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Towards large scale quantum computing – a many qubit ion trap at room temperature

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Large scale quantum computing is subject to extensive research and the ideal platform for general purpose quantum computers has yet to be found. Trapped ions as qubits excel in terms of gate fidelity and coherence times but so far systems have mostly been limited to only a small number of qubits. Our system is designed to support a linear chain of up to 50 ions which can be individually addressed, providing a versatile platform with many qubits and a high level of control. At the heart of the system is a 3-dimensional ion trap consisting of gold coated laser machined glass. The trap operates in ultra-high vacuum at room temperature. Individual addressing is implemented using a waveguide array. One application of this system is research towards large distance error correction, eventually enabling fault tolerant quantum computation. The high level of control is furthermore advantageous for the simulation of complex Hamiltonians, effectively performing quantum simulation at scale. Lastly, the segmented electrodes of the trap allow splitting of the ion chain into multiple segments for parallel quantum processing.

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