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REMS Visit RES and Follow the Paper Trail.



Above: The wind turbine at RES has been operating for 17 years

On 12th April REMS members gathered at RES, (Renewable Energy Systems), for a visit organised by Tony Manning. Their wind turbine is visible from the M25 near Kings Langley. RES headquarters, formerly the Ovaltine Egg Farm, was refurbished to minimise energy requirements. The turbine was bought second hand from a wind farm in Denmark and is complemented by solar panels for both heating and solar electricity. Some of the hot water is stored for use later but the system here is not entirely satisfactory. The main heating system is via a large wood chip boiler. Some examples of RES projects include The Wild Horse Project in Washington where RES was the plant contractor, Taugberg wind farm in Co. Cork with 11 turbines owned by RES, Albion Square PV canopy in Woking and development of some off-shore wind farms owned by Centrica to give but a few.

The audience had plenty of questions about wind energy and discovered that the bulk of the turbines are AC machines with step up transformers in the towers to increase voltage for the power lines. Usually the maximum output is stated but this requires the correct wind speed, it would be more usual to have around half of the maximum capacity generated. Lunch was taken at the Paper Mill in Apsley before the visit to the Paper Trail. **Continued page 4**

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Capital Ring Walk 11

On 31 March 10 REMS members enjoyed a capital walk from Hendon Central Station through several parks surrounding Dollis Brook and other streams via East Finchley, where we stopped for an excellent lunch at the Old White Lion, to Highgate.



Margaret Stedman organised the walk, which is section 11 of the Capital Ring Walk. She is fifth from the left in the picture. The venue for lunch was well chosen by Ruth (extreme left) and George (on Margaret's left) Freeman. Well fuelled we got to the top of the world at Highgate Station and look forward to section 12.

Mike Quinton

Modern Cryptography Made Clear

On Monday 5th March Richard Pinch (Cheltenham) gave a very well received and informative lecture on Modern Cryptography at the William Penney Theatre, Aldermaston. This was the first joint Institute of Physics and Institute of Mathematics and its Applications local branch meeting held at the Berkshire Centre and was attended by over 60 people. The talk covered both symmetric (secret key) cryptography and asymmetric (public key) cryptography. The demands of cyberspace and the use of asymmetric key cryptography to achieve confidentiality and authentication on the internet were also clearly described. Richard received questions ranging from internet security to quantum cryptography. If you would like to know more about forthcoming local IOP or IMA events please email IOP.Lectures@awe.co.uk

Designing the Best 3D Display

NEW DATE
Monday 11 JUNE 2012

William Penney Theatre, AWE, Aldermaston,
Reading, RG7 4PR

Tea/Coffee and Biscuits will be served from
7pm. The lecture is open to all, including non-
members. Lecture 7.30pm

Details email: IOP.lectures@awe.co.uk

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The Medium and the Message:
Broadcasting, podcasting, YouTube and
other ways of communicating physics
29 June 2012, Institute of Physics,
Organised by the IOP Physics Communicators Group

The Physics Communicators Group Summer meeting will investigate the wide array of different media that can be used to communicate physics. Speakers are expected to include Deborah Cohen, Editor of the BBC Radio Science Unit' Alessio Bernadelli & Melisa Akdogan (a TV director/producer).

For more information & registration please visit: -
<http://www.iop.org/conferences>

REMS Visit: Fishmongers' Hall and Organs

On 2nd of April George Freeman & John Belling organised a trip to The Fishmongers' Company which is one of the ancient guilds of the City of London and the history goes back 700 years. The hall by London Bridge was burnt down in the Great Fire and has been rebuilt twice since then with extensive work after the bomb damage of the war. The company still influences the fish and shellfish trade monitoring fish at Billingsgate Market. It has various educational establishments, some promoting cooking in schools. The Company runs the Doggett's Coat and Badge wager each year for "six Watermen in their first year of Freedom". The first race from London Bridge to Chelsea was in 1715.



After lunch our guide was Ian Shaw, the official organist at St Mary Abchurch and St Clements Eastcheap and visiting organist at St Magnus the Martyr, London Bridge. He took us into these churches which were rebuilt after the 1666 Great Fire by Wren and have pipes and cases from that date. St Magnus the Martyr has been much altered over the years with a major work in 1924. It has very fine woodwork. The peal of 12 bells was installed in 2009 (Whitechapel Foundry). St Clement, Eastcheap, organ is 17th century by Renatus Harris.

St Mary, Abchurch, has a unique painted dome of 1708 and a Grinling Gibbons reredos. The organ case is 1717 and the works were installed by Noel Mander in 1954.



Photographs from Mike Quinton

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A short car journey took us to Frogmore Paper Mill. Once called the Convent Mill. The site was used for papermaking, all hand done, in 1774.

The London wholesale stationers, the Fourdrinier brothers, obtained the 1799 patent of Frenchman Nicholas L Roberts for a paper-making machine. They commissioned Bryan Donkin to develop the machine thus creating the world's first continuous paper making-machine which was installed in Frogmore. A second improved machine was installed in 1803. The Frogmore mill was once water-powered, (below).



Above:- Machine 4. A more “modern machine”. 1% pulp in water is fed in on the left. Water is drained and pressed from the paper until the paper shown on the right continues down the machine to be dried by steam heated rollers and collected as a continuous roll of paper. This machine dates from 1902.

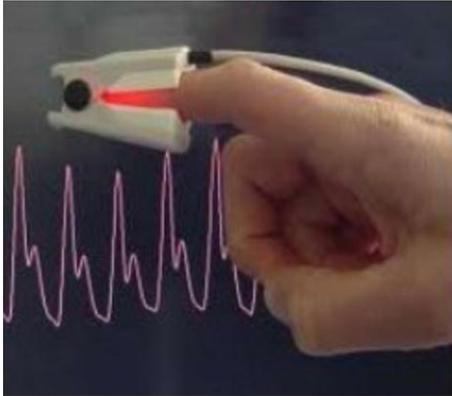
The Fourdrinier brothers became bankrupt in 1810 but Donkin continued making machines which were sold subject to royalties payable, the majority of paper-making machines worldwide a still known as Fourdrinier machines. In 1890 The British Paper Company was operating the mill using waste paper and cotton. Early output was sold to John Dickenson whose factory was further along the river. Bus, Tram and rail tickets of various colours were also produced at the mill. A second machine was installed in 1907, having being built in 1890. This machine was once powered by a steam engine and was producing paper for around 100years. The economic climate brought this machine to a halt in 2009.

As part of the tour there was a demonstration of letterpress printing with a group member printing the notice above left. Hand papermaking was also included as was an exhibition & a tour of the factory.



Above: Waste material and the shredder.

Optical sensing in medicine



On 17 April, at our Milton Keynes Centre, Professor Panicos Kyriacou of the City University described his involvement in Biomedical Engineering since the mid 90's and his experiences in the academic, clinical and industrial arenas. Research activities lie in the application of electronic, optical, and physical techniques to solve practical problems in anaesthesia, surgery, and intensive care. Current areas of research are:

- medical sensors and instrumentation
- biosignal analysis
- biomedical optics
- physiological measurement
- physiological modelling

Optical sensors in medicine might be described as being in an adolescent stage, where their power and potential are being recognized, but are still developing rapidly. The talk focused on the application of optics in the development of medical sensors and demonstrated how such technologies can be used as medical "tools".

Some examples are an oesophageal pulse oximetry for cardiothoracic surgery patients in collaboration with St Bartholomew's Hospital, optical sensors in neonatal monitoring together with Great Ormond Street Hospital for Children and funding from EPSRC. Funded by the City University is noninvasive detection of anaemia in collaboration with Barts and The London NHS Trust. Fibre-optic sensors in spinal disease with GE Healthcare, BioInteractions, The Royal London Hospital with funding from EPSRC (pending) were also described. Throughout human history, light has played an important role in medicine. New optical technologies are revolutionizing many fields. The development of optical sensors is a current strength of the UK.

Medical students need an understanding of physics

Accompanying five Lancet articles on the important relationship between medicine and physics, Professor Sir Peter Knight, President of the Institute of Physics (IOP), urges medical schools to consider making qualifications in physics a prerequisite to entry.

Professor Knight says, "Physics has transformed medicine and, as this transformation is surely set to continue and accelerate, medical schools should consider restoring the requirement for applicants to hold A level or equivalent qualifications in physics."

The journal articles, to be published in The Lancet on Wednesday, 18 April, reflect on the historical relationship between the two fields; describe the contemporary physics-based methods used for diagnosis and treatment; as well as looking to the two fields' relationship in the future.

While physics already underpins many techniques used to diagnose illness (think X-rays, clinical PET scanning, MRI....) and to treat illnesses (radiotherapy, minimal-access surgery, scaling theory...), the future of medicine looks to be even more tied up in physics. The complexities of personalised medicine suggest that medicine is likely to become an information science, where a vast amount of complex data are analysed by techniques such as machine learning to discover patterns and principles; this is the physicist's forte.

Professor Knight argues that "for medical practitioners to make full use of modern physics-based technologies for diagnosis and treatment, it would be hugely beneficial to have a sound understanding of the physics involved.

"Basic physics was once a compulsory element in undergraduate medical education in the UK, with exemption for students with an A level pass in physics. This requirement was dropped in the 1980s.... I would ask UK medical schools to consider restoring the requirement for applicants."

Professor Knight also urges the UK Government to remember the symbiotic relationship between fundamental physics research and advances in modern technology and recognise that continued support for fundamental research will continue to deliver medical advances in years to come.

Joe Winters Senior Press Officer IOP

How Round is the Electron and Why Does it Matter?

Dr Michael R Tarbutt,

Centre for Cold Matter Imperial College,
London

Institute of Physics 25th April 2012



The lecture explored the connections between the shape of the electron, the direction of time and the existence of antimatter.

Electrons have been conceptualized as point-like objects with negligible dimensions. Meanwhile, the seemingly empty space that surrounds the electron is teeming with pairs of particles and antiparticles that fleet in and out of its existence, also called virtual particles. Modern physics then sees the electrons as inseparable from the cloud of the virtual particles that surrounds it. Whilst precisely measuring this cloud is extremely difficult scientists have predicted the electron to be very nearly, but not precisely, a sphere. The electron could be thought to be somewhat of a tiny battery,



complete with positive and this pull from opposite poles would in principle warp the cloud's morphology. Although this distortion would be extraordinarily minute, the consequences would be on a cosmic scale, namely account for the fact that the universe is almost entirely made of matter, challenging the current theories of physics that predict that there should be roughly equal amounts of matter and antimatter. So, the current model predicts that the electron is slightly aspheric, with a distortion characterized by the electric dipole moment. However no experiment so far has ever detected this deviation.

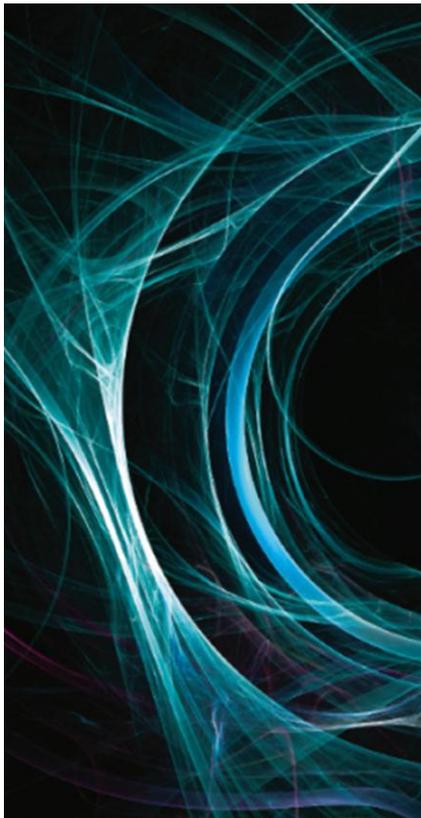
The electron is a fundamental particle of nature. It has a series of properties.

- 1 Mass $(9.10938215 \pm 0.000000450) \times 10^{-31}$ Kg,
- 2 Charge = $-1.602176487 \pm 0.00000040 \times 10^{-19}$ Coulombs;
- 3 Magnetism, its magnetic dipole = $-928476377 \pm 0.00000023 \times 10^{-24}$ J/T;
- 4 Spin = $5.27285814 \pm 0.00000026 \times 10^{-35}$ J. The intrinsic property of spin causes the electron dipole moment.

Finally,

- 5 Roundness; although its size has not been obtained yet.

Measuring its roundness has important consequences. There are four major questions that could be answered with investigating the shape of the electron. **Continued page 7**



Teachers Awards 2012

The Institute of Physics (IOP) is celebrating the work of outstanding teachers in the classroom and beyond.

There is no denying that teachers contribute immensely to society. However, sometimes they do not get the recognition they deserve.

We want to shine a light on the passion and commitment of our best physics (secondary) and science (primary) teachers at our annual awards dinner, alongside distinguished research scientists and industrialists.

If you know a teacher worthy of celebration, why not nominate them for an IOP Teachers Award?

Nominate at www.iop.org/teachersawards by 31 May 2012.

E-mail your questions to teachersawards@iop.org.

IOP Institute of Physics

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A- Could measuring the electron's shape provide an answer to explain time-reversal symmetry? What about the origins of the arrow of time? Well, a non-spherical electron breaks time-reversal symmetry.

B Where is all the antimatter? There is a matter-antimatter symmetry. Every particle has a corresponding antiparticle, identical except for opposite charge. They were made in equal number in the big bang. However, the universe is made of matter, and matter appears to be ubiquitous. A non-spherical electron breaks the symmetry of matter and antimatter.

C Could the research into the shape of the electron suggest and evidence that there are new laws of physics? The Standard Model (SM) gives a prediction that the electron has a deviation from being round, but it may well be the case that there are other theories that could give different answers!

D Will then the shape of the electron give us the final answer?

Electrons have the property of spin. The electrons display precession when exposed to magnetic and electric fields. And it is by measuring the change on precession when exposed to electric fields that yields the results regarding its shape. If the shape is ovoid, then, the electron would wobble.

Hudson and the team at Imperial College studied the roundness of electrons by measuring the degree of wobbling of the particles in an electric field. The rounder the electron, the reduction of the wobbling displayed. There was no sign of wobbling!!

These results provide a challenge to the established views. The research continues.

Dr Nuria M Calvo

Improved measurement of the shape of the electron J J Hudson, D F M Kara, I J Smallman, B E Sauer, M R Tarbutt, & E A Hinds. Nature 473, 493-96 (26 May 2011)

REMS visit to the Jordans (Quaker) Meeting House on Thursday, 24th November 2011.

This report has just been received 2 May 2012.



REMS members outside the meeting house

There were two presentations given during the day, the first by Terrence Price, before lunch, and the second, given after lunch, was a combined effort by Mrs Janet May-Bowles, historian and Miss Sue Smithson, the M H librarian, while we were outside in the grounds of the Meeting House.

Summary of "Nuclear Power: the first half-century" presented by Mr Terrence Price

Although he is no longer a working professional in the nuclear power industry, he can look back on more than fifty years of involvement when asked to look to the future. His brief for the Jordans meeting was to assess the history of the industry and to offer some guidance for the future, since the UK and other countries have to consider their future energy requirements and how they will be met. The big issues are safety, economics, continued availability of fuel, the link with nuclear weaponry, nuclear waste disposal and public opinion.

When the first nuclear power reactor was built at Windscale in 1948 the UK was one of the leaders in the new field but now has slipped to ninth place. The UK nuclear power design team settled for an air-cooled system based on that of Harwell, as opposed to the water-cooled systems used by the US, which were subsequently shown to be vulnerable to water-flow blockages, as

demonstrated at Chernobyl in 1986.

Various European countries, like Sweden, have decided not to shut down their nuclear power plants, or like Denmark are relying on power from other neighbours who are using nuclear power.

The UK Government is currently going through the process of deciding whether to build more nuclear power reactors and which type. It is a pity that the UK Government, which at one stage had obtained ownership of the Westinghouse nuclear power company, sold it to the Japanese in 2005/6. Shortly after this sale the orders for new nuclear plants started to flow.

Once again, politicians are arguing against nuclear power, even though it is evident that nuclear radiation, except for the immediate operating staff, in the event of an accident, may cause very few, if any, civilian casualties.



Terrence Price (left) and visit organiser Peter Murden

The problem of waste disposal is also being highly exaggerated. Only a very small proportion of the nuclear waste is highly radioactive and other countries, such as Sweden have achieved a very effective waste disposal programme. It remains to be seen how much the UK public opinion responds to the emerging power proposals.

Peter Murden

Relevant publications by Terrence Price:

- 1 "Political electricity" by Terrence Price, OUP, 1999
- 2 "Politics of Electricity production", Nature, Vol 351, No 6326, June 1991.