INNOVATION insights

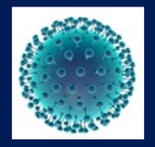
THE LATEST INNOVATIONS, COLLABORATIONS AND TECHNOLOGY TRANSFER
FROM THE UNIVERSITY OF OXFORD

ISSUE 12 JUNE 2019

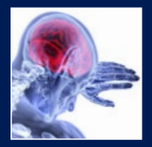
MENTORING OXFORD ENTREPRENEURS

Oxford University and Vodafone, helping the bright sparks of Oxford.

Enhanced nanoscale communication ▶



Zika viral vector vaccine ▶



Protection against blast-induced traumatic brain injury ▶

Electrodynamic Micro-Manipulator ▶

OXFORD UNIVERSITY INNOVATION

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INNOVATION insights

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Successful collaboration

From academic inspiration to societal impact and value

It's great news that Nightstar Therapeutics, a 2013 spinout using gene therapy to save the sight of individuals suffering from rare eye diseases, has been acquired for $877m. With the resources of US biotech company Biogen behind it, Nightstar's products will reach the market more quickly and change lives for the better. It's quite remarkable that Nightstar has progressed from spinout to exit in just six years, at a valuation that makes it Oxford's largest exit to date.

Nightstar's success was only possible as a result of clinicians and academic researchers working closely together. We're now seeing something similar happening in a different field – Artificial Intelligence (AI). Dialogue between industry, wider society and academia is critical to ensure that the benefits of AI make a positive impact in society, within a considered and accepted ethical framework. Oxford is hosting a major conference in September bringing together all the different interest groups, with different streams exploring Technology and Applications of AI, AI in Healthcare, and AI in Society. More details can be found at https://ouinnov.co/aioxford.

Enjoy reading news of the latest innovations from Oxford in this edition of Innovation Insights. If there are any topics you would like to hear more about in future editions of Innovation Insights, please do get in touch via the contact details included in this edition.

News

Nightstar acquisition featured in latest OUI Quarterly Update

The clinical-stage gene therapy company Nightstar Therapeutics became one of the UK's largest ever biotech exits, sold to Biogen for $877m.

FULL ARTICLE ▶

OUI gets gold for being green

Phil Priest, OUI Facilities and Health & Safety Officer, was on hand to collect three awards on behalf of OUI's continued commitment to become more sustainable and help reduce the University's environmental impact.

FULL ARTICLE ▶

Venture capital firm invests in Oxford spinout

Samsung Ventures led a £3m investment round allowing Oxford Semantic Technologies to scale its business turning organisations' data into machine-readable knowledge.

FULL ARTICLE ▶

And the GUV 2019 Personality of the Year award goes to…

Dr Mark Mann, humanities and social sciences lead, for his role in developing OUI's social enterprise programme and implementing it across the University.

FULL ARTICLE ▶

Sustainable water supplies for rural communities

Oxford University has launched its latest crowdfunding campaign to provide reliable drinking water in Africa.

FULL ARTICLE ▶

A new home for Oxford Humanities

A new humanities centre, including an Institute for the Ethics of AI and designed to encourage cross-disciplinary and collaborative study, will be created thanks to the largest philanthropic donation to Oxford - £150m - in modern times.

FULL ARTICLE ▶

Sickle cell screening during pregnancy

Prenatal diagnosis is used to identify genetic disorders, usually for couples who are at risk of having a child affected by a severe disorder, such as sickle-cell anaemia. Researchers at Oxford have developed a simple non-invasive prenatal diagnostic technique that can screen for sickle-cell disease.

Current methods of foetal testing are invasive, such as amniocentesis, and carry a risk of miscarriage. The new technique measures the frequency of the mutated allele, compared to that expected from the maternal DNA and could have wide applications in prenatal diagnostics.

FULL WEB PROFILE ▶

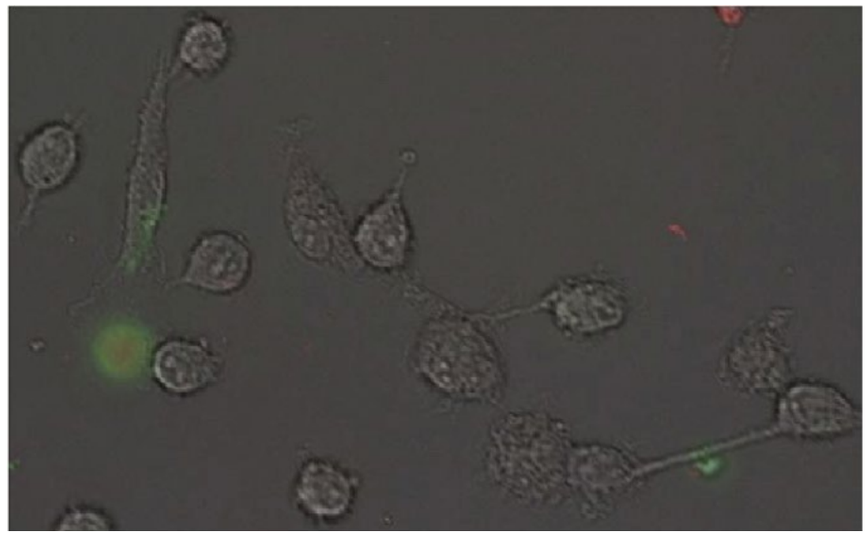
Biosensors for bacterial detection

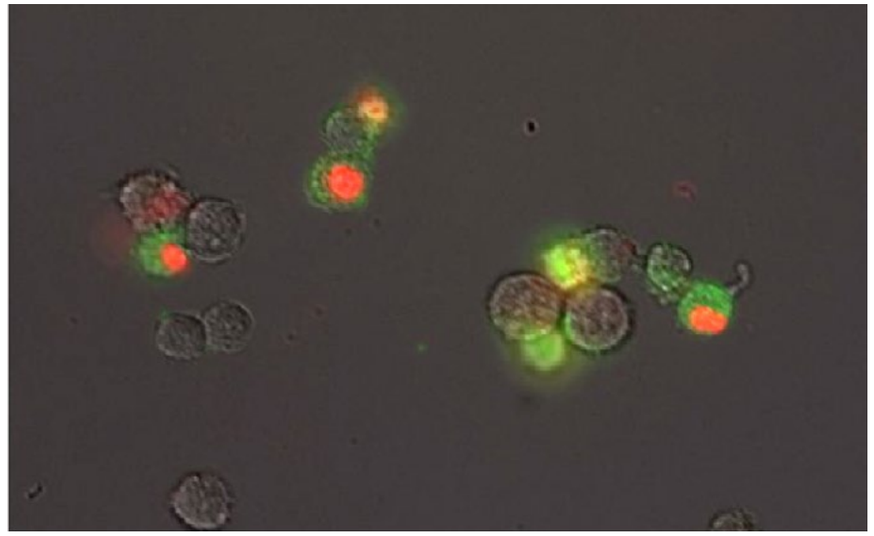
Contamination detection is of paramount importance in both the food industry, environmental monitoring and wastewater treatment. Such detection would ideally be performed using imaging systems. However, this is difficult in practice. Imaging systems have not been successfully used to detect bacterial contamination caused by food residues on surfaces, and sensors used in wastewater treatment rely upon immersion.

This means that such sensors cannot provide desirable continuous monitoring. Oxford researchers have developed a novel sensing solution providing high sensitivity for detection of bacteria on surfaces and removing the requirement for immersion in wastewater monitoring.

FULL WEB PROFILE ▶

New treatment in chronic lymphocytic leukaemia





Forodesine is a drug that has been used in clinical trials to treat patients with chronic lymphocytic leukaemia (CLL) but has shown limited efficacy in humans despite promising in-vitro studies.

Scientists at the University of Oxford have demonstrated greater efficacy of the drug in patients with CLL that have a specific genetic mutation compared to those who do not. It is expected that CLL patients with this mutation will have a higher response rate to the drug which will ultimately improve treatment efficacy and increase life expectancy.

FULL WEB PROFILE ▶

Enhanced nanoscale communication

Molecular communication is a system seen across the natural world, which uses molecules to exchange information from one entity to another. Working at the nanoscale, it allows signalling processes to be achieved in compact designs and can interface different nanoscale components in lab-on-chip devices. These have numerous applications in the fields of drug assessment, chemical sensing and plant science.

Current molecular communication uses diffusion and diffusion-plus-drift processes, which do not require chemical reactions or biological processes. Exploiting diffusion makes these techniques very simple, but also slow, which limits the achievable rate of information transfer. By combining diffusion and fluid flow, the information rate can be increased but flow is limited by the mechanical nature of the system.

Oxford University academics have developed a novel technique which achieves molecular drift in a static fluid medium by using electric fields along with natural surface charge distributions present in potential information carrying molecules. This facilitates faster communications, along with bi-directional information exchange.

FULL WEB PROFILE ▶

Li-Fi supporting data transfer

Oxford academics have developed a portfolio of technologies that use visible light for wireless communication by using light from LEDs, which are rapidly replacing conventional lighting in both workplaces and homes.

By 2019 it is predicted that there will be 11.5 billion mobile connected devices in the world, and total mobile data traffic is expected to increase by 8 times between 2016 and 2022. High concentrations of devices using the radio frequency spectrum will generate so much interference that service quality will be dramatically degraded.

A key part of the solution to this so called "spectrum crunch" is to exploit new parts of the electromagnetic spectrum to support mobile wireless communications. LEDs can be modulated at relatively high frequencies, allowing them to support wireless communication using existing infrastructure.

FULL WEB PROFILE

Protection against blast-induced traumatic brain injury

If an individual is subjected to an explosion, this can result in a traumatic brain injury from the blast waves. Blast panels are usually present in shields, walls or helmets, e.g. for military use, to protect the wearer against injury from explosions.

When a conventional blast panel is used in a helmet, in order to help prevent the wearer of the helmet from sustaining a traumatic brain injury, such blast panels aim to reflect or attenuate the shockwave incident from explosions. These conventional helmets containing blast panels often involve a unique material or a sandwich panel.

The team at Oxford has developed a new concept whereby the material properties of the panel are gradually modified to alter the shock front, potentially attenuating the effect of the blast on the brain behind a helmet for example.

FULL WEB PROFILE ▶

Innovative motion sickness solution developed at Oxford

We all spend a lot of time travelling each day. A considerable part of the population is affected by travel sickness during journeys, and as such cannot use their electronic devices without feeling adverse effects such as nausea, fatigue or headaches.

Although some drug-based options are commercialised to avoid this condition, they are costly, their side effects make them unappealing and they don't work for everyone.

Researchers at the University of Oxford have developed a new algorithm which obtains real-time movement data from vehicles and reduces the effects of travel sickness by moving content on the screen accordingly. This can easily be implemented into software on most commonly used devices and can be customised to suit both the individual and the type of travel.

FULL WEB PROFILE ▶

Body motion monitoring in MRI and CT imaging

Magnetic resonance imaging (MRI) and computerised tomography (CT) scanners are medical devices that produce highly detailed images of human and animal anatomy. Stable and high-resolution MRI and CT images with minimum artefacts are obtained if body motion is adequately monitored.

To date, monitoring of body motion due to breathing is achieved with respiratory balloons, however, limitations such as calibration and the need for repressurisation make this a non-optimal technique. Piezoelectric sensors would be preferred for such monitoring if it wasn't for the presence of metallic films in their structure, which degrade the images produced by both scanning techniques.

Researchers at the University of Oxford have developed a novel graphene-based piezoelectric sensor that is compatible with both MRI and CT imaging. Main advantages include radiolucency and minimal distortion to the magnetic field. The technology opens new opportunities for graphene-based systems in MRI and CT sensing and diagnostics.

FULL WEB PROFILE ▶

Early gestational diabetes diagnostic

Gestational diabetes occurs when a woman becomes resistant to the effects of insulin during pregnancy and isn't able to make enough to overcome the resistance. It usually becomes evident in the second or third trimester. Gestational diabetes can cause complications for both mother and baby during and after birth.

These include the baby growing larger than usual, which may lead to difficulties during the delivery and increases the likelihood of needing induced labour or a caesarean section, and increased risk of premature birth and stillbirth. However, the risk of complications can be reduced if the disease is detected early enough and well managed.

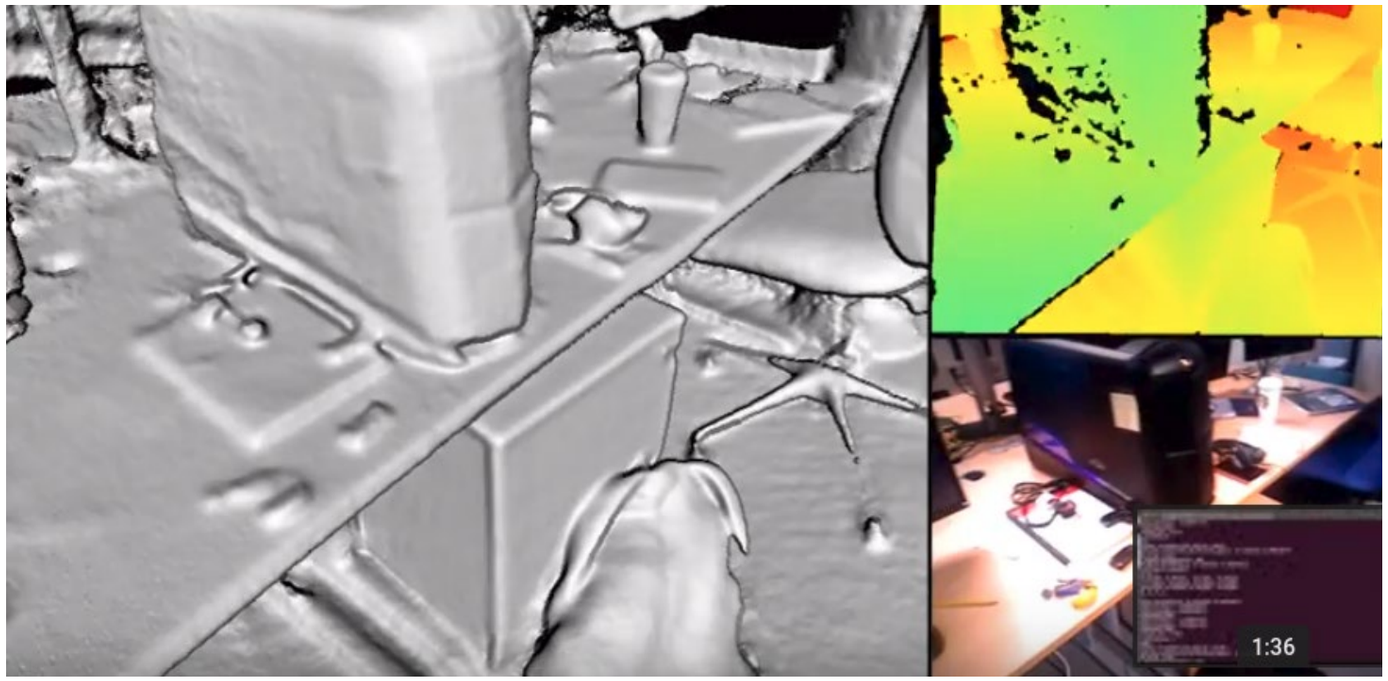
Scientists at the University of Oxford have developed a test where circulating biomarkers from the placenta give an early indication of mothers who either are already presenting with gestational diabetes or are highly likely to develop the disease. Early diagnosis is key to managing the condition well and reducing complications arising from the disease.

FULL WEB PROFILE ▶

Accurate camera relocalisation

In the field of computer vision for robotics systems, camera pose relocalisation is one of the most important requirements for simultaneous localisation and mapping (SLAM), virtual and augmented reality (VR/AR) and navigation.

Tracking camera poses or localisation is generally reliable, but from time to time the tracking can be lost and the camera pose can become unknown. It is important to be able to "relocalise" the camera with respect to the map that has been built, rather than start the reconstruction again from the beginning. Camera pose relocalisation is also the key to reuse a pre-built 3D map by aligning current live frames with the map. In VR/AR applications, it enables multiple users to collaborate or share information with each other while exploring the same 3D environment.

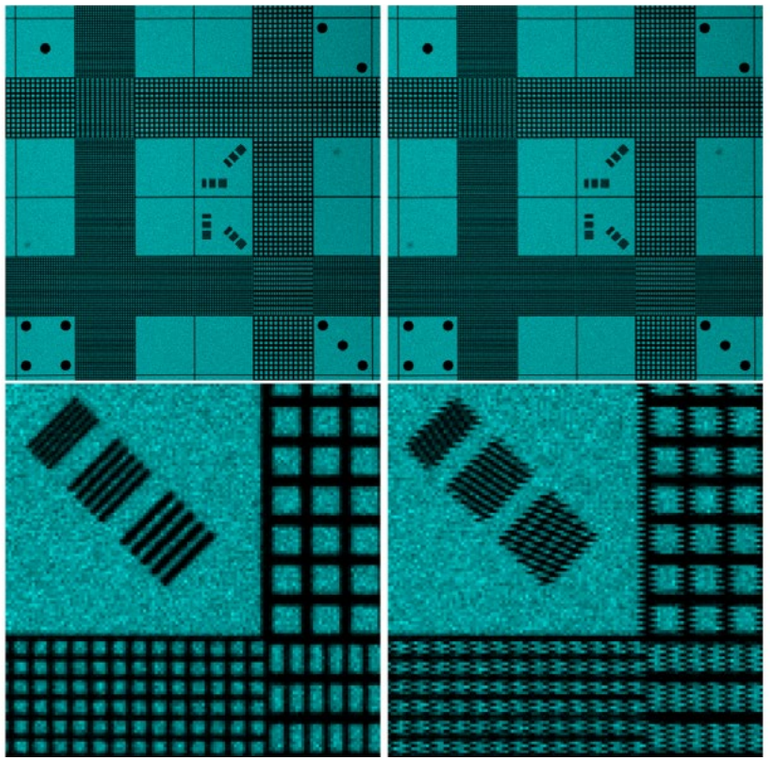


Researchers at Oxford have developed an algorithm that uses a single RGB-D frame as an input to estimate the respective 6-D camera pose relative to a map built beforehand, which can be used with a SLAM or VR/AR system.

FULL WEB PROFILE ▶

Correcting imaging artefacts due to bidirectional scanning

Current image processing acquisition techniques enable not only visualisation of dynamic processes, but the possibility of carrying out quantitative analysis. However, with present-day methods, when an image is acquired, scanning speed variations take place, causing jaggedness artefacts.



This, added to naturally occurring artefacts, significantly reduces the ability to obtain high-resolution images. Based on this issue, researchers at the University of Oxford have developed an image processing technique which enables fast reconstruction of high-resolution images.

One type of image affected by these movement-derived artefacts is acquired by a laser scanning microscope (LSM) and this application has been used to validate the technology. As a result, the image processing system has been able to correct dynamic biological samples images independently from the microscope's settings.

FULL WEB PROFILE ▶

A new method to produce organic compounds

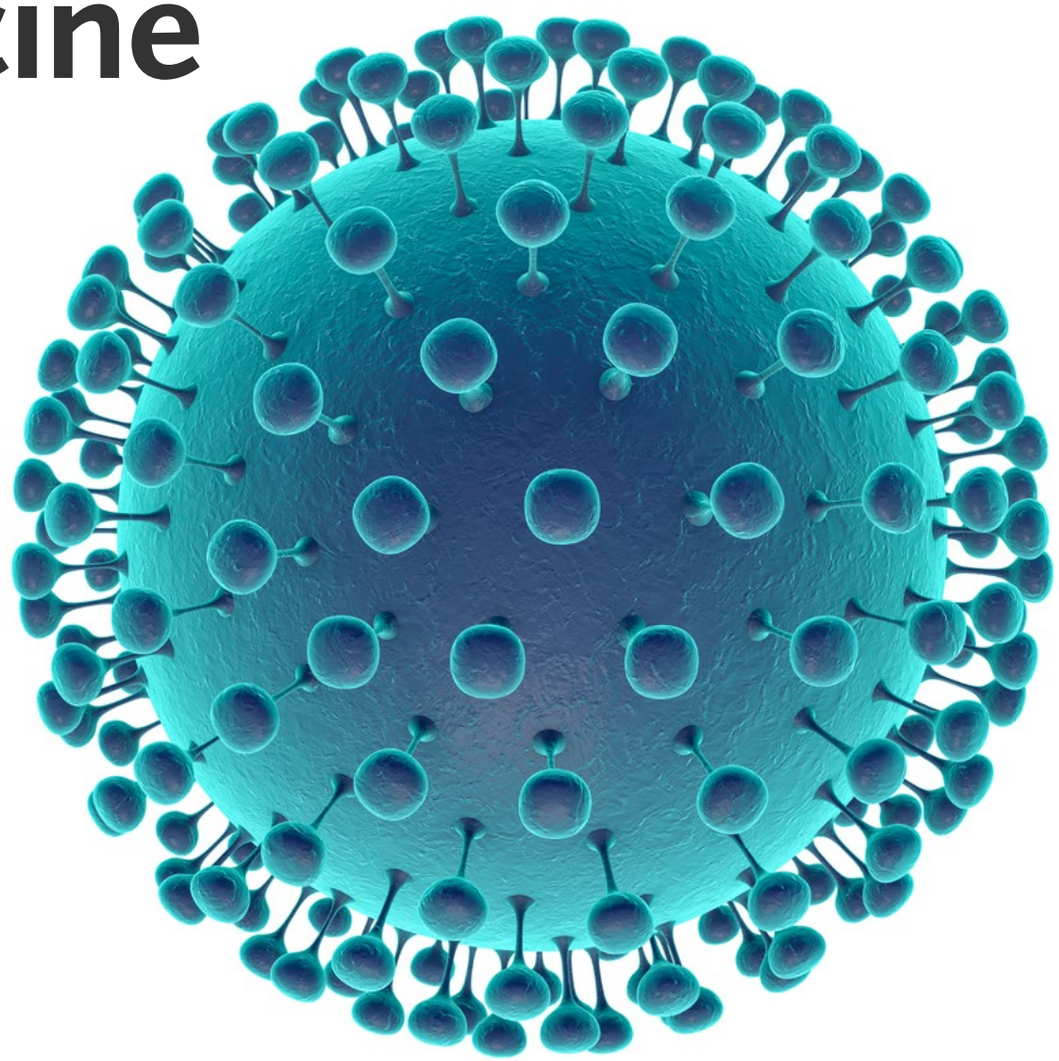
Linear alpha-olefins are an important class of organic compounds as they are key precursors in the generation of several fuels, petrochemicals and fine chemicals. Consequently, the field of alpha-olefins represents an essential market that is in constant demand in the energy formation sector.

Traditionally, linear alpha-olefins are synthesised by two main routes: ethylene oligomerisation and Fischer-Tropsch Synthesis (FTS). However, ethylene is an expensive industrial raw material, and additional emission processes and energy costs are usually associated with the formation of conversional FTS catalysts.

Researchers at Oxford have tackled this issue and developed a novel and more sustainable method for the preparation of such catalysts. The new catalytic system allows for high conversions of CO_2 and/or CO and H_2 into desired olefins.

FULL WEB PROFILE ▶

Zika viral vector vaccine



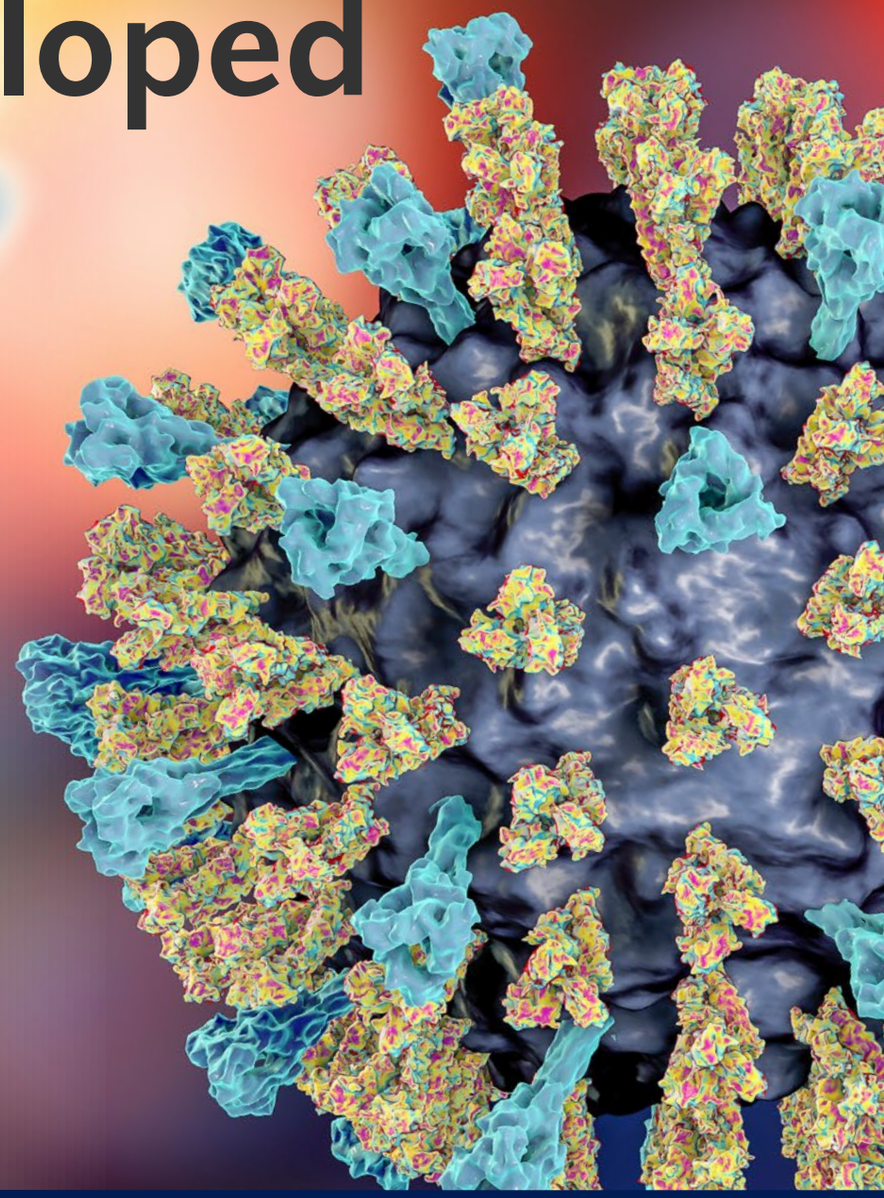
The Zika virus (ZIKV) outbreak in South America escalated into a global health crisis, mainly due to an association found between ZIKV infection and neurologic diseases in developing foetuses, such as microcephaly and Guillain-Barre syndrome; as well as with the ability of ZIKV to be passed by sexual transmission.

The virus has now spread to more than 45 countries, 25 of which reported severe ZIKV-associated disease. As a result, there is an urgent need to prevent men and importantly women both before and during pregnancy from being infected by ZIKV.

Oxford researchers have developed a Zika viral-vectored vaccine carrying a sequence encoding a Zika structural antigen. The sequence is a consensus derived from the bioinformatic analysis of the African and Asian lineages of the virus. A patent has been filed for the technology.

FULL WEB PROFILE ▶

Rapid detection of developed viruses and lipid-coated nanoparticles

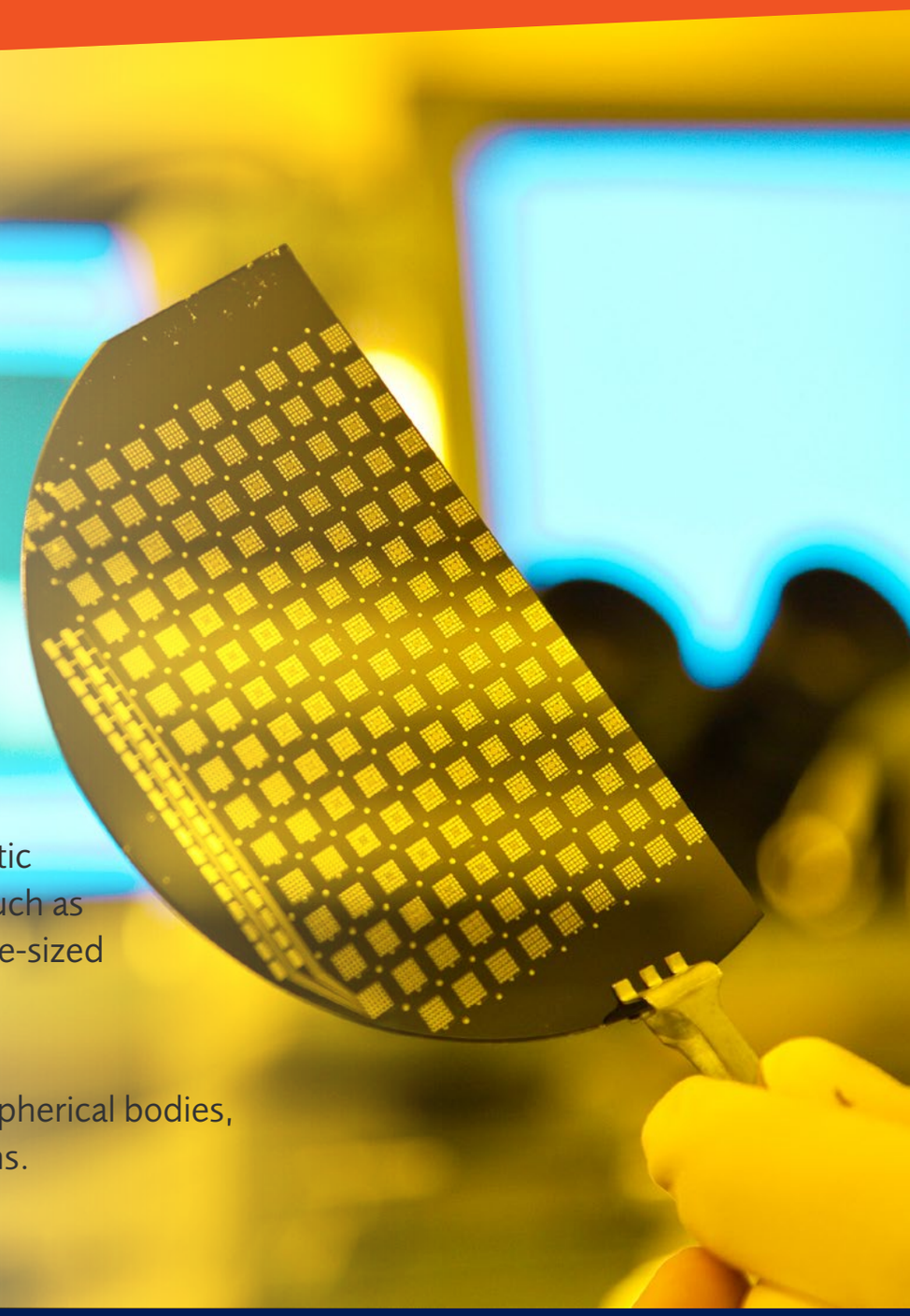


Traditional approaches for virus detection and quantification such as cell culture and antigen-based tests are often limited by long waiting times or limited sensitivity and specificity. Oxford University researchers have invented a novel, rapid, approach for labelling lipid-coated nanoparticles, such as enveloped viruses, exosomes or synthetic lipid vesicles.

This method uses calcium ions to mediate an interaction between the surface of the lipid particle and DNA. The DNA can be modified with fluorophores for rapid optical detection of the particles or can include a functionalised group for particle pull-down using affinity purification.

FULL WEB PROFILE ▶

Electrodynamic Micro-Manipulator



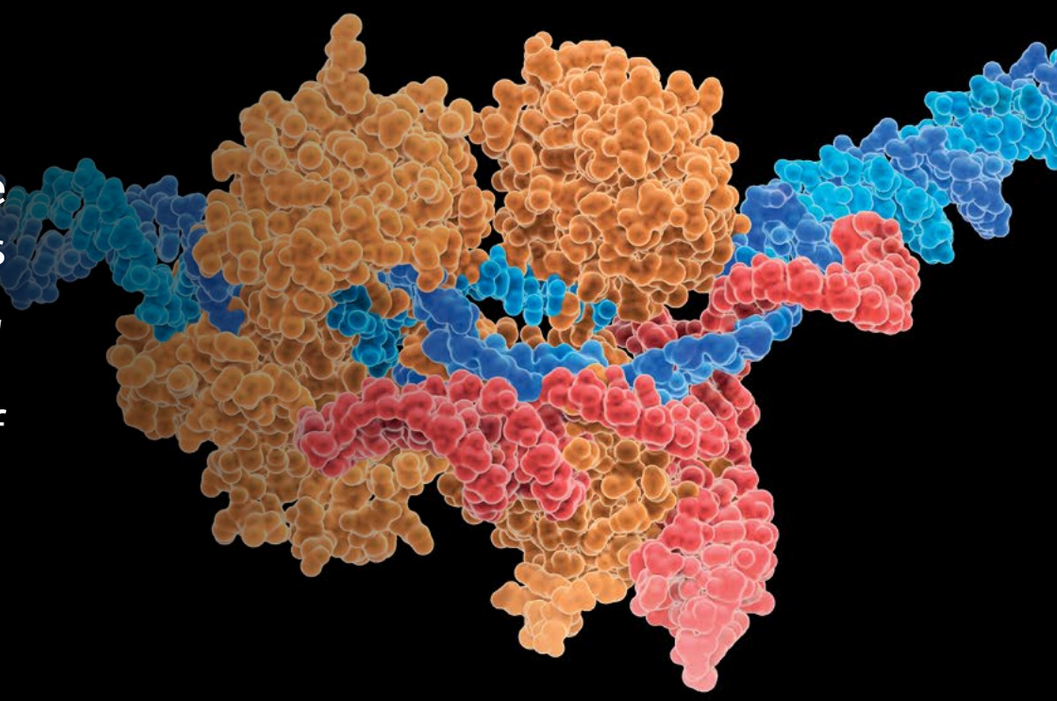
The handling of non-spherical micron-sized objects is a challenge for the manufacturing industry and for the wider exploitation of nanomaterials. Current manipulation techniques consist of pick-and-place machines used to place microelectronic components onto circuit boards, and optical methods that use laser radiation to manipulate objects.

Pick-and-place methods are unsuitable for objects smaller than 100 microns because electrostatic and Van der Waals attraction prevents their release. This is particularly true of planar objects, such as 2D nanomaterials, which possess a large surface area. Optical methods work well for nanometre-sized objects but scale poorly to larger object sizes because of the increasing optical power required, which causes heating.

Oxford researchers have developed a novel and robust approach for the manipulation of non-spherical bodies, in which an electrical field levitates, aligns and orients the object, under air or vacuum conditions.

FULL WEB PROFILE ▶

Logical control of CRISPR gene editing system



The recent development of gene editing using biological system CRISPR, creates the prospect of dramatic developments in medicine for gene repair and cancer therapy. The CRISPR/Cas9 system allows targeted DNA cleavage and hence editing of the genome. However, unwanted DNA cuts, resulting from non-specific delivery to off-target cells, could promote tumorigenesis. Cell-specific activation of CRISPR/Cas9 is essential to avoid this problem.

Researchers at the University of Oxford have developed a control system that allows spatio-temporal activation of CRISPR, based on an engineered RNA guide strand. This technology is modular, so both targeting and sensing can be adapted to allow new genes to be targeted, subject to the detection of new biomolecular triggers. It also provides a platform technology that can be applied to any gene therapy based on RNA-dependent nucleases such as Cas9.

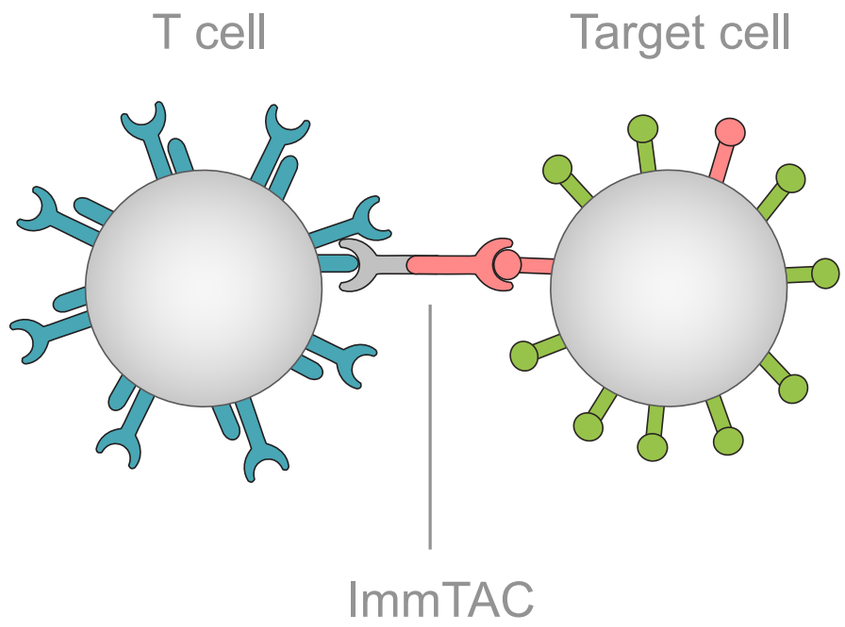
FULL WEB PROFILE ▶

Understanding T cell activation through mathematical modelling

Immunocore, a leading T cell receptor biotechnology company, has been working with Professor Omer Dushek from the Dunn School of Pathology through Consulting Services to create a mathematical model for T cell activation by Immunocore's ImmTAC® therapeutics.

ImmTAC molecules are a new class of biologics designed to activate a highly potent and specific T cell response to cancer cells. Immunocore's lead candidate is in clinical studies as a treatment for patients with metastatic uveal and cutaneous melanoma, aggressive forms of cancer.

Through Consulting Services, Immunocore was able to access world-class expertise in the specific area they needed to convert a conceptual model of the molecular mechanism of ImmTAC-mediated T cell activation into a mathematical model. This consultancy has provided insights into how the properties of ImmTAC molecules could be tailored to provide greater clinical benefit in specific tumour types.



FURTHER INFORMATION ▶

A novel algorithm for human-centric lighting

Light Emitting Diodes (LEDs) offer significant advantages in power consumption, colour control and lifetime when compared to conventional lighting sources.

However there are dramatic variations in the output spectra of LEDs, and precise spectra control of a multi-primary LED is an extremely challenging task.

Oxford researchers have developed a novel method to generate metamers – colours that appear to match despite having non-matching spectral power distributions – using an algorithm to calibrate non-linear spectral shifts in LED light sources. This algorithm offers an attractive solution for applications requiring precise control of a multi-primary light source, such as managing sleep patterns.

FULL WEB PROFILE ▶

Mentoring Oxford entrepreneurs

One blue and one red, Oxford University and Vodafone are two iconic British institutions only separated by 25 miles of the A34, and both are creating global impact. That's a great opportunity to do something special, and we have created a spark to get things going.

Bright Sparks is a mentoring programme designed for startups. Each startup is assigned a Vodafone mentor who would offer advice and assistance with strategy and marketing. Oxford University Innovation selected 10 startups to participate in Bright Sparks based on their areas of expertise, stage of development and enthusiasm for the project.

CONTINUED ▶

The ten startups were:

Care Compare - A care and physiotherapy services comparison engine

CycleLand - A peer-to-peer bike sharing service

Global Jet Watch - Commissioning telescopes to investigate and understand the behaviour of black holes

Greater Change - Enabling secure, cashless donations to homeless people

Oxtractor: Delivering actionable insights from social data

Pidge: The ecosystem platform for amateur sports teams

Pinboard: One-to-one student skill sharing

SwitchThat: Simple, unified automation for smart properties

Total Mama: Revolutionising pregnancy by empowering women with information and insight

Ufonia: The talking artificial intelligence (AI) doctor

So, what benefits do the participants get out of it? Well, the Oxford startups get a great new mentor and, via their mentorship, access to the vast knowledge and expertise of Vodafone across their markets, technology and digital strategy. They also get a valuable insight into how big companies operate and, of course, a potential first customer on their doorstep.

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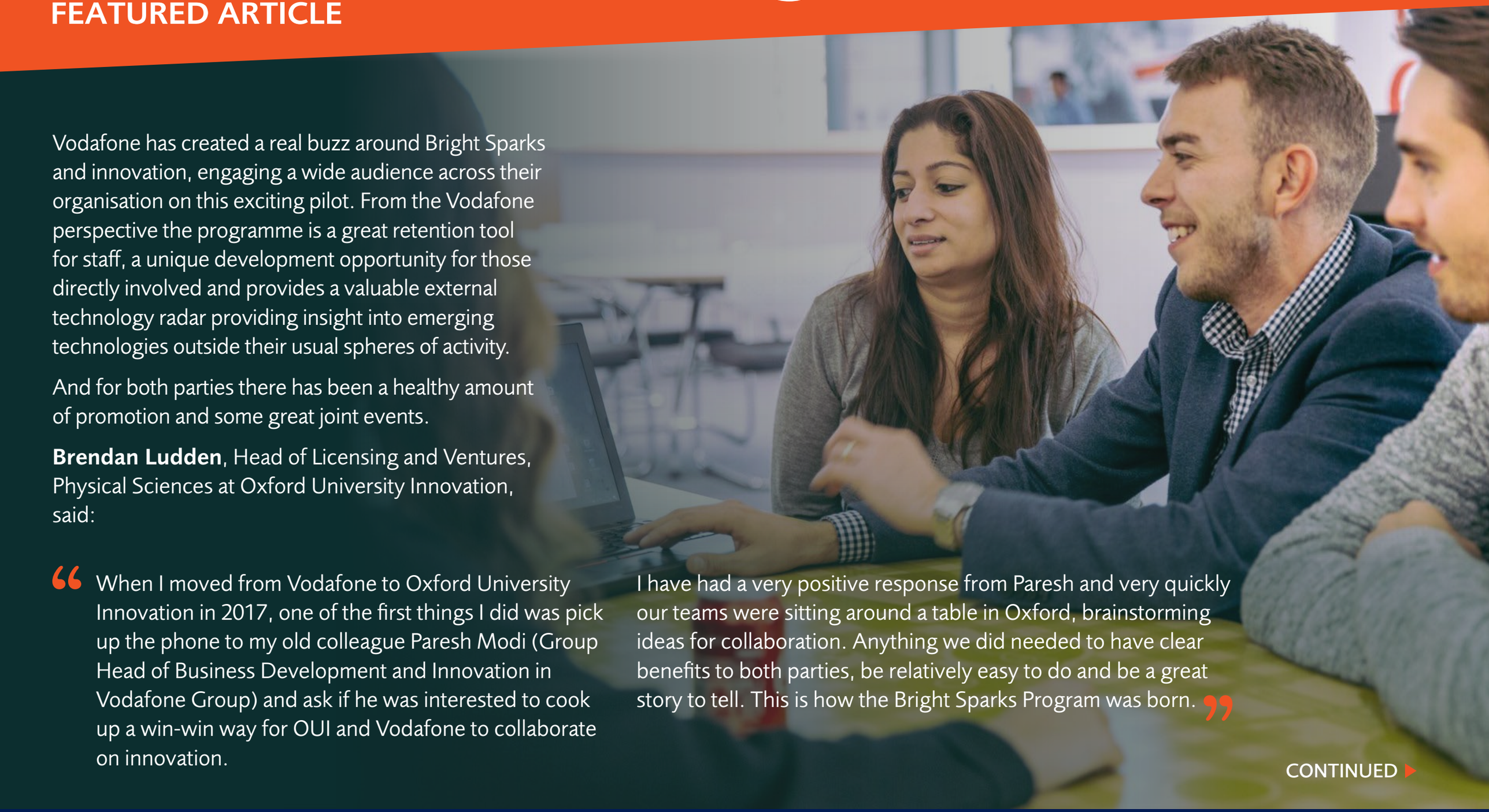
INNOVATION insights

FEATURED ARTICLE



Vodafone has created a real buzz around Bright Sparks and innovation, engaging a wide audience across their organisation on this exciting pilot. From the Vodafone perspective the programme is a great retention tool for staff, a unique development opportunity for those directly involved and provides a valuable external technology radar providing insight into emerging technologies outside their usual spheres of activity.

And for both parties there has been a healthy amount of promotion and some great joint events.

Brendan Ludden, Head of Licensing and Ventures, Physical Sciences at Oxford University Innovation, said:

> When I moved from Vodafone to Oxford University Innovation in 2017, one of the first things I did was pick up the phone to my old colleague Paresh Modi (Group Head of Business Development and Innovation in Vodafone Group) and ask if he was interested to cook up a win-win way for OUI and Vodafone to collaborate on innovation.
>
> I have had a very positive response from Paresh and very quickly our teams were sitting around a table in Oxford, brainstorming ideas for collaboration. Anything we did needed to have clear benefits to both parties, be relatively easy to do and be a great story to tell. This is how the Bright Sparks Program was born.

CONTINUED ▶

INNOVATION insights

FEATURED ARTICLE

Cath Spence, who leads the OUI startup incubator, has been looking after the initiative for OUI from the beginning, added:

> It's been a great programme. Fully of energy, fun & inspiration. Working with the mentors from Vodafone has been just fabulous for the teams. And it's not all been one way! Early on we hosted a networking dinner for the teams, their mentors and some key people from both Oxford and Vodafone. Our after-dinner speaker was Rt Revd Steven Croft, Bishop of Oxford, who offered a wonderful insight into the Ethics of AI.

Our teams have thoroughly enjoyed working with their Vodafone mentors. There have been some great outcomes. All the teams have made huge strides during the year, between them securing new contracts, grant funding, and places in specialist business support programmes.

Vodafone have paired our teams with some of their top people. However, it's clear this is not just a business relationship for them. The mentors have brought some fabulous skills and wisdom to our teams but it's more than that. If you watch them in meetings, it's clear that the mentors are truly part of the teams they support. I've been so impressed with all of them. I can't wait to meet the next cohort of mentors!

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OXFORD INNOVATION SOCIETY 2019

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

- Tuesday 17 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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