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Media Information

Over £3.8 Million for New Research in Scotland

Top researchers are to develop their ideas here in Scotland, thanks to grants totalling £3.87 million awarded by The Royal Society of Edinburgh (RSE). Innovative research is being supported through the RSE in partnership with key funders in the public and private sectors. Over forty five new awards offering public benefits in areas such as healthcare, the ageing population, environment and communications are detailed below. The awards are to be presented on Friday 26 September by Cabinet Secretary for Education and Lifelong Learning, Fiona Hyslop MSP and the President of the RSE, Sir Michael Atiyah, OM, PPRS. The prestigious ceremony will take place in the Great Hall of Edinburgh Castle. For the first time, this year's Awards Reception, hosted by The Scottish Government, will involve early career scientists.

Earlier this year the findings of an independent Ernst & Young Review of the Scottish Enterprise/RSE Enterprise Fellowships programme were announced. The Enterprise Fellowship programme, funded by Scottish Enterprise and delivered by the Royal Society of Edinburgh, is designed to recognise the importance of developing individuals' business skills to become the driving force behind that business. As a result of the positive review, Scottish Enterprise has committed to fund this programme for a further five years. Eight RSE/Scottish Enterprise Fellows will start their commercialisation projects next month in the first round of the new phase of the programme. The Scottish Government has provided extra funding to enable the Society to implement the Enderby Report recommendations, which included lengthening the Scottish Government Personal Research Fellowships from three to five years, awarding six Fellowships each year, instead of three, and funding them on the standard full economic cost basis.

RSE President, Sir Michael Atiyah, OM said:

> *Our Research Awards recognise, celebrate and promote excellence. They support some of the most outstanding young scientists and innovators working in Scotland today. The benefits of their research are far-reaching. The additional funding from Scottish Enterprise and The Scottish Government is significant for research in Scotland. I thank them and all of our funding partners and wish the Awardees every success*.

The organisations and trusts which fund the RSE to administer these awards are: BBSRC, BP, Caledonian Research Foundation, Lloyds TSB Foundation for Scotland, the Science & Technology Facilities Council, Scottish Enterprise and the Scottish Government. The latest funding is part of the RSE's successful Research Awards

scheme which supports exceptionally talented academics and potential entrepreneurs. The highly competitive awards enable people with good ideas, across a spectrum of disciplines to research and develop their work for the good of Scotland and beyond. The institution listed immediately prior to each Awardee's project summary indicates where the research will be undertaken.

Cormack Vacation Research Scholarships

Lucy Clark
Department of Applied Mathematics, The University of St Andrews
The Magnetic Properties of X-ray Bright Points in the Solar Corona

X-ray bright points are small, bright, loop structured phenomena observed in the solar corona. As an important feature within the solar corona, X-ray bright points are a key part of the coronal heating problem, a solution to which continues to be a great issue within the field of solar physics. Within the report, X-ray Telescope data, along with a full-disk MDI magnetogram, were used to investigate several of the magnetic properties of X-ray bright points present in the solar corona. The magnetic topology of each of the bright points was studied in detail to determine the connectivity of the magnetic field in the region of the coronal brightenings and to see how this can affect the strength of an X-ray bright point.

Blair Johnston
School of Mathematics and Statistics, The University of St Andrews
The Origin of Solar Magnetic Fields

The solar surface is threaded by magnetic fields that are directed both into and out of the Sun, forming magnetic flux features. The large-scale magnetic features follow an eleven-year cycle whereas small-scale magnetic features appear not to. The large-scale magnetic fields are believed to be generated by dynamo action at the base of the convection zone and it was widely believed that a second, local, dynamo acting closer to the surface created the small-scale magnetic fields. Parnell et al. (2008) discovered that the distribution of magnetic flux features on the solar surface obeys a single power-law over five orders of magnitude, suggesting that the generation of magnetic fields is scale-free. In this project, I analysed full-disc magnetograms to investigate whether the power-law index varies over the solar cycle. The results suggest that the slope essentially remains the same, further supporting the ideas presented by Parnell et al. (2008).

Ciara Quinn
School of Physics and Astronomy, The University of St Andrews
Sizing the Nurseries of Planets: a disk survey of the Taurus star-forming region
The study of circumstellar disks is a cornerstone for our understanding of star and planet formation. In this project I have placed constraints on planet formation in the Taurus star forming region, by compiling a database of multi-wavelength photometry data: sub-mm from SCUBA and IR data from Spitzer, and compared these observational re-sults with a large grid of models. I have found that most disks are larger in radius than our solar system, and many of them do have enough mass for the formation of massive planets. Therefore, a large fraction of stars potentially could form planets. However, I did find evidence for clearings in the inner disk, which would be indicative of currently ongoing planet formation.

Cormack Vacation Research Scholarships

William M R Simpson
Applied Mathematics, The Solar Group, The University of St. Andrews
Are Coronal Null Points a necessary requirement for Solar Flares and Coronal Mass Ejections?

Solar flares and Coronal Mass Ejections are two types of solar phenomena that occur in intense magnetic regions of our Sun. Certain mathematical models have been proposed for these phenomena that require the presence of a magnetic null point in the solar atmosphere. Unfortunately it is almost impossible to observe these coronal nulls directly. An alternative approach is to combine magnetic observations and 3D-modelling methods to extrapolate the coronal magnetic field from the photospheric field of an active region. We can then determine its magnetic topology and locate any nulls. The purpose of this project was to investigate the topology of the observed magnetic field of active-region AR0486 during the time of the X17.2 flare. An analysis of the physical character and behaviour of the magnetic nulls discovered in that region was undertaken, confirming the prediction of a stable null point within the vicinity of the Solar flare site.

James Sinclair
School of Physics and Astronomy, The University of St. Andrews
Synthetic Photometry of Gas Giants and Brown Dwarfs

Brown Dwarfs are of great interest since they occupy the mass range between giant planets and main-sequence stars and therefore exhibit both stellar and planetary properties. The mentioned mass range defines the 'Substellar regime' and their associated effective temperatures define the L and T spectral types. Substellar spectra are highly complex, due to the presence of cloud formation processes in their atmospheres. Additionally, many observational challenges exist which hinder determining their stellar features – effective temperature, surface gravity and metallicity. Theoretical modelling of substellar objects aims to fully characterise their atmospheres in order to match or predict observational properties. My project applied current, observational photometric practices on synthetic Drift-Phoenix model spectra for M and L dwarfs. These results were compared with current observational studies. A correlation of the H2O J index with effective temperature was revealed. Colour-Colour plots also show that these models are strongly indicative of observed Substellar objects. However, discrepancies do exist.

Rafal Szepietowski
Institute for Astronomy, Royal Observatory Edinburgh, The University of Edinburgh
The Dynamical History of Globular Clusters in N-body Models of Galaxy Haloes

The Cold Dark Matter paradigm, in which the dominant self-gravitating constituent of the universe is a massive elementary particle, has been very successful in explaining galaxy formation. However, the cosmological formation of the eldest parts of galaxies - globular clusters - has not yet been understood. A possible solution to this problem might be found by computer simulation. A recent study of the Virgo Consortium called "Aquarius" focuses on the formation of single dark matter haloes of galactic mass. The aim of this project is to develop simple models for locating globulars in the early stages of pregalactic collapse and trace those objects to yield the final predicted spatial distribution which will be compared with the actual distribution of globulars.

Lessells Travel Scholarships

Derek J Bennet
Department of Aerospace Engineering, The University of Strathclyde, Glasgow
Emergent Behaviour in Swarm Engineered Systems using Dynamical Systems Theory
Visiting Nihon University College of Science and Technology, Tokyo, Japan

In the near future swarms of interacting 'agents' (robots, unmanned aerial vehicles – UAVs, spacecraft) may be used to solve a variety of engineering problems in an efficient and robust way. These include engineering problems on the smaller scale, such as micro UAVs and self-assembling MEMs devices to the large scale, such as space-craft flying in formation. By taking advantage of the notion of emergent behaviour we can achieve a system that, although controlled in a relatively simple manner, will achieve a complex global behaviour as the 'agents' in the system interact. My work so far has been concerned with developing distributed dynamical control laws for pattern forma-tion and reconfigurability in a swarm of 'agents' and testing these algorithms in simula-tion. The aim of the project whilst in Japan is to validate experimentally these control algorithms for a small swarm of real UAVs.

Alasdair W Clark
Department of Electronics and Electrical Engineering, The University of Glasgow
Extreme Sensitivity by Engineering Plasmon Resonance Sensors
Visiting Department of Bioengineering, University of California, Berkeley, USA

Nanoparticles formed from noble metals exhibit unique optical properties as a consequence of highly defined local surface plasmon resonances (LSPR), so leading to amplification and confinement of the electromagnetic field around particular facets within their structures. These enhanced fields can be harnessed to significantly improve (by several orders of magnitude) the sensitivity of existing bio-sensing techniques, enabling single molecule events to be monitored. By specifically engineering the geometry of unique silver split-ring particles, with dimensions much smaller than the wavelength of light, we can create highly functional, extremely sensitive bio-sensors. Tuning the morphology of these structures on a nanometre scale allows us to achieve previously unseen levels of sensing functionality and selectivity. Integration of this technology onto so-called "Lab on a chip" formats presents exciting opportunities for the future of fast, low-cost, highly sensitive biological detection and characterisation.

Rory Hadden
School of Engineering and Electronics, The University of Edinburgh
Ignition of forest vegetation by embers during wildfires
Visiting Combustion Processes Lab, Department of Mechanical Engineering, University of California, Berkeley, USA

Every year large wildfires result in loss of human life, billions of dollars of damage to homes and infrastructure and the devastation of wildlife habitats. Climate change has resulted in an increase in the intensity and frequency of these fires, in addition to creating a longer fire season. The improvement and development of new fire-fighting tools, especially those predicting fire spread, is seen as an essential step in minimising the damage caused by wildfires. One important mechanism responsible for fire spread is that of hot embers which are transported by the wind and settle in

an area of unburnt, dry vegetation. These embers can result in the ignition of new fires many hundreds of metres or even kilometres from the initial fire. The project aims to determine experimentally the physical and chemical mechanisms which control ember ignition of forest vegetation to aid the development of fire spread prediction models.

Lessells Travel Scholarships

Scott Heron
Integrative and Systems Biology, The University of Glasgow
Surface Acoustic Waves for Sample Delivery to Mass Spectrometry
Department of Medicinal Chemistry, University of Washington, Seattle, USA

Surface acoustic wave (SAW) devices can be used to manipulate droplets of liquid through movement, mixing or atomisation. Such a device can be used to mix liquids in channels or droplets; to act as a delivery system moving droplets to electrodes or to and from microfluidic entrance / exit ports; and as a method to introduce peptide samples to a Mass Spectrometer (peptide identification). The incorporation of an Ion funnel to the systems interface will improve readings and efficiency, reducing sample volumes and processing time. The analysis of peptides taken from unknown cancer cells helps to identify cancer types and this system will help to speed up this process through a reduction in sample volume and miniaturisation of technology. The inclusion and development of the ion funnel is the purpose of the research grant awarded by the Lessells Scholarship, taking place at the University of Washington, Seattle.

David H Thomas
Medical Physics and Engineering, The University of Edinburgh
An optical investigation of microbubble response to medical imaging ultrasound pulses
Group of Experimental Echocardiography, in the Department of Biomedical Engineering, Erasmus Medical Center, Rotterdam, The Netherlands

Early diagnosis of cardiovascular disease may improve the chances of cure. Medical imaging methods, including ultrasound, are currently not successful at early diagnosis. Injections of microbubbles into the bloodstream can be used to improve ultrasound images of the circulation, but the way microbubbles oscillate when hit with ultrasound pulses is not yet fully understood. The use of the high speed ‘Brandaris 128’ camera at the Erasmus Medical Center in Rotterdam will allow more detailed study of the effects of pulse sequences on the oscillations of microbubbles. The Brandaris 128 allows ultra high-speed imaging at frame rates of 25 million frames per second (one million times faster than a regular video camera), and is unique to Rotterdam. The effect of ultra-sound pulses on the oscillations of individual microbubbles can be studied in great detail, potentially leading to novel diagnostic and therapeutic techniques.

Becky Warren
Bioelectronics and Bioengineering, The University of Glasgow
The effect of mechanical forces on cell function and protein expression
Department of Physics, University of Gothenburg/Chalmers Institute of Technology, Gothenburg, Sweden

The focus of my work is upon using an engineering platform to create an environment that will enable the study of cell function in response to mechanical

forces. Many cells, such as muscle, heart and epithelium, are subjected to dynamic mechanical stresses during their normal physiological function. Optical tweezers make use of laser light to manipulate cells and beads, and have the potential to provide a toolset for the development of a series of sophisticated assays for exploring cell activities whilst the cell is being challenged mechanically. The results of studies such as this are vital in biomedical research; unless we can study cells in a similar environment to that which they experience in the body, how accurate can our information be? The work I hope to carry out in Sweden aims to address this issue by focusing on epithelial cells.

Dr Rachel Walcott
School of Geosciences, The University of Edinburgh
River basin dynamics - investigating the link between erosion and sedimentation

The properties and depositional architecture of sediments deposited by rivers control their suitability for storage of water, hydrocarbons and dissolved carbon dioxide. Therefore, a rigorous understanding of the competing processes controlling basin dynamics and sedimentation is of great practical benefit in exploiting our natural resources and planning for climate change. River basins are complex systems which develop through the interaction of climatically and tectonically controlled mechanisms. Although many aspects of basin evolution can be simulated using numerical models, existing models miss an important slope-dependent feedback and therefore have artificially immobile river basin geometries. This impedes our understanding of the link between erosion and sediment deposition. I will incorporate a process that simulates this crucial feedback into an existing, state-of-the-art landscape evolution model which, along with extensive analysis of field data, will offer a clear insight into the mechanisms that control river basin dynamics and the link between erosion and sedimentation.

Caledonian Research Foundation/RSE Personal Research Fellowships in the Biomedical Sciences

Dr Michelle Scott
Biological Chemistry and Drug Discovery, The University of Dundee
Characterisation of the nucleolar protein interaction network

The nucleus of eukaryotic cells is compartmentalised to house several different structures responsible for specific cellular activities. One such structure is the nucleolus which produces ribosomes. In recent years, various proteins involved in other processes have been found in the nucleolus, raising the intriguing question of the involvement of the nucleolus in other cellular activities. Protein–protein interactions carry out and regulate most cellular activities. The comprehensive study of such interactions leads to a better understanding of cellular processes and of the molecular mechanisms of diseases when these processes are deregulated. The goal of this project is to investigate the nucleolar protein interaction network in order to gain a better understanding of its proteins and the processes in which it is involved. This should provide insight into the role of the nucleolus in numerous diseases, including cancer and viral infections, and might eventually lead to the development of novel therapies.

Caledonian Research Foundation/RSE Personal Research Fellowships in the Biomedical Sciences

Dr Sarah Trewick
Wellcome Trust Centre for Cell Biology, University of Edinburgh
DNA repair in heterochromatin and CENP-A chromatin

Your DNA is under attack from chemicals and radiation in the environment, as well as from dangerous chemicals produced by your own cells. Your DNA is your blueprint, so DNA damage is very serious and can put you at risk from cancer. However, you have highly efficient surveillance and repair systems that detect and mend DNA damage. Despite the large amount of damage inflicted on your DNA, only rarely do the cells' maintenance processes fail and allow permanent changes to your DNA. Cells organise their DNA by packing unused DNA into a dense inaccessible form known as heterochromatin. Meanwhile, DNA that is frequently needed by the cell is left relatively unpackaged. When DNA damage occurs, the packaging is removed or modified to create enough space to allow the DNA repair machinery access to the DNA helix. I am studying how DNA repair occurs in the tightly packed heterochromatin.

Lloyds TSB Foundation for Scotland/RSE Research Studentship

Stephen McQuaker
Department of Chemistry, The University of Glasgow
A New Way to Reduce the Oxidative Damage of Ageing

Cell mitochondria are responsible for the generation of the body's natural "energy currency" in the the form of adenosine triphosphate, via aerobic respiration. The production of reactive oxygen species (ROS) as by-products of this process is possibly the main endogenous source of oxidative stress in the body. ROS are highly damaging species that initiate radical cascades inside an organism that indiscriminately damage proteins, cell membranes, DNA, etc. It is vital to minimise oxidative stress, as strong evidence exists linking it as major cause of many age-related pathologies including neurodegenerative diseases and particularly those related to mytochondrial dysfunction. This project will investigate novel targeted materials which simultaneously identify and actively prevent ROS generation. We will further the understanding of ROS generation, their role in the ageing process and investigate new ways of combatting oxidative damage to prevent disease and ensure healthy old age.

Lloyds TSB Foundation for Scotland/RSE Personal Research Fellowship

Dr Michelle Luciano
Department of Psychology, University of Edinburgh
Gene-environment interactions in depression and related psychological traits in the aged.

The aim of my research is to find genes influencing depression, anxiety and neuroticism in 70 year-olds assessed on social and individual variables, including social support, exercise and diet. Various genes have been shown to increase one's risk of depression, but these genes have not been studied in elderly samples. I will test whether these and other genes are related to depression and anxiety in the aged, and importantly, whether this relationship is the same or different across certain environmental circumstances (e.g., diet). I will also study the extent to which a

personality trait, neuroticism (i.e., a tendency to be tense and nervous), contributes to depression and anxiety. Understanding the genetic and environmental pathways that influence depression and anxiety in the elderly may lead to new drug treatments, genetic identification of predisposed individuals enabling early intervention, and behavioural interventions focused on the best environmental protectors.

Dr Gill Douce
Division of Infection and Immunity, FBLS, The University of Glasgow
Molecular characterisation of in-vivo induced genes of Clostridium difficile

The hospital-acquired 'superbug' Clostridium difficile (C. diff) causes chronic and relapsing diarrhea, which frequently kills elderly and hospitalised patients. Infection is associated with antibiotic treatment that removes the normal protective flora of the gut, leaving the patient vulnerable to colonisation by this pathogen. Until recently, symptoms were largely associated with the production of two toxins. However, strains of bacteria that do not make these toxins but are still causing disease are being isolated, suggesting other factors are important. Using a refined in- vivo model of C.difficile disease, we have identified several unusual structures that appear to 'stick' the bacteria to the gut wall. Whilst not previously observed with C. difficile, similar structures produced by other mucosal bacteria correlate with enhanced disease. This Fellowship provides the opportunity to study these structures in detail and determine whether they provide an 'Achilles heel' at which new drugs or vaccines can be targeted.

Lloyds TSB Foundation for Scotland/RSE Workshop

Professor Ronald McQuaid
Employment Research Institute, Napier University, Edinburgh
The Employability of Older People

Work is an important key to people's welfare, including that of many older people. Across OECD countries a partial solution to problems arising from the ageing populations is to retain greater numbers of older people in the labour market, for example by encouraging tapering retirement through pension changes, raising the age of retirement, changing the workplace and work contracts etc. Yet currently, those aged from 50 years are among the most vulnerable groups in terms of lack of employment, vulnerability to unwanted unemployment and early retirement and detachment from the workplace. This affects the labour market and people's quality of life in different ways, e.g. terms of different work-life balances and links between work and mental health. The workshop, with international experts including Professor David Bloom of Harvard University, seeks to improve our understanding and awareness of the implications of future changing work patterns for older people.

Scottish Government/RSE Arts & Humanities Networks

Professor Graham Hair
Department of Music, The University of Glasgow
Listening to Music: Interdisciplinary Perspectives on Measurement, Analysis and Interpretation

Music has engaged the interest of many different communities, and the study of music has been pursued from many different viewpoints. Practising musicians and those who study music within formal academic disciplines have in common the experience of listening to music, but the way they communicate about this

experience varies greatly. For this project, a Scottish-based Inter-disciplinary Listening Network (SILIN) will hold a conference and a series of three one-day colloquium/workshop sessions. Musical practitioners (both individuals and cultural institutions, within and beyond Scotland) and scholars in the humanities will be brought together with scientists from various other faculties to investigate the relationship between empirical measurement, analysis from different viewpoints and the varieties of interpretative strategies. Listening to music informs what practitioners do, and understanding better what listening to music entails may help us to elucidate music's nature, extent and limits.

Patricia Whatley
Centre for Archive and Information Studies, The University of Dundee
Identity and Memory: An Interdisciplinary and cross-sectoral Research Network in Scotland

The development of this network, with partners comprising the RCAHMS, the National Galleries of Scotland, Napier University and the University of Dundee will involve academics and members of the community in online and face to face discussion on the creation and preservation of memory with a view to encouraging the exchange of views and growth of research in this important area. The areas of memory and identity provide rich opportunities for interdisciplinary and cross-sectoral debate which is currently lacking in a Scottish context. The problem of recording and preserving memory and of adequately representing communities and societies is particularly relevant in the 21st century. In this area academic studies are currently dominated by North Americans, South Africans and Australasians, reflecting to an extent the memories and identities lost or destroyed during traumatic events, which provide the impetus to re-capture identity and memory. In Scotland there has been little work done in this area and this research network will be unique in Scotland, if not the UK. The project will have a number of strands: a website/blog; three workshops, a series of public lectures, a conference and a publication.

Dr John Henry
Science Studies Unit, The University of Edinburgh
and Dr Monica Azzolini
School of History, Classics, and Archaeology The University of Edinburgh
Reading the Heavens: The Crawford Collection in the History of Astronomy at the Royal Observatory of Edinburgh

In 1888 James Ludovic Lindsay, 26th Earl of Crawford (1847–1913), bequeathed his superb personal library of the history of astronomy to the nation of Scotland. This collection of 15000 books and manuscripts is housed in the Library of the Royal Observatory Edinburgh. It is one of the top five libraries of the history of astronomy in the world, and is a great national treasure. Unfortunately, in spite of its undeniable importance, the Collection is hardly ever used. The aim of the workshop is to bring together at the ROE a number of leading historians of astronomy from all over the world, to enable them to see and use the collection. The organisers see this as the first stage of a continuing effort, including further bids for grants, publications based on the collection, an on-line catalogue and other enhancements, to make this world-class library known throughout the world.

Scottish Government/RSE Arts & Humanities Workshops

Dr Penny Fielding
Department of English Literature, The University of Edinburgh
Stevenson in the Twenty-first Century

2008-09 marks a major revival of the study of Robert Louis Stevenson. The UNESCO Edinburgh World City of Literature currently place Stevenson centrally in their city-wide reading project, and the New Edinburgh Edition of the Complete Works of Stevenson will be launched – the first scholarly edition of his complete writing. Our project explores Stevenson afresh, looking at how his works were produced in the nineteenth century, and how they can be read in the twenty-first. An international workshop for bibliographic scholars in July 2008 has investigated the composition and publication history of Stevenson's texts and this will be followed by two public lectures exploring his novels in the context of Edinburgh as both a Civic Centre and a city of darker secrets. These events locate Stevenson as a writer of world importance, with a focus on how his work helps us understand the cultural history of the city of Edinburgh.

Dr James A Harris
Department of Philosophy, The University of St Andrews
Scottish Philosophy Then and Now

What is the relevance of the tradition of Scottish philosophy to Scotland's situation today? In particular, what is the relevance of the philosophy of the eighteenth-century 'Scottish Enlightenment'? We will answer these questions by means of a close examination of the eighteenth-century Scottish debate about the politics and economics of nationhood. We believe that this debate has much to offer present-day Scotland as it reconsiders the 1707 Act of Union. A series of workshops, visits from international scholars, and a major conference will enable a sustained investigation of this hypothesis.

Scottish Government/RSE Personal Research Fellowships

Dr Henry Bookey
School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh
Integrated Nonlinear Optics for Sensing Applications

Photonic devices are established in many application areas – communications, computing, sensing, medical diagnostics. However, the increasing complexity of optical systems demands new optical integration techniques for cost reduction. Ultra-short pulse lasers can be used to both machine and write waveguides into materials. This technique, with its unique 3D writing and material design freedom, allows new generations of device designs to be explored and will seed innovation in the optoelectronics and lab-on-chip sectors. I propose to exploit this emerging technology to develop completely new integrated sensor devices. For sensing, nonlinear optical processes are of interest as a means to create broadband sources. Nonlinear processes can also be used directly to measure sample properties. Optical interaction can be enhanced with high field confinement in photonic crystal fibres. This work will use the inscription technique, together with novel optical fibres to miniaturise sensor systems that have thus far been limited to laboratory use.

Scottish Government/RSE Personal Research Fellowships

Dr Arnaud Javelle
Department of Molecular and Environmental Microbiology, College of Life Sciences, The University of Dundee
Characterization of the ubiquitous sulphate transporter from the SulP family
The first step of sulphate assimilation is its transport into cells where it can be metabolized. This initial step involves specific sulphate permeases, also called SulP proteins. These proteins are ubiquitous from bacteria to man. The philosophy of my project, in agreement with the citation of the biologist Jacques Monod “What is true for Escherichia coli is also true for the elephant” is to use simple and well studied bacterial model organisms which possess the SulP proteins. In these model organisms, powerful genetic and biochemical tools will be used to shed more light on SulP transporter properties and more generally on sulphate cycling in the cell. Although my project is purely fundamental, any advance in our understanding of the mode of action of these SulP transport systems will have a potential impact on society, given the importance of these proteins in different biological processes, including human disease.

Dr Nicholas Kamenos
Department of Geographical and Earth Sciences, The University of Glasgow
Impacts of climatic variability on shallow water marine ecosystems and resources

Changes in the marine environment and the resources it supports are being observed globally. It is therefore essential that we obtain a clear understanding of the relationships between climatic variability and Scottish marine ecosystems. Such information can be gained by observing relationships between past changes in climate and marine organisms. Past ecosystem information will be derived from diverse assemblages associated with marine coralline algae. Temporal changes in those assemblages will be related to historical changes in marine climate obtained from novel organic recorders; the algae themselves. Relationships between climate-ecosystem time series will allow us to better understand, and project, how contemporary marine ecosystems and associated resources will respond to the projected changes in European climate patterns.

Dr Stephen Anderson Moggach
Department of Chemistry, The University of Edinburgh
Compression-Tuning of Porous Materials

Porous solids contain large pores capable of absorbing other molecules. They have been shown to be catalysts, selective absorbants (used in separation technologies) and gas storage materials (useful for hydrogen storage). Pore size determines the proper-ties of these materials, and the aim of this project is to use pressure to modify properties though compression of pore size and shape. The scope for pressure to change material properties has been demonstrated in previous work on amino acids and molecular mag-nets. This work focused on hydrogen bonding and magnetism, while the present pro-posal is concerned with compressibility of pore spaces, and the practical and technological applications of this. Porous dipeptides and metal organic frameworks are molecular analogues of the more familiar zeolites, but they are both more compressible and more amenable to chemical modification. They are therefore ideal subjects for the new and completely unique approach to pore modification being proposed here.

Scottish Government/RSE Personal Research Fellowships

Dr Thomas Philbin
School of Physics and Astronomy, The University of St Andrews
Quantum Forces - New Theory For A New Technological Age

Material bodies at close separations experience a mysterious phenomenon called Casimir forces. These are forces that are caused by, literally, nothing: they are caused by the vacuum itself because of its quantum nature. This subject has been transformed in the past decade or so by the development of precision experiments to measure these quantum forces and test the theoretical predictions. I propose to use new theory tools to solve some outstanding problems in the area of Casimir forces. The method combines physical interpretation of the complicated mathematics with the use of symbolic and numerical computing. This subject has importance for future micro- and nano-technology because the Casimir forces between the moving parts of devices become significant on these scales and may possibly be manipulated to the advantage of the technology.

Dr Stuart Reid
Department of Physics & Astronomy, The University of Glasgow
The Universe seen through gravitational waves

Observing gravitational waves will open up an entirely new field in Astronomy, providing information unobtainable any other way. Einstein proposed that gravity can be represented geometrically as the distortion of the fabric of space-and-time by massive objects, like a weight distorts a rubber sheet. Motions of the largest and most violent astrophysical objects, such as black holes and supernovae, create ‘ripples’ in space-time - gravitational waves - like ripples on a pond. However, these signals are very small, so building detectors of high enough sensitivity is currently one of the most significant challenges faced by experimental physicists. My research is aimed at developing precision optics formed from novel materials, employing techniques such as surface characterisation, polishing and chemical etching, in addition to thermal treatment, with the goal of developing instrumentation for future gravitational wave observatories, to enable the observation of gravitational waves from far out in our Universe.

Scottish Government/RSE Support Research Fellowships

Dr Matt Clarke
School of Chemistry, The University of St Andrews
Cleaner synthesis of pharmacogically important amines

The industrial synthesis of drugs, agrochemicals and ultrafine chemicals mainly relies on technology that has a large environmental impact relative to other sectors. The methods used to make carbon-carbon and carbon-nitrogen bonds frequently generate significant waste products and often require extra chemical reactions (creating waste, using energy) to temporarily protect sensitive parts of the molecule during the reaction. A hot topic for the future of chemical synthesis is to develop reactions that generate minimal waste and can deliver value-added products directly from economic starting materials. The project to be initiated in this Fellowship is to develop one such reaction called asymmetric hydroaminomethylation, which is actually a tandem process involving three reactions proceeding sequentially in a single reactor vessel. This would be an attractive strategy to access molecules that

are widespread in pharmaceuticals and fine chemicals with significantly lower levels of waste and energy usage.

Scottish Government/RSE Support Research Fellowships

Professor Anne Magurran FRSE
School of Biology, The University of St Andrews
Biological diversity in a changing world: the consequences for Scotland's biota

Ecological communities, such as the bird community in a highland moor or the fish community in the North Sea, are composed of species, some of which are abundant while the remainder – typically the majority – are rare. Although the relative distribution of abundances will stay more or less constant over time, the abundances of the individual species can vary considerably. In this project I will measure the variation in species abundances within these species abundance distributions, and quantify the background rate at which rare species become common and vice-versa. This will enable me to determine the extent to which the biological diversity of a community changes in the face of anthropogenic impacts such as disturbance or climate change. I will examine a range of vertebrate and invertebrate, aquatic and terrestrial Scottish communities. A deeper understanding of the temporal dimension of species abundance distributions will contribute to management of biodiversity within Scotland.

Dr Patrick Meir
School of Geosciences, The University of Edinburgh
Understanding the tropical carbon cycle: enhanced expertise and new applications

The project will improve understanding of the role of the tropical carbon cycle in the global carbon cycle. My work will focus on the interaction between forests and the atmosphere, especially in terms of emissions or absorption of carbon dioxide. The project has three components addressing issues relating to land use, carbon cycling, and biodiversity: (i) the impact of warming and drying on Amazonian rain forest functioning; (ii) the effects of land use change on carbon storage in Peruvian montane rain forests; (iii) linking this knowledge to, and exchanging expertise with, a Scottish carbon management company in the context of recent international policy decisions made at the UN Climate Change Conference, at Bali, December 2007.

Scottish Enterprise/RSE Enterprise Fellowships

Arfan Ali
Institute of Petroleum Engineering, Heriot-Watt University, Edinburgh
Rapid, Non-Destructive Petrophysical Core Analysis from Magnetic Techniques

The focal point of the business is the rapid prediction of key properties from extracted borehole samples (core samples from the oil, gas, and mining industries) using rapid, non-destructive, environmentally friendly, magnetic techniques. Our magnetic measurements have shown strong correlations with key parameters, including mineral content (especially clay) and permeability. Our techniques allow extremely rapid predictions of these parameters to be made in oil or gas wells, or mining boreholes, allowing operating companies to make important field development decisions much quicker than is currently possible. Our techniques have several

advantages over current conventional core analysis measurements. They require no extra preparation of the sample, and can be performed at a variety of scales. Our techniques also allow the rapid re-evaluation of old core datasets, to quickly aid the identification of potential reserves that had been missed in the past. This is extremely important in the hunt for future reserves.

Dr Graham Berry
Division of Electronic Engineering and Physics, The University of Dundee
Metal Nanodispersions in New Healthcare Products

Recent concerns over hospital-acquired infections have highlighted the need for minimising the possibility of contamination. Silver, long recognised for its antimicrobial activity, can be used to manufacture effective wound dressings which prevent such infection. Having devised a novel method of creating stable aqueous nanodispersions of metals, including silver and copper, I propose to combine these with innovative fabrics manufactured by local Scottish textiles companies to produce a completely new range of healthcare products, including silver-impregnated wound dressings. Activated carbon filters are used currently in ostomy pouches to absorb potentially embarrassing odours. The addition of copper to the filter makes the odour abatement more effective. Our nano-copper dispersion should enable more economical use of copper which, combined with more cost-effective processing, will result in highly effective odour filtration at a lower cost, thus benefiting manufacturer and patient alike.

Richard Boyle
The Departments of Bioengineering & Electronic & Electrical Engineering, The University of Strathclyde, Glasgow
Advanced Stethoscope
Heart disease is an enormous problem, especially in Scotland, and using a stethoscope in order to identify heart problems is very difficult. Recent studies suggest that a great deal of time and money are spent in detecting patients with no heart problems. With this in mind, the current project is seeking to develop an advanced stethoscope system that will enable the user to both see and hear a more detailed version of a patient's heart function by allowing them to listen to any abnormal sounds more clearly, and therefore produce an improved diagnosis of any heart problems. It is also envisaged that this device will be used as a training tool in order to assist physicians improve their skills in diagnosing heart problems.

Scottish Enterprise/RSE Enterprise Fellowships

Dr Xibei Jia
School of Informatics, The University of Edinburgh
Quaid: a platform for improving data quality

Information holds the key to success. The accuracy of data determines the effectiveness of business strategy, operational performance and regulatory compliance. Based on an award- winning and highly successful EPSRC research programme in the University of Edinburgh, Quaid is a data quality platform for financial services which enables new products and services to be generated from existing digital assets. The platform enables organisations to monitor data quality and clean 'dirty' data. Its benefits over existing solutions include: increased automation of data quality process; greater accuracy of data; and, ease of use. Through Quaid, we envisage a highly innovative data-quality company headquartered in Scotland, leading with cutting-edge technology in the global marketplace that will generate

revenue from a hybrid model: licensing of packaged solutions to end users; selling embedded components through third-party vendors, such as data integration, data warehousing vendors; consultancy and professional services; and, selling reference ('clean') data.

Dr Iva Navratilova
College of Life Sciences, The University of Dundee
Kinetic Discovery

Compounds with 'slow off-rate' kinetics are correlated with improved chance of success in the clinic. Thus there is a growing demand by drug designers for complete kinetic, thermodynamic and stoichiometric characterisation for each compound. Surface plasmon resonance (SPR)-based screening can inform compound design in a more detailed fashion than simple IC50 data from biochemical assays, as it is the only single platform to provide full kinetic, thermodynamic and stoichiometry characterization for small molecules, peptides, proteins, antibodies, nucleic acids, membranes to whole cells and viruses. Kinetic Discovery proposed to generate revenue by serving this market. Kinetic Discovery intends to build its own intellectual property in screening and lead discovery from its services revenue base.
Dr Iva Navratilova, is a recognized world expert in developing SPR screening methods, espe-cially for membrane proteins and this expertise has considerable commercial potential in its own right.

Dr Sau-Yin Sek
School of Chemistry, The University of Edinburgh
Synthetic Nanomachines

There is evidence of increased interest and demand in nanotechnology applications, reflected currently by the significant volume of research in this area. One particular area of interest, with a huge potential for future growth as an underpinning technology for a wide range of future generation products concerns nanomachines. Recent advances by Professor Dave Leigh's research group at University of Edinburgh with catenanes and rotaxanes, reflect the huge potential to develop and exploit new applications using these species in the field of nanotechnology. Currently, key to the research being undertaken to produce nanomachines is the availably of sufficient quantities of the substrates required to make the nanomachines. The basic idea behind the proposed business, Synthetic Nanomachines, is the manufacture of specific chemicals that have mechanically-interlocked architectures, which can be used as "building blocks" for the production of nanomachines.

David Tonery
School of Computing, The University of Dundee
Homogeneous Charge Compression Ignition (HCCI) Motor Engine Greenhouse Incubator

The Homogeneous Charge Compression Ignition (HCCI) Motor Engine is the stepping stone between present conventional motor engines and the fuel cell, or hydrogen vehicles of the future. The General Motors Corporation calls HCCI "the most awaited advanced combustion technology of the past 30 years."
The process in which HCCI burns fuel inside an engine results in lower emissions and improved fuel consumption. An expected drop in fuel consumption of 20% and a similar reduction in CO2 emissions is a major benefit in reducing the demand for fossil fuels while reducing harmful CO2 emissions.

Dr Bo Xiao
EaStChem School of Chemistry, The University of St Andrews
MOF Materials for the Delivery of Nitric Oxide for Therapeutic Applications

Nitric oxide (NO) has strong anti-thrombosis, wound healing and anti-bacterial proper-ties that offer great promise for treating a number of different medical problems, which opens a great number of different potential markets for NO-based therapies. The major issue with NO gas is how to deliver it to the area of need in physiologically relevant amounts. Based on our expertise in developing functionalised porous materials and gas adsorption, we have successfully invented zeolite-based NO delivery materials, and this has led directly an exclusive licence for commercialisation in this area. However, a drawback of zeolites is their low gas storage capacity in relation with their structure. Nanoporous metal organic framework (MOF) materials have diverse structures that provide great opportunities to improve gas storage. We wish to develop a high capacity alternative to competitor technologies based on these new types of MOF materials.

BBSRC/RSE Enterprise Fellowships

Dr Davidson Day Ateh
Neuroscience Centre, Institute of Cell and Molecular Sciences, Queen Mary University of London
Bioengineered Therapeutics Delivery Platform for Neurological Diseases

Delivery of drugs into the brain and spinal cord can be highly problematic. Many compounds fail to be developed into drugs because they cannot travel into the brain or spinal cord, or get broken down too quickly by the body. Pharmaceutical companies recognise these issues as major development hurdles for compounds, including those of potential use in disorders such as Alzheimer's and Parkinson's diseases. These disorders are generally long lasting, seriously impair quality of life and can lead to death. We have developed a delivery platform compatible with many classes of pharmaceutical agents, including small drug molecules and larger biologicals. The platform will facilitate the delivery of drugs directly into nerve cells in a targeted manner and will contribute to the development of medicines for neurological and neurodegenerative disorders, where there is expected to be a huge rise in patients due to the extension of life expectancy in many countries.

Dr Nick Montague
Department of Biological Chemistry, The John Innes Centre, Norwich
Encapsidated Mimics as real-time PCR controls

New molecular techniques for disease diagnostics are highly sensitive; it is therefore very important to have reliable experimental controls. To this end we have engineered a harmless plant virus to mimic the diagnostic target. Synthetic sequence elements from the diagnostic target disease have been added into the genome of Cowpea Mosaic Virus (CPMV). The CPMV particles are highly resistant to degradation, even over periods of many months in contact with biological fluids, and therefore provide an excellent protective environment for the genetic material. These virus particles make ideal controls as they can be added to a fresh sample prior to any processing and thus surveil for errors at all stages of the testing protocol. This is invaluable when screening for notifiable diseases where a false-negative result can have serious implications for infection control. Our technology has successfully been evaluated in veterinary diagnostic applications, and has attracted interest from commercial testing and reagent manufacturing companies.

BBSRC/RSE Enterprise Fellowships

Dr Caroline Pennington
BioMedical Research Centre, University of East Anglia, Norwich
Realtime validation of mammalian cell identity and gene expression analysis

Animal cells, removed from tissues, will continue to grow if supplied with the appropriate nutrients and conditions. This process, called Cell Culture, is a basic and fundamental tool for biomedical research. It is important that the appropriate cell type is used when researching the mechanisms of disease at the cellular level. However, the contamination of cell cultures with faster growing cell types is a growing problem in research laboratories worldwide. Indeed, investigators have suggested that between 15% and 30% of cell lines may be cross-contaminated or mislabelled. It is clear that this a serious issue that can result in years of wasted time and resources, can invalidate, or at least cast doubts on the relevance of published research and affect the careers and reputations of scientists. We are developing an easy-to-use service to confirm the identity of cell lines using simple non-gel-based technology.

Dr Zimei Rong
School of Engineering and Materials Science, Queen Mary University of London
A sensor based diffusion property tester

We are aiming to provide biosensors and biosensor-based products for tissue engineering and regenerative medicine. For monitoring nutrients and metabolites in tissue scaffolds, glucose (lactate) biosensors were fabricated. Commercialisation (scale-up of the fabrication) will improve our biosensor manufacture technique and likely lead to clinically useful biosensors. The biosensors were incorporated into bioreactors where they measured analyte concentrations which control medium flow to optimise nutrient delivery and waste removal. Nutrient and waste transport in scaffolds occurs mainly through diffusion, and values of the diffusion coefficients are required for designing such biomaterials. A method was developed to determine glucose diffusion coefficients through collagen gels. When a gel without glucose is immersed into glucose solution we measure glucose concentration evolution in the gel. The key novelty is that we developed an advanced mathematical expression to simu-late glucose transport in the gel. The diffusion coefficients were determined by fitting the simulated to the experimental concentration profiles.

Science & Technology Facilities Council/RSE Enterprise Fellowship

Dr Shin-Sung Kim
Department of Physics, The University of the West of Scotland
Piezo actuators with integrated extension sensor for precision fluidic applications

The project aims to provide enhanced solutions for precision control of microfluidic applications by incorporating an innovative smart actuator sensing (SAS) technology, which is based on the integration of piezoelectric displacement sensors and piezoelectric actuators. The SAS technology enables continuous monitoring and control of the displacement of the actuator. It also benefits from an open-loop control of the actuator displacement, alleviating the inherent hysteresis in the actuator. The ceramic-based SAS technology is also highly compatible with microfluidic applications and will be able to offer enhanced precision and added functionalities for micro-manipulation of fluids such as micro-drop generation, micro pipetting,

precision-dosage drug mixing and micro pump-ing. The overall compactness, cost-effectiveness and potential for diverse functionalities makes the SAS-enabled microfluidic device a preferable solution in the demanding biomedical applications.

About the RSE

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• Organising lectures, debates and conferences
• Conducting major independent inquiries
• Providing educational activities for school students throughout Scotland
• Distributing almost £2 million per year to top researchers and entrepreneurs
• Showcasing to the World the best of our research and development
• Increasing two-way international exchanges
• Encouraging, promoting and rewarding excellence
• Offering state-of-the-art conference facilities
• Publishing internationally respected learned journals

The RSE was founded in 1783 by Royal Charter for the "Advancement of Learning and Useful Knowledge". It is regarded as Scotland's National Academy of Science and Letters. Today it has around 1400 Fellows whose expertise encompasses the full spectrum of the sciences, medicine, engineering and technology, education, law, the arts, humanities, social sciences, business, industry, the professions and public service. This multi-disciplinary perspective makes the RSE unique amongst the United Kingdom's learned societies. It is funded by a range of carefully selected charitable, public and private bodies. Its mission today is providing public benefit through the advancement of learning and useful knowledge. The Royal Society of Edinburgh, Scotland's National Academy, is Scottish Charity No. SC000470.

About Scottish Enterprise
Scottish Enterprise is Scotland's main enterprise, innovation and investment agency. Working in partnership with industry, academia and the public sector, SE aims to help make Scotland a place where business can thrive and key industries can be competitive. Its focus is to help businesses grow, encourage greater innovation and create the right conditions for companies to access property, markets and finance to increase productivity and increase Scotland's ability to compete internationally.

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