Lead Applicant	Co-Applicant	Research Body	Proposal Title	Co-Funder	Budget +OH	Summary
Alan Ryder		University of Galway	Downstream Protein Analysis - Polarized Emission Spectroscopy (Dpa-Pes).		€1,249,851.09	Making protein-based treatments like vaccines, antibodies, and insulin, safely and in large volumes poses many challenges one of which is accurately measuring protein size, purity, and stability during manufacturing. Proteins are inherently sensitive and are easily damaged, reducing their therapeutic effectiveness and the biggest issues are when protein shape or size changes. Here we will develop fast, inexpensive, non-destructive, and non-contact, light based techniques for measuring proteins during manufacturing. This novel DPA-PES measurement methodology exploits aspects of chemistry, physics, mathematics, and optics to better measure protein quality via their interaction with polarised light, ultimately leading to better quality medicines.
Martin Caffrey		Trinity College Dublin	A High-Resolution Structure-Informed Approach To Understanding The Mechanism Of Action Of Bacterial Envelope Enzymes And Carriers For Long-Term Use In Antibiotic Design And Discovery		€1,281,762.80	Lipoproteins play key roles in bacteria. They are synthesized by enzymes that are essential in common pathogenic bacteria. Because they have no equivalents in humans, these enzymes are potential drug targets. In this project, we will establish the molecular blueprint of these and related enzymes and proteins that will, in time, help develop new, urgently needed antibiotics targeting pathogens against which a growing number of antimicrobials are ineffective. The project will train the next generation of highly skilled, innovative scientists and will generate new knowledge and intellectual property in the form of tools, reagents, and lead compounds for commercial exploitation.
Fiona Doohan		University College Dublin	Wheathealth: Enhancing Our Understanding Of Wheat-Microbe Interactions To Improve Disease Control And Food Security		€1,279,433.42	In light of climate change, loss of biodiversity, war, shifting diets, and a growing global population, we need to urgently rethink our tillage practices in order to guarantee the security of future food supplies. We need new control strategies to reduce disease-associated losses and compensate for the reduction in pesticide usage proposed under the EU Green Deal (50% reduction by 2030). This project aims to better understand and harness natural plant and microbial biodiversity in order to control wheat diseases. It will improve our understanding of ecosystem function and enhance our ability to produce food in a sustainable manner.

Kingston Mills		Trinity College Dublin	Induction And Regulation Of Immune Responses In The Nose - Informing The Design Of An Effective Nasal Vaccine Against Bordetella Pertussis		€1,299,990.90	Vaccines are highly effective at controlling infectious diseases and save millions of lives annually. Some vaccines can completely prevent infection with viruses or bacteria. However, the whooping cough (pertussis) and COVID-19 vaccines, while preventing severe disease, do not prevent infection of the nose, allowing transmission of the microbe from vaccinated individuals. Here we will make a thorough study of immune responses to Bordetella pertussis in the nasal tissue. This will inform the design a more effective vaccine against pertussis, based on intranasal delivery of the vaccine formulated with molecules that generate sterilizing immunity and immunological memory in the respiratory tract.
Sean Leen		University of Galway	Tailored Manufacturing For Safe, Sustainable Offshore Wind Turbine Support Structure Materials (Transforrm)	SEAI	€1,289,370.50	This project proposes to use a combination of laboratory testing and computer modelling to improve manufacturing processes for high temperature rolling and welding of steels for more sustainable, safe design of support structures for larger offshore wind turbines. Computer models will be developed to determine the effect of the rolling and welding processes on through-thickness non-uniformity of mechanical properties, especially cracking due to fatigue. The models will be verified by experimental testing. Digital tools will be developed using these models and applied to design case studies for fixed and floating offshore wind turbine structures, to demonstrate the sustainability benefits.
Fionnuala McAuliffe		University College Dublin	Preterm Birth Prevention With Oral Probiotics: A Double-Blinded Placebo Controlled Randomized Controlled Trial On Lactobacillus-Crispatus-Containing Probiotic Therapy In Women At Risk Of Preterm Birth (The Prepop Study)		€1,231,283.60	Preterm birth, when a baby is born too soon, is the biggest killer of infants and children. Of those who survive, many are left with complex long-term health and cognitive problems. This places huge burden on these babies, their families, and the society in which they live. Most preterm births occur when healthy vaginal microbes become replaced by unhealthy microbes, leading to vaginal inflammation that triggers preterm birth. By using a probiotic supplement and novel scientific techniques to detect its effect, this project hopes to finally find a preterm birth prevention strategy that we, as a society, so desperately need.

David Finlay		Trinity College Dublin	Investigating Oxysterols As Modulators Of Cytotoxic Natural Killer Cell Responses		€1,276,850.90	Our immune systems has "ON" switches and "OFF" switches so that we can be protected from infection without unwanted collateral damage to our bodies. Natural Killer (NK) cells are the assassins of our immune system and can directly kill virally infected cells and cancer cells. We have found that cholesterol-like factors stop NK cells from killing and believe that this is a new type of "OFF" switch. We plan to study how this "OFF" switch works and its role in controlling our immune system. Discovering and understanding "OFF" switches will lead to new immunotherapies for patients with immunological diseases.
Guangxue Wu		University of Galway	Alleviation Mechanisms And Microbial Interactions Induced By Conductive Materials In Sulphate-Stressed Anaerobic Digestion Ecosystems	SEAI	€911,903.60	Methane recovery from waste reduces the dependence on fossil fuel energy, fulfilling the Sustainable Development Goals. However, the existence of sulphate inhibits methane production, which can be alleviated by dosing conductive materials. In this project, by combining advanced techniques from microbiology, engineering, and chemistry, underlying microbial mechanisms and interactions for methane production will be investigated with the dosage of conductive materials for alleviating sulphate inhibition. The outputs will provide knowledge for developing novel methane recovery biotechnologies from waste to protect our ecosystem and conserve of our natural resources.
Ulla Knaus		University College Dublin	Raising Oxidants For Immune Protection In Infectious Disease		€1,295,630.60	Emerging infectious diseases and increasing antibiotic resistance will be a challenge for healthcare, society, and the economy for the next decades. Existing approaches in microbe detection, data sharing, vaccine and drug development need to be strengthened, but new strategies in infection control are also required. One arm of the immune system remembers microbes, but destruction takes several days. Hence, the other arm called innate immunity is the first line of defense that attacks any invader. Our goal is boosting innate defense systems in lungs and gut during the acute early phase of infection by triggering prolonged activation of protective enzymes.

Igor Shvets	Karsten Fleischer	Trinity College Dublin/ Dublin City University	Nanolaminates: Synthetic High Performance Materials (Lasima)		€1,277,216.70	To meet targets for sustainability and climate action it is key to develop manufacturing technologies and materials minimising energy use during production. Unfortunately, in many fields abundant materials with sufficient performance have already been pushed to their physical limits. Our methodology will enable known, sustainable materials to perform beyond their intrinsic capacity. Lasima will develop novel multi-layered materials. By layering we can synergistically combine known materials to overcome each of their limitations, creating a metamaterials with enhanced properties far beyond the constituents. Lasima uses methods, directly industry applicable and targets materials used in renewable energy production, displays and future electronics.
Orla O'Sullivan		Teagasc	Fitbiota: Examining The Emergence Of A Fit Gut Microbiome In Young Adults And The Potential Impacts On Gut Health		€1,063,822.50	The human intestinal tract is host to an extensive population of microorganisms (the microbiome) working in concert to play a pivotal role in human health. Almost every aspect of modern lifestyles can impact the microbiome; recently the concept that regular exercise may foster or assist the maintenance of a preferential gut microbiome has gained momentum. Fitbiota aims to specifically understand the role physical fitness plays in modulating the gut microbiome and investigate if there indeed is a “fit” microbiome profile and can this be transferred to a host resulting in improved health?

Barry Hayes		University College Cork	Autonomous Open Energy Communities: A New Paradigm For Power Grid Operations (Autonomy)		€1,032,955.20	Recent global events highlight the urgency of divesting from fossil fuels. However, our electricity grids were designed around centralised, fossil-fuel based energy sources, and are not capable of integrating vast numbers of decentralised renewable energy sources effectively. Inspired by recent advances in artificial intelligence, AUTONOMY will create revolutionary new tools to manage electrical energy resources at the local level and maximise the economic benefits for individuals and communities when interacting with the energy markets. AUTONOMY will also develop new approaches to grid planning to ensure equitable access to the grid and energy markets for all users in the post-carbon era.
Andrew Bowie		Trinity College Dublin	Pyhin Proteins: Emerging Central Defenders In The Human Anti-Viral Innate Immune Response		€1,290,271.90	When our cells encounter an invading virus, anti-viral immune processes are mobilised to combat the virus. Understanding exactly how cells respond to viruses is critical, since the exact nature of the immune response influences whether the virus is cleared effectively or instead causes chronic disease. We have discovered that human PYHIN proteins play a key role in both directly targeting invading viruses and in controlling the release of cytokine and interferons, which are alarm signals that alert surrounding cells to the presence of a virus. In this project we will examine in-depth how exactly PYHINs contribute to human anti-viral immunity.

Cormac Taylor		University College Dublin	Glycoplex: A New Entity Regulating Glucose Metabolism In Hypoxic Cells.		€1,241,228.90	Cells normally use oxygen to make energy but when oxygen is scarce (hypoxia) such as in rapidly proliferating cells, they need to switch to glucose metabolism to survive. This switch has important implications for cell survival during immunity but also for cancer cell survival. Therefore understanding how glucose metabolism (glycolysis) is regulated is key to understanding metabolism in health and disease and to produce new therapeutic agents. In this study we identify a new mechanism of regulating glucose metabolism in low hypoxia and aim to fully interrogate the structure function and role of this complex in healthy and cancer cells.
Jane Farrar		Trinity College Dublin	Exploration Of Gene Therapies For Ocular Disorders		€1,291,440.60	Dry age related macular degeneration (AMD) is a debilitating condition that affects around 10% of people over 65 years, yet there are no therapies on the market. The disease is thought to be caused by a combination of risk factors including genetics, age, and lifestyle. In the current application we propose to generate novel gene therapies and test and compare their efficacy in multiple model systems of AMD. The most efficacious will be further studied and combined in dual-therapies (with two gene in each construct), which will subsequently be tested and compared in our multiple models systems.
Marco Ruffini	Dan Kilper	Trinity College Dublin	Twilight: Twin Lightpaths, A Digital Twin Framework For Full Automation Of Disaggregated Optical Networks.		€1,290,541.30	Optical networks are the lifeblood of the internet. This involves using of signals encoded in light to transfer information. They have to evolve constantly to keep up with the ever-increasing usage of the internet. However today they lack flexibility, which is slowing down the development of new digital systems such as Smart Cities and Virtual/Augmented Reality. TwiLight addresses this challenge by creating a digital twin of the optical network. This is a safe testing environment for networks that will (i) help develop and test new solutions, and (ii) facilitate fast changes to networks without risking any disruption.

Jurgita Ovadnevaite		University of Galway	Fingerprinting Climate Change And Air Pollutant Culprits (Epic-Air)		€1,205,850.25	Atmospheric aerosol particles contribute to over 8 million premature deaths per year globally due to their important role in Climate Change and Air Quality. It is, therefore, crucial to understand sources of these particles as well as to assess their impacts on human health and climate. Our project will deploy a sophisticated online instrumentation and develop new methods to allow the concurrent assessment of particle health and climate impacts. Moreover, the project will use models to evaluate how these toxic particles affect climate change and, in turn, how the climate change impacts the properties of the particles.
Walter Kolch		University College Dublin	The Role Of Dynamic Protein-Protein Interaction Changes In Adaptive Drug Resistance		€1,299,470.99	Most cancer treatments are thwarted by drug resistance. Here, we investigate a new source of drug resistance, namely changes in multi-protein complexes (MPCs). MPCs are teams of proteins working together. Changing the interactions in these teams can help cells to quickly adapt to and escape therapy. We use modern technologies allowing us to systematically map the interaction changes in MPCs when cells become drug resistant. To prove that these interaction changes cause drug resistance, we artificially create or destroy them. We believe that such critical interactions could be new targets for cancer therapies that eventually may replace genome damaging drugs.
Cynthia Coleman	Pilib Ó Broin	University of Galway	Midios: Microrna In Diabetic Osteopathy		€1,284,962.10	Type 2 diabetes causes the sugar level in the blood to rise. Some people with type 2 diabetes experience changes in their bones, making the bone prone to fracturing. This project identifies new molecular treatments to protect the bones of someone with diabetes. We will use computers to model how diabetes hurts the bone cells and identify treatments to intervene. We will use biology to measure how well the new therapies protect the bones in the diabetic environment. The findings of this project could help people living with type 2 diabetes, alleviating suffering and increasing quality of life.

Martin Clynes	Finbarr O'Sullivan	Dublin City University	Investigating The Biological Roles Of Polyamines In Cho And Other Cells		€1,280,387.30	The Biopharmaceutical industry is a major contributor to human welfare; the ability to clone the genes for human proteins and to produce them using large quantities of cells in fermenters has provided healthcare systems with an array of new medicines. In spite of these great successes and contribution to human welfare, the biopharmaceutical industry faces challenges. These are expensive medicines to produce. As more of these products are approved, the cost is becoming challenging for healthcare providers. This project will investigate how optimising cell nutrition with molecules called polyamines may be used to improve productivity of biopharmaceuticals by animal cells.
Emanuele Pelucchi		Tyndall National Institute	"Expanding" Site-Controlled Quantum Dot Technology: Photonic Cavity Toolkit Development For Quantum Integration (Exquis)		€1,296,252.34	Communication and computation are key activities. Extraordinary technological efforts have been essential to the current digital era. Yet, we are on the brink of a potential redefinition of ICT standards. The incoming "second quantum revolution" offers unmatchable opportunities for fast transmission and manipulation of information, potentially making current technologies obsolete, especially for large-scale computational tasks. Exquis exploits such exciting premises to address fundamental steps for the demonstration of fundamental photonic devices for “quantum” information processing based on semiconductor “artificial atom” technology and integrated photonics, with European and all Irish partners working in synergy towards an ambitious and potentially high-gain goal.

Madeleine Lowery		University College Dublin	Closed-Loop Deep Brain Stimulation For Parkinson'S Disease: Foundations For Clinical Translation		€1,292,673.10	Deep brain stimulation (DBS) applies tiny electrical pulses to neurons within the brain to treat Parkinson's disease symptoms. Smart DBS systems which use 'closed-loop' control offer the possibility of automatically adjusting stimulation to adapt to changes in patient symptoms and side-effects, identifying the best stimulation parameters. This type of adaptive or closed-loop DBS is not yet available due to a number of scientific and technical challenges. In this project, we will address these using computational modelling and experimental studies to develop new methods for closed-loop DBS to provide long-term adaptive control of patient symptoms while minimising stimulation-induced side effects.
Mani Ramaswami		Trinity College Dublin	Ataxin-2 And The Molecular Control Of Of Mrnp Condensates		€1,282,848.40	Mutations in the human ataxin-2 gene can cause ALS or spinocerebellar ataxia-2 (SCA-2). Drugs that reduce levels of the protein are in clinical trials for ALS. Our recent work indicates that the Ataxin-2 protein regulates many biological processes important for health, of which only one may be relevant in disease. We will follow up on these observations using innovative and state-of-the-art approaches to: (a) identify specific regions of the Ataxin-2 protein valuable to pharmacologically target for potentially equal therapeutic effectiveness but fewer side effects; (b) find new ataxin-2 associated proteins with similar roles and uses in health and disease.
Daniel J Kelly	Pieter Brama	Trinity College Dublin/ University College Dublin	Engineering Structurally Anisotropic And Mechanically Functional Musculoskeletal Tissues By Guiding The Fusion, Differentiation And (Re)Modelling Of Stem Cell Derived Cartilage Spheroids		€1,283,547.30	The field of tissue engineering seeks to combine cells and scaffolding materials to grow replacement tissues. Despite decades of research, existing strategies are unable to produce engineered tissues with the same structure and function as normal tissues, limiting their clinical utility. The goal of this project is to use emerging 3D (bio)printing technologies to help recreate the conditions that instruct normal tissue development, thereby enabling the engineering of musculoskeletal tissues. The ability to bioprint such functional tissues will transform orthopaedic medicine, providing grafts to regenerate damaged joints and thereby prevent the development of osteoarthritis, a debilitating disease affecting millions worldwide.

Louise McNamara		Teagasc	Elevate: Epidemiology Of Barley Yellow Dwarf Virus (Bydv) In Ireland Under Current Climate And Elevated Temperature And Co2		€734,744.40	Barley yellow dwarf virus (BYDV) is one of the most detrimental infecting agents impacting cereal production worldwide. ELEVATE is an ambitious programme of research that will carry out the studies needed to generate the data necessary to establish a model to predict potential yield loss in barley associated with different virus strains, presence of co-infection, and timing of infection. Crucially, ELEVATE will also look ahead to how 'extreme' weather events and a changing climate will impact both virus transmission and aphid behavior, and establish a platform to evaluate new and old barley genetics.
Rhodri Cusack		Trinity College Dublin	Robust Motion Correction For Functional Mri Using Deep Neural Networks		€1,289,623.80	Brain development in infants and its disruption by preterm birth or perinatal injury can be measured with functional MRI (fMRI). Unfortunately, infants move and this corrupts images. We will apply deep neural networks (DNNs), the technology underlying breakthroughs in artificial intelligence, to correct motion noise in infant fMRI data. This project will initiate a collaboration between Trinity and scientists in Canada, Israel and the UK, to evaluate four strategies, of increasing potential benefit but also greater complexity. The Award will enable transformative infant fMRI applications and bring Ireland to the forefront of the rapidly growing intersection of DNNs and MRI.
Naomi Harte		Trinity College Dublin	Speechspace - A Framework For Understanding And Modelling Multimodal Interactions		€1,285,416.70	Speech is not just something you hear. It is something you see too. Humans use a multitude of cues to communicate when talking, including the intonation of the voice, lip movement, gestures, word choice, facial expression. Current theories recognise that humans alter their voice to ensure their communication is successful in a noisy environment. This project extends this simplistic view of communication and develops a framework to consider all the elements of speech we can tune in a conversation. This framework will enable us to teach machines to understand speech too, and deliver the robust speech technology of the future.

Silvia Giordani		Dublin City University	Bio-Inspired Functionalization Of Nanoplatforms For Targeted Delivery Of Therapeutics		€1,026,941.90	The quality and efficiency of every pharmacological therapeutic process is measured by its ability to deliver the exact amount of a drug, at an accurate rate, to a precise location within a complex organism. This is undoubtedly one of the most critical scientific challenges of the 21st century. By developing methodologies for successfully addressing this challenge, we can make game-changing contributions to personalized medicine, to disease detection and to new delivery modes that maximize benefits to the patient whilst limiting collateral cellular damage. This project seeks to develop unique biocompatible nanoplatforms with diagnostic, imaging and therapeutic functions.