Abstract Submitted
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Hyperpolarizability and operational magic wavelength in an optical lattice clock R BROWN, N. PHILLIPS, K. BELOY, W. MCGREW, M. SCHIOPPO, R. FASANO, X. ZHANG, H. LEOPARDI, D. NICOLODI, T. FORTIER, A. LUDLOW, NIST — One of the largest systematic frequency shifts in optical lattice clocks arises from light shifts due to the trapping lattice. At the 1x10ˆ-18 level we find that light shift effects beyond the dominant electric dipole coupling (hyperpolarizability, magnetic dipole, and electric quadrupole) become relevant. Including finite temperature effects, we observe a simple linear + quadratic scaling of clock frequency shift with trap depth. For any choice of trap depth, we may tune our trapping laser to a corresponding "operational magic wavelength" where the clock shift is insensitive to uncontrolled changes in trap depth. We further explore atomic temperature-dependent effects by implementing a third stage of quenched sideband laser cooling on the ultra-narrow $^1S_0$ to $^3P_0$ clock transition. This cooling allows us to achieve near unit occupation of the ground band of our 1-D optical lattice (corresponding to temperatures in the 100's of nK) within a few 10's of ms. This cooling implies increased atomic confinement, which we use as a lever arm to explore previously unobservable magnetic dipole and electric quadrupole effects.

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