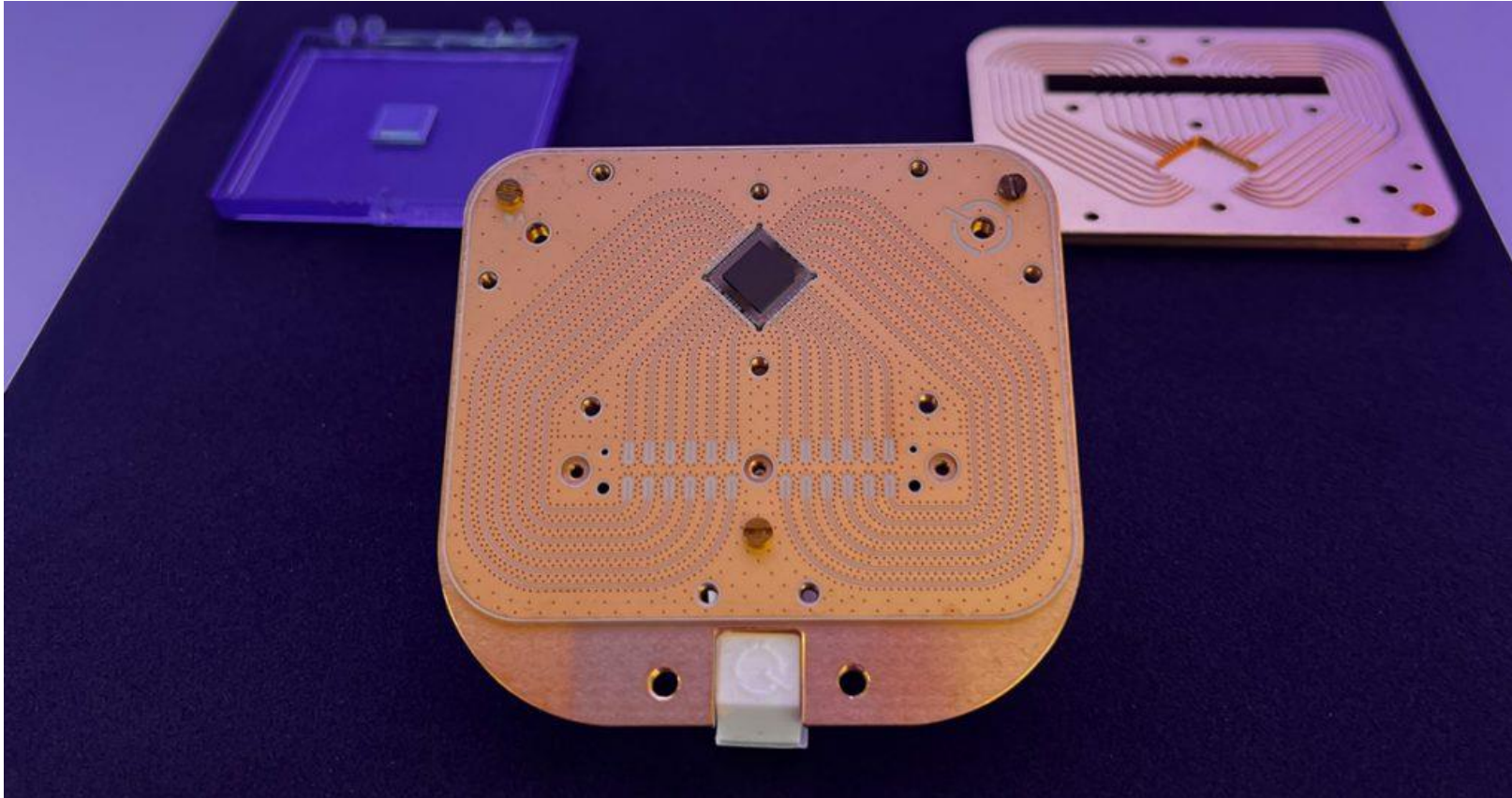


Small steps and quantum leaps – insights from DeiC's quantum activities



DeiC Conference 2025 – October 29, 2025



The new VLQ quantum computer contains 24 superconducting qubits in a star-shaped topology and will be available to users in Denmark!

Outline

1. Introduction to DeiC's Quantum Department

2. Quantum Overviews, Guides, and Tutorials

- a. DeiC's New Quantum Guide
- b. Quantum Stakeholder Overview
- c. Proof-of-concept Quantum Use Cases

3. LUMI-Q Consortium + VLQ Access

4. Q-Access

- a. Consulting Service and Office Hours
- b. Sandbox Access
- c. Calls for specialized Access
- d. VLQ Access

5. Q-Competence

6. Q-Algorithm

7. Niels Bohr Quantum Summer School

1. Introduction to DeiC's Quantum Department

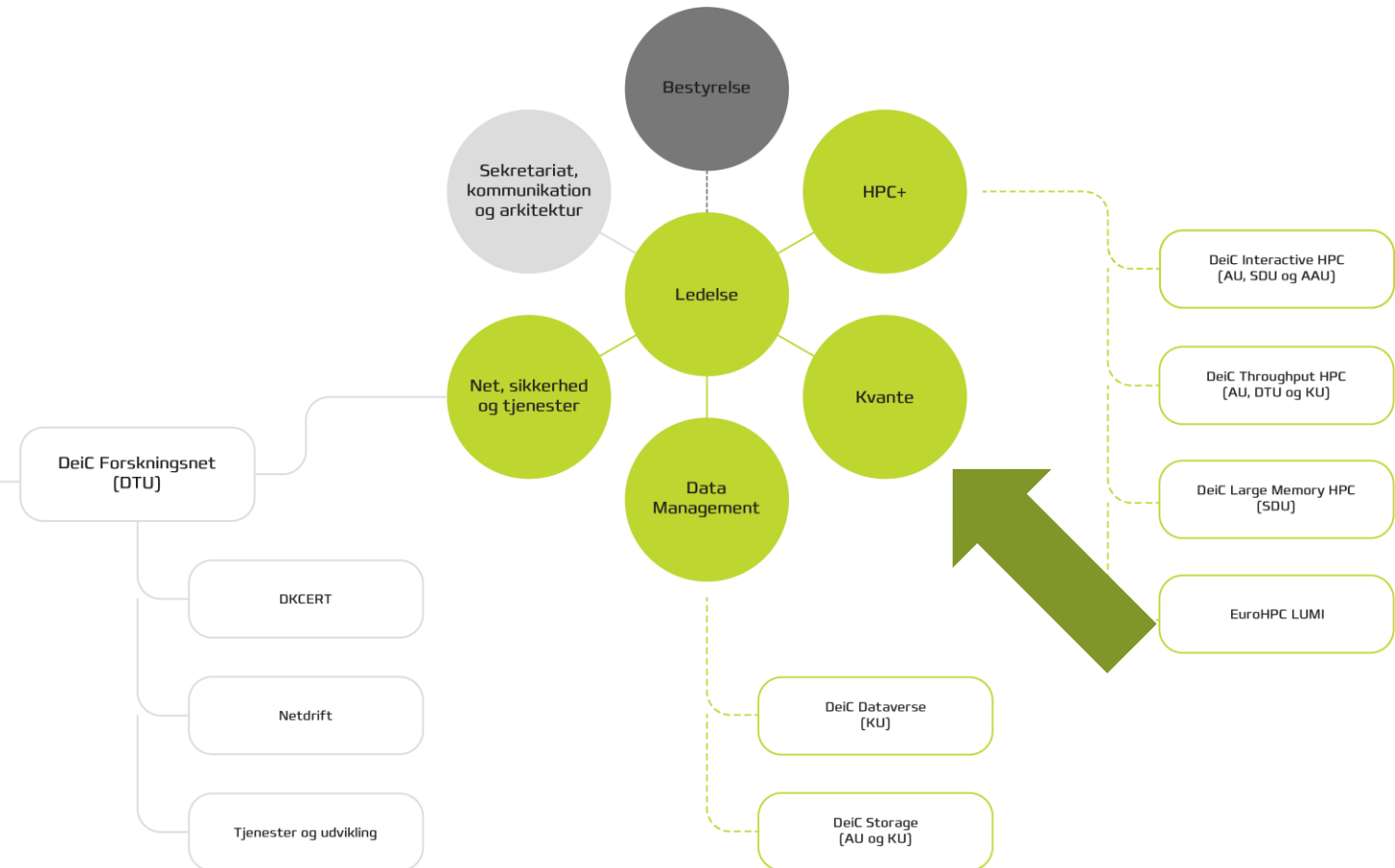
Overview of DeiC



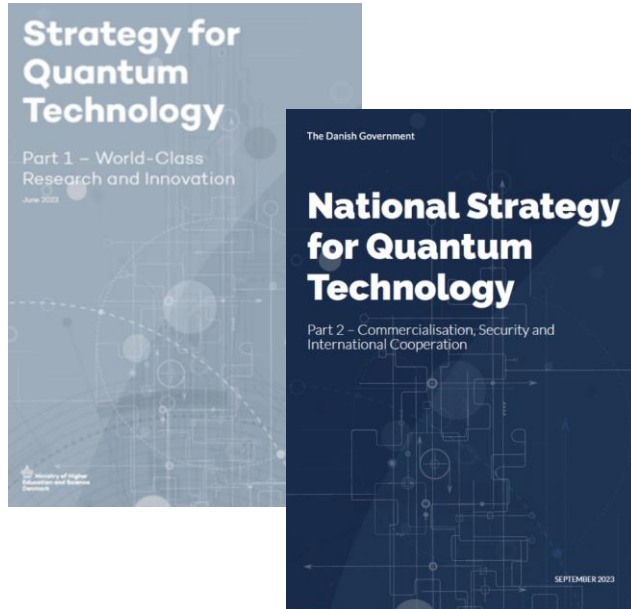
The **Danish e-Infrastructure Consortium (DeiC)** develops and coordinates access to digital research infrastructure for Danish universities, enabling research and education at a high international level.



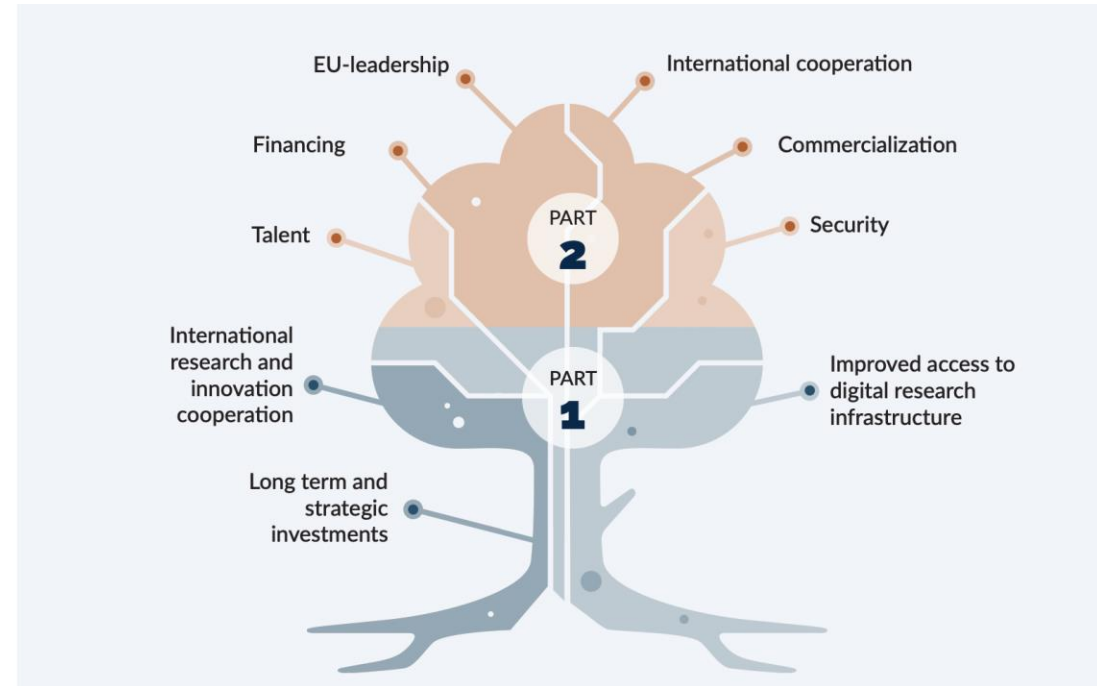
The research network is a high-speed network that connects Danish universities and research institutions.



Danish National Quantum Strategy



**Link between
Part 1 and
Part 2**



National Quantum infrastructure:

<https://www.deic.dk/quantum-infrastructure>

Grants and Funding:

<https://www.deic.dk/da/quantum-technology/grants-and-funding>

Strategy - part 1:

<https://ufm.dk/en/publications/2023/strategy-for-quantum-technology-part-1-2013-world-class-research-and-innovation>

Strategy - part 2:

<https://eng.em.dk/publications/2023/national-strategy-for-quantum-technology>

The Objective of the Strategy for Quantum Technology - Part 1

Denmark aims to have one of the world's leading quantum research environments and to have the ability to effectively translate research into new, usable technology.

DeiC's Quantum Department is the newest department in DeiC, established as part of the implementation of the Danish government's national quantum strategy.

Initiatives

Q-Access

- Calls for specialized access to quantum computers.
- Sandbox access via Microsoft Azure for testing.
- Consulting service with quantum experts.
- Access to the new LUMI-Q VLQ quantum computer.
- Overviews, guides, and step-by-step tutorials.

Q-Competence

- Disseminate skills and increase understanding of the potential and risks of quantum technology.
- Financial support for developing quantum computing material and events.

Q-Algorithm

- DQA Academy to boost work in developing and testing quantum algorithms and the associated software stack.
- Scholarships for Ph.D. students and Postdocs.

Niels Bohr Quantum Summer School

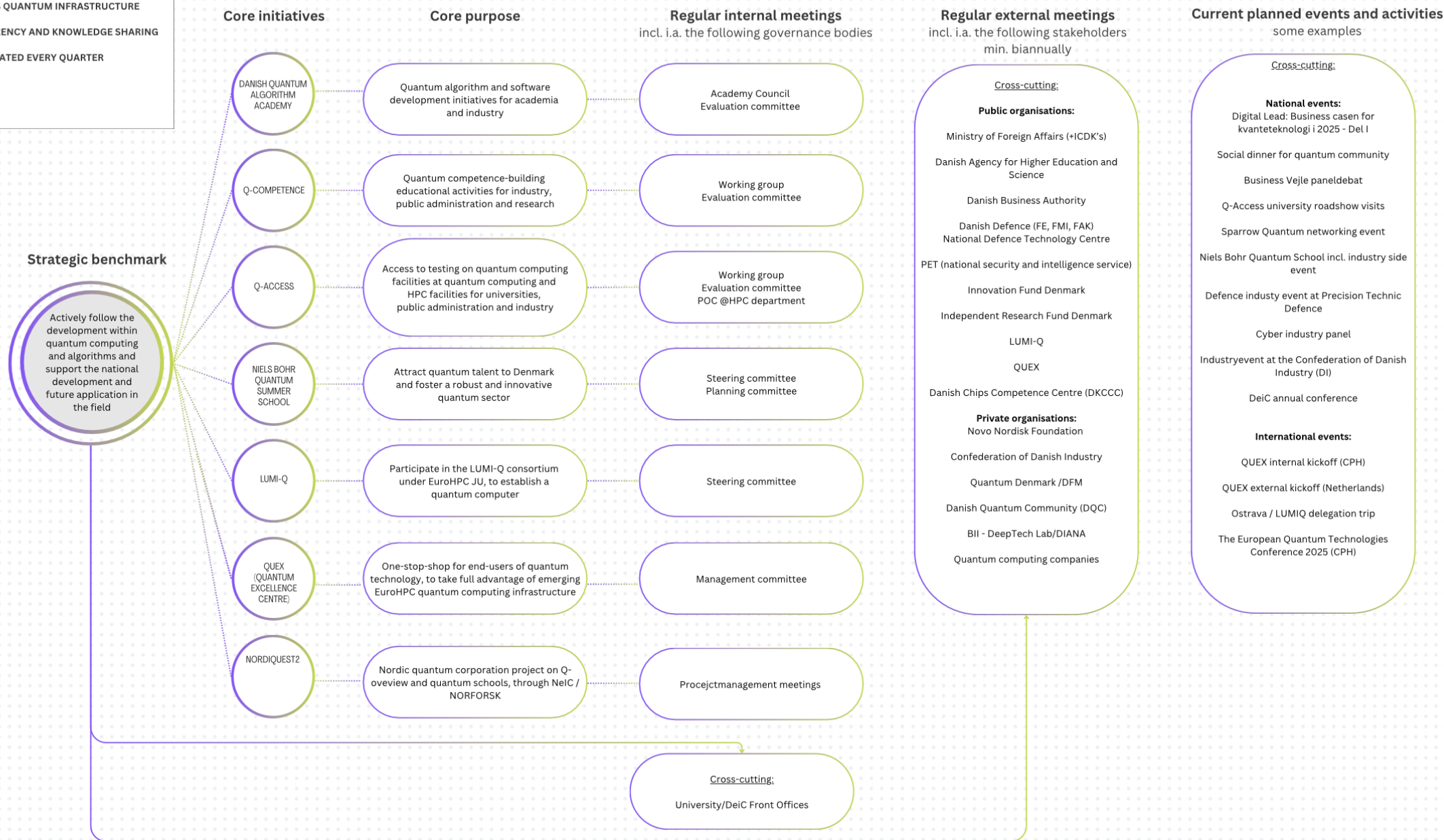
Two-week summer school, for the next 4 years, for both Danish and international Ph.D. students to learn about quantum computing and attract talent to the quantum community in Denmark.

LUMI-Q

The LUMI-Q consortium set up a quantum computer called "VLQ," which has 24 superconducting qubits in a star-shaped topology. IQM in Finland is the hardware provider, and it is deployed in the Czech Republic at the IT4Innovations Centre at the Technical University of Ostrava.

DEIC QUANTUM DEPARTMENT: GOVERNANCE STRUCTURE & STRATEGIC ROADMAP FOR 2026

PURPOSE: TO VISUALIZE HOW DEIC BUILDS QUANTUM INFRASTRUCTURE
AVAILABLE ON [DEIC'S WEBSITE](#) FOR TRANSPARENCY AND KNOWLEDGE SHARING
LIVING WORKING DOCUMENT, UPDATED EVERY QUARTER



2.Quantum Overviews, Guides, and Tutorials

DeiC's New Quantum Computing Guide



A clear, unified overview of quantum computing published by DeiC's Q-Access team to show:

- What resources exist (types, major providers, etc).
- How to get access.
- How quantum devices are benchmarked.
- Interdisciplinary Interfaces (e.g., the interface to AI)

The guide targets **multiple audience groups**:

- General audiences (policy makers, journalists, industry newcomers)
- Researchers and technical users
- Decision makers (funding, infrastructure)

The guide is a **living document** and will be updated regularly!

Quantum Computing Guide

for General Audiences to Technical Users in Denmark

Published by DeiC's Quantum Department

Last Updated September, 2025



Danish e-infrastructure Consortium, Produktionstorvet. Building 426,
2800 Lyngby, Denmark.

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Quantum Computing Guide – Navigation



Jump directly to what you need!

- Sec 1: Historical background and motivation
 - John Preskill: Quantum computing 40 years later
 - IBM: What is quantum computing?
- Sec 2: Quantum algorithms and their applications
 - Quantum Algorithm Zoo
- Sec 3-5: Practical access mode
 - DeiC Q-Access: Access to Quantum Computers
 - VLQ: the quantum computer of the LUMI-Q consortium
 - UCloud User Guide
 - Google Quantum AI: Choosing hardware for your qsim simulation
- Sec 6-7: Benchmarks, modalities and pricing
 - Deep Lall et al: A Review and Collection of Metrics and Benchmarks for Quantum Computers: definitions, methodologies and software
- Sec 8: EuroQHPC - an integration project
 - The European High Performance Computing Joint Undertaking: Quantum Computers
- Sec 9: Quantum Interface with AI
 - Jacob Biamonte et al: Quantum Machine Learning
 - Maria Schuld & Francesco Petruccione: Machine Learning with Quantum Computers
 - LUMI: From binary computing to quantum AI
- Appendix: Additional services and initiatives

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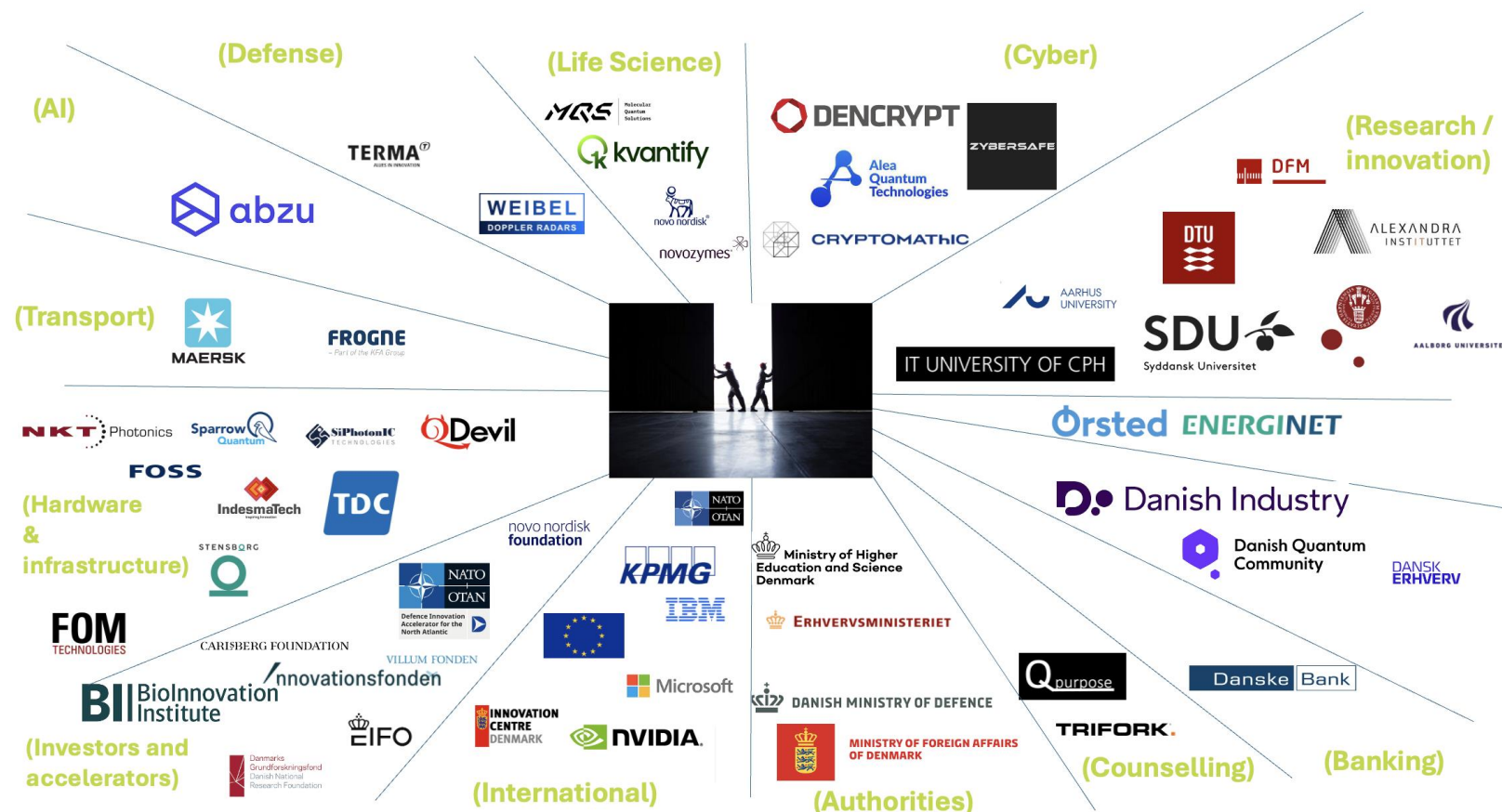
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Overview of Quantum Stakeholders

Goal: Understand the purpose and focus of the various Danish-based quantum actors, including how they are financed and how they each represent the Danish quantum effort in different ways.



Available in Danish and English



Developing Proof-of-concept Use Cases



- We are currently in the **noisy intermediate-scale quantum (NISQ)** era, with QPUs not yet capable of **fault tolerance** or **quantum advantage**, but there are many algorithms with the great potential use cases.
- The most common class of NISQ algorithms are “variational algorithms” which leverage classical optimization of tunable parameters.
- DeiC is developing some simple **proof-of-concept use cases** (for both **academia and industry**) with **step-by-step explanations** of the thought process and implementation to help, especially Danish, users best utilize quantum computing resources.
- The three main areas for which DeiC is developing proof-of-concept use cases, and which seem the most promising, are **optimization, simulation, and machine learning**.

Optimization

From minimizing risk to maximizing throughput, optimization problems are ubiquitous across many industries, especially in *finance, logistics, and engineering*.

Simulation

Simulating quantum systems is a notoriously difficult but powerful tool for solving problems in *chemistry, physics, material science, and the pharmaceutical industry*.

Machine Learning

From *anomaly detection* and *classification problems* to *generating text and images*, machine learning has found countless applications touching almost every sector of society.

Proof-of-concept Use Case: Optimization



- Practically speaking, these proof-of-concept quantum use cases include a **step-by-step guide** starting from the problem description, then **formalizing and embedding the problem into a quantum system** and finally **describing and implementing a quantum algorithm to solve it**.
- The first proof-of-concept use case that DeiC has developed is in optimization.

Proof-of-concept Quantum Use Case Optimization

In the current NISQ (noisy intermediate-scale quantum) era, the most feasible and promising use cases for quantum computing are optimization, simulation, and machine learning.

Optimization	Simulation	Machine Learning
From minimizing risk to maximizing throughput, optimization problems are ubiquitous across many industries, especially in finance, logistics, and engineering.	Simulating quantum systems is a notoriously difficult task for solving problems in chemistry, physics, material science, and the pharmaceutical industry.	From anomaly detection and classification problems to generating text and images, machine learning has found countless applications touching almost every sector of society.

To tackle problems in these areas, most NISQ algorithms take a hybrid approach by using classical optimization techniques to tune the parameters of variational quantum circuits. In this proof-of-concept use case, we will consider an optimization problem in logistics and then walk through, step by step, a variational quantum algorithm which solves the problem.

This proof-of-concept use case is part of a series produced by DeiC's Quantum Department as part of the Q-Access initiative to make quantum use-case development more accessible to Danish academia and industry. You can find the proof-of-concept use cases for **simulation** and **machine learning** at <https://www.deic.dk/q-access>. We will assume a basic familiarity with the quantum circuit model of quantum computing, but we will also try to give as many details as possible.

Problem: Optimizing Last-Mile Routes for a Delivery Company

Suppose that there are two delivery drivers who need to cover six delivery zones labeled A, B, C, D, E, and F. For each pair of zones, there is some cost to both of these zones being placed on the same route, e.g. long distance between the zones, high chance of traffic-jamming if one driver serves both zones, delivery time-window conflicts between the two, etc.

Goal: Assign each zone to one of two routes in such a way that separates pairs that "don't play nicely". This problem can be formulated as a **max-cut problem** for the graph whose vertices is the set of zones $Z = \{A, B, C, D, E, F\}$ and whose edges are weighted by the costs. To separate the pairs that don't play nicely we want to consider a cut, which is a subset of the edges that once removed separates the vertices into two groups. Moreover, we want to find a cut that minimizes the sum of the cost of the edges in the cut. Below is an example cut that might seem reasonable, separating the zones into a route consisting of $\{A, B, E\}$ and a route consisting of $\{C, D, F\}$.

Max-cut problems like this can be solved using a variational quantum algorithm called QAOA (quantum approximate optimization algorithm). In fact, QAOA is quite general and can be used to solve a wide

but there may be better cuts. Our goal then becomes to find the cut x with the minimum cost, i.e.

$$\arg\min_x C(x). \quad (9)$$

Expressing our optimization problem in terms of finding a minimum will allow us to put it into the framework of quantum annealing, but first we need to embed our problem into a quantum system.

Embedding Our Problem in a Quantum System

Embedding cuts as the states of a quantum system is rather straightforward, since we defined the cuts in the way we will have an associated qubit, and the state corresponding to a cut

$$x) \otimes |x_A\rangle \otimes |x_C\rangle \otimes |x_D\rangle \otimes |x_E\rangle \otimes |x_F\rangle. \quad (10)$$

the corresponding quantum state is

$$|x\rangle = |0\rangle \otimes |0\rangle \otimes |1\rangle \otimes |0\rangle \otimes |1\rangle \quad (11)$$

first need to know the cost of placing each pair of qubits A and B in the same route by c_{AB} and so we not depend on the order, so we have $c_{AB} =$

$$\begin{aligned} 0 \quad c_{AB} &= 6 & c_{AF} &= 31 \\ 8 \quad c_{BA} &= 41 & c_{BF} &= 12 \\ 9 \quad c_{BC} &= 20 & c_{CF} &= 7 \\ 12 \quad c_{CB} &= 12 & c_{DF} &= 8 \\ 13 \quad c_{CD} &= 12 & c_{EF} &= 15 \end{aligned} \quad (2)$$

it is a **Hamiltonian**, which we will discuss in more detail in the next section in our problem. To translate the cost function from which is a 1-qubit gate defined by its action on the basis states $|ij\rangle$ and

$$Z|0\rangle = |0\rangle \quad Z|1\rangle = -|1\rangle \quad (13)$$

the cost function as

$$\frac{1}{2}(I_{AB} - Z_A \otimes Z_B)|x_A\rangle \otimes |x_B\rangle \quad (14)$$
$$|x_A\rangle \otimes |x_B\rangle. \quad (3)$$
$$|x_A\rangle \otimes |x_B\rangle \otimes |x_C\rangle \otimes |x_D\rangle \otimes |x_E\rangle \otimes |x_F\rangle. \quad (4)$$
$$x_A = 0 \text{ or vice versa, then } A \text{ and } B \text{ are in the cut. Therefore, we need an expression that is} \quad (5)$$
$$-x_B \quad (5)$$
$$x_A x_B = 0 \text{ or vice versa, then } A \text{ and } B \text{ are in the cut. Therefore, we need an expression that is} \quad (6)$$
$$x_A x_B = 0 \text{ or vice versa, then } A \text{ and } B \text{ are in the cut. Therefore, we need an expression that is} \quad (6)$$

but the $|x\rangle$ is to undo double counting. Now, according to the cut x , we can also see exactly

$$C(x) = -(-c_{AC} + c_{AD} + c_{AE} + c_{BC} + c_{BD} + c_{BE} + c_{CD} + c_{DE} + c_{EF}) = -158 \quad (8)$$

If the Hamiltonian is given by one of the Pauli operators, i.e. the X gate, Y gate, and Z gate, then this unitary evolution operator is a rotation of the Bloch sphere around the x -axis, y -axis, and z -axis, respectively.

$$U(t) = \exp(-iHt). \quad (20)$$
$$\exp(-iXt) = R_X(2t) \quad \exp(-iYt) = R_Y(2t) \quad \exp(-iZt) = R_Z(2t) \quad (21)$$

in the naive gate set of a number of quantum computing platforms, ubiquitous built-out of Pauli operators is often quite feasible. Now, ground state of the cost Hamiltonian H_C from Equation (16) is of

$$H_C = \frac{1}{2} \sum_{i,j \in Z} c_{ij} \cdot Z_i \otimes Z_j. \quad (22)$$

us. Indeed, these constant terms would just introduce a global phase which we can ignore. For this modified Hamiltonian \tilde{H}_C , the unitary

$$\tilde{U}_C(t) = \sum_{i,j \in Z} R_{Z_i Z_j}(c_{ij} \cdot t). \quad (23)$$

but instead $R_{Z_i Z_j}(t) = R_{Z_i}(t) \otimes R_{Z_j}(-t)$. However, the $R_{Z_i Z_j}$ gate is a two-qubit gate and is not implementable with a single-qubit gate and a CNOT gate. However, the $R_{Z_i Z_j}$ gate is a two-qubit gate and is not implementable with a single-qubit gate and a CNOT gate. However, the $R_{Z_i Z_j}$ gate is a two-qubit gate and is not implementable with a single-qubit gate and a CNOT gate.

of the unitary evolution operator for a time-dependent Hamiltonian discretization procedure called **Lie Trotterization**. For our problem,

$$U(t) = (1 - \epsilon) \cdot H_{\text{unint}} + \epsilon \cdot H_C. \quad (24)$$

ed to divide our time interval from $t = 0$ to $t = 1$ into N intervals of intervals are given by

$$0 = t_0, t_1 = \frac{1}{N}, t_2 = \frac{2}{N}, \dots, t_N = 1. \quad (25)$$

if H_{unint} will not "commute" with H_{unint} , or in this case H_C , which matters. Taking into account this time-ordering at each step is unitary evolution. The ansatz considered in QAOA, is inspired by the very evolution operator, which in this case is given by

$$U(t_k) H_{\text{unint}} \exp(-iH_C t_k) = \prod_{k=1}^N U(t_k) H_{\text{unint}} U(t_k)^\dagger. \quad (26)$$

plies both Hamiltonians alternately to approximate the evolution of Equation (24). Indeed, as $N \rightarrow \infty$, this approximation of $U(1)$ is exact. There are higher-order Trotterizations as well with usually worse depth scaling per time step. Moreover, in QAOA, we with parameters, which can be optimized to significantly increase discretization.

the system evolves adiabatically according to a given state $|\psi^{(0)}\rangle$ of a Hamiltonian H_{unint} . The system evolves adiabatically according to a given state $|\psi^{(0)}\rangle$ of a Hamiltonian H_{unint} . The system evolves adiabatically according to a given state $|\psi^{(0)}\rangle$ of a Hamiltonian H_{unint} .

tackle the first question, because it should shed some light on the second question, and hopefully make the path towards developing QAOA feel more natural.

For a time-independent Hamiltonian, solving Schrödinger's equation gives a unitary operator that evolves the system, which is given by

"There must be a gap between the ground state and the lowest energy excited state throughout the evolution of the system. However, "level" in this context is defined in terms of the gap and the uncertainty principle to ensure that the gap is never closed."

3. LUMI-Q Consortium and the New Quantum Computer “VLQ”

Overview of LUMI Consortium

- The **European High-Performance Computing Joint Undertaking (EuroHPC JU)** has been pooling European resources to develop a variety of supercomputers for processing big data, based on competitive European technology.

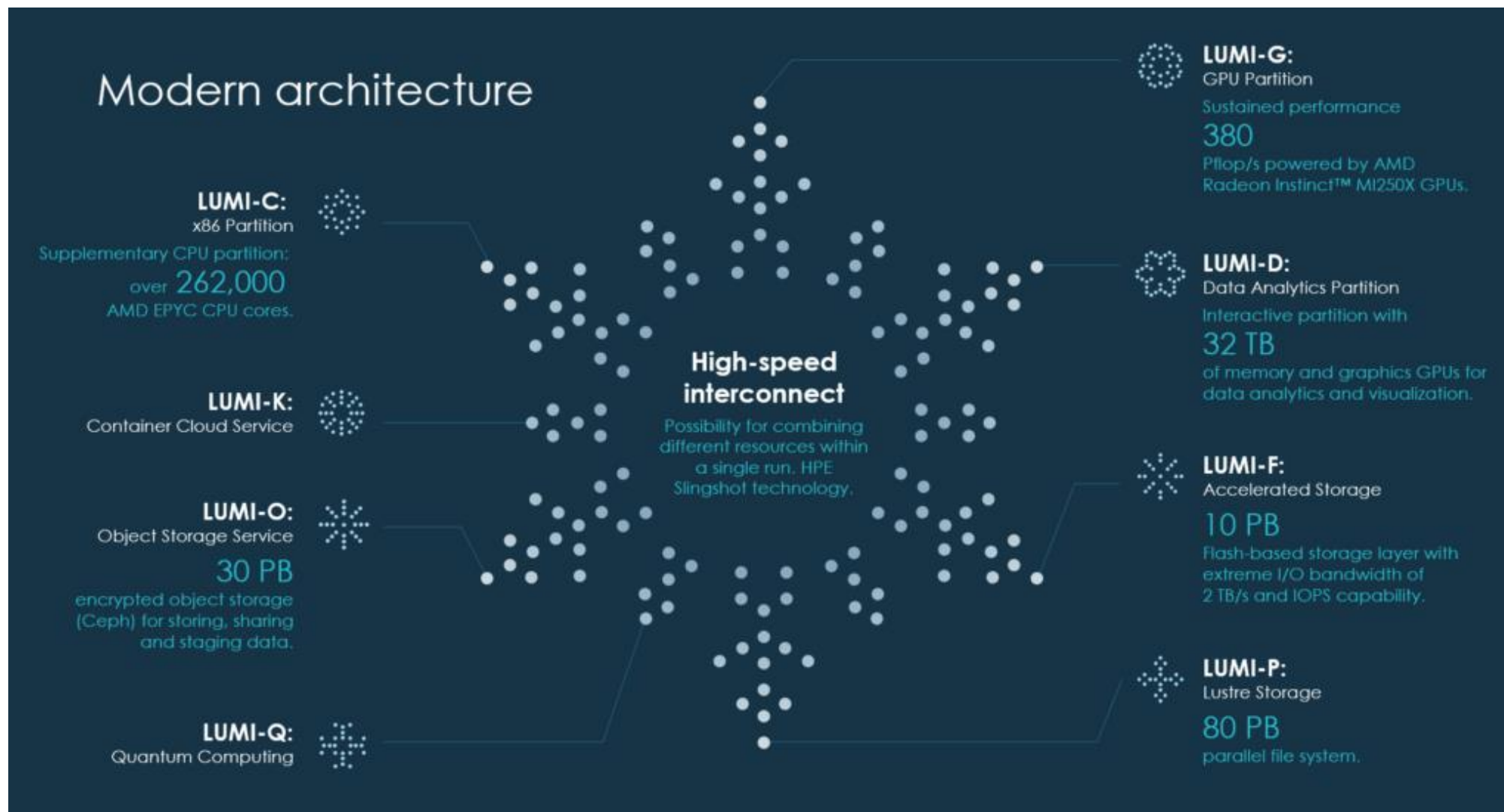


EuroHPC
Joint Undertaking

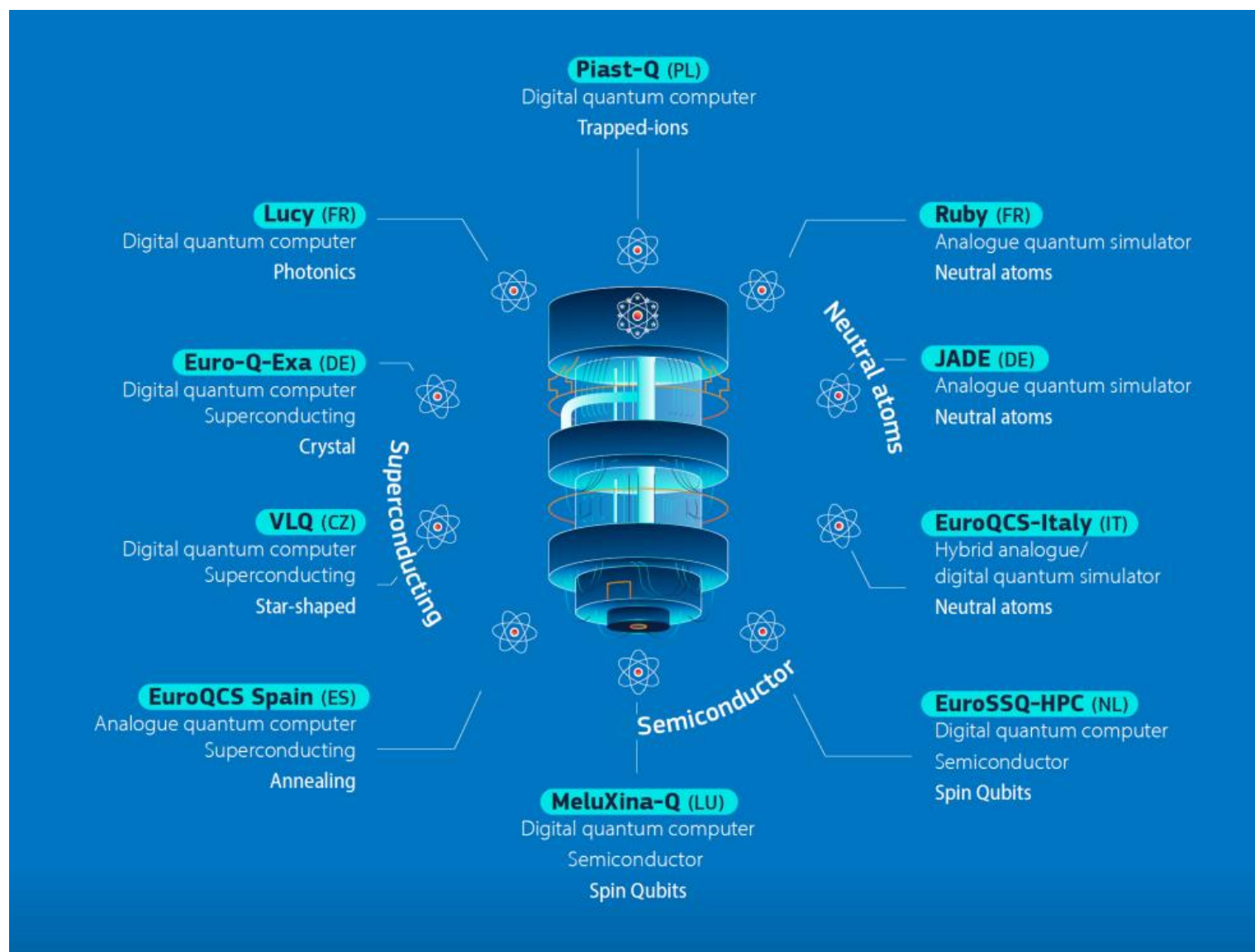
The LUMI logo features the letters "LUMI" in a large, bold, black, sans-serif font, with a thin horizontal line above and below the text.

- **LUMI**, which is in CSC's data center in Kajaani, Finland, is one such supercomputer and is hosted by the **LUMI consortium**.
- The **LUMI (Large Unified Modern Infrastructure) consortium** countries are Finland, Belgium, the Czech Republic, Denmark, Estonia, Iceland, the Netherlands, Norway, Poland, Sweden, and Switzerland.

Overview of LUMI Architecture



EuroHPC JU Quantum Computers



Overview of LUMI-Q



VLQ, the quantum computer of the LUMI-Q consortium, will provide a European-wide quantum computing environment **integrated with the EuroHPC infrastructure**. VLQ will allow the integration of the targeted EuroHPC quantum computer into EuroHPC supercomputer **KAROLINA** in Czechia, **LUMI** in Finland, and **EHPCPL** in Poland.

LUMI-Q CONSORTIUM MEMBERS

- Coordinator: VSB – Technical University of Ostrava, IT4Innovations National Supercomputing Center, Czechia
- CSC – IT Center for Science, Finland
- VTT Technical Research Centre of Finland Ltd, Finland
- Chalmers University of Technology, Sweden
- Danish e-Infrastructure Consortium (DeiC), Denmark
- Akademickie Centrum Komputerowe Cyfronet AGH, Poland
- Nicolaus Copernicus Astronomical Center, Poland
- Sigma2 AS, Norway
- Simula Research Lab, Norway
- SINTEF AS, Norway
- University of Hasselt, Belgium
- TNO Netherlands Organisation for Applied Scientific Research, the Netherlands
- SURF BV, the Netherlands

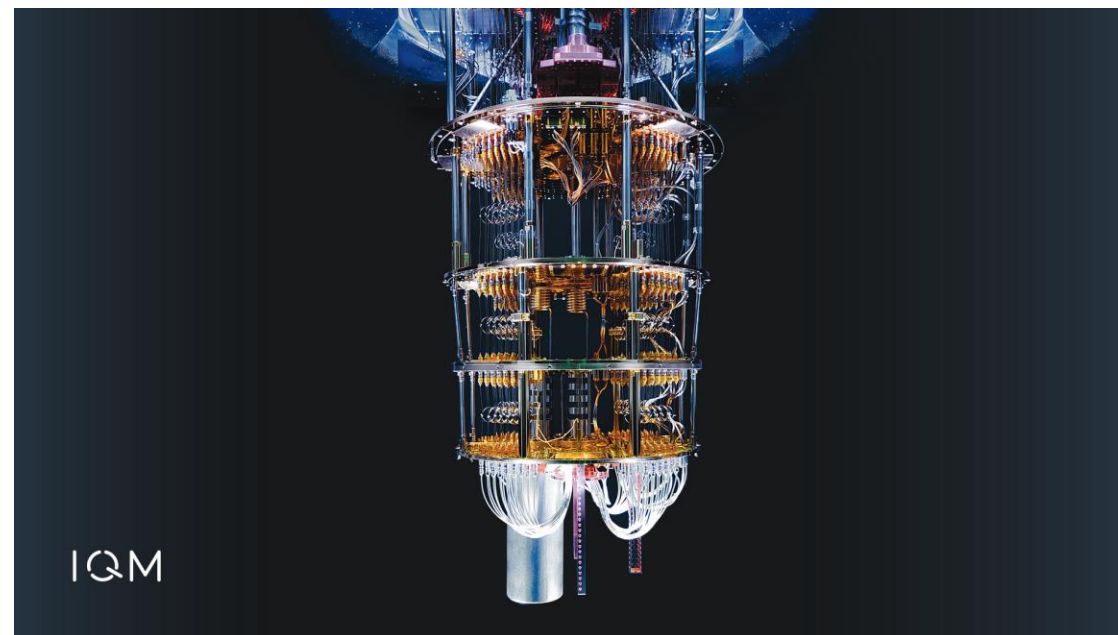


ARCHITECTURE

- at least 24 physical qubits,
- the star-shape topology,
- the total cost of the system is EUR 5.0 million,
- integrated into the EuroHPC supercomputer KAROLINA,
- IQM Quantum Computers, supplier of systems,
- installation and commissioning will take place in 2025.

Overview of IQM

- IQM is the **leading European quantum hardware company in superconducting circuits**, headquartered in **Espoo, Finland**.
- IQM builds **superconducting full-stack quantum computers** with up to 150 high-fidelity qubits.
- Currently, IQM has **some*** QPU access available through AWS (Amazon Braket).



Industrial and Academic Customers

CINECA



OAK RIDGE
National Laboratory

VTT



Hewlett Packard
Enterprise

JÜLICH
Forschungszentrum

EVIDEN
an atos business

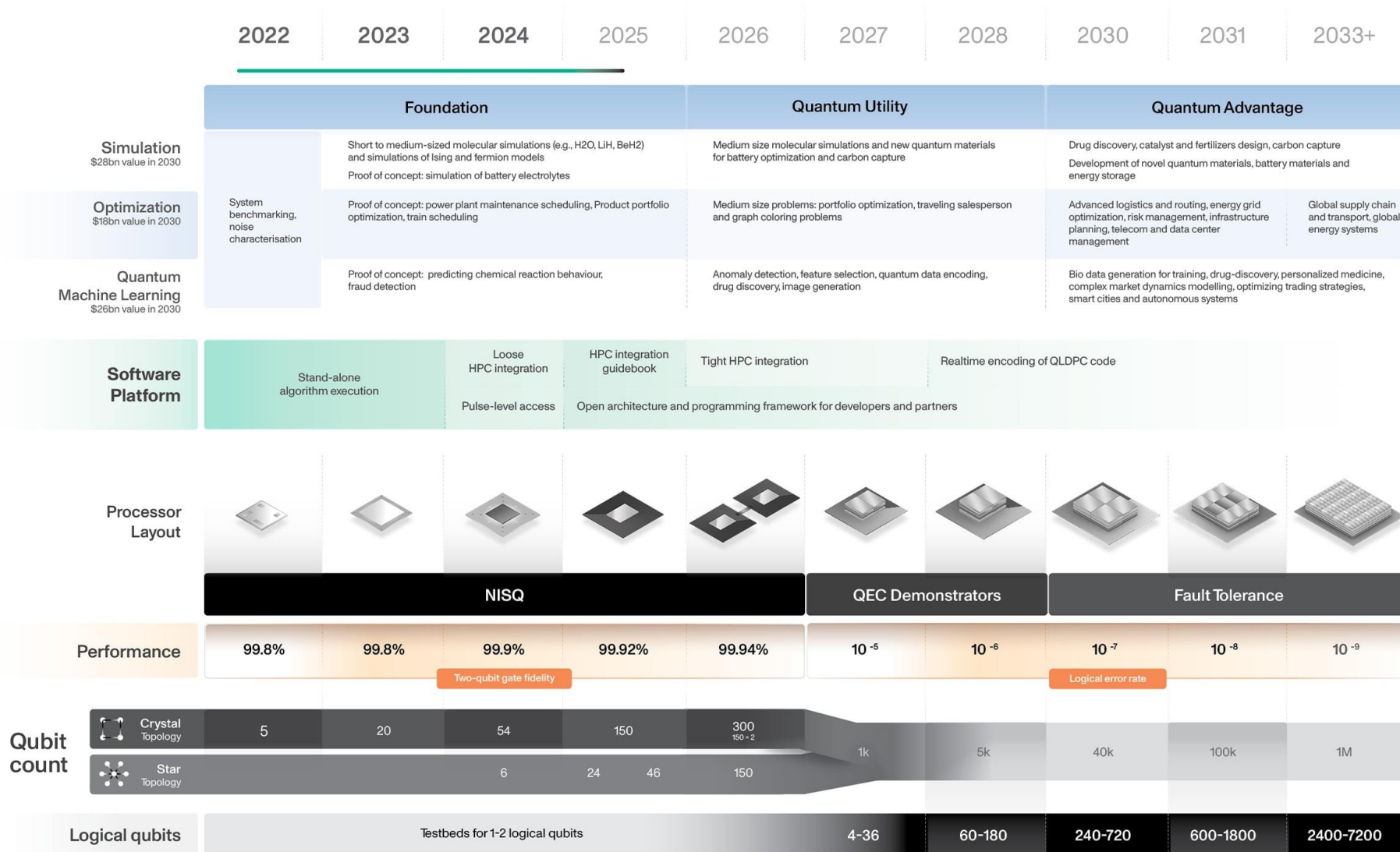
links
PASSION FOR INNOVATION

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER



충북대학교
CHUNGBUK NATIONAL UNIVERSITY

Overview of IQM



Overview of IT4I



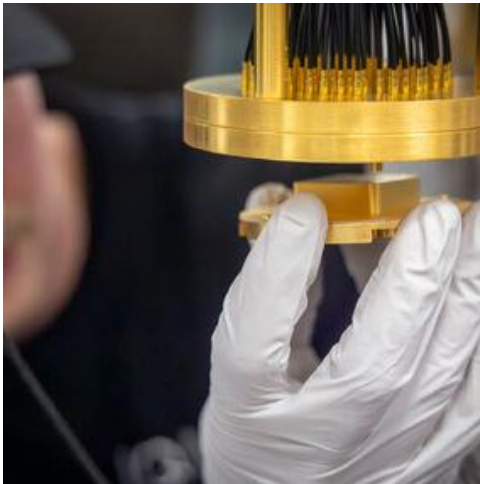
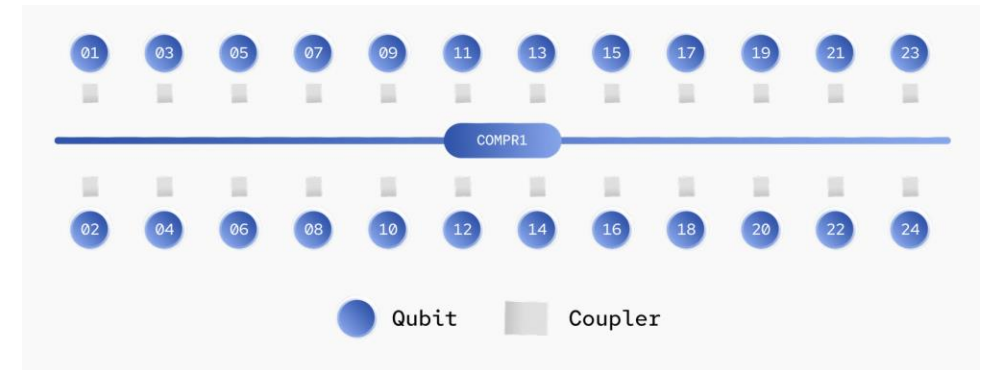
- In the **Czech Republic**, **IT4I** is the leading research, development, and innovation centre active in the fields of HPC, QC, AI, and their application to other scientific fields, industry, and society.
- IT4I operates the most powerful supercomputing systems in the Czech Republic, including **KAROLINA**, which are provided to Czech and foreign research teams from both academia and industry.



PUT INTO OPERATION	summer 2021
THEORETICAL PEAK PERFORMANCE	15,690 Tflop/s
OPERATING SYSTEM	Rocky Linux 8.9
COMPUTE NODES	831
CPU	720x 2x AMD 7H12, 64 cores, 2,6 GHz, 92,160 cores in total 72x 2x AMD 7763, 64 cores, 2,45 GHz, 9,216 cores in total 72x 8x NVIDIA A100 GPU, 576 GPU in total 32x Intel Xeon-SC 8628, 24 cores, 2,9 GHz, 768 cores in total 36x 2x AMD 7H12, 64 cores, 2,6 GHz, 4,608 cores in total 2x 2x AMD 7452, 32 cores, 2,35 GHz, 128 cores in total
RAM PER COMPUTE NODE	256 GB / 1 TB (GPU) / 24 TB fat node 320 GB HBM2 (8 x 40 GB) GPU
ACCELERATORS	576x NVIDIA A100
STORAGE	30.6 TB / home (1.93 GB/s sequential write performance, 3.10 GB/s sequential read performance), 1,361 TB / scratch (NVMe, 730.9 GB/s sequential write performance, 1, 198.3 GB/s sequential read performance)

Hardware Details of VLQ

- VLQ's contains a 24-qubit QPU based on superconducting transmon qubits designed for cutting-edge quantum research that requires high connectivity.
- A central resonator hub connects a large number of qubits, optimizing connectivity for highly interactive quantum processes and dramatically reducing the number of SWAP operations needed.

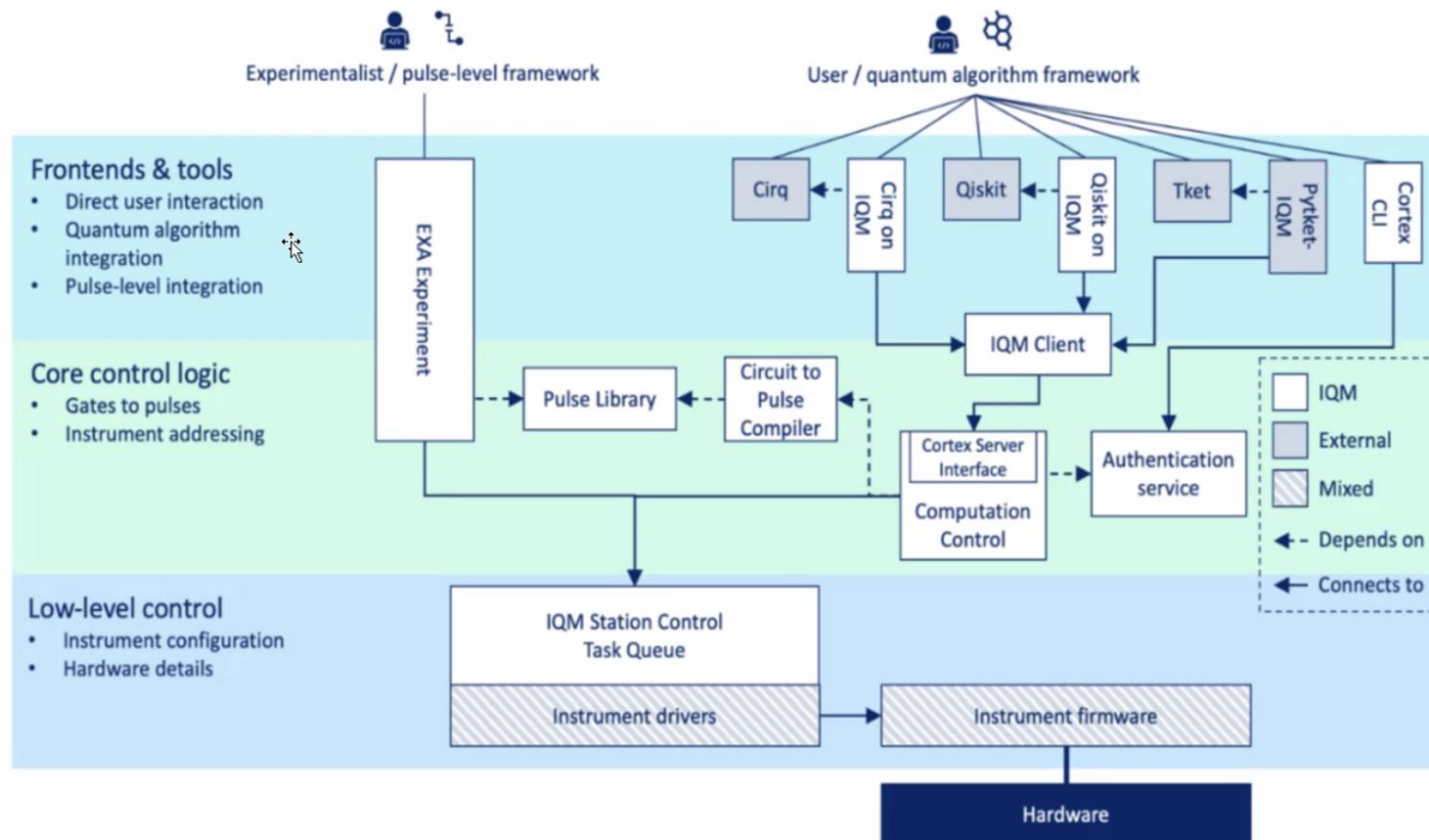


Hardware Details of VLQ



Software Details of VLQ

LUMI-Q MACHINE IMPLEMENTATION



Impact for Q-Access and Denmark



Summary

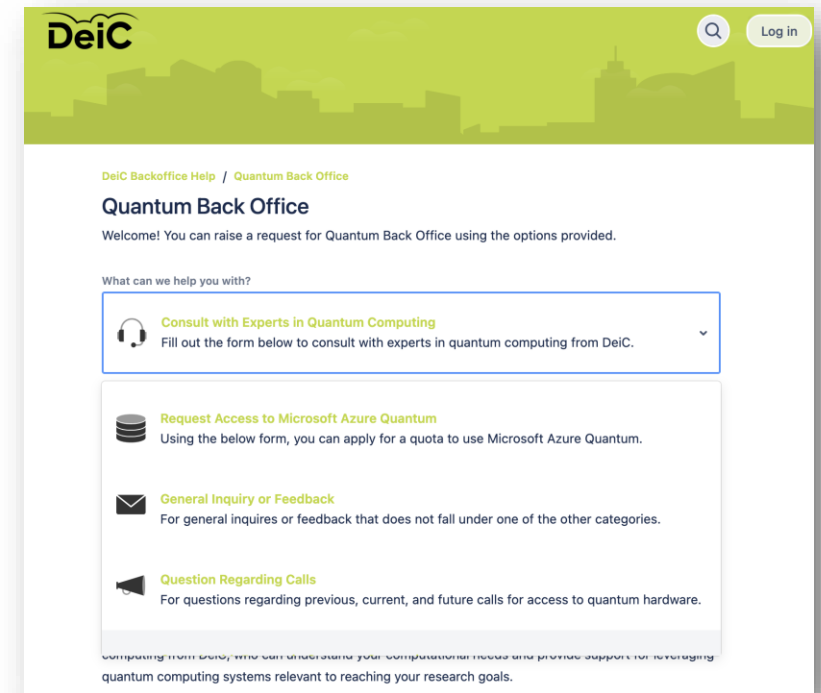
- LUMI-Q VLQ will be an **additional access option provided by Q-Access** to Danish academia.
- DeiC will provide **onboarding sessions and consulting** to help Danish academia and industry take full advantage of VLQ (in addition to what will be offered by IQM and IT4I).
- The **close HPC integration and pulse-level access** will open new possibilities for applications and diversify DeiC's Q-Access offering.
- There is **potential for Danish industry** to take advantage of LUMI-Q VLQ.
- DeiC is **developing proof-of-concept use cases** to showcase how to take advantage of quantum computers like VLQ!

4. Q-Access

Consulting with Quantum Experts



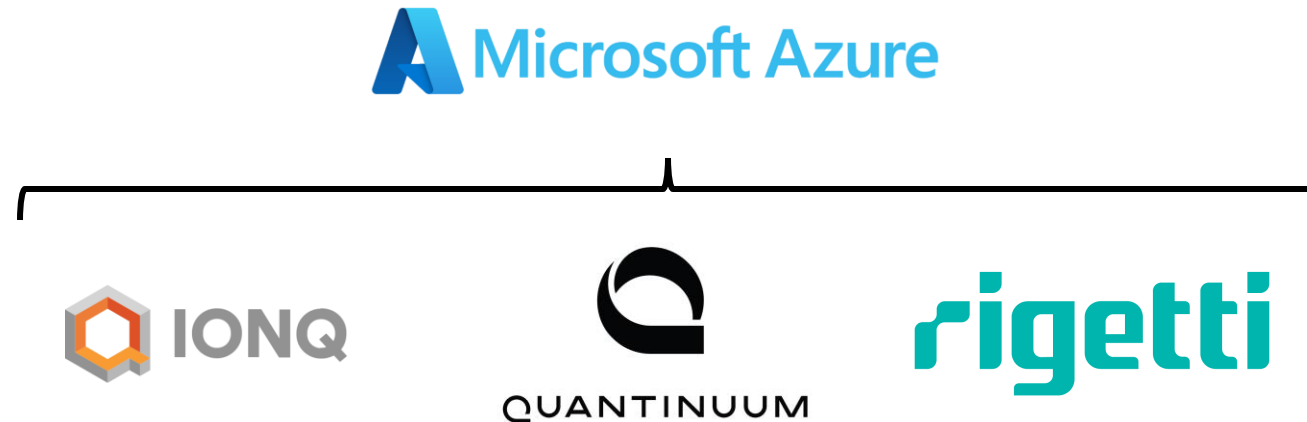
- DeiC provides **consulting with experts in quantum computing**, who can understand your computational needs and provide support for leveraging quantum computing systems relevant to reaching your research goals.
- These services can be utilized by both universities, industry, and the public sector.
- These experts can provide advice and share technical expertise on porting and optimizing applications for quantum computing environments and offer guidance on software development as needed.
- DeiC is now offering **weekly Office Hours** as well to make it easier to drop in and ask questions.
- There are also **Jira Forms** for questions regarding calls, for general inquiry or feedback, and for requesting sandbox access to hardware!



Sandbox Access to Quantum Hardware



- Currently, sandbox access to Microsoft Azure for testing worth up to **25.000 DKK** can be applied for by filling out a simple form at: <https://deic-backoffice.atlassian.net/servicedesk/customer/portal/3/group/4/create/35>
- DeiC will evaluate and respond to your application within a week.
- Users can reapply after they use their allocated resources for a total of **100.000 DKK**.



- IBM and Amazon Braket sandbox access are currently under development. More details coming soon!
- This sandbox access can also be used in conjunction with Ucloud resources for testing hybrid algorithms.

Calls for Specialized Access



- For access to specific quantum hardware and corresponding hardware-specific simulators via one of the calls for quantum access, there is a pool of **11.000.000 DKK**.
- See <https://www.deic.dk/da/quantum-technology/grants-and-funding> for active and previous calls!

Active calls:

Access to quantum computing resources for researchers at Danish universities

Call opens: September 12, 2025

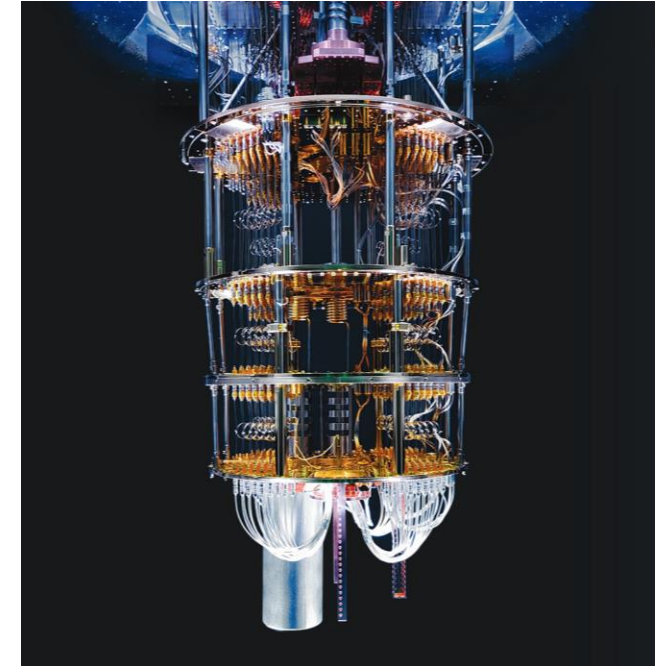
Call closes: October 31, 2025

- **Full Call Description**
- **Application Template**

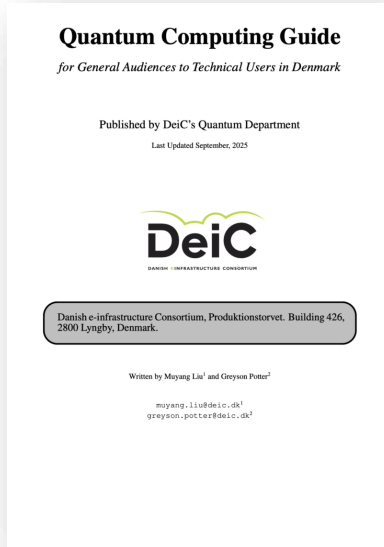
Access to LUMI-Q VLQ and EuroHPC JU



- LUMI-Q VLQ will be an **additional access option provided by Q-Access** to Danish academia.
- DeiC will provide **onboarding sessions and consulting** to help Danish academia take full advantage of VLQ.
- The **close HPC integration and pulse-level access** will open new possibilities for applications and diversify DeiC's Q-Access offering.
- Direct access to the LUMI-Q VLQ quantum computer, through DeiC's participation in the LUMI-Q Consortium, will be available through a **call for applications in early 2026**.
- 50% of VLQ access will also be available through EuroHPC, along with the other quantum computers partially financed by the EuroHPC Joint Undertaking.

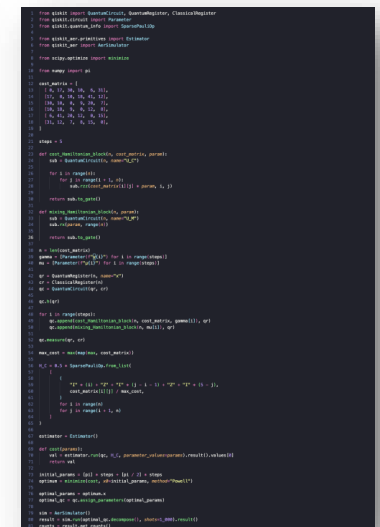
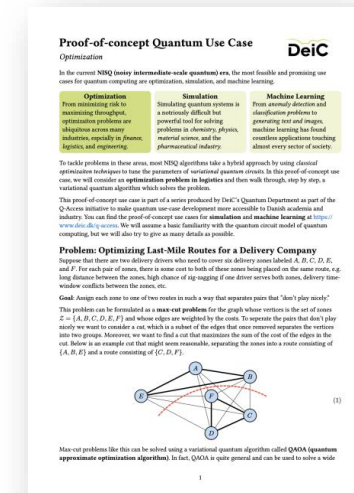


Guides and Tutorials



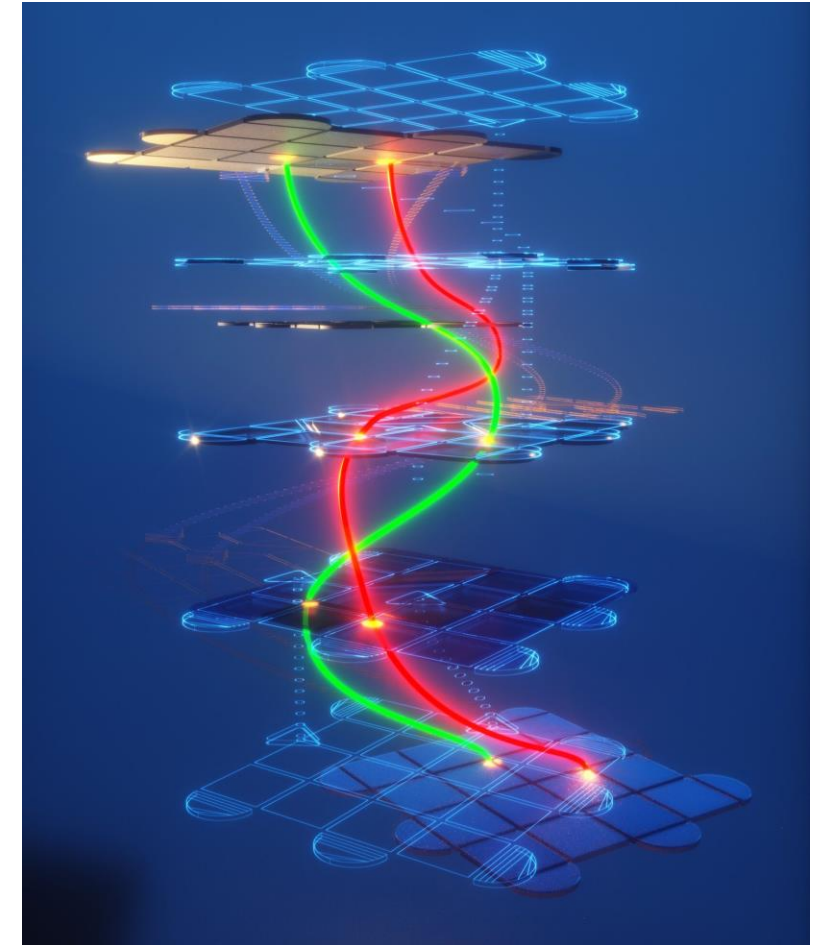
- Overview published by DeiC's Q-Access team to provide a clear and understandable description of the quantum computing resource available to users in Denmark as well as tutorials and guides of how to use them.
- Designed to be useful to both non-technical audiences (policymakers, journalists, and industry leaders) and professional quantum computing users both inside and outside Denmark.
- Begins with an introduction to quantum computing principles, followed by descriptions of different quantum devices, real-world applications, and tutorials for accessing and using resources.

- DeiC is developing some simple **proof-of-concept use cases** (for both **academia and industry**) with **step-by-step explanations** of the thought process and implementation to help, especially Danish, users best utilize quantum computing resources.
- **Proof-of-concept use case for optimization is available**, with proof-of-concept use cases in simulation and machine learning coming by the end of 2025!



Q-Access – Next Steps

- Currently, DeiC's Quantum Department is on its **second roadshow to the Danish Universities!**
- Actively developing more **proof-of-concept use cases in simulation and machine learning** and working on **implementing them on a variety of platforms including VLQ.**
- Investigating further integrations with **HPC, UCloud, EuroHPC**, etc. and how to best utilize these in conjunction with quantum resources offered by DeiC.
- The **next call** for specialized access to quantum hardware (and hopefully VLQ coming) will be in **January 2026.**
- Continuing to investigate new access options for quantum hardware and ways to help Danish users get the most out of what is already offered!



5. Q-Competence

Q-Competence



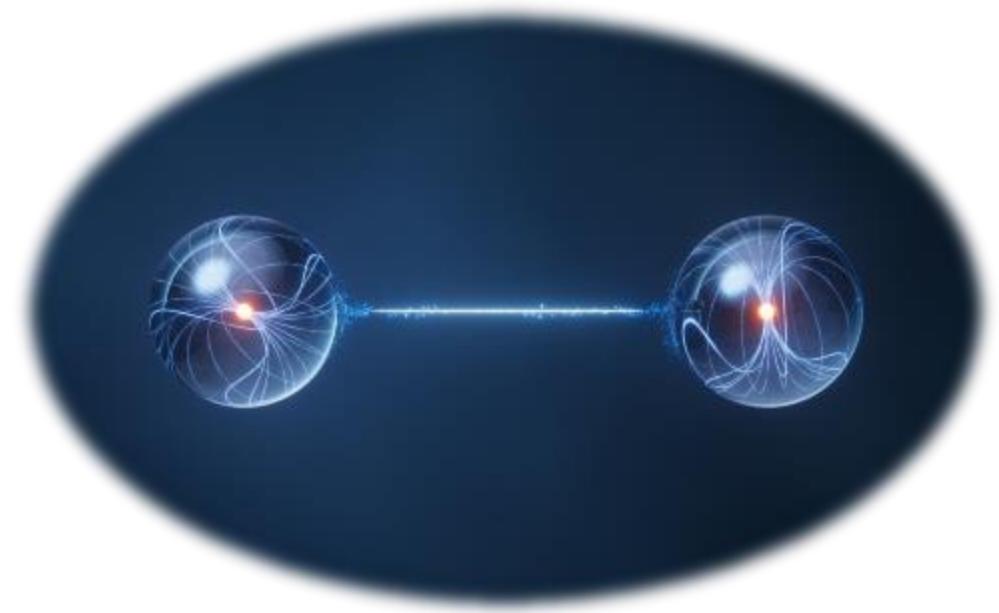
Missioned from the Danish National Quantum Strategy:

Build national competence by supporting educational activities related to quantum computing

All Danish public and private organisations can apply for financial support for their quantum educational projects!

Working group members

- Chairperson: *TBD, member from DeiC's board by DeiC's Board in Q4, 2025*
- AAU: Associate Professor Rolf Lyhneborg Lund
- SDU: Professor Jørgen Ellegaard Andersen
- KU: Associate Professor James Emil Avery
- DTU: Senior Researcher Mikkel Heuck
- Alexandra Instituttet: CSO Martin Møller
- DIREC: Director Thomas Riisgaard Hansen
- DeiC: Project Manager Dennis Lange Wollbrink
- DeiC: Quantum Consultant Maria Tammelin Gleerup
- DeiC: Head of Quantum Henrik Navntoft Sønderskov



Q-Competence



Where are we now?

- 2 calls for tender issued in Q4, 2024 and Q2, 2025
- 3 projects funded from the 1st call and 3 projects funded from 2nd call

Projects from 1st call

- Quantum Computing to Business (QC2B)
PI Jørgen Ellegaard Andersen, Professor, Center for Quantum Mathematics, University of Southern Denmark
- Danish Quantum Integration Program (DQIP)
PI Jacob Friis Sherson, Professor MSO, Dep. of Management, Aarhus University
- Training for Large-Scale Simulations of Quantum Systems
PI Mark Kamper Svendsen, Assistant Professor, Niels Bohr Institute, University of Copenhagen

Stay tuned! Projects from 2nd call will be announced before end of 2025 when contracts are signed

Q-Competence – Next Steps

Next steps

- Announce 3rd call in Q1/Q2 2026
- Future calls may have thematic focuses - according to demand

More info

- <https://www.deic.dk/da/q-competence>
- <https://deic.dk/da/quantum-technology/grants-and-funding>
- <https://deic.dk/en/news/2025-7-10/deic-contributes-to-securing-quantum-talent-in-denmark>

DeiC Contributes to securing Quantum Talent in Denmark

DeiC is allocating DKK 6 million to three different educational initiatives focused on the use of quantum computers – benefitting businesses, researchers, and public administration alike.

BY
Marie Charlotte Søbye

10/07/2025 12:07

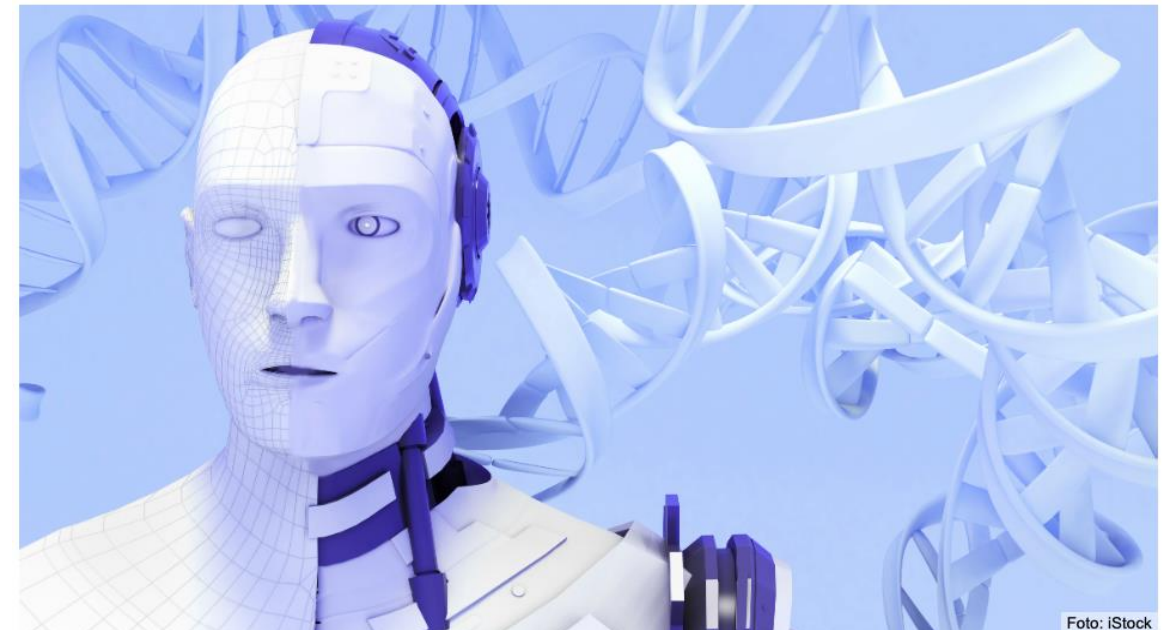
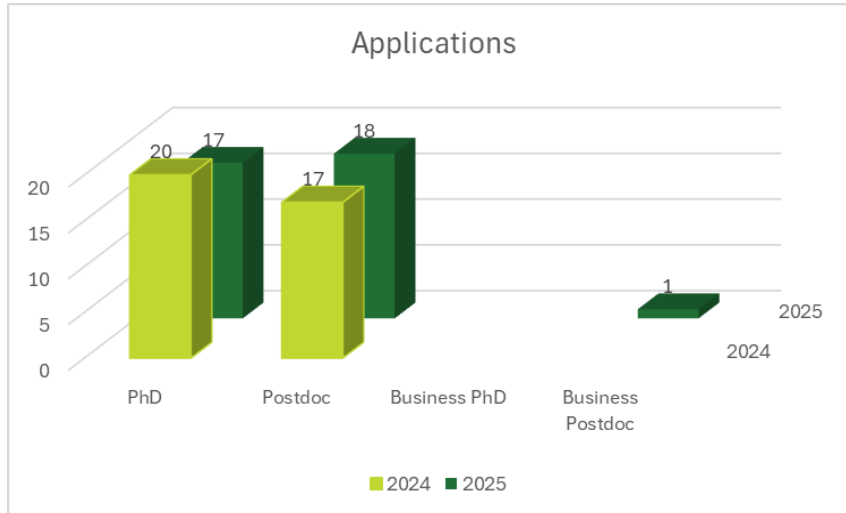


Foto: iStock

6. Q-Algorithm

Q-Algorithm – a quantum excellence center for developing and testing algorithms



The Danish Quantum Algorithm Academy supports Danish quantum research by funding PhD and Postdoc positions (including industrial).

The goal is to build a competitive community in quantum algorithms and software. DQA Academy also hosts workshops, lectures, and events to foster collaboration and progress in the field, while also building an alumni network to keep past participants engaged.

Members of the Q Algorithm Academy:

Aalborg University: Professor Torben Larsen, Department of Electronic Systems
Alternate: Professor Rafal Wisniewski, Department of Electronic Systems

Aarhus University: Professor Jaco van de Pol, Department of Computer Science
Alternate: Professor Nikolaj Zinne, Department of Physics and Astronomy

Roskilde University: Teaching Associate Professor Sune Thomas Bernth Nielsen, Department of People and Technology
Alternate: Associate Professor Mads Rosendal, Department of People and Technology, Programming, Logic, and Intelligent Systems

University of Southern Denmark: Professor Jørgen Ellegaard Andersen, Department of Mathematics and Computer Science
Alternate: Professor Jacob Kongsted, Department of Physics, Chemistry and Pharmacy

Technical University of Denmark:
Associate Professor Sven Karlsson, Department of Applied Mathematics and Computer Science
University of Copenhagen
Associate Professor Michael Kastoryano, Department of Computer Science

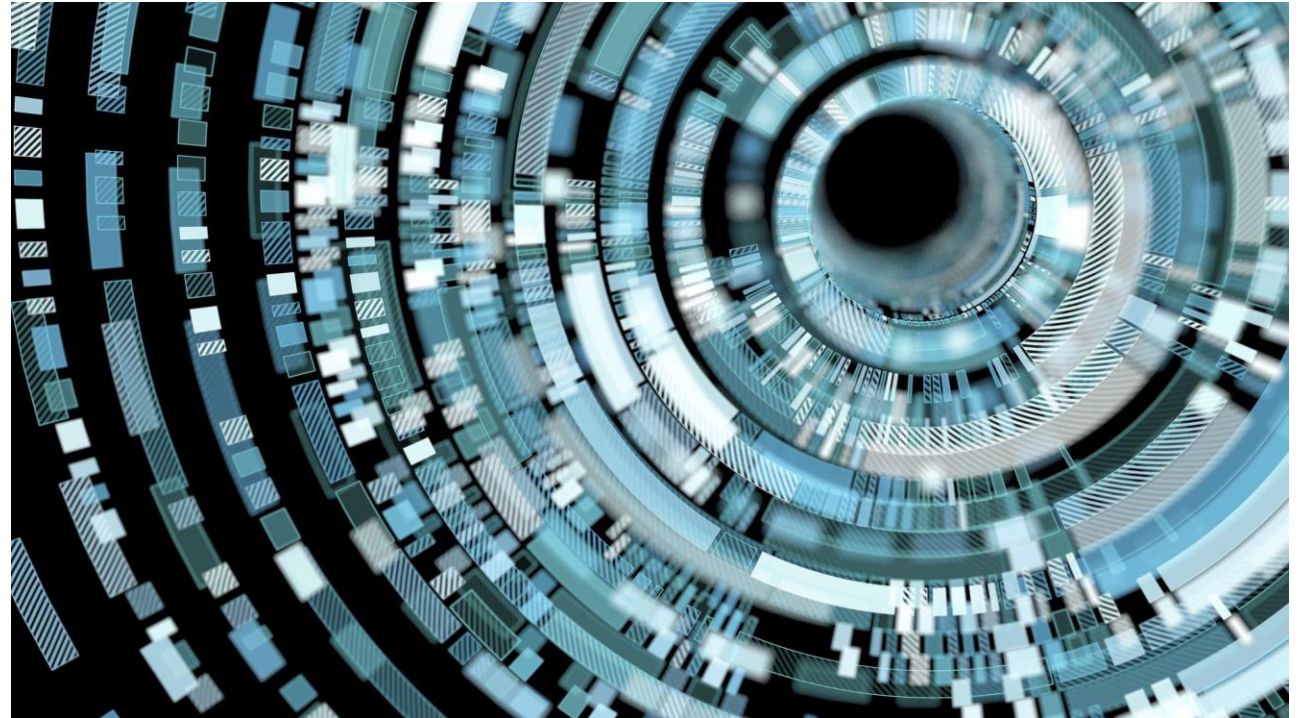
DeiC: Ex officio members: Head of Quantum Infrastructure, Henrik Navntoft Sønderskov, DeiC
Programme Coordinator, Louise Juel Broch, DeiC

Q-Algorithm – Next Steps

Next call will be announced in Q1 2026.

The academy is working on the following events:

- 12-12 Seminar for scholarship recipients in May 2026
- Delegation trip to London expected June 2026



7. Niels Bohr Quantum Summer School



The summer school directly aligns with Denmark's national quantum strategy, aiming to cultivate and attract more 'quantum talent' to strengthen Denmark's leadership in this cutting-edge field



Coordinated by DeiC in collaboration with University of Copenhagen, University of Southern Denmark, Technical University of Denmark, Aalborg University, Aarhus University, Innovation Centre Denmark in Seoul, Tel Aviv, Munich, Boston and Silicon Valley.

Funding for 4 summer schools

2025: Niels Bohr Institute, University of Copenhagen

2026: Center for Quantum Mathematics, University of Southern Denmark, Odense

2027: DTU

2028: Aalborg University

➔ [Quantumsummer.dk](https://www.quantumsummer.dk)

➔ <https://www.linkedin.com/company/niels-bohr-quantum-summer-school/>

The 2025 edition:

250 applications

70 students admitted + 14 on a waiting list

Some changes in the group underway due to world politics

Only 20 students from Danish universities!



Thank you all for listening!

Stick around for Q&A!