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Trapped Ion Quantum Computing with Microwaves JOE RANDALL, University of Sussex, Imperial College, SEBASTIAN WEIDT, EAMON STANDING, SIMON WEBSTER, KIM LAKE, DAVID MURGIA, TOMAS NAVICKAS, BJOERN LEKITSCH, MARCUS HUGHES, ROBIN STERLING, DARREN DE MOTTE, GOURI GIRI, ANDREA RODRIGUEZ, ANNA WEBB, University of Sussex, HWANJIT RATTANASONTI, PRASANNA SRINIVASAN, MICHAEL KRAFT, University of Southampton, JESSICA MACLEAN, CHRIS MELLOR, University of Nottingham, WINFRIED HENSINGER, University of Sussex — To this point, entanglement operations in trapped ion qubits have been predominantly performed with lasers. However, this becomes problematic when scaling to large numbers of qubits due to the challenging engineering required. The use of stable and easily controllable microwaves to drive entanglement gates can overcome this problem. We will present our work towards implementing multi-qubit entanglement gates using microwaves in an experimental setup that produces a static magnetic field gradient of 24 T/m over an ion string. We will first present a scheme for preparing and manipulating dressed-state qubits and qutrits that are highly robust to decoherence from magnetic field fluctuations. We will also present our work experimentally demonstrating motional sideband transitions and Schrödinger cat states using microwaves in conjunction with the magnetic field gradient, as well as sideband cooling to the ground state of motion using dressed-states. Furthermore, we will show our latest results in creating microfabricated ion trap chips towards large scale quantum computing and simulation.

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