

**Two Fully Funded PhD Positions in the Area of  
Coherent Raman Spectroscopy/Microscopy for biomedical applications  
Department of Electronic Engineering  
Maynooth University, Ireland**

The Department of superposition Electronic Engineering at Maynooth University is pleased to announce that two PhD studentships are available with the start date of fall 2020 in the area of **Coherent Raman spectroscopy/microscopy for biomedical applications**.

<b>Open positions</b>	2 PhD Studentships in Biomedical Engineering/Photonics/Optics/Optical physics
<b>Location</b>	Department of Electronic Engineering, Maynooth University
<b>Duration</b>	4 Years
<b>Funding / Stipend</b>	The PhD positions are both funded for 4 years, including a monthly stipend and a travel budget to present at international conferences, workshops and seminars. The studentships will cover fees and a stipend of € 18,500 per annum.
<b>Contact</b>	Dr Bryan Hennelly ( <a href="mailto:bryan.hennelly@mu.ie">bryan.hennelly@mu.ie</a> )
<b>Closing Date</b>	10 <sup>th</sup> July 2020

### **General Research Theme of the PhD Projects**

The objective of this project is to design, build, and test a proof-of-concept label-free flow cytometer based on the current state-of-the-art for high-speed broadband coherent spectroscopy. Flow cytometry has become a cornerstone in clinical diagnostics, and a powerful discovery tool in biotechnology; research applications include immunology, stem cell research, and apoptosis, and clinical applications include phenotyping, immuno-oncology, and organ transplant. The pharmaceutical industry uses flow cytometry for drug discovery and in vitro toxicity testing. All these various applications require a fluorophore that selectively binds to an antibody that is unique to the target cell. The fact that a fluorophore molecule must be tailored to each application is a limitation. This proposed project aims to develop a label-free flow cytometry approach that replaces the fluorescence module in the traditional flow cytometer with a highspeed broadband CARS system, capable of classifying cells based on subtle differences in their biochemical composition. This project aims to replace the fluorescence module in flow cytometry with a coherent Raman spectroscopy system. Raman spectroscopy is a powerful technique for the identification, classification, and diagnosis of cancer cells and tissues and is based on the inelastic scattering of light that occurs when incident laser photons interact with molecular bonds in the sample (usually positioned on microscope), resulting in emitted photons of a different energy and colour. The slow acquisition times of Raman spectroscopy can be overcome using coherent Raman scattering, a class of third-order nonlinear optical spectroscopies that employ a sequence of light pulses to set up a vibrational coherence within the ensemble of molecules inside the laser focus; this enhances the Raman response by several orders of magnitude allowing for much faster acquisition. The project is based on a recently proposed form of coherent Raman spectroscopy known as Broadband Coherent Raman Spectroscopy and we are working closely with an inventor of this technology. The work will potentially broaden the range of new applications of flow cytometry in both clinical and biotechnology research. The two PhD projects will focus on the development and optimisation of the Broadband CARS microscopy/cytometry platform, the development of

a high-speed numerical processing pipeline to classify the cells, and the design of a flow-cytometry module for down-stream sorting.

## **PhD Studentships**

The PhD positions are both funded for 4 years, including a monthly stipend and a travel budget to present the research outputs at international conferences, workshops and seminars. The studentships will cover fees and a stipend of € 18,500 per annum. The successful candidates will be enrolled on the PhD programme in the Department of Electronic Engineering at Maynooth University. The successful candidates will write their theses on topics related to **Broadband Coherent Raman Spectroscopy for rapid cellular classification and integration with flow-cytometry**, supervised by Dr Bryan Hennelly for the entire duration of their PhD programme.

Each successful candidate will be an integral part of the overall research programme that Dr Hennelly is leading around the topic of biomedical microscopy and spectroscopy. The successful candidates will be prepared to work with Dr Hennelly's network of collaborators who are among the leading scholars working on state of the art technologies in biology, imaging, spectroscopy, and mathematics.

In addition to PhD supervision, the successful candidates, where relevant, will benefit from a wide range of training activities, namely, a range of modules for transferable skills such as research integrity, research management, entrepreneurship, patents, etc. The student may also benefit from summer/winter schools and an overseas research visit to our collaborators in the US and UK.

Successful candidates will be supported to present their research findings at major international conferences, workshops and seminars within the scope of their research projects.

## **Duties and Responsibilities**

1. Undertake postgraduate research in the area of agreed research project.
2. Work closely with the academic supervisor to ensure that the progress of the individual project is in line with the objectives of Dr Hennelly's research programme.
3. Work effectively within a multidisciplinary environment that includes biologists and mathematicians.
4. Attend and participate in all training events and supervisory meetings.
5. Prepare PhD progress reports.
6. Present and publish research outputs to both academic and non-academic audiences.
7. Attend and participate in academic and non-academic conferences, events and seminars.
8. Contribute to teaching/training of undergraduate and postgraduate project students working with Dr. Hennelly's group.

As the description of the duties and responsibilities cannot be exhaustive, it is worth mentioning that the PhD students may be required to undertake other duties that are broadly in line with the objectives of their research projects.

## **Qualifications, Expected Skills and Competencies**

1. PhD applicants must hold at least a first or upper second-class honours Bachelor's or Master's degree in Electrical, Electronic Engineering, Physics, Biomedical Engineering, Optics, or a related discipline.
2. Excellent background in physics/optics/mathematics/signal processing.
3. An aptitude for experimental work with optics/electronics.
4. Strong mathematical, analytical and programming skills.
5. Highly proficient English language skills.
6. Excellent written and verbal communication, including presentation skills.

7. Excellent organisational skills, attention to detail and the ability to meet deadlines.
8. Ability to think logically, create solutions and make informed decisions.
9. Willingness to work collaboratively in a research environment.
10. A strong commitment to their own continuous professional development.

## **Application Process / Additional Information**

Applications must be sent by e-mail to Dr Bryan Hennelly ([bryan.hennelly@mu.ie](mailto:bryan.hennelly@mu.ie)). Early applications are strongly encouraged.

Applications should include:

1. A cover letter explaining the applicant's motivation and interest in the project topic. Any relevant background and/or experience needs to be mentioned.
2. A Curriculum Vitae that includes the applicant's educational qualifications and any scientific publications and achievements.
3. Academic transcripts.
4. Two academic references.

Informal enquiries concerning the advertised positions, accompanied with the CV and a motivation letter, can be made to Dr Bryan Hennelly ([bryan.hennelly@mu.ie](mailto:bryan.hennelly@mu.ie)).

Applications will close on **10<sup>th</sup> July 2020**. The received applications will be analysed after the application deadline, and the shortlisted candidates will be invited to a Skype interview.