

A stylized orange wave graphic with a black surfboard icon. The wave is composed of several peaks and troughs, with the central peak being the tallest. A black surfboard icon is positioned on the left side of the wave, appearing to ride the crest of the wave. The word "SURF" is written in white, bold, uppercase letters on the black surfboard. The rest of the title "ing the quantum wave" is written in black, bold, lowercase letters to the right of the surfboard.

SURFing the quantum wave

Ariana Torres Knoop

We are getting a quantum computer!!!



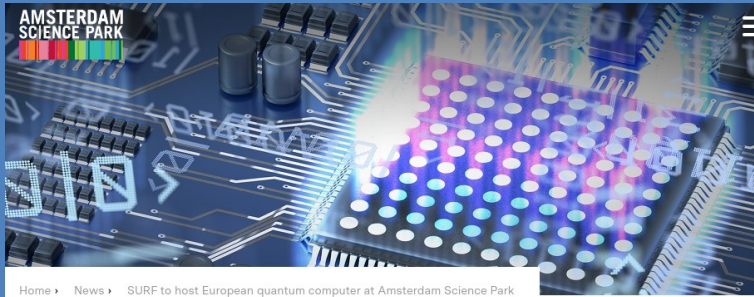
SURF, EuroHPC JU and Quantum Delta NL

[Home](#) > [News](#) > **SURF Hosts European Quantum Computer**

22 October 2024

SURF hosts European quantum computer

SURF



Home > News > SURF to host European quantum computer at Amsterdam Science Park

October 23, 2024

SURF to host European quantum computer at Amsterdam Science Park

Deep Tech | Quantum technology and Quantum computing

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Nederland krijgt een grote Europese quantumcomputer

EMERCE TECH

Home/ Tech/ SURF gaat Europese kwantumcomputer in Amsterdam hosten

Nieuws ~ 23 oktober 2024 - 10:50

SURF gaat Europese kwantumcomputer in Amsterdam hosten

SURF gaat in Nederland een Europese kwantumcomputer hosten. De kwantumcomputer komt op Amsterdam Science Park te staan.

NOS Nieuws Sport Live Programma's

Voorpagina Amsterdam

Het Parool

Verder in het nieuws Kunst & Media Uit in Amsterdam

Nieuws

Amsterdam Science Park krijgt een van acht Europese quantumcomputers: 'Grote impuls voor de stad'

Amsterdam Science Park wordt de thuisbasis van een Europese quantumcomputer. Een grote stap, zowel voor de wetenschap als voor de stad, zegt hoofd quantum computing Ariana Torres-Knoop van Surf, een van de

(N) nieuwsuur Vandaag in de uitzending

WOENSDAG

Nederland krijgt een van acht grote Europese quantumcomputers

SURF

fd. Mijn nieuws Net binnen Beurs Krant Podcasts FD Persoonlijk Abonneren

22 okt 12:01

Grote Europese kwantumcomputer komt naar Amsterdam

Jan Fred van Wijnen

Amsterdam is gekozen als locatie voor een van de kwantumcomputers die door heel Europa worden gebouwd. Brussel stimuleert de Europese ontwikkeling.

The European High Performance Computing Joint Undertaking (EuroHPC JU)

Home About Supercomputers Access to Our Supercomputers Research & Innovation News & Events Media Documents Contact

Home > New EuroHPC Quantum Computer to Be Hosted in the Netherlands

PRESS RELEASE | 22 October 2024 | European High-Performance Computing Joint Undertaking | 5 min read

New EuroHPC Quantum Computer to Be Hosted in the Netherlands

It takes a village...

Axel Berg
Huub Stoffer
Marieke Wervers

Patricia Engel-Sotomayor
Wesley Kooiman
Heleen Platenkamp
Shalini Tijkhoeri

Dorien Brugmans-Slot
Tom Hoeven
... and many more at SURF

Jacco de Vries (Nikhef, UM)
Joost van Echtelt
Arjen van Rijn

Evert van Nieuwenbrug (Leiden, aQa)
Nicolas Renaud (NLeSC)
Marco Matters (TUD, Quantum Inspire)
Carl Mensh (VSC)
Sabine Mehr (GENCI)

... and others

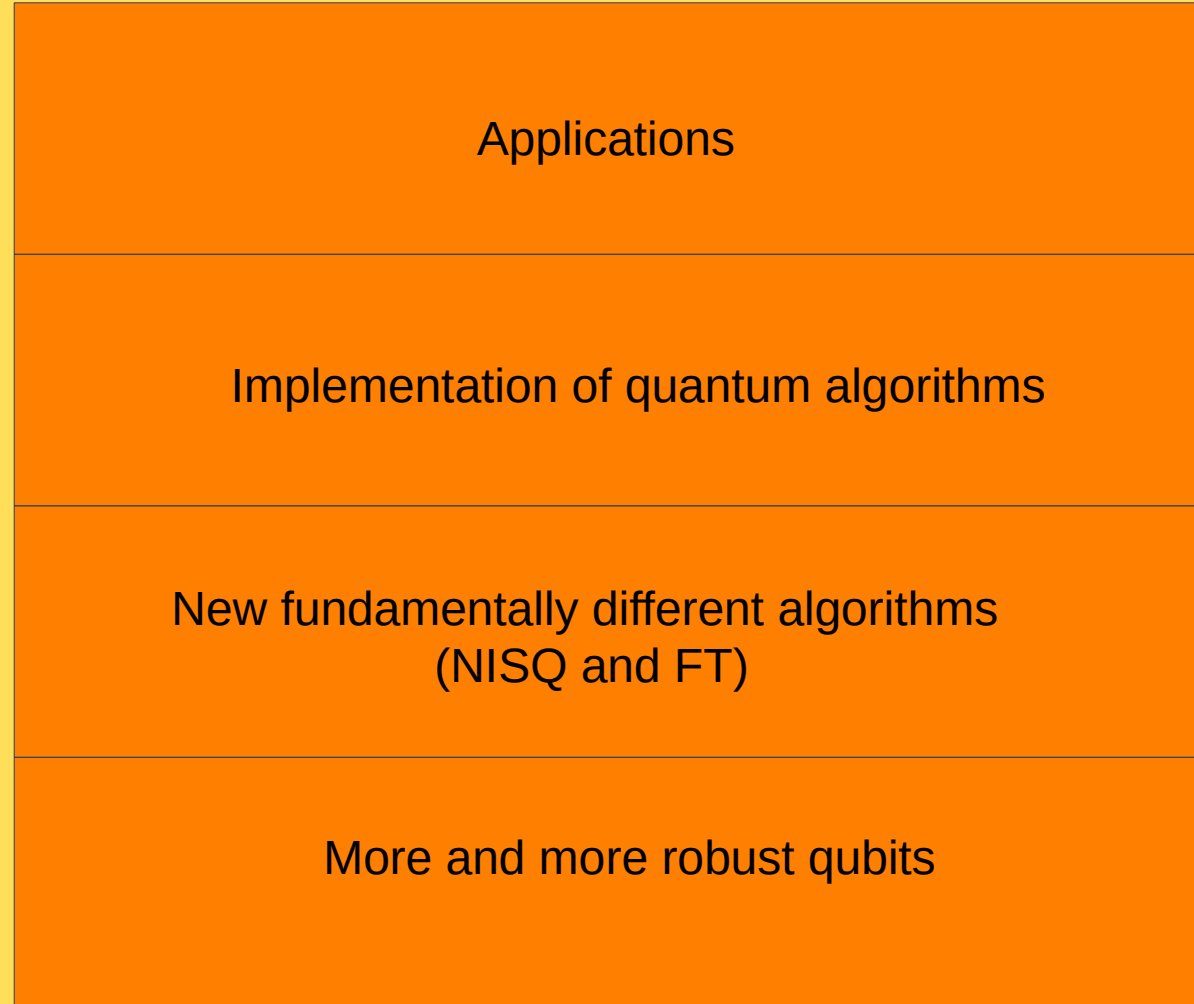
**Thank you all for the
work, input, reviewing,
editing, support,
discussions, etc.**

“The question is not longer only about theoretical capability but also practical applicability in real computing environments”

(HPCwire)

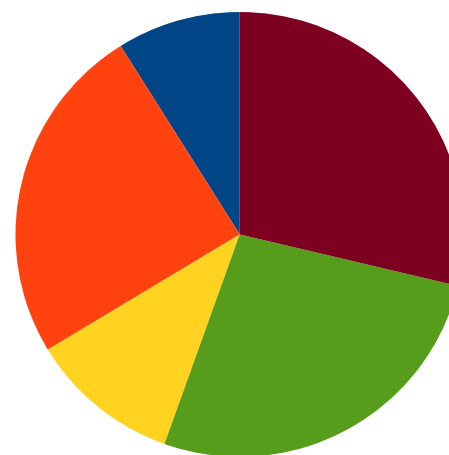
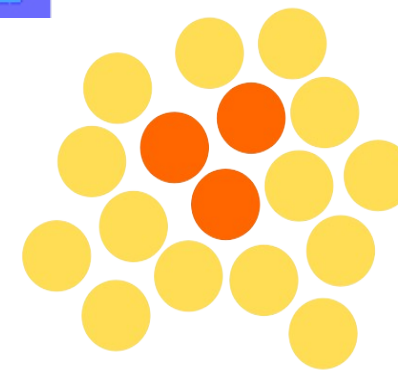
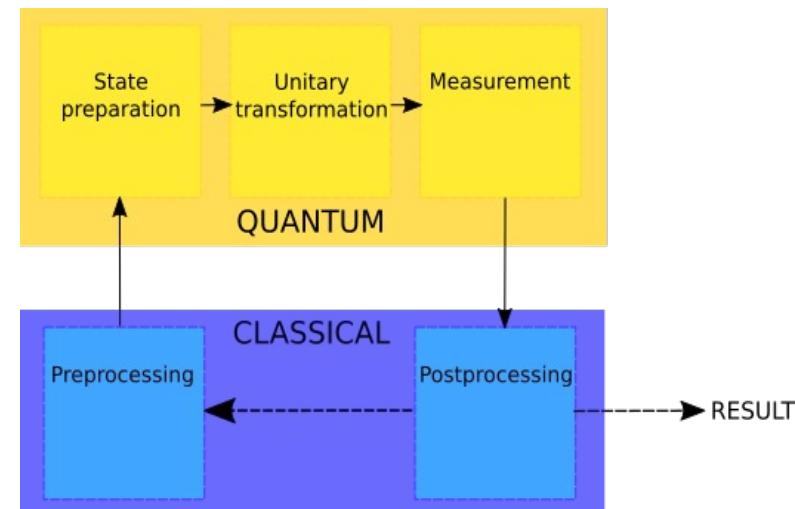
| How do we get there?

Integration to the classical ecosystem



Integration to classical ecosystem: HPC

- Why not?!
- Hybrid quantum algorithms are currently the only way to exploit NISQ devices
- **Quantum algorithms requires the support of classical resources**
- **The execution of quantum algorithms will most likely always be part of a larger hybrid workflow**
- Many of the most promising applications of quantum computing overlap strongly with existing applications of HPC
- **Simulation of quantum computers requires large computational resources**
- User base and infrastructure



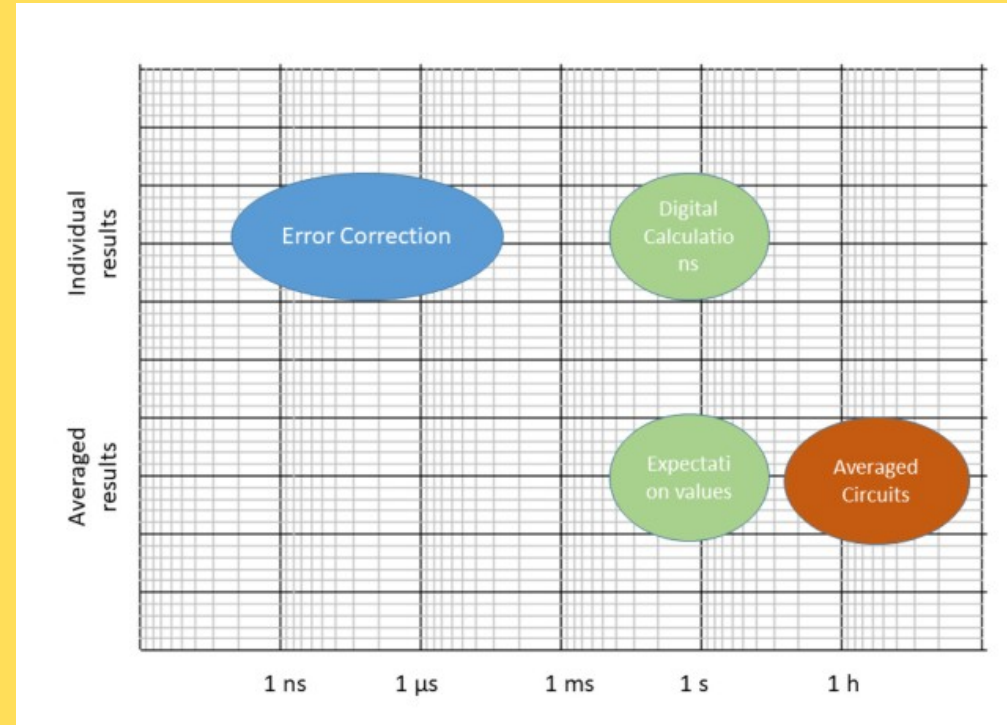
- Biochemistry, Bioinformatics
- Chemical Sciences and Materials, Solid State Physics
- Earth Sciences and environmental Studies
- Engineering, Mathematics, Computer Sciences
- Computational Physics

“Use of quantum computers to address existing computing challenges while leveraging the plethora of existing HPC tools, systems and workflows”

(2021 IEEE, Quantum Computers for High Performance Computing, Humble et al.)

Quantum for HPC, HPC for Quantum

- Usage of real quantum resources as accelerators: simulate quantum systems, optimizations, QML, CFD...
- Usage of classical resources to compute the theoretical output of a quantum algorithms
- Usage of classical resources for pre- post-processing (including error mitigation)
- Usage of classical resources for variational optimization
- Usage of classical resources for circuit cutting and knitting
- *Usage of classical resources for error correction (conditional preparation of quantum states based on intermediate measurements)*



(2021 IEEE, Quantum Computers for High Performance Computing, Humble et al.)

What is the expected resource balance?
How tightly do the resources need to be coupled?
What is the latency needed?

Quantum for HPC: what is peculiar about Quantum?

- Tightly couple, unbalanced
- Scarce resource
- One user at the time
- Calibrations
- Non-homogeneous qubits
- ...

→ More of a system-to-system integration

How should we schedule the jobs?

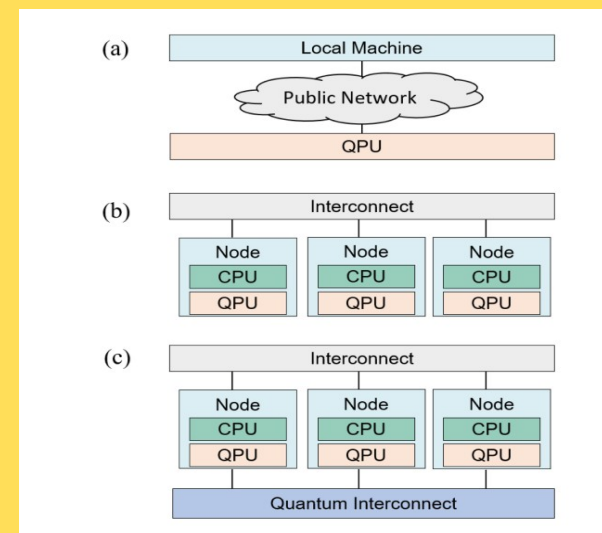
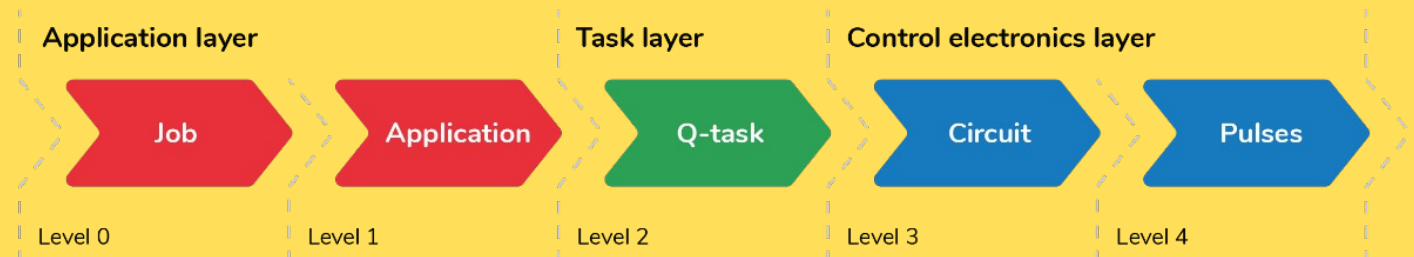
What needs to be optimized?

How do we share resources?

Access and authentication?

Resource monitoring?

How should the macro and micro architecture look like?



(2021 IEEE, Quantum Computers for High Performance Computing, Humble et al.)

About EuroHPC



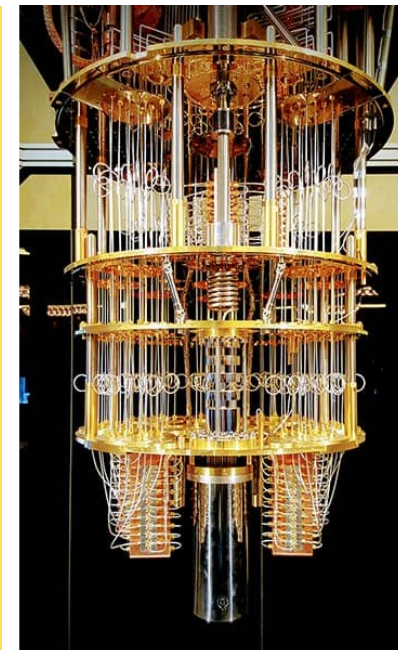
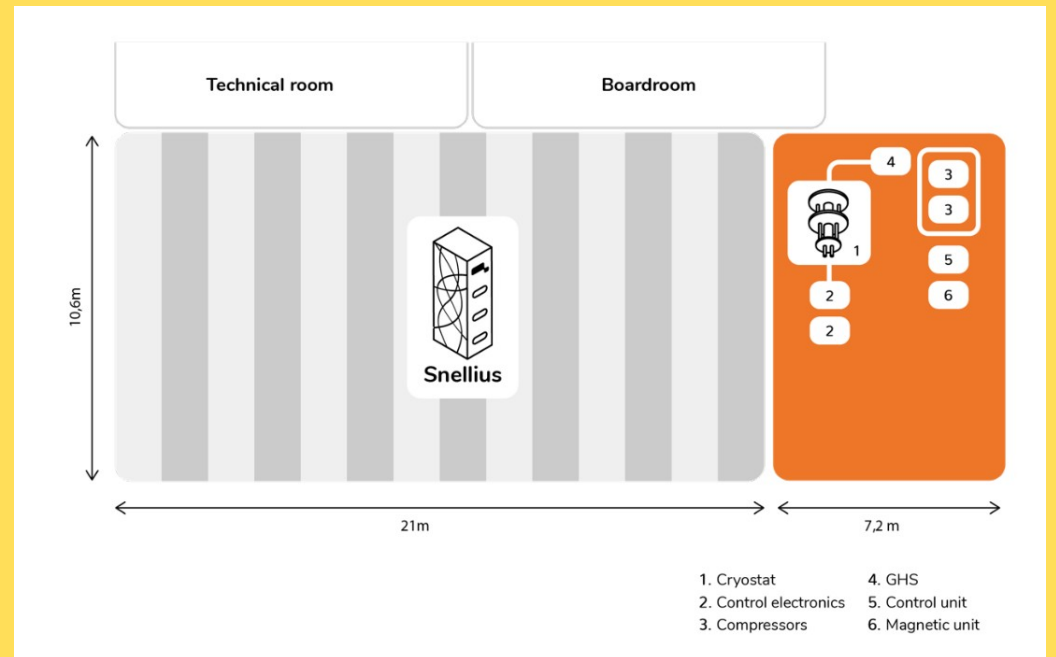
The EuroHPC JU has signed hosting agreements for six new quantum computers in Europe

-  LUMI-Q - Czechia
-  EuroQCS-France
-  Euro-Q-Exa - Germany
-  EuroQCS-Italy
-  EuroQCS-Poland
-  EuroQCS-Spain



Co-funded by the European Union

- 2 extra hosting sites
 - MeluxinaQ (Lux)
 - EuroSSQ-HPC (NL)



| The consortium

University of Antwerpen (BE),

GENCI (FR),

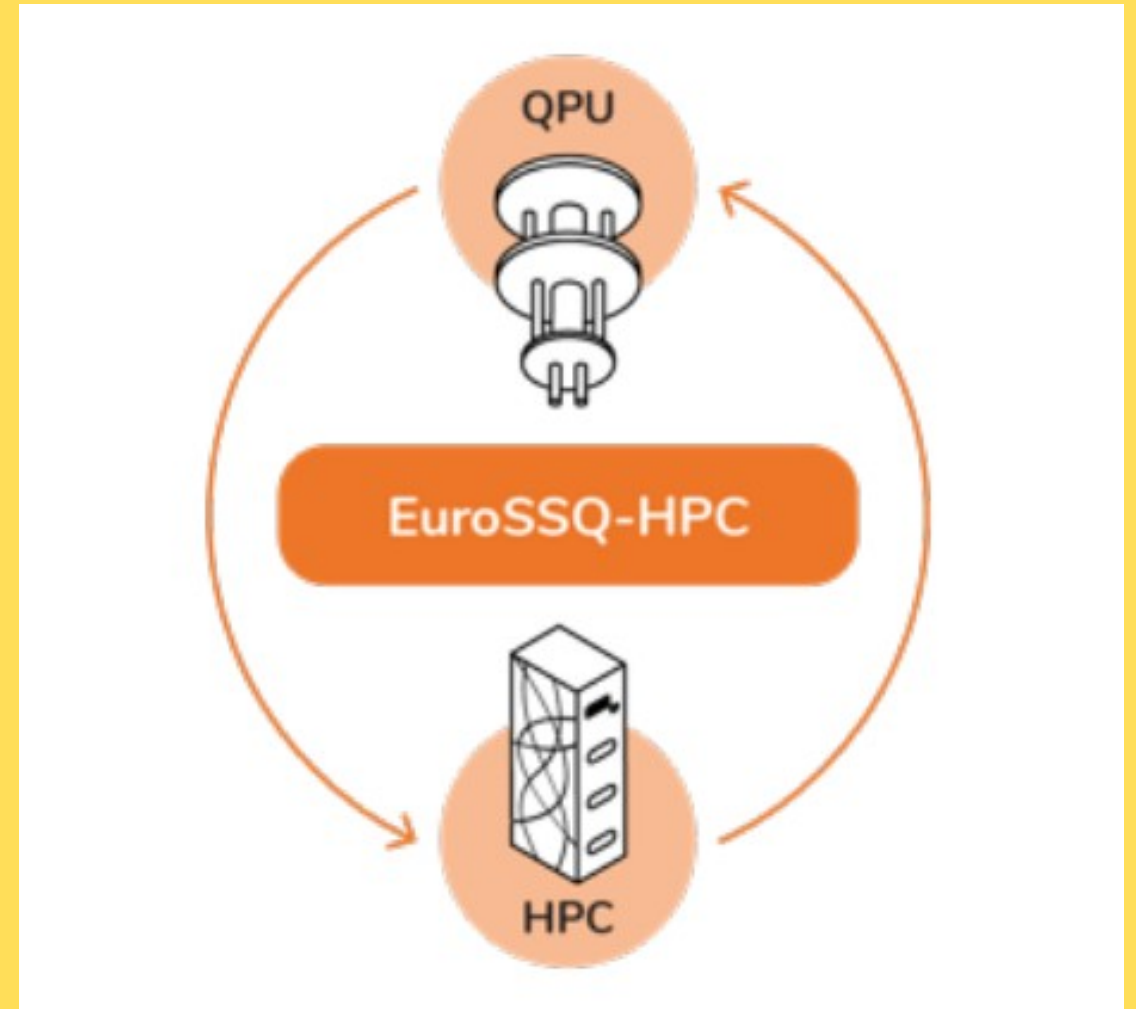
NL eScience Center (NL),

Leiden University, aQa (NL),

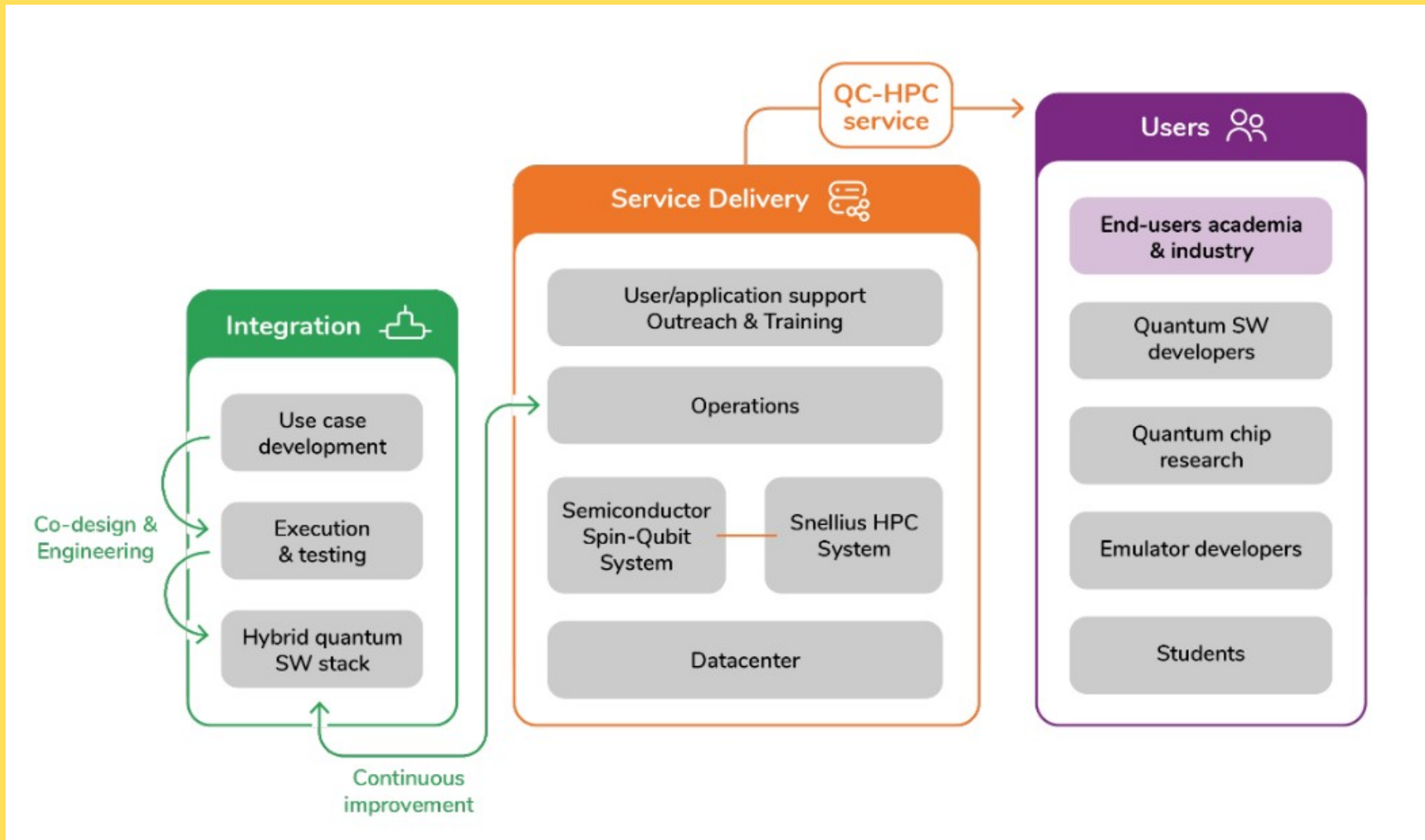
Delft University of Technology (NL),

National Institute of Subatomic Physics, UM (NL)

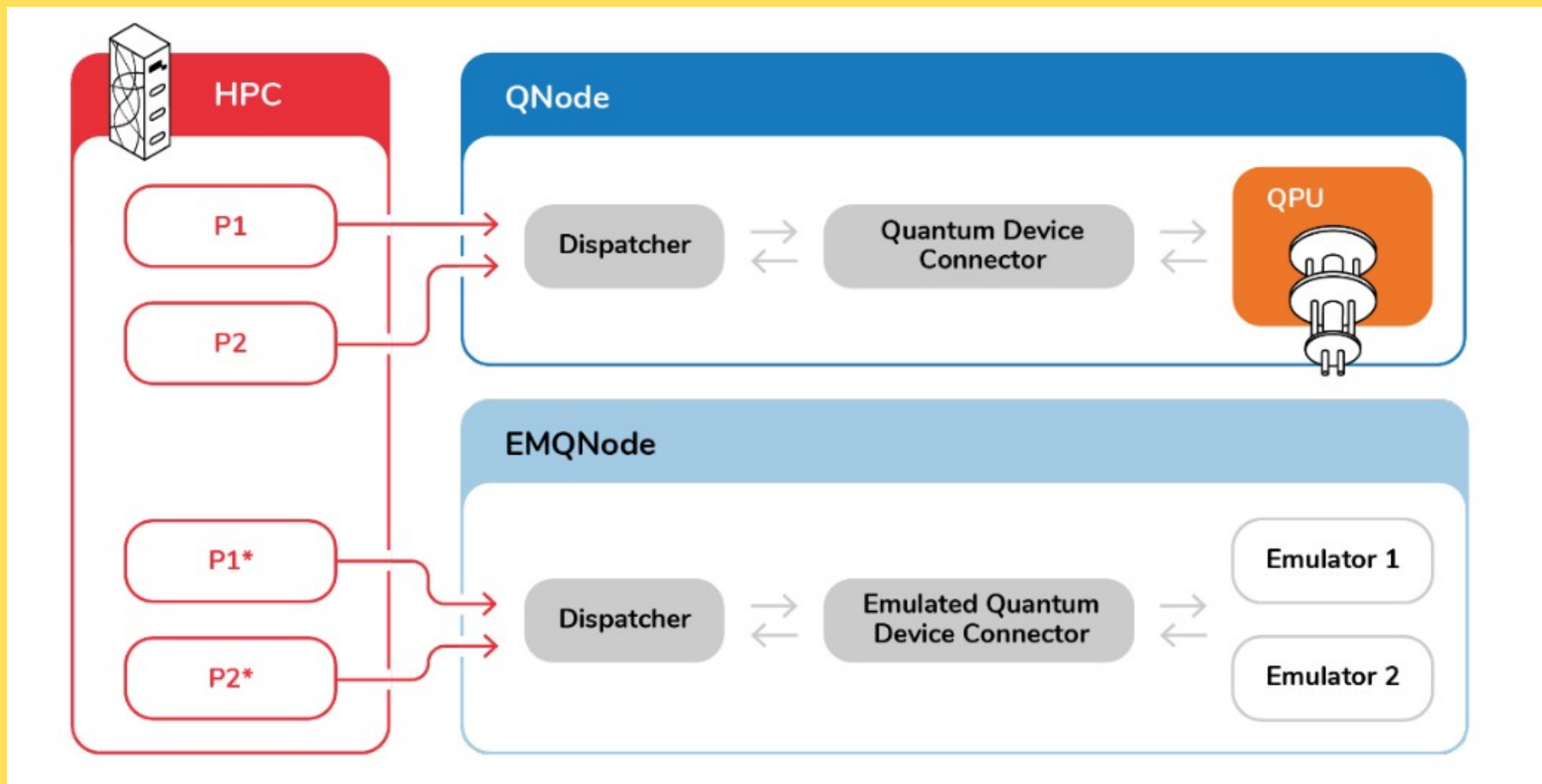
SURF (NL)



Our approach



Our approach



| Our quantum computer

- **Spin semiconducting qubits (Si or Si/Ge)**
- Fast gates → allow for longer circuits
- Relatively long coherence times
- Small qubits → millions in one chip
- Compatible with current semicon technology and industry
- Potentially can operate at relatively high temperature (4K)
- Greater controls due to isolation of individual electrons

<https://www.youtube.com/watch?v=y9dt5uTvsEM>
<https://www.youtube.com/watch?v=fBnKec6uI0U>
<https://www.youtube.com/watch?v=Re4I22ycc-k>
<https://www.youtube.com/watch?v=IPqd7A8mAzg>
<https://www.youtube.com/watch?v=SI4gQ-kYXLI>

| ... But the quantum computer will not be the first quantum equipment at SURF

| SURF's quantum key distribution test bed

Provides the opportunity for researchers and developers within the Netherlands to explore innovative applications and use-cases of QKD technology

Four end nodes:

Amsterdam SciencePark,
Utrecht SURF headquarters,
Groenekan Dataplace,
University Medical Center Utrecht

Center hub:

Utrecht University.

