THE ROYAL SOCIETY

The Royal Society Research Fellows Conference 2014: Speakers

There will be 39 speakers at the Research Fellows Conference, for a timetable of events, please see the Research Fellows Conference details. Here is a list of the speakers, in alphabetical order, with the abstract of their talk and a short biography.

Dr Janet Anders

Classical and quantum non-equilibrium processes

Abstract: Brownian motion of nanoparticles is used extensively for the investigation of thermodynamic properties and processes. For example, the link between information theory and thermodynamics as exemplified in the heat to work conversion achieved by Maxwell's demon, and Landauer's erasure principle was only recently experimentally verified. However, the characterisation of non-equilibrium processes involving large temperature differences on the micro- and nano-scale has remained challenging. I will introduce a novel theoretical model that captures the non-equilibrium situation of heated particles in a dilute gas. I will then report on first experimental temperature measurements on the nanoscale using nanospheres that are levitated solely by laser light. The method opens the door for non-equilibrium experiments in the unexplored underdamped regime and informs current optomechanics experiments that aim to reach the motional quantum ground state of macroscopic trapped particles – an incarnation of Schrödinger's cat.

Bio: Dr Janet Anders is a Royal Society Dorothy Hodgkin research fellow with a background in quantum information theory. After studying theoretical physics in Germany, and completing her PhD at the National University of Singapore in 2007, she moved to UCL first as a postdoc, and from 2009 as a research fellow. Recently she moved to a proleptic lecturer position at the University of Exeter where she will lead a new research group in quantum information theory. Anders has made important contributions in the area of quantum computation, entanglement in quantum many-body systems and in quantum thermodynamics.

Dr Adam Barker

Bringing science to the Cloud

Abstract: The era of big data is upon us - the Volume, Velocity and Variety of enterprise and scientific data are growing at an exponential rate, and will continue to do so for the foreseeable future. Hidden inside this flood of raw data is the knowledge capable of having transformative impacts across virtually every area of society. There has been a surge of interest in scientists wanting to utilise cloud computing for their data-intensive research. Cloud computing allows organisations to lease resources through the Internet using a pay-per-use model. In this talk I will introduce the concept of cloud computing, and discuss the opportunities and challenges for scientific applications. I will then present an overview of my research conducted under the Royal Society Industry Fellowship scheme, which is addressing the problem of how to deploy applications across a large set of cloud servers, so as to maximise performance and minimise costs.

Bio: Dr Adam Barker is a Lecturer in Computer Science at the University of St Andrews, a Royal Society Industry Fellow, and an Honorary Fellow at the University of Edinburgh. He worked as a Research Fellow at the University of Oxford, University of Melbourne and University of Edinburgh. He holds a PhD in Informatics from the University of Edinburgh (2007). Adam leads the St Andrew's Big Data Lab (www.big-data.co.uk), a group of researchers working on innovative technologies to address current and future data-intensive challenges. Adam has over 35 peer-reviewed publications, and currently holds grants from the EPSRC, Royal Society and Amazon.

Dr Esther Becker

New insights into diseases of the 'little brain'

Abstract: My talk will focus on the function of a specific part of our brain, the cerebellum, which lies at the back of the skull underneath the two brain hemispheres. Even though cerebellum literally means "small brain", it contains more neurons than the rest of our brain combined, making it a fascinating structure to study. We are very interested in the molecular mechanisms that shape this complex brain structure and lead to diseases when going awry. I will present our recent findings on how specific gene mutations contribute to abnormal cerebellar development and cerebellar disorders in mice and men. Interestingly, the traditional function of the cerebellum is thought to be control of movement and balance. However, I will also discuss new and exciting data that link the cerebellum to cognitive function and diseases such as autism.

Bio: Originally from Germany, I gained an MSc in Medical Biology from the University of Amsterdam and then went to Harvard Medical School for my PhD, where I elucidated specific signaling mechanisms that contribute to cell death in nerve cells. During my graduate studies, I was supported by a Boehringer Ingelheim and an Albert J. Ryan fellowship. Subsequently I came to the University of Oxford, supported by an HFSP fellowship, to study the molecular and genetic disease mechanisms that underlie cerebellar ataxia in mice and men. I am continuing this research passion now as a DHF supported by the Royal Society.

Dr Jennifer Bizley

From micro-volts to music - how do we rerelate the activity of single neurons to our perception of sound

Abstract: Listening to auditory cortex: from the firing of single neurons to perception. Neuroscientists have a good understanding of how sensory receptors transform signals in the world, such as the sound of someone's voice, into electrical impulses that are passed to the brain. However, we know much less about how these signals are processed within the brain to create our perception of the world around us. My lab addresses this challenge by training ferrets in listening tasks, for example to discriminate the identity of a vowel, so that we use the animal's judgment on a single trial as a measure of how they perceived a given stimulus. By implanting microelectrode arrays into Auditory Cortex we can observe the activity of multiple single neurons, as well as the Local Field Potential, which gives the average activity of a local population of neurons. Using computational techniques we can then decode these responses to explore which neural signatures give rise to perception.

Bio: Jennifer Bizley was an undergraduate at the University of Cambridge and completed her D.Phil at the University of Oxford. She remained in Oxford as a post-doc and then as a Royal Society Dorothy Hodgkin Fellowship holder. In 2011 she moved her fellowship to UCL to establish her own laboratory and in 2012 was awarded a Sir Henry Dale Fellowship.

Professor Clive Bowman

Individualised divergences, covariance networks and drugs

Abstract: Presenting straightforward, applied mathematical and computational research on filtering co-occurrences ('needles') from co-incidences in complex high dimensional problems ('haystacks'). This via the simultaneous projection of disparate data into the space of evidence to answer the actual question. Characterisation as a shape that can be decomposed into 'nets'. Exemplified by industrial collaborator's real use in finding determinants of drug safety ('costly fish'). Possible interest to those interested, for example, in finding dangerous genes, profitable customers or potential radicalised terrorists, from a shoal of 'not-interesting' fish.

Bio: Clive Bowman is an Entrepreneur with 28 years of Medicine development experience. A Biologist, Chartered Statistician & Mathematician - he is a Royal Society Industrial Fellow and visiting Professor in Mathematics at University of Reading (and University of Leeds). He is currently Head of European Biostatistics and Data Operations for the Japanese pharmaceutical Daiichi-Sankyo. His academic collaborations and research interests are in multivariate analysis, data mining and informatic pattern discovery of relevance to the clinic. He is a Fellow of the Linnean Society, Fellow of the Royal Statistical Society and Fellow of the Royal Society of Medicine.

Dr Caroline Brennan

Using zebrafish to gain insight into the cell biology of psychiatric disease and potential therapeutics

Abstract: Psychological disease including addiction is a major concern for modern society. There is clear evidence that one's genetic make-up influences behavior and the likelihood of developing psychiatric disease but it has proved difficult to identify the specific genes involved. To aid identification of genetic factors influencing vulnerability to psychiatric disease and addiction and the search for effective treatments we have developed zebrafish assays of behaviours associated with psychiatric disease; drug seeking and impulse control. As zebrafish are vertebrate and share genetic makeup, neural pathways and circuits with mammals including humans, genes that affect zebrafish behavior give insight into factors that may control the related behaviour in humans. By screening lines of mutagenised zebrafish we have identified novel genetic variants affecting zebrafish behaviour. Interrogation of human data shows an association of variants in the human versions of these genes with smoking behavior and psychiatric disease. We collaborate with Pfizer to apply our assays to drug discovery programmes.

Bio: Undergraduate at KCL in biochemistry and pharmacology with PhD in pharmacology. Subsequently studied developmental biology and the use of zebrafish for genetic screening at UCL. In 2008 at QMUL initiated research programme using zebrafish to explore genetics of behaviours of relevance to psychiatric disease. In 2012 became consultant for Pfizer and awarded Royal Society Industrial Research Fellowship.

Professor Alan Chalmers

High dynamic range video: A step change in imaging technology

Abstract: High Dynamic Range (HDR) imaging technology enables all the lighting in a real-world scene to be captured. There are no more areas of under- or over-exposed pixels. Until the recent development of novel compression algorithms, the huge data requirements of capturing and storing real-world lighting prevented HDR video from being supported on existing ICT infrastructure, as uncompressed HDR video at 1080p resolution generates a CD's worth of data a second. Now emerging, HDR video offers the revolutionary potential for example, to clearly see the soccer ball as it is kicked from the sunshine into the shadow of the stadium, or security cameras to see detail in both the dark and bright areas. HDR can even help you choose the right tile for your bathroom with confidence, by accurately capturing the bespoke light in your room. This talk will highlight the step change in imaging that HDR will bring about.

Bio: Alan Chalmers is a Royal Society Industry Fellow and Professor of Visualisation at WMG, University of Warwick, UK. He has an MSc with distinction from Rhodes University, 1985 and a PhD from University of Bristol, 1991. He has published over 200 papers in leading conferences and journals on high-fidelity multi-sensory virtual environments, HDR imaging, and virtual archaeology. He is Honorary President of Afrigraph, a former Vice President of ACM SIGGRAPH, and Chair of EU COST Action IC1005, which is co-ordinating research and development of HDR activity across Europe. Chalmers is also founder of the spinout company, goHDR Ltd.

Dr Susan Cox

Accelerating super-resolution microscopy

Abstract: Seeing life at the nanoscale Fluorescence microscopy is a vital tool in the life sciences as it allows the positions of different proteins within the cell to be imaged with different colours. However, until recently the resolution of this method was limited to a few hundred nanometres. Over the last ten years, super-resolution methods have pushed the resolution of down to the nanoscale. One class of methods, localization microscopy, builds up a high resolution image from the localized positions of many single fluorophores, but generally acquiring the data requires several minutes acquisition on a specialist microscope. We have developed a new method which allows localization data to be extracted from images taken on a standard widefield microscope, and only requires a few seconds to acquire the data. This allows us to image the dynamics of live cells at 50 nm resolution.

Bio: Susan did her PhD at Cambridge investigating strongly correlated electron systems, and continued these investigations while a Seaborg Fellow at Los Alamos National Laboratory. She then moved to the lab of Rainer Hentzmann, where she worked on novel fluorescence imaging methods. Having started to develop her own techniques, she was awarded a Wellcome Trust VIP Fellowship and then a Royal Society Fellowship to continue her work.

Dr Jonathan Dawes

Mathematical models for pattern formation

Abstract: Pattern formation is concerned with the spontaneous emergence of coherent structures in nature and the laboratory. Classic examples include stripes on tropical fish, ordered patterns of convecting eddies in a fluid, and banded vegetation in the desert. Patterns, similar to these, that form through so-called 'Turing' instabilities seem to occur all over physics, chemistry and biology. Mathematical work shows that there are two typical kinds of instability: a small-amplitude pattern appears either smoothly everywhere at the same time, or abruptly as a parameter varies. The abrupt case is often associated with hysteresis and, intriguingly, the formation of localised patches of regular pattern surrounded by the unpatterned homogeneous background state. This presentation will introduce key mathematical ideas in pattern formation, and present a historical survey of progress made since the start of the twentieth century. I will end by outlining why the behaviour of systems that form localised states is of interest in order to understand outstanding challenges in fluid dynamics including tipping points in models of climate subsystems.

Bio: Jonathan Dawes studied mathematics at the University of Cambridge, completing his BA and the Certificate of Advanced Study in Mathematics (a.k.a. Part III). He remained in Cambridge to pursue a PhD under the guidance of Prof. Michael Proctor FRS and was elected to a Junior Research Fellowship at Trinity College, Cambridge, in 2000. He later spent 4 years as a College Lecturer at Newnham College and was awarded a Royal Society University Research Fellowship in 2007. In 2009 he was appointed to a Readership in Applied Mathematics at the University of Bath.

Dr Tom Dunkley Jones

A unicellular view of ancient global change

Abstract: Our understanding of ancient oceans and global climate is predominantly derived from the fossil remains of single celled marine organisms. In the deep-oceans these biomineralized remains are the largest component of sea-floor sediments and provide a record of life in the oceans over millions of years. Today, the eastern Equatorial Pacific – where deep nutrient-rich waters upwell to the surface ocean - is a key component of the Earth's carbon cycle and a major hotspot of biological productivity. Here, I'll present new records of ecosystem perturbations in this region through the largest climate transition of the past 90 million years, the onset of the current "icehouse" climate state. At this time, Antarctic glaciers rapidly expanded to continental scale ice-sheets within a few hundred thousand years. Using analyses of community structure and turnover in both the zoo- and phytoplankton, we demonstrate the strong linkages between high-latitude cooling and turnover in tropical ecosystems.

Bio: Tom Dunkley Jones (CI) is a Royal Society Dorothy Hodgkin research fellow and Birmingham Fellow at the University of Birmingham. He is a micropalaeontologist and palaeooceanographer focusing on the evolution and palaeoecology of the coccolithophore algae. His work has been published in Nature, Earth and Planetary Science Letters, and Geology. He has participated in Integrated Ocean Drilling Program (IODP) Expeditions as both a ship and shore-based scientist and was awarded the Geological Society President's Award for Young Geoscientists in 2010.

Dr Radek Erban

Multiscale modelling in cell and molecular biology

Abstract: I am an applied mathematician. The key goals of my research are the development, analysis and application of mathematical and computational techniques for biological problems. The mathematical and computational methods range from detailed molecular-based simulations to coarse-grained (mean-field, continuum) models. In some applications, microscopic detail is only required in a relatively small region, but using the microscopic model over the whole simulation domain is computationally intensive. In my talk, I will discuss multiscale methods for coupling models with various levels of detail which are used in different parts of the computational domain. I will present methods which use a detailed modelling approach in localized regions of particular interest (in which accuracy and microscopic detail is important) and a less detailed model in other regions in which accuracy may be traded for simulation efficiency. Biological applications include processes in cell and molecular biology (actin dynamics, calcium dynamics) and models in developmental biology.

Bio: I obtained my PhD in Mathematics from the University of Minnesota in 2005 and since then I have worked as a researcher in the Mathematical Institute, University of Oxford. In recent years, I was awarded a European Research Council Starting Independent Researcher Grant (2009), a Philip Leverhulme Prize (2010), a Royal Society University Research Fellowship (2011) and an OUP John Fell Fund Main Award (2012) for my work in applied mathematics. I have been a Nicholas Kurti Junior Research Fellow at Brasenose College since 2011. In Oxford, I was previously affiliated with Somerville College (as a Fulford Junior Research Fellow, 2008-2011) and Linacre College (as a Junior Research Fellow, 2005-2008).

Dr Emily Flashman

Coping with Hypoxia - and enzymatic perspective

Abstract: Oxygen is all around us, but in situations such as extreme exercise or travelling to altitude it can become a limited resource for our cells; this is known as hypoxia. Biochemically, we cope with a well-defined 'hypoxic response', whereby a transcription factor, HIF, drives compensatory responses such as increased blood vessel growth and blood cell formation. Hypoxia is a chronic feature in many disease states, and the consequent hypoxic response can help (cardiovascular disease) or hinder (cancer) prognosis. We are interested in the molecular rationale by which the oxygen-dependent HIF hydroxylase enzymes act as the key oxygen sensors in the hypoxic response. We are using what we have learnt from the HIF hydroxylases to identify other potential oxygen sensors (non-HIF related), and now have evidence of an oxygen-sensing capacity for some histone demethylases. This infers that epigenetic regulation could be directly altered in hypoxic disease states.

Bio: Having completed a B.Sc. Hons in Biochemistry at Southampton University (1999), and a D.Phil. in Cardiovascular Medicine at the University of Oxford (2004), Emily stayed in Oxford to move to the Department of Chemistry with Prof. Chris Schofield. Here she investigated the biochemical properties of Fe(II)/2-oxoglutarate dependent oxygenases, focussing on those involved in the response to hypoxia. In 2010 Emily was awarded a Dorothy Hodgkin Fellowship to investigate the molecular mechanisms of oxygen sensing by the HIF hydroxylases. Emily has also been awarded a L'Oréal-UNESCO Fellowship for Women In Science (2011).

Dr Wladek Forysiak

Information capacity limits in optical fibre communications

Abstract: Optical fibre networks form the physical infrastructure carrying most of the telecommunications traffic around the global internet. The relentless demand for increasing bandwidth, driven most recently by internet video and the construction of massive warehouse-scale data centres, means that the once-considered infinite bandwidth of optical fibre could be completely full within a decade. In this presentation, I will describe the worldwide optical communications network, and explain why and how the fundamental limits to the information carrying capacity of optical fibre are being approached. Starting with the fundamental formula of channel capacity due to Claude Shannon (1948), I will explain the nonlinear Shannon limit in optical fibre, and describe how leading researchers around the world are tackling the anticipated "capacity crunch". I will review which new approaches and technologies to alleviating these limits look most promising for the near future and beyond.

Bio: Wladek Forysiak is Director, Technology and Systems at Oclaro Technology Ltd and Royal Society Industry Fellow at Aston University. He started an academic career as a physicist researching nonlinear dynamics and chaos in lasers, moving latterly to electronic engineering, and studying the application of solitons in optical communications. In 2000 he was a co-founder of Marconi Solstis, a successful technology transfer from UK academia to industry which led to the deployment of the world's longest, unregenerated terrestrial optical fibre communication system. Since then, he has continued working in the UK optical communications industry with Marconi, Ericsson and Oclaro.

Dr Kerry Franklin

Light, temperature and plant development

Abstract: Light and temperature are two of the most important environmental cues regulating plant development, providing both spatial and seasonal information. Our work investigates crosstalk between these signalling networks. Plants monitor their ambient light environment using specialised photoreceptors. A major role of these photoreceptors in natural environments is the detection of neighbouring vegetation and initiation of architectural responses to avoid shading. Modest changes in ambient growth temperature can, however, dramatically affect photoreceptor signalling. We have shown that light quality signals can enhance plant freezing tolerance at cool, but not warm temperatures. High temperatures have dramatic effects on plant architecture. We have shown that high temperature and light quality pathways converge on shared signalling nodes to control elongation growth, via regulation of the hormone auxin. This talk will combine plant physiology, molecular cell biology and mathematical modelling to discuss the roles of light quality and temperature on plant growth and development.

Bio: Kerry Franklin is a Royal Society URF and senior lecturer at the University of Bristol. She obtained her PhD in plant photobiology from the University of Southampton in 2001. Following this, she worked as a PDRA at the University of Leicester and a Human Frontier Science Program Fellow at the Plant Gene expression Centre, USA. Her work investigates light and temperature signalling networks in plants and the adaptive significance of different developmental strategies. In 2010, Kerry was awarded both the Society of Experimental Biology President's medal in Plant Science and the Federation of European Societies of Plant Biology award.

Professor Mark Gieles

Modelling self-gravitating systems: from binary stars to galaxies

Abstract: A surprising energy source powering the evolution of dense stellar systems Some of the most beautiful astronomical objects that can be seen with a small telescope are the majestic globular clusters. They contain about a million stars densely packed together and held together by gravitational attraction. Because of their extreme ages, they carry important clues about the conditions of the early Universe and are tracers of the formation and evolution of the Milky Way. A characteristic property of globular clusters is that orbital energy exchange between stars, a mechanism comparable to satellite slingshots, is important. This means that orbits of stars have significantly evolved since they formed. I will show how the complex evolution of globular clusters can be captured by simple laws and discuss the intriguing similarities between the physics of kinetic energy generation in the cores of globular clusters and the nuclear fusion process in stars.

Bio: Mark Gieles received his PhD degree at Utrecht University in the Netherlands in 2006. He then moved to the European Southern Observatory (ESO) in Chile as a research fellow and support astronomer at the Very Large Telescope in the Atacama desert. In 2009 he obtained a University Research Fellowship (URF) of the Royal Society which he took up at the Institute of Astronomy of the University of Cambridge. In January 2013 he started as the first chair in astrophysics to start a new astrophysics research group in the Department of Physics of the University of Surrey.

Dr Eva Gluenz

Breaking the symmetry: how a parasite changes its shape

Abstract: Cells are not just 'bags full of proteins'. Many, including the single-celled parasite Leishmania, have a precisely defined shape and internal architecture. When the Leishmania parasite travels from the gut of a sandfly to infect human cells, it changes its shape. How does this happen and why? We filmed live Leishmania and used fluorescent molecules and electron microscopy to reveal changes to their internal organisation. As soon as the parasites experience the high temperatures and acidic conditions associated with the move from insect to mammal, the cell growth pattern changes: an asymmetric cell division produces a parasite with a different shape. Inside the cell, the nine-fold symmetry of the cell's flagellum is broken, changing this cellular appendage from a device built for swimming into a structure resembling a sensory antenna, likely to be important for survival in the human body.

Bio: I have a longstanding interest in the biology of a group of unicellular parasites called trypanosomatids. For my PhD at the London School of Hygiene and Tropical Medicine (2001-4) I studied developmentally regulated proteins of Trypanosoma cruzi. During my postdoctoral work in Keith Gull's lab in Oxford (2004-11) I made a number of discoveries about the organisation and replication of mitochondrial DNA in the African trypanosome T. brucei. In 2011 I started my own research group in Oxford as a Royal Society URF with a project entitled 'Host-parasite interactions: the role of the Leishmania flagellum in infection'.

Dr Natalia Gromak

Understanding pathology of neurodegenerative diseases

Abstract: Around forty human diseases are associated with insertion of short repeated sequences in different parts of human genes. This leads to severe problems with neurons and muscles, often resulting in premature patients' death. The symptoms of these devastating diseases are worsening during patients' life time due to the increase in size of repeated sequences. The pathology of these diseases is associated with disruption of the function of the gene with expanded sequences; however, the mechanism of such expansions is not clear. My lab studies mechanisms underlying these neurodegenerative diseases, focusing on nucleotide expansion diseases Friedreich's ataxia and Fragile X syndrome. We have discovered that repeated sequences form unusual DNA structures, which directly interfere with gene's function to make proteins. This knowledge helps us to establish foundation for future therapeutic developments to treat these devastating diseases.

Bio: I was born in Belarus where I studied until I was 20. I did my BSc in Molecular Biology jointly in the Belarus State University and University of Edinburgh. I carried out my PhD in the University of Cambridge (1997-2001), investigating regulation of alternative splicing. My BSc and PhD studies were supported by the Darwin Trust of Edinburgh studentships. I did my Post-Doctoral work in the University of Oxford (2002-2011), investigating mechanisms of gene transcription. I was awarded RS URF in 2011 in the University of Oxford. Currently I am also a Senior Science Research Fellow in St.John's College, Oxford.

Dr Gavin Hesketh

After the Higgs: Run 2 at the LHC

Abstract: 2012, the ATLAS and CMS experiments announced the discovery of a new sub-atomic particle, which appears to be the long-sought Higgs boson. Following this discovery, the Nobel Prize in physics 2013 was awarded to Francois Englert and Peter Higgs, theoretical physicists who independently predicted it's existence in 1964. It is often said that this discovery completes the Standard Model of particle physics, our picture of the sub-atomic world. So why do we plan to continue running the LHC for years to come? I will cover some of what we still have to learn about the newly discovered particle, and some other things that the LHC may reveal in the next few years.

Bio: I received my PhD in Experimental Particle Physics from the University of Manchester in 2003, working on the D0 experiment at Fermilab, USA. As post-doctoral researcher at Northeastern University, Boston, again on the D0 experiment, I worked on the most precise measurements of important backgrounds to the Higgs boson, and performed a direct search for the Higgs. In 2009 I moved to CERN as a Fellow, in time for the start of the LHC. In 2010 I joined UCL with a RS URF, now working on the ATLAS experiment.

Dr Chris Illingworth

Intra-host evolution of the influenza virus

Abstract: Evolution has shaped biological life over billions of years. Yet in viruses, the smallest biological entities, evolution can bring about important changes in a matter of days. Recent years have seen the emergence of new strains of influenza virus, which cause severe disease, but do not easily transmit from person to person. An open question is whether these strains could evolve greater transmissibility, and cause a major pandemic. Influenza spreads via successive infection and transmission events. Genome sequencing technology allows for snapshots of the viral population to be taken across the course of an infection, putting the process of evolution under the microscope. My work aims to understand and interpret such data, exploiting its potential to shed light on the progress of disease. I present a novel statistical method to learn how natural selection has affected influenza viruses during a single infection, characterising in detail the forces underlying viral evolution.

Bio: Dr Chris Illingworth read Mathematics at Cambridge University before moving into biological research, receiving a PhD from the University of Essex for his thesis, "Structural and Electrostatic Flexibility in Proteins: Computational Approaches to Ligand Binding''. Chris pursued an interest in evolution during postdoctoral work at the Wellcome Trust Sanger Institute, where he developed techniques to exploit time-resolved genome sequence data to elicit the role of selection acting upon a population. As a Sir Henry Dale Fellow at the University of Cambridge Chris continues to explore new ways of using sequence data to improve our understanding of pathogen evolution.

Dr Jens Januschke

Asymmetries of neural stem cell division in Drosophila

Abstract: The generation of different cell types is a key aspect of multicellular organisms, but how do cells become different from each other? One way cellular diversity can be achieved is through the action of stem cells. Like most if not all cells stem cells are polarized. This asymmetry is used by some stem cells to generate cell fate and if polarity in stem cells is lost, diseases can be triggered. We are using Drosophila neural stem cells address the question of how cell polarity and hence cell fate is established and maintained over many rounds of consecutive cell divisions which involve rapid polarization and depolarization events. We hypothesize that the transmission of cell fate information between different cell generations invokes cellular memory in Drosophila neuroblasts. We are exploring cell intrinsic asymmetries and their relevance to the maintenance of stem cell fate. Video data of our latest progress will be presented.

Bio: I was fortunate to be awarded a Sir Henry Dale fellowship in 2012, which I used to start my own laboratory in the College of Life Sciences at the university of Dundee. I moved to the north after working as a postdoctoral fellow in the Institute for research in Biomedicine in Barcelona where I worked on centrosome asymmetry in neuroblasts. Before that I studied mRNA localisation and the cytoskeleton during oogenesis in Drosophila in the Institute Jacques Monod in Paris and received basic training in Drosophila genetics and cell biology in the Institute of developmental biology in the university of Cologne from where I graduated.

Dr Andreas Kranis

Multi-scale animal breeding for the 21st century

Abstract: Agricultural genetic improvement is performed in pyramids: selective breeding in small nucleus populations is disseminated to large, global food supply chains. Therefore, breeding decisions have a major global impact. Breeding objectives are increasingly multidimensional as biosecurity, welfare and biodiversity become more important. Optimising progress in these traits, along with core productivity traits, offers challenges. Traditionally, breeders relied on pedigree information to make breeding decisions, but thanks to the 'genomic revolution', more precision is achieved when genomic information is also used for selection, because it offers improved accuracy in predicting genetic merit. Accumulating genomic information contributes to biological understanding, but also produces massive datasets. So, efficient data management and scalable algorithms are required to harness the power of 'big data'. This paper discusses how breeding organisations are responding to this challenge by employing sophisticated data science to cope with the rapidly growing scale of genomic datasets for delivering sustainable genetic progress.

Bio: My main roles as a Research Geneticist in Aviagen are to design, develop the software platform and manage the routine genomic evaluations for meat-type chickens. My responsibilities also include the coordination of research with academic collaborators and the knowledge transfer for the in-house implementation. As a Royal Society Industry Fellow I am now working in Roslin Institute to explore how genomic technologies can be used to maintain and manage diversity in commercial breeding programs as part of a sustainable genetic progress.

Dr Karen Lipkow

Ready, Steady... Hold it! Exposing the poised nature of genomes and their 3D organisation

Abstract: The DNA of all eukaryotes is present in the nucleus as chromatin, in which DNA is closely associated with hundreds of different proteins. The precise combination at a given location determines how a gene is regulated. Experimentally measuring this protein distribution results in extensive datasets that are impossible to interpret by eye. We have applied a newly developed method to analyse chromatin from the model organism S.cerevisiae (bakers yeast). By carefully reducing the complexity of the original data, we identified five distinct chromatin states. These states differ in relevant biological properties, such as enrichment of gene ontologies. They form no detectable pattern in 1D along the chromosomes, but co-localise in 3D. To our surprise, much of the chromatin is poised, ready for change, under both standard and heat stressed conditions. This highlights the great dynamic capability of gene regulation, and how much is learned when taking a Systems view.

Bio: Karen Lipkow has been a Group Leader since 2007, at the Cambridge Systems Biology Centre, and recently at the Babraham Institute. She was trained as a Molecular Biologist, with a Masters project on fly development at Rockefeller University, and a doctorate on DNA transposition in Oxford. Enjoying the science but missing the maths, she switched to Computational Biology of bacterial chemotaxis for her postdoc in Cambridge. Her own research group now combines a variety of experimental and computational approaches to study the interplay of cellular architecture and function, focusing on bacterial signalling, and dynamic chromatin organisation in the yeast nucleus.

Dr Richard Massey

Imaging the invisible: dark matter

Abstract: I use the Hubble Space Telescope to take images of dark matter, the Universe's most common ingredient. Dark matter is completely invisible, but we know that dark matter is all around our galaxy and others because it is heavy, and exerts a gravitational pull. To map out where it is, I watch how its gravity affects things that we can see. Collisions between groups of galaxies are the Largest Hadron Colliders in the Universe – bigger and faster than anything we can build on Earth. The directions that bits fly out of these cosmic collisions tell us about galaxies' three ingredients: stars, swirling clouds of gas, and dark matter. Ordinary material stops at the point of impact, like a car crash, but dark matter whizzes straight through. I'm surveying hundreds of these collisions (like the "Bullet Cluster") to pin down exactly how it behaves – and what it might be made of.

Bio: I obtained a PhD in astrophysics from Cambridge, then worked at CalTech and the Royal Observatory Edinburgh before taking up a URF in Durham. I primarily use the Hubble Space Telescope – it takes great photos, but has a frustratingly narrow field of view. To enable much broader surveys, I am building a new telescope that will float from a high-altitude balloon. Three times higher than planes, and above 99% of the Earth's atmosphere, this should obtain the same high-resolution images as Hubble. However, it costs only 1% as much as a satellite, is reusable, and will have a wide-angle lens.

Dr Oleg Mitrofanov

Terahertz wave near-field microscopy: scientific applications

Abstract: Use of terahertz waves for scientific investigations has grown recently, ranging from detection of interstellar molecular clouds and bio-tissue hydration levels to observation of electron-hole pair binding into excitons. The need for understanding of physical processes in small systems, such as electron/exciton ensembles in quantum wires and quantum wells, plasmons in graphene, and biological cells require application of THz imaging and spectroscopy with a spatial resolution, which is over two orders of magnitude higher than the diffraction limit. To enable these investigations, we have developed high-spatial resolution and high sensitivity THz near-field probes, based on evanescent waves that penetrate through single sub-wavelength size (~1/100 of the wavelength) apertures. The probes allow mapping THz fields in space and time. We will discuss applications of these probes in scientific and applied research, including imaging of THz surface waves, non-contact mapping of the conductivity in graphene and detection of plasmons in graphene nano-structures.

Bio: Oleg Mitrofanov began his research on near-field scanning probe microscopy at NJIT and Bell Laboratories (USA), where he demonstrated one of the first high-spatial resolution terahertz near-field microscopes. After graduation, he worked on charge transport, optics and exciton properties of semiconductors at the Research Division of Bell Labs. In 2009 he was awarded the RS URF to pursue his investigations of terahertz near-field microscopy at UCL, where he established the Ultrafast Laser Research Lab. He is currently working on overcoming the spatial resolution limitations of THz imaging and on applications of this technique for condensed-matter physics research and applied research.

Dr Michelle Moram

New materials on the nanoscale

Abstract: There is enormous current demand for better electronic materials (e.g. photocatalysts, energy storage) and devices (e.g. brighter lighting, denser memories, higher power electronics). However, although most devices contain just a few layers, they can be deceptively simple: complex emergent effects must be understood and controlled. Not surprisingly, it's hard to find the right combinations of materials for optimised performance. My group is addressing these challenges by developing broad new palettes of materials ('ingredients') and new kinds of complex nanoscale structures ('sandwiches' and 'cakes'), increasing the degrees of freedom available for device design. In particular, I will highlight why solid-state nitrides offer surprisingly rich and unexplored combinations of properties, of interest for a very wide range of applications (the full banquet!). I will also highlight briefly our new EPSRC Electron Beam Epitaxy Facility for materials discovery, which is now accessible to Research Fellows from all fields through collaboration.

Bio: I completed a BSc. Chemistry at University College Cork in 2003, then moved to the University of Cambridge for a PhD in Materials Science on III-nitride semiconductors (2006). I subsequently spent 4 years working on III-nitride semiconductors as an independent Oppenheimer Research Fellow and Jesus College Research Fellow at the Departments of Physics and Materials Science at Cambridge. In 2010 I took up a Royal Society URF on the development of new functional nitride materials, followed by a proleptic Lectureship at the Dept. Materials at Imperial College London in 2011.

Dr Sarah Newey

Reprogramming adult human cells to generate models of neurodegenerative disease

Abstract: The idea of being able to make an adult human cell revert back to an embryonic state that has the potential to generate any cell type in the body has long been a dream of cell biologists – equivalent to reversing a car up a one way street. With exciting new cell reprogramming technology, this is now possible and opens the door on generating relevant cell types for studying a variety of diseases. I am using this technology to grow functional brain cells or neurons for the study of neurological disorders such as Alzheimer's Disease and schizophrenia . My talk will discuss my progress in this 'human disease in a dish' project and the advantages and pitfalls of this approach.

Bio: Sarah Newey graduated from the University of Bath with a BSc in Biochemistry and obtained her doctorate at Oxford University, where she worked with Prof Kay Davies and Prof Derek Blake on the function of the dystrophin protein complex in muscle and brain. In 2001, Sarah was awarded a Wellcome Trust Travelling Fellowship to study molecular mechanisms underlying neuronal differentiation in the laboratory of Prof Linda Van Aelst, Cold Spring Harbor Labs, New York. In 2005, she returned to Oxford and had two children before joining the Dept of Pharmacology in 2009 where she holds a Dorothy Hodgkin Fellowship.

Dr Rebecca Notman

Modelling the elastic and barrier properties of skin

Abstract: The stratum corneum (SC) is the topmost layer of the skin. This very thin layer is an amazing biological barrier that prevents substances in the environment from getting inside the body and stops water from escaping. A thorough understanding of the SC is important for numerous applications including the delivery of bioactive molecules across skin and innovative touch technologies. Keratins are proteins found in the SC, which give elastic response and flexibility to skin. The hierarchical assembly of keratin proteins into long rope-like filaments is key to their function. Here we report molecular dynamics computer simulations that have enabled us to establish the first credible structural models of the smallest keratin sub-unit, the dimer. Subsequently, the simulations have been used to inform a mesoscale model of filament formation, which has provided the first definitive links between molecular structure and mechanical properties of keratin.

Bio: Dr Rebecca Notman is a Royal Society University Research Fellow in the Department of Chemistry at the University of Warwick (2012-Present). Her research interests lie in molecular simulations at the interface between biological and materials modelling. From 2009-2012, Rebecca held an independent Science City Research Fellowship, also in Warwick with an honorary position in the Department of Mathematics at the University of Birmingham. Rebecca first came to Warwick Chemistry in 2007 to take up a PDRA position in Biomaterials Modelling (2007-2009). Prior to this she achieved her PhD in Computational Pharmaceutical Science at King's College London (2003-2007).

Dr Silvia Paracchini

Breaking the symmetry: structural laterality and handedness

Abstract: Breaking the symmetry: the Nodal pathway and handedness. Determination of left/right asymmetry in vertebrates is achieved by breaking symmetry through the nodal flow, a well-established mechanism, which leads to a cascade of genes being expressed only at the left-side of the embryo. However, it is not so well established what determines behavioural asymmetries, such as language and hand preference in humans. Handedness is an intriguing trait displaying a worldwide bias of one left-hander every nine right-handers. We have shown for the first time that the same biological pathways controlling, structural asymmetry are also involved in controlling handedness reporting the first genetic association statistically significant (P<0.5*10-8). Our data also support the hypothesis of a correlation between handedness and psychiatric disorders, but this is likely to be more complex than previously thought and cannot be detected by simply assessing the frequency of left-handers in groups of patients. Our data have important implications for the fields of neuroscience and human evolution.

Bio: I have held a Royal Society URF since 2011 at the University of St Andrews where I am leading a research program in neurogenetics. This year I have also been Visiting Professor at the University of Cagliari. Before joining St Andrews, I was a post-doc in Prof. Tony Monaco's lab (University of Oxford), where I investigated the genetics of dyslexia. I obtained a DPhil degree in Human Genetics (Oxford University, 2003) and a laurea cum laude in Biological Sciences (University of Pavia, Italy, 1998).

Dr John Pinney

Mutation or mistake? Network analysis for better systems biology

Abstract: Systems biology fuses mathematical modelling with large-scale experimental data to allow an understanding of biological systems at a minute level of detail. Successful systems biology depends crucially on mathematical models based on an accurate knowledge of protein function. Although many such functions are already known from model organisms, it can be difficult to extrapolate to other species. Indeed, many of the problems encountered in systems biology are related to mistakes made in assigning protein function. In this talk I will present recent work based on an evolutionary approach to metabolic network modelling that allows the identification of mistakes in protein function assignment and the inference of enzymes that have diverged from their ancestral function. I will show how these techniques can be used to fill gaps in our knowledge when constructing metabolic models, resulting in a direct improvement in the accuracy of our model cellular systems.

Bio: Dr John Pinney is a Royal Society University Research Fellow at the Centre for Integrative Systems Biology and Bioinformatics (CISBIO), based in the Department of Life Sciences at Imperial College London. As an undergraduate, he studied physics at the University of Sheffield, later moving into biology and graduating with a PhD in bioinformatics from the University of Leeds in 2005. His research focuses on computational systems biology, especially the application of network analysis to the evolution and function of biological systems.

Dr Elva Robinson

Social networks in spatially dispersed ant colonies: foraging, information transfer and resource redistribution.

Abstract: Within any social group, the networks of interactions between members have important effects on the way the group functions, communicates and, ultimately, succeeds as a group. Social insects, such as ants, are ideal model systems for studying social networks, because they can readily be observed and manipulated at both individual and group levels. Some species of ants add an intermediate level, by spreading their colony out across multiple nests, connected by a network of trails. I have used radio-tagging, mapping and network modelling to investigate the how network structure in these decentralised ant colonies impacts on the key social processes of collecting and distributing food throughout the colony. The results suggest that these networks have evolved to strike a balance between efficiency (minimising number of connections) and robustness (allowing spare connections to exist); properties which are important to all transportation networks, at any scale.

Bio: Elva Robinson studies the organisation of social insect societies, combining empirical and modelling work to identify the simple rules followed by individual members of a colony, and to determine how they interact to produce adaptive group-level behaviours. Elva began working in this area with an interdisciplinary PhD at the University of Sheffield (Biology / Computer Science). After post-doctoral work at the University of Bristol, she moved to the University of York on a Royal Society Dorothy Hodgkin Fellowship and is based in both the York Centre for Complex Systems Analysis and the Department of Biology.

Dr. Asel Sartbaeva

Symmetry breaking flexibility in frameworks

Abstract: Today synthetic zeolites are the most important catalysts in petrochemical refineries because of their high internal surface areas and catalytic and chemical properties. There have been considerable efforts to synthesize new zeolites with specific pore geometries, to add to 200 available at present. Millions of hypothetical structures have been generated on the basis of energy minimization, and there is an ongoing search for criteria capable of predicting new zeolite structures. We have recently discovered a new property of realizable zeolites – the flexibility window – which is a theoretical measure which can provide a valuable selection criterion when evaluating hypothetical zeolite framework structures as potential synthetic targets.

Bio: I received my MSc degree at the Kyrgyz-Russian Slavic University in 1999, and MPhil and PhD degrees at Cambridge University in 2002 and 2005. I worked at the Department of Physics in ASU from 2005 till 2007. In 2007, I was awarded a Samuel and Violet Glasstone Fellowship, and have moved to the Department of Chemistry in Oxford. Since 2010 I am a URF, first at Oxford and from 2012 at Bath. I work on porous materials.

Dr Francisco Suzuki-Vidal

Imaging extreme plasmas for laboratory-astrophysics

Abstract: The field of laboratory plasma astrophysics aims at simulating large-scale astrophysical phenomena through small-scale laboratory experiments. The use of multi-Mega Ampere electrical currents from the MAGPIE generator at Imperial College London allows producing dense, supersonic plasma flows to study, for instance, processes relevant to stellar formation such as the launching of magnetically-driven jets and the formation of strong radiative shocks. The experiments are characterised by short spatial (~mm) and temporal scales (~ns), which require fast and accurate diagnostics to characterise the plasma dynamics. I will present an overview of the different imaging techniques used in the experiments, ranging from simple pinhole imaging to the use of sub-ns laser probing (interferometry and Schlieren) which allows obtaining the distribution of electron density in the plasma. In addition the use of fast-framing imaging (~100 million frames per second) allows recording the time evolution of the plasma.

Bio: I am a researcher in experimental physics using dense plasmas. I received a degree in physics from Pontificia Universidad Catolica de Chile, Santiago, Chile, in 2004 and a Ph.D. in physics from Imperial College London, London,U.K., in 2009. My thesis was on "Experimental study of radiatively cooled magnetically driven plasma jets". After my Ph.D. I continued as a research associate at the plasma physics group at Imperial College, where I have advanced the field of laboratory plasma astrophysics by being involved in international collaborations performing experiments with high-electrical currents and high-power lasers.

Dr Indi Tristanto

Challenges in aero-thermal modelling of green and efficient aero engines

Abstract: As a core element in global economic growth, aviation traffic has been growing at an annual global growth rate of around 4% in the past four decades. Improvement in combustor and turbine technology is important in sustaining such a growth whilst minimising the environmental impact. Traditionally, combustor and turbine are designed in isolation since specialised numerical tools are usually employed to handle very different key thermo-fluid parameter scales within the two components. However, in order to improve specific fuel consumption, thermo-fluid interactions between them needs to be better understood. The interaction must account for heat transfer management that employs rows of very small nozzles to inject the coolant. This issue is addressed at Rolls-Royce by a coordinated research effort in which the fellowship is one of them.

Bio: Indi Tristanto joined Rolls-Royce CFD methods group in 2006. His main interest lies on the thermo-fluid modelling of realistic flows that range from engine operational issues of contaminant ingestion problems to design issue of high temperature flows in turbo-machinery, solid oxide fuel cells and civil nuclear reactors. His previous positions were a lecturer at the University of Manchester and a researcher at Loughborough University. Indi holds a Chartered Engineer status that is awarded by the Engineering Council, UK.

Dr Elizabeth Tunbridge

The brain is never at rest: from genes to networks to disease

Abstract: Optimal brain function requires the co-ordination of activity within and between networks of brain regions. Neuroscientists have traditionally studied brain activity during task performance, however the majority of the brain's energy expenditure occurs at rest. In recent years, it has been demonstrated that network activity can be detected and quantified using neuroimaging techniques in resting volunteers. Furthermore, the coherence of these networks is altered in various disease states, and is influenced by genetic factors. I am interested in understanding how genetic variants (particularly those implicated in psychiatric disorders) alter the coherence of these 'resting state networks'. I will give two specific examples: one gene that influences resting state network activity in a manner consistent with its known function, and a second in which resting state network coherence has provided clues to the underlying biology of a gene of unknown function that is associated with schizophrenia.

Bio: Liz Tunbridge's research aims to understand how individual molecules influence brain function and thereby alter risk for psychiatric disorders, with the aim of identifying new treatment targets for these devastating disorders. She studied Molecular and Cellular Biology at the University of Bath, before being awarded a Wellcome Trust 4-year PhD studentship in Neuroscience (consisting of a MSc and DPhil) at the University of Oxford. After a brief spell working at the National Institute of Mental Health in the US, she returned to Oxford and was awarded a Royal Society University Research Fellowship to continue her research in 2009.

Dr Bruce Turnbull

Constructing spherical capsules from pentagonal proteins

Abstract: My group constructs three dimensional objects using protein molecules as building blocks. Our aim is to make nanoscale delivery vehicles that can transport drugs into specific target cells. We start with a protein that has a natural ability to enter cells and we reengineer it so that it may self-assemble into larger capsules. The protein we use has five identical chains that come together to form a pentagon. While pentagons do not tile well in two dimensions, they can be arranged in three dimensions to form dodecahedra. Larger symmetrical assemblies are also possible if we reengineer each corner of the pentagon so that it may interact with either one or two neighbouring pentagons. This trick is used by some natural viruses to introduce pentagonal building blocks into a hexagonal lattice. The result is a protein capsule that could ultimately find use in drug delivery.

Bio: Dr Turnbull is a synthetic chemist with interests in synthetic biology. He gained his BSc and PhD in Chemistry from the University of St Andrews. He then held a Wellcome Trust Research Fellowship at UCLA and University of Leeds where he was subsequently a University Research Fellow (2005-2013) and is now Associate Professor in the School of Chemistry and Astbury Centre for Structural Molecular Biology. He chairs an EU COST network called "Multivalent Glycosystems for Nanoscience" and he was awarded the 2013 RSC Carbohydrate Award for his studies on the synthesis of sugars and their interactions with bacterial toxins.

Dr Araxi Urrutia

How does our genome store complexity?

Abstract: Large brains and long lifespans are some of the key human characteristics. Yet despite their evolutionary importance and clinical relevance when disrupted, we know very little about the molecular mechanisms driving the evolution of these and other complex adaptations. Working with collaborators in the UK and abroad, my work aims to uncover the basic gene networks underlying complex traits by comparing genomes from multiple species. So far, we have found that larger brains in mammals are closely associated with increases in copy number of immune genes. The fact that these genes are more active in the brain forming tight interaction networks supports a direct role for the immune system in the evolution of brainier mammals. Additional research in my lab has shown that big-data comparative approaches can be successfully applied to evolution of other novel adaptations including the evolution of disease carrier body lice morphs from the benign head lice.

Bio: Following a three year maternity break, Dr Araxi Urrutia secured a L'Oreal UK Women in Science Fellowship and a Royal Society Dorothy Hodgkin Research Fellowship. Based at the University of Bath, Araxi has been the recipient of a Biochemical Society Early Career Award in recognition to her contributions to functional and evolutionary biology and now heads research group of seven PhD students. Araxi has a long-standing commitment towards gender equality, awarded a SHE inspiring women award and named a Raising Talent by the Women's Forum for Society and the Economy, she leads the Athena SWAN team in her Department.

Dr Silke Weinfurtner

Hydrodynamic simulations of black holes

Abstract: One of the main reasons for which progress is quantum gravity has not been as fast as we would have hoped is precisely the fact that the regimes in which it is relevant are particularly hard to access experimentally and observationally. This lack of experimental guidance can be to some extend compensated by the careful analysis of "analogue systems". These are easy-to-access physical systems which can be studied in the laboratory and manage to mimic aspects of quantum gravity. After a brief introduction, I will focus on a particular example, namely the analogy between the propagation of fields in the vicinity of a black hole and shallow water waves in an open channel flow. Within this setup it is straightforward to recover and comprehend the analogue of the process dubbed as Hawking radiation, i.e. the process that allows black holes to evaporate away their mass.

Bio: I am a physicist working on theoretical and experimental quantum gravity studies. My undergraduate and graduate studies took place at the TUM and the MPI for Quantum Optics. My PhD studies were carried out at the Victoria University of Wellington in New Zealand. I hold two postdoctoral appointments before accepting the URF, at the University of British Columbia in Canada and SISSA in Italy. I have successfully applied for the following research fellowships: DAAD PhD stipend, IOF Marie-Curie Fellowship, Career Integration Fellowship, 2 Fqxi mini-grants, 2 SISSA Young Researchers Fellowships, Nottingham Advanced Research Fellowship, Vidi, and the URF.

Dr Paul Williams

Will flights get bumpier because of climate change?

Abstract: Atmospheric turbulence is the leading cause of aircraft incidents. Every year, turbulence injures hundreds of passengers (sometimes fatally) and costs airlines around $100m. Turbulence in clear air (as opposed to clouds) is especially difficult to avoid, because it is invisible. Clear-air turbulence is produced by atmospheric wind shears, which are expected to get stronger because of climate change. However, the response of clear-air turbulence to climate change had not previously been studied. Recently we have shown using climate model simulations that clear-air turbulence changes significantly when the atmospheric CO2 is doubled. For example, within the busy North Atlantic flight corridor in winter, most clear-air turbulence measures show a 10-40% increase in the average strength of turbulence. They also show a 40-170% increase in the likelihood of encountering turbulence strong enough to dislodge unsecured objects. We conclude that climate change will lead to bumpier transatlantic flights by the middle of this century. Reference: Williams and Joshi (2013) Intensification of winter transatlantic aviation turbulence in response to climate change. Nature Climate Change 3(7), 644-648.

Bio: Dr Paul Williams studied physics at the University of Oxford, and is now a Reader in the Department of Meteorology at the University of Reading. His long-term research aim is to improve our ability to simulate and predict weather and climate, both by increasing our understanding of atmospheric and oceanic fluid dynamics (especially small-scale processes and how to parameterise them) and by developing better numerical integration schemes. He was recently awarded a Philip Leverhulme Prize in Earth, Ocean and Atmospheric Sciences, as well as the Royal Meteorological Society's Michael Hunt Award for excellence in science communication.

Professor Karen Wilson

Waste not want not - catalysing a sustainable future

Abstract: Catalytic technologies play a critical role in the economic development of both the chemicals industry and modern society, underpinning 90 % of chemical manufacturing processes and contributing to over 20% of all industrial products. Concerns over dwindling oil reserves, carbon dioxide emissions from fossil fuel sources and associated climate change is driving the urgent need for clean, renewable energy supplies. In a post-petroleum era, catalysis researchers will need to rise to the challenge of synthesising chemical intermediates and advanced functional materials and fuels from non-petroleum based feedstocks derived from waste forestry and agricultural materials or even aquatic biomass such as seaweed and algae. This presentation will highlight recent successes in catalyst design which have been facilitated by advances in chemical synthesis, nanotechnology and spectroscopy that offer an unprecedented opportunity to sculpt the atomic structure of solid catalysts and to peer inside their microscopic workings.

Bio: Karen is currently a Chair of Catalysis and Research Director of the European Bioenergy Research Institute at Aston University, where she also holds a Royal Society Industry Fellowship in collaboration with Johnson Matthey. Karen's research interests lie in the design of heterogeneous catalysts for clean chemical synthesis, particularly the design of tuneable porous materials for sustainable biofuels and chemicals production from renewable resources. Karen has a BA (Hons) in Natural Sciences from the University of Cambridge (1992), an MSc with distinction in heterogeneous catalysis from the University of Liverpool (1993) and a PhD (1996) in heterogeneous catalysis and surface science from the University of Cambridge. Following post-doctoral research at Cambridge and the University of York, Karen was appointed to her first independent academic position at York in 1999 where she stayed until 2009 after appointment to a Readership in Physical Chemistry at Cardiff University.