Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Micromotion based single-qubit addressing with trapped-ions NITZAN AKERMAN, NIR NAVON, SHLOMI KOTLER, YINNON GLICKMAN, IDO ALMOG, ROEE OZERI, Weizmann Institute of Science — Individual-particle addressing is a necessary capability in many quantum information experiments. For example, characterization of multi-qubit operations with quantum process tomography (QPT). We propose and demonstrate a scheme that exploits the inhomogeneous excess micromotion in ion trap to address single-qubits in a chain of several ion-qubits, separated by only few microns. The scheme uses a laser field which is resonant with the micromotion sideband of a narrow optical quadrupole transition and acts as a dressing field with a spatially-dependent coupling along the chain. As a consequence, the level spacing of each ion, in the dressed state picture, becomes position dependent and individual ions can be spectrally separated. We have demonstrated Individual Rabi flops with 85% fidelity in a three-ion chain. For the case of only two ions, the coupling can be tailored to vanish on one of the two. This allows preparing any two-qubit product state as well as completing state tomography without direct spatially-selective imaging. We demonstrate full QPT for two-qubit Sørensen-Mølmer entangling interaction (Bell-state preparation fidelity of 98%) which has not been process-analyzed yet. Our tomography resulted process fidelity of 92%. N. Navon et. al. arXiv:1210.7336(1012).

Nitzan Akerman
Weizmann Institute of Science

Date submitted: 30 Jan 2013 Electronic form version 1.4