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Southwest Quantum Information and Technology

Eleventh Annual Meeting, February 19-22, 2009
Seattle, Washington

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Ion Trap Photonic Quantum Networks

Christopher Monroe, JQI and University of Maryland

(Session 6 : Saturday from 10:15-11:00)

Abstract. The local manipulation and entanglement of nearby atomic ion qubits through their Coulomb interaction is now established as one of the most reliable ways to build entangled states. Trapped ions can also be coupled through a photonic channel, allowing for various remote probabilistic ion-ion entanglement protocols. Recent experiments have shown entanglement, a Bell inequality violation, teleportation, and operation of a two-qubit quantum gate between two ions separated by 1 meter. Despite the probabilistic nature of this ion/photon network, it can be efficiently scaled to much larger numbers of ions for distributed large-scale quantum computing and long-distance quantum communication, especially when accompanied by local Coulomb-mediated deterministic quantum gates. Future work will couple photons emitted from trapped ions into optical cavities, and perhaps interface trapped ion qubits with other optically-active qubits such as quantum dots.