Scientists post a lower speed limit for magnetic recording

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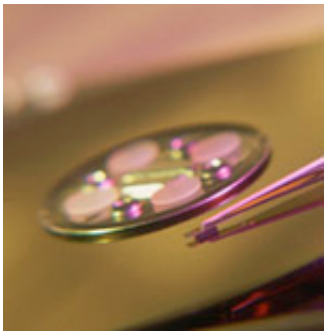

The speed of magnetic recording -- a crucial factor in a computer's power and multimedia capabilities -- depends on how fast one can switch a magnet's poles. An experiment at the Stanford Synchrotron Radiation Laboratory (SSRL) found that the ultimate speed of magnetic switching is at least 1,000 times slower than previously expected. The result, which appears in the April 22 issue of the journal Nature, has implications for future hard disk computer drive technologies.

In the push toward ever-faster magnetic recording, experts expected to find a physical limit, a threshold speed beyond which materials would respond chaotically. "If you had asked me a year ago, 'How fast does one have to create a pulse that does not switch magnetization?' my answer would have been one femtosecond (one thousandth of a trillionth of a

second)," said Professor Joachim Stöhr, deputy director of SSRL. "Chaotic behavior was not expected in this experiment, which ran in the picosecond (trillionth-of-a-second) range."

In a computer hard drive, a writing head hovers over a disk that's rapidly spinning -- at up to 15,000 rotations per minute, or 150 times faster than a CD player. An electric current running in the head creates a magnetic field, which records data by turning tiny areas of the disk's surface into microscopic magnets. The disk is coated with a special, grainy material that allows only two, opposite directions of the magnetization, representing the 0 or 1 of a basic unit of data, or bit. High recording speed requires the coating material to respond and switch its poles quickly enough to record each bit reliably.

The challenge now will be to understand why the maximum speed seems to be at least 1,000 times lower than expected. The explanation, Siegmann said, could lie in the way thermal motion interacts with the magnetization process.

The limit on recording speed must be somewhere between 100 billion and a trillion bits per second, but is unlikely to ever affect technology, said Seagate's Weller. State-of-the-art drives can now record about 1 billion bits per second, and long before that speed can be increased 100-fold, other physical constraints will get in the way, he said. In particular, higher speed requires smaller magnetic grains, but their size cannot go below the size of atoms.

The SSRL result could be an important step toward understanding the basic physics of data recording, leading to the development of entirely new technologies. A promising idea, Weller said, is heat-assisted recording, where a small section of the recording medium is temporarily brought to a high temperature, to speed up its magnetization reversal.

Read more technical details about experiment on Stanford University News web-site.