CENTRE FOR JOINT WARFARE STUDIES

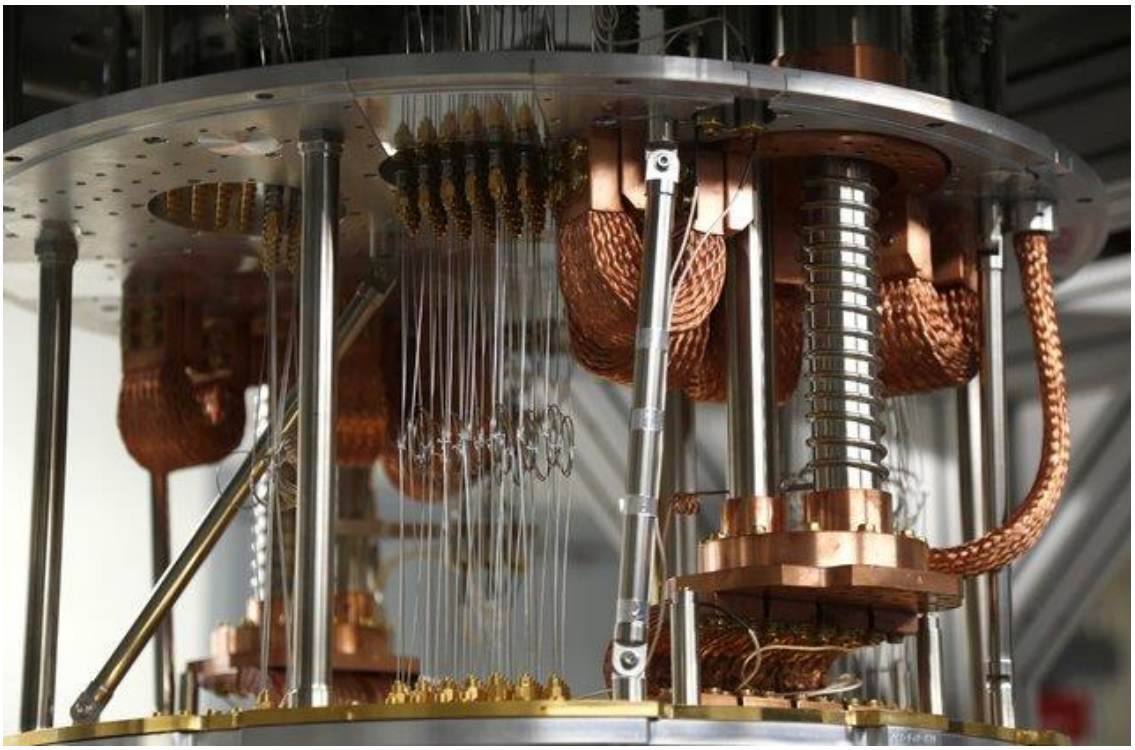
CENJOWS

QUANTUM COMPUTING IN CHINA

1. **Advancements in China's Quantum Computing Technology.** Quantum computing is beginning to reveal many secrets of the nature with revolutionary applications. Quantum communication has the potential to become an integrated, standard component of global communication networks. More details on the sequences of operations used for various quantum algorithms such as study of Shor's algorithm, Grover's algorithm, Deutsch–Jozsa algorithm, amplitude amplification, quantum Fourier transform, quantum gate, quantum adiabatic algorithm and quantum error correction is useful for understanding quantum computing.

2. Sintia Radu, in her article titled New Warnings Over China's Efforts in Quantum Computing has suggested that the United States should be concerned about China's ability to redirect 'enormous resources' to strategic fields[1].

[1] ***https://www.usnews.com/news/best-countries/articles/2020-01-31/google-quantum-chief-warns-china-can-quickly-develop-supercomputers***



(Electronics used in quantum computers are shown in the quantum computing lab at the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y.(AP IMAGE)

3. Just days after officials in China announced the completion of building in a single week a new hospital for patients infected with the coronavirus and begin building a second one, Google engineering director Hartmut Neven warned that the Asian giant's ability to quickly devote massive resources to a single task poses a new technological challenge to the U.S. and other countries. Speaking at an event at the Center for Strategic and International Studies in Washington, D.C., Neven, who is tasked at Google with researching and developing the world's fastest supercomputers, says the Chinese might soon make tremendous progress that could compromise the U.S. leadership position in this field[2]. "We are indeed most worried (about) an unknown competitor out of China to beat us in the race to (such a) machine because China as a society just has the ability to steer enormous resources in the directions that are deemed strategically important," Neven says. Quantum computing employs quantum mechanics to bring huge leaps forward in processing power. While no country has yet developed such a fully operational machine, China does not have facilities equivalent to the U.S. laboratories researching and testing quantum computers – but they will get there, Neven adds.

4. "China plan to have three different labs and they will actually all be devoted to quantum information (the science at the core of building quantum computers)." In addition to fifth-generation and artificial intelligence, quantum computing is another area of technological competition between countries, and one in which the U.S. and China are competing to be the world's leader. The global quantum-computing market is estimated to reach $948.82 million by 2025 and such technology could be a game changer in many industries. Developing quantum computers will bring tremendous advantages to various industries, experts say, as these super fast computers will be able to tackle very complex

[2] ***Ibid***

calculations that today's computers cannot handle. Quantum computers could process never-before-seen amounts of data, which can lead to more efficient communication between devices and a boost for overall innovation.

5. Several countries are in this race. President Donald Trump signed a bill in 2018 that officially earmarked $1.2 billion for quantum information development in the next decade. Last year, Google claimed it overtook Chinese efforts and developed a machine that can solve a problem in just 200 seconds, which would take a supercomputer today about 10,000 year[3]. Canada, Germany, the United Kingdom, France, Russia, Japan and South Korea are also looking into the supercomputers of tomorrow and pouring large sums of money into research and development.

6. Earlier, a top quantum scientist has revealed that China will make significant breakthroughs in quantum computing in the next three to five years, leading to advancements in supercomputing and public information security. Pan Jianwei, one of the world's leading quantum physicists and a member of the 13th National Committee of the Chinese People's Political Consultative Conference (CPPCC), affirmed on Saturday at the first session of the 13th CPPCC National Committee in Beijing that China expects to make significant breakthroughs in quantum computing in the next three to five years, which will further the field of supercomputing and better safeguard public information[4].

7. The first applications for a universal quantum computer are likely to be for drug and materials discovery, financial services and supply chain. The development of Quantum Computers is of great importance for the defence forces as well. First and most obvious military application for a modern, fully functional quantum computer is the capability to engage in near-instantaneous hacking into encrypted military servers, and those controlling the national infrastructure systems of the probable adversaries.

8. China is already launching unhackable experimental satellites with quantum-based communication systems, building quantum radars, hundreds of kilometers worth of quantum communication lines, and creating the world's fastest supercomputers. China's quantum satellite - nicknamed Micius after a 5th century BC Chinese scientist was launched from the Jiuquan satellite launch centre on 16 August 2016.

9. European Quantum Communication Research Agenda flagship programme is not far behind. It will centre mainly on quantum cryptography and quantum networking. Its main applications are in probably secure communication, long-term secure storage, cloud computing and other cryptography-related tasks, as well as, in the future, secure quantum communication networks distributing quantum resources like entanglement and connecting remote devices and systems.

10. Indian Institute of Science is also deeply involved in the Quantum Computing research activities. The areas covered by the Institute are: NMR (Nuclear Magnetic Resonance) implementation of quantum algorithm, Implementation of superconducting qubits, Implementation of quantum dots and nanostructures, Implementation of ion trap qubits, Quantum algorithms, Quantum entanglement in many body systems, Large scale computation with integer, polynomial and power series and Foundational aspects of

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[3] ***ibid***

[4] ***http://www.china.org.cn/china/NPC_CPPCC_2018/2018-03/05/content_50657395.htm***

quantum computation. While the Physics departments at the Indian Institute of Science, Bangalore, and the Harish Chandra Research Institute, Allahabad, have only forayed into the theoretical aspects of quantum computing, DST (Department of Science and Technology) is actually planning to fund a quantum computing project in a big way.