See http://eng.iop.org for further details
A Note from your Chair (John Battye)

The good news is that the visits to Culham on the 23\textsuperscript{rd} May and to the Diamond Light Company, next to Harwell, on 14\textsuperscript{th} July went well. The bad news is that you are all still not very keen to contribute to the group’s activities, or is it that you just can’t find the time? In spite of the request put in the last edition of our Newsletter we received no articles, or suggestions as to what you might like as group activities. In the hope of getting some contributions for the next Newsletter I repeat the request I made last time.

“As regards future articles I think it desirable, in at least a first instance, that we have a number of them from different members, outlining the company they work for and its position in the market place. Our information is that your industries and locations are so varied that a good selection should provide quite interesting reading. Articles of a few hundred words would seem to be of a useful length. Otherwise any submissions on an engineering topic will be seriously considered for our publication. Note that it is probably better that you do not mention your company’s name, otherwise you will need to get their written approval of what you have written and send us a copy please. It will also reduce the probability that what we publish will be seen as favouring one company over another, which could give us legal difficulties. We are a charity.

We are not looking for highly technical presentations. There are plenty of other publications where I think these will be far more appropriate, and it would be better for you to publish in any case. Overall we have a membership with a very wide range of employment environments and we want to try and provide a little something that will appeal to as many as possible. To that end articles do not have to be on only technical matters. Business, managerial or multicultural matters relating to work in the engineering field are also of interest.”

Please make your submissions to me John Battye
(john.battye@physics.org)

Our AGM: 1.30 pm on Friday 5\textsuperscript{th} October 2007 in the Glazbrook Room at 76 Portland Place, London W1B 1NT (See page 12).
Visit to See Culham’s Nuclear Fusion Power Projects
By John Battye

The visit was on the 23rd May, one of those hot, sticky days of early summer. It started with a lecture theatre presentation on the basics and continued with a tour around the facilities by guides from Culham’s technical staff.

At Culham there are basically two projects relating to the overall objective of producing electricity by way of nuclear fusion. They are; the Joint European Torus (JET) and the Mega Ampere Spherical Tokamak (MAST). In both the focus is on producing heat by nuclear fusion, since the production of electricity from heat is by conventional means, i.e. heat is used to warm water, to produce steam, to power steam turbine driven electrical generators.

JET, the oldest of the projects, currently includes financial contributions from mainly western EU countries, together with Finland, Sweden and Switzerland. The design team started work in 1973, construction started in 1979 and first operation began in 1983. There has been a sea of problems to overcome; making, evacuating and maintaining the vacuum in such a large vessel, generating, guiding, controlling and maintaining a plasma beam suitable for producing the necessary nuclear reactions, increasing beam strength to allow useful power extraction, extracting power in the plasma beam to allow the production of electricity and determining radiation levels, and materials to withstand the radiation over a prolonged period and minimise radioactive waste products.

There have been advances along all the research fronts to the point were the focus of effort may be described as increasing and sustaining beam strength from the very small, very intermittent beams that were produced in 1983, to larger currents lasting over seconds that can be produced today. Since the beam is circular, in the current design about 3m diameter, large magnets are needed to keep it in place and these unfortunately consume a great deal of electricity themselves. To counter this, i.e. to produce more electricity than is consumed, the plasma beam power needs increasing but unfortunately this makes it more difficult to control and so maintain.
The current equipment is just capable of producing more electricity than it consumes but still the plasma controllability is a major handicap to making it generate so much electricity that becomes economically viable. However, research to date has shown that one aspect of the design is almost unopposedly in its favour, physical size. The larger the machine can be made the easier it will be possible, all other things being more or less equal, to control and maintain the plasma beam and so generate a surplus of power. As a result it has now been decided to build a considerably larger machine at St Paul-lez-Durance near Marseille in France. Its goal; ‘to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes.’ The name of the project set up to do this is ITER.

Work began on the second project, MAST, in 1999. This British initiative, predominantly British effort and predominantly British funded project has the primary objective of producing a more compact design. As a side benefit it produces information useful for ITER and so gets a small measure of funding from the European community. Features that the MAST project includes to help gain information to help the ITER project are; adaptable fuelling and heating systems, digital control systems to produce tighter control and extensive and advanced diagnostic features to test features and facilitate data collection that should better define ITER’s operating envelope.

In spite of the above some may think the MAST project smacks of the age old British failing of running up R&D bills introvertedly pursuing perfection, rather than pushing to get a speedy financial return to stimulate the ever greedy market place to self interestedly ‘fall over itself’ to provide funding for the subject in general. By contrast consider what a beastly monster, not least conceptually, the conventional reciprocating internal combustion engine basically is, yet look how well it has evolved with liberal funding provided enthusiastically by an appreciative market keen to achieve any form of cheap mobility. Consider all the exotic nuclear fission reactors Britain developed in past years, at great expense and delay and heartache, compared to the simple heavy water reactors. Heavy water reactors that are used almost universally elsewhere in the world and which have evolved well enough to produce sufficiently reliable, safe, power.
Of overall note is that there has been international collaboration into how to produce electricity by way of nuclear fusion for nearly forty years. Some of you may recall that it was being said forty years ago that it was hoped nuclear fusion plants would be producing electricity in about forty years time. If so you will no doubt be thinking, ruefully that here we are, forty years later, and it is still being said that it will be forty years before nuclear fusion produces commercial electricity. It is tempting to say, “What on earth has been going on all this time”, but clearly much has. It is just that the ‘end’ is still far from sight, although appearances are now that at least the ‘light at the end of the tunnel’ is said to be finally growing steadily larger. Perhaps part of the problem is that to the general populace, including politicians and the majority of media personnel, science is a black art to be mistrusted. They are proud not to understand it, they don’t understand the subtlety of what they are told about it and they easily run away with their over simplified misunderstandings which they have a detrimental ability to magnify. Consider the hospital’s name, MRI, for what we know as an NMR machine, because of patient’s fear generated by the word ‘nuclear’. Or Britain’s powerful opposition to nuclear power, in part due to fear of a Chernobyl like occurrence, when one considers that we buy nuclear generated electricity from France, which has almost sixty nuclear power stations, many far closer to the heavily populated parts of Britain than most of Britain’s own nuclear power plants.

The overall expenditure on the projects to produce nuclear electricity by way of nuclear fusion have been miniscule by British standards, never mind European standards, or world standards, when compared to the amounts spent on trying to achieve continuity and security of alternatives, e.g. oil and gas supplies. Almost all the wars in the near and middle east since 1900 have had that as a major objective and it looks as if the way the world is aligning for the future the trend is sure to continue as vigorously as ever it did in the past. There are now more ‘hungry’ players than during the last century.

Consider merely the latest bout in the Middle East. As an ‘up front’ cost the US has spent well over 400 billion $ US in three years. That is just to destroy things; the cost of rebuilding will be many times that. And then there are the growing costs of measures to increase ‘security’, in part due to that venture, but also to earlier ‘mess ups’ connected with earlier efforts to achieve or maintain hegemony. Compare these costs to the mere five billion Euros, circa six billion $ US) over the next ten years that together
the many national contributors plan to fund ITER with. Money, remember, is only an easily convertible trading means for resources, world resources, resources, e.g. oil, gravel, lime, timber, steel that are increasingly costly to produce or recover. So, as you probably all realise as engineers, such things as windmills, solar panels and better insulation although useful contributions to answering the problem of the world’s energy shortage are by no means the answer. Cheap, economically, sustainable base load power production is required. At present the greatest hope for this is nuclear fusion plants. I think we all ought to do our bit to help educate the public to so perhaps influence the politicians. After all, your efforts don’t have to be too taxing. What about over a pint or two, or if that doesn’t sit will with your beliefs, over a cup of coffee or a plate of nuts, or ..... And don’t forget that almost the most wasteful thing you can do with gas, or oil or coal is burn it. They are in themselves wonderful starting points for the production of a multitude of products from fertilizer, through plastics to lipstick. Besides polluting the earth as we burn the raw materials what are we going to do when they have gone, even if, by then we have cheap, sustainable energy from nuclear fusion.

Well, Britain’s general nulearphobe stance, compared with France’s general nuclearphile stance, is resulting in the next major step in the development of Nuclear Fusion power technology moving across the Channel. To France will go the ‘spin off’ benefits of a lift to their local economy, paid for by the other participating partners. Spin off in terms of additional infrastructure e.g. roads, international school, and doorstep development of the technology and workforce. Today we are importing builders from Poland; in times to come it will be the nuclear engineers and technicians from France. They already have a vast pool of them. I wonder who wants all our media studies graduates.
Visit to ‘The Diamond Light Source’ next to Harwell
By John Battye

The EPG’s initial enquiries to visit the new cyclotron at Harwell were directed towards their first general open day on 14th July. The facility’s construction was the result of the government, in 1998, identifying of an area of technology that Britain would benefit from in the future. Existing facilities such as that at Daresbury, near Manchester, were aging and nearing the end of their expected life. It was foreseen that the right ‘up market’ machine could not only satisfy UK demand but hope to attract considerable business from the wider EU and, indeed, the rest of the world. It was further expected that if of appropriately flexible design, notably in terms of easy wide ranging, accurate, tunability and provision for many users to work on the equipment at the same time, operational costs could be kept sufficiently low as to attract a lot of additional business, additional business in the form of research into a wider range of topics than had hitherto been possible. So it was that the new ‘second generation’ machine came to be embarked upon under the banner of ‘The Diamond Light Source’ with 86% funding from the government and 14% funding from ‘The Welcome Trust’.

The site chosen was one next to Harwell, the attractions being mainly; the availability of suitable land (long owned by the UKAEA), its proximity to many doorstep high technology companies (spun off from the adjacent old UKAEA Harwell research facility), numerous other high technology companies in the wider surrounding area, the convenient availability of an existing heavy power feed from the nearby Didcot power station and the proximity of Oxford University and other universities with very active technology orientated departments.

Under the wing of the principle construction contractor Costain work building the new facility began in March 2003. The plant became operational in January 2007, although not yet provided with all the forty experimental stations it will eventually be able to accommodate. Its cost so far has been about £380 million.

As regards the open day it seems that Diamond did considerable advertising in their immediate geographic area, e.g. advertising in local newspapers etc, to give the local populace a chance to look around the great new shiny doughnut, covering an area of five football pitches, with...
associated outbuildings, that had recently appeared 'on their doorstep'. They were expecting up to about 4000 visitors and as such had set up extensive car parks, employed an army of seemingly specialist stewards, provided batteries of some of the smartest Port-a-Loos I've ever seen (complete with simulated wood finishes and reproductions of French Impressionist paintings) and a number of marques for refreshments and special displays. Entry was only by those who had previously booked.

Inside the main building more stewards directed the visitors as appropriate and Diamond employees stood on hand to provide additional explanation over and above the basic outlines provided on the many display boards and solid state VDU's. There were also numerous exhibitors from outside organisations, e.g. Cardiff University, who had already used, or planned soon to use, the light source. The Diamond physicists and engineers, if you found the right one, which was in fact very easy to do, were able to answer more or less any question one might have and the wide variety of users and prospective users attended their display stands showed just what a very wide range of uses the new facility has. It really does look as if it might stimulate a lot of new research.

Whether the result of being told, by way of a notice board, or asking, there are any number of interesting facts and figures concerning this new facility. Every individual will, of course, be interested by different things so there is not much point in trying to satisfy all by writing reams and reams here. Much is available on the web site www.diamondlightsource.co.uk and more can be provided by phone from the 'horses mouth', Diamond staff, for those who want more. However, to give a little flavour, by way of a random selection, one might include that; the facility took 2 million man-hours to construct, it consumed 2000 tons of steel, it is expected to provide employment for about 350 employees, it typically draws about 11 Mw of electricity, and produces up to 3 Gev electrons running in a vacuum of one picobar. Most communication, other than phone lines, is by fibre optic. For mechanical stability the whole rig is built on a heavy concrete foundation set on piles because the surface chalk was insufficiently stable and a measure of decoupling was required from outside vibrations, e.g. earth quakes, (don't forget even distant earthquakes cause some effect here, as they do everywhere else). Needless to say there is heavy screening from radiation, shutdown trips occur if it is measures above 5% of legal limits.
Perhaps a rather depressing point to some in the UK may be that it seems much of the equipment came from abroad. Yes, as we know the trend here for decades has been to develop ‘service’ industries, which I suppose means selling such as hamburgers to each other, at the expense of manufacturing. The licensed manufacture of (foreign designed) hamburgers doesn’t count in my book. Nor can I see that GDP (increased by selling hamburgers to one another) is such a useful measure of economic strength when considering a nation’s wealth as a whole. During the twenty or so years since a well known British PM declared that Britain’s way forward was to move more heavily to service industries, UK industry has dropped its contribution to the UK economy from 25% to 13%. I note that those economies, e.g. China, that have been accumulating large sums by manufacturing are now beginning to move into big league service industries such as banking (note China’s recent 9 billion sterling loan to Barclays Bank). Methinks the UK should not be so naive as to think they are going to be left alone in this area. I, as I guess you might too, still believe it needs a strong manufacturing sector, not least to save some semblance of knowledgeable balance in the populace as a whole. Did I hear recently that GCSE science papers are to be made easier with such questions as, “Did Galileo use a telescope, a microscope or a horoscope to look at the stars?”

Anyway, to be more specific about the manufactured products that have gone into the making of the Diamond Light Source. It seems that for the most part; the stainless steel ring and its branches (all precision engineered of course) with its countless flanges, welds and other connecting pieces, came from Germany, the magnets, there are an awful lot of them, came largely from Germany and Russia, most of the communication electronics from China, the precision laser alignment system to critically align the whole rig came from the US. As regards, Diamond’s technical staff --- there to answer our queries --- many were English, but there was a fair sprinkling of foreign accents. Those in academia take note .... product, packaging, appropriately trained ‘human’ stock levels, departmental closures. Then for the government’s consideration, consider the lack of a network of appropriate home companies, in our new service economy, for these newly graduated people to climb up to get the required experience.

What I found more surprising was that one of the technical staff, an EU mainlander by origin, began referring to distances in yards. I thought a
fruitier in the NE --- according to BBC news reports a year ago --- selling apples in pounds and ounces was bad enough but an EU mainlander working here in a high tech company referring to yards! When I started my ‘A’ levels nearly half a century ago the first thing my physics teacher said was, “Your ‘A’ level exam’s will be in MKS. From now on we are going to do everything in MKS. That’s the way the world, and Britain, is going.” During my subsequent working life I began to think, until recently, that it was only the Americans really dragging their feet, not that we too were trying to pull Europe back 200 years to the horrors of calculations in imperial, or the like. Or was it that the person speaking to me, like his ancestors 2000 years ago, was trying too hard to communicate with the local barbarians. Who is it makes the Pendalino trains that Virgin use, have the world’s biggest fleet of heavy lifting barges, has one of the world’s biggest independent construction companies outside of the US, the world’s biggest high tech compressor manufacturers, one of the biggest industrial communications manufacturers, one of the worlds biggest car manufacturers..... to mention just a few things that pop to mind. Yes, I admit they are generally low profile things that the majority of the public don’t realise or even know about, but they are things on which the world’s modern living depends. As many say, “History keeps repeating itself.”
Visits

We are currently planning some more visits to sites of scientific and engineering interest in the UK. Those in the immediate 'pipeline' are a visit to the Jodrell Bank Radio Telescope, a little south of Manchester, and one to Thames Water's modern plant near Heathrow Airport.

As always with these visits it is very desirable that we get a fair attendance in order to justify our request. This is particularly so in the case of the visit to Jodrell Bank, partly because it is only being organised, by those willing to show us around, on the understanding they we can show sufficient interest and partly because the organisers are charging a fee which we plan to cover from EPG funds. The more 'heads' the fee is spread over the better.

For those of limited financial means we are offering a few travel grants. Please e-mail our secretary, Samantha Davidson (s.davidson@physics.org) both if you wish to apply for a place on a visit and, making your case, if you wish to apply for a grant.
If you wish to attend please apply soon to facilitate organisation.

Thoughts & Comments Please

We, your committee, are very keen to hear of any thoughts or comments you may have following your reading of this Newsletter. Please e-mail them to Samantha (s.davidson@physics.org).

Events of interest

Please see our website at: http://eng.iop.org

Ideas for future meetings

The group welcomes ideas or topics for future events. Please contact the Chair (John Battye) or Secretary (Samantha Davidson).
Your EPG Committee ‘06/’07

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We are looking for two new ordinary committee members. If you wish to join please contact John Battye.

AGM 2007 and Discussions

Friday 5th October in the Glazbrook Room @ Institute of Physics, 76 Portland Place, London W1B 1NT

- 1.30 pm --- Engineering Physics Group AGM
- 2.00 pm --- Discussion Meeting: The Future of the Engineering Physics Group

Tea, coffee and buscuits will be available.

This newsletter is also available on the web and in larger print sizes

The contents of this newsletter do not necessarily represent the views or policies of the Institute of Physics, except where explicitly stated.

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