Physics Postgraduate Conference

Tuesday 16th August 2022

JA 314

Time	Student	Primary Supervisor
10:00 - 10:15	**Anna Gribbon**	**Griffin**
	Characterizing scattering of orbital angular momentum states Light carrying orbital angular momentum (OAM) experiences changes to the OAM spectrum when scattering occurs. Over the course of my PhD, we aim to characterize how scattering affects OAM beams and how this varies with scattering particle and OAM beam metrics. This could provide useful information for telecommunications, where information is lost due to OAM beam distortion on scattering. We also aim to use this concept to distinguish forward-scattered light in marine conditions and improve ocean monitoring measurements.	
10:15 – 10:30	**Ross Cassells**	**Strain**
	Visible Light Photonic Circuits for Quantum Technology Applications This talk presents my progress in the theoretical simulations, design, and fabrication of SU8 waveguides and gallium nitride (GaN) optical chips. GaN has the advantage of being transparent at the wavelength of interest (635 nm) and has scalability factors for compact visible light photonic circuits with various waveguide devices. Progress has been made on both SU8 and GaN platforms and discusses the current state of the art as well as future work.	
10:30 – 10:45	**Jordan Hill**	**Dawson**
	Deep ultraviolet micro-LEDs for advanced optical communications GaN-based micro light emitting diodes (LEDs) have been used in many applications; recently, they have shown their potential within optical wireless communications (OWC) due to their high modulation bandwidth. Ultraviolet (UV) wavelengths have gained interest within OWC due to the low noise and high scattering. In my first-year work, I have learned the fabrication and design of micro-LEDs emitting in the UV range based on AlGaN materials. I have developed an optimized process flow with optimized ohmic contacts, providing devices with low turn-on voltages and high -3dB modulation bandwidths. My different-size devices with the diameter in the range from 40 mm to 200 mm show the trend that the smaller the lateral pixel size, the higher current density and power density they can reach. Meanwhile, these devices also present high -3dB bandwidths over 900 MHz when the pixel diameters are smaller than 100 mm. I plan to show the OWC potential of these devices in the following months.	

10:45 – 11:00	**Charlotte Hodges**	**Hastie**
	Ultra-coherent semiconductor disk lasers for quantum technologies The laser systems for coherent matter quantum technologies - like external cavity diode lasers (ECDLs) - require frequency referencing, stabilization, and extensive beam-correction optics for sufficient performance, and are bulky and power-limited. This project will develop a compact, self-referenced and ultra-stable visible semiconductor disk laser suitable for strontium atom cooling. Characterization of a blue-diode-pumped AlGaAs/GaAs SDL sample (achieving maximum multi-mode output power of approximately 28 mW centred on 695 nm), and a single-frequency SDL (with maximum output power of 90 mW at 689 nm) is presented. Future research is discussed.	
Break 11:00-11:30		
11:30 - 11:45	**Isaac Noman**	**Laurand**
	Interfacial Self-Assembly of Colloidal Quantum Dot Microspheres; Towards Platforms for Optical Devices of the Future An entirely bottom-up fabrication route towards both colloidal quantum dot supraparticles (CQD-SPs) and their ensembles embedded into a PDMS surrogate is presented. Supraparticles are comprised from CdSe/ZnS CQDs, serving as both the gain medium and resonance cavity to enable lasing action from these CQD-SPs. To produce ensembles of these CQD-SPs we employ a variation of the gel-trapping-technique, exploiting self-assembled interfacial monolayers of our SPs. We suggest these CQD-SPs embedded into a PDMS surrogate can serve as useful platforms to realise metamaterials for potential applications in sensing, energy harvesting, and for integrated photonics.	
11:45 - 12:00	**Alexander Zotov**	**Rossi**
	RF readout of hole double quantum dots in silicon Semiconductor quantum dots are a promising platform for implementing qubits, the elementary building block of quantum computer. A challenge that still faces all current qubit implementations is their scalability. Dispersive RF readout offers a new way of reading out the state of these semiconductor qubits with a small footprint. In this presentation we will discuss and analyse a previously unseen signal response from dispersive RF readout of hole double quantum dots in silicon.	
12:00 - 12:15	**Ryan Greer**	**Mathieson**
	Towards optogenetic cortical implants for hearing impaired Hearing loss affects roughly half a billion people worldwide and afflicted people can often become distanced from society and lead unhappy and unfulfilling lives. As part of the HearLight consortium, an EU Horizon 2020 project, we are developing cortical implant technology which could translate to clinical benefit for patients beyond what is possible with state-of-the-art cochlear implants. µLED (micro-light emitting diode) arrays have been designed which can stimulate the auditory cortex in mouse brains with spatio-temporal precision. Experimentation with these devices will allow us to understand how best to activate the auditory cortex in next generation auditory prostheses.	

12:15-12:30	**Reece Jones**	**Rossi**
	A Deterministic Creation of Point Defects in Silicon Carbide for Applications in Quantum Technologies Silicon carbide (SiC) is a CMOS compatible material, well established in the high-power electronics industry owing to features such as its wide bandgap. These allow SiC to be a possible platform for large scale quantum system integration. Spin-active point defects could act as a solid-state qubit, the heart of quantum computation. There exist numerous SiC polytypes, defects, growth and implantation techniques that alter properties of the spin-active defects. It is then essential for future applications and fabrication, features such as placement, density and emission wavelength of these defects are deterministic techniques. In this work, carbon-implanted 4H-SiC samples with clear silicon vacancy emission has been annealed with varying temperature and time, post-implantation.	
Lunch 12:30-14:00		
14:00-14:15	**Dafydd Owen-Newns**	**Hurtado**
	Ultrafast Neuromorphic processing using Vertical Cavity Surface Emitting Lasers Neuromorphic processing is an alternative method of computing using architecture inspired by biological neurons in the brain. Recent developments have seen use of photonic devices as novel hardware platforms for implementation of neuromorphic systems, running at higher speeds and using less power than silicon electronics. In this work, we demonstrate the use of vertical cavity surface emitting lasers (VCSELs) as ultrafast photonic spiking neurons, and show an application of these in a machine learning system.	
14:15 – 14:30	**Iain MacCuish**	**Griffen**
	Towards the Modelling of a Single-Shot Contrast Interferometer Atom interferometry utilises the wave nature of atoms for precise measurements, mapping the phase of a matter wave to a measurable physical quantity. We examine a contrast interferometer that utilises a symmetric three-arm scheme with a Bose-Einstein Condensate (BEC) to read out the phase in a single measurement. The time-dependent BEC interference pattern acts as a distributed Bragg reflector for the reflection of an incident probe beam. We discuss the theory underpinning the contrast interferometer, present an analysis of the measured photon statistics, and show the ongoing development of a scheme to model data from the interferometer photon counts.	

14:30 - 14:45	**Johnathan Gray**	**Herrnsdorf**
	Quantum Enhanced Imaging Using Ultrafast Electronic Visual Display Technology The low size, weight and power consumption combined with MHz modulation bandwidth of MicroLEDs them the future of high speed visible light communication. This project has used a 16,000 pixel MicroLED array known as the "Megaprojector" to transmit data using on-off keying (OOK) and pulse-position modulation (PPM), using the high sensitivity offered by single photon detectors. 4-PPM data patterns were transmitted to a SPAD at $\sim$ 250 kfps with a BER of 2 x 10−3, approaching the limit of the Megaprojector's speed. Improving the FPGA firmware will allow higher data rates in the future.	
14:45 - 15:00	**Mugove Maruzane**	**Massabuau**
	Characterization of gallium oxide with electron probe micro analyzer, photoluminescence spectroscopy, and ultraviolet-visible spectroscopy Wide band gap semiconductors such as gallium oxide have gained a lot of interest due to their desirability as efficient replacement candidates for ultraviolet C devices and in certain high-power applications. Well-established characterization techniques such as energy dispersive imaging, wavelength dispersive x-ray imaging, and cathodoluminescence can be performed by the electron probe analyzer along with the use of photoluminescence which uses an ultraviolet excitation laser and ultraviolet-visible spectroscopy has proven to be valuable in the research and development of wide band semiconductors that can be used in power electronics applications and act as adequate replacements for power electronics and ultra-violet applications.	