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NOTE: IF THE DATE, TIME, OR ROOM BELOW IS DIFFERENT FROM THE PROGRAM, THE PROGRAM TAKES PRECEDENT

SPONSOR TALK Bentfeldt, Arne 5/17/2023 10:15 - 10:30 Sand Castle II

The solution to Packaging, Assembling and Testing Photonics Devices from R&D to Mass Production

The presentation gives a short introduction of ficonTEC. The company was founded in 2001 and is the market leader when it comes to assembly and test of photonic devices. After a quick overview of different assembly and test technologies, available platforms and its differences will be explained.

PLENARY Dominguez, Margaret 5/16/2023 11:00 - 12:00 Sea Oats

NASA's mission: exploring the universe and educating the public

Dr. Margaret Dominguez has worked at NASA for over 14 years as an optical engineer. She has worked on both the Hubble and James Webb Space Telescopes and is currently working on the Roman Space Telescope. Webb and Roman are both infrared observatories designed to complement and extend the discoveries of Hubble. During her talk she will discuss the evolution of the different astronomical space telescopes and how their discoveries are impacting schools and the public worldwide.

PLENARY Wieman, Carl 5/17/2023 13:00 - 14:15 Sea Oats

Teaching Students to Think like Scientists and Engineers

A primary educational goal is to teach students how to solve problems like skilled engineers or scientists. We have studied the problem-solving processes used by skilled practitioners and have identified a set of decisions that guide this process. I will discuss these results and how these findings can be applied in several different educational contexts ranging from introductory courses to graduate training to best develop these problem-solving skills in students.

ETP23-ETP100-002 Tobon-Maya, Heberley 5/18/2023 09:00 - 09:15 Seahorse

Beyond maxima and minima: A hands-on approach for undergraduate teaching of diffraction

In this work, the simplicity in the architecture of an accessible, cost-effective, and 3D-printed digital lensless holographic microscope is used as an educational tool to study the diffraction theory by providing experimental explanations of the phenomena for undergraduate students. The recording and reconstruction steps of the lensless holographic technique take the students to two the bidirectionally of the diffraction phenomena in a completely hands-on approach. The integration of the theory with an accessible experimental setup generates an innovative way of teaching the diffraction phenomena in a classroom.

ETP23-ETP100-003 Gibson, Graham 5/16/2023 16:00 - 16:15 Sand Castle I

Biophotonics For All: Light transport through tissue

Biophotonics is becoming increasingly prominent in value and visibility. What was once an advanced field of research is now being included increasingly in undergraduate and postgraduate programmes. With the primary motivation of increasing biophotonics-related STEM awareness, we developed a simple and inexpensive LEDs and camera set up that allows visualising the blood vessels beneath the skin. The kit uses inexpensive blue, green, red and near-infrared LEDs to show the absorption of shorter wavelengths and transmission in the longer wavelengths in the finger. As an outreach and educational tool, this kit will illustrate the potential of using light for diagnostics.

ETP23-ETP100-004 Atieh, Ahmad 5/18/2023 11:00 - 11:15 Sand Castle I

Optical communication system software enabling remote education and teaching

OptiSystem software is a versatile software that can be used for designing, simulating, and optimizing photonic components, optical links, systems, and networks. A free version of OptiSystem called OptiPerformer allows teaching optical communication, and other Photonics courses for students. Optiwave has also created sets of lab experiments for teaching. The experiments are ready for teaching as they have a description, tasks, questions, and a solution manual. Students can work remotely on their class

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due to any conditions such as COVID. Additionally, universities would allow students to practice on a semi-realistic environment whenever there are no available experimental photonics labs.

ETP23-ETP100-006 Zapata Valencia, Samuel Ignacio 5/18/2023 09:15 - 09:30 Sand Castle I

Pokémon and the Harmonic Oscillator: A didactic formulation

In the first approach of the harmonic oscillator, the underlaying physics concepts tend to be daunting for the students. This work presents an innovative approximation for teaching the harmonic oscillator through the physical study of a Pokémon known as Spoink. The morphology of that creature allows for modeling its dynamic as a mass-spring system, and the available information about its heart rate allows to analyze its behavior as a forced harmonic oscillator. A theoretical analysis of that Pokémon and its heart rate is shown as an example to guide high school and first-year college students to understand harmonic oscillator behavior.

ETP23-ETP100-007 Rivera Ortega, Alberto Uriel 5/18/2023 09:30 - 09:45 Sand Castle I

STEM educational resource to send data via laser, using micro:bit and a USB GPIO module

Electronic communication is a very important and widely used topic in the field of Engineering and Physics. Due to this, it is relevant for educators and students to have an educational resource with the aim of easing the teaching/learning process regarding to the concept and basics of this topic. In this manuscript, it is presented a novel prototype that sends and receives single character or string via a laser and fiber optics, allowing the manipulation of the hardware and software involved. The characters are coded and sent by modulating the duration of the laser light pulses (pulse width) by using LabVIEW through a USB GPIO module; while the reception and decoding of the characters are achieved via a photoresistor module and a micro:bit board, respectively. A quialitative demonstration regarding to the application of light intensity and beam division is also included.

ETP23-ETP100-009 Silberman, Donn 5/16/2023 14:00 - 14:15 Seahorse

Teaching quantum to high school students

This paper describes and provides examples of getting high school students interested in quantum information and then teaching them some aspects that draw them in and keeps their attention. These examples are informal education for afterschool programs that can begin with a presentation during a regular science class period. The goal of this paper is to provide methods that have been successful and can be duplicated in other geographic locations globally. These methods include providing other volunteers, such as Optica and SPIE Student Chapter members at colleges and universities and professionals in industry, with easy-to-follow written materials and easy to acquire hands-on materials for low-cost laboratory experiences. The importance of bringing the hands-on experiences to the high school students early in the process is highlighted and getting them to understand that the quantum world is basically at the atomic level and not the macroscopic world we experience every day.

While there are many programs worldwide aimed at teaching quantum to high school students, they each have their strengths and challenges with a variety of outcomes. Here the author provides the best practices he has found from some of these programs and merges them with his own experiences in the optics and photonics education outreach endeavors to deliver a concise path for quantum outreach volunteers to use in their programs.

ETP23-ETP100-010 Herger, Edward 5/18/2023 11:15 - 11:30 Sand Castle I

Developing a classroom system to visualize wave optics phenomena

While mathematical analysis of wave physics involves Complex algebra and beyond, waves are also very familiar objects in everyday life. The Wave Optics Visualizer is a water basin with a unique wave generating device that takes advantage of the familiar water wave to produce and visualize a wide range of wave physics phenomena. Many visually interesting demonstrations can be produced and can also be directly related to classroom themes at multiple academic levels. The device is carefully designed to perform its main functions as well as to be portable for use in classrooms and other locations for demonstration. The Wave Optics Visualizer is based on a heavy duty cart with three main systems; the water pump system, the wave generator and the visualization system. The water pump system allows water to fill the basin as well as to be easily drained to a holding tank for easy transportation. The wave generator is a computer controlled array of sixteen independent actuators, programming allows multiple wave programs to be produced. Finally, the visualization system consists of a machine vision camera and LED illumination, this

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system allows excellent wave visibility and the ability to freeze or slow the observation by matching the camera frame rate to the wave frequency. The Wave Optics Visualizer provides an effective and portable tool for demonstrating and teaching the complicated phenomena of wave physics.

ETP23-ETP100-011 Kruschwitz, Jennifer 5/17/2023 09:30 - 09:45 Sand Castle II

Course structure for the University of Rochester's Hybrid Optics Masters Education (HOME) Program

The Institute of Optics at the University of Rochester (UofR) launched a new program in the Fall of 2020 for students interested in earning an MS in optics. The program is referred to as the Hybrid Optics Masters Education, or HOME. The HOME system of coursework allows working individuals to take classes remotely either synchronously with in-person MS students through Zoom, or asynchronously guided by the professor. Courses are structured to be inclusive to the online learner through group projects and discussion with other in-person/online students, and one-on-one interaction with the professor and teaching assistant. Each course has specific learning objectives and may incorporate a variety of technology platforms to engage the student, and create an active learning environment. The degree requirements for the MS HOME and in-person Optics MS are identical, only the form of curriculum delivery has been modified. Optics faculty were enrolled in a specific course through the UofR's Warner School of Education to develop their online curriculum. Detailed information about requirements for the degree, as well as layout, tools, and other relevant resources used will be shared in this paper.

ETP23-ETP100-012 O'Neill, Laurel 5/18/2023 09:30 - 09:45 Sand Castle II

experiments in optics and photonics education at The Pennsylvania State University

During the fall semester of 2022 an experimental first-year seminar on applied optics was taught for the first time at The Pennsylvania State University. The goal of the course is to retain students in electrical engineering while steering them towards a specialization in optics and photonics. This was attempted by hands-on experiments demonstrating basic concepts in optics, and tours of laboratories on campus that demonstrate the wide range of applications in electrical and optical engineering. Labs included aligning fiber optics, building telescopes, building pinhole cameras, experiments with fluorescence and transmission spectroscopy, and demonstrations of polarization. The effectiveness of the course presentation is evaluated based on student response and feedback. This course lays the foundation for further experimental lab-based courses in optics at Penn State.

ETP23-ETP100-015 Tyndall, Caitríona 5/16/2023 09:45 - 10:00 Sand Castle I

Training the future photonics research leaders: a summer fellowship programme to attract students to pursue a career in photonics research.

The IPIC Summer Fellowship Programme gives undergraduate students a high quality immerse research experience with the objective to attract the best undergraduate students from across Ireland to purse a PhD in photonics. Students join a leading research group, working in multi-disciplinary and multi-cultural teams to complete novel research projects in state-of-the-art facilities. A parallel Development Programme supports students in learning skills in science communication, networking, technical skills and more with the aim to build confident, well-trained researchers for future roles in academia and industry. Since 2017, 52% of graduated programme alumni have proceeded to a postgraduate, either masters or PhD.

ETP23-ETP100-019 Lukishova, Svetlana 5/16/2023 13:00 - 13:15 Seahorse

Sustainable education in the age of the second quantum revolution: fifteen years of the University of Rochester NSF supported efforts

Using NSF-funded Quantum Optics/Nano-Optics facility and the Integrated Nanosystems Center we introduced sturdy quantum/nano-optics experiments to classes from freshman to senior and graduate student levels, so students learn "quantum" and "nano" concepts in practice by doing labs with photon counting instrumentation widely used in these inseparable technologies. We trained future technicians, students of a local Monroe Community College (MCC) by bringing them to the university to carry out 3-h quantum/nano mini-labs. From 2006 to spring 2022, a total of ~850 students have utilized quantum/nano labs (including 144 MCC students) and more than 250 students have used them for lab demonstrations.

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ETP23-ETP100-020 Al-Juboori, Haider 5/17/2023 14:45 - 15:00 Seahorse

Develop the Innovative and Pioneering Concepts for Photonics and Optics Outreach Program

Optical and laser engineering are not only prevalent in science fiction movies but find numerous technological applications ranging from additive manufacturing over machining of micro/nano-scale features to biomedical imaging or space telescopes applications. In a related context, science simplification lectures with diverse visualization techniques and OSA optics suitcase can be utilized to bring attention and inspire careers in future technologies.

The suggested work focuses on developing the outreach program to train the trainees (as photonic ambassadors) specifically in the field of photonics and optical applications which is the expanded programme for multidisciplinary outreach activities for school students over 10 years (or pre-university students in the future) [1]. The extended activities can support a wide range of students in Ireland, Europe, and international prospects as well, which increases the possibility of promoting photonics technology careers in the future.

The paper will explain the guidelines and topics of the proposed practical workshop (INNOVATIVE WAYS TO PHOTONICS FUTURE "TRANSFER THE KNOWLEDGE") which can help trainees and give them some techniques for engaging targeted students and creating an interactive environment. The detailed characterization of the workshop structure and related pragmatic sessions will be illustrated in this work as well as the systematic steps of the developed program outline

ETP23-ETP100-021 Trebino, Rick 5/18/2023 09:15 - 09:30 Seahorse

Re-inventing the lecture: recent progress

The educational lecture, invented by the ancient Sumerians, hasn't changed in 5000 years, remaining a talking head before a bleak blackboard. It has even sat out the spectacular ongoing digital revolution. Worse, lectures must be created from scratch, with minimal-to-no assistance from others, absorbing vast amounts of educator time. As a result, similar lectures are currently prepared independently and redundantly by post-secondary-school and college lecturers around the world, who together annually spend tens of billions of hours and roughly a trillion dollars doing so. The situation is analogous to that of books before Gutenberg. I am proposing a solution to this problem and have created two entire courses of lectures as examples.

ETP23-ETP100-022 Danner, Aaron 5/17/2023 14:45 - 15:00 Sand Castle II

Lessons we learned when creating four Massive Open Online Courses (MOOCs)

Over the past two years, our team of three (one professor, one video editor, and one student) has designed, filmed, and launched four free Massive Open Online Courses (MOOCs) on the edX platform along with several YouTube short courses. In this paper, we will share our motivations behind these courses, along with details of our filming setup (recommended equipment and costs), timeline, workload, and finally enrolment statistics and feedback from students who have benefitted from the courses. We found that MOOCs are highly appreciated by students around the world if they are well-designed.

ETP23-ETP100-023 Froehly, Luc 5/16/2023 15:15 - 15:30 Sand Castle I

Teaching through history - the preservation of modern French scientific heritage in optics

The teaching of science is enriched by simultaneously describing its historical development, and science history is a central component of many educational programmes. In this paper, we describe a project to preserve the history of optics research at the Université de Franche-Comté in Besançon France, including major video and oral histories, the safeguarding of original manuscripts, and the establishment of hologram and instrumentation exhibits. These exhibits are now an important component of our outreach and education efforts, and our presentation aims to provide a useful overview for others wishing to implement similar projects in their own institutions.

ETP23-ETP100-024 Pathak, Yash 5/16/2023 13:15 - 13:30 Seahorse

Online lab course using photons

Quantum science and technology has applications in sensing, computing, and communication. They can revolutionize many aspects of the society like health, resource allocation, finance etc. Young scientists need to explore the field's fundamentals and cutting-edge applications. We present our online Experimental-based Quantum Technologies course that makes this education

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more accessible. The module has six lectures and hands-on experiments. The participants enter the lab using VR goggles and 360° live video conferencing and perform the experiment over a virtual network connection. Experiments focus on observing physical effects and conceptualize findings. We'll share our insights from this course's that enables self-paced remote-learning.

ETP23-ETP100-025 Sollapur, Rudrakant 5/16/2023 13:30 - 13:45 Seahorse

Experimental Elective Course for Master Students

Quantum science and technology education is in increasing demand from both educational and industrial establishments. Photon-based systems play a vital role in experimental-based education and training. This contribution features our most recent Master's level course, 'Experimental Quantum Technologies,' which was offered in 2022.

This unique course provided brief introductions to each topic with minimal theoretical formulation, and emphasized on observing quantum phenomena. Lab instructions contained the physics and mathematics needed to understand the experiments. The reports were succinct and focused on understanding the experimental results. Our contribution will address the course's key outcomes, including experiments done and planned for 2023.

ETP23-ETP100-027 Álvarez, Juan Rafael 5/16/2023 15:30 - 15:45 Seahorse

Measuring Wigner functions of quantum states of light in the undergraduate lab

We present an educational activity for measuring Wigner functions of quantum states of light in the undergraduate laboratory using continuous variable tomography. The activity utilizes both simulated and experimental data, and explains the Radon inverse transform in the filtered backprojection approximation, balanced homodyne detection, and various representations of quantum states of light. The activity was tested with 25 students in the spring of 2021 and was designed to provide a similar experience either in-person or virtually. An open-access user-friendly interface is provided to aid in its implementation.

ETP23-ETP100-028 Chekhovskaya, Natalia 5/17/2023 14:15 - 14:45 Seahorse

Open educational resources to boost training of photonics technicians

The photonics and optics community is facing challenges in advancing the national capacity of the technical workforce. Among other vital strategies to resolve this complex task is creating access to an open and adaptable curriculum and supplemental resources. This presentation will discuss resources developed and curated by LASER-TEC. The LASER-TEC library provides open access to editable resources for the photonics core curriculum and specializations, including comprehensive course materials, textbooks, lab manuals, educational modules, lesson plans, and more. LASER-TEC aims to develop and share resources to broaden access to educational materials and improve the quality of optics and photonics education.

ETP23-ETP100-030 Charles, Elizabeth 5/17/2023 14:45 - 15:00 Sand Castle I

Research-practice partnerships and communities of practice for fostering better teaching and learning

We report on how research-practice partnerships have flourished at the college and university level in the greater Montreal area, and how it has fostered bringing discipline content knowledge AND pedagogical knowledge together to design effective instructional innovations – specifically for a college-level course on waves, optics and quantum physics. These AL activities and resources are shared with physics instructors through a community of practice. The sharing is done through 1) a repository of teaching and learning materials on our website, 2) peer mentoring and professional development, 3) a free annual conference, and 4) monthly virtual meetings.

ETP23-ETP100-031 Adams, Rhys 5/16/2023 15:45 - 16:00 Sand Castle I

Students' reflections on the impact of paid summer photonics research internships

The authors have previously reported on a collaboration allowing pre-university students to engage in university photonics research through paid summer internships. We have surveyed all students who have participated in these paid summer research internships during the first ten years of this collaboration. We now report on the students' reflections on 1) how these internships have impacted their personal and professional lives, and 2) the strengths and weaknesses of these internships, such that we can improve the "student experience" for future internships.

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ETP23-ETP100-032 Aehle, Stefan 5/16/2023 16:15 - 16:30 Seahorse

Development of a multi-perspective approach to quantum education through analog experiments

It is the contextual distance from everyday life and the physical world we know, that makes quantum phenomena hard to grasp. Therefore we are developing a multi-perspective approach to quantum education to allow for discussions from different angles. Through analog experiments we bridge the gap between a classical and a quantum understanding of different phenomena: One such experiment focusses on polarisation phenomena, while others delve into more complex subject matter of Hardy experiments, and nitrogen-vacancy centers as an example for application. By adding a haptic component to the teaching material, this approach aims at novice learners in high school and university classrooms.

ETP23-ETP100-033 Reinsch, Tobias 5/16/2023 18:30 - 19:30 Poster Session

Introduction to modern quantum technologies via astronomy

The Quantum Revolution 2.0 requires beyond the theoretical understanding of entanglement, Hamiltonians as well as wave functions and their properties experimental and practical skills in order to make them applicable. Therefore, working in the field of quantum technologies it is worthwhile to invest in the practical education of the students. Making quantum physics interesting for a broad range of students a good motivation is needed. Experience shows that college students are eager to learn about astronomy and astrophysics. We present a path combining this motivation with the education in quantum technology. Skills from photonics, metrology as well as atom physics will be applied to quantum sensors based on NV centers in diamond. We developed this approach for physics students, physics teacher students as well as engineers who have little experience with quantum technology so far.

ETP23-ETP100-034 Ramirez-Zavala, Sergio Ivan 5/18/2023 11:30 - 11:45 Sand Castle I

Fabrication and characterization of a tunable Fabry-Perot interferometer made with easily accessible materials

In this work, the fabrication and characterization of a tunable Fabry-Perot interferometer made with accessible materials for students is proposed. Here, the materials are a polished stainless steel plate, a syringe needle, epoxy clay, and a piece of standard single-mode optical fiber. The reflective surfaces are formed by the plate-air and air-fiber optic interfaces. Besides, the length of the air cavity is controlled with a sleeve of epoxy clay with thermal properties. Taking advantage of these properties, the fringe pattern is shifted one free spectral range with a low temperature change. Finally, the experimental results are corroborated with the theoretical results.

ETP23-ETP100-035 Siahmakoun, Azad 5/17/2023 11:15 - 11:30 Sand Castle II

Undergraduate Research Training Boot-Camp Using Thin-Film Optics Technology

The purpose of the Research Training Institute (RTI) is to make the invisible world of research visible to undergraduate researchers, through a set of seminars on essential topics and optics project activities. We conduct a five-week research boot-camps each summer for KAUST (King Abdullah University of Science and Technology) STEM students. The key learning goal of the thin film optics problem is to demonstrate the applicability of research skills across modeling, research design, fabrication process, and testing exercise. We present our findings from five RTI workshops based on students' responses in the workshop evaluation and their research outcomes.

ETP23-ETP100-037 Viera-González, Perla M. 5/16/2023 18:30 - 19:30 Poster Session

"Let Science come to your space" - Delivering Astronomy and Optics outreach activities outside the cities

Increasing science awareness can help increase interest in science, give the public a deeper understanding of science and its application, and lead to more informed choices in society. The Faculty of Physics and Math Science of the Universidad Autonoma de Nuevo Leon works on a program where teachers and students perform outreach activities related to Astronomy, Optics, and Physics in different spaces outside the metropolitan area. These include a mobile planetarium, hands-on activities, science demonstrations, and more. This works presents a summary of the places visited since 2017 and the impact of this program.

Updated 4/27/2023 – For any discrepancy in time and room, the official ETOP program takes precedent.

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ETP23-ETP100-038 Muñoz Ríos, Ana María 5/16/2023 18:30 - 19:30 Poster Session

Outreach experiments guide for an optic show to pre-college level by Medellin student chapter

There is a lack of knowledge among the community that prevents them from pursuing a career in the science of light. Due to the importance of introducing optics and photonics fields and their relevance in both, industry, and academy to pre-college students, outreach activities such as showing optical experiments become relevant. The method used to present science to students impacts their perspective directly; therefore, an adequate optics show oriented to the comprehension of pre-college students is required to improve the knowledge transmission. Here we present how an optics show is carried out by our student chapter at Universidad Nacional de Colombia, Medellin campus, along with hints and suggestions, as well as a useful guide for beginners in outreach. The explanation methodology, the components and setups to perform common optics phenomena experiments such as diffraction, color theory, polarization, fluorescence, phosphorescence, and optical illusions are presented.

ETP23-ETP100-039 Shen, Xin 5/18/2023 09:45 - 10:00 Sand Castle I

3D integral imaging sensing and visualization: an undergraduate project-based learning on optics and photonics

We have developed a project-based learning approach with the aim of teaching, education and undergraduate research in optics and photonics. The proposed project-based learning process is focused on the development of hands-on experiments with light field integral imaging optical sensing and visualization technologies. The undergraduate research projects enable our engineering school students with different levels and majors to gain a deep understanding on optics and photonics through early research experience and student-faculty engagement.

ETP23-ETP100-040 Reyes, Ana Karen 5/17/2023 11:15 - 11:30 Starfish

Proposal for teaching about optics to blind people through the workshop called My Hands See.

This work presents the didactic material and the implementation of the project "my hands see" where we transmit basic concepts about optics to people with blindness and visual weakness. Among the concepts that students can learn during this workshop are: wavelength, frequency, period, amplitude and absorption. The "my hands see" workshop has been successfully implemented in different institutions where people with multiple disabilities are cared for, and although the workshop is initially designed for blind students, it has been a useful activity for communities living with a different disability.

ETP23-ETP100-041 Kaiser, Thomas 5/17/2023 11:15 - 11:30 Seahorse

Augmented Reality in Labwork Training

Preparing for a labwork experiment in a hands-on course usually comes with reading the written material in advance which should enable the students to prepare the tasks in the lab. We use Augmented Reality on a tablet to project the actual lab setup for a Fourier Optics experiment together with a virtual lecturer onto the kitchen table of the students. The students have thus a much better connection to the real experiment. While doing the experiment, AR provides additional information such as simulated diffraction data which enrich the learning experience.

ETP23-ETP100-042 Kaiser, Thomas 5/17/2023 09:45 - 10:00 Sand Castle II

The Virtual Reality Cleanroom Training

When students take a lecture in photonic microstructure technology, they learn about the processes which take place in a cleanroom, e.g. how a scanning electron microscope works, or how lithography is done. Acquiring the actual skills to perform these tasks is, however, cumbersome due to the limited accessibility of a cleanroom. Offering a substantial number of students the possibility to actually work there is not possible. We have created a VR App to train students in operating the machinery and doing the processes and alignment procedures in the cleanroom before their first entry.

ETP23-ETP100-043 Scheiger, Philipp 5/16/2023 16:30 - 16:45 Seahorse

Activating teaching with analog experiments to distinguish entanglement and hidden parameters.

Entanglement is one of the most central concepts required for quantum revolution 2.0, in particular in quantum sensing and quantum computing. However, entanglement is also one of the most difficult aspects for learners to grasp. Education and teaching

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should thus pay special attention to this topic, so as not to leave the impression of incomplete quantum physics or explanations with hidden parameters. Historically, Bell's inequality and its experimental confirmation should be mentioned here as a major milestone in quantum mechanics. In our experience, Bell's inequality is difficult for students to follow and therefore the experiment in itself may not be particularly convincing.
Thus, we would like to present a learning unit that ties in with and dispels the intuitive notion of hidden parameters. We rely on a mix of cognitively activating teaching methods and analogy experiments. The students are activated and supported by proven methods from physics education research such as peer instruction, worked examples and working with multiple representations. The goal is to animate the students to play out a thought experiment with and without hidden parameters. In addition to the proper quantum mechanical calculus, the students' task is to illustrate quantum mechanics with a hidden parameter using analog experiments with classical parameters (material properties or programmable chips). The result should be a contradiction between the quantum mechanical solution and quantum physics with hidden parameters as proposed by Lucien Hardy. The experiment according to Hardy can clarify unambiguously at the end that a hidden parameter cannot describe quantum mechanics.

ETP23-ETP100-045 Horvath, Tomas 5/16/2023 18:30 - 19:30 Poster Session
Transmission convergence layer analysis of passive optical networks with own-developed FPGA card
Passive optical networks play an important role in access networks and currently in 5G networks. The passive optical network (PON) recommendations publish two sectors: Institute of Electrical and Electronics Engineers (IEEE) and International Telecommunication Union (ITU) with transmission speeds from 1 to 100 Gbit with wavelength division multiplex (WDM). The recommendations of ITU defined the different encapsulation methods for the Ethernet frame, which leads to the necessity of new tools for control and data transmission. In laboratory exercise, the students will use a field programmable gate array (FPGA) network interface card (NIC) for data transmission evaluation. The ITU passive optical networks use different encapsulation methods for data transmission. The students will learn about mapping the Ethernet frame into the GEM frame in passive optical networks. Analysis of downstream frames (broadcast method) (125 µs length) with control messages is included in the tutorial to describe a different data concept in relation to current networks. The students will learn the relationship between a well-known media access control (MAC) address and a unique ONU-ID in a passive optical network. Furthermore, the transmission container (T-CONT) defines a unique service such as voice over IP (VoIP) with T-CONT1 etc. The main purpose is to prove that not all data communication has to rely on packet transmission. There is no freely available tool to deal with data analysis (control message and unique IDs) for passive optical networks. The students will learn about the architecture of the home-developed system with real-time data analysis in the downstream direction.

ETP23-ETP100-046 Otani, Yukitoshi 5/17/2023 10:00 - 10:15 Sand Castle II
Teaching an introductory optics lab course for Mechanical Engineering students
In April 2022, the Mechanical Engineering Department at Utsunomiya University incorporated a 4-week-long segment in experimental optics into their year-long laboratory course. While each segment is taught to groups of 8-9 students, the students are rotated through the various segments throughout the year, so that about 100 students work the experiments in a full year. The optics segment consists of three topics: interferometry, Schlieren imaging, and optical fiber communication. In his paper, we provide details on the content and implementation of the course.

ETP23-ETP100-047 Manfield, Russell 5/16/2023 15:45 - 16:00 Seahorse
Educating decision makers on resource allocations for quantum technologies
While quantum science is an important part of STEM curricula, new learning paths are needed for those who want to create value with emerging products and services using quantum technologies. A massive open online course (MOOC) can help align quantum science with quantum strategy and educate a skilled, distributed workforce to capture value from quantum innovations. With tools for identifying value opportunities unique to quantum technologies, a MOOC can connect technology advances with market expectations through an innovation thesis. Our experience in building such a MOOC highlights successes and limitations and suggests future research and pedagogical development.

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ETP23-ETP100-048 Galvez, Enrique 5/16/2023 08:30 - 09:00 Seahorse

Quantum optics laboratories with motorized components

Quantum optics laboratories with correlated photons are an excellent platform for advanced undergraduate laboratories that illustrate the fundamentals of quantum mechanics. Popular laboratories include single-photon interference, the quantum eraser, polarization entanglement, and photon non-splitting at a beam splitter, to name a few. These experiments involve significant expenditures of optical and electro-optical components, and so only one setup is likely affordable by most institutions, limiting student access to them. All these experiments involve linear motion or rotation of optical components. We have motorized these components and driven them by a computer via serial connections. This way the lab can be accessed sequentially by a larger number of students either remotely using remote desktop, or in-person (motorized manipulations ensure reproducibility). In addition, for the case of polarization entanglement, where the tuning of the entangled state is done by optimizing the setting two optical components, the motorized capability allows for an automated closed-loop optimization of the setting of these components, yielding an entangled state of the highest fidelity, violating the CHSH Bell inequality by the maximum amount. More recently, we have used motorized components and a commercial fiber-coupled beam splitter to demonstrate the Hong-Ou-Mandel interference with no greater level of difficulty than other similar quantum optics laboratories. This work was funded by NSF grant PHY-2011937.

ETP23-ETP100-049 Heron, Paula 5/18/2023 11:00 - 11:30 Sand Castle II

Improving Student Learning: The Dual Roles of Conceptual Understanding and Reasoning Ability

Research shows that dual-process theories of reasoning – the fast and slow processes that govern reasoning and decision-making in everyday life – can explain student responses to physics questions and guide the development of effective instructional strategies.

ETP23-ETP100-050 Sokoloff, David 5/17/2023 11:00 - 11:30 Sand Castle I

Active Learning of Optics and Photonics Including Virtual Options

Active learning strategies have been developed to enhance students' understanding of optics and photonics in the introductory physics course at the university, college and secondary levels. (1) This talk will present examples of such activities that are designed to actively engage students in the learning process. (2,3) These include activities using low-cost commonly available materials, those using technology and those designed for active, virtual learning. (4) Research evidence of enhanced learning will also be presented.

(1) David R. Sokoloff, “Active Learning of Introductory Light and Optics,” Phys. Teach. 54: 1, 18 (2016).
(2) Active Learning in Optics and Photonics Training Manual, David R. Sokoloff, ed., (Paris, UNESCO, 2006).
(https://pages.uoregon.edu/sokoloff/ALOPManual2ndPrint11616.pdf)
(3) David R. Sokoloff, RealTime Physics: Active Learning Laboratories, Module 4: Light and Optics, 3rd Edition (Hoboken, NJ, John Wiley and Sons, 2012).
(4) https://pages.uoregon.edu/sokoloff/HomeAdaptedILDs.html

ETP23-ETP100-051 Posner, Matthew 5/16/2023 18:30 - 19:30 Poster Session

Photonique en français : technical photonic workshops for communication in French

Montréal, QC, is a multicultural city where both French and English are prominent, and is home to a strong network of companies and universities with photonics activities, attracting many international students and professionals. Quebec province’s official language is French; within an English-dominating North American socio-economical context, the provincial government actively legislates and promotes the use of French as the common language. Given that scientific research relies on global communication between foreign countries, which is typically in English, it is thus difficult for non-native French speakers to find relevant opportunities to practice French outside of their immediate workplace and without the pressure of their daily tasks. The “Photonique en Français” program offers workshops for French, English and Bilingual people to develop their technical, social and professional communication skills. The pilot program was supported by an IEEE Photonics Society Educational Seed Grant and coordinated by the IEEE Montreal Photonics Society Chapter. Six workshops ran from September to November 2022, with the

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participation of thirty individuals, five subject matter experts and three facilitators. The paper outlines the program design and implementation, with focus on workshop lesson plans incorporating active learning pedagogy and objective-oriented interactions for groups size of 10-15 people. We will report findings of the evaluation of the pilot from class observations, interviews with the moderators, post-training surveys and focus groups with highly-engaged participants and subject-matter experts. Lessons learned will be shared with recommendations for practitioners to implement technical sessions in languages other than English.

ETP23-ETP100-052 Massa, Nicholas 5/16/2023 15:15 - 15:45 Sand Castle II

The PBL Projects: Advancing photonics technician education for over 25 years

In this presentation, we describe the genesis and evolution of the PBL Projects of the New England Board of Higher Education (NEBHE). Since 1995, NEBHE has been awarded seven NSF-ATE grants to develop photonics curricula and provide teacher/faculty professional development in their use. Over the last 15 years, the curriculum materials and professional developed have evolved from traditional text-based content and laboratory experiments in optics and photonics to multimedia online problem-based learning (PBL) modules called “PBL Challenges” in which students engage in solving real-world problems faced by the photonics industry and research universities with the goal of improving problem-solving and critical thinking skills. Over 20 PBL Challenges have been developed and are available to educators at no cost at www.pblprojects.org.

ETP23-ETP100-053 Lewandowski, Heather 5/16/2023 09:30 - 10:00 Seahorse

Quantum optics experiments in undergraduate labs

The second quantum revolution has driven an increased need for quantum proficient STEM graduates. To address this need, there are many new educational programs and degrees being developed that are often focused on computational or conceptual knowledge around quantum.

However, there has been lack of work understanding how laboratory courses and experiments contribute to undergraduate quantum education. One particular set of quantum optics labs (often called single-photon labs) are used widely across the US due to support from the Advanced Lab Physics Association (ALPhA). Through their equipment purchasing and faculty professional development programs, they have supported over 100 institutions engage with these experiments.

Although significant resources (time and money) have be dedicated to implementing these experiments in undergraduate labs, there is little research into what students are gaining from these experiences and how that might be improved. Through interviews with instructors and interviews and clinical observations of students working with these experiments, we are beginning to understand what goals instructors have for these labs and how students are achieving these goals.

ETP23-ETP100-054 Hutama, Daniel 5/17/2023 11:00 - 11:15 Seahorse

A review of photonics training and education in Canada

This study provides a comprehensive and up-to-date portrait of the skills desired by the Canadian photonics industry. To accomplish this, we investigate Canadian job postings on popular employment websites in the fields of optics and photonics to characterize clusters of skills in high demand. We supplement this investigation with an analysis of responses to a questionnaire distributed to over 300 companies with Canadian operations. With this information, we provide specific recommendations for Canadian academic institutions and policy makers to improve the competitiveness of educational programs to better meet training needs conveyed by the industry.

ETP23-ETP100-055 Shiell, Rayf 5/16/2023 10:00 - 10:15 Sand Castle II

Integrated testlets in optics and photonics: an assessment tool suitable for textbook and online delivery

Integrated testlets are a means to assess students' understanding of complex knowledge through a scaffolded question structure, adopting an answer-until-correct approach, with grades awarded according to the number of attempts made by each student. In comparison with traditional multiple-choice-based assessments, an integrated testlet *purposefully* presents dependent items that build on each other. We have extended their delivery to an online format, using WeBWorK, and also as end-of-chapter questions in a forthcoming optics textbook. This is one part of our revising and updating of Pedrottis’ "Introduction to Optics". We shall share aspects of integrated testlet construction, optimization, and delivery.

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ETP23-ETP100-056 Hasanovic, Moamer 5/16/2023 10:00 - 10:30 Seahorse

Quantum education - how to teach a subject that nobody fully understands?

Quantum technologies are expected to be the most transformational technologies of the 21st century changing the way we sense the world around us, approach our security, and process critical information. The transition from quantum research labs to the commercial environment requires a sizable quantum workforce skilled to support the Quantum 2.0. To achieve the goal of the full quantum ecosystem, the society at all levels needs to be made aware of this emerging field, and then be inspired, attracted, educated, and trained with the new quantum skills and competencies. This poses a challenge as quantum science is a very hard and non-intuitive subject. How to teach quantum mechanics that, as the famous quantum scientist Richard Feynman once said, ”nobody understands”?

In this presentation, we are going to share our experiences and results of EdQuantum, an NSF funded project whose goal is to develop a curriculum for the training of future quantum technicians. The intent of the proposed curriculum is to provide an important first step in quantum education at associate’s level. The curriculum relies heavily on the visual hands-on approach based on the commercially available quantum educational hardware. Through algebra-based theory and simple experiments, the curriculum strives to bring the complex quantum science to the level understandable to the individuals without strong scientific background. As such, it may also be used to raise awareness and inspire high school students to seek careers as future quantum scientists.

ETP23-ETP100-057 Steenkamp, Christine Margarete 5/18/2023 09:00 - 09:30 Sand Castle II

Laboratories-first optics and photonics education: analyzing epistemic insights in an educational program

Laboratory-based learning is a crucial component of physics and engineering education. However, is a year of labs effective as the first introduction to optics and photonics?

We use an analytical instrument from Legitimation Code Theory that distinguishes different epistemic insights required in a specialized field: principle-based knowledge, applying legitimate procedures, and the ability to envision different approaches to a problem. Transitioning appropriately between insights is crucial for problem solving. Analysis shows that our labs can cultivate the ability to transition between insights. Feedback from recent graduates evaluates the efficacy. The instrument has potential for further application in curriculum design.

ETP23-ETP100-059 Lukas, Fabian 5/16/2023 09:00 - 09:30 Sand Castle II

Remote-controlled experiments for photonics lab training

Remote-controlled experiments have become an integral part of the everyday life of modern scientists. To teach this experience in full equivalence to hands-on lab training and at the highest academic standards, we developed two fully remote-controlled experiments which were integrated into the regular curricula of our Schools in 2022. This high practice level is achieved in the context of our international Master's degree program in Photonics at the Friedrich Schiller University Jena and the PhD program of the Germany-wide Max Planck School of Photonics (MPSP), thus reaching out to both graduate students and early-career scientists. Our remote-controlled experiments were realized using our home-built XRTwinLab as an open-source framework. This digital version is complemented by a fully synchronized twin in a real lab. The latter consists of pre-built modules that can be easily adapted by educators. We created 3D printable attachments that allow the addition of actuators to standard optical components. Finally, to facilitate the use of remote labs as close as possible to real lab work, the framework supports immersive technologies, such as virtual (VR) and augmented reality (AR).

In this invited contribution, we will first give an overview of our various efforts in the digitalization of photonics education. Further, we will focus on a case study of our Michelson interferometer experiment. It is particularly important to us that a physical experiment takes place, which confronts the students with all the challenges of a real and imperfect environment. We will also discuss the functionality and transferability of our approach and share original student feedback.

ETP23-ETP100-060 Liu, Jing 5/16/2023 18:30 - 19:30 Poster Session

Innovative Practice of Promoting Academic Literacy of Undergraduates by Journals

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This paper puts forward the teaching design idea of promoting teaching by journals. Taking the course of Electrodynamics for undergraduate students majoring in optoelectronic information science and engineering in our university as an example, this paper expounds the teaching design methods and practical exploration from the perspective of academic journals, focusing on the cultivation of undergraduate students' academic literacy in mathematical formula editing, mathematical content writing, critical spirit and ethical integrity.

ETP23-ETP100-061 Liu, Jing 5/17/2023 09:15 - 09:30 Seahorse

Merging Humanities and Social Sciences Knowledge in Teaching Electrodynamics for Undergraduates

In recent years, knowledge in humanities and social sciences has been incorporated into the course material, the details that related to the course of electrodynamics in other disciplinary, such as the history, traditional culture, and philosophy, has been introduced and merged in the preparing, teaching and discussing process of the course.

ETP23-ETP100-062 Gampe, Stefano 5/16/2023 13:30 - 13:45 Sand Castle II

The usage of immersive technologies in learning environments

Currently, immersive technologies are enjoying great popularity. This trend is reflected in technological advances and the emergence of new products for the mass market, such as augmented reality glasses. The range of applications for immersive technologies is growing with more efficient and affordable technologies and student adoption. Especially in education, the use will improve existing learning methods.

Immersive application use visual, audio and haptic sensors to fully engage the user in a virtual environment. This impression is reinforced with the help of realistic visualizations and the opportunity for interaction. In particular, Augmented reality is characterized by a high degree of integration between reality and the inserted virtual objects.

An augmented interactive simulation for the determination of the specific charge of an electron will be used as an example to demonstrate how such immersion can be created for users. A virtual Helmholtz coil is used to measure and calculate the e/m constant. The voltage at the cathode for generating the electron beam, but also the voltage of the homogeneous magnetic field for deflecting the electron beam, can be variably controlled by haptic user input. Based on these voltages, an immersive virtual electron beam is calculated and visualized.

In this paper, the authors discuss the conceptual steps of this immersive application and address the challenges associated with designing and developing an augmented and interactive simulation.

ETP23-ETP100-063 Dark, Marta 5/18/2023 09:45 - 10:00 Sand Castle II

Developing technical and soft skills in an introductory undergraduate optics course

The laboratory-based Optics course was envisioned by the Department as a bridge to upper-level laboratory courses, thus students must display increased initiative and collaborative skills. Recently however, it appears student initiative has declined. Activities within the course have been refined and new ones developed to build technical skills such as problem solving and optical design. New activities have been developed as well to build soft skills, for example, self-awareness, time management and adaptability. The new activities appear to improve soft skill development. Technical skills were positive, however it is not clear that the revisions resulted in a significant improvement.

ETP23-ETP100-065 Saleh, Bahaa 5/18/2023 11:00 - 11:15 Seahorse

The visual system as a comprehensive example for teaching optics and image processing

A course devoted to a single major system or application contains many examples that enhance learning of principles taught in other basic courses. The visual system is an excellent comprehensive example using principles of optics and image processing. I will describe a course Visual Optics offered in the BS degree program in Photonic Science and Engineering at the University of Central Florida. The course covers optics and image formation in the human eye, retinal photodetection, and spatial and temporal neural processing that enable tasks such as change detection, brightness and texture discrimination, recognition, and color vision.

ETP23-ETP100-066 Shen, Chao 5/18/2023 10:00 - 10:15 Sand Castle II

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Flipped Classroom Approach in Optoelectronics Course for Electronic and Information Engineering Students
Optoelectronics is one of the core courses for first year graduate students major in communication engineering and electronic and information engineering at Fudan University. The conventional approach to teach students from a diverse academic background is challenging. In 2022, we introduce flipped classroom approach in optoelectronic course. The course is organized under 15 topics in optoelectronics. Students will take the lead in presentation, topic discussion and case study. We find that by introducing the flipped classroom approach, students are able to master the course materials with better efficiency. We will also discuss how to run a hybrid classroom.

ETP23-ETP100-067 Barata, Jagoba 5/16/2023 16:00 - 16:15 Sand Castle II
Practical training of stellar interferometry by measuring spectral fringes visibilities
In this work, we show an experiment in which the analysis of the fringe visibilities at different wavelengths provides information of the spectral morphology of stellar sources. Interference fringes have been acquired by employing a set-up that is used by the students of the Master of Space Science and Technology at our University to learn the operation of the Michelson Stellar Interferometer [1, 2]. For our purposes, we have inserted a filter wheel, which allows the use of up to 9 astronomical filters, between the camera and the telescope obscured by a double-aperture lid. The spectral emission of stellar sources, either single or binary stars, has been simulated by using a broadband LED light emitted from the output surfaces of the 2 meter-long polymer optical fibers. Different morphologies of stars, such as a uniform disk with a circumstellar envelop, have been simulated by using polymer optical fibers with a ring-doped structure. By analyzing the variation of the fringe visibility with the wavelength, we are able to determine the angular size/separation of our light sources, as well as to find the structure of the stars.
[1] L. Arregui, M. A. Illarramendi, J. Zubia, R. Hueso and A. Sánchez-Lavega. “Interferometry of binary stars using polymer optical fibres”. European Journal of Physics, 38, 045704 (2017).
[2] A. Sanchez-Lavega et al., “The aula espazio gela and the master of space science and technology in the Universidad del País Vasco,” European Journal of Engineering Education 39 (5), 518–526 (2014).

ETP23-ETP100-068 Vauderwange, Oliver 5/17/2023 14:30 - 14:45 Starfish
Dynamic curricular concepts for research orientated programs in optics and photonics: The importance of consistent evaluation
Redesigning a curriculum for teaching media technology is a major challenge. Up-to-date teaching and learning concepts are necessary that meet the constant technological progress and prepare students specifically for their professional life. Teaching and studying should be characterized by a student-oriented teaching and learning culture. In order to achieve this goal, consistent evaluation is essential. The aim of the evaluation concept presented here is to generate structured information regarding the quality of content-related, didactic and organizational aspects of teaching. The exchange of opinions between students and lecturers should be encouraged in order to continuously improve the teaching and learning processes.

ETP23-ETP100-069 Freericks, James 5/16/2023 14:30 - 14:45 Seahorse
Should we trade off higher-level mathematics for abstraction to improve student understanding of quantum mechanics?
Undergraduate quantum mechanics focuses on teaching through a wavefunction approach with the representation in position space. This leads to a differential equation perspective for teaching the material. However, we know that abstract representation-independent approaches often work better with students, by comparing the series solution of the harmonic oscillator to the abstract operator method. Which is likely to lead to a better understanding. We have been teaching a class focused on an operator-first viewpoint, which we like to call operator mechanics. It teaches quantum mechanics in a representation-independent fashion and allows for most of the math to be algebraic, rather than based on differential equations. I will summarize the experiences we have had with this approach and describe what resources are available for others interested in trying the approach in their classroom. Together, we can help modernize quantum instruction, which is desperately in need of modernization for the second quantum revolution.

ETP23-ETP100-070 Schuessler, Hans 5/16/2023 13:45 - 14:00 Sand Castle I
Demonstration of the Arago spot

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A benchtop setup for showing how the Arago spot occurs was implemented. Students in a Modern physics class use it to see how light waves diffract around the circumference of a small hole in the middle of a metallic disc and create a bright spot in the center of the shadow of the disk.
A short MP4 video demonstrates this experiment.

ETP23-ETP100-071 Curticapean, Dan 5/16/2023 16:30 - 17:00 Sand Castle I
The Impact of the International Year of Light and its legacy
The paper will focus on the activities of the International Year of Light IYL with their impact in life, science, art, culture, education and outreach as well as the importance in promoting the objectives for sustainable development.
We will present our activities carried out in the run-up to or during the IYL, as well as reports on the generic projects that led to the success of the IYL. The success of the IYL is illustrated by examples and statistics.
Relating to the potential and success of the IYL, the impact and the genesis of the International Day of Light (IDL) is presented.

ETP23-ETP100-072 Micali, Ross 5/18/2023 10:15 - 10:30 Sand Castle II
Innovative approaches for training precision optics technicians
Abstract: The dramatic shortage of Optics technicians is having an impact on the ability of America to compete in the international marketplace. This has caused educational institutions to rethink how they educate the future workforce. Programs such as, quick-start, micro-credentials, and partnerships are changing the educational landscape.

ETP23-ETP100-073 Kim, Daewook 5/16/2023 09:30 - 09:45 Sand Castle I
Optical Sciences Winter School for Enabling Future Students in Optics Society
Optical Science and Engineering are areas of growing importance that are too often missing from traditional undergraduate science and engineering curricula. Often, aspects of optics and photonics are picked up as side topics in undergraduate and graduate courses along the way to obtaining more traditional STEM degrees.
Since 2016, the Optical Sciences Winter School has been held during the winter break of the University of Arizona's academic calendar. Its annual participants are now approximately 50-60 undergraduate students (juniors and seniors) from U.S. Universities who demonstrate an aptitude for science and research. These students participate in a three- to five-day immersion experience, learning the many opportunities and benefits that choosing optics and photonics for their graduate studies can offer.
The Optical Sciences Winter School brings together a select group of undergraduate students for an overview of foundational topics in optics and their relation to current research. It also provides a forum for faculty, alumni, and invited guests to share results, approaches and methodologies in optics and photonics research and education that are unique to the undergraduate setting.
This event is not focused on a specific school's program but tries to highlight the diverse optics programs in the U.S. Many sessions are filled with various invited faculties and researchers' presentations from prominent optical physics and engineering undergraduate or graduate institutions.

ETP23-ETP100-074 Martirez, Samuel 5/18/2023 09:30 - 09:45 Seahorse
Smartphone-based approach to demonstrating relativistic aberration of light using electronic circuit analogues for undergraduates in the Philippines
Previously, we demonstrated an electronic circuit analogue of one of the Special Relativity (SR)'s phenomena called Relativistic Aberration of Light, which describes the change in the angle an observer sees a light source relative to their direction of motion at relativistic speeds. It used bulky laboratory equipment such as function generators, oscilloscopes, and power supplies together with our all-pass filter (APF)-based electronic circuit analogue to perform experiments. Here, we present a novel smartphone-based experimental set-up that replaces the bulky laboratory equipment with a low-cost smartphone system, consisting of (i) an Android application and (ii) an ESP32-based external module.

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ETP23-ETP100-076 Rivera, John Gabriel 5/17/2023 15:00 - 15:15 Sand Castle I

Concept Connectivity: An educational and research framework for scientific learning in optics and photonics education

In our previous works, we have reported analogues of certain phenomena from Special Relativity using simple and low-cost optical-, photonic-, and electronic-platform technology. These analogues can mimic certain characteristics of the relativistic phenomena, which has potential for research and educational applications. However, there is a lack of a framework with which these analogues can be incorporated. Thus, we present a novel framework that we refer to as Concept Connectivity. It is characterized by the use of analogies in forming logical connections between different concepts from seemingly distinct fields of study, which has benefits for science education and research applications.

ETP23-ETP100-077 Petkie, Douglas 5/16/2023 15:30 - 15:45 Sand Castle I

Project Based Learning Models to Build Workforce Pathways through Value Creation

A collaborative partnership between Worcester Polytechnic Institute, Quinsigamond Community College, and Spark Photonics will share insights and programmatic components of a blended learning pedagogy that is rooted in a Project Based Learning (PBL) approach. The program goals are to create awareness and training opportunities and expand the pathways for students to enter the optics and photonics industry. The authors will present how elements of this ecosystem, that include value creation initiatives, PBL immersive experiential learning, stakeholder analyses, internships, STEM education outreach, and near-peer mentoring, help identify multiple pathways to educational and career opportunities in the burgeoning integrated photonics industry and Department of Defense Research Labs. The authors will share how this model leverages existing educational and outreach programs in the context of a Manufacturing USA Institute, AIM Photonics, as well as the impact of additional state and federal investments in the regional context of Central Massachusetts.

ETP23-ETP100-078 Venegas-Gomez, Araceli 5/16/2023 14:15 - 14:30 Seahorse

Qureka! Box: An educational tool for hands-on Quantum Computing

Quantum Computing, founded on the unintuitive principles of quantum mechanics, has been a very complex and difficult subject to understand. Additionally, quantum computing is currently in an early stage of development, limiting individuals who do not have previous experience or knowledge from pursuing their interests in this field.

To bridge this skill gap and escalate the quantum computing education, it is essential to introduce the basic concepts used in quantum computing using an interactive learning approach that fosters curiosity among students.

QURECA presents the “Qureka! Box”, a specialized educational tool demonstrating the core concepts of quantum computing with a unique teaching methodology encouraging young students to enter this ever-growing field. The “Qureka! Box” includes 3D representations to support the understanding and visualization of basic quantum concepts, student worksheets, and instruction guides for students and teachers.

The teaching methodology comprises five modules. In each of the modules, the principles of quantum physics that are essential for the development of quantum computation are established through active, hands-on, and game-based learning resources. These include visualization tools such as a 3D Bloch Sphere and the “QbitBox” to familiarize students with the concept of superposition, entanglement, interference and measurement, and a card game that demonstrates the difference between classical and quantum computers.

With an aim to make quantum computing simple, this portable, easy-to-use “Qureka! Box” is designed to attract educators and students at the secondary and high school levels, as well as professionals eager to learn how to naturally handle quantum computing concepts.

ETP23-ETP100-079 Vogt, Alexis 5/16/2023 10:00 - 10:30 Sand Castle I

If you build it, they will come: Creating "Ecosystems" to produce the next generation of optics technicians

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Precision optics manufacturing companies across the U.S. are suffering from a critical shortage of technicians. This shortage impacts supply chain, delays shipments and impedes the productivity of any industry reliant on optics. Further, it stifles innovation and requires engineers with advanced degrees to complete the work of technicians. Development of the current and next-generation optics manufacturing workforce is vital.
Monroe Community College (MCC) in Rochester, NY offered the nation's first Optical Systems Technology program. By collaborating with industry, community, and governmental partners, MCC grew the program over several decades to a record-high graduating class today with a 100-percent job placement rate. Unfortunately, MCC alone cannot meet the demand for optics technicians with 500 new graduates needed every year just in the Western NY region.
The U.S. Department of Defense sees this critical workforce shortage as a threat to national security and charged the American Center for Optics Manufacturing – AmeriCOM – to increase the number of optics technicians. Recognizing the success of connecting industry, community, and governmental partners with an optics-focused academic institution, AmeriCOM is replicating this "ecosystem" model in regions across the country.
The initiative has: 1) Extensively enhanced precision optics technician training with innovative approaches that meet the needs of the optics industry and students; 2) Increased the number and diversity of optics technicians nationwide; and 3) Established opportunities for student and faculty engagement with the optics industry. This presentation will discuss how MCC and AmeriCOM have successfully deployed the ecosystem model to strengthen the nation's precision optics workforce.

ETP23-ETP100-081 Huang, Yifan 5/16/2023 18:30 - 19:30 Poster Session
Project-based practical learning in the course of optical system design
Traditional classroom teaching is insufficient in training students' ability to solve practical problems. The optical design course aims at developing students' ability to design optical systems. In regular classroom teaching, students can learn design theories and universal design methods, but the lack of real engineering project experience leads to design results that cannot meet the actual needs. To solve this problem, we added four weeks of project-based practical learning to the optical design course in the summer semester. Enterprises are invited to put forward the specific needs of the project. Students are divided into groups to (1) summarize the parameters and operating conditions of the optical system, (2) Demonstrate the design principle scheme, carry out manufacturing technology research and cost estimation, (3) System module division and subsystem design, (4) Overall system design. During this process, teachers, the enterprises, and the student design team have no less than 4 discussions. Students are also invited to the factory to observe the processing and testing of optical components. Students continuously optimize the system structure parameters with the support of teachers, enterprises, and reference materials. Finally, a complete project design report will be formed, and a defense will be conducted with teachers and enterprises. According to the survey, the students have great enthusiasm for practical learning of the actual project, and more than 95% said that they have mastered the practical optical system design method through training.

ETP23-ETP100-083 Deveney, Ed 5/16/2023 16:00 - 16:15 Seahorse
Quantum mechanics in a quicker, more intuitive, and accessible way
We highlight our experiences migrating from a canonical educational approach and text for our quantum mechanics course to a modern approach and text emphasizing superposition and entanglement that espouses real-world applications, technologies, and questions along with the intuition and computational skills for practitioners to play an active role. As part of our approach, we couple experiments and undergraduate research centered around commercially available educational entanglement sources that include student-appropriate experiments. This approach may better promote quantum technologies, prepare scientists, technicians, and engineers, and offer deeper insight to what quantum is really telling us.

ETP23-ETP100-085 Arrizabalaga, Oskar 5/16/2023 18:30 - 19:30 Poster Session
Asymmetric Fabry-Perot cavity onto optical fibre tip to developing high performance sensing devices
In this project, we present an experiment of how the academic knowledge acquired can be applied to the development of technologies that improve the quality of life. We believe that the teaching of experiment-oriented topics, combined with a dynamic and dialogue-based classroom delivery, can encourage greater class participation. This experiment is designed around

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commonly used optoelectronic devices, such as LEDs, to engage students' interest. Additionally, students will learn to investigate non-trivial features of such devices, for example, that it is possible to relate the emission spectrum of a resonant cavity to physical parameters that affect the cavity, such as temperature or strain.

ETP23-ETP100-087 Verlage, Erik 5/16/2023 09:45 - 10:00 Sand Castle II

Beyond ray optics: building photonics intuition for waveguide modes using digital simulations and games

The Virtual Manufacturing Lab (VM-Lab) at MIT has created a library of photonics simulations that use novel data visualization and dynamic electric field profiles to teach photonic circuit components. These simulations address key student misconceptions about waveguide modes and photonic integrated circuit components. Students learn about the fundamentals of silicon photonics by exploring waveguide modes, mode superposition, on-chip interferometers, resonant structures, and more. In addition, interactive learning games introduce students to the application areas of photonic integrated circuits, including on-chip chemical sensing, data centers, wireless communication, and LiDAR imaging.

ETP23-ETP100-088 Sánchez-Guerrero, Guillermo Ezequiel 5/16/2023 18:30 - 19:30 Poster Session

Learning Optics and Electrodynamics as part of the Bachelor of Information Technology Security curriculum

The bachelor's in information technology security of the UANL used to teach the students the use of hardware and software for IT security tasks; moreover, the constant evolution of technology and the imminent arrival of new technologies led to needing to include Physics in the curriculum. The updates in this academic program include a subject called Transmission Signals, where fundamental electrodynamics and optics are covered, along with the explanation of its application in IT Security. The present work shows the impact of this subject on the curriculum and the work proposed to improve the development of IT Security students.

ETP23-ETP100-090 Flockhart, Gordon 5/16/2023 16:15 - 16:30 Sand Castle II

Photonic systems integration for postgraduate students in the Centre for Doctoral Training in Applied Photonics.

In 2018, the UK government invested £446 million in 75 Centres for Doctoral Training (CDT). This paper describes the development, implementation and evaluation of a taught course developed for the CDT in Industry-Inspired Photonic, Imaging, Sensing and Analysis. With an aim to broaden the researcher's skills, the course utilises an NI myRIO device to introduce programmable digital hardware through accessible coding to students from a range of undergraduate backgrounds undertaking postgraduate research in applied photonics. Technical knowledge and team working skills are developed and applied through a group project demonstrating an integrated photonic system.

ETP23-ETP100-091 Han, Kyu Young 5/18/2023 10:00 - 10:30 Sand Castle I

Exploring optics and photonics using open-source hardware and software

Optics and photonics are increasingly important in modern industry. However, the traditional curriculum has often not met expectations of undergraduates. In this talk, I will overview a new lab course that introduces how our daily life benefits from photonics techniques by making and designing simple devices, and controlling them via scripts. This includes smart lighting, display, autonomous car, etc. Open-source hardware and software allow students to readily learn various topics without prior knowledge of electronics and programming.

ETP23-ETP100-092 Joenathan, Charles 5/17/2023 14:45 - 15:00 Starfish

35 years of optic education at Rose-Hulman: from optical sciences to optical engineering - 3 cycles of ABET accreditation.

Rose-Hulman Institute of Technology has 35 years of graduating optical scientist and engineers. The change from the Applied Optics degree program to Optical Engineering degree program occurred in 2003 which paved the way for ABET accreditation. The program in the past and the present reinforces the idea that we are educating our students in the applications of optics to deal with real world problems and practice in the profession of optical engineering. The RHIT program has been on the forefront of developing project-based learning since the inception of the program in 1983. Since the name changed the optical engineering program (OE) has completed 3 cycles of ABET accreditation and we are continuously improving our OE curriculum to meet the

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current and future needs of the industry as well as for cutting edge research. To lead the ABET review, Rose-Hulman initiated the dialogue with SPIE to be the lead society for optical engineering in 2004. In this paper we will discuss several steps taken to develop a world class OE program with state-of-the art laboratory facilities for undergraduate optical engineering education.

ETP23-ETP100-093 Nourrit, Vincent 5/18/2023 11:30 - 11:45 Sand Castle II

The influence of education and professional experience on misconceptions in optics in optometry

In several countries such as the UK, the optometric profile has shifted towards a healthcare professional. The optics lecturer has thus to help students with often a limited interest and background in optics to become professionals with a reasonable understanding of the main optical phenomena and how they can be put in use in optometric instruments. In this context, and in order to help improving teaching strategies, the aim of this study was to identify misconceptions in optics among optometry students, and to assess if these misconceptions would change with professional experience and continuous education. An on line, anonymous, survey was carried out among first, second, third year Optometry students and qualified optometrists registered for at least two years with the General Optical Council. The number of respondents in the four groups was respectively 67, 54, 22 and 74. The survey consisted of 40 True/False/Pass questions regarding the nature of light (7), geometrical optics (8), visual optics (11) physical optics and ophthalmic applications (14). Results show that the misconceptions identified are similar to those reported in other science groups (e.g. image formation, wave nature of light) with the exception of few more directly related to Optometry concepts. If globally, students understanding improve with academic education, a number of misconceptions however persist along their studies and new misconceptions may also appear as students are introduced to new concepts, which may not always be clarified afterwards with professional experience.

ETP23-ETP100-094 Serna Otálvaro, Samuel Felipe 5/17/2023 09:30 - 09:45 Seahorse

Photonic Integrated Circuit Design and Characterization for Undergrad Workforce Training

Integrated circuits using light and electricity are ubiquitous in our daily life. In academia, electronics has reached maturity to a point where is taught even to children and K-12. This is not the case for photonic-based circuits, which are only studied in grad-level courses. In this contribution, we will present our approach to teach hands-on design, characterization and analysis of photonics integrated circuits (PICs) with passive and active devices in packaged and non-packaged chips. Basic concepts on propagation losses, confinement factors, free spectral range, quality factor, interferometric-based measurements, phase changes, Bragg bandgap design and packaging are covered in depth.

ETP23-ETP100-095 Robinson, Leanne 5/16/2023 16:30 - 16:45 Sand Castle II

Integration of a constructed lamp-based spectral calibration station into a radiometry course

Calibrated integrating spheres can be expensive thus in this paper, we set out to design, construct, test, and evaluate a NIST-traceable FEL Lamp/Plaque setup for in-house spectral calibration as well as integration into the undergraduate and graduate curriculum at the Center for Imaging Science at the Rochester Institute of Technology (RIT). This calibration station will be integrated into the lab section of RIT's radiometry course to educate students on how to conduct spectral radiometric calibration, independent of an integrating sphere. Our take-away is to illustrate how others can replicate our station so as to teach students about hands-on spectral radiometric calibration.

ETP23-ETP100-096 Durana, Gaizka 5/16/2023 13:45 - 14:00 Sand Castle II

A tabletop rotor kit as training platform for fiber optic-based sensing

In order to make aware of the importance that fiber optic sensors have in the modern industry, students in the master´s degree in Telecommunications Engineering at the University of the Basque Country are faced with a practical case of interest that provides a convenient training platform for learning important aspects of fiber-based optical sensing, such as probe design, the calibration curve, data interpretation and management, etc. The hands-on experiment runs around a tabletop rotor kit that includes different rotating parts and custom-designed fiber-based displacement sensors for monitoring the dynamics of the rotation. Practical aspects such as data interpretation and processing are dealt thoroughly, but without neglecting more fundamental aspects involved in the design of the optical probe.

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Presentation and Poster Descriptions

ETP23-ETP100-098 Buitrago-Duque, Carlos 5/17/2023 11:30 - 11:45 Sand Castle II

Introduction to Holography at undergraduate level using research-grade open-source software

An undergraduate-level holography workshop is presented. It starts with a review of imaging, interference, and diffraction concepts, which are then used for the description of analog holography and its later translation into digital holography. As hands-on application of these notions, a lecturer-guided activity in which the participants generate a computational off-axis hologram and calculate its reconstruction, is performed using the open-source plugin "Numerical Propagation" for ImageJ. This software allows the manipulation of complex-valued wavefields, thus letting the participants recreate step-by-step the stages of the holographic process, while directly identifying when each physical phenomenon is at play.

ETP23-ETP100-099 Serna Otálvaro, Samuel Felipe 5/17/2023 11:30 - 11:45 Starfish

Extending education and outreach in optics with the visually and hearing impaired

We present an activity organized by different student chapters in countries of Latin America geared towards the discussion and development of materials to teach optics and astronomy with and to the visually and hearing impaired. The event has been completed twice, once remote, in 2020, and another hybrid in 2022, with the in-person section hosted in Bogota, Colombia with remote participants from several countries. The event aims to develop educational materials, create a space for synergic interactions between different populations, and facilitate the expansion to different languages and regions in the Americas, particularly to reach under-served and remote communities.

ETP23-ETP100-100 Saini, Sajan 5/16/2023 13:00 - 13:30 Sand Castle II

Application-specific upskilling/reskilling in integrated photonics using MOOCs, bootcamps, laboratory test kits, and VR/digital or augmented reality games

Co-packaged integrated photonics and microelectronics are proliferating as a solution for systems applications spanning datacom, wireless, sensing, imaging. This technology adoption has accelerated the need to develop a more modular, multimodal silicon photonics curriculum for mid-career professionals and 2-, 4-year college educators. This program has founded: (i) an online MOOC education platform with training courses and an awareness learning module; (ii) an annual in-person summer school and testing/packaging workshop; (iii) VR training simulations, and digital and augmented reality games; and (iv) testing kits for laboratory instruction. We'll review (i)-(iv) and our current strategy to leverage for blended, interstitial learning.

ETP23-ETP100-101 Weninger, Drew 5/17/2023 09:00 - 09:15 Sand Castle I

The Massachusetts LEAP network: Building a template for a hands-on advanced manufacturing hub in integrated photonics

MassTech Collaborative has helped to make the Commonwealth of Massachusetts a beacon for advanced manufacturing. In partnership with the AIM Photonics manufacturing institute, MassTech has launched five Laboratories for Education and Application Prototypes (LEAPs) within academic institutions and/or companies spread across Massachusetts, to develop a skilled workforce in integrated photonics. Hands-on and in-person workshops, bootcamps and laboratory courses are offered at these LEAPs to learners from academia, industry, and the government. The MA LEAP network stands as an excellent self-sustaining model for hands-on STEM education and workforce training for the rest of the country.

ETP23-ETP100-102 Rockstuhl, Carsten 5/16/2023 14:15 - 14:45 Sand Castle I

Experiments to educate about established and new optical science and technology

Education in optics and photonics happens at many different levels. Starting with the education of pupils at a secondary school level, we wish to further educate university students and the general public. In that context, the education of physics teachers requires particular attention as they, in turn, will educate future generations of citizens.

Here, we summarize our latest contributions to this endeavor and give an overview of two sets of experiments used to educate across these levels. First, we outline experiments that educate about coherence, and second, an analogy experiment for detecting gravitational waves that captures essential details of LIGO.

Updated 4/27/2023 – For any discrepancy in time and room, the official ETOP program takes precedent.

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Presentation and Poster Descriptions

ETP23-ETP100-103 Demirbas, Elif 5/17/2023 09:00 - 09:30 Sand Castle II

Short and long range light detecting and ranging (LiDAR) kits for laboratory training of undergraduate students

At Bridgewater State University, Photonics and Optical Engineering Department, Semiconductor Laser Research Group is working on the design and characterization of quantum dot lasers and their silicon photonics applications. One of the applications we are interested in is the Light Detecting and Ranging (LiDAR) system. In this work, for education and laboratory training of the students, we use the commercial LiDAR kits to understand how the time of flight (TOF) principle work. I will show the details of the laboratory training and the results of the characterizations of the LiDAR kits to determine the distance of obstacles.

ETP23-ETP100-104 Ploeg, Sequoia 5/17/2023 11:45 - 12:00 Sand Castle II

Open-source curriculum for teaching integrated photonics design

We present a new open-source, online and freely available set of course material and resources for teaching integrated photonic design and simulation to electrical engineers and students with an interest in photonic engineering. In collaboration with Google, we've designed a curriculum complete with background motivation material, code examples, component and system design problems, and full circuit examples that teach learners a series of open-source Python tools and guide them step-by-step through design, simulation, and modeling, giving them the resources and information on how to submit their devices for manufacturing should they wish to test their devices' performance.

ETP23-ETP100-106 Tamuleviciene, Asta 5/17/2023 15:00 - 15:15 Sand Castle II

The Success Story of the Photonics-Related Curriculum Concept Developed in the Engineering Study Program from Undergraduate to Graduate

Lithuania is recognized as a laser-tech cluster and therefore the Materials Engineering and Nanotechnologies study program carried out at the Kaunas University of Technology is tempting to address the competencies required by the beneficiaries. Students are introduced to Optics and Laser technologies via three recently revised dedicated courses that have theory lectures, practical tasks, and lab works. Considering the challenges and needs of the laser-related economy in Lithuania the courses in Optics were adapted to include fundamental and applied research-based topics along with problem-based learning tasks directly related to the real-life problems that expand the content of the classical textbooks.

ETP23-ETP100-107 Dominguez Flores, Carmen Edith 5/17/2023 15:00 - 15:15 Seahorse

Science is also a women's thing: A meeting between girls and female scientists

In Mexico, just a little more than 30% of the scientist are women. One of the main reasons why girls decide not to study science is the shortage of female scientist models. This situation is a matter of concern for the CIO-OPTICA-SPIE student chapter. For that reason, we decided to create and organize an event aimed at high school women students interested in a STEM career. This event was launched as our main event for the international day of girls and women in science. Enthusiastic girls for STEM participated in conferences about the importance of women in science, experimented with optics and photonics, visited laboratories such as biophotonics, optical metrology, vision optics, nanophotonics, and fiber optic sensors. This event has been organized for five editions since 2020 with the financial support of SPIE, OPTICA and CIO. Around 300 female high school students participated, who were highly impacted by this event.

ETP23-ETP100-108 Chalyan, Astghik 5/16/2023 14:00 - 14:15 Sand Castle II

10 years of Photonics Explorer Kit and the future

More than 10 years ago, the Photonics Explorer Kit (PEK) was developed for secondary schools to inspire the next generation towards photonics. Furthermore, it went beyond Europe and was widely used during optics outreach activities, International Day of Light events by many optics-related organisations, SPIE and Optica student chapters.
Nearly 4000 PEKs, used by 200000 students annually, have already been distributed worldwide and aimed to delegate the impact of light and light technologies in schools, universities, companies and beyond.
We want to demonstrate the multiuse of this educational kit and the positive impact we will make in the future.

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Presentation and Poster Descriptions

ETP23-ETP100-109 Eybposh, M. Hossein 5/16/2023 09:30 - 09:45 Sand Castle II

Teaching optics with LightFlow, an intuitive framework for light propagation simulations

We introduce LightFlow, a new open-source software for simulating light propagation through custom optical components and systems using TensorFlow and Keras frameworks for GPU acceleration. The user-friendly modular architecture allows for easy building and modification of complex optical configurations, and the software's expandable nature enables the custom development of new optical components. The GPU-accelerated processing capabilities allow for efficient and real-time visualization, making it valuable for advanced optics education in classrooms and labs.

ETP23-ETP100-112 Ghosh, Sumit 5/16/2023 18:30 - 19:30 Poster Session

Outreach Education in Optics: International Day of Light activities for under-privileged school students

As part of its altruistic activities, the Indian Student Chapter of Optica, Hyderabad-India carried out an Optics Sensitization program for the under-privileged school students. Onus was on delivering the complex aspects of lights like interference, diffraction, polarization, reflection, refraction, dispersion, scattering etc., through experiential learning using optical kits. Since most of the students belonged to the deprived sections of the society who were never exposed to complex optical gadgets, we used rudimentary but effective tools for demonstration purpose. The ubiquitous laser and a telescope were also displayed for the students to appreciate how light-based technologies have revolutionized the human society. A do-it-yourself session was also organized for the students to make themselves a crude telescope. Audience comprised both of students and teachers. We could record an overwhelming response for the program from the participants who despite the financial limitations, showed eagerness to pursue science as a future career option especially follow the path of light and optics.

ETP23-ETP100-113 Chekhovskaya, Natalia 5/17/2023 10:00 - 10:30 Seahorse

Building sustainable photonics ecosystem in Florida

The unique Florida optics and photonics ecosystem offers dynamic solutions to workforce development, driving the advancement of science and technology. Close partnership with the research university, state colleges, and the photonics industry ensures that the state’s education and training programs, which range from fast-track short certificates to doctoral degrees, are finely tuned to the industry’s needs. The established framework also facilitates innovative programs for re-skilling and upskilling the incumbent workforce. During this presentation, the authors representing CREOL at the University of Central Florida, Florida Photonics Cluster, LASER-TEC, Valencia College, and Indian River State College will discuss the critical components of this thriving ecosystem

ETP23-ETP100-114 Fok, Mable 5/16/2023 16:15 - 16:30 Sand Castle I

Toy box optics: Bringing optical technologies home and to schools

We have developed three experiments using items found in toy box or around the house to demonstrate and explain optical concepts. Videos of the experiments, their principle, and applications are available on a YouTube channel. The first experiment uses moldable putty to make a shapeable lens and light guide to observe refraction and total internal reflection. The second experiment alters the color of light using flashlights and dry erase markers. Depending on the color of light is used to illuminate it, the color pattern of clothing changes. The third experiment uses bubble to explain light interference.

ETP23-ETP100-116 Wong, Nicholas H. L. 5/17/2023 14:15 - 14:30 Starfish

Authentic assessment in optics and photonics

In schools and universities, conventional pen-and-paper-tests which include multiple choice or theoretical derivations, as well as laboratory experiment tasks, are assessment mainstays in most STEM subjects. However, how much do these assessment types test student competency in an applied context? That is, how authentic are these activities in assessing workforce-ready graduates? Authentic assessment focuses on activities that accurately reflect the tasks and contextual environments that employees would carry out and be exposed to in a real-world setting. We review developments in authentic assessment and how it can be applied in general STEM as well as specifically optics and photonics contexts.

ETP23-ETP100-117 Rzeznicka, Izabela 5/18/2023 11:15 - 11:30 Seahorse

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Presentation and Poster Descriptions

Smartphone-based optical sensing for biomedical and environmental monitoring
The advancement in CMOS technology in the recent years, along with the increasing processing speed and storage capacity of smartphones, have opened up overabundance of opportunities to realize low cost smartphone-based analytical devices. In a medical field, such devices can be used to detect malaria or to monitor physiological parameters in real time outside of hospital premises. They can also be used as low-cost devices for environmental sensing and protection. In this presentation, we will demonstrate smartphone-based methods for potassium sensing in blood plasma and for quantification of copper ions in waters. Such methods offer a cost-effective alternative especially for African countries where there is a limited access to sophisticated equipment. With the Japan Science and Technology-sponsored project in Africa, we are now preparing related educational materials for use in Botswana's schools and universities. We hope that bridging optical education with chemical analyses will bring good health and well-being for people in Africa.

ETP23-ETP100-118 Chakraborty, Shantanu 5/17/2023 09:45 - 10:00 Seahorse
Introducing optical properties of liquid crystals and polarization in undergraduate optics course
Liquid crystals are fluids, they have a robust response to weak external fields, which makes the liquid crystal displays possible. They possess small amount of orientational order as they undergo liquid-like diffusion. Phase transitions separate the liquid crystal phase from other phases; in fact, the liquid crystal to liquid transition reveals the basic thermodynamics common to all phase transitions. Presence of orientational order means that liquid crystals interact with light in many of the ways solids do. Therefore, the behavior of polarized light can be introduced and investigated from the optical properties of the liquid crystal phase at undergraduate level.

ETP23-ETP100-119 Vargas-Rodriguez, Everardo 5/16/2023 16:45 - 17:00 Sand Castle II
Implementation of a Peltier thermoelectric cooler driver for tuning DFB laser modules.
In this work it is presented a simple and low cost Peltier thermoelectric cooler (TEC) driver for tuning a DFB laser. This driver can be implemented by students since it is based on a general-purpose microcontroller development board, a power switch-mode drivers for TEC modules, and a few generic electronic components. Furthermore, the principles of operation of overall TEC driver are presented and performance results of its application for tuning a DFB laser are provided.

ETP23-ETP100-120 Chang, Yun-Chorng 5/17/2023 15:15 - 15:30 Sand Castle I
Developing Photonic outreach kits via OPTIC 2022 Photonics Outreach Contest in Taiwan: Perspectives and future challenges
Demonstrating a good optic outreach kit is a good way to attract more students to pursuit a career in Optics and Photonics. Therefore, we encourage college students to develop outreach kits by holding a Photonic Outreach Contest during OPTIC 2022, which is the biggest annual gathering of scientists in the fields of Optics and Photonics in Taiwan. In this talk, we will introduce the outreach kits from the winning teams and discuss about how we will proceed to use them for the next step. We will also share out perspectives of the direction we may take in the near future.

ETP23-ETP100-121 Chekuri, Venkata Adithya 5/16/2023 13:45 - 14:00 Seahorse
Toward a Quantum-Enabled Workforce: Curriculum Design, Project Based Learning, and Institutional Partnerships as Integrated Methodologies
In this presentation, we first present our novel initiatives aimed at educating and training the next generation of quantum engineers via a project based learning approach, emphasizing the role of a commercial quantum key distribution (QKD) test bed as the tool to provide "hands on" training and skills to our M. Eng students. Next, the potential implications of these initiatives in the context of cutting-edge graduate education and research are discussed. Finally, we offer insight into our efforts at developing robust quantum education curricula and experiential learning approaches at the grassroots level on a wider scale, by partnering with institutions such as Historically Black Colleges and Universities (HBCUs).

ETP23-ETP100-122 Serou, Pujitha 5/16/2023 18:30 - 19:30 Poster Session

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Presentation and Poster Descriptions

Design and Simulation of Attenuation and Chromatic Dispersion of Optical fibre communication system to enhance student's understanding

This paper focuses on the pedagogic approach to assist the researchers and students to start their journey in Optical Fibre Communications - in a captivating manner all the while remaining simple in understanding. It concentrates mainly on the core propagation properties of optical fibre transmission, namely, Attenuation and Chromatic Dispersion. Although, many software and publications are available to efficiently simulate a given optical fibre communication system, they remain quite complex, costly, and complicated for a beginner to understand.

This paper aims to support the students with detailed explanation along with screenshots of the step-by-step procedure to follow to reach the desired output. MATLAB is used for this purpose as it is easily understandable and available for most students and researchers. Moreover, this code can also be executed on a platform called OCTAVE, which is available for free. Therefore, this code can be accessed and utilised by everyone, just by installation of the software.

ETP23-ETP100-123 Williams, Michael 5/17/2023 11:45 - 12:00 Starfish

Continuing the Search for Equity: Advancing the Need for More Representation of Black Scientists in Optics and Photonics

The events of 2020 have forced us all to confront the dark truths of racial injustice and police brutality that so many black people have endured for decades. The scientific community especially had its own awakening to the bias, indifference, and discrimination that black scientists have seen and experienced, including the fact that as a whole, the many contributions that black scientists have given to science have not been embraced nor celebrated by their colleagues mainly because of their skin color. In this presentation, I share my story on how I was able to earn the Ph.D. in optics through my matriculation of entirely all historically black colleges and universities, how the black scientific community responded to the cry for racial equality, and why it is so important to advocate on their behalf for racial equity in the sciences.

ETP23-ETP100-124 Muriungi, Kithinji 5/17/2023 15:15 - 15:30 Sand Castle II

Design Perspectives for a Photonics and Optics Capacity Building Program for the Under-served Communities.

Theoretical concepts of Photonics and Optics-related subjects might be perceived as future technologies (particularly in under-served communities) despite the tremendous progress in research and development. For this reason, designing any program for capacity building requires proper consideration of the targetted communities for viability, applicability, replicability, sustainability, and scalability. In this paper, several local cases will be cited, and insights will be shared to demonstrate best practices, critical perspectives, and factors such as sociocultural, technological, economic, industrial, infrastructure, environmental, and political, among others. Considering these factors effectively facilitates the creation of a highly impactful and valuable program. Human-centered (user-centered) design approaches are key in ensuring the program serves the intended needs of the targetted communities without compromising their diverse values perspectives or the inclusivity perspectives of the designers of the program.

ETP23-ETP100-125 Lam, Matilynn 5/16/2023 18:30 - 19:30 Poster Session

Key stakeholders' interpretations of scientific Information Literacy: A survey of Orange and Seminole County K-16 educators

Due to the constant presence of information, it is imperative that today's students can evaluate and apply the information effectively. This skillset, known as information literacy (IL), is valuable in all fields, yet state and national education standards have little in terms of developing those skills in current curriculums. Due to this lack, it is increasingly important to have open discussions about IL with key education stakeholders, like K-16 educators, to identify their interpretations and assessment of IL and its potential integration into the science curriculum.

We aim to answer three questions: (1) How do Central Florida education stakeholders interpret information literacy, (2) How is information literacy represented by stakeholders when teaching scientific content, and (3) How can data from education stakeholders support developing initial threshold concepts for scientific information literacy? To begin, a set of focus groups were

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conducted with Central Florida K-16 educators and librarians to determine how they interpreted and assessed IL, and the perceived obstacles they encounter with integrating IL in science instruction. As these educators and librarians are involved with the current guidelines and standards, the insight they provided from these discussions will be useful in aligning IL with these standards and threshold concepts. These discussions have also allowed for the survey development to probe a larger set of higher educators. This survey will allow education stakeholders to evaluate IL within science classrooms. This data will allow us to generate greater awareness about IL and its teaching practices and better understand educator perceptions of IL.

ETP23-ETP100-126 Renner, Daniel 5/17/2023 09:30 - 10:15 Sand Castle I

Panel Discussion - Optics and photonics industry drivers for workforce education and training

This is a Panel Discussion that will address the current gaps in optics / photonics education relative to what industry needs. The education gaps will be discussed for all workforce levels: technicians, engineers, management, etc. Most importantly, the Panel will discuss possible paths to take in the immediate future to bridge these gaps and get to a point where educational institutions can provide education and training that is highly effective to industry.

ETP23-ETP100-128 Searles, Thomas 5/16/2023 14:00 - 14:15 Sand Castle I

Building a supportive environment for graduate trainees in optics

Research and education in the field of optics cannot be decoupled. In fact, the laboratory and classroom are often purposefully merged to provide hands-on experience to students through an instructional lab course or research experience. Research infrastructure and a critical mass of faculty expertise in optics can be out of reach for many institutions. However, some non–research-intensive institutions host teaching and research labs with relatively low operating costs that have a broad and profound impact on trainees. Here, we will share best practices for mentoring students in optics with the intentional inclusion from the viewpoint of four current graduate trainees. The aim of our talk is to present food for thought from the perspective of mentees whose experiences in optics labs have shaped their academic carreer. In addition, the speaker will also detail her journey with mentors who have changed the lives of many with research and education opportunities in optics, sometimes with little support or infrastructure.

ETP23-ETP100-129 Searles, Thomas 5/16/2023 15:15 - 15:30 Seahorse

Quantum Engineering Degree Programs for the Future National QIS Workforce

The 2018 National Quantum Initiative Act calls for the creation of a proficient, skilled workforce to meet the anticipated demand of industry and overcome the challenges presented by research and development of emerging quantum applications. As a result, a number of federally-funded programs focusing on quantum education have emerged. Simultaneously, significant strides have been made with respect to research and development of near-term intermediate scale quantum systems, such as cloud-accessible quantum computers based on trapped-ion, photonics, or superconducting transmon qubits, primarily by a workforce of PhD-level workers. As the industry grows, the types of jobs will also grow and as such, others in the workforce with bachelor's and master's degrees will play a bigger role, especially in the scaled production of quantum hardware.

To date, most of the initial investment in QISE in the US was geared towards physics and quantum materials science, with 41% of related academic programs being hosted in traditional Physics departments. Here, we present the state of the art with respect to quantum engineering degree programs in the US and globally [1]. Specifically, we will detail the work with respect to updating an ABET-accredited Engineering Physics curricula at UIC to encourage students to gain experience and knowledge in quantum engineering.

Reference:

[1] A. Asfaw et. al, "Building an Undergraduate Quantum Engineering Program" IEEE Transactions on Education, 65, 220 (2022).

ETP23-ETP100-131 Thériault, Gabrielle 5/17/2023 09:15 - 09:30 Sand Castle I

Beam characterization using an industrial grade beam profiler in an academic context

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Industrial-grade laser beam profiler is being used in an academic context for different beam characterization as for Rubidium gas excitation and the mode stability of some visible LED lasers. It is also used in the AIM Photonics Bootcamp to show attendees the interference pattern from a free space Mach-Zender interferometer.
Those applications and experiments added value to the curriculum of many students and allow to enrich multiple hands-on demonstration, undergrad courses and post-grad research.

ETP23-ETP100-133 Zhong, Hairong 5/18/2023 09:45 - 10:00 Seahorse

Intelligent cloud teaching of photoelectric courses

With the wide application of mobile Internet, cloud computing, big data, artificial intelligence technology in the field of education, a new teaching model based on the cloud teaching platform has been proposed and developed rapidly. According to the whole chain process of “curriculum construction-implementation-evaluation”, the quaternity intelligent cloud teaching framework of teaching content, teaching tools, teaching management and teaching evaluation, including intelligent cloud teaching materials, cloud class, cloud teaching big data management, and intelligent monitoring system of teaching quality, have been studied and constructed in this paper. The data and services of the four modules can be mutually invoked and supported. The research and practice of intelligent cloud teaching has been carried out in the core courses of “Optoelectric Technology”, “Applied Optics”, “Physical Optics”, “Photoelectric Information Comprehensive Experiments”, “Electrodynamics” and so on.

ETP23-ETP100-134 Lvovsky, Alexander 5/16/2023 09:00 - 09:30 Seahorse

Polarization and entanglement of photons as basis for explaining quantum physics.

A by-product of recent achievements in quantum information science is a dramatic improvement of our understanding of quantum fundamentals. I took advantage of this progress to create a conceptually new course of quantum theory, which introduces this discipline to the students using the most mathematically simple, low-dimensional physical system: the polarization of the photon. Combined with early introduction of entanglement, this approach helps the student acquire a deep understanding of the quantum principles and avoid the usual confusion that most beginners are prone to. In particular, it permits resolving the notorious paradox associated with the nature of quantum measurements and the role of the observer, while taking the student on a fascinating tour of today’s hottest research topics such as quantum cryptography, nonlocality and teleportation. The theoretical course can be combined with a series of laboratory experiments. This includes polarization state engineering and tomography, heralded single photons, single-photon interference, quantum nonlocality, remote state preparation and quantum tomography of a harmonic oscillator.

I implemented this approach in my textbook titled Quantum physics: An introduction based on photons (https://link.springer.com/book/10.1007/978-3-662-56584-1) and tested it in undergraduate settings in Calgary and Oxford, as well as in the framework of the Quantum Club for senior high school students (https://bit.ly/quantum_club). In all cases, an excellent rapport with students has been established and the course received excellent reviews.

ETP23-ETP100-135 Cheng, Xiangai 5/18/2023 11:45 - 12:00 Seahorse

Using "Cloud Class Plus" for online and offline hybrid teaching interaction model: the case of the Applied Optics Course

The development of "Internet+" and "cloud technology" is forcing the traditional universities teaching mode to change. The use of mobile teaching assistants such as "cloud class" and "cloud textbook" can effectively improve teaching efficiency and quality. On this basis, the online and offline hybrid teaching interaction mode based on "Cloud Class +" is constructed and applied to the teaching practice of the Applied Optics course. The online and offline hybrid teaching interaction model is introduced in detail from three aspects: pre-class preparation, in-class discussion, and post-class feedback. Moreover, its practical results are analyzed, which can provide useful references for solving hot topics and difficult problems in education and teaching.

ETP23-ETP100-137 Gupta, Shravan 5/17/2023 11:45 - 12:00 Sand Castle I

Student leadership and teamwork opportunities through structured optics outreach at scale

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Presentation and Poster Descriptions

We present a scalable and sustainable model to engage teams of undergraduate and graduate students in developing and delivering optics outreach activities. This structured approach to outreach provides a rich opportunity for students to work in teams and foster crucial leadership skills that will serve them well in their professional careers. Colleges and universities have enormous potential to deliver high-quality science outreach by leveraging their STEM and pedagogical expertise, facilities, materials, and philanthropic support. Coalescing these resources, however, is often challenging due to constraints on students' time, splintered and duplicated efforts, and lack of clear directives. We detail the development of our student-led optics outreach program at The Institute of Optics, scalable to accommodate varying levels of student commitment, and our organizational structure that promotes sustainability between generations of student leaders. Our teams participate in three key activities focused on K-12 youth: maintaining and adding to a library of interactive educational outreach demos, hosting outreach events for the greater community, and volunteering at outreach events run by local organizations. Additionally, we are piloting an undergraduate course focused on applying the engineering design process to the design and construction of new outreach demos. This enables us to develop more technical demos beyond the scope of volunteer time and also engages faculty with outreach. As a result of these initiatives, our Optics Outreach Team has grown from a handful of passionate seniors and graduate students to over 30 students at all levels of study, including many that are new to outreach.

ETP23-ETP100-139 Boudoux, Caroline 5/17/2023 11:30 - 12:00 Seahorse

It Goes Without Saying – A Series of Doctoral Workshops for Engineering Students

For a long time, a Ph.D. in engineering felt like The Matrix: "No one can be told what the Matrix is. You have to see it for yourself," – said Morpheus to Neo in the 1999 movie. After mentoring graduate students for more than 15 years and teaching mandatory doctoral workshops for more than 5, I present a field guide to help Ph.D. students in engineering navigate such uncharted research waters. STEM faculty members have long-trained carbon copies of themselves: budding academics who intuitively survived a sink-or-swim mentoring approach. However, the current shortage of highly qualified personnel, particularly in industry, requires that we modernize our doctoral education to combat attrition and graduate a more diverse class. Hypotheses explaining student attrition revolve around three themes. Grasp: postgraduate candidates need to understand better what a Ph.D. is and what is expected of them. The first theme transforms implicit expectations into explicit notions. Research project management: while Ph.D. students are expected to lead a research project toward producing novel and significant results, they are seldom taught project management skills. The second theme revolves around project management skills within a research project in engineering. Impostor syndrome and other road bumps: the third theme explores modern practical themes ranging from time management to unconscious biases and psychological safety. In this presentation, I will describe Doctoral Workshops at Polytechnique, introduce the companion book (MIT Press, 2024) for reference until students call themselves doctors, and listen to input from the formidable ETOP community.

ETP23-ETP100-140 Himel, Marc D 5/17/2023 10:15 - 10:30 Sand Castle I

Implementing and growing a global college recruiting program

MKS Instruments is engaged in a robust global program for our ever-expanding college recruiting and internship efforts. Our global strategy for Early Talent programs provides both a defined recruiting approach and a structured program experience which includes events, well-defined learning objectives, networking and educational opportunities, executive exposure, and more. To solidify MKS as an employer of choice, we provide a comprehensive and engaging Co-op/Intern experience that starts when they accept and continues after they complete their assignment. We will share aspects of our program's objectives, structure, lessons learned, and some personal reflections as we enter the program's third year.