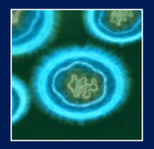
INNOVATION insights

THE LATEST INNOVATIONS, COLLABORATIONS AND TECHNOLOGY TRANSFER
FROM THE UNIVERSITY OF OXFORD

ISSUE 9 MAY 2018

OXFORD VACCINE DEVELOPMENT

Two Oxford spinouts lead the way in vaccine development ▶



Sequencing the bacterial genome ▶

Analysis of next-generation sequencing data ▶

Advanced printing methods ▶

Simplified joint alignment ▶

OXFORD UNIVERSITY INNOVATION

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INNOVATION insights

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Showcasing technology

...an opportunity to discover the latest from Oxford

It's nearly that time of year again when there is an opportunity to discover the latest from Oxford. On 13th June the significant players in life sciences around Oxford will come together to host the annual Technology showcase.

Delivering patient benefit from ideas that have originated in a University laboratory usually takes years, and always requires a partnership representing clinical, patient and financial interests – but all working towards the same goal. It is in this spirit that we join together with our colleagues in the NIHR Oxford Biomedical Research Centre and Oxford AHSN for our 6th Technology Showcase, this year titled 'Therapeutics, Small Molecules and Biologics'.

More details can be seen on page 28. Please register – we hope to see you there.

This edition also features an article from OUI's COO, Adam Stoten, about the world class work being done on vaccine development in Oxford, and two of the high-profile spinout companies formed to fight diseases from 'flu to cancer that have an enormous human and economic cost.

We hope that you enjoy reading news of the latest innovations from Oxford in this edition of Innovation Insights.

Matt Perkins, CEO

News

Board level changes at OUI

The innovation arm of Oxford University gains impact at board level with the addition of Nicola Blackwood, the former Minister for Public Health and Innovation, and Jonathan flint, the former Chief Executive of Oxford Instruments.

FULL ARTICLE ▶

AI-assisted treatment for stroke victims

Brainomix has secured £7m investment to bring its artificial intelligence software, to automate stroke diagnosis and improve treatment outcomes, to the global healthcare market.

FULL ARTICLE ▶

DNA sequencing spinout secures funding

Oxford Nanopore, has raised £100m in venture funding for a new facility to include lab, logistics and clean room space at Oxfordshire's Harwell campus.

Courtesy of Harwell Campus

FULL ARTICLE ▶

Recycling plastic waste

Oxford Sustainable Fuels, a recent spinout promising to transform waste from plastic, tyres and biomass into high quality transportation fuels and chemicals, has raised £1m in seed investment.

FULL ARTICLE ▶

Oxford spinout improves transplant success

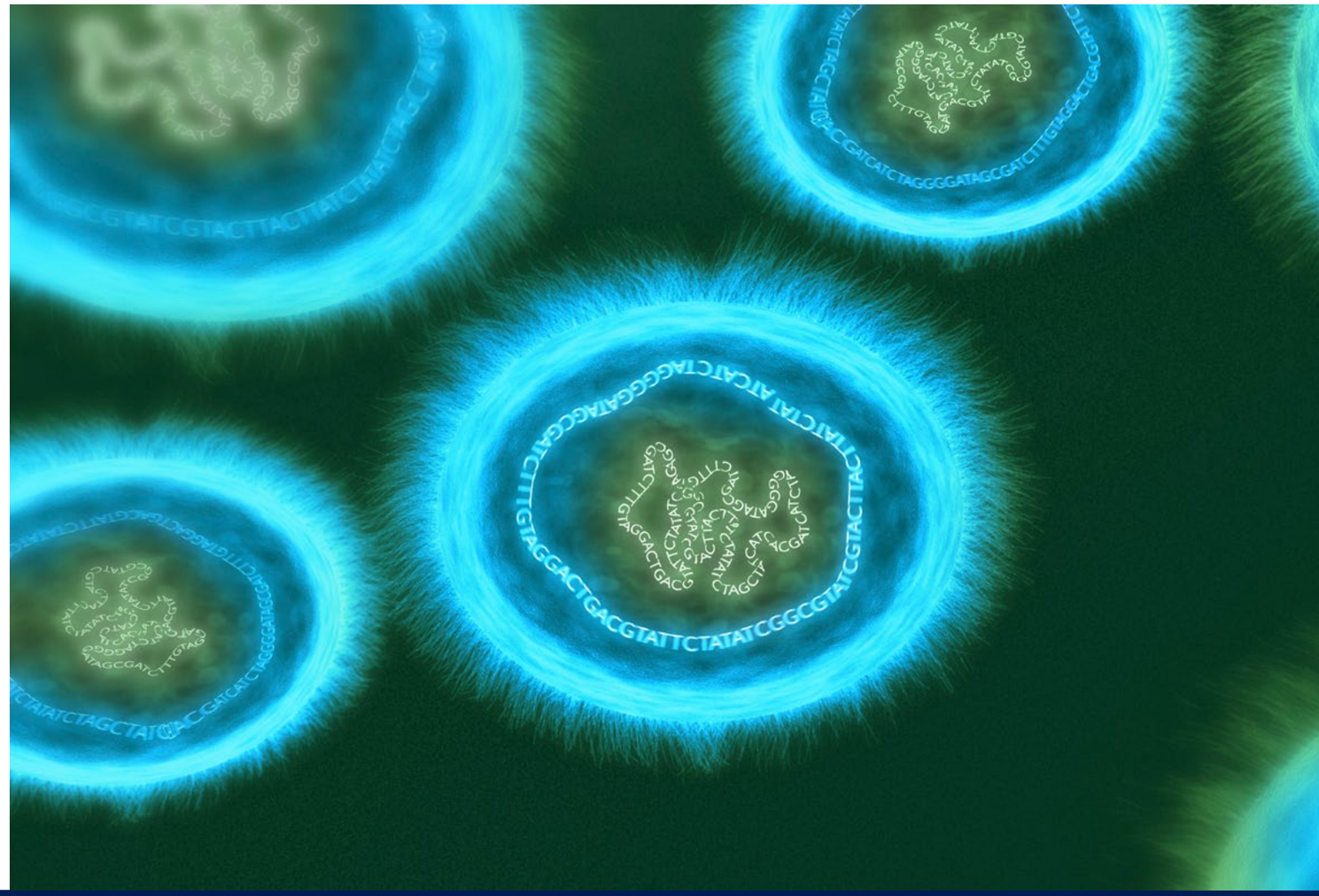
OrganOx's liver perfusion device maintains donor livers at body temperature for up to 24 hours, increasing both the number available for transplant and the transplant success rate.

FULL ARTICLE ▶

Sequencing the bacterial genome

The opportunities for bacterial population genomics that are being realised by the application of next-generation sequencing require novel bioinformatics platforms.

The PubMLST molecular typing databases, powered by the Bacterial Isolate Genome Sequence Database (BIGSDB) are scalable, web-accessible databases that meet these needs. BIGSDB enables phenotype and sequence data, which can range from a single sequence read to whole genome data, to be efficiently linked for a limitless number of bacterial specimens. Previously, it was not possible to analyse whole genomes using the gene-by-gene approach, the pubMLST databases now enable the elucidation of the structure and function of bacteria by means of a population genomics approach.



FULL WEB PROFILE ▶

Innovation in the Social Sciences and Humanities

The Oxford Martin School, a beautiful 19th Century building known for its pioneering research to address global challenges, hosted the March Oxford Innovation Society meeting and dinner.

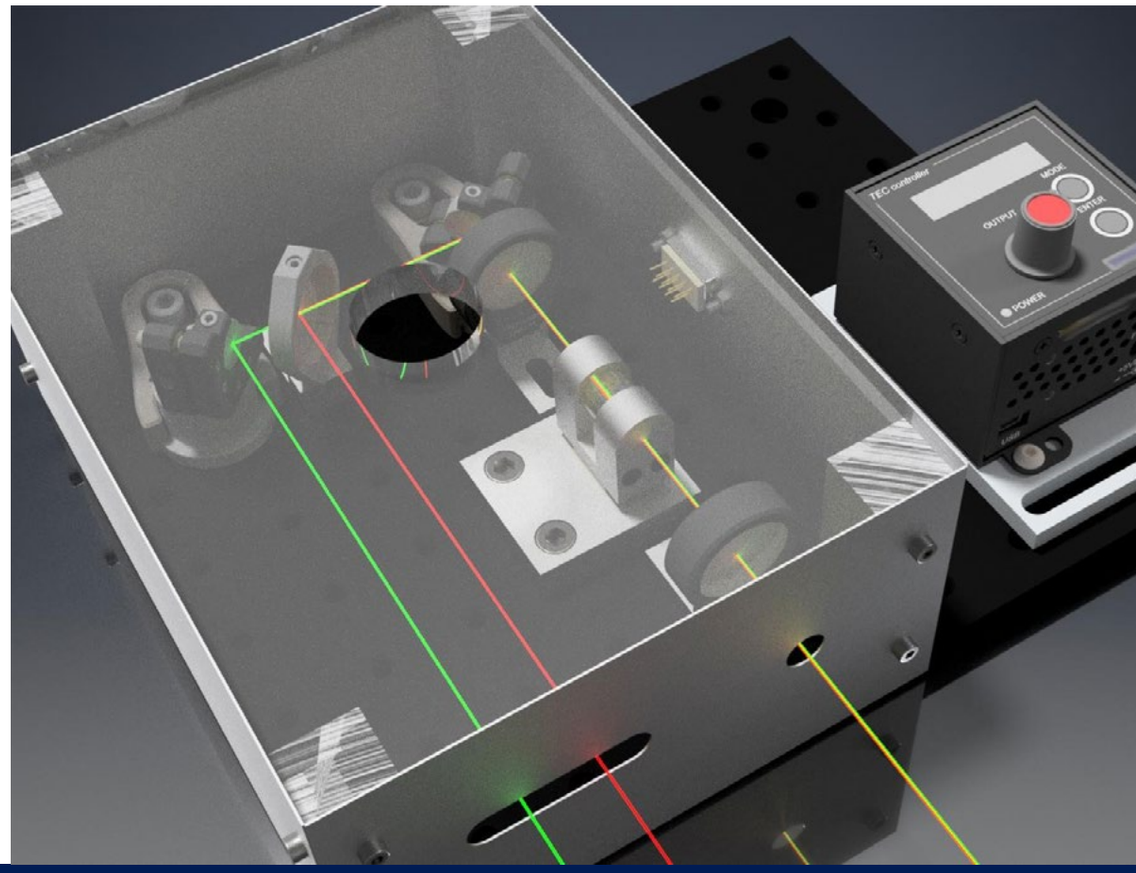
The evening began with a talk from Dr Hannah Maslen, Deputy Director of Uehiro Centre, on speech networks in the cerebral cortex and how to develop rehabilitation solutions using innovative brain-computer interfaces. Dr Mariarosaria Taddeo, Deputy Director of Digital Ethics Lab in the Oxford Internet Institute discussed the digital ethics of cyber conflicts and cybersecurity. Professor Andrew Stephen, Associate Dean of Research & L'Oréal Professor of Marketing, Saïd Business School Oxford highlighted a number of issues marketeers face using digital media channels. Dr David Levy, Director of the Reuters Institute for the Study of Journalism completed the talks with his comparative study of online news consumption.

FURTHER INFORMATION ABOUT THE OIS ▶

Optical quantum memory for on-demand storage

The development of quantum computers is fast-becoming a key focus within the machine-learning, big-data, finance, security and healthcare industry. Their applications are wide-ranging and have capabilities far beyond those of traditional computers. However, quantum memory technology has been difficult to implement, due to storage and retrieval efficiency, low storage bandwidth and the presence of unwanted noise.

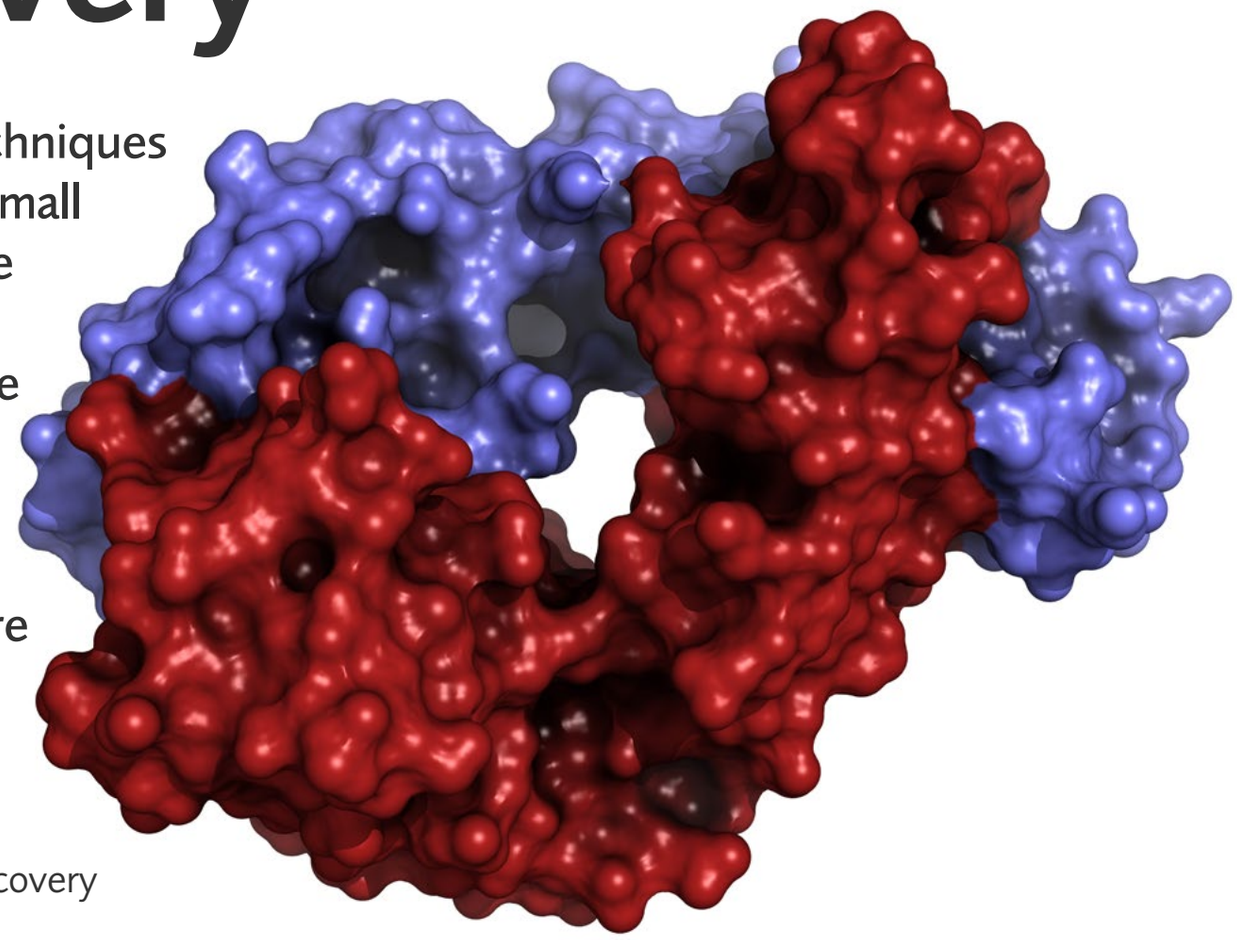
Oxford University academics have overcome this problem and developed an integrated, fibre-based quantum memory, which allows for the on-demand storage and retrieval of broadband (>1GHz) pulses of light. This memory could be used as an enabling component of linear optical quantum computing networks, applications in quantum metrology and computing.



FULL WEB PROFILE ▶

NMR in drug discovery

Whilst "traditional" Nuclear Magnetic Resonance (NMR) techniques can provide a wealth of information about the structure of small proteins (up to 40kDa) and their behaviour in solution, more advanced techniques are required for the analysis of larger macromolecules. As 70-80% of eukaryotic proteins assemble into larger structures, the ability to analyse very large proteins is of critical importance in drug discovery.
The widespread use of modern techniques, such as methyl TROSY, is inhibited by current data analysis methods that are often time consuming, error prone and expensive.



Oxford researchers have developed a method for the robust assignment of methyl TROSY spectra. This innovative technology will allow a powerful but under-utilised technique to find mainstream use for structural biology, drug discovery and agrichemicals.

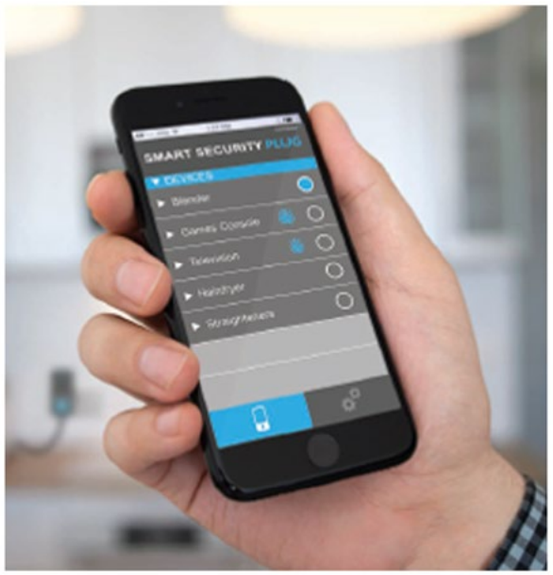
FULL WEB PROFILE ▶

Smart case for mains plugs

Access to electrical appliances in homes, public spaces and commercial sectors can present safety and security risks. There are also financial and lifestyle benefits if usage of electrical devices can be controlled.

SecuriPlug is a lockable case for mains plugs of electronically powered devices. SecuriPlug offers authorised control either locally, for example via a fingerprint scanner, a key, keyfob, or remotely by connecting to smart devices such as mobile phones and tablets.

Local control of the SecuriPlug allows manual override in situations where the user wants to quickly turn on/off a device. Remote access offers other functionality such as setting of timers and monitoring usage.



FULL WEB PROFILE ▶

Public Policy & Leadership workshop

OUI's Consulting Services group recently delivered a widely acclaimed Public Policy and Leadership programme to India's next generation leaders. Supported by the British High Commission, the New Delhi weekend workshops were the output of a successful bid put together by OUI working with consultants drawn from Oxford and beyond.

The programme was designed to:

- develop leadership skills for public policy making;
- learn innovative approaches and tools in public policy making and;
- develop practical skills in effective policy design, implementation and analysis.
- support networking opportunities amongst themselves, the Oxford team, the CRISP and Gurukul Chevening Fellowship alumni http://www.chevening.org/programme/crisp; and http://www.chevening.org/programme/gurukul

The team comprised Richard Briant, Stephen Whitefield and Andrew Gibbons from Oxford, Shruti Kapila from Cambridge, Romy Briant MBE and guest speakers from India. Excellent feedback was received by the attendees and it certainly looks like a very engaging few days as can be seen from the photos taken during the programme.

FURTHER INFORMATION ▶

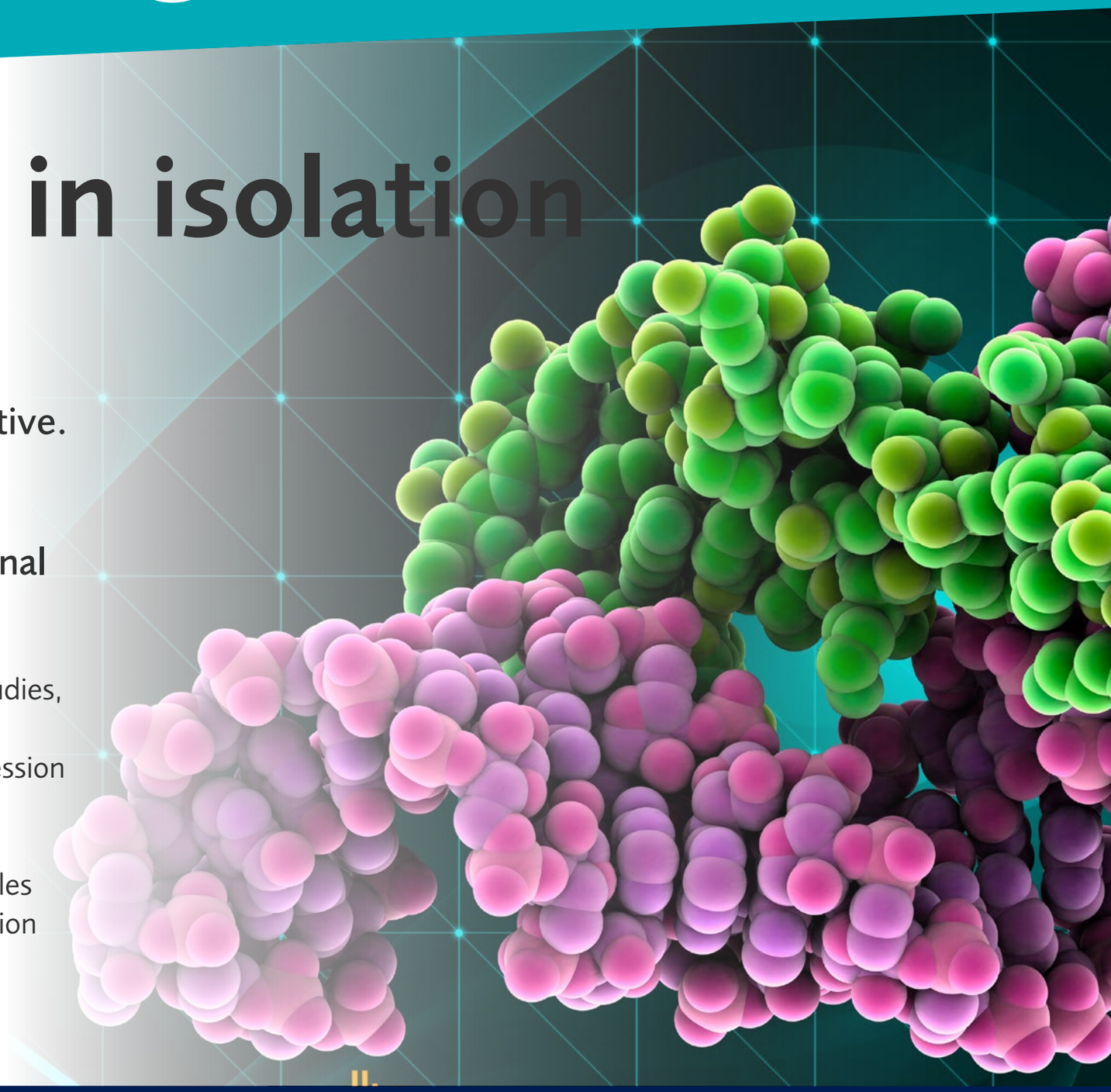
Targeting a solution for IBD

The symptoms of inflammatory bowel disease (IBD) are currently poorly managed by anti-TNFα therapy, with only 60% of patients responding to this 'gold-standard' treatment. Other treatments, such as anti-inflammatory drugs, have associated adverse effects making them undesirable to use. Therefore, there is a need for new therapeutics to treat IBD.

Researchers at Oxford have found that Oncostatin-M (OSM) has a major role in an inflammatory pathway thought to underlie IBD, and so novel drugs to treat IBD may be designed around targeting OSM and its receptor. OSM levels were also found to be indicative of disease allowing a novel method of diagnosis as well as prognosis. Furthermore, a patient's response to anti-TNFα therapy correlated to their levels of OSM and so could serve as a method of determining first line treatment options.

FULL WEB PROFILE ▶

Cluster analysis in isolation



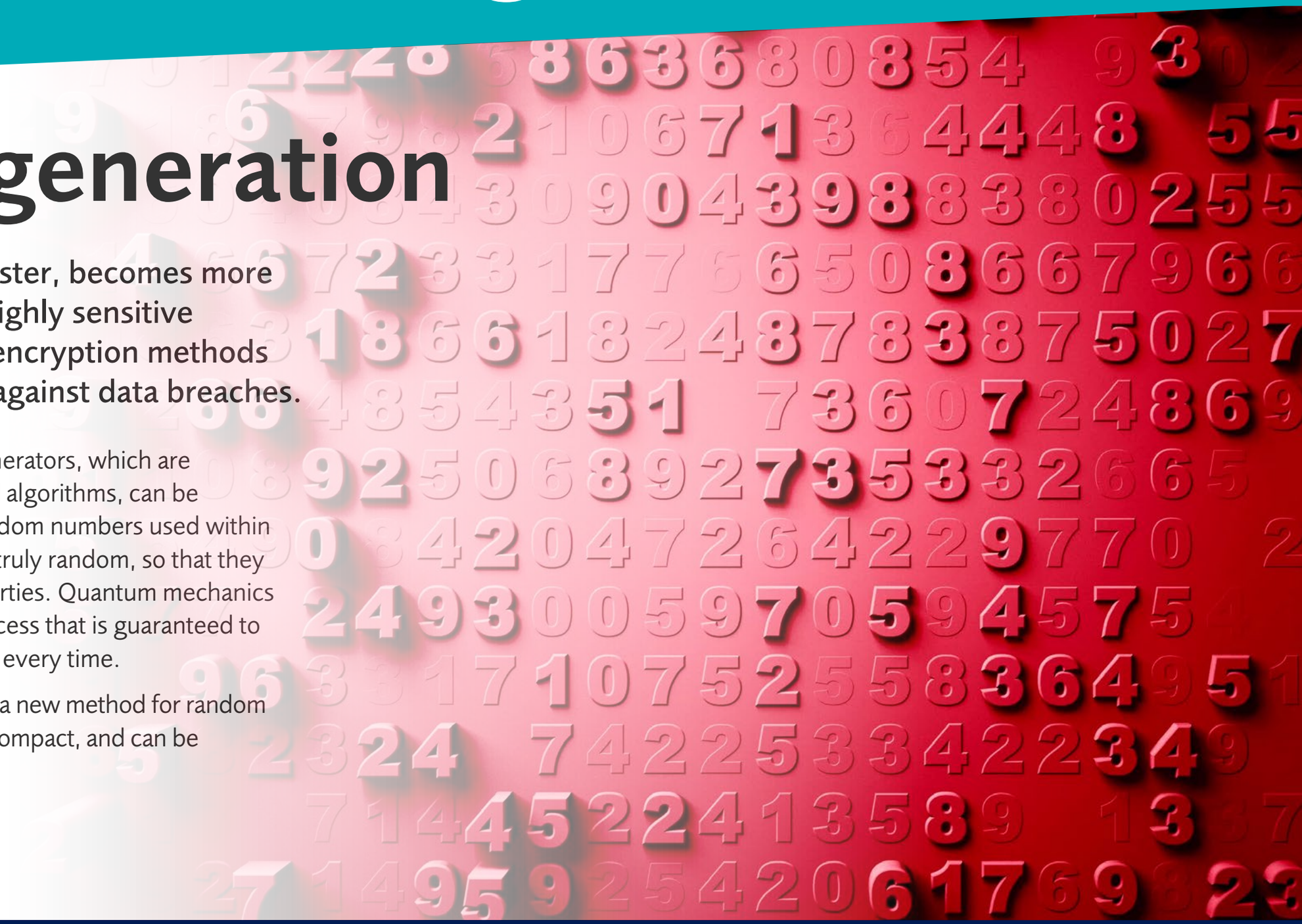
The number of gene expression studies being conducted has risen exponentially with high-throughput techniques becoming more cost-effective. Many datasets generated from these studies are customised to answer specific research questions but could provide useful insights beyond the original purpose.

Cluster analysis segments data, also known as gene expression studies, provides meaningful groups with an understanding of the natural structure of the data. Existing cluster analysis tools, for gene expression datasets, can only process datasets individually.

Oxford University researchers have developed software that enables automated, simultaneous cluster analysis of multiple gene expression datasets, irrespective of their datatype and source organism.

FULL WEB PROFILE ▶

Future generation



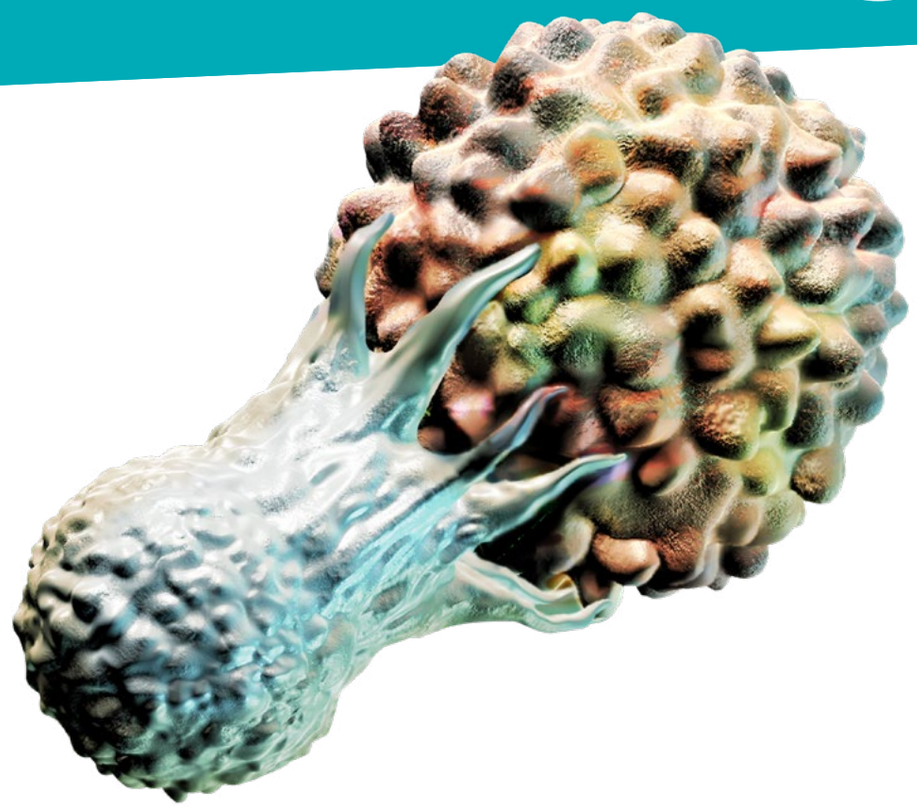
As online data moves faster, becomes more complex and contains highly sensitive information, advanced encryption methods are required to protect against data breaches.

Traditional random number generators, which are implemented in software-based algorithms, can be predictable. It is crucial that random numbers used within computational applications are truly random, so that they cannot be predicted by third parties. Quantum mechanics offers a fundamentally new process that is guaranteed to produce truly random numbers every time.

Oxford academics have created a new method for random number generation that is fast, compact, and can be manufactured at low cost.

FULL WEB PROFILE ▶

Consulting on immunotherapeutic approaches to cancer treatment



Harnessing the body's immune system to destroy cancer cells has been making headlines over the past few years. The FDA approved multiple immunotherapy treatments in 2017 targeting different cancers such as liver cancer, bladder cancer, and leukaemia.

Professor Anton van der Merwe from the Dunn School of Pathology studies the mechanisms by which surface receptors on T-cells and other leukocytes recognise abnormal cells. This is crucial to designing new T-cell therapies which specifically recognise cancer cells, allowing different types of cancer to be targeted, improving efficacy and reducing side-effects. The receptors he studies include existing and potential targets of checkpoint inhibitors, which have already revolutionised cancer care. With the support of OUI Consulting Services, Prof van der Merwe provides advice to companies developing novel immunotherapeutic approaches that manipulate or target cell surface receptors. His research on how these receptors function has provided major insights, which are influencing exciting new developments.

FURTHER INFORMATION ▶

Analysis of sequencing data

The UK Biobank provides researchers with up to 500,000 genotypes, however analysis of this wealth of data can prove difficult.

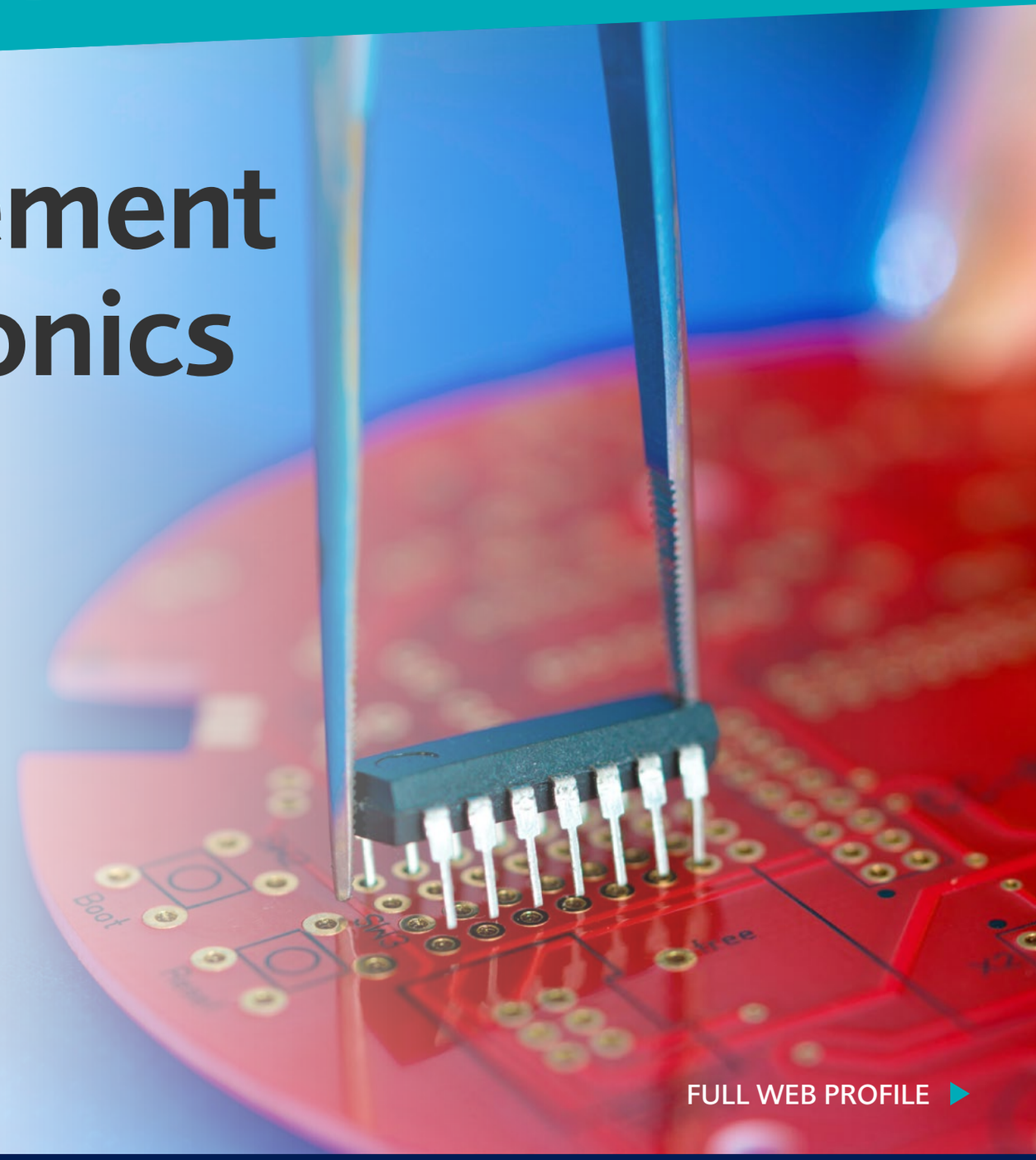
Researchers at the University of Oxford have developed BGENIE, a software tool for analysis of a genome-wide association study, which uses the UK Biobank BGEN file format. BGENIE is the first solution of its kind to work directly with data from the UK Biobank, giving a drastic increase in computational efficiency. This can allow geneticists to better exploit the wealth of data that the UK Biobank provides.

FULL WEB PROFILE

Integrated measurement for quantum electronics

Research & development activities, such as molecular and nano-electronics, rely on non-invasive electronic measurements in their experiments. At present, there is not a modular instrument that can maintain a required readout and control performance across all quantum devices.

Researchers at Oxford University have managed to solve this problem by creating an innovative combination of circuit designs, which can be used for low-noise electronic measurements. The design allows the measurement of all types of quantum electronic devices, which require stability and protection. This technology will be useful for those working on delicate nano-electronic devices; molecular electronics; scanning tunnelling microscopy; advanced biophysics and bioanalysis.



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Advances in silicon solar cells

Silicon electronic devices and other optoelectronic devices, such as solar cells, often have defects on their surfaces and within the bulk material. The defects significantly reduce device stability and efficiency. To reduce the effects of these defects, devices are “passivated" with hydrogen - a process that improves their performance and makes them less reactive by bonding them to hydrogen.

Oxford academics have developed technology that can introduce significant atomic hydrogen to samples by passing hydrogen through a barrier layer. Hydrogen diffuses atomically through the barrier layer and is released in atomic form on the opposite side, which faces the sample. This can be used to passivate the defects both at the surface and in the bulk material. This has multiple advantages over current passivation techniques, and the technology is TRL 3.

FULL WEB PROFILE ▶

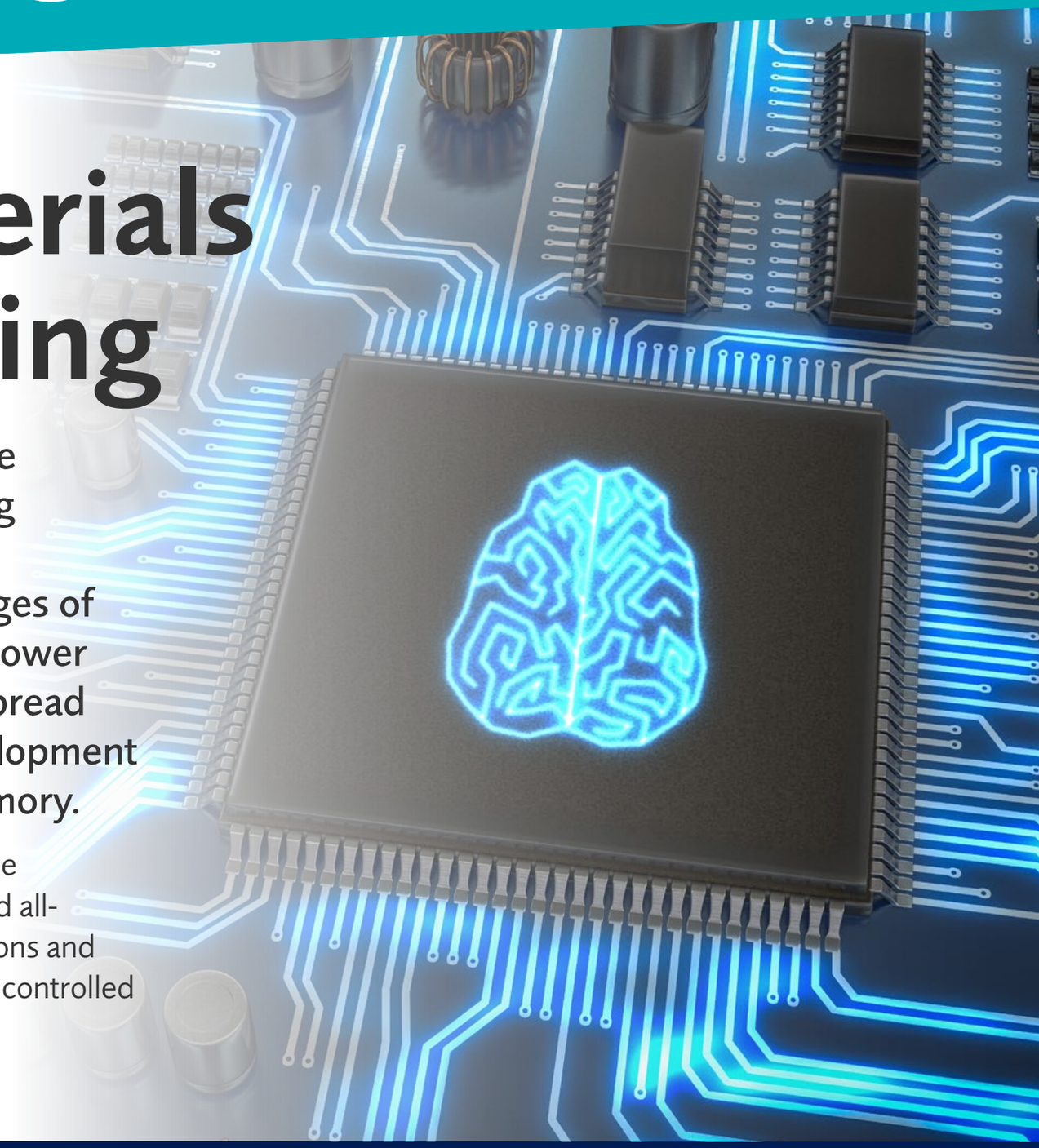
Advanced printing methods

Flexible electronic devices have only been made possible due to the development of printing techniques, capable of depositing conductive materials on a range of substrates. In the world of electronics, there is a drive towards miniaturisation, which means smaller features will need to be printed.

Oxford researchers have developed a solvodynamic printing methodology capable of depositing lines of silver nanoparticles with line widths of only 30μm from a 200μm nozzle. This technique uses a combination of immiscible solvents which may also reduce the terminal nozzle blockages experienced when attempting to print nanoparticles.

FULL WEB PROFILE ▶

Phase change materials for optical computing



New and exciting approaches and architecture designs are transforming the world of computing. Photonic computing represents a solution with a plethora of advantages over traditional semiconductor systems. Amongst the advantages of using all-optical systems are higher transmission speeds, lower energy consumption and systems miniaturisation. Widespread implementation of photonic computing requires the development of efficient optical transistors and non-volatile optical memory.

Researchers from the University of Oxford, the University of Münster and the Karlsruhe Institute of Technology have developed micro-optical switches and all-photonic memory based on phase change materials for optical communications and computing. The microscale tuneable switches can be electrically or optically controlled showing ultrafast switching times and low energy consumption.

FULL WEB PROFILE ▶

Simplified joint alignment

Knee replacements are a routine procedure, which help to relieve the pain caused by osteoporosis, osteoarthritis and other joint diseases. Around 80,000 knee replacements are carried out in the UK every year with the number set to grow as the population ages. The quality of outcome is highly dependent on how the new knee is aligned to distribute the strain. Current methods for aligning the implant during surgery are complex and can be difficult to reproduce.

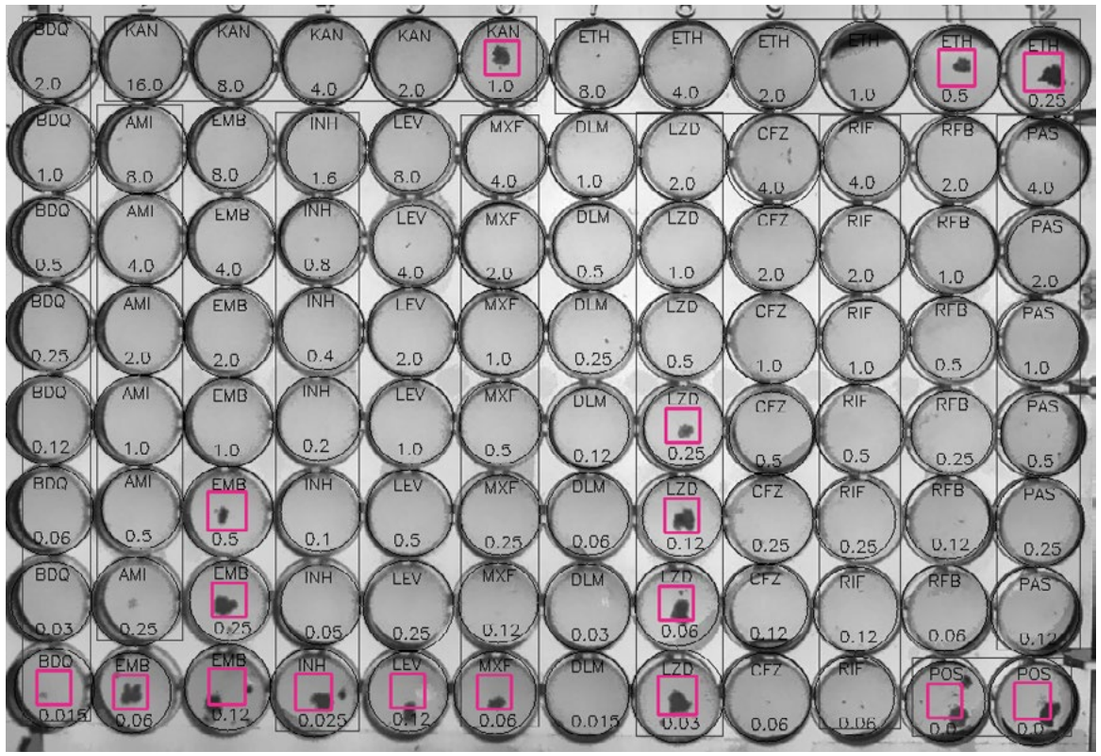
Oxford researchers have developed a surgical tool capable of accurately and reproducibly aligning the joint during surgery, resulting in better surgical outcomes.

FULL WEB PROFILE ▶

Bacterial growth detection using digital images

The development of multi-drug resistant (MDR) bacteria is currently one of the most pressing issues in modern human and animal health. This has led to the development of rapid microbiological detection techniques to improve antibiotic susceptibility testing and optimise patient care.

Oxford scientists have developed software to read digital images of microbial growth under different antibiotic conditions. Microbiologists will be able to perform fast and reliable measurements to determine which antibiotic would be most effective for each individual case.



FULL WEB PROFILE ▶

Electrocatalyst with wide range of applications

The transition metal complex, $Ru(bpy)_3^{2+}$, is deployed in electrocatalyst and electrochemiluminescence applications due to its robust nature and ability to form excited states, which emit light during relaxation.

Researchers at the University of Oxford have developed a synthesis route to $Ru(bpy)_3^{2+}$ doped Nafion® nanostructures, which overcome several drawbacks of solution phase $Ru(bpy)_3^{2+}$.

The Nafion® support is chemically inert and allows for facile catalyst recovery without compromising reactivity. These nano particles are suitable for a wide range of applications from electrochemical sensors to biological imaging due to the range of cations that can be selected.

FULL WEB PROFILE ▶

Oxford's vaccine legacy continues to grow

Adam Stoten, Chief Operating Officer, Oxford University Innovation

Oxford University's long history of world-leading vaccine research has recently given rise to two of the most exciting companies in vaccine development. OUI's Adam Stoten explains.

The introduction of vaccines in the last 100 years has transformed how we tackle many of the world's most serious and life-threatening diseases. They have saved countless millions of lives while generating profound economic impact. A recent economic analysis of 10 vaccines used in low/middle-income countries estimated that an investment of $34 billion to provide the immunisations resulted in savings of $586 billion in reducing the costs of illness and $1.53 trillion including broader economic benefits [(1)].

While many infectious diseases are now prevented by safe and effective vaccines, a significant number, such as malaria, tuberculosis and Middle Eastern Respiratory Distress Syndrome (MERS), still present major healthcare challenges.

CONTINUED ▶

Oxford University has long been at the forefront of novel vaccine technologies, underscored in 2005 with the creation of the Jenner Institute, bearing the name of Edward Jenner – the Gloucestershire physician and "father of vaccinology". The Jenner Institute combined the vaccine research and development activities of Oxford University and The Pirbright Institute (for Animal Health), and uniquely it focuses both on diseases of humans and livestock. A major theme is translational research involving the rapid early-stage development and assessment of new vaccines in clinical trials.

This translational focus has resulted in a close collaborative relationship between Jenner investigators and OUI, working together to assess and protect the intellectual property associated with new vaccine technologies, and to find either existing companies to partner in their future development and commercialisation, or increasingly working with external investors to spin out new vaccine-focussed companies.

Vaccitech

Leading the charge in terms of recent vaccine spinouts is Vaccitech, founded by Jenner investigators Profs Adrian Hill and Sarah Gilbert (pictured right), and led by vaccine industry veteran Dr Tom Evans. Vaccitech's mission is to develop one of vaccinology's holy grails; a universal influenza vaccine. A universal 'flu vaccine elicits a protective immune response to the internal antigens which remain conserved across different strains of the virus. This would have the major benefit of removing the need to guess the prevalent strain ahead of each winter 'flu season, and then having to manufacture that year's vaccine based on this prediction – which is not always right.

CONTINUED ▶

Vaccitech is in the midst of a large Phase II clinical trial which is testing its universal 'flu vaccine in conjunction with the normal seasonal vaccine in people over 65 years old. Results are expected in the next 18 months and if positive could set the scene for a major change in how we protect against influenza.

Vaccitech is also using its technology platform of replication-deficient viral vectors to support a second clinical phase candidate; this time a vaccine against antigens associated with prostate cancer, which would be used to treat, rather than prevent, the condition. Earlier stage programmes are addressing Hepatitis B and Human Papilloma Virus and the emerging pathogen MERS.

Established in 2016 with £10m investment, Vaccitech has proceeded to raise a further £20m from investors including Oxford Sciences Innovation (OSI), GV and Sequoia China.

SpyBiotech

Taking a different approach is another recent Jenner vaccine spinout – SpyBiotech. The company was established with £4m seed funding, also from OSI and GV, in 2017 and was founded by a multidisciplinary team including CEO Sumi Biswas, an Associate Professor in the Jenner Institute, her Jenner colleagues Prof Simon Draper and Dr Jing Jin, and Mark Howarth, a Professor in the University's Biochemistry department.

CONTINUED ▶

INNOVATION insights

FEATURED ARTICLE

SpyBiotech is developing vaccines using virus-like particles (VLPs), which look like a virus on the outside but do not contain any viral genetic material, so they cannot cause disease. Uniquely, SpyBiotech has licensed from OUI IP for "protein superglue", which enables the company to rapidly develop new vaccine candidates by decorating the outer coat of the VLP with disease specific antigens, a process which has historically been slow, challenging and sometimes impossible. SpyBiotech is not yet in clinical trials with its vaccine candidates but its platform technology is applicable to a wide range of infectious diseases (viral, bacterial, parasitic) and potentially to cancer.

Vaccitech and SpyBiotech are just two examples of the pipeline of new vaccines and related technologies emerging from Oxford's research, and OUI would be keen to explore partnering opportunities for current licensing opportunities including Dengue Fever, Malaria and Meningitis vaccines, novel adjuvants and innovative vector-related technologies.

Refs: (1) Ozawa S, et al. (2016) Return on investment from childhood immunization in low- and middle-income countries, 2011-20. Health Aff (Millwood) 35:199–207

Further information on Vaccitech ▶

Further information on SpyBiotech ▶

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Interested in collaborations in medical sciences?

The Business Development Team for the Medical Sciences Division works with scientists and companies to facilitate collaborative research projects and strategic partnerships.

Access our expertise and Oxford's research excellence – www.medsci.ox.ac.uk/business-development

THERAPEUTICS, SMALL MOLECULES AND BIOLOGICS

TECHNOLOGY SHOWCASE | OXFORD 2018

Wednesday 13th June 2018, 12.00pm - 18.30pm
Saïd Business School, Park End Street, Oxford OX1 1HP

Therapeutics, Small Molecules and Biologics, the 2018 Technology Showcase from NIHR Oxford Biomedical Research Centre, Oxford University Innovation and Oxford AHSN, will highlight the most exciting commercial opportunities and projects in this field.

Click here for the programme ▶

Click here to register ▶

INNOVATION insights

OXFORD INNOVATION SOCIETY 2018

The Oxford Innovation Society (OIS) is an open innovation network for industry, academia, and investors. Upcoming meetings will be held on:

- Thursday 21 June
- Thursday 27 September

Meetings are held in Oxford for OIS members and invited guests, and are followed by a formal reception and dinner.

Details on www.innovation.ox.ac.uk/ois

INNOVATION insights

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