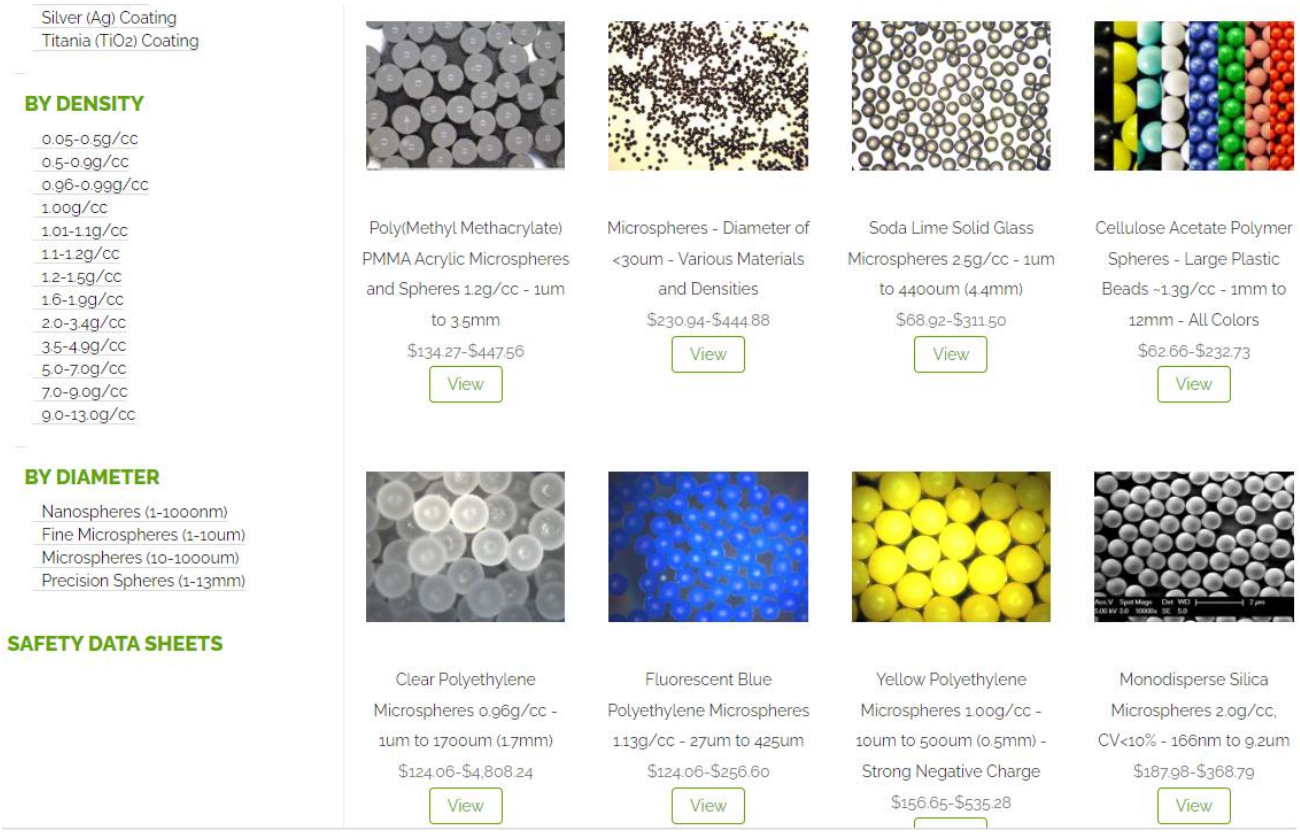
You will be part of and contribute to the **EU research project SEQUOIA** on developing a novel quantum OCT system.

Read More and how to apply here

Did you know ?

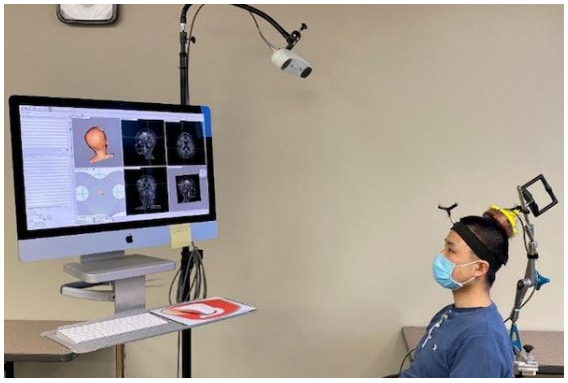
Cospheric is a global leader in **manufacturing and distribution of precision nanospheres, microspheres, and larger spherical particles.** Scientists and engineers worldwide rely on us as a proven source to fulfill their needs for **spherical microparticles in narrow size ranges, wide selection of colors, densities, properties, and formulations.**

Check their products here



Did you know ?

Noninvasive, ultrasound-based brain biopsy is feasible, safe in people



Sonobiopsies generate genetic, molecular data to inform treatment decisions for brain diseases

Researchers at **Washington University in St. Louis** have developed an **anatomically precise technique called sonobiopsy** that uses **ultrasound and microbubbles to disrupt the barrier temporarily and allow RNA, DNA and proteins from the brain to spill out into the blood, where they can be detected and analyzed**. The researchers developed and previously tested the technique in animals. In a new study, available online in the journal NPJ Precision Oncology, they showed that the technique is feasible and safe for use in people, and could open the door to noninvasive biopsies for suspected brain tumors and other brain diseases.

The procedure works by using **focused ultrasound to target a lesion in the brain with millimeter-scale accuracy,** followed by the **injection of microbubbles into the bloodstream. The microbubbles travel to the targeted spot and then pop, tearing tiny holes in the blood-brain barrier that close within a few hours, leaving no lasting damage.** That window of time is long enough for biomolecules from the lesion to escape into the blood, where they can be collected with an ordinary blood draw. Read More

Did you know ?

21st October is the Day Of Photonics

On 21 October 1983, the General Conference on Weights and Measures **adopted value for the speed of light.**

On the occasion of this anniversary, every year hundreds of activities are voluntarily organised around the world to promote photonics.

Photonics is the science and technology of light. It encompasses all of the products and processes around the emission, manipulation, transmission and detection of light and other electromagnetic radiation. It can carry far more information than radio frequency and microwave signals. It may not be obvious, but it underpins a large number of industries. Athough most people are familiar with lasers, fibre optics, the optical components in mobile phones, and that light and radiations are a crucial part in the latest medical instruments, the word Photonics is still largely obscure.

Photonics is not just featuring in grand projects and big business like aerospace, homeland security or biotechnology. Photonics affects all of us in our everyday lives, improving food production with remote sensing, advancing healthcare and keeping a close eye on global warming.

Photonics is providing solutions to many of the global challenges we face, like improved agriculture and farming, providing clean water and sanitisation, and developing the latest medical diagnostics tools to tackle cancers, sepsis, and blindness.

Next time you tap on a smartphone (a device in your pocket that holds more information than all the books in all of the libraries in the world), or watch your smart TV, if you happen to get into a self-driving car, or perhaps when you next 'facetime' your loved ones, think of photonics 😊

With photonics, we are striving to create a better quality of life for all.

Did you know ?

World Mental Health Day – 10 October 2023

The theme of this year's World Mental Health Day (10 October 2023) is '**Mental Health is a Universal Human Right'**. While this is undoubtedly true and to be celebrated, it is the theme from last year which may have stronger resonance with many of you reading this. Last year the theme was 'Looking After Number 1'.

There is an article on Mental Health UK which expands on this. It starts: '***With everything that is happening around us right now, it can be easy to feel powerless, but there are aspects of our life we can manage and control. We want you to embrace what is in your power to start doing, stop doing or change – something that will support your mental health.'***

University of Kent has been going through a period of intense change for the past few years and the intensity of this is currently increasing, not waning. There is a plethora of support mechanisms available at the University. One thing you might consider doing to assist with how you manage your mental health is to become conversant with what is available and try out some of the resources.

Wellbeing - Student Guide - University of Kent

Identifying and Responding to Student Mental Health Problems - University of Kent - Overview (marshallacm.co.uk)

Mental Health Help links. (jgstudentlets.co.uk)

Mental health (pshe-association.org.uk)

Mental health - Kent County Council

Did you know ?

☕ Looking to build your network?

With [UCL Coffee Connect,](#) you're paired with a fellow alum or current student for a virtual catch-up.

Whether for professional development or just a relaxed chat about life at or since university, it's a fantastic way to get to know someone new.

Sign up by Friday 3 November to take part.

You can find more information about the programme (including registration) on UCL website:

[UCL Coffee Connect | UCL Alumni - UCL – University College London](#)

OPTICS & PHOTONICS NEWS

Optics & Photonics News Magazine
October 2023 Issue

- **Generative AI Meets Scientific Publishing**
- **Lasers and Optics in Archaeology**
- **The Double-Clad Fiber Laser**

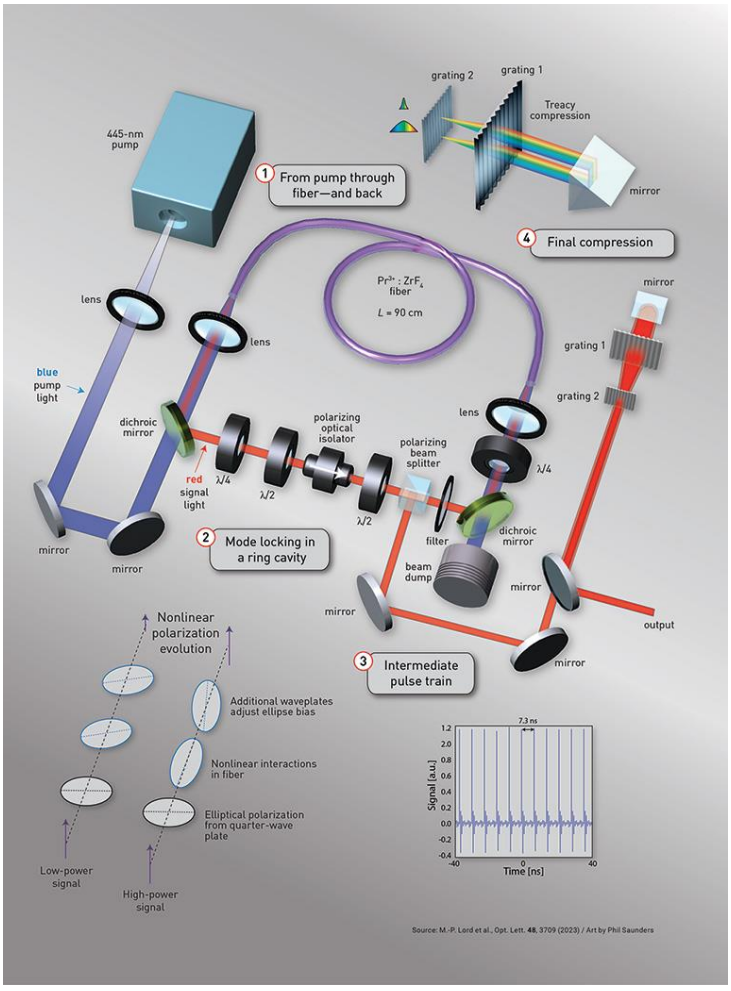
Browse all Issues

NetLaS

OPTICS & PHOTONICS NEWS

A Visible-Light Femtosecond Fiber Laser: Tutorial

In July 2023, a team at Université Laval, Canada, reported the **first fiber laser to produce femtosecond (fs) pulses in a visible wavelength.** OPN got in touch with three researchers behind the work—Marie-Pier Lord, Michel Olivier and Réal Vallée—for a walk-through of the laser setup.



From pump through fiber—and back

The laser journey begins with **pump light from a multimode, 445-nm laser diode,** which is routed via **mirrors and an achromatic lens** to be coupled into the **cladding of a length of ZrF_4 fiber.** The development in recent years of such "ZBLAN" fibers and laser diodes, Olivier notes, has been crucial in moving toward a practical visible-light fs fiber laser. Read More

NetLaS

OPTICS & PHOTONICS NEWS

The laser industry's variety of sectors makes prediction difficult—but also provides opportunities for growth

by Tom Hausken

A strength of the laser market is that it is diversified across many sectors, from industrial, military and security equipment to medical devices and consumer products. At any given time, new applications are emerging that promise growth. It is the sign of a healthy laser industry.

The diversification also makes it difficult to characterize and forecast the market. The major sectors do not necessarily move in phase, and some may be countercyclical, helping balance the industry in a turbulent economy.

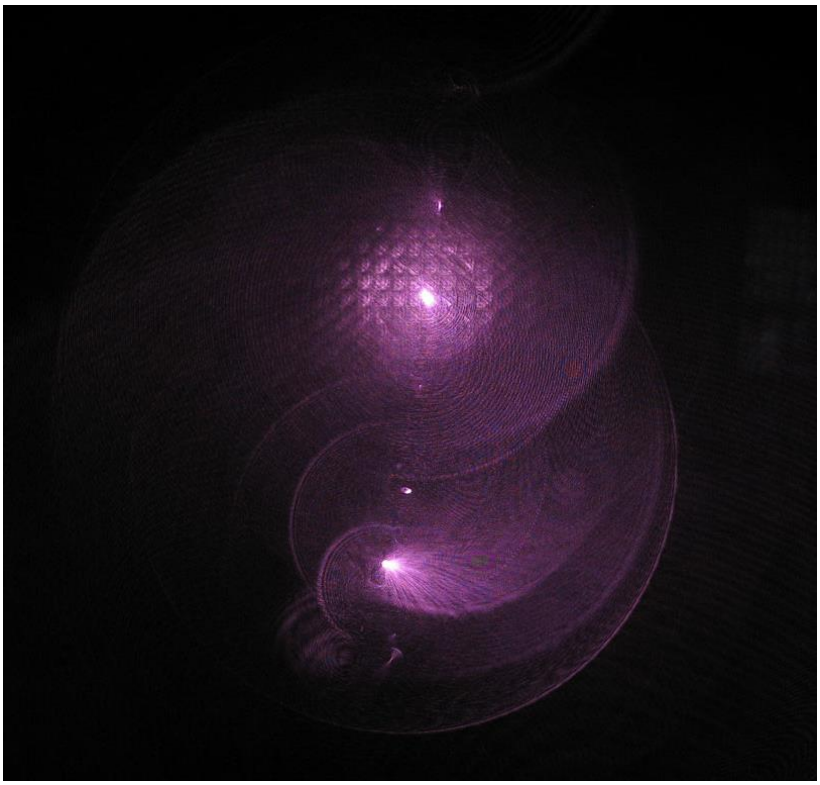
For a flavor of that diversity and what it means, we here look at the laser market "sideways"—from the viewpoint of four players that, while not always what one might think of as "laser companies," are associated with some key market segments. **Their performance and prospects offer insight into the many forces shaping the health of the laser business as a whole**. Read More

NetLaS

OPTICS & PHOTONICS NEWS

Image of the Week

Striking images of optics and photonics, contributed by OPN readers



Out-of-Band Laser Scattering

A 1064-nm laser scattering in a research set-up photographed with a 4 MP digital CCD camera. The brightest upper spot is the beam blocked by black cardboard, and the lower spots are from optical components.

—Dirk Voigt, Ministry of Defence, Netherlands

Webinars

We recommend our NETLAS PhD students to attend these upcoming webinars (part of the free Thorlabs webinar series). Thorlabs' Digital Webinars are covering a variety of topics, each with a dedicated live Q&A session, and have a common goal of providing educational, engaging, and valuable content.

Thorlabs Previously Recorded Webinars

Thorlabs' Digital Webinar series began in mid-2020. Each webinar and Q&A session is recorded and added to the archive on Thorlab's web page.

November
29
2023

Up Next! Driving Photonics Learning: Join Thorlabs on their Latest Education Journey

Join us in our upcoming webinar where Thorlabs' Bill Warger and Noa Shaw will shed light on our latest venture - the Mobile Lab Experience. **The mobile photonics lab offers a unique opportunity for people to discover photonics by experiencing the concepts, people, and technology they might otherwise not have access to.**

Dr. Bill Warger, Director of Photonics Education,
and Noa Shaw, Sales Enablement Specialist, Thorlabs

Bill graduated from Stevens Institute of Technology with a degree in engineering physics. He went on to get his PhD from Northeastern University in electrical engineering and did a postdoc at Massachusetts General Hospital. Bill spent 10 years at Thorlabs supporting product development across the entire portfolio before concentrating his efforts to generate a series of immersive learning experiences.

Noa is a Rutgers graduate who specializes in marketing and creating engaging and relevant content within the fields of digital media, video production, advertising, graphic design, and web design. He is currently leading the efforts behind the Mobile Lab for Thorlabs and is working to build out this initiative further.

Click to Register!

A Team of Photonics Experts are Travelling around the Country in the Thorlabs Mobile Lab.

The Mobile Photonics Lab Experience successfully made its first trip out of state to Rochester, New York!
They visited Monroe Community College, Brighton High School, and the Thorlabs Lens Systems office over the course of three days to demonstrate with their “Introduction to Photonics” course and speak about photonics careers.

Visit www.thorlabs.com/mobilelab to learn more

When a five-year-old boy was blinded after a regular eye exam failed to spot a retinal detachment, his father made it his life's work to help eye care professionals by revolutionising retinal imaging.

Optos was founded by **Douglas Anderson** with the goal to make a patient-friendly device to capture a digital ultra-widefield image of the retina. Today, millions of patients around the world have benefited from optomap® retinal imaging. **You will find optomap systems in many independent High Street optometrists,** as well as eye clinics at Great Ormond Street Hospital in London and Harvard Medical Center in Massachusetts.

Optos core products produce high resolution optomap images of 82% or 200◦ of the retina, **something no other imaging device is capable of in a single comfortable capture.**

The most recent innovation from **Optos** integrates ultra-widefield retinal imaging and **image-guided Optical Coherence Tomography (OCT).** This combined device **facilitates the early detection, management and effective treatment of disorders and diseases evidenced in the retina** such as retinal detachments and tears, glaucoma, diabetic retinopathy, and age-related macular degeneration. More than 1,000 published and ongoing clinical trials as well as thousands of case studies and testimonials show the long-term value of optomap imaging and OCT in diagnosis, treatment planning, and patient engagement.

Optos Retinal Imaging Devices and Software Solutions | Learn More

Virtual Interactive Showroom (optos.com)

Retinal Physician - NEW PRODUCT APPLICATIONS: Optos Retinal Imaging System Offers New Color Modality

Better textile sorting and less food waste:

Perhaps an odd mix, but hyperspectral imaging can advance both.

HyperSort, a new project supported by a 14 million DKK investment from the Innovation Fund, unites laser technology, chemometrics, textile recycling, and meat processing experts to **create an advanced hyperspectral imaging system.** Its primary objectives are **to improve textile sorting efficiency and reduce food waste.**

The project addresses challenges in hyperspectral imaging, using NKT Photonics' supercontinuum light source to enhance resolution, penetration depth, and material differentiation. This technology has applications in, e.g., **food analysis** due to its minimal heating effects and operational distance capabilities.

The project aims to develop an industry-ready hyperspectral optical engine to advance textile recycling and side-stream meat processing, ultimately making a significant global impact.

Read more in the press release from the Innovation Fund.

Our NETLAS Beneficiary Innolume is proud to report that they **continue the work on InAs/GaAs #Quantum Dots** which was **started by two the Nobel Prize Laureates** working together at Ioffe Institute in St. Petersburg. The first: **Zhores Alferov**, Nobel Prize in Physics 2000 for invention of semiconductor heterostructures and demonstration of first diode laser operating at room temperature and the second: **Alexei Ekimov**, Nobel Prize in Chemistry in 2023 for the discovery and development of Quantum Dots.

Innolume **was founded in Dortmund, Germany in 2003 as a spin-off from Zhores Alferov's laboratory** and started commercialization of QD photonics components such as Fabry-Perrot and DFB lasers, Semiconductor Optical Amplifiers, arrays, gain chips, as well as continued intensive research work. **In 2007 Innolume demonstrated the first semiconductor frequency comb laser with stable performance and 10 Gbps error free signal transmission** on each of ten lasing lines (A.Gubenko et al, El.Lett). A proper QD gain media was the key to have stable multiple wavelength operation. Read More

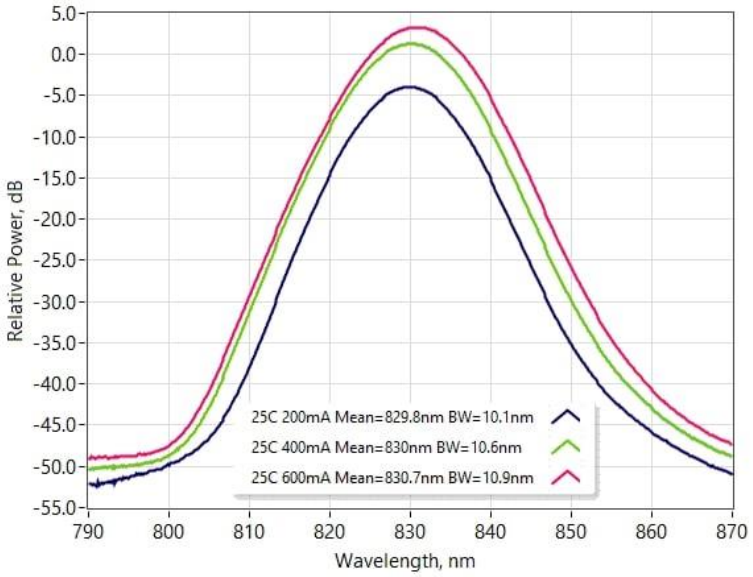
Today Innolume serves more than **100 customers worldwide offering laser diodes with superior performance** compared to conventional Quantum Well lasers, including such parameters as uncooled operation at 110℃ with high efficiency, high power, low noise, narrow lasing linewidth, reduced sensitivity to back reflection, stable multiple lasing wavelength (combs), and finally significantly enhanced reliability. In combination with well established cost effective high volume manufacturing of GaAs devices, all these parameters dictate massive penetration of InAs/GaAs QD photonics components into Cloud Networking, AI/ML clusters, LiDARs and other markets.

New SLD in the product portfolio!

Innolume introduces new superluminescent light emitting diode at short wavelength of 830nm.

This SLD provides 50mW ex fiber and it's a **perfect component for OCT**, **sensors and spectroscopy applications.**

You can review the preliminary specification of SLD-830-10-YY-50



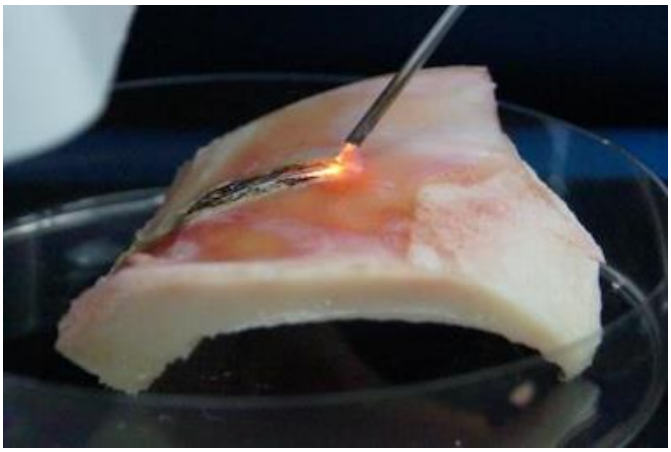
Fell free to **contact them for your specific project,** they are offering **customized solutions**!

Ablation guided by OCT as alternative to milling should improve surgery for spinal canal stenosis

A project at Germany's **LZH** research center is developing a **laser platform intended to simplify surgery for spinal canal stenosis**, a narrowing of the spinal canal in the lower back. The condition causes severe pain due to pressure on the nerves in the spinal cord, and traditional surgical solutions have included selectively **removing bone from identified areas to relieve the pressure**, often through a localized milling operation.

LZH and its partners are now **investigating whether a laser-based ablation method for bone removal would offer more precise control of the procedure for surgeons**, and be more comfortable for patients.

The **InTherSteLa project,** named for Innovative Therapy for Spinal Canal Stenosis using **Laser Ablation under OCT Control**, is scheduled to run until 2025 supported by €250k of federal funding. Participating photonics partners include **Laseroptik** and **Qioptiq Photonics**.



Bone machine: relieving pressure

"Traditionally, **spinal canal stenosis surgeries involve expanding the vertebral canal using a milling tool** to thin part of the posterior bony arch of a vertebra as well as parts of the intervertebral joints," commented LZH. "There is always **a risk** that the **underlying meninges surrounding the nerve canal may be injured and cerebrospinal fluid may leak out**. Such complications not only prolong the surgery itself but also the recovery time for patients."
Read More

VCSEL specialists **Octlight** indicated that its Caliper-HERO swept source technology was to be used for the OCT imaging aspects of the project. Check their products at:
Caliper Products (octlight.com)

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Coherent support the **cutting-edge research** of Scientific and LifeSciences customers and partners with photonics solutions. Discover how their lasers are used...

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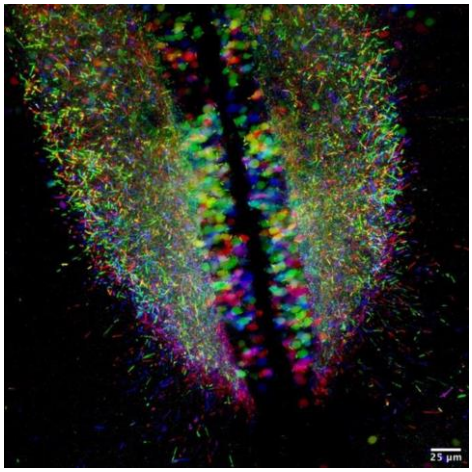

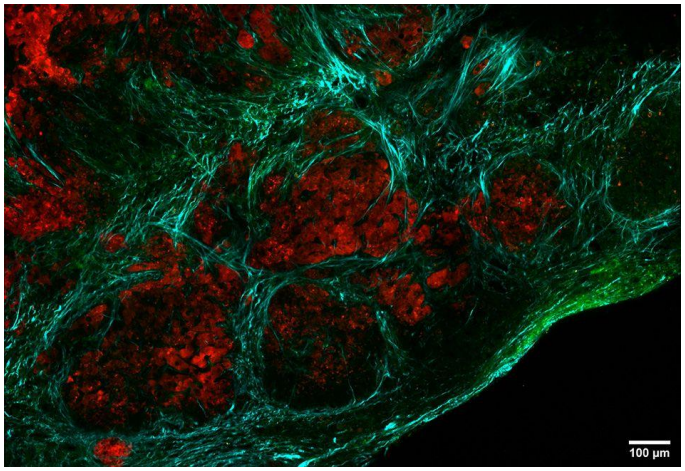

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Customer Success Stories | Coherent

Right to Food

WE STAND FOR THE RIGHT TO FOOD

Working in partnership with The Food Foundation, University of Kent will adopt measures to protect its students and staff from food insecurity. Its Canterbury and Medway campuses will be places where the right to food is realised in practice - in student kitchens, canteens, the university estate, the courses on offer and through research collaborations.

"Our commitment to the Right to Food goes to the very heart of what we believe a university is here to do. We want to use our strengths in research and innovation, the passion and commitment of our students and staff, and our deep links with our communities and our region to drive and inspire positive change. We are proud to be a Right to Food University and, in developing our approach and learning as we do so, to share that learning with others."

Professor Karen Cox, Vice-Chancellor and President, University of Kent

Read More

How Do You Build a Career that You Love? — a Career Pivoting Masterclass led by Professor Sam Shah

Podcast By Esh Tatla
Director and Host of Health Beyond Tomorrow • Final Year Medical Student at University of Nottingham • BMedSci (hons)

Sam joined Esh and **shared his wisdom and experience on striking a balance between meticulous career planning and embracing life's unpredictabilities**.

🔍 Topics covered:

- Finding Your Ikigai 🌸
- Work That Feels Like Play 😊
- Embracing Failures 📈
- Mediocrity in the NHS? 🏥
- Breaking Stereotypes 🔥
- Top Tips on Career Pivoting 🔄

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YouTube: https://linktw.in/gyhjkp

Spotify: https://lnkd.in/ee6kMF2Z

Apple Podcast: https://lnkd.in/egmpxDb8

Happy Birthday to Alfred Nobel

21 October 1833 - 1896

A bust of Alfred Nobel, surrounded by a beautiful wall of flowers donated by the Chamber of Commerce of Imperia, Sanremo and the Town of Sanremo: carnations in various pink and wine red nuances, light pink chrysanthemums, pink amaryllis and roses in various pink hues. © Nobel Media AB 2016. Photo: Pi Frisk

Alfred Nobel (1833-1896) was born in Stockholm, Sweden, on 21 October 1833. His family was descended from Olof Rudbeck, the best-known technical genius in Sweden in the 17th century, an era in which Sweden was a great power in northern Europe. Nobel was **fluent in several languages, and wrote poetry and drama**. Nobel was also very interested **in social and peace-related issues**, and held views that were considered radical during his time.

Alfred Nobel's interests are reflected in the prize he established.

Read more about his life and his interests – science, inventions, entrepreneurship, literature and peace work.

Alfred Nobel's life - NobelPrize.org

We invite all partners to communicate events and ideas to place in our newsletter

Please send any piece of news, on NETLAS activities or anything else happening that may be of interest to the NETLAS community, to Ramona Cernat: R.Cernat@kent.ac.uk and to Adrian Podoleanu: ap11@kent.ac.uk