

Quantum physicists control supercurrent

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Netherlands scientists say they've shown that in a quantum-mechanical circuit, the current can be reversed by using a single electron.

The researchers led by Leo Kouwenhoven from the Delft University of Technology created a superconducting quantum interference device, or SQUID, and discovered they could reverse the current by placing an electron on a "weak link" where the current has to jump across a kind of barrier.

In the SQUID made by Kouwenhoven's team the current circulates around a ring-shaped circuit made from microscopic aluminum wire. There are two breaks in the loop, each bridged by wires just 60 nanometres wide and made from the semiconductor indium arsenide. At very low temperatures the aluminum becomes superconducting and the current is carried by pairs of electrons with zero electrical resistance.

The team used electric fields to turn the semiconductor nanowires into "quantum dots" -- isolated islands of electrical charge. Electron pairs can jump to and from the islands, so the supercurrent becomes chopped into discrete parcels of two electrons.

By adding just one electron to the quantum dot the researchers found they could reverse the direction of the supercurrent.

The physics are explained in the journal *Nature*.

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