EPSRC and SFI Centre for Doctoral Training in PHOTONIC INTEGRATION AND ADVANCED DATA STORAGE

PIADS Student Handbook
A MESSAGE FROM OUR DIRECTOR

Professor Paul Townsend
I am delighted to have this opportunity to introduce you to our PIADS Centre for Doctoral Training. PIADS offers a range of exciting research and training opportunities that will enable you to gain a PhD qualification in a world-class photonics research ecosystem with cutting-edge facilities and unique training offerings spanning Ireland and the UK. If you choose to carry out your PhD in Ireland you will join the IPIC SFI Research Centre in Photonics which comprises more than 200 people carrying out internationally-leading research ranging from photonics theory to advanced integrated systems. We accept the best candidates from all over the world and cover all stipend, research, training and registration costs within the programme. Our researchers go on to work for some of the best companies and research institutes in the world. If you aspire to be a future leader in photonics R&D there is no better place to start your career than here!
The Centre for Doctoral Training (CDT) in Photonic Integration and Advanced Data Storage (PIADS) is a partnership between the Irish Photonic Integration Centre, Queen’s University Belfast and the University of Glasgow. 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 used to improve health and well-being.

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 additional investment from Science Foundation Ireland (SFI), resulting in a vibrant joint EPSRC and SFI funded centre.

Our aim through this doctoral training programme is to help to address a skills shortage in the photonics industry by educating future scientists and engineers.
The Irish Photonic Integration Centre (IPIC), the SFI Centre for photonics, is Ireland’s centre of excellence for research, innovation and PhD training in photonics – the science and application of light – which today represents a 0.5 Trillion$ global industry.

Photonic integration technology is the focus of our research, spanning areas from photonics theory right through to device and system development and fabrication, enabled through our in-house laboratories and semiconductor fabrication facilities at Tyndall National Institute.

We work closely with over 30 industry partners to develop their next-generation products, across Ireland’s high-growth technology sectors of ICT and MedTech, supporting their attraction to and growth in Ireland. In addition, we commercialise our disruptive technologies through start-up companies and co-ordinate the Photonics Ireland National Technology Platform.

"Talent development is at the core of IPIC in order to meet our ambition for research excellence and its transition to societal and economic impact. PIADS is a key element that delivers an enhanced learning experience and empowers students to reach their full potential and become one of the world’s future photonics research leaders”

Patrick Morrissey, IPIC Centre Manager
**Biomedical**

The objective of the Biomedical theme is to work towards developing the World’s smallest integrated imaging system for guided surgery. In the future, surgeons will require the ability to generate high quality, diagnostic images deep within the body using micro-scale instrumentation such as arterial guidewires. This theme will develop novel innovations in micro-scale cameras and surgical platform integration technologies, multi-spectral diagnostic imaging and in-body optical powering and data transmission.

**Optical Communications**

The Communications theme focuses on real-time internet that will require a converged wireless/optical edge cloud with unprecedented ability to dynamically reconfigure in the wavelength and time domain in response to rapid and massive bandwidth fluctuations and latency-critical service demands. This theme will address the question: can we build a coherent transceiver at the tens of Euro cost point required for the network edge and, if so, how will this transform metro-scale access network design?

**Packaging & Hybrid Integration**

The Packaging and Hybrid Integration theme focuses on the high cost of photonic packaging, which can amount to ~80% of total product cost in some applications, restricting the deployment of photonics to a relatively small number of markets to date. This theme will develop optical and electrical wafer-scale assembly and packaging processes and low cost cooling technologies that aim to ‘break this cost barrier’.

**Monolithic & Heterogeneous Integration**

‘Printed photonics on anything’ - This theme is developing a range of essential semiconductor material, device and integration technologies, with a key objective being to find new ways to combine photonics and electronics together on multiple substrates (silicon, ceramic, polymer etc.) with unprecedented simplicity and cost-effectiveness, using transfer printing.
MEET THE TEAM

IPIC Operations Team

Patrick Morrissey
IPIC Centre Manager
patrick.morrissey@tyndall.ie

Melissa Walsh
Training Programme Manager
melissa.walsh@tyndall.ie

Caitriona Tyndall
Education & Public Engagement Officer
caitriona.tyndall@tyndall.ie

Martin O’Connell
EU Programmes Manager
martin.oconnell@tyndall.ie

Monika Zygowska
Programme Manager
monika.zygowska@tyndall.ie

Ann Heffernan
Centre Administrator
ann.heffernan@tyndall.ie

David McGovern
Industry Engagement Manager
david.mcgovern@tyndall.ie

Anna Kaar
Finance Coordinator
anna.kaar@tyndall.ie

- Training Course & Learning Support
- Upskilling Advice & Assistance
- Personal Career Development Planning
- Public Engagement Training
- Public Engagement Co-ordination
- Grant Applications Workshops
- Funding Proposal Writing
- Industry Engagement Advice
- Commercialisation Workshops
Niall Boohan

PhD Project: Optoelectronic device modelling

Project Intro: I do a wide variety of optoelectronic modelling and design. So far I've looked at very fundamental mathematical approaches to grating design as well as device level modelling using commercial modelling software in support of teams developing photonic devices in Tyndall.

What made you want to do a PhD? I wanted to increase my skill-set, particularly looking at developing more computer modelling skills for photonics. A PhD has allowed my to explore these areas in much more depth than would have been possible otherwise.

Thomas O'Connor

PhD Project: Boron containing alloys of III-Nitride semiconductors for Ultraviolet emission

Project Intro: I am working on the growth and modelling of boron containing III-Nitride alloys, for their application in UV light emitting diodes and lasers. With this research we are aiming for greater flexibility in tuning the bandgap energy and emission wavelengths of III-N devices. Addition of boron to III-Ns make it possible to reduce the overall internal field in the corresponding (B, Al, Ga)N/(B, Al, Ga)N heterostructures (piezoelectric and spontaneous polarization components of the internal field can cancel each other) and thus suppress the quantum confined stark effect leading to potentially more efficient UV emitters.
Ayse Atar

**PhD Project:** Inverted laser structures for photonic integration: epitaxy, simulation and design challenges

**Project Intro:** I am aiming to propose a diffusion and transport model by combining diffusion equations and material growth processes. Identifying parameters by fitting the new model to the SIMS results and working on the growth process to solve this Zn tailing problem. After solving this issue, I will grow an inverted p-i-n laser structure.

Samira Jastan

**PhD Project:** Narrow linewidth Blue Laser systems.

**Project Intro:** Narrow linewidth lasers in the blue wavelength range can open up new doors in various applications such as underwater communications, medical diagnostics, and sensing areas. The aim of this project is to provide a compact system with further narrowing using the Silicon Nitride photonic integration techniques.

**What made you want to do a PhD?** First of all, I am really interested in this field, and I would like to play an instrumental part in developing pioneering technologies. But, I thought my experiences weren’t enough, so I decided to pursue my education to increase my abilities and enhance my knowledge. In my opinion, a PhD is a good opportunity to fulfill my academic ambitions and definitely can help me to find my desired career in the future.
CURRENT STUDENTS

2020 Cohort

PhD Project: Precision targeted tumour responsive fluorophores: theranostic probes for real time biomarker sensing and for intraoperative fluorescence guided surgery

Project Intro: I work with metal complexes that can be used in bio-imaging and sensing. My research will investigate the performance of these complexes in a range of mammalian cell lines.

James McCloskey

PhD Project: Non-classical light emission from III-N quantum dots

Project Intro: I’m interested in anything physics related! I chose to work in photonics because of how broad it is as a field, and because of the interesting quantum mechanics involved. The project I am doing involves many-body quantum mechanics calculations, which is what I’m primarily interested in. I generally enjoy any maths-heavy physics and computational physics.

Rhianne Curley

PhD Project: Design and Fabrication of Low-Cost Glass Substrates for Wafer-Level PIC Packaging

Project Intro: I will be designing and testing the efficiency of various glass substrates used to connect Photonic Integrated Chips to sources, fibres, etc.

What made you want to do a PhD? The amount of resources available to PhD students is substantial. A PhD helps open many pathways for future careers and creates multiple opportunities for networking.

Robert Bernson
PhD Project: High speed InP photonics compatible with micro transfer printing.

Project Intro: My project covers research work related to design, fabrication and integration of III-V photonic devices to make photonic integrated circuits (PIC). I'm working on fundamental design of devices and also developing lots of technical expertise in labs and cleanrooms. By the end of the project, it will be very exciting to see a novel PIC developed and demonstrated from my research.

What made you want to do a PhD? I decided to do a PhD because I realize it is the way to lead me towards the frontier of the modern technology and research. It gives me many more opportunities to learn and grow as a researcher and enables me to pursue more professional goals in my career.

Fariba Jamali

PhD Project: Burst Mode Transmission for Coherent PONs

Project Intro: With the PON moving to the higher speeds allowed by the coherent modulation (100Gb/s and beyond) it is critical to maintain the granularity of BW allocation within the same wavelength since most individual users will not need an entire wavelength's worth of capacity. Time division multiplexing (TDM) is the simplest choice in downstream, which operates in continuous mode. In upstream time domain multiplexing requires burst mode transmitters and receivers, which will introduce specific challenges for coherent transmission. This project will focus on these challenges for coherent transmission in burst mode.

What made you want to do a PhD? There are lots of good reasons for doing a PhD; mine was my passion to research in optical communication and also to improve my employment prospects.
THE PIADS JOURNEY

IPIC Students

Ayse Atar
2019 PIADS Cohort

My PhD work is mainly based on the dopant profile in MOVPE grown III-V materials. I am conducting my research at the Irish Photonic Integration Centre in Cork, which is the newest partner of the CDT-PIADS program. So far, I have had an amazing experience and I have already seen the benefits of this program in many ways.

The program is rich with training in entrepreneurship, leadership, management and personal effectiveness, and also visits to industrial companies and research centres. The CDT-PIADS program started with a one-week induction program in the University of Glasgow, where we were introduced to the program and met with the program administrators and the other CDT PhD students. Learning the details of the PIADS program, visiting the facilities of a partner university and getting to know the other students and their research environment have been a great experience. I think some of us have already discovered quite a few future collaboration opportunities.

The way I see it, this program both gives the opportunity to conduct high level scientific research for an academic career, and also prepares the students to discover the many other pathways best suited for their skills and interests. I feel very privileged to be a part of this program.

Rhianne Curley
2020 PIADS Cohort

I joined PIADS in September 2020 and I am currently completing my PhD in Dublin City University. My PhD work involves luminescent metal complexes or probes that can be used to measure oxygen in cancer cells. The long-term aim of this project is to develop and optimise luminescent probes that can be used to selectively target cancer cells. These probes will have an application in both light-guided surgery and also in photonics.

Since starting my PhD journey with PIADS I have already had the chance to collaborate with the UK and NI students through planning the summer conclave event and participating in the winter school and the Insights to Industry module. I have also had the opportunity to get involved in outreach activities like the Cork Discovers EU Researchers’ Night and CEIA HighTechElec Transition Year Week.

Being a part of PIADS has provided me with a great support system, I enjoy being part of a cohort as it’s nice to have a group of like-minded people to go through the PIADS PhD journey with. The diversity in each of our scientific backgrounds and PhD projects provides a great opportunity to learn about different fields of science to my own and also for collaboration. I am extremely grateful to be part of the CDT-PIADS programme and looking forward to the next three years.
**YEAR 1 OVERVIEW**

**IPIC 1st year PIADS PhD Snapshot**

- **Induction week in University of Glasgow**
  - **September**

- **Insights to Industry Module**
  - **October**

- **Insights to Industry Group Project**
  - **December**

- **End of Semester 1**

- **Winter School**
  - **January**

- **1st Years Organise Summer Conclave**

- **IPIC Annual Industry Day**
  - **March**

- **Responsible Research & Innovation Course**

- **Seagate: Teamwork & Collaboration Skills Module**
  - **April**

- **Summer Conclave**
  - **June**

- **End of Semester 2**

---

Optional Advanced Practical Training Courses at IPIC:
- Compound Semiconductor Device Fabrication 5ECTS
- Photonics Packaging 5ECTS
TRAINING

Compulsory Modules

Insights to Industry 5 ECTS
- Delivered by University of Glasgow

Teamwork & Collaboration Skills 5 ECTS
- Delivered by Queens University Belfast in collaboration with Seagate Technology

Responsible Research & Innovation
- 2 Day Training
- Delivered by ORBIT
Insights to Industry

Weekly Workshops

[1] **Problem Setting:** meet your team and your project mentor

[2] **Effective Teamwork:** project planning using Belbin roles

[3] **Problem Solving:** marketing problem solving ideas and check-in with project mentor

[4] **Business Communication:** team presentations to mentors and panel

[5] **Professional Development:** a reflection on our professional development opportunities

**Assessment**

- Group Presentation (15 mins - 35%)
- Group Report (1500 words - 35%)
- Individual Reflection (750 words - 30%)
Teamwork & Collaboration Skills

Course Outline

• Pre-session facilitated by Seagate Technology

• Self-paced eLearning: Global Collaboration on Seagate iMap

• Students to complete "Before You Begin, Rate your Current Ability"

• Workshop 1: Working with Behaviour Styles

• Workshop 2: Global Collaboration

• Two interviews with Seagate leaders

• Mentor session with Seagate leader: global mentor's meeting and follow-on discussion

• Students to submit 2-3 page paper for assessment.
Responsible Research & Innovation

2-Day PIADS Training

Day 1
- Overview of RRI
- Area 4P Framework
- PERSUE Tool

Day 2
- Guest Speaker
- Case Studies
- Team Challenge
- Team Presentations
TRAINING OVERVIEW

Transferable Skills
INDUCTION WEEK

2020 Schedule

Day 1
- Directors Welcome: Prof Robert Bowman (QUB), Prof Paul Townsend (IPIC), Prof John Marsh (UOG)
- PIADS Programme Overview
- Meet the Team

Day 2
- IPIC Specialised Courses Overview
- Commercialisation Workshop
- EDI (Equality, Diversity & Inclusion) Activity

Day 3
- Introduction to Public Engagement
- Time Management Tips
- How to be an Effective Student Rep
- Introduction to Conclave Planning

Day 4
- Responsible Research and Innovation Training
- PIADS Quiz!
The PIADS Winter School is an annual event that enables students to develop key skills and supports them be well rounded researchers.

**Monday**
- Welcome & Opening Remarks
- Developing Your Publications Profile
- EPE @ Home

**Tuesday**
- Participating Effectively at Conferences
- Elevator Pitch Training
- Connecting with Photonics Societies

**Wednesday**
- Connecting with Industry
- An Industrial Perspective
- CV and Interview Tips
- Careers Drop-in Clinic

**Thursday**
- Doctoral Forum
- CDT Steering Board
- Social Activity

**Friday**
- Elevator Pitch Deliveries
- EPE @ Home Deliveries
- Closing Remarks
The PIADS Summer Conclave is a research showcase organised by the first year students each year. The conclave is usually a 2-day in-person event but has gone virtual for the 2020 and 2021 events.

**2021 Schedule**

**Day 1**
- Director Welcome
- 2020 Cohort Overview
- Flash Presentations (1-2)
- Flash Talks (1-4)
- Keynote Speaker
- Poster Session
- Networking

**Day 2**
- Flash Presentations (3-8)
- Flash Talks (5-10)
- Panel Discussion

**Day 3**
- Flash Presentations (9-12)
- Flash Talks (11-14)
- Keynote Speaker
- Awards & Closing Remarks
We strive to make photonics accessible to everyone. Photonics, the study of light, focuses on generating, controlling, and detecting photons, and can be found in every part of our daily lives; from the lighting in our homes, to medical devices through to the technology we use to communicate with each other.

We bring the science to you through immersive and fun demonstrations at a number of public events throughout the year, including Cork Discovers, Culture Night, the National Ploughing Championship, Glasgow Science Festival and Northern Ireland Science Festival.
With over 300,000 people working internationally in the field of photonics, this growing sector presents many opportunities for future scientists and engineers.

Our multiple programmes are designed to inform and inspire students to pursue education and careers in core science subjects, such as physics and engineering, and to show that these opportunities are equally open to female students.

Each PIADS student must complete two EPE activities per year. Activities include in-class school visits, SFI Research Centres TY Week, vlogging, I'm a scientist get me out of here, IPIC Centre Podcast, Northern Ireland, Glasgow & Cork Science festivals.
HOWN TO APPLY

5 PhD studentships available each year

2. Search for PIADS Centre for Doctoral Training PhD Studentships
3. Identify your preferred IPIC research theme
4. Following the application steps, note your preferred project theme and submit your application to careers@tyndall.ie

Contact melissa.walsh@tyndall.ie, PIADS programme manager at IPIC for any application or PIADS programme queries.
PIADS, IPIC

Email: piads@ipic.ie
Call: + 353 21 4904177
Twitter: @CDT_PIADS, @IPICIreland
Visit: www.ipic.ie/piads/

“This publication has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) 18/EPSRC-CDT/3585 and the Engineering and Physical Sciences Research Council EP/S023321/1.”