Coherent control of population transfer between Wannier-stark states in an optical lattice via one- and two-phonon interference

CHAO ZHUANG, CHRISTOPHER PAUL, SAMANSA MANESHI, LUCIANO CRUZ, AEPHRAIM STEINBERG, CQIQC, IOS, and Department of Physics, University of Toronto, Canada — We demonstrate coherent control of population transfer between quantum vibrational states in an optical lattice by using interference between a 2-phonon excitation at $\omega$ and a 1-phonon excitation at $2\omega$. By varying the relative phase between phase modulation (PM) of the lattice at $\omega$ and amplitude modulation (AM) at $2\omega$, we observe oscillations in the branching ratio between transition to the first excited state and higher excited states. We will present experimental data showing the quantum interference between a 2-PM-phonon and a 1-AM-phonon for different excitation amplitudes. Our best result, by tuning the excitation amplitude and relative phase, shows an improvement of coupling into the first excited state by 23% and the branching ratio by a factor of $3.5 \pm 0.7$, when the total population in the higher excited states is reduced to our measurement noise level.

Chao Zhuang
CQIQC, IOS, and Department of Physics, University of Toronto, Canada

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