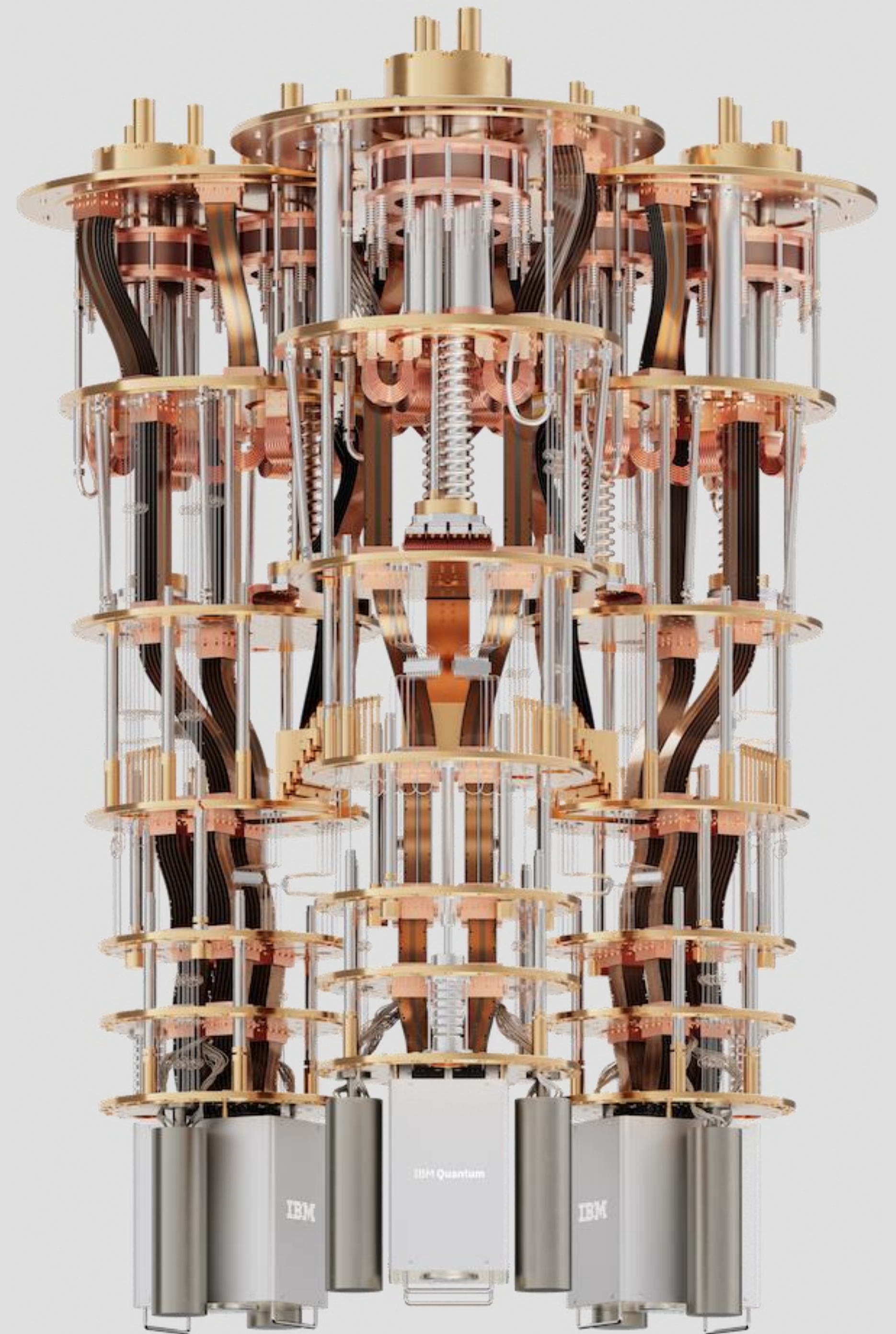
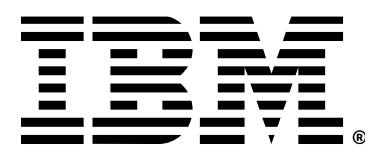


2025년 「글로벌 기업 협업 프로그램」

# IBM Quantum 사업설명회



# What is quantum computing?

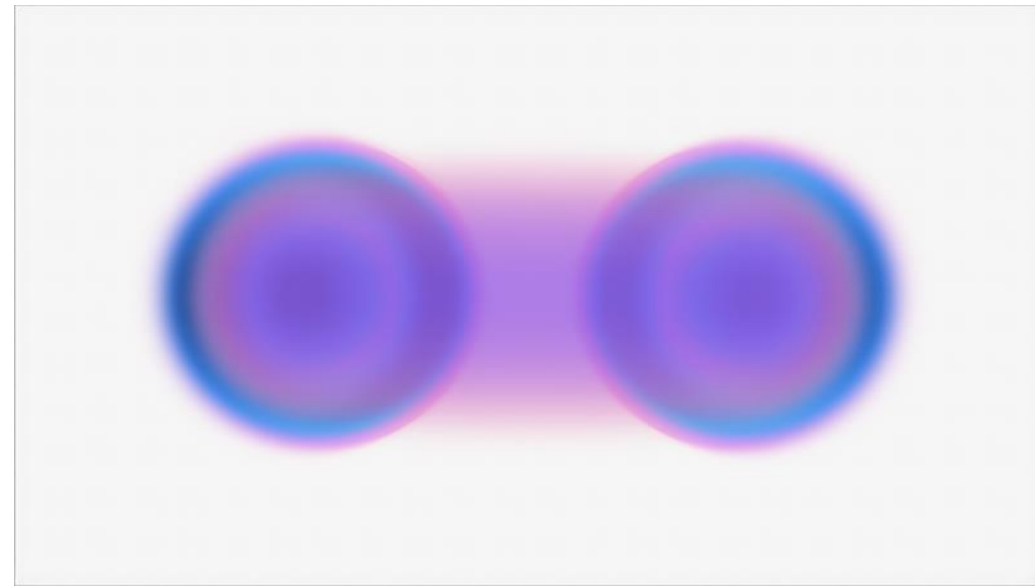
## Uniquely quantum

Some problems are classically intractable and will never be solvable with traditional computers



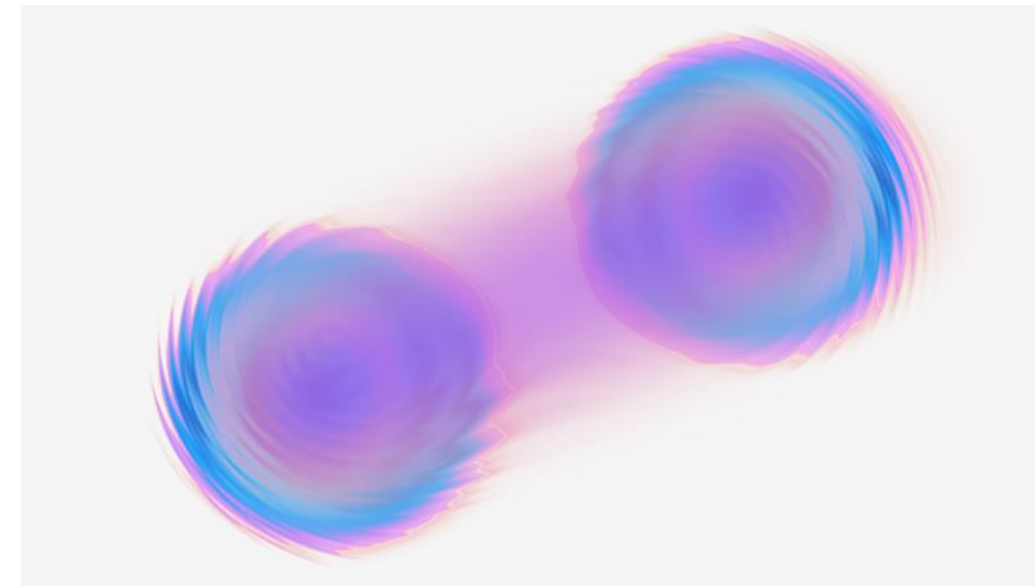
### Superposition

A quantum system existing in a complex linear combination of two states until it is measured



### Entanglement

Information shared jointly between entangled pairs or groups



### Interference

Interaction that affects likelihood of solutions

**Moore's law:** the number of transistors in a classical integrated circuit doubles about every two years ... but we are approaching the end due to physical limitations

[Approaching the physical limit: IBM created the world's first 2 nm node chip in 2021, with transistors as small as 10 silicon atoms](#)

These Quantum concepts can reduce the number of computational steps required for certain algorithms & At a ~100 qubit scale, with sufficient circuit depth and complexity, classical computers can no longer simulate exactly

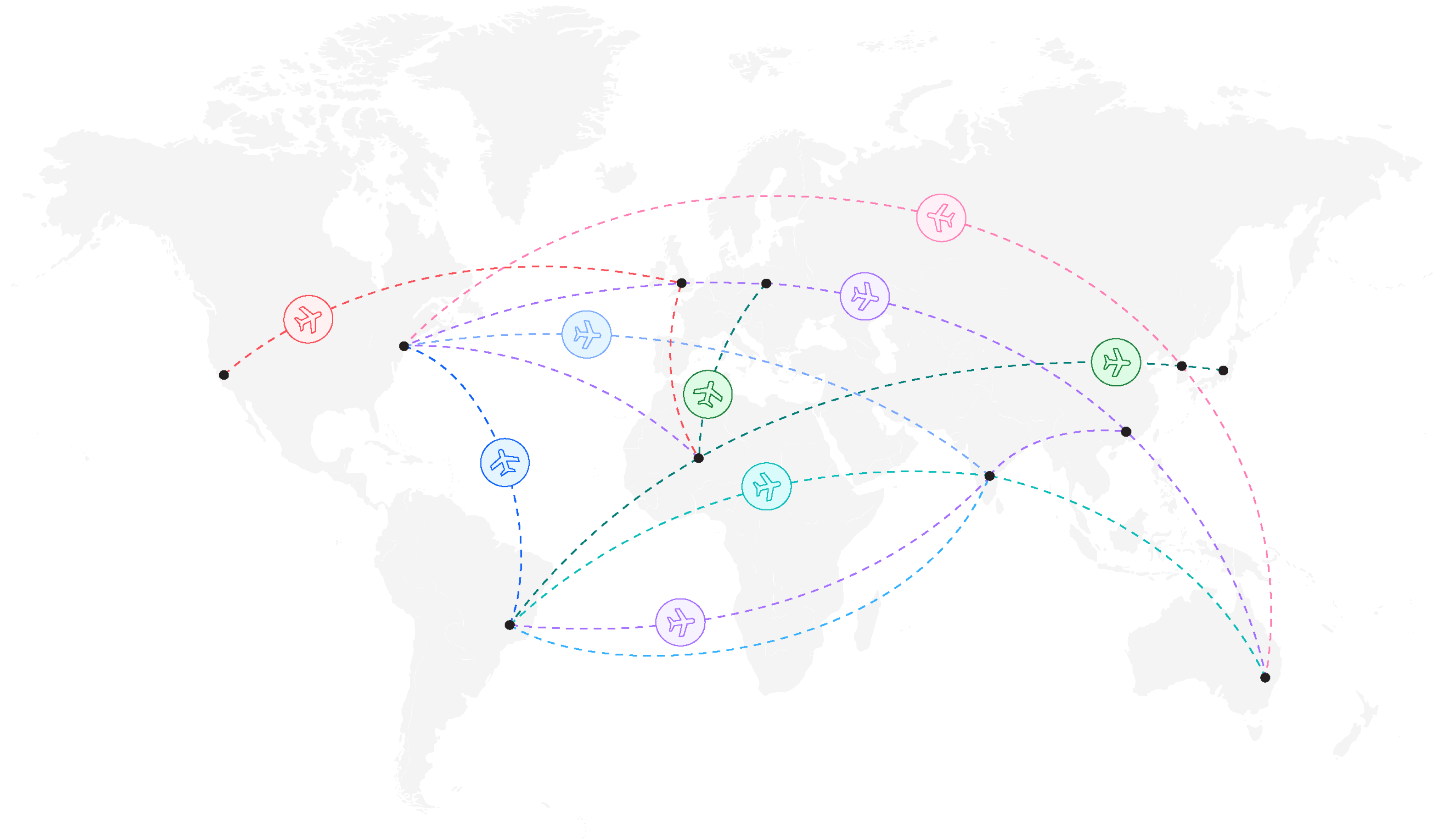
# Quantum computing

## The new wave of computing

Potential to **Unlock** previously unsolvable problems with quantum computing, cutting computing time **from years to hours**.

**A new paradigm** of thinking launches inventors into previously uncharted discovery territories with **new use cases**.

**Accelerate** discovery through a **powerful** hybrid quantum-classical approach.



# The **new** wave of computing



## **Classical computer**

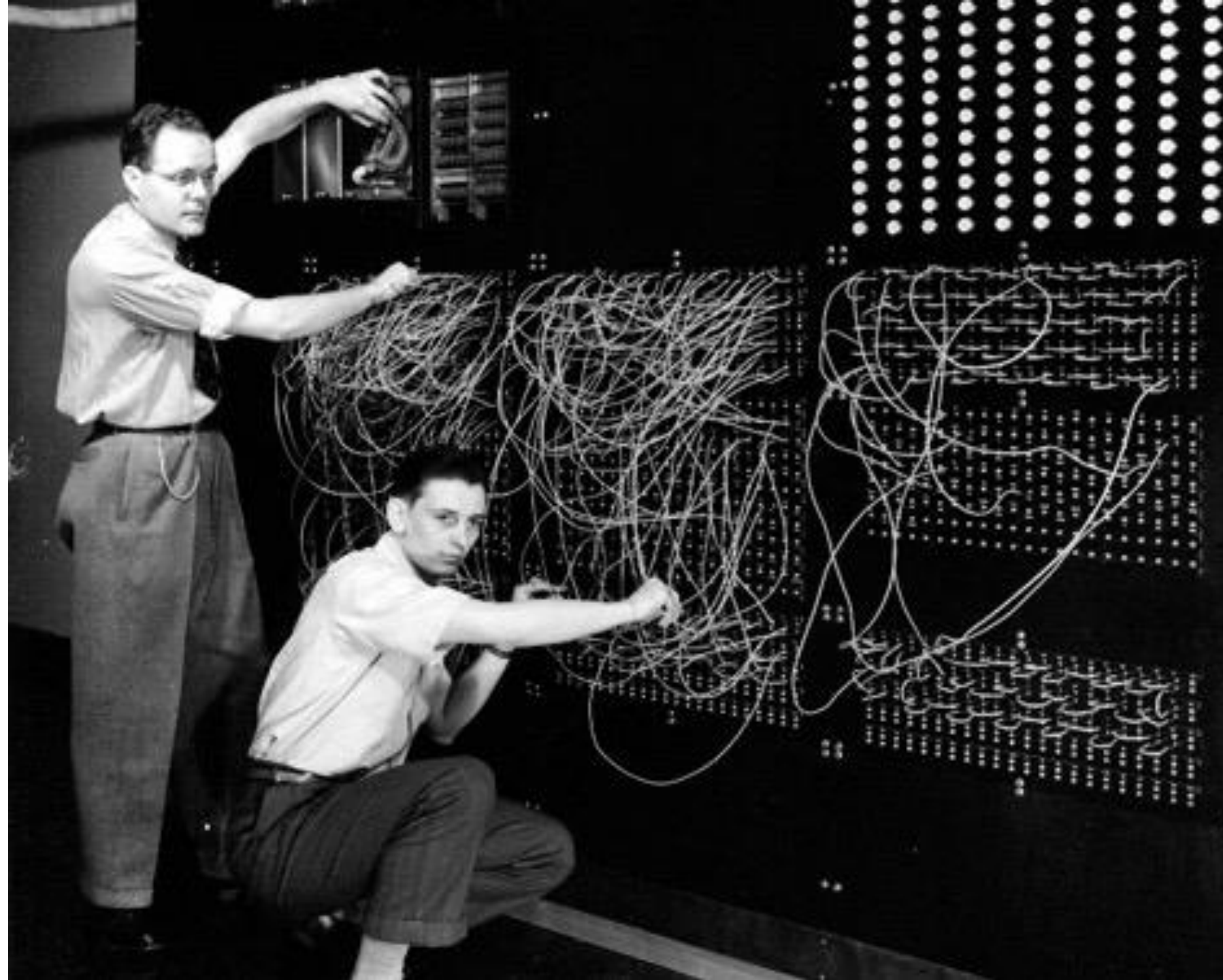
Well suited for many problems



## **Quantum computer**

Unlock classically intractable problems

## Classical computers before error correction



Credit: Courtesy of Computer History Museum

1937

Atanasoff-Berry computer solves systems of linear equations for astronomy research.

1941

British Bombe deciphers German Enigma codes.

1944

IBM Harvard Mark I simulates atomic reactions for Manhattan Project.

1945

ENIAC calculates artillery firing tables for the US Army.

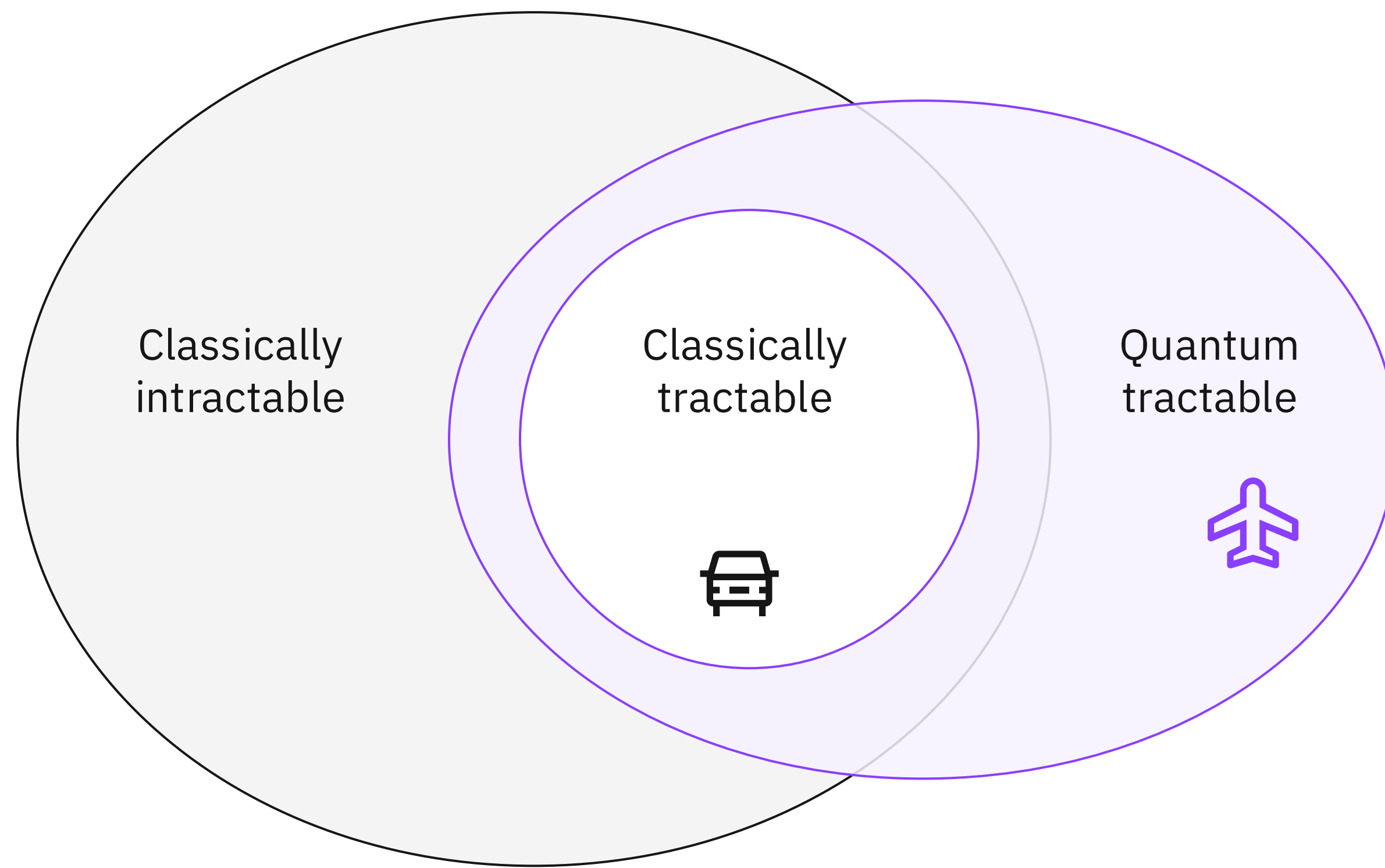
↳ 1950

Hamming “error correction” codes are introduced.

## Unlock discovery with quantum computing

Harnesses the capacity to advance conceptual and tools-based discovery

Quantum computers are **exponentially more powerful** than classical computers



1. **A new way of computing**  
New paradigm of problem-solving and thinking
2. **Solving new problems**  
Unlock classically unsolvable problems, cutting computation time down from hours to minutes
3. **Discovery of new use cases**  
Expand discovery into new computational spaces

Investment in quantum computing is accelerating at an unprecedented pace

Accelerating adoption and usage

48%

Customer spend CAGR<sup>1</sup>

\$42B

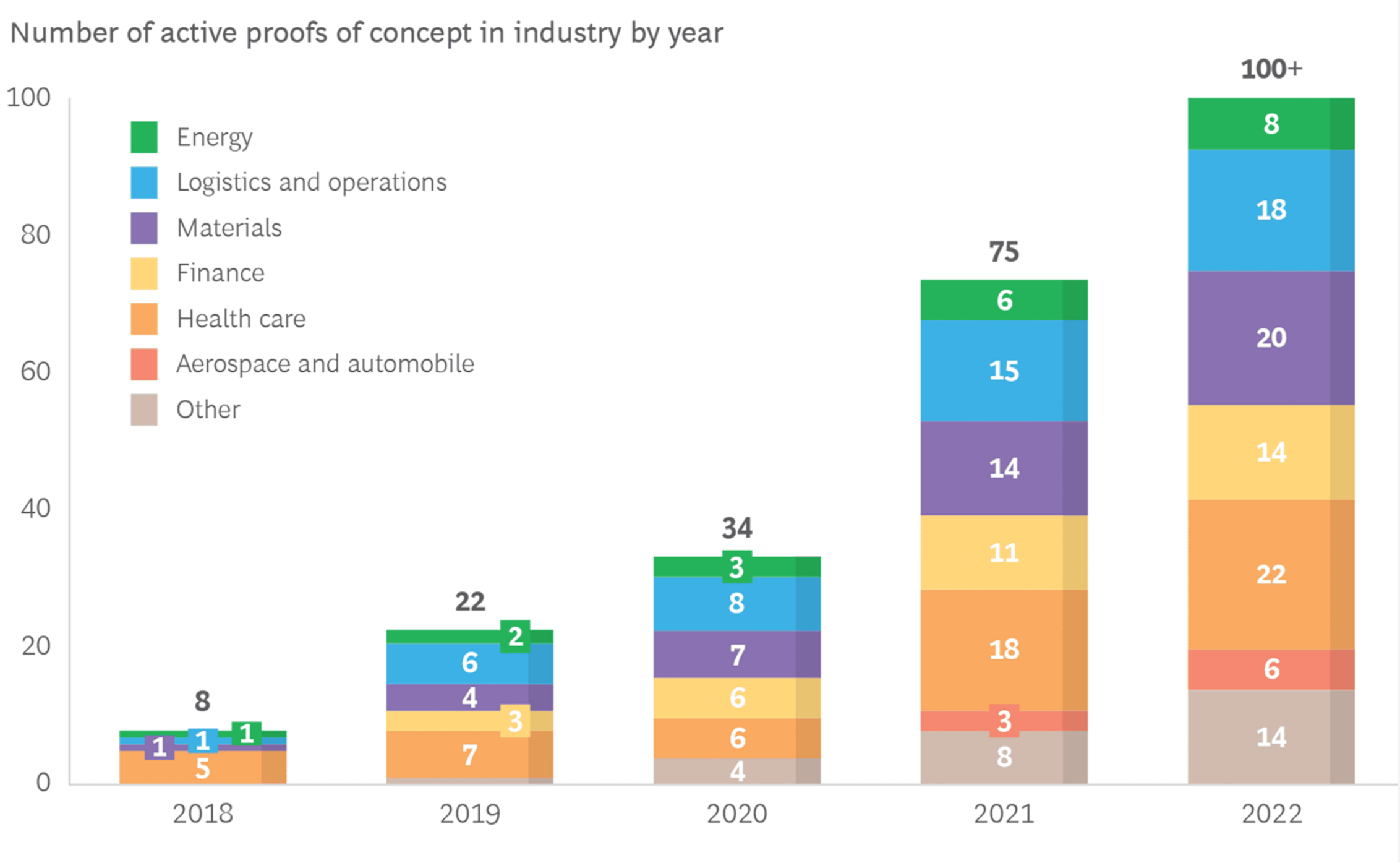
Global investment<sup>2</sup>

80%

Increase in expected investment by users<sup>3</sup>

3x

Enterprise use case activity 2020–2022<sup>4</sup>



Source 1: IDC, IDC’s Worldwide Quantum Computing Forecast: 2023–2027: Surfing the Next Wave of Quantum Innovation,” IDC #US49198322, 2023.  
Source 2: McKinsey & Co., “Steady progress in approaching the quantum advantage,” 2025.  
Source 3: BCG, “Why users should start building [quantum] capabilities now,” 2022 Q2B Conference.  
Source 4: BCG, “Quantum Computing Is Becoming Business Ready,” 2023.

Investment in quantum technologies is accelerating at an unprecedented pace

1.2B

US dollars

**United States – National Quantum Initiative Act**  
Authorized funding over 5 years for quantum computing R&D<sup>2</sup>

55B

US dollars

Global investments in quantum computing technologies<sup>1</sup>

1.8B

Euros

**France – French Quantum Strategy**  
Investment over course of 2021–2025, with goal of developing international partnerships and creating 30,000 jobs<sup>1</sup>

3.3B

Euros

**Germany – Quantum Technology Plan**  
Investment to develop a universal quantum computer by 2026<sup>3</sup>

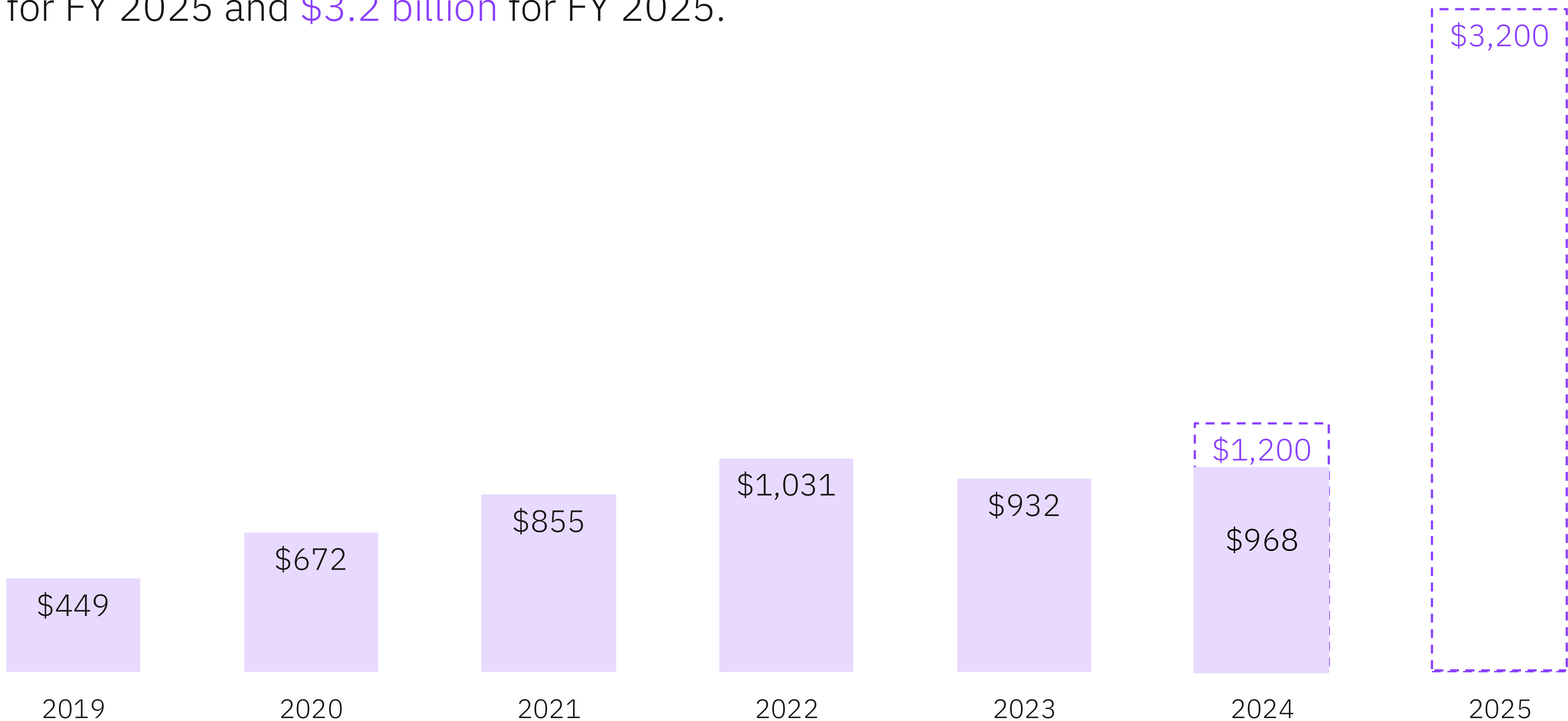
Source 1: Sylvain Duranton (BCG), “Quantum Computing Takes Off With \$55 Billion In Global Investments,” [Forbes.com](#), June 26, 2025.

Source 2: H.R.6227–115<sup>th</sup> Congress (2017–2018).

Source 3: Quantum Technologies Action Plan, May 2023.

# Funding for quantum research is accelerating

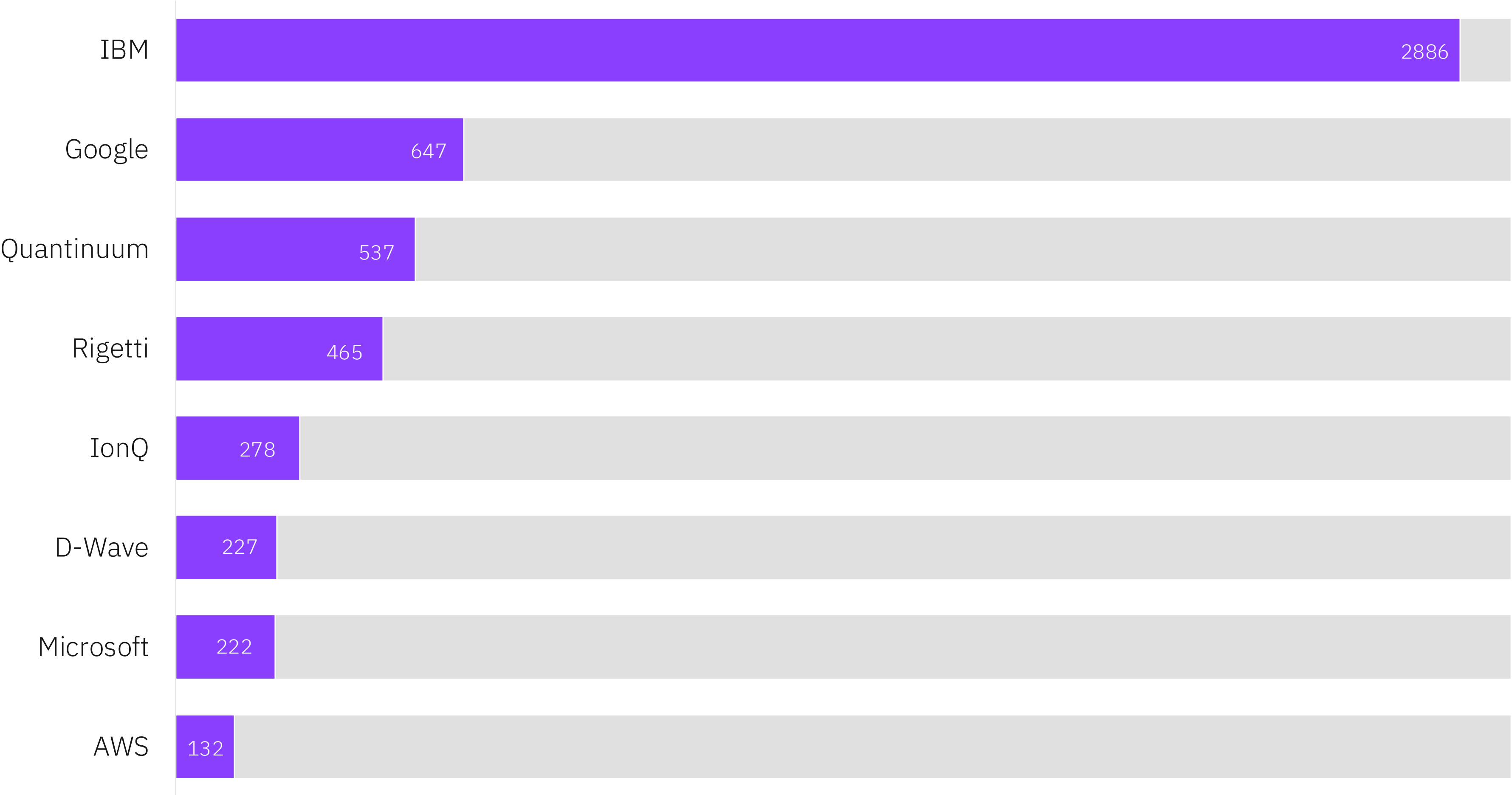
Over the past 5 years, funding from the US National Quantum Initiative Act has **doubled**, reaching **\$968 million** in FY 2025, with a reauthorization request of **\$1.2 billion** for FY 2025 and **\$3.2 billion** for FY 2025.



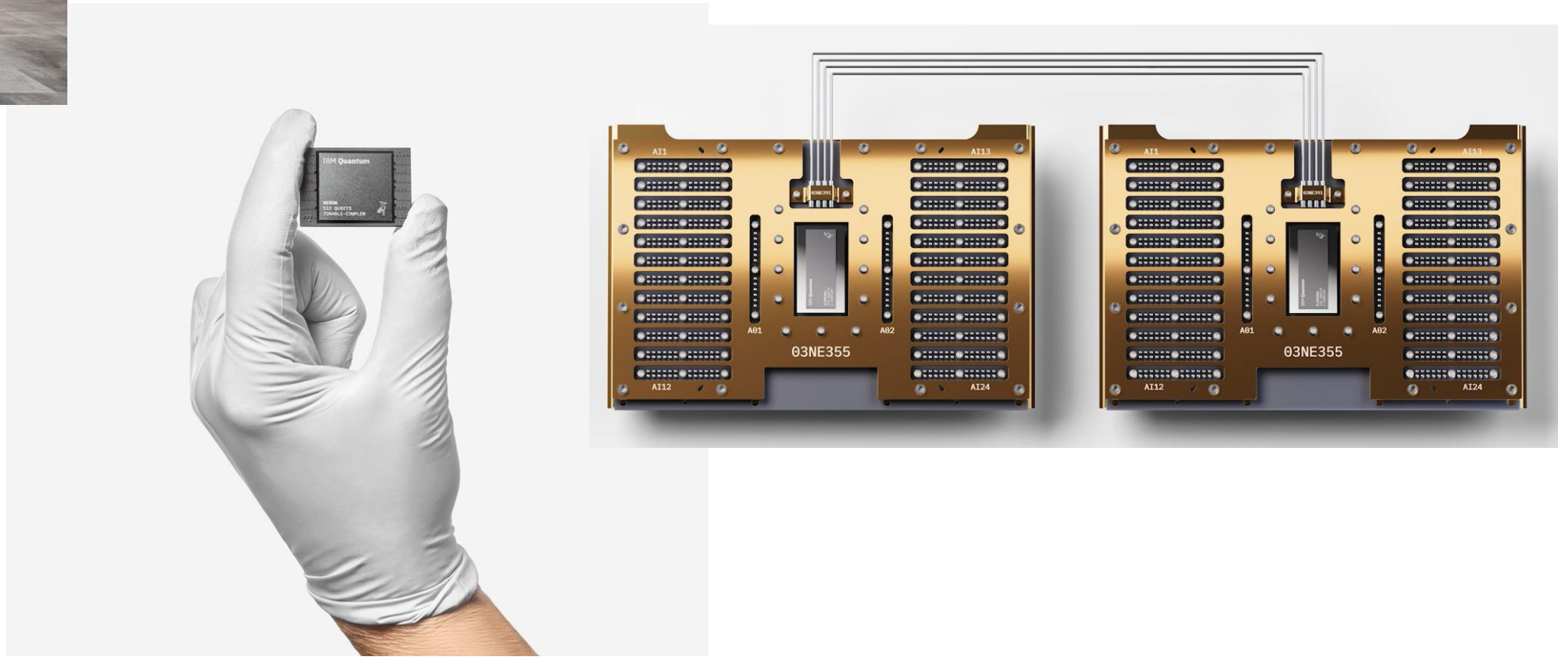
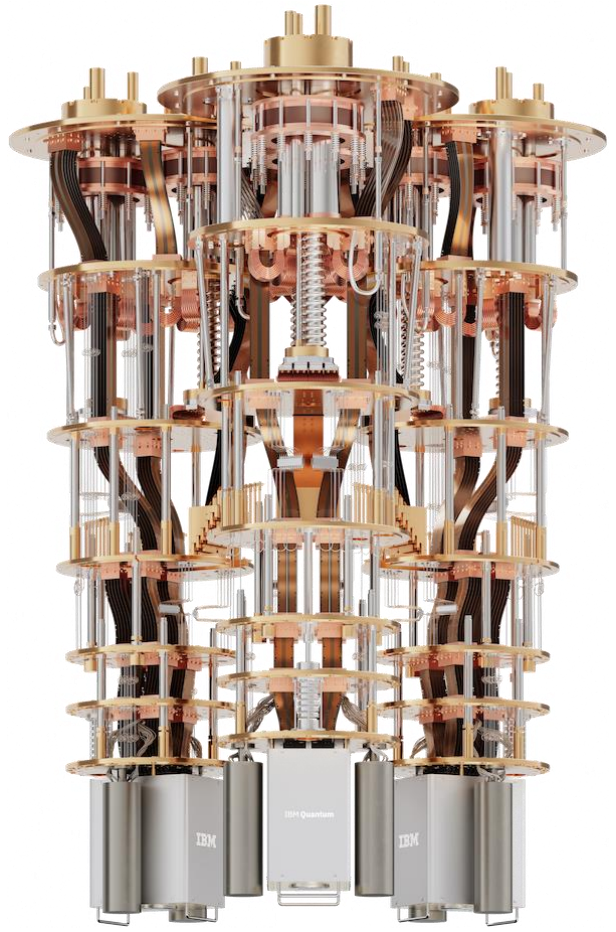
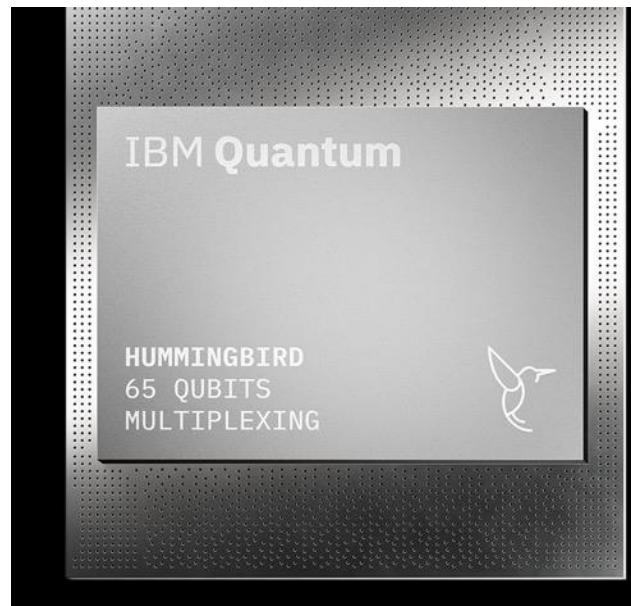
Source: Subcommittee on Quantum Information Science, “National Quantum Initiative Supplement to the President’s FY 2025 Budget,” December 2023. 2019–2022 are reported budget expenditures, while 2023 is enacted budget authority and 2025 is requested budget a authority.

\*Dotted lines on graph represent requested budget authority for NQIA reauthorization. The NQIA program funds four component areas: quantum sensing and metrology, quantum computing, quantum networking, QIS for advancing fundamental science, and quantum technology.

IBM quantum hardware and software drives most of the research in quantum computing



Source: Publications on arXiv in the quantum physics category as of April 18, 2025.

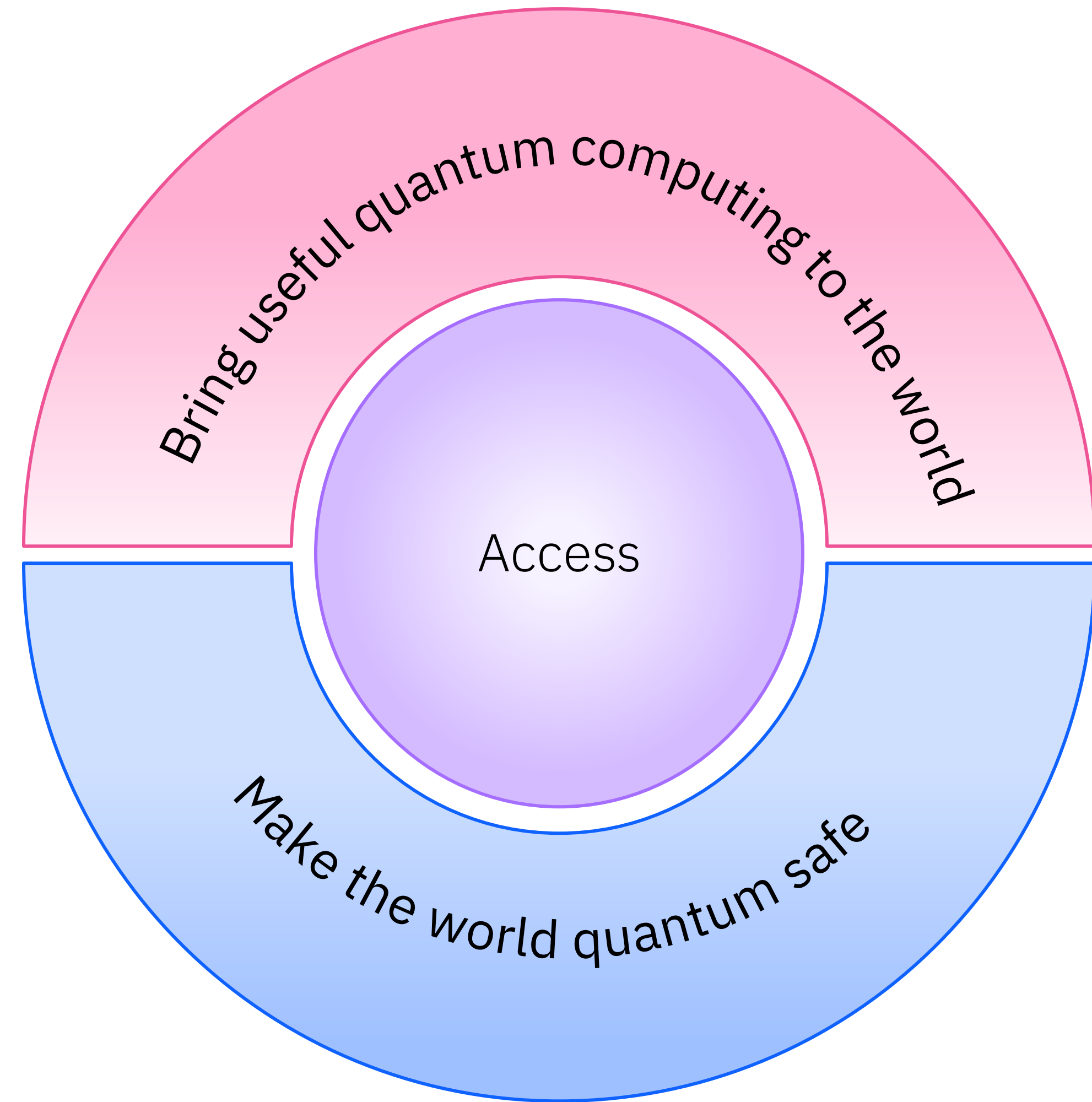


# IBM Quantum Mission

[IBM Quantum](#) leads the world in quantum computing. This technology is widely expected to solve valuable problems that are unsolvable using any known methods on classical supercomputers.

---

The huge societal benefits of quantum computing come with [challenges](#) to data security. IBM co-created crucial [first quantum-safe algorithms](#). We now deliver industry-first quantum-safe technology and services.



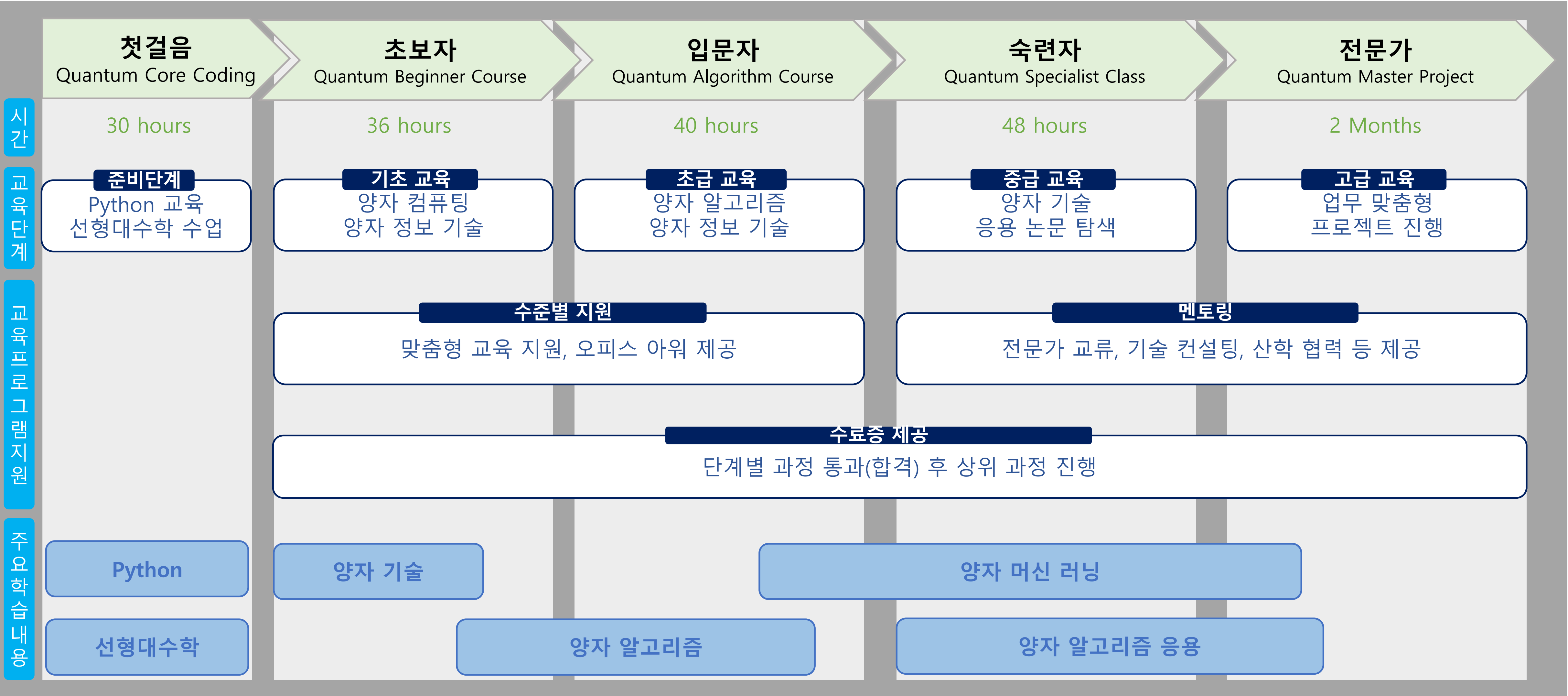
**IBM Qauntum** 사업을 통해 유망한 양자컴퓨팅 관련 창업기업의 **양자컴퓨팅 역량을 강화**하여, 우리 창업기업이 다가오는 양자기술 시대에 선제적으로 대응할 수 있도록 **기술 리더십을 확보** 하고자 합니다.

- 각 기업 및 개인 별 양자 컴퓨팅 지식 기반에 맞춰 차별화 된 교육 프로그램 구성
- 연세대학교에서 양자 컴퓨팅 교육, 세미나 및 양자 전문가 성장을 위한 멘토링 시스템 제공
- 성공적인 프로젝트 수행을 위한 자문, 컨설팅, 산학 협력 모색 등 지원
- IBM Quantum 세미나 및 MeetUp 행사 초대 및 참여를 통해 우수 기업과의 사업/기술 협력 논의 기회 마련

상세지원 사항

구분	지원 항목		주요 내용
중기부	제품 및 서비스 고도화	제품개선·개발	■ 제품 및 서비스 개발, 기술 개선, 기업 운영 등 기업 성장동력 마련을 위한 사업화 자금 최대 3억원 지원
		주관기관 특화프로그램	■ 주관기관에서 보유한 인프라(인력, 네트워크 등)를 연계하여 제품·서비스 고도화 지원
	네트워킹	성과공유회	■ 우수사례 발표, 성과공유, 네트워킹 자리 마련
IBM + QIC	서비스 지원		■ IBM Quantum system access 제공
	교육 및 세미나		■ IBM QIC (Quantum Innovation Center) 교육 제공
	컨설팅		■ 양자 사업 및 역량 개발 컨설팅
	마케팅		■ PR기사 리뷰 등 지원
	판로개척		■ Qiskit Meetup 행사/경진대회 초대 및 참여
	기타지원 (IBM Quantum Network 가입시 지원가능)		■ IBM Quantum 세미나 및 Meet-up 행사 초대 및 참여 - IBM Think Event, IBM Quantum Partner Forum, IBM Startup Kick-off, IBM Demo Day for Startups showcase 등 ■ IBM Quantum Network : Startups 등록 및 협업방안 모색

양자컴퓨팅 교육 프로그램



\* 참여기업의 프로젝트 및 보유 역량에 따른 변경 가능

# 양자 애플리케이션은 일반적으로 세 가지 영역에 걸쳐 활용되고 있습니다.

Simulating Quantum Systems

Artificial Intelligence

Optimization / Monte Carlo



Quantum chemistry  
Material science  
High energy physics



Better model training  
Pattern recognition  
Fraud detection

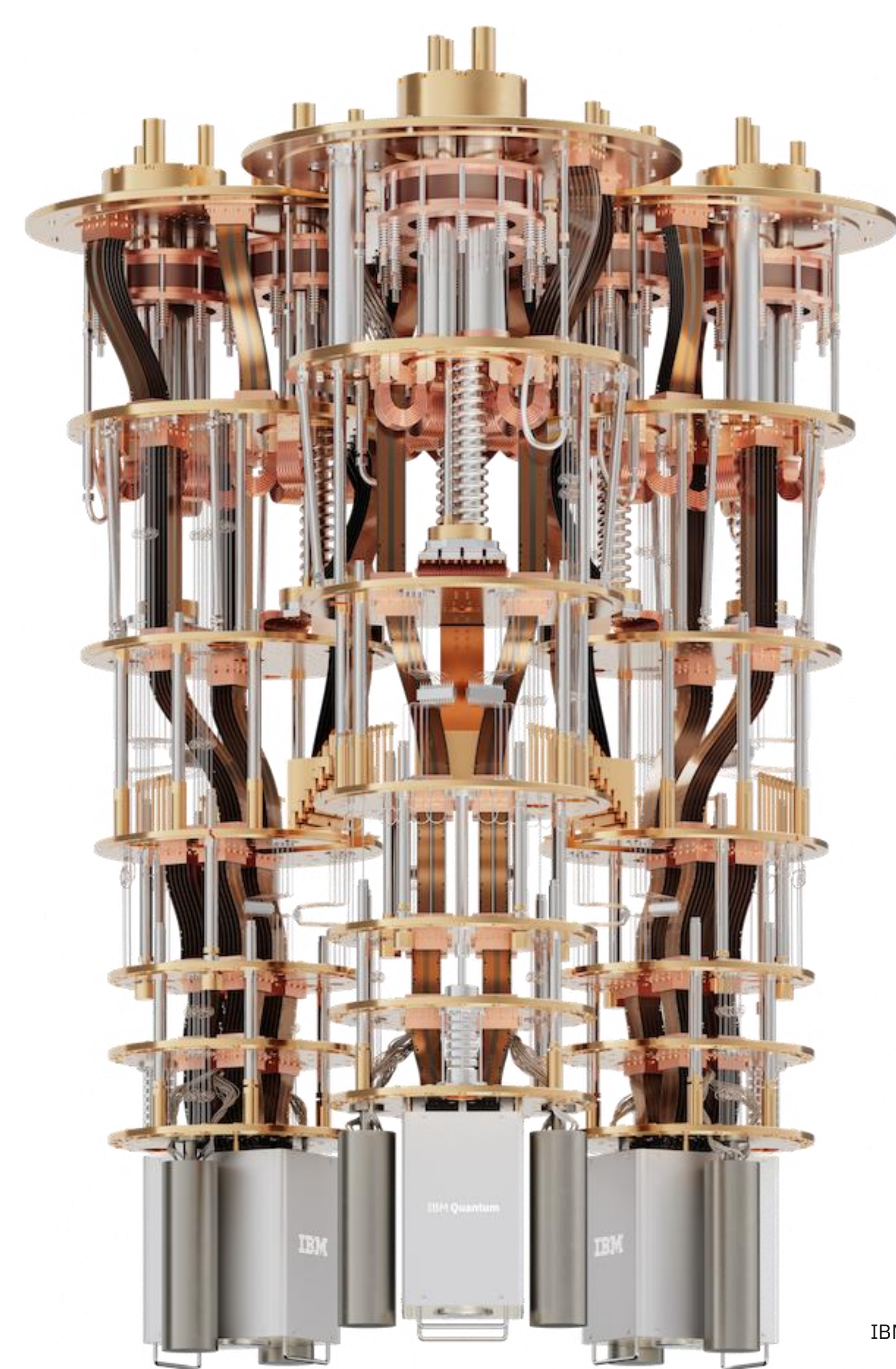


Portfolio optimization  
Risk analysis  
Loans & credit scoring  
Monte Carlo-like applications

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IBM Quantum

Simulating Quantum Systems		Artificial Intelligence		Optimization / Monte Carlo	
Improved battery materials	Genomic Analysis	Derivatives Pricing	Planning	Fluid Dynamics	
Manufacturing defect identification	Chemical product design	Investment Risk Analysis	Quality Control		
Semiconductor materials	Catalyst discovery	Portfolio Management	Vehicle Routing		
Chemical property prediction	Chemical process optimization	Transaction Settlement	Raw materials shipping	and many more ...	
Drug Discovery	High energy physics classification	Finance Offer Recommender	Refining Processes		
Protein Structure Predictions	Transaction classification	Credit/Asset Scoring	Seismic imaging		
Disease Risk Predictions	Product recommendation	Airline Scheduling	Disruption Management		
Accelerated Diagnosis	Fraud detection	Irregular Operations	Freight Forecasting		
	Risk analysis	Network Optimization	Irregular Operations		
	Options pricing	Product Portfolio Optimization Process	Fabrication Optimization		
			Manufacturing Supply Chain		



# IBM Quantum for bringing useful quantum computing to the world includes:

Maintaining the industry's largest fleet of **utility-scale quantum systems** on the cloud for our clients and the quantum community to experiment with.

Building and updating a **development and innovation roadmap** that will help us scale quantum computing, from the hardware to the software necessary for quantum advantage.

Nurturing a **community of clients and partners** that includes 250+ Fortune 500 companies, academic institutions, national labs and startups—all working to solve real scientific and business problems with quantum computing.

Developing Qiskit, an open source toolkit and world-class **user experience** that makes quantum computing easy to learn and use by bringing resources together in one place.

Making the world **quantum safe** with technologies that will secure enterprises in the quantum future.

Inventing what's next in quantum  
Providing our partners technology for  
the quantum future

#### Hardware

100+ qubit utility-scale fleet  
Middleware  
Suite of tools for workload optimization

#### Software

Qiskit® Runtime: enables **easy build** and **deployment**  
of cloud-based quantum workflows  
Qiskit: open-source SDK

#### Expertise

Ecosystem  
IBM Quantum Network  
Trust and reputation  
Development and innovation roadmap

Join us in creating the future of  
quantum computing



## IBM Quantum capabilities

Utility-scale quantum fleet  
enabling utility-scale work

### **100+ qubits**

The world's largest fleet of quantum computing systems, all with more than 100 qubits

Advanced processors offering error per layered gate (EPLG) as low as  $4 \times 10^{-4}$  and CLOPS (a measure of how quickly our processors run quantum volume circuits in a series) as high as 200K

### **Enhanced connectivity**

New coupling technologies to forge more connections between qubits

### **Powerful processors**

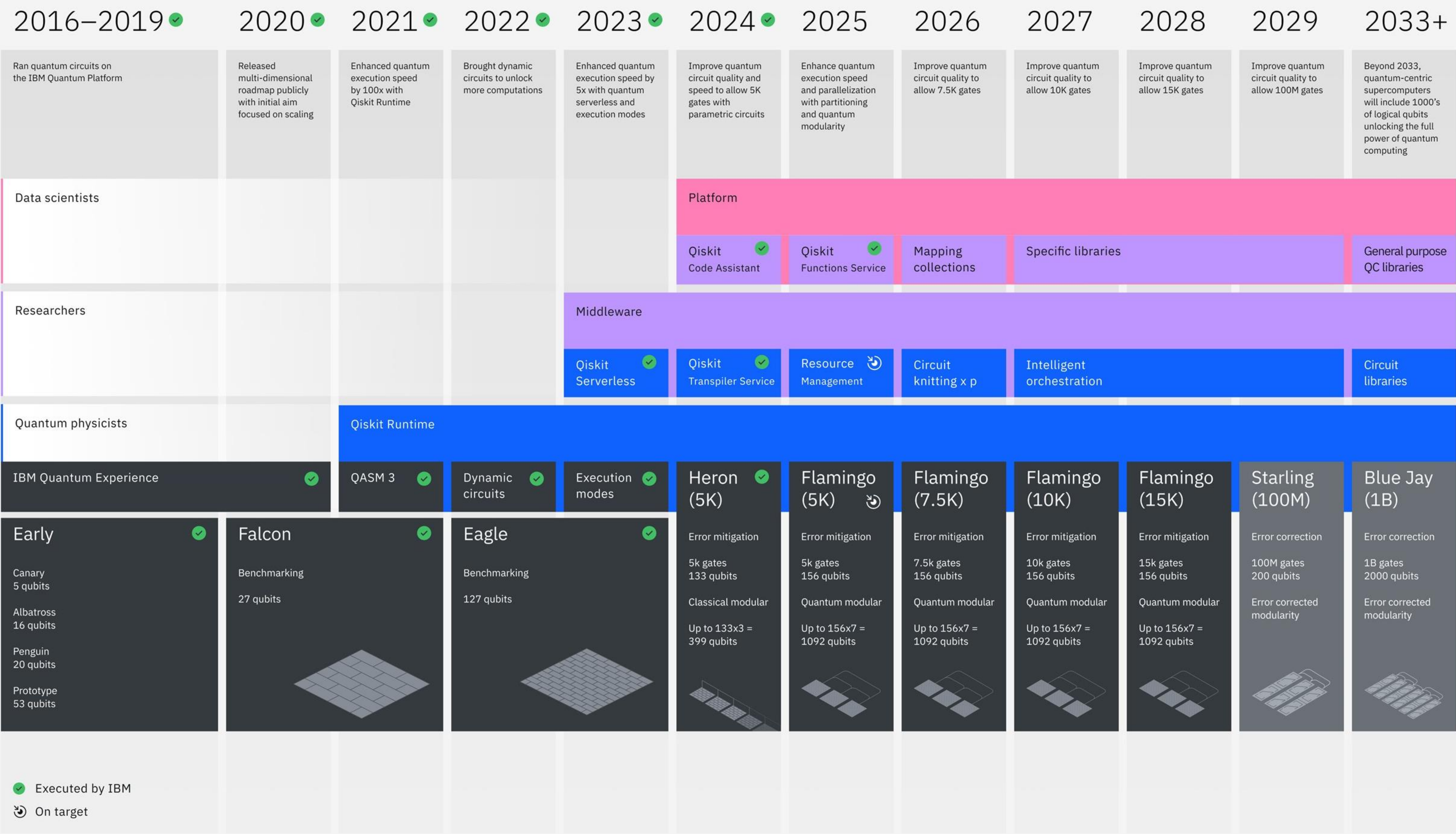
Tunable couplers between fixed-frequency qubits dramatically reduce noise

See all available system metrics:  
[quantum.ibm.com/services/resources?tab=systems](https://quantum.ibm.com/services/resources?tab=systems)

Learn more about performance metrics:  
[www.ibm.com/quantum/blog/quantum-metric-layer-fidelity](https://www.ibm.com/quantum/blog/quantum-metric-layer-fidelity)



24



# Qiskit

# Qiskit SDK v1.x

The most stable open-source quantum SDK and utility-scale tool for building and constructing quantum circuits

74%

of quantum programmers prefer Qiskit SDK

(2025 Unitary Fund survey)

8+

hardware manufacturers support Qiskit-based quantum programs

(Alpine Quantum • Amazon Bracket • Azure Quantum • IBM Quantum • IonQ • IQM • Quantinuum • Rigetti)

Up to

5x

faster with parallelism made possible by new batch execution mode

16x

faster binding and transpiling

(Compared to Qiskit 0.33)

23%

fewer 2Q gates

(Compared to Tket 1.21  
Avg. of six 100-qubit algorithms)

55%

decrease in memory usage

(Compared to Qiskit 0.39  
Avg. of six 100-qubit algorithms)

# Qiskit 1.0 represents a new era for quantum computing

55% decrease in  
memory usage

Compared to Qiskit 0.39

Average of six 100-qubit algorithms

---

16x faster binding  
and transpiling

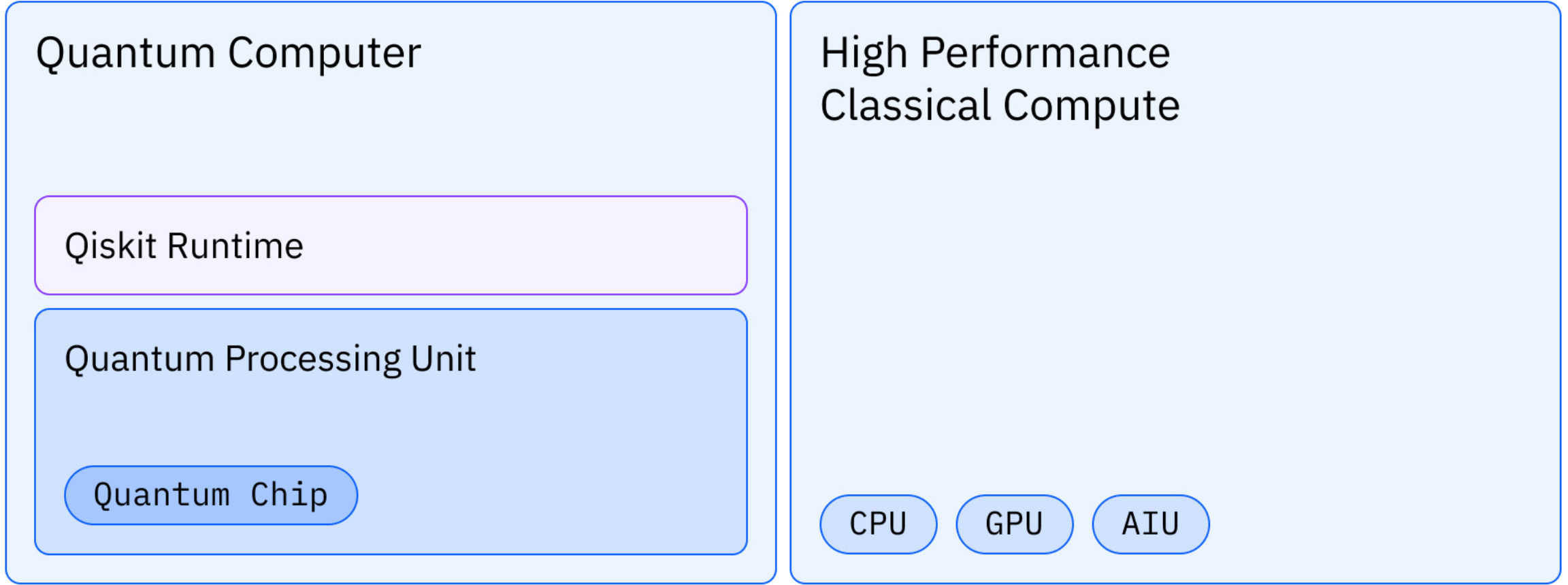
Compared to Qiskit 0.33

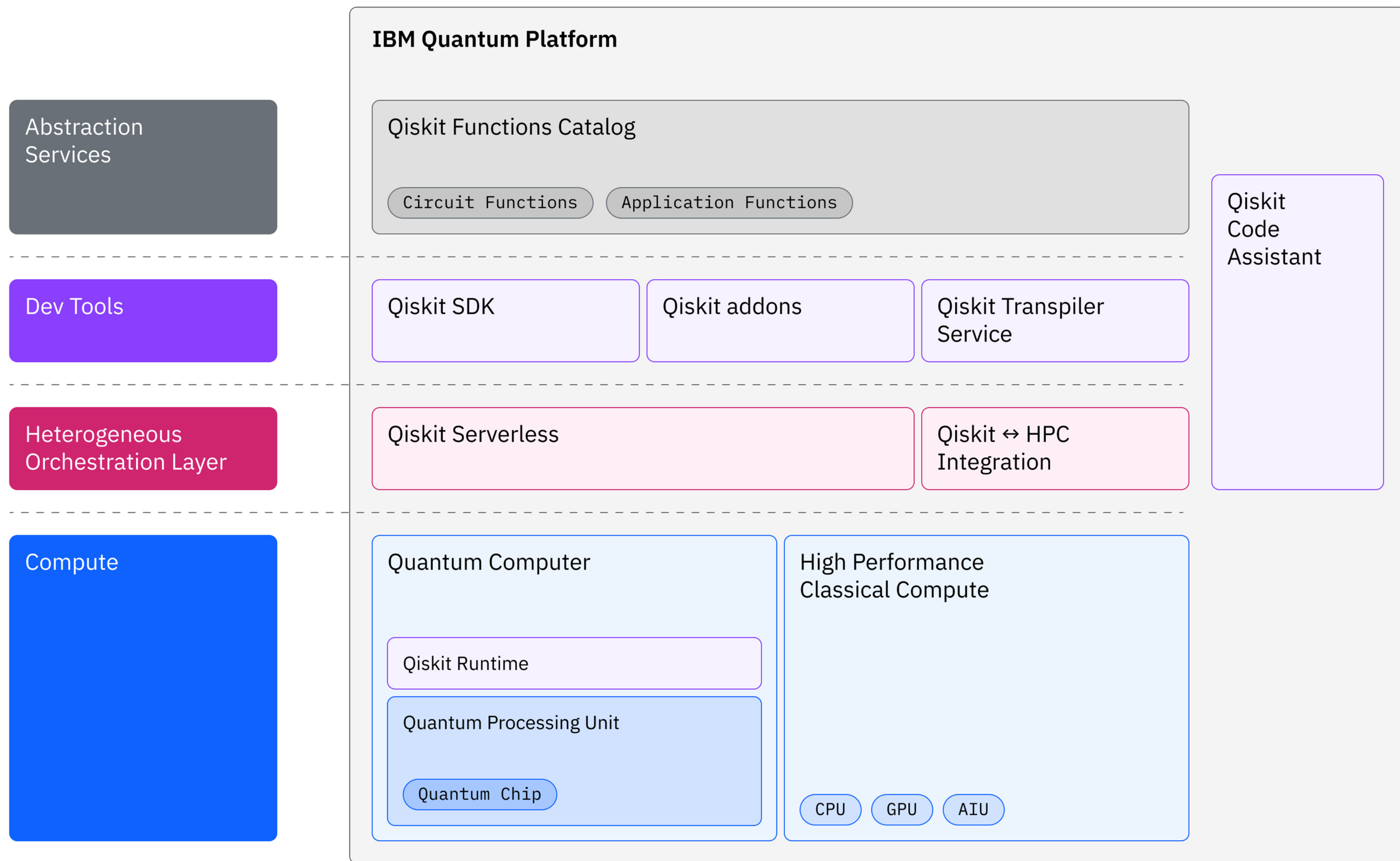
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23% fewer 2Q gates

Compared to Tket 1.21

Average of six 100-qubit algorithms





# Qiskit SDK

[arXiv:2405.08810](https://arxiv.org/abs/2405.08810)

The lingua franca of quantum computing;  
write once and execute quantum circuits on  
**10+** different hardware providers

IBM Quantum  
AQT  
IQM  
Azure Quantum  
Alice & Bob  
IonQ  
Amazon Braket  
Superstaq  
Quantinuum  
Rigetti

Quantum SDK Preferred  
(2025 Unitary Fund Survey)

74%

Qiskit contributors that  
are external to IBM

74%

Dependent Qiskit Projects

5185

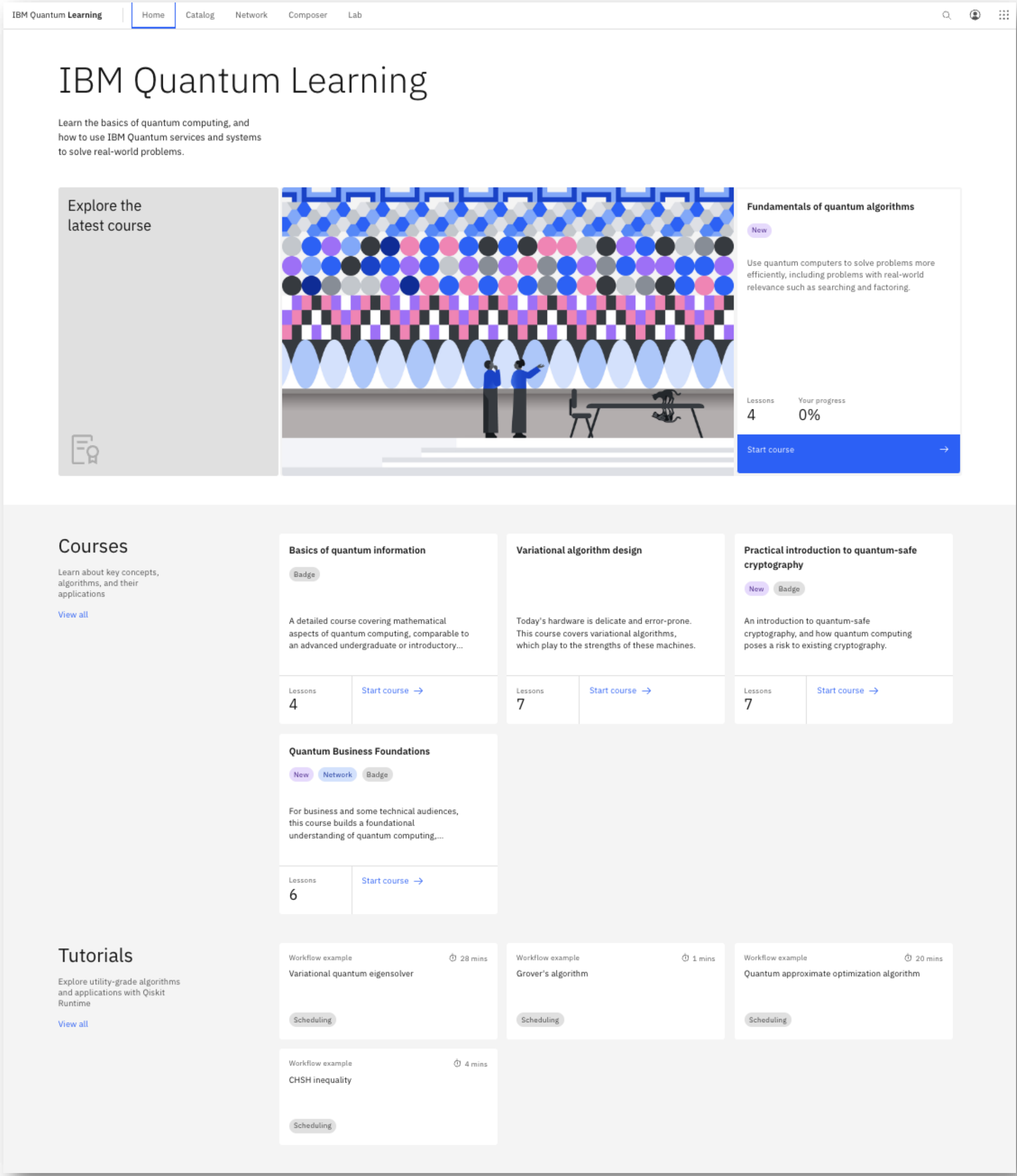
# IBM Quantum Learning

Learn the basics of quantum computing and how to solve real-world problems with IBM Quantum services and systems

Courses, tutorials, and educational resources by leading quantum experts, including:



John Watrous  
Technical Director  
IBM Quantum Education





## Qiskit Quantum Seminar

Qiskit

153 videos 29,763 views Updated today



▶ Play all

↻ Shuffle

Stay up to date with the latest academic and research topics in the quantum community by joining our live discussions every Friday at 12PM EDT. Tune in to gain insights from experts and engage with a community of quantum enthusiasts!



1 **Efficient classical shadow tomography with number conservation with Anushya Chandran**

Qiskit • 116 views • Streamed 1 hour ago



2 **Efficient Long-Range Entanglement using Dynamic Circuits with Elisa Bäumer**

Qiskit • 2.4K views • Streamed 3 weeks ago



3 **On quantum backpropagation and information reuse | Qiskit Quantum Seminar with Amira Abbas**

Qiskit • 2.6K views • Streamed 4 weeks ago



4 **Near-Term Quantum Algorithms for Optimization with Ashley Montanaro**

Qiskit • 2.4K views • Streamed 1 month ago



5 **Quantum Many-body theory in the Quantum Information era with Matthew Fisher | Qiskit Quantum Seminar**

Qiskit • 2.8K views • Streamed 1 month ago



6 **Realization and Characterization of Topological Phases on Quantum Processors**


Qiskit • 2.9K views • Streamed 2 months ago

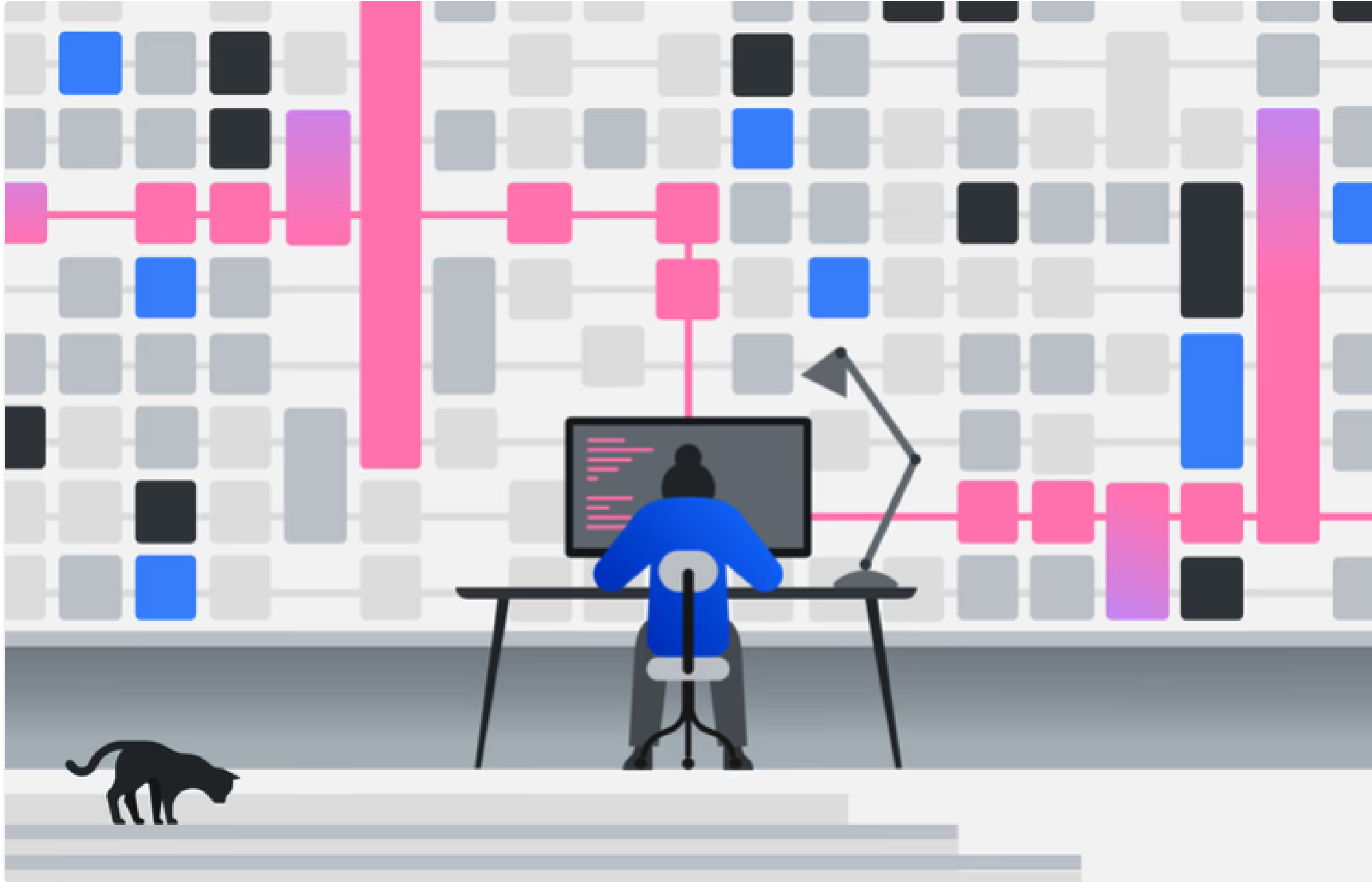
# IBM Quantum Learning

Learn the basics of quantum computing, and how to use IBM Quantum services and systems to solve real-world problems.

IBM Quantum Challenge  
2024 starts June 5th

[Register today →](#)





Quantum Computing in Practice

New

Video

Learn about realistic potential use cases for quantum computing and best practices for experimenting with quantum processors having 100 or more qubits.

Lessons

2

Your progress

N/A

Start course

→

# IBM Quantum Network

A global community driving innovation

250+

Member organizations

39

Quantum Innovation Centers,  
8 with Dedicated Service

125+

Members of QICs

Includes research centers and universities

50+

Industry clients

Includes Quantum Accelerator, Premium  
Plan, and industry QIC members

40+

Startups

10+

Ecosystem Partners

Includes re-sellers, GSIs, and ISVs

1Qbit Systems

Accelequant

Adam Mickiewicz University

Agnostiq Inc

Alabama A&M University

Alabama State University

Albany State University

Algorithmiq Oy

Aliro Quantum

American Express

Amgen

AnaQor

AngelQ

Ansys Inc

Applied Quantum Computing

Aqarios

Argonne National Lab

Arizona State University

Assured Information Security

Banco Bilbao Vizcaya

Argentaria

Banco Bradesco

Basque Center for Applied  
Mathematics

Basque Center for Climate  
Change

Basque Center for  
Neuroscience (Achucarro)

Basque Center on Cognition,  
Brain and Language

Basque Center on Materials,  
Applications and  
Nanostructures

Beit

Biofisika Institute

BlueQubit

Boeing

Bosch

BosonQ Psi

Boston University

Bowie State University

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Bundesdruckerei GmbH

Bundeswehr University Munich

Entropica Labs

ETH Zurich

ExxonMobil

EY Global

Fachhochschule  
Nordwestschweiz

Fermi National Accelerator  
Laboratory

Florida A&M University

Fraunhofer

GE Global Research

General Atomics

George Mason University

Georgia Institute of  
Technology

Global Data Quantum

Good Chemistry

Haiqu

Hampton University

Hanlim Pharm

Harvard University

Hitachi Ltd

Howard University

HQS Quantum Simulations

HSBC

Hydro-Quebec

Hyundai Motor Company

IBM-HBCU Quantum Center -  
Howard University

IBM-Illinois Discovery  
Accelerator Institute -  
University of Illinois Urbana  
Champaign

III Taiwan

Ikerbasque Foundation

Indian Institute of Technology  
Madras

Industrial Technology  
Research Institute

Infleqtion

Institute of Theoretical and  
Applied Informatics Polish  
Academy of Sciences

Istituto Nazionale di Fisica  
Nucleare

Morgan State University

Multiverse Computing

National Centre for Nuclear  
Research

National Energy Technology  
Laboratory

National Institute for Nuclear  
Physics

National Quantum Computing  
Centre

National Taiwan University

Naval Air Warfare Center  
Aircraft Division

Naval Air Warfare Center  
Weapons Div.

Naval Information Warfare  
Center Atlantic Command

Naval Information Warfare  
Center Pacific Command

Naval Surface Warfare Center

Netherlands eScience Center

Netherlands Organization for  
Applied Scientific Research

New Mexico State University

New York University

Norfolk State University

North Carolina AT State  
University

North Carolina Central  
University

North Carolina State University

Northeastern University

Northwestern University

Oak Ridge National Lab

OESIA

OVH Groupe SA

Pacific Northwest National Lab

Perimeter Institute for  
Theoretical Physics

Phasecraft

Plateforme d’Innovation  
Numerique et Quantique

Polymat

Poznan Supercomputing and  
Networking Center

College

Spelman College

State Farm Insurance

Stellenbosch University

STFC Hartree Centre (UKRI)

Stony Brook University

Strangeworks

Sumitomo Mitsui Trust Bank  
Limited

Sungkyunkwan University

Suntory

Super Tech Labs

Surf

System Vertrieb Alexander  
GmbH

T-Systems International GmbH

Technical University of  
Denmark

TECNALIA Research &  
Innovation

Tecnologico de Monterrey

Tekniker

Tennessee State University

Texas Southern University

The University of Texas at San  
Antonio

Tokyo Electron Limited

Tokyo University of Agriculture  
and Technology

Toppan Inc

Toshiba

Toyota

Truist Financial Corp

Tuskegee University

Ulsan National Institute of  
Science and Technology

United States Air Force  
Research Lab

United States Naval  
Postgraduate Military  
University

United States Naval Research  
Laboratory

United States Naval Undersea  
Warfare Center

We have entered the era of Quantum Utility.

Our offerings are changing for this new era.





<https://www.ibm.com/thought-leadership/institute-business-value/report/quantum-decade>

**IBM Quantum**