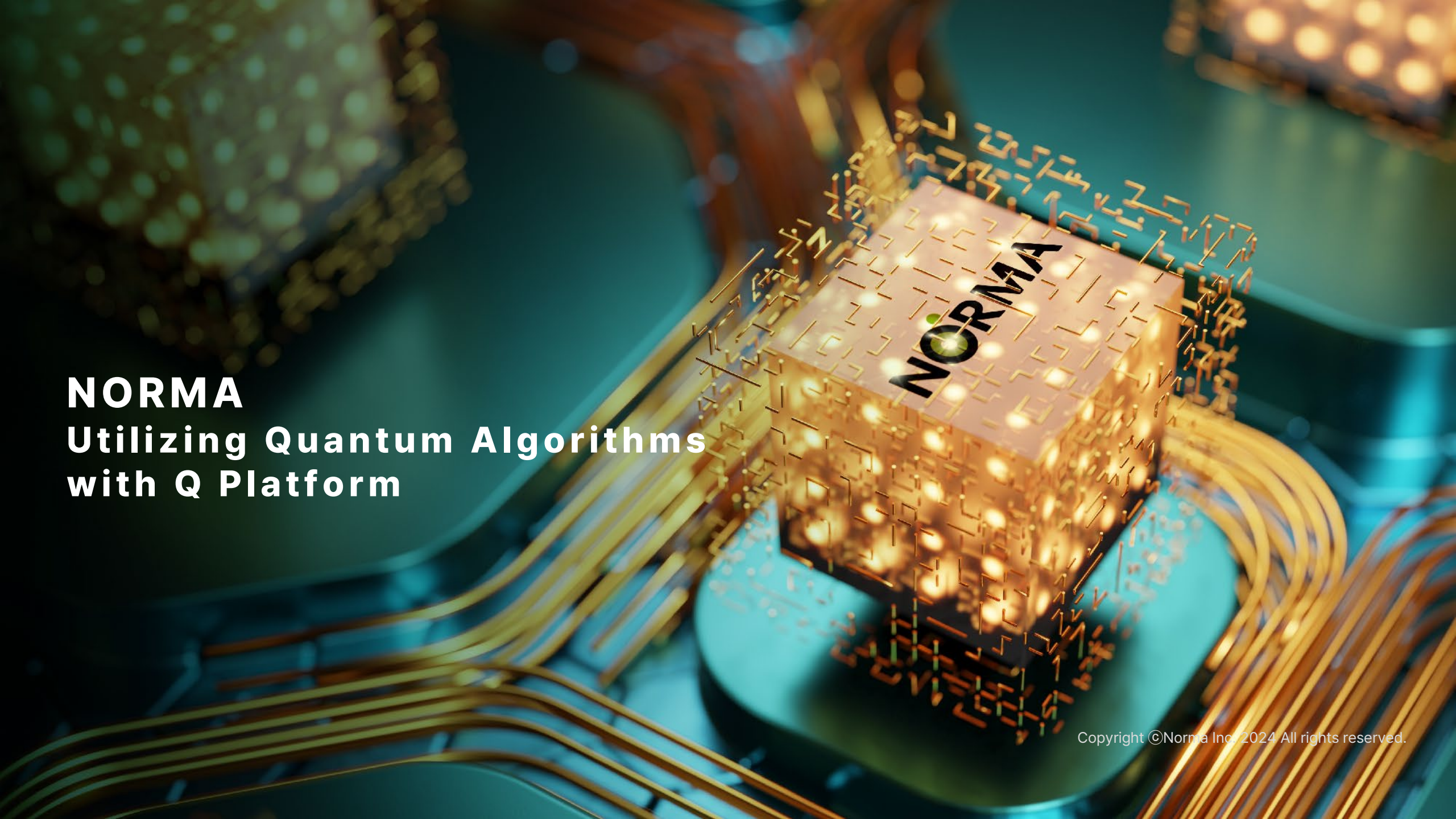


NORMA
Utilizing Quantum Algorithms with Q Platform

The Next Q Platform

Norma leads in quantum innovation, providing a unique platform for superior computing and robust Post-Quantum Cryptography (PQC) security. As pioneers, we accelerate the quantum era's growth with our expertise in computing and security.

Norma Quantum Services

Q Platform | Operating System

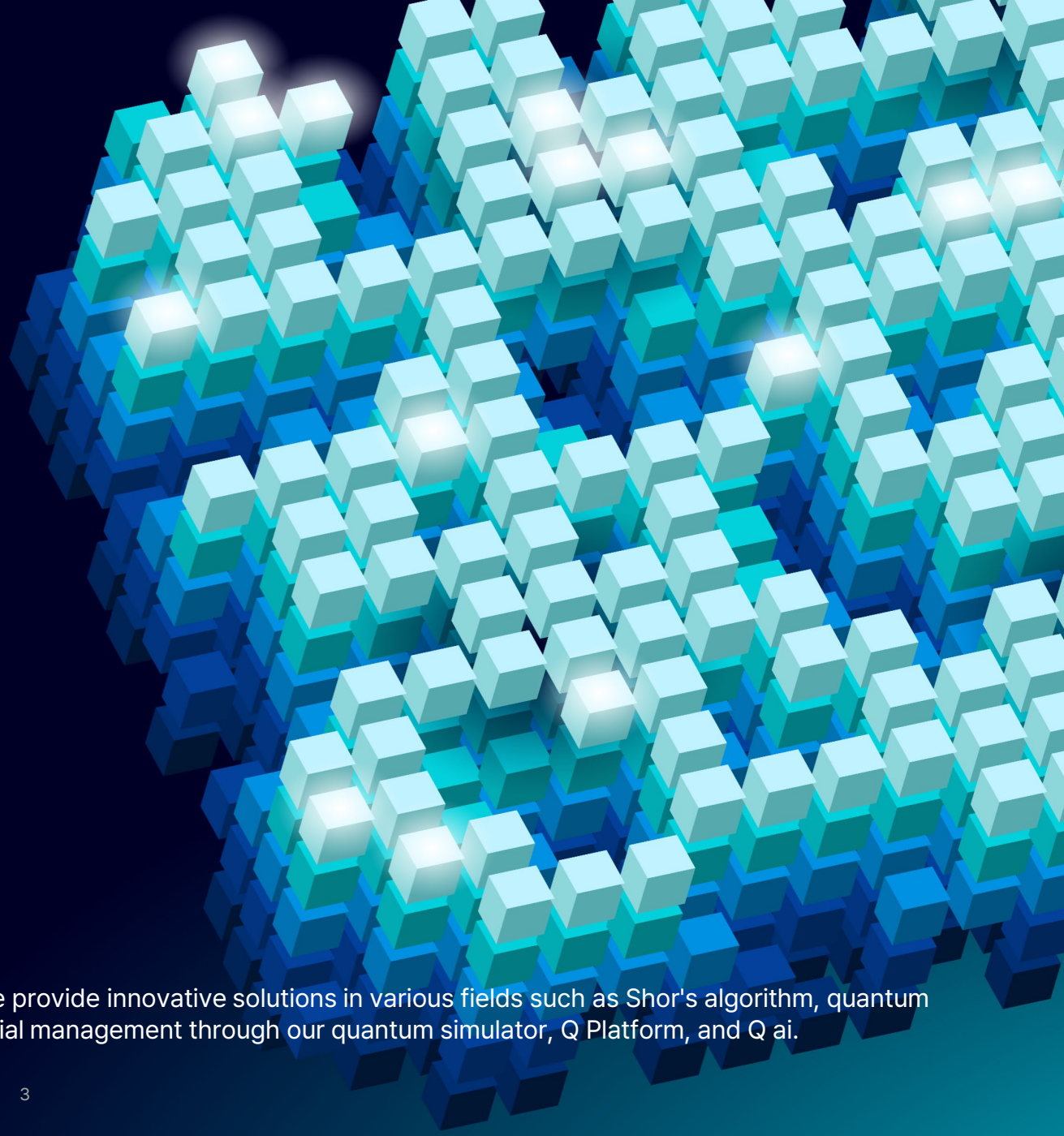
Provides quantum simulators and SDKs

Q AI | Application

Supports quantum AI solutions for technological innovation

Q Computing | Hardware

R&Ds, Consults for quantum computers

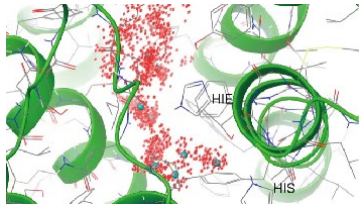


- As the only company in Korea developing quantum supremacy applications, we provide innovative solutions in various fields such as Shor's algorithm, quantum traffic management systems, quantum drug development, and quantum financial management through our quantum simulator, Q Platform, and Q ai.

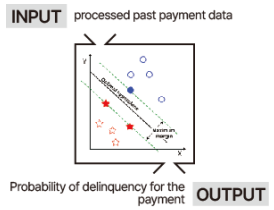
Norma Quantum Services

Q AI

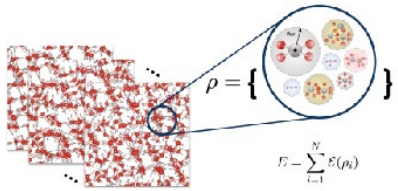
Pharmaceuticals/Biotechnology



Finance



New Materials



Aerospace/Space Exploration

Q Platform

Simulator

NVIDIA, QPlayer

SDK

Qiskit, PENNYLANE, Turing

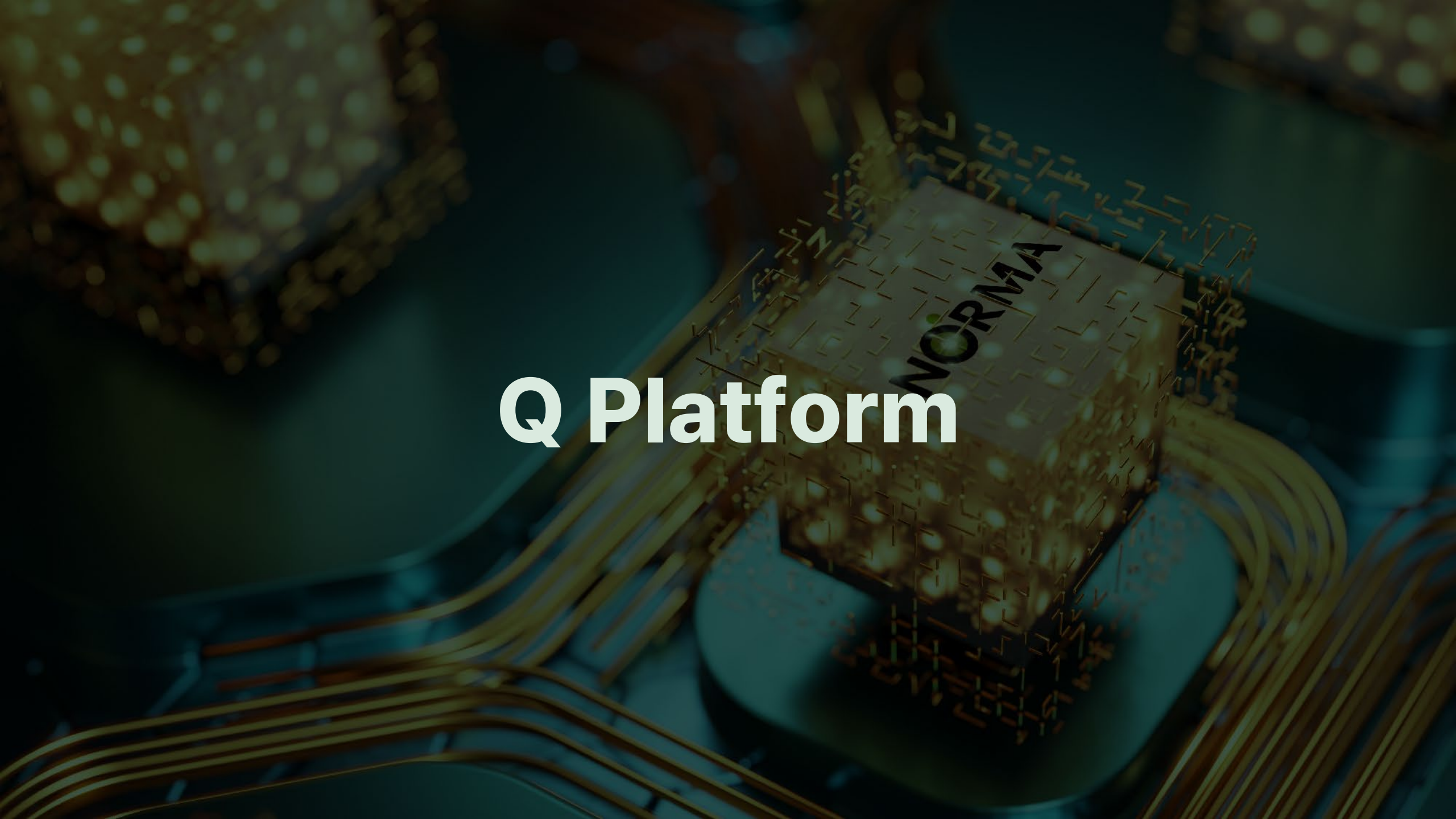
Q Computing

R&D

IQM, QUANDELA, KiSTi, QUANTUM ENGINEERING PROGRAMME SINGAPORE, VTT, KQIA, SOTATEK

Consulting

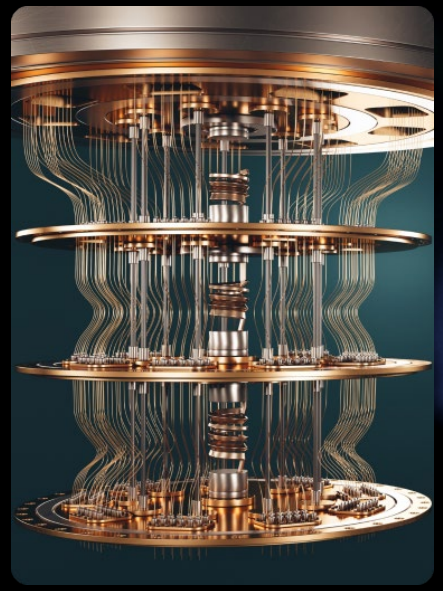
IBM, ENTRUST, STRANGE WORKS

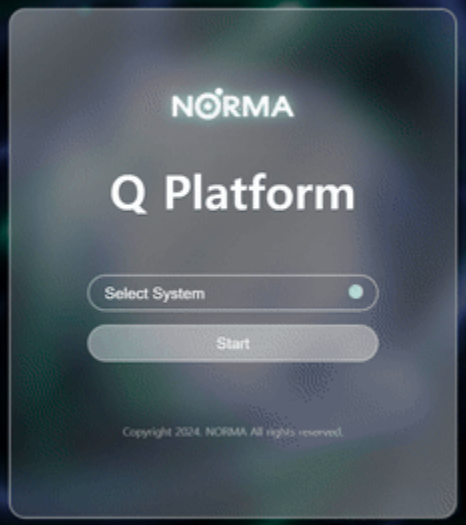


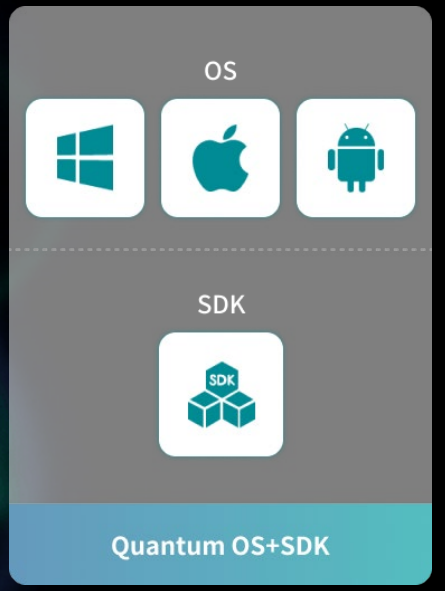
Q Platform

Q Platform

The Q Platform is an innovative platform that leverages the principles of quantum mechanics to enable complex computations. It provides a user-friendly development environment and powerful simulation tools, significantly enhancing the accessibility and efficiency of quantum computing.







Features

- Innovative quantum computing platform based on the principles of quantum mechanics.
- Utilizes interference and entanglement to perform complex calculations.
- Applicable to various tasks including factorization and quantum simulation.

Main Components

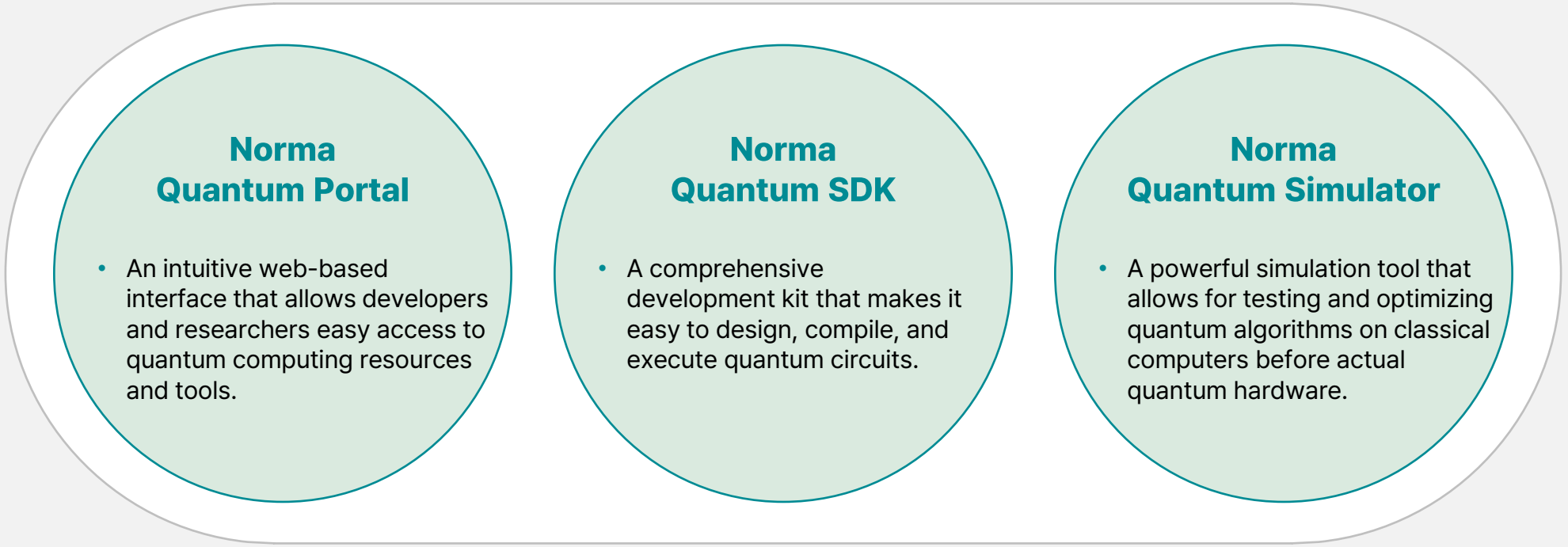
- Quantum Portal: Supports access to various quantum computing resources and tools.
- Quantum SDK: Provides a comprehensive environment from quantum circuit design to execution.
- Quantum Simulator: Supports quantum circuit simulation on classical computers.

Functionality

- Provides a user-friendly environment to enhance accessibility to quantum computing.
- Supports compatibility with various operating systems and third-party platforms.

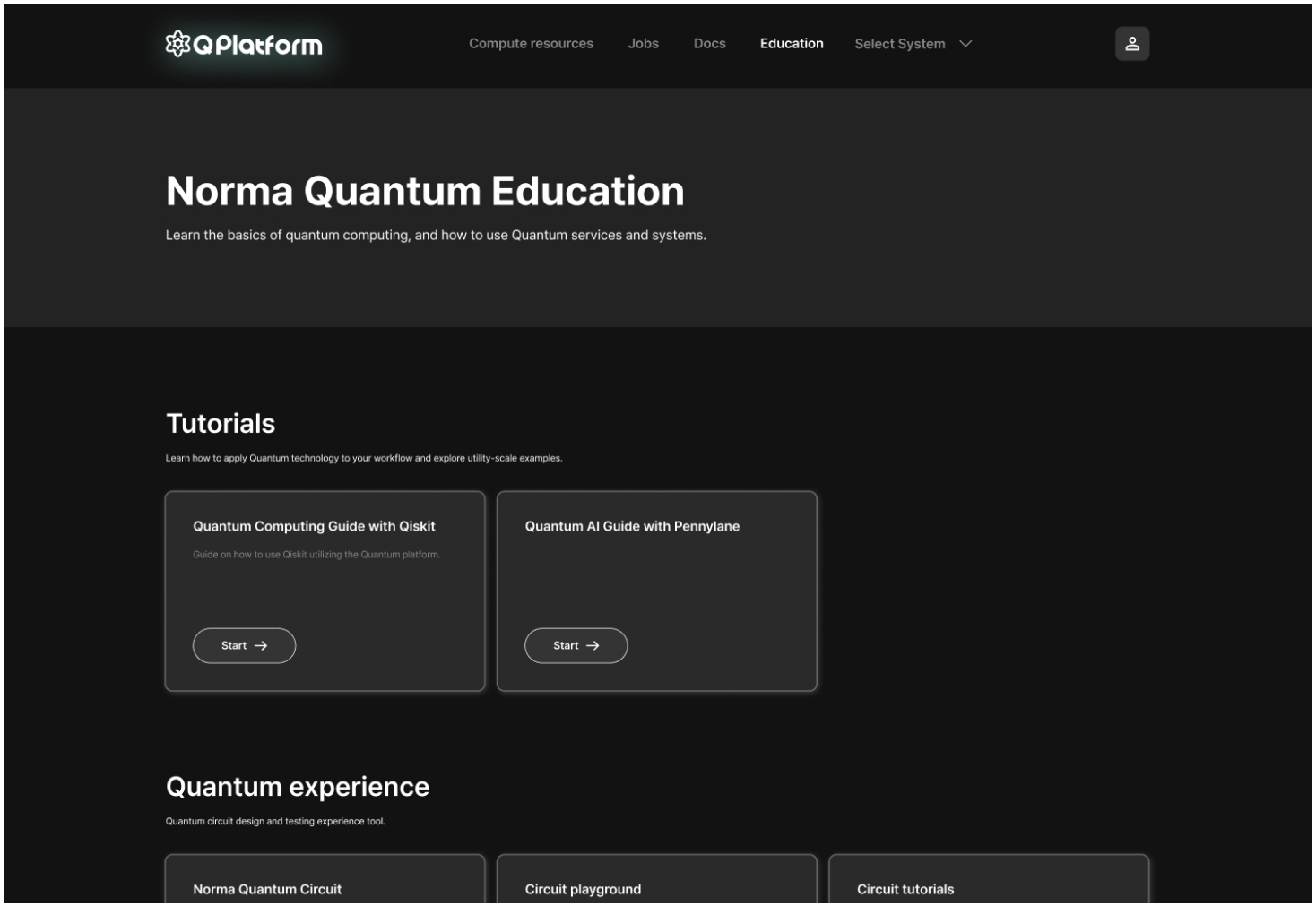
Q Platform

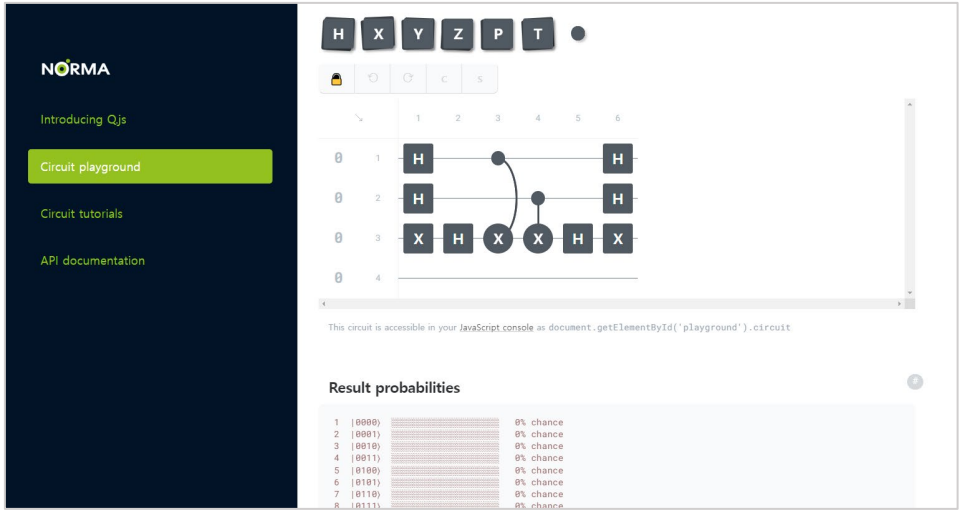
The Q Platform enables users to explore new solutions through quantum technology, solve tangible problems, and lead future-oriented innovations. It is an essential tool for realizing the potential of quantum computing and driving industry-wide changes.

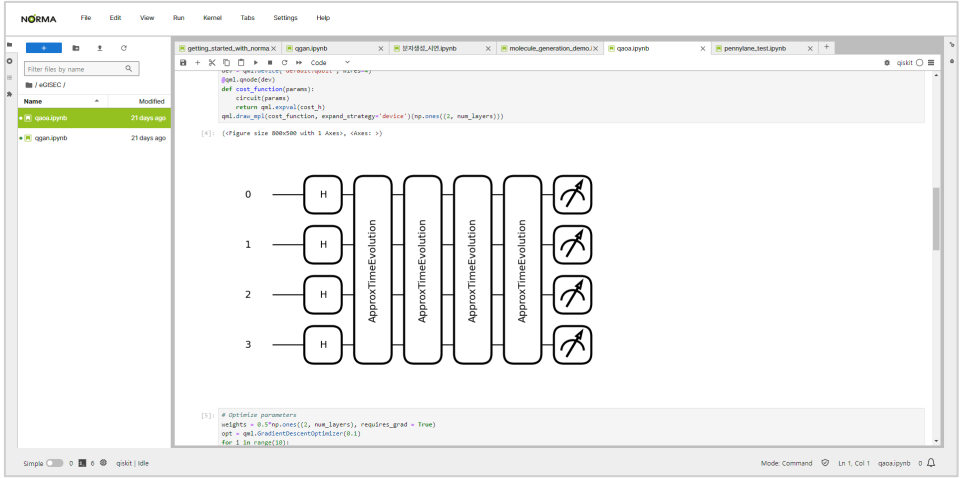


Key Features - Education

We offer education on fundamental technologies such as quantum theory and circuits, as well as a variety of quantum development examples and tutorials, including quantum algorithms, machine learning, optimization, and simulation.

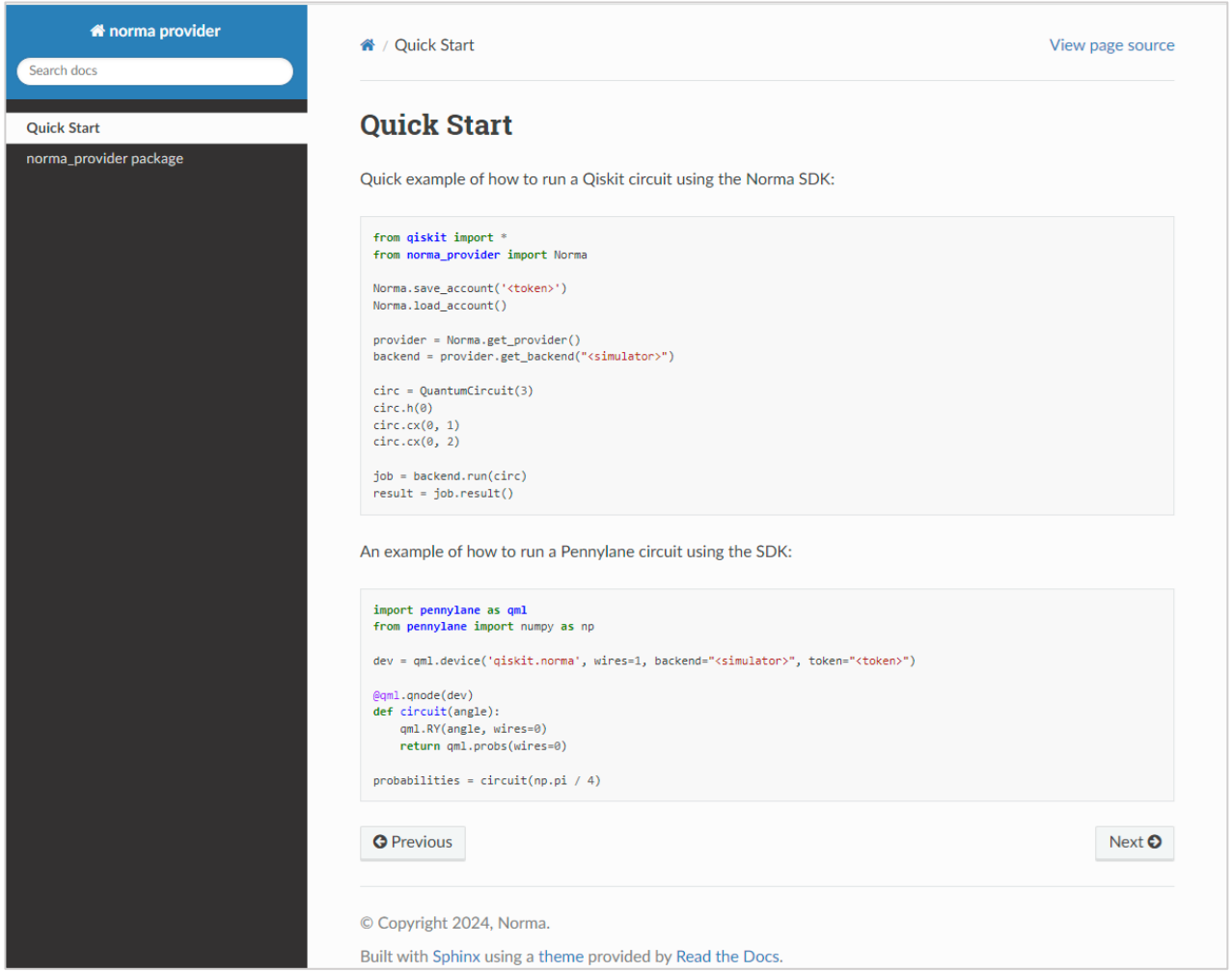


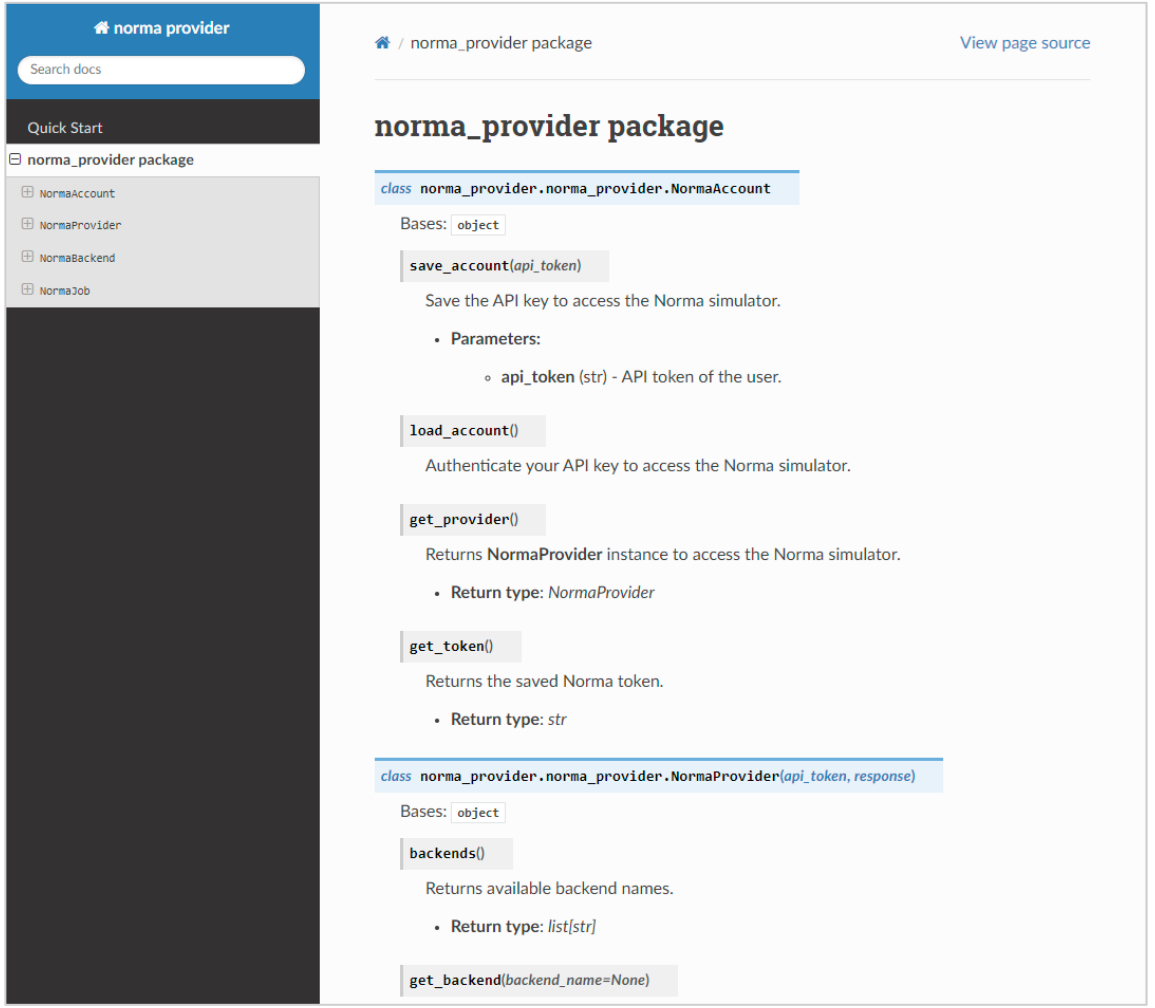




Key Features - User Guide and Application

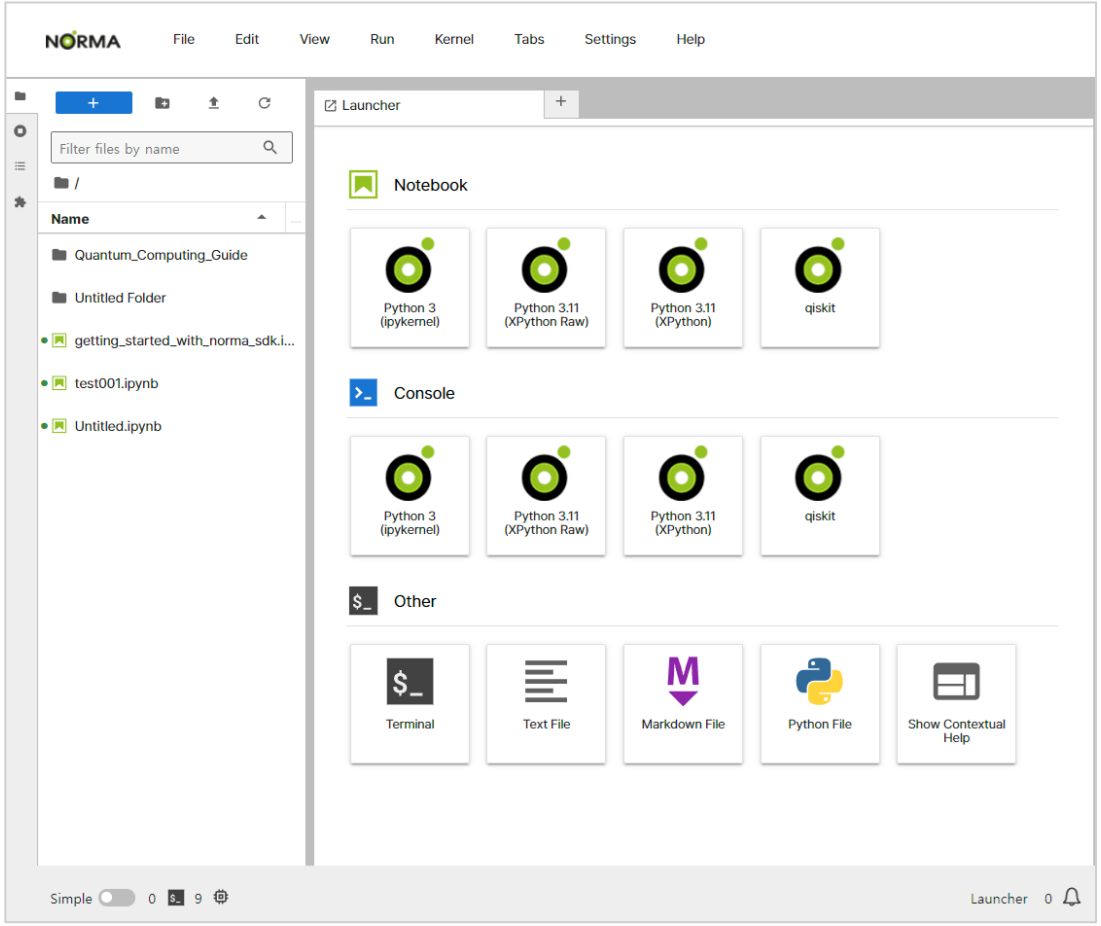
We provide comprehensive documentation, including a user guide on how to use and apply the Norma Quantum Platform and an API reference for backend integration with simulators and quantum computers.

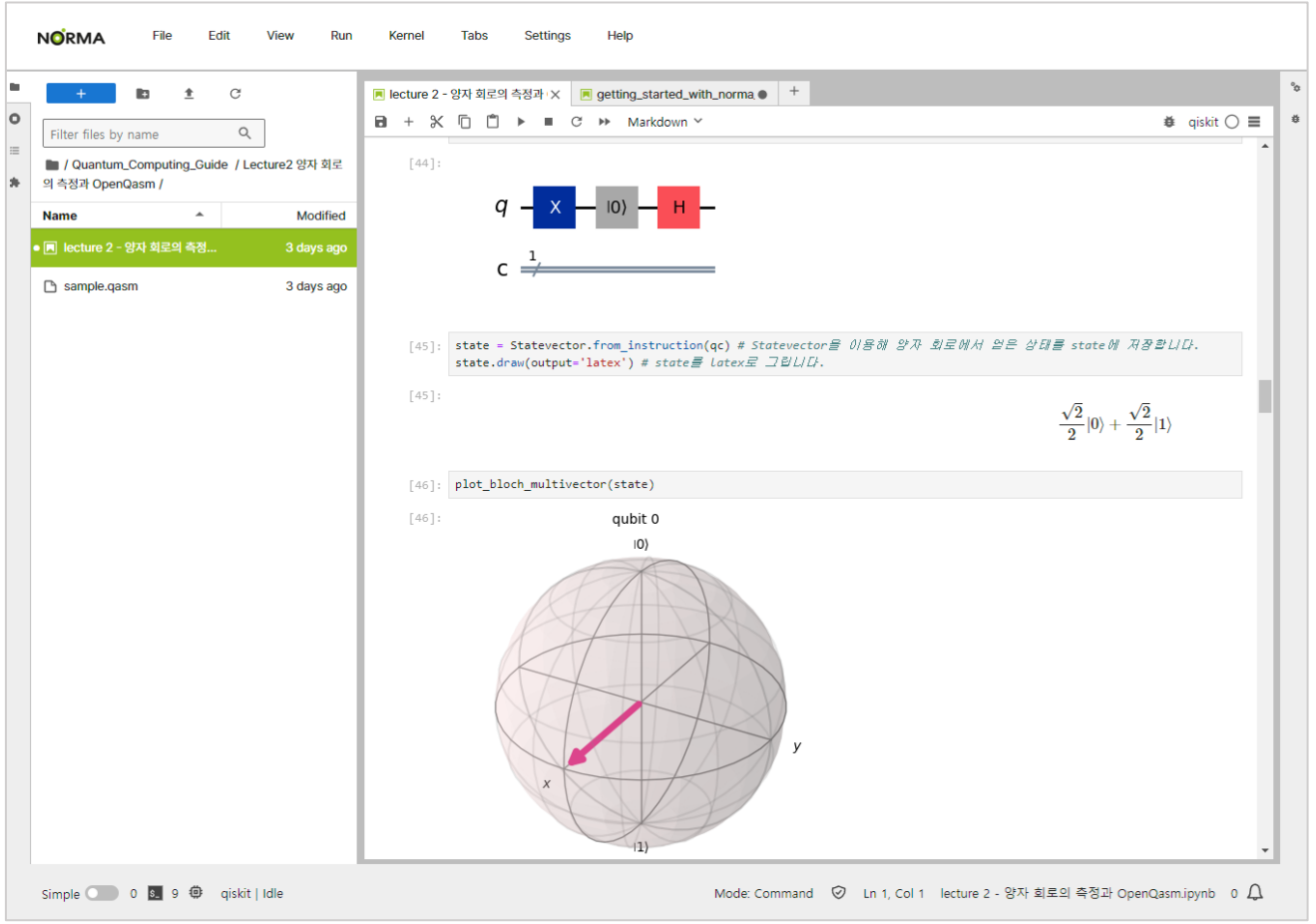




Key Features - SDK

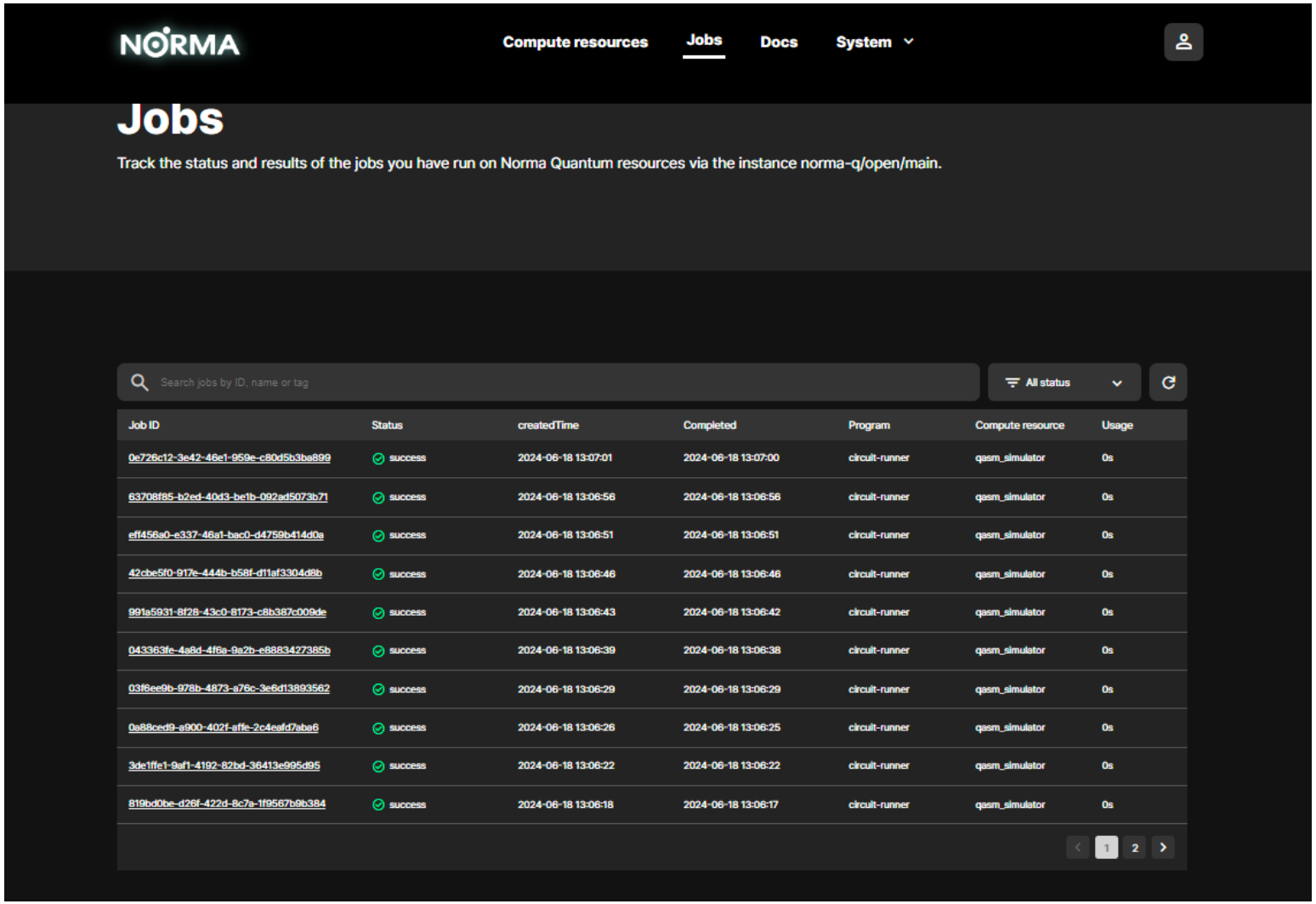
The Norma Quantum SDK supports languages and libraries for programming quantum algorithms. It provides tools to develop complex quantum logic as modules and includes tools to integrate with Qubit backends.

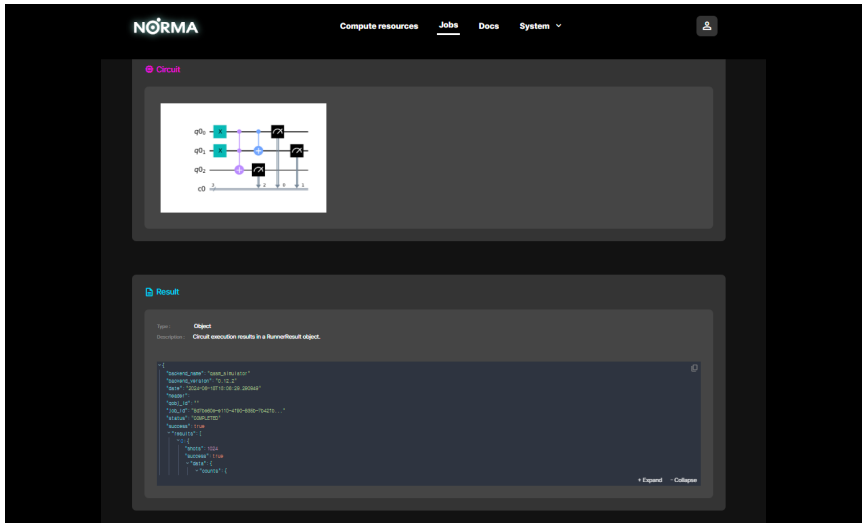




Key Features - Job History

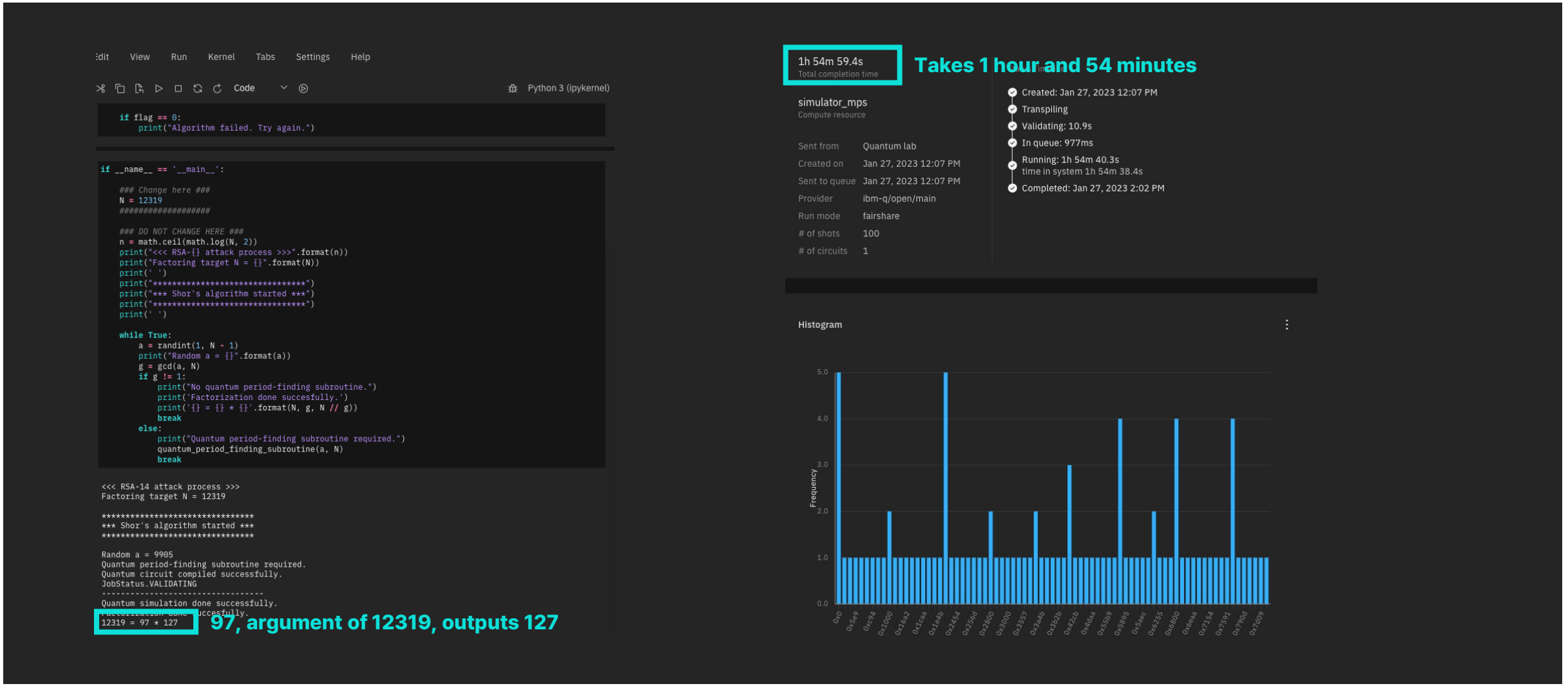
Track, analyze, and reuse the execution history of quantum programming tasks to enhance job efficiency and achieve cost savings.

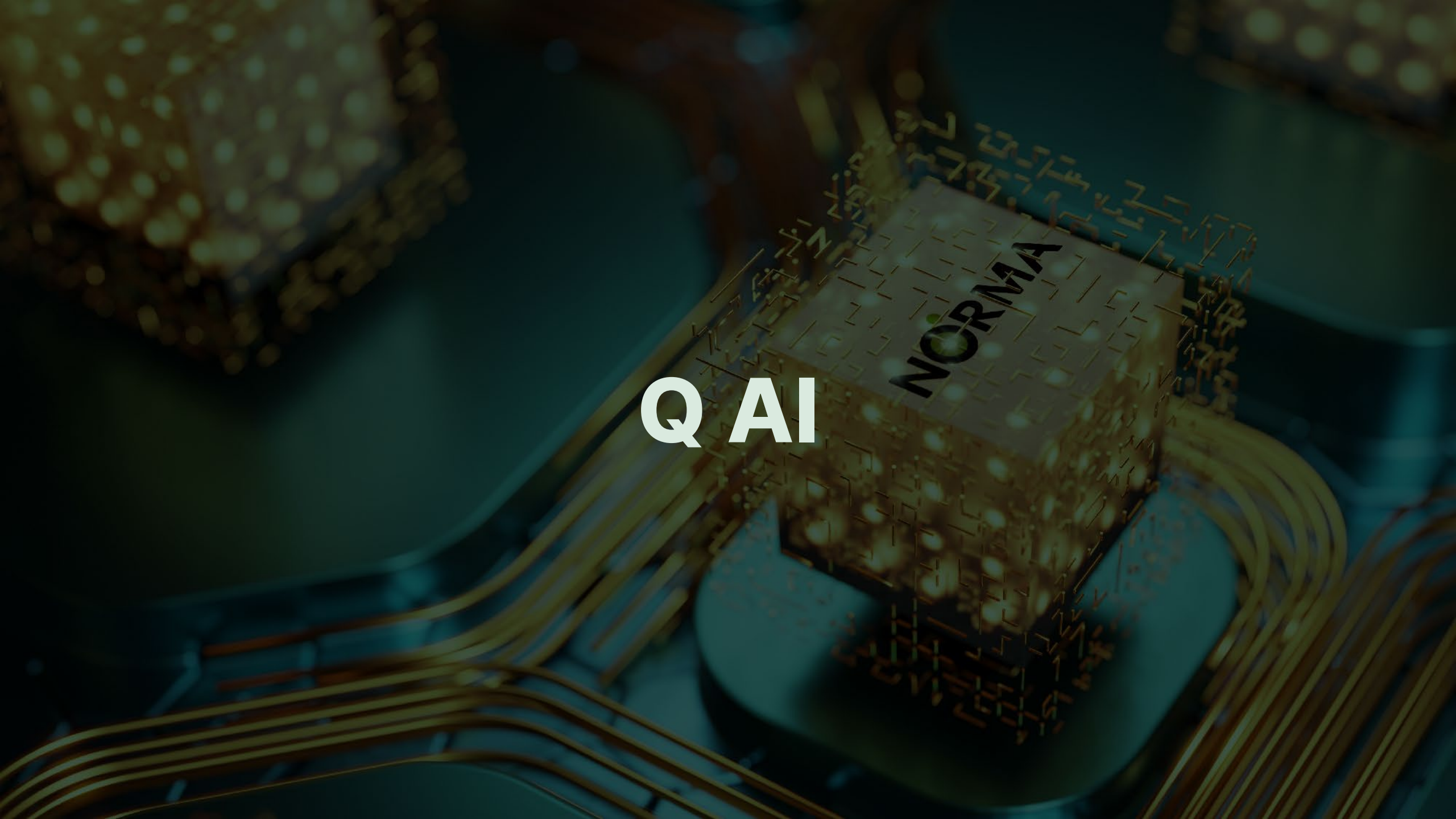




Q Platform Use Cases - RSA Key Cracking

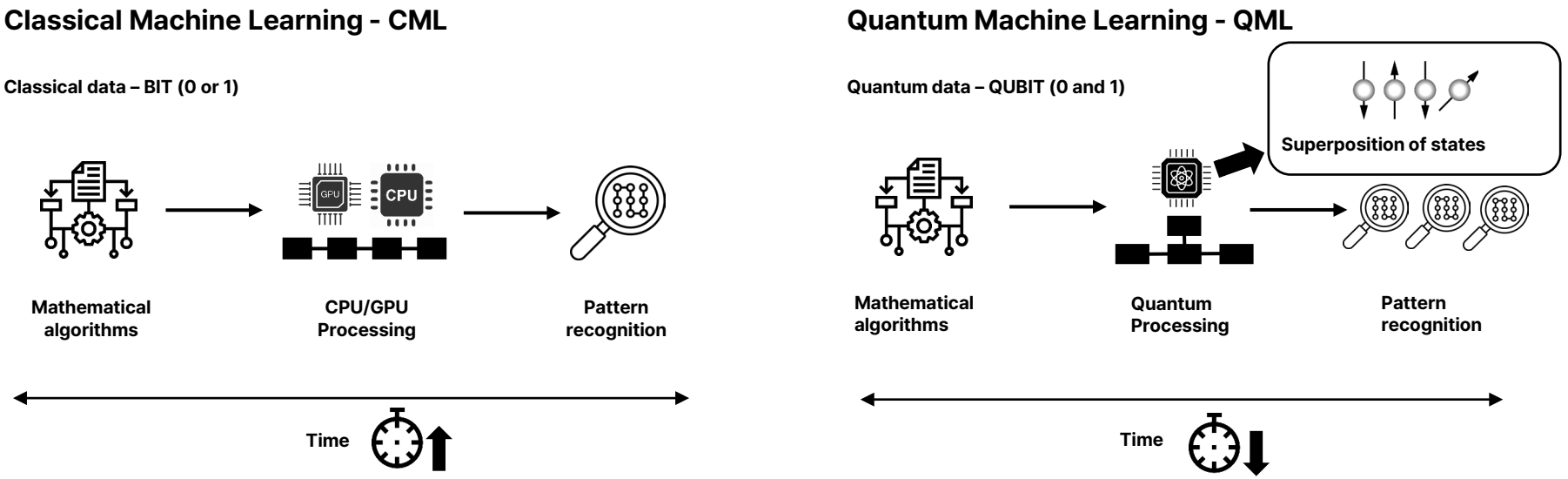
The Q Platform has a practical use case where it demonstrated an attack using a quantum computer to crack RSA keys.





Q AI

Advantages of Q AI



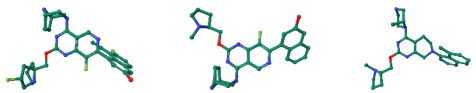
Advantages of using Quantum Computers for AI

- Useful when large computational resources are needed for training high dimensional data
- Utilizes superposition and entanglement
  → Speed-up over conventional methods in certain cases

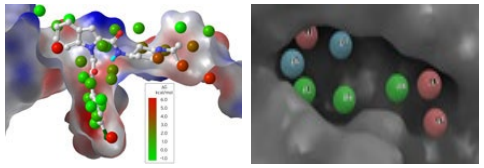
Q AI Use Case – inCerebro Drug Design Project

Training Data Preparation

Gather Ligands from Experiments



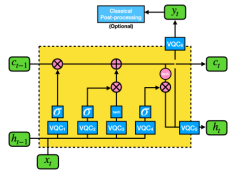
Target-specific Virtual Screening of the Ligand Library



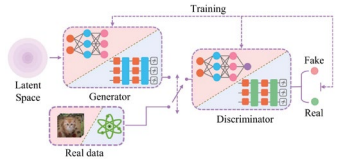
Quantum Computing

Generative AI for Small Molecules

Seq2seq w/ QLSTM

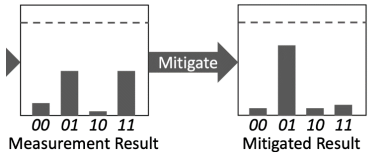


Quantum Hybrid GAN



Quantum Platform·Computer

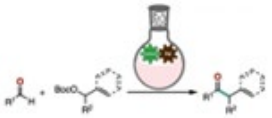
Quantum Error Mitigation



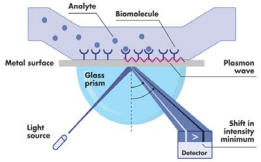
Algorithm Optimization for Hardware

Quantum Advantage Verification

Select and Synthesize Drug Candidate



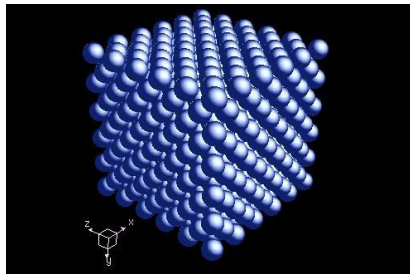
Measure Binding Affinity with Target Protein



Compare with Classical AI Generated Molecules to Verify Quantum Advantage

- Generate ligands that act as inhibitors of a target protein
- Train AI using available ligand datasets → Generate ligands using the trained model → Verification with in vitro experiments
- Potentially achieve quantum advantage using quantum machine learning models (QLSTM, QGAN)
- **Received research grant from the National Research Foundation of Korea**

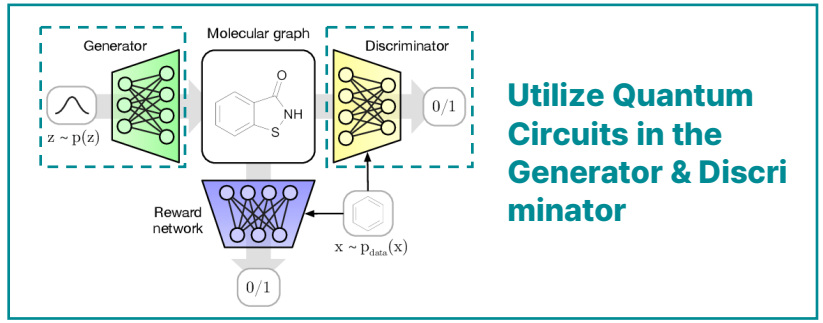
Q AI Use Case- CO2 Reduction Reaction Catalyst Design



Encoding and Preprocessing

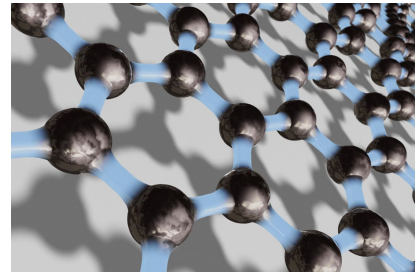
P	15	15	30.974	1.750	1.060	Orange
S	16	16	32.060	1.850	1.020	Yellow
Cl	17	17	35.453	1.800	0.990	Green
K	19	19	39.098	1.440	2.030	DeepPink
Ca	20	20	40.080	1.180	1.740	Grey
Sc	21	21	44.956	1.370	1.440	Pink
Ti	22	22	47.900	1.370	1.320	Green
V	23	23	50.941	1.370	1.220	Grey
Cr	24	24	51.996	1.370	1.180	Blue
Mn	MN2	25	54.938	1.370	1.170	Green
Mn	MN3	25	54.938	1.370	1.170	Red
Mn	MN4	25	54.938	1.370	1.170	Purple
Fe	26	26	55.847	0.900	1.170	Orange
Co	27	27	58.933	0.880	1.160	Brown
Ni	28	28	58.710	0.690	1.150	Brown
Cu	29	29	63.540	0.720	1.170	Red
Zn	30	30	65.370	0.740	1.250	Brown
Ga	31	31	69.720	1.370	1.260	Pink

Input into the Generative Model



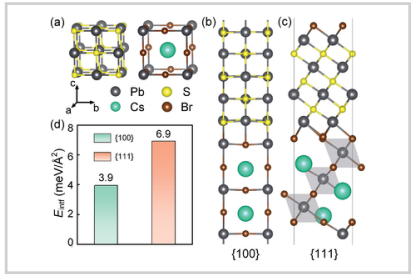
Utilize Quantum Circuits in the Generator & Discriminator

Generative Model Output (New Material)



Evaluate using Quantum Chemistry Calculations

성균관대학교 SUNG KYUN KWAN UNIVERSITY



Experimental Verification

충남대학교 Chungnam National University

Design Success or Evaluate & Feedback

- The electrochemical CO2 reduction reaction (CO2RR) decreases CO2 emissions and creates useful byproducts
- Discovering promising CO2RR catalysts has become a meaningful task, with machine learning being applied to accelerate discovery
- This project aims to create new catalysts using generative quantum machine learning

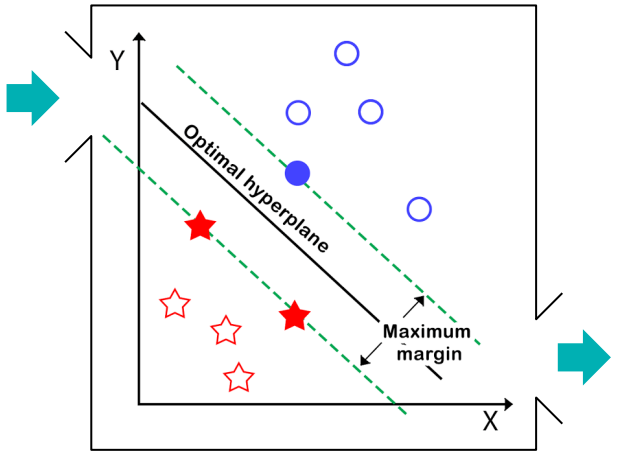
Q AI Use Case - HectoFinancial Quantum Credit Scoring System (CSS)

Input

Historical payment data

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	...	V22	V23	V24
0	-1.359807	-0.072781	2.536347	1.378155	-0.338321	0.462388	0.239599	0.098698	0.363787	0.090794	...	0.277838	-0.110474	0.066928
1	1.191857	0.266151	0.166480	0.448154	0.060018	-0.082361	-0.078803	0.085102	-0.255425	-0.166974	...	-0.638672	0.101288	-0.339846
2	-1.358354	-1.340163	1.773209	0.379780	-0.503198	1.800499	0.791461	0.247676	-1.514654	0.207643	...	0.771679	0.909412	-0.689281
3	-0.966272	-0.185226	1.792993	-0.863291	-0.010309	1.247203	0.237609	0.377436	-1.387024	-0.054952	...	0.005274	-0.190321	-1.175575
4	-1.158233	0.877737	1.548718	0.403034	-0.407193	0.095921	0.592941	-0.270533	0.817739	0.753074	...	0.798278	-0.137458	0.141267
5	-0.425966	0.960523	1.141109	-0.168252	0.420987	-0.029728	0.476201	0.260314	-0.568671	-0.371407	...	-0.559825	-0.026398	-0.371427
6	1.229658	0.141004	0.045371	1.202613	0.191881	0.272708	-0.005159	0.081213	0.464960	-0.099254	...	-0.270710	-0.154104	-0.780055
7	-0.644269	1.417964	1.074380	-0.492199	0.948934	0.428118	1.120631	-3.807864	0.615375	1.249376	...	-1.015455	0.057504	-0.649709
8	-0.894286	0.286157	-0.113192	-0.271526	2.669599	3.721818	0.370145	0.851084	-0.392048	-0.410430	...	-0.268092	-0.204233	1.011592
9	-0.338262	1.119593	1.044367	-0.222187	0.499361	-0.246761	0.651583	0.069539	-0.736727	-0.366846	...	-0.633753	-0.120794	-0.385050
10	1.449044	-1.176339	0.913860	-1.375667	-1.971383	-0.629152	-1.423236	0.048456	-1.720408	1.626659	...	0.313894	0.027740	0.500512
11	0.384978	0.616109	-0.874300	-0.094019	2.924584	3.317027	0.470455	0.538247	-0.558895	0.309755	...	0.238422	0.009130	0.996710
12	1.249999	-1.221637	0.383930	-1.234899	-1.485419	-0.753230	-0.689405	-0.227487	-2.094011	1.323729	...	-0.483285	0.084668	0.392831
13	1.069374	0.287722	0.828613	2.712520	-0.178398	0.337544	-0.096717	0.115982	-0.221083	0.460230	...	0.074412	-0.071407	0.104744
14	-2.791855	-0.327771	1.641750	1.767473	-0.136588	0.807596	-0.422911	-1.907107	0.755713	1.151087	...	0.222182	1.020586	0.028317

including transaction dates, transaction amounts, and the number of delinquencies



Quantum machine learning-based credit evaluation models (QSVM, VQC)

Output

Probability of delinquency for the given payment

79%

- HectoFinancial utilizes past mobile payment histories of its users to develop a credit evaluation model.
- This model estimates future financial risk based on the past data of the individual being assessed.
- By applying quantum machine learning models (QSVM, VQC) to the traditional credit scoring system, the performance of the credit evaluation model is enhanced, resulting in improved predictions of delinquency probabilities for payments.

Quantum Computer Development/Service

Strategy for In-House Quantum Computer Development

Norma is committed to developing its own quantum computer by building a CUDA Quantum-based simulation infrastructure, incorporating global technologies, and promoting the commercialization of quantum technologies through Quantum AI.

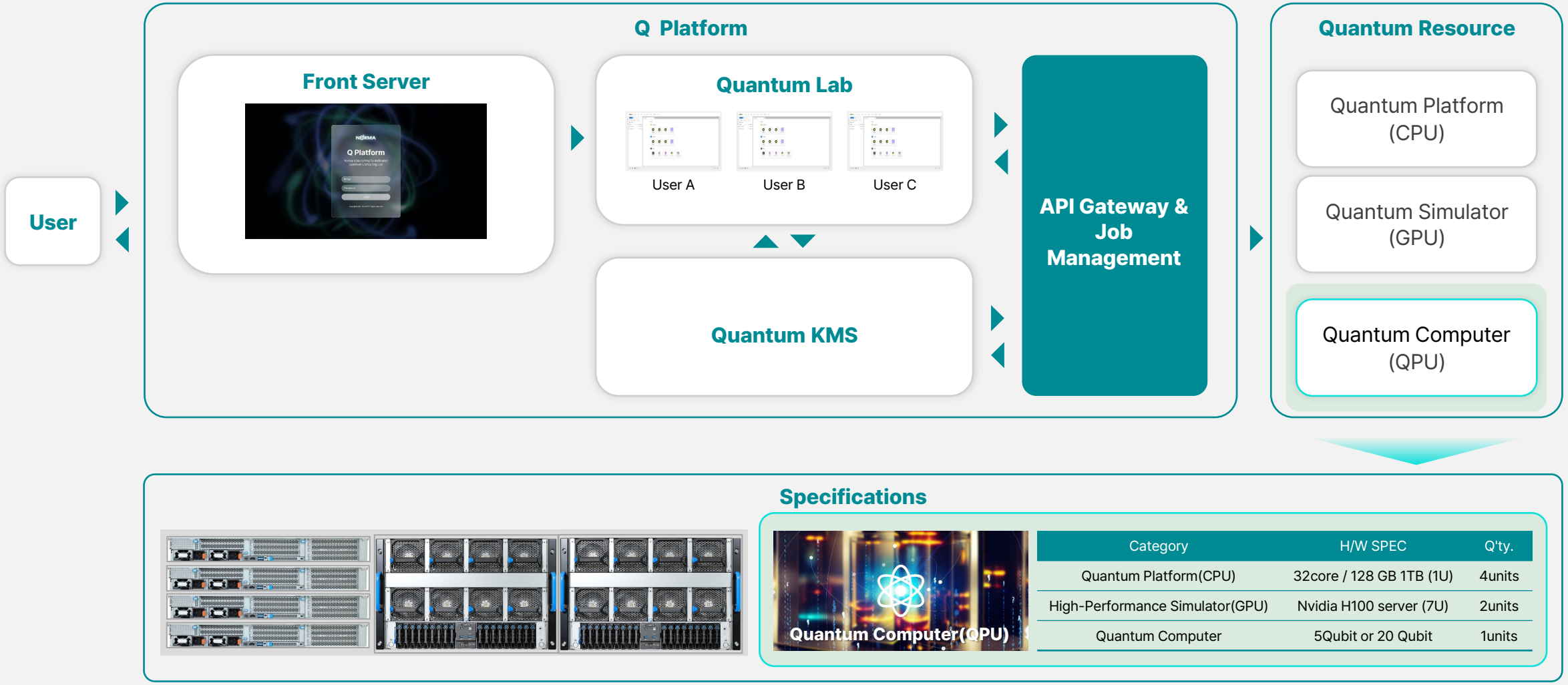
Objectives

Advance quantum computer technology and foster an ecosystem through the development of applications utilizing Quantum AI

- ✓ Establish a development platform for the creation and application of AI algorithms based on quantum computing.
- ✓ Upgrade existing AI technologies with quantum computing and develop new Quantum AI applications.
- ✓ Promote industrial innovation and the commercialization of quantum technology.

Phase 1	**Initial Infrastructure Research**	• Goal: Establish a quantum development platform. • Details: Create a user-friendly development environment to improve accessibility. • Expected Outcomes: Activate quantum computing technology and validate initial technologies.
Phase 2	**Development of GPU-Based High-Performance Quantum Simulator**	• Goal: Utilize the Nvidia CUDA Quantum platform to build a high-performance quantum simulator. • Details: Provide a simulation environment for testing and validating complex quantum algorithms. • Expected Outcomes: Accelerate research and development and develop demonstrable technologies.
Phase 3	**Supply of Quantum Computers**	• Goal: Secure actual quantum computers through collaboration with domestic or global partners. • Details: Enhance research capabilities by introducing leading technologies from around the world. • Expected Outcomes: Commence practical quantum computing research and expand international collaboration networks.

Strategy for In-House Quantum Computer Development

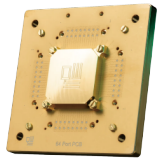


Specifications

Category	H/W SPEC	Q'ty.
Quantum Platform(CPU)	32core / 128 GB 1TB (1U)	4units
High-Performance Simulator(GPU)	Nvidia H100 server (7U)	2units
Quantum Computer	5Qubit or 20 Qubit	1units

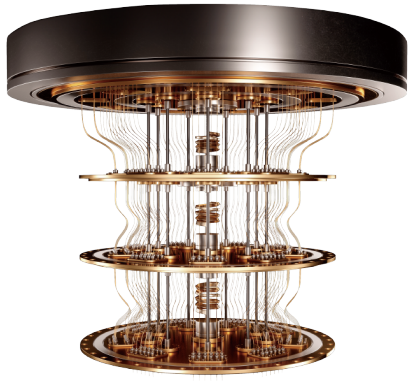
In-House Quantum Computer Development

Q Computing is a quantum computer that operates with the Q Platform (OS), developed in collaboration with multiple companies, including VTT and BLUEFORS.



QPU

Superconducting
Quantum Processor



Cryogenic Refrigerator

Qubit Controller

Qubit Measurement
and Control System

Q Platform

Quantum Algorithm
Programming

Joint Development

QUANTWARE VTT KRISS 한국표준과학연구원 DOOJIN (주)두진 Zurich Instruments

Norma Quantum Computer Development Roadmap

2023

- Technology Cooperation Agreements with Global Companies
- Launch of Q Platform

2024

- Integration with Global Quantum Hardware Companies
- R&D with Domestic Quantum Computer Component Developers

2025

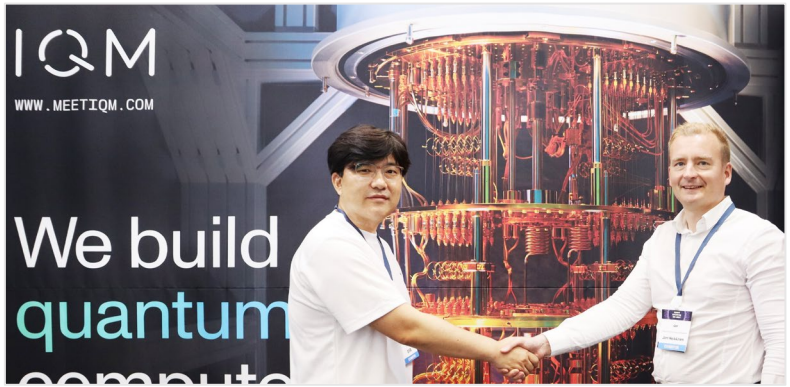
- Release of Norma's In-House Quantum Computer Prototype


Business Strategy
and Vision

Partnerships

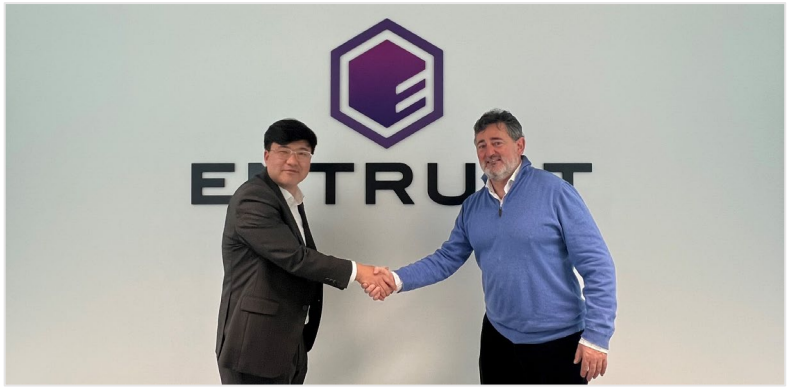
Collaboration with leading quantum security and computing firms worldwide for joint solutions and technology exchange.

Established a PQC VPN with U.S. company IONQ and collaborated on quantum resources.



Partnered with Finland's IQM for quantum computing research and utilization in Europe.

Collaborated with IBM on utilizing quantum computing and PQC encryption.



Partnered with Entrust for PQC encryption standards in Europe.

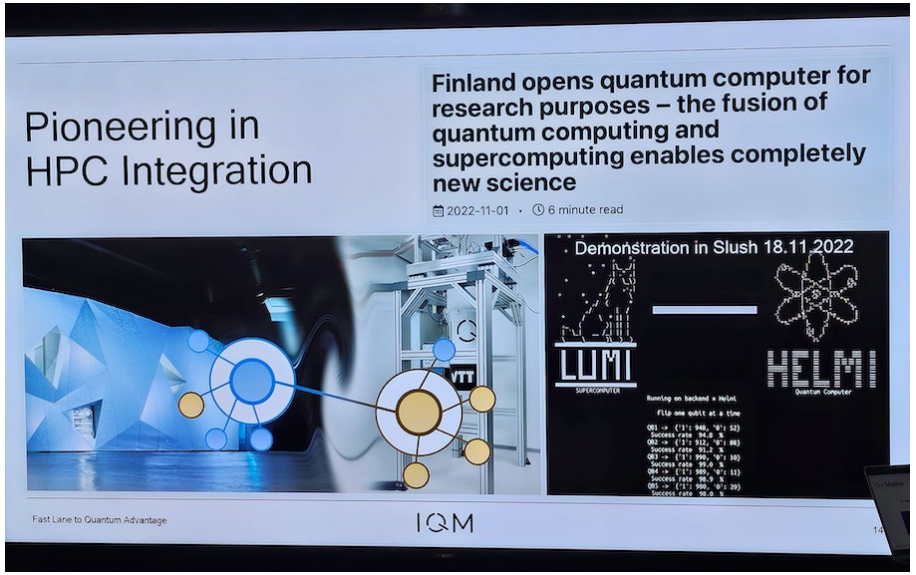
Engaged in talks with France's Quandela for photonics-based quantum computing cooperation.

Signed an MOU with Saudi Arabia's ITB for exporting quantum security solutions.

Norma's European Tour for Quantum Computer Companies and Collaboration Discussions

NORMA Utilizing Quantum Algorithms with Q Platform Business Strategy and Vision

Norma's European Tour for Quantum Computer Companies and Collaboration Discussions



Norma's Visit and Residency Discussions at Quantum Basel, Switzerland

NORMA Utilizing Quantum Algorithms with Q Platform Business Strategy and Vision

Global Quantum Alliance with IQM, VTT, BLUEFORS, NVIDIA, and More

Norma is forging a global quantum alliance with leading quantum companies through these strategic technological collaborations, we aim to create a superior quantum world

Norma's Global Partnerships

QUANDELA · NVIDIA · BLUEFORS · IQM · QuantumBasel · Zurich Instruments · SANDBOXAQ · VTT · IQuEra Computing Inc. · QUANTWARE

NORMA

Quantum Momentum

Contact +82-2-923-1988 Seongdong-gu, Achasan-ro 15-gil 52, Samhwan Digital Venture Tower, Suite 202-203 www.norma.co.kr