Training the future photonics research leaders: a Summer Fellowship Programme to attract students to pursue a career in photonics research

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ABSTRACT

The Tyndall & IPIC Summer Fellowship Programme gives undergraduate students a high quality immersive research experience with the objective to attract the best undergraduate students from across Ireland to purse a PhD in photonics. Students join a leading research group, working in multi-disciplinary and multi-cultural teams to complete novel research projects in state-of-the-art facilities. A parallel Development Programme supports students in learning skills in science communication, networking, technical skills, with the aim to build confident, well-trained researchers for future roles in academia and industry.

The objectives of the programme include (1) increase the number of Irish students who progress to complete a PhD, in particular in photonics or wider STEM subject, (2) improve gender diversity by aiming to have 40%+ representation of women each year, (3) provide career-enhancing skills (4) provide an inclusive, positive experience where students build multi-disciplinary networks.

Applicant numbers have grown 5-fold between 2017 and 2022, extending this fellowship to a nationally recognised programme. The programme has had 38% women representation through this 6-year period and has attracted the highest calibre students with 84% of the 2022 cohort obtaining 1:1 or first-class honours. Since 2017, 52% of the graduated programme alumni have proceeded to a postgraduate, either masters or PhD.

We continue to develop the programme to ensure it as one of the top national summer training programmes. In the words of an alumna, “The IPIC programme taught me a lot about research, learning, and STEM career options [and] heightened my interest in pursuing post graduate studies.”

Fellowship, internship, photonics, training, development, ICT, research skills, diversity, networking, STEM.

1. INTRODUCTION

The Information and Communications Technology (ICT) sector is one of the largest growing sectors in Ireland[1] and accounts for approximately one-fifth of Gross Value Added (GVA) to the Irish economy[2]. The sector is set to continue growing in the next 10 years. According to Cedefop Skills Forecast, a project funded by the European Union, the number of ICT professionals who hold high-level qualifications is expected to increase to 74% in 2030 [3]. Ireland therefore has a

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key role in delivering highly qualified professionals to the ICT job market. In 2021, Irish universities list 335 PhD graduates in natural sciences, mathematics and statistics, which accounts to 22% of all PhD graduates in 2021. Of those 52% were female identifying[4]. However, globally only 20% of physics and 15% of engineering graduates are women[5].

In order to support the growth of the Irish ICT sector more undergraduate students need to be encouraged to pursue postgraduate opportunities in photonics and ICT. Similarly, in order to increase the number of women in high-level supervisor positions, female-identifying undergraduate students need to gain technical skills and create connections with women role models.

The Summer Fellowship Programme is coordinated by the SFI centre for photonics, the Irish Photonic Integration Centre (IPIC). It is a 12-week training programme, started in 2017, for undergraduate students and gives real-world experiences of conducting research projects in world-leading facilities while additionally giving these students career enhancing skills. The main objective of this programme is to give undergraduate students an immersive research experience to inform them of what a PhD and subsequent research career may involve. The aims of the programme include:

(1) Increasing recruitment of Irish students to highly qualified professionals to the Irish ICT job market.
(2) Improving gender diversity by aiming to have 40%+ representation of women each year.
(3) Providing career-enhancing skills ahead of applicants applying to our PhD programme.
(4) Providing inclusive, positive experiences for building multi-disciplinary networks.

2. METHODS TO ATTRACTING HIGH CALIBRE STUDENTS

The Summer Fellowship Programme is an immersive programme held for 3 months in June to August each year. The programme is open to all undergraduate students registered in Republic of Ireland (ROI) Universities and Institutes of Technology (IT). Students from 1st year to 4th year are able to apply and programme applicants are sought from all STEM disciplines, including but not limited to physics, engineering and chemistry.

Promotion of the Summer Fellowship is through a number of streams including (1) social media posts on partner websites, Twitter and Instagram including Tyndall National Institute and Women in Technology and Science Ireland (WITS), (2) direct contact from programme coordinator to all physics, mathematics, engineering and chemistry departments in all ROI universities and ITs, (3) attending career fairs organised by university and IT student societies and (4) word-of-mouth from Summer Fellowship alumni. The most successful form of promotion is direct engagement from the programme coordinator with Universities and ITs in ROI where 66% of the applicants heard about the programme through the academic department. 10% of applicants heard of the programme from peers such as friends and programme alumni.

The application process takes approximately 5 months. Before applications are opened supervisors are approached to design bespoke projects for the Summer Fellows. The collated projects are promoted along with the application form and include background, methods, expected results, key words and degree programme(s) that would suit the project. Applications open on the 1st December each year and close the following 31st January. Before applications close, a hybrid information evening is offered for potential applicants to gain more insight into the programme and to learn more about research at IPIC. Applications are through an online Microsoft form which includes: (2) key demographics including name, email, university, degree programme, current/estimated grades, (2) personal statement and (3) top 3 projects.

Applicant details are shared with project supervisors for review. 3-4 candidates are selected for each project for interview. Interviews take place over a 2 week period in February/March. Final applicants are typically chosen by end of March with Letters of Offer issued before 31st March. To ensure we maintain contact with applicants the Application Form is linked to a Data Protection Notice (DPN). All application data is kept until the start of the next programme. Key details of applicants such as names and contact emails are kept for 3 years, stated explicitly in the DPN. Applicants are contacted when new postgraduate opportunities are available and when a new round of Summer Fellowship recruitment begins. In order to gain key insights into the impact of the programme we track our Summer Fellowship alumni over a 3 year period using tracking surveys every 2 years, LinkedIn and direct contact with alumni.

The programme is evaluated at all levels and touchpoints (figure 2.1). The feedback from applicants, Summer Fellows, Supervisors and Development Programme facilitators informs the programme for the next year and aids in continuously improving the programme.

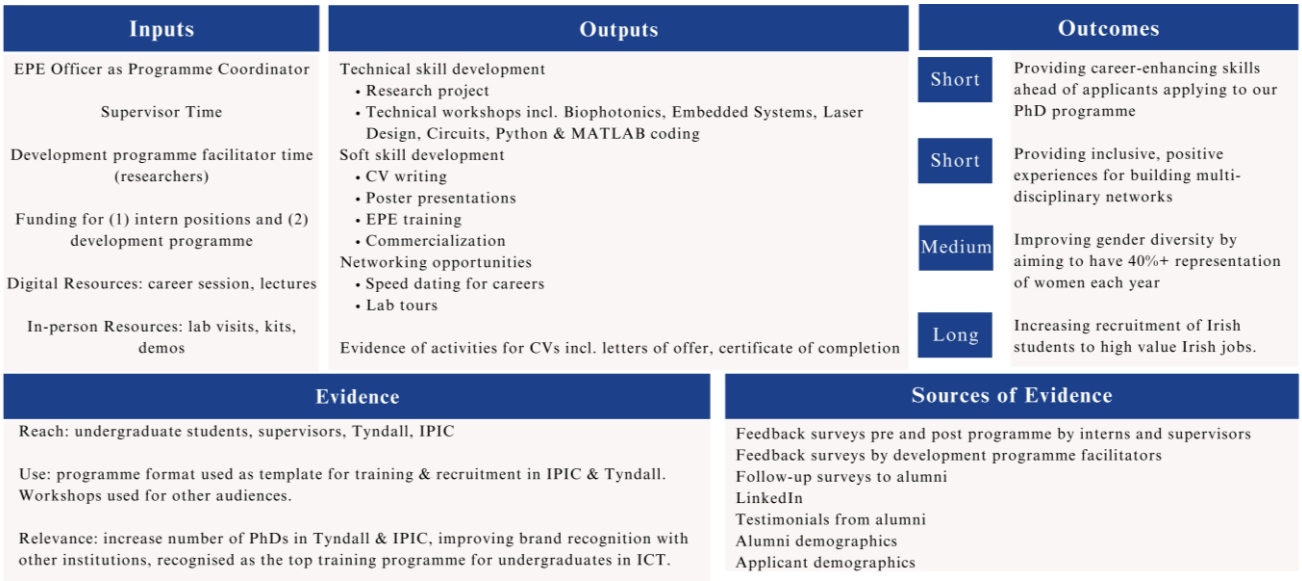

Figure 2.1 Logic Model for Summer Fellowship Programme.

3. A DYNAMIC TEACHING PROGRAMME FOR STUDENT GROWTH

Each Summer Fellow conducts a dedicated research project over 12 weeks with a supervisor from IPIC. The projects are put forward by IPIC researchers under the IPIC research themes; BioPhotonics, Optical Communications, Monolithic & Heterogeneous Integration and Packaging & Hybrid Integrations. Project supervisors come from a range of career stages including group heads, senior research fellows and postdocs, and therefore this can be an ideal opportunity for early career researchers to gain experience in teaching and supervision. Project titles from the 2022 programme include:

- Development of Optical Probe for Non-invasive Evaluation of Bone Quality.
- Photonic generation of THz signals for future high capacity wireless communication systems.
- Design and experimental study of Bloch surface wave sensors and filters.
- Modelling of the heat sink integrated micro-thermoelectric cooler for thermal management of the photonic device.

The Development Programme, shown in Figure 3.1, is an 8-week skill enhancing programme that runs parallel to the projects. The programme includes technical workshops, soft-skills sessions and networking opportunities. Each year the programme improves based on feedback from Summer Fellowship alumni and supervisors. The technical workshops aim to give Summer Fellows a more comprehensive overview of research at IPIC and Tyndall National Institute. These include the BioPhotonics Workshop[6,7], Laser Design and Embedded Systems. In addition the programme offers training in python and MATLAB. For all of these sessions Summer Fellows receive certificates of completion which can be added to their CVs. The Summer Fellows not only develop their technical skills but are additionally given training in soft skills such as CV writing, poster presentation skills and Education & Public Engagement training.

The programme also aims to create networks between the Summer Fellows and peers at IPIC, while they are encouraged to create a Summer Fellows network through regular meetings to share experiences. Each year the programme hosts a

'Speed Dating for Careers' event with current PhDs from IPIC and our partners in Tyndall National Institute, Queen's University Belfast and Glasgow University. The event allows Summer Fellows to ask questions about research projects, how to get a PhD and life as a PhD student. Finally, throughout the development programme lab tours are offered by IPIC and Tyndall National Institute students and staff. These lab tours allow Summer Fellows the opportunity to experience all of our state-of-the-art labs, not just the ones they access as part of their project, and build connections with researchers outside of their project area.

On the final day of the programme Summer Fellows are invited to present at a poster session. The poster session allows students to showcase their research over the 12-week programme, gain key skills in presentations and network with peers. A poster competition allows Summer Fellows to experience the judging process that they would experience as a PhD in a conference. The top 3 posters are presented with a prize and an opportunity to join IPIC's annual Industry Day.

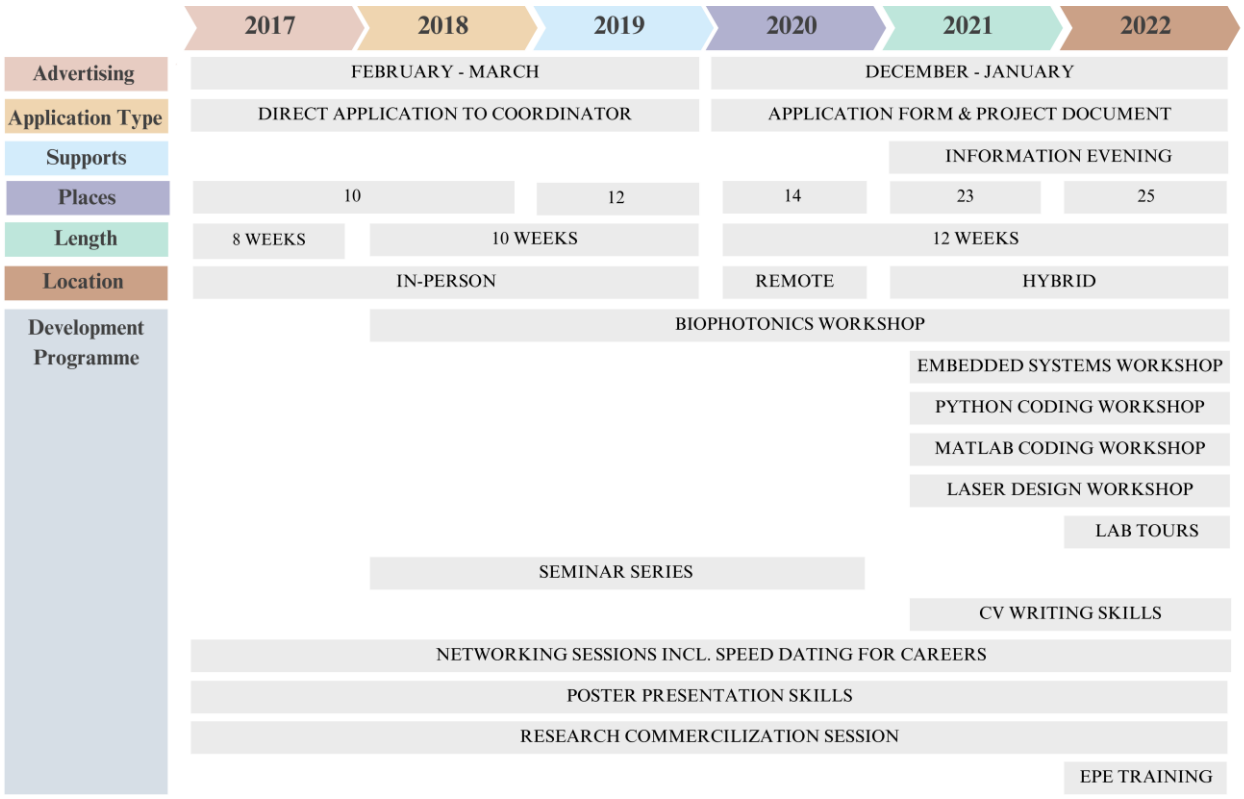

Figure 3.1 Summer Fellowship overview 2017 – 2022.

4. PROGRAMME SUCCESSES

The Summer Fellowship Programme has grown from strength to strength each year. It has become one of the top ICT-focused internship programmes in Ireland, with internships on offer from companies such as Intel, Analog Devices and IBM. Since 2017 the programme has seen an increase in the number of applicants from 35 in 2017 to 165 in 2022. Subsequently the number of placements has grown, with 25 Summer Fellows joining us in 2022 (figure 3.1), driven by the positive feedback from previous students. While the programme has grown we have maintained the quality of the programme and standard of Summer Fellows, for example since 2021, 79% of Summer Fellows had a 1.1 honours degree (equivalent to 3.68 GPA or higher). To date the programme has hosted 92 Summer Fellows since 2017, of those 38% have

been women. In addition to the Summer Fellows enjoying the programme (figure 4.1) the supervisors of the projects are on the whole very satisfied. 81% of supervisors agreed the Summer Fellow was able to complete their project in the timeframe while 77% agreed they contributed to their group's research goals.

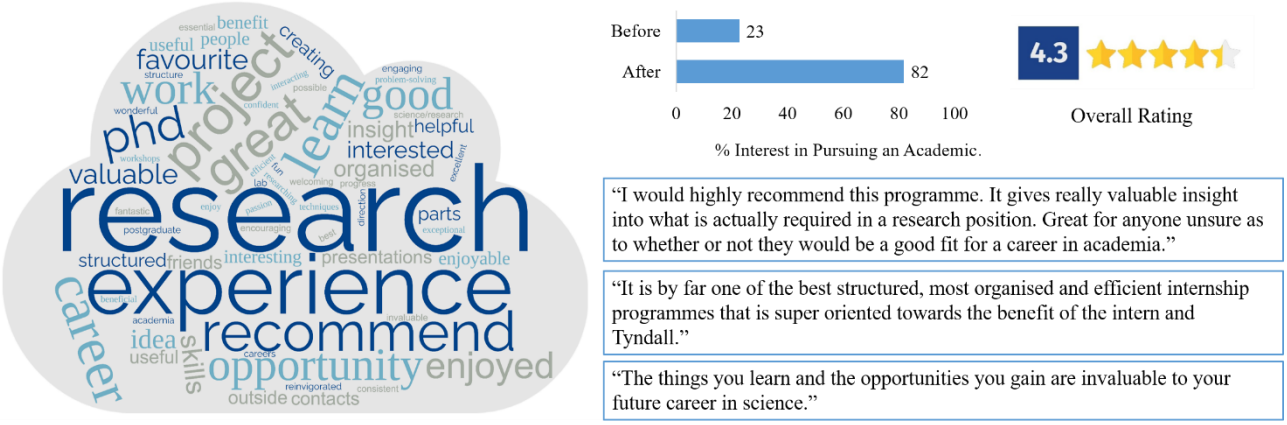

Figure 4.1 Summer Fellowship Feedback – Summer Fellows.

The Summer Fellowship programme has contributed to our alumni pursuing further careers in STEM. Of those graduated programme alumni 52% have proceeded to a postgraduate, either masters or PhD (figure 4.2). To date, 10 Summer Fellow alumni have proceeded to PhD with IPIC and Tyndall National Institute while a further 9 have proceeded to PhD with prestigious universities including Cambridge, UK and Oxford, UK. The progamme is still at the early stages and we therefore are unable to assess where those who pursued a postgraduate in STEM progress to. However, of the IPIC PhD and Postdoc trainees, approximately 170 to date, who have transitioned to industry since 2014, approximately 50% work in Ireland, 30% across Europe and most of the remaining in the US. We aim for our current postgraduates from the Summer Fellowship programme to follow this trend in the future.

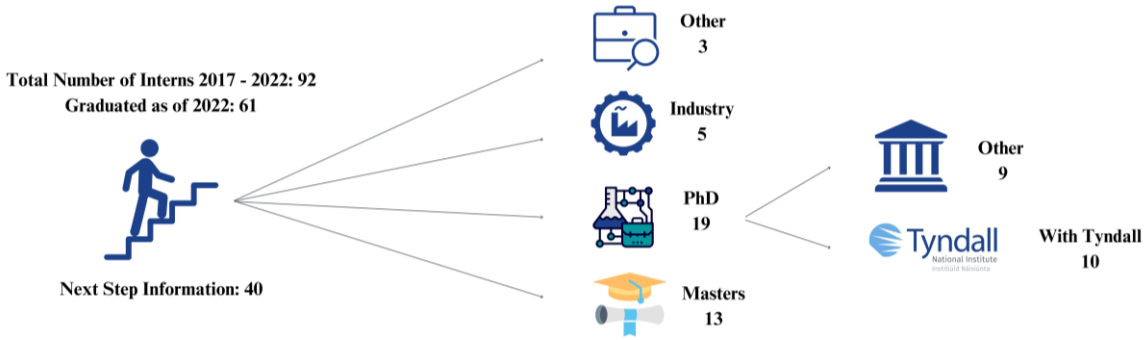

Figure 4.2 Summer Fellowship Programme impact.

The IPIC and Tyndall Summer Fellowship programme demonstrates the importance of giving students every opportunity to grow in the careers and directing their own learning. Our success can be attributed to the constant adaptation of the programme, built on student and supervisor experiences and needs. Supervisors return year on year knowing the students are high quality and capable of completing their projects. Students apply based on the positive experiences of their peers and training excellence at IPIC and Tyndall National Institute.

Figure 4.3 Summer Fellows.

Footnotes

For more information contact the programme coordinator Caitríona Tyndall, caitriona.tyndall@tyndall.ie. Visit our website https://www.ipic.ie/.

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