An Electrically Readable Spin Memory

Gregory S. Boebinger, National High Magnetic Field Laboratory

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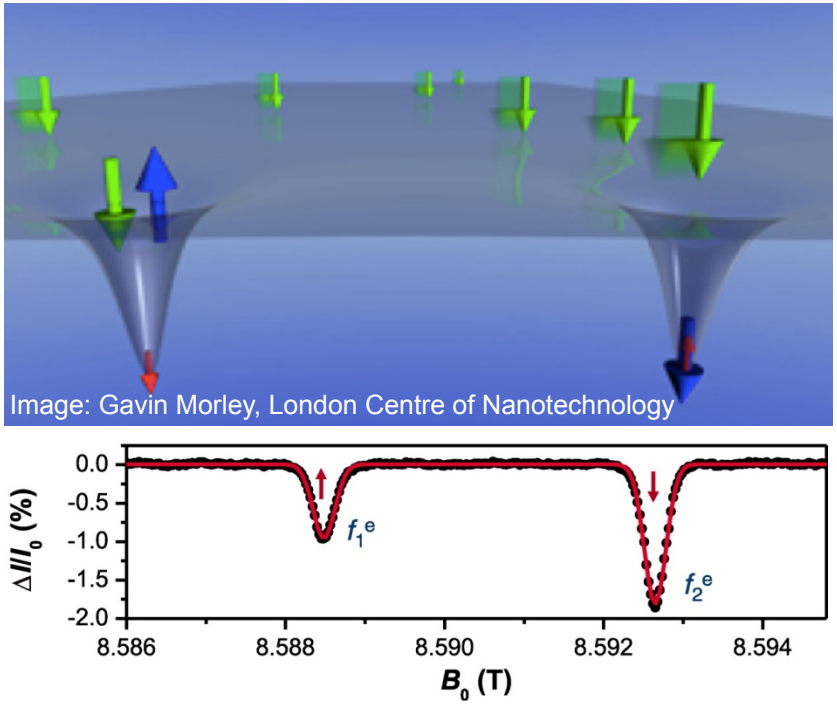
Electron Magnetic Resonance Facility

Phosphorus impurities in silicon provide a robust spin system which has great promise for quantum information applications. We have previously shown that the electron spins can be manipulated using high-frequency micro-waves, and can be read-out electrically with high sensitivity at high fields.

We have now shown experimentally for a spin ensemble that electron spin information can be stored in the ^{31}P nuclear spin, and that this stored information can be read out efficiently at high magnetic fields through changes in the photo-current. *The achieved storage time is close to two minutes,* which is many orders of magnitude longer than can be achieved by electron spins alone.



(Top) Electron spins of free electrons are illustrated in green, P donor electron spins in blue, and ^{31}P nuclear spins in red. The surface represents the potential of the conduction band. (Bottom) The nuclear spin is sensed by reading the state of the donor electron spins using electrically detected high-field electron spin resonance (ESR). When the nuclear spin is down, the electron spin is up and thus, it can trap a free down-spin electron. This trapping reduces the free electron mobility and thus, the electric current.

McCamey, D.R.; van Tol, J.; Morley, G.W. and Boehme, C., **Science**, **330**, 1652-1656 (2010).

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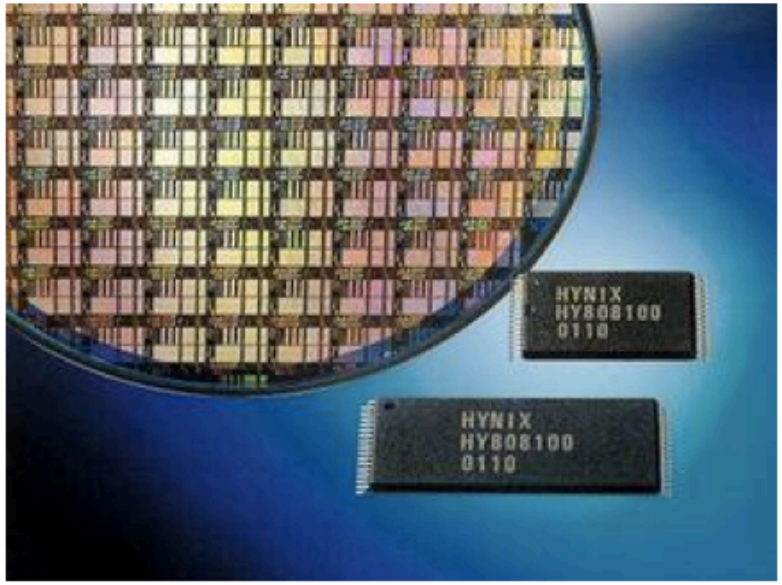

Enlarge HYNIX/AFP/Getty Images

Semiconductor computer chips like this one rely on electricity — positive or negative charges — to store data. Using high power magnets in a lab, researchers have developed a new way to store data in the spin of an atom's nucleus.

The research described on the first slide of this highlight was featured during a four-minute piece on National Public Radio's Morning Edition program on December 17th 2010.

The work has also been reported in several popular science journals such as Scientific American (Dec. 20, 2010) and the UK's Institute of Physics journal Physics World.

www.npr.org/2010/12/17/132118276

www.scientificamerican.com/article.cfm?id=spin-memory

physicsworld.com/cws/article/news/44616

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