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Tech, IBM develop fastest microchip yet

Supercold for speed: Work could make cars, weapons, the Internet run more smoothly.

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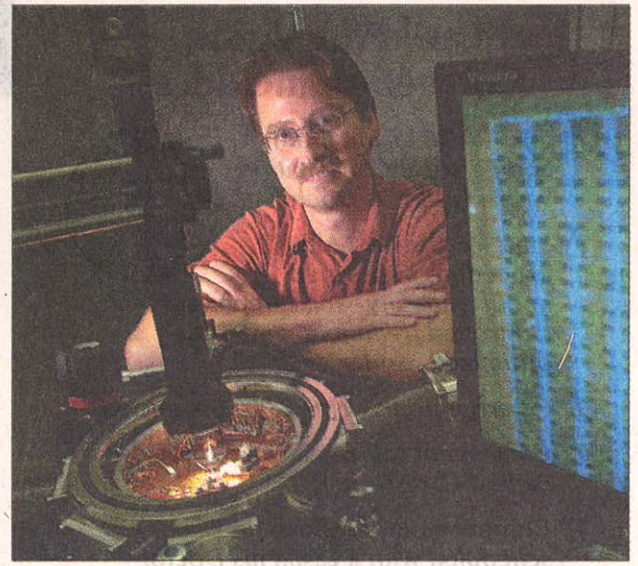
New York – In an advance that could affect the future of electronics, communications and even moon exploration, Georgia Tech and IBM Corp. are announcing today that they have set a microchip speed record by applying freezing temperatures found naturally only in outer space.

Direct applications for the research are limited because of the extreme cold involved – 451 degrees below zero. But the work could help improve technology requiring great processing speeds, including radar-using cruise control for

➤ Please see **CHIP, A12**



RICH ADDICKS / Staff

Georgia Tech professor **John D. Cressler** led the Tech team. The chip, in the super-cooling container in front of him, can do more than 500 billion cycles a second.

WHAT IT IS

Silicon-germanium chilled to nearly the coldest temperature possible.

HOW IT WORKS

Researchers used liquid helium to cool the chip and stimulated the frozen transistor with electromagnetic energy so it turned on and off 500 billion times a second.

WHAT IT MEANS

The newly proven potential for microchips could lead to improved cellphones, communications networks, automotive radar and defense electronics. A direct application is for electronics in outer space.

Chip: It's fast, cold and easier to produce

➤ Continued from A1

cars and systems for handling Internet traffic, said David Ahlgren, an IBM senior engineering manager.

Other potential applications include defense electronics and remote sensing, where information is gathered at a distance for use in medicine, oil exploration or other fields.

Researchers used liquid helium to cool the chip, achieving the record speed of 500 billion cycles per second, or 500 gigahertz. It is a first for silicon-based technology and an indicator that low-cost microchip production techniques have a long future ahead of them.

"It's a new milestone," said John Cressler, a professor and researcher with Georgia Tech's School of Electrical and Computer Engineering and the Georgia Electronic Design Center.

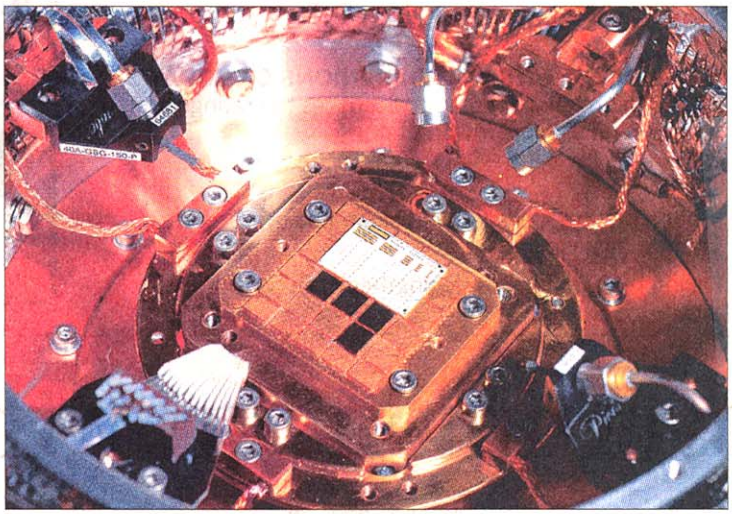
Just knowing such speeds are possible points the way to improved technology that works at room temperature, Cressler said.

"We're learning the best path forward to build the next generation of devices," Cressler said. "How fast a system you could ultimately build with this remains to be seen, but certainly significantly faster than what you can do today."

Having much faster chips also means existing devices could operate at their current speeds but use less power, which for something like a cellphone could mean longer talk times, Ahlgren said.

The new research shows that industry fears of approaching limits for microchip performance are unwarranted, said Dan Olds, principal analyst with the Gabriel Consulting Group in Oregon.

"It shows there's plenty of envelope that can still be pushed," he said. "You can take comfort in the fact that there are a lot of smart people out there working to make things ever faster."



GARY MEEK / Georgia Tech

This is a close-up of the cryogenic test station at Georgia Tech. This is where a silicon-germanium microchip was speeded up by bringing it down to a hyper-cold temperature, the kind that occurs naturally only in space. It could be used first on the moon.

The frozen chip's speed rating should not be confused with the gigahertz speeds popularly used to describe personal computer performance, the researchers said. The new results refer to how fast a transistor, the technology at the core of modern electronics, can switch an electrical current on and off in a useful way.

This will not let you "build a 500-gigahertz computer," Cressler said. He added that using the technology commercially in its current form is impractical since "you're not going to carry around liquid helium" to freeze the chips.

But there is one environment where such microchips would be useful with no liquid helium required: the lunar surface.

Georgia Tech is working with NASA to build electronic systems for a return to the moon. Because of the temperature extremes there, NASA currently has to keep electronics in a "warm box," Cressler said.

"That really confines the way they can build robotics and rover systems," he said. "What they want to have is electronics that can operate in the ambient environment of the moon, to withstand those temperatures."

The experiments at Georgia Tech's cryogenic lab are intended to explore the speed limits of chips made from silicon-germanium, which operate faster when very cold. Germanium is added to traditional silicon technology to improve efficiency, creating chips useful for low-power, high-speed applications.

Technology using such chips include cellphone handsets, handheld Global Positioning System receivers, and systems used to handle high-speed data over fiber optic networks, IBM's Ahlgren said.

Other firms working with the technology include Freescale Semiconductor Inc., Texas Instruments Inc. and Sony Corp.

Commercial silicon-germanium chips in limited production have transistors operating at frequencies from 50 gigahertz to 200 gigahertz, Cressler said.

The IBM prototype chips tested at Georgia Tech operated at 350 gigahertz at room temperature and 500 gigahertz when chilled near absolute zero — about minus 459 degrees Fahrenheit, the temperature at which all internal motion of molecules stops.

Such chip speeds have been reached with more exotic and expensive materials, but the new result is a first for silicon-based chips, which can be manufactured in large quantities with conventional low-cost methods.

A microchip made of very uncommon and costly materials holds the highest speed record at 604 gigahertz, Cressler said.

The previous speed record for a silicon-based chip, set in 2003 at room temperature, was 375 gigahertz, he said.