Advances in SWaP-reduced Rb optical atomic clocks

Judith Olson[1], Robert Fasano, Andrew Kortyna, Clinton Cahall, Paul Morton

[1]Infleqtion, Louisville, CO, USA

Email: judith.olson@infleqtion.com

Infleqtion's efforts to further miniaturize their optical atomic clock technology are showing interesting early efforts. The talk will cover two areas. First is the advances in manufacturing readiness level and performance assessments for the commercial Rb optical atomic clock product - Tiqker Prime. Tiqker Prime targets ADEV values of < 3e-13 at 1 s and minimum levels <5e-15 in a 3U, rack-mountable package. Secondly, advances toward reduced form-factors and power draw for a similarly performing future clock product are discussed.

One advancement includes reduction in physics package volume by more than 10x while increasing its ruggedization. This was accomplished through multi-use materials, extensive finite element analysis modeling, and path length engineering. Thermal engineering enables the system to draw < 3 W of power over an extended temperature range while maintaining a highly stable optical path. Future efforts to leverage the atomics package design for larger vapor cells and in other use cases is also explored.

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A look toward improved miniaturized laser sources based on internal photonic developments is also explored, some available direct at 778.1 nm. The tradeoffs in this laser space for deployable rubidium optical frequency spaces is explored. A SWaP reduction and performance improvement is anticipated from novel lasers being offered near the clock transition, with entire photonically-integrated laser systems likely possible in next few years.

A future look toward long-term, chip-scale optical atomic clocks is given based on the rubidium two-photon transition. Integration of vapor cells onto a photonic integrated circuit (PIC) is explored.