UCD SCIENCE SHOWCASE



Welcome

I am very pleased to introduce the first edition of the UCD Science Showcase. The purpose of this publication is to share some highlights of UCD scientific research with the public, government agencies, industry and university colleagues alike, and acknowledge a selection of our best scientists whose work is described here. However, I must emphasise that this is only a small sample of the huge variety of research that takes place in UCD. Such is the talent base that we could easily have material for several volumes of such stories per year.

Most interviews featured were with Dr Claire O'Connell, science writer and journalist. I am sure they will offer the reader an opportunity to appreciate challenges, successes and what it takes to translate scientific endeavour into something that has meaning beyond university boundaries, into something that represents a contribution to wider knowledge and society; additionally, they illustrate timescales involved and perseverance needed to decipher complexity.

Overall the UCD College of Science covers core disciplines and applied disciplines including biological, chemical, geological, mathematical, physical and computer sciences as well as finance, actuarial sciences, meteorology and biopharmaceutical sciences. Disciplines are represented through seven Schools: Biology and Environmental Science, Biomolecular and Biomedical Science, Chemistry and Chemical Biology, Computer Science and Informatics, Geological Sciences, Mathematical Sciences and Physics. In addition to schools playing an important role in education programmes they act as host for each academic in the wider university context.

Increasingly big questions require answers that draw on a multitude of skills often situated at the interface of disciplines. For this reason UCD created several institutes and centres, which connect knowledge across boundaries and break down academic silos. Research questions addressed by these institutes, which include academics from the College of Science, look at green energy and the environment, biomedical research, complex numerical systems, nanotechnology, sensors and the interface of biology and technology.

I am very pleased to see new and existing strong collaborations between UCD experts and international colleagues leading to high impact publications, a recognised measure of academic excellence, and also allowing knowledge transfer to take place. Research in the sciences is an expensive activity and I want to gratefully acknowledge the support our researchers and the University receives from the Irish state and its agencies, EU agencies, international trusts, industrial sponsors and individuals.

Professor Joe Carthy
UCD College Principal and Dean of Science

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UCD Science Showcase

Science & Technology

Professor Pádraig Cunningham

Professor of Knowledge & Data Engineering,
UCD School of Computer Science & Informatics

In tune with the hipsters

Think of a hipster city, one that latches on to music trends early and throws them off before they become stale. Seattle? New York? London? Try again: Oslo, Dublin and Atlanta top the charts in a study by UCD researchers Professor Pádraig Cunningham and Conrad Lee, published on the online scientific forum *Physics arXiv at http://arxiv.org/pdf/1204.2677v1.pdf.*

By studying listening data from the Internet radio Last.fm - and borrowing some analysis tips from pigeons - they mapped the preferences in more than 200 cities over around three years and saw who the trendsetters and followers were.

"Last.fm logs data about what people are listening to," explains Professor Cunningham, who is Professor of Knowledge and Data Engineering at UCD School of Computer Science & Informatics.

He and PhD student Lee analysed the 'scrobbles', or bits of data, and mapped them geographically for various music genres.

And unsurprisingly, certain groups of countries tended to bond together in musical taste. "Ireland clusters in with the UK and Australia clusters in with New Zealand and then at the next level up they cluster with Canada - there seems to be a British Empire thing going on," says Professor Cunningham. "And the German speaking countries and the South American countries also cluster together."

To get a more dynamic picture, Cunningham and Lee looked to a recent study of pigeons that used GPS tracking to work out which birds led and which followed.

"That kind of analysis can be adapted to look at the music listening data," explains Professor Cunningham. "And we showed that systematically there are cities that lead other cities - the trends happen there first and they get picked up in other cities later on."

Taking all music together, Atlanta led the trends in North America, while for indie music, Montreal and Toronto were the leaders with Denver and Seattle are at the bottom. "That's surprising, we always would have thought of Seattle as a hipster place," says Professor Cunningham.

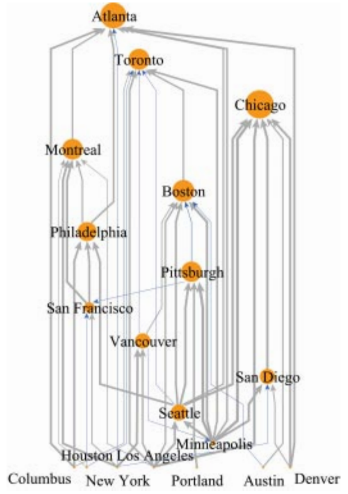
For hip-hop, Atlanta was again the trailblazer, along with Chicago and Toronto, with Austin and Denver and even New York City lagging behind. Meanwhile in Europe, Oslo, Dublin and Paris were among the hipster cities setting the trends.

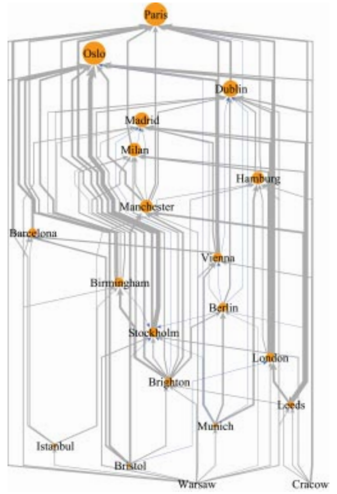
"It's hard to explain how this influence manifests itself but it is clear that it is there," says Professor Cunningham. There are some limitations to the study - not least that the listening habits of people who tune into Last.fm may not represent the wider public. But the general approach of spotting trendsetters is an important component of the wider research carried out by the Science Foundation Ireland funded Clique Research Cluster, which Professor Cunningham directs.

"We have a collaboration with Storyful, we analyse news trends on Twitter and try and identify authoritative sources associated with particular news stories," he offers as an example of ongoing research. "In any situation where there is a lot of data available, you have this potential to identify how trends move around the world, and it's interesting to be able to identify where these trends start."

Key research interests:

Big Data Analytics
Social Network Analysis
Scalable Machine Learning
Bioinformatics





Dr Maria Meehan

Senior Lecturer, UCD School of Mathematical Sciences

Bringing maths to a new generation of minds

For many of us, our experience of learning maths ends when we leave school. Yet studying maths at college can open up whole new worlds of understanding. Dr Maria Meehan is intent on finding out more how students make that leap to advanced mathematical thinking.

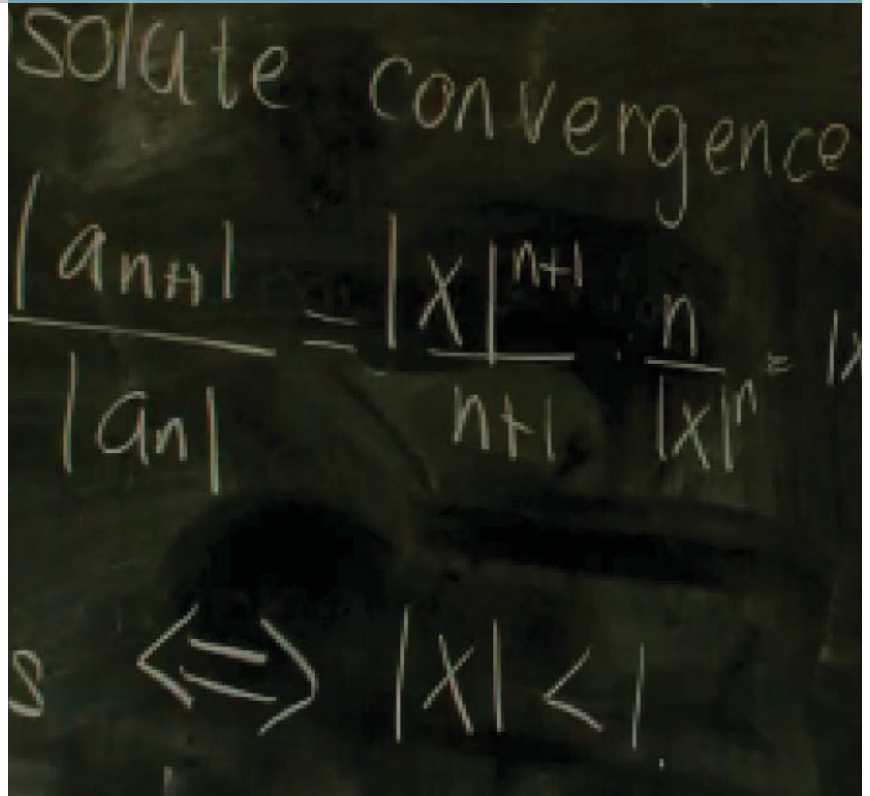
She also spearheads an initiative that places UCD undergraduates into schools to help develop their communication skills and encourage young minds to study maths at third level.

Dr Meehan's own journey through maths education was sparked at an early age. "When I was about 12 I wanted to be a maths teacher more than anything else in the world, and that is why I did a maths degree," she explains. "Then I realised the maths at college is so different to the maths at school - I became really hooked on it, this other side of maths, the proving and definitions and the theoretical and abstract side, I fell for that completely."

Now a Senior Lecturer at UCD School of Mathematical Sciences, Dr Meehan is interested in how students themselves make that leap to advanced mathematical thinking. She carries out 'action research' by reading the literature and then testing out concepts with her students to see how they learn. "You come up with particular tasks, or you experiment with the way that you present the material," explains Dr Meehan. "The best thing for me is looking at what students do, getting them to work in class and seeing what their ideas are. Some might be right and some might be wrong, but the wrong ones are also valid in that it is a misconception that they might need to address."

Key research interests:

Mathematics Education at Third Level
Advanced Mathematical Thinking
Noticing in Teaching
Mathematics Teacher Education



The students can sometimes even come up with their own novel ideas when solving the problems: "When you teach something for a few years you get used to the way you think about things, but then you can get a surprise," says Dr Meehan.

She is part of a group of maths educators around Ireland who encourage research into the area, and she also runs an elective module for undergraduate students at UCD to help encourage their own communication skills. The 'Undergraduate Ambassadors Scheme' places UCD students in local secondary schools, where they can work alongside maths teachers for a few hours each week and develop a special project of interest to the students.

"They are acting as ambassadors for mathematics and ambassadors for UCD," explains Dr Meehan. "It's nice that there's a student in the classroom who is studying maths or engineering or actuarial science and they give this other side to the subject."

The initiative is now in its fifth year and has been growing in popularity, according to Dr Meehan, who explains that the module - for which the students get credit - involves demonstrating transferrable skills.

"They have to give me evidence that their ability to communicate maths has improved as a result of this module," she says. "There's no point being excellent at your subject if you can't when you go out, be it as a teacher or part of a research team or working with industry, and communicate ideas."

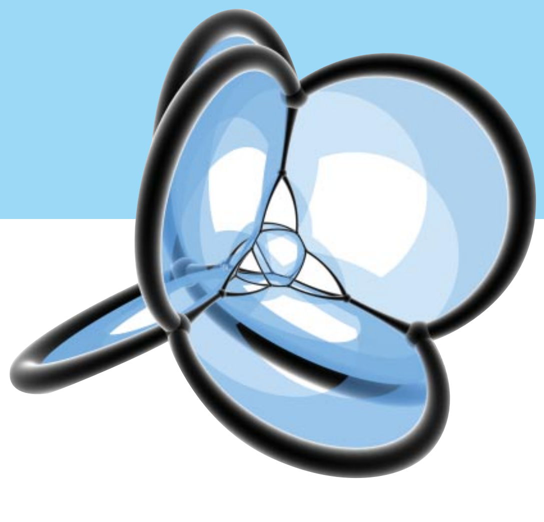
Dr Michael O'Neill

Senior Lecturer, UCD School of Computer Science & Informatics

Evolution solutions, computer style

Key research interests:

Complex & Adaptive Systems
Natural Computing
Evolutionary Computation
Genetic Programming
Swarm Intelligence
Application of Biological Principles to Problem Solving



How can you harness the powerful force of evolution to help crack down on money laundering? Or to come up with better buildings, communications networks and animations?

Taking tricks from the natural world and using them in computer software is opening up new opportunities to tackle problems and boost design processes, and Dr Michael O'Neill at Complex & Adaptive Systems Laboratory in UCD is forging ahead.

Computers and biological evolution fit well together in 'natural computing', he explains. "We are taking inspiration from the processes and systems in the natural world and using those to develop software for solving real world problems," says Dr O'Neill, who originally studied biochemistry in UCD.

He now heads the Natural Computing Research & Applications Group in UCD, which is known worldwide for its work in natural computing and evolution. "We try and distill the essence of evolution, then if you put the power of that process into software you can get an artificial evolutionary process - and you can breed solutions to problems," he explains.

The UCD researchers have been working with industry through a Science Foundation Ireland funded Financial Mathematics and Computing Cluster (FMC2), where Dr O'Neill is a principal investigator. "We have been taking inspiration from nature and using it to come up with ways of managing portfolios and developing high frequency algorithmic trading," he explains.

"We have worked with companies to develop anti-money-laundering software using these evolution algorithms. You want to detect patterns in transactions that are coming through different financial organisations and you need some automation to flag up transactions that are of interest for the institutions so that they can follow up. Then they don't have to have a team of people going through every single transaction, and they can be more focused on the alerts."

Evolving solutions through software can also help boost the creative design process for architects and engineers, according to Dr O'Neill, who is working with colleagues in UCD School of Architecture and UCD School of Civil, Structural and Environmental Engineering to explore the possibilities.

"You can plug in your particular style to seed different structures, and the evolutionary engine then presents the designer with a population of alternative designs," he explains. "The designer can pick the ones they like and those designs become parents which produce children, and the design can evolve over generations. It allows people to explore designs that they may not have necessarily come up with."

Dr O'Neill's team is also putting natural computing to work to help manage communications networks - a project with Bell Labs is working on solutions to manage power in devices as they dynamically pick up phone signals. The approach can even make computer games more realistic by 'evolving' animated characters to create natural movements and diversity.

Meanwhile Dr O'Neill is helping to encourage secondary school students to become interested in studying maths and computers - for several years a Google funded summer school has attracted secondary school students to come to UCD to study a university module called "Introduction to Computer Science and Programming".

And their heads are being turned, he notes: "We have had a huge increase in first preferences for computer science in UCD as a result of initiatives like this."

Professor Gary McGuire

Associate Professor, UCD School of Mathematical Sciences

Getting ahead of the curve in online security

If you have ever paid for something online with your credit card, you have probably wondered whether prying eyes could view your precious account information as you sent it into the ether. Of course, protecting valuable communications is not new: wars have been turned on the efforts of code-crackers deciphering details of intercepted enemy plans.

But today the battle is waged online, a cat-and-mouse chase between sender and hacker - and as computers get more powerful the protective codes have to keep ahead to remain useful. Enter the science of cryptography, or 'hidden writing', which is a focus of research at the Claude-Shannon Institute, a Science Foundation Ireland funded group across UCD, Dublin City University, NUI Maynooth and University College Cork.

Professor Gary McGuire, Associate Professor of Maths at UCD School of Mathematical Sciences and Director of the Claude-Shannon Institute explains how the approach seeks to disguise messages as they move from sender to legitimate receiver.

"The idea is you would have some message to be communicated between two people and there are prying eyes that want to read the message and you want to protect it from them," he says. "So the message is transformed into some garbled form that looks like nonsense, and only the receiver knows the transformation and then has to reverse the transformation. The goal is that the eavesdropper is not able to deduce the transformation."

It works because the transformation uses secret 'keys' that allow the information to be encrypted and to allow the receiver to unlock the message."There's often one key to encrypt the message and there's a different key to decrypt the message," explains Professor McGuire.

"This is very useful in certain protocols, say for buying something on the Internet with a credit card - it is used all the time for validation between two computers."

Key research interests:

Error Correction
Cryptography
Discrete Mathematics
Algebra
High Performance Computing

But as computing power grows, the threat to security gets bigger too - if you have enough computing power you could theoretically try all possible keys in a practical amount of time: just like fast fingers trying out a combination lock. The current standard for keys is called RSA, but as computers grow more powerful, it will become more cumbersome in the face of security threats, explains Professor McGuire. An alternative is elliptic curve cryptography (ECC), which is a focus of work in UCD.

"The main difference between RSA and ECC is the key size," explains Professor McGuire. "The size of the key matters, because if they key is too big the computation slows down and it starts taking too long to do the encryption, so you would be sitting at your Internet terminal waiting for something to happen - you might even think it has frozen. What's happening with RSA is that as computers get more powerful their keys have to keep doubling in size and they are getting far too big - and the main advantage of ECC is that it has much smaller key size, therefore it is faster."

ECC, which has its roots in 19th century maths, has a special trick up its sleeve: the mathematical computation that you use to encrypt can be calculated on an elliptic curve.

"This operation is complicated which makes it hard for the eavesdropper to undo it, that is what makes it secure," says Professor McGuire. But there is always room for improvement, and UCD is working to make ECC encryption faster and applying it to practical situations.

One success came in looking at a new equation for an elliptic curve, published in the literature in 2007, which involved a different formula. "We got very excited when we saw that, we started to study this formula and it turned out to be faster than the previous formulas," says Professor McGuire. Working with Intel and UCC, the UCD team then applied that discovery to a real-world item: a microprocessor.

And while the researchers come up with faster ways to encrypt, there are plenty of future applications. The next big security issue is the cloud, according to Professor McGuire, where we store information not locally in our own devices such as computers and laptops, but in servers.

"We are moving to small mobile devices and those have big security problems," he says. "A lot of business executives are doing so much of their business using their smartphones. There's a lot of private data that should not be in the public, either by voice or email, that is flying around, and encrypting that is a big problem."

Professor Peter Hogan

Associate Professor of Relativity Theory, UCD School of Physics

Probing mysteries of the Universe with Einstein

What springs to mind when you think of Albert Einstein? Maybe it's E=mc2, the snappy equation for Special Relativity, which he published in 1905. But there's a lot more to Einstein, not least his theory of General Relativity. That's Einstein's theory of gravity, which he brought to the world in 1915.

Almost a century later, theoretical physicists are still exploring that solution, which has helped us to gain insight into the fundamental workings of the Universe.

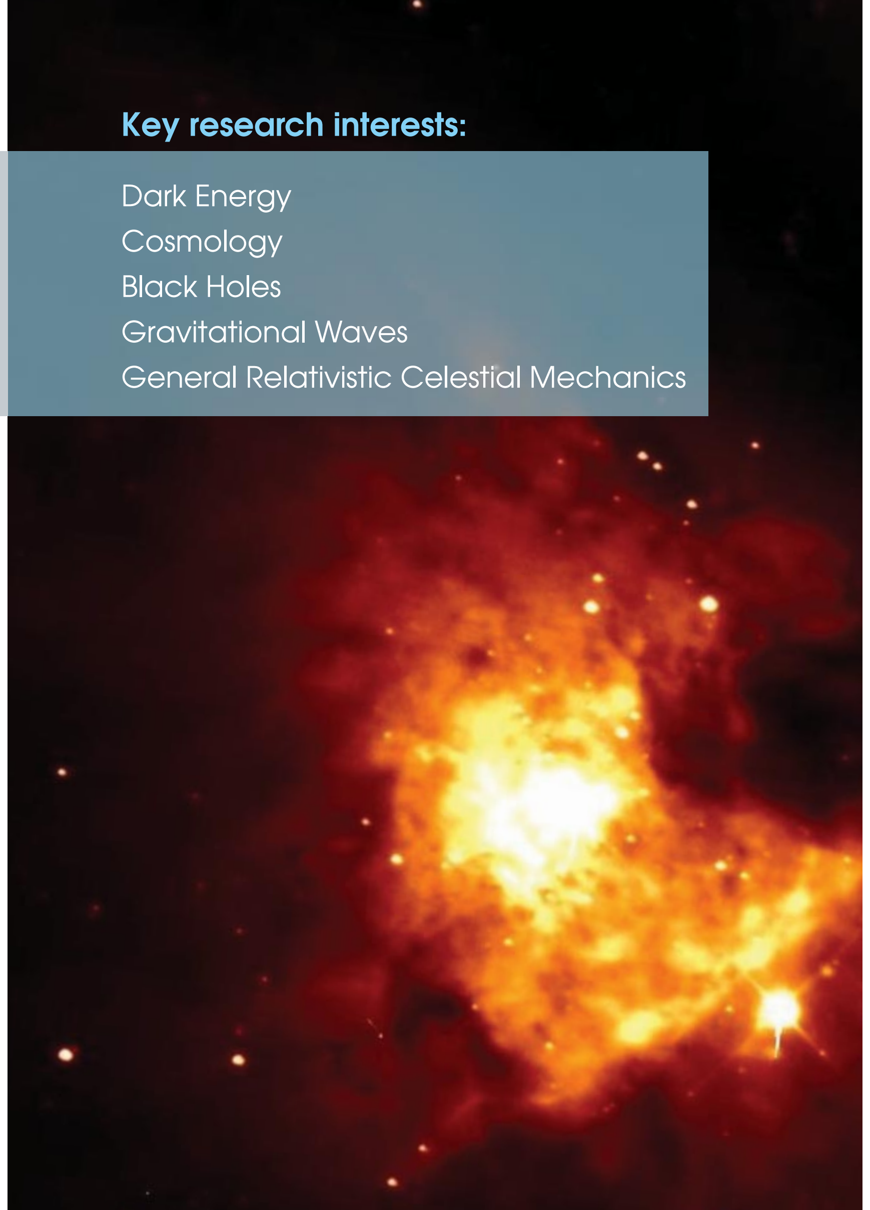
"Einstein solved the problem of gravity and we are working on trying to understand the solution," says Professor Peter Hogan, a theoretical physicist who specialises in General Relativity at UCD.

He describes General Relativity as a "fabulous theory" and one that has underpinned enormous advances: "It is the theory that predicts the existence of black holes, gravitational radiation and the Big Bang beginning of the Universe," he says.

Professor Hogan, who is Associate Professor of Relativity Theory at the UCD School of Physics, has worked with some of the world's leading relativists and has long-standing collaborations with colleagues in France, Japan, South Africa and the United States.

"I believe that if you work in science you need to test yourself by collaborating with the best people abroad," he says. "It's like a sportsperson who wants to compete at the highest level - they have to compete with the best people."

With his collaborators, Professor Hogan has worked on Einstein's theory in order to understand more about binary stars, or couplets of stars that orbit around a common centre of mass.



Key research interests:

Dark Energy
Cosmology
Black Holes
Gravitational Waves
General Relativistic Celestial Mechanics

"One of the amazing things about General Relativity is it gives you a mathematical tool to model gravitational fields due to a binary star or a black hole or the gravitational field of the Universe," says Professor Hogan.

"And if the source of the gravitational field is a binary star system, you could work out from the theory how those stars are moving."

Professor Hogan has also used General Relativity to help shed light on dark matter, a mysterious substance that is thought to be behind the accelerating expansion of the Universe.

He and French collaborator Claude Barrabès demonstrated through their equations that dark matter is a product of gravitational shock waves colliding.

"You do that in General Relativity by solving Einstein's equations and a solution gives you a way of modelling the gravitational field after the waves have collided," says Professor Hogan. "And in that field we identified this dark matter."

"Keeping active in research is an important behaviour to model for students," he adds. "I see my job as teaching and studying."

Professor Hogan's most recent book, *Equations of Motion in General Relativity (International Series of Monographs on Physics)*, is co-authored with Hideki Asada and Toshifumi Futamase and published by Oxford University Press.

Dr Ronan McNulty

Senior Lecturer, UCD School of Physics

The hunt for the Higgs

Key research interests:

Particle Physics
Higgs
Boson
CERN
Large Hadron Collider (LHC)
Collider

On the morning of July 4th 2012, the eyes of the world were focused on CERN in Geneva where a big announcement about the elusive Higgs particle was anticipated. The quest to find this particle - a missing piece in the model of physics that describes matter in the universe - had been going on for decades. Had they discovered something? And if so, what would it mean?

The Higgs boson, which was proposed by British scientist Peter Higgs and others around 50 years ago, is one of 17 fundamental particles that everything in our universe can be decomposed into, explains Dr Ronan McNulty, a senior lecturer at UCD School of Physics and a visiting professor at the University of Liverpool.

"At that time, theoretical physics was at an impasse," he says. "It could successfully describe all of electricity, magnetism and radioactivity, but only if the particles involved were massless. Higgs and others came up with an ingenious mechanism by which mass could be introduced into the theory."

However, to make a Higgs boson in the laboratory you need to reproduce energies that existed about one billionth of a second after the Big Bang, more than 13.7 billion years ago. Enter the Large Hadron Collider (LHC), a 27km-long ring-shaped underground track where beams of protons are smashed together at the speed of light. "The LHC fires two protons together at high energies and this energy turns into mass," explains Dr McNulty. "Sometimes a Higgs boson is produced which decays instantaneously into other particles which we can detect. By reconstructing the decay fragments, we can infer the presence of the Higgs."

Results from two experiments at the Large Hadron Collider - ATLAS and CMS - had each pinpointed a particle consistent with the predicted Higgs. Present at the conference was Peter Higgs himself, who was visibly moved by the enormity of the occasion. "This is probably the most important physics discovery for 80 years," says Dr McNulty. "It is the culmination of 50 years of experimental searching and has been a truly global endeavour.

Several thousand scientists from over 50 countries have contributed to the Higgs discovery. We in Ireland are privileged to be part of this worldwide effort of humanity to understand the essence of our universe."

Dr McNulty's group made an important contribution to the search for the Higgs through their work on the 'LHCb' experiment at CERN, one of the four experiments that operate on the LHC collider. The UCD group made a particular breakthrough by analysing W and Z bosons, which are heavy, like the Higgs. "A careful investigation of the properties of the W and Z, such as we made in 2008, is a window onto the Higgs," he explains. "Of even greater importance is that fact that when the Higgs boson decays, it often produces W and Z bosons. Therefore, being able to reconstruct W and Z bosons is a necessary first step to being able to reconstruct the Higgs."

Higgs bosons are around 10,000 times rarer than W and Z bosons, but as the UCD researchers work through the information from the LHCb experiment, Dr McNulty is hopeful they will also see a hint of the presence of the Higgs there. Two UCD students, funded by IRCSET and SFI, are writing theses on their search for the Higgs, using data that they collected when they spent a year at CERN as part of their PhD studies.

Dr McNulty describes how the next few years are going to be "incredibly exciting" as researchers figure out the nature of the Higgs: "Many people expect that the Higgs will reveal much deeper truths about the nature of the universe - it may be the product of supersymmetry for example. To answer these questions we must gather as many Higgs bosons as possible and see how they behave."

"I believe it sends an inspirational message that science is fascinating, fun, and makes the world a better place," he says. "And beyond the noble aim of understanding the very nature of our universe, we reap the rewards of this curiosity in technology which gives us new medical detectors like PET scans and hadron (anti-cancer) therapy, more efficient electricity generation or a new social order (CERN played a role in the development of the worldwide web)."

Professor Hans Benjamin Braun

Associate Professor, UCD School of Physics

Nanoscale magnetism and spintronics

Magnetism lies at the heart of information technology. Whenever we check our emails, consult Google, read Wikipedia or interact with the elusive 'Cloud', we access information that is physically stored on magnetic hard disk drives. An individual bit of information is written onto a tiny region of magnetic material, currently less than 30 nanometres across, that is a mere 150 atoms, or about 1/1500 the diameter of a human hair. In tandem with Moore's law, the capacity of hard disks has grown exponentially during the past few decades, doubling every 18 months.

"Most of us assume that this trend will continue indefinitely, but we are running out of options to make these bits smaller," explains Professor Hans-Benjamin Braun from the UCD School of Physics. "Since higher information density means smaller bit sizes, we soon reach a regime where the magnetically encoded bit undergoes random Brownian motion due to the ambient temperature."

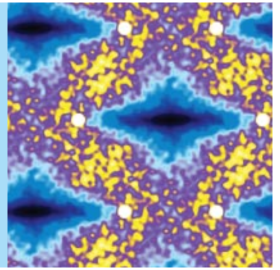
In order to avoid such disastrous loss of stored information, researchers are trying to find new materials where the magnetization is exceptionally stable. "However, we still need to be able to switch those bits, which forces us to find novel ways of manipulating magnetization," he adds. Industry is currently focussing on 'heat assisted magnetic recording' (HAMR), a technology that will be used in the imminent generation of hard disks.

Fundamentally new concepts are needed if the current increase in storage density is to be maintained in the long run. This is where academic research steps in, as industry often does not have the resources to entertain research on such long-term goals which are important for society," says Braun whose Nanomagnetism group is supported by two consecutive SFI Principal Investigator Awards. His team aims at using the electron's spin rather than its charge for information processing, a novel technology termed 'Spintronics'.

According to Braun "Spin-based information processing will require much less power than its conventional electronics counterpart which, as we all know, is producing excessive heat.

Key research interests:

Condensed Matter Physics
Strongly Correlated Electron Systems
Quantum Magnetism
Nanomagnetism
Spintronics
Quantum Computing
Polarized Neutron Scattering



This is an extremely important aspect for future sustainability as the carbon footprint of global IT infrastructures exceeds that of worldwide air traffic."

Spintronics also opens the way for quantum mechanical information processing or quantum computing, which would offer unprecedented computational power which will enable breaking of all current encryption schemes used for secure online transactions. Such quantum bits are extremely fragile, and progress on the control of such 'qubits' has just been recognized with the Award of the 2012 Nobel Prize to quantum physicists Serge Haroche and David Wineland.

Braun's group has also been exploring new ways to encode information by using 'topologically' robust spin configurations which are stable even at the tiniest length scales. An example of such a configuration is a 'Skyrmion' where the spins form an arrangement resembling a firework bouquet.

Braun described these ideas in an extensive article on '*Nanomagnetism and Topology*' in *Advances in Physics*, one of the most widely read scientific journals and ranked in the top ten of the more than ten thousand journals classified by the Web of Science.

The article offers important insight into the design and manipulation of spin-based bits and has been welcomed by experts in the field including 2007 Nobel Laureate Albert Fert who wrote enthusiastically "I like these Skyrmions!" Fert and Grünberg discovered 'giant magnetoresistance' (GMR), an effect that is currently used in read heads of hard disk drives.

Their discovery also paved the way for the development of magnetic RAM (MRAM), an entirely new class of memory which retains its content even with the power switched off. Apart from uses in space missions, such MRAMs will be used as a backup memory in next generation Airbus aircraft. Discoveries like GMR are often serendipitous in nature, and need a considerable lead-in time before they become established in industry. For example, Braun's work on thermal decay in slim nanoparticles more than a decade ago has now "..become the industrial standard for guiding media design for hard disk technology..." (Hitachi GST). It is therefore likely that some of the exciting concepts that are currently being investigated in Braun's team, such as harnessing novel emergent magnetic monopoles, will find their way into devices of the future.

Figure caption: Diffraction image of emergent magnetic monopoles in an array of magnetic nanoislands. (Image courtesy of Dr Gerard Duff and Dr Remo Hügli)

UCD Science Showcase

Environment

Dr Francesca Paradisi

College Lecturer in Chemical Biology,
UCD School of Chemistry & Chemical Biology

Going to extremes to find greener chemicals

Key research interests:

Green Chemistry: Dehydrogenases for biocatalytic transformations

Green Chemistry: Enzyme immobilization

Anti Cancer & Blood Clotting: Synthesis of rigid amino acids for incorporation into short polypeptides

Antibiotics: Synthesis of small molecules with antimicrobial properties

Next time you watch a TV programme that cracks a crime using DNA evidence, tip your hat to the microbe that makes it all possible.

That molecular sleuthing using DNA samples owes its success to an enzyme from a heat-loving bug that hangs out in hot springs and thermal vents. Because the enzyme can withstand high temperatures, we can use it in cycles of chemical reactions that multiply tiny amounts of DNA up into useful quantities, much like a molecular photocopier. Then the DNA can be sequenced and, hopefully, the crime can be solved.

It's an example of how the adaptations of 'extremophiles' that happily live in seemingly harsh environments can inspire useful chemical processes, and UCD researcher Dr Francesca Paradisi is on the case.

Her approach looks at 'halophile' organisms that can live in high salt concentrations such as the Dead Sea, and she's working out whether some of their enzymes could help make chemical processes in industry greener.

Paradisi, who studied chemistry at Bologna in Italy, wasn't familiar with extremophiles before she came to UCD to work with Professor Paul Engel just after she finished her PhD. But when she saw what his group was doing, she was intrigued by the possibilities. Now a college lecturer at UCD School of Chemistry and Chemical Biology, she has built up her own team and they have been meticulously screening various halophiles for a type of enzyme called alcohol dehydrogenase (ADH).

It's an enzyme that many organisms - including ourselves - produce naturally, and it is used in chemical processes in the food and pharmaceutical industries.

So why might an ADH from a salt-loving organism be particularly useful? "The idea is that enzymes that are produced by these halophiles, due to their particular high-salt environment, will be more likely to adjust to a solvent situation - when you have high salt you have less water around the enzyme," explains Dr Paradisi.

The trick is to find enzymes that tick several boxes: they are easy to purify from the organism, they are stable so they don't need too much cosseting and their special properties can make a range of chemical processes greener.

So Paradisi's team has been cloning, isolating and analysing various ADH enzymes from three types of halophile to see what kinds of talented enzymes they produce naturally.

The lab has been focusing on three main organisms: Halobacterium salinarium, Haloarcula marismortui and Haloferax volcanii, explains Dr Paradisi, but the initial work has been difficult because so little is known about how to purify the proteins. However, despite the newness of the area, already they are turning up promising candidate enzymes, and soon the group will publish the first of the findings in the journal *Extremophiles*.

Their approach is also attracting the interest of industry: Dr Paradisi's group has an ongoing collaboration with Spanish biotech company Arquebios, and she is in talks with other potential partners. She stresses that the organisms used in this process are safe. "These organisms are completely harmless, and they are generally growing in a highly-salted environment so as soon as you put them in water in the sink they burst."

So what is the ultimate goal? To develop a system where a specially engineered bug can produce useful amounts of one or more useful enzymes like a biological printing press, explains Dr Paradisi, whose work has received funding from the Environmental Protection Agency, Science Foundation Ireland, IRCSET and Merck.

"Enzymes are a little different from small chemicals that you would find in nature - they are quickly reproduced and we can clone them," she says. "So we are looking to use a host cell that can be engineered in such a way that it produces a higher amount of the extremophile enzymes."

Dr Conor Sweeney

Lecturer, UCD School of Mathematical Sciences

Clever computing for better wind forecasts

Weather forecasting is a number-crunching affair: under the watchful eyes of meteorologists, data from weather stations around Ireland get digested by massively powerful computers and are mixed with global models to work out the future probabilities of cloud, rain, wind and occasionally even sunny weather in locations around the country. But forecasting something as variable as wind is tricky - particularly if you want to predict windiness at a specific location, like a wind farm.

Once again computers can help, and UCD researcher Dr Conor Sweeney is looking at how fine-tuning the weather forecast could help local wind-farms manage their resources.

A native of Dublin, Dr Sweeney started out his career as an engineer, working in Italy and the US designing machinery for material handling. He enjoyed the experience of living overseas, but the work began to lose its appeal.

"The shine wore off - it didn't involve an awful lot of thought beyond a formulaic approach to design, so I wanted to do something that I found interesting," he recalls. A PhD in Trinity re-ignited his curiosity as he worked on a noisy problem in aeronautics. "We were interested in the noise given off by an aircraft when it lands, and how to design aircraft so they could be more silent - we were trying to come up with a new way of solving how the air flows around awkward shapes," says Dr Sweeney. "We wrote a computer programme that solved the equations in a different way, it was a lot more efficient and worked well when you had awkward shapes."

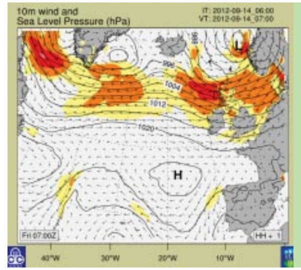
That computing experience came in handy for his next project - working with Met Éireann and the Dublin Institute of Advanced Studies on ways to predict the effects of climate change on Ireland. "We wanted to run computer models to downscale what was going to happen," he explains. "I knew a lot about computational models - and it turns out the governing equations are the same."

From there it was a logical move into further work on forecasting, and after a brief round trip to Africa on a motorbike, in 2007 Dr Sweeney came on board at UCD School of Mathematical Sciences. There he has been looking at ways to improve wind forecasting, because being able to predict with high certainty the levels of wind at specific windfarms would help balance inputs into the national electricity grid, and so ultimately make wind energy more cost-efficient.

"The problem with wind is that you can't turn it on and off," says Dr Sweeney. "EirGrid has to strike a balance between wind usage and using gas turbines - and they don't need this uncertainty."

Looking at a regional weather forecast - which can get down to a resolution of 2.5km in Ireland - will not necessarily tell you much about local effects at individual wind farms, explains Dr Sweeney. "There could be loads going on within that 2.5km that would have a local impact - there could be a valley or a hill that the model hasn't accounted for - so at the wind farm, the wind could behave differently to the forecast model."

In a project funded by Science Foundation Ireland, Dr Sweeney is part of a team at UCD that has been figuring out how to scale down the wind forecast for specific sites using relatively little computing power - so a solution could be run on a desktop computer. The trick is to compare forecast data to the data on what then happened at the location, to see the 'hit rate' of the forecast, he explains.



Key research interests:

Climate Modelling

Numerical Weather Prediction

Probabilistic Forecasting

Statistical Post-Processing

"You have the forecast and later you get the observations, so you know what happened," he says. "If the forecast says it is always going to be 10 metres per second and it's always 8 metres per second, then you subtract 2 - we are using ideas as simple as that, how the forecast compares with the observations."

Taking other factors into account, such as wind direction and using more advanced statistical methods, can increase the skill of the forecast even further, he adds. The project is currently applying the approach at seven locations around Ireland to localise the wind forecast. "That has worked very well," says Dr Sweeney, who says they hope to engage wind farms at a later point. And the solutions they develop could be applied to wind farms anywhere in the world: "It's a big problem; a lot of countries just take the outputs of computer models - but it's easy to apply these simple, quick processes. The extra number crunching you are doing is very small but the added forecast skill potentially is of big value."

Dr Dominic Zerulla

Senior Lecturer, UCD School of Physics

Making light work of solar cells

How do you harvest light in a solar cell? It's a question that has prompted decades of research, and some valiant records have been set.

Now by redesigning the architecture of third generation solar cells at the nano-level, a team in UCD has come up with an approach that could ultimately allow useful levels of light to be harvested in everyday applications.

It is difficult to improve on the records of over 42 per cent of light harvesting that have been achieved experimentally for multi-junction solar cells, but such cells are prohibitively expensive, explains Dr Dominic Zerulla, a Senior Lecturer at UCD School of Physics.

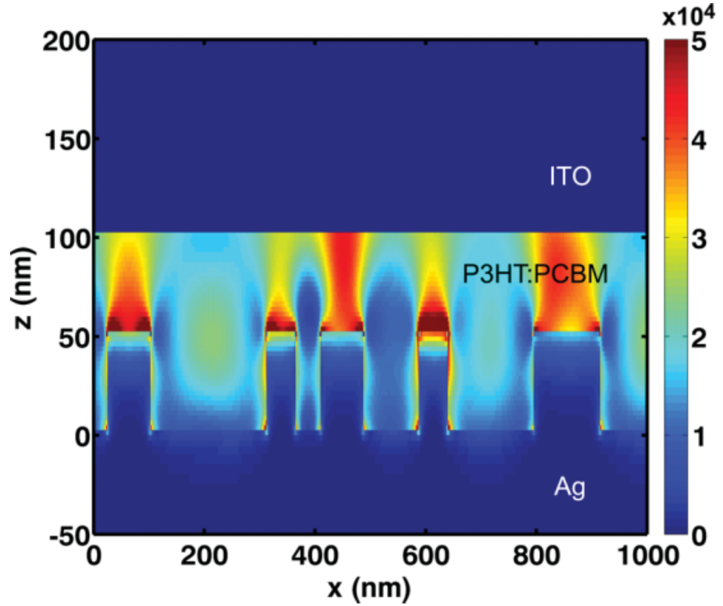
"Real progress above the state of the art is very, very difficult," he says. But, just as we don't all need to be Olympic athletes in order to do everyday things like catch the bus, "routinely achieving a lower level of solar harvesting around 10 per cent in extremely cheap cells [less than 1$ per Watt] could still be of enormous practical use," says Dr Zerulla, who heads the UCD Plasmonics and Ultra-fast NanoOptics group.

"If we achieve eight percent and boost to 10 per cent but keep the price low, it becomes commercially viable - one also has to see the difference between routinely achievable efficiency and showing the efficiency of the cell at peak performance in a lab."

The work of the group at UCD focuses on dye and quantum dot-sensitised systems, which are improved by complex but mass producible nano-structures so they can harvest energy from light more efficiently.

Key research interests:

Nano-Photonics
Plasmonics
Solar Cells
Nanomedicine
Ultra Fast Lasers
Magneto-Optics



As an added benefit, the thickness of the cell's 'active layer' can be reduced, which positively affects their efficiency, explains Dr Zerulla.

His group has optimised the nano-structures by superimposing tooth-grating structures. Doing so results in a far thinner layer that can remain active over a wide spectrum of wavelengths, as they describe in a paper in *Applied Physics Letters*.

"You have to tailor your nanostructure design to generate optical characteristics which perfectly fit the properties of the active layer of the cell," explains Dr Zerulla. "Then the harvesting qualities of your cell are optimum across the entire wavelengths range."

Working with collaborators in Germany, the UCD group has shown in a simulation that the method works well. They are now developing working cells and have linked in with UCD engineers to create metallic nanostructured glass stamps that could allow the solar cells to be produced in large amounts.

Dr Zerulla's work is part of the Science Foundation Ireland funded Solar Energy Conversion Strategic Research Cluster, and keeping an eye to the real world is an important aspect of the approach, he explains: "The process we are using must be mass producible, non-toxic and cost-effective."

Professor Christopher Bean

Associate Professor of Geophysics, UCD School of Geological Sciences

Catching the prelude to an eruption

When a volcano blows its top, it can have a huge impact. Locally, a big eruption can cause deaths and the destruction of homes and livelihoods. And in some cases the effects can be felt further afield - just ask anyone who was stranded in 2011 when planes were grounded due to the ash cloud from Eyjafjallajökull in Iceland.

Being able to better predict volcanic eruptions in advance could bring enormous benefits to society, cutting down on false alarms and getting people out of harm's way when it matters.

That's why Professor Chris Bean and his lab spend quite a bit of their time listening to what volcanoes have to say. By installing sensitive instruments to detect ground vibrations right at the top of volcanoes, the Seismology and Computational Rock Physics Lab at UCD Earth Institute is picking up telling signals about gas and magma moving around in the edifice, and they are working out the signatures that can predict trouble is on its way.

"Eruptions occur when you get hot material rising towards the surface," says Professor Bean, who is Leader of Seismology and Computational Rock Physics Lab at UCD School of Geological Sciences.

"We are interested in the very near surface behaviour of the volcano with a view to understanding how the system works and also giving us better forecasting of volcanic eruptions."

By saturating the crater with sensors, Professor Bean and his team pick up vibrations in the edifice that can tell them about when and where hot fluids and gases are moving within the edifice. The trick is to find characteristic signatures in the data that could signal an eruption is imminent.

They eavesdrop on craters in various places, such Costa Rica and Mt Etna, and they plan to go to Indonesia too. And this year they are installing a permanent network in Iceland - the data will be beamed back to Ireland, allowing the team to monitor activity at a distance.

Key research interests:

Natural Hazards
Volcanic Eruptions
Geoscience
Dangerous Environment
Restless Earth
Active Planet

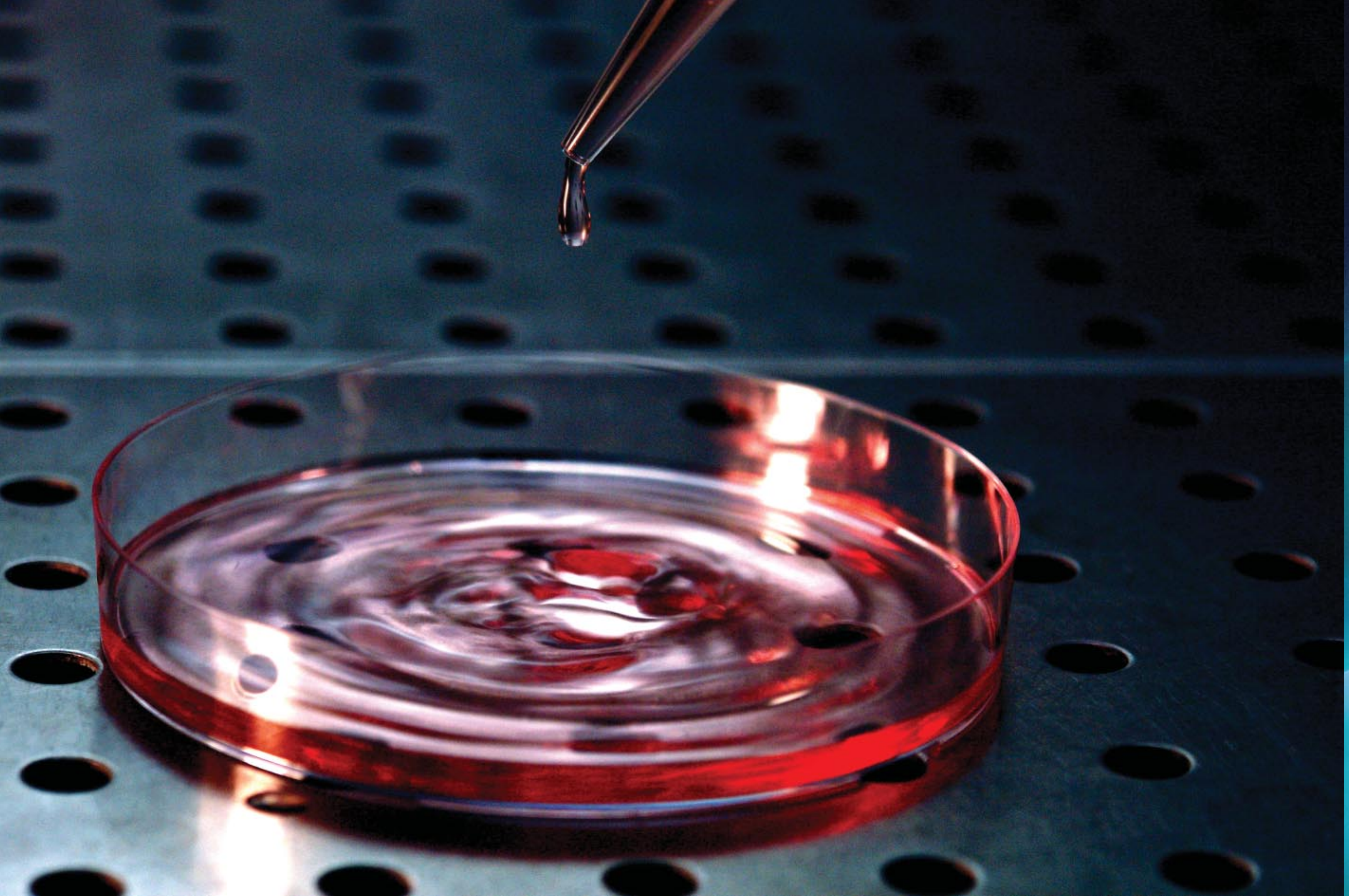
"We saturate the summit area at the very top of the volcano with these instruments," explains Professor Bean. "And because in Ireland we are not running an observatory, we are not at the coal face in terms of the hazard, we have the time to do a lot of the science, to attempt to understand the problem more than you can do when you are firefighting."

By monitoring data, running computer simulations to model crater activity and linking up with University College London to carry out complementary lab work the team is digging deep into those signals to look for signs about whether a spurt of activity could have the legs to go all the way to an eruption.

"One of the most dangerous things you can do is to generate false alarms and predictions - people lose faith in your ability to inform them," says Professor Bean. "So we are trying to better constrain our ability to forecast what is actually going to turn out to be an eruption."

As well as the obvious benefits of predicting when a volcano is about to blow its top, listening to the Earth's signals can more generally help to build up a better understanding of how the planet works, explains Professor Bean.

"It gives us a window into where we are and how we are still on a journey," he says. "Sometimes when you are trudging up the side of a mountain you think there is something bigger going on, and that makes it worth it."



UCD Science Showcase

Health

Dr Tara McMorrow

Lecturer, UCD School of Biomolecular & Biomedical Science

Keeping an eye on kidneys

Every day, you depend on your kidneys to filter your blood and keep it healthy. But if your kidneys fail - perhaps due to injury or a chronic condition like diabetes - you could need artificial dialysis or a transplant to stay alive.

Dr Tara McMorrow, a UCD Conway Institute Investigator, Lecturer in Pharmacology in the UCD School of Biomolecular and Biomedical Science and a group leader of the Renal Disease Research Group, is working on several angles to help. She wants to better understand what happens to cells as kidneys get damaged and fail, and to work out how to spot the warning signs of kidney problems earlier so doctors can intervene before it's too late for the failing organ.

It's an important area for Ireland: reports suggest that one in nine people here have some form of kidney damage, according to Dr McMorrow. "The majority of these people will not know they have any kind of kidney damage until they require dialysis, which can mean being hooked up to a machine for hours two or three times each week," she says.

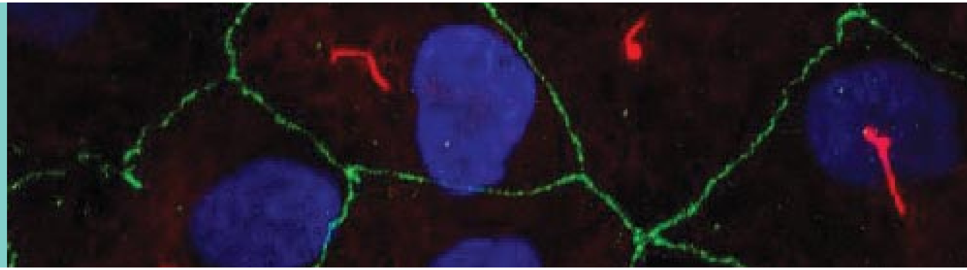
So what happens in the kidney to cause it to fail so catastrophically? One aspect seems to involve a change in epithelial cells that line the tubules in the kidneys. They switch to a more wound-healing type of cell, and this causes scarring to build up.

"Just like if you cut yourself, the scar that forms would be called the fibrosis, and this is what happens to the kidney," explains Dr McMorrow. "And it strangles the kidney so it can't function."

Her research looks at various cellular processes that are implicated in this scarring, which may still be an issue even after transplant: anti-rejection drugs may also encourage scarring and the 'new' kidney becomes damaged over time.

Key research interests:

Cancer
Kidney Disease
Cell Sensors
Cell Division
Carcinogens
Toxicology



"At the moment we have nothing to block that damage," explains Dr McMorrow. "And it's too late by the time we can detect it in a patient. But if we could detect it at an earlier point then the person could be helped to maintain kidney function for a lot longer."

That's why the group at UCD is working closely with clinicians at Beaumont and St Vincent's University Hospitals in Dublin to look for useful 'biomarkers' of damage that could give clinicians an early warning sign that something is going awry in the kidneys.

"If you can maintain the function even at approximately 30 per cent you can maintain renal function for several more years, so it delays the need for dialysis and transplant," says Dr McMorrow.

They are also involved in a European project called SYSKID, which is studying kidney disease as a complication of diabetes. The idea is to find markers of damage that show up in easily obtained patient samples, such as urine.

"We are analysing potential early biomarkers and genes we have identified in our screens that could possibly be used as early signals of kidney damage," explains Dr McMorrow. "And this project is looking to screen significant numbers of patients with diabetes throughout Europe to identify them."

The Renal Disease Research Group is currently funded by EU 6th and 7th Framework programmes, MRCG-HRB joint funded programme, CEFIC-LRI programme and the American Cystinosis Foundation.

Professor Jeremy Simpson

Professor of Cell Biology, UCD School of Biology & Environmental Science

Toxin tricks could help deliver drugs

Imagine a delivery person arrives at your house with a package. You open it up, and, depending on what it is, you decide where it will go in the house. It's a book? That goes on the shelf. New clothes? Into the wardrobe. But if it's something you don't want, or that you don't trust, it goes into the bin.

Similarly, when a molecule or compound gets delivered to a cell in your body, it is trafficked to a location in the cell's interior. And in the case of some molecules, they get routed into the cellular bin, a compartment called the lysosome.

This can be a problem when you want to deliver a drug or therapeutic agent to a cell, explains Professor Jeremy Simpson, Professor of Cell Biology at UCD School of Biology & Environmental Science. "Once the molecule gets inside cells the default pathway is to the lysosome, where everything is destroyed and recycled," he explains. "And if you are trying to deliver a sensitive molecule, that could be disadvantageous."

"One way to try and get over this hurdle is to deliver greater numbers of the molecules to the cell, but that's an expensive process and one that can push up the risk of side-effects for a patient," says Professor Simpson. Wouldn't it be better to deliver the drug molecules in a way that means they don't get trafficked to the bin?

It turns out that some toxins have already cracked that problem - molecules such as ricin (which was infamously used to assassinate Georgi Markov in the 1970s with a stab from a loaded umbrella tip) and some food poisoning agents made by bacteria can avoid getting shuttled to the bin.

To better understand this alternative trafficking process, Professor Simpson and his team are working with human cells growing in the lab. They are painstakingly knocking down each of 22,000 genes one by one and looking at how this affects the fate of the E. coli Shigalike toxin when it gets taken up.

Key research interests:

Drug Delivery
Cell Screening
Intracellular Trafficking
Automated Microscopy
Application of Nanotechnology to Cells

"We are working with a safe version of the toxin and we have fluorescently labelled it so we can visualise it as it passes through the different compartments of the cell," explains Professor Simpson.

Manually trawling through the data from millions of cells would be a mammoth task, so the project is using an automated microscopy system that acquires images of the cells and analyses them.

They are currently doing an initial genome screen of the cells challenged with the toxin to narrow down the search for genes involved in its trafficking. "We want to get the 22,000 genes down to a more manageable number of interesting things," says Professor Simpson.

He is also collaborating with Professor Kenneth Dawson and Professor Gil Lee to visualise what happens to cells when you deliver fluorescently-labelled nanoparticles to them.

Drawing up lists of genes associated with the movement of toxins and nanoparticles in cells could help in the design of targeted delivery systems for such agents so they can avoid the lysosome, explains Professor Simpson. "And ultimately, the potential long-term advantage is that you could deliver much lower doses of therapeutic agents and they would be effective."

Dr Brian Vohnsen

Stokes Lecturer, UCD School of Physics

Shedding new light on eye disease

Key research interests:

Biophotonics
Vision
Microscopy
Adaptive Optics
Diagnostic Imaging
Photoreceptor Optics

It's sometimes said the eyes are windows into the soul - but with the right technology they can also offer insights into their own health.

Being able to image tiny structures and cells in the eye can potentially identify the early stages of degenerative blindness, and it may also help eye surgeons carry out corrective procedures. So Dr Brian Vohnsen and his team at the Advanced Optical Imaging Group in UCD are developing ways to image the eye both closely and rapidly.

One of their approaches uses a laser to build up an extremely high-resolution image of the retina - that's the light-detecting area at the back of the eye.

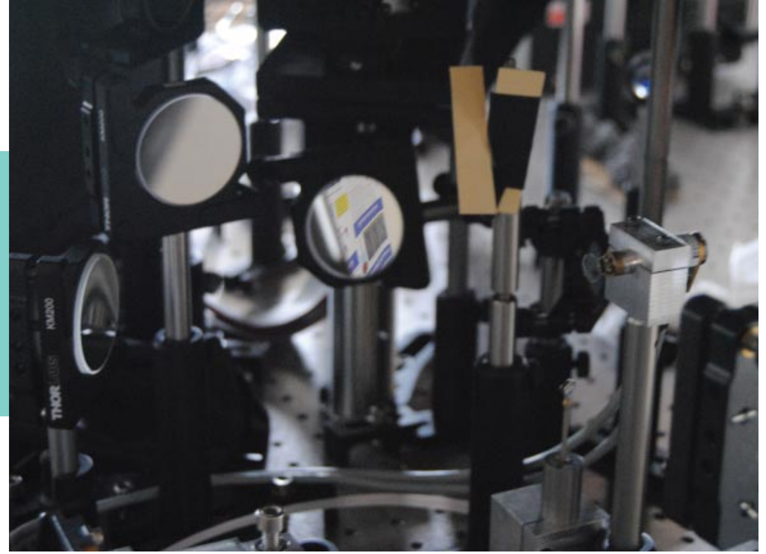
Being able to view it up close may ultimately help clinicians detect the early signs of age-related macular degeneration, or AMD. One of the most common causes of sight loss in the over 50s, AMD involves the progressive death of light-sensitive cells in a key part of the retina. So how does the UCD group get that picture?

"We try to image the retina in the living eye as well as we can," explains Dr Vohnsen, who originally comes from Denmark and is a Stokes Lecturer at UCD School of Physics. "We send a laser beam into the eye, using the pupil as a pivot point, then the eye focuses the beam and we scan line by line across the retina."

By detecting the small amount of light that is reflected back, the approach rapidly builds up a high-resolution image, explains Dr Vohnsen.

At the moment, the usual test for signs of AMD looks for a loss of visual function, but imaging the eye may be able to instead pick up structural changes or 'bumps' that can appear on the retina in early AMD, notes Dr Vohnsen. So far the team has been testing out the approach on their own eyes and they can see light-sensitive cells in the retina. The goal is to capture images from an important section of the retina called the fovea.

"We have patented a technology that can reduce the size of the focal spot so it can be better matched to the fovea," explains Dr Vohnsen. His group, which receives funding from Enterprise Ireland and Science Foundation Ireland, is also looking at ways to image collagen in the cornea, the clear pane over the front of the eye.



Surgeons can carry out corrective procedures that remove some of the corneal tissue, and the imaging technology could ultimately allow them to monitor the corneal collagen in real time, according to Dr Vohnsen. That work is currently being carried out in preclinical models, but in collaboration with consultant ophthalmologist Mr Arthur Cummings, the hope is to translate the imaging technology to the clinic.

The move from bench to industry and bedside is a key focus for Dr Vohnsen, who also set up a Taught Masters Programme in NanoBioScience when he moved to UCD in 2008. "The students learn about optics, nanophotonics, molecules, lasers and innovation," he explains. "And we would like them to apply their research."

Professor Stefan Oscarson

Professor of Chemical Biology, UCD School of Chemistry & Chemical Biology

A sweet trick for fighting infection

We all know that eating too much sugar is not great for your health. But there's more to sugars than the granules you sprinkle into coffee. Sugar structures, or carbohydrates, play important roles in how bacteria, fungi and viruses interact with our bodies and cause infection. And Professor Stefan Oscarson is looking at ways to harness those interactions in our favour - whether to design new antibiotics or improve vaccines.

In some cases, sugar molecules on the surface of cells are like hooks or locks that bacteria and viruses can access by binding to them through proteins on their own surfaces.

This molecular interaction prevents the pathogens from being washed away by mechanical defence systems and gives them the possibility to start an infection and also to go inside the cells, where they are less visible to our immune system and can cause trouble.

Professor Oscarson, who is Professor of Chemical Biology at UCD, and members of his team at the Centre for Synthesis and Chemical Biology (CSCB) and UCD School of Chemistry and Chemical Biology are looking at ways to make mimics of the carbohydrate structures in the lab.

"The idea is that if you can identify these receptors and synthesise a mimic of the carbohydrate, that would then bind to a protein on a free bacterium or virus," he explains. "Then the protein on the pathogen is occupied and it can no longer interact with the receptor on the human cell."

Blocking the binding of bacteria to cells could potentially offer a route to new antibiotics, which are sorely needed due to the rise in antibiotic-resistant strains of bacteria. One of the pathogens that Professor Oscarson is investigating is E. coli, which can cause urinary tract infections, and his team has identified a carbohydrate-based structure that could potentially block the bacterium from accessing human cells.

Another branch of the lab's work looks at using carbohydrate chemistry to improve vaccines. "Many recent mass vaccines in Ireland are based on carbohydrate structures that you find on the surface of bacteria," says Professor Oscarson.

He describes carbohydrate-based vaccines such as the 'Hib' vaccine against a strain of meningitis-causing bacteria as a "tremendous success" but notes there could be room to improve further too. In some cases where the native bacterial structure can't be used a synthetic structure produced in a chemistry lab is an attractive alternative. And it's not just bacteria he has in his sights: he is also looking at how clever chemistry could combat hard-to-thwart fungal pathogens.

More generally, he has also cracked a major challenge in carbohydrate chemistry - while in Sweden he figured out how to increase the yield of sucrose synthesis. While plants make it apparently effortlessly, making table sugar in the lab was difficult as the yields were low.

But in 2000, Oscarson invented an improved method: "Earlier yields were around 10 per cent, but we managed to get a yield of 80 per cent," he recalls. "It was the holy grail of carb chemistry."

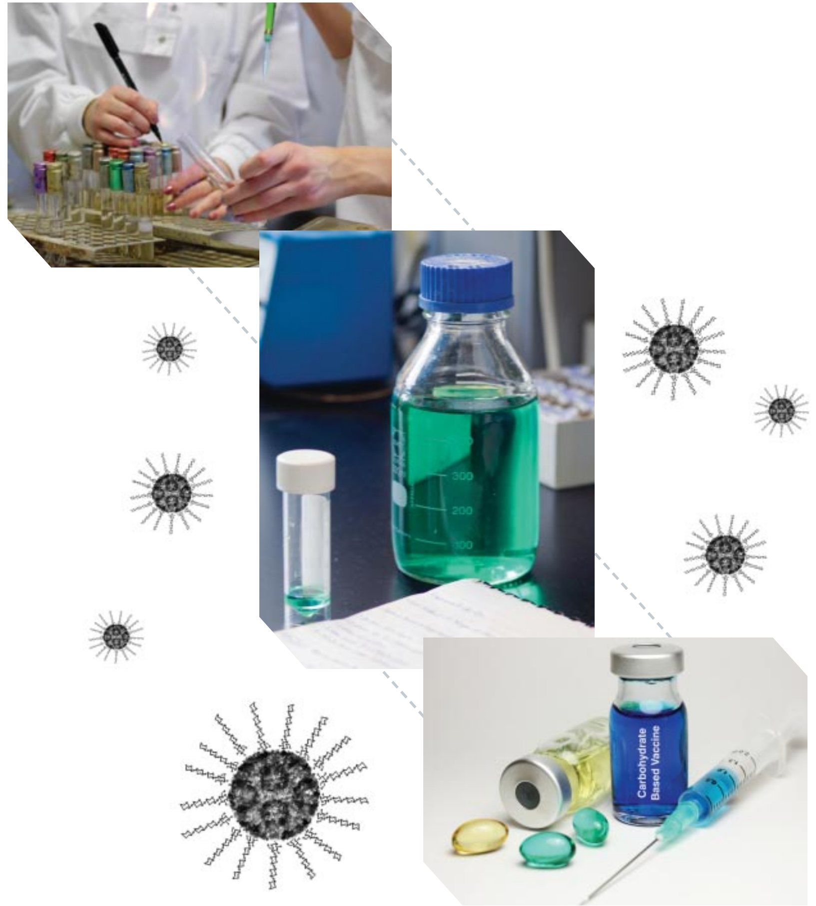
Key research interests:

Synthetic Vaccines

Sugar-based Antibiotics

Carbohydrate Chemistry

Glycoscience



Dr Oliver Blacque

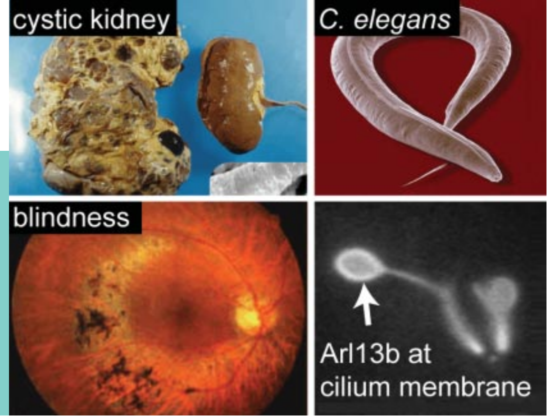
Lecturer, UCD School of Biomolecular & Biomedical Science

Worming out answers about cilia and disease

Key research interests:

Understanding Human Disease using Model Organism

Cilia Diseases: Cystic Kidneys, Blindness, Obesity



What can a tiny worm tell us about human disease? Plenty, if you know what questions to ask and how to wriggle out the answers. And Dr Oliver Blacque does. He is looking to a roundworm to find out more about tiny structures called primary cilia, because it's now emerging that when something goes wrong with such cilia in humans, disease can follow.

Primary cilia are tiny, non-moving appendages that stick out of various cells in the body, and they crop up all through the animal kingdom.

Until recently they were thought to be 'vestigial' structures. But recently the field of cilia biology has blown open, and primary cilia are now thought to play roles in sensory processes, including vision, taste, smell and development explains Dr Blacque, who studied biochemistry at UCD and is now a Principal Investigator and College Lecturer at the UCD School of Biomedical and Biomolecular Science.

"Probably the biggest interest in the field is how cilia sense chemical signals and co-ordinate processes in our bodies," he says.

Cilia dysfunction has been linked to several medical disorders in humans, many of which are rare, but cilia problems are also behind a more common genetic disorder called autosomal dominant polycystic kidney disease, which damages the kidneys over time.

While working as a post-doctoral researcher at Simon Fraser University in Canada, Dr Blacque made a major breakthrough that linked another condition called Bardet-Biedl syndrome (BBS) with primary cilia problems. The list of symptoms in BBS is long - blindness, infertility, mucus in the lungs, organs on the wrong side of the body, kidney defects, bone abnormalities, protruding features on face, fluid build-up in brain, obesity, muscle movement problems and diabetes rank among them - but this just shows how widespread the effects of cilia are, he says.

"We realised the genes behind BBS were also important for maintaining normal cilia function, and that led me into the cilia field."

Dr Blacque returned to UCD and through a Science Foundation Ireland President of Ireland Young Researcher Award he established a lab to look at cilia disease using worms. But these are not just any worms; he is using a tiny roundworm called Caenorhabditis elegans, which is a workhorse of scientific studies: the tiny worms are easy to grow and they share many of the same genes as humans.

"We know that most biological processes share great overlap between simpler and more complex systems," he says. "We wanted to know about the basic properties of cilia-disease genes, and by looking in the worm we have experimental advantages to answer that question a lot faster."

A key approach he takes is to knock out the genes in question in the worm. Then by looking at what happens when a particular gene is no longer functioning, he can get insight into what that gene normally does.

"If you were an alien from outer space and you didn't know how a car worked, you might take out the engine first and see that it didn't move, so you know the engine is involved in movement - we do the same thing genetically," he explains.

Dr Blacque is particularly interested in how cilia-disease genes affect the movement of molecules in cilia. By labelling proteins in the worm and watching under the microscope in real time he can see what happens to trafficking in and out of the cilia when genes of interest are missing. His work - on which he collaborates with colleagues in Canada and Europe - has already identified important genes for controlling entry and exit of molecules into the cilium at its base, and the hope is that the findings will help to shed light on disease processes: "We feel that by teasing out the transport function of the cilia-associated genes we will get a better understanding of how disorders can arise when cilia are not functioning."

Dr Claire O’Connell

Dr Claire O’Connell is a science writer and journalist. She studied science at University College Dublin, starting her undergraduate degree in 1988. She specialised in Botany and then went on to do a PhD in UCD with Professor Finian Martin in the Department of Pharmacology, studying gene expression and morphology in mammary gland development.

In the late 1990s she did post-doctoral research at the University of Glasgow (fruit flies) and the University of Sydney (human brain pathology) before leaving the lab and working in e-learning for several years.

She switched to journalism and has been contributing to The Irish Times and other outlets for more than seven years. She also holds a Masters in Science Communication from Dublin City University.

This publication features Claire O’Connell’s interviews with the following academics: P. Cunningham, M. Meehan, M. O’Neill, G. McGuire, P. Hogan, R. McNulty, F. Paradisi, C. Sweeney, D. Zerulla, C. Bean, T. McMorrow, J. Simpson, B. Vohnsen, S. Oscarson and O. Blacque.

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