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Two-photon Resonant Ramsey Interference using a Repeated-Query Scheme for Atomic Clock Development[1] ZACHARY WARREN, RENU TRIPATHI, GOUR PATI, Delaware State University — For communication and navigation, precision atomic clock technology relies on optical resonances with narrow linewidths and high signal-to-noise ratios. Continuous optical pumping of rubidium atoms produces stable and coherent atomic dark state resonances with some limitations. To overcome power broadening and light shift, an optical two-pulse sequence comprising of a coherent population trapping (CPT) preparation pulse and short query pulse is used to generate and detect Ramsey interference fringes. The fringe-width of Ramsey interference is decided by the free evolution time, T, the time separation between the two pulses. Often, Ramsey fringes produced by two-photon frequency detuning have nearly uniform amplitude around the frequency sweep center, and the central fringe can be nearly indistinguishable from the surrounding ones. We introduce a repeated-query scheme using periodic query pulses for the Ramsey interrogation. Unlike the two-pulse scheme, the repeated-query scheme enhances the central fringe amplitude while suppressing the side fringes. We have conducted numerical simulations and experiments to demonstrate the effectiveness of the repeated-query scheme. Applying the scheme to future clock experiments would show increased stability relative to the two-pulse method.

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