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Physicists put a new spin on electrons

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In the first demonstration of its kind, researchers at the University of British Columbia have controlled the spin of electrons using a ballistic technique--bouncing electrons through a microscopic channel of precisely constructed, two-dimensional layer of semiconductor.

It's the first time the intrinsic properties of a semiconductor—not external electric or magnetic fields-have been used to achieve the effect. The findings, published this week in *Nature*, could have implications for the development of so called 'spintronic' circuits: systems that use the directional spin of electrons to store and process data.

"The need to use high-frequency external fields to control spin is one of the major stumbling blocks in using electrons for information processing, or in a spintronic circuit," notes Joshua Folk, principal investigator on the project and Canada Research Chair in the Physics of Nanostructures. "We show that the spin of electrons can be controlled without external fields, simply by designing the right circuit geometry and letting electrons move freely through it."

The new technique uses the natural interactions of the electrons within the semiconductor micro-channel to control their spin--a technique that is a major step, but not yet flexible enough for industrial applications, notes Folk, an Assistant Professor with Physics and Astronomy who came to UBC via the Massachusetts Institute of Technology.

Electronic systems that use the spin of an electron--a quantum mechanical property that comes in two varieties: up or down--would work similarly to today's transistors, but be smaller and use less energy.

Presently, electrical charge alone is responsible for the logic functions in circuits. Power consumption by these circuits is the primary roadblock to faster, more powerful processors. A spintronic circuit has the potential to use less power by storing and manipulating a bit of information as electron spin.

Spintronic circuits may also be a viable avenue for building quantum information processing devices. The exponentially faster processing possible with such a device could have applications ranging from code breaking, to dramatically improved drug design, to simulations of complex processes in molecular systems.

Next steps by Folk and his team—working with colleagues at the Universität Regensburg in Germany—will include using new devices to gain more precise control over the alignment and trajectory of the electrons.

More information:
www.nature.com
www.physics.ubc.ca/~jfolk

Source: University of British Columbia (news : web)