Quantum Computing & Simulation Hub

EPSRC Pioneering research and skills

UK NATIONAL QUANTUM TECHNOLOGIES PROGRAMME

UKRI Engineering and Physical Sciences Research Council

Imperial College London

University of Sussex

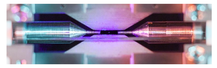
UNIVERSITY OF Southampton

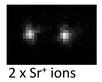
UNIVERSITY OF OXFORD

NQIT Networked Quantum Information Technologies

SCIENCE TO SHAPE THE FUTURE OF THE ARMY · ARMY RESEARCH OFFICE · 1951

Trapped ions





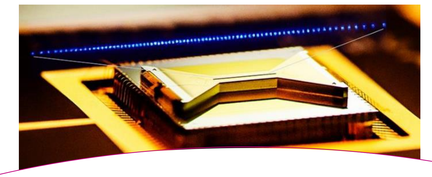
2 x Sr^+ ions

Identical qubits → scalability

Long coherence times ($T_2^* > 50$ s) → excellent quantum memory

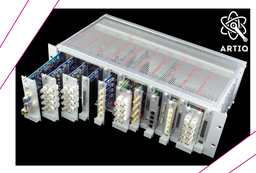
Proven high-fidelity quantum operations → fault-tolerance

- state preparation error ≈ $2 \cdot 10^{-4}$
- readout error ≈ $5 \cdot 10^{-4}$
- single-qubit gate error ≈ 10^{-6}
- two-qubit gate error ≈ 10^{-3} (100 μs gate duration)
- fast two-qubit gate error ≈ $2.5 \cdot 10^{-3}$ (1.6 μs gate duration)



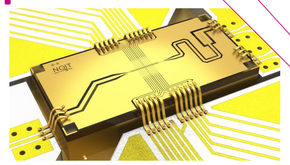
Control system

ARTIQ

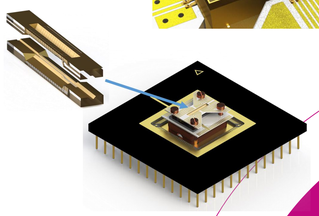


Advanced ion traps

Traps for microwave-driven quantum logic gates



Macroscopic traps with integrated optical cavity



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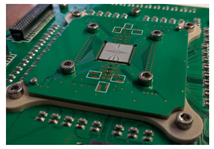
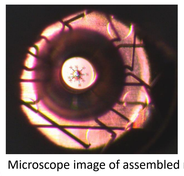
OXFORD IONICS

Quick turnaround cryogenic testbed

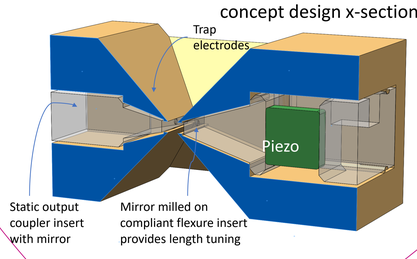




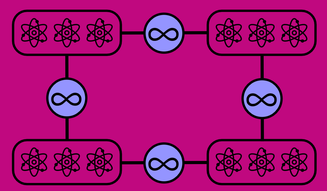
Microfabricated traps with integrated optical cavity

Microscope image of assembled microcavity

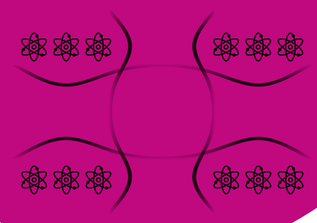
1-DOF cavity trap concept design x-section



Quantum charge coupled device

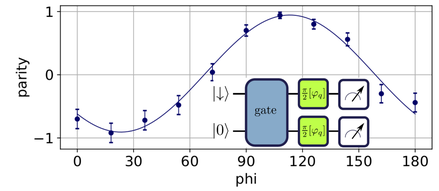


Quantum networks

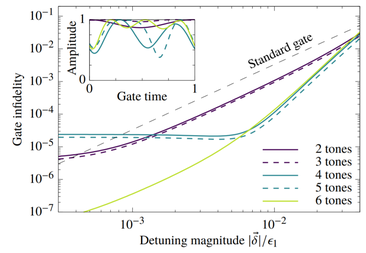


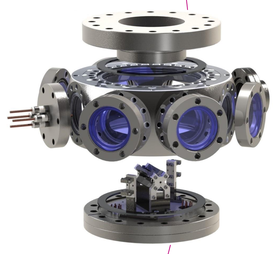
Robust entangling gates

Mixed-species gates

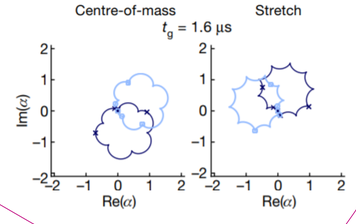


Noise-resistant gates





Fast two-qubit entangling gates t_g = 1.6 μs



OXFORD HIGHQ

ColdQuanta UK

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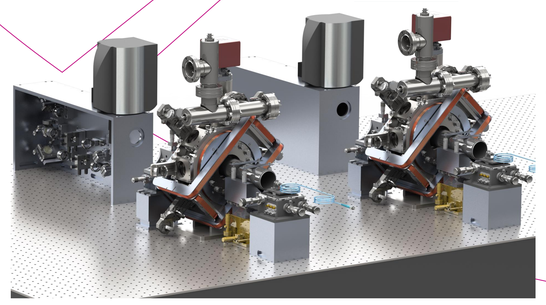
QUANTUM FLAGSHIP

European Commission

Quantum networking

UNIVERSITY OF OXFORD



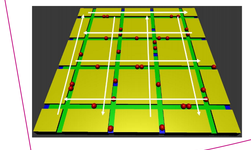
Two-node networking experiment
remote entanglement with F=0.94 at 180/sec

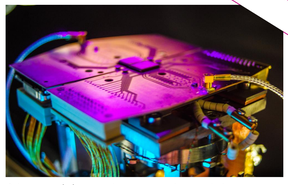
example applications:

- device-independent QKD
- blind quantum computing
- entanglement distillation across nodes

Large scale quantum computation

Shuttling ions for Noisy-Intermediate-Scale-Quantum (NISQ) devices





A two module quantum computer prototype

Universal Quantum