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Signatures of effective three- and four-body interactions and dynamics in collapse-and-revival interferometry PHILIP JOHNSON, American University, EITE TIESINGA, JQI, NIST and University of Maryland — When ultracold atoms are loaded into an optical lattice, the confinement of the atoms within the wells modifies their effective interaction properties and dynamics. For atoms in the lowest vibrational state, collision-induced virtual excitations to excited states result in both renormalization of the two-body interactions, and effective three-, four- and higher-body interactions. The strength of the effective interactions depends in interesting ways on the lattice depth, dimensionality, and geometry. We show how this physics can be understood within an effective Hamiltonian approach that is particularly useful for understanding the nonlinear interferometry of collective states of atoms in lattices. We also show how the phase dynamics of collective states in the lattice can be surprisingly sensitive to four-body interactions.

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