LIST OF FUNDED PROJECTS – SFI-IRC PATHWAY PROGRAMME

Awardee	Research Body	Co-Funder	Proposal Title	Award amount	Summary
AHSS Projects					
Nora White	Maynooth University		Irish Scripts on Stone - the origins and early development of Irish epigraphic culture	€524,037.63	The fact that there is no complete modern corpus of early Irish inscriptions in both ogham and Latin scripts means that this valuable resource is never used in research on early medieval Ireland. The lack of a comprehensive catalogue is a glaring gap in the fields of both Epigraphy and Early Irish. The OG(H)AM project (an IRC/AHRC-funded collaboration between Maynooth University and the University of Glasgow) is currently working on remedying this situation in relation to material in the ogham script. My proposal aims, not only to do the same for inscriptions in the Latin script (primarily found on cross-slabs), but to take the next, crucial step in using all of this newly generated, interdisciplinary data, along with practical experimentation in letter carving, to answer new and long-standing research questions around the origins and development of writing in Irish, such as: Who is writing and who is reading in early medieval Ireland? The proposed project will build on collaborations with the archaeological sector (university and state bodies) and will also establish Irish Epigraphy in the international field of Digital Epigraphy and ensure that data on the Irish material will be accessible, interoperable and re-usable for all.
Frances Nolan	University College Dublin		Law versus practice: women and property-ownership in early modern Ireland, 1541-1800	€563,503.17	An SFI-IRC Pathway award is sought for a landmark interdisciplinary research project on women and property-ownership in early modern Ireland. 'Law versus practice' will employ a wide range of primary source material to interrogate the nature, development and impact of female property-ownership between 1541 and 1800; a period characterised by war, plantation and demographic change. By examining women's property-ownership over a significant period of time, it will be possible to explore disparities between law and practice, analyse the impact of gender upon the operation of the legal system, and shine a light on women's experiences during a period of profound change. There is considerable scope for research in this area, not least because of the existence of records relating to sixteenth- and seventeenth-century Irish land settlements. Interdisciplinary collaboration with a PhD candidate specialising in Digital Humanities will underpin the production and dissemination of key research findings. A website will provide a platform for visual representations of data, including the 'mapping' of women's property-ownership and its impact in episodes of confiscation; it will also provide a 'home' for relevant digitised and transcribed source material, allowing students, scholars and the wider public to explore women's lives and experiences in early modern Ireland.

Sarah Raine	University College Dublin	Improvising Across Boundaries: Voicing the experience of women and gender-minority improvising musicians	€601,449.40	Improvising Across Boundaries will explore the experiences of women and gender-minority improvising instrumentalists in Ireland and musical improvisation as a space for counter-hegemonic practices and thinking. We ask – "by focusing on improvising, how can we theorise gendered experience?". Improvising Across Boundaries considers a significant issue on the island of Ireland – the considerable gender imbalance within improvisation, and amongst instrumentalists more generally – and addresses the lack of scholarly understanding of women and gender-minority musicians. This co-produced, collaborative project aims to facilitate the sharing of practice and knowledge amongst fifteen musicians, involving them in generating, analysing, and articulating data. Through collaborators, outputs, and a mixed-methods approach to data gathering, this project will also place this evidence within a wider, island of Ireland context. Findings will be analysed through frames from gender studies, queer studies, anthropology, and cultural and media studies. We aim to develop: new theoretical frameworks for conceptualising gendered experience; a model for co-produced, practice-led research; a range of Open Access outputs for a mixed audience; and a co-produced summer camp for girls and gender-minority pupils. The findings of this research will be made available to industry gatekeepers with the intention of instigating and scaffolding long-term change.
Nicola Palladino	Trinity College Dublin	"From Policy to Practices: Aligning Artificial Intelligence socio-technical design to European Union values and incoming regulation"	€565,619.83	The European Union is discussing a proposal for a 'Regulation Laying Down Harmonised Rules On Artificial Intelligence', better known as 'Artificial Intelligence Act' (AIA), establishing regulatory requirements for AI systems. In so doing EU aims to position trustworthy and human-centric AI as the distinctive trademark for Europe and its industry as a leader in cutting-edge AI and set the global standard for the future use of AI. However, practitioners are still struggling to understand how to implement ethical and good governance principles in their operational routines. Although many technical tools have been developed in the last few years, they appear poorly integrated with broader accountability mechanisms. This project aims to fill this gap by linking regulatory and social requirements, technical tools and organizational practices into a comprehensive governance framework supported by a system of indicators, criteria, and operational plans. In the end, extensive stakeholder engagement and a use-centered approach will be employed to develop the "Guidebook on Artificial Intelligence Act Compliance" an instrument aimed at providing practitioners with concrete guidance on how to comply with the incoming EU regulation.

Karen Taylor	University of Galway	EPA / Met Eireann	Establishing a long-term record of natural climate variability to inform future climate predictions for Ireland (CORE)	€567,768.31	Human-induced climate change is one of the greatest global threats of the 21st Century to environmental and socioeconomic sectors. There is a pressing need to address pertinent inconsistencies in the Irish palaeoclimatic record regarding abrupt climate events, which currently inform climate prediction models and subsequent mitigation and adaptation policies. CORE seeks to create the first robust, high-resolution regional temperature record since the end of the last ice age, focusing on abrupt climate events in western Ireland. Reconstruction of past climates is challenging due to timeline uncertainties, human impact on the landscape and methodological incompatibilities. As a development of the applicant's research, this project aims to i)rectify critical issues in the Irish palaeoclimatic record by employing a uniform, innovative and multi-method approach to climate reconstruction using complementary palaeolimnological (study of past lakes systems) techniques which infer direct temperature estimates and supporting environmental information, and ii)reconstruct an environmental baseline for freshwater lake systems and generate important insights into natural system responses to abrupt climatic change aiding modern conservation. The project will prioritise research excellence, generate high-quality contributions to European and global climate science and policy, and enhance the Irish palaeoclimatic research community-'we reconstruct Earth's past in order to better understand our future'.
Cassandra Smith-Christmas	University of Galway		GAELFAM (Gaeltacht Families and Multilingualism)	€563,333.58	Despite its many successes in revealing the complex relationship between language, the family, and society, the sociolinguistic subfield known as 'Family Language Policy' ('FLP') is in need of new vantage points and methodologies in order to advance. Through its novel focus on Gaeltacht families who use a language other than Irish or English in the home, Gaeltacht Families and Multilingualism (GAELFAM) will play a critical role in shaping future FLP research agendas as well as make a real-world impact on the everyday lives of families and young people in Ireland and further afield. GAELFAM will use ethnographic methods— including case studies; ethnographies of communities and schools; and semi-structured interviews —in attaining its key research objectives. Embedded in GAELFAM's implementation are improved methods for collecting FLP data digitally. GAELFAM will strengthen Dr. Cassie Smith-Christmas' position as a leading researcher in FLP and her expertise will enable the PhD researcher to successfully complete their doctoral studies. GAELFAM's comprehensive communication and dissemination strategies are designed to lead to impact at the international, national, and local levels, in academia and in society alike, particularly in terms of shaping language policy and practice in an increasingly multilingual Ireland.

Noel O'Connell	University College Cork	CODA: A Hidden Minority Amongst the Majority. An Ethnographic Study of Hearing Children of Deaf Adults and the Negotiation of Threatened Social Identities	€565,442.18	Currently, over 90% of children born to deaf adults (CODAs) can hear (Wilhelm 2008). While CODAs grow up in sign language, they are perceived by society to be outside of what is constituted as “normal” family culture (Napier 2021). Whereas deafness stigma may have consequences for deaf adults (Mousley & Chaudoir 2018), it remains unclear the degree to which “courtesy stigma” or stigma by association impacts on CODAs (Moroe 2019). CODA, through its PI and PhD projects, will address this question which is currently underexplored particularly using child-centred methodologies. It will conduct ethnographic interviews with CODA adults and children in Ireland (north and south) to explore how this group negotiate the courtesy stigma of their parents’ deaf identity. The project aligns with the United Nations commitment to protecting the right of children to an inclusive and safe environment free from stigma and discrimination (SDG 10; UNCRC 1989). CODA utilises novel cross-disciplinary research approaches by combining theory from sociology with insights from Deaf Studies and Childhood Studies in order to explore two fundamental social concerns of our time: (1) the problem of courtesy stigma affecting children and families; (2) and the complex nature of identity in an ableist society.
Andrew McDiarmid	University College Dublin	Forgotten Funding: The Tontine and its cultural and societal impact on Britain and Ireland, 1693-1900	€503,780.13	As the tontine’s popularity as a state revenue-raising tool declined in the late-eighteenth century, it simultaneously emerged as a popular instrument among private groups raising funds for infrastructural/cultural projects across Britain and Ireland. The scheme impacted all areas of society, providing funding for public/private buildings, including homes, theatres, and coffeehouses. The cultural impact was significant, providing tontine-funded educational and performance spaces, and inspiring writers to incorporate the scheme into literary works. Today, tontine funded buildings exist throughout Britain and Ireland, but the history has been forgotten. Scholars have focussed on the financial aspect of the tontine, failing to consider its wider cultural impact. This project addresses this by undertaking a novel exploration of tontine development in different locations, in conjunction with a wider study of the cultural impact; including the enlargement of the public sphere through tontine-funded spaces, and how popular cultural was influenced by the scheme. Importantly, it considers female tontine investment, aided by an integrated PhD Project focussed on the role of Irish women as investors. Research outputs will place the tontine in its historic context and provide a framework for a modern tontine-type funding instrument, kick-starting a debate on the possibilities of this type of funding today.

Tim Groenland	University College Dublin	The Publishing Infrastructures of Contemporary Anglophone Literature	€560,969.16	This project will conduct a comparative study of publishing infrastructures across three different Anglophone territories – Ireland, the US, and Britain – to identify how those infrastructures shape contemporary literature. Publishing has been transformed during recent decades, at both local and global scales. The digital revolution and the entry of tech giants into the publishing business have had global effects on publishing and on the development of literary forms. Ireland's status as a small literary market close to (and in symbiotic relationship with) major centres of power in the US and Britain makes it an ideal hub for this analysis. The project will use a range of methodologies including literary scholarship, author and other stakeholder interviews, and cultural analytics to analyse the infrastructures mediating literary culture today. Drawing on the recent turn towards the study of literary institutions, it will identify and analyse the key forces mediating and shaping contemporary literary publishing. By focusing on case studies and using social network analysis to map the networks through which books are created and sold, the project will not only expand our understanding of publishing conditions in Anglophone literature but will make an important contribution to improving equity of access to publication.
Margaret McLafferty	ATU	Student Mental Health and Wellbeing on the Island of Ireland	€559,648.92	High levels of psychological problems are common among college students globally. The researcher and colleagues form an interdisciplinary team with a strong track record of student mental health research. Our recent work revealed elevated rates of psychopathology and suicidality among students commencing college. Building on this existing collaboration between ATU and Ulster University, the proposed project aims to expand on these findings by: 1) developing a large-scale, standardised, longitudinal wellbeing study across a wide range of colleges on the island of Ireland, 2) exploring how parenting behaviour in the years prior to commencing college may impact on the transition to college, 3) exploring how school/universities help prepare students for this transition, 4) evaluating if variations in prevalence rates of mental health disorders and suicidal behavior are related to the different education systems on either side of the Irish border. The findings from this project will benefit numerous stakeholders including students, educators and mental health service providers providing a better understanding of student mental health and identifying early intervention strategies. Such work is timely and of great importance, as many adolescents have been struggling since the onset of the pandemic, which may impact on their education and wellbeing in future years.

Camila Tavares Pereira	University College Cork	Transferability of resilience in informal settlements (TRIS): a model for assessing climate risk and empowering women as decision-makers	€563,874.88	Currently, 1 billion dwellers live in informal settlements characterised by a lack of urban services, poorly constructed housing, no legal tenure, and most vulnerable to climate-related risk. Because of the lack of governmental support, the climate risk burden management falls entirely on these communities. Thus, the primary objective of this project is to establish a transferable and community-based Climate Change Risk Assessment (CCRA) model for informal settlements in the Global South (GS). The project also proposes to transfer the GS knowledge on community-based adaptation measures and risk reduction to Ireland. We will implement a hybrid framework that integrates fieldwork, interview, workshop, remote sensing, machine learning, and geospatial analysis. The PI will be the project leader and responsible for creating, validating, and transferring the model in the GS and the community-based approach to Ireland, while the PhD for analysing the gender dynamics on climate risk reduction measures in the GS and Global North. In this way, the project will support the Sustainable Development Goals (SDG), specifically SGD5, SDG11, and SDG13, by empowering women as key actors in disaster preparedness and risk reduction, enhancing community-led measures to upgrade settlements, and supporting reducing exposure and vulnerability to climate-related extreme events.
Boris Kayachev	Trinity College Dublin	Enjambement in Latin poetry: prosody, pragmatics and word order	€566,078.33	Prosody (intonation, stress, rhythm) is a crucial tool that languages use to convey meanings; yet since prosody is not systematically encoded in writing, we have very little direct evidence about the prosody of a dead language like Latin. Enjambement in Latin poetry (the non-coincidence of a verse break with a syntactic boundary) is a largely neglected piece of evidence that can shed light on the prosodic organisation of Latin. In contrast to previous research that only considered, on limited material, the prosodic properties of specific lexical and syntactic categories, this project will also explore in depth how enjambement is used to express pragmatic meanings. It will systematically investigate enjambement across two corpora of Latin verse: (a) early comedy (Plautus and Terence); and (b) classical epic (Virgil's Aeneid and Valerius Flaccus' Argonautica). The first corpus is arguably the closest approximation of actual spoken Latin we possess, the second consists of highly sophisticated artistic texts: the former can thus be used to make inferences about the prosody of 'ordinary' Latin, the latter may provide the key to understanding how the prosody, word order and pragmatics of poetic language differ from those of 'ordinary' Latin.

Maria Shmygol	University of Galway	Foreign Places and National Identities in English Drama, 1560-1660	€555,550.95	This project investigates how plays set in 'foreign' places interrogate and codify a sense of English national and racial identity. It interrogates how plays produced between 1560 and 1660 invoked global locations that were sources of suspicion, cultural interest, and colonial desire. These hundred years were a key period when England underwent political shifts and began to gain global standing and colonial territories; it was also a key period for the rise of commercial theatre. I will make available a body of new knowledge that will give the scientific community a better understanding of how England's cultural, commercial, and colonial interests in—and anxieties about—different kinds of 'foreign' places shaped key developments in drama and theatrical practice. My doctoral student and I will build a database of English plays set in the Mediterranean, Africa, India, and the Americas. We will develop digital methodologies for quantitative research to identify trends pertaining to particular dramatists, theatres, years, and locations. Our analysis of the data will be communicated to the scientific community through conferences and peer-reviewed publications, and to the wider community through social media, blogs, an online exhibition, and public engagement events in schools.
Darren Roddy	Royal College of Surgeons in Ireland	Early stress, the maturing brain and psychosocial function. Exploring relationships between early life adversity and functional outcomes in adolescence through to early adulthood: a longitudinal study of three international cohorts.	€530,276.73	Early life adversity (ELA) can result in future social and behavioural difficulties, educational and employment impairments and a predisposition to mental illness. However, the effects of ELA on the maturing adolescent brain and how this mediates functional deficits remain mostly unknown. This project will analyse previously collected data from three large population-based cohort studies: IMAGEN (EU), Adolescent Brain And Cognitive Development study (USA) and Irish Adolescent Brain Development study. A nested dataset of demographic, ELA, MRI and outcome measures (including neuropsychological, social, socioeconomic and educational scores) will be created and matched for data equivalence over 3 time-points. This study will use state-of-the-art structural neuroimaging processing to determine volumes of stress-linked limbic substructures including hippocampal subfields, and amygdalar and thalamic nuclei. Bespoke previously validated diffusion tractography of connecting white matter tracts will be used to estimate markers of structural connectivity. Data will be interrogated to explore the cross-sectional, longitudinal and predictive relationships between ELA, limbic anatomy, structural connectivity and functional outcomes as these adolescent brains mature into adulthood. A separate Irish-only analysis will be undertaken to explore Irish-specific associations and predictive models. Irish adolescents, families, clinicians and educators will guide analysis and the impact of potential findings through regular focus meetings.

STEM Projects

Bharathi Konkena	Trinity College Dublin	SEAI	High Areal Capacity Lithium and Sodium Ion Battery Electrodes from Two-Dimensional Ternary Metal Phosphide Nanosheets (2DNs-BAT)	€567,025.20	Discovery of new electrode materials with capable of achieving very high areal capacity is required for increasing the energy density of lithium/sodium(Li/Na)-ion batteries. The proposed research will focus to explore a new class of layered and non-layered materials based on Si/Ge/Sn based ternary metal phosphides. These materials possess attractive Li/Na ion storage capacity with theoretical capacities over 1600 mAh/g. Here, liquid phase exfoliation will be employed for size selective nanosheets and characterize with state of the art physico-chemical, electrochemical, microscopy and spectroscopy techniques. Subsequently, these nanosheets will be fabricated into solution-processed thin films for use as Li/Na storing electrodes. To achieve high areal capacities, we will combine these promising materials using a electrode architecture by combination of exfoliated nanosheets with carbon nanotube networks. Based on electrode thickness, we will demonstrate half/full cells of these electrodes to achieve near-state-of-the-art energy and power densities. The systematic investigations on precise monitoring of electrode optimization, conductivity and porosity as well as thickness dependent rate performance allow us to provide a critical assessment for the future developments in Li/Na-ion battery research. This will have a potential impact on scientific/technological field in both academic and industrial sectors to achieve “excellence and attractiveness in research and innovation".

Oleksii Rukhlenko	University College Dublin	Using cyber-physical network modelling to tackle RAS-driven cancers	€565,735.20	Mutations in the RAS family genes are among the first discovered oncogenic mutations. Although RAS proteins and their signalling networks have long been studied, a central question whether the reversal of RAS-driven transformation can be achieved is still open. The proposed project will reveal how RAS-driven oncogenic transformation can be reversed.RAS, RAF, MEK and ERK inhibitors are currently ineffective in pancreatic and colorectal RAS-mutant cancers. Using next-generation computational modelling and validating its predictions experimentally, I showed that specific combinations of small molecule inhibitors effectively suppress both downstream RAS signalling and proliferation of RAS-mutant cancer cells.I will elucidate the network-wide effects of RAS-driven transformation and potential resistance mechanisms using cSTAR, an approach which I have recently developed. This approach combines network inference, machine learning and dynamic network modelling to describe how cell fate decisions are generated by the cell. I will use different RAS-mutant colorectal and pancreatic cancer cell lines as model systems. Applying different perturbations, I will measure proteomic and transcriptomic responses to reconstruct and computationally model signalling networks that control the transformation process. These models will reveal optimal ways to reverse the oncogenic RAS transformation, which will be rigorously validated both in vitro and in vivo.
Sean Jordan	DCU	ProtoSigns: Protocells in the Archaean rock record – Implications for the origin of life and detection of biosignatures	€562,735.20	Fossilised remains of protocells transitioning towards first living organisms may be observable in the early rock record distorting our interpretation of biosignatures. Protocells – cellular structures existing before life – would have comprised simple membranes and primitive molecular machinery. Recent evidence suggests that these structures share morphological similarities with microfossils, severely impacting our interpretation of biosignatures on Earth. The potential for preserved protocells to complicate the interpretation of the rock record has long been recognised yet has not been systematically tested. An understanding of the possible preservation of prebiotic structures is almost non-existent. This project will use a novel microfluidic approach to expand experimental scope for formation of protocells of increasing complexity in early Earth environments. The resulting microstructures will be subjected to silicification and diagenesis under different temperatures and pressures, mimicking the principal preservation pathway for early Archean microfossils. State-of-the-art analytical techniques will be used to characterise these biomorphs, providing the first rigorous investigation of the feasibility of protocell preservation and how this might express in the geological record. This project has the capacity to represent a paradigm shift in our fundamental understanding of the origin and evolution of life on Earth and possibly elsewhere in the Solar System.

Laetitia Chauve	Trinity College Dublin	POLYCEL (POLYploid C.ELegans): Consequences of whole genome duplication on physiology and genome regulation in a synthetic C. elegans tetraploid.	€563,830.48	Gene duplications play a major evolutionary role by providing raw material for functional innovation. Whole Genome Duplication (WGD), or polyploidization, is a particular case of duplication, where the entire genetic sequence is repeated within the nucleus. In plants, WGD is recognized as a major evolutionary force, linked to speciation and the ability to resist periods of stress. In animals, examples of current polyploid species are rarer, but several ancient WGD events are known: for instance, two rounds of WGD occurred during early vertebrate evolution. Those events are usually followed by gene loss and diploidization, processes which reshape the genome and channel evolutionary outcomes. The reason for the success of polyploidy in animals is unclear. One debated hypothesis states that polyploidy is adaptive on the short-term, however this has never been studied in animals. This question is highly relevant for cancer, as polyploidy is strongly correlated with drug resistance and poor prognosis. We are investigating the consequences of polyploidy in the nematode Caenorhabditis elegans, where tetraploidy can be artificially constructed. This project aims at understanding how animals adapt to polyploidy, and studying its potential adaptive consequences on the short term by combining genomics sequencing techniques, evolution experiments and genetic screening.
Bartosz Bieszczad	University College Dublin	Nature Inspired Chemical Transformations	€564,694.90	The vast majority of existing synthetic methods depend on polar reactivity, where two-electron pathways are activated thermally. A complementary and much less exploited approach involves radical reactivity. Indeed, over the course of chemical evolution, Nature has developed the ability to tame highly reactive radical species and exploit them in biochemical pathways in order to prepare complex molecules with a high degree of selectivity. The key research question for this proposal is: can some of these biochemical mechanisms exploiting radicals be adopted to organic synthesis? This challenge is exemplified by three bioinspired research projects. 1,2-amino migrations will be developed to convert readily available α-amino acids into more valuable β-amino acids without the need for de-novo synthesis. Chiral organophosphorus species will be used as chiral hydrogen atom donors in catalytic asymmetric hydrogen atom transfer reactions. Finally, a new approach to radical conjugate addition employing asymmetric, organocatalytic xanthate transfer for the synthesis of aza-polycylic scaffolds will be developed. Methods will be scaled up using flow chemistry. All methodologies will allow new disconnections and access to difficult molecular configurations, having potential impact well beyond the field of chemistry.

Zhi Li	TNI		Monolithic Integration with Pyramidal Micro-LEDs: Bringing AR/VR Displays into Reality (MICROBAR)	€563,335.60	Micro-light-emitting diodes (micro-LEDs) spanning blue, green and red emissions with high efficiency and brightness are highly desired for virtual/augmented reality (VR/AR) applications. However, the current approach for device fabrication leads to significant efficiency drop for small devices, in particular for traditional red micro-LEDs based on AlGaInP, which hinders the advance of applications mentioned above. In this proposal, we aim to achieve highly efficient red micro-LEDs based on InGaN materials via epitaxial growth on semi-polar planes of GaN pyramids. These directly grown pyramid micro-LEDs, benefiting from a variety of advantages such as significantly reduced polarization fields on semi-polar planes, higher light extraction efficiency and the damage-free epitaxy process, are expected to emit native and bright red light, which will be ground-breaking technologies for the displays if successful. Moreover, by adding InGaN-based blue and green micro-LEDs growth to the same chips, we aim to demonstrate monolithically integrated RGB micro-LED structures in the same wafer. Compared to the conventional hybrid integration process, this integration approach in the epitaxy level based on only InGaN materials will enable higher resolution and brightness, and lower production cost for microdisplays. These technologies will pave the pathway toward ultrahigh definition displays for VR/AR applications.
Andrei Ermakov	Maynooth University	SEAI	Maximising the power capture from cyclorotor wave energy converters	€535,699.40	This project is dedicated to development of a radically new control strategy for cyclorotor-based Wave Energy Converters (WEC) and is applicable to other cyclorotor-based energy devices (wind, tidal and wave). The proposed control strategy will increase efficiency, increase energy extracted and extend the device's lifespan. The most recent experimental and numerical simulations have shown that cyclo-rotor WECs are currently 40% more efficient than traditional WECs, and potentially 45% more efficient if the optimal design and real time control method is derived making it competitive with offshore wind energy. The MaxRotorWEC project supports development of the new control strategy, focusing on demonstrating its commercial viability, strengthening Irish leadership in wave energy. This requires financial assessment, mathematical modelling and engineering optimisation in order to minimise the levelised cost of produced electrical energy (LCoE). A linearised mathematical model for the cyclorotor, new estimator of rotor state and predictors for relative foil-fluid velocity, as well as real time control will be developed. Cyclorotor-based WEC farms near the Irish coast will be modelled and performance assessed. In addition to vastly improving the LCoE of cyclorotor wave energy devices, the new control strategy will benefit vertical H-Dareus wind turbines, tidal turbines, cyclocopters, and Voith Schneider propellers.

Dan Wu	Royal College of Surgeons in Ireland	AI prediction of vaping toxicants from pyrolysis chemistry of e-liquids: Potential to avert a future public health crisis.	€549,133.20	Electronic cigarettes, are marketed as a safer means to inhale nicotine without the inherent health risks of tobacco. In their first manifestation there was only four chemicals in a vaping solution but this has dramatically increased in recent years. There are currently more than 7,000 flavoured vaping solutions on the market containing over 200 discrete chemical entities. As temperatures reached in vaping devices can be equivalent to a laboratory pyrolysis apparatus (up to 950 ˚C), the potential for unexpected chemistries to take place on individual components within a vape solution is high. The goal of this proposal is to leverage the power of artificial intelligence to predict the pyrolysis chemistries of all known chemicals in vaping solutions, cross correlate the results with experimental mass spectrometry databases and combine with calculated bond dissociation energies to generate a vaping health risk predictor. New experimental pyrolysis in-flow methods will be developed to validate the most important predicted results and explore the potential of acid, base and metal catalysed pyrolysis reactions taking place in the complex vaping mixtures. Research action is required to prevent another tobacco-like health catastrophe as many negative health impacts will not materialise in the vaping population for another decade.
Ana González Suárez	University of Galway	Heart-Save: Developing a next-generation non-thermal treatment for cardiac arrhythmia	€563,087.05	Recognising an ageing European population, an epidemic of atrial fibrillation (AF) is predicted in the next decade, with almost 18M citizens affected in 2030. The current impact on public health is substantial, with more than 1M hospital admissions accruing to €40B in healthcare costs annually. Left untreated, AF substantially increases the risk of stroke (70% of these patients will die), congestive heart failure, dementia and death. Current ablation treatments are based on destroying tissue-causing arrhythmias by heating, but neglect their origin site – neuronal cells on the epicardium known as ganglionated plexi, GP. Furthermore, these thermal-based treatments have significant associated risks due to tissue overheating, which can lead to symptomatic stroke, transient ischemic attacks and microemboli. The proposed project is focused on developing a novel and non-invasive disruptive technology capable of locating and non-thermally ablating the origin site of AF by using pulsed electric fields. The methodology includes developing complex numerical models to explore new impedance-based methodologies to localise GP-sites, as well as animal models to validate and optimise the prototype. The project outcome will provide a revolutionary new AF treatment technology, leading to a more sustainable therapy in terms of efficiency, safety and cost reduction in European healthcare systems.

Vivek Verma	University of Limerick	Template Assisted Crystallisation of Oligonucleotide Drugs (EMERALD)	€564,727.00	Oligonucleotides are a promising class of therapeutic molecules that can target genes directly and influence proteins at the level of initial expression providing effective precision medicine. The recent approval of a few oligonucleotide-based drugs by the US Food and Drug Administration (FDA) has boosted oligonucleotide therapeutic research and production. Antisense oligonucleotide (ASO) is an RNA-based platform that has gained significant attention due to its ability to modulate gene expression. In an oligonucleotide manufacturing process, approximately 50% of the waste is generated from the purification and isolation steps. These processes involve chromatography and lyophilisation techniques that are energy inefficient, time-consuming, and unsustainable. Therefore, a revolutionary approach is needed to improve sustainability, reduce the carbon footprint, and make the process economical. The goal of EMERALD is to develop a crystallisation protocol for oligonucleotides using a novel templated strategy to improve the purification and isolation process of oligonucleotide manufacturing. This will enable the production of robust oligonucleotide crystals with improved physicochemical properties required for downstream processing. Further, the influence of nucleotide sequence will be studied to generalise a crystallisation protocol for different types of oligonucleotides. Lastly, the oligonucleotide crystallisation learnings will be translated to develop a crystallisation protocol for a marketed ASO.
Janna Luessing	University of Galway	Elucidating roles for CCCH-type Zinc finger proteins in cellular responses to DNA double strand breaks	€564,332.19	Here, I propose to dissect the mechanisms by which two Zinc finger proteins (CCCH-type) that our preliminary data has implicated in DNA double-strand break (DSB) repair. CCCH-type Zinc fingers primarily bind RNA, while RNA has emerging roles in DSB repair. We originally identified ZC3H11a and ZC3H14 as partners of the key DSB response kinase, ATM. Previous studies suggested that ZC3H11a functions in the life cycle of nuclear-replicating viruses, while mutations of ZC3H14 have been linked to non-syndromic autosomal recessive intellectual disability. Deregulation of both has been reported in cancers. Four hypotheses will be addressed across two work packages: 1) ZC3H14 recruits RNF8 to DNA damage foci. 2) ZC3H14 function at sites of DSBs requires RNA and/or RNA binding proteins. 3) ZC3H11a is recruited to DSBs early in the DDR as an ATM substrate that facilitates HDR. 4) ZC3H11a is involved in HDR of heterochromatic regions through mediating chromatin relaxation. These hypotheses will be addressed using a suite of biochemical, cell biological and genomic approaches, available in the host and collaborating laboratories, and will lead to novel insights that will increase understanding of fundamental biology and may, ultimately, result in improved diagnostic and therapeutic interventions relevant to cancer, neurology and/or virology.

Merve Zeden	University of Galway	Targeting essential genes with chimeric antisense oligonucleotides (ASOs) as novel antibacterial agents and antibiotic adjuvants to overcome antimicrobial resistance (AMR) in Methicillin Resistant Staphylococcus aureus (MRSA) and other AMR pathogens	€566,380.98	The relentless rise of antimicrobial resistant (AMR) infections constitutes a leading threat to public health that must be counteracted by the development of novel antibacterial agents and alternative approaches. This proposed project will focus on designing, evaluating, and "perfecting" chimeric antisense oligonucleotides (ASOs) that can inhibit growth of Staphylococcus aureus, MRSA, and ESKAPE pathogens which are on the World Health Organisation's list of priority pathogens. Chimeric ASOs will undergo modification with oligopeptides in collaboration with Profs Paul Murphy (Galway) and Marc Devocelle (RCSI) to facilitate delivery into bacterial cells. Several genes essential for S. aureus survival and antibiotic resistance will be selected as targets for ASOs. These include, adenylate cyclase DacA, lipoteichoic acid synthase LtaS, and phosphoglucosamine mutase GlmM. Expanding on this approach, combinations of ASOs and other novel antimicrobial agents will also be tested against MRSA and other ESKAPE pathogens. My recent unpublished work showed that guanosine can re-sensitise MRSA to beta-lactam antibiotics. The activity of combinations of ASOs, purines, pyrimidines (and their analogues), and conventional antibiotics against MRSA will be evaluated. Exploiting new technologies to counter antibiotic resistance in this project will lay the foundations for therapeutic strategies to improve the limited treatment options for AMR infections.
Karen Lange	University College Dublin	Rare Disease Modelling and Drug Discovery in C. elegans: using CRISPR genome editing in worms to help diagnose and treat ciliopathies	€566,749.67	While individual rare diseases are uncommon, collectively they affect 1 in 25 people. Patients with rare diseases often experience symptoms for years before obtaining a diagnosis and most rare diseases have no treatment. This proposal aims to use CRISPR genome editing in an animal model, Caenorhabditis elegans, to help diagnose and identify novel treatments for a specific class of rare disorders called ciliopathies. Ciliopathies are caused by defective cilia, antenna-like sensory organelles that are found on almost all human cells. Identifying pathogenic ciliopathy variants helps patients obtain an accurate diagnosis. This project will establish 50 worm strains containing missense patient mutations in 4 ciliopathy genes (B9D1, B9D2, MKS1, TMEM67). Using quantitative readouts of cilium structure/function, this allelic series will provide unprecedented insight into the contribution of specific missense variants to ciliopathies and instruct the reclassification of variants of uncertain significance (VUS) as pathogenic or benign. Additionally, two complementary approaches (genetic suppressor screen and drug repurposing screen) will be used to identify novel therapeutics that restore cilia function to C. elegans ciliopathy mutants. This research will establish C. elegans for disease modelling and drug discovery; the methods developed here can be broadly applied to any conserved gene with quantifiable phenotypes.

Friederike Uhlig	University College Cork	GO-AHEAD "Gastrointestinal Oxytocin is importAnt in HEalth And Disease"	€565,994.90	The goal of this proposal is to investigate whether oxytocin produced in the gastrointestinal tract has potential as a novel therapeutic target for the treatment of disorders where gut-brain-axis communication is dysregulated such as autism spectrum disorder (ASD), obesity and irritable bowel syndrome. We will focus on ASD, one of the most frequent neurological disorders in the Irish population with significant gastrointestinal comorbidities and a paucity of treatment approaches targeting both behavioural and intestinal symptoms.Oxytocin produced in the brain is known to play a crucial role for physiological health and sociability. In addition to the brain, reports suggest that 25 to 60 % of gastrointestinal neurons are oxytocinergic. It is unclear however which stimuli induce oxytocin secretion from gastrointestinal neurons and whether it modulates gastrointestinal function and behaviour. The microbiota has a potential role because microbiota-targeting interventions increase systemic oxytocin levels and microbes residing near enteric neurons modulate the secretion of other intestinal hormones. I aim to investigate how microbes modulate intestinal oxytocin secretion in-vitro, whether intestinal oxytocin modulates gut and brain physiology ex-vivo, and GI function and behaviour in healthy as well as autism model animals.
Yasaman Kouchekzadeh Yazdi	Dublin Institute for Advanced Studies	Hawking Radiation and Black Hole Entropy in Causal Set Theory	€527,327.00	Our current best understanding of black holes is in the semiclassical context of black hole thermodynamics. In this context, black holes radiate as black bodies (Hawking radiation) and have a characteristic entropy (Bekenstein-Hawking black hole entropy) proportional to their event horizon. While both Hawking radiation and black hole entropy have been derived in numerous independent ways, thus giving us confidence in their reality, a fundamental understanding of them has been elusive. A suggestive possibility is that we should look for this fundamental understanding beyond the semiclassical theory. The goal of this project is to do exactly this. I aim to understand Hawking radiation and black hole entropy, or any modifications to them that may arise, in the context of the Causal Set Theory approach to quantum gravity. In causal set theory, spacetime is discrete and causality is fundamental. Recent advances in understanding quantum field vacuum states and entanglement entropy in causal sets describing flat and cosmological spacetimes have paved the way to treat the black hole case. I will use these techniques to study the manifestations of Hawking radiation and black hole entropy in causal sets, thus advancing our understanding of black holes further into the quantum regime.

Daniel Alonso Gamero Quijano	University of Limerick		“A Bio-Mimetic Electrochemical Immunoassay Platform for the Early Detection of Chronic Amyloid-derived Diseases”	€561,663.90	MimiChron aims to improve the scientific understanding of neurodegenerative diseases by developing a novel and accessible platform to identify and treat such diseases. The evolution of amyloids (e.g., Amyloid light chain, Amyloid β, tau, α-synuclein, lysozyme) has been linked to neurodegenerative diseases (e.g., Parkinson's, Alzheimer's, among others) and cancer proliferation; however, the protein's aggregation mechanism and the local environment's role that triggers the amyloid formation remains unclear. Furthermore, there are currently no efficient diagnostic methods for the early identification of such chronic diseases. To address these issues, MimiChron will showcase bioelectrochemistry at biomimetic polarisable liquid-liquid (or "soft") interfaces as a novel tool to understand the mechanisms of denaturation, cross-linking and aggregation of proteins at a cell membrane leaflet. A direct application of MimiChron's methodology will be the development of a disruptive dual-mode electrochemical immunoassay platform for detecting amyloid monomer and oligomer proteins, early-stage indicators of neurodegenerative diseases. Such technology will enhance Ireland's international reputation in the fields of bioelectrochemistry, biosensor and biomedical device technology, delivering novel next generation technology to provide significant economic and societal benefit to Irish people, and attract high-calibre academic attention. Intellectual property generated will be exploited through licensing the technology.
Aaron Fox	Teagasc	EPA	Unlocking the black box: Consequences of agricultural grassland management intensity on soil microbiome-mediated nutrient cycling potential in Europe	€566,894.90	The widespread conversion from plant species-rich, extensively managed grasslands to plant species-poor, intensively managed grasslands in Europe has had profound consequences on the community structure of the soil microbiome. The soil microbiome plays an instrumental role in many soil nutrient cycles, thus this significant shift may have had profound effects on these processes, though this is currently unknown. The proposed research will address this fundamental research gap in two phases. Firstly, the influence of grassland management intensity on soil microbiome-mediated nutrient cycling potential will be measured across ten contrasting regions in Europe, using metagenomic analysis of microbial functional genes involved in the soil nitrogen and carbon cycles and in phosphorus turnover. Secondly, a number of complimentary focused studies will be undertaken. These will focus on the influence of the following aspects on microbiome-mediated soil nutrient cycling potential; 1) the presence of specific plant species 2) temporal effects and 3) soil microbiome community structure. A greater understanding of the influence of grassland management intensity on microbiome-mediated soil nutrient cycling potential is of crucial importance for the development of more sustainable management practices, as is stipulated by both the Irish Government’s FoodWise 2030 and EU Farm to Fork policies.

Tatsiana Mikulchyk	Technological University Dublin	Development of panchromatic photopolymerisable hybrid sol-gel material for holographic recording of full-colour holographic optical elements for augmented reality displays (PolyGlass4AR)	€553,069.60	The progress of Augmented Reality (AR) technology has become a strong driver for the development of innovative holographic optical elements (HOE) and photosensitive materials. Holographic materials suitable for production of the appropriate HOEs are emerging but these materials have insufficient robustness, sensitivity to water infiltration and low temperature resistance. Thus, existing materials do not satisfy all the requirements for the fabrication of robust and insensitive to the environment HOEs. New robust materials are needed to replace these soft polymers once the new applications transition into everyday use in wearable devices and outdoor applications.PolyGlass4AR will develop a novel panchromatic photopolymerisable sol-gel (PHSG) with improved mechanical, temperature and water resistance by use of the hybrid sol-gel technology. The panchromatic PHSG will combine the advantages of a glass-like material with photosensitivity at RGB wavelengths which will be introduced by the material's functionalisation. The research advances will be demonstrated by developing two complex HOEs, a grating combiner and a full-colour holographic lens, for waveguide AR display systems anticipated as the next-generation technology. PolyGlass4AR will deliver an innovative material solution for the fabrication of full-colour HOEs with stable performance at different ambient conditions and increase the technological potential of HOEs for the real-world products.
Ali Alehosseini	Teagasc	Optimising solute transport dynamics in dairy matrices focused on increasing the sustainability of industrial scale cheese manufacture	€563,810.90	The proposed project seeks to develop Specific Smart Sustainable Cheese Manufacturing Methods to (1)Reduce cheese moisture content(~5%) for long distance export, by optimizing molecular-interactions between cheese matrix constituents, (2)Facilitate the migration of salt molecules through the low solvent matrix, (3)Recycle the salty whey stream during cheese manufacturing. These techniques will lead to a more sustainable production by (1)Decreasing the cost of global transportation by ~5-6% per tonne of milk-solids exported, (2)Increasing the factory milk-solids throughput by ~10% and enabling processing of increased milk volumes, (3)Recovering 1.8% more whey-solids; (4)Reducing salt usage by 25% and reduced disposal costs for salty whey by 15%. The reduction in salty whey produced (~16%) will prevent 42.6 tonnes of salt per 10000 tonnes of cheese from going to waste. This will build on recent preliminary research—conducted by the lead applicant—and focus on investigation of casein-matrices at micro-structural-scale, development of new methodologies, and model-systems to measure and track solute migration in cheese matrices. The proposed project will deliver climate resilient, economically viable, and sustainable smart cheese manufacturing solutions in alignment with EU and Irish government research initiatives. The Main Mentor and the Academic Contributor are Dr Diarmuid JJ Sheehan-Teagasc and Prof Alan Kelly-UCC, respectively.

Claire Healy	Trinity College Dublin	Lipid and Iron Overloaded Lung Macrophages Fuel Opportunistic Non-Tuberculous Mycobacterial (NTM) Respiratory Infections	€565,390.13	Non-tuberculous mycobacterial lung disease (NTM-LD) is now recognized as a chronic condition with considerable morbidity, mortality and inadequate treatment strategies. NTM-LD commonly occurs in those living with respiratory co-morbidities, resulting in decreased quality of life and increased mortality for these vulnerable individuals. The incidence of NTM infections is on the rise globally, including in Ireland. This increasing trend in NTM infections indicates a growing global disease burden which we do not have the effective tools and measures to manage. There is an urgent need to better understand how opportunistic NTM pathogens interact with the compromised host to develop improved targeted therapies for NTM-LD. The diseased lung microenvironment is vastly different to that of the healthy lung, yet how this altered nutrient landscape promotes infection remains to be fully elucidated. The aim of my proposed research is to examine the role of nutrient-dysregulated alveolar macrophages, the key intracellular niche for NTM during infection, in promoting NTM-LD. Using novel in vitro and in vivo approaches, we will dissect the host-pathogen interactions between NTM and the host in the context of chronic lung disease, allowing us to define pathways of NTM-mediated host immune injury that will unveil therapeutic targets for this often-untreatable disease.
Alexander Jaeger	TNI	WiMag - Wireless Magnetic Tracking for Collaborative Environments	€530,580.60	Motion capture systems measure the motion of people and objects in 3D space and are widely used in film production, engineering, virtual reality and medicine. The market leading motion capture systems use optical techniques to measure light from a subject in order to track its position and orientation in space. However, the underlying principles of optical motion capture make these systems prone to tracking errors due to line of sight constraints; Optical systems can malfunction in scenarios where multiple subjects are tracked or if obstacles in the environment break the line of sight between the subject and optical measurement unit. Magnetic tracking technology serves as an alternative tracking method that does not require line of sight to be maintained. Existing magnetic motion tracking systems are large, bulky wired devices making them unsuitable for many motion tracking applications in which optical methods are often preferred. WiMag addresses these shortcomings by developing a novel wireless magnetic motion tracking system suitable for multi-user motion capture applications. The proposed system has the potential to radically shape the future of virtual reality by enabling the tracking of multiple subjects in a common environment.

Daniela Ottaviani	Royal College of Surgeons in Ireland	CDK12/MED1/ER, a functional transcriptional complex and actionable vulnerability in breast cancer brain metastasis.	€547,976.60	Brain metastases are one of the most lethal and poorly managed clinical complications in breast cancer patients. Approximately 70% of breast cancer patients have estrogen-receptor-(ER)-positive tumours, 40% of whom relapse, and up to 30% of these are at risk of developing metastatic spread to the brain. From longitudinal global genomic and transcriptomic studies of primary and metastatic patient tumours undertaken in our group, I identified the transcriptional cyclin CDK12 as a top ranked amplified gene, which is routinely overexpressed in brain metastasis. In preliminary studies, I found that CDK12 modulates estrogenic pro-tumorigenic signalling by modifying ER and MED1 chromatin accessibility. Furthermore, therapeutic inhibition of CDK12 reduces cell viability in patient in vitro and ex-vivo model systems. The aim of this proposal is to investigate the potential of CDK12 as a novel actionable target and companion diagnostic in metastatic breast cancer, to evaluate the efficacy of targeting CDK12 with novel small molecule inhibitors, and to decipher the function and mechanism of action in breast cancer brain metastasis. Successful completion of this proposal will provide fundamental information on the CDK12/ER/MED1 transcriptional complex in metastatic disease, with potential translational clinical relevance as a new targeted therapeutic option to treat breast cancer brain metastases.
Kiva Brennan	Trinity College Dublin	Improving Paediatric Vaccines - Closing the Window of Vulnerability	€566,776.13	Worldwide, millions of children die every year due to infectious diseases. While vaccinations have saved millions of lives, there remains a significant need to enhance childhood vaccine efficacy. Infants receive vaccinations against dangerous infections but achieve full protection only after several booster vaccinations. This is because their immune systems are not fully mature and do not function in the same way as an adult's immune system, leaving a "window of vulnerability" in a child's life before booster vaccinations can take effect. To maximise the effectiveness of vaccines, adjuvants can be added to boost the immune response. Most vaccines and adjuvants are developed and tested in adults; thus, effective adjuvants for the paediatric population are often overlooked. I have identified an innovative adjuvant for paediatric vaccines using human neonatal blood. My aim is to narrow the window of vulnerability to vaccine preventable disease in a child's life by translating this adjuvant into pre-clinical models. This award will allow me to carry out proof-of-concept studies in neonatal animal models illustrating that addition of paediatric-relevant adjuvants to current vaccines can improve vaccine responses. Furthermore, bioinformatics and computer-aided drug design will be utilised to develop a proprietary paediatric adjuvant for future commercial development.

Kulwinder Kaur	Royal College of Surgeons in Ireland		NanoDOT: Nano-Engineered Biomaterial Delivery System with Controlled Strontium Release as a Reparative Treatment Strategy for Osteoporotic Vertebral Bone	€549,711.50	This project will tackle the clinical orthopaedic challenge of osteoporotic vertebral fractures, for which there is currently no reparative treatment, by developing an advanced therapeutic injectable technology to restore structural integrity and function of disease-damaged bone. This will be achieved through an innovative research programme that aims to investigate and implement a transformative therapeutic strategy to target impaired bone remodelling, and the regenerative potential of strontium doped nano-hydroxyapatite particles (Sr-nHA) to promote bone formation and inhibit bone resorption, in an effort to drive regeneration in osteoporotic diseased bone. In addition, an innovative biomaterial strategy will be employed, incorporating mechanically robust Nanosilicates (NSs) within thermoresponsive, injectable and pH responsive collagen-microspheres, for the local and controlled release of Sr-nHA in a load-bearing, acidic osteoporotic environment. This project has the potential to provide a pioneering advance for OVF treatment through a minimally-invasive therapeutic platform. In addition, this technology can also be applied as an innovative prophylactic measure in diseased vertebrae adjacent to fractured vertebrae, to regenerate bone and prevent secondary fractures.
Neil Coughlan	University College Cork	EPA	Azbio: sustainable valorisation of agri-food wastewaters	€544,157.00	The valorisation of Irish agri-food wastewaters remains a considerable challenge, especially as quantities increase in line with expansion of the sector, along with the production of new wastewaters (e.g., novel liquid anaerobic-digestates and filtered/fractioned slurries). Multitiered indoor cultivation-systems situated in industry settings have demonstrable potential to boost sustainability of the agri-food sector. The Azbio (Azolla-Bioreactor) project will optimise remediation of high-nutrient wastewaters derived from the agri-food sector through secure multitiered indoor cultivation of Azolla using infrastructure already in place at UCC, while developing new multi-species bioreactors for greater system efficacy based on naturally occurring ecological-interactions. In addition to its rapid growth and high protein content, secondary plant bio-compounds generated by Azolla have been linked to reduced methane production when ingested by ruminants. To better exploit higher yields, bio-compounds and %-protein will be determined for plants cultivated on different wastewaters under varied growth conditions. The use of waste Azolla biomass as a peat alternative for horticulture will also be assessed. Azbio will be the foundation for implementation of Azolla and/or complementary species groupings for wastewater valorisation and provide a platform for exploration of Azolla as a high-protein dietary supplement to diminish ruminant methane production, with waste biomass as a peat alternative.

Ibrahim Saana Amiinu	University of Limerick	SEAI	Metal Phosphorised Carbon Nanofiber Networks as Advanced Cathodes for Aluminium-ion Batteries	€566,161.10	Rechargeable aluminium-ion batteries offer the tantalising prospect of high energy density using components that can facilitate safe-by-design production of cheaper, durable, and sustainable batteries with a high energy-to-price ratio. This battery technology, while having enormous potential for applications ranging from consumer electronics to grid storage, has not yet demonstrated viability due to several critical limitations. Primarily, the lack of efficient cathode materials to efficiently cycle Al-ion or complexes and deliver high energy density . Currently used graphitic materials in AIBs are less effective due to their limited capacity (60-120 mAh/g), costly synthesis approaches, and cathode design flaws. This project will develop facile and low-cost synthesis protocols to fabricate an interconnected metal phosphide functionalised carbon nanofiber network cathodes and develop the mechanisms to control the intrinsic architecture, coupled with a pure Al-coated Cu-silicide nanowire anode, to deliver high capacity (250-600 mAh/g) and long-term stability. These electrode architectures will advance the development of AIBs by (1) addressing the critical issue of poor electrolyte penetration and the sluggish redox processes to boost rate performance, (2) significantly enhance the poor electronic/electrical conductivity properties, (3) overcome the performance-limiting issue of cathode disintegration during cell operation, and (4) unveil the hidden electrode redox chemistries for performance enhancement.
Emma Chambers	Dublin Institute for Advanced Studies	SEAI	MOD3LTHERM - MODelling the 3D thermal and Lithospheric Structure of geoTHERMal regions	€518,346.54	Whilst high-enthalpy geothermal systems (e.g. Krafla, Iceland) are already delivering significantly to decarbonisation, low-enthalpy regions (e.g. Ireland) still require significant risk reduction to understand the heat resource, before they can be fully exploited. The work flows for determining ‘heat in place’ in both scenarios are different in detail, but have some common characteristics. In this project we build on recent pilot work in geophysical estimation of deep sub-surface temperatures in a low enthalpy environment (Ireland). Two core weaknesses in the previous approach were limited lithological constraints and no independent control on the results. We develop a new joint geophysical-petrological-lithological inversion scheme by adapting two separate modelling codes, WINTERC and LitMod3D (Fullea et al., 2021 & 2009), and modify to a full 3D inversion for all available datasets. This new workflow relates newly available velocity and geophysical information to rock type and then predicts the geophysical-petrological-lithological response for different lithologies under variable thermal conditions and determines the geothermal gradients. We will test the methodology for two case studies: all-Ireland low-enthalpy and local (km) scale high-enthalpy (Krafla). The main applications are to quantify Ireland’s deep geothermal potential, and use the new workflows as a resource to investigate geothermal regions, worldwide.

Shane Dooley	Dublin Institute for Advanced Studies	New approaches to robust and resource-efficient quantum metrology	€533,734.20	Quantum metrology is an emerging technology aimed at high-precision estimation of physical quantities. Two of the main challenges in developing quantum-enhanced sensors are: (1) to find ways of overcoming dephasing and thermalisation, which can severely degrade sensor performance, and (2) using the least resources necessary to achieve a given sensor performance. I propose a research programme that takes a novel perspective to both of these challenges. On the first challenge, I consider an approach to quantum metrology based on recently discovered violations of thermalisation in large quantum systems, so-called quantum many-body scars. On the second challenge, the usual approach to resource-counting only takes account of a few types of resource. Notably, the thermodynamic cost of quantum metrology is largely unexplored. I propose to exploit recent advances in our understanding of the thermodynamics of information to investigate the energy costs in quantum metrology, and the interplay and tradeoffs between the various resources. The ultimate goal of the research programme is to develop novel methods for robust and resource-efficient quantum metrology that will be applicable to a broad range of sensing tasks.
Daniel Wigger	Trinity College Dublin	Quantum Acoustic Networks with Colour Centres in Atomically Thin Materials (QuANCAT)	€540,594.20	The current second quantum revolution aims on generating and utilizing various quantum degrees of freedom in actual applications. The proposed project is located in the heart of this process as it will develop novel concepts to transmit and operate quantum information on a microchip platform. To reach this ambitious goal the planned approach will contribute establishing quantum phononics, utilizing quantum acoustic waves. Using phonons has the tantalizing advantage that phonons have in comparison to photons of the same frequency a much smaller wavelength and can thus be used and guided on much smaller length scales. The considered material platform is based on layered van der Waals materials which can be produced with single atom thickness, which further promotes the potential of ultimate atomistic miniaturization. In practice the phonons will be used to communicate between single qubit systems in the form of atomic defect centres in the material. These defect centres have the advantage that they offer single photon emission at room temperature. Thus, combining phonons and photons offers the possibility to create hybrid quantum chips that interface single light quanta, for long distance communication, with single sound quanta, for on-chip quantum communication, via qubits at ambient conditions.