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Realization of arithmetic addition and subtraction in a quantum system[1] MARK UM, JUNHUA ZHANG, DINGSHUN LV, YAO LU, SHUOMING AN, JING-NING ZHANG, KIHWAN KIM, Tsinghua Univ, M.S. KIM, Imperial College London, HYUNCHUL NHA, Texas A&M University at Qatar — We report an experimental realization of the conventional arithmetic on a bosonic system, in particular, phonons of a 171Yb+ ion trapped in a harmonic potential. The conventional addition and subtraction are totally different from the quantum operations of creation $\hat{a}^\dagger$ and annihilation $\hat{a}$ that have the modification of $\sqrt{n}$ factor due to the symmetric nature of bosons. In our realization, the addition and subtraction do not depend on the number of particles originally in the system and nearly deterministically bring a classical state into a non-classical state. We implement such operations by applying the scheme of transitionless shortcuts to adiabaticity [1,2] on anti-Jaynes-Cummings transition. This technology enables quantum state engineering and can be applied to many other experimental platforms.

[1] M. V. Berry, J. Phys. A 42, 365303 (2009).
[2] J. Zhang, et al., Phys. Rev. A 89, 013608 (2014).

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