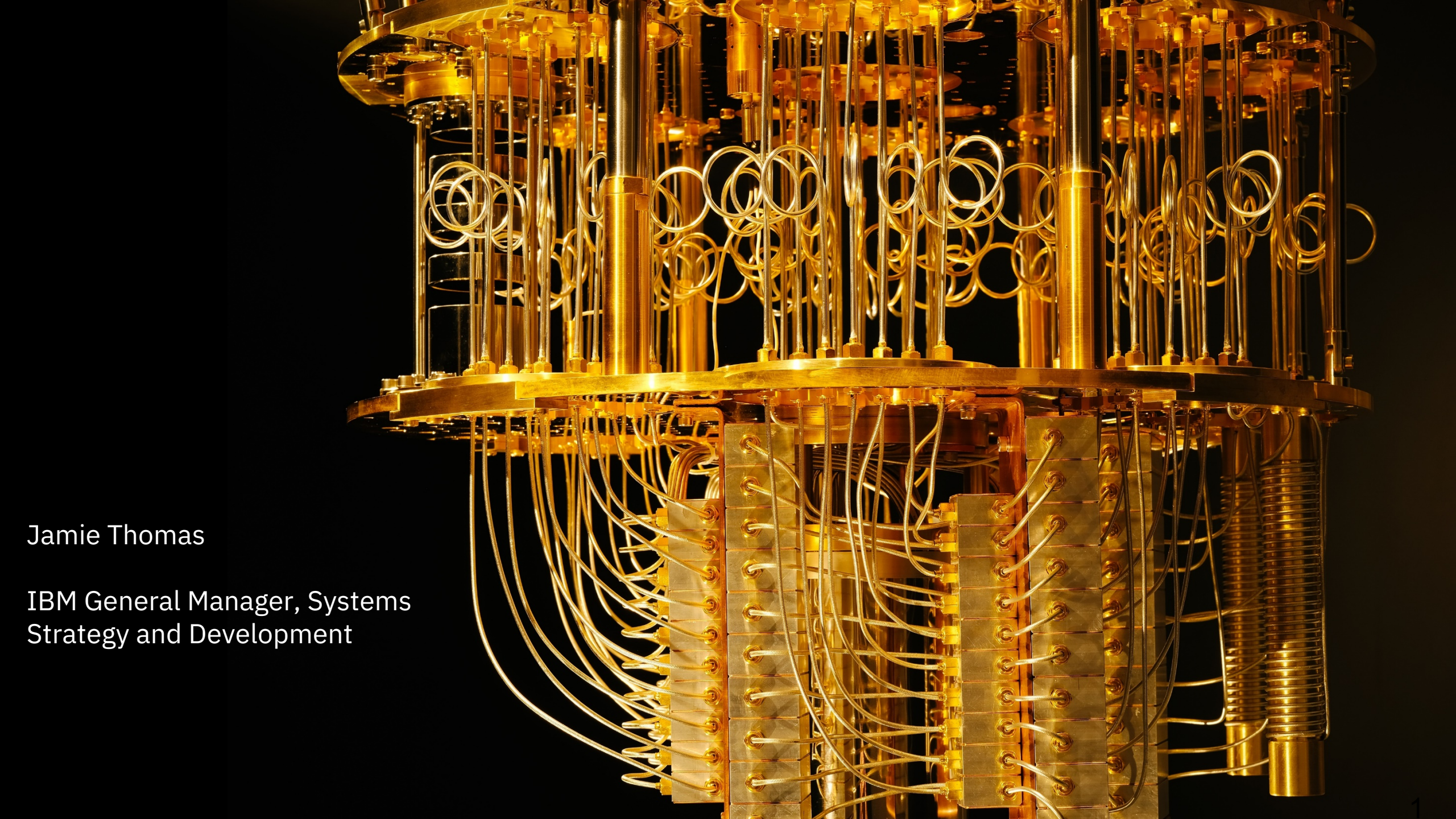


Jamie Thomas

IBM General Manager, Systems Strategy and Development

About Me

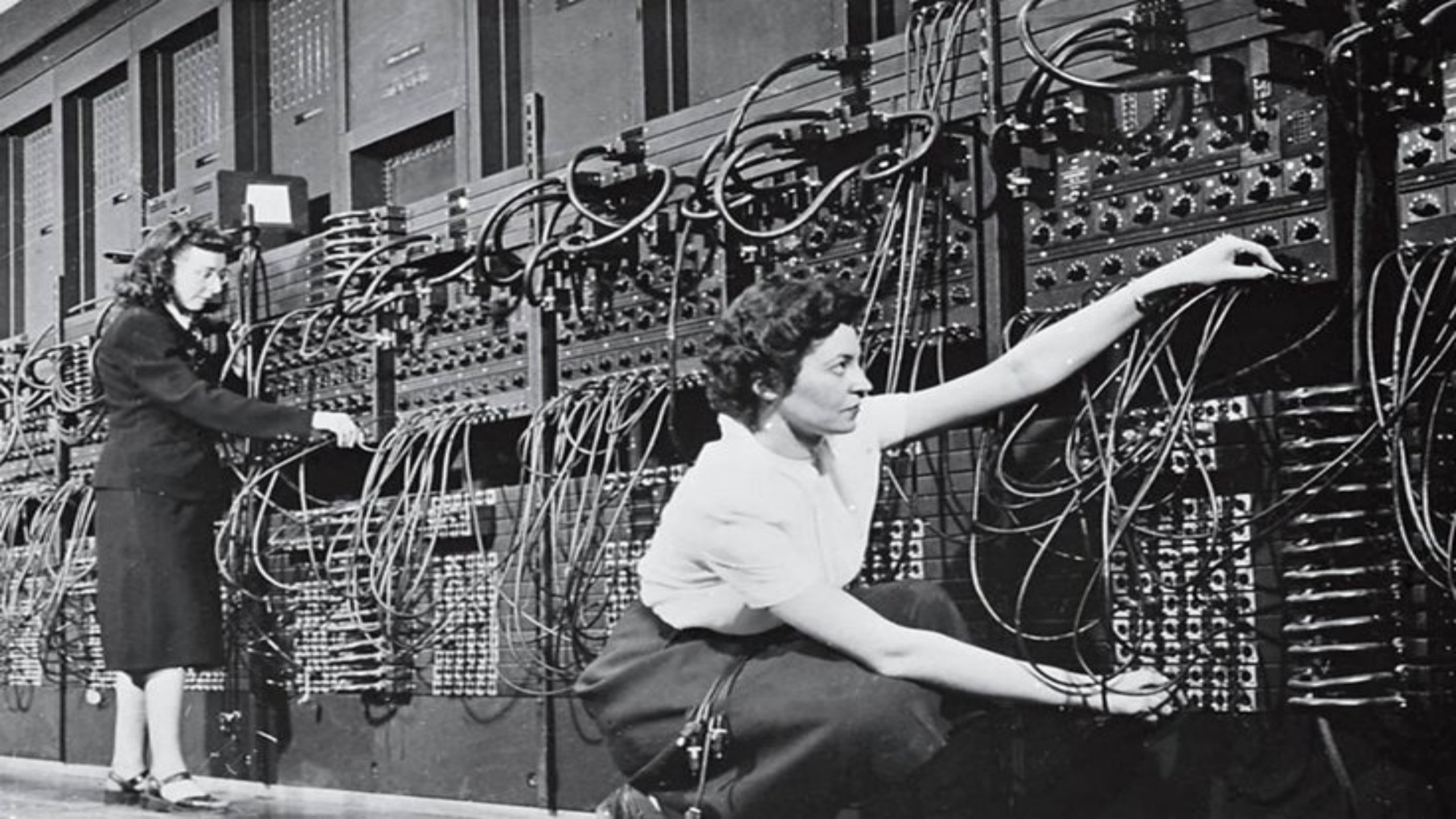
Responsible for strategy, development and client experience – IBM Power, Mainframe, Storage and Quantum offerings

Also own IBM's worldwide supply chain and manufacturing operations

Prior roles in Storage, Tivoli (Systems Management and Internet of Things), Rational development tools and WebSphere

University of Tennessee – Knoxville Computer Science Alumni

Is Quantum Computing important?



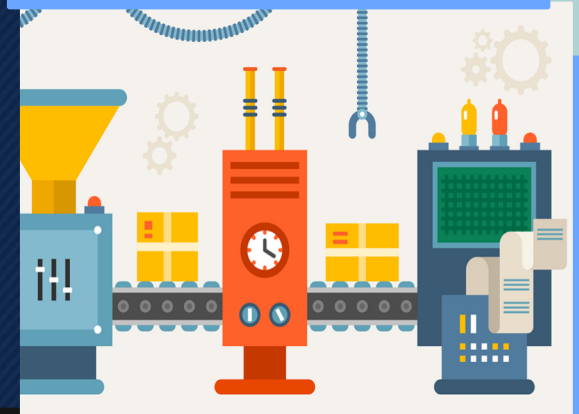
Quantum potential drives dynamic business landscape

Increasing complex simulation could increase the rate of drug discovery by 5% to 10% and accelerate development times by 15% to 20%.

Quantum computing will not replace classical computing, but the market could be more than $50 billion by 2030

US Government National Quantum Initiative $1.3B through 2023

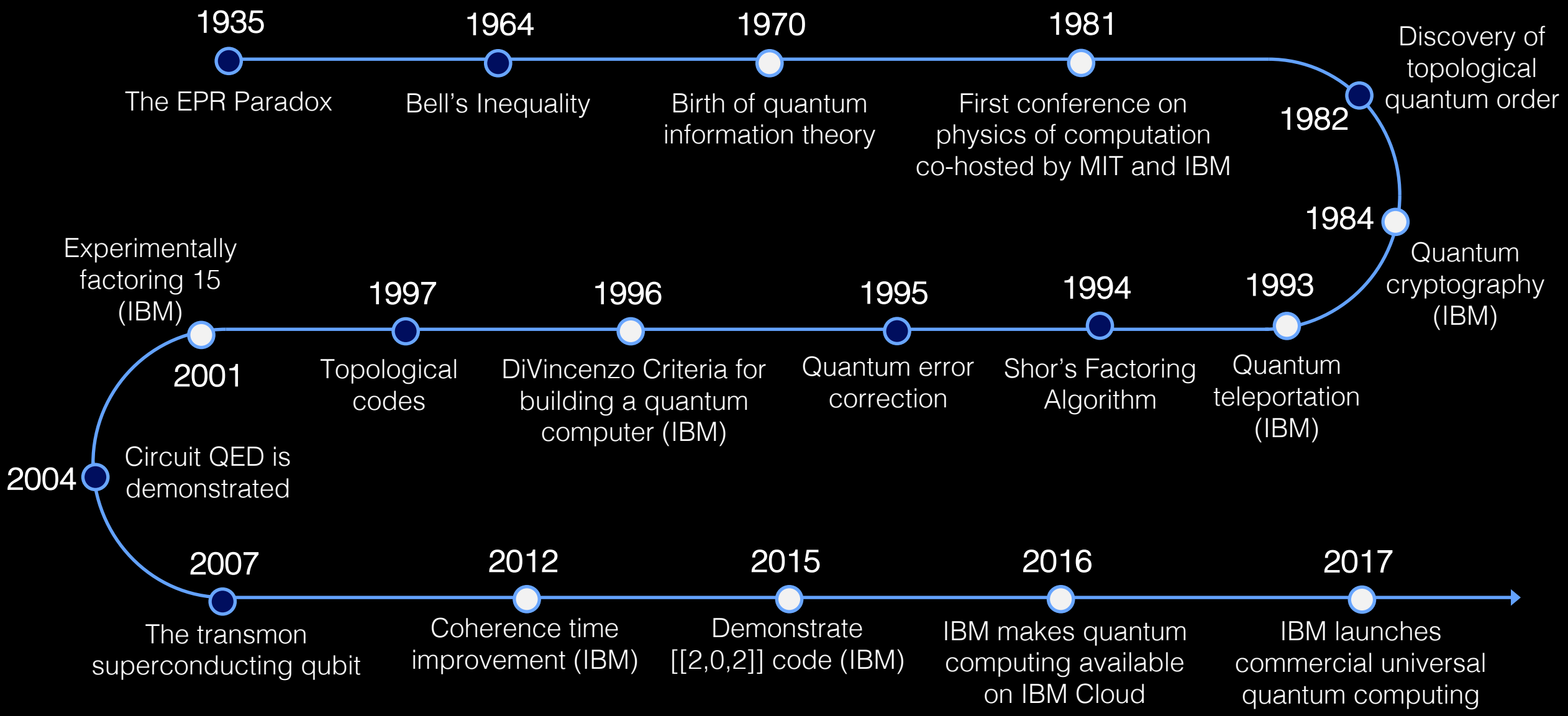
European Quantum Technology Flagship will provide €1 billion of funding for quantum research over the next ten years, funding 20 projects from 21 countries



Leading Industries for Quantum Computing Adoption will include Life Sciences, Financial Services, Aerospace, Oil, Gas, and Mining, Agriculture, and Automotive

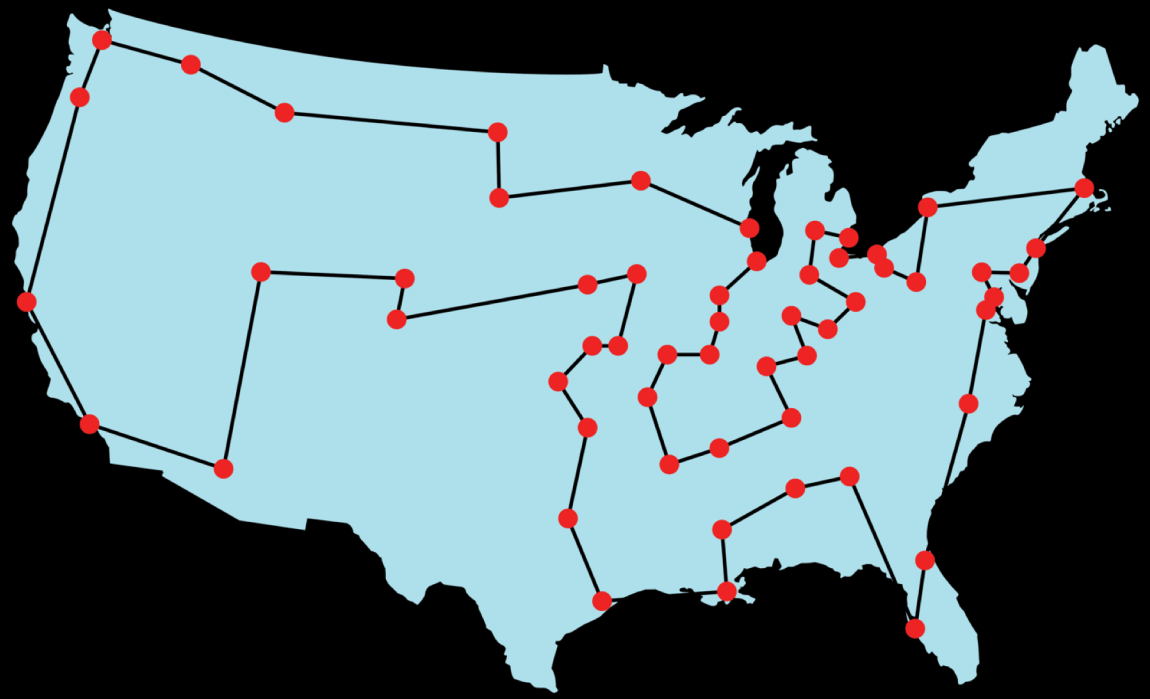
In May of 1981, IBM and MIT hosted the Physics of Computation Conference

A history of quantum computing



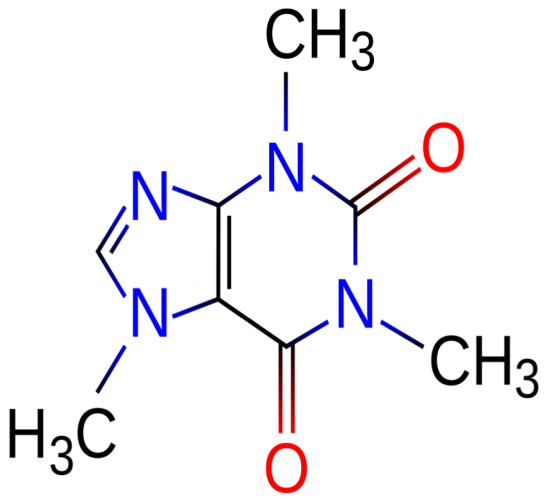
Our intuition about
what we can compute
is wrong

summit
IBM



Source: New York Times

It is impossible to model caffeine on today’s most powerful super computers, but we could represent it using 160 quantum bits, or qubits.



A new model of computation that changes the game

Building Quantum Applications is about working out how to use these two principles in a new model of computation

1). A physical system in a perfectly definite state can still behave randomly.

2). Two systems that are too far apart to influence each other can nevertheless behave in ways that, though individually random, are somehow strongly correlated.

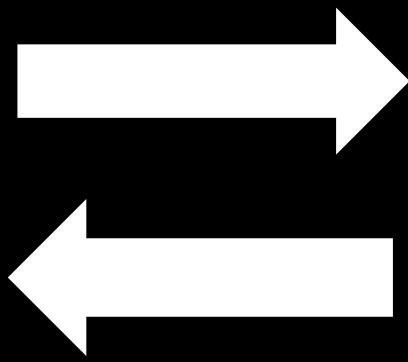
2^{50}

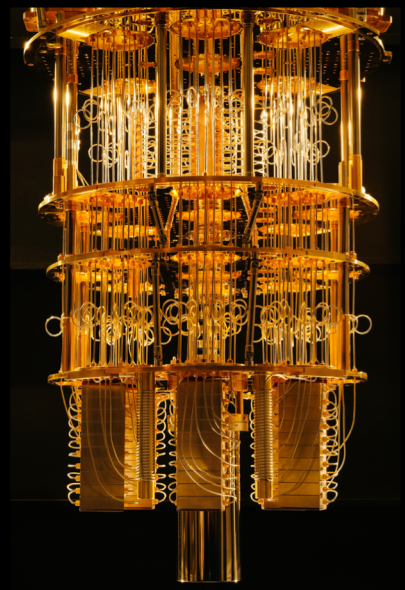
basis states in prototype
50 qubit IBM **Q** system

2^{300}

more basis states than there are atoms in the observable universe

Classical computers aren’t going away…





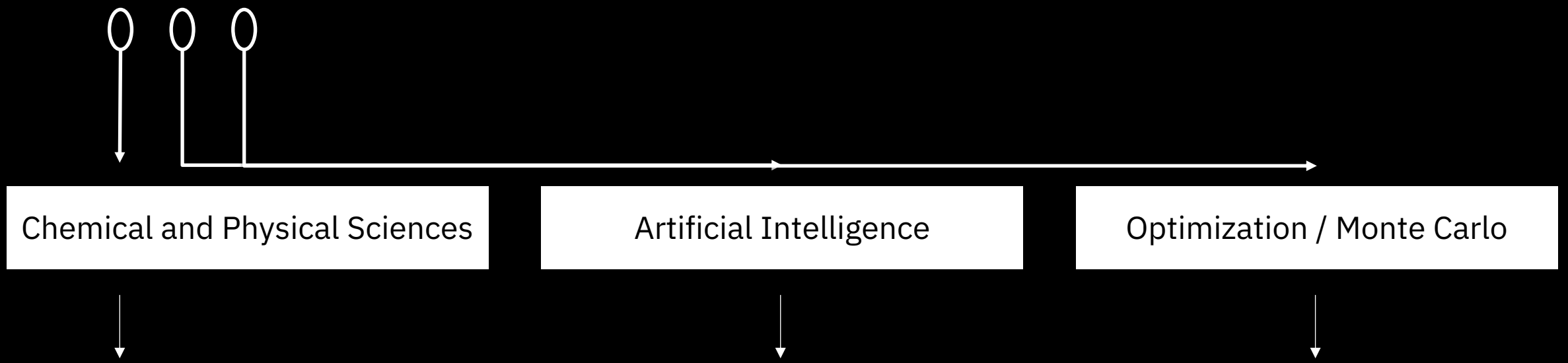
Modern Infrastructure for Big Data & AI

Store, manage and process huge quantities of data to extract insights and take business action.

Quantum Computers

Explore large set of possibilities and identify optimal answer to drive business value.

Research towards the first use cases with quantum advantage…



- Quantum chemistry
- Material science
- High energy physics

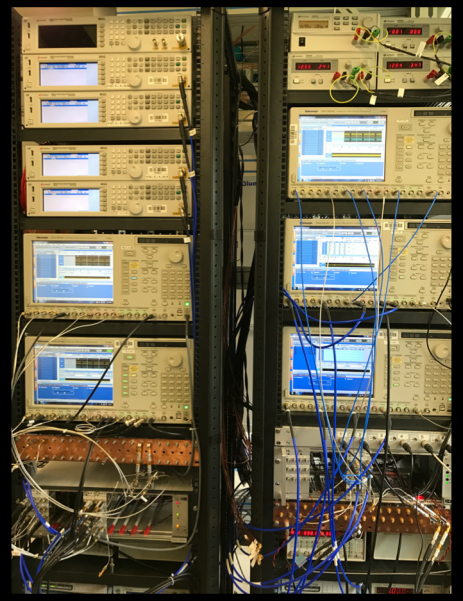
- Better model training
- Pattern recognition
- Fraud detection

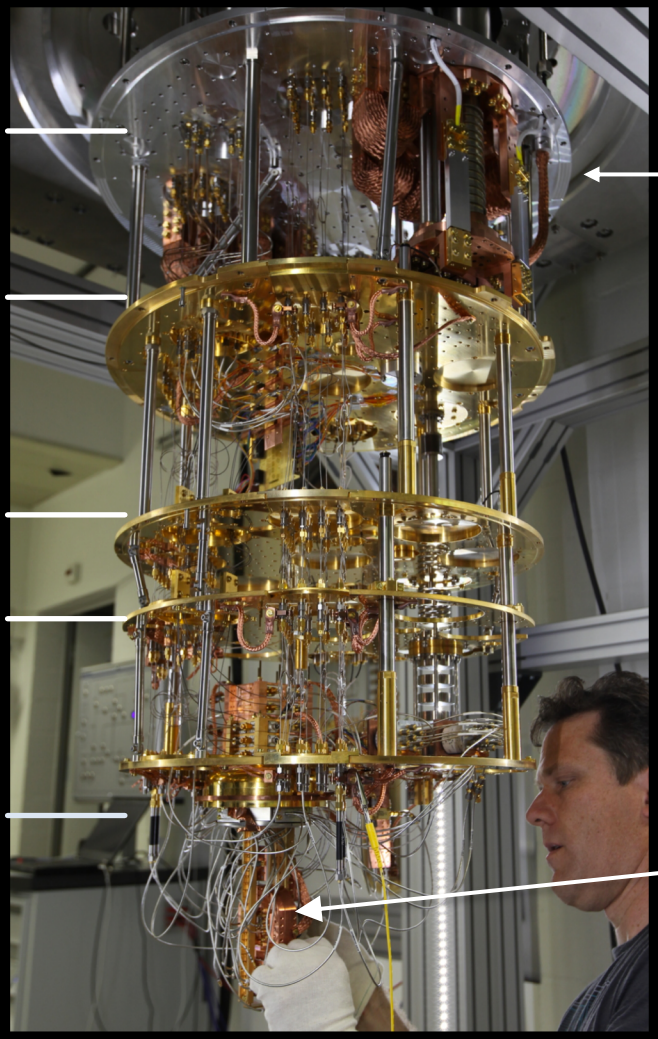
- Portfolio optimization
- Risk analysis
- Monte Carlo-like applications

Commercializing
Quantum Computing
via IBM **Q**

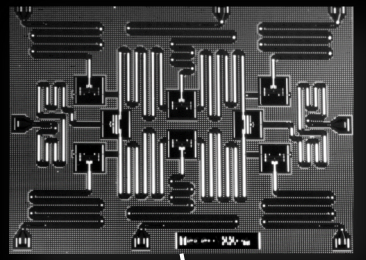
IBM Q quantum computing systems

Microwave electronics

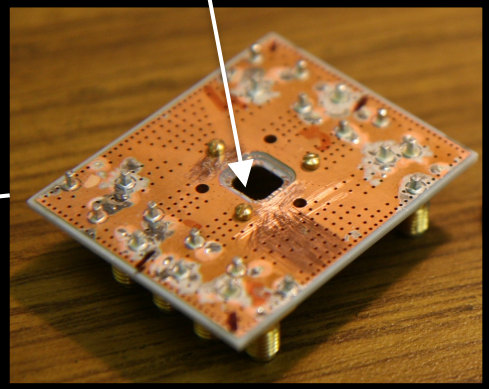




Refrigerator to cool qubits to 10 - 15 mK with a mixture of ^{3}He and ^{4}He

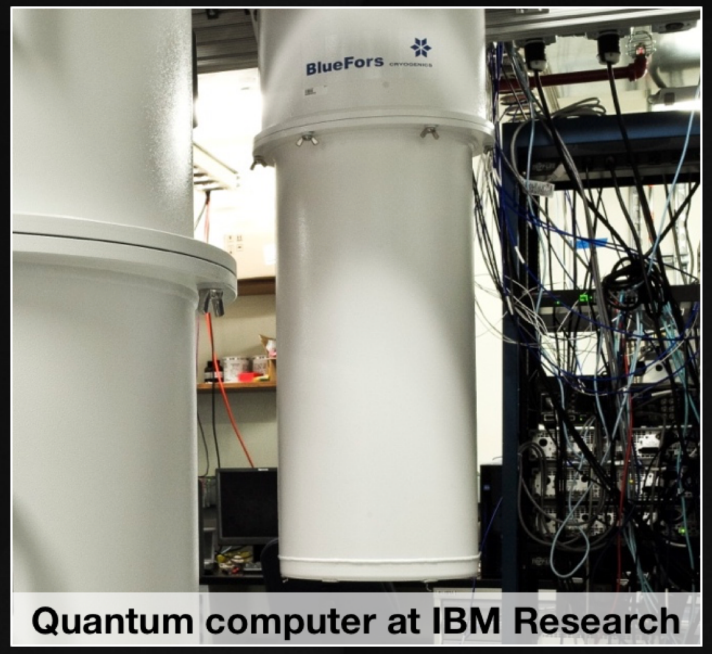


Chip with superconducting qubits and resonators

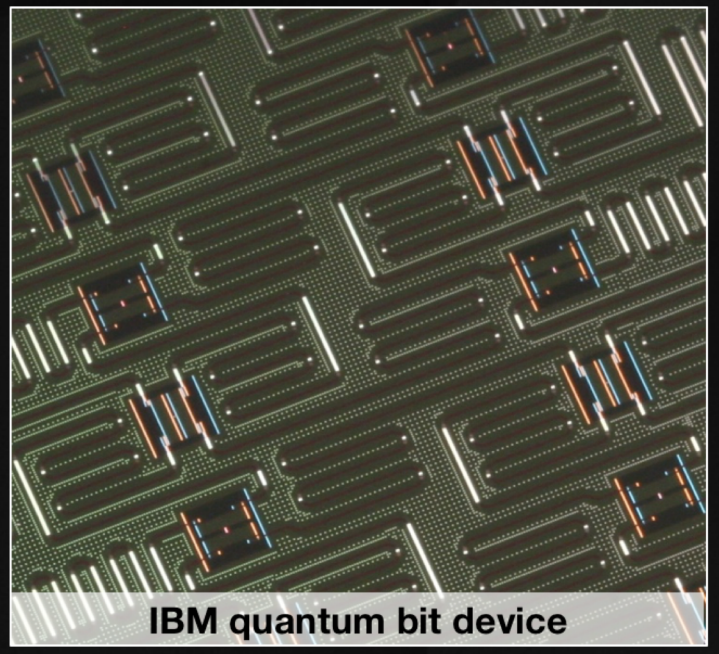


PCB with the qubit chip at 15 mK Protected from the environment by multiple shields

IBM released the IBM Q Experience in 2016



Quantum computer at IBM Research


IBM quantum bit device

IBM Quantum Experience

In May 2016, IBM made a quantum computing platform available via the IBM Cloud, giving students, scientists and enthusiasts hands-on access to run algorithms and experiments

The IBM Q Experience has seen extraordinary adoption

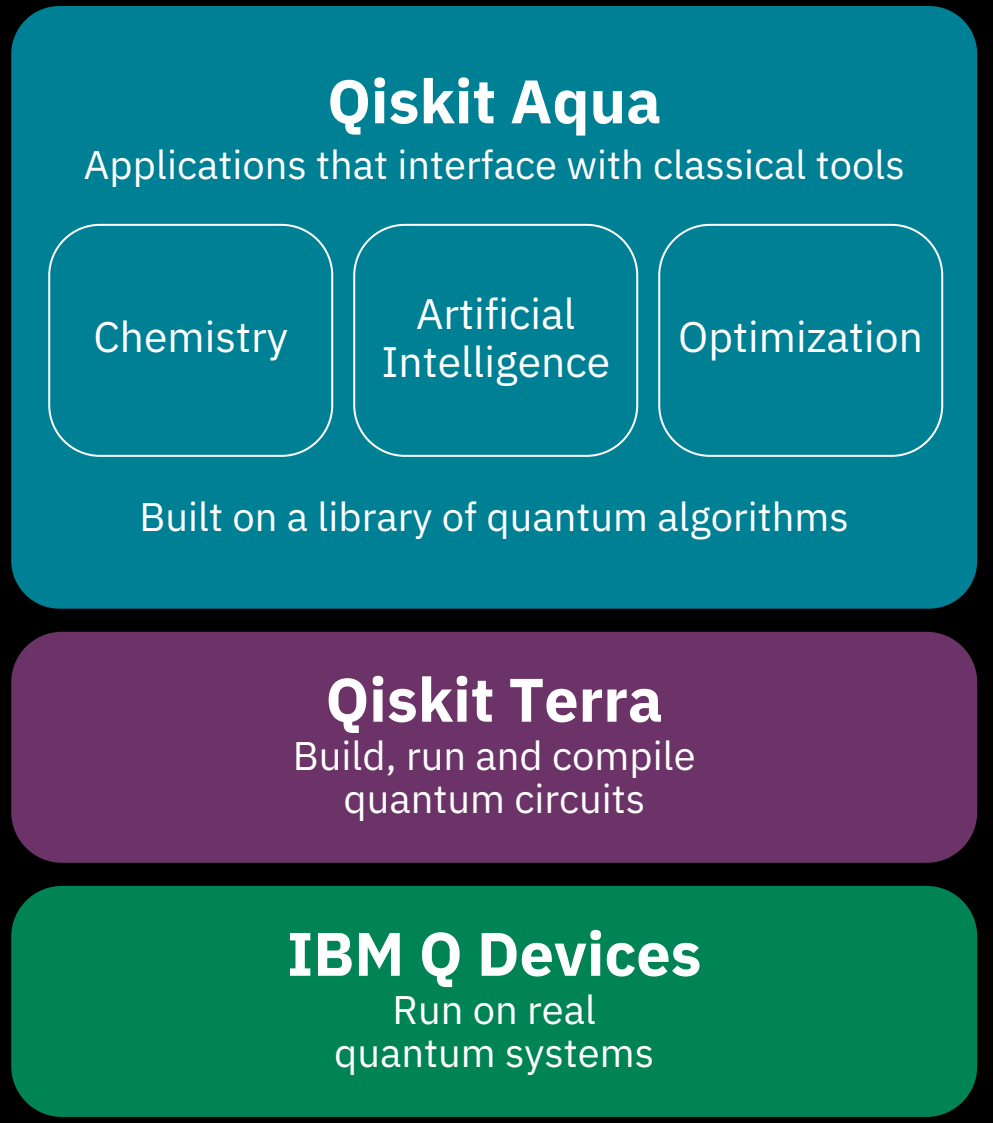
- First quantum computer on the cloud
- > 100,000 users
- All 7 continents
- > 6 **Million** experiments run
- > 120 papers
- > 1500 colleges and universities, 300 high schools, 300 private institutions

Programming with Qiskit Aqua

The world's first and only end-to-end programming framework for quantum computers

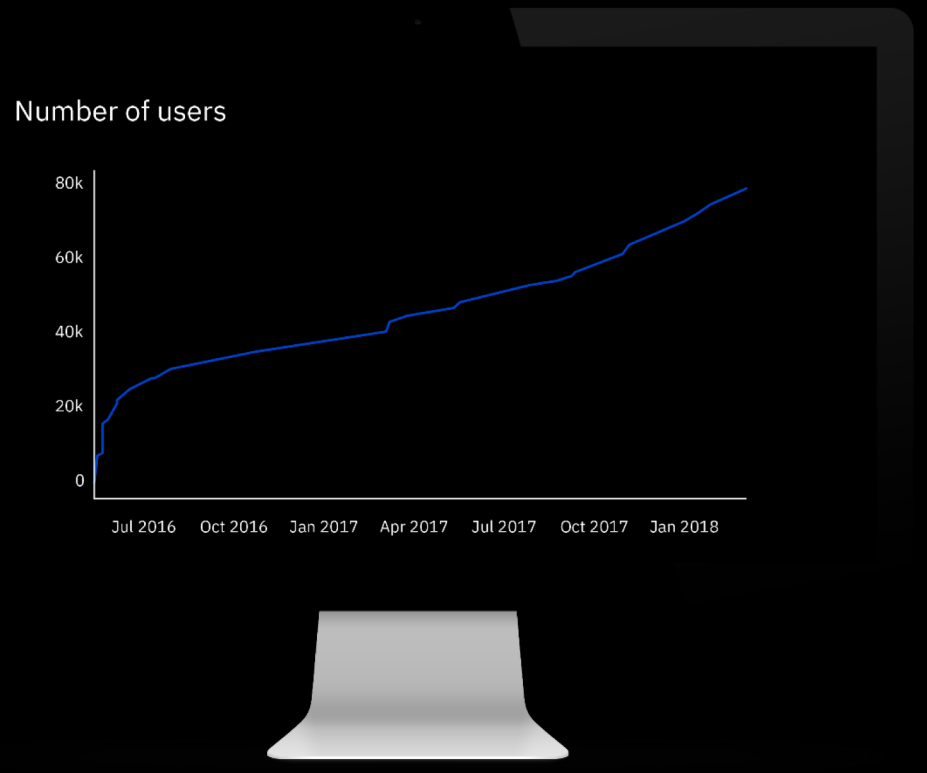
- Interface existing classical applications
- No new programming languages to learn
- Open source
- Modular and extensible

https://qiskit.org/aqua



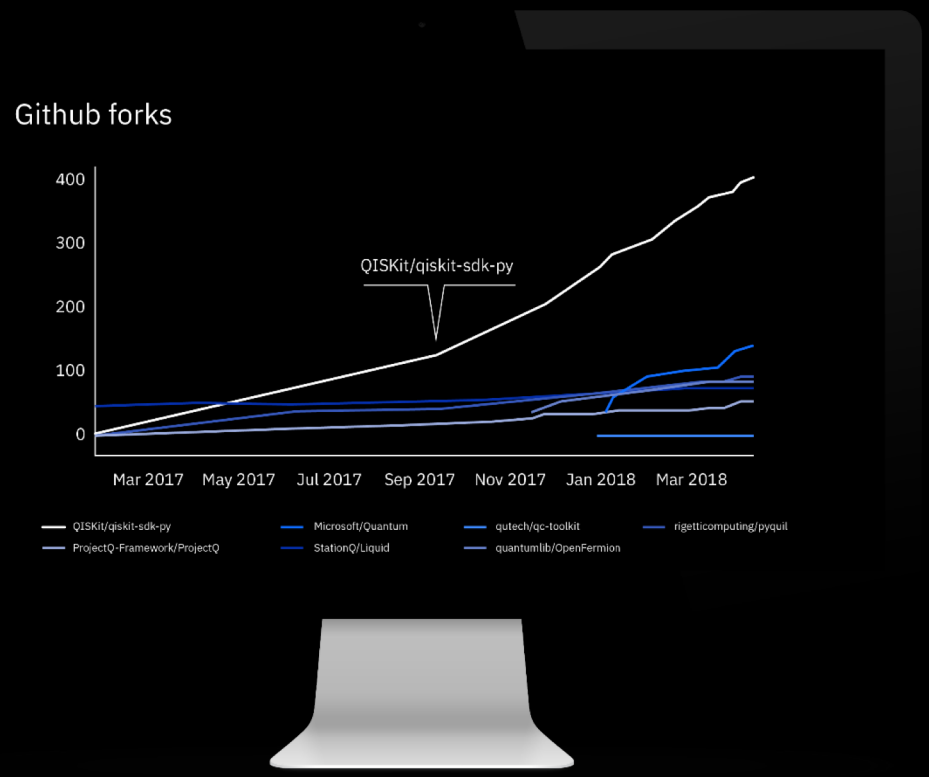
IBM Q is the largest and fastest growing *Quantum Community*

IBM Q Experience



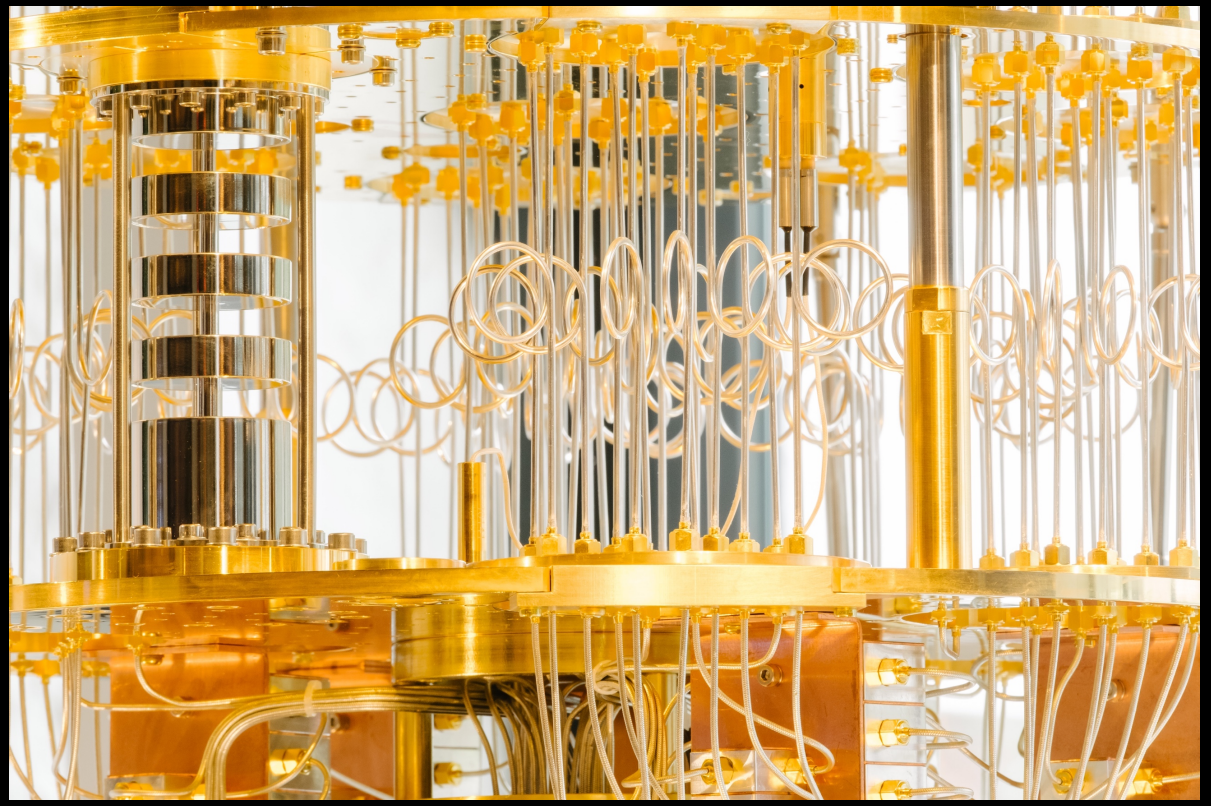
- Open to public for research and education
- Access via IBM Cloud

QISKit.org



Software kit for short depth quantum circuits and building near term applications and experiments on quantum computers.

IBM announced in early 2017 that we were building the first universal quantum computers for business and science



The IBM **Q** Network

In December, 2017, IBM launched the **IBM Q Network**, a collaboration with leading Fortune 500 companies and research institutions with a shared mission to ...

Accelerate Research

Collaborate with the most advanced academic and research organizations to advance quantum computing technology.

Launch Commercial Applications

Engage industry leaders to combine IBM's quantum computing expertise with industry specific expertise to accelerate development of the first commercial use cases.

Educate and Prepare

Expand and train the ecosystem of users, developers, and application specialists that will be essential to the adoption and scaling of quantum computing.

The IBM Q Network

Hubs

Keio University
Tokyo, Japan

Oxford University
Oxford, UK

Oak Ridge National Laboratory
Oak Ridge, TN, USA

University of Melbourne
Parkville VIC, Australia

North Carolina State University
Raleigh, NC, USA

Universität der Bundeswehr
München, Germany

Partners

JPMC
New York, NY, USA

Samsung
Seoul, South Korea

Daimler
Stuttgart, Germany

JSR
Minato-ku, Tokyo, Japan

Education Partner

MIT
Cambridge, MA, USA

Academic Partner

Universidade do Minho
Portugal

Members

Honda
Minato, Tokyo, Japan

Barclays
London, UK

Hitachi Metals
Minato, Tokyo, Japan

Nagase
Chuo-ku, Tokyo, Japan

Startups

1QBit

Cambridge Quantum Computing

Q-CTRL

QC Ware

Quantum Benchmark

QxBranch

Strangeworks

Zapata Computing

Recent IBM **Q** Network news: New hub at North Carolina State

IBM Announces Collaboration with North Carolina State University to Accelerate Quantum Computing

NC State to join the IBM Q Network as first university-based IBM Q Hub in North America

NEWS PROVIDED BY
IBM →
May 10, 2018, 09:00 ET

SHARE THIS ARTICLE

YORKTOWN HEIGHTS, N.Y., May 10, 2018 /PRNewswire/ -- IBM (NYSE: IBM) today announced that North Carolina State University (NC State) will join the IBM Q Network™ as the first university-based IBM Q Hub in North America. The university will work directly with IBM to advance quantum computing and industry collaborations, as part of the IBM Q Network's growing quantum computing ecosystem.

IBM **Q** Network-wide resources and collaboration

Technical support for system use

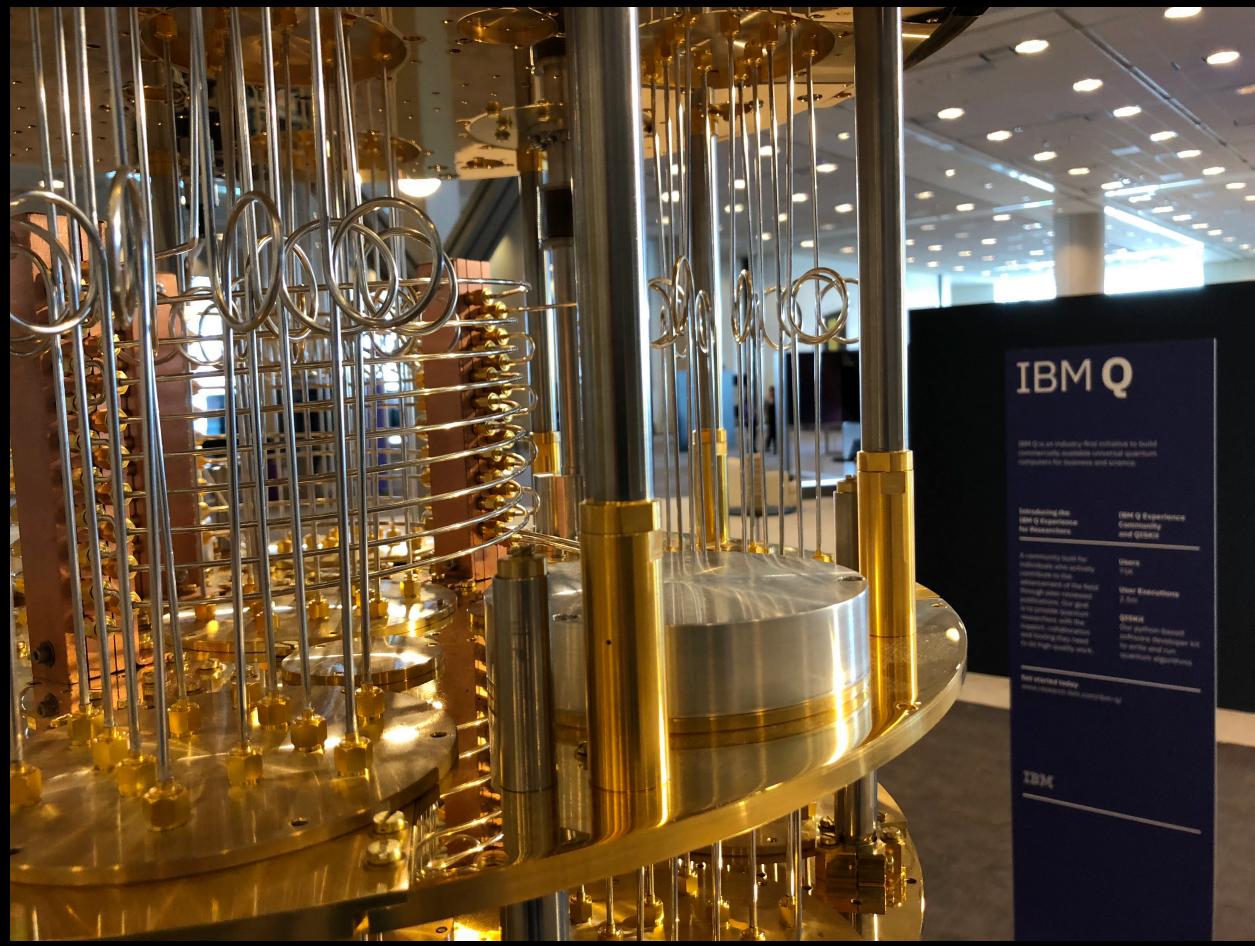
Educational content and resources

Advisory council of representatives from each organization

Industry and academic workshops

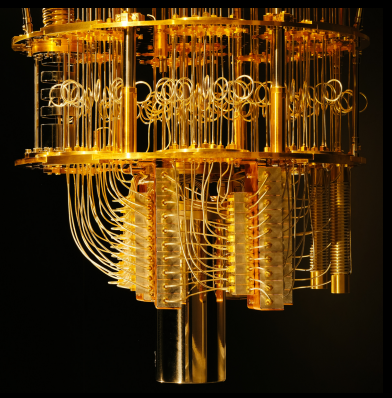
Opportunities to share individual ideas and innovations across Network

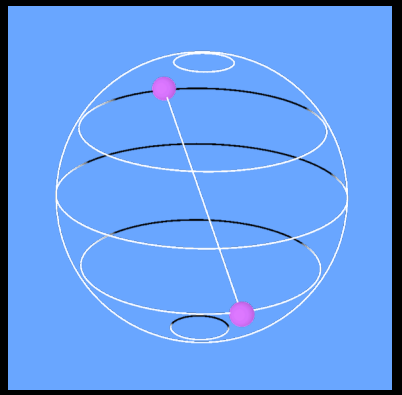
Opportunities for researcher exchange and collaboration across network



Your next steps to getting Quantum Ready

IBM Q





Discover more about IBM's quantum computing initiative

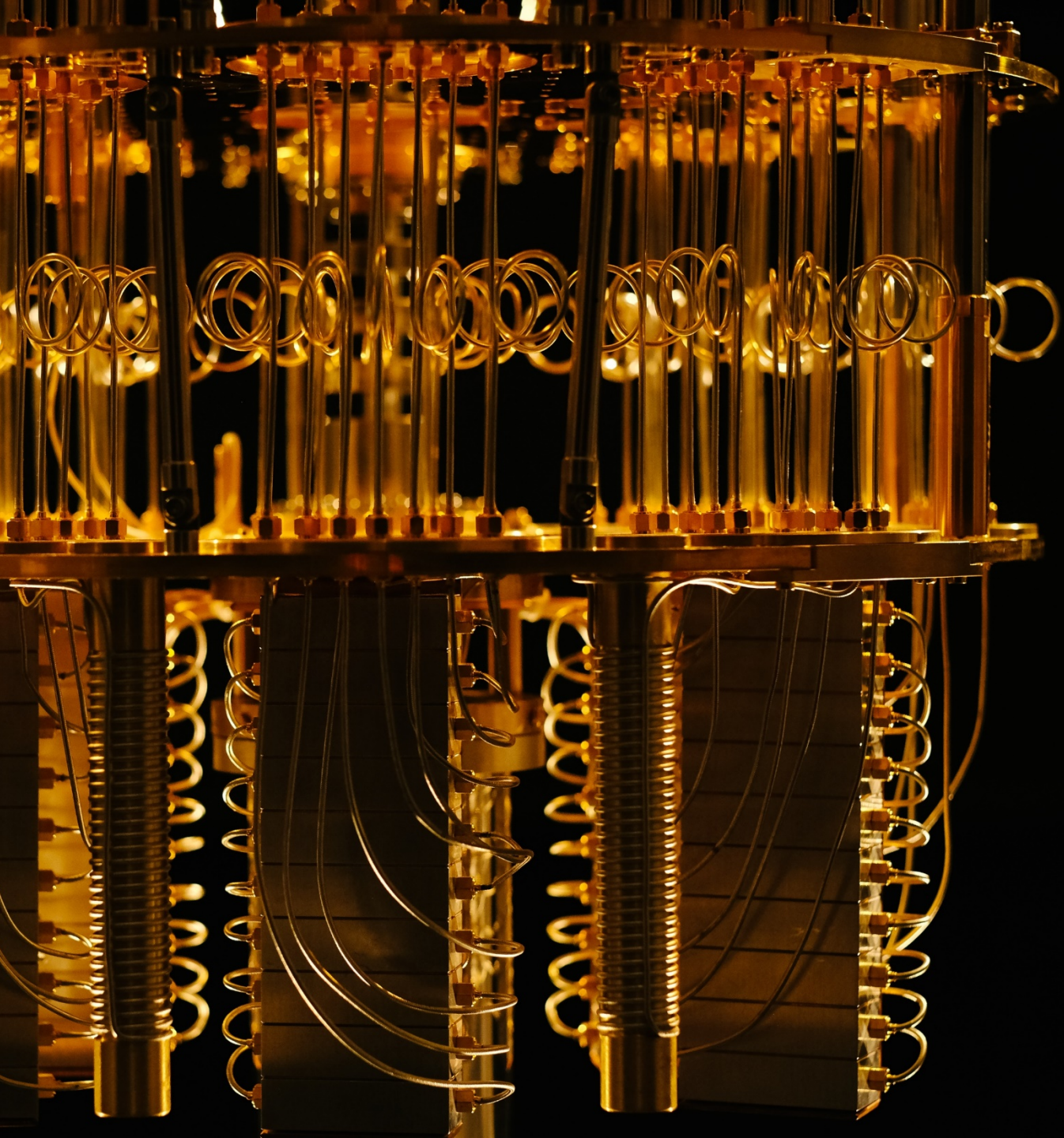
Explore the **IBM Q Experience** and start using real machines today

Learn about and start using the **QISKit** software development kit

Collaborate, research through the **IBM Q Network**

https://www.research.ibm.com/ibm-q/

https://qiskit.org/



IBM Q