Nano-Magnet Motions Controlled by Spin-Polarized Currents

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In the field of "spin-tronics" scientists and engineers seek to make devices that take advantage of the electron's intrinsic spin as well as its charge. This field has had great success in applications in which the orientation of small magnets affects the flow of electrons. For instance, this principle is now used in the magnetic-field sensors that read out information in computer disk drives. However, previously it has been impractical to implement the reverse process efficiently on small length scales – to control the orientation of magnets through a direct interaction with a small current.

We have recently demonstrated a new mechanism that permits such control. If electrons flow though specially designed "nanopillar" devices consisting of two magnetic layers separated by a non-magnetic metal, the first magnetic layer generates a spin-polarized current by filtering spin-up from spin-down electrons. The spin-polarized current can then apply a strong torque to the second nanomagnet downstream called the free layer. This torque causes the free-layer's magnetic moment to spiral away from its original direction, and can cause it to oscillate or even reverse its magnetic direction. We are investigating the application of such "spin-transfer torques" for manipulating nanomagnets within ultra-dense magnetic memory systems and in signal-processing devices.

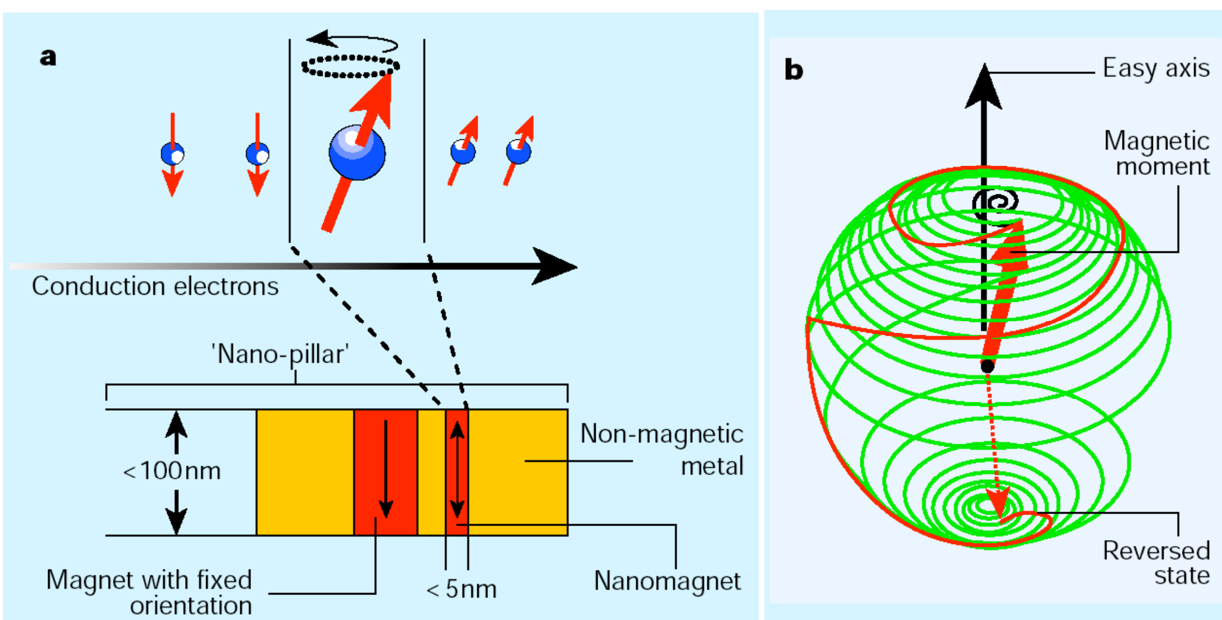

Figure courtesy of Jonathan Sun, IBM.

References
[1] For further information about this NSEC, link to **<www.cns.cornell.edu>** or email **<cns@cornell.edu>**
[2] S. Kiselev *et al. Nature,* **425,** 380 (2003)