

SFGate.com**HP Labs' find could revolutionize computing**

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HP Labs said Wednesday that it has proved the existence of a new element in electrical engineering that was first described in a scientific paper 37 years ago.

Called the memristor, short for "memory resistor," it could make possible cell phones that don't lose memory, data centers that operate despite fluctuations in power, and computers that recognize and remember human faces and learn from experience.

The tiny particle is 5 nanometers thick - as small as a sugar molecule - and was described this week in a paper published in the latest issue of *Nature* by a team of four Hewlett-Packard researchers led by R. Stanley Williams, the founding director of HP Labs' Information and Quantum Systems Lab.

It is considered the fourth fundamental circuit - the other three are the resistor, the capacitor and the inductor - and it ultimately will allow computer systems to permanently retain information and to remember and associate information by recognizing patterns, similar to the way the human brain works.

But commercialization of the technology is probably still many years away.

Like many other companies, HP has been looking for technology to solve the current limitations of memory chips for several years, said Leon Chua, a professor of electrical engineering at Berkeley. He laid the theoretical foundation for the memristor in a paper he published in 1971.

Chua did the mathematics that showed why the memristor had to exist. He was awarded the IEEE W.R.G. Baker prize for his work, which he compared to Dmitri Mendeleev's organization of the periodic table in the late 1800s revealing the existence of several missing chemical elements.

"Everybody was barking at the wrong horse," Chua said, but HP was motivated to figure it out because chips are a multibillion-dollar industry. He said the lab has been very secretive about its work, and he was surprised.

"Nobody thought it would be practical, not even me," he said.

Some researchers have compared the discovery of the memristor to the creation of the transistor, on which Silicon Valley is built.

But the technology is so new it will be many years before anyone can judge how important the memristor is, said Wolfgang Porod, the director for the Center of Nano Science and Technology at the University of Notre Dame.

To build products based on memristors that are competitive even with today's chips will require billions of the tiny devices to work together, he said.

That will be a challenge in digital products, like memory chips, and even harder in analog products, like artificial intelligence networks, which have stricter rules for how information is interpreted.

HP Labs would have an easier time if the memristor only had to compete against vacuum tubes like the transistor did, Porod said, but "the transistor sets a high bar."

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