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# A new Quantum Computation and simulation platform based on Yb Rydberg atoms in optical tweezers

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We present our efforts towards a new quantum simulation and computation platform based on Yb Rydberg atoms in optical tweezers. Based on the so-called OMG Qu-Bit architecture [1] our approach promises efficient and robust options for storage, manipulation and read-out of quantum information based on the two-electron valence structure of Yb. Resource efficient schemes for error correction [2], high-fidelity mid-circuit read-out [3,4,5] and optical control of Rydberg [6] atoms are among the promising features of this new architecture. Tailored to the capabilities of our experimental approach we demonstrate machine learning assisted design of a two-qubit gate in a Rydberg tweezer system [7]. Two low-energy hyperfine states in each of the atoms represent the logical qubit and a Rydberg state acts as an auxiliary state to induce qubit interaction. Utilizing a hybrid quantum-classical optimizer, we generate optimal pulse sequences that implement a CNOT gate with high fidelity, for experimentally realistic parameters and protocols, as well as realistic limitations. We show that local control of single qubit operations is sufficient for performing quantum computation on a large array of atoms.

[1] Chen et al., PRA 105, 052438 (2022)
[2] Wu et al., Nature Comm. 13, p4657 (2022)
[3] Ma et al., arXiv 2305.05493
[4] Huie et al., arXiv 2305.02926
[5] Lis et al., arXiv 2305.19266
[6] Burgers et al., PRX Quantum 3, 020326 (2022)
[7] Heimann et al., arXiv 2306.08691

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