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Quantum Control of Optomechanical Systems

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ABSTRACT:

The optomechanical radiation pressure interaction provides the means to create entanglement between a mechanical oscillator and an electromagnetic field. I will show how we can utilize this entanglement within the framework of time-continuous quantum control in order to engineer the quantum state of the mechanical system. Specifically, I will analyze the creation of bipartite mechanical entanglement via time-continuous entanglement swapping, and preparation of a squeezed mechanical state by time-continuous teleportation. Furthermore I will discuss an experimental demonstration of optomechanical state estimation by Kalman filtering as a first step towards the implementation of the analyzed protocols. The presented protocols extend earlier work analyzing pulsed optomechanical entanglement creation—recently realized experimentally—and teleportation. They are all feasible in current optomechanical systems working in the strong-cooperativity regime.