Convergence: The Promise and Reality of AI & Quantum

November 14, 2022

Quantum Computing with Neutral Atoms

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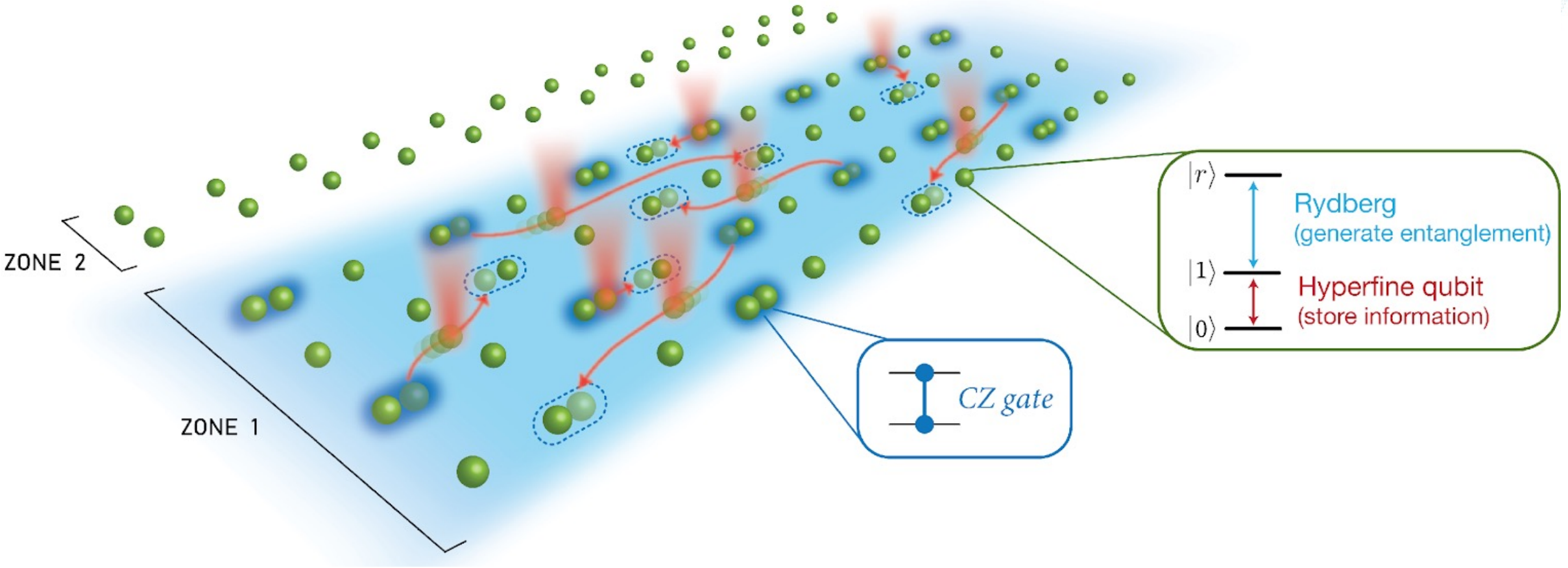
Quantum computing with neutral atoms as qubits

"Now, we can, in principle make a computing device in which the numbers are represented by a row of atoms with each atom in either of the two states. That's our input. [Then the] Hamiltonian starts.. The ones move around, the zeros move around. Finally, .. a particular bunch of atoms.. represents the answer. Nothing could be made smaller.. Nothing could be more elegant."*

R.P. Feynman, 1983, Los Alamos

Concept: movable individual atoms trapped in laser beams



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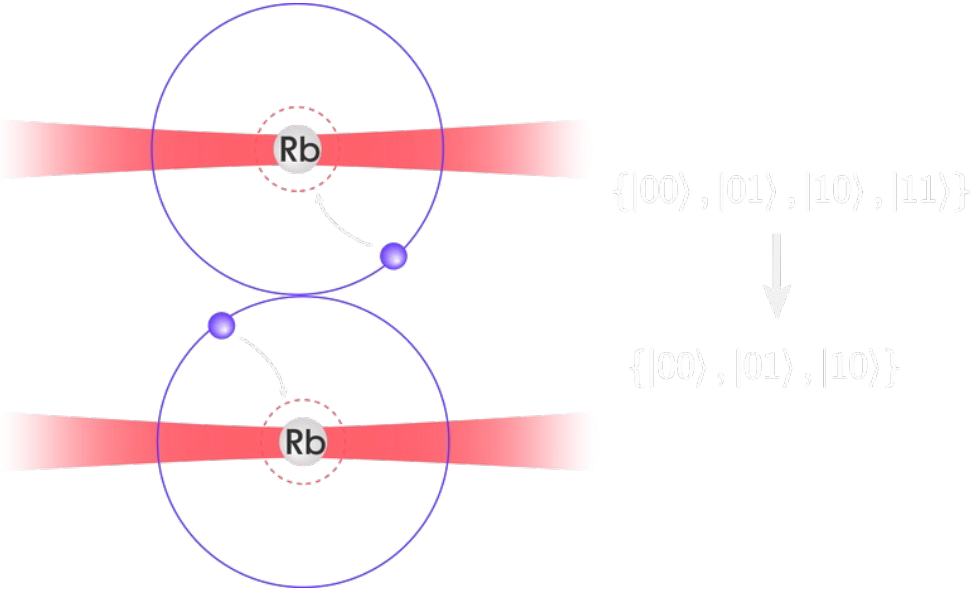
Quantum simulation and computing with neutral atoms

- In collaboration with Mikhail Lukin and Markus Greiner (Harvard).
- Boston-based start-up company: Quera delivers neutral-atom quantum simulator with 256 atoms accessible via AWS.



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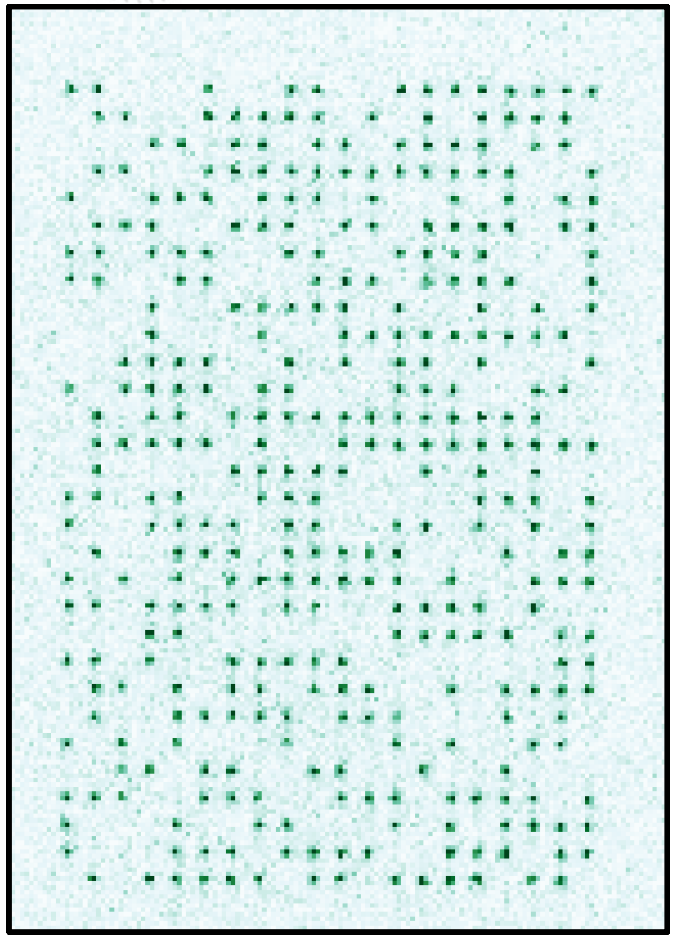
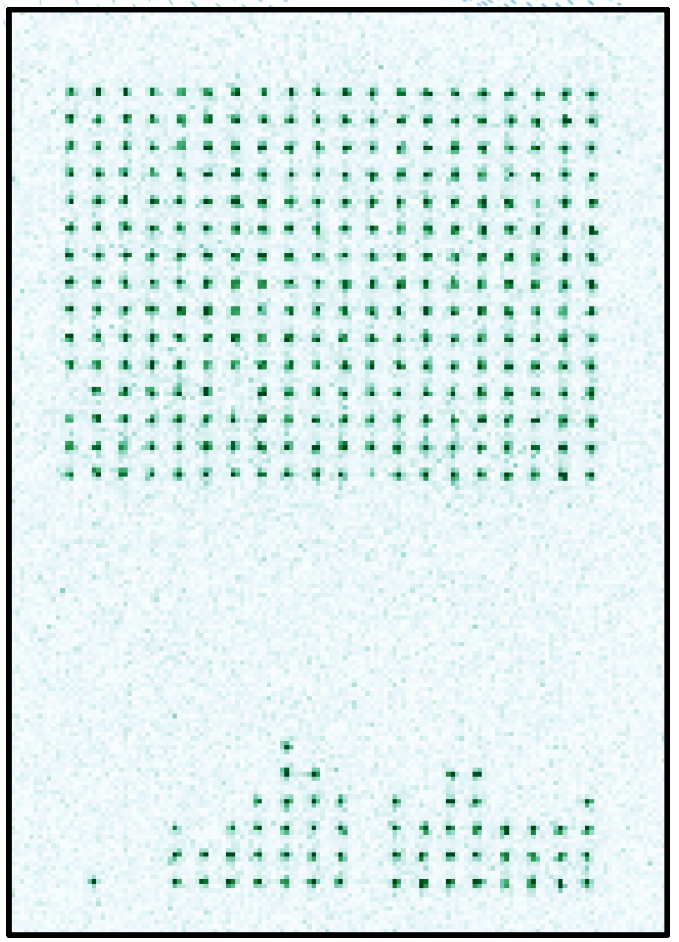
Sorting 300 individual atoms into an array of traps

Initial loading





After sorting

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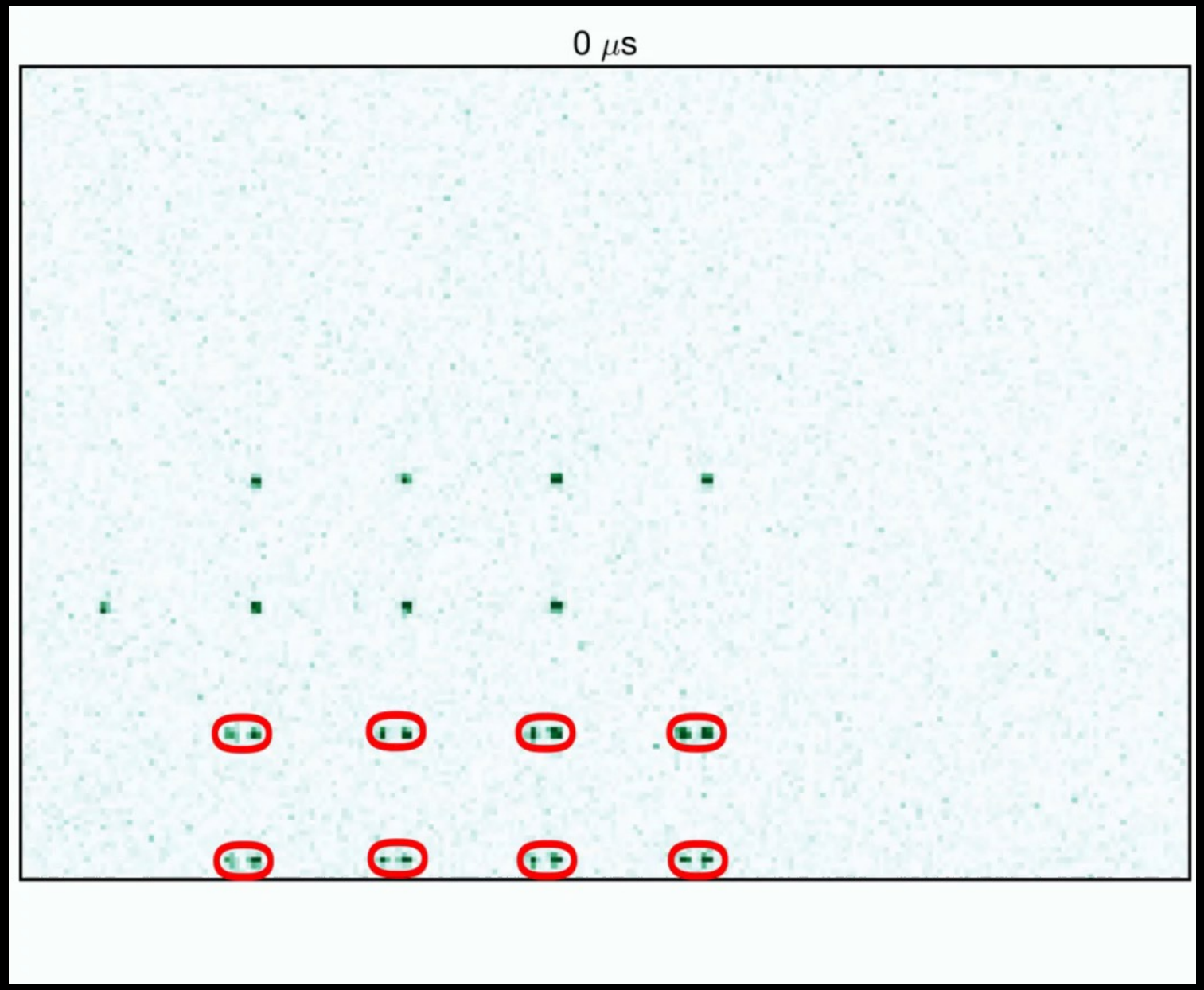
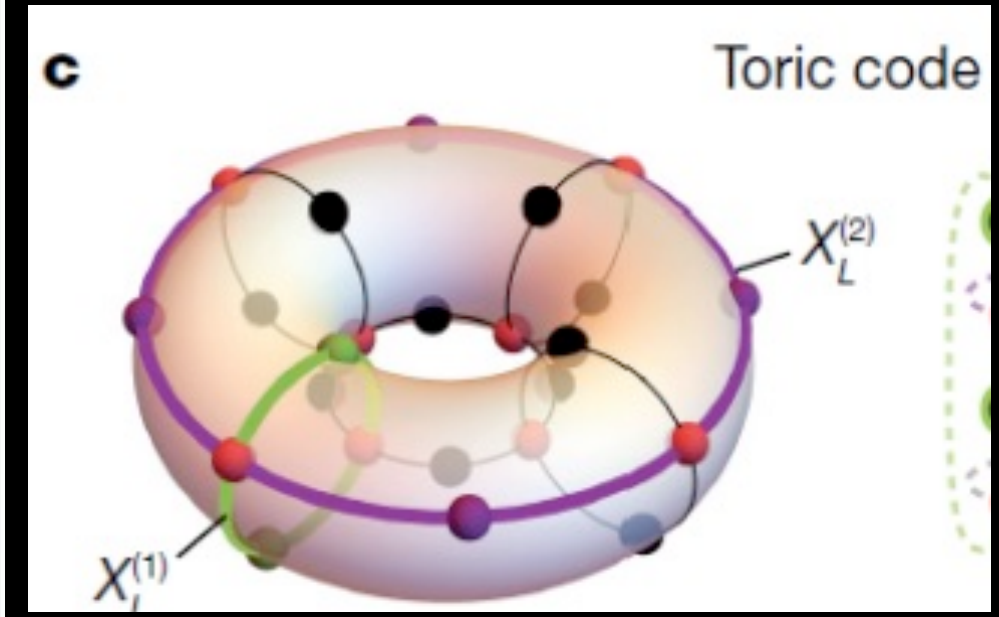
Towards quantum error correction: Toric code





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I expect that in the next 5 years, we will have quantum computing hardware with error correction, enabling 10-100 logical qubits from 10^4 to 10^5 physical qubits.
We will need to invent and test quantum algorithms that are hardware efficient (matched to strengths of hardware).
Can some form of Quantum AI be realized?

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