FEATURE

China claims milestone in quest for 'quantum supremacy'

Google only other researcher that says it has achieved computing goal

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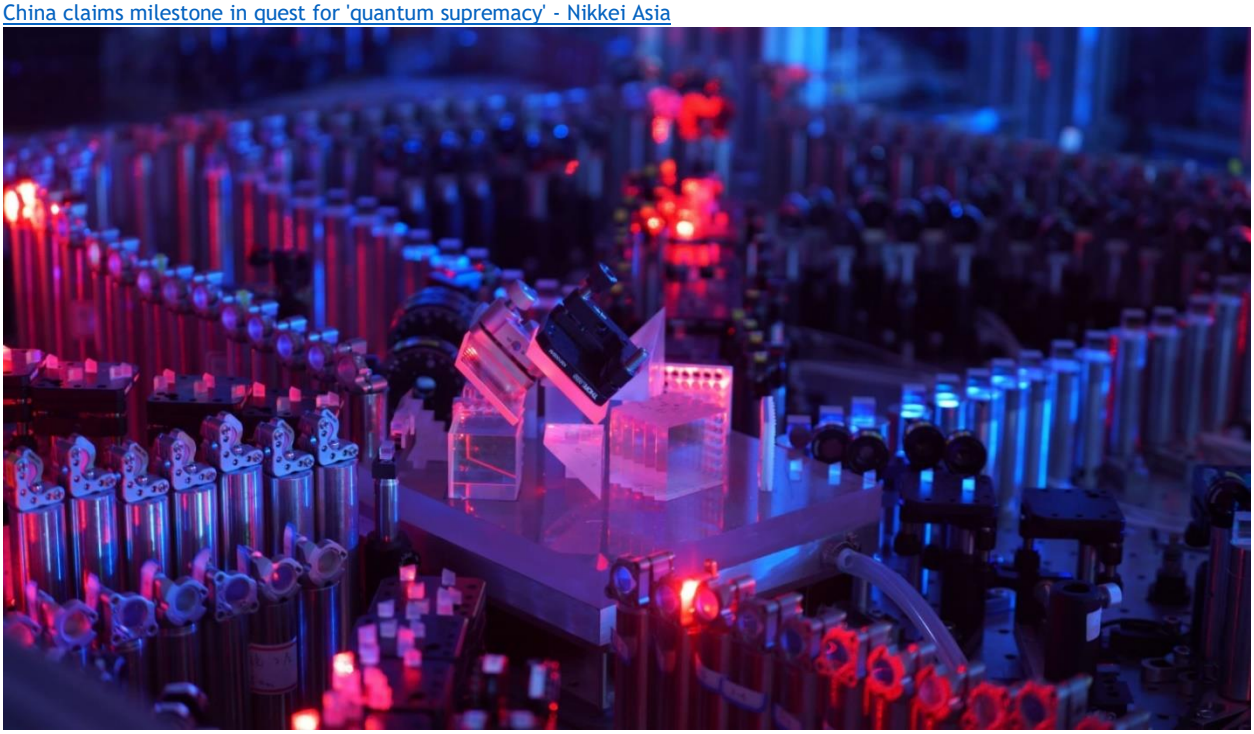
China claims milestone in quest for 'quantum supremacy' - Nikkei Asia



An optical quantum computer developed by a team of Chinese researchers including those from the University of Science and Technology of China. (courtesy of Han-Sen Zhong of the research group)

TOKYO -- It is called "quantum supremacy," the ability to harness quantum technology to achieve computational power that cannot be achieved by a conventional computer. So far, only Google has laid claim to reaching that milestone, but now a team of researchers in China say they too conquered that level.

So far, the quantum computers used are designed to solve specific, narrowly defined problems, so the long-term outlook for the technology is still uncertain, but China's growing prominence in the field is striking.

In an article published in the Dec. 3 issue of the American academic journal Science, the Chinese team, including researchers from the University of Science and Technology of China, said they were able to solve a problem in 200 seconds that would have taken Japan's Fugaku conventional supercomputer, currently the world's fastest, 600 million years or 2.5 billion years by China's Sunway TaihuLight supercomputer.

Using particles of light known in physics as photons, the team built a quantum computer to solve a specific problem called "Gaussian boson

sampling," which involves calculating the distribution of a large number of photons.

It is difficult for conventional computers to calculate a problem that involves the strange quantum properties of photons. But quantum computers are based on quantum mechanics and promise to bring innovative changes to the development of materials and drugs, assessment of financial risks and artificial intelligence using big data. But they were regarded as a "dream technology" due to the difficulty of development.

That changed when Google claimed the achievement of quantum supremacy in the British scientific journal Nature last year.

Google said in that report that it took 200 seconds to perform a calculation that would have taken a supercomputer 10,000 years to compute.

Google checked the output from a random-number generator for that achievement, but since then the focus has shifted to possible practical applications for the real world.

Google performed the calculation in superconducting electronic circuits where temperatures are reduced so low that material is in a superconducting state. With IBM adopting the same approach, superconducting quantum computing has become the mainstream of the technology.

In contrast, the Chinese team employs photons traveling through circuits that combines mirrors and other materials. Because it does not require equipment to deep refrigeration and vacuum vessels, it is much easier to use.

"The Chinese technology will undoubtedly contribute to the development of optical quantum computing," said Shuntaro Takeda, associate professor at the University of Tokyo.

But Google's quantum computer is "overwhelmingly superior" to China's at present, Takeda said, noting that the Chinese computer is aimed specifically at achieving quantum supremacy and is not considered applicable to other calculations. Therefore, there is no current prospect for the practical use of the Chinese technology, and it is unclear how it can be improved.

Nevertheless, there is no denying that China is making progress in quantum computing technology.

Pan Jianwei, of University of Science and Technology of China and who is known as "Father of Quantum" in China, led the latest breakthrough. Credited for respected achievements in studies on quantum communication, cryptography and other technologies, he is globally known as well.

The Chinese experiments suggest the team is well funded and has many excellent researchers, said Tomoyuki Horikiri, associate professor at Yokohama National University.

And the cutting-edge devices used in the project indicates that China has also stepped up its fabrication abilities, Horikiri said.

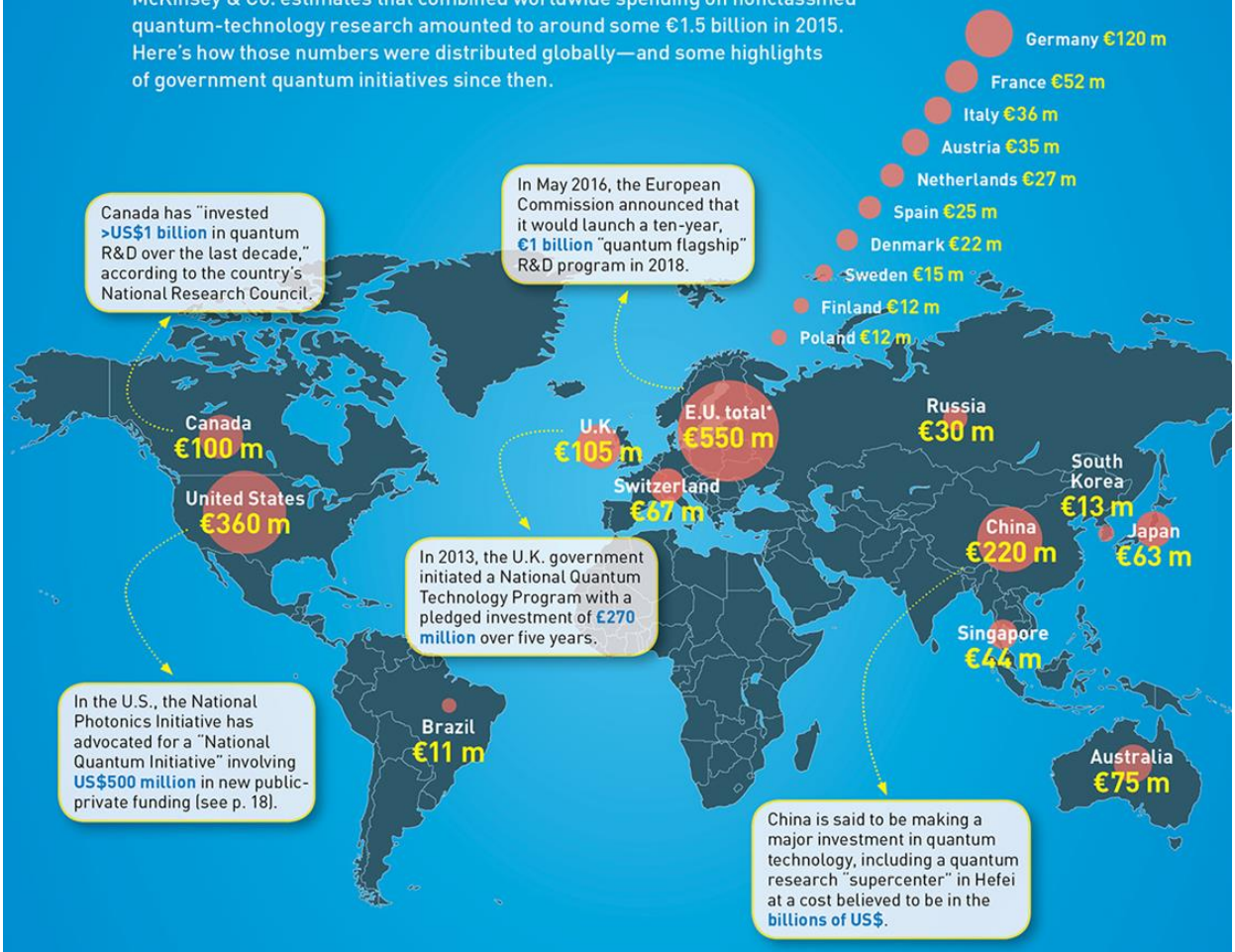
China has positioned the development of quantum computers as a key project, setting up related facilities in Anhui Province at a cost close to almost $10 billion. It is expected to keep accelerating the development program.

The U.S. government has a plan to invest $1.3 billion over five years from 2019 to develop quantum computing technologies. Competition in the field between the U.S. and China is expected to further intensify even after the change of government in the U.S. in January.

Quantum Technology

Funding the Future

McKinsey & Co. estimates that combined worldwide spending on nonclassified quantum-technology research amounted to around some €1.5 billion in 2015. Here's how those numbers were distributed globally—and some highlights of government quantum initiatives since then.



QUANTUM APPLICATIONS

SECURITY
Quantum communications can increase data security on networks—reducing theft of sensitive information and promoting trust

COMMUNICATIONS
Tiny ultra-precise quantum clocks will allow denser communications traffic, and could reduce risk of transmission failures

INFORMATION
It's believed that quantum computers could ultimately tackle problems out of reach of classical computing algorithms

ENVIRONMENT
Quantum sensors for measuring gravity could aid flood prevention by providing more accurate monitoring of the water table

FINANCE
Financial markets that depend on split-second decisions could benefit from the increase in accuracy of the new generation of atomic clocks

*Sum for all E.U. countries including the U.K. as of 2015.
Sources: European Union; U.K. Government Office for Science; National Research Council Canada; National Photonics Initiative, USA.
Infographic by Stewart Wills and Alessia Kirkland