



AN EPSRC & SFI CENTRE FOR DOCTORAL TRAINING

PIADS CDT



SPOTLIGHT REPORT

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WELCOME



Welcome note by PIADS Chair of Doctoral Forum

Emma Crothers

It is with great pleasure that I welcome you to the 2023 Research Report of the EPSRC-SFI Centre for Doctoral Training in Photonic Integration & Advanced Data Storage (PIADS).

PIADS CDT represents a unique cross-geographic collaboration between The Queen's University of Belfast, the University of Glasgow and the Irish Photonic Integration Centre (IPIC), uniting a diverse cohort of talented students and a network of pioneering industry sponsors from the UK and EU to address the opportunities that arise at the intersection of photonic integration and advanced data storage technologies.

This academic year marks a significant milestone as our tenth cohort of students joins the PIADS CDT family to advance scientific knowledge through innovative PhD and EngD research. Just as no two research projects follow the same path, a founding principle of the CDT emphasises the need to nurture the individual growth of each PIADS student. We recognise that effective personal and professional development is as unique as one's talents, passions, and aspirations, and capitalising on these differences is essential to creating the diversely skilled workforce that will be the future of photonics in the UK and beyond.

In my role as (outgoing) Chair of the Doctoral Forum, I have had the privilege of hearing daily about the remarkable ways my fellow students have leveraged the support of the expansive PIADS network to make their time in PIADS something extraordinary. From globe-trotting to deliver award-winning presentations in front of expert audiences, to spearheading conferences, workshops and initiatives that address complex scientific, societal, and environmental challenges, our students continually demonstrate the type of ingenuity and ambition that is needed to drive progress and break new ground in cutting-edge technological sectors.

As we collectively emerge from the shadow of the COVID-19 pandemic, I am hopeful that this new cohort of students will draw strength and inspiration from the accounts contained within this 2023 Research Report, which serves to give a small insight into the remarkable work being done in the CDT every day. If you would like to learn more about any of the topics covered in the following pages, or if you would like to explore potential collaborations of any kind, please don't hesitate to reach out.

And finally, to all contributors to this year's Report - thank you for being an integral part of our vibrant PIADS community.



WHAT IS PIADS?



We are the Photonic Integration and Advanced Data Storage Centre for Doctoral Training

The Centre for Doctoral Training (CDT) in Photonic Integration and Advanced Data Storage is a partnership between Queen's University Belfast, the University of Glasgow, and the Irish Photonic Integration Centre (IPIC). We aim to tackle some of the challenges created by the increasing quantities of data generated by today's society.

The Centre's focus is on developing highly-manufacturable photonic integration technologies related to the magnetic storage of digital information. However, the development of these technologies will be relevant to a wide spectrum of end-users – from telecommunications to biophotonics, in which optical technologies are applied to living organisms and health care.

Established in 2014 (PIADS 1.0) with substantial investment from the Engineering and Physical Sciences Research Council (EPSRC) and both universities and industrial partners, the centre was successfully renewed in 2019 (PIADS 2.0) with investment from Science Foundation Ireland (SFI), resulting in a vibrant joint EPSRC and SFI funded centre.

It is our aim to help to address a skills shortage in the photonics industry by educating fifty future scientists and engineers over the next seven years.



Our Technical Focus

CDT research students are engaged on a range of challenging doctoral research projects across the Centre's **five main research themes**, with some live projects under each theme detailed below.

All students are jointly supervised by academic staff from the University of Glasgow, Queen's University Belfast and the Irish Photonic Integration Centre.



Themes (A-E) Live Projects

A. Ultra-Reliable Semiconductor Lasers Operating in Hostile Environments

Dynamic Properties for InGaN/GaN-based Distributed Feedback Laser Diodes
Junction Temperature characterisation of oxide aperture VCSELs
Integrated photonic devices for smart gas sensors

B. Low Cost Planar Lightwave Circuit Platforms Suitable for Volume Manufacture

Integrated Quantum Photonic Sensors and Circuits
Controlling heat flow at the nanoscale using ferroelectric-based thermal mirrors
Temporal Dynamics of strongly coupled epsilon near-zero plasmonics

C. Novel Nanoplasmonic Devices Capable of Operating in Extreme Environments

Novel Materials synthesis for HAMR plasmonics
Inter-metallic plasmonic antennas
Bringing ab-initio design into the lab: design of new plasmonic materials

D. Atomic Scale Analysis Techniques

Characterising nanoscale thermal transport at functional interfaces
Heat generation and transport in nanostructured materials
Reprogrammable micro-magnetic transport

E. Advanced Materials for Magnetic Recording

Molecule based magnets
Novel magnetic states in 3D nano-magnetic systems
Manipulation and exploitation of the dynamic processes of skyrmions

OUR INDUSTRY

THE FOUNDATION OF PIADS

The jointly funded EPSRC and SFI CDT Photonic Integration & Advanced Data Storage (PIADS) centre addresses a unique technological opportunity – the intersection of photonic integration and data storage. The success of CDT PIADS 2.0 is contingent on the continuation & evolution of our unique anchor - tenant partnership model which brings together a range of strategic partners of different shapes & sizes, each making valued contributions to enrich the PIADS 2.0 training environment. The make-up of partner companies mirrors the photonics industry in the UK & Ireland.

The founding vision of CDT PIADS is to train cohorts of high calibre doctoral research students in the skillsets needed by the data storage & photonics partner base & the wider UK supply chain.

Students are trained in an interdisciplinary environment encompassing the five themes of robust semiconductor lasers, planar lightwave circuits, plasmonic devices, advanced characterisation & materials for high density storage.

The programme embeds a strong ethos of intellectual enquiry that empowers students to move between fundamental & applied research through the appropriate combination of high level technical, scientific & research training; courses in innovation, management, leadership & personal effectiveness; industrial seminars & placements; student-led activities such as conclaves, public engagement and winter schools.



OUR EDI COMMITMENT

It is now well known that teams that are gender, age, and ethnically diverse make better decisions up to 87% of the time. Specifically, gender diverse companies achieve 53% higher returns on equity and are 70% more likely to report successfully capturing new markets. However, while the percentage of minoritized groups within STEM is increasing, the numbers are still significantly low. For instance, the STEM workforce has women making up 26%. Despite efforts to improve representation within STEM as a sector, according to the COST Action MP1403 Nanoscale Quantum Optics (NQO) Gender Survey 2019, 75% of women disagree or strongly disagree with the statement that “Women and men have equal opportunities in career advancement”. Making this not only a lack of representation problem, but also an issue of how minoritized groups are supported in this sector.

At PIADS, we aim to deliver long-term data storage solution for today’s data driven world whilst deliberately and purposefully embedding EDI practices into the programme at all stages, ensuring the development of a PIADS community which is welcoming, supportive, and inclusive for all to thrive. To achieve this, we have taken several steps to increase engagement through all aspects of our programme. From continuously reviewing all of job adverts to eliminate possible bias language to monitoring interview questions and widening funding to support non-UK domiciled students in order to foster a globalised cohort where intercultural exchanges and perspectives are the norm.

Our hope is to maximise the impact of our programme whilst making it a more welcoming, engaging, and rewarding place for those who are involved whilst contributing to the sector in an equitable manner.

If you missed some of our previous EDI activities, or are new to PIADS, you may want to check out:

- Our ‘PIADS celebrate pride’ campaign where we collated movies, TV shows, books, and general media that celebrated, educated about, or simply represented the LGBTQIA+ community.
- Our ‘Women Behind PIADS’ campaign where, for International Women’s Day in 2021, we celebrated the outstanding support team for our programme.
- The documentary ‘Picture a Scientist’. This award-winning documentary tackles difficult issues, such as sexism and misogyny, within the scientific community whilst providing new perspectives on how to make science itself more diverse, equitable, and open to all.
- The strong, student contributions such as the STEMInist Network at QUB (a tremendous effort by our CDT student Emma Crothers) and participation in outreach events such as science festivals (surely inspiring the next generation of scientists that come to see those).

If you would like to learn more about our EDI vision, or to get involved, please contact our EDI Champion Dr Rair Macedo on Rair.Macedo@glasgow.ac.uk.

The people in PIADS - Directors

We are proud to have a strong network of academic partners and students as part of our PIADS CDT Team, who regularly communicate their research, industrial outputs and collaborative ventures in brilliant ways. We are also aware that much of the activity of our centre would not be made possible without the dedication and creativity of our strong leadership and support team: the directors and people behind the scenes. Below is a short bio on each of these key team members, and you should feel free to contact them at their email provided, should you have any questions, or wish to engage with the CDT PIADS programme.



Prof. Robert Bowman, PIADS CDT Director

Robert's current research is directed towards the development and evaluation of advanced materials for data storage technology in partnership with Seagate Technology. Topics being investigated include: rare earth magnetism, rare-earth-ferromagnetic coupling phenomena, synthetic magnetic multilayers and plasmonic materials to facilitate heat assisted magnetic recording sponsored by industry. He leads a team of 3 PDRAs and 7 PhDs. This is recognised through the award in 2017 of a Seagate Technology / Royal Academy of Engineering Research Chair.



Prof. John Marsh, PIADS CDT co-director

John is Professor of Optoelectronic Systems and Director of the James Watt Nanofabrication Centre. He was previously Head of the School of Engineering from 2010-2016, and led the unification of the four departments of the former Faculty of Engineering into a single School. This was followed by a term as a Dean for Transnational Education (2016-2019). He has a wide experience of semiconductor laser technology and integrated optics, ranging from epitaxial growth through to the design and development of integrated laser modules for applications including advanced printing and imaging.



Prof. Paul Townsend, PIADS CDT co-director

Paul is Head of the Photonics Centre at Tyndall National Institute and Research Professor in the Department of Physics at University College Cork in Ireland. The Photonics Centre comprises nine internationally-recognised research teams (around 130 staff and PhD students in total) carrying out R&D and commercialisation activities spanning the areas of semiconductor materials and devices, photonic integration and packaging, through to advanced photonic systems for telecommunications and healthcare applications. Since June 2012 he is also Director of the new SFI Irish Photonic Integration Centre (IPIC).

The people in PIADS - behind the scenes (1)



Lynda Mahon

PIADS CDT Executive Manager - l.davison@qub.ac.uk

Lynda has worked at QUB for over 18 years. During this time, she has held various positions across the University. In the last seven years she has specialised in Post Graduate Research and Training and previously led the Doctoral Training Programmes within the Arts Humanities and Social Sciences Faculty at QUB (Northern Bridge AHRC and NINE ESRC). Lynda joined the PIADS team in November 2021 and looks forward to seeing the development of the programme.



Vicky Weir

PIADS Clerical officer - v.weir@qub.ac.uk

Vicky worked for Belfast News Letter and Mirror Group for 14 years as the Library Manager for all of their Irish publications and websites. She came to Queen's in 2006 and worked in different areas within the Uni. Vicky joined the PIADS team in 2018 to help look after all the students at different stages of their PhD and assist with the recruitment of new students, work in the background with the running of the programme, finances and events.



Elisabeth Wintersteller

Training Programme Manager - elisabeth.wintersteller@tyndall.ie

Before moving to Ireland, Elisabeth worked in academia for 7 years, including positions at the European Molecular Biology Laboratory (EMBL) in Heidelberg, Germany and at Medical University Innsbruck, Austria. She is experienced in coordinating and administering national as well as EU grants and has coordinated the development of online education and training programmes for PhD and postdoctoral students. Elisabeth coordinates the PIADS programme at IPIC.

The people in PIADS - behind the scenes (2)



Welcome to Lisa Campbell

PIADS CDT External Engagement Manager - Lisa.Campbell@glasgow.ac.uk

Lisa is an accomplished marketing professional with experience gained in Higher Education, Local Government and Social Care. In her most recent role, Lisa had directorate responsibility for Marketing and Communications, with a particular focus on developing human rights based campaigns to achieve real change. Lisa is looking forward to promoting the research capability of the Centre whilst developing lasting partnerships that meet the demands of industry.

In her spare time, Lisa enjoys walking with her dogs in the Ochil Hills.



Professor John Marsh – a well-deserved retirement

John has been an integral part of the PIADS programme since its inception. It all began with a short phone call asking him if he would be interested in setting up a centre – a short flight later and the rest is history. John's vast knowledge, contacts and support have driven the programme forward and he will be sorely missed. From the staff and students within the PIADS community we wish John a very long and happy retirement.



Welcome to Professor Marc Sorel - new CDT co-director

John will be replaced by Professor Marc Sorel, who has previously chaired our Research and Training Committee and had a very active role within the PIADS Management Team. We are delighted Marc has agreed to take on this additional role and look forward to working with him.



A

— SPOTLIGHT —

ON OUR STUDENTS

World Photonics Congress 2023

by Fariba Jamali, 2020 cohort

I had the privilege of attending the CLEO/Europe-EQEC 2023 conference, Europe's largest conference on photonics and related research fields. The conference took place from June 26th to 30th at the International Congress Centre in beautiful Munich, Germany, as part of the World of Photonics Congress 2023.

This joint event encompassed five scientific conferences, including plenaries and joint sessions, offering a comprehensive lecture program that addressed all aspects of optical technologies. Throughout the conference, I had the opportunity to attend various sessions, including plenary lectures, keynote and tutorial speeches, invited talks, contributed talks, and poster sessions, all covering diverse topics.

The talks delivered by researchers from different backgrounds were truly enlightening and significantly expanded my knowledge across a wide range of research areas. Additionally, the conference featured an extensive trade show, attracting exhibitors from around the world. At the trade show, I had the chance to explore the latest trends in photonics, with a special focus on automation and robotics, laser systems for production engineering, biophotonics, and imaging.



I had the honor of presenting my research on "SOA-Based Power Equalisation on a 100 Gb/s Passive Optical Network," offering a novel solution to equalise upstream PON packets in the optical domain using SOA preamplifier instead of the challenging electrical domain approach with BM-TIA.

The experience at CLEO/Europe-EQEC 2023 was incredibly valuable, allowing me to immerse myself in cutting-edge research, connect with experts in the field, and gain insights into the latest developments in photonics technology. It has motivated me to extend my studies and pursue hands-on experiments.

Advanced Process Data Analytics Course – DataHow Zurich, Switzerland

by Padraig McGirr, 2020 cohort

During this summer, I got the opportunity to attend a 4-day long training course and conference in ETH Zurich ran by a company called DataHow. The focus of this course was data analytics and modelling methodologies for bioprocess data.

On the EngD pathway of the PIADS programme I have worked with a company called Causeway Sensors. At Causeway we develop sensing technology capable of providing rapid, accurate and cost-effective concentration measurements of specific biomolecules. These measurements provide valuable insight into the bioprocesses used in biologics. Bioprocesses are complex and involve many processing parameters making it difficult to predict and optimize in a biopharma setting. The focus of this course was to identify important process drivers, forecast the process and quality of the final product. By participating in this course, I was curious to find out how our technology could help facilitate this data driven approach.

The first two days of this course focused on covering the statistical techniques used in predictive models, these methods ranged from multivariate data analysis to machine learning. After each day of the programme there were opportunities to go out for dinner to mix with other attendees and learn about their backgrounds. As the course progressed to day three, we learnt about the use of digital twins and hybrid modelling within bioprocessing and how this can be used to facilitate decision making. On the final day of training, we had a Swiss apéro on the balcony of a bar overlooking the Limmat valley.

To conclude the event there was a conference with a variety of pharmaceutical and technology companies that gave talks on current projects within the drug development industry. By attending this course, I was able to gain experience on current approaches used by large and small pharma companies. It also allowed me to develop a better understanding of how Causeway Sensors, and the work I do, can provide value to this industry.

20th International Microscopy Congress (IMC)

by Ben Smith, 2019 cohort

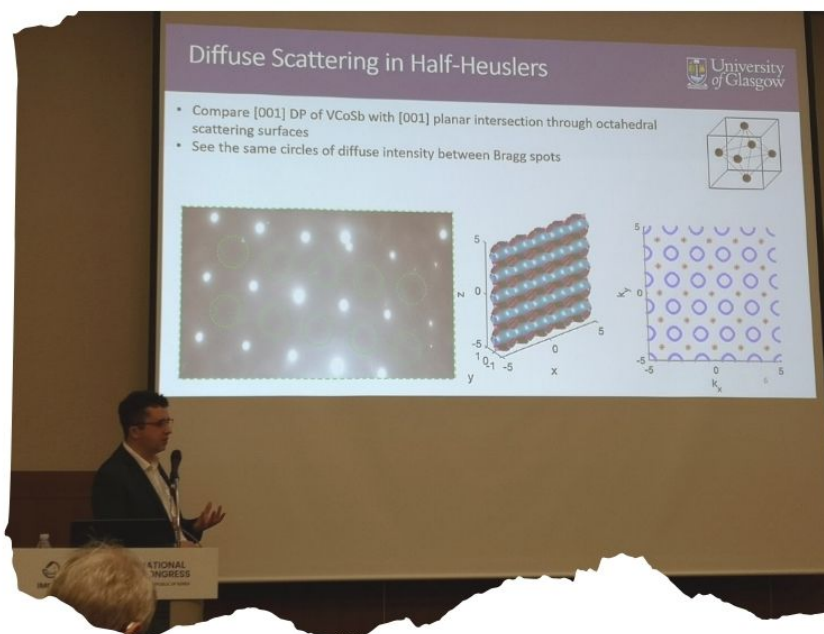
The 20th International Microscopy Congress (IMC) was held in September in the coastal city of Busan, South Korea. Held every four years, the IMC is dubbed the 'Olympics of Microscopy', bringing together researchers and industrialists to discuss the latest advancements in microscopy. Attendees has the opportunity to attend plenary lectures given by three Nobel Laureates: Dr. Richard Henderson gave his lecture on the development of cryo-electron microscopy; Prof. Konstantin Novoselov presented on the future of 2D materials; and Prof. Joachim Frank spoke on the use of cryo-EM for the study of biomolecules.

Outside of the lofty heights of Nobel Laureate lectures, the scientific programme for the conference was divided into three streams: Life Science, Physical Science and Analytic Science, with several sessions running concomitantly during the day from each theme. The scale of IMC was impressive. Alongside the bewildering number of sessions, the exhibition hall was filled with stalls from every microscopical company one could think of. The companies ran demonstrations and presentations throughout the day displaying their products' latest technological advancements.

The conference organisers ran a number of tours throughout the week. The tour I took part in included a cable car trip offering views of Busan's city scape, a traditional Korean lunch of Bibimbap and a wonder down the commercial district of Jeonpo Gwangjang Street. The conference Gala dinner also showcased some Korean culture: delegates were treated to performances from Korean opera singers and a K-pop group.

I was lucky to have my abstract accepted for a talk in the Electron Energy Loss Spectroscopy (EELS) category. The talk outlined the challenges associated with the quantification of the half-Heusler VCoSb using standard EELS techniques and my work using processes to overcome these challenges. When quantifying these samples we are particularly interested in the presence of structural vacancies and how the form of clusters these vacancies take.

If you have the opportunity to attend the 21st IMC in four years' time I would definitely recommend it!



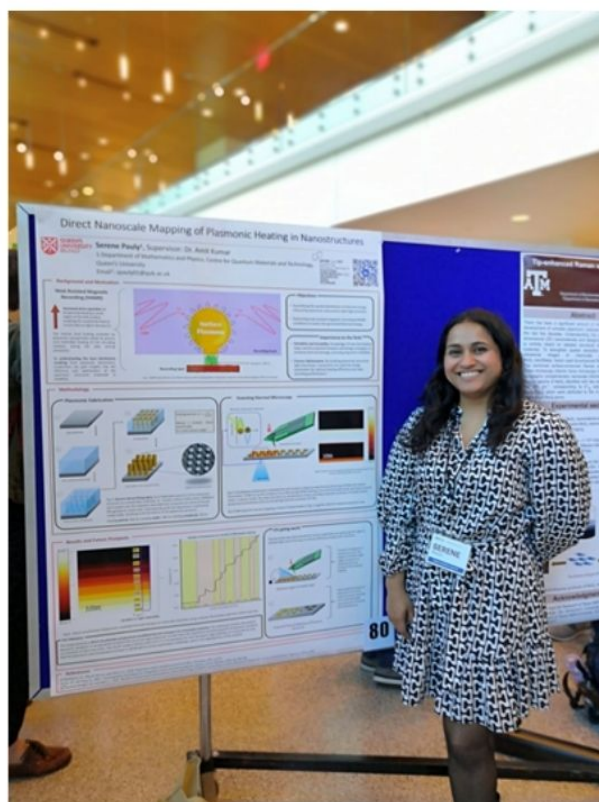
Surface Plasmon Photonics 10 (SPP10)

by Serene Pauly, 2020 cohort

I had the privilege of attending the Surface Plasmon Photonics 10 (SPP10) conference held at Rice University, where I presented a poster titled "Direct Nanoscale Mapping of Plasmonic Heating in Nanostructures." The SPP10 conference brought together renowned scholars, researchers, and industry experts in the field of surface plasmon photonics. The event served as a platform to discuss the latest advancements, exchange ideas, and foster collaborations in this rapidly evolving field. As a PhD student specializing in surface plasmonics, attending this conference was a valuable opportunity to enhance my knowledge and showcase my research to a highly distinguished audience.

Presenting my poster was an exhilarating experience. The research focused on developing a novel technique using near-field scanning thermal microscopy to directly visualize and quantify plasmonic heating effects at the nanoscale. The findings shed light on the thermal properties of plasmonic nanostructures and their potential applications in various fields, including nanophotonics and optoelectronics. The poster presentation allowed me to engage in stimulating discussions with experts in the field, receive constructive feedback, and explore potential collaborations. Throughout the conference, I had the opportunity to attend numerous keynote lectures, panel discussions, and parallel sessions. Prominent researchers shared their groundbreaking discoveries, cutting-edge techniques, and theoretical advancements in surface plasmon photonics. The topics ranged from plasmonic waveguides and metamaterials to quantum plasmonics and sensing applications. These sessions provided valuable insights into the current state-of-the-art and future directions of the field.

In conclusion, my time at the Surface Plasmon Photonics 10 conference held at Rice University was an enriching and rewarding experience. I am grateful to Queen's University and the academic affairs for awarding me the Emily Sarah Montgomery Travel Scholarship for supporting my participation in this esteemed event. The knowledge and connections gained from the SPP10 conference will undoubtedly shape my future research endeavors and contribute to the advancement of surface plasmon photonics.



Lab visit at the University of Colorado

by Mawgan Smith, 2021 cohort

This spring, I had the privilege of spending two weeks in Colorado at the University of Colorado Colorado Springs (UCCS). There, I met with leading experts in magnetism to learn more about multi-layered magnetic structures and how to effectively characterise their behaviour.



Magnetic multilayers provide an intriguing platform to study nearly limitless configurations of magnetic order. The physics behind multilayers, specifically synthetic antiferromagnets (SAFs), is famous in the magnetism community for underpinning the discovery and development of giant magnetoresistance. Though this phenomenon remains obscure beyond magnetism circles, its application to magnetic reading devices has significantly shaped global data infrastructure in the last few decades, as rewarded with the 2004 Nobel prize in physics.

Multilayers can be characterised by a variety of techniques, one among them being ferromagnetic resonance (FMR). The opportunity to work alongside researchers at UCCS performing FMR experiments was invaluable, with many useful insights into the physics and experimental characterisation of SAFs being shared. Here at the University of Glasgow we are interested in studying hybrid quasiparticles known as magnon-polaritons and one of my current research projects is looking at these quasiparticles in SAFs. Accurately determining innate material parameters, tunable during fabrication, is essential for predicting magnon-polariton characteristics. Analysing distinct resonances reveals these key parameters, confirming whether the engineered structure behaves as designed, or in unexpected ways. Furthermore, mapping the resonances facilitates the design of customized cavity resonators to investigate these light-matter interactions.

I sincerely thank UCCS and PIADS CDT for facilitating this informative research visit. Meticulous study of multilayers and their applications will continue opening new frontiers in science and technology. In kind, old frontiers are often still worth exploring, and never truly old when looked upon with new eyes. As such, on the weekend I took a break from meticulousness and set myself upon an iota of the wonderful landscape of Colorado, hiking to the Garden of the Gods and Mt Manitou, enjoying nature's magnetism at its finest.

Giving a talk at Photonics West 2023

by Niall Boohan, 2019 cohort

My first in person conference was Photonics West, which is an annual optics conference held in San Francisco every January. It was a fantastic experience, but was also a reminder of how much had been missed with COVID. The weather, although mid-winter, was still a welcome break from Cork. One or two days even warranting just a T-shirt. The conference is very general, so it encompasses all areas of optics. Many of the topics, such as VR/AR and quantum technologies, have exploded in terms of research over the past number of years. The scale of the event is something I hadn't realised before attending, with twenty thousand visitors, it felt more like a music festival than an academic conference. There were many activities on offer during the day to take a break from all the different talks. Khet, which was best described as laser chess was one of the highlights and very fitting for the setting. The conference hosts a trade floor that is acres in size. Dazzling products and technology are on display from all the biggest brands in the optics. I was honoured to give a talk at this vast conference on our findings from the Ph.D. project, and the results were well received. The group of talks I was placed in was chiefly focused on computer modelling of optics and not specific to laser gratings that my research is focused on. It was very helpful to get different view-points on my results as feedback.



As the conference was over five days, there were many opportunities to see the local sights. Although we were still a bit too far to venture down to silicon valley; Chinatown, Fisherman's Wharf and Lombard Street were all in striking distance. And as we were in the world capital of technology, I got to see my first self-driving car, a Waymo! Networking is one of the main driving forces behind these conference, and it was highly encouraged with many events taking place. The Star Wars themed party had thousands of guests and was held several floors below Union Square. It will be a memory that will stay with me for a while!

What I liked most about the conference was how broad it was. It was great to get such an overview of everything happening in optics at a pivotal time in my Ph.D. and research career and just be exposed to so many different ideas and the trajectory of the field of optics over the next few years.

Dive into the Entrepreneurship World with Tyndall Explorer Program

by Shengtai Shi, 2020 cohort



In a rapidly changing world, technology and science is a fundamental driven force for a brighter future of human being. While some may argue it is a double-edged sword in some cases, it is down to the each individual person who works on it and the values he or she believes to push hard to transfer a piece of technology for something great in our life.

From February till May, I had the privilege to attend the annual Tyndall Explorer program, which is dedicated to boost entrepreneurship from deep-tech researchers. Since years ago in my undergraduate studies, I have heard about startups stories of the pioneers in different sectors who shaped our way of life. The spirit of these inspiring stories to pursue innovation and make positive impacts for the society have really connected with a part of my mind, and gradually as I get more experienced during my study and work, I feel entrepreneurship is a good alternative path to connect to the real world and apply what I have learned.

So after my master's degree, I chose to join a startup team in Barcelona and worked as a research engineer to help develop a novel shortwave infrared image sensor based on colloidal quantum dots.

That working experience really provided me a chance to get hands on about technology entrepreneurship work. I got to feel the passion and vision from the founders, and also realize through the hard times (especially after the pandemic happened) that entrepreneurship faces high uncertainty and risks all the time, after all, it is a complex process incorporating many decision-making factors from both the business and technology world.

That first real experience in the entrepreneur world was inspiring to me. Although it wasn't a flashy perfect example of deep tech startup, I convinced myself that deep tech entrepreneurship is something meaningful to pursue in my career. At Tyndall Explorer program this year, through the 12 weeks of learning from business leaders, excellent researchers and many inspiring entrepreneurs, I felt truly rewarded to know on a holistic level how to prepare myself to be better technology entrepreneur. Especially a very important point to take away is to place customer discovery a priority, and gather as much as real market feedback before embarking on this everlasting journey. As I reflect on my learnings, I felt I could frame the problem I am solving more precisely in the real world and pin-point its significance. In addition, I am able to translate the meaning of my work much better in the business language. There is no doubt, all kinds of learnings in the Tyndall Explore Program formed a promising avenue to facilitate the semiconductor laser my colleague and myself is working on towards better commercialization and also enabling us to avoid typical pitfalls.

As a well-structured and supported program, I definitely believe Tyndall Explorer is a highly enriching experience for any researcher interested in entrepreneurship. Although the motivation and path towards building a deep-tech start-up may vary from many entrepreneurs, I believe tech entrepreneurship could bring good to people and the society around us. I will continue exploring on this path, and hope to find my endeavor worthwhile in the future.

MRS SPRING 2023

by Nicholas Stephen, 2019 cohort

In April 2023, I was fortunate enough with a few colleagues from Queen's to swap the cloudy and overcast skies of Belfast for sunny San Francisco to attend the Material Research Society (MRS) 2023 Spring Meeting. Running over 5 days, this conference brought together scientists based in material research with over 59 symposium sessions with themes including photonics, nanomaterials and quantum systems.

At the conference, I was given the opportunity to outline my work on dislocation and strain in InGaAs metamorphic buffers, which has since been published in the article "Dislocation and strain mapping in metamorphic parabolic graded InGaAs buffers on GaAs". The presentation was well-received, and it was a great confidence boost to present to the wider scientific community at my first conference overseas. Given the breadth of subjects being presented, I attended a mixture of presentations from fellow Queen's PhD students and people I knew from undergraduate to learn more about the latest discoveries and advances in the material science field. An example being obtaining bandgaps in batteries using low loss electron energy loss spectroscopy (EELS). As well as being interesting, this talk helped me a great deal for my current work which is evaluating bandgaps via EELS.

Of course, I also took the opportunity to do some tourist sightseeing! Some of the visits included Alcatraz, walking across the Golden Gate Bridge, going to the Punchline Comedy Club and strolling around the Palace of Fine Arts. There were also many great food options for eating out with one being a Ramen bar called Ippudo (I would certainly recommend the Chicken Kara-Age rice dish). Overall, I had a great time at MRS Spring 2023 and would like to thank PIADS in support of funding attendance to the conference.



Tyndall Postgraduate Poster Competition

by Suraj Kumar Kothuri, 2022 cohort

I believe that social gatherings, academic conferences, and presentations play crucial role in fostering intellectual growth, knowledge exchange, and professional development by giving platform for students and researchers from diverse backgrounds to converge, engage in meaningful discussions, and share valuable insights. These gatherings have the potential to pave way for great collaborations.

I am part of PIADS 2022 Cohort, based in Biophotonics group at Tyndall National Institute, Ireland. In the recent competition titled, 'Tyndall Postgraduate Poster Competition – 2023,' I have presented my work titled, 'Broadband Diffuse Optical Characterization of Human Cadaver Bone (500-1100nm).' This work characterizes bone optical properties which gives us information about how light travels in bone and its regions. We use what is called 'Time of Flight (ToF)' technique. My work also provided optical properties of different constituents that are responsible for the formation of whole bone. The novelty of this work lies in the characterization of optical properties of fresh human bone, which has not been previously addressed in the literature.



My work can be of great help for the researchers who work on bone related research projects, especially in bone pathology diagnosis since they will now have more information on bone and its properties. This work also helps to overcome challenges faced in non-invasive bone diagnosis if not fully but to a significant extent.

I would like to thank PIADS CDT and Tyndall Institute for giving me constant encouragement and a platform to showcase my work. This competition particularly helped me refine my scientific communication skills and hone my brevity in poster presentation. I stood as runner-up in the Early Student category which motivated me to excel more in my coming years of research.

One simple way to attract more Women into Photonics (1)

Nicola Parry, 2020 cohort
interviewed by Benet Hanley

Enigma People Solutions actively works with clients in the Photonics industry in the UK and internationally, to recruit technical leaders. Their Director Ben Hanley sits on the steering committee for PIADS.

We recently interviewed Nicola Parry one of the PIADS students about her views and experiences on the course, the photonics industry and being a woman in STEM.

So were talking a little bit about the opportunity to increase the number of girls and women in the tech industry in general, but especially in things like Electronics and Photonics and such sectors. Any thoughts or advice to the industry in terms of how you can attract more girls and women into the industry?

I think possibly, the most important thing would be representation. Just having visible, successful women in STEM that are taking up space and holding high level positions in companies, in a male dominated field is crucial. Just to show young women and girls that there is room for them in this industry, not to mention people of colour, LGBTQ+ people, and every other minority group that are commonly under-represented in positions of power. Throughout my education, on more than one occasion I have been the only girl in the room, and making your voice heard is even harder than normal, because you fear that you're going to be judged because of your gender. Had it not been for me having a female physics teacher in high school, and her actively encouraging me and putting the effort into me, I never would have even considered pursuing science. I think translating that more widely to the entire industry, this could look like encouraging female employees to be involved in more public engagement work, or inviting them to networking events. If your company is required to do a talk, put a female employee forward to conduct these talks. Consider them for high level positions because it's possible they might have just had to work a little bit harder to get there than their male counterparts. And while all of this is important, it is equally important that this work is not purely performative. So, these activities also need to be carried out alongside actively listening to and seeking out the opinions of minority groups within the company then acting on any suggestions and not just ignoring them.

One simple way to attract more Women into Photonics (2)

Nicola Parry, 2020 cohort
interviewed by Benet Hanley

That's a good point. It seems that every time I ask somebody that question about who's inspired them or what got them to science, it's actually the school level, a teacher has made a difference, made them think about, "actually, this could be a career for me".

So we're talking about events, and you were kind enough to join us at the Technology Scotland annual dinner? I'm keen hear your thoughts about the event, and what if anything you got from attending the event.

This is my first in person experience at any kind of industry or networking event. So before I was quite... maybe not apprehensive, but nervous that it was going to be a daunting experience. But I was pleasantly surprised at how friendly and welcoming everybody was, and there was a good variety of talks. One from government, one from industry, other sponsors, and the main speaker was amazing and has an inspiring life story. This wasn't the sort of thing that you would typically hear at this sort of event, so it was nice to have that variety. The one thing I would say, which is reflective of the whole industry, as we have just spoken about, not a criticism of the organizers, was that there was a lack of diversity in the room. Whilst having a discussion with some other attendees, someone suggested a practical idea on how to address this, such as requiring each company to have at least one or two graduates or junior employees at their table, just to get some new faces and offer opportunities for people at early stages of their career. I thought that was a really good idea.

I like that. It is a simple idea, often these events end up being high level treats for executive teams. Why not bring a couple of your most junior employees, so it gives a different feel to the room. I really like that.

Was there anything, in terms of your view of the photonics industry, anything – hopes or dreams or opinions you want to share with us?

I guess, I think the one thing that we keep getting told by people involved in the CDT is the amount of growth that's currently being seen in the photonics industry. During the pandemic, a lot of industries and companies have been having to lay people off and are really struggling. But from what we have been hearing, a lot of companies that are involved with the CDT, have been expanding or hiring more people since the start of the pandemic, which is really fortunate, and I think a good indication of what an innovative and successful industry Photonics is at the moment.

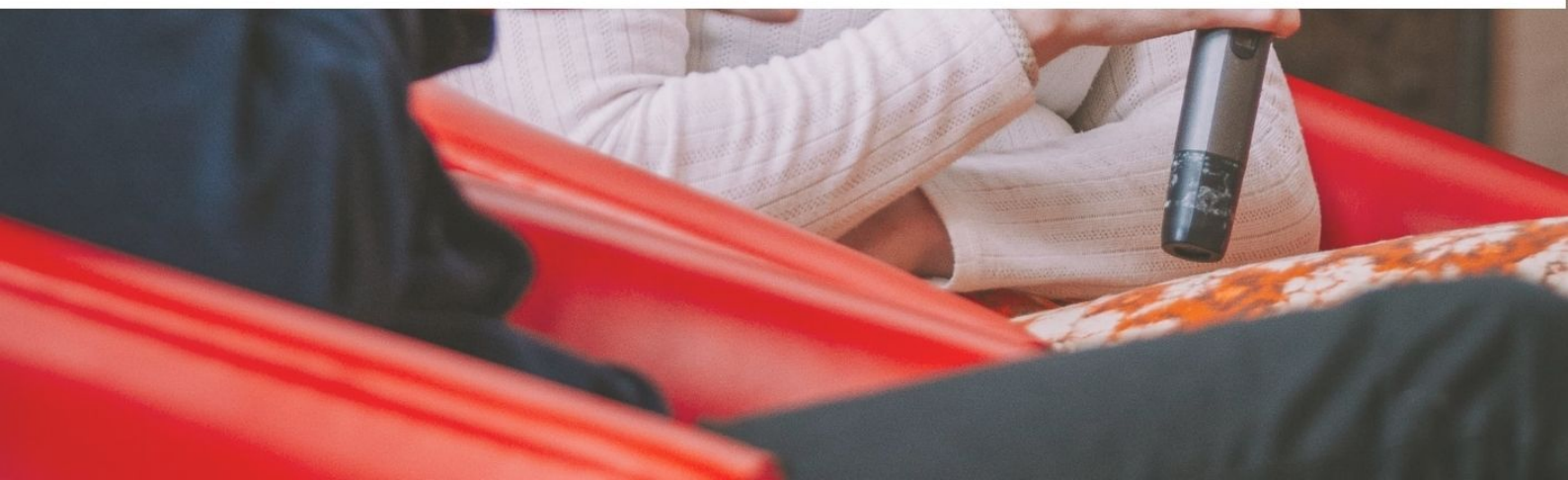
Enigma People Solutions is an award-winning technology recruitment consultancy. We find technical leaders for the emerging and enabling technology industries. Visit our [services page](#) for more information. Visit our [job search page](#) for the latest vacancies in photonics, electronics, semiconductor, software and IoT in Scotland and the UK. Check out our [blog page](#) for the latest in the technology industry. You can get in touch with us hello@enigmapeople.com or call us on + 44 131 510 8150

Full interview available at:
<https://enigmapeople.com/one-simple-way-to-attract-more-women-into-photonics/>



OUR

ANNUAL EVENTS



2023 Winter School at Queen's University Belfast

by Lynda Mahon

Queen's University Belfast was delighted to host the PIADS Winter School in January 2023. The School lived up to its name with snow and ice throughout the event!!! The PIADS cohorts arrived on 17th January to wintery scenes at QUB, however we got everyone warmed up with a networking event in the School of Maths and Physics, followed by a hearty dinner in a local restaurant n Botanic Avenue.



The programme for the Winter School was packed full of sessions on RRI delivered by Bernd Carsten Stahl, Professor of Critical Research in Technology at the School of Computer Science, University of Nottingham and former Director of the Centre for Computing and Social Responsibility at De Montfort University, Leicester, UK. We had talks from leading Senior Nature Editor Samuel Valdwel and a lively panel discussion on the topic of Life After the PhD with PIADS alumni, including Dr Jade Scott, Dr Steffan Gwyn, alongside Dr Sian Farrell Co-founder and Chief Executive Officer at StimOxyGen.

The students also engaged in a student led quiz hosted at the new Elmwood 1 Students Union with quiz master Adam Murphy asking the questions! The final day had Skillfluence deliver an exciting session on communicating with impact, that provided insightful ideas and tools into how to communicate research to a wide range of stakeholders.



CONCLAVE 2023

by Giacomo Graziano, 2022 cohort

PIADS CDT students are spread across three main institutions, but cross-contamination of ideas is not just a concept for us. This year, the dynamic minds of PIADS CDT students converged in the heart of Belfast, transforming the prestigious Great Hall of Queen's University into a hub of creativity and intellectual exchange.

Over two days, 60+ students, alongside esteemed academics, and industrial partners, engaged in discussions that set the stage for a new era in photonics. The PhD students showcased an inspiring array of research, ranging from plasmonic biosensors to silicon nitride resonators, from photonic crystals to high-speed printable III-V Electro Absorption Modulators. Each presentation highlighted the vast potential of photonics, showcasing its capacity to revolutionize our lives in unimaginable ways and at the same time, also represented a fruitful occasion to practise communicating their work effectively.

In addition to the students' contributions, the Conclave 2023 offered the opportunity to listen to two inspiring talks from two speakers who are shaping the future of Photonics. Yann Amouroux, the visionary Director at Optica Europe, took us on a riveting exploration of photonics' future. Through vivid narratives and insightful discussions, he unveiled cutting-edge trends, including the fusion of photonics with artificial intelligence and virtual reality. His words sparked a burst of entrepreneurship among PIADS CDT students, fuelling their passion to actively contribute to this dynamic field.

Meanwhile, Professor Peter James Parbrook, from Tyndall Institute shared his inspiring journey through the world of LEDs. He showcased the path from challenges to success, revealing the transformative power of perseverance and innovation. His tale resonated with our students, reminding them that every obstacle surmounted paves the way for ground-breaking achievements.

We thank all attendees for making the Conclave this year so successful.
And to the next year's PIADS PhD-students-to-be: good luck!

With love,
PIADS 2022 Cohort

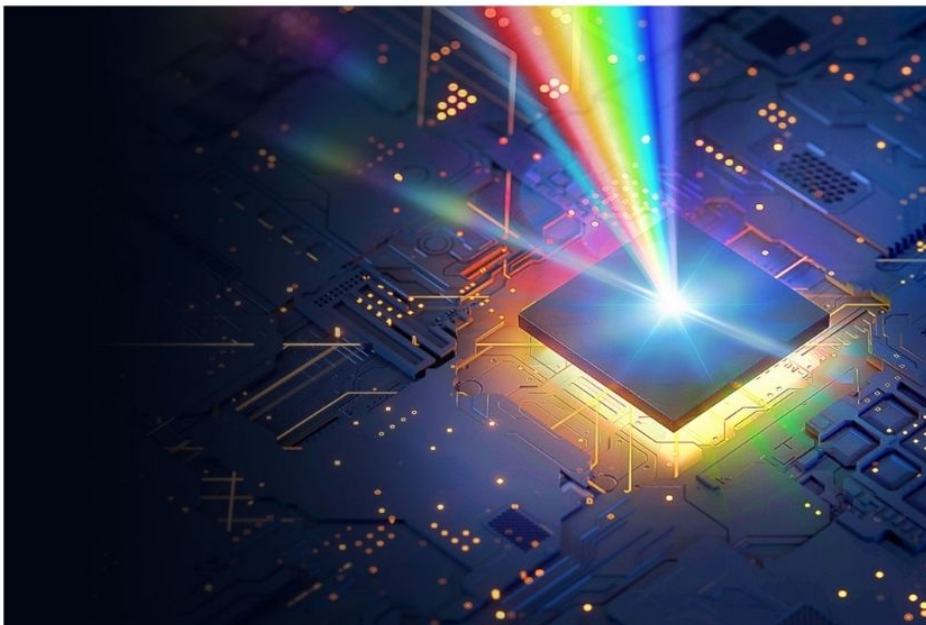


IPIC INDUSTRY FORUM 2023

by Elisabeth Wintersteller

'Building the Future with Talent & Technology' - was the motto of the 2023 IPIC Industry Forum that took place on 14th March 2023 online. Over 115 participants from industry and the IPIC RPOs attended the event. We heard details on the ongoing research projects, engagement opportunities and an outlook on the future of IPIC. Equally important to the research is the talent development within IPIC. On the industry day we highlighted three main areas of IPIC's talent development: the Summer Fellowship Programme, cohort based PhD training where IPIC is partner in the CDT PIADS, and cohort based training for postdoctoral fellows in the MSCA COFUND programme Sparkle. A highlight of this industry forum was the presentation of 50 technology posters by our trainees to our industry partners.

The poster presentation was paired with a session called 'Meet our trainees' which provided a platform to meet and engage with industry representatives. The main objectives were to network with our industry partners, introduce trainees as potential candidates for upcoming positions, present the research projects and developments to our key partners, and get a better understanding of our industry partners' needs. We had thriving and fruitful discussions at the forum in 2023 which follows a series of successful industry events. We are looking forward to another edition in 2024.





Illuminations

The illumination of architectural space by artificial and natural light can transform the experience of our surroundings. David Bakelaar's practice has long investigated the 'luminescent' qualities of colour. A hanging bundle of low-energy bulbs arranged in sculptural horizontal plastic shells becomes a subtle nod to the colour of the spectrum, while coloured PVC is vibrant and strongly evokes composition of coloured light.

Ernst Chladni has created a new installation inspired by Sarah 'Dance' Cornwell, who discovered the construction of stars in 1925. Her character of 800 coloured ball sides, each marked with the individual signature of University College Cork staff and students, reflects the natural light in the space as well as the university's commitment to gender equality in the sciences.

PIADS PUBLIC ENGAGEMENT

OUR EPE OVER THE LAST 12 MONTHS

Glasgow Science Festival 2023

"Glasgow's Looking Forward"

by Ruaridh Smith, 2019 cohort

Last June, Mark Cunningham, Mawgan Smith and I represented PIADS at the Glasgow Science Festival. As one of the largest science festivals in the UK, this was an excellent opportunity to share our research with the public and engage with pupils from local schools. This year's theme was 'Glasgow's looking forward' and we were again based in the Kibble Palace at Glasgow Botanic Gardens. Over the course of two days, members of the public and groups of primary school children visited our stall where we provided an insight into optics research through our two hands-on demonstrations.

Due to an attempted redecoration of the Kibble Place last year by a few overenthusiastic future scientists, our crowd-pleasing science stickers were banned. Instead, we had to rely on jelly babies and a Nintendo soundtrack to draw in the crowds.

The jelly babies were for our wave machine. This was a long line of skewers taped together, onto which pupils could impale a jelly baby and then oscillate to induce wave-like motion. We were then left to describe the movement of the colourful skewers and explain the link to the behaviour of light (while additional jelly babies were consumed).

Our next demonstration showed how music from a phone could be converted into a light signal, wirelessly detected by a solar panel and then played out of a speaker. This light-to-sound demonstration was sufficiently impressive to engage older children and adults, whilst still appealing to our younger target audience. Denounced as 'magic' by some, they were then invited to experiment with varying the distance of the solar panel from the light source to see what effect this had on sound quality and volume.

Over the course of a hectic few days, we were able to demonstrate and (hopefully!) entertain countless groups of school children and I would like to thank Mark and Mawgan for their help in tirelessly engaging with pupils and sharing their enthusiasm for optics.

Northern Ireland Science Festival 2023

by Lynda Mahon

PIADS, working with our anchor partners Seagate and Smart Nano NI, delivered two fantastic and engaging events as part of the NI Science Festival in February 2023. A team of PIADS students including Tiernan McCaughery, Will Lee, Katherine Stevens, James Dalzell, Catalina McLaughlin, John Adeniran, Shuquai Cai, Daniel Kusneof attended two events. The first based in Londonderry/Derry at the Foyleside shopping centre with the second event being held in Belfast at the new Ulster University campus. The team of students delivered, alongside the team from Seagate and Smart Nano NI, a range of interactive science experiments and provided a range of science kits for children to take home.



Cork Science Festival

by Elisabeth Wintersteller



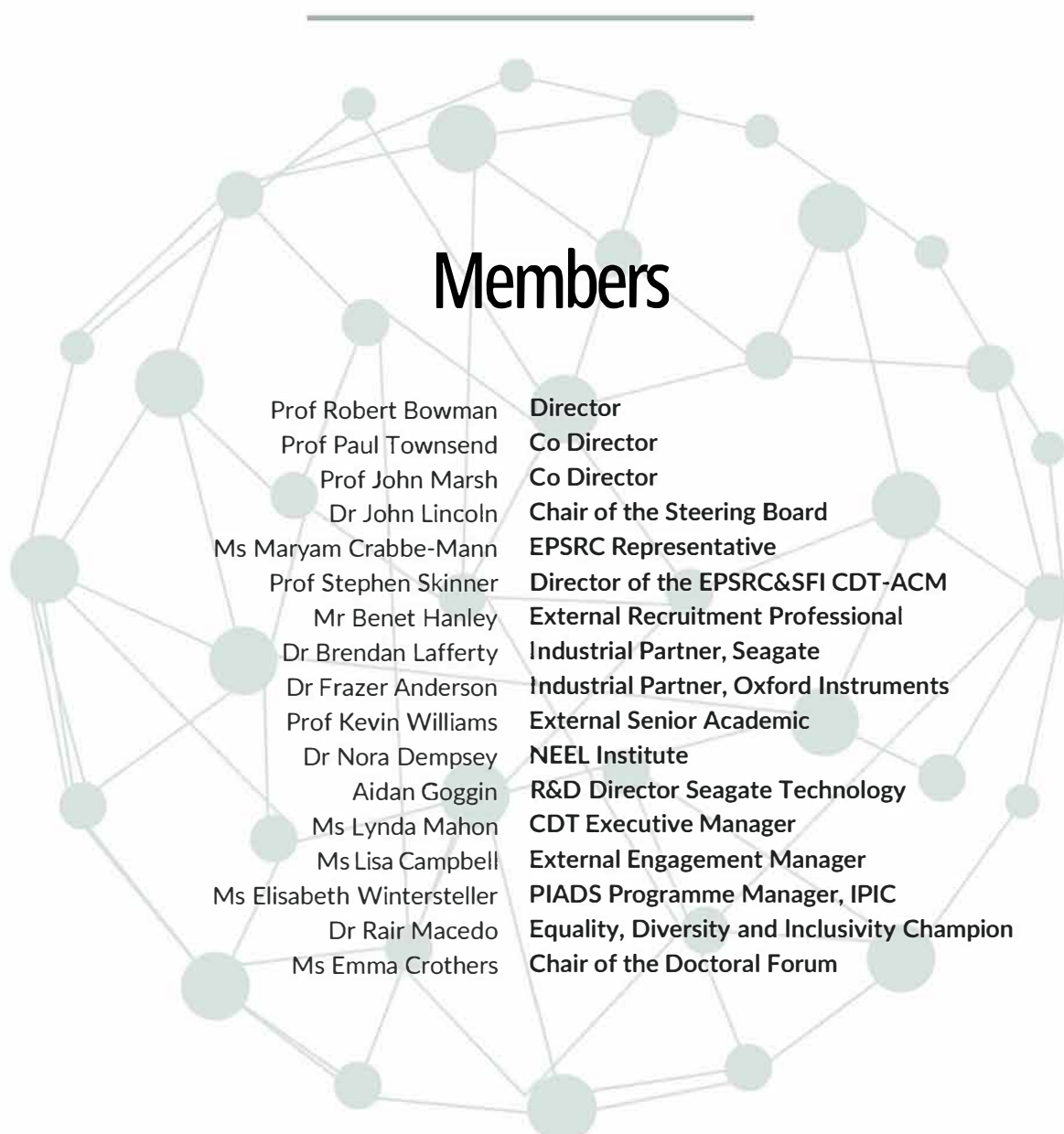
The 2022 Cork Science Festival took place from 13th to 20th November 2022. It aims to promote the culture of science through a program of public engagement events, talks, exhibitions, open days and workshops. It was a great pleasure for PIADS being part of Cork Science Festival in 2022. Our students organised and ran a pub quiz on 16th November 2022, called 'No such thing as a fun science quiz'. In 7 rounds and over 50 questions our students challenged our contestants.

From objects, to Science Fact or Science Fiction, the good old picture round and really nerdy science, this quiz provided everything the quiz heart desires and more - or do you know how many slaps it takes to cook a steak medium-rare? Our students went above and beyond to organise this fun evening in Cork, we had 60 participants attending the quiz. It was especially great to see how our ROI based PIADS students collaborated with the UK students in making this a successful event. Special thanks to Dr Caitriona Tyndall for her expertise on public engagement events and for co-organising the pub quiz.

OUR STEERING BOARD

The CDT Steering Board provides important oversight & guidance on the strategic direction of our CDT, ensuring that it remains closely aligned to industry roadmaps.

It has executive & oversight authority over all aspects of strategy, policies & performance, meeting bi-annually to monitor progress against the CDT Key Performance Indicators. These include: the recruitment of a diverse, well-qualified student cohort; the delivery of a high quality & dynamic doctoral training programme; the provision of rich & embedded industrial engagement; the delivery of doctoral research projects that are cutting-edge, innovative & collaborative; & strong & robust governance & management.



GET IN TOUCH

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