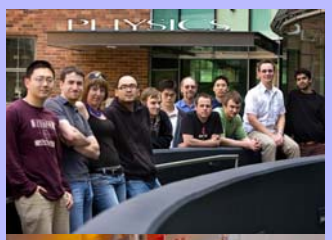
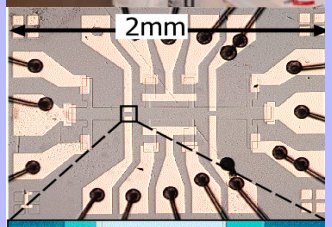
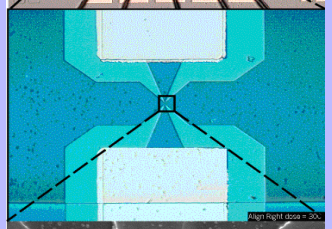
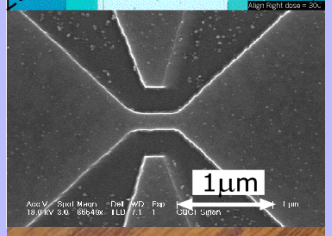
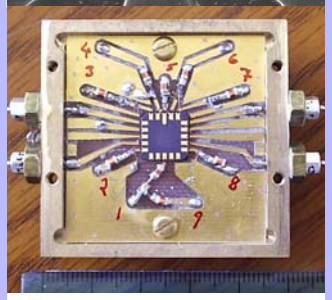
Quantum Electronics:
PhD projects available at UNSW

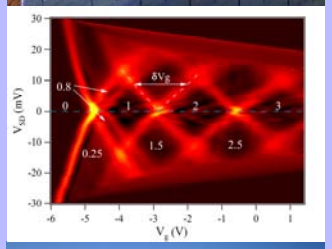












The Quantum Electronic Devices Group studies the fundamental electronic and magnetic properties of advanced nanostructure devices. Research students use state-of-the-art semiconductor clean-room processing equipment to fabricate these devices, and ultra-low temperatures and sensitive electronics to study them. Students regularly make international trips to conferences and to visit collaborators - the group has active links with leading laboratories in the UK (Cambridge), USA (Oregon), Germany (Bochum), Italy (Camerino, Pisa) and New Zealand (Massey, VUW).

Research Projects

A number of experimental projects are available, including:

- **Holes in Semiconductor Nanodevices:** We are world leaders in fabricating p-type quantum wires and quantum dots, which show outstanding electrical properties and possibilities for spintronics applications. Holes are spin 3/2 particles, and this gives them quite different properties than ordinary spin-1/2 electrons. The project will develop novel devices including quantum point contacts and quantum dots to study the unusual spin-properties of holes.
- **High speed quantum devices:** Most quantum devices are studied at low frequencies (<1 kHz). Higher speeds (~1GHz) provide new tools for probing many body quantum states, and also allow the time evolution of quantum states to be studied. This project will study high-frequency properties of quantum wires, quantum state evolution, and fluctuations.
- **New ways of controlling the spins of holes:** Normally magnetic fields are used to manipulate the spin of electrons and holes. This project will develop devices in which the spins are controlled simply with electrical fields, through the spin-orbit interaction.
- **Spin pumping:** This project will investigate the generation of pure spin currents for quantum spin transistors.

Research Facilities

UNSW has superb facilities for nanoelectronic device fabrication, with full clean-rooms allowing devices as small as 10nm to be made. In addition there are extensive facilities for measuring the electrical properties of devices in the quantum limit of ultra-low temperatures (0.02K), high magnetic fields (17T), and fast timescales (100ns).

What will you learn?

Students learn all aspects of semiconductor processing techniques, ultra-low temperature cryogenics (down to 0.01K), programming computer controlled measurement systems, and low-noise electrical measurement techniques.

Financial assistance

Students eligible for an Australian Postgraduate Award receive a generous top-up scholarship. We have a very limited number of scholarships for highly motivated students who narrowly miss out on APAs.

See **www.phys.unsw.edu.au/QED** for more details. Contact

Prof. Alex Hamilton Alex.Hamilton@unsw.edu.au,
A/Prof. Adam Micolich mico@phys.unsw.edu.au.