Abstract Submitted
for the DAMOP10 Meeting of
The American Physical Society

Opto-mechanical transducers for long-distance quantum communication applications PETER RABL, ITAMP, Harvard-Smithsonian CfA, KAI STANNIGEL, Institute for Theoretical Physics, University of Innsbruck, ANDERS SORENSEN, Niels Bohr Institute, University of Copenhagen, PETER ZOLLER, Institute for Theoretical Physics, University of Innsbruck, MIKHAIL LUKIN, Physics Department, Harvard University — We describe a new scheme for the implementation of a quantum interface between stationary qubits and a photonic channel. In our approach the coupling is mediated by an opto-mechanical device where the motion of a nano-mechanical resonator acts as a transducer for magnetic, electric and optical interactions. This scheme does not rely on coherent optical transitions and is therefore applicable for a wide range of spin and charge based qubits. We analyze a quantum network based on opto-mechanical quantum transducers and derive a simple model to describe the effective coupling of the qubits to a common optical fiber. We analyze the implementation of quantum state transfer protocols and study the influence of the intrinsic noise which is added by the opto-mechanical device. Our analysis shows that experimental conditions to achieve high state transfer fidelities are equivalent to conditions necessary for opto-mechanical ground state cooling and therefore are within experimental reach.

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Date submitted: 21 Jan 2010 Electronic form version 1.4