Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

Single Motional Quantum Exchange between Independently Trapped Ions[1] K.R. BROWN, C. OSPELKAUS, Y. COLOMBE, A.C. WILSON, D. LEIBFRIED, D.J. WINELAND — The Coulomb coupling of ions in separate potential wells is a key feature of proposals to implement quantum simulation and could enable logic operations to be performed in a multi-zone quantum information processor without the requirement of bringing the ion qubits into the same trapping potential. It might also extend the capabilities of quantum logic spectroscopy to ions that cannot be trapped in the same potential well as the measurement ion, such as oppositely charged ions or even antimatter particles. We report recent results demonstrating tunable coupling of two $^{9}Be^{+}$ ions held in trapping potentials separated by 40 μm [1]. The ions are trapped 40 μm above the surface of a microfabricated planar trap with independently tunable axial frequencies of $\sim$4 MHz. The trap is cooled to 4.2 K with a helium bath cryostat to suppress anomalous heating and to extend the lifetime of ions from minutes to days. By preparing approximate motional number states with n=0 and n=1 in the respective wells, and tuning the confining wells into resonance, a single quantum of motion is exchanged between the ions in $\sim$200 μs.

[1] arXiv:1011.0473, accepted to *Nature*.

[1]Work supported by IARPA, DARPA, ONR, and the NIST Quantum Information Program.

Kenton Brown
National Institute of Standards and Technology

Date submitted: 28 Jan 2011 Electronic form version 1.4