Tiny Magnets May Form Basis For Computing Breakthrough

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Body

An international team of scientists plans to announce today the discovery of a material that may one day become the foundation of an entirely new approach to computing, making possible machines hundreds of thousands of times as fast as today's supercomputers.

The researchers, from the Xerox Corporation, the University of Barcelona in Spain and the City College of New York, plan to announce the creation of a microscopic magnet, one molecule in size, derived from a special combination of manganese, oxygen, carbon and hydrogen.

A computer data storage system based on such a magnet could alone pack data thousands or millions of times more densely than today's memory and storage systems.

The behavior of the material also holds out the more remarkable possibility that the new molecule might one day become the basic building block underlying an approach to computing known as ***quantum computing***, which until now has been discussed only in theoretical terms.

While today's digital computers are based on systems composed of millions of switches capable only of being in "on" and "off" states, scientists have since the early 1980's speculated about a new kind of computing based on a radically different kind of physics derived from the world of quantum mechanics.

Used to describe interactions in the microscopic world of atomic structures, quantum physics might one day help create a computer in which a single atom switching between many different quantum states could simultaneously perform different operations, thereby speeding up computations to a hitherto unthinkable scale.

The research team said the new material was a crystalline substance that consists of clusterlike structures of 12 manganese and 12 oxygen atoms surrounded by chemical groups found in ordinary vinegar. Using magnets the size of these molecules, it might some day be possible to store hundreds of gigabytes of data in an area no larger than the head of a pin, the team said. A gigabyte is equal to the amount of information on 62,500 typed, double-spaced pages.

The research team said that the new molecules had exhibited a physical phenomenon called quantum magnetic hysteresis, in which material can contain multiple magnetic states at the same time. That might one day make it possible to create a tiny device that would hold multiple bits of data simultaneously, unlike today's memory building blocks, which can hold only one bit at a time. To be sure, the researchers were quick to point out that they had not actually figured out how to read or write information from the tiny new molecules yet.

"We haven't made working memory devices yet," said Ronald F. Ziolo, a chemist with Xerox's Wilson Center for Research and Technology, based in Webster, N.Y. "And no one has yet figured out how this might be done."

He said that scientists had considered the possibility of using light as a device for reading and writing information from the small molecules. The research team was formed about two years ago after researchers from Xerox and the University of Barcelona presented papers at a European conference on quantum materials sponsored by NATO.

The brute speed of a machine based on quantum principles could be used to solve many complex computing problems, but might also raise new ones. For example, it could undercut things like today's data- scrambling technology, which is based on the fact that conventional computers require many years to factor very large numbers that are the products of pairs of large prime numbers. A ***quantum computer*** might be able to do the factoring in a reasonable period of time, thereby putting a powerful tool in the hands of thieves.

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