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Dressed-state qubits and magnetic field gradients for multi-ion quantum gates SIMON WEBSTER, KIMBERLEY LAKE, DAVID MURGIA, JOE RANDALL, EAMON STANDING, SEBASTIAN WEIDT, WINFRIED HENSINGER, University of Sussex — Strong magnetic field gradients enable multiple-qubit gates between ions without decoherence due to off-resonant excitation by laser light, however the need for qubit states to be sensitive to magnetic field gradients leads to decoherence from fluctuating magnetic fields. We demonstrate the use of dressing microwave fields to decouple an ionic qubit from magnetic field noise, significantly increasing its coherence time, and perform single-qubit gates using radiofrequency fields [1]. By integrating permanent magnets within our ion trap we generate a field gradient of 24 Tm^{-1} and use this gradient to entangle a single trapped ion's internal and motional states and generate Schroedinger cat states. We also report the first realisation of driving motional sideband transitions with microwave dressed states, and demonstrate near perfect individual addressing of ions. We will also present our work creating microfabricated ion trap architectures for quantum simulation and quantum computation.

[1] S. C. Webster et al., Phys. Rev. Lett 111, 140501 (2013)

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