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Double-EIT Ground-State Cooling of Stationary Two-Dimensional Ion Lattices[1] MU QIAO, YE WANG, ZHENGYANG CAI, BOTAO DU, PENGFEI WANG, CHUNYANG LUAN, WENTAO CHEN, KIHWAN KIM, Tsinghua University — We theoretically and experimentally study the electromagnetically-induced-transparency (EIT) cooling of two-dimensional ion lattices in a Paul trap. We realize the EIT ground-state cooling with $^{171}\mathrm{Yb}^{+}$ ions with hyperfine-energy levels different from other ions with a simple Λ-scheme that has already been used. We observe a cooling rate $\dot{\bar{n}} = 3 \times 10^4$quanta/s and a cooling limit $\bar{n} = 0.06 \pm 0.059$ for a single ion. The measured cooling rate and limit are consistent with theoretical predictions. We apply the double-EIT cooling on two-dimensional (2D) lattices with up to 12 ions and observe an average phonon number $\bar{n} = 0.54 \pm 0.12$ for the center of mass mode. Different from the 2D crystal in the Penning trap, cooling rates of multiple ions are similar to that of a single ion. The ground-state cooling of a 2D lattice with a large number of $^{171}\mathrm{Yb}^{+}$ ions will advance the field of the quantum simulation of 2D systems. Our method can be also extended to the other hyperfine qubits.

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