fascination

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Science & Technology Facilities Council

ABOUT STFC

The Science and Technology Facilities Council (STFC) delivers fundamental scientific research in areas ranging from particle and nuclear physics to space, laser and materials science. Providing access to and managing a range of world-class research facilities, our research seeks to understand the Universe on every level - from the largest astronomical scales to the tiniest constituents of matter.

From cancer treatment to airport security, high-tech jobs to hydrogen-powered cars, energy generation to accident-scene emergency care, our impact is felt within and beyond the UK in many aspects of daily life.

Through our UK operations and our involvement in major international collaborations, we generate outcomes that shape societies, strengthen economies, build industries, create jobs and transform lives.

STFC online

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Don't miss an issue

Fascination is STFC's in-house magazine, published quarterly with additional themed editions throughout the year.

To receive an electronic version straight into your inbox, please visit: www.stfc.ac.uk/fascination and subscribe.

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WELCOME

A warm welcome to the summer 2014 edition of *Fascination*.

We have a brand new look and lots of great stories to share from STFC, bringing you closer than ever to our science and its impact on the UK and the rest of the world.

In this edition we meet two brilliant female scientists who are inspiring people with their work in a way like no other – by getting on their soapbox. Soapbox Science is bringing science to the people in parks, on busy city streets, and a whole host of unassuming public areas. Read more about this unique project on page 10.

Each year, millions of us sniffle and sneeze our way through a bout (or five) of the incurable common cold. But in this edition (page 22), we reveal how new research done at the Diamond Light Source could lead to a potential cure for the common cold, amongst other currently incurable viruses.

The construction phase of the E-ELT (European Extremely Large Telescope) got started with a bang in June, as scientists blew the top off a mountain in Chile to make way for it. We take a look at what jaw-dropping things the E-ELT will do when complete, and how it will benefit the world, on page 14.

On page 20, hear from the winner of the IOP (Institute of Physics) Physics Journalism Prize, Cynthia Garber, on her trip to Fermilab and her approach to science journalism.

We also have a fresh new section called 'Reaching out' (page 26, where in each issue, we'll take a look at some of the fantastic public engagement work we've done in the last quarter. In this edition, we bring news of the Faraday Challenge winners, news from this year's Big Bang Fair and the exciting second phase of our Explore Your Universe project.

Fascination will be brought to you every quarter, with some special editions throughout the year. If you'd like to receive an electronic version straight to your inbox, please visit: www.stfc.ac.uk/fascination.

We hope you enjoy reading it!

Best wishes,
Your Fascination editorial team

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NEWS

Earth's twin discovered

NASA astronomers have discovered the most similar planet to Earth ever found.

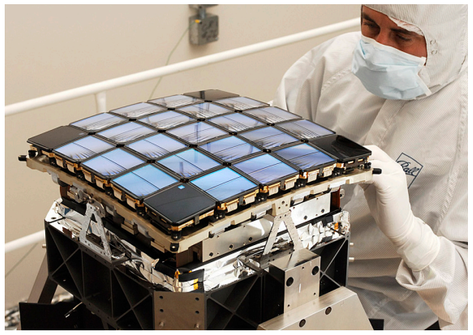
Kepler -186f is a rocky, Earth-sized exoplanet (a planet orbiting a star other than our Sun) located over 500 light years away.

Exoplanets are quite common - astronomers have found over 1000 exoplanets spread across the whole sky - but Kepler -186f is special. Not only is it the closest in size we have ever found to Earth, but Kepler -186f is also orbiting a star within its habitable zone. The habitable zone - otherwise known as the 'Goldilocks zone' - is the range of distance from a star where liquid water could collect on the planet's surface without boiling or freezing: just like Earth to our Sun.

Kepler -186f was discovered as part of NASA's Kepler Mission, using a specially-designed telescope with a large field of view (105 square degrees), called a photometer.

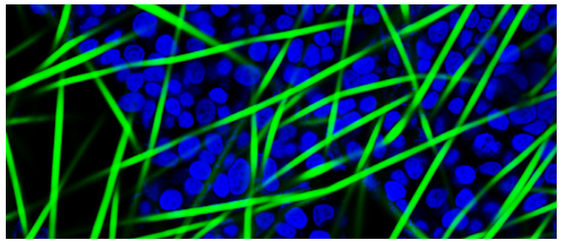
For the duration of the mission - about three and a half years or more - the Kepler telescope monitors the brightness of over 100,000 stars in a particular area of the Milky Way, looking for Earth-sized planets like Kepler -186f, in or close to a habitable zone. The mission also aims to find out how many other exoplanets are within habitable zones.

Visit www.kepler.nasa.gov to find out more about the Kepler Mission.



Credit: NASA/Kepler mission
Kepler focal plane assembly

World's smallest scaffolding used to build new livers



Credit: The Electrospinning Company
An electrospun scaffold using fibres a hundred times thinner than a human hair.

Waiting for a replacement organ that never comes is the heart-breaking reality for 14% of patients requiring a liver transplant. The demand for replacement livers has always far outweighed supply, with over 10,000 people waiting for a liver transplant in the EU alone. Many patients die, or become too sick to undergo surgery during the wait.

But now a UK business, STFC spin-out The Electrospinning Company (TECL), is using technology originally designed for use in space to assist in a ground-breaking project called Re-Liver, which aims to improve the treatment of liver-associated diseases.

For its part in the project, TECL is combining space technology developed at STFC with a process known as electrospinning, in which an electrical charge is used to produce fibres that are a hundred times thinner than a human hair. These fibres are electrospun into microscopic 3D scaffolds, much smaller than the eye can see. Composed from synthetic, medical grade polymers which mimic the cellular behaviour of real human tissues, these scaffolds have been approved by the US Food and Drug Administration (FDA).

With industrial and academic partners in Germany and Italy, alongside the University of Manchester, the EU-funded project is developing artificially grown, mini liver organs, known as organoids. These organoids consist of cells that provide liver cell functions, which could be used to treat liver-associated diseases such as haemophilia.

For more information, visit: www.stfc.ac.uk/3177

STFC's I-TAC receives 100th Hitachi Tabletop SEM in the UK, improving imaging capabilities

In excess of 60 companies at STFC's I-TAC (Innovations Technology Access Centre) in Daresbury, Cheshire and Harwell, Oxford, now have flexible access to two new Hitachi Tabletop SEMS (scanning electron microscopes).

The two new Hitachi tabletop SEMS are the 100th and 101st to be installed in the UK, out of just 3000 in use worldside.

The SEMs provide the ideal platform for all companies at I-TAC, including those working in bioscience, energy, space technologies, advanced materials and chemical engineering, to quickly and easily understand their materials, conduct research and development work, and solve problems.

Access has already enabled companies to achieve over £80 million in investment, create over 100 jobs and develop over 40 products.

For more information about I-TAC, visit: www.stfc.ac.uk/2590

Cobalt Light Systems win prestigious MacRobert Award

Cobalt Light Systems, an STFC spin-out company, has won the UK's top engineering award for its unique liquids scanner.

INSIGHT100 can scan and identify potential liquid explosives in seconds, and could help lift the blanket ban for passengers carrying liquids in hand luggage.

Synonymous with spotting the 'next big thing' in the technology sector, the MacRobert Award is the UK's longest running national prize for engineering. It identifies outstanding innovation with proven commercial promise and tangible societal benefit.

John Robinson FREng, Chair of the MacRobert Award judging panel, said: "The promise of this single fundamental innovation to improve the lives of millions of people in such a variety of ways meant Cobalt stood out in what has been a particularly competitive year for the MacRobert Award.

"Beyond the outstanding technical innovation itself, Cobalt also captured the judges' attention with its hearty ambition. A fast-growing yet humble SME, it is a shining example of the technology transfer process from UK research labs into a successful commercial enterprise."

Credit: Cobalt Light Systems

Cobalt Light Systems CEO, Paul Loeffen, said, "My colleagues and I are honoured that our work has been recognised in this way. It is tremendously satisfying to take a research discovery from the laboratory and develop it into a viable commercial product which is already enhancing passenger safety at airports. Receiving this award is truly a great success for UK science and engineering."

Read more about Cobalt Light Systems and INSIGHT100 on page16.

NEWS

World's first maximum performance computer coming this summer

Credit: STFC
STFC's Blue Joule, an IBM BlueGene/Q system, is the current most powerful supercomputer in the UK

Supercomputers are now key to advancement in every aspect of research, but are limited by their power consumption. This means that their continuing development requires the application of powerful, cutting-edge technologies to make them increasingly energy efficient.

In summer 2014, MPC-X, the world's first maximum performance computer, will be installed at the Hartree Centre at STFC's Daresbury Laboratory, Cheshire. A highly energy efficient supercomputer, the MPC-X, a collaboration between STFC and Maxeler Technologies has been funded by the Department of Business Innovation and Skills, and should speed up dataflow computing and reduce the energy costs for both scientific and industry partners.

Once MPC-X is online, it will enable industry and academia to develop products and services for a massive range of applications – including medical imaging and healthcare data analytics, industrial microscopy, large-scale simulations, media and entertainment.

The next step in supercomputing is exoscale supercomputers, which will perform a million trillion calculations per second!

SKA update

Once built, the SKA (Square Kilometer Array) will be the world's largest radio telescope, made up of hundreds of thousands of radio antennae in Australia and South Africa. Giving astronomers the ability to view the sky in unprecedented detail, and to make observations thousands of times faster than current radio telescopes, it is hoped that the SKA will help us understand some of the fundamental questions we have about the Universe – including how it formed.

In March, the UK Minister for Universities and Science, David Willetts, visited Australia to see the planned site there for the SKA. Along with Australian Foreign Minister, Julie Bishop, David Willetts toured two of the SKA precursor telescopes – the Murchison Widefield Array (MWA) and the Australian SKA Pathfinder (ASKAP).

On the SKA site in Karoo, South Africa, a milestone has been reached - the first of 64 antennas that will make up MeerKAT, South Africa's radio telescope, was officially launched. South Africa's Minister of Science and Technology, Derek Hanekom, marked the occasion and officially opened the MeerKAT Karoo Array Processor Building - the underground data centre for the MeerKAT telescope, built at the Karoo observatory site.

Credit: SKA
Australian Foreign Minister Julie Bishop and UK Minister for Universities and Science David Willetts visiting the Australian SKA site

STFC and NPL collaborate

Credit: NPL
The National
Physical Laboratory

The UK's National Physical Laboratory (NPL) has signed a Memorandum of Understanding with STFC to increase collaboration with ISIS and to jointly enhance our understanding of advanced materials. Of particular interest are multiferroics, a group of materials that show great promise for use in the next generation of computing devices (including mobile devices) – allowing them to be smaller, more powerful and more energy efficient.

Before these materials can be used by industry, we need to understand them on an atomic scale. The first steps in this new collaboration involve taking real-time measurements of high-resolution neutron diffraction patterns and electric polarisation on relevant technological materials. For multiferroic materials, an understanding of the magnetic structure, and neutron diffraction can provide significant insights. By combining the expertise of both the NPL and ISIS in developing a new measurement technique, the hope is that we can build on our understanding of these important materials.

UK still a leading knowledge economy in physics

A new report published by STFC in partnership with the Institute of Physics (IOP) and the Engineering Physical Sciences Research Council shows that the quality and quantity of physics papers from the UK, compared to international competitor nations, gives us a clear lead in the field.

The report, which looks at case studies, citations and publication statistics spanning from 2002 – 2011, examines patterns of performance in physics and other factors, such as international collaboration and impact. It shows that, even though there have been fewer investments in the physical sciences field than other areas of science (such as the life sciences), the UK succeeded in achieving the highest scientific impact among the ten largest publishing countries in physics.

The report also shows that UK physics has become more internationally collaborative - two out of three UK physics papers have at least one author with a non-UK address. Our top three collaborating nations are France, the USA and Germany.

You can read the full report on our website: www.stfc.ac.uk/3142

NEWS

Demonstrating the benefits of investment

Each year, STFC demonstrates the benefits of investing in scientific research. We do this by asking those we have awarded grants to tell us about the progress of their research and the scientific outputs it has achieved.

We then use an online system called Researchfish to efficiently capture and analyse this information. Outputs are categorised into 11 different areas; publications, collaborations and partnerships, further funding, technology developments, intellectual property and licensing – allowing us to get a rounded view of what the outcomes of our investment have been and where our strengths are.

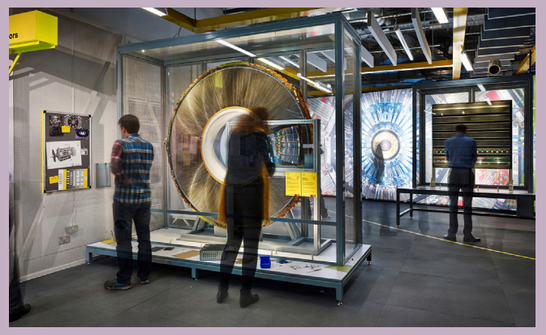
From looking at Researchfish, we can see that technology developments submitted to STFC show potential for application in the security, energy and health and environmental sectors. We also know that our research has a global reach, with research disseminated in Germany, France, China, the USA and many more locations.

Work is underway to incorporate some of our large scale facilities into the Researchfish system, allowing us to capture outputs that arise from the various experiments that are conducted by our facilities.

Once we have analysed all the data available, we present the results to the Department for Business, Innovation and Skills and STFC's Executive Board. This helps us demonstrate the scope and impact of our funding and the productivity of our industry, and it also helps make the case for future funding allocation.

researchfish

Collider exhibition kicks off its tour at MOSI



Credit: Nick Rochowski 2013

The Science Museum's touring Collider exhibition has made its first stop at the Museum of Science and Industry (MOSI), Manchester.

The hugely-successful exhibition attracted over 50,000 people in the first two months alone during its London run.

Collider is your chance to 'step inside the world's greatest science experiment'. It provides a unique combination of video, theatre, real artefacts and sound art to create a realistic exhibition that transports visitors to Geneva, behind-the-scenes at CERN's Large Hadron Collider (LHC).

The exhibition, sponsored by STFC, was developed in close collaboration with CERN, has been designed with a creative team including an Olivier award-winning playwright and CGI film-maker.

John Womersley, Chief Executive of STFC, said: "The award of the Nobel Prize this year for the discovery of the Higgs boson has focused attention on CERN, and how experiments there are helping us understand the Universe we live in. The Collider exhibition offers an opportunity for everyone in the region to see this work up close and to understand just how important a role physicists, engineers and technicians from all over the UK, including the North West, have played in this science."

Collider will run at MOSI until1 October 2014. For more information, please visit MOSI's website: www.mosi.org.uk/whats-on/collider

New publications

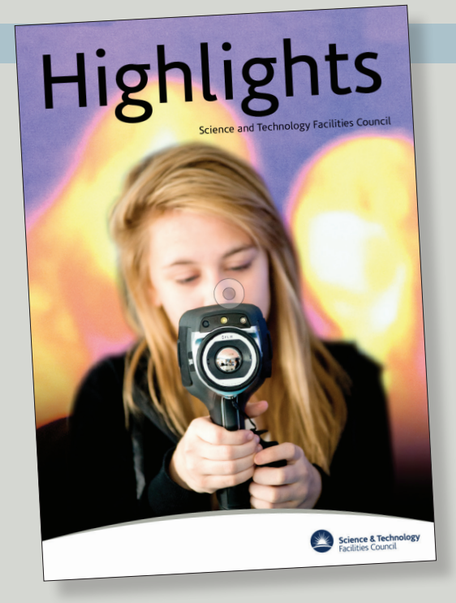
Highlights brochure

Produced annually, *Highlights* is an in-depth look at some of STFC's most noteworthy stories and exciting scientific developments from the past year.

Combining scientific insight with real-world context, *Highlights* brings our science to life, telling stories of how the impact of our science can be felt in everyday life.

This edition includes a look at how research is helping turn bags into lithium-ion batteries, the vital discovery about wood-eating gribbles that could address energy concerns and how research is helping to develop a technique that can diagnose breast cancer instantly.

Read the brochure online at: www.stfc.ac.uk/highlights



STFC's Impact Report

Science is vital - we use it to develop state-of-the-art solutions to everyday issues. If you've ever wondered what science has done for you, you can find out by taking a look at our latest impact report.

Our *Impact Report* provides quantitative data and case study examples which illustrate the breadth and depth of our impact. For example, how a technique developed at STFC's central laser facility with Exeter University could lead to instant diagnosis of breast cancer, and how, thanks to collaboration between STFC and the University of Aberdeen, gravity sensors using quantum sensing techniques, adapted from satellites, can find new oil and gas fields.

In particular, we showcase how STFC has played a key role in developing and delivering real impact in two of the Government's 'eight great technology' themes – big data and space.

During these challenging economic times, STFC has harnessed our world-leading expertise and facilities to generate outcomes that shape our society and strengthen our economy.

Read the report online at: www.stfc.ac.uk/2424

Soapbox Science: bringing science to the public

Soapbox Science is bringing science to the public in a way like no other. Transforming busy streets, parks, and a whole host of unassuming public areas into arenas for learning, a team of some of the UK's leading female scientists are engaging, informing and inspiring all kinds of people with science– without a PowerPoint slide in sight.

Credit: Soapbox Science/L'Oréal-UNESCO for Women in Science 2013
Dr Seirian Sumner and Dr Nathalie Pettorelli, founders of Soapbox Science.

Having just received funding from STFC's Public Engagement Award Programme, these remarkable scientists will be getting on their soapboxes in more places than ever before, hosting a series of free events up and down the country. We caught up with founders, Dr Seirian Sumner (SS) and Dr Nathalie Pettorelli (NP), to find out more.

Let's start with the basics: what is Soapbox Science?

NP: Soapbox Science is a no-frills, grass-roots approach to bringing science to the public. It is designed to engage with the whole spectrum of society, in particular people who would not otherwise seek out scientific events. It aims to transform urban areas into centres of science engagement, enticing the public to take a break from their day-to-day activities to learn, question, and interact with cutting-edge scientists.

SS: Enthusing the general public about science and technology while challenging clichés about what a top scientist is, is really what Soapbox Science is about.

What kinds of topics do the soapbox speakers cover – anything weird and wonderful?

SS: We aim to capture all topics relevant to science, technology, engineering and mathematics (STEM): our speakers are from physics, medicine, biology, chemistry, computer science, conservation or psychology. You name it, we have it!

NP: Sometimes the weirdness resides in what you would think we should know by now (e.g, why do we have left handed and right handed people?), sometimes it simply is in what people get interested in (e.g why would you want to know which bacteria are found in your poo?).

Do you have any favourite topics?

SS: My top favourite so far is Dr Emily Cross, who is an ex-ballet dancer. She is now a neurobiologist and combines her love of dance with studies of the brain: what happens in our brain when we dance/move? Emily had the people of the Southbank doing the Macarena – it was a splendid spectacle, and was an excellent way to engage people with an important scientific question.

NP: Our scientists are science communication enthusiasts, and as such they generally manage to get me interested in all their topics. At the end, it would be hard for me to pick a favourite!

This year marks the fourth year of Soapbox Science events. Going back to the beginning of the journey, what gave you the idea for the project? What do you want to achieve?

SS: Four years ago, we both worked at the Zoological Society of London (ZSL) as research fellows. We were both in our thirties, contemplating the paucity of senior women working in our field: the gradual disappearance of our female peers, the vast underrepresentation of female speakers in conferences and committees, and the lack of female role models at the top of the science career ladder. We wanted to do something about this, and came up with a simple idea – putting fantastic examples of female scientists in the streets of London on soapboxes to show that you do not need a beard or a hairy chest to be a brilliant physicist, an exciting engineer, or an inspirational biologist! We were both awardees of the L'Oreal For Women In Science Fellowships and research scientists at ZSL staff: we decided to approach these organisations for help, and the rest is history!

NP: With Soapbox Science, we want to achieve two things: first, we want to enthuse people, all people, about science. Our goal there is to make science accessible to anyone, irrespective of education or financial means. Second, we want to raise the profile, and challenge the public's view, of women's role in science. Through our events, website and social media, we hope to champion a change in gender inequality in STEM by highlighting the struggles many women face when pursuing a career in scientific research.

> "You do not need a beard or a hairy chest to be a brilliant physicist, an exciting engineer or an inspirational biologist!"
>
> - Dr Seirian Sumner

Why do you think there are fewer women in science than there are men?

NP: Science is an increasingly competitive environment, with more people competing for diminishing pots of research money. Those that work the longest hours, work the conference and committee networking world relentlessly, and are able to follow the best job opportunities irrespective of where they are, are the ones that succeed. Yet in a society where parental care falls mostly to women, where salaries still favour men, where compromises in domestic life are more readily expected from women, and where childcare is costly and rarely easily accessible at the work place, maximizing your chances of academic success while aspiring to raise a family can look quite incompatible for most women. But the challenge goes beyond parenthood: recent work suggests that we do live in a world of unconscious bias: women are perceived 'less appointable' than males in the job market; the achievements of female scientists tend to be less celebrated.

What have your personal experiences been like as women in science?

NP: For many years, I was a single woman able to accommodate large amount of work and high geographical mobility. These characteristics

Credit: Soapbox Science/L'Oréal-UNESCO for Women in Science 2013

generally buffer you against most of the issues mentioned above. However, it does not prevent you from noticing that your male colleagues are generally taken more seriously than you are, and I did sometimes have the impression that more was required for me to access key opportunities.

SS: I've been lucky enough to work with people who are supportive of women in science. My postdoc advisor took great pains to introduce me to another woman in the department who was, like me, doing their PhD abroad and juggling a long-distance relationship. A few years later when I was pregnant with my first child, I expressed concern to my line-manager about what impact having a baby would have on my career. He simply said I'd have a baby, come back to work and carry on. This gave me the confidence to do just that – get on with it! Supportive colleagues and bosses help, but there is no better advice to any women in science planning a family than "Plan now, be determined and find innovative ways to juggle your work and personal life". Now my kids are old enough to swing an insect net, they are starting to help out - they are much better at spotting tiny insects than me! By sharing my passion for my science with them (and their friends!), I get to learn more and explore the world outside my narrow research field, and perhaps sow the seeds for a few tiny scientists of the future!

What do you think needs to happen to inspire more women with science, mathematics and engineering subjects?

NP: I don't think women are not inspired by STEM subjects – I think the problem is to retain the ones that are inspired, at all levels of education, so that more women end up having in career in science.

SS: We need to focus on providing the girls who choose science with the knowledge base to plan their careers alongside their personal aspirations: for example, delaying having your first baby until you have an independent position/fellowship gives you autonomy – you can be your own boss and work flexibly to fit your own agenda.

So what inspired you to get into science?

NP: Science allows me to express myself and be creative in my work; to explore the world, meet incredible people and broaden my horizons; to feel that what I do matters. It's not the topic that got me hooked on science, it's the lifestyle!

SS: I can't remember thinking of doing anything else!

What has been the highlight of the project so far?

SS: I love the enthusiasm of our speakers, their anxiousness before the event, and their euphoria and sense of achievement afterwards. I also love hearing how taking part in Soapbox has helped boost their profile in some way – some say it helped in promotions, getting on the right committee, being an invited speaker; even FRS (Fellow of the Royal Society) professors say they crossed thresholds they never thought they'd cross! That's what this is all about.

NP: For me, it would have to be the moment we were able to bring our events outside London. Having people contacting us, wanting to organise their own event locally, was an incredibly heart-warming moment. This year, Soapbox made it to Dublin, Bristol and Swansea as well as London. We have also recently received a grant from STFC's Public Engagement Awards Programme, so we hope to see more and more local events popping up in various UK cities in the coming years.

We're proud to support the next step in the Soapbox Science project. What will the grant from STFC's Public Engagement Awards Programme allow you to do?

SS: We have received £90,000 from the STFC Pubic Engagement Awards Programme. From October 2014, this grant will support a two-year venture to expand Soapbox Science to the far-flung corners of the UK, with the specific aim of promoting the UK's female scientists who conduct STFC-related science.

NP: The grant will also provide a much needed support staff member to help us juggle Soapbox with our 'day jobs' of being scientists ourselves! Watch out for our advert for this support staff member.

How can people get involved?

NP: If you missed our events in June and July this year, there are lots of other ways you can engage with Soapbox Science. For example, you can follow us on Twitter (@Soapboxscience) to keep up-to-date with our activities and future events.

SS: If you're a woman in STEM, why not apply to become one of our speakers? Our call for speakers in the autumn is currently out. If you are an STFC-funded woman in science, or your research is relevant to STFC themes, then we want to hear from you!

NP: We are always searching for new contributions for our blog (see www.soapboxscience.org for examples): so if you have an idea for an opinion piece relevant to issues linked to women in science, you can drop us an email at: soapboxscience@gmail.com.

Visit: www.soapboxscience.org

Tweet: @Soapboxscience

Email: soapboxscience@gmail.com

Credit: Soapbox Science/L'Oréal-UNESCO for Women in Science 2013

An explosive start for the E-ELT

Credit: ESO
Artist impression of the E-ELT

Date: Thursday 19 June 2014. Location: 80 miles south-east of the Pacific port city of Antofagasta. Occasion: a 10,000-foot mountain high up in the arid Chilean Andes becomes 80 feet shorter – in spectacular fashion.

Before the eyes of an enthralled global audience watching this dramatic demolition live over the internet, the Cerro Armazones rumbles with thunder as dynamite blasts away the cap of ancient rock comprising its summit. Why? To enable the creation of a plateau that will be home to the European Extremely Large Telescope (E-ELT), the biggest telescope of its kind ever built anywhere in the world. Offering astonishing power, sophistication and insight, this revolutionary instrument will allow astronomers to reach deeper into space, further back in time and more intimately into the workings of the Universe than any other optical telescope.

Astronomy goes large

Appropriately presiding over a landscape reminiscent of the Moon or Mars, the Cerro Armazones enjoys cloudless nights around 90% of the year. That makes it the perfect spot for stargazing – especially when the instrument in question will represent the outcome of a two-decades-long, billion-Euro-plus international collaboration designed to propel astronomy to unprecedented new heights. The 'E-ELT Groundbreaking', as June's explosive event has neatly been christened, is therefore a key milestone in the telescope's journey from drawing-board to reality.

Being built by the European Southern Observatory (ESO), an intergovernmental astronomy organisation supported by the UK together with 14 other countries, the E-ELT will constitute what's already been dubbed 'the world's biggest eye on the sky'. Its 39.3 metre primary mirror will make it comfortably the most powerful optical and infrared telescope anywhere in the world, equipping astronomers to investigate the origins and evolution of galaxies, the nature of mysterious 'dark matter', the formation of planets beyond our own solar system and much, much more.

Two impressive statistics convey a flavour of the E-ELT's jaw-dropping capabilities: the facility will capture 15 times more light than any other telescope currently in existence; and the images it generates will be 16 times sharper than even the awe-inspiring pictures that the Hubble Space Telescope has produced, transforming our whole perception of the cosmos in recent years. With 2023 the anticipated completion date for construction of the E-ELT, there's a palpable sense of excitement in terms of what this exceptional new facility could help astronomers to achieve.

Close to home

The E-ELT represents one of the biggest global scientific collaborations ever undertaken. Moreover, although located 7000 miles away from the UK, the impact and benefits it generates will be felt very close to home. The UK Government has invested £88 million in the project – a significant stake which is securing for both industry and the research base in this country a pivotal role in the telescope's construction and eventual operation, as well as in the development of the array of cutting-edge instrumentation that will constitute a cornerstone of the facility.

What this boils down to in day-to-day terms is UK scientists and engineers, supported by STFC, harnessing their expertise and ingenuity to find ways of ensuring that the E-ELT realises its full potential, while delivering a welcome boost for the national economy. Already, UK organisations have secured contracts totalling around £9 million and it's estimated that this figure could snowball by up to ten times over the coming years. Nor should the value of the wider spin-offs be underestimated, with sectors ranging from medicine to energy the potential beneficiaries of technology developed for the E-ELT.

Professor John Womersley, STFC's CEO, clearly recognises this broader significance when he comments: "E-ELT is one of the highest priorities for STFC and the UK astronomy community. It not only has the potential for enormous benefit to UK industry but will be the world's pre-eminent astronomical observatory for many years to come."

And it's a project whose construction phase got off to an explosive start this summer.

For more information, visit the ESO website: www.eso.org

Watch video coverage of the project on YouTube: www.youtube.com/user/ESOobservatory

Change is in the air

Queues, confusion, confiscations – they've been part of the airport experience since restrictions on carrying liquids in hand luggage came into effect eight years ago. Those restrictions were, of course, triggered by a failed terrorist plot to bring down transatlantic airliners using explosives smuggled inside soft-drinks bottles. But now the inconvenience and disruption affecting millions of passengers each year are on course to disappear, thanks to a unique screening machine that grew out of cutting-edge STFC research carried out a decade ago.

No hiding place

Developed by STFC spinout Cobalt Light Systems Ltd and resembling a large microwave, INSIGHT100 is deceptively simple. You hand over your bottle of wine or tube of toothpaste, for example, and the operator places it inside the machine. No need to open the bottle or tube, no need to study the contents – the operator simply shuts the door and within a few seconds the readout displays a definitive, unambiguous result: 'Clear' or 'Alarm'.

INSIGHT100 delivers phenomenal accuracy, pinpointing dangerous liquids, gels and powders with virtually a 100% success rate and generating a 'false positive' reading less than 0.5% of the time. It's extraordinarily versatile too, with the capacity to identify substances concealed in plastic or glass containers that are transparent, opaque, coloured or only part-filled – and even if the contents consist of more than one substance.

Sixty-five of these ingenious machines are currently on trial at airports across the EU, including Heathrow, Gatwick and many other major flight hubs. The results have been so encouraging that the days of being prevented from carrying liquids in hand luggage in quantities of more than 100 millilitres look to be numbered. Phased removal of the current restrictions is anticipated by 2016 – and it's not just passengers and airlines that stand to benefit. INSIGHT100 also offers a much-needed solution to a big waste problem for airports themselves. At Heathrow, for instance, 2000 tonnes a year of confiscated containers holding water, perfumes, duty-free alcohol and much more besides currently need to be disposed of.

Laser appraiser

The secret of INSIGHT100's game-changing capabilities lies in laser light, or more precisely what happens to light when it strikes molecules. Back in 2004, working at STFC's Central Laser Facility and collaborating with chemicals giant ICI and the University of Michigan, Professor Pavel Matousek came up with a remarkable invention rooted in a long-known scientific phenomenon.

First observed in the 1920s, the 'Raman effect' is the name given to the change in light's wavelength that occurs as light hits molecules and some of it is scattered. Every different substance creates its own slightly different Raman 'signature', in terms of the altered wavelength of the scattered light, and this betrays the substance's exact chemical composition. Professor Matousek's breakthrough involved developing a new laser-based technique that could identify Raman signatures produced by individual layers just beneath an object's surface.

The technique was named Spatially Offset Raman Spectroscopy (more digestibly abbreviated to 'SORS') and the platform had been created for a spinout company with a very clear mission: to commercialise the breakthrough and develop products that could appraise the contents of closed containers quickly and accurately – and therefore solve a range of real-world needs.

Light work

Inside the INSIGHT100, SORS technology goes about its business quietly and effectively, as lasers penetrate containers and the resulting Raman signatures produce a chemical fingerprint of the contents that's automatically and instantly compared with an extensive 'threat library'. Totally safe for operators and public alike, it's no wonder that INSIGHT100 has won this year's prestigious MacRobert Award (see page 5).

The machine has clear potential to be deployed in a range of locations beyond the world of aviation, such as railway stations, shipping terminals, border crossings, government buildings and prestige tourist attractions. Moreover, just as this pioneering scanner grew out of solutions developed by Cobalt Light Systems to aid verification of pharmaceuticals enclosed in bags and bottles, so INSIGHT100 opens up the prospect of its ground-breaking technology being adapted and applied in spheres ranging from cancer screening to the detection of counterfeit goods.

Fast, accurate and easy to use, INSIGHT100 has brilliantly demonstrated that it has the capability to make light work of really difficult challenges – and to make life much easier for an awful lot of people.

For more information about Cobalt Light Systems, visit: www.cobaltlight.com

Time travelling to your perfect home

Zoopla Property Group customers can now time journeys to their perfect home via foot, car or public transport, thanks to space technology.

Searching online for the perfect new home has just got easier thanks to technology originally designed for use in space. Leading property website, Zoopla Property Group, is using a revolutionary app developed by a small UK space tech company, iGeolise Ltd, that enables its online house hunters to instantly search for new homes by travel time, as opposed to distance, according to their mode of transport.

The app, called 'Travel Time', uses satellite maps overlaid with public transport and road data to instantly identify, rank and sort potential properties based on journey time – between a home and place of work for example. It takes into account whether travel is by car, foot, bus, train or tram. It even factors in average walking speed, position of bus stops and stations, regularity of public transport at given times of day, even road speed limits and the distances between junctions.

Lawrence Hall of Zoopla Property Group said: "A destination may be close by, but it could be difficult to get to. Similarly another property can be a fair distance away, but could in fact be quicker to get to than a property closer by. This is really important detail if you want a home which is say within 30 minutes commute time from where you work. Travel Time is a brilliant addition to our platform, and with millions of users searching our site each month this technology is great news for property hunters and our members."

Managed by STFC, the ESA BIC Harwell enables small companies with brilliant ideas using space technology, to transfer these ideas for use into non-space industries. iGeolise co-founders, Charlie Davies and Peter Lilley, joined the ESA BIC Harwell just over a year ago, where they found the ideal environment to combine innovation and the necessary business support to take their pioneering technology further commercially into the non-space sector.

Paul Vernon, STFC's Head of Campus Development, said: "iGeolise is solid proof that with the right business support and expertise, pioneering start-up companies, such as iGeolise, can take UK space technologies into completely different industries, turning brilliant ideas into successful, vibrant businesses. I am thrilled that Zoopla Property Group has now adopted this technology onto its website - this is exactly what STFC and the ESA BIC Harwell sets out to help small companies achieve."

Peter Lilley, Co-founder and CEO at iGeolise, said: "It is superb news that Zoopla Property Group, a leader in the online property search industry, is using Travel Time on its website. At least 40% of all web searches are for geographical information, so we knew we had developed a really useful and revolutionary product. Our focus has always been on the commercialisation of our technology, so becoming an incubatee at STFC's ESA BIC Harwell put us in the perfect position to access the specialist business expertise we needed to gain the exposure and contacts with the right audiences and markets, and this is critical to the success of our business."

Applications for iGeolise's technology are not just limited to home hunters. It can be used to search for restaurants or jobs that are so many minutes away from home, or it can be used by companies to estimate their carbon foot print. These are just some of the many uses of Travel Time currently being trialled across the world.

For more information, visit: www.igeolise.com

Credit: Kts | Dreamstime.com

Winning the Physics Journalism Award

Science journalist Cynthia Graber, Winner of the International Physics Journalism Award, tells us about the science that inspired her prize-winning article, and what happened when she visited Fermilab.

A few years ago, I wrote a story for the *Boston Globe Sunday Magazine* on regenerative medicine and the attempt to grow new body parts. In the story, I traced the complexity of the science: from multiplying cells in culture, to the formation of tissue, through to challenges of growing three-dimensional structures from scratch. The final question of how to grow complex organs such as a heart remains the most unyielding of all, still out of reach for modern medicine.

In the course of my reporting, I met Michael Levin, director of the Tufts University Center for Regenerative and Developmental Biology, who was demonstrating shocking successes in achieving complex animal regeneration by manipulating electric signals. These electric signals are one of the ways in which cells communicate. Levin's approach is a rare one, not attempted or considered by many biologists.

I was captivated. His research deserved a more thorough article, I thought, beyond the few paragraphs I would dedicate to it in the *Boston Globe*. As I delved deeper into Levin's scientific explorations, I began calling other top scientists in the admittedly limited field of bioelectric signaling. They had fascinating stories of their own, and they agreed that the results from Levin's lab were some of the most exciting they'd seen.

"Why isn't this more generally known or understood in biology?" I asked them all. "Why is this aspect of biology considered fringe?"

Because, they told me, most biologists aren't trained in physics.

Eventually, I published a lengthy profile of Levin – who started reading university-level physics and biology textbooks when he was eight – and of the history of research into bioelectricity in the online science magazine Matter. The resulting story, '*Electric Spark: Could electricity be the key to unlocking human regeneration?*' won the IOP-STFC Physics Journalism award this past January.

When I applied for the award, I knew my report might not focus directly enough on physics. But I hoped the judges would find merit in the importance of interdisciplinary research, on the role of physics in biology. I was thrilled when I heard that the judges agreed. Professor Dame Athene Donald, professor of experimental physics at the University of Cambridge, said, "It was good to see the winning entry demonstrate such an interesting example from the breadth of issues for which physics is so pertinent. Too often physics is thought of as quite a narrow, self-contained subject, instead of as a way of thinking that underpins many other disciplines."

My approach to physics mirrors Professor Donald's quote, that physics is a way of thinking that underpins other disciplines. While I have been a journalist for almost 15 years, physics is not my beat. Physics, however, has frequently played a role in my stories: batteries to store renewable energy; light-emitting diodes; fusion research. I podcast for Scientific American's 60-Second Science, and I've covered physics-focused topics, such as black holes.

But I've never covered particle physics. This was on my mind when, as part of the award, I flew from Boston to Chicago for the annual meeting of the American Association for the Advancement of Science. Before the meeting began, I was given a tour of Fermi National Accelerator Laboratory in Batavia, Illinois.

It was with some trepidation and a hint of an apology that I introduced myself to the scientists at Fermilab. I'm a full-time science journalist, but their research lies outside my area of expertise, I admitted. They were gracious with their knowledge and time, and I received a sweeping view of the history of the site, the important research that has taken place there over the decades, and the ways in which Fermilab is transforming itself to ask new questions.

That final bit interested me the most. Fermilab had been one of the most important research institutions in the world in the study of high-energy particle physics. With the unveiling of the Large Hadron Collider (LHC), the focus shifted. Some experiments at Fermilab shut down, and, while Fermilab scientists are lead participants in the LHC, many moved overseas.

But new experiments have begun, and Fermilab is repositioning itself for the future. While still hosting scientific investigations on everything from dark matter to superconducting magnets to, yes, its core focus of fundamental principles about particles, the lab has begun the process of reinventing itself as the international centre for neutrino research. Understanding neutrinos could help solve as yet unanswered questions, such as why the world is made of matter.

I greatly enjoyed the visit, and I encourage journalists to apply for the IOP-STFC award, even if their reports link physics to other disciplines. I'm thankful for the opportunities afforded by the award, and I look forward to continuing to weave physics into stories about science from around the world.

Image courtesy of Cynthia Graber

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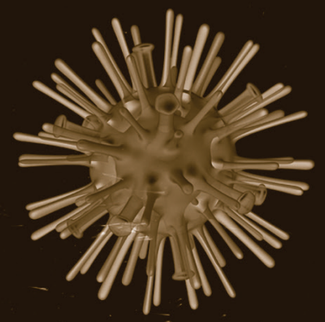
The search for a common cold cure heats up

There has never been a cure for the common cold. Contagious and, just like the name suggests, very common, we've all had to accept the occasional bout of this illness as a fact of life. But, thanks to a new compound, maybe not for much longer…



The common cold is so ubiquitous that most adults suffer between two and five colds a year. School children are even more affected, falling victim to a cold between seven and ten times every year. In fact, young children are the main reservoir for the common cold viruses, and you are most likely to be infected at home.

An international team of scientists have developed a new compound which could form the basis of a drug to treat the group of closely-related viruses responsible for hand, foot and mouth disease and other wide-spread viruses, including poliovirus and the common cold.

This currently untreatable viral group, which belongs to the enterovirus genus, is a major global threat to public health, causing numerous epidemics in children - particularly in Asia - with 10 million cases reported every year in China alone.

The new inhibitor, which has so far only been tested in isolated cells, was created using structure-based drug design that works in three stages of research;

- Solve the pathogen's structure
- Determine how that structure relates to the functioning of the pathogen
- Develop a means of disabling the pathogen by interacting with its structure

Using cutting edge-techniques at Diamond Light Source, the UK's national synchrotron funded by STFC and the Wellcome Trust, the collaboration team hailing from Oxford, Beijing, Leeds and Innsbruck first solved the structure of the EV71 virus (against which the drug is particularly effective) back in 2012. At this time, they discovered a small pocket inside the virus which a drug might fit into.

Enteroviruses, which are part of the virus family called picornaviruses, have an outer shell which, once inside a host cell, breaks apart, releasing the viral RNA into the cell and infecting it.

The team used life science beamlines I03 and I24 at Diamond to guide their development of the methodology behind a potential drug molecule that can sit inside the virus' pocket, where it locks the virus rigid, preventing the shell from breaking open and releasing its RNA. It is therefore stopped in its tracks and unable to infect the host.

This discovery, published in *Nature Structural and Molecular Biology*, may also have important implications for combating other diseases. Professor Dave Stuart, at the University of Oxford and Life Science Director at Diamond, who worked on the new inhibitor, explains: "By targeting a structural feature also found in related viruses, it should be possible to devise similar therapeutics to target them. Within the field, I am aware of one company that is already making progress in targeting the major common cold virus. Our work is still at an early stage, but we are working with academic groups in China to take the inhibitor forward."

This research is still in its early stages, and there is a considerable way to go before the drug treatment is available on the market. It's also important to note that viruses evolve exceptionally fast, and it may be that EV71 mutates to overcome the inhibitor. However, the early signs are promising, and now that the methodology exists, scientists may be able to develop the inhibitor to become resistant to mutations.

The speed with which this development has come about – in less than two years from the original discovery of the virus structure – demonstrates the vast potential of structure-based drug design, and the remarkable capabilities that are now at scientists' disposal in the fight against disease.

Credit: Alena Sivyi | Dreamstime.com

Science at ISIS

Our suite of neutron and muon instruments at ISIS give unique insights into the properties of materials on the atomic scale. Here we highlight some of the research currently taking place using instruments on this ground-breaking facility.

Credit: STFC

Might muons and a microwave make marvellous materials?

A group from Glasgow are trying to find greener, more efficient ways of making nanomaterials using Emu, an instrument on ISIS.

The researchers have synthesised nanoparticles of the battery material, LiFePO4, using a microwave synthesis method and investigated the diffusion of lithium in this nanostructure for the first time, using muons.

By looking at how these battery materials work at the atomic scale, they hope to develop better battery materials in the future.

Helping make hydrogen cars a reality

The race is on to produce the first commercially available hydrogen car. With the depletion of fossil fuels, hydrogen could be the alternative, provided it can be produced without using fossil fuels.

But there are challenges in both producing and storing hydrogen that need to be overcome. Toyota, who hope to release a hydrogen fuel cell vehicle in 2015, have been working with ISIS scientists to address one of those challenges: hydrogen loss during cycling.

Shin-ichi Towata, from Toyota Central Research and Development Laboratories Inc, said: "Our work with ISIS has allowed us to develop in operando neutron powder diffraction techniques that has provided important insights into the nature and location of hydrogen in Ti-V-Cr-Mo alloy for hydrogen storage systems. This in turn provides new opportunities for the rational improvement of these materials for use as storage for future hydrogen cars."

Shining the beam on anti-cancer drugs

Cisplatin, the most famous and most widely-prescribed drug of its kind, offers treatment for several types of cancer - such as testicular, lung, bladder and ovarian. It works by latching on to the cancer cell's DNA, preventing cell division, and marking the cell for destruction.

Cisplatin treatment, however, is tough to endure, owing to its significant toxicity to healthy cells. Critically, in many cases, cancer cells develop resistance.

In the hope of generating new anti-cancer agents able to overcome this acquired resistance, a group of scientists from Portugal have been studying cisplatin as well as new platinum and palladium-based complexes with anti-tumour properties.

Unravelling the boundaries in a solid-liquid relationship

In nature, many different and fascinating solid-liquid relationships exist – from hairy fishing spiders that skate the surface of their watery hunting ground, to waxy lotus leaves with a water-repelling surface to help keep the dirt out.

The ability to mimic these kinds of surface phenomena has a benefit to industry, and so understanding these solid-liquid surface interactions is important.

Recently, a technique used to study nanostructured surfaces and thin films, called grazing-incidence small-angle neutron scattering , was used for the first time on Sans2d. The research will contribute to a better understanding of lubrication and open routes for the development of smart liquids with amendable properties.

Credit: STFC

REACHING OUT

Making science accessible and engaging is important to STFC, and we are committed to inspiring people of all ages with science. Read the latest on our latest outreach work…

Kingsbridge Community College wins Faraday Challenge final

Credit: IET
Barry Brooks, President of IET presents winning team, Kingsbridge Community College and their teacher, Martyn Luckhurst, with their prize.

Credit: IET
Students participating in the final challenge.

After battling it out in the final heat, Kingsbridge Community College from Devon have been crowned the winners of the IET (Institute of Engineering and Technology) 2013-14 Faraday Challenge.

STFC's Rutherford Appleton Laboratory (RAL) hosted the final on 20 June, in which teams from the three top schools on the leaderboard; Withington Girls' School, Manchester; Colston's School, Bristol; and winning team Kingsbridge Community College, battled it out in a tough engineering challenge to win £1000 for their school.

The final was the last in a series of Faraday Challenge Days, delivered by the IET in 45 schools and 12 IET Academic Partner universities nationally. STFC also hosted two Faraday Challenge Days – one at RAL and one at Daresbury Laboratory.

At each Faraday Challenge Day, STEM professionals challenged six teams of six students (aged 13-14) to research, design and make prototype solutions to real-life engineering problems. Teams won points based on their performance. This year, the theme was 'Mission to Mars', so teams were challenged to construct a prototype rocket which could launch using the system provided, design, build and demonstrate a prototype transport system to move the rocket to the launch site, and demonstrate how the rocket works by launching it in a simulated environment. In the final, teams had the added pressure of ensuring that the transporter stopped automatically after three metres, displayed night-time lights, and that the rocket could carry two payloads – one light and fragile, the other heavy and non-fragile.

The Faraday Challenge is a great way for schools to engage their students in STEM subjects, and provides them with a good example of how STEM subjects can be applied in the real world.

Gareth James, IET Head of Education, said: "Students who take part in the Faraday Challenge Days experience hands-on design and practical work, giving them a peek into the life of a real engineer, the variety of engineering out there and the central role it plays in our everyday lives.

"There is huge demand for new engineers and technicians and we are confident that this will challenge young people's perceptions of engineers and hopefully make them consider engineering as a career choice."

To find out more about the Faraday Challenge and for information about becoming a host school for a 2014/15 Faraday Challenge Day, please visit the IET's website: http://faraday.theiet.org/

Particle Physics Masterclasses underway

In March, over 1000 physics students got the chance to see their learning come to life, when STFC kick-started this year's round of Particle Physics Masterclasses at Rutherford Appleton Laboratory and Daresbury Laboratory.

Particle Physics Masterclasses are part of an exciting national programme founded and co-ordinated by the Institute of Physics (IOP) and run by researchers from around 20 different organisations up and down the country until the Autumn. At our Rutherford Appleton Laboratory, we have been successfully hosting Particle Physics Masterclasses since 1996 when they were first set up by the IOP. Particle Physics Masterclasses are now held around the world in over 40 countries.

Thanks to our fantastic in-house expertise and access to world-class facilities, STFC are in a unique position to deliver an exciting, varied programme of these Masterclasses in the UK. Designed to support students' learning by demonstrating some of the real-life applications of their subject, our Masterclasses convey the excitement in ground-breaking particle physics and materials science research. We deliver hands-on workshops and interactive activities that let students get close to the science. By showing participants the impact our particle physics community are making in the world, we hope to inspire the next generation of particle physicists.

Masterclasses consist of a range of immersive activities, including tours of our facilities (location dependant), exciting talks by resident physicists and university researchers, interactive activities using real data from the Large Hadron Collider at CERN and exclusive access to some of our exhibitions.

Our Particle Physics Masterclasses have gone down so well that they were even described by one teacher as "the best school trip ever."

To find out more or to find out when our next Particle Physics Masterclasses are taking place, please visit: www.stfc.ac.uk/2763 or you can tweet us @stfc_matters

Phase two of Explore Your Universe announced

Inspiring more than 156,000 people in its two-year run, the first phase of the hugely successful Explore Your Universe project has now been completed.

Funded by STFC and in partnership with the UK's Science Centres sector, phase one of the Explore Your Universe project gave10 UK Science and Discovery Centres and museums the chance to involve their visitors in a cutting-edge programme of events, school workshops and hands-on activities relating to the physical sciences.

Visitors to Explore Your Universe venues up and down the country got to take part in a range of fun activities - such as handling meteorites, performing optics experiments and using a thermal imaging camera - which were linked to our research by skilled science explainers, engaging people of all ages and both sexes with STFC science.

'Meet the Researcher' events gave participants the chance to meet and talk to researchers about their careers, and the Explore Your Universe activities were designed to be inspirational and engaging to both boys and girls - another step towards correcting the underrepresentation of women in STEM careers. The evaluation showed that there were no differences in the enjoyment between boys and girls of all ages taking part.

The project also funded a series of national staff training academies, the production of flexible science resources and some essential scientist training, meaning the legacy of good work left behind by the Explore Your Universe project can continue to help the science community to reach out.

Building on the success of the project, phase two will be launched shortly. It will welcome more organisations into the network, and provide ongoing support, networking and training opportunities. It will also explore ways of generating interest from even more people, especially underrepresented groups, supporting family engagement and promoting increased awareness of where science can take you.

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Establishments at Rutherford Appleton Laboratory, Oxfordshire; Daresbury Laboratory, Cheshire;
UK Astronomy Technology Centre, Edinburgh; Chilbolton Observatory, Hampshire; Isaac Newton Group, La Palma;
Joint Astronomy Centre, Hawaii.

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