The state of the art and experimental perspectives on optical lattice clocks

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We will present an overview of optical lattice clocks. In particular, we will discuss the primary factors that contribute to clock instability. By synchronously interrogating two independent atomic systems with the same clock laser, we may remove the Dick effect and common mode reject laser noise. Under these conditions, atomic detection noise including quantum projection noise becomes one of the largest contributors to clock instability and, in the near future, will motivate the use of non-classical states for improved performance.

In addition to stability, clock performance is also characterized by accuracy. We describe our experimental efforts to characterize systematic frequency shifts in 171Yb optical lattice clocks. Following a significant effort to characterize and control BBR shifts at 10^{-18}, we have turned our attention to the characterization of higher order light shifts due to atomic confinement in the optical lattice. We also report the characterization a broader class of systematics including the DC stark effect, the first and second order Zeeman effects and first order Doppler effects associated with the motion of the lattice. We work to suppress longitudinal quantum tunneling related effects by sideband cooling using the clock laser quenched by a dipole-allowed excited-to-further-excited state laser.