

Branch committee

Dr Barbara J Gabrys CPhys FInstP, Chair
E-mail barbara.gabrys@materials.ox.ac.uk

Leonard Lewell CPhys MInstP, Secretary
E-mail londonse@physics.org

Dr Mark Telling CPhys MInstP, Treasurer
E-mail mark.telling@stfc.ac.uk

David Parkes
Berkshire Centre representative
Email ; IOP.lectures@awe.co.uk

Stephen Elsmere
Berkshire Centre representative
Stephen.Elsmere@awe.co.uk

Prof. R Mackintosh CPhys MInstP
Milton Keynes Centre representative
E-mail r.mackintosh@open.ac.uk

Dr Diane Crann MInstP
Hertfordshire Centre representative
E-mail d.crann@herts.ac.uk

Bob Boutland CPhys MInstP
Education representative
and e-newsletter editor
E-mail rh.boutland@physics.org

Dr Michelle Supper MInstP
Media representative
E-mail amagich@hotmail.com

J A Belling MInstP REMS visit secretary
E-mail john.a.belling.secrems@gmail.com

Dr Fei Chen MInstP
E-mail fei.chen@cranfield.ac.uk
Outreach Representative

James Kneller
E-mail ap09010@QMUL.ac.uk
Student Representative

Prof. P I P Kalmus OBE CPhys Hon.FInstP
E-mail p.i.p.kalmus@qmul.ac.uk

Lee Crouch
Regional officer South East
E-mail lee.crouch@iop.org

Non-Committee
Dr C Isenberg
Kent Centre Representative
E-mail c.isenberg@kent.ac.uk

From Bits to Qubits: Quantum Information Processing using Quantum Optics



Above Dr Barbara Gabrys & Professor Sir Peter Knight

On 16th November, preceding the Branch Dinner at which he was guest of honour, Professor Sir Peter Knight, President of the Institute of Physics, explained how Qubits have the potential to greatly increase processing and communication speed. The first quantum algorithms were created by Peter Shor and were capable of rapidly factorising large numbers. This in turn could break keys in encrypted communications. Quantum communication can allow the sending and reception of secure information with the ability to see if the communication has been intercepted. This is because the uncertainty principle states that 'a quantum system cannot be measured without disturbing it'. Qubits of light having one of two polarizations, eg vertically and horizontally can be used to represent the states 1 or 0. A key is sent using a string of randomly polarized photons. The receiver randomly detects the information using two analysers. The sender the states the correct analyser settings and this allows the receiver to pick out the key from the results. Arthur Ekert proposed a system using entangled pairs of photons where any detection by an eavesdropper would destroy the correlation. Experiments have now been conducted over distances approaching 150 km and 1 megabits/second has been achieved over 50 km, enough for video conferencing. Different systems used for the quantum processor were discussed, correlated spin states of hydrogen nuclei, NMR, trapped atoms and atom chips. Nature could well have got here before us as experiments indicate that entanglement has a role in fast information exchange during photosynthesis. A fascinating talk about the topic including some new developments.

See The IOP booklet 'The Age of the Qubit' for further information.
http://www.iop.org/publications/iop/2011/page_52065.html

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How Round is the Electron and Why Does It Matter ?



Above: Dr Michael Tarbutt & Dr Cyril Isenberg.

At our Kent Centre on 1 November, Dr Michael Tarbutt, of Imperial College London, gave a lecture concerned with the measurement of the electric dipole moment of the electron. This is an indication of the non-spherical nature of the electron. The bicycle wheel in the photograph was used to demonstrate gyroscopic motion of the electron.

Although no conclusive results have yet been obtained, there are fundamental implications regarding time symmetry, the backward and forward flow of time, and the symmetry between matter and anti-matter. As more accurate measurements become available the bounds on the magnitude of the dipole moment will be lowered and physicists await a conclusive result.

**This newsletter has been produced by
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**The contents do not necessarily
represent the views or policies of the
Institute of Physics, except where
explicitly stated.**

**The Institute of Physics,
76 Portland Place, London
W1B 1NT, UK.
Tel 020 7470 4800.
Fax 020 7470 4848.**

Information

- All of our lectures are free to all, and last about one hour
- All venues are wheelchair accessible
- Details listed are subject to possible alteration
- Any views expressed are not necessarily those of IOP
- Join our e-mail list, e-mail michelle@scienceinspired.com

Venues

LONDON

- Refreshments are served from 6.00 p.m. on the lecture day
- Lectures are held at 6.30 p.m. at Institute of Physics, 76 Portland Place, London W1B 1NT
- The closest underground stations are Great Portland Street, Regent's Park and Oxford Circus
- Please book your place at least a day in advance by calling 020 8845 2295 or e-mail londonsoutheast@physics.org

AWE

- Lectures are held at 7.30 p.m. in the William Penney Theatre, AWE, Aldermaston, Reading RG7 4PR
- The theatre entrance can be found on the A340 Basingstoke to Newbury road, just before the Heath End roundabout at Tadley
- E-mail iop.lectures@awe.co.uk for further information

HERTS

- Lectures are usually held in the Lindop Building, University of Hertfordshire, College Lane, Hatfield
- For further information on this season's events, contact Dr Diane Crann, d.crann@herts.ac.uk or 077 70 444 614

KENT

- Lectures are held at 7.30 p.m. in Rutherford Lecture Theatre 1, the Physics Building at the University of Kent
- Further information can be obtained from Dr Cyril Isenberg, c.isenberg@kent.ac.uk or 01227 823768

MK

- Lectures are held at 7.30 p.m. in the Berrill Lecture Theatre, Open University, Walton Hall, Milton Keynes MK7 6AB
- For further information contact Prof. Ray Mackintosh, r.mackintosh@open.ac.uk, or Tracy Bartlett, t.a.bartlett@open.ac.uk

Christmas lectures for schools

**Gulbenkian Theatre, University of Kent, with performances
at 11.00 a.m. and 2.30 p.m.**

Booking is essential – please call 01227 769075

**KENT • 29 November • Dr Gianluca Memoli
Bubbles Everywhere**



What can describe both the birthplace of stars, and the inside of a washing machine? Dr Gianluca Memoli is a "bubble scientist". His audience-guided interactive talk, paced by demonstrations and stories, will show that bubbles are everywhere!

**KENT • 30 November • Prof. Mohamed Sobhy
How Do We See Colour?**



Colour vision arises from the interplay between the physical world, the eye and the brain, and many scientists believe that the colours we see exist only in our brains. Prof. Sobhy will explain and show how we discriminate between colours.

From Wales to Benin – physics communicators take the prize



Dr Aude Alapini Odunlade



Above. Dr Martyn Bull, The Chair of the Communicators Group introduces the event.



Rhys Phillips

An Exeter-based astrophysicist and a Cardiff-based Research Engineer for EADS have won the Institute of Physics' (IOP) inaugural Early Career Communicators' Award for the inspirational activities they have undertaken to introduce a diverse range of people to the wonders of physics.

At the prize-giving event on Tuesday 8 November - which was conducted to give four shortlisted candidates the opportunity to display their communication success to a panel of experienced communicators - Dr Aude Alapini Odunlade, an Associate Research Fellow in Astrophysics at the University of Exeter, explained how she has worked in Europe, Africa and Asia to inspire and excite. Her presentation to the assembled crowd and judges focused on work that Aude has undertaken in the country she grew up in, Benin in West Africa.

Following initial success in 2006, explaining a solar eclipse to hundreds of children and adults, Aude took a show on a national tour to six Beninese cities throughout the International Year of Astronomy 2009, and is now working towards the establishment of a Science and Communication Centre in Benin.

Her fellow-winner, Rhys Phillips, a maths and physics graduate who works at EADS Innovation Works UK in the Lightning, Electrostatics and EMH (electromagnetic hazards) group, presented an incredible range of communication activities.

From the construction of a Lego based science club workshop, initially developed for one science club but now being rolled out across Wales, reaching at least 3,000 children each year, to a range of shows on Radio Cardiff, a community-based radio channel, including the Monday breakfast show and a weekly half-hour science show called Pythagoras' Trousers.

With remarkable tenacity and an already full schedule, Rhys is now working on the roll-out of a 'science cabaret' show to help introduce physics in a fun context to new audiences. He recently made his debut stand-up comedy performance at Bright Club Wales and is working with friends towards the establishment of an annual Cardiff Science Festival.

The judging panel – which comprised of Guardian science correspondent Alok Jha, the Metro's Metrocosm editor Ben Gilliland and Professor of Science Communications at the University of Reading Averil MacDonald – was impressed by all four shortlisted candidates but felt the high impact and legacy of Aude's activities, and the incredible range of Rhys' undertakings, gave them the edge.

On winning the prize, Aude said, "Winning the Very Early Career Physics Communicator Award is like an exceptional cherry on an amazing cake! The cherry is the award, with the recognition of my work in physics communication. The cake is the contacts and network that I have met at the award meeting, which will help me take my communication activities forward. (Continued page 4)



Guardian science correspondent Alok Jha

"The other finalists all had impressive projects and ideas. Having been selected as one of two winners, out of the 26 high profile applications, means that I am definitely doing something right. This is a breath of renewed energy and conviction that will help me carry on my communication projects, impacting and enthusing children and adults alike with physics, science and technology for years to come. Thank you!"

Rhys said, "None of the finalists here today are doing these activities because they want the recognition – it's the rewarding feeling you get when a child tells you that because of your talk they want to be a scientist, and the enjoyment of interacting with a variety of people.

"However, it is great to have this voluntary work recognised by the Institute of Physics and I'm honoured to have jointly won the first of these awards. I hope



**The four finalists (left to right)
Rhys Phillips, Martin Archer, Aude Alapini-Odunlade & Suzie Sheehy**

I can work with all three of the other finalists in the near future and Aude and I are already in discussions regarding a joint science communication project to do together."

On the importance of science communication, Alok Jha, who gave a keynote speech before the finalists' presentations, said, "Science is at the heart of many of the most important issues we face as a society: climate change, public health, nuclear power, education.

"Every day, the government, businesses and law courts make decisions that will affect us all, and they all say they do it based on evidence. Science communicators can analyse and shed light on these institutions and ideas. And a good coverage of science creates exactly the kind of interested and engaged citizens that are integral to properly-functioning democracy."



The judges & runners up. Left to Right: -Alok Jha, Suzie Sheehy, Ben Gilliland, Professor Averil McDonald & Martin Archer



**Article by Joe Winters
IOP's Senior Press Officer**

The Judges and Winners

Left to Right: -

Alok Jha,

**Dr Aude Alapini
Odunlade,**

Ben Gilliland,

Rhys Phillips,

**Professor Averil
MacDonald.**

See the video at: -

[http://www.iop.org/news/
11/nov/page_52734.html](http://www.iop.org/news/11/nov/page_52734.html)

Oxford Mini Plant

REMS visited the Oxford Mini Plant on Thursday 3rd November. No, it's not a small sample from the botanical gardens. It's where they build the BMW Mini. The visit was so oversubscribed, that an overflow tour had to be arranged a fortnight later on 17th.

Production at the plant is at a rate of about one car every eight minutes. That's a little over seven an hour. A day's production in two shifts of 9¼ hours (but they can go up to 10) is about 140. So in a six day week they build more than 800 cars. They are not far from reaching the two millionth

since the new mini was launched in 2001.

But what is truly amazing is that they are all different. Each customer plans his or her car on line (or an agent does it) and the choice is enormous. There are three models, Hatchback, Convertible and Clubman, each with variations. Two more models are to be added soon (Coupé and Roadster). There's a couple of dozen different colours and you can choose another colour and/or pattern for the roof, one of 27 different wheel trims, a diesel or petrol engine (choice from three sizes), right or left hand drive and a host of optional toys (like satnav, blue tooth etc). There will be a world-wide launch of the two new models in February 2012 followed by a UK launch in March. (Apparently UK and the rest of the world were the other way round at the last launch.) The basic price is about £12,000 but you can easily double that if you want everything.

You can try this for yourself at www.mini.co.uk but don't press the final buy button if you don't actually want to buy one. You will need to select the quick link "Design your Mini". The one I designed (at home, afterwards) cost £22,000.

Our guides, John and Terry, (both humourists) took us first to see the main assembly line. It was a surprise to see such a variety of cars streaming along it, everyone a different colour or shape. Beginning with the basic shell, the bits are added one by one in sequence in a production line nearly a mile long. It turns back on itself a dozen times, goes up and down and even round and round.



At one point the bodies are gripped in a cradle that rotates so as to present itself to the workforce in an ergonomically optimal way. Nobody has to crawl underneath because the body is rotated through 90 degrees so that the bottom is on the side. Nobody has to stretch because the cradle is raised or lowered within reach. And so on

Each body and each part are bar-coded so that the right component arrives at the right point at the right time, in accordance with the customer's specification. Even the engine is bar coded. It comes to Oxford as a complete unit, made elsewhere. Robots check that everything

is in the right position – gear lever, handbrake, coil springs – before other robots lift it from below into position and then bolt it into place. Most importantly, robots check that it is the right engine for this individual car. The correct fuel is put into the tank, coolant is measured in, and at the end of the line, the car is driven away. It undergoes rigorous tests before being loaded onto a train or transporter lorry

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(Continued from page 5.)

and taken to its already known destination in the UK or world-wide. (It sells in 80 countries.) No cars are kept waiting on site.

After showing us the main assembly line our guides drove us in buses to the bodyshop. In an earlier process in Swindon, sheet steel is cut and pressed into several hundred differently shaped pieces. In the Oxford bodyshop these are spot welded together by robots. It was a surreal experience watching these monsters pick up a shape and, with great sweeping movements rotate it about three axes, and place it in position. Another robot would pick up another piece and with similar gestures hold it against the first. Electrodes closed in and, sometimes accompanied by huge sparks, made half a dozen or more welds, joining the pieces together. The joined up piece was then passed on to the next robot in the line.

One of the guides, Terry, without a flicker of expression said he was glad there were not very many ladies in the group. Occasionally one of the robots would reach outside the cage, pick one up and carry her inside. None had ever been seen again. None of the ladies laughed.

Somebody asked what current was involved in the welding. "Ten volts" was not well received. "Less than a volt" was better, but nobody was satisfied until "over two thousand amps" was elicited. Each weld took about a quarter of a second. Somebody muttered "Two hundred and fifty joules". Everyone was happy. Well, we are physicists.

I asked the other guide, John, whether the robots had a union. "Oh yes," was the dead pan response. "Unite!"

After the welding and before the assembly the body shells are painted. They wouldn't let us into the paint shop. It has to be scrupulously clean in there. The just had to take one look at us...

They wouldn't allow us to take any photos inside the other buildings. But they did allow a group photo in the reception area. One has the group standing between a small robot and a recently built mini, wearing the black protective coats they provided for the tour. The other was beside one of the first cars assembled on the site (in about 1912), a bull nosed Morris.

I have already been asked if I will arrange another visit next year. So if you'd like to come, watch out on the REMS website.

John Temple

'Crime, Radio and Smart Buildings'

22 November University of Kent.

Joint Meeting with SEKAS



Left to Right: Dr Cyril Isenberg and Dr John Batchelor from the University of Kent, and Dr John Kemp from the South East Kent Astronomical Society.

Dr John Batchelor examined the early successes of radio by the Marconi Company in arresting Dr Crippen on his arrival, by liner, in New York and rescuing passengers from the Titanic disaster and the subsequent mobile phone revolution.

One current problem is the smuggling of mobile phones into prisons in order to organize crimes and escapes. Dr Batchelor and his team have produced materials that can be incorporated into walls that will prevent prisoners communicating with the outside world by stopping transmission through the walls, but will allow warders, operating at a different frequency, to contact each other. This was a wonderfully clear lecture containing examples of these new materials.

Dr C Isenberg

Red Sprites at the IOP 28 March 2012



Book with the branch secretary: londonsoutheast@physics.org

“Engineering the Olympics”

See the webcast at <http://tv.theiet.org/channels/news/12078.cfm>

EEESTA's thirteenth annual prestige seminar - took place on the evening of Wednesday 9th November 2011, at the University of Hertfordshire. There were 320 delegates, including over 50 students from six schools and two Universities in the region.

After an informal networking buffet, the seminar was opened by our host for the evening, Professor Quintin McKellar, Vice Chancellor of the University of Hertfordshire.



Above: Professor Quintin McKellar

He then handed over to the Chairman, John Armitt CBE, Chairman of the Olympic Delivery Authority (ODA).

Before the main business of the evening the Chairman had two pleasant tasks to fulfill for EEESTA: he presented the EEESTA Innovation Award, and acknowledge three Friends of EEESTA.



Left:

Jemma Goldstein accepts the 2011 EEESTA Innovation Award from John Armitt

This year The EEESTA Innovation Award went to Jemma Goldstein of Haberdashers' Aske's School for Girls an outstanding Arkwright Scholar. The Arkwright Trust is a charity which aims to promote engineering to young people and now has several hundred scholars each year across the whole country. Jemma aspires to read Physics at Manchester and has strong interests in space and astronomy. After receiving the Award, Jemma gave a very confident “Thank You” speech.

EEESTA owes a deep debt of gratitude to a few individuals who have helped to make these seminars a success over these last 12 years. This evening the following people were made Friends of EEESTA to thank them for their involvement:

- Kate Bellingham, President Young Engineers,
- Tony Roche, a past President Institution of Mechanical Engineers,
- Ron Elston, one of the founders of EEESTA.



Above:

Tony Roche, Ron Elston, Kate Bellingham & John Armitt

The Chairman then set the scene for the evening and introduced the first speaker.

In his talk entitled “Designing the Olympic Park” Jerome Frost MA MRTPI, Head of Design & Regeneration for the ODA, described how a 246 hectare polluted post-industrial wasteland had to be converted into a site suitable for the construction of the Olympic facilities. Consideration had to be given to overall design,



Above: Jerome Frost

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town planning and sustainability, to ensure that the programme delivers a lasting legacy,



Above: Simon Wright

The second speaker, Simon Wright, was appointed ODA Director of Infrastructure and Utilities in 2006. In his talk entitled "London 2012 – Olympic Park: Delivery of a Time Critical Major Programme" he explained that traversed by overhead high voltage cables, rivers, railways and roads, the development of the area posed many challenges. One of the greatest was managing the logistics of a very large dynamically changing construction site. Materials from demolition and ground remedial activities have been recycled and kept on site where possible.



Above: Lord Mawson

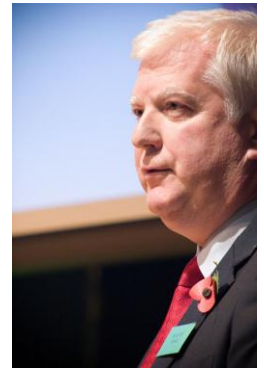
The third speaker, Lord Mawson OBE, sits on the Board of the Olympic Park Legacy Company. In his talk he first described two regeneration projects he had instigated, where their success was due to the local people, he proposed those models as the means to ensure a lasting legacy for the Olympic Park.

The seminar ended with a chaired question and answer session which provided further interesting insights from all the speakers. The Chairman then summed up, mentioning the topic for the 2012 Seminar, "The Herschel Space Observatory".



Above:
Amused speakers during the Question and Answer session

The Vote of Thanks was given by Roy F Hill BA MBA, European Managing Director of CH2M HILL. CH2M HILL was the principal sponsor of this EEESTA Seminar



Right: Roy F Hill

The Seminar was also supported by IOP London and South East Branch, and various professional engineering Institutions.

Ian Williamson

Photographs by Will Dennehy Photography



Above: The Large attentive audience

WOOFYT



Above: The WOOFYT ready for action.

At the beginning of November Jeremy Sampson brought his WOOFYT, (wooden one-octave organ for young technologists), to Brookside Primary in Bicester with L&SE Branch support. All children had an opportunity to play the WOOFYT, this needs teamwork to produce a recognisable tune. If the people on the pump stopped there would be no air, if the students leaning on the pressure bag failed to keep the manometer balls in the correct place then the note would be wrong and finally the pupils must play the notes in the correct order.



Before playing the WOOFYT Mr Sampson conducted a rhythm session, covered the KS2 sound requirement of the national curriculum, explained manometers, non-return valves and the workings of the WOOFYT. With Branch support the WOOFYT will be in North London towards Easter and at St John's Church, Boxmoor, Hemel Hempstead in May 2012.

Upcoming Events

29 & 30 November 2011.

University of Kent: Christmas Lecture for Schools
See page 2. Booking Required.

7 December 2011.

At the IOP, 76 Portland Place, London W1B 1NT:
'Faster, Higher, Stronger: Hero Materials in Sport'.
Book at: londonse@physics.org

At the Lindop Building College Lane Campus,
Hatfield, AL10 9AB: 'The mystery of Cosmic Rays'.
Book with d.crann@herts.ac.uk

13 December 2011.

At the Berrill Lecture Theatre, Open University,
Walton Hall, Milton Keynes, MK7 6AA:
'Astronomy by Microscope'.

25 January 2012.

At the Lindop Building College Lane Campus,
Hatfield, AL10 9AB: 'Natural Calligraphy – how
nature draws beautiful lines'.
Book with d.crann@herts.ac.uk

15 February 2012.

At the IOP, 76 Portland Place, London W1B 1NT:
'The end of the world in 2012? The astronomer's
perspective'.
Book at londonse@physics.org

22 February 2012.

At the Lindop Building College Lane Campus,
Hatfield, AL10 9AB: 'Do we owe everything to the
stars?'.
Book with d.crann@herts.ac.uk

The branch event calendar lists our activities at: -
http://www.iop.org/activity/branches/south_east/lse/calendar/index.html

The Hertfordshire Centre Event Leaflet is at: -

http://www.iop.org/activity/branches/south_east/lse/calendar/files/file_52860.pdf

A branch event leaflet for 2012 is in preparation by
our media representative Michelle Supper and will be
at http://www.iop.org/activity/branches/south_east/lse/
(when ready) and also available as a printed leaflet.