



Little Book of Photonics Careers



Science
Foundation
Ireland **sfi**
For what's next



IPIC

BRINGING PHOTONICS TO LIFE



UCC

Coláiste na hOllscoile Corcaigh
University College Cork, Ireland



Tyndall

National Institute
Institiúid Náisiúnta



Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



DCU



CORK INSTITUTE OF TECHNOLOGY

INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Contents

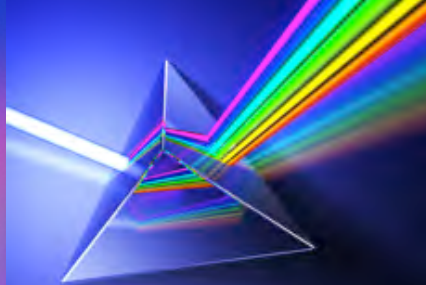
What is photonics?	3
What is a career in photonics?	5
Photonics in lighting and screens	7
Photonics in telecommunications	8
Photonics in medicine and imaging	9
Brian Murray	12
Yan Zhao	14
Megan O'Brien	16
John O'Dowd	18
Colette McDonagh	20
Frank Smyth	22
Monika Zygowska	24
Padraic Morrissey	26
Andrea Pacheco	28
Laura Horan	30
John Hayes	32
Agnieszka Gocalinska	34
Anil Jain	36
Una Buckley	38
Ludovic Caro	40
Sinéad Byrne	42
Caroline Lai	44

The Irish Photonic Integration Centre (IPIC) funded by Science Foundation Ireland brings together over 150 researchers from five universities and institutes to develop new light-enabled technologies. Targeting the ICT, medical devices and diagnostics sectors, IPIC works with 25 industry partners developing world leading technologies, for example

- Ensuring that the Internet of the future will be fast and efficient by developing our fibre optic broadband communication system.
- Developing new medical instruments to help the surgeon 'see' better or receive real time updates from inside the body

We developed this book to showcase some of the many exciting and diverse careers in photonics.





What is Photonics?

Photonics is the science and technology of generating, controlling, and detecting light.

It touches people on so many levels: producing glasses to help people see, developing telescopes to explore distant galaxies, creating medical sensors to diagnose diseases, and providing the building blocks of the Internet allowing us to communicate with friends right across the world.

Photonics truly is the enabler of many technologies, so joining the revolution allows you to have impact in many ways you might never have imagined.



Photonics impacts our everyday lives

- Lighting
- Screens
- Telecommunications
- Imaging
- Medicine
- Safety
- Security
- Energy



Curious mind?
Passion for problem solving?
Learning new things?

What is a career in Photonics?

A career in photonics starts with a degree in one of the physical sciences, e.g. physics, engineering

For further details on Physics courses across Ireland, check out the Institute of Physics' resources http://www.iopireland.org/publications/iopi/page_48801.html

To learn more about engineering programmes in Ireland, explore Engineer's Ireland resource website <https://www.steps.ie/>

Undergraduate students can gain valuable experience by doing summer internships. At IPIC, we run a summer internship programme to give students experience in our world-class research facilities.



Ireland - a world leader

- Over 300,000 jobs in Europe alone
- Median salary in Ireland \$63,649
- High level of job satisfaction with 96% respondents say they enjoy their work.

SOURCE: 2017 SPIE Global salary report data

IN IRELAND

- **Jobs** – 160,000 in physics-based industries
- **Turnover** - €48.7 bn
- **R&D** - €2.3 bn



Photonics in Lighting & Screens

- Developments in photonics have brought us from the incandescent filament light bulbs of Edison's era through to modern day LED bulb providing consumers with more efficient lighting solutions.
- **The new Páirc Uí Chaoimh is the first stadium in Ireland with LED lighting which significantly reduces glare, eliminates flicker and reduces energy consumption**
- Photonics has provided us with the colour images and increasingly sharper TV, smartphone and tablet screens that we use on a daily basis.
- **Oculus a Facebook company, based in Cork, are developing the world's most advanced LED technology for virtual reality headsets and augmented reality smartglasses.**

Photonics in Telecommunications

Fibre optic technology contributes to our increasing demand for fast and reliable internet speeds. Current research is working on increasing the capacity of the fibre optic network to cope with future demand.

Irish company Eblana Photonics develop high performance lasers for optical fibre communications from their laboratories in Dublin.

Photonics in Medicine & Imaging

Photonics can help in the diagnosis and treatment of many conditions. From the simple pulse oximeter measuring blood O₂ levels to routine keyhole endoscopy to assess internal organs.

Ireland is one of Europe's largest MedTech hotspots and is home to 300+ companies, employing 25,000 people, many of whom are now integrating photonics into their products.

Photonics can play a role in many other applications, such as agriculture. Dublin company Equilume develop light therapy solutions to maximise health, growth and performance in horses.

Design Engineer

Professor of Physics

Astrophysics Student

PhD student

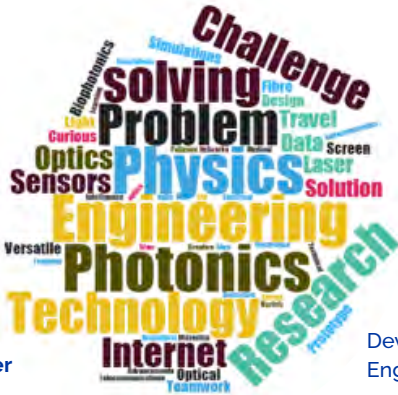
Component Engineer

Technical Sensor Specialist

Analog Circuit Design Engineer

Optical
Engineer

System
Engineer



Researcher

Development
Engineer

Senior Scientist

Entrepreneur

Analog Circuit Design Engineer

Lithography Engineer

CEO Pilot Photonics



Faces of Photonics



Brian Murray

Photonics Systems PhD Student,
Tyndall National Institute



Brian completed a B.Sc. in Physics & Applied Mathematics in UCC before starting his PhD developing technologies to send information efficiently inside data centres.

He uses computer simulations to firstly understand the problem and test his ideas, before going to the lab to put them into practice, sending signals down kilometres of optical fibre to monitor how the information is transmitted.

'I've never been happy with too much repetition in life and my career in science has certainly avoided that so far. I also enjoy spending time teaching undergraduate students in UCC'

His advice to those considering a career in physics:

'Take the leap! Physics is a wonderful subject to study in college; even if you don't become a scientist, the problem-solving and numerical skills you develop lend themselves readily to other careers.'

Yan Zhao

Development Engineer,
Radisens Diagnostics



Yan has travelled the world as part of his career, starting at Hunan University in China, before moving to England and now Ireland.

He is part of a team who are developing one of the world's first real-time blood diagnostics systems that is easy to use, rapid, compact and removes the use of needles. They are even working with the European Space Agency to deploy the technology on the International Space Station. Yan's day to day work includes advanced 3D modelling to ensure that developmental devices will not only perform but that they will also be compatible with manufacturing processes.

'My education and training gave me the ability to continuously develop my knowledge, often in new topics.'

What's Yan advice to those starting their science careers?

'Most technologies are cross-disciplinary, so try not to focus in on any one area too early but rather expand your horizons at an early stage in your education.'

Megan O'Brien

**Astrophysics student,
University College Cork**



Megan is currently completing the first step of her career covering a variety of courses –

from lasers in the lab to learning about the formation of white dwarfs and neutron stars and even looking at physics on a whole new level with quantum mechanics.

'A typical week in college would have a mix of lectures/tutorials and hands-on experimental labs. When I'm not in lectures or the lab, I'm usually working on assignments and lab reports due for the following week.'

What's the best part of her work?

'The 'Eureka' moments in the lab after solving a problem set or an experimental set-up gone wrong are just the best!'

John O`Dowd

Senior Optical Engineer,
Faz Technology



Graduating from Trinity College Dublin with a physics degree and PhD, John has embarked on quite a diverse career journey.

Following his PhD studies, John moved to Tyndall National Institute where he worked in the Photonic systems group. He then moved on to work with a startup company – Intune Networks and currently works with Faz Technology. Working with Faz has given John the opportunity to work on a research vessel in the North Sea.

On board the research vessel, new technologies for exploration and surveying are developed. These include remotely operated vehicles and autonomous underwater vehicles.

‘Day to day I am responsible for design and development of tunable laser based optical interrogators which can be used to monitor offshore subsea structures and marine vessels that are deployed for environmental monitoring.’

“Physics has opened so many opportunities for me, I have been able to use the skills and training to develop technology for use in range of industries including the telecommunications and the energy industry.”

Colette McDonagh

Professor of Physics,
Dublin City University



As Professor in Physics in DCU, Colette has two sides to her job. Firstly she is world leading academic in the field of Biophotonics, the study of the interaction of light with the body, where she leads a team developing

new types of optical chemical sensors for biosensing. Secondly Colette teaches physics to undergraduate students, guiding them through lectures and laboratory sessions.

'This can be full-on but interacting with and guiding the students is one of the many satisfying aspects of my job. I also enjoy the challenge of taking on new roles e.g. Head of Teaching, Head of School, Dean of Faculty.'

'A degree in physics is a very versatile qualification with graduates employable in diverse areas such as banking and finance, data, software, R&D as well as the more traditional roles of the physicist in teaching, engineering and biomedical fields.'

Frank Smyth

CEO Pilot Photonics



Frank is one of Ireland's growing number of technology entrepreneurs, individuals who create companies that develop and sell new technologies and services.

Pilot Photonics are developing a new type of laser that increases the capacity of the fibre optic networks that make up the internet.

As the CEO of a small company a typical day includes everything from reviewing detailed research plans to customer meetings. He also still gets to spend some time in the lab with the R&D team on a good day!

'Entrepreneurship is like a rollercoaster with lots of highs and lows. I also love the idea of getting technology that we have developed out into the world. We are currently working with the European Space Agency who have talked about putting our technology into orbit - that would be a real buzz!'

Frank has a B. Eng. in Electronics, a M.Sc. in Engineering and a PhD in Photonics.

Monika Zygowska

**Senior Scientist,
Johnson & Johnson, Ireland**



Monika has completed an Engineering MSc prior to joining Tyndall where she was subsequently awarded a PhD.

Monika has since gained industrial experience as an Analytical Development Chemist with GlaxoSmithKline and then embarked on a career in medical devices with the world leading Healthcare company Johnson and Johnson. J&J have their Medical Device Test Method Centre of Excellence based in Cork and Monika's role is critical to ensuring maintenance of quality across the manufacturing processes life cycle. Monika's multidisciplinary background has also led to research roles at universities in Ireland, France and Poland.

'The diverse skills you learn as an engineer and a scientist are invaluable in all sorts of industry and academic settings. I have been able to use my knowledge and experience to work in research but also in the areas of pharmaceutical and medical device industry which I am really passionate about. As possibilities in those sectors are endless, I look forward to continuously grow and challenge myself professionally.'

Padraic Morrissey

Photonics Packaging Scientist,
Tyndall National Institute



Padraic works in one of the widest ranging disciplines, finding new ways to integrate photonics and electronic components into miniaturised packages covering everything from devices for eye imaging, aircraft sensing



and fast data communications. This must be done in such a way that the devices can be transferred to the production line following testing and evaluation.

'The best thing about my job is the variety! Because it is research, there are new challenges and problems to be solved daily. This keeps the work interesting and means you are constantly learning new skills.'

For students considering what to study at university, an undergraduate degree in physics or engineering is a great starting point as it gives you a great understanding of problem solving, which is useful in whatever direction your career takes you! Research institutes often offer summer internships to university students and this can be a great way to see first-hand what a research environment is like.

Andrea Pacheco

Biophotonics PhD Student,
Tyndall National Institute



Andrea joined Tyndall from Columbia where she completed her degree at the Universidad Nacional de Colombia.





She is working on a grand challenge of developing a clinical device to monitor oxygen levels in the lungs of preterm babies. If successful, the technology will greatly help in the care of these vulnerable infants. The work is in collaboration with the Cork University Hospital and the Science Foundation Ireland funded INFANT Centre.

'One of the exciting aspects of my work is the opportunity to brainstorm ideas with my research group and supervisor, so team work and problem solving are all part of my day. Also important is creativity, a willingness to learn, and the opportunity to travel to international conferences where I can show my work and get feedback from researchers in my field.'



Laura Horan

Technical Sensor Specialist,
Germany



Laura has utilised her education in physics (degree and PhD in UCC & Tyndall) to build an exciting international career.

This includes working for Coopervision in the UK and now ZF TRW Automotive in Germany, where she designs new optical sensors. Laura works alongside specialised tool engineers to turn her designs into real products. Optical sensors are essential components for assisted driving today and autonomous driving tomorrow. Key elements of Laura's work include the opportunity to travel to customer sites to present new products and she is regularly invited to technical meetings to present new ideas.

'Receiving the opportunities to work abroad have been big highlights for me. My biggest challenge has been to become comfortable with public speaking. It used to terrify me but now is one of the best aspects of my job.'



John Hayes

Researcher in Residence,
Integer Holdings Corporation



John's role is to develop technologies that add intelligence to medical devices, such as the addition of sensors to measure pressure, velocity and temperature of blood flow inside arteries.

These devices help guide surgeons during procedures and improve patient outcome.

'My working day can involve prototype development, project management, customer visits and observing medical procedures to assess clinical requirements. A broad scientific knowledge is required, as well as good communication, interpersonal, business and marketing skills.'

'Whatever career you choose, the most important thing is to have a strong interest in the area since this will help you through difficult periods. If you are genuinely interested then you will improve continuously.'

'The opportunities are out there; multinationals, start your own company, academia, research institutes etc.'

Integer is a global leader in the design and development of medical devices with over 1,000 employees in Ireland

John has a B.Eng. Electrical/Electronic from University College Cork and a PhD from Tyndall.

Agnieszka Gocalinska

Epitaxy Growth Researcher,
Tyndall National Institute

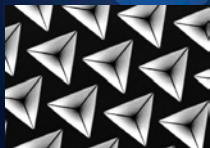


Agnieszka's career has transitioned across Europe from Poland to Italy and now Ireland. Her work is focused on material studies where she grows crystals through a method called epitaxy.

This means depositing one crystallographic layer at a time to build up a multi-layered structure. The end-product is a material that can be used to make a transistor, a solar cell or a laser (or some other photonic device!).

'I was awarded a prestigious funding award to carry out my PhD studies. This gave me an opportunity to work with world-class scientists on a daily basis and also to travel to collaborating labs.'

'I like the variety of what I do. My job has a good balance in many aspects: team vs individual work, long and short term project, blue-sky research and simple lab tasks, lab work and desk work. My career is flexible, versatile and satisfying.'



Anil Jain

Analog Circuit Design Engineer,
Sicoya GmbH, Germany



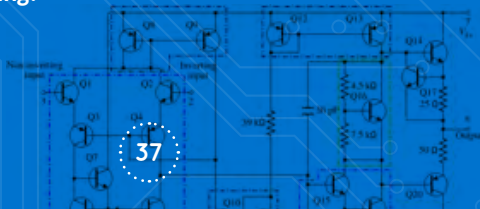
Anil's career has allowed him to travel the world, studying electrical engineering in India and New York before moving to Ireland and onto Germany.

These opportunities have allowed Anil to experience many cultures, and he has always been made to feel welcome. A typical day is spent working on designing circuit blocks which requires both creativity and patience as they are complex and it might take a long time – a few months to a year, to design.

Anil's employer is a Silicon Photonics start-up company, an emerging new technology field that combines photonics with silicon onto one small chip.

'The work-life balance is great as employers are generally very flexible with working hours.'

'The most important aspect for me is that I get ample space and time to be creative. Being a circuit designer is a life-long learning exercise and hence it is never boring!'



Una Buckley

Principal Component Engineer,
Dell-EMC Ireland



Una works for one of the world's largest providers of data storage and cloud computing solutions. These provide storage for all of our messages, photos and videos that we store on our phones and tablets.



She is responsible for qualifying all new optical transceivers for the company. These are devices that convert an electrical signal into an optical signal and vice versa to transfer information across data centres. Her work includes the establishment and day-to-day management of the Optics Test Centre where she works closely with suppliers to ensure that the technology works.

'With this role, I have travelled to Asia and the US allowing me to experience other cultures and work environments.' I also really enjoy being involved with the Diversity & Inclusion team with Dell Cork Manufacturing and particularly working with initiatives to encourage girls to consider STEM subjects and careers.'

Una has a B.Sc. in physics and M.Eng.Sc in microelectronics.



Ludovic Caro

Device Development PhD Student,
Tyndall National Institute



Ludovic is a microscale builder! His role is to develop new lasers to make the Internet faster. To achieve this he creates laser designs using equations on the physics of the laser to predict how these novel designs would work.

Then it's off to the cleanroom facility where he makes the devices, about 1mm in size, through the process of lithography where layers as thin as 500 nm – about 100x thinner than a hair are laid on top of each other to create the sophisticated structures. This involves a lot of patience, and some steady hands as the devices can be quite fragile!

'The whole process of having an idea and turning it into an actual thing gives quite a sense of achievement. This is a job that takes patience and where you need to be creative, but when it works and your creation comes to life, it is incredibly rewarding!'

Sinéad Byrne

Lithography Engineer,
Intel Ireland



Sinead's role is to ensure the quality of an important structure in the manufacturing process for semiconductor chips. Reticles are opaque plates with holes that allow light to shine through in a defined pattern which



is then transferred onto a semiconductor wafer. This is a critical step in the production of semiconductor chips. These chips power everything from computers to mobile phones.

Career highlight? 'Travelling to our R&D factory in the US and representing the department as a key player in the transfer of our latest technology to the Ireland campus.'

'Don't assume a company that makes a specific product e.g. microchips, is all computer based and not for you. Photonics is not restricted to just what you learned in college, it is a continuously developing area and you could be part of the latest breakthroughs.'

Sinéad has a B.Sc. in Forensic & Environmental Science (DIT) and a M.Sc. in Forensic Technology from University of Dundee.

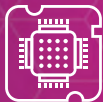


Caroline Lai

Senior Fibre Optic System Engineer,
Rockley Photonics, California, USA



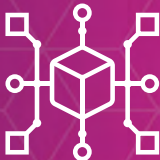
Caroline is a member of Rockley's Product Development team based in Pasadena, California. She is responsible for designing the systems aspect of the company's next-generation data centre technology.



Experts predict that data traffic in data centres could be 1000× more than today in order to keep up with demand for internet services over the next 10 years.

‘The transition from academia to industry was a big change as the pace of work was so different. Deadlines are more frequent and are designed around finances and market input. The expectations for success are very high and days can be quite demanding.’

Caroline was a Postdoctoral Researcher in Tyndall before joining Rockley and has a B.A.Sc, MSc. And PhD in Electrical Engineering.





Inspiring Ireland's next generation of scientists and engineers

App developer; nanomaterials engineer; data scientist; these are all careers that didn't exist 10 years ago and are at the cutting edge of development and innovation today. They are all also rooted in Science, Technology, Engineering and Mathematics (STEM).

STEM education is undergoing a revolution with more variety in third level courses, and better resources for both female and male students to build exciting careers and to effect positive change in the world and drive a sustainable international economy.





Science Foundation Ireland is the national foundation for investment in STEM and works to support a wide range of impactful research from photonics to the environment, and through its Smart Futures programme provides students in Ireland with information about careers and supporting the young men and women who will make up tomorrow's leaders in STEM discovery <http://www.smartfutures.ie>

Did you know that there are over 120,000 people working in jobs that use STEM skills in Ireland?'









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