

Non-destructive measurement of trapped-ion mechanical oscillators

Presenting Author : Pan-Yu Hou

Tsinghua University, Beijing, China

houpanyu@mail.tsinghua.edu.cn

Abstract

Bosonic quantum error correction (QEC) encodes quantum information in high-dimensional harmonic oscillators, providing hardware-efficient alternatives to traditional QEC approaches using two-level systems. Recent breakthroughs in cavity quantum electrodynamics systems have demonstrated bosonic QEC beyond the break-even point. While motional modes of trapped ions exhibit excellent coherent properties, their exploration of bosonic QEC has been hindered by backaction from photon recoil during state-dependent fluorescence detections. Here, we propose a scheme that enables non-destructive readout of a trapped-ion motional mode. This scheme leverages a 'protection' mode in a symmetric odd-number ion chain and high-fidelity two-mode state transfer. I will present the principle and details of this scheme, as well as the results of repetitive readout for the lowest two Fock states of a motional mode.

References

- [1] Pan-Yu Hou, Jenny J Wu, Stephen D Erickson, Daniel C Cole, Giorgio Zarantonello, Adam D Brandt, Andrew C Wilson, Daniel H Slichter, Dietrich Leibfried
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Figures

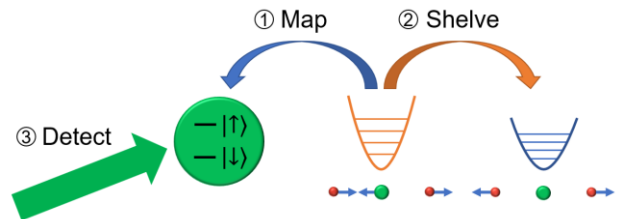


Figure 1: Diagram of a non-destructive measurement for a trapped ion motional state.