CENG487 - Introduction to Qauntum Computing

Hardware Implementations

Fall 2021

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Most powerful quantum computers

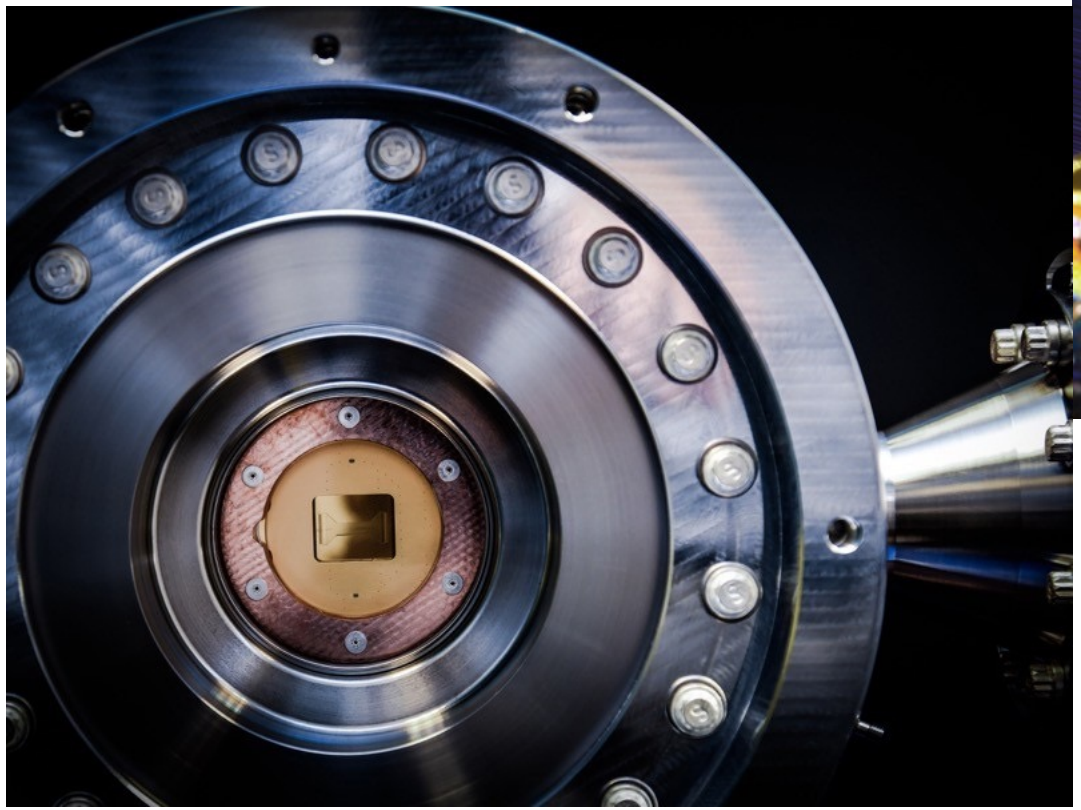
Name/Designation	Manufacturer	Architecture	Release date	Qubits
IBM Eagle	IBM	Superconducting	Late 2023	127
Jiuzhang	USTC	Photonics	2020	76
Bristlecone	Google	Superconducting	5 March, 2018	72
IBM Manhattan	IBM	Superconducting		65
Sycamore	Google	Nonlinear superconducting resonator	2019	53
IBM Q 53	IBM	Superconducting	1 October, 2019	53
IBM Q 50 prototype	IBM	Superconducting		50
N/A	Google	Superconducting	Q4 2017 (planned)	49
Tangle Lake	Intel	Superconducting	9 January, 2018	49
IBM Dublin	IBM	Superconducting		27

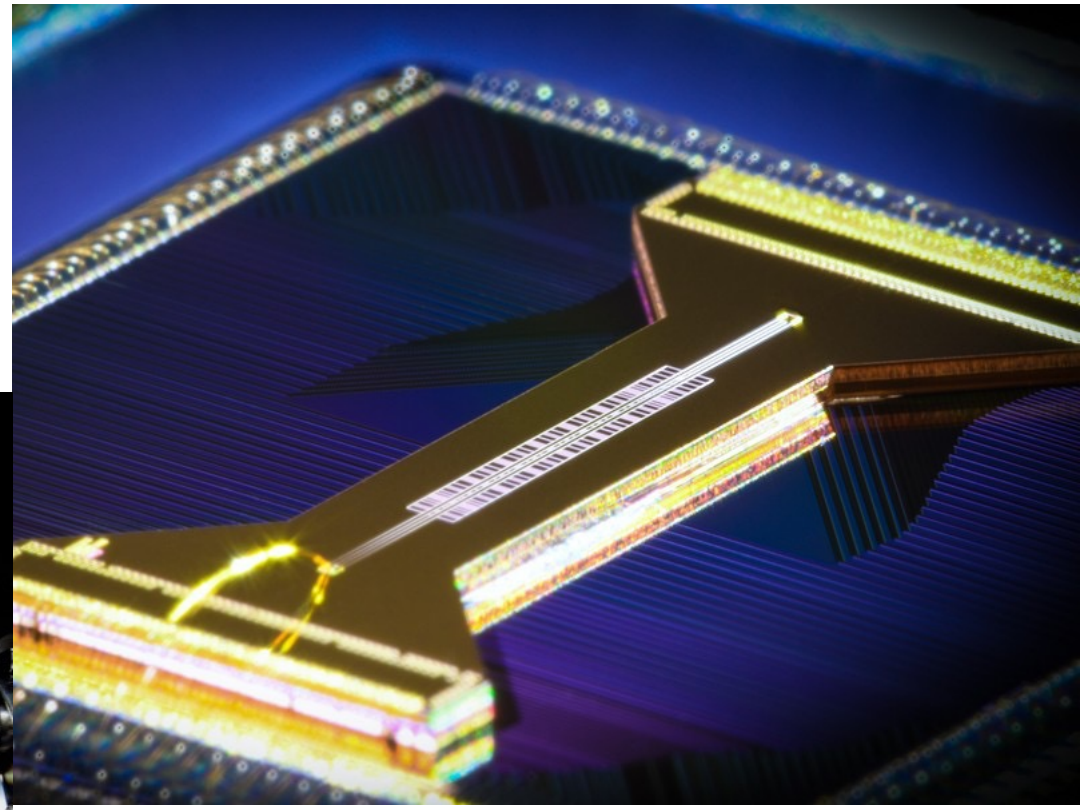
Source: IBM, Verdict, Wikipedia (sources cited: Nature, Live Science, IBM, Futurism, MIT Technology Review, IEEE Spectrum, SPIE)

Hardware

- Ion traps (atoms)
  - First quantum gate (CNOT) was build using ion traps in 1995 by C. Monreo and D. Wineland
- Superconductors (electrons)
- Optical (photons)
- Nuclear Magnetic Resonance (molecules)
- Diamond (atoms)

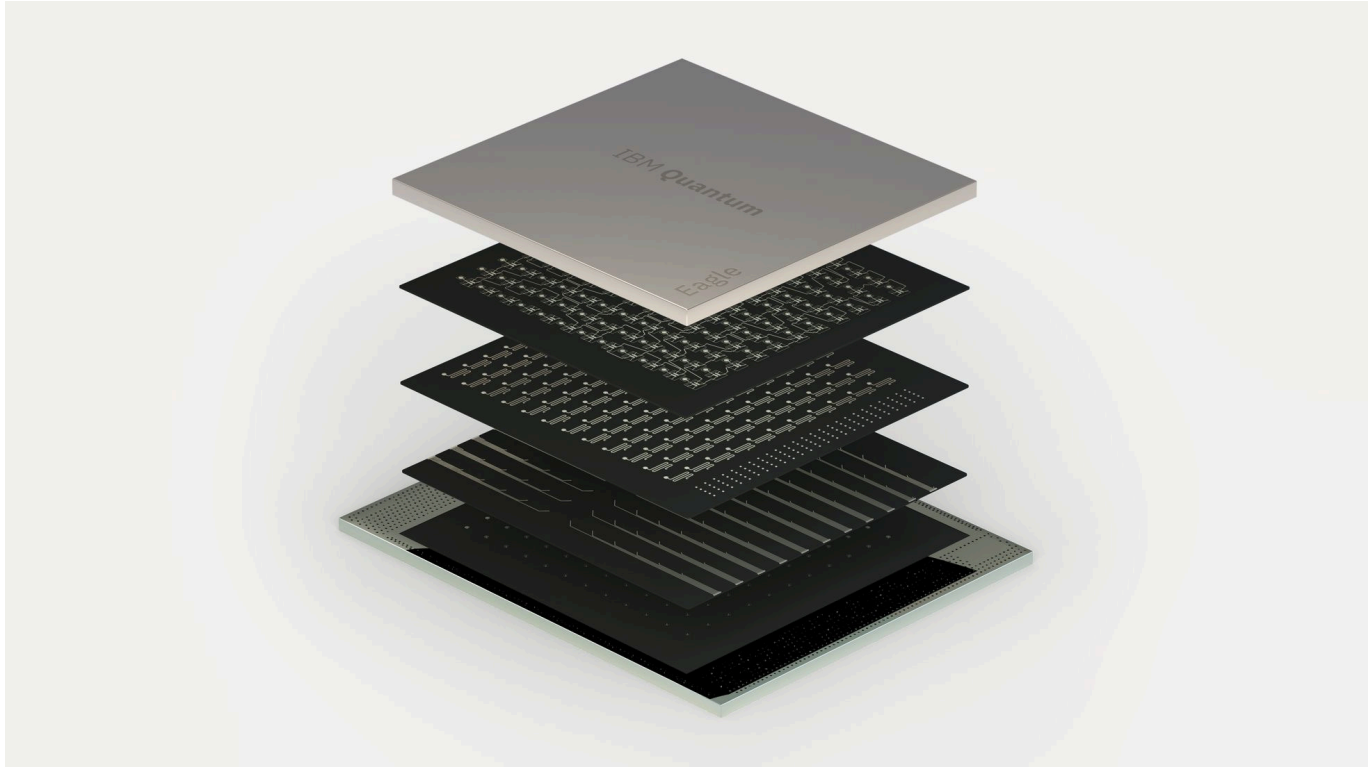
Ion traps



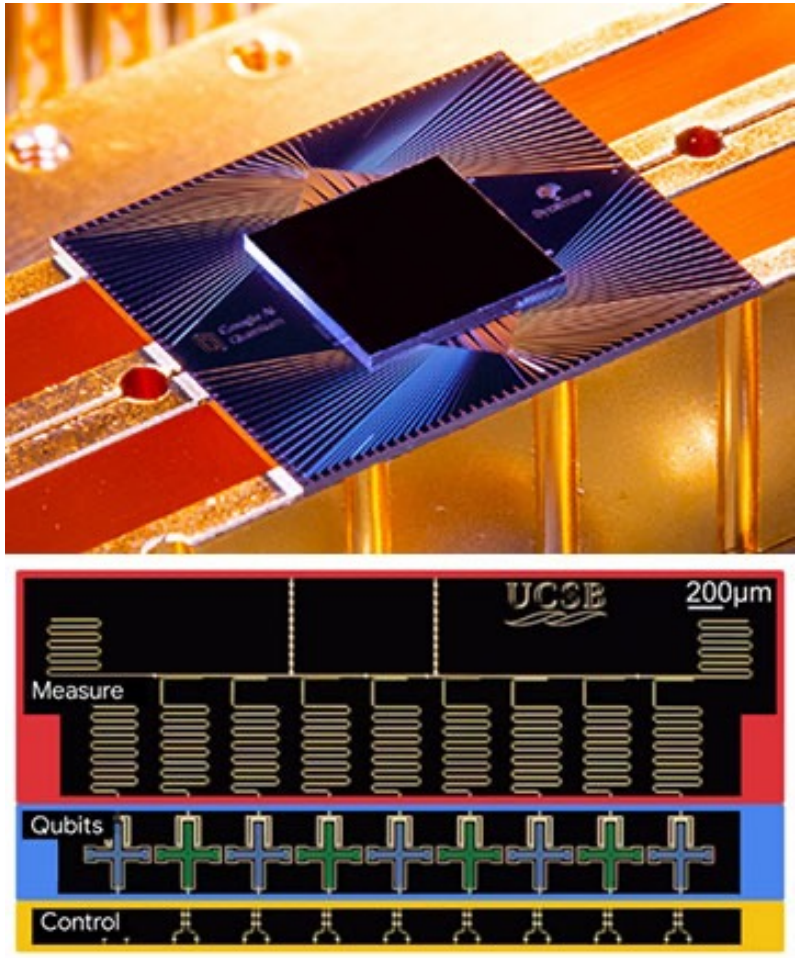


An ion trap from Honeywell's quantum computer. Credit: Honeywell Quantum Solutions

Superconductors



https://newsroom.ibm.com/2021-11-16-IBM-Unveils-Breakthrough-127-Qubit-Quantum-Processor



The Google Sycamore chip (top) involves an architecture constructed of control circuitry, superconducting qubits (in aluminum-on-silicon), and microwave resonators for measurement. [Image: Erik Lucero, Google (top); Google AI Quantum (bottom)]

Optical

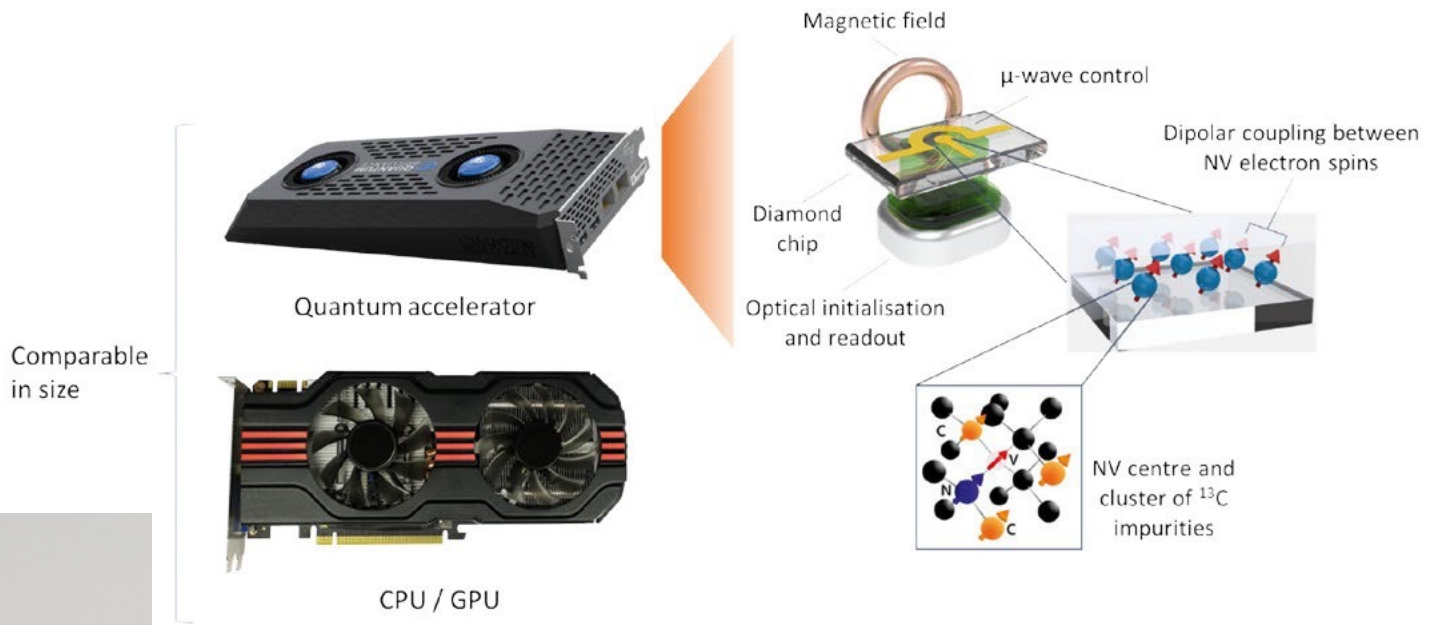
A photo of the Jiuzhang light-based quantum computer prototype
Photo: courtesy of University of Science and Technology of China

NMR

SpinQ Chief Scientist Prof. Bei Zeng from University of Guelph, announced the SpinQ Gemini, the first commercially available desktop quantum computer. Source: https://mathstat.uoguelph.ca/feature/quantum_computer

Quantum information processing experiment equipment. Image: https://ocw.mit.edu/courses/physics/8-13-14-experimental-physics-i-ii-junior-lab-fall-2016-spring-2017/experiments/quantum-information-processing/

Diamond



Room-temperature diamond Quantum Accelerators could become just another component for a PC, offering quantum capabilities when there's an advantage -**Quantum Brilliance**

Thank you!