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QUANTUM COMPUTER DEVELOPMENT BOLSTERED BY FELLOWSHIP
- A Hitachi-Cambridge team develops a new silicon qubit –

Hitachi Europe Ltd. announced today that a member of a Hitachi-Cambridge team has been awarded a fellowship to support the development a new silicon device for quantum computing: a quantum-dot spin qubit. This structure, based on years of work on single-electronics, is a new step in the development of a quantum computer based on conventional silicon technology.

This is one of ten promising doctoral projects with potential to make a significant impact on health, environment and industry which will now be taken towards commercialisation, thanks to funding and support by the Royal Commission for the Exhibition of 1851. The Commission was originally established by Prince Albert to organise the Great Exhibition of 1851 and ensure its profits went towards furthering "productive industry".

The Industrial Fellowships provide recent graduates with the means to develop innovative technology with commercial potential, ideally leading to a patent, while completing a PhD or EngD. Each Fellow receives up to £80,000 worth of funding over three years for their work, to be carried out in collaboration with an academic institution and a business partner.

One of this year's Industrial Fellowships has been awarded to Pratyay Poddar, previously an associate research scientist at the Hitachi Laboratory. Pratyay's project aims to develop a silicon-based method for transporting electrons by trapping them in surface acoustic waves. This will be key to developing an affordable quantum computer that could unlock a raft of potential applications including bioinformatics, molecular modelling, codebreaking and encryption.

The world's most powerful supercomputers could be made obsolete in the future, by a totally different approach to processing information. In a classical computer, the basic unit of information is the 'bit', which can exist in one of two possible states, 0 or 1. Quantum computers make use of quantum bits (qubits), which can exist in a superposition of both states - a mixture of both 0 and 1 simultaneously. Qubits are also subject to quantum entanglement. When two or more are entangled, they behave as one system, so that measurements of the qubits are strongly correlated. Thus the potential processing power of a quantum information system increases exponentially rather than linearly with the number of qubits.

Although the principles behind quantum computing have been established and small model systems constructed, it still remains a considerable task to scale these up to practical, working computers. In classical computers, electrons are transferred during information processing via electrical wiring, but quantum effects require much more space.

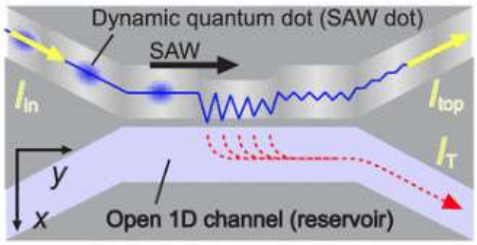

Figure 1 Simplified experimental layout of SAWs carrying out a single electron in each potential minimum through the completely depleted channel

Pratyay's project is looking at developing new ways of scaling this down.

This project is developing silicon structures with a high precision layer of Zinc Oxide. Zinc Oxide is piezoelectric, so can create the required acoustic waves when microwaves are applied to it. The silicon-based approach is critical for the technology to work within existing computer manufacturing infrastructure.

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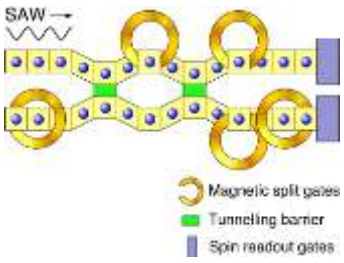

Figure 2 Quantum computation scheme

Quotes

Prof. Barnes, academic advisor of Pratyay's Ph.D. project, said: "having worked on the fundamental aspects of the use of surface acoustic waves (SAWs) for quantum technologies over the past fifteen years, I am very happy to see Hitachi Europe and the Royal Commission pick up this project and I hope they will push this technology towards a viable technology".

Bernard Taylor, Chairman of the Royal Commission for the Exhibition of 1851, said: "Britain is renowned for carrying out world leading research but often we have fallen behind in turning that expertise into commercial applications. These fellowships have been designed to identify research with potential to solve current problems in a commercially viable way. In doing so, we continue the spirit of the Great Exhibition of 1851 which showcased the inventive genius that led the world in innovation".

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About the Fellow: Pratyay Poddar

Hitachi Cambridge Laboratory and the University of Cambridge

Project: Low cost quantum information processing using Si based surface acoustic wave quantum computation Technology

After school in India and a physics degree in Germany, Pratyay joined this team in the world-renowned Cavendish laboratory with Hitachi Europe Limited. A belief in the world changing potential of quantum computing, and recognition of the importance of silicon-based technology, led him to embark on this PhD.

About the team

The team is formed by members of the Cavendish Laboratory of the University of Cambridge, U.K. and staff from the Hitachi Cambridge Laboratory, Hitachi Europe Ltd., U.K. The collaborative activity between the Hitachi Cambridge Laboratory, and the Cavendish Laboratory, which started in 1989, has resulted in the development of the world's first single-electron memory device, announced in 1992, the first single-electron logic device, announced in 1995, and one of the first silicon qubit devices, announced in 2005. Subsequent development led to the PLEDM® conventional memory device, and now the team is heavily involved in the development of devices for quantum information processing, nanospintronics and electron microscopy.
http://www.hit.phy.cam.ac.uk
http://www.hitachi.co.uk/about/hitachi/research/

About Hitachi Europe Ltd.

Hitachi Europe Ltd., a subsidiary of Hitachi, Ltd., 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, financial services; digital media & consumer products and others with operations and research & development Laboratories across EMEA. For more information, visit http://www.hitachi.eu.

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges with our talented team and proven experience in global markets. The company's consolidated revenues for fiscal 2014 (ended March 31, 2015) totaled 9,761 billion yen ($81.3 billion). Hitachi is focusing more than ever on the Social Innovation Business, which includes power & infrastructure systems, information & telecommunication systems, construction machinery, high functional materials & components, automotive systems, healthcare and others. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

About Cambridge University

Founded in 1209, the mission of the University of Cambridge is to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence. To date, 90 affiliates of the University have won the Nobel Prize.
The University comprises 31 autonomous Colleges, which admit undergraduates and provide small-group tuition, and 150 departments, faculties and institutions. It is a global university: its

19,000 student body includes 3,700 international students from 120 countries. Cambridge researchers collaborate with colleagues worldwide, and the University has established larger-scale partnerships in Asia, Africa and America.
The University sits at the heart of one of the world's largest technology clusters. The 'Cambridge Phenomenon' has created 1,500 hi-tech companies, 14 of them valued at over US$1 billion and two at over US$10 billion. Cambridge promotes the interface between academia and business, and has a global reputation for innovation.
For more detailed information, including a History of Cambridge University and How the University works, visit http://www.cam.ac.uk/about-the-university.

About the Royal Commission for the Exhibition of 1851
The Royal Commission for the Exhibition of 1851 offers major awards to scientists and engineers for research, development and design. First established to stage the Great Exhibition in 1851, the Royal Commission's extraordinary history is founded on an inspired vision of the importance of education to economic success.

Awarded to the most promising science and engineering graduates annually, the Industrial Fellowships form a crucial part of the Commission's work, with the specific aim of encouraging profitable innovation in British industry.

Each three-year Fellowship is worth up to £80,000 and those awarded must work to develop a patented and profitable technology, while completing a PhD or EngD.
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