Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Generating cat states with fermionic atoms in a driven optical lattice[1] MIKHAIL MAMAEV, JILA, CU Boulder, ANA MARIA REY, JILA, NIST, CU Boulder — We propose a protocol for generating spin cat states (also called generalized GHZ states) with ultracold fermionic atoms in 3D optical lattices or optical tweezer arrays. Our method uses on-site interactions, laser driving and harmonic trapping to generate energetic constraints upon the atomic motion. These constraints permit the stepwise transformation of a local two-component superposition into a spatially extended many-body entangled state, by allowing one component to evolve while keeping the other one unchanged. The protocol requires no site-resolved driving lasers, has a generation time linear in the size of the cat, and exhibits robustness to global phase drifts of the drive. Furthermore, it naturally includes a harmonic trap that is otherwise detrimental to many entanglement-generating protocols. The ability to implement this protocol in state-of-the-art tweezer arrays or 3D lattice clocks allows for immediate use of the cat state for metrological improvement beyond the standard quantum limit in real-world sensors.

[1]We acknowledge funding from the AFOSR, DARPA and ARO, NSF, and NIST.

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Date submitted: 30 Jan 2020 Electronic form version 1.4