



THE WINTON PROGRAMME FOR THE  
**Physics of Sustainability**

ANNUAL REPORT

**2013**

The Winton Programme for the Physics of Sustainability, was established in 2011 through a £20 million donation to the Cavendish by David Harding, an alumnus of the Physics Department.

The aim is to support research programmes that explore basic science that could lead to the technologies we will need in the future to tackle the demands of an expanding population faced with declining natural resources.

This is the second annual report for the Winton Programme, detailing the core activities and highlighting some of the research and connections that are already emerging.



# REVIEW

Richard Friend, Cavendish Professor of Physics



The Winton Programme for the Physics of Sustainability is now firmly established, reaching widely across the Cavendish Laboratory and drawing in collaborations across the University. The programme has the grand objective of supporting new science that can address real and practical challenges under the broad agenda of ‘sustainability’. This is not a blueprint that tells us what to do; indeed we were clear that because we wanted to support new science that was not already on our agenda, we were not sure what this would be. The themes now developing, as described in this annual report, have arisen from bottom-up initiatives from staff across the Cavendish Laboratory and from the excellent cohorts of Winton Fellows and Winton Scholars now in place. Several links with the life sciences have emerged independently, with interests in the role of coherent quantum mechanical phenomena in photosynthesis, in solar cells based on molecular materials, and in the operation and control of photosynthetic algae. Connections with the chemistry and materials science of the rest of the periodic table are also developing strongly, and there is a real appetite for discovery of new phenomena in new materials. The support from David Harding for the Winton Programme has also enabled the University to secure government funding for a new building on the West Cambridge site. This £25.6M project will provide for the construction of the Maxwell Centre, as we describe in this report. This is a major step towards the reconstruction of the Cavendish Laboratory, but it will also play a major role also in bringing the sciences on the West Cambridge site together and in providing a natural point of contact with industry.

# PROGRAMME UPDATE

Nalin Patel, Programme Manager



*“This year has seen a doubling of the Winton community with new Scholars, Fellows and a Lecturer supported by the programme. A further boost has been provided by the funding for the Maxwell Centre which will generate new opportunities to expand the scope of the Winton activities to the physical sciences as well as engaging with industry.”*

## Overview of 2013

This year has been a significant one for the Winton Programme for the Physics of Sustainability building upon the foundations that were set up during 2012. The Programme has continued to attract some of the brightest young scientists to work on a range of new research activities, mainly based at the Cavendish but with increasing links to other related departments. The Winton community in 2013 has doubled with our second cohort of Scholars and Fellows in place and will soon expand further with the latest recruits to start later this year.

The Programme is starting to see new results emerging from the research from the Winton funded researchers as well as others who have been awarded Winton pump-prime grants for novel exploratory research. The emphasis on taking research in new directions and taking on high-risk and high impact activities has been a core feature of these activities, some examples of which will be described later in this report.

The other major event this year is the securing of funds to construct the Maxwell Centre on the West Cambridge site. This Centre will provide space for laboratories and offices to enable increased interactions between disciplines in the physical sciences and industry with Winton Programme being an integral part of the Maxwell Centre.

## Programme Activities

The current focus of the programme has been a “bottom-up” approach to developing new research activities which may have an impact in the future on some of the global sustainability related challenges we face. Attracting talented scientists from around the world has been a primary goal through funding PhD students and Advanced Research Fellows. The thirteen Scholars and four Fellows currently in place will soon be joined by eight additional Scholars and one Fellow. This recruiting of new scientists to the Cavendish will continue to be a core part of the Programme.

In addition, existing junior and senior staff at the Cavendish, along with collaborators in other departments, are able to explore new fields of research through the Winton pump prime awards. These awards of up to £50k enable researchers to take on high-risk projects, which have the potential for high impact but would normally be difficult to fund through conventional research funding. In total nine awards have been made to date, with the majority of these involving collaborations with other departments. The pump-prime scheme remains open for further applications.

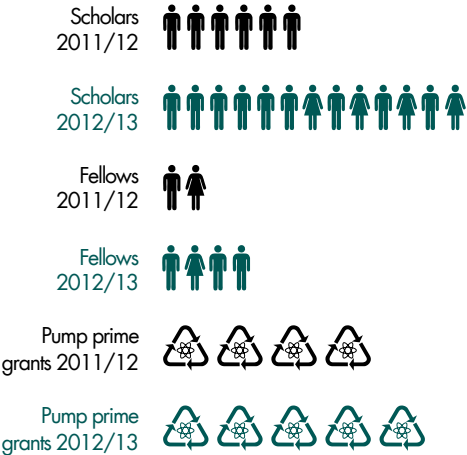
The establishment of the Maxwell Centre and the first appointment of a Winton affiliated Lectureship position at the Cavendish, will bring scope for setting up

larger research programmes. These will have the freedom to operate in new areas of science, and have the opportunity to increase collaborations with other related departments as well as developing industry interactions. The involvement of industry will be an important factor to convert the world leading research in Cambridge to commercial applications.

Two other important activities of the Programme are the annual Winton Symposium and the support from the

International Advisory Board. The Inaugural Symposium, last year brought together world-leading scientists to the Cavendish to debate the science behind some of the fundamental limits to “Energy Efficiency”. This provides an opportunity for researchers in Physics, as well as other related departments, to hear some inspiring talks and consider how their research could contribute to these important issues. A similar format Symposium will be held this year on “Materials Discovery”, which again will cover a broad range

of disciplines. The International Advisory Board members are invited to Cambridge at the same time as the Winton Symposium. This distinguished list of scientists from around the world have considerable experience in managing research, and provide advice on the future strategic direction of the Programme.



Number of Winton Scholars and Fellows in place and the number of pump prime awards granted in the respective academic years.

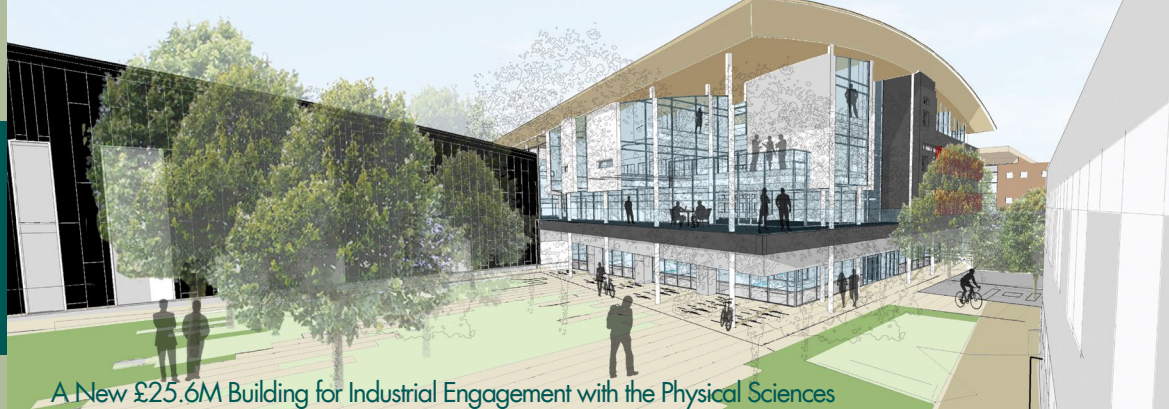


Architect's impression of the new Maxwell Centre.



# THE MAXWELL CENTRE

*“The University has already invested very heavily to build up our research base on the West Cambridge science and technology campus, and through the Maxwell Centre, we will capitalise on this resource by embedding industrial engagement still further into the University” Professor Sir Leszek Borysiewicz, Vice Chancellor of the University of Cambridge*



**W**e are delighted to report the award of a grant of £21M from the UK Research Partnership Investment Fund 2012-2015 (UKRPIF) of the Higher Educational Funding Council for England (HEFCE) for the construction of the Maxwell Centre. With a further contribution of £4.6M from the University, the Centre will be completed by late 2015.

The four main objectives of the UKRPIF scheme are to:

- Enhance the research facilities of higher education Institutions (HEIs) undertaking world-leading research
- Encourage strategic partnerships between HEIs and other organisations active in research
- Stimulate additional investment in HE research
- Strengthen the contribution of the research base to economic growth

The rules of the scheme were that funding was to be allocated on the basis that HEIs have secured at least double the funding requested from non-governmental sources. Of central importance to the success of the bid was the gift by David Harding of £20M to create the Winton programme, which in its scale and unrestricted scope matched perfectly the intentions of the scheme and will form the core of activities in the new building.

David Willetts, Minister for Universities and Science, said he believes this project will ‘not only deliver new knowledge and applications for industry, but will accelerate growth and foster innovation between the research base and business, keeping the UK ahead in the global race.’

This will not be conventional research or ‘business as usual’, but a major effort to go beyond the boundaries of traditional physical science concepts through a bottom-up approach to fundamental research. Work on the specific challenges facing collaborators will be combined with research into areas at the edges of current conception – the ‘unknown unknowns’.

The key innovation is the central role of industrial liaison and the accommodation of our industrial collaborators within the building. This will involve both the undertaking of experiments and in the interpretation and exploitation of the results of innovative types of experiment and theoretical investigations. There will be a strong emphasis upon the role of Scientific Computing and the needs of industry. Accommodation will be provided for students who take courses supported by the Centres for Doctoral Training. A substantial fraction of the building will involve new projects, many of which have received ‘pump-prime’ funding from the Winton programme and other sources, to initiate projects that extend the range of their scientific endeavours.

# LECTURESHIP

Dr Suchitra Sebastian



Fig 1

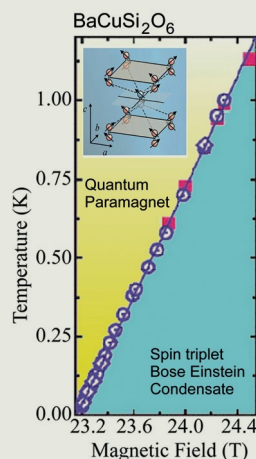


Fig 2

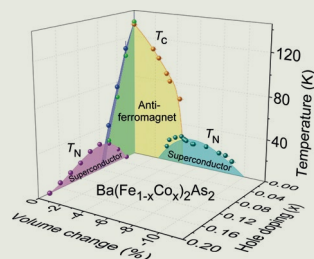
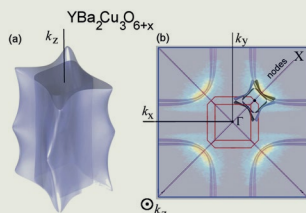


Fig 3



Suchitra Sebastian will be appointed to an academic staff position at the Cavendish, with her research closely linked to the Winton Programme. Suchitra works in the area of new materials. Her research involves the search for unconventional phases of matter by the synthesis of pristine single crystals of new materials and the tuning of their properties using external parameters such as applied magnetic fields, strain, and electric fields. Highlights of her research have included discoveries in a magnetic Bose Einstein condensate (for which she was awarded the Lee-Osheroff-Richardson prize), the realisation of quantum Hall effect plateaux in a spin system, the creation of a high temperature superconductor from an iron pnictide antiferromagnet solely upon the application of strain (for which she was awarded the IUPAP Young Scientist Medal in Magnetism), and the resolution of the low temperature electronic structure of the mysterious underdoped copper oxide high temperature superconductors (for which she was awarded the IOP Moseley Medal and Prize, and the L'Oréal-UNESCO Fellowship).

Her future research plans include the creation of novel functional materials such as memory devices in which the

transport of spin currents is rendered dissipationless by a coupling of spin and orbital channels in topological semiconducting materials, the creation of ultra-low power devices, non-volatile memory, and optical switches based on electric field triggered metal-insulator transitions in Mott insulating oxides, a new generation of spin, orbital, and electronically entangled multiferroics in frustrated magnets, and electrical field tuned high temperature superconductors. She was recently awarded a 2013 ERC starting grant for the study of Unconventional Superconductivity from a Mott Insulating Parent Material.

## References:

1. S. E. Sebastian *et al.* *Nature* **441**, 617 (2006).
2. P. L. Alireza *et al.* *Journal of Physics: Condensed Matter* **21**, 012208 (2009).
3. S. E. Sebastian *et al.* *Nature* **454**, 200 (2008).
4. S. E. Sebastian *et al.* *Nature Commms.* **2**, DOI:10.1038/ncomms1468 (2011).
5. S. E. Sebastian *et al.* *Phys. Rev. Lett.* **108**, 196403 (2012).

Fig 1: Creation of a low dimensional spin Bose Einstein Condensate upon applied magnetic field tuning of a quantum magnet [1].

Fig 2: Creation of high temperature superconductivity upon the application of either strain [2] or chemical doping on an iron arsenide material.

Fig 3: Resolution of the electronic structure of an underdoped high temperature superconductor using quantum oscillation measurements [3-5].

# FELLOWSHIP



The first two cohorts of Winton Advanced Research Fellows are now well established in the department and are growing their groups and collaborations as well as busy publishing papers. Summary of the research of the first two Fellows is described below. These four Fellows will be joined, in October of this year, by the latest appointment, Dr Ottavio Croze. His work on swimming micro-organisms including photosynthetic algae is already linked to activities in the Department of Applied Mathematics and Theoretical Physics (DAMTP) and Department of Plant Sciences in Cambridge.

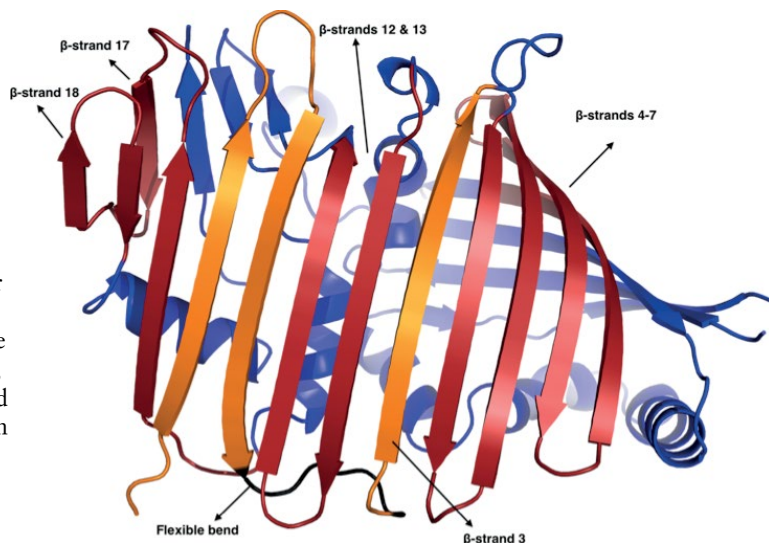
Fig. 1, opposite: The Fenna-Matthews-Olson protein, part of the photosynthetic apparatus of green sulphur bacteria. Room-temperature, coherent quantum energy transport was observed in this complex in 2010.

## Alex Chin

I have continued to develop my research into the theory of dissipative quantum dynamics in photosynthesis, with an expanded group of three PhD students, a MPhil student and a postdoctoral research assistant. Over the last year, the team has published work on photosynthetic energy transfer and charge separation, ultrafast spectroscopic analysis, photonic crystals and long-lasting quantum coherence in biomolecular environments. The latter work, published in *Nature Physics* (*Nature Physics* 9, 113-118 (2013)), attracted popular media attention in both the UK and abroad.

A variety of exciting new theoretical and experimental collaborations, most notably with the Optoelectronics group in Cambridge and Microsoft Research, have also recently expanded the team's research interests to include organic photovoltaic devices and adaptive, non-equilibrium quantum machines. These and other new lines of work require advanced theoretical

approaches, especially for simulating and analysing experimental data. Alongside the development of computational techniques for these problems, the team are also pursuing new *ab initio* methods for obtaining essential simulation parameters



with new Winton Fellow Nicholas Hine, enabling a fully multi-scale description of charge and energy transport in both biological and new types of artificial light-harvesting devices.

Alex Chin is now also a Fellow and Director of Studies at Robinson College, Cambridge.





## Siân Dutton

During the last 12 months I have been joined by a PhD student and project students both undergraduates and graduate students from the nanoDTC. Next year we will be joined by two further PhD candidates. Research has been focused on looking for new materials with applications in batteries and some exploratory work on solid state magnetic cooling.

Work on batteries is focused on considering new electrodes within the mature field of Li-ion batteries and more exploratory work on Na- or Mg-ion systems. For Li-ion batteries our focus is on forming metastable kinetic phases through low temperature ion exchange reactions. One family of materials we have been investigating are those structurally related to  $\text{CaFe}_2\text{O}_4$  such as  $\text{LiFeTiO}_4$  and  $\text{Li}_2\text{Fe}_3\text{SbO}_8$ . Formed from the stable Na-analogues we observe a subtle distortion in the structure of the Li-containing phases. Experiments are currently on-going to understand the nature of these changes and to manipulate the structure to increase the capacity and electrical conductivity of the parent phase. Work on Mg-ion batteries is

focused on demonstrating viable systems. Our objective is to use oxide, as opposed to sulphide, cathodes in order to increase the operating voltage and extend the capacity.

In addition to work on battery materials we have also begun a project exploring complex lanthanide oxides for solid-state magnetic cooling. Initiated as a part III student project this work was continued by an undergraduate summer student. Our preliminary results studying doping in gadolinium gallium garnet indicate that how the changes in entropy are presented has a dramatic impact on the results. For Al-doping in gadolinium gallium garnet we find that the changes in the volume and density are significant when considering the relative quantities of materials required for a given change in magnetic entropy.

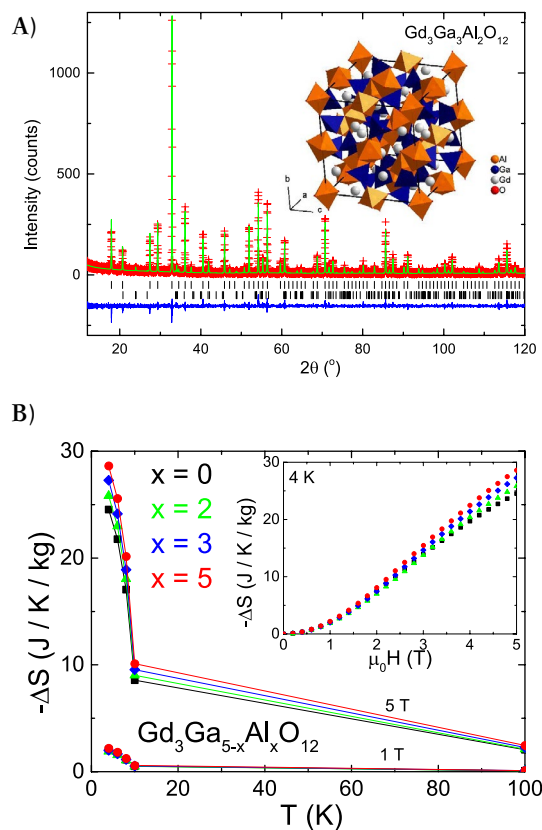


Fig. 2, above: a) Powder X-ray diffraction pattern of Al-doped Gadolinium Gallium Garnet,  $\text{Gd}_3\text{Ga}_5\text{Al}_x\text{O}_{12}$ , the crystal structure is inset. b) Changes in magnetic entropy as a function of doping in  $\text{Gd}_3\text{Ga}_{5-x}\text{Al}_x\text{O}_{12}$  ( $0 \leq x \leq 5$ )

# SCHOLARSHIPS

**S**even new Winton Scholars have started their PhD programs in Physics in 2012/13 to add to the first cohort of six. Once again the candidates originate from around the globe, with this cohort including scientists from Armenia, China, Germany, New Zealand, Poland and the UK. We have also had a number of exceptional female candidates with four selected for scholarships. The research topics for the new Scholars and their supervisors are listed below:

**Mr Steffen Illig**

Establishing relationships between microstructure and electrical properties in organic materials  
Supervisor: Prof Henning Sirringhaus

**Mr Andreas Jakowetz**

Ultrafast spectroscopy on processes in organic solar cells  
Supervisor: Prof Richard Friend

**Miss Sarah Morgan**

Theory of open quantum dynamics in nanoscale systems  
Supervisor: Dr Alex Chin

**Miss Xiaoyuan Sheng**

Structure and Function of Polymers far from Equilibrium  
Supervisor: Ulrich Steiner

**Miss Hannah Stern**

Ultrafast spectroscopy of organic materials to understand the generation of excitons via

singlet exciton fission  
Supervisor: Prof Richard Friend

**Mrs Monika Szumiło**

Organic thermoelectric materials  
Supervisor: Prof Henning Sirringhaus

**Mr Vahe Tshitoyan**

Nano-spintronics  
Supervisors: Dr Andrew Ferguson and Dr Andrew Irvine

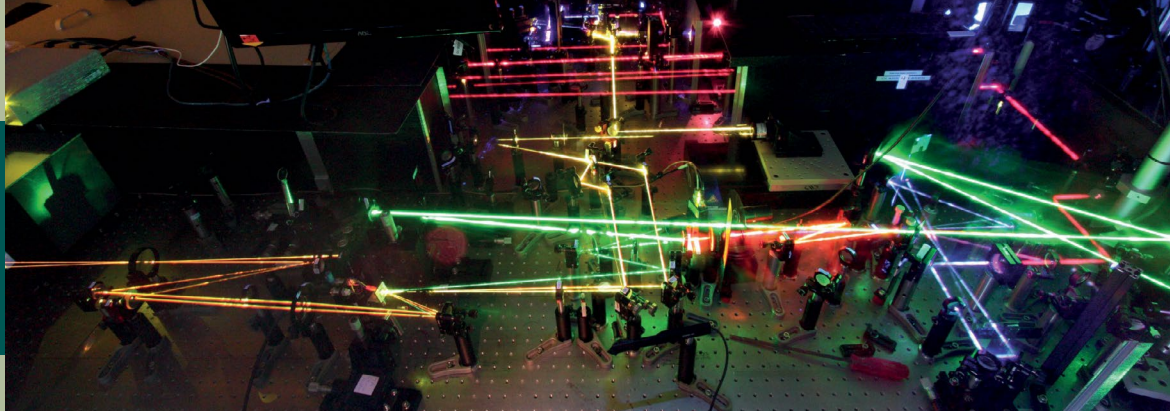
Offers have also gone out to eight researchers for the third cohort of Winton Scholars. The majority of which will be joining the Cavendish in October 2013.

The Scholars from the first cohort are well embedded into their research in the different groups at the Cavendish, with the experimentalists getting to grips with their research topics and the theoreticians already publishing papers on their work. All the Scholars were able to attend summer schools, providing an opportunity to meet other young scientists and hear about some of the latest developments in their fields. One of the Scholars, Michael Price, also attended the Doha 2012 UN Climate Change Conference as part of a New Zealand student delegation. He shared some of his experiences with the Winton Community on how the meetings are arranged and the difficulties with getting agreement between such large numbers of countries on global issues.

# PUMP PRIME

*“the pump prime grant paid for a bespoke laboratory apparatus that has enabled new science and there has also been an increase in cross-disciplinary collaborations within Cambridge and overseas”*

Dr Brian Walker



The pump-prime scheme remains open to providing funding up to £50k for projects to work on speculative research, which if successful could lead to significant results with potential for follow-on research. The first four awards that were made last year have all come to completion, with a further five new awards made.

One of the awards that has completed, was made to Dr Brian Walker to work on “Singlet Fission: Towards a Universal Mechanism and High Efficiency Photovoltaics”. The project has made progress towards the original objectives with demonstration and improved understanding of the process of singlet fission, which can lead to improved efficiency of solar cells. The work has expanded to studying new hybrid solar cells as well as working with colleagues in chemistry who are using nanoparticles with the supramolecular architecture of photosystem II, which is the protein complex that produces the charges for photosynthesis to occur in nature.

Three awards were made earlier this year are as follows:

Dr Mete Atatüre and Dr Jason Robinson (Department of Materials Science & Metallurgy) will work on “Revealing Quantum Magnetism at Oxide Interfaces via Diamond-Based nano-MRI”. The project aims to develop and use a new magnetometry technique that can probe

magnetism directly at the interface. The understanding of charge and spin on these length scales can aid the design of future materials for transport and storage devices.

Dr Erika Eiser and Prof Clare Grey (Department of Chemistry) will investigate “New colloidal materials for battery and photonic applications”. By using DNA with specific binding properties grafted to colloids they aim to control the porosity of a colloidal gel. The ability to tune porosity on various length scales will open up new avenues to build photonic amorphous systems and new types of lithium-ion battery electrodes.

Prof Mark Warner and Prof Martin Čopič (University of Ljubljana) will study “Solar energy harvesting and light scattering on polydomain nematic elastomers”. The funding will provide support for the visit of Prof Čopič to Cambridge to perform experiments on solar to mechanical energy converters using nematic liquid crystal materials. Theoretical analysis of this system was published recently by a Winton Scholar Miloš Knežević with Prof Warner (Appl. Phys. Lett. 102, 043902 (2013)).

A further two awards have just been made to Professor Charles Smith and Dr Malcolm Connolly on “Building a quantum capacitance microscope for probing coherence in molecular qubits” and Dr Akshay Rao on “Spin Control in Organic Semiconductors”.

# EVENTS

*The Winton Symposium is a major annual event in the Cavendish calendar, with the opportunity to invite world-leading experts to debate a topical issue. The broad theme for this year will be “Materials Discovery”.*

**T**he Inaugural Winton Symposium was held at the Cavendish on 1<sup>st</sup> October 2012, which brought together world-leading scientists to talk on the theme of “Energy Efficiency”. The Pippard Lecture theatre was close to capacity (450 people) to hear and debate with the experts the fundamental limits to the generation, storage and use of energy. The audience included students and senior staff from the Cavendish as well as other departments; there was also a significant participation from outside the University from academics as well as industrialists and other interested parties.

Malcolm Keay from the Oxford Institute for Energy Research set the scene for the symposium by linking energy efficiency and sustainability by describing the Jevons Paradox. This states that as efficiency increases, consumption rises leading to an overall increase in resource usage. He provided a number of examples including lighting which has increased in efficiency by nearly a factor of 1,000 between 1800 and 2000, whereas consumption has increased by more than 10,000 times in this time period. The take home message was that improvements in energy efficiency can lead to sustainability, but this requires appreciation of how this fits with the wider context.

Professor James Speck from the University of California, Santa Barbara highlighted

the progress and future advances possible with gallium nitride LEDs, which are already transforming the lighting industry. In contrast the progress made with transportation has not been so rapid, with Dr Donald Hillebrand from the Argonne National Laboratory providing details of some of the advances in efficiency that can still be made with combustion engines as well as highlighting the challenges faced for adoption of alternative fuel based vehicles.

Information technology is a rapidly growing user of energy, where advances in technology could make a significant impact. Professor Eli Yablonovitch, from University of California, Berkeley demonstrated routes to reducing switching voltage to the millivolt range, which would lead to orders of magnitude reduction in energy consumption. On a related topic, Dr Stuart Parkin from the IBM Almaden Laboratory described a number of new technologies for storage, with the drive to find a static storage media that uses no energy to retain information, but is also very fast to access. A different perspective on computation was provided by Professor Simon Laughlin from the Department of Zoology in Cambridge in his talk “What makes brains efficient?” He showed how nature combines chemical processes for algebra and electrical methods for communication, with information sent at low energy levels into parallel low rate lines to reduce energy consumption.





Harnessing the energy of the sun with solar cells, was reviewed by Professor Jenny Nelson from Imperial College. Although there has been considerable progress in efficiency of solar cells, there is still significant headroom for further improvements, with a need to balance efficiency with increased cost due to more complex device architectures. Professor Richard Cogdell, Director of the Glasgow Biomedical Research Centre, explained how light is harvesting works in nature. Richard concluded that nature does not always evolve to optimise energy efficiency with other survival factors having an influence. However, some of the biological modules have very high efficiency and use novel approaches to harvesting light and doing chemical work, which could provide future directions for making energy efficient systems.

The Winton Programme was delighted to invite **Professor Ashok Gadgil** from Lawrence Berkeley National Laboratory to Cambridge to talk about his work related to Energy and the Environment and in particular his projects on deploying technology in the developing world. His talk at the Cavendish “Innovating Technologies for the Poorest Two Billion” attracted a large audience, where he described some of the successful projects and some of the lessons he has learnt from trying to solve real-world problems.

One project was started in response to providing support to the refugees that resulted from the conflict in Sudan that started in 2003. Following a visit by Ashok to Darfur, he realised that one of the issues was the difficulty of cooking food in the camps, with wood scarce and the traditional three-stone fires being very inefficient. This led to the Berkeley-Darfur Stove project, which produced a low cost solution (\$20 per stove), which raised the efficiency of cooking from 5-7% to 35%. This not only saved money, with fuelwood an expensive commodity, but also reduced the risk of danger to women who had to leave the camp and travel long distances to gather fuelwood. The talk and visit from Prof Gadgil, gave an opportunity for scientists to see how it is possible that technology innovation can have an impact in the developing world.

Other events included teatime meetings hosted by Professor David MacKay with guests invited to briefly introduce their interests to the audience, followed by informal round table discussions. Some of the invited guests and their topics are listed below.

The Cambridge Forum for Sustainability and the Environment  
Dr Rosamunde Almond, executive secretary of the Forum

Energy efficient magnetic cooling technology  
Dr Sibel Ozcan, University start-up Camfridge and Quantum Matter group

Creating Impact from Research  
Dr Andrea Cantone and Dr Gillian Davis, Cambridge Enterprise.

Biological photovoltaic systems  
Prof Chris Howe, Department of Biochemistry.

Can you build a computer without using roads?  
Where we are going we don't need roads!  
Dr Chris Forman, Institute for Manufacturing (IfM).

Sustainability and Architecture  
Prof Koen Steemers, Head of the Department of Architecture.

Improving industrial energy efficiency through technology, process and behaviour innovation - policy applications of research  
Niall Mackenzie, DECC.

Smart energy meters for all - sustainability panacea or waste of money?  
Dr Michael Pollitt, Judge Business School.

PEOPLE







## International Advisory Board Members

**Chair - Professor Paul Alivisatos**  
Director, Lawrence Berkeley National  
Laboratory, CA, USA

**Professor Flemming Besenbacher**  
Director of Interdisciplinary Nanoscience Center  
University of Aarhus, Denmark

**Professor Emily Carter**  
Director, Andlinger Center for Energy and the  
Environment, Princeton University, USA

**Professor Tony Cheetham**  
Department of Materials Science and Metallurgy,  
University of Cambridge

**Professor Clare Grey**  
Department of Chemistry,  
University of Cambridge

**Professor Sir Peter Knight**  
Principal, Kavli Royal Society International  
Centre, Chicheley Hall, UK

**Professor Sir Christopher Llewellyn Smith**  
Department of Theoretical Physics,  
University of Oxford

**Professor David MacKay**  
Cavendish Laboratory, Cambridge

**Professor Dr. Jürgen Mlynek**  
President, Helmholtz Association, Germany

**Dr Stuart Parkin**  
IBM Corporation, San Jose, CA, USA

**Professor Ajay Sood**  
Department of Physics, Indian Institute of  
Science, Bangalore,  
and, President, Indian Academy of Sciences

**Professor Andrew Wee**  
Dean of Science, National University of  
Singapore

**Professor Claude Weisbuch**  
École Polytechnique, Palaiseau, France, and  
Department of Materials Science,  
University of California, Santa Barbara, CA,  
USA

## Managers of the Winton Fund for the Physics of Sustainability

**Chair - Professor Lynn Gladden CBE FRS**  
Pro-Vice-Chancellor with responsibility for  
research, University of Cambridge

**Professor Sir Richard Friend FRS**  
Cavendish Professor of Physics and Director  
of the Winton Programme for the Physics of  
Sustainability, University of Cambridge

**David Harding**  
Founder, Chairman and Head of Research,  
Winton Capital Management Ltd

**Professor Andy Parker**  
Head, Department of Physics, University of  
Cambridge

**Professor Tim Morris**  
Head, School of Physics and Astronomy,  
University of Southampton

**In attendance:**  
Professor Robert Kennicutt,  
Head, School of the Physical Sciences,  
University of Cambridge

Opposite page, top left to bottom right:

Miss Xiaoyuan Sheng, Prof Michael Köhl, Prof Sir  
Richard Friend, Prof Ulrich Steiner, Prof Jeremy  
Baumberg, Mr Michael Price, Prof Henning  
Sirringhaus, Prof David Ritchie, Dr Nalin Patel,  
Mr Steffen Illig, Prof Charles Smith, Miss Sarah  
Morgan, Prof David MacKay, Dr Andrew Morris, Dr  
Nicholas Hine, Dr Siân Dutton, Dr Andrew Irvine,  
Mr Breannán Ó Conchúir, Dr Ottavio Croze, Mr Jan  
Mertens, Dr Michelle Moram, Mr Nicholas Paul, Miss  
Hannah Stern, Dr Alex Chin, Dr Erwin Reisner, Prof  
Alison Smith, Dr Akshay Rao, Dr Alessio Zaccone, Dr  
Erika Eiser, Dr Pietro Cicuta, Dr Suchitra Sebastian,  
Dr Jason Robinson, Mr Andreas Jakowetz, Prof Clare  
Grey, Dr Malcolm Connolly, Mr Vahe Tshitoyan,  
Dr Mete Atatüre, Mr Milan Vrućinić, Dr Andrew  
Ferguson, Mr Miloš Knežević, Prof Mark Warner, Mrs  
Monika Szumilo.



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