

Walls falling faster for solid-state memory

June 9 2010

After running a series of complex computer simulations, researchers have found that flaws in the structure of magnetic nanoscale wires play an important role in determining the operating speed of novel devices using such nanowires to store and process information. The finding, made by researchers from the National Institute of Standards and Technology, the University of Maryland, and the University of Paris XI, will help to deepen the physical understanding and guide the interpretation of future experiments of these next-generation devices.

Magnetic nanowires store information in discrete bands of magnetic spins. One can imagine the nanowire like a straw sucking up and holding the liquid of a meticulously layered chocolate and vanilla milkshake, with the chocolate segments representing 1s and the vanilla 0s. The boundaries between these layers are called [domain walls](#). Researchers manipulate the information stored on the nanowire using an electrical current to push the domain walls, and the information they enclose, through the wire and past immobile read and write heads.

Interpretations of experiments seeking to measure how domain walls move have largely ignored the effects of "disorder"—usually the result of defects or impurities in the structure of the nanowires. To see how disorder affects the motion of these microscopic magnetic domains, NIST researchers and their colleagues introduced disorder into their [computer simulations](#).

Their simulations showed that disorder, which causes friction within the [nanowires](#), can increase the rate at which a current can move domain

walls.

According to NIST physicist Mark Stiles, friction can cause the domain walls to move faster because they need to lose energy in order to move down the wire.

For example, when a [gyroscope](#) spins, it resists the force of gravity. If a little friction is introduced into the gyroscope's bearing, the gyroscope will fall over more quickly. Similarly, in the absence of damping, a domain wall will only move from one side of the nanowire to the other. Disorder within the nanowire enables the domain walls to lose energy, which gives them the freedom to "fall" down the length of the wire as they move back and forth.

"We can say that the domain wall is moving as if it were in a system that has considerably greater effective damping than the actual damping," says NIST physicist and lead researcher Hongki Min. "This increase in the effective damping is significant enough that it should affect the interpretation of most future domain wall experiments."

More information: H. Min, R.D. McMichael, M.J. Donahue, J. Miltat and M.D. Stiles. Effects of disorder and internal dynamics on vortex wall propagation. Phys. Rev. Lett. 104, 217201. May 26, 2010.
prl.aps.org/abstract/PRL/v104/i21/e217201

Provided by National Institute of Standards and Technology

Citation: Walls falling faster for solid-state memory (2010, June 9) retrieved 20 March 2024 from <https://phys.org/news/2010-06-walls-falling-faster-solid-state-memory.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private

study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.