DAMOP06-2006-000628

Abstract for an Invited Paper
for the DAMOP06 Meeting of
the American Physical Society

Scaling Up Ion and Atom Traps with Silicon Based VLSI and MEMS Technologies[1]

RICHART SLUSHER, Lucent Technologies

Quantum computers, quantum simulators, and quantum repeaters require thousands or even millions of physical qubits in order to reach the performance levels required for interesting applications where the quantum information processing exceeds classical capabilities. Recently developed silicon VLSI and MEMS fabrication techniques are described that can achieve this scaling from the present levels of a few qubits for both ions and atoms. Ion traps are being fabricated using patterned metal electrodes isolated by SiO_2 and SiN on doped silicon substrates. The electrodes are in planar configurations so that CMOS electronics can be integrated below each electrode. The CMOS electronics can switch the required voltage sequences to each electrode for ion transport throughout the spatially multiplexed array of planar traps. Ion trap densities near 1000 ions/cm^2 are possible with these techniques. Atom traps can be formed holographically by Spatial Light Modulators based on MEMS mirror arrays. These optical traps can be rapidly re-configured in arbitrary 2D patterns in order to accomplish the scalable entanglement between trapped atoms required for cluster state quantum computation. Present technology should allow forming tens of thousands of traps over fields 500 μm on a side.

[1]This work is funded by ARDA