The quantum future is closer than it seems

Aleš Gros

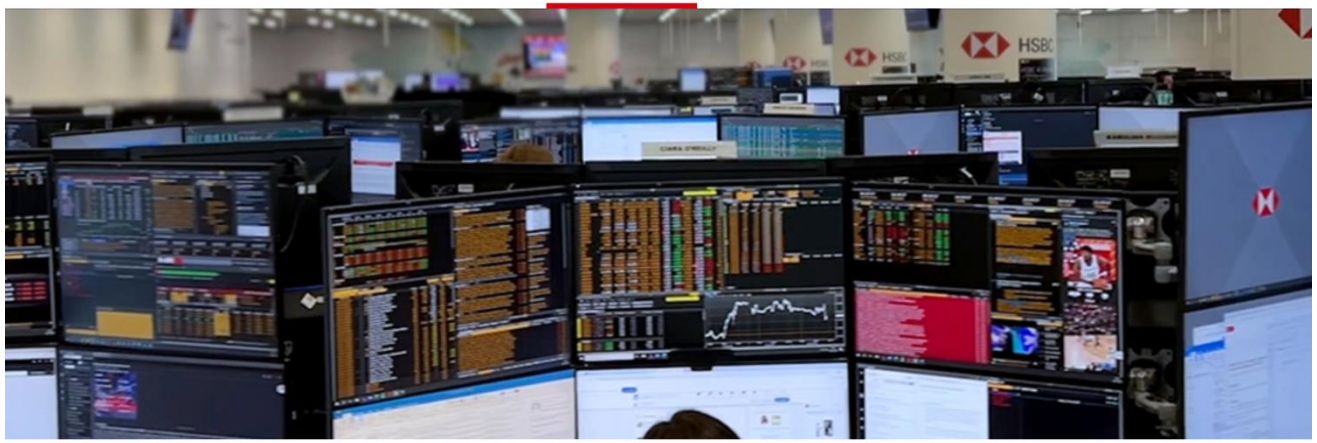
IT Architect, Client Engineering team

IBM Quantum Ambassador

E-mail: ales.gros@si.ibm.com



HSBC Who we are Investors News and views Careers Online banking Contact



HSBC demonstrates world's first-known quantum-enabled algorithmic trading with IBM

25 Sep 2025

Market Summary > IBM Common Stock

282.16 USD

+9.54 (3.50%) ↑ past 5 days

Closed: Sep 30, 19:03 EDT • Disclaimer

After hours 282.14 −0.020 (0.0071%)

1D 5D 1M 6M YTD 1Y 5Y



https://www.hsbc.com/news-and-views/news/media-releases/2025/hsbc-demonstrates-worlds-first-known-quantum-enabled-algorithmic-trading-with-ibm

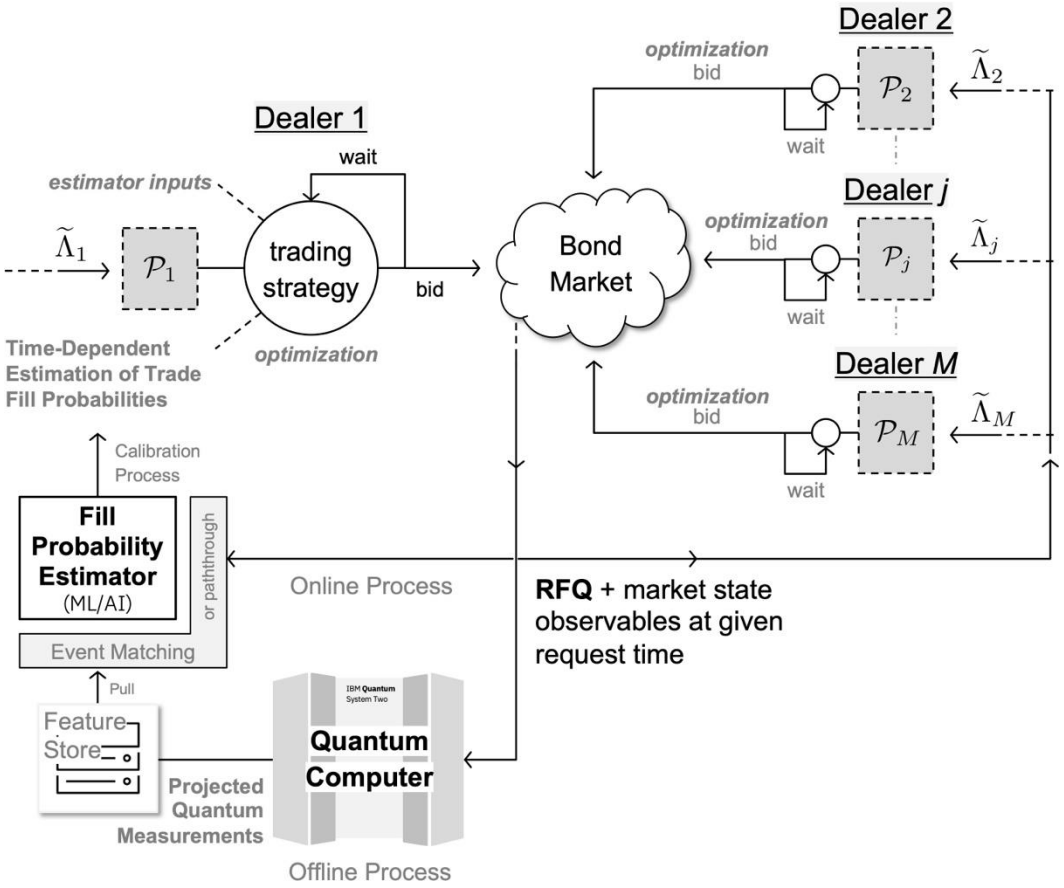
Trade execution optimization in corporate bond markets

QML

IBM and the algorithmic trading division of HSBC partnered to explore the potential for hybrid quantum algorithms to optimize trade execution strategies for corporate bonds.

Using real production-scale data, they investigated whether a form of quantum-enhanced likelihood estimation could obtain better estimates of trade fill probabilities in credit orders, testing their approach on IBM Quantum Heron processors.

The researchers observed a relative gain of up to ~34% in the models with access to quantum-hardware-transformed data, demonstrating that quantum is a useful and relevant discovery tool in modeling complex financial markets.



The figure above shows the bigger picture considered when developing this solution, where the focus in this project has been first on building better optimization inputs with lower errors in fill probability estimates that feed subsequent trading strategies.

Read the paper → arXiv:2509.17715

Read the press release → https://ibm.biz/hsbc-pr

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Where we are with Quantum?

IBM is the clear leader in this 2025 Quantum Insider report on superconducting quantum computers

Competitive Landscape

Organization	Commercial	Operational	Research	Technical
IBM				
Google				
Rigetti				
Alice & Bob				
IQM				
Qolab				
Quantum Circuits				
Oxford Quantum Circuits				
QuantWare				
SpinQ				
Origin Quantum				
Fujitsu				
Anyon Systems				
Chinese Academy of Sciences				
Annealing Systems				
D-Wave				

Low	*Medium*	*High*	*N/A*

QUANTUM INSIDER

Shared with permission of The Quantum Insider Intelligence Platform

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IBM leads in quantum computer deployments

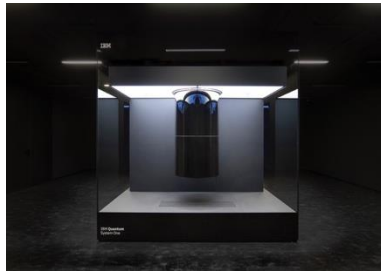
- 60 quantum devices (<100 qubits)
- 31 quantum computers (>100 qubits) that can run circuits with >5000 two-qubit gates
- Average 97% availability across fleet
- 99% availability of at least one Heron R2+
- Job success rate >99.5%

2 Quantum Data Centers



IBM US Quantum Data Center
Poughkeepsie, USA
August 2019

Currently operating 6 quantum computers with 100+ qubits

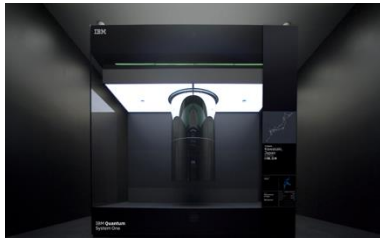


IBM EU Quantum Data Center
Ehningen, Germany
October 2024

Currently operating 2 quantum computers with 100+ qubits

9 Quantum Computers On-Site

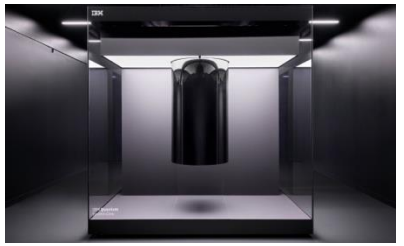
Quantum Computational Center
University of Tokyo
Shin-Kawasaki, Japan
June 2021, 2023 & Sep 2025



Discovery Accelerator
Cleveland Clinic
Ohio, USA
March 2023, Nov 2025



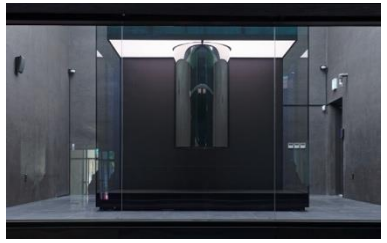
Discovery Accelerator
PINQ²
Bromont, Canada
September 2023, Jul 2025



Quantum Computational Center
Rensselaer Polytechnic
Troy, New York
April 2024



Quantum Computational Center
Yonsei University
Seoul, South Korea
September 2024



JHPC-quantum Riken
Kobe, Japan
May 2025



IBM-Euskadi Quantum Computational Center
San Sebastián, Spain
October 2025



National Quantum Algorithm Center
Chicago, USA
Projected 3Q 2026

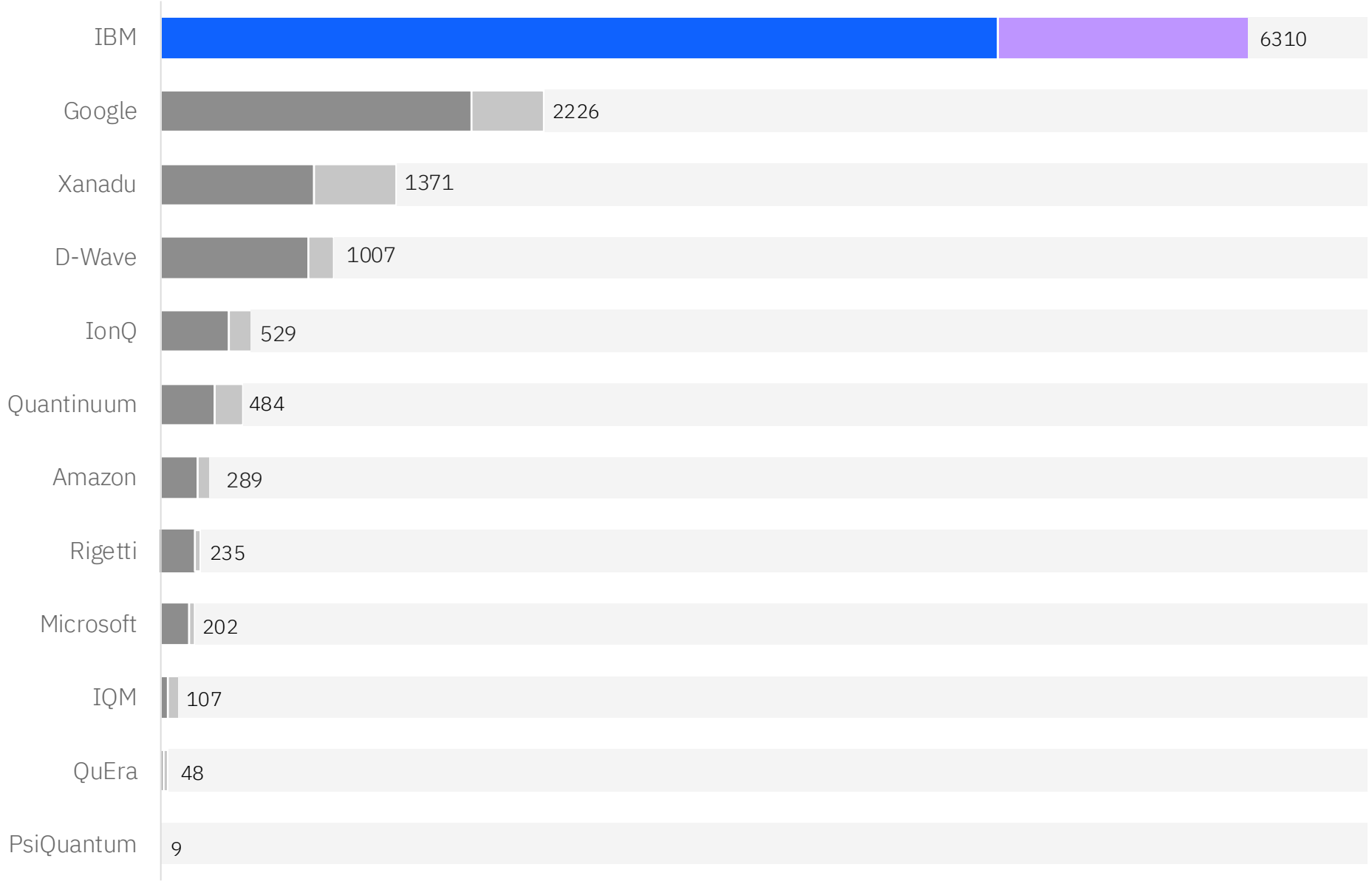


Quantum Valley Tech Park
Andhra Pradesh, India
Projected 2H 2026



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Research papers on arXiv using IBM quantum hardware and software



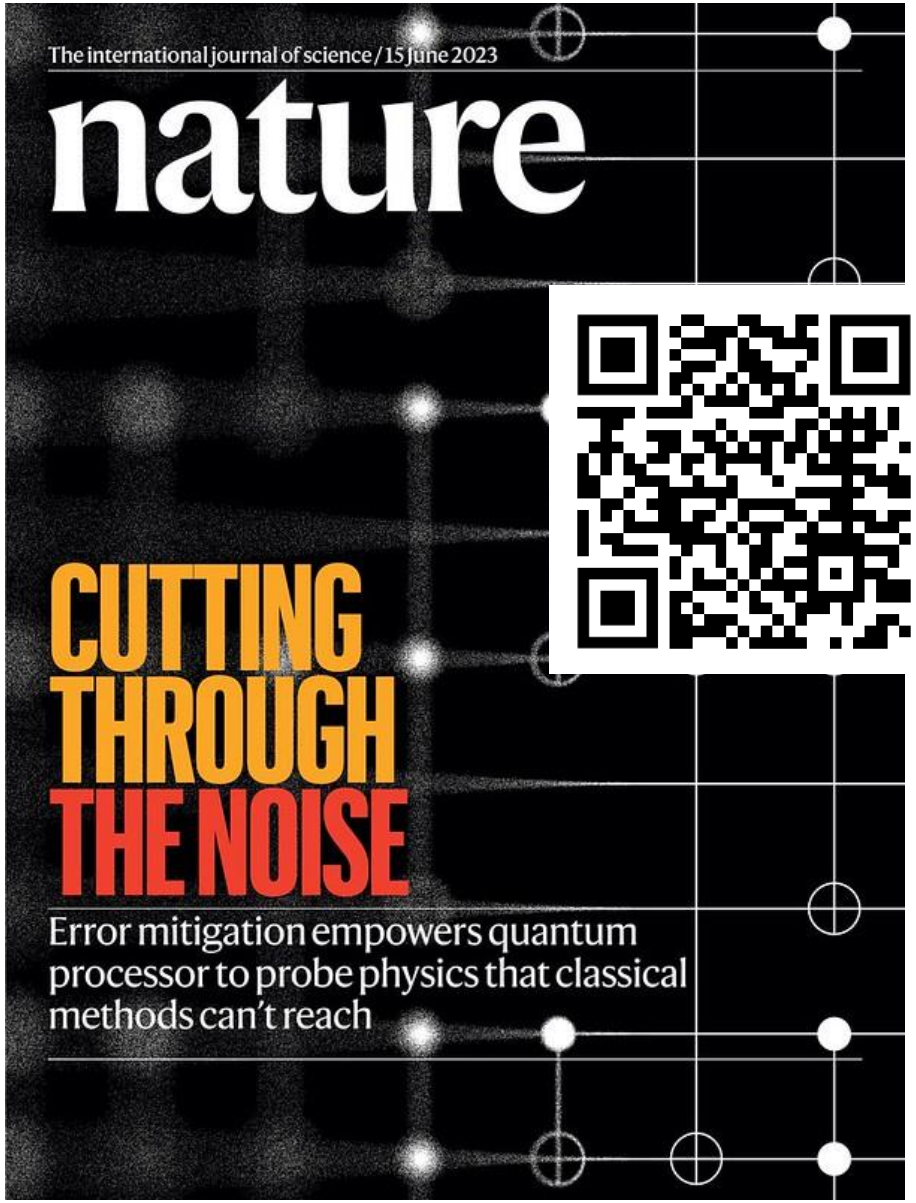
Data is current as of 7/27/26. The data was obtained by (1) collecting all arXiv papers mentioning quantum computing related phrases; (2) cleaning up the corresponding LaTeX files and removing bibliographies/ citations/formatting; and (3) searching for SW and service keywords found in the 2024 Unitary Foundation Survey and publicly known quantum HW names, with the constraint that an action word (e.g., “run”) is required to exist in the same sentence with the keyword(s).

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IBM Quantum

Leading Innovation

Propelling us into the quantum computing frontier



2023 – Demonstrating quantum utility over brute force classical computing regarding optimization



2024 – Charting a path towards quantum error correction, demonstrating high-threshold, low-overhead fault-tolerant quantum memory

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Source: 1. https://www.nature.com/articles/s41586-024-07107-7
Source: 2. https://www.nature.com/articles/s41586-023-06096-3

The case for quantum utility

Quantum utility →

Gates: 3K | 5K | 100M

Pre-utility | Error mitigation | Fault Tolerant Quantum Computers

Year: 2023 | 2024 | 2029

All circuits can be brute-force run on classical hardware



Only approximate solutions exist in this regime for exploring quantum advantage

Well into the fault-tolerant regime, where today's known quantum algorithms exist



The estimated cost of simulating a 40-qubit spin chain Schrödinger equation using 1024 H100 GPUs[1,2] is in the order of $30M.

The cost of running the 120-qubit, 3k gate 2023 Nature paper on current quantum hardware is roughly $4.8k[3].

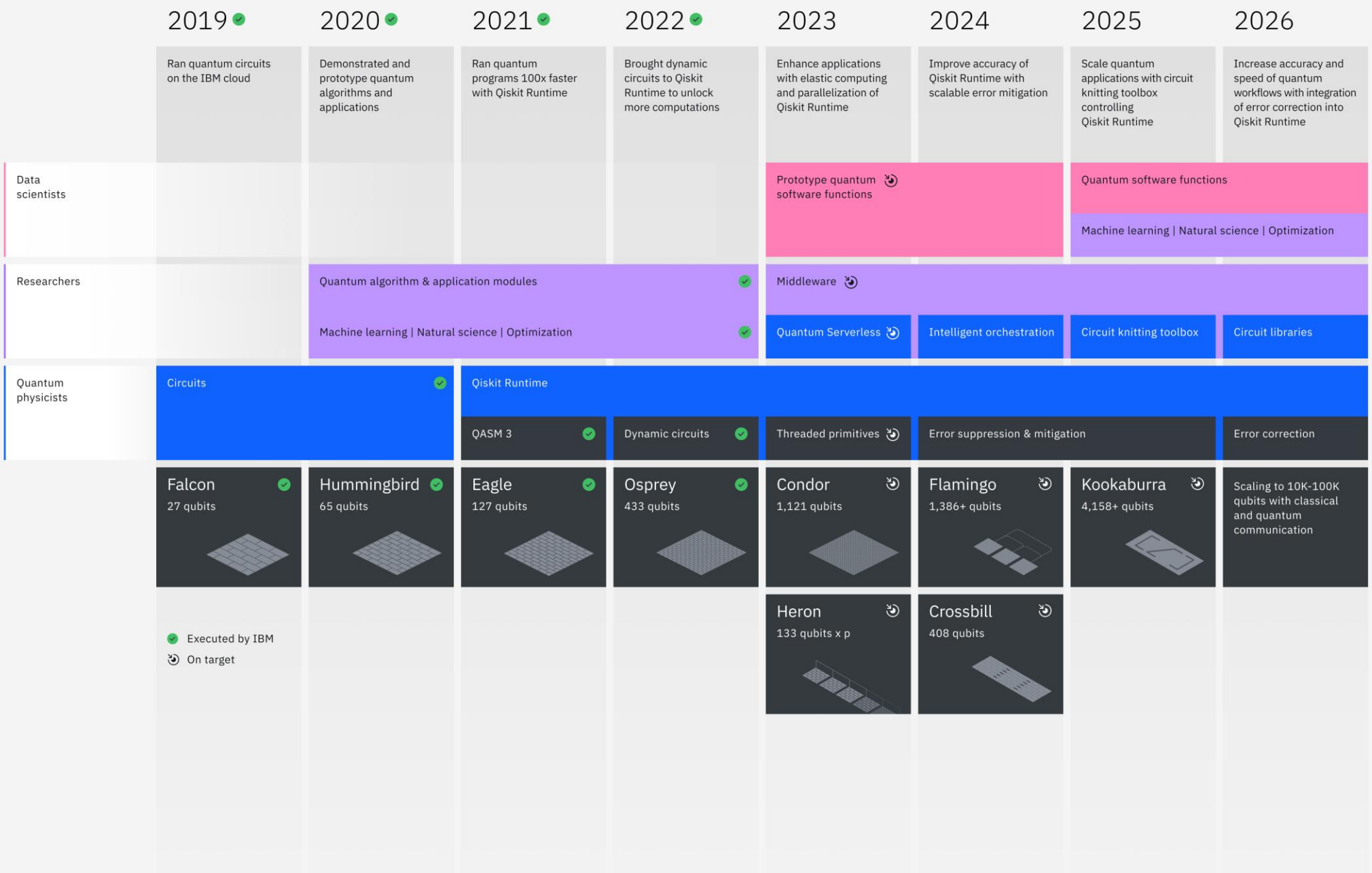
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1. Accelerating Google's QPU Development with New Quantum Dynamics Capabilities, NVIDIA Developer, 18 November 2024.
2. Nvidia Hopper H100 80GB Price Revealed, Future US, 29 April 2022.
3. Running in session mode as a premium user of IBM Quantum Platform

Previous development roadmap

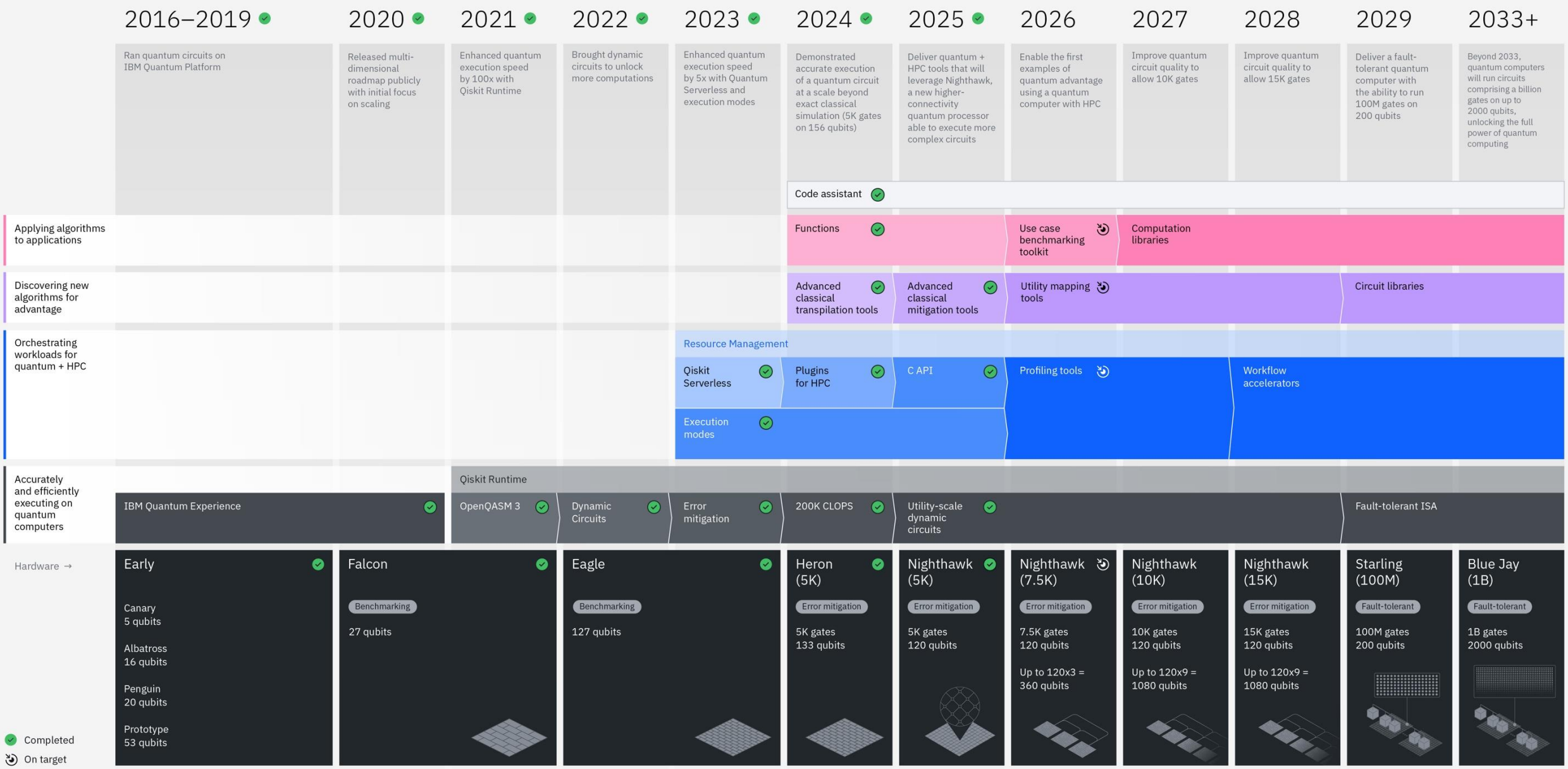
Back in 2020, IBM released an ambitious roadmap for maturing and scaling quantum technology.

This roadmap set us on course to deliver a 1,000+ qubit chip in just three years while developing software and services necessary to run applications on quantum systems.



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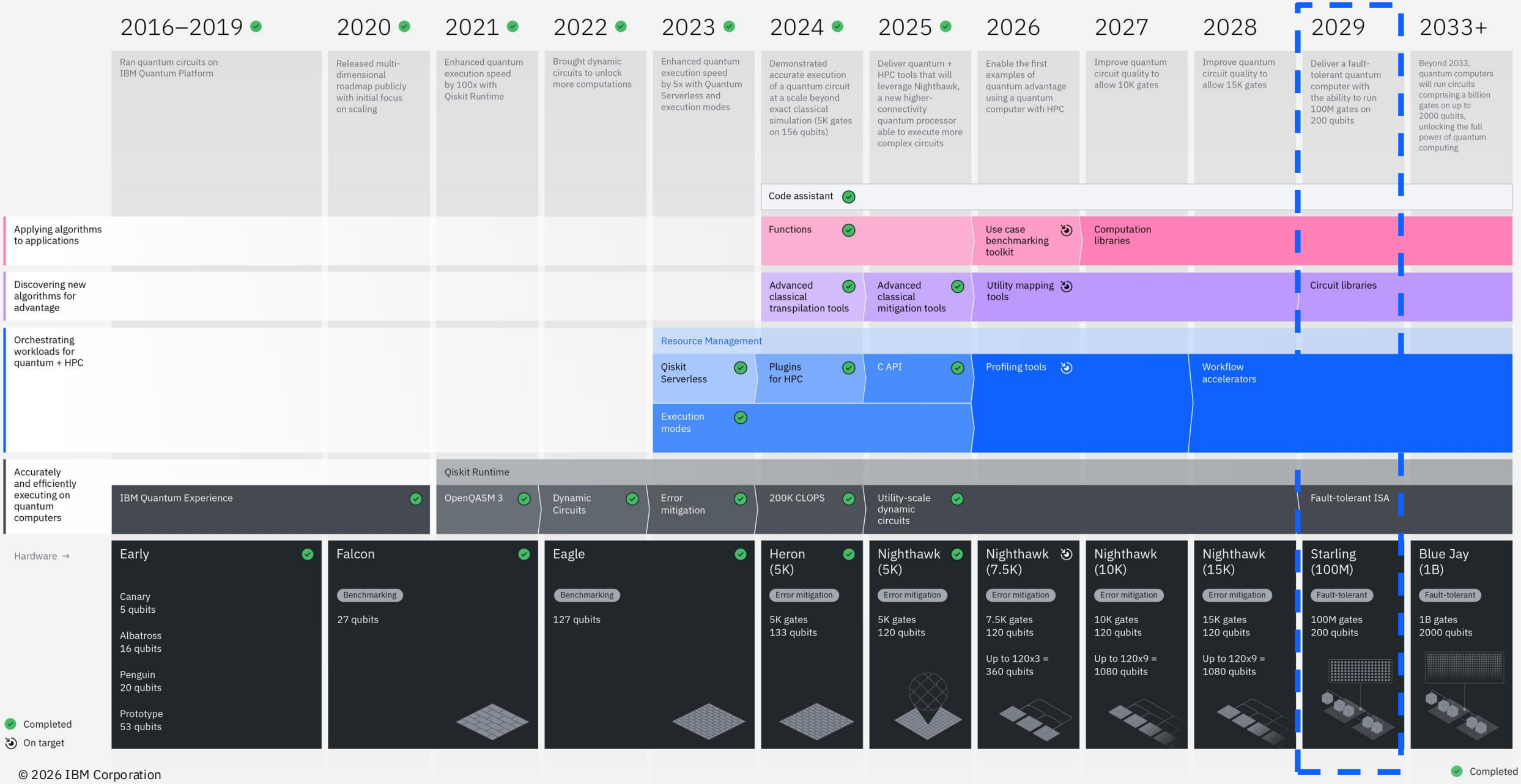
Development Roadmap



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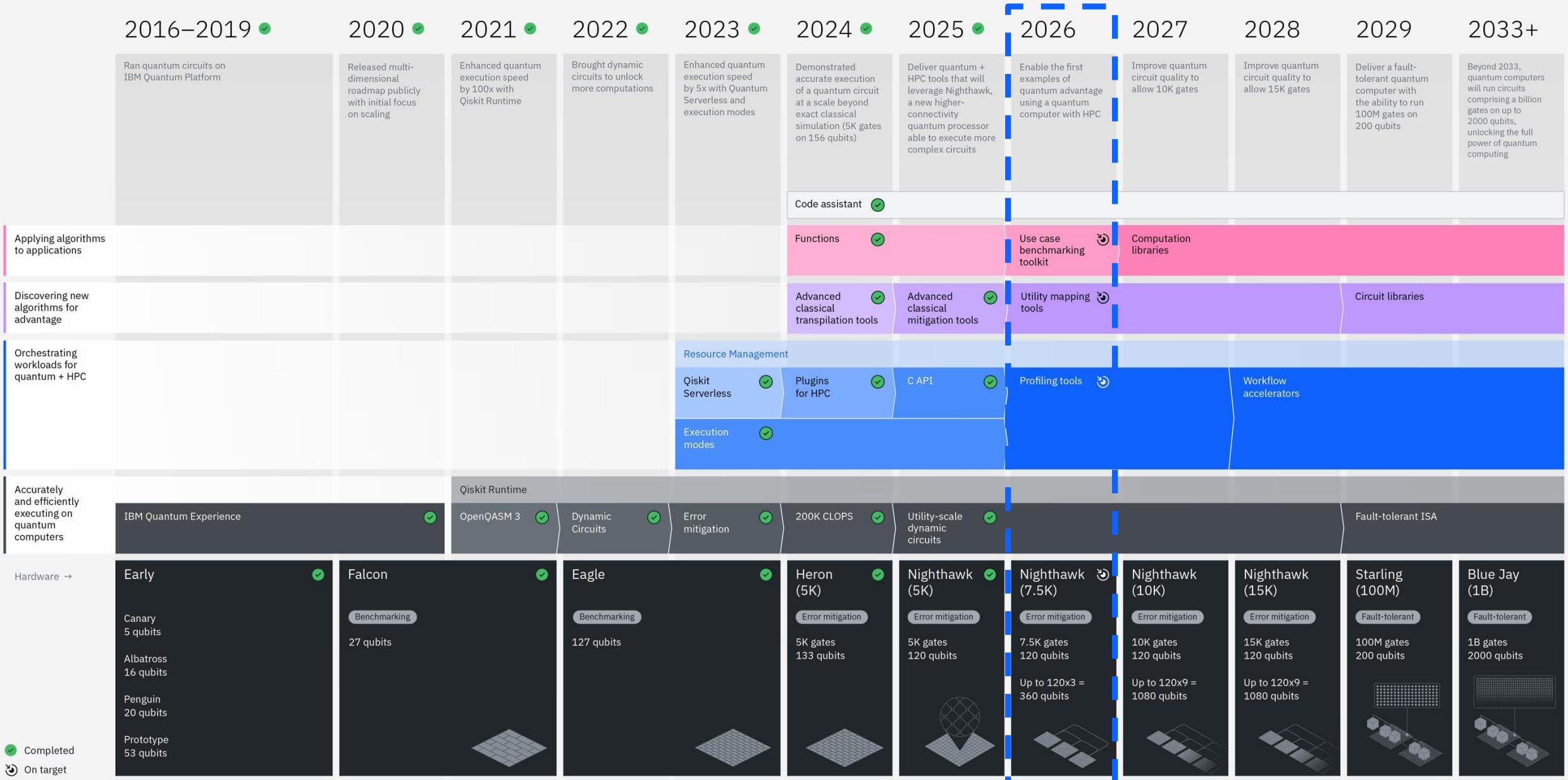
Completed
On target

Development Roadmap



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Development Roadmap



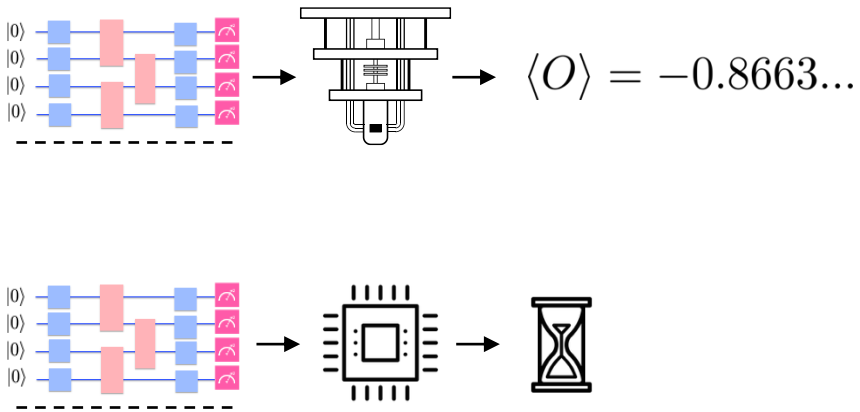
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Completed
On target

Quantum utility vs. quantum advantage

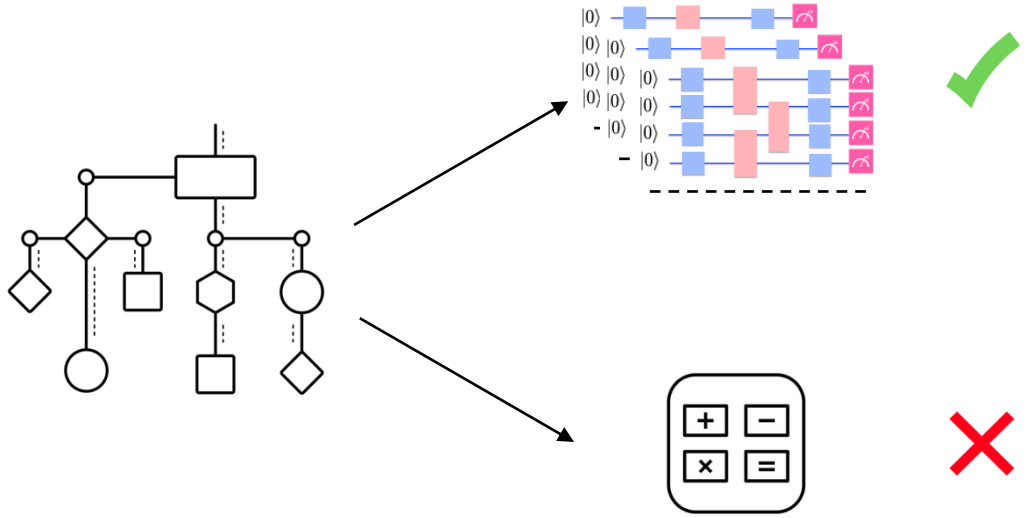
Quantum utility:

A quantum computer is the best platform on which to run a quantum circuit.



Quantum advantage:

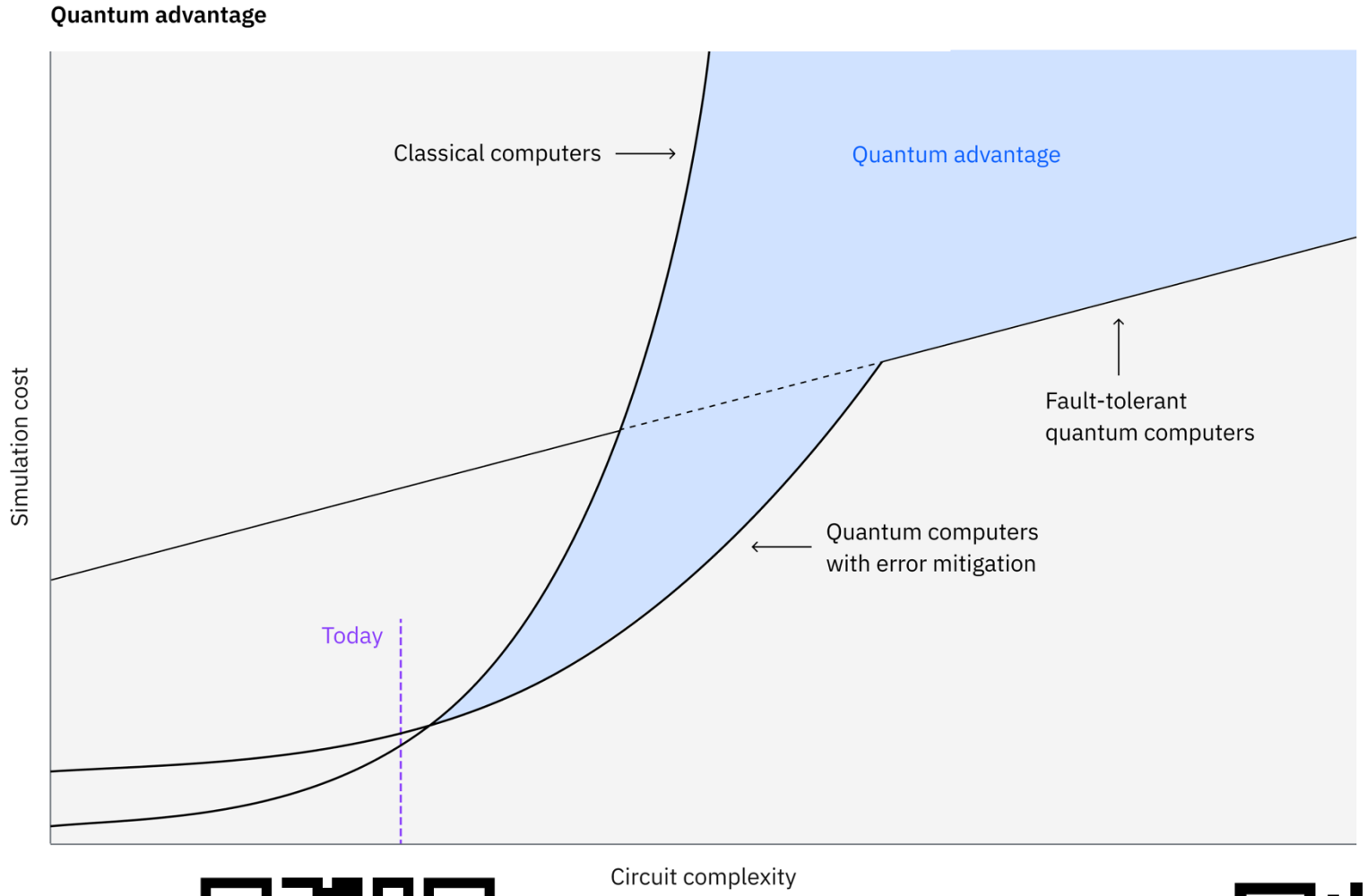
A quantum computer can solve a problem more accurately, cheaper, or more efficiently than classical computing alone



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What is quantum advantage?

- The ability to execute an information processing task on quantum hardware in a way that satisfies two essential criteria:
- 1. This correctness of the output can be **rigorously validated**.
- 2. The calculation is performed with a **quantum separation** that offers superior efficiency, cost-effectiveness, or accuracy than what can be obtained with classical methods alone.



Read the white paper → https://ibm.biz/QA-whitepaper
Read the blog → https://ibm.biz/QA-blog

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https://quantum-advantage-tracker.github.io/

Advantage trackers

Track verifiable quantum advantage claims across three pathways, with clear evidence requirements and contributing institutions.

Observable estimations | Variational problems | Classically verifiable problems

Variational problems

Submissions must bound the ground-state energy from above. Verified entries include evidence that the ansatz and optimization respect the variational principle.

View hamiltonians | Open submission ticket

Date ↓	Name / Institutions	Method	Hamiltonian	Qubits	Gates	Energy (Eh) [upper, lower bound]	Runtime (seconds)	Compute resources
2025-11-21	[4Fe-4S] (54e, 36o) CISD By: IBM, RIKEN	Configuration Interaction with singled and doubles	4fe_4s_54e_36o			-326.7421234190204 [N/A, N/A]	Q: - C: -	Q: - C: -
2025-11-21	[4Fe-4S] (54e, 36o) RHF By: IBM, RIKEN	Restricted Hartree-Fock	4fe_4s_54e_36o			-326.54741547585223 [N/A, N/A]	Q: - C: -	Q: - C: -
2025-11-20	TrimCI_202511_6e7 By: University of Wisconsin – Madison	TrimCI	4fe_4s_54e_36o			-327.175 [N/A, N/A]	Q: - C: 50400	Q: - C: 12 Node × 2 × AMD EPYC 7713 64C 2GHz = 1536 cores
2025-11-20	TrimCI_202511_1e4 By: University of Wisconsin – Madison	TrimCI	4fe_4s_54e_36o			-326.913 [N/A, N/A]	Q: - C: 900	Q: - C: Apple M1 Ultra, 20 cores
2025-11-20	TrimCI_202511_1e3 By: University of Wisconsin – Madison	TrimCI	4fe_4s_54e_36o			-326.81 [N/A, N/A]	Q: - C: -	Q: - C: Apple M1 Ultra, 20 cores

Key milestones in bringing useful quantum computing to the world

2016

Quantum is online

IBM puts quantum devices on the cloud

2023

Establish quantum utility

5K operations on 100+ qubits

2026

Demonstrate quantum advantage

With clear separation and verifiability

2028

Demonstrate all key elements of a fault-tolerant quantum computer

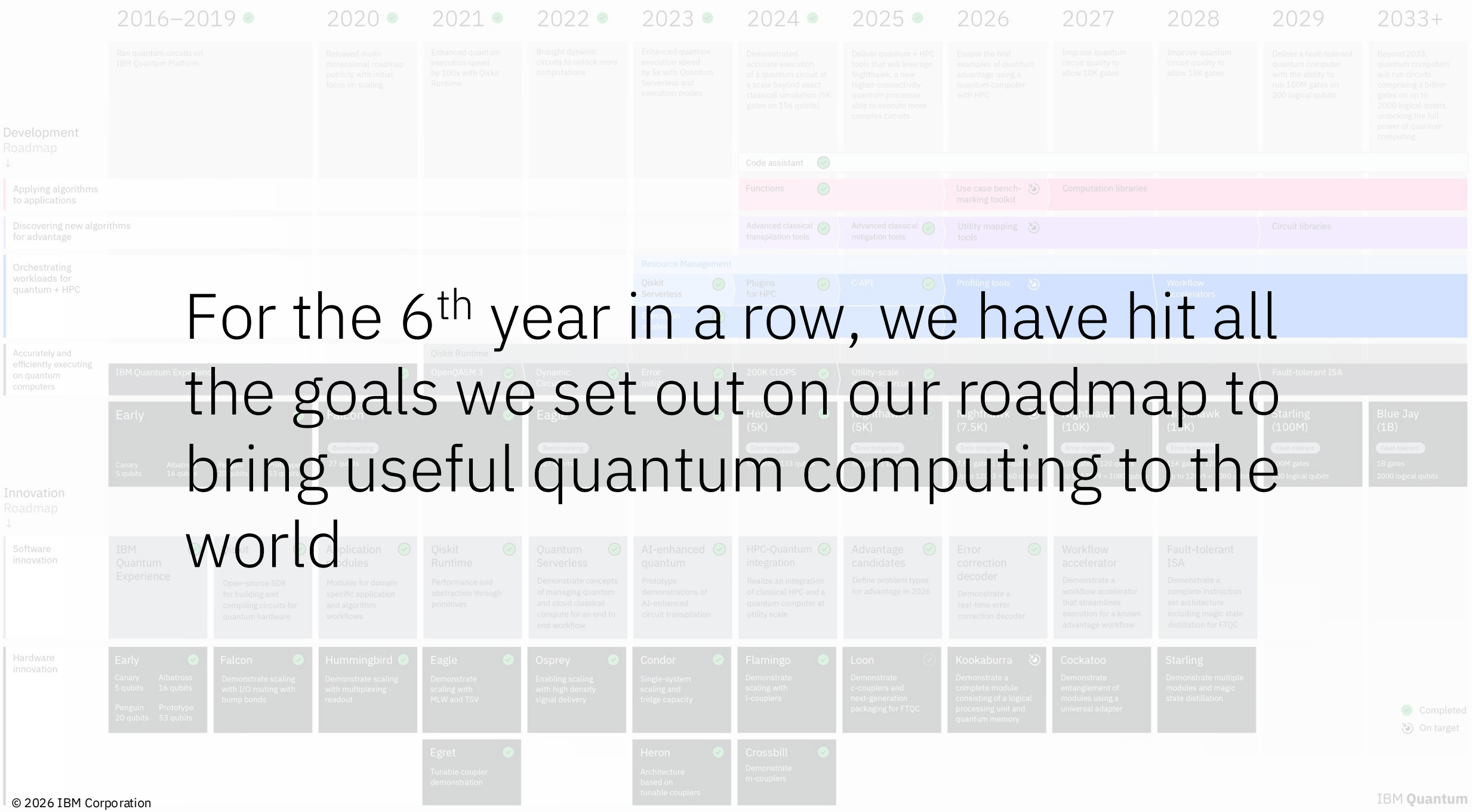
Architecture, coupled logical modules, magic state factory

2029

Deliver the first fault-tolerant quantum computer

100M operations on 200 qubits

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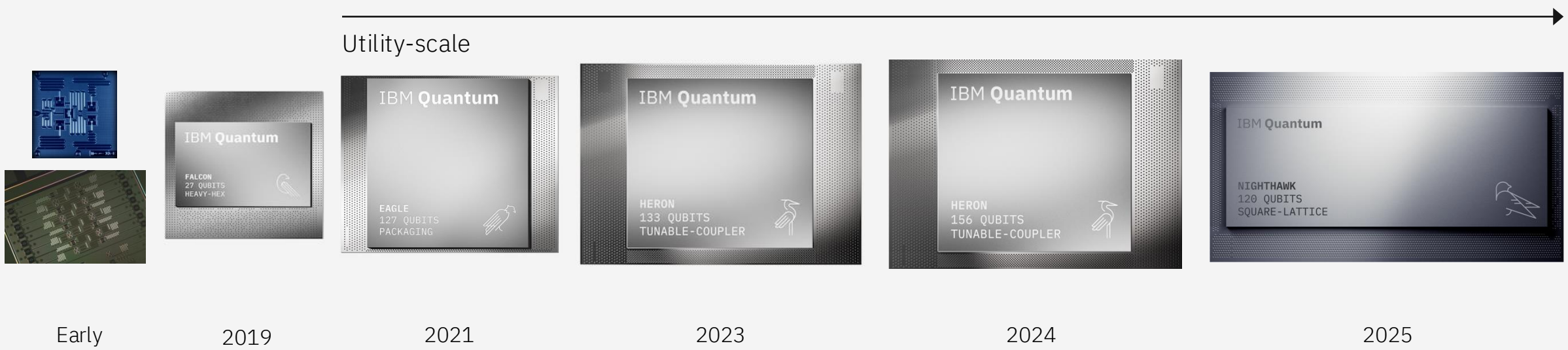
For the 6th year in a row, we have hit all the goals we set out on our roadmap to bring useful quantum computing to the world

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We have transitioned from quantum devices for studying quantum to quantum computers that enable scientific research with quantum

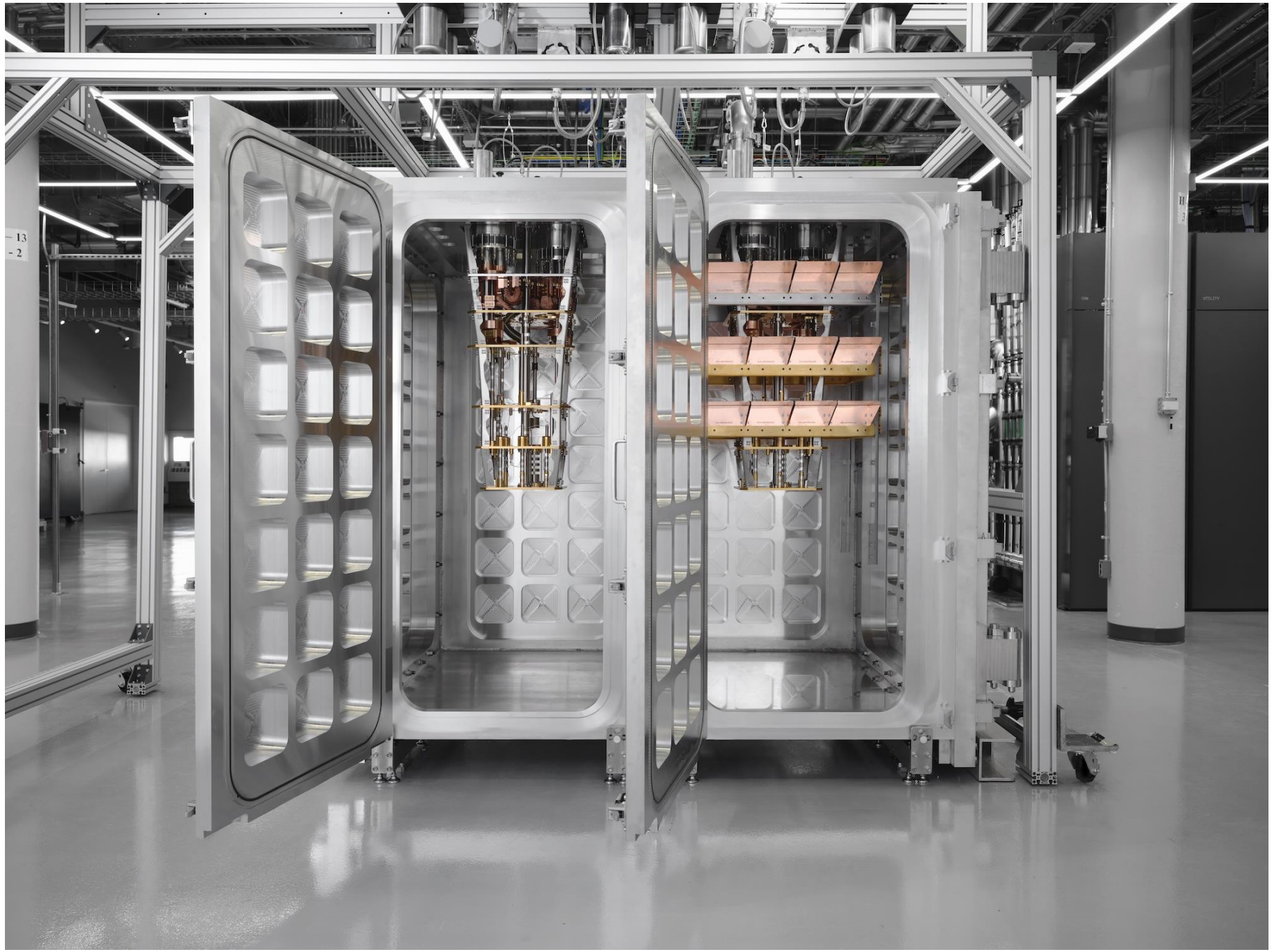
Since 2016, IBM has publicly deployed:

- √ 60 quantum devices (<100 qubits)
- √ 31 quantum computers (>100 qubits) that can run circuits with >5,000 two-qubit gates



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Modular cryogenic infrastructure

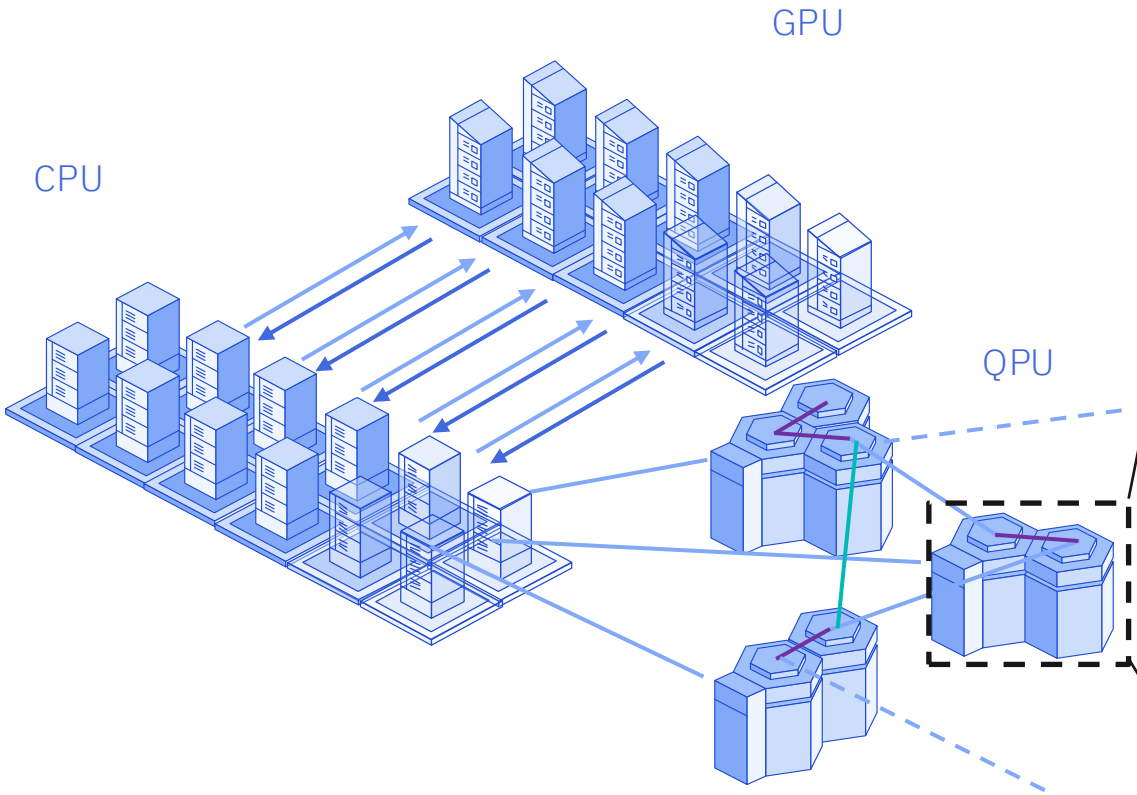


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Quantum-centric supercomputing

Delivering impactful quantum computing requires the interplay of quantum and classical resources at scale

Quantum-centric supercomputing is the path toward industrial-scale applications



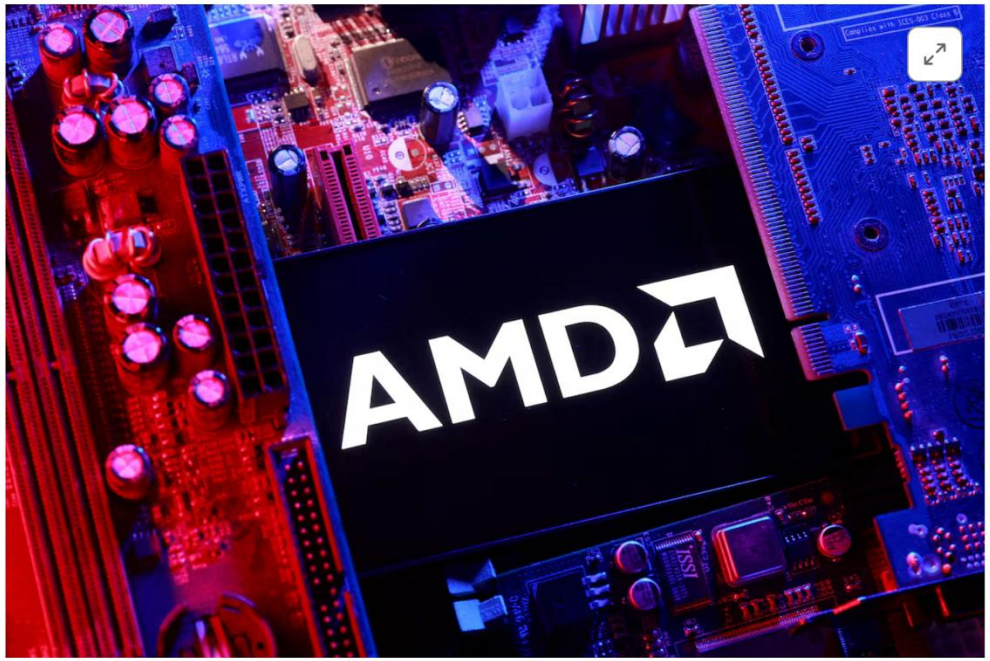


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IBM says conventional AMD chips can run quantum computing error correction algorithm

By **Stephen Nellis**

October 24, 2025 11:03 PM GMT+2 · Updated October 24, 2025



[1/2] An AMD logo and a computer motherboard appear in this illustration taken August 25, 2025. REUTERS/Dado Ruvic/Illustration/File Photo Purchase Licensing Rights

SAN FRANCISCO, Oct 24 (Reuters) - IBM (IBM.N) said on Friday it can run a key quantum computing error correction algorithm on commonly available chips from Advanced Micro Devices (AMD.O), a step toward commercializing super-powerful computers.

The U.S. stalwart is racing to develop quantum computing against Microsoft (MSFT.O) and Alphabet's (GOOGL.O) Google, which announced a breakthrough algorithm this week.

Get a daily digest of breaking business news straight to your inbox with the Reuters Business

IBM has a multi-year plan to build a quantum computer called Starling by 2029. Gambetta said the algorithm work disclosed Friday was completed a year ahead of schedule.

IBM shares closed up 7.88% at $397.46 on Friday after the news, and AMD shares closed up 7.63% at $252.92.

IBM press release: https://newsroom.ibm.com/2025-08-26-ibm-and-amd-join-forces-to-build-the-future-of-computing

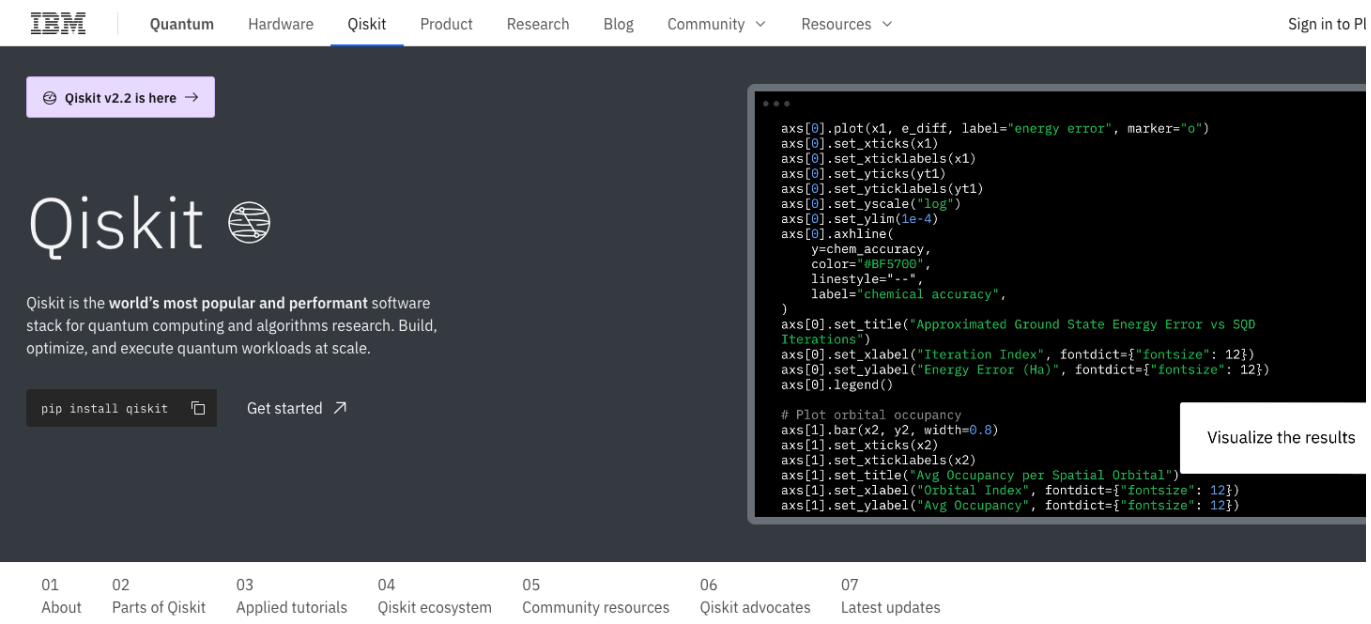
https://www.reuters.com/business/ibm-says-key-quantum-computing-algorithm-can-run-conventional-amd-chips-2025-10-24 /

How to access/start with Quantum?

QISKIT

https://www.ibm.com/quantum/qiskit

https://qiskit.org/documentation/finance/tutorials/03_european_call_option_pricing.html



Open-source quantum software for large-scale execution

13M

Qiskit downloads

74%

Developers prefer Qiskit as primary SDK, according to the Unitary Foundation

Pricing European Call Options ¶

Pricing European Call Options
Introduction
Uncertainty Model
Payoff Function
Evaluate Expected Payoff
Evaluate Delta

Introduction ¶

Suppose a European call option with strike price K and an underlying asset whose spot price at maturity S_T follows a given random distribution. The corresponding payoff function is defined as:

$$\max\{S_T - K, 0\}$$

In the following, a quantum algorithm based on amplitude estimation is used to estimate the expected payoff, i.e., the fair price before discounting, for the option:

$$\mathbb{E}\left[\max\{S_T - K, 0\}\right]$$

as well as the corresponding Δ, i.e., the derivative of the option price with respect to the spot price, defined as:

$$\Delta = \mathbb{P}\left[S_T \geq K\right]$$

The approximation of the objective function and a general introduction to option pricing and risk analysis on quantum computers are given in the following papers:

- Quantum Risk Analysis. Woerner, Egger. 2018.
- Option Pricing using Quantum Computers. Stamatopoulos et al. 2019.

[1]:
```
import matplotlib.pyplot as plt

%matplotlib inline
import numpy as np

from qiskit import QuantumCircuit
from qiskit.algorithms import IterativeAmplitudeEstimation, EstimationProblem
from qiskit.circuit.library import LinearAmplitudeFunction
from qiskit_aer.primitives import Sampler
from qiskit_finance.circuit.library import LogNormalDistribution
```

Uncertainty Model ¶

We construct a circuit to load a log-normal random distribution into a quantum state. The distribution is

IBM Quantum offerings

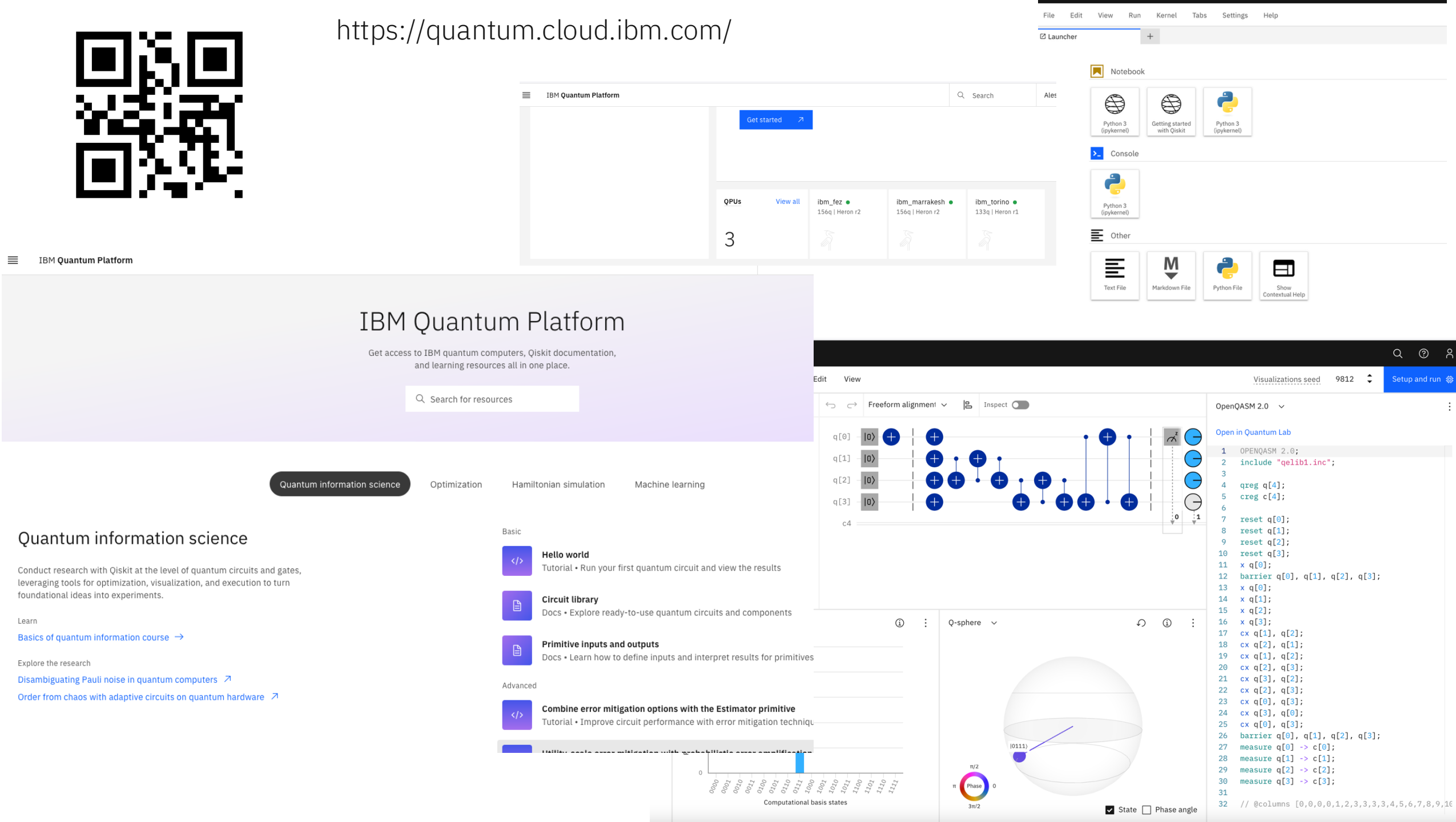
Access quantum computing

Provided pricing assumes use of <200 qubit quantum computers

Open Plan	Pay-as-you-go Plan	Flex Plan	Premium Plan	On-Prem Plan
		Subscription required	Subscription required	Subscription required
Best for Learning quantum computing and exploring IBM quantum technology.	Best for Discovering quantum utility through proof-of-concept and business model validation.	Best for Performing quantum utility research projects and prototyping with flexible access.	Best for Executing a strategic quantum roadmap and developing quantum algorithms and applications at scale.	Best for Exploring quantum algorithms and applications with high control over your resources and data.
☐ Access to Qiskit Runtime as a service ☐ Access to 100+ qubit utility-scale quantum computers	☐ Access to Qiskit Runtime as a service ☐ Access to 100+ qubit utility-scale quantum computers ☐ IBM Quantum™ technical support	☐ Access to Qiskit Runtime as a service ☐ Access to 100+ qubit utility-scale quantum computers ☐ IBM Quantum technical support ☐ IBM Quantum Network membership[1] ☐ Optional access to our Quantum Accelerator offering ☐ Advanced software features ☐ Early access to new features Purchased in Resource Units (RUs) 1 RU = 1 min. of usage on <200 qubit computer 0.5 min. on 200 to <500 qubit computer [1]: 3,500 RU minimum purchase required	☐ Access to Qiskit Runtime as a service ☐ Access to 100+ qubit utility-scale quantum computers ☐ IBM Quantum technical support ☐ IBM Quantum Network membership ☐ Optional access to our Quantum Accelerator offering ☐ Advanced software features ☐ Early access to new features Purchased in Quantum Allocation Units (QAUs) 1 QAU = up to 1600 RUs per 28-day period 1 RU = 1 min. of usage on <200 qubit computer 0.5 min. on 200 to <500 qubit computer	☐ Access to Qiskit Runtime as a service ☐ Access to 100+ qubit utility-scale quantum computers ☐ IBM Quantum technical support ☐ IBM Quantum Network membership ☐ Optional access to our Quantum Accelerator offering ☐ Advanced software features ☐ Full computer capacity purchased as a service ☐ Quantum system location on client site
Free Access to utility scale quantum computers for up to 10 minutes of runtime per month.	Starting at **$96 USD / minute** Pay for what you use. Billed per second of usage via IBM Cloud.	Starting at **$72 USD / minute*** Purchase the capacity you need with Resource Units and use them throughout the contract period. *Based on list price for 1 RU (Resource Unit) purchase with min. of 400 RUs	Equivalent to **$48 USD / minute*** Reserve the capacity you need for the year with Quantum Allocation Units and use up to 1600 minutes per QAU every 28-day rolling time-window. *Based on list price for 1 QAU (Quantum Allocation Unit) purchased with min. of ¼ QAU	**Price requires quote** Access to an entirely on-prem quantum system that is serviced and maintained by IBM.

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https://quantum.cloud.ibm.com/



IBM QUANTUM IN EUROPE?

IBM Quantum Europe Data Center

Located in Ehningen, Germany

The Data Center in Europe is part of our long-term worldwide plan. It reflects the growing maturity of our own platform and customer sophistication and demand

Hardware

Increasing IBM's global fleet of leading universal quantum computers

Quantum Data Center with **utility-scale QPUs**:

- **Two Eagle** processors (127 qubits)
- **One Heron** processor (156 qubits)

Access

Choose how to consume EU data center resources

EU-based QPUs are accessible through **various access plans**

- IBM Quantum Platform (Premium Plan, Flex Plan, Pay-as-you-go)

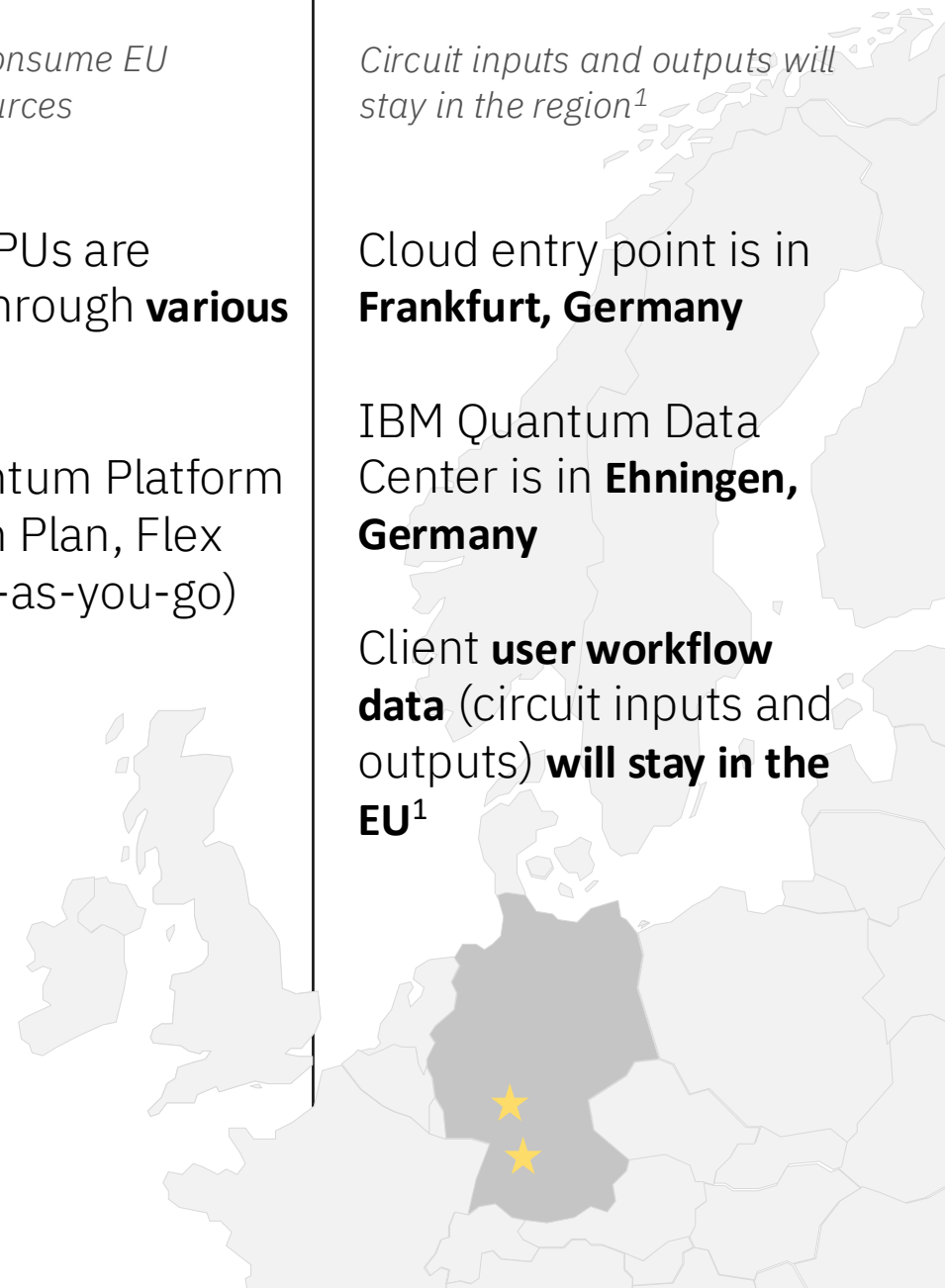
Data Locality

Circuit inputs and outputs will stay in the region[1]

Cloud entry point is in **Frankfurt, Germany**

IBM Quantum Data Center is in **Ehningen, Germany**

Client **user workflow data** (circuit inputs and outputs) **will stay in the EU[1]**



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[1]: when accessing through virtual private endpoints to ensure EU-based data flow between client and IBM

BasQ
Basque Quantum

A regional quantum initiative promoted by the Basque Government for developing industrially useful algorithms

Joint sponsored research in applications in condensed matter, physics and chemistry

Now home to Europe's first IBM Quantum System Two, located at the IBM-Euskadi Quantum Computational Center in San Sebastián







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BasQ

Simulating complex interactions from high-energy physics

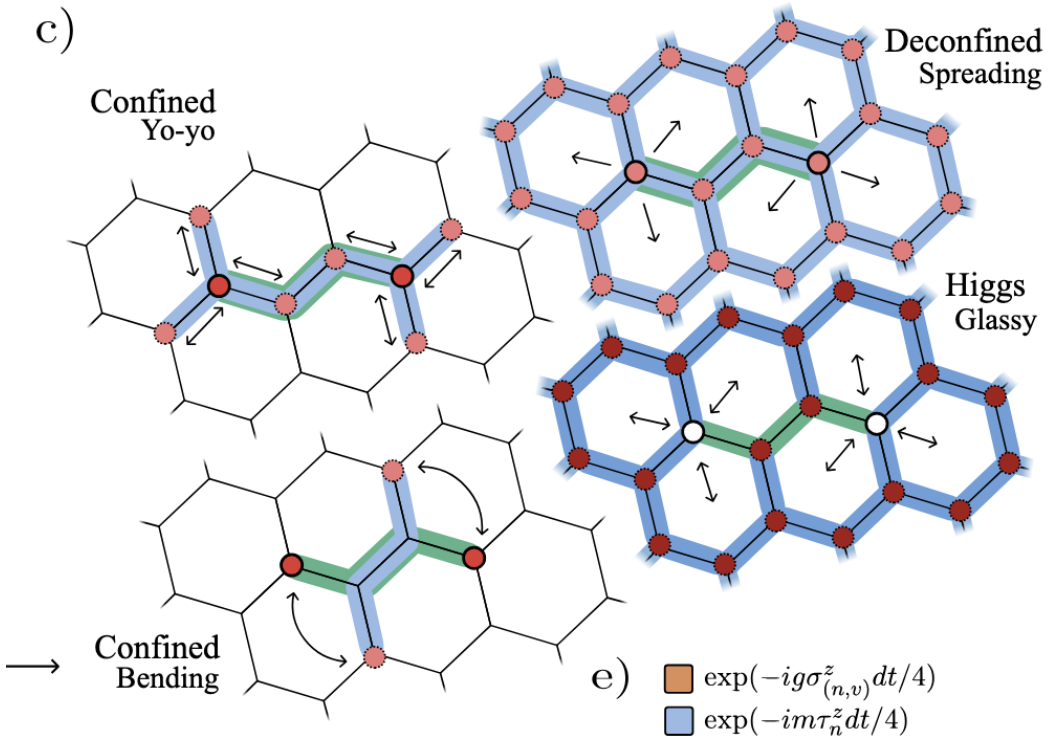
Hamiltonian simulation

BasQ and IBM researchers simulated the behavior of quarks and strong force interactions in a simplified model of nature.

This work pushed boundaries of scale, using 144 qubits and 7,862 two-qubit gates, establishing a milestone for quantum simulation and elucidated the real time behavior of confining strings.

"We came to the conclusion that this could be a really key enabling technology, that could help us keep producing excellent science, technology, and innovation... So the Basque government made a strong, institutional bet on quantum computing."

Javier Aizpurua
Scientific Director of the Basque Quantum Initiative



The figure above shows four modes of quark and strong force behavior in the simplified model of physics. These simplified models can offer real insights into the nature of matter in the universe, and this work shows the power of quantum computers to run models at scale.

Read the paper → arxiv:2507.08088
Read the blog→ ibm.com/quantum/blog/basque-quantum-leadership

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At IBM, we're building an open software ecosystem that gives users the capabilities and tools they need to extract value from quantum computers in a scalable way.

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Our IBM mission

Bring useful quantum computing to the world

Make the world quantum safe



BIZTOPIX 2026

Na valovih digitalne suverenosti

📅 24. in 25. november 2026

📍 Grand Hotel Bernardin, Portorož

Torek, 24. 11. 2026	
08:30 - 09:30	**Registracija**
09:30 - 09:35	**Otvoritev**
09:35 - 09:50	**IBM pozdravni nagovor** ROBERT BOŽIČ, Izvršni direktor IBM Slovenija LANA ILOVIĆ, Generalna direktorica in vodja tehnologije za regijo IBM CET
09:50 - 10:20	**The Future of Tech: The AI-Quantum Revolution** DR. ALESSANDRO CURIONI, IBM Fellow, VP IBM Research and Director IBM Research Zurich, Switzerland
10:20 - 10:40	**Open by Design - Your Platform. Your AI. Your Choice.** WOJCIECH FURMANKIEWICZ, Head of Technology Sales for CEE at Red Hat
10:40 - 11:00	**Vision 2030: Agentic Runtime Security and the Future of Enterprise Tech** ANNA MCDOUGALL, IBM HashiCorp Field CTO
11:00 - 11:30	**ODMOR ZA MREŽENJE**

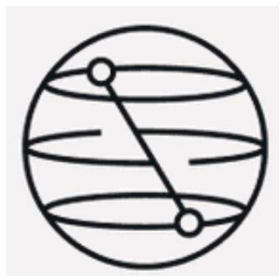
Spoštovani!

Vabimo vas, da si rezervirate datum, 24. in 25. november 2026 za udeležbo na BIZTOPIX2026

konferenci, kjer bomo skupaj raziskovali, kako v dobi umetne inteligence ohraniti nadzor nad podatki, sistemi in digitalno prihodnostjo ter obenem pospeševati inovacije.

PRIJAVITE se lahko že danes z promocijsko kodo **BIZTOPIX@IBM#VIP,** ki vam zagotavlja brezplačno udeležbo.

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