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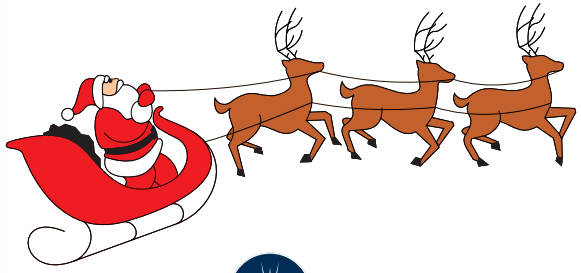
Innovations

Seasons Greetings from Innovations



Innovations Club

Science & Technology Facilities Council

Smaller and cheaper but 300 times more intense - Scientists and supercomputers prove theory which could revolutionise lasers

More brilliant X-rays, more cost-effective methods for developing new energy sources and advanced manufacturing processes are just some of the benefits which may come from a novel technology, proven at the theoretical level by a consortium of British and European laser scientists. The research, led by scientists at STFC's Central Laser Facility (CLF), is published in Nature Physics (October 10 2010).

A team of scientists from the Instituto Superior Tecnico in Lisbon, Imperial College London, and the Universities of St Andrews, Lancaster and Strathclyde as well as STFC's Central Laser Facility staff have demonstrated the feasibility of a groundbreaking method called Raman amplification which can take long laser pulses and compress them to 1000 times shorter, but with intensities 300 times greater. This means that current very expensive and complex laser set-ups could eventually be replaced with smaller and more cost-effective systems. This would make many technologies, including methods used to develop x-rays which rely on lasers, far more accessible and easier to mass-produce. This latest development is another step in laser scientists' quest to develop ever more powerful lasers, increasingly demanded by new technologies since the invention of the laser 50 years ago.

The technique has been examined over a two year period, using some of the world's most powerful supercomputers, to test every possible aspect of the theory. "*In the past, studies have been carried out to test the theory, but only using simplified models which do not include all of the relevant phenomena. Our new model has shown that, in most cases, the amplified laser beam breaks up into 'spikes', making it difficult to focus the beam to a small spot*" said Dr Raoul Trines from STFC's Central Laser Facility. "*But for a few special cases, the amplified laser pulse is of excellent quality, enabling exceptionally tight focusing of the beam*".

Professor John Collier, Director, STFC's Central Laser Facility said; "*This year's celebration of 50 years of the laser* is a poignant reminder that we need to start thinking about the next generation of laser technology. We have come to rely on lasers so much in our daily lives, for everything from high speed internet connections to medical techniques, that we can't afford to pause even for a moment in developing laser techniques further, because these new techniques take years to develop and test*".

The next step is to apply the theoretical study on an actual high power laser and fine tune the method through rigorous experimental testing.

The study has been funded by the Accelerator Science and Technology Centre (ASTeC) with cross-departmental involvement within STFC, including collaboration with STFC's e-science department through the use of the CLF's SCARF LEXICON supercomputer and the Instituto Tecnico in Lisbon, Imperial College London and the Universities of St Andrews, Lancaster and Strathcylde. It has also been made possible through a grant from one of STFC's sister councils, the Engineering and Physical Sciences Research Council (EPSRC).

Optics being aligned on a laser system at the CLF

New technology offers prospect of better bone disease diagnosis

Scientists and medics are set to test a unique technology which could help in the early diagnosis of conditions such as the painful brittle bone disease. The technology, which uses a novel technique devised by STFC's Central Laser Facility (CLF), is to be tested for the first time with NHS hospital patients.

The Spatially Offset Raman Spectroscopy (SORS) instrument, the first to be commercially available, is being delivered on Wednesday 3rd November to the Institute of Orthopaedics and Musculoskeletal Science, University College London (UCL) on the Royal National Orthopaedic Hospital (RNOH) site in Stanmore, Middlesex. The machine, which is being supplied by Cobalt Light Systems Ltd, will undergo testing to assess its usefulness with the long term aim of developing a specialist medical device to diagnose and detect early signs of diseases such as brittle bone disease and osteoarthritis.

The instrument will be used to take measurements on volunteering patients coming in for routine appointments for specific bone disorders that have already been diagnosed. The measurements will test the way the technology works and the methods used for analysing the results. If successful, this could lead to preventive measures being taken at an early stage of disease development and the improved monitoring of the effects of treatments. At the moment brittle bone disease, a genetic bone condition, is often diagnosed after multiple painful fractures have already occurred to newborn babies.

The SORS technique was patented at STFC's Central Laser Facility (CLF) in Oxfordshire, and the instrument developed for bone scanning through collaboration with the CLF's spin out company, Cobalt Light Systems Ltd, and the Institute of Orthopedics and Musculoskeletal Science at University College London, one of the UK's specialist centres for bone disorders. more

Aligning the Spatially Offset Raman Spectroscopy (SORS) instrument

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"This is a very important and exciting step in our research to use this science to develop a diagnostic technology that will allow simpler and more cost effective ways of diagnosing and treating people with painful and degenerative muscular skeletal diseases at a much earlier stage. Our aim is to enable treatment to be more effective in improving quality of life", said Professor Allen Goodship, Director of the Institute of Orthopedics and Musculoskeletal Science.

"The equipment uses the SORS technique noninvasively to safely determine the chemistry of bone tissue several millimeters beneath the skin", said RNOH Consultant Dr. Richard Keen. *"This involves pressing a probe with a safe, low power laser beam gently against the skin in areas where bone is mainly covered by skin. Many bone diseases arise because of subtle changes in the bone protein chemistry but these are invisible to conventional techniques like X-rays. The wonderful thing about the SORS technique is its potential ability to detect these subtle molecular changes. If successfully developed, this type of technology may reduce the need for additional, often invasive tests such as biopsies which could revolutionise the way we currently do our work."*

This new study will establish the feasibility of development of this type of disease diagnosis on patients and, if successful, will pave the way for future patient clinical trials to validate potential wider applications such as screening for osteoporosis and connective tissue disorders.

"We are very excited about the further development of this new technology on patients for the first time," said Cobalt Light Systems' Chief Executive, Dr Paul Loeffen. *"Since scientists at the CLF made the breakthrough in discovering SORS a few years ago, the team at Cobalt Light Systems have worked hard to develop and refine this technology. Now we'll start to see how the technique can make a real difference to peoples' lives. We'll be very busy in the next few years learning what we can from these tests so we can perfect the technology for wider use."*

The SORS technique has further potential for applications such as research into drug delivery, the probing of pharmaceutical products through coatings and packaging for quality control, security screening, and the subsurface probing of paints and food products.

Daresbury scientist in £2.4m project for research into global challenges

David Emerson of Daresbury Laboratory's Computational Science and Engineering Department (CSED) is to play a major role in a collaborative research project to investigate how engineering flow systems can help respond to global health, transportation, energy and climate challenges over the next 40 years.

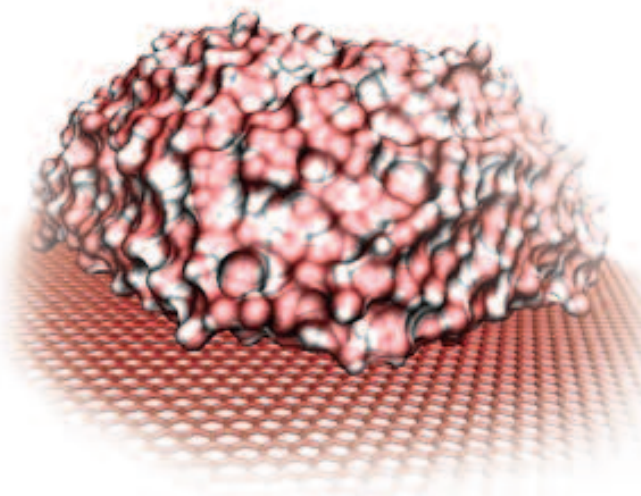
The United Nations estimates that by 2050 four billion people in 48 countries will lack sufficient water. But 97 percent of the water on the planet is saltwater, and much of the remaining freshwater is frozen in glaciers or the polar ice caps. Technologies for large-scale purification of seawater or other contaminated water to make it drinkable are therefore urgently needed.

The £2.4m project, led by Professor Jason Reese at the University of Strathclyde and which also includes Dr. Duncan Lockerby at the University of Warwick, is funded by the Engineering and Physical Sciences Research Council (EPSRC) alongside support worth £720,000 from nine industrial partners which include Jaguar and Land Rover, the Health Protection Agency and EDF. This multi-disciplinary team will deliver new techniques for simulating fluid dynamics - a critical area of research that is key to innovating in these visionary applications.

Micro and nano scale engineering presents an important opportunity to help meet these pressing challenges. For example, early indications are that membranes of carbon nanotubes have remarkable properties in filtering salt ions and other contaminants from water. Also, controlling the turbulent drag on aircraft and ship hulls, which is a major inefficiency in modern transportation, may be achievable by embedding micro systems or nano structures over the vehicle's surface.

Using his specialist skills in parallel algorithms and high performance computing, David will work on delivering the project's underlying scientific methodology and a unique software demonstrator. The work will benefit from access to CSED's advanced computational facilities and particularly the proposed Hartree Centre.

David Emerson said *"This is a great illustration of the growing importance of computational science in the quest to find solutions to the problems facing the world today as well as being an excellent example of academia and industry working together to address these very critical issues."*



Simulation of a water droplet
Credit: University of Strathclyde

From cancer therapy to airport security - STFC Daresbury Laboratory showcases its expertise in Accelerator Science and Technology

Industry representatives from forward thinking and innovative research companies from across the country met at STFC's Daresbury Laboratory on 22 October 2010, to gain a deeper insight into Daresbury's strong reputation as a leader in the field of accelerator science and technology, its expert capabilities and facilities, and to learn how it could be applicable and beneficial to their own businesses and research.

Accelerator science and technology is the design, development, integration and commissioning of a wide range of electron accelerators for light sources, future colliders and accelerators for both basic and applied research. It is applicable to many industrial and scientific sectors including healthcare, particularly in cancer detection and therapy; energy and environment, in supporting future energy programmes and safer disposal of radioactive nuclear waste; in the automotive and aerospace engineering sector to make more efficient use of fuel; as well as in the security sector, particularly for airport x-ray scanning.

Daresbury Laboratory is internationally recognised as a world innovator in accelerator science, its current facilities and expertise include the Cockcroft Institute (link opens in a new window), EMMA, Daresbury's new pioneering accelerator which is paving the way for a new generation of low-cost, compact, high-performance accelerators applicable in fields as diverse as cancer therapy and power generation, as well as ALICE (link opens in a new window). more

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STFC's Dr Susan Smith, Director of Accelerator Science said: *"The UK holds a world-leading position in accelerator science and today's event has provided an opportunity to hear from Daresbury's own experts in the field and has enabled delegates to identify mutually beneficial technology development opportunities and ways in which they could collaborate with STFC in developing new products, processes or services for commercial exploitation."*

The event also included a series of presentations from leading accelerator scientists and technologists from Daresbury and the Cockcroft Institute, followed by a tour of Daresbury's ALICE and EMMA accelerators as well as the new Engineering Technology Centre. The event ended with case study presentations from two cutting edge businesses that have benefitted from successful collaboration with Daresbury.

Dr Ed Morton, Technical Director at security technology company, Rapiscan Systems, highlighted how collaboration with STFC has meant that Rapiscan is now the subject of major product development investment and that Rapiscan's manufacturing facilities are being established in the UK, based on Daresbury Laboratory facility designs, and how they now operate successfully in an international market.

Neil Shakespeare, owner of the Shakespeare Engineering Group, explained how funding from STFC and the sharing of STFC's expertise and knowledge has helped his business to start to become the only manufacturer of superconducting RF accelerators in the UK.

Daresbury's accelerator expertise and facilities and STFC's Engineering Technology Centre (ETC) operate together to help academics and businesses find cost-effective solutions to complex and often unique scientific and technical challenges.

IPS grant schemes

Due to the move to the new grants processing system the IPS/Follow on Fund grants round for January has been cancelled. The Mini IPS open call will also be shut on December 7th.

We anticipate that the April call will be open as usual but will publish details of the closing date on our website as soon as the transition is complete. The Mini IPS scheme will be opened as soon as possible and will be communicated via the website as soon as possible.

Future events - IBIZ 2011 - connecting global life sciences

The UK Trade & Investment Life Sciences International Business Innovation Zone (IBIZ 2011) is being held on 9 - 10 March 2011 within the Healthcare Innovation EXPO.

With 100 overseas partners and 30 UKTI Commercial Officers attending, IBIZ 2011 will be a huge opportunity for you to capitalise on overseas market opportunities.

The programme features:

- **Meetings with international buyers** - if you are looking to grow your business internationally, you'll be able to register as a visitor and use the partnering system to select partners and book meetings
- **Innovation Showcase** - stand packages will be available for UK companies with innovative products looking to showcase their offering to a UK and international audience
- **Seminar programme** - a comprehensive programme demonstrating business opportunities in overseas markets, NHS procurement, aid funded business, and regenerative medicine
- **IBIZ Invest** - an exciting opportunity for businesses seeking growth investment to apply to pitch to an invited audience of investors

Please go to **http://www.ibizlifesciences.com/** for further information,