Australian Government
Department of Industry, Innovation and Science

Science

CASE STUDY

Noise in quantum electronics

Particles at the atomic and sub-atomic level don't play by the normal rules of physics. They follow their own mind-bending laws, which we call quantum physics. These tiny particles can 'tunnel' through other particles, be in multiple states at the same time and can get spookily entangled over distances.

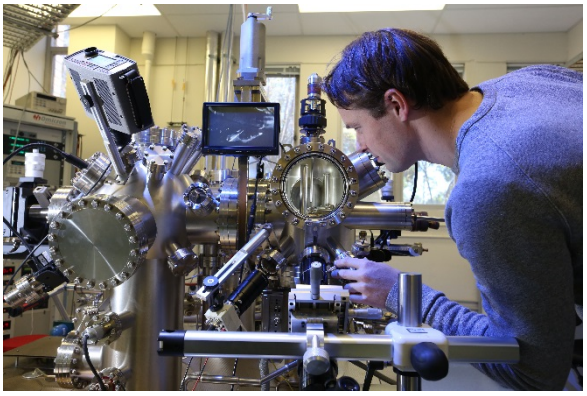

Image: Researcher, Joris Keizer, using a scanning tunnelling microscope to fabricate silicon devices with atomic precision

Quantum computing aims to use the unique and sometimes quirky properties of quantum physics to solve complex problems in finance, medicine, weather forecasting and physics, much faster than traditional computers can. To get there we must be able to precisely and predictably manipulate material at the quantum scale. However, quantum scale electronic devices are traditionally plagued by high levels of noise, or unintended and uncontrolled environmental interference. **Understanding and controlling noise has become critical for the development of quantum computers** and the continued miniaturisation of traditional computers.

Australia-India Strategic Research Fund

Professor Michelle Simmons and her team at the Centre for Quantum Computing in the University of New South Wales are working to develop a quantum computer. They are currently the only group in the world fabricating and optimising quantum electronic devices using silicon and germanium.

Professor Simmons believes that international collaboration is essential for their world-leading science. So she and her team, with support from the Australia-India Strategic Research Fund, are working with the Indian Institute of Science to tackle the problem of noise. Their collaboration combines Australia's state-of-the-art fabrication facilities and India's ultrasensitive noise measurement apparatus – with great results.

Professor Simmons says "Our Indian partners were able to look at the devices we made and could tell us what the issues were that made a particular device behave badly. As a consequence, we could change our fabrication process to get our devices working better."

Outcomes from the collaboration so far have included: the discovery of a new state of matter; the development of new techniques for the production of atomic-scale germanium and silicon transistors; and the repeated production of quantum electronic devices with the lowest levels of electrical noise to date.

Over the next five years, the team is planning to produce a 10-qubit quantum integrated circuit device.

International cooperation is accelerating Australian and Indian efforts to produce a scalable quantum computer, and the rest of the world is watching closely.

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Indian Team Leader:
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Indian Institute of Science

Find out more

For more information on the Australia-India Strategic Research Fund, visit www.science.gov.au/aisrf.