LIST OF FUNDED PROJECTS

Awardee	Research Body	Proposal Title	Award amount	Summary
STEM Projects				
Colm Delaney	Trinity College Dublin (TCD)	Biomimetic nanocomposite architectures for responsive photonics (BIONICA)	€590,513.90	The origins of structural colour in nature has been traced back over 515 million years. In the plant and animal kingdoms, its presence has been attributed to camouflage, signalling, mimicry, and distraction. As the vibrancy and striking reflection suggest, the mysticism of structural colouration is found in its incredible intricacy, and the ability to create multilayer reflectors, diffracting grating, and scattering features, using naturally high refractive index materials, such as guanine, cellulose, and chitin on the nano and macro scales. Not only do these give rise to the most beautiful and strongest colours observed in nature, the dazzling iridescent shades of such as beetles, butterflies, chameleons, but they can actually be modulated by in a split second to blend in, stand out, or completely disappear. While scientists have agreed on the value of such materials, synthetic analogues with such functionality have not come close to the complexity or responsiveness of hierarchical photonic structures found in nature. This project will combine, self-assembling nano materials, stimuli-responsive polymers, 2 photon-polymerisation, and numerical simulation to yield programmable photonic structures, colour-mixing, angle independent colouration, and image encryption, which represent a new generation of dynamic photonic devices.
Nidhi Kedia-Mehta	Maynooth University (MU)	MAIT-NK cell interactions might underpin dysfunction of NK cells in obesity and obesity related cancers	€592,832.66	Natural killer (NK) cells are a critical component of the anti-tumour response. NK cells are involved in immune surveillance and are highly cytotoxic against tumour cells. A loss of NK cell activity results in increased tumour burden and poor prognosis, as is observed in obesity. Recently, Mucosal Associated Invariant T (MAIT) cells have been highlighted as potent regulators of NK cells. MAIT cells can drive strong NK cell responses via their production of interferon-gamma (IFN-?). Conversely, interleukin-17 (IL-17) production by MAIT cells inhibits NK cells, leading to tumour progression in murine models of disease. In obesity, MAIT cells display defective IFN-? production with a strong IL-17 bias. It is currently unknown if altered MAIT cells in obesity are driving/exacerbating the defective NK cell responses reported. In the proposed study, we aim to elucidate the molecular and metabolic mechanisms via which MAIT cells regulate NK cell responses in the steady state. We will also investigate how “obese” MAIT cells dysregulate NK cells. Finally, we aim to explore if glucagon like peptide-1 (GLP-1), a potent weight therapy, GSK3 inhibitor and ROS scavengers can normalize MAIT-NK cell interactions in people with obesity.

Jatin Nagpal	University College Cork (UCC)	The role of early-life microbiome in sculpting stress-social neural circuits in zebrafish.	€592,401.80	Mental health disorders are debilitating and increasing. The causal mechanisms underlying these conditions, many affecting social interaction and response to stress, often emerge during early brain development. Stress and social behaviours are closely intertwined; they share neuroanatomical circuits and modulators in the brain and reciprocally affect each-other. Maturation of the host-associated microbiota also occurs during the same early critical window. Alterations in microbiota have been linked to both, social phenotypes associated with neurodevelopmental disorders as well as anxiety disorders. In this project 'brainbiome' , I propose to use zebrafish, a naturally gregarious model with conserved neuroanatomy, to investigate the mechanistic link between the microbiota and development of stress-social circuits. Harnessing the transparency and external development of zebrafish, the oxytocinergic hypothalamic structure-function will be analysed as a function of early-life microbiota and exposure to stress, using neuroanatomical, endocrine and behavioural approaches. Integration of host and microbiota genomics and metabolome as well as activity imaging of enteroendocrine-vagus route will shed light on the mechanisms of microbiota-neurodevelopment cross-talk. The key findings distilled from these experiments will then be translated to zebrafish models of early-life microbiota disruption with the aim of rescuing the stress-social deficits associated with these models using microbiota-based therapeutics.
Alessandra Imbrogno	Tyndall National Institute (TNI)	Green energy storage: development of sustainable supercapacitors by direct laser writing of natural materials (SUPER-GREEN)	€570,726.40	The rapid increase in demand for powered IoT sensor devices poses environmental concerns both in terms of high energy production requirements and end-of-life disposal. Implementation of eco-friendly energy storage systems and self-powered solutions is crucial to ensure future sustainability of the IoT sector. Accordingly, SUPER-GREEN proposes the development of novel self-powered and eco-friendly supercapacitors whereby electrode materials will be fabricated by direct laser writing of biopolymers and eco-friendly materials will be used as electrolytes. Self-powering features based on triboelectric processes will be incoroporated, also using low cost environmental materials. The final aim is the ambitious realisation of compostable and green supercapacitors. Based on initial proof-of concept supercapacitors realised from cork and chitosan-based polymers, our aim is to expand both the performance and the low environmental footprint of our fabricated devices and to test their performance for practical IoT powering applications. The compostable nature of the “all natural” supercapacitive platforms will be assessed, thus opening the way for future development of energy storage platforms with fully degradable capabilities.
Despina Bazou	University College Dublin (UCD)	Extramedullary disease in Multiple Myeloma - Finding new therapeutic targets by dissecting the cell heterogeneity with an integrated transcriptomic and proteomic analysis	€591,659.50	Multiple Myeloma (MM) is a neoplastic plasma cell disorder characterised by clonal proliferation of malignant plasma cells in the bone marrow. Despite improved survival rates, therapy is not curative and all patients ultimately relapse. MM can eventually progress to extramedullary disease (EMD), which indicates that malignant plasma cells migrate outside of the bone marrow. To date, no official guidelines regarding EMD treatment are available globally. Thus, clinicians treat it as the primary disease, despite being known that EMD is already resistant to MM first-line therapy. There is urgent need to elucidate the molecular mechanisms behind EMD metastasis and identify therapeutic targets that can arrest EMD and thus extend overall patient survival. To address this need, I will use a Multi-Omics approach to: i) identify the transcriptomic and proteomic profile that discriminates EMD from non-EMD MM disease; ii) investigate the role of immune cells in EMD development; iii) identify novel MM chemoresistance signatures that define EMD development; iv) establish the causality of the transcriptomic/proteomic profile of EMD patients in established MM cell lines. The results originating from my project will allow for an informed optimisation of EMD treatment and assist in prioritising efficient and precision treatment for pre-EMD MM patients.

Maria Kyraleou	Technological University Dublin (TU Dublin)	Irish whiskey evaluation of biomarkers on maturation	€592,997.90	Irish whiskey is one of the most important representatives of alcoholic beverage exports for Ireland. However, its rapidly growing demand has increased the risk of brand or generic counterfeiting, which is a significant problem with Scotch Whisky. Counterfeiting, adulteration or breaches of the Irish Whiskey technical file in terms of production could potentially damage the Irish whiskey brand reputation and market, and even be harmful for consumers health. This highlights the urgent need for validated chemical-based methods to characterize congeners that can be used as biomarkers of authentication of Irish Whiskey. In whiskey production, the flavour of the new make spirit is derived from the raw material, the malting, fermentation and distillation processes. The characteristics of the final product are a combination of the new make spirit plus those generated during maturation and blending. We aim to expand on significant chromatography mass spectrometry expertise to monitor changes that occur in volatile, semi volatile and non-volatile congeners created throughout production. By elucidating the chemical pathways of whiskey flavour we aim to specify the chemically fingerprint of Irish whiskey types and brands so that this data can be used as the basis for regulation, authenticity and traceability in the future.
David Jones	University College Cork (UCC)	SOS-Phosphorus: Sustainable Organic Synthesis with Phosphorus	€589,343.90	Phosphorus-based medicines are vital for the treatment of conditions such as HIV and cancer. Organophosphorus compounds are manufactured using phosphorus trichloride. This process is unstainable due to the scarcity of feedstock materials and is environmentally damaging. The development of new synthetic precursors inorganophosphorus chemistry are urgently needed. I will develop new applications of sulfur-containing organophosphorus compounds to address this challenge. These reagents are potentially sustainable entryways into organophosphorus compounds as they can be prepared without using phosphorus trichloride. Herein, I will develop a fundamentally new way of making P-stereogenic compounds enabled by sulfur. I propose that by using chiral bases to effect an enantioselective elimination reaction at sulfur, valuable chiral organophosphorus compounds can be prepared in high enantiopurity. I will apply this new approach to the synthesis of potential anti-viral drugs, which will demonstrate its impact to the medicinal and pharmaceutical chemistry sectors. I will also show how underutilised phosphorus sources can be upcycled to make sulfur-containing organophosphorus compounds, thus providing for sustainable routes for their preparation and further exploitation.
Judith Evers	University College Dublin (UCD)	Closed-loop cortical stimulation for Parkinson's disease	€592,152.13	Deep brain stimulation(DBS) is an effective symptomatic treatment in Parkinson’s disease(PD) but there is a strong clinical need to enlarge the benefitting patient population, reduce side effects and increase battery life. This project combines two approaches to achieve this: (1)establish the primary motor cortex as a novel target for brain stimulation and (2)implement closed-loop stimulation aligned to symptom severity. Cortical stimulation is innovative, easily accessible and therefore less invasive. Antidromic activation of cortical neurons plays an important role in the mechanism of subthalamic DBS and cortical stimulation has shown mild-moderate short-term improvement in patients ineligible for DBS while closed-loop stimulation is capable of controlling symptoms while delivering less stimulation, reducing side effects and increasing battery life. Towards this objective, the aim of this project is to develop closed-loop cortical stimulation to treat PD symptoms in rats. First, optimal cortical stimulation parameters will be determined, including long-term efficacy and safety. Second, a reliable cortical biomarker will be identified. Thirdly, closed-loop cortical stimulation will be implemented and compared to open-loop cortical stimulation and conventional DBS. The results and insights will provide a path for clinical translation of cortical stimulation, a less invasive alternative which can be offered to a larger patient population.

Arundhati Roy	University of Limerick (UL)	Porous organic cages to enable water purification	€592,058.90	Water is ubiquitous, yet reliable access to clean water is a grand and urgent challenge facing our society. This proposal, AQUACAGE, addresses the United Nations Sustainable Development Goal 6 (SDG6) by developing new science that will enable disruptive new technologies to meet the demand for fresh water. In this context, anthropogenic water pollution, particularly persistent and mobile organic contaminants (PMOCs) from industrial effluents and agrochemicals is a primary reason for water scarcity. The state-of-the-art organic contaminant remediation methods are handicapped by slow kinetics, interference during adsorption and energy-intensive regeneration cycles. AQUACAGE will design, prepare and characterise novel porous organic cages (POCs), which are hitherto unexplored with respect to remediation of PMOCs/industrial effluents from water. The properties of POC have largely addressed solution-phase properties with solid-state porosity remaining underexplored. Further, most POC based physisorbents are handicapped by inappropriate pore shape/size, leading to weak and poorly selective binding sites. AQUACAGE will create new families of hydrophobic POCs and derived membranes to enable trace scavenging of drinking water toxins, focusing upon several agrochemicals and industrial effluents. The research plan of AQUACAGE will address three generations of POCs and derived membranes, leading to benchmark pollutant removal from water at lab-scale.
Conor Finlay	Trinity College Dublin (TCD)	Macrophage Activation and Transition in the Autoimmune Kidney (MacATAK): uncovering functional outcomes of macrophage differentiation in the inflamed kidney	€594,365.20	Macrophages are capable of a remarkable array of functions, that differ by tissue and inflammatory status. Most macrophages in the body are tissue-resident and perform homeostatic functions. However, during inflammation monocytes recruited to tissues, differentiate into pro-inflammatory M1 macrophages through exposure to type 1 cytokines. Resolution of inflammation, or exposure to type 2 cytokines, leads to macrophages adopting the anti-inflammatory pro-repair M2 phenotype. My findings indicate that adoption of tissue residency alters their functional capacity to become M1 or M2 activated. To explore this further, we will investigate the disease ANCA-associated vasculitis (AAV), which is characterised by irreversible macrophage-driven damage to the kidney. We will first create a model of macrophage differentiation in the inflamed kidney that will act as framework for understanding how macrophages drive both repair injury. We will next use a model of AAV to show that macrophage differentiation paths can be modified therapeutically, to shift away from inflammatory M1 phenotypes towards adoption of tissue residency that supports resolution of inflammation in autoimmunity. The outputs of this project will provide the basis for development of urinary biomarkers of kidney inflammation and highlight druggable targets in autoimmune kidney disease.
Sean Kelly	Dublin City University (DCU)	PLAS-ME: Plasma for Agriculture Sustainability through Manure Enhancement	€582,807.73	Spreading manure fertilizer in farming is key to recycling the macronutrients of Nitrogen, Phosphorus, and Potassium ('NPK'), essential for plant growth. The Nitrogen content of manures (e.g., cattle slurry), however, requires significant supplementation from Nitrogen-based chemical fertilizers, an essential component in achieving the high growth yields required to sustain current food production. Nitrogen-based fertilizer is currently produced using natural gas in the Haber-Bosch process contributing ~2-3 % to annual global greenhouse gas emissions. The low Nitrogen content in manures is exacerbated by the Nitrogen loss from ammonia outgassing during storage and land spreading. While this ammonia is not a greenhouse gas it is a very damaging air pollutant that is not only detrimental to human health but has a destabilizing impact on sensitive ecosystems resulting in a loss of biodiversity. The use of acid supplements to halt ammonia losses from manures is an emerging solution. This project proposes the novel use of plasma-produced nitric acid as a slurry additive to lower the climate and air polluting impacts of manures while also enhancing manure Nitrogen content. Plasma technology powered by renewable electricity requires only air and water as a feedstock offering a zero-emissions alternative to the current greenhouse gas emitting Haber-Bosch process.

Mika Holmberg	Dublin Institute for Advanced Studies (DIAS)	Moon-magnetosphere interaction and its relevance to life in the outer Solar System	€587,851.10	Are we alone in the Universe? This is one of the most important questions humanity is facing today. For long the only planet thought to potentially harbour alien life was Mars, but with the exploration of the outer Solar System came the realisation that alien life might exist on ocean bearing moons in the outer Solar System. This is the reason why the largest space agencies in the world are currently focusing on exploration of the Jovian moons, like the ESA mission Jupiter Icy Moons Explorer (JUICE). JUICE will study Jupiter and its space environment, with a special focus on the habitability of Jupiter's moons. In September 2024, JUICE will encounter its first science targets as it performs its first swing-by of the Moon. The swing-by will provide an unprecedented opportunity to explore the plasma environment of the Moon and its interaction with the magnetosphere of Earth, with a payload that can provide more detailed and accurate observation than ever before. This will be important not only for our understanding of the Moon - magnetosphere system of Earth, which is crucial for future moon missions, but also for the future moon explorations that JUICE will perform in the Jovian system.
Aisling Coughlan	University College Dublin (UCD)	Harnessing epigenetics to define BCL-2 dependence in Multiple Myeloma	€575,723.97	Multiple Myeloma (MM) is an incurable malignancy driven by uncontrolled plasma cell growth. Improved therapeutic targets and combinations are urgently required. Anti-apoptotic BCL-2 family proteins are attractive targets, with inhibitors (venetoclax) already in trial/use. Venetoclax displays highest efficacy in t(11;14) translocated patients. However, it is unclear why translocation of CCND1 induces BCL-2 dependence and confers venetoclax sensitivity. Therefore, we aim to understand the molecular mechanisms determining venetoclax sensitivity, and exploit these mechanisms for broader therapeutic benefit across non-translocated patients. Epigenetic cancer therapies are promising due to the abundance of different modulator compounds which tend to be well-tolerated by patients. To understand reliance on BCL-2 in translocated patients, I will use state-of-the-art epigenetic profiling techniques including CUT&Tag and 4C-seq to compare BCL-2 regulatory mechanisms between t(11,14) and non-t(11,14) MM. Additionally, I will carry out a functional CRISPR screen in venetoclax-resistant MM cells to identify epigenetic regulators whose disruption sensitizes non-translocated cells to venetoclax. Finally, I will perform epigenetic compound treatments and CUT&Tag mapping of epigenetic features in primary patient MM samples as proof-of-concept of epigenetic sensitization to venetoclax treatment. Combining venetoclax with epigenetic modifiers could be an effective strategy for elderly patients that cannot handle aggressive treatment regimes such as chemotherapy.
Alan Costello	The National Institute for Bioprocessing Research and Training (NIBRT)	RNA delivery vectors for transfer RNA therapeutics	€591,390.90	Premature termination codons (PTC) are responsible for multiple human genetic diseases with no established therapeutic options. PTC suppression during translation has promise for treating genetic disorders, however small molecules promoting PTC read-through have not thrived in clinical trials. RNA therapeutics are an attractive alternative to traditional small molecule approaches as discovery can benefit from intuitive rational design and directed evolution. Transfer RNA (tRNA) molecules have been rationally engineered to decode in-frame PTCs while maintaining amino acid specificity. However, tRNA PTC suppression efficiency and therapeutic delivery are limiting the potential of these therapies. I propose to overcome these limitations by: Investigating RNA delivery vectors consisting of immature or pre-tRNA molecules to increase molecule stability during therapeutic delivery, evaluation of natural RNA modifications in the context of therapeutic delivery for increased thermal stability and resistance to RNA degradation and directed evolution of PTC suppressor tRNA molecules for enhanced suppression activities, while maintaining amino acid fidelity. If successful, this proposal will yield new biomolecules to treat human genetic disease where no current therapeutic exists. It will provide a general platform for discovery of PTC suppressor tRNAs with retained amino acid identity and provide new designs for RNA delivery vectors of small RNA therapeutics.

Lizy Abraham	South East Technological University (SETU)	An Artificial Intelligence (AI) – based Automated Approach for the Classification of Pediatric Heart Murmurs and Disease Diagnosis using Wireless Phonocardiography	€556,070.00	Congenital Heart Diseases (CHDs) are malformations that occur due to abnormal development of the heart at the birth of a child. Listening to the heart with a stethoscope to identify heart murmurs, continues to remain the most common clinical screening method to detect heart problems in newborns. However it depends greatly on the physician's experience. The gold standard for diagnosis of CHD is Echocardiography but has its limitations when performed on children. It takes almost 30 to 45 minutes, and children should remain still during the period. Referring to all children with a murmur for the expensive and lengthy diagnostic procedure such as echocardiography is not feasible and cost-effective. Another valuable alternative is using intelligent techniques to analyze phonocardiogram (PCG), which is a plot of heart murmurs obtained with a digital stethoscope. PCG signals combined with the power of Artificial Intelligence (AI), can provide an objective interpretation of heart sounds to complement the traditional auscultation methods that use Echocardiogram. This research proposes an automated AI-based cardiac disorder detection system using the PCG heart sound signals. This will support physicians and primary health care providers for the early diagnosis of CHDs, instead of children undergoing expensive and lengthy diagnostic procedures directly.
Darren O'Connell	University College Dublin (UCD)	The genomics of adaptation in a hyper-diverse genus of bees: the past, present and future of important wild pollinators	€592,699.20	Some lineages of organisms adaptively radiate into a phenomenal diversity of species, while others do not. Identifying the mechanisms underlying such adaptive divergence is a central challenge in evolutionary biology, and integrating the assessment of genomic and phenotypic diversity is a key step in determining the drivers of divergence. It is increasingly possible to investigate the interplay of different biological mechanisms – from ecology to genomics – that generate these contrasting patterns of diversity. Here I will use ecological and comparative genomics to investigate five sister bee genera that provide unique untapped opportunities for understanding how species diversify. The genus Andrena exhibits incredible species diversity with more than 1600 species, while its four sister genera include a total of 11 species (Alocandrena, Cubiandrena, Megandrena, and Ancylandrena). The Andrena genus therefore provides an optimal model for unravelling the mechanisms driving diversification. These data will also facilitate determining how the different populations and species, within and between these evolutionary disparate genera, are responding to changes in the environment, and what makes some groups more likely to persist, highlighting key candidate traits for adaptation to the environment. Importantly, this will facilitate the identification and conservation of some of the most important insect pollinators.
Eileen Ryan	University College Cork (UCC)	BLOOD: The role of Bacterial Lipids in the micrObe-hOst Dialogue	€592,433.90	Gut bacteria synthesise a repertoire of uncharacterised lipids; how are they differentially influencing health and disease and how can they be exploited for health benefits? Although a new and evolving area, certain bacterial lipids are already shown to have important bioactivity e.g., some gut associated bacteria produce diverse inflammatory modulating sphingolipids, others produce novel glycine lipids (our work) which are potent ligands of host Toll-like receptor 2 (TLR2) with both pro-, and anti-inflammatory capacity. AIM: BLOOD will provide extend and improve our knowledge by (1) providing a comprehensive, open-access bacterial lipid database (BacLipidMaps) via liquid-chromatography-mass spectrometry based lipidomics and supporting software (2) establishing the type and range of bacterial lipids in humans across various states of heath and disease by profiling biobanked human plasma and faecal samples and utilising data repositories (such as MetaboLights) for appropriate human lipidomic data and (3) isolating specific bacterial lipids and determining their roles in microbe-microbe and microbe-host interactions via shotgun sequencing, mammalian cell culture and gene expression profiling. BLOOD represents the first large-scale, comprehensive, and qualitative comparison of the lipidome of gut associated bacteria. It will uncover novel bacterial lipids that may represent an avenue for the development of biomarkers and/or therapeutics of disease.

Qian Xu	University College Dublin (UCD)	A multi-therapeutic strategy for diabetic wound healing based on the injectable ECM-Mimetic hydrogel delivery of tailored ADSC-derived exosomes	€593,186.70	Diabetic wound healing is a significant healthcare burden for patients, their families, healthcare providers, and society. The self-perpetuating inflammatory stage and impaired skin cell functions are the key dysregulated events in diabetic wound healing, leading to the failure of healing. Due to the complexity of the wound environment and the tissue repair response, no single treatment has been found to meet all the needs of diabetic wounds. A combination of different therapeutic approaches aimed at correcting multiple deficits simultaneously would help lead to a successful outcome for diabetic wound healing. This project aims to produce a bioactive hydrogel scaffold that can withstand the harsh wound environment, regulate the local wound environment, and act as a temporary matrix that allows normal cellular activities to occur. The tailored exosomes will be protected by the scaffold and released in a controlled manner, and synergistically participate in regulating abnormal cellular processes in diabetic wounds. This proposed project seeks to modulate the harsh wound environment to restore the healing potential of the major players involved in the healing process, ultimately promoting wound healing. It can be envisaged that this versatile platform technology can also be used for a broad range of other biomedical applications.
Thi Nga Tran	University of Galway	Functional Thin Film Based on CO2-derived Polymers and Stimuli-responsive Nanoparticles for Wound Healing Applications (WOUNDER)	€575,755.80	Wound is one of the most common health issues worldwide. Annually, the cost of wound care has continuously increased to 96.8 billion dollars. As an innovative solution, WOUNDER will establish a novel, cost effective and sustainable CO2-derived thin film- mesoporous silica nanoparticles (MSNs) platform for wound healing treatment. The green water-based process will be exploited to produce high performance, renewable and low CO2 footprint biocomposites composed of poly (propylene carbonate) (PPC), a CO2-based polymer, and stimuli-responsive MSNs. The porosity of incorporated MSNs with different pore-blocking chemistries offers a great versatility to load different therapeutic agents along with their sustained and controlled release, promoting the delivery of multiple therapeutic agents and the healing process. The versatility of the fabrication process will enable the incorporation of low-cost plant-based bioactive compounds and therapeutic agents with differing water-soluble characteristics to obtain multi-functional and programable wound healing materials. These technologies and materials will immediately impact patient outcomes, social wellbeing, and the medical infrastructure, as well as the circular economy and sustainable development of next generation advanced materials, thus contributing to accomplish the objectives of United Nations sustainable development goals 3 and 13 on the improvement of public health and the protection of the planet, respectively.

Tapas Mitra	University of Galway	SMARTFOLD: Development of a smart shape-memory scaffold to support degenerated cartilage and control therapeutic delivery to reduce chronic pain in osteoarthritis	€593,257.60	Knee osteoarthritis (OA) is the most common age-related joint disease and fourth leading cause of disability worldwide. The ageing global population and the growing obesity epidemic means that the prevalence of OA is set to increase year-on-year. Medications and physical exercise are the first choice in OA treatment, but when these fail, knee arthroplasty is the only option for OA patients. The COVID-19 pandemic negatively impacted OA patients by disrupting their access to health care, resulting in delays in joint replacement surgery, which in turn resulted in worsening pain, increased patient dissatisfaction, and a backlog of surgeries. This highlighted the urgent need to develop an alternative, less invasive method of OA treatment. The goal of this project is to replace the current invasive procedure (knee arthroplasty) with an injectable shape-memory scaffold loaded with a pain-relieving therapeutic agent. The scaffold can withstand the forces routinely encountered in weight-bearing joints to prevent further degeneration of diseased cartilage and released cargo therapeutics would alleviate pain in the knee joint. The hypothesis is that the proposed scaffold could attenuate the progression of joint damage and the released therapeutics would relieve pain, eliminating the need for analgesia and knee replacement.
Chinmoy Kundu	Tyndall National Institute (TNI)	Designing secure integrated sensing and communication systems for next-generation wireless networks (SECURE-ISAC)	€581,166.20	Future wireless networks will support many emerging services, such as, remote healthcare, indoor localization, factory automation, Wi-Fi sensing, unmanned aerial vehicles, and autonomous driving. These applications demand precise sensing and localization. Traditionally, sensing and communication systems are designed separately. However, due to the rapid proliferation of wireless devices and mobile services, the frequency spectrum is becoming increasingly congested. Therefore, integrated sensing and communication (ISAC) systems are becoming popular. ISAC designs sensing and communication functionality jointly by considering the shared spectrum, energy, and hardware resources. As information-bearing signals are reused for the purpose of sensing, the sensing signal itself is susceptible to eavesdropping by targets. Therefore, the aim of the project is to secure the ISAC transmission from eavesdropping. Deviating from the traditional methods of providing security through cryptography which require secret key management and heavy computation, the security in ISAC will be provided at signal level through physical layer security (PLS) techniques. In this project, I will develop secure transmit waveforms and receive beamformers for large-scale ISAC systems consisting of multiple targets against active and passive eavesdroppers while serving multiple users. I will formulate mathematical optimization problems to obtain solutions by developing novel signal processing algorithms and machine learning techniques.
Sujit Jung Karki	University College Dublin (UCD)	REVBY: Ramularia collo-cygni Effector Virulence in BarleY	€615,007.50	One of the major constraints on agricultural food production is yield loss due to crop pathogens. Barley is one of the most important cereal crops worldwide and the largest crop in Ireland, constituting 70% of the 2.45 million tonnes of cereal produced (CSO, 2021). Ramularia Leaf spot (RLS) is one of the most prominent threats to barley production in Europe including Ireland with yield losses up to 1 tonne per hectare. Ramularia collo-cygni (Rcc) is the fungal causal agent of RLS in barley and its genome is predicted to encode for a repertoire of effector proteins. However, there is no knowledge of any Rcc effector function. REVBY will identify Rcc effectors that modulate barley defence and physiological processes. Using transcriptomic analysis of Rcc isolates that differ in aggressiveness against barley, we will identify and characterise effector genes key to virulence and disease development. REVBY will be the first study to characterise Rcc virulence effectors to understand how Rcc colonises barley to cause disease. These key effector/virulence factors are potential novel targets for disease control via targeted chemical inhibitor design or by engineering barley host interactors that control disease. Monitoring such virulence gene evolution could be used to predict disease outbreaks

Oonagh Giggins	Dundalk Institute of Technology (DkIT)	A Digital Health Program Targeting Physical Activity among Middle-Aged Menopausal Women at Risk of Coronary Heart Disease	€559,455.55	Coronary heart disease (CHD) is one of the leading causes of death globally. In women, the menopause is a major risk factor for CHD, with the decline in oestrogen having a detrimental effect on cardiovascular function. Regular physical activity (PA) can help menopausal women reduce their CHD risk. Digital health interventions are increasingly being used to target PA in a range of chronic health conditions. However, despite the development of multiple digital interventions, it remains unclear how to design engaging and effective digital PA interventions. This proposed research will design, develop and evaluate a digital health intervention for menopausal women at risk of CHD, an underrepresented group in CHD research. Specifically, this research will focus on the development of a 'just in time adaptive intervention', which seeks to deliver PA support when most needed, and when it is most likely to be engaged with. This research will engage potential end users in different phases of the development process, integrating their requirements into the intervention. The developed intervention will be evaluated, tested and optimised through a series of trials examining the acceptability and feasibility of the approach. The overall efficacy of the intervention will be evaluated in a pretest-posttest trial.
Omar Mamad	RCSI University of Medicine and Health Sciences	MiR-CDD: microRNA targeting as mechanism-based therapeutics for CDKL5 Deficiency Disorder (CDD)	€567,322.17	CDKL5 deficiency disorder (CDD) is a neurodevelopmental disease characterised by early-onset epilepsy, intellectual disability, motor disabilities. There is an urgent and unmet need to develop therapeutic strategies based on the underlying causes of CDD. My approach will target molecules called microRNAs, important controllers of gene activity. Our group has shown that inhibiting certain microRNAs can modify synaptic structures in the brain, improve motor control, and either stop seizures or prevent epilepsy in animal models. This represents an entirely new way to treat CDD. I shall test the idea that specific microRNAs are involved in the key features of CDD and seek evidence that we can alleviate seizures and other behavioural/physiological deficits by their targeting. I will investigate this using the novel CDKL5 exon 6 knockout mouse model. My studies will focus on two microRNAs specifically dysregulated in CDD specifically regulated in CDD. Then rationally design and deliver antisense oligonucleotide inhibitors to these in vivo. I will assess their effects using multi-site recordings of brain activity, single cell sequencing, behavioural assays and histopathology to follow the course and understand the mechanism of disease-modification. Together, my studies will improve our understanding of CDD and drive the development of advanced new precision therapies.
XianXian Zhao	University College Dublin (UCD)	Electromagnetic Transient Modelling and Stability Analysis of a Wind and PV Dominated Irish Power System for 2030 and Beyond	€544,957.60	To combat climate change, Ireland has committed to be carbon neutral by 2050. The Irish government's 2021 Climate Action Plan targets up to 80% electricity generation from renewables by 2030, while the Russia-Ukraine conflict is encouraging EU countries to accelerate plans to end reliance on Russian fossil fuels and switch to renewables. To ensure delivery of decarbonisation aspirations, while maintaining stable and secure system operation, new modelling and analysis approaches are required to assess systems that are predominately based on converter-based renewables, rather than traditional synchronous generator-based thermal plants. Therefore, high-fidelity electromagnetic transient models of the Irish grid for 2030, and beyond, will be developed and validated. Grid stability and innovative technical solutions will be analysed for a comprehensive range of future system conditions and dimensioning events, leading to the development of new robust system management and economic operational rules. Subsequently, the developed control strategies and network configurations will be evaluated through real-time hardware-in-the-loop studies. Novel model-order reduction techniques will be developed to simplify electricity networks, in order to accelerate simulations, and facilitate analysis and control design of complex renewables-dominated converter-based power systems, leading to the development of an open-source, multi-scale, multi-temporal simulation tool for future power system dynamic studies.