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Scalable Microwave Addressing of Trapped Ion Qubits at Fault-tolerant Error Levels[1] DIANA PRADO LOPES AUDE CRAIK, NORBERT LINKE[2], University of Oxford, DAVID ALLCOCK, NIST, USA, THOMAS HARTY, MARTIN SEPIOL, DEREK STACEY, ANDREW STEANE, DAVID LUCAS, University of Oxford — We present results obtained with a two-zone, scalable prototype surface-electrode ion trap for storing and individually addressing memory qubits. The trap has 4 integrated microwave electrodes per zone, designed to provide enough degrees of freedom for independent, parallel control of the microwave field amplitude, phase and polarization at each ion. In a demonstration experiment, we use two trap electrodes, one in each zone, to drive Rabi flops in a Calcium-43 ion trapped in the zone we wish to address, while nulling the microwave field in the neighbor zone. We measure Rabi frequency ratios between the addressed and nulled zones of up to 1400, implying that spin-flip errors of order 10^{-6} are achievable. We also demonstrate polarization control of the microwave field by selectively driving one of two near-degenerate transitions out of the qubit states, one of which is driven by σ^+ polarization and the other by σ^- polarization. We null the σ^+ component of the microwave field at the ion and measure a Rabi frequency ratio of ≈ 350 between the σ^- and σ^+ transitions. Finally, a new design concept for scalable microwave surface-electrode ion traps is presented and progress on the next-generation prototype is reported.

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