Eureka 2025! Physics for Security

7 – 9 July 2025

Apex City of Bath Hotel, James Street West, Bath, BA1 2DA

TOPTICA THORLABS NKT Photonics

HORIBA LASER 2000 Quantum Design UK AND IRELAND E&EO UK Ltd

Nanoscale Advances Nanoscale Horizons Nanoscale

EKSPLA EKSMA OPTICS

Welcome

Welcome to the 2025 Eureka Conference, which this year is organised around the theme of Physics for Security. Organised by the University of Bath's Physics Department, this is a three-day meeting which will take place at the Apex City of Bath Hotel. The conference will focus on emerging new science, as well as new technology that is not mature yet but has significant potential to be.

The topics covered by the conference will include specialty optical fibres, quantum photonics, two dimensional materials and application, functional and quantum materials and devices, lasers and emitters, nano and photonic platforms, sensing technology, nonlinear photonics, and biosensing methods.

This international conference aims to bring together academia, industry, and other stake holders, such as fund-managers, scientific editors, and policy makers. The programme will include talks, poster sessions and an industrial exhibition. There will be a best poster competition, judged by the Awards Committee.

We look forward to welcoming you to what promises to be an engaging and supportive conference.

Best wishes,

The Technical Organising Committee

Department of Physics | UNIVERSITY OF BATH

Day 1

Monday 7 July

09:30 – 10:00	Registration and Coffee		
Plenary Talks			**Lansdown Suite 1**
10:00 – 11:00	Jeremy Baumberg University of Cambridge	**Rapid optical vibrational sensing of trace volatiles to ppb levels**	New breakthroughs in surface-enhanced Raman scattering (SERS) allow low-cost robust approaches to sensing of trace analytes in solution or vapour. These have applications in healthcare technologies, environmental protection, agritech, and security. I will discuss our advances, and their implications.
11:00 – 12:00	Sandrine Heutz Imperial College London	**Molecular approaches to electronics and quantum technologies**	Molecular semiconductors are attractive alternatives to inorganics and have established themselves in optoelectronic applications such as OLEDs. This presentation will focus on their quantum properties and their potential in energy and sensing applications.
12:00 – 13:30	Lunch		
Optional Activities (Available to book when registering)			
13:45 – 17:30	Visit to Stonehenge	Departing from the Apex Hotel at 13:45 Arriving back at the Apex Hotel at 17:30	
18:00	Delegate Dinner	Lansdown Bar Apex City of Bath Hotel, James Street West, Bath, BA1 2DA	

Day 2

Tuesday 8 July

Over day 2 and 3 of the Eureka 2025! Physics for Security conference, we will be holding a range of sessions which you can choose to join. Details of the speakers at these sessions can be found further in this programme.

09:30 – 10:00	Registration and Coffee			
Session 1				
10:00 – 12:00	**Photonics for Security** Room: Kingsmead 2	**Novel Optical Fibres** Room: Camden Room	**Materials in Quantum Technologies** Room: Walcot Room	**Exhibition** Room: Lansdown Suite 1
12:00 – 13:30	Lunch			
Session 2				
13:30 – 15:30	**Advances in Nanophotonics, Quantum Materials, and Light-Matter Interactions Part I** Room: Kingsmead 2	**Organic Electronic Materials and Devices Part I** Room: Kingsmead 2	**Quantum Systems and Future Networks** Room: Camden Room	**New Phenomena in 2D Materials: Theory and Experiments** Room: Walcot Room	**Exhibition** Room: Lansdown Suite 1
15:30 – 16:00	Coffee Break			
Poster Session and Exhibition			**Lansdown Suite 1**	
16:00 – 18:00	Details for all posters are available at the end of this programme.			

Day 3

Wednesday 9 July

Over day 2 and 3 of the Eureka 2025! Physics for Security conference, we will be holding a range of parallel sessions which you can choose to join. Details of the speakers at these sessions can be found further in this programme.

09:30 – 10:00	Registration and Coffee			
Session 3				
10:00 – 12:00	**Advances in Nanophotonics, Quantum Materials, and Light-Matter Interactions Part II** Room: Kingsmead 2	**Organic Electronic Materials and Devices Part II** Room: Camden Room	**Remote sensing, machine learning and fluid dynamics: astronomers' toolkit for industrial collaboration** Room: Walcot Room	**Exhibition** Room: Lansdown Suite 1
12:00 – 13:30	Lunch			
Session 4				
13:30 – 15:30	**Advances in Nanophotonics, Quantum Materials, and Light-Matter Interactions Part III** Room: Kingsmead 2	**Bioelectronics** Room: Camden Room	**Materials and novel imaging techniques for security and defence** Room: Walcot Room	
15:30 – 16:00	Coffee Break			
Session 5				
16:00 – 18:00	**Advanced Materials and Structures** Room: Kingsmead 2			

Photonics for Security *Tuesday 8 July 2025* *Kingsmead 2*			
10:00 – 10:30	***KEYNOTE*** Monica Allen Air Force Research Laboratory	**Invertible optical nonlinearity in epsilon-near-zero materials**	We conducted a theoretical and experimental study on the origin of nonlinearities in indium tin oxide (ITO) films dominated by intraband and interband transitions. Our work reveals the relationship between large nonlinearity and intrinsic properties of ITO films, to enable design of photonic nonlinear devices.
10:30 – 11:00	***KEYNOTE*** Jeffery Allen Air Force Research Laboratory	**Photonic Dirac Waveguides**	We demonstrate theoretically and confirm experimentally that adiabatic topological metasurfaces with slowly varying synthetic gauge fields significantly improve characteristics of symmetry protected topological photonic metasurfaces - spin-Hall and valley-Hall structures that can be applied to 2D photonic devices where high quality of modes is important.
11:00 – 11:30	***INVITED*** Philip Soan Defence Science and Technology Laboratory	**Imaging the Battlefield One Photon at a Time**	Long Range 3D imaging has the potential to be of huge benefit for military applications. Dstl has been exploring novel techniques for long range active imaging using photon counting devices. Some experimental results of imaging at 1.4km will be presented.
11:30 – 12:00	***INVITED*** John Robertson Defence Science and Technology Laboratory	**Sensing for Defence and Security**	An overview of Dstl and the Sense and Understand research programme, including sensing for defence and security in contested and congested environments. Including multi-domain distributed sensing with data and information fusion to improve threat detection, situational awareness, and decision-making.

Novel Optical Fibres *Tuesday 8 July 2025* *Camden Room*			
10:00 – 10:30	***INVITED*** Austin Taranta University of Southampton	**Antiresonant Hollow Core Fibre: The Ideal Platform for Resonant Fiber-Optic Gyroscopes**	The resonant fiber-optic gyroscope is an advanced navigation sensor with great unrealized potential due to performance limitations of conventional optical fibres. Recent advances in antiresonant hollow core fibres dramatically remove these limitations, opening new possibilities in gyro accuracy, compactness, and environmental robustness.
10:30 – 11:00	Peter Mosley University of Bath	**Novel fibres for photonic quantum technologies**	I present recent developments in the application of microstructured optical fibre to photonic quantum technologies. Specific advances include universal wavelength conversion interfaces for secure quantum networks, generation of narrow-bandwidth single-photons suitable for coupling to quantum memories, and low-loss interfaces for quantum memory in fibre.
11:00 – 11:30	Robbie Mears University of Bath	**Hollow core fibres for the ultraviolet**	In this talk I will outline recent work on hollow core fibres for the deep-ultraviolet and vacuum-ultraviolet. A brief overview of fabrication challenges and solutions will be presented along with advances in the field.
11:30 – 12:00	***INVITED*** Ian Davidson University of Southampton	**Hollow-Core Optical Fibres for Security**	Optical fibres are a vital part of society that have traditionally had a solid, all-glass structure. However, in recent years, alternative hollow-core designs have been shown to offer superior performance. My talk will focus on these recent designs and their suitability for various (security) applications.

Materials in Quantum Technologies *Tuesday 8 July 2025* *Walcot Room*			
10:00 – 10:30	***KEYNOTE*** Hannah Stern University of Oxford	**Spin defects in hexagonal boron nitride for quantum sensing and networking**	In this talk, I will show quantum coherent control under ambient conditions of a single-photon emitting defect in hexagonal boron nitride. I will show how this carbon-related defect has a spin-triplet electronic ground-state manifold. I will reveal that the spin coherence is governed predominantly by coupling to only a few proximal nuclei and is prolonged by decoupling protocols. Finally, I show how these results open routes to explore this defect type for nanoscale magnetometry.
10:30 – 11:00	***INVITED*** Stephen Church University of Manchester	**High-throughput automated characterization for nano-optoelectronics**	Future scalable manufacturing of nanomaterials requires the rapid characterization of the device properties to ensure high yield. We present the automated characterization of 10,000s of nano-lasers and single-photon emitters and then use data-driven approaches to design, and manufacture, lasers with improved performance.
11:00 – 11:30	***KEYNOTE*** Jan Tomczak King's College London	**From electron-electron correlations to device functionalities**	Modern devices largely use copper and silicon, where electrons act nearly independently. This talk explores correlated materials—especially transition-metal oxides—where strong electron-electron interactions lead to collective behaviours and exotic phases, offering potential for ultrafast switches, sensors, and low-voltage transistors or memory elements.
11:30 – 12:00	Simon Bending University of Bath	**Vortex Pinning and Dynamics in the Ferromagnetic Iron-based Superconductor EuFe2(As1-xPx)2**	Superconductivity coexists with ferromagnetism in EuFe2(As1−xPx)2 below the 19K magnetic ordering temperature. The influence of the ferromagnetic domain structure on the vortex dynamics has been investigated with magnetometry and MFM imaging. Results are well explained by a theory of vortex polaron formation that we develop.

Advances in Nanophotonics, Quantum Materials, and Light-Matter Interactions Part I *Tuesday 8 July 2025* *Kingsmead 2*			
13:30 – 14:00	***KEYNOTE*** Ortwin Hess Trinity College Dublin	**Nanoplasmonic Quantum Photonics**	This presentation explores how nanoplasmonic quantum photonics transforms quantum technologies by enabling room-temperature quantum effects via nanoscale field confinement and strong photon-emitter interactions. Highlighting ultrafast single-photon emission, multipartite entanglement, near-field coupling, and quantum sensing through coherent perfect absorption, it outlines pathways to practical ambient-condition quantum devices.

Organic Electronic Materials and Devices Part I *Tuesday 8 July 2025* *Kingsmead 2*			
14:30 – 15:00	***INVITED*** Christian Nielsen Queen Mary University	**Organic Semiconductors for Biosensing Applications**	My talk will focus on new semiconducting materials for organic electronic and bioelectronic applications. With an overarching aim of introducing added functionalities, I will discuss new molecular designs and subsequent evaluation of materials in the context of (bio)electronic devices.

Quantum Systems and Future Networks *Tuesday 8 July 2025* *Camden Room*			
13:30 – 14:00	***KEYNOTE*** Patrick Gill National Physical Laboratory	**International networks of quantum clocks**	Optical atomic clocks are now capable of fractional frequency uncertainties at the part in 10^18 level, offering highly sensitive systems for tests of fundamental physics and future resilience in global navigation systems. Clock performance, their international comparison and dissemination of these systems will be discussed.
14:00 – 14:30	Dmitry Skryabin University of Bath	**Towards frequency agile microresonator comb generators.**	Microresonator frequency combs is a disruptive technology making an impact across spectroscopy, timing, navigation and telecom. Results on tunability of frequency combs across the telecom and wider near-infrared spectral bands using microresonator parametric oscillator and 2nd harmonic techniques will be presented.
14:30 – 15:00	Alex Davis University of Bath	**Quantum Light Sources in Structured Fibre**	Photonic crystal fibre is a powerful platform for quantum optics, enabling a variety of parametric processes with applications including quantum networking and nonclassical light generation. I will present our most recent work using this technology, including frequency conversion and cavity-enhanced sources.
15:00 – 15:30	***KEYNOTE*** Ruth Oulton University of Bristol	**The future of quantum networks**	Quantum networks, currently mainly used for secure communications, will increasingly enable the distribution of complex entangled photonic states. I will discuss how they will enable entanglement-driven distributed quantum sensing and timing, and allow quantum computers to scale.

New Phenomena in 2D Materials: Theory and Experiments *Tuesday 8 July 2025* *Walcot Room*			
13:30 – 14:00	***KEYNOTE*** Akhil Rajan University of St Andrews	**Epitaxial growth of large-area monolayers and van der Waals Heterostructures of transition metal chalcogeides**	Layered 2D transition metal chalcogenides exhibit highly-tunable electronic and collective states. Fabricating these systems with high enough uniformity, however, has proved challenging. We will show a new bottom-up method enabling growth of uniform, large-area monolayers ideal for constructing high-quality van der Waals heterostructures.
14:00 – 14:30	Michele Pizzochero University of Bath	**π-electron magnetism in graphene nanoribbons**	Magnetism is typically associated with d- or f-electrons, yet carbon—a light element—challenges this view. In this talk, I use ab initio calculations to show that graphene nanoribbons can host π-electrons that give rise to magnetism and correlated phenomena.
14:30 – 15:00	Marcin Mucha-Kruczinsky University of Bath	**Emergence and tuning of topological electronic states at graphite junctions**	I will discuss emergence of topological electronic states at the interface between two rhombohedral graphite crystals. I will propose that such interfaces can be used to explore transition between topologically trivial and nontrivial phases by sliding one of the crystals with respect to the other.
15:00 – 15:30	Habib Rostami University of Bath	**Hidden Pseudospin Order as a Source of Circular Dichroism and Ultrafast Kerr rotation in Bulk WSe_2**	I will present experimental and theoretical results demonstrating efficient circular dichroism in bulk WSe_2, probed via an ultrafast Kerr rotation signal. This response arises from hidden pseudospin order and atomic orbital effects, highlighting new opportunities for ultrafast spin and valley control in bulk layered materials.

Advances in Nanophotonics, Quantum Materials, and Light-Matter Interactions Part II *Wednesday 9 July 2025* *Kingsmead 2*			
10:00 – 10:30	***KEYNOTE*** Alexander Tartakovskii University of Sheffield	**Nanophotonics and strong light-matter interaction with multilayer van der Waals materials**	Layered van der Waals materials known for their intriguing optical properties in few-atom-thick graphene-like form find growing use in nanophotonics as quasi-bulk with thicknesses from 10s to 100s of nanometres. This progress including our own recent work will be reviewed.
10:30 – 11:00	Said Ergoktas University of Bath	**Very-large-scale reconfigurable intelligent surfaces for dynamic control of terahertz and millimeter waves**	We present a graphene-based THz modulator integrated with thin-film transistor technology, enabling a >300,000 pixel spatial light modulator with programmable THz reflection and transmission patterns. Demonstrations include a single-pixel mm-wave camera and dynamic beam steering, advancing THz imaging and communications applications.
11:00 – 11:30	***INVITED*** Euan Hendry University of Exeter	**Effects of negative frequencies during temporal diffraction**	We show that graphene is capable of modulating transmission on a timescale that is substantially faster than the period of the THz wave. This leads to an extremely large bandwidth for the generated frequencies during temporal diffraction, even crossing the origin to generate negative frequencies.
11:30 – 12:00	Pieter Keenan University of Bath	**Loading the quantum dice - Measuring competing outcomes in a single molecule reaction**	The atomic resolution of a scanning tunnelling microscope (STM) can give control over the probability of inducing single-outcome single-molecule reactions. I will discuss our recent demonstration that it is possible to measure and influence the outcome of a single-molecule reaction with multiple competing outcomes.

Organic Electronic Materials and Devices Part II *Wednesday 9 July 2025* *Camden Room*			
10:00 – 10:30	***INVITED*** Saverio Russo University of Exeter	**Perovskite photodetectors**	In this talk I will provide an overview of recent advances on the wafer-scale synthesis of sustainable perovskites for optoelectronic applications and present a novel light-free method for the characterization of defects in perovskite devices under operating conditions.
10:30 – 11:00	Kamal Asadi University of Bath	**Temperature-resilient polymer-based electronic devices**	The operational temperature of polymer-based electronics is often limited below 70 °C due to reliability concerns. We demonstrate how modifying polymethyl methacrylate extends its stable operating range and reveal that at elevated temperatures, charge transport in conjugated polymers is primarily governed by amorphous regions.
11:00 – 11:30	***KEYNOTE*** Henning Sirringhaus University of Cambridge	**Charge transport and thermoelectric physics of conjugated polymers at ultrahigh charge densities**	Organic electrochemical transistors (OECTs) are of interest for applications in bioelectronics, neuromorphic computing and thermoelectrics and operate at very charge carrier concentrations. Understanding the charge transport physics in this regime, where the repulsive Coulombic electron-electron interactions and the attractive interactions between the mobile charge carriers and the charge-balancing counterions need to be considered, poses new challenges.

Remote sensing, machine learning and fluid dynamics: astronomers' toolkit for industrial collaboration *Wednesday 9 July 2025* *Walcot Room*			
10:00 – 10:25	Hendrik Van Eerten University of Bath	**Remote sensing, machine learning and fluid dynamics: astronomers' toolkit for industrial collaboration**	I describe the range of activities of Bath Astrophysics, emphasizing potential areas of overlap and interests with industry. Research includes (underwater) acoustics, remote sensing, (computational) fluid dynamics of galaxies, cosmology and astrophysical explosions, statistics and machine learning applied to large samples of galaxy observations.
10:25 – 10:40	***KEYNOTE*** Rebecca Huffee Space West	**The Regional Ecosystem**	Space West supporting regional growth in the space sector underpinned by academic partnerships.
11:00 – 11:25	Philippe Blondel University of Bath	**From the deep ocean to space debris – Remote sensing with industry and for security**	Space debris are an increasing risk to space activities, and millions are too small to map from Earth. Building on our sonar expertise, we use multi-aspect radars from a modular, dynamic small-satellite constellation, with a scaled laboratory demonstrator and a Canadian Space Agency feasibility study.
11:25 – 11:40	***INVITED*** Marcus Donnelly Systems Engineering & Assessment Ltd	**Collaboration between SEA and the University of Bath**	The talk will briefly summarise the conduct and outcome of a joint project between SEA and the University, as well as other collaboration including SEA's funding of a PhD student through the ART-AI CDT.
11:40 – 12:00	Business Partnerships at Bath	**Business Partnerships at Bath – Supporting Industry & Academic Collaboration**	An overview of funding mechanisms and support available for academic and industry partners, to foster collaboration and deliver impact. Presented by the University of Bath Business Partnerships & Knowledge Exchange Team.

Advances in Nanophotonics, Quantum Materials, and Light-Matter Interactions Part III *Wednesday 9 July 2025* *Kingsmead 2*			
13:30 – 14:00	***KEYNOTE*** Anatoly Zayats King's College London	**Spin-orbit coupling in nanophotonics**	Spin-orbit coupling shapes the topology of evanescent fields and vector beams, creating complex field structures analogous to condensed matter phenomena, such as skyrmions, merons and hopfions. This talk will discuss the principles, emerging phenomena and applications of the topological optical fields in nanophotonics and metamaterials.
14:00 – 14:30	Daniel Wolverson University of Bath	**Electron-phonon coupling in charge density wave TMDs: experimental and computational probes**	Charge density wave materials are an intriguing subset of the transition metal chalcogenides; Raman microscopy and time-resolved ARPES contribute to understanding them, and both techniques depend on the electron-phonon coupling. I will discuss a necessary extension of plane-wave DFT codes to model experimental data.
14:30 – 15:00	Soraya Caixeiro University of Bath	**Nano- and Micro-lasers for biointegration and biosensing**	Nano- and micro-lasers offer compact, tunable light sources ideal for biointegration and biosensing. Their small footprint, biocompatibility, and high sensitivity enable real-time, in situ monitoring of biological environments, paving the way for advanced diagnostics, implantable devices, and precision biomedical applications.

Bioelectronics *Wednesday 9 July 2025* *Camden Room*			
13:30 – 14:00	***KEYNOTE*** Rylie Green Imperial College London	**New material technologies for interfacing with the body**	A range of polymer based electronic materials including conductive hydrogels (CHs), conductive elastomers (CEs) and living electrodes (LEs) have been developed. These technologies provide synergy between low impedance charge transfer, reduced stiffness and an ability to be provide a biologically active interface. A range of electrode approaches are presented spanning wearables, implantables and drug delivery devices.
14:00 – 14:30	***INVITED*** Monica Craciun University of Exeter	**Self-powered textile integrated wearables for health and sports performance monitoring**	This talk presents our recent advances in integrating 2D materials into textile substrates for wearable electronics, including graphene-coated fibres and fabrics for sensors and energy harvesters. We demonstrate scalable fabrication methods enabling self-powered, flexible, and comfortable smart textiles for health monitoring, robotics, and environmental sensing applications.
14:30 – 15:00	Adelina Ilie University of Bath	**Bloodless revolution – a non-invasive continuous monitor for diabetes and other chronic diseases**	I will introduce a pioneering non-invasive, wearable technology platform to prevent, diagnose, and manage chronic conditions, starting with diabetes. Conceptually, the technology promises needle/blood-free, quantitative and continuous monitoring, enabled by its unique architecture and the exploitation of preferential pathways of biological analytes through the skin.
15:00 – 15:30	Alain Nogaret University of Bath	**Single shot detection of alterations across multiple ionic currents from assimilation of cell membrane dynamics**	Ion channel dysfunction is a causative factor in many neurological diseases, defining the implicated channels as key drug targets. Here, we introduce a single-shot method for detecting alterations amongst all ion channels from subtle changes in membrane voltage in response to chaotically driven current protocol.

Materials and novel imaging techniques for security and defence *Wednesday 9 July 2025* *Walcot Room*			
13:30 – 14:00	***INVITED*** Robert Simpson University of Birmingham	**The Tunable World of Phase Change Photonics**	Phase change materials exhibit radical permittivity differences between their amorphous and crystalline structural phases. They are now being developed for active holographic displays, setting the weights in optical neural nets, storing data, and beam steering.
14:00 – 14:30	***INVITED*** Mark Farries University of Nottingham	**Small-core, single mode, chalcogenide glass optical fibre for MIR (mid-infrared) sensors and devices**	The design and fabrication of single mode optical fibres for the mid-ir wavelength region are described. The unique design is fabricated in arsenic sulfide chalcogenide glass with precise control of the refractive index profile. Mode profiles show that the optical fibre exhibits single mode operation.
14:30 – 15:00	***KEYNOTE*** Ken McEwan Defence Science and Technology Laboratory	**Revisiting up-conversion imaging in the single photon counting age**	Up-conversion imaging was originally demonstrated back in the 1970s but the concept has seen a resurgence in interest as new materials, lasers and sensors have become available. In this presentation we discuss work that combines the strength of up-conversion imaging with the time resolution of quantum cameras.
15:00 – 15:30	***INVITED*** James Almond Cambridge Consultants	**Novel imaging using multi-wavelength holography**	We critically evaluate multi-wavelength holographic imaging for imaging around corners, through scattering media, and for ultra-high-resolution 3D surface mapping. Drawing on experimental and theoretical work, we highlight its potential and limitations across these challenging imaging scenarios.

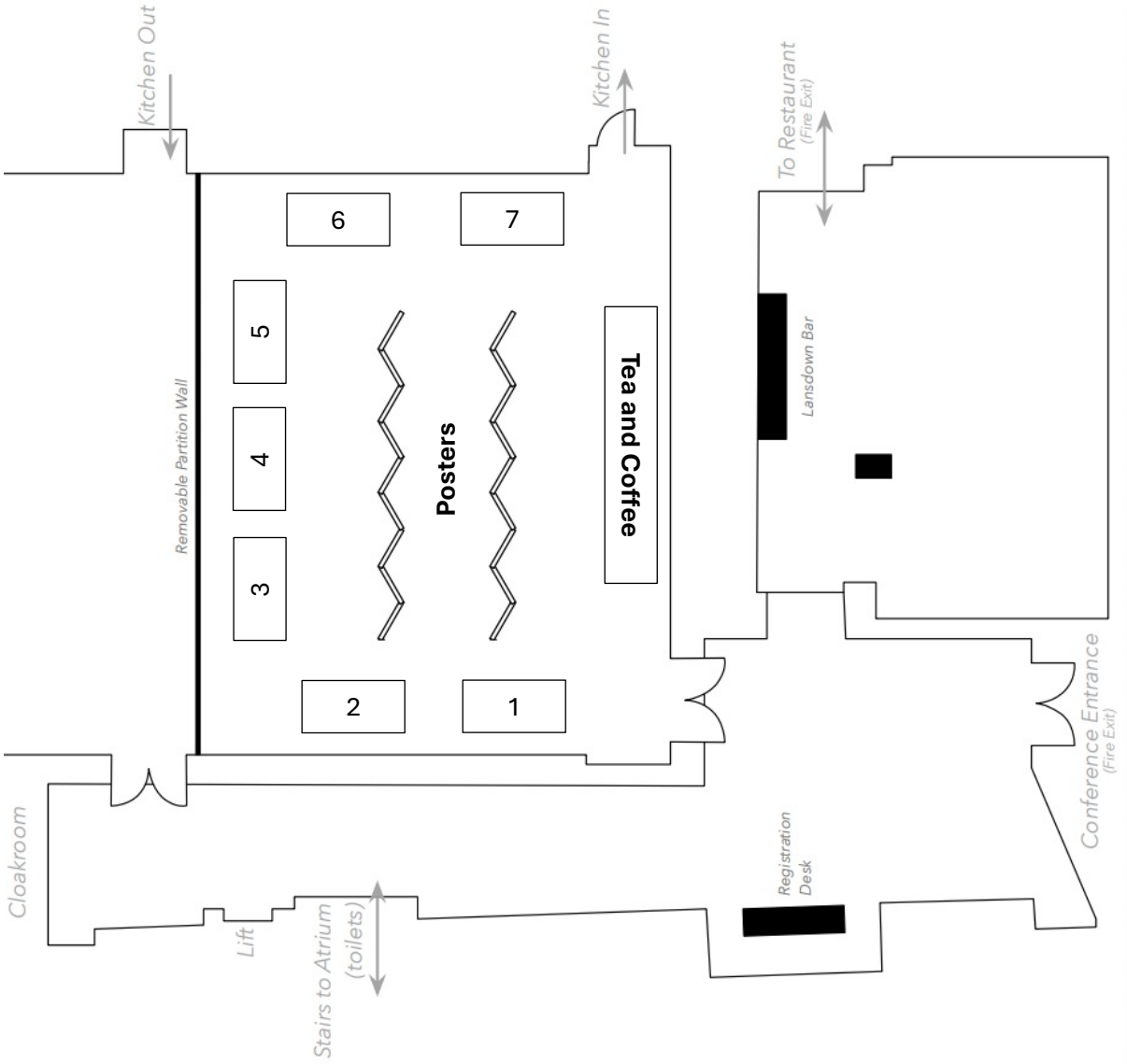
Advanced Materials and Structures *Wednesday 9 July 2025* *Kingsmead 2*			
16:00 – 16:20	Matthew Cole University of Bath	**Nanoengineering: Realising structure-related functionality of 1D and 2D nanomaterials**	One- and two-dimensional nanomaterials offer a raft of unique properties across a plethora of engineering disciplines. From novel electronics architectures and health-enhancing nano needles, to self cleaning surfaces and optical bar coding. However, to achieve these near-atom-scale functionalities requires new processes and techniques. Here we will explore some of the techniques developed in my group to realise such unique nanoengineered devices including selective growth and alignment of carbon nanotubes and graphene folding.
16:25 – 16:45	James Roscow University of Bath	**Design and properties of piezoelectric composites for sonar**	We'll discuss how the combination of electrochemical techniques with different materials and synthetic bioreceptors can lead to low-cost portable biosensors and lab-on-chip devices for the detection of a range of biomarkers in medical diagnosis and for water/wastewater monitoring.
16:50 – 17:10	Pedro Estrela University of Bath	**Electrochemical Biosensors and Biodevices for Medical Diagnosis and Water Monitoring**	We'll discuss how the combination of electrochemical techniques with different materials and synthetic bioreceptors can lead to low-cost portable biosensors and lab-on-chip devices for the detection of a range of biomarkers in medical diagnosis and for water/wastewater monitoring.
17:15 – 17:35	Xiaoze Pei University of Bath	**Superconducting networks for hydrogen power flight**	Hydrogen-powered electric aircraft is crucial to achieve ambitious environmental targets. A reliable, high-power density, and high-efficiency cryogenic superconducting DC distribution network is essential to enable hydrogen-powered electric aircraft. This presentation will explore the system design, control, and fault protection for cryogenic and superconducting DC distribution networks.

Advanced Materials and Structures (Continued) *Wednesday 9 July 2025* *Kingsmead 2*			
17:40 – 18:00	George Neville University of Bath	**Physisorption in Nanoporous Carbons for Safe and Stable LH_2 Infrastructure**	Physisorption in nanoporous carbons enables ultra-dense, persistent hydrogen storage, even beyond cryogenic conditions. Neutron scattering experiments and high-pressure sorption modelling reveal how confined hydrogen remains stable above the critical temperature (33 K), supporting the next-generation of safe and secure LH_2 infrastructure for aerospace and beyond.

Exhibition

Lansdown Suite 1

Tuesday 8 July 2025, 09:30 – Wednesday 9 July, 13:30



1 – **Toptica**

2 – **ThorLabs**

3 – **NKT Photonics**

4 - **Horiba**

5 - **EKSPLA**

6 – **Laser 2000**

7 – **Quantum Design**

Poster Session and Presentation

Lansdown Suite 1

Tuesday 8 July 2025, 16:00 – 18:00

Poster By	Title	Abstract
Hoyeon Choi University of Bath	Nonlinear photochemical metamorphosis of bio-mimetic nanoparticles	Using chiral second harmonic spectroscopy, we demonstrate real-time in situ detection of the photochemical metamorphosis of CdTe nanoparticles with extraordinarily high sensitivity. Also, the particles exhibit a strong second harmonic chiral response in the Mie scattering regime which is an unseen effect up today.
Daniel Chambers-Sims University of Birmingham	Goos Hanchen sensing for the detection of DNA with Black Silver	This project aims to create a sensor for tumour-derived DNA utilising Black Silver, an ENZ nanomaterial. Previously, we detected 1 fM of strepdavin binding to Black Silver using the Goos-Hanchen effect in just 30 minutes. Now, we aim to detect subfemtomolar concentrations of DNA.
Eleanor Gaggs University of Birmingham	Continuously tuneable optical properties of antimony trisulphide	Sb2S3 is the first VIS-NIR transparent phase change material. Our objective is to use this material to control metasurface optical traps for cold atom interferometry. We report how short-range crystallographic transitions enable continuous tuning of its refractive index.

Poster By	Title	Abstract
Rebecca Walters University of Bath	Rubidium-filled hollow-core fibres for integrated quantum technologies	We are developing rubidium-filled hollow-core optical fibres to enable strong light–matter interactions for quantum technologies, due to the potential for miniaturisation and fibre network integration. Fibre design considerations encompass optical guidance, vapour loading, and adsorption. The filled fibre has applications in quantum memory and sensing.
Hannah Martin University of Bath	Intramolecular Dissociation of Bromobenzene Adsorbed on Si(111)-7x7	Manipulating matter is now routine with a scanning tunnelling microscope (STM). Injection from a STM tip can perform controlled “intramolecular surgery” by dissociating individual atoms from molecules. We quantify the bias thresholds required and the probe current dependence of bromine dissociation from bromobenzene.
Nguyen Vo University of Bath	Rayleigh analysis for quantifying the lattice deformation and domain wall mobility of freeze-cast anisotropic porous ferroelectric composite	This study refines Rayleigh analysis for porous ferroelectric composites by introducing density- and orientation-based adjustments. These corrections decouple intrinsic and extrinsic dielectric contributions from relative density and pore orientation effects, enabling accurate characterisation of ferroelectric properties in complex, non-monolithic ceramics.
Luke Soneji University of Bath	Rhombohedral graphite junctions as a platform for continuous tuning between topologically trivial and non-trivial electronic phases	We propose junctions between rhombohedral graphite crystals as a platform that enables smooth transition between topologically trivial and non-trivial regimes. By invoking an analogy with the Su-Schrieffer-Heeger model, the appearance of topological junction states is related to the symmetry at the interface between the crystals.

Poster By	Title	Abstract
Will Smith University of Bath	Fibre Bragg Gratings in a Photonic Crystal Fibre Photon-Pair Source	Developing high quality single photon sources are key to progressing quantum technology. This work looks at integrating fibre Bragg gratings directly into a photonic crystal fibre pair source to improve its function as a heralded single photon source.
Mugerabe Zerabza University of Bath	The folded pseudochiral Fermi surface of charge density wave material 4Hb-TaSe2	Tantalum dichalcogenides (TaX_2, X = S, Se) exhibit Mott insulating, superconducting, and charge density wave (CDW) behaviour. In 4Hb-$TaSe_2$, T-layers host a $\sqrt{13}\times\sqrt{13}$ CDW leading to a pseudochiral Fermi surface. Time-resolved ARPES reveals band hybridization and ultrafast CDW oscillations of ~2.2 THz upon laser excitation.
Charlie Perek-Jennings University of Bath	Control of Alkali Vapour Density Using Gold Nanoparticles for light matter interaction	Gold nanoparticle-coated enclosures enable precise control of alkali vapour density. When illuminated at the nanoparticle's plasmonic frequency, alkali atoms desorb increasing atomic vapour density, enabling high speed control of vapour density. We present a scheme with enhanced performance, newly applied to commercially available enclosures.
Georgia Booton University of Bath	Cavity-based high-speed low-loss all-optical switching in rubidium vapour	Quantum technologies require a fast, low-loss switch to re-route photons whilst preserving their quantum state. We utilise the strong two-photon absorption in rubidium vapor to mediate a controlled phase shift interaction. Our switching results demonstrate a pathway to tackle scalability challenges in quantum computation.
Athirah Rosli University of Bath	Investigating Nonlinearity in Femtosecond Pulsed Transmission through Multimode Anti-resonant Hollow-core Fibres	This study investigates nonlinear effects in single-mode and multimode anti-resonant hollow-core fibres, focusing on spectral broadening and changes in the modal content. Experiments examine the influence of fibre design, anti-resonant transmission bands, mode interactions, and the contribution of Raman scattering using Argon-filled fibre.

Poster By	Title	Abstract
John Kerr University of Bath	Metasurfaces coupled with bulk hexagonal boron nitride enhance Raman scattering	We demonstrate that bulk hexagonal boron nitride (hBN) coupled with metallic metasurfaces can form chemically stable, durable platforms with electromagnetic enhancements. Raman mapping and simulations confirm hBN thickness and wavelength effects, demonstrating the potential for scalable, cost-effective plasmonic devices for surface-enhanced spectroscopy applications.
Ruidong Ji University of Bath	Chirality conferral enables the observation of Raman optical activity	Chirality conferral is fundamental for understanding the origin of life, and it is of direct importance for synthesizing new pharmaceuticals in the face of growing antibiotic resistance. However, chirality conferral from one form of matter to another via electromagnetic fields is more subtle and less explored. Here we report chirality conferral between gold nanohelices and achiral molecules (crystal violet).
Bradleigh Kerrigan University of Bath	Nonlinear Chiroptical Scattering from Hybrid Nanohelices	Higher Harmonic scattering has emerged as a powerful background-free tool for characterising the chiroptical properties of an isotropically dispersed medium. Previous work has successfully applied this technique to both plasmonic and dielectric structures. This work applies the method to characterising the properties of hybrid nanohelices.
Dylan Jones, Marcin Mucha-Kruczynski, Adelina Ilie, Lucian Covaci University of Bath & University of Antwerp	One-dimensional Lieb superlattices: from the discrete to the continuum limit	We investigate Lieb lattices in 1D potentials with discrete lattice symmetry-breaking, across all length-scales. New effects (quadratic and flat band intersections, tilted/anisotropic Dirac cones) occur, while the predicted omnidirectional Super-Klein Tunneling disappears. Findings are relevant for artificial lattices, 2D covalent organic/metal-organic frameworks, inorganic 2D solids.

Poster By	Title	Abstract
Thomas Readyhoof University of Nottingham	New Mid-Wave Infrared (MWIR) Fibre Lasers	Breakthrough Fibre Lasers Towards Pulsed Operation in the 4-7 µm Wavelength Region: Doping Chalcogenide Glass Fibres with Lanthanide Ions
Ned Dreamer University of Bath	In-Plane Organic Ferroelectric Memory Diodes	We propose a new design for ferroelectric memory diodes with applications in neuromorphic computing. The device utilizes in-plane ferroelectricity to enable charge injection from metal electrodes to organic semiconductors where usually not possible. The devices are effective for use as artificial synapses and VLSI.
Akito Miyama University of Birmingham	Early Diagnosis of Parkinson's Disease Using gold nanoparticle dimers	We developed an efficient method to fabricate gold nanoparticle dimers using hydrochloric acid and bis(phenyl)phosphine (BSPP). The resulting dimers form a structure in which interparticle distance reflects the size of bound molecules. By combining these dimers with SERS, we successfully distinguished the morphology of α-synuclein, enabling structural identification of aggregates. We also performed numerical simulations to reproduce the morphology-dependent optical behavior of the dimers, and the results were consistent with experimental observations. This method holds strong potential for label-free, morphology-specific detection of protein aggregates and may serve as a valuable tool for the early diagnosis of Parkinson's disease.
Eric Lundgren University of Bath	Shining Light on Single Molecule Dynamics: One Photon At A Time	We develop a scanning tunnelling microscopy luminescence setup, capable of measuring light emission from molecular reactions with single-photon sensitivity in combination with atomic-resolution spatial imaging of electronic states, allowing unprecedented insight into the step-by-step mechanics of molecular reactions.

Many thanks to our sponsors whose generosity has made this event possible!

GOLD Sponsors	SILVER Sponsors	BRONZE Sponsors	Poster Prizes
TOPTICA THORLABS NKT Photonics	HORIBA	E&EO UK Ltd EKSPLA EKSMA OPTICS LASER 2000 Quantum Design UK AND IRELAND	Nanoscale Advances Nanoscale Horizons Nanoscale