

Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Experimental realization of phonon shift operation in a trapped ion system¹ MARK UM, JUNHUA ZHANG, SHUOMING AN, DINGSHUN LV, YAO LU, SHEN CHAO, LUMING DUAN, KIHWAN KIM, Center for Quantum Information, Institute for Interdisciplinary Information Sciences, Tsinghua University — We report an experimental realization of phonon shift operation in a trapped ion system. The shift operation is a pure addition or subtraction without the modification of a state amplitude by \sqrt{n} , which transfer the state from $|n\rangle$ to $|n+1\rangle$ or from $|n\rangle$ to $|n-1\rangle$ for any n . We implement the pure addition by applying π pulse of a blue-sideband transition $|\downarrow, n\rangle \rightarrow |\uparrow, n+1\rangle$ followed by a π pulse of resonant carrier transition of spin $|\uparrow, n+1\rangle \rightarrow |\downarrow, n+1\rangle$. For subtraction we exchange the order. The essence is in an adiabatic blue-sideband π operation with high-fidelity and speed regardless of phonon number n (0 to 10) through the same operation in Ref. [1]. Although the pure shift operations are different from creation \hat{a}^\dagger and annihilation \hat{a} , it produces a non-classical state of phonon [2]. We observe a negative probability in the Wigner function of a phonon state after the pure shift operation on various phonon states. The scheme can be used for the projective measurement of phonon number states and the test of boson sampling problem [3].

[1] Junhua, et al., PRA 89, 013608 (2014).

[2] Daniel K, et al., PRL 110, 210504 (2013).

[3] Shen, et al., arxiv:1310.4860

¹This work was supported by the National Basic Research Program of China Grant 2011CBA00300, 2011CBA00301, 2011CBA00302, the National Natural Science Foundation of China Grant 61073174, 61033001, 61061130540.

Mark Um
Center for Quantum Information, Institute for
Interdisciplinary Information Sciences, Tsinghua University

Date submitted: 29 Jan 2014

Electronic form version 1.4