ABSTRACT

QUANTUM INFORMATION PROCESSING WITH TRAPPED CA+ IONS

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Trapped strings of cold ions provide an ideal system for quantum information processing. Quantum information is stored in individual ions, these qubits are individually prepared, the corresponding quantum states are manipulated and measured with nearly 100% detection efficiency. With a small ion-trap quantum computer based on several trapped Ca++ ions as qubits we have generated in a pre-programmed way various quantum states that are of particular interest for analyzing the behaviour of an ion quantum register. Scaling the ion trap quantum computer eventually requires the implementation of error correction which in turn needs high fidelity gate operations. For this, quantum process tomography is used to characterize and optimize the Cirac- Zoller CNOT gate operations. Another strategy for scaling up quantum computers is given by the use of flying qubits that allow one to interconnect nodes of small ion trap processors. With a new cavity QED setup we create an ion-qubit to photon-qubit interface for interconnecting ion-trap based quantum computers. With this device a source of deterministically generated single photons can be built and atomphoton entanglement can be investigated. This work is supported by the Austrian Science Fund (FWF), by the European Commission (QGATES, CONQUEST) and in parts by ARDA and ARO.