PhD Thesis Defense JAN HUWER 'Experimental Tools for Quantum Networking Operations with Single Photons and Sinlge Ions'

JAN HUWER

January 29, 2014

Wednesday January 29, 11:00. ICFO Auditorium

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Quantum Photonics

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One promising approach for future quantum networks is the combination of strings of trapped ions as quantum-information processors with entangled photon pairs produced by spontaneous parametric down conversion (SPDC) to establish quantum communication links

between distant processing units.

This work reports on experiments using a hybrid quantum-optics set-up, comprising two separate linear ion traps and a resonant SPDC photon-pair source. It demonstrates the controlled interaction of single entangled photon pairs with a single trapped 40Ca+ ion. Preparing the ion as a polarization selective absorber in the main polarization bases allows for the reconstruction of the biphoton quantum state, manifesting the photon entanglement in the absorption process.

Beyond that, the thesis documents the implementation of additional experimental tools enabling quantum state transfer experiments from photons to single ions. A dedicated narrow bandwidth laser system is set up, laser sequences are developed for state discrimination and state rotations of ion qubits, and for the creation and characterization of coherent superposition states, of particular importance for state-transfer schemes.

Finally, detection efficiencies of single Raman photons emitted by an ion are characterized with a well-controlled single-photon source, and absorption probabilities of single photons are determined with a calibrated laser beam, providing precise values to assess efficiencies for different transfer scenarios.

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