

PRESS RELEASE

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UK companies to build radically new operating system for quantum computers

Government innovation award will fund quantum operating system

14 May 2020 – A consortium led by Cambridge-based quantum computing software developer [Riverlane](#) has been awarded a £7.6M grant from the government's Industrial Challenge Strategy Fund to deploy a highly innovative quantum operating system.

The project will deliver an operating system that allows the same quantum software to run on different types of quantum computing hardware. By working together, the quantum operating system, Deltaflow.OS, will be installed on every quantum computer in the UK accelerating the commercialisation of the UK's quantum computing sector.

Joining the Riverlane led consortium are the UK's most exciting quantum hardware companies, SeeQC, Hitachi Europe, Universal Quantum, Duality Quantum Photonics, Oxford Ionics, and Oxford Quantum Circuits, along with UK-based chip designer, ARM, and the National Physical Laboratory.

Dr Steve Brierley, CEO of Riverlane, said: "*We are delighted to have been awarded this grant to build and install the quantum operating system Deltaflow.OS on all leading hardware platforms in the UK. Together with consortium partners, we have a unique opportunity to accelerate the commercialisation of the UK quantum technology sector and overtake global competitors in this space.*"

Dr M. Fernando Gonzalez Zalba, Head of Quantum Computing at the Hitachi Cambridge Laboratory, said: "*At Hitachi Europe, we are building a quantum computer based on the very same microprocessor technology that we can find in our laptops, cars and mobile phones. Deltaflow.OS will enable us to deliver a full stack solution that will help solve customer's greatest computational challenges.*"

“By making OQC’s stack compatible with Deltaflow.OS, we’re helping build a new standardised quantum ecosystem. This UK-first effort to build compatibility is a critical step in ensuring the widest possible use of our consortium’s technologies and opening up this ecosystem to new players, generating additional commercial opportunities” said Dr Ilana Wisby, CEO of Oxford Quantum Circuits.

In the very same way that regular computers need an operating system, quantum computers need one too. However, there is no quantum version of Windows, IOS or Linux. Without an operating system, computers would be much less useful. By automating the scheduling of tasks and allocation of resources, such as memory and disk space, operating systems simplify the use of computers so everyone can benefit from them. Quantum computers are expected to outperform conventional computers at specific tasks, such as predicting the properties of a new medicine or vaccine. To get the best performance out of quantum computers, elements of conventional computers and quantum computers have to be integrated tightly, which makes it difficult to design an operating system.

Deltaflow.OS is the first of its kind. While competitors typically present quantum computers as a “black box”, Deltaflow.OS exposes the different elements of the full quantum computing stack. This gives users the power to schedule tasks in an optimal way, improving the performance of quantum computers by orders of magnitude compared to other leading approaches. Once the hardware and software are tightly integrated, the performance is expected to improve even further.

Riverlane, experts in quantum software, will lead on the development of a dataflow framework, a runtime and powerful quantum applications. Leading hardware companies - SeeQC, Oxford Quantum Circuits, [Hitachi Europe](#), Universal Quantum, Oxford Ionics and Duality Quantum Photonics – will evolve their technology and develop firmware for their quantum processors that will later interface with Deltaflow.OS. Experts in chip design ARM will develop specific control systems emulators. A prerequisite for delivering a portable yet hardware-aware system is a standardised hardware abstraction layer. The National Physical Laboratory will coordinate the definition of this standardised interface based on its expertise in developing technical standards for breakthrough technology and will hence play a vital role in delivering the project.

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Notes for editors

About Riverlane

Riverlane builds ground-breaking algorithms and software to unleash the predictive power of quantum computing. With a multidisciplinary team of world-leading researchers, our mission is to make quantum computers useful sooner. Backed by leading venture-capital funds and the University of Cambridge, Riverlane collaborates with leading quantum hardware providers, as well as visionary chemical, pharmaceutical and materials companies. For more information, visit <https://riverlane.com>.

ARM

Arm is the world's leading technology provider of silicon IP for the intelligent System-on-Chips at the heart of billions of devices.

National Physical Laboratory (NPL)

NPL is the UK's National Metrology Institute, providing the measurement capability that underpins the UK's prosperity and quality of life. From new antibiotics to tackle resistance and more effective cancer treatments, to secure quantum communications and superfast 5G, technological advances must be built on a foundation of reliable measurement to succeed. Building on over a century's worth of expertise, our science, engineering and technology provides this foundation. We save lives, protect the environment and enable citizens to feel safe and secure, as well as support international trade and commercial innovation. As a national laboratory, our advice is always impartial and independent, meaning consumers, investors, policymakers and entrepreneurs can always rely on the work we do.

Based in Teddington, south-west London, NPL employs over 600 scientists. NPL also has regional bases across the UK, including at the University of Surrey, the University of Strathclyde, the University of Cambridge and the University of Huddersfield's 3M Buckley Innovation Centre.

Oxford Quantum Circuits

At OQC, we're creating the core of the quantum revolution to solve some of humanity's most significant challenges. Founded in 2017, OQC has built the UK's most advanced superconducting quantum computer in the UK, the only one commercially available in the country. With its patented innovation, the Coaxmon, a unique 3D architecture bringing key componentry & wiring off-chip, OQC is furthering the scalability of its technologies without

any compromise on quality. Keeping practical applications in mind, OQC's ambition is to lead the industry on Quantum Computing as a Service. <https://oxfordquantumcircuits.com>

SeeQC UK

Seeqc is developing the first fully digital quantum computing platform for global businesses. Seeqc combines classical and quantum technologies to address the efficiency, stability and cost issues endemic to quantum computing systems. The company applies classical and quantum technology through digital readout and control technology and a unique chip-scale architecture. Seeqc's quantum system provides the energy- and cost-efficiency, speed and digital control required to make quantum computing useful and bring the first commercially-scalable, problem-specific quantum computing applications to market. Seeqc is a spin-out of HYPRES, the world's leading developer of superconductor electronics. Seeqc is based in Elmsford, NY with facilities in London, UK and Naples, Italy.

Oxford Ionics

Oxford Ionics are creating high performance quantum computers by combining the world's highest quality qubits – trapped ions – with our unique noiseless electronic qubit control technology.

Duality Quantum Photonics

Duality Quantum Photonics are developing special purpose quantum computers in integrated photonics. We will provide quantum computing tools to model industrially relevant problems where we can provide a quantum performance advantage.

Hitachi Europe

About the Hitachi Cambridge Laboratory

The Hitachi Cambridge Laboratory (HCL) was established through collaboration between the Cavendish Laboratory of the University of Cambridge, and the Research & Development Group of Hitachi, Ltd. The areas of research activity in HCL include microelectronics, magnetism, optoelectronics and semiconductor physics, with view to creating new concept advanced electronic and optoelectronic devices. Currently research projects are being pursued in the areas of Quantum information and Spintronics. For more information, visit <http://www.hit.phy.cam.ac.uk>.

About Hitachi Europe Ltd.

Hitachi Europe Ltd., a wholly owned subsidiary of Hitachi, Ltd. (TSE: 6501, "Hitachi") is headquartered in Maidenhead, UK. The company is focused on its Social Innovation

Business - delivering innovations that answer society's challenges. Hitachi Europe and its subsidiary companies offers a broad range of information & telecommunication systems; rail systems, power and industrial systems; industrial components & equipment; automotive systems, digital media & consumer products and others with operations and research & development Laboratories across EMEA. For more information, visit <http://www.hitachi.eu>.

Universal Quantum

To change the world for the better. From medicine to finance, Universal Quantum builds quantum computers with trapped ions that will solve real-world problems that would currently take the fastest supercomputers billions of years to solve. We build fully electronic quantum computing modules based on silicon technology, where calculations are carried out by the application of voltages to a microchip. Our modules can be connected using ultrafast electric field links to form an architecture which scales to millions of qubits.