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Dynamically decoupled three-body interactions with applications to interaction-based quantum metrology KHAN W. MAHMUD, Joint Quantum Institute, University of Maryland, EITE TIESINGA, Joint Quantum Institute, NIST and University of Maryland, PHILIP R. JOHNSON , American University — We propose a stroboscopic method to dynamically decouple the effects of two-body atom-atom interactions for ultracold atoms, and realize a system dominated by elastic three-body interactions. Using this method, we show that it is possible to achieve the optimal scaling behavior predicted for interaction-based quantum metrology with three-body interactions. Specifically, we show that for ultracold atoms quenched in an optical lattice, we can measure the three-body interaction strength with a precision proportional to $\bar{n}^{-5/2}$ using homodyne quadrature interferometry, and $\bar{n}^{-7/4}$ using conventional collapse-and-revival techniques, where $\bar{n}$ is the mean number of atoms per lattice site. Both precision scalings surpass the nonlinear scaling of $\bar{n}^{-3/2}$, the best so far achieved or proposed with a physical system. Our method of achieving a decoupled three-body interacting system may also have applications in the creation of exotic three-body states and phases.

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