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Ultraefficient Cooling of Resonators: Beating Sideband Cooling with Quantum Control XIAOTING WANG, SAI VINJANAMPATHY, University of Massachusetts at Boston, FREDERICK STRAUCH, Williams College, KURT JACOBS, University of Massachusetts at Boston — There is presently a great deal of interest in cooling high-frequency micro- and nano-mechanical oscillators to their ground states. The present state of the art in cooling mechanical resonators is a version of sideband cooling, which was originally developed in the context of cooling trapped ions. Here we present a method based on quantum control that uses the same configuration as sideband cooling–coupling the resonator to be cooled to a second microwave (or optical) auxiliary resonator–but will cool significantly colder. This is achieved by applying optimal control and varying the strength of the coupling between the two resonators over a time on the order of the period of the mechanical resonator. As part of our analysis, we also obtain a method for fast, high-fidelity quantum information transfer between resonators.

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