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Building a cryogenic quantum computing demonstrator based on trapped ions

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Surface electrode ion traps are well suited for building a scalable quantum computer because ions trapped in a Paul trap can have long coherence times combined with high fidelities, and it is possible to move the qubits around in a 2-D surface. I will present our design for a cryogenic setup aimed at increasing the fidelity of state preparation and quantum gates. Our experiments allow us to use different ion traps featuring sections for loading and storing ions as well as junctions, interaction, and detection zones. We are building two setups, one based on 9Be+ logic ions together with 40Ca+ ions for sympathetic cooling and a second one based on 43Ca+ logic ions with 88Sr+ ions for sympathetic cooling. The experiment control system is based on the ARTIQ hardware/software stack. It controls the DC lines for the surface electrodes, RF electronics for the RF trap drive and also the AOMs, and microwave electronics which are used for driving single- and two-qubit gates via a microwave field.

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