US-Ireland R&D Programme project details:

Project title and award details	Lay abstract
Title: AQUASORB: Predictive Modelling of Atmospheric Water Sorption. **Lead applicant**: Michael Zaworotko **Co-applicants**: James Stewart & Brian Space **Lead RoI institution**: University of Limerick **Value of award:** RoI: €473,365 NI: £287,267 US: $450,000 **Partner Institutions**: Queens University Belfast & North Carolina State University	The sustainable collection and management of water is a global challenge, particularly in relation to harvesting water from the atmosphere, dehumidification of indoor air and water use in farming. Desiccants are materials that can capture atmospheric water, but they require large amounts of energy to be used, and therefore not very sustainable. This project brings together research groups with the critical combination of expertise to make breakthroughs in developing newer more efficient and effective desiccants – Prof. Zaworotko in Limerick, with expertise in solid desiccants, Prof. James in Belfast with expertise in liquid desiccants, and Prof. Space in North Carolina in the US, with expertise in using computers to model interactions between water and materials. The aim will be to make the collection of water under temperatures and atmospheric conditions more effective, with a lower energy and carbon footprint.
Title: Visible Light-wave Generation and Manipulation through Non-Linear Waveguide Technology (VIBRANT) **Lead applicant**: Brian Corbett **Co-applicants**: Robert Bowman & Shamsul Arafin **Lead RoI institution**: Tyndall National Institute **Value of award:** RoI: €444,289 NI: £295,720 US: $425,000 **Partner Institutions:** Queens University Belfast & Ohio State University	Photonic integrated circuits (PICs) are microchip-like devices that can generate, detect and process light signals. They have widespread uses, including in medical devices, sensors, telecommunications and making different types of measurements. These types of circuits are currently quite effective at using 'infrared' light but more work is needed to make them more efficient at using 'visible' light. The research in this project, led by teams in the ROI, NI and US with expertise in working with lasers, new PIC materials and in manipulating light behaviour, will seek to design and develop new PICs capable of generating and working with green light. These green light PICs could be particularly useful for health devices to diagnose more quickly and effectively.
Title: Enabling Beyond-5G Wireless Access Networks with Robust and Scalable Cell-Free Massive MIMO **Lead applicant:** Le-Nam Tran **Co-applicants:** Hien Quoc Ngo & Lee Swindlehurst **Lead RoI institution:** University College Dublin **Value of award:**	With the rollout of 5G, research has shifted towards the next generation of wireless telecommunications. The next generation is expected to provide very high connectivity, but that potential is limited due to how the network is structured – where voice and data information is passed from one 'cell' to another (using telephone masts for example), which can also interfere with each other's signals. 'Cell-free' is a type of communications network that could overcome these limitations and provide a

RoI: €451,525 NI: £298,974 US: $562,967 **Partner Institutions:** Queens University Belfast & University of California Irvine	uniformly good service for all users. The research in this project, led by teams in the US, ROI and NI with expertise in various aspects of wireless communication, will am to develop a novel 'cell-free' network that is practical to use, robust enough to minimise the risk of down-time, as well as being energy efficient.
Title: SWEET: Hardware and Software Sustainable Wearable Edge InTelligence **Lead applicant:** Deepu John **Co-applicants:** Hans Vandierendonck & Dimitrios S. Nikolopoulos **Lead RoI institution:** University College Dublin **Value of award:** RoI: €434,594 NI: £299,751 US: $600,000 **Partner Institutions:** Queens University Belfast & Virginia Tech	The research in this project will develop new hardware, software and algorithms to push the boundaries of what is possible from 'wearable' sensors (such as smartwatches, activity trackers and fitness monitors). These sensors could be enhanced to deliver more continuous monitoring of various health signs, allowing quicker and earlier intervention to save lives and prevent illnesses. With expertise in artificial intelligence, hardware and software development, and cloud computing, the researchers hope to deliver health monitoring approaches that are both more advanced and easier to be made accessible to more people.
Title: Highly efficient magnetoelectric nano-antenna array with wide operational bandwidth **Lead applicant:** Saibal Roy **Co-applicants:** Gareth Conway & Shad Roundy **Lead RoI institution:** Tyndall National Institute **Value of award:** RoI: €450,399 NI: £298,097 US: $385,000 **Partner Institutions:** Queens University Belfast & University of Utah	The larger size and efficiency of traditional communications antennas are linked to the nature of the radio waves they send out and receive back, placing limitations on how effective they are. In this project, the aim is to develop a new type of 'magnetoelectric' antenna that can be smaller and work effectively across many different radio wave frequencies, from high-frequency (for example, in 5G telecommunications) to low-frequency (for example, while working in or communicating through underground settings). They could even have potentially have uses in very small scale settings – for example, in wireless implants. Researchers from the ROI, NI and US with complimentary expertise in magnetoelectric materials and wireless communications will lead these studies to transform traditional antennas into devices that can meet various future needs.
Title: Bacterial-based Biosensor Digital Twin for Microbial Community Sensing **Lead applicant:** Alan O'Riordan **Co-applicants:** James Dooley & Sasitharan Balasubramaniam	In the 21st century, a major challenge is our understanding of the relationship microbes such as bacteria have with people and the wider environment around them. By having a deeper understanding of microbial behaviour and activity as they evolve and change will enable us to develop new strategies to take

Lead RoI institution: Tyndall National Institute **Value of award:** RoI: €446,798 NI: £299,994 US: $399,974 **Partner Institutions:** Ulster University & University of Nebraska-Lincoln	appropriate actions before the microbes can result in harmful impact. The microbial community and their activities and behaviours are continuously evolving due to various effects, including actions by humans. In this project, the researchers think that applying digital technologies will allow us to better understand and predict how microbes are likely to behave. In two settings – bacterial communication in infected wounds and bacterial communities in the soil – they will use sensors and artificial intelligence-based approaches to create a toolkit for sensing microbial communication and behavioural changes. What they learn could be applied to various settings related to environmental protection and healthcare delivery.