

Abstract Submitted
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Ultrafast Interferometry and Gates with Trapped Ions¹ KALE JOHNSON, DAVID WONG-CAMPOS, BRIAN NEYENHUIS, JONATHAN MIZRAHI, CHRISTOPHER MONROE, Joint Quantum Institute and University of Maryland Department of Physics, College Park, Maryland 20742 — We sense the motion of a trapped atomic ion using a sequence of state-dependent ultrafast momentum kicks. We use this atom interferometer to characterize a nearly-pure quantum state with $n = 1$ phonon and accurately measure thermal states ranging from near the zero-point energy to $\bar{n} \sim 10^4$, with the possibility of extending at least 100 times higher in energy. The complete energy range of this method spans from the ground state to far outside of the Lamb-Dicke regime, where atomic motion is greater than the optical wavelength. Apart from thermometry, these interferometric techniques are useful for quantum information purposes, and we discuss the outlook for ultrafast entangling gates between multiple trapped ions.

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