



Mice, matter and antimatter

Matter and anti-matter are believed to have been created in equal amounts when the Universe came into existence at the Big Bang, and yet in the Universe today there is only matter. The quest to understand more about the mysterious neutrino particle which is thought to be responsible for this phenomenon has just taken a major step forward.

The Muon Ionisation Cooling Experiment (MICE) project, based at RAL, has achieved an important milestone with the successful transport of a beam of muon particles along the MICE muon beam.

Ken Long of Imperial College (and a regular visitor to RAL) is part of the project management team, "Observing the first particles to pass through the MICE Muon Beam was an immensely exciting moment and represents the culmination of a fantastic, international team effort. It really marks the end of the beginning; we can now begin to tune up the beam and work towards the demonstration of ionisation cooling."

The MICE project aims to demonstrate the technology required for a Neutrino Factory. This new facility would allow the characteristics of the neutrino to be explored with unprecedented accuracy, reshaping our understanding of the structure of nature and the forces that bind it together.



→ Ken Long and the MICE team

Movers and shakers

1 **Sean Langridge** (ISIS) has been appointed Visiting Professor with the Condensed Matter group in the School of Physics and Astronomy at the University of Leeds. Since joining RAL as an instrument scientist, Sean has worked with the Leeds group to develop a very successful programme studying nanoscale electronic phenomena in metallic systems. One of their current projects is focused on the understanding of interfacial behaviour in spintronic materials.

2 To celebrate its 50th anniversary, the Society for Applied Science has nominated not just one but *three* publications from the CLF's Lasers for Science group within its 16 most ground-breaking papers from the last 50 years. This is an outstanding achievement and congratulations go to the authors of the papers who include **Tony Parker, Pavel Matousek, Mike Towrie** and **Ian Clark**. More details are available on the CLF web site www.clf.rl.ac.uk. Pavel is also the author of one of the most cited articles of 2007, based on data from Web of Science.

3 **Guenter Grossmann** (PSD) has been elected a Fellow of the Institute of Physics in recognition of his contribution to biophysics research and, in



→ Left to right: Ian Clark, Mike Towrie, Pavel Matousek and Tony Parker

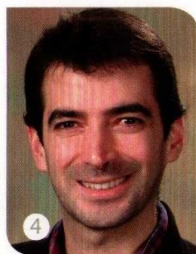
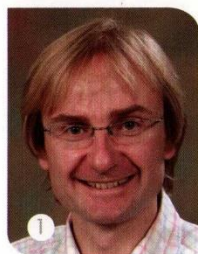
particular, to the development of small angle x-ray scattering in the biomolecular field. Guenter's election means that the SR Molecular Biophysics Group now includes three IoP Fellows.

4 **Laurent Chapon** (ISIS) has been awarded the Physical Crystallography Award by the British Crystallographic Association's Physical Crystallography Group. The prize is awarded every two years for the best recently published work by a person in the early stages of their career in the field of physical crystallography, and whose research is expected to make a significant impact in the field.

A paper by 5 **Andy Irving** (Technology) to be published

in IET Signal Processing provides a solution to the century old mathematical problem of dynamic hysteresis. Andy has shown that it can be solved by including the influence of the ascending order gradients. The method describes the behaviour in terms of general response functions and the properties of the excitation processes that act on the system.

The first PhD from the Cockcroft Institute has been awarded to 6 **Duncan Scott** (ASTeC). Duncan's PhD was based on the design of the helical undulator for the International Linear Collider. You can read more about the project and see a picture of the undulator on page 6.



Magnetic bacteria for cancer therapy

Certain naturally occurring bacteria are able to create tiny magnets that could be intensified and developed for use in cancer treatments, according to research by a team of scientists from the SRS, Diamond, ILL and University of Edinburgh.

For many years scientists have been trying to take advantage of the natural ability that certain bacteria have for creating these chains of tiny magnets that are less than 1/1000th of the size of a human hair. Known as 'bio-nanomagnets', they could hold the key to creating effective, targeted anti-cancer therapies. Guided magnetically, they could be used as miniature shuttles for moving drugs around the human body to specific sites, particularly to cancer tumours. The heat generated from the external

magnet used to make the bio-nanomagnets vibrate would also destroy the surrounding diseased cells without affecting healthy tissue.

In their natural state the magnetic properties of these bio-nanomagnets are not normally effective for this kind of application but the Edinburgh team has been able to strengthen them by feeding them a cobalt metal solution. Using the SRS, the research team has used highly polarised X-rays to prove that the cobalt was successfully incorporated

into the bio-nanomagnets, leading to beneficial changes in their magnetic properties.

Neil Telling (PSD) said, "Using X-rays in this way to understand the properties of bio-nanomagnets is an area that has been highly active at Daresbury for some time, thanks largely to pioneering work performed by scientists at Manchester University. It's great to see the SRS play a significant role in the study of materials that could be used for future cancer therapies."



Seeing through the packaging

When you take a tablet, you assume that it will contain the active ingredients listed on the packaging, and in the specified quantity.

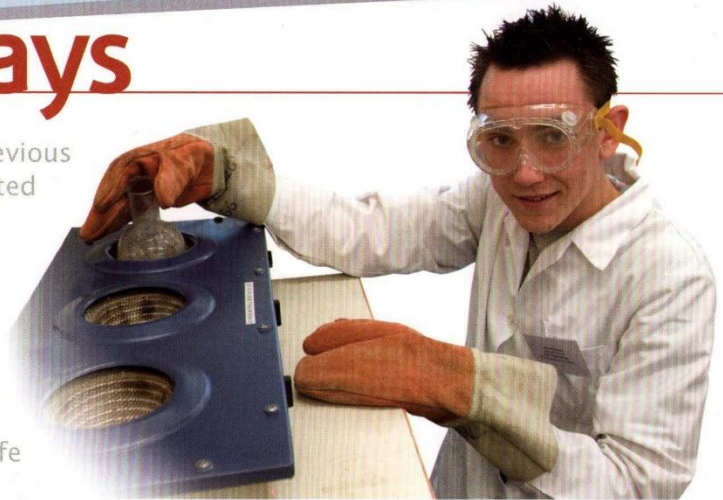
Pharmaceutical companies constantly analyse the medicines coming off their manufacturing lines to ensure that their products meet stringent quality and safety requirements. A technique called Spatially Offset Raman Spectroscopy or 'SORS', developed by the Lasers for Science group in CLF has been adapted to

scan medicines within their packaging and verify the composition. It has been tested by Pfizer, a leading pharmaceutical company, and proved to be more accurate than any of the other non-invasive methods that are currently available.

The technique has a number of commercial applications including identifying counterfeit drugs, the diagnosis of bone diseases like osteoporosis or the detection of explosives. SORS project leader, Pavel Matousek is working with colleagues in CLIK to launch STFC's latest spin-out company, LiteThru Ltd.

School days

For some years, STFC (and its previous incarnations) has actively supported the Engineering in Education Scheme (EES) run by the Engineering Development Trust. The scheme aims to encourage young people into engineering and technology careers. It links teams of year 12 students with a local company that has a real-life engineering problem it needs the young people to solve.



→ An EES student gets to work in one of Technology's workshops

Nationally, more than 2000 students take part each year and for the second time, STFC Rutherford Appleton Laboratory (RAL) hosted a three day residential workshop for schools in and around the Thames Valley.

During the workshop, 11 teams, together with their teachers and engineers, developed the

practical aspects of their projects using RAL's well-equipped workshops, testing facilities and technical staff. With projects ranging from redesigning a cooling tower for Didcot Power Station to a replacement railway bridge for Mott Macdonald, the students face the same challenges as professional engineers.

Masterclasses

Another regular feature on the schools outreach programme is the Particle Physics Masterclass series. Traditionally held in National Science Week, this year's masterclasses saw over 500 A' level physics students spend at day at RAL learning about the LHC, ISIS and



→ Mike Johnson shows an ISIS beamline to a group of Particle Physics Masterclass students

NEWS snippets:

Taking DSIC forward

The Minister for Science and Innovation, Ian Pearson, visited the Daresbury Science and Innovation Campus to announce an agreement that will realise the development of the crucial next phase of the Campus.

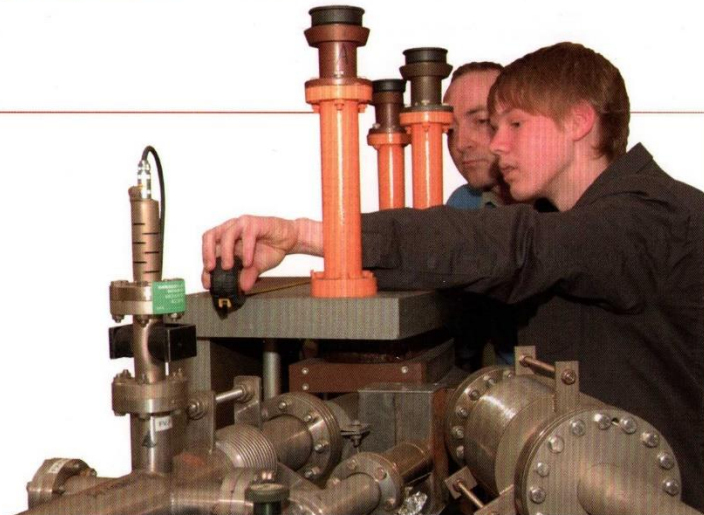
The new development adjoins the existing Daresbury Innovation Centre and the Cockcroft Institute (the National Centre for Accelerator Science). The first phase of development will be a new state of the art 'grow-on' building called Vanguard House.



Left to right: Ian Pearson MP, Keith Mason STFC CEO, Michelle Taylor of St Modwen Properties plc and Sir Martin Harris, Chair of the Daresbury SIC.

Sun shines on e-Science

Computing giants, Sun Microsystems are the leaders in their field. And when it comes to testing their new products, they like to work with the best. The e-Science High Performance Computing Services Group, led by Pete Oliver has been testing Sun's Blade 8000 P system to see if its performance meets the manufacturer's claims. "We've not tested it to destruction, but we've certainly put it through its paces" says Pete. "Sun get the reassurance that their products can cope within a complex computing environment, and we get to try out the very latest kit!"



→ Frank Jackson (ASTeC) shows a student one of the SRS beamlines

Diamond, and more than 50 visit DL to learn about the SRS and ALICE. One of the main aims of the masterclasses is to give the students a feel for what a career in science is like.

Sorting out the arrangements requires a huge amount of organisation and many staff gave up their time to help with

→ EES students work out a solution to their engineering challenge

the tours, talks and computer sessions. Feedback from the schools that attended is excellent and we know that the masterclasses influence the students' choice of degree (positively, of course!).

Helping out with school events is always good fun and very rewarding. If you would like to get involved, please contact Elizabeth Clarke at RAL (ext. 5950) or Alan Brown at DL (ext. 3671).



Expertise on your doorstep

STFC accelerator scientists, RAL design engineers and the machining workshop at RAL have joined forces to deliver a unique Hi-Field superconducting undulator magnet with world-leading performance.

The HeLiCal collaboration comprises Technology, ASTeC, the German institute DESY and the universities of Durham and Liverpool. Working together, they have designed and manufactured the prototype magnet as part of development work for the International Linear Collider. A spin-out programme has now been set up to further develop the technology for light sources such as Diamond, and potentially for a free electron laser (the technology likely to be used in the New Light Source).

A conventional undulator is a stack of magnets arranged so that the poles alternate. The charged particle beam (of protons or electrons) follows these 'wiggles' and emits the required radiation.

The HeLiCal Undulator has the magnet coils in a continuous helix shape so the beam rotates. It consists of a complex 2m double helix of superconducting cables precisely wound onto a steel bobbin and made

into a superconducting magnet. The two coils are closely spaced and run in opposite directions so that the central fields interfere, leaving just the desired helical field. This needs fine positioning of the cables, and hence very accurate machining, so that the fields really do cancel out.

The project presented a number of problems, as Project Manager, Steve Carr (Technology) explains, "To achieve the levels of performance that the scientists were looking for, we needed exceptionally precise machining with a very high degree of uniformity. Initially, we gave the work to an outside company, but they were unable to deliver the quality that we needed. We had not appreciated that colleagues in the workshop could tackle a project of this size, but they were confident that they could... and they were right!"

Milling the two helixes required a special technique developed in R12. "It was quite a challenge but ultimately proved to be very successful" commented workshop manager Richard Day. The team also perfected a technique of winding the superconducting cables like a flat ribbon.

Recent magnetic tests show that the undulator performance far exceeds expectation. As Jim Clarke (ASTeC) says "It has been a very rewarding collaboration to combine the skills of ASTeC and Technology, and we are all delighted with the undulator's performance."

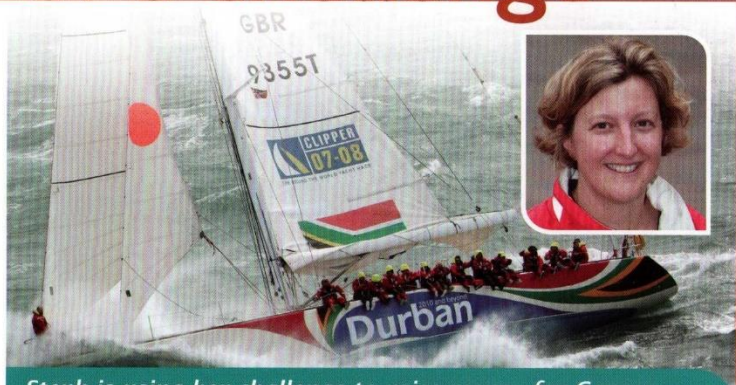
If you have a world-class challenge, don't hesitate to contact RAL's R12 workshop, they might be able to help with a world-class solution!



→ The RAL team with the HeLiCal undulator

In search of a challenge

Sailing across the Atlantic might not be your idea of fun, but you will agree that it is definitely a challenge. Two years ago Steph Hills (FBU and Technology Information Manager) announced to her sailing friends that she wanted to sail across the Atlantic. On May 24, she will start the biggest challenge of her life so far.



Steph is using her challenge to raise money for Cancer Research UK. If you would like to sponsor her, please go to www.justgiving.co.uk/sailorsteph

Steph will be taking part in the final leg of the Clipper 07-08 Round the World Race from Jamaica to Liverpool via New York, Halifax and Cork. She will join the crew of Durban 2010 and Beyond, one of 10 identical 68ft

racing yachts, each sponsored by a city. The skipper and seven of the crew have taken part in the whole race but the remaining 10 crew are 'leggers' like Steph.

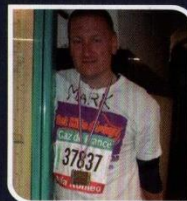
"I started sailing in 2005 and really enjoyed the exhilaration of being on the water, and the camaraderie", she explains. "I get a real buzz out of racing in the Solent but this race is a bit different. Crossing the Atlantic will be the longest that I've ever been at sea and the furthest that I've ever been from land."

There are few creature comforts on board. Crew members sleep in narrow bunks and will be able to shower once every eight days. Everyone takes their turn being 'mother'; preparing meals and keeping the boat clean and tidy below deck. But the priority is to keep the boat sailing as fast as possible 24/7. Life on board will be physically and mentally exhausting.

The race is due to finish in Liverpool on 5 July. More than 40000 people lined the quayside to see the yachts start the race in September last year, and the city has promised an even more spectacular finish this year, as part of its European Capital of Culture celebrations.

MARATHON round-up

Name: Mark Westall (ISIS)
Marathon: Paris
Time: 4 hrs 11 mins 9 secs
Charity: Get Kids Going
Best bits: Scenery and atmosphere
Worst bits: Running out of energy and blisters



Name: Matt Dickson (ISIS)
Marathon: London
Time: 5hr 29 mins 8 secs
Charity: HCPT
Best bits: The continuous support all the way round
Worst bits: Realising at 15 miles that I would need to jog/walk the rest



Name: Jacque Kueh (Technology)
Marathon: London
Time: 4hr 31 mins
Charity: Conservation of the Orangutan in Sepilok, Borneo
Worst bits: Feeling I could not carry on at mile 19
Best bits: Seeing my cheer squad at mile 20



Contact Mark, Matt or Jacque if you would like to support any of their charities.

Unbeatable performance

As well as carrying out world leading science, staff at RAL have another specialism hidden up their sleeves – table tennis.

The A and B teams are highly ranked in Division 1 and the F team has won Division 5 of the local league. The C team of Chris Rowlatt, Tim Pett, Steve Gardner and captain, Brian Wyborn has won Division 2 after notable victories over strong local sides.

Although Tim, Steve and Brian have played well this season, Chris, a sandwich student in ISIS, has shown outstanding performance. He has played 51 matches and won 51, giving him the highest recorded score for the local division this season. He has also won the Division 2 individual knockout cup.

Playing table tennis from the age of 12, Chris moved on from his first club in Lliswerry, Wales, to bigger and better prospects. By the age of 15, he was playing internationally for Wales. "After I finish my placement at ISIS, I hope to continue attending table tennis training camp. Hopefully my experience will benefit other aspiring Welsh internationals."

After Chris finishes his placement at RAL, he hopes to continue attending training camps. His expertise will be put to good use coaching fellow students wishing to play for Wales.



→ Left to right: Chris Rowlatt, Brian Wyborn and Steve Gardner

Having won Division 2, the C team will move up to Division 1. "There is some trepidation. Without Chris the team will undoubtedly be weaker", explains Brian. "However, there is also some excitement as this will be the highest standard that some of us have ever played. We can only do our best and who knows what next year's batch of sandwich students and new recruits will bring!"

Anyone interested in joining the RAL table tennis club should contact Brian Wyborn on ext. 5589.

CLF accept the Microsoft Challenge

The Microsoft UK Challenge in aid of the NSPCC is billed as the ultimate team-building event for businesses across the UK. It consists of four days and nights of adrenaline filled action with the teams kayaking, mountain biking, navigating by torchlight and running, but also using their brains to crack codes and complete complex tasks. This year, a team from the CLF will be taking up the Challenge, which takes place in Scotland in June.

Paul Holligan is the team captain, "when I agreed to take part, I thought it was just a bit of fun – I'm reasonably fit but one look at the Challenge web site and I realised that the participants take it very seriously. So, we're all training hard for the event, and we're about to start some serious fundraising."

You can sponsor the team at <https://www.nspcc.org.uk/challenger/sponform.asp>, and we'll let you know how they get on in the next edition of Facts.

Left to right: Paul Holligan, Matt Streeter, Rob Heathcote, Jorge Suarez-Merchan and Rich Bickerton. Also in the team, Chris John and Graham Wiggins.

