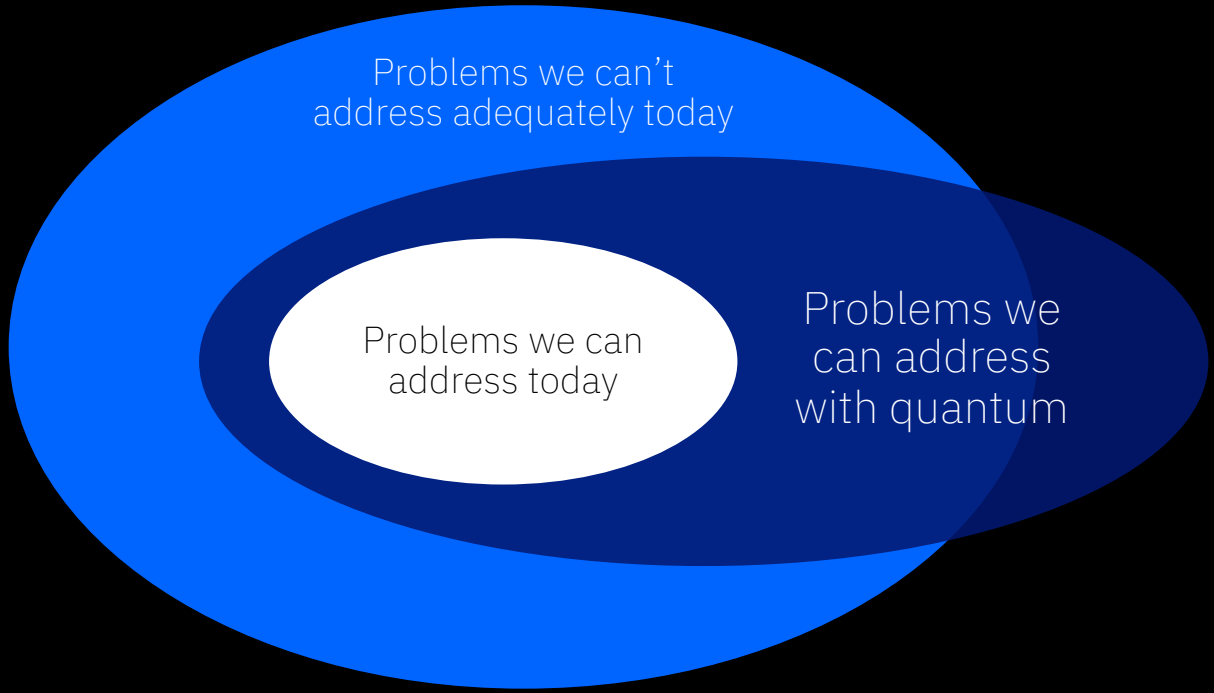
IBM Quantum

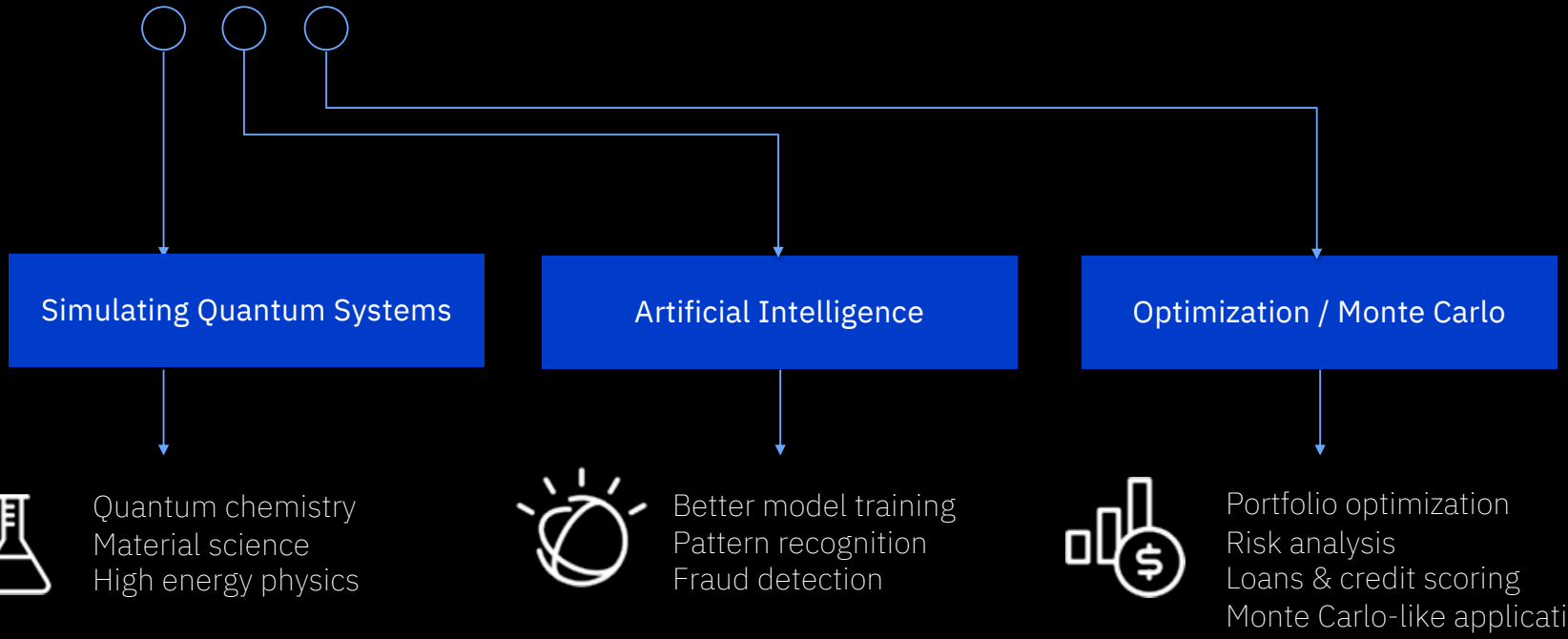
https://ibm.com/quantum-computing/

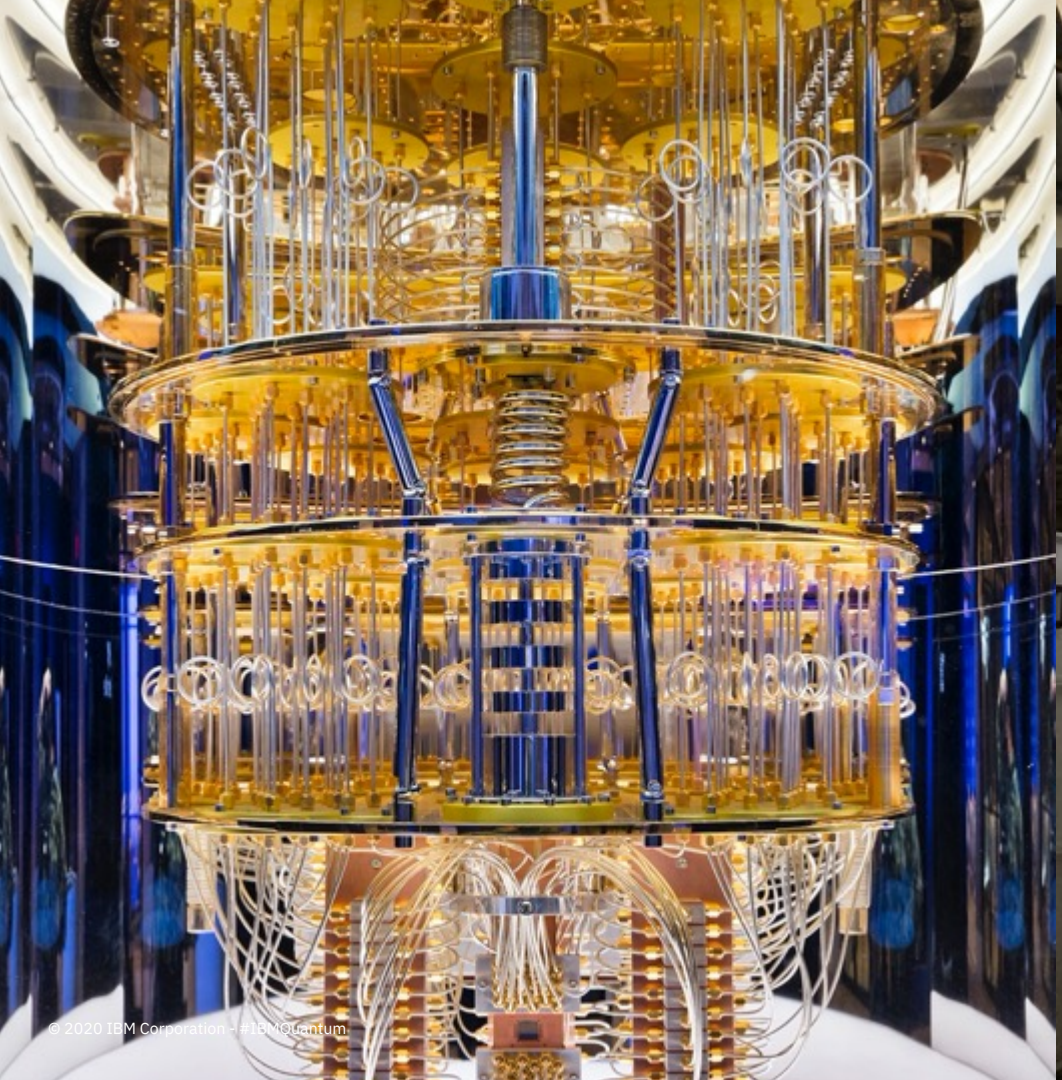
Why quantum?



Despite how sophisticated digital computing has become, there are many scientific and business problems for which we've barely scratched the surface.

Quantum applications span three general areas

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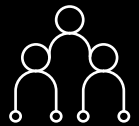
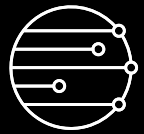
IBM Quantum Network

A collaborative community of discovery

Educate and Train



Accelerate Research



Develop Applications

IBM Quantum Network: A Snapshot

Over 247,000 users have...

Run over 400 Billion quantum circuits

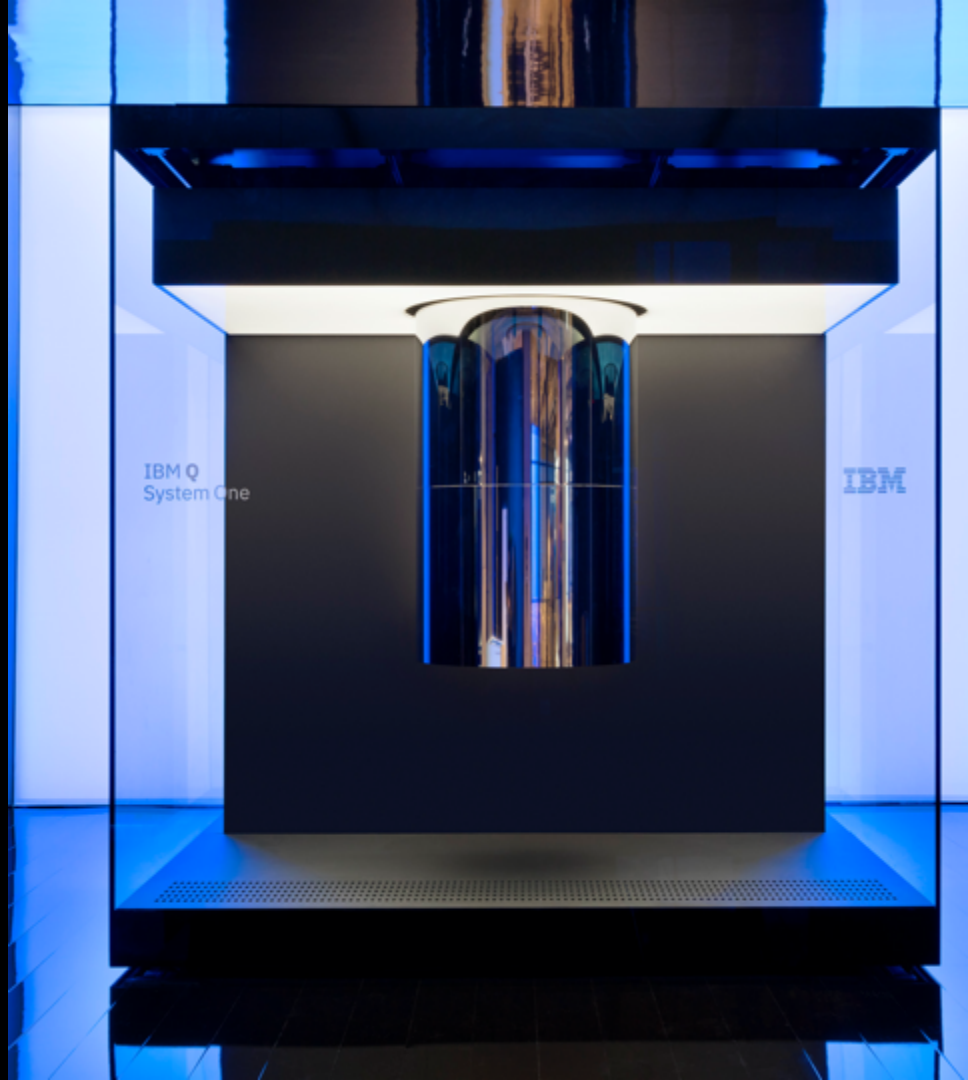
On 29 quantum computers

More than 130 Clients and Partners

Collaborating on 30+ applications

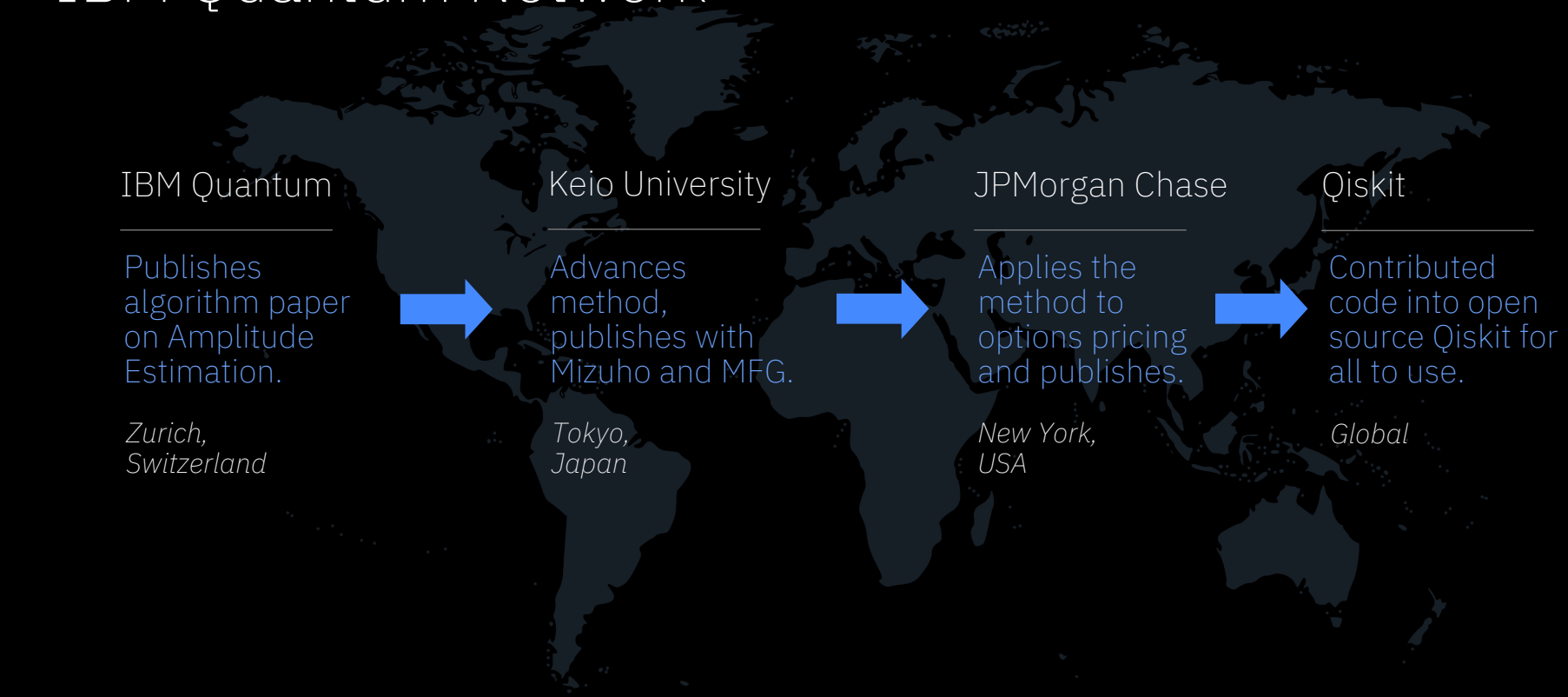
Over 300 contributors to Qiskit

Over 400 scientific papers so far



Engaging Industry

A Snapshot of Global Collaboration in the IBM Quantum Network



IBM Quantum

Publishes algorithm paper on Amplitude Estimation.

Zurich, Switzerland

Keio University

Advances method, publishes with Mizuho and MFG.

Tokyo, Japan

JPMorgan Chase

Applies the method to options pricing and publishes.

New York, USA

Qiskit

Contributed code into open source Qiskit for all to use.

Global

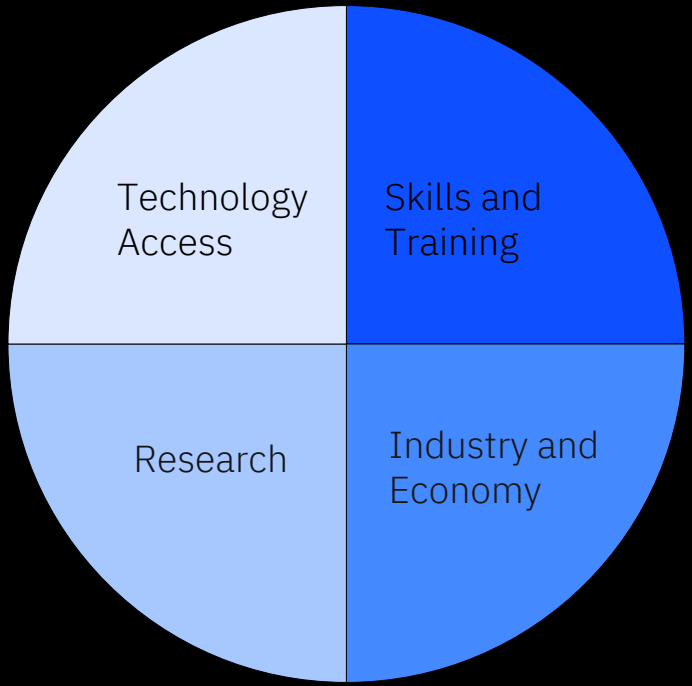
IBM Quantum Network Today

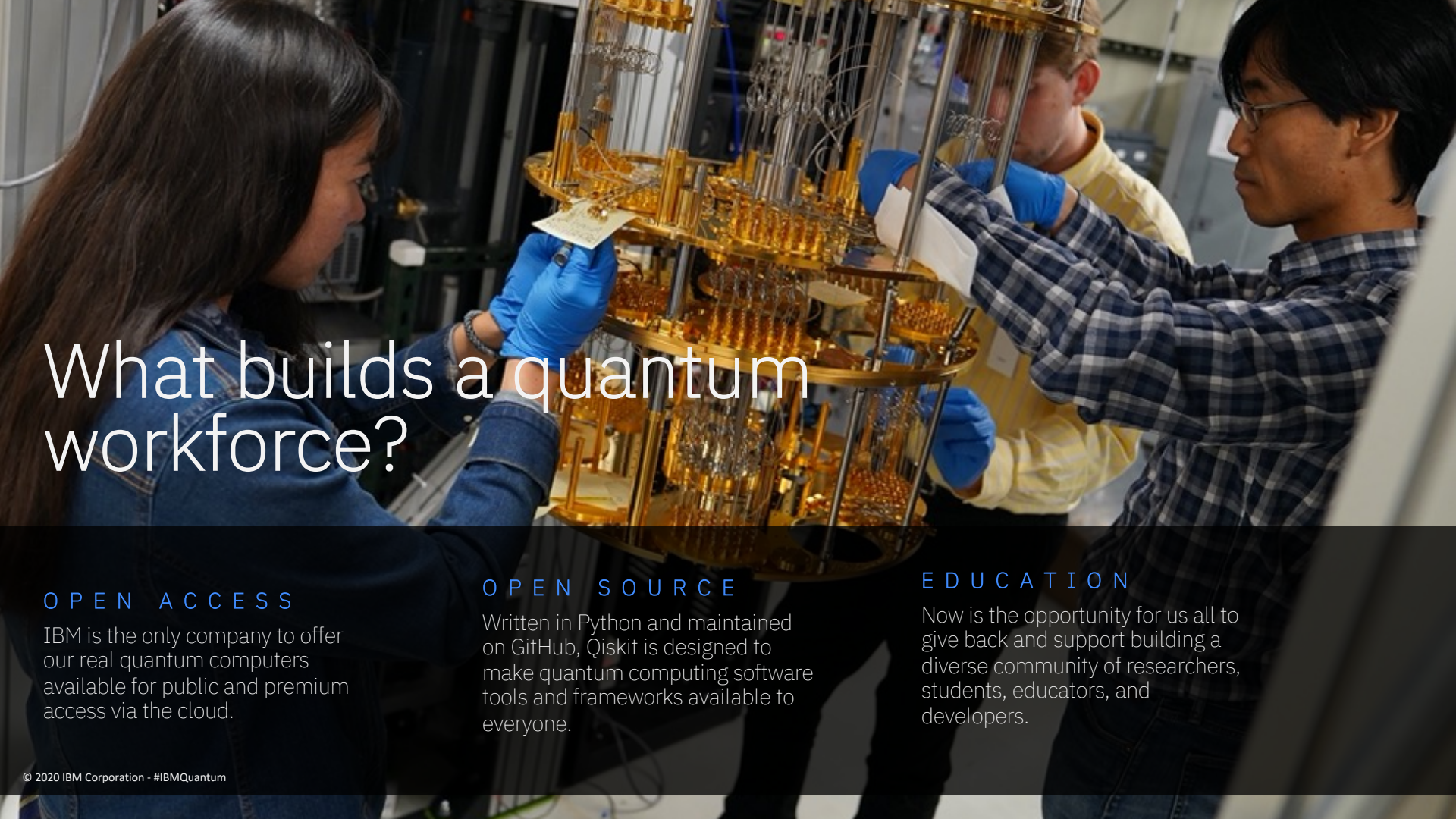
Total: 132 members worldwide

1QBit
A*Quantum
Aalto University
Accenture
Agnostiq
AIQTech
AIS
Aliro
Amgen
Anthem
Apply Science
Archer
Argonne Lab
Barclays
BEIT
Berkeley Lab
Boeing
Boston University
Boxcat
BP
Brookhaven Lab
CERN
Chalmers University
CMC
Cornell
CQC
CSIC Spain
CU Boulder
Daimler
Delta
DIC
Duke
EDX.org
Entropica
EPFL
Equal1
ETH Zurich
ExxonMobil
Fermilab
Flight Profiler
Florida State
Fraunhofer
General Atomics
Georgia Tech
Goldman Sachs
Grid
Harvard
Hitachi
Iberian Nanotech Lab
III Taiwan
ITRI
Johns Hopkins
JoS Quantum
JP Morgan Chase & Co.
JSR Corp
KAIST
Keio University
Labber Quantum
Lockheed Martin
Los Alamos National Laboratory
MaxKelsen
MDR
Miraex
MIT
Mitsubishi Chemical
Mizuho
MUFG
Multiverse
Munich Hub at U. Bundeswehr
National Taiwan University
National U. Singapore
Naval Research Lab
NC State University
Netramark
Nordic Quantum
Northwestern
Notre Dame
NYU
Oak Ridge National Lab
Opacity
Paypal
Princeton
ProteinQure
Purdue
Q-CTRL
QC Ware
Qu&Co
QuantFi
Quantum Benchmark
Quantum Machines
Quemix
Qunasys
Rahko
Saarland University
Samsung
Sandia National Lab
SoftwareQ
SolidStateAI
Sony
Stanford
Strangeworks
SuMiTB
Super.tech
SVA
Toshiba
Toyota
Tradeteq
U. Automata Madrid
U. Basque Country
U. Chicago
U. Georgia
U. Illinois
U. Innsbruck
U. Melbourne
U. Minho
U. Montpellier
U. New Mexico
U. Oxford
U. Sherbrooke
U. Stony Brook
U. Tennessee
U. Turku
U. Waterloo
University of Tokyo
US Air Force Research Lab
Virginia Tech
Wells Fargo
Wits
Woodside Energy
Xanadu
Zapata
Zurich Instruments

Building a Quantum Industry and Ecosystem

IBM and organizations worldwide are partnering to advance quantum computing with broad-scale, jointly-run programs to advance quantum across all four essential areas.





What builds a quantum workforce?

OPEN ACCESS

IBM is the only company to offer our real quantum computers available for public and premium access via the cloud.

OPEN SOURCE

Written in Python and maintained on GitHub, Qiskit is designed to make quantum computing software tools and frameworks available to everyone.

EDUCATION

Now is the opportunity for us all to give back and support building a diverse community of researchers, students, educators, and developers.

Open Source Textbook

https://qiskit.org/textbook

Traditional Quantum Computation Course

Linear Algebra Quantum Mechanics → Quantum Algorithms → Quantum Hardware

Learn Quantum Computation using Qiskit Textbook

Python Qiskit → Quantum Programming → Quantum Algorithms on Today's Hardware

Chapters:

0. Prerequisites
1. Quantum States and Qubits

2. Single Qubits and Multi-Qubit Gates
3. Quantum Algorithms
4. Quantum Algorithms for Applications

5. Investigating Quantum Hardware Using Qiskit

6. Implementations of Recent Quantum Algorithms

Enabling Research: 400+ Papers and Counting! https://ibm.biz/q-network-arxiv

Performing Quantum Computing Experiments in the Cloud

Simon J. Devitt
Center for Emergent Matter Science, RIKEN, Wakoshi, Saitama 315-0198, Japan.
(Dated: September 2, 2016)

Quantum computing technology has reached a second renaissance in the past five years. Increased interest from both perimental progress anticipated by m cloud, with users released the *Qua* this paper we take quantum informa chip to realise pr ory and Fault-tol While the results

PHYSICAL REVIEW A 94, 012314 (2016)

Experimental test of Mermin inequalities on a five-qubit quantum computer

Daniel Alsina and José Ignacio Latorre
Departament Física Quàntica i Astrofísica, Universitat de Barcelona, Diagonal 645, 08028 Barc and Institut de Ciències del Cosmos (ICCUB), Martí i Franquès 1, 08028 Barcelona, Sp
(Received 25 May 2016; published 11 July 2016)

Violation of Mermin inequalities is tested on the five-qubit IBM quantum computer. For three

Experimental Comparison of Two Quantum Computing Architectures

N. M. Linke,[1] D. Maslov,[2,3] M. Roetteler,[4] S. Debnath,[1] C. Figgatt,[1] K. A. Landsman,[1] K. Wright,[1] and C. Monroe[1,3,5]
[1]*Joint Quantum Institute and Department of Physics,*

Compressed quantum computation using the IBM Quantum Experience

M. Hebenstreit,[1] D. Alsina,[2,3] J. I. Latorre,[2,3] and B. Kraus[1]
[1]*Institute for Theoretical Physics, University of Innsbruck,*
[2]*Dept. Física Quàntica i Astrofísica, Universitat de Barcelona, Diagon*
[3]*Institut de Ciències del Cosmos, Universitat de Barcelona, Diagonal*

ProjectQ: An Open Source Software Framework for Quantum Computing

Damian S. Steiger, Thomas Häner, and Matthias Troyer
Institute for Theoretical Physics, ETH Zurich, 8093 Zurich, Switzerland
(Dated: December 28, 2016)

We introduce ProjectQ, an op features a compiler framework simulator with emulation capab mation. We introduce our Pyth provide example implementatio tum algorithms through simulat a back-end connecting to the IB users, users can provide back-en compilation can provide plug-in strategies.

Quintuple: a Python 5-qubit quantum computer simulator to facilitate cloud quantum computing

Christine Corbett Moran[a,b,*]
[a]*NSF AAPF California Institute of Technology, TAPIR, 1207 E. California Blvd. Pasadena, CA 91125*
[b]*University of Chicago, 2016 SPT Winterover Scientist, Amundsen-Scott South Pole Station,*

A quantum teleportation experiment for undergraduate students

S. Fedortchenko*
Laboratoire Matériaux et Phénomènes Quantiques, Sorbonne Paris Cité, Université Paris Diderot, CNRS UMR 7162, 75013, Paris, France

With the rapid progress of quantum information these recent years, it becomes more and more

Homomorphic Encryption Experiments on IBM's Cloud Quantum Computing Platform

He-Liang Huang,[1,2] You-Wei Zhao,[2,3] Tan Li,[1,2] Feng-Guang Li,[1,2] Yu-Tao Du,[1,2] Xiang-Qun Fu,[1,2] Shuo Zhang,[1,2] Xiang Wang,[1,2] and Wan-Su Bao[1,2,*]
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y of China, Hefei, Anhui 230026, China
at Microscale and Department of Modern Physics,

New Journal of Physics
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DPG IOP Institute of Physics

PAPER

Entropic uncertainty and measurement reversibility

Mario Berta[1], Stephanie Wehner[2] and Mark M Wilde[3,4]
Quantum Information and Matter, California Institute of Techn
delft University of Technology, Lorentzweg 1, 2628 CJ Delft, The N
itute for Theoretical Physics, Department of Physics and Astrono
rsity, Baton Rouge, LA 70803, USA
hom any correspondence should be addressed.

Demonstration of *entanglement assisted invariance* on IBM's Quantum Experience

Sebastian Deffner
Department of Physics, University of Maryland Baltimore County, Baltimore, MD 21250, USA

Leggett-Garg test of superconducting qubit addressing the clumsiness loophole

Emilie Huffman[1,2] and Ari Mizel[1]
oratory for Physical Sciences, College Park, Maryland 20740, USA
ment of Physics, Duke University, Durham, North Carolina 27708, USA

O Computador Quântico da IBM e o *IBM Quantum Experience*

IBM Quantum Computer and the IBM Quantum Expe

Alan C. Santos*[1]
de Física, Universidade Federal Fluminense, Niterói, Rio de Ja

Quantum state reconstruction made easy: a direct method for tomography

R. P. Rundle,[1] Todd Tilma,[2] J. H. Samson,[1] and M. J. Everitt[1,*]
[1]*Quantum Systems Engineering Research Group & Department of Physics, Loughborough University, Leicestershire LE11 3TU, United Kingdom*
[2]*Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550, Japan*

Approximate Quantum Adders with Genetic Algorithms: An IBM Quantum Experience

Rui Li[1], Unai Alvarez-Rodriguez[2], Lucas Lamata[2], and Enrique Solano[2,3]

[1]Department of Physics, Zhejiang University, Hangzhou 310027, China
[2]Department of Physical Chemistry, University of the Basque Country UPV/EHU, Apartado 644, 48080 Bilbao,

IBM Quantum – Resource links

IBM Quantum
http://ibm.com/quantum-computing

IBM Quantum Experience
https://quantum-computing.ibm.com/

Qiskit
https://qiskit.org

IBM Q Network research paper publications:

https://ibm.biz/q-network-arxiv

Qiskit textbook, video series and other learning
https://qiskit.org/learn

Quantum Volume advancement
IBM Delivers Its Highest Quantum Volume to Date

Open Pulse Development
https://arxiv.org/pdf/1809.03452.pdf

Error Mitigation
https://www.nature.com/articles/s41586-019-1040-7

IBM **Quantum**

https://quantum-computing.ibm.com