

EPSRC Centre for Doctoral Training in

**PHOTONIC  
INTEGRATION AND  
ADVANCED  
DATA  
STORAGE**

# CONCLAVE 2017

the annual CDT PIADS conference

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# WHO WE ARE

## CDT PIADS

The EPSRC Centre for Doctoral Training in Photonic Integration and Advanced Data Storage (CDT PIADS) was established in 2014 with substantial investment from the Engineering and Physical Sciences Research Council (EPSRC), the University of Glasgow and Queen's University Belfast, as well as our industrial partners. We aim to tackle some of the challenges created by the increasing quantities of data generated by today's society. Our focus is on developing highly manufacturable photonic integration technologies related to the magnetic storage of digital information. The CDT addresses a skills shortage in the photonics industry by educating fifty future scientists and engineers over the next eight years. We offer students a cutting-edge research environment with doctoral research projects that cut across physics, materials, and electrical and optical engineering, with applications as diverse as data storage and biosciences.

## QUEEN'S UNIVERSITY BELFAST

### CENTRE FOR NANOSTRUCTURED MEDIA

The CDT is part of the Centre for Nanostructured Media at Queen's University Belfast, which performs a wide range of research into topics including thin films, crystals, plasmonics, ferroelectrics, magnetism, microscopy and more. Through the ANSIN labs, in partnership with Seagate Technology, the CNM has access to excellent equipment and processing facilities. ANSIN's best-in-class facilities extend over four laboratory suites, comprising 2,000 square metres of advanced laboratory space, with some £15M of capital equipment ranging from physical vapour deposition, through advanced nanoscale metrology to state of the art electron and ion microscopy for structure/chemical determination.



## UNIVERSITY OF GLASGOW

### THE MCMP GROUP

The Materials and Condensed Matter Group at Glasgow is one of six research groups in the School of Physics and Astronomy. The MCMP's expertise is focused upon the imaging and analysis of materials at lengths from the sub-millimetre to the atomic scale through the application of electron and ion microscopes. Research at Glasgow has advanced the understanding of structure-property relationships in important technological materials such as nanomagnetic structures, semiconductor devices, thin film optical coatings, oxide materials including ferroelectrics, advanced metal alloys, and polymer films and devices.



### ELECTRONICS AND NANOSCALE ENGINEERING

Electronics and Nanoscale Engineering is one of the five cross-disciplinary Research Divisions in the School of Engineering. The Division has an outstanding reputation for its work on electronic, photonic, microsystem and nanofabrication technologies. Research in the Division addresses a broad range of socially and industrially important applications, with numerous partnerships in academia, industry and government bodies. Key areas of interest for the ENE Research Division are photonic devices with emphasis on communications, quantum information processing, terahertz and millimetre wave technology, advanced microelectronic devices, device simulation, sensors, instrumentation and metrology.

### THE JAMES WATT NANOFABRICATION CENTRE

The School of Engineering also hosts the James Watt Nanofabrication Centre. The JWNC brings together 35 years of expertise in nanotechnology at Glasgow and undertakes fundamental, applied and commercial research, and development and low-volume production using a vast array of qualified process modules and background IP. The JWNC has research collaborations across the world that address many of the global grand challenges facing society. Kelvin Nanotechnology Ltd. provides commercial access to the centre, facilities and expertise for governments, institutes and universities, along with working with over 288 companies from 28 countries around the world.

## INDUSTRY PARTNERS

### FOUNDING PARTNERS



#### SEAGATE TECHNOLOGIES

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#### CST

Compound Semiconductor Technologies Global Ltd. (CST Global) is an independent, volume-producer of III-V compound semiconductors for the fabrication of photonics products. They provide a custom foundry service, as well a range of high-volume, standard laser products for the optical communications markets.

<http://www.cstglobal.uk/>



#### KELVIN NANOTECHNOLOGY

Kelvin Nanotechnology Ltd (KNT) provide nanofabrication solutions to industry and academia through the state of the art James Watt Nanofabrication Centre (JWNC) at the University of Glasgow. They specialise in high resolution, large area, multilevel electron beam lithography.

<http://www.cstglobal.uk/>



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#### OXFORD INSTRUMENTS PLASMA TECHNOLOGIES

Oxford Instruments offer flexible, configurable process tools and leading-edge processes for the precise, controllable and repeatable engineering of micro- and nano-structures. They provide process solutions for the etching of nanometre-sized features, nanolayer deposition and the controlled growth of nanostructures.

<https://www.oxford-instruments.com/businesses/nanotechnology/plasma-technology>



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Oclaro, Inc. (Nasdaq: OCLR), is a leader in optical components, modules, and subsystems for optical transport and metro networks, enterprise networks, and data centers. Leveraging more than three decades of innovation in laser technology, photonic integration, and transceiver/subsystem design.

<http://www.oclaro.com/>



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II-VI



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OTHER PARTNERS AND NETWORKS

EPSRC

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Research Council



Department for the  
Economy

Innovate UK  
Knowledge Transfer Network







# CONCLAVE PROGRAMME

WEDNESDAY 21 JUNE

WEDNESDAY	
12:00	<b>Lunch</b> We welcome all delegates to join us for lunch to start the day.
13:00	<b>Welcome – Start of the Conclave</b> The Conclave opens with an introduction of the CDT from Prof. Robert Bowman & Prof. John Marsh.
13:30	<b>Introduction:</b> CDT Cohort 2015 The first cohort introduce themselves and give an overview of their research activities over the past year.
14:00	<b>Introduction:</b> Industry Partners We invite our industry partners to introduce themselves and their activities.
14:45	<b>Break</b>
15:00	<b>Industrial Keynote:</b> Dr. Hans Mulders (FEI) We are thrilled to welcome Dr. Mulders from our partner FEI as our industrial keynote speaker this year.
16:00	<b>Introduction:</b> CDT Cohort 2016 The second cohort introduce themselves reflect on their experience of the taught part of the CDT.
16:30	<b>Structured Networking</b> We invite our delegates to get to know each other better through a structured networking session
17:00	<b>Poster Session:</b> 2015 Cohort The 2015 Cohort present their research in a relaxed poster session.
18:00	<b>Break</b>
19:00	<b>Dinner</b>



## THURSDAY 22 JUNE

THURSDAY	
10:00	<b>Introduction:</b> Academics of the CDT Some of our academics give us brief overviews into some of their research.
11:00	<b>Academic Keynote:</b> Prof. Beverly J. Inkson (UoS) We are delighted to welcome Professor of Nanostructured Materials, Beverly J. Inkson from the University of Sheffield as our keynote speaker for this year.
12:00	<b>Lunch</b>
13:00	<b>Teambuilding</b> Engage in some short team activities to energise for the rest of the day.
14:00	<b>Focused Networking</b> We recommend students speak to their supervisors, and invite our industrial partners to an industrial forum. New students will have a focused session with CDT Manager Brenda Morris and Outreach Manager Caryn Hughes.
15:00	<b>Close of the Conclave</b> Prof. Robert Bowman summarises our activities for the past and coming year
15:15	<b>End</b>

# ACADEMIC PROFILES

## QUEEN'S UNIVERSITY BELFAST



**PROF ROBERT BOWMAN**

Prof. Robert Bowman FInstP, is the Director of the CDT PIADS, as well as Head of QUB's School of Maths and Physics. He was recently awarded the prestigious Seagate Technology/Royal Academy of Engineering Research Chair in Advanced materials for Data Storage (2017-2022). His current research concerns the development of advanced materials for data storage technology, including investigating rare earth magnetism, rare-earth ferromagnetic coupling phenomena, tailored magnetic multilayers and materials to facilitate heat assisted magnetic recording sponsored by industry. He is also the Director of Causeway Sensors Ltd., a spin-out company specialising in nanostructured surfaces for a range of sensing applications.



**PROF MARTY GREGG**

Prof Marty Gregg leads the nanoscale ferroelectric activity in Queen's University Belfast. He has had research activities on ferroelectric thin films and superlattices grown by Pulsed Laser Deposition (PLD) in the past, but more recently his research has involved the characterisation and understanding of well-controlled nanoscale ferroelectric entities from high purity bulk crystals using Focused Ion Beam milling.



**DR SOLVEIG FELTON**

Dr Solveig Felton joined the Centre for Nanostructured Media as a lecturer in 2013. Currently her interests are focused on nanomagnetism, studying magnetic domain structures and artificial frustrated magnets using techniques such as Magnetic Force Microscopy (MFM) and Lorentz Transmission Electron Microscopy (LTEM) and studying the magnetic interactions in molecular materials using Superconducting Quantum Interface Device (SQUID) magnetometry. She is also the CDT Training Coordinator at QUB.



### DR MIRYAM ARREDONDO-ARECHAVALA

Miryam Arredondo joined the Centre for Nanostructured Media as a lecturer in 2012. She received her primary degree from the Instituto Tecnológico Superior de Irapuato (Mexico) and obtained her PhD from the University of New South Wales (Australia) in 2011 at Prof. Valanoor's group. In 2010, she joined the Max Planck Institute of Microstructure Physics for a postdoctoral fellowship in a European project in functional oxides (IFOX).

Her research has focused on exploring ferroelectrics and other functional oxides via transmission electron microscopy (TEM) techniques. She has ample experience in TEM and her current interests are focused in dynamic studies of functional materials, with special interest on ferroics. She is a member of the Institute of Physics, Juno IOP Champion and member of the SWAN self-assessment team of the school.



### DR FUMIN HUANG

Dr. Fumin Huang is currently a Lecturer in the School of Mathematics and Physics at Queen's University Belfast. He obtained BSc and MSc degrees in the Physics Department of Peking University (China) and PhD degree at King's College London. After PhD he had several years postdoctoral research experience at the Optoelectronics Research Centre of University of Southampton and the Cavendish Laboratory of University of Cambridge, respectively. He joined Queen's University Belfast as a lecturer in 2013.

His main research interest is in the fields of plasmonics and superresolution optics, including quantum plasmonics, thermo plasmonics, plasmonic sensors, refractory plasmonic materials, near-field optical microscopy and far-field superoscillation optics etc.



### DR AMIT KUMAR

Dr Amit Kumar received his B.Tech in Metallurgical and materials Engineering from the Indian Institute of Technology, Kharagpur in 2005 before taking Research Associate posts at the Pennsylvania State University and Oak Ridge National Laboratory in the US. He became a Lecturer at Queen's University Belfast in 2013. Amit's research interests cover ferroelectrics, Scanning Probe Microscopy, local electrochemistry in batteries & fuel cells and nonlinear optics.



### DR BOB POLLARD

Dr Bob Pollard is a Senior Lecturer and academic of the Centre for Nanostructured Media at QUB, as well as Director and CEO of the spin-out company Causeway Sensors Ltd. His career has focused on the fabrication of ultra thin films and functional nanostructures, with interest on nanorod arrays for optical sensing.



**PROF JOHN MARSH**

John Marsh is the Deputy Director of CDT PIADS and Professor of Optoelectronic Systems at the University of Glasgow, Dean of the University of Glasgow UESTC Partnership, and Deputy Director of the PIADS CDT. He has worked in the high technology and higher education sectors for more than 30 years, joining the University of Glasgow in 1986 and founding Intense Photonics Ltd in 2000. In 2006 he was jointly awarded the 2006 IEEE/LEOS Engineering Achievement Award 'for extensive development and commercialization of quantum well intermixing for photonic devices', and was also awarded the 2006 IEEE/LEOS Distinguished Service Award. He served as the President of the IEEE Photonics Society in 2008 and 2009. A graduate of the Universities of Cambridge, Liverpool and Sheffield, he is a Fellow of the IET, Institute of Physics, Royal Society of Arts and OSA. He was elected a Fellow of the Royal Society of Edinburgh in 2000, of the IEEE in 2000, and of the Royal Academy of Engineering – the UK's National Academy of Engineering – in 2007. His research focuses on semiconductor lasers and monolithic photonic integrated circuits (PICs) in InP and GaAs, with a wide range of applications including sensing, material processing, communications and healthcare.



**PROF MARC SOREL**

Prof Marc Sorel has been engaged with research related to integrated optics, silicon photonics and semiconductor lasers for over 15 years. He has published over 300 journal and conference papers, and serves or has served in several conference scientific committees including ECIO, ECOC, Photonics North and CLEO Europe. Research Projects include Semiconducting Ring Lasers, Ultrashort pulse laser diodes, Coupled ring resonators on silicon-on-insulator and InSb-based mid IR LEDs for gas sensing. He is also the CDT Training Coordinator at UofG.



**PROF RICHARD HOGG**

Prof Richard Hogg is currently Professor of Nanoscale and Electronic Engineering at the University of Glasgow. He has a background at NTT Basic Research Laboratory, the University of Tokyo, Toshiba Research Europe's Cambridge Laboratory, and Agilent Technologies. In 2003 he joined the Electronic and Electrical Engineering Department of the University of Sheffield, where he was Professor of Semiconductor Devices. Some of his achievements include the development of multi-section QD super luminescent diodes (SLDs) for state-of-the-art device performance and the first demonstration of SLD OCT imaging, as well as development of new fabrication processes for GaAs devices. Prof Hogg is among world-leading researchers in EP-VECSEL manufacture and engineering.



### PROF DAVID CUMMING

Prof. David Cumming, FRSE, FIEEE, is presently the Head of the School of Engineering at UofG with 120 academic staff and a turnover of £37m p.a. He is an electronics engineer who has focused on VLSI design and microsystem technology for sensors and imaging applications. He has published nearly 300 papers, held numerous grants and supervised over 20 PhD students. He has led several large grants since 2000 including SHEFC RDG "IDEAS" (a £1.3m collaboration with Glasgow, Edinburgh, and Strathclyde Universities), coordinating "MINT" (a £1.6m EU FP5 international collaboration), the EPSRC S&I award (£4.2m with SFC co-funding to set up the Electronic Systems Design Centre at GU of which he was the founding director) and most recently the £3.4m EPSRC PG, Multicorder. His research has led to one university spin-out (Mode DX) and sensor technology that led to the Ion Torrent gene sequencing system, now owned by Thermo Fisher. He has previously served on the Scottish (Government) Science Advisory Council and is presently a member of SFC's Research and Knowledge Exchange Committee.



### PROF SANDY COCHRAN

Prof Sandy Cochran is Professor of Ultrasound Materials and Systems and his research focuses on materials and systems to apply ultrasound principally in medicine and life sciences. His lab is the only one in the UK dedicated to medical ultrasound materials and systems, and one of only a handful like it in the world. He is particularly interested in new piezoelectric materials and better utilisation of existing materials, miniature devices for clinical applications of high resolution ultrasound imaging, focused ultrasound surgery and ultrasound-targeted drug delivery, ultrasound for transmission beamforming and manipulation of cells and particles, miniature and microscale ultrasound systems for biomedical applications and ultrasound and other techniques for sensing the body.



### PROF DAVID HUTCHINGS

Professor David C. Hutchings, FInstP SMIEEE, is a world leading expert on nonlinear optics and optoelectronic integration in semiconductors. His research interests and experience encompasses nonlinear optics, monolithic and heterogeneous optoelectronic integration, semiconductor theory and modelling, and computational electromagnetics. He has a background at CREOL, Univ. of Central Florida, and with fellowships at the University of Glasgow from the Royal Society of Edinburgh & Scottish Office/Executive (1992--1995, 2003) and EPSRC (1995--2000). He served (2005--2010) as the Head of the Graduate School (Associate Dean) in the Faculty of Engineering at the University of Glasgow. He has authored over 80 papers in leading, peer-reviewed journals and over 160 conference presentations.



### PROF ROBERT HADFIELD

Prof Robert Hadfield is Head of the Division of Electronic and Nanoscale Engineering and Professor of Photonics. He holds a European Research Council Consolidator Grant and is co-investigator of QUANTIC, the UK Quantum Technology hub in imaging, led by the University of Glasgow. He has a past at the US National Institute of Standards and Technology, and as a Royal Society University Research Fellow and Reader in Physics at Heriot-Watt. He was awarded the 2012 J&E Hall Gold Medal of the Institute of Refrigeration and the 2013 Brian Pippard Prize of the Institute of Physics Superconductivity Group. He is a Fellow of the Institute of Physics, the Institution of Engineering and Technology, and the Optical Society of, as well as a Senior Member of IEEE and SPIE. He serves on the editorial boards of the journals Superconductor Science and Technology (IoP), Optics Express (OSA) and Royal Society Open Science (Royal Society of London). He is also editor of the Springer Quantum Science and Technology Series on Superconducting Devices in Quantum Optics.



### DR DAVID CHILDS

David T.D. Childs received the B.Sc. degree in Physics, the M.Sc. degree in Semiconductor Science and Technology from Imperial College, London in 1996 and 1997 respectively. He continued at Imperial where he received his PhD in Properties and applications of 1.3 $\mu$ m InAs/GaAs Quantum Dot Devices in 2002. He was then with the R&D Department of Marconi Optical Components (latter Bookham, now Oclaro) at the Caswell semiconductor research and fabrication facility until 2006, where he was responsible for the development of a range of telecoms lasers. During this time he also worked on several European projects developing Quantum Dot technology. Following this he joined the department of Electronic and Electrical Engineering at the University of Sheffield. There he was engaged in a number of projects developing semiconductor light sources from visible through to THz wavelengths. He was also involved in developing systems to demonstrate the application of semiconductor devices to fields ranging from selective laser melting (3D printing), to mid-infrared hyper-spectral imaging (biomedical imaging). Since 2015 he is a lecturer in the Electronic and Nanoscale Engineering group within the School of Engineering at the University of Glasgow. He has contributed to over 100 journal and conference publications. His research interests span from semiconductor light emitter development through photonic integration to the applications of these devices and systems from communications to biomedicine.



### DR MATTEO CLERICI

Dr Matteo Clerici received the PhD in physics in 2010 and joined the School of Engineering of the University of Glasgow in October 2015. He co-authors 50 journal papers, and has more than 40 invited talks at international conferences on topics such as linear and nonlinear optics, terahertz photonics, quantum optics and plasma physics. His current research activity is concerned with terahertz single cycle pulses generation, manipulation and detection, with the development of novel imaging techniques for low amplitude THz and optical fields, and with quantum optics applications.



### DR HADI HEIDARI

Dr Hadi Heidari (PhD, SMIEEE), is a Lecturer in the School of Engineering at the University of Glasgow, United Kingdom. Prior to this, he was a postdoctoral researcher at the Electronic and Nanoscale Engineering Division of the University of Glasgow. He received BSEE and MSEE degrees in 2005 and 2008, respectively. Following 3-years working in industry and academia, he completed his Ph.D. in Microelectronics from the University of Pavia, Italy. His research interests are focused on the magneto-electronics, CMOS sensory microsystems, sensor interfaces, device modelling and flexible electronics.

Dr Heidari is member of IEEE Sensors Council Administrative Committee, IEEE Sensors Council Young Professional Programme Chair and Senior Member of IEEE. He served on the organizing committee of several conferences including General Chair of UK-China Emerging Technologies (UCET) 2017 Workshop, social media chair of the IEEE SENSORS 2016 and 2017 conferences, track chair at NGCAS 2017 conference, local organizing committee of the IEEE PRIME 2015 conference, and organizer of a special sessions on the IEEE ISCAS 2016 and 2017 conferences. He is and a committee member of the IEEE Sensors Council UKRI Chapter. Dr Heidari has authored or co-authored over 40 peer-reviewed publications in international journals or conference proceedings and acts as a reviewer for several journals and conferences. He received honorary mention paper award at the IEEE ISCAS 2014 conference, Gold Leaf award at IEEE PRIME 2014 conference, and co-recipient of the ISSCC 2016 Silk Road Award. He was a research visitor with the University of Macau, China, McGill University, Canada, and the University of Sydney, Australia.



### DR LIANPING HOU

Dr Lianping Hou is currently a lecturer at Electronic and Nanoscale Engineering, School of Engineering, University of Glasgow working on semiconductor integrated optics, high power and high frequency semiconductor mode locked lasers, monolithic integrated CWDM and DWDM laser sources, terahertz technology, nanotechnology and photonics, graphene modulators. He is a member of the Optical Society of America, a member of IEEE. He is the author and co-author of more than 110 journal and conference papers and the inventor of several patents.





### DR DONALD MACLAREN

Dr Donald MacLaren is a lecturer in physics at the University of Glasgow. His research interests are centred on the structural and functional characterisation of advanced materials, especially using electron microscopy techniques. He is currently managing research programmes in the areas of thermoelectrics, resistive memory, functional oxides and plasmonics.



### DR IAN MACLAREN

Dr Ian MacLaren is Senior Lecturer in Physics at the University of Glasgow. His research work concentrates on the study of the structure and chemistry of materials and artificial structures at the nano- and atomic-scale, principally using transmission electron microscope. Current research areas include nano precipitation in high strength steels, corrosion of nuclear reactor materials, growth of heterostructures for infrared optoelectronics, and the understanding of processing - structure - function links in functional oxides.



### DR DAMIEN MCGROUTHER

Research aims to provide fundamental insight into the behaviour and performance properties of technologically relevant materials and structures with nanometre scale dimensions. Work focuses on the following areas: Nanomagnetism: domain & domain wall behaviour in thin films and nanostructures influenced by rapid magnetic field pulses and current induced spin transfer. Development of novel Transmission Electron Microscopy (TEM) techniques for imaging magnetic structure with high spatial and temporal resolution and performance of in-situ experiments.



### DR STEPHEN MCVITIE

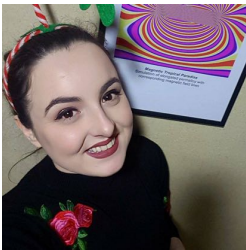
Dr Stephen McVitie is a Senior Lecturer with the School of Physics and Astronomy at the University of Glasgow. His interests include the development of magnetic imaging techniques using electron-microscopy and magnetic force microscopy and micromagnetic characterisation of magnetic thin films.

# STUDENT PROFILES

## 2014-2015 COHORT



Hi, I'm **Ali Mugahid**. I am currently investigating a variety of core-shell plasmonic nanostructures composed of noble metals and refractory oxides with different geometries, including nanospheres, nanospheroids, and a range of oxides, such as  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{ZrO}_2$  and  $\text{TiO}_2$ . The studies aim to reveal how the optical absorption, field enhancement and thermal stability are impacted by the various structural parameters, which will provide important insight for developing effective optical nanodevices for applications in high-temperature environment such as heat assisted magnetic recording (HAMR), surface enhanced Raman spectroscopy (SERS), thermophotovoltaics, and thermal cancer therapy.



Hi everyone. I'm **Alison Cowan**. I began my scientific journey by undertaking an undergraduate MSci Physics course at QUB. I worked with transmission electron microscopy for my final year project and that is where my love for characterising materials began. I applied for the CDT, was given a place and found myself over in sunny Scotland and just couldn't bring myself to leave. My project combines both magnetism and electron microscopy, and will mainly focus on Lorentz magnetic imaging and material characterisation.

I'm currently investigating magnetostriction in permalloy thin films under the watchful eye of Dr. S.McVitie (UofG). Magnetostriction can simply be defined as the dimensional change of a material under the application of an applied magnetic field i.e. it will either shrink or stretch, but this is a tiny tiny effect in the order of  $10^{-6}$  so can be difficult to characterise. Pretty cool! Materials with little to no magnetostriction are sought after for the next generation of data storage devices and that is the main aim of my work! If you are interested in this please do not hesitate to come over for a wee chat or take a look at my poster!



Hi, I'm **David Kane**. Working in Dr Bob Pollard's group, my main area of study is optimising plasmonic nanorod systems, with a keen focus on the materials deposition aspect. Outside of physics, I'm a co-founder of Farset Labs, a STEM charity and Belfast's first hackerspace. When not wrangling with one of the above, I enjoy photography, microelectronics, and really good tea. It's worth noting that I have experimentally confirmed the latter two do not mix well.



I'm **Emma Marlow** and I am currently immersed in my Queen's based PhD project, "Nanostructured Plasmonic Arrays for Optical Detection" with my supervisors, Dr Bob Pollard (QUB) and Professor Marc Sorel (UoG). I love my project; the field of plasmonic sensors is so fast-paced and my time and focus is on constantly improving the sensor's specific surface.

Before joining the CDT, I didn't follow the typical academic pathway; in 2014, I graduated with a first-class honours MSci degree in Physics and decided to leave academia, taking a job in an energy company as an analyst. I realised very early on that I wanted to pursue a PhD, actually doing research instead of just reading about it so I happily accepted the opportunity to join the CDT in June 2015.

My experience of the CDT has been positive, the first year gave me the opportunity to refresh some concepts and skills that were a bit rusty and also develop new ones before beginning my project. My favourite addition over a typical studentship is the Innovation Academy, which helps develop skills in a way which is not typically part of a normal PhD.

Outside of Physics, I enjoy all the usual activities- particularly eating, travelling and relaxing with friends, family and dogs.



I'm **Hannah Johnston**. I undertook my undergraduate at Queen's University Belfast, and achieved an MSci in Physics in 2015.

Numerous optical devices are now incorporating nanostructures which can be used in HAMR, biosensing or for optical communications. In order to use nanostructures for different applications, optimisations of the structures themselves and how they can be integrated into different devices with a viable source and detector must be investigated.

In this project, we will begin by looking at a simple situation with a single source and a nanostructure surface. Maximising the sensitivity of the nanostructure to biological interactions at wavelengths corresponding to accessible laser lines will be achieved by tuning the dimensions of the nanostructures. Different energy sources will be researched during this project including planar light source and ultrasound. Characterisation of the device components will be undertaken in order to allow for optimisation; design of the device can be upgraded after completion of characterisation.

The device can be upgraded for a multiplexed operation where a single planar source, such as a semiconductor laser, interacts with multiple spots on the nanostructure surface and how these spots can be imaged and analysed on a CCD or CMOS type detector.



I'm **Iain Butler**. I am in the second year of the CDT. My PhD project is looking at using quantum dot semiconductor lasers in harsh environments with Prof. Richard Hogg in Glasgow and Seagate. My undergraduate degree from the University of Exeter with in BSc in Computer Science with Electronic Engineering, I have made good use of the technical and academic training from the CDT and institutions. Along with the innovation academy and industrial networking opportunities the CDT it has provided me with a unique experience.



I'm **Jade Scott**, currently based at QUB and working on my PhD project, Antiferromagnetic Materials for Optical Recording, supervised by Prof. Robert Bowman (QUB) and Dr Stephen McVitie (UoG). I'm working with synthetic ferrimagnet thin film structures, characterising them and working with the atomistic simulation package, VAMPIRE, to try and understand and predict their behaviour.

I completed my MPhys at the University of Liverpool, away back in 2014, and have since tried my hand at accountancy before realising that I wasn't quite cut out for it. I joined the CDT in June 2015, not only on the realisation that I really wanted to continue in academia, but because of the opportunity presented by the links between industry and the two universities, skills development and the chance to be part of a close-knit cohort of students to work and learn with. Outside of physics, I love to bake, spend time with family, friends and pets, and watching F1.



My name is **Jennifer Mackel** and I am part of the CDT in Photonic Integration and Advanced Data Storage. Before joining the CDT, I acquired an MSci in Physics and Astrophysics from Queen's University Belfast; I really enjoyed my time at Queen's and wanted to do my PhD there, and the CDT seemed like a great opportunity to work in cutting edge research and build up other skills at the same time.

My research focuses on new magnetic systems for potential data storage applications, particularly the use of magnetic skyrmions for memory and logic. I am currently investigating bulk chiral magnetic systems and thin film growth techniques to identify new ways of creating and manipulating skyrmions.

When I'm not in the lab I enjoy running, strength training, reading and painting. I currently live in Belfast with my partner and my cat, who thankfully are very patient with my often-busy work schedule.



Hello, my name is **Liam Wright** and I'm a PhD student at the University of Glasgow. I completed my MSci in Physics at the University of Glasgow in 2016 and joined the PIADS CDT shortly after. After a year of courses and projects I delved into my PhD, with the aim of characterising the functionality of metallic nanoparticles as a method concentrating light to well beyond the diffraction limit - needed in HAMR as a source of heating a very small spot of the recording media. Supervised by Dr Donald McLaren in the Material and Condensed Matter Physics, we are examining different materials and geometries of nanoparticles using electron energy loss spectroscopy in the scanning transmission electron microscope. This CDT brings about a real opportunity to collaborate across different universities and disciplines. I've have been able to take advantage of this by carrying out fabrication, metallisation, and analysis of nanoelements using the facilities at both Queen's University Belfast and University of Glasgow.



Hi, I'm **Matt Colbear**. I studied Chemical Physics at the University of East Anglia after being drawn into discovering how things worked in chemistry and physics at A-Level. My current research is looking into developing the use of functional domain walls in oxides for memory storage applications. As I enjoy playing computer games, it's great to have the opportunity to work in developing something that could one day be used for data storage.

## 2016 COHORT



I am **Ali Al-Moathin**, an electrical engineer holding MSc in optoelectronics from Lund university/ Sweden (recipient of Erasmus Mundus MSc Scholarship) and a BSc in Electrical Engineering from Blekinge Institute of technology -Sweden and a BSc in Maths from the University of Baghdad.

From my previous studies and past career experience, I developed extensive knowledge in antenna design, light propagation inside tissues, RF amplifier design, waveguide design, analogue current sensor, speech signal coding/encoding for mobile application, robotic design and photovoltaic system. I am currently a PhD student doing Photonics integration and advanced data storage at both Queen's and Glasgow universities. My current research interests focus on developing a new hybrid integrated circuit that combines both photonic (PIC) and an electronic integrated circuit (EIC) to achieve a high speed and performance for communication applications.



Hi I'm **Ben King**. Before joining the CDT, I obtained an MPhys from the University of Durham in 2016. In the first year of the CDT I carried out a mini project in Glasgow on the characterisation of Photonic Crystal Surface Emitting lasers (PCSELS), a novel laser device that provides high power which scales with area, low divergence, control of beam shape and polarisation, and beam steering. For my PhD, I will be continuing my research in Glasgow into the modelling, fabrication, and characterisation of PCSEL devices, in particular the incorporation of quantum dots as the active laser medium.

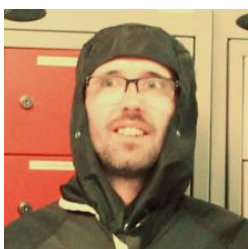


My name is **Christopher Gough** and I am a member of the second cohort of the CDT. In 2016 I graduated with a master's degree in Physics from the University of Glasgow. While at Glasgow I completed two projects in the Materials and Condensed Matter Group, which sparked my interest in solid state physics.

When searching for a Ph.D. the Photonic Integration and Advanced Data Storage CDT attracted me because of the world leading research carried out by Glasgow and Queen's, along with the experience and facilities both universities provide. I have really enjoyed the first year and am looking forward to beginning my research, where I will be examining the integration of III-V lasers to waveguides, principally at Glasgow.



Hi, I'm **Chris Lambert**. I guess I am currently working on being a jack of all trades. I graduated with a 1st Class Honours as a Master of Science in Chemistry from QUB, followed by a 3-month stint in Germany sampling both their unique culture and making sure I'm punctual. The work was based upon computational chemistry, like my Masters project in Dye Sensitised Solar Cells. After this I worked in industry with Norbrook Pharmaceuticals, followed by this current bash at Physics and Engineering with QUB and GLA. During this year I've managed to expand my knowledge with projects involving magnetic nanoparticles and their use in cancer treatment, for example. I'd say that after missing Physics for so long, I am definitely a man who likes both a challenge and punishment. I'm just about to start into an industrial PhD with Seagate too; I cannot wait for this new experience and the opportunities this will present to me. Outside of this I try to do my best to socialise, swim, read some good ole fiction by the fire and eat at my favourite restaurant; part of my attempts to stave off madness.



I'm **Darren McMahon**. I graduated from the Open University with a 2:1 in Natural Science specializing in Physics in 2015. I have been with the CDT from September 2016 and this summer I will be investigating the temperature and heat transfer in plasmonic nanoantennas with the hope of continuing this during my PhD. The CDT has provided me with the opportunity to expand upon my knowledge and get hands on experience in a lab. I like the way the CDT has been scheduled as it has both a learning element and a practical element. The modules assume that you have a basic knowledge of the topics and expand upon this, while the practical components allow you to experience what your PhD will be like. The CDT also provides you with the opportunity to attend the Innovation Academy in Dublin, where the Guinness is excellent, and where you are tasked with thinking about the practical applications of your PhD. I feel the CDT is a wonderful opportunity for anyone who has an interest in physics and engineering.



Hi, I'm **Jack Brennan**. I did my BSc in Physics at QUB before spending a year studying and working in Laboratoire Aimé Cotton, Paris. My PhD will be a collaboration between University of Glasgow and Laboratoire Aimé Cotton, investigating the Optical and Plasmonic properties of Silver Nanofractals.

(Hopefully there actually are some interesting properties or it will be a long 3 years!)

Outside Physics, I fancy myself a pretty funny guy, and I enjoy playing pretty much any sport and eating everything I can get my hands on.

I chose the CDT because it was an opportunity to meet different academics and tailor a project to suit my needs.... really, I knew I wanted to work in materials physics, but needed to figure out exactly what I wanted to do and have a bit more time to decide!! I've enjoyed my time so far and I'm really looking forward to getting settled into my own project and having something to work on consistently.



Hello all, my name is **Ross Jordan** and physics is my passion to contribute to society. I started an undergraduate in Physics to expand my knowledge and understanding and in my progression, I understood I wanted it to have a real-world impact. The CDT has allowed me to pursue this goal in the field of magnetics. I'm about to begin my study into the world of ferromagnetics and the effect of heat on the crystal structure of the media. The advantages of the CDT are the extra modules on learning real world skills in business and communication, allowing me to become a well-rounded researcher with plenty to contribute. Feel free to ask me questions at the conclave!



My name is **Shane McCartan**. I studied physics at QUB. During my masters project I researched charged conducting domain walls in ferroelectrics using scanning probe microscopy (SPM) techniques under the supervision of Prof. Marty Gregg, an incredibly exciting area of research. This nurtured my interest in materials and condensed matter physics, which is the main reason I joined the CDT. For my two month research project at Queen's in semester 2, I rejoined Marty's group and continued the work from my master's project. Here, the focus was on trying to identify the conduction characteristics of charged domain walls by utilising the Hall effect in conjunction with variants of SPM. For my PhD project, I have moved to Glasgow to study charged domain walls from a different perspective, primarily scanning transmission electron microscopy, under the supervision of Dr. Ian MacLaren. Outside of this I really enjoy listening to traditional Irish music, playing trad music, talking about trad music, and carrying my guitar about everywhere I go.





Hi there, I'm **Sia Andersson** and I graduated in 2016 with an MSci in Physics from the University of Glasgow, UK. During my undergraduate degree, I did my projects with the Materials and Condensed Matter Physics group on elemental quantification and atomic ordering with TEM and STEM techniques, meaning I get very excited by small deviations in pixels and graphs. With the CDT, I've worked on projects relating to superluminescent diode OCT systems and evaluation of materials for HAMR, and the CDT has also helped me uncover my secret potential as a budding graphics designer in designing a product catalogue for a prosthetic limb company, and skincare packaging for a start-up. I also designed this booklet! The CDT has been a wonderful opportunity that's has involved me in unexpected things; for example I never imagined would be Lead Organiser for a conference like this Conclave, and yet here I am. Over the summer, I will be doing my project with Kelvin Nanotechnology Ltd., based on campus at the University of Glasgow, and hopefully stay for the rest of my PhD. In my spare time, I'm an avid equestrian and rumoured bunny whisperer.



Hey there, I'm **Steffan Gwyn**. Last year I graduated with a Physics MPhys degree from the University of Manchester. I started on the CDT course in September, and the fact that I've gotten to live in two cities, and spend a long time in a third, has been fantastic! It's been a unique experience, and the rest of the cohort have definitely made it fun. My summer project will involve investigating various GaN laser structures, and am aiming to fabricate one by the end of the summer. I'll carry this on into my PhD project and will be looking into designing novelty GaN structures as well as the integration of GaN onto silicon. Outside of my PhD, I am a keen squash player, playing in local leagues and tournaments, as well as being interested in photography. I'll be taking my camera around the hotel throughout the day, so please don't shy away!

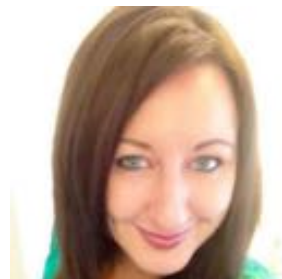


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## WEBSITE

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