SU2P Symposium

James Watt Conference Centre

Heriot Watt University

SU2P Banquet

The Dalmahoy Hotel

8th SU2P Symposium Programme

James Watt Conference Centre - Heriot Watt University

Day 1 Wednesday April 5th 2017

08.30	Tea/Coffee and registration	(exhibition)
09.30	Welcome Address & Intro	Steve McLaughlin Heriot Watt - Symposium Host
09.45	**Energy & Environment** Keynote 1	***Caroline Nichol – Edinburgh*** ***"Multi spectral lidar for forest mapping: current capabilities and technological challenges"***
10.15	Keynote 2	***Jenny Nelson – Imperial College London*** ***"Light harvesting and solar energy conversion in molecular electronic materials"***
10.45	Q/A	Facilitator - Malte Gather - St Andrews
11.15	Tea/coffee (exhibition)	
11.45	15 one minute poster presentations	Sponsored by **SUPA**
12.00	**Healthcare & Medicine** Keynote 3	***Lambertus Hesselink -Stanford*** ***"A Novel Differential Phase Contrast X-Ray Imaging System with Applications in Medicine and Aviation Security"***
12.30	Keynote 4	***Robert Henderson -Edinburgh*** ***"CMOS sensors for photonic molecular fingerprinting of disease pathology"***
13.00	Q/A	Facilitator - Ian Underwood – Edinburgh tbc
13.30	Lunch & Exhibition	
14.30	15 one minute posters	Sponsored by **SUPA**
14.45	Student presentation	**Clara Vergez - Edinburgh** ***" Lighting up the cause of heart attacks"***
15.00	Student presentation	**Tomas Aidukas - Glasgow** ***"Low-cost Gigapixel Microscope for Rapid Blood Tests and Disease Diagnosis"***
15.15	Q/A	Facilitator – Alan Miller SUPA
15.30	Tea/Coffee (exhibition)	
16.00	**Communications & IT** Sponsored by the **KTN** Keynote 5	***Tommaso Calarco - ULM*** ***"From Quantum Science to Quantum Technologies"***
16.30	Keynote 6	***Dieter Jaksch - Oxford*** ***"Early Applications of First Generation Quantum Information Devices"***
17.00	Q/A	Facilitator - Andrew Daley - Strathclyde
17.30	Poster Session & drinks	
18.30	Coach	Departs for Dalmahoy Hotel and Banquet

19.15	Symposium Banquet Dalmahoy Hotel	- **with Keynote Prof Harald Haas of PURE Lifi**
22.30	Coach	Coach returns to James Watt Conference Centre

Day 2 Thursday April 6th 2017

08.30	Tea/Coffee (exhibition)	
09.00	Introduction	
09.10	**Advanced Manufacturing** Sponsored by the **KTN** Keynote7	***Bill O'Neill – Cambridge*** ***"Carbon nanofibres: synthesis, processing and applications."***
09.40	Keynote 8	***Chris Sutcliffe - Liverpool*** ***"Metal Additive Manufacturing a Future Production Mass Manufacturing Solution?"***
10.10	Q/A	Facilitator - Duncan Hand - Heriot Watt
10.40	Tea/Coffee (exhibition)	
		Sponsored by **SUPA**
11.10	Student presentation	**Amiel Lopes – Heriot Watt** ***"Micromachining of Fused silica using picosecond pulses"***
11.25	Student presentation	**Enrico Carnemolla - Heriot Watt** ***"Hybrid nonlinearities in transparent conducting oxides: Enabling novel functionalities in integrated photonics"***
11.40	Student presentation	**Matthew Johnson – Glasgow** ***"New Optical Elements for Precision Metrology with Atoms"***
11.55	Student presentation	**Najwa Sidqi – Heriot Watt** ***"Efficient Single-Photon emitters for quantum information"***
12.10	Student presentation	**Iman Tavakkolnia - Edinburgh** ***"Nonlinear Fourier Transform – A New Signal Processing Technique for Data Transmission over Optical Fibre"***
12.25	Q/A	Facilitator – Alan Miller SUPA
12.45	Lunch & Exhibition	
13.45	**Defence & Security** Keynote 9	***Peter Asenbaum - Stanford*** ***"Atoms as a non-local probe for gravity"***
14.15	Keynote 10	***Mike Holynski - Birmingham*** ***"Cold atom gravity gradiometry"***
14.45	Q/A	Facilitators - Giles Hammond/Douglas Paul -Glasgow
15.15	Awards and Closing Remarks	Allister Ferguson - Strathclyde
15.30	Close	

Speaker Information

Energy & Environment 	**Caroline Nichol - Edinburgh University** ***Multi spectral lidar for forest mapping: current capabilities and technological challenges*** Laser altimetry, or Light detection and ranging (LIDAR) is a well established and powerful tool used both in terrestrial and airborne platforms to provide detailed measurements of vegetation structure, and to support a range of themes from sustainable forest management to carbon accounting. This talk will focus on the technical development of LiDAR from single frequency to multiple frequencies, for improving quantification of forest structure. A history of the engineering and scientific developments with a forward looking projection of where the field is moving will be presented. Caroline Nichol received her PhD in 2000 from the University of Edinburgh and is currently Senior Faculty in the School of GeoSciences at the University of Edinburgh. Caroline's research utilises both optical and LiDAR remote sensing to understand canopy-level (particularly forests) physiology and biosphere-atmosphere processes. Caroline's recent research has centred on investigations into retrievals of solar induced fluorescence, utilizing optical data to monitor and track disease development in UK forests and investigating new airborne multi spectral LiDAR data in north American and Canadian forest canopies.
Energy & Environment 	**Jenny Nelson - Imperial College London** ***Light harvesting and solar energy conversion in molecular electronic materials*** Molecular electronic materials such as conjugated polymers have attracted intense interest for applications in light emission, energy conversion, thin-film electronics and other fields. They have been studied intensively for photovoltaic energy conversion, where their appeal lies in the potential to tune material properties (electronic, optical, mechanical and thermal) through control of chemical structure and molecular packing, whilst using facile fabrication methods. In this talk, we will address the relationship between the optical properties of the materials and the performance of photovoltaic devices, considering the effects of optical gap and of specific optical absorption on the practical limits to power conversion efficiency. We use experimental characterization and molecular modelling to investigate the origin of the optical absorption in terms of molecular structure and conformation, and use our results to propose design rules for enhanced light harvesting in solar energy conversion devices.

Jenny Nelson is a Professor of Physics at Imperial College London, where she has researched novel varieties of material for use in solar cells since 1989. Her current research is focussed on understanding the properties of molecular and hybrid semiconductor materials and their application to solar energy conversion. This work combines fundamental electrical, spectroscopic and structural studies of molecular electronic materials with numerical modelling and device studies, with the aim of optimising the performance of solar cells and other devices based on molecular and hybrid materials. She also works with the Grantham Institute for Climate Change at Imperial to explore the mitigation potential of renewables energy technologies. She is an ISI Highly Cited Researcher in Materials Science and has published over 250 articles in peer reviewed journals, several book chapters and a book on the physics of solar cells. She holds a number of awards including the 2016 Institute of Physics Faraday medal and was elected as a Fellow of the Royal Society in 2014.

Healthcare & Medicine

Lambertus Hesselink - Stanford University

A Novel Differential Phase Contrast X-Ray Imaging System with Applications in Medicine and Aviation Security

Differential Phase Contrast (DPC) Imaging provides measurement of X-ray absorption, phase and small angle scatter. We have developed a unique system, 3-Fates, with a wide field of view (FoV), single step exposure and high contrast. A novel Photon Electron Source Array (PeXSA) enables motionless DPC imaging, with a FoV similar to traditional X-ray sources. We demonstrate the potential for high resolution medical imaging and improved object discrimination for aviation security applications

Professor Hesselink's research is focused on 3-D X-ray imaging and nano photonics in the visible and X-ray regimes. He pioneered Holographic Data Storage, and invented the C-aperture for highly efficient nano- photonics applications, among several other major research accomplishments. In addition to DPC X-ray 3-D imaging his group currently focuses on DNA synthesis using the Nano Optical Conveyor Belt incorporating C-apertures. Among other significant awards he is a Fulbright scholar, a Fellow of the OSA and SPIE, and a member of the Royal Dutch Academy of Arts and Sciences.

Healthcare & Medicine

Robert Henderson - University of Edinburgh

CMOS sensors for photonic molecular fingerprinting of disease pathology

Currently poor and slow identification of pulmonary infections results in the use of broad spectrum multi-drug treatment regimes, unfavourable for patients in critical care and exacerbating the antimicrobial resistance problem. The UK EPSRC Proteus project is developing a medical device that can sense physiological parameters such as pH through the use of

fluorescent or Surface Enhanced Raman Sensors (SERS) on the end of custom multicore optical fibres, while time resolved single photon counting spectroscopic techniques based on single photon (SPAD) sensors are being applied to aid in the disambiguation between bacterial fluorescent probes and tissue auto-fluorescence signals.

Robert of Henderson is a Professor of Engineering at the UoE, where he holds an ERC advanced grant for his world leading work on CMOS single photon avalanche diode (SPAD) detectors. After his PhD, he spent 16 years in industry at CSEM, VLSI Vision Ltd and ST Microelectronics designing image sensors for mobile phone applications before joining the UoE in 2005. He has since developed some of the world's first SPAD detectors in nanometer CMOS technology and is leading SPAD sensor related biomedical, microscopy and quantum imaging projects.

Communications & IT

Tommaso Calarco - University of Ulm

From Quantum Science to Quantum Technologies

The first quantum revolution – understanding and applying the physical laws of the microscopic realm – resulted in ground-breaking technologies such as the transistor and the laser. Now, our growing ability to manipulate quantum effects is paving the way for a second quantum revolution.

The long-term horizon is a "Quantum Web": quantum computers, simulators and sensors interconnected via quantum networks distributing information and quantum resources such as coherence and entanglement, yielding unprecedented computing power, guarantee data privacy and communication security, and provide ultra-high precision synchronization, measurements and diagnostics for a range of applications available to everyone locally and in the cloud.

Tommaso Calarco has pioneered the application of quantum optimal control methods to quantum computation and to many-body quantum systems. Currently he is the director of the Institute for Complex Quantum Systems at the University of Ulm and of the Center for Integrated Quantum Science and Technology, which involves the University of Ulm, the University of Stuttgart and the Max Planck Institute for Solid State Research. He is an author of the "Quantum Manifesto", and a member of the Strategic Advisory Board of the ERANet QuantERA as well as of the European Commission Expert Group on the Quantum Technology Flagship.

Communications & IT

Dieter Jaksch - Oxford University

Early Applications of First Generation Quantum Information Devices

I will provide an overview of recent progress in developing the first generation of quantum devices that promise to outperform classical

computers in solving challenging computational tasks. Possible applications range from acting as a quantum co-processors capable of taking on a limited set of specific tasks to machines that solve hard optimization problems efficiently. My talk will focus on the potential of early quantum devices, which are expected to consist of only tens to hundreds of qubits, to tackle 'useful' problems that may be of interest beyond the immediate academic community.

Prof Dieter Jaksch is the Head of Atomic & Laser Physics at the University of Oxford and a Tutorial Fellow at Keble College. He is a theoretical physicist with a background in Quantum Optics and the physics of ultracold ensembles of gaseous atoms. His research interest is in developing applications of first generation quantum devices and in the physics and functionality of strongly correlated quantum matter far away from thermal equilibrium.

Advanced Manufacturing

Bill O'Neill - Cambridge University

Carbon nanofibres: synthesis, processing and applications.

Carbon nanotubes (CNTs) have physical and mechanical properties that are superior to many known materials. They offer high strength, stiffness, electrical and thermal conductivity, thus making them extremely attractive for many future industrial applications. However, most research and development on bulk CNT materials production and applications has taken place on a small scale due to limitations in material production technologies and cost. As a result, integration of CNT structures into commercial products has not been widespread. I will present the latest developments in the synthesis and processing of carbon nanotube fibres, and discuss their application potential in electrical systems.

Prof Bill O'Neill, is the Director of the Centre of Industrial Photonics, a Fellow of Downing College, Cambridge, and Director of the EPSRC Centre for Doctoral Training in Ultra Precision. His research interests focus on laser matter interactions, materials processing and the creation of next generation manufacturing capabilities.

Advanced Manufacturing

Chris Sutcliffe - Liverpool University

Metal Additive Manufacturing a Future Production Mass Manufacturing Solution?

Metal Additive manufacturing is still in its infancy as manufacturing technologies go this proposal will investigate the current state of the art in laser based additive manufacturing suggesting future avenues for interesting research and leading onto identify new markets for adoption of the technology.

Professor Sutcliffe, works in additive manufacturing (AM) particularly laser

melting and inkjet printing developing new processes and products. His work is patented, licensed and published worldwide and has resulted in the development of implants and manufacturing equipment. He holds a tenured academic position at the University of Liverpool and is Research Director at Renishaw AMPD and Director and co-founder of Fusion Implants. He has, or is, involved in 19 grants has successfully supervised 15 PhD students and has 19 active patents.

Defence and Security

Peter Asenbaum - Stanford University

Atoms as a non-local probe for gravity

Freely falling atoms are ideal test masses to study gravitational interactions. Light pulse interferometry allows one to study the motion of the atoms in respect to the laser beams, which act as rulers for the atomic position. Recent advances in interferometer times and large momentum transfer are crucial for applications such as gravity imaging as well as high precision tests of fundamental physics, e.g. the equivalence principle or quantum states in curved spacetime.

Dr. Peter Asenbaum received his PhD in Physics from the University of Vienna in 2014. The same year he joined the group of Mark Kasevich at Stanford University to work on high precision atom interferometry.

Defence and Security

Mike Holynski - Birmingham University

Cold atom gravity gradiometry

The UK National Quantum Technology Hub in Sensors and Metrology is creating a range of sensors based on cold atoms. A particular focus is on the creation of gravity gradiometry sensors for applications such as the location of underground assets, such as pipes or tunnels, and gravity mapping for resilient navigation. In order for cold atom gradiometry to bring benefit to such applications, a significant effort is needed in increasing the technology readiness of both the underpinning hardware and the sensors themselves, with a recent push being towards demonstrations in the field.

Michael Holynski is the lead of the atom interferometry team at the University of Birmingham. The team works on a range of cold atom based gravity and gravity gradient sensing, with a particular focus on the development of field ready prototypes and enabling capability within industry. One such project is the DSTL Gravity Imager, a gravity gradiometry array which targets defence orientated applications. In addition to development of the sensor hardware, the team develops new techniques in gravity inversion in order extract better information from gravity maps.

Exhibitors in James Watt Centre

Exhibiting SU2P Industrial Partners

Kaiam Corporation	**M Squared Lasers**	**Coherent**

Exhibiting Industry and KE Partners

AMS Technologies	**Hamamatsu**	**Laser Quantum**
Elliot Scientific	**Eluxi**	**Technology Scotland**
SUPA	**KTN**	

Student Presentations

Name	Abstract
Clara Vergez **Lighting up the cause of heart attacks**	The coronary arteries are 3-4 mm thick blood vessels carrying oxygen to the heart muscle; their blockage is the cause of heart attacks. This occurs when the fatty plaques which build up in the walls of these vessels, break and expose their clot-forming contents to the blood, leading to a blockage. However, not all plaques are prone to rupture and inflammatory cells (specifically macrophages) play a defining role in turning a "stable" plaque into a "vulnerable" one, likely to cause a heart attack. Therefore, research in the field currently focuses on detecting vulnerable plaques in the hope that we will be better able to identify at-risk patients, treat them appropriately and avoid a future heart attack. My project aims to tag vulnerable plaques by enhancing the detectability of macrophages using Optical Coherence Tomography (OCT), an imaging system already used in the clinic to visualise the arterial wall in patients. We hypothesise that a clinically approved solution of metal nano-particles (name withheld), will be taken up by these macrophages and enhance their OCT signal both *in vitro* and *in vivo* using a clinical OCT system. I have designed and 3D printed a "phantom" artery model for *in vitro* imaging of particle-filled macrophages with the clinical OCT catheter. Alongside this I am working with clinicians on the analysis of OCT images from a human clinical trial assessing the effects of the same nano-particle in human patients having recently suffered a heart attack. I have shown that particle-filled macrophages do produce a significantly higher OCT signal as compared to control macrophages in the *in vitro* model. In proving this I

	have produced a robust image analysis framework for use on the clinical-trial data. The next step involves testing the same hypothesis on an *ex vivo* animal model to confirm that the nano-particle will enhance the detection of macrophages in a more biologically relevant system.
Tomas Aidukas **Gigascope: Low-cost Gigapixel Microscope for Rapid Blood Tests and Disease Diagnosis**	High-performance optical instruments required for disease diagnosis, drug development/testing, medical research and many other applications are bulky, expensive, and limited by fundamental limitations of optics. Third-world countries where many people suffer from undiagnosed diseases such as malaria and sickle-cell disease would benefit greatly if such equipment would be affordable, portable and would not require experts for operating it. Moreover, current microscopes have an inversely proportional relationship between resolution and field-of-view (FoV). This causes problems for applications such as histology or high-throughput drug testing where both – high resolution and wide FoV – are required. To resolve these issues, we are developing a 3D printed microscope called Gigascope costing under £150 based on a recently developed Fourier Ptychography technique [1], [2] where a modified Raspberry Pi camera is used for imaging and a Raspberry Pi board does data acquisition and processing. This technique produces wide FoV, high resolution gigapixel images and offers multiple imaging modalities such as brightfield, darkfield, phase contrast, optical sectioning, 3D imaging etc. [3], [4] Cheap mobile phone based microscopes have been introduced for low-cost imaging with resolutions around 5 microns [5], whereas we expect to achieve resolutions up to 0.5 microns within the same FoV resulting in gigapixel images. Such resolution would allow identification the presence of hemozoin pigments - that have lengths up to 0.5 microns - inside malaria infected blood cells [6] The processing power of the Raspberry Pi would be capable of cell-counting for routine blood tests. Furthermore, Gigascope could be used for imaging biopsy samples for disease diagnosis such as cancer. Together with its price, transportability, and high image quality it would be extremely useful not only to third-world countries, but also for application in the rapidly growing field of point-of-care testing. The wide field of view together with high resolution can greatly reduce the number of confocal microscopes being used for drug discovery which would producing drugs faster and cheaper.
Matthew Johnson **New Optical Elements for Precision Metrology with Atoms**	The University of Strathclyde's Experimental Quantum Optics and Photonics group, as part of the UK national Quantum Technology Hub for Sensing and Metrology, have been developing new timing and measurement devices based on atom-light interactions. Atomic systems herald vastly improved sensors for Magnetometry, Gravimetry, Inertial guidance and Atomic clocks. The biggest barrier for industry and commercialisation is compactification and portability. A development using diffracted light from microfabricated gratings, a Grating MOT (Magneto-Optical Trap) confines atoms with a single laser beam. Recent work**[1]** has confirmed the grating-trap's efficiency around 10-6 atoms, rivalling that of standard six-beam MOTs. For inertial sensing, optical-waveguides generated holographically from Fresnel

	Zone-Plates (FZPs)**[2]** are used to confine Bose-Einstein condensates. Recent characterisation in the average RMS error in the brightest 10% of the hologram is measured at 3% at most. In this presentation, we will cover the work done on Sensors and Metrology at Strathclyde, with a focus on compact optics for atoms, including FZP holograms and diffraction-grating traps.
Amiel Lopes **Micromachining of Fused silica using picosecond pulses**	Glass is widely used to manufacture optical components, typically using mechanical grinding and polishing techniques. Whilst this is straightforward for flat and spherical surfaces, other more complex shapes present difficult manufacturing challenges. Laser machining is a potential solution and indeed CO_2 lasers are now used commercially to machine and polish fused silica optics. Ultrashort pulsed (ps, fs) lasers offer the capability of much finer scale surfaces features coupled with the ability to machine a much wider range of glasses due to the very high peak power and short interaction time of individual laser pulses with the work piece. We present optimised parameters for efficient and controlled machining of fused silica glass using picosecond laser pulses. We also demonstrate a three-step process for the generation of optical and micro-optical components in fused silica. In the first step, the glass substrate is machined using picosecond laser pulses. The second step is used to reduce the surface imperfections generated in the first step. Finally a continuous wave CO_2 laser is used to provide an optically-smooth surface.
Enrico Carnemolla **Hybrid nonlinearities in transparent conducting oxides: Enabling novel functionalities in integrated photonics**	Noble metals are key compounds for the design and fabrication of plasmonic devices despite they introduce numerous technological limitations such as high losses, incompatibility with CMOS fabrication, and lack of tunability (both static and dynamic). All these issues can be addressed at once by the alternative use of Transparent Conductive Oxides (*TCOs*), which have been demonstrated to possess reasonably low absorption at telecom wavelength, offer static and dynamic control over their optical properties, and rely on well established fabrication procedures [1-2]. In within the class of TCOs, Aluminum Zinc Oxide (*AZO*) shows large and ultrafast variation of the refractive index if probed around its ε-near-zero (ENZ) wavelengths, due to Kerr-type nonlinearities. Moreover, because of the hybrid nature of these materials (i.e. in between metals and dielectrics), interband and intraband carriers transitions refers to nonlinear effects which can be ultra-fast, large in magnitude, and opposite in sign [3-4]. Here we explored the behavior of AZO when photocarrier excitation is triggered by simultaneous two-color pumping. The transmitted spectra of the probe signal at the material ENZ wavelength (1300nm) are recorded by suing a Pump and probe set-up allowing for simultaneous NIR (787nm) and UV (262nm) excitation (see Figure 1a). To investigate the targeted hybrid nonlinearities, the output spectrum of the transmitted pulses have been recorded both as a function of the temporal distance between the NIR and UV pulse (Δt), and between the overall pump signal and the probe ($\Delta\tau$). The results are plotted in color bar in Fig.1-b, where we represent the wavelength shift $\Delta\lambda$ of the probe carrier wavelength (Figure 1b) as a function of both Δt and $\Delta\tau$. These results show that both a blue- and a red-shift of the carrier wavelength (which is as large as the entire pulse bandwidth) can be optically induced and that these effects are algebraically summable (see Figure 1b). These

	results have direct implications for the realization of ultra-fast all-optical signal routers. Additionally, our studies also reveal the possibility to exploit such hybrid nonlinearities for enlarging the material bandwidth up to 2.2THz thus making our material platform suitable for THz generation and detection [5-6]. In conclusion, all these results bring to light unprecedented capabilities of TCOs which could be of great importance for the fabrication of optical XOR gates, three-state logic devices with ultrafast switching functionalities, and other optical modules operating in the THz frequency range.
Najwa SIDQI **Efficient Single-Photon emitters for quantum information**	Quantum dots based microcavities represent a big prospect for the single-photon technology and a high potential for devices such as single-photon emitters for quantum information. The growing interest in optical quantum computing has given new challenges to single-photon technology and therefore to microcavities technology. The potential and the suitability of cavity based single-photon emitters for optical quantum computing will be represented. The new challenges for microcavities fabrication and properties will be discussed through research activity of Helia-Photonics, local Scottish company and a member of Spin-Nano H2020 research network.
Iman Tavakkolnia Nonlinear Fourier Transform – A New Signal Processing Technique for Data Transmission over Optical Fibre	The exponential growth in demand for high data transmission rates driven by the emerging technologies such as cloud computing and on-demand HD video streams has put huge pressure on the data transmission systems and most importantly long-haul optical fibre links which are the backbone for almost all global data traffic. Therefore, an ongoing extensive effort is being made by the researchers all over the world to overcome this so-called capacity crunch. Recently, nonlinear Fourier transform (NFT) was proposed for overcoming the fibre impairments and most importantly the nonlinearity. NFT can be used either as a signal processing method or as a tool for achieving the ultimate capacity of optical fibre. The promising results achieved so far has persuaded many research groups to put extra effort in developing methods based on NFT. However, due to the novelty and mathematical complexity many aspects of NFT are still challenging. In this presentation, with focus on the presenter's work, a review of the research on NFT, started from 2013, will be presented. Different methods based on NFT, achievements, and challenges ahead will be discussed. A capacity analysis for the communication system based on NFT will be explained. Also, it will be demonstrated that 10 Gbps can be transmitted over 7100 km with only continuous spectrum signaling in 26 GHz of bandwidth if correct system parameters and signaling methods are chosen.

Poster List

Umair Ahmed Korai Baloch	**Nonlinear effects in silicon waveguides.**
Georgia Anastasiadi	**Machined multicore optical fibres for cell optical manipulation**
Will Brown	**Optimising biologically inspired rings for quantum-enhanced light harvesting**
James Burch	**Flexible Metasurface Holograms**
Enrico Giuseppe Carnemolla	**Ultrafast optical modulation exploiting metacavities**
Jake Charsley	**Frequency Combs for Astronomy: Enabling Exoplanet Finder**
Laura Cowan	**Infrared image enhancement by superresolution and novel imaging architectures.**
Francois Damanet	**Effects of the quantized atomic motion on cooperative spontaneous emissions of light**
Alastair Doye	**Determining Local Structural and Chemical Ordering in Amorphous MoSix for Superconducting Nanowire Single-Photon Detectors**
Ross Drysdale	**Application of Multi-Spectral Snapshot Imaging in Retinal Oximetry**
Katie Ember	**Developing a Non-Invasive Spectroscopic Technique for Detecting Liver Damage**
Francesca Farrell	**Irradiance of an LED edge-lit elastomeric light guide**
Adam Fleming	**All Optical Control of Light Scattering**
Ronnie Gallagher	**Can Microwave Frequencies be Used to Differentiate Between Rock Types?**
Roopam Gupta	**Label-free classification of human immune cells using wavelength modulated Raman Spectroscopy**
Paul Hill	**Integrating Diamond with GaN Photonic Devices**
Craig Hunter	**Stabilisation of Semiconductor Disk Lasers for Atomic Spectroscopy**
Matthew Johnson	**Fresnel Holography for Atomic Waveguides**
Oguzhan Kara	**Broadband Mid-Infrared Dual Comb Spectroscopy with Independent Asynchronous Optical Parametric Oscillators**
Xin Li	**One-Dimensional Chirality: Strong Optical Activity in Epsilon-Near-Zero Metamaterials**
Luke Maidment	**Compressive sampling for spectral imaging**
Adria Escobet Montalban	**Compact Light Sheet Microscopes and Applications**
Giovanna Marocco	**MEMS gradiometers for attitude control on CubeSats**
John McPhillimy	**Micro Assembly of separate devices by transfer printing**
Andreas Noack	**Interferometer Readout for MEMS Accelerometer**
Joshua Robertson	**Spiking photonic neurons with Vertical-Cavity Surface-Emitting Lasers**
Ross	**Direct laser written micro-optics for optical biopsy instruments**
Adeel Shafi	**Development of Ultrasonic Contrast Microbubbles for Preclinical in-vivo Optical and Ultrasonic imaging**
Najwa Sidqi	**High efficiency dielectric distributed Bragg mirrors for quantum information systems**
Martin Sinclair	**Photonic Rotation Sensing**
Simon Tait	**Silicon Nitride Membranes: Mechanical & Optical Studies for Low Thermal Noise Precision Measurements**
Zeno Tornasi	**Optical scattering at 1550 nm in bulk magnetic Czochralski silicon**
Araceli Venegas Gomez	**Adiabatic cooling and state preparation in quantum simulation**
Liam Walker	**Feedback Cooling and Quantum Measurement**

Guanglei Xu	**Adiabatic dynamics with Classical Noise in Optical Lattices**
Jorge Yago Malo	**Dissipative generation of highly-entangled fermionic states for high-sensitivity sensing**