Science Foundation Ireland

Science Foundation Ireland:
Celebrating 10 Years of Discovery

SFI **Vision**

Ireland will be a global knowledge leader that places scientific and engineering research at the core of its society to power economic development and social progress.

SFI **Mission**

SFI will build and strengthen scientific and engineering research and its infrastructure in the areas of greatest strategic value to Ireland's long-term competitiveness and development.

Contents

Introduction

At the dawn of the 21st century, Ireland experienced a fundamental change in how academic research is funded here - and that change was to transform the country's global reputation and output in science and engineering.

The stage was already set: the Programme for Research in Third-Level Institutions (PRTLI) was strengthening the infrastructure and research capability, Ireland's economy was on the up and a Foresight exercise had identified where Ireland could carve out niches of expertise that would be valued beyond our borders.

From that vision came Science Foundation Ireland (SFI), the State agency founded to manage investment of public funds into fundamental and excellent research in life sciences and ICT, and later energy was added as a third strand.

The momentum gathered pace, and centres of excellence and research clusters fostered collaborative partnerships between academic researchers, with industry and reaching overseas.

As the capacity built, Ireland's growing reputation of a place to do good science has attracted some of the brightest minds to move here, through SFI award programmes.

Young researchers have been encouraged through SFI programmes to stay in Ireland and put down the roots of their knowledge here, keeping a pipeline of innovative and sometimes game-changing pursuits flowing.

And what happens when you give researchers the space to explore? It allows bright minds to recognise when serendipity strikes and to harness those unexpected discoveries, driving research in new and exciting directions.

As the science and engineering research flourished, the output was further recognised, to the extent that Ireland ranks in the top 20 nations for quality of scientific publications. And in some areas - such as immunology and nanotechnology - we are soaring to the top of the charts.

Patents rose too - in many cases marking the movement of discoveries towards the market or clinic – and industry collaborations between SFI researchers and companies ranging in size from indigenous SMEs to giant multi-national corporations such as Intel and Pfizer now further strengthen Ireland's knowledge economy.

New and innovative Irish companies have developed too on a foundation of SFI-funded research, including HeyStaks, which offers web users a new and more effective way of searching the Internet, and BlueBox Sensors, which can provide real-time readouts of changes in brain chemicals over time.

Over the years SFI has built and worked in partnership with Government Departments and state agencies such as Enterprise Ireland, IDA Ireland, Health Research Board, Higher Education Authority and many more to generate the knowledge that will bring economic benefits and societal value to Ireland.

And while this booklet cannot capture the scope or impact of the full decade of discovery that has been driven by SFI-funded research, it aims to offer snapshots of where the journey is taking us.

10 Discoveries and Developments

1 Closing the gap on junctionless transistors

Prof JP Colinge at Tyndall National Institute has made a junctionless transistor, which can facilitate future miniaturisation and reduced energy consumption of electronic devices. In his device, electron flow is controlled by a silicon gate circling a silicon nanowire. The gate can be "tightened" to restrict the flow of electrons, similar to a ring around a hosepipe restricting the flow of water.

2 Wasting proteins found in Duchenne muscular dystrophy

Prof Kay Ohlendieck's team at NUI Maynooth combed through proteins produced in Duchenne muscular dystrophy and found key molecules linked to the process of muscle cell death in the degenerative condition. They have also demonstrated that a form of genetic treatment can diminish the wasting effects.

3 Getting closer to the Higgs Boson

A team led by Dr Ronan McNulty from University College Dublin was the first to 'rediscover' both the W and Z bosons using the LHCb detector, one of the experiments at the Large Hadron Collider at CERN. This is a key milestone in their hunt for the elusive Higgs Boson, the sub-atomic particle that explains why things are heavy.

4 Blooming genes discovered

Dr Frank Wellmer's lab at Trinity College Dublin formed part of a team that identified genes which are switched on and off for flower development in the well-characterised plant *Arabidopsis thaliana*, or thale cress. The findings could ultimately help to improve crop yields.

5 Key insight into nanoparticle interactions

Prof Kenneth Dawson from University College Dublin found that nanoparticles in a biological system become covered by a cloak or corona of molecules from that system. The finding has fundamental implications for the use of manufactured nanoparticles in medicine, industry and the environment.

6 Better Weather Forecasting

With support from SFI the Irish Centre for High-End Computing (ICHEC) is collaborating with Met Éireann to develop and run both Climate and Numerical Weather forecast models. The aim is to improve the accuracy of weather forecasts, giving better predictions of extreme events such as storms and major rainfall, and to better predict the power output from turbines on wind farms. Running flood models and improved climate models help Ireland prepare for future change, to avoid loss of life and property damage.

7 Getting a grip on graphene

Prof Jonathan Coleman and his team at the Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) have developed a method to split the abundant carbon material graphite down into billions of individual layers of graphene in solution. These atom-thick layers could be used to make stronger and lighter plastics, to enhance electronic processing and improve energy conservation.

8 Unravelling the cause of diabetes

A team led by Prof Luke O'Neill at Trinity College Dublin has discovered that the peptide hormone Islet Amyloid Polypeptide (IAPP), which gets deposited in the pancreas in Type 2 diabetes, is a trigger for inflammatory molecules that damage the pancreas in the disease, offering a new understanding of how the condition arises.

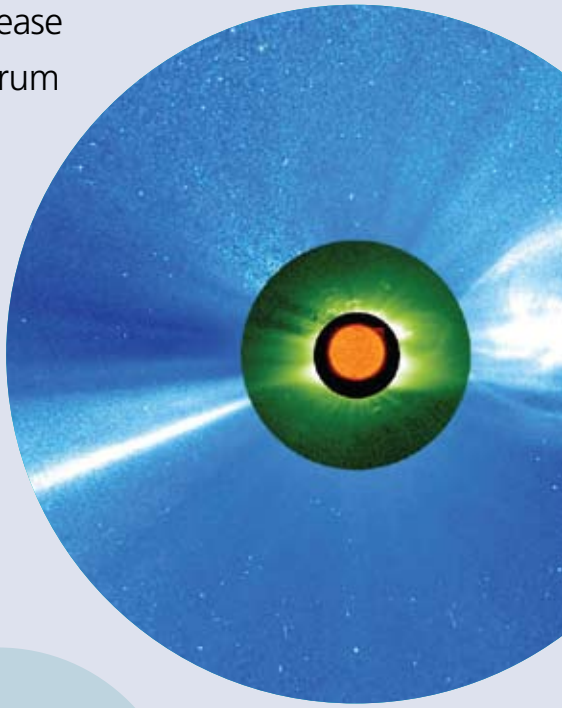
9

A new weapon against a major healthcare bug

Researchers at the SFI-funded Alimentary Pharmabiotic Centre in University College Cork and Teagasc Moorepark have found a new antimicrobial agent, Thuricin CD, that can kill the antibiotic-resistant bacterium *Clostridium difficile*, which poses a major problem in clinical and healthcare settings.

The new antibiotic could reduce the risk of disease recurrence compared with that of broad-spectrum antibiotic treatment, because it spares the normal gut flora that help to limit *C. difficile* growth. Thuricin CD was discovered by screening over 30,000 bacteria isolated from the human gut.

"Thuricin is an important discovery in the search for new therapies to combat *C. difficile* infection," says Barry Kiely, CEO of healthcare company Alimentary Health, to which Thuricin is licenced. "The licensing of Thuricin is proof of how collaborative industry-academic research projects are producing tangible results that will ultimately benefit the end user, and how an Irish biotechnology firm can collaborate with internationally recognised Irish researchers to strengthen Ireland's knowledge economy."



10

Blazing a path from the Sun to Earth

Dr Peter Gallagher's group at Trinity College Dublin has analysed three-dimensional images of the Sun taken by NASA's twin STEREO satellites. The research has identified features of solar storms and the paths of high-energy particles to Earth that stand to improve our forecasts of when disturbances in the Sun's atmosphere are likely to interfere with telecommunications systems on Earth.

10 SFI research links with multi-national companies

1 New views on sporting events

Disney Research and SFI CSET CLARITY are working together to explore how using multiple cameras can enhance the high-end broadcast of major athletic events and bring well-known sports to larger audiences, and how enhanced visuals and statistics can be used by coaches. The findings stand to be applied widely in sports and broadcasting.

2 IBM collaborations

IBM has numerous collaborations with SFI research groups. As an example, IBM has established a 'collaboratory' with Irish Higher Education Institutions, in which IBM researchers will share skills and resources with university researchers to develop knowledge and skills relating to exascale stream computing. The "collaboratory" which is supported by IDA Ireland enables IBM supercomputing and multidisciplinary researchers to work alongside SFI-supported researchers at the SFI CSET Centre for Telecommunications Value-Chain Research (CTVR) in Trinity College Dublin, the Photonics Systems Group at the Tyndall National Institute in Cork, and the Applied Optics Research Group at National University of Ireland Galway.

3 Faster, cost-effective network communications

The Photonics Systems group at Tyndall National Institute works with major international companies – including British Telecom - to discover ways of speeding up and simplifying how information is moved over optical networks. The aim is to support future cost-effective and high-bandwidth connections.

4 Applied optics

Japanese firm Shimadzu, one of the world's leading manufacturers of advanced imaging equipment for medical diagnosis and treatment, is collaborating with the Applied Optics Group at NUI Galway, led by SFI researcher Prof Chris Dainty. The collaboration focuses on the field of imaging techniques, where the NUIG group has a number of patents.

5 Flexible displays for electronics

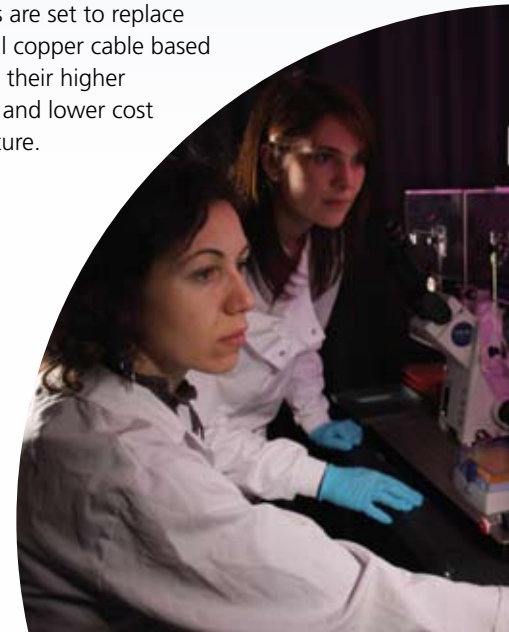
The SFI-funded Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) and Hewlett-Packard are collaborating to develop a cost effective flexible, transparent, thin-film electrode. This is a critical component in the development of new electronic flexible displays that can be used for laptops, e-books and other electronic devices that are ultra-thin, flexible, lightweight and have low power consumption.

6 Monitoring brain chemistry in real time

Prof John Lowry at NUI Maynooth worked with Eli Lilly and Solvay Pharmaceuticals (now part of Abbott) to develop a sensor platform that offers real-time readouts of chemical changes in the brain over time. The system, which was informed by SFI-funded research, has been licenced to spin-out company BlueBox Sensors.

7 Developing better communications systems

Working with Cork-based company Firecomms, researchers at Tyndall National Institute have developed and demonstrated high speed photonic transceivers for next-generation short-reach communication systems. These high-integrated components are set to replace conventional copper cable based systems due their higher bandwidths and lower cost of manufacture.



8 Intel and SFI centres

Intel has strong links with SFI research centres. The Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) has a long history of working with the company on research for its future technologies and products – including a collaboration with Prof Mike Coey on the use of magnetic nanomaterials for data storage. Intel has placed researchers at CRANN, which signifies the special relationship.

Meanwhile Intel has a collaborative programme with Tyndall National Institute to investigate next generation materials, devices and photonics technologies that could have a profound impact on the performance and direction of future electronic devices. The agreement is the first of a kind for Intel in Ireland and establishes a direct collaboration between Tyndall and the heart of Intel's technology research group in the US.

9 Detecting cancer cells in the blood

The Biomedical Diagnostics Institute at Dublin City University is collaborating with J&J's Ortho Clinical Diagnostics Division on an instrument to detect cancer cells in the blood. Their approach aims to advance the sensitivity and use of the company's existing platform for monitoring a patient's response to cancer therapy.

10 Cisco engages with SFI Researchers

Cisco's 170-strong R&D operation in Galway is already making significant contributions to the networking giant's product strategy, especially several unified communications features of Cisco Quad. Notably SFI supported engagement with Cisco include the Digital Enterprise Research Institute (DERI) and Waterford Institute of Technology's TSSG research group.

10 Rising Stars

1

Dr Ross O'Neill
Hamilton Institute, NUI Maynooth

Dr O'Neill has developed MuteButton, a non-invasive system to address tinnitus. The device plays music to the user through their ears and tongue simultaneously in order to target integration centres in the brain and train them to ignore perceived but imaginary sounds in tinnitus.

2

Dr Lourdes Basabe-Desmonts
Biomedical Diagnostics Institute, Dublin City University

Dr Basabe-Desmonts is developing new types of sensing surfaces to monitor the development of adult stem cells. The technique should shed light on the biology of stem cells and also help to enrich stem cell populations for use in cell-based therapies. She was one of four recipients of the 2010 L'Oreal UNESCO For Women in Science Awards (UK Ireland).

3

Dr Andreas Amann
Tyndall National Institute

Dr Amann's research focuses on the use of semiconductor lasers to perform logical operations, similar to those carried out in a computer. By substituting the electronics currently used in computers and telecom equipment with lasers instead, it would be possible to achieve increased telecommunication speeds and bandwidths.

4

Dr Daniel Kelly
Trinity College Dublin

Dr Kelly's work focuses on the development of novel adult stem cell-based therapies for the regeneration of damaged or diseased cartilage in joints. He is also carrying out research on next generation vascular stents for use in the treatment of peripheral arterial disease.

5

Dr David Finn
NUI Galway

Dr Finn is looking at brain receptors, neurochemistry and behaviour in order to increase our understanding of the neurobiological mechanisms that underlie the development and treatment of pain, inflammation, mood disorders and impaired cognition.

6

Dr Silvia Giordani
CRANN, Trinity College Dublin

Dr Giordani's aims to increase the function of nanostructures, tiny objects whose properties are opening new opportunities in manufacturing. One of her projects is to develop nanotubes with molecular switches for smart and sensitive devices.

7

Dr Oliver Blacque
University College Dublin

Dr Blacque is using a roundworm model to tease out the molecular workings of primary cilia, appendages on many animal cell types that have a role in sensory perception. In humans, defects in these functions underlie forms of kidney disease, bone abnormalities and blindness.

8

Dr Barry O'Sullivan
4C, University College Cork

Dr O'Sullivan's research includes real-world applications of artificial intelligence and optimisation in telecommunications and timetabling. He was the first ever Irish researcher to give an invited address at the renowned AAAI (Association for the Advancement of Artificial Intelligence) Conference in the United States.

9

Prof Fergal O'Brien
Royal College of Surgeons in Ireland

Prof O'Brien's group has spent around a decade researching materials based on collagen, the most common protein found in the body, for different regenerative medicine applications including, most notably, bone.

The commercial potential of one particular product is undergoing significant investigation. This is a new bone graft substitute that consists of hydroxyapatite and collagen, which are natural components found in bone itself.

The highly specialised structure and surface of the resulting graft substitute, HydroxyColl, has been optimised so that when the material is implanted at a site of bone injury, it recruits the body's own regenerative mechanisms and encourages bone to repair.

In particular, the porous nature of the HydroxyColl means that fluids can perfuse through it and cells can grow dynamically and form networks. Then the implanted scaffold material biodegrades over time to leave the regenerated bone in place. The material could also be used to help improve the bioactivity of dental and orthopaedic implants.

HydroxyColl is one of a number of products from Prof O'Brien's lab that are being commercialised with support from Enterprise Ireland building on SFI-funded research.

"Moving scientific research into the clinical and /or commercial arena can be a slow process and without adequate funding at the basic research level, the quality of products/therapies developed in Irish universities will be inferior to that required to attract investment, which ultimately benefits the Irish economy," says Prof O'Brien.

"Although there are no guarantees on how successful the products will ultimately be, I believe that the sustained funding provided to my lab by SFI is a good example of how at least we can strive to produce the best therapies possible by funding good scientific research which may eventually translate to the commercial and clinical arenas.

10

Dr Emma Teeling
University College Dublin

Dr Teeling is looking at the genetics of bats. Her work compares genomes of bats and various other animal species to tease out how nature has addressed particular problems and could inform about individual conditions such as inherited deafness, as well as more general ageing and the immune response.

10 SFI researchers **engaging with Irish companies**

1

Teaching old drugs new tricks

Irish biotechnology company Sigmoid Pharma has a long-standing collaboration with Prof Cormac Taylor's lab at Unversity College Dublin. Their studies, which received SFI funding, have led to Sigmoid's innovative formulations being used to treat chronic inflammatory bowel disease by delivering existing medication in a new way.

2

A new test for thyroid disorders

SFI-funded CSET the Biomedical Diagnostics Institute has teamed up with Cork-based company Audit Diagnostics to produce a rapid, low-cost test for thyroid disorders, which can be misdiagnosed due to their general symptoms. The project aims to develop a test that will avoid delayed or incorrectly prescribed therapies.

3

Discovering and organising experts in the enterprise

Companies will be able to keep better track of their in-house expertise thanks to Saffron, an information system developed at NUI Galway's Digital Enterprise Research Institute (DERI) in conjunction with Storm Technology in Galway. Saffron uses text analysis to extract areas of expertise from in-house publications and associates them with those employees that are most knowledgeable on the topic.

4

Getting a closer look at the product

Irish company Eblana Photonics uses the Advanced Microscopy Laboratory at the SFI-funded Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) to image and generate elemental composition maps of tiny structures in their laser emitting diode, which emits at near-infrared wavelengths for high speed optical communications, sensing, measurement and other applications.

5

Delivering innovation in medicine

The Regenerative Medicine Institute (REMEDI) at NUI Galway has a partnership with Galway-based company Creganna-Tactx Medical, which designs and manufactures technologies for minimally invasive delivery and access systems. Together they are developing one-stop platforms to allow stem cells grown at a facility to be transported to a clinical site, thawed and delivered in a rate-controlled manner into the body.

6

Boosting analytical expertise in Irish industry

The SFI-funded Irish Separation Science Cluster, led by Dublin City University, is linking with companies through the IDA to provide research opportunities and training in advanced analytical techniques.

7

Tuning in to next generation communications

Intune Networks is a leader in the area of ultra-high speed switching lasers for telecommunications networks. They are collaborating with the SFI-funded Centre for Telecommunications Valuechain Research (CTVR) and the 'Photonic Integration: From Atoms to Systems' (PiFAS) Strategic Research Cluster. Collaborative topics include coherent laser photonics, integrated optical channel monitors and tunable lasers for the next generation wireless communication schemes.

8

Photonics research

PIFAS (Photonic Integration From Atoms to Systems) is a SFI funded Strategic Research Cluster based at the Tyndall National Institute tasked with the goal of developing and supporting photonics research in Ireland. SensL an Irish SME, is collaborating with PIFAS SRC to develop solid state, low light level detectors based on silicon technology, targeted for use in PET scanners.

9

Managing virtual forests

Collaboration between experts in constraint computation at the SFI-funded centre 4C at University College Cork and Irish company TreeMetrics has led to the development of a system to optimise the management of forest resources.

The Cork firm developed laser technology for measuring trees in the forest, and through an Enterprise Ireland Innovation Partnership 4C helped TreeMetrics convert that data into knowledge that means better use of our forest resources, not just in Ireland but worldwide.

"We found out by pure chance that there was a world-leading optimisation lab in our own city and we quickly picked up the phone," says TreeMetrics CEO Enda Keane. "The most important point is, they delivered the technology for us - it has given us a real edge. They delivered."

The company, which now offers measurement and 'virtual sawmill' technology to analyse forest resources quickly and accurately, is now working with partners and clients around the world.

"We like to say we help computers to help people make better decisions," comments Prof Eugene Freuder from 4C. "TreeMetrics had some data that may have been of some use already but we wanted to transform it into more knowledge and help people make better decisions in the forestry area."

10

Targeting immune disease

One of Ireland biggest success stories in moving research output towards the clinic has been Dublin-based Opsona Therapeutics.

With its origins in SFI-funded research carried out at Trinity College Dublin, Opsona has been developing and testing therapies to selectively target important molecules in the immune system called toll-like receptors that drive chronic conditions such as arthritis as well as problems of rejection after transplants.

Putting it firmly on the world stage, the biotech company has also set up a large-scale collaboration with Pfizer, with the aim of discovering new agents for the treatment of autoimmune and inflammatory diseases.

10 Tales of the Unexpected

1

New test for blood cells, RCSI/BDI

A Science Foundation Ireland-funded project that set out to examine blood cells called platelets, which are important clinical indicators in cardiovascular disease, has come up with a novel test that can open up new research into the field.

"The question we were asking was if we study individual platelets can we understand new biology, and while studying techniques to do that we came up with a new assay," explains Prof Dermot Kenny from RCSI, who collaborated on the project with the Biomedical Diagnostics Institute at Dublin City University.

The test they have developed deposits platelet-specific proteins on to a glass chip in a defined pattern, then as a blood sample washes over it the platelets stick to the chip. The micro-patterning of the proteins on the chip allows researchers to tailor the platform to isolate platelets expressing particular proteins, and the approach, which has been successfully tested in patients, stands to open up new avenues of research in platelet adhesion and function, and possibly diagnostics.

"We started off on one track and we ended up with what could be a commercial test, and that came out of doing good science," says Prof Kenny.

2

Malaria response gene turns up

While investigating how auto-immune diseases are triggered in the body, Prof Luke O'Neill from Trinity College Dublin and collaborators in Oxford made a fortuitous breakthrough in understanding an individual's response to malaria: if a gene called Mal is overactive it means the person is more likely to succumb to the disease.

3

Unexpected role for cell death proteins

Research into the complex mechanisms behind how cells die took an unexpected twist when Prof Seamus Martin's lab at Trinity College Dublin discovered that members of a key family of proteins called Bcl-2 - which are the targets of potential anti-cancer therapies - may not only have a role in cell death but also in the function of cell components called mitochondria.

4

Building blocks for new drugs

A team led by Prof Pat Guiry at University College Dublin cracked a problem that had puzzled scientists for decades when they discovered a selective way to make a particularly important class of compound, or building block, when they were working with metal-complexes of their own ligands. The finding could help boost the design and discovery of new therapeutic agents.

5

Speed gene test for horses

While analysing genes in thoroughbred racehorses, Dr Emmeline Hill at University College Dublin identified important genetic information relating to racing performance, paving the way for the development of a commercial 'speed gene' test to help match horses with courses and inform breeding and training decisions.

6

Down Syndrome genetic clues

During a trawl through genetic evolution over the last half-billion years, Dr Aoife McLysaght at Trinity College Dublin unexpectedly discovered a dosage-balance pattern in several genes relating to Down Syndrome and highlighted other genes that may be linked to the condition. The findings could shed light on maintaining the health of people with Down Syndrome into older age.

7

A quicker way to detect radiation exposure

Research by Dr Ciaran Morrison's group at NUI Galway found that DNA damage causes cells to make more 'centrosomes', small structures important for cell division. This finding is now being applied in a European study to develop faster procedures to screen for radiation exposure in humans.

8

New cell found in the immune system

Working with collaborators in the UK, Prof Padraic Fallon from Trinity College Dublin identified a previously undiscovered white blood cell called the nuocyte that is involved in allergic responses. The discovery could aid the development of new treatments for asthma and other allergic diseases.

9

Ocean technology to pick up heart problems

Dr Scott Rickard at University College Dublin uses the mathematical technique 'blind source separation' that was originally developed for use in US Navy submarines to allow the sonar system to distinguish between multiple different sound reflective bodies in the water. But Rickard is using the same technique to develop a wearable heart monitor (integrated into a vest) that will be able to detect blockages in the coronary arteries. This has the potential to replace invasive techniques such as angiograms.

10

A light switch moment at CLARITY

Dr Robert Byrne's group from SFI CSET CLARITY was researching a type of chemical mixture called ionic liquids, and discovered that by turning on and off light probes they could control the viscosity of the liquid. This has led to the development of an optically switchable valve for microfluidic devices, which they hope will replace mechanical-based valving technology that requires extensive power and electrical connections.

10 Researchers who moved to Ireland

Eugene Freuder: helping computers help people make better decisions

1

4C, a computer science research lab at University College Cork that uses computers help people make better decisions, was formed when Prof Freuder moved his research lab from the US to merge with the UCC Constraint Processing Group. Prof Freuder is a Member of the Royal Irish Academy, a Fellow of the American Association for the Advancement of Science and was the founding Editor-in-Chief of the journal Constraints.

Chris Dainty: improving the visual world

2

Prof Dainty moved from Imperial College to NUI Galway in 2002, where he founded the Applied Optics Group, which focuses on adaptive optics, vision science, imaging and scattering. Prof Dainty has served as President of the International Commission for Optics and the European Optical Society, and in 2011 is President of the Optical Society of America.

Ulla Knaus: dissecting our response to disease threat

3

Prof Knaus moved from The Scripps Research Institute in La Jolla, California to the UCD Conway Institute of Biomolecular & Biomedical Research on a SFI Stokes Professorship. Her work looks at some of the molecular mechanisms our body's immune system uses against invading disease-causing organisms.

Jochen Prehn: looking at matters of cell life and death

4

In 2003, Prof Jochen Prehn moved from the Johann Wolfgang Goethe University Clinic in Frankfurt, Germany, to the Royal College of Surgeons in Ireland. Prof Prehn uses imaging, mathematical and molecular techniques to understand processes that underpin cell death and cell survival, which are of relevance to neurological disorders, cancer treatments and diabetes mellitus.

Lokesh Joshi: investigating the sweetest of sciences

5

Prof Joshi moved from Arizona State University to the National Centre for Biomedical Engineering Science at NUI Galway, where he is SFI Stokes Professor of Glycosciences and leads the Alimentary Glycoscience Research Cluster. His work looks at the structures and roles of sugar chains in health and disease conditions in biological systems, and seeks the potential for new technologies, biodiagnostics and biotherapeutics.

Walter Kolch: a bird's eye view of cancer and stem cells

6

Prof Kolch came to University College Dublin from the Beatson Institute in Glasgow, where he was examining cellular systems relating to cancer. He now directs Systems Biology Ireland, a CSET that combines the power of maths, computer models and biology to address questions about how cancer and stem cells operate, which stands to open up avenues for more effective therapeutic drug design.

Suzi Jarvis: improving tools for nano

7

In 2002, Prof Jarvis moved from the Nanotechnology Research Institute in Tsukuba, Japan, to Ireland with SFI funding. Now based at University College Dublin, her work is improving techniques to look at biological structures on the nanoscale and gaining insights into clinically important structures such as amyloid, which has relevance in Alzheimer's disease.

Jonathan Blackledge: Dublin Institute of Technology (DIT)

8

Prof Blackledge came to his post as SFI Stokes Professor of Information and Communications Technology at Dublin Institute of Technology with a wealth of experience and world renown in engineering, computing and mathematical sciences, having held academic posts in the UK, South Africa and Poland. Current research interests include biomedical signal analysis, audio data processing, financial mathematics and cryptology.

9 Stewart Fotheringham: putting information in its place

There's no shortage of data in the world today, and the emerging field of 'geocomputation' aims to make that information more useful by capturing, visualising, analysing and modelling data linked to points in space.

The approach can extract useful information about a multitude of important topics, including health service provision, coastal flooding and trends in crime.

Leading the charge in Ireland is Prof Stewart Fotheringham, who moved to NUI Maynooth in 2004 through SFI's Research Professorship scheme.

There he established the National Centre for Geocomputation, which is now regarded as one of the top-five geocomputation centres in the world. And more recently, SFI has funded the Strategic Research Cluster in Advanced Geotechnologies (StratAG), which is based at NUIM but also brings in Trinity College Dublin, Dublin Institute of Technology and University College Dublin.

"The burgeoning field of geocomputation is a very practical science which aims to provide decision makers in public bodies and private industry with vastly better information from which they can make important decisions," says Prof Fotheringham, who was actively involved in large GIS (geographical information system) based initiatives in the USA, Canada and the UK before moving to Maynooth.

"It is about spatial data, and that means any data that can be linked to points in space, each with an X-Y co-ordinate. The location is linked to other 'attributes', which could be figures for crimes, unemployment rates, incidence of a particular disease, pollution levels – there are infinite possibilities."

Research at the National Centre for Geocomputation and StratAG includes projects as diverse as developing in-car navigation systems that can update drivers in real time about road conditions, more 'intelligent' cities and carving up Ireland into more useful spatial units to improve data collection and analysis.

10 Prof Oliver Dolly: New uses for next-generation Botox

Botox, may have made its way into common parlance thanks to its wrinkle-smoothing effects, but SFI Professor of Neurotherapeutics Prof Oliver Dolly, based at Dublin City University, has been working with Allergan on clinical uses of botulinum neurotoxin, including tailoring a variant of the protein to target sensory nerves and alleviate pain. Prof Dolly was attracted back to DCU from Imperial College London following the award of a SFI Research Professorship.

10 International Collaborations

1 GAIA: shortening software development cycles

Lero, the SFI-supported Irish Software Engineering Research Centre, and NUI Galway played an important role in an EU-wide project called GAIA, which used agile software methods to help shorten development cycles. The project's motto? 'From idea to product in 6 months'.

2 Understanding a disease-causing fungus

Dr Geraldine Butler's lab at University College Dublin was part of an international consortium that made major breakthroughs in the genetics of a clinically important Candida species of fungus. From genetic information they identified increased copies of genes involved in adhesion and in the cell wall, and the insights may lead to new treatment methods for Candida infections.

3 Finding an early signature of pregnancy complication

Prof Louise Kenny at University College Cork has worked with teams around the world to find a signature of metabolic 'biomarkers' that can identify in early pregnancy which women will go on to develop a potentially fatal complication called pre-eclampsia. The Scope study, which was part-funded by SFI, paves the way for a new test in the clinic.

4 Looking for the next silicon

Researchers from Tyndall National Institute are working with the University of Texas at Dallas, Queens University Belfast and Dublin City University to explore the use of new semiconductor materials with the potential to create more energy-efficient transistors for ICT. More efficient gate oxide materials would not only support further miniaturisation but also improve the battery life of portable devices.

5 Unravelling brain connections

Dr Kevin Mitchell's lab Trinity College Dublin is teaming up with scientists in Oxford to help figure out how our brain cells are guided to wire together correctly. They have identified at an atomic level how some key proteins interact to 'tell' cells to avoid each other. Developing ways to control such reactions could offer a way of helping nerves regrow after injury.

6 Translating patent information

The Centre for Next Generation Localisation at Dublin City University is a partner on PLUTO (Patent Language Translations Online), an EU project that aims to facilitate patent searches in different countries by translating information into the relevant languages. CNGL bring to the target platform a state-of-the-art translation engine, MaTrEx.

7 Getting new insights into cancer processes

SFI-funded researchers Prof Walter Kolch and Prof William Gallagher at University College Dublin are leading two major EU-wide cancer projects: one to explore the genetic mutations that lead to the development of childhood cancers and the other to investigate therapeutic approaches for a type of hard-to-treat breast cancer.

8 Putting sensors to work

A long-term collaboration between Prof Dermot Diamond's lab in the CLARITY CSET and Gordon Wallace's team at the University of Wollongong has worked on developing 'smart' sportswear that incorporates textiles modified to make garments 'self-aware' (capable of sensing heart and breathing rate, for example) and the development of a robotic fish (WANDA) for environmental monitoring that incorporates an integrated micro-videocamera, wireless communications and artificial muscle fins for movement.

9 NEMO: Monitoring 'invisible' seizures in vulnerable babies

Seizures or 'fits' are the most common neurological emergency encountered in the neonatal intensive care unit (NICU) – they are caused by problems such as lack of oxygen around the time of birth, haemorrhage and meningitis.

But here's the problem: seizures can be very difficult to detect in newborns, and there may be no obvious outward signs that the baby is experiencing one, making intervention or treatment difficult.

The only accurate tool for diagnosis is EEG monitoring, a measure of electrical brain activity, but newborn EEG interpretation is a highly specialised skill and few experts are available.

Dr Geraldine Boylan, who directs the Neonatal Brain Research Group at University College Cork, has been carrying out research with collaborators into automating EEG interpretation so that seizures can be detected reliably in the NICU.

Cork is part of an EU-wide project, NEMO, to further develop and test the technology so that seizures can be detected rapidly and the information can be shared with specialists remotely so timely decisions can be made for treatment.

10 Fuel-producing bugs

SFI-funded scientists at University College Cork have worked with researchers at University of Kent to show that simple bacteria can be modified to produce biofuels and medicines and help reduce our over-reliance on oil-derived products. The bacteria can be manipulated to construct internal pockets inside themselves that work as mini-factories where biofuels and medicines could be produced.

10 Education and Outreach Programmes

1

Reaching out from CSETs

Each of SFI's Centres for Science, Engineering and Technology supports active education and outreach. Initiatives have included public talks from SFI-funded researchers aimed at engaging the wider public, games for schoolchildren using sensor and interactive technology being developed at CSETs and school essay competitions that encourage teenagers to think about the impact of science on society.

2

Science Gallery

SFI-funded researchers work with the Science Gallery in Dublin on specific exhibitions to capture the public imagination. Popular installations have included Bubble, which explained the physics behind the mesmerising soapy structures, while 'Infectious! Stay Away' exposed the visiting public to plenty of science about bugs and disease.

3

Robot competitions

There's nothing like a bit of healthy competition to encourage participation, and when robots are involved too, the formula never fails. Tournaments such as RoboRugby and Robocup encourage students at SFI-funded centres to engage with computer and robotic technology, going on to compete in the international competitions.

4

Young Scientist Exhibition

SFI engages with the annual BT Young Scientist and Technology Exhibition by maintaining a public stand and offering an award to the project that most advances research in the areas of science and/or engineering supporting sustainable energy and energy efficient technologies. The yearly event draws hundreds of projects from primary and secondary school students around Ireland.

5

Fostering a better understanding of stem cell research

The Regenerative Medicine Institute (REMEDI) at NUI Galway is a partner on the EuroStemCell project that connects European citizens with stem cell research. The project unites more than 90 European stem cell and regenerative medicine research laboratories in a co-ordinated effort to engage with the public about their science.

6

It's a rap for science

The Alimentary Pharmabiotic Centre at University College Cork is has struck the right note with their Science Raps Challenge, a competition aimed at encouraging students to express their thoughts about science and technology through rap music. The initiative has spawned creations such as "Spectrometry Rap" and "Genesis Lab Rat Rap Irish Hip Hop".

7

The Investigators

SFI provided funding for a successful TV series about Irish researchers, their impacts and wider fields of study. The series, The Investigators, was aired on RTE television and topics included Ireland in space, ageing, sensors, climate change, crops of the future and the 'nano' revolution.

8

Analysing Language

The Centre for Next Generation Localisation (CNGL), an SFI-funded university-based research consortium located at DCU, UCD, TCD and UL organises the All-Ireland Linguistics Olympiad. CNGL invites transition-year and 5th-year students in Ireland with an interest in languages and use their analytical skills to learn about linguistics and participate in this fun competition, with a view to representing Ireland in the International Linguistics Olympiad.

9

Speakers for schools

A talk by a scientist or engineer can be a welcome and fun event for students in their schoolday. The SFI website lists a range of speakers from around the country who are happy to come in and talk to students about their fields and what life is like for a researcher. Such exercises can have enormous impact on the next generation of Irish scientists and engineers.

The Speakers for Schools programme links SFI investigators with schools to help advance public understanding of science and engineering. Through the programme, over 100 researchers have given talks on their own research, more general science and engineering topics, or on careers in science and engineering.

Topics include from '*How to think like a computer*' (Prof Kevin Ryan, The Irish Software Engineering Research Centre, UL), '*Why Blood is Red – Drugs, Vampires, & Medicine*' (Prof Mathias Senge, TCD), '*Pregnancy - So difficult, that's why only women can do it*' (Prof Louise Kennedy, UCC), '*How ecstasy affects your brain*' (Prof William O Connor, UL), '*Robots are invading our lives*' (Brian MacNamee, DIT) and '*Email and Web Spam: What it is and how to combat it?*' (Dr Sarah Jane Delany, DIT).

10

Ireland's Only Computer & Communications Museum

Located in the Digital Enterprise Research Institute (DERI) at NUI Galway, this collaboration with eGalway tells the fascinating story of key moments in the history of communications. It looks at the impact of the radio, has a section dedicated to computer gaming, considers the growth of new communications industries on Ireland and tracks the development of the portable computer, printer and microprocessor.

10 Areas of Focus

1

Nanotechnology: the big impact of small particles

Nanotechnology is a rising tide that lifts many boats. As science and engineering converge on this tiny scale, where materials acquire new and useful properties, more functional products are in the offing - such as smaller and faster computer chips and more targeted agents for diagnosing and treating disease.

Since making its first funding awards in 2001, SFI has supported nanotechnology and nanoscience-related activities as part of its core objective of funding quality scientific research in ICT, the life sciences and energy.

In particular, the SFI-funded centres CRANN (Centre for Research on Adaptive Nanostructures and Nanodevices) at Trinity College Dublin and Tyndall National Institute in Cork have been crucibles of academic and technical excellence and industry engagement, working with a range of Irish and multi-national partners in areas as diverse as telecommunications, medical devices, solar energy conversion, flexible display materials and energy-efficient electronics.

But while nanoscience forges ahead, it is crucial to understand its safety and the interactions of engineered nanoparticles with the environment – including our bodies – and the SFI-funded strategic cluster BioNanoInteract is one of the world's leading centres for these investigations.

2

Immunology: in our self-defence

The immune system is a factor in a wide range of diseases, from the sudden onset of potentially fatal sepsis after surgery to more chronic conditions like heart disease, arthritis, multiple sclerosis and cancer. SFI funds the Immunology Research Cluster at Trinity College Dublin and NUI Maynooth, and welcomed the announcement in 2010 by Thomson Reuters' Essential Science Indicators Database that Ireland is among the world's leading nations in this field, behind only Switzerland and the United States.

3

Semantic web: making the Internet smarter

Looking for what you want in a sea of online information can sometimes lead to frustration. But the growing 'semantic web' aims to make more sense of the data by describing and linking datasets so that computers can identify connections between them and return more meaningful search results. The SFI-funded Digital Enterprise Research Centre at NUI Galway is an internationally recognised institute in semantic web research, education and technology transfer.

Financial services: calculating the risk

4

The Financial Mathematics Computation Cluster (FMC2) seeks to encourage the growth of the financial services sector in Ireland by carrying out research into areas such as asset management and financial risk. The SFI-funded collaboration is between University College Dublin, Dublin City University and NUI Maynooth and is supported by several industry partners, including Pioneer Investments Ltd, Ryan Capital Ltd and the Institute of Bankers in Ireland.

Constraint computation: making hard choices easier

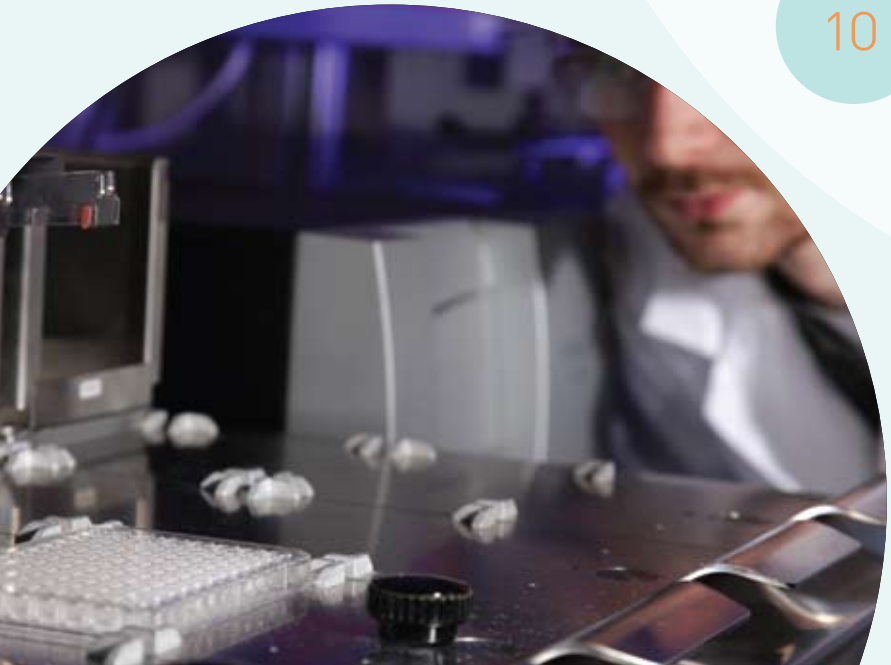
5

We all like to have choices in life, but sometimes having too many choices can pose a problem. Constraint computation offers a way of representing knowledge and optimising choices, and the Cork Constraint Computation Centre (4C at University College Cork) is enhancing the approach and applying it in domains as diverse as energy, healthcare, manufacturing and telecommunications.

Regenerative medicine: getting to grips with a leading edge of medicine

6

Stem cells and gene therapy hold enormous promise for managing and possibly even curing diseases once thought unassailable. The SFI-funded Regenerative Medicine Institute (Remedi) based at NUI Galway is delving into the biology, development and application of gene and adult stem cell therapies, looking to harness their capacity in treating conditions such as heart disease and joint problems.



Diagnostics: detecting disease quickly and conveniently

7

In the future, trips to the clinic could mean a confirmed diagnosis on the spot – and in some cases you may not even have to leave home. Point-of-care diagnostics and remote health monitoring are rapidly emerging areas, and the SFI-funded Biomedical Diagnostics Institute is developing platforms to detect signs of disease early, often from a patient sample of only a few drops of blood.

Energy: the newest strand

8

When SFI was founded the main areas of research funding were in ICT and life sciences. Since then, energy has been added and in 2008 SFI assumed administrative responsibility for the Charles Parsons Awards, which fund key areas of energy-related research around Ireland including electricity generation and sustainable sources of energy such as the ocean and microbial activity.

Advanced drug formulation: improving design

9

Producing active ingredients for medicines is a major activity in the Irish pharmaceutical sector. The SFI-funded Solid State Pharmaceutical Cluster, led by the University of Limerick, analyses mechanisms that allow pharmaceutical solids to be produced with predefined characteristics, and the objective is to rationally design solid-state pharmaceutical materials to meet the demands of advanced formulation and drug delivery systems.

Telecommunications: managing network traffic

10

The Internet is an old infrastructure trying to cope with the demands of enormous volumes of traffic. A Strategic Research Cluster called FAME (Federated, Autonomic Management of End-to-end Communication Services), led by Waterford Institute of Technology, aims to reduce the resulting congestion by developing 'autonomic management' on networks so resources are used more dynamically.

10

Things You May Not Know About

SFI Research

1

Obama administration uses SFI-funded web technology

US President Barack Obama's administration chose to use Internet technology developed at the SFI-funded CSET DERI in NUI Galway in its economic stimulus package website Recovery.gov. The web standard, Semantically-Interlinked Online Communities or SIOC, aims to connect online community sites and internet-based discussions.

2

SFI researcher was first to decode an Irish genome

A team led by Prof Brendan Loftus at University College Dublin was the first to decode and publish analysis of an Irish genome. Taken from a male of Irish descent, the data stand to offer an insight into DNA variation associated with Ireland's island population.

3

The world's purest quantum dot came from Cork

Researchers at the SFI-funded Tyndall National Institute developed the purest nanometre-scale semiconductor "quantum dots" that show a record improvement in optical characteristics over the best previously reported results. This progress promises to pave the way to improved optical sources and applications in the field of quantum communication and computing, such as ultra- secure communication systems.

4

A standard cryptographic algorithm contains the name of an SFI researcher

Prof Michael Scott at Dublin City University made an important contribution to the field of cryptography, an important component of Internet security, when he helped discover a new "pairing" algorithm that was hundreds of times faster. The standard algorithm for implementing "pairings" is now called the BKLS algorithm - and the S at the end stands for Scott.

5

SFI Researcher is one of worlds most cited computer scientists

Prof Des Higgins at University College Dublin has one of the most cited computer publications, although interestingly he is a biochemist. In the 1980s he co-developed CLUSTAL, a programme to align DNA and protein sequences, which became one of the most widely used bioinformatics tools in the world. One of the papers describing this work is the 10th most cited scientific publication of all time.

6

Twitter translation for World Cup

SFI researchers at the Centre for Next Generation Localisation (CNGL) developed a translation service called "Twanslator" for the online social media site Twitter so fans could translate updates, or tweets, about the World Cup football tournament. The system instantly translated and streamed tweets from six European languages into English and vice versa.

7

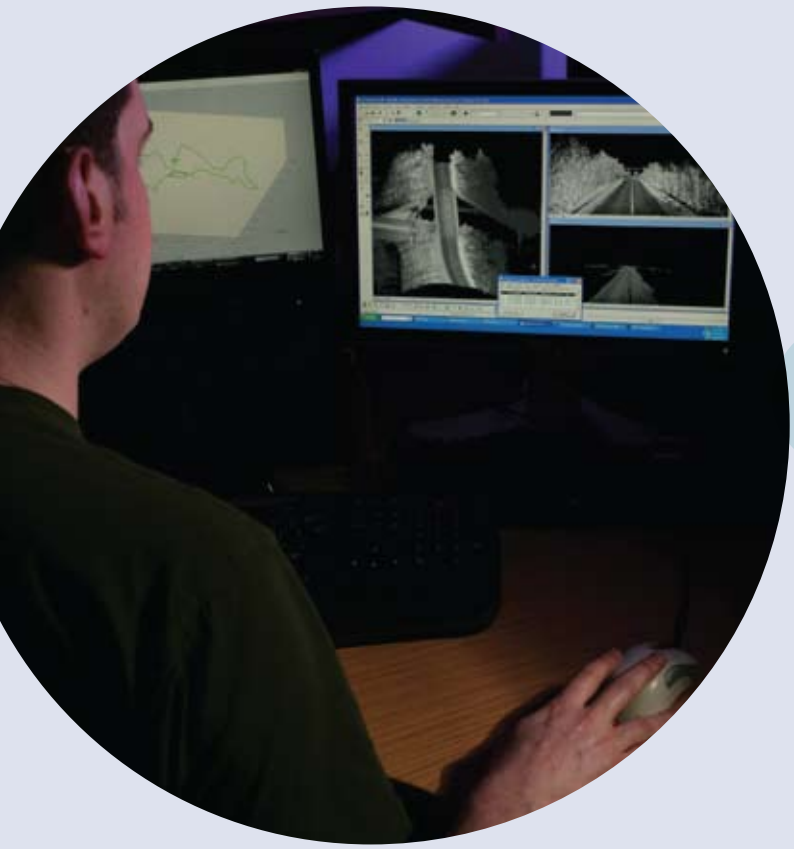
Microsopy lab at SFI centre is among world's top facilities

The Advanced Microscopy Laboratory at the SFI-funded centre CRANN in Trinity is one of only a handful of such facilities worldwide. The suite of powerful instruments not only allows scientists to see material and biological structures at the nanoscale but also to alter and fabricate nanostructures to offer new functions.

8

Increased recognition of Irish research output

The first decade of the 21st century has seen Irish research output change substantially, and the quality of that output has driven Ireland from a global citation ranking of 36th in 2003 to 19th in 2008. Certain areas of excellence have shone particularly brightly, including immunology and material science, based on the quality of publications.



9

SFI resarcher's Oscar-winning role

Prof Anil Kokaram won an Oscar for the development of visual effects software for the film industry. He worked as a consultant with the UK-based The Foundry, a leading developer of image processing software for the post-production industry, and won his Oscar in 2005.

The visual effects and image-processing software developed by Prof Kokaram and the team have been used on a host of high-profile feature films including Casino Royale, X-Men, The Last Stand, The Da Vinci Code and Charlie and the Chocolate Factory.

10

UCC/Tyndall at the top of the microelectronics world

The Irish approach to promoting interaction between universities and industry in the field of microchip design was recognised as the best in the world at a conference in San Francisco in 2009. Representatives from University College Cork and the SFI-funded Tyndall National Institute received the Outstanding Chapter of the Year Award from the IEEE Solid-State Circuits Society, the world's largest professional association in the field.


Science Foundation Ireland: Celebrating Ten Years
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