

Light
Laboratory
Presents

OPTICAL SCIENCE

PAST
PRESENT
FUTURE



Taighde Éireann
Research Ireland



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Light Laboratory: Optical Science Past, Present, Future is a series of Citizen Science events bringing the worlds of STEM and Arts & Humanities together.

Held during Science Week in November 2025 to celebrate the theme
Then. Today. Tomorrow.

Funded by Research Ireland under the Discover Science Week Programme and organised by The Future Humanities Institute and IPIC - Tyndall National Institute at University College Cork.



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LIGHT LABORATORY: OPTICAL SCIENCE PAST, PRESENT, FUTURE

NOVEMBER 1 - 10

**Book display -
Q Floor Boole Library**

We celebrated Science Week with a curated book display exploring the wonders of light and optics across time.

From ancient philosophical reflections on perception to cutting-edge photonics and quantum optics, discovering how ideas about light have shaped our understanding of the universe and continue to illuminate the future.

**FROM WONDER
TO 'WHAT IF?'**

**FROM AWE TO
APPLICATION**

NOVEMBER 14 AND 16

Light Laboratory: Optical Science Past, Present, Future

We began at The Granary Theatre, transformed for Science Week into a dynamic Light Laboratory, where Optical Science principles of the past were demonstrated with dramatic effect.

Following this, and adjacent to The Granary Theatre at the Tyndall National Institute, scientists guided attendees through cutting-edge research and technologies that build on those foundational principles, offering a glimpse into the present frontiers of Optical Science.

Then, over refreshments, ideas and visions for the future were shared and exchanged. How might these technologies evolve? What could the future of light look like?

NOVEMBER 23

Astronomy and Art: Astronomy, Architecture and Geometry

The workshop began with a guided tour of Ireland's only university observatory - the historic Crawford Observatory.

Following the tour, the next stop is Dr Dora Allman Room with panoramic views of the campus and city with a hands-on creative workshop with artist Dominic Fee. Inspired by the observatory's distinctive hexagonal roof,

Dominic guided the process of creating geometric designs using compasses. This hands-on session invited attendees to explore the role of geometry in both science and art.

NOVEMBER 29

Pop Up Light Laboratory: Public talk at Kinsale Library

This engaging talk by Prof Peter O' Brien traced key scientific moments, from Newton's prism experiment to the revolutionary transatlantic telegraph cable to discover how light has shaped our understanding of the world — and transformed it!

Featuring demonstrations from the Irish Photonic and Integration Centre at Tyndall National Institute UCC, the Light Laboratory explored how cutting edge photonic research in MedTech, artificial intelligence, communications and sustainability is changing how we innovate, connect and live.

OPTICAL SCIENCE: PAST

Over two days during Science Week, we welcomed students and teachers from Cork city and county, community and youth groups as well as interested members of the public.

From Newton's prism experiment to the first transatlantic telegraph cable, the story of light is the story of discovery. At The Granary theatre we celebrated Ireland's rich legacy of light and its influence on modern technology. Through an engaging mix of storytelling and interactive demonstrations, the session traced the journey from ancient solar engineering at Newgrange to cutting-edge photonics shaping today's world.



NOVEMBER 14 AND 16: THE GRANARY THEATRE AND TYNDALL NATIONAL INSTITUTE



These breakthroughs laid the foundations for modern optics and changed how we see and understand the world and the mysteries of the cosmos. **Light lets us see what's out there even if we can't go there ourselves.**



OPTICAL SCIENCE: PAST

During an interactive presentation in the Granary Theatre's light-box theatre, the audience engaged and discovered

Ireland's Light Heritage:

Showcased milestones from prehistoric monuments to transatlantic communication breakthroughs.

Scientific Exploration:

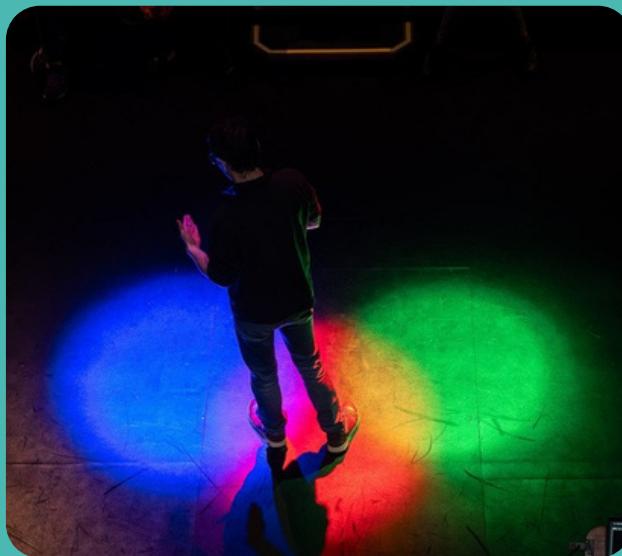
Participants learned about the light spectrum, colour mixing, and atmospheric phenomena such as Rayleigh scattering.

Interactive Demonstrations:

Hands-on activities included refraction experiments, fibre optics, and light-based data transmission.

Future Applications:

Discussed light's role in advancing medicine, sustainability, accessibility, and space exploration.



Photos by Marcin Lewandowski, Sound of Photography

Visitors also had a behind-the-scenes tour of the Tyndall fabrication facility, where science meets fabrication to create these next-generation devices. Together, these breakthroughs show how light can make technology faster, smarter, and more sustainable improving communication, healthcare, and the environment for everyone.

Light-based technologies are the invisible force transforming the visible world reshaping how we live and work. Today, photonics powers everything from medical imaging to high-speed communications. At the Tyndall National Institute, visitors explored cutting-edge technologies like handheld OCT devices and photonic chips, witnessing how light continues to transform **MedTech and healthcare, AI, communications and sustainability.** Photonic chips are not only faster and more efficient, they're also greener, reducing energy use and material waste compared to traditional electronics.

Advanced photonic packaging allows light-based chips and electronic components to be combined in compact, high-performance systems that are energy-efficient and cost-effective.



OPTICAL SCIENCE: PRESENT

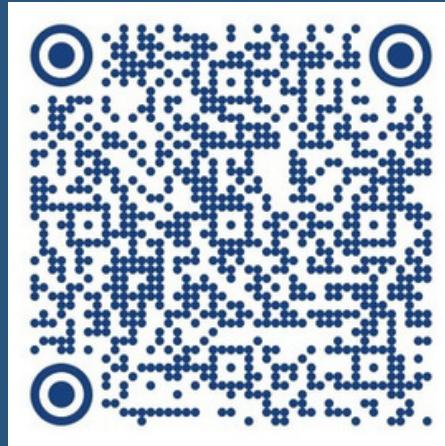


Photos by Marcin Lewandowski, Sound of Photography



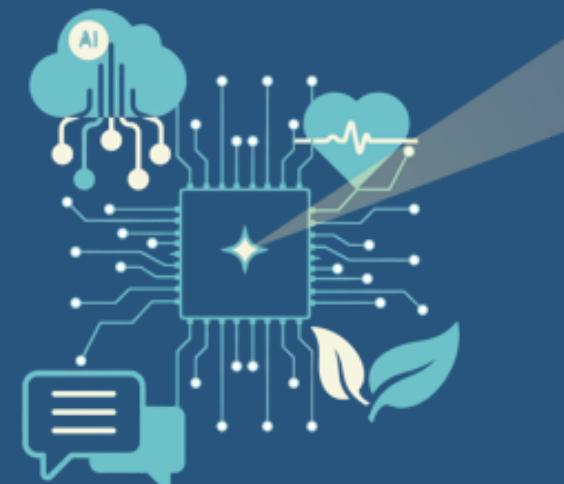
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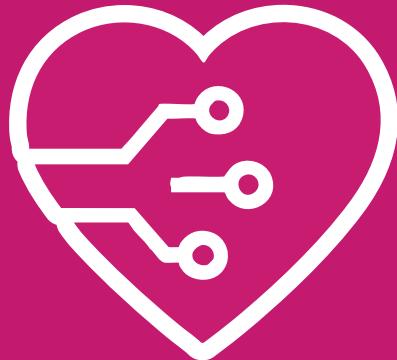
ADVANCED PHOTONIC PACKAGING AND INTEGRATION



Advanced packaging is a key driver for next-gen semiconductor systems, meeting demands for high performance, energy efficiency, compact size and low cost. The Packaging and Integration group's research tackles major challenges in materials, design, and scalable manufacturing processes for photonic and microelectronic packaging. Led by Prof. Peter O'Brien, the team combines deep expertise with cutting-edge facilities to develop wafer-scale packaging, optical coupling, and integration technologies. Their long-term focus is on 3D photonic-electronic chiplet systems—one of the most complex packaging challenges.

Prof O'Brien's group is a lead partner in major European initiatives like PIXEurope, PIXAPP, Europractice, and PhotonHub Europe, and collaborates with top manufacturers such as ficonTEC and X-Celeprint to drive innovation in high-throughput manufacturing enabling sustainable scalable, surface-mounted and pluggable photonic solutions for communications, AI and medical applications. The group also contributes to education through photonics training programs, helping shape the future of the field globally.



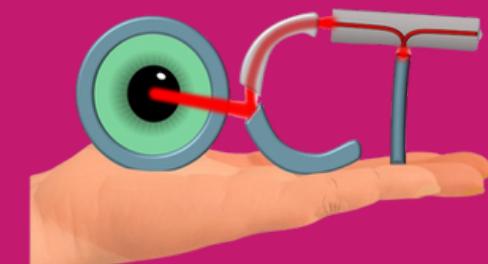


MEDTECH

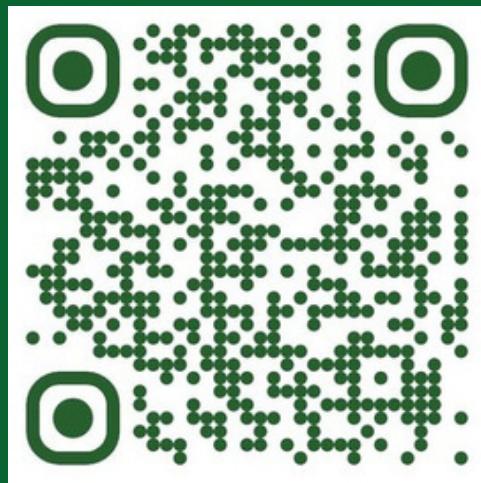


PIONEAR is a breakthrough in sound detection, using light instead of electricity to 'hear' the world. Traditional microphones rely on electrical signals, which can introduce noise and limit sensitivity. By harnessing the power of light, this technology reduces interference and energy use, paving the way for cleaner, faster, and more sustainable sensing. It's not just a microphone—it's the future of listening.

HandheldOCT Medical imaging is essential for diagnosing disease, however, traditional systems are bulky and expensive. The Handheld OCT (Optical Coherence Tomography) Chip changes that by shrinking advanced imaging technology into a portable device. OCT uses light waves to capture detailed, cross-sectional images of tissue—perfect for eye exams, skin analysis, and even early cancer detection, bringing high-quality imaging to clinics, remote areas, and even home healthcare. Why is this important? Early diagnosis saves lives, and portability means more people can benefit. By combining photonics with miniaturisation, this innovation puts powerful diagnostic tools in the palm of your hand. It's a step toward a future where healthcare is faster, smarter, and available to everyone.



CARDIS Cardiovascular disease (CVD) is one of the leading causes of death worldwide, and early detection is critical for saving lives. The CARDIS project has developed a unique photonic-based medical device to screen for arterial stiffness—a key marker for hypertension and heart disease. The device uses Laser Doppler Vibrometry (LDV), where a low-power laser measures tiny vibrations in the skin caused by the heartbeat, helping doctors identify patients at risk. At the heart of the device is a silicon photonics chip, which integrates complex optical functions into a compact, handheld system. This innovation enables fast, reliable, and non-invasive screening at the point of care bringing cutting-edge photonics into everyday healthcare, making early cardiovascular screening accessible and affordable.



SUSTAINABILITY

Microchips power everything—from smartphones to satellites—but making them is resource-intensive and environmentally challenging. FUTUR-IC is a global collaboration, including MIT and leading photonics researchers, focused on creating sustainable chip manufacturing and packaging. The goal? Reduce energy use, cut waste and design processes that are kinder to the planet. This project explores advanced materials, photonic integration, and innovative packaging techniques to make chips smaller, faster, and greener. Why is this important? As demand for electronics grows, so does the environmental footprint of production. FUTUR-IC aims to break that cycle by introducing eco-friendly solutions without compromising performance. These innovations could transform industries, enabling devices that are both powerful and sustainable. FUTUR-IC isn't just about technology—it's about responsibility, ensuring that the next generation of electronics supports a healthier planet while driving progress in computing, communication, and beyond.

Why Light-Based Technologies Are Greener.

Light-based (photonic) technologies use photons instead of electrons to transmit and process information. This fundamental shift dramatically reduces energy consumption as photons travel without resistance, unlike electrical currents that generate heat and waste energy. Lower heat means less cooling is required, cutting power demands in data centers and devices. Manufacturing photonic components often uses fewer raw materials and supports miniaturisation, which lowers resource use and waste. In applications like sensing and imaging, photonics can deliver higher precision with less power, making medical devices and communication systems more sustainable. By replacing copper wires and bulky electronics with optical fibers and chips, photonics helps reduce carbon footprints across industries. Simply put, light-based technologies combine speed, efficiency, and sustainability—powering a cleaner future for computing, healthcare, and global connectivity.



COMMUNICATIONS & DATA CENTRES

Datacentre Optical Switch - collaboration with UC Berkeley, US



Data centers—the backbone of the internet—are under pressure to handle ever-growing traffic. Enter the UC Berkeley Switch, a silicon photonic device that moves data at lightning speed using light instead of electricity. Traditional switches rely on electrical signals, which create heat and slow things down. This photonic switch operates in sub-microsecond timeframes, dramatically improving efficiency and scalability. Why does this matter? Faster switches mean quicker cloud services, smoother video streaming, and better support for AI applications. They also reduce energy consumption, helping data centers become greener. The UC Berkeley Switch is a glimpse into the future of computing, by merging photonics with silicon, this innovation delivers speed, sustainability, and reliability—all in one tiny chip. It's not just about faster internet; it's about building the infrastructure for tomorrow's digital world.

PhotonicLEAP tackles one of the biggest challenges in photonics: cost. Photonic chips—devices that use light instead of electricity—are essential for high-speed internet, medical imaging, and advanced computing. But packaging these chips is expensive and complex. PhotonicLEAP introduces a scalable packaging solution that cuts costs by up to 90%, making photonic technology more accessible than ever. Why is this important? Lower costs mean photonics can move beyond research labs into everyday applications, from faster cloud services to portable diagnostic tools in hospitals. It also supports sustainability by minimizing materials and energy use during manufacturing. PhotonicLEAP is more than a technical upgrade—it's a game-changer that accelerates the adoption of light-based technologies worldwide, unlocking new possibilities for communication, healthcare, and beyond.



HOW WILL LIGHT SHAPE TOMORROW?

What's next for light?

From spectrum to sustainability, from awe to ambition, from wonder to what's next. Imagine greener data centres, ultra-fast optical switches, and photonic innovations that reshape industries. The future of light promises speed, efficiency, and sustainability and illuminating new paths for science and society. The Light Laboratory is always open and the next discovery might be yours!

OPTICAL SCIENCE: FUTURE







LIGHT TRANSFORMING
HEALTHCARE

LIGHT SUPPORTING A
SUSTAINABLE WORLD

ADVANCES IN SPACE
EXPLORATION AND TRAVEL

VIRTUAL REALITY AND
HOLOGRAMS

FASTER, BETTER
CONNECTIVITY

CURING BLINDNESS AND
SMART IMPLANTS

The Past

HOW ARE RAINBOWS MADE?

Rainbows form when sunlight bends and splits into colours through raindrops

HOW DO SCIENTISTS ANALYSE THIS?

Scientists use instruments like spectrometers to analyse light — like using starlight to find out what stars are made of!

Sheila Tinney - broke barriers in physics, inspiring generations of Irish scientists



SO WHITE LIGHT IS ACTUALLY MANY COLOURS?

Yes — Isaac Newton proved it with a prism

AND WHAT WAS IRELAND'S ROLE?

In 1866, the Valentia Transatlantic Cable transformed communications, laying the foundation of today's global networks

OPTICAL SCIENCE

The Present

SO HOW DOES THE PAST SHAPE TODAY?

Our world is powered by light. Optical science drives advances in sustainability, medicine, communications and AI



"LIGHT ON A CHIP?"

Yes — tiny beams of light are now being used inside microchips to move data faster and more efficiently



John Tyndall showed that light could be guided — a breakthrough that paved the way for fibre optics



AND IRELAND'S ROLE TODAY?

Ireland is a leader in optical microchip innovation. Tyndall National Institute drives global research, training and innovation in optical science — powering progress for a brighter future

The Future

HOW WILL LIGHT SHAPE TOMORROW?

From spectrum to sustainability, from awe to ambition, from wonder to what's next.

Your insights have illuminated the path ahead.

LIGHT TRANSFORMING HEALTHCARE

LIGHT SUPPORTING A SUSTAINABLE WORLD

VIRTUAL REALITY AND HOLOGRAMS

ADVANCES IN SPACE EXPLORATION AND TRAVEL

FASTER, BETTER CONNECTIVITY

CURING BLINDNESS AND SMART IMPLANTS

A future where every beam of light sparks connection, creativity, and care — thank you for being part of the Light Laboratory journey.



Fadó

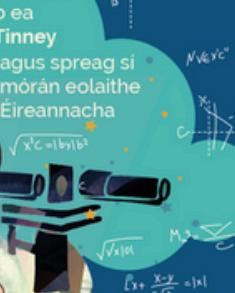
CONAS A DHÉANTAR BOGHA BÁISTÍ?

Feiceann tú bogha báistí nuair a lúbann solas na gréine agus binn sé mar dhathanna éagsúla tri bhraonta báistí

CONAS A DHÉANANN EOLAITHE ANALÍS AIR SEO?

Scientists use instruments like spectrometers to analyse light — like using starlight to find out what stars are made of!

Ceannróidí na fisice ab ea Sheila Tinney agus spreag sí mórán eolaithe Éireannacha



TÁ MÓRÁN DATHANNA SA SOLAS BÁIN MAR SIN?

Tá – chruthaigh Isaac Newton é sin le priosma

AGUS CÉN RÓL A BHÍ AG ÉIRINN?

In 1866, d'athraigh Cábla Trasatlantach Dhairbhe cursáil cumarsáide ó bhonn, agus chuir sé túis le snáthoptaic an lae inniu

EOLAÍOCHT OPTÚIL

Inniu

TIONCHAR NA STAIRE AR AN LÁ INNIU

Cumhacht an domhain is ea an solas. Cuireann eolaiocht optúil go mór le hinbhuanaitheacht, leigheas, cumarsáid agus AI.



"SOLAS AR SHLIS?"

Is ea – úsáidtear gathanna beaga solais i micrishliseanna anois chun sonrai a bhogadh nios tapúla agus nios éifeachtúla

AGUS RÓL NA hÉIREANN INNIU?

Ceannróidí is ea Éire i nuálaiocht na micrishliseanna. Cuireann Institiúid Náisiúnta Tyndall taighde, oiliúint agus nuálaiocht san eolaiocht optúil chun cinn ar fud an domhain – rud a dhéanfaidh todhchai nios gile



Chruthaigh John Tyndall go bhféadfai solas a threorú – rud a chur túis le snáthoptaic



An Todhcháí

AN IMREOIDH SOLAS TIONCHAR AR AN TODHCHÁI?

Ó AINEOLAS GO hEOLAS

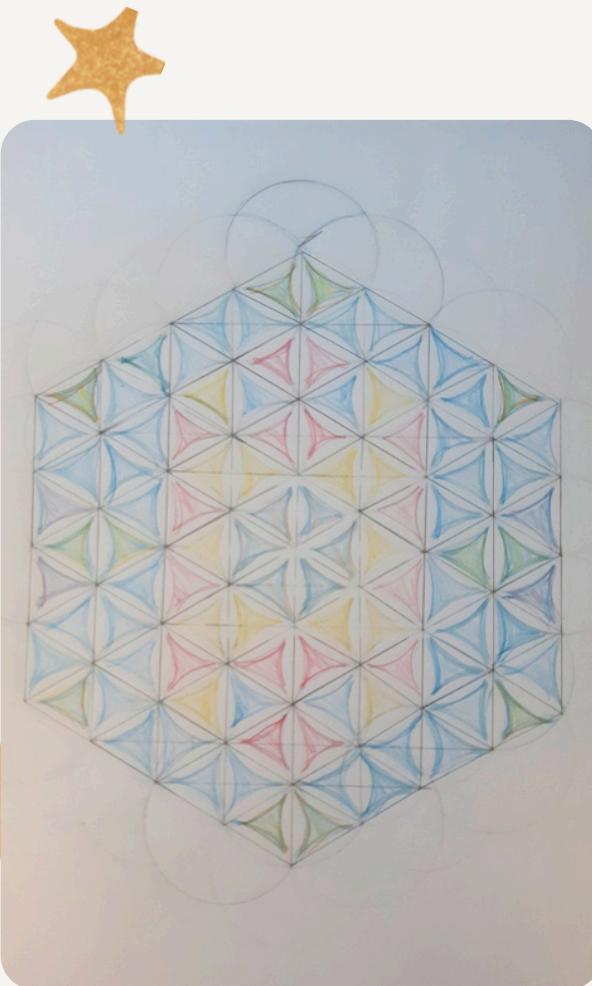
ROINN DO CHUID SMAointe FAOI THODHCHAÍ AN tSOLAÍS. SCRÍOBH NÓ TARRAING LÉARÁID

Ó IONTAS GO BEART

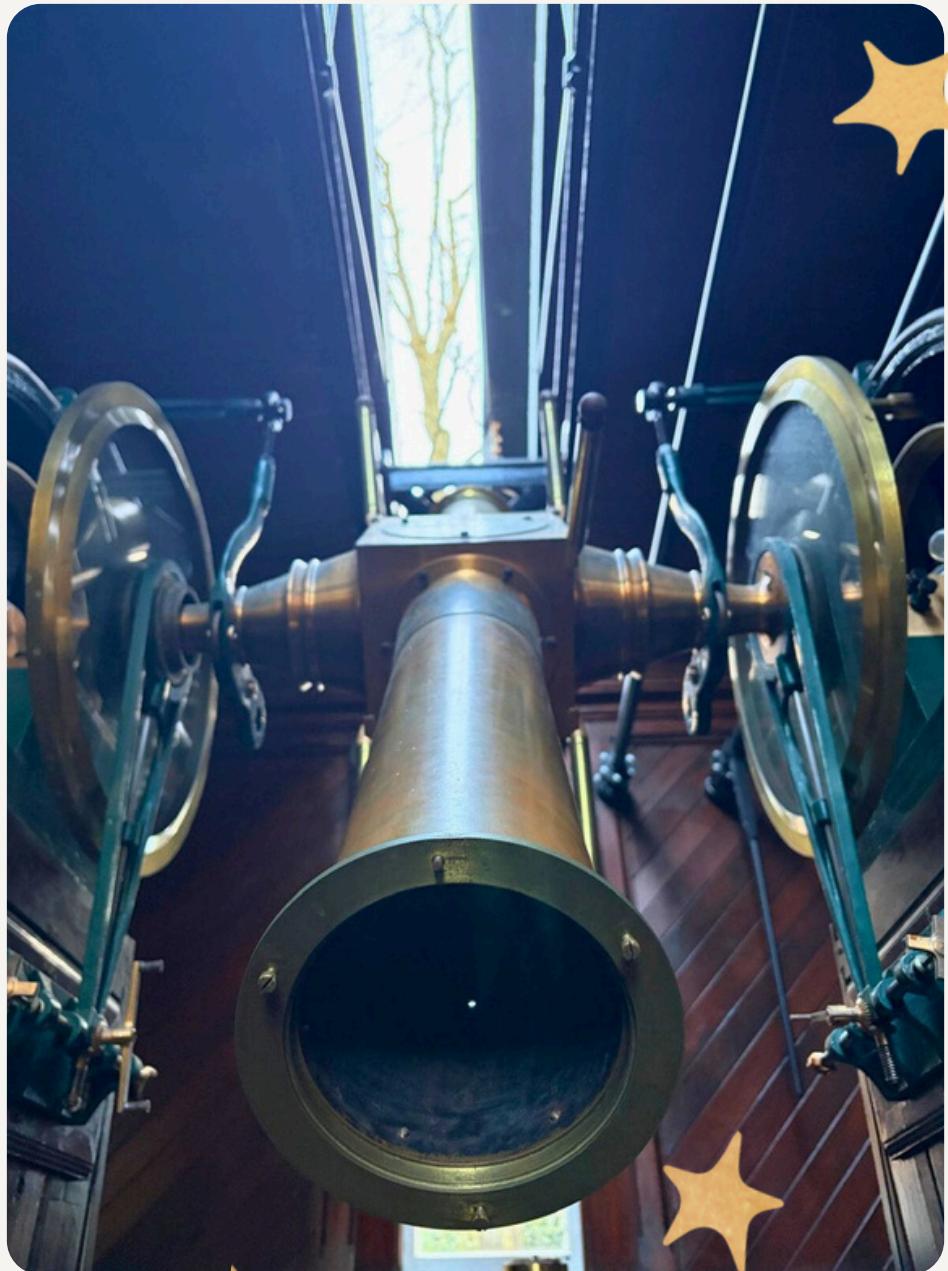
AN SOLAS MAR RÉITEACH AR DHÚSLÁIN AN DOMHAIN

Níl an todhcháí cinnte fós – Bíodh páirt agatsa ann!





NOVEMBER 23 ASTRONOMY & ART ASTRONOMY, ARCHITECTURE AND GEOMETRY



Step inside the Crawford Observatory and discover Ireland's astronomical heritage. This workshop blended science and creativity, inviting participants to design geometric patterns inspired by the observatory's architecture. Led by artist Dominic Fee, the session explored how geometry connects art and astronomy.

Optical science plays a vital role in this journey. From the telescopes housed in observatories to the lenses and prisms that reveal the hidden properties of light, optical science has shaped our understanding of the universe. It allows us to observe distant galaxies, decode the structure of stars, and even explore the microscopic patterns in nature that inspire artistic design. By connecting the precision of optics with the creativity of geometry, we celebrate how light — both as a physical phenomenon and a metaphor — illuminates our path from past discoveries to future innovations.



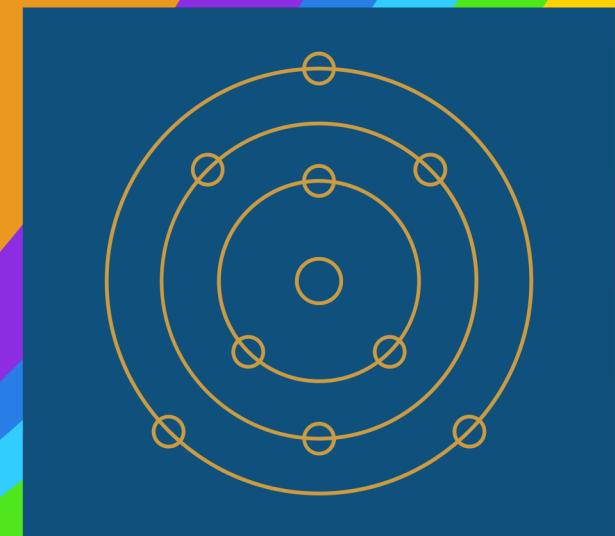
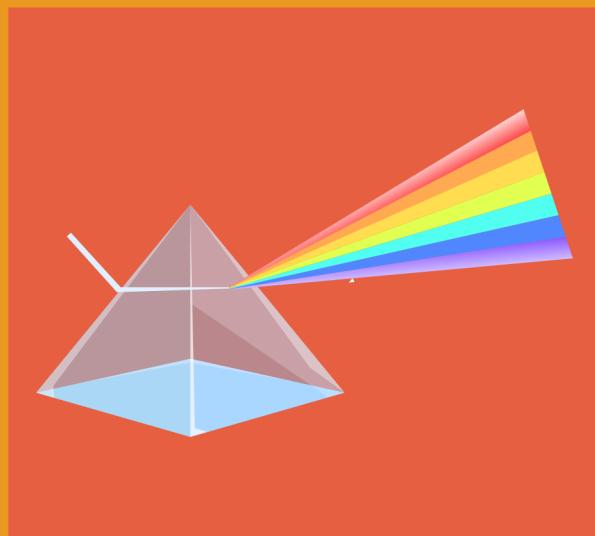
At Kinsale Library, Prof. Peter O'Brien traced the journey of light through history, from Newton's prism to today's photonic breakthroughs. Featuring live demonstrations from Tyndall scientists, this talk showed how light has shaped our world and continues to drive innovation in medicine, communications and sustainability.



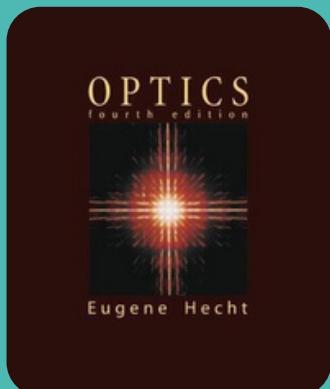
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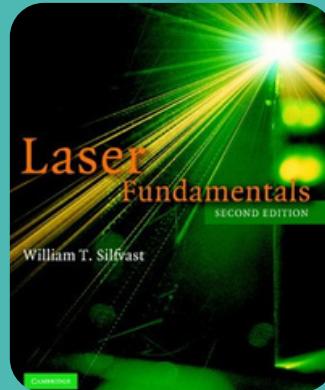
POP UP LIGHT LABORATORY
KINSALE LIBRARY
NOVEMBER 29



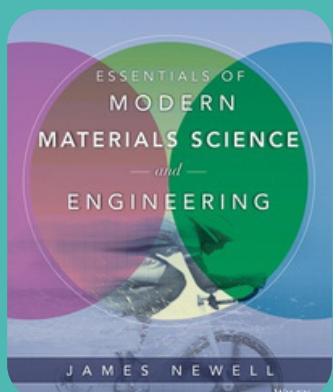
BOOLE LIBRARY BOOK DISPLAY Nov 1-10



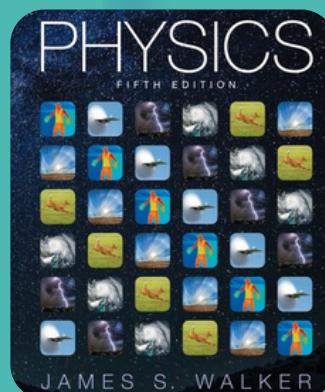
Optics
by Hecht, Eugene
2002, Fourth international
edition



Laser fundamentals
by Silfvast, William Thomas
2004, Second edition.

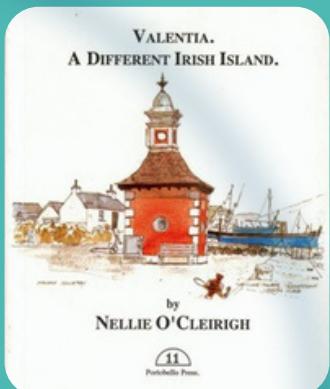


**Essentials of Modern
Materials Science and
Engineering**
by Newell, James
2009

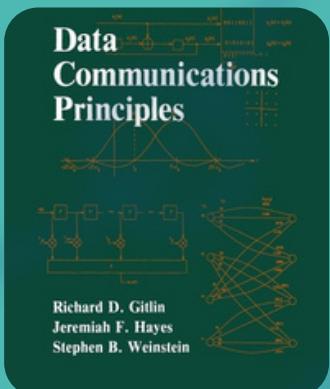


Physics
by Walker, James S
2017, Fifth edition

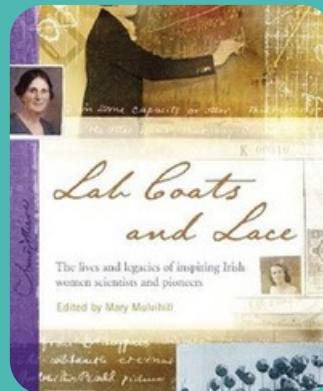
BOOK DISPLAY SAMPLE



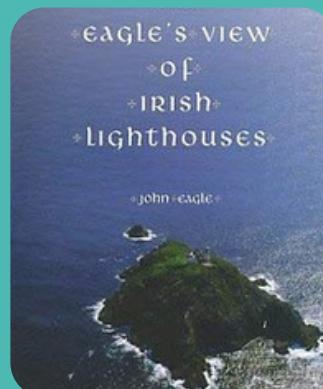
**Valentia:
a different Irish island**
by Ó Cleirigh, Nellie
1992



**Data communications and
transmission principles:
an introduction**
by Simmonds, Andrew
1997



**Lab coats and lace: the lives
and legacies of inspiring
Irish women scientists and
pioneers**
by Mulvihill, Mary
2009



**An Eagle's view of Irish
lighthouses**
by Eagle, John
1999

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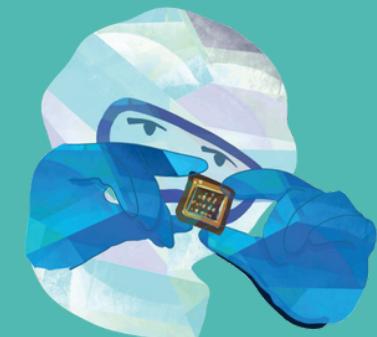
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