Towards fault-tolerant quantum computing with neutral atoms

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Neutral atoms have emerged as a leading platform for digital quantum simulations and quantum computing, with present-day systems surpassing a thousand qubits and achieving gate fidelities near the 99.9% level.

As the field transitions toward scalable, fault-tolerant quantum computing, robust quantum error correction becomes increasingly important.

In this talk, I will describe work at the University of Strasbourg developing architectures for efficient quantum error correction tailored to Rydberg-atom arrays.

I will present new ideas and codes for performing error correction, highlighting conditions under which the latter offer advantages over conventional schemes.

One example is low-density parity-check codes that can encode more information and protect better from physical errors with respect to conventional surface codes. Both challenges and new ideas for performing error-corrected logical quantum computation within this framework are discussed.