Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Continuous Variable Quantum Gates in a System of Trapped Ions
GLEB MASLENNIKOV, JAREN GAN, CHI HUAN NGUYEN, KO-WEI TSENG, Centre for Quantum Technologies, National University of Singapore, DZMITRY MATSUKEVICH, Centre for Quantum Technologies, Physics Department, National University of Singapore, COLD TRAPPED IONS GROUP AT CENTRE FOR QUANTUM TECHNOLOGIES, SINGAPORE TEAM — Motional states of trapped ions are attractive for quantum information processing because they offer, in principle, a larger Hilbert space compared to the ions spin degree of freedom in the same physical system. Here we report on recent progress to explore the feasibility of continuous variable approach to quantum computations with just a single trapped $^{171}Yb^{+}$ ion. By applying spin dependent force at the frequency corresponding to a difference between the frequencies of two modes of motion we implement a gate corresponding to a swap of populations of the modes conditioned on the internal state of the ion. We utilize this gate in an efficient scheme to produce maximally entangled (NOON) states of up to 4 phonons. We devise and implement an algorithm to perform a single-shot measurement of the Wigner function of the motional state and also a measurement of the overlap between quantum states belonging to two different motional modes. Finally we discuss the applicability of this gate to universal quantum computing with continuous variables.

Dzmitry Matsukevich
National University of Singapore

Date submitted: 01 Feb 2019 Electronic form version 1.4