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Precision measurements of lattice-induced frequency shifts in the Yb optical lattice clock NATHANIEL PHILLIPS, KYLE BELOY, NIST-Boulder, NATHAN HINKLEY, NIST-Boulder and Dept. of Physics, University of Colorado, MARCO SCHIOPPO, JEFF SHERMAN, CHRIS OATES, ANDREW LUDLOW, NIST-Boulder — Optical clocks based on ultra-cold, lattice trapped alkaline-earth-like atoms interrogated on the ultra-narrow $^1S_0 \leftrightarrow ^3P_0$ transition promise timing performance at unprecedented levels. Recently, our ytterbium optical lattice clock demonstrated record frequency instability of 1.6×10^{-18} in fractional units. Evaluation of the clock uncertainty at the 10^{-18} level requires characterization of the atomic response to two main systematic frequency shifts: one due to ambient blackbody radiation and one due to the lattice itself. In this talk, we discuss an evaluation of the residual lattice Stark shifts. Ytterbium atoms are cooled and trapped in a cavity-enhanced standing wave of light (optical lattice). We operate the lattice near its magic wavelength, where the scalar Stark shift of each clock state is equal so that the natural transition frequency is preserved. The buildup cavity permits an enhancement of the lattice intensity (I) by a factor of more than twenty over levels limited by the total laser output power available. Exploiting the intense lattice electric field, we make precision measurements of the hyperpolarizability ($\propto I^2$) and M1 and E2 multipole ($\propto \sqrt{I}$) contributions to Stark shifts of the clock transition in Yb.

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