DiNAQC
Digital Neutral Atom Quantum Computer

Planqc is building a prototype quantum computer in DiNAQC on which a quantum algorithm relevant to DLR research will be identified, customized to the neutral atom platform and executed on the 100-qubit demonstrator at the end of the project.

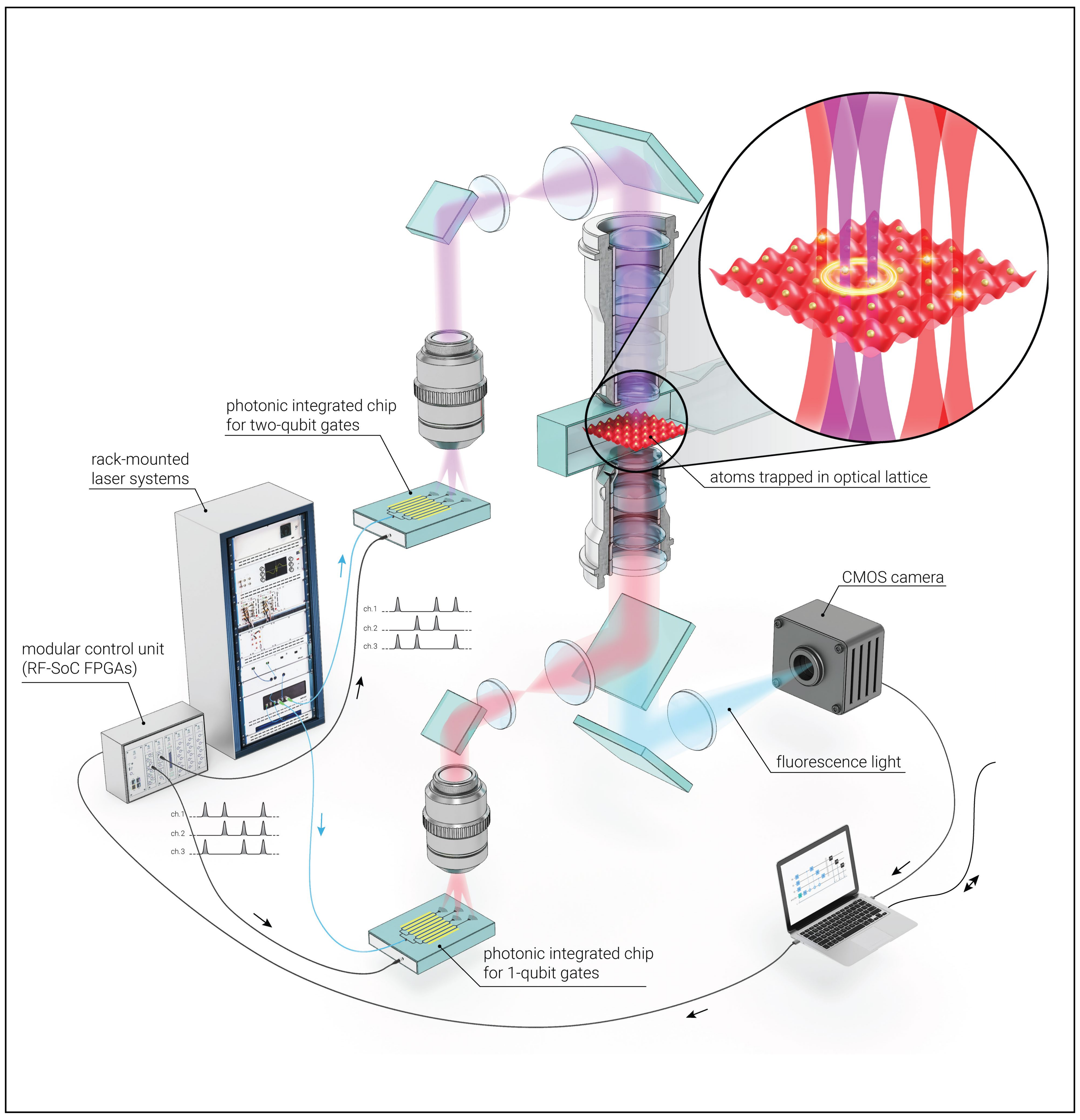
- 100 Qubits
- 2 Logical Qubits (error corrected)
- Testbed for real-world algorithms
- Duration 42 months

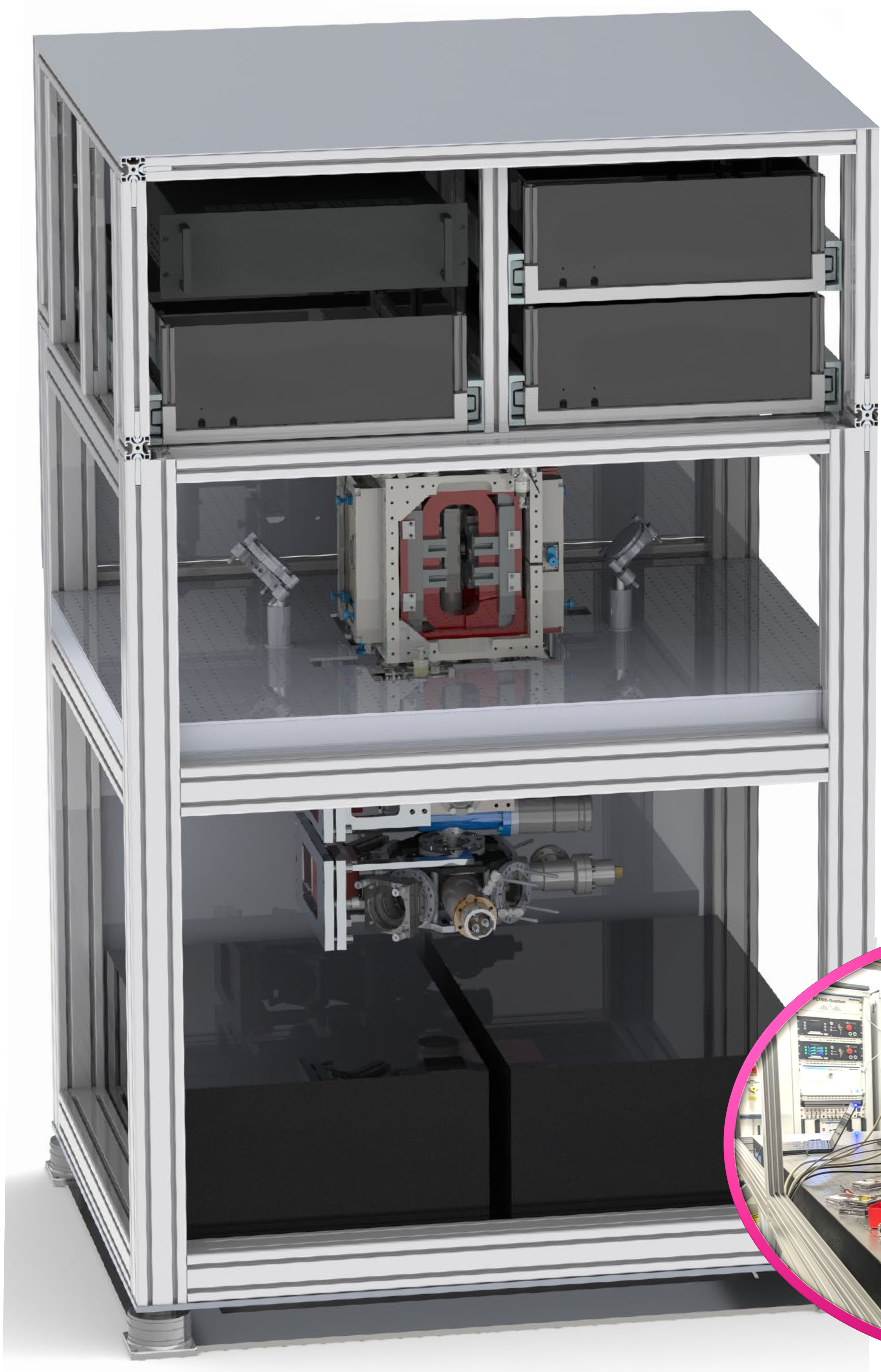
Objective

In the DiNAQC demonstrator, individual ultracold strontium atoms in optical traps are used for the qubits. Each atom realizes a qubit, which is controlled by further laser beams. Entanglement between two qubits is generated by fast laser pulses that couple the qubits to highly excited Rydberg states. Neutral atom quantum computers are particularly scalable because the atoms can be arranged in any two-dimensional configuration and because each atom – and therefore each qubit – is identical to every other atom. Atoms do not require cryogenic cooling, as they can be cooled to microkelvin temperatures using lasers alone.

Challenge

Digital quantum computing with neutral atoms has only become conceivable in recent years with the development of correspondingly powerful and high-quality laser technologies. The unique selling point of DiNAQC is that planqc, as the first spin-off from Munich Quantum Valley, has chosen the bosonic isotope of the alkaline earth atom strontium as its quantum information carrier. This leads us to expect outstanding gate fidelities and coherence properties. The approach we have chosen enables rapid scaling to hundreds and, in perspective, thousands of qubits. With DiNAQC, we go beyond these developments and clearly focus on a major challenge in quantum computing: the demonstration of first error mitigation and error correction protocols for neutral atoms.





Motivation

Neutral atoms are a young quantum computing platform that has made massive progress in recent years. Due to their intrinsic scalability, neutral atoms are considered one of the most promising approaches for advancing into the realm of an industrially relevant quantum advantage, even with quantum processors that are not fully error-corrected.

Technology

The lenses are mounted around the glass cell. Photons with a wavelength of 461 nm, which propagate downwards from the atomic register located in the image plane, are guided through dichroic optics to a high-resolution camera, which in turn is read out by a computer. Laser pulses of other wavelengths are generated by electronic signals controlling the integrated optical circuits. The pulses generated here are bundled by small lenses and transported to the atomic level by further optics via the lenses. Figure from patent application "Hardware-efficient neutral atom quantum computing method and device", European patent application (filed on 27.06.2023).

More information about the project on our website

A project of

planqc

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Get in touch.
We enable quantum!

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