

THE VISION

ML4Q stands for Matter and Light for Quantum Computing. The Cluster of Excellence set off in 2019 for a long collaborative journey in order to develop new computing and networking architectures using new findings in fundamental research in solid-state physics, quantum optics and quantum information.

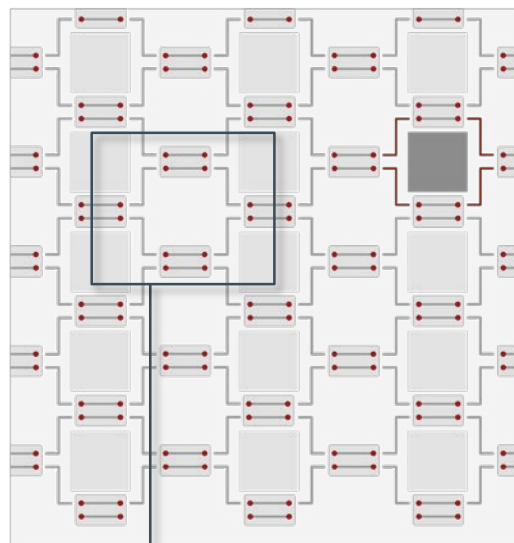
THE CLUSTER'S MISSION

Using the principles of quantum mechanics, it is the long-term goal of ML4Q to develop new computing and networking architectures with a power beyond anything classically imaginable. Quantum computers could be powerful tools in key areas such as materials design, pharmaceuticals, or artificial intelligence.

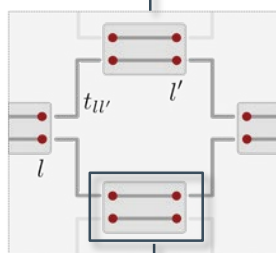
Quantum communication could be made effectively secure. ML4Q builds on the complementary expertise in the three key research fields of solid-state physics, quantum optics, and quantum information science to develop the best hardware platform for quantum information technology, and provide comprehensive blueprints for a functional quantum information network.

The long-term goal of the cluster is to realize network and processing architectures protected by error-correction protocols and eventually connected to a quantum version of the internet.

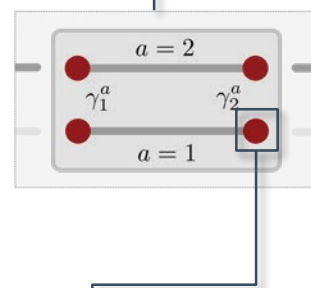
This goal defines a hierarchy of challenges, both in fundamental science and in technology, which must be overcome at early and intermediate stages.



The processor units of a network comprise arrays of qubits whose implementation requires scalable designs. We envision to realize these units by the end of the second funding period.



The ML4Q core projects are dedicated to the development of both spin qubit platforms as well as topologically protected Majorana qubits as an alternative platform with the prospect of superior performance in the long term.



As Majorana-based quantum information hardware is still in its infancy, major intermediate challenges need to be overcome. These include the actual engineering of Majorana qubits.



On an even more fundamental level, the realization and optimization of quantum materials harboring Majorana states are goals for the first two years of the running period.

ML4Q IN NUMBERS

151

MEMBERS AND ASSOCIATES



39

PROFESSORS



58

PHD STUDENTS



35

POSTDOCS



25

FEMALE SCIENTISTS



52

INTERNATIONAL SCIENTISTS



4

UNIVERSITIES



3

NON-UNIVERSITY RESEARCH INSTITUTIONS

YOUNG SCIENTISTS

Attracting and retaining the best young talent in the field by offering competitive career opportunities is a top priority for ML4Q. Current offers include:

- Undergraduate grants
- Independence grants for postdoctoral researchers
- New tenure-track professorships
- ML4Q Research School with cluster-specific courses, e.g. "Platforms for Quantum Technologies" for Master students
- Master program for Quantum Technology in Aachen as well as specialized lectures on quantum technologies in Bonn and Cologne

