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Matter-field quadrature interferometry for nonequilibrium ultracold atoms in optical lattices[1] PHILIP JOHNSON, American University, EITE TIESINGA, Joint Quantum Institute of NIST and University of Maryland — We propose an interferometric technique for making time-resolved measurements of matter-field quadrature operators for nonequilibrium ultracold atoms in optical lattices. The technique creates two subsystems of atoms—the arms of the interferometer—in different spin states and lattice sites. A Feshbach resonance turns off atom-atom interactions in one spin subsystem, making it a well-characterized reference state, while atoms in the other subsystem undergo nonequilibrium dynamics for a variable hold time. The dynamics can involve a variety of Hamiltonians and lattice geometries (e.g., cubic, honeycomb, superlattices), including systems with tunneling, spin orbit couplings using artificial gauge fields, and perturbations from external fields. Interfering the subsystems via a second beam-splitting operation, quadrature observables are mapped directly onto the relative spin populations. In this talk, I describe the general technique and then present analytic results for the special case a deep lattice with negligible tunneling. I also describe how the interferometer can be used to determine atom-atom interaction strengths and test the physics of so-called super-Heisenberg scaling.

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